

Stationary Battery Hazards - Update

INFOBATT2006

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Types of Batteries

- Lead Acid
 - VRLA
 - Flooded
- Nickel-Cadmium
 - Flooded

Large VRLA Battery



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Large Flooded Lead-Acid Battery



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Common Hazards

- A. Gas Emissions
- B. Electrical Shock
- C. Results of External Short Circuits
- D. Ground Faults
- E. Thermal Run-Away
- F. Chemical Spills



Gas Emissions

- All batteries emit gas!
- The amount depends directly on the amount of overcharge current.
- The gas consists of hydrogen and oxygen.
- Float charge current is extremely small - very small amount of gas.
- Overcharging Results in significant gas emission.
- Thermal run-away results in extreme gas emission.
- Hydrogen sulfide is emitted during a thermal runaway.
- 4% Hydrogen is the "lower flammable limit".



Methods of Protection Against Excessive Gas Generation

- Ventilate the space.
- Limit over current.
- Monitor the hydrogen concentration

Results of not properly ventilating a battery room.



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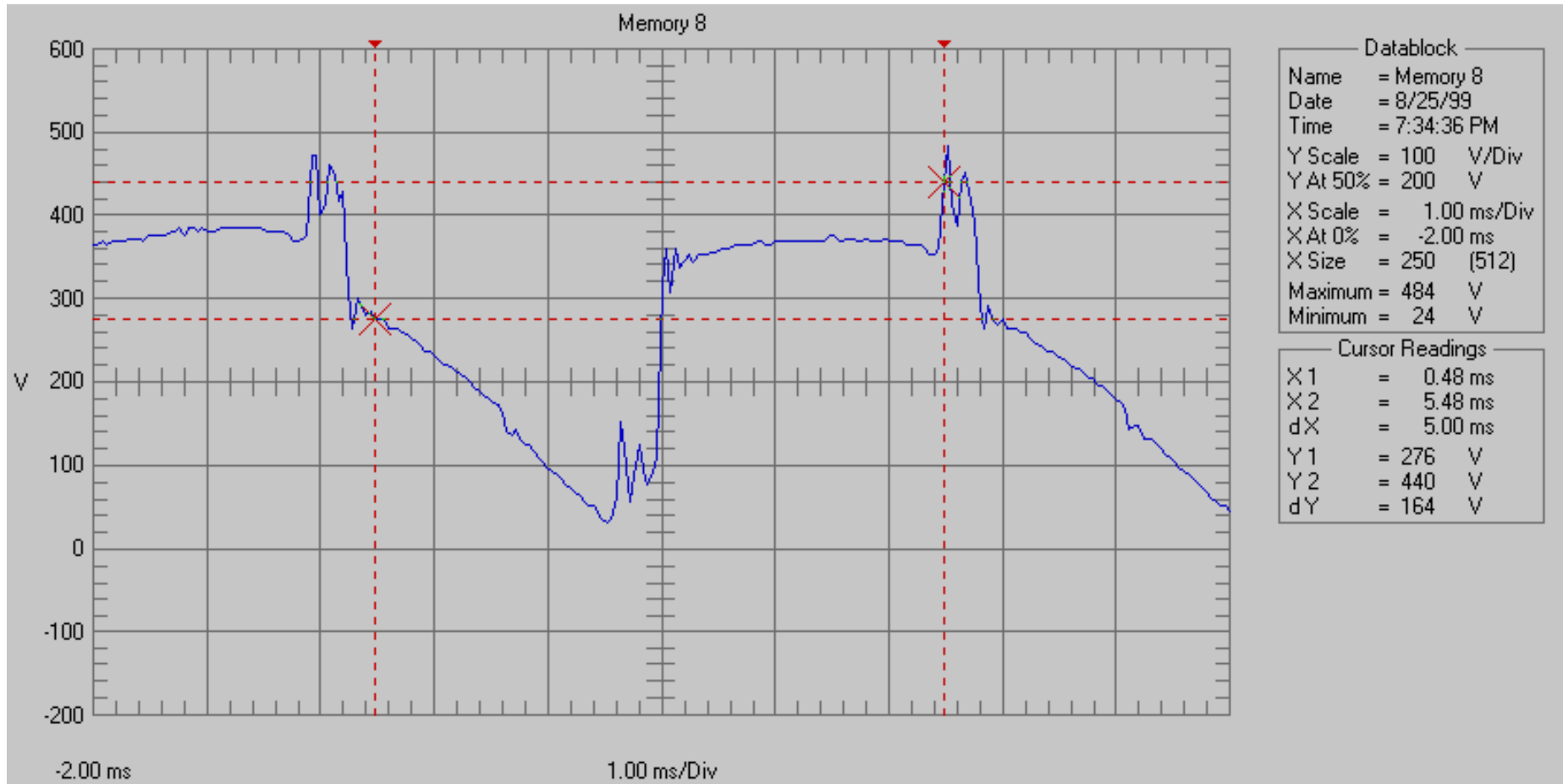
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Electrical Shock

