

# LiPo Battery Safety

The following information is to be used as a guideline for the safe handling, storage and charging of lithium polymer (LiPo) batteries. Original provided by the University of Vermont.

## General Information

Li-Po batteries can store approximately 350% more energy than a typical Nickel-Cadmium (NiCd) battery pack and weigh approximately 10-20% less. LiPo batteries can discharge much more current than a NiCd battery and can be fully charged within approximately one hour.

LiPo batteries do not develop memory or voltage depression characteristics like NiCd batteries; they do not need to be discharged before being charged. There are different types of Lithium Polymer (LiPo) batteries:

**Primary or non-rechargeable metallic lithium cells:** These cells are constructed with metallic lithium. The metallic lithium in a non-rechargeable primary lithium battery is a *combustible alkali metal that self-ignites at 352 degrees F.*

In a normal atmosphere, these batteries react explosively with water to form hydrogen. The presence of minute amounts of water may ignite the material and the hydrogen gas. Lithium fires can also throw off highly reactive molten lithium metal particles. Cells adjacent to any burning material could overheat causing a violent explosion.

Because there is metallic lithium in a non-rechargeable lithium battery, a Class D fire extinguisher must be used to effectively fight a fire involving non-rechargeable lithium batteries

**Secondary or rechargeable lithium-ion cells:** Rechargeable secondary cells utilize lithium ions that are intercalated into graphite, lithium metal oxides and/or lithium salts. *There is no metallic lithium in a lithium-ion battery.*

Because there is no metallic lithium in a lithium-ion battery, ordinary extinguishing agents (e.g., ABC fire extinguisher) can be used effectively on a fire involving lithium-ion batteries.

# Hazards of Lithium Polymer Batteries

Mishandling of LiPo batteries can lead to fires, explosions, and toxic smoke inhalation.

*Always read the manufacturer-specific battery manual for instructions regarding the handling, charging and safe usage of your manufacturer-specific LiPo batteries.*

The initial source of lithium battery heat can be caused by:

- external sources, *such as welding, soldering, etc., or*
- internal sources, *such as heating caused by short circuiting, excessive running currents for prolonged periods of time, forced over-discharge, charging, or excessive mechanical abuse.*

*Never solder directly to any LiPo battery.*

## Charging Lithium Polymer Batteries

LiPo batteries must only be charged with a manufacturer recommended LiPo charger.

LiPo batteries have very specific charging requirements. Some chargers, such as those used for toys or cell phones, are made to charge a specific cell count and are not configurable for other cell counts. The LiPo charger used must be able to handle the cell count of the battery you are charging.

Be aware that many of the more expensive LiPo chargers will automatically detect the cell count of the battery being charged; cheaper chargers will require a manual setting.

A 1S or 1 cell LiPo battery has a nominal voltage of 3.7 V. When fully charged it has a maximum voltage of 4.2 V. When fully discharged, it should never go below 3.0 V without risking cell damage.

A 5S4P battery pack means that the pack contains 5 cells in a series circuit and 4 cells in a parallel circuit. Since each cell is 3.7 V (nominal) a 5S LiPo battery has a nominal voltage of 18.5 v, a fully charged voltage of 21.0 v and a maximum discharged voltage of 15.0 V before damage occurs.

When charging LiPo batteries, they must be charged at the voltage of the number of cells in series. Example: A 5S4P pack must be charged as a 5-cell pack.

# LiPo Battery Charging Tips

Never, under **ANY** circumstances let the positive and negative battery leads touch. This can lead to cell ballooning, cell damage, fire or an explosion. If you notice your LiPo battery pack is swelling, disconnect the charging device immediately. If necessary, put the battery in a non-combustible bucket or container and observe it for 15 minutes.

Never charge a LiPo battery on a wooden or other combustible (carpeted) surface. Always charge LiPo batteries on surfaces made of cement, steel, ceramic or stone.

Never charge a LiPo battery near an exit. Keep exit egress clear in case of a fire or emergency.

Never leave a charging LiPo battery pack unattended. Never store batteries inside of an automobile.

Have a fire extinguisher near the LiPo battery charging area and/or a large bucket of dry sand. **NEVER** extinguish LiPo batteries with water.

Never charge LiPo batteries near any flammable products, including liquids or gases.

Double check that the setting for the lithium polymer charger is correct for the pack being charged—this includes the cell count as well as the current settings.

In general, most LiPo batteries should be charged to no more than 4.2 volts per cell or depleted to less than 3.0 volts per cell. There are new generation batteries available that can handle higher / lower voltages, but they are still new and thus are the exception to the rule.

Do not fully discharge your LiPo battery pack. Discharging a LiPo beyond its critical minimum voltage (often 3.0 V) can cause damage to the battery.

Ensure that charging leads are connected correctly. Reverse charging can lead to cell damage, fire or explosion.

If you have damaged a LiPo battery in any way, do not attempt to charge it.

Never charge a LiPo pack that has ballooned or swelled due to over/under-charging or from a crash. Never charge a lithium polymer battery pack that has been punctured or damaged in a crash.

Never charge a LiPo battery while it is inside your model or other electronic device. If it catches fire, it can lead to total destruction of the item inside which it is being charged.

# LiPo Battery Storage

Never put LiPo batteries or battery packs in pockets, drawers or bags where they might contact something made of metal. This can cause a short circuit.

Do not store LiPo batteries in extreme temperatures below 0 C or above 50 C.

Always store LiPo pack in a safe and non-combustible container away from flammable/combustible materials.

A LiPo Sack or metal/ceramic storage container is safest. Always store your LiPo's partially charged so they maintain their performance levels over time; there is no need to cycle them unless stored for periods longer than 3-6 months.

When storing batteries for extended periods, **store at a half-charged state.**

## Emergency Response and Disposal

To dispose of a LiPo battery, discharge it fully then dispose of batteries properly via campus recycling.

If the electrolyte in the cells gets on your skin, wash the area thoroughly with soap and water. If it gets in your eyes, rinse at emergency eyewash station for 15 minutes with cool water and seek immediate medical attention.

Do not inhale the smoke/fumes of a LiPo battery that is on fire. The smoke is toxic. Leave the area and call 911 immediately.

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