

## **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

12 May 2016

Forty-ninth session

Geneva, 27 June – 06 July 2016

Item 4 (c) of the provisional agenda

**Electric storage systems: miscellaneous**

### **Transport of damaged/defective lithium batteries, Step I**

#### **Transmitted by European Association for Advanced Rechargeable Batteries (RECHARGE) and the International Organization of Motor Vehicle Manufacturers (OICA)**

#### **Introduction**

1. The transport of damaged/defective lithium batteries is currently regulated in SP376. It allows two ways of transport, either A P908/LP904 for the transport of damaged/defective lithium batteries, non-reactive under normal transport conditions or B using a competent authority approval to transport damaged / defective lithium batteries possibly reactive under normal transport conditions.
2. OICA members have examined several approvals given by competent authorities of different countries which indicate different transport solutions by using different packagings based on different testing and calculations methods. They recognised many similarities, summarized and proposed them as working document ST/SG/AC.10/C.3/2015/51 at the last ECOSOC Sub-Committee of Experts on the Transport of Dangerous Goods (TDG) meeting at Geneva in December 2015.
3. The outcome of the discussion at the Geneva meeting in December 2015 was to discuss this technical issue at the 3rd Informal Working Group Lithium Batteries and Manual of Tests and Criteria Meeting at Bordeaux in March/April 2016 for a technical review by the participating battery experts. The ECOSOC Sub-Committee of Experts on the Transport of Dangerous Goods (TDG) provided mandate to the Group to submit the outcome of this technical discussion at the Geneva meeting in June/July 2016.
4. The outcome of this roundtable discussion was the conformable agreement of the attendant technical experts, that there is an increasing need for a transparent, practical and safe solution without competent authority approvals, but under a high constant safety standard (comparable to transports, approved by the competent authorities) to transport such damaged/defective lithium batteries (B) with the packaging instructions available in the regulation to avoid island solutions (approved packaging solution only usable by one OEM/packaging manufacturer and authority). A performance based packaging for damaged/defective lithium batteries (e.g. currently discussed and developed by SAE Technical Standard G-27 Committee on behalf of ICAO T.I. for the air transport of safe Lithium Batteries) was discussed as a possible future, innovative, practical and high safety transport solution, maybe for all types of damaged/defective lithium batteries (A and B) also considering the actual damage or/and defect, using mitigation and /or prevention measures as well as finally a packaging of the then needed quality to cover all risks.

5. The development of such a performance based packaging and the integration into the UN Recommendations on the Transport of Dangerous Goods is a good mid-term approach, but it probably needs time to develop and agree on, because of the individual characteristics of the different lithium cells and lithium batteries (e.g. chemistry, size, weight, watt hour rating etc.). The packaging performance and the applicable packaging characteristics (e.g. verification of the packaging criteria, means of identification, gas management etc.) shall be exactly discussed and determined. This might not be a reachable goal in this biennium. A first attempt to show such a solution will be made in a further INF-Paper to be discussed at the Sub-Committee.
6. However there is an urgent and increasing need for different branches of industry (packaging industry, cell and battery manufacturer as well as E-bike and car manufacturer, etc.) to have a solution to deal with those batteries on a larger scale. There will be an increasing cell and battery diversity and quantity on the market in many different countries and therefore an increasing number of as damaged/defective diagnosed lithium batteries that have to be dealt with. This should no more happen on a one battery, one engineer, one packaging, one approval and one transport solution, but on the basis e.g. of general written packaging instruction in the regulation.
7. On the basis of several current approvals given by competent authorities, the technical discussion at the 3rd Informal Working Group Lithium Batteries and Manual of Tests and Criteria Meeting at Bordeaux, the comments received by the ECOSOC Sub-Committee of Experts on the Transport of Dangerous Goods (TDG) last December and from authorities, associations and industry as well as to promote the current discussion to achieve a performance based packaging as transport solution within this biennium, Recharge and OICA propose the following “one step” proposal for the transport of such damaged/defective batteries (B) without competent authority approval according to a revised SP376 and the introduction of a new P9XX and LP9XX.
8. Recharge and OICA propose following technical details, e.g.:
  - (a) The use of a PG I performance level packaging because on the basis of most of the current competent authority approvals,
  - (b) That the outside surface temperature of the completed package shall not have a temperature of more than 100°C, as already known from packing instruction P500 (UN3365, Oxygen Generator),
  - (c) That a momentary spike in temperature up to 200°C shall be acceptable, as already known from UN Recommendations on the Transport of Dangerous Goods sub-section 2.1.3.6.4 (a) for Class 1 articles,
  - (d) That the packaging shall meet the criteria “no hazardous flame outside”, “no hazardous ejection fragments” and “no damage of the packaging” based on the current discussions on performance based packaging (e.g. at ICAO T.I./SAE Technical Standard G-27 Committee), since this is seen as a further safe step towards a performance based packaging (bearing in mind that any other innovative solutions and packaging that cannot confirm will still have the option of obtaining a competent authority approval),
  - (e) That some kind of gas management is necessary according to the current competent authority approvals and as specified in section 5.5.2 of the UN Recommendations on the Transport of Dangerous Goods (special provisions applicable to fumigated cargo transport units (UN 3359)),

