GNB

ABSOLYTE® XL

Batteries

I & O MANUALS

Section 92.80

Installation and Operating Instructions For ABSOLYTE® XL Batteries

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

SECTION 1: SAFETY MESSAGES

1.0 General Information

CAUTION!

Before proceeding with the unpacking, handling, installation and operation of this sealed lead-acid storage battery, the following information should be reviewed thoroughly. The safety procedures should be strictly adhered to when working with Absolyte XL batteries.

1.1 Sulfuric Acid Burns

DANGER!
SULFURIC ACID BURNS

Batteries contain sulfuric acid which can cause burns and other serious injury. **In the event of contact with sulfuric acid, 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.

1.2 Explosive Gases

DANGER!
EXPLOSIVE GASES

Batteries could generate explosive gases, which when released, can explode and cause blindness and other serious injury. If the safety vent opens while the explosive gases are being generated (eg. in the event of a charger malfunction), these explosive gases will be released.

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

All installation tools should be adequately covered with vinyl electrical tape to minimize possibility of shorting across connections.

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

1.3 Electrical Shock and Burns

DANGER!
ELECTRICAL SHOCK AND BURNS

HIGH VOLTAGE...
RISK OF SHOCK.
DO NOT TOUCH
UNINSULATED
TERMINALS OR
CONNECTORS.

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.

Ensure 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 GNB representative. Local conditions may introduce situations not covered by GNB Safety Precautions. If so, contact the nearest GNB representative for guidance with your particular safety problem; also refer to applicable federal, state and local regulations as well as industry standards.

1.3.1 Static Discharge Precautions for Batteries

When maintaining a connected battery string, 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.

1.4 Safety Alert

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

1.5 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 2: DELIVERY INFORMATION

2.1 Receipt of Shipment

Immediately upon delivery, examine packaging 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. If cell or unit damage is found, request an inspection by the carrier and file a damage claim.

2.2 Concealed Damage

Within 15 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 3: STORAGE INFORMATION

Do not remove shipping materials if a storage period is planned. To avoid cell damage do not stack pallets.

3.1 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 (25°C, 77°F), clean, dry location.

3.2 Storage Interval

If stored at 25°C (77°F) or below, the battery should be given its initial charge (refer to Section 9) at or before 6 months and recharged at 6 month intervals. Storage at elevated temperatures will result in accelerated rates of self discharge and grid corrosion. For every 10°C (18°F) temperature increase above 25°C (77°F), the time interval for the initial charge and recharge should be halved. Thus if a battery was stored at 35°C (95°F) the maximum storage interval would be 3 months. Storage beyond these periods without proper charge can result in excessive sulphation of plates which is detrimental to battery performance and life.

Failure to charge accordingly may void the battery's warranty.

Note: Storage in temperatures above 25°C (77°F) will result in loss of operating life.

SECTION 4: BATTERY ENVIRONMENT INFORMATION

4.1 General

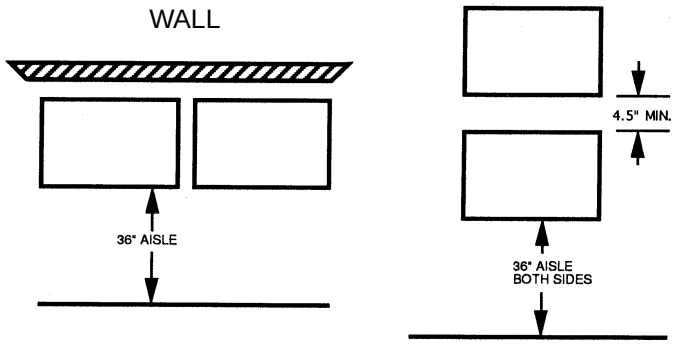
Prior to starting installation of the Absolyte XL Battery System, a review of this section is strongly recommended.

4.2 Space Considerations

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. A minimum of 36" aisle space should be available. After installation, any additional equipment installed after the battery should not compromise access to the battery system.

When planning system space requirements, allow at least 6 inches past system total length wherever a terminal plate assembly is to be located. Allow 4.5" minimum between back to back stacks.

See Figure 1 for typical space allocations required. For total length, width and height dimensions of connected systems, consult layout/wiring diagram for the particular system.



Note: Figures that are shown are top views.

TYPICAL SYSTEM SPACING
Figure 1

4.3 Battery Location & Ambient Temperature Requirements

It is recommended that the battery unit be installed in a clean, cool, dry location. Floors should be level.

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

TABLE A
TEMPERATURE EFFECTS ON LIFE

Maximum Annual Average Battery Temperature	Maximum Battery Temperature	Percent Reduction In Battery Life
25°C (77°F)	50°C (122°F)	0%
30°C (86°F)	50°C (122°F)	30%
35°C (95°F)	50°C (122°F)	50%
40°C (104°F)	50°C (122°F)	66%
45°C (113°F)	50°C (122°F)	75%
50°C (122°F)	50°C (122°F)	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 life of the battery is calculated to be only 10 years.

The battery temperature shall not be allowed to exceed 50°C (122°F). Minimum battery temperature is -40°C (-40°F). Temperature records shall be maintained by the user in accordance with the maintenance schedule published in this manual.

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 3°C (5°F).

4.4 Ventilation

Tests have confirmed that 99% of the gases generated are recombined within the cell if operated under manufacturers recommendations. No special ventilation and/or battery room is required.

Should the battery be subjected to conditions such as excessive overcharge, hydrogen and oxygen can be vented to the atmosphere. Therefore, the battery should never be installed in an air-tight enclosure. Sufficient precautions must be taken to prevent excessive overcharge.

4.5 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. Consult layout/wiring diagram for the battery system weight Prior to installation, a determination should be made that the floor integrity is adequate to accommodate the battery system.

