SPACESAVER® SYSTEMS

Interlock™ AVR45, AVR75, AVR95, AVR125 HT45, HT95, HT125

Installation and Operation Manual

Proposition 65 Warning:	Battery posts, terminals and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. Batteries also contain other chemicals known to the State of California to cause cancer. **WASH HANDS AFTER HANDLING.**

E.P.M. Form No. 1112 Revised 11/24 © 2024 by EPM Printed in U.S.A.

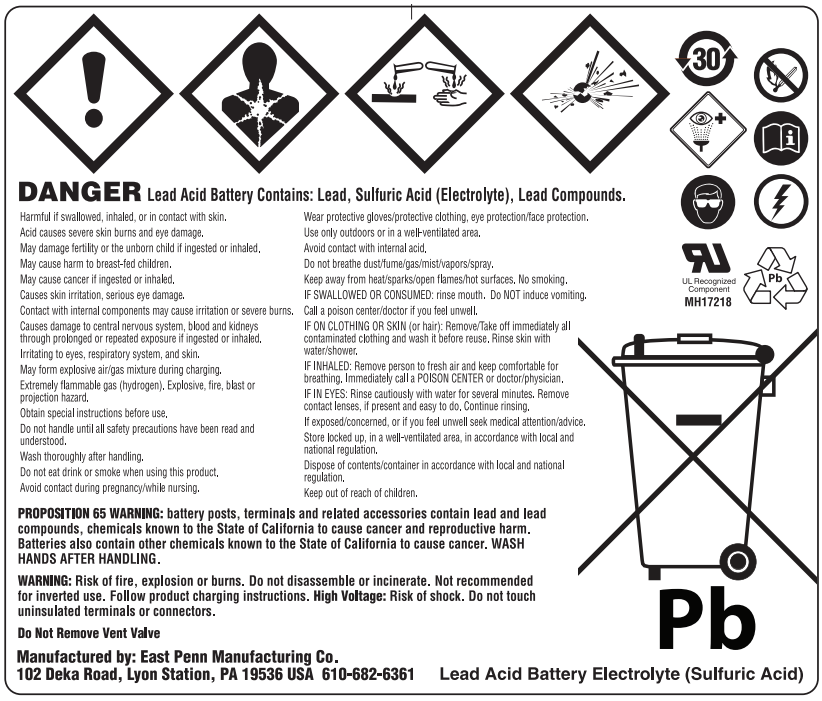
INTERLOCK TABLE OF CONTENTS

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.



DANGER Lead Acid Battery Contains: Lead, Sulfuric Acid (Electrolyte), Lead Compounds.

Harmful if swallowed, inhaled, or in contact with skin.
Acid causes severe skin burns and eye damage.
May damage fertility or the unborn child if ingested or inhaled.
May cause harm to breast-fed children.
May cause cancer if ingested or inhaled.
Causes skin irritation, serious eye damage.
Contact with internal components may cause irritation or severe burns.
Causes damage to central nervous system, blood and kidneys through prolonged or repeated exposure if ingested or inhaled.
Irritating to eyes, respiratory system, and skin.
May form explosive air/gas mixture during charging.
Extremely flammable gas (hydrogen). Explosive, fire, blast or projection hazard.
Obtain special instructions before use.
Do not handle until all safety precautions have been read and understood.
Wash thoroughly after handling.
Do not eat drink or smoke when using this product.
Avoid contact during pregnancy/while nursing.

Wear protective gloves/protective clothing, eye protection/face protection.
Use only outdoors or in a well-ventilated area.
Avoid contact with internal acid.
Do not breathe dust/fume/gas/mist/vapors/spray.
Keep away from heat/sparks/open flames/hot surfaces. No smoking.
IF SWALLOWED OR CONSUMED: rinse mouth. Do NOT induce vomiting.
Call a poison center/doctor if you feel unwell.
IF ON CLOTHING OR SKIN (or hair): Remove/Take off immediately all contaminated clothing and wash it before reuse. Rinse skin with water/shower.
IF INHALED: Remove person to fresh air and keep comfortable for breathing. Immediately call a POISON CENTER or doctor/physician.
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
If exposed/concerned, or if you feel unwell seek medical attention/advice.
Store locked up, in a well-ventilated area, in accordance with local and national regulation.
Dispose of contents/container in accordance with local and national regulation.
Keep out of reach of children.

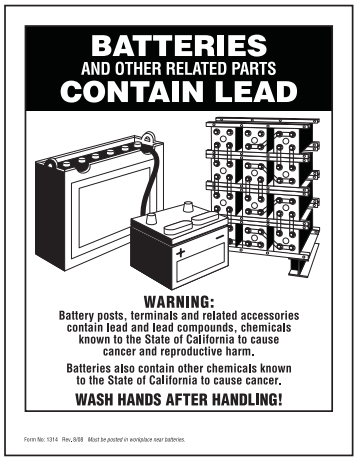
UL Recognized Component
MH17218

PROPOSITION 65 WARNING: battery posts, terminals and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. Batteries also contain other chemicals known to the State of California to cause cancer. WASH HANDS AFTER HANDLING.

WARNING: Risk of fire, explosion or burns. Do not disassemble or incinerate. Not recommended for inverted use. Follow product charging instructions. **High Voltage:** Risk of shock. Do not touch uninsulated terminals or connectors.

Do Not Remove Vent Valve

Manufactured by: East Penn Manufacturing Co.
102 Deka Road, Lyon Station, PA 19536 USA 610-682-6361 **Lead Acid Battery Electrolyte (Sulfuric Acid)**



SAFETY PRECAUTIONS

Although all valve-regulated cells have the electrolyte immobilized within the cell, the electrical hazards 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 40°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 (as defined by ASTM F1505 “Standard Specification for Insulated and Insulating Hand 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.

   SDS sheets can be obtained at www.eastpennmanufacturing.com
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 string 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. **Never** remove or tamper with the pressure relief valves, except for cell replacement. Warranty void if vent valve is removed.
7. Inspect flooring and lifting equipment for functional adequacy.
8. Adequately secure cell modules, racks, or cabinets to the floor.
9. Connect support structures to ground system in accordance with applicable codes.
10. The below IEEE Standards contain additional information. Other standards may be relevant to your specific application.

    IEEE 1184 - Guide for Batteries for UPS Systems

    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 data and notify carrier of any damage.

Original packaging should remain on battery during transportation to prevent damage to the battery or short circuit of the terminals.

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 cells by the terminal posts.

   NOTE : Do not place cells in an upright position during installation, storage or transporting.
5. When lifting cells and modules, 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.

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. Battery pallets shall not be double stacked, or equipment stored on top.
4. 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).
5. 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.

Storage / Refresh *Continued*

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.

6. 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.
7. 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), as called out in Appendix F for Unigy II & Appendix G for Deka Fahrenheit HT 2V.
8. All requested information on "Refresh Record Form" in Appendix B should be completed for each refresh charge.
9. Cells shall not be stored beyond 12 months. Storing beyond 12 months will affect warranty.
10. If the storage / refresh requirements cannot be met, contact East Penn Reserve Power's Product Support group for alternate instructions.

INSTALLATION

General

Caution should be taken when installing cells to ensure no damage occurs. Cells shall not be dropped, slid, or placed on rough or uneven surfaces such as tray lips or grated flooring. Mishandling of cells 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.

NOTE: If battery monitoring system is installed prior to battery being placed in service; monitoring system should remain off to prevent discharging of battery.

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 string, proper techniques should be applied per electrical standards, such as NEC and/or local codes. Two 0.201 diameter x 0.750 center holes are provided in back of each module to accept a # 6 x 0.750 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 string and/or stack to stack 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 system for service and inspection.

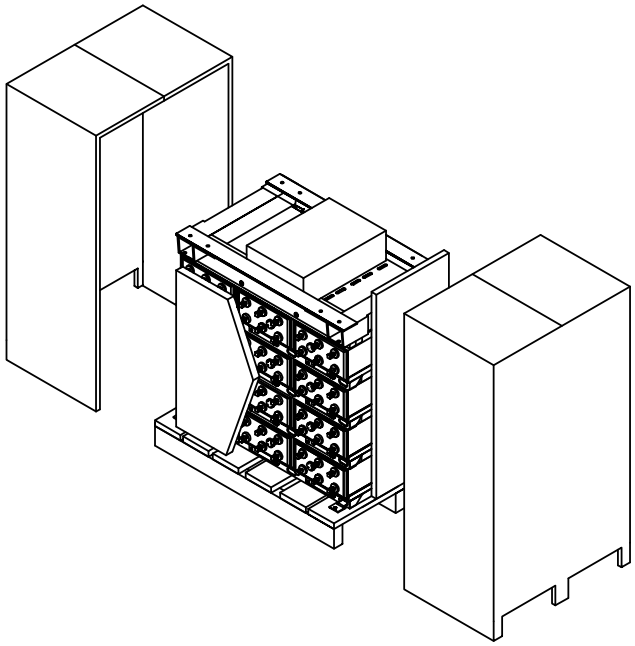
Hardware Torque Requirements

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

System Installation

System Shipment

Battery string will be received per drawing below.



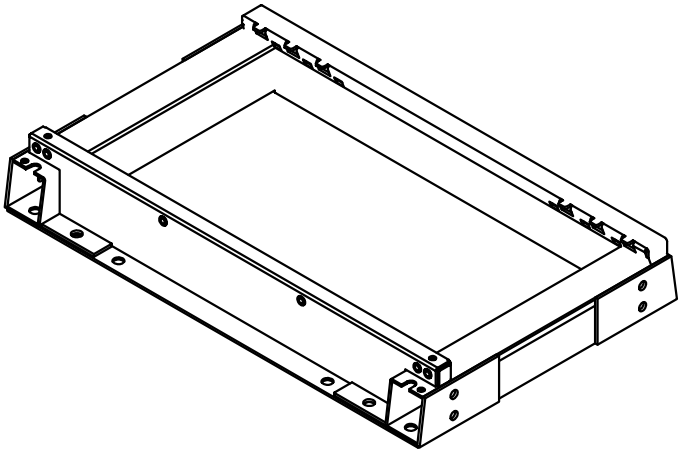
Interlock Module Installation

Assemble battery string per the following details.

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

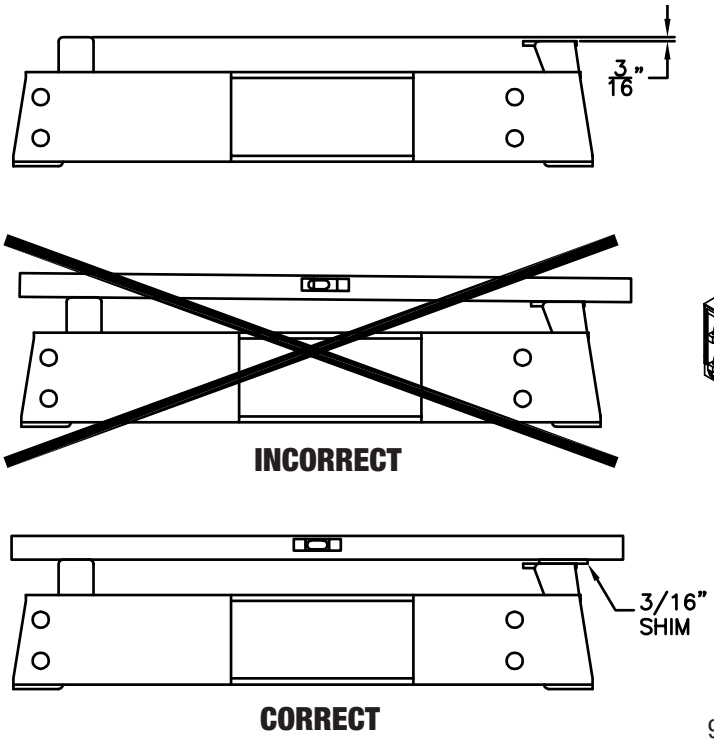
1. Remove floor-mounting base support from the top of the modules. Base(s) are wire tied to module assembly.
2. Position base(s). Consult included battery string layout diagram for required base layout. If it can not be located, contact East Penn Mfg. for a copy. Refer to your delivery number, located on the packing slip. This will aid in obtaining the proper drawing.
3. Bases are required to be level prior to installing modules.

Interlock Base



4. Anchor holes can be marked and drilled with bases in place. **Consult Appendix E for anchor hole pattern.** All anchor holes in base are required to be used to meet seismic requirements. **Consult local building codes for anchor bolt requirements. Anchor bolts not included due to site specific requirements.**
5. 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 can be discarded.
6. When leveling Interlock battery strings using a 1-piece base support, it is critical to note that the back channel is 3/16" shorter than the front channel. If a level is placed across the front and rear channels, a 3/16" shim should be placed on top of the rear channel in order to level properly. **Refer to "Interlock Leveling Diagram" below.**

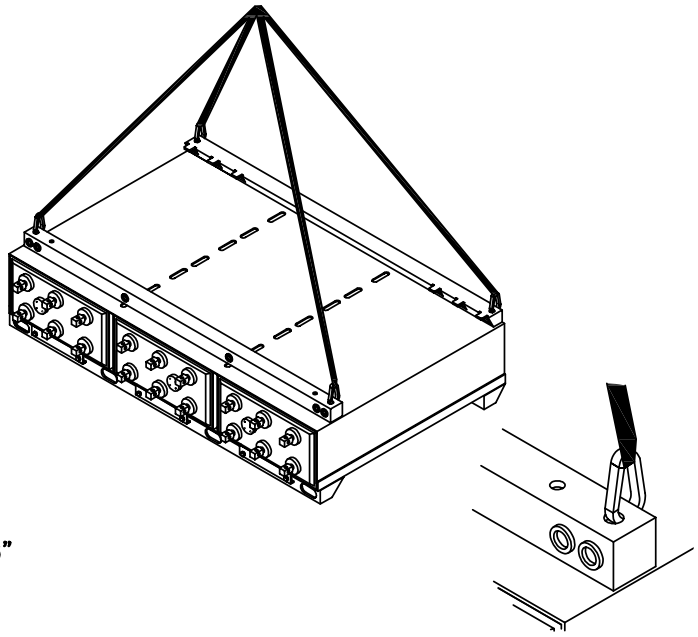
Interlock Leveling Diagram



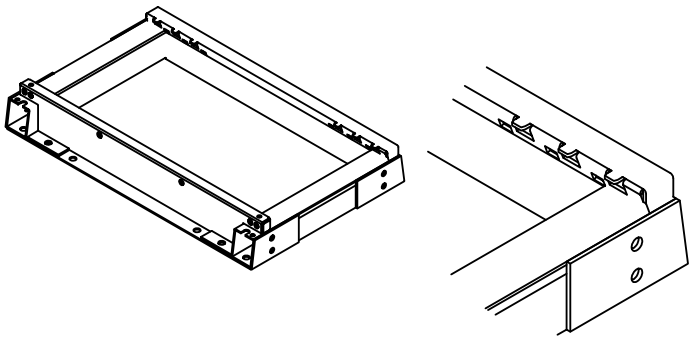
7. **Module / Base Shimming**
   a. Prior to installation, the floor on which the battery string is to be installed should be level and capable of supporting the weight of the battery string. A 1° taper on a floor can result in a ½" variation at the top of one eight-high stack of modules. This can be compounded by the tolerance of each module.
   b. Standard steel shim stock such as AISI/SAE 1010 can be used. Stainless steel is not required since these batteries are AGM and should not be exposed to a corrosive environment. Shim dimensions will vary depending on the location and levelness. *Shims are not provided by East Penn due to site specific requirements.*
   c. If floors are not level, shim material can be placed under each of the base supports within a battery string until they are level. All base supports within a battery string must be level with each other – do not level individual bases as this could cause variation in height from one stack to another.
   d. It is recommend to place an interstack connector on the system to ensure no stress will be placed on the cell posts. Reference *Safety Section of this manual* and battery schematic for all necessary precautions. If the connector is aligned, it may be removed and the module installation can continue.
   e. Reference Appendix E for Base Support layout dimensions
   f. Once all the modules are installed and aligned, joining plates (pg a.8 Part 3) which are provided with the parts kit should be installed at the top of every stack. This provides an additional tool to ensure levelness.
   g. Assuming these guidelines are followed, the electrical connections can be installed easily without any issues of misalignment or undue stress on the cell posts.

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

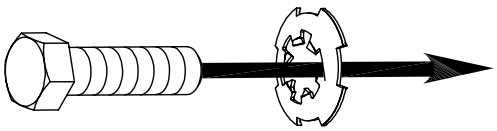
8. Install modules onto bases using supplied lifting straps. Two straps required to lift each module. Consult below diagram for proper sling attachment.



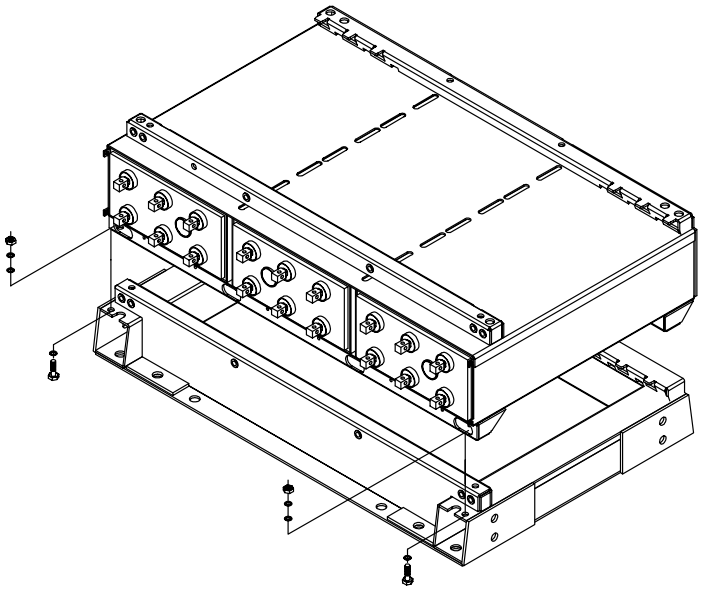
9. Installed battery string should be compared to battery string layout drawing for correctness. As each module is installed all hardware should be checked for proper torque before proceeding to next module.
   a. Module slides into cut outs in back of base. Lower first module onto base with module slightly forward. Slide module towards back of base until locked into slots.

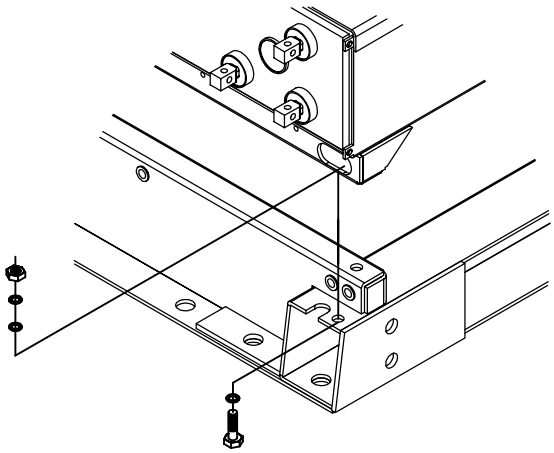


b. Module connecting hardware is furnished with a dragon tooth washer in place of a lock washer and flat washer. The dragon tooth washer is used to enhance the electrical conductivity of the grounding system within a stack of modules. To ensure the dragon tooth washer is installed correctly; the curve of the washer must face away from the bolt head. **Stack to stack grounding electrical conductivity is the responsibility of the installer.**

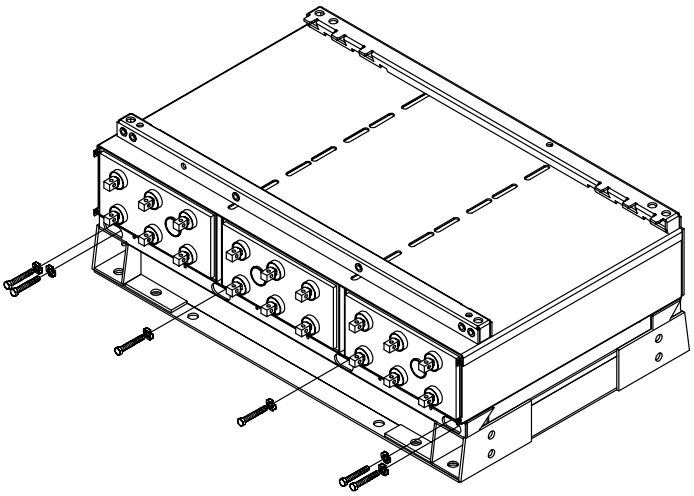


c. For seismic applications two – 3/8-16 x 1.00" bolts are required to be installed as per below.

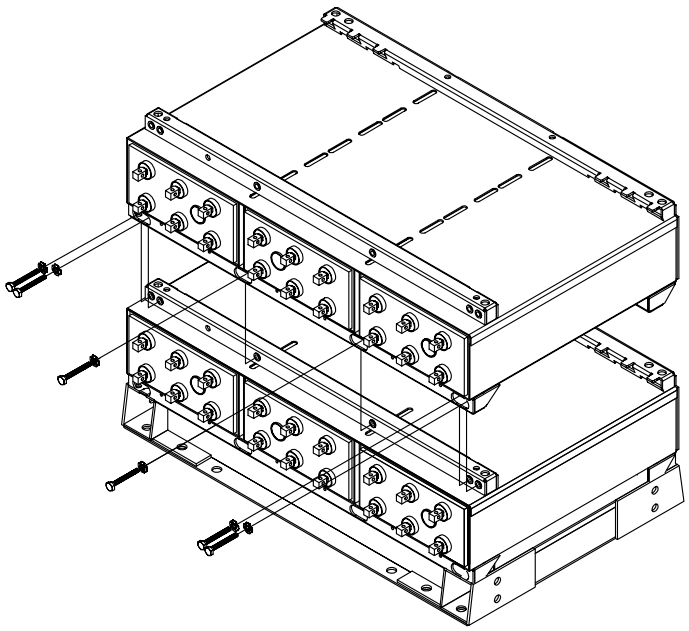


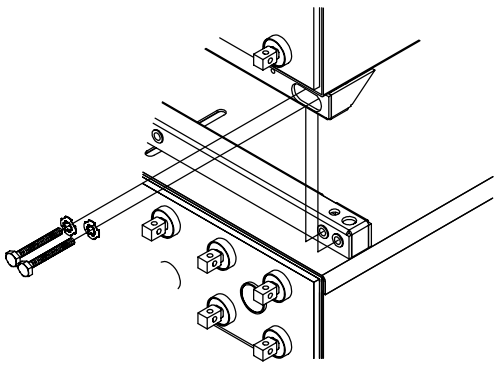


d. Connect the module to the base with a maximum of six – 3/8-16 x 1.25" bolts & dragon tooth washers in the front only. Consult “Hardware Torque Requirements” (pg a.4) for proper torque values.

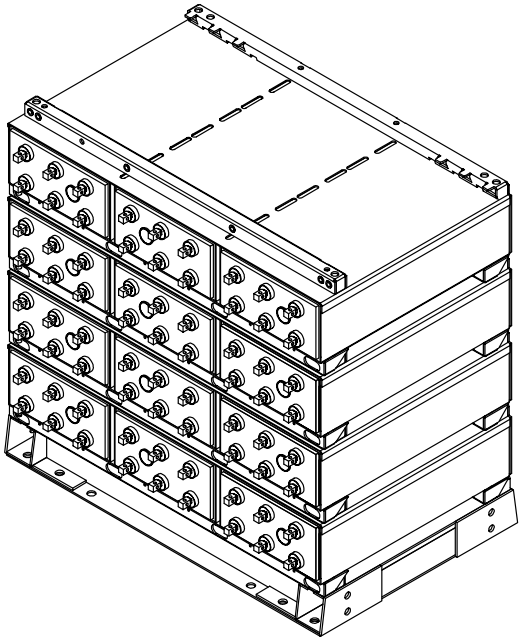


e. Connect the modules to each other with a maximum of six 3/8-16 x 1.25" bolts & dragon tooth washers installed in the front of the modules. Process to be repeated until all modules are installed. Consult “Hardware Torque Requirements” (pg a.4) for proper torque values.



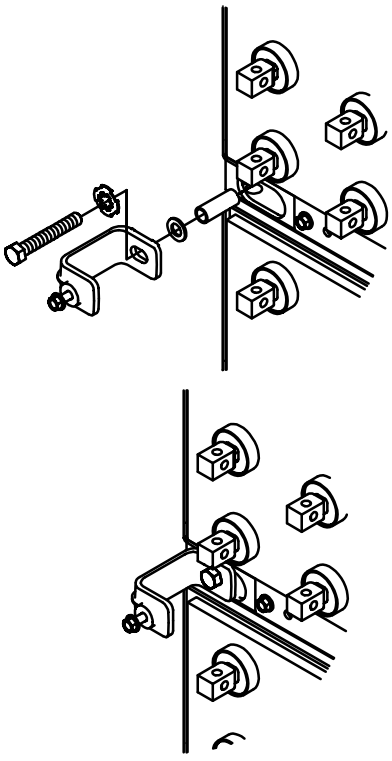


10. Module layout should be compared to battery string layout diagram and all hardware should be checked for proper torque before proceeding. Consult “Hardware Torque Requirements” (pg a.4) for proper torque values.

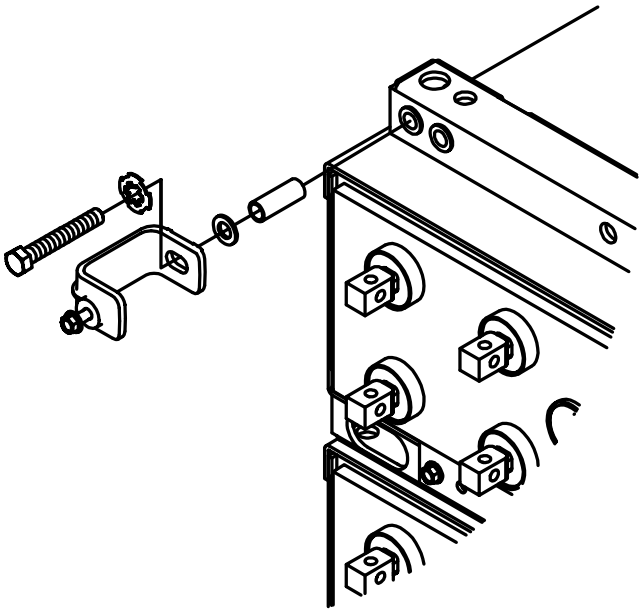


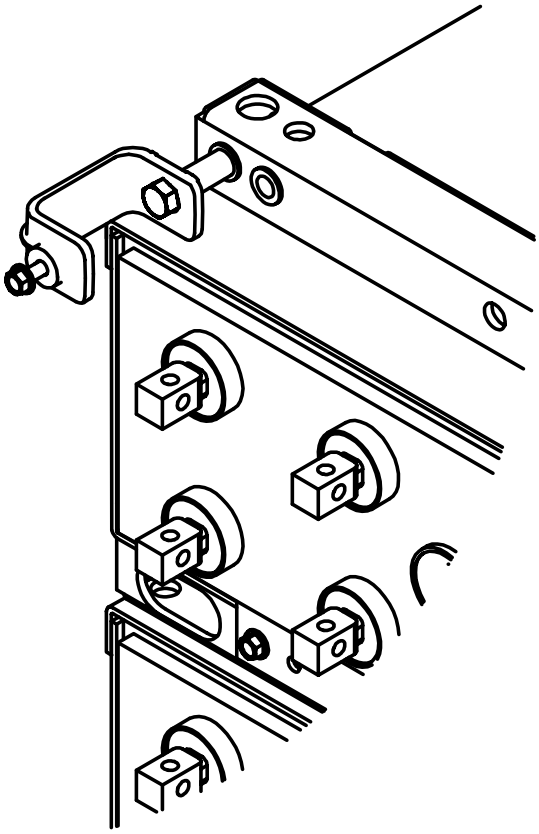
Safety Shield Bracket Assembly

1. Safety shield brackets are to be installed at the outside corners of every 2 modules starting from the bottom and working towards the top. This is to be repeated for each stack in the battery system. For stacks containing odd number of modules an additional set of safety shield brackets will be required to be installed at the top of the module. Use 3/8-16 x 2.50" hardware to install brackets. Bracket should be flush with side of module to ensure correct safety shield alignment. Tighten, do not torque hardware.

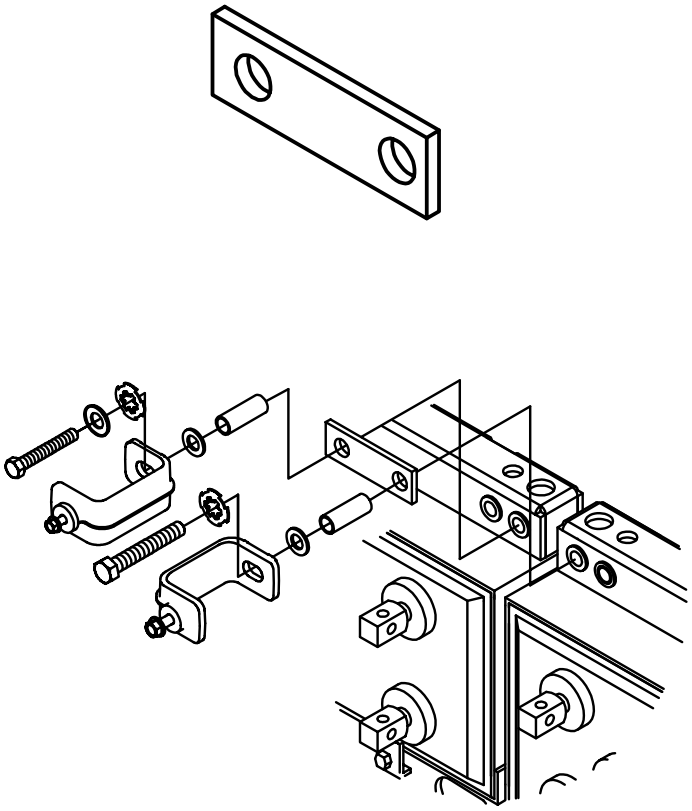


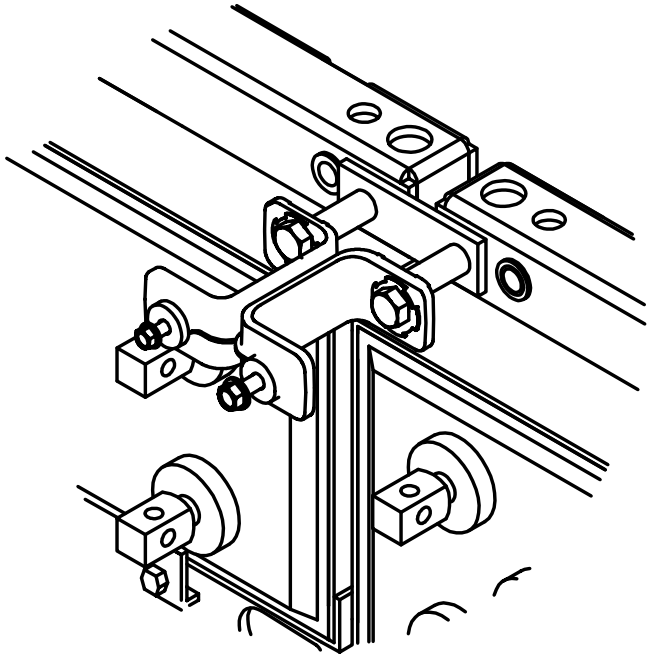
2. Safety shield brackets are to be installed at the top of the module in the same manner as detailed previously. Tighten, do not torque hardware.





3. For multiple stack systems, joining plates are to be installed at the front of the modules at the top of the stacks. One joining plate is to be used at the junction of two modules. Use the 3/8-16 x 2.50" hardware used to connect the safety shield bracket together. **Stack to stack grounding electrical conductivity is the responsibility of the installer.**





Electrical Connection

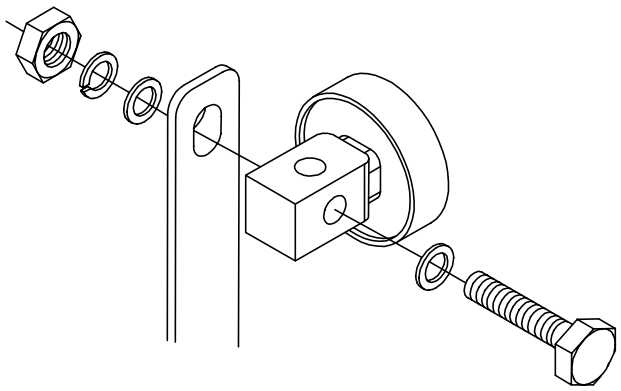
Connector Assembly

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 string is supplied with a connector package appropriate to the required load the battery string is connected to. Review the below chart “Connector Packages” to ensure the correct connector package has been supplied.

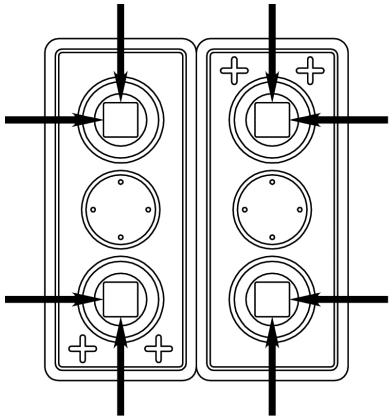
CONNECTOR PACKAGES			
Type	**Plate**	**AMPS**	**WPC**
1CU	5 - 15	≤ 250	≤ 480
	17 - 27	≤ 450	≤ 720
	29 - 33	≤ 550	≤ 880
2CU	5 - 33	≤ 900	≤ 1440
4CU	5 - 33	≤ 2000	≤ 3200
6CU	5 - 33	≤ 3000	≤ 4800

BOLT PACKAGE	
1CU	1/4-20 x 1.25"
2CU	1/4-20 x 1.50"
4CU	1/4-20 x 1.75"
6CU	1/4-20 x 2.00"

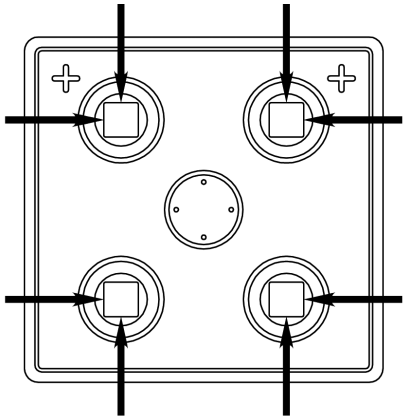
3. Installation and direction of the cell post hardware is important. Consult below diagram for clarification.



