

Transportation Regulations for Lithium Metal and Lithium-Ion Cells and Batteries

- **Which organizations and regulations govern the transport of lithium metal and lithium-ion cells and batteries?**

The regulations that govern the transport of primary lithium (metal) and rechargeable lithium-ion (including lithium-ion polymer) cells and batteries include 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. In addition, lithium and lithium-ion cells and batteries are regulated in the U.S. in accordance with Part 49 of the Code of Federal Regulations, (49 CFR Sections 100-185) of the U.S. Hazardous Materials Regulations (HMR). Section 173.185 and the Special Provisions contained in Section 172.102 provide information on the 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 U.S. Department of Transportation's (DOT) Pipeline and Hazardous Materials Safety Administration (PHMSA), is responsible for writing the U.S. regulations that govern 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 UN Manual of Tests and Criteria.

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

On August 6, 2014, the U.S. DOT Pipeline and Hazardous Materials Safety Administration (PHMSA) published significant revisions to the US transportation regulations for lithium batteries. These revisions harmonize the US regulations with many aspects of the international transportation regulations. The transportation regulations are based on the mass of lithium in the anode of a lithium metal (primary) cell or battery or Watt-hour (Wh) rating of a lithium-ion cell or battery; and are outlined in the chart below. Compliance with the amended regulations is mandatory by February 6, 2015.

Transport by Highway, Rail and Vessel (U.S. Domestic)

Primary Cell/Battery Max. Li Content	Li-ion Cell/Battery Max. Watt-hours	Shipping Classification/ Testing	Maximum Package Weight	Special Packaging/ Markings
1.0 g / 2.0 g	20 Wh / 100 Wh	Excepted / T1-T8 ⁽¹⁾	30 kg (Primary/Li-ion)	Yes
>1.0 g / >2.0 g	>20 Wh / >100 Wh	Class 9 / T1-T8 ⁽²⁾⁽⁴⁾	None	Yes ⁽³⁾
5.0 g / 25 g	60 Wh / 300 Wh	Excepted / T1-T8 ⁽²⁾⁽⁴⁾	30 kg (Primary/Li-ion)	Yes ⁽³⁾

- (1) All cells and batteries must pass UN T1-T8 Tests.
- (2) Cells and batteries must pass UN T1-T8 Tests and must be shipped as Class 9 hazardous materials unless transported by motor vehicle or rail car within the domestic US only. See pages 9 & 10.
- (3) Requires Class 9 markings, label, specification packaging, and shipping papers unless transported by motor vehicle or rail car within the domestic US only. See pages 9 & 10.
- (4) 49 CFR 173.185(a)(1)(i) allows for a cell or battery that is of a type tested pursuant to the UN Manual of Tests and Criteria, Revision 3, Amendment 1 or any subsequent revision applicable at the time of testing, need not be retested.

Transport by Air (U.S. Domestic)

Primary Cell/Battery Max. Li Content	Li-ion Cell/Battery Max. Watt-hours	Shipping Classification/ Testing	Maximum Package Weight	Special Packaging/ Markings
0.3 g / 0.3 g	2.7 Wh / 2.7 Wh	Excepted / T1-T8 ⁽¹⁾	2.5 kg (Primary, Air) 2.5 kg (Li-ion, Air)	Yes
1.0 g ⁽⁵⁾ / 2.0 g ⁽⁶⁾	20 Wh ⁽⁵⁾ / 100 Wh ⁽⁶⁾	Class 9 (Air) / T1-T8 ⁽²⁾	2.5 kg (Primary, Air) 10 kg (Li-ion, Air)	Yes ⁽³⁾
>1.0 g / >2.0 g	>20 Wh / >100 Wh	Class 9 / T1-T8 ⁽²⁾	35 kg (Primary, Air) 35 kg (Li-ion, Air)	Yes ⁽⁴⁾

- (1) Cells and batteries must pass UN T1-T8 Tests.
- (2) Cells and batteries must pass UN T1-T8 Tests and be shipped as Class 9 hazardous materials.
- (3) Air shipment requires Class 9 markings, label and modified shipping papers.
- (4) Requires Class 9 markings, label, specification packaging, and shipping papers.
- (5) Maximum of eight (8) cells per package when transported by air.
- (6) Maximum of two (2) batteries per package, when transported by air.

