

## Technical Notice

### Transport Regulations for Lithium Metal Batteries

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## 1. Exemptions

Lithium metal batteries are dangerous goods, UN No. 3090. Therefore, they are generally subject to transport regulations, depending on the transport mode. However, most Tadiran Lithium Batteries listed in the product data catalogue are exempted from the regulations if the following conditions are given:

- The batteries have not more than 2 g aggregate lithium content, each cell not more than 1 g lithium content (see table 1).
- Hybrid batteries containing not more than 1,5 g aggregate lithium content and a Wh rating of the rechargeable part (HLC) of less than 10 Wh.
- The batteries have passed the UN tests (Table 1).
- The batteries shall be packed in inner packagings that completely enclose them. They shall be protected to prevent short circuits.
- The gross mass does not exceed 30 kg per package (ADR / RID /IMDG-Code).
- The net mass does not exceed 2.5 kg per package (IATA DGR).
- Lithium metal cells / batteries as air-cargo containing more than 0.3 g but less than 1 g / 2 g lithium content are restricted (please refer to packaging instruction 968 part IB and II).
- The „Cargo Aircraft Only“-handling label and the “Lithium Battery Mark” (IB und II) together with Class 9 hazard label must be attached on the package (IATA DGR).
- The packaging shall be strong and capable of withstanding a 1.2 m drop test.
- For more details see special provision 188 (ADR/RID/IMDG-Code) and section II of packing instructions 968 - 970 (IATA DGR).

## 2. Classification of lithium metal batteries

Table 1 shows Tadiran Lithium Metal Batteries and which of them are exempted from the dangerous goods regulations and which are not. The regulations for not exempted batteries are summarized in table 2.

System	Size	Type				Exempted <sup>1)</sup>	Lithium content [g]	UN Test passed	UN Number
Lithium thionylchloride (LTC)	1/10C		TLH-2450	TL-2450		Yes	0,18 g	Yes	3090/91
	1/10D			SL-786	SL-886	Yes	0,3 g	Yes	3090/91
	1/6D			SL-789	SL-889	Yes <sup>2)</sup>	0,5 g	Yes	3090/91
	1/2AA	SL-350	SL-550	SL-750	SL-850	Yes <sup>2)</sup>	0,35 g	Yes	3090/91
	2/3AA	SL-361	SL-561	SL-761	SL-861	Yes <sup>2)</sup>	0,5 g	Yes	3090/91
	AA	SL-360	SL-560	SL-760	SL-860	Yes <sup>2)</sup>	0,65 g	Yes	3090/91
	C			SL-2770	SL-2870	No	2,5 g	Yes	3090/91
	D			SL-2780	SL2880	No	5 g	Yes	3090/91
	DD			SL-2790		No	10 g	Yes	3090/91
Hybrid Layer Capacitors (HLC)	AAA	HLC-1020 (3,7 V)				Yes	0,07 Wh	Yes	3090/91
	1/2AA	HLC-1520 (3,7 V)				Yes	0,22 Wh	Yes	3090/91
	2/3AA	HLC-1530 (3,7 V)				Yes	0,4 Wh	Yes	3090/91
	AA	HLC-1550 (3,7 V)				Yes	0,86 Wh	Yes	3090/91
Tadiran Lithium metal oxide (TLM)	1/2AA	TLM-1520HPM				Yes	0,04 g	Yes	3090/91
	2/3AA	TLM-1530HPM				Yes	0,1 g	Yes	3090/91
	AA	TLM-1550HPM				Yes	0,4 g	Yes	3090/91

<sup>1)</sup> if conditions mentioned in the text are fulfilled  
<sup>2)</sup> see also IATA DGR under UN 3090 / PI 968 / Table 968-II

**Table 1**

Classification of Tadiran Lithium Metal Batteries

## 3. UN tests

Table 1 also shows the status of UN-tests for Tadiran Lithium Metal Batteries according to the UN Manual of Tests and Criteria, part III, sub-section 38.3. Regarding Tadiran Lithium Batteries not listed in table 1, please apply to Tadiran Batteries for a confirmation.

