



U.S. Department
of Transportation
**Federal Aviation
Administration**

SAFO

Safety Alert for Operators

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Flight Standards Service
Washington, DC

http://www.faa.gov/other_visit/aviation_industry/airline_operators/airline_safety/safo

A SAFO contains important safety information and may include recommended action. SAFO content should be especially valuable to air carriers in meeting their statutory duty to provide service with the highest possible degree of safety in the public interest. Besides the specific action recommended in a SAFO, an alternative action may be as effective in addressing the safety issue named in the SAFO.

Subject: Risks of Fire or Explosion when Transporting Lithium Ion or Lithium Metal Batteries as Cargo on Passenger and Cargo Aircraft

Purpose: This SAFO serves to alert Title 14 of the Code of Federal Regulations (14 CFR) part 121, 125, 129 and 135 operators of the potential risk for a catastrophic hull loss due to significant identified dangers associated with the transport of lithium batteries as cargo on either passenger or cargo aircraft. Additionally, this SAFO contains information and recommendations, the Federal Aviation Administration (FAA) strongly recommends, for operators to consider when developing risk mitigation measures before transporting lithium ion or lithium metal batteries as cargo on passenger and cargo aircraft.

NOTE: This SAFO only addresses lithium batteries not contained in or packed with equipment when offered for cargo and is not intended to cover the provisions concerning passengers and crew.

Background: Due to recent findings of the FAA, the International Civil Aviation Organization (ICAO), and the FAA William J. Hughes Technical Center (FAA Tech Center), both Boeing and Airbus aircraft manufacturers have issued communications to advise operators of the dangers associated with transporting lithium batteries as cargo on passenger and cargo aircraft. Lithium batteries are currently classified as Class 9 hazardous materials in Title 49 CFR, Hazardous Materials Regulations (HMR) and the ICAO Technical Instructions. The term "lithium batteries" as used in this SAFO include the following:

- **Lithium Ion Batteries.** (UN3480). These are rechargeable lithium batteries, similar to those found in cameras, cell phones, laptop computers, and radio-controlled toys. Lithium polymer batteries are types of lithium ion batteries.
- **Lithium Metal Batteries.** (UN3090). These cannot be recharged and are designed to be discarded once their initial charge is used up.

This SAFO recognizes that both ICAO and Title 49 CFR prohibit the carriage of lithium metal batteries (UN3090) as cargo on passenger aircraft. However, this prohibition does not mitigate the risks associated with the carriage of lithium ion batteries (UN3480) as cargo on passenger aircraft, nor mitigate the risks associated with carrying either lithium ion batteries (UN3480) or lithium metal batteries (UN3090) aboard cargo aircraft.

NOTE: For clarity, UN3480 and UN3090 do not include lithium batteries contained in or packed with equipment.

Title 49 CFR §173.185 contains conditional exceptions for Class 9 lithium battery cargo shipments, which include most lithium batteries and devices transported by air. "Conditional exceptions" means that batteries and cells meeting specific criteria AND which have passed testing in accordance with the United

Nations (UN) Manual of Tests and Criteria may be shipped with relief from some marking, labeling, documentation and packaging requirements. Conditional exceptions are provided for certain small lithium batteries under specific conditions. However, these small batteries are still classified as a hazardous material. Operators may not be aware they are accepting and transporting lithium batteries meeting these conditional exceptions unless they have implemented procedures through their own policies or variations to require customers to identify these shipments when offered for transportation.

Aircraft manufacturers Airbus and Boeing, as well as the European Aviation Safety Agency (EASA) and ICAO, have recently published material on the risks associated with the carriage of lithium batteries. These references include the following:

- Airbus operators can reference Airbus In-Service Information publication, ISI 00.00.00182, dated July 24, 2015;
- Boeing operators can reference Boeing Multi Operator message, MOM-MOM-15-0469-01B, dated July 17, 2015;
- EASA Safety Information Bulletin – Operations – SIB No.: 2015-19; 05 October 2015; Transport of Lithium Batteries as Cargo by Air.
- ICAO Electronic Bulletin, EB 2015/48; AN 11/2.1; 15 September 2015.

Discussion: FAA testing has shown that a single lithium battery (cell), whether metal or ion, in thermal runaway will spread to the neighboring batteries in the package and to adjacent packages. Thermal runaway is initiated by an internal short within the battery that may be caused by a manufacturing contaminant, battery damage during handling or from heat produced in the environment, such as by an adjacent fire.

