

Transportation of Li-ion batteries

Ruling Bodies

There are several organizations currently regulating the transportation and shipment of lithium-ion batteries. Although most published regulations currently only specify restrictions for primary (non-rechargeable) lithium-ion batteries, it should be noted that we anticipate these regulations to include secondary (rechargeable) lithium-ion batteries in the near future. These regulations can be found as part of the following:

International

- International Civil Aviation Organization (ICAO) – Technical Instructions (TI):
- International Air Transport Association (IATA) – Dangerous Goods Regulations:
http://www.iata.org/whatwedo/dangerous_goods
- International Maritime Dangerous Goods (IMDG) Code:
http://www.imo.org/Safety/mainframe.asp?topic_id=158

United States

- US Department of Transport (DOT), Research and Special Programs Administration (RSPA), Office of Hazardous Materials Safety: <http://hazmat.dot.gov/regs/intl/icao.htm>
- US Hazardous Materials Regulations, Code of Federal Regulations, Part 49 (49 CFR Sections 100–185)

Lithium-equivalence

Lithium ion and lithium polymer cells and batteries are deemed to have a lithium weight equivalence of 0.3 times the cell capacity in ampere hours; multiplied by the number of cells for a battery pack.

- An 18650 lithium-ion cell with a capacity of 2 ampere hours would have a lithium-equivalence of 0.6g.
- A typical laptop battery with 8 cells (2 4-cell series in parallel) would have a lithium-equivalence of 4.8g.

United Nations T1 – T8 Tests

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

Class 9 Hazardous Material

49 CFR 173.140 – Miscellaneous Hazardous Materials

A material which presents a hazard during transportation but which does not meet the definition of any other hazard class. This class includes:

- (a) Any material which has an anesthetic, noxious or other similar property which could cause extreme annoyance or discomfort to a flight member so as to prevent the correct performance of assigned duties;
or
- (b) Any material that meets the definition in 49 CFR 171.8 of this sub-chapter for an elevated temperature material, a hazardous substance, a hazardous waste, or a marine pollutant.

International Shipping Regulations (by lithium or lithium-equivalent weight)

<i>Primary Cell/Battery Max. Lithium Content</i>	<i>Lithium Ion & Polymer Cell/Battery Max. Lithium Content</i>	<i>Shipping Classification/Testing</i>	<i>Special Packaging/Markings</i>
1.0 g / 2.0 g	1.5 g / 8.0 g	Excepted / T1 – T8 ^(1, 2)	Yes ⁽⁴⁾
> 1.0 g / > 2.0 g	> 1.5 g / 8.0 g	Class 9 / T1 – T8 ^(2, 3)	Yes ⁽⁵⁾

- (1) As of January 1, 2005, all cells and batteries shipped by air must pass UN T1 – T8 tests.
- (2) Under the ICAO-TI, all cells and batteries failing the UN T1 – T8 Tests shipped from the US must secure an Approval from the US Department of Transport prior to shipment.
- (3) Must pass UN T1 – T8 Tests and be shipped as a Class 9 hazardous material.
- (4) Packages containing more than 12 batteries or 24 cells must meet packaging, marking and shipping requirements.
- (5) Class 9 markings, label, specification packaging and shipping papers are required.

US Shipping Regulations (by lithium or lithium-equivalent weight)

<i>Primary Cell/Battery Max. Lithium Content</i>	<i>Lithium Ion & Polymer Cell/Battery Max. Lithium Content</i>	<i>Shipping Classification/Testing</i>	<i>Special Packaging/Markings</i>
1.0 g / 2.0 g ⁽¹⁾	1.5 g / 8.0 g	Excepted ⁽²⁾	No ⁽²⁾
5.0 g / 25.0 g	5.0 g / 25.0 g	Excepted / T1 - T8 ⁽⁵⁾⁽⁶⁾⁽⁷⁾	No ⁽⁴⁾
> 5.0 g / > 25.0 g	> 5.0 g / > 25.0 g	Class 9 / T1 - T8 ⁽⁵⁾⁽⁶⁾⁽⁷⁾	Yes ⁽⁸⁾

- (1) This value applies to solid cathode cells and batteries. Liquid cathode cells and batteries may contain up to 0.5 g / 1.0 g of lithium.
- (2) Excepted from regulations. US Department of Transport Interim Final Rule December 15, 2004 states that certain marking requirements apply to excepted primary lithium cells and batteries.
- (3) If the cell / battery passes the UN T1 – T8 Tests, it is excepted from regulations.
- (4) If the cell / battery passes the UN T1 – T8 Tests, not Class 9 marking, Class 9 label, or specification packaging is required.
- (5) Must pass UN T1 – T8 tests and be shipped as a Class 9 hazardous material.
- (6) Cells and batteries that do not pass the UN T1 – T8 Tests may still be shipped upon securing Approval from the US Department of Transport.
- (7) 49 CFR 173.185(d): Except for transportation aboard passenger-carrying aircraft, cells and batteries and equipment containing cells and batteries that were first transported prior to January 1, 1995, and were assigned to Class 9 on the basis of the requirements of this sub-chapter in effect on October 1, 1993, may continue to be transported in accordance with the applicable requirements in effect on October 1, 1993.
- (8) Class 9 markings, label, specification packaging and shipping papers are required.