

Understanding The Data

The information contained in the battery reports can look a little confusing at first but with a few explanations of what is going on, all should hopefully seem a lot clearer.

An electric model aircraft requires power (P) which is measured in Watts (W) to enable it to fly. The amount of Watts being consumed can be calculated by using Ohms Law ($W = V \times I$) where V = Volts and I = Current. So, for example a model helicopter with a 12V battery, drawing 10A is theoretically consuming 120W (12 x 10) HOWEVER, when you look at the graphs you will see that at certain currents the voltage of the battery is lower than at others, SO the power consumed has to be calculated at the actual voltage which is present at the time of current measurement and not what the rated voltage of the battery is, so a battery that holds a higher voltage under the intended load will waste less energy and produce better results in the model.

One of the factors that makes a good battery is cell balance, this means that all of the cells are in the same state of charge throughout the charge/discharge cycle of the battery. There are basically two forms of cell imbalance which can occur and effect your battery in a negative way. 1. 'State of Charge' imbalance and 2. 'Capacity Miss-match'. (See Figs 1 and 2 for a balanced and imbalanced battery) A way of explaining these types of problems is as follows:

State of Charge Miss-match

Think of a 3 x series battery and imagine that the cells are buckets of water. Now if each bucket is 1 gallon in size and you fill each bucket simultaneously with 3 gallons of water each bucket would be full with 1 gallon in each. Now if you imagine that one bucket started with a pint of water already in it, and you try to pour the 3 gallons in (charging the battery), the bucket that started with the extra pint would be full first and then spill over (over-charge). Conversely, if two of the buckets started off full, but one had one pint less than full, when you empty the buckets (discharging the battery) one bucket would be empty first. If this bucket was a cell in a pack it would then get over discharged and could become damaged. This is 'State of Charge' miss-match.

Capacity Miss-match

Now if you imagine that one of the buckets is smaller than the other two, it would be full before the others when filled (charged), then over charged at the top end, also it would be empty and over discharged at the bottom end. This is called 'Capacity Miss-match'. The first condition can be resolved by balancing the pack, and batteries such as the Tanic Tap battery which I have reviewed have connectors to enable the end user to do just that. However the other condition 'Capacity Miss-match' can not be resolved and a battery in this condition should not be used for safety reasons.

Please note: The re-balancing procedure described above applies to Li-Ion and Li-Po batteries only, Ni-cd and Ni-MH batteries are usually balanced through the normal charging process if charged on a decent charger, however Ni-cd's and Ni-MH's can also be re-balanced by being charged from their discharged state at C/10 for 14-16 hours on a slow, or trickle charger.

The other sign of a suitable battery, is the amount of Watt hours (Wh) it produces at the intended current, compared to the weight of the battery, so a good battery would have lots of Wh available yet still be nice and light, this is the energy density of the battery.

When selecting your battery you must also be aware of the voltage rating of your motor and ESC. If you exceed the rated voltage of your ESC, you will blow it up. If you exceed the rated voltage of your motor you will waste energy, as the magnetic windings inside are only efficient up to their maximum designed voltage, after this the excess power is dissipated in heat, ultimately resulting in a damaged motor. If you use a

battery with a voltage below the optimum rating, or a battery that drops significantly under the desired

current causing the voltage to be below, or close to this level, then you may find there is not enough power to get your model off the ground. So always check the manufacturers ratings to get the best out of your equipment.

So, what is the best battery available for me?

Well, it all depends on what equipment you have and what you are trying to do with it. You need to select a battery with the voltage suitable for your motor and ESC (see above) You will also want to go for the one that best suits your flying style. If you just want pure endurance then the high current rating (the times C factor) will not effect you too much as you will be running at a *relatively* low current. However if you are up for some hot 3D then you will want the best energy to weight ratio possible as you will be consuming lots of power. You will still need to keep within your voltage 'window', so decide what style of flying you intend to do, check out the graphs and other data to help with your selection, and enjoy your flying!

