



INSTALLATION AND OPERATION MANUAL

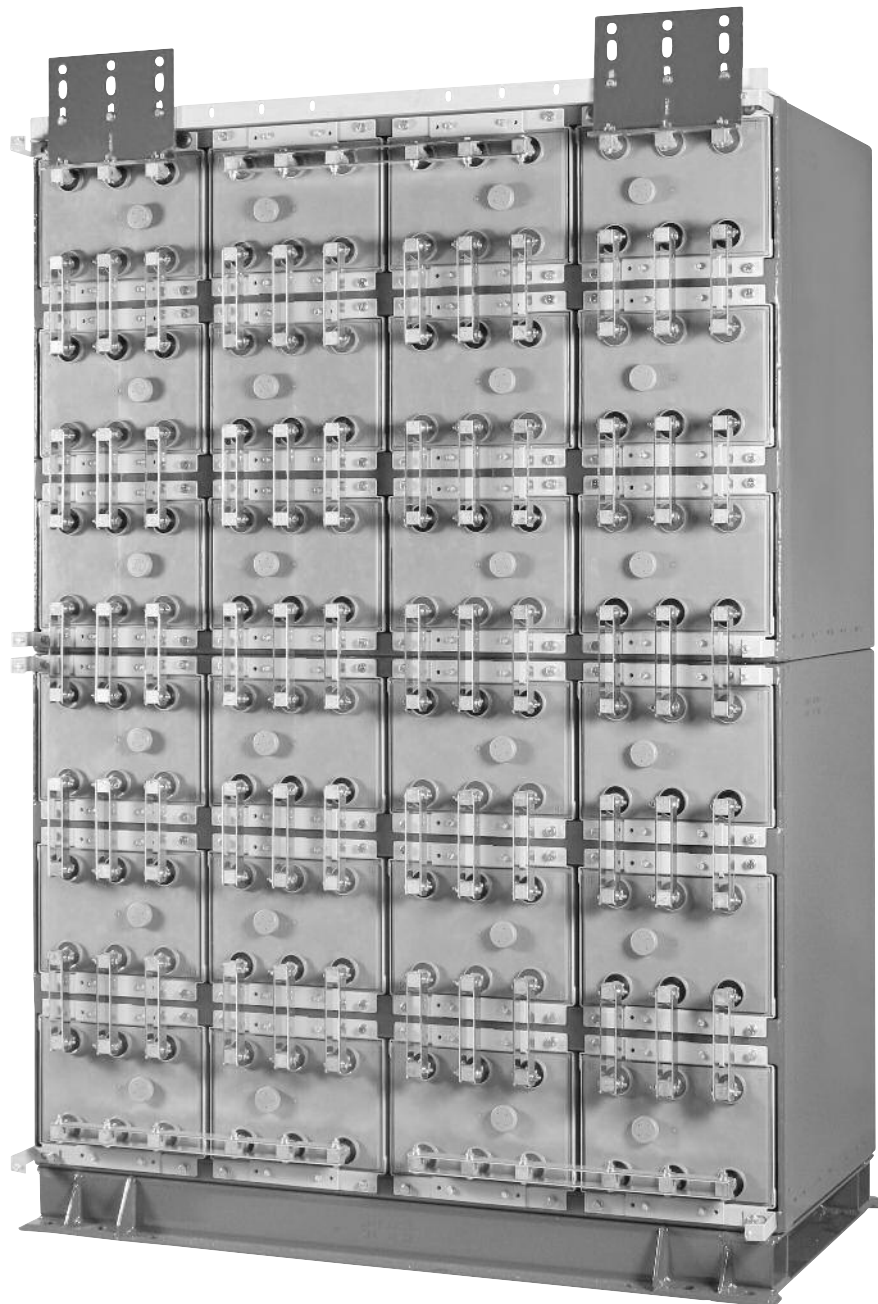


TABLE OF CONTENTS

SAFETY PRECAUTIONS

Protective Equipment	3
Procedures	3

RECEIVING & STORAGE

Receiving Inspection	3
Unpacking	3
Storage	4

INSTALLATION

General	4
Grounding	4
Electric Code for Maintenance Access	4
Hardware Torque Requirements	4

System Installation

System Shipment	5
Module Installation	5
Cell Installation	7

Electrical Connection

Connector Assembly	8
--------------------------	---

Terminal Assembly

Top Termination	
AVR3500	10
AVR4000	12

FINAL ASSEMBLY

Check Procedure	14
-----------------------	----

SAFETY SHIELD ASSEMBLY

Corner Safety Shield Assembly	14
Stack-Stack Safety Shield Assembly	14
Front Safety Shield Assembly	15

SYSTEM OPERATIONS

Charge Voltage	16
Charge Current	16
Temperature Compensation	16
Cell Voltage	16
Equalizing	16
Battery Operation	16
Rectifier Ripple Voltage	16

RECORD KEEPING

.....	16
-------	----

MAINTENANCE

Annual Inspection	17
Battery Cleaning	17
Capacity Testing	17
Cell/Sleeve Removal Procedure	17
Acid Volumes & Weights	17

APPENDIX A


Base Anchor Hole Pattern	18
--------------------------------	----

APPENDIX B

Voltage Compensation Chart	19
Charge Current Limits	19

APPENDIX C

Battery Maintenance Report	20
----------------------------------	----



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.



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)

4-1034

**BATTERIES
AND OTHER RELATED PARTS
CONTAIN LEAD**



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

Form No. 1214 Rev. 9/00 About the printed in verbatim case ADVISE.

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).

SAFETY PRECAUTIONS

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

WARNING: Risk of fire, explosion or burns. Do not disassemble, heat above 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.

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

1. Cells should be stored indoors in a clean, level, dry, cool location. Recommended storage temperature is 0°F to 90°F (-18°C to 32°C).
2. Stored lead-acid cells self discharge and must be given a boost charge to prevent permanent performance degradation.

0°F to 77°F (-18°C to 25°C) storage:

Batteries should be recharged six months from date of manufacture.

>77°F (25°C) storage:

Use the chart below for recharge intervals. Voltage readings should be taken on a monthly basis. Cells that reach 2.10V per cell or less should be recharged regardless of scheduled interval. Record dates and conditions for all charges during storage.

3. If a boost charge is required; the recommended charge is 24 hours at a constant voltage equal to 2.40V per cell.
4. Do not store beyond 12 months.
5. Store in horizontal position only.

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.

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.*

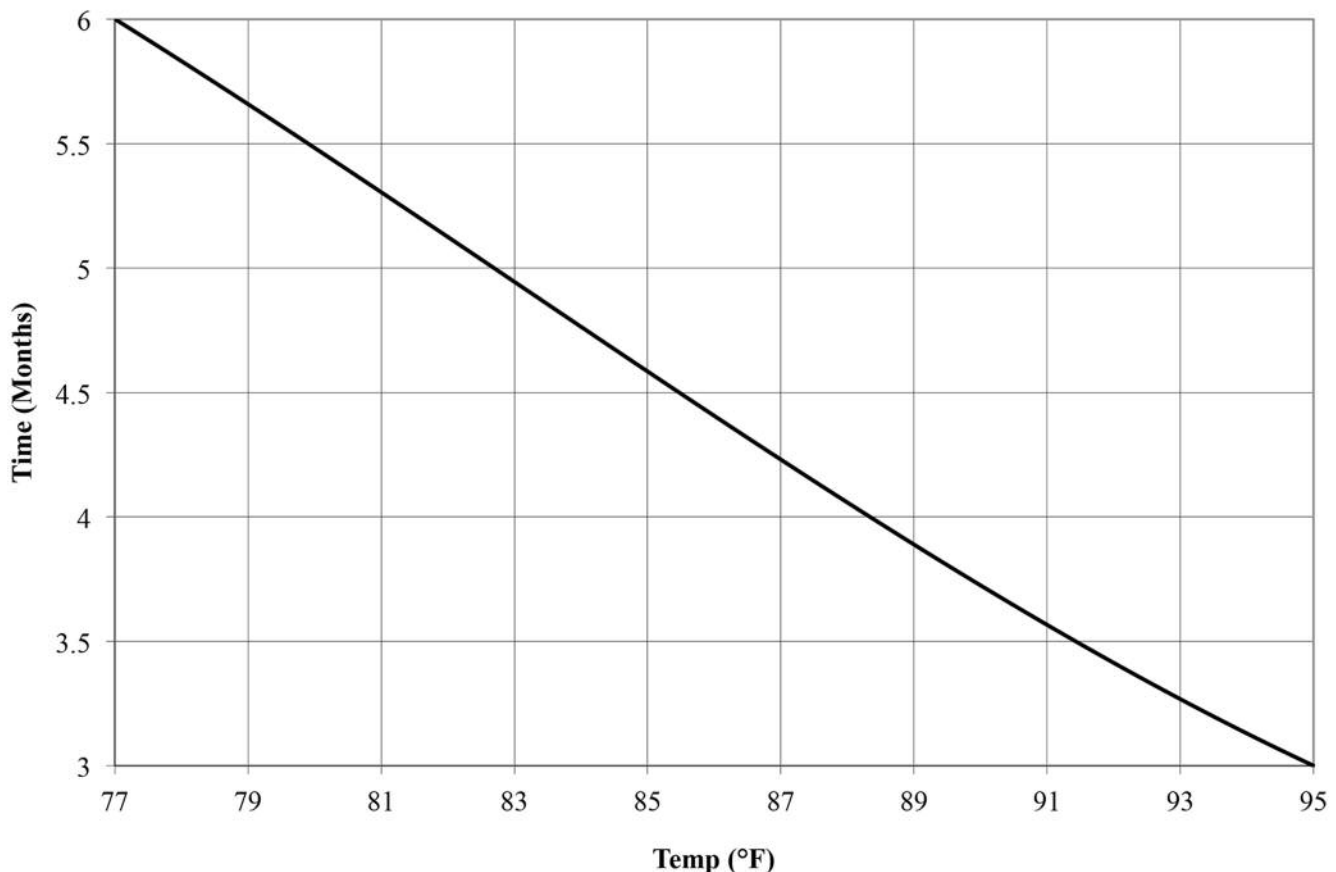
***Note: Battery string and/or stack to stack grounding, if required, is the installer's responsibility.**

