



LITHIUM BATTERY GUIDE FOR SHIPPERS

A Compliance Tool for All Modes of Transportation

Revised September 2021



U.S. Department
of Transportation
**Pipeline and
Hazardous Materials
Safety Administration**

WWW.PHMSA.DOT.GOV

INTRODUCTION

This compliance resource was prepared to assist a shipper to safely package lithium cells and batteries for transport by all modes of transportation according to the latest (May 11, 2020; HM-2150) regulatory requirements. This guide provides scenario-based situations that outline the applicable requirements that a shipper must follow to ship packages of lithium cells and batteries in various configurations. Each distinct shipping guide in this document refers to the regulatory requirements for a specific lithium cell/battery type, configuration, and size. In this way, a shipper will easily find the applicable provisions that they must follow depending on the scenario they encounter as a shipper.

Please note that these shipping guides are based on the Hazardous Materials Regulations (HMR; 49 CFR Parts 171-180) and can be used as a compliance tool to help outline applicable scenario-based regulatory requirements; this document is not a substitute for the HMR. While every effort has been made to provide a simplified compliance resource consistent with the HMR, if there is any instance in which this document is inconsistent with the HMR, then the HMR requirements supersede this guide. The regulations themselves are the final authority for proper shipping procedures.

The HMR includes provisions for the classification, packaging, hazard communication (e.g., package marking, labeling, shipping papers), stowage, and handling of all hazardous materials. The purpose of these regulations is to protect the safety of people, property, and the environment when hazardous materials such as lithium batteries and battery-powered devices are shipped. If the applicable minimum regulatory requirements are not followed, lithium cell or battery shipments may be more likely to contribute to fires, injuries, or other incidents during transport.

Whether shipping a single battery, a palletized load of batteries, or a battery-powered device, the safety of the package, and those who handle it along its journey, depends on compliance with the HMR. Failure to comply with the applicable regulations may result in fines or even criminal prosecution.

For any questions about regulatory requirements, please contact our Hazardous Materials Information Center at **1-800-467-4922/202- 366-4488** or infocntr@dot.gov. The information center can answer any regulatory questions and provide additional compliance resources.

WHY LITHIUM BATTERIES ARE REGULATED IN TRANSPORTATION

Lithium cells and batteries power countless items that support everyday life from portable computers, cordless tools, mobile telephones, watches, to wheelchairs and motor vehicles. Our society has come to depend on lithium cells and batteries for an increasingly mobile lifestyle. Today's lithium cells and batteries are more energy dense than ever, bringing a steadily growing number of higher-powered devices to market. With the increased energy density comes greater risk and the need to manage it. Shippers play an important role in reducing this risk and preventing incidents—including fires aboard aircraft or other transport vehicles.

The risks posed by lithium cells and batteries are generally a function of type, size, and chemistry. Lithium cells and batteries can present both chemical (e.g., corrosive or flammable electrolytes) and electrical hazards. Unlike standard alkaline batteries, most lithium batteries manufactured today contain a flammable electrolyte and have an incredibly high energy density. They can overheat and ignite under certain conditions, such as a short circuit or improper design or assembly. Once ignited, lithium cell and battery fires can be difficult to extinguish. Additional, although infrequent, events can result in lithium cells and batteries experiencing thermal runaway, a chain reaction leading to a violent release of stored energy and flammable gas. This thermal runaway can propagate to other batteries or conductive materials nearby, potentially resulting in large scale thermal events with severe consequences.

The Federal Aviation Administration (FAA) Technical Center issued a series of test reports in 2004, 2006, 2010, and 2014 that characterized the hazards posed by lithium cells and batteries transported as cargo on aircraft and the effectiveness of certain aircraft fire suppression agents and packaging configurations in mitigating the associated risks. The FAA Technical Center testing shows that oxygen starvation through depressurization in the case of cargo aircraft, common shipping containers (e.g., unit load devices), or aircraft fire suppression systems are not effective in containing or suppressing many potential lithium cell or battery fires.

CELL VS. BATTERY

CELL: A cell is a single encased electrochemical unit.

BATTERY: A battery is made up of multiple electrically connected component cells such as in a laptop computer battery. A battery can also only be made up of a single cell such as the common AA, C, or a coin cell. A single cell battery is considered a "cell" and must be offered for transportation in accordance with the requirements for cells.

Lithium cells and batteries can become dangerous and cause fires, and electrical shocks if not safely packaged and handled when transported. Misused, mishandled, modified, improperly packaged, improperly stored, overcharged, damaged, or defective lithium cells or batteries can short circuit, overheat, and sometimes cause fire. The heat from a single cell in thermal runaway can propagate from cell to cell and package to package until the entire shipment has been consumed. Temperatures experienced involving lithium cells or batteries in thermal runaway are sufficient to ignite typical fiberboard packaging and nearby materials.

Always remember that ALL lithium cells and batteries are hazardous materials when being transported, no matter the size or quantity. However, there may be certain exceptions from the regulations depending on certain conditions and limitations. Shippers may be relieved of certain regulatory requirements—if cells and batteries meet specific:

- Size limitations
- Packaging requirements
- Hazard communication requirements
- Additional requirements for air transportation

THE HMR, INTERNATIONAL, AND MODAL REQUIREMENTS

This document provides generalized guidance on the requirements for proper packaging and hazard communication of shipments of lithium cells and batteries and lithium battery-powered equipment by all modes of transportation. Shipments to, from, or within the United States are subject to the HMR. For international transport, PHMSA authorizes the use of the International Civil Aviation Organization's Technical Instructions for the Safe Transport of Dangerous Goods by Air (ICAO Technical Instructions) and the International Maritime Dangerous Goods Code (IMDG Code) subject to the additional conditions and limitations of the HMR specified in subpart C of part 171 of the HMR (§§ 171.22-26).

VESSEL TRANSPORTATION

Lithium batteries and battery-powered equipment may be transported within the United States by vessel and by motor vehicle or rail either before or after being transported by vessel in accordance with the IMDG Code. We recommend that shippers consult the most recent edition of the IMDG Code, issued by the International Maritime Organization (IMO) for additional requirements. Publications and regulations issued by IMO can be found at: www.imo.org.

AIR TRANSPORTATION

Lithium batteries and battery-powered equipment may be transported within the United States by aircraft and by motor vehicle or rail either before or after being transported by aircraft in accordance with the ICAO TI. We recommend that shippers consult the most recent edition of the ICAO TI for additional requirements, along with any applicable origin/destination State Variations. State Variations are additional conditions and limitations imposed by the country of origin and destination. For example, US State Variations contain the additional HMR requirements that apply when shipping to, from, or within the US by air under the ICAO TI. Publications and regulations issued by ICAO can be found at: www.icao.int.

For both international and domestic shipments, we also recommend checking with the air carrier for any additional requirements. Many air carriers have supplemental policies and/or limitations with respect to lithium battery shipments. These requirements can often be found by consulting directly with the air carrier or International Air Transport Association (IATA) publications. Air carriers, working closely with the FAA, use their Safety Management Systems (SMS) to evaluate their ability to safely carry lithium batteries and determine safety mitigation strategies. FAA resources can be found at: www.faa.gov/hazmat.

In summary, when shipping batteries for air transportation, shippers should always consult their air carrier or ICAO/IATA publications for both country-specific and carrier-specific policies/limitations.

LITHIUM BATTERY TYPES

There are many different chemistries of lithium cells and batteries, but for transportation purposes, all lithium cells and batteries fall into one of two basic types: lithium ion and lithium metal. Both battery types are characterized by a higher energy and a longer operating life than alkaline, nickel cadmium, and nickel metal hydride chemistries.

- Lithium ion (Li-ion), including lithium polymer (Li-Po):
 - are generally rechargeable (secondary) batteries
 - are found in a wide range of electronic devices such as laptop and tablet computers, cellular telephones, hybrid vehicles, etc.



- Lithium metal (LiM)
 - are generally non-rechargeable (primary, one-time use).
 - have a longer life than standard alkaline batteries
 - are commonly used in hearing aids, wristwatches, smoke detectors, cameras, key fobs, children's toys, etc.



LITHIUM CELLS AND BATTERY TESTING REQUIREMENTS

Shippers are responsible for ensuring that lithium cells and batteries offered for transportation have passed the design tests found in the United Nations (UN) Manual of Tests and Criteria, Section 38.3. The UN 38.3 testing accounts for transportation impacts such as:

- Altitude
- External short circuit
- Forced discharge
- Impact/crush
- Overcharge
- Shock
- Thermal test
- Vibration

Effective January 1, 2022, lithium cell and battery manufacturers and subsequent distributors of lithium cells and batteries manufactured after January 1, 2008 must make a lithium battery test summary available to others in the supply chain. The test summary includes a standardized set of elements that provide traceability and accountability to ensure that lithium cell and battery designs offered for transport meet UN 38.3 test requirements. We recommend the shipper check with the battery manufacturer or distributor to determine if a battery design has passed these tests, or obtain, if possible, the test summary. For additional information on test summaries, refer to PHMSA's "[Announcing New UN Requirement for Lithium Battery Test Summaries](#)" outreach publication.

Any change or modification to a lithium battery that would lead to a failure of any of the UN 38.3 tests must be considered a new type and subjected to the required tests. See the UN Manual for the types of changes that may be considered sufficiently different from a tested type and that may lead to a failure of a lithium battery test result.

See § 173.185(a) for all testing and test summary requirements. Refer to §§ 173.185(d) and (e), respectively, for exceptions from the testing requirements for lithium cells or batteries shipped for disposal or recycling and for low production runs and prototype lithium cells or batteries.

HOW ARE LITHIUM BATTERIES REGULATED?

Lithium cells and batteries are Class 9 (miscellaneous) hazardous materials. There are eight possible descriptions for lithium cells and batteries, depending on the battery chemistry. These descriptions, or proper shipping names, are found in the Hazardous Materials Table (HMT) in § 172.101 of the HMR. They are as follows:

- **Stand-alone**—Package contains only the cells/batteries—no equipment:
 - UN3090, Lithium metal batteries *including lithium alloy batteries*
 - UN3480, Lithium ion batteries *including lithium ion polymer batteries*
- **Packed with**—Package contains not only the equipment, but also cells/batteries that are not installed in the equipment:
 - UN3091, Lithium metal batteries packed with equipment *including lithium alloy batteries*
 - UN3481, Lithium ion batteries packed with equipment *including lithium ion polymer batteries*
- **Contained in**—Package contains equipment with cells/batteries installed:
 - UN3091, Lithium metal batteries contained in equipment *including lithium alloy batteries*
 - UN3481, Lithium ion batteries contained in equipment *including lithium ion polymer batteries*
- **Vehicles**—Package or shipment contains a vehicle powered by lithium batteries:
 - UN3171, Battery-powered vehicle
- **Cargo Transport Unit**—Lithium batteries installed in a cargo transport unit and designed only to provide power external to the cargo transport unit.
 - UN3536, Lithium batteries installed in cargo transport unit lithium ion batteries or lithium metal batteries

What are considered “Vehicles” or “Equipment” in the HMR?

