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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**

**Sixty-third session**
Geneva, 27 November-6 December 2023
Item 4 (c) of the provisional agenda
**Electric storage systems:**
**Transport provisions**

# Transport provisions for hybrid batteries with both lithium-ion and sodium-ion cells

**Submitted by the expert from China***

## I. Introduction

1. Hybrid batteries with both lithium-ion and sodium-ion cells (hereinafter referred to as hybrid Li-Na batteries) are a new type of battery product, composed of lithium ion cells and sodium ion cells connected in series. By combining the advantages of the high energy density of lithium ion batteries and the adaptability to low-temperature environments of sodium ion batteries, they are expected to be widely used in the automobile and energy storage industries.

2. At the sixty-second session of Sub-Committee, experts from China submitted informal document INF.33 to address transport provisions for these hybrid Li-Na batteries. Considering that the energy density of such batteries is between that of lithium ion and sodium ion ones, as well as the inability to fully discharge, it is proposed to transport the hybrid Li-Na battery according to the testing procedures and other provisions for lithium ion batteries.

3. Most experts who spoke supported the intention of that document and kindly provided their comments for improvement. With this feedback, the experts from China have prepared this modified document for the Sub-Committee's consideration.

4. Experts reminded at the last session that the lithium ion cells and sodium ion cells used in the hybrid Li-Na batteries should be tested in accordance with their respective procedures specified in 38.3 of the *Manual of Tests and Criteria*. Actually, informal document INF.33 (sixty-second session) stated that "component cells of the battery shall be of a type proved to meet the respective testing requirements of the *Manual of Tests and Criteria*, part III, sub-section 38.3". In this new document, we adjusted the wording slightly to emphasize this issue (see paragraph 10 in proposal 1 below).

5. In addition, it was suggested to clarify in the proposed special provision (SP) XXX how such hybrid Li-Na batteries can be regarded as meeting the requirements of SP 188, as

* A/77/6 (Sect. 20), table 20.6

in SP 387. Currently, the prerequisite for transporting either a lithium ion or sodium ion battery in accordance with SP 188 is that the battery should have a watt-hour rating of not more than 100 Wh and have the watt-hour rating marked on its outer case. Thus, the experts from China believe the same requirement should be applied to the hybrid Li-Na battery (see paragraph 12 in proposal 1 below).

6. Furthermore, due to the addition of a new paragraph (h) in 2.9.4, all provisions that list specific paragraphs in 2.9.4 also need amendments, including SP 188 (c), the first paragraph of SP 310, SP 363 (f), the ninth paragraph of SP 388 and the first paragraph of SP 389.

7. Meanwhile, it was suggested that a more comprehensive consideration should be given to assess the impact of the proposed amendments on the entire *Model Regulations*, including the need to clarify the transport provisions for hybrid Li-Na battery-powered vehicles and energy storage systems. If the Sub-Committee agrees with the principle of proposal 1 to transport such hybrid Li-Na batteries as lithium ion ones, then vehicles powered by such batteries should be classified as UN 3556 VEHICLE, LITHIUM ION BATTERY POWERED (see proposal 2 below). Similarly, hybrid Li-Na battery energy storage systems should be assigned to entry UN 3536 LITHIUM BATTERIES INSTALLED IN CARGO TRANSPORT UNIT (see proposal 3 below). Besides, paragraphs in SP 388 addressing hybrid electric vehicles transported with batteries installed should also be amended to include hybrid Li-Na batteries, as well as sodium ion batteries (see proposal 4 below).

8. Finally, some experts recommended to introduce a new UN number, considering that such hybrid Li-Na battery consists of two types of cells which should be classified as different UN numbers when transported separately. On one hand, there has already been a precedent in the *Model Regulations* that batteries containing both lithium metal cells which are classified as UN 3090 and lithium ion cells which are classified as UN 3480 should be transported under the entry UN 3090 (see 2.9.4 (f) and SP 387). On the other hand, we have not yet found the necessity to differentiate transport requirements for the hybrid Li-Na batteries from those for lithium ion batteries. If we choose to introduce new entries, four entries will be needed at least (battery itself, battery contained in or packed with equipment, battery-powered vehicle, and battery installed in cargo transport units (CTUs). The experts from China believe that the ideal approach in this situation should be to utilize the existing UN numbers to the utmost and insist on the preference on transporting the hybrid Li-Na battery according to the testing procedures and other provisions for lithium ion batteries, as proposed in informal document INF.33 (sixty-second session).

