



**RELAY GEL™**



Section 95.10 2006-04

# INSTALLATION & OPERATING INSTRUCTIONS



**INDUSTRIAL POWER**

# INDEX

	<b>Page</b>
<b>Section 1 - GENERAL INFORMATION</b>	
1.0 Relay Gel Batteries	1
<b>Section 2 - SAFETY PRECAUTIONS</b>	
2.0 Safety Alert	1
2.1 Sulfuric Acid Burns	1
2.2 Explosive Gases	1
2.3 Electrical Shock and Burns	1
2.4 Important Message	2
<b>Section 3 - RECEIPT OF SHIPMENT</b>	
3.0 Delivery Inspection	2
3.1 Concealed Damage	3
<b>Section 4 - STORAGE PRIOR TO INSTALLATION</b>	
4.0 Storage Location	3
4.1 Storage Interval	3
<b>Section 5 - GENERAL INSTALLATION CONSIDERATIONS</b>	
5.0 Battery Location	3
5.1 Battery Orientation	4
5.2 Ventilation	4
5.3 Temperature Variations	4
5.4 Floor Loading	4
5.5 Floor Anchoring	4
5.6 Open Circuit Voltage Check	5
<b>Section 6 - RACK SYSTEM - INSTALLATION</b>	
6.0 Placement of Units	5

(continued on next page)

## INDEX (continued)

	<b>Page</b>	
<b>Section 7 - ELECTRICAL INSTALLATION CONSIDERATIONS</b>		
7.0	Connecting Cables	5
7.1	Paralleling	5
7.2	Connection Preparation	5
7.3	Torqueing	6
7.4	Connections	6
7.5	Connection Check	6
7.6	Battery To Charger Connection	6
7.7	Connection Resistance	7
<b>Section 8 - INITIAL CHARGE</b>		
8.0	Constant Voltage Initial Charge	7
<b>Section 9 - OPERATION</b>		
9.0	Float Charge	8
9.1	Float Voltages	8
9.2	Voltmeter Calibration	9
9.3	Recharge	9
9.4	Determining State of Charge	10
9.5	Effects of Temperature	10
9.6	Effects of Float Voltage	11
<b>Section 10 - EQUALIZATION</b>		
10.0	Equalizing Charge	11
10.1	Equalizing Frequency	11
<b>Section 11 - MAINTENANCE SCHEDULE</b>		12
<b>Section 12 - TAP CONNECTIONS</b>		13
<b>Section 13 - TEMPORARY NON-USE</b>		13
<b>Section 14 - UNIT CLEANING</b>		13
<b>Battery Maintenance Report Template</b>		14

## SECTION 1 - GENERAL INFORMATION

### 1.0 RELAY GEL VRLA BATTERIES

In normal use, the battery will not release hydrogen gas or acid mist, and will not leak acid. However, there is the possibility that under abnormal operating conditions hydrogen gassing, acid mist, and leaking electrolyte could occur. Thus GNB recommends that Section 2 of these instructions entitled "SAFETY PRECAUTIONS" be reviewed thoroughly and strictly followed when working with batteries.

## SECTION 2 - SAFETY PRECAUTIONS



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

### 2.0 SAFETY ALERT



#### CAUTION

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

### 2.1 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 to prevent injury if contact is made with the acid.

### 2.2 EXPLOSIVE GASES



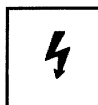
**DANGER**  
**EXPLOSIVE GASES**



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 (e.g., in the event of a charger malfunction), these explosive gases will be released.

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

### 2.3 ELECTRICAL SHOCK AND BURNS



**DANGER**  
**ELECTRICAL SHOCK  
AND BURNS**



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

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

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.


Loose or dirty connectors/connections can cause battery fires. Keep all connectors/connections clean and torques at proper values. Keep outside of batteries clean and dry. Neutralize any acid corrosion with a cloth moistened with a solution of baking soda and water, then wipe off all traces of soda.

Do not move or shift racks/cabinets once installed without first disconnecting load to rack/cabinet and all inter-rack/cabinet connections. Consult wiring diagrams for location of these connections.