SECTION 5: UNPACKING

5.1 General

Do not remove shipping materials if a storage period is planned.

5.2 Accessories

NOTE: Check accessory package against packing list to assure completeness. Do not proceed with installation until all accessory parts are available.

Accessories are packed separately and will include the following:

- Layout/wiring diagram
- Installation and operating instructions
- Lifting straps and lifting shackles
- Bottom Supports - I beams
- Hardware bag for I beam installation
- Hardware bag for module to module connections
- Standard clear covers
- Top clear covers
- Clear cover mounting brackets and assembly hardware
- Terminal plates
- Terminal plate mounting bracket
- Terminal plate hardware kit
- Terminal Plate Cover and assembly hardware
- Module tie plates and hardware (where required)
- Lead-Tin Plated copper connectors
- Hardware bag for connectors
- NO-OX-ID® “A” * grease
- Battery warning label
- Battery nameplate
- Cell numerals with polarity indicators
- Shims (leveling)
- Seismic Shims (where required)
- Alignment (drift) pins

*Registered Trademark of Sanchem Inc.

5.3 Recommended Installation Equipment and Supplies

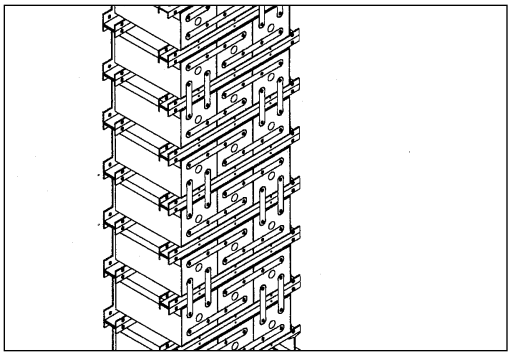
- Fork lift, portable boom crane or A-Frame hoist
  - — XL2000 Module Weight: 315 kg (695 lb)
  - — XL3000 Module Weight: 447 kg (985 lb)
  - — Bottom Support (I-beams) Height: 10 mm (4 in)
- Chalk line
- Line Cord
- Torpedo level (Plastic)
- Plywood straight edge 1/2” x 4” x 48”
- Torque wrenches (100 in-lbs, 35 ft-lbs)

- Ratchet wrench with 10, 13, 17, 19 mm and 1/2 in. sockets
- Box wrenches 10, 13, 17, 19 mm sizes
- Vinyl electrical tape
- Paper wipers
- 3M Scotch Brite® scour-pads™*
- Hammer drill (Floor anchoring)

* Registered trademark of 3M

5.4 Unpacking

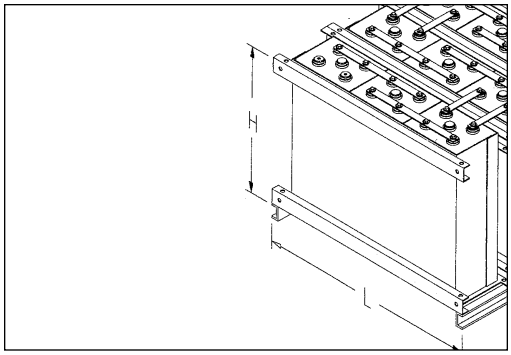
The battery modules are generally packed in groups. Lag bolts (1/2 in.) retain the modules to the shipping pallet together with a protective hood bolted in place. Modules are also bolted together at the top adjacent channels. See Figure 2.



PACKAGED MODULES
Figure 2

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 6.5 System Assembly).

Note: Placement of modules on shipping pallet has no relationship to final installation and should be disregarded.



UNPACKING MODULES
Figure 3

SECTION 6: SYSTEM ASSEMBLY

6.1 Module Assembly Identification

Consult layout/wiring diagram for total number and type of module assemblies in system. Compare required module assemblies called for on layout/wiring diagram with modules in shipment for completeness before continuing further.

The Absolyte XL has a standard module configuration of two cells per module. Where application voltage requires, a module may have only one cell in a two-cell tray. For example, a 46 volt system will consist of eleven full modules and one single-cell module. Assemblies can be rotated 180° for proper polarity location.

6.2 Stacking Limitations

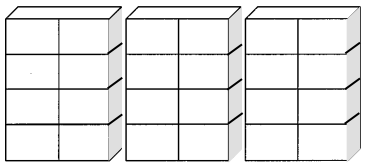
There are recommended limits on stacked (horizontal only) battery configurations, see Table B and consult your layout/wiring diagram.

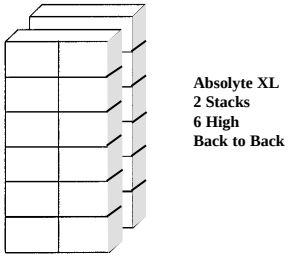
TABLE B
Absolyte XL Stacking Limitations

XL System	Non-Seismic	Seismic
XL2000	8 High	6 High
XL3000	6 High	4 High
XL4000	8 High	6 High
XL5000	6 High	4 High
XL6000	6 High	4 High

6.3 Module Arrangements

Absolyte XL batteries may only be arranged horizontally. Figure 4 shows some typical arrangements.





TYPICAL SYSTEM ARRANGEMENTS
Figure 4

Modules are shipped without connectors installed. The wiring diagram enclosed with shipment will show proper battery hook-up.

6.4 Modifications & Alterations

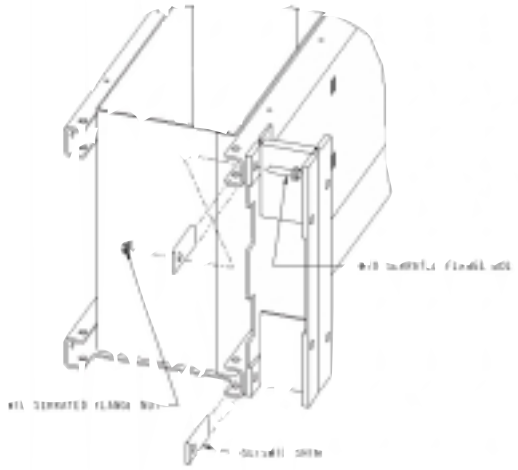
Any modifications, alterations or additions to an Absolyte XL system, without the expressed written consent of GNB Engineering, may void any warranties and/or seismic qualifications. Contact your GNB representative for additional information.