- (f) That the packaging performance can be verified by a physical test or by a theoretical calculation based on all material properties and the worst failure modes, according to the admission of the packagings which are applicable by the current competent authority approvals,
- (g) That the transport document shall include a reference to the used packaging instruction, comparable to the revised Special Provision 310 and to several current competent authority approvals, which also include this requirement,
- (h) That in case of dry ice or liquid nitrogen usage as a coolant, the requirements as specified in section 5.5.3 of the UN Recommendations on the Transport of Dangerous Goods shall apply and the inner packaging and outer packaging shall maintain their integrity at the temperature of the refrigerant used as well as the temperatures and the pressures which could result if refrigeration were lost. These requirements are already known from packing instruction P650 (9) for UN3373 (Biological Substance, Category B).

## Proposal

9. Recharge and OICA propose the revision of SP376 and the introduction of the new P9XX and LP9XX for the transport of damaged/defective lithium batteries possibly reactive under normal transport conditions (B) without a competent authority approval as follows (changes underlined):

*“Lithium ion cells or batteries and lithium metal cells or batteries identified as being damaged or defective such that they do not conform to the type tested according to the applicable provisions of the Manual of Tests and Criteria shall comply with the requirements of this special provision.*

*For the purposes of this special provision, these may include, but are not limited to:*

- *Cells or batteries identified as being defective for safety reasons;*
- *Cells or batteries that have leaked or vented;*
- *Cells or batteries that cannot be diagnosed prior to transport; or*
- *Cells or batteries that have sustained physical or mechanical damage.*

**NOTE:** *In assessing a battery as damaged or defective, the type of battery and its previous use and misuse shall be taken into account.*

*Cells and batteries shall be transported according to the provisions applicable to UN 3090, UN 3091, UN 3480 and UN 3481, except Special Provision 230 and as otherwise stated in this special provision.*

*Cells and batteries shall be packed in accordance with packing instructions P908 of 4.1.4.1 or LP904 of 4.1.4.3, as applicable.*

*Cells and batteries liable to rapidly disassemble, dangerously react, produce a flame or a dangerous evolution of heat or a dangerous emission of toxic, corrosive or flammable gases or vapours under normal conditions of transport shall be transported in accordance with packing instructions P9XX of 4.1.4.1 or LP9XX of 4.1.4.3 or under conditions specified by the competent authority, as applicable.*

*Packages shall be marked “DAMAGED/DEFECTIVE LITHIUM ION BATTERIES” OR “DAMAGED/DEFECTIVE LITHIUM METAL BATTERIES”, as applicable.*

