Full Scale Battery Fire Test Plan

Presented to: Systems Working Group
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Full Scale Battery Tests

• Purpose: To document the characteristics of large battery fires in a realistic aircraft environment.

• Test article: FAA Fire Safety 727 freighter
  – Class C compartment with Halon 1301 suppression
  – Class E main deck compartment, no suppression
    • Fire hardened with cargo liner material
  – Fully operational air-packs
  – Extinguishment system: CO2 and water spray
FAA Fire Safety 727
Full Scale Battery Tests

• **Fire load:**
  – 5000 cells in original fiberboard packing
  – Adjacent flammable materials: 18”x18”x18” cardboard boxes with shredded paper

• **Cell types:**
  – Lithium-ion, type 18650
  – Lithium metal, type 123
  – Mixed (AA size)
    • Nickel Cadmium
    • Nickel metal hydride
    • Alkaline
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- **Test locations**
  - Forward Class C compartment
  - Main deck Class E compartment

- **Ignition sources**
  - Nichrome wire in adjacent box with shredded paper.
    - Simulate fire from external source
  - Cartridge heater replacing a single cell
    - Simulate a cell in thermal runaway
Full Scale Battery Tests
Full Scale Battery Tests

• **Measure:**
  – Propagation of thermal runaway within the battery shipment
  – Spread of fire to adjacent combustibles
  – Smoke density
  – Smoke penetration into the cabin and cockpit
  – Temperatures
  – Pressure

• **Compare:** Baseline (no cells), cell chemistries, ignition sources
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- **Considerations**
  - Compartment loading
    - Full compartment will increase smoke density
  - Containerized or palletized cargo
  - Aircraft emergency procedures
    - Air-pack setting
  - Test article limitations
    - Temperature limits
    - Pressure limits
Full Scale Battery Test Matrix

• Cargo compartment location
  – Test 1. Baseline (no cells)
  – Test 2. 5000 mixed NiCad, NiMH, Alkaline,
    • Cartridge heater
  – Test 3. 5000 mixed
    • Adjacent fire
  – Test 4. 5000 lithium-ion, cartridge heater
  – Test 5. 5000 lithium-ion, adjacent fire
  – Test 6. 5000 lithium metal, cartridge heater
  – Test 7. 5000 lithium metal, adjacent fire
Full Scale Battery Test Matrix

• Main deck location
  – Test 8. Baseline (no cells)
  – Test 9. 5000 mixed, cartridge heater
  – Test 10. 5000 mixed, adjacent fire
  – Test 11. 5000 lithium-ion, cartridge heater
  – Test 12. 5000 lithium-ion, adjacent fire
  – Test 13. 5000 lithium metal, cartridge heater
  – Test 14. 5000 lithium metal, adjacent fire.
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