▪ What international transportation regulations currently are in effect?

International transportation regulations require lithium cell and battery manufacturers or companies that ship equipment packed with or containing these cells and batteries, to meet UN testing, marking, packaging, labeling and shipping paper specifications. These regulations are incorporated into the ICAO Technical Instructions, IATA Dangerous Goods Regulations and IMDG Code.

The transportation regulations are based on the mass of lithium in the anode of a lithium metal (primary) cell or battery or Watt-hour (Wh) rating of a lithium-ion cell or battery; and are outlined in the chart below.

Primary Cell/Battery Max. Li Content	Li-ion Cell/Battery Max. Watt-hours	Shipping Classification/ Testing	Maximum Package Weight	Special Packaging/ Markings
0.3 g / 0.3 g	2.7 Wh / 2.7 Wh	Excepted / T1-T8 ⁽¹⁾	2.5 kg (Primary, Air) 2.5 kg (Li-ion, Air)	Yes
1.0 g ⁽⁵⁾ / 2.0 g ⁽⁶⁾	20 Wh ⁽⁵⁾ / 100 Wh ⁽⁶⁾	Excepted / T1-T8 ⁽¹⁾ Class 9 (Air) / T1-T8 ⁽²⁾	2.5 kg (Primary, Air) 10 kg (Li-ion, Air) 30 kg (Both, Ground) 30 kg (Both, Ocean)	Yes ⁽³⁾
>1.0 g / >2.0 g	>20 Wh / >100 Wh	Class 9 / T1-T8 ⁽²⁾	35 kg (Primary, Air) 35 kg (Li-ion, Air)	Yes ⁽⁴⁾

- (1) Cells and batteries must pass UN T1-T8 Tests. Cells and batteries that pass UN Tests are excepted from regulation. NOTE: The IMDG Code contains a grandfather clause for testing "small" cells and batteries until December 31, 2013.
- (2) Cells and batteries must pass UN T1-T8 Tests and be shipped as Class 9 hazardous materials.
- (3) Air shipment requires Class 9 markings, label and modified shipping papers.
- (4) Requires Class 9 markings, label, specification packaging, and shipping papers.
- (5) Maximum of eight (8) cells per package when transported by air.
- (6) Maximum of two (2) batteries per package, when transported by air.

▪ **How are Watt-hours calculated for lithium-ion cells and batteries?**

Multiply a cell or battery's rated capacity, in ampere-hours, by its nominal operating voltage.

How is equivalent lithium content calculated for lithium-ion cells and batteries?

With the regulatory revisions published on August 6, 2014 by the U.S. DOT Pipeline and Hazardous Materials Safety Administration (PHMSA), the concept of equivalent lithium content has been formally removed from regular use. The basis for the calculation is provided below for reference only.

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 UN numbers and proper shipping names apply to lithium cells and batteries?**

The table below outlines the UN numbers and proper shipping names which have been established for shipments of lithium cells and batteries. Under the regulatory revisions published on August 6, 2014 by the U.S. DOT Pipeline and Hazardous Materials Safety Administration (PHMSA), the use of these UN numbers and proper shipping names has been formally accepted for domestic shipments in the U.S. and to Canada.

