

## LITHIUM BATTERIES

On August 9, 2007, the U.S. Department of Transportation (“DOT”) issued a final rule affecting the transportation of lithium batteries. The rule became effective on January 1, 2008 and has the potential to affect travelers who carry lithium batteries to power devices such as laptops, video camera, digital cameras and a myriad of other consumer electronic devices. The rule is not particularly complex, but it is technical and can easily confuse both the traveler and the TSA security officers, charged with enforcement. The adoption of this rule harmonizes the US regulations with the (globally accepted) UN Dangerous Goods regulations. Thus, by complying with these rules when you leave home, you will also be in compliance with rules at most other airports in the world.

In this document, the rule will be explained and a number of suggestions offered to help ease any restrictions imposed by the rule. You can read the entire rule at

<http://www.regulations.gov/fdmspublic/component/main?main=DocumentDetail&o=09000064802c465d>

The DOT adopted this rule for a simple reason: Fire at 10,000 m is bad, and a shorted lithium battery can cause a fire. The Federal Aviation Agency demonstrated that a lithium battery fire in the cargo (baggage) space of a commercial jet may overwhelm the fire suppression system<sup>1</sup>. In addition, the DOT has investigated at least 11 incidents, including the large fire involving two pallets of primary Lithium batteries at LAX in 1999. Lithium batteries are defined as hazardous materials under DOT regulations. The rule just adopted tightens the methods for handling these batteries to reduce the potential for a thermal run-away event and the resulting fire. The combination of the flammable lithium and high energy density makes these cells different from alkaline batteries, nickel-cadmium batteries and nickel-metal hydride batteries. The DOT rule is risk based. It recognizes that the amount of stored energy is the major driver of the risk of a fire. The amount of stored energy is a function of the number of cells in the battery and the total amount of lithium present. In developing this rule, the DOT also distinguished between a “**primary battery**”, that is non-rechargeable battery; and a “**secondary battery**”, which is rechargeable. This led the DOT to categorize the batteries for regulation as follows:

	Small Less than or equal to	Medium Between	Large More than
Cells			
Primary	1 g Li <sup>a</sup>	1 g Li <sup>a</sup> and 5 g Li <sup>a</sup>	5 g Li <sup>a</sup>
Secondary	1.5 g ELC <sup>b</sup>	1.5 g and 5 g ELC <sup>b</sup>	5 g ELC <sup>b</sup>
Batteries			
Primary	2 g Li <sup>a</sup>	2 g Li <sup>a</sup> and 25 g Li <sup>a</sup>	25 g Li <sup>a</sup>
Secondary	8 g ELC <sup>b</sup>	8g and 25 g ELC <sup>b</sup>	25 g ELC <sup>b</sup>

<sup>a</sup> Mass of lithium metal. For lithium ion cells, use ELC.

<sup>b</sup> Equivalent Lithium Content (for a cell this is the cell’s ampere-hrs\*0.3; for a battery, this is the sum of the ELC for each cell.)

<sup>1</sup> DOT/FAAIARI-04/26

The Rule and what it means to you:

This discussion is limited to those aspects of transporting lithium batteries most likely to be encountered by air travelers. This discussion does not address issues related to commercial shipments of lithium batteries or of devices powered by these batteries.

### Primary Lithium Batteries

Primary lithium batteries and cells are forbidden on passenger-carrying aircraft. The only exception to this is for small batteries contained in a device which power that device. In this case, the device must be packed in strong outer packaging and the total mass of lithium is limited to 5 kg (11 pounds). This means you cannot take a primary lithium battery on board an aircraft, except as described in the next section.

### Consumer Electronic Devices

A passenger is limited to carrying on a medium lithium battery powered device to the battery contained in the device AND no more than two spare medium batteries if they comply with these conditions:

1. A primary battery (lithium metal battery) must not have more than 2 grams of lithium.
2. A secondary battery (lithium-ion, rechargeable) for a single battery must not have more than 8 g total ELC and the aggregate is limited to a total of 25 g ELC. Batteries which fall below the 8-gram threshold do not count into the aggregate.
3. Each spare battery must be packed in such a manner as to prevent a short-circuit across the contacts.
4. You can carry on small lithium batteries without regulation, as long as they are protected from a short-circuit.

Common consumer electronics, such as cell phones, small camera, and most laptop computers are still allowed in both carry-on and checked baggage. The rule limits bringing only two extended life spare rechargeable lithium batteries, such as for a laptop (see illustration) or a professional video camera (see illustration) on board as carry-on baggage.



