

## DRI BATTERY USE GUIDELINES<sup>1</sup>

### General Guidelines

- It is DRI's policy to follow the National Electrical Codes (NEC) Articles 370, 373 and 374 when working with batteries. All materials used must be UL listed.
- All personnel must use the required personal protective equipment (PPE) as specified in their field Hazards 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 them 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**
- When working with unsealed (liquid acid) type lead-acid batteries (the standard automotive and marine/RV type) or during battery charging operations it is recommended that you wear<sup>2</sup> face and eye protection, gauntlet type rubber gloves and rubber treated aprons or full suit. If this level of protection is not available, a minimum of eye protection, non-porous gloves, long-sleeved shirt and pants, and closed shoes should always be worn. There needs to be a source of clean water (preferably an eyewash and 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 manufacturer before working on these systems, including jump starting (see [Basic automotive jump starting instructions](#) from cartalk.com.)
- **DRI 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.** (See the links below for descriptions of these and other battery types.)
- **Make sure that you are using any battery in an appropriate application as specified by the manufacturer. In particular, charging equipment must be**

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<sup>1</sup> Thanks to Blackhawk Solar for their help with this guideline (530-283-1396)

<sup>2</sup> Standard household type batteries (AAA, AA, A, B, C, D's etc.) do not require all the PPE listed.

designed specifically for the type of battery in use. 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 Charging section for details.)

- **Automotive and deep-cycle batteries are extremely heavy for their size. Use [proper safe-lifting precautions](#) when moving them. For batteries without handles or cases, a battery lifter may be necessary.**

### **Battery Use and Storage**

- Any enclosure that houses lead-acid 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 lead-acid 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, stationary installations, NEC recommends that there be an area of 36" wide in front of the battery enclosure to insure a safe work area.
- Over current devices such as fuses or circuit breakers should be placed 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. When storing or transporting batteries, make sure that no metal objects can contact the terminals, and that batteries cannot contact each other. Additional storage precautions should be observed with batteries slated for disposal; see disposal section below.

## Battery Charging

- Make sure that the batteries you want to charge are designed for this. For example, inadvertently charging an alkaline (non-chargeable household type) 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.** At a minimum, chargers should be timed to shut off or revert to a low trickle charge. Better designs include monitors of battery parameters such as temperature and state of charge. 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 build up 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.
- Always check wet battery electrolyte levels 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 (NiCd), and other rechargeable batteries all contain heavy metals in quantities that are hazardous to the environment. In addition, they 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. DRI EH&S can provide specific recycling options for the used batteries you generate.
- Alkaline (household) batteries also contain heavy metals, but not in quantities to make them of interest to metal recyclers. It is much better for the environment and saves DRI money for disposal to use rechargeable batteries, which can be recycled at little or no cost.
- Batteries slated for disposal should be placed in a non-conductive container no more than one layer deep. If the battery retains some charge, cover its terminals with a layer of electrical tape. This is particularly important for rechargeable battery packs which can contain enough energy to start a fire if shorted.

## References

- Alternative Energy, John Drake Services, Inc.  
[http://www.solarseller.com/battery\\_information\\_page .htm](http://www.solarseller.com/battery_information_page.htm)
- Battery Types, Tips and Technology, Garden State Battery  
[http://www.gardenstatebattery.com/en-us/battery\\_types\\_and\\_tips.htm](http://www.gardenstatebattery.com/en-us/battery_types_and_tips.htm)
- Buggy Battery Safety, Ohio State University Extension  
[http://ohioline.osu.edu/aex-fact/0596\\_2.html](http://ohioline.osu.edu/aex-fact/0596_2.html)
- Jumping a Car Safely, Prevent Blindness America  
<http://www.preventblindness.org/safety/battery.html>
- Lead Acid Battery Safety, Battery Council International  
<http://www.batterycouncil.org/LeadAcidBatteries/EnvironmentalRegulations/LeadAcidBatterySafety/tabid/96/Default.aspx>
- Lithium Ion Battery Charging and Safety  
<http://www.batteryuniversity.com/partone-12.htm>
- The Care and Feeding of Gel Batteries, Craig LeBarge  
<http://www.qsl.net/wb3gck/gel-cell.htm>
- Universal Waste Batteries, Environmental Protection Agency  
<http://www.epa.gov/epaoswer/hazwaste/id/univwast/battery.htm>
- Jump Starting Instructions  
[www.cartalk.com/content/features/roadside/jumpstart.pdf](http://www.cartalk.com/content/features/roadside/jumpstart.pdf)