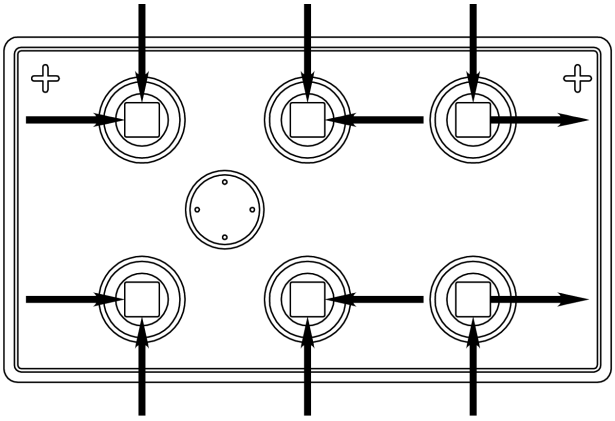
5 to 15 Plate



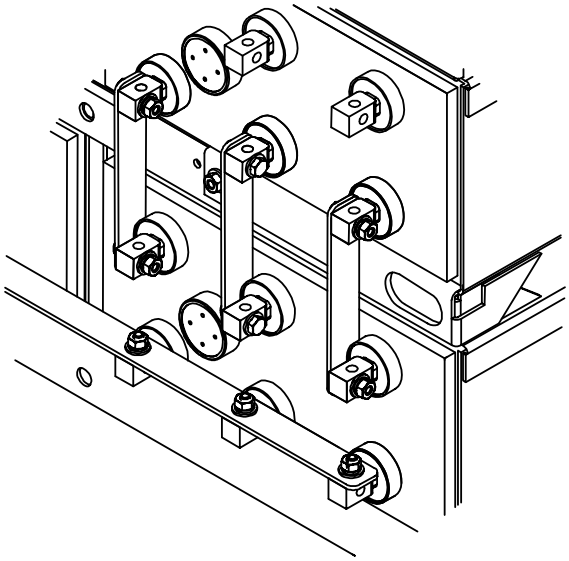
17 to 27 Plate



29 to 33 Plate

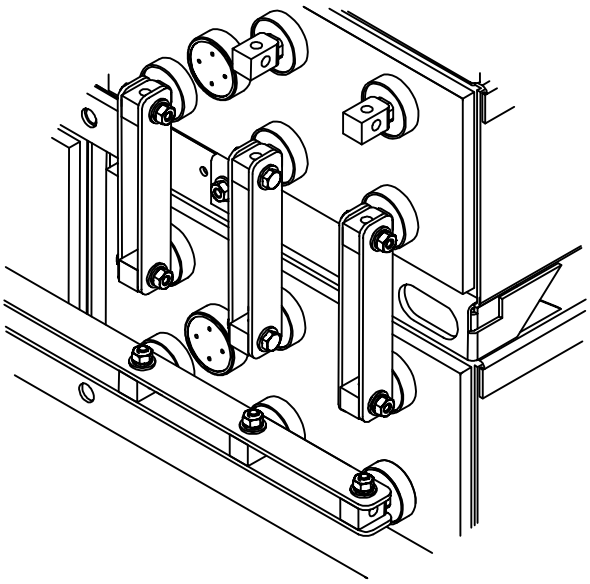


4. Unigy II & Fahrenheit HT 2V battery strings are typically supplied with connector package 1CU requiring one connector per post.

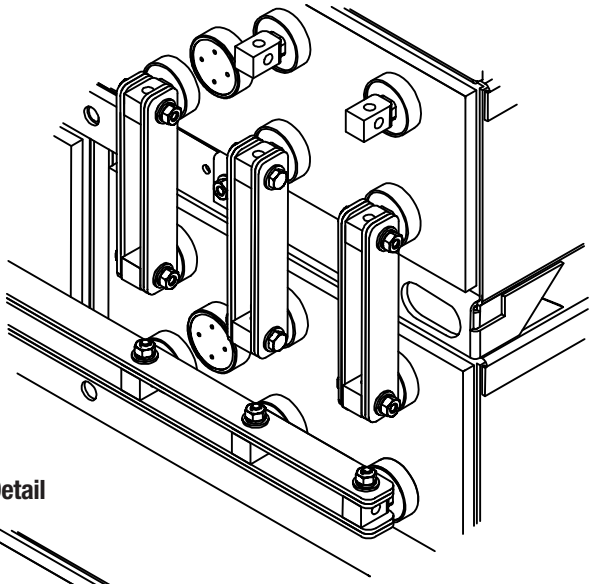


5. High rate applications will require multiple connectors to be used per cell post. A 2CU connector package will require 2 connectors per connection (1 per side), see example below. A 4CU package will require 4 connectors per connection (2 per side) and a 6CU package will require 6 connectors per connection (3 per side). Tighten & torque all bolts after all connectors are installed. Consult “Hardware Torque Requirements” (pg a.4) for proper torque values.

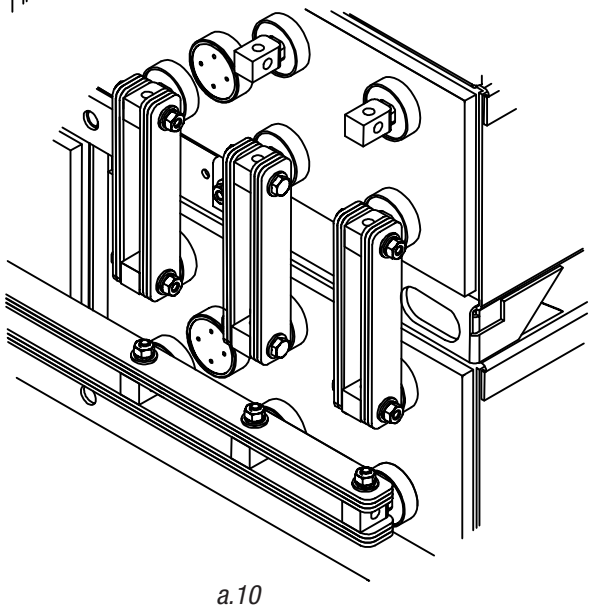
2CU Package Detail



4CU Package Detail



6CU Package Detail



6. Some installations require a vertical “C” connector. This “C” connector is limited to a 2CU connector package.

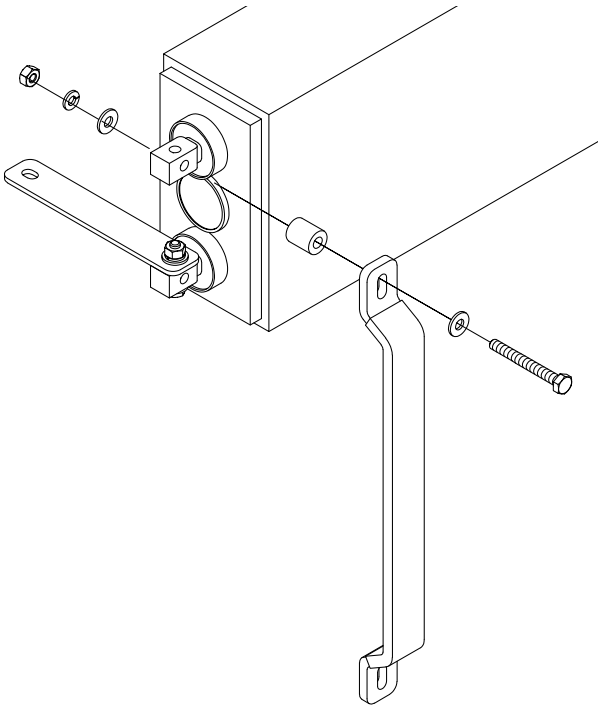
Consult below for proper installation for particular cell type being installed.

5 to 7 Plate

Install spacer between cell post and “C” connector.

Duplicate connection process at both connection points.

Torque all hardware to 125 in-lb.

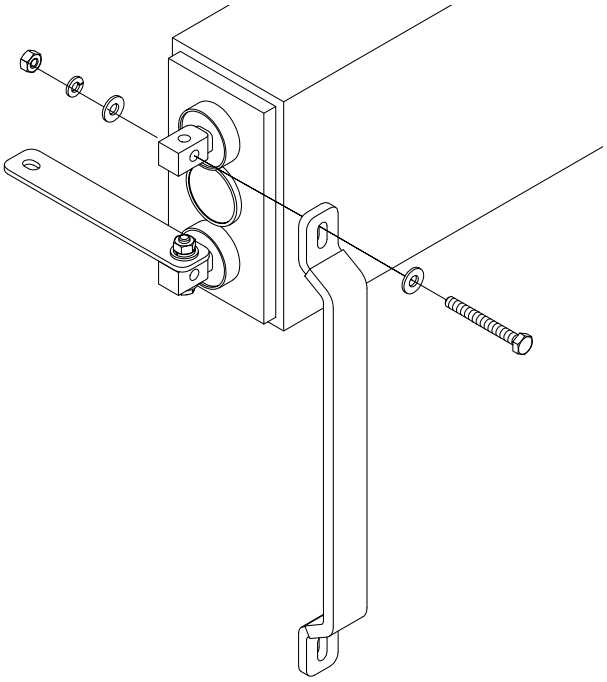


9 to 15 Plate

Install “C” connector to cell post.

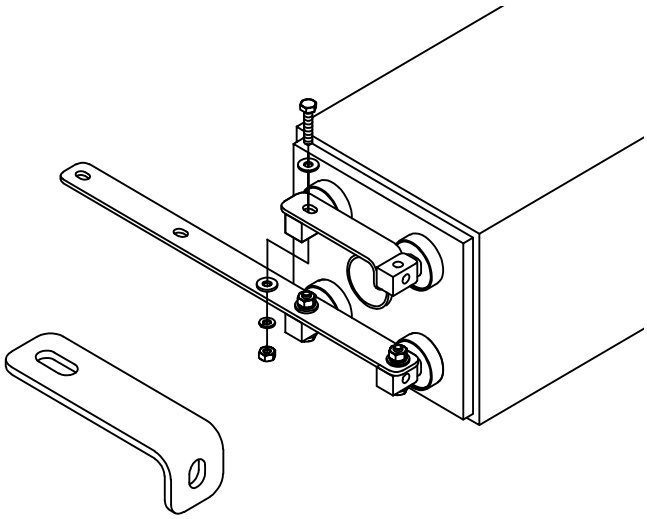
Duplicate connection process at both connection points.

Torque all hardware to 125 in-lb.

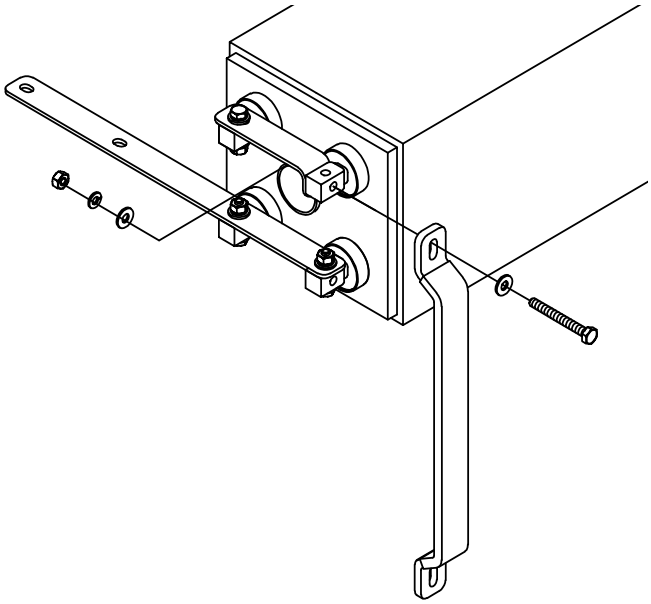


17 to 27 Plate

1. Install “L” connector with vertical bolt as below. Bolt should be installed loosely for future adjustments. Duplicate connection process at both connection points



2. Install “C” connector to cell post using horizontal bolt as below. Bolt should be installed loosely for future adjustments. Duplicate connection process at both connection points.

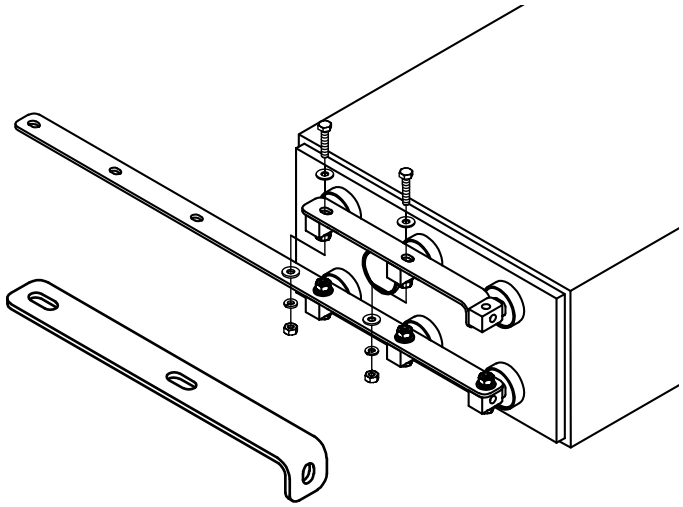


3. Ensure proper alignment of connectors to cell posts.
4. **Tighten & torque the horizontal bolt to 125 in-lb prior to tightening and torqueing the vertical bolt in step 1.**

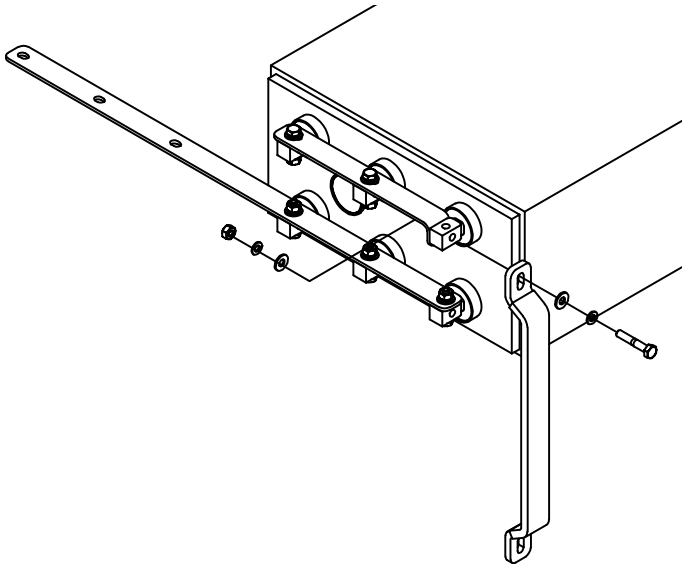
   NOTE: For this connection point it is acceptable to torque the head of the bolt.

29 to 33 Plate

1. Install “L” connector with vertical bolt as below. Bolts should be installed loosely for future adjustments. Duplicate connection process at both connection points.



2. Install “C” connector to cell post using horizontal bolt as below. Bolt should be installed loosely for future adjustments. Duplicate connection process at both connection points.



3. Ensure proper alignment of connectors to cell posts.
4. **Tighten & torque the horizontal bolt to 125 in-lb prior to tightening and torqueing the vertical bolts in step 1.**

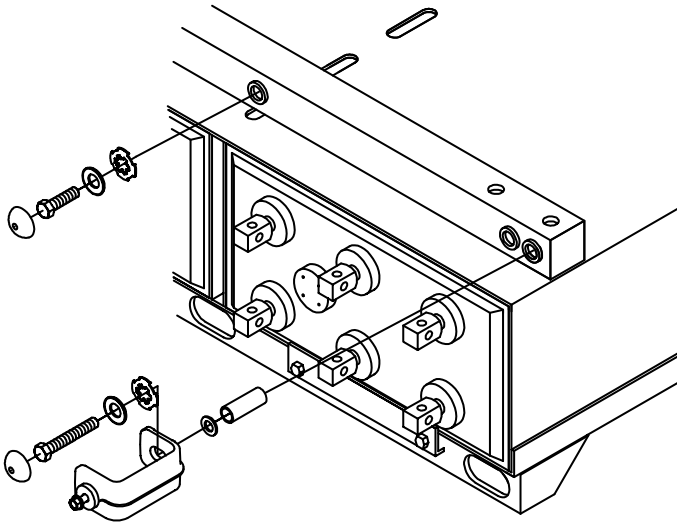
   NOTE: For this connection point it is acceptable to torque the head of the bolt.

Terminal Assembly

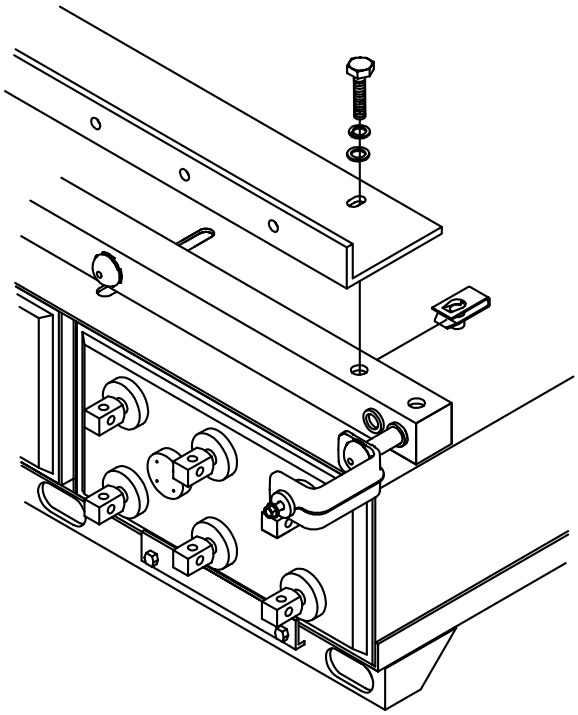
Top Termination

Consult battery string layout diagram for termination location.

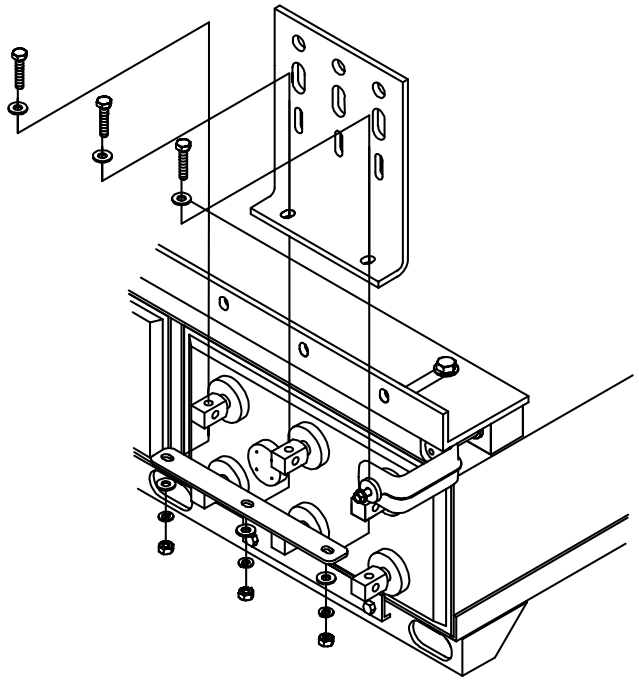
1. Remove module bolt directly behind terminal plate location. If location contained safety shield bracket assembly install cap washer in front of dragon tooth washer and re-install safety shield bracket assembly Install plastic cap after bolts are torqued. Consult “Hardware Torque Requirements” (pg a.4) for proper torque values.



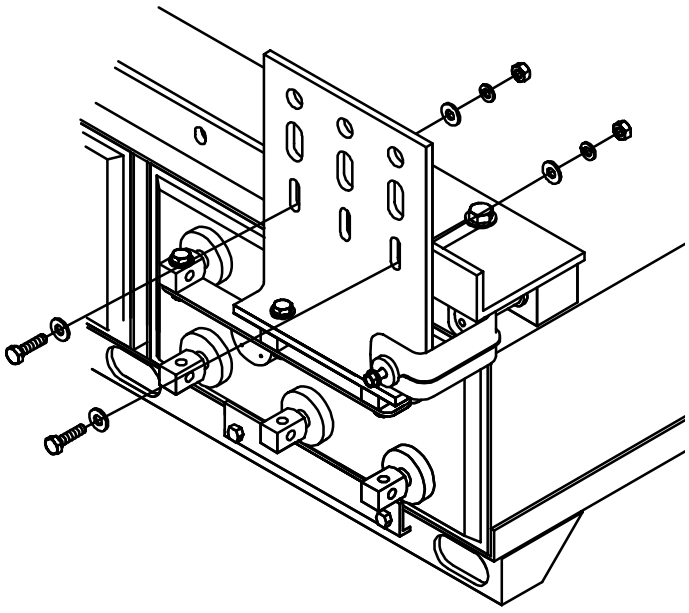
2. Slip clip onto back of channel through cutout. Install terminal plate bracket to the top of the module. Use 3/8-16 x 1.25" hardware. Install loosely for future alignment.



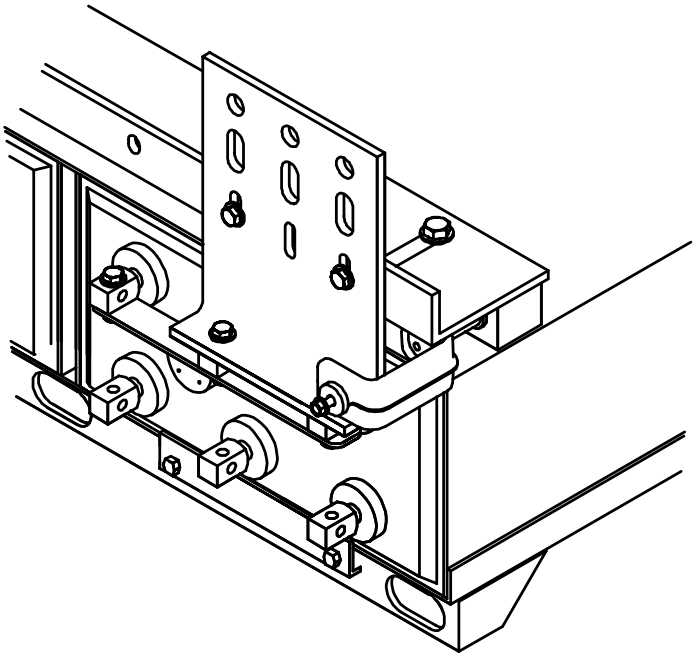
3. Install terminal plate to battery posts using 1/4-20 hardware (consult battery string layout diagram & parts kit for specific length).



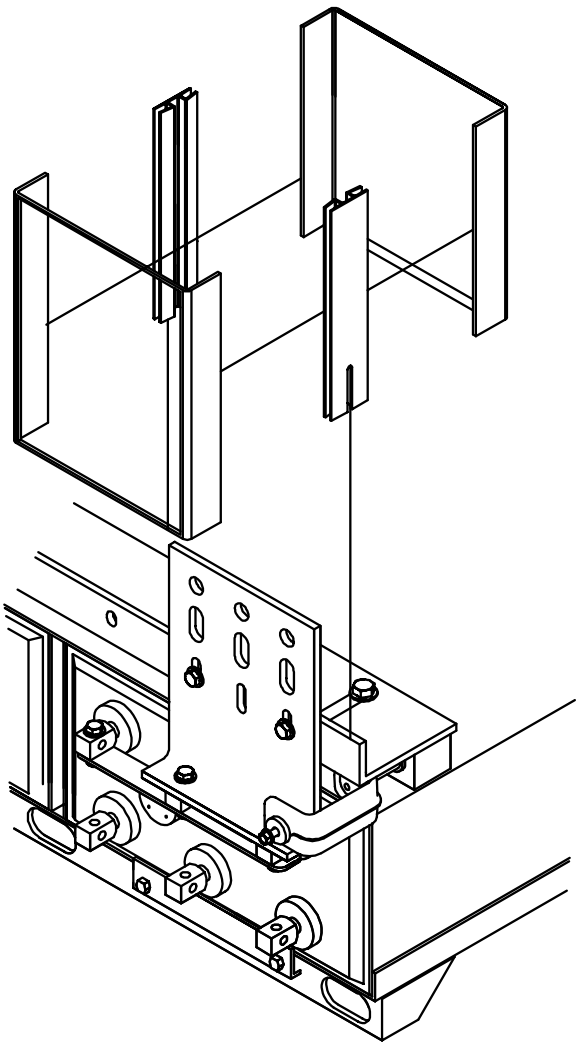
4. Attach terminal plate to terminal plate bracket. Note position of terminal plate. Terminal plate bracket may have to be moved in order to be flush with the terminal plate.



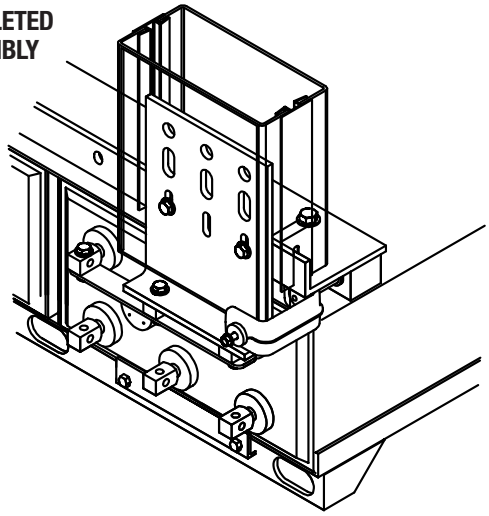
5. After confirming alignment safety shield bracket hardware should be tightened, but not torqued. All remaining hardware should be torqued. Consult “Hardware Torque Requirements” (pg a.4) for proper torque values.



6. Assemble the four parts of the top terminal safety shield as detailed below.

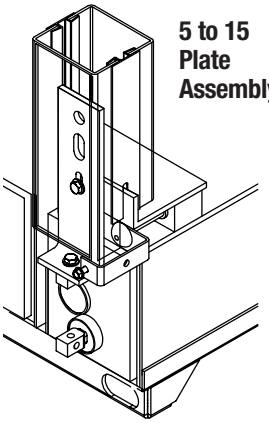


COMPLETED ASSEMBLY

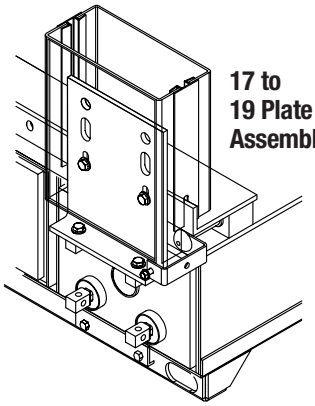


7. Top terminal assembly will vary by battery plate size.

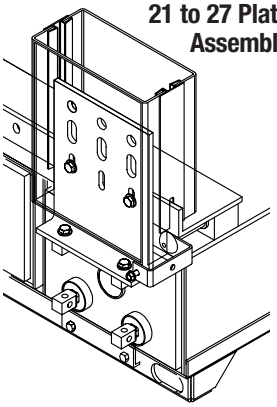
5 to 15 Plate Assembly



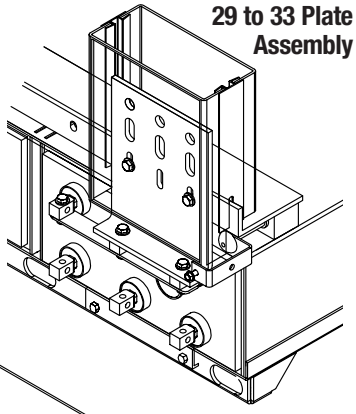
17 to 19 Plate Assembly



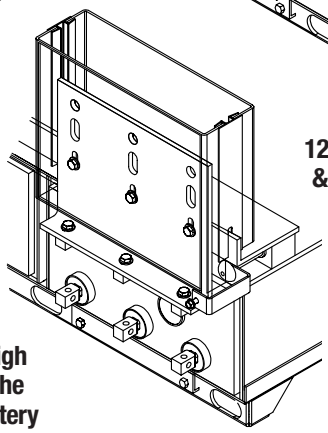
21 to 27 Plate Assembly



29 to 33 Plate Assembly

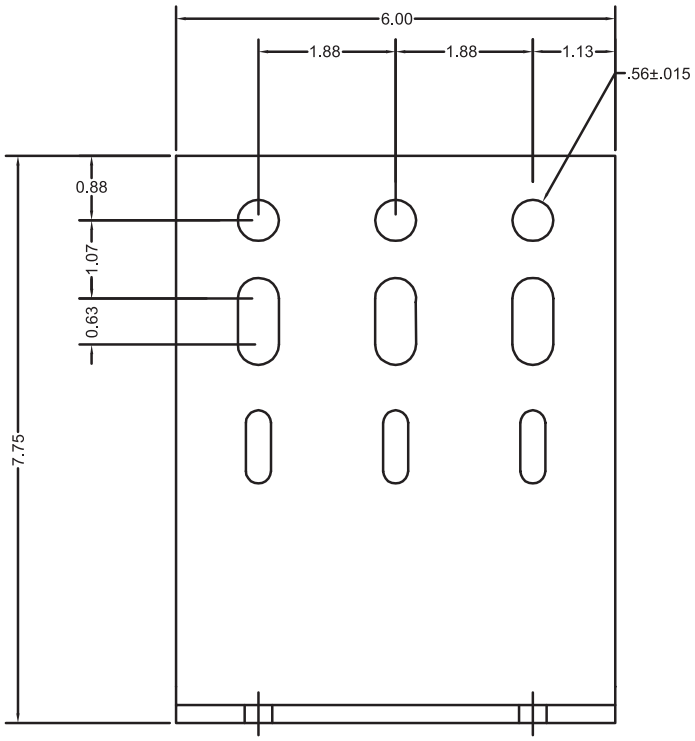


125-33 Plate & High Rate Assembly



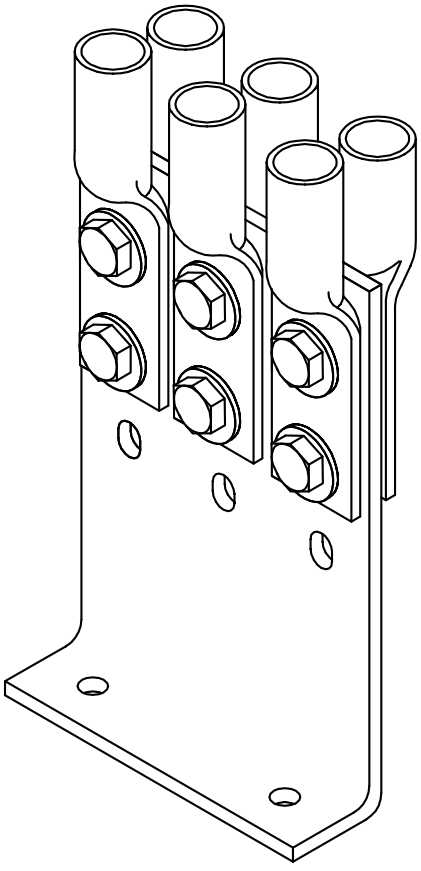
**** When assembling the 125-33 Plate & High Rate terminal plate; the center bolt to the battery post should be loosely installed prior to installing the outer bolts.**

8. Top terminal plates are designed to accept up to 0.50" dia. bolt and use a maximum 1.75" center, 2 hole lug.
Lug and lug hardware not included.



Top terminal plate hole to hole dimensions typical.
21 to 33 top terminal plate detailed above.

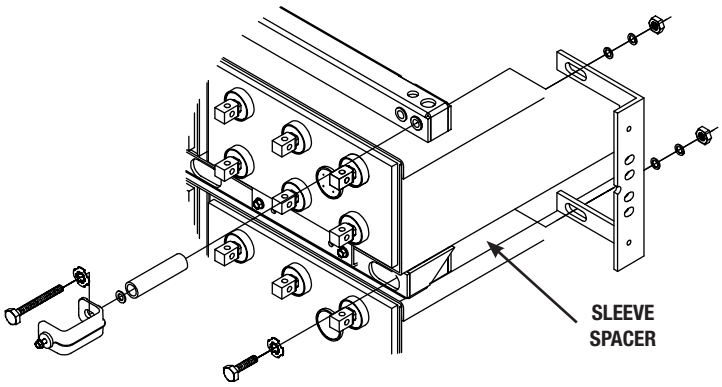
9. **Lugs can be positioned on both sides of the terminal plate.**



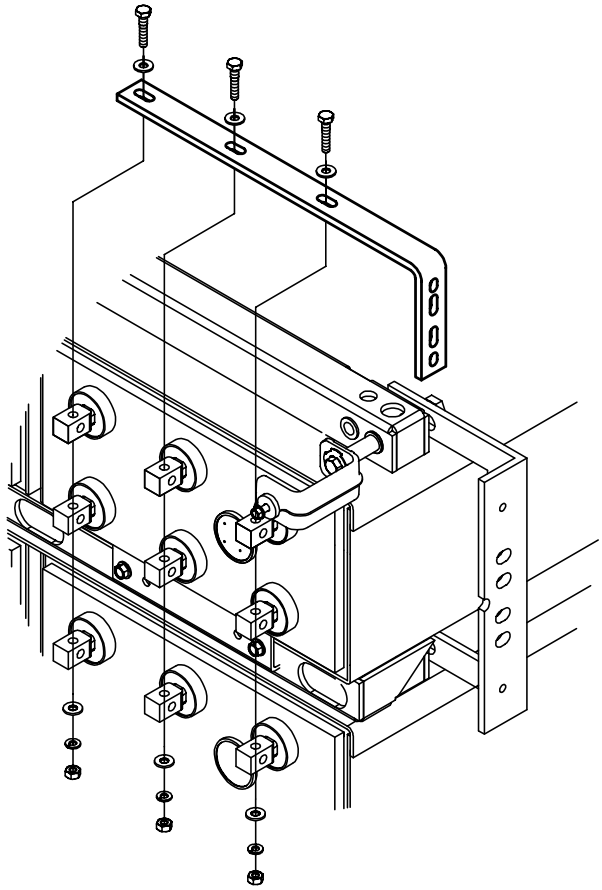
Side Termination

Consult battery string layout diagram for termination location.

