DGP-WG/05-IP/14
18/3/05

DANGEROUS GOODS PANEL (DGP)

MEETING OF THE WORKING GROUP OF THE WHOLE

Montreal, 18 to 22 April 2005

METHANOL MICRO FUEL CELL (MFC)

(26 pages)
DGPWG.05.IP.014.EN.METHANOL MICRO FUEL CELL.DOC

Methanol Micro Fuel Cell (MFC)

for ICAO DGP

held on 18 to 22 April,2005, at Montreal

prepared by JEMA

(The Japan Electrical Manufacturers' Association)

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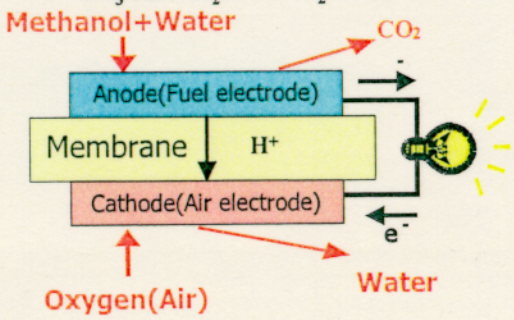
Methanol Fuel Cell

- Fuel Cell is a Generator, NOT a battery -

MFC
(Methanol Micro Fuel Cell)

1.21V (25℃)
Theoretical efficiency 98%

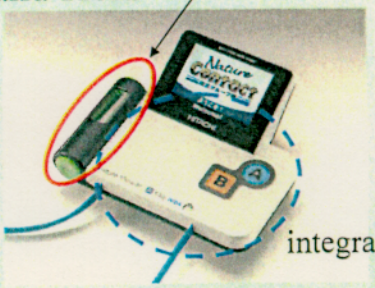
$$CH_3OH + H_2O \rightarrow CO_2 + 6H^+ + 6e$$



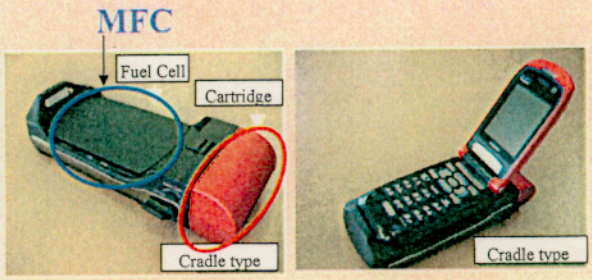
$$6H^+ + 3/2O_2 + 6e \rightarrow 3H_2O$$

MFC Proto Type

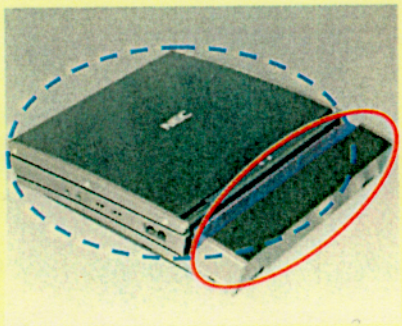
Hand Held — Fuel Cartridge

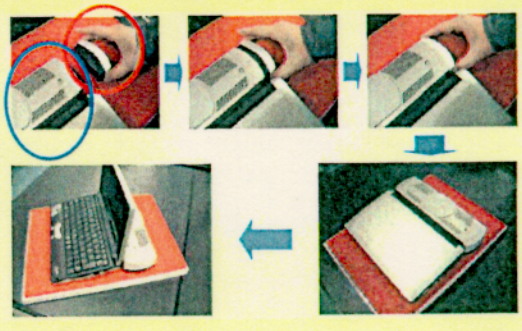


Cellular Phone



Note PC





UN Classification
Dec. 1st, 2004

Fuel Cell Cartridges	Fuel cell cartridges contained in equipment
FUEL CELL CARTRIDGES containing flammable liquids	Dangerous goods in machinery or apparatus
	
New entry UN3473 (Class 3)	Existing entry UN3363 (Class 9)

IEC Activity

- **Micro Fuel Cell System**

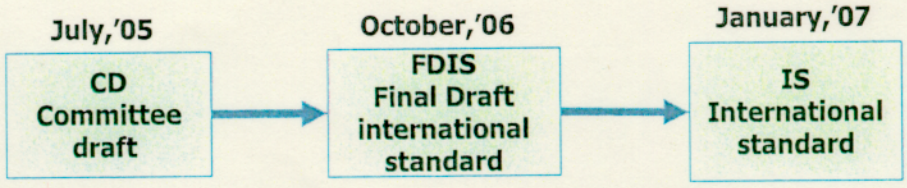
  IEC TC105 : Fuel Cell

  Micro Fuel Cell Safety

  Working Group 8 Convener Mr. Harry Jones (UL):

  CD(Committee draft) target date is July, 2005.

