LiPo Battery Basics 1

UNDERSTANDING THE LABELS

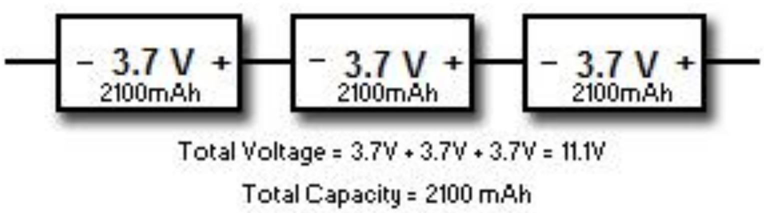
Labels contain plenty of information, but understanding them is often confusing. A few simple definitions will help you.

Number of Cells (3S, 4S, etc.):

When talking about a LiPo, the primary characteristics to understand are the battery's voltage and capacity. This is typically noted in a shorthand such as "4S-2200". In this example, "4S" denotes that the battery has four cells in series. The nominal voltage of each cell is 3.7 volts (4.2v fully-charged), so the total pack voltage is:

4 cells x 3.7v = 14.8v.

The second number denotes the capacity of the battery in milliamp-hours (mAh). A fully charged 2200mAh pack is rated to provide a current of 2200 milliamps (2.2 amps) for one hour before it is fully discharged. This capacity value is completely independent of how many cells are in series. In simple terms, the capacity value allows you to estimate how long a battery will provide useful power in a given application. In practical terms for RC use, the capacity rating is typically only helpful for rough comparisons of different batteries. i.e. a 2S-5000 battery will provide about double the run time of a 2S-2500 lipo in the same RC vehicle.



3S-2100 Lipo

Capacity:

The capacity rating of a LiPo battery tells its output potential, or how long you can take power from the battery at a given rate before it reaches the cutoff voltage, or is discharged. The faster you take power from the battery, the less time it will last.

Many times, our batteries' capacities are listed in milliampere hours (mAh). This is merely a metric conversion to a smaller unit. 1 ampere hour = 1,000 milliampere hours, so 2.2 Ah is 2,200 mAh.

Discharge Rating:

"C" represents a measure of the rate at which a battery can be discharged relative to its maximum capacity. If the battery is discharged at a rate higher than the discharge rating, the battery may be damaged, or worse, could pose a safety hazard, like a fire.

If a battery's discharge rating is 15C, it means that the most power that can be drawn from it at one time is equal to 15 times its capacity. Using the example of a battery which has a capacity of 2,200 mAh, this means that greatest flow of electricity you can safely get from the battery is 15 x 2,200 = 33,000 milliamperes (or 33 amperes).

The discharge rating listed on the battery's label is based on what the manufacturer believes the pack will handle during discharge without degrading the pack. These discharge ratings, sometimes mistakenly referred to as C ratings, can be optimistic and are best used as a guideline.

Many batteries with provide two discharge ratings such as 30C/60C. These represent the continuous and burst ratings. The first number means that it will continuously support a 30C discharge, and for short bursts (typically less than 15 seconds) it should support 60C. This allows for spikes during rapid throttle changes, but shouldn't be something you use regularly. If you need higher current levels, buy a higher capacity/rated pack.

Going to an example of a 4S-2200 battery, let's say it is rated for 20C discharge. To calculate the maximum discharge capability of the battery, we multiply 20 by the second number:

20A x 2200mAh = 44000 milliamps = 44 amps

The calculation tells us that this battery can safely be used in a system that is expected to continuously pull 44 amps or less. It also means that a fully-charged battery will last about three minutes at that current draw.

2200mAh / 44000mA = .05 hours = 3 minutes

Using the same logic, a 4S-2200 30C battery would be valid for applications requiring up to 66 amps of current, with a two-minute duration.

2200mAh / 66000mA = .0333 = 1.9 minutes

Flight Time

One of the important considerations when choosing a LiPo Battery for aircraft is flight time. Depending on the type of plane, the user may only require 3-5 minutes of flight time. However, for many contests, longer flight times are desired.

Flight time calculation for electric powered aircraft is a matter of determining the current draw from the plane and applying that to the capacity of the battery. Let's look at a typical sport plane using a 4S-4000mAh LiPo.

First, you need to determine the *average current draw* from the motor and servos. Let's assume our sports plane with a wing span of 45 inches weighing 4-6 pounds has an average current draw of about 25 amps (25,000mA). To calculate the flight time, we need to use the following formula:

$$Flight\ Time\ = \frac{Battery\ Capacity\ (mAh)}{Average\ Current\ Draw\ (mA)} \times 60\ (\frac{minutes}{hour})$$

So, for our example, the calculation would be:

$$Flight\ Time\ = \frac{4000\ (mAh)}{25{,}000\ (mA)} \times 60\ \left(\frac{minutes}{hour}\right)\ = 9.6\ minutes$$

This calculation is only as accurate as your "guess" at the average current draw, so it just gives you a ball park number for flight time.

Note: A conservative estimate of the average current draw for typical sports flying is about 20% of the maximum current draw for scale flying. This can increase to over 65% of the maximum current draw for aggressive flying. This is based on Castle Creations Data Logger.

Internal Resistance:

This represents the internal resistance of a cell or pack. Some chargers will test the IR for each cell within a pack during the charge cycle. As internal resistance increases, the battery efficiency decreases. So as a general rule, the lower the resistance the more punch a battery will provide. It's nice to know, but not something to get hung up over as a beginner. As a rule, packs advertising a high discharge capacity will have a lower IR.