International Civil Aviation Organization

DGP-WG/22-WP/13
31/10/22

WORKING PAPER

DANGEROUS GOODS PANEL (DGP)
WORKING GROUP MEETING (DGP-WG/22)

Montréal, 21 to 25 November 2022

Agenda Item 1: Harmonizing ICAO dangerous goods provisions with UN Recommendations on the Transport of Dangerous Goods (REC-A-DGS-2025)
1.2: Develop proposals, if necessary, for amendments to the *Technical Instructions for the Safe Transport of Dangerous Goods by Air* (Doc 9284) for incorporation in the 2025-2026 Edition

DEVELOPMENT OF PROVISIONS FOR SODIUM ION BATTERIES

(Presented by The Rapporteur of the DGP-WG/UN Harmonisation)

SUMMARY

This working paper provides the changes provisionally adopted by the UN Subcommittee of Experts on the Transport of Dangerous Goods to incorporate provisions for Sodium ion batteries into the 23rd edition of the UN Model Regulations. The purpose of providing this consolidated content is to provide an opportunity for the DGP-WG to consider inclusion of these provisions into the 2025-2026 Edition of the Technical Instructions.

Action by the DGP-WG is in paragraph 2.

1. INTRODUCTION

1.1 The UN Subcommittee of Experts on the Transport of Dangerous Goods has over the last few years considered proposals to adopt detailed provisions for sodium ion batteries. This work concluded at the 59th session of the Subcommittee in December 2021 with adoption of provisions for sodium ion batteries that will be included in the 23rd revised edition of the UN Model Regulations.

1.2 While the UN Subcommittee will only formally ratify the changes for the 23rd edition of the Model Regulations at the 61st session in November / December and therefore working papers addressing harmonisation with the UN Model Regulations would normally only be submitted to DGP-WG/23 it was thought that given the extensive discussions that have taken place on the provisions for lithium batteries, that it may be appropriate for the DGP-WG to be presented with the detailed provisions for sodium ion batteries as they could appear in the Technical Instructions.

1.3 The appendix to this working paper sets out the provisions for sodium ion batteries. These are taken directly from the consolidated changes to the UN Model Regulations that will be subject to ratification by the Subcommittee.

1.4 Essentially, the Subcommittee has agreed that sodium ion batteries will be subject to the same provisions, including testing of cell and battery design types in accordance with subsection 38.3 of the UN *Manual of Tests and Criteria* as apply to lithium ion cells and batteries.

1.5 However, one significant difference for sodium ion batteries is that they can be shipped at zero state of charge. Consequently, the Subcommittee has adopted a new Special Provision 400 that identifies that the sodium ion cell or battery is short-circuited, such as by use of a busbar between terminals, then the cell or battery is not subject to other provisions of the Regulations. This applies also to sodium ion cells or batteries packed with or contained in equipment. The Model Regulations require that when the cell or battery is shipped in this configuration the package must still bear the [lithium] battery mark and the dangerous goods contained in the cells must be permitted to be shipped as limited quantity and the quantity of the dangerous goods in the cell must not exceed the limit for limited quantity for that dangerous goods, see SP AXXX in the appendix.

2. ACTION BY THE DGP-WG

2.1 The DGP-WG is invited to: The DGP-WG is invited to review the consolidated changes outlined for sodium ion batteries as shown in the appendix to this working paper. The consolidated changes are provided for the purposes of discussion for the DGP to consider:

2.1.1 The potential issues around adoption of the UN provisions for air transport. In particular the DGP-WG is invited to review the draft wording of Special Provision AXXX, in particular subparagraph f). The original UN wording has been modified to apply the appropriate paragraph references for the Technical Instructions. However, there are significant differences between limited quantity in the UN Model Regulations and in the Technical Instructions. There are many substances permitted as limited quantity in the Model Regulations where for air transport they are not. The limited quantity limits for surface transport apply to the inner packaging net quantity, whereas for air transport it is the net quantity per package;

2.1.2 Should there be revisions proposed to Table 8-1 to include sodium ion batteries the same as apply for lithium ion batteries? While the current development of sodium ion batteries is largely for fixed storage applications as the sodium ion batteries don’t have the necessary energy density to make their use in consumer electronics practical, that may change.

2.2 The DGP-WG is invited to engage with their industry between now and DGP-WG/23 to identify potential issues and challenges associated with adopting provisions for sodium ion batteries in air transport with the objective of being able to consider in detail the changes that will be proposed in the UN harmonisation working papers at DGP-WG/23.

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APPENDIX

PROPOSED AMENDMENT TO PART 2 OF THE TECHNICAL INSTRUCTIONS

Part 2

CLASSIFICATION OF DANGEROUS GOODS

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Chapter 9

CLASS 9 — MISCELLANEOUS DANGEROUS SUBSTANCES AND ARTICLES, INCLUDING ENVIRONMENTALLY HAZARDOUS SUBSTANCES

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9.2 ASSIGNMENT TO CLASS 9

The substances and articles of Class 9 are subdivided as shown in Table 2-16.

