



Transportation Regulations for Lithium, Lithium Ion and Polymer Cells and Batteries

■ **Which organizations and regulations govern the transport of lithium, lithium ion and polymer cells and batteries?**

The international transportation of primary lithium (non-rechargeable) and rechargeable lithium ion (including polymer) cells and batteries is regulated by the International Civil Aviation Organization (ICAO) Technical Instructions and corresponding International Air Transport Association (IATA) Dangerous Goods Regulations, and the International Maritime Dangerous Goods (IMDG) Code. The transportation of lithium and lithium ion cells and batteries is regulated in the US in accordance with Part 49 of the Code of Federal Regulations, (49 CFR Sections 100-185) of the US Hazardous Materials Regulations (HMR). Section 173.185 provides specifications on exceptions and packaging for shipping based on details of weights, tests and classifications. The hazardous materials table in Section 172.101 also provides related shipping information. The Office of Hazardous Materials Safety, which is within the US Department of Transportation's (DOT) Research and Special Programs Administration (RSPA), is responsible for coordinating the transportation of hazardous materials (also known as dangerous goods) by air, rail, highway and water and drafting the regulations that govern such materials. These regulations are based on the UN Recommendations on the Transport of Dangerous Goods Model Regulations and the Manual of Tests and Criteria.

■ **What transportation regulations are currently in effect in the U.S.?**

Based on lithium weight (for primary cells and batteries) and equivalent lithium content* (for lithium ion cells and batteries), the following shipping regulations currently are in effect:

Primary Cell / Battery Max. Lithium Content	Lithium Ion & Polymer Cell / Battery Max. Lithium Content	Shipping Classification/Testing	Special Packaging/Markings
1.0 gram / 2.0 grams ⁽¹⁾	1.5 grams / 8.0 grams	Excepted ⁽²⁾	No
5.0 grams / 25 grams	5.0 grams / 25 grams	Excepted /T1-T6 ^(3, 4)	No ⁽³⁾
>5.0 grams / >25 grams	>5.0 grams / >25 grams	Class 9 /T1-T6 ^(4, 5)	Yes ⁽⁶⁾

- (1) Applies to cells and batteries with solid cathodes. The maximum lithium content for cells and batteries with liquid cathodes is 0.5 grams / 1.0 gram.
- (2) Excepted from regulations. (No testing, marking, specification packaging, or labeling required.)
- (3) Excepted from regulations only if pass the UN T1-T6 Tests.
- (4) Cells and batteries that fail to meet requirements of UN Tests can only be shipped if shipper secures an Approval from the US DOT. (See page 4 regarding Exemptions and Approvals for shipping and testing.)
- (5) Must pass UN T1-T6 Tests and be shipped as a Class 9 hazardous material.
- (6) Requires Class 9 markings, label, specification packaging, and shipping papers.

* Equivalent lithium content for lithium ion and lithium polymer cells and batteries in grams on a per cell basis is calculated as 0.3 times the rated capacity in ampere-hours. The equivalent lithium content for a battery or battery pack is the rated capacity in ampere-hours for a single cell multiplied by 0.3 and then multiplied by the number of cells in the battery.

■ **What international transportation regulations go into effect in 2003?**

New regulations that pertain to the transportation of all lithium and lithium ion cells and batteries are scheduled to become effective in 2003.

There are different effective dates for the regulations that apply to different modes of transportation. The new regulations require battery and cell manufacturers or companies that ship equipment packed with or containing these cells and batteries to meet new testing, marking, packaging, labeling and shipping paper specifications. These new regulations are incorporated into the ICAO Technical Instructions (2003-2004 Edition) and IATA Dangerous Goods Regulations (44th Edition) with an effective date of January 1, 2003; the IMDG Code (2002 Edition) with an effective date of January 1, 2004; and the US HMR pursuant to a final rule not yet issued by RSPA but with an anticipated effective date of October 1, 2003, with a one year transition period to October 1, 2004.

