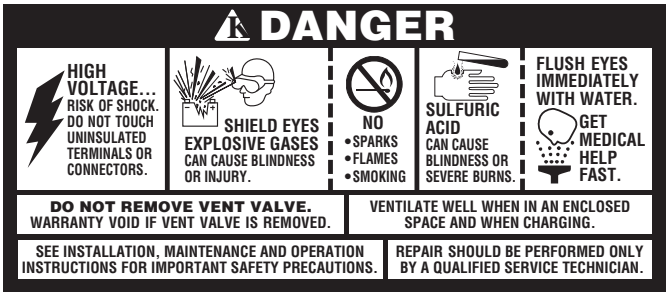
8A & 8G BATTERY INSTALLATION AND OPERATING INSTRUCTIONS

This manual is intended to be a guide to optimize battery performance for multiple cyclic & float applications. Consult applicable User Manuals for additional parameters for specific systems. This manual is not intended for SLI or Vehicle related applications. Vehicle / Equipment Owner's Manual should be followed for SLI & Vehicle related applications.



California Proposition 65 Warning

Batteries, battery posts, terminals and related accessories contain lead and lead compounds, and other chemicals known to the state of California to cause cancer and birth defects or other reproductive harm. **Wash hands after handling.**

SAFETY PRECAUTIONS

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

Protective Equipment

Although VRLA batteries can vent or leak small amounts of electrolyte, electrical safety is the principle but not the only concern for safe handling. Per IEEE 1188 recommendations, the following minimum set of equipment for safe handling of the battery and protection of personnel shall be available:

- **Safety glasses with side shields, or goggles, or face shields as appropriate. (Consult application specific requirements)**
- Electrically insulated gloves, appropriate for the installation.
- Protective aprons and safety shoes
- Portable or stationary water facilities in the battery vicinity for rinsing eyes and skin in case of contact with acid electrolyte.
- Class C fire extinguisher
- Acid neutralizing agent.
- Adequately insulated tools.
- Lifting devices of adequate capacity, when required.

SAFETY PRECAUTIONS *(con't)*

Procedures

Consult User Manual of specific application for additional Safety & Operating requirements.

The following safety procedures should be followed during installation: **(Always wear safety glasses or face shield.)**

1. These batteries are sealed and contain no free electrolyte. Under normal operating conditions, they do not present any acid danger. However, if the battery jar or cover is damaged, acid could be present. **Sulfuric acid is harmful to the skin and eyes. Flush affected area with water immediately and consult a physician if splashed in the eyes. Consult MSDS for additional precautions and first aid measures.**
2. Prohibit smoking and open flames, and avoid arcing in the immediate vicinity of the battery.
3. Do not wear metallic objects, such as jewelry, while working on batteries. Do not store un-insulated tools in pockets or tool belt while working in vicinity of battery.
4. Keep the top of the battery dry and clear of all tools and other foreign objects.
5. Provide adequate ventilation as regulated by Federal, State and Local codes and follow recommended charging voltages.
6. Extinguishing media: Class ABC extinguisher. **Note: CO_2 may be used but not directly on the cells due to thermal shock and potential cracking of cases.**
7. **Never** remove or tamper with pressure relief valves. Warranty void if vent valve is removed.
8. Inspect all flooring and lifting equipment for functional adequacy.

RECEIVING AND STORAGE

Receiving Inspection

Upon receipt, and at the time of actual unloading, each package should be visually inspected for any possible damage or electrolyte leakage. If either is evident, a more detailed inspection of the entire shipment should be conducted and noted on the bill of lading. Record receipt date, inspection data and notify carrier of any damage.

Unpacking

1. **Always wear eye protection.**
2. Check all batteries for visible defects such as cracked containers, loose terminal posts, or other unrepairable problems. Batteries with these defects must be replaced.
3. Check the contents of the package against the packaging list. Report any missing parts or shipping damage to your East Penn agent or East Penn Mfg. Co. immediately.
4. Never lift batteries by the terminal posts.
5. Always lift batteries by the bottom or use the lifting handles.

Storage

1. Batteries should be stored indoors in a clean, level, dry and cool location. Recommended storage temperature is 0°F to 90°F (– 18°C to 32°C).
2. Stored lead-acid batteries self discharge and must be given a charge six months from date of manufacture to prevent permanent performance degradation. Record dates and conditions for all charges during storage.
3. Recommended charge during storage is at a constant voltage of 13.80V (6.90V for 6V battery) for 24 hours at 77°F (25°C).
4. Do not store beyond 12 months.

