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Battery Maintenance for Alternative Energy Systems February 2025

Below are tips on maintenance and charging vented lead acid batteries used in alternative energy systems. Vented batteries have cell caps that can be opened by the consumer. Do not confuse these with sealed batteries with non-openable caps.

Safety: Lead acid batteries are dangerous devices if not handled correctly. They contain corrosive fluids and generate explosive gasses. Below are recommended safety procedures.

1. Eye safety: Always wear protective goggles or face shield. The corrosive electrolyte can splash into the eyes and cause injury.
2. Skin safety: Wear rubber gloves to protect hands from the acid. Wear protective clothing. A cheap rain suit works quite well. Keep baking soda handy to neutralize battery acid. Wash tops of batteries with a solution of baking soda if there is an accumulation of acid residue.
3. Explosion: All battery enclosures should be hermetically isolated from electrical equipment and vented to the outside to prevent sparks from igniting volatile gasses produced in charging. Before maintenance, all batteries should be disconnected from charging sources and the enclosure allowed to vent.
4. Create a kit including all of the safety items mentioned above and also including a good hydrometer or refractometer and a modest digital voltmeter.

Battery Electrolytes:

1. Battery water level should be monitored at least once a month, more often after heavy charging. Water should be added when level drops to 1/2" below full level. Full level is 1/4" below the bottom of the fill cylinder. Use distilled water. Fill cells slowly. A pump sprayer dedicated to this purpose is very handy.
2. Add water after charging to avoid overflow due to expansion unless the cells are critically low. If any plates are exposed, add only enough water to cover them, charge batteries fully and then fill if needed.

3. Charging:

4. Do not let battery voltage fall below these values (most inverters will prevent this automatically):
 - a. 12 volt system: 11 volts
 - b. 24 volt system: 22 volts.
 - c. 48 volt system: 44 volts

5. Daily charge: Ideally, charging should achieve the manufacturer's recommended voltages every day. This process known as Bulk charging. If you can't find the recommended voltages the values below are typical:
 - a. 12 volt system: 14.5 volts.
 - b. 24 volt system: 29.1 volts.
 - c. 48 volt system: 58.2 volts.

6. Battery industry claims that this voltage level should be maintained for 6 hours. Holding for this time is called Absorption. This is rarely practical in alternative power systems, but we recommend holding this voltage level for at least two hours every day. Modern charging systems are programmable to achieve this charge level and duration.

7. Maintenance charge: After the daily Bulk and Absorption Cycles the batteries should be charged at a lower voltage if solar is available. The lower voltage lessens the evaporation of water from the battery cells. This lower charge is called Float. Below are typical float voltages:
 - a. 12 volt system: 13.8 volts.
 - b. 24 volt system: 27.6 volts.
 - c. 48 volt system: 55.2 volts.

8. Equalizing charge: Eventually through daily charging and discharging, the electrolyte in lead acid batteries becomes stratified and the acid is concentrated in the bottom of the cells. This problem is resolved by a deliberate over-charging of the batteries, called an equalizing charge. This is achieved by charging the batteries to the voltage indicated below and holding it for at least two hours. This should be done once a month. See the instructions for your charging system for specific steps to initiate an equalizing charge.
 - a. 12 volt system: 15.5 volts.
 - b. 24 volt system: 31.0 volts.
 - c. 48 volt system: 62.0 volts.

9. Testing batteries: There are a number of ways a battery array can be tested, most usually: specific gravity and at-rest voltage. The method that is most practical for the residential user is measuring specific gravity.

10. Measuring specific gravity: Batteries should be tested at least once every 6 months to ensure they are in good condition. One bad battery in an array can shorten the life of every battery in the array. Specific gravity should be checked after the batteries are fully charged. Stop charging and ventilate the battery compartment

before testing specific gravity. Here's how to test specific gravity:

- a. Obtain a good hydrometer or refractometer. The hydrometer should have a numeric scale, not colored balls. A hydrometer can be purchased at Napa Auto Supply. A refractometer can be purchased on the internet or from us.
- b. Wear goggles, gloves and protective clothing.
- c. Charge batteries to full. Check water level. If significant water is added, charge batteries again.
- d. Using hydrometer:
 - i. Lower hose of hydrometer into electrolyte. Squeeze bulb and draw in enough electrolyte to raise float, but not so much as to cause float to run into the top of housing. Hold hydrometer vertical. The surface of the electrolyte will have some curvature – read scale at lower edge of this curvature.
 - ii. Correct the reading for the temperature.
 - iii. Squeeze all of the electrolyte back into the cell from which it was drawn. Avoid dribbling any electrolyte onto skin or clothing.
- e. Using a refractometer: Follow the directions provided with the instrument. Do not neglect calibrating the instrument.
- f. Record the reading, which cell it came from and the date. This will help track battery condition. Apply reading to this scale:

Percent of charge	Specific gravity
• 100%	1.265
• 75%	1.225
• 50%	1.190
• 25%	1.155
• 0%	1.120
- g. If you have applied proper charging voltage to a battery (bulk charging voltage for 6 hours and equalization charge for 2 hours) and the specific gravity for all cells is not close to 1.265, the battery may be past its useful life. Replace individual batteries only if the array is less than one year old.

11. Testing with at-rest-voltage: Charge the batteries fully -- Apply bulk voltage for 6 hours and equalizing voltage for 2 hours. See above for these voltages. Disconnect the batteries and let them rest for 2 hours. Voltage should read 12.6 for a 12 volt battery, 6.3 for a 6 volt battery and 2.1 for a 2 volt battery.

If you have any questions, I would be happy to arrange an on-site inspection of your battery system. I have available additional literature on this subject, please ask if you are interested.

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