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**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

Thirty-sixth session
Geneva, 30 November – 9 December 2009
Item 4 of the provisional agenda

ELECTRIC STORAGE SYSTEMS

Proposal for a new proper shipping name for ultracapacitors

Transmitted by KiloFarad International (KFI)¹

Introduction

1. The thirty-fifth session the Sub-Committee considered KFI's proposal in document ST/SG/AC.10/C.3/2009/13 for a new proper shipping name to cover ultracapacitors. The Sub-Committee generally agreed that a proper shipping name for ultracapacitors would be appropriate and provided a number of useful comments on the proposal. KFI agreed to submit a revised proposal taking those comments into account.

2. As described in more detail in ST/SG/AC.10/C.3/2009/13, ultracapacitors are devices which store but do not produce electrical energy. They contribute to increased fuel efficiency in many alternative energy solutions such as hybrid vehicles. Some ultracapacitors contain flammable liquid absorbed in a solid with small amounts present as free liquid. Others use a liquid electrolyte that is not subject to Dangerous Goods Regulations. KFI provided a powerpoint presentation demonstrating that the primary risk of these devices would be their

¹ In accordance with the programme of work of the Sub-Committee for 2009-2010 approved by the Committee at its fourth session (refer to ST/SG/AC.10/C.3/68, para. 118(c) and ST/SG/AC.10/36, para. 14).

charge and to deal with this concern KFI proposed that ultracapacitors be required to be transported uncharged.

Discussion of comments and proposed solutions

3. A listing of Sub-Committee comments, other than those of an editorial nature, and KFI responses is as follows:
 - (a) **Definition proposed for inclusion in the glossary** – Some were concerned that the ultracapacitor definition would be lost by including it in the glossary. *Solution:* KFI proposes to include the definition in the proposed special provision.
 - (b) **Revised proper shipping name** – It was recommended that the proper shipping name be revised to include the word “uncharged”. *Solution:* The proper shipping name was revised to include the word “uncharged”.
 - (c) **Limited quantity specification** – It was noted that considering the liquid was for the most part absorbed into a solid, compliance with the 1 liter limited quantity amount would be hard to verify. *Solution:* The limited quantity amount specified was changed to a 5 kilogram mass limit, making the quantity easier to verify. This mass limit is approximately equivalent to a 1 liter volumetric liquid limit.
 - (d) **The pressure of gas in used ultracapacitors at end of life** – It was noted that the pressure within an ultracapacitor could reach 1500 kPa at the end of its useful life and the question was raised as to whether a pressure limit should be included. *Solution:* It should be noted that the amount of gas in the ultracapacitor will be small in that the amount of space provided inside an ultracapacitor for gas buildup is small. For a large ultracapacitor, the amount of gas built up would fill a 7 cubic centimeter cube at atmospheric pressure. To deal with pressure build up, ultracapacitors commonly include either a re-sealable vent or a weak point in the casing so that the ultracapacitor will relieve the internal pressure safely. To verify ultracapacitors will fail in a safe manner, a design test requirement is proposed to demonstrate “relief of the pressure in the device so that the ultracapacitor does not fragment and it does not rocket.” See Special Provision(SP) 282(e) in Chapter 3.3 where similar text is used. As written the requirements ensure safety independent of the pressure that is built up so that KFI does not consider the specification of a maximum pressure necessary.
 - (e) **The ability to check the amount of free liquid in ultracapacitors that could be treated as not subject to the Model Regulations** – KFI had proposed that ultracapacitors with less than 30ml free liquid could be treated as non-dangerous under specified conditions. Several commenters wondered how this could be verified in transport and also commented on the amount of free liquid. *Solution:* Free liquid is included in an ultracapacitor to ensure complete wetting of the activated carbon. The amount of free liquid is self limiting because free liquid serves no other purpose. An ultracapacitor with a capacitance of 10 kilofarads could be expected to hold much less than 10 ml free liquid. Considering the

robust nature of the ultracapacitor shell as demonstrated by a 10m drop test, such an amount seems reasonable. KFI proposes that ultracapacitors of 10 kilofarads or less and meeting specified requirements be treated as not subject to the Model Regulations. For compliance verification purposes, KFI proposes that each ultracapacitor be marked with its Farad rating, except that ultracapacitors of less than 100 Farad would be exempted due to size considerations.