1. Remove module bolts (3/8-16 x 1.25") from the module where side termination is to be installed. If safety shield bracket is at one of these locations, retain for later use.
2. Install plastic side terminal bracket in location where bolts were removed in previous step. Use 3/8-16 x 2.50" bolts. Bolts should be installed loosely for future adjustments. Replace safety shield bracket at same location from previous step.

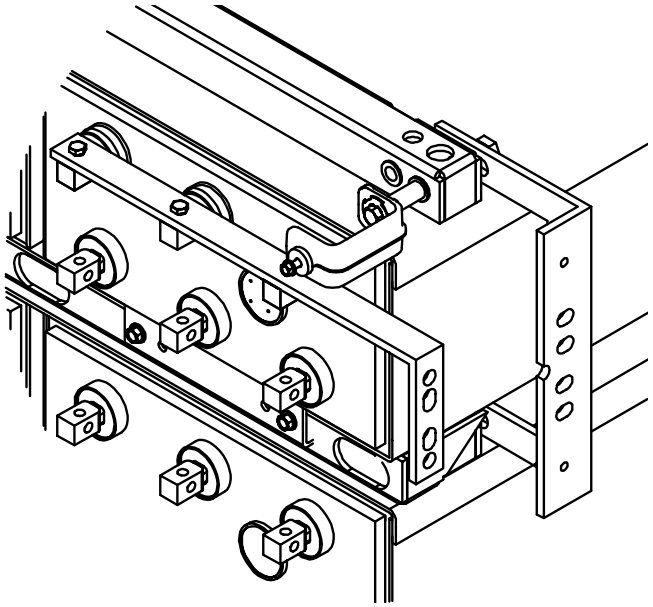


3. Install side terminal connectors to battery posts using 1/4- 20 bolts. Bolts should be installed loosely for future adjustments.

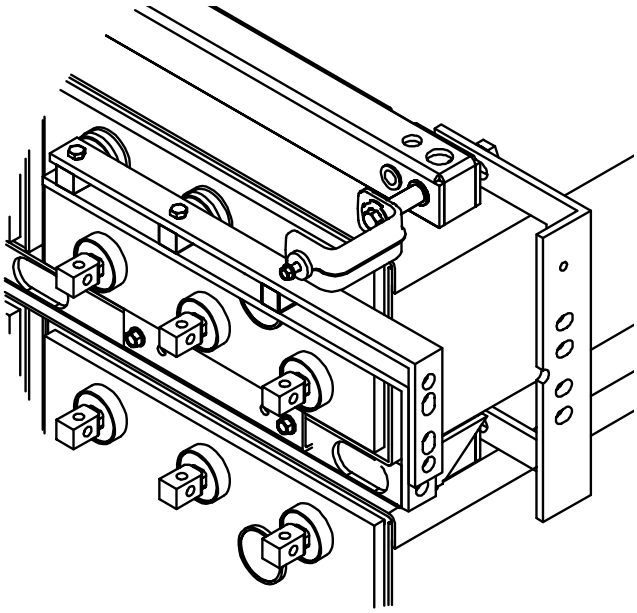


Review the "Connector Packages" chart (pg a.9) to ensure the correct connector package has been supplied.

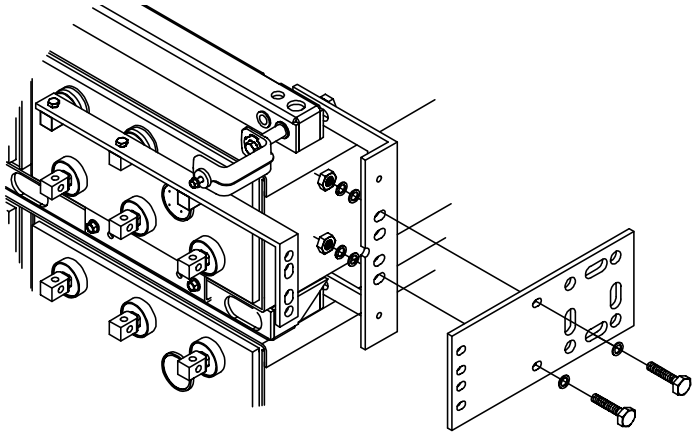
1CU / 2CU CONNECTOR PACKAGE
(single connector)



4CU / 6CU CONNECTOR PACKAGE
(double connector)

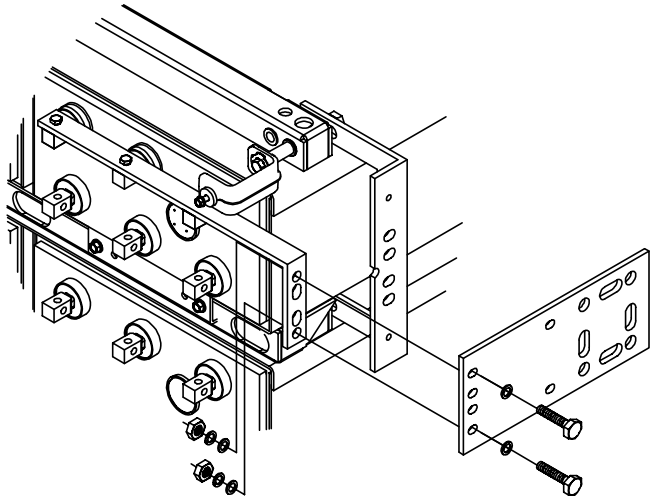


4. Install side terminal plate to terminal plate bracket using 1/4-20 x 1.00" hardware. Bolts should be installed loosely for future adjustments.

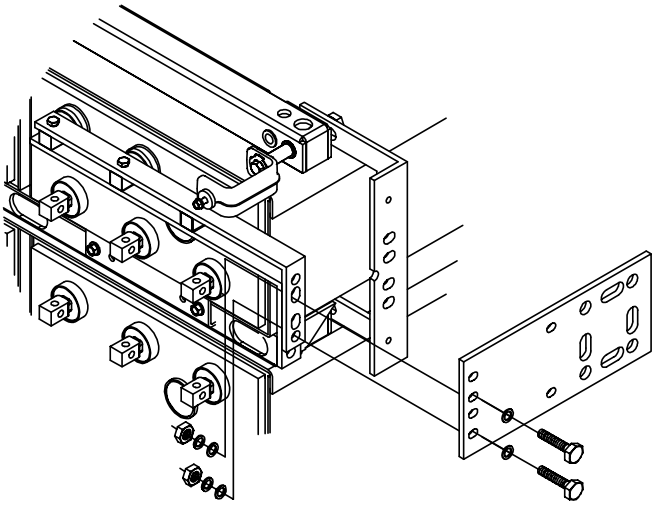


5. Connect side terminal plate to side terminal plate connectors. Bolt length is dependent on connector package as noted below.

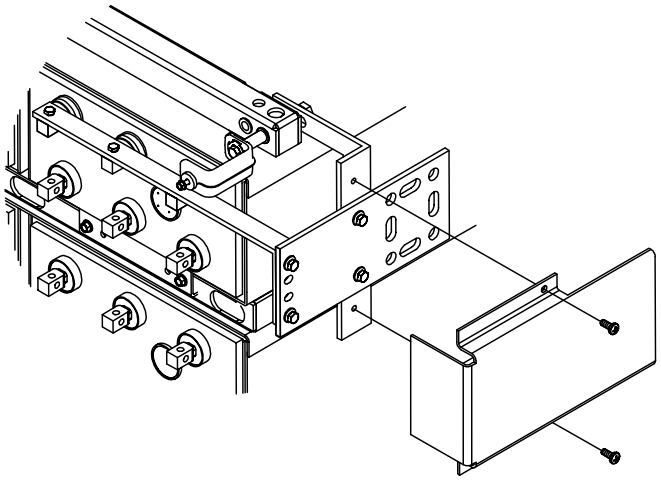
1CU / 2CU CONNECTOR PACKAGE
(1/4-20 x 1.00" hardware required)



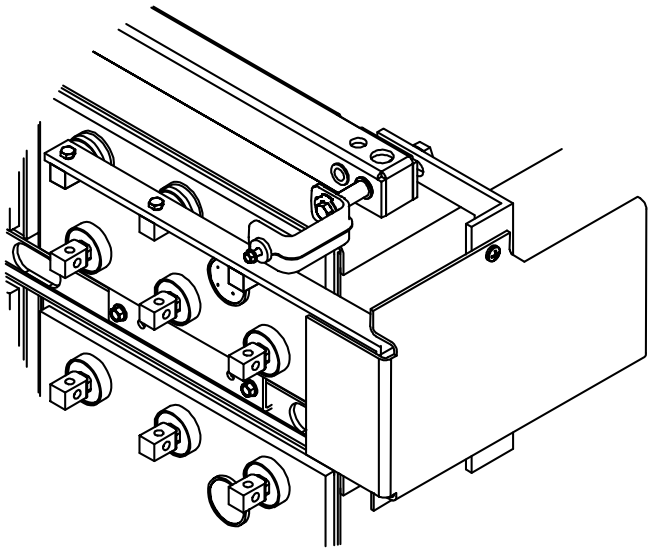
4CU / 6CU CONNECTOR PACKAGE
(1/4-20 x 1.25" hardware required)



6. After all parts are installed and alignment is confirmed, safety shield bracket hardware should be tightened, but not torqued. All remaining hardware should be torqued Consult “Hardware Torque Requirements” (pg a.4) for proper torque values.
7. Install side terminal shield to side terminal plate Bracket using 1/4-20 x 0.625" screws. Tighten but do not torque hardware.

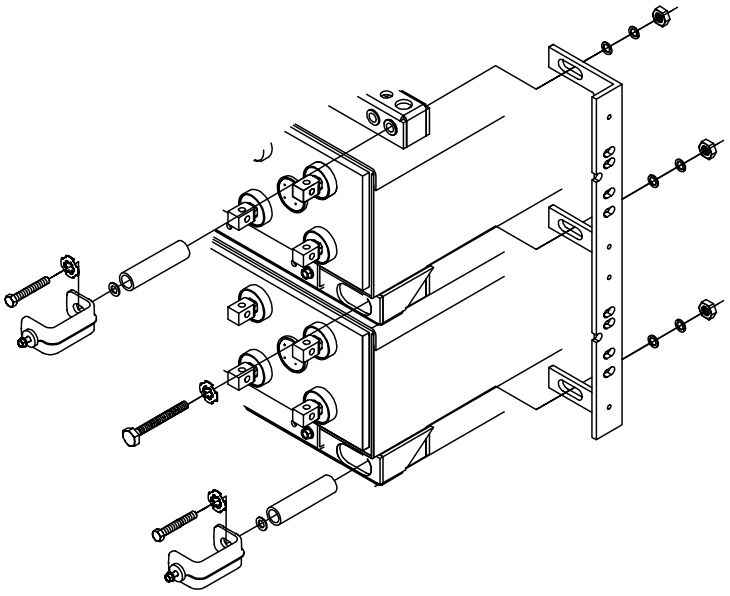


FINAL ASSEMBLY

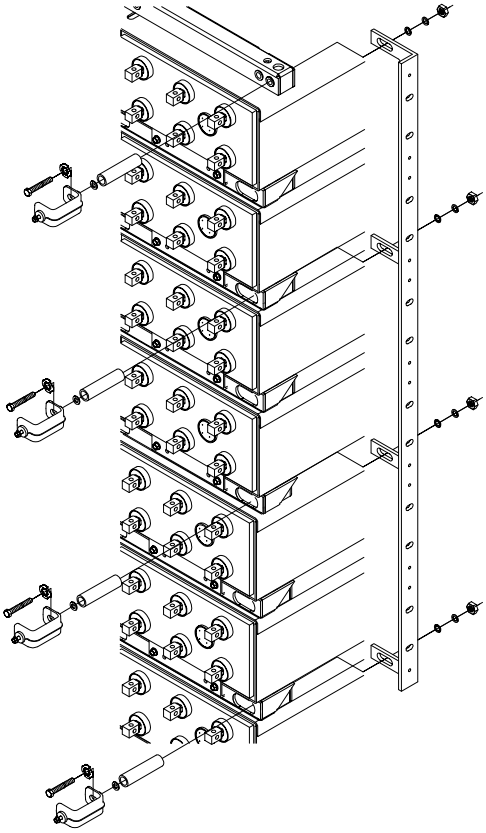


8. Depending on the termination location, side terminal plates may be adjacent to each other. The side terminal bracket attachment is different depending on the number of adjacent terminal plates.

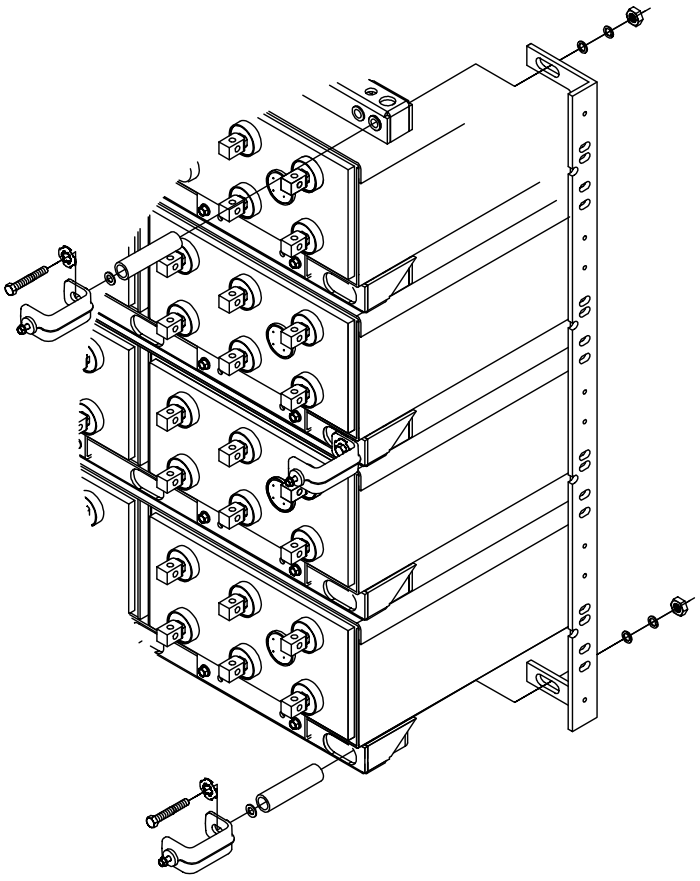
TWO TERMINAL PLATE BRACKET ASSEMBLY



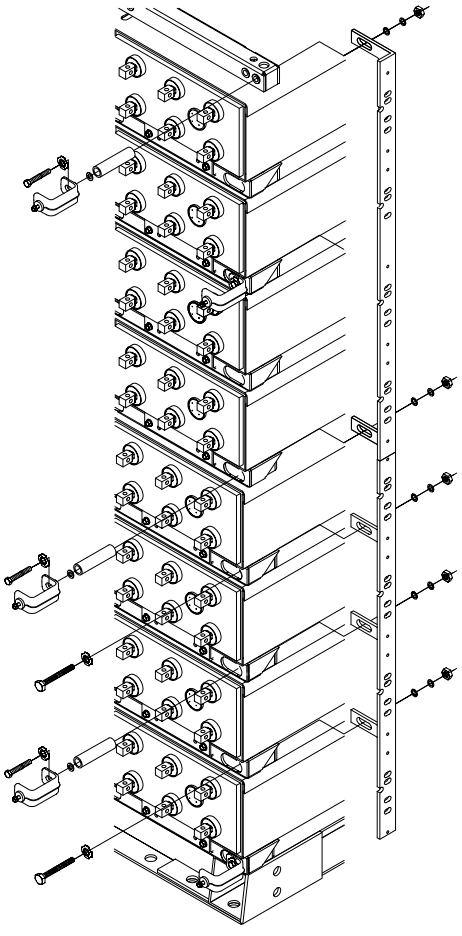
SIX TERMINAL PLATE BRACKET ASSEMBLY



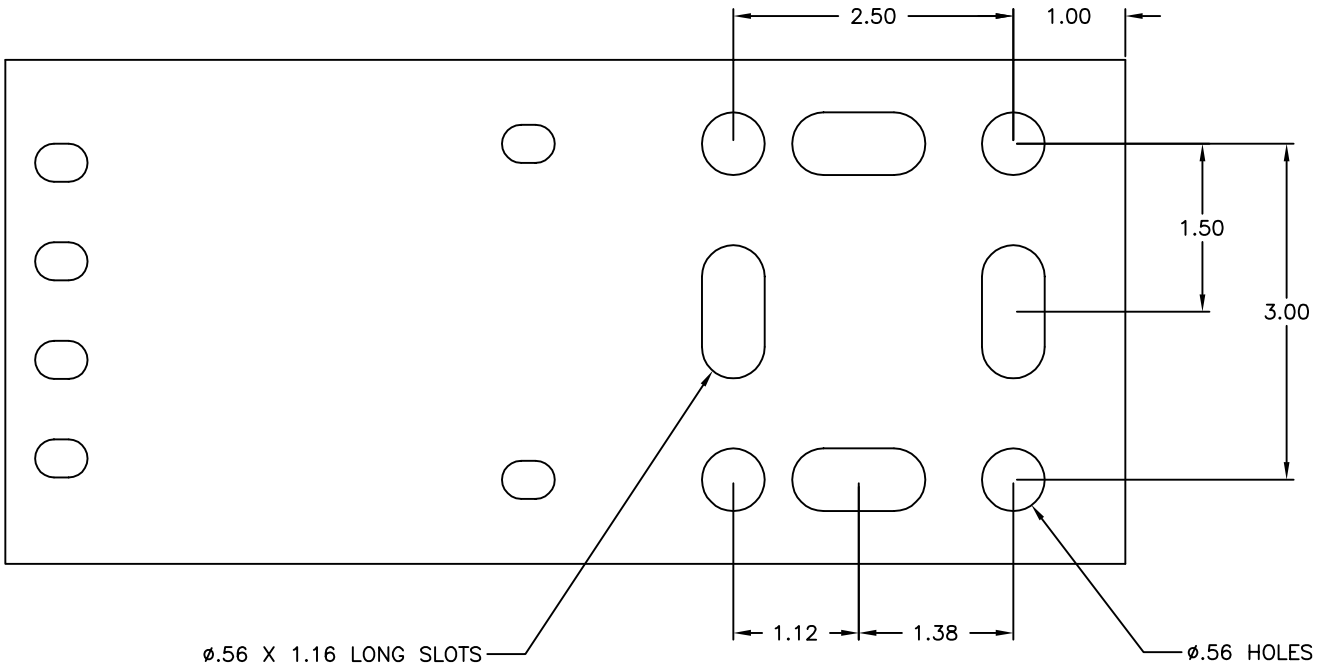
FOUR TERMINAL PLATE BRACKET ASSEMBLY



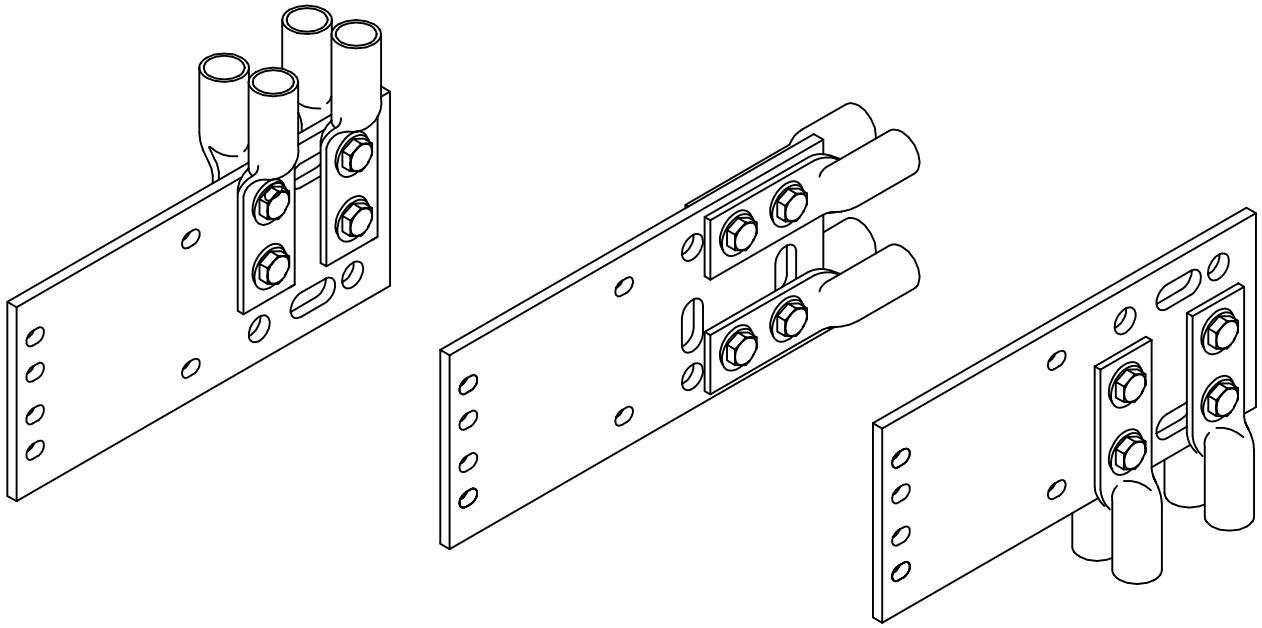
EIGHT TERMINAL PLATE BRACKET ASSEMBLY
(Installed in two sections)



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. Lugs can be positioned on both sides of the terminal plate. **Lug and lug hardware not included.**



Lug Positioning Options



Final Assembly Check Procedure

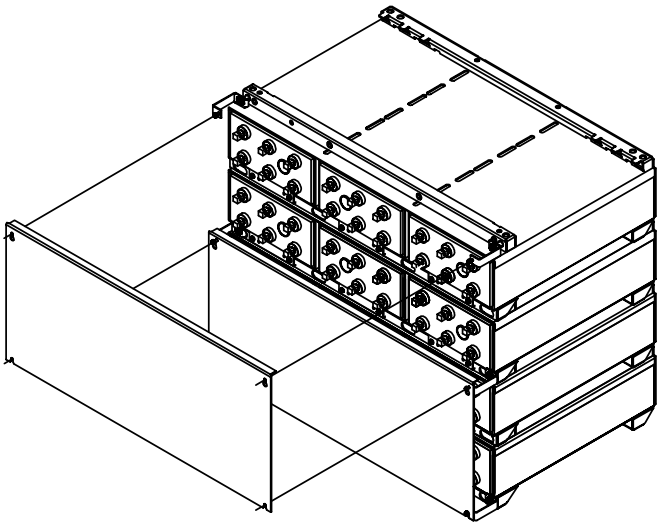
1. For future identification, individual cells should be numbered in electrical connection sequence, beginning with number one (1) at the positive end of the battery string.

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

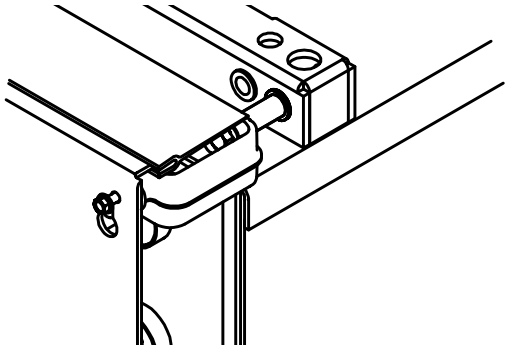
2. Read and record the voltages of the individual cells to assure that they are connected properly. The total battery string voltage should be approximately equal to the number of cells connected in series, multiplied by the measured voltage of one cell If the measured is less, recheck the connections for proper polarity. Verify that all cell 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" form in Appendix K of this manual. Review the records of each connection and detail resistance measurements. Clean, remake, and re-measure 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 string performance is based on the output at the cell terminals. Therefore, the shortest electrical connection between the battery string 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 string and operating equipment than customer specified. Excessive voltage drop in cables will reduce the desired reserve time and power from the battery string.

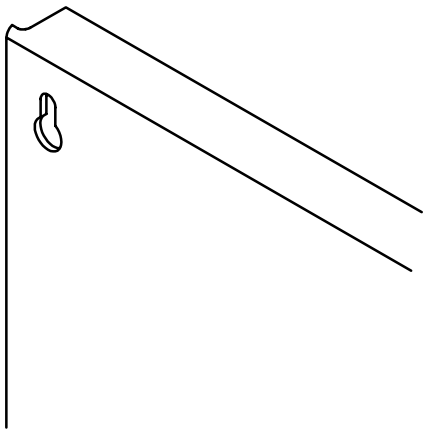


TOP

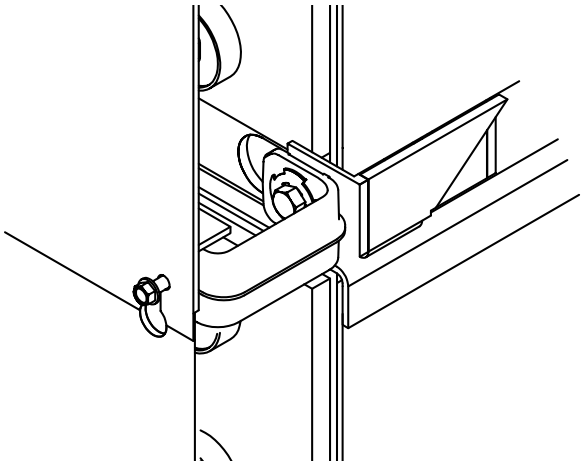


Safety Shield Assembly

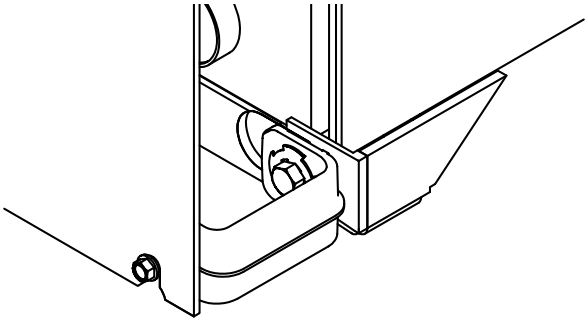
1. All safety shield brackets should already be installed at this time. Refer to "Interlock Module Installation" section for bracket installation.
2. Safety shields are designed with a "keyhole" type attachment.



OVERLAP



BOTTOM

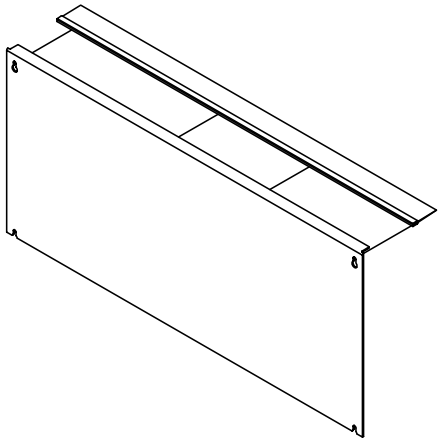


3. One shield will cover two modules. Starting at the bottom of the stack; hang the first shield on the top brackets through the large part of the keyhole. At the same time aligning the cutout at the bottom of the shield with the second set of brackets. The next shield will overlap the previously installed shield. For stacks containing odd number of modules a single module safety shield will be supplied. After all shields are in place, tighten the outer bolt, but **do not torque.**

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

The following charging parameters are for Standby (Float) Applications.

For Renewable Energy (Cyclic) Applications refer to Appendix H.

Charger Voltage (per cell)

2.25V ± 0.5% @ 77°F (25°C)

When setting the float voltage on the charger, the battery string should be set to float at the nominal cell float voltage times the number of cells per battery string. The charger must be able to maintain the battery string voltage within ± 0.5% of the desired level at all times.

Example: For a 48V system, the float voltage may vary from 53.73V to 54.27V

Charge Current

Charge current should not exceed the recommended minimum and maximum requirements as detailed in Appendix F for Unigy II & Appendix G for Deka Fahrenheit HT 2V.

Temperature Compensation

Battery voltage should be adjusted for ambient temperature variations.

2mV per °C (1.8°F) per 2v cell.

Consult **Voltage Compensation Chart (Appendix F for Unigy II & Appendix G for Deka Fahrenheit HT 2V)** for temperature compensation voltage maximum and minimum limits.

Cell Voltage

Individual cell voltages may vary by ± 0.05V per cell of the average battery string float voltage.

It is not unusual to observe a wide float voltage range between cells for the first 6 months of operation. After the initial 6 months, an individual cell voltage of 2.15V or less while following the published float charge instructions indicates a potential problem and action should be taken to replace the low voltage unit.

Contact East Penn's Reserve Power Product Support Department at ReservePowerWarranty@dekabatteries.com for additional assistance.

Equalizing

Upon installation of the battery string, an optional charge of 2.40V per cell ± 0.5% @ 77°F (25°C) for 24 hours (not to exceed 24 hours) can be applied. (**NOTE:** Verify that the higher cell voltage will not adversely affect any other connected equipment). **If this is done, be sure to reset the charging equipment to the proper float voltage upon completion of the equalize charge.**

Example: For a 48V system, the equalize voltage may vary from 57.31V to 57.89V

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 operating temperature should not exceed 95°F (35°C) and should never exceed 105°F (40.5°) for more than an 8 hour period. 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.**

NOTE: The battery system should not be discharged below published EOD (end of discharge) ratings.

Rectifier Ripple Voltage

FREQUENCY

Ripple that has a frequency greater than 667Hz (duration less than 1.5ms) is acceptable, unless it is causing additional cell heating.

Ripple that has a frequency less than 667Hz (duration greater than 1.5ms), must meet the following voltage specification to be acceptable.

VOLTAGE

Ripple voltage shall be less than 0.5% peak to peak (.177% rms) of the manufacturer's recommended battery 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 string and inform the user if and when corrective action needs to be taken. Values should be recorded using "Battery Maintenance Report" in Appendix K.

All measuring equipment should be in good operating condition and accuracy should be confirmed on an annual basis to NIST traceable standards.

After installation and when the battery string has been on float charge for one week, the data as detailed in the below *"Maintenance Section"* should be recorded.

Failure to maintain proper records including information as detailed below may result in voiding any applicable warranty.

ACCEPTANCE / PERFORMANCE TESTING

An acceptance / performance test, if required can be performed upon initial installation to ensure the battery meets the initial requirements.

A performance test should be completed if, over the life of the battery, operation is questionable.

If an acceptance or performance test is required, follow the guidelines in Appendix J in conjunction with IEEE-1188.

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 a.3).

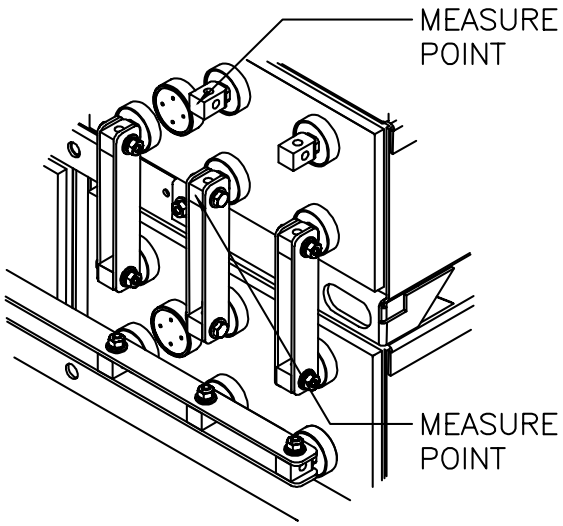
Annual Inspection

For Renewable Energy (Cyclic) applications, some of the following recommendations may not apply.

Discharge and recharge affect voltage and ohmic values. These readings should be taken only after the battery string has been on continuous, uninterrupted float charge for at least one month.

The following values should be recorded using the Battery Maintenance Report in Appendix K. Additional copies available at www.eastpennmanufacturing.com

1. Conduct a visual inspection of each cell.
2. Battery string voltage at battery terminals while battery is on float.
3. Charger voltage at the charger panel.
4. Individual cell voltages. Cells should be within ± 0.05 volts of the average cell float voltage.
5. Ambient temperatures within area of battery string
6. Average battery string temperature at a minimum of three different cells at varying locations. Temperatures shall be taken at the negative post.
7. Individual cell ohmic readings. To provide accurate / consistent values, cells must be fully charged, at same temperature and probes placed at same location each time readings are taken. On a 4-post cell, place meter leads on the left positive & left negative posts or right positive & right negative posts. For 6-post cells, measure from center positive to center negative posts. Do not measure diagonally from positive to negative posts. See below example for specific location.



8. All intercell, interunit and terminal connection resistances. 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 a.4) for proper torque values. If reading remains high, clean contact surfaces according to Step 1 under Connector Assembly. Recheck the micro-ohm reading.

   Failure to maintain proper records including information as detailed above may result in voiding any applicable warranty.

Battery Cleaning

Batteries, cabinets, racks, and modules should be cleaned with clean water. If neutralizing is required use a mixture of 1 lb baking soda to 1 gallon of 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 results 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."

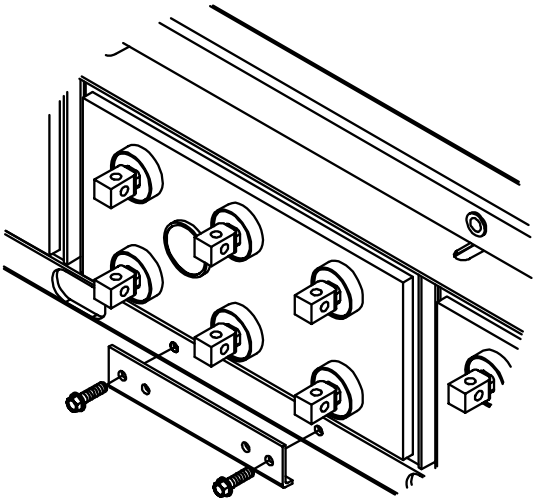
When performing capacity testing and recording data refer to IEEE 1188 recommendations.

NOTE: When discharging at higher rates than originally specified, extra connectors may need to be added to prevent excessive voltage drop and / or excessive temperature rise.

