

**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

13 June 2024

Sixty-fourth session

Geneva, 24 June-3 July 2024

Item 4 (b) of the provisional agenda

Electric storage systems:

Hazard-based system for classification
of lithium batteries

**New identification system – lithium cells and batteries –
packing instructions**

Transmitted by the expert from the United Kingdom

I. Introduction.

1. Within informal document INF.27 the expert from the United Kingdom makes proposals for additions to the Dangerous Goods List and new special provisions. This document provides text for new packaging instructions. Existing packing instructions are amended within the document on consequential amendments, informal document INF.29

II. Packaging instructions

2. The following packing instructions have been written following the concepts that are common throughout the UN packaging system. Essentially, the hazard is identified and the packaging is then designed to mitigate the hazard such that it is contained within the packaging and as such the risk to the means of transport is mitigated.

3. For lithium cells, batteries and articles containing lithium cells and batteries the hazard based classification system results in 4 basic divisions:

- Non- propagating with a low temperature profile (P940/LP940)
- Non-propagating with a high temperature profile (P941/LP941)
- Propagating without flames (P942/LP942)
- Propagation with flames (P943/LP943)

4. There are no separate packing instructions for damaged/defective cells, batteries or articles since the damaged items hazard cannot be any more severe than the original fully charged test and as such the appropriate hazard and therefore protection level has already been determined.

III. Proposals

5. The following new packing instructions are suggested for addition to the *Model Regulations*:

| P940 | PACKING INSTRUCTION | P940 |
|---|---------------------|------|
| This instruction applies to UN Numbers:(Lithium ion and metal cells in divisions G and H) and (Articles containing Lithium Ion or Metal cells in divisions G and H) | | |

The following packages are authorised, provided that the general provisions of 4.1.1 and 4.1.3 are met:

Drums (1A2, 1B2, 1N2, 1H2, 1D 1G);
Boxes (4A, 4B, 4C1, 4C2, 4D, 4F, 4G, 4H1, 4H2, 4N)
Jerricans (3A2, 3B2, 3H2).

Packaging shall meet the packing group II performance level

Additional requirements:

Cells shall be protected from short circuiting with each other and any electrically conductive materials

Articles shall be prepared or packed so that accidental operation is not possible

| P941 | PACKING INSTRUCTION | P941 |
|---|---------------------|------|
| This instruction applies to UN Numbers:(Lithium ion and metal cells in divisions E and F) and (Articles containing Lithium Ion or Metal cells in divisions E and F) | | |
| The following packages are authorised, provided that the general provisions of 4.1.1 and 4.1.3 are met: | | |
| Drums (1A2, 1B2, 1N2, 1H2, 1D 1G); Boxes (4A, 4B, 4C1, 4C2, 4D, 4F, 4G, 4H1, 4H2, 4N) Jerricans (3A2, 3B2, 3H2). | | |
| Packaging shall meet the packing group II performance level | | |
| Inner packagings and arrangements | | |
| Cells and articles shall be separated from each other using electrically non-conductive materials (e.g. individually wrapped or packaged, using layer pads and dividers or trays) | | |
| Additional requirements: | | |
| Articles shall be prepared or packed so that accidental operation is not possible | | |

| P942 | PACKING INSTRUCTION | P942 |
|---|---------------------|------|
| This instruction applies to UN Numbers:(Lithium ion cells, lithium metal cells, lithium ion batteries and lithium metal batteries and articles containing lithium ion cells, lithium metal cells or batteries in divisions C and D) | | |
| The following packages are authorised, provided that the general provisions of 4.1.1 and 4.1.3 are met: | | |
| Drums (1A2, 1B2, 1N2, 1H2, 1D 1G); Boxes (4A, 4B, 4C1, 4C2, 4D, 4F, 4G, 4H1, 4H2, 4N); Jerricans (3A2, 3B2, 3H2). | | |
| Packagings shall meet the packing group II performance level. | | |
| (1) Inner packagings or arrangements to separate each cell, small battery or article | | |
| Layer pads and dividers; | | |
| Trays with dividers or recesses; | | |
| Rigid inner packagings of fibreboard, plastics, wood, glass or metal (electrically non-conductive or with non-conductive barrier), with inner dividers when used for multiple items; | | |
| Individual items packed in flexible inner packagings of plastics and paper (bags and complete wraps) | | |
| (2) Inner packagings and arrangements for batteries | | |
| Batteries (including battery modules) with a gross mass not exceeding 1 kg shall meet the packaging requirements for cells. | | |
| Batteries with a gross mass exceeding 1 kg shall be separated from other batteries in the packaging. | | |