  Regarding transportation fuel cartridges, several test items, such as extreme temperature exposure, altitude simulation, vibration test, drop test etc. are under discussion.



Safety Tests(Working Draft)

- **Altitude Simulation**

  To simulate the effects of high altitude

  68 KPa for 6 hours

  no leakage, no fire, no explosion

- **Vibration Test**

  To simulate effects of normal transport vibration

  7Hz to 200 Hz and back to 7Hz 15 minutes and repeated 12 times

  no leakage, no fire, no explosion

- **Temperature Cycling**

  To simulate effects of low and high temperature exposure and the effects of extreme temperature change

  Fuel Cartridge :70 deg.C/-40deg.C 2 hours each and repeated 10 times

  MFC :55 deg.C/-40deg.C 2 hours each and repeated 10 times

  no leakage, no fire, no explosion

Safety Tests(continued)

- **Drop Test**

  To simulate the effects of an inadvertent drop

  Fuel Cartridge :1.5m onto a rigid surface in three directions

  MFC :75cm desktop type, 1m handheld type

  no leakage, no fire, no explosion

- **Compressive loading**

  To simulate the effects of the forces reasonably encountered due to being stepped on or something heavy being placed on the fuel cells

  Fuel Cartridge :100kg 5sec

  MFC :25kg 5sec

  no leakage, no fire, no explosion

- **External short circuit**

  To simulate the effects of an external short circuit on the fuel cells

  0.1 ohm 5 minutes

  no leakage, no fire, no explosion

Safety Tests(continued)

•Surface and exhaust gas temperature

To ensure no risk of burn injury caused by contact with the enclosure of fuel cell power system or blown exhaust gas from the vent

Surface : Room+30 deg.C(metal) Room+50 deg.C(mold)

Exhaust : below 70 deg.C 1cm from exhaust area

no burn

•Long Term Storage

To simulate the effects of long term storage at elevated temperature upon a fuel cell cartridge and ensure no leakage

50 deg.C for 28days

no methanol leakage

•Fuel Cartridge Internal Pressure

To simulate the effects of high internal pressure of a fuel cell cartridge and ensure no leakage

2 times of the fuel vapor pressure at 60 deg.C for 1 min.

no sudden dropping of pressure during the test

Safety Tests(continued)

•Fuel Cell Power Unit Internal Pressure

To simulate the effects of a high internal pressure of a fuel cell power unit. (Pressurized cartridge only)

1.5 times of the maximum pressure of the cartridge 1min

no sudden dropping of pressure during the test

•Connection Cycling

To simulate the effects of attach and detach of the fuel cartridge to the fuel cell power unit

Fuel Cartridge :10 cycles

MFC :1000 cycles

no methanol leakage, no fire and no explosion at final cycle

•Emission

To ensure the concentration of hazardous emission gas (CO,CO2 or organic compounds such as methanol, formaldehyde, formic acid and methanol formate) shall be under the specific value

Methanol <200ppm, CO <25ppm, CO2 <5000ppm,

Formaldehyde <0.3ppm, Formic acid <5ppm(Tentative)

