

Full Scale Battery Fire Test Plan

Presented to: Systems Working Group

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Federal Aviation
Administration



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

Full Scale Battery Tests

- **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**

Full Scale Battery Tests

- **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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