Based on lithium content (for primary cells and batteries) and equivalent lithium content (for lithium ion cells and batteries), the following new shipping regulations will apply pursuant to the dates noted above:

Primary Cell / Battery Max. Lithium Content	Lithium Ion & Polymer Cell / Battery Max. Lithium Content	Shipping Classification/Testing	Special Packaging/Markings
1.0 gram / 2.0 grams	1.5 grams / 8.0 grams	Excepted / T1-T8 ^(1, 2, 3)	Yes ⁽⁴⁾
>1.0 gram / >2.0 grams	>1.5 grams / >8.0 grams	Class 9 / T1-T8 ^(3, 5)	Yes ⁽⁶⁾

- (1) Cell and battery design types manufactured prior to January 1, 2003 are excepted from T1-T8 testing through December 31, 2004.
- (2) Starting January 1, 2005 all cells and batteries must be tested. Cells and batteries that pass UN Tests are excepted from regulation.
- (3) If shipping from the U.S. under the ICAO Technical Instructions (2003-2004 Edition) and cells or batteries fail to pass the required UN Tests, shipper must secure an Approval from the U.S. DOT prior to offering products for shipment. (See page 4 regarding Exemptions and Approvals for shipping and testing.)
- (4) Packages containing more than 12 batteries or 24 cells must meet new packaging, marking, and shipping paper requirements.
- (5) Must pass UN T1-T8 Tests and be shipped as a Class 9 hazardous material.
- (6) Requires Class 9 markings, label, specification packaging, and shipping papers.

■ **What are the UN “T” tests required by the UN regulatory scheme?**

The UN Manual of Tests and Criteria, Part III, Subsection 38.3, establishes the UN T1-T8 Tests that are listed below. The effective dates of the new testing requirements for different modes of transportation are referenced above. These tests only have to be performed once for each cell and battery of a given design, and must be completed prior to shipment. Lithium cells or batteries, which differ from a tested type by:

- (a) A change of more than 0.1 g or 20% by mass, whichever is greater, to the cathode, to the anode, or to the electrolyte; or
- (b) A change that would materially affect the test results,

shall be considered a new design type and shall be subjected to the required tests. Cells and batteries of identical design only have to be tested one time, even if they are manufactured in and shipped from multiple locations.

The following tests must be performed on all primary lithium, rechargeable lithium ion and lithium polymer cells and batteries. Each cell and battery type must be subjected to tests 1 to 8. Tests 1 to 5 must be conducted in sequence on the same cells or batteries. Tests 6 and 8 should be conducted using not otherwise tested cells or batteries. Test 7 may be conducted using undamaged batteries previously used in Tests 1 to 5 for purposed of testing on cycled batteries.

Test T1: Altitude Simulation – Simulates air transport under low-pressure conditions. Store at pressure of 11.6 kPa or less for at least six hours at 20° ±5°C.

Test T2: Thermal Test – Assesses cell and battery seal integrity and internal electrical connections using thermal cycling to simulate rapid and extreme temperature changes. Perform 10 cycles between 75° ±2°C and -40° ±2°C, six hours per cycle with no more than 30 minutes between cycles, and then observe for 24 hours at 20° ±5°C.

Test T3: Vibration – Simulates vibration during transport. Perform sinusoidal waveform with a logarithmic sweep between 7 Hz and 200 Hz and back to 7 Hz traversed in 15 minutes. This cycle shall be repeated 12 times for a total of three hours for each of three mutually perpendicular mounting positions of the cell or battery. One of the directions of vibration must be perpendicular to the terminal face.

Test T4: Shock – Simulates possible impacts during transport. Half-sine shock of peak acceleration of 150 g_n and pulse duration of six milliseconds (large cells and batteries: 50 g_n / 11 milliseconds). Each cell or battery shall be subjected to three shocks in the positive direction and three shocks in the negative direction of three mutually perpendicular mounting positions of the cell or battery for a total of 18 shocks.

Test T5: External Short Circuit – Simulates an external short circuit. After stabilizing at 55° ±2°C, apply an external resistance of less than 0.1 ohm for one hour and then observe for six hours.

