University of Nebraska Medical Center

BREAKTHROUGHS FOR LIFE.®

ENVIROMENTAL HEALTH AND SAFETY

LITHIUM BATTERY TRANSPORTATION PLAN

Lithium batteries are used in many electronic devices such as cameras, cell phones, laptop computers, medical equipment and power tools.

While most lithium batteries are safe, there have been recent reports of incidents involving the failure of lithium batteries:

- Computer batteries have heated up and caused fires on cargo and passenger aircraft.
- A charging lithium ion battery exploded on a mini-submarine designed to carry U.S. Navy SEALs to shore.
- A passenger's camera batteries began smoking at the boarding gate.
- Two large battery packs in a checked baggage began smoldering. The bag burst into flames when an airline agent picked it up.

Once ignited, they can cause any nearby batteries to overheat and catch fire. These fires are difficult to put out, especially on aircraft and produce toxic and irritating fumes.

In the United States, lithium batteries are subject to the Department of Transportation (DOT) and the International Air Transport Association (IATA) Regulations and regulated as dangerous goods. When you ship lithium batteries, including those **contained in** or **packed with** devices and equipment, you **must** meet shipping requirements and declare package contents to postal carriers, couriers or transport companies.

985480 Nebraska Medical Center / Omaha, NE 68198-5480
Phone: 402-559-6356/ Fax: 402-559-8370 / www.unmc.edu/ehs/

Definitions

A **cell** is a single encased electrochemical unit (one positive and one negative electrode) with a voltage differential across its two terminals.

- Did you know that AA batteries and AAA batteries are actually cells?

A **battery** is two or more cells that are electrically connected together and fitted with devices such as a case, terminals, marking and protective devices that it needs to function properly.

- Did you know that battery packs, modules or battery assemblies manufactured to provide a source of power to another piece of equipment are treated as batteries?

A **lithium metal battery** (primary) is usually non-rechargeable, contains metallic lithium and features a higher energy density than other non-rechargeable batteries. Lithium metal batteries are often used in calculators, pacemakers, remote car locks and watches, to name a few.

A **lithium ion battery** (secondary) is rechargeable, does not contain metallic lithium and features high energy density. A lithium polymer battery is considered a type of lithium ion battery. Lithium ion batteries are used in consumer products such as cell phones, electric vehicles, laptop computers, power tools and tablets.

A lithium ion or metal battery **contained in equipment** means that the battery is fitted or joined to the actual device. Examples include a calculator, laptop computer or watch—with an integrated lithium battery.

A lithium ion or metal battery **packed with equipment** is not fitted or joined to the device. An example would be a power tool packed alongside a spare battery.

Short circuit protection - Preventing lithium batteries from short circuit is very important to keep them from overheating and catching fire. Always keep lithium batteries isolated from metal objects (e.g. jewelry, keys) or other conductive materials by enclosing each one separately and insulating terminals with a non-

conductive material (e.g. electrical tape). Pack them so they cannot shift during transport.

A lithium battery inside equipment is protected from short circuit because it is secured in the actual device and cannot move around during transport. Make sure no switches or power buttons can be accidentally turned on during transport.

Watt-hour (Wh) Rating -The Wh indicates the amount of energy contained in a lithium battery. DOT & IATA Regulations regulate lithium ion batteries based on their Wh rating.

Calculating the Wh rating - The Wh rating must appear on the battery case if it was made on or after January 1, 2009. If it is not there, you can calculate the Wh rating by using one of these formulas:

1. If you know the nominal voltage (V) and the capacity in ampere-hours (Ah), then **Wh = (V) x (Ah)**; or

2. If you know the nominal voltage (V) and the capacity in milliampere-hours (mAh), then **Wh = (V) x (mAh ÷ 1000)**.

If you are still not sure what your lithium battery's Wh rating, contact its manufacturer.

Calculating the lithium content?

You can calculate the lithium content, in grams (g), of a lithium metal cell:

1. If you know the battery's capacity in ampere-hours (Ah), then **Grams (g) lithium metal = (Ah) x 0.3**; or

2. If you know the capacity in milliampere-hours (mAh), then **Grams (g) lithium metal = (mAh ÷ 1000) x 0.3**.

To calculate the lithium content of the battery, simply multiply the grams (g) of lithium metal by the number of cells in the battery.

Buying lithium batteries

Always buy lithium batteries from a reputable manufacturer or distributor that has documented proof that the batteries have been tested and meet the UN Manual of Tests. If a lithium battery does not meet the conditions, then the manufacturer must correct any failures and have it retested. This ensures a higher level of safety for design deficiencies or flaws. Lithium batteries are subject to rigorous testing according to the UN Manual of Tests and Criteria.

The UN Manual of Tests and Criteria lists eight tests. Required tests vary depending on the type and design of lithium battery.

