

**Battery Packaging
Guidelines**

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Battery Packaging Guidelines

Veolia ES Technical Solutions, LLC (Veolia) has developed these guidelines for packaging batteries in an effort to provide its customers with instructions on how to safely package and ship batteries for recycling or disposal. By following these proper packaging methods, any potential hazards will be minimized while the batteries are accumulated at the generator's location as well as during transportation to a recycling or disposal facility.

Historically, there were several incidents reported where a fire occurred as a result of small batteries being improperly packed in a drum. Veolia's goal is to assure that all batteries it manages are properly packaged and therefore the risk of such an incident occurring is minimized.

All batteries pose potential hazards during transportation, therefore it is imperative that all batteries comply with the proper US Department of Transportation (USDOT) packaging requirements that are referenced in this document. These guidelines were specifically developed to address the shipment of batteries by highway, rail and cargo vessel. Additional requirements may apply to air shipments.

General Guidelines Applicable to All Batteries Regardless of Type or Size

- Only chemically compatible battery types should be packed in the same package. Do not mix acidic batteries with alkaline batteries.
- USDOT requires that all batteries be packaged in a manner to prevent short circuiting and damage to the terminals. Acceptable methods for short circuit prevention and terminal protection are described in the next section of this document
- Note that batteries with recessed terminals in which damage to the terminals or short circuits would not occur and those batteries that fall under the exception for 9-volts or less as described below do not require additional short circuit protection.
- All methods employed to protect from short circuit and to protect the terminals of the batteries must be adequate to withstand conditions normally incident to transportation. This includes the effects of shifting and vibration caused during transportation and subsequent handling!
- All batteries should be stored in a cool, dry environment.
- Leaking batteries must be individually packaged and may require shipment as an EPA hazardous waste.
- Incident reporting in accordance with §171.16 is required for ALL incidents involving shipments of batteries or battery-powered devices including fire, violent rupture, explosion, or a dangerous evolution of heat. This requirement applies to all battery shipments, including batteries that are excepted from the HMR requirements.

Exception for Spent Batteries of the Type "Batteries, Dry, Sealed, n.o.s." With a Marked rating of 9-volts or Less

In accordance with 49 CFR 172.102, Special Provision 130, used or spent dry, sealed batteries of both non-rechargeable and rechargeable designs, described as "Batteries, dry, sealed, n.o.s." and are not specifically covered by another proper shipping name, with a marked rating up to 9-volts are not likely to generate a dangerous quantity of heat, short circuit, or create sparks in transportation. Therefore, used or spent batteries of the type "Batteries, dry, sealed, n.o.s." with a marked rating of 9-volts or less that are combined in the same package and transported by highway or rail for recycling, reconditioning, or disposal are not subject to the regulation and do not require terminal protection or protection against short circuiting. Note that batteries utilizing different chemistries (i.e., those battery chemistries specifically covered by another entry in the §172.101 Table) as well as dry batteries with a marked rating greater than 9-volt may not be combined with used or spent batteries in the same package.



Health and Safety Considerations

Many batteries contain toxic and/or corrosive materials. While intact, these batteries do not pose a health or safety hazard during use. However, if a battery becomes damaged there is a potential for exposure to these hazardous materials. If a battery becomes damaged or begins to leak consult a Safety Data Sheet from the manufacturer of the battery to obtain applicable health and safety data.

Battery Specific Information

The following pages contain specific packaging requirements for the most common battery types currently available. If you have a specialty battery that is not identified in the following guidelines please contact your customer service representative for specific packaging requirements (i.e. special use batteries, thermal batteries, etc.).

The battery specific packaging information contained in this document is strictly to be used as guidance when packaging batteries. Per USDOT regulation and agency guidance documents, any electrical device, even one not otherwise subject to the HMR (either by specific exception from the HMR, or because the device and its power source contains no material meeting the definition of a hazardous material), is forbidden from being offered for transportation, or transported, if the device is likely to create sparks or a dangerous evolution of heat, unless packaged in a manner that precludes such an occurrence.

For some batteries the packaging guidelines contained within this document may be more stringent than the USDOT packaging requirements. If circumstances dictate the use of a packaging method that is authorized by the USDOT but not listed in this document is required, authorization must be obtained from the Veolia Corporate Transportation Department.

Exceptions to these packaging procedures must be approved by Veolia Branch and Corporate EHS&T management. Packaging policy exceptions will only be approved when it can be shown that (1) the alternative packaging scenario complies with USDOT requirements, and (2) the packaging required by company policy is not feasible or practical to use given the unique characteristics of the batteries or the customer project.

The document will be amended as additional information regarding battery packaging is available.



PREVENT SHORT CIRCUITS AND PROTECT BATTERY TERMINALS

All batteries with exposed terminals must be packaged in a manner to prevent short circuiting and with adequate protection of the battery terminals.

To prevent short circuiting the USDOT has identified the following methods as acceptable methods of short circuit protection:

1. Packaging each battery or each battery-powered device when practicable, in fully enclosed inner packagings made of non-conductive material.
2. Reattach the manufacturer's original terminal caps/covers and further secure the covers in place with tape if loose or seem likely to fall off during transportation/handling.
3. Separating or packaging batteries and battery-powered devices in a manner to prevent contact with other batteries, devices or conductive materials (e.g., metal) in the packagings.
4. Ensuring exposed terminals are protected with non-conductive caps, non-conductive tape, or by other appropriate means. Proper insulation includes taping the terminals of the batteries or packaging in individual clear plastic bags. Clear tape is required for small batteries so that battery identification is still possible. The tape or protective covering must be of sufficient durability and secured in a manner that it remains intact and abrasion-free during transportation/handling. Other forms of insulation may also be used provided they do not obscure the battery identification markings.

To prevent damage to terminals the USDOT has identified the following methods as acceptable methods for protecting battery terminals:

1. Securely attaching covers of sufficient strength to protect the terminals.
2. Packaging the battery in a rigid plastic packaging.
3. Constructing the battery with terminals that are recessed.
4. Cushioning and packaging the batteries to prevent shifting which could loosen terminal caps or reorient the terminals.

BATTERIES PACKED IN OUTER CONTAINERS

Multiple (chemically compatible) batteries may be packed together in a single outer packaging in accordance with the following requirements:

- Batteries with different DOT shipping names should not be combined in the same outer packaging unless authorized by the US DOT under specific packaging instructions or an exclusion from the regulations.



- Batteries must be packaged in a manner that meets or exceeds the battery specific packaging requirements specified within this document and all applicable regulations.
- Wet cell batteries must be placed in an upright position and secured from movement within the outer container.
- The outer container must be constructed of a material that is non-conductive and compatible with the battery chemistry.
- The total weight of the outer packaging must not exceed the weight rating tested for the container.