## 4. Overview dangerous goods by transport mode

Transport regulations for lithium metal batteries					
UN-No. and class	Limitations and instructions	Passenger aircraft IATA DGR	Cargo aircraft IATA DGR	Road/Railway transport ADR/RID	Sea transport IMDG Code
<b>Lithium metal batteries</b>					
UN 3090 Class 9	Maximum net mass per package	Forbidden as of 2015	35 kg	according to packaging approval	
	Packing group		See LTN-065-71 page 5 ff.	II according to P903	II according to P903
	Packing instruction		968	P 903 (1, 2), LP 903	
	Marking		Class 9 hazard label for lithium batteries and handling label "Cargo Aircraft Only"	Class 9A hazard label for lithium batteries	
<b>Lithium metal batteries contained in equipment / packed with equipment</b>					
UN 3091 Class 9	Max. Qty. of batteries per piece of equipment	5 kg / -	35 kg / -		
	Max. Qty. of batteries per package, excluding equipment	- / 5 kg	- / 35 kg		
	Packing group	not assigned			
	Packing instruction	P 970 / 969	P 970 / 969	P 903 (3, 4), LP 903	P 903
	Marking	Lithium Battery Mark	Class 9 hazard label for lithium batteries and handling label "Cargo Aircraft Only"	Class 9A hazard label for lithium batteries	
Further instructions		see packing instructions		see special provision 230	

**Table 2**

Transport regulations for fully regulated lithium metal cells / batteries with more than 1 g / 2 g lithium content. Hybrid batteries with more than 1,5 g or 10 Wh.

It is necessary to refer to the listed regulations and instructions for detailed information. They are revised on a regular basis. The tables are based on the revisions effective in December 2019.

The applicable documents are:

ADR: European Agreement concerning the International Carriage of Dangerous Goods by Road,

IATA DGR: International Air Transport Association, Dangerous Goods Regulations,

ICAO: International Civil Aviation Organization, Technical Instructions for the Safe Transport of Dangerous Goods by Air,

IMDG Code: International Maritime Dangerous Goods Code,

RID: International Statutory Order on the Conveyance of Dangerous Goods by Rail,

UN: United Nations Recommendations on the Transport of Dangerous Goods.

## 5. Shipping of defect cells

Tadiran must be contacted prior to the shipping of defective cells in order to agree on the procedure.

## 6. Markings



Class 9(A) Hazard Label for lithium batteries

*reduced size  
black on white*

Name: Lithium battery  
Cargo IMP Code: RBI, RBM, RLI, RLM  
Minimum dimensions: 100 x 100 mm

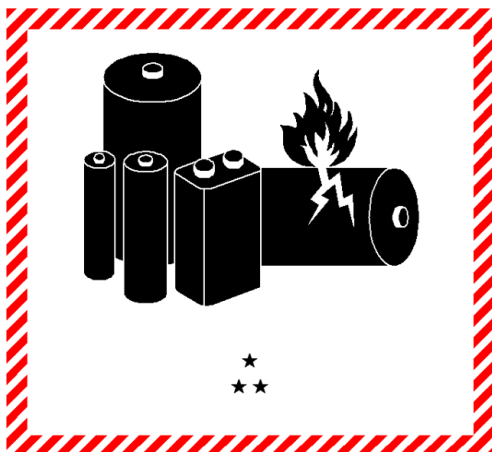
Symbol (seven vertical black stripes in upper half; battery group, one broken and emitting flame in lower half); black  
Background: White



Handling Label Cargo Aircraft Only

*reduced size,  
black on orange (Pantone colour no. 151U)*

Name: Cargo Aircraft Only  
Cargo IMP Code: CAO  
Minimum dimensions: 120 x 110 mm



Lithium Battery Mark

*reduced size,  
black on white,  
red boarder with diagonal hatchings (min 5 mm)*

Minimum dimensions 120 x 110 mm

\* Place for UN number(s) (rec. 12 mm high)  
\*\* Place for telephone number for additional information

Minimum dimensions: 120 x 110 mm

## ADR 2019 Transport Regulations for Road and Rail Transport Overview

UN 3090	LITHIUM-METALL-BATTERIES				See ADR chapter
UN 3091	LITHIUM-METALL-BATTERIES CONTAINED IN EQUIPMENT or LITHIUM-METALL-BATTERIES PACKED WITH EQUIPMENT				
Class	9	Miscellaneous	x	x	2.2
Classification code	M4	Lithium Batteries	x	x	2.2.9.1.2.
Classification		Lithium cells and batteries	x	x	2.2.9.1.7
Packing group		See page 6 ff.	x	x	2.0.1.3
Hazard label	9A	Hazard label 9A for lithium batteries	x	x	5.2.2
Special provisions	188	Excepted if ...	x	x	3.3
	230	Class 9 if...	x	x	
	310	Prototypes	x	x	
	360	Battery powered vehicles	x		
	376	Damaged or defective lithium batteries	x	x	
	377	Lithium batteries for disposal or recycling	x	x	
	387	Hybrid batteries special deviation 188	x	x	
	636	Used batteries		x	
	670	Lithium batteries in household appliances	x		
Limited quantities	LQ0	No	x	x	3.4.6
Excepted quantity	E0	No	x	x	3.5.1.2
Packing instructions	P903	Lithium batteries	x	x	4.1.4.1
	P908	Defect batteries	x	x	
	P909	Batteries for disposal	x	x	
	P910	Prototypes	x	x	
	P911	Damaged or defective battery	x	x	
	LP903	Large packaging for single battery	x	x	
	LP904	Large packaging for single damaged or defect battery	x	x	
	LP 905	Prototypes	x	x	
	LP 906	Defective/ single demanded batteries	x	x	
Transport Category	2	Exemption unter 333 kg	x	x	1.1.3.6
Tunnel code	E	Forbidden in tunnels of category E	x	x	8.6

