

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

Sub-Committee of Experts on the Transport of Dangerous Goods

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### PROPOSALS OF AMENDMENTS TO THE RECOMMENDATIONS ON THE TRANSPORT OF DANGEROUS GOODS

#### Changes to UN/SCETDG/30/INF.25

Transmitted by the US Fuel Cell Council (USFCC)

#### **Background**

1. The fuel cell industry extends our congratulations and our gratitude to the experts from Canada, France, the United States, Switzerland, Belgium, the Netherlands, and all of the others who are working on this important topic. The effort is worthwhile to everyone, since it will result in improved understanding and shipment of fuel cell cartridges and fuel cell equipment in a safe and sure manner.
2. The fuel cell industry wishes to support and anticipates the acceptance of both ST/SG/AC.10/C.3/2006/82 and UN/SCETDG/30/INF.25 transmitted by the expert from Canada. For this reason this proposal herein assumes that all the changes in both ST/SG/AC.10/C.3/2006/82 and UN/SCETDG/30/INF.25 have been accepted by the Sub-Committee. This proposal herein only proposes changes to one aspect of the prior work, shown below in **underlined bold type**.
3. **Referenced documents.** The following documents form the basis for this submittal:
  - A) **IEC PAS 62282-6-1**, *Fuel cell technologies - Part 6-1: Micro fuel cell power systems – Safety*. This Specification defines Micro fuel cells, micro fuel cell cartridges, and the requirements for their design, construction and testing for safety. It has been accepted by the International Civil Aviation Organization (ICAO) as the appropriate reference for micro fuel cells carried onboard passenger aircraft in carry-on baggage under certain conditions. IEC PAS 62282-6-1 requires compliance with ISO TS 16111 for fuel cell cartridges using hydrogen absorbed in metal hydrides.
  - B) **ISO TS 16111**, *Transportable gas storage devices -- Hydrogen absorbed in reversible metal hydride*. This specifies the requirements for the design, construction, and

testing for the safety of transportable metal hydride storage systems of all sizes. It also requires compliance with ISO 7866, ISO 9809-1, ISO 9809-3, ISO 11114-4, and other standards as required by the authority having jurisdiction, as necessary for safety.

**C) ISO 7866, Gas cylinders — Refillable seamless aluminium alloy gas cylinders — Design, construction and testing**

**D) ISO 9809-1, Gas cylinders — Refillable seamless steel gas cylinders — Design, construction and testing — Part 1: Quenched and tempered steel cylinders with tensile strength less than 1 100 MPa.** Limits the tensile strength of steels used where hydrogen embrittlement might occur to less than 950 MPa (or 880 MPa in some instances).

**E) ISO 9809-3, Gas cylinders — Refillable seamless steel gas cylinders — Design, construction and testing — Part 3: Normalized steel cylinders**

**F) ISO 11114-4, Transportable gas cylinders — Compatibility of cylinder and valve materials with gas contents — Part 4: Test methods for selecting metallic materials resistant to hydrogen embrittlement.** Specifies test methods and how to evaluate the results of these tests in order to qualify steels suitable for use with hydrogen.

**G) United States Department of Transportation Pipeline and Hazardous Materials Safety Administration Special Permit DOT-SP 13598 (THIRD REVISION) issued to Jadoo Power Systems.**

**H) United States Department of Transportation Pipeline and Hazardous Materials Safety Administration Special Permit DOT-SP 13280 issued to Ovonic Hydrogen Systems, L.L.C.**

**I) United States Department of Transportation Research and Special Programs Administration Exemption DOT-E 12650 issued to Ballard Power Systems**

## Rationale

1. The fuel cell industry seeks new proper shipping names for fuel cell cartridges and fuel cell devices in order to make shipment of these articles easier and safer by avoiding incorrect classification by shippers and providing appropriate requirements for classification, packaging, shipment and carriage. Fuel cells and fuel cell cartridges are unique devices and may be best shipped with this guidance.
2. Fuel cell cartridges containing hydrogen absorbed in metal hydrides have been shipped safely, without untoward incidents, under permissions from the United States Department of Transportation since 2001. These granted permissions include the following general set of requirements:
  - a. Cartridge shell designed in accordance with a design specification acceptable to the authority granting the permission (US DOT 3AL-1800).
  - b. Cartridge shell Design Service Pressure of at least 12.4 Mpa (1800 psig).
  - c. Maximum water capacity of 1.54 litres (3.25 pounds), 1.79 litres (3.79 pounds), or 2.37 litres (5 pounds).
  - d. Pressure or thermal relief device required to pass a fire test
  - e. Internal construction must prevent detrimental forces on the canister caused by the hydride material.
  - f. Air shipment by cargo aircraft allowed (DOT-SP 13598) or shipment by motor vehicle, cargo vessel and rail only.
  - g. Automated or professional refilling/charging.
  - h. Maximum charging pressure of 2.8 Mpa (400 psig)
  - i. Strong outer packaging or UN Packing Group III specification packaging.
  - j. Five year maximum service life for each cartridge.

