

BATTERY CHARGING GUIDE

The charging characteristics of NiCd and NiMH batteries are very similar; the recommended method is constant current charging. This is where the charger provides a fixed charging current to the battery. The variant in these types of charger is the rate in which they provide this charging current and for nickel-based generally slow (trickle), quick (rapid) and fast current chargers. Within these different types of charger you will find varying levels of quality generally related to price.

Nickel-based batteries initially have a huge number of tiny crystals (approx 1um) on the surface of the positive plate of the battery. Over time, these crystals get replaced by much larger crystals (approx 50 to 100um) presenting a much smaller surface area to the electrolyte and hence reducing battery performance. It is generally considered that fast rate charges reduce the rate of this crystalline growth and are recommended over slow rate charging for nickel based batteries.

A General Formulae

A common question is how long to leave your battery on charge. A general formula has been produced for you to calculate an estimate for charge time of your battery:

$$\text{Suitable charging time (Hours)} = \frac{\text{Capacity of battery (mA)} * 1.2}{\text{Output current of charger (mA)}}$$

The value gained from dividing the 'Capacity of Battery' by 'Output current of charger' gives what is called the C rating. The C rating is widely used to represent the charge or discharge rate equivalent to the rate capacity of the battery. E.g. A cell has a rating of 4Ah, charging at the C rate, the output of the charger will be 4A. Charging or discharging at the C rate does not mean that the cell will charge/discharge in 1 hour, cell data sheets need to be consulted to find the correct charge/discharge rates relative to a given C rate. Multiples of C are often used, i.e. for the example above, 2C would mean 8A and C/2 would indicate 2A charge/drain current.

The figure of 1.2 in the numerator (top of the equation) comes from the fact that when using fast constant current chargers, you need to put up to 120% energy into the battery to get 100% (full charge) out. When using slow charging techniques this figure should be increased to 1.4 as nickel based systems charge better at higher currents.

This formula is also based on cells which are taken to 0.9V per cell before charging; again it should be stressed that this is an approximation formula and should not be used if you require precise charge times and characteristics.

A fast charge is characterised by the ratio between the charge current and the capacity of the battery. If the charging current is 1/10 or less of the capacity of the battery, this is deemed to be slow charging. Charging at 1/10 or greater is deemed as fast charging. The above formula is a general rule and should not be taken as the definite value to go by, it also assumes that the battery you are charging is in a fully discharged state when you put it on charge.

General Charging Tips

- Try to avoid overcharging; this is the main and most common cause of reduction in life in NiMH and NiCd batteries.
- Nickel-based batteries prefer fast-charging but you must take care when using this method because overcharging at this rate will very quickly damage the cells.
- Avoid high temperature during charging. Discontinue the use of chargers that overcharge batteries.
- A charger for nickel-metal-hydride can also accommodate nickel-cadmium, but not the other way around. A charger designed for nickel-cadmium would overcharge the nickel-metal-hydride battery.
- Nickel- and Lithium-based batteries require different charge algorithms. The two chemistries can normally not be interchanged in the same charger.
- Do not leave your batteries in the charger when not charging.
- Don't leave rechargeable batteries unused for too long. If you do have to leave them stored for an extended period, it is recommended that you leave them at approximately 40% charge. Then charge them up again before use.
- Always charge your batteries before use either when first purchased or if they have been unused for any length of time. (NiMH or NiCd can lose up to 30% of their capacity per month).
- Always use the correct type of charger. Some chargers are specifically designed for certain types of battery (i.e. NiMH or NiCd). Always check you are using the right charger for your batteries.
- Try to keep your battery and charger contacts clean. This will ensure good connections between the devices and optimise operation.
- It is generally considered that fully discharging your battery before charging it up is recommended to prolong performance. Repetitive partial charging and discharging does not really affect your batteries performance due to the so-called 'Memory Effect'.