Lithium-Ion Battery Safety and Compliance

(Webinar #2 in our Series)

May 14, 2024

Presenters:

Bruce Armbruster, Directing Consultant, ALL4

Paul Johnson, Senior Managing Consultant, ALL4

Neal Suchak, Senior Communications Specialist, PHMSA

Andrew D'Rozario, Sales Engineer, Americase

Moderator:

Mike Liebert, Directing Consultant, ALL4

www.all4inc.com

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Logistics

- Thank you for attending!
- Questions?
  - Due to time constraints, we will not be answering questions live on this webinar. We'll provide email addresses at the end of the webinar and you can email any questions you may have to the speakers directly.
- Will I get a copy of the slides?
  - Yes, we will post webinar recording and slide deck on our website and a link with access will be emailed to participants.
- A certificate of attendance will be sent to all attendees

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Agenda

- **BRUCE/PAUL** – Lithium Battery Packaging and Handling
- **NEAL** – Lithium Battery Packaging for Recycle and Disposal
- **ANDREW** – Lithium Battery Safety Solutions

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Lithium-Ion Battery Packaging and Handling

May 14, 2024

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Batteries Are Everywhere!



- Cell phones
- Electric vehicles
- Power tools
- Computers





- Personal mobility devices (scooters, wheelchairs)
- Power supplies/backups (personal and large scale)



- Alarm systems
- Watches/clocks
- Digital cameras





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Why is packaging such an important topic?





- Safety
  - Property
  - Employees
  - Public
- Regulatory requirement

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Understanding Battery Hazards



Lithium batteries present both chemical and electrical hazards.



Batteries can be dangerous if not safely packaged and handled when transported.



When ignited or involved in a fire they may be difficult to extinguish. However, water is almost always the best fire-fighting agent.

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Battery Primer

Battery Types

- **Primary batteries** are a single use battery that provides electrical current until the “charge” or stored energy is depleted.
- **Secondary batteries** are rechargeable and may be “reenergized” many times before they begin to lose the ability hold an electrical charge.
- Batteries can be further described by the chemistry present within the cell.

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Battery Primer

Lithium Battery Types

- It is important to know the chemistry of the batteries you are handing. Information about your batteries may be found in the SDS or manufacturer's literature.

- **Primary battery** contain lithium metal or lithium alloys. These are often used in, cameras, military applications and oil exploration. Examples of these batteries include Thionyl Chloride, Sulfur Dioxide chemistries.

- **Secondary battery** chemistries include **lithium** Ion or polymer batteries.

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General Safety

- Never attempt to re-charge a primary battery.
- Never overcharge a battery.
- Never leave your battery powered device charging unattended for long periods of time.
- Avoiding crushing or puncturing the battery case or cells.
- Never dispose of your batteries in a fire.
- Protect (insulate) the terminals (tape, bag, orientation).
- Never throw batteries into the trash or curbside recycle bin.

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Packaging Lithium Batteries for Transportation

- All Lithium batteries must be **protected from short circuit** and movement during transportation.
- Specific markings unique to lithium battery packages are required by regulation.
- Specific packagings unique to the type and size of the batteries are required when offered for transportation.
- Batteries being shipped for **recycling or disposal** have unique packaging requirements.
- **Damaged batteries** have unique packaging requirements.

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Importance of Packaging

Why do we care?

- **Safety**
  - Public
  - Employee
  - Property
  - Emergency Responders
- **Regulatory Requirements**
  - It’s the law



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Getting Started





























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Work Area

- Have a plan.
- Select an area that is away from normal work areas, traffic flows and buildings.
- Anticipate potential for a battery incident.



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Packaging Tasks

Once the working area is established and the batteries are present:

- Sort batteries by type and size
  - Never package mixed chemistries together
  - Identify damaged batteries and set aside for individual packaging.
- Prepare each battery for inner packaging
  - Tape/insulate terminals
  - Place into individual, non-conductive closed containers.
- Damaged and defective batteries MUST be packaged separately and in individual outer containers.

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Sorting

- **Separate batteries based on chemistry.**
- **Separate batteries based on condition.**
  - Damaged, Defective and Recalled batteries must be packaged



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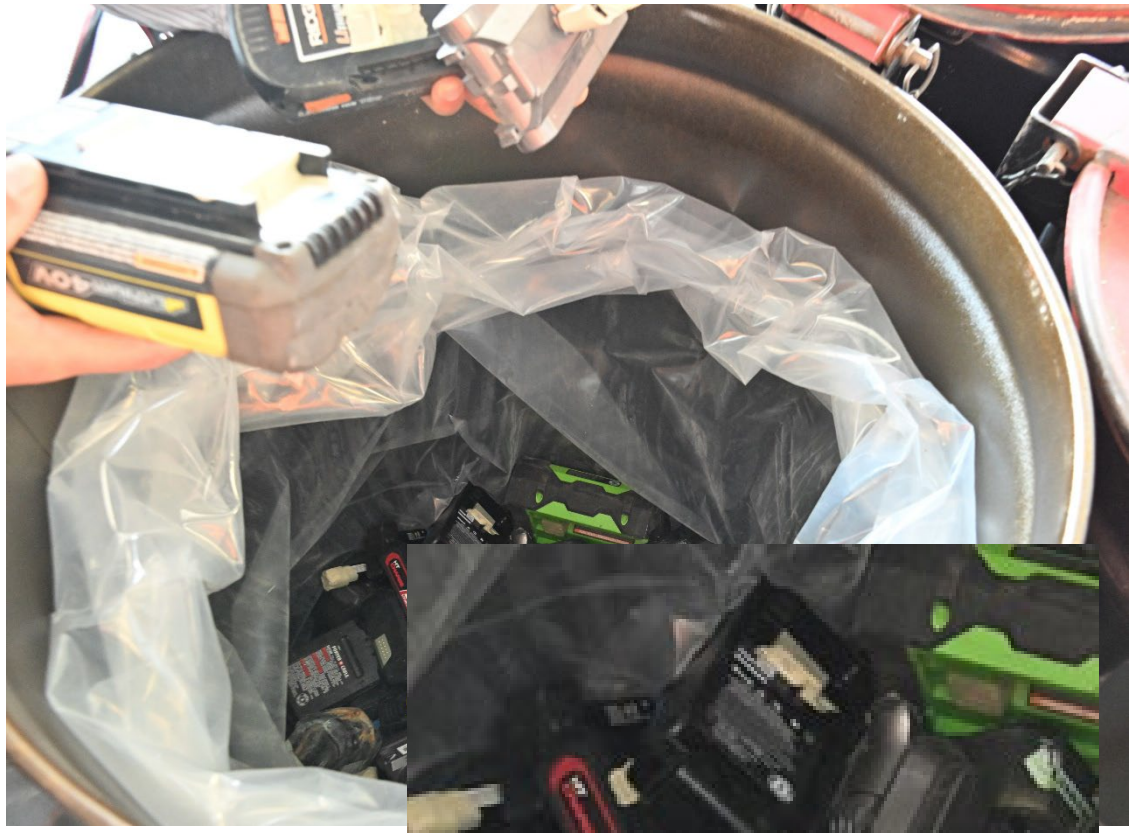
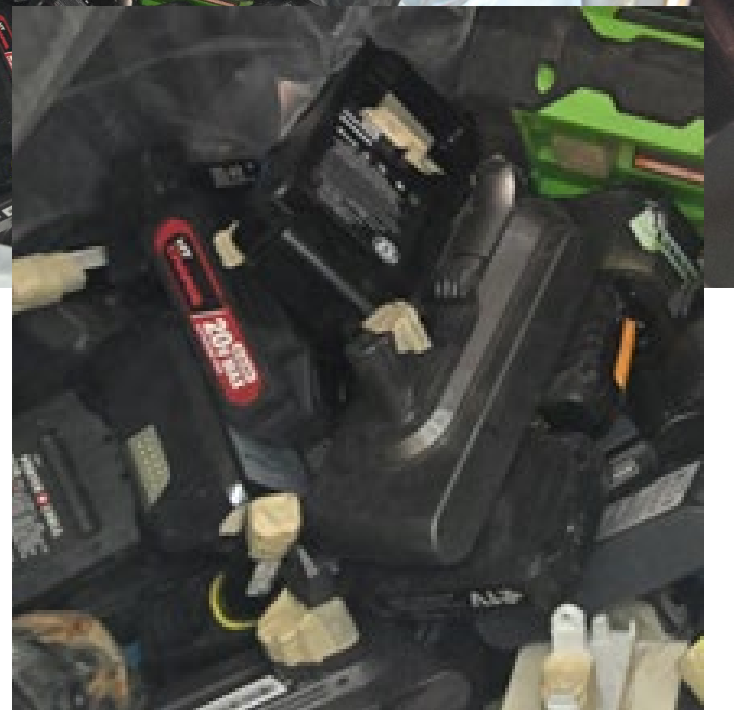
Isolate Terminals









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Isolate Terminals





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Isolate Terminals





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Packaging Tasks

Packaging

- Place batteries into strong outer packages or as necessary UN certified containers (DDR).
- Line metal containers with nonconductive liners.
- Surround the batteries with nonconductive, non-flammable cushioning material.
- Mark packages
  - Label packages with specific required information.