Do not lift cells by terminal posts. Do not tamper with post seals, protective covers, pressure relief vents or other battery components.

Disconnect 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.

	<b>CAUTION !</b>
<p>If the foregoing precautions are not fully understood, clarification should be obtained from your nearest GNB Network Power 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 before proceeding to install or service these batteries. Refer to applicable federal, state and local regulations as well as industry standards.</p>	

## 2.4 IMPORTANT MESSAGE

	<p>The symbol at left indicates an important message. If not followed, damage to and/or impaired performance of the battery may result.</p>
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## SECTION 3 - RECEIPT OF SHIPMENT

### 3.0 DELIVERY INSPECTION

Immediately upon delivery, examine for possible damage caused in transit. Damaged packing material 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 immediately. Any battery with post or seal damage should be replaced.

### 3.1 CONCEALED DAMAGE

Within 15 days of receipt, examine all batteries for concealed damage. If damage is noted, immediately request an inspection by the carrier and file a concealed damage claim. Any delay in notifying carrier may result in loss of right to reimbursement for damages.

## SECTION 4 - STORAGE PRIOR TO INSTALLATION

### 4.0 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. Do not stack pallets or possible battery damage may occur.

### 4.1 STORAGE INTERVAL



The storage intervals between the date of shipment and the date of initial charge should not exceed six (6) months. The battery should be given its initial charge (refer to Section 8) before the end of the above stated storage interval. Storage at elevated temperatures will result in accelerated rates of self discharge. A general rule of thumb is that for every 10°C (18°F) increase above 25°C (77°F) the time interval for initial charge should be halved. For example, if a battery was stored at 35°C (95°F) the initial charge time interval would be 3 months. If the battery was stored at 30°C (86°F) the initial charge time interval would be 4.5 months. Storage beyond these periods without proper charge can result in excessive sulfation of the plates which is detrimental to battery performance and life.

## SECTION 5 - GENERAL INSTALLATION CONSIDERATIONS

Prior to starting the installation of the RELAY GEL battery system, a review of this section is strongly recommended.

### 5.0 BATTERY LOCATION



It is recommended that the battery be installed in a clean, cool, dry location. Floors should be reasonably level and able to support the battery weight. A location having an ambient temperature of 25°C (77°F) will result in optimum battery life and performance. Temperatures below 18°C (65°F) reduce battery efficiency. Temperatures above 27°C (80°F) will result in a reduction of battery life. Continuous operation above 50°C (122°F) is not recommended.

A designated aisle space should be provided to permit initial installation and future service or surveillance of the batteries.

## 5.1 BATTERY ORIENTATION

The RELAY GEL battery can only be installed in a vertical orientation with the posts pointing up (per Figure 1). This battery may not be placed on its sides. Contact your local GNB Industrial Power representative if you require the battery to be placed in a different orientation.

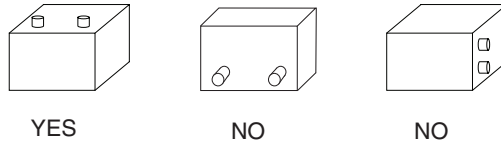


Figure 1

## 5.2 VENTILATION



The RELAY GEL battery is a valve regulated battery which under normal recommended charging in a stationary application does not vent any gases.

However, should the battery be subjected to excessive overcharge, hydrogen and oxygen can be vented to the atmosphere. Therefore, the battery should **NEVER BE INSTALLED IN AN AIRTIGHT ENCLOSURE**. Sufficient precautions must be taken to prevent excessive overcharge. Normal ventilation sufficient for human occupation will be adequate to avoid hazardous conditions.

Tests have confirmed that more than 99% of gases generated are recombined within the battery. Under normal operating conditions, no special ventilation and/or battery room is required.

RELAY GEL batteries can be installed in close proximity to electronic equipment only when the heat generated by this equipment is removed by ventilation.

## 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 should not directly influence portions of battery string temperatures. Every effort should be made to keep temperature variations within 3°C (5°F).