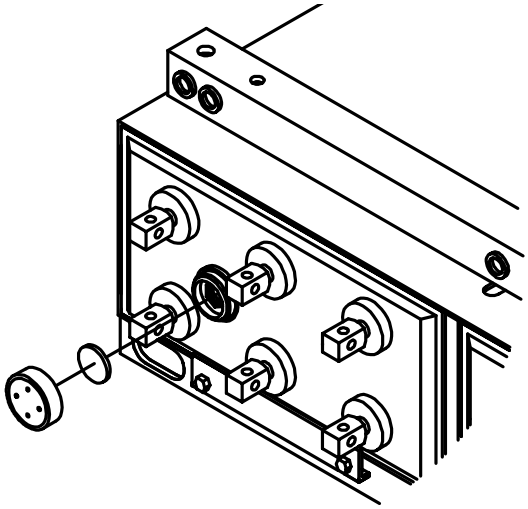
Should it be determined that any individual cell(s) need to be replaced, contact East Penn.

CELL REMOVAL PROCEDURE

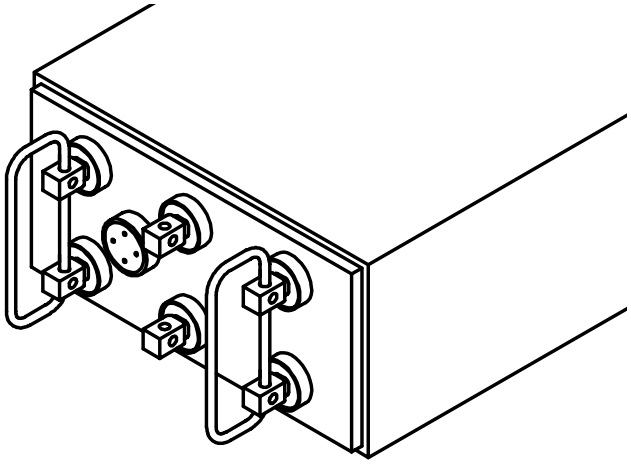
1. Before removing cell, review Safety Precautions (pg a.3) of this manual. Contact East Penn with specific questions or concerns.
2. Disconnect Charger and the system ground connection.



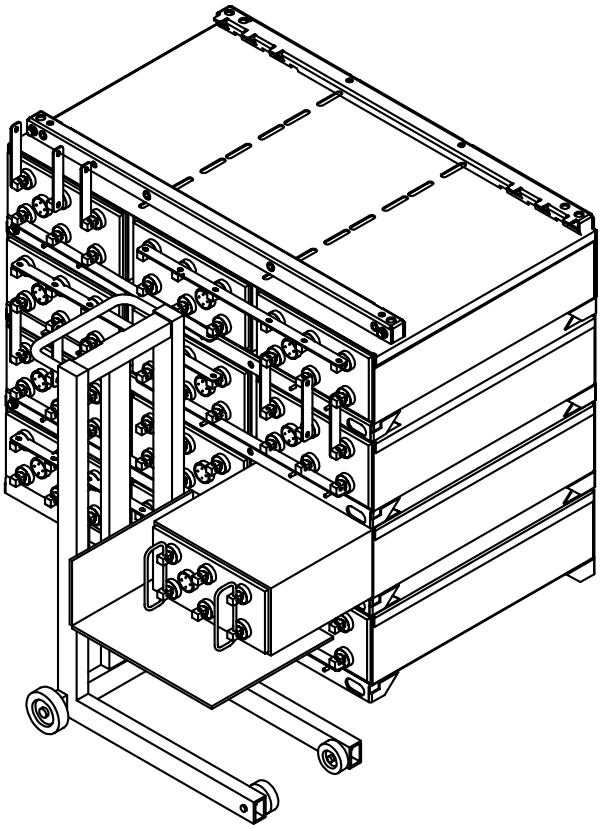
3. Remove connectors from cell being removed.
4. Remove cell retainer bar(s) from cell being removed.
5. Cells develop internal pressure. Relieving this pressure from the cell will make it easier to remove the cell from the module.
   a. Pry off vent shroud using insulated flat head screwdriver.
   b. Remove flame arrestor (round white disc).
   c. Unscrew valve ¼ turn using 17mm hex key (pressure will release).



   d. Tighten valve immediately and torque to 12-14 in lb with 17mm hex key.
6. Lifting device shall be rated to handle weight of cell.
7. Remove one cell at a time.



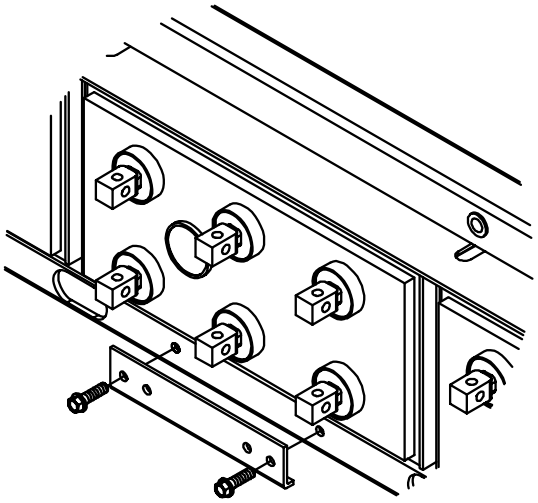
a. Thread non-metallic rope through two battery terminals and knot.



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

Cell Replacement Procedure

1. Cells develop internal pressure. Relieving this pressure from the cell will make it easier to install the cell into the module. Follow the steps of “Cell Removal Procedure” item 4.



2. Ensure cell polarity is correct prior to installing cell
3. Replace cell retainer bar.
4. Refer to “Electrical Connection” section for installing connectors of replacement cell.

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. The charging system for these batteries shall prevent charging outside of the battery specifications through the use of voltage (and temperature for VRLA) monitoring and controls, or both current and temperature monitoring and controls. The system may also use current monitoring to prevent out of condition specifications.

4. 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.

5. 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.

6. 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.

7. 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.

8. 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.

9. Unigy II modules are designed to have 0.5” (12.7mm) horizontal spacing and 2” (50.8mm) vertical spacing for air circulation. Modules should be spaced at a minimum of 2” (50.8mm) from any wall or obstacle.

10. Minimum & maximum allowable operating range is -40°C (-40°F) to 40°C (104°F).

11. Minimum & maximum allowable discharge current to an end voltage of 1.75 vpc is listed as follows:

Unigy II - Minimum & Maximum Discharge Currents

Battery Type	Minimum Discharge Current	Maximum Discharge Current
	Amps	Amps
AVR45-5	1.2	152
AVR45-7	1.8	228
AVR45-9	2.4	304
AVR45-11	3.0	380
AVR45-13	3.6	456
AVR45-15	4.2	532
AVR45-17	4.8	610
AVR45-19	5.4	686
AVR45-21	6.0	762
AVR45-23	6.7	838
AVR45-25	7.3	914
AVR45-27	7.9	991
AVR45-29	8.5	1067
AVR45-31	9.1	1143
AVR45-33	9.7	1219

Battery Type	Minimum Discharge Current	Maximum Discharge Current
	Amps	Amps
AVR75-5	2.1	182
AVR75-7	3.1	273
AVR75-9	4.1	363
AVR75-11	5.1	454
AVR75-13	6.2	545
AVR75-15	7.2	636
AVR75-17	8.2	727
AVR75-19	9.2	818
AVR75-21	10.3	909
AVR75-23	11.3	999
AVR75-25	12.3	1090
AVR75-27	13.4	1181
AVR75-29	14.4	1272
AVR75-31	15.4	1363
AVR75-33	16.4	1454

Battery Type	Minimum Discharge Current	Maximum Discharge Current
	Amps	Amps
AVR95-7	4.0	360
AVR95-9	5.4	480
AVR95-11	6.7	600
AVR95-13	8.1	720
AVR95-15	9.4	840
AVR95-17	10.8	960
AVR95-19	12.1	1080
AVR95-21	13.4	1200
AVR95-23	14.8	1320
AVR95-25	16.1	1440
AVR95-27	17.5	1560
AVR95-29	18.8	1680
AVR95-31	20.2	1800
AVR95-33	21.5	1920
AVR125-33	29.3	2049

Deka Fahrenheit 2V - Minimum & Maximum Discharge Currents

Battery Type	Minimum Discharge Current	Maximum Discharge Current
	Amps	Amps
HT45-5	1.1	136
HT45-7	1.6	204
HT45-9	2.2	272
HT45-11	2.7	340
HT45-13	3.2	408
HT45-15	3.8	476
HT45-17	4.3	545
HT45-19	4.9	614
HT45-21	5.4	682
HT45-23	6.0	750
HT45-25	6.5	818
HT45-27	7.0	886
HT45-29	7.6	955
HT45-31	8.1	1023
HT45-33	8.7	1091

Battery Type	Minimum Discharge Current	Maximum Discharge Current
	Amps	Amps
HT95-7	3.6	292
HT95-9	4.8	389
HT95-11	6.0	486
HT95-13	7.2	583
HT95-15	8.4	680
HT95-17	9.6	777
HT95-19	10.8	875
HT95-21	12.0	972
HT95-23	13.2	1069
HT95-25	14.4	1166
HT95-27	15.6	1263
HT95-29	16.8	1360
HT95-31	18.0	1458
HT95-33	19.2	1555

HT125-33	26.2	1833

APPENDIX B

EastPenn	REFRESH RECORD FORM							Rev. 1 5-14-24
	EPM Order Number*		Pallet ID Number	Individual Performing Test (Full Name)			Date of Refresh	Refresh Duration
	Information Prior to Refresh			READINGS TO BE TAKEN 1 HOUR BEFORE THE COMPLETION OF REFRESH CHARGING			Notes & Comments	
Model Number	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								
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Cell 54								
Cell 55								
Cell 56								
Cell 57								
Cell 58								
Cell 59								
Cell 60								

ALL FIELDS TO THE RIGHT OF THE JAR 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)

REFRESH RECORD FORM

Rev. 1
5-14-24

EASTPENN

EPM Order Number*	Pallet ID Number	Individual Performing Test (Full Name)	Date of Refresh	Refresh Duration

Model Number	Information Prior to Refresh			READINGS TO BE TAKEN 1 HOUR BEFORE THE COMPLETION OF REFRESH CHARGING			Notes & Comments	
	Date Code	Cell Serial Number	Open Circuit Voltage	Cell Voltage Reading	Charging Current	Cell Temperature		
Cell 61								
Cell 62								
Cell 63								
Cell 64								
Cell 65								
Cell 66								
Cell 67								
Cell 68								
Cell 69								
Cell 70								
Cell 71								
Cell 72								
Cell 73								
Cell 74								
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Cell 111								
Cell 112								
Cell 113								
Cell 114								
Cell 115								
Cell 116								
Cell 117								
Cell 118								
Cell 119								
Cell 120								

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

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

Unigy II - Cell Weight and Volume

Battery Type	Cell Weight		Electrolyte (per cell)				Pure Acid (per battery)	
			Volume		Weight		Wieght	
	lb	kg	gal	liter	lb	kg	lb	kg
AVR45-5	18	8	0.37	1.40	4.00	1.81	1.60	0.72
AVR45-7	25	11	0.52	1.96	5.60	2.54	2.24	1.02
AVR45-9	32	15	0.67	2.52	7.22	3.28	2.89	1.31
AVR45-11	39	18	0.81	3.08	8.83	4.00	3.53	1.60
AVR45-13	46	21	0.96	3.64	10.43	4.73	4.17	1.89
AVR45-15	53	24	1.11	4.20	12.04	5.46	4.81	2.18
AVR45-17	60	27	1.26	4.76	13.65	6.19	5.46	2.47
AVR45-19	67	30	1.41	5.32	15.26	6.92	6.10	2.77
AVR45-21	74	34	1.55	5.89	16.87	7.65	6.74	3.06
AVR45-23	81	37	1.70	6.45	18.47	8.38	7.39	3.35
AVR45-25	88	40	1.85	7.01	20.08	9.11	8.03	3.64
AVR45-27	95	43	2.00	7.57	21.69	9.84	8.67	3.93
AVR45-29	102	46	2.15	8.13	23.30	10.57	9.31	4.22
AVR45-31	109	49	2.30	8.69	24.91	11.30	9.96	4.52
AVR45-33	116	53	2.44	9.25	26.51	12.03	10.60	4.81
AVR75-5	28	13	0.61	2.30	6.58	2.98	2.63	1.19
AVR75-7	39	18	0.86	3.28	9.39	4.26	3.75	1.70
AVR75-9	50	23	1.11	4.22	12.04	5.46	4.83	2.19
AVR75-11	61	28	1.36	5.15	14.76	6.70	5.90	2.68
AVR75-13	72	33	1.61	6.09	17.44	7.91	6.97	3.16
AVR75-15	83	38	1.86	7.03	20.13	9.13	8.05	3.65
AVR75-17	94	43	2.10	7.96	22.81	10.35	9.12	4.14
AVR75-19	105	48	2.31	8.75	25.08	11.38	10.02	4.55
AVR75-21	116	53	2.60	9.84	28.19	12.79	11.27	5.11
AVR75-23	127	58	2.84	10.77	30.87	14.00	12.34	5.60
AVR75-25	137	62	3.09	11.71	33.56	15.22	13.42	6.09
AVR75-27	148	67	3.34	12.64	36.23	16.44	14.48	6.57
AVR75-29	159	72	3.59	13.58	38.92	17.65	15.56	7.06
AVR75-31	170	77	3.83	14.52	41.60	18.87	16.63	7.54
AVR75-33	181	82	4.08	15.46	44.29	20.09	17.71	8.03
AVR95-7	44	20	0.96	3.63	10.54	4.78	4.41	2.00
AVR95-9	57	26	1.22	4.62	13.40	6.08	5.60	2.54
AVR95-11	70	32	1.49	5.66	16.40	7.44	6.86	3.11
AVR95-13	83	38	1.76	6.68	19.36	8.78	8.09	3.67
AVR95-15	96	44	2.04	7.73	22.42	10.17	9.38	4.25
AVR95-17	108	49	2.30	8.72	25.28	11.47	10.57	4.79
AVR95-19	121	55	2.48	9.38	27.18	12.33	11.37	5.16
AVR95-21	134	61	2.89	10.94	31.70	14.38	13.26	6.01
AVR95-23	147	67	3.08	11.67	33.84	15.35	14.15	6.42
AVR95-25	160	73	3.39	12.84	37.23	16.89	15.57	7.06
AVR95-27	172	78	3.69	13.96	40.48	18.36	16.93	7.68
AVR95-29	186	84	3.93	14.89	43.17	19.58	18.05	8.19
AVR95-31	198	90	4.22	15.96	46.28	20.99	19.35	8.78
AVR95-33	211	96	4.50	17.04	49.41	22.41	20.66	9.37
AVR125-33	300	136	6.81	25.79	73.92	33.53	30.90	14.02

***Data subject to change.*

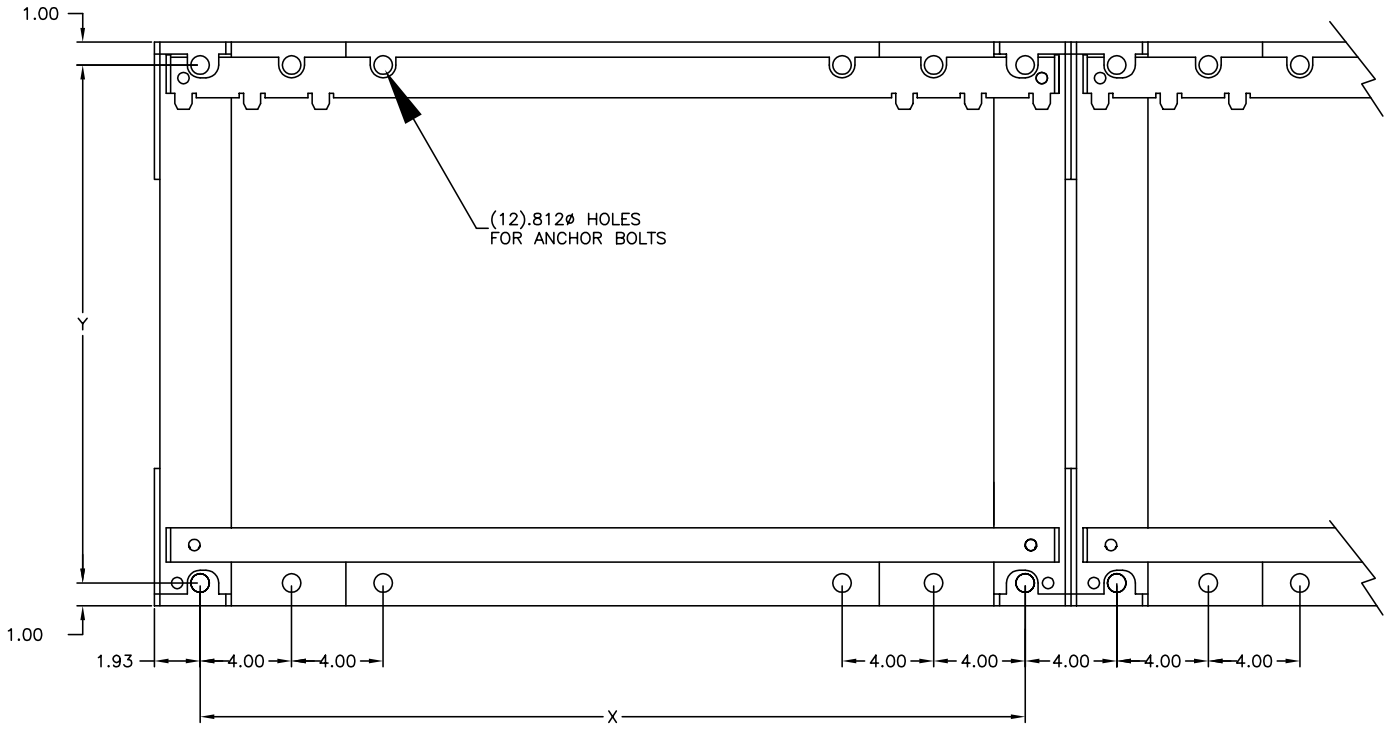
Fahrenheit HT 2V - Cell Weight and Volume

Battery Type	Cell Weight		Electrolyte (per cell)				Pure Acid (per battery)	
			Volume		Weight		Wieght	
	lb	kg	gal	liter	lb	kg	lb	kg
HT45-5	18	8	0.37	1.40	4.00	1.81	1.60	0.72
HT45-7	25	11	0.52	1.96	5.60	2.54	2.24	1.02
HT45-9	32	15	0.67	2.52	7.22	3.28	2.89	1.31
HT45-11	39	18	0.81	3.08	8.83	4.00	3.53	1.60
HT45-13	46	21	0.96	3.64	10.43	4.73	4.17	1.89
HT45-15	53	24	1.11	4.20	12.04	5.46	4.81	2.18
HT45-17	60	27	1.26	4.76	13.65	6.19	5.46	2.47
HT45-19	67	30	1.41	5.32	15.26	6.92	6.10	2.77
HT45-21	74	34	1.55	5.89	16.87	7.65	6.74	3.06
HT45-23	81	37	1.70	6.45	18.47	8.38	7.39	3.35
HT45-25	88	40	1.85	7.01	20.08	9.11	8.03	3.64
HT45-27	95	43	2.00	7.57	21.69	9.84	8.67	3.93
HT45-29	102	46	2.15	8.13	23.30	10.57	9.31	4.22
HT45-31	109	49	2.30	8.69	24.91	11.30	9.96	4.52
HT45-33	116	53	2.44	9.25	26.51	12.03	10.60	4.81
HT95-7	44	20	0.96	3.63	10.54	4.78	4.41	2.00
HT95-9	57	26	1.22	4.62	13.40	6.08	5.60	2.54
HT95-11	70	32	1.49	5.66	16.40	7.44	6.86	3.11
HT95-13	83	38	1.76	6.68	19.36	8.78	8.09	3.67
HT95-15	96	44	2.04	7.73	22.42	10.17	9.38	4.25
HT95-17	108	49	2.30	8.72	25.28	11.47	10.57	4.79
HT95-19	121	55	2.48	9.38	27.18	12.33	11.37	5.16
HT95-21	134	61	2.89	10.94	31.70	14.38	13.26	6.01
HT95-23	147	67	3.08	11.67	33.84	15.35	14.15	6.42
HT95-25	160	73	3.39	12.84	37.23	16.89	15.57	7.06
HT95-27	172	78	3.69	13.96	40.48	18.36	16.93	7.68
HT95-29	186	84	3.93	14.89	43.17	19.58	18.05	8.19
HT95-31	198	90	4.22	15.96	46.28	20.99	19.35	8.78
HT95-33	211	96	4.50	17.04	49.41	22.41	20.66	9.37
HT125-33	300	136	6.81	25.79	73.92	33.53	30.90	14.02

Unigy II / Deka Fahrenheit HT 2V - Interlock Base Anchor Hole Pattern

NO. OF PLATES	2 & 4 CELL MODULES															
	45 Ah.				75 Ah.				95 Ah.				125 Ah.			
	X		Y		X		Y		X		Y		X		Y	
	In	mm	In	mm	In	mm	In	mm	In	mm	In	mm	In	mm	In	mm
5	5.84	148	12.91	328	5.84	148	20.01	508	---	---	---	---	---	---	---	---
7	8.81	224	12.91	328	8.81	224	20.01	508	8.81	224	22.63	575	---	---	---	---
9	11.81	300	12.91	328	11.81	300	20.01	508	11.81	300	22.63	575	---	---	---	---
11	14.81	376	12.91	328	14.81	376	20.01	508	14.81	376	22.63	575	---	---	---	---
13	17.81	452	12.91	328	17.81	452	20.01	508	17.81	452	22.63	575	---	---	---	---
15	20.81	529	12.91	328	20.81	529	20.01	508	20.81	529	22.63	575	---	---	---	---
17	10.75	273	12.91	328	10.75	273	20.01	508	10.75	273	22.63	575	---	---	---	---
19	12.25	311	12.91	328	12.25	311	20.01	508	12.25	311	22.63	575	---	---	---	---
21	13.75	349	12.91	328	13.75	349	20.01	508	13.75	349	22.63	575	---	---	---	---
23	15.25	387	12.91	328	15.25	387	20.01	508	15.25	387	22.63	575	---	---	---	---
25	16.75	425	12.91	328	16.75	425	20.01	508	16.75	425	22.63	575	---	---	---	---
27	18.25	464	12.91	328	18.25	464	20.01	508	18.25	464	22.63	575	---	---	---	---
29	19.75	502	12.91	328	19.75	502	20.01	508	19.75	502	22.63	575	---	---	---	---
31	21.25	540	12.91	328	21.25	540	20.01	508	21.25	540	22.63	575	---	---	---	---
33	22.75	578	12.91	328	22.75	578	20.01	508	22.75	578	22.63	575	22.75	578	24.09	612

NO. OF PLATES	3 & 6 CELL MODULES											
	45 Ah.				75 Ah.				95 Ah.			
	X		Y		X		Y		X		Y	
	In	mm	In	mm	In	mm	In	mm	In	mm	In	mm
5	10.69	272	12.91	328	10.69	272	20.01	508	---	---	---	---
7	15.14	385	12.91	328	15.14	385	20.01	508	15.14	385	22.63	575
9	19.64	499	12.91	328	19.64	499	20.01	508	19.64	499	22.63	575
11	24.14	613	12.91	328	24.14	613	20.01	508	24.14	613	22.63	575
13	28.64	727	12.91	328	28.64	727	20.01	508	28.64	727	22.63	575
15	33.14	842	12.91	328	33.14	842	20.01	508	33.14	842	22.63	575
17	18.05	458	12.91	328	18.05	458	20.01	508	18.05	458	22.63	575
19	20.30	516	12.91	328	20.30	516	20.01	508	20.30	516	22.63	575
21	22.55	573	12.91	328	22.55	573	20.01	508	22.55	573	22.63	575
23	24.80	630	12.91	328	24.80	630	20.01	508	24.80	630	22.63	575
25	27.05	687	12.91	328	27.05	687	20.01	508	27.05	687	22.63	575
27	29.30	744	12.91	328	29.30	744	20.01	508	29.30	744	22.63	575
29	31.55	801	12.91	328	31.55	801	20.01	508	31.55	801	22.63	575
31	33.80	859	12.91	328	33.80	859	20.01	508	33.80	859	22.63	575
33	36.05	916	12.91	328	36.05	916	20.01	508	36.05	916	22.63	575



Unigy II - Standby (Float) Application

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 ºC

Charge Current Limits

AVR45 Series

Cell Type	Max. Charge Current (A)	Min. Charge Current (A)**
AVR45-5	16.5	4.9
AVR45-7	24.7	7.4
AVR45-9	32.9	9.9
AVR45-11	41.1	12.3
AVR45-13	49.4	14.8
AVR45-15	57.6	17.3
AVR45-17	65.8	19.7
AVR45-19	74.1	22.2
AVR45-21	82.3	24.7
AVR45-23	90.5	27.2
AVR45-25	98.7	29.6
AVR45-27	107	32.1
AVR45-29	115	34.6
AVR45-31	123	37.0
AVR45-33	132	39.5

AVR75 Series

Cell Type	Max. Charge Current (A)	Min. Charge Current (A)**
AVR75-5	27.3	8.2
AVR75-7	41.0	12.3
AVR75-9	54.6	16.4
AVR75-11	68.3	20.5
AVR75-13	81.9	24.6
AVR75-15	95.6	28.7
AVR75-17	109	32.8
AVR75-19	123	36.9
AVR75-21	137	41.0
AVR75-23	150	45.0
AVR75-25	164	49.1
AVR75-27	177	53.2
AVR75-29	191	57.3
AVR75-31	205	61.4
AVR75-33	218	65.5

AVR95 Series

Cell Type	Max. Charge Current (A)	Min. Charge Current (A)**
AVR95-7	51.5	15.4
AVR95-9	68.7	20.6
AVR95-11	85.8	25.7
AVR95-13	103	30.9
AVR95-15	120	36.0
AVR95-17	137	41.2
AVR95-19	154	46.3
AVR95-21	172	51.5
AVR95-23	189	56.6
AVR95-25	206	61.8
AVR95-27	223	66.9
AVR95-29	240	72.1
AVR95-31	257	77.2
AVR95-33	275	82.4

AVR125 Series

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

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

Deka Fahrenheit HT 2V - Standby (Float) Application Charge Current Limits

Cell Type	Max. Charge Current (A)	Min. Charge Current (A)**
HT45-5	14.7	4.4
HT45-7	22.1	6.6
HT45-9	29.4	8.8
HT45-11	36.8	11.0
HT45-13	44.2	13.3
HT45-15	51.5	15.5
HT45-17	58.9	17.7
HT45-19	66.3	19.9
HT45-21	73.6	22.1
HT45-23	81.0	24.3
HT45-25	88.3	26.5
HT45-27	96	28.7
HT45-29	103	30.9
HT45-31	110	37.0
HT45-33	118	39.5

Cell Type	Max. Charge Current (A)	Min. Charge Current (A)**
HT95-7	46.3	13.9
HT95-9	61.8	18.5
HT95-11	77.2	23.2
HT95-13	93	27.8
HT95-15	108	32.4
HT95-17	124	37.1
HT95-19	139	41.7
HT95-21	154	46.3
HT95-23	170	50.9
HT95-25	185	55.6
HT95-27	201	60.2
HT95-29	216	64.8
HT95-31	232	69.5
HT95-33	247	74.1

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

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

Unigy II / Deka Fahrenheit HT 2V - Renewable Energy (Cyclic) Applications

Charge Parameters

Bulk Charge	Max. Current (Amps)	Reference Below Chart
Absorption (Regulation)Charge	Constant Voltage	2.35 - 2.40 vpc
Float Charge	Constant Voltage	2.24 - 2.26 vpc
Equalize Charger	Constant Voltage	2.40 - 2.43 vpc
Temperature Coefficient	3mV / °C	

Unigy II / Deka Fahrenheit HT 2V - Renewable Energy (Cyclic) Voltage Compensation

°C	Absorption Regulation Charge	Float Charge	Equalize Maintenance	°F
≥35	2.370	2.220	2.400	≥95
34	2.373	2.223	2.403	93.2
33	2.376	2.226	2.406	91.4
32	2.379	2.229	2.409	89.6
31	2.382	2.232	2.412	87.8
30	2.385	2.235	2.415	86.0
29	2.388	2.238	2.418	84.2
28	2.391	2.241	2.421	82.4
27	2.394	2.244	2.424	80.6
26	2.397	2.247	2.427	78.8
25	**2.400**	**2.250**	**2.430**	**77.0**
24	2.403	2.253	2.433	75.2
23	2.406	2.256	2.436	73.4
22	2.409	2.259	2.439	71.6
21	2.412	2.262	2.442	69.8
20	2.415	2.265	2.445	68.0
19	2.418	2.268	2.448	66.2
18	2.421	2.271	2.451	64.4
17	2.424	2.274	2.454	62.6
16	2.427	2.277	2.457	60.8
15	2.430	2.280	2.460	59.0
14	2.433	2.283	2.463	57.2
13	2.436	2.286	2.466	55.4
12	2.439	2.289	2.469	53.6
11	2.442	2.292	2.472	51.8
≤10	2.445	2.295	2.475	≤50

Deka Battery Maintenance Report

Company _____ Service Date _____
Address _____ Battery Dwg # _____
Battery Location & I.D. Number _____ Connector Pkg _____
Total No. of Cells _____ Charger Output Voltage _____ Float Current _____ Battery I.D. # _____
Battery Type* _____ Total Battery Voltage _____ *(read at battery terminals)* Ambient Air Temp. _____ 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							
8								38							
9								39							
10								40							
11								41							
12								42							
13								43							
14								44							
15								45							
16								46							
17								47							
18								48							
19								49							
20								50							
21								51							
22								52							
23								53							
24								54							
25								55							
26								56							
27								57							
28								58							
29								59							
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: _____

(Form available as an Excel Spreadsheet. Consult your EPM Representative.)

Notation: This form must be completed and submitted with any product warranty claim.
Readings should be taken at Installation and at least annually thereafter.

Deka Battery Maintenance Report

Company _____ Service Date _____
Address _____ Battery Dwg # _____
Battery Location & I.D. Number _____ Connector Pkg _____
Battery I.D. # _____

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
61								111							
62								112							
63								113							
64								114							
65								115							
66								116							
67								117							
68								118							
69								119							
70								120							
71								121							
72								122							
73								123							
74								124							
75								125							
76								126							
77								127							
78								128							
79								129							
80								130							
81								131							
82								132							
83								133							
84								134							
85								135							
86								136							
87								137							
88								138							
89								139							
90								140							
91								141							
92								142							
93								143							
94								144							
95								145							
96								146							
97								147							
98								148							
99								149							
100								150							
101								151							
102								152							
103								153							
104								154							
105								155							
106								156							
107								157							
108								158							
109								159							
110								160							

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

Battery Maintenance Report

Company _____ Service Date _____
Address _____ Battery Dwg # _____
Battery Location & I.D. Number _____ Connector Pkg _____
Battery I.D. # _____

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
161								201							
162								202							
163								203							
164								204							
165								205							
166								206							
167								207							
168								208							
169								209							
170								210							
171								211							
172								212							
173								213							
174								214							
175								215							
176								216							
177								217							
178								218							
179								219							
180								220							
181								221							
182								222							
183								223							
184								224							
185								225							
186								226							
187								227							
188								228							
189								229							
190								230							
191								231							
192								232							
193								233							
194								234							
195								235							
196								236							
197								237							
198								238							
199								239							
200								240							

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

ACCEPTANCE & PERFORMANCE TESTING

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

1. Make sure all cell connections are clean, tight (i.e. – torqued to specification) and free of corrosion. Proper cell connections shall be verified via ohmic measurements between the connector and cell post.
2. 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 "Voltage Compensation Chart" in Appendix F of this manual.

   To ensure the cells are fully charged within 24 hours; the charger used for this equalizing charge must be sized to begin its charge with a charge current equal to at least the minimum, and not to exceed the maximum charge current for the given cell type (model), as called out in Appendix D of this manual. If multiple strings are to be charged simultaneously, the charge current requirement must be multiplied by the number of strings.

   Within 1 hour of the completion of the equalize charge, measure and record each cell's on-charge voltage and temperature measured at the negative terminal.

   The "Refresh Record Form" in Appendix B can be used to record the requested data.

   If these requirements cannot be met, contact East Penn Reserve Power's Product Support Department 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 requirements.

   NOTE: Cells shall remain on float charge until the discharge test is performed.

   Within 1 hour of the start of the discharge test, measure and record each cell's on-charge cell voltage and ohmic value as well as a representative cell temperature measured at the negative terminal. Per IEEE 1188:2005, a representative minimum of 10% of the cell temperatures are to be averaged to develop the average cell temperature that will be used with the temperature correction factor provided within this document.

   The "Refresh Record Form" in Appendix B can be used to record the requested data.

   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 charge, the desired acceptance or performance test can be performed per the following guidelines in conjunction with IEEE-1188.

1. IEEE 1188-2005 states "The discharge rate(s) and test length and their duration(s) should correspond as closely as is practical to the battery string duty cycle." Prior to discharging the battery string, the desired discharge rate should be within East Penn published ratings, end voltage & temperature. Anything outside of these values shall be reviewed by East Penn Reserve Power's Product Support Department.
2. 2. It is important to ensure all connectors and cables are sized correctly to support the discharge rating. Improper connectors and cable sizing can cause excessive temperature to rise, and excessive voltage drop. This can significantly impact expected runtimes and battery string life expectancy. Record individual cell voltages during the discharge. Be sure to record the time at which each cell drops below the design's average end voltage if this occurs during the test.
3. If a DC load bank is used, be sure to disconnect the battery string from the UPS charger/load circuit. If an AC load bank is used, be sure to connect the load bank to the UPS system prior to discharge. Be sure to calibrate the load bank to the desired discharge amp or watt setting while the UPS is operating from its' power supply.
4. During the discharge, if an individual cell is approaching reversal of its polarity (i.e. – 0 volts), but the battery string terminal voltage has not reached its test limit (i.e. – 1.67 vpc), the test should be continued with the bad cell "jumpered out" where feasible. **Upon doing this, a new end voltage should be calculated based on the remaining cells.**
5. For discharges 1 hour or greater, capacity should be determined by the time adjustment method defined by IEEE-1188 according to the following formula:

   % Capacity 77°F (25°C) = [Ta x Kt x 100] /Ts

   Where:
   Ta = Actual test time to the specified end voltage
   Ts = Rated time to the specified end voltage
   Kt = Temperature correction factor (Ref. Table 1)

   Discharge tests designed for 1 hour with an average unit temperature of less than 77°F (25°C) shall follow the procedure for discharges of less than 1 hour.