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Inner Packaging and Cushioning

- **Non-DDR**
  - Multiple batteries in one inner packaging
- **DDR**
  - One battery per inner packaging
  - One inner packaging per outer packaging



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Inner Packaging and Cushioning





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Inner Packaging and Outer Packaging





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Add Cushioning Material and Seal





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Damaged, Defective and Recalled (DDR) Lithium Batteries



"Lithium cells or batteries that have been damaged or identified by the manufacturer as being defective for safety reasons, that have the potential of producing a dangerous evolution of heat, fire, or short circuit (e.g., those being returned to the manufacturer for safety reasons)" are **FULLY REGULATED**.







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Damaged, Defective, and Recalled (DDR) Lithium Batteries

173.185 (f)

- Batteries must be **individually** packaged in non-metallic inner packaging that completely encloses the battery
- Inner packaging surrounded by non-combustible, non-conductive, and absorbent cushioning material
- Single inner packaging must be placed in performance-oriented packaging at the Packing Group I performance level I
- If you are using a package with a special permit, you MUST follow the packaging manufacturer's instructions EXACTLY, including the use of any specific packaging components specified (e.g., cushioning, tape)







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Training

A hazmat employee is a person who is employed by a hazmat employer and who directly affects hazardous materials transportation.

Members of the public or untrained employees often initiate the management of discarded lithium batteries

- E-waste Handlers
- Retail vendors
- Automotive scrap yards
- The public
- MRF's

When untrained personnel or members of the public prepare batteries for transportation or recycling without proper training and knowledge of the basic safety risks, the results may be catastrophic.

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Consequences of improperly packaged Li-ion batteries.

Undeclared lithium batteries stoke San Pedro container fire

Rich Miller March 14, 2022

(SAN PEDRO, Calif.) — The U.S. Coast Guard worked with port partners to identify shipping containers with undeclared hazardous materials that led to a shipping container fire in the Port of Los Angeles-Long Beach on March 4.

At approximately 8:20 p.m., watch standers at Coast Guard Sector Los Angeles-Long Beach received a report of a shipping container on fire that was due to be loaded on a vessel sailing for China on March 10.

The Los Angeles Fire Department extinguished the fire, but efforts were complicated due to the container not being marked as hazardous materials. The bill of lading for the container indicated that it carried "synthetic resins." Further investigation revealed that it actually held used lithium-ion batteries, which are a regulated hazardous material.



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Examples of improperly packaged, undeclared batteries and electronics







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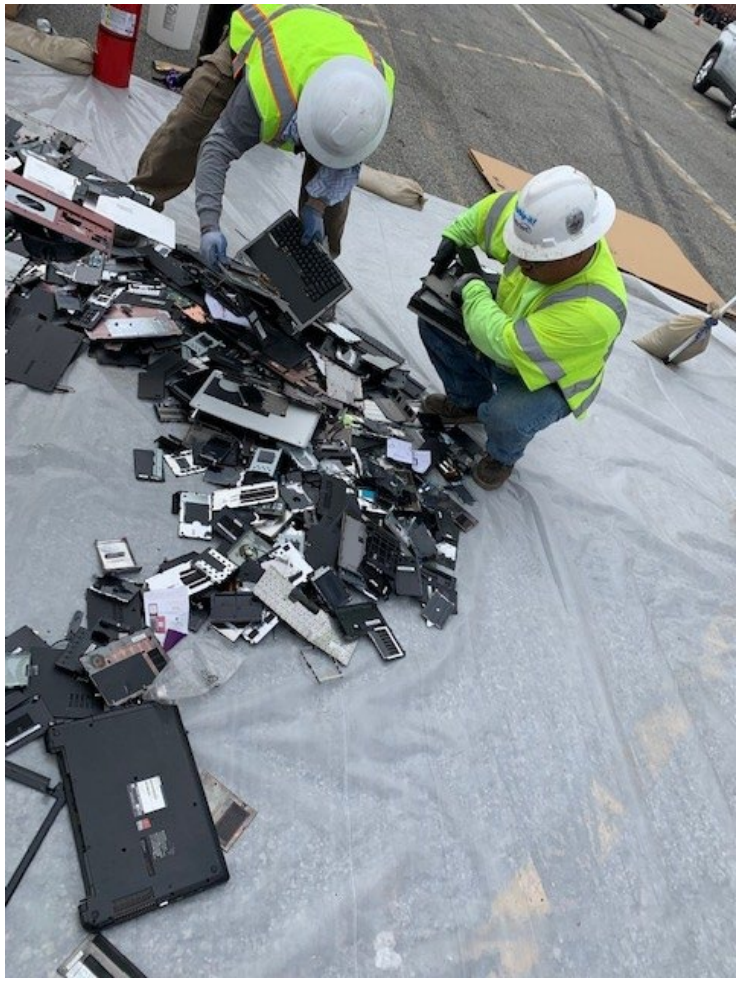
This material had to be de-packed, sorted, identified and repackaged in the field







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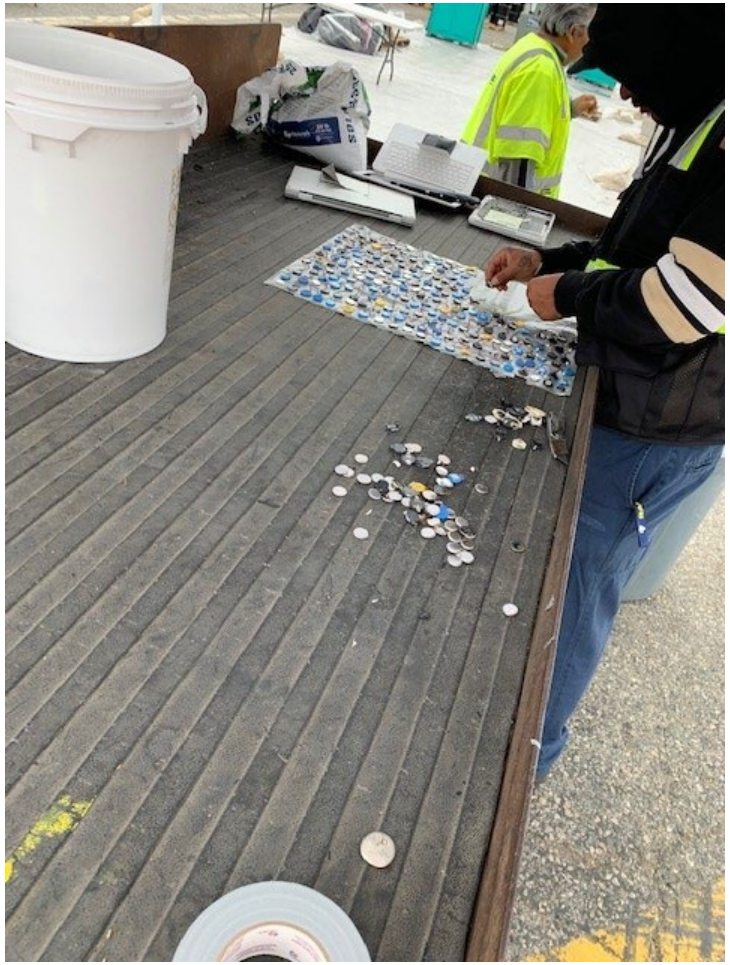
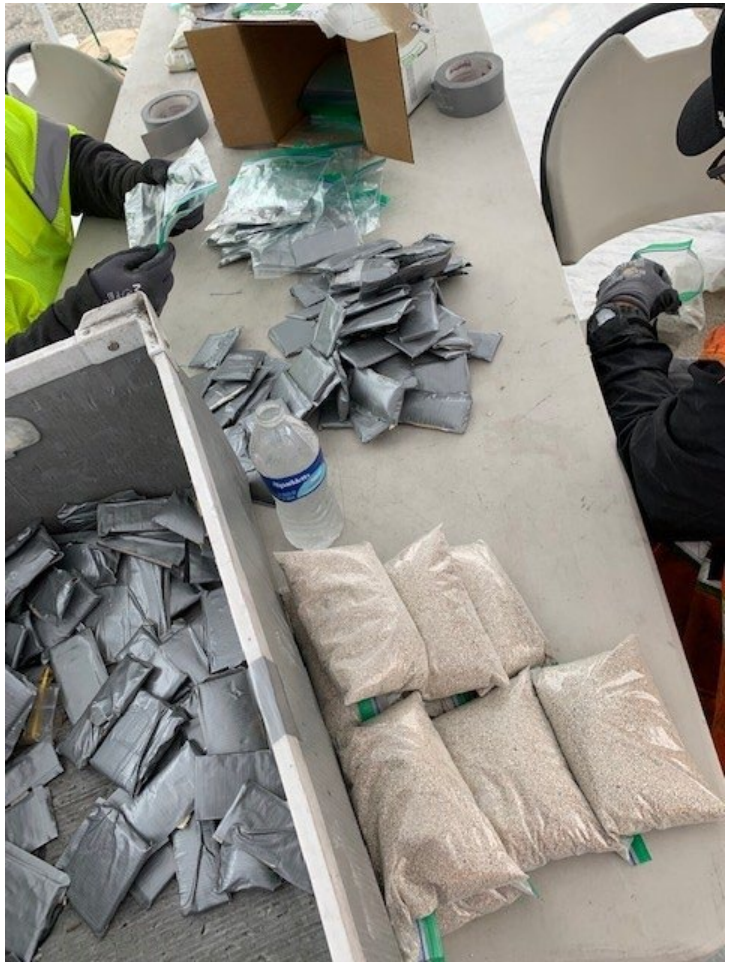
Insulation of coin cell batteries and packaging of DDR batteries







