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Title 49 - Transportation

Subtitle B - Other Regulations Relating to Transportation

Chapter I - Pipeline and Hazardous Materials Safety Administration, Department of Transportation

Subchapter C - Hazardous Materials Regulations

Part 173 - Shippers - General Requirements for Shipments and Packagings

Subpart E - Non-bulk Packaging for Hazardous Materials Other Than Class 1 and Class 7

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§ 173.185 Lithium cells and batteries.

As used in this section, *consignment* means one or more packages of hazardous materials accepted by an operator from one shipper at one time and at one address, receipted for in one lot and moving to one consignee at one destination address. *Equipment* means the device or apparatus for which the lithium cells or batteries will provide electrical power for its operation. *Lithium cell(s) or battery(ies)* includes both lithium metal and lithium ion chemistries. *Medical device* means an instrument, apparatus, implement, machine, contrivance, implant, or in vitro reagent, including any component, part, or accessory thereof, which is intended for use in the diagnosis of disease or other conditions, or in the cure, mitigation, treatment, or prevention of disease, of a person.

(a) **Classification.**

- (1) Each lithium cell or battery must be of the type proven to meet the criteria in part III, sub-section 38.3 of the UN Manual of Tests and Criteria (IBR; see § 171.7 of this subchapter). Lithium cells and batteries are subject to these tests regardless of whether the cells used to construct the battery are of a tested type. A single cell battery as defined in part III, sub-section 38.3 of the UN Manual of Tests and Criteria is considered a "cell" and must be offered for transportation in accordance with the requirements for cells.
 - (i) Cells and batteries manufactured according to a type meeting the requirements of sub-section 38.3 of the UN Manual of Tests and Criteria, Revision 3, Amendment 1 or any subsequent revision and amendment applicable at the date of the type testing may continue to be transported, unless otherwise provided in this subchapter.
 - (ii) Cell and battery types only meeting the requirements of the UN Manual of Tests and Criteria, Revision 3, are no longer valid. However, cells and batteries manufactured in conformity with such types before July 2003 may continue to be transported if all other applicable requirements are fulfilled.
- (2) Each person who manufactures lithium cells or batteries must create a record of satisfactory completion of the testing (e.g. test report) required by this paragraph prior to offering the lithium cell or battery for transport and must:

- (i) Maintain this record for as long as that design is offered for transportation and for one year thereafter; and
 - (ii) Make this record available to an authorized representative of the Federal, state or local government upon request.
- (3) Beginning January 1, 2022 each manufacturer and subsequent distributor of lithium cells or batteries manufactured on or after January 1, 2008, must make available a test summary. The test summary must include the following elements:
- (i) Name of cell, battery, or product manufacturer, as applicable;
 - (ii) Cell, battery, or product manufacturer's contact information to include address, telephone number, email address, and website for more information;
 - (iii) Name of the test laboratory, to include address, telephone number, email address, and website for more information;
 - (iv) A unique test report identification number;
 - (v) Date of test report;
 - (vi) Description of cell or battery to include at a minimum;
 - (A) Lithium ion or lithium metal cell or battery;
 - (B) Mass of cell or battery;
 - (C) Watt-hour rating, or lithium content;
 - (D) Physical description of the cell/battery; and
 - (E) Cell or battery model number or, alternatively, if the test summary is established for a product containing a cell or battery, the product model number.
 - (vii) List of tests conducted and results (*i.e.*, pass/fail);
 - (viii) Reference to assembled battery testing requirements (if applicable);
 - (ix) Reference to the revised edition of the UN Manual of Tests and Criteria used and to amendments thereto, if any; and
 - (x) Signature with name and title of signatory as an indication of the validity of information provided.
- (4) Except for cells or batteries meeting the requirements of paragraph (c) of this section, each lithium cell or battery must:
- (i) Incorporate a safety venting device or be designed to preclude a violent rupture under conditions normally incident to transport;
 - (ii) Be equipped with means of preventing external short circuits; and
 - (iii) Be equipped with a means of preventing dangerous reverse current flow (*e.g.*, diodes or fuses) if a battery contains cells, or a series of cells that are connected in parallel.