Vehicles are self-propelled apparatus designed to carry one or more persons or goods. Examples of such vehicles are electrically-powered cars, motorcycles, scooters, three- and four-wheeled vehicles or motorcycles, trucks, locomotives, bicycles (pedal cycles with an electric motor) and other vehicles of this type (e.g. self-balancing vehicles or vehicles not equipped with at least one seating position), lawn tractors, self-propelled farming and construction equipment, boats, aircraft, wheelchairs and other mobility aids.

Equipment means the device or apparatus for which the lithium cells or batteries will provide electrical power for its operation.

BATTERY SIZE – SMALLER BATTERY THRESHOLDS

It is important to remember that the size of the cell or battery has important implications for shipping requirements. Size refers not only to physical dimensions and weight, but also the energy capacity of the battery. For lithium ion cells and batteries, size is measured by Watt-hour (Wh) ratings. For lithium metal cells and batteries, size is measured by lithium content in grams (g). The Wh rating is often marked on the outside case of the lithium ion cell or battery.

The size of a lithium cell or battery is an important aspect of classification because “smaller” cells and batteries qualify for certain exceptions from regulatory requirements when packed in certain quantities. For the purposes of DOT regulations, a “smaller” cell or battery is as follows:

- **Lithium Ion:** Cells equal to or less than 20Wh; and Batteries equal to or less than 100Wh
 - For highway and rail ONLY: Cells not exceeding 60Wh; and Batteries not exceeding 300Wh
- **Lithium Metal:** Cells equal to or less than 1g; and Batteries equal to or less than 2g
 - For highway and rail ONLY: Cells not exceeding 5g; and Batteries not exceeding 25g

Note: For a single cell battery, such as a typical coin cell or standard AA or AAA replacement battery, refer to the size for cells.

Cells and batteries that exceed these “smaller” cell or battery size thresholds must be shipped as fully regulated Class 9 hazardous material. The shipping requirements for these fully regulated cells and batteries are more stringent. The shipping guides outlined on page 7 and the flowcharts on pages 8 and 9 make the distinction between size thresholds, when applicable, for shipping purposes.

DISPOSAL OR RECYCLING LITHIUM BATTERY PROVISIONS

FOR MOTOR VEHICLE ONLY

Lithium cells and batteries, including those contained in or packed with equipment, being shipped for disposal or recycling may qualify for certain exceptions in § 173.185(d) of the HMR. The following exceptions only apply when transported by motor vehicle to a permitted storage facility, disposal site, or for the purposes of recycling:

Many packages designed to ship lithium batteries for recycling are subject to the terms of a DOT Special Permit (DOT-SP). When utilizing packaging subject to the terms of a DOT-SP, the exact instructions of the DOT-SP provided by the manufacturer must be followed.

- UN 38.3 cell and battery testing
- UN specification packaging requirements (when packed in a strong outer packaging)

In addition, when these shipments meet the applicable size, packaging, and hazard communication conditions for “smaller” cells and batteries in § 173.185(c) of the HMR, they are also eligible for the “smaller” cells and batteries exceptions.

Please note that all other requirements of the HMR apply, including, but not limited to, protecting the lithium cells and batteries from short circuiting and from damage caused by shifting within the outer package. For more details on the requirements for a specific shipment, use the appropriate shipping guide in this document.

SHIPPING DAMAGED, DEFECTIVE, OR RECALLED LITHIUM 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 only be transported by highway, rail, or vessel. **These cells or batteries are strictly forbidden for transportation by aircraft.** Furthermore, they must be packaged according to the provisions of § 173.185(f), which include:

- Placing the cell or battery in individual, non-metallic inner packaging that completely encloses the cell or battery
- Surrounding the inner packaging with cushioning material that is non-combustible, electrically non-conductive, and absorbent
- Packaging the inner packaging in Packing Group I performance level packaging. Note that only one inner packaging may be placed in an outer packaging (i.e., only one cell or battery per package)
- Marking the outer package with an indication that the package contains a damaged battery, in addition to any other required marks and labels on the package

Note that there are no exceptions from any HMR requirements (e.g., training, shipping papers, marking, labeling) for damaged lithium cells or batteries.

Many packages designed to ship damaged, defective, or recalled batteries are subject to the terms of a DOT Special Permit (DOT-SP). When utilizing packaging subject to the terms of a DOT-SP, the exact instructions of the DOT-SP provided by the manufacturer must be followed.



SHIPPING GUIDES

For the purposes of this document, the eight ways to describe and configure packages of lithium cells and batteries, including smaller cells and batteries, are divided between ten distinct, standalone shipping guides. The shipping guides are numbered Guide 01 - Guide 10.

The flowcharts on pages 8 and 9 provide a process to navigate possible descriptions/packaging configurations. Use the flowcharts to determine the appropriate shipping guide in this document. Each shipping guide contains information on the required hazard communication, quantity limitations, and packaging. Each shipping guide also contains additional requirements or restrictions depending on the mode of transport (i.e., highway, rail, aircraft, and vessel).

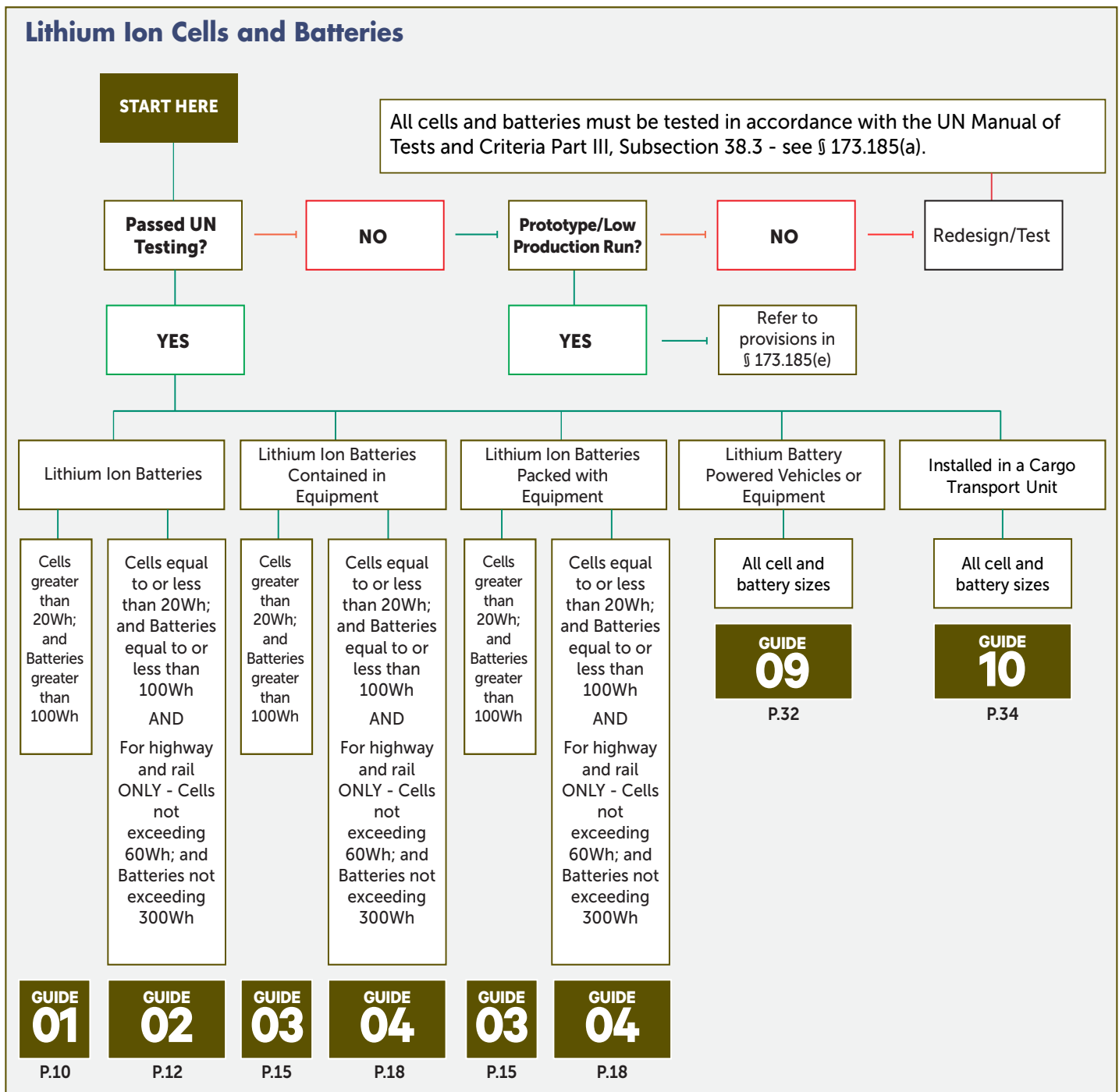
If viewing this document electronically (i.e., on a computer or device), the guide number icons below are hyperlinked to the corresponding shipping guide for quicker navigation through the document.