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Proper preparation of batteries for transportation is a difficult task in the field.

Care must be taken when handling, insulating and packaging the batteries for transportation.



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The Importance of Understanding the Hazards











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Worst Case Scenarios



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Best Management Practices

- Learn and comply with all federal, state, and local requirements.
- Take every precaution to prevent thermal runaway and fires.
- Develop written compliance programs;
  - Packaging and storage guidelines
  - Establish approved storage locations
  - Employee training
  - Periodic auditing, visual and thermal inspections of storage areas
- Insulate and isolate the terminals of the batteries with non-conductive tape, plastic bags, or other separation techniques;
- Mark and label packages and storage areas;
- Preventing damage to batteries;

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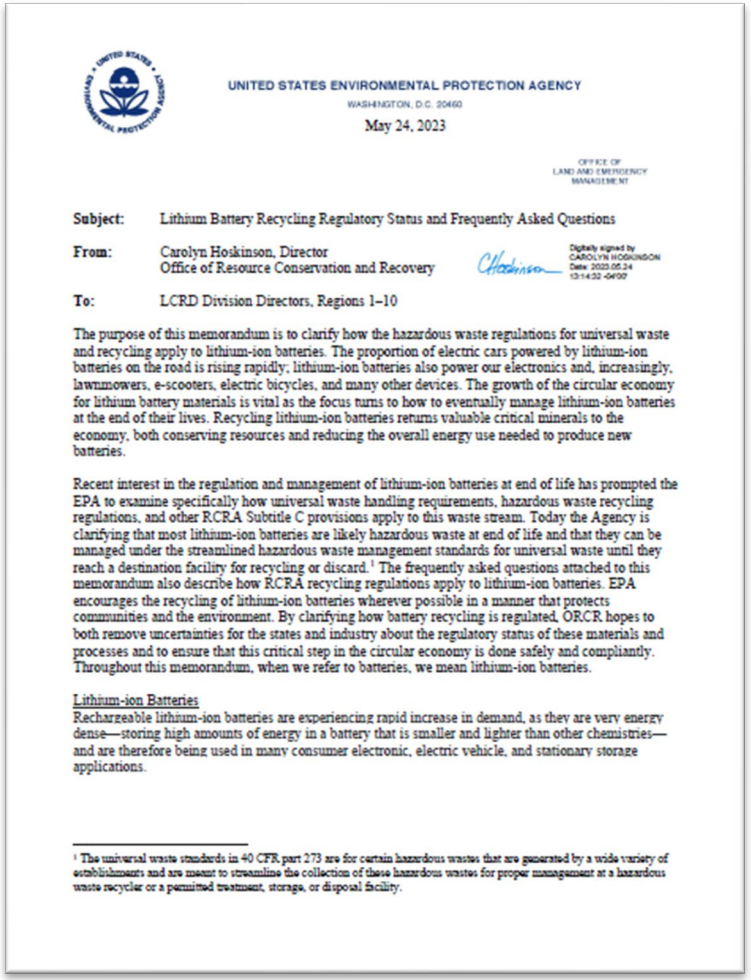
Resources and Services are Available



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

May 24, 2023

OFFICE OF
LAND AND EMERGENCY
MANAGEMENT

Subject: Lithium Battery Recycling Regulatory Status and Frequently Asked Questions

From: Carolyn Hoskinson, Director
Office of Resource Conservation and Recovery

Digitally signed by CAROLYN HOSKINSON
Date: 2023.05.24 13:14:32 -04'00'

To: LCRD Division Directors, Regions 1–10

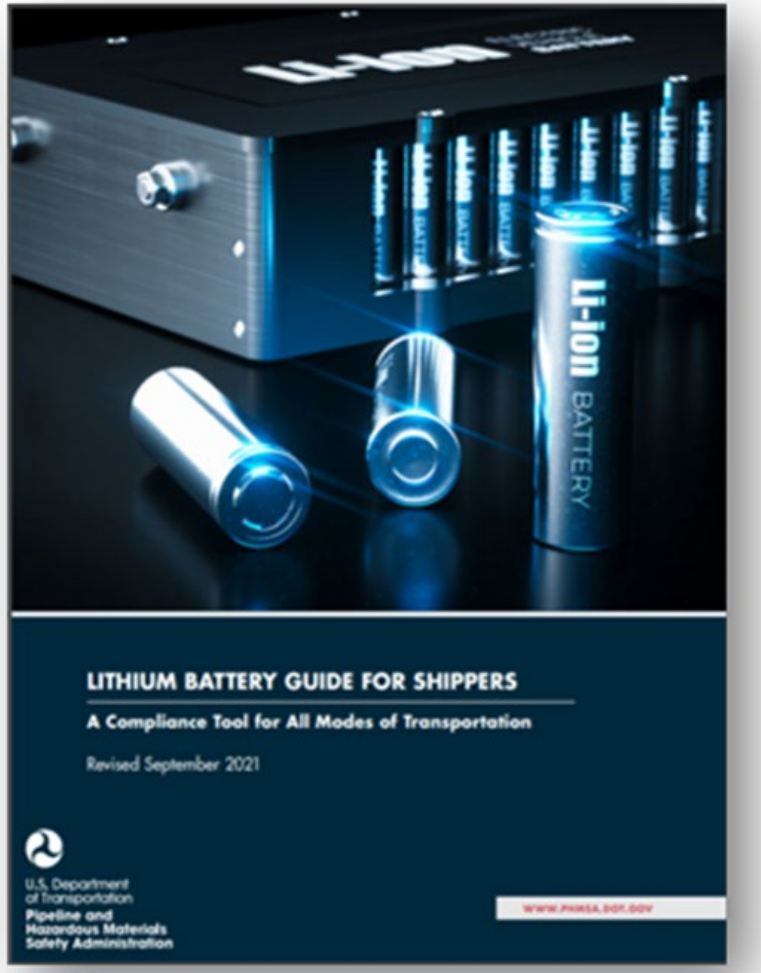
The purpose of this memorandum is to clarify how the hazardous waste regulations for universal waste and recycling apply to lithium-ion batteries. The proportion of electric cars powered by lithium-ion batteries on the road is rising rapidly; lithium-ion batteries also power our electronics and, increasingly, lawnmowers, e-scooters, electric bicycles, and many other devices. The growth of the circular economy for lithium battery materials is vital as the focus turns to how to eventually manage lithium-ion batteries at the end of their lives. Recycling lithium-ion batteries returns valuable critical minerals to the economy, both conserving resources and reducing the overall energy use needed to produce new batteries.