## 5.4 FLOOR LOADING



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

## 5.5 FLOOR ANCHORING

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

## 5.6 OPEN CIRCUIT VOLTAGE CHECK

The voltage of each unit should be checked to insure the voltage is at least 12.6 volts. If any unit has a voltage lower than 12.6 volts, follow the initial charge procedures shown in Section 8.

## SECTION 6 - RACK SYSTEM - INSTALLATION

### 6.0 PLACEMENT OF UNITS ON RACK

When installing units on a rack, start on the lower tier for stability and safety reasons. Place units on the rack so that the positive (+) of one unit is connected to the negative (-) of the next unit. Standard spacing is 12mm (1/2 inch) minimum between units.

Determine the number of units to be placed on each row. If a row of units does not fill the entire rack length, fill the remaining space with foam cell spacers in seismic installations.

## SECTION 7 - ELECTRICAL INSTALLATION CONSIDERATIONS

### 7.0 CONNECTING CABLES: BATTERY SYSTEM TO OPERATING EQUIPMENT

Battery performance is based on the output at the battery terminals. Therefore, the shortest electrical connections between the battery system and the operating equipment should be used for maximum total system performance. A terminal plate kit should be utilized when connecting multiple cables to a battery terminal post.

#### DO NOT SELECT CABLE SIZE BASED ON CURRENT CARRYING CAPACITY ONLY.

Cable size selection should provide the lowest voltage drop possible between the battery system and operating equipment. Excessive voltage drop will reduce the desired support time of the battery system.

### 7.1 PARALLELING



Where it is necessary to connect battery systems in parallel to obtain sufficient capacity, cable connections from the bus/load to each of the parallel strings is preferred rather than inter-string paralleling. The maximum number of parallel strings recommended by GNB Network Power in high rate applications is 4.

Cables should be sized to minimize voltage drop, and for proper current carrying capability. 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 and size to provide proper load sharing on discharge plus satisfactory recharge with the same float voltage per string. Care should be taken to ensure the overall resistance of the connection between batteries and equipment bus are consistent between strings.

### 7.2 CONNECTION PREPARATION



Gently clean contact surfaces only by using a brass suede brush, 3M Scotch Brite scouring pad, or #00 grade steel wool being careful not to remove lead plating from inter-unit connectors. Immediately after contact areas are cleaned, apply a thin coating of NO-OX-ID grease to these surfaces only.



### 7.3 CONNECTION TORQUEING

After cleaning contact surfaces, install all connectors hand tight to allow for final alignment of units. Once final alignment is made, all connections should be torqued to the value shown on the battery label (typically this value is 11.3 N-M or 100 inch-lb.)

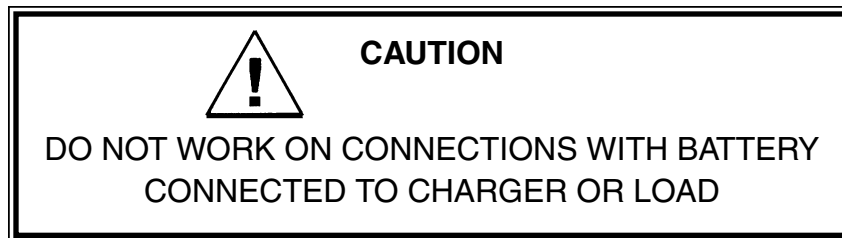
Complete connection of units by installing the inter-tier cables and terminal plates (when required).

**Caution.** do not make connections to the load at this time.

### 7.4 CONNECTIONS



Battery terminal and intercell connections should be corrosion free and tight for trouble-free operation. Periodically, these connections should be inspected to ensure cleanliness and integrity.



If corrosion is present, disconnect the connector from the terminal. Gently clean the affected area using a brass suede brush, 3M Scotch Brite scouring pad, or #00 steel wool being careful not to remove lead plating from interunit connectors. Apply a thin coat of NO-OX-ID grease to the cleaned contact surfaces. Re-install connectors and retorqued connections.

All terminals and intercell connections should be retorqued at least once every year.

Maintaining electrical integrity of connectors is important, since poor connections will result in reduced battery output and, in extreme cases, may add to heating and could result in melted battery posts, circuit interruptions, or battery fires.

