

Fuel Cell Fire Test Plan

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Federal Aviation
Administration



Back Ground

- **Fuel cells are an alternate power source used in lieu of or in conjunction with batteries to power electronic equipment.**
- **Fuel cells use a hydrocarbon fuel source to generate electrical power, with water as the byproduct**
- **Fuel sources range from highly flammable to relatively inert**

FUEL CELLS

- **Definition:** An electrochemical cell in which the energy of a reaction between a fuel, such as liquid hydrogen, and an oxidant, such as liquid oxygen, is converted directly and continuously into electrical energy
- **FAA Concerns**
 - In-flight use and operation
 - Carry on luggage
 - Checked luggage
 - Bulk Shipment

Micro Fuel Cell Fuels

- **Methanol**

- Methanol is oxidized directly in the Direct Methanol Fuel Cell (DMFC) system.
- Reformed methanol fuel cells (RMFC) produce hydrogen “on demand” and consume the hydrogen immediately within the fuel cell.

- **Formic Acid**

- Fuel (formic acid) concentration: < 85% wt (Not Flammable).
- Formic acid is oxidized directly in the Formic Acid Fuel Cell system.

Micro Fuel Cell Fuels

- **Borohydride**
 - Direct liquid Borohydride (Class 8) is oxidized directly in the Direct Borohydride Fuel Cell (DBFC) system.
 - Indirect Borohydride (Class 8 or 4.3) produce hydrogen “on demand” and consume the hydrogen immediately within the fuel cell.
- **Butane**
 - A Butane or a Butane/Propane mix is oxidized directly by a solid oxide fuel cell system.
- **Hydrogen Stored in Metal Hydrides**
 - Hydrogen gas is chemically stored in metal powder under low pressure.
 - Hydrogen is produced “on demand” and consumed immediately within the fuel cell.

Test Plan

- **FAA Fire Safety engineers are currently supporting FAA HAZMAT and PHMSA in developing rule makings regarding fuel cell use in flight, packed in checked and carry on luggage, and bulk shipping.**
- **An analysis is being conducted to determine the relative hazards of the various fuel sources and storage mechanisms**
- **Flammability tests will be conducted on existing fuel cartridges supplied by industry participation**

Test Plan

- **Flammability tests will be conducted on the different technologies as production units become available:**
 - Individual units
 - Bulk shipments
 - Fuel cells in use powering electronic equipment
 - Fuel cells charging batteries