6.5 Bottom Supports (I-beams)

Locate bottom I-beam supports and M10 serrated flange bolts and nuts. 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. Consult layout/wiring diagram for proper location of positive/negative terminals relative to I-beam.

NOTE: Failure to use seismic shims (on systems where seismic shims are indicated) will result in the assembly not meeting seismic certification criteria.

Secure I-beam support to a module channel as shown in Figures 5 & 6, with access slots outward. Torque hardware to 47 Newton-meters (35 Ft-Lbs) using insulated tools. The side of the I-beam will be approximately 10mm (.38") away from the end of the channels.



I-BEAM
HARDWARE INSTALLATION
Figure 5

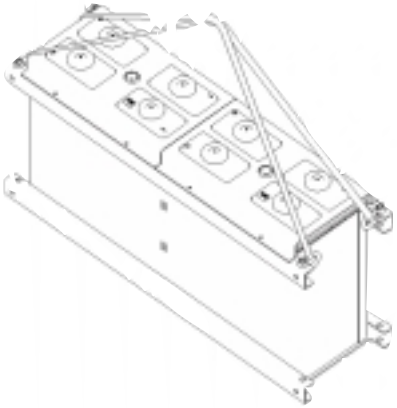
HORIZONTAL BASE SUPPORT INSTALLED
Figure 6

Similarly, install the remaining I-beam on the other side of the module.

6.6 Handling of Modules

The module/I-beam assembly may now be removed from the pallet using methods outlined below. See Figures 7 and 8. Remaining modules may be removed in a similar manner.

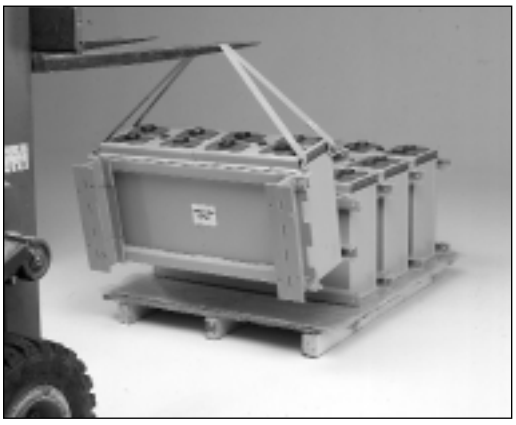
The design of the modular tray permits handling by a fork lift, portable crane or by a hoist sling . Whichever method is used, make sure equipment can safely handle the module weight. See Section 5.3 for module weights.
Always use the two lifting straps and four lifting shackles for lifting and placement of modules. See Figure 7.



HANDLING - LIFTING STRAP PLACEMENT
Figure 7

NOTE (for Figure 7):

1) Straps must be criss-crossed.
2) Observe lifting shackle orientation and proper channel hole use.
3) See Figure 13 for handling modules in horizontal orientation.
4) Never lift more than one module with straps and hooks.



HANDLING MODULE
Figure 8

6.7 Tip Over Procedure

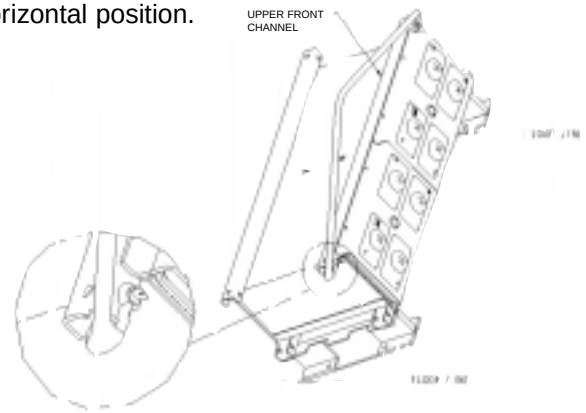
In order to stack modules in the horizontal position, refer to Figures 9 through 11 to perform the tip-over procedure. The module/I-Beam assembly tip-over should be performed first. This procedure can be performed using a portable boom crane or fork lift in conjunction with the lifting straps and lifting shackles supplied.

A. Install lifting strap using lifting shackles in channel base holes at each end of module upper **front** channel as shown in Figure 9.

B. Center the lifting hook onto strap and lift until strap is under tension and raises bottom of module from floor surface.

C. While exerting manual force on the upper **front** of module, lower hoist until module is in horizontal position. See Figures 10 and 11.

D. After tip over procedure when module is horizontal, install the four lifting shackles and two lifting straps as shown in Figure 12 to position and handle battery in horizontal position.



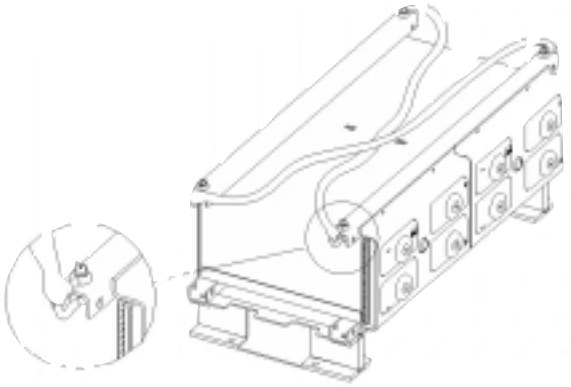
TIP-OVER PROCEDURE - SHACKLE-STRAP USAGE
Figure 9

NOTE (for Figure 9):

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.