# II. Proposals

## A. Proposal 1

9. The experts from China suggest that hybrid Li-Na batteries should be transported in accordance with provisions for lithium ion batteries. Thus, we propose:

10. To add in 2.9.4 of the *Model Regulations* a new 2.9.4 (h) as follows:

> "(h) Hybrid batteries, containing both lithium ion cells and sodium ion cells (see special provision XXX of chapter 3.3), shall meet the following conditions:
>
> (i) The lithium ion cells and sodium ion cells are electrically connected;
>
> (ii) The battery has been tested as a lithium ion battery;
>
> (iii) Each component lithium ion and sodium ion cell of the battery shall be of a type proved to meet the respective testing requirements of the *Manual of Tests and Criteria*, part III, sub-section 38.3."

11. To add a new special provision XXX to UN Nos. 3480, 3481, 3551 and 3552 in the dangerous goods list (chapter 3.2 of the *Model Regulations*):

| UN No. | Name and description | Class or division | Subsidiary hazard | UN packing group | Special provisions |
|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) |
| 3480 | LITHIUM ION BATTERIES (including lithium ion polymer batteries) | 9 | | | 188<br>230<br>310<br>348<br>376<br>377<br>384<br>387<br>**XXX** |
| 3481 | LITHIUM ION BATTERIES CONTAINED IN EQUIPMENT or LITHIUM ION BATTERIES PACKED WITH EQUIPMENT (including lithium ion polymer batteries) | 9 | | | 188<br>230<br>310<br>348<br>360<br>376<br>377<br>384<br>387<br>390<br>**XXX** |
| 3551 | SODIUM ION BATTERIES with organic electrolyte | 9 | | | 188<br>230<br>310<br>348<br>376<br>377<br>384<br>400<br>401<br>**XXX** |
| 3552 | SODIUM ION BATTERIES CONTAINED IN EQUIPMENT or SODIUM ION BATTERIES PACKED WITH EQUIPMENT, with organic electrolyte | 9 | | | 188<br>230<br>310<br>348<br>360<br>376<br>377<br>384<br>400<br>401<br>**XXX** |

12. To add a new special provision XXX to chapter 3.3 of the *Model Regulations*:

"XXX Hybrid batteries in conformity with 2.9.4 (h) containing both lithium ion cells and sodium ion cells shall be assigned to UN Nos. 3480 or 3481, as appropriate. When such batteries are transported in accordance with special provision 188, the watt-hour rating of each battery shall be not more than 100 Wh and shall be marked on the outside case."

13. In addition, due to the amendments proposed in paragraph 10, some relevant paragraphs need to be amended accordingly, including SP 188 (c), the first paragraph of SP 310, SP 363 (f), the ninth paragraph of SP 388 and the first paragraph of SP 389. The proposed amendments are as follows (deleted text appears in ~~strikethrough~~ and new text in **bold underlined**):

14. Amend SP 188 (c) to read:

"Each lithium cell or battery meets the provisions of 2.9.4 (a), (e), (f) if applicable**,** ~~and~~ (g) **and (h) if applicable** or for sodium ion cells or batteries, the provisions of 2.9.5 (a), (e) and (f) shall apply;"

15. Amend the first paragraph of SP 310 to read:

"Cells or batteries from production runs of not more than 100 cells or batteries, or pre-production prototypes of cells or batteries when these prototypes are transported for

testing, shall meet the provisions of 2.9.4 with the exception of 2.9.4 (a), (e) (vii), (f) (iii) if applicable, (f) (iv) if applicable**,** ~~and~~ (g)**, (h) (ii) if applicable and (h) (iii) if applicable**."

