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, potential hazards may 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 (Uninterruptible 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

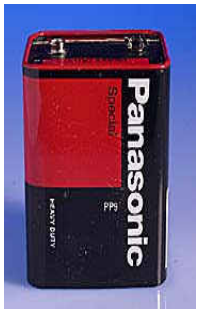
marked rating up to 9-volts are not likely to generate a dangerous quantity of heat, short circuit, or create sparks in transportation. Therefore, used or spent batteries of the type "Batteries, dry, sealed, n.o.s." with a marked rating of 9-volts or less that are combined in the same package and transported 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.

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 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

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.

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

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.

Broken Batteries:

Broken lead acid batteries and clean up materials may be described on the shipping paper using the Batteries, wet containing acid proper shipping. When shipped on a hazardous waste manifest with US EPA waste codes this shipping name must be preceded by word "Waste".

Damaged lead acid batteries that are no longer capable of retaining electrolyte must be packaged as described in 49 CFR §173.159(k). 49 CFR §173.159(k) provides several packaging alternatives for damaged lead acid batteries:

- Drain the battery of fluid to eliminate the potential for leakage during transportation.
- Individually pack the battery in a leak proof intermediate package (poly bag sufficient to contain the battery and prevent punctures of the bag) with sufficient compatible absorbent material capable of absorbing the release of any electrolyte and place the intermediate packaging in a leakproof outer packaging (poly drum 1H2).
- Pack the battery in a salvage packaging, or
- When packaged with other batteries or materials (e.g., on pallets or non-skid rails) and secured to prevent movement during transport, pack the battery in leakproof packaging to prevent leakage of battery fluid from the packaging under conditions normally incident to transportation

Please note than many neutralizing agents used in the cleanup of broken batteries contain carbonate compounds and will generate carbon dioxide when reacting with electrolyte. When this reaction occurs in a

vapor tight container the pressure can build to a point that poses a hazard to personnel handling the container. Packaging methods to separate these carbonate compounds from additional acid electrolyte must be used to reduce the potential for incidents in transport.

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

US DOT Packaging Requirements: 49 CFR §173.159a
Non-spillable lead acid batteries are excepted from the packaging requirements of 49 CFR §173.159 when prepared and packaged in accordance with 49 CFR §173.159a. 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.

Broken Batteries:
Broken lead acid batteries and clean up materials may be described on the shipping paper using the Batteries, wet containing acid proper shipping. When shipped on a hazardous waste manifest with US EPA waste codes this shipping name must be preceded by word "Waste".

Damaged lead acid batteries that are no longer capable of retaining electrolyte must be packaged as described in 49 CFR §173.159(k). 49 CFR §173.159(k) provides several packaging alternatives for damaged lead acid batteries:

- Drain the battery of fluid to eliminate the potential for leakage during transportation.
- Individually pack the battery in a leak proof intermediate package (poly bag sufficient to contain the battery and prevent punctures of the bag) with sufficient compatible absorbent material capable of absorbing the release of any electrolyte and place the intermediate packaging in a leak-proof outer packaging (poly drum 1H2).
- Pack the battery in a salvage packaging, or
- When packaged with other batteries or materials (e.g., on pallets or non-skid rails) and secured to prevent movement during transport, pack the battery in leak-proof packaging to prevent leakage of battery fluid from the packaging under conditions normally incident to transportation

Please note than many neutralizing agents used in the cleanup of broken batteries contain carbonate compounds and will generate carbon dioxide when reacting with electrolyte. When this reaction occurs in a vapor tight container the pressure can build to a point that poses a hazard to personnel handling the container. Packaging methods to separate these carbonate compounds from additional acid electrolyte must be used to reduce the potential for incidents in transport.

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

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

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

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

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

US DOT Packaging Requirements: 49 CFR §172.102 Special Provision 130 for highway shipments
For vessel shipments nickel metal hydride batteries are subject to additional requirements (see Special Provision 340)

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

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.

Sodium Ion Batteries

Typical Uses: Hearing aids, watches, cameras, calculators

Composition: Sodium-ion battery (also called NIB) is a type of rechargeable battery analogous to the lithium-ion battery, but using sodium ions (Na^+) as the charge carriers.