- (f) **The need to exempt modules was questioned** – It was noted that modules consisted of a group of cells and the justification for exempting them was questioned. *Solution:* KFI removed the reference to modules from excepted equipment and components.
- (g) **The ability to verify that the ultracapacitor is transported uncharged** – While it was generally acknowledged that the danger of these devices was minimal provided they were transported uncharged, there was concern that the state of charge could not easily be checked in transport. *Solution:* It is common practice to transport ultracapacitors uncharged. It is proposed that terminals of ultracapacitors and ultracapacitor modules be fitted with a conductive material connecting the terminals. Electrically connecting the terminals would ensure that the ultracapacitor is uncharged. Small ultracapacitors with a capacitance of 100 Farad or less would alternately be required to be packed to prevent short circuits. Experience has shown the charge contained in such small devices is not generally sufficient to create a hazard and the small size of these devices makes applying a shorting component impracticable.
- (h) **Verification of no dangerous goods being present** – There was concern that there was no way to verify the absence of no dangerous goods in the case of ultracapacitors containing a nonflammable liquid, particularly when these were considered not subject to the Regulations. *Solution:* KFI has proposed an external marking for these ultracapacitors.
- (i) **Need to assign these devices to class 9** – Assignment to class 9 was questioned by at least one speaker. Others supported assignment to class 9. *Response:* KFI believes class 9 is appropriate because it permits coverage of ultracapacitors irrespective of whether dangerous goods are present. As such only one entry is needed for ultracapacitors of this type.
- (j) **Is a gross mass limit necessary?** – *Response:* Ultracapacitors themselves are relatively small. Ultracapacitors are assembled into modules. A gross mass limit would only serve to limit the size of modules that might be transported for energy conservation projects. There is no apparent benefit for such a limit.
- (k) **Are the drop, pressure, and vent tests necessary?** – This question was raised considering the low degree of hazard posed. *Response:* KFI considered these tests appropriate to demonstrate the robustness of these devices. Similar tests are commonly applied to ultracapacitors to demonstrate integrity under use conditions. KFI would have liked to simply apply these test requirements by

reference to an industry standard. However, among the applicable standards there is some variation in test prescriptions.

- (1) **The need to address other types of capacitors which must hold some level of charge during transport.** – It was noted that there are other types of capacitors, commonly referred to as hybrid or asymmetric capacitors, that must hold some level of charge in order to maintain continued viability. The transport conditions for this type of unit are not covered by the current proposal. *Response:* KFI will prepare a separate proposal to address transport conditions for this type of capacitor.

Proposal

4. Based on the above discussion of comments received, KFI proposes to add the following new entry to the Dangerous Goods List:

(1)	(2)	(3)	(4)	(5)	(6)	(7a)	(7b)	(8)	(9)	(10)	(11)
XXXX	ULTRACAPACITOR, UNCHARGED	9			AAA	5kg	E0	P003			

5. Add the following new special provision AAA:

“AAA This entry applies to ultracapacitors that are energy storage devices which store but do not produce electricity, without chemical reaction, in a mixture of a solid (e.g., activated carbon) and an absorbed liquid electrolyte. These devices may contain small amounts of free liquid electrolyte solution, including dangerous goods (e.g., a flammable liquid) or other liquids not subject to these Regulations. Except when contained in equipment, ultracapacitors shall be transported in an uncharged state with the positive and negative terminals of each ultracapacitor or ultracapacitor module connected by an electrically conductive material. Alternatively, ultracapacitors with a capacitance of 100 Farad or less may be shipped without a conductive shorting element provided they are packaged in a manner to prevent short circuiting. Each ultracapacitor design type shall be tested to demonstrate the ability to show:

- (a) It can withstand a 10m drop test without loss of contents;
- (b) It can withstand a 95 kPa pressure differential test without loss of contents;
- (c) The device can retain a pressure build up in the casing equivalent to 1.5 times the pressure buildup at the point of venting; and
- (d) The installed vent will relieve the pressure in the device so that the ultracapacitor does not fragment and it does not rocket.

Except for ultracapacitors with a capacitance of 100 farads* or less, the outside casing of each ultracapacitor shall be marked with the rated capacitance in Farads.

Ultracapacitors meeting the above requirements are not subject to these Regulations under the following conditions:

- (a) The ultracapacitor has a capacitance of 10 kilofarads or less;
- (b) When installed in conveyances, completed conveyance components, or in equipment; and
- (c) When not containing any substances classified as dangerous goods. When the capacitance of such ultracapacitors exceeds 10 kilo farads, the outside casing shall bear a mark indicating it contains no dangerous goods.

* Note by the secretariat : The Sub-Committee may wish to consider amending the table in 1.2.2.1 to introduce the measurement of capacitance with the SI unit : F(farad).