   For discharges less than 1 hour, capacity should be determined by the rate adjustment method defined by IEEE-1188 according to the following formula

   % Capacity 77°F (25°C) = [Xa x Kc x 100] / Xt

   Where:
   Xa = Actual rate used during discharge test
   Xt = Published rate for actual time of discharge test to specified terminal or cell/unit voltage
   Kc = Temperature correction factor (Ref. Table 2).
6. Upon completion of the acceptance or performance test, the battery system should be recharged at the normal float voltage of 2.25 volts per cell. Temperature compensation charging parameters shall be applied as detailed in "Voltage Compensation Chart" in Appendix F.

K_t Factor (Discharges ≥ 1 hr.)

Temperature		K_t Factor
°C	°F	
35.0	95	0.962
34.4	94	0.963
33.9	93	0.965
33.3	92	0.967
32.8	91	0.969
32.2	90	0.971
31.7	89	0.973
31.1	88	0.975
30.6	87	0.977
30.0	86	0.978
29.4	85	0.980
28.9	84	0.983
29.3	83	0.986
27.8	82	0.989
27.2	81	0.992
26.7	80	0.995
26.1	79	0.997
25.6	78	0.998
25.0	77	1.000
24.4	76	1.005
23.9	75	1.010
23.3	74	1.013
22.8	73	1.016

Temperature		K_t Factor
°C	°F	
22.2	72	1.019
21.7	71	1.022
21.1	70	1.026
20.6	69	1.033
20.0	68	1.034
19.4	67	1.038
18.9	66	1.043
18.3	65	1.047
17.8	64	1.052
17.2	63	1.056
16.7	62	1.060
16.1	61	1.065
15.6	60	1.070
15.0	59	1.073
14.4	58	1.026
13.9	57	1.080
13.3	56	1.083
12.8	55	1.087
12.2	54	1.094
11.7	53	1.101
11.1	52	1.109
10.6	51	1.116
10.0	50	1.124

K_C Factor (Discharges ≤ 1 hr.)

Temperature		K_C Factor
°C	°F	
35.0	95	0.926
34.4	94	0.929
33.9	93	0.933
33.3	92	0.936
32.8	91	0.940
32.2	90	0.943
31.7	89	0.947
31.1	88	0.951
30.6	87	0.954
30.0	86	0.958
29.4	85	0.962
28.9	84	0.966
29.3	83	0.971
27.8	82	0.976
27.2	81	0.980
26.7	80	0.985
26.1	79	0.990
25.6	78	0.995
25.0	77	1.000
24.4	76	1.005
23.9	75	1.010
23.3	74	1.018
22.8	73	1.027

Temperature		K_C Factor
°C	°F	
22.2	72	1.035
21.7	71	1.044
21.1	70	1.053
20.6	69	1.062
20.0	68	1.071
19.4	67	1.080
18.9	66	1.089
18.3	65	1.099
17.8	64	1.109
17.2	63	1.119
16.7	62	1.129
16.1	61	1.139
15.6	60	1.149
15.0	59	1.163
14.4	58	1.176
13.9	57	1.190
13.3	56	1.205
12.8	55	1.220
12.2	54	1.232
11.7	53	1.244
11.1	52	1.256
10.6	51	1.269
10.0	50	1.282

EU DIRECTIVE 2023 / 1542 ARTICLE 10

To comply with Article 10 of EU Directive 2023 / 1542 the below information is required for any battery that has a rating ≥ 2 kWh.

Unigy II

Part A

Battery Type			AVR75-29	AVR75-31	AVR75-33	AVR95-23	AVR95-25	AVR95-27	AVR95-29	AVR95-31	AVR95-33	AVR125-33
Rated Capacity	8 hr to 1.75 Vpc	Ah	1064	1140	1216	1045	1140	1235	1330	1425	1520	2000
		W/C	261	279	298	260	284	307	331	354	378	494
		kWh	2.1	2.2	2.4	2.1	2.3	2.5	2.6	2.8	3.0	4.0
Capacity Fade		%	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1
Power Fade		%	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1
Internal Resistance		Ohms	0.000233	0.000232	0.000222	0.000269	0.000250	0.000243	0.000223	0.000215	0.000207	0.000177
Internal Resistance Increase		%	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1
Energy Round Trip Efficiency		%	80	80	80	80	80	80	80	80	80	80
Energy Round Trip Efficiency Fade		%	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1
Design Life		(yrs)	20	20	20	20	20	20	20	20	20	20

Part B

Discharge Rate			C8	C8	C8	C8	C8	C8	C8	C8	C8	C8
Charge Rate			C5	C5	C5	C5	C5	C5	C5	C5	C5	C5
Ratio W vs Wh			8	8	8	8	8	8	8	8	8	8
DoD		%	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1
Power Capacity (kWh)		20%	0.42	0.45	0.48	0.42	0.45	0.49	0.53	0.57	0.60	0.79
		80%	1.7	1.8	1.9	1.7	1.8	2.0	2.1	2.3	2.4	3.2

N/A[1] - required information does not exist for referenced batteries.

Deka Fahrenheit HT 2V

Part A

Battery Type			HT95-25	HT95-27	HT95-29	HT95-31	HT95-33	HT125-33
Rated Capacity	8 hr to 1.75 Vpc	Ah	1020	1105	1190	1275	1360	1789
		W/C	254	275	296	317	338	442
		kWh	2.0	2.2	2.4	2.5	2.7	3.5
Capacity Fade		%	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1
Power Fade		%	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1
Internal Resistance		Ohms	0.000250	0.000243	0.000223	0.000215	0.000207	0.000177
Internal Resistance Increase		%	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1
Energy Round Trip Efficiency		%	80	80	80	80	80	80
Energy Round Trip Efficiency Fade		%	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1
Design Life		(yrs)	22	22	22	22	22	22

Part B

Discharge Rate			C8	C8	C8	C8	C8	C8
Charge Rate			C5	C5	C5	C5	C5	C5
Ratio W vs Wh			8	8	8	8	8	8
DoD		%	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1
Power Capacity (kWh)		20%	0.41	0.44	0.47	0.51	0.54	0.71
		80%	1.6	1.8	1.9	2.0	2.2	2.8

N/A[1] - required information does not exist for referenced batteries.

SPACESAVER® SYSTEMS

Non-Interlock™ AVR45, AVR75, AVR95 HT45, HT95

Installation and Operation Manual

Proposition 65 Warning:	Battery posts, terminals and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. Batteries also contain other chemicals known to the State of California to cause cancer. **WASH HANDS AFTER HANDLING.**

E.P.M. Form No. 1112 Revised 11/24 © 2024 by EPM Printed in U.S.A.

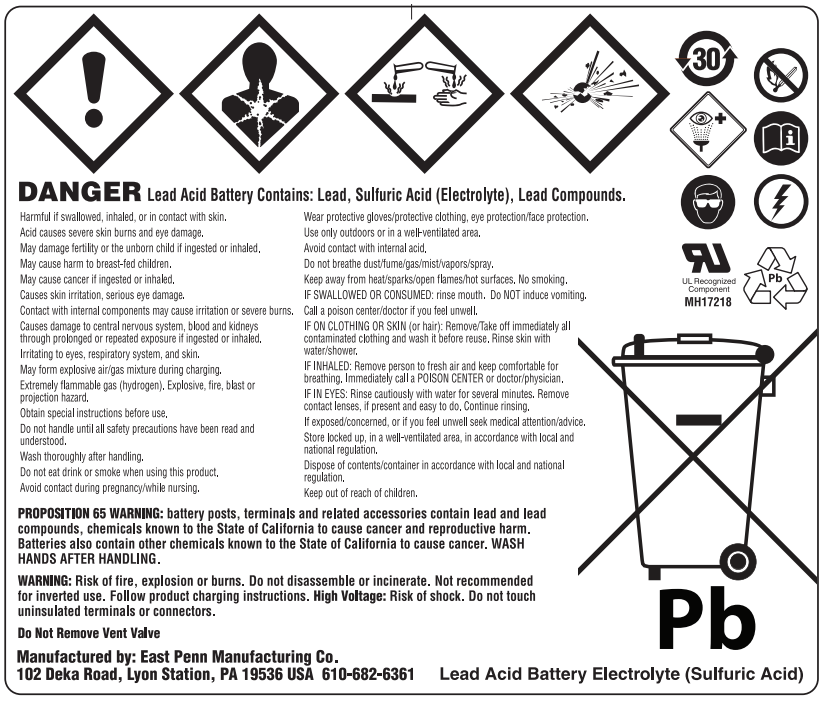
NON-INTERLOCK TABLE OF CONTENTS

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.



DANGER Lead Acid Battery Contains: Lead, Sulfuric Acid (Electrolyte), Lead Compounds.

Harmful if swallowed, inhaled, or in contact with skin.
Acid causes severe skin burns and eye damage.
May damage fertility or the unborn child if ingested or inhaled.
May cause harm to breast-fed children.
May cause cancer if ingested or inhaled.
Causes skin irritation, serious eye damage.
Contact with internal components may cause irritation or severe burns.
Causes damage to central nervous system, blood and kidneys through prolonged or repeated exposure if ingested or inhaled.
Irritating to eyes, respiratory system, and skin.
May form explosive air/gas mixture during charging.
Extremely flammable gas (hydrogen). Explosive, fire, blast or projection hazard.
Obtain special instructions before use.
Do not handle until all safety precautions have been read and understood.
Wash thoroughly after handling.
Do not eat drink or smoke when using this product.
Avoid contact during pregnancy/while nursing.

Wear protective gloves/protective clothing, eye protection/face protection.
Use only outdoors or in a well-ventilated area.
Avoid contact with internal acid.
Do not breathe dust/fume/gas/mist/vapors/spray.
Keep away from heat/sparks/open flames/hot surfaces. No smoking.
IF SWALLOWED OR CONSUMED: rinse mouth. Do NOT induce vomiting.
Call a poison center/doctor if you feel unwell.
IF ON CLOTHING OR SKIN (or hair): Remove/Take off immediately all contaminated clothing and wash it before reuse. Rinse skin with water/shower.
IF INHALED: Remove person to fresh air and keep comfortable for breathing. Immediately call a POISON CENTER or doctor/physician.
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
If exposed/concerned, or if you feel unwell seek medical attention/advice.
Store locked up, in a well-ventilated area, in accordance with local and national regulation.
Dispose of contents/container in accordance with local and national regulation.
Keep out of reach of children.

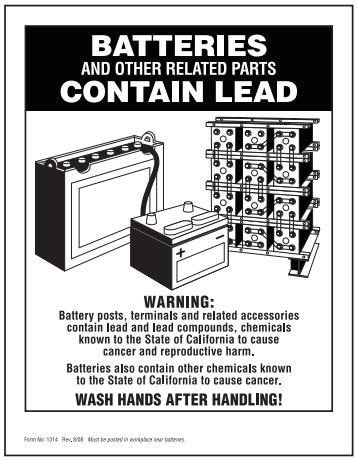
UL Recognized Component
MH17218

PROPOSITION 65 WARNING: battery posts, terminals and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. Batteries also contain other chemicals known to the State of California to cause cancer. WASH HANDS AFTER HANDLING.

WARNING: Risk of fire, explosion or burns. Do not disassemble or incinerate. Not recommended for inverted use. Follow product charging instructions. **High Voltage:** Risk of shock. Do not touch uninsulated terminals or connectors.

Do Not Remove Vent Valve

Manufactured by: East Penn Manufacturing Co.
102 Deka Road, Lyon Station, PA 19536 USA 610-682-6361 **Lead Acid Battery Electrolyte (Sulfuric Acid)**



SAFETY PRECAUTIONS

Although all valve-regulated cells have the electrolyte immobilized within the cell, the electrical hazards 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 40°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 (as defined by ASTM F1505 “Standard Specification for Insulated and Insulating Hand 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.

   SDS sheets can be obtained at www.eastpennmanufacturing.com
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 string 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. **Never** remove or tamper with the pressure relief valves, except for cell replacement. Warranty void if vent valve is removed.
7. Inspect flooring and lifting equipment for functional adequacy.
8. Adequately secure cell modules, racks, or cabinets to the floor.
9. Connect support structures to ground system in accordance with applicable codes.
10. The below IEEE Standards contain additional information. Other standards may be relevant to your specific application.

    IEEE 1184 - Guide for Batteries for UPS Systems

    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 data and notify carrier of any damage.

Original packaging should remain on battery during transportation to prevent damage to the battery or short circuit of the terminals.

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 cells by the terminal posts.

   NOTE : Do not place cells in an upright position during installation, storage or transporting.
5. When lifting cells and modules, 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.

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. Battery pallets shall not be double stacked, or equipment stored on top.
4. 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).
5. 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.

Storage / Refresh *Continued*

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.

6. 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.
7. 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), as called out in Appendix F for Unigy II & Appendix G for Deka Fahrenheit HT 2V.
8. All requested information on "Refresh Record Form" in Appendix B should be completed for each refresh charge.
9. Cells shall not be stored beyond 12 months. Storing beyond 12 months will affect warranty.
10. If the storage / refresh requirements cannot be met, contact East Penn Reserve Power's Product Support group for alternate instructions.

INSTALLATION

General

Caution should be taken when installing cells to ensure no damage occurs. Cells shall not be dropped, slid, or placed on rough or uneven surfaces such as tray lips or grated flooring. Mishandling of cells 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.

NOTE: If battery monitoring system is installed prior to battery being placed in service; monitoring system should remain off to prevent discharging of battery.

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 string, proper techniques should be applied per electrical standards, such as NEC and/or local codes. Two 0.201 diameter x 0.750 center holes are provided in back of each module to accept a # 6 x 0.750 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 string and/or stack to stack 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 system for service and inspection.

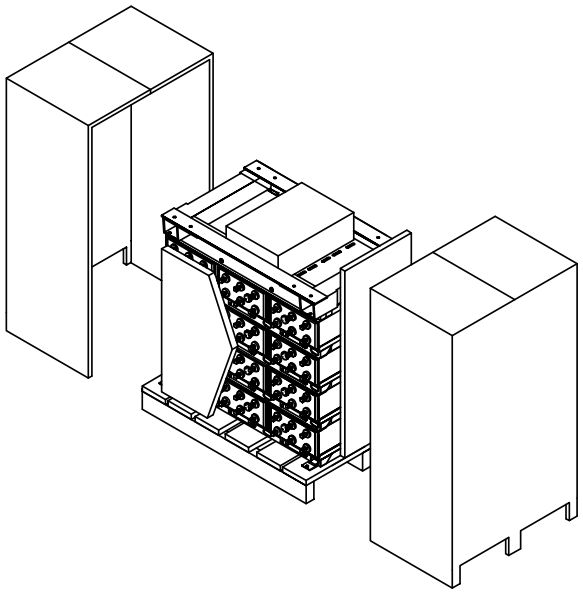
Hardware Torque Requirements

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

System Installation

System Shipment

Battery string will be received per drawing below.



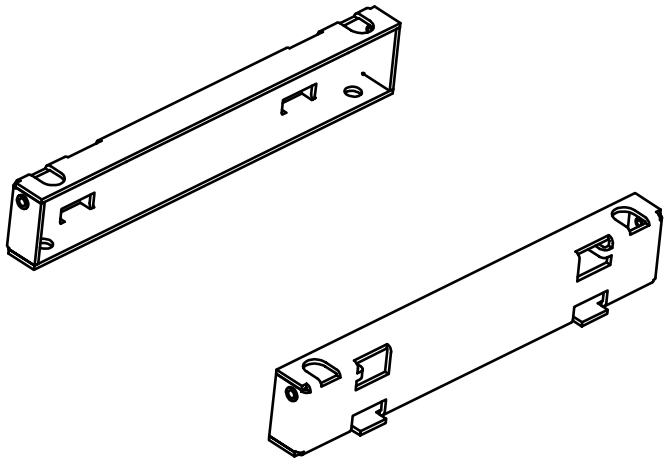
Non-Interlock Module Installation

Assemble battery string 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(s) are wire tied to module assembly.
2. Position base(s). Consult included battery string layout diagram for required base layout. If it can not be located, contact East Penn Mfg. for a copy. Refer to your delivery number, located on the packing slip. This will aid in obtaining the proper drawing.
3. Bases are required to be level prior to installing modules.

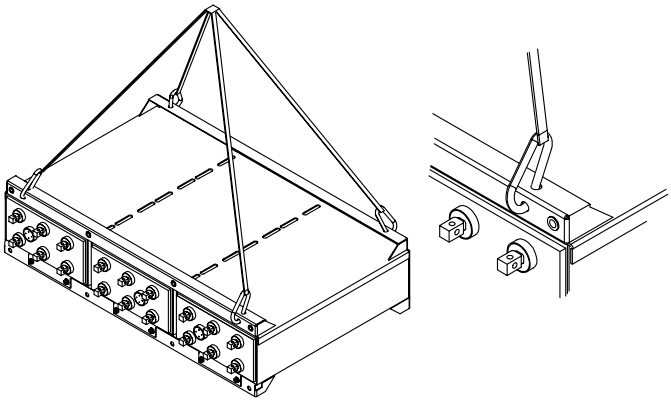
Non-Interlock Base



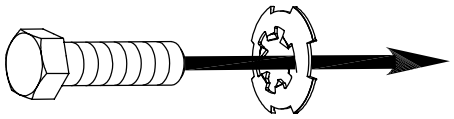
4. Anchor holes can be marked and drilled with bases in place. **Consult Appendix E for anchor hole pattern.** All anchor holes in base are required to be used to meet seismic requirements. **Consult local building codes for anchor bolt requirements. Anchor bolts not included due to site specific requirements.**
5. 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 can be discarded.
6. **Module / Base Shimming**
   a. Prior to installation, the floor on which the battery string is to be installed should be level and capable of supporting the weight of the battery string. A 1° taper on a floor can result in a ½" variation at the top of one eight-high stack of modules. This can be compounded by the tolerance of each module.
   b. Standard steel shim stock such as AISI/SAE 1010 can be used. Stainless steel is not required since these batteries are AGM and should not be exposed to a corrosive environment. Shim dimensions will vary depending on the location and levelness. *Shims are not provided by East Penn due to site specific requirements.*
   c. If floors are not level, shim material can be placed under each of the base supports within a battery string until they are level. All base supports within a battery string must be level with each other – do not level individual bases as this could cause variation in height from one stack to another.
   d. It is recommend to place an interstack connector on the system to ensure no stress will be placed on the cell posts. Reference *Safety Section of this manual* and battery schematic for all necessary precautions. If the connector is aligned, it may be removed and the module installation can continue.
   e. Reference Appendix E for Base Support layout dimensions
   f. Once all the modules are installed and aligned, joining plates (pg b.7 Part 3) which are provided with the parts kit should be installed at the top of every stack. This provides an additional tool to ensure levelness.
   g. Assuming these guidelines are followed, the electrical connections can be installed easily without any issues of misalignment or undue stress on the cell posts.

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

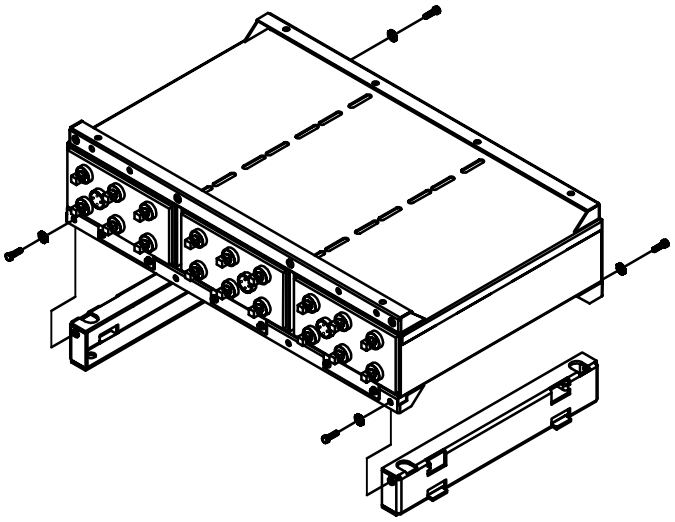
7. Install modules onto bases using supplied lifting straps. Two straps required to lift each module. Consult below diagram for proper sling attachment.

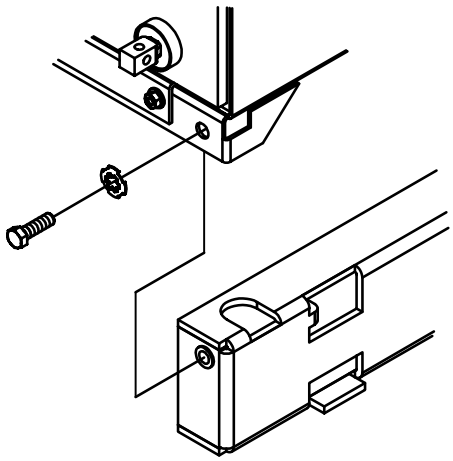


8. Module connecting hardware is furnished with a dragon tooth washer in place of a lock washer and flat washer. The dragon tooth washer is used to enhance the electrical conductivity of the grounding system within a stack of modules. To ensure the dragon tooth washer is installed correctly; the curve of the washer must face away from the bolt head. **Stack to stack grounding electrical conductivity is the responsibility of the installer.**

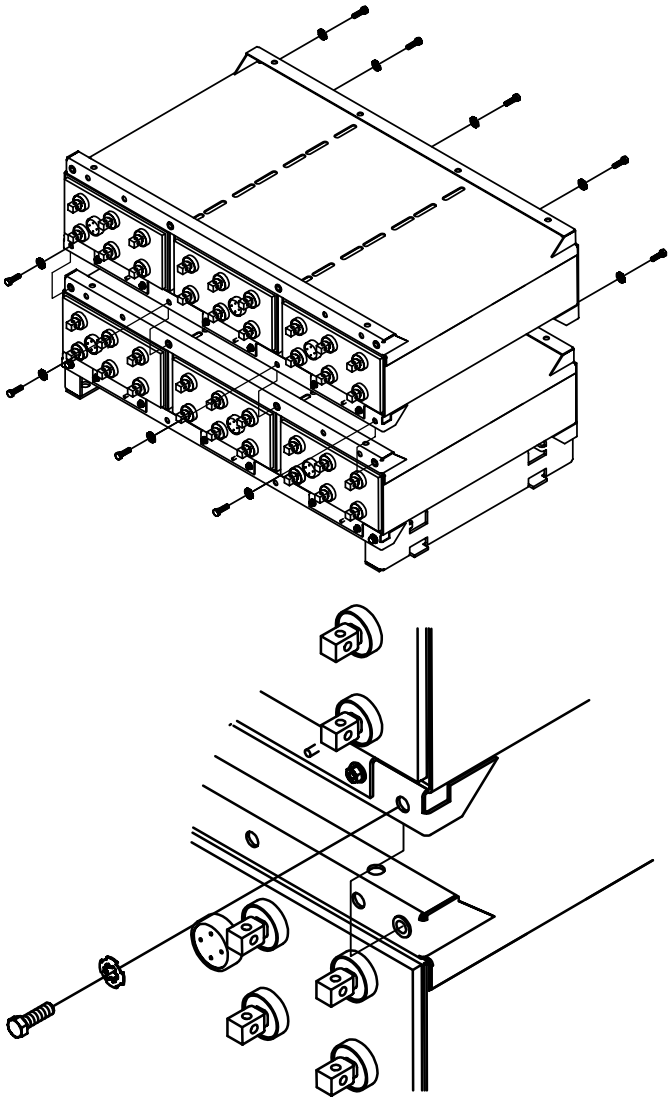


9. Installed battery string should be compared to battery string layout drawing for correctness. As each module is installed all hardware should be checked for proper torque before proceeding to next module.
   a. Connecting the module to the base will require four 3/8-16 x 1.25" bolts. One bolt for the front and one bolt for the rear required for each base. Consult “Hardware Torque Requirements” (pg b.4) for proper torque values.

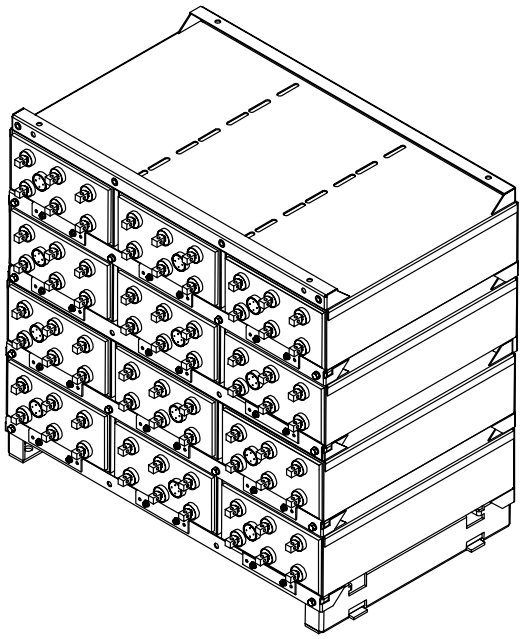




   b. Connect the modules to each other with eight 3/8-16 x 1.25" bolts & dragon tooth washers. Four for the front and four in the rear of each module. Procedure to be repeated until all modules are installed. Consult “Hardware Torque Requirements” (pg b.14) for proper torque values.

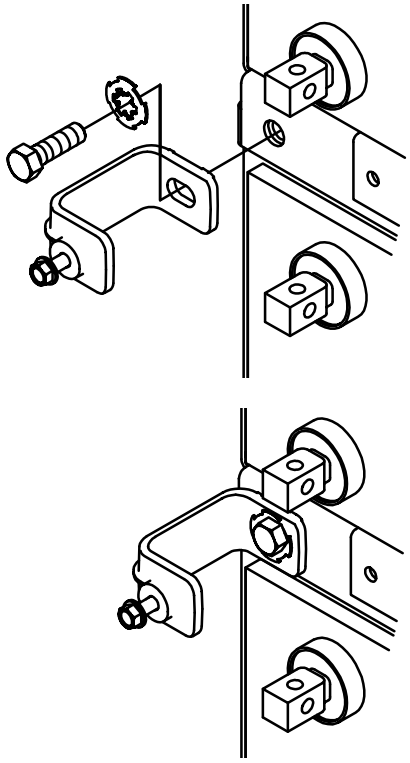


10. Module layout should be compared to battery string layout diagram and all hardware should be checked for proper torque before proceeding. Consult “Hardware Torque Requirements” (pg b.4) for proper torque values.

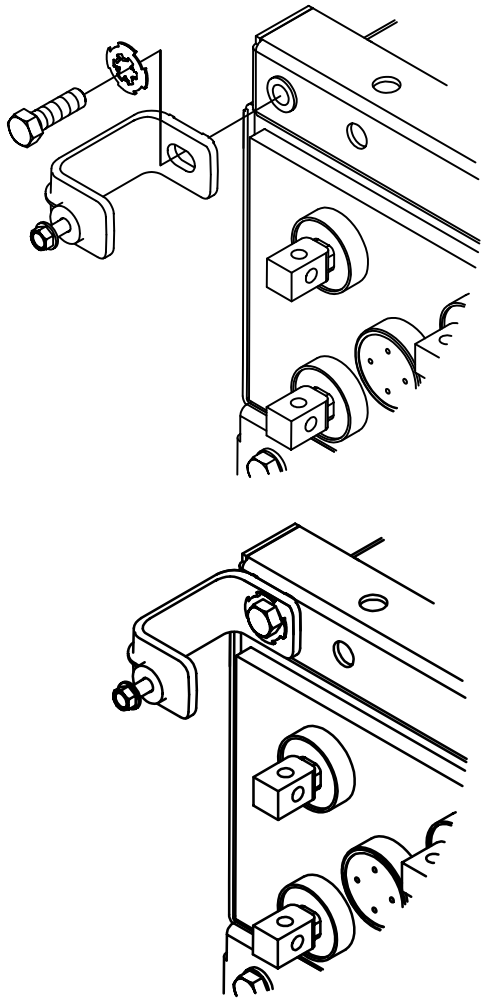


Safety Shield Bracket Assembly

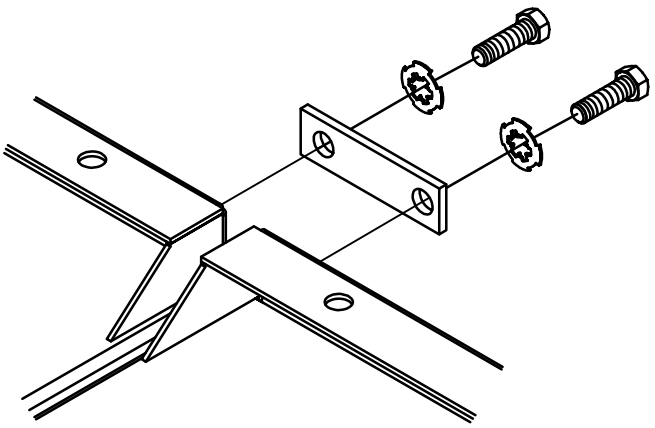
1. Safety shield brackets are to be installed at the outside corners of every 2 modules starting from the bottom and working towards the top. This is to be repeated for each stack in the battery system. For stacks containing odd number of modules an additional set of safety shield brackets will be required to be installed at the top of the module. Use 3/8-16 x 2.50" hardware to install brackets. Bracket should be flush with side of module to ensure correct safety shield alignment. Tighten, do not torque hardware.



2. Safety shield brackets are to be installed at the top of the module in the same manner as detailed previously. Tighten, do not torque hardware.



3. For multiple stack systems, joining plates are to be installed 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 the 3/8-16 x 1.25" hardware to install the joining plate to the modules. Hardware should be torqued after module installation is complete. Consult “Hardware Torque Requirements” (pg b.4) for proper torque values. **Stack to stack electrical conductivity is the responsibility of the installer.**



Electrical Connection

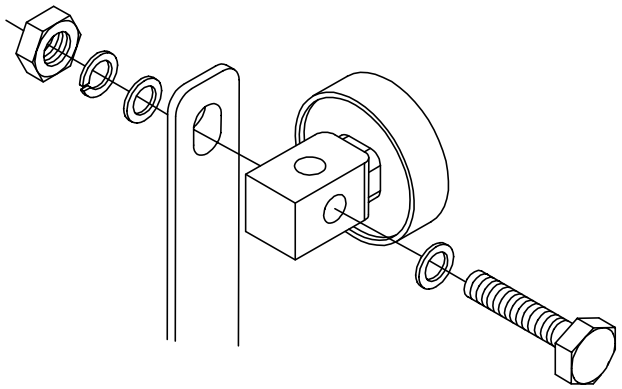
Connector Assembly

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 string is supplied with a connector package appropriate to the required load the battery string is connected to. Review the below chart “Connector Packages” to ensure the correct connector package has been supplied.

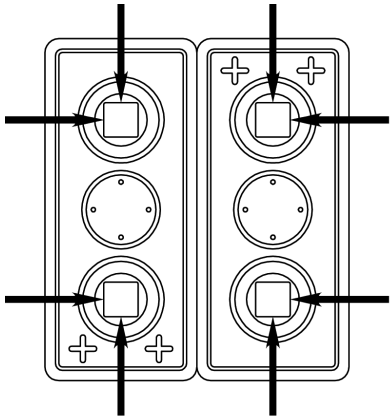
CONNECTOR PACKAGES			
Type	**Plate**	**AMPS**	**WPC**
1CU	5 - 15	≤ 250	≤ 480
	17 - 27	≤ 450	≤ 720
	29 - 33	≤ 550	≤ 880
2CU	5 - 33	≤ 900	≤ 1440
4CU	5 - 33	≤ 2000	≤ 3200
6CU	5 - 33	≤ 3000	≤ 4800

BOLT PACKAGE	
1CU	1/4-20 x 1.25"
2CU	1/4-20 x 1.50"
4CU	1/4-20 x 1.75"
6CU	1/4-20 x 2.00"

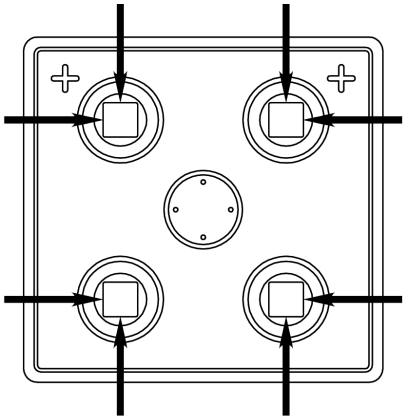
3. Installation and direction of the cell post hardware is important. Consult below diagram for clarification.



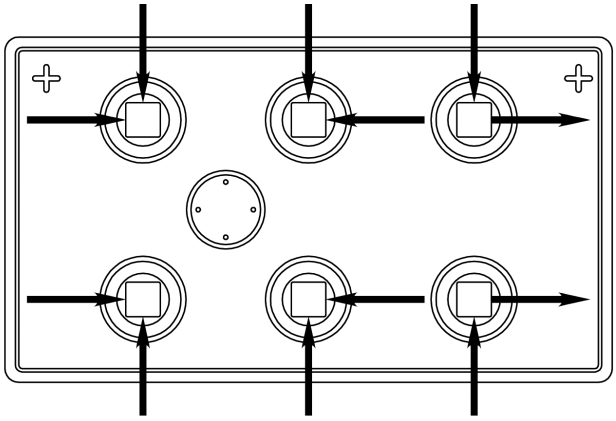
5 to 15 Plate



17 to 27 Plate

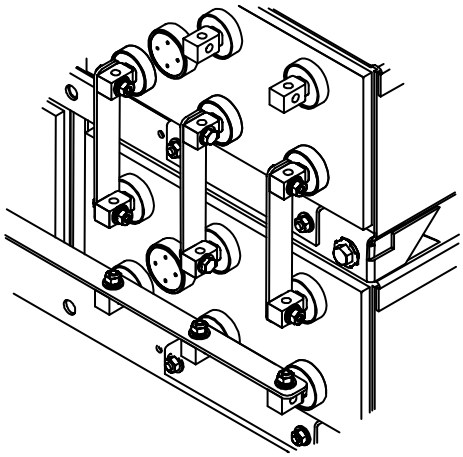


29 to 33 Plate



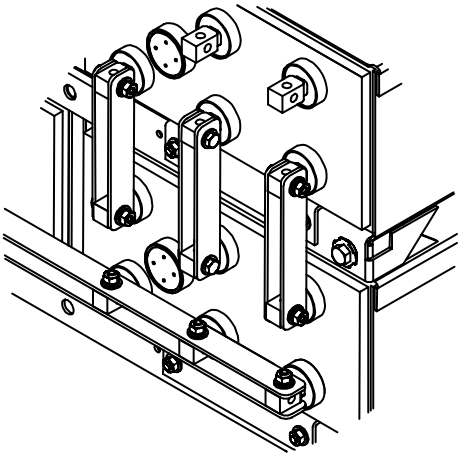
4. Unigy II & Fahrenheit HT 2V battery strings are typically supplied with connector package 1CU requiring one connector per post.