**1.6.1.29**

Lithium cells and batteries manufactured according to a type meeting the requirements of sub-section 38.3 of the Manual of Tests and Criteria, Revision 3, Amendment 1 or any subsequent revision and amendment applicable at the date of the type testing may continue to be carried, unless otherwise provided in ADR.

Lithium cells and batteries manufactured before 1 July 2003 meeting the requirements of the Manual of Tests and Criteria, Revision 3, may continue to be carried if all other applicable requirements are fulfilled.

**2.2.9.1.7**

Lithium batteries shall meet the following requirements, except when otherwise provided for in ADR (e.g. for prototype batteries and small production runs under special provision 310 or damaged batteries under special provision 376).

**NOTE:** For UN 3536 LITHIUM BATTERIES INSTALLED IN CARGO TRANSPORT UNIT, see special provision 389 in Chapter 3.3.

Cells and batteries, cells and batteries contained in equipment, or cells and batteries packed with equipment, containing lithium in any form shall be assigned to UN Nos. 3090, 3091, 3480 or 3481 as appropriate. They may be carried under these entries if they meet the following provisions:

- (a) Each cell or battery is of the type proved to meet the requirements of each test of the Manual of Tests and Criteria, Part III, sub-section 38.3;

**NOTE:** Batteries shall be of a type proved to meet the testing requirements of the Manual of Tests and Criteria, part III, sub-section 38.3, irrespective of whether the cells of which they are composed are of a tested type.

- (b) Each cell and battery incorporates a safety venting device or is designed to preclude a violent rupture under normal conditions of carriage;
- (c) Each cell and battery is equipped with an effective means of preventing external short circuits;
- (d) Each battery containing cells or 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 shall be manufactured under a quality management programme that includes:
- (i) A description of the organizational structure and responsibilities of personnel with regard to design and product quality;
  - (ii) The relevant inspection and test, quality control, quality assurance, and process operation instructions that will be used;
  - (iii) Process controls that should include relevant activities to prevent and detect internal short circuit failure during manufacture of cells;
  - (iv) Quality records, such as inspection reports, test data, calibration data and certificates. Test data shall be kept and made available to the competent authority upon request;
  - (v) Management reviews to ensure the effective operation of the quality management programme;
  - (vi) A process for control of documents and their revision;
  - (vii) A means for control of cells or batteries that are not conforming to the type tested as mentioned in (a) above;
  - (viii) Training programmes and qualification procedure for relevant personnel; and
  - (ix) Procedure to ensure that there is no damage to the final product.

**NOTE:** In house quality management programmes may be accepted. Third party certification is not required, but the procedures listed in (i) to (ix) above shall be properly recorded and traceable. A copy of the quality management programme shall be made available to the competent authority upon request.

- (f) Lithium batteries, containing both primary lithium metal cells and rechargeable lithium ion cells, that are not designed to be externally charged (see special provision 387 of Chapter 3.3) shall meet the following conditions:
- (i) The rechargeable lithium ion cells can only be charged from the primary lithium metal cells;
  - (ii) Overcharge of the rechargeable lithium ion cells is precluded by design;
  - (iii) The battery has been tested as a lithium primary battery;

- (iv) 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;
- (e) Manufacturers and subsequent distributors of cells or batteries manufactured after 30 June 2003 shall make available the test summary as specified in the Manual of Tests and Criteria, Part III, sub-section 38.3, paragraph 38.3.5.

Lithium batteries are not subject to the provisions of ADR if they meet the requirements of special provision 188 of Chapter 3.3.

### Special Provision 188

Cells and batteries offered for carriage are not subject to other provisions of ARD if they meet the following:

- (a) For a lithium metal or lithium alloy cell, the lithium content is not more than 1 g, and for a lithium ion cell, the Watt-hour rating is not more than 20 Wh;  
*c* When lithium batteries in conformity with 2.2.9.1.7 (f) are carried in accordance with this special provision, the total lithium content of all lithium metal cells contained in this battery shall not exceed 1.5 g and the total capacity of all lithium ion cells contained in the battery shall not exceed 10 Wh (see special provisions 387).
- (b) For a lithium metal or lithium alloy battery the aggregate lithium content is not more than 2 g, and for a lithium ion battery, the Watt-hour rating is not more than 100 Wh. Lithium ion batteries subject to this provision shall be marked with the Watt-hour rating on the outside case, except those manufactured before 1 January 2009;  
**Note:** When lithium batteries in conformity with 2.2.9.1.7 (f) are carried in accordance with this special provision, the total lithium content of all lithium metal cells contained in this battery shall not exceed 1.5 g and the total capacity of all lithium ion cells contained in the battery shall not exceed 10 Wh (see special provisions 387).
- (c) Each cell or battery meets the provisions of 2.9.4 (a), (e), (f) and (g);
- (d) Cells and batteries, except when installed in equipment, shall be packed in inner packagings that completely enclose the cell or battery. Cells and batteries shall 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. The inner packagings shall be packed in strong outer packagings which conform to the provisions of 4.1.1.1, 4.1.1.2, and 4.1.1.5;
- (e) Cells and batteries when installed in equipment shall be protected from damage and short circuit, and the equipment shall be equipped with an effective means of preventing accidental activation. This requirement does not apply to devices which are intentionally active in transport (radio frequency identification (RFID) transmitters, watches, sensors, etc.) and which are not capable of generating a dangerous evolution of heat. When batteries are installed in equipment, the equipment shall 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 package shall be marked with the appropriate lithium battery mark, as illustrated at 5.2.1.9;

This requirement does not apply to:

- (i) packages containing only button cell batteries installed in equipment (including circuit boards); and
- (ii) packages containing no more than four cells or two batteries installed in equipment, where there are more than two packages in the consignment.

When packages are placed in an overpack, the lithium battery mark shall either be clearly visible or reproduced on the outside of the overpack and the overpack shall be marked with the word "OVERPACK". The lettering of the "OVERPACK" mark shall be at least 12 mm high.

**Note:** Packages containing lithium batteries packed in conformity with the provisions of Part 4, Chapter 44, packing instructions 965 or 968, Section IB of the ICAO Technical Instructions that bear the mark as shown in 5.2.1.9 (lithium battery mark) and the label shown in 5.2.2.2.2, model No. 9A shall be deemed to meet the provisions of this special provision.

- (g) Except when batteries are installed in equipment, each package shall 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: and
- (h) Except when batteries are installed in or packed with equipment. packages shall not exceed 30 kg gross mass.

As used above and elsewhere in ARD. "lithium content" means the mass of lithium in the anode of a lithium metal or lithium alloy cell. As used in this special provision "equipment" means apparatus for which the lithium cells or batteries will provide electrical power for its operation.

Separate entries exist for lithium metal batteries and lithium ion batteries to facilitate the carriage of these batteries for specific modes of carriage and to enable the application of different emergency response actions.

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

### Special Provision 230

Lithium cells and batteries may be carried under this entry if they meet the provisions of 2.2.9.1.7.

### Special Provision 310

The testing requirements in the Manual of Tests and Criteria, part III sub-section 38.3 do not apply to production runs, consisting of not more than 100 cells or batteries, or to pre-production prototypes of cells or batteries when these prototypes are carried for testing when packaged in accordance with packing instruction P910 of 4.1.4.1 or LP905 of 4.1.4.3, as applicable.

The transport document shall include the following statement: "Carriage in accordance with special provision 310".

Damaged or defective cells, batteries, or cells and batteries contained in equipment shall be carried in accordance with special provision 376 and packaged in accordance with packing instructions P908 of 4.1.4.1 or LP904 of 4.1.4.3, as applicable.

Cells, batteries or cells and batteries contained in equipment transported for disposal or recycling may be packaged in accordance with special provision 377 and packing instruction P909 of 4.1.4.1.

### Special Provision 360

Vehicles only powered by lithium metal batteries or lithium ion batteries shall be classified under the entry UN 3171 battery-powered vehicle.

### Special Provision 376

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 carriage; 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 carried according to the provisions applicable to UN No. 3090, UN No. 3091, UN No. 3480 and UN No. 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 identified as damaged or defective and 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 packed and carried in accordance with packing instruction P911 of 4.1.4.1 or LP906 of 4.1.4.3., as applicable. Alternative packing and/or carriage conditions may be authorized by the competent authority of any ADR Contracting Party who may also recognize an approval granted by the competent authority of a country which is not an ADR Contracting Party provided that this approval has been granted in accordance with the procedures applicable according to RID, ADR, ADN, the IMDG Code or the ICAO Technical Instructions. In both cases the cells and batteries are assigned to transport category 0. Packages shall be marked "DAMAGED/DEFECTIVE LITHIUM-ION BATTERIES" or "DAMADGED/ DEFEVTIVE LITHIUM METAL BATTERIES", as applicable. The transport document shall include the following statement "Transport in accordance with special provision 376".

If applicable, a copy of the competent authority approval shall accompany the carriage.