US DOT Description:

Proper Shipping Name	Batteries, containing sodium *or* Cells, containing sodium
Hazard Class	4.3
Identification Number	UN3292

Batteries and cells may not contain any hazardous material other than sodium, sulfur or sodium compounds (*e.g.,* sodium polysulfides, sodium tetrachloroaluminate, *etc.*). Cells not forming a component of a completed battery may not be offered for transportation at a temperature at which any liquid sodium is present in the cell.

US DOT Packaging Requirements: Packaging requirements for Sodium-ion batteries/cells are found in 49 CFR §173.189.

Sodium-Ion Cells

- Cells must be protected against short circuit and must consist of hermetically sealed metal casings that fully enclose the hazardous materials and that are so constructed and closed as to prevent the release of the hazardous materials under normal conditions of transport.

- Cells must be placed in suitable outer packagings with sufficient cushioning material to prevent contact between cells and between cells and the internal surfaces of the outer packaging, and to ensure that no dangerous shifting of the cells within the outer packaging occurs in transport.

- Cells must be packaged in 1A2, 1B2, 1N2, 1D, 1G, 1H2, 4A, 4B, 4N, 4C1, 4C2, 4D, 4F, 4G, 4H1, 4H2, 3A2, 3B2 or 3H2) outer packagings rated at the Packing Group II performance level.

Sodium-Ion Batteries

- Batteries must consist of cells secured within, and fully enclosed by a metal casing so constructed and closed as to prevent the release of the hazardous materials under normal conditions of transport. Batteries may be offered for transportation, and transported, unpacked or in non-UN specification protective packagings.

- Batteries containing liquid sodium may be transported by motor vehicle, rail car or vessel under the following conditions:
    - Batteries must be equipped with an effective means of preventing external short circuits, such as by providing complete electrical insulation of battery terminals or other external electrical connectors. Battery terminals or other electrical connectors penetrating the heat insulation fitted in battery casings must be provided with thermal insulation sufficient to prevent the temperature of the exposed surfaces of such devices from exceeding 55 °C (130 °F).

    - No battery may be offered for transportation if the temperature at any point on the external surface of the battery exceeds 55 °C (130 °F).

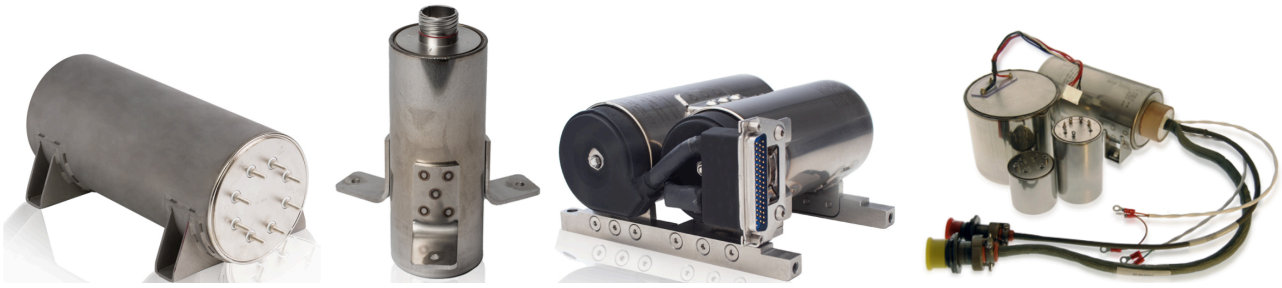
    - If any external source of heating is used during transportation to maintain sodium in batteries in a molten state, means must be provided to ensure that the internal temperature of the battery does not reach or exceed 400 °C (752 °F).

- When loaded in a transport vehicle or freight container:
    - Batteries must be secured so as to prevent significant shifting within the transport vehicle or freight container under conditions normally incident to transportation;

    - Adequate ventilation and/or separation between batteries must be provided to ensure that the temperature at any point on the external surface of the battery casing will not exceed 240 °C (464 °F) during transportation; and

    - No other hazardous materials, with the exception of cells containing sodium, may be loaded in the same transport vehicle or freight container. Batteries must be separated from all other freight by a distance of not less than 0.5 m (1.6 feet).