Proper Shipping Name	UN Number
Lithium-ion batteries	UN 3480
Lithium-ion batteries packed with equipment	UN 3481
Lithium-ion batteries contained in equipment	UN 3481
Lithium metal batteries	UN 3090
Lithium metal batteries packed with equipment	UN 3091
Lithium metal batteries contained in equipment	UN 3091

▪ **The U.S. DOT prohibits the transport of primary lithium (metal) cells and batteries as cargo by passenger aircraft into, out of, or within the United States. What are the implications on shipments of primary lithium (metal) cells and batteries?**

The U.S. DOT prohibits the offering for transportation and transportation of primary lithium (metal) cells and batteries as cargo aboard passenger-carrying aircraft into, out of, or within the United States. However, primary lithium (metal) cells with no more than 1 g of lithium content and batteries with an aggregate lithium content of no more than 2 g THAT ARE PACKED WITH OR CONTAINED IN EQUIPMENT are not subject to this prohibition provided the net weight of the batteries in each package does not exceed 5 kg (11 lbs.) and the package contains no more than the number of lithium metal cells or batteries necessary to power the piece of equipment, plus two spares.

The regulatory revisions published on August 6, 2014, by the U.S. DOT Pipeline and Hazardous Materials Safety Administration (PHMSA) are now more generally consistent with Packing Instructions 968-970 (for lithium metal batteries) in the ICAO Technical Instructions and IATA Dangerous Goods Regulations. The international regulations include the following State Variations, specific to U.S. cargo air shipments:

- The following statement (marking) must be placed on packages containing **only** primary lithium (metal) cells with no more than 1 g of lithium content and batteries with an aggregate lithium content of no more than 2 g, that do not exceed the quantity limits (per package) shown in the U.S. regulations: "LITHIUM METAL BATTERIES - FORBIDDEN FOR TRANSPORT ABOARD PASSENGER AIRCRAFT." or "PRIMARY LITHIUM BATTERIES - FORBIDDEN FOR TRANSPORT ABOARD PASSENGER AIRCRAFT." The marking must be on a background of contrasting color in letters at least 6 mm (0.25 inch) on packages having a gross mass of 30 kg (66 lbs) or less, except that smaller font may be used as necessary to fit package dimensions.
- Packages containing primary lithium (metal) cells with more than 1 g of lithium content and batteries with an aggregate lithium content of more than 2 g, that exceed the quantity limits (per package) shown in the U.S. regulations must contain the "Cargo Aircraft Only" label. See example below.



▪ **What U.S. Postal Service transportation regulations are in effect?**

The U.S. Postal Service (USPS) standards identify all small consumer-type lithium batteries as mailable when properly packaged and labeled.

Small consumer-type primary lithium (metal) cells or batteries (lithium metal or lithium alloy) like those used to power cameras and flashlights are mailable with the following restrictions. Each cell must contain no more than 1.0 g of lithium content per cell. Each battery must contain no more than 2.0 g aggregate lithium content per battery. Additionally, each cell or battery must meet the requirements of each test in the *UN Manual of Tests and Criteria*, Part III, and subsection 38.3 as referenced in DOT'S hazardous materials regulation at 49 CFR 171.7. All primary lithium (metal) cells and batteries must be mailed within a firmly sealed package; the package must be strong enough to prevent crushing of the package or exposure of the contents during normal handling in the mail. All outer packages must have a complete delivery and return address.

Small primary lithium (metal) cells and batteries are mailable as follows:

- (a) Via surface transportation when the cells or batteries (not packed with or installed in equipment) are "in the originally sealed packaging." Cells or batteries must be separated and cushioned to prevent short circuit, movement or damage. They are forbidden aboard passenger aircraft. The outside of the package must be marked on the address side, "Surface Mail Only, Primary Lithium Batteries - Forbidden for Transportation Aboard Passenger Aircraft." The mail piece must not exceed five (5) pounds.

