Robbe Operating Instructions for NiMH Batteries

Nickel-Metal-Hydride battery

Over the last few years the modern Nickel-Metal-Hydride (NiMH) battery has developed into a genuine alternative to Nickel-Cadmium (NC) types. They are now also capable of delivering high currents, and as such are suitable for use as radio control system batteries as well as flight / drive batteries. In broad terms they offer 1.5 times the capacity of NC batteries for the same weight, and are also environmentally friendly. Nevertheless, there are a few important basic rules which need to be observed when handling this type of battery. Please read right through these instructions before using NiMH packs for the first time.

Charge rate

The term (C) is now in common use to define the magnitude of charge and discharge currents; this represents the connection between the charge current and the battery capacity.
For example, if a 600 mAh battery is to be charged at a rate of "1C", a current of 600 mA must flow.

Conditioning

A new battery, or one which has not been used for a long period, must be conditioned before being used. The same applies to a battery which has been deep-discharged, as there's a chance that some of its cells may have suffered reversed polarity. Conditioning takes about 24 to 26 hours at a charge rate of 0.1C. **Example:** A 4.8 Volt / 800 mAh NIMH battery; charge current 1/10C = 80 mA.

Charging procedures

When dealing with NiMH batteries we have to differentiate between normal and fast charging. Once again, the standard charge rate term (C) is used to describe the charge and discharge currents (charge current 1C = 1 x capacity value). **Example:** A 600 mAh battery is charged at a rate of 1C when a current of 600 mA flows.

The term 'normal charging' refers to the process of charging a battery at 0.1C to 0.2C. Since it is always necessary to charge more energy into a battery than can be recovered from it, the charge time for **normal charging** at 0.1C is not 10 hours, but 16 hours, i.e. normal charging requires an overcharging factor of 60%. Even at this low current, extended charging will damage the battery and should always be avoided, since the excess electrical energy cannot be stored, and instead triggers chemical processes which reduce the effective life of the battery.

Charge currents in the range 0.3C to 0.5C are commonly referred to as accelerated charging.

The term **fast charging** applies to the process of charging NiMH batteries at rates higher than 0.5C. If the charge rate is higher than 0.1C, the charge current must be switched off as soon as the battery is fully charged. One effective means of terminating the charge is known as the 'digital delta-peak' process. This means that the charger monitors the battery voltage and cuts off the current when the voltage starts to decline (i.e. when the pack is full).
Not all automatic delta-peak charge cut-off processes are suitable for NiMH batteries, as most chargers were designed for NC batteries and therefore switch off too late, i.e. the NiMH battery is overcharged, causing it to overheat and suffer permanent damage.
The delta-peak cut-off sensitivity of a NiMH charger should be no worse than 10 mVolt / cell.

Please ensure that a fast-charge process is not followed by a trickle charge current which in turn overcharges the pack. It is essential to disconnect the fully charged battery from the charger soon after the fast-charge process is concluded. Please refer to the information provided by the charger manufacturer to find out whether the unit is suitable for NiMH batteries. All robbe fast chargers which feature an automatic digital delta-peak charge cut-off circuit are suitable for charging NiMH batteries.
If you are not sure, you can carry out your own simple test of your charger: if you charge a NiMH battery at a current of 1C, its temperature should be no higher than about 40°C.: when the cut-off circuit is triggered. Chargers which allow the battery to become considerably hotter are not suitable, and will cause permanent damage to your NiMH packs.

We recommend the following charge rates for NiMH batteries:
High-energy batteries: 0.5C to1C; please observe the limits **stated by the manufacturer** on the battery label.
High-current batteries: usually 1C, although many battery types can be charged at 1.5C ... 2C. Please observe the limits stated by the manufacturer on the battery label**.**

Batteries develop different internal crystal structures depending on the magnitude of the charge current they are required to deliver. This means that flight / drive batteries which are discharged at high currents must also be charged at a high rate (fast-charged). The higher the charge current you use, the lower the voltage drop when the pack is discharged.

Caution - charging in the transmitter:
Always observe the maximum permissible charge current stated for the transmitter charge socket.
If you are using an automatic charger or a process which includes discharging, it is essential to by-pass the protective diode in the transmitter.

Temperature
NiMH batteries only achieve their full capacity on charge when they are close to room temperature (20°C). Warm cells absorb less energy, and can therefore deliver less energy.

