

## 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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### Sub-Committee of Experts on the Transport of Dangerous Goods

#### Forty-eighth session

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Item 3 of the provisional agenda

#### Listing, classification and packing

## Classification procedures related to sodium-ion batteries

### Transmitted by the expert from the United Kingdom

#### Introduction

1. This informal document invites comments on how the Model Regulations should address the carriage requirements for advanced low cost battery materials based on sodium-ion technology.
2. The current classification system does not address the particular circumstances of sodium-ion batteries. The existing entry for batteries containing sodium (UN3292) and Special Provision 239 are relevant to cell chemistries such as sodium sulphur and sodium metal chloride which contain metallic sodium, but do not recognise the lesser risk posed by sodium-ion cell chemistry. This raises the question as to how they should be classified.

#### Background

3. Sodium-ion technology has the potential to be a low cost alternative to and a direct replacement for established lithium-ion battery cells. Sodium-ion technology offers comparable energy density and performance to lithium-ion.
4. The sodium salts used to prepare sodium-ion batteries are highly abundant in the earth's crust; approximately 2.6% for sodium and 0.005% for lithium. Sodium salts generally come from sodium chloride which can be extracted relatively cheaply from seawater.
5. The key operational difference between sodium-ion and lithium technology is that sodium-ion technology can be discharged to 0 volts, without affecting the performance of the cell.
6. Batteries using sodium-ion technology can therefore be stored and transported in a completely discharged state, with terminals shorted if required. In this state they pose no risk from stored electro-chemical energy.
7. Sodium-ion is also intrinsically safer than lithium-ion technology because there is:
  - (a) A more stable solid electrolyte interface (SEI) layer.

This is a layer formed on the negative electrode in both lithium-ion and Sodium-ion cells during the first charge (which is performed by the cell manufacturer). The SEI layer provides a stable interface between the negative electrode and the electrolyte. If this breaks down, an exothermic reaction can occur, so a more stable SEI layer found in sodium-ion cells means a safer battery.

- (b) A reduced level of labile oxygen.

Labile oxygen is oxygen from the cathode which is easily released. As oxygen is an oxidant and flammable if released near the electrolyte solvent, the lower the oxygen lability the better.

- (c) A lower volatility electrolyte.

This means the battery is less likely to catch fire.

- (d) Reduced self-heating.

Safety testing data on sodium-ion cells, using accelerating rate calorimetry, shows that they have greater thermal stability and a lower rate of energy release than equivalent lithium-ion cells currently on the market (i.e. lithium cobalt oxide and lithium iron phosphate). They are consequently less likely to enter thermal runaway when exposed to extreme temperatures.

8. Despite some consumer markets requiring batteries to be transported containing charge so they can be used immediately, there will be significant segments where the supply of a battery in an uncharged state will be perfectly acceptable. Batteries for the important market of energy storage can be supplied uncharged and batteries for other markets can be charged by a local agent if required.

9. The increased conductivity of sodium-ion electrolytes, which allows the use of lower concentrations of electrolyte salts, contributes to reducing the cost. Furthermore, lithium-ion cells need to use copper foil current collectors, which are both heavy and expensive. In sodium-ion cells, this can be replaced with aluminium foil, which is lighter and less expensive.

10. The significant cost reduction may accelerate the take up of applications that are currently too expensive to market widely, such as stationary energy storage and electric vehicles.

11. The current classification system does not address the particular circumstances of sodium-ion batteries. The existing entry for batteries containing sodium (UN3292) and Special Provision 239 are relevant to cell chemistries such as sodium sulphur and sodium metal chloride which contain metallic sodium, but do not recognise the lesser risk posed by sodium-ion cell chemistry. This situation is akin to that of lithium batteries (UN 3090) prior to the sub-committee's decision to recognise lithium-ion cells and batteries as being substantially different from lithium metal types. Like their lithium counterparts, sodium-ion cells contain sodium salts, NOT sodium metal.

## Proposal

12. The Sub-Committee is invited to consider the information presented in this paper and offer opinions on how sodium-ion batteries could be classified for carriage. For example, would requirements similar to those for asymmetric capacitors (UN 3508) be appropriate?

13. If the Sub-Committee is interested in pursuing this work, the United Kingdom would be willing to develop a formal paper containing detailed proposals for consideration at a future session.

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