- Electrical shock is directly related to system voltage.
- Lead acid batteries operate at a nominal voltage of 2 volts per cell.
- A typical car battery has 6 cells and is thus 12 V.
- The actual voltage is closer to 2.25 volts per cell and thus the system voltage as measured would be about 13.5 Volts.
- A telephone office uses -48 Volt power and 24 cell batteries.
- The normal system voltage is usually 52-54.5 Volts.
- These voltages present little shock hazard.
- UPS systems usually operate at much higher voltages.
- Small self contained "bread box" size systems usually contain a 12 Volt battery.
- Large UPS systems usually operate at 540 Volts DC and have 240 cell battery. **THIS VOLTAGE IS LETHAL!**

Voltage to Ground Waveform





Methods of Protection Against Electrocution

- Don't Touch high voltage systems.
- Avoid water on high voltage systems.



External Short Circuit Hazard

- Short Circuits will melt things.
- A battery can develop extremely large current into a short.
- Burns can result from the above.
- Fires can result from above.

Methods of Protection Against Shorts



- Provide space between electrically “hot” elements.
- Provide insulation to isolate “hot” elements.
- Keep battery areas free of other objects.
- Provide over-current protective devices.
- Conductor protection methods.



Ground Faults

- Causes of ground faults in batteries.
- Results of Ground Faults
- Methods to Detect Ground Faults



Causes of Ground Faults in Batteries

- Dirt on the surface of the container
- Hole in the container.
- Jar to cover seal failure
- Post seal leak.



Results of Ground Faults



FIRES!



Methods to Detect Ground Faults

- Insulation resistance test.
2000 Megohms @ 1000VDC
- Observation - Not to good.

Megohmmeters



Extech B380360



AVO Biddle BM21



Typical Values Measured

- Typical 240 cell monoblock – 100,000 to 250,000 Megohms.
- Typical 240 cell individual VRLA cells – 10,000 to 150,000 Megohms.



Finding the Bad Cell or Monoblock

- Disconnect an intercell connector in the middle of the string.
- Measure both sides of the split string.
- Continue the process until the bad cell is found.



Thermal Run-Away

- Thermal run-away is where a battery draws progressively larger current until destruction.
- The results of a thermal run-away is a fire and a toxic spill.



Early Detection Methods

- Monitor float current continuously.
- Measure float current periodically.
- Monitor battery temperature continuously.
- Measure battery temperature.



What is Float Current?

- Float current is the current drawn by a battery when fully charged with a float voltage applied. This is the current necessary to replace internal losses in a battery.



