



Battery Use and Disposal Guidelines

General Guidelines

These guidelines apply to batteries that are rechargeable and non-disposable, but that have a service life and require periodic replacement. However, even non-rechargeable household-type alkaline batteries (AAA, AA, C, D, 9-volt, etc.) can present hazards. They can leak over time, particularly when left in equipment, creating visible deposits of potassium hydroxide or potassium carbonate that can be corrosive to the skin. Wear gloves when handling or removing batteries, or cleaning residues off equipment terminals.

- It is UNLV's policy to follow the National Electrical Code (NEC) Articles 370, 373 and 374 when working with batteries. All materials used must be listed by Underwriters Laboratories (UL).
- For field use of equipment containing rechargeable batteries, all personnel must use the required personal protective equipment (PPE) as specified in their field Hazard Analysis and Mitigation Plan (HAMP). A class B-rated fire extinguisher should be nearby.
- Depending on the type of batteries used, handling, transporting and installing can pose several different threats to personnel and property. Some hazards associated with batteries include, but are not limited to:
 - **Caustic and/or acid burns**
 - **Hydrogen gas accumulation and explosion**
 - **Electric shock**
 - **Potential high currents, arcing, burns, and fire. Lithium metal batteries in particular are prone to fire.**
- When working with unsealed (liquid acid) type lead acid batteries, or during battery charging operations, wear face and eye protection, gauntlet type rubber gloves and rubber treated aprons or full suit. There needs to be eyewash and possibly a shower

nearby in case of accidental contact. Do not wear nylon clothes as this can cause a static spark that can ignite the hydrogen gas.

- Automotive batteries, as well as those found in fork trucks, floor cleaners, golf carts, and electric vehicles store large amounts of energy and require equipment-specific precautions. Consult the manual or the manufacture before working on these systems (such as jump starting).
- UNLV RMS generally recommends that you use “Gel Cel”, “Absorbed Glass Mat” or “Sealed” type batteries, as these reduce the chance of accidental acid spill or hydrogen gas explosion, compared to traditional lead acid batteries. However, these generally take longer to charge.
- Make sure that you are using any battery in an appropriate application as specified by the manufacturer. In particular, charging equipment must be designed specifically for the type of battery. At a minimum, the charger should be equipped with a timer. Better units monitor battery voltage, temperature, state-of-charge or other parameters to prevent overcharging. **MANY BATTERIES ARE CAPABLE OF THERMAL RUNAWAY IF OVERCHARGED.** This leads to venting, leakage, fire or explosion. See Battery Charging section below.

Battery Use

- Any enclosure that houses batteries **MUST** be adequately ventilated. The amount of ventilation required depends on the size and type of the batteries, their temperature, and the amount of current used to charge them. **Always follow the manufacturer’s recommendations for handling and venting.**
- Do not install any spark producing components (relays, switches, etc.) in the same enclosures or in close proximity to the batteries.
- Battery placement in any enclosure should guarantee that there is minimal chance of accidental shorting during routine maintenance and use. It is recommended that insulated tools be used to reduce the risk of a short. Remove rings, necklaces or other metal that could accidentally contact the battery terminals.
- For large installations, NEC recommends that there be an area of thirty-six inches (36”) wide in front of the enclosure to ensure a safe work area.
- Overcurrent devices such as fuses or circuit breakers should be place as close to the batteries as possible and the wire size used should be large enough to handle any over current surges.
- Do not place electrolyte or gel containing batteries where they may freeze and subsequently crack releasing hazardous materials to the environment. Use secondary containment for any battery other than a non-spillable type.

Battery Charging

- Make sure that the batteries you want to charge are designed for this. For example, inadvertently charging an alkaline (non-rechargeable) battery can cause an explosion.
- Use the appropriate kind of charger for your battery type. **A standard automotive battery charger should not be used to charge “Gel Cel,” Valve Regulated Lead Acid (VRLA), or Absorbed Gas Mat (AGM) type batteries.** Lithium batteries require very specialized chargers and interlocks. **If overcharged, lithium batteries may violently ignite.** Consult the manufacturer for the proper charger for your battery type, paying special attention in case of newer high energy density types.
- Battery charging can produce explosive gases and an electrolyte film may form on top of the batteries. Adequate ventilation is required for all lead acid and gel battery charging operations to avoid buildup of flammable gas. No smoking or open flames or ignition sources should be present in a battery charging area. The presence of an electrolyte film can cause an acid burn and also act as a conductor to transmit a charge to any grounded source. It is recommended that this film be removed using a neutralizer.
- During charging operations, wear the PPE described above in General Guidelines, and ensure that eyewash and safety shower stations are functional before charging.
- Always check the battery’s electrolyte level before and after charging to guarantee it is at a safe level. “Dry” charging can cause a fire or explosion.