BATTERIES LOADED ONTO A PALLET

When loading batteries onto a pallet for transportation the following requirements must be followed:

- Batteries must be stacked on the pallet with the terminals protected from short-circuits with non-conductive caps, tape or other insulating material and facing away from touching terminals of other batteries.
- Layers of batteries with top facing terminals should be stacked in a manner that will protect the terminals from damage or breakage. Heavy batteries should always be placed on the lowest level to prevent crushing. Layers should be separated by waffle board or sheets of cardboard for stabilization and to help prevent short circuits.
- Batteries must be secured against movement or shifting on the pallet by nailing wooden cleats to the pallet. Plastic banding or shrink-wrap of sufficient strength should be wrapped around the completed pallet to secure the batteries in place. Banding must not be in a position in which it will come in contact with the battery terminals. When using non-conductive banding to secure batteries to pallets, precautions should be taken to assure any metal clips used to connect the banding straps do not come in contact with exposed battery terminals.
- Pallets must be of good integrity with no broken or loose boards and must be sturdy and durable enough to handle the weight of the battery load.
- Batteries secured to a pallet in accordance with 49 CFR §173.159(d)(1) are considered to be a single non-bulk package even if the completed package weighs more than 400 kg (882 pounds). Therefore, marking and labeling should be in accordance with the non-bulk packaging requirements found under 49 CFR, Subpart D – Marking and Subpart E – Labeling.

BATTERIES AS PART OF A POWER SUPPLY SYSTEM

Office UPS Units

Office UPS units (Uninterruptable Power Supplies), containing non-spillable lead acid batteries, are designed to be serviced by non-qualified personnel and have safety measures incorporated into their design. This may include protecting terminals from short circuit within the unit or encasing the batteries in a non-conductive housing that will be removed and replaced as a unit. These safety features will allow for office UPS units to be transported “as is” with the batteries in place.

Industrial Battery Power Supplies

Industrial battery power supplies are intended to only be serviced by qualified personnel and as such, do not include the same types of safety features found in office UPS units. These units will often have more batteries for a higher voltage and the batteries will often be much larger. All shipments of industrial battery power supplies must meet the following requirements:

1. Battery Power Supplies must be safely de-energized prior to shipment.
2. Batteries must be removed from the racking system and packaged in accordance with Veolia policy.
3. Palletized materials must be evaluated to assure that the pallet can safely support the weight of the load.

Since these units will typically require a qualified electrician to remove them from service, it is recommended that the electrician disconnects the batteries at the same time. Under no circumstances should industrial battery power supplies be transported with the batteries in place and electrically connected.



Alkaline Batteries, Dry-Cell



Typical Uses: Flashlights, cameras, portable radios, audio players, and toys.

Composition: Alkaline batteries have a zinc anode and a manganese dioxide cathode. The electrolyte used in an alkaline battery is a paste of either potassium hydroxide or sodium hydroxide. Each of these components, along with conductors and separators are then assembled into or contained within a hermetically sealed unit. Typical household size alkaline battery is a 1.5 volt (AA, AAA, C, D).

US DOT Description:

Proper Shipping Name	Batteries, dry, sealed, n.o.s.
Hazard Class	N/A (NONE)
Identification Number	N/A
Packing Group	N/A

US DOT Packaging Requirements: 49 CFR §172.102 Special Provision 130

All dry cell batteries other than those excepted below must be prepared and packaged in a manner to prevent:

1. A dangerous evolution of heat,
2. Short circuits, and
3. Damage to terminals

Batteries must be packaged in strong outer packagings or, if large enough, firmly secured to pallets capable of withstanding the shocks normally incident to transportation.

Exception for Spent Batteries of the Type “Batteries, Dry, Sealed, n.o.s.” with a Marked Rating of 9-Volts or Less

Used or spent dry, sealed batteries of both non-rechargeable and rechargeable designs, described as “Batteries, dry, sealed, n.o.s.” and are not specifically covered by another proper shipping name, with a marked rating up to 9-volts are not likely to generate a dangerous quantity of heat, short circuit, or create sparks in transportation. Therefore, used or spent batteries of the type “Batteries, dry, sealed, n.o.s.” with a marked rating of 9-volts or less that are combined in the same package and transported by highway or rail for recycling, reconditioning, or disposal are not subject to the regulation and do not require terminal protection or protection against short circuiting. Note that batteries utilizing different chemistries (i.e., those battery chemistries specifically covered by another entry in the §172.101 Table) as well as dry batteries with a marked rating greater than 9-volt may not be combined with used or spent batteries in the same package.

NOTE: Multiple 1.5-volt alkaline batteries interconnected or grouped in series are not included in this exception and must continue to be packaged in accordance with SP130 (terminals must be protected against damage and short circuits).

US EPA Regulations: Since this class of battery does not fail the TCLP nor does it contain any free liquids, it is not classified as a hazardous waste as defined by the US EPA and as such, is not subject to the universal waste requirements. Individual states may adopt more stringent regulations than the federal regulations; therefore, alkaline batteries may be classified as a universal waste in some states.



Lead Acid Batteries, Wet-Cell



Typical Uses: Automotive, marine, industrial applications.

Composition: Lead acid batteries have a lead anode and a lead dioxide cathode. The electrolyte is an aqueous solution of sulfuric acid. The battery cell contains 60 to 75 percent lead and lead oxide, by weight, and the electrolyte contains between 28 and 51 percent sulfuric acid, by weight.

US DOT Description:

Proper Shipping Name	Batteries, wet, filled with acid
Hazard Class	8
Identification Number	UN2794
Packing Group	PG III

US DOT Packaging Requirements: 49 CFR §173.159

All lead acid batteries must be prepared and packaged in a manner to prevent:

1. A dangerous evolution of heat,
2. Short circuits, and
3. Damage to terminals

Batteries must be packaged in USDOT authorized packagings which include:

Non-Bulk Containers:

- Specification packages listed in 49 CFR §173.159(c). The most common of these containers are the 4G fiberboard box, the 1G fiberboard drum and the 1H2 poly drum. Metal drums are not authorized for shipping wet cell batteries,
- To prohibit battery movement within drums or boxes, the use of folded cardboard, “honeycomb” cardboard or other bulky packing materials should be utilized. The use of vermiculite, floor dry or other granular absorbents is not recommended and may be subject to additional charges.
- Batteries must be shipped in an upright configuration and must be secured within the package to prevent the battery from reorienting in transport.
- **1H2 poly drums larger than 5 gallons should not be used for the transport of lead acid batteries.** As an alternative, multiple, larger-sized batteries should be secured to pallets for transport or packaged in lined 1G fiberboard drums.

Palletized Batteries:

- When secured to a pallet for transport, non-conductive strapping must be used. **Metal banding is not permissible due to the potential risk of short circuiting.** When using non-conductive banding to secure batteries to pallets, precautions should be taken to assure any metal clips used to connect the banding straps do not come in contact with exposed battery terminals.
- Firmly secured to skids or pallets capable of withstanding the shocks normally incident to transportation. The pallet must not exceed a height of 1.5 times the width of the pallet and must be capable of withstanding a superimposed weight of 2 times the weight of the pallet. The battery terminals must not be relied upon to support any of the superimposed weight and must not short out if a conductive material is placed in direct contact with them,

US EPA Regulations: Rules specific to the recycling of lead acid batteries are contained in 40 CFR part 266 Subpart G. As an alternative to this section, generators of lead acid batteries may choose to manage their lead acid batteries in accordance with the universal waste standards. When managed as a universal waste, each battery or each package containing batteries must be marked with the words “Universal Waste Batteries,” “Waste Batteries,” or “Used Batteries.” Broken or damaged batteries that no longer qualify for either the recycling exemption or the universal waste exemption must be managed as a hazardous waste. The RCRA waste codes D002 and D008 apply when the batteries or containers hold liquid electrolyte. The RCRA waste code D008 only applies to batteries or containers that have no liquids within them.



