

Installation and Operating Instructions for Stryten Energy Absolyte® AGP Batteries



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SECTION 1

1.0 General Information

The Absolyte AGP battery is of the valve-regulated lead-acid (VRLA) design and so can operate with lower maintenance (e.g. no maintenance water additions) in comparison to conventional flooded lead-acid batteries. The Absolyte AGP VRLA design is also inherently safer than conventional flooded lead-acid batteries. Under normal operating conditions and use, the Absolyte AGP battery minimizes hydrogen gas release, and virtually eliminates acid misting and acid leakage. However, there is the possibility that under abnormal operating conditions (e.g. over-charge), or as a result of damage, misuse and/or abuse, potentially hazardous conditions (hydrogen gassing, acid misting and leakage) may occur. Thus, Stryten Energy recommends that Section 2.0 of these instructions entitled “SAFETY PRECAUTIONS” be reviewed thoroughly prior to commissioning, and strictly followed when working with Absolyte AGP batteries.



CAUTION!

Before proceeding with the unpacking, handling, installation and operation of this VRLA storage battery, the following general information should be reviewed together with the recommended safety precautions.

SECTION 2

2.0 Safety Precautions

2.1 Sulfuric Acid Electrolyte Burns



DANGER
SULFURIC ACID
ELECTROLYTE BURNS



“Warning: Risk of fire, explosion or burns. Do not disassemble, heat above 50°C or incinerate.” Batteries contain dilute (1.310 nominal specific gravity) sulfuric acid electrolyte which can cause burns and other serious injury. In the event of contact with electrolyte, flush immediately and thoroughly with water. Secure medical attention immediately.

When working with batteries, wear rubber apron and rubber gloves. Wear safety goggles or other eye protection. These will help prevent injury if contact is made with the acid.

2.2 Explosive Gases



DANGER
EXPLOSIVE
GASES



Hydrogen gas formation is an inherent feature of all lead acid batteries. Absolyte AGP VRLA batteries, however,

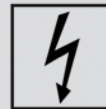
significantly reduce hydrogen formation. Tests have shown that 99% or more of generated gases are recombined within the cell under normal operating conditions. Under abnormal operating conditions (e.g. charger malfunction), the safety valve may open and release these gases through the vent. The gases can explode and cause blindness and other serious injury.

Keep sparks, flames, and smoking materials away from the battery area and the explosive gases.

All installation tools should be adequately insulated to minimize the possibility of shorting across connections.

Never lay tools or other metallic objects on modules as shorting, explosions and personal injury may result.

2.3 Electrical Shock and Burns



DANGER
ELECTRIC SHOCK
AND BURNS



Multi-cell systems attain high voltages, therefore, extreme caution must be exercised during installation of a battery system to prevent serious electrical burns or shock.

Interrupt the AC and DC circuits before working on batteries or charging equipment.

Assure that personnel understand the risk of working with batteries, and are prepared and equipped to take the necessary safety precautions. These installation and operating instructions should be understood and followed. Assure that you have the necessary equipment for the work, including insulated tools, rubber gloves, rubber aprons, safety goggles and face protection.



CAUTION!

If the foregoing precautions are not fully understood, clarification should be obtained from your nearest Stryten Energy representative. Local conditions may introduce situations not covered by Stryten Energy Safety Precautions. If so, contact the nearest Stryten Energy representative for guidance with your particular safety problem; also refer to applicable federal, state and local regulations as well as industry standards.

2.3.1 Static Discharge Precautions for Batteries

When maintaining the batteries, care must be taken to prevent build-up of static charge. This danger is particularly significant when the worker is electrically isolated, i.e. working on a rubber mat or an epoxy painted floor or wearing rubber shoes.

Prior to making contact with the cell, discharge static electricity by touching a grounded surface.

Wearing a ground strap while working on a connected battery string is not recommended.

**2.4 Safety Alert**

The safety alert symbol on the left appears throughout this manual. Where the symbol appears, obey the safety message to avoid personal injury.

**2.5 Important Message**

The symbol on the left indicates an important message. If not followed, damage to and/or impaired performance of the battery may result.

SECTION 3**3.0 Receipt of Shipment**

Immediately upon delivery, examine for possible damage caused in transit. Damaged packing material or staining from leaking electrolyte could indicate rough handling. Make a descriptive notation on the delivery receipt before signing. Look for evidence of top loading or dents in the steel modules. If cell or unit damage is found, request an inspection by the carrier and file a damage claim.

3.1 Concealed Damage

Within 10 days of receipt, examine all cells for concealed damage. If damage is noted, immediately request an inspection by the carrier and file a concealed damage claim. Pay particular attention to packing material exhibiting damage or electrolyte staining. Delay in notifying carrier may result in loss of right to reimbursement for damages.

SECTION 4**4.0 Storage Prior to Installation****4.1 Storage Location**

If the battery is not to be installed at the time of receipt, it is recommended that it be stored indoors in a cool [77°F (25°C) or less], clean, dry location. Do not stack pallets or cell terminal damage may occur.

4.2 Storage Interval

The storage interval from the date of battery shipment to the date of installation and initial charge should not exceed six (6) months. If extended storage is necessary, the battery should be charged at regular intervals until installation can be completed and float charging can be initiated. When in extended storage, it is advised to mark the battery pallets with the date of shipment and the date of every charge. If the battery is stored at 77°F (25°C) or below, the battery should be given a freshening charge (perform per Section 11 Initial Charge) within 6 months of the date of shipment

and receive a freshening charge (perform per Section 11 Initial Charge) at 6 month intervals thereafter. Storage at elevated temperatures will result in accelerated rates of self discharge. For every 18°F (10°C) temperature increase above 77°F (25°C), the time interval for the initial freshening charge and subsequent freshening charges should be halved. Thus, if a battery is stored at 95°F (35°C), the maximum storage interval between charges would be 3 months (reference Appendix B). Storage beyond these periods without proper charge can result in excessive sulphation of plates and positive grid corrosion which is detrimental to battery performance and life. Failure to charge accordingly may void the battery's warranty. Initial and freshening charge data should be saved and included with the battery historical records; (see Section 15 - Records).

SECTION 5**5.0 Installation Considerations**

Prior to starting installation of the Absolyte Battery System, a review of this section is strongly recommended.

5.1 Space Considerations**Important Message**

Any modifications, alterations or additions to an Absolyte system, without the expressed written consent of Stryten Energy Engineering, may void any warranties and/or seismic qualifications. Contact your Stryten Energy representative for additional information.

It is important to know certain restrictions for the area where the battery is to be located. First, a designated aisle space should be provided to permit initial installation as well as for service or surveillance. After installation, any additional equipment installed after the battery should not compromise access to the battery system.

A minimum aisle space of 36 inches from modules / 33 inches from covers should be available adjacent to the battery system. See Figure 1 for typical space allocations required. Following the spacing requirements will aid in maintenance of the battery and help maintain air flow to battery surfaces to enhance heat dissipation.

NOTE: When planning system space requirements, allow at least 6 inches past system total length wherever a terminal plate assembly is to be located. (See Figure 1A)

Figure 1 A-B are typical. For total length, width and height dimensions of connected systems, consult layout/wiring diagram for the particular system.



5.2 Battery Location & Ambient Temperature Requirements

It is recommended that the battery unit be installed in a clean, cool, dry location. Floors should be level. Absolyte batteries can be installed in proximity to electronic equipment.

A location having an ambient temperature of 75°F (24°C) to 77°F (25°C) will result in optimum battery life and performance. Temperatures below 77°F (25°C) reduce battery charge efficiency and discharge performance. Temperatures above 77°F (25°C) will result in a reduction in battery life (see table below.)

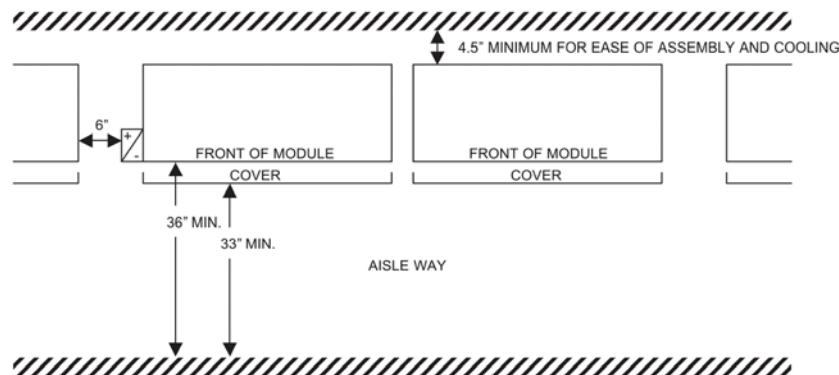


FIGURE 1A - HORIZONTAL END TO END

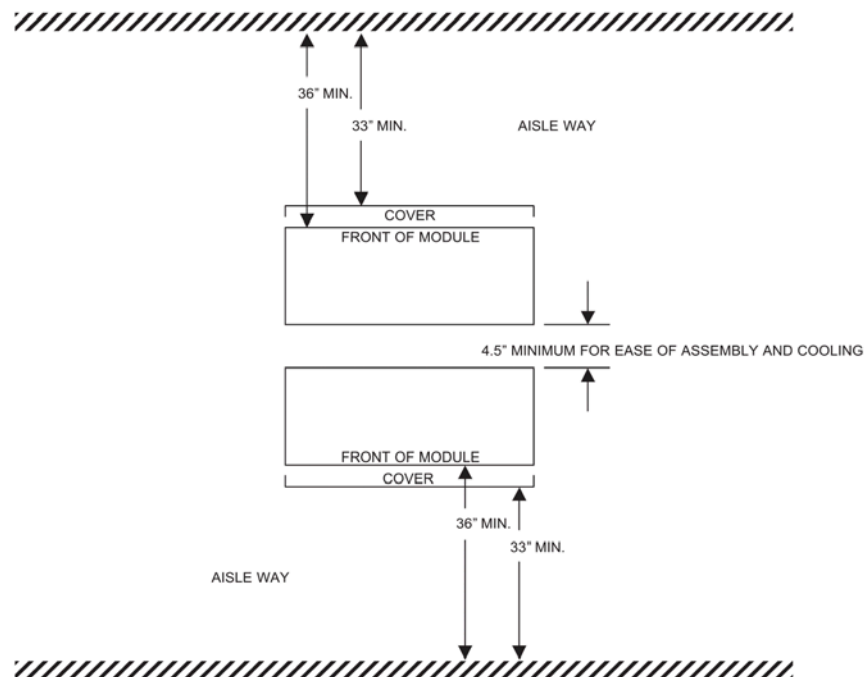


FIGURE 1B - HORIZONTAL BACK TO BACK

FIGURE 1 - TYPICAL SYSTEMS (TOP VIEW)

Annual Average Battery Temperature	Maximum Battery Temperature	Percent Reduction in Battery Life
77°F (25°C)	122°F (50°C)	0%
86°F (30°C)	122°F (50°C)	30%
95°F (35°C)	122°F (50°C)	50%
104°F (40°C)	122°F (50°C)	66%
113°F (45°C)	122°F (50°C)	75%
122°F (50°C)	122°F (50°C)	83%

For example: If a battery has a design life of 20 years at 77°F (25°C), but the actual annual average battery temperature is 95°F (35°C), the projected service life of the battery is calculated to be only 10 years.

Temperature records shall be maintained by the user in accordance with the maintenance schedule published in this manual. The battery temperature shall not be allowed to exceed the maximum temperature shown above. It is important to maintain the battery temperature as close to 77°F (25°C) as possible to achieve the optimum service life from your battery.

5.3 Temperature Variations

Sources of heat or cooling directed on portions of the battery can cause temperature variations within the strings, resulting in cell voltage differences and eventual compromise of battery performance.

Heat sources such as heaters, sunlight or associated equipment can cause such temperature variations. Similarly, air conditioning or outside air vents may cause cell string temperature variations. Every effort should be made to keep temperature variations within 5°F (3°C).