THE SHIPPING GUIDE NUMBERS ARE AS FOLLOWS:

GUIDE 01	UN3480 LITHIUM ION BATTERIES (FULLY REGULATED CELLS AND BATTERIES)	P. 10
GUIDE 02	UN3480 LITHIUM ION BATTERIES (SMALLER CELLS AND BATTERIES)	P. 12
GUIDE 03	UN3481 LITHIUM ION BATTERIES PACKED WITH OR CONTAINED IN EQUIPMENT (FULLY REGULATED CELLS AND BATTERIES).	P. 15
GUIDE 04	UN3481 LITHIUM ION BATTERIES PACKED WITH OR CONTAINED IN EQUIPMENT (SMALLER CELLS AND BATTERIES)	P. 18
GUIDE 05	UN3090 LITHIUM METAL BATTERIES (FULLY REGULATED CELLS AND BATTERIES)	P. 21
GUIDE 06	UN3090 LITHIUM METAL BATTERIES (SMALLER CELLS AND BATTERIES)	P. 23
GUIDE 07	UN3091 LITHIUM METAL BATTERIES PACKED WITH OR CONTAINED IN EQUIPMENT (FULLY REGULATED CELLS AND BATTERIES)	P. 26
GUIDE 08	UN3091 LITHIUM METAL BATTERIES PACKED WITH OR CONTAINED IN EQUIPMENT (SMALLER CELLS AND BATTERIES)	P. 29
GUIDE 09	UN3171 BATTERY-POWERED VEHICLE	P. 32
GUIDE 10	UN3536 CARGO TRANSPORT UNITS	P. 34

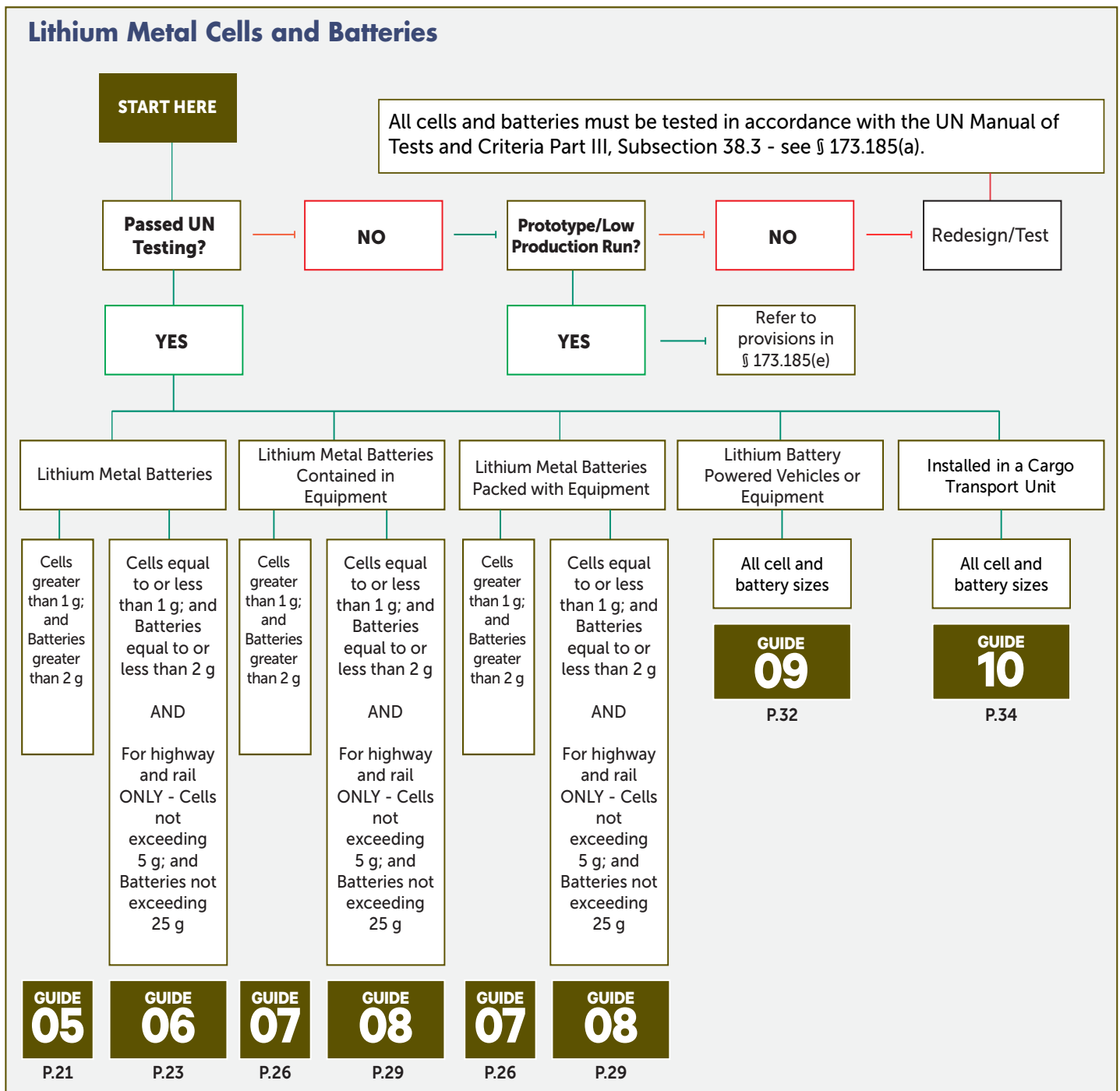
INSTRUCTIONS

Use this flowchart to direct to the appropriate guide number in this publication for information on hazard communication, quantity limits, and packaging requirements for lithium ion cells and batteries. If viewing this document electronically (i.e., on a computer or de-vice), the guide number icons below are hyperlinked to the corresponding shipping guide for quicker navigation through the document.



INSTRUCTIONS

Use this flowchart to direct to the appropriate guide number in this publication for information on hazard communication, quantity limits, and packaging requirements for lithium metal cells and batteries. If viewing this document electronically (i.e., on a computer or device), the guide number icons below are hyperlinked to the corresponding shipping guide for quicker navigation through the document.



GUIDE 01

UN3480 LITHIUM ION BATTERIES (FULLY REGULATED CELLS AND BATTERIES)

This guide outlines the requirements for lithium ion batteries being shipped as fully regulated Class 9 lithium batteries. Always check the applicable special provisions in § 172.102 for any additional requirements or restrictions that may not be included in this guide.

UN ID Number: UN3480

Proper Shipping Name: Lithium Ion Batteries

Hazard Class Label: Class 9 Lithium Battery

Packaging Requirements - § 173.185(b) (see Guide 01 diagram for additional details):

- Cells and batteries must be:
 - * Protected against short circuiting. This means that terminals must be protected!
 - * Placed in non-metallic inner packagings that completely enclose the cell or battery and separate them from contact with electrically conductive materials (e.g., metal) in the packaging.
 - * Packed to prevent shifting that could cause damage to the cells or batteries within the outer packaging.
- The outer packaging must be a UN specification packaging meeting Packing Group II performance requirements. Remember, all packaging instructions provided by the packaging manufacturer must be followed!
 - * Alternatively, instead of a UN specification package, lithium batteries with a mass of 12 kg (26.5 lbs) or more with a strong, impact-resistant outer casing, may be packed in strong outer packaging (such as crates) or banded to pallets or other handling devices. Batteries packaged in this way require Associate Administrator approval for air transport.

Required Hazard Communication – Subparts C-E of Part 172 (see Guide 01 diagram for additional details):

- Class 9 Lithium Battery label
- Cargo Aircraft Only label (if being shipped for air transport – § 172.101(j)(4))
- UN ID number – UN3480
- Proper Shipping Name mark – “Lithium ion batteries”
- Consignee (shipper) or Consignor (recipient) name and address
- When overpacked (e.g., authorized outer packagings are further packaged or consolidated by any means), the Class 9 Lithium Battery label, Cargo Aircraft Only label (as applicable), UN ID number, and Proper Shipping Name must be visible or replicated on the overpack (§ 173.25).

Additional Details:

- DOT Hazmat Employee Training – All employees involved in the shipment, including preparation for shipment are subject to the hazmat employee training requirements of § 172.704.
- Hazardous Materials Shipping Paper – Shippers must prepare and offer a hazardous materials shipping paper prepared in accordance with subpart C of part 172 of the HMR (§§ 172.200-205).
- Emergency Response Information and Emergency Response Telephone Number – Shippers must provide the appropriate emergency response information and emergency response telephone number per subpart G of part 172 of the HMR (§§ 172.600-606).

Additional Air Restrictions or Requirements:

- Damaged lithium ion batteries are forbidden from air transport. See page 6 for information on damaged batteries.
- These shipments are forbidden to be transported as cargo on passenger aircraft (column 9 of the HMT - § 172.101).

GUIDE 01

UN3480 LITHIUM ION BATTERIES (FULLY REGULATED CELLS AND BATTERIES)

Additional Air Restrictions or Requirements Cont'd:

- When shipped by cargo aircraft, the lithium ion cells and batteries must be offered at a state of charge not exceeding 30 percent of their rated capacity (special provision A100 – § 172.102).
- Packages may not exceed a 35kg net quantity of lithium ion cells and batteries, unless approved by the Associate Administrator (column 9 of the HMT - § 172.101). “Net quantity” refers to the weight of the cells and batteries, not packaging materials.
- Up to two replacement lithium ion cells and batteries specifically used for medical devices may be transported as cargo on passenger aircraft and exceeding 30 percent state of charge, when approved by the Associate Administrator, and meeting the requirements of § 173.185(g).
- Lithium ion 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) (§ 173.185 (b)(7)).

PACKAGING AND HAZARD COMMUNICATION DIAGRAM

The inner packaging must completely enclose the cells or batteries in the package. The inner packaging may also be used to meet protection against short circuiting/terminal protection requirements. See § 173.185(b)(3)(i).



Protection against short circuiting/terminal protection is an important aspect of packaging. Any method is acceptable, provided this important performance requirement is met.

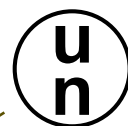
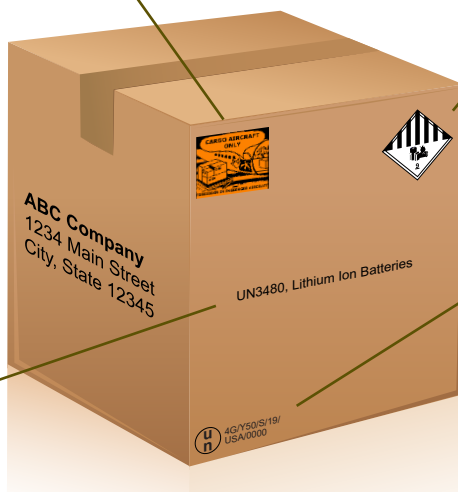


CARGO AIRCRAFT ONLY Label § 172.448
(if being shipped for air transport)



Class 9 Lithium Battery Label § 172.447

Consignee (shipper) or Consignor (recipient) Name and Address - § 172.301



**4G/Y50/S/19/
USA/0000**

Sample UN Specification Package Marking

For UN Specification packaging, always follow the packaging manufacturer's packaging and closure instructions

Authorized Specification Outer Packaging Types*:

Boxes: Metal (4A, 4B, 4N), wooden (4C1, 4C2, 4D, 4F), fiberboard (4G), or solid plastic (4H1, 4H2)

Drums: Metal (1A2, 1B2, 1N2), plywood (1D), fiber (1G), or plastic (1H2)

Jerricans: Metal (3A2, 3B2) or plastic (3H2)

See § 173.185(b)(3)(ii).

*Must be rated to the Packing Group II Performance Level

GUIDE 02

UN3480 LITHIUM ION BATTERIES (SMALLER CELLS AND BATTERIES)

This guide outlines the requirements for lithium ion batteries meeting exceptions for smaller lithium cells and batteries in § 173.185(c). Batteries manufactured after December 31, 2015, must be marked with the Wh rating. Always check the applicable special provisions in § 172.102 for any additional requirements or restrictions that may not be included in this guide.