Lead Acid Batteries, Non-Spillable (Valve Regulated Lead Acid)



Typical Uses: Camcorders, computers, portable radios, lawn equipment, portable industrial equipment, marine applications

Composition: Like wet cell lead acid batteries, non-spillable or Valve Regulated Lead Acid (VRLA) batteries also have a lead anode, a lead dioxide cathode, and an aqueous sulfuric acid electrolyte. However, because of the way in which non-spillable batteries are manufactured, the electrolyte will not spill out of the battery. Although somewhat of a misnomer, these batteries are often referred to as sealed lead acid batteries. There are two primary categories of non-spillable batteries:

1. Absorbed glass mat (AGM) batteries, these batteries contain a liquid electrolyte that is absorbed into a glass mat sandwiched between the electrodes.
2. Gel cell batteries, these are batteries which have a chemical added to the electrolyte which causes it to form a gel which will not spill from the battery.

Non-spillable batteries authorized to be shipped under the below listed shipping name and packaging standards must be clearly marked “NONSPILLABLE” or “NONSPILLABLE BATTERY” by the manufacturer.

US DOT Description:

Proper Shipping Name	Batteries, wet, non-spillable
Hazard Class	8
Identification Number	UN2800
Packing Group	PG III

US DOT Packaging Requirements: 49 CFR §173.159 or 49 CFR §173.159a

As an alternative to the packaging requirements of 49 CFR §173.159, non-spillable lead acid batteries may be prepared and packaged in accordance with 49 CFR §173.159a. (See ‘Lead Acid, Wet Cell’ guidelines for the packaging requirements of 49 CFR §173.159.) For non-spillable batteries packaged under 49 CFR §173.159a, the batteries must be packaged in strong outer packages and must be prepared in a manner to prevent:

1. A dangerous evolution of heat,
2. Short circuits, and
3. Damage to terminals

The batteries and outer packaging must be plainly and durable marked “NONSPILLABLE” or “NONSPILLABLE BATTERY”.

Additional Packaging Requirements:

1. **1H2 poly drums larger than 5 gallons should not be used for the transport of lead acid batteries.** As an alternative, larger quantities of small non-spillable batteries should be packaged in lined 1G fiberboard drums.
2. Larger batteries, comparable to an automotive battery should be packaged following the packaging requirements of 49 CFR §173.159. (See the ‘Lead Acid, Wet Cell’ guidelines for packaging requirements of 49 CFR §173.159)
3. Batteries must be shipped in an upright configuration and must be packaged to prevent the battery from reorienting in transport.
4. To secure batteries within drums or boxes, the use of folded cardboard, “honeycomb” cardboard or other bulky packing materials should be utilized. The use of vermiculite, floor dry or other granular absorbents is not recommended and may be subject to additional charges.



US EPA Regulations: Rules specific to the recycling of lead acid batteries are contained in 40 CFR part 266 Subpart G. As an alternative to this section, generators of lead acid batteries may choose to manage their lead acid batteries in accordance with the universal waste standards. When managed as a universal waste, each battery or each package containing batteries must be marked with the words “Universal Waste Batteries,” “Waste Batteries,” or “Used Batteries.”

Broken or damaged batteries that no longer qualify for either the recycling exemption or the universal waste exemption must be managed as a hazardous waste. The RCRA waste codes D002 and D008 apply when the batteries or containers hold liquid electrolyte. The RCRA waste code D008 applies only to batteries or containers that have no liquids within them.



Lithium Metal Batteries

(See separate listing for Lithium Ion Batteries)



Typical Uses: Cameras, calculators, watches, small electronics etc.

Composition: These cells and batteries are constructed with metallic lithium. The metallic lithium in a non-rechargeable primary lithium battery is a combustible alkali metal that self-ignites at 352°F, and when exposed to water or seawater reacts exothermically and releases hydrogen. Lithium metal batteries include lithium alloy batteries.

The table below lists several of the most common types of lithium batteries.

Anode	Cathode	Electrolyte
Lithium	Manganese Dioxide	Lithium perchlorate in an organic solvent*
Lithium	Iron Sulfide	Organic solvent*
Lithium	Thionyl Chloride	Lithium tetrachloroaluminate in thionyl chloride
Lithium	Sulfur Dioxide	Lithium bromide in sulfur dioxide and acetonitrile

*Organic solvents may include one or more of the following: propylene carbonate, dioxolane, dimethoxyethane, ethylene carbonate

US DOT Description:

Proper Shipping Name	Lithium metal batteries	Lithium metal batteries contained in equipment	Lithium metal batteries packed with equipment
Hazard Class	9	9	9
Identification Number	UN3090	UN3091	UN3091
Packing Group	No PG (PG II optional until 1/1/16)	No PG (PG II optional until 1/1/16)	No PG (PG II optional until 1/1/16)

US DOT Packaging Requirements: 49 CFR §173.185

All lithium batteries must be prepared and packaged in a manner to prevent:

1. A dangerous evolution of heat,
2. Short circuits, and
3. Damage to terminals

Due to the high degree of hazard presented by lithium batteries additional packaging restrictions are necessary to ensure the safety of the general public as well as Veolia employees and facilities. These include applying short circuit protection to ALL battery terminals and restricting the methods of short circuit protection to packaging lithium batteries individually in clear plastic bags or packages or using clear tape over the terminals. This includes lithium batteries with recessed terminals and terminals contained within plugs attached to the battery.

Lithium batteries and cells transported for recycling or disposal by motor vehicle only:

- Packaged in non-bulk strong outer packagings, 49 CFR §173.185(d)
- Strong outer packages must meet general packaging requirements of 49 §§173.24 and 173.24a
- Not subject to testing and recordkeeping requirements of 49 CFR §173.185(a).
- Lithium batteries shipped by vessel must be in UN specification packaging (PG II) per 173.185(b)(3).



Damaged, Defective or Recalled Cells or Batteries – According to §173.185(f), lithium cells or batteries that have been damaged or identified as defective and have the potential of producing a dangerous evolution of heat, fire, or short circuit may be transported by highway, rail or vessel only, and must be packaged as follows:

- Each cell or battery must be placed in individual, non-metallic inner packaging that completely encloses the cell or battery;
- The inner packaging must be surrounded by cushioning material that is non-combustible, non-conductive, and absorbent; and
- Each inner packaging must be individually placed in one of the following UN specification packagings meeting the Packing Group I level: Metal (4A, 4B, 4N), wooden (4C1, 4C2, 4D, 4F), or solid plastic (4H2) box; Metal (1A2, 1B2, 1N2), plywood (1D), or plastic (1H2) drum; and
- 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.

US EPA Regulations: Lithium metal is a water reactive metal. As such lithium batteries should be managed as a universal waste in accordance with 40 CFR Part 273. All containers of universal waste batteries must be marked with the words “Universal Waste Batteries,” “Waste Batteries,” or “Used Batteries.”



Lithium Ion Batteries

(See separate listing for Lithium Metal Batteries)



Typical Uses: Cameras, computers, phones, power tools, etc. Various sizes including AAA, AA and button cell. Lithium ion batteries are often contained in non-standard sizes and shape battery packs used for special applications. Button cells with codes beginning in LIR are lithium ion.