5.4 Ventilation

The Absolyte battery is a Valve Regulated Lead Acid (VRLA) low maintenance design. Tests have confirmed that under recommended operating conditions in stationary applications, 99% or more of gases generated are recombined within the cell. In most cases, no special ventilation and or battery room is required. Consult your local building and fire codes for requirements that may apply to your specific location.

Hydrogen and oxygen gases can be vented to the atmosphere under certain conditions. Therefore, the battery should never be installed in an air-tight enclosure. Sufficient precautions must be taken to prevent excessive overcharge.

5.5 Floor Loading

The floor of the area where the battery system is to be installed should have the capability of supporting the weight of the battery as well as any auxiliary equipment. The total battery weight will depend on the cell size, number of cells, as well as module configuration involved. Prior to installation, a determination should be made that the floor

integrity is adequate to accommodate the battery system.

5.6 Floor Anchoring

Where seismic conditions are anticipated, floor anchoring must be implemented.

Where non-seismic conditions are anticipated, anchoring of horizontally stacked systems is recommended for maximum stability. Four 9/16" (14.3 mm) holes are provided in each I-Beam support for anchoring. To maintain seismic certification, use four anchor bolts per horizontal support. Anchor design is the responsibility of the purchaser/installer.

5.7 Connecting Cables: Battery System to Operating Equipment

The Absolyte cell is a UL recognized component. Battery performance is based on the output at the battery terminals. Therefore, the shortest electrical connections between the battery system and the operating equipment results in maximum total system performance.

DO NOT SELECT CABLE SIZE BASED ON CURRENT CARRYING CAPACITY ONLY. Cable size selection should provide no greater voltage drop between the battery system and operating equipment than necessary. Excess voltage drop will reduce the desired support time of the battery system.

5.7.1 Paralleling

Where it is necessary to connect battery strings in parallel in order to obtain sufficient load backup time, it is important to minimize the difference in voltage drop between the battery strings in parallel in order to promote equal load sharing upon discharge. Therefore, equal resistance of cable connections for each parallel string is important. When paralleling multiple strings to a load or common bus, please follow these guidelines:

- Each parallel string must have the same number of cells (same string voltage).
- The cables connecting the positive and negative terminals of each string to the load (or bus) should be of the **SAME SIZE** (i.e. same capacity/cross-sectional area).
- The cables connecting the positive and negative terminals of each string to the load (or bus) should be of the **SAME LENGTH**. Choose the shortest cable length that will connect the battery string that is furthest from the load, and cut all cables used to connect each string to the load to this same length.

5.8 Stacking Limitations

There are recommended limits on stacked battery configurations. Please refer to Appendix D for additional information. NOTE: Horizontal module arrangement only.

5.9 Terminal Plates



Each system is supplied with a terminal plate assembly for the positive and negative terminations. These should always be used to provide proper connection to the operating equipment and cell terminals. Any attempt to connect load cables directly to cell terminal may compromise battery system performance as well as the integrity of cell post seals.

5.10 Grounding

It is recommended that the modules or racks be grounded in accordance with NEC and/or local codes. See Appendix C for recommended procedure.

SECTION 6

6.0 Unpacking and Handling

6.1 General

Do not remove shipping materials if a storage period is planned, unless charging is required per Section 4.2.



PACKED MODULES
Figure 2

The battery modules are generally packed in groups. Lag bolts retain the modules to the shipping pallet together with protective hood bolted in place. Modules are also bolted together at the top adjacent channels. See Figure 2.

6.2 Accessories

Accessories are packed separately and will include the following: (**Note:** Some items may not be provided depending on battery configuration).

- Layout/wiring diagram
- Installation and operating instructions
- Lifting straps and lifting shackles
- Protective covers and hardware
- Terminal plate assembly kits and covers
- Module tie plates (where required) (i.e. side-by-side stacks)
- Vertical or horizontal supports (i.e. I-beams)
- Lead-Tin Plated copper intercell connectors
- Assembly hardware
- NO-OX-ID® "A"* grease
- Battery warning label
- Battery nameplate
- Cell numerals with polarity indicators
- Shims (leveling)
- Drift pins
- Seismic Shims (where required).

*Registered Trademark of Sanchem Inc.

NOTE: Check battery components against supplied drawings to assure completeness. Do not proceed with installation until all accessory parts are available.

6.3 Recommended Installation Equipment and Supplies

- Fork lift or portable boom crane
- Chalk line
- Line Cord
- Torpedo level (Plastic)
- Plywood straight edge 1/2" x 4" x 48"
- Torque wrenches
- Ratchet wrench with 10, 13, 17, 19 mm sockets and 2 and 15 mm deep sockets
- Box wrenches of 10, 13, 15, 17 and 19 mm sizes
- Vinyl electrical tape
- Paper wipers
- 3M Scotch Brite® scour-pads™†
- Hammer drill (floor anchoring)

† Trademark of 3M

6.4 Unpacking

Carefully remove bolts and protective shipping hood. See Figure 3. Remove the bolts holding modules to shipping pallet. Also remove hardware bolting upper channels of modules together. Do not remove modules at this time. Base supports for horizontally stacked modules are more easily attached before removing modules from pallet (see Section 8.0 System Assembly and Section 9.0 Connections).

Note: Placement of modules on shipping pallet has no relationship to final installation.



UNPACKED MODULES
Figure 3



6.5 Handling

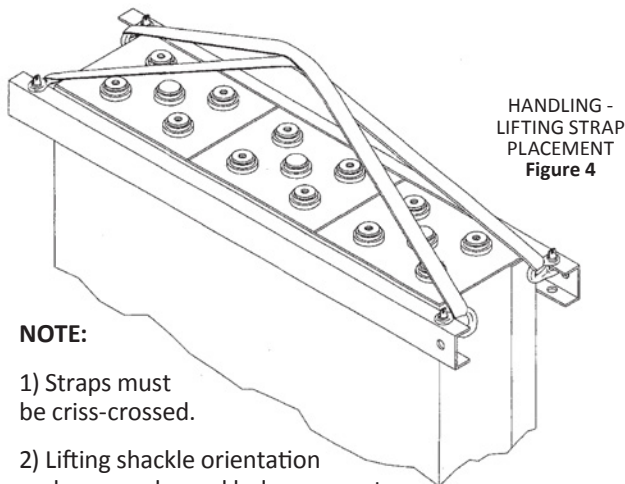
The design of the modular tray permits handling by a fork lift, portable crane or by a hoist sling (see Figure 4). Whichever method is used, make sure equipment can safely handle the module weight.

Always use the two lifting straps and four lifting shackles for lifting and placement of modules.



CAUTION!

If a fork lift or portable crane is used to handle modules in a horizontal position, a piece of insulating material such as heavy cardboard, rubber insulating mats or plywood should be used between handling equipment and module tops to prevent shorting of module top connections with metal parts of lift equipment.



HANDLING -
LIFTING STRAP
PLACEMENT
Figure 4

NOTE:

- 1) Straps must be criss-crossed.
- 2) Lifting shackle orientation and proper channel hole use must be observed.
- 3) See Figure 14 for handling modules in horizontal orientation.
- 4) Never lift more than two joined modules with straps and hooks.

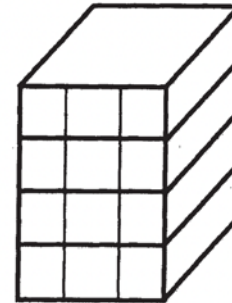
SECTION 7

7.0 System Arrangements

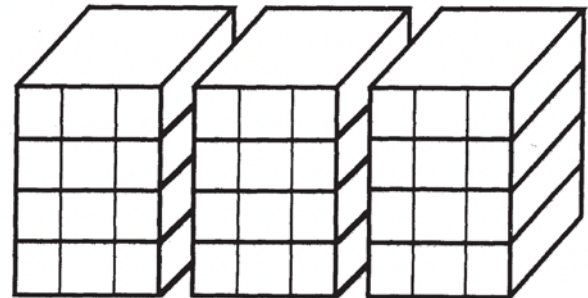
7.1 Module Arrangements

Absolyte batteries are recommended for installation in a horizontal orientation only. However, vertical installation is approved for 50G systems consisting of single cell modules. Figures 6 and 7 are typical arrangements and are not intended to represent all configuration possibilities.

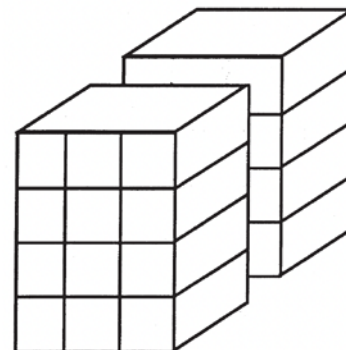
Module stack height limitation depends on cell size and the seismic requirements of the application. Please refer to Appendix D for additional information.



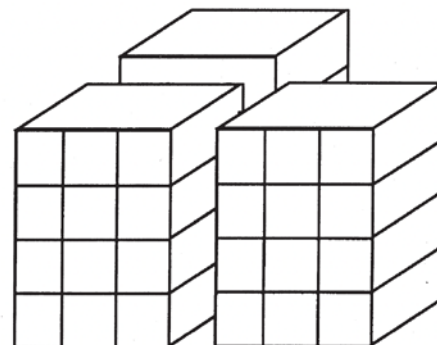
HORIZONTAL
SINGLE STACK
Figure 6A



HORIZONTAL MULTIPLE STACKS
END TO END
Figure 6B



HORIZONTAL
SINGLE STACK
BACK TO BACK
Figure 6C



HORIZONTAL MULTIPLE STACKS
BACK TO BACK AND END TO END
TYPICAL HORIZONTAL STACK ARRANGEMENTS
Figure 7

7.2 Dummy Cells within a Module

Where application voltage requires, a dummy cell can replace a live cell in a module. For example, a 46 volt, three cell per module system may consist of seven full modules and one module containing two live cells and either an empty space, or a dummy cell.

SECTION 8

8.0 System Assembly

8.1 Horizontal Single Stack

Consult layout/wiring diagram for total number and type of module assemblies in system. There can be varying combinations of cell arrangements within the module. May contain dummy cells depending on total system voltage.

Compare required module assemblies called for on layout/wiring diagram with modules in shipment for completeness before continuing further.

8.1.1 Bottom I-beam Supports

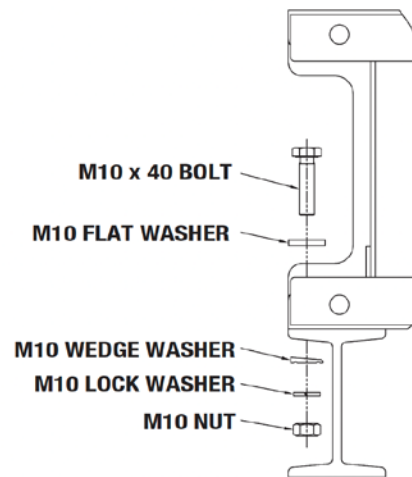
Locate bottom I-beam supports and M10 I-beam hardware kit. I-beam supports and seismic shims should be attached to the appropriate module assembly shown on the layout/wiring diagram prior to removal from shipping pallet.

NOTE: Seismic shims will be supplied with systems for which they are required to maintain seismic compliance.

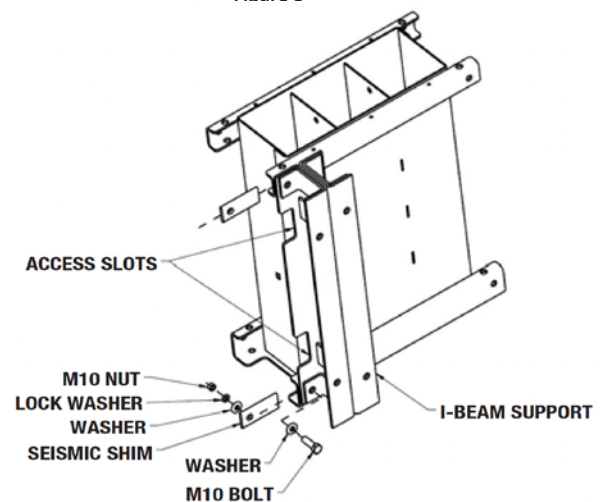
Secure I-beam support to a module channel as shown in supplied drawing, with access slots outward. Please refer to Figure 8 and 9 for general hardware installation information. Seismic shims, when supplied, are placed between the channel and the nut and oriented so as to not extend beyond the end of the channel. Torque hardware to 47 Newton-meters (35 ft-lbs) using insulated tools. When correctly attached, the I-beam support will be flush with the front module channel and approximately 13mm (0.50") away from the back of the module. The side of the I-beam support will be approximately 10mm (0.38") away from the end of the channels.