Thermal Batteries



Typical Uses: Ground vehicles, launch vehicles, marine applications, oil and gas drilling and satellites

Composition: Thermal batteries are known by different names: molten salt batteries, or liquid sodium batteries.
Thermal batteries contain: lithium anodes, iron disulfide cathodes, fused eutectic solid mixture of inorganic salts as the electrolyte, and a pyrotechnic blend of iron powder and potassium perchlorate (heat powder) as the heat source. The key to the long life of thermal batteries is that the electrolyte is a mixture of solid sodium or lithium salt that becomes liquid when heated. Thermal batteries are activated by an electronic squib or mechanical striker which activates a primer, which in turn ignites the pyrotechnic and melts the salt electrolyte.

Thermal batteries can provide several output voltages from one battery and are compatible with either steady load conditions or pulsed applications. A thermal battery is totally inert and non-reactive until activated. Because most external environments have little or no effect on the inactivated battery, it can be stored for 20+ years. The battery can be activated at any time without preparation, and will begin supplying power almost immediately. After activation, the battery quickly reaches peak voltage, which declines gradually during the rest of its active life. Once activated, the battery functions until a critical active material is exhausted or until the battery cools below the electrolyte's melting point. Thermal batteries remain inert during storage and are typically hermetically sealed so they can withstand environmental stresses. They are designed to handle extreme temperatures (either high or low, and have a range of more than 100C), vibration, mechanical shock, vacuum, very high or low pressures, EMI, and acceleration. Thermal batteries have a relatively short activated life, can develop high surface temperatures, can have non-linear output voltages, and are one time use batteries. Thermal batteries work through a chemical reaction of the solid lithium salt mixture. The battery has many cells in series that each has an anode, cathode, electrolyte, and igniter. The igniter sets off pyrotechnic reactions in each cell which increases the temperature to the melting point of the electrolyte. The molten electrolyte is highly conductive which allows current to flow between the anode and cathode of each cell. Thermal batteries are designed to be in storage for 20+ years then be used at full capacity. The electrolyte is stored as a solid salt, but still can react with the anode and cathode materials over the expected storage time. The chemical reaction can reduce the power capacity of the battery, as well as damage the anode or cathode.

US DOT Description:

Proper Shipping Name	Varies depending on the composition of the thermal battery and the USDOT EX Letter
Hazard Class	Varies (1.4S, 5.1, 4.1, 9, etc.)
Identification Number	Varies

Note: Thermal batteries are typically classified as non-explosive but some do require a USDOT EX letter.

Some thermal batteries contain asbestos! Other hazardous components include chromium, lithium, or thermal battery powder.

Caution When Handling: If the battery is designed to be activated by an electrical pulse then the possibility exists for the battery to be activated by any stray electrical pulse, such as static electricity. To prevent accidental activation, some thermal batteries are shipped with the squib contacts shorted together with copper wire. If such a wire is not present during storage, a single strand copper of 20 gauge or larger should be connected between the squib contacts to prevent accidental activation. When the battery is installed in the next assembly or system, the squib shorting wire should be removed. Note that when the shorting wire is removed, the battery will be subject to ignition by stray electrical signals or static electricity and great care should be used to prevent such signals from contacting the squib terminals. Thermal batteries should not be allowed to contact bare skin either during or immediately after activation. Following performance requirements, the battery should be allowed to cool down in ambient conditions for four to six hours or until the outer case has reached room temperature. Personnel handling the battery immediately after activation should wear protective clothing as required by OSHA for handling high temperature substances. At a minimum, high temperature rated insulated gloves, a full-face shield, and protective coveralls are recommended. If the surface of the battery container is distorted, dented, or punctured before activation, the battery must NOT be activated. The squib terminals should be shorted together and the battery should be disposed of as required by local, state, and federal EPA regulations.

Inspection/Deactivation: Inspect thermal batteries to determine if they have been activated already or if they are still active. If deactivation is required, follow manufacturer specific procedures since the method varies with different battery types.

US EPA Regulations: The RCRA Waste codes to be included on the manifest for Thermal Batteries can vary based on the chemical composition. Many self-contained thermal batteries carry no RCRA codes, but others are D001 (flammable solids). Thermal batteries containing chromium would be D001 (oxidizer) and D007 (chromium). Other thermal batteries containing lithium or releasing hydrogen sulfide gas would be D003 (water reactive/H2S gas former).

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.