In 2015, FAA Tech Center testing showed that the ignition of the unburned flammable gases associated with a lithium battery fire could lead to a catastrophic explosion. The current design of the Halon 1301 fire suppression system (concentration 5%) in a Class C cargo compartment in passenger airplanes is incapable of preventing such an explosion. In addition, tests also revealed that the ignition of a mixture of flammable gases could produce an over pressure, dislodging pressure relief panels, and thereby allowing leakage from the associated cargo compartment. This could lead to the spread of smoke and gases from the fire into occupied areas of the airplane. The number of cells necessary to produce this condition is small and can occur with just a few packages. Operators are encouraged to refer to SAFO 10017 for further information with the understanding that the recommendations contained in that SAFO may be amended with information sourced from continuing research.

A summary of the flammable gas testing and findings can be found at: (Note: this link contains video presentations and may require a lengthy download.) http://www.fire.tc.faa.gov/ppt/systems/Sept_18_2015_Battery_Public_Meeting.pptx. A continually updated listing of research performed by the FAA Tech Center on lithium ion batteries can be found at, <http://www.fire.tc.faa.gov/systems/Lithium-Batteries>.

Recommended Action: Before operators engage in the transport of lithium ion batteries as cargo on passenger aircraft, or lithium ion or lithium metal batteries on cargo aircraft, be aware that ICAO and major airframe manufacturers (Boeing and Airbus) have recommended that operators perform safety risk assessments in order to establish whether, or how, they can manage the risk associated with the transport of these batteries. The FAA strongly supports these recommendations. The FAA encourages those operators who have previously performed a risk assessment to reevaluate their assessment in light of the further evidence gained through the recent testing of lithium batteries. Operators that have implemented a formal Safety Management System (SMS) should accomplish a Safety Risk Assessment (SRA), in accordance with the Safety Risk Management process in its SMS.

The FAA also is working with operators to ascertain what actions they take in response to the ICAO recommendations and manufacturer publications to eliminate or reduce the risk. When considering risk mitigation strategies the FAA recommends cargo and passenger operators who wish to carry lithium ion batteries as cargo, review and consider the following:

- All lithium batteries per 49 CFR §171.2(e), 175.3, and 175.30(a) must comply with appropriate packaging and shipping requirements for dangerous goods;
- High density packages of lithium batteries and cells increases risk;
- Training of personnel who handle lithium batteries per 14 CFR §121.1001(a), 121.1003(a), and
- 49 CFR §172.704 must include information on the dangers associated with any lithium battery; the proper labeling; the proper loading; the proper rejection criteria for damaged shipments; and emergency response procedures in the event of a heat/smoke/fire event involving lithium batteries.

When transporting lithium ion batteries, operators should consider (not limited to) the following:

- The types, quantities and the frequency of carriage of lithium batteries (including state of charge of the battery, if known);
- Evaluation of the fire protection features of each model of aircraft they operate;
- The operator's specific lithium battery acceptance requirements for packaging, state of charge, and any other limitations placed upon the shipper;
- The history of the shipper's compliance with dangerous goods transport regulations;
- The means of loading and limitations on lithium battery shipments within the cargo compartment of cargo aircraft or lithium ion batteries within the cargo compartment of passenger aircraft, e.g., bulk loaded, containers, covered pallets;
- The containment characteristics of Unit Load Devices (ULD);
- The specific hazards and safety risks associated with each battery and cell type to be carried alone or in combination;
- The chemical composition of the batteries and cells;
- Location of batteries in the cargo compartment, including:
 - Proximity to other batteries, and
 - Proximity to other dangerous goods
- Notification procedures for the flightcrew:
 - Location of the batteries in the cargo compartment;
 - Accessibility of the batteries to the crew;
 - Quantity of items being shipped;
 - The capability of the crew to fight an in-flight lithium battery fire.

Related Information:

- SAFO 10017, Risks in Transporting Lithium Batteries in Cargo by Aircraft. 10/8/10.
http://www.faa.gov/news/press_releases/media/safo10017.pdf.
- SAFO 15010, Carriage of Spare Lithium Batteries in Carry-on and Checked Baggage. 10/8/15.
https://www.faa.gov/other_visit/aviation_industry/airline_operators/airline_safety/safo/all_safos/media/2015/SAFO15010.pdf.

Contact: Questions or comments regarding this SAFO should be directed to the FAA Air Transportation Division, AFS-200, at (202) 267-8166. Questions or comments concerning 49 CFR Hazardous Material Regulations should be directed to the FAA Office of Hazardous Materials Safety, ADG-200, at (202) 267-9432.