1CU Package Detail

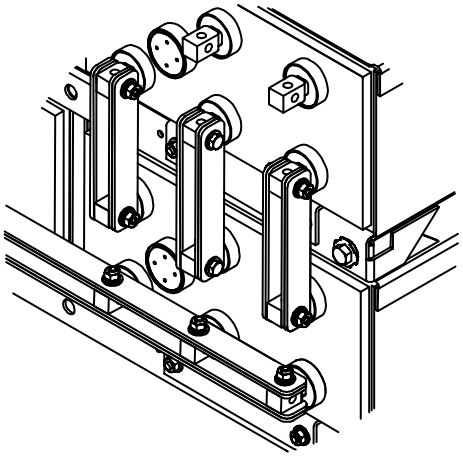


5. High rate applications will require multiple connectors to be used per cell post. A 2CU connector package will require 2 connectors per connection (1 per side), see example below. A 4CU package will require 4 connectors per connection (2 per side) and a 6CU package will require 6 connectors per connection (3 per side). Tighten & torque all bolts after all connectors are installed. Consult “Hardware Torque Requirements” (pg b.4) for proper torque values.

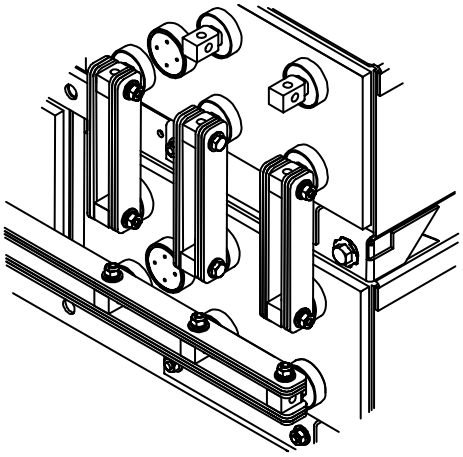
2CU Package Detail



4CU Package Detail



6CU Package Detail



6. Some installations require a vertical “C” connector. This “C” connector is limited to a 2CU connector package.

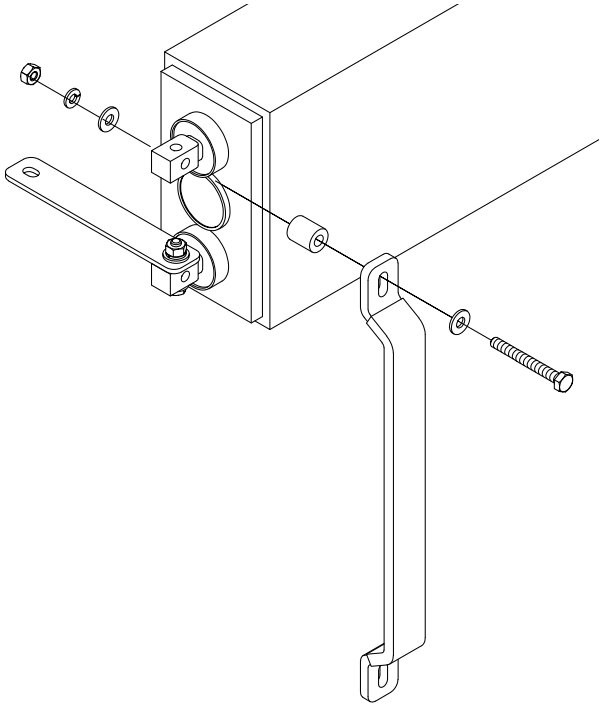
Consult below for proper installation for particular cell type being installed.

5 to 7 Plate

Install spacer between cell post and “C” connector.

Duplicate connection process at both connection points.

Torque all hardware to 125 in-lb.

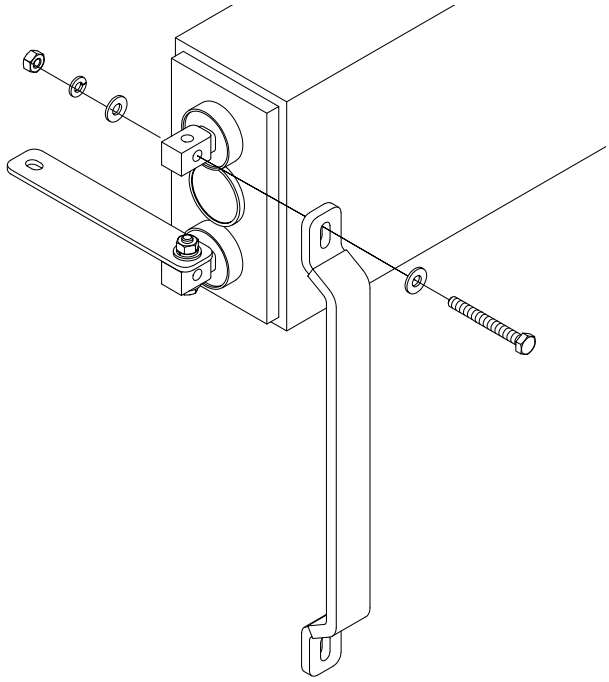


9 to 15 Plate

Install “C” connector to cell post.

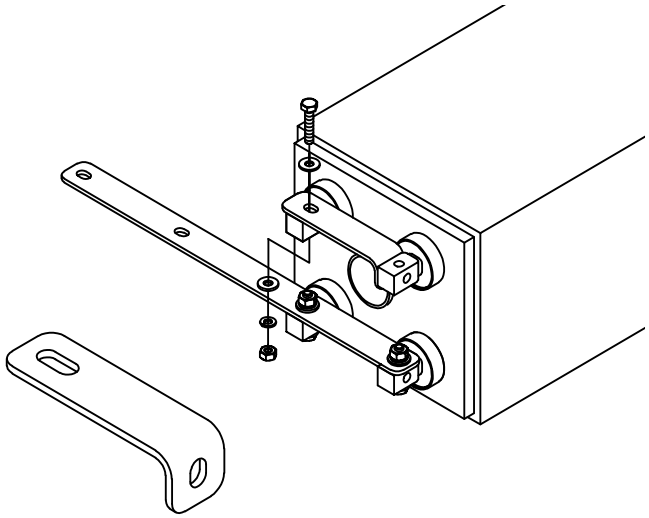
Duplicate connection process at both connection points.

Torque all hardware to 125 in-lb.

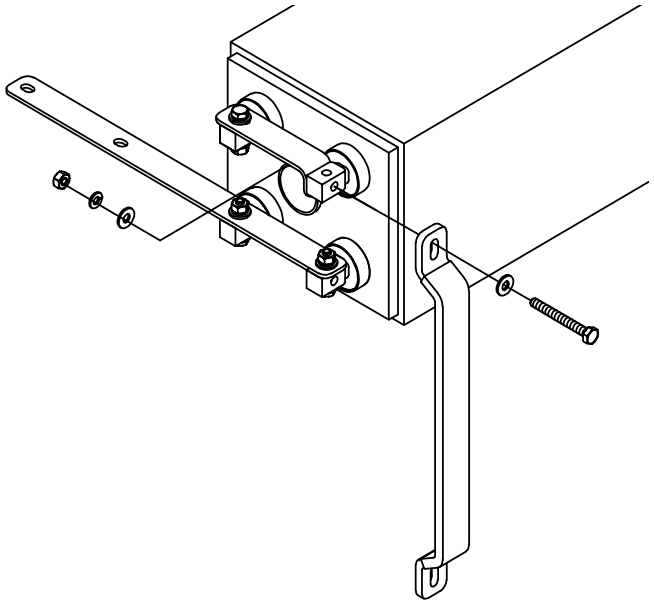


17 to 27 Plate

1. Install “L” connector with vertical bolt as below. Bolt should be installed loosely for future adjustments. Duplicate connection process at both connection points



2. Install “C” connector to cell post using horizontal bolt as below. Bolt should be installed loosely for future adjustments. Duplicate connection process at both connection points.

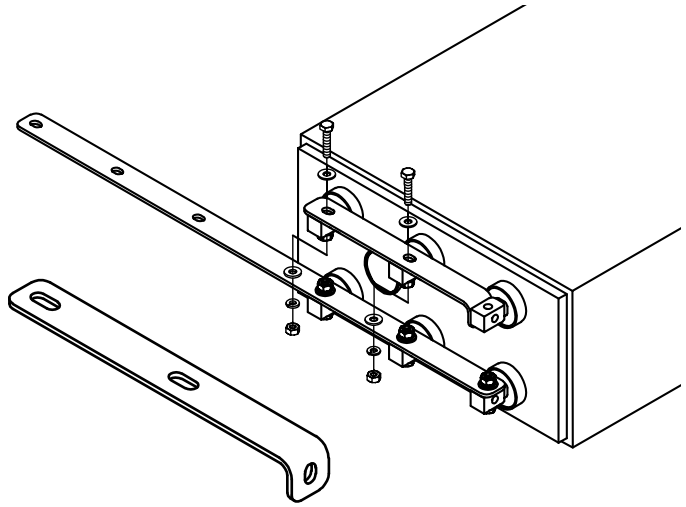


3. Ensure proper alignment of connectors to cell posts.
4. **Tighten & torque the horizontal bolt to 125 in-lb prior to tightening and torqueing the vertical bolt in step 1.**

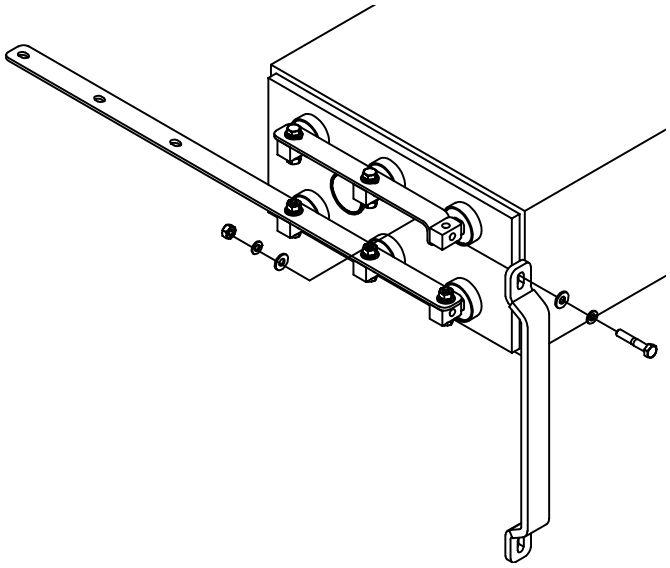
   NOTE: For this connection point it is acceptable to torque the head of the bolt.

29 to 33 Plate

1. Install “L” connector with vertical bolt as below. Bolts should be installed loosely for future adjustments. Duplicate connection process at both connection points.



2. Install “C” connector to cell post using horizontal bolt as below. Bolt should be installed loosely for future adjustments. Duplicate connection process at both connection points.



3. Ensure proper alignment of connectors to cell posts.
4. **Tighten & torque the horizontal bolt to 125 in-lb prior to tightening and torqueing the vertical bolts in step 1.**

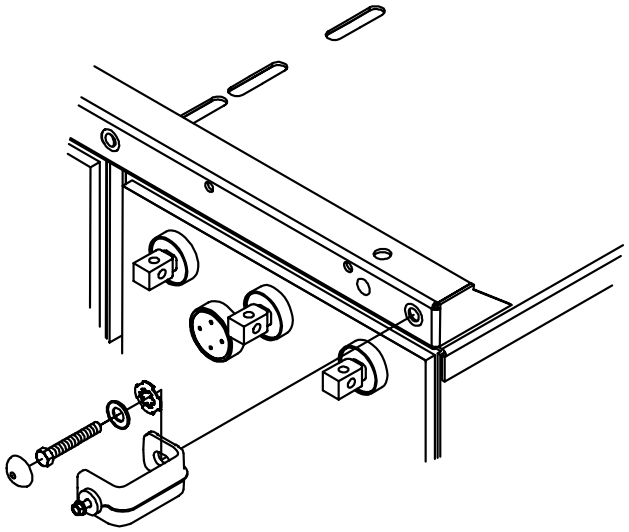
   NOTE: For this connection point it is acceptable to torque the head of the bolt.

Terminal Assembly

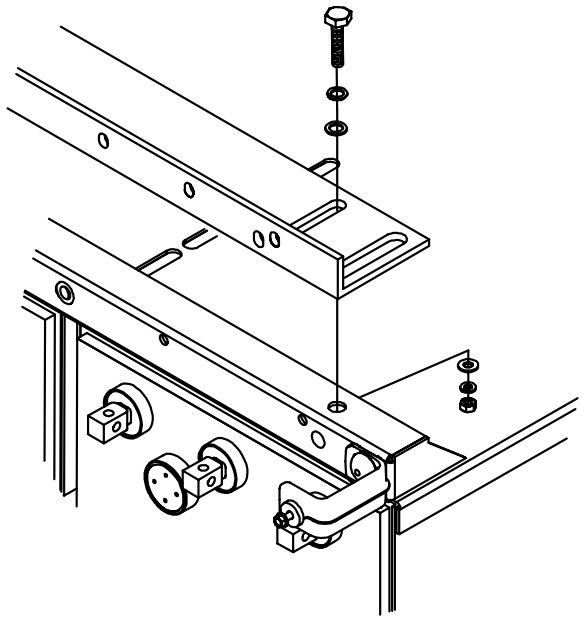
Top Termination

Consult battery string layout diagram for termination location.

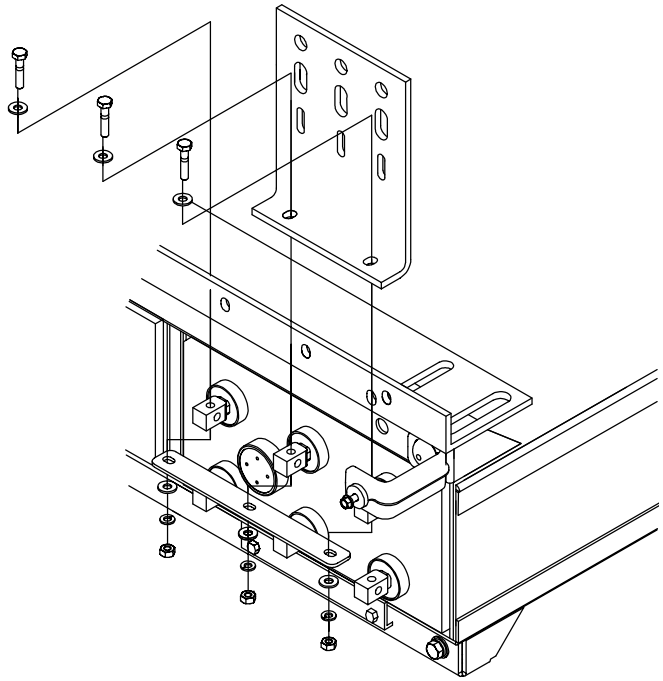
1. Remove module bolt directly behind terminal plate location. If location contained safety shield bracket assembly install cap washer in front of dragon tooth washer and re-install safety shield bracket assembly Install plastic cap after bolts are torqued. Consult “Hardware Torque Requirements” (pg b.4) for proper torque values.



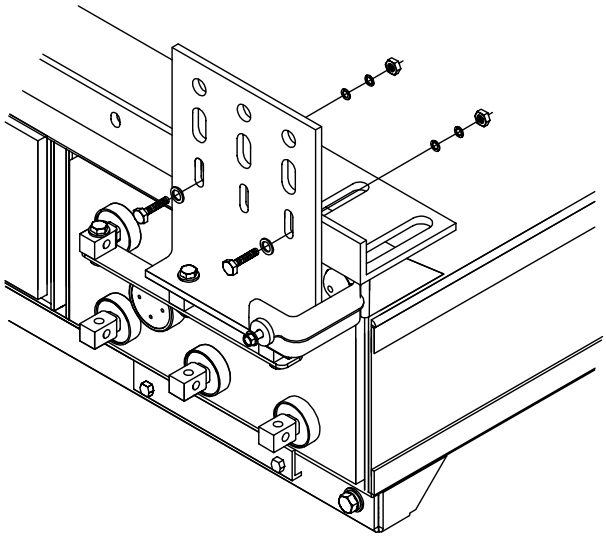
2. Install terminal plate bracket to the top of the module. Use 3/8-16 x 1.25" hardware. Install loosely for future alignment.



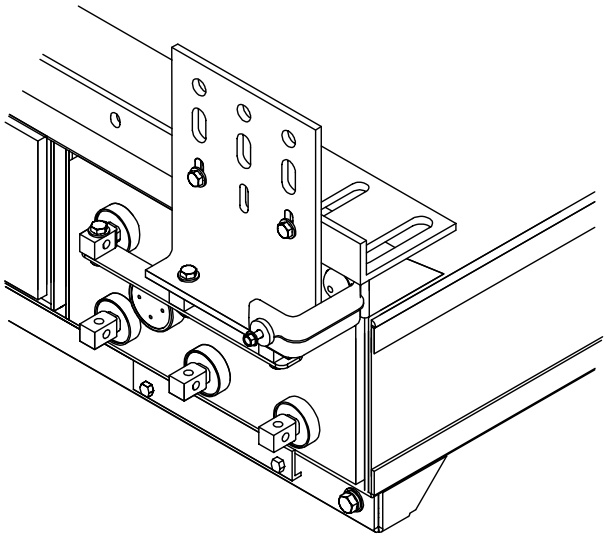
3. Install terminal plate to battery posts using 1/4-20 hardware (consult battery string layout diagram & parts kit for specific length).



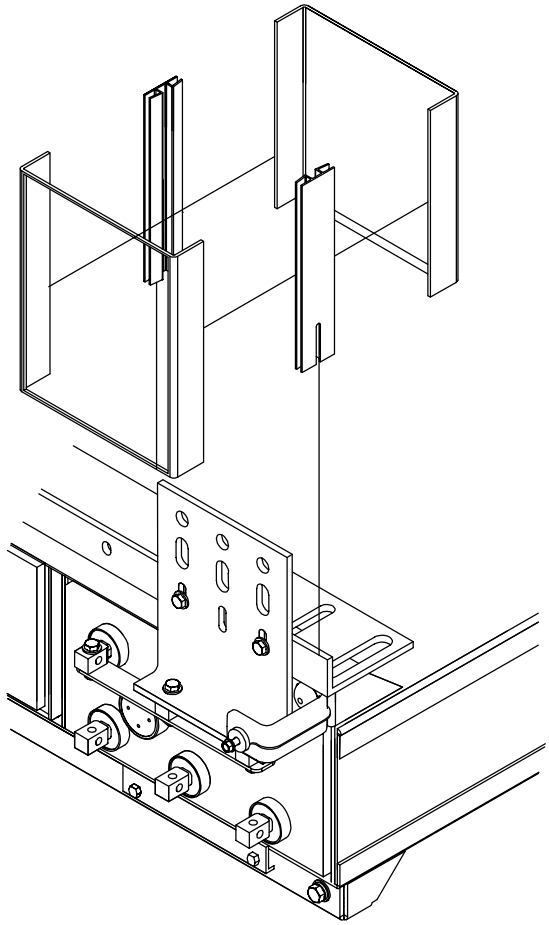
4. Attach terminal plate to terminal plate bracket. Note position of terminal plate. Terminal plate bracket may have to be moved in order to be flush with the terminal plate.



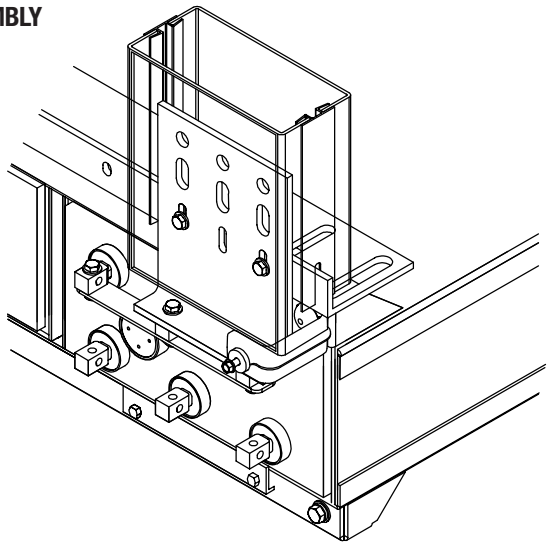
5. After confirming alignment safety shield bracket hardware should be tightened, but not torqued. All remaining hardware should be torqued. Consult “Hardware Torque Requirements” (pg. b.4) for proper torque values.



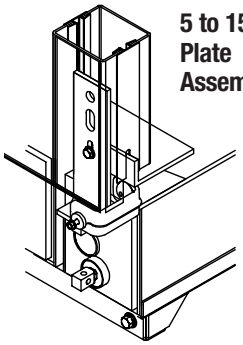
6. Assemble the four parts of the top terminal safety shield as detailed below.



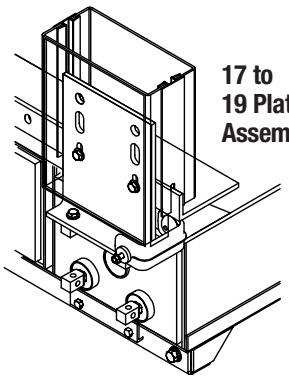
COMPLETED ASSEMBLY



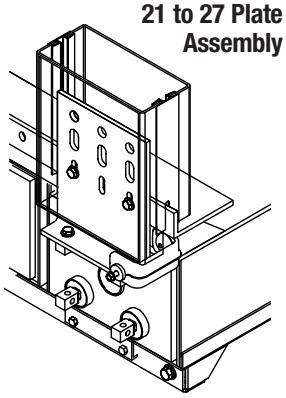
7. Top terminal assembly will vary by battery plate size.



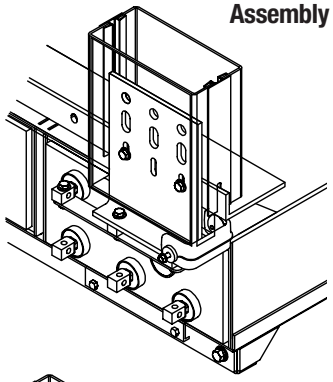
5 to 15 Plate Assembly



17 to 19 Plate Assembly



21 to 27 Plate Assembly



29 to 33 Plate Assembly

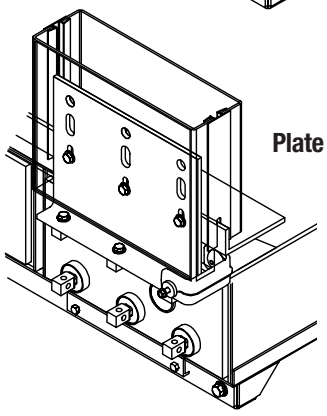
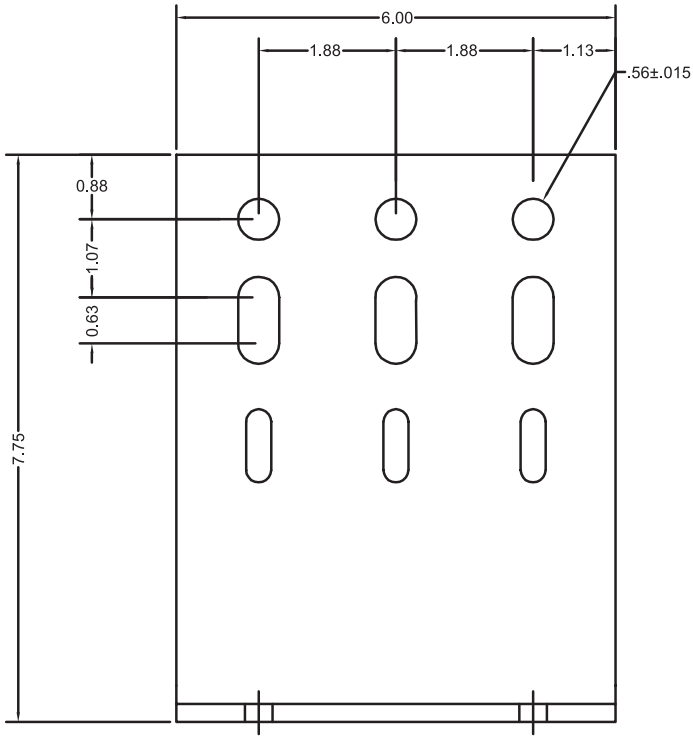


Plate High Rate Assembly

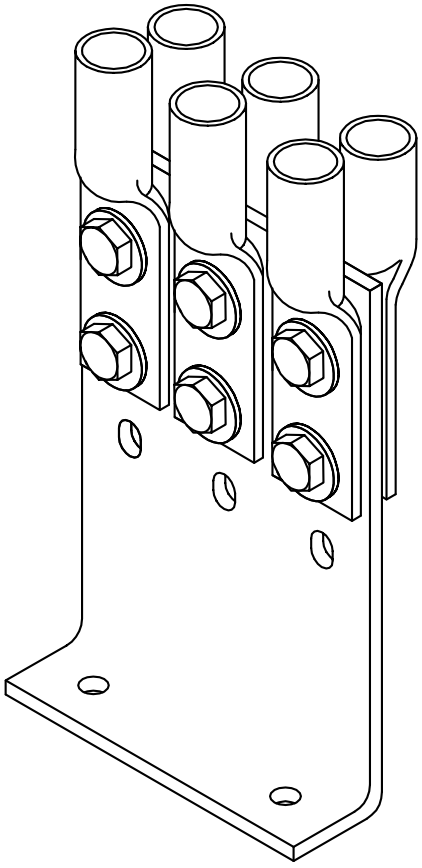
***** When assembling the High Rate Assembly plate, the center bolt to the battery post should be loosely installed prior to installing the outer bolts.***

8. Top terminal plates are designed to accept up to 0.50" dia. bolt and use a maximum 1.75" center, 2 hole lug.
   Lug and lug hardware not included.



Top terminal plate hole to hole dimensions typical.
21 to 33 top terminal plate detailed above.

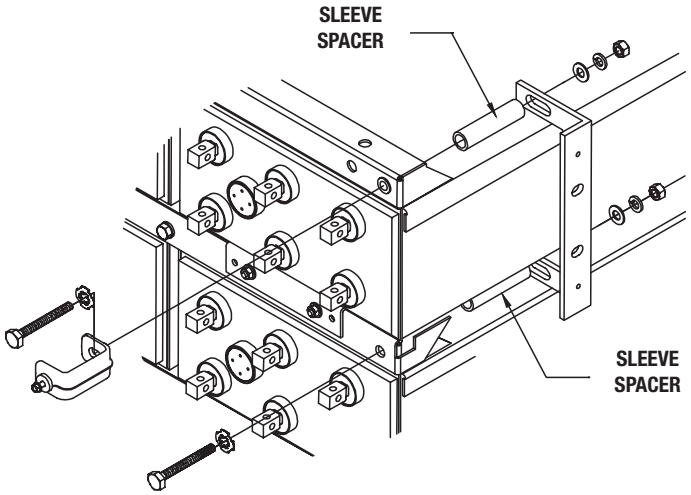
9. **Lugs can be positioned on both sides of the terminal plate.**



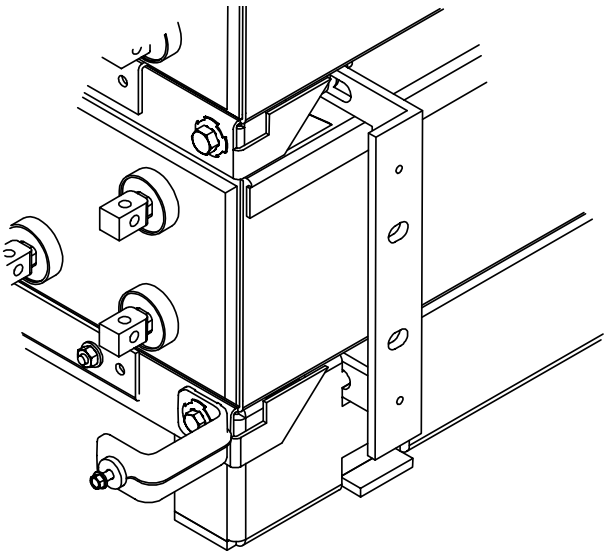
Side Termination

Consult battery string layout diagram for termination location.

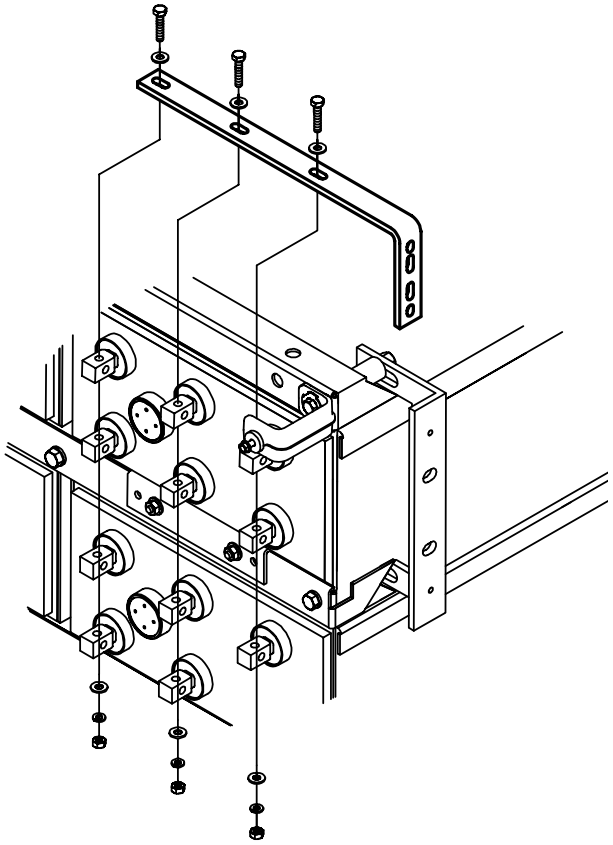
1. Remove module bolts (3/8-16 x 1.25") from the module where side termination is to be installed. If safety shield bracket is at one of these locations, retain for later use.
2. Install plastic side terminal bracket in location where bolts were removed in previous step. Use 3/8-16 x 4.50" bolts. Bolts should be installed loosely for future adjustments. Replace safety shield bracket at same location from previous step.



3. The side terminal may be located at the bottom module. Slot in lower arm of side terminal bracket slips over tab in base plate. The upper side terminal bracket connection should be attached as called out in previous section.

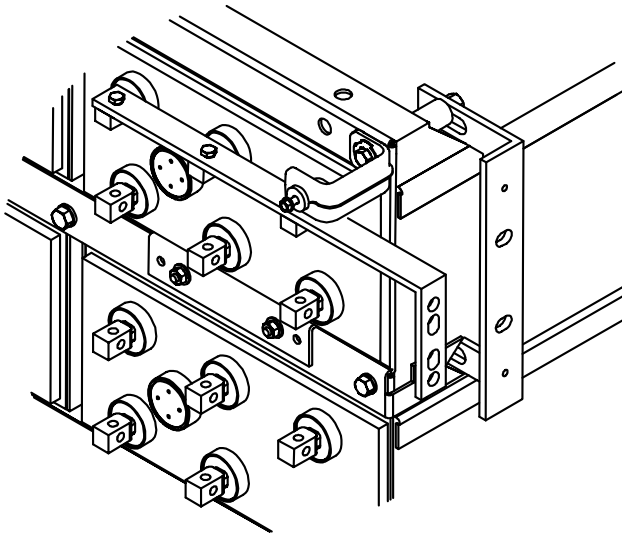


4. Install side terminal connector to battery posts using 1/4- 20 bolts. Bolts should be installed loosely for future adjustments.

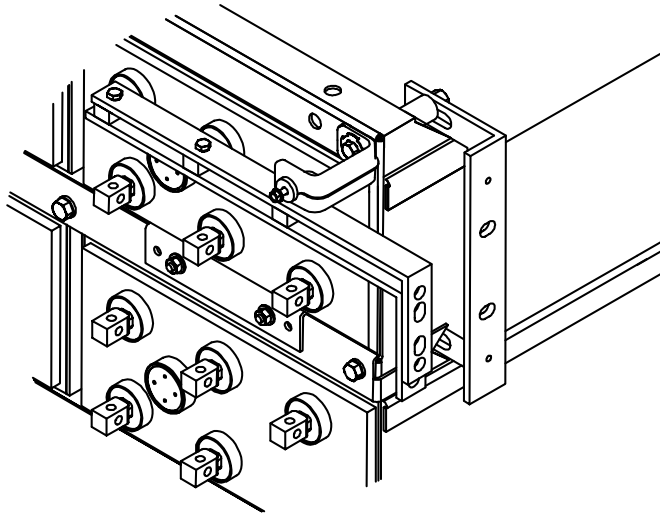


Review the “Connector Packages” chart (pg b.8) to ensure the correct connector package has been supplied.