INSTALLATIONS

General

Caution should be taken when installing batteries to insure no damage occurs. The battery cabinet, tray, rack, etc. shall be inspected for sharp edges that could cause damage to the battery casing. Batteries shall not be dropped, slid, placed on rough or uneven surfaces such as tray lips or grated flooring. Mishandling of batteries could result in equipment damage or human injury. East Penn will not be liable for damage or injury as a result of mishandling or misuse of the product.

Grounding

When grounding the battery system, proper techniques should be applied per electrical standards, such as NEC and/or local codes, as well as User Manual of specific application.

BATTERY ASSEMBLY

(Always wear eye protection.)

1. Set up the batteries so that the positive post (+) of one battery is connected to the negative post (–) of the next battery for all series connections.
2. All battery electrical contact surfaces shall be cleaned by rubbing gently with a non-metallic brush or pad before installing connectors. No-Ox-ID grease can be used but is not required.

BATTERY ASSEMBLY *(con't)*

3. Install all electrical connectors / cables and bolting hardware loosely to allow for final alignment of batteries. Torque to manufacturer recommendations.
4. After torquing, read the voltage of the battery string to ensure the individual batteries are connected correctly. The total voltage should be approximately equal to the number of batteries times the measured voltage of one battery (when connected in series). If the measurement is less, recheck the connections for proper voltage and polarity.
5. Read and record connection resistance and note the method of measurement. This helps determine a satisfactory initial installation and can be used as a reference for future maintenance requirements. **See Appendix B,** recording forms, in the back of the manual. **Clean, remake and remeasure any connection having a resistance measurement greater than 10% of the average of all the same type of connections.**
6. 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.

   Cable size selection should be determined by current carrying requirements as well as providing a minimum voltage drop between battery system and operation equipment. Proper techniques should be applied per electrical standards, such as NEC and/or local codes. **Note: Excess voltage drop will reduce the support time of the battery system.**

SYSTEM OPERATION

State of Charge

Battery state of charge can be determined by measuring the open circuit voltage. Consult the below table.

State of Charge vs. Open Circuit Voltage*

% Charge	Gel	AGM
100	12.85 or higher	12.80 or higher
75	12.65	12.60
50	12.35	12.30
25	12.00	12.00
0	11.80	11.80

NOTE: Divide values in half for 6-volt battery(ies)

**The "true" O.C.V. of a battery can only be determined after the battery has been removed from the load (charge / discharge) for 24 hours.*

Charging

Consult Charger User Manual of specific application for Safety and Operating requirements.

For cyclic applications it is important that the battery(ies) be charged fully after each discharge. It is recommended that 108% to 115% of the Ah (Amp Hour) capacity removed from the battery(ies) be replaced after each discharge. This additional Ah is to compensate for any efficiency losses between the battery charger and the battery(ies)

SYSTEM OPERATION *(con't)*

Charge Voltage

For both 8A & 8G batteries the following voltage settings should be followed:

Charge / Absorption / Equalize

13.80V to 14.60V @ 77°F (25°C)

Float / Standby

13.50V + .01 @ 77°F (25°C)

The charger must be able to maintain the system voltage within ± 0.5% of the desired level at all times.

Note: Divide values in half for 6-volt battery(ies).

Temperature Compensation

Battery voltage should be adjusted for ambient temperature variations.

3mV per °C (1.8°F) per cell
18mV per 12V battery
9mV per 6V battery

For temperatures above 77°F (25°C) subtract and for temperatures below 77°F (25°C) add.
Consult **Voltage Compensation Chart in Appendix A** for temperature compensation voltage maximum and minimum limits.
The average battery operating temperature should not exceed 95°F (35°C) and should never exceed 105°F (40.5°C) for more than an eight-hour period. Operating at temperatures greater than 77°F (25°C) will reduce the operating life of the battery. **If operating temperatures are expected to be in excess of 95°F (35°C), contact East Penn for recommendations.**
Discharging at temperatures less than 77°F (25°C) will reduce the capacity of the battery.