### Special Provision 377

Lithium ion and lithium metal cells and batteries and equipment containing such cells and batteries carried for disposal or recycling, either packed together with or packed without non-lithium batteries, may be packaged in accordance with packing instruction P909 of 4.1.4.1.

These cells and batteries are not subject to the provisions of 2.2.9.1.7 (a) to (g).

Packages shall be marked "LITHIUM BATTERIES FOR DISPOSAL" or "LITHIUM BATTERIES FOR RECYCLING".

Identified damaged or defective batteries shall be carried in accordance with special provision 376 and packaged in accordance with P908 of 4.1.4.1 or packing instructions LP904 of 4.1.4.3, as applicable.

### Special Provision 387

Lithium batteries in conformity with 2.2.9.1.7 (f) containing both primary lithium metal cells and rechargeable lithium ion cells shall be assigned to UN Nos. 3090 or 3091 as appropriate. When such batteries are carried in accordance with special provision 188, the total lithium content of all lithium metal cells contained in the battery shall not exceed 1.5 g and the total capacity of all lithium ion cells contained in the battery shall not exceed 10 Wh.

### Special Provision 636

Up to the intermediate processing facility, lithium cells and batteries with a gross mass of not more than 500 g each, lithium ion cells with a Watt-hour rating of not more than 20 Wh, lithium ion batteries with a Watt-hour rating of not more than 100 Wh, lithium metal cells with a lithium content of not more than 1 g and lithium metal batteries with an aggregate lithium content of not more than 2 g, not contained in equipment, collected and handed over for carriage for sorting, disposal or recycling, together with or without other non-lithium cells or batteries, are not subject to the other provisions of ADR including special provision 376 and 2.2.9.1.7, if the following conditions are met:

- (a) The cells and batteries are packed according to packing instruction P909 of 4.1.4.1 except for the additional requirements 1 and 2;
- (b) A quality assurance system is in place to ensure that the total amount of lithium cells and batteries per transport unit does not exceed 333 kg;

**NOTE:** *The total quantity of lithium cells and batteries in the mix may be assessed by means of a statistical method included in the quality assurance system. A copy of the quality assurance records shall be made available to the competent authority upon request.*

(c) Packages are marked:

"LITHIUM BATTERIES FOR DISPOSAL" or "LITHIUM BATTERIES FOR RECYCLING" as appropriate.

### Special Provision 670

(a) Lithium cells and batteries installed in equipment from private households collected and handed over for carriage for depollution, dismantling, recycling or disposal are not subject to the other provisions of ADR including special provision 376 and 2.2.9.1.7 when:

- (i) They are not the main power source for the operation of the equipment in which they are contained;
- (ii) The equipment in which they are contained does not contain any other lithium cell or battery used as the main power source; and
- (iii) They are afforded protection by the equipment in which they are contained.

Examples for cells and batteries covered by this paragraph are button cells used for data integrity in household appliances (e.g. refrigerators, washing machines, dishwashers) or in other electrical or electronic equipment;

(b) Up to the intermediate processing facility lithium cells and batteries contained in equipment from private households not meeting the requirements of (a) collected and handed over for carriage for depollution, dismantling, recycling or disposal are not subject to the other provisions of ADR including special provision 376 and 2.2.9.1.7, if the following conditions are met:

- (i) The equipment is packed in accordance with packing instruction P909 of 4.1.4.1 except for the additional requirements 1 and 2; or it is packed in strong outer packagings, e.g. specially designed collection receptacles, which meet the following requirements:
- The packagings shall be constructed of suitable material and be of adequate strength and design in relation to the packaging capacity and its intended use. The packagings need not meet the requirements of 4.1.1.3;
  - Appropriate measures shall be taken to minimize the damage of the equipment when filling and handling the packaging, e.g. use of rubber mats; and
  - The packagings shall be constructed and closed so as to prevent any loss of contents during carriage, e.g. by lids, strong inner liners, covers for transport. Openings designed for filling are acceptable if they are constructed so as to prevent loss of content;
- (ii) A quality assurance system is in place to ensure that the total amount of lithium cells and batteries per transport unit does not exceed 333 kg;  
**NOTE:** *The total quantity of lithium cells and batteries in the equipment from private households may be assessed by means of a statistical method included in the quality assurance system. A copy of the quality assurance records shall be made available to the competent authority upon request*
- (iii) Packages are marked "LITHIUM BATTERIES FOR DISPOSAL" or "LITHIUM BATTERIES FOR RECYCLING" as appropriate. If equipment containing lithium cells or batteries is carried unpackaged or on pallets in accordance with packing instruction P909 (3) of 4.1.4.1, this mark may alternatively be affixed to the external surface of the vehicles or containers).  
**NOTE:** *"Equipment from private households" means equipment which comes from private households and equipment which comes from commercial, industrial, institutional and other sources which, because of its nature and quantity, is similar to that from private households. Equipment likely to be used by both private households and users other than private households shall in any event be considered to be equipment from private households.*