NOTE: The use of leveling shims is required when assembling any Absolyte system in order to meet seismic requirements. Failure to use the shims to level each module and to fill spaces between tray channels during module assembly will result in the assembly not meeting seismic certification criteria.

Similarly, install the remaining I-beam support on the other side of the module (see Figure 10).



HARDWARE INSTALLATION FOR 2.67"
WIDE I-BEAM SUPPORT
Figure 8



HARDWARE INSTALLATION FOR
4.5" WIDE I-BEAM SUPPORT
Figure 9



COMPLETED I-BEAM SUPPORT TO
MODULE INSTALLATION
Figure 10

8.1.2 Handling

The module/base support assembly may now be removed from the pallet using methods outlined in section 6.5, Handling. Also see Figure 11. Remaining modules may be removed in a similar manner.

8.1.3 Horizontal Stacking

In order to stack modules in the horizontal position, refer to Figures 11 thru 13 to perform the tip-over procedure. The module/base support assembly tip-over should be performed first. This procedure can be performed using a portable boom crane or fork lift in conjunction with the lifting straps and lifting shackles supplied.



CAUTION!

DO NOT ATTEMPT TO PERFORM TIP-OVER OF MODULE MANUALLY AS SERIOUS PERSONAL INJURY AND MODULE DAMAGE MAY RESULT.

A. Install lifting strap using lifting shackles in channel base holes at each end of module upper rear channel as shown in Figure 12A.

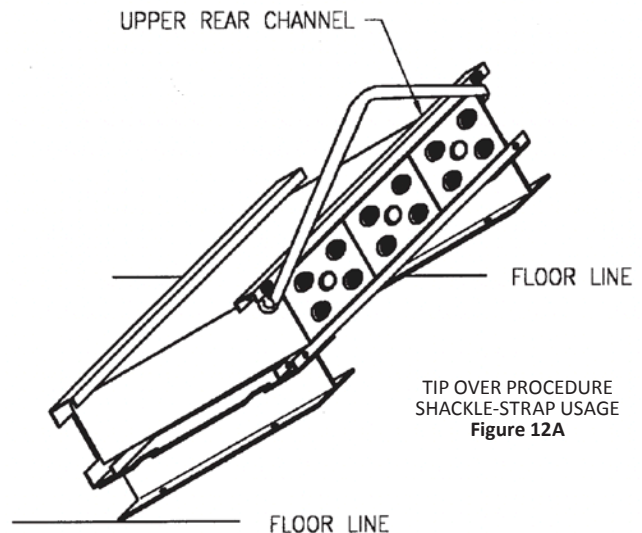
B. Center the lifting hook onto strap and lift until strap is under tension and raises bottom of module from floor surface so that upper and lower diagonal corners are in a vertical mode.

C. While exerting manual force on the upper rear of module, lower hoist until module is in horizontal position. See Figures 12B and 13.

D. When module is horizontal, install the four lifting shackles and two lifting straps as shown in Figure 14.



E. Where floor anchoring is required, position module/base assembly in desired location. Mark floor through I-beam holes and remove module/base assembly. Install floor anchoring and reposition module/base assembly over anchoring. Prior to installing nuts and washers, check that assembly is level in both axes. Level using shims provided. Torque anchor hardware to manufacturer's recommended value.

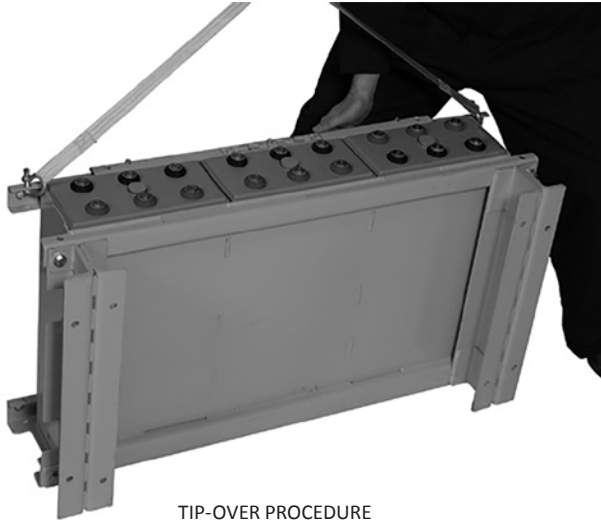


NOTE:

- 1) One strap with shackles used for tip-over procedure.
- 2) Observe channel hole used as well as direction of shackle insertion.
- 3) Tip over procedure for single modules only.

F. Using Steps A-D and the layout/wiring diagram, position the next module on top of first so that channels of each mate with one another using drift pins to align channel holes. Make sure channel ends and sides of the upper and lower modules are flush. Install serrated flange bolts and nuts in open holes, finger tight. Remove lifting straps. Use leveling shims to fill gaps between trays. See Figures 15, 16, and 17A.

G. At this time, check to see that the first two modules are plumb front to back and side to side using wooden or plastic level together with plywood straight edge. This is to insure proper alignment for module interconnection later on. Torque hardware to 47 Newton-meters (35 Ft-Lbs).



TIP-OVER PROCEDURE
Figure 12B

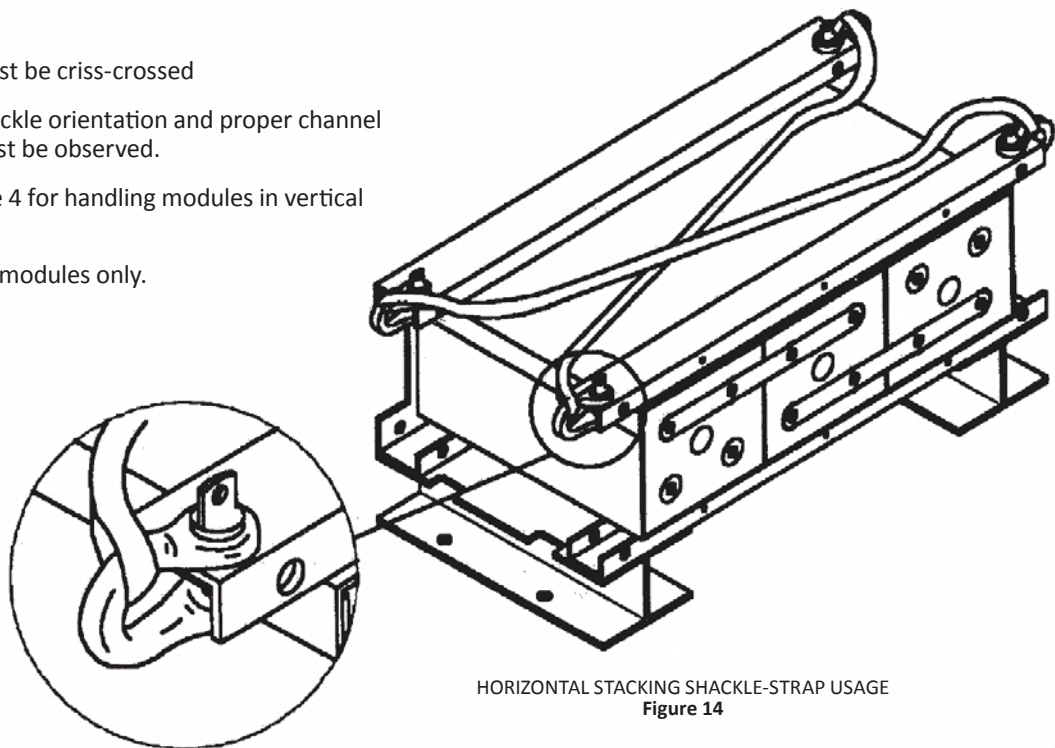


MODULE WITH BASE ASSEMBLY
AFTER TIP-OVER
Figure 13



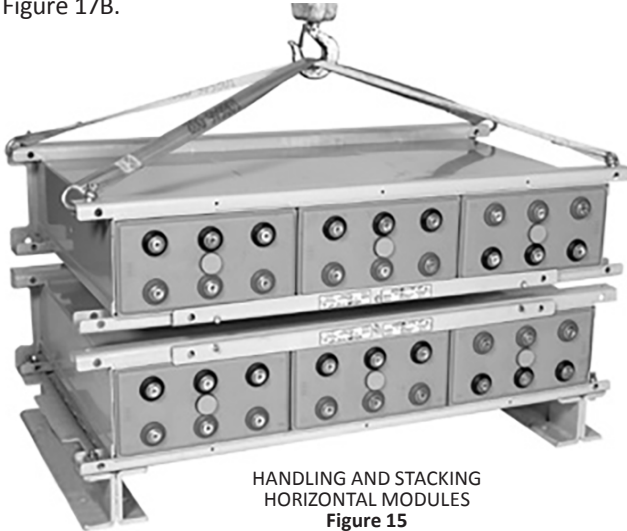
NOTE:

- 1) Straps must be criss-crossed
- 2) Lifting shackle orientation and proper channel hole use must be observed.
- 3) See Figure 4 for handling modules in vertical orientation.
- 4) Lift single modules only.

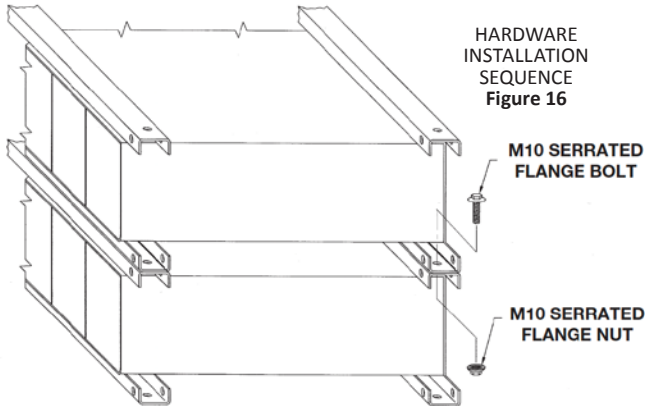


HORIZONTAL STACKING SHACKLE-STRAP USAGE
Figure 14

H. Proceed with stacking of remaining modules, checking that stack is plumb in both axes as stacking progresses before torquing hardware. Be certain to check the layout/wiring diagram for correct horizontal orientation to provide proper polarity interconnection as stacking progresses. See Figure 17B.



HANDLING AND STACKING
HORIZONTAL MODULES
Figure 15



HARDWARE
INSTALLATION
SEQUENCE
Figure 16



INSTALLING HARDWARE
Figure 17A



COMPLETED
HORIZONTAL
STACK
Figure 17B

8.2 Horizontal-Multiple Stacks

It is recommended that all of the first modules with bottom supports attached (see Section 8.1.1) be placed in position first. A chalk line floor mark should be used to assure all stacks will be in a straight line. This applies for stacks end-to-end or end-to-end and back-to-back. Also refer to Section 8.1.3, Items A through H (Item E for base module leveling).

Module ends should be butted together so that module side channel ends meet (see Figure 18).

Refer to layout/wiring diagram for seismic shim requirements.

At this time stack tie plates should be installed (see Section 8.2.1). It will be necessary to temporarily remove the hardware fastening the base modules to the I-beams.

See Figure 20A. Install tie plates and hardware. Torque to 47 Newton-meters (35 Ft-Lbs).

