

Flammability Assessment of Lithium Primary and Lithium-ion Batteries

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Test Goals and Parameters

- **Assess threat of bulk shipments of lithium cells to aircraft when involved in a cargo compartment fire.**
 - Cell flammability characteristics
 - Effectiveness of onboard fire extinguishing systems
 - Ability of cargo compartment to withstand a fire involving lithium cells
- **Lithium primary cell types included CR2 and PL123A**
- **Lithium-ion cell type 18650 in 50 and 100% charge states**

Definitions

- **Lithium Primary cells**
 - Single use, non-rechargeable, constructed with metallic lithium
- **Lithium-ion cells**
 - Multi-use, rechargeable, no metallic lithium used in the construction of the cell

Test Results and Findings: Lithium Primary Cells

- **Easily ignited**
- **Burns with sufficient heat to ignite adjacent cells**
- **Halon 1301 ineffective**
- **Auto-ignition temperature below that typically found in fully suppressed cargo compartment fire**
- **Molten lithium sprayed from a burning cell can penetrate the cargo liner**
- **Pressure pulse can raise the pressure in the cargo compartment, activating the pressure equalization devices or dislodging the cargo liner, compromising the integrity of the compartment**

Test Results and Findings: Lithium-ion Cells

- Vents flammable electrolyte liquid when exposed to relatively small fire source.
- The temperature in a fully suppressed cargo fire is sufficient to cause the cells to vent
- The electrolyte does not self ignite, it needs an external ignition source.
- Halon 1301 is effective in extinguishing the electrolyte fire.
- There is no molten lithium
- Pressure pulse is equal to or greater than the primary cells, posing a risk to cargo compartment integrity