Understanding Lithium Shipping Regulations

Quality Battery Packs for Industrial Applications

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Shipping Lithium & Li-Ion batteries

- Two regulating authorities: U.S. Hazardous Materials Regulations (HMR) and its associated Code of Federal Regulations (CFR), and International Air Transport Association (IATA)
- All lithium/lithium ion cells and batteries are regulated as Class 9 “hazardous materials” or “dangerous goods” for shipping domestically & internationally
- There are exceptions to the HMR & IATA regulations for “small” lithium/li-ion batteries based on amount of lithium in these batteries
- Amount of lithium in li-ion batteries is determined by “equivalent lithium content”
- Equivalent lithium content: Calculated in grams on per-cell basis as 0.3 times the rated capacity of the cell in Ampere-hours times the number of cells per pack
Calculating Equivalent Lithium Content (for Li-ion)

**Example:**
- A lithium ion **cell** with rated capacity of 2.2Ah
- Applying conversion factor of 0.3, the cell has 0.66 grams (2.2 x 0.3 = 0.66) of equivalent lithium content
- A battery **pack** containing 9 of these cells contains 5.94 grams of equivalent lithium content (9 cells x 0.66 = 5.94g ELC)

$$2.2 \times 0.3 \times 9 = 5.94 \text{ grams of equivalent lithium content in 9-cell 2.2Ah pack}$$
Lithium/Li-Ion Battery Transportation Regulations Currently in Effect for Domestic Shipping

In HMR: 49 CFR Section 173.185

<table>
<thead>
<tr>
<th>Primary Cell / Battery Maximum Lithium Content</th>
<th>Lithium Ion &amp; Polymer Cell / Battery Maximum Lithium Content</th>
<th>Shipping Classification / Testing</th>
<th>Special Packaging / Markings</th>
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<tbody>
<tr>
<td>1.0 g / 2.0 g</td>
<td>1.5 g / 8.0 g (max = 12 cell 2.2Ah pack or 9 cell 2.4Ah pack)</td>
<td>Excepted</td>
<td>No</td>
</tr>
<tr>
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<td>Excepted / T1-T6</td>
<td>No</td>
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Grandfather Clause in IATA: Lithium / Lithium ion cell and battery designs previously exempted from testing & manufactured before January 1, 2003 do not require testing until January 1, 2005
**Proposed DOT change for Domestic Shipping of New* Products: Adoption of IATA (SP A45) regulations, estimated by Summer 2005**

Still under negotiation:

- Economic impact on small business with regard to testing costs was not considered in proposal
- May be able to piggy back testing of similar designs and/or similar cells
- Maximum equivalent lithium content

**Either way: International regulations are in effect; more stringent testing will be necessary!**

*Proposal says designs previously excepted & mfg’d prior to 1/1/03 have until 1/1/05*
UN Manual of Tests & Criteria “T” Tests
Required:

- T1 Altitude Simulation
- T2 Thermal Test
- T3 Vibration
- T4 Shock
- T5 External Short Circuit
- T6 Impact
- T7 Overcharge
- T8 Forced Discharge

In addition to the testing cost ($4k-$5k), each test requires several cells/packs to produce the test

Currently IATA only, but part of proposed rule
Cells and Batteries Required for UN “T” Tests

**T1 – T5**
- 20 primary cells and 8 primary batteries
- 20 rechargeable cells and 16 rechargeable batteries

**T6**
- 10 or 20 (prismatic) primary cells and 10 or 20 (prismatic) rechargeable cells

**T7**
- 8 rechargeable batteries

**T8**
- 10 primary cells and 20 rechargeable cells

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<th>Prismatic Cells</th>
<th>Battery Packs</th>
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<tr>
<td>Primary</td>
<td>40</td>
<td>50</td>
<td>8</td>
</tr>
<tr>
<td>Secondary</td>
<td>50</td>
<td>60</td>
<td>24</td>
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The “20%” Rule

Section 38.3.2 of the UN Manual of Tests and Criteria

• Used to determine “new” type of cell or battery that requires testing

• A change of more that 0.1 g or 20% by mass, whichever is greater, to the cathode, to the anode, or to the electrolyte; or

• A change that would materially affect the test results
Other Exceptions, Special Provisions, and Approvals For Prototypes

Special Provision DOT, IATA, ICAO

• Prototype lithium batteries and cells that are packed with not more than 24 cells or 12 batteries per packaging that have not been tested to the requirements may be transported if approved by the Associate Administrator

• Can be transported by ground or by cargo aircraft only (DOT)

• Must be packaged to meet the requirements of Packaging Group 1

• Each cell and battery must be individually packed in an inner packaging inside and outer packaging and surrounded be cushioning material that is non-combustible and non-conductive. Cells and batteries must be protected against short circuit
Contact Rose for further information

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