Charge Current

To properly determine the amount of charge current required the following variables are to be considered:

- DoD (Depth of Discharge)
- Temperature
- Size & efficiency of the charger
- Age and condition of battery(ies)

Maximum charge current should be limited to 30% of the C20 Ah rate for the battery(ies) being used in the system.

Example: 8G24 C20 rate – 73.6Ah
Max. recharge rate: 73.6Ah x 0.3 = 22.1A

Consult **Charging Current vs Charging Time chart in Appendix A** as a guide line to determine recharge time from 0% to 90% state of charge at an initial charge current.

Discharge Voltage Curve

To estimate battery voltage during a constant current discharge at various DoD (Depth of Discharge) consult chart **Discharge Voltage Curve in Appendix A.**

NOTE: Battery voltage can vary depending on temperature, age, and condition of battery.

RECORD KEEPING

Voltages, Temperatures & Ohmic Readings

Consult User Manual of specific application for additional Safety & Operating requirements.

Record keeping is an important part of battery maintenance and warranty coverage. This information will help in establishing a life history of the battery and inform the user if and when corrective action needs to be taken. (Refer to Appendix B, Battery Maintenance Report).

After installation and the batteries are at a fully charged condition, the following data should be recorded:

Depending on application, some of the following recommendations may not apply.

- Battery and/or string terminal voltage
- Charger voltage
- Individual battery float / charge voltages
- Individual battery ohmic readings**
- Ambient temperatures
- Terminal connections should be checked to verify all connections are properly torques. Micro-ohm readings should be taken across every connection. Refer to meter manufacturer's instructions for proper placement of probes. If any reading differs by more than 20% from its initial installation value, re-torque the connections. If the reading still remains high, clean contact surfaces according to installation portion of this manual.

**** Note: To provide accurate / consistent values, battery(ies) must be fully charged, at same temperature and probes placed at same location each time readings are taken.**

MAINTENANCE

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

Consult User Manual of specific application for additional Safety & Operating requirements.

Annual Inspection

Depending on the application, some of the following recommendations may not apply.

1. Conduct a visual inspection of the battery(ies).
2. Record battery and /or string voltage. The accuracy of the DMM (Digital Multimeter) must be 0.05% (on dc scale) or better. The DMM must be calibrated to NIST traceable standards. Because voltage readings are affected by discharge and recharges, for cyclic applications, the battery(ies) must be in a fully charged condition prior to taking readings. Batteries should be within ± 0.30 volts (+ 0.15 volts for 6V) of the average battery float voltage.
3. Record charger voltage.
4. Record the ambient temperature.
5. Record individual battery ohmic readings.***
6. Record all interunit and terminal connection resistances. Micro-ohm readings should be taken during this inspection. If any reading is greater than 20% from initial readings, retorque the connection. Recheck the micro-ohm reading. If the reading remains high, clean contact surface according to installation portion of this manual.

***** Note: To provide accurate / consistent values, battery(ies) must be fully charged, at same temperature and probes placed at same location each time readings are taken.**

MAINTENANCE *(con't)*

Rectifier Ripple Voltage

FREQUENCY

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

Ripple that has a frequency less than 667Hz (duration greater than1.5ms), must meet the following voltage specification to be acceptable.

VOLTAGE

Ripple voltage shall be less than .5% peak to peak of the manufacturer's recommended string voltage.

Battery Cleaning

Batteries, cabinets, racks, and modules should be cleaned with clean water. If neutralizing is required, use a mixture of baking soda and water. Use clean water to remove baking soda residue. Never use solvents to clean the battery(ies).

Capacity Testing

Capacity tests should not be run unless the battery's operation is questionable. Do not discharge the battery(ies) beyond the specified final voltage. When discharging at higher rates, extra connectors may be required to prevent excessive voltage drop. When performing capacity testing and recording data use applicable standard and/or User Manual.