Composition: Rechargeable secondary cells utilize lithium ions that are intercalated into graphite, lithium metal oxides and/or lithium salts. Common metal oxides and salts include lithium cobalt oxide, lithium manganese oxide and lithium iron phosphate. Metallic lithium is not used as either the anode or cathode in a lithium ion battery. The electrolyte in a lithium ion battery is typically an organic solvent. Organic solvents may include one or more of the following: propylene carbonate, dioxolane, dimethoxyethane, ethylene carbonate. Lithium ion batteries include lithium ion polymer batteries.

US DOT Description:

Proper Shipping Name	Lithium ion batteries	Lithium ion batteries contained in equipment	Lithium ion batteries packed with equipment
Hazard Class	9	9	9
Identification Number	UN3480	UN3481	UN3481
Packing Group	No PG (PG II optional until 1/1/16)	No PG (PG II optional until 1/1/16)	No PG (PG II optional until 1/1/16)

US DOT Packaging Requirements: 49 CFR §173.185

All lithium batteries must be prepared and packaged in a manner to prevent:

1. A dangerous evolution of heat,
2. Short circuits, and
3. Damage to terminals

Due to the degree of hazard presented by lithium batteries additional packaging restrictions are necessary to ensure the safety of the general public as well as Veolia employees and facilities. These include applying short circuit protection to ALL battery terminals and restricting the methods of short circuit protection to packaging lithium batteries individually in clear plastic bags or packages or using clear tape over the terminals. This includes lithium batteries with recessed terminals and terminals contained within plugs attached to the battery.

Lithium batteries and cells transported for recycling or disposal by motor vehicle only:

- Packaged in non-bulk strong outer packagings, 49 CFR §173.185(d)
- Strong outer packages must meet the general packaging requirements of 49 §§173.24 and 173.24a
- Not subject to testing and recordkeeping requirements of 49 CFR §173.185(a).
- Lithium batteries shipped by vessel must be in UN specification packaging (PG II) per 173.185(b)(3).

Exceptions for small and medium sized lithium cells/batteries – Relief from certain DOT requirements can be found in 49 CFR §173.185(c) for certain small lithium metal and lithium ion cells and batteries. Special hazard communication and marking requirements will need to be met.

Damaged, Defective or Recalled Cells or Batteries – According to §173.185(f), lithium cells or batteries that have been damaged or identified as defective and have the potential of producing a dangerous evolution of heat, fire, or short circuit may be transported by highway, rail or vessel only, and must be packaged as follows:



- Each cell or battery must be placed in individual, non-metallic inner packaging that completely encloses the cell or battery;
- The inner packaging must be surrounded by cushioning material that is non-combustible, non-conductive, and absorbent; and
- Each inner packaging must be individually placed in one of the following UN specification packagings meeting the Packing Group I level: Metal (4A, 4B, 4N), wooden (4C1, 4C2, 4D, 4F), or solid plastic (4H2) box; Metal (1A2, 1B2, 1N2), plywood (1D), or plastic (1H2) drum; and
- 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.

US EPA Regulations: Lithium metal is a water reactive metal. As such lithium batteries should be managed as a universal waste in accordance with 40 CFR Part 273. All containers of universal waste batteries must be marked with the words “Universal Waste Batteries,” “Waste Batteries,” or “Used Batteries.”



Magnesium Batteries



TYPICAL USES: Flashlights, cameras, portable radios, audio players, and toys.

COMPOSITION: Magnesium batteries have a magnesium anode, manganese dioxide cathode, and an electrolyte of a paste containing magnesium bromide or magnesium perchlorate with a chromate inhibitor to prevent corrosion to the magnesium anode. Each of these components, along with conductors and separators are then typically assembled into or contained within a hermetically sealed unit. If the battery is not a hermetically sealed unit, the battery should be considered a specialty battery and the following information is not applicable. For assistance in determining the proper packaging for these specialty batteries please contact customer service.

US DOT DESCRIPTION:

Proper Shipping Name	Batteries, dry, sealed, n.o.s.
Hazard Class	N/A (NONE)
Identification Number	N/A
Packing Group	N/A

US DOT PACKAGING REQUIREMENTS: 49 CFR §172.102 Special Provision 130

All dry cell batteries must be prepared and packaged in a manner to prevent:

1. A dangerous evolution of heat,
2. Short circuits, and
3. Damage to terminals

Batteries must be packaged in strong outer packagings or, if large enough, firmly secured to pallets capable of withstanding the shocks normally incident to transportation.

EXCEPTION FOR SPENT BATTERIES OF THE TYPE “BATTERIES, DRY, SEALED, N.O.S.” WITH A MARKED RATING OF 9-VOLTS OR LESS

In accordance with 49 CFR 172.102, Special Provision 130, used or spent dry, sealed batteries of both non-rechargeable and rechargeable designs, described as “Batteries, dry, sealed, n.o.s.” and are not specifically covered by another proper shipping name, with a marked rating up to 9-volts are not likely to generate a dangerous quantity of heat, short circuit, or create sparks in transportation. Therefore, used or spent batteries of the type “Batteries, dry, sealed, n.o.s.” with a marked rating of 9-volts or less that are combined in the same package and transported by highway or rail for recycling, reconditioning, or disposal are not subject to the regulation and do not require terminal protection or protection against short circuiting. Note that batteries utilizing different chemistries (i.e., those battery chemistries specifically covered by another entry in the §172.101 Table) as well as dry batteries with a marked rating greater than 9-volt may not be combined with used or spent batteries in the same package.

US EPA REGULATIONS: Based on the original composition and charge state of the battery, these batteries may fail the TCLP for chromium. As such magnesium batteries should be managed as a universal waste in accordance with 40 CFR Part 273. All containers of universal waste batteries must be marked with the words “Universal Waste Batteries,” “Waste Batteries,” or “Used Batteries.”



Mercury Batteries



TYPICAL USES: Hearing aids, pacemakers, camera, calculators, watches, etc.

COMPOSITION: Mercury batteries have a zinc anode and a mercuric oxide cathode. The electrolyte used in a mercury battery is a paste of either potassium hydroxide or sodium hydroxide. Each mercury cell contains a total of 20 to 50 percent mercury by weight. Each of these components, along with conductors and separators are then assembled into or contained within a hermetically sealed unit.

US DOT DESCRIPTION:

Packages containing less than 3 pounds of mercury batteries

Proper Shipping Name	Batteries, dry, sealed, n.o.s.
Hazard Class	N/A
Identification Number	N/A
Packing Group	N/A

US DOT PACKAGING REQUIREMENTS: 49 CFR §172.102 Special Provision 130

All dry cell batteries must be prepared and packaged in a manner to prevent:

- A dangerous evolution of heat,
- Short circuits, and
- Damage to terminals

Batteries must be packaged in strong outer packagings.

Packages which contain greater than 3 pounds of mercury batteries meet the US DOT definition of a hazardous substance and must be prepared for transport in accordance with the US DOT regulations using the proper shipping name “RQ Environmentally hazardous substance solid, n.o.s. (Mercury)”.