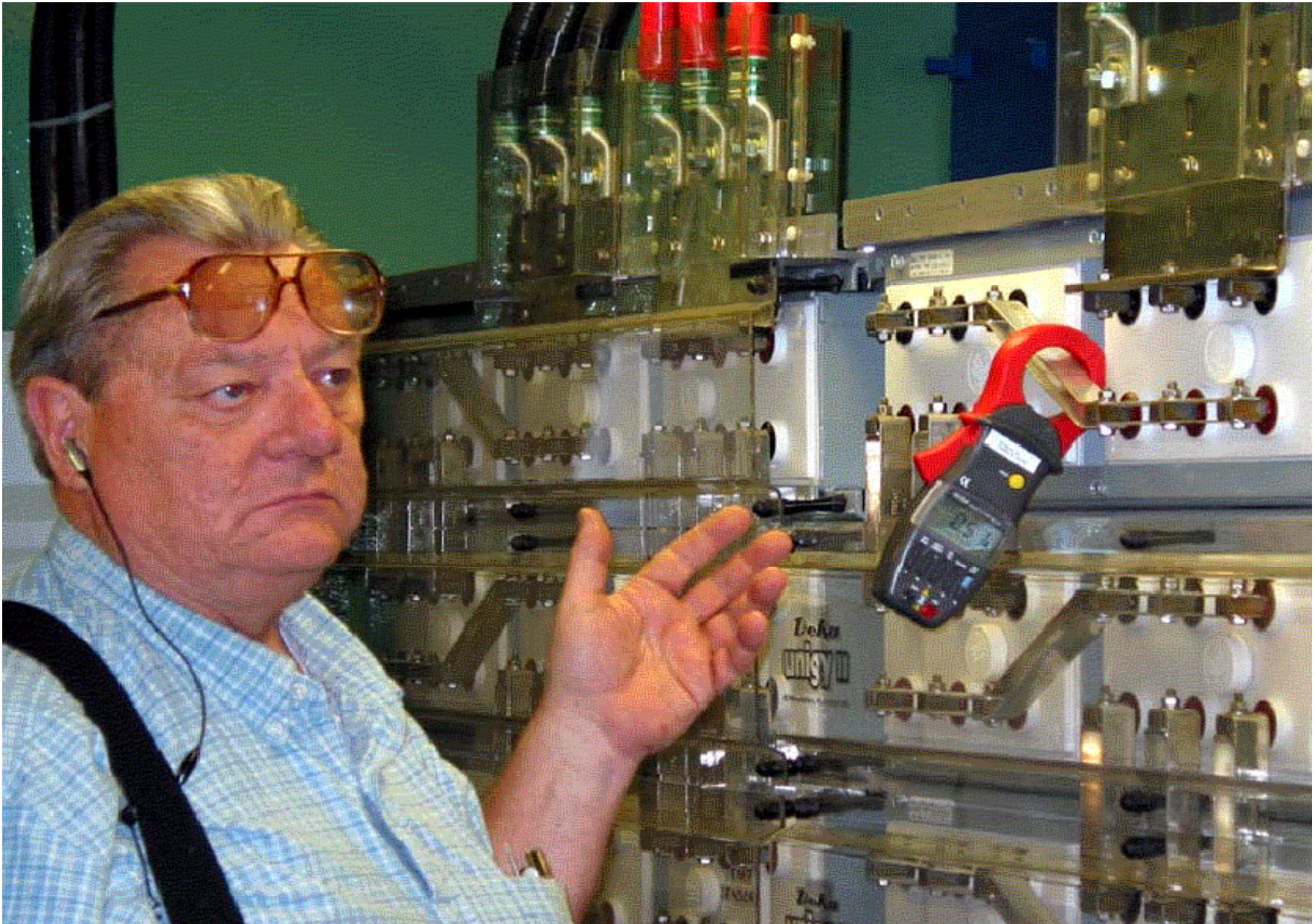
What is the correct value of float current?

- For a VRLA battery, it is 0.050A/100Ahr. Some designs are much lower.
- For flooded lead-acid batteries it is 0.010-0.025A/100Ahr.



Relative Value of Monitoring

- Monitoring the float current is the best predictor of a battery failure. The next best method is periodic measurement of float current.
- Measurement of temperature is a very late predictor.



