Battery Shipping

Batteries are very common today in portable electronics, tools and other applications. But did you know that they can become a source of dangerous heat, sparks or fire if they are improperly packaged for shipping? For this reason, Estes customers must follow applicable safety regulations and appropriate precautions when preparing batteries for transportation. Battery shipments may be subject to both U.S. and international safety regulations, and because of the potential dangers associated with violations of those regulations, people who do not follow the regulations when packing their shipments could be subject to fines, other penalties or liability issues.

In some cases, such as with alkaline or certain nonspillable lead-acid batteries, your responsibilities may be limited to simple steps such as: selecting strong outer packaging; carefully protecting battery terminals to prevent sparking or short circuit; and carefully preparing the interior package components to keep tools or other metal objects away from batteries.

Other types of batteries, including lithium ion and lithium metal types, may be fully regulated as hazardous materials (also known as dangerous goods) for transportation, so that in addition to those basic safety precautions they require use of specialized packaging, specific hazard labeling, and documents certifying compliance with the applicable regulations.

This document reviews some of the more common battery types and how to properly ship them. Please pay careful attention to the information and compare it to how you currently prepare your battery shipments.

Protect batteries and terminals

When shipping almost any battery, you must protect all terminals against short circuits that can result in fires. Protect terminals by completely covering them with an insulating, non-conductive material (e.g., using electrical tape or enclosing each battery separately in a plastic bag), or packing each battery in fully enclosed inner packaging to ensure exposed terminals are protected.

- Package the batteries to keep them from being crushed or damaged, and to keep them from shifting during handling.
- ***Always*** keep metal objects or other materials that can short circuit battery terminals away from the batteries (e.g., using a separate inner box for the batteries).
- ***Never*** use Air services to ship batteries recalled by the manufacturer for safety reasons, or batteries accumulated for recycling.
- When sending equipment for repairs, such as computers and cell phones or other battery operated devices, if there is any risk that the device could overheat, it should be sent ***without*** batteries.

> **Note:** *To prevent fire, any device with installed batteries **must not** turn on while in transport. Protect switches that can be accidentally activated. Even very simple devices like flashlights or rechargeable drills can generate a dangerous amount of heat if accidentally activated.*

Types of batteries

There are a variety of batteries available today and, while in transport, many are regulated as hazardous materials (also known as dangerous goods). Some of the battery types shown may be shipped under regulatory exceptions that do not require full compliance with the hazardous materials/dangerous goods regulations. In addition, there are some battery types (e.g., conventional dry cell or alkaline batteries in consumer sizes) that are not regulated at all, provided they are adequately protected against short circuit.

> **Note:** *While this document is designed to highlight safety practices for Estes customers who pack and ship batteries, it **does not** replace the applicable regulations. For more information, consult the U.S. DOT's Hazardous Materials Regulations (49 CFR). You may also consult U.S. DOT's online information at http://phmsa.dot.gov/hazmat, or call the U.S. DOT's Hazardous Materials Information Center at 1-800-467-4922.*

ID Number	Proper Shipping Name and Description	Hazard Class
UN2794	Batteries, Wet, Filled with Acid	8
UN2795	Batteries, Wet, Filled with Alkali	8
UN2800	Batteries, Wet, Nonspillable	8
UN3028	Batteries, Dry, Containing Potassium Hydroxide Solid	8
UN3090	Lithium Metal Batteries	9
UN3091	Lithium Metal Batteries Contained in Equipment or Lithium Metal Batteries Packed with Equipment	9
UN3292	Batteries, Containing Sodium	4.3
UN3480	Lithium Ion Batteries	9
UN3481	Lithium Ion Batteries Contained in Equipment or Lithium Ion Batteries Packed with Equipment	9

Wet Batteries (UN2794 and UN2795)

These batteries are commonly used in cars, electric wheelchairs, forklifts, some continuous computer power sources and other applications. They contain highly corrosive acid or alkali and can cause fires from short circuit. ***All*** terminals must be protected against short circuit, and the batteries packaged and tested according to 49 CFR 173.159 for U.S. shipments (see Figs. 1 and 2).