UN ID Number: UN3480
Proper Shipping Name: Lithium ion batteries
Hazard Class Label: N/A

Packaging Requirements - § 173.185(b) (see Guide 02 diagram for additional details):

- Cells and batteries must be:
 - Protected against short circuiting. This means that terminals must be protected!
 - Placed in non-metallic inner packagings that completely enclose the cell or battery and separate them from contact with electrically conductive materials (e.g., metal) in the packaging.
 - Packed to prevent shifting that could cause damage to the cells or batteries within the outer packaging.
- Each outer package must be a strong outer packaging and capable of withstanding a 1.2 meter drop test, in any orientation, without damage to the cells or batteries, without shifting that would allow battery-to-battery contact, and without release of the contents. They are not required to be packaged in UN specification packaging.
- Completed package must not exceed 30 kg (66 pounds) gross weight. See **Additional Air Restrictions or Requirements** for the package quantity limits for air transportation.

Required Hazard Communication - § 173.185(c) (see Guide 02 diagram for additional details):

- Lithium Battery Mark
 - UN ID Number – 3480 (Replaces “*” on Lithium Battery Mark)
 - Telephone number for additional information (Replaces “**” on Lithium Battery Mark)
 - When placed in an overpack, the mark must be visible or reproduced on the overpack and the overpack must be marked with the word “OVERPACK” in lettering at least 12 mm (0.47 inches) high
- Text marking that shipment is forbidden for transport aboard passenger aircraft (see § 173.185(c)(1)(iii) for text marking options) or Cargo Aircraft Only (CAO) label (For shipments made in accordance with international standards and regulations, the CAO label may be required)
- For highway and rail transportation only: Cells that exceed 20 Wh, but do not exceed 60 Wh, and batteries that exceed 100 Wh, but do not exceed 300 Wh, the text marking “LITHIUM BATTERIES—FORBIDDEN FOR TRANSPORT ABOARD AIRCRAFT AND VESSEL” is required. (See § 173.185(c)(1)(iv)). This text marking should be used in place of the transport aboard passenger aircraft text marking or CAO label.

Additional Details - § 173.185(c):

- Hazmat employees are not subject to the training requirements of § 172.704. However, for air shipments, each person who prepares a package for shipment, must receive instruction on these requirements, corresponding to their functions.
- No Hazardous Materials Shipping Paper required
- No Emergency Response Information and Emergency Response Telephone Number required

GUIDE 02

UN3480 LITHIUM ION BATTERIES (SMALLER CELLS AND BATTERIES)

Additional Air Restrictions or Requirements - § 173.185(c)(4):

- Damaged lithium batteries are forbidden from air transport. See page 6 of this guide for information on damaged batteries.
- These shipments are forbidden to be transported as cargo on passenger aircraft. (§ 172.101).
- When shipped by cargo aircraft, lithium ion cells and batteries must be offered at a state of charge not exceeding 30 percent of their rated capacity.
- Each package may not exceed the limits in the following table:

CONTENTS	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.
Maximum net quantity (mass) per package	2.5 kg	n/a	n/a.

- Only one package of lithium cells and batteries may be placed in an overpack. If a package is placed in an overpack (i.e., consolidated or packaged further), the CAO label or forbidden for passenger air marking must be visible or affixed on the outside of the overpack.
- A shipper may not offer more than one package of smaller lithium cells or batteries in any single consignment.
- Packages 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).
- Each shipment must include an indication on the air waybill that the shipment complies with § 173.185(c)(4) or the applicable ICAO Packing Instruction, when an air waybill is used.
- Packages and overpacks of smaller lithium cells and batteries must be offered to the operator separately from cargo that is not subject to the HMR and must not be loaded into a unit load device before being offered to the operator.
- Each person who prepares a package for shipment, must receive instruction on these requirements, corresponding to their functions.
- Lithium ion cells and batteries must not be packed in the same outer packaging with other hazardous materials.
- A shipment that exceeds the quantity limitations in the table, the overpack limit, or consignment limit, must be shipped as a fully regulated lithium ion battery (See Guide I for provisions). However, if the package contains no more than 10 kg of lithium ion cells or batteries, UN specification packaging is not required when the package displays both the Lithium Battery Mark and the Class 9 Lithium Battery Label. See § 173.185(c)(5) for details.

Consignment means one or more packages accepted by an operator from one shipper at one time and at one address, received for in one lot, and moving to one consignee at one destination address.

GUIDE 02

UN3480 LITHIUM ION BATTERIES (SMALLER CELLS AND BATTERIES)

PACKAGING AND HAZARD COMMUNICATION DIAGRAM

Protection against short circuiting/terminal protection is an important aspect of packaging. Any method is acceptable, provided this important performance requirement is met.



UN Specification packaging is not required! Packaging must meet performance requirements listed in the 'Packaging Requirements' section of this shipping guide.



CARGO AIRCRAFT ONLY label **§ 172.448**

Alternatively, a text marking listed in § 173.185(c)(1)(iii) may be used, as applicable. However, the CAO label may be required for shipments made in accordance with international standards and regulations.

Text markings, when used, must use letters 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.

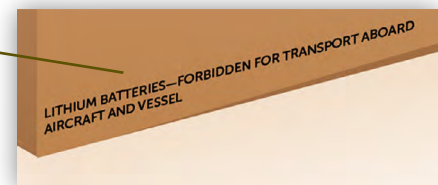
Letters must be at least 12 mm (0.5 inch) in height on packages having a gross weight of more than 30 kg (66 pounds).



Lithium Battery Mark **§ 173.185(c)(3)**

Mark must include:

- UN ID Number(s)
- Telephone Number for Additional Information About the Shipment



If cells exceed 20 Wh, but do not exceed 60 Wh, or batteries exceed 100 Wh, but do not exceed 300 Wh...

The text marking "LITHIUM BATTERIES—FORBIDDEN FOR TRANSPORT ABOARD AIRCRAFT AND VESSEL" is required. See § 173.185(c)(1)(iv). This text marking should be used in place of the transport aboard passenger aircraft marking or CAO label.

GUIDE 03

UN3481 LITHIUM ION BATTERIES PACKED WITH OR CONTAINED IN EQUIPMENT (FULLY REGULATED CELLS AND BATTERIES)

This guide outlines the requirements for lithium ion batteries packed with or contained in equipment being shipped as fully regulated Class 9 lithium batteries. Always check the applicable special provisions in § 172.102 for any additional requirements or restrictions that may not be included in this guide.

UN ID Number: UN3481

Proper Shipping Name: Lithium ion batteries packed with *or* contained in equipment

Hazard Class Label: Class 9 Lithium Battery

Packaging Requirements - § 173.185(b) (see Guide 03 diagram for additional details):

- Cells and batteries must be:
 - * Protected against short circuiting. This means that terminals must be protected!
 - * Packed to prevent shifting that could cause damage to the cells or batteries within the outer packaging.
- Equipment must be protected from accidental activation.
- For packages with lithium cells or batteries packed with equipment:
 - * Cells and batteries must be placed in non-metallic inner packagings that completely enclose the cell or battery and separate them from contact with equipment or electrically conductive materials (e.g., metal) in the packaging.
 - * A UN specification packaging meeting Packing Group II performance requirements must be used as either the outer packaging for any spare batteries or the outer packaging for both the batteries and the equipment. Remember, all packaging instructions provided by the packaging manufacturer must be followed!
- For packages with lithium cells or batteries contained in equipment:
 - * 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.
 - * Equipment must be secured to prevent damage caused by shifting within the outer packaging and be packed to prevent accidental operation during transport.

Required Hazard Communication – Subparts C-E of Part 172 (see Guide 03 diagram for additional details):

- Class 9 Lithium Battery Label
- Cargo Aircraft Only Label, if shipped by air and lithium cells or batteries exceed 5 kg net weight – § 172.101(j)(4)
- UN ID Number – UN3481
- Proper Shipping Name Mark – “Lithium ion batteries packed with equipment” or “Lithium ion batteries contained in equipment”, as appropriate.
 - * Note: if the package contains both lithium ion batteries packed with and contained in equipment, the proper shipping name is “Lithium Ion Batteries Packed with Equipment”. See special provision 181 in § 172.102.
- Consignee (shipper) or Consignor (recipient) name and address
- Per special provision 181 in § 172.102, a package containing both lithium ion and lithium metal battery chemistries must include hazard communication for both battery types (See Guide 07 for Lithium Metal Battery hazard communication requirements).
- When overpacked (e.g., authorized outer packagings are further packaged or consolidated by any means), the Class 9 Lithium Battery label, Cargo Aircraft Only label (as applicable), UN ID number, and Proper Shipping Name must be visible or replicated on the overpack (§ 173.25).

GUIDE 03

UN3481 LITHIUM ION BATTERIES PACKED WITH OR CONTAINED IN EQUIPMENT (FULLY REGULATED CELLS AND BATTERIES)

Additional Details:

- DOT Hazmat Employee Training – All employees involved in the shipment, including preparation for shipment are subject to the training requirements of § 172.704.
- Hazardous Materials Shipping Paper – Shippers must prepare and offer a hazardous materials shipping paper prepared in accordance with subpart C of part 172 of the HMR (§§ 172.200-205).
- Emergency Response Information and Emergency Response Telephone Number – Shippers must provide the appropriate emergency response information and monitored emergency response telephone number per subpart G of part 172 of the HMR (§§ 172.600-606).

Additional Air Restrictions or Requirements:

- Damaged lithium batteries are forbidden from air transport. See page 06 of this guide for information on damaged batteries.
- For passenger aircraft, the package may not exceed 5 kg net quantity (column 9 of the HMT - § 172.101). "Net quantity" refers to the weight of the batteries, not packaging materials or the equipment.
- For cargo aircraft, the package may not exceed 35 kg net quantity, unless excepted by the Associate Administrator (column 9 of the HMT - § 172.101). "Net quantity" refers to the weight of the batteries, not packaging materials or the equipment.

PACKAGING AND HAZARD COMMUNICATION DIAGRAM



OUTER PACKAGING FOR PACKED WITH EQUIPMENT VS. CONTAINED IN EQUIPMENT

For lithium batteries **PACKED** with equipment:

The outer packaging holding the batteries must meet the Packing Group II performance requirements. Batteries can be packed in this manner and then packaged with the equipment or the inner packagings containing can be packaged with the equipment in a Packing Group II performance package. For UN Specification packaging, always follow the packaging manufacturer's packaging and closure instructions.

For lithium batteries **CONTAINED** in equipment:

The outer packaging does not need to be UN Specification packaging – in fact, the equipment can be transported unpackaged if it provides adequate protection to the battery.

