



The Bottom Line

DECEMBER 2022 | VOL. 157

SHIPPING LITHIUM-ION BATTERIES

Summary

Despite multiple significant fire incidents, sections of the logistics community remain unaware of the hazards and potential consequences when a lithium-ion battery fails and goes into thermal runaway.

Background

M. Stanley Whittingham created the first rechargeable lithium-ion battery using titanium disulfide as a cathode material. Exxon tried to commercialize this battery in the late 1970s, but found the synthesis expensive and complex, as titanium disulfide is sensitive to moisture and releases toxic hydrogen sulfide gas on contact with water. More prohibitively, the batteries were also prone to spontaneously catch fire due to the presence of metallic lithium in the cells. Exxon, therefore, discontinued development of Whittingham's lithium-titanium disulfide battery. The first prototype of the modern Li-ion battery was developed by Akira Yoshino in 1985, which was commercialized by a Sony and Asahi Kasei team led by Yoshio Nishi in 1991.

While Li-ion batteries are a great technology that allow for storage of large amounts of energy in small spaces and with high energy densities, they still have numerous safety concerns. It is well documented the batteries can **fail** in dangerous ways, causing fires, explosions, toxic

gas emissions and associated hazards. Some have failed dramatically with no warning, or with such speed that there is no time to react to any warning signs.

Current Status

Li-ion batteries are transported in a number of different contexts, each requiring different logistics and presenting different transport risks. These include:

- a) New and unused batteries shipped on their own in dedicated packaging.
- b) New batteries shipped as part of packaged electronic equipment.
- c) Used or reconditioned batteries in working order, shipped separately, or built into equipment.
- d) Batteries shipped as part of electric vehicles (EVs), either in new or used.
- e) Defective batteries shipped for reconditioning, recycling, or disposal.

Transport regulations are complex and depend on the type of battery, the mode of transport and whether they are shipped on their own or built into equipment.

The relevant regulations are the IMDG Code for transport by sea, IATA by air and ADR by road. All three sets of regulations are based on the UN Model Regulations on the Transport of Dangerous Goods, adapted where appropriate for specific circumstances for each mode.

Using the correct packaging for shipping Li-ion batteries



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batteries is an important factor to consider, with use of non-compliant packaging having the potential to lead to dangerous situations. Choosing the correct packaging and means of transportation is critical.

Recently, serious and sometimes catastrophic incidents involving lithium-ion batteries have become more commonplace, with fires reported in all modes of transport—[ocean](#), [air](#) and [land](#)—as well as in [warehouses](#) where such consignments are at rest.

Impact

On August 19, 2021, a container loaded with discarded lithium batteries caught fire while enroute to the Port of Virginia. Further investigation by the Department of Transportation (DOT) and Pipeline and Hazardous Materials Safety Administration (PHMSA) determined that the shipper failed to properly placard, label, mark and package the lithium batteries, class 9, UN 3480 and 3481, and identified the cause of fire to be residual charge/full circuit, which led to a thermal increase.

Shippers should be aware that products containing dangerous goods like lithium batteries must be transported within the guidelines of multiple regulations. Individual countries' transportation regulations such as the USDOT, Transport Canada, the International Air Transport Association (IATA), and the International Maritime Dangerous Goods Code (IMDG) all regulate the transport of lithium batteries.

All persons involved in preparing, packaging, and completing paperwork must be formally trained in these procedures before offering batteries for transport.

Specific training requirements are outlined in the UN 38.3, but they generally include the following:

- General awareness/familiarization training of regulations;
- Function-specific training on shipping lithium batteries;
- Lithium battery safety; and
- Security awareness training

HAZMAT Bill of Ladings, Airway Bills, and other Dangerous Goods paperwork—such as a Shipper's Declaration of Dangerous Goods—must be completed before lithium batteries are offered for transport. Failure to comply can result in costly delays, the shipment being rejected by carriers, or even fines for failure to follow the proper paperwork requirement.

RESOURCES:

[Lithium-ion Battery](#) (Wikipedia)

[Lithium Batteries Whitepaper](#) (Brookes Bell)

[Car Carrier Abandoned After Catching Fire in Atlantic](#) (gCaptain)

[Marine Safety Alert/Lithium Battery Fire](#) (USCGSA)

[Lithium Battery Guide for Shippers](#) (DOT)