

"TURBULATOR"

Newsletter
of the Rio Rancho
Radio Control
Flying Club
AMA Club #2770

WATERMAN FIELD

ELEVATION 5840 FEET

35° 17.2'N 106° 44.8'W

Biplane at the Santa Fe Float Fly



PRESIDENT'S CORNER

"Da Prez Sez"

Summer is fading fast, our last outdoor meeting of the summer is September. This summer had a lot of good flying at Cochiti lake, but quite a few windy days at the field. The activity at the field has been light with plenty of time for everyone to fly. Last week's Fun Fly at Cochiti was good, and not to many flyers with a calm morning gave everyone ample flying time. Rick S. was at the field a few times during his visit, and even got to try his new Cub on floats at Cochiti Lake. So get some planes ready and get out to the field and have some fun before it cools down.

Coming events

1. Meeting Sat Sept 6 10:00 at the field

A Guide to Understanding LiPo Batteries

Part II

Internal Resistance: The Mystery Number

There is one very important rating we haven't talked about yet: Internal Resistance (or IR). Problem is, you won't find the IR rating anywhere on the battery. That's because the internal resistance of a battery changes over time, and sometimes because of the temperature. However, just because you can't read the rating on the battery doesn't mean it isn't important. In a way, the internal resistance is one of the most important ratings for a battery.

To understand why the IR is important, we have to understand what it is. In simple terms, Internal Resistance is a measure of the difficulty a battery has delivering its energy to your motor and speed control (or whatever else you have a battery hooked up to). The higher the number, the harder it is for the energy to reach its preferred destination. The energy that doesn't "go all the way" is lost as heat. So the internal resistance is kind of a measure of the efficiency of the battery.

Internal Resistance is measured in milliohms ($m\Omega$).

1,000 milliohms is equal to 1 Ohm (Ω)

Measuring the IR of your battery requires a special toolset. You either need a charger that will measure it for you or a tool that specifically measures internal resistance. Given that the only tool I have found for this (at least in the hobby world) is almost as expensive as a charger that does this for you, I'd go with a charger for this process. Some chargers measure each cell's IR separately, and some measure the entire battery pack as a whole. Since internal resistance is a

cumulative effect, and the cells are wires in series, if you have a charger that does each cell independently, you need to add up the IR values of each cell, like this:

Suppose we have a 3S (3-cell) LiPo battery, and the measuring the cells independently yields these results.

Cell 1 3 $m\Omega$

Cell 2 5 $m\Omega$

Cell 3 4 $m\Omega$

To find the total internal resistance for the battery pack, we would add up the values for the three cells.

$$3 + 5 + 4 = 12 \text{ m}\Omega$$

For a charger that measures the pack as a whole, all you would see is the 12 $m\Omega$ - the rest would be done for you - behind the scenes, as it were. Either way, the goal is to have the IR for the entire pack.

The first reason internal resistance is important has to do with your battery's health. As a LiPo battery is used, a build up of Li_2O forms on the inside terminals of the battery (we'll go more in depth on this later in the Discharging section). As that build up occurs, the IR goes up, making the battery less efficient. After many, many uses, the battery will simply wear out and be unable to hold on to any energy you put in during charging - most of it will be lost as heat. If you've ever seen a supposed fully charged battery discharge almost instantly, a high IR is probably to blame.

Here's how Internal Resistance works, and how it can tie in the performance of your R/C car, airplane, or helicopter:

First, we have to understand Ohm's Law. It says that the current (Amps) through a conductor between two points is directly proportional to the

difference in voltage across those two points.

The modern formula is as follows: Amps = Volts / Resistance. In the formula, the resistance is measured in Ohms, not milliohms, so we'd have to convert our measurements. If we use our previous 3S LiPo, and plug it into the equation along with a 1A draw, we can find out how much our battery pack's voltage will drop as a result of the load. First, we have to change the equation to solve for volts, which would look like this:

$$\text{Amps} \times \text{Resistance} = \text{Volts}$$

So plugging in our numbers and solving the equation would look like this:

$$1\text{A} \times 0.012 \Omega = 0.012\text{V}$$

So our battery would experience a tiny drop in voltage when a 1A load is applied. Considering our 3S LiPo is around 12.6V when fully charged, that's not a big deal, right? Well, let's see what happens when we increase the load to 10A.

$$10\text{A} \times 0.012 \Omega = 0.120\text{V}$$

Now we see that when we increased the load 10X, we also increased the voltage drop 10X. But neither of these examples are very "real world". Let's use the Slash VXL from the previous section and plug those numbers in. If you recall, our Velineon motor has a maximum continuous current rating of 65A. Let's assume we manage to hit that mark when driving and use that.

$$65\text{A} \times 0.012 \Omega = 0.780\text{V}$$

Wow, more than 3/4 of a volt! That's around 6.2% of the total voltage of our battery pack. Pretty respectable, but it's still a reasonable drop in voltage.