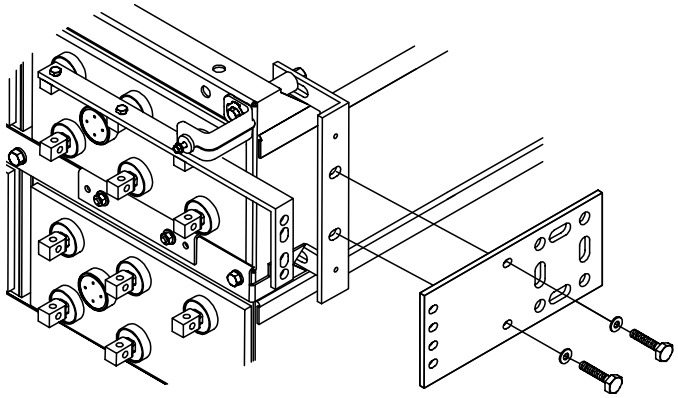
1CU / 2CU CONNECTOR PACKAGE
(single connector)



4CU / 6CU CONNECTOR PACKAGE
(double connector)

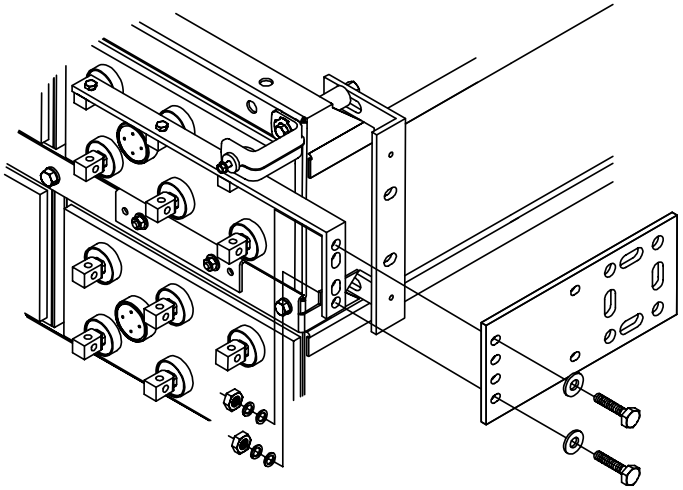


5. Install side terminal plate to terminal plate bracket using 1/4-20 x 1.00" hardware. Bolts should be installed loosely for future adjustments.

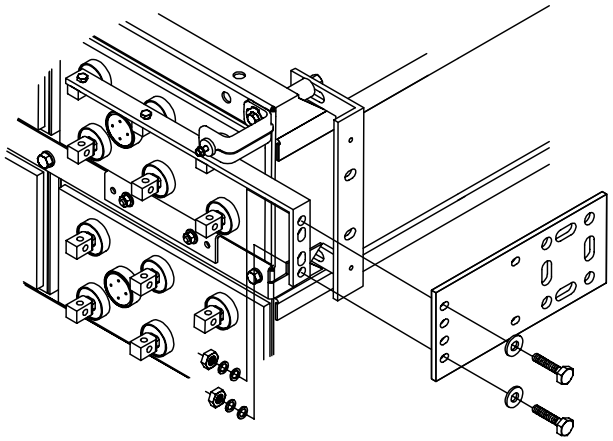


6. Connect side terminal plate to side terminal plate connectors. Bolt length is dependent on connector package as noted below.

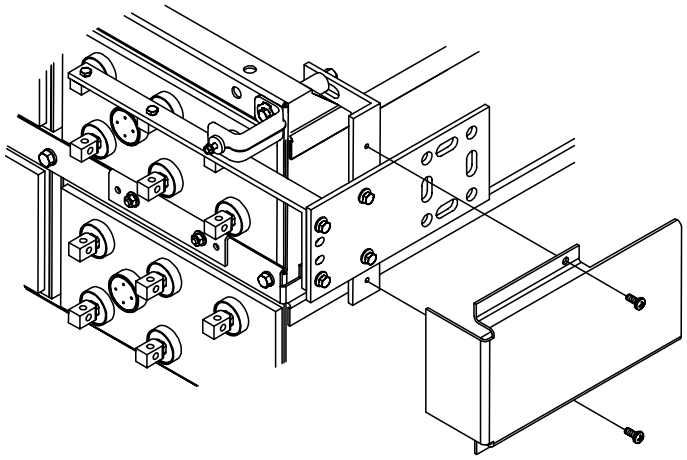
1CU / 2CU CONNECTOR PACKAGE
(1/4-20 x 1.00" hardware required)



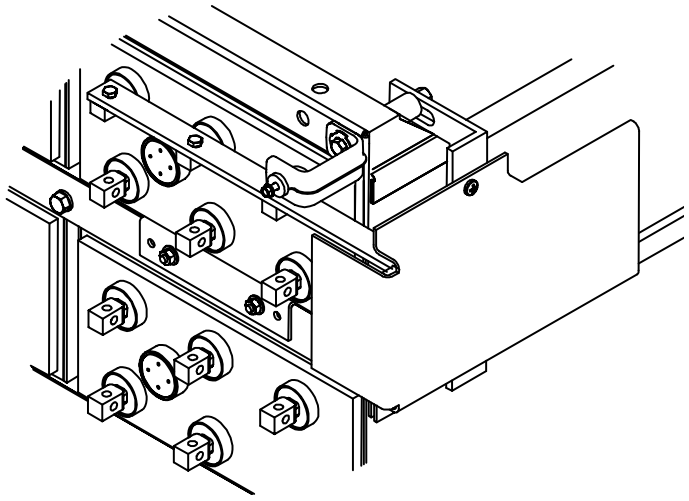
4CU / 6CU CONNECTOR PACKAGE
(1/4-20 x 1.25" hardware required)



7. After all parts are installed and alignment is confirmed, safety shield bracket hardware should be tightened, but not torqued. All remaining hardware should be torqued Consult "Hardware Torque Requirements" (pg b.4) for proper torque values.
8. Install side terminal shield to side terminal plate Bracket using 1/4-20 x 0.625" screws. Tighten but do not torque hardware.

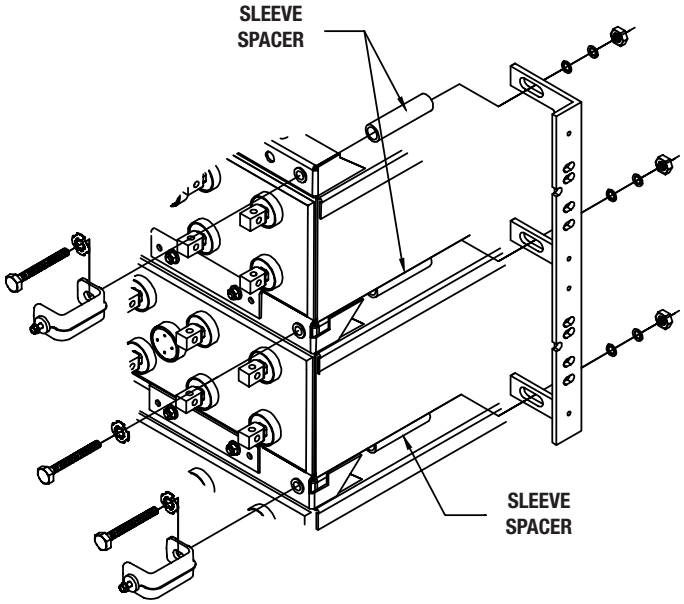


FINAL ASSEMBLY

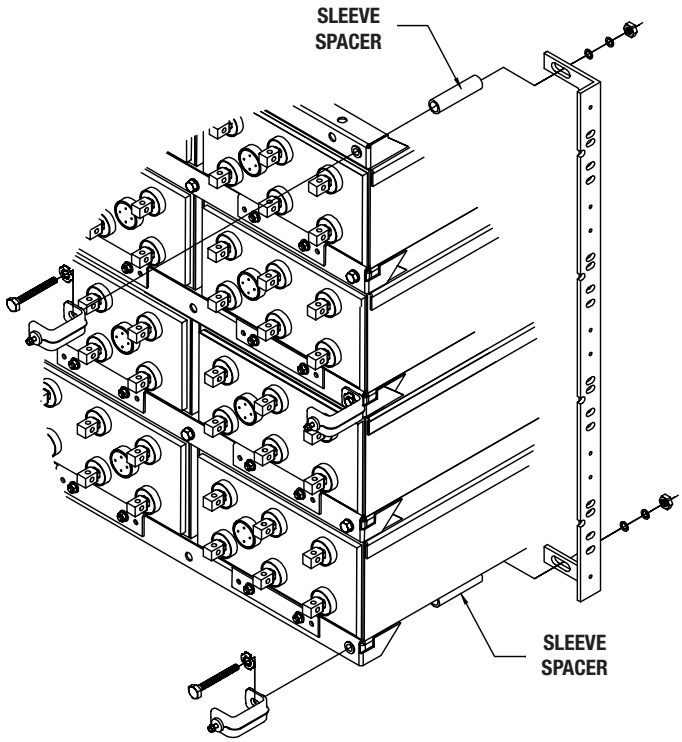


9. Depending on the termination location, side terminal plates may be adjacent to each other. The side terminal bracket attachment is different depending on the number of adjacent terminal plates.

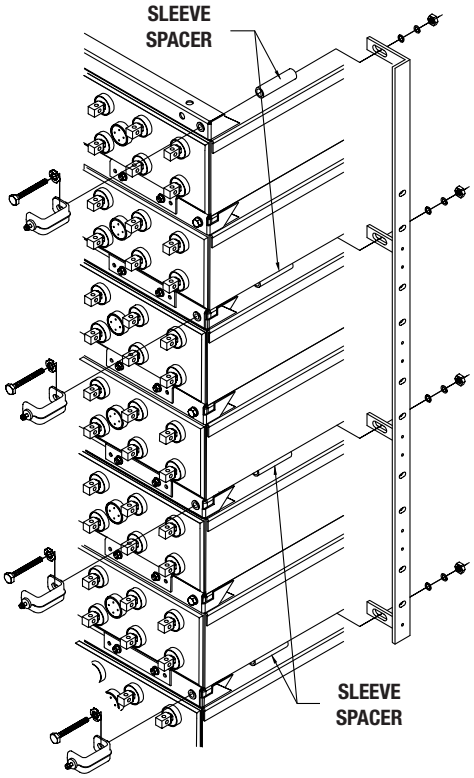
TWO TERMINAL PLATE BRACKET ASSEMBLY



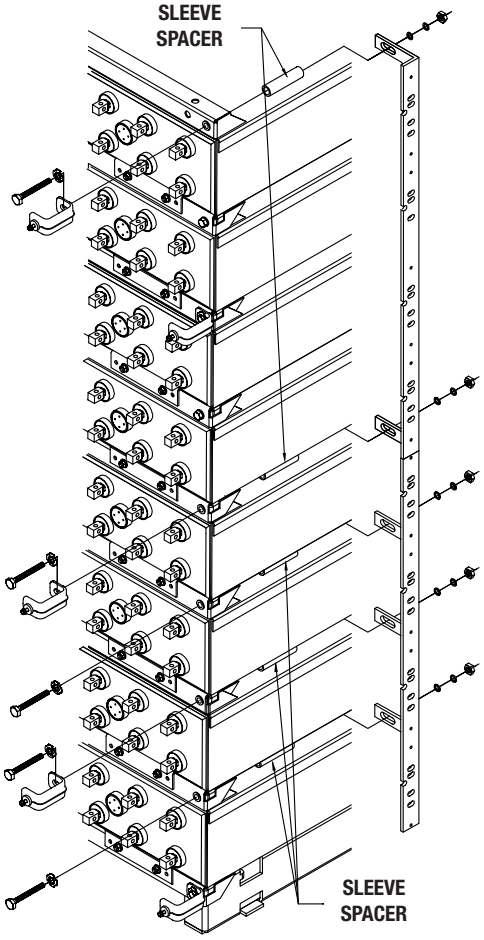
FOUR TERMINAL PLATE BRACKET ASSEMBLY



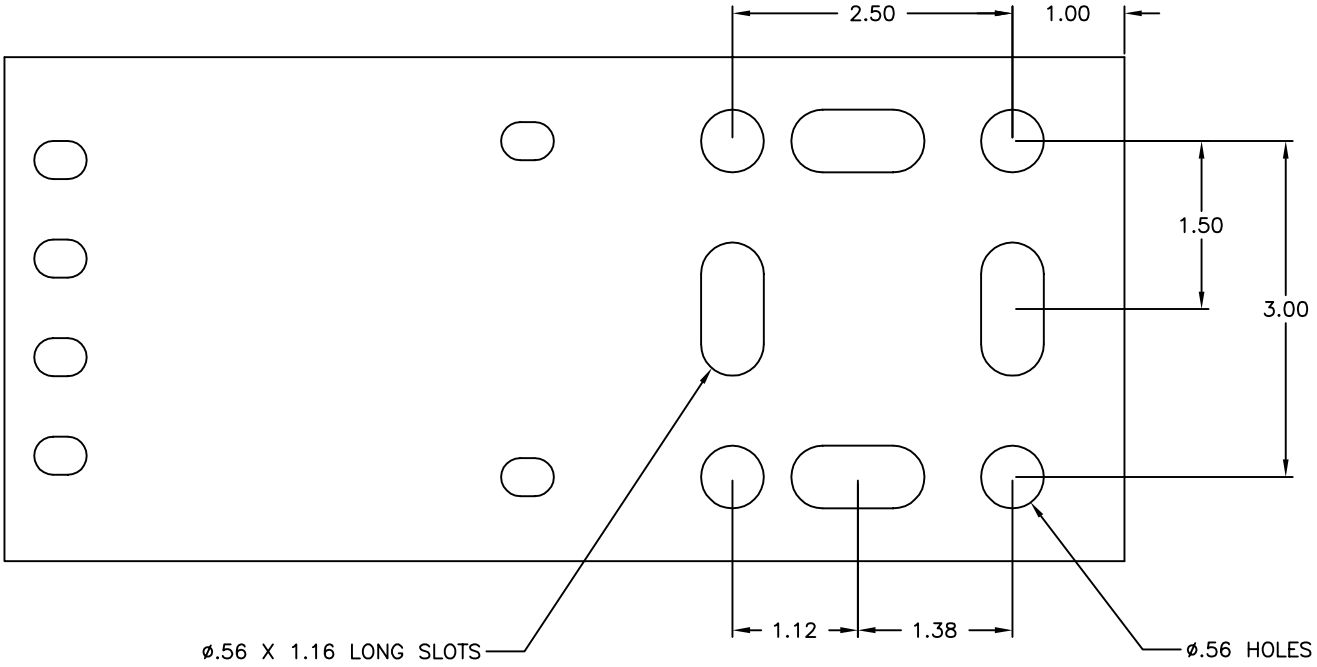
SIX TERMINAL PLATE BRACKET ASSEMBLY



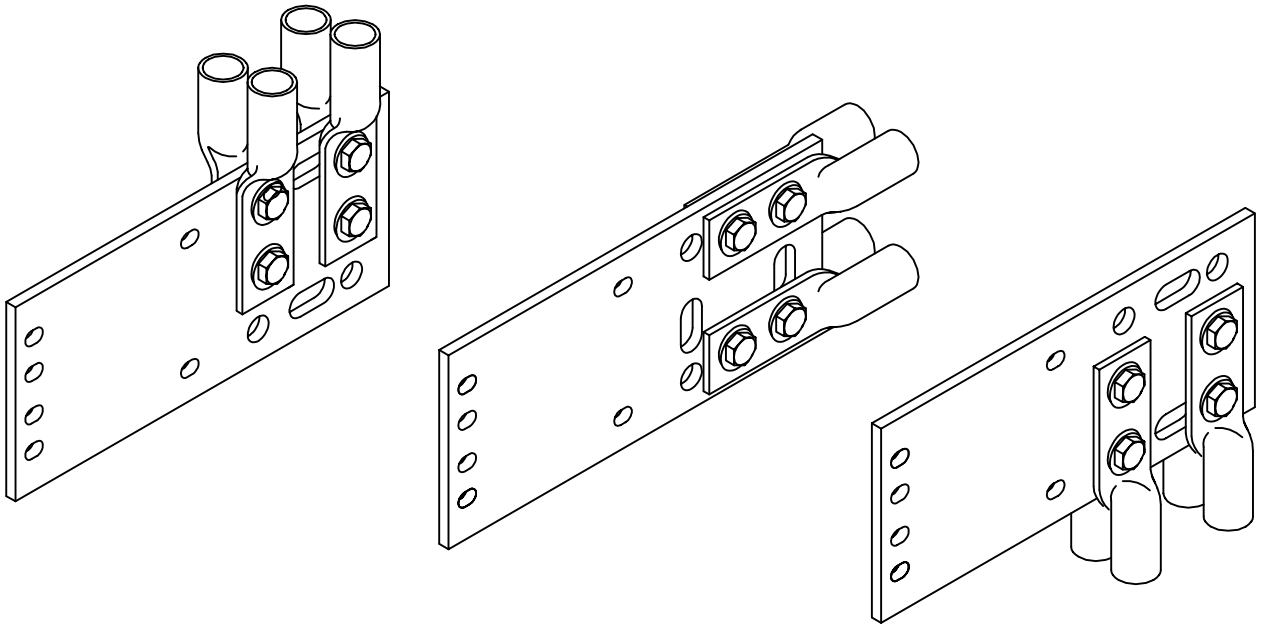
EIGHT TERMINAL PLATE BRACKET ASSEMBLY
(Installed in two sections)



10. 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. Lugs can be positioned on both sides of the terminal plate. **Lug and lug hardware not included.**



Lug Positioning Options



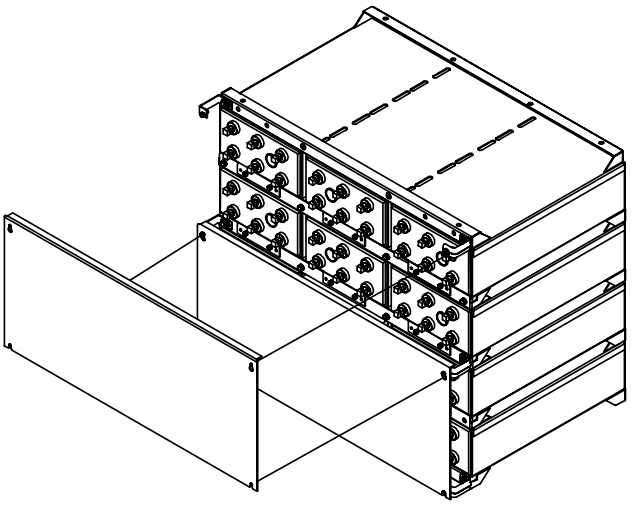
Final Assembly Check Procedure

1. For future identification, individual cells should be numbered in electrical connection sequence, beginning with number one (1) at the positive end of the battery string.

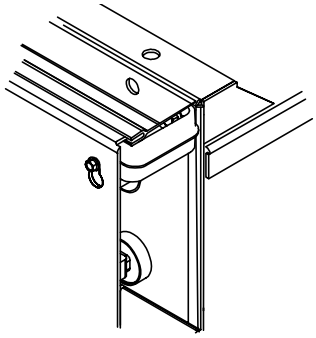
   NOTE: Following steps are to be followed with battery disconnected from any load or charge source.
2. Read and record the voltages of the individual cells to assure that they are connected properly. The total battery string voltage should be approximately equal to the number of cells connected in series, multiplied by the measured voltage of one cell If the measured is less, recheck the connections for proper polarity. Verify that all cell 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" form in Appendix K of this manual. Review the records of each connection and detail resistance measurements. Clean, remake, and re-measure 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 string performance is based on the output at the cell terminals. Therefore, the shortest electrical connection between the battery string 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 string and operating equipment than customer specified. Excessive voltage drop in cables will reduce the desired reserve time and power from the battery string.

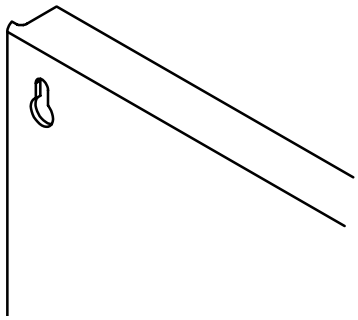


TOP

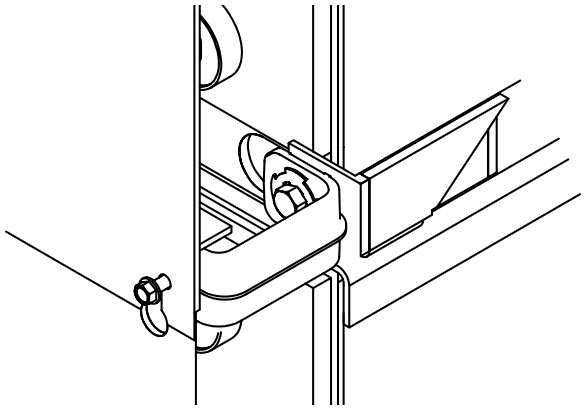


Safety Shield Assembly

1. All safety shield brackets should already be installed at this time. Refer to "Non-Interlock Module Installation" section for bracket installation.
2. Safety shields are designed with a "keyhole" type attachment.

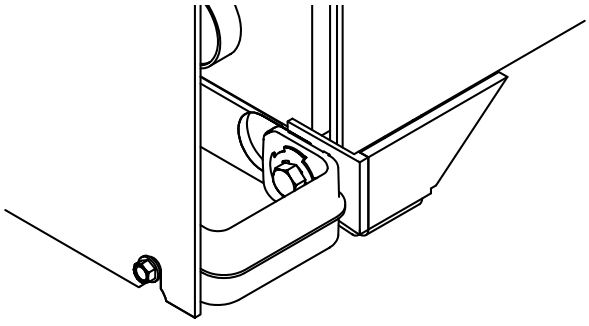


OVERLAP



3. One shield will cover two modules. Starting at the bottom of the stack; 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. The next shield will overlap the previously installed shield. For stacks containing odd number of modules a single module safety shield will be supplied. After all shields are in place, tighten the outer bolt, but **do not torque.**

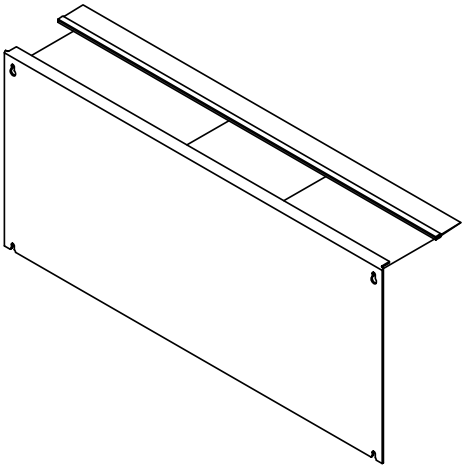
BOTTOM



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

The following charging parameters are for Standby (Float) Applications.

For Renewable Energy (Cyclic) Applications refer to Appendix H.

Charger Voltage (per cell)

2.25V ± 0.5% @ 77°F (25°C)

When setting the float voltage on the charger, the battery string should be set to float at the nominal cell float voltage times the number of cells per battery string. The charger must be able to maintain the battery string voltage within ± 0.5% of the desired level at all times.

Example: For a 48V system, the float voltage may vary from 53.73V to 54.27V

Charge Current

Charge current should not exceed the recommended minimum and maximum requirements as detailed in Appendix F for Unigy II & Appendix G for Deka Fahrenheit HT 2V.

Temperature Compensation

Battery voltage should be adjusted for ambient temperature variations.

2mV per °C (1.8°F) per 2v cell.

Consult **Voltage Compensation Chart (Appendix F for Unigy II & Appendix G for Deka Fahrenheit HT 2V)** for temperature compensation voltage maximum and minimum limits.

Cell Voltage

Individual cell voltages may vary by ± 0.05V per cell of the average battery string float voltage.

It is not unusual to observe a wide float voltage range between cells for the first 6 months of operation. After the initial 6 months, an individual cell voltage of 2.15V or less while following the published float charge instructions indicates a potential problem and action should be taken to replace the low voltage unit.

Equalizing

Upon installation of the battery string, an optional charge of 2.40V per cell ± 0.5% @ 77°F (25°C) for 24 hours (not to exceed 24 hours) can be applied. (NOTE: Verify that the higher cell voltage will not adversely affect any other connected equipment). If this is done, be sure to reset the charging equipment to the proper float voltage upon completion of the equalize charge.

Example: For a 48V system, the equalize voltage may vary from 57.31V to 57.89V

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 operating temperature should not exceed 95°F (35°C) and should never exceed 105°F (40.5°) for more than an 8 hour period.

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.**

NOTE: The battery system should not be discharged below published EOD (end of discharge) ratings.

Rectifier Ripple Voltage

FREQUENCY

Ripple that has a frequency greater than 667Hz (duration less than 1.5ms) is acceptable, unless it is causing additional cell heating.

Ripple that has a frequency less than 667Hz (duration greater than 1.5ms), must meet the following voltage specification to be acceptable.

VOLTAGE

Ripple voltage shall be less than 0.5% peak to peak (.177% rms) of the manufacturer's recommended battery 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 string and inform the user if and when corrective action needs to be taken. Values should be recorded using "Battery Maintenance Report" in Appendix K.

All measuring equipment should be in good operating condition and accuracy should be confirmed on an annual basis to NIST traceable standards.

After installation and when the battery string has been on float charge for one week, the data as detailed in the below *"Maintenance Section"* should be recorded.

Failure to maintain proper records including information as detailed below may result in voiding any applicable warranty.

ACCEPTANCE / PERFORMANCE TESTING

An acceptance / performance test, if required can be performed upon initial installation to ensure the battery meets the initial requirements.

A performance test should be completed if, over the life of the battery, operation is questionable.

If an acceptance or performance test is required, follow the guidelines in Appendix F in conjunction with IEEE-1188.

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 b.3).

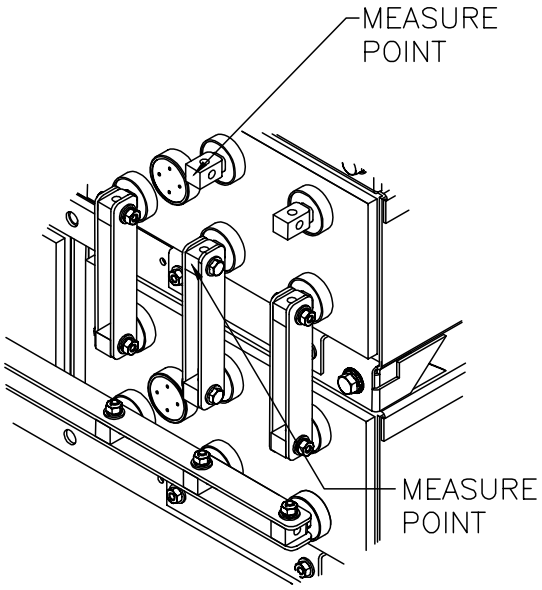
Annual Inspection

For Renewable Energy (Cyclic) applications, some of the following recommendations may not apply.

Discharge and recharge affect voltage and ohmic values. These readings should be taken only after the battery string has been on continuous, uninterrupted float charge for at least one month.

The following values should be recorded using the Battery Maintenance Report in Appendix K. Additional copies available at www.eastpennmanufacturing.com

1. Conduct a visual inspection of each cell.
2. Battery string voltage at battery terminals while battery is on float.
3. Charger voltage at the charger panel.
4. Individual cell voltages. Cells should be within ± 0.05 volts of the average cell float voltage.
5. Ambient temperatures within area of battery string
6. Average battery string temperature at a minimum of three different cells at varying locations. Temperatures shall be taken at the negative post.
7. Individual cell ohmic readings. To provide accurate / consistent values, cells must be fully charged, at same temperature and probes placed at same location each time readings are taken. On a 4-post cell, place meter leads on the left positive & left negative posts or right positive & right negative posts. For 6-post cells, measure from center positive to center negative posts. Do not measure diagonally from positive to negative posts. See below example for specific location.



8. All intercell, interunit and terminal connection resistances. 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 b.4) for proper torque values. If reading remains high, clean contact surfaces according to Step 1 under Connector Assembly. Recheck the micro-ohm reading.

   Failure to maintain proper records including information as detailed above may result in voiding any applicable warranty.

Battery Cleaning

Batteries, cabinets, racks, and modules should be cleaned with clean water. If neutralizing is required use a mixture of 1 lb baking soda to 1 gallon of 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 results 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."

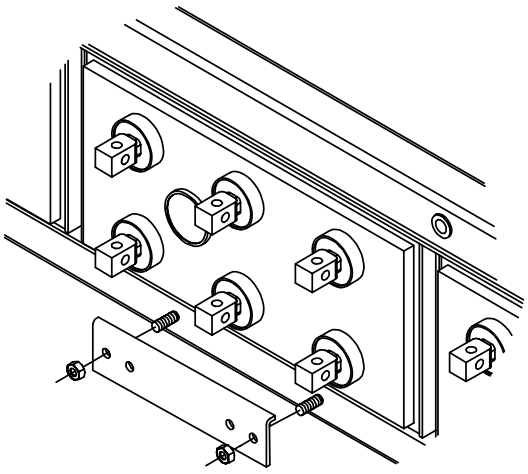
When performing capacity testing and recording data refer to IEEE 1188 recommendations.

NOTE: When discharging at higher rates than originally specified, extra connectors may need to be added to prevent excessive voltage drop and / or excessive temperature rise.

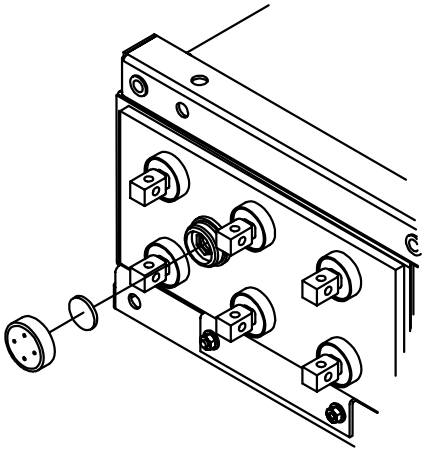
Should it be determined that any individual cell(s) need to be replaced, contact East Penn.

CELL REMOVAL PROCEDURE

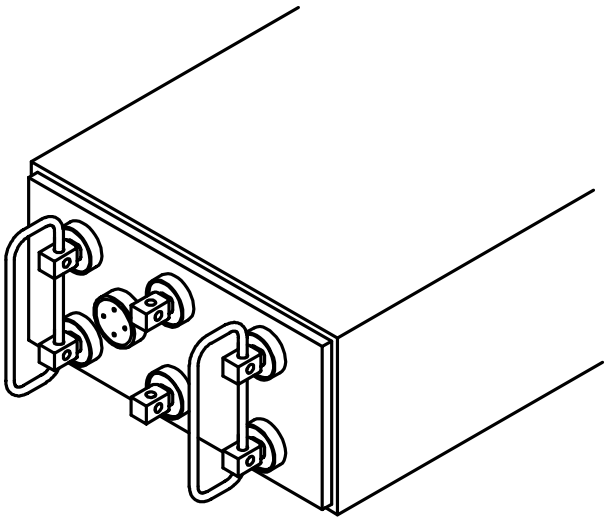
1. Before removing cell, review Safety Precautions (pg b.3) of this manual. Contact East Penn with specific questions or concerns.
2. Disconnect Charger and the system ground connection.
3. Remove connectors from cell being removed.
4. Remove cell retainer bar(s) from cell being removed.



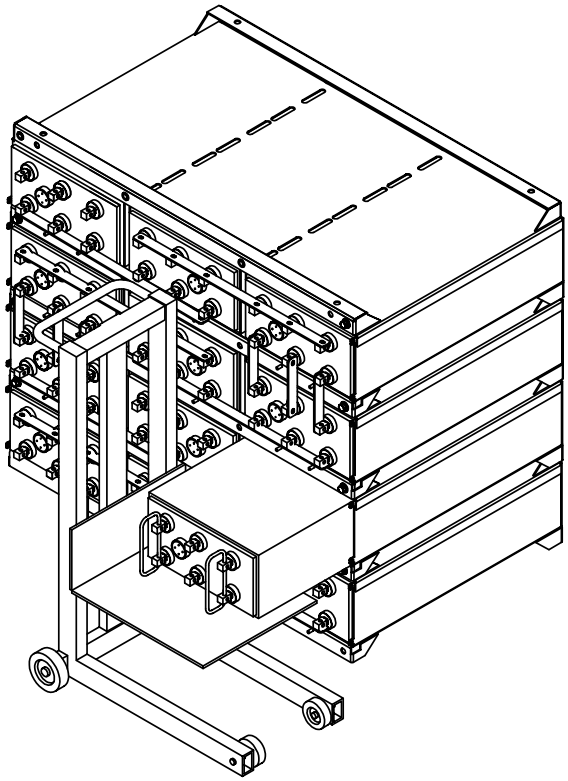
5. Cells develop internal pressure. Relieving this pressure from the cell will make it easier to remove the cell from the module.
   a. Pry off vent shroud using insulated flat head screwdriver.
   b. Remove flame arrestor (round white disc).
   c. Unscrew valve ¼ turn using 17mm hex key (pressure will release).
   d. Tighten valve immediately and torque to 12-14 in lb with 17mm hex key.



6. Lifting device shall be rated to handle weight of cell.
7. Remove one cell at a time.
   a. Thread non-metallic rope through two battery terminals and knot.

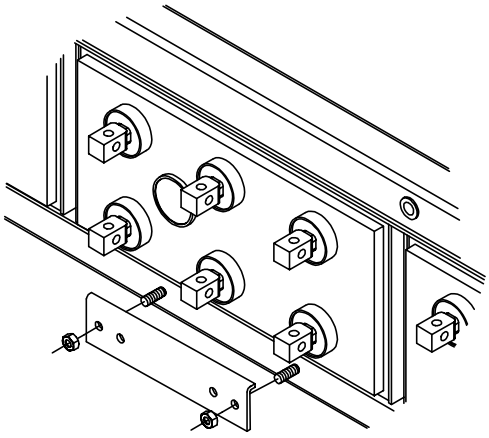


8. Pull cell from module onto lifting device. Care should be taken so lifting device does not come in contact with cell posts.



Cell Replacement Procedure

1. Cells develop internal pressure. Relieving this pressure from the cell will make it easier to install the cell into the module. Follow the steps of “Cell Removal Procedure” item 4.
2. Ensure cell polarity is correct prior to installing cell
3. Replace cell retainer bar.