TIP-OVER PROCEDURE
Figure 10

MODULE AFTER TIP-OVER
Figure 11



HORIZONTAL STACKING SHACKLE-STRAP USAGE
Figure 12

6.8 Floor Anchoring

Where seismic conditions are anticipated, floor anchoring should be provided. Such anchoring is the responsibility of the user.

Where non-seismic conditions are anticipated, anchoring is recommended for maximum stability.

Four 9/16” (14.3 mm) holes are provided in the I-Beam for anchoring.

Where floor anchoring is required, position module/I-Beam 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. When level, fasten assembly and torque nuts to 47 Newton-meters (35 Ft-Lbs).

6.9 Horizontal Stacking For Single Stacks

In order to complete stacking of a horizontal single stack refer to Figures 12 to 15 and steps A through C listed below.

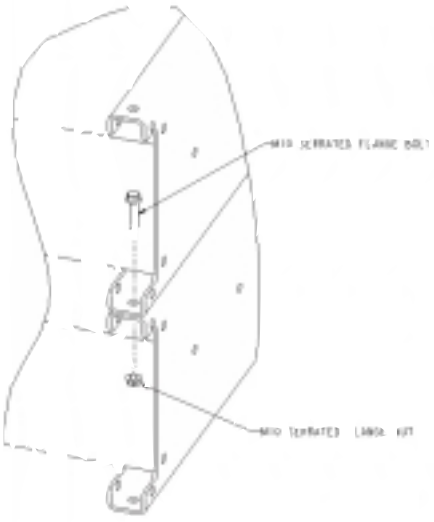
NOTE: The use of leveling shims is required when assembling any Absolyte XL system in order to meet seismic requirements. Failure to use the shims to level each module and to fill spaces between tray channels during module assembly will result in the assembly not meeting seismic certification criteria.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

A. Using Section 6.6 and 6.7 and the layout/ wiring diagram, position the next module on top of first so that channels of each mate with one another. Use drift pins to align channel holes. Make sure channel ends and sides of the upper and lower modules are flush. Remove lifting straps and install M10 serrated flange bolts and nuts in open holes, finger tight. Use leveling shims to fill gaps between trays. See Figures 13, 14 and 15.

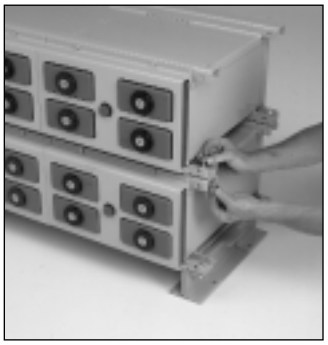
B. At this time, check to see that the first two modules are plumb front to back and side to side using wooden or plastic level together with plywood straight edge. This is to insure proper alignment for module interconnection later on. Torque hardware to 47 Newton-meters (35 Ft-Lbs).

C. 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 16 for completed assembly.

HANDLING AND STACKING HORIZONTAL MODULES
Figure 13



HARDWARE INSTALLATION SEQUENCE
Figure 14



INSTALLING HARDWARE
Figure 15

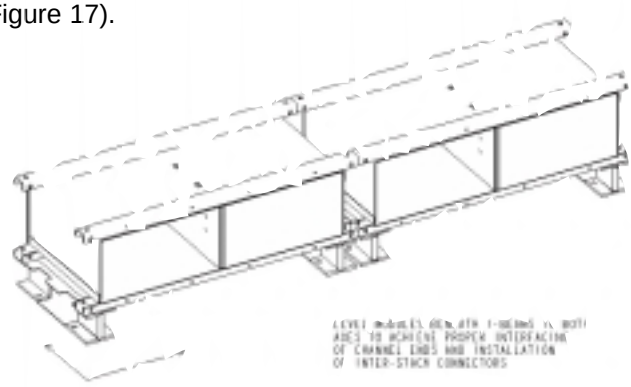
COMPLETED HORIZONTAL STACK
Figure 16

6.10 Horizontal-Multiple Stacks

6.10.1 Stacking Base Modules

It is recommended that all of the first modules with bottom supports attached (see Section 6.5) 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. Refer to Sections 6.6 and 6.7 for handling and tip over procedures.

For stacks end-to-end, module ends should be butted together so that module side channel ends meet (see Figure 17).



POSITIONING HORIZONTAL BASE MODULES
Figure 17

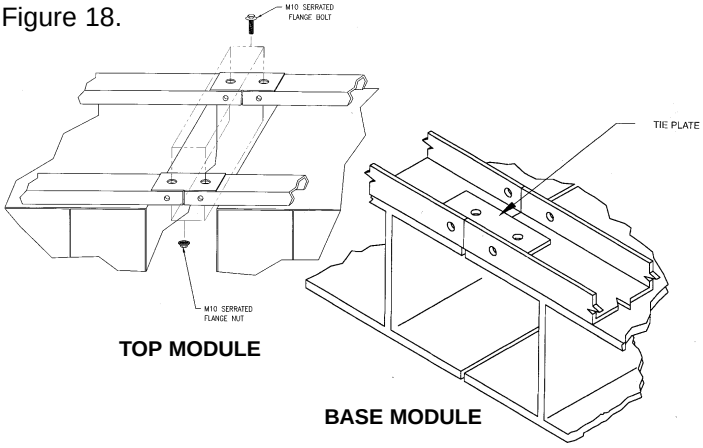
For stacks back-to-back, the two base modules are positioned to provide a minimum 4.5” spacing between the bottoms of the modules (not I-beam edges). Refer back to Figure 1.

Refer to layout/wiring diagram for seismic shim requirements.

6.10.2 Stack Tie Plates

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

To achieve maximum stack stability, especially where seismic conditions may exist, as well as proper interfacing of inter-stack 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 to connect the module channels of adjacent stacks. See Figure 18.