So, yeah, the voltage drops. But so what? What does that actually mean? How does it affect my R/C vehicle? Well, let's continue on with our example to show you.

The Velineon motor our Slash VXL uses has a Kv rating of 3500. That means it spins 3,500 RPM per volt. On a fully charged 3S LiPo we'll see this (assuming no voltage drop):

$$12.6\text{V} \times 3500\text{RPM} = 44,100 \text{ RPM}$$

Now, assuming we can hit that 65A draw on our unloaded motor (which we can't in real life, but for the purposes of demonstration we can), here's the RPM on the same motor with our voltage drop from before:

$$11.82\text{V} \times 3500\text{RPM} = 41,370 \text{ RPM}$$

Difference of 2,730 RPM

See the drop in performance? That's the effect Ohm's Law has on our hobby. A lower internal resistance means your car or truck or airplane or boat or helicopter goes faster and has more power.

This begs the question: how low should it be? Unfortunately, there's no easy answer for this. It's all dependent on your use case and battery. What is great for one battery may be terrible for another. Based on my online research, combined with my own experience and findings, I would say, as a general rule, a per cell rating of between 0-6 mΩ is as good as it gets. Between 7 and 12 mΩ is reasonable. 12 to 20 mΩ is where you start to see the signs of aging on a battery, and beyond 20mΩ per cell, you'll want to start thinking about retiring the battery pack. But this is only a guide - there is no hard rule set here. And if your charger doesn't give you the per cell measurements, you'll have to divide your total count by the number of cells in your battery to get an approximate per cell rating.

Internal Resistance and C-Rating

There are many people out there that believe a higher C-Rating will make their vehicle perform

better. We know from our previous discussion on C-Ratings that you need to account for the power draw your motor has when picking out the right C-Rating for your battery, but does more equal better? Many people say yes.

But there isn't anything intrinsic to the C-Rating that substantiates their claims. It's simply not true that a higher C-Rating makes your car or airplane faster.

However, there is a correlation between the C-Rating of a battery and the internal resistance of that battery. In general, batteries with a higher C-Rating also have a low internal resistance. This isn't always the case, as there are always vagaries in manufacturing, but the general idea seems to hold true. And a lower IR will make a car or airplane faster.

This is a case of correlation not equaling causation. It's really the internal resistance making a battery faster, not the C-Rating. ***(The bottom line on internal resistance is this: We've all had a battery that charges fine but when you put on your plane it has poor performance, discharges quickly and just doesn't have the umph that it used to. This is due to the internal resistance climbing as the battery ages. Its probably time to get rid of the battery. If you have questions on internal resistance ask me about it, Don)***



MEETING MINUTES

Minutes from the August 2014 Club Meeting

The meeting was called to order @ 10:00am.

The minutes were accepted as published.

Treasurers Report was accepted as presented.

Membership Report: The club has 43 members.

Field Report: The work party cleared weeds and filled the erosion created by the rain. Vic brought some crusher fine and filled the cracks in the runway.

Safety: Remember to use the Pilot Boxes when you are flying.

Unfinished business:

1. Mike has taken on the job of finding a place to hold the annual Christmas party. He's looking to keep the party in Rio Rancho and is considering the Italian American Club, or the Senior Center. If you have suggestions please contact Mike Skipwith.

2. There will be a working party to complete field repairs next Saturday at 9:00am.

New Business: 1. it was discussed as to the clubs participation in National Model Aviation Day this year. We had participated last year and so far there hasn't been much interest in participation this year. Last year we were the only club

in the Albuquerque area that participated in this AMA program. The discussion was tabled.

2. There was a discussion of the annual Santa Fe clubs float fly at Cochiti Lake. This is a good event to go to to either fly or participate. There will be a number of club members going up. The dates of the event are 23/24 August. Lunch will be included in the pilots fee.

3. Mike Skipwith made a proposal to change the club By-Laws Article III section I Membership article A4. to lower the age of Senior Life Members from the age of 90 to the age of 85.(See the official wording in the email accompanying this newsletter) The bylaws require notification to all members of a by-law change and a vote at the next meeting.

The meeting adjourned at 10:25.

There was no Raffle.



Turbulator:

Editor Don McClelland

We are always looking for articles, pictures and your input!

For comments, or suggestions

Please Email Don at

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RIO RANCHO RC CLUB

AMA Charter #2770

www.rioranchorcfllyers.org

Next Club Meeting

September 6th 10:00am at
Waterman field.