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| <p>(3) Fully encased batteries (and battery modules) or articles in excess of 100 kg gross mass Providing that in the event of an internal short circuit the surface temperature of the battery casing or article does not exceed 200°C the battery or article may be transported unpackaged in dedicated handling devices, on pallets, in crates or other untested packagings or in vehicles or containers. In such transport batteries or articles may be arranged in layers providing that the battery or article is not bearing any of the stacking load and the batteries or articles are not in direct contact with each other.</p> |
| <p>Additional requirement:</p> <p>(1) Packagings must be capable of withstanding a thermal runaway event in any cell or cell in a battery or in an article such that the surface temperature of the external surface of the outer packaging does not exceed 100 °C and no flames exit the packaging. Cells shall be protected from short circuiting with each other and any electrically conductive materials</p> <p>Articles shall be prepared or packed so that accidental operation is not possible</p> |

| P943 | PACKING INSTRUCTION | P943 |
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| <p>This instruction applies to UN Numbers:(Lithium ion cells, lithium metal cells, lithium ion batteries, and lithium metal batteries in divisions A and B)</p> | | |
| <p>The following outer packagings of combination packagings are authorised, provided that the general provisions of 4.1.1 and 4.1.3 are met:</p> <p>Outer packaging Drums (1A2, 1B2, 1N2, 1H2, 1D 1G); Boxes (4A, 4B, 4C1, 4C2, 4D, 4F, 4G, 4H1, 4H2, 4N); Jerricans (3A2, 3B2, 3H2). Packagings shall meet the packing group II performance level.</p> <p>Inner packagings and arrangements Layer pads and dividers separating each item; Trays with dividers or recesses separating each item; Rigid inner packagings of fibreboard, plastics wood, glass and metal, with inner dividers separating each cell; or Individual items packed in flexible inner packagings of, metal, plastics and paper (including complete wraps and bags),</p> | | |
| <p>Additional requirements:</p> <p>(1) Packagings shall be tested and shown to withstand a thermal runaway event of the maximum total Watt hour rating of all cells and batteries (at 100% SOC) that the packaging may contain. The test shall show that the surface temperature of the external surface of the outer packaging does not exceed 100 °C (a momentary spike to 200 °C is permitted) no flames or debris exit the packaging and the outer packaging retains its structural integrity. This test to be conducted under conditions specified by the Competent Authority responsible for issuing the UN approval mark for the packaging.</p> <p>(2) Cells and batteries shall be protected from internal short caused by contact with electrically conductive materials</p> <p>(3) Articles shall be prepared or packed so that accidental operation is not possible</p> | | |

| LP940 | PACKING INSTRUCTION | LP940 |
|---|---------------------|-------|
| <p>This instruction applies to UN Numbers:(Lithium ion and metal cells, lithium ion and metal batteries, and articles containing lithium cells or batteries in divisions G and H)</p> | | |
| <p>The following large packagings are authorised, provided that the general provisions of 4.1.1 and 4.1.3 are met:</p> <p>Steel (50A) Aluminium (50B) Natural wood (50C) Plywood (50D) Reconstituted wood (50F) Rigid Fibreboard (50G) Rigid plastics (50H)</p> | | |

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| Metal other than steel or aluminium (50N) |
| Packaging shall meet the packing group II performance level |
| Additional requirements: Cells shall be protected from short circuiting with each other and any electrically conductive materials Articles shall be prepared or packed so that accidental operation is not possible |