Disposal

- Lead acid and gel batteries, mercury button batteries, nickel cadmium, nickel metal hydride, and other rechargeable batteries all contain heavy metals in quantities that are hazardous to the environment. In addition, many also contain corrosive chemicals (typically sulfuric acid or potassium hydroxide) which are also hazardous. Lithium batteries contain both combustible and water-reactive materials. Never dispose of these kinds of batteries in the normal trash. The batteries named above are considered Universal Waste by the EPA and should be disposed by an approved recycler. UNLV RMS can provide specific recycling options for the used batteries you generate.
- Alkaline (household) batteries and non-lithium coin cell batteries also contain heavy metals, but not in quantities to make them of interest to metal recyclers. Therefore, these currently can be disposed in the regular trash, until such time as recycling becomes viable. It is much better for the environment to use rechargeable batteries, which can be recycled at little or no cost.
- Non-rechargeable lithium metal batteries such as 3V and coin cell models can generally be included in battery recycling programs. RMS can take these batteries and ensure they reach proper recycling facilities.
- You can submit a waste disposal request for batteries to RMS at the following link:
<https://rms.unlv.edu/forms/waste/>



Figure 1

Left: 3V lithium batteries, which can be recycled

Right: AA alkaline battery, which cannot currently be recycled

Shipping Batteries or Equipment that Contains Batteries

Most rechargeable equipment at UNLV contains either lithium-ion, nickel-cadmium, or nickel-metal hydride (NiMH) batteries. Periodically, a situation is faced where such equipment must be shipped, such as to the manufacturer, a service/repair center, or other collaborators. There are inherent hazards in shipping battery-powered equipment, particularly with lithium batteries. The guidance below will help you determine if such a shipment would qualify as Dangerous Goods, or if any additional postings or declarations might be necessary. ***In general, it is best to discharge, disconnect, and/or remove the batteries from a piece of equipment before shipping, in order to reduce the likelihood of shorting out or overheating.***

Not all lithium batteries are the same. Lithium metal batteries use metallic lithium as their anode, have high charge densities, and are not rechargeable. Lithium-ion batteries contain lithium compounds and are rechargeable. Both present a unique safety hazard due to the flammable nature of their electrolytes, which can place restrictions on shipping (particularly by air).

- If you plan to ship a piece of equipment that contains **lithium metal** batteries, you **MUST** notify RMS and complete the DOT/IATA shipper's training, as this is considered Dangerous Goods shipping. This requirement applies even if you ship the equipment with the batteries still securely contained within it.
- You also must be approved for Dangerous Goods shipping if you ship **lithium-ion** batteries that are **NOT** contained in equipment or packed with equipment.
- For lithium-ion batteries contained in equipment or packed with equipment, it is generally possible to ship without falling into the Dangerous Goods requirements. Most battery packs fall below the 100 Watt-hour (W-h) per battery pack, or 20 W-h per individual cell energy threshold which would trigger the Dangerous Goods shipping requirements, but you should check the specifications first to ensure this is the case before shipping.



Figure 2. Example of lithium-ion batteries that are packed with, or contained in, the equipment they power. At energy levels of <100 W-h per battery pack or 20 W-h per cell, these are exempt from Dangerous Goods shipping requirements.

You must place the special label depicted below (with a working contact number) on your shipment of equipment with lithium-ion batteries <100 W-h, even if you plan on using ground-shipment methods. The only exception is if one of the following conditions are met:

- The package contains only button-cell batteries installed in equipment, or
- Each package contains <4 cells (contained in equipment) or <2 batteries (contained in or packed with equipment).



Figure 3. Mandatory label for lithium ion battery shipments that fall below DOT thresholds for Hazardous Materials labeling

FedEx Ground guidance for shipping lithium batteries (ion and metal):

<http://www.fedex.com/us/services/pdf/Shipping-Lithium-Batteries-via-FedEx-Ground.pdf>

Rules on lithium-ion batteries can be confusing, so please contact UNLV RMS if you have any questions or need clarification.