



WORKING PAPER

**DANGEROUS GOODS PANEL (DGP)
MEETING OF THE WORKING GROUP OF THE WHOLE**

Auckland, New Zealand, 4 to 8 May 2009

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 2011/2012 Edition

Agenda Item 2.3: Part 3 — Dangerous Goods List, Special Provisions and Limited and Excepted Quantities

Agenda Item 2.4: Part 4 — Packing Instructions

LIMITED QUANTITIES PROVISIONS FOR FUEL CELL CARTRIDGES

(Presented by USFCC)

SUMMARY

This paper proposes the adoption of new provisions to allow the carriage of fuel cell cartridges under the provisions of limited quantities.

Action by the DGP-WG is in paragraph 2.

1. INTRODUCTION

1.1 During DGP/21 (5-16 November 2007) the Dangerous Goods Panel (DGP) reviewed and incorporated amendments to the *Technical Instructions for the Safe Transport of Dangerous Goods by Air* (Doc 9284) to reflect the decisions taken by UN Sub-Committee of Experts on the Transport of Dangerous Goods (UNSCOE) at its thirtieth session and adopted by the UN Committee of Experts on the TDG and on the GHS at its third session (Geneva, 15 December 2006). These changes had been reviewed and modified at an earlier meeting of the DGP Working Group of the Whole in Memphis (DGP-WG/07, 30 April to 4 May 2007). Further discussions on amendments to the individual parts of the Technical Instructions were introduced at DGP/21 including some relating to packing instructions for fuel cell cartridges as reflected in the meeting report under 2.9.1.2. Unfortunately, the limited quantities provisions, adopted by the UNSCOE for fuel cell cartridges, were not reflected in the Technical Instructions.

1.2 The Fifteenth revised edition of the UN Recommendations on the Transport of Dangerous Goods: Model Regulations (the “UN Model Regulations”) currently provides for limited quantity exceptions for all types of fuel cell cartridges, which are provided below for ease of reference:

UN #	Proper Shipping Name	Classification	Limited Quantity
UN 3473	Fuel cell cartridges <i>containing flammable liquids</i>	3	1 litre
UN 3476	Fuel cell cartridges <i>containing water-reactive substances</i>	4.3	500 ml or 500 g
UN 3477	Fuel cell cartridges <i>containing corrosive substances</i>	8	1 litre or 1 kg
UN 3478	Fuel cell cartridges <i>containing liquefied flammable gas</i>	2.1	120 ml
UN 3479	Fuel cell cartridges <i>containing hydrogen in metal hydride</i>	2.1	120 ml

1.3 As defined in the Technical Instructions, a fuel cell cartridge is *an article* (emphasis added) that stores fuel for discharge into the fuel cell through a valve(s) that controls the discharge of fuel into the fuel cell. As articles, fuel cell cartridges are inherently robust packaging, designed and constructed to withstand conditions of normal use and reasonably foreseeable misuse. The UN Model Regulations permits limited quantities of such articles to be placed in suitable outer packagings, so long as the gross mass of the package does not exceed 30 kg G. The USFCC proposes that the Dangerous Goods Panel adopt limited quantity exceptions for fuel cell cartridges consistent with those provided for in the UN Model Regulations for the articles, and further proposes net quantity per package limits for the limited quantity exceptions of half the net quantity permitted per package on passenger aircraft.

1.4 Furthermore, Special Provisions A146, A161 and A162 place additional requirements on the design and construction of fuel cell cartridges, including, for example, that any fuel cell cartridges which contain liquids must be capable of withstanding a 100 kPa (gauge) pressure differential and all fuel cell cartridges must withstand a 1.2 m drop test onto an unyielding surface in the orientation most likely to result in failure of the containment system (1.8 m for UN 3479) without leakage. Special Provision A146 further specifies that “*fuel cell cartridges ... must be designed and constructed to prevent fuel leakage under normal conditions of transport*”.

1.5 Cartridges containing liquefied flammable gases are additionally required to withstand, without leakage or bursting, a pressure of at least two times the equilibrium pressure of the contents at 55°C and must pass the water bath test prescribed in 6;5.4.1 of the Technical Instructions (Special Provision A161) — consistent with aerosols (UN 1950) for which a limited quantity exception of 30 kg G is permitted by the Technical Instructions. Cartridges containing hydrogen in metal hydride are additionally required to withstand, without leaking or bursting, the greater of two (2) times the design pressure of the cartridge at 55°C or 200 kPa more than the design pressure at 55°C, and must pass a 1.8 m drop test, fire test, hydrogen cycling test, and a production leak test (Special Provision A162).