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/Retorque Requirements

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



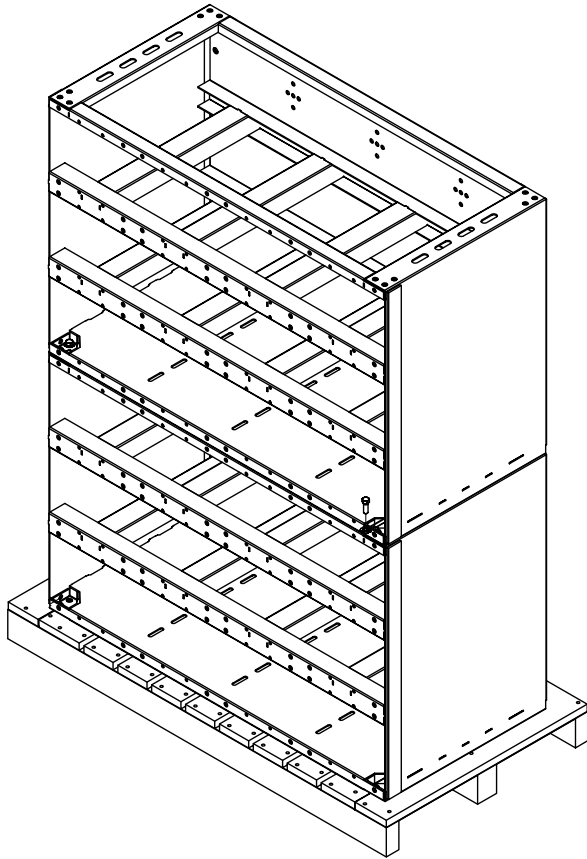
System Installation

System Shipment

Battery System will be received in two separate shipments.

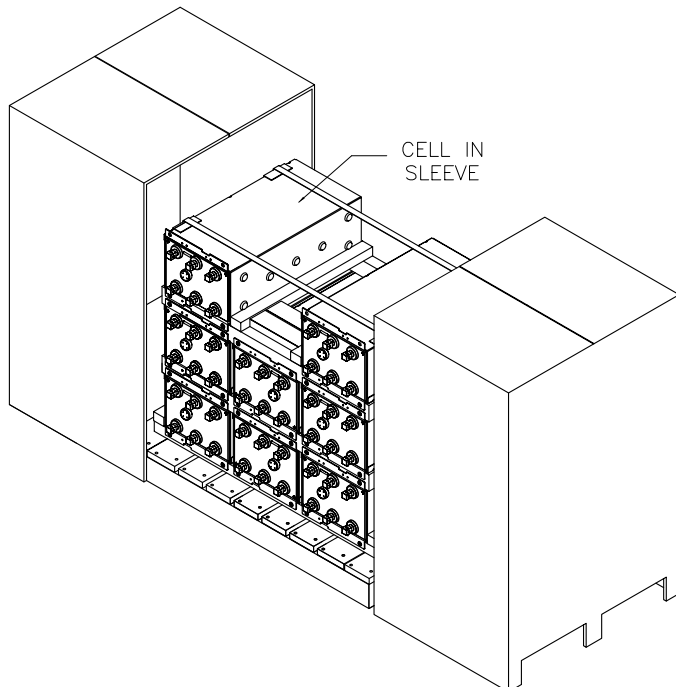
First shipment: modules and base.

NOTE: Bases shipped on separate pallet.



Second shipment: cells in sleeves and system hardware.

NOTE: System hardware on separate pallet. System hardware consists of battery connectors & hardware, module assembly hardware and safety shields.



Module Installation

Assemble system per the following details.

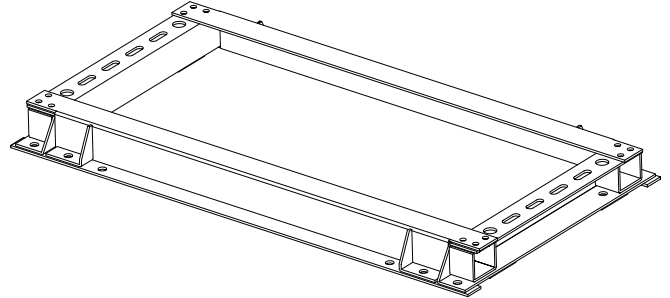
All parts should be verified against packaging list. Report any missing parts.

Base Shimming

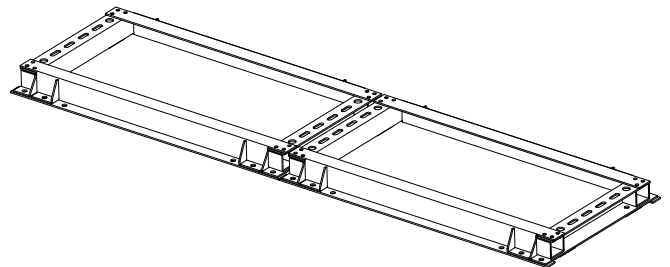
1. Prior to installation, the floor on which the battery string is to be installed should be level and capable of supporting the weight of the battery string. A 1° taper on a floor can result in a ½" variation at the top of one six-high stack of modules. This can be compounded by the tolerance of each module.
2. 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.
3. 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.
4. 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.

Base Installation

1. Position bases, consult included layout diagram for required configuration.

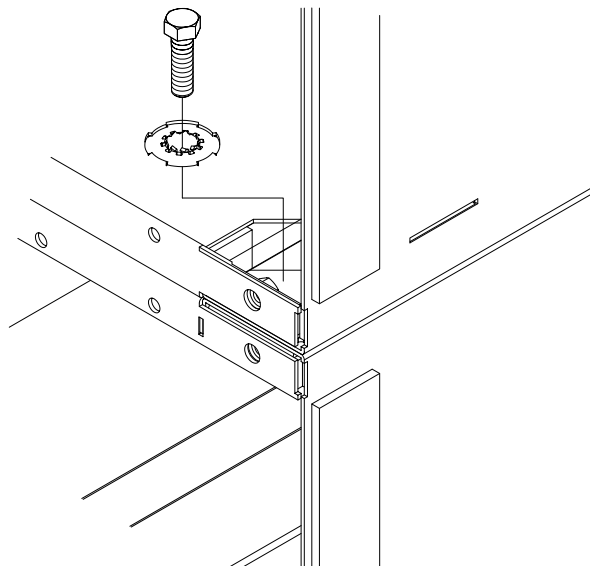
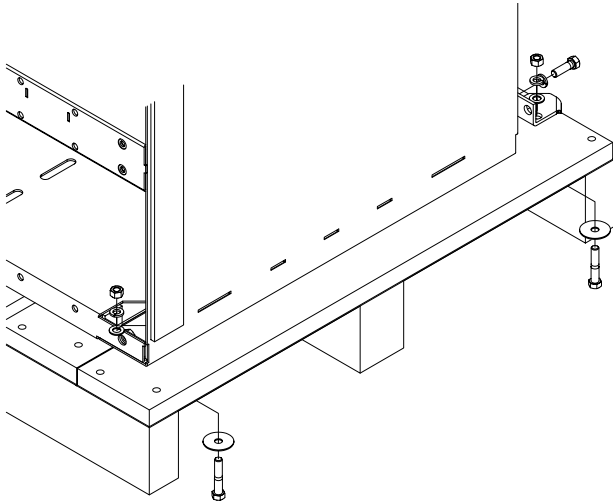


2. Bases require no spacing between each other in multiple stack battery systems.



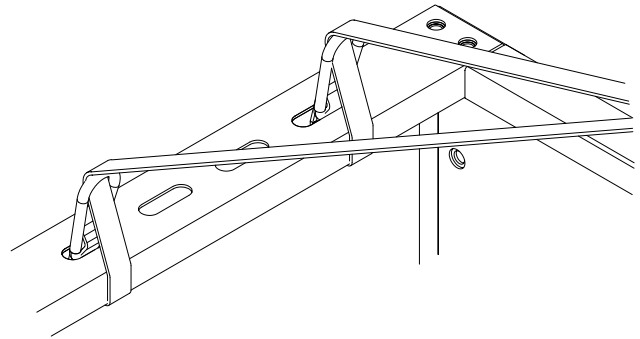
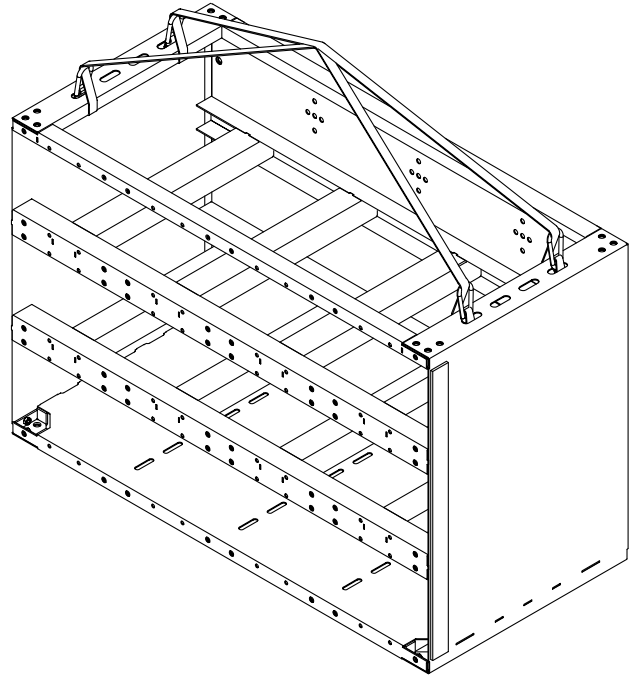
3. Anchor holes can be marked and drilled with bases in place. **Consult Appendix A for anchor hole pattern.** All anchor holes in base (16 per base) are required to be used to meet seismic requirements. **Consult local building codes for anchor bolt requirements. Anchor bolts not included due to site specific requirements.**

4. 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 should be discarded.