Recent interest in the regulation and management of lithium-ion batteries at end of life has prompted the EPA to examine specifically how universal waste handling requirements, hazardous waste recycling regulations, and other RCRA Subtitle C provisions apply to this waste stream. Today the Agency is clarifying that most lithium-ion batteries are likely hazardous waste at end of life and that they can be managed under the streamlined hazardous waste management standards for universal waste until they reach a destination facility for recycling or discard.[1] The frequently asked questions attached to this memorandum also describe how RCRA recycling regulations apply to lithium-ion batteries. EPA encourages the recycling of lithium-ion batteries wherever possible in a manner that protects communities and the environment. By clarifying how battery recycling is regulated, ORCR hopes to both remove uncertainties for the states and industry about the regulatory status of these materials and processes and to ensure that this critical step in the circular economy is done safely and compliantly. Throughout this memorandum, when we refer to batteries, we mean lithium-ion batteries.

Lithium-ion Batteries

Rechargeable lithium-ion batteries are experiencing rapid increase in demand, as they are very energy dense—storing high amounts of energy in a battery that is smaller and lighter than other chemistries—and are therefore being used in many consumer electronic, electric vehicle, and stationary storage applications.

[1] The universal waste standards in 40 CFR part 273 are for certain hazardous wastes that are generated by a wide variety of establishments and are meant to streamline the collection of these hazardous wastes for proper management at a hazardous waste recycler or a permitted treatment, storage, or disposal facility.





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U.S. DOT Lithium Battery Packaging for Recycling & Disposal

Presented by:
Neal Suchak
Senior Communications Specialist, Office of Hazmat Safety – Communications Branch
Pipeline and Hazardous Materials Safety Administration (PHMSA)
U.S. Department of Transportation

Neal.Suchak@dot.gov
(202) 839-0498



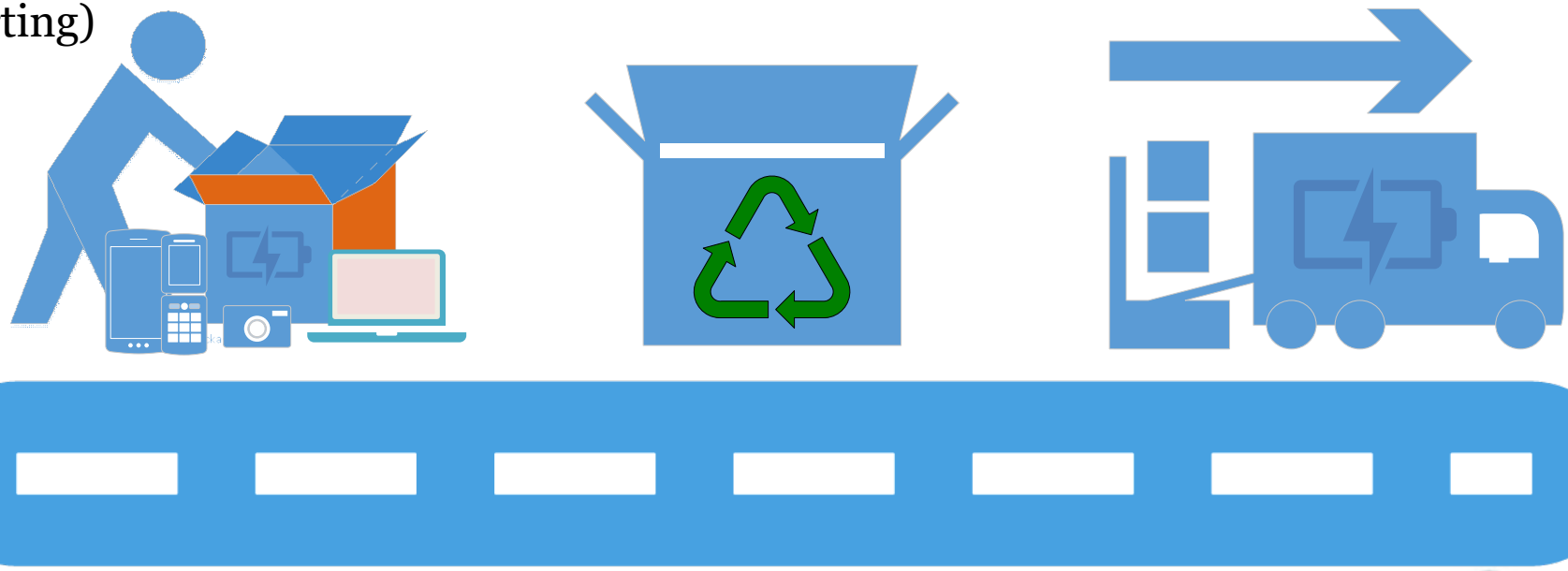
DOT in the Supply Chain

Oversight Over the Transportation Process

Identification and Classification (collection/ sorting)

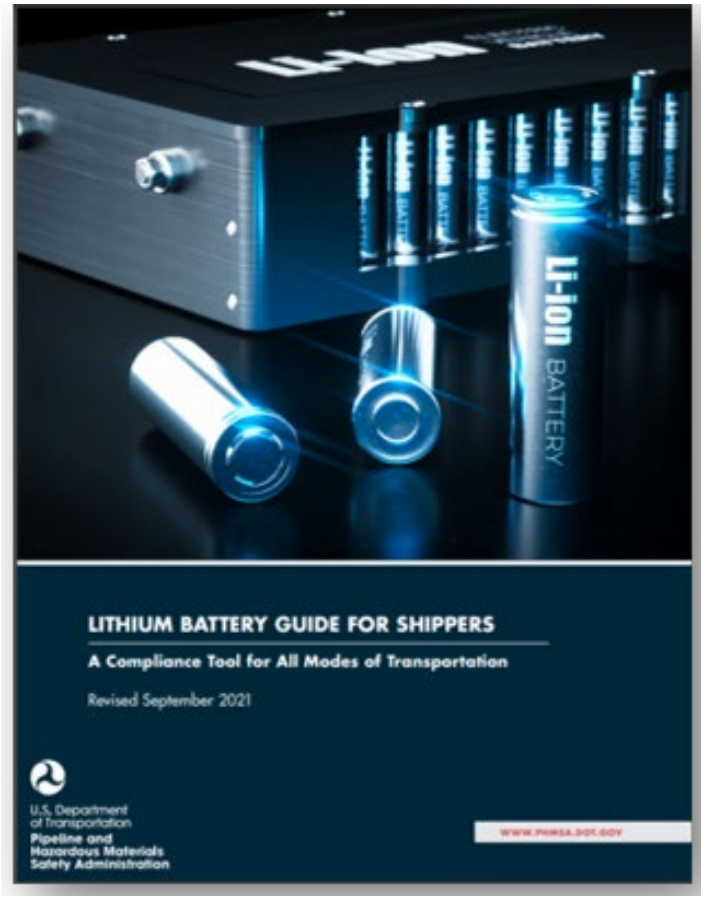
Packaging and Hazard Communication

Movement





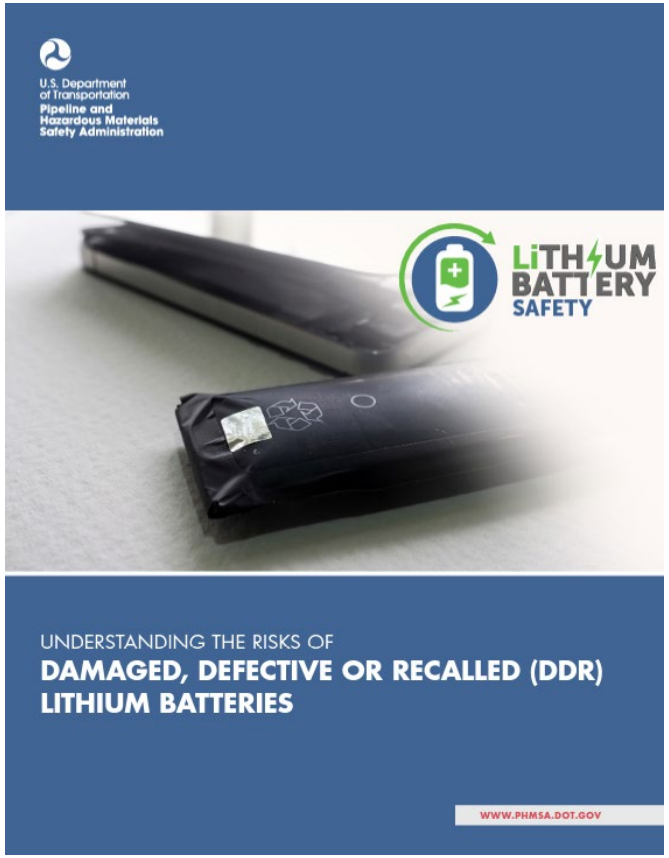
Lithium Battery Guide for Shippers



https://www.phmsa.dot.gov/training/hazmat/lithium-battery-guide-shippers

Video: How to Use the Lithium Battery Guide for Shippers

Understanding the Risks of Damaged, Defective, or Recalled (DDR) Lithium Batteries



https://www.phmsa.dot.gov/training/hazmat/understanding-risks-damaged-defective-or-recalled-ddr-lithium-batteries

