Hazard Analysis for Various Lithium Battery Chemistries and Sizes

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Lithium-metal, lithium-ion and lithium-ion-pouch batteries offer many advantages over alternative battery technologies. They possess a high energy density per unit mass, relatively constant voltage during discharge, relatively low maintenance, good low-temperature performance and a long shelf life. For all of these reasons, their use and installation onboard aircraft has become increasingly prevalent. Some of the uses for lithium batteries on today's aircraft include emergency lighting, cockpit voice recorders, flight data recorders, electronic locator transmitters, main batteries, avionics equipment, emergency medical equipment and others.

There are hazards associated with the use of these batteries due to their high energy content and potential thermal instability however. Failure of a lithium battery often times results in thermal runaway, which is a self-sustaining uncontrolled increase in temperature and consequently pressure, within the battery. Thermal runaway often results in fire as the flammable gases vented from the battery are ignited due to the high temperatures. Additionally, any unburnt vented battery gases can be toxic and could accumulate resulting in the potential for an explosion.

Tests were conducted on of lithium-ion, lithium-pouch and lithium metal battery cells of various cathode chemistries and sizes to evaluate their failure effects. First tests were performed with a single cell in thermal runaway. Next, a propagation test with five cells was conducted. Finally, a vent gas ignition test to determine the flammability of the vent gasses was performed. The presentation will provide test details and review their results.