Test T6: Impact – Simulates an impact. Place a 15.8 mm diameter bar across the center of the sample and then drop a 9.1 kg mass from a height of 61 ±2.5 cm on to the bar, and then observe for six hours.

Test T7: Overcharge – Evaluates the ability of a rechargeable battery to withstand overcharge. Charge at twice the manufacturer’s recommended maximum continuous charge current for 24 hours at ambient temperature, and then observe for seven days.

Test T8: Forced Discharge – Evaluates the ability of a primary or rechargeable cell to withstand forced discharge. Force discharge at ambient temperature at an initial current equal to the maximum discharge current specified by the manufacturer, and then observe for seven days.

■ **How many primary and rechargeable cells or batteries are required for testing, and which tests are performed for each?**

T-Tests	Primary Cells	Primary Batteries	Rechargeable Cells	Rechargeable Batteries
T1 – T5	20	8	20	16
T6	10	—	10 or 20 ⁽¹⁾	—
T7	—	—	—	8
T8	10	—	20	—
Total	40	8	50 or 60	24

(1) 20 = prismatic cells

■ **Where can I obtain a copy of the complete UN testing requirements?**

You can obtain a copy of the test requirements portion of the UN Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria, from Ultralife’s web site at:

http://www.ultralifebatteries.com/whitepapers/Amend_UN_Tests_and_Criteria_ST-SG-AC.10-27_Add.2.pdf.

■ **If my cells or batteries must be tested prior to shipping, how am I supposed to ship these products to a testing facility without violating the hazardous materials regulations?**

Under 49 CFR 173.185(j) of the US HMR, when not contained in equipment, cells and batteries shipped for testing purposes may be shipped only by highway and as Class 9 hazardous materials.

■ **Has the testing deadline been extended for small cells and batteries?**

As noted above, lithium cells not exceeding 1 gram and batteries not exceeding 2 grams of lithium metal, and lithium ion cells not exceeding 1.5 grams and batteries not exceeding 8 grams of equivalent lithium content that were designed and manufactured prior to January 1, 2003, are excepted from the UN T1-T8 testing requirements until December 31, 2004 if shipped internationally *by air* or in the U.S. by any mode of transportation. The European road regulations (ADR) provide an exception from testing for small cells and batteries until June 30, 2003. The IMDG Code provides an exception from testing for small cells and batteries until January 1, 2004. After these dates **all** lithium and lithium ion cells and batteries, regardless of their lithium weight, must be tested prior to shipment.

■ **What does Class 9 mean?**

Class 9 is one of nine hazardous materials shipping classifications defined by the US HMR and other transportation regulations. Class 9 defines the specification packaging, markings, labeling, and shipping paper requirements for miscellaneous hazardous materials, which include lithium and lithium ion cells and batteries, among other materials. See **Exhibit A** for packaging, marking, labeling, and shipping paper requirements. Additional information on shipping hazardous materials can be found on the US DOT website at: <http://www.dot.gov> or at IATA's web site at: <http://www1.iata.org/dangerousgoods/index>.

■ **What are the new Class 9 shipping requirements for cells and batteries that exceed a certain lithium content?**

There is another important regulatory change pertaining to larger lithium and lithium ion cells and batteries and Class 9 hazardous materials. The following cells and batteries must pass the new UN Tests **and** be shipped as Class 9 hazardous materials pursuant to the effective dates for different modes of transportation noted earlier:

- A lithium metal or lithium alloy cell with a lithium content of more than 1.0 gram
- A lithium metal or lithium alloy battery with an aggregate lithium content of more than 2 grams
- A lithium ion cell with an equivalent lithium content of more than 1.5 grams
- A lithium ion battery with an aggregate equivalent lithium content of more than 8 grams

■ **Are there any new marking and packaging requirements for excepted cells and batteries?**

Yes. Pursuant to the effective dates for different modes of transportation noted earlier, packages containing more than 24 lithium or lithium ion cells or 12 lithium or lithium ion batteries, including batteries packed with equipment, must:

- Be marked to indicate that they contain lithium or lithium ion cells or batteries and that special procedures should be followed in the event that the package is damaged;
- Be capable of withstanding a 1.2 meter (3.9 ft.) drop test in any orientation without damage to cells or batteries contained in the package, without shifting of the contents that would allow short circuiting and without release of package contents; and
- Not exceed 30 kg (66.1 lbs.) gross mass. (The 30 kg limit does not apply to batteries packed with equipment.)

