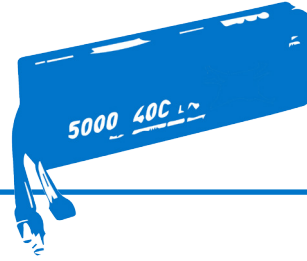


LITHIUM POLYMER BATTERY AND FUEL SAFETY



WHAT IS A LITHIUM POLYMER BATTERY?

The Lithium Polymer (LiPo) battery is a rechargeable battery commonly used in the RC and UAV communities. LiPo batteries have many advantages over other rechargeable batteries (NiCad, NiMh, etc.). They are lightweight, can be made in almost any shape and size, they have large capacities, and higher discharge rates. But perhaps the biggest advantage of LiPo batteries is that they can be charged over a 100 times without losing any significant performance.

WHAT IS THE COMPOSITION OF A LIPO BATTERY?

LiPo battery consists of one cell or 2 or more cells connected to provide a specific voltage and/ or current capacity. The battery is interfaced into an AV using a basic connector, such as a Deans. The connector consists of a red (+) and black (-) lead as well as a Cell Balancer Connection.

Each cell in a multi-cell LiPo pack is rated for 3.7 volts and requires a charging voltage of 4.22 volts. When operating with a LiPo battery it is EXTREMELY important that you do not allow any cell to drop below 3 volts. Discharging a LiPo cell to less than 3 volts can cause irreparable damage to the internal chemistry causing dramatic reduction in battery life, charge capacity, and discharge time.

It is not uncommon for individual cells in a battery pack to discharge at different rates over the duration of a flight. Cells may vary in voltage by a couple tenths of a Volt during discharge. It is important to program your transmitter or Autopilot to alert you before a cell drops below 3 volts. In order to provide a safety margin, it is common practice to program transmitters and autopilots to give a warning when cell voltage drops to 3.3 Volts. To determine the alert voltage for a multi-cell battery packs multiply the number of cells in the pack by 3.3. Example: 3 cell pack $3 \times 3.3V = 9.9V$, set your battery alarm to go off at 9.9V.

LIPO TERMINOLOGY

Typically, LiPo terms and battery data are abbreviated. It's imperative that you familiarize yourself with relevant terms and abbreviations and understand your battery's capabilities to avoid damaging the batteries or AV systems.

A typical LiPo Data imprint will look like the following:

14.8V 5000mAh * * * 4S/1P 20C * 4C charge

(V) OR VOLTAGE OF THE LIPO. As we said, each cell possesses a nominal voltage of 3.7V. We can multiply the number of cells by 3.7 to determine our voltage of 14.8V ($4 * 3.7V = 14.8V$).

(S), OR S VALUE shows how many cells are connected in series, raising the S means increasing the voltage of the pack. (4S means that 4 cells are connected in series).

(P) OR P VALUE indicates how many cells are connected in parallel, raising the P means increasing the current (typically measured in milliamps or amps) capacity of the p means that no other cells are connected in parallel.

MAH stands for milli-Amp-hour (1/1000th of an Ah) and denotes the capacity of a LiPo. The mAh is the standard method for stating capacity of all battery types. The Ah rating of a battery refers to how many amps a battery can output for 1 hour before it is depleted. (A 5000mAh pack can output 5A for 1 hour).

C VALUE is a variable just like X from your algebra days. It is tied to a capacity of a LiPo and as such can be used to figure things like charge rates and maximum continuous discharge rates.

The C Value is tied to the capacity of the pack. It can be used to estimate charge times, discharge times, and battery stress. For example if a pack is discharged at 1C, it will be totally discharged in 1 hour. It will also be charged in 1 hour when fully discharged. At 2C those time are cut roughly in half and at 3C those times will be cut down to roughly 1/3rd.

Figuring out what the C Value is for a particular pack is simple. Take the capacity of the pack in mAh, divide it by 1000 to get Ah and then drop the "h". The result is the C Value.

LIPO SAFETY

LIPO BATTERIES REQUIRE SPECIAL HANDLING and must be handled correctly. Misuse, including improper charging, handling, and storage can cause LiPo batteries to burn or explode.

ONLY USE A CHARGER THAT IS DESIGNED FOR USE WITH LIPO BATTERIES and rated for the number of cells in your battery packs. Depending on the charger, you may have to manually set data such as cell count and charge rate. Others may detect the number automatically. It's important you verify all data is correct before attempting to charge your batteries. Double-check your settings for cell count and current no matter what type of charger you are using. Always read and follow the instructions that came with your charger and battery packs. Charging batteries should never be left unattended and should never be charged while inside your vehicle or AV.

WHEN TRANSPORTING YOUR LIPO BATTERIES, use a non-flammable container that does not contain sharp objects that could puncture the battery packaging. Don't carry LiPo batteries in your pockets or throw them into a tool box. Keep batteries away from children and hot surfaces, such as a car hood on a hot summer day.

NEVER HANDLE DAMAGED BATTERIES WITH BARE HANDS. If a damaged battery leaks on your skin, wash immediately with soap and water. In the event it gets into your eyes, flush with cool water and seek medical attention. A fire extinguisher or bucket of sand should always be kept nearby when charging LiPo batteries, do not try to put out a LiPo fire with water.

WHEN OPERATING YOUR RC VEHICLES IN OR AROUND WATER, make sure your LiPo battery is protected from the water; never let your LiPo get wet. Always ensure you do not reverse your positive and negative leads when connecting batteries to your equipment. Always inspect your LiPo battery after each use. In the event of a crash, secure and isolate your LiPo for at least an hour, even if it visually appears to be OK. Do not continue using it if the packaging is torn or punctured or if you notice any ballooning of the battery. Continued use or charging of a damaged LiPo battery could result in an explosion and fire.

MAKE SURE YOUR LIPO BATTERY IS IN GOOD CONDITION and partially charged before storing. Keep them in non-flammable containers, away from sharp objects or flammable materials, Ensure you store your batteries in a moderate temperature setting, safely away from children. Under no circumstances should you store dead or damaged LiPo batteries.

IN THE EVENT OF A DEAD OR DAMAGED BATTERY, discharge the battery; place it outside in a covered container of salt water for 2 weeks. Be careful to store the salt water away from pets and animals. If the battery is damaged or ballooned, skip the discharging step and go straight to salt water submerging. After 2 weeks the LiPo can now be disposed of in your household trash.

FUEL SAFETY

In addition to electric systems, some UAS and RC AV run off of fuel combustion engines. The type of fuel and fueling methods greatly vary, but the basic safety guidelines apply to all systems.

WHEN FUELING AND DEFUELING YOUR AV it is important to ensure you are in an isolated area, free from open flame or heat source. Be sure to use the proper Personal Protective Equipment (PPE) when working with fuel. Eye protection and gloves should always be used to prevent skin or eye contamination.

BE SURE TO STORE YOUR FUEL IN AN ISOLATED, LOCKED CONTAINER. Ensure fuel is only stored in approved containers that are sealed tightly, as the methanol attracts water. Keep out of direct sunlight, ultra violet rays can break down the chemical integrity of fuel and damage your engine.