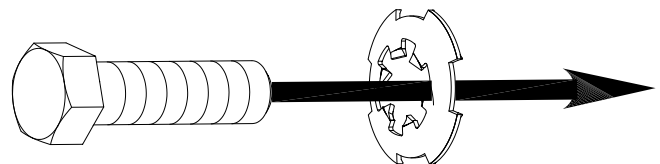


CAUTION: Never lift more than one module at a time with the supplied lifting slings.

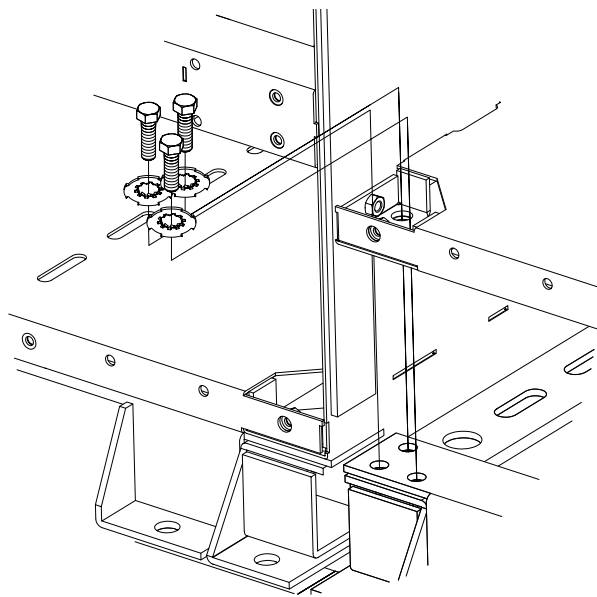
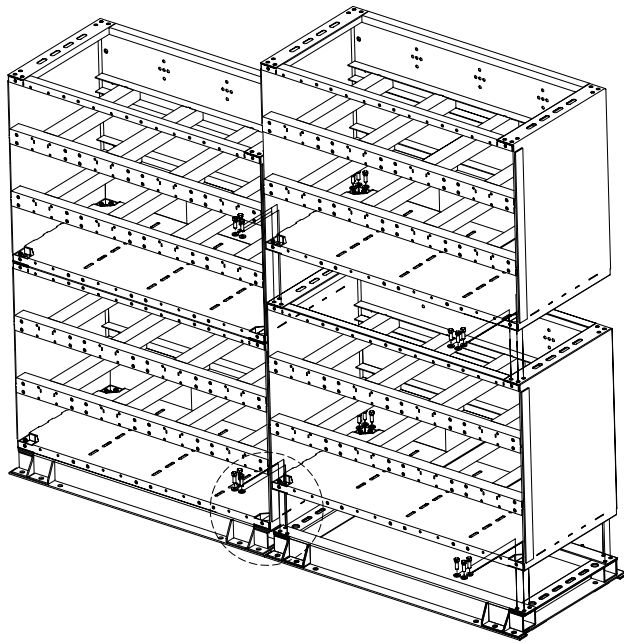
5. Install modules onto bases using supplied lifting straps. Consult below diagram for proper sling attachment and lifting. Consult included layout diagram for module position.



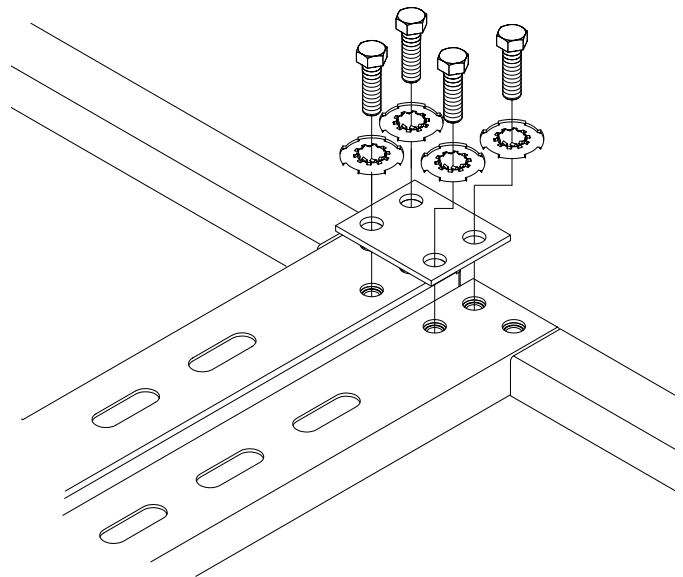
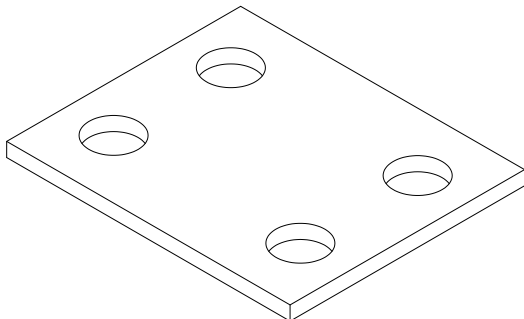
6. Module connecting hardware is furnished with a dragon tooth washer in place of a lock washer and flat washer. The dragon tooth washer is used to enhance the electrical conductivity of the grounding system within a stack of modules. To ensure the dragon tooth washer is installed correctly; the curve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



7. Install modules onto bases, limit two modules per base. Bolt modules to bases and to each other using supplied hardware (1/2-13 x 1.50") and ones removed from modules during dismantling. Twelve bolts per module. Stack to stack level shall be verified. Torque bolts to 100 ft-lb (135.5 Nm).



8. Joining plates are to be placed at the rear of the modules at the top of the stacks. One joining plate is to be used at the junction of two modules. Use 1/2-13 x 1.25" hardware to install the plates. Hardware should be torqued after module installation is complete. Torque bolts to 100 ft-lb (135.5 Nm).



9. 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. 2) for proper torque values.

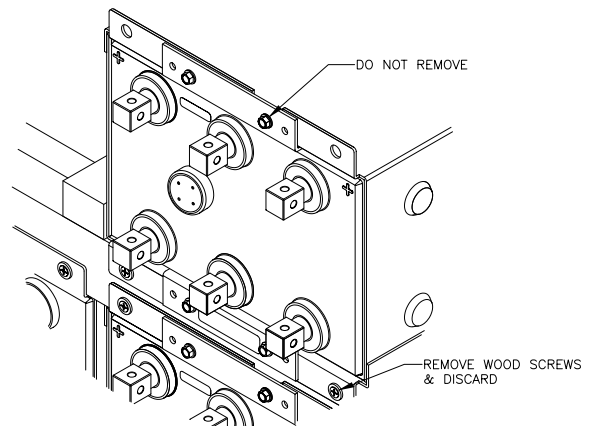
Cell Installation

Assemble system per the following:

All parts should be verified against packaging list.

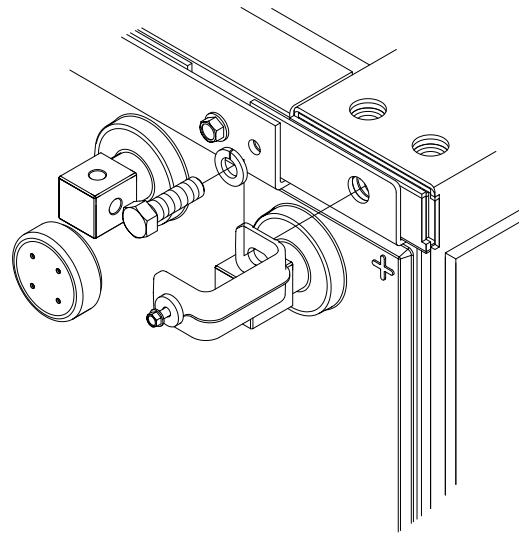
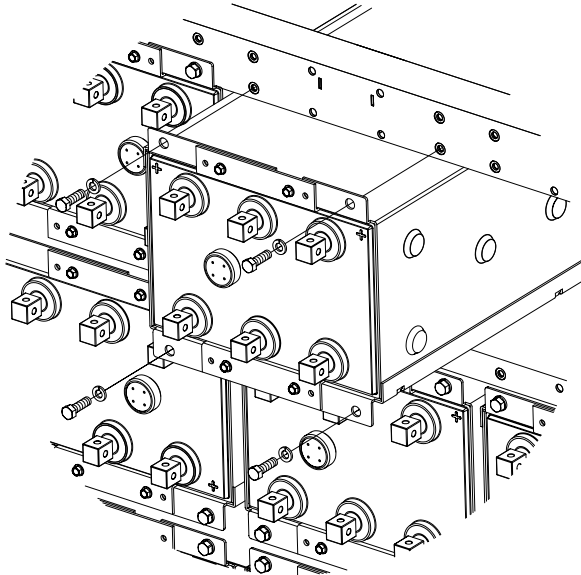
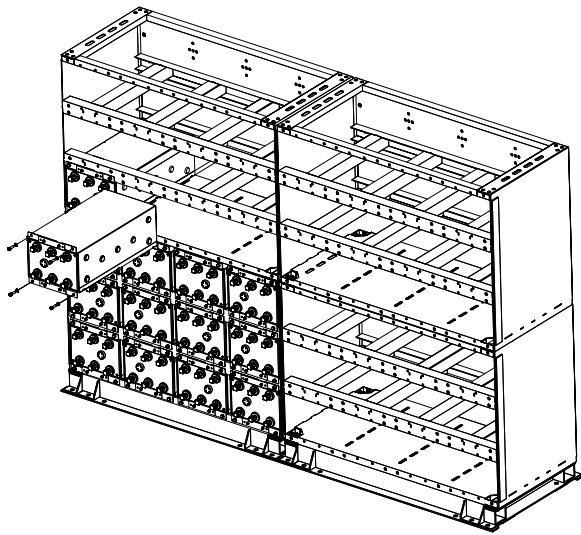
Report any missing parts. All hardware included on separate pallet marked "Accessories".