### 7.5 BATTERY TO CHARGER CONNECTION

The positive (+) terminal of the battery should be connected to the positive (+) terminal of the charger and the negative (-) terminal of the battery to the negative (-) terminal of the charger. A terminal plate kit should be utilized when connecting multiple cables to a battery terminal post.

## 7.6 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 insure 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% or 5 microhms, whichever value is greater over the average. If any connection resistance exceeds the average by more than 10% or 5 microhms, whichever is greater, 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 remeasured. Any connection which has a resistance value 20% above its bench mark value should be corrected.

## SECTION 8 - INITIAL CHARGE

### 8.0 CONSTANT VOLTAGE METHOD



Batteries lose some charge during shipment as well as during the period prior to installation. A battery should be given its initial charge as soon as possible after receipt.

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 may be used.

Table A lists recommended voltages and charge time for the initial charge. Select the highest voltage the system allows to perform the initial charge in the shortest time period. Do not exceed the highest voltage listed for a given temperature. Do not exceed the maximum current(s) shown in Section 9.3.

**TABLE A**  
**INITIAL CHARGE**

<u>Ambient Temp.</u>	<u>Cell Voltage</u>	<u>Time Charge - Hours</u>
25°C (77°F)	2.35	48
25°C (77°F)	2.40	24

NOTE: Time periods listed in Table A are for temperatures from 21°C (70°F) to 32°C (90°F); for temperatures 13°C (55°F) to 20.5°C (69°F), double the number of hours. For temperatures other than 25°C (77°F) the following formula can be used to determine the recommended initial charge voltage **per cell** (VPC):

$$V \text{ corrected} = V_{25^{\circ}\text{C}} - [(T \text{ actual} - 25^{\circ}\text{C}) \times (0.003 \text{ V}/^{\circ}\text{C})] \text{ or}$$
$$V \text{ corrected} = V_{77^{\circ}\text{F}} - [(T \text{ actual} - 77^{\circ}\text{F}) \times (0.0017 \text{ V}/^{\circ}\text{F})]$$

Example at 29.4°C (85°F) and at 24 hr. initial charge

$$V \text{ corrected} = 2.40 - (29.4 - 25) (0.003)$$
$$= 2.40 - 0.0132$$
$$= 2.387 \text{ VPC}$$

Raise the voltage to the maximum value permitted by the system equipment, but do not exceed the maximum voltage listed for a given temperature. **When charging current has tapered and stabilized (no further reduction for three hours)**, charge for the hours shown in Table A or until the lowest unit voltage ceases to rise. Correct charge time for the temperature at the time of stabilization. To determine the lowest voltage unit, monitoring should be performed during the final 10% of the charge time.

## SECTION 9 - OPERATION

### 9.0 FLOAT CHARGE

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 the battery terminals and also supply the normal 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.

### 9.1 FLOAT VOLTAGES



Following is the float voltage range recommended for the RELAY GEL Battery System. Select the “volts per cell” (VPC) value within the range listed that will result in the battery series string having an average volts per cell equal to that value.

RECOMMENDED FLOAT VOLTAGES: 77°F (25°C) = 2.25 VPC to 2.30 VPC

MAXIMUM CURRENT: 20A / 100 AH (20 hr rating to 1.75V @ 25C)

For temperatures other than 77°F (25°C) the following formula can be used to determine the recommended float charge voltage **per cell**:

$$V \text{ corrected} = V_{25^{\circ}\text{C}} - [(T \text{ actual} - 25^{\circ}\text{C}) \times (0.0055 \text{ V}/^{\circ}\text{C})] \text{ or}$$
$$V \text{ corrected} = V_{77^{\circ}\text{F}} - [(T \text{ actual} - 77^{\circ}\text{F}) \times (0.003 \text{ V}/^{\circ}\text{F})]$$

Minimum float voltage (temperature corrected) is 2.21 VPC. Temperature correction does not apply below this value.

Maximum float voltage (temperature corrected) is 2.40 VPC. Temperature correction does not apply above this value.

