RECOGNITION OF HAZARDS

RECOGNIZING HAZARDS IN LITHIUM-ION BATTERIES

Lithium-ion batteries and other similar battery technologies are presenting unique risks to firefighters and the general public. In order to be able to protect the public and our first responders, it's important to be able to recognize where lithium-ion batteries are found, what they look like, and the unique hazards they present.

WHERE ARE LITHIUM-ION BATTERIES FOUND?

Lithium-ion batteries are found in a variety of different technologies that can be located almost anywhere. It's important to recognize where lithium-ion batteries might be located in order to take the proper precautions when arriving on a fire scene.

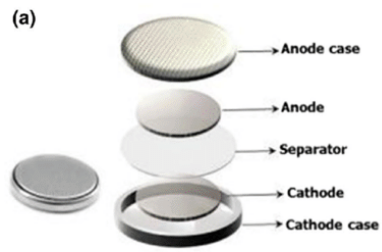
Lithium-ion batteries can be found in the following technologies. (Note that this is not a comprehensive list.)

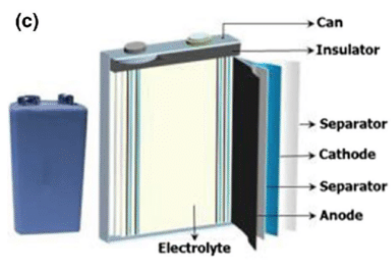
- Consumer electronics
  - Electronic cigarettes
  - Cell phones, laptops, and other portable electronic devices
  - Power tools, portable battery banks
- Micro-mobility devices
  - Electric bicycles
  - Electric scooters
  - Electric wheelchairs
- Electric vehicles
  - All electric vehicles
  - Hybrid electric vehicles
  - Electric golf carts
- Energy Storage Systems
  - Residential
  - Commercial
  - Utility

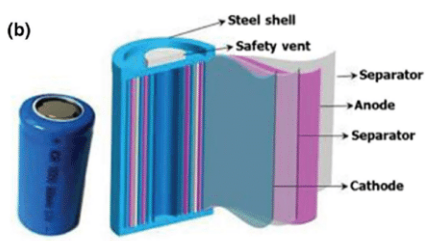
WHAT DO LITHIUM-ION BATTERIES LOOK LIKE?

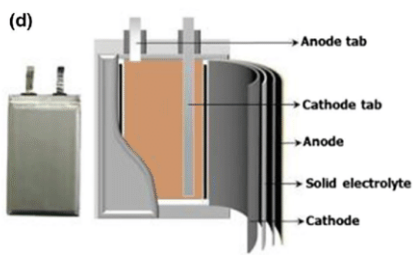
Lithium-ion batteries come in many different shapes and sizes. Batteries by definition are made up of multiple battery cells. There are four main types of lithium-ion battery cells:

- Coin (a)
- Cylindrical (b)
- Prismatic (c)
- Pouch (d)









RECOGNITION OF HAZARDS

WHY ARE LITHIUM-ION BATTERIES HAZARDOUS?

Most lithium-ion batteries that have been properly tested and listed should be safe to use as intended without exposing individuals to an unreasonable amount of risk. Unfortunately, when a battery is damaged to a certain extent it can go into thermal runaway, potentially causing a fire or explosion that is very difficult to control or extinguish. Once extinguished, the battery cells still preset a standard energy hazard which can cause a dangerous shock or even reignite the fire.

WHAT IS THERMAL RUNAWAY?

Thermal runaway refers to the uncontrollable chain reaction that occurs when a battery cell has an internal short circuit. This short circuit generates heat, and transfers that heat to neighboring battery cells, causing them to generate their own heat and continue to other battery cells in a cascading event. This heat generation also converts the internal components of the battery cell into a flammable and toxic gas. This gas will pressurize the cell and eventually burst out, usually causing a distinctive popping sound. Once the flammable and toxic gas mixture finds an ignition source, a battery fire or explosion can occur.

WHAT IS STRANDED ENERGY?

Standard energy refers to the fact that it is difficult to discharge the electrical potential energy from a battery cell after it has been damaged. You can not simply unplug a battery to de-energize it. This electrical potential energy that is trapped in a damaged battery can be a shock hazard to firefighters as they are conducting overhaul and a reignition hazard as batteries are known to reignite several hours or even weeks after the fire is thought to be fully extinguished. It is important to use nonconductive equipment when performing overhaul in a fire that might involve lithium-ion batteries. It is also essential to continue to don SCBA when around damaged lithium-ion batteries as reignition could occur and discharge toxic and flammable gasses.

KEY RESOURCES

- Consumer Electronics
  - Resource: Lithium-Ion Battery Safety Tip Sheet
- Electric Bicycles and scooters
  - Resource: E-Bike & E-Scooter Video from NFPA
- Electric and Hybrid Vehicles
  - Resource: Stranded Energy in Electric Vehicles and Firefighting Challenges NFPA video
  - Video Resource: EV Fire Safe Video on Thermal Runaway
- Energy Storage Systems
  - Resource: NFPA ESS Safety Fact Sheet
- Recycling Centers & Waste Management Locations
  - Video Resource: Lithium batteries become costly fire hazards for recycling centers
- UL FSRI Training: The Science of Firefighting and Lithium-Ion Batteries