Table 2-16. Substances and articles of Class 9

UN number	*Name*	*Notes*
. . .		
Lithium batteries		
. . .		
Sodium ion batteries		
3551	**Sodium ion batteries** with organic electrolyte	See 9.4
3552	**Sodium ion batteries contained in equipment** with organic electrolyte	
3552	**Sodium ion batteries packed with equipment** with organic electrolyte	
Capacitors		
. . .		

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9.4 SODIUM ION BATTERIES

Cells and batteries, cells and batteries contained in equipment, or cells and batteries packed with equipment containing sodium ion, which are a rechargeable electrochemical system where the positive and negative electrode are both intercalation or insertion compounds, constructed with no metallic sodium (or sodium alloy) in either electrode and with an organic non aqueous compound as electrolyte, shall be assigned to UN Nos. 3551 or 3552 as appropriate.

Note.— Intercalated sodium exists in an ionic or quasi-atomic form in the lattice of the electrode material.

They may be transported under these entries if they meet the following provisions:

a) each cell or battery is of the type proved to meet the requirements of applicable tests of the UN *Manual of Tests and Criteria*, Part III, sub-section 38.3.

b) each cell and battery incorporates a safety venting device or is designed to preclude a violent rupture under conditions normally encountered during transport;

c) each cell and battery is equipped with an effective means of preventing external short circuits;

d) each battery containing cells or a series of cells connected in parallel is equipped with effective means as necessary to prevent dangerous reverse current flow (e.g., diodes, fuses, etc.);

e) cells and batteries must be manufactured under a quality management program as prescribed under 9.3 e) 1) to 9);

f) manufacturers and subsequent distributors of cells or batteries must make available the test summary as specified in the UN *Manual of Tests and Criteria*, Part III, sub-section 38.3, paragraph 38.3.5.

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Part 3

DANGEROUS GOODS LIST, SPECIAL PROVISIONS AND LIMITED AND EXCEPTED QUANTITIES

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Chapter 2

ARRANGEMENT OF THE DANGEROUS GOODS LIST (TABLE 3-1)

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Table 3-1. Dangerous Goods List

Name	*UN No.*	*Class or division*	*Subsidiary risk*	*Labels*	*State variations*	*Special provisions*	*UN packing group*	*Excepted quantity*	*Passenger aircraft*		*Cargo aircraft*	
									Packing instruction	*Max. net quantity per package*	*Packing instruction*	*Max. net quantity per package*
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*
Batteries, containing metallic sodium or sodium alloy †	3292	4.3		Danger if wet		A194 A183 AXXY		E0	FORBIDDEN		492	No limit
Cells, containing metallic sodium or sodium alloy †	3292	4.3		Danger if wet		A94 AXXY		E0	492	25 kg	492	400 kg
Sodium ion batteries with organic electrolyte	3551	9		Miscellaneous — Lithium batteries		A88 A99 A154 A164 A183 [A201] AXXX AXXY		E0	FORBIDDEN		See 965	

Sodium ion batteries contained in equipment with organic electrolyte	3552	9		Miscellaneous — Lithium batteries		A48 A88 A99 A154 A164 A185 AXXX AXXY		E0	967	5 kg	967	35 kg
Sodium ion batteries packed with equipment with organic electrolyte	3552	9		Miscellaneous — Lithium batteries		A48 A88 A99 A154 A164 A185 AXXX AXXY		E0	966	5 kg	966	35 kg
. . .												

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Chapter 3

SPECIAL PROVISIONS

Table 3-2. Special provisions

TIs	*UN*	
. . .		
A88		Pre-production prototypes of lithium batteries or cells or sodium ion cells or batteries, when these prototypes are transported for testing, or low production runs (i.e. annual production runs consisting of not more than 100 lithium batteries or cells or sodium ion cells or batteries) of lithium batteries or cells or sodium ion cells or batteries that have not been tested to the requirements in Part III, subsection 38.3 of the UN Manual of Tests and Criteria may be transported aboard cargo aircraft if approved by the appropriate authority of the State of Origin and the State of the Operator and the requirements in Packing Instruction 910 of the Supplement are met. A copy of the document of approval including the quantity limitations must accompany the consignment. Transport in accordance with this special provision must be noted on the dangerous goods transport document. Irrespective of the limit specified in column 13 of Table 3-1, the cell or battery as prepared for transport may have a mass exceeding 35 kg.
. . .		
A99		Irrespective of the quantity limits for cargo aircraft specified in column 13 of Table 3-1, and in Section I of Packing Instructions 965, 966, 967, 968, 969 and 970, a lithium or sodium ion cell or battery (i.e. UN 3090, ~~or~~ UN 3480 or UN 3551), including when packed with equipment or contained in equipment (i.e. UN 3091, ~~or~~ UN 3481 or UN 3552) that meets the other requirements of Section I of the applicable packing instruction, may have a mass exceeding 35 kg, if approved by the appropriate authority of the State of Origin and the State of the Operator and the requirements in Packing Instruction 974 of the Supplement are met. A copy of the document of approval must accompany the consignment. Transport in accordance with this special provision must be noted on the dangerous goods transport document.
A154	(≈376)	Lithium ~~ion cells or batteries and lithium~~ metal, lithium ion or sodium ion cells or batteries, identified as being defective for safety reasons, that have the potential of producing a dangerous evolution of heat, fire or short circuit are forbidden for transport (e.g. those being returned to the manufacturer for safety reasons or cells or batteries that cannot be diagnosed as defective prior to transport). Lithium ~~ion cells or batteries and lithium~~ metal, lithium ion or sodium ion cells or batteries identified as being damaged such that they do not conform to the type tested according to the applicable provisions of the UN *Manual of Tests and Criteria* are forbidden for transport. For the purposes of this special provision, these may include, but are not limited to:

TIs	*UN*	

a) cells or batteries that have leaked or vented;

b) cells or batteries that cannot be diagnosed prior to transport; or

c) cells or batteries that have sustained physical or mechanical damage.

In assessing a cell or battery as defective or damaged, an assessment or evaluation must be performed based on safety criteria from the cell, battery or product manufacturer or by a technical expert with knowledge of the cell's or battery's safety features. An assessment or evaluation may include, but is not limited to, the following criteria:

a) acute hazard, such as gas, fire, or electrolyte leaking;

b) the use or misuse of the cell or battery;

c) signs of physical damage, such as deformation to cell or battery casing, or colours on the casing;

d) external and internal short circuit protection, such as voltage or isolation measures;

e) the condition of the cell or battery safety features; or

f) damage to any internal safety components, such as the battery management system.

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A185	(360)	Vehicles only powered by lithium metal, ~~batteries or~~ lithium ion or sodium ion batteries must be assigned to UN 3171 **Battery-powered vehicle**. Lithium batteries installed in cargo transport units, designed only to provide power external to the transport unit must be assigned to UN 3536 **Lithium batteries installed in cargo transport unit**.

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AXXX	Sodium-ion cells and batteries and sodium-ion cells and batteries contained in or packed with equipment, prepared and offered for transport, are not subject to other provisions of these Instructions if they meet the following: a) the cell or battery is short-circuited, in a way that the cell or battery does not contain electrical energy. The short-circuiting of the cell or battery shall be easily verifiable (e.g. busbar between terminals); b) each cell or battery meets the provisions of 2;9.4 a), b), d), e) and f); c) each package must be marked according to 5;2.4.16; d) except when cells or batteries are installed in equipment, each package must be capable of withstanding a 1.2 m drop test in any orientation without damage to cells or batteries contained therein, without shifting of the contents so as to allow battery to battery (or cell to cell) contact and without release of contents; e) cells and batteries when installed in equipment must be protected from damage. When batteries are installed in equipment, the equipment must be packed in strong outer packagings constructed of suitable material of adequate strength and design in relation to the packaging's capacity and its intended use unless the battery is afforded equivalent protection by the equipment in which it is contained; [f) each cell, including when component of a battery, must only contain dangerous goods that are authorized to be transported in accordance with the provisions of 3;4.1.2, and the quantity of the dangerous goods in the cell must not exceed the quantity specified in Table 3-1, column 11 for the limited quantity packing instruction.]
AXXY	Sodium ion cells and batteries with organic electrolyte must be transported as UN 3551 or 3552 as appropriate, sodium-ion batteries with aqueous alkali electrolyte must be transported as UN 2795 **Batteries, wet, filled with alkali**, electric storage.

Part 4

PACKING INSTRUCTIONS

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Chapter 11

CLASS 9 — MISCELLANEOUS DANGEROUS GOODS

Packing Instruction 965

Cargo aircraft only for UN 3480 and UN 3551

1. **Introduction**

This entry applies to lithium ion, ~~or~~ lithium polymer or sodium ion batteries. This packing instruction is structured as follows:

— Section IA applies to [~~lithium ion~~] [lithium ion and sodium ion] cells with a Watt-hour rating in excess of 20 Wh and [~~lithium ion~~] [lithium ion and sodium ion] batteries with a Watt-hour rating in excess of 100 Wh, which must be assigned to Class 9 and are subject to all of the applicable requirements of these Instructions; and
— Section IB applies to [~~lithium ion~~] [lithium ion and sodium ion] cells with a Watt-hour rating not exceeding 20 Wh and [~~lithium ion~~] [lithium ion and sodium ion] batteries with a Watt-hour rating not exceeding 100 Wh.

A single cell battery as defined in Part III, sub-section 38.3.2.3 of the UN *Manual of Tests and Criteria* is considered a "cell" and must be transported according to the requirements for "cells" for the purpose of this packing instruction.

2. [~~**Lithium**~~] **[Lithium ion and sodium ion]** **batteries forbidden from transport**

The following applies to all [~~lithium ion~~] [lithium ion and sodium ion] cells and batteries in this packing instruction:

Cells or batteries identified as being damaged or defective in accordance with Special Provision A154 are forbidden for transport.

Waste [~~lithium~~] [lithium and sodium ion] batteries and [~~lithium~~] [lithium and sodium ion] batteries being shipped for recycling or disposal are forbidden from air transport unless approved by the appropriate national authority of the State of Origin and the State of the Operator.