<u>P9XX</u>	<u>PACKING INSTRUCTION</u>	<u>P9XX</u>
<p><u>This instruction applies to damaged or defective lithium ion cells and batteries and damaged or defective lithium metal cells and batteries, including those contained in equipment, of UN Nos. 3090, 3091, 3480 and 3481.</u></p>		
<p>(1) <u>The packaging shall conform to the packaging group I performance level and meet the following criteria:</u></p> <p>a) <u>The outside surface temperature of the completed package shall not have a temperature of more than 100°C. A momentary spike in temperature up to 200°C is acceptable.</u></p> <p>b) <u>No hazardous flame outside.</u></p> <p>c) <u>No hazardous ejection fragments.</u></p> <p>d) <u>No damage of the packaging.</u></p> <p>e) <u>Gas management (e.g. filter system, air circulation, containment for gas etc.), and</u></p>		
<p>(2) <u>The quality of the packaging is verified by one of the following methods:</u></p> <p>(a) <u>The packaging performance shall be demonstrated by a test or by a calculation corresponding to the maximum mass and energy of the cell/battery type as defined in the UN Manual of Tests and Criteria paragraph 38.3.2.2 in the condition of transport.</u></p> <p>(b) <u>The calculation has to run on a verified model. The test and calculation should be done under a quality management system (as described e.g.in section 2.9.4 (e)).</u></p>		
<p>(3) <u>The test/verification report/result shall be available on request. As a minimum requirement, the cell and battery name, the cell and battery number, the weight, type, energy content of the cells and batteries and the packaging identification shall be listed.</u></p>		
<p>(4) <u>The transport document according to chapter 5. 4 shall include the following statement: "Transport in accordance with P9XX".</u></p>		
<p>(5) <u>When dry ice or liquid nitrogen is used as a coolant, the requirements of section 5.5.3 shall apply. The inner packaging and outer packaging shall maintain their integrity at the temperature of the refrigerant used as well as the temperatures and the pressures which could result if refrigeration were lost.</u></p>		
<p><u><b>Additional requirements:</b></u></p> <p><u>Batteries shall be protected against short circuit.</u></p> <p><u>Protection against short circuits includes, but is not limited to:</u></p> <ul style="list-style-type: none"> <li>- <u>individual protection of the battery terminals.</u></li> <li>- <u>inner packaging to prevent contact between cells and batteries.</u></li> <li>- <u>batteries with recessed terminals designed to protect against short circuits, or</u></li> <li>- <u>the use of a non-conductive and non-combustible cushioning material to fill empty space between the cells or batteries in the packaging.</u></li> </ul>		

<u>LP9XX</u>	<u>PACKING INSTRUCTION</u>	<u>LP9XX</u>
<u>This instruction applies to damaged or defective lithium ion cells and batteries and damaged or defective lithium metal cells and batteries, including those contained in equipment, of UN Nos. 3090, 3091, 3480 and 3481.</u>		
<p>(1) <u>The packaging shall conform to the packaging group I performance level and meet the following criteria:</u></p> <p>a) <u>The outside surface temperature of the completed package shall not have a temperature of more than 100°C. A momentary spike in temperature up to 200°C is acceptable.</u></p> <p>b) <u>No hazardous flame outside.</u></p> <p>c) <u>No hazardous ejection fragments.</u></p> <p>d) <u>No damage of the packaging.</u></p> <p>e) <u>Gas management (e.g. filter system, air circulation, containment for gas etc.), and</u></p>		
<p>(2) <u>The quality of the packaging is verified by one of the following methods:</u></p> <p>(a) <u>The packaging performance shall be demonstrated by a test or by a calculation corresponding to the maximum mass and energy of the cell/battery type as defined in the UN Manual of Tests and Criteria paragraph 38.3.2.2 in the condition of transport.</u></p> <p>(b) <u>The calculation has to run on a verified model. The test and calculation should be done under a quality management system (as described e.g.in section 2.9.4 (e)).</u></p>		
<p>(3) <u>The test/verification report/result shall be available on request. As a minimum requirement, the cell and battery name, the cell and battery number, the weight, type, energy content of the cells and batteries and the packaging identification shall be listed.</u></p>		
<p>(4) <u>The transport document according to chapter 5. 4 shall include the following statement: "Transport in accordance with LP9XX".</u></p>		
<p>(5) <u>When dry ice or liquid nitrogen is used as a coolant, the requirements of section 5.5.3 shall apply. The inner packaging and outer packaging shall maintain their integrity at the temperature of the refrigerant used as well as the temperatures and the pressures which could result if refrigeration were lost.</u></p>		
<p><u>Additional requirements:</u></p> <p><u>Batteries shall be protected against short circuit.</u></p> <p><u>Protection against short circuits includes, but is not limited to:</u></p> <ul style="list-style-type: none"> <li>- <u>individual protection of the battery terminals.</u></li> <li>- <u>inner packaging to prevent contact between cells and batteries.</u></li> <li>- <u>batteries with recessed terminals designed to protect against short circuits, or</u></li> <li>- <u>the use of a non-conductive and non-combustible cushioning material to fill empty space between the cells or batteries in the packaging.</u></li> </ul>		

## Conclusion

Recharge and OICA propose the above changes of SP376 and the introduction of a new P9XX and LP9XX for consideration by the ECOSOC Sub-Committee of Experts on the Transport of Dangerous Goods (TDG) as a practical high safety transport solution and as an intermediate step to define and determine performance based packaging criteria for damaged/defective lithium batteries.