§172.102, SPECIAL PROVISION 340

This entry applies only to the vessel transportation of nickel-metal hydride batteries as cargo. Nickel-metal hydride button cells or nickel-metal hydride cells or batteries packed with or contained in battery-powered devices transported by vessel are not subject to the requirements of this special provision. See "Batteries, dry, sealed, n.o.s." in the §172.101 Hazardous Materials Table (HMT) of this part for transportation requirements for nickel-metal hydride batteries transported by other modes and for nickel-metal hydride button cells or nickel-metal hydride cells or batteries packed with or contained in battery-powered devices transported by vessel. Nickel-metal hydride batteries subject to this special provision are subject only to the following requirements: (1) The batteries must be prepared and packaged for transport in a manner to prevent a dangerous evolution of heat, short circuits, and damage to terminals; and are subject to the incident reporting in accordance with §171.16 of this subchapter 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 nickel metal hydride battery; and (2) when loaded in a cargo transport unit in a total quantity of 100 kg gross mass or more, the shipping paper requirements of Subpart C of this part, the manifest requirements of

§176.30 of this subchapter, and the vessel stowage requirements assigned to this entry in Column (10) of the §172.101 Hazardous Materials Table.

§172.102, SPECIAL PROVISION 422

When labelling is required, the label to be used must be the label shown in § 172.447. Labels conforming to requirements in place on December 31, 2016 may continue to be used until December 31, 2018. When a placard is displayed, the placard must be the placard shown in § 172.560.

§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.

§173.189 Batteries containing sodium or cells containing sodium.

a) Batteries and cells may not contain any hazardous material other than sodium, sulfur or sodium compounds (*e.g.,* sodium polysulfides, sodium tetrachloroaluminate, *etc.*). Cells not forming a component of a completed battery may not be offered for transportation at a temperature at which any liquid sodium is present in the cell. Batteries may only be offered for transportation, or transported, at a temperature at which any liquid sodium present in the battery conforms to the conditions prescribed in paragraph (d) of this section.

b) Cells must be protected against short circuit and must consist of hermetically sealed metal casings that fully enclose the hazardous materials and that are so constructed and closed as to prevent the release of the hazardous materials under normal conditions of transport. Cells must be placed in suitable outer packagings with sufficient cushioning material to prevent contact between cells and between cells and the internal surfaces of the outer packaging, and to ensure that no dangerous shifting of the cells within the outer packaging occurs in transport. Cells must be packaged in 1A2, 1B2, 1N2, 1D, 1G, 1H2, 4A, 4B, 4N, 4C1, 4C2, 4D, 4F, 4G, 4H1, 4H2, 3A2, 3B2 or 3H2) outer packagings that meet the requirements of part 178 of this subchapter at the Packing Group II performance level.

c) Batteries must consist of cells secured within, and fully enclosed by a metal casing so constructed and closed as to prevent the release of the hazardous materials under normal conditions of transport. Batteries may be offered for transportation, and transported, unpacked or in protective packagings that are not subject to the requirements of part 178 of this subchapter.

d) Batteries containing any liquid sodium may not be offered for transportation, or transported, by aircraft. Batteries containing liquid sodium may be transported by motor vehicle, rail car or vessel under the following conditions:

   1) Batteries must be equipped with an effective means of preventing external short circuits, such as by providing complete electrical insulation of battery terminals or other external electrical connectors. Battery terminals or other electrical connectors penetrating the heat insulation fitted in battery casings must be provided with thermal insulation sufficient to prevent the temperature of the exposed surfaces of such devices from exceeding 55 °C (130 °F).
   2) No battery may be offered for transportation if the temperature at any point on the external surface of the battery exceeds 55 °C (130 °F).
   3) If any external source of heating is used during transportation to maintain sodium in batteries in a molten state, means must be provided to ensure that the internal temperature of the battery does not reach or exceed 400 °C (752 °F).
   4) When loaded in a transport vehicle or freight container:
      i) Batteries must be secured so as to prevent significant shifting within the transport vehicle or freight container under conditions normally incident to transportation;
      ii) Adequate ventilation and/or separation between batteries must be provided to ensure that the temperature at any point on the external surface of the battery casing will not exceed 240 °C (464 °F) during transportation; and
      iii) No other hazardous materials, with the exception of cells containing sodium, may be loaded in the same transport vehicle or freight container. Batteries must be separated from all other freight by a distance of not less than 0.5 m (1.6 feet).

e) Vehicles, machinery and equipment powered by sodium batteries must be consigned under the entry "Battery-powered vehicle or Battery-powered equipment."

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.