TIE PLATE ASSEMBLIES - HORIZONTAL STACKS
Figure 18

Position plates on the module channels and secure with hardware as shown. Where stacks have different heights (for example a 3 high stack adjacent to 4 high stack), install plates on shorter stack top module and adjacent module. Torque hardware to 47 Newton-meters (35 Ft-Lbs).

6.10.3 Horizontal Stacking

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 6.9. 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 chord attached to upper module corners of opposite end modules as stacking progresses aids in alignment.

This completes the mechanical assembly of the battery system.

For installation of intermodular connections and terminal plate assembly, see Section 7.

For installation of protective module cover, see Section 10.

SECTION 7: ELECTRICAL CONNECTIONS

7.1 Post Preparation

All module terminals were greased at the factory. 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) to all terminal surfaces, bolts, and washers. This will preclude oxidation after connections are completed.

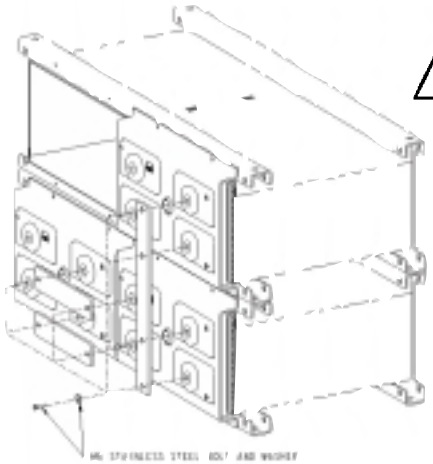
7.2 Connector Preparation

Consult layout/wiring diagram for correct quantity of lead-tin plated copper connectors required for each connection. Follow procedure in Section 7.1 and brighten lead-tin plated surfaces coming in contact with copper posts. Apply a thin film of NO-OX-ID "A" grease to these areas. 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 on horizontal arrangements that the upper bolts be installed first to reduce risk of accidental shorting.

7.3 Connections

Refer to layout/wiring diagram for connector placement and materials list. Figure 19 shows typical module connections, intrastack connections and interstack connections.

When all inter-module connections have been installed, tighten all connections to 11.3 Newton-meters (100 in-Lbs) Use insulated tools.



STACK CONNECTIONS
Figure 19

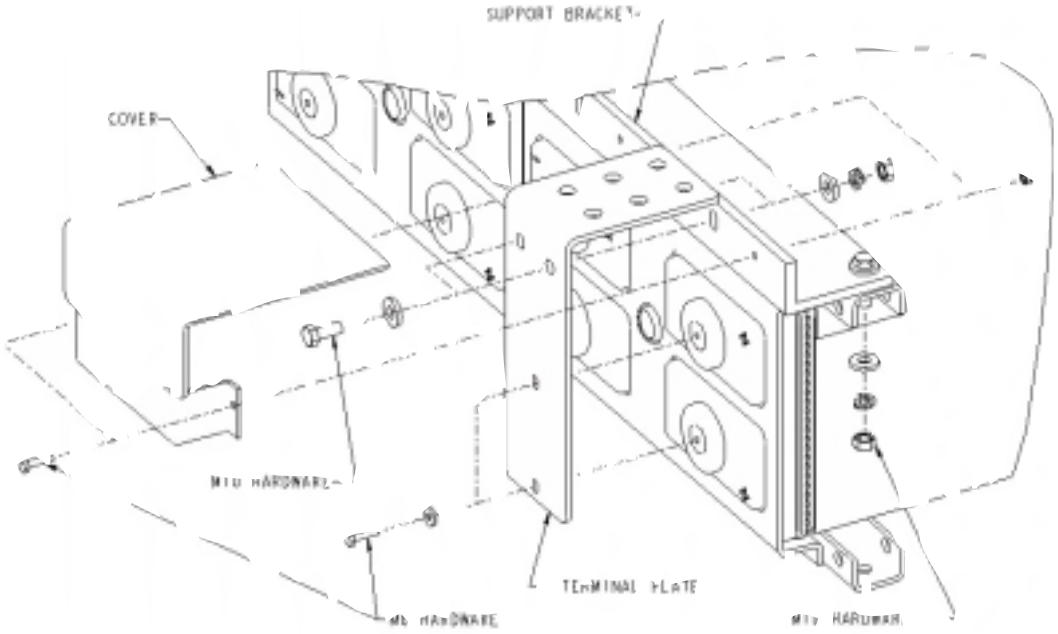
7.4 Terminal Plates

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.

Terminal plate assembly varies with termination location. Refer to layout/wiring diagram termination location on your battery. Figure 20 shows top termination assembly with instructions. Do not make connections to operating system at this time.

BILL OF MATERIALS — TOP TERMINAL PLATE ASSEMBLY

ITEM	DESCRIPTION	QTY PER SYSTEM
1	Plate - Top Terminal	2
2	Bracket — Terminal Support	2
3	Lock Washer M10	8
4	Flat Washer M10	16
5	Nut M10 X .8D	8
6	Bolt M10 X 40	8
7	Cover - Top Terminal	2
8	Nut M6 X .8D	Varies
9	Bolt M6 X 25	Varies



Assembly Instructions:

Refer to layout/wiring diagram for location of terminal plate assembly in your battery configuration. Assemble Terminal Support Bracket to module channel using hardware indicated, items 3, 4, 5, 6. Hardware will be located in bag labeled K17-417050P. Assemble Terminal Plate to Support Bracket and battery posts. Hardware to attach to Support Plate is also located in K17-417050P. It is recommended that all connections be torqued to 11 Newton-meters (100 in-Lbs). After making cable connections, assemble Terminal Plate Covers to Terminal Support Bracket using hardware indicated, items 8 & 9. Hardware to assemble Terminal Plate Covers will be located in kit labeled K17-417223. Refer to Sections 7.1 and 7.2 for electrical contact surface preparation of terminal plate components.