1. Remove cells from pallet.
 - a. Remove metal strapping. Caution should be taken to avoid metal strapping coming in contact with battery posts.
 - b. Remove wood screws from wood spacer. Cell retainer bolts shall not be removed.



- c. Install cells into modules. Consult layout drawing for cell location and polarity. Attach cell to module using (4) 3/8-16 x 1.25" hardware*. Torque bolts to 25 ft-lb (33.8 Nm).

***Shield brackets to be installed prior to bolt assembly per page 8, Section 10**



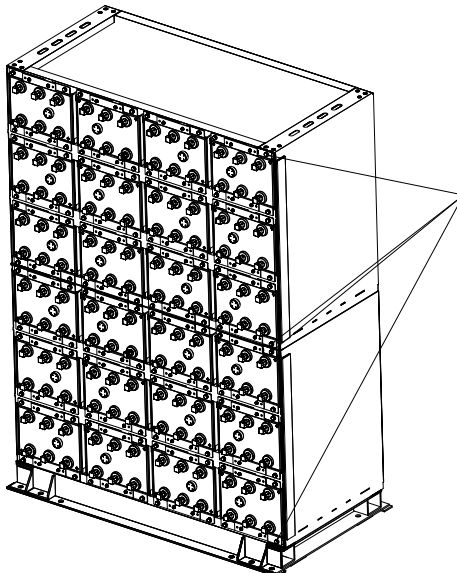
ELECTRICAL CONNECTION

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 package has been supplied.

Connector Kit	
Kit	WPC
4CU / 8CU	≤ 4100
6CU / 12CU	> 4100

10. Safety Shield Brackets are to be installed at the outside corners of each module (4 per module). Consult below detail for locations. Use 3/8-16 x 1.25" hardware to install brackets. Torque bolts to 25 ft-lb (33.8 Nm). **Care should be taken when installing cells that lifting device does not damage brackets.**



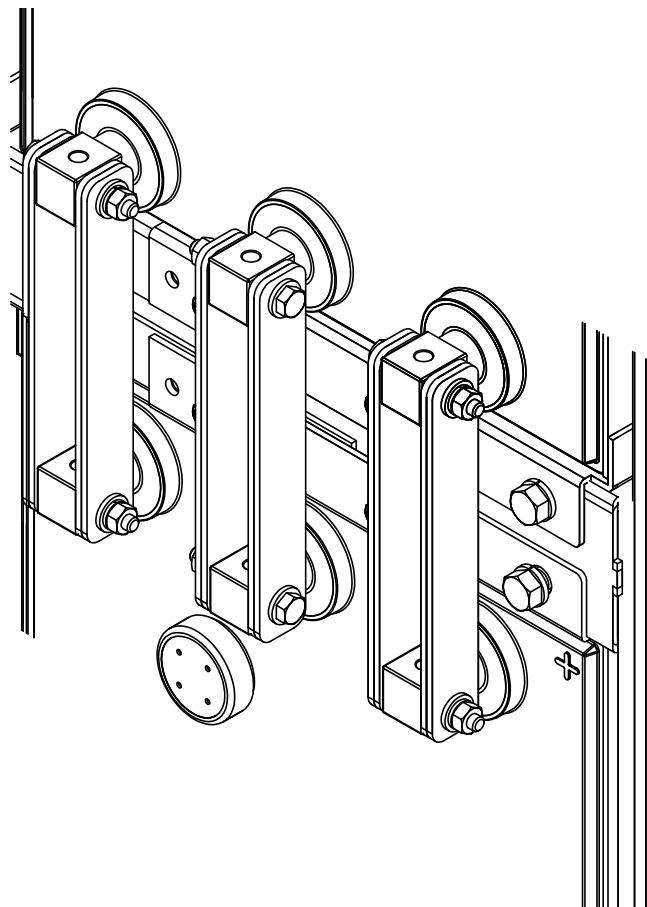
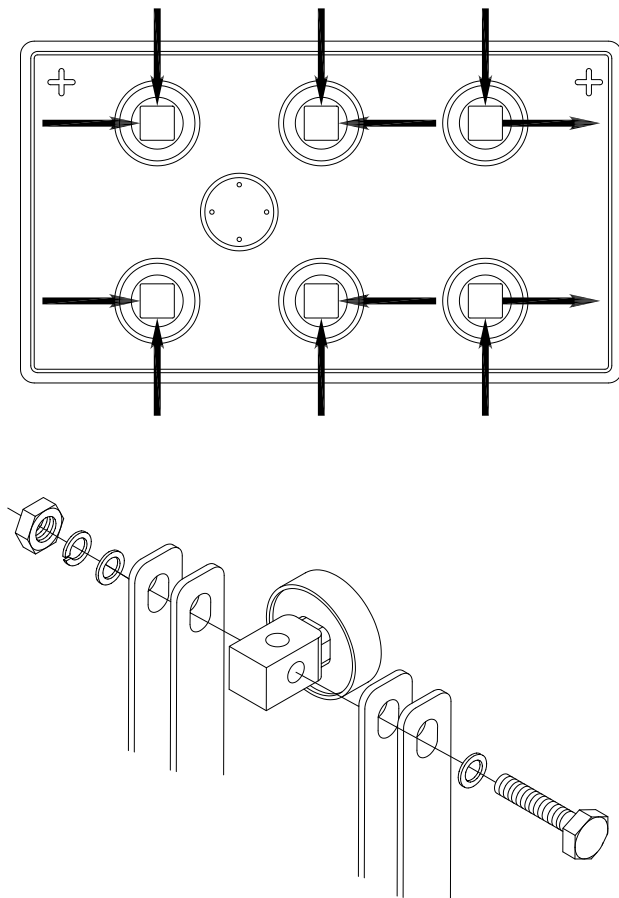
SHIELD BRACKET
MOUNTING
LOCATION
4 PER MODULE

3. Bolt Assembly Packages are dependent on battery type (AVR3500 or AVR4000). The below charts detail bolt lengths and part numbers for each battery type.

Bolt Assembly Package		
Connector Package	Bolt Assembly	Bolt Assembly Part Number
4CU	1/4-20 x 1.75"	JMP1435
6CU	1/4-20 x 2.00"	JMP1409
8CU	1/4-20 x 2.25"	JMP1451
12CU	1/4-20 x 2.75"	JMP1453

Bolt Assembly Package		
Connector Package	Bolt Assembly	Bolt Assembly Part Number
4CU	1/4-20 x 2.00"	JMP1409
6CU	1/4-20 x 2.25"	JMP1451
8CU	1/4-20 x 2.50"	JMP1450
12CU	1/4-20 x 3.00"	JMP1456

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



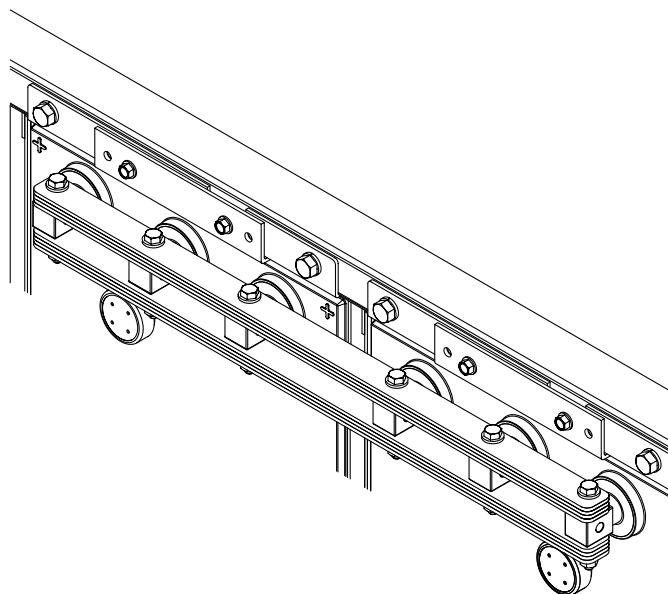
VERTICAL CONNECTION

5. The vertical connections will require a different quantity of connectors than the horizontal connections. Consult Accessory Kit description to confirm correct connector kit and review the "Connector Package Detail" drawing included with the system layout drawing to ensure proper connection quantities.

A "4CU / 8CU" connector kit will require 4 connectors per vertical connection (2 per side) and 8 connectors per horizontal connection (4 per side).

A "6CU / 12CU" connector kit will require 6 connectors per vertical connection (3 per side) and 12 connectors per horizontal connection (6 per side).

The proceeding example represents a "4CU / 8CU" Connector Kit.



HORIZONTAL CONNECTION

TERMINAL ASSEMBLY

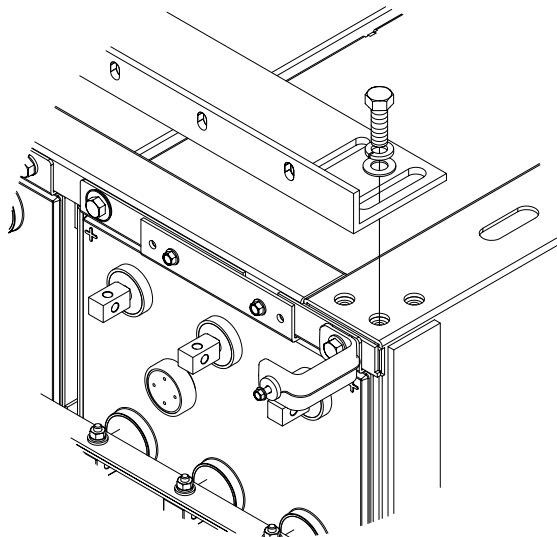
Top Termination

Top termination assembly procedure is dependent on the battery type being installed.