IA. **SECTION IA**

Each lithium ion cell or battery must meet the provisions of 2;9.3. Sodium ion cells and batteries must meet the provisions 2;9.4.

IA.1 **General requirements**

— Part 4;1 requirements must be met.
— [~~Lithium ion~~] [Lithium ion and sodium ion] cells and batteries must be offered for transport at a state of charge not exceeding 30 per cent of their rated capacity. Cells and/or batteries at a state of charge greater than 30 per cent of their rated capacity may only be shipped with the approval of the State of Origin and the State of the Operator under the written conditions established by those authorities.

Note.— Guidance and methodology for determining the rated capacity can be found in sub-section 38.3.2.3 of the UN Manual of Tests and Criteria.

Table 965-IA

UN number and proper shipping name	*Net quantity per package*	
	Passenger	*Cargo*

UN 3480 **Lithium ion batteries** UN 3551 **Sodium ion batteries**	Forbidden	35 kg

IA.2 **Additional requirements**

- [~~Lithium ion~~] [Lithium ion and sodium ion] cells and batteries must be protected against short circuits.
- [~~Lithium ion~~] [Lithium ion and sodium ion] cells and batteries must be placed in inner packagings that completely enclose the cell or battery then placed in an outer packaging. The completed package for the cells or batteries must meet the Packing Group II performance requirements.
- [~~Lithium ion~~] [Lithium ion and sodium ion] cells and batteries must not be packed in the same outer packaging with substances and articles of Class 1 (explosives) other than Division 1.4S, Division 2.1 (flammable gases), Class 3 (flammable liquids), Division 4.1 (flammable solids) or Division 5.1 (oxidizers).
- A [~~lithium ion~~] [lithium ion and sodium ion] cell or battery with a mass of 12 kg or greater and having a strong, impact-resistant outer casing may be transported when packed in strong outer packagings or protective enclosures (e.g. in fully enclosed or wooden slatted crates) not subject to the requirements of Part 6 of these Instructions, if approved by the appropriate authority of the State of Origin. A copy of the document of approval must accompany the consignment.
- ~~Batteries~~ Lithium batteries manufactured after 31 December 2011 and sodium ion batteries manufactured after 31 December 2025 must be marked with the Watt-hour rating on the outside case.

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IA.3 **Outer packagings**

Boxes	*Drums*	*Jerricans*
Aluminium (4B)	Aluminium (1B2)	Aluminium (3B2)
Fibreboard (4G)	Fibre (1G)	Plastics (3H2)
Natural wood (4C1, 4C2)	Other metal (1N2)	Steel (3A2)
Other metal (4N)	Plastics (1H2)	
Plastics (4H1, 4H2)	Plywood (1D)	
Plywood (4D)	Steel (1A2)	
Reconstituted wood (4F)		
Steel (4A)		

IB. **SECTION IB**

[~~Lithium ion~~] [Lithium ion and sodium ion] cells or batteries prepared in accordance with this section are subject to all of the applicable provisions of these Instructions (including the requirements in paragraph 2 of this packing instruction and of this section) except for the provisions of Part 6.

[~~Lithium ion~~] [Lithium ion and sodium ion] cells or batteries shipped in accordance with the provisions of Section IB must be described on a dangerous goods transport document as set in Part 5;4. The packing instruction number "965" required by 5;4.1.5.8.1 a) must be supplemented with "IB". All other applicable provisions of Part 5;4 apply.

Lithium ion cells and batteries may be offered for transport provided that each cell and battery meets the provisions of 2;9.3 a), e) and g) or for sodium ion cells or batteries, the provisions of 2;9.4 a), e) and f) and the following:

1) for [~~lithium ion~~] [lithium ion and sodium ion] cells, the Watt-hour rating (see the Glossary of Terms in Attachment 2) is not more than 20 Wh;

2) for [~~lithium ion~~] [lithium ion and sodium ion] batteries, the Watt-hour rating is not more than 100 Wh;
   - the Watt-hour rating must be marked on the outside of the battery case except ~~for those~~ lithium ion batteries manufactured before 1 January 2009;

IB.1 **General requirements**

- Cells and batteries must be packed in strong outer packagings that conform to Part 4;1.1.1, 1.1.3.1 and 1.1.10 (except 1.1.10.1).
- [~~Lithium ion~~] [Lithium ion and sodium ion] cells and batteries must be offered for transport at a state of charge not exceeding 30 per cent of their rated capacity. Cells and/or batteries at a state of charge greater than 30 per cent of their rated capacity may only be shipped with the approval of the State of Origin and the State of the Operator under the written conditions established by those authorities.

Note.— Guidance and methodology for determining the rated capacity can be found in sub-section 38.3.2.3 of the UN Manual of Tests and Criteria.