4. Refer to “Electrical Connection” section for installing connectors of replacement cell.

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. The charging system for these batteries shall prevent charging outside of the battery specifications through the use of voltage (and temperature for VRLA) monitoring and controls, or both current and temperature monitoring and controls. The system may also use current monitoring to prevent out of condition specifications.
4. 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.
5. 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.
6. 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.
7. 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.
8. 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.
9. Unigy II modules are designed to have 0.5” (12.7mm) horizontal spacing and 2” (50.8mm) vertical spacing for air circulation. Modules should be spaced at a minimum of 2” (50.8mm) from any wall or obstacle.
10. Minimum & maximum allowable operating range is -40°C (-40°F) to 40°C (104°F).
11. Minimum & maximum allowable discharge current to an end voltage of 1.75 vpc is listed as follows:

Unigy II - Minimum & Maximum Discharge Currents

Battery Type	Minimum Discharge Current	Maximum Discharge Current
	Amps	Amps
AVR45-5	1.2	152
AVR45-7	1.8	228
AVR45-9	2.4	304
AVR45-11	3.0	380
AVR45-13	3.6	456
AVR45-15	4.2	532
AVR45-17	4.8	610
AVR45-19	5.4	686
AVR45-21	6.0	762
AVR45-23	6.7	838
AVR45-25	7.3	914
AVR45-27	7.9	991
AVR45-29	8.5	1067
AVR45-31	9.1	1143
AVR45-33	9.7	1219

Battery Type	Minimum Discharge Current	Maximum Discharge Current
	Amps	Amps
AVR75-5	2.1	182
AVR75-7	3.1	273
AVR75-9	4.1	363
AVR75-11	5.1	454
AVR75-13	6.2	545
AVR75-15	7.2	636
AVR75-17	8.2	727
AVR75-19	9.2	818
AVR75-21	10.3	909
AVR75-23	11.3	999
AVR75-25	12.3	1090
AVR75-27	13.4	1181
AVR75-29	14.4	1272
AVR75-31	15.4	1363
AVR75-33	16.4	1454

Battery Type	Minimum Discharge Current	Maximum Discharge Current
	Amps	Amps
AVR95-7	4.0	360
AVR95-9	5.4	480
AVR95-11	6.7	600
AVR95-13	8.1	720
AVR95-15	9.4	840
AVR95-17	10.8	960
AVR95-19	12.1	1080
AVR95-21	13.4	1200
AVR95-23	14.8	1320
AVR95-25	16.1	1440
AVR95-27	17.5	1560
AVR95-29	18.8	1680
AVR95-31	20.2	1800
AVR95-33	21.5	1920

Deka Fahrenheit 2V - Minimum & Maximum Discharge Currents

Battery Type	Minimum Discharge Current	Maximum Discharge Current
	Amps	Amps
HT45-5	1.1	136
HT45-7	1.6	204
HT45-9	2.2	272
HT45-11	2.7	340
HT45-13	3.2	408
HT45-15	3.8	476
HT45-17	4.3	545
HT45-19	4.9	614
HT45-21	5.4	682
HT45-23	6.0	750
HT45-25	6.5	818
HT45-27	7.0	886
HT45-29	7.6	955
HT45-31	8.1	1023
HT45-33	8.7	1091

Battery Type	Minimum Discharge Current	Maximum Discharge Current
	Amps	Amps
HT95-7	3.6	292
HT95-9	4.8	389
HT95-11	6.0	486
HT95-13	7.2	583
HT95-15	8.4	680
HT95-17	9.6	777
HT95-19	10.8	875
HT95-21	12.0	972
HT95-23	13.2	1069
HT95-25	14.4	1166
HT95-27	15.6	1263
HT95-29	16.8	1360
HT95-31	18.0	1458
HT95-33	19.2	1555

APPENDIX B

EASTPENN

REFRESH RECORD FORM

Rev. 1
5-14-24

EPM Order Number*	Pallet ID Number	Individual Performing Test (Full Name)	Date of Refresh	Refresh Duration

	Information Prior to Refresh			READINGS TO BE TAKEN 1 HOUR BEFORE THE COMPLETION OF REFRESH CHARGING			Notes & Comments	
Model Number	**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								
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Cell 53								
Cell 54								
Cell 55								
Cell 56								
Cell 57								
Cell 58								
Cell 59								
Cell 60								

ALL FIELDS TO THE RIGHT OF THE JAR 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)

REFRESH RECORD FORM

Rev. 1
5-14-24

EASTPENN

EPM Order Number*	Pallet ID Number	Individual Performing Test (Full Name)	Date of Refresh	Refresh Duration

Model Number	Information Prior to Refresh			READINGS TO BE TAKEN 1 HOUR BEFORE THE COMPLETION OF REFRESH CHARGING			Notes & Comments	
	Date Code	Cell Serial Number	Open Circuit Voltage	Cell Voltage Reading	Charging Current	Cell Temperature		
Cell 61								
Cell 62								
Cell 63								
Cell 64								
Cell 65								
Cell 66								
Cell 67								
Cell 68								
Cell 69								
Cell 70								
Cell 71								
Cell 72								
Cell 73								
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Cell 113								
Cell 114								
Cell 115								
Cell 116								
Cell 117								
Cell 118								
Cell 119								
Cell 120								

ALL FIELDS TO THE RIGHT OF THE JAR 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

Unigy II - Cell Weight & Volume

Battery Type	Cell Weight		Electrolyte (per cell)				Pure Acid (per battery)	
			Volume		Weight		Weight	
	lb.	kg.	gal	liter	lb.	kg.	lb.	kg.
AVR45-5	18	8	0.37	1.40	4.00	1.81	1.60	0.72
AVR45-7	25	11	0.52	1.96	5.60	2.54	2.24	1.02
AVR45-9	32	15	0.67	2.52	7.22	3.28	2.89	1.31
AVR45-11	39	18	0.81	3.08	8.83	4.00	3.53	1.60
AVR45-13	46	21	0.96	3.64	10.43	4.73	4.17	1.89
AVR45-15	53	24	1.11	4.20	12.04	5.46	4.81	2.18
AVR45-17	60	27	1.26	4.76	13.65	6.19	5.46	2.47
AVR45-19	67	30	1.41	5.32	15.26	6.92	6.10	2.77
AVR45-21	74	34	1.55	5.89	16.87	7.65	6.74	3.06
AVR45-23	81	37	1.70	6.45	18.47	8.38	7.39	3.35
AVR45-25	88	40	1.85	7.01	20.08	9.11	8.03	3.64
AVR45-27	95	43	2.00	7.57	21.69	9.84	8.67	3.93
AVR45-29	102	46	2.15	8.13	23.30	10.57	9.31	4.22
AVR45-31	109	49	2.30	8.69	24.91	11.30	9.96	4.52
AVR45-33	116	53	2.44	9.25	26.51	12.03	10.60	4.81
AVR75-5	28	13	0.61	2.30	6.58	2.98	2.63	1.19
AVR75-7	39	18	0.86	3.28	9.39	4.26	3.75	1.70
AVR75-9	50	23	1.11	4.22	12.04	5.46	4.83	2.19
AVR75-11	61	28	1.36	5.15	14.76	6.70	5.90	2.68
AVR75-13	72	33	1.61	6.09	17.44	7.91	6.97	3.16
AVR75-15	83	38	1.86	7.03	20.13	9.13	8.05	3.65
AVR75-17	94	43	2.10	7.96	22.81	10.35	9.12	4.14
AVR75-19	105	48	2.31	8.75	25.08	11.38	10.02	4.55
AVR75-21	116	53	2.60	9.84	28.19	12.79	11.27	5.11
AVR75-23	127	58	2.84	10.77	30.87	14.00	12.34	5.60
AVR75-25	137	62	3.09	11.71	33.56	15.22	13.42	6.09
AVR75-27	148	67	3.34	12.64	36.23	16.44	14.48	6.57
AVR75-29	159	72	3.59	13.58	38.92	17.65	15.56	7.06
AVR75-31	170	77	3.83	14.52	41.60	18.87	16.63	7.54
AVR75-33	181	82	4.08	15.46	44.29	20.09	17.71	8.03
AVR95-7	44	20	0.96	3.63	10.54	4.78	4.41	2.00
AVR95-9	57	26	1.22	4.62	13.40	6.08	5.60	2.54
AVR95-11	70	32	1.49	5.66	16.40	7.44	6.86	3.11
AVR95-13	83	38	1.76	6.68	19.36	8.78	8.09	3.67
AVR95-15	96	44	2.04	7.73	22.42	10.17	9.38	4.25
AVR95-17	108	49	2.30	8.72	25.28	11.47	10.57	4.79
AVR95-19	121	55	2.48	9.38	27.18	12.33	11.37	5.16
AVR95-21	134	61	2.89	10.94	31.70	14.38	13.26	6.01
AVR95-23	147	67	3.08	11.67	33.84	15.35	14.15	6.42
AVR95-25	160	73	3.39	12.84	37.23	16.89	15.57	7.06
AVR95-27	172	78	3.69	13.96	40.48	18.36	16.93	7.68
AVR95-29	186	84	3.93	14.89	43.17	19.58	18.05	8.19
AVR95-31	198	90	4.22	15.96	46.28	20.99	19.35	8.78
AVR95-33	211	96	4.50	17.04	49.41	22.41	20.66	9.37

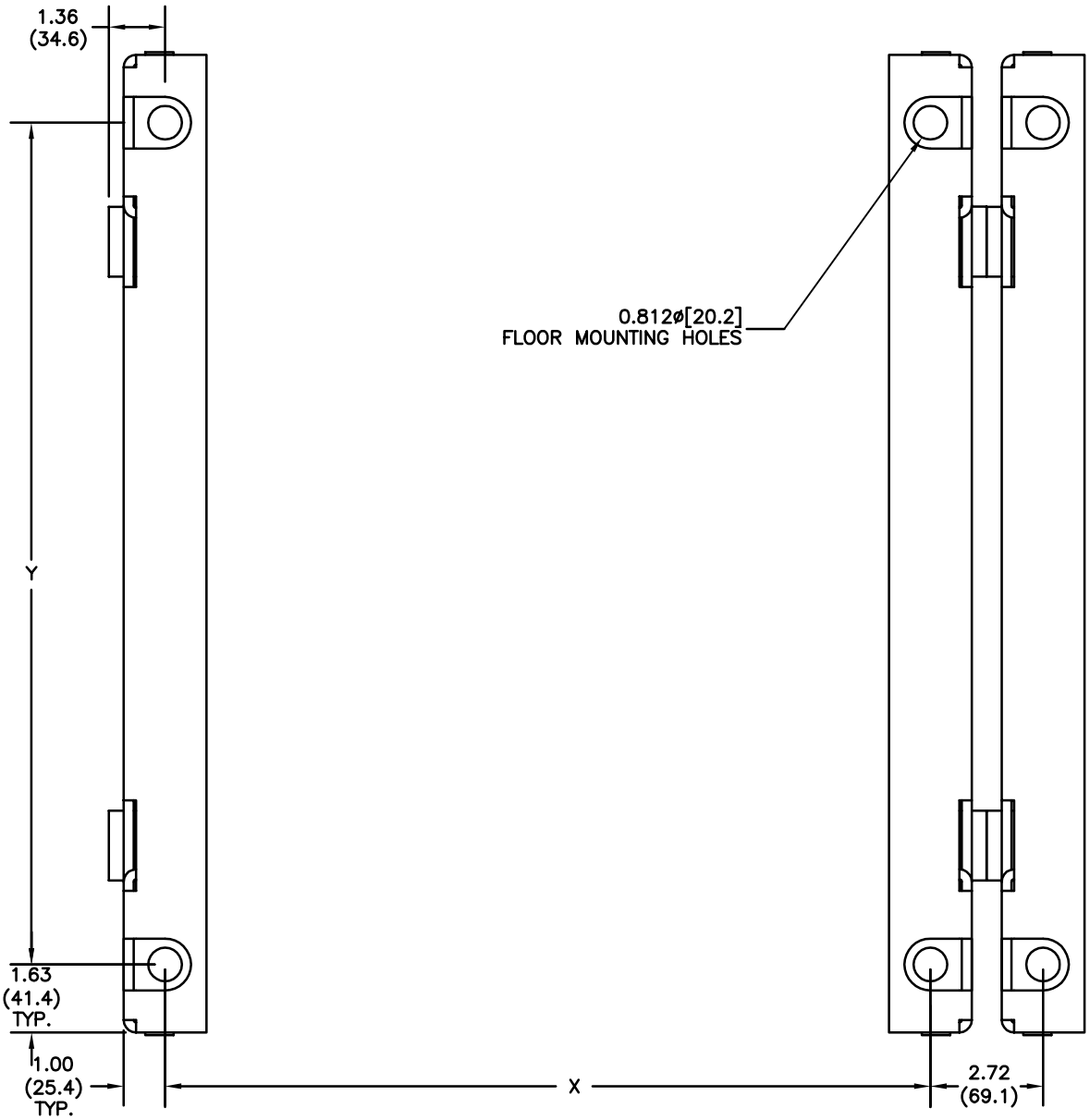
***Data subject to change.*

Deka Fahrenheit HT 2V - Cell Weight & Volumes

Battery Type	Cell Weight		Electrolyte (per cell)				Pure Acid (per battery)	
			Volume		Weight		Weight	
	lb	kg	gal	liter	lb	kg	lb	kg
HT45-5	18	8	0.37	1.40	4.00	1.81	1.60	0.72
HT45-7	25	11	0.52	1.96	5.60	2.54	2.24	1.02
HT45-9	32	15	0.67	2.52	7.22	3.28	2.89	1.31
HT45-11	39	18	0.81	3.08	8.83	4.00	3.53	1.60
HT45-13	46	21	0.96	3.64	10.43	4.73	4.17	1.89
HT45-15	53	24	1.11	4.20	12.04	5.46	4.81	2.18
HT45-17	60	27	1.26	4.76	13.65	6.19	5.46	2.47
HT45-19	67	30	1.41	5.32	15.26	6.92	6.10	2.77
HT45-21	74	34	1.55	5.89	16.87	7.65	6.74	3.06
HT45-23	81	37	1.70	6.45	18.47	8.38	7.39	3.35
HT45-25	88	40	1.85	7.01	20.08	9.11	8.03	3.64
HT45-27	95	43	2.00	7.57	21.69	9.84	8.67	3.93
HT45-29	102	46	2.15	8.13	23.30	10.57	9.31	4.22
HT45-31	109	49	2.30	8.69	24.91	11.30	9.96	4.52
HT45-33	116	53	2.44	9.25	26.51	12.03	10.60	4.81
HT95-7	44	20	0.96	3.63	10.54	4.78	4.41	2.00
HT95-9	57	26	1.22	4.62	13.40	6.08	5.60	2.54
HT95-11	70	32	1.49	5.66	16.40	7.44	6.86	3.11
HT95-13	83	38	1.76	6.68	19.36	8.78	8.09	3.67
HT95-15	96	44	2.04	7.73	22.42	10.17	9.38	4.25
HT95-17	108	49	2.30	8.72	25.28	11.47	10.57	4.79
HT95-19	121	55	2.48	9.38	27.18	12.33	11.37	5.16
HT95-21	134	61	2.89	10.94	31.70	14.38	13.26	6.01
HT95-23	147	67	3.08	11.67	33.84	15.35	14.15	6.42
HT95-25	160	73	3.39	12.84	37.23	16.89	15.57	7.06
HT95-27	172	78	3.69	13.96	40.48	18.36	16.93	7.68
HT95-29	186	84	3.93	14.89	43.17	19.58	18.05	8.19
HT95-31	198	90	4.22	15.96	46.28	20.99	19.35	8.78
HT95-33	211	96	4.50	17.04	49.41	22.41	20.66	9.37

Unigy II / Deka Fahrenheit HT 2V Non-Interlock Base Anchor Hole Pattern

NO. OF PLATES	3 & 6 CELL MODULES												2 & 4 CELL MODULES			
	45 Ah.				75 Ah.				95 Ah.				95 Ah.			
	X		Y		X		Y		X		Y		X		Y	
	In	mm	In	mm	In	mm	In	mm	In	mm	In	mm	In	mm	In	mm
5	11.72	298	10.64	270	11.72	298	17.74	451	—		—		—		—	
7	16.16	410	10.64	270	16.16	410	17.74	451	16.16	410	20.30	516	9.86	250	20.30	516
9	20.66	525	10.64	270	20.66	525	17.74	451	20.66	525	20.30	516	12.86	327	20.30	516
11	25.16	639	10.64	270	25.16	639	17.74	451	25.16	639	20.30	516	15.86	403	20.30	516
13	29.66	753	10.64	270	29.66	753	17.74	451	29.66	753	20.30	516	18.86	479	20.30	516
15	34.17	868	10.64	270	34.17	868	17.74	451	34.17	868	20.30	516	21.86	555	20.30	516
17	19.07	484	10.64	270	19.07	484	17.74	451	19.07	484	20.30	516	11.8	300	20.30	516
19	21.32	542	10.64	270	21.32	542	17.74	451	21.32	542	20.30	516	13.3	338	20.30	516
21	23.57	599	10.64	270	23.57	599	17.74	451	23.57	599	20.30	516	14.8	376	20.30	516
23	25.82	656	10.64	270	25.82	656	17.74	451	25.82	656	20.30	516	16.3	414	20.30	516
25	28.07	713	10.64	270	28.07	713	17.74	451	28.07	713	20.30	516	17.8	452	20.30	516
27	30.32	770	10.64	270	30.32	770	17.74	451	30.32	770	20.30	516	19.3	490	20.30	516
29	32.57	827	10.64	270	32.57	827	17.74	451	32.57	827	20.30	516	20.8	528	20.30	516
31	34.82	884	10.64	270	34.82	884	17.74	451	34.82	884	20.30	516	22.3	566	20.30	516
33	37.07	942	10.64	270	37.07	942	17.74	451	37.07	942	20.30	516	23.8	605	20.30	516



Unigy II - Standby (Float) Application

Voltage Compensation

°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 ºC

Charge Current Limits

AVR45 Series

Cell Type	Max. Charge Current (A)	Min. Charge Current (A)**
AVR45-5	16.5	4.9
AVR45-7	24.7	7.4
AVR45-9	32.9	9.9
AVR45-11	41.1	12.3
AVR45-13	49.4	14.8
AVR45-15	57.6	17.3
AVR45-17	65.8	19.7
AVR45-19	74.1	22.2
AVR45-21	82.3	24.7
AVR45-23	90.5	27.2
AVR45-25	98.7	29.6
AVR45-27	107	32.1
AVR45-29	115	34.6
AVR45-31	123	37.0
AVR45-33	132	39.5

AVR75 Series

Cell Type	Max. Charge Current (A)	Min. Charge Current (A)**
AVR75-5	27.3	8.2
AVR75-7	41.0	12.3
AVR75-9	54.6	16.4
AVR75-11	68.3	20.5
AVR75-13	81.9	24.6
AVR75-15	95.6	28.7
AVR75-17	109	32.8
AVR75-19	123	36.9
AVR75-21	137	41.0
AVR75-23	150	45.0
AVR75-25	164	49.1
AVR75-27	177	53.2
AVR75-29	191	57.3
AVR75-31	205	61.4
AVR75-33	218	65.5

AVR95 Series

Cell Type	Max. Charge Current (A)	Min. Charge Current (A)**
AVR95-7	51.5	15.4
AVR95-9	68.7	20.6
AVR95-11	85.8	25.7
AVR95-13	103	30.9
AVR95-15	120	36.0
AVR95-17	137	41.2
AVR95-19	154	46.3
AVR95-21	172	51.5
AVR95-23	189	56.6
AVR95-25	206	61.8
AVR95-27	223	66.9
AVR95-29	240	72.1
AVR95-31	257	77.2
AVR95-33	275	82.4

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

Deka Fahrenheit HT 2V - Standby (Float) Application Charge Current Limits

Charge Current Limits

HT45 Series

Cell Type	Max. Charge Current (A)	Min. Charge Current (A)**
HT45-5	14.7	4.4
HT45-7	22.1	6.6
HT45-9	29.4	8.8
HT45-11	36.8	11.0
HT45-13	44.2	13.3
HT45-15	51.5	15.5
HT45-17	58.9	17.7
HT45-19	66.3	19.9
HT45-21	73.6	22.1
HT45-23	81.0	24.3
HT45-25	88.3	26.5
HT45-27	96	28.7
HT45-29	103	30.9
HT45-31	110	37.0
HT45-33	118	39.5

HT95 Series

Cell Type	Max. Charge Current (A)	Min. Charge Current (A)**
HT95-7	46.3	13.9
HT95-9	61.8	18.5
HT95-11	77.2	23.2
HT95-13	93	27.8
HT95-15	108	32.4
HT95-17	124	37.1
HT95-19	139	41.7
HT95-21	154	46.3
HT95-23	170	50.9
HT95-25	185	55.6
HT95-27	201	60.2
HT95-29	216	64.8
HT95-31	232	69.5
HT95-33	247	74.1

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

Unigy II / Deka Fahrenheit HT 2V - Renewable Energy (Cyclic)

Renewable Energy (Cyclic) Charge Parameters

Bulk Charge	Max. Current (Amps)	Reference Below Chart
Absorption (Regulation)Charge	Constant Voltage	2.35 - 2.40 vpc
Float Charge	Constant Voltage	2.24 - 2.26 vpc
Equalize Charger	Constant Voltage	2.40 - 2.43 vpc
Temperature Coefficient	3mV / °C	

Unigy II / Deka Fahrenheit HT 2V - Renewable Energy (Cyclic) Voltage Compensation

°C	Absorption Regulation Charge	Float Charge	Equalize Maintenance	°F
≥35	2.370	2.220	2.400	≥95
34	2.373	2.223	2.403	93.2
33	2.376	2.226	2.406	91.4
32	2.379	2.229	2.409	89.6
31	2.382	2.232	2.412	87.8
30	2.385	2.235	2.415	86.0
29	2.388	2.238	2.418	84.2
28	2.391	2.241	2.421	82.4
27	2.394	2.244	2.424	80.6
26	2.397	2.247	2.427	78.8
25	**2.400**	**2.250**	**2.430**	**77.0**
24	2.403	2.253	2.433	75.2
23	2.406	2.256	2.436	73.4
22	2.409	2.259	2.439	71.6
21	2.412	2.262	2.442	69.8
20	2.415	2.265	2.445	68.0
19	2.418	2.268	2.448	66.2
18	2.421	2.271	2.451	64.4
17	2.424	2.274	2.454	62.6
16	2.427	2.277	2.457	60.8
15	2.430	2.280	2.460	59.0
14	2.433	2.283	2.463	57.2
13	2.436	2.286	2.466	55.4
12	2.439	2.289	2.469	53.6
11	2.442	2.292	2.472	51.8
≤10	2.445	2.295	2.475	≤50

3mV per ºC

Battery Maintenance Report

Company _____ Service Date _____
Address _____ Battery Dwg # _____
Battery Location & I.D. Number _____ Connector Pkg _____
Total No. of Cells _____ Charger Output Voltage _____ Float Current _____ Battery I.D. # _____
Battery Type* _____ Total Battery Voltage _____ *(read at battery terminals)* Ambient Air Temp. _____ 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							
8								38							
9								39							
10								40							
11								41							
12								42							
13								43							
14								44							
15								45							
16								46							
17								47							
18								48							
19								49							
20								50							
21								51							
22								52							
23								53							
24								54							
25								55							
26								56							
27								57							
28								58							
29								59							
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: _____

(Form available as an Excel Spreadsheet. Consult your EPM Representative.)

Notation: This form must be completed and submitted with any product warranty claim.
Readings should be taken at Installation and at least annually thereafter.

Deka Battery Maintenance Report

Company _____ Service Date _____
Address _____ Battery Dwg # _____
Battery Location & I.D. Number _____ Connector Pkg _____
Battery I.D. # _____

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
61								111							
62								112							
63								113							
64								114							
65								115							
66								116							
67								117							
68								118							
69								119							
70								120							
71								121							
72								122							
73								123							
74								124							
75								125							
76								126							
77								127							
78								128							
79								129							
80								130							
81								131							
82								132							
83								133							
84								134							
85								135							
86								136							
87								137							
88								138							
89								139							
90								140							
91								141							
92								142							
93								143							
94								144							
95								145							
96								146							
97								147							
98								148							
99								149							
100								150							
101								151							
102								152							
103								153							
104								154							
105								155							
106								156							
107								157							
108								158							
109								159							
110								160							

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

Battery Maintenance Report

Company _____ Service Date _____
Address _____ Battery Dwg # _____
Battery Location & I.D. Number _____ Connector Pkg _____
Battery I.D. # _____

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
161								201							
162								202							
163								203							
164								204							
165								205							
166								206							
167								207							
168								208							
169								209							
170								210							
171								211							
172								212							
173								213							
174								214							
175								215							
176								216							
177								217							
178								218							
179								219							
180								220							
181								221							
182								222							
183								223							
184								224							
185								225							
186								226							
187								227							
188								228							
189								229							
190								230							
191								231							
192								232							
193								233							
194								234							
195								235							
196								236							
197								237							
198								238							
199								239							
200								240							

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

ACCEPTANCE & PERFORMANCE TESTING

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

1. Make sure all cell connections are clean, tight (i.e. – torqued to specification) and free of corrosion. Proper cell connections shall be verified via ohmic measurements between the connector and cell post.
2. 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 "Voltage Compensation Chart" in Appendix F of this manual.

   To ensure the cells are fully charged within 24 hours; the charger used for this equalizing charge must be sized to begin its charge with a charge current equal to at least the minimum, and not to exceed the maximum charge current for the given cell type (model), as called out in Appendix D of this manual. If multiple strings are to be charged simultaneously, the charge current requirement must be multiplied by the number of strings.

   Within 1 hour of the completion of the equalize charge, measure and record each cell's on-charge voltage and temperature measured at the negative terminal.

   The "Refresh Record Form" in Appendix B can be used to record the requested data.

   If these requirements cannot be met, contact East Penn Reserve Power's Product Support Department 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 requirements.

   NOTE: Cells shall remain on float charge until the discharge test is performed.

   Within 1 hour of the start of the discharge test, measure and record each cell's on-charge cell voltage and ohmic value as well as a representative cell temperature measured at the negative terminal. Per IEEE 1188:2005, a representative minimum of 10% of the cell temperatures are to be averaged to develop the average cell temperature that will be used with the temperature correction factor provided within this document.

   The "Refresh Record Form" in Appendix B can be used to record the requested data.

   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 charge, the desired acceptance or performance test can be performed per the following guidelines in conjunction with IEEE-1188.

1. IEEE 1188-2005 states "The discharge rate(s) and test length and their duration(s) should correspond as closely as is practical to the battery string duty cycle." Prior to discharging the battery string, the desired discharge rate should be within East Penn published ratings, end voltage & temperature. Anything outside of these values shall be reviewed by East Penn Reserve Power's Product Support Department.
2. 2. It is important to ensure all connectors and cables are sized correctly to support the discharge rating. Improper connectors and cable sizing can cause excessive temperature to rise, and excessive voltage drop. This can significantly impact expected runtimes and battery string life expectancy. Record individual cell voltages during the discharge. Be sure to record the time at which each cell drops below the design's average end voltage if this occurs during the test.
3. If a DC load bank is used, be sure to disconnect the battery string from the UPS charger/load circuit. If an AC load bank is used, be sure to connect the load bank to the UPS system prior to discharge. Be sure to calibrate the load bank to the desired discharge amp or watt setting while the UPS is operating from its' power supply.
4. During the discharge, if an individual cell is approaching reversal of its polarity (i.e. – 0 volts), but the battery string terminal voltage has not reached its test limit (i.e. – 1.67 vpc), the test should be continued with the bad cell "jumpered out" where feasible. **Upon doing this, a new end voltage should be calculated based on the remaining cells.**
5. For discharges 1 hour or greater, capacity should be determined by the time adjustment method defined by IEEE-1188 according to the following formula:

   % Capacity 77°F (25°C) = [Ta x Kt x 100] /Ts

   Where:
   Ta = Actual test time to the specified end voltage
   Ts = Rated time to the specified end voltage
   Kt = Temperature correction factor (Ref. Table 1)

   Discharge tests designed for 1 hour with an average unit temperature of less than 77°F (25°C) shall follow the procedure for discharges of less than 1 hour.

   For discharges less than 1 hour, capacity should be determined by the rate adjustment method defined by IEEE-1188 according to the following formula

   % Capacity 77°F (25°C) = [Xa x Kc x 100] / Xt

   Where:
   Xa = Actual rate used during discharge test
   Xt = Published rate for actual time of discharge test to specified terminal or cell/unit voltage
   Kc = Temperature correction factor (Ref. Table 2).
6. Upon completion of the acceptance or performance test, the battery system should be recharged at the normal float voltage of 2.25 volts per cell. Temperature compensation charging parameters shall be applied as detailed in "Voltage Compensation Chart" in Appendix F.

K_t Factor (Discharges ≥ 1 hr.)

Temperature		K_t Factor
°C	°F	
35.0	95	0.962
34.4	94	0.963
33.9	93	0.965
33.3	92	0.967
32.8	91	0.969
32.2	90	0.971
31.7	89	0.973
31.1	88	0.975
30.6	87	0.977
30.0	86	0.978
29.4	85	0.980
28.9	84	0.983
29.3	83	0.986
27.8	82	0.989
27.2	81	0.992
26.7	80	0.995
26.1	79	0.997
25.6	78	0.998
25.0	77	1.000
24.4	76	1.005
23.9	75	1.010
23.3	74	1.013
22.8	73	1.016

Temperature		K_t Factor
°C	°F	
22.2	72	1.019
21.7	71	1.022
21.1	70	1.026
20.6	69	1.033
20.0	68	1.034
19.4	67	1.038
18.9	66	1.043
18.3	65	1.047
17.8	64	1.052
17.2	63	1.056
16.7	62	1.060
16.1	61	1.065
15.6	60	1.070
15.0	59	1.073
14.4	58	1.026
13.9	57	1.080
13.3	56	1.083
12.8	55	1.087
12.2	54	1.094
11.7	53	1.101
11.1	52	1.109
10.6	51	1.116
10.0	50	1.124

K_C Factor (Discharges ≤ 1 hr.)

Temperature		K_C Factor
°C	°F	
35.0	95	0.926
34.4	94	0.929
33.9	93	0.933
33.3	92	0.936
32.8	91	0.940
32.2	90	0.943
31.7	89	0.947
31.1	88	0.951
30.6	87	0.954
30.0	86	0.958
29.4	85	0.962
28.9	84	0.966
29.3	83	0.971
27.8	82	0.976
27.2	81	0.980
26.7	80	0.985
26.1	79	0.990
25.6	78	0.995
25.0	77	1.000
24.4	76	1.005
23.9	75	1.010
23.3	74	1.018
22.8	73	1.027

Temperature		K_C Factor
°C	°F	
22.2	72	1.035
21.7	71	1.044
21.1	70	1.053
20.6	69	1.062
20.0	68	1.071
19.4	67	1.080
18.9	66	1.089
18.3	65	1.099
17.8	64	1.109
17.2	63	1.119
16.7	62	1.129
16.1	61	1.139
15.6	60	1.149
15.0	59	1.163
14.4	58	1.176
13.9	57	1.190
13.3	56	1.205
12.8	55	1.220
12.2	54	1.232
11.7	53	1.244
11.1	52	1.256
10.6	51	1.269
10.0	50	1.282

APPENDIX K

EU DIRECTIVE 2023 / 1542 ARTICLE 10

To comply with Article 10 of EU Directive 2023 / 1542 the below information is required for any battery that has a rating ≥ 2 kWh.

Unigy II

Part A

Battery Type			AVR75-29	AVR75-31	AVR75-33	AVR95-23	AVR95-25	AVR95-27	AVR95-29	AVR95-31	AVR95-33	AVR125-33
Rated Capacity	8 hr to 1.75 Vpc	Ah	1064	1140	1216	1045	1140	1235	1330	1425	1520	2000
		W/C	261	279	298	260	284	307	331	354	378	494
		kWh	2.1	2.2	2.4	2.1	2.3	2.5	2.6	2.8	3.0	4.0
Capacity Fade		%	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1
Power Fade		%	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1
Internal Resistance		Ohms	0.000233	0.000232	0.000222	0.000269	0.000250	0.000243	0.000223	0.000215	0.000207	0.000177
Internal Resistance Increase		%	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1
Energy Round Trip Efficiency		%	80	80	80	80	80	80	80	80	80	80
Energy Round Trip Efficiency Fade		%	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1
Design Life		(yrs)	20	20	20	20	20	20	20	20	20	20

Part B

Discharge Rate			C8	C8	C8	C8	C8	C8	C8	C8	C8	C8
Charge Rate			C5	C5	C5	C5	C5	C5	C5	C5	C5	C5
Ratio W vs Wh			8	8	8	8	8	8	8	8	8	8
DoD		%	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1
Power Capacity (kWh)		20%	0.42	0.45	0.48	0.42	0.45	0.49	0.53	0.57	0.60	0.79
		80%	1.7	1.8	1.9	1.7	1.8	2.0	2.1	2.3	2.4	3.2

N/A[1] - required information does not exist for referenced batteries.

Deka Fahrenheit HT 2V

Part A

Battery Type			HT95-25	HT95-27	HT95-29	HT95-31	HT95-33	HT125-33
Rated Capacity	8 hr to 1.75 Vpc	Ah	1020	1105	1190	1275	1360	1789
		W/C	254	275	296	317	338	442
		kWh	2.0	2.2	2.4	2.5	2.7	3.5
Capacity Fade		%	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1
Power Fade		%	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1
Internal Resistance		Ohms	0.000250	0.000243	0.000223	0.000215	0.000207	0.000177
Internal Resistance Increase		%	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1
Energy Round Trip Efficiency		%	80	80	80	80	80	80
Energy Round Trip Efficiency Fade		%	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1
Design Life		(yrs)	22	22	22	22	22	22

Part B

Discharge Rate			C8	C8	C8	C8	C8	C8
Charge Rate			C5	C5	C5	C5	C5	C5
Ratio W vs Wh			8	8	8	8	8	8
DoD		%	N/A1	N/A1	N/A1	N/A1	N/A1	N/A1
Power Capacity (kWh)		20%	0.41	0.44	0.47	0.51	0.54	0.71
		80%	1.6	1.8	1.9	2.0	2.2	2.8

N/A[1] - required information does not exist for referenced batteries.

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