UC Irvine
Environmental Health & Safety

Lithium-Ion Batteries (Research Applications)

REFERENCE GUIDE

Issued: February 2026

Lithium-Ion batteries offer high energy density, allowing for fast charging and beneficial run times in various research operations, such as robotics and drones. They are readily available for purchase and use; however, they present many safety risks and concerns that must be addressed *prior to use*.

Lithium-Ion Battery Hazards

- **Thermal Runaway –** Intense heat from a failing cell can propagate to others, causing rapid fire to spread, explosions, and toxic smoke (including hydrogen fluoride and carbon monoxide gases).
- **Fire and Explosion –** Damaged, defective, or improperly charged batteries can ignite unexpectedly, causing severe burns or fatality.
- **Chemical Hazards –** Broken batteries can leak harmful electrolytes.
- **Manufacturing Defects** – Internal short circuits.

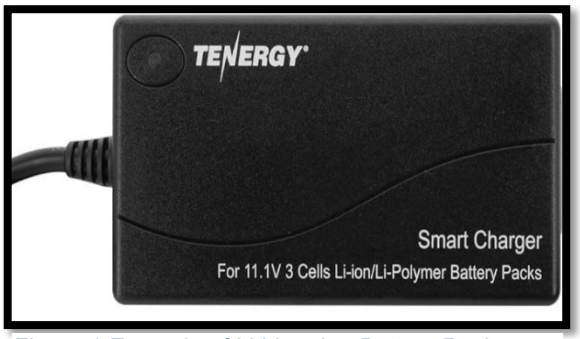

Figure 1 Example of Lithium Ion Battery Pack

Safe Guidelines for Usage and Storage

- **Use only approved certified devices** – When feasible, purchase batteries tested and certified directly from reputable U.S based manufacturers.
- **Proper charging** – Use only the charging cable supplied with the device. Do not comingle various manufacturers devices, chargers, and cords. Ensure charging and handling are done on non-combustible surfaces (e.g. lab benchtop, metal, or stone) and away from combustible materials (e.g. paper, fabric, carboard, etc.)
    - **Do not leave** devices unattended when charging, do not charge overnight, and unplug when done.
    - **Avoid overcharging** – only charge to an optimal range of 40%-80% to minimize stress on the batteries.
    - **Avoid extreme levels** – allowing the battery to hit 0% (full discharge) or keeping it at 100% for long periods can shorten its lifespan
    - **Consider** charging batteries in a Lithium-ion battery charging bag to contain potential fire damage.
- **Storage conditions –** Store in cool, dry places, avoid extreme heat or direct sunlight. This can be in an approved dedicated fire-proof lithium-ion battery charging/storage cabinet.

- **Disposal**
    - Never dispose of batteries in a regular trash can.
    - If the battery is in ***good condition***, follow Facilities Management's guidance under "Batteries / Printer Cartridges" on their recycling website
    - If the battery is in ***poor condition*** (leaking, swollen, crushed, punctured, or damaged), submit a Hazardous Waste Pickup Request

Warning Signs

Discontinue use immediately if a battery exhibits any of these signs:

- **Physical Changes** – bulging, swelling, or warping of the casing.
- **Odors** – A strange, sweet, or pungent smell.
- **Sounds** – Hissing, popping, or crackling sounds.
- **Temperature** – Feeling extremely hot to the touch.
- **Visual** – Smoke, venting gas, or leaking liquid.

Fires – If a fire starts, leave immediately, close the doors, and **call 9-1-1**. Notify your PI/supervisor/manager and EHS immediately after contacting 911.

Additional Considerations

- Whenever possible, reduce or eliminate the use of lithium-ion powered batteries in project scope development and explore alternatives to battery charging (e.g. Lithium-Iron-Phosphate, Sodium-Ion, solid-state batteries, or Zinc-air batteries)
- Develop standard operating procedures (SOPs) on the proper steps to use lithium-ion batteries for specific project or research use.
- Ensure all people involved in use, store, and charging lithium-ion batteries are trained on the SOP before utilizing them.

Additional Information

Electrical Safety Foundation International Flyers - *How to Store and Charge Batteries: Lithium-Ion Battery Safety: https://www.esfi.org/how-to-store-and-charge-batteries/*