<table>
<tr><th>Test Name</th><th>Purpose of Test</th><th>Test Requirements Met If:</th></tr>
<tr><td>1. Altitude simulation</td><td>To simulate air transport under low-pressure conditions</td><td rowspan="4">There is no leakage, no venting, no disassembly, no rupture and no fire; and if the open circuit voltage of each test cell or battery after testing is not less than 90% of its voltage immediately before this procedure. The voltage requirement does not apply to test cells and batteries at fully discharged states.</td></tr>
<tr><td>2. Thermal test</td><td>To assess cell and battery seal; to confirm integrity and internal electrical connections</td></tr>
<tr><td>3. Vibration</td><td>To simulate vibration during transport</td></tr>
<tr><td>4. Shock</td><td>To simulate possible impacts during transport</td></tr>
<tr><td>5. External short circuit</td><td>To simulate an external short circuit</td><td rowspan="2">The external temperature does not exceed 170°C and there is no disassembly, no rupture and no fire within six hours of this test.</td></tr>
<tr><td>6. Impact / Crush</td><td>To simulate an impact</td></tr>
<tr><td>7. Overcharge</td><td>To evaluate the ability of a rechargeable battery to withstand an overcharge condition</td><td rowspan="2">There is no disassembly and no fire within seven days of the test</td></tr>
<tr><td>8. Forced discharge</td><td>To evaluate the ability of a rechargeable cell to withstand a forced discharge condition</td></tr>
</table>

Counterfeit and no-brand lithium batteries are also of concern, because they may not have been safety tested. These lithium batteries may be poorly designed, have little protection, or contain manufacturing flaws.

Did you know that when you interconnect or assemble tested cells, you must also test the resulting battery?

Did you know that lithium batteries that have been altered must be retested, even if the batteries were tested before the alteration?

Flying with lithium batteries.

You can carry spare lithium batteries or lithium batteries contained in equipment (cell phone, laptop or tablet) with you in your carry-on baggage. For larger items containing lithium batteries, such as mobility aids or medical equipment, you should contact your air carrier for further details.

Important Notes:

- You must insulate the terminals to protect lithium batteries from short circuit.
- Do not leave spare lithium batteries loose in your bag.
- Never pack spare lithium batteries into your checked baggage.
- Check with your air carrier if you plan on carrying lithium batteries contained in equipment in your checked baggage.
- Never carry or check damaged lithium batteries onto an aircraft.

Shipping Lithium Batteries

The DOT & IATA Regulates the safe handling, offering for transport, and transporting of lithium batteries by specifying classification, documentation, and labelling, packaging and training requirements.

All designs and types of lithium batteries must meet the requirements of the UN Manual of Tests and Criteria to be shipped safely.

Shippers must meet the requirements set out in the DOT & IATA Regulations for the handling, offering for transport, transporting and importing of lithium batteries in the United States. The requirements vary by mode of transport.

All UNMC and Nebraska Medicine shipments of lithium batteries are required to be reviewed by trained and certifide EHS staff, to determine the proper packaging and paperwork is completed.

For shipments of lithium batteries you must do the following:

1. Complete Lithium Battery Review Form (Appedix A)

   It is mandatory that you provide all of the required information or the form will be returned unprocessed. The information is required by the regulations in order to determine the proper shipping and packaging requirements for the type of battery you are shippng.

2. Return the Form to EHS via fax (9-8370) or email (**unmcehs@unmc.edu**).

3. Wait for EHS staff to review the form and contact you to schedule the shipment.

It is **FORBIDDEN** to ship damaged, defective, recalled or recycled lithium batteries by aircraft. This ban applies whether or not these lithium batteries are contained in equipment.

Appendix A

Lithium Battery Shipment Review Form

(Complete form on next page)

Lithium Battery Shipment Review Application

Your Name : _____

Phone Number: _____ E-mail address: _____

Department: _____

Supervisor: _____ Zip Code: _____

This form is intended to be used to request a lithium battery shipment review:

Explain the lithium battery or cells you would like to ship.

Contained within device ☐ Packed with device ☐ Lithium battery only ☐

Lithium ion ☐ Lithium Metal ☐ Other_____ ☐

Shipping Item? ☐ or Passenger Aircraft ☐

Was the battery or cell altered or damaged? Yes ☐ No ☐

Note: * Required field for Lithium Ion and ** Required for Lithium Metal

Equipment & Battery

Description: _____

*Volts (V): _____

*Ampere-hours (Ah): _____

**Grams (g) of Lithium: _____

Quantities / Volumes: _____

Manufacture: _____

Module Number: _____

Item catalog number (if available): _____

Signature: _____ Date: _____

Print Name: _____

Required: Include or attach technical information and SDS (MSDS)

Once completed, please return this form to EHS via fax (9-8370) or email to unmcehs@unmc.edu