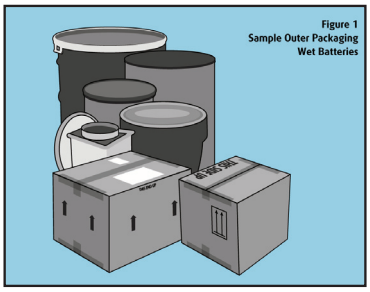

Figure 1
Sample Outer Packaging
Wet Batteries

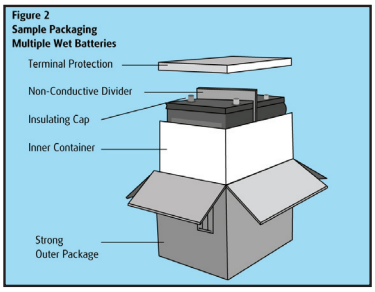

Figure 2
Sample Packaging
Multiple Wet Batteries

Nonspillable Batteries (UN2800)

These batteries may not be subject to the Hazardous Materials Regulations if they meet the pressure differential and vibration testing in 49 CFR 173.159, as well as being plainly and durably marked either "NONSPILLABLE" or "NONSPILLABLE BATTERY" on the outer packaging (see Fig. 3). Conformance with 49 CFR 173.159a is mandatory and the batteries must be prepared for transport so as to prevent short circuit and unintentional activation of any devices or equipment in the package.

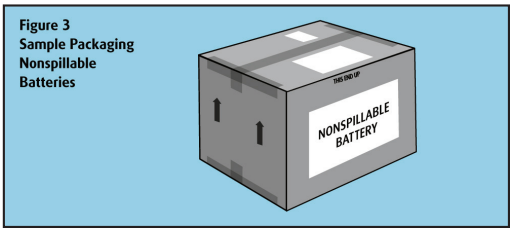

Figure 3
Sample Packaging
Nonspillable
Batteries

Nonspillable acid or alkali batteries that comply with certain additional testing are not subject to any regulations, provided the terminals are protected against short circuit. These additional requirements, which are stated in 49 CFR 173.159a(d), require that the battery contain no free-flowing liquid, and the electrolyte must not flow from a cracked case at 55°C (131°F). The battery and package should be marked "NONSPILLABLE" or "NONSPILLABLE BATTERY."

Dry Batteries, Containing Potassium Hydroxide Solid (UN3028)

In the U.S., these batteries must be prepared according to Special Provision 237 in 49 CFR 172.102, which states that UN3028 materials "must be prepared and packaged in accordance with the requirements of 173.159(a), (b), and (c).

Dry Batteries, Sealed, n.o.s.

These batteries are typically used for portable power applications, are hermetically sealed and generally use metals (other than lead) and/or carbon as electrodes. They must meet all the requirements set forth in Special Provision 130 in 49 CFR 172.102, which includes prevention of the dangerous evolution of heat from short circuit or damage.

Other batteries

Although common dry cells (e.g., AA, C, D batteries) may not be regulated as hazardous materials, all batteries can cause fires from short circuit if batteries and terminals are not protected. Each battery shipment must meet all the requirements set forth in Special Provision 130 in 49 CFR 172.102, which includes prevention of the dangerous evolution of heat from short circuit or damage.

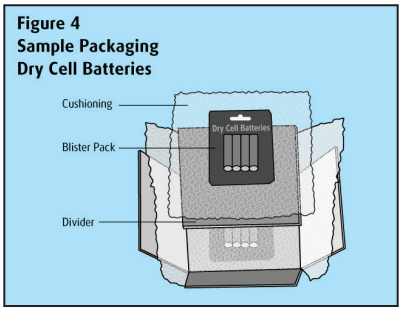

Figure 4
Sample Packaging
Dry Cell Batteries

Lithium batteries (UN3090, UN3091, UN3480, UN3481)
Regulatory changes related to lithium batteries are dynamic. Note that regulations applicable to lithium batteries shipped domestically within the U.S. may also change in the near future.

About lithium batteries
Because lithium batteries are designed to provide high levels of power, the electrical energy in these batteries is significant, meaning that such batteries can sometimes generate a great amount of heat if short circuited. In addition, the chemical contents of these batteries may catch fire if damaged or if improperly designed or assembled. For these reasons, there are safety regulations controlling the shipment of these types of batteries. ***Shippers must conform*** to the applicable regulations published by PHMSA.

While all lithium batteries are classified as hazardous materials (also referred to as dangerous goods), there are exceptions for common small sizes of these batteries that simplify the rules for shipping these items. This document describes the rules for shipping these small lithium batteries.