1.6 In addition to the safety both inherent to and required of fuel cell cartridges by the Technical Instructions, fuel cell cartridges are already permitted to be transported in non-specification packaging when packed with equipment and when packed in equipment (for example, refer to Packing Instructions 216, 217, 375, 376, etc). In addition, several types of fuel cell cartridges contain substances which are already permitted to be transported under limited quantity exceptions by air under the Technical Instructions when not in robust articles (for example, UN 1993, Flammable liquid, n.o.s.; UN 1230, Methanol; UN 1759, Corrosive solid, n.o.s.; UN 1760, Corrosive liquid, n.o.s.; etc).

1.7 For the reasons specified above, the USFCC firmly believes that there are sufficient arguments based in both safety and on precedent to enable the DGP to take a supportive position on this proposal. Fuel cell cartridges are articles which are designed and constructed to safely contain small quantities of dangerous goods in transport, and should be provided a limited quantity exception. In addition to the justification provided from a safety perspective, there are several arguments which may be made in support of commercial rationale for allowing limited quantity exceptions for these articles.

1.8 Prohibiting fuel cell cartridges from being transported by air as limited quantities does not provide for multimodal packaging uniformity and restricts shippers' flexibility to transport their packages by the most appropriate mode. The prohibition on transporting limited quantities of fuel cell cartridges in the Technical Instructions complicates transport logistics and leads to additional expenses to the shippers as it forces them to maintain at least two inventories of packagings: one for limited quantity packagings destined for ground and sea transport and one for UN performance packagings for air transport.

1.9 There are consumer and emergency services applications for micro fuel cell cartridges. As such there is a growing need to ship varying quantities of fuel cell cartridges in outer packagings of different sizes. To require that such shipments be in UN performance packaging when transported by air will dramatically increase costs through increased testing, reduce flexibility in packagings used and complicate providing a complete packaging inventory for all transport eventualities. In the case of cartridges used for emergency purposes, it will likely frustrate their efficient and rapid transport under critical circumstances.

1.10 Finally, the prohibition on air transport of fuel cell cartridges in limited quantity places the emerging fuel cell technology at a competitive disadvantage with other portable sources of electric power and affects negatively their development as an alternative energy source.

2. ACTION BY THE DGP-WG

2.1 The DGP-WG is invited to:

- a) amend the various entries for fuel cell cartridges appearing in Table 3-1 as indicated in Appendix A.
- b) add the following new packing instructions in Part 4 of the Technical Instructions: Y215, Y374, Y495, Y873, as shown in Appendix B.

APPENDIX A

AMENDMENTS TO TABLE 3-1

Name	UN No.	Class or division	Subsidiary risk	Labels	State variations	Special provisions	UN packing group	Excepted quantity	Passenger aircraft		Cargo aircraft	
									Packing instruction	Max. net quantity per package	Packing instruction	Max. net quantity per package
1	2	3	4	5	6	7	8	9	10	11	12	13
Fuel cell cartridges, containing corrosive substances	3477	8		Corrosive		A146 A157		E0	873 <u>Y873</u>	5 kg <u>2.5 kg</u>	873	50 kg
Fuel cell cartridges, containing flammable liquids	3473	3		Liquid flammable		A146		E0	374 <u>Y374</u>	5 kg <u>2.5 kg</u>	374	50 kg
Fuel cell cartridges, containing hydrogen in metal hydride	3479	2.1		Gas flammable		A146 A162		E0	215 <u>Y215</u>	1 kg <u>0.5 kg</u>	215	15 kg
Fuel cell cartridges, containing liquefied flammable gas	3478	2.1		Gas flammable		A146 A161		E0	215 <u>Y215</u>	1 kg <u>0.5 kg</u>	215	15 kg
Fuel cell cartridges, containing water-reactive substances	3476	4.3		Danger if wet		A146 A157		E0	495 <u>Y495</u>	5 kg <u>2.5 kg</u>	495	50 kg

APPENDIX B

PACKING INSTRUCTION Y215

Limited quantities for UN 3478 and 3479 only

General requirements

Part 3.4 requirements must be met.