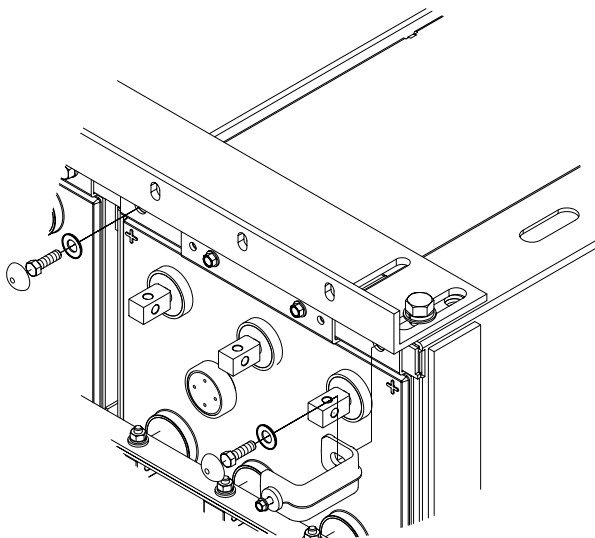
AVR3500 Top Termination

Consult layout diagram for termination location.

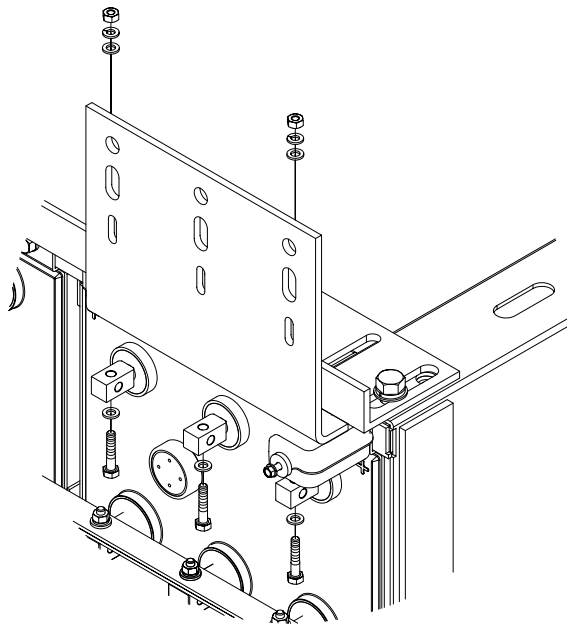
1. Install terminal plate bracket to the top of the module. Use 1/2-13 x 1.50" hardware. Install loosely for future alignment.



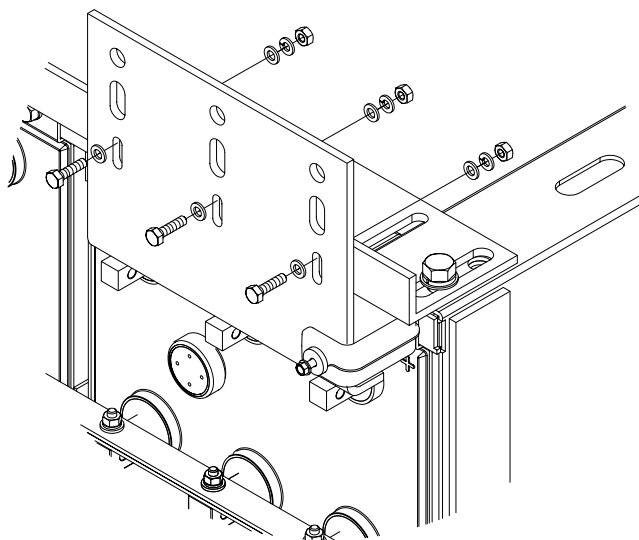
2. Remove cell sleeve bolts directly behind location of terminal plate.
3. Replace flat washer with cap washer. Re-install 3/8-16 x 1.25" into cell sleeve with safety shield bracket (if required). Torque hardware at 25ft-lb (33.8Nm). Install rubber caps over bolts.



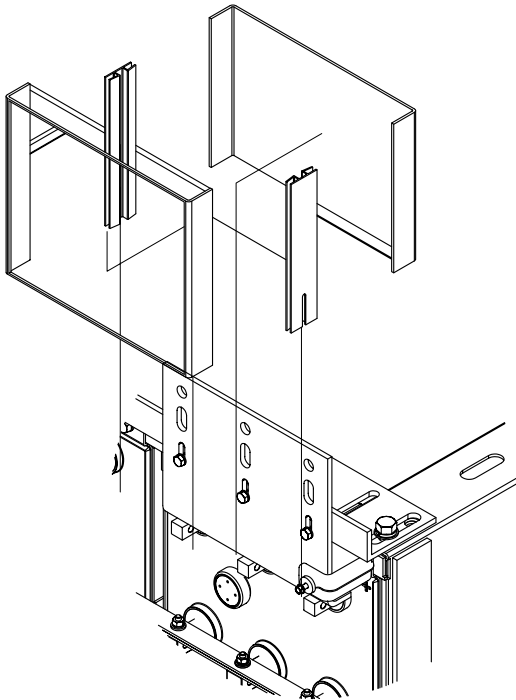
4. Install terminal plate to battery posts using 1/4-20 x 1.50" hardware. **Note direction of terminal plate.**



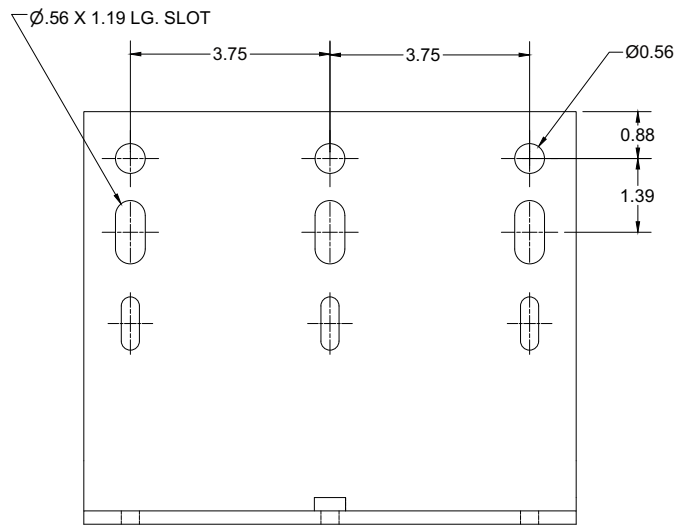
5. Attach terminal plate to terminal plate bracket. Terminal Plate Bracket may have to be moved in order to be flush with the terminal plate.



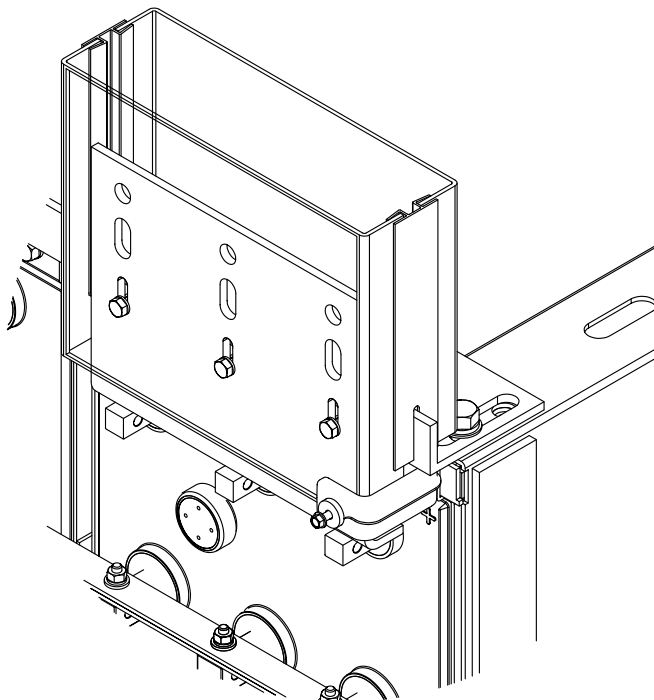
6. Torque 1/2-13 hardware at 100 ft-lb (135.5 Nm) and 1/4-20 hardware at 125 in-lb (14.1 Nm).
7. Assemble the four parts of the top terminal safety shield as detailed below.



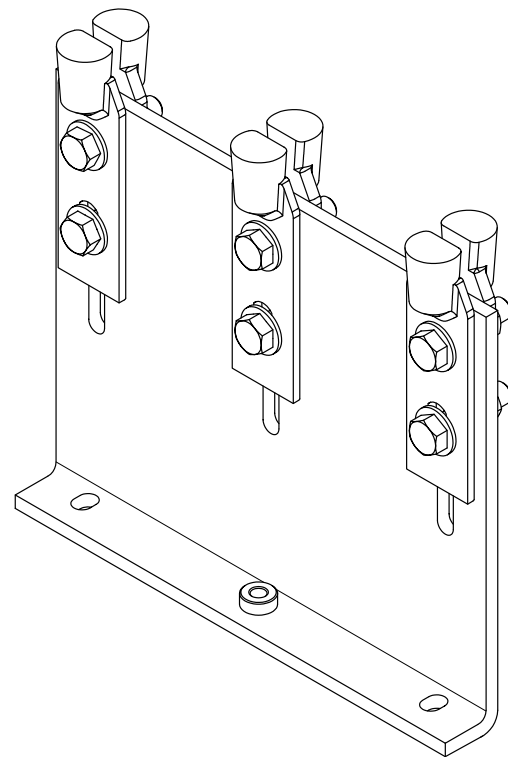
8. Top terminal plate designed to use up to 0.50" dia. bolt and a maximum 1.75" centers, 2 hole lug. Lug hardware not included.