EXCEPTION FOR SPENT BATTERIES OF THE TYPE “BATTERIES, DRY, SEALED, N.O.S.” WITH A MARKED RATING OF 9-VOLTS OR LESS

Used or spent dry, sealed batteries of both non-rechargeable and rechargeable designs, described as “Batteries, dry, sealed, n.o.s.” and are not specifically covered by another proper shipping name, with a marked rating up to 9-volts are not likely to generate a dangerous quantity of heat, short circuit, or create sparks in transportation. Therefore, used or spent batteries of the type “Batteries, dry, sealed, n.o.s.” with a marked rating of 9-volts or less that are combined in the same package and transported by highway or rail for recycling, reconditioning, or disposal are not subject to the regulation and do not require terminal protection or protection against short circuiting. Note that batteries utilizing different chemistries (i.e., those battery chemistries specifically covered by another entry in the §172.101 Table) as well as dry batteries with a marked rating greater than 9-volt may not be combined with used or spent batteries in the same package.

US EPA REGULATIONS: Mercury batteries typically fail the TCLP for mercury. As such, all mercury batteries should be managed as a universal waste in accordance with 40 CFR Part 273. All containers of universal waste batteries must be marked with the words “Universal Waste Batteries,” “Waste Batteries,” or “Used Batteries.”

When not shipped as universal waste, the RCRA Waste code D009 (mercury) would need to be included on the manifest.



Nickel Cadmium Batteries, Wet-Cell



Typical Uses: Industrial applications, back up batteries and computers

Composition: Nickel cadmium (NiCd) batteries have a cadmium anode and a nickel oxyhydroxide cathode. The electrolyte within a wet cell NiCd battery is an aqueous solution of potassium hydroxide.

US DOT Description:

Proper Shipping Name	Batteries, wet, filled with alkali
Hazard Class	8
Identification Number	UN2795
Packing Group	PG III

US DOT Packaging Requirements: 49 CFR §173.159

All wet cell NiCd batteries must be prepared and packaged in a manner to prevent:

1. A dangerous evolution of heat,
2. Short circuits, and
3. Damage to terminals

Batteries must be packaged in US DOT authorized packagings which include:

1. Specification packages listed in §173.159(c). The most common of these containers are the 4G fiberboard box and the 1H2 poly drum. Metal drums are not authorized for shipping wet cell batteries,
2. Firmly secured to skids or pallets capable of withstanding the shocks normally incident to transportation. The pallet must not exceed a height of 1.5 times the width of the pallet and must be capable of withstanding a superimposed weight of 2 times the weight of the pallet. The battery terminals must not be relied upon to support any of the superimposed weight and must not short out if a conductive material is placed in direct contact with them,
3. In accordance with one of the other packaging alternatives not specifically listed above.

US EPA Regulations: Wet cell NiCd batteries contain a liquid electrolyte which exhibits the characteristic of corrosivity and when tested will fail the TCLP for cadmium. As such, wet cell NiCd batteries should be managed as a universal waste in accordance with 40 CFR Part 273. All containers of universal waste batteries must be marked with the words "Universal Waste Batteries," "Waste Batteries," or "Used Batteries."

When not shipped as a universal waste, the RCRA Waste code D002 (Corrosivity) and D006 (cadmium) would need to be included on the manifest.



Nickel Cadmium Batteries, Dry-Cell



Typical Uses: Cameras, rechargeable appliances such as portable power tools, hand held vacuums, etc.

Composition: Dry cell nickel cadmium (NiCd) batteries have a cadmium anode and nickel oxyhydroxide cathode. The electrolyte used in a dry cell NiCd battery is a paste of potassium hydroxide. Each of these components, along with conductors and separators are then assembled into or contained within a hermetically sealed unit.

US DOT Description:

Proper Shipping Name	Batteries, dry, sealed, n.o.s.
Hazard Class	N/A
Identification Number	N/A
Packing Group	N/A

US DOT Packaging Requirements: 49 CFR §172.102 Special Provision 130
All dry cell batteries must be prepared and packaged in a manner to prevent:

1. A dangerous evolution of heat,
2. Short circuits, and
3. Damage to terminals

Batteries must be packaged in strong outer packagings or, if large enough, firmly secured to pallets capable of withstanding the shocks normally incident to transportation.

Exception for Spent Batteries of the Type "Batteries, Dry, Sealed, n.o.s." with a Marked Rating of 9-Volts or Less

Used or spent dry, sealed batteries of both non-rechargeable and rechargeable designs, described as "Batteries, dry, sealed, n.o.s." and are not specifically covered by another proper shipping name, with a marked rating up to 9-volts are not likely to generate a dangerous quantity of heat, short circuit, or create sparks in transportation. Therefore, used or spent batteries of the type "Batteries, dry, sealed, n.o.s." with a marked rating of 9-volts or less that are combined in the same package and transported by highway or rail for recycling, reconditioning, or disposal are not subject to the regulation and do not require terminal protection or protection against short circuiting. Note that batteries utilizing different chemistries (i.e., those battery chemistries specifically covered by another entry in the §172.101 Table) as well as dry batteries with a marked rating greater than 9-volt may not be combined with used or spent batteries in the same package.

SPECIAL REQUIREMENTS FOR "UN3208, Batteries dry containing potassium hydroxide solid, 8, III"

USDOT regulations contain Special provision 237 for the shipping name "Batteries, dry, containing potassium hydroxide solid, electric storage". SP 237 states that the batteries must be prepared and packaged in accordance with the requirements of 173.159(a), (b), and (c) and that for transportation by aircraft, the provisions of 173.159(b)(2). On January 7, 2013 (HM-215L) USDOT modified SP 237 by clarifying the applicability of the provision. Specifically language was added to state that the entry for "Batteries, dry, containing potassium hydroxide solid, electric storage" may only be used for the transport of non-activated batteries that contain dry potassium hydroxide and that are intended to be activated prior to use by the addition of an appropriate amount of water to the individual cells. Therefore, spent or used dry cell Ni-Cad batteries that don't meet these specifications described above should be assigned the proper shipping name "Batteries, dry, sealed, n.o.s. (Nickel Cadmium Batteries)".

US EPA Regulations: Dry cell NiCd batteries typically will fail the TCLP for cadmium. As such, dry cell NiCd batteries should be managed as a universal waste in accordance with 40 CFR Part 273. All containers of universal waste batteries must be marked with the words "Universal Waste Batteries," "Waste Batteries," or "Used Batteries." When not shipped as a universal waste, the RCRA Waste code D006 (cadmium) would need to be included on the manifest.



Nickel Metal Hydride Batteries



Typical Uses: Cameras, rechargeable appliances such as portable power tools, hand held vacuums, etc.

Composition: Nickel metal hydride (NiMH) batteries have a hydrogen-absorbing metal alloy anode and a nickel oxyhydroxide cathode. The electrolyte in a NiMH battery is typically a potassium hydroxide paste. Each of these components, along with conductors and separators are then assembled into or contained within a hermetically sealed unit.

US DOT Description:

Proper Shipping Name	Batteries, dry, sealed, n.o.s.
Hazard Class	N/A
Identification Number	N/A
Packing Group	N/A

US DOT Packaging Requirements: 49 CFR §172.102 Special Provision 130
All dry cell batteries must be prepared and packaged in a manner to prevent:

1. A dangerous evolution of heat,
2. Short circuits, and
3. Damage to terminals

Batteries must be packaged in strong outer packagings or, if large enough, firmly secured to pallets capable of withstanding the shocks normally incident to transportation.