Marking for use on packages containing small primary lithium (metal) cells and batteries:

**SURFACE MAIL ONLY,
PRIMARY LITHIUM BATTERIES -
FORBIDDEN FOR TRANSPORT
ABOARD PASSENGER AIRCRAFT**

- (b) Via surface or air transportation when the cells or batteries are properly installed in the equipment they operate and the mail piece has no more than the number of batteries needed to operate the device. Cells or batteries properly installed in the device they operate must be protected from damage and short circuit, and the device must be equipped with an effective means of preventing accidental activation. The equipment must be cushioned to prevent movement or damage. The mail piece must not exceed 11 pounds.
- (c) Via surface or domestic (only) air transportation when the cells or batteries are properly packed with the equipment they operate and the mail piece has no more than the number of batteries needed to operate the device. Cells or batteries must be packaged separately and cushioned to prevent movement or damage. The outside of the package must be marked on the address side "Package Contains Primary Lithium Batteries." The mail piece must not exceed 11 pounds.

Marking for use on packages containing small primary lithium (metal) cells and batteries packed with equipment:

**PACKAGE CONTAINS
PRIMARY LITHIUM BATTERIES**

Small consumer-type rechargeable lithium-ion cells and batteries like those used to power cell phones and laptop computers are mailable with the following restrictions. Each cell must not exceed a Watt-hr rating of 20 Wh. Each battery must not exceed a Watt-hr rating of 100 Wh. Additionally, each cell or battery must meet the requirements of each test in the *UN Manual of Tests and Criteria*, Part III, and subsection 38.3 as referenced in the DOT's hazardous materials regulation at 49 CFR 171.7. All secondary lithium-ion cells and batteries must be mailed within a firmly sealed package; the package must be strong enough to prevent crushing of the package or exposure of the contents during normal handling in the mail. All outer packages must have a complete delivery and return address.

Small lithium-ion cells and batteries are mailable as follows:

- (a) Via surface or domestic (only) air transportation individual cells or batteries (not packed with or installed in equipment) must be mailed in "the originally sealed packaging" with no more than three (3) batteries per package. Cells or batteries must be separated and cushioned to prevent short circuit, movement or damage. The outside of the package must be marked on the address side, "Package Contains Lithium-ion Batteries (no lithium metal)."

- (b) Via surface or domestic (only) air transportation when individual cells or batteries are mailed with (but not installed in) the equipment they operate and the mail piece has no more than the number of batteries needed to operate the device; up to a maximum of three (3) batteries. Cells or batteries must be packaged separately and cushioned to prevent movement or damage. The outside of the package must be marked on the address side, "Package Contains Lithium-ion Batteries (no lithium metal)."

Marking for use on packages containing small lithium-ion cells and batteries, including cells or batteries packed with (but not installed in) equipment:

**PACKAGE CONTAINS LITHIUM-ION
BATTERIES (NO LITHIUM METAL)**

- (c) Via surface or air transportation when individual cells or batteries are properly installed in the equipment they operate. Cells or batteries properly installed in the device they operate must be protected from damage and short circuit, and the device must be equipped with an effective means of preventing accidental activation. The equipment must be cushioned to prevent movement or damage.

USPS LITHIUM BATTERY MAILABILITY CHART (for small, consumer-type batteries)

Primary Lithium Batteries	Surface transportation	Domestic air transportation	Mail piece weight limit	International APO/FPO/DPO
Without the equipment they operate (individual batteries)	Mailable	Prohibited on passenger aircraft	5 lb.	Prohibited
Packed with equipment but not installed in equipment	Mailable	Mailable	11 lb.	Prohibited
Contained in (properly installed in equipment)	Mailable	Mailable	11 lb.	Mailable

Note 1: Each primary cell must not contain more than 1 g lithium content.

Note 2: Each primary battery must not contain more than 2 g lithium content.

Secondary Lithium-ion Batteries	Surface transportation	Domestic air transportation	Mailpiece battery limit	International APO/FPO/DPO
Without the equipment they operate (individual batteries)	Mailable	Mailable	No more than three (3) batteries	Prohibited
Packed with equipment but not installed in equipment	Mailable	Mailable	No more than three (3) batteries	Prohibited
Contained in (properly installed in equipment)	Mailable	Mailable	No more than three (3) batteries	Mailable

Note 3: Each secondary cell must not contain more than 20 Wh (Watt-hour rating) per cell.

Note 4: Each secondary battery must not exceed 100 Wh per battery.

