COMMITTEE OF EXPERTS ON THE TRANSPORT OF DANGEROUS GOODS AND ON THE GLOBALLY HARMONIZED SYSTEM OF CLASSIFICATION AND LABELLING OF CHEMICALS

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NEW ENTRIES FOR FUEL CELL CARTRIDGES AND FUEL CELL POWERED DEVICES

Transmitted by the expert from the United States of America

Introduction

1. Fuel cell technologies have advanced rapidly in recent years such that commercial products may be introduced in the marketplace as soon as the year 2004. Fuel cell applications can roughly be categorized into the following areas: (1) Motor vehicles, (2) Stationary (for generation of electricity) and (3) Portable (small) electronic equipment. Technologies and materials involved in these fuel cell applications are still in the early stages. Among different fuel cell technologies, Direct Methanol Fuel Cell (DMFC) technology is the most developed technology for portable power fuel cell devices such as cell phones, computers, cameras etc. DMFC's use methanol or methanol/water solutions as fuel. DMFC's do not burn the methanol; they produce electricity through an electrochemical process that combines protons from methanol and oxygen. For portable electronic equipment, the fuel is contained in a small replaceable cartridge, which is installed in a fuel cell. The fuel cell may also be a standalone component of a device. Many portable devices that are now typically powered by batteries may be powered by fuel cells (utilizing DMFC's) in the near future.

2. Portable electronic equipment is intended for consumer use and is commonly carried on board aircraft by passengers or transported by the air mode. Currently there are adequate provisions in the UN Model Regulations for transport of portable electronic equipment powered by batteries but not by fuel cells containing methanol. The Expert from the United States of America has developed proposed provisions for such devices for consideration by the Sub-Committee.

3. The objective of this paper is to address the appropriate requirements for fuel cell devices containing methanol to ensure that an adequate level of safety in transport is afforded while at the same time minimizing undue restrictions for their use. Equipment powered by fuel cells containing methanol will be used by consumers. The proposals in this paper take account of the experience gained through the development of requirements for the safe transport of lithium batteries. The primary hazard possessed in fuel cell cartridges containing methanol is "fire" because methanol is a flammable liquid. We are proposing that fuel cells be classified as dangerous goods of Class 9 taking into account the small quantities of methanol in the cartridges, the relative ease of putting out a methanol fire and the circumstances under which these devices will be transported, distributed and used. Steps taken to ensure that the cartridges are constructed and tested to minimize the probability of leakage and access to the methanol will ensure transport safety involving fuel cell cartridges.

Proposals

4. Create two new entries:

(1) ID #: UN XXXX
PSN: Fuel Cell Cartridges containing methanol
Class: 9
Packing Group: II
Special Provision: SP ZZZ
Packing Instruction: P903 with modification to existing text.

(2) ID#: UN YYYY
PSN: Fuel Cell Cartridges containing methanol Contained In Equipment or
Fuel Cell Cartridges containing methanol Packed With Equipment
Class: 9
Packing Group: II
Special Provision: SP ZZZ
Packing Instruction: P903 with modification to existing text

5. Create a new Special Provision SP ZZZ:

This entry applies to fuel cell cartridges containing methanol or aqueous methanol solutions. Fuel cell cartridges may be transported under this entry if they meet the following provisions:

(a) Each fuel cell cartridge shall contain no more than 150 ml of methanol or aqueous methanol solution;

(b) Each fuel cell cartridge is of the type proved to meet the requirements of the tests specified in the Manual of Tests and Criteria, Part III, Subsection 38.4;

(c) Equipment containing fuel cell cartridges or packed with fuel cell cartridges shall be protected to prevent short circuit;

(d) The testing requirements in Chapter 38.4 of the Manual of Tests and Criteria do not apply to production runs or pre-production prototypes consisting of not more than 100 fuel cell cartridges when theses cartridges are transported for testing, if:

(i) the fuel cell cartridges are transported in an outer packaging that meets the criteria for packing group I packagings; and
(ii) each fuel cell cartridge is individually packed in an inner packaging that meets the requirements for packing group II further packed inside an outer packaging and is surrounded with non-combustible absorbent material.

6. Revise the text of Packing Instruction 903 as follows:

P903	**PACKING INSTRUCTION**	**P903**
This instruction applies to UN Nos 3090, 3091, XXXX and YYYY		
The following packagings are authorized, provided the general provisions of **4.1.1** and **4.1.3** are met: Packaging conforming to the packing group II performance level. When lithium cells and batteries or fuel cell cartridges are packed with equipment, they shall be packed in inner fiberboard packagings that meet requirements for packing group II. When lithium cells and batteries or fuel cell cartridges are contained in equipment, the equipment shall be packed in strong outer packagings in such a manner as to prevent accidental operation during transport.		
Additional requirement: Batteries and equipment shall be protected against short circuits.		

7 Proposed fuel cell cartridge tests (to be incorporated in the Manual of Tests and Criteria, Part III, Section 38.4)

38.4 Fuel cell cartridges

38.4.1 Purpose

This section presents the procedures to be followed for the classification of fuel cell cartridges containing methanol (see UN XXXX and applicable special provisions of Chapter 3.3 of the Model Regulations).

