

Impact of Lithium Battery Vent Gas Ignition on Cargo Compartment Fire Protection

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A danger of shipping lithium batteries in an aircraft is the risk of thermal runaway propagation, causing an uncontrollable fire in the cargo compartment. During thermal runaway hydrogen and hydrocarbons may accumulate in the shipping boxes and free space within the cargo compartment and ignite to cause a pressure pulse sufficient to dislodge pressure relief panels and cargo liner and thus compromise the safety of the aircraft. With the pressure relief panels removed or liner compromised the compartment would no longer be able to fully contain the Halon 1301 fire extinguishing agent.

A series of tests were conducted to determine the minimum quantity of 18650 sized battery cells required to produce a flammable gas mixture which, if ignited, would be capable of producing a pressure rise that would open pressure relief panels and possibly dislodge cargo liners. A mixture of bottled battery vent gas and air was metered into a balloon at a concentration previously shown to maximize the pressure rise of combustion. A spark igniter located within the balloon ignited the mixture. Validation tests were conducted to determine if the pressure rise from combustion of the bottled battery gas mixture replicated the pressure rise of the actual vented battery gasses. The results showed an identical pressure rise.

The tests were conducted in two test articles. Initially, tests were carried out in a 10.8 m³ pressure chamber to determine the relationship between the volume of lithium battery vent gasses and the pressure rise in the chamber when the gasses were ignited. Later, tests were performed in a 737 forward cargo compartment to determine the pressure rise and corresponding number of lithium-ion batteries required to dislodge the compartment pressure relief panels or damage the cargo liner.