9. Lugs can be attached to both sides of top terminal plate.



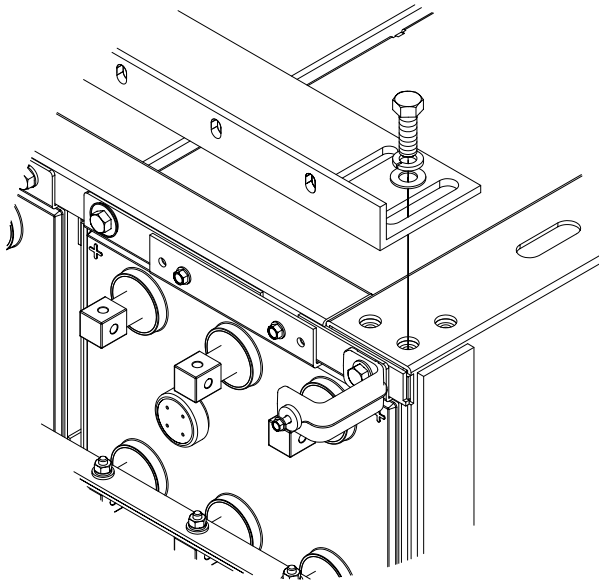
COMPLETED ASSEMBLY



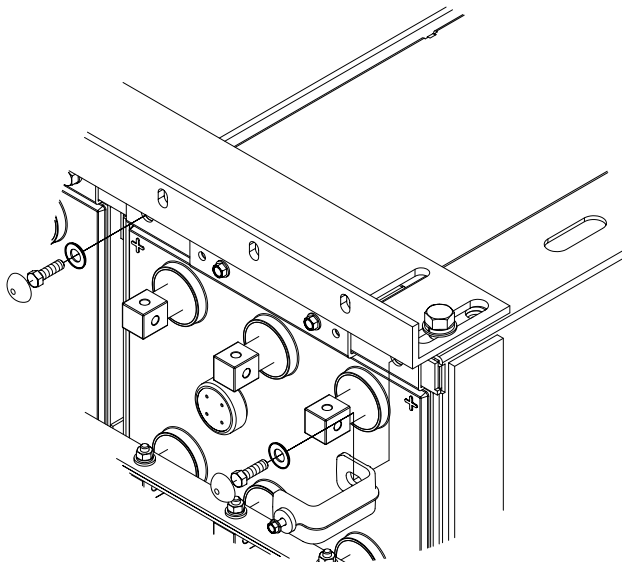
AVR4000 Top Termination

Consult layout diagram for termination location.

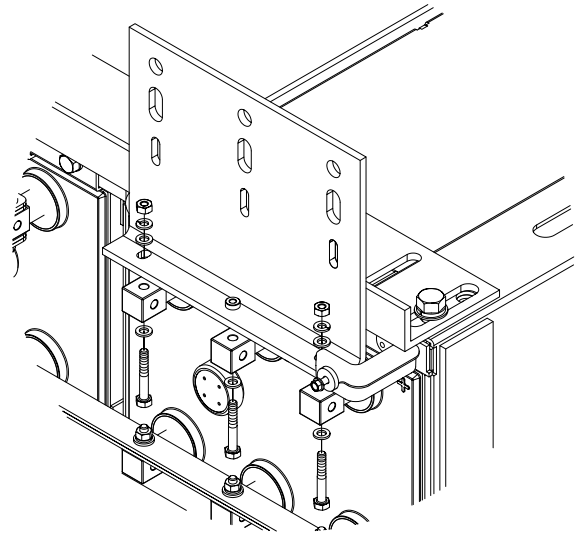
1. Install terminal plate bracket to the top of the module. Use 1/2-13 x 1.50" hardware. Install loosely for future alignment.



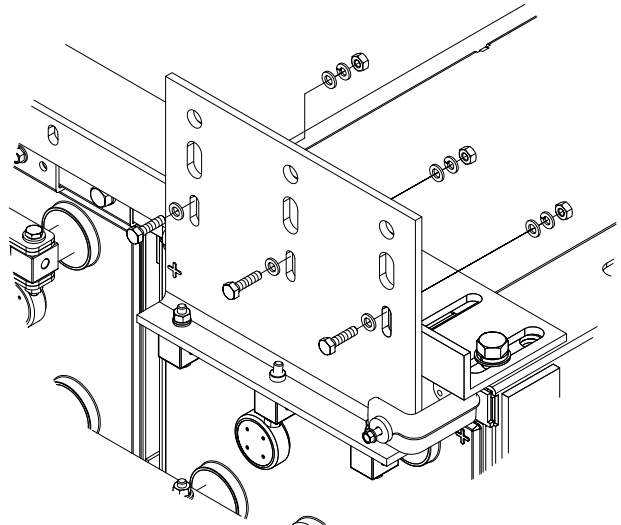
2. Remove cell sleeve bolts directly behind location of terminal plate.
3. Replace flat washer with cap washer. Re-install 3/8-16 x 1.25" into cell sleeve with safety shield bracket (if required). Torque hardware at 25 ft-lb (33.8Nm). Install rubber caps over bolts.



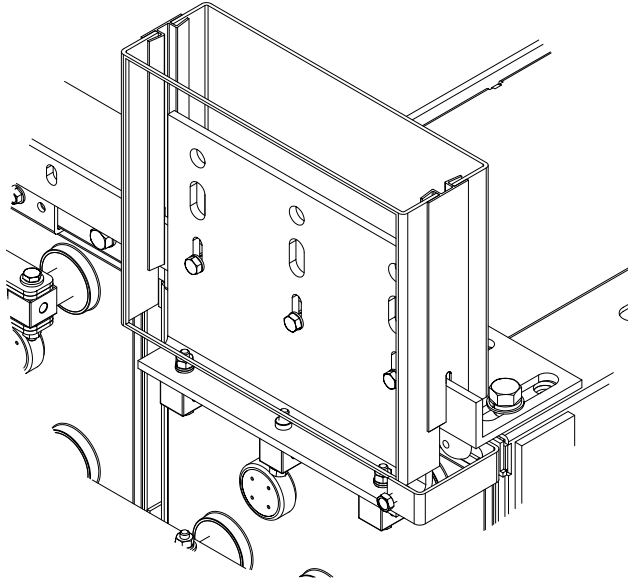
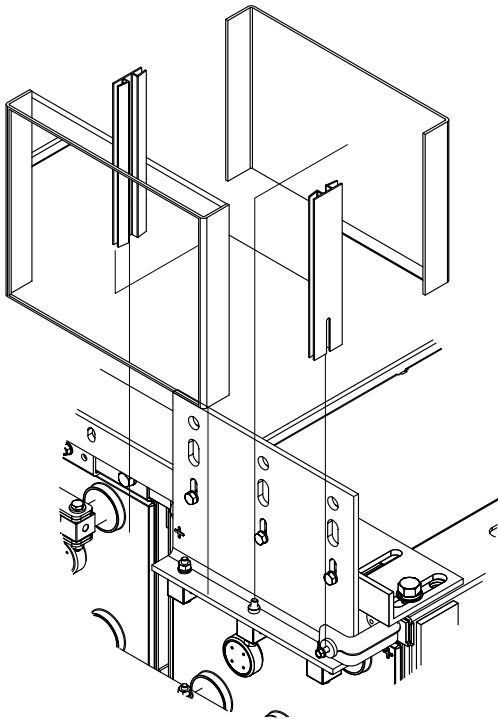
4. Install terminal plate to battery posts using 1/4-20 x 1.75" hardware. **Note direction of terminal plate.**



5. Attach terminal plate to terminal plate bracket. Terminal Plate Bracket may have to be moved in order to be flush with the terminal plate.

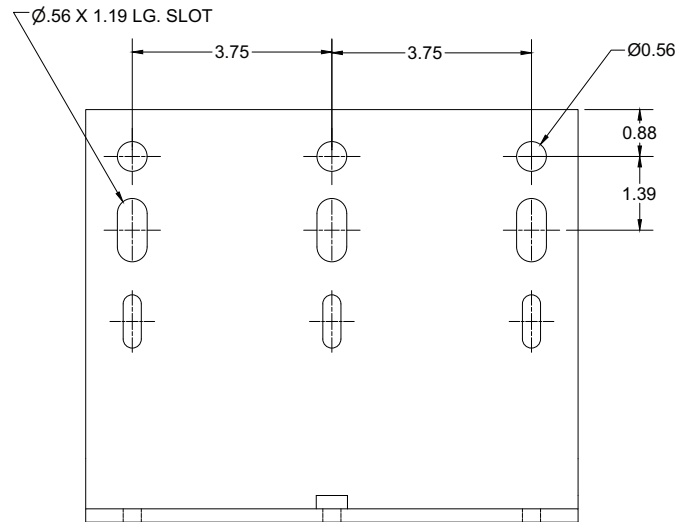


6. Torque 1/2-13 hardware at 100 ft-lb (135.5 Nm) and 1/4 20 hardware at 125 in-lb (14.1 Nm).
7. Assemble the four parts of the top terminal safety shield as detailed below.

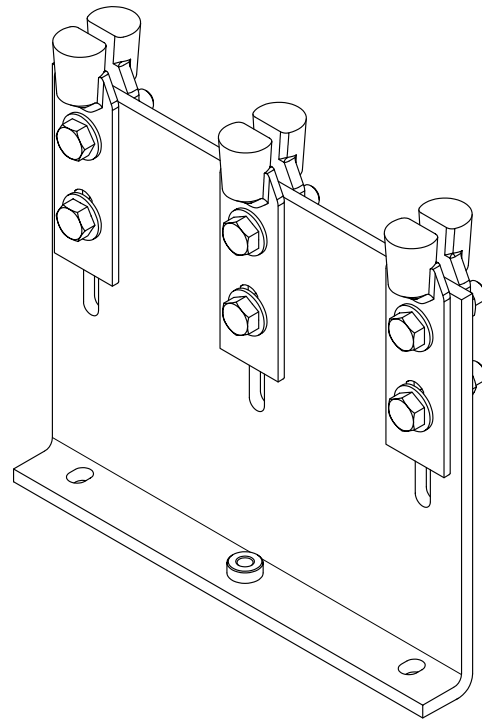


COMPLETED ASSEMBLY

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



9. Lugs can be attached to both sides of top terminal plate.



FINAL ASSEMBLY

CHECK PROCEDURE

1. For future identification of all cells, number individual cells in sequence, beginning with number one (1) at the positive end of the battery. The last cell of the battery string is located at the negative output terminal.
2. Read and record the voltages of the 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 measurement is less, recheck the connections for proper polarity. Verify that all cell and battery string 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 recording forms in Battery Maintenance Report 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 battery terminals. Therefore, the shortest electrical connection between the battery system and the operating equipment results in maximum total system performance.

