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This month, one of our members, Mike Anderson, has put together an article on LiPo batteries and their "C" ratings.

HOW GOOD ARE YOUR LIPOS?
BY MIKE ANDERSON

The only practical method we have to judge LiPo quality is the C-rating on the pack label. C-ratings are simple multipliers that tell us the maximum allowable discharge current that we can safely use that will maintain a usable voltage and not unduly shorten pack life. A pack rated for 30C can, in theory, be safely and continuously discharged at 30 times its rated capacity (expressed in amp-hours). A 1000 mAh pack has a one amp-hour capacity and if it's rated for 30C we can discharge it at 30/hr x 1 amp-hr = 30 amps.

RESISTANCE IS FUTILE

All batteries have some internal electrical resistance (IR) and that resistance generates internal heat as the battery is discharged and reduces available voltage. Fortunately, LiPo cells have low internal resistance, typically in the 3 to 30 milliohm (mOhm) range, so that heat gener-

ated tends to be a small fraction of the power going to the motor. But too much heat from too much current can lead to overheating and short cell life.

John Julian in Australia, Wayne Giles in the U.K. and Mark Forsyth in the U.S. have worked on a method to predict the maximum allowable continuous current a LiPo cell could maintain and have developed a simple equation that anyone can use to predict the safe limits on discharge current for any Lipo. Max Amp draw = Square root of (6 x Capacity/IR). Google "RCGroups.com: a simple lipo performance tool" to read more about the 'magic formula.'

For cells larger than around 2200 mAh, the best cells have IR values close to 3 mOhm. It doesn't matter if the cells are rated for 25C or 65C, 3 mOhms is the best reported so far.

If we apply the formula above, we see that the maximum safe continuous discharge current at 3 mOhm IR on a 2500 mah pack would be 71 amps or 28C. On a 5000 mAh pack, it would be 100 amps or 20C.

All this implies that most packs labelled with a C rating more than 30C can't actually deliver more than 30C currents and live very long.

Measuring IR isn't easy: chargers that can measure IR do exist but at the time

or writing, only the iCharger 206 & 306 can give reliable IR measurements. There has been mixed results reported using the PowerLab 8 & 6 chargers.

Wayne Giles, a U.K. hobbyist and retired electrical engineer, has devised a simple IR meter that is effective on a range of cells and has proven to be very reliable and handy. Google "rcgroups.com: esr ir meter for lipos" to read more.

REAL WORLD CURRENTS

Most of us fly a 6 to 8 minute flight and land with at least 20% of the battery capacity remaining. No matter what size cells you fly, a six-minute flight that consumes 80% of the capacity in 1/10th of an hour is flying at an average discharge current of 10C. So if most of our cells have an actual maximum allowable current corresponding to 20C or 30C, most of us are still in the 'safe zone.' As we add more cycles and cell IR starts to creep up, the 'safe zone' gets smaller and smaller, so one day that 10C flight will exceed the current delivering capacity of those cells and that will be close to end of the pack's life.

So we shouldn't despair too much about the true performance limits of packs labeled higher than 40C but we should monitor their internal resistances to judge when a pack is being pushed too hard or when its useful life is almost over.

Is it worth the money to buy 65C packs? For the general sport flyer, it probably isn't. I've always advocated buying the highest C-rated packs you can afford, reasoning that high C-ratings equate to low IRs but the evidence is mounting that it isn't true. Keep in mind that the 'Max Amps equation' is a hobbyist development that is just now getting some attention online.

This information is presented here to advise electric flyers that there may be a better way to think about LiPo performance limits. We need to collect more data, so consider doing your own measurements and sharing your results. Google "rcgroups.com: lipoly objective performance database" to see how. ✈

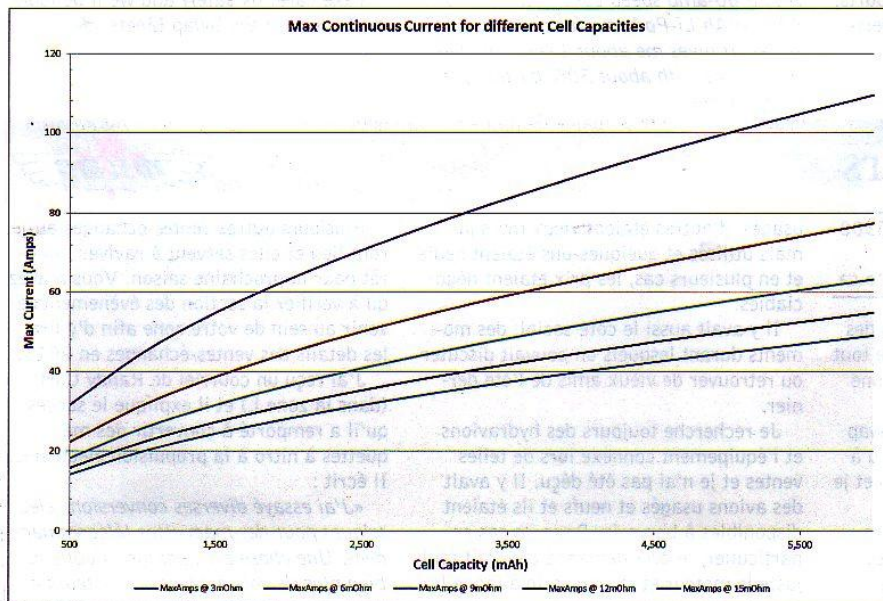


Figure 1 Predicted maximum current for different rated cell capacities and IRs

True C-rating vs Rated Cell Capacity