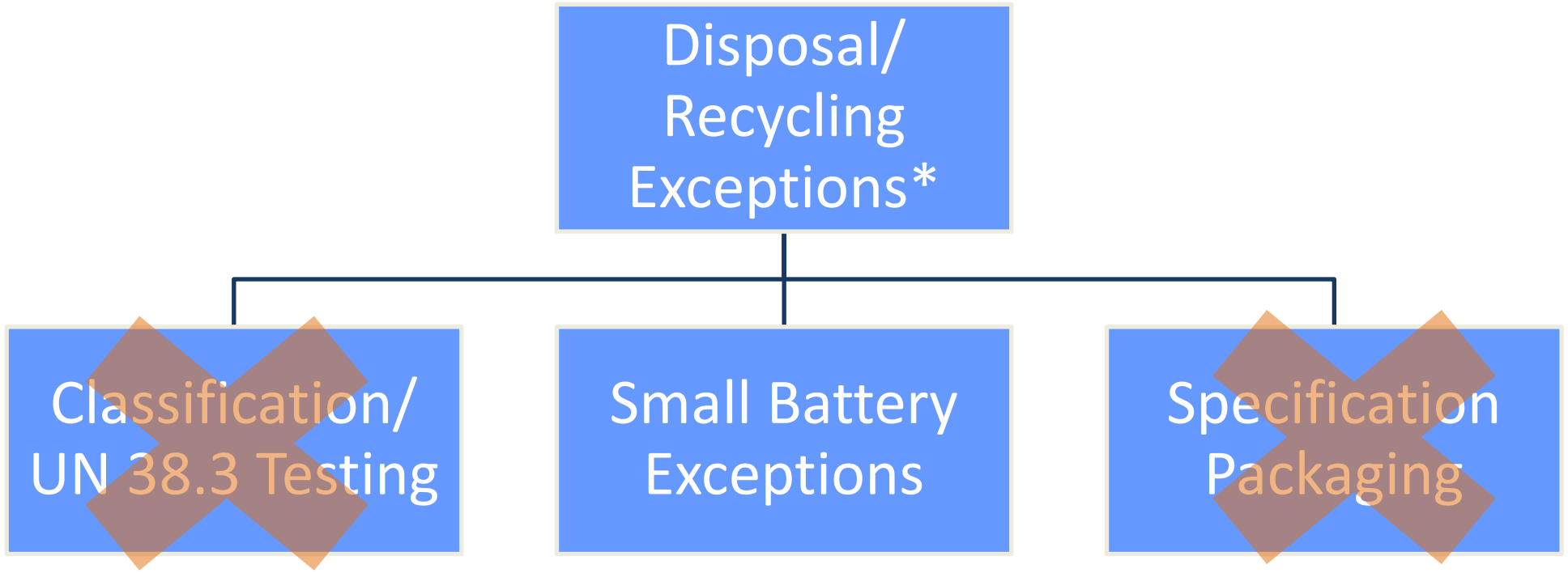
Hazardous Materials Regulations (HMR)

- Section 173.185 in the HMR addresses requirements for lithium batteries, including the exceptions for recycling lithium batteries:

1. Classification/ UN 38.3 Testing
   Paragraph (a)
2. Packaging
   Paragraph (b)
3. "Small" battery exceptions
   Paragraph (c)
4. Disposal/ Recycling Exceptions
   Paragraph (d)
5. Damaged, Defective, Recalled (DDR) Requirements
   Paragraph (f)



Disposal/Recycling Exceptions



TRANSPORTATION BY MOTOR VEHICLE ONLY

49 CFR § 173.185(d)



Small Battery Exception



NOT REQUIRED:

- Shipping papers
- Specification (UN) packaging
- Hazmat employee training
- Placards
- Class 9 label
- Emergency Response Telephone Number

49 CFR § 173.185(c)(3) & 40 CFR §§ 273.14, 273.34

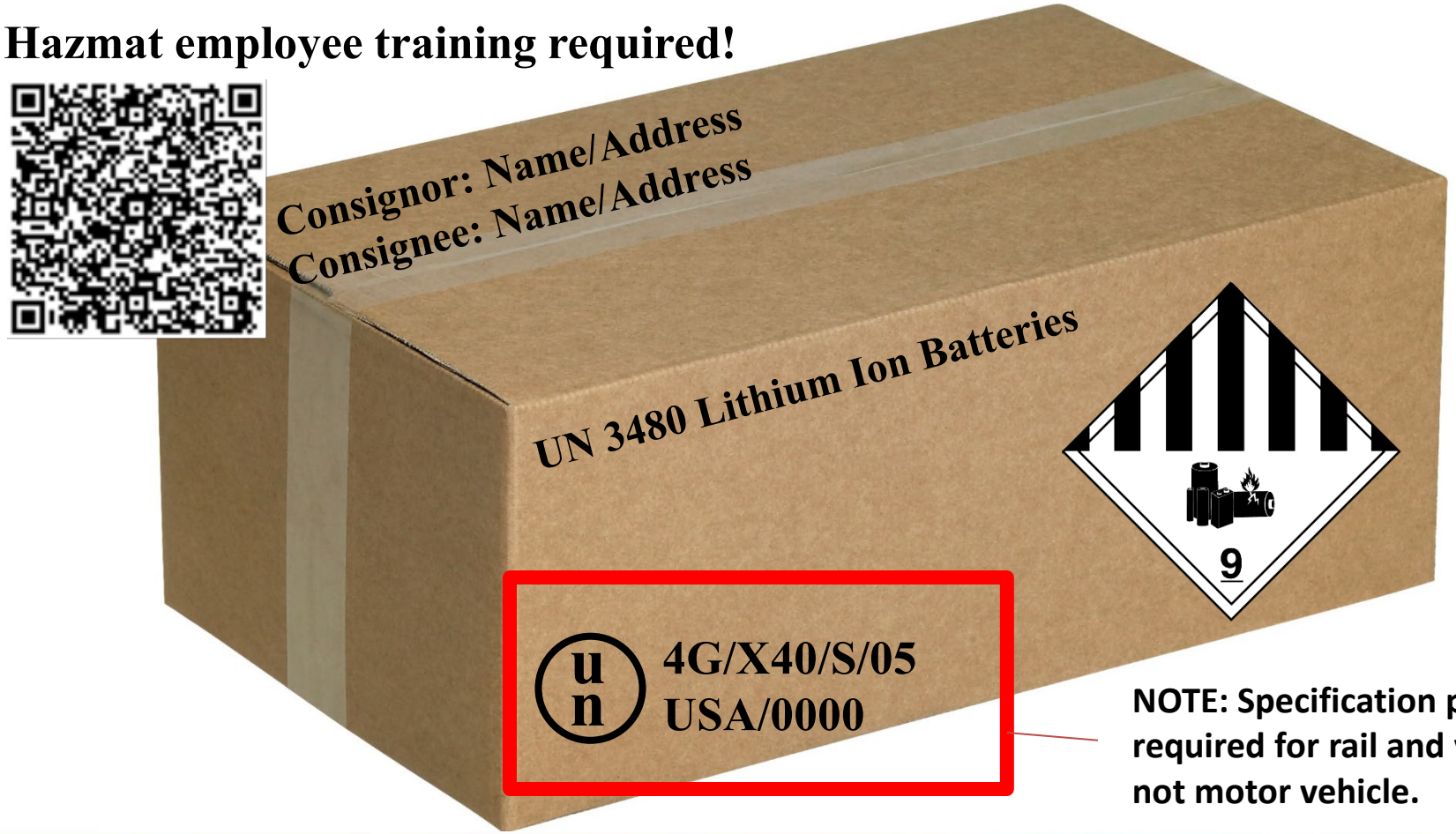


- May be combined with exceptions for recycling
- No more than 66 lbs gross weight
- Batteries must NOT be damaged, defective, recalled
- Small li-ion = 300wh (ground), 100wh (air/vessel)
- Small li-metal = 25g (ground), 2g (air/vessel)



Over 66 lbs Gross or Larger-Sized Batteries?

