Batteries Explained

CHOOSING THE RIGHT BATTERY

Rechargable batteries have come a long way in the past decade or two and whereas early modellers had only one choice - the humble nicad, today there is a vast array of different types on the market.

Unfortunately, all this choice can leave modellers confused as to which is the best battery to use and how to take care of them.

Get a good charger

I can't stress strongly enough the importance of buying a decent charger if you want to get maximum performance and life from your batteries -- whatever type you're using.

Until a few years ago, the only charger most people owned was the wall-wart one that came with their radio. These are simple, effective and cheap -- hence their wisespread use until recently.

Now, thanks to the ever-decreasing cost of electronics, there is wide choice of "intelligent" computerized chargers on the market that will not only charge your batteries but also tell you just how much energy was used and allow you to easily measure the actual capacity.

What's more, these chargers are usually able to cope with all the common battery types we use in RC modelling.

A typical price for such a charger is R 800.00 – R 4000.00, depending on a number of factors and features.

I really recommend that whatever charger you purchase, you make sure it can handle LiFePO4 or A123 batteries, since these are the most promising new technology we've seen in years and are already becoming widely used.

Caring for your batteries

There are some pretty simple basic rules of thumb that can extend the life and performance of your batteries:

- don't overcharge or run your batteries flat
- don't subject batteries to extremes of heat or cold
- choose an appropriate battery for the job
- only use a charger designed for the type of battery you're using
- never short-out a battery
- never leave batteries in a fully discharged state

A neglected or mis-treated battery will seldom last long and may cost you a model so try to treat them with the respect and care they deserve.

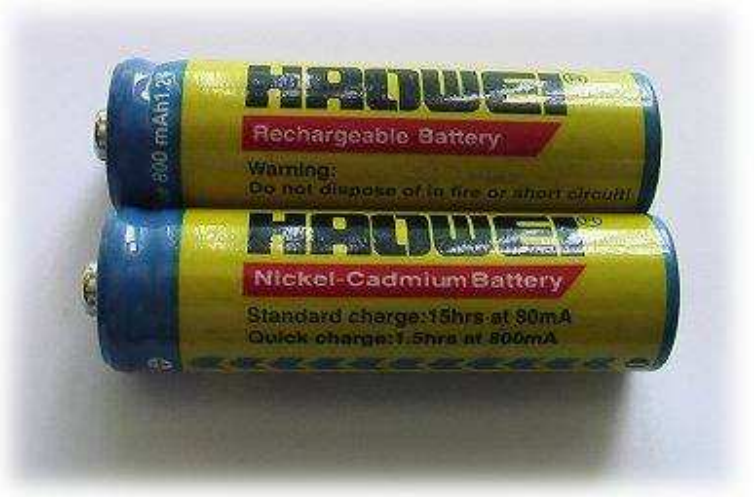
Choose the appropriate battery for the task

Since your entire RC system is dependent on the batteries you use, don't penny-pinch when choosing your batteries. It's a false economy to lose a R5000 model airplane for the sake of saving R50 on a receiver pack.

Read through the following pages to get an idea of where each different battery type can be best used and which is best suited to your exact needs.

Nickel Cadmium (NiCad) Batteries

STANDARD EQUIPMENT FOR YEARS



Nicads have been around for a very long time and were the only option for many RC applications for decades. These days however, they have largely been replaced by more advanced technologies. However, there are still places where nicad batteries can hold their own.

Nicad Pro's:

- low internal resistance (high-currents)
- low self-discharge
- less affected by low temperatures than some

Nicad Con's:

- heavier/bulkier than other battery technologies
- suffer from memory/voltage-depression
- environmentally unfriendly

A word about memory

One of the biggest problems that affects nicad batteries is something often referred to as "memory".

This is more accurately refered to as voltage-depression and occurs when a battery is repeatedly charged but only partially discharged. Over time, the battery appears to lose capacity to the point that only a small percentage of its rated energy storage is still useable.

The only way to recover the lost storage is by cycling the battery through a series of deeper discharge and recharge operations until its capacity is restored.

If you don't have a charger that will allow you to perform these capacity restoring charge/discharge cycles then avoid recharging your nicads when they're only partially discharged -- or allow your batteries to discharge until they're nearly flat at least once every dozen charges.

When to use

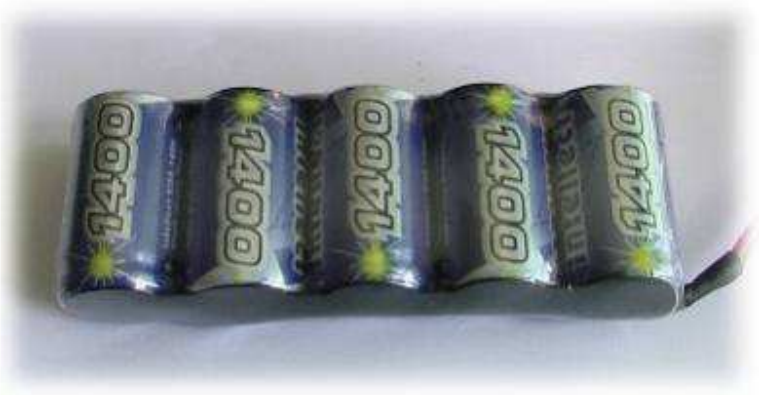
Nicads continue to be used for both transmitter and receiver packs although with the advances in other battery technologies and growing environmental concerns, most manufacturers are now providing more modern options.