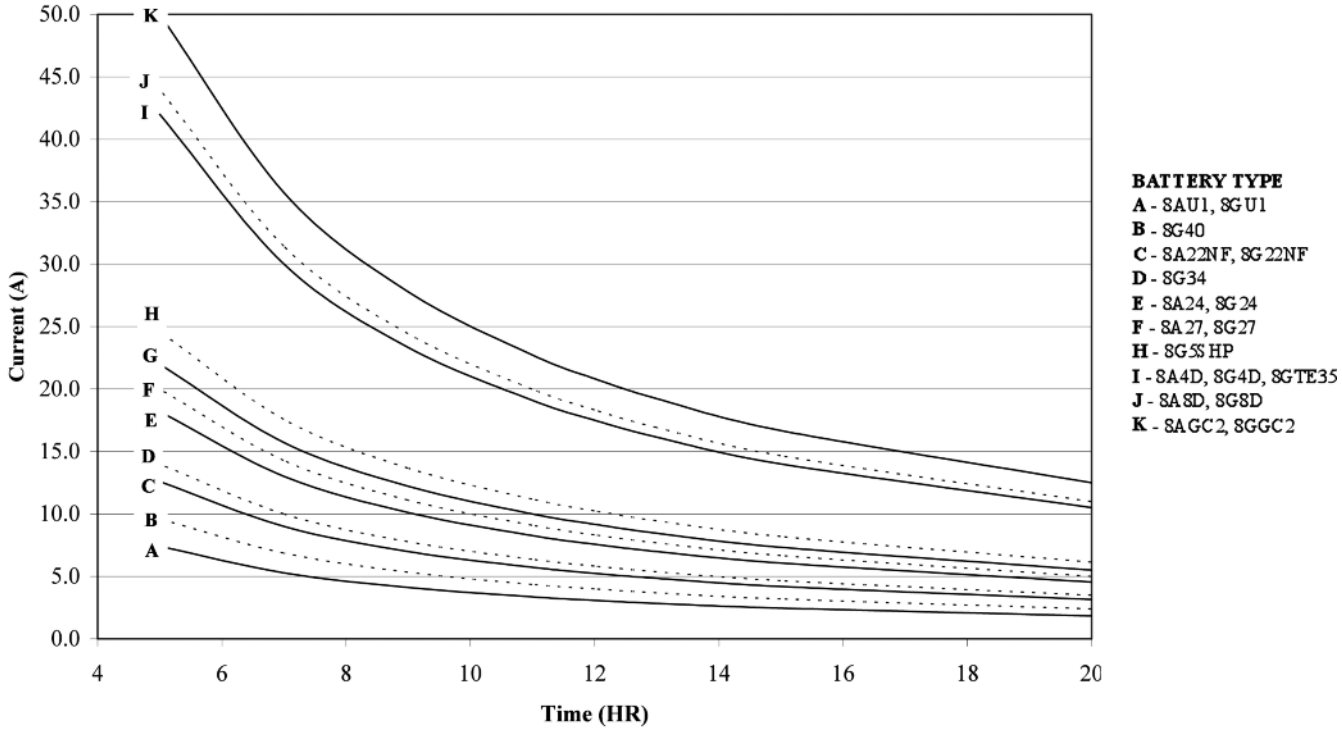
Should it be determined any individual battery(ies) or cell(s) need to be replaced, contact your nearest East Penn agent or East Penn Mfg. Co.

Voltage Compensation Chart

°C	Float	Charge/Absorption		°F
		Min.	Max.	
≥35	13.32	13.62	14.40	≥95
34	13.34	13.64	14.42	93.2
33	13.36	13.66	14.44	91.4
32	13.37	13.67	14.45	89.6
31	13.39	13.69	14.47	87.8
30	13.41	13.71	14.49	86.0
29	13.43	13.73	14.51	84.2
28	13.45	13.75	14.53	82.4
27	13.46	13.76	14.54	80.6
26	13.48	13.78	14.56	78.8
25	13.50	13.80	14.58	77.0
24	13.52	13.82	14.60	75.2
23	13.54	13.84	14.62	73.4
22	13.55	13.85	14.63	71.6
21	13.57	13.87	14.65	69.8
20	13.59	13.89	14.67	68.0
19	13.61	13.91	14.69	66.2
18	13.63	13.93	14.71	64.4
17	13.64	13.94	14.72	62.6
16	13.66	13.96	14.74	60.8
≤15	13.68	13.98	14.76	≤59