Below are the two typical discharge graphs mentioned earlier, which demonstrate the difference between a good and a bad (balanced and imbalanced) battery.

Fig 1

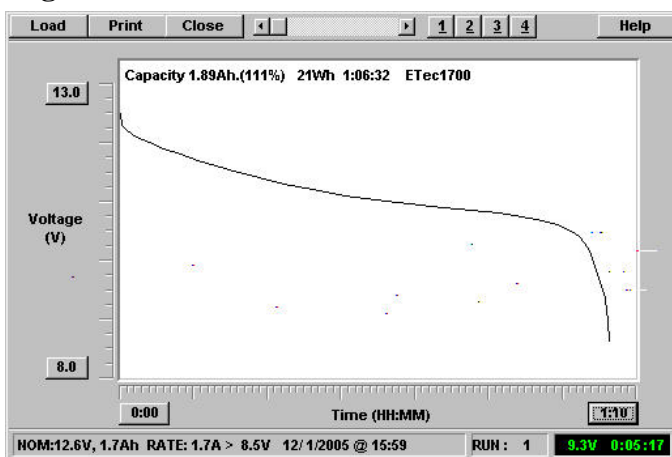


Fig 1 shows a battery in perfect balance with a nice smooth discharge curve all the way down to the cut-off point.

Fig 2

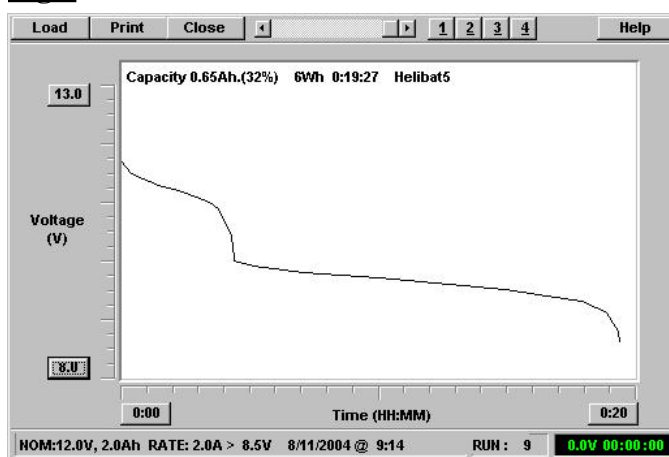


Fig 2 shows a very imbalanced battery pack. You can clearly see the 'kink' where one or more cells drop out about 30% into the discharge cycle.

Glossary of Terms

Amp / Ampere (A): The basic unit of current flow

Ampere hour (Amp hour, Ah): A measurement of the capacity of a storage medium (a single cell or a battery). A cell which can supply 1 Amp for 1 hour before it is discharged to a specified minimum level is said to have a capacity of 1 Amp hour (1Ah)

Battery: A bank of individual cells connected together

Cell: One section of a battery.

Hertz (Hz): the measurement of frequency. Hertz represents the number of cycles of an electrical signal measured in one second.

Impedance (Z): A resistance which is not just a pure resistance. This is to say that its loading characteristics are frequency dependent. Impedance consists of some value of resistance in conjunction with capacitance and/or inductance.

Resistor (R): An electrical device which impedes (resists) current flow regardless of frequency. Basic unit of measurement is the Ohm

Volt (V): The basic unit of "electromotive force". One Volt applied to a resistance of one Ohm will force a current of one Ampere to flow.

Watt (W): The basic unit of power. 1 Volt across 1 Ohm (giving 1 Amp) dissipates 1 Watt (all as heat with a resistive load)

Watt hour (Wh): A measurement of the capacity of a storage medium (a single cell or a battery). A cell which can supply 1 Watt for 1 hour before it is discharged to a specified minimum level is said to have a capacity of 1 Watt hour (1Wh)