Methyl formate <100ppm

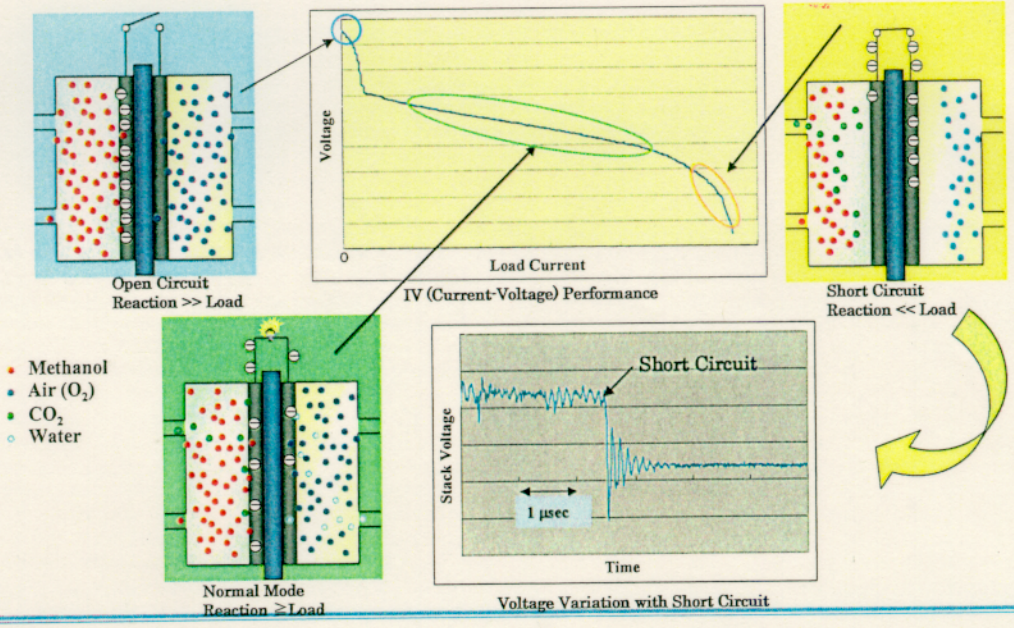
Safety Feature

1. External Short
2. Mechanism to prevent fuel leakage

   (Valve mechanism)

Short-circuit behavior

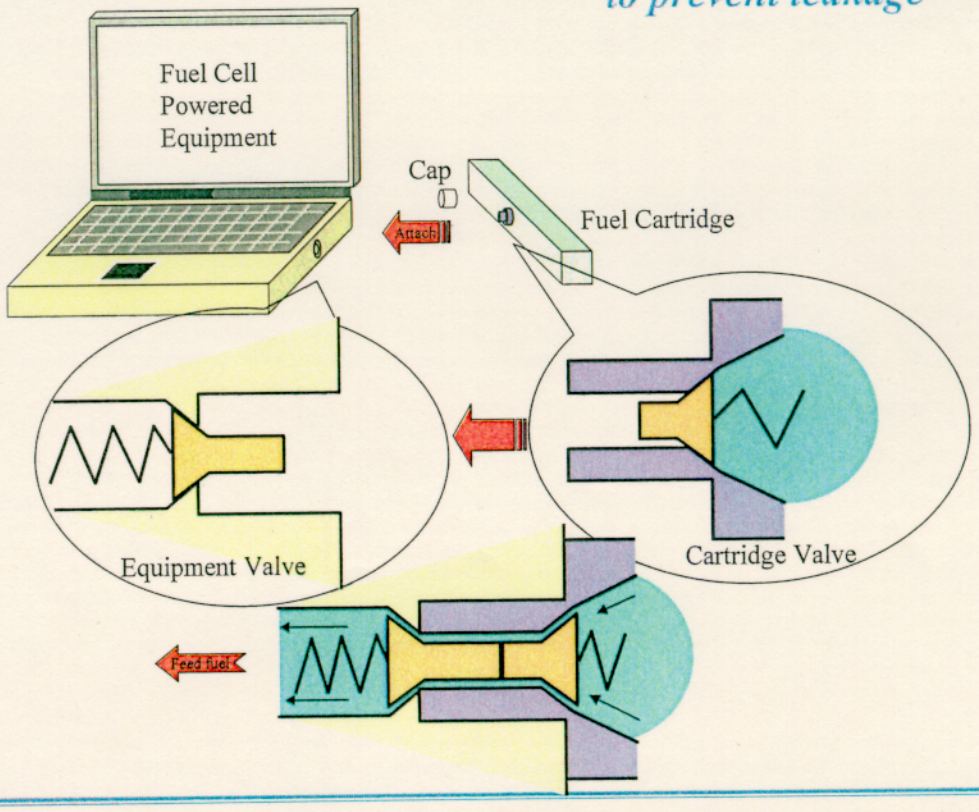
- Unlike standard batteries, fuel cell powered devices show no hazardous effect , in case of short circuit
- The voltage drops less than one micro second



Video show for short-circuit

- **a cartridge is exchanged smoothly, without power shutdown. Users have merits to work with computers continuously.**
- **in case of short circuit , winking green light (power supply) is off, no hazardous effect happens.**
- **remarkable safety of fuel cell for short circuit is confirmed.**

Micro Fuel Cell Valve Safety Mechanism to prevent leakage



Proposal

The Working Group is requested to give due consideration on establishing a new paragraph in Part 8. 1.1.2 as follows.

r) Methanol micro fuel cell-powered equipments (e.g. portable electronic equipments such as personal computers, consumer electronics, etc.), fuel cell cartridges contained in the equipments, and spare fuel cell cartridges, subject to the following conditions.

-in carry-on baggage

-The maximum capacity of each fuel cell cartridge is limited to not more than 200mL.

- The quantity of spare fuel cell cartridges per person must not exceed 5 pcs.

Thank you

for your attention