GUIDE 03

UN3481 LITHIUM ION BATTERIES PACKED WITH OR CONTAINED IN EQUIPMENT (FULLY REGULATED CELLS AND BATTERIES)

PACKAGING AND HAZARD COMMUNICATION DIAGRAM (Cont'd)

The inner packaging must completely enclose the cells or batteries in the package. The inner packaging may also be used to meet protection against short circuiting/terminal protection requirements. See § 173.185(b)(3)(i).



Protection against short circuiting/terminal protection is an important aspect of packaging. Any method is acceptable, provided this important performance requirement is met.



CARGO AIRCRAFT ONLY Label § 172.448
(required if shipped by air and lithium cells and batteries exceed 5 kg net weight)



Class 9 Lithium Battery Label § 172.447



Consignee (shipper) or Consignor (recipient) Name and Address - § 172.301

UN ID Number and Proper Shipping Name § 172.301

un 4G/Y50/S/19/
USA/0000

Sample UN Specification Package Marking

For UN Specification packaging, always follow the packaging manufacturer's packaging and closure instructions

Authorized Specification Outer Packaging Types*:

Boxes: Metal (4A, 4B, 4N), wooden (4C1, 4C2, 4D, 4F), fiberboard (4G), or solid plastic (4H1, 4H2)

Drums: Metal (1A2, 1B2, 1N2), plywood (1D), fiber (1G), or plastic (1H2)

Jerricans: Metal (3A2, 3B2) or plastic (3H2)

See § 173.185(b)(3)(ii).

*Must be rated to the Packing Group II Performance Level

GUIDE 04

UN3481 LITHIUM ION BATTERIES PACKED WITH OR CONTAINED IN EQUIPMENT (SMALLER CELLS AND BATTERIES)

This guide outlines the requirements for lithium ion batteries packed with or contained in equipment being sent under the smaller lithium batteries provisions of § 173.185(c). Batteries manufactured after December 31, 2015 must be marked with the Wh rating. Always check the applicable special provisions in § 172.102 for any additional requirements or restrictions that may not be included in this guide.

UN ID Number: UN3481

Proper Shipping Name: Lithium ion batteries packed with *or* contained in equipment

Hazard Class Label: N/A

Packaging Requirements - § 173.185(b) (see Guide 04 diagram for additional details):

- Cells and batteries must be:
 - Protected against short circuiting. This means that terminals must be protected!
 - Packed to prevent shifting that could cause damage to the cells or batteries within the outer packaging.
- For packages with lithium cells or batteries packed with equipment:
 - Cells and batteries must be placed in non-metallic inner packagings that completely enclose the cell or battery and separate them from contact with the equipment or electrically conductive materials (e.g., metal).
 - The outer packaging must be a strong rigid outer package that is capable of withstanding a 1.2 meter drop test without damage to the cells or batteries, without shifting that would allow battery-to-battery contact, and without release of the contents of the package.
- For packages with lithium cells or batteries contained in equipment:
 - The outer packaging must be a strong rigid outer package unless the cell or battery or battery contained in equipment are afforded equipment protection by the equipment in which they are contained.

Consignment means one or more packages 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.

Required Hazard Communication - § 173.185(c) (see Guide 04 diagram for additional details):

- Lithium Battery Mark - EXCEPT: when a package contains button cell batteries installed in equipment (including circuit board); OR when a package contains no more than four lithium cells or two lithium batteries contained in equipment, when there are no more than two packages in a consignment.
 - UN ID Number – 3481 (Replaces “*” on Lithium Battery Mark)
 - Telephone number for additional information about the shipment (Replaces “**” on Lithium Battery Mark)
 - When placed in an overpack, the mark must be visible or reproduced on the overpack and the overpack marking must be marked with the word “OVERPACK” in lettering at least 12 mm (0.47 inches) high.
- If the package exceeds 5 kg net weight of lithium batteries, text marking that shipment is Forbidden by Passenger Aircraft (see § 173.185(c)(1)(iii) for text marking options) or the Cargo Aircraft Only (CAO) Label. For shipments made in accordance with international standards and regulations, the CAO label may be required.
- For highway and rail transportation only: Cells that exceed 20 Wh, but do not exceed 60 Wh, and batteries that exceed 100 Wh, but do not exceed 300 Wh, the text marking “LITHIUM BATTERIES—FORBIDDEN FOR TRANSPORT ABOARD AIRCRAFT AND VESSEL” is required. (See § 173.185(c)(1)(iv)). This text marking should be used in place of the transport aboard passenger aircraft text marking or CAO label.

GUIDE 04

UN3481 LITHIUM ION BATTERIES PACKED WITH OR CONTAINED IN EQUIPMENT (SMALLER CELLS AND BATTERIES)

Required Hazard Communication Cont'd (see Guide 04 diagram for additional details):

- Per special provision 181 in § 172.102, a package containing both lithium ion and lithium metal battery chemistries must include hazard communication for both battery types.

Additional Details - § 173.185(c):

- Hazmat employees are not subject to the training requirements of § 172.704. However, for air shipments, each person who prepares a package for shipment, must receive instruction on these requirements, corresponding to their functions.
- No Hazardous Materials Shipping Paper required
- No Emergency Response Information and Emergency Response Telephone Number required

Additional Air Restrictions or Requirements - § 173.185(c)(4):

- Damaged lithium batteries are forbidden from air transport. See page 06 of this guide for information on damaged batteries.
- 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.
- All persons preparing a package for shipment, must receive adequate instruction on these conditions and limitations, corresponding to their functions.
- When the package must be marked with the lithium battery mark and an air waybill is used, there must be an indication on the air waybill that the shipment complies with § 173.185(c)(4) or the applicable ICAO Packing instruction.



GUIDE 04

UN3481 LITHIUM ION BATTERIES PACKED WITH OR CONTAINED IN EQUIPMENT (SMALLER CELLS AND BATTERIES)

PACKAGING AND HAZARD COMMUNICATION DIAGRAM



Any lithium cell or battery packed with equipment (i.e., spare batteries) must be placed in an inner packaging that completely encloses the cell or battery in the package. The inner packaging may also be used to meet protection against short circuiting/terminal protection requirements. See § 173.185(b)(3)(i).

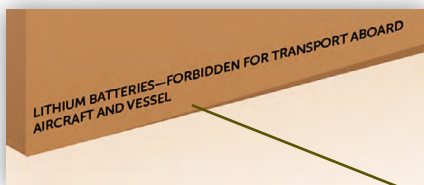


Protection against short circuiting/terminal protection is an important aspect of packaging. Equipment must also be protected from accidental activation. In addition, the packaging should prevent any damage to the batteries. Any method is acceptable, provided these important performance requirements are met.

UN Specification packaging is not required! Packaging must meet performance requirements listed in the 'Packaging Requirements' section of this shipping guide.



CARGO AIRCRAFT ONLY label § 172.448 (Only if the package exceeds 5 kg net weight of lithium batteries. Alternatively, a text marking listed in § 173.185(c)(1)(iii) may be used, as applicable. However, the CAO label may be required for shipments made in accordance with international standards.)



If cells exceed 20 Wh, but do not exceed 60 Wh, or batteries exceed 100 Wh, but do not exceed 300 Wh...

The text marking "LITHIUM BATTERIES—FORBIDDEN FOR TRANSPORT ABOARD AIRCRAFT AND VESSEL" is required. See § 173.185(c)(1)(iv).

This text marking should be used in place of the transport aboard passenger aircraft marking or CAO label.



**Lithium Battery Mark
§ 173.185(c)(3)**

Mark must include:

- UN ID Number(s)
- Telephone Number for Additional Information About the Shipment

See the Hazard Communication section of this shipping guide for exceptions from this requirement.

Text markings, when used, must use letters 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.

Letters must be at least 12 mm (0.5 inch) in height on packages having a gross weight of more than 30 kg (66 pounds).

GUIDE 05

UN3090 LITHIUM METAL BATTERIES (FULLY REGULATED CELLS AND BATTERIES)

This guide outlines the requirements for lithium metal batteries being shipped as fully regulated Class 9 lithium batteries. Always check the applicable special provisions in § 172.102 for any additional requirements or restrictions that may not be included in this guide.

UN ID Number: UN3090

Proper Shipping Name: Lithium metal batteries

Hazard Class Label: Class 9 Lithium Battery

Packaging Requirements - §173.185(b)(see Guide 05 diagram for additional details):

- Cells and batteries must be:
 - * Protected against short circuiting. This means that terminals must be protected!
 - * Placed in non-metallic inner packagings that completely enclose the cell or battery and separate them from contact with electrically conductive materials (e.g., metal) in the packaging.
 - * Packed to prevent shifting that could cause damage to the cells or batteries within the outer packaging.
- The outer packaging must be a UN specification packaging meeting Packing Group II performance requirements. Remember, all packaging instructions provided by the packaging manufacturer must be followed!
 - * Alternatively, instead of a UN specification package, lithium batteries with a mass of 12 kg (26.5 lbs) or more with a strong, impact-resistant outer casing, may be packed in strong outer packaging (such as crates) or banded to pallets or other handling devices. Batteries packaged in this way require Associate Administrator approval for air transport.

Required Hazard Communication – Subparts C-E of Part 172 (see Guide 05 diagram for additional details):

- Class 9 Lithium Battery Label
- Cargo Aircraft Only Label (if being shipped for air transport) – § 172.101(j)(4)
- UN ID Number – UN3090
- Proper Shipping Name Mark – “Lithium metal batteries”
- Consignee (shipper) or Consignor (recipient) name and address
- When overpacked (e.g., authorized outer packagings are further packaged or consolidated by any means), the Class 9 Lithium Battery label, Cargo Aircraft Only label (as applicable), UN ID number, and Proper Shipping Name must be visible or replicated on the overpack (§ 173.25).

Additional Details:

- DOT Hazmat Employee Training – All employees involved in the shipment, including preparation for shipment are subject to the hazmat employee training requirements of § 172.704.
- Hazardous Materials Shipping Paper – Shippers must prepare and offer a hazardous materials shipping paper prepared in accordance with subpart C of part 172 of the HMR (§§ 172.200-205).
- Emergency Response Information and Emergency Response Telephone Number – Shippers must provide the appropriate emergency response information and emergency response telephone number per subpart G of part 172 of the HMR (§§ 172.600-606).

Additional Air Restrictions or Requirements:

- Damaged lithium batteries and batteries are forbidden from air transport. See page 6 of this guide for information on damaged batteries.

GUIDE 05

UN3090 LITHIUM METAL BATTERIES (FULLY REGULATED CELLS AND BATTERIES)

Additional Air Restrictions or Requirements Cont'd:

- These shipments are forbidden to be transported as cargo on passenger aircraft (column 9 of the HMT - § 172.101).
- These shipments may not exceed 35 kg net quantity, unless they are approved by the Associate Administrator (column 9 of the HMT - § 172.101). "Net quantity" refers to the weight of the batteries, not packaging materials.
- Up to two replacement lithium metal cells and batteries specifically used for medical devices may be transported as cargo on passenger aircraft, when approved by the Associate Administrator, and meeting the requirements of § 173.185(g).
- Lithium metal 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) (§ 173.185(b)(7)).