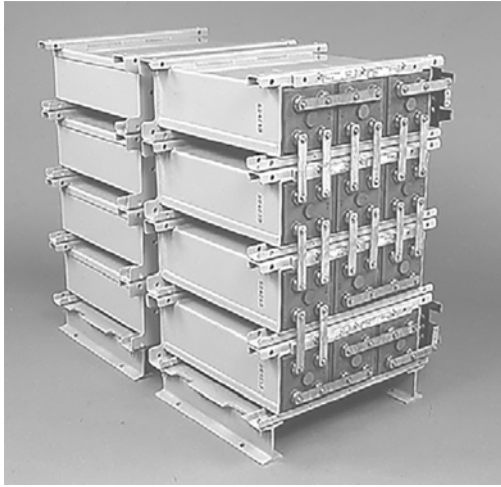
For stacks back-to-back, the two base modules are positioned to provide a minimum 4.5" spacing between the bottoms of the modules (not I-beam edges). See Figure 19A.

When all base modules are set in place, continue with stacking of subsequent modules. Procedures for assembly of multiple horizontal stacks are the same as outlined in section 9.1. Also consult layout/wiring diagram. Each stack should be built up in sequence to the same level until the top modules in all stacks are the last to be installed. The use of a line cord attached to upper module corners of opposite end modules as stacking progresses aids in alignment. See Figure 19B.

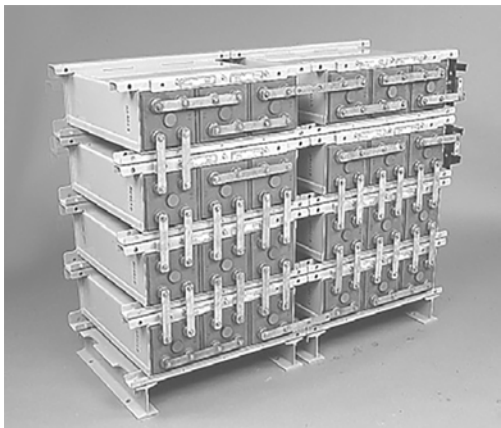


Note:
1) Level modules beneath I-beams in both axes to achieve proper interfacing of channel ends and installation of inter-stack connectors.

POSITIONING HORIZONTAL BASE MODULE
Figure 18



HORIZONTAL STACKS — BACK TO BACK POSITIONING
 Figure 19A



COMPLETED HORIZONTAL STACKS — SIDE BY SIDE
 Figure 19B

8.2.1 Stack Tie Plate

To achieve maximum stack stability, especially where seismic conditions may exist, as well as proper interfacing of interstack connections, metal tie plates are provided. The plates used on stacks end to end are 3" x 1" x 1/8" with two 9/16" holes. Use one tie plate at each interface on only the base and top modules of adjacent stacks. See Figures 20A and 20B.

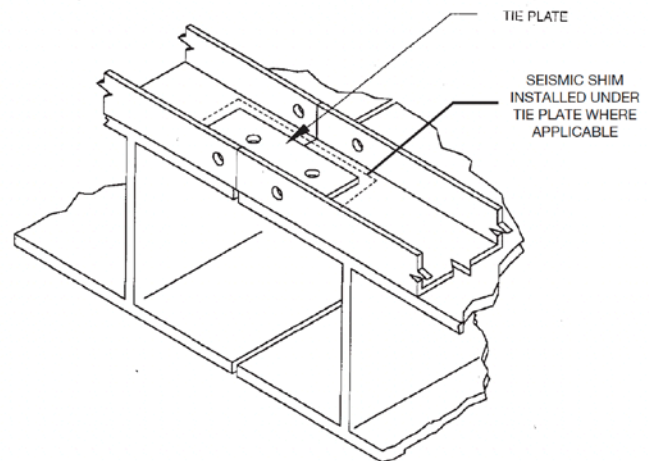
Position plates on the front and back channels and secure with hardware shown. Where stacks have different levels, install plates on shorter stack top module and adjacent module. Torque hardware to 47 Newton-meters (35 Ft-Lbs).

This completes the mechanical assembly of the battery system.

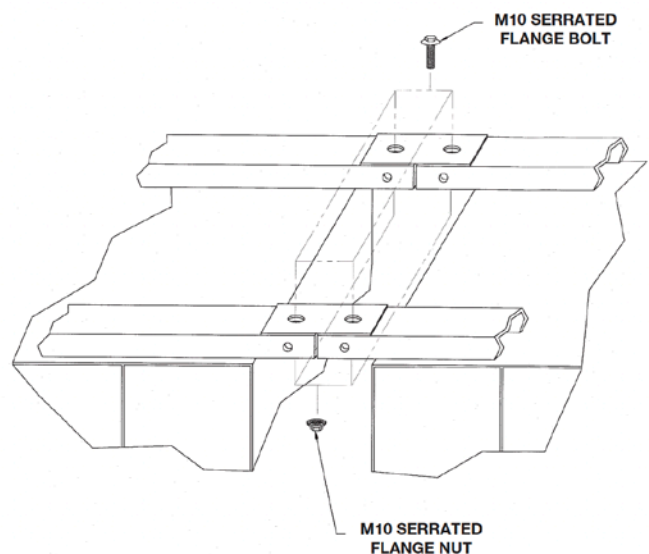
For installation of connections and terminal plate assembly, see Section 9.

For installation of protective module cover, see Section 10.

TYPICAL ASSEMBLY FOR BOTTOM MODULES
 HARDWARE AND SEQUENCE OF
 ASSEMBLY SAME AS 20B



TIE PLATE BOTTOM MODULES
 Figure 20A



TIE PLATE TOP MODULES
 Figure 20B

SECTION 9

9.0 Connections

9.1 Post Preparation

Using either a brass bristle suede shoe brush or 3M Scotch Brite scouring pad, brighten the flat copper terminal surfaces to ensure lowest resistance connections.

Apply a thin film of NO-OX-ID "A" grease (supplied with battery) to all terminal mating surfaces. This will preclude oxidation after connections are completed.

9.2 Connections - System Terminals

Each system is supplied with a terminal plate assembly for the positive and negative terminations. These should always be used to provide proper connection to the operating equipment and cell terminals. Any attempt to connect load cables directly to cell terminals may compromise battery system performance as well as the integrity of cell post seals.

For terminal plate assembly, see Figure 22 (6 cell modules at low rate) or Figure 23. Consult layout/wiring diagram for proper kit use. It is recommended that all components be assembled in place with hardware torqued to 11.3 Newtonmeters (100 in-lbs). Retorque value is also 11.3 Newtonmeters (100 in-lbs).

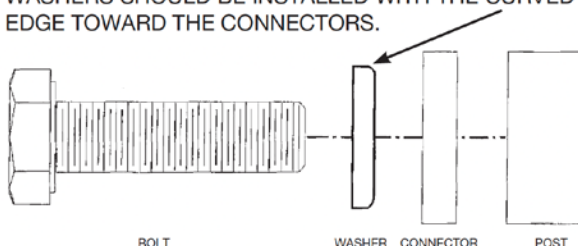
Refer to Sections 9.1 and 9.3 for electrical contact surface preparation of terminal plate components.

As shown, terminal plate assembly can be varied to satisfy module terminal location as well as orientation of terminal plate in a horizontal or vertical plane. **Do not make connections to operating system at this time.**

9.3 Connections - INTER-Module

Consult layout/wiring diagram for correct quantity of lead tin plated copper connectors required at each connection. Follow procedure in Section 9.1 and brighten lead-tin plated surfaces coming in contact with copper posts. Apply a film of NO-OX-ID "A" grease to these areas. NOTE: Apply a minimum amount of grease to cover the surface. As a rule: "If you can see it, it's too much". Where multiple connectors are required across any single connection, brighten both sides of connectors along the entire length. Grease these areas as well. It is recommended when installing connectors that the upper bolts be installed first to reduced risk of accidental shorting.

WASHERS SHOULD BE INSTALLED WITH THE CURVED EDGE TOWARD THE CONNECTORS.



Cells are interconnected with connectors and hardware as shown in Figures 21A and 21B

9.4 Connections - INTER-Stack

Multiple stacks end to end are interconnected as shown in Figure 21C and 21D. Follow procedures in Section 9.1 and Section 9.3. Also see Section 9.5, Connections - Torquing.



9.5 Connections - Torquing

When all inter-module connections have been installed, tighten all connections to 11.3 Newton-meters (100 in-lbs) Use insulated tools. All connections should be rechecked after the initial charge, due to heating during charge.

9.6 Connection - Check

Again, visually check to see that all module terminals are connected positive (+) to negative (-) throughout the battery.

Also measure the total voltage from terminal plate to terminal plate. This should be approximately equal to 2.15 volts times the number of cells in the system, e.g., a 24 cell system would read: $24 \times 2.15v = 51.6$ volts.

9.7 Connection Resistance

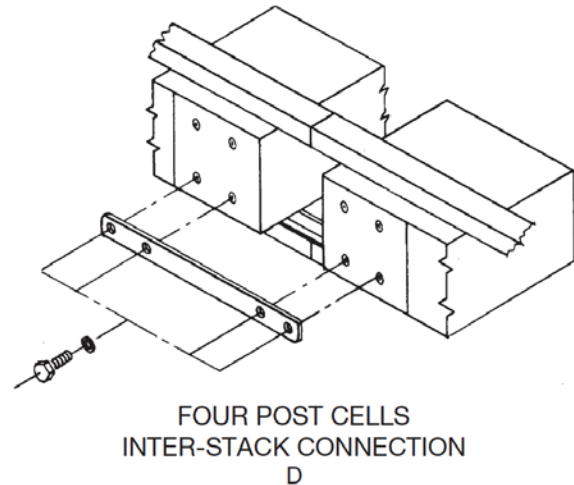
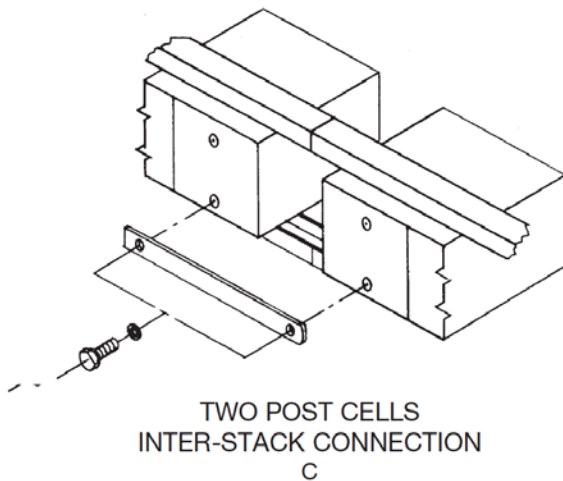
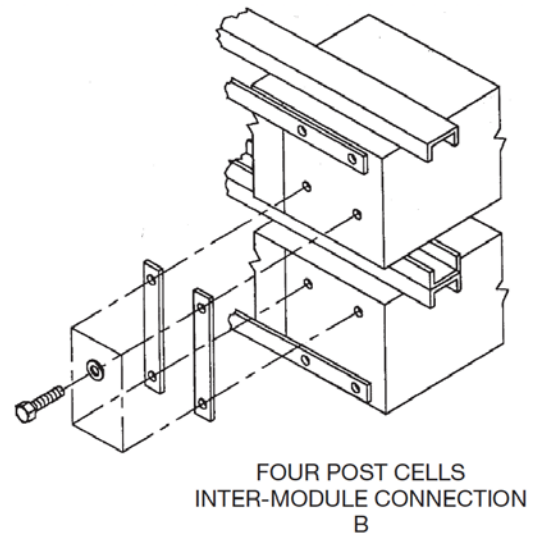
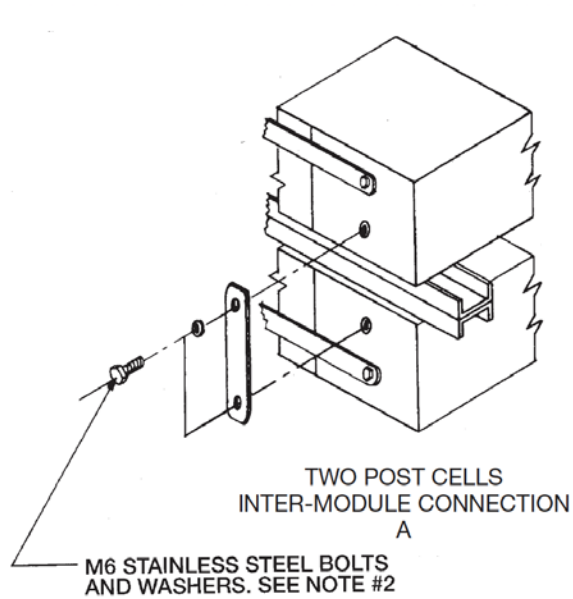
Electrical integrity of connections can be objectively established by measuring the resistance of each connection. These resistances are typically in the microhm range. Meters are available which determine connection resistance in microhms. Be sure that the probes are touching only the posts to ensure that the contact resistance of connector to post is included in the reading.