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Clamp-on Ammeter

- Extech 380935 (No Longer in Catalog)
- UEI Model DL-235 (US Importer)
- Actual Manufacturer:
Fine Instruments Corp. Model 135





Methods to Isolate a Battery

- Battery Disconnect Device
- Unwiring
- Unplugging



Battery Disconnect Device

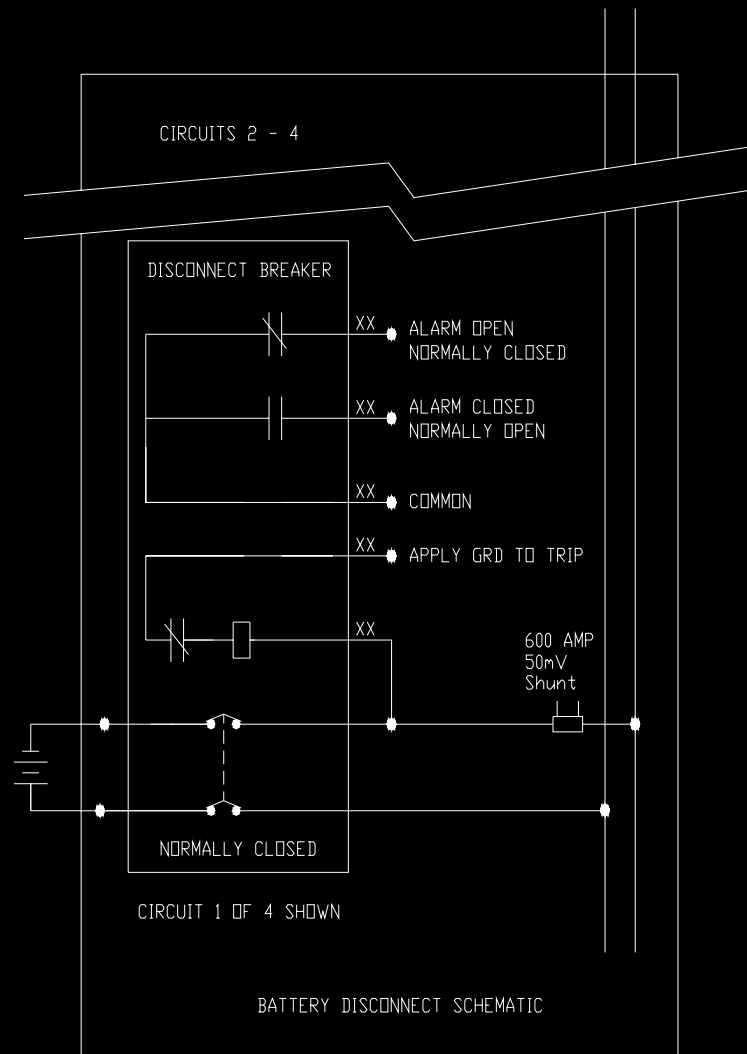
- Must be a 2-Pole device
- Necessary to isolate both sides of the battery
- Stops a ground fault fire.

4-Circuit Battery Disconnect



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Chemical Spills

- Spills are another potential hazard.
- Lead-acid batteries contain an electrolyte that consists of a dilute concentration of sulfuric acid. The specific gravity is usually 1.300 or less. Water may be added to this without exothermic reaction.
- Nickel-Cadmium batteries contain a dilute concentration of potassium hydroxide.



Chemical Spills

continued

- Valve-regulated Lead-acid batteries have their electrolyte contained in a blotter like separator between the plates. They contain very little or no free electrolyte. For example a 1600Ahr cell would contain no more than 1 teaspoon of free electrolyte when the cell is factory new. As the cell ages, any free electrolyte is electrolyzed to gas.
- Flooded lead-acid batteries contain "free" electrolyte that may spill if the container is damaged. Such damage is drastically more likely during installation activities when cells are being transported.
- Nickel-cadmium batteries are generally similar in hazard to flooded lead-acid but are usually much smaller.



Methods of Spill Protection

- Spill containment systems
- Physical protection of the battery from damage



Spill Containment Systems

- Spill containment systems have been deployed widely.
- Some have produced more hazard than they have protected against.
- Some of the spill containment "pillows" have proven to spread fire.
- Those that are "fire Retardant" may lose that protection over time.
- "Third Party" certified material and systems are needed.