Single packagings are not allowed.

1) Compatibility requirements

— Substances must be compatible with their packagings as required by 4.1.1.3.

<u>UN number and proper shipping name</u>	<u>Quantity</u>
<u>UN 3478 Fuel cell cartridges containing liquefied flammable gas</u>	<u>0.5 kg of fuel</u>
<u>UN 3479 Fuel cell cartridges containing hydrogen in metal hydride</u>	<u>cell cartridges</u>

ADDITIONAL PACKING REQUIREMENTS

— Fuel cell cartridges must be securely cushioned in the outer packagings.

— Fuel cell cartridges must not exceed 120 ml water capacity each.

OUTER PACKAGINGS

Boxes

Aluminium
Fibreboard
Natural wood
Plastic
Plywood
Reconstituted wood
Steel

Drums

Aluminium
Fibreboard
Plastic
Plywood
Steel

Jerricans

Steel
Plastics
Aluminium

PACKING INSTRUCTION Y374

Limited quantities for UN 3473 only

General requirements

Part 3:4 requirements must be met.

Single packagings are not allowed.

1) Compatibility requirements

— Substances must be compatible with their packagings as required by 4:1.1.3.

<u>UN number and proper shipping name</u>	<u>Quantity</u>
<u>UN 3473 Fuel cell cartridges</u>	<u>2.5 kg of fuel cell cartridges</u>

ADDITIONAL PACKING REQUIREMENTS

- Fuel cell cartridges must be securely cushioned in the outer packagings.
- Fuel cell cartridges must not exceed 1 L of flammable liquid fuel.

OUTER PACKAGINGS

Boxes

Aluminium
Fibreboard
Natural wood
Plastic
Plywood
Reconstituted wood
Steel

Drums

Aluminium
Fibreboard
Plastic
Plywood
Steel

Jerricans

Steel
Plastics
Aluminium

PACKING INSTRUCTION Y495

Limited quantities for UN 3476 only

General requirements

Part 3:4 requirements must be met.

Single packagings are not allowed.

1) Compatibility requirements

— Substances must be compatible with their packagings as required by 4:1.1.3.

<u>UN number and proper shipping name</u>	<u>Quantity</u>
<u>UN 3476 Fuel cell cartridges</u>	<u>2.5 kg of fuel cell cartridges</u>

ADDITIONAL PACKING REQUIREMENTS

- Fuel cell cartridges must be securely cushioned in the outer packagings.
- Fuel cell cartridges must not exceed 500 ml of liquid water reactive fuel or 500 g of solid water reactive fuel.
- The mass of each fuel cell cartridge must not exceed 1 kg.

OUTER PACKAGINGS OF COMBINATION PACKAGINGS (see 6:3.1)

Boxes

Aluminium
Fibreboard
Natural wood
Plastic
Plywood
Reconstituted wood
Steel

Drums

Aluminium
Fibreboard
Plastic
Plywood
Steel

Jerricans

Steel
Plastics
Aluminium

PACKING INSTRUCTION Y873

Limited quantities for UN 3477 only

General requirements

Part 3;4 requirements must be met.

Single packagings are not allowed.

1) Compatibility requirements

— Substances must be compatible with their packagings as required by 4;1.1.3.

<u>UN number and proper shipping name</u>	<u>Quantity</u>
<u>UN 3477 Fuel cell cartridges</u>	<u>2.5 kg of fuel cell cartridges</u>

ADDITIONAL PACKING REQUIREMENTS

- Fuel cell cartridges must be securely cushioned in the outer packagings.
- Fuel cell cartridges must not exceed 1 L of liquid corrosive fuel or 1 kg of solid corrosive fuel.
- The mass of each fuel cell cartridge must not exceed 1 kg.

OUTER PACKAGINGS OF COMBINATION PACKAGINGS (see 6;3.1)

Boxes

Aluminium
Fibreboard
Natural wood
Plastic
Plywood
Reconstituted wood
Steel

Drums

Aluminium
Fibreboard
Plastic
Plywood
Steel

Jerricans

Steel
Plastics
Aluminium

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