Exception for Spent Batteries of the Type “Batteries, Dry, Sealed, n.o.s.” with a Marked Rating of 9-Volts or Less

Used or spent dry, sealed batteries of both non-rechargeable and rechargeable designs, described as “Batteries, dry, sealed, n.o.s.” and are not specifically covered by another proper shipping name, with a marked rating up to 9-volts are not likely to generate a dangerous quantity of heat, short circuit, or create sparks in transportation. Therefore, used or spent batteries of the type “Batteries, dry, sealed, n.o.s.” with a marked rating of 9-volts or less that are combined in the same package and transported by highway or rail for recycling, reconditioning, or disposal are not subject to the regulation and do not require terminal protection or protection against short circuiting. Note that batteries utilizing different chemistries (i.e., those battery chemistries specifically covered by another entry in the §172.101 Table) as well as dry batteries with a marked rating greater than 9-volt may not be combined with used or spent batteries in the same package.

US EPA Regulations: Since this class of battery does not fail the TCLP nor does it contain any free liquids, it is not classified as a hazardous waste as defined by the US EPA and as such, is not subject to the universal waste requirements. Individual states may adopt more stringent regulations than the federal regulations; therefore, NiMH batteries may be classified as a universal waste in some states.



Silver Oxide Batteries



Typical Uses: Hearing aids, watches, cameras, calculators

Composition: Silver oxide batteries have a zinc anode and a silver oxide cathode. The electrolyte used in a silver oxide battery is a potassium hydroxide or sodium hydroxide paste. Each of these components, along with conductors and separators are then assembled into or contained within a hermetically sealed unit. In addition to the above materials, many of the older silver oxide batteries contained a significant amount of mercury. Batteries containing both silver and mercury should be managed as mercury batteries. The below listed information is for non-mercury containing silver oxide batteries.

US DOT Description:

Proper Shipping Name	Batteries, dry, sealed, n.o.s.
Hazard Class	N/A
Identification Number	N/A
Packing Group	N/A

US DOT Packaging Requirements: 49 CFR §172.102 Special Provision 130

All dry cell batteries must be prepared and packaged in a manner to prevent:

1. A dangerous evolution of heat,
2. Short circuits, and
3. Damage to terminals

Batteries must be packaged in strong outer packagings or, if large enough, firmly secured to pallets capable of withstanding the shocks normally incident to transportation.

Exception for Spent Batteries of the Type “Batteries, Dry, Sealed, n.o.s.” with a Marked Rating of 9-Volts or Less

Used or spent dry, sealed batteries of both non-rechargeable and rechargeable designs, described as “Batteries, dry, sealed, n.o.s.” and are not specifically covered by another proper shipping name, with a marked rating up to 9-volts are not likely to generate a dangerous quantity of heat, short circuit, or create sparks in transportation. Therefore, used or spent batteries of the type “Batteries, dry, sealed, n.o.s.” with a marked rating of 9-volts or less that are combined in the same package and transported by highway or rail for recycling, reconditioning, or disposal are not subject to the regulation and do not require terminal protection or protection against short circuiting. Note that batteries utilizing different chemistries (i.e., those battery chemistries specifically covered by another entry in the §172.101 Table) as well as dry batteries with a marked rating greater than 9-volt may not be combined with used or spent batteries in the same package.

US EPA Regulations: Silver oxide batteries typically will fail the TCLP for silver and older silver oxide batteries will typically fail the TCLP for silver and mercury. As such, silver oxide batteries should be managed as a universal waste in accordance with 40 CFR Part 273. All containers of universal waste batteries must be marked with the words “Universal Waste Batteries,” “Waste Batteries,” or “Used Batteries.”

When not shipped as a universal waste, the RCRA Waste code D011 (silver) would need to be included on the manifest.



Carbon Zinc Batteries



Typical Uses: Flashlights, toys, etc.

Composition: Carbon zinc batteries, often referred to as Heavy Duty Batteries, have a zinc anode and a cathode that contains a mixture of manganese dioxide, carbon and electrolyte. The batteries also contain a carbon electrode that serves as a cathode current collector. The electrolyte is an aqueous solution of ammonium chloride and zinc chloride or a solution of zinc chloride. The electrolyte is mixed with the other components of the battery to form a paste. Each of these components, along with conductors and separators are then assembled into or contained within a hermetically sealed unit.

US DOT Description:

Proper Shipping Name	Batteries, dry, sealed, n.o.s.
Hazard Class	N/A (NONE)
Identification Number	N/A
Packing Group	N/A

US DOT Packaging Requirements: 49 CFR §172.102 Special Provision 130

All dry cell batteries must be prepared and packaged in a manner to prevent:

1. A dangerous evolution of heat,
2. Short circuits, and
3. Damage to terminals

Batteries must be packaged in strong outer packaging or, if large enough, firmly secured to pallets capable of withstanding the shocks normally incident to transportation.

Exception for Spent Batteries of the Type “Batteries, Dry, Sealed, n.o.s.” with a Marked Rating of 9-Volts or Less

Used or spent dry, sealed batteries of both non-rechargeable and rechargeable designs, described as “Batteries, dry, sealed, n.o.s.” and are not specifically covered by another proper shipping name, with a marked rating up to 9-volts are not likely to generate a dangerous quantity of heat, short circuit, or create sparks in transportation. Therefore, used or spent batteries of the type “Batteries, dry, sealed, n.o.s.” with a marked rating of 9-volts or less that are combined in the same package and transported by highway or rail for recycling, reconditioning, or disposal are not subject to the regulation and do not require terminal protection or protection against short circuiting. Note that batteries utilizing different chemistries (i.e., those battery chemistries specifically covered by another entry in the §172.101 Table) as well as dry batteries with a marked rating greater than 9-volt may not be combined with used or spent batteries in the same package.

US EPA Regulations: Since this class of battery does not fail the TCLP nor does it contain any free liquids, it is not classified as a hazardous waste as defined by the US EPA and as such, is not subject to the universal waste requirements. Individual states may adopt more stringent regulations than the federal regulations; therefore, carbon zinc batteries may be classified as a universal waste in some states.



Battery Appendix

The following contains excerpts from the US DOT regulations, 49 CFR Part 171-173, that are referenced in the guidance document. For a complete version of the hazardous materials regulations consult the Code of Federal Regulations.

