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Technical Information Sheet No.3

Charging Nickel Metal Hydride Cylindrical Cells & Batteries

Introduction

Nickel Metal hydride (NiMH) cylindrical cells* and batteries are similar, in many ways, to the familiar Nickel Cadmium (NiCd) types. They are similar in voltage, usually available in similar sizes, and normally require constant current charging. However, there are important differences which users should be aware of. For instance, NiMH types are typically more sensitive to abuse than traditional NiCd

NiMH button cells generally have different charging requirements to the spirally wound cylindrical types, as their internal construction is normally different. (Although strictly speaking, both "button" and "cylindrical" types are cylindrical, button types normally have a larger diameter than height and the terms are popularly used to distinguish the two).

The information given here is a generalised guide, and some NiMH cells from some manufacturers may have different requirements. It is therefore important to check the cell manufacturers data sheets for definitive information.

Charging Methods

The recommended method is constant current. It is possible to "fast charge" or "overnight charge" most cylindrical NiMH cells and batteries. Long term "trickle charging" is not generally recommended, as it may reduce battery life. However, if it is employed, a very low rate of charge is indicated, to reduce any battery degradation to a minimum.

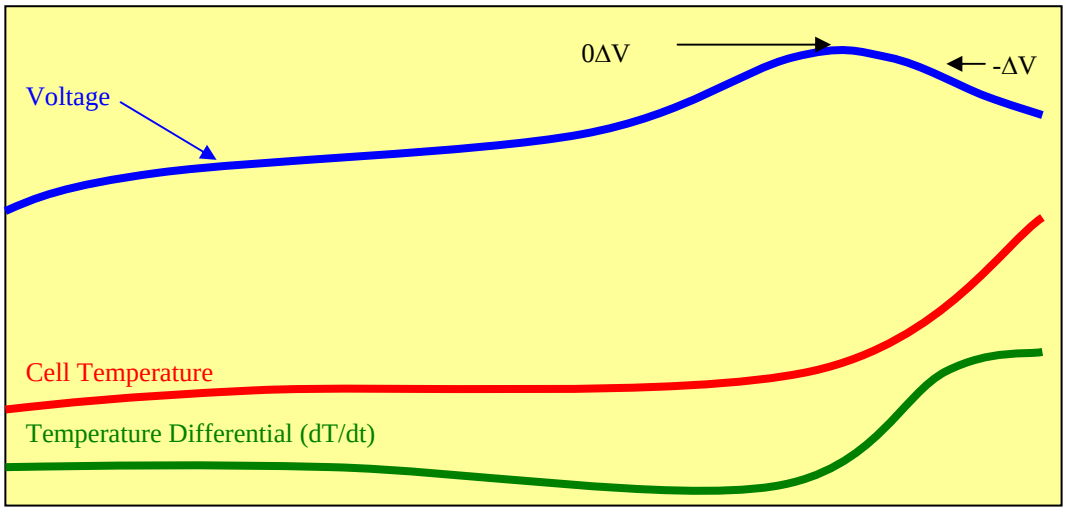

Figure 1: Typical NiMH Cell Voltage and Temperature during charge.

Fast Charging

It is possible to charge most cylindrical NiMH cells at the "one hour" or "C**" rate although the "two hour" or "C/2" rate is generally kinder to the battery. However, overcharging at this rate would very quickly damage the cells, so it is important to ensure that this does not occur, by having a reliable method of stopping the charge once the battery is fully charged.

There are various methods of achieving "end of charge" control. Amongst the most popular are "negative delta V (-ΔV)" and "zero delta V (0Δ)" detectors. "Change of temperature (dT/dt)" detectors are also commonly used. These make use of the charging characteristics of a typical NiMH cylindrical cell, as shown in figure 1. Many manufacturers suggest the use of both negative or zero delta V together with change of temperature detection, in case one method fails to detect.

Suitable charge control chips are available from the usual sources, as are application notes. AllBatteries is unable to suggest charging circuits for your application, but does stock a range of chargers, including fast chargers. Please contact our sales department for further details.

On Charge Voltage

Obviously, it is also important to control the charging current and there must be sufficient voltage to force the current into the cell or battery. During charge the voltage may rise as high as 1.55V per cell, so it is important to ensure that the charge can maintain the constant current with the battery at this voltage.

Temperature

The exact recommended temperature range for charging may vary from one cell manufacturer to another. Typical ranges are as follows:

Charge Rate	Typical Recommended Range
Fast Charge (C to C/2)	+10 to +45°C
Standard (C/10)	0 to +45°C
Trickle (C/250 to C/500)	+10 to +35°C

NB: Button cells charge over different temperature ranges.

Overnight or Standard Charging.

Charging at the "ten hour" or C/10 rate takes 14 to 16 hours to fully recharge the cell or battery. Limited overcharging at this rate is acceptable, so it is not generally necessary to have an accurate end of charge detector. However, prolonged overcharging would damage the cells, so it is necessary to have either a strict routine, where charging is definitely discontinued after 14 to 16 hours, or to use a timer.

Occasional overcharge, where a partly discharged battery is put back on charge, is not likely to have any noticeable effect. However, repeatedly recharging an already fully charged battery, or a battery with a large part of its charge remaining, will damage the battery and degrade performance and reduce battery lifetime, possibly dramatically.

Trickle Charging

Long term trickle charging i.e. continuous charging at a low current, is not recommended for NiMH cylindrical cells. Experience has shown that long term charging (i.e. overcharging) at C/10 or C/20 rates will degrade the battery. If trickle charging cannot be avoided, it is suggested that the rate be limited to C/250 to C/500. Charging at this rate will be sufficient to replace charge losses due to self discharge, but should limit any degradation to an acceptable level. (NB: Self-discharge rates increase with temperature. At high temperatures, e.g. above about 45ºC, the rate may be too high to be negated by trickle charging at the recommended rates)

Glossary: (* & **)

Cell: A single electrochemical unit, usually sealed within a metal "can" and fitted with pressure relief vents or devices. The voltage produced by each cell is a function of the chemistry employed. NiMH cells are nominally rated at 1.2V each.
Battery: Originally an assembly of two or more cells but also now commonly employed to mean a cell in usable form i.e. complete with sleeve and/or label and either contact surfaces or tags or pins.
C: Commonly used to designate a charge or discharge rate equivalent to the rated capacity of the battery e.g. charging a battery nominally rated with a capacity of 4Ah at the C rate would be charging at 4A. This does NOT mean that the battery will fully recharge in one hour, as the battery will not have a charging efficiency of 100%. For instance, some of the charging energy is dissipated as heat. Charging efficiency will depend on the cell type, charging rate and temperature, but would typically be between 50 and 75%.
Sub multiples and multiples of "C" are commonly used, such as C/2 or 2C, which for a 4Ah cell would be 2A and 8A respectively.

Further Advice

Our technical department is happy to offer further advice. Remember, we carry a range of standard chargers in stock can often arrange the production of special chargers, subject to a minimum batch size of 25 pieces. We can also supply standard chargers, printed with your logo and part number, subject to the same minimum batch size.

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