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

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

SAFETY SHIELD ASSEMBLY

Safety Shields are provide to insulate battery room attendants from electrical shock. Proper installation is critical.

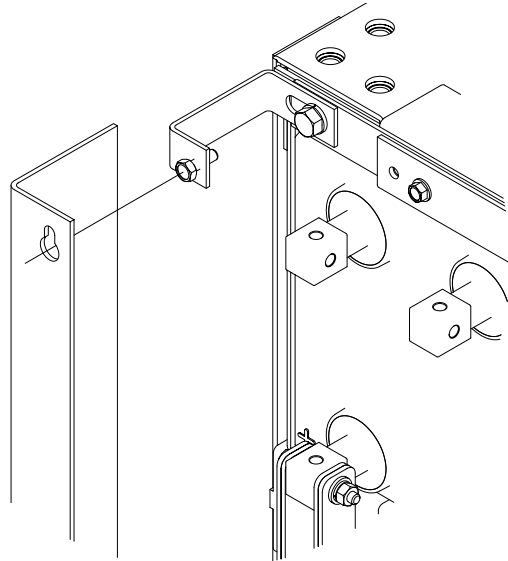
Corner Safety Shield Assembly

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



3. One corner safety shield will cover one module. Hang the first corner shield on the top brackets through the large part of the keyhole. At the same time aligning the cut out at the bottom of the shield with the second set of brackets

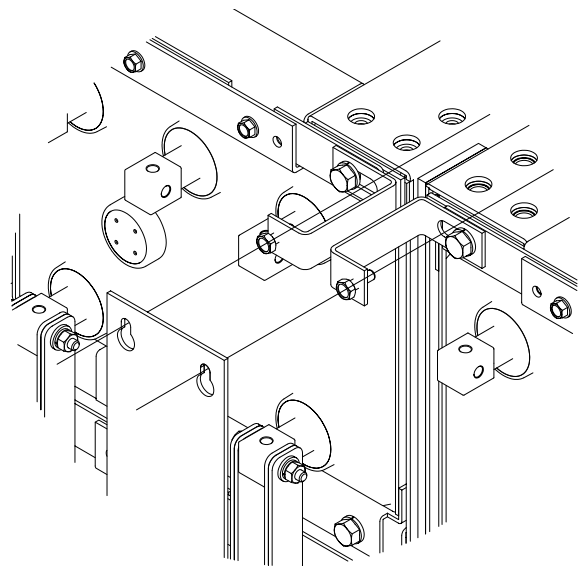
Note: There are right and left corner safety shields. It is important that the correct shield be installed on the correct side.

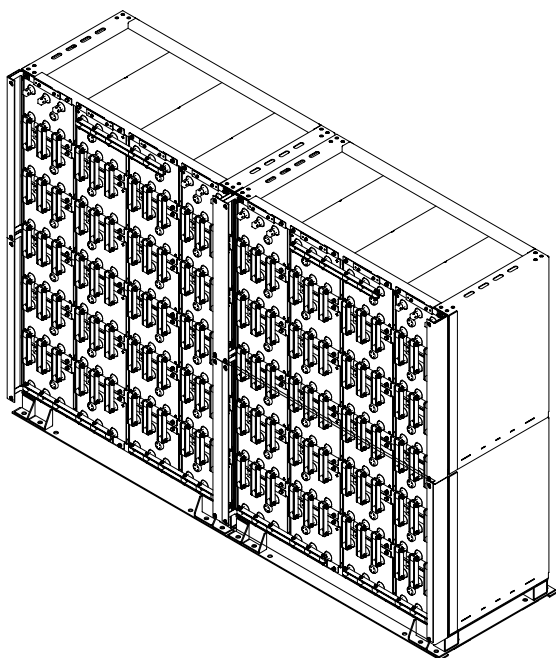


This process is to be repeated for all ends of the battery system.

Stack to Stack Safety Shield Assembly

1. Systems with multiple stacks will require a Stack to Stack Safety Shield to be installed.
2. Stack to stack safety shields are to be installed prior to installing front Safety Shields.
3. Stack to stack safety shields are designed with a keyhole type attachment, similar to the corner safety shields.

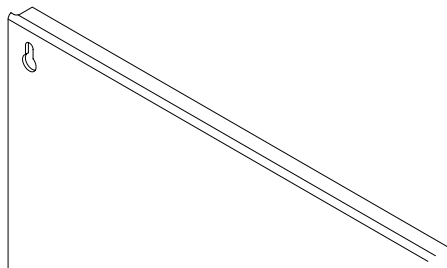




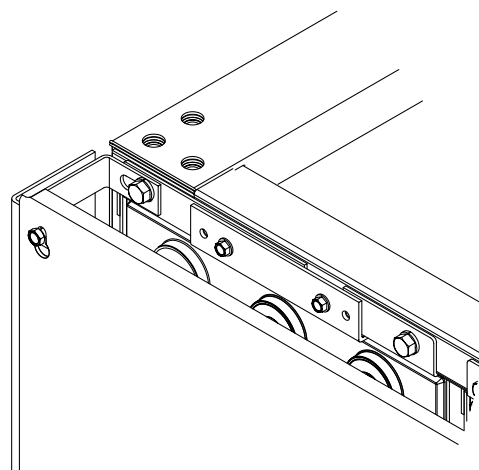
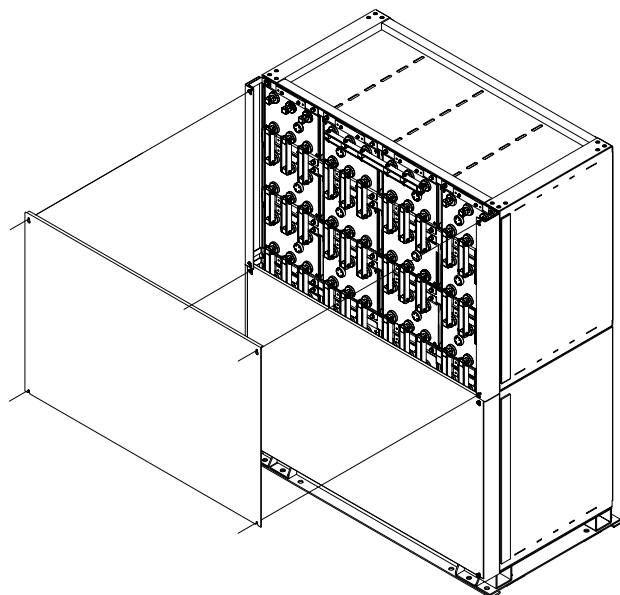
COMPLETE ASSEMBLY

Front Safety Shield

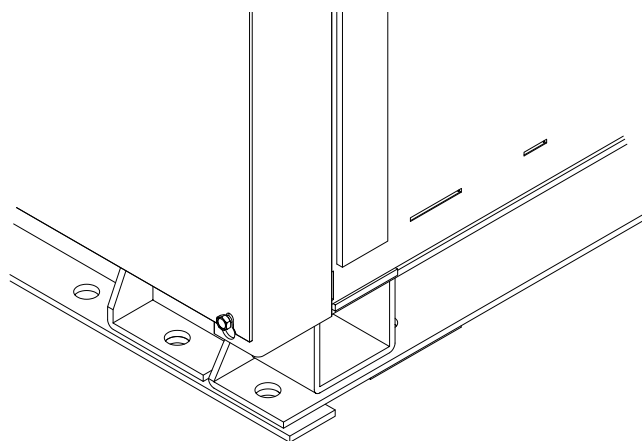
1. Front Safety Shields are designed with a “keyhole” type attachment.



2. One shield will cover one module. Hang the first shield on the top brackets through the large part of the keyhole. At the same time aligning the cut out at the bottom of the shield with the second set of brackets



TOP

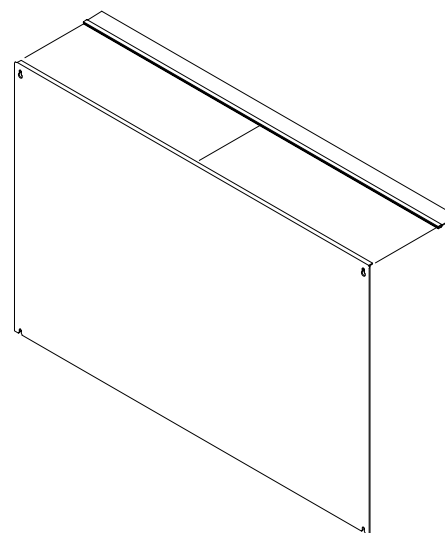


BOTTOM

3. After all shields are in place tighten but do not torque all hardware.

Top Protection Shield Installation

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



SYSTEM OPERATIONS

Charger Voltage (per cell)

2.25V ± 0.01 @ 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.

Charge Current

Charge current should not exceed the recommended minimum and maximum requirements as detailed in Appendix B.

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 B) for temperature compensation voltage maximum and minimum limits.

Cell Voltage

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

Equalizing

Upon installation of the battery string, an optional charge of 2.40V per cell ± 0.01 @ 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.

