Battery Gas Analysis

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Thermal runaway of lithium-metal and lithium-ion cells has resulted in numerous fires. Often the fires are fueled by the flammable gasses that are vented from the batteries. In addition to those installed on the aircraft, millions of lithium batteries are shipped every year as cargo. A Class C cargo compartment is equipped to have an initial concentration of 5% Halon 1301 fire-suppressing agent, followed by a residual concentration of 3% for the remainder of a flight. These halon concentrations are effective at mitigating fires involving typical cargo; however, there is concern whether these concentrations are sufficient to handle a cargo fire involving lithium batteries and to mitigate the risks of a potential explosion of the accumulated vented battery gasses.

Small-scale tests were carried out in a 21.7 liter combustion sphere where a gas chromatograph, non-dispersive infrared (NDIR), paramagnetic analyzer, and pressure transducer were used to quantify the individual gasses released from lithium batteries. Once the gas constituents were quantified, tests were performed to measure the pressure increase from combustion. Large-scale tests were then conducted in a 10.8 m^3 combustion chamber, a volume comparable with that of a cargo compartment, to validate the small-scale tests and to evaluate the effect of Halon 1301 on battery vent gas combustion.