



Containerized Lithium Battery Shipments

In this document, find information about regulations guiding the shipment of lithium batteries and associated recommendations.

Risk Analysis:

The use of lithium batteries as a power source for a variety of products has dramatically increased. As a result, so too has their containerized shipments, both as entire cell or battery consignments and as product components. Initially, there was only one type of lithium battery but with this increased need and desire for greater safety and efficiency, lithium batteries continue to evolve. In this document, the variations based on chemical composition and longevity are referenced collectively as "lithium-ion batteries." Today the preferred battery energy source for many manufacturers is lithium-ion batteries because they are relatively inexpensive, lightweight and rechargeable.

Lithium-ion batteries, however, can be relatively unstable and reactive under some conditions with a propensity for self-heating, sometimes to the point of thermal runaway and fire. This then means that they may represent a safety risk during transportation. This is particularly true if the batteries are improperly packaged, incorrectly declared, poorly manufactured, untested, defective, subjected to shock/impact or damaged. The degree of risk is typically inherent to the state of charge (SoC) i.e., charge determines the available energy within the battery, in the form of heat, to be released. The risks can be particularly serious with lithium-ion batteries because fires are particularly challenging to extinguish and thermal runaway, if established, can cause fire to quickly spread through an entire container load including adjacent consignments. This type of situation can be particularly concerning if there is hazardous cargo onboard.

Lithium-ion batteries are governed by the United Nations Economic Commission for Europe (UNECE) Dangerous Goods (DG) transportation regulations¹, the International Maritime Dangerous Goods (IMDG) Code and are regulated as a hazardous material under the U.S. Department of Transportation's (DOT) Hazardous Materials Regulations (HMR; 49 C.F.R., Parts 171-180)". All lithium batteries are considered as '*Class 9 miscellaneous dangerous substances and articles*'. The DG regulations clearly set out the required UN testing and criteria to be met for safe transportation certification plus the relevant shipment labelling, packing, mass/volume per container, etc. The assignment of a specific UN number is largely dependent on how the products are packaged and their chemical composition. UN designations for lithium batteries include UN numbers 3480, 3481, 3090, 3091, 3536 and 3171 among others; UN3171 is specifically covered by a separate AIG Marine Loss Control Engineering (MLCE) publication on electric vehicles.

Each UN designation is also subject to special requirements with two specifically relating to shipping defective or damaged batteries and those shipped as waste or recycling. In other words, these must be shipped differently since they present an increased safety risk.

Unfortunately, the DG transportation regulations have not kept pace with either technology development or the commercial demand. The original regulation some 40 years ago was based battery weight but today lithium-ion batteries can derive more energy from their active material and can weigh much less. And the increased demand has led to more poor quality, untested and defective lithium-ion batteries being traded globally.^{2,3} Both aspects can be expected to drive an increase in the number of potentially unsafe containers within the global supply chain. The fire risks from a single container during road transport are significant enough, but this exponentially increases when considering a freight train, an aircraft or a containership (particularly if multiple containers become involved in a fire).

Considerations for manufacturers and shippers:

1. Ensure cargo is certified safe for transport as legally required by manufacturers/shippers in accordance with the UN Manual of Tests and Criteria and appropriately declared under the correct UN number to the



carrier. Failure to do so could create a significant liability if a major loss is determined to have been caused by their product.

2. Ensure your organization has a nominated DG specialist that has completed the required training and qualifications. They should have responsibility for the sign-off on all lithium battery products confirming they are certified per UN testing and criteria for safe transportation and for creating the proper declaration documents.
3. Ship only in accordance with the appropriate DG regulation recognizing containerized lithium batteries shipments may be multi-modal on a given supply lane, e.g. IMDG for marine, ADN for inland marine, ICAO TI and IATA for air, RID for rail, ADR for road or CFR in the US. Although UN numbers are interchangeable, each transport mode may have slightly different Special Provisions requirements.
4. Coordinate stowage away from external sources of heat and moisture where possible. Internal container temperatures may be twice the outside ambient temperature, for instance just due to sun radiation, if that is likely to occur and such temperatures may exceed the maximum permissible for the batteries, shipment per temperature-controlled reefer container may be necessary.
5. It is recommended that fully loaded containers of battery packs be stowed on deck only and separated (at least 1 container in between) from other containers with combustible and corrosive materials of IMDG Class 3, 4 and 8. This recommendation is an addition to and beyond the recommendations included in item 3 above.
6. Develop strict quality control procedures to identify, segregate and quarantine lithium batteries, products or packages, with the potential for an increased safety risk based on visible inspection and temperature monitoring, e.g., using an infrared thermometer.
7. Do not load any products or packages found to be heating, visibly damaged, mis-handled, impacted, or dropped. If found, this should be segregated to a separate storage area and a quality control evaluation should be made before approval for reloading. Note, these products may now present an increased safety risk and must meet the requirements of the relevant Special Provisions under the applicable DG regulations for defective, damaged, waste or recycling.
8. Work with your cargo handling personnel and logistics partners to educate them on the safety risks and the importance of careful handling during staging, stuffing, transit, destuffing and placing into storage.
9. Work with your customers to educate them on the safety risks and importance of careful handling, as well as the need for a strict quality control procedure to inspect shipment on arrival and segregate any products or packages found to be visibly damaged, mis-handled, impacted, or dropped, place into quarantine until a quality control evaluation can be made.

For further information, please contact your local Marine Loss Control Engineering team.

1. "Dangerous Goods | UNECE." 01 Sept. 2020, <https://unece.org/transport/dangerous-goods>.
2. <https://www.consumeraffairs.com/lithium-ion-batteries#:~:text=The%20lithium%20battery%20can,No%20injuries%20have%20been%20reported>.
3. <https://www.cpsc.gov/Recalls/2022/Fitbit-Recalls-Ionic-Smartwatches-Due-to-Burn-Hazard-One-Million-Sold-in-the-U-S>



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