Despite the development of hi-capacity and hi-current lithium polymer (LiPo) batteries, some electric fliers still prefer to use Nicads as a power source on extremely fast models where weight is less of an issue than the ability to safely deliver extremely high currents.

However, it is pretty hard to recommend Nicad batteries for general use these days. As you'll find out as you read on, new technologies have largely left Nicads in the dust.

Nickel Metal Hydride (NiMH) batteries

CHEAP, RELIABLE AND EFFECTIVE



Nickel Metal Hydride (NiMH) batteries have largely taken over from nicads in the area of transmitter packs.

Although early NiMH cells were sometimes problematic and not well suited to applications such as RC systems, today's versions are far advanced and represent the most practical solution for many applications.

Just about the only problem I've found with NiMH batteries is that many of those made in China simply don't have the claimed capacity and can therefore leave users wondering why they're not holding a proper charge.

NiMH Pro's:

- high capacities possible (AA cells of up to 2700mAH)
- no memory/voltage-depression effects
- less of an environmental problem than nicads

NiMH Con's:

- can self-discharge more rapidly than other technologies
- hi-capacity batteries can be delicate and unsuited to receiver packs
- not always the advertised capacity
- some chargers false peak and therefore do not fully charge these cells

The essential forming charge

Whereas nicad cells can be used straight out of the box, NiMH packs require a "forming charge" if you're ever going to see their maximum capacity realized.

This forming charge must be done at no more than the 10-hour charge rate (1/10C) and ensures that the plates inside the cells are properly conditioned for use.

You should not use a peak-detecting "smart" charger for this forming charge as it will almost certainly either false-peak or fail to detect when the battery is fully charged. It's best to just use the wall-wart charger that came with your radio and calculate how many hours will be required to pump 120% of the cell's rated capacity into the battery.

For example, if your wall-wart charges at 50mA and you're trying to form-charge a 1500mAH battery then you need to leave it on for (1500/50) x 1.2 which is 36 hours.

Always keep an eye on a new battery that's being form-charged to make sure it doesn't get warm. If it does then it's taken a full charge (it was proabably half-charged to start with).

When to use

Right now, NiMH batteries are about the best choice for transmitter packs in many models.

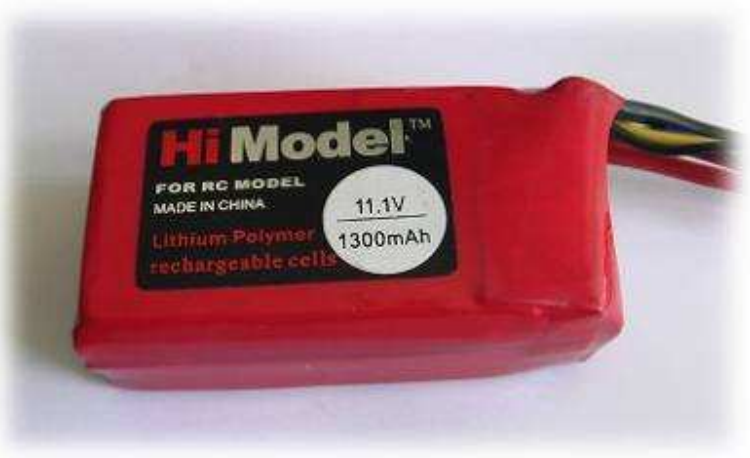
Caution must be observed when using hi-capacity NiMH cells (over 1650mAH in AA size) because these are more easily damaged by over-charging or charging at too high a current. I prefer to stick with a good quality 1650mAH transmitter pack and top them up at the field if needed (charging at up to 1.0A).

While the higher capacity NiMH cells (up to 2700mAH in AA size) might seem to be better, they will self-discharge more quickly when the gear is turned off and can only be charged at currents of about 250mAH -- making field-top-ups impractical.

And don't be tempted to use the hi-capacity AA cells for receiver packs on anything larger than a .40-sized sports model. The price you pay for this higher capacity is a decided tendency for the voltage to drop under load. There's always a risk that if the voltage drops enough, your receiver will stop working and you could lose control of the model (particularly true with 2.4GHz radio systems).

Lithium Polymer (LiPo) batteries

MAKING ELECTRIC FLIGHT REALLY PRACTICAL



Before the LiPo came along, electric models tended to be heavy and offered only limited performance and endurance.

Heavy nicads or NiMH batteries represented a lot of weight and that really limited the designer's and builder's choices.

However, the LiPo has changed all that and now many electric models have superior speeds, rates of climb and endurance to their internal combustion-powered equivalents.