PACKAGING AND HAZARD COMMUNICATION DIAGRAM

The inner packaging must completely enclose the cells or batteries in the package. The inner packaging may also be used to meet protection against short circuiting/terminal protection requirements. See § 173.185(b)(3)(i).



Protection against short circuiting/terminal protection is an important aspect of packaging. Any method is acceptable, provided this important performance requirement is met.



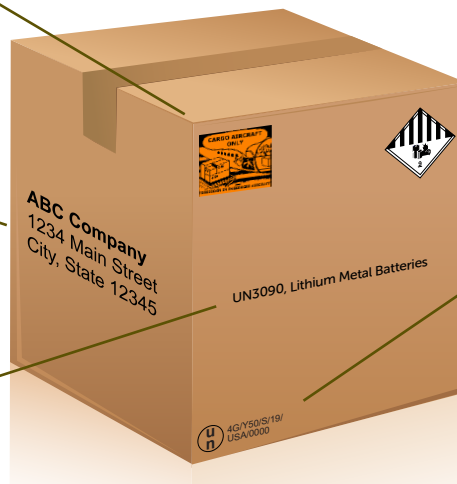
CARGO AIRCRAFT ONLY Label § 172.448
(if being shipped for air transport)



Class 9 Lithium Battery Label § 172.447

**Consignee (shipper) or
Consignor (recipient)
Name and Address -
§ 172.301**

**UN ID Number and
Proper Shipping Name -
§ 172.301**



**4G/Y50/S/19/
USA/0000**

Sample UN Specification Package Marking

For UN Specification packaging, always follow the packaging manufacturer's packaging and closure instructions

Authorized Specification Outer Packaging Types*:

Boxes: Metal (4A, 4B, 4N), wooden (4C1, 4C2, 4D, 4F), fiberboard (4G), or solid plastic (4H1, 4H2)

Drums: Metal (1A2, 1B2, 1N2), plywood (1D), fiber (1G), or plastic (1H2)

Jerricans: Metal (3A2, 3B2) or plastic (3H2)

See § 173.185(b)(3)(ii).

*Must be rated to the Packing Group II Performance Level

GUIDE 06

UN3090 LITHIUM METAL BATTERIES (SMALLER CELLS AND BATTERIES)

This guide outlines the requirements for lithium metal batteries being sent under the smaller lithium batteries provisions of § 173.185(c). Always check the applicable special provisions in § 172.102 for any additional requirements or restrictions that may not be included in this guide.

UN ID Number: UN3090

Proper Shipping Name: Lithium metal batteries

Hazard Class Label: Class 9 Lithium Battery

Packaging Requirements - § 173.185(b) (see Guide 06 diagram for additional details):

- Cells and batteries must be:
 - Protected against short circuiting. This means that terminals must be protected!
 - Placed in non-metallic inner packagings that completely enclose the cell or battery and separate them from contact with electrically conductive materials (e.g., metal) in the packaging.
 - Packed to prevent shifting that could cause damage to the cells or batteries within the outer packaging.
- Each outer package must be a strong outer packaging and capable of withstanding a 1.2 meter drop test, in any orientation, without damage to the cells or batteries, without shifting that would allow battery-to-battery contact, and without release of the contents. They are not required to be packaged in UN specification packaging.
- Completed package must not exceed 30 kg (66 pounds) gross weight. See Additional Air Restrictions or Requirements for the package quantity limits for air transportation.

Required Hazard Communication - § 173.185(c) (see Guide 06 diagram for additional details):

- Lithium Battery Mark
 - UN ID Number – 3090 (Replaces “*” on Lithium Battery Mark)
 - Telephone number for additional information about the shipment (Replaces “***” on Lithium Battery Mark)
 - When placed in an overpack, the mark must be visible or reproduced on the overpack and the overpack must be marked with the word “OVERPACK” in lettering at least 12 mm (0.47 inches) high
- Text marking that shipment is forbidden for transport aboard passenger aircraft (see § 173.185(c)(1)(iii) for text marking options) or Cargo Aircraft Only (CAO) Label (For shipments made in accordance with international standards and regulations, the CAO label may be required)
- For highway and rail transportation only: Cells that exceed 1g, but do not exceed 5g, and batteries that exceed 2g, but do not exceed 25g, the text marking “LITHIUM BATTERIES—FORBIDDEN FOR TRANSPORT ABOARD AIRCRAFT AND VESSEL” is required. (See § 173.185(c)(1)(iv)). This text marking should be used in place of the transport aboard passenger aircraft text marking or CAO label.

Additional Details - § 173.185(c):

- Hazmat employees are not subject to the training requirements of § 172.704. However, for air shipments, each person who prepares a package for shipment, must receive instruction on these requirements, corresponding to their functions.
- No Hazardous Materials Shipping Paper required
- No Emergency Response Information and Emergency Response Telephone Number is not required

GUIDE 06

UN3090 LITHIUM METAL BATTERIES (SMALLER CELLS AND BATTERIES)

Additional Air Restrictions or Requirements - § 173.185 (c)(4):

- Damaged lithium batteries are forbidden from air transport. See page 06 of this guide for information on damaged batteries.
- These shipments are forbidden to be transported as cargo on passenger aircraft.
- Each package may not exceed the limits in the following table:

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
Maximum number of cells/batteries per package	No Limit	8 cells	2 batteries.
Maximum net quantity (mass) per package	2.5 kg	n/a	n/a.

- Only one package of lithium cells and batteries may be placed in an overpack. If a package is placed in an overpack (i.e., consolidated or packaged further), the CAO label or forbidden for passenger air marking must be visible or affixed on the outside of the overpack.
- A shipper may not offer more than one package of smaller lithium cells or batteries in any single consignment.
- Packages 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).
- Each shipment must include an indication on the air waybill that the shipment complies with § 173.185(c)(4) or the applicable ICAO Packing instruction, when an air waybill is used.
- Packages and overpacks of smaller lithium cells and batteries must be offered to the operator separately from cargo that is not subject to the HMR and must not be loaded into a unit load device before being offered to the operator.
- Each person who prepares a package for shipment, must receive instruction on these requirements, corresponding to their functions.
- Lithium metal cells and batteries must not be packed in the same outer packaging with other hazardous materials.
- A shipment that exceeds the quantity limitations in the table, the overpack limit, or consignment limit, must be shipped as a fully regulated lithium metal battery (See Guide 05 for provisions). However, if the package contains no more than 2.5 kg of lithium metal cells or batteries, UN performance packaging is not required when the package displays both the Lithium Battery Mark and the Class 9 Lithium Battery Label. See § 173.185(c)(5) for details.

Consignment means one or more packages 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.

GUIDE 06

UN3090 LITHIUM METAL BATTERIES (SMALLER CELLS AND BATTERIES)

PACKAGING AND HAZARD COMMUNICATION DIAGRAM

Protection against short circuiting/terminal protection is an important aspect of packaging. Any method is acceptable, provided this important performance requirement is met.



UN Specification packaging is not required! Packaging must meet performance requirements listed in the 'Packaging Requirements' section of this shipping guide.



CARGO AIRCRAFT ONLY label § 172.448

Alternatively, a text marking listed in § 173.185(c)(1)(iii) may be used, as applicable. However, the CAO label may be required for shipments made in accordance with international standards and regulations.

Text markings, when used, must use letters 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.

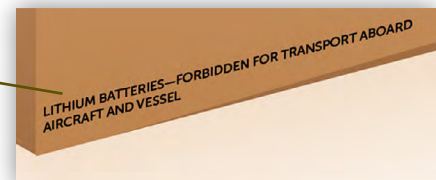
Letters must be at least 12 mm (0.5 inch) in height on packages having a gross weight of more than 30 kg (66 pounds).



Lithium Battery Mark § 173.185(c)(3)

Mark must include:

- UN ID Number(s)
- Telephone Number for Additional Information About the Shipment



If cells exceed 1g, but do not exceed 5g, or batteries exceed 2g, but do not exceed 25g...

The text marking "LITHIUM BATTERIES—FORBIDDEN FOR TRANSPORT ABOARD AIRCRAFT AND VESSEL" is required. See § 173.185(c)(1)(iv).

This text marking should be used in place of the transport aboard passenger aircraft marking or CAO label.

GUIDE 07

UN3091 LITHIUM METAL BATTERIES PACKED WITH OR CONTAINED IN EQUIPMENT (FULLY REGULATED CELLS AND BATTERIES)

This guide outlines the requirements for lithium metal batteries packed with or contained in equipment being shipped as fully regulated Class 9 lithium batteries. Always check the applicable special provisions in § 172.102 for any additional requirements or restrictions that may not be included in this guide.

UN ID Number: UN3091

Proper Shipping Name: Lithium metal batteries packed with *or* contained in equipment

Hazard Class Label: Class 9 Lithium Battery

Packaging Requirements - § 173.185(b) (see Guide 07 diagram for additional details):

- Cells and batteries must be:
 - Protected against short circuiting. This means that terminals must be protected!
 - Packed to prevent shifting that could cause damage to the cells or batteries within the outer packaging.
- Equipment must be protected from accidental activation.
- For packages with lithium cells or batteries packed with equipment:
 - Cells and batteries must be placed in non-metallic inner packagings that completely enclose the cell or battery and separate them from contact with equipment or electrically conductive materials (e.g., metal) in the packaging.
 - A UN specification packaging meeting Packing Group II performance requirements must be used as either the outer packaging for any spare batteries or the outer packaging for both the batteries and the equipment. Remember, all packaging instructions provided by the packaging manufacturer must be followed!
- For packages with lithium cells or batteries contained in equipment:
 - 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.
 - Equipment must be secured to prevent damage caused by shifting within the outer packaging and be packed to prevent accidental operation during transport.

Required Hazard Communication – Subparts C-E of Part 172 (see Guide 07 diagram for additional details):

- Class 9 Lithium Battery Label
- Cargo Aircraft Only Label, if shipped by air and lithium cells or batteries exceed 5 kg net weight – § 172.101(j)(4)
- UN ID Number – UN3091
- Proper Shipping Name Mark – “Lithium metal batteries packed with equipment” or “Lithium metal batteries contained in equipment”, as appropriate.
 - Note: if the package contains both lithium metal batteries packed with and contained in equipment, the proper shipping name is “Lithium metal batteries packed with equipment”. See special provision 181 in § 172.102.
- Consignee (shipper) or Consignor (recipient) name and address
- Per special provision 181 in § 172.102, a package containing both lithium ion and lithium metal battery chemistries must include hazard communication for both battery types.
- When overpacked (e.g., authorized outer packagings are further packaged or consolidated by any means), the Class 9 Lithium Battery label, Cargo Aircraft Only label (as applicable), UN ID number, and Proper Shipping Name must be visible or replicated on the overpack (§ 173.25).