Table 965-IB

Contents	*Net quantity per package*	
	Passenger	*Cargo*
Lithium ion cells and batteries Sodium ion cells and batteries	Forbidden	10 kg

IB.2 **Additional requirements**

- Cells and batteries must be packed in inner packagings that completely enclose the cell or battery then placed in a strong rigid outer packaging.
- Cells and batteries must not be packed in the same outer packaging with substances and articles of Class 1 (explosives) other than Division 1.4S, Division 2.1 (flammable gases), Class 3 (flammable liquids), Division 4.1 (flammable solids) or Division 5.1 (oxidizers).
- Cells and batteries must be protected so as to prevent short circuits. This includes protection against contact with electrically conductive material within the same packaging that could lead to a short circuit.
- Each package must be capable of withstanding a 1.2 m drop test in any orientation without:
  - damage to cells or batteries contained therein;
  - shifting of the contents so as to allow battery to battery (or cell to cell) contact;
  - release of contents.
- Each package must be capable of withstanding, without damage to the cells or batteries contained therein and without any reduction of effectiveness, a force applied to the top surface equivalent to the total weight of identical packages stacked to a height of 3 m (including the test sample) for a duration of 24 hours.
- Each package must be marked with the appropriate [~~lithium~~] battery mark (Figure 5-3) in addition to the appropriate Class 9 hazard label (Figure 5-26) and the cargo aircraft only label (Figure 5-28).

IB.3 **Outer packagings**

Boxes	*Drums*	*Jerricans*
Aluminium	Aluminium	Aluminium
Fibreboard	Fibre	Plastics
Natural wood	Other metal	Steel
Other metal	Plastics	
Plastics	Plywood	
Plywood	Steel	
Reconstituted wood		
Steel		

Packing Instruction 966

Passenger and cargo aircraft for UN 3481 and UN 3552 (packed with equipment) only

1. **Introduction**

This entry applies to lithium ion, ~~or~~ lithium polymer or sodium ion batteries packed with equipment.

Section I of this packing instruction applies to [~~lithium ion and lithium polymer~~] [lithium ion, lithium polymer and sodium ion] cells and batteries that are assigned to Class 9. Certain [~~lithium ion and lithium polymer~~] [lithium ion, lithium polymer and sodium ion] cells and batteries offered for transport and meeting the requirements of Section II of this packing instruction, subject to paragraph 2 below, are not subject to other additional requirements of these Instructions.

A single cell battery as defined in Part III, sub-section 38.3.2.3 of the UN *Manual of Tests and Criteria* is considered a "cell" and must be transported according to the requirements for "cells" for the purpose of this packing instruction.

For the purpose of this packing instruction, "equipment" means apparatus for which the lithium cells or batteries will provide electrical power for its operation.

2. **~~Lithium~~ [Lithium ion and sodium ion] batteries forbidden from transport**

The following applies to all [~~lithium ion~~] [lithium ion and sodium ion] cells and batteries in this packing instruction:

Cells or batteries identified as being damaged or defective in accordance with Special Provision A154 are forbidden for transport.

I. **SECTION I**

Each lithium ion cell or battery must meet the provisions of 2;9.3. Sodium ion cells and batteries must meet the provisions 2;9.4.

I.1 **General requirements**

Part 4;1 requirements must be met.

UN number and proper shipping name	*Package quantity (Section I)*	
	Passenger	*Cargo*
UN 3481 **Lithium ion batteries packed with equipment** UN 3552 **Sodium ion batteries packed with equipment**	5 kg of ~~lithium ion~~ cells or batteries	35 kg of ~~lithium ion~~ cells or batteries

I.2 **Additional requirements**

- [~~Lithium ion~~] [Lithium ion and sodium ion] cells and batteries must be protected against short circuits. This includes protection against contact with conductive materials within the same packaging that could lead to a short circuit.
- [~~Lithium ion~~] [Lithium ion and sodium ion] cells and batteries must:
  - be placed in inner packagings that completely enclose the cell or battery, then placed in a packaging of a type shown below that meets the Packing Group II performance requirements, then placed with the equipment in a strong, rigid outer packaging; or
  - be placed in inner packagings that completely enclose the cell or battery, then placed with the equipment in a packaging of a type shown below that meets the Packing Group II performance requirements.
- The equipment must be secured against movement within the outer packaging.
- The number of cells or batteries in each package must not exceed the number required for the equipment's operation, plus two spare sets. A "set" of cells or batteries is the number of individual cells or batteries that are required to power each piece of equipment.
- ~~Batteries~~ Lithium batteries manufactured after 31 December 2011 and sodium ion batteries manufactured after 31 December 2025 must be marked with the Watt-hour rating on the outside case.