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| LP941 | PACKING INSTRUCTION | LP941 |
| This instruction applies to UN Numbers:(Lithium ion and metal cells in divisions E and F) and (Articles containing Lithium Ion or Metal cells in divisions E and F) | | |
| The following large packagings are authorised, provided that the general provisions of 4.1.1 and 4.1.3 are met: | | |
| Inner packagings and arrangements | Outer packagings | |
| Cells and articles shall be separated from each other using electrically non-conductive materials (e.g. individually wrapped or packaged, using layer pads and dividers or trays) | Steel (50A) Aluminium (50B) Natural wood (50C) Plywood (50D) Reconstituted wood (50F) Rigid Fibreboard (50G) Rigid plastics (50H) Metal other than steel or aluminium (50N) | |
| Packaging shall meet the packing group II performance level | | |
| Additional requirements: Articles shall be prepared or packed so that accidental operation is not possible | | |

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| LP942 | PACKING INSTRUCTION | LP942 |
| This instruction applies to UN Numbers:(Lithium ion and metal cells, lithium ion and metal batteries, and articles containing lithium cells or batteries in divisions G and H) | | |
| The following large packagings are authorised, provided that the general provisions of 4.1.1 and 4.1.3 are met: | | |
| Inner packagings and arrangements | Outer packagings | |
| (1) to separate each cell, small battery or article Layer pads and dividers; Trays with dividers or recesses; Rigid inner packagings of fibreboard, plastics, wood, glass or metal (electrically non-conductive or with non-conductive barrier), with inner dividers when used for multiple items; Individual items packed in flexible inner packagings of plastics and paper (bags and complete wraps) | Steel (50A) Aluminium (50B) Natural wood (50C) Plywood (50D) Reconstituted wood (50F) Rigid Fibreboard (50G) Rigid plastics (50H) Metal other than steel or aluminium (50N) | |
| (2) arrangements for batteries | | |

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| Batteries (including battery modules) with a gross mass not exceeding 1 kg shall meet the packaging requirements for cells. | |
| Batteries with a gross mass exceeding 1 kg shall be separated from other batteries in the packaging. | |
| Packaging shall meet the packing group II performance level | |
| Additional requirements: | |
| (1) Packagings must be capable of withstanding a thermal runaway event in any cell or cell in a battery or in an article such that the surface temperature of the external surface of the outer packaging does not exceed 100 °C and no flames exit the packaging. | |
| Cells shall be protected from short circuiting with each other and any electrically conductive materials | |
| Articles shall be prepared or packed so that accidental operation is not possible | |

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| LP943 | PACKING INSTRUCTION | LP943 |
| This instruction applies to UN Numbers:(Lithium ion and metal cells, lithium ion and metal batteries, and articles containing lithium cells or batteries in divisions G and H) | | |
| Packaging shall meet the packing group II performance level | | |
| Inner packagings and arrangements | | |
| Outer packagings | | |
| Layer pads and dividers separating each item; | Steel (50A) | |
| Trays with dividers or recesses separating each item; | Aluminium (50B) | |
| Rigid inner packagings of fibreboard, plastics wood, glass and metal, with inner dividers separating each cell; or | Natural wood (50C) | |
| Individual items packed in flexible inner packagings of, metal, plastics and paper (including complete wraps and bags), | Plywood (50D) | |
| | Reconstituted wood (50F) | |
| | Rigid Fibreboard (50G) | |
| | Rigid plastics (50H) | |
| | Metal other than steel or aluminium (50N) | |
| Packaging shall meet the packing group II performance level | | |
| Additional requirements: | | |
| (1) Packagings shall be tested and shown to withstand a thermal runaway event of the maximum total Watt hour rating of all cells and batteries (at 100% SOC) that the packaging may contain. The test shall show that the surface temperature of the external surface of the outer packaging does not exceed 100 °C (a momentary spike to 200 °C is permitted) no flames or debris exit the packaging and the outer packaging retains its structural integrity. This test to be conducted under conditions specified by the Competent Authority responsible for issuing the UN approval mark for the packaging. | | |
| (2) Cells and batteries shall be protected from internal short caused by contact with electrically conductive materials | | |
| Articles shall be prepared or packed so that accidental operation is not possible | | |