GUIDE 07

UN3091 LITHIUM METAL BATTERIES PACKED WITH OR CONTAINED IN EQUIPMENT (FULLY REGULATED CELLS AND BATTERIES)

Additional Details:

- DOT Hazmat Employee Training – All employees involved in the shipment, including preparation for shipment are subject to the training requirements of § 172.704.
- Hazardous Materials Shipping Paper – Shippers must prepare and offer a hazardous materials shipping paper prepared in accordance with subpart C of part 172 of the HMR (§§ 172.200-205).
- Emergency Response Information and Emergency Response Telephone Number – Shippers must provide the appropriate emergency response information and monitored emergency response telephone number per subpart G of part 172 of the HMR (§§ 172.600-606).

Additional Air Restrictions or Requirements:

- Damaged lithium batteries are forbidden from air transport. See page 06 of this guide for information on damaged batteries.
- For passenger aircraft, the package may not exceed 5 kg net quantity. "Net quantity" refers to the weight of the batteries, not packaging materials or the equipment (column 9 of the HMT - § 172.101).
- For cargo aircraft, the package may not exceed 35 kg net quantity, unless excepted by the Associate Administrator. 'Net quantity' refers to the weight of the batteries, not packaging materials or the equipment (column 9 of the HMT - § 172.101).
- Per special provision A101, the quantity of lithium metal in batteries contained in any piece of equipment must not exceed 12g per cell and 500g per battery.

PACKAGING AND HAZARD COMMUNICATION DIAGRAM

OUTER PACKAGING FOR PACKED WITH EQUIPMENT VS. CONTAINED IN EQUIPMENT

For lithium batteries **PACKED** with equipment:

The outer packaging holding the batteries must meet the Packing Group II performance requirements. Batteries can be packed in this manner and then packaged with the equipment or the inner packagings containing can be packaged with the equipment in a Packing Group II performance package. For UN Specification packaging, always follow the packaging manufacturer's packaging and closure instructions.

For lithium batteries **CONTAINED** in equipment:

The outer packaging does not need to be UN Specification packaging – in fact, the equipment can be transported unpackaged if it provides adequate protection to the battery.



GUIDE 07

UN3091 LITHIUM METAL BATTERIES PACKED WITH OR CONTAINED IN EQUIPMENT (FULLY REGULATED CELLS AND BATTERIES)

PACKAGING AND HAZARD COMMUNICATION DIAGRAM

The inner packaging must completely enclose the cells or batteries in the package. The inner packaging may also be used to meet protection against short circuiting/terminal protection requirements. See § 173.185(b)(3)(i).



Protection against short circuiting/terminal protection is an important aspect of packaging. Any method is acceptable, provided this important performance requirement is met.



CARGO AIRCRAFT ONLY Label § 172.448
(required if shipped by air and lithium cells and batteries exceed 5 kg net weight)



Class 9 Lithium Battery Label § 172.447



Consignee (shipper) or Consignor (recipient) Name and Address - § 172.301

UN ID Number and Proper Shipping Name - § 172.301

u n 4G/Y50/S/19/
USA/0000

Sample UN Specification Package Marking

For UN Specification packaging, always follow the packaging manufacturer's packaging and closure instructions

Authorized Specification Outer Packaging Types*:

Boxes: Metal (4A, 4B, 4N), wooden (4C1, 4C2, 4D, 4F), fiberboard (4G), or solid plastic (4H1, 4H2)

Drums: Metal (1A2, 1B2, 1N2), plywood (1D), fiber (1G), or plastic (1H2)

Jerricans: Metal (3A2, 3B2) or plastic (3H2)

See § 173.185(b)(3)(ii).

*Must be rated to the Packing Group II Performance Level

GUIDE 08

UN3091 LITHIUM METAL BATTERIES PACKED WITH OR CONTAINED IN EQUIPMENT (SMALLER CELLS AND BATTERIES)

This guide outlines the requirements for lithium metal batteries packed with or contained in equipment being sent under the smaller lithium batteries provisions of § 173.185(c). Always check the applicable special provisions in § 172.102 for any additional requirements or restrictions that may not be included in this guide.

UN ID Number: UN3091

Proper Shipping Name: Lithium metal batteries packed with or contained in equipment

Hazard Class Label: N/A

Packaging Requirements - § 173.185(b) (see Guide 08 diagram for additional details):

- Cells and batteries must be:
 - Protected against short circuiting. This means that terminals must be protected!
 - Packed to prevent shifting that could cause damage to the cells or batteries within the outer packaging.
- For packages with lithium cells or batteries packed with equipment:
 - Cells and batteries must be placed in non-metallic inner packagings that completely enclose the cell or battery and separate them from contact with the equipment or electrically conductive materials (e.g., metal).
 - The outer packaging must be a strong rigid outer package that is capable of withstanding a 1.2 meter drop test without damage to the cells or batteries, without shifting that would allow battery-to-battery contact, and without release of the contents of the package.
- For packages with lithium cells or batteries contained in equipment:
 - The outer packaging must be a strong rigid outer package unless the cell or battery or battery contained in equipment are afforded equipment protection by the equipment in which they are contained.

Consignment means one or more packages 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.

Required Hazard Communication - § 173.185(c) (see Guide 08 diagram for additional details):

- Lithium Battery Mark - EXCEPT: when a package contains button cell batteries installed in equipment (including circuit board); OR when a package contains no more than four lithium cells or two lithium batteries contained in equipment, when there are no more than two packages in a consignment.
 - UN ID Number – 3091 (Replaces ‘*’ on Lithium Battery Mark)
 - Telephone number for additional information about the shipment (Replaces ‘**’ on Lithium Battery Mark)
 - When placed in an overpack, the mark must be visible or reproduced on the overpack and the overpack must be marked with the word "OVERPACK" in lettering at least 12 mm (0.47 inches) high.
- If the package exceeds 5 kg net weight of lithium batteries, text marking that shipment is Forbidden by Passenger Aircraft (see § 173.185(c)(1)(iii) for text marking options) or Cargo Aircraft Only (CAO) Label. For shipments made in accordance with international standards and regulations, the CAO label may be required.
- For highway and rail transportation only: Cells that exceed 1g, but do not exceed 5g, and batteries that exceed 2g, but do not exceed 25g, the text marking “LITHIUM BATTERIES—FORBIDDEN FOR TRANSPORT ABOARD AIRCRAFT AND VESSEL” is required. (See § 173.185(c)(1)(iv)). This text marking should be used in place of the transport aboard passenger aircraft text marking or CAO label.
- Per special provision 181 in § 172.102, a package containing both lithium ion and lithium metal battery chemistries must include hazard communication for both battery types.

GUIDE 08

UN3091 LITHIUM METAL BATTERIES PACKED WITH OR CONTAINED IN EQUIPMENT (SMALLER CELLS AND BATTERIES)

Additional Details - § 173.185(c):

- Hazmat employees are not subject to the training requirements of § 172.704. However, for air shipments, each person who prepares a package for shipment, must receive instruction on these requirements, corresponding to their functions.
- No Hazardous Materials Shipping Paper required
- No Emergency Response Information and Emergency Response Telephone Number required

Additional Air Restrictions or Requirements - §173.185(c)(4):

- Damaged lithium batteries are forbidden from air transport. See page 06 of this guide for information on damaged batteries.
- 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.
- All persons preparing a package for shipment, must receive adequate instruction on these conditions and limitations, corresponding to their functions.
- When the package must be marked with the lithium battery mark and an air waybill is used, there must be an indication on the air waybill that the shipment complies with § 173.185(c)(4) or the applicable ICAO Packing instruction.



GUIDE 08

UN3091 LITHIUM METAL BATTERIES PACKED WITH OR CONTAINED IN EQUIPMENT (SMALLER CELLS AND BATTERIES)

PACKAGING AND HAZARD COMMUNICATION DIAGRAM



Any lithium cell or battery packed with equipment (i.e., spare batteries) must be placed in an inner packaging that completely encloses the cell or battery in the package. The inner packaging may also be used to meet protection against short circuiting/terminal protection requirements. See § 173.185(b)(3)(i).

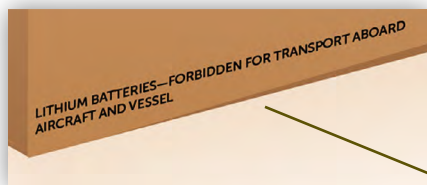


Protection against short circuiting/terminal protection is an important aspect of packaging. Equipment must also be protected from accidental activation. In addition, the packaging should prevent any damage to the batteries. Any method is acceptable, provided these important performance requirements are met. See § 173.185(b)(2).

UN Specification packaging is not required! Packaging must meet performance requirements listed in the 'Packaging Requirements' section of this shipping guide.



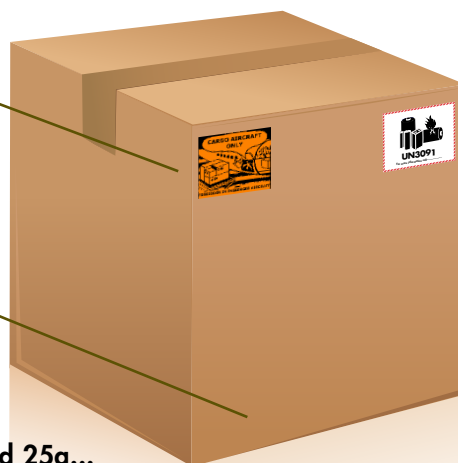
CARGO AIRCRAFT ONLY label § 172.448 (Only if the package exceeds 5 kg net weight of lithium batteries. Alternatively, a text marking listed in § 173.185(c)(1)(iii) may be used, as applicable. However, the CAO label may be required for shipments made in accordance with international standards and regulations.)



If cells exceed 1g, but do not exceed 5g, or batteries exceed 2g, but do not exceed 25g...

The text marking "LITHIUM BATTERIES—FORBIDDEN FOR TRANSPORT ABOARD AIRCRAFT AND VESSEL" is required. See § 173.185(c)(1)(iv).

This text marking should be used in place of the transport aboard passenger aircraft marking or CAO label.



**Lithium Battery Mark
§ 173.185(c)(3)**

Mark must include:

- UN ID Number(s)
- Telephone Number for Additional Information About the Shipment

See the Hazard Communication section of this shipping guide for exceptions from this requirement.

Text markings, when used, must use letters 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.

Letters must be at least 12 mm (0.5 inch) in height on packages having a gross weight of more than 30 kg (66 pounds).