Under these rules, you cannot ship a primary lithium battery as baggage. Here are some ideas for battery safety.

- Clearly identify every battery you use as to type. If it does not contain lithium, make certain it is clearly marked. For example, place a label on the battery which states “Does not contain lithium”.
- Pack spare batteries in carry-on baggage. In the passenger compartment, flight crews can better monitor safety conditions to prevent an incident, and can access fire extinguishers, if an incident does happen.
- Keep spare batteries in the original retail packaging, to prevent unintentional activation or short-circuiting.
- For loose batteries, place tape across the battery's contacts to isolate terminals. Isolating terminals prevents short-circuiting.
- If original packaging is not available, effectively insulate battery terminals by placing tape over the contacts. Place each battery in its own protective case, plastic bag, or package. Do not permit a loose battery to come in contact with metal objects, such as coins, keys, or jewelry.
- Only charge batteries which you are sure are rechargeable! Non-rechargeable batteries are not designed for re-charging, and become hazards if they are placed in a battery charger. NEVER attempt to recharge a battery unless you know it is rechargeable.
- If you have already charged a non-rechargeable battery, do NOT bring such a battery on board an aircraft.
- Use only chargers designed for your type of batteries. If unsure about compatibility, contact the product manufacturer.
- Take steps to prevent crushing, puncturing, or putting a high degree of pressure on the battery, as this can cause an internal short-circuit, resulting in overheating.

For lithium batteries, determine the lithium content or equivalent lithium content. For a primary battery, contact the manufacturer. For a secondary battery, determine the approximate lithium content by using the relation that 8 g Equivalent Lithium Content = 100 watt-hours. You can determine the watt-hour rating for a battery by multiplying the voltage by the rated milli-amperes and dividing by 1000. For example, the lithium-ion battery in the Toshiba laptop this discussion is being written with is rated at 10.8 volts and 8400mAh. This corresponds to 90.7 watt-hours, or just under 8 g ELC. Under these rules, I could take this laptop on-board and as many spare batteries as I want. These can be placed in checked baggage, though the DOT recommends that you carry them on board with you. However, if you need to take a large capacity, external battery, such as the Bix BP 140 with you, you must take it as carry-on baggage. This battery has a 144 watt-hour rated capacity and is over the 8 g ELC limit. Your limit is 25 g ELC.

If you are traveling with several lithium batteries, I suggest that you download a copy of the Final Rule (see above) and carry it with you. The final paragraph of the rule (49 CFR 175.10(17)) is the portion of the rule which allows you to carry up to 25 g ELC on-board in your carry-on baggage. Be prepared to prove to TSA that you are fully compliant with this rule.

As a final note, the International Civil Aviation Organization is considering eliminating the exception to allow passengers and crew to carry on small and medium lithium batteries. If ICAO

does this, then the U.S. DOT must consider following suit and most likely will. The implication is that you should try to use other types of batteries, such as nickel metal hydride.

Summary:

The following table summarizes the battery rule. Remember, this only applies to lithium batteries.

Lithium Battery Rules		
Battery Description	In Checked Baggage	In Carry-on Baggage
Lithium Metal Battery installed in a device	Permitted <sup>1</sup>	Recommended <sup>1</sup>
Spare Lithium Metal Battery – not installed in a device, with no more than 2 grams lithium	<b>Forbidden</b>	Permitted in carry-on baggage <sup>2</sup>
Lithium Metal Battery, spare or installed, over 2 grams lithium	<b>Forbidden</b>	Forbidden
Lithium-ion battery installed in a device, up to 8 grams ELC	Permitted <sup>1</sup>	Recommended <sup>1</sup>
Lithium-ion battery – not installed in a device, up to 8 grams lithium ELC	<b>Forbidden</b>	Permitted in carry-on baggage <sup>2</sup>
High-capacity lithium battery, installed or spare with between 8 and 25 grams ELC lithium	Spare batteries are <b>Forbidden</b> Installed in a device is permitted <sup>1</sup>	Spare Batteries: Permitted <sup>2</sup> Installed Batteries: Permitted <sup>1</sup>
<ol style="list-style-type: none"> <li>1. It is preferred to bring battery-powered devices as carry-on. If checked, positively ensure that the switches will remain off (tape switches).</li> <li>2. Take protective measures to prevent short-circuits. Place tape over contacts and place each battery in its own zip-lock bag.</li> </ol>		