

HAZARDOUS MATERIALS

Lithium Batteries Fuel Cells

Presented to: Systems Working Group

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Federal Aviation
Administration



Lithium-Ion Battery Report

- **Final report published**
- **“Flammability Assessment of Bulk Packed, Rechargeable Lithium-Ion Cells in Transport Category Aircraft”, Harry Webster
DOT/FAA/AR-06/38, September 2006**
- **Available on our website**
- **www.fire.tc.faa.gov**

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**

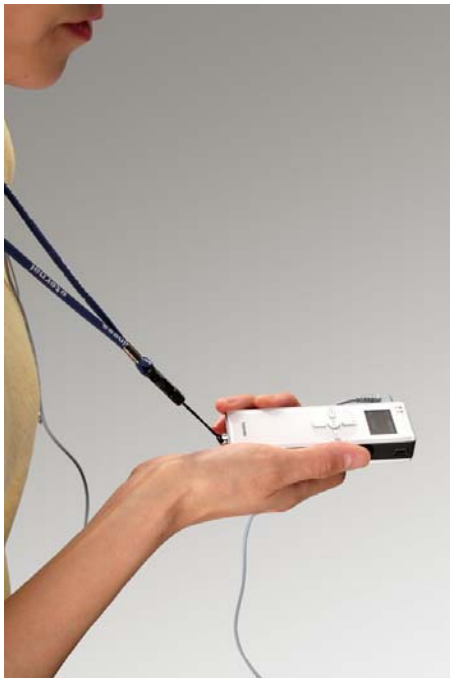
- Fuel (formic acid) concentration: < 85% wt (Not Flammable).
- Formic acid is oxidized directly in the Formic Acid Fuel.

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.

Micro Fuel Cell Powered Small Gadgets

music player



cell phone

handy terminal



fuel cartridge

Micro fuel cell powered Laptops



fuel cell cartridge installation

Examples



Examples



Examples



Future Tests

- **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.**
- **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