(b) **Packaging.**

- (1) Each package offered for transportation containing lithium cells or batteries, including lithium cells or batteries packed with, or contained in, equipment, must meet all applicable requirements of subpart B of this part.
- (2) Lithium cells or batteries, including lithium cells or batteries packed with, or contained in, equipment, must be packaged in a manner to prevent:
 - (i) Short circuits;
 - (ii) Damage caused by shifting or placement within the package; and
 - (iii) Accidental activation of the equipment.
- (3) For packages containing lithium cells or batteries offered for transportation:
 - (i) The lithium cells or batteries must be placed in non-metallic inner packagings that completely enclose the cells or batteries, and separate the cells or batteries from contact with equipment, other devices, or electrically conductive materials (e.g., metal) in the packaging.
 - (ii) The inner packagings containing lithium cells or batteries must be placed in one of the following packagings meeting the requirements of part 178, subparts L and M, of this subchapter at the Packing Group II level:
 - (A) Metal (4A, 4B, 4N), wooden (4C1, 4C2, 4D, 4F), fiberboard (4G), or solid plastic (4H1, 4H2) box;
 - (B) Metal (1A2, 1B2, 1N2), plywood (1D), fiber (1G), or plastic (1H2) drum;
 - (C) Metal (3A2, 3B2) or plastic (3H2) jerrican.
 - (iii) When packed with equipment, lithium cells or batteries must:
 - (A) Be placed in inner packagings that completely enclose the cell or battery, then placed in an outer packaging. The completed package for the cells or batteries must meet the Packing Group II performance requirements as specified in paragraph (b)(3)(ii) of this section; or
 - (B) Be placed in inner packagings that completely enclose the cell or battery, then placed with equipment in a package that meets the Packing Group II performance requirements as specified in paragraph (b)(3)(ii) of this section.
- (4) When lithium cells or batteries are contained in equipment:
 - (i) The outer packaging, when used, must be constructed of suitable material of adequate strength and design in relation to the capacity and intended use of the packaging, unless the lithium cells or batteries are afforded equivalent protection by the equipment in which they are contained;
 - (ii) Equipment must be secured to prevent damage caused by shifting within the outer packaging and be packed so as to prevent accidental operation during transport; and
 - (iii) Any spare lithium cells or batteries packed with the equipment must be packaged in accordance with paragraph (b)(3) of this section.
- (5) Lithium batteries that weigh 12 kg (26.5 pounds) or more and have a strong, impact-resistant outer casing may be packed in strong outer packagings; in protective enclosures (for example, in fully enclosed or wooden slatted crates); or on pallets or other handling devices, instead of packages

meeting the UN performance packaging requirements in paragraphs (b)(3)(ii) and (iii) of this section. Batteries must be secured to prevent inadvertent shifting, and the terminals may not support the weight of other superimposed elements. Batteries packaged in accordance with this paragraph may be transported by cargo aircraft if approved by the Associate Administrator.

- (6) Except for transportation by aircraft, the following rigid large packagings are authorized for a single battery, and for a single item of equipment containing batteries, meeting provisions in paragraphs (b)(1) and (2) of this section and the requirements of part 178, subparts P and Q, of this subchapter at the Packing Group II level:
 - (i) Metal (50A, 50B, 50N) metal packagings must be fitted with an electrically non-conductive lining material (e.g., plastics) of adequate strength for the intended use;
 - (ii) Rigid plastic (50H);
 - (iii) Wooden (50C, 50D, 50F);
 - (iv) Rigid fiberboard (50G).
 - (7) For transportation by aircraft, lithium cells and batteries must not be packed in the same outer packaging with substances and articles of Class 1 (explosives) other than Division 1.4S, Division 2.1 (flammable gases), Class 3 (flammable liquids), Division 4.1 (flammable solids), or Division 5.1 (oxidizers).
- (c) **Exceptions for smaller cells or batteries.** Other than as specifically stated below, a package containing lithium cells or batteries, or lithium cells or batteries packed with, or contained in, equipment, that meets the conditions of this paragraph is excepted from the requirements in subparts C through H of part 172 of this subchapter and the UN performance packaging requirements in paragraphs (b)(3)(ii) and (iii) of this section under the following conditions and limitations.
- (1) **Size limits.**
 - (i) The Watt-hour (Wh) rating may not exceed 20 Wh for a lithium ion cell or 100 Wh for a lithium ion battery. After December 31, 2015, each lithium ion battery subject to this provision must be marked with the Watt-hour rating on the outside case.
 - (ii) The lithium content may not exceed 1 g for a lithium metal cell or 2 g for a lithium metal battery.
 - (iii) Except when lithium cells or batteries are packed with or contained in equipment in quantities not exceeding 5 kg net weight, the outer package that contains lithium cells or batteries must be appropriately marked: "PRIMARY LITHIUM BATTERIES - FORBIDDEN FOR TRANSPORT ABOARD PASSENGER AIRCRAFT", "LITHIUM METAL BATTERIES - FORBIDDEN FOR TRANSPORT ABOARD PASSENGER AIRCRAFT", "LITHIUM ION BATTERIES - FORBIDDEN FOR TRANSPORT ABOARD PASSENGER AIRCRAFT", or "LITHIUM BATTERIES - FORBIDDEN FOR TRANSPORT ABOARD PASSENGER AIRCRAFT", or labeled with a "CARGO AIRCRAFT ONLY" label as specified in § 172.448 of this subchapter.
 - (iv) 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 or 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." A package marked in accordance with this paragraph does not need to display the marking required in paragraph (c)(1)(iii) of this section.