Hazmat employee training required!



NOTE: Specification package required for rail and vessel – not motor vehicle.

EV or Electric Storage Batteries

Alternative packaging

- Batteries that weigh over 12 kg (26.5 lbs)
- Must have strong, impact-resistant outer casing

Not permitted for passenger aircraft (Cargo Aircraft requires Approval by AA)

May be packed:

- In "strong outer packagings"
- In protective enclosures (e.g., crates)
- On pallets

49 CFR § 173.185(b)(5)
or
49 CFR § 173.185(d)



Rolla, MO – January 27, 2022



A trailer load of new Chevy Bolt batteries got involved in a traffic accident on its way to Oklahoma. Packaging may have played a role in keeping this incident becoming much worse than it was.

Rolla, MO – January 27, 2022





Damaged, Defective, Recalled (DDR)

Even when transported for recycling/disposal DDR batteries are **FULLY REGULATED!**





- Defective
- Leaked or vented
- Sustained physical or mechanical damage
- Cannot be diagnosed
- Known misuse of the battery
- Damage to safety features, components, or short circuit protection



Packaging DDR Batteries

- Batteries must be **individually** packaged as follows:
  - Non-metallic, inner packaging that completely encloses the battery
  - Inner packaging surrounded by non-combustible, non-conductive, and absorbent cushioning material
  - Single inner packaging must be placed in **performance-oriented packaging at the Packing Group I performance level.**



DOT Special Permits (DOT SPs)



What are Special Permits?

- DOT special permits (SPs) are an extension of the regulations and offer alternative provisions
- There are two types of SPs:

Manufacture, mark, and sell (MMS) packaging	Offer



What are examples of DOT SPs?



DOT-SP 14849



DOT-SP 16474

Disclaimer: images are examples of DOT Special Permit packaging and not an endorsement of any particular product or company

Example DDR Kits







Disclaimer: images are examples of DOT Special Permit packaging and not an endorsement of any particular product or company

Pictured L-R: DOT-SP 20549, DOT-SP 20432, DOT-SP 20910

DDR Kits



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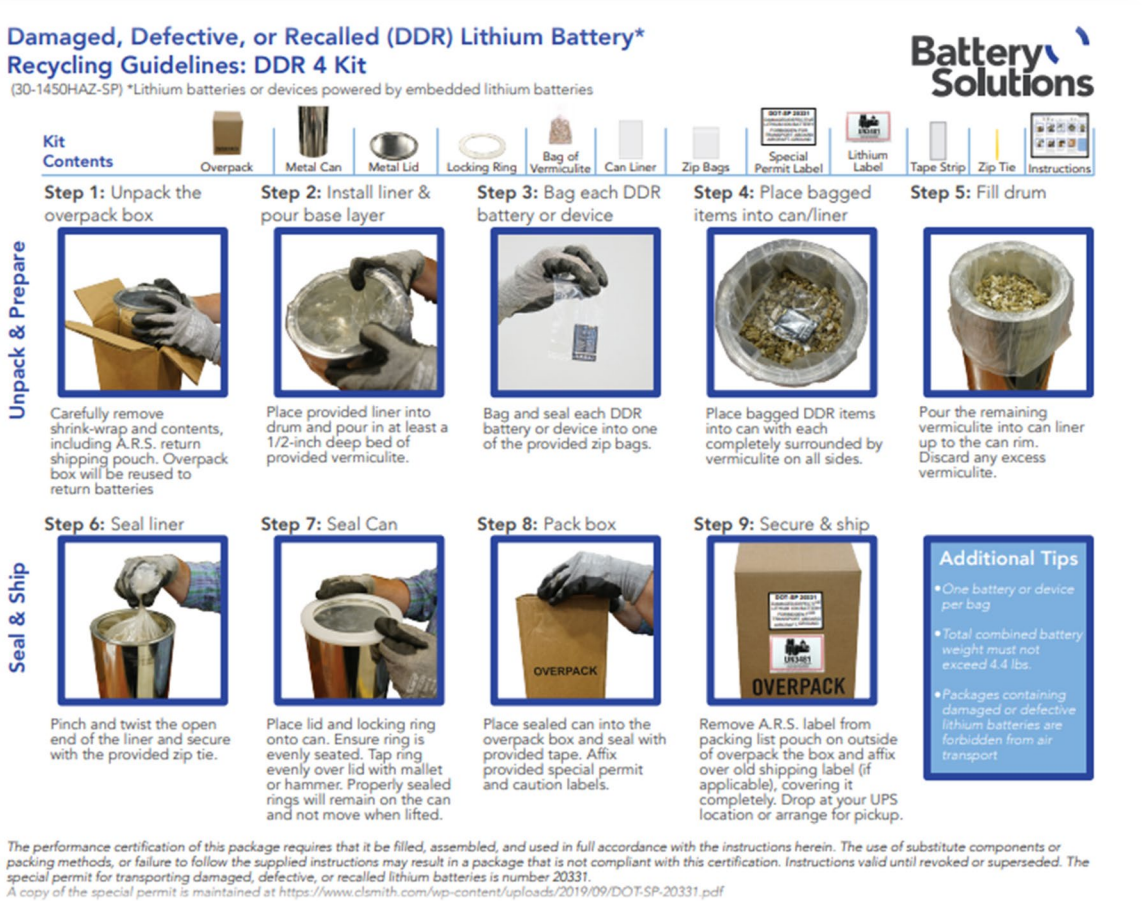
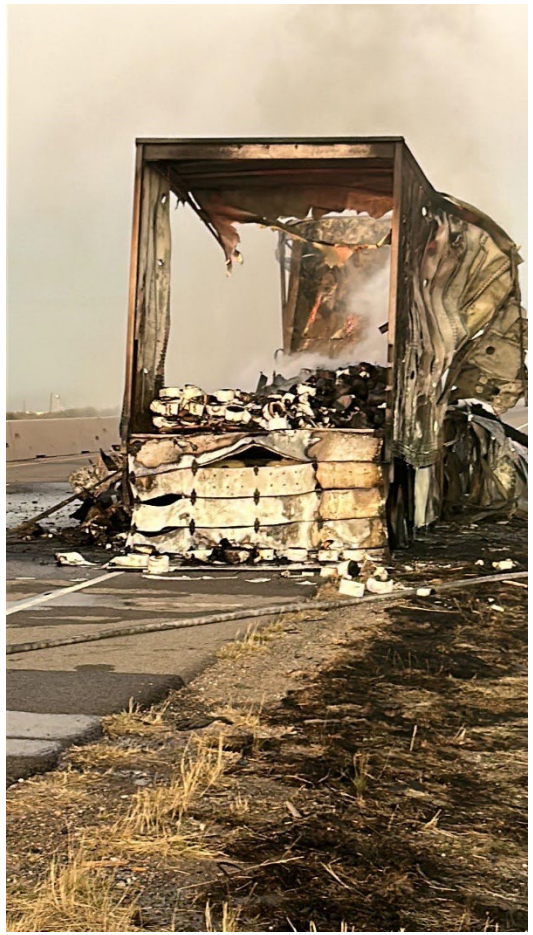


Pictured: DOT-SP 20331



Monahan, TX – February 23, 2023







Hazardous Materials Information Center



1-800-467-4922

Hazardous Matters Newsletter



- Letter from PHMSA leaders
- Rulemakings
- New publications/resources
- Public events

https://www.phmsa.dot.gov/training/hazmat/phmsas-quarterly-hazmat-newsletter



Lithium-Ion Battery Safety & Compliance 2024

May 2024

Americase®

Presenter



Andrew D'Rozario
Business Development Manager, Hazmat
Americase

- Expert on current and upcoming regulations regarding lithium-ion battery transportation with a focus on DDR. Extensive knowledge of manufacturing capabilities, lithium battery engineering, and container capabilities.
- Sits on:
  - SAE Battery Transport Committee
  - SAE J3303
- Membership on:
  - PRBA
  - COSTHA

Providing INNOVATIVE SOLUTIONS to Complex Problems



Americase designs and fabricates cutting-edge protection containers for the transportation and storage of hazmat and high value goods.