▪ **What are the UN "T" tests required by the UN regulator scheme?**

The UN Manual of Tests and Criteria, Fifth Revised Edition with amendment 1 (2011), contains the UN T1-T8 Tests that are listed below. 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) For primary cells and batteries, 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;
- (b) For rechargeable cells and batteries, a change in nominal energy in Watt-hours of more than 20% or an increase in nominal voltage of more than 20%; or
- (c) A change that would lead to a failure of any of the tests,

shall be considered a new design type and shall be subjected to the required tests. In the event that a cell or battery does not meet one or more of the test requirements, steps must be taken to correct the deficiency or deficiencies that caused the failure before such a cell or battery type is retested.

The following tests must be performed on all primary lithium (metal), rechargeable lithium-ion and lithium-ion polymer cells or batteries that are less than 12Kg. See table below to determine quantities required for testing.

Test T1: Altitude Simulation - Simulates air transport under low-pressure conditions. Store at 11.6 kPa or less for six (6) hours at 20°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 ten (10) cycles between 72°C and -40°C, six (6) hours per cycle with no more than 30 minutes between cycles, and then observe for 24 hours.

Test T3: Vibration - Simulates vibration during transport. Sinusoidal waveform with a logarithmic sweep between 7 Hz and 200 Hz and back to 7 Hz in 15 minutes. This cycle must be repeated 12 times for a total of three (3) hours for each of three (3) mutually perpendicular mounting positions of the cell or battery.

Test T4: Shock - Simulates possible impacts during transport. Half-sine shock of peak acceleration with three (3) shocks in the positive direction, followed by three (3) shocks in the negative direction for a total of 18 shocks.

Test T5: External Short Circuit - Simulated an external short circuit. After stabilizing at 55°C, apply an external resistance of less than 0.1 ohm for one (1) hour past the battery case temperature returning to 55C and then observe for six (6) hours.

Test T6: Impact - Simulates an impact. Place a 15.8 mm diameter bar across the sample and then drop a 9.1 kg mass from a height of 61 cm on to the bar, and then observe for six (6) hours. Note: Cells that are of prismatic, pouch, coin/button in nature or is a cylindrical cell less than 20mm in diameter, will be subjected to a crush test in place of the impact test.

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, and then observe for seven (7) days.

Test T8: Forced Discharge - Evaluates the ability of a primary or a rechargeable cell to withstand forced discharge. Force discharge at an initial current equal to the maximum discharge current specified by the manufacturer, and then observe for seven (7) days.

Note: Batteries larger than 12KG will need to go through modified version of this testing with adjusted quantities. Contact Ultralife for specific details.

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

Tests are performed sequentially on the same group of cells or batteries as shown below:

T-Tests	Primary Cells	Primary Batteries	Rechargeable Cells	Rechargeable Batteries
T1 - T5	20	8	10	8 ⁽²⁾ /4 ⁽²⁾
T6	10	---	5 or 10 ⁽¹⁾	---
T7	---	---	---	8 ⁽²⁾ /4 ⁽²⁾
T8	10	---	20	---
Total	40	8	35 or 50	16 or 8

(1) 10 = prismatic cells

(2) 8 small batteries, 4 large batteries

Additional guidelines are outlined in the UN Manual of Tests and Criteria for larger battery assemblies.

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?

The regulatory revisions published on August 6, 2014, by the U.S. DOT Pipeline and Hazardous Materials Safety Administration (PHMSA) have modified the requirements outlined under 49 CFR 173.185(e) for cells and batteries shipped for testing purposes. Stringent packaging requirements apply to this situation and outer packaging must comply with Packing Group I requirements (vs. Packing Group II used for fully-regulated lithium battery shipments). The changes alleviate the need to secure separate "competent authority approval" for U.S. domestic shipments by highway, rail and vessel.

