

# Rocky Mountain Modeleers Safety Officer Tips: March 2020

By David Dust and Jim Foerster

## Li-Po Flight Battery Testing – Measuring and Interpreting Internal Resistance

1. **Measuring a Battery's Internal Resistance:** Internal resistance for each cell in a battery are measured using a battery charger that has that specific capability. Internal resistance is measured in terms of milli-ohms (i.e.,  $m\Omega$ ) and is a measure of a battery's ability to deliver power to an aircraft's power system under load. Whereas, voltage is a static measure of a battery's ability to store and hold a charge.

The battery charger will let you measure the internal resistance of a battery at any charge level; however, the internal resistance values for a battery can differ depending on the charge level. Hence to get consistent internal resistance values for comparison purposes, I have found it most useful to measure internal resistance when the batteries are either at the storage level (i.e., 3.8 volts per cell) or fully charged (i.e., 4.2 volts per cell). However, measuring internal resistance immediately after charging the battery can result in getting misleadingly low internal resistance values. Battery adapters can influence resistance measurements, so only use adapters when absolutely necessary.

It is helpful to measure and record the internal resistance of your batteries on regular basis to get a sense of how the internal resistance varies with use and how it affects the flight performance of your aircraft. It is important to also recognize that different battery chargers may provide slightly different resistance values, hence it is best to compare resistance values from tests using the same charger. I recommend that batteries with questionable internal resistance values, especially after not being used in a while, should be carefully "ground tested" before being used to power an aircraft in flight. There are a number of ways to "ground test" a battery, but the simplest way is to power a securely restrained aircraft and watch for a sudden drop in power while applying full or high throttle.

2. **Interpreting Internal Resistance Measurements:** The following are general rules for interpreting internal resistance measurements, based upon my experience monitoring about 70 batteries over the past 5 years:
  - New batteries and batteries in optimum condition typically have internal resistance values less than  $15 m\Omega$ , with a variation of less than  $5 m\Omega$  between cells; such as a reading of: *009 009 008 mΩ*.
  - A battery that has cells with internal resistances greater than  $15 m\Omega$  can still be quite usable (for example: *021 020 020 mΩ*); however, the performance of the battery, and subsequently the aircraft, will decrease as the internal resistance increases gradually over time, especially in cooler weather. In addition, batteries with higher internal resistance tend to get hotter sooner and require longer to cool down before charging.
  - A battery that is losing or has lost a cell (or cells) will have a cell with an internal resistance much higher (i.e., 10 or more  $m\Omega$ s) than at least one cell in the battery, such as a reading of: *015 035 012 mΩ*. or *043 079 071 mΩ*.