- k. Pressure cycling required at stated intervals, with burst testing to ensure no unexpected failures due to degraded material properties or detrimental stresses occur during the service lifetime.
  - l. Incident reporting required.
3. All shipments have been completed without incident. No leakage, rupture, fire, or other untoward incidents have occurred at any time.
  4. All testing has been acceptable. All inspections and burst tests have resulted in acceptable results-
  5. There is no reason to exclude these successful fuel cell cartridges and products from shipment under the new UN shipping name and number.
  6. In order to assure future designs permitted under this new UN Shipping Number meet the general requirements of previously permitted designs given above, new cartridges permitted under this new UN Shipping Number meeting ISO 16111: 2006 must meet the following requirements in order to comply with ISO 16111: 2006:
    - a. ISO TS 16111: 2006 Clause 5.1, *Shell design*, requires: "The canister shell shall be designed according to ISO 7866, ISO 9809-1, ISO 9809-3, ISO 11119-1, ISO 11119-2 or standards registered in accordance with ISO 16528, as applicable, or as required by the authority having jurisdiction".
    - b. ISO TS 16111: 2006 Clause 5.2 requires that all stresses be taken into account in establishing the design stress.
    - c. ISO TS 16111: 2006 Clause 5.4, *Overpressure and fire protection*, requires a pressure relief device or other feature to prevent dangerous failures. Clause 6.2 tests this function.
    - d. ISO TS 16111: Clause 6.5, *Hydrogen cycling and strain measurement test*, verifies that internal construction prevents detrimental forces on the cylinder caused by the hydride material.
    - e. ISO 9809-1 limits the tensile strength of steels used where hydrogen embrittlement might occur to less than 950 MPa (or 880 MPa in some instances).
  7. IEC 62282-6-1 Clause B.4.17.1.15 establishes that the maximum volumetric capacity of the fuel cartridge utilizing metal hydride technology shall not exceed 1 litre.

### **Proposal to amend UN/SCETDG/30/INF.25**

1. The USFCC proposes that the maximum size limit proposed in paragraph 1 of UN/SCETDG/30/INF.25 be modified to allow the continued successful shipment of fuel cell cartridges containing hydrogen absorbed in metal hydride complying with the aforementioned requirements up to a maximum volume of 1 litre. The following changes to Special Provision 328 are proposed with the new modifications **underlined and in bold type**:

"328 This entry applies to fuel cell cartridges including when contained in equipment or packed with equipment. Fuel cell cartridges installed in or integral to a fuel cell system are regarded as contained in equipment. Fuel cell cartridge means an article that stores fuel for discharge into the fuel cell through a valve(s) that controls the discharge of fuel into the fuel cell. Fuel cell cartridges, including when contained in equipment, shall be designed and constructed to prevent fuel leakage under normal conditions of transport.

Fuel cell cartridge design types using liquids as fuels shall pass an internal pressure test at a pressure of 100 kPa (gauge) without leakage.

Except for fuel cell cartridges containing hydrogen in metal hydride which shall be in compliance with ISO TS 16111: 2006, each fuel cell cartridge design type shall be shown to pass a 1.2 meter drop test onto an unyielding surface in the orientation most likely to result in failure of the containment system with no loss of contents.

**Fuel cell cartridges containing hydrogen in metal hydride transported under this shipping name shall have a water capacity less than or equal to 1 litre.**

2. In paragraph 2 of un/scetdg/30/inf.25, the USFCC proposes to change the first sentence of proposed special provision 3CC to read as follows with the new modifications **underlined and in bold type**:

"3CC Fuel cell cartridges containing hydrogen in a metal hydride **transported under this shipping name shall have a water capacity less than or equal to 1 litre**, shall be in compliance with ISO TS 16111: 2006 and, except during the fire test, shall pass all the required tests without leakage.

Fuel cell cartridges containing hydrogen in a metal hydride which are transported as limited quantities in accordance with Chapter 3.4 shall have a water capacity less than or equal to 120 ml and shall not contain more than 25 g of hydrogen."

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