Battery Operation

Battery string operating temperature will affect battery string capacity and operating life. Temperatures greater than 77°F (25°C) will reduce the operating life of the battery. For every 13°F (7°C) increase in operating temperature above 77°F (25°C), the warranty period will be proportionally reduced by 50% as shown below:

Operating Temperature		Proportional Percentage (%) of Life
°F	°C	
77	25	100%
81	27	80%
87	30	60%
90	32	50%

The battery string operating temperature should not exceed 95°F (35°C) and should never exceed 105°F (40.5°C) for more than an eight-hour period. If operating temperatures are expected to be in excess of 95°F (35°C), contact East Penn for recommendations.

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

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 C.

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.

MAINTENANCE

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

Annual Inspection (1)

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

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

Battery Cleaning

1. Disconnect battery system from power source.
2. Dust accumulation can be removed with cloth dampened with clean water.
3. Corrosion buildup should be neutralized using a mixture of baking soda and water. Use cloth dampened with clean water to remove residue.

Capacity Testing

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

Cell / Sleeve Removal Procedure

1. Before removing cell/sleeve review "Safety Precautions" on pg. 3 of this manual. Contact East Penn Mfg. Company Inc. with specific questions or concerns.
2. Disconnect battery system from power source.
3. Remove safety shield from subject module.
4. Remove connectors pertaining to cell being removed.
5. Remove 3/8-16 bolts from cell/ sleeve.
Do not remove retainer bar from cell/sleeve.
6. All tools used to remove cell/sleeve shall be insulated to avoid contact with battery posts.
7. Lifting device shall be rated to handle weight of cell/sleeve.
8. Remove one cell/sleeve at a time.
9. A slot is provided on the cell/sleeve to assist in removing cell/sleeve from module.
10. Refer to Page 5 "Cell Installation" for installing replacement cell.

Acid Volumes & Weights

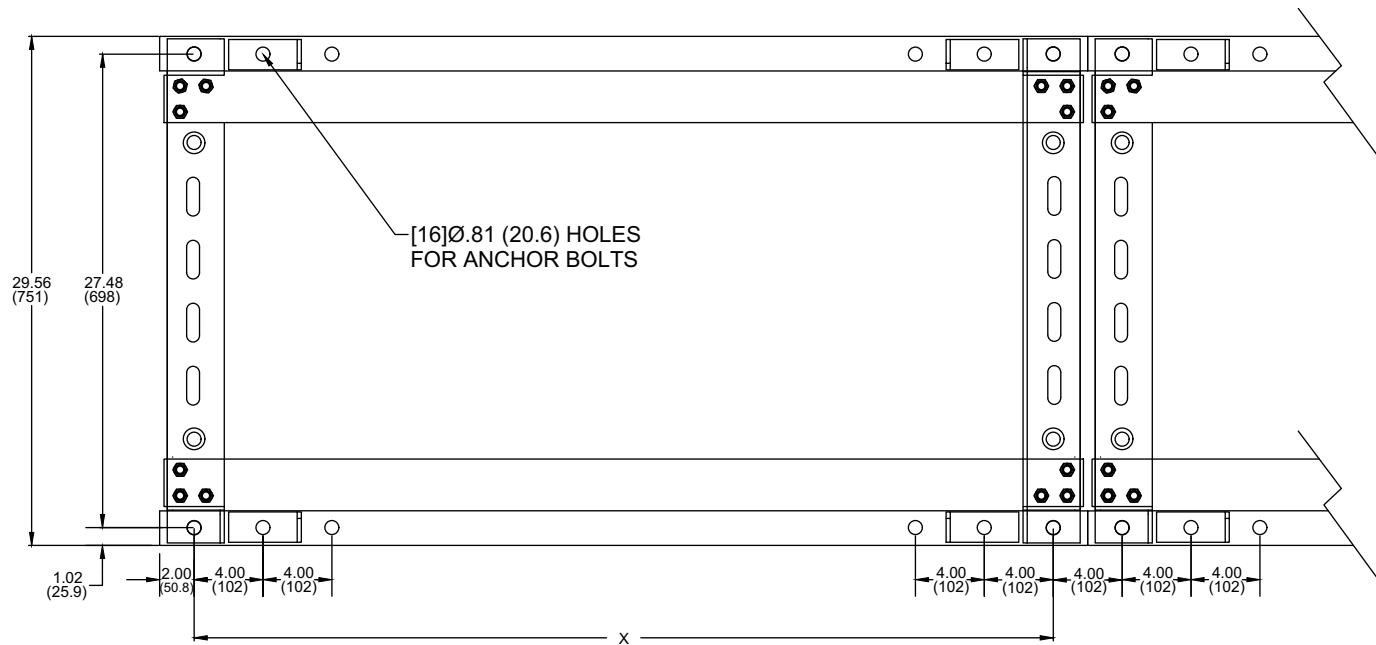
Battery Type	Electrolyte (per cell)				Pure Acid (per cell)			
	Volume		Weight		Volume		Weight	
	gal	liter	lb	kg	gal	liter	lb	kg
AVR3500	6.81	25.79	73.92	33.53	1.93	7.30	29.55	13.40
AVR4000	6.77	25.64	73.48	33.33	1.92	7.28	29.47	13.37

****Data subject to change without notice.**

APPENDIX A

BASE ANCHOR HOLE PATTERN

Module Type	in	mm
4x3	49.87	1266.7
2x3	23.32	592.3



APPENDIX B

VOLTAGE COMPENSATION CHART

°C	Float Voltage per Battery	°F
≥35	2.230	≥95
34	2.232	93.2
33	2.234	91.4
32	2.236	89.6
31	2.238	87.8
30	2.240	86.0
29	2.242	84.2
28	2.244	82.4
27	2.246	80.6
26	2.248	78.8
25	2.250	77.0
24	2.252	75.2
23	2.254	73.4
22	2.256	71.6
21	2.258	69.8
20	2.260	68.0
19	2.262	66.2
18	2.264	64.4
17	2.266	62.6
16	2.268	60.8
15	2.270	59.0
14	2.272	57.2
13	2.274	55.4
12	2.276	53.6
11	2.278	51.8
≥10	2.280	≥50

12mV per °C

CHARGE CURRENT LIMITS

Battery Type	Max. Charge Current (A)	Min. Charge Current (A)**
AVR3500	351.9	105.6
AVR4000	380.6	114.2

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

APPENDIX C



BATTERY MAINTENANCE REPORT

Company:

Address:

Battery Location & Room #:

Total No. of Cells:

Battery Type * :

Date of Mfg. * :

Site Load IN KVA:

UPS Mfg. & Model:

Battery's Environment):

Service Date:

Battery Dwg. #

Connector Pkg.

Battery I.D. #:

Ambient Air Temperature:

Installer:

Date Installed:

(Mfg. & Model)

(Note if voltage is expressed in RMS, Peak, or Peak to Peak)

Charger Output Voltage:

Total Battery Voltage:

Panel Meter Voltage:

Conductance / Impedance Meter:

AC Ripple Voltage:

Float Current:

(To be read @ battery terminals)

(Display Voltage)

(Note if voltage is expressed in RMS, Peak, or Peak to Peak)

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

Cell / Jar No.	Serial Number	Cell Temp.	Volts (Float)	Cell Ohmic Value "	Connector Ohmic Value 1	Connector Ohmic Value 2	Connector Ohmic Value 3	Cell Temp.	Volts (Float)	Cell Ohmic Value "	Connector Ohmic Value 1	Connector Ohmic Value 2	Connector Ohmic Value 3
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													
16													
17													
18													
19													
20													
21													
22													
23													
24													
25													
26													
27													
28													
29													
30													

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

Remarks and Recommendations:

Readings Taken By:

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

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



BATTERY MAINTENANCE REPORT

Company:
Address:

Service Date:
Battery Dwg. #
Connector Pkg.
(See Manual)

Battery Location & Room #:

Battery I.D. #:

Cell / Jar No.	Serial Number	Cell Temp.	Volts (Float)	Cell Ohmic Value	1	2	3	Cell / Jar No.	Serial Number	Cell Temp.	Volts (Float)	Cell Ohmic Value	1	2	3
61								106							
62								107							
63								108							
64								109							
65								110							
66								111							
67								112							
68								113							
69								114							
70								115							
71								116							
72								117							
73								118							
74								119							
75								120							
76								121							
77								122							
78								123							
79								124							
80								125							
81								126							
82								127							
83								128							
84								129							
85								130							
86								131							
87								132							
88								133							
89								134							
90								135							
91								136							
92								137							
93								138							
94								139							
95								140							
96								141							
97								142							
98								143							
99								144							
100								145							
101								146							
102								147							
103								148							
104								149							
105								150							



BATTERY MAINTENANCE REPORT

Company: _____

Address: _____

Service Date: _____

Battery Dwg. # _____

Connector Pkg. _____
(See Manual)

Battery Location & Room #:

Battery I.D. #:

Cell / Jar No.	Serial Number	Cell Temp.	Volts (Float)	Cell Ohmic Value	Connector Ohmic Value 1	Connector Ohmic Value 2	Connector Ohmic Value 3	Cell / Jar No.	Serial Number	Cell Temp.	Volts (Float)	Cell Ohmic Value	Connector Ohmic Value 1	Connector Ohmic Value 2	Connector Ohmic Value 3
151								196							
152								197							
153								198							
154								199							
155								200							
156								201							
157								202							
158								203							
159								204							
160								205							
161								206							
162								207							
163								208							
164								209							
165								210							
166								211							
167								212							
168								213							
169								214							
170								215							
171								216							
172								217							
173								218							
174								219							
175								220							
176								221							
177								222							
178								223							
179								224							
180								225							
181								226							
182								227							
183								228							
184								229							
185								230							
186								231							
187								232							
188								233							
189								234							
190								235							
191								236							
192								237							
193								238							
194								239							
195								240							



www.dekabatteries.com

East Penn Manufacturing Co. Lyon Station, PA 19536-0147 Phone: 610-682-3263 Fax: 610-682-4781 e-mail: reservepowersales@dekabatteries.com

All data subject to change without notice. No part of this document may be copied or reproduced, electronically or mechanically, without written permission from the company.