

Technical Note **Equalizing Batteries**

Freedom and Link

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Introduction

Equalizing or conditioning batteries refers to a method of charging deep-cycle wet cell batteries that is intended to restore battery capacity, revive battery efficiency, and extend battery life. The process involves periodically applying a controlled overcharge cycle to batteries. This type of charge cycle requires that certain procedures and precautions be followed.

Why Equalize Batteries?

While a battery is being discharged, sulfuric acid in the electrolyte reacts with the lead plates in a chemical reaction that produces electricity and lead sulfate. When the battery is recharged, electricity flows back into the battery and causes a reverse chemical reaction that turns the lead sulfate back into lead and sulfuric acid. With each discharge and recharge cycle however, a small amount of lead sulfate remains on the plates. Using a three-stage charger will minimize the amount of residual sulfate left on the plates, but some will still accumulate with each discharge and recharge cycle.

If this sulfate is left in place for a long time, it will harden or crystallize and eventually reduce the battery's capacity, increase its internal resistance, and its ability to produce an adequate amount of power. When this situation occurs, even an equalization charge can not remove the sulfate and the battery becomes useless, except as an item to be recycled to reclaim the lead and prevent contamination of the environment.

Over time, the electrolyte tends to stratify into layers of acid and water with higher concentrations of acid near the bottom of each cell and more diluted electrolyte near the top. This causes uneven specific gravity within a cell, further reducing its capacity and efficiency.

The Equalizing Process

An equalizing charge is a controlled overcharging cycle that performs several actions within the battery and provides certain benefits. During equalization, the voltage is raised to approximately 2.7 volts per cell, or about 16.2 volts for a 12-volt battery. The current output of the charger should be limited to about 5% of the battery capacity. In other words, a 200 amp-hour battery should be allowed to accept no more than about 10 amps of current. This will prevent overheating. The equalization cycle is timed to be between four and eight hours, depending on the features of the charging source. The cycle can always be terminated early if necessary. The particular battery manufacturer's recommendations for equalization time should be followed.

This elevated voltage results in a vigorous charging action within each cell, and has several effects on the battery. Much of the residual sulfate is forced to re-combine with the electrolyte in the form of sulfuric acid. Crystallized sulfate that does not re-combine is broken loose from the plates and falls harmlessly to the bottom of the battery. Deep-cycle batteries have additional space beneath the plates intended to collect this material. This action cleans the plates, exposing fresh lead to the electrolyte, and restores battery capacity.

The vigorous bubbling action that occurs during equalization stirs up the electrolyte and restores it to a consistent mixture of acid and water. The equalizing process causes all cells in a battery to reach their maximum idle potential of 2.1 volts.

When to Equalize

Refer to the battery manufacturer's recommendations before equalizing, as each manufacturer has different suggestions on how often and how long to equalize their batteries. It is a good practice to equalize batteries after every 10 or 12 deep-discharge and recharge cycles. For batteries being constantly discharged and recharged, this means about every two weeks. Periodically used batteries should be equalized two or three times a year. Batteries just used seasonally should be equalized at the beginning and end of the season. When using a battery monitor such as a Link 2000, it is good practice to equalize when you notice the charge efficiency factor (CEF) begin to drop.

How to Equalize

Always follow the battery manufacturer's recommendations. However, the following guidelines may help:

- Only wet cell deep-cycle batteries should be equalized. Never equalize gel batteries or maintenance-free batteries.
- The batteries should be fully charged and near ambient temperature before beginning an equalization charging cycle.
- Each cell should have a sufficient amount of electrolyte to cover the plates. They should not be topped up until the equalization is complete. As there is some heating of the cells during equalization, the electrolyte will expand and possibly overflow the cells if they were topped-off before equalizing. Not only will this make a mess, but force you to terminate the equalizing cycle too early to gain maximum benefit and will result in diluted electrolyte when water is added.
- Caps should be left on each cell. The caps are vented, so when left on, they will prevent splattering of electrolyte onto the top of the battery when the bubbles pop. Laying a paper towel over the caps is a good idea. This makes it easy to spot a cell that starts spitting electrolyte, and will soak up the liquid when this occurs.
- The batteries give off significant quantities of explosive hydrogen and oxygen gas during equalizing. They also produce moisture that contains some amount of corrosive sulfuric acid, so it is imperative that sufficient ventilation is provided. Avoid smoking or generating any sparks or flames near the batteries during this charge cycle.
- All DC loads on the batteries should be turned off and disconnected. As battery voltage is higher than normal during this charge cycle, some DC equipment could be damaged if left on. These loads draw current from the charger, which should be available to the battery instead.
- Equalize one bank of batteries at a time.
- To limit the charging current to less than 15 amps DC with the older Freedom inverter/chargers, set the power sharing feature of the charger to 5 amps AC using the remote control panel. Newer versions automatically set a special equalizing current limit during the equalizing cycle.

- Batteries need to be observed throughout the equalizing process for any spitting cells. If this occurs, terminate the equalize cycle early. Do not start an equalize cycle and then leave the batteries unattended.
- After equalizing, turn off the charging source and allow the batteries to cool to ambient temperature before resuming normal float charging. When the batteries are cool, check the specific gravity in each cell. They should all be 1.265 +/- .050 at 80 degrees Fahrenheit.
- Refill each cell with distilled water up to the full indicator.

Starting and Stopping the Equalize Charge Cycle

When using the standard Freedom remote control panel, an equalizing charge cycle is started by turning dip switch #1 on for one second and then back off again. This will start an eight-hour equalization cycle. After the cycle times out, the charger will go to float mode. To terminate the cycle early or to allow the battery to cool down after equalizing, interrupt the AC input power to the charger. When AC power is reapplied to the charger, it will resume normal charging.

When using the Link 2000 remote control panel, the equalize charge cycle is started by first turning the charger on and waiting until it is in float mode. Then, press the SETUP button and hold it until it begins to flash. Then, release the SETUP button and immediately press both the VOLTS and A hrs buttons simultaneously, and hold for five seconds until the red CHARGE LED begins to flash and the "E" in the display goes out. To terminate the equalize cycle and force the charger into the float mode, repeat the same setup procedure. The cycle will terminate automatically after eight hours or if AC input power to the charger is interrupted.

When using the Link 2000R to control equalization using the Freedom charger, it operates the same as the Link 2000 described above. If the alternator is the charging source, some differences will be apparent. The procedure for start/stop equalizing is the same, but control of the charging source (alternator) is different. The cycle is 3.5 hours long, and the charge current is limited to 4% of battery capacity up to 16 amps maximum.

Additional precautions

If some battery cells begin spitting electrolyte during equalization and continue spitting long after the charger has been turned off, this indicates that the spitting battery may have a shorted cell. If this occurs, disconnect any batteries that are in parallel with the questionable battery, as these batteries will continue to supply current to the questionable battery and cause it to become very hot. When things cool down, check the suspect battery with a hydrometer. A shorted cell will read much lower than the other cells. If this is the case, the battery should be replaced.

Batteries that are likely to develop a shorted cell are more likely to do so during an equalization cycle, since the battery is being subjected to increased thermal stress during this type of charge than it is accustomed to. It is likely that the battery would have developed the shorted cell sooner or later, but it's better to find this out when the batteries are being closely monitored as during an equalization cycle.

When you work with batteries, always wear protective clothing and eye protection. Avoid generating sparks, open flames, or smoking near batteries.

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