AIRCRAFT BATTERY FIRE SAFETY

Tests were performed at the William J. Hughes Technical Center by the Fire Safety Team of the Airport and Aircraft Research and Development Division to examine the fire safety hazards that cylindrical lithium-ion and lithium-ion polymer batteries may pose on aircraft. Tests were conducted on individual, manufacturer-supplied battery cells to determine how the cells would react in a fire situation. Tests were also conducted to determine what potential fire hazard the battery cells themselves may pose and to determine the effectiveness of a typical hand held extinguisher on a fire involving the battery cells. The battery cells that were tested were all commercial off-the-shelf products that are being considered by manufacturers for aircraft power-related usage. In recent years, there has been an increase in the use of lithium batteries for aircraft applications.

The results of the tests showed that both the cylindrical and polymer-type battery cells can react violently when exposed to an external fire. The cylindrical cells vented in a manner by which the electrolyte would spray out forcefully and ignite, accompanied by both a rise in temperature and pressure. The polymer battery cells did not have any vent locations. Instead, they were designed with a seam around the perimeter of the cell that would open thereby exposing the flammable electrolyte. The failure of the polymer-type battery cells greatly fueled the existing fire as the full amount of the electrolyte was exposed instantaneously to the fire source. In both single- and multi-cell tests, the lithium polymer battery cells, which consist of a different chemical reaction and possess a much higher energy density and power capacity, resulted in significantly higher temperature and pressure increases compared to the cylindrical cell types. Tests conducted with a hand-held Halon 1211 fire extinguisher showed that the halon was able to extinguish all three types of battery fires. However, for the polymer battery cells, even after several attempts, the halon extinguishing agent was not able to prevent the cells from reigniting.

The tests on lithium battery cells provided much insight into the potential hazards that these new battery technologies may pose. The results can be used to determine what requirements and safeguards need to be placed on the battery packaging system that house these cells. Such safeguards include proper vent placement and sizing, overcharge and thermal protection circuits, and barriers between cells to prevent thermal propagation from one cell to the adjacent cells. The next step will be to conduct tests on prototype lithium batteries for aircraft.

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Proposed Aircraft Battery Cells