Battery HRR/Propagation

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As time continues, the technology and chemistry in voltaic cells continue to change. A result has been an increase in energy density within cells. The consumer demand has also increased and this combination has led to an increased risk of fire and smoke incidents in aircraft.

Three series of tests were conducted in an attempt to understand the cell to cell propagation of lithium-ion battery thermal runaway so that prevention measures could be developed. The first set of tests involved the examination of a variety of packaging materials, the second examined the effectiveness of various extinguishing agents and the third series determined the heat release of cells under various conditions.

The first series of tests consisted of battery boxes with 16 18650 lithium-ion cells were tested with various package divider materials to determine their effect on thermal runaway propagation. Insulative package dividers decreased the rate of propagation and conductive dividers increased the rate of propagation while also increasing its onset time. The state-of-charge of the 2600mAh cells was also shown to prevent propagation at values of 30% and lower.

Hot-plate tests were conducted to compare the cooling effectiveness of various extinguishing agents to determine their applicability to lithium-ion battery fires. Aqueous agents were shown to be the most effective. Verification extinguishing agent tests were additionally performed with lithium-ion batteries.

Finally, heat release rate tests were conducted with a cone calorimeter to determine the variation of heat release resulting from thermal runaway of a variety of lithium-ion chemistries under varying states-of-charge.