



The Dead Stick Flyer

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Tech Corner:

Lithium Battery Charging & Maintenance: by Ron Lazzeri

With all of the different Lithium battery chemistry types and charging equipment on the market today, I thought it would be good to write an article describing some general guidelines for the safe handling, charging, and storage maintenance of the various batteries.

This can be a very complicated topic to discuss with a lot technical details to observe and follow, but I will make this article easy to read and easy to follow for 3 of the most used RC batteries today. It will, however, take some thought and preparation on the user's part to be successful.

Note: Going forward "V" stands for Voltage

- **Battery chemistry types:**
 - LiPo (Lithium Polymer)
 - A123 & LIFE
 - Lilo (Lithium Ion)
- **Standard battery voltage parameters per cell:**

	LiPo	A123/LiFe	Lilo
Nominal Rated Voltage	3.7v	3.3v	3.6v
Maximum Charging Voltage	4.2v	3.6v	4.1v
Storage Voltage	3.8v	3.3v	3.7v
Minimum Discharging Voltages	3 - 3.3v	2.6 – 2.9v	2.9 – 3.2v

- **Battery Pack Amperages (MAH) and Voltages (DC):**

- **Battery Cells:** all of the battery types listed above can be purchased in various amperage and voltage configurations. The batteries can be found in single or multiple cell configurations from 1 to 6 cells commonly known and packaged as:

- 1S: single cell, 2S: two cells, 3S: three cell
- 4S: four cells, 5S: five cells, 6S: six cells

- **Battery Voltages:** each of the configurations above determine the nominal voltage of a battery pack. With each cell addition to the pack, the voltage increases by the nominal voltage of the individual cell.

- **Example:**

- 1S LiPo = 3.7v (1 x 3.7v)
- 2S LiPo = 7.4v (2 x 3.7v)
- 3S LiPo = 11.1v (3 x 3.7v)
- 4S LiPo = 14.8v (4 x 3.7v)
- 5S LiPo = 18.5v (5 x 3.7v)
- 6S LiPo = 22.2v (6 x 3.7v)

- **Battery Pack Amperages:** battery packs will be configured with a certain amperage capacity rating like 1400mah, 2200mah, or 3800mah, etc. The packs will also be given a certain charge and discharge rating known as the “C” rating. The “C” stands for the capacity rating or the overall ability of a battery to accept or discharge a certain amount of amperage per the batteries voltage rating.

- **Battery charging MAH/AMP rating:**

- A battery will be given a charging rating which is the charging amperage rate you should configure in your charger to safely charge the battery. Could be 0.5mah, 1.0amp, or higher.
- A battery’s charging rating is calculated as follows:
 - **Battery capacity / 1000 = 1C Rating**
 - Example 2200mah / 1000 = 2.2C (1C rating)
 - To calculate a higher C rating like a 2C rating you would multiply the 1C rating x 2 = 4.4C. Higher C calculations would be calculated the same way for 3C, 4C, 5C, etc.
 - The battery manufacturer should provide on the battery the safe charging C rating but if they don’t, 1C is a good rule to follow.

- **Battery Discharging MAH/AMP Rating:**
 - *The manufacturer should provide on the battery pack the discharge rating or capacity of the battery like 35-90C. This will enable you to properly match the battery discharge power capabilities to the power requirements of your plane, quad copter or car.*
 - *The first number, 35C, is the normal sustained power discharge capabilities for the battery during its overall use.*
 - *The second number, 90C, is the burst power discharge capabilities of the battery but only for a short duration. If you need to climb and consume a lot of power in a short period of time, this rating will indicate how this battery should perform under these circumstances.*

- **Charging/Discharging Batteries:**

- *The process of Charging Lithium batteries is not that complicated. Here are some important tips for the proper charging of the battery types.*
 - *The most important tip is make sure your charger has the capability of charging the battery type or chemistry you need to charge. This is very important because selecting the correct battery type means you are selecting the correct charging and cut-off voltage for the battery and will ensure the charger does not over-charge the battery, causing damage and/or an explosive fire.*
 - *For example, your charger should have the capability of charging LiPo, A123/LiFe, and Lilo batteries and have the following charging functions like charge, balance charge, fast charge, storage charge and discharge. Additionally, the charger will have the ability to charge NiCD/NiMH batteries as well.*
 - *Before charging your batteries, you must be sure to select the appropriate battery type before connecting your battery to your charger. Next, while in the charger's battery configuration mode, you will need to verify or change the amperage rate, voltage, capacity, and whether you want to charge, balance charge, fast charge, storage charge, or discharge the battery. This will tell the charger exactly what you want to do. If you accurately select the correct battery type and have a current charger with*

the current battery chemistry configurations built in, it will handle all the voltage parameters for you.

- **Charge Function:** *this mode is a straight charging of the battery at the maximum charge voltage to arrive at the correct nominal battery voltage. This function does not determine if each cell is being charged correctly and could end up with one or more cells being over/under charged. The charger is only connected to the battery power lead.*
- **Balance Charge:** *this mode is a charge function that monitors each cell by using the balance lead on the battery. The power lead and the balance lead of the battery is connected to the charger. The charger will monitor and work to keep all cells at the same voltage by discharging any cell that is out of line with the others until they are all at the same voltage levels before the full charge process ends. This is by far the best way to charge Lithium batteries for safety, long term health of the battery and maximum performance with all cells at their peak voltage.*
- **Fast Charge:** *this mode is similar to the charge function except that it is done at a much higher amperage rate. This function is usually used when you are pressed for time and need the battery up to full amperage/voltage ASAP. This should be the exception charge rule and not your everyday rule. It will eventually wear your battery down if not handled correctly.*
- **Storage Charge:** *this mode is an automatic function to be used whenever you will not be using your batteries for 2 months or more. This function will get the battery to 70% charge level so the battery can be safely and optimally stored for a period of time. Generally, Lithium Polymer batteries do not hold up well long term by being stored at full charge. Both power and balance leads are connected to the charger.*
- **Discharge:** *this mode will discharge the battery down to each cells lowest permissible voltage level so you can then charge it back up and check on the health of the battery. It will tell you how much MAH capacity it took to discharge and charge it back up providing you an indication of the remaining battery capacity. Both power and balance leads are connected to the charger.*

- ***Physical Storage of LiPo Batteries:***

It is a good practice to store LiPo batteries in a fire proof container like a metal ammo case, an approved LiPo charging bag or box. LiPo batteries are the most vulnerable of all the Lithium batteries you will use so it is wise to safeguard your home, your car/trailer, or anywhere you store these batteries.