§172.102, SPECIAL PROVISION 130

"Batteries, dry, sealed, n.o.s.," commonly referred to as dry batteries, are hermetically sealed and generally utilize metals (other than lead) and/or carbon as electrodes. These batteries are typically used for portable power applications. The rechargeable (and some non-rechargeable) types have gelled alkaline electrolytes (rather than acidic) making it difficult for them to generate hydrogen or oxygen when overcharged and therefore, differentiating them from non-spillable batteries. Dry batteries specifically covered by another entry in the §172.101 Table must be transported in accordance with the requirements applicable to that entry. For example, nickel-metal hydride batteries transported by vessel in certain quantities are covered by another entry (see Batteries, nickel-metal hydride, UN3496). Dry batteries not specifically covered by another entry in the §172.101 Table are covered by this entry (i.e., Batteries, dry, sealed, n.o.s.) and are not subject to requirements of this subchapter except for the following:

- a) Incident reporting. For transportation by aircraft, a telephone report in accordance with §171.15(a) is required if a fire, violent rupture, explosion or dangerous evolution of heat (i.e., an amount of heat sufficient to be dangerous to packaging or personal safety to include charring of packaging, melting of packaging, scorching of packaging, or other evidence) occurs as a direct result of a dry battery. For all modes of transportation, a written report submitted, retained, and updated in accordance with §171.16 is required if a fire, violent rupture, explosion or dangerous evolution of heat occurs as a direct result of a dry battery or battery-powered device.
- b) Preparation for transport. Batteries and battery-powered device(s) containing batteries must be prepared and packaged for transport in a manner to prevent:
 - 1) A dangerous evolution of heat;
 - 2) Short circuits, including but not limited to the following methods:
 - i. Packaging each battery or each battery-powered device when practicable, in fully enclosed inner packagings made of non-conductive material;
 - ii. Separating or packaging batteries in a manner to prevent contact with other batteries, devices or conductive materials (e.g., metal) in the packagings; or
 - iii. Ensuring exposed terminals or connectors are protected with non-conductive caps, non-conductive tape, or by other appropriate means; and
 - 3) Damage to terminals. If not impact resistant, the outer packaging should not be used as the sole means of protecting the battery terminals from damage or short circuiting. Batteries must be securely cushioned and packed to prevent shifting which could loosen terminal caps or reorient the terminals to produce short circuits. Batteries contained in devices must be securely installed. Terminal protection methods include but are not limited to the following:
 - i. Securely attaching covers of sufficient strength to protect the terminals;
 - ii. Packaging the battery in a rigid plastic packaging; or
 - iii. Constructing the battery with terminals that are recessed or otherwise protected so that the terminals will not be subjected to damage if the package is dropped.
- c) Additional air transport requirements. For a battery whose voltage (electrical potential) exceeds 9 volts-
 - 1) When contained in a device, the device must be packaged in a manner that prevents unintentional activation or must have an independent means of preventing unintentional activation (e.g., packaging restricts access to activation switch, switch caps or locks, recessed switches, trigger locks, temperature sensitive circuit breakers, etc.); and
 - 2) An indication of compliance with this special provision must be provided by marking each package with the words "not restricted" or by including the words "not restricted" on a transport document such as an air waybill accompanying the shipment.
- d) Used or spent battery exception. Used or spent dry batteries of both non-rechargeable and rechargeable designs, with a marked rating up to 9-volt that are combined in the same package and transported by highway or rail for recycling, reconditioning, or disposal are not subject to this special provision or any other requirement of the HMR. Note that batteries utilizing different chemistries (i.e., those battery chemistries specifically covered by another entry in the §172.101 Table) as well as dry batteries with a marked rating greater than 9-volt may not be combined with used or spent batteries in the same package. Note also that this exception does not apply to batteries that have been reconditioned for reuse.

§172.102, SPECIAL PROVISION 237

"Batteries, dry, containing potassium hydroxide solid, *electric storage*" must be prepared and packaged in accordance with the requirements of § 173.159(a) and (c). For transportation by aircraft, the provisions of § 173.159(b)(2) apply. This entry may



only be used for the transport of non-activated batteries that contain dry potassium hydroxide and that are intended to be activated prior to use by the addition of an appropriate amount of water to the individual cells.

§173.21(c) Forbidden materials and packages

(c) Electrical devices, such as batteries and battery-powered devices, which are likely to create sparks or generate a dangerous evolution of heat, unless packaged in a manner which precludes such an occurrence.

§173.159 Batteries, wet

- a) Electric storage batteries, containing electrolyte acid or alkaline corrosive battery fluid (wet batteries), may not be packed with other materials except as provided in paragraphs (g) and (h) of this section and in §§173.220 and 173.222; and any battery or battery-powered device must be prepared and packaged for transport in a manner to prevent:
 - 1) A dangerous evolution of heat (i.e. , an amount of heat sufficient to be dangerous to packaging or personal safety to include charring of packaging, melting of packaging, scorching of packaging, or other evidence);
 - 2) Short circuits, including, but not limited to:
 - i. Packaging each battery or each battery-powered device when practicable, in fully enclosed inner packagings made of non-conductive material;
 - ii. Separating or packaging batteries and battery-powered devices in a manner to prevent contact with other batteries, devices or conductive materials (e.g. , metal) in the packagings; or
 - iii. Ensuring exposed terminals are protected with non-conductive caps, non-conductive tape, or by other appropriate means; and
 - 3) Damage to terminals. If not impact resistant, the outer packaging must not be used as the sole means of protecting the battery terminals from damage or short circuiting. Batteries must be securely cushioned and packed to prevent shifting which could loosen terminal caps or reorient the terminals. Batteries contained in devices must be securely installed. Terminal protection methods include but are not limited to:
 - i. Securely attaching covers of sufficient strength to protect the terminals;
 - ii. Packaging the battery in a rigid plastic packaging; or
 - iii. Constructing the battery with terminals that are recessed or otherwise protected so that the terminals will not be subjected to damage if the package is dropped.

173.159a Exceptions for non-spillable batteries

- a) Exceptions for hazardous materials shipments in the following paragraphs are permitted only if this section is referenced for the specific hazardous material in the §172.101 table or in a packaging section in this part.
- b) Non-spillable batteries offered for transportation or transported in accordance with this section are subject to the incident reporting requirements. For transportation by aircraft, a telephone report in accordance with §171.15(a) is required if a fire, violent rupture, explosion or dangerous evolution of heat (i.e., an amount of heat sufficient to be dangerous to packaging or personal safety to include charring of packaging, melting of packaging, scorching of packaging, or other evidence) occurs as a direct result of a non-spillable battery. For all modes of transportation, a written report in accordance with §171.16(a) is required if a fire, violent rupture, explosion or dangerous evolution of heat occurs as a direct result of a non-spillable battery.
- c) Non-spillable batteries are excepted from the packaging requirements of §173.159 under the following conditions:
 - 1) Non-spillable batteries must be securely packed in strong outer packagings and meet the requirements of §173.159(a). A non-spillable battery which is an integral part of and necessary for the operation of mechanical or electronic equipment must be securely fastened in the battery holder on the equipment;
 - 2) The battery and outer packaging must be plainly and durably marked "NON-SPILLABLE" or "NON-SPILLABLE BATTERY." The requirement to mark the outer package does not apply when the battery is installed in a piece of equipment that is transported unpackaged.
- d) Non-spillable batteries are excepted from all other requirements of this subchapter when offered for transportation and transported in accordance with paragraph (c) of this section and the following:
 - 1) At a temperature of 55 °C (131 °F), the battery must not contain any unabsorbed free-flowing liquid, and must be designed so that electrolyte will not flow from a ruptured or cracked case; and
 - 2) For transport by aircraft, when contained in a battery-powered device, equipment or vehicle must be prepared and packaged for transport in a manner to prevent unintentional activation in conformance with §173.159(b)(2) of this Subpart.