In addition, the revised 49 CFR 173.185(e) regulations and Special Provision A88 in the ICAO Technical Instructions and IATA Dangerous Goods Regulations contain provisions that authorize shipments by cargo aircraft (only) of prototype cells and batteries. However, shippers who want to offer prototype cells and batteries by cargo air transport must first secure a "competent authority approval" from the appropriate transportation agency in the country of origin. In the U.S., shippers must apply for this approval with the U.S. Department of Transportation's Pipeline and Hazardous Materials Safety Administration (PHMSA).

Shippers of prototype cells and batteries also have the option of shipping their products internationally by cargo vessel. No approval is required for such shipments but there are very stringent packaging requirements. The provision that applies to such shipments is Special Provision 310 in the IMDG Code.

- **Are there any marking, packaging, and shipping paper requirements for excepted cells and batteries?**

Yes. The regulatory revisions published on August 6, 2014, by the U.S. DOT Pipeline and Hazardous Materials Safety Administration (PHMSA) have consolidated the previously published Special Provisions 188 and 189 into 49 CFR 173.185(c) entitled, "exceptions for smaller cells and batteries." It is important to note that this new provision requires small lithium-ion batteries to be marked with the Wh rating after December 31, 2015.

When shipping small cells and batteries by highway, rail and vessel in the U.S. under 49 CFR 173.185(c) and by vessel under the IMDG Code:

The exceptions in 49 CFR 173.185(c) for highway, rail and vessel transport of small cells and batteries (and equipment packed with or containing them) are generally consistent with Special Provision 188 from the IMDG Code and the UN Model Regulations.

- Cells and batteries are subject to the applicable UN testing requirements and manufacturers must maintain a record of testing as noted in 49 CFR 173.185(a).
- Except when small lithium metal cells or batteries are packed with or contained in equipment in quantities less than 5 kg net weight, the following marking must be placed on packages: "LITHIUM METAL BATTERIES - FORBIDDEN FOR TRANSPORT ABOARD PASSENGER AIRCRAFT." or "PRIMARY LITHIUM BATTERIES - FORBIDDEN FOR TRANSPORT ABOARD PASSENGER AIRCRAFT." The marking must be on a background of contrasting color in letters at least 12 mm (0.5 inch) in height on packages have a gross mass of more than 30 kg (66 lbs); **or** at least 6 mm (0.25 inch) on packages having a gross mass of 30 kg (66 lbs) or less, except that smaller font may be used as necessary to fit package dimensions.
- Cells and batteries must be placed in inner packagings and packaged to prevent short circuits in accordance with the requirements of 49 CFR 173.185(b). UN specification packaging is not required.
- Package must not exceed 30 kg (66 lbs) gross weight (does not apply to lithium cells or batteries packed with or contained in equipment.)
- Except for a package containing button cell batteries installed in equipment (including circuit boards), or no more than four lithium cells or two lithium batteries installed in the equipment, the outer package must be marked with: (1) an indication that the package contains "lithium metal" or "lithium ion" cells or batteries, as appropriate; (2) an indication that the package is to be handled with care and that a flammable hazard exists if the package is damaged; (3) an indication that special procedures must be followed in the event the package is damaged, to include inspection and repacking if necessary; and (4) a telephone number for additional information. An example of a recommended marking (label) can be found on page 10.
- Except when cells or batteries are contained in equipment, each package must be capable of withstanding a 1.2 m 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.
- Each shipment of one or more packages marked as indicated above must be accompanied by a document that includes the same information.
- For international shipments by vessel, additional requirements may apply and it is recommended that the shipper refer to IMDG Code Chapter 3.3 Special Provision 188 for more details.

When shipping medium cells and batteries domestically (highway or rail only) in the U.S. under 49 CFR 173.185(c):

As noted above, the exceptions in 49 CFR 173.185(c) for highway and rail transport of medium cells and batteries (and equipment packed with or containing them) are unique to domestic shipments in the U.S. only. The requirements outlined for small cells (see above) are still applicable. However, the size limitations and marking of the outer packaging are modified.