Terminal Plate Kit Materials & Assembly
Figure 20

7.5 Paralleling

Where it is necessary to connect battery systems in parallel to obtain sufficient capacity, cable connections to each of the parallel strings are important.

Cables should be sized to minimize voltage drop, not only for current carrying capacity. The ampacity of the cables should not be exceeded, and they should be as short as possible. However, the lengths of cables for all of the systems being paralleled to the load should be equal in length to provide proper load sharing on discharge, satisfactory recharge as well as the same float voltage per string.

7.6 Connecting Cables: Battery System to Operating Equipment

Rated 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 desired. Excess voltage drop will reduce the desired support time of the battery system.

7.7 Connection - Check

Again, visually check to see that all module terminals are connected positive (+) to negative (-) throughout the battery. Positive terminals have red cap. Negative terminals have black cap.

Also measure the total open circuit voltage from terminal plate to terminal plate. This should be approximately equal to 2.14 volts times the number of cells in the system, e.g., a 24 cell system would read: 24 x 2.14v = 51.4 volts. An incorrect voltage reading may mean connectors were installed incorrectly.

SECTION 8: IDENTIFICATION LABELS

8.1 Surfaces

Make sure surfaces are free of dirt and grease by wiping with clean, dry wipers (isopropyl alcohol may be used) to ensure proper label adhesion.

8.2 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 cell being identified. Designate the positive terminal cell as #1 with succeeding cells in series in ascending order.

8.3 System Polarity Labels

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

8.4 Warning Label

Apply pressure sensitive warning label provided on a prominently visible module side or end.

8.5 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.

SECTION 9: BATTERY CHARGING

9.1 Initial Charge

Batteries lose some charge during shipment as well as during the period prior to installation. A battery should be installed and given its initial charge as soon after receipt as possible. Battery positive (+) terminal should be connected to charger positive (+) terminal and battery negative (-) terminal to charger negative (-) terminal. Failure to perform the initial charge within the time limits stated in section 3.2 will affect the performance and life of the battery and may void the warranty.

9.2 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 C 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.

TABLE C

INITIAL CHARGE AT 25°C (77°F)

CELL VOLTS	TIME-HRS (Minimum)
2.30	24
2.35	12

NOTE: Time periods listed in Table C are for 25°C (77°F). For other temperatures see temperature correction table in Table D.

TABLE D

TEMPERATURE CORRECTION OF CHARGER VOLTAGE

ACTUAL TEMPERATURE	CORRECTED VOLTAGE
52°C (126°F) or above	2.20
45°C (113°F)	2.24
35°C (95°F)	2.30
25°C (77°F) or below	2.35

V corrected = V25°C - ((T actual -25°C) x (.0055 V/°C))
V corrected = V77°F - ((T actual - 77°F) x .003V/°F))

Raise the voltage to the maximum value permitted by the system equipment, without exceeding 2.35 VPC. When charging current has tapered and stabilized (no further reduction for three hours), charge for the hours shown in the above table or until the lowest cell voltage ceases to rise. To determine the lowest cell, monitoring should be performed during the final 10% of the charge time.

Record battery terminal voltages and individual cell voltages.

SECTION 10: PROTECTIVE MODULE COVERS

10.1 General

Each module is provided with a transparent protective cover to help prevent accidental contact with live 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.

10.2 Transparent Cover Installation

Refer to Figure 21 for Transparent Cover installation. Install standoff legs and standoff keys first, as shown.

The cover is then installed by grasping it so that the GNB logo is upright. Locate slots at bottom of cover to the bottom standoff legs and slide in place. Locate holes at top of cover and install to top standoff legs. Refer to Figure 21.

SECTION 11: BATTERY OPERATION

11.1 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. Generally, Absolyte XL cells require approximately 105-110% of the ampere-hours removed to be returned to a full state of charge.

The upper voltage settings recommended, given that the maxium charge current is 5% of the nominal C/100 Amp-hour rating and the ambient temperature is 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 a GNB representative when determining proper recharge profiles.

11.2 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.

11.3 Float Charge - Float Voltages

Following are the float voltage ranges recommended for the Absolyte XL Battery System. Set charger voltage to a value that will result in the series string having an average volts per cell between 2.23 to 2.25 VPC (25°C, 77°F)

NOTE: Recommended float voltages are for 25°C (77°F). For other temperatures apply the termperature correction factors in Table E. The minimum voltage is 2.20 VPC. The maximum voltage is 2.35 VPC.

TABLE E
TEMPERATURE CORRECTION OF FLOAT VOLTAGE:

ACTUAL TEMPERATURE	CORRECTED VOLTAGE
32°C (90°F) or above	2.20
25°C (77°F)	2.24
15°C (59°F)	2.29
5°C (40°F) or below	2.35

V corrected = V25°C - ((T actual - 25°C) x (.0055V/°C))
V corrected = V77°F - ((T actual - 77°F) x (.003 V/°F))

Modern constant voltage output charging equipment is recommended for the floating charger method of operation of GNB 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 9), the charger should be adjusted to provide the recommended float voltages at the battery terminals.