We are industry experts, actively contributing to the development and application of regulations and standards.



With Americase, your products will be safely transported and/or stored while meeting all current and future requirements.

Major Milestones

1990s

- Developed/launched ATA 300 Rated Airline and Road Style Cases.

2000s

- Developed/launched Shipping Containers for Probe Cards that Test LSI Chips, Oxygen Bottle Shipping Containers & Oxygen Generator Shipping Cases.
- Developed AKROTHERM, a heat-mitigating product, to meet new DOT31FP-HM224B airline regulations for transporting oxygen.
- Acquired the precision metal fabricator, Gen-X, to enhance manufacturing capacity of aluminum cases in-house as well as manufacture new products for the aerospace market.

2010s

- Achieved ISO 9001 and AS9100 quality certifications.
- FAA Fire Testing Center named the Americase oxygen generator packaging “the best future option for containing lithium-ion battery thermal runaway events”.
- Received DOT-SP16011 that allows for shipping damaged, defective, and recalled (DDR) lithium-ion batteries.
- Developed/launched Helicopter Blade Case, The Battery Bag, & The Battery Box.
- NASA awarded Design and Development contract to Americase for NORS Project which produced and delivered high pressure Oxygen and Nitrogen to the International Space Station.

2020s

- Developed/launched the Data Center Lithium-ion Battery Case & Large Format Lithium-Ion Battery Case for the Automotive industry (EVs).
- Expanded suite of transportation cases for crucial OEM helicopter components including main rotor hubs, and others.
- Launched in-house R&D Team focused on the development of safe transport and storage of lithium batteries.

We are the Industry Experts

We don’t just research the industry standards and regulations; we actively contribute to the writing process and assist regulatory bodies in the practical application of these requirements. Our regulatory body work includes:

- SAE G27 Lithium Battery Packaging Committee & Battery Transportation Committee
- Medical Device Transport Council (MDTC)
- UN Informal Working Group on Hazard Classification of Lithium Batteries
- Dangerous Goods Advisory Council (DGAC)
- The Council on Safe Transportation of Hazardous Articles, Inc. (COSTHA)
- Portable Rechargeable Battery Association (PRBA)

Lithium Battery Fires in the Headlines

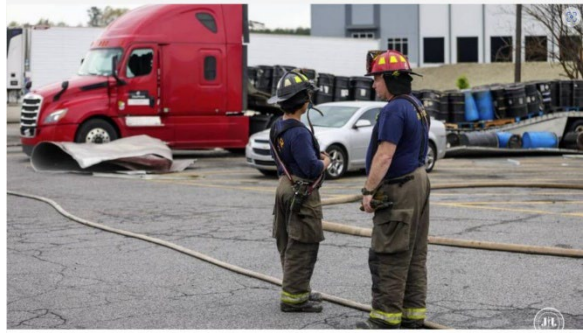
Americase

Lithium-ion batteries are fueling the fire on a burning cargo ship full of Porches

2 years ago

A ship full of burning luxury cars highlights the fire risks of lithium-ion batteries. ...





02 Apr 2023

Barrels of discarded lithium batteries exploded during transport on their way to recycling

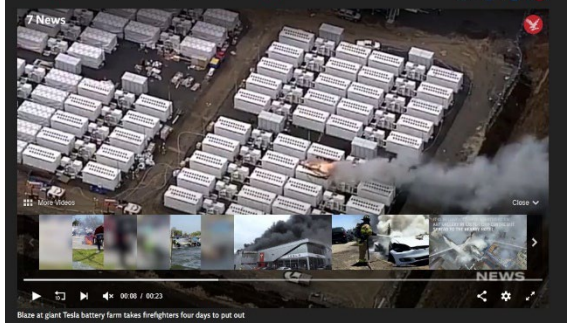
EN

News > World

Blaze at giant Tesla battery farm takes firefighters four days to put out

'This is the first Megapack fire that's ever happened in the world, is our understanding'

Justin Vallejo New York • Monday 02 August 2021 23:41 BST • Comments



Blaze at giant Tesla battery farm takes firefighters four days to put out



Industrial fire involving lithium batteries forces evacuations in Morris

Lithium Batteries Could Spark 'Catastrophic' Plane Fires, FAA Warns

Fire suppression systems are "incapable" of controlling the blaze.

By ABC News
February 9, 2016, 3:26 PM



FAA Warning Over Lithium Batteries

Watch what happens when a shipment of ion batteries spontaneously ignites.



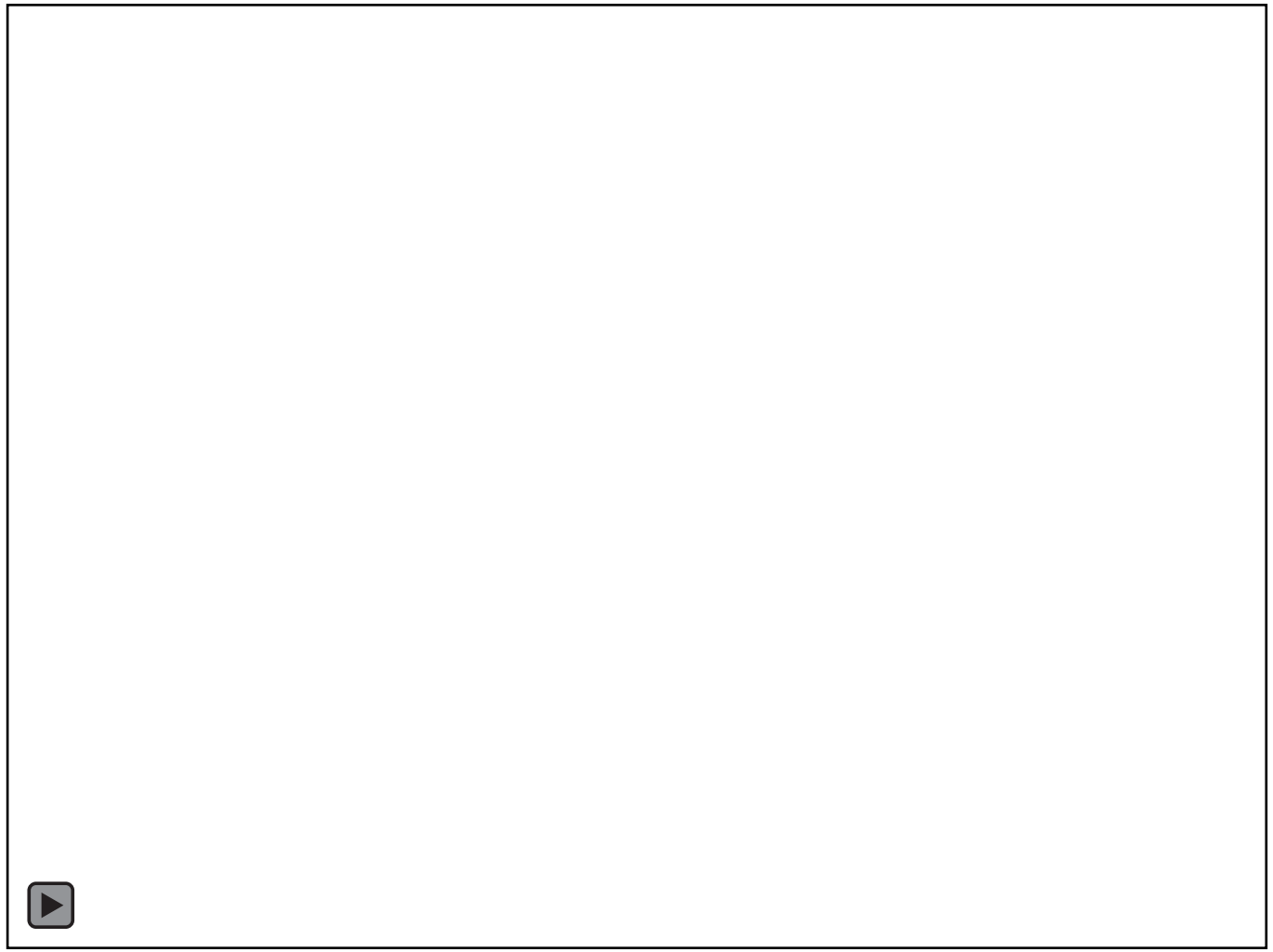
HOME > NEWS > OUTAGES

South Korea's government to grill Kakao after data center fire cripples key services