I.3 **Outer packagings**

Boxes	*Drums*	*Jerricans*
Aluminium (4B) Fibreboard (4G) Natural wood (4C1, 4C2) Other metal (4N) Plastics (4H1, 4H2) Plywood (4D) Reconstituted wood (4F) Steel (4A)	Aluminium (1B2) Fibre (1G) Other metal (1N2) Plastics (1H2) Plywood (1D) Steel (1A2)	Aluminium (3B2) Plastics (3H2) Steel (3A2)

II. **SECTION II**

[~~Lithium ion~~] [Lithium ion and sodium ion] cells and batteries packed with equipment, when complying with Section II of this packing instruction, are only subject to the following additional provisions of these Instructions:

— Part 1;2.3 (General — Transport of dangerous goods by post);
— Part 5;2.4.16 (Shipper's responsibilities — Special marking requirements for lithium batteries);
— Part 7;4.4 (Operator's responsibilities — Reporting of dangerous goods accidents and incidents);
— Part 7;4.5 (Operator's responsibilities — Reporting of undeclared and misdeclared dangerous goods);
— Part 8;1.1 (Provisions concerning passengers and crew — Dangerous goods carried by passengers or crew); and
— Paragraphs 1 and 2 of this packing instruction.

Lithium ion cells and batteries may be offered for transport provided that each cell and battery meets the provisions of 2;9.3 a), e) and g) or for sodium ion cells or batteries, the provisions of 2;9.4 a), e) and f) and the following:

1) for [~~lithium ion~~] [lithium ion and sodium ion] cells, the Watt-hour rating (see the Glossary of Terms in Attachment 2) is not more than 20 Wh;

2) for [~~lithium ion~~] [lithium ion and sodium ion] batteries, the Watt-hour rating is not more than 100 Wh;
   — the Watt-hour rating must be marked on the outside case except ~~for those~~ lithium ion batteries manufactured before 1 January 2009.

II.1 **General requirements**

Contents	*Package quantity (Section II)*	
	Passenger	*Cargo*
Net quantity of [~~lithium ion~~] [lithium ion and sodium ion] cells or batteries per package	5 kg	5 kg

Packing Instruction 966

II.2 **Additional requirements**

- [~~Lithium ion~~] [Lithium ion and sodium ion] cells and batteries must:
  - be placed in inner packagings that completely enclose the cell or battery, then placed in a strong rigid outer packaging that conforms to Part 4;1.1.1, 1.1.3.1 and 1.1.10 (except 1.1.10.1); or
  - be placed in inner packagings that completely enclose the cell or battery, then placed with the equipment in a strong rigid outer packaging that conforms to Part 4;1.1.1, 1.1.3.1 and 1.1.10 (except 1.1.10.1).
- Cells and batteries must be protected against short circuits. This includes protection against contact with electrically conductive material within the same packaging that could lead to a short circuit.
- The equipment must be secured against movement within the outer packaging.
- The number of cells or batteries in each package must not exceed the number required for the equipment's operation, plus two spare sets. A "set" of cells or batteries is the number of individual cells or batteries that are required to power each piece of equipment.
- Each package of cells or batteries, or the completed package, must be capable of withstanding a 1.2 m drop test in any orientation without:
  - damage to cells or batteries contained therein;
  - shifting of the contents so as to allow battery to battery (or cell to cell) contact;
  - release of contents.
- Each package must be marked with the appropriate [~~lithium~~] battery mark (Figure 5-3).
  - the package must be of such size that there is adequate space to affix the mark on one side without the mark being folded.
- The words "lithium ion batteries" or "sodium ion batteries", "in compliance with Section II of PI966" must be placed on the air waybill, when an air waybill is used. Where packages of Section II [~~lithium~~] batteries from multiple packing instructions are included on one air waybill, the compliance statement for the different [~~lithium~~] battery types and/or packing instructions may be combined into a single statement provided that the statement identifies the applicable [~~lithium~~] battery type(s) and packing instruction numbers.
- Where a package contains a combination of [~~lithium~~] batteries contained in equipment and [~~lithium~~] batteries packed with equipment that meet the limits for [~~lithium~~] cells or batteries of Section II, the following additional requirements apply:
  - the shipper must ensure that all applicable parts of both packing instructions are met. The total mass of lithium batteries contained in any package must not exceed 5 kg;
  - the words "lithium ion batteries" or "sodium ion batteries", "in compliance with Section II of PI966" must be placed on the air waybill, when an air waybill is used.
- Any person preparing or offering cells or batteries for transport must receive adequate instruction on these requirements commensurate with the functions for which they are responsible.

II.3 **Outer packagings**

Boxes	*Drums*	*Jerricans*
Aluminium	Aluminium	Aluminium
Fibreboard	Fibre	Plastics
Natural wood	Other metal	Steel
Other metal	Plastics	
Plastics	Plywood	
Plywood	Steel	
Reconstituted wood		
Steel		

II.4 **Overpacks**

When packages are placed in an overpack:

a) the packages must be secured within the overpack;

b) the intended function of each package must not be impaired by the overpack; and

c) the [~~lithium~~] battery mark (Figure 5-3) required by this packing instruction must either be clearly visible or the mark must be reproduced on the outside of the overpack and the overpack must be marked with the word "Overpack" in lettering of at least 12 mm high.

Packing Instruction 967

Passenger and cargo aircraft for UN 3481 and UN 3552 (contained in equipment) only

1. **Introduction**

This entry applies to lithium ion, ~~or~~ lithium polymer or sodium ion batteries contained in equipment.