At low temperatures (below 20 °C) **the ability of a NiMH battery** to deliver high currents gradually diminishes.
At temperatures below 10°C the maximum battery performance falls further,
and the user must expect a marked loss of performance.
If you are obliged to use NiMH batteries at low temperatures, it is essential to take into account that their useful operating times will be significantly shorter.

Effective battery life
Depending on usage and the type of charge process employed, NiMH batteries can be expected to last for about 500 to a maximum of 1000 cycles. After this the pack will be exhausted, and is ready for disposal.

Self-discharge
At a temperature of 20°C NiMH batteries lose about 1.5% of their charge per day, so after about 75 days a fully charged pack will be completely flat. For this reason it is absolutely essential to top up your batteries before you use them.
Storage: if a NiMH battery is not to be used for the foreseeable future, it should be stored in dry conditions at a temperature of 10 to 20°C. When first stored, the pack should be charged to a capacity of at least 30 ... 100%. If you do this, the battery will regain almost its full capacity after one conditioning charge.

Final discharge voltage, deep-discharging
The permissible final discharge voltage of a NiMH battery is about 1 Volt per cell, measured under load. If cells are discharged beyond this point, they become deep-discharged, and this can cause one or more cells to reverse their polarity. Negative potential is present at the positive terminal of a reversed-polarity cell, and positive potential at the negative terminal (this can be checked under small load using a voltmeter). Cell damage caused in this way is often permanent, but can sometimes be corrected by giving the pack an immediate normal charge lasting 14 to 16 hours. Always avoid deep-discharging NiMH batteries, as this can easily result in irreparable damage to the cells.
When handling NiMH cells a number of cautionary measures must always be taken in order to avoid personal injury and damage to property. When you use these batteries you accept personal responsibility for any repercussions.

Storage
If a NiMH battery is not to be used for the foreseeable future, it should be stored in dry conditions at a temperature of 10 to 20°C. It makes no difference whether the battery is first discharged to the final discharge voltage or is still fully charged. The only advantage to discharging before storage is that virtually the full voltage and capacity will be available immediately after the first charge.
If the pack is not discharged before storage, the first charge afterwards will **only produce** about 90 to 95% of the voltage level and capacity, and full performance will not be available until it has undergone two or three charge cycles.

Safety notes
When handling NiMH cells a number of cautionary measures must always be taken in order to avoid personal injury and damage to property. When you use these batteries, you accept responsibility for any repercussions.

- NiMH cells must never come into contact with open fire, as they may explode if the cell temperature rises to about 60°C.
- Never forcibly open NiMH cells; injury hazard through corrosive materials.
- Never short-circuit NiMH cells - fire hazard, possible explosion hazard.
- If electrolyte should escape from the cell, do not allow it to touch your skin or eyes. If this should happen despite taking normal precautions, immediately wash it off using plenty of clean water, and seek medical attention without delay. Never place NiMH cells or batteries in your mouth, as they contain toxic materials.
- Never solder directly to the cell can using a soldering iron: insulation damage, increased internal cell pressure, blocking of the safety valve.
- Charged batteries are not children's toys. Always store these batteries well out of the reach of children.
- Please read and observe the safety notes and other information provided by the battery manufacturer before charging and discharging the cells.

Disposal
On no account dispose of exhausted batteries in the domestic waste.
To protect the environment, take defective and exhausted packs to your local battery collection centre after ensuring **that** they are **completely discharged.** Collection points include all retail outlets where dry and rechargeable batteries are sold, and also local authority toxic waste collection sites. To avoid short-circuits, any exposed contacts should be carefully insulated. The cost of returning and recycling old batteries is included in their original purchase price. All the above-named collection points are legally obliged to accept batteries, whether you purchased them there or not. Exhausted batteries can be recycled, and the materials re-introduced into the production chain. Please help to protect the environment!

Salt water sailing (this addition by WRYC)
Occasionally, *quickly* rinse your battery pack in hot (50 ^{0}C) clean fresh tap water to remove any salt film that may be forming and could wreck the whole battery by flattening one cell.
The flat cell may be reverse charged and ruined. The entire battery pack will be useless if the cells have been glued together.

It is advisable to remove the battery from the boat as soon as possible after sailing.

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