Fire at SK Group data center also hit Naver - but Kakao reportedly had a flawed recovery plan

October 17, 2022 By: Peter Judge Have your say

Lithium Battery – Thermal Runaway



Special Permits

Americase

DDR

March 31, 2020

U.S. Department
of Transportation

Pipeline and Hazardous
Materials Safety Administration

East Building, PHH-30
1200 New Jersey Avenue S.E.
Washington, D.C. 20590

DOT-SP 16011
(TENTH REVISION)

EXPIRATION DATE: 2024-02-29

(FOR RENEWAL, SEE 49 CFR 107.109)

1. GRANTEE: Americase, Inc.
Waxahache, TX

2. PURPOSE AND LIMITATIONS:

a. This special permit authorizes the manufacture, mark, sale and use of four specially designed packagings intended for the transport of certain limited-size lithium ion cells and batteries that may be damaged or defective, are suspected of being damaged or defective including instances where the cells or batteries can't be appropriately assessed prior to transport and the packaging is being used as an added safety precaution. This special permit provides no relief from the Hazardous Materials Regulations (HMR) or the International Maritime Dangerous Goods (IMDG) Code other than as specifically stated herein. The most recent revision supersedes all previous revisions.

b. The safety analyses performed in development of this special permit only considered the hazards and risks associated with transportation in commerce. The safety analyses did not consider the hazards and risks associated with consumer use, use as a component of a transport vehicle or other device, or other uses not associated with transportation in commerce.

c. This special permit serves as an "exemption" under Chapter 7.9, Section 7.9.1 of the IMDG Code (see IMO MSC/Circ. 1075-Granting Exemptions from the Provisions of the IMDG Code) and as a "Competent Authority Approval" as defined under 49 CFR § 107.1.

Prototype

March 19, 2021

U.S. Department
of Transportation

Pipeline and Hazardous
Materials Safety Administration

East Building, PHH-30
1200 New Jersey Avenue S.E.
Washington, D.C. 20590

DOT-SP 20798
(SECOND REVISION)

EXPIRATION DATE: 2025-02-28

(FOR RENEWAL, SEE 49 CFR 107.109)

1. GRANTEE: Americase, LLC
Waxahachie, TX

2. PURPOSE AND LIMITATIONS:

a. This special permit authorizes the manufacture, mark, sale, and use of certain 4G and 4B boxes for the transportation in commerce of prototype and low production lithium ion cells and batteries. This special permit provides no relief from the Hazardous Materials Regulations (HMR) or the International Civil Aviation Organization's Technical Instructions for the Safe Transport of Dangerous Goods by Air (ICAO TI) other than as specifically stated herein. The most recent revision supersedes all previous revisions.

b. The safety analyses performed in development of this special permit only considered the hazards and risks associated with transportation in commerce. The safety analyses did not consider the hazards and risks associated with consumer use, use as a component of a transport vehicle or other device, or other uses not associated with transportation in commerce.

c. This special permit serves as an approval under Special Provision A88 and State Variation US 3 of the ICAO TI and as a "Competent Authority Approval" as defined under 49 CFR § 107.1.

Battery Bag





Used for both DDR and Prototype Batteries (DOT SP 16011 and DOT SP 20798)

Battery Super Box



- DOT SP 16011
  - DDR
- DOT SP 20798
  - Prototype
- Approved for 5700 WH
- Shipping and Storage

Storage?

1. Where battery storage is contained in one or more approved prefabricated portable structures providing a complete 2-hour fire-resistance rated enclosure, *fire barriers* and *horizontal assemblies* are not required.

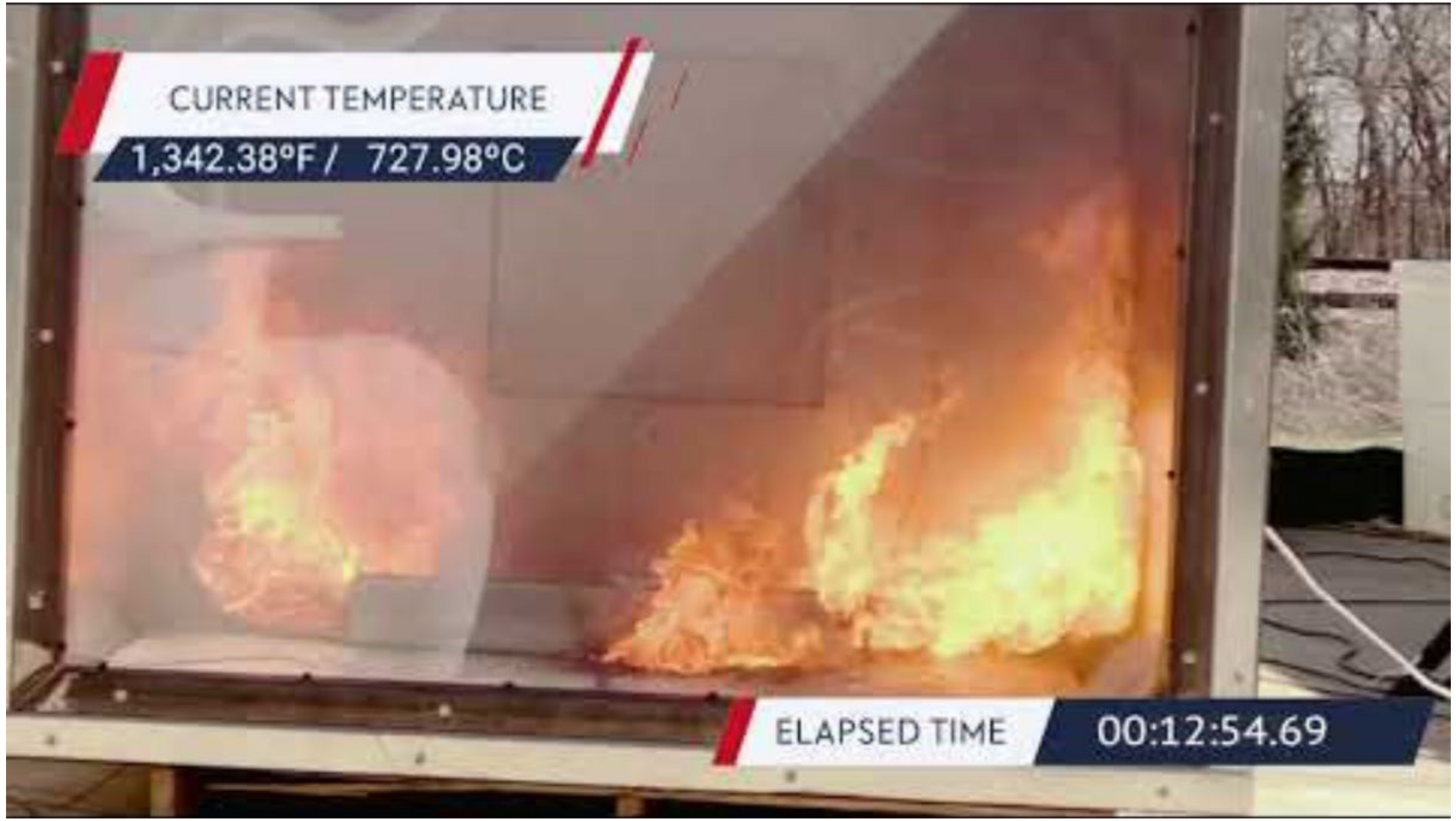
100% SoC Thermal runaway test in packaging with:

- No flame escaping packaging
- No Projectiles
- External Temp. below 451 F
- No cross actuation from batteries “near neighbors”



We also performed a fire test on the exterior to show that our container would not actuate batteries from an external fire or increase the heat on the interior of the container which could result in thermal runaway as well.

Battery Backup Unit (BBU) Storage/Transport



We Understand

- Regulations are constantly evolving and changing
- Packaging can follow or help influence regulations
- Testing to ensure compliance and safety
- Industry Support

Contact Info

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