- (v) The marking specified in paragraphs (c)(1)(iii) and (iv) of this section must have a background of contrasting color, and the letters in the marking must be:
 - (A) At least 6 mm (0.25 inch) in height on packages having a gross weight of 30 kg (66 pounds) or less, except that smaller font may be used as necessary when package dimensions so require.
 - (B) At least 12 mm (0.5 inch) in height on packages having a gross weight of more than 30 kg (66 pounds).
- (vi) When a package marked or labeled in accordance with paragraph (c)(1)(iii) or (iv) of this section is placed in an overpack, the selected marking or label must either be clearly visible through the overpack, or the marking or label must also be affixed on the outside of the overpack.
- (vii) Except when lithium cells or batteries are packed with, or contained in, equipment, each package must not exceed 30 kg (66 pounds) gross weight.
- (2) **Packaging.** Lithium cells and batteries must be packed in inner packagings that completely enclose the cell or battery then placed in a strong rigid outer package unless the cell or battery is contained in equipment and is afforded equivalent protection by the equipment in which it is contained. Except when lithium cells or batteries are contained in equipment, each package of lithium cells or batteries, or the completed package when packed with equipment, must be capable of withstanding a 1.2 meter drop test, in any orientation, without damage to the cells or batteries contained in the package, without shifting of the contents that would allow battery-to-battery (or cell-to-cell) contact, and without release of the contents of the package.
- (3) **Lithium battery mark.** Each package must display the lithium battery mark except when a package contains button cell batteries installed in equipment (including circuit boards), or no more than four lithium cells or two lithium batteries contained in equipment, where there are not more than two packages in the consignment.
 - (i) The mark must indicate the UN number: "UN3090" for lithium metal cells or batteries; or "UN3480" for lithium ion cells or batteries. Where the lithium cells or batteries are contained in, or packed with, equipment, the UN number "UN3091" or "UN3481," as appropriate, must be indicated. Where a package contains lithium cells or batteries assigned to different UN numbers, all applicable UN numbers must be indicated on one or more marks. The package must be of such size that there is adequate space to affix the mark on one side without the mark being folded.

Figure 1 to paragraph (c)(3)(i) introductory text



- (A) The mark must be in the form of a rectangle or a square with hatched edging. The mark must be not less than 100 mm (3.9 inches) wide by 100 mm (3.9 inches) high and the minimum width of the hatching must be 5 mm (0.2 inches), except marks of 100 mm (3.9 inches) wide by 70 mm (2.8 inches) high may be used on a package containing lithium batteries when the package is too small for the larger mark;
- (B) The symbols and letters must be black on white or suitable contrasting background and the hatching must be red;
- (C) The “*” must be replaced by the appropriate UN number(s) and the “**” must be replaced by a telephone number for additional information; and
- (D) Where dimensions are not specified, all features shall be in approximate proportion to those shown.

(ii) [Reserved]

(iii) When packages are placed in an overpack, the lithium battery mark shall either be clearly visible through the overpack or be reproduced on the outside of the overpack and the overpack shall be marked with the word "OVERPACK". The lettering of the "OVERPACK" mark shall be at least 12 mm (0.47 inches) high.

(4) **Air transportation.**

(i) For transportation by aircraft, lithium cells and batteries may not exceed the limits in the following Table 1 to paragraph (c)(4)(i). The limits on the maximum number of batteries and maximum net quantity of batteries in the following table may not be combined in the same package. The limits in the following table do not apply to lithium cells and batteries packed with, or contained in, equipment.

Table 1 to Paragraph (c)(4)(i)

Contents	Lithium metal cells and/or batteries with a lithium content not more than 0.3 g	Lithium metal cells with a lithium content more than 0.3 g but not more than 1 g	Lithium metal batteries with a lithium content more than 0.3 g but not more than 2 g	Lithium ion cells and/or batteries with a watt-hour rating not more than 2.7 Wh	Lithium ion cells with a watt-hour rating more than 2.7 Wh but not more than 20 Wh	Lithium ion batteries with a watt-hour rating more than 2.7 Wh but not more than 100 Wh
Maximum number of cells/batteries per package	No Limit	8 cells	2 batteries	No Limit	8 cells	2 batteries.
Maximum net quantity (mass) per package	2.5 kg	n/a	n/a	2.5 kg	n/a	n/a.