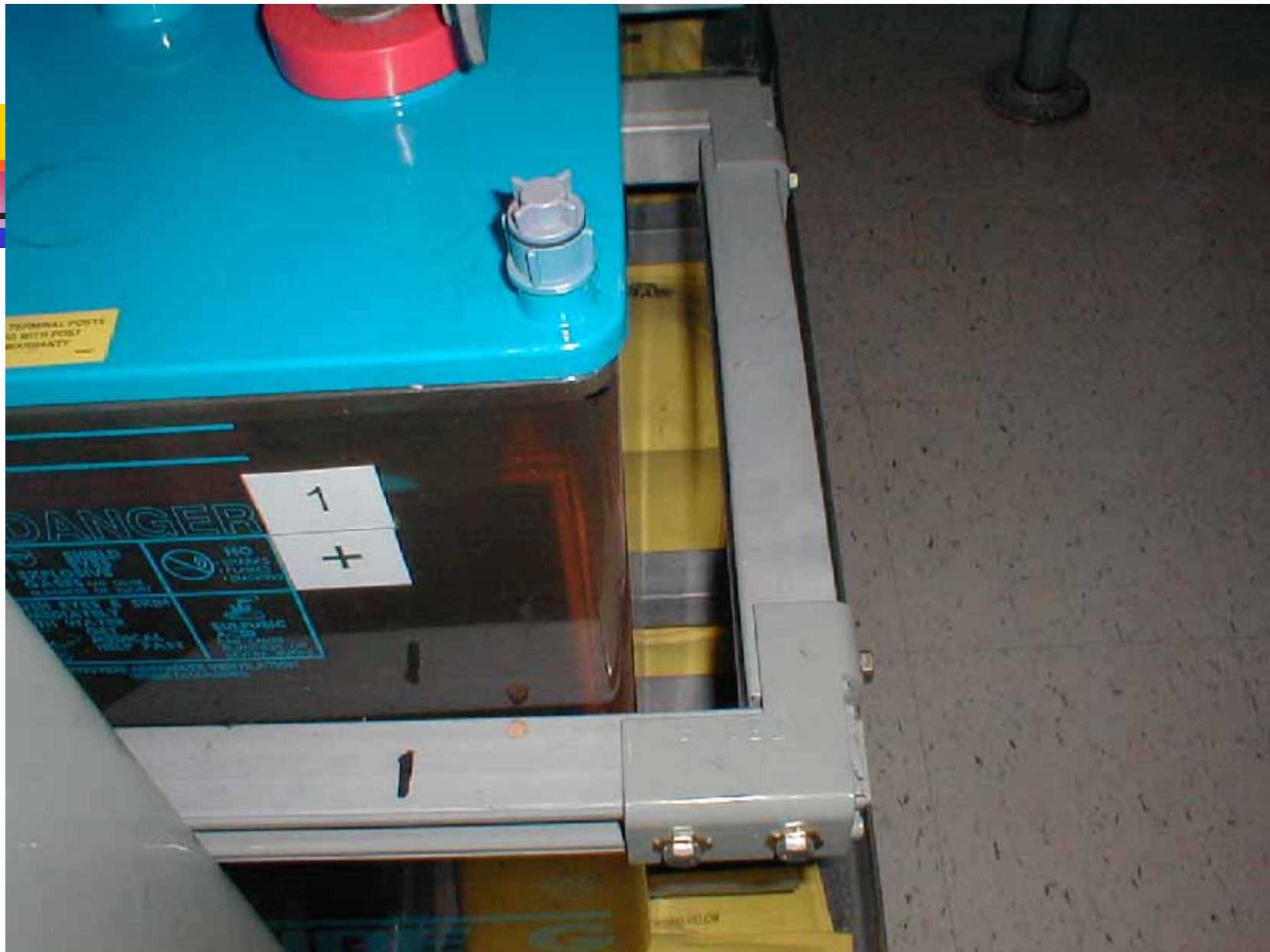


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Physical Protection of the Battery

- Proper racks for seismic areas.
- Proper mounting of batteries and racks.
- Clear areas around batteries.
- Clean areas around batteries.



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Battery Not Bolted Down



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QUESTIONS ???