Resistance measurements or microhm measurements should be taken at the time of installation and annually thereafter. Initial measurements at installation become the bench mark values and should be recorded for future monitoring of electrical integrity.

It is important that the bench mark value for all similar connections be no greater than 10% over the average. If any connection resistance exceeds the average by more than 10%, the connection should be remade so that an acceptable bench mark value is established.

Bench mark values for connection resistances should also be established for terminal plates, where used, as well as cable connections. Bench mark values should preferably be established upon installation.

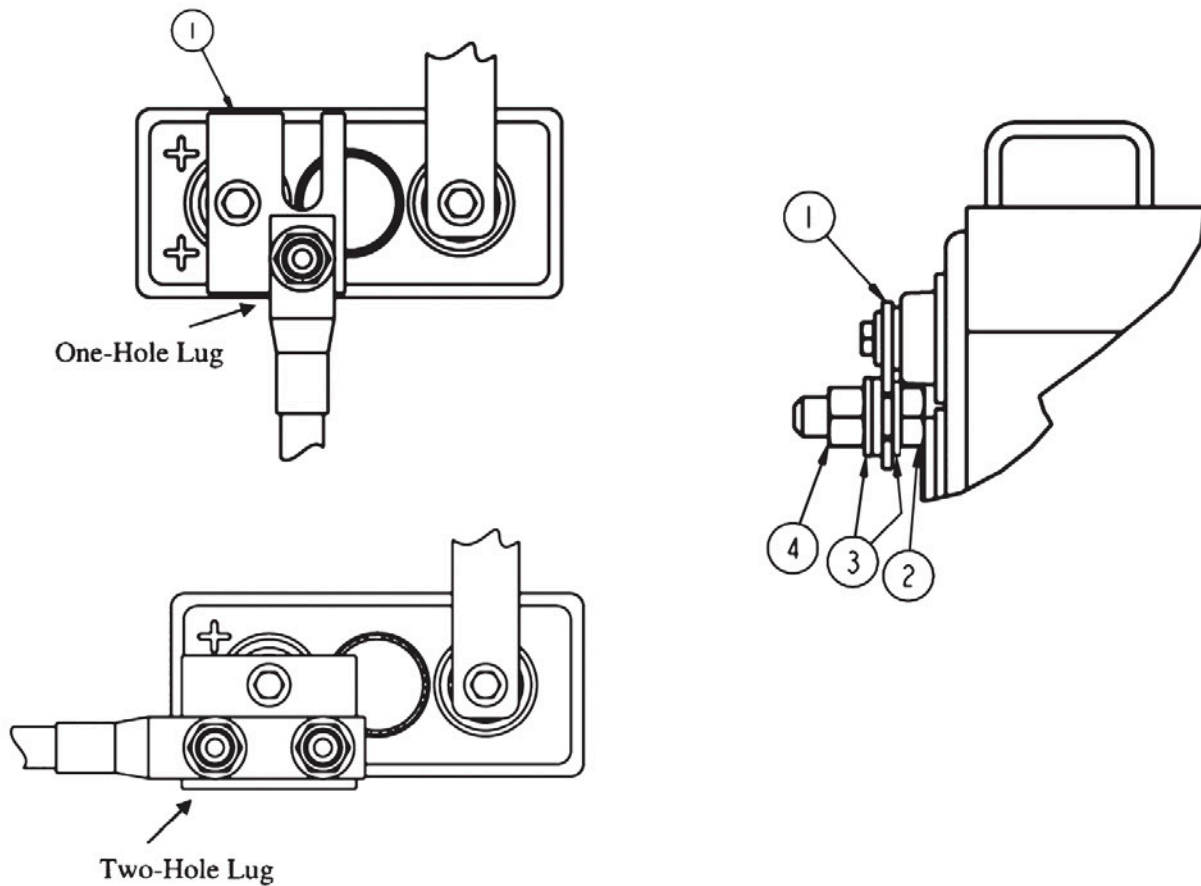
All bench mark values should be recorded. Annually, all connection resistances should be re-measured. Any connection which has a resistance value 20% above its benchmark value should be corrected.



Note:

- 1) See Section 9 - Connections
- 2) Torque hardware to 11.3 Newton-meters (100 in-lbs).
- 3) Consult layout/wiring diagram received with battery system
- 4) Curved edge of washer should face the connector.

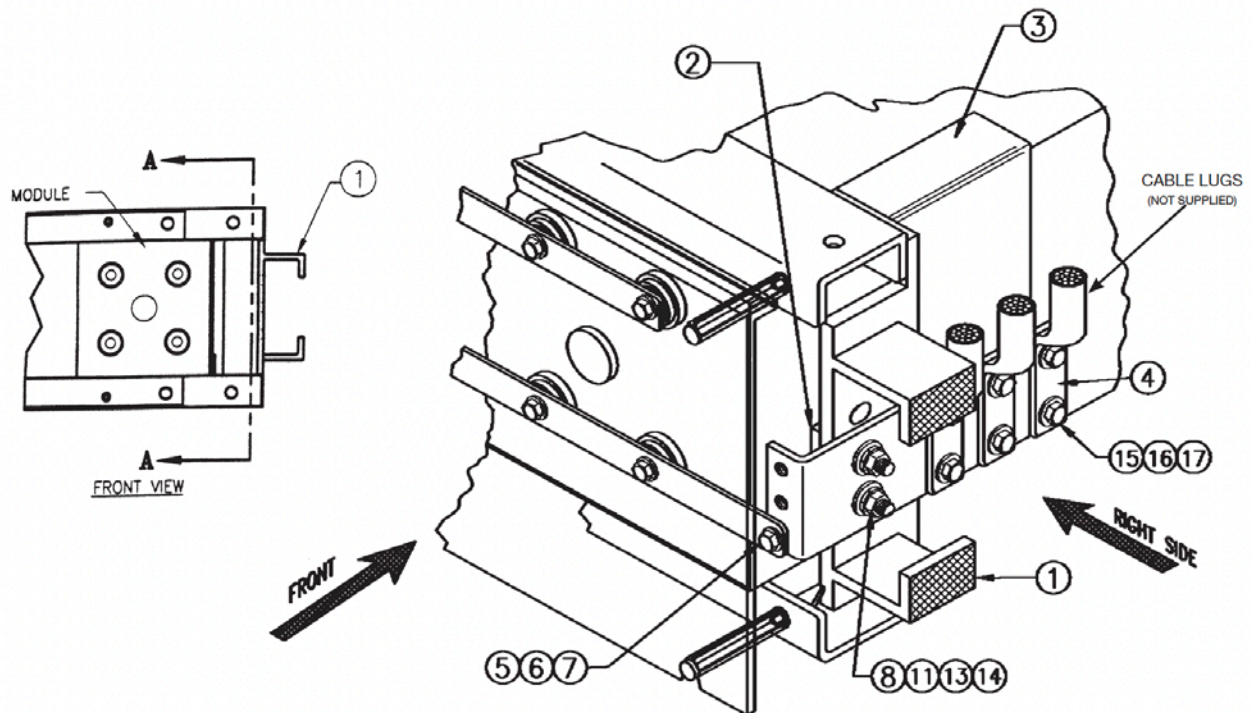
VARIOUS INTER STACK AND
INTER-MODULE CONNECTIONS
HORIZONTAL ARRANGEMENTS
Figure 21



ITEM	PART DESCRIPTION	MATERIAL	QTY.
1	TERMINAL PLATE	LEAD PL. COPPER	1
2	BOLT M12 - 30	STAINLESS STEEL	2
3	WASHER - FL 13.0 X 24.0 X 2.5	STAINLESS STEEL	4
4	NUT M12 X 8d	STAINLESS STEEL	2

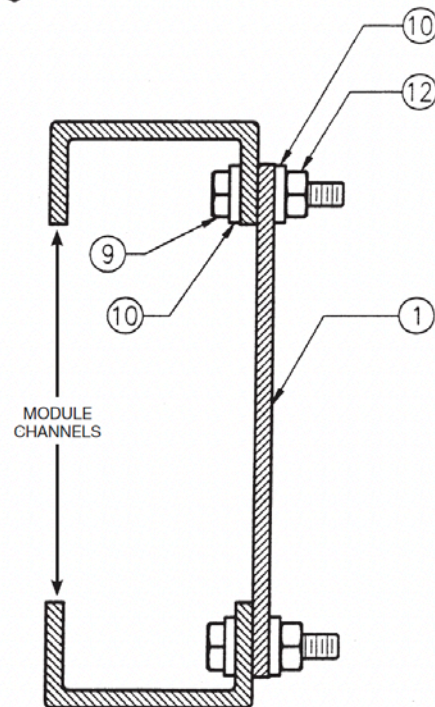
* Quantity shown is for one terminal plate assembly.

TERMINAL PLATE KIT
 6 CELL MODULES
 LOW RATE - 3 HOURS OR LONGER BACK-UP
 K17-417002
 Figure 22



ITEM	PART DESCRIPTION	MATERIAL	QTY.*
1	TERMINAL PLATE MOUNTING BRACKET	POLYMER	1
2	BACKING PLATE SUPPORT	PAINTED STEEL	1
3	TRAY INSULATING SHIELD	POLYMER	1
4	TERMINAL PLATE	COPPER LP	1
5	M6 X 25 BOLT	STAINLESS	2
6	M6 X 3 FLAT WASHER	STAINLESS	4
7	M6 NUT	STAINLESS	2
8	M10 X 40 BOLT	STAINLESS	2
9	M8 X 30 BOLT	STAINLESS	2
10	M8 X 2 FLAT WASHER	STAINLESS	4
11	M10 X 4 FLAT WASHER	STAINLESS	4
12	M8 NUT	STAINLESS	2
13	M10 LOCK WASHER	STAINLESS	2
14	M10 JAM NUT	STAINLESS	2
15	M12 X 40 BOLT	STAINLESS	6
16	M12 X 2.5 FLAT WASHER	STAINLESS	12
17	M12 NUT	STAINLESS	6

* QUANTITY SHOWN IS FOR ONE TERMINAL PLATE ASSEMBLY.



