Lithium Battery Update

Lithium Metal Cell Container Vent Tests

Presented to: Systems Working Group
By: Harry Webster, FAA
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Lithium Metal Cell Container Tests

• Background
  – Lithium metal cells are banned from cargo shipment on U.S. passenger aircraft, but are allowed to be shipped on cargo aircraft
  – The International Civil Aviation Organization (ICAO) allows small quantities of lithium metal cells to be shipped on passenger aircraft when packed in metal containers
  – There are currently no approved and tested containers that can sufficiently contain the known effects of accidental lithium metal battery ignition.
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- Previous testing results / Conclusions:
  - As few as 6 CR2 lithium metal cells, induced into thermal runaway, were sufficient to cause failure.
  - Common metal shipping containers, pails and drums, are not designed to withstand the pressures from a lithium metal cell fire.
  - Flame arrestor vent screens attached to an overpack container failed to contain a lithium metal cell fire.
Lithium Metal Cell Container Tests Over Pack Screen Failure
Lithium Metal Cell Container Tests

• Tests were designed to evaluate the effectiveness of an end-of-line deflagration flame arrestor as a container vent
  – the selected 1” vent was installed onto drum lid
  – in each test one cell was replaced with a 100 watt cartridge heater to simulate one cell in thermal runaway
  – pressure transducer installed on side of drum
  – Cell, drum internal and vent temperatures were recorded
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Vent
Lithium Metal Cell Container Test
(30 Gallon steel) Configuration
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• Three tests were conducted
  – The first and second tests were wired in a group around the cartridge heater
    • 6 cells
    • 18 cells
  – The third test was ¼ of standard packaging 123’s
    • 99 cells, 1 replaced by heater
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- Evaluation of effectiveness
  - Internal fire containment
  - Pressure release
  - Container and vent integrity
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Data

18 Cells: Temperature (°F) / Pressure (PSI)

99 Cells: Temperature (°F) / Pressure (PSI)
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• Results
  – 6 Cell test
    • Internal fire containment, smoke release, no pressure rise or pressure pulse, bulging of the lid,
  – 18 Cell test
    • Internal fire containment, smoke release, pressure rose with a few pressure pulses of .40 increase psi along with bulging of the lid,
  – 99 Cell test
    • Internal fire containment, pressure increased to .50 psi, pressure pulses up to 5.85 psi, large amount of smoke released, lid bulged and was permanently deformed
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• Conclusions
  – Deflagration flame of arrestors of this type can safely release the pressure generated by a lithium metal battery fire without allowing flaming gases to escape
  – The pressure and temperatures generated by a lithium metal battery fire is a function of the number of cells involved