§173.185 Lithium cells and batteries

As used in this section, *lithium cell(s) or battery(ies)* includes both lithium metal and lithium ion chemistries. *Equipment* means the device or apparatus for which the lithium cells or batteries will provide electrical power for its operation.

- 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.



- 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 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) 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 effective means of preventing external short circuits; and
 - iii. Be equipped with an effective 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. Movement within the outer 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 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 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 against movement within the outer packaging and be packed so as to prevent accidental operation during transport; and
 - iii. Any spare lithium ion 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 and assemblies of such batteries, 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 (b)(4) of this



- section. Batteries or battery assemblies must be secured to prevent inadvertent movement, and the terminals may not support the weight of other superimposed elements. 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.
- c) Exceptions for smaller cells or batteries. 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 (b)(4) of this section under the following conditions and limitations.
- 1) Size limits:
 - i. The Watt-hour 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 metal cells or batteries are packed with or contained in equipment in quantities less than 5 kg net weight, the outer package that contains lithium metal cells or batteries must be marked: "PRIMARY LITHIUM BATTERIES-FORBIDDEN FOR TRANSPORT ABOARD PASSENGER AIRCRAFT" or "LITHIUM METAL BATTERIES-FORBIDDEN FOR TRANSPORT ABOARD PASSENGER AIRCRAFT."
 - 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 and 25 g for a lithium metal battery and 60 Wh for a lithium ion cell or 300 Wh for a lithium ion battery provided the outer package is marked: "LITHIUM BATTERIES-FORBIDDEN FOR TRANSPORT ABOARD AIRCRAFT AND VESSEL."
 - v. The marking specified in paragraphs (c)(1)(ii) and (c)(1)(iii) 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) 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. 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. Except when lithium cells or batteries are contained in equipment, each package 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) Hazard communication. Except for a package containing button cell batteries installed in equipment (including circuit boards), or no more than four lithium cells or two lithium batteries installed in the equipment:
 - i. The outer package must be marked with:
 - A. An indication that the package contains "lithium metal" or "lithium ion" cells or batteries, as appropriate;
 - B. An indication that the package is to be handled with care and that a flammable hazard exists if the package is damaged;
 - C. An indication that special procedures must be followed in the event the package is damaged, to include inspection and repacking if necessary;
 - D. A telephone number for additional information.
 - ii. Each shipment of one or more packages marked in accordance with this paragraph must be accompanied by a document that includes the following:
 - A. An indication that the package contains "lithium metal" or "lithium ion" cells or batteries, as appropriate;
 - B. An indication that the package is to be handled with care and that a flammable hazard exists if the package is damaged;
 - C. An indication that special procedures must be followed in the event the package is damaged, to
 - D. include inspection and repacking if necessary; and
 - E. A telephone number for additional information.
 - 4) Air transportation. For transportation by aircraft, lithium cells and batteries may not exceed the limits in the following table. 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:



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.

- i. The outer package must be durably and legibly marked with the following handling marking, which is durable, legible and displayed on a background of contrasting color:



- A. The marking must be not less than 120 mm (4.7 inches) wide by 110 mm (4.3 inches) high except markings of 105 mm (4.1 inches) wide by 74 mm (2.9 inches) high may be used on a package containing lithium batteries when the package is too small for the larger marking;
- B. The symbols and letters must be black and the border must be red;
- C. The “*” must be replaced by “lithium ion battery” and/or “Lithium metal battery” as appropriate and the “xxx-xxx-xxxx” must be replaced by a telephone number for additional information; and
- D. When packages required to bear the handling marking are placed in an overpack, the handling marking must either be clearly visible through the overpack, or the handling marking must also be affixed on the outside of the overpack, and the overpack must be marked with the word “Overpack”.
- ii. Each shipment with packages required to bear the handling marking must include an indication the shipment contains “lithium ion batteries” or “lithium metal batteries,” as appropriate, and when an air waybill is used, an indication on the air waybill of compliance with this paragraph (c)(4) (or the applicable ICAO Packing Instruction).
- iii. 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 spares, and the total net quantity (mass) of the lithium cells or batteries in the completed package must not exceed 5 kg.
- iv. 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 in this paragraph, must receive adequate instruction on these conditions and limitations, commensurate with their responsibilities.



- v. A package that exceeds the number or quantity (mass) limits in the table shown in this paragraph (c)(4) is subject to all applicable requirements of this subchapter, except that a package containing no more than 2.5 kg lithium metal cells or 10 kg lithium ion cells or batteries is not subject to:
 - A. The UN performance packaging requirements in paragraphs (b)(3)(ii) of this section when the package displays both the lithium battery handling marking and the Class 9 label; and
 - B. The shipping paper requirements of subpart C of part 172 when the offeror provides the air carrier alternative written documentation containing the name and address of the offeror and consignee, the UN number, an indication of compliance with this paragraph (c)(4) applies (or the applicable ICAO Packing Instruction), and the number of packages and the gross mass of each package and notification is given to the pilot-in-command in accordance with §175.33 of this subchapter.
- 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 from the testing and record keeping requirements of paragraph (a) and the specification packaging requirements of paragraph (b)(3) of this section, when packed in a strong outer packaging conforming to the requirements of §§173.24 and 173.24a. A lithium cell or battery that meets the size, packaging, and hazard communication conditions in paragraph (c)(1)-(3) of this section is excepted from subparts C through H of part 172 of this subchapter.
- e) Low production runs and prototypes. Low production runs (i.e., annual production runs consisting of not more than 100 lithium cells or batteries), or prototype lithium cells or batteries transported for purposes of testing, are excepted from the testing and record keeping requirements of paragraph (a) of this section provided:
 - 1) Except as provided in paragraph (e)(3) 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 non-conductive;
 - 2) The inner packages containing lithium cells or batteries are packed in one of the following packagings that meet the requirements of part 178, Subparts L and M at 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.
 - 3) Lithium batteries that weigh 12 kg (26.5 pounds) or more and have a strong, impact-resistant outer casing or assemblies of such batteries, 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 (b)(4) of this section. The battery or battery assembly must be secured to prevent inadvertent movement, and the terminals may not support the weight of other superimposed elements;
 - 4) 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; and
 - 5) 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.
- 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, non-conductive, and absorbent; and
 - 3) Each inner packaging must be individually placed in one of the following packagings meeting the requirements of part 178, subparts L and M, 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; 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.
- g) 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.



Key Definitions:

Anode - The electrode where oxidation occurs in an electrochemical cell. It is the negative electrode on a battery.

Battery - A device consisting of one or more electrically connected electrochemical cells which is designed to receive, store, and deliver electric energy.

Cathode - The electrode where reduction occurs in an electrochemical cell. It is the positive electrode on a battery.

Cell - A system consisting of an anode, cathode, and an electrolyte, plus such connections (electrical and mechanical) as may be needed to allow the cell to deliver or receive electrical energy.

Electrolyte - A chemical compound (salt, acid, or base) that dissociates into electrically charged ions when dissolved in a solvent. The resulting electrolyte (or electrolytic) solution is an ionic conductor of electricity.

Hermetically sealed - A device or unit that is sealed and for practical purposes is considered airtight.

Primary cells and batteries - Non-rechargeable cells and batteries.

Secondary cells and batteries - Rechargeable cells and batteries.



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