Section I of this packing instruction applies to [~~lithium ion and lithium polymer~~] [lithium ion, lithium polymer and sodium ion] cells and batteries that are assigned to Class 9. Certain [~~lithium ion and lithium polymer~~] [lithium ion, lithium polymer and sodium ion] cells and batteries offered for transport and meeting the requirements of Section II of this packing instruction, subject to paragraph 2 below, are not subject to other additional requirements of these Instructions.

A single cell battery as defined in Part III, sub-section 38.3.2.3 of the UN *Manual of Tests and Criteria* is considered a "cell" and must be transported according to the requirements for "cells" for the purpose of this packing instruction.

For the purpose of this packing instruction, "equipment" means apparatus for which the lithium cells or batteries will provide electrical power for its operation.

2. ~~Lithium~~**[Lithium ion and sodium ion] batteries forbidden from transport**

The following applies to all [~~lithium ion~~] [lithium ion and sodium ion] cells and batteries in this packing instruction:

Cells or batteries identified as being damaged or defective in accordance with Special Provision A154 are forbidden for transport.

I. **SECTION I**

Each lithium ion cell or battery must meet the provisions of 2;9.3. Sodium ion cells and batteries must meet the provisions 2;9.4.

I.1 **General requirements**

Equipment must be packed in strong rigid outer packagings that conform to Part 4;1.1.1, 1.1.3.1 and 1.1.10 (except 1.1.10.1). Large equipment can be offered for transport unpackaged or on pallets when the cells or batteries are afforded equivalent protection by the equipment in which they are contained.

	Package quantity (Section I)	
UN number and proper shipping name	*Passenger*	*Cargo*
UN 3481 **Lithium ion batteries contained in equipment** UN 3552 **Sodium ion batteries contained in equipment**	5 kg of ~~lithium ion~~ cells or batteries	35 kg of ~~lithium ion~~ cells or batteries

I.2 **Additional requirements**

- The equipment must be secured against movement within the outer packaging and must be equipped with an effective means of preventing accidental activation.
- Where multiple pieces of equipment are packed in the same outer packaging, each piece of equipment must be packed to prevent contact with other equipment.
- ~~Batteries~~ Lithium batteries manufactured after 31 December 2011 and sodium ion batteries manufactured after 31 December 2025 must be marked with the Watt-hour rating on the outside case.

I.3 **Outer packagings**

Boxes	*Drums*	*Jerricans*
Aluminium	Aluminium	Aluminium
Fibreboard	Fibre	Plastics
Natural wood	Other metal	Steel
Other metal	Plastics	
Plastics	Plywood	
Plywood	Steel	
Reconstituted wood		
Steel		

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II. **SECTION II**

[~~Lithium ion~~] [Lithium ion and sodium ion] cells and batteries contained in equipment, when complying with Section II of this packing instruction, are only subject to the following additional provisions of these Instructions:

— Part 1;2.3 (General — Transport of dangerous goods by post);
— Part 5;2.4.16 (Shipper's responsibilities — Special marking requirements for lithium batteries);
— Part 7;4.4 (Operator's responsibilities — Reporting of dangerous goods accidents and incidents);
— Part 7;4.5 (Operator's responsibilities — Reporting of undeclared and misdeclared dangerous goods);
— Part 8;1.1 (Provisions concerning passengers and crew — Dangerous goods carried by passengers or crew); and
— Paragraphs 1 and 2 of this packing instruction.

Lithium ion cells and batteries may be offered for transport provided that each cell and battery meets the provisions of 2;9.3 a), e) and g) or for sodium ion cells or batteries, the provisions of 2;9.4 a), e) and f) and the following:

1) for [~~lithium ion~~] [lithium ion and sodium ion] cells, the Watt-hour rating (see the Glossary of Terms in Attachment 2) is not more than 20 Wh;

2) for [~~lithium ion~~] [lithium ion and sodium ion] batteries, the Watt-hour rating is not more than 100 Wh;
— the Watt-hour rating must be marked on the outside of the battery case except ~~for those~~ lithium ion batteries manufactured before 1 January 2009.

Devices such as radio frequency identification (RFID) tags, watches and temperature loggers, which are not capable of generating a dangerous evolution of heat, may be t~~r~~ansported when intentionally active. When active, these devices must meet defined standards for electromagnetic radiation to ensure that the operation of the device does not interfere with aircraft systems. The devices must not be capable of emitting disturbing signals (such as buzzing alarms, strobe lights, etc.) during transport.

II.1 **General requirements**

Equipment must be packed in strong rigid outer packagings that conform to Part 4;1.1.1, 1.1.3.1 and 1.1.10 (except 1.1.10.1). Large equipment can be offered for transport unpackaged or on pallets when the cells or batteries are afforded equivalent protection by the equipment in which they are contained.