P903	PACKING INSTRUCTION	P903
This instruction applies to UN Nos. 3090, 3091, 3480 and 3481.		
For the purpose of this packing instruction, "equipment" means apparatus for which the lithium cells or batteries will provide electrical power for its operation. The following packagings are authorized provided the general provisions of 4.1.1 and 4.1.3 are met:		
(1) For cells and batteries:		
<p style="margin-left: 40px;">Drums (1A2, 1B2, 1N2, 1H2, 1D, 1G); Boxes (4A, 4B, 4N, 4C1, 4C2, 4D, 4F, 4G, 4H1, 4H2); Jerricans (3A2, 3B2, 3H2).</p>		
Cells or batteries shall be packed in packaging so that the cells or batteries are protected against damage that may be caused by the movement or placement of the cells or batteries within the packaging.		
Packaging shall conform to the packing group II performance level.		
(2) In addition for cells or batteries with a gross mass of 12 kg or more employing a strong, impact resistant outer casing, and assemblies of such cells or batteries:		
<p style="margin-left: 40px;">(a) Strong outer packaging; (b) Protective enclosures (e.g. in fully enclosed or wooden slatted crates); or (c) Pallets or other handling devices.</p>		
Cells or batteries shall be secured to prevent inadvertent movement, and the terminals shall not support the weight of other superimposed elements.		
Packaging need not meet the requirements of 4.1.1.3.		
(3) For cells or batteries packed with equipment:		
Packaging conforming to the requirements in paragraph (1) of this packing instruction, then placed with the equipment in an outer packaging; or		
Packaging that completely enclose the cells or batteries, then placed with equipment in a packaging conforming to the requirements in paragraph (1) of this packing instruction.		
The equipment shall be secured against movement within the outer packaging.		
(4) For cells or batteries contained in equipment:		
Strong outer packaging constructed of suitable material, and of adequate strength and design in relation to the packaging capacity and its intended use. They shall be constructed in such a manner as to prevent accidental operation during carriage. Packaging need not meet the requirements of 4.1.1.3.		
Large equipment can be offered for carriage unpackaged or on pallets when the cells or batteries are afforded equivalent protection by the equipment in which they are contained.		
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 carried when intentionally active in strong outer packaging.		
<b>Additional requirement:</b>		
Cells or batteries shall be protected against short circuit.		

P908	PACKING INSTRUCTION	P908
<p>This instruction applies to damaged or defective lithium ion cells and batteries and damaged or defective lithium, defective metal cells and batteries, including those contained in equipment, of UN Nos. 3090, 3091, 3480 and 3481.</p>		
<p>The following packaging are authorized provided the general provisions of 4.1.1 and 4.1.3 are met:                      For cells and batteries and equipment containing cells and batteries:                          Drums (1A2, 1B2, 1N2, 1H2, 1D, 1G)                          Boxes (4A, 4B, 4N, 4C1, 4C2, 4D, 4F, 4G, 4H1, 4H2)                          Jerricans (3A2, 3B2, 3H2)</p> <p>Packaging shall conform to the packing group II performance level.</p> <ol style="list-style-type: none"> <li>1. Each damaged or defective cell or battery or equipment containing such cells or batteries shall be individually packed in inner packaging and placed inside an outer packaging. The inner packaging or outer packaging shall be leak-proof to prevent the potential release of electrolyte.</li> <li>2. Each inner packaging shall be surrounded by sufficient non-combustible and electrically non-conductive thermal insulation material to protect against a dangerous evolution of heat.</li> <li>3. Sealed packaging shall be fitted with a venting device when appropriate.</li> <li>4. Appropriate measures shall be taken to minimize the effects of vibrations and shocks, prevent movement of the cells or batteries within the package that may lead to further damage and a dangerous condition during carriage. Cushioning material that is non-combustible and electrically non-conductive may also be used to meet this requirement.</li> <li>5. Non combustibility shall be assessed according to a standard recognized in the country where the packaging is designed or manufactured.</li> </ol> <p>For leaking cells or batteries, sufficient inert absorbent material shall be added to the inner or outer packaging to absorb any release of electrolyte.</p> <p>A cell or battery with a net mass of more than 30 kg shall be limited to one cell or battery per outer packaging.</p>		
<p><b>Additional requirement:</b>                      Cells or batteries shall be protected against short circuit.</p>		