(ii) Not more than one package prepared in accordance with paragraph (c)(4)(i) of this section may be placed into an overpack.

(iii) A shipper is not permitted to offer for transport more than one package prepared in accordance with the provisions of paragraph (c)(4)(i) of this section in any single consignment.

- (iv) Each shipment with packages required to display the paragraph (c)(3)(i) lithium battery mark must include an indication on the air waybill of compliance with this paragraph (c)(4) (or the applicable ICAO Technical Instructions Packing Instruction), when an air waybill is used.
 - (v) Packages and overpacks of lithium batteries prepared in accordance with paragraph (c)(4)(i) of this section must be offered to the operator separately from cargo which is not subject to the requirements of this subchapter and must not be loaded into a unit load device before being offered to the operator.
 - (vi) For lithium batteries packed with, or contained in, equipment, the number of batteries in each package is limited to the minimum number required to power the piece of equipment, plus two spare sets, and the total net quantity (mass) of the lithium cells or batteries in the completed package must not exceed 5 kg. A "set" of cells or batteries is the number of individual cells or batteries that are required to power each piece of equipment.
 - (vii) Each person who prepares a package for transport containing lithium cells or batteries, including cells or batteries packed with, or contained in, equipment in accordance with the conditions and limitations of this paragraph (c)(4), must receive instruction on these conditions and limitations, corresponding to their functions.
 - (viii) Lithium cells and batteries must not be packed in the same outer packaging with other hazardous materials. Packages prepared in accordance with paragraph (c)(4)(i) of this section must not be placed into an overpack with packages containing hazardous materials and articles of Class 1 (explosives) other than Division 1.4S, Division 2.1 (flammable gases), Class 3 (flammable liquids), Division 4.1 (flammable solids), or Division 5.1 (oxidizers).
- (5) For transportation by aircraft, a package that exceeds the number or quantity (mass) limits in the table shown in paragraph (c)(4)(i) of this section, the overpack limit described in paragraph (c)(4)(ii) of this section, or the consignment limit described in paragraph (c)(4)(iii) of this section is subject to all applicable requirements of this subchapter, except that a package containing no more than 2.5 kg lithium metal cells or batteries or 10 kg lithium ion cells or batteries is not subject to the UN performance packaging requirements in paragraph (b)(3)(ii) of this section when the package displays both the lithium battery mark in paragraph (c)(3)(i) and the Class 9 Lithium Battery label specified in § 172.447 of this subchapter. This paragraph does not apply to batteries or cells packed with or contained in equipment.
- (d) ***Lithium cells or batteries shipped for disposal or recycling.*** A lithium cell or battery, including a lithium cell or battery contained in equipment, that is transported by motor vehicle to a permitted storage facility or disposal site, or for purposes of recycling, is excepted -
- (1) From the testing and record keeping requirements of paragraph (a) and the UN performance packaging requirements in paragraphs (b)(3)(ii), (b)(3)(iii) and (b)(6) of this section, when packed in a strong outer packaging conforming to the applicable requirements of subpart B of this part; and
 - (2) From subparts C through H of part 172 of this subchapter when the lithium cell or battery meets the size, packaging, and hazard communication conditions in paragraph (c)(1)-(3) of this section.
- (e) ***Low production runs and prototypes.*** Low production runs (*i.e.*, annual production runs consisting of not more than 100 lithium cells or batteries), prototype lithium cells or batteries transported for purposes of testing, and equipment containing such cells or batteries are excepted from the testing and record keeping requirements of paragraph (a) of this section, provided:

- (1) Except as provided in paragraph (e)(5) of this section, each cell or battery is individually packed in a non-metallic inner packaging, inside an outer packaging, and is surrounded by cushioning material that is non-combustible and electrically non-conductive, or contained in equipment. Equipment must be constructed or packaged in a manner as to prevent accidental operation during transport;
- (2) Appropriate measures shall be taken to minimize the effects of vibration and shocks and prevent shifting of the cells or batteries within the package that may lead to damage and a dangerous condition during transport. Cushioning material that is non-combustible and electrically non-conductive may be used to meet this requirement;
- (3) The lithium cells or batteries are packed in inner packagings or contained in equipment. The inner packaging or equipment is placed in one of the following outer packagings that meet the requirements of part 178, subparts L and M, of this subchapter at the Packing Group I level. Cells and batteries, including equipment of different sizes, shapes or masses must be placed into an outer packaging of a tested design type listed in this section provided the total gross mass of the package does not exceed the gross mass for which the design type has been tested. A cell or battery with a net mass of more than 30 kg is limited to one cell or battery per outer packaging;
 - (i) Metal (4A, 4B, 4N), wooden (4C1, 4C2, 4D, 4F), or solid plastic (4H2) box;
 - (ii) Metal (1A2, 1B2, 1N2), plywood (1D), or plastic (1H2) drum.
- (4) For a single battery, and for a single item of equipment containing cells or batteries, the following rigid large packagings are authorized:
 - (i) Metal (50A, 50B, 50N) metal packagings must be fitted with an electrically non-conductive lining material (e.g., plastics) of adequate strength for the intended use;
 - (ii) Rigid plastic (50H);
 - (iii) Plywood (50D).
- (5) Lithium batteries, including lithium batteries contained in equipment, that weigh 12 kg (26.5 pounds) or more and have a strong, impact-resistant outer casing may be packed in strong outer packagings, in protective enclosures (for example, in fully enclosed or wooden slatted crates), or on pallets or other handling devices, instead of packages meeting the UN performance packaging requirements in paragraphs (b)(3)(ii) and (iii) of this section. The battery must be secured to prevent inadvertent shifting, and the terminals may not support the weight of other superimposed elements;
- (6) Irrespective of the limit specified in column (9B) of the § 172.101 Hazardous Materials Table, the battery or battery assembly prepared for transport in accordance with this paragraph may have a mass exceeding 35 kg gross weight when transported by cargo aircraft;
- (7) Batteries or battery assemblies packaged in accordance with this paragraph are not permitted for transportation by passenger-carrying aircraft, and may be transported by cargo aircraft only if approved by the Associate Administrator prior to transportation; and
- (8) Shipping papers must include the following notation: "Transport in accordance with § 173.185(e)."
- (f) **Damaged, defective, or recalled cells or batteries.** Lithium cells or batteries that have been damaged or identified by the manufacturer as being defective for safety reasons, that have the potential of producing a dangerous evolution of heat, fire, or short circuit (e.g., those being returned to the manufacturer for safety reasons) may be transported by highway, rail or vessel only, and must be packaged as follows:

- (1) Each cell or battery must be placed in individual, non-metallic inner packaging that completely encloses the cell or battery;
- (2) The inner packaging must be surrounded by cushioning material that is non-combustible, electrically non-conductive, and absorbent; and
- (3) Each inner packaging must be individually placed in one of the following packagings meeting the applicable requirements of part 178, subparts L, M, P, and Q of this subchapter at the Packing Group I level:
 - (i) Metal (4A, 4B, 4N), wooden (4C1, 4C2, 4D, 4F), or solid plastic (4H2) box;
 - (ii) Metal (1A2, 1B2, 1N2), plywood (1D), or plastic (1H2) drum; or
 - (iii) For a single battery, and for a single item of equipment containing cells or batteries, the following rigid large packagings are authorized:
 - (A) Metal (50A, 50B, 50N);
 - (B) Rigid plastic (50H);
 - (C) Plywood (50D); and
- (4) The outer package must be marked with an indication that the package contains a “Damaged/defective lithium ion battery” and/or “Damaged/defective lithium metal battery” as appropriate. The marking required by this paragraph must be in characters at least 12 mm (0.47 inches) high.

(g) **Limited exceptions to restrictions on air transportation of medical device batteries.** Irrespective of the quantity limitations described in column 9A of the § 172.101 Hazardous Materials Table of this subchapter, up to two replacement lithium cells or batteries specifically used for a medical device as defined in this section may be transported as cargo on a passenger aircraft. Packages containing these cells or batteries are not subject to the marking requirement in paragraph (c)(1)(iii) of this section or the “CARGO AIRCRAFT ONLY” label required by § 172.402(c) of this subchapter and may be transported as cargo on a passenger aircraft when approved by the Associate Administrator and provided the following conditions are met:

- (1) The intended destination of the cells or batteries is not serviced daily by cargo aircraft if a cell or battery is required for medically necessary care; and
- (2) Lithium ion cells or batteries for medical devices are excepted from the state of charge limitations in § 172.102, special provision A100, of this subchapter, provided each cell or battery is:
 - (i) Individually packed in an inner packaging that completely encloses the cell or battery;
 - (ii) Placed in a rigid outer packaging; and
 - (iii) Protected to prevent short circuits.

(h) **Approval.** A lithium cell or battery that does not conform to the provisions of this subchapter may be transported only under conditions approved by the Associate Administrator.

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