■ **How do the regulations apply to Class 9 lithium or lithium ion cells and batteries packed with or contained in equipment?**

If cells or batteries that are classified as Class 9 are packed with or contained in equipment the equipment also must be shipped as Class 9 hazardous material.

■ **What regulations apply to the shipment of discharged lithium cells and batteries?**

Except when shipped for disposal, the US HMR prohibits the shipping of any cell that has been discharged to the extent that the open circuit voltage is less than two volts or is less than 2/3rd of the voltage of the fully charged cell, whichever is less. It is Ultralife Batteries' policy to ship discharged or depleted lithium cells and batteries by ground only.

■ **Are there any training requirements for employees of companies that ship lithium cells and batteries?**

Yes. In the US, employees involved in the packaging or shipment of Class 9 lithium or lithium ion cells and batteries must complete a "49 CFR" certified hazardous materials training course. Employees must renew their certification training every three years. It is strongly recommended that employees also complete an "IATA training" course.

■ **Can exemptions to the shipping regulations be requested?**

Yes. Exemptions to the regulations for a specific cell or battery type should be requested from the countries of origin and destination, and cleared with the carrier. An "Approval" from the U.S. DOT serves a similar purpose. Sufficient product information must be provided in the request and should include cell and battery lithium content, any safety test data available, and the application in which the cells or batteries will be used. If granted, an Approval can take from 12 to 16 weeks to secure from the DOT. Approvals are transferable, so if a cell or battery manufacturer obtains an Approval it may be transferred to their customer(s) who would receive and subsequently re-ship the product. Note: Under 49 CFR 173.185(j) of the US HMR, when not contained in equipment, cells and batteries shipped for testing purposes may be shipped only by highway and as Class 9 hazardous materials. The cells or batteries must be individually packed in an inner packaging, surrounded by cushioning material that is non-combustible and nonconductive.

■ **Do batteries that are manufactured by battery assembly companies have to be tested even if they use cells that have already been tested by the cell manufacturer?**

Yes. Unless shipped with DOT approval, tests must be performed by the battery assembly company any time a battery design is created, or changed in a manner that would materially affect the test results. Cells and batteries of identical design only have to be tested one time, even if they are manufactured in and shipped from multiple locations. Assembly company employees involved in the packaging or shipment of Class 9 batteries must complete a certified hazardous materials shipping training course.

■ **Do the shipping regulations apply to any company that ships batteries, even if they are not the original cell or battery pack manufacturer?**

All Ultralife OEM customers, distributors, battery assemblers, etc., are responsible for adhering to the packaging and marking requirements when re-shipping cells or batteries, and must ensure that the proper packaging and labeling is used when using packaging or labels other than the original materials in which the product was received. All Ultralife OEM customers, distributors and battery assemblers are responsible for obtaining new UN testing if they combine, reconfigure or assemble cells or batteries such that they differ from the original tested version (e.g., building cells into a battery pack). As previously described, new tests must be performed on a cell or battery if the cell or battery differ from the original tested type by:

- (a) A change of more than 0.1 g or 20% by mass, whichever is greater, to the cathode, to the anode, or to the electrolyte; or
- (b) A change that would materially affect the test results.

■ **Are there any fines if shipping regulations are violated?**

Yes! Each violation of the US DOT HMR is subject to a fine of up to \$27,500. Fines are additive and multiple fines may be imposed for a single shipment of cells or batteries that may have a combination of testing, packaging, labeling or other violations, and can surpass \$150,000 per package.