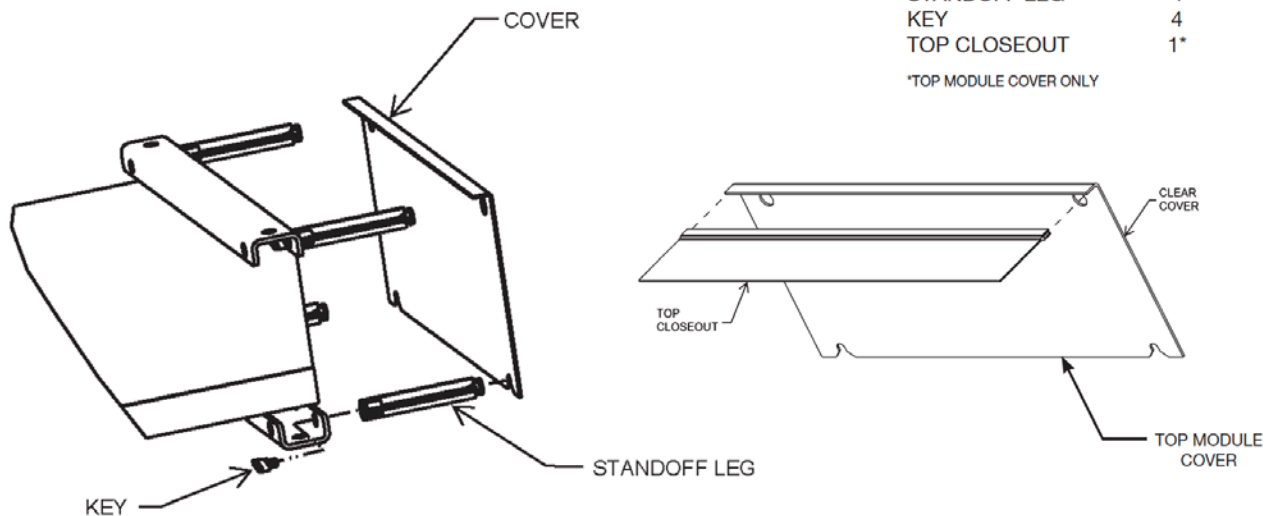
TERMINAL PLATE KIT
 K17-417003

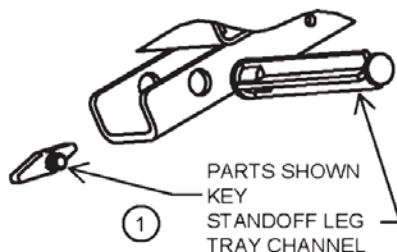
Figure 23

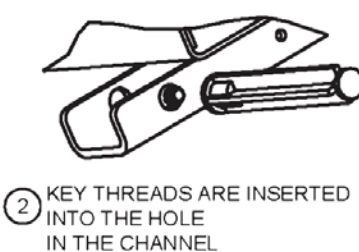
TO ASSEMBLE THE ABSOLYTE GP MODULE COVER, THE FOLLOWING ARE NEEDED:

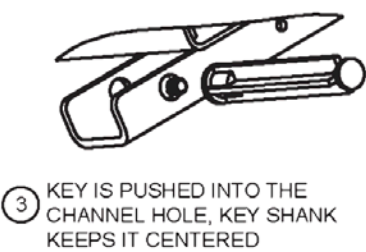
ITEM	QUANTITY
CLEAR COVER	1
STANDOFF LEG	4
KEY	4
TOP CLOSEOUT	1*

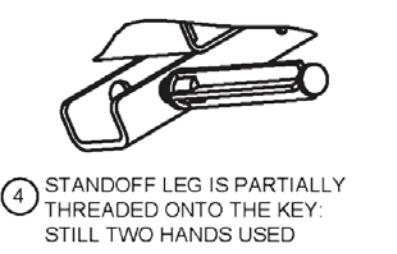
*TOP MODULE COVER ONLY

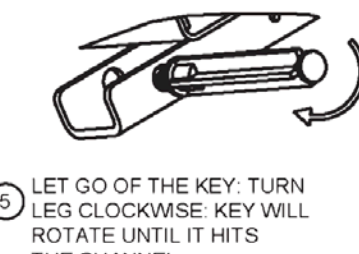


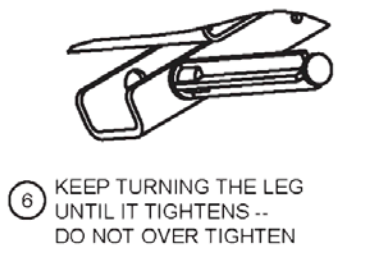
- 

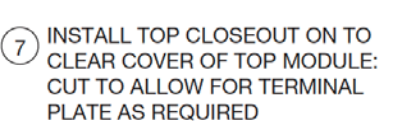
① PARTS SHOWN
KEY
STANDOFF LEG
TRAY CHANNEL
- 

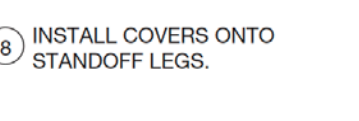
② KEY THREADS ARE INSERTED
INTO THE HOLE
IN THE CHANNEL
- 

③ KEY IS PUSHED INTO THE
CHANNEL HOLE, KEY SHANK
KEEPS IT CENTERED
- 

④ STANDOFF LEG IS PARTIALLY
THREADED ONTO THE KEY:
STILL TWO HANDS USED
- 

⑤ LET GO OF THE KEY: TURN
LEG CLOCKWISE: KEY WILL
ROTATE UNTIL IT HITS
THE CHANNEL
- 

⑥ KEEP TURNING THE LEG
UNTIL IT TIGHTENS --
DO NOT OVER TIGHTEN
- 

⑦ INSTALL TOP CLOSEOUT ON TO
CLEAR COVER OF TOP MODULE:
CUT TO ALLOW FOR TERMINAL
PLATE AS REQUIRED
- 

⑧ INSTALL COVERS ONTO
STANDOFF LEGS.

INSTALLATION GUIDE FOR ABSOLYTE AGP MODULE COVER

Figure 24

9.8 Cell Numerals

A set of pressure sensitive cell numerals and system polarity labels are supplied and should be applied at this time.

Cell numerals should be applied to the top of the module and as close to the cell being identified as possible. Suggest application to cell restraint bars or to module channels. Designate the positive terminal cell as #1 with succeeding cells in series in ascending order.

The system polarity labels should be applied next to the positive and negative terminals.

9.9 Warning Label



Apply pressure sensitive warning label provided on a prominently visible module side or end (The module cover is recommended).

9.10 Battery Nameplate

For future reference and warranty protection, apply pressure sensitive nameplate on a prominently visible module. Fill in date of installation and the specified capacity and rate.

Make sure surfaces are free of dirt and grease by wiping with clean, dry wipers to ensure proper label adhesion.

For protective module cover installation, see Section 10.

SECTION 10

10.0 Protective Module Covers



Each module is provided with a transparent protective cover to help prevent accidental contact with live module electrical connections, and to provide easy visual access to the system.

When all system assembly has been completed, as well as initial testing including initial charge and cell float voltage readings, all covers should be installed. Covers should remain in place at all times during normal operation of the battery system.

10.1 Module Cover Installation

Refer to Figure 24 for installation of the transparent Module Covers. Install standoff legs and standoff keys first, as shown.

The cover is then installed by grasping it so that the logo is upright. Locate slots at the bottom of cover to the bottom standoff legs and slide in place. Locate the holes at top of cover and install to top standoff legs. Refer to Figure 24.

SECTION 11

11.0 Initial Charge

Batteries lose some charge during shipment as well as during the period prior to installation. A battery should be given its initial charge at installation. Battery positive (+) terminal should be connected to charger positive (+) terminal and battery negative (-) terminal to charger negative (-) terminal.

Failure to perform the freshening charge within the limits stated in Section as well as failure to perform the initial charge upon installation of the battery 4 will affect the performance and life of the battery and may void the warranty.



11.1 Constant Voltage Method

Constant voltage is the only charging method allowed. Most modern chargers are of the constant voltage type.

Determine the maximum voltage that may be applied to the system equipment. This voltage, divided by the number of cells connected in series, will establish the maximum volts per cell (VPC) that is available.

Table B lists recommended voltages and charge times for the initial charge. Select the highest voltage the system allows to perform the initial charge in the shortest time period.

NOTE: Time periods listed in Table B are for 77°F. For other temperatures a compensation factor of .003 V/°F (.0055 V/°C) per cell is recommended. The minimum voltage is 2.20 VPC, temperature correction does not apply below this voltage.

TEMPERATURE CORRECTION

$V_{corrected} = V_{25^{\circ}C} - ((T_{actual} - 25^{\circ}C) \times (.0055V/^{\circ}C))$ or
 $V_{corrected} = V_{77^{\circ}F} - ((T_{actual} - 77^{\circ}F) \times (.003V/^{\circ}F))$

See Appendix A for standard values.

STEP 1

A. Set constant voltage charger to maximum setting without exceeding 2.35 VPC. Example: For a target charge of 2.35 VPC on a 24-cell system, you would set the charger voltage to 56.4 volts.

Depending on the battery's state of charge, the charger may go into current limit at the beginning and decline slowly once the target charge voltage is reached.

B. Record time and current at regular intervals – every hour as a minimum.

C. Continue charging the battery until there is no further drop in charge current over 3 consecutive hours. This could take days if the battery has been in storage for a long time.

D. When the current has stabilized, proceed to step 2.

STEP 2

A. Continue the charge for the time listed in Table B depending on the charger voltage setting. The time is IN ADDITION to the time spent charging in Step 1. Example, charge for 12 hours if the charger voltage is set to 2.35 VPC.

TABLE B INITIAL CHARGE (77°F)	
CELL VOLTS	TIME-HRS (Minimum)
2.30	24
2.35	12

B. Record cell voltages hourly during the last 3 hours of the charge time. If, after the charge time has completed, but the lowest cell voltage has continued to rise, you may extend the charge, monitoring cell voltages hourly, until the lowest cell voltage ceases to rise.

C. Proceed to Step 3.

STEP 3

The initial charge is complete. Charger voltage can now be reduced to float voltage setting per Section 12.2. For a target float charge of 2.25 VPC on a 24-cell system, you would set the charger voltage to 54 volts.

SECTION 12

12.0 Operation

12.0.1 Cycle Method of Operation

In cycle operation, the degree of discharge will vary for different applications. Therefore, the frequency of recharging and the amount of charge necessary will vary. The amount of charge necessary depends on the number of ampere hours discharged. Generally, Absolyte GP cells require approximately 105-110% of the ampere-hours removed to be returned to achieve a full state of charge.

The upper voltage settings recommended, given that the maximum charge current is 5% of the nominal C100 Amp-hour rating and ambient temperatures of 25°C (77°F), are as follows:

2.28 ± 0.02 VPC @ 0-2% DOD

2.33 ± 0.02 VPC @ 3-5% DOD

2.38 ± 0.02 VPC @ >5% DOD

Due to the variety of applications and charging equipment (particularly in Photovoltaic systems) it is recommended that you contact an Stryten Energy representative determining proper recharge profiles.

12.1 Floating Charge Method



In this type of operation, the battery is connected in parallel with a constant voltage charger and the critical load circuits. The charger should be capable of maintaining the required constant voltage at battery terminals and also supply a normal connected load where applicable. This sustains the battery in a fully charged condition and also makes it available to assume the emergency power requirements in the event of an AC power interruption or charger failure.

12.2 Float Charge - Float Voltages



Following are the float voltage ranges recommended for the Absolyte Battery System. Select any "volts per cell" (VPC) value within the range listed that will result in the series string having an average volts per cell equal to that value.

RECOMMENDED FLOAT RANGE (@77°F)
2.23 to 2.27 VPC

NOTE: Recommended float voltages are for 77°F. For other temperatures a compensation factor of .003 V/°F (.0055 V/°C) per cell is recommended. The minimum voltage is 2.20 VPC, temperature correction does not apply below this voltage. The maximum voltage is 2.35 VPC, temperature correction does not apply above this voltage.

TEMPERATURE CORRECTION

$$V \text{ corrected} = V_{25^{\circ}\text{C}} - ((T_{\text{actual}} - 25^{\circ}\text{C}) \times (.0055\text{V}/^{\circ}\text{C})) \text{ or}$$

$$V \text{ corrected} = V_{77^{\circ}\text{F}} - ((T_{\text{actual}} - 77^{\circ}\text{F}) \times (.003\text{V}/^{\circ}\text{F}))$$

See Appendix A for standard values.

Modern constant voltage output charging equipment is recommended for the floating charger method of operation of Absolyte batteries. This type of charger, properly adjusted to the recommended float voltages and following recommended surveillance procedures, will assist in obtaining consistent serviceability and optimum life.

After the battery has been given its initial charge (refer to Section 11), the charger should be adjusted to provide the recommended float voltages at the battery terminals.

Do not use float voltages higher or lower than those recommended. Reduced capacity or battery life will result.

Check and record battery terminal voltage on a regular basis. Monthly checks are recommended. See Section 15.0, Records, second bullet. If battery float voltage is above or below the correct value, adjust charger to provide proper voltage as measured at the battery terminals.