See § 173.185(c)(v) & (vi).

GUIDE 09

UN3171 BATTERY-POWERED VEHICLE

This guide only applies to vehicles powered by lithium ion or metal batteries, where the lithium battery is installed in the vehicle. Vehicles are self-propelled apparatus designed to carry one or more persons or goods. Examples of such vehicles include electrically-powered cars, motorcycles, scooters, three- and four-wheeled vehicles or motorcycles, trucks, locomotives, bicycles (pedal cycles with an electric motor) and other vehicles of this type (e.g. self-balancing vehicles or vehicles not equipped with at least one seating position), lawn tractors, self-propelled farming and construction equipment, boats, aircraft, wheelchairs and other mobility aids.

Equipment powered by lithium ion or metal batteries must be consigned under the entries “Lithium metal batteries contained in equipment” (Guide 07 or 08), “Lithium metal batteries packed with equipment” (Guide 07 or 08), “Lithium ion batteries contained in equipment” (Guide 03 or 04), or “Lithium ion batteries packed with equipment” (Guide 03 or 04). Examples of equipment include lawnmowers, cleaning machines or model boats and model aircraft.

See Special Provision 134 in § 172.102 for additional applicability information that may not be included in this guide.

UN ID Number: UN3171

Proper Shipping Name: Battery-powered vehicle

Hazard Class Label: Class 9 Miscellaneous

Shipping Requirements (§ 173.220):

- Vehicles powered by lithium metal batteries that are transported with these batteries installed are forbidden aboard passenger-carrying aircraft.
- Lithium batteries contained in vehicles, engines, or mechanical equipment must be securely fastened in the battery holder of the vehicle, engine, or mechanical equipment, and be protected in such a manner as to prevent damage and short circuits (e.g., using non-conductive caps that cover the terminals entirely).
- Except for vehicles transported by highway, rail, or vessel with prototype or low production lithium batteries securely installed, each lithium battery must be of a type that has successfully passed the UN 38.3 tests, unless approved by Associate Administrator.
- Items containing other hazardous materials, such as fire extinguishers, compressed gas accumulators, safety devices, and other hazardous materials that are both integral components of a motor vehicle, engine, or mechanical equipment and necessary for the operation of the vehicle, engine, or mechanical equipment, or for the safety of its operator or passengers must be securely installed in the motor vehicle, engine, or mechanical equipment.
- If a vehicle can be handled in other than an upright position, the vehicle must be secured in a strong, rigid outer packaging. The vehicle must be secured by means capable of restraining the vehicle in the outer packaging to prevent any shifting during transport which would change the orientation or cause the vehicle to be damaged.
- Where the lithium battery is removed from the vehicle and is packed separate from the vehicle in the same outer packaging, the package must be consigned as “UN 3481, Lithium ion batteries packed with equipment” (Guide 03 or 04) or “UN 3091, Lithium metal batteries packed with equipment” (Guide 07 or 08).
- Any equipment (other than the vehicle, engine, or mechanical equipment), such as consumer electronic devices containing lithium batteries, must be described as “Lithium metal batteries contained in equipment” (Guide 07 or 08) or “Lithium ion batteries contained in equipment,” (Guide 03 or 04) must be transported in accordance with any applicable requirements of the HMR.
- Shipments made in conformance with these provisions (§ 173.220) are not subject to any other HMR requirements for transportation by motor vehicle and rail car.

Additional Vessel Transport Requirements (§§ 176.905/906):

- See § 176.905 for additional requirements and exceptions for vehicles and § 176.906 for additional requirements and exceptions for engines.
- Vessel shipments conforming to any applicable requirements in §§ 173.220, 176.905, and 176.906 are not subject to any other requirements of the HMR.

GUIDE 09

UN3171 BATTERY-POWERED VEHICLE

Additional Air Transport Requirements - §§ 173.220 & 173.27:

- See §§ 173.220 and 173.27 for any additional requirements for air transport.
- For transportation by aircraft, shipments in conformance with the applicable requirements in §§ 173.220 and 173.27 are not subject to:
 - The requirements of subparts D, E, and F (marking, labeling and placarding, respectively) of part 172
 - Emergency response telephone requirements (§ 172.604)
- NOTE: All other applicable HMR requirements, including training, shipping papers, emergency response information, notification of pilot-in-command, general packaging requirements, and the requirements specified in § 173.27 must be met.

Lithium battery must be securely fastened in the battery holder



Vehicles that can be handled in non-upright positions (e.g., scooters, hoverboards, or bikes) must be secured in a strong, rigid outer package. The vehicles must be secured in a manner to prevent changes in orientation or damage to the vehicle.

Lithium batteries must be protected from damage and short circuit (e.g., by using non-conductive caps to cover terminals)



GUIDE 10

UN3536 Cargo Transport Units

This guide only applies to lithium ion batteries or lithium metal batteries installed in a cargo transport unit and designed only to provide power external to the cargo transport unit.

UN ID Number: UN3536

Proper Shipping Name: Lithium batteries installed in cargo transport unit *lithium ion batteries or lithium metal batteries*

Hazard Class Label: N/A (see Required Hazard Communication for additional details)

Transport Requirements - § 172.102, Special Provision 389:

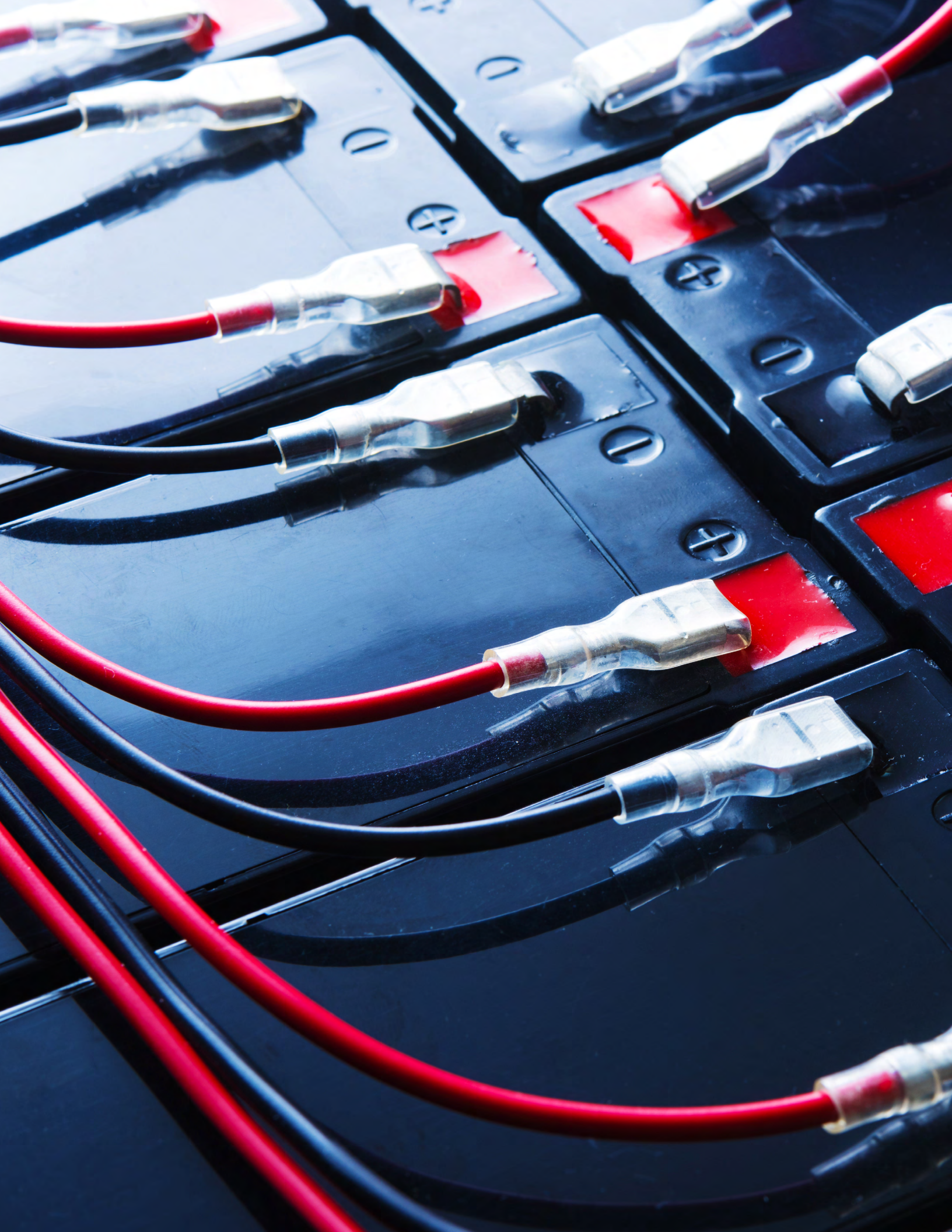
- The lithium batteries must be of a type that have successfully passed the UN38.3 tests and contain the necessary systems to prevent overcharge and over discharge between the batteries.
- The lithium batteries must be securely attached to the interior structure of the cargo transport unit (e.g., by means of placement in racks, cabinets, etc.) in such a manner as to prevent short circuits, accidental operation, and significant movement relative to the cargo transport unit under the shocks, loadings, and vibrations normally incident to transport.
- Hazardous materials necessary for the safe and proper operation of the cargo transport unit (e.g., fire extinguishing systems and air conditioning systems), must be properly secured to or installed in the cargo transport unit and are not otherwise subject to the requirements of the HMR.
- Hazardous materials not necessary for the safe and proper operation of the cargo transport unit must not be transported within the cargo transport unit.

Required Hazard Communication - § 172.102, Special Provision 389 (see Guide 10 diagram for additional details):

- The batteries inside the cargo transport unit are not subject any marking or labeling requirements.
- The cargo transport unit must display the UN ID number (3536) on an orange panel, white square on point, or a Class 9 placard. The three options for displaying the UN ID number are displayed in the diagram below.
- The cargo transport unit must be placarded on two opposing sides with the Class 9 placard.
- Transportation by aircraft is forbidden, unless approved by the Associate Administrator.

PACKAGING AND HAZARD COMMUNICATION DIAGRAM







**For additional information contact:
PHMSA's Hazardous Materials Info Center**

1-800-HMR-4922

(1-800-467-4922)

Email: infocntr@dot.gov

<http://hazmat.dot.gov>

**Pipeline and Hazardous Materials
Safety Administration**

Outreach, Engagement, and Grants Division

East Building, 2nd Floor

1200 New Jersey Ave., SE

Washington, DC 20590

Email: training@dot.gov

202-366-4900

202-366-7342 (Fax)



U.S. Department
of Transportation

**Pipeline and
Hazardous Materials
Safety Administration**

PHH50-0186-0921