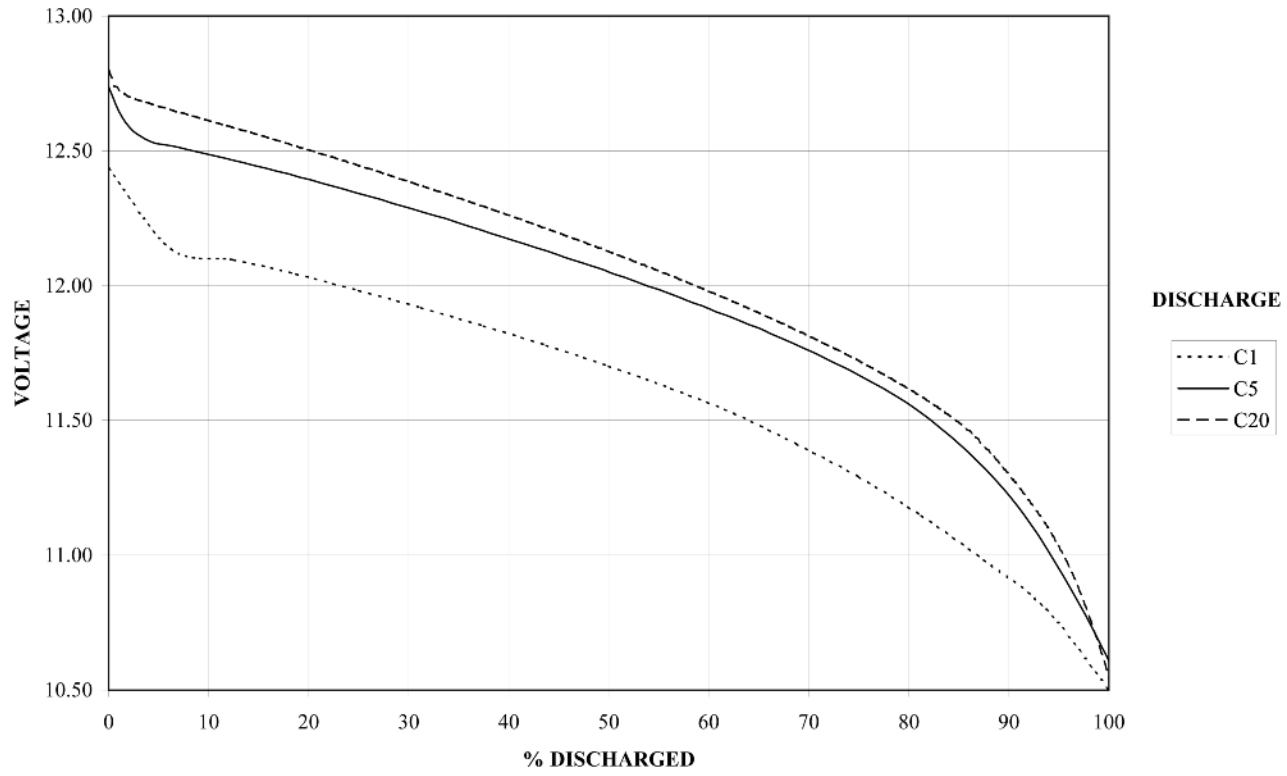
Note: 1. Above values based on 12-volt battery.
2. Divide above values in half for 6-volt battery.

CHARGING CURRENT VS. CHARGING TIME*



*** Above values are to 90% SOC (State of Charge) based on C100 Ah capacity**

DISCHARGE VOLTAGE CURVE



APPENDIX B

BATTERY MAINTENANCE REPORT

Inspection Date _____ No. of Units/String _____

Company _____ Type _____

Address _____ Date New _____

Battery location and/or number _____ Date Installed _____

Individual Battery Readings

Charger Output _____Amp Air Temperature _____°F

Total Battery String Voltage _____ Panel Meter Volts _____

Year _____			Year _____			Year _____			Year _____		
Unit Number	Volts	Ohms or Mhos	Unit Number	Volts	Ohms or Mhos	Unit Number	Volts	Ohms or Mhos	Unit Number	Volts	Ohms or Mhos
1			1			1			1		
2			2			2			2		
3			3			3			3		
4			4			4			4		
5			5			5			5		
6			6			6			6		
7			7			7			7		
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36			36			36			36		
37			37			37			37		
38			38			38			38		
39			39			39			39		
40			40			40			40		
Avg. Voltage			Avg. Voltage			Avg. Voltage			Avg. Voltage		

Readings Taken By _____ Remarks/Recommendations _____

Readings should be taken at installation and annually thereafter.

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