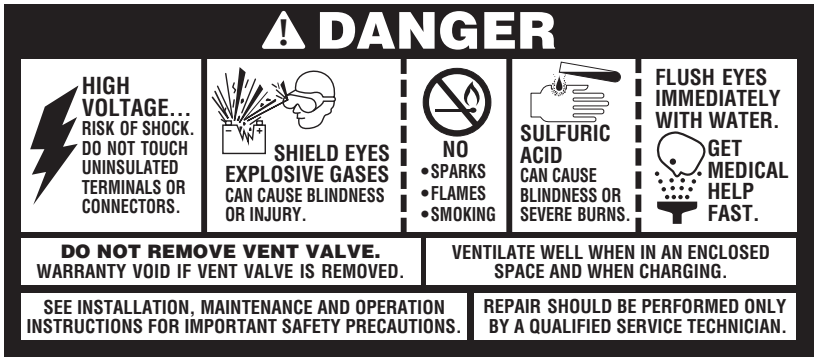
STATIONARY BATTERY INSTALLATION AND OPERATING INSTRUCTIONS



Required by California Proposition 65

WARNING: Battery posts, terminals and related accessories contain lead and lead compounds, chemicals known to the state of California to cause cancer and 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

To assure safe battery handling, installation and maintenance, the following protective equipment should be available:

1. **Safety glasses or face shields**
2. Acid-resistant gloves
3. Protective aprons
4. Lifting devices
5. Tools with insulated handles

Procedures

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

1. Adequately secure battery racks or cabinet enclosures to the floor.
2. Connect support structures to ground system in accordance with applicable codes.
3. Inspect all flooring and lifting equipment for functional adequacy. Specifically review floor loading capacity.
4. **Prohibit smoking and open flames, and avoid arcing in the immediate vicinity of the battery.**
5. Keep the top of the battery clear of all tools and other foreign objects.
6. Provide adequate ventilation and follow recommended charging voltages.
7. Avoid wearing metallic objects such as jewelry while working on the battery.
8. **Never** remove or tamper with the pressure relief valves.
9. These batteries are sealed and contain no free electrolyte. Under normal operating conditions they do not present any acid danger. However, if the battery case 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.**
10. Do not use CO_2 to extinguish battery fires. Use a halon-generated fire extinguisher system.

RECEIVING AND STORAGE

Receiving Inspection

Upon receipt, and at the time of actual unloading, each package should be visually inspected for apparent damage and 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 (Always wear eye protection.)

1. Never lift batteries by the terminal posts. Always lift batteries by the bottom or use the lifting handle.
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.

Storage

1. Cells should be stored indoors in a clean, level, dry and cool location. Recommended storage temperatures are 0°F to 90°F (-18°C to 32°C).
2. Lead acid batteries self-discharge and must be given a boost charge periodically to prevent permanent performance degradation. Batteries should not be stored for more than 180 days without applying a boost charge of 13.8 volts ± 1% per battery until the current stabilizes. Record dates and conditions for all charges during storage.

INSTALLATIONS

Cabinets

Cabinet systems come factory assembled and prewired. Do not tip or turn cabinets on their sides when positioning them in their intended installation area. Cabinets must be used in an upright position. These systems are preconnected. Only inter-shelf, inter-cabinet and connections to the load are required. See the connection diagram inside the cabinet. Inter-cabinet and load connection cables are not included.

Racks

Assemble racks in accordance with the intended arrangement, align with level and bolt to the floor. See rack assembly instructions.

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. Make sure they match the connection diagram. For parallel or parallel/series combinations, check the connection diagram.
2. The intercell connector contact surfaces should be cleaned by rubbing gently with a non-metallic brush or pad before installing connectors.
3. Install all intercell connectors loosely to allow for final alignment of batteries, then torque to 45 ± 5 inch pounds.
4. When more than one intercell connector per battery is required, stack the connectors one on top of another.

General

1. Apply lockwasher. Torque the terminal bolts or nuts to 45 ± 5 inch pounds. **DO NOT OVERTORQUE.** Some batteries have cable harnesses.
2. Clean all outside surfaces of batteries, cabinets and racks with soapy water only. Do not use solvents.
3. For future identification of all racked batteries, apply individual battery numbers in sequence beginning with number one at the positive end of the first battery.
4. After torquing the connections on racked batteries, read the voltage of the battery string to assure that 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 polarity.
5. Read and record intercell connection resistance and the method of measurement. This helps determine a satisfactory initial installation and can be used as a reference for future maintenance requirements. See Appendix A, recording forms, in the back of the manual. Clean, remake and remeasure any connection having a resistance measurement greater than 20% of the average of all the same type of connections (intercell, inter-tier or shelf, inter-rack or inter-cabinet).
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 result in maximum total system performance.

   Do not select cable size on current carrying capability only. Cable size should not provide a greater voltage drop between the battery system and operating equipment than specified. Excess voltage drop will reduce the desired support time of the battery system.Cables are not recommended for connecting parallel battery strings.

7. When paralleling valve-regulated batteries, the capacity, arrangement and external circuit length should be identical for each battery because a wide variation in battery circuit resistance can result in unbalanced charging (i.e., excessive charging currents in some batteries, and undercharging in others). As a consequence, a single battery failure in one battery string and the subsequent loss of performance capabilities of that string, will result in higher loads in the other parallel string(s), which may exceed the ratings of the battery connections. This can damage the battery system and dramatically shorten battery life.

SYSTEM OPERATION

These batteries are designed for continuous float application. The charger must be able to sustain the system voltage within ± 1% of the desired level at all times. The desired float voltage varies with temperature according to the table below.

Battery Temperature Degrees F	Battery Temperature Degrees C	Per Battery Float Voltage ± 1%
50°	10°	13.5
59°	15°	13.5
68°	20°	13.5
77°	25°	13.5
86°	30°	13.5
95°	35°	13.4

Equalizing

Upon installation of the battery, an optional boost charge of 13.8 volts ± 1% for a maximum of 24 hours can be applied. If this is done, be sure to reset the charging equipment to the proper float voltage. 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 remain in excess of 95°F (35°C), contact MK Battery for recommendations.

PERIODIC MAINTENANCE

(Always wear eye protection; keep sparks and flames away.)

Annual Inspection

1. Conduct a visual inspection of the battery.
2. Record the battery string voltage.
3. Check the charger voltage.
4. Check the individual battery voltages. Batteries should be within ± 0.18 volts of float voltage.
5. Check the ambient temperatures.
6. Check all inter-battery and terminal connections. Micro-ohm readings should be taken during this inspection. If any reading differs by more than 20% from the inital reading taken, retorque the connection to 45 ± 5 inch-pounds. Recheck the micro-ohm reading. If the reading remains high, clean the contact surfaces according to Step 2 under Battery Assembly.

Capacity Testing

Capacity tests may be run if operation is questionable. Do not discharge the batteries beyond the specified final voltage. Record all findings.

Should it be determined that any individual battery need be replaced, contact your nearest MK Battery agent or MK Battery Service Center.

APPENDIX A

BATTERY MAINTENANCE REPORT

Date _____ No. of Calls _____

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			
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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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