38.4.2 Scope

38.4.2.1 Fuel cell cartridges containing methanol shall be subjected to the tests, as required by special provision SP ZZZ of Chapter 3.3 of the Model Regulations prior to the transport of a particular fuel cell cartridge design type. Fuel cell cartridges containing methanol which differ from a tested design type by a change that would materially affect the test results shall be considered to be new design types and shall be subjected to the required tests.

38.4.2.2 For the purposes of classification, the following definitions apply**:**

Fuel cell means a device that produces electricity through an electrochemical process by combining protons from a fuel such as methanol or hydrogen and oxygen. Only fuel cells that operate on methanol directly, i.e. without fuel reforming or processing into hydrogen, are considered to be within the scope of this subchapter.

Direct methanol fuel cell means a fuel cell that operates on methanol or methanol and water solutions and does not reform or process hydrogen.

Fuel cell powered equipment means an article or device that is electronically powered by a direct methanol fuel cell.

Fuel cell cartridge means a container that stores methanol for discharge into fuel cell powered equipment through a valve(s) that controls the discharge of fuel into such equipment. It is to be designed and constructed using materials in its structure, valve(s) and all other components that will securely contain fuel from leakage when tested in the performance tests specified in this subchapter.

Mass loss means a loss of the total test cartridge mass of greater than 1.0 % after the test.

Fuel means methanol or methanol and water solution used to produce electricity in a fuel cell.

Type means a particular fuel cell design type.

38.4.3 Procedure

Ten (10) representative samples of the same type of fuel cell cartridge, filled to their design capacity, shall be subjected to tests 1 through 5 as specified. Samples of each type of fuel cell cartridge containing methanol shall be subjected to tests 1 through 3 in sequence on the same cartridge. Tests 4 and 5 should be conducted using samples of either untested cartridges or undamaged cartridges previously used in Tests 1 through 3.

38.4.3.1 Test 1: Altitude Simulation

38.4.3.1.1 Purpose

This test simulates air transport under low-pressure conditions.

38.4.3.1.2 Test procedure

Test sample fuel cell cartridges shall be stored at a pressure of 11.6 kPa or less for at least six hours at ambient temperature (20 ± 5 °C).

38.4.3.1.3 Test criteria and results assessment

Cartridges meet this requirement if there is no mass loss after the test is performed.

38.4.3.2 Test 2: Extreme temperature exposure:

38.4.3.2.1 Purpose

This test assesses the fuel cell cartridge's structure and valve integrity using rapid and extreme temperature changes.

38.4.3.2.2 Test procedure

Test sample fuel cell cartridges shall be stored for at least 2 hours at a test temperature of 75 ± 2 °C, followed by storage for at least 2 hours at a temperature of -40 ± 2 °C. This procedure is to be repeated 10 times, with no more than a 30-minute maximum time interval allowed between each temperature extreme.

38.4.3.2.3 Test criteria and results assessment

Cartridges meet this requirement if there is no mass loss after the test is performed.

38.4.3.3 Test 3: Vibration test:

38.4.3.3.1 Purpose

This test simulates vibration during transport.

38.4.3.3.2 Test procedure

Test sample fuel cell cartridges are firmly secured to the platform of the vibration machine without distorting the cartridges in such a manner as to faithfully transmit the vibration. The vibration shall be a sinusoidal waveform with a logarithmic sweep between 7 Hz and 200 Hz and back to 7 Hz traversed in 15 minutes. This cycle shall be repeated 12 times for a total of 3 hours for each of three mutually perpendicular mounting positions of the fuel cell cartridge test samples.

38.4.3.3.3 Test criteria and results assessment

Cartridges meet this requirement if there is no mass loss after the test is performed.

38.4.3.4 Test 4: Drop test:

38.4.3.4.1 Purpose

This test simulates possible impacts to a fuel cell cartridge during transport.

38.4.3.4.2 Test procedure

Test sample fuel cell cartridges are dropped from a height of 1.5 m onto a concrete surface in three orientations: valve up, valve down and horizontal. Three separate drops shall be conducted on each test cartridge. Prior to conducting the drops, 5 of the fuel cell cartridges shall be stored for at least 2 hours at 50 ± 2 °C , and 5 of the fuel cell cartridges shall be stored for at least 2 hours at –18 ± 2 °C.

38.4.3.4.3 Test criteria and results assessment

Cartridges meet this requirement if there is no mass loss after the test is performed.

38.4.3.5 Test 5: Crush (compressive loading) test:

38.4.3.5.1 Purpose

This test simulates possible crushing force applied to a fuel cell cartridge.

38.4.3.5.2 Test procedure

Test sample fuel cell cartridges are to be placed between two flat wooden blocks of approximately 240 mm (10 inches) long, 100 mm (4 inches) wide and 13 mm (1/2 inch) thick. The crushing force is to be applied to the exposed surfaces of the enclosure gradually. Each force applicator is to exert 100 kg on the sample for one minute. Test sample cartridges are divided into two groups; 5 tested on the wide side and 5 tested on the narrow side. Each sample is to be subjected to only a single crush. Separate samples are to be used for each crush.

38.4.3.5.3 Test criteria and results assessment

Cartridges meet this requirement if there is no mass loss after the test is performed.