16. Amend SP 363 (f) to read:

"Engines or machinery may contain other dangerous goods than fuels (e.g. batteries, fire extinguishers, compressed gas accumulators or safety devices) required for their functioning or safe operation without being subject to any additional requirements for these other dangerous goods, unless otherwise specified in these Regulations. However, lithium batteries shall meet the provisions of 2.9.4, except that 2.9.4 (a), ~~e~~ (vii), (f) (iii) if applicable, (f) (iv) if applicable**,** ~~and~~ (g)**, (h) (ii) if applicable and (h) (iii) if applicable** do not apply when batteries of a production run of not more than 100 cells or batteries, or pre-production prototypes of cells or batteries when these prototypes are transported for testing, are installed in machinery or engines. Furthermore, sodium ion batteries shall meet the provisions of 2.9.5, except that 2.9.5 (a), (e) and (f) do not apply when batteries of a production run of not more than 100 cells or batteries, or pre-production prototypes of cells or batteries when these prototypes are transported for testing, are installed in machinery or engines.

Where a lithium battery installed in a machinery or an engine is damaged or defective, the machinery or engine shall be transported as defined by the competent authority."

17. Amend the ninth paragraph of SP 388 to read:

"Dangerous goods, such as batteries, airbags, fire extinguishers, compressed gas accumulators, safety devices and other integral components of the vehicle that are necessary for the operation of the vehicle or for the safety of its operator or passengers, shall be securely installed in the vehicle and are not otherwise subject to these Regulations. However, lithium batteries shall meet the provisions of 2.9.4, except that 2.9.4 (a), (e) (vii), (f) (iii) if applicable, (f) (iv) if applicable**,** ~~and~~ (g)**, (h) (ii) if applicable and (h) (iii) if applicable** do not apply when batteries of a production run of not more than 100 cells or batteries, or pre-production prototypes of cells or batteries when these prototypes are transported for testing, are installed in vehicles. Furthermore, sodium ion batteries shall meet the provisions of 2.9.5, except that 2.9.5 (a), (e) and (f) do not apply when batteries of a production run of not more than 100 cells or batteries, or pre-production prototypes of cells or batteries when these prototypes are transported for testing, are installed in machinery or engines."

18. Amend the first paragraph of SP 389 to read:

"This entry only applies to lithium ion batteries or lithium metal batteries installed in a cargo transport unit and designed only to provide power external to the cargo transport unit. The lithium batteries shall meet the requirements of 2.9.4 (a) to ~~(g)~~**(h)** and contain the necessary systems to prevent overcharge and over discharge between the batteries."

## B. Proposal 2

19. If the Sub-Committee agrees that the transport of vehicles powered by the hybrid Li-Na batteries should follow provisions for those powered by lithium-ion batteries (UN 3556), the experts from China would then propose to amend SP 360 and SP 388 as follows (deleted text appears in ~~strikethrough~~ and new text in **bold underlined**):

20. Add a new second sentence to SP 360 to read:

"Vehicles only powered by lithium metal, lithium ion or sodium ion batteries shall be assigned to the entries UN 3556 VEHICLE, LITHIUM ION BATTERY POWERED or UN 3557 VEHICLE, LITHIUM METAL BATTERY POWERED or UN 3558 VEHICLE, SODIUM ION BATTERY POWERED, as applicable. **Vehicles only powered by hybrid batteries containing both lithium ion cells and sodium ion cells shall be assigned to the entry UN 3556 VEHICLE, LITHIUM ION BATTERY POWERED.** Lithium batteries installed in cargo transport units,

designed only to provide power external to the transport unit shall be assigned to entry UN 3536 LITHIUM BATTERIES INSTALLED IN CARGO TRANSPORT UNIT."

21. Amend the sixth paragraph of SP 388 to read:

"UN 3556 VEHICLE, LITHIUM ION BATTERY POWERED, UN 3557 VEHICLE, LITHIUM METAL BATTERY POWERED and UN 3558 VEHICLE, SODIUM ION BATTERY POWERED, as applicable, apply to vehicles powered by lithium ion, lithium metal or sodium ion batteries transported with the batteries installed. **Vehicles only powered by hybrid batteries containing both lithium ion cells and sodium ion cells shall be assigned to the entry UN 3556 VEHICLE, LITHIUM ION BATTERY POWERED**."