Example     At 18.3°C (65°F)

$$\begin{aligned} V \text{ corrected} &= 2.27 - (18.3-25) (0.0055) \\ &= 2.27 + 0.037 \\ &= 2.307 \text{ VPC} \end{aligned}$$

Modern constant voltage output charging equipment is recommended for the float charge method of operation for the 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 8), 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 loss of battery life will result.

## 9.2 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 measure individual cell/battery voltages. These meters should be checked against a standard every six months and calibrated when necessary.

## 9.3 RECHARGE

All batteries should be recharged as soon as possible following a discharge with constant voltage chargers. Recharge time should not exceed recommendations given in Section 8.0, Table A. However, to recharge in the shortest period of time, raise the charger output voltage to the highest value that the connected system will permit. Do not exceed 2.40 VPC. Maximum recharge current should be limited to 20A / 100 AH (20 hr rating to 1.75V@25C). The charger used should incorporate a current limit feature. The maximum recommended charge current for the battery is as shown below:

<u>Model</u>	<u>Current (Amps)</u>
Relay Gel R12VU1	6.0
Relay Gel R12V22	10.0
Relay Gel R12V24	14.3
Relay Gel R12V27	17.2
Relay Gel R12V31	20.9

## 9.4 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. This state of charge can be identified to some degree by the amount of charging current going to the battery. When charging, the current read at the charger ammeter will be a combination of the load current plus the current necessary to charge the battery. A condition where the current remains constant for a period of three consecutive hours would reflect approximately 90 to 95% state of charge.

If the normal connected load is variable (e.g., telecommunications), the following method can be used to check the state of charge of the battery. With the battery on float and stabilized, measure the voltage across a pilot unit. If the voltage is stable for three consecutive hours, the battery is considered 100% charged.

## 9.5 EFFECTS OF TEMPERATURE

Temperature has a direct effect on the life of a battery. The design life of the battery is based on an average annual temperature of 25°C (77°F). As the temperature increases above 25°C (77°F), the life of the battery decreases. The chart below shows the effects of temperature.

<u>Maximum Annual Average Battery Temperature</u>	<u>Maximum Battery Temperature</u>	<u>Percent Reduction In Battery Life</u>
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 10 years at 25°C (77°F), but the actual annual average battery temperature is 35°C (95°F), the projected life of the battery is calculated to be only 5 years [10 years - (10 years X 0.50) = 5 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 25°C (77°F) to achieve the optimum service life from your battery.

## 9.6 EFFECTS OF FLOAT VOLTAGE

Float voltage also has a direct effect on the service life of your battery. A float voltage above the recommended limits reduces service life. The chart below shows the effects of float voltage (temperature corrected, see section 9.1) on battery life.

Temperature corrected 25°C (77°F) Float voltage per cell		Percent Reduction In Battery life
<u>Minimum</u>	<u>Maximum</u>	
2.25	2.30	0%
2.31	2.35	50%
2.36	2.40	75%

For example: A battery has a design life of 10 years, but the actual annual average float voltage is 2.33 volts per cell. The projected life of the battery is calculated to be 5 years [10 years - (10 X 0.50) = 5 years].

Voltage records shall 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.

## SECTION 10 - EQUALIZATION

### 10.0 EQUALIZING CHARGE

Under normal operating conditions an equalizing charge is not required. An equalizing charge is a special charge given to a battery when non-uniformity in voltage has developed between units. It is given to restore all units 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.

The recharge parameters of Section 9.3 apply for this section also.

Non-uniformity of units 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 unit temperatures greater than 3°C (5°F) in the series string at a given time, due to environmental conditions or battery arrangement, can cause low voltage batteries.

### 10.1 EQUALIZING FREQUENCY



An equalize charge should be given when either of the following conditions exist.

- A. The float voltage of the pilot unit (or any unit for quarterly readings ) is less than 2.21 VPC.
- B. A recharge of the battery is required in a minimum time following an emergency discharge.

## SECTION 11 - MAINTENANCE SCHEDULE



A pilot unit is selected in the series string to reflect the general condition of all units in the battery. The pilot unit should be the battery with the lowest voltage in the string following the initial charge. By measuring the pilot unit voltage, it serves as an indicator of battery condition between scheduled overall individual unit readings.