12.3 Voltmeter Calibration



Panel and portable voltmeters used to indicate battery float voltages should be accurate at the operating voltage value. The same holds true for portable meters used to read individual cell voltages. These meters should be checked against a standard every six months and calibrated when necessary.

12.4 Recharge

All batteries should be recharged as soon as possible following a discharge with constant voltage chargers. However, to recharge in the shortest period of time, raise the charger output voltage to the highest value which the connected system will permit. Do not exceed the voltages and times listed in Table C, Section 13.2.

12.5 Determining State-of-Charge

If the normal connected load is constant (no emergency load connected), the following method can be used to determine the approximate state-of-charge of the battery. The state-of-charge can be identified to some degree by the amount of charging current going to the battery. When initially placed on charge or recharge following a discharge, the charging current, read at the charger ammeter, will be a combination of the load current

plus the current necessary to charge the battery. The current to the battery will start to decrease and will finally stabilize when the battery becomes fully charged. If the current level remains constant for three consecutive hours, then this reflects a state-of-charge of approximately 95 to 98%. For most requirements, the battery is ready for use.

If the normal connected load is variable (i.e. telecommunications), the following method may be used to check the state-of-charge of the battery. Measure the voltage across a pilot cell (See Section 14.0 for definition of pilot cell). If the voltage is stable for 24 consecutive hours, the battery reflects a state of charge of approximately 95%.

12.6 Effects of Float Voltage



Float voltage has a direct effect on the service life of your battery and can be the cause of thermal instability.

A float voltage above the recommended values reduces service life. The chart below shows the effects of float voltage (temperature corrected) on battery life.

Temperature corrected 77°F (25°C)		Percent
Float voltage per cell		Reduction in Battery Life
Minimum	Maximum	
2.23	2.27	0%
2.28	2.32	50%
2.33	2.37	75%

Voltage records must be maintained by the user in accordance with the maintenance schedule published in this manual. To obtain the optimum service life from the battery, it is important to make sure the battery's float voltage is within the recommended range.

12.7 Float Current and Thermal Management

Increased float current can portend a condition known as thermal runaway, where the battery produces more heat than it can dissipate. VRLA batteries are more prone to thermal runaway because the recombination reaction that occurs at the negative plate, and reduces water loss, also produces heat. High room temperature, improper applications, improper voltage settings, and incorrect installation practices can increase the chances of thermal runaway.

As with good record-keeping practices, monitoring float current can prevent a minor excursion from becoming a major issue.

12.8 AC Ripple

AC ripple is noise or leftover AC waveform riding on the DC charge current to the battery that the rectifier did not remove. It is usually more pronounced in UPS than telecom systems. Proper maintenance of the UPS capacitors will reduce the amount of ripple going into the battery.

Establishment of absolute limits for AC ripple has always been problematic because the degree of damage it causes

depends on the wave shape, peak-to-peak magnitude and frequency. Accurate characterization of AC ripple requires an oscilloscope and even then, only represents a picture of the ripple at that moment in time.

Whatever its exact characteristics, AC ripple is always harmful to batteries. Depending on its particular properties, ripple can result in overcharge, undercharge and microcycling that can prematurely age the battery. The most common and damaging result of AC ripple is battery heating which can lead to thermal runaway. AC ripple will decrease battery life and should be reduced as much as possible.

12.9 Ohmic Measurements

Impedance, resistance and conductance testing is collectively known in the industry as ohmic measurements. Each measurement is derived using a manufacturer-specific and proprietary algorithm and / or frequency. This means that one type of measurement cannot be converted or related easily to another. "Reference" ohmic values are of dubious value because so many factors can affect the way the readings are made and displayed by the devices. Connector configuration and AC ripple as well as differences between readings of temperature and probe placement will prevent the ohmic devices from generating consistent and meaningful data. The meters work better with monoblocs and small capacity VRLA products and less well with large (>800-Ah) VRLA and flooded battery designs. Users should be particularly skeptical of data taken on series-parallel VRLA battery configurations as the feedback signal to the device may follow unforeseen paths that can overwhelm it.

It is best for users to establish their own baseline values for their battery as specifically configured. Do not rely on reference values.

If users wish to enhance normal maintenance and record keeping with ohmic measurements, Stryten Energy recommends the trending of this data over time. Use a first set of readings taken 6 months after initial charge and installation as the baseline data. Subsequent measurements should be taken using the same device over the life of the battery. Because cell positioning within the string (connector configuration to a particular cell) can affect the reading, always compare each cell at baseline to itself in the new data. Standalone ohmic data is not sufficient to justify warranty cell replacement.

Responsible ohmic device manufacturers acknowledge that there is no direct relationship between percent ohmic change from baseline and battery capacity. A change from baseline of 25% or less is in the normal noise or variability range. Changes between 25% and 50% may call for additional scrutiny of the system. An IEEE compliant discharge test is usually warranted on systems exhibiting more than a 50% change from baseline. Consult an Stryten Energy representative for specific questions about ohmic data.

SECTION 13

13.0 Equalizing Charge



Under normal operating conditions an equalizing charge is not required. An equalizing charge is a special charge given a battery when non-uniformity in voltage has developed between cells. It is given to restore all cells to a fully charged condition. Use a charging voltage higher than the normal float voltage and for a specified number of hours, as determined by the voltage used.

Non-uniformity of cells may result from low float voltage due to improper adjustment of the charger or a panel voltmeter which reads an incorrect (higher) output voltage. Also, variations in cell temperatures greater than 5°F (2.78°C) in the series string at a given time, due to environmental conditions or module arrangement, can cause low cells.

13.1 Equalizing Frequency

An equalizing charge should be given when the following conditions exist:

- A.** The float voltage of any cell (as per Section 14.0) is less than 2.18 VPC.
- B.** A recharge of the battery is required in a minimum time period following an emergency discharge.
- C.** Individual cell(s) float is more than +/- 0.05 volts from average.
- D.** Accurate periodic records (See Section 15) of individual cell voltages show an increase in spread since the previous semi-annual readings.

An annual equalize charge is recommended to help ensure uniform cell performance.

13.2 Equalizing Charge Method

Constant voltage charging is the method for giving an equalizing charge. Determine the maximum voltage that may be applied to the system equipment. This voltage, divided by the number of cells connected in series, will establish the maximum volts per cell that may be used to perform the equalizing charge in the shortest period of time (not to exceed 2.35 VPC applicable at 77°F, 25°C). Refer to Table C for voltages and recommended time periods.

NOTE: Charge volts listed in Table C are for 77°F. For other temperatures a compensation factor of .003 V/°F (.0055 V/°C) per cell is recommended. The minimum voltage is 2.20 VPC. The maximum voltage is 2.35 VPC. Temperature correction does not apply outside of this range. $V_{corrected} = V_{25°C} - ((T_{actual} - 25°C) \times (.0055 \text{ V/°C}))$ or $V_{corrected} = V_{77°F} - ((T_{actual} - 77°F) \times (.003 \text{ V/°F}))$

See Appendix A for standard values.

STEP 1

- A.** Set constant voltage charger to maximum setting without

exceeding 2.35 VPC.

Example: For a target charge of 2.35 VPC on a 24-cell system, you would set the charger voltage to 56.4 volts.

- B.** Record time and current at regular intervals – every hour as a minimum.
- C.** Continue charging the battery until there is no further drop in charge current over 3 consecutive hours.
- D.** When the current has stabilized, proceed to step 2.

STEP 2

- A.** Continue the charge for the time listed in Table C depending on the charger voltage setting. The time is IN ADDITION to the time spent charging in Step 1.

Example, charge for 12 hours if the charger voltage is set to 2.35 VPC.

TABLE C EQUALIZE CHARGE (77°F)	
CELL VOLTS	TIME (HOURS)
2.30	24
2.35	12

- B.** Record cell voltages hourly during the last 3 hours of the charge time. If, after the charge time has completed, but the lowest cell voltage has continued to rise, you may extend the charge, monitoring cell voltages hourly, until the lowest cell voltage ceases to rise.

- C.** Proceed to Step 3.

STEP 3

The Equalize charge is now complete. Charger voltage can now be reduced to float voltage setting per Section 12.2. For a target float charge of 2.25 VPC on a 24-cell system, you would set the charger voltage to 54 volts.

SECTION 14

14.0 Pilot Cell



A pilot cell is selected in the series string to reflect the general condition of cells in the battery. The cell selected should be the lowest cell voltage in the series string following the initial charge. See Section 11.0 - Initial Charge. Reading and recording pilot cell voltage monthly serves as an indicator of battery condition between scheduled overall individual cell readings.

SECTION 15

15.0 Records



The following information must be recorded at installation, and annually for every year of operation after installation. These records must be maintained throughout the life of the battery and made available

for review by Stryten Energy representatives for capacity or life related warranty claims. Failure to collect and store these maintenance data will void the warranty. Please review the warranty statement specific to the battery application for any additional requirements.

- Individual cell voltages
- Overall string voltage
- Ambient temperature immediately surrounding battery
- Battery temperature at several places throughout the string. Recommend 1 reading per battery stack. More data points are recommended for larger batteries and to check for temperature gradients. Readings on the tray, cell cover or negative terminal are good places to measure battery temperature. Take readings away from HVAC sources.
- Float current measured at stack to stack connections (optional)
- Ohmic measurements (optional). Baseline ohmic readings of individual cells should be taken 6 months from the date of initial charge.
- Retorque connectors as part of annual maintenance.

ONCE PER YEAR READINGS ARE THE ABSOLUTE MINIMUM REQUIRED TO PROTECT WARRANTY. More frequent readings are recommended, especially for critical sites. Good record-keeping will prevent minor issues from escalating into more serious problems over time. See Figure 25 for sample record keeping form.

SECTION 16

16.0 Tap Connections

Tap connections should not be used on a battery. This can cause overcharging of the unused cells and undercharging of those cells supplying the load, thus reducing battery life.

SECTION 17

17.0 Temporary Non-Use

An installed battery that is expected to stand idle longer than the maximum storage interval (see Sec. 4.2), should be treated as stated below. The maximum storage interval is 6 months if stored at 77°F.

Give the battery an equalizing charge as per Section 13. Following the equalizing charge, open connections at the battery terminals to remove charger and load from the battery.

Repeat the above after every 6 months (77°F) or at the required storage interval. See Section 4.2 for adjustments to storage intervals when the storage temperature exceeds 77°F.

To return the battery to normal service, re-connect the battery to the charger and the load, give an equalizing charge and return the battery to float operation.

SECTION 18

18.0 Unit Cleaning

Periodically clean cell covers with a dry 2" paintbrush to remove accumulated dust. If any cell parts appear to be damp with electrolyte or show signs of corrosion, contact your local Stryten Energy representative.



CAUTION!

Do not clean plastic parts with solvents, detergents, oils, mineral spirit or spray type cleaners as these may cause crazing or cracking of the plastic materials.



CAUTION!

DO NOT WORK ON CONNECTIONS WITH BATTERY CONNECTED TO CHARGER OR LOAD.

SECTION 19

19.0 Connections



Battery terminals and intercell connections should be corrosion free and tight for trouble-free operation. Periodically these connections should be inspected.

If corrosion is present, disconnect the connector from the terminal.

Gently clean the affected area using a suede brush or Scotch Brite scouring pad. Apply a thin coating of NO-OX-ID "A" grease to the cleaned contact surfaces, reinstall connectors and retorque connections to 11.3 Newton-meters (100 inch pounds).

ALL TERMINAL AND INTERCELL CONNECTIONS SHOULD BE RETORQUED AT LEAST ONCE EVERY YEAR TO 11.3 NEWTON-METERS (100 INCH POUNDS).

NOTE: Design and/or specifications subject to change without notice. If questions arise, contact your local sales representative for clarification.

SECTION 20

20.0 Capacity Testing

When a capacity discharge test is desired, it is recommended that it be performed in accordance with IEEE-1188*, latest revision.

An equalizing charge, as described in Section 13.2, must be completed within 7 days prior to the capacity test. The batteries must be returned to float charging immediately after the equalize charge completes. Allow the batteries to float at least 72 hours prior to capacity discharge.

