DANGEROUS GOODS PANEL (DGP)

TWENTIETH MEETING

Agenda Item 2: Development of recommendations for amendments to the Technical Instructions for the Safe Transport of Dangerous Goods by Air (Doc 9284) for incorporation in the 2007-2008 Edition

IEC MICRO FUEL CELL SAFETY SPECIFICATION SUPPLEMENTAL INFORMATION REGARDING THE EXCEPTION FOR FUEL CELL CARTRIDGES AND SYSTEMS CARRIED BY PASSENGERS AND CREW

(Presented by U.S. Fuel Cell Council)

The following testing is required by IEC PAS 62282-6-1 Ed. 1

5.1 Abnormal operations and fault conditions

5.1.1 General

5.1.1.1 Equipment shall be designed so that the risk of fire due to mechanical or electrical overload or failure, or due to abnormal operation or careless use, is limited as far as practicable.

5.1.1.2 After abnormal operation or a single fault, the equipment shall still be in full working order.

5.1.1.3 It is permitted to use fusible links, thermal cutouts, over-current protection devices and the like to provide adequate protection if investigated and found not to become an ignition source.

5.1.1.4 Compliance is checked by inspection and by the tests of Section 5.1.2.

5.1.2 Compliance Testing

5.1.2.1 Before the start of each test, the equipment is to be operating normally.

5.1.2.2 If a component or subassembly is so enclosed that short-circuiting or disconnection is not possible, it is permitted to make the tests on sample parts provided with

special connecting leads. If this is not possible or not practical, the component or subassembly as a whole shall pass the tests.

5.1.2.3 Equipment is tested by applying abnormal and fault conditions that may occur in normal use and foreseeable misuse. Hazard Analysis, clause 4.2, shall be used for guidance in identifying key faults to test. In addition, equipment that is provided with a protective covering is tested with the covering in place under normal idling conditions until steady conditions are established.

5.1.2.4 The equipment, circuit diagrams, FMEA, Hazard Analysis, Section 4, and component specifications are to be examined to determine those fault conditions that might occur. Examples include:

A. Short circuits and open circuits of semiconductor devices and capacitors;
A. Faults causing continuous dissipation in resistors designed for intermittent dissipation;
B. Internal faults in integrated circuits causing excessive dissipation.

5.1.3 Acceptance Criteria

During the tests of simulation of abnormal operating and fault conditions:

A. The equipment shall not emit molten metal.
B. Circuit traces that are designed to intentionally open in a repeatable manner in non-incendive circuits shall be in accordance with the Standard for *Electrical Apparatus for Explosive Gas Atmospheres – Part: 15 type of protection "n,"* IEC 60079-15, or shall be isolated from fuel areas.
C. Enclosures shall not deform in such a way as to cause access to hazardous parts.
D. The temperatures of insulating materials other than thermoplastic materials shall not exceed 150°C (302°F) for Class A, 165°C (329°F) for Class E, 175°C (347°F) for Class B, 190°C (374°F) for Class F and 210°C (410°F) for Class H materials.
E. Temperatures and arcing that may occur shall not be a potential ignition source. If such an occurrence is deemed to become a potential ignition source, other means shall be provided to prevent the arcing or high temperature from occurring.
F. If the failure of the insulation would not result in hazardous energy levels becoming accessible, a maximum temperature of 300°C (572 °F) is permitted. Higher temperatures are permitted for insulation made of glass or ceramic material.

5.1.6 Abnormal Operation – Batteries

A fully charged rechargeable battery provided with, or recommended by the manufacturer for use with the fuel cell power unit shall be used for each of the following tests:

5.1.6.1 For evaluating the overcharging of a rechargeable battery, a battery is charged for a period of 7 h in accordance with each of the following conditions:

A. With the battery charging circuit adjusted for its maximum charging rate (if such an adjustment exists); followed by

B. Any single component failure that is likely to occur in the charging circuit and which would result in overcharging of the battery;

C. The battery is charged for 7 h with any single component failure that is likely to occur and which would result in reversed charging of the battery; and

D. The battery is subjected to rapid discharge by open circuiting or short-circuiting any current-limiting or voltage-limiting components in the load circuit of the battery under test.

5.1.6.2 These battery abnormal tests shall not result in any of the following:

A. Chemical or fuel leaks of the battery, micro fuel cell, or fuel cartridge caused by cracking, rupturing or bursting of a jacket;

B. Explosion of the battery or micro fuel cell, if such explosion could result in injury to a user; or

C. Emission of flame or expulsion of molten metal to the outside of the equipment.

D. Ignition of the fuel cell power system or cartridge or fuel contained therein.

E. After completion of the tests, the equipment is subjected to dielectric testing.

5.1.7 Abnormal Operation - Simulation of Faults Based on Hazard Analysis

The following faults are to be simulated:

5.1.7.1 Any abnormal conditions deemed necessary, based upon Hazard Analysis, Section 4 to evaluate the protection parameters provided for the system, e.g. over-temperature protection, short circuit, stack voltage.

5.1.7.2 Short circuit, disconnection or overloading of all relevant components and parts unless they comply with Fire Enclosures, Sections 4.2.6, 4.4.6, 4.7.2.1, and 4.7.3.4.

Note: An overload condition is any condition between normal load and the maximum current condition up to short circuit.

5.1.7.3 Temperatures in excess of the over-temperature protection circuitry to ensure the safety of the system.

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