■ **Are there any carry-on provisions in the regulations that enable passengers to carry electronic devices containing lithium or lithium ion batteries or spare batteries on to airplanes?**

Yes. There are provisions in the ICAO Technical Instructions and US HMR that enable passengers to carry on consumer electronic devices (watches, calculators, cameras, cellular phones, laptop computers, PDA's, games, camcorders, etc.) that utilize lithium batteries containing less than 2 grams of lithium or lithium ion batteries containing less than 8 grams of equivalent lithium content. These provisions also allow an unlimited number of spare batteries that contain less than these quantities (2 grams / 8 grams).

Passengers can also carry no more than two spare lithium ion batteries that contain between 8 and 25 grams of equivalent lithium content. Passengers are prohibited from carrying on lithium batteries containing more than 2 grams of lithium and lithium ion batteries containing more than 25 grams of equivalent lithium content.

All spare batteries must be individually protected so as to prevent short circuits and carried in carry-on baggage only.

■ **Where can I find information on the transportation regulations that apply to Ultralife's lithium, lithium ion and polymer cells and batteries?**

You can obtain a list of Ultralife's cells and batteries, which includes lithium weights and transportation classifications, from Ultralife's web site at:

http://www.ulbi.com/whitepapers/Ultralife_Battery_Lithium_Weights_and_Transportation_Classifications.pdf.

■ **Who can I contact if I have more questions about battery transportation?**

Please contact Ultralife Batteries, Inc. for answers to questions regarding the transportation of Ultralife lithium, lithium ion or polymer cells and batteries at: 800-332-5000 (US & Canada); 315-332-7100; or 44-1235-542600 (Europe); or visit Ultralife's web site at: <http://www.ultralifebatteries.com>.

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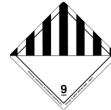
Exhibit A - Packaging, Marking, Labeling, and Shipping Paper Requirements for Class 9 Lithium and Lithium ion Cells and Batteries

- 1. PACKAGING** - Use only packaging that meets “Packing Group II” performance standards. Refer to the appropriate hazardous materials transportation regulations for the list of approved Packing Group II packaging and Performance - Oriented Packaging Standards.
 - ⇒ Packages must not exceed 5 kg (gross weight) for passenger aircraft
 - ⇒ Packages must not exceed 35 kg (gross weight) for cargo aircraft
- 2. MARKING** – The following markings must be applied to the packaging:
 - ⇒ Shipping name: *Lithium batteries*
 - ⇒ Identification number: *UN 3090* (or *UN 3091* for lithium batteries packed with or contained in equipment)
 - ⇒ Shippers name and address
 - ⇒ Name and address of company or individual receiving batteries (also known as the “consignee”)

NOTE: Effective January 1, 2004, the following “Air Eligibility Marking” also will be required on Class 9 packages shipped by air:



- 3. LABELING** – The following Class 9 label must be used:



- 4. SHIPPING PAPERS** (*Bill of Lading*) – The following information must be included on shipping papers:
 - ⇒ Proper shipping name, hazard class, identification number, and packing group in the following order (*Example: Lithium batteries, 9, UN 3090, PG II*)
(*Example: Lithium batteries contained in equipment, 9, UN 3091, PG II*)
 - ⇒ Number of packages
 - ⇒ Weight
 - ⇒ Page number and total number of pages (*Example: Page 1 of 2 Pages*)
 - ⇒ Emergency telephone number (Ultralife uses Chemtrec in the US: 1-800-424-9300)
 - ⇒ Shipper’s certification (*Example: This is to certify that the above-named materials are properly classified, described, packaged, marked, and labeled, and are in proper condition for transportation (by air, if applicable) according to the applicable international and national governmental regulations.*)
 - ⇒ Signature of shipper

NOTE: If SHIPPING BY AIR, the following additional information is required for hazardous materials:

- ⇒ Air Waybill Number
- ⇒ Indication of whether “Passenger and Cargo Aircraft” or “Cargo Aircraft Only”
- ⇒ Airport of Departure
- ⇒ Airport of Destination
- ⇒ Shipment Type: Non-radioactive or radioactive
- ⇒ Type of package (*Example: Fiberboard box*)
- ⇒ Place and date of signing of shippers certification