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

The following data should be read and permanently recorded for review by supervisory personnel:

- 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 battery voltages
  2. Battery string terminal voltages
  3. Ambient temperature
- B. Every 12 months, a complete set of readings as specified in Paragraph A above must be done and all individual connections retorqued.
- 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 (quarterly) are desirable.

Minimum Maintenance Schedule*			
Item	Action	Interval	Refer to Section
Installation	Initial Charge	Upon Installation	8.0
String Voltage	Measure/Record	Every 3 Months	9.1
Individual Voltages	Measure/Record	Every 12 Months	9.1
Pilot Unit Voltage	Measure/Record	Every 3 Months	11.0
Ambient Temperature	Measure/Record	Every 3 Months	9.5
Inter-Unit Connections	Inspect/Retorque (Clean as Needed)	Every 12 Months	7.4

\*Failure to adhere to these minimum maintenance schedules will void the battery's warranty.

## SECTION 12 - TAP CONNECTIONS

Tap connections should not be used on a battery. This can reduce battery life.

## SECTION 13 - TEMPORARY NON-USE

An installed battery that is expected to stand idle for over 6 months should be treated as follows:

- A. Give the battery an equalizing charge. Following the equalizing charge, open the connections at the battery terminals to remove charger and load from the battery.
- B. Every six months, temporarily connect battery to charger and give an equalizing charge.
- C. To return the battery to normal service, retorque all connections per Section 7.3 and then re-connect the battery to the charger and return the battery to float operation.
- D. If the battery is standing at an elevated temperature, corrections to the time period to equalize charge should be corrected per Section 4.1.

## SECTION 14 - UNIT CLEANING



Periodically clean unit covers to remove accumulated dust. If any unit or parts appear to be damp with electrolyte or show signs of corrosion, clean with a solution of baking soda and water or isopropyl alcohol, and re-examine within 30 days to determine if the condition re-occurs. If so, contact your local GNB representative.



### CAUTION

**Do not clean plastic parts with any solvents, detergents, mineral spirits, or spray-type cleaners other than those mentioned here as these can cause crazing or cracking of the plastic materials.**



## RELAY GEL BATTERY MAINTENANCE REPORT

Date \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

Battery location and/or number \_\_\_\_\_

No. of Units \_\_\_\_\_ Type \_\_\_\_\_ Date New \_\_\_\_\_ Date Installed \_\_\_\_\_

Serial No. \_\_\_\_\_

### INDIVIDUAL UNIT READINGS

### PILOT UNIT READINGS

Charger Output \_\_\_\_\_ Batt. Temperature \_\_\_\_\_ °C/°F \_\_\_\_\_

Total Battery Voltage \_\_\_\_\_ Panel Meter Volts \_\_\_\_\_

### MONTHLY RECORD

Unit No.	Volts	Unit No.	Volts	Unit No.	Volts	Unit No.	Volts	Unit No.	Volts	Unit 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	

Date	Pilot Unit Volts	Batt. Term. Volts	Batt. Temp

Remarks and Recommendations: \_\_\_\_\_

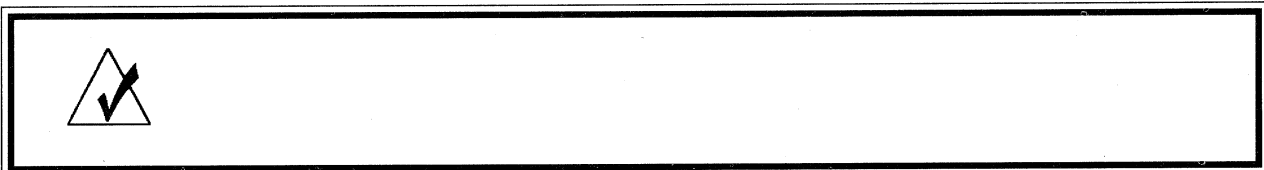
\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

READINGS TAKEN BY: \_\_\_\_\_

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