- For transportation by highway or rail only, the lithium content of the cell and battery may be increased to 5 g for a lithium metal cell and 25 g for a lithium metal battery and 60 Wh for a lithium-ion cell or 300 Wh for a lithium-ion battery provided the outer package is marked: "LITHIUM BATTERIES - FORBIDDEN FOR TRANSPORT ABOARD AIRCRAFT AND VESSEL." The marking must be on a background of contrasting color in letters at least 12 mm (0.5 inch) in height on packages have a gross mass of more than 30 kg (66 lbs); **or** at least 6 mm (0.25 inch) on packages having a gross mass of 30 kg (66 lbs) or less, except that smaller font may be used as necessary to fit package dimensions.

When shipping small cells and batteries by air under 49 CFR 173.185(c) and the ICAO Technical Instructions and IATA Dangerous Goods Regulations:

The exceptions in 49 CFR 173.185(c) for air transport when shipping small cells and batteries (and equipment packed with or containing them) are generally consistent with Section II of Packing Instructions 965-970 of the ICAO Technical Instructions and IATA Dangerous Goods Regulations. As noted earlier in this document, the international regulations include the following State Variations, specific to U.S. cargo air shipments:

- The following statement (marking) must be placed on packages containing **only** primary lithium (metal) cells with no more than 1 g of lithium content and batteries with an aggregate lithium content of no more than 2 g, that do not exceed the quantity limits (per package) shown in the U.S. regulations: "LITHIUM METAL BATTERIES - FORBIDDEN FOR TRANSPORT ABOARD PASSENGER AIRCRAFT." or "PRIMARY LITHIUM BATTERIES - FORBIDDEN FOR TRANSPORT ABOARD PASSENGER AIRCRAFT." The marking must be on a background of contrasting color in letters at least 6 mm (0.25 inch) on packages having a gross mass of 30 kg (66 lbs) or less, except that smaller font may be used as necessary to fit package dimensions.

Most air carriers defer to the ICAO Technical Instructions and IATA Dangerous Goods Regulations when accepting shipments. It is recommended that the shipper review 49 CFR 173.185(c)(4) and Section IB and Section II of Packing Instructions 965-970 for guidance on marking, packaging and shipping paper requirements.

Recommended marking for use with excepted lithium metal and lithium-ion cells or batteries:

- **Minimum dimensions required for international air shipments: 120mm x 110 mm.*** Where packages are of dimensions such that they can only bear smaller labels, the dimensions may be 74 mm x 105 mm. *Smaller dimensions can be used for shipments by motor vehicle, cargo vessel and rail.*
- **Color required for international air shipments: Black with red hatching on a contrasting background.** *Black hatching can be used for shipments by motor vehicle, cargo vessel and rail.*
- **Actual label applied will need to indicate "Lithium metal battery" or "Lithium ion battery", as applicable. In addition, actual label will need to indicate shipper's specific telephone number(s) for additional information.**



Example – Lithium Hazard Label (not shown with actual dimensions)

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

When packed with (vs. installed in) equipment, Class 9 lithium or lithium-ion cells or batteries must still be properly packaged and labeled as Class 9 materials. These shipments must use the appropriate UN number and shipping name; UN 3091 for lithium metal batteries and UN 3481 for lithium-ion batteries.

When properly installed in equipment, more flexible packaging requirements are available for Class 9 lithium or lithium-ion cells or batteries. However, these cell and batteries are still considered Class 9 materials, and shipments must still use the appropriate UN number and shipping name; UN 3091 for lithium metal batteries and UN 3481 for lithium-ion batteries.

Package weight limits for cells and batteries packed with, or installed in equipment, vary by shipping mode (ground, air, ocean). It is recommended that the shipper directly consult the appropriate transportation regulation for more details.

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

Yes. The international and U.S. transportation regulations require employees involved in the packaging or shipment of Class 9 lithium or lithium-ion cells and batteries to complete hazardous materials (dangerous goods) certification training. Employees must renew their certification training every three years for ground and ocean transportation and every two years for air transportation.