Contents	*Package quantity (Section II)*	
	Passenger	*Cargo*
Net quantity of ~~lithium ion~~ cells or batteries per package	5 kg	5 kg

II.2 **Additional requirements**

— The equipment must be secured against movement within the outer packaging and must be equipped with an effective means of preventing accidental activation.
— Cells and batteries must be protected so as to prevent short circuits.
— Where multiple pieces of equipment are packed in the same outer packaging, each piece of equipment must be packed to prevent contact with other equipment.
— Each package must be marked with the appropriate ~~lithium~~ battery mark (Figure 5-3). The package must be of such size that there is adequate space to affix the mark on one side without the mark being folded.
  — This requirement does not apply to:
    — packages containing only button cell batteries installed in equipment (including circuit boards); and
    — packages containing no more than four cells or two batteries installed in equipment, where there are not more than two packages in the consignment.
— Where a consignment includes packages bearing the lithium battery mark, the words "lithium ion batteries" or "sodium ion batteries", "in compliance with Section II of PI967" must be placed on the air waybill, when an air waybill is used. Where packages of Section II [~~lithium~~] batteries from multiple packing instructions are included on one air waybill, the compliance statement for the different [~~lithium~~] battery types and/or packing instructions may be combined into a single statement provided that the statement identifies the applicable [~~lithium~~] battery type(s) and packing instruction numbers.
— Any person preparing or offering cells or batteries for transport must receive adequate instruction on these requirements commensurate with the functions for which they are responsible.

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II.3 **Outer packagings**

Boxes	*Drums*	*Jerricans*
Aluminium	Aluminium	Aluminium
Fibreboard	Fibre	Plastics
Natural wood	Other metal	Steel
Other metal	Plastics	
Plastics	Plywood	
Plywood	Steel	
Reconstituted wood		
Steel		

II.4 **Overpacks**

When packages are placed in an overpack:

a) the packages must be secured within the overpack;

+

b) the intended function of each package must not be impaired by the overpack; and

+

c) the [~~lithium~~] battery mark (Figure 5-3) required by this packing instruction must either be clearly visible or the mark must be reproduced on the outside of the overpack and the overpack must be marked with the word "Overpack" in lettering of at least 12 mm high.

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Part 5

SHIPPER'S RESPONSIBILITIES

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Chapter 2

MARKING

2.4.16 Special marking requirements for lithium or sodium ion batteries

2.4.16.1 Packages containing lithium or sodium ion cells or batteries prepared in accordance with Section II of Packing Instructions 966, 967, 969 or 970 and Section IB of Packing Instructions 965 and 968 must be marked as shown in Figure 5-3.

2.4.16.2 The mark must indicate the appropriate UN number preceded by the letters "UN" as follows:

a) "UN 3090" for lithium metal cells or batteries;

b) "UN 3480" for lithium ion cells or batteries;

c) "UN 3091" for lithium metal cells or batteries contained in, or packed with, equipment; or

d) "UN 3481" for lithium ion cells or batteries contained in, or packed with, equipment.

e) "UN 3551" for sodium ion cells or batteries;

f) "UN 3552" for sodium ion cells or batteries contained in, or packed with, equipment.

Where a package contains lithium cells or batteries assigned to different UN numbers, all applicable UN numbers must be

indicated on one or more marks.

2.4.16.3 The mark must be in the form of a rectangle or a square with hatched edging. The symbol (group of batteries, one damaged and emitting flame, above the UN number for lithium ion ~~or~~, lithium metal or sodium ion batteries or cells) must be black on white or suitable contrasting background. The hatching must be red. The mark must be a minimum dimension of 100 mm wide × 100 mm high and the minimum width of the hatching must be 5 mm. If the size of the package so requires, the dimensions may be reduced to not less than 100 mm wide × 70 mm high. Where dimensions are not specified, all features must be in approximate proportion to those shown on the full-size mark (Figure 5-3).

2.4.16.4 Packages containing lithium batteries or sodium ion that meet the requirements of Section IB of Packing Instructions 965 or 968 must bear both the [~~lithium~~] battery mark (Figure 5-3) and the [~~lithium~~] battery Class 9 hazard label (Figure 5-26).

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Figure 5-3. [~~Lithium battery~~]Battery mark

Chapter 3

LABELLING

3.5 LABEL SPECIFICATIONS

3.5.1 Class hazard label specifications

3.5.1.1 Labels must satisfy the provisions of this section and conform, in terms of colour, symbols and general format, to the specimen labels shown in Figures 5-4 to 5-26.

Note.— Where appropriate, labels in Figures 5-4 to 5-26 are shown with a dotted outer boundary as provided for in 3.5.1.1 a). This is not required when the label is applied on a background of contrasting colour.

Class hazard labels must conform to the following specifications:

. . .

c) With the exception of labels for Divisions 1.4, 1.5 and 1.6 of Class 1, the upper half of the label must contain the pictorial symbol and the lower half must contain the class or, in the case of labels for Class 5, the division number, as appropriate. However for the Class 9 label for ~~lithium~~ batteries (Figure 5-26), the upper half of the label must only contain the seven vertical stripes of the symbol and the lower half must contain the group of batteries of the symbol and the class number. Except for the Class 9 label for ~~lithium~~ batteries (Figure 5-26), the label may include such text as the UN number, or words describing the hazard class (e.g. “flammable”) in accordance with 3.5.1.1 e) provided that the text does not obscure or detract from the other required label elements.

. . .

— END —