LiPo Pro's:

- highest power/weight ratio
- very low self-discharge
- less affected by low temperatures than some

LiPo Con's:

- intolerant of over-charging
- intolerant of over-discharging
- significant fire risk

LiPo precautions

NEVER CHARGE A LIPO BATTERY UNATTENDED, THEY CAN/MIGHT /WILL CATCH ALIGHT IF SOMETHING GOES WRONG!!!!!!!!!!

Whenever a lot of energy is stored in a small space there are dangers.

Just as dynamite, TNT and nitroglycerine represent a huge danger if abused or mis-used, so it is with LiPo batteries.

There have been many well documented instances of LiPo batteries becoming powerful incendiary devices when over-charged or physically damaged so you need to be very careful when using these batteries.

Always charge them in a safe environment -- preferably placing them inside a fireproof box or bag "just in case".

Always use a suitable charger and charge-rate, don't ever be tempted to try and charge too fast or too long. The results could be very nasty.

And never over-discharge a LiPo. Unlike most other battery types, running a LiPo too flat will permanently damage it. Subsequent attempts to recharge an over-discharged LiPo can result in a loss of capacity (at best) and a nasty fireball (at worst).

When to use

If you want to obtain maximum performance from an electric-powered model then nothing really compares to LiPo batteries.

Although a number of LiPo packs are now available for transmitters, I really don't recommend them for a number of reasons. Not only do they supply your transmitter with a higher voltage than the manufacturer suggests (and will thus void your warranty in many cases), they almost always have to be unplugged and/or removed from the case for recharging.

For a while it was quite popular to use LiPo packs and regulators to power a model's airborne RC equipment.

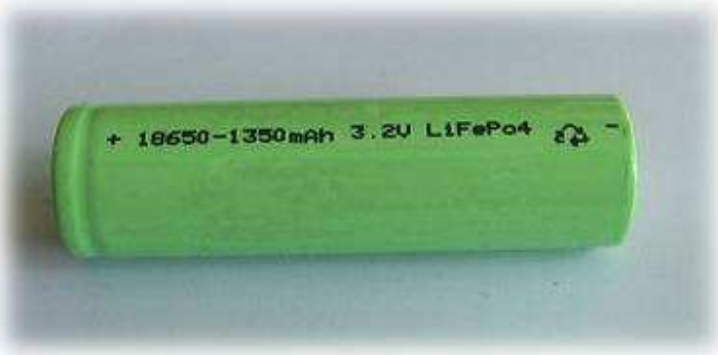
Since a two-cell LiPo produces 7.2 volts, a regulator is essential or it's very likely the servos will be damaged through overheating.

Given the fire danger and other risks associated with LiPo use, I can't really recommend that you use LiPos for your receiver packs -- the extra complexity simply adds extra things to go wrong.

If you want the benefits of lithium technology powering your receiver and servos then you need the next type of battery technology...

Lithium Iron Phosphate (LiFePO4) and A123 batteries

PERHAPS THE BEST BATTERY TECHNOLOGY AVAILABLE



Imagine if we could combine the safety and durability of nicads with the capacity and light-weight of LiPos. Wouldn't that be the best of all worlds?

Well that's pretty much what you get with the latest battery technology known as Lithium Iron Phosphate (LiFePO4).

Batteries based on this technology have almost the same power to weight ratio as LiPos but are far more tolerant of over and under-charging.

In a situation where a LiPo might explode into flames, the LiFePO4 cell will probably just vent some harmless gas.

LiFePO4 Pro's:

- very high power/weight ratio
- very low self-discharge
- more tollerant of over/under-charge/discharge
- can be used for RC gear without needing regulators

LiFePO4 Con's:

- Only a limited range of battery capacities currently available
- Odd-sizes for most cells (not AA, C, D, etc)
- LiFePO4-capable charger needed

LiFePO4 and A123, what's the difference?

Some people tend to use the terms LiFePO4 and A123 interchangeably -- but there is a significant difference between the two.

The fact is that A123 is a brand name for a specific type of LiFePO4 battery that incorporates nano-technology to significantly increase the current-handling capabilities.

The capabilities of an A123 battery are truly impressive -- with a 2300mAH pack being able to deliver currents of up to 100A for 10 seconds or more without damage. That's a 40C rating.

A standard LiFePO4 battery by comparison, may have only a 3-5C rating which is perfectly adequate for most RC applications but nowhere near as suited to hi-current applications (such as electric power) as a true A123.

When to use

Well the answer to this is simple -- use LiFePO4/A123 batteries whenever it's possible.

I've switched to LiFePO4 batteries for all my models now and have had absolutely zero problems.

My NiMH receiver packs now sit unused in a drawer under my bench, having been replaced by some 1350mAH packs I built myself for under $10 each.

Given that LiFePO4 batteries are cheaper, smaller, lighter and better in just about every way than any of the other technologies when used as receiver pack, I'd say there's little reason not to use them.

I also notice that hi-current LiFePO4 batteries are now becoming available to replace LiPos for electric power. They're a little higher and heavier than the equivalent LiPo but for many folks, this will be a small price to pay for the dramatically increased safety and robustness they offer.

Hope this helps understand batteries!

Some info from http://www.rcmodelreviews.com