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

Yes. Exemptions to the regulations for shipments of a specific cell or battery type may 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 and there are several provisions in the U.S. and international regulations that specify when a shipper of lithium batteries should secure an Approval from a "competent authority." Sufficient product information should be provided in the request and include cell and battery lithium content, safety test data (if available), and the application in which the cells or batteries will be used. In some cases, Approvals may be transferable, such that if a cell or battery manufacturer obtains an Approval, it may be transferred to recipients who subsequently handle and re-ship the product.

- **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 manufacturers?**

All 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 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 battery pack). As previously described, new tests must be performed on a cell or battery if the cell or battery differs from the original tested type by:

- (a) For primary cells and batteries, 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;
- (b) For rechargeable cells and batteries, a change in Watt-hours of more than 20% or an increase in voltage of more than 20%; or
- (c) A change that would materially affect the test results.

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

Yes! Significant fines can result from violations of U.S. and/or international regulations. For example, each violation of the U.S. DOT HMR is subject to a fine of up to \$50,000 (or up to \$100,000 if DOT finds the violation results in "*death, serious illness, or severe injury to any person or substantial destruction of property.*") In some cases, 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.

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

Yes. There are provisions in the ICAO Technical Instructions and U.S. DOT HMR that enable passengers to carry on most consumer batteries and personal battery-powered consumer electronic and medical devices, including spare batteries, when carried for personal use.

Each spare battery must be individually protected as to prevent damage and short circuits by placement in original retail packaging or by otherwise insulating the terminals, e.g., by taping over exposed terminals or placing each battery in a separate plastic bag (such as a Ziploc[®] bag) or protective pouch, and carried in carry-on baggage only.

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

Battery-powered devices should be protected from accidental activation.

Batteries allowed in carry-on baggage include:

Lithium-ion (including lithium polymer) rechargeable batteries: Passengers may carry consumer-sized lithium-ion batteries; containing no more than 100 Watt-hours per battery. This includes: AA, AAA, 9-volt, mobile/cell phone, PDA, camera, camcorder, MP3 player, hand held game and standard laptop computer batteries.

- With the approval of the operator (airline), passengers can also bring two (2) larger lithium-ion batteries; more than 100 Watt-hours and up to 160 Watt-hours, in their carry-on baggage. This size includes larger extended-life laptop batteries.

Primary lithium metal (non-rechargeable) batteries: These batteries are used in cameras and other personal electronic devices such as small flashlights and personal air ionizers. Consumer-sized batteries (up to 2 grams of lithium per battery) may be carried. This includes: AA, AAA, CR123A, CR1, CR2, CRV3, CR22, 2CR5, etc., as well as lithium watch batteries (also called coin or button cells).

Passengers are prohibited from carrying on lithium metal batteries containing more than 2 grams of lithium content.

- **Are there any provisions in the regulations that allow lithium metal or lithium-ion batteries in checked baggage?**

Spare lithium metal or lithium-ion batteries are NOT allowed in checked baggage. Battery-powered devices with batteries installed in the device are allowed in checked baggage. Devices containing batteries, particularly those with moving parts or those that can heat up, such as cordless power tools, should be protected from accidental activation by moving the on/off switch to the "off" position or by placing the device in a protective case.

- **Is there a limit to the number of batteries that can be carried in carry-on baggage?**

There is no limit to the number of consumer-size batteries or battery-powered devices that a passenger can carry. **Only the larger lithium-ion batteries are limited to two (2) spare batteries per passenger.**

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

You can obtain a list of the Ultralife's cells and batteries, which includes lithium weights and transportation classifications, from the Ultralife website at: www.ultralifecorporation.com.

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

Please contact Ultralife for answers to questions regarding the transportation of Ultralife lithium, lithium-ion or lithium polymer cells and batteries at: 800-332-5000 (U.S. & Canada), 315-332-7100 (International) or visit Ultralife's website at: www.ultralifecorporation.com.

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