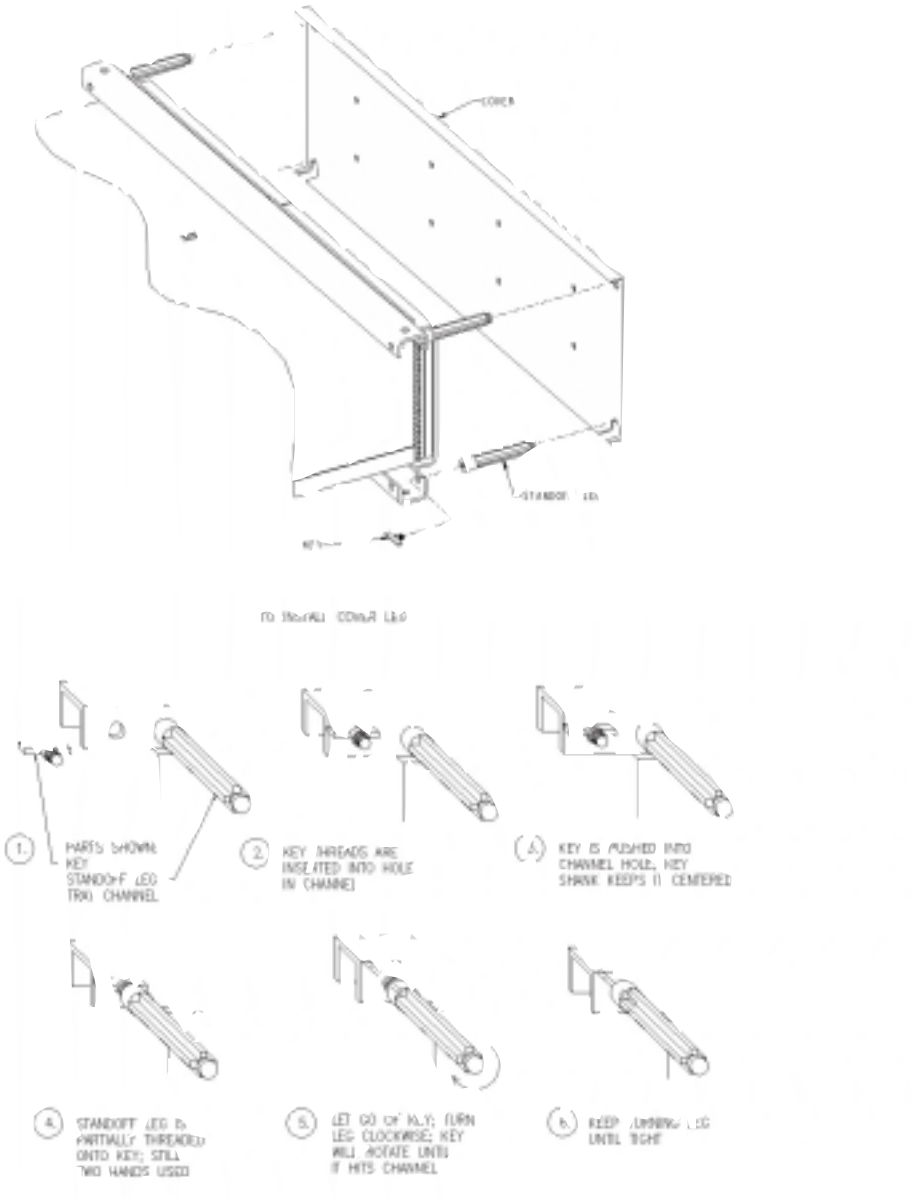
Do not use float voltages higher or lower than those recommended. Reduced capacity or battery life will result.

11.4 Recharge

All batteries should be recharged as soon as possible following a discharge with constant voltage chargers. 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 and D in Section 9 .

BILL OF MATERIALS — PROTECTIVE COVER MATERIALS

ITEM	DESCRIPTION	QTY PER SYSTEM
1	Protective Cover	1
2	Standoff Leg	4
3	Standoff Key	4



Assembly Instructions:

Install standoff legs and standoff keys to module channel as shown. The cover is then installed by grasping it so that the GNB logo is upright. Located slots at bottom of cover to bottom standoff legs and slide in place. Locate holes at top of cover and install to top standoff legs.

Standoff legs need not be removed to access cells, simply remove protective cover.

Protective Cover Materials and Assembly
Figure 21

11.5 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 12.1 for definition of pilot cell). If the voltage is stable for 24 consecutive hours, the battery reflects a state of charge of approximately 95%.

11.6 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.

TABLE F

FLOAT VOLTAGE EFFECTS ON LIFE

Temperature corrected 25°C (77°F) Float voltage per cell		Percent Reduction
Minimum	Maximum	in Battery Life
2.23	2.25	0%
2.28	2.30	50%
2.33	2.35	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.

11.7 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.

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.

11.7.1 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 25°C, 77°F). Refer to Table G for voltages and recommended time periods.

11.7.2 Equalizing Frequency

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

A. The float voltage of any cell is less than 2.18 VPC.

B. A recharge of the battery is required in a minimum time period following an emergency discharge.

C. The float voltage range within a string is greater than 0.10 volts.

D. Accurate periodic records (See Section 16) of individual cell voltages show an increase in spread since the previous semi-annual readings.

TABLE G

EQUALIZE CHARGE AT 25°C, 77°F

CELL VOLTS	TIME (HOURS)
2.30	24
2.35	12

NOTE: Charge volts listed in Table C are for 25°C (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 = V25°C - ((T actual-25°C) x (.0055 V/°C))or
V corrected = V77°F - ((T actual-77°F) x (.003 V/°F))

Raise the voltage to the maximum value permitted as described above. When charging current has tapered and stabilized (no further reduction for three hours), charge for the hours shown in Table G or until the lowest cell voltage ceases to rise. Monitoring of cell voltages should be started during the final 10% of the applicable time period to determine lowest cell in the battery.

SECTION 12: RECORDKEEPING

12.1 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 9.1 - Initial Charge. Reading and recording pilot cell voltage monthly serves as an indicator of battery condition between scheduled overall individual cell readings.

12.2 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.

12.3 Records

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

A. Upon completion of the initial charge and with the battery on float charge at the proper voltage for one week, read and record the following:
   1. Individual cell voltages
   2. Battery terminal voltages
   3. Ambient temperature
   4. Optional: Temperature of the negative terminal of each cell/unit of battery.