After the capacity discharge has completed, the batteries can be recharged in the shortest amount of time by following the equalize charge procedure described in Section 13.2.

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

DATE: _____
 COMPANY: _____
 ADDRESS: _____
 No. of CELLS: _____ TYPE: _____
 SERIAL NUMBER: _____
 BATTERY LOCATION / NUMBER: _____
 MANUF. DATE: _____
 INSTALL DATE: _____
 SYSTEM VOLTAGE: _____ TEMPERATURE: _____ CHARGER VOLTAGE: _____ CHARGER CURRENT: _____
 PAGE 1 OF _____



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

ADDITIONAL COMMENTS:

DATE: _____ ABSOLYTE BATTERY MAINTENANCE REPORT
 COMPANY: _____ SERIAL NUMBER: _____ PAGE 1 OF _____
 ADDRESS: _____ BATTERY LOCATION / NUMBER: _____
 No. of CELLS: _____ TYPE: _____ MANUF. DATE: _____ INSTALL DATE: _____
 SYSTEM VOLTAGE: _____ TEMPERATURE: _____ CHARGER VOLTAGE: _____ CHARGER CURRENT: _____

Cell No.	Volts	Conn. Resist.	Ohmic C / R / I	Temp	Cell No.	Volts	Conn. Resist.	Ohmic C / R / I	Temp	Cell No.	Volts	Conn. Resist.	Ohmic C / R / I	Temp	Cell No.	Volts	Conn. Resist.	Ohmic C / R / I	Temp
121					181					211					221				
122					182					212					222				
123					183					213					223				
124					184					214					224				
125					185					215					225				
126					186					216					226				
127					187					217					227				
128					188					218					228				
129					189					219					229				
130					190					220					230				
131					191					221					231				
132					192					222					232				
133					193					223					233				
134					194					224					234				
135					195					225					235				
136					196					226					236				
137					197					227					237				
138					198					228					238				
139					199					229					239				
140					200					230					240				
141					201					231									
142					202					232									
143					203					233									
144					204					234									
145					205					235									
146					206					236									
147					207					237									
148					208					238									
149					209					239									
150					210					240									

ADDITIONAL COMMENTS: _____

APPENDIX A
Temperature Corrected Float Voltages
 Expressed in Volts per Cell

		Float Voltage at 25°C				
		2.23	2.24	2.25	2.26	2.27
Battery Temperature (°C)	3	2.35				
	4	2.35	2.35			
	5	2.34	2.35			
	6	2.34	2.35			
	7	2.33	2.34	2.35		
	8	2.33	2.34	2.35		
	9	2.32	2.33	2.34	2.35	
	10	2.32	2.33	2.34	2.35	
	11	2.31	2.32	2.33	2.34	2.35
	12	2.31	2.32	2.33	2.34	2.35
	13	2.30	2.31	2.32	2.33	2.34
	14	2.30	2.31	2.32	2.33	2.34
	15	2.29	2.30	2.31	2.32	2.33
	16	2.28	2.29	2.30	2.31	2.32
	17	2.28	2.29	2.30	2.31	2.32
	18	2.27	2.28	2.29	2.30	2.31
	19	2.27	2.28	2.29	2.30	2.31
	20	2.26	2.27	2.28	2.29	2.30
	21	2.26	2.27	2.28	2.29	2.30
	22	2.25	2.26	2.27	2.28	2.29
	23	2.25	2.26	2.27	2.28	2.29
	24	2.24	2.25	2.26	2.27	2.28
	25	2.23	2.24	2.25	2.26	2.27
	26	2.23	2.24	2.25	2.26	2.27
	27	2.22	2.23	2.24	2.25	2.26
	28	2.22	2.23	2.24	2.25	2.26
	29	2.21	2.22	2.23	2.24	2.25
	30	2.21	2.22	2.23	2.24	2.25
	31	2.20	2.21	2.22	2.23	2.24
	32	2.20	2.21	2.22	2.23	2.24
	33		2.20	2.21	2.22	2.23
	34		2.20	2.21	2.22	2.23
	35			2.20	2.21	2.22
	36			2.20	2.20	2.21
	37				2.20	2.21
	38					2.20
	39					2.20

		Float Voltage at 77°F				
		2.23	2.24	2.25	2.26	2.27
Battery Temperature (°F)	55	2.30	2.31	2.32	2.33	2.34
	56	2.29	2.30	2.31	2.32	2.33
	57	2.29	2.30	2.31	2.32	2.33
	58	2.29	2.30	2.31	2.32	2.33
	59	2.28	2.29	2.30	2.31	2.32
	60	2.28	2.29	2.30	2.31	2.32
	61	2.28	2.29	2.30	2.31	2.32
	62	2.28	2.29	2.30	2.31	2.32
	63	2.27	2.28	2.29	2.30	2.31
	64	2.27	2.28	2.29	2.30	2.31
	65	2.27	2.28	2.29	2.30	2.31
	66	2.26	2.27	2.28	2.29	2.30
	67	2.26	2.27	2.28	2.29	2.30
	68	2.26	2.27	2.28	2.29	2.30
	69	2.25	2.26	2.27	2.28	2.29
	70	2.25	2.26	2.27	2.28	2.29
	71	2.25	2.26	2.27	2.28	2.29
	72	2.25	2.26	2.27	2.28	2.29
	73	2.24	2.25	2.26	2.27	2.28
	74	2.24	2.25	2.26	2.27	2.28
	75	2.24	2.25	2.26	2.27	2.28
	76	2.23	2.24	2.25	2.26	2.27
	77	2.23	2.24	2.25	2.26	2.27
	78	2.23	2.24	2.25	2.26	2.27
	79	2.22	2.23	2.24	2.25	2.26
	80	2.22	2.23	2.24	2.25	2.26
	81	2.22	2.23	2.24	2.25	2.26
	82	2.22	2.23	2.24	2.25	2.26
	83	2.21	2.22	2.23	2.24	2.25
	84	2.21	2.22	2.23	2.24	2.25
	85	2.21	2.22	2.23	2.24	2.25
	86	2.20	2.21	2.22	2.23	2.24
	87	2.20	2.21	2.22	2.23	2.24
	88		2.21	2.22	2.23	2.24
	89		2.20	2.21	2.22	2.23
	90		2.20	2.21	2.22	2.23
	91			2.21	2.22	2.23
	92			2.21	2.22	2.23
	93			2.20	2.21	2.22
	94			2.20	2.21	2.22
	95				2.21	2.22

APPENDIX B
MAXIMUM STORAGE INTERVAL BETWEEN FRESHENING CHARGES
VERSUS AVERAGE STORAGE TEMPERATURE

		Maximum Storage Interval	
		Months	Days
Average Ambient Storage Temperature (°C)	25	6	0
	26	5	18
	27	5	7
	28	4	26
	29	4	16
	30	4	7
	31	3	29
	32	3	21
	33	3	13
	34	3	7
	35	3	0
	36	2	24
	37	2	18
	38	2	13
	39	2	8
	40	2	4
	41	1	29
	42	1	25
	43	1	22
	44	1	18
	45	1	15

		Maximum Storage Interval	
		Months	Days
Average Ambient Storage Temperature (°F)	77	6	0
	78	5	23
	79	5	17
	80	5	10
	81	5	4
	82	4	29
	83	4	23
	84	4	18
	85	4	12
	86	4	7
	87	4	3
	88	3	28
	89	3	23
	90	3	19
	91	3	15
	92	3	11
	93	3	7
	94	3	4
	95	3	0
	96	2	27
	97	2	23
	98	2	20
	99	2	17
	100	2	14
	101	2	11
	102	2	9
	103	2	6
	104	2	4
	105	2	1
	106	1	29
	107	1	27
	108	1	25
	109	1	23
	110	1	21
	111	1	19
	112	1	17
	113	1	15

APPENDIX C

BONDING & GROUNDING OF BATTERY RACK

INTRODUCTION

1. To insure personnel safety, and equipment protection, operation, and reliability, the battery rack should be connected to the Common Bonding Network (CBN).
2. Electrical continuity between modules is provided through the use of serrated hardware. If continuity between the horizontal supports (I-beams) and the bottom module is desired, the use of a grounding kit (Stryten Energy P/N: K17ABSIIIPGRND) is required.

This kit is available through your local Stryten Energy representative.

GROUNDING KIT INSTALLATION

1. Each kit consists of the following components:
 - (2) #6 AWG, 12 in. 90°C cables
 - (4) "C" shaped beam clamps
 - (4) 1/4-20 x 0.75 in. bolts
 - (4) 1/4-20 x 1.00 in. bolts
2. Using (1) 1/4-20 x 1.00 in. bolt per beam clamp, connect (1) beam clamp to the I-beam flange and (1) beam clamp to the back flange of the module (see Figure 1). Be sure to securely tighten the bolts such that the paint is penetrated (see Figure 2).
3. Attach each end of cable assembly to a beam clamp using (1) 1/4-20 x 0.75 in. bolt per end (see Figure 3). Tighten hardware securely.
4. Repeat Steps 2 and 3 for the second horizontal support (I-beam)

CONNECTING TO THE CBN

1. The recommended location for attaching the frame ground is the back "C" channel on the upper module of the stack (see Figure 4).
2. Once the location is determined, it will be necessary to drill (2) holes for the frame ground conductor/lug (installer supplied). Note, hole size and spacing will be dependent on the lug.
3. Using a grinder, etc., remove the paint from around the holes drilled in Step 2. Apply a thin film of NO-OX-ID "A" grease to the bare metal and attach the frame ground conductor/lug.



Figure 1:
Beam Clamp
Installation



Figure 2:
Adequate Paint
Penetration

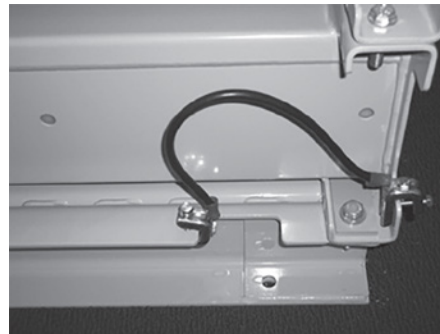


Figure 3:
Cable Assembly
Installation



Figure 4:
Recommended
Frame Ground
Location

APPENDIX D
**Maximum Module Stack Heights
Horizontal Arrangement**

1997 UBC Ground Level Zone					
Series	Height	1	2B	3	4
100G	10 high	100G33	100G33	100G31	100G17
	9 high	100G33	100G33	100G33	100G23
	8 high	100G33	100G33	100G33	100G33
90G	10 high	90G15	90G15	90G15	90G09
	9 high	90G15	90G15	90G15	90G11
	8 high	90G15	90G15	90G15	90G15
50G	10 high	50G09	50G09	50G09	50G09
	9 high	50G11	50G11	50G11	50G11
	8 high	50G15	50G15	50G15	50G15

IEEE 693-2005 Certification Level			
Series	Height	High	Moderate
100G	10 high		
	8 high		X
	5 high		X
90G	10 high		
	8 high		X
	5 high	X	
50G	10 high		
	8 high		X
	5 high	X	

IBC 2018 Certification			
Series	Height	S _{DS} at/below grade	S _{DS} above grade
100G*	10 high		
	8 high	0.81	0.51
	5 high	0.81	0.51
90G	10 high		
	8 high	0.81	0.51
	5 high	2.50	1.56
50G	10 high		
	8 high	0.81	0.51
	5 high	2.50	1.56

*For higher SDS design, contact Stryten Energy

The Energy to Challenge

Stryten Energy helps solve the world's most pressing energy challenges with a broad range of energy storage solutions and components across the Essential Power, Motive Power, Transportation, Military and Government sectors. Headquartered in Alpharetta, Georgia, we partner with some of the world's most recognized companies to meet the growing demand for reliable and sustainable energy storage capacity. Stryten powers everything from submarines to subcompacts, microgrids, warehouses, distribution centers, cars, trains and trucks. Our stored energy technologies include advanced lead, lithium and vanadium redox flow batteries, intelligent chargers and energy performance management software that keep people on the move and supply chains running.

Learn more at www.stryten.com