

Series Charging of Nickel-Cadmium Batteries

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Introduction:

Can Nickel-Cadmium Batteries be charged in series?

The answer is both yes and no as it depends entirely on the charging method and equipment.

Operation Description:

Nickel-Cadmium batteries can be charged in series if, and only if it is done with constant current.

A more complete answer, however, depends on the purpose of the charging.

If the purpose is to simply charge a discharged battery, any method available will do (will have to do).

But, if the purpose is to charge a battery for test purposes (to determine if the battery is airworthy) then constant current is the only way, as it is established by the manufacturers of the batteries.

When a battery is charged in constant voltage (or other voltage dependent methods) then the individual cells that make up the battery can easily become imbalanced¹. This is one of the reasons why a periodic deep cycle is needed.

When a Nickel-Cadmium battery is charged at constant current, all cells are free to develop a voltage that becomes indicative of their charge acceptance. It is for this reason that Nickel-Cadmium batteries can be charged perfectly well in series².

Why charge batteries in series? Strictly for efficiency reasons. The typical charge time for a Saft battery is 6 hours³, therefore, if two batteries can be charged simultaneously, there is a significant gain in time.

Charging two batteries in series requires a higher capability in the Charger-Analyzer and a corresponding higher safety margin. The Superseder/MasterCharger was designed for both. It can provide constant current charging from one cell up to 50 cells and it can only output current while connected to a battery (no dangerous "hot" terminals).

What about the task of measuring 40 cells, not just 20?

Yes, measuring the voltage on each cell is laborious and error prone but it can be done (not just on 20 cells but on all 40 – there is plenty of time). To alleviate this burden, the BTAS16 Battery Test System was designed to automatically take all necessary measurements, accurately and efficiently (see <http://jfmeng.com/btas16.htm>).

What about discharging two batteries?

Discharging of two batteries, for the purpose of Capacity Testing, presents a different situation. At constant current, it basically does not matter how many batteries are connected but there is a power dissipation limitation. The current model of Superseder/MasterCharger is limited to a maximum of 60A for one 24V battery or 30A for two 24V batteries. At a higher voltage and/or current, the heat dissipation will exceed the cooling capability in the load banks.

¹ Note that Lead-Acid batteries can also suffer from the same imbalance problem, although to a lesser extent.

² Note that a typical aircraft battery can be looked at as a series string of 20 individual batteries.

³ Two hours of Main Charge (C/2) and four hours of Topping Charge (C/10).

Yes, it is possible to lower the current and extend the time to accommodate batteries that would otherwise exceed the power dissipation limit, but it may be necessary to account for possible performance differences at the lower current.

But, there is a more fundamental issue here. Capacity testing is not simply based on a battery terminal measurement; it requires that all cells be measured, because the battery will fail capacity the moment that any one of the cells fails capacity, thus requiring rapid measurement of all cell voltages. It is already quite demanding to quickly monitor 20 cells, let alone 40 of them.

The BTAS16 system again comes into play by providing an easy method to measure all cells, not just 20 but 40!

Summary:

- Series charging of Nickel-Cadmium batteries is perfectly normal provided that it is done with constant current.
- Series discharging, however, is not that simple, as it is affected by other factors that limit the gain in testing efficiency.

JFM Engineering has over 30 years in the development and manufacturing of precision instruments for the testing of batteries and an FAA certified repair station for the testing and maintenance of aircraft batteries of all types.

For additional information, please contact the sales department at 305-592-2272 or visit our website www.jfmeng.com for complete information on our products and services.