B. Every 12 months, a complete set of readings as specified in Paragraph A above must be done.

C. Whenever the battery is given an equalizing charge, an additional set of readings should be taken and recorded as specified in Paragraph A above.

The suggested frequency of record taking is the absolute minimum to protect warranty. For system protection and to suit local conditions or requirements, more frequent readings (monthly) are desirable. See Figure 22 for sample record form.

A complete recorded history of the battery operation is essential for obtaining satisfactory performance, and life. Good records will also show when corrective action may be required to eliminate possible charging, maintenance or environmental problems.

SECTION 13: TAP CONNECTIONS

13.1 Tap Connections

Tap connections are not to 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 14: TEMPORARY NON-USE

14.1 Temporary Non-Use

An installed battery that is expected to stand idle longer than the maximum storage interval (see Section 3.2), should be treated as stated below. The maximum storage interval is 6 months if stored at 25°C, 77°F.

Give the battery an equalizing charge as per Section 11.7.2 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 (25°C, 77°F) or at the required storage interval. See Section 3.2 for adjustments to storage intervals when the storage temperature exceeds 25°C, 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 15: BATTERY MAINTENANCE

15.1 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 GNB representative.

15.2 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.

GNB Industrial Battery Company

ABSOLYTE BATTERY MAINTENANCE REPORT

Date_____

Company_____

Address_____

Battery location and/or number_____

No. of Cells_____ Type_____ Date New_____ Date Installed_____

Serial No._____

INDIVIDUAL CELL READINGS

Charger Output_____ Amp. Air Temperature_____ °F

Total Battery Voltage_____ Panel Meter Volts_____

Cell No.	Volts	Cell No.	Volts	Cell No.	Volts	Cell No.	Volts	Cell No.	Volts	Cell No.	Volts
1		33		65		97		129		161	
2		34		66		98		130		162	
3		35		67		99		131		163	
4		36		68		100		132		164	
5		37		69		101		133		165	
6		38		70		102		134		166	
7		39		71		103		135		167	
8		40		72		104		136		168	
9		41		73		105		137		169	
10		42		74		106		138		170	
11		43		75		107		139		171	
12		44		76		108		140		172	
13		45		77		109		141		173	
14		46		78		110		142		174	
15		47		79		111		143		175	
16		48		80		112		144		176	
17		49		81		113		145		177	
18		50		82		114		146		178	
19		51		83		115		147		179	
20		52		84		116		148		180	
21		53		85		117		149		181	
22		54		86		118		150		182	
23		55		87		119		151		183	
24		56		88		120		152		184	
25		57		89		121		153		185	
26		58		90		122		154		186	
27		59		91		123		155		187	
28		60		92		124		156		188	
29		61		93		125		157		189	
30		62		94		126		158		190	
31		63		95		127		159		191	
32		64		96		128		160		192	

PILOT CELL READINGS Cell No._____

MONTHLY RECORD

Date	Pilot Cell Volts	Batt. Term. Volts	Air Temp.
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			

Remarks and Recommendations_____

READINGS TAKEN BY

WHEN ADVICE IS DESIRED PLEASE FORWARD A DUPLICATE OF THIS REPORT TO YOUR GNB REPRESENTATIVE

Figure 22

GNB

ABSOLYTE® XL

Batteries

GLOBAL OPERATIONS

NORTH AMERICA
GNB Industrial Power
Lombard, Illinois U.S.A.
TEL: 1.630.629.5200
FAX: 1.630.629.2635

GNB Industrial Power
Mississauga, Ontario Canada
TEL: 1.905.624.1107
FAX: 1.905.624.1801

EUROPE
Exide Technologies
Im Thiergarten, Germany
TEL: 49.6042.81.177
FAX: 49.6042.81.216

Exide Technologies
Aalst, Belgium
TEL: 32.53.73.53.53
FAX: 32.53.77.75.56

MIDDLE EAST/AFRICA
Exide Technologies
Abu Dhabi, U.A.E.
TEL: 971.2.226235
FAX: 971.2.227644

JAPAN
GNB Industrial Power Japan
Tokyo, Japan
TEL: 81.3.5269.1061
FAX: 81.3.5269.1069

AUSTRALIA/NEW ZEALAND
Exide Technologies
Padstow, N.S.W. Australia
TEL: 61.2.9722.5700
FAX: 61.2.9774.2966

SOUTH EAST ASIA
Exide Technologies S.E. Asia
Singapore
TEL: 65.546.2866
FAX: 65.546.2966

CHINA/HONG KONG
Exide Technologies
Kowloon, Hong Kong
TEL: 852.2.956.6688
FAX: 852.2.956.2161

LATIN AMERICA
GNB Industrial Power
Atlanta, Georgia U.S.A.
TEL: 1.770.551.9136
FAX: 1.770.206.9650

INDIA
GNB Industrial Power
Bangalore, India
TEL: 91.80.529.7326
FAX: 91.80.529.7326

www.gnb.com

Total Battery Management

GNB's commitment to the environment constitutes a complete approach to the business of recycling, manufacturing and distribution that continues to set the standard in the battery industry.

For the past 75 years, GNB has led the industry's effort to recycle rather than discard used batteries. Last year alone, GNB safely processed more than 250,000 tons of lead.

Let GNB take the risk out of the disposal of your spent batteries. As part of a Total Battery Management program, GNB will pick up and transport any spent lead acid batteries to GNB-owned, EPA approved recycling centers globally.

Only companies with the strongest possible financial resources are able to make that kind of long-term commitment to recycling — and GNB has what it takes to help you.

GNB

INDUSTRIAL POWER

(Part No. Z99-420174) RPT 4/01 Printed on recycled paper.

LEAD RETURN RECYCLE