

# Transport of lithium batteries as cargo

## Background

### Types and characteristics of Lithium batteries

Two major types of lithium batteries power many types of consumer electronic devices: lithium ion batteries (including lithium ion polymer) and lithium metal batteries. Lithium ion batteries are typically rechargeable, and power devices such as laptop computers, mobile phones and portable music players, while non-rechargeable lithium metal batteries are normally used to power devices including cameras, flashlights and Automatic External Defibrillators. A lithium metal battery typically is composed of a single cell, while a lithium ion laptop battery may be composed of between 6 and 12 cells.



Lithium ion battery

### Risks posed by Lithium batteries

When lithium batteries are mishandled, damaged, improperly packaged, overcharged, defective, or of an inferior design, they may overheat and ignite. Additionally, when lithium batteries are exposed to heat or an external fire source, they may also ignite. Unlike previous battery chemistries, lithium batteries contain a flammable electrolyte that is vented as the temperature in a cell increases. This electrolyte is easily ignited, and the heat from a single burning lithium cell is transferred to adjacent cells, creating an escalating fire within a multiple cell battery, and spreading to multiple batteries in a single shipment.



Lithium metal batteries

Lithium metal batteries also pose both an electrical and chemical hazard, and have different characteristics in a fire than lithium ion batteries. Testing conducted by the U.S. Federal Aviation Administration (FAA) determined that Halon, the extinguishing agent typically used in aircraft, is ineffective in suppressing a fire involving lithium metal batteries. In fact, the fire proceeded as if the Halon were not present. The tests found that a fire involving a single lithium metal battery would spread to adjacent batteries, that a pressure pulse would be generated that could cause a cargo liner to fail, and that a relatively small fire source was sufficient to ignite the batteries. The tests also determined that the heat from a suppressed cargo fire was above the auto-initiation temperature of the lithium metal batteries, resulting in a situation where a successfully suppressed fire from an independent source could be sufficient to ignite a shipment of lithium metal batteries.

Because of the propensity for lithium batteries to ignite and burn violently when exposed to heat or fire, large quantities of even properly prepared, undamaged batteries can pose a significant risk to the safety of an aircraft. A shipment of lithium batteries can significantly intensify the severity of a fire, turning a survivable event into an uncontrollable fire.

## Lithium battery incident history

According to the FAA, there have been over 40 lithium battery incidents documented involving smoke, fire, extreme heat or explosion in air transportation since the introduction of lithium batteries in the early 1990s. The incidents have occurred both in the passenger cabin and in cargo compartments when batteries have been shipped as cargo on passenger and cargo-only aircraft. Lithium battery fires may be the result of external short circuit (e.g. contact with other batteries or metal), internal short circuit (e.g. design deficiency, manufacturing defect), damage, or exposure to an external fire or heat source. Counterfeit batteries often lack safety features and may be poorly manufactured, leading to a higher likelihood of being involved in an incident.

Additionally, lithium batteries have played a significant role in several major hull loss accidents.

## Present ICAO regulations applicable to consumer lithium batteries

Lithium batteries used in most consumer electronic devices are not subject to the majority of the provisions for dangerous goods in the ICAO Technical Instructions when shipped in packages containing fewer than eight cells or two batteries. The provisions that are excepted include the requirement to place a dangerous goods label on the package, the requirement to place the shipment on the

notification to the pilot in command (NOTOC), the requirement for airline personnel to perform an acceptance check of the package, or the requirement for shippers to be trained in the dangerous goods regulations. While these provisions do apply to packages containing more than eight cells or two batteries packages, industry practice often results in many smaller packages being shipped together. When this occurs, tens of thousands of batteries may be shipped on pallets aboard aircraft while being excepted from the majority of the dangerous goods provisions. Furthermore, while the ICAO Technical instructions prohibit the transport of batteries recalled for safety reasons, and specify the types of tests batteries are required to pass before being shipped in commerce, they place no restriction on the total quantity of lithium batteries allowed on aircraft. Additionally, there is no requirement for lithium batteries to be placed in a cargo compartment with a suppression system capable of allowing the aircraft to safely land in the event of a fire.

## IFALPA Position

IFALPA believes that current regulations do not properly address the risk posed by the carriage of lithium batteries as aircraft cargo. The Federation therefore urges ICAO, States, and Industry Stakeholders to take action to safely transport lithium batteries and protect commercial transport aircraft, crews and passengers from the risk of a fire caused or made worse by these batteries.

Some of the specific actions are described below.

### Lithium Ion batteries as cargo

Lithium ion batteries are shipped both in or with equipment, and as packages containing only batteries. While batteries contained in equipment are afforded some external protection by the equipment, incident data have shown that fires involving equipment may still occur. The regulatory exceptions granted to lithium ion batteries, lithium ion batteries in equipment, and lithium ion batteries packed with equipment should therefore be eliminated, providing for full regulation under the ICAO Technical Instructions for the Safe Transportation of Dangerous Goods by Air. Provisions in the Technical Instructions would provide that each shipment of lithium ion batteries be subjected to the following conditions:

- ▶ Design testing of each battery according to the UN Manual of Tests and Criteria
- ▶ Each cell or battery be protected from short circuit
- ▶ Packaging in strong outer UN specification packaging
- ▶ A Dangerous Goods Transport Document be provided
- ▶ The package be marked with a Class 9 Dangerous Goods label
- ▶ An acceptance check is required to be performed by the operator
- ▶ A Pilot Notification Form (NOTOC) provided to the pilot in command indicating the quantity of batteries being carried
- ▶ Training be provided to persons preparing batteries for shipment

These provisions of the Technical Instructions would significantly improve the safety of lithium battery shipments. By eliminating regulatory exceptions, the batteries would be shipped in improved packaging, reducing the possibility or severity of damage to a package. A Class 9 label, recognized worldwide regardless of language, would increase awareness of the potential hazard from the shipment and reduce the likelihood that damaged packages would be loaded onto an aircraft. An acceptance check would provide an opportunity to detect any damage to a package or irregularity in the preparation of a shipment, as well as facilitating the removal of packages from the automated sort processes at an airport, reducing the opportunity for damage. By including batteries on the Pilot Notification Form (NOTOC), the flight crew would be provided information regarding the type, quantity and location of batteries on their aircraft, which may influence crew decision-making during an in-flight emergency. This would also allow the flight crew to communicate the hazard aboard the aircraft to emergency response personnel on the ground. Training is crucial to ensure that battery shippers can comply with the existing regulatory requirements and safely prepare shipments. The overall visibility of lithium ion battery shipments would be greatly improved by fully regulating each shipment.

Furthermore, the total quantity of lithium ion batteries at any single location or in a single cargo compartment should be limited. The risk of a fire on an aircraft can never be completely eliminated, but by limiting the number of batteries at a single location, the severity of a fire involving those batteries can be reduced. A conservative approach to the number of batteries at a single location should be adopted until testing is available to determine the quantity of batteries that can be successfully extinguished using aircraft fire suppression systems.

### Lithium Metal batteries as cargo

Lithium metal batteries should be fully regulated under the ICAO Technical Instructions for the Safe Transport of Dangerous Goods, and current regulatory exceptions should be eliminated. Full regulation of lithium metal batteries would result in the same safety improvements cited above for lithium ion batteries, as would limiting the quantity of lithium metal batteries at any single location or in a single cargo compartment.

Additionally, lithium metal batteries should be packaged such that a fire involving these batteries could be mitigated and allow the continued safe flight of the aircraft.