P909	PACKING INSTRUCTION	P909
<p>This instruction applies to UN Nos. 3090, 3091, 3480 and 3481 carried for disposal or recycling, either packed together with or packed without non-lithium batteries.</p>		
<ol style="list-style-type: none"> <li>(1) Cells and batteries shall be packed in accordance with the following:                         <ol style="list-style-type: none"> <li>(a) The following packaging are authorized, 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, 4N, 4C1, 4C2, 4D, 4F, 4G, 4H2); and                                  Jerricans (3A2, 3B2, 3H2).</li> <li>(b) Packaging shall conform to the packing group II performance level.</li> <li>(c) Metal packaging shall be fitted with an electrically non-conductive lining material (e.g. plastics) of adequate strength for the intended use.</li> </ol> </li> <li>(2) However, lithium ion cells with a Watt-hour rating of not more than 20 Wh, lithium ion batteries with a Watt-hour rating of not more than 100 Wh, lithium metal cells with a lithium content of not more than 1 g and lithium metal batteries with an aggregate lithium content of not more than 2 g may be packed in accordance with the following:                         <ol style="list-style-type: none"> <li>(a) In strong outer packaging up to 30 kg gross mass meeting the general provisions of 4.1.1, except 4.1.1.3, and 4.1.3.</li> <li>(b) Metal packaging shall be fitted with an electrically non-conductive lining material (e.g. plastics) of adequate strength for the intended use.</li> </ol> </li> <li>(3) For cells or batteries contained in equipment, strong outer packaging constructed of suitable material, and of adequate strength and design in relation to the packaging capacity and its intended use, may be used. Packaging need not meet the requirements of 4.1.1.3. Equipment may also be offered for carriage unpackaged or on pallets when the cells or batteries are afforded equivalent protection by the equipment in which they are contained.</li> </ol>		

(4) In addition, for cells or batteries with a gross mass of 12 kg or more employing a strong, impact resistant outer casing, strong outer packaging constructed of suitable material and of adequate strength and design in relation to the packaging's capacity and its intended use, may be used. Packaging need not meet the requirements of 4.1.1.3.

**Additional requirements:**

1. Cells and batteries shall be designed or packed to prevent short circuits and the dangerous evolution of heat.
2. Protection against short circuits and the dangerous evolution of heat includes, but is not limited to:
  - individual protection of the battery terminals,
  - inner packaging to prevent contact between cells and batteries,
  - batteries with recessed terminals designed to protect against short circuits, or
  - the use of an electrically non-conductive and non-combustible cushioning material to fill empty space between the cells or batteries in the packaging.
3. Cells and batteries shall be secured within the outer packaging to prevent excessive movement during carriage (e.g. by using a non-combustible and electrically non-conductive cushioning material or through the use of a tightly closed plastics bag).

P910	PACKING INSTRUCTION	P910
<p>This instruction applies to UN Nos. 3090. 3091. 3480 and 3481 production runs consisting of not more than 100 cells or batteries and to pre-production prototypes of cells or batteries when these prototypes are carried for testing.</p>		
<p>The following packaging are authorized provided that the general provision of <b>4.1.1</b> and <b>4.1.3</b> are met</p> <p>(1) For cells and batteries. including when packed with equipment:                      Drums (1A2, 1B2, 1N2, 1H2, 1D, 1G);                      Boxes (4A, 4B, 4N, 4C1, 4C2, 4D, 4F, 4G, 4H1, 4H2);                      Jerricans (3A2, 3B2, 3H2);</p> <p>Packaging shall conform to the packing group II performance level and shall meet the following requirements:</p> <ol style="list-style-type: none"> <li>a) Batteries and cells, including equipment, of different sizes, shapes or masses shall be packaged in an outer packaging of a tested design type listed above provided the total gross mass of the package does not exceed the gross mass for which the design type has been tested;</li> <li>b) Each cell or battery shall be individually packed in an inner packaging and placed inside an outer packaging;</li> <li>c) Each inner packaging shall be completely surrounded by sufficient non-combustible and electrically non-conductive thermal insulation material to protect against a dangerous evolution of heat;</li> <li>d) Appropriate measures shall be taken to minimize the effects of vibration and shocks and prevent movement of the cells or batteries within the package that may lead to damage and a dangerous condition during transport. Cushioning material that is non-combustible and electrically non-conductive may be used to meet this requirement;</li> <li>e) Non-combustibility shall be assessed according to a standard recognized in the country where the packaging is designed or manufactured;</li> <li>f) A cell or battery with a net mass of more than 30 kg shall be limited to one cell or battery per outer packaging.</li> </ol> <p>(2) For cells and batteries contained in equipment:                      Drums (1A2, 1B2, 1N2, 1H2, 1D, 1G);                      Boxes (4A, 4B, 4N, 4C1, 4C2, 4D, 4F, 4G, 4H1, 4H2);                      Jerricans (3A2, 3B2, 3H2).</p> <p>Packaging shall conform to the packing: group II performance level and shall meet the following requirements:</p>		