## C. Proposal 3

22. Similarly, in the case that the Sub-Committee agrees to transport hybrid Li-Na battery energy storage systems under the entry UN 3536 LITHIUM BATTERIES INSTALLED IN CARGO TRANSPORT UNIT, the experts from China then propose to amend SP 360 and SP 389 as follows (deleted text appears in ~~strikethrough~~ and new text in **bold underlined;** those amendments already mentioned in proposals 1 and 2 are not highlighted again):

23. Amend SP 360 to read:

"360 Vehicles only powered by lithium metal, lithium ion or sodium ion batteries shall be assigned to the entries UN 3556 VEHICLE, LITHIUM ION BATTERY POWERED or UN 3557 VEHICLE, LITHIUM METAL BATTERY POWERED or UN 3558 VEHICLE, SODIUM ION BATTERY POWERED, as applicable. Vehicles only powered by hybrid batteries containing both lithium ion cells and sodium ion cells shall be assigned to the entry UN 3556 VEHICLE, LITHIUM ION BATTERY POWERED. Lithium batteries **or hybrid batteries containing both lithium ion cells and sodium ion cells** installed in cargo transport units, designed only to provide power external to the transport unit shall be assigned to entry UN 3536 LITHIUM BATTERIES INSTALLED IN CARGO TRANSPORT UNIT."

24. Amend the first paragraph of SP 389 to read:

"389 This entry only applies to lithium ion batteries ~~or~~**,** lithium metal batteries **or hybrid batteries containing both lithium ion cells and sodium ion cells** installed in a cargo transport unit and designed only to provide power external to the cargo transport unit. The lithium batteries shall meet the requirements of 2.9.4 (a) to (h) and contain the necessary systems to prevent overcharge and over discharge between the batteries."

## D. Proposal 4

25. The second and third paragraphs of SP 388 are proposed to be amended to include hybrid Li-Na batteries, as well as sodium ion batteries, as follows (deleted text appears in ~~strikethrough~~ and new text in **bold underlined**):

"Vehicles powered by a fuel cell engine shall be assigned to the entries UN 3166 VEHICLE, FUEL CELL, FLAMMABLE GAS POWERED or UN 3166 VEHICLE, FUEL CELL, FLAMMABLE LIQUID POWERED, as appropriate. These entries include hybrid electric vehicles powered by both a fuel cell and an internal combustion engine with wet batteries, **metallic** sodium batteries**, sodium alloy batteries**, lithium metal batteries ~~or~~**,** lithium ion batteries**, hybrid batteries containing both lithium ion cells and sodium ion cells or sodium ion batteries**, transported with the battery(ies) installed.

Other vehicles which contain an internal combustion engine shall be assigned to the entries UN 3166 VEHICLE, FLAMMABLE GAS POWERED or UN 3166 VEHICLE, FLAMMABLE LIQUID POWERED, as appropriate. These entries include hybrid electric vehicles powered by both an internal combustion engine and

wet batteries, **metallic** sodium batteries**, sodium alloy batteries**, lithium metal batteries ~~or,~~ lithium ion batteries**, hybrid batteries containing both lithium ion cells and sodium ion cells or sodium ion batteries**, transported with the battery(ies) installed."

# III. Sustainable Development Goals

26. The hybrid Li-Na battery is a burgeoning battery product which combines the advantages of both lithium ion and sodium ion batteries. It is expected to have widespread applications in energy storage systems and automobiles. Its strong energy storage capacity and wide range of operating temperatures will help achieve the temporal and spatial transfer of electricity, allowing remote areas without the conditions to establish power plants and relevant infrastructures to equally have access to electricity. Clarifying transport provisions for these batteries would contribute to sustainable development goal (SDG) 7 "*affordable and clean energy*", to be specific, to target 7.1 "*Ensure access to affordable, reliable, sustainable and modern energy for all*" and target 7.b "*By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small-island developing States, and land-locked developing countries, in accordance with their respective programmes of support*".