Lithium Battery Types
There are two major types of lithium batteries, both contain extremely high levels of energy. They are:

Lithium Ion (Li-ion) – These types are rechargeable
- Sometimes called "secondary lithium batteries."
- Includes lithium polymer (Li-Po) batteries
- Often found in common electronics such as cell phones and laptops.

Lithium Metal – Generally non-rechargeable
- Sometimes called "primary lithium batteries."

Shipping lithium batteries by ground
Additional weight and labeling requirements now apply to ground shipments of lithium batteries in the U.S. The requirements differ depending upon what type of lithium battery you are shipping (lithium ion or lithium metal) and whether you are shipping batteries packed without equipment, batteries packed with equipment, or batteries contained in equipment. These requirements also apply to cross-border ground shipments from the U.S. to Canada and Mexico.

Required labels and markings
Requirements for the use of the labels and markings vary depending upon the type of battery being shipped (lithium ion or lithium metal) and how the batteries are packed (without equipment, with equipment, or contained in equipment).

Required documentation
Many shipments must be accompanied by documentation identifying the battery type that must also state the following:
- The package must be handled with care because a fire hazard exists if it is damaged.
- Special procedures are to be followed if the package is damaged, to include inspection and repacking if necessary.
- A telephone number for additional information.

Distinctive handling label
A handling label is required under most conditions to identify the presence of lithium ion or lithium metal batteries. Such labels must be at least 110 mm × 120 mm and be on the outside of a package containing lithium ion batteries. For smaller packages that can only bear smaller labels, the label dimensions may be 105 mm wide × 74 mm high.





Labels and markings for ground shipments

Ground shipments must also display a marking that identifies the presence of lithium ion or lithium metal batteries and that states the following:

- The package must be handled with care because a fire hazard exists if it is damaged.
- Special procedures are to be followed if the package is damaged, to include inspection and repacking if necessary.
- A telephone number for additional information.

The distinctive handling labels (shown on the previous page) may be used. Other stickers or markings may be used, but they ***must*** provide all the required information.

What are some ways I can help prevent a short-circuit or activation of lithium batteries in my shipment while in transport?

A major risk of shipping lithium batteries is short-circuit of a battery or inadvertent activation while in transport. All batteries should be packed to eliminate the possibility of a short-circuit or activation (see Figure 5 for an example). Ensure no batteries can come in contact with other batteries, conductive surfaces or metal objects while in transport.

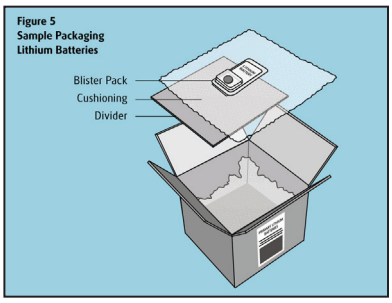

Figure 5
Sample Packaging
Lithium Batteries

What does the abbreviation "Wh" mean?

"Wh" stands for "watt-hour." It is a measure used to indicate the energy capacity of a lithium ion cell or battery.

What is the "state of charge" or SOC?

This term refers to the percentage of the electrical stored capacity in a rechargeable cell or battery (e.g., lithium ion cells or batteries) that is available for use. A fully charged lithium ion battery has a 100% state of charge (SOC). Research has demonstrated that for lithium ion batteries, reduced SOC may provide an additional level of safety during transport and reduce the likelihood of a thermal event. Effective April 1, 2016, all lithium ion batteries (without equipment) shipped by air must not exceed 30% SOC.

What is a "button battery"?

A button battery is a small round battery where the height is less than the diameter also commonly referred to as "coin batteries." Examples can be found in watches, calculators, electronic clocks, toys and other applications.

What is a "cell" versus a "battery" under this regulation?

- A battery is two or more cells electrically connected together by permanent means, including case, terminals and markings.

  Note: *"Battery packs," "modules" or "battery assemblies" are treated as batteries under this regulation.*

- A cell is a single encased electrochemical unit. It has one positive and one negative electrode that exhibit a voltage differential across its two terminals.

  Note: *Many cells can be termed "battery" or "single-cell battery" in common conversation, but under this regulation a single cell must use the requirements related to "cells" only. Examples of a "cell" would be a CR123 primary lithium cell used for cameras and flashlights*

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