**ADR / RID – Packing Instructions**

- a) Equipment of different sizes, shapes or masses shall be packed in an outer packaging of a tested design type listed above provided the total gross mass of the package does not exceed the gross mass for which the design type has been tested;
  - b) The equipment shall be constructed or packaged in such a manner as to prevent accidental operation during transport;
  - c) Appropriate measures shall be taken to minimize the effects of vibration and shocks and prevent movement of the equipment within the package that may lead to damage and a dangerous condition during transport. When cushioning material is used to meet this requirement it shall be non-combustible and electrically non-conductive; and
  - d) Non-combustibility shall be assessed according to a standard recognized in the country where the packaging is designed or manufactured.
- (3) The equipment or the batteries may be carried unpackaged under conditions specified by the competent authority of any Contracting Party to ADR, which may also recognize an approval granted by the competent authority of a country which is not a Contracting Party to ADR, provided that this approval has been granted in accordance with the procedures applicable according to RID, ADR, ADN, the IMDG Code or the ICAO Technical Instructions. Additional conditions that may be considered in the approval process include but are not limited to:
- a) The equipment or the battery shall be strong enough to withstand the shocks and loadings normally encountered during carriage, including transshipment between cargo transport units and between cargo transport units and warehouses as well as any removal from a pallet for subsequent manual or mechanical handling; and
  - b) The equipment or the battery shall be fixed in cradles or crates or other handling devices in such a way that it will not become loose during normal conditions of carriage.

**Additional requirements**

The cells and batteries shall be protected against short circuit:

Protection against short circuits includes, but is not limited to,

- individual protection of the battery terminals,
- inner packaging to prevent contact between cells and batteries,
- batteries with recessed terminals designed to protect against short circuit, or
- the use of electrically non-conductive and non-combustible cushioning material to fill empty space between the cells or batteries in the packaging.

P911	PACKING INSTRUCTION	P911
<p>This instruction applies to damaged or defective cells and batteries of UN Nos. 3090, 3091, 3480 and 3481 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 carriage.</p>		
<p>The following packaging are authorized, provided that the general provision of <b>4.1.1</b> and <b>4.1.3</b> are met: For cells and batteries and equipment containing cells and batteries:</p> <p style="padding-left: 40px;">Drums (1A2, 1B2, 1N2, 1112, 1D, 1G); Boxes (4A, 4B, 4N, 4C1, 4C2, 4D, 4F, 4G, 4H1, 4112); Jerricans (3A2, 3B2, 3112)</p> <p>The packagings shall conform to the packing group I performance level.</p> <p>(1) The packaging shall be capable of meeting the following additional performance requirements in case of rapid disassembly, dangerous reaction, production of a flame or a dangerous evolution of heat or a dangerous emission of toxic, corrosive or flammable gases or vapours of the cells or batteries:</p> <ul style="list-style-type: none"> <li>(a) 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;</li> <li>(b) No flame will occur outside the package;</li> <li>(c) No projectiles will exit the package;</li> <li>(d) The structural integrity of the package shall be maintained</li> </ul>		

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(e) The packagings shall have a gas management system (e.g. filter system, air circulation, containment for gas, gas tight packaging etc.), as appropriate.

- (2) The additional packaging performance requirements shall be verified by a test as specified by the competent authority of any ADR Contracting Party provided that this test has been specified in accordance with the procedures applicable according to RID, ADR, AND, the OMDG Code or the ICAO Technical Instructions<sup>a</sup>.

A verification report shall be available on request. As a minimum requirement, the cell or battery name, the cell or battery number, the mass, type, energy content of the cells or batteries, the packaging identification and the test data according to the verification method as specified by the competent authority shall be listed in the verification report

- (3) 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.

#### Additional requirements

Cells or batteries shall be protected against short circuit.

<sup>a</sup> *The following criteria, as relevant, may be considered to assess the performance of the packaging:*

- (a) *The assessment shall be done under a quality management system (as described e.g. in section 2.2.9.1.7 (e)) allowing for the traceability of tests results, reference data and characterization models used;*
- (b) *The list of hazards expected in case of thermal run-away for the cell or battery type, in the condition it is carried (e.g. usage of an inner packaging, state of charge (SOC), use of sufficient non-combustible, electrically non-conductive and absorbent cushioning material etc.), shall be clearly identified and quantified; the reference list of possible hazards for lithium cells or batteries (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) can be used for this purpose. The quantification of this hazards shall rely on available scientific literature;*
- (c) *The mitigations effects of the packaging shall be identified and characterized, based on the nature of the protections provided and the construction material properties. A list of technical characteristics and drawings shall be used to support this assessment (Density [ $\text{kg m}^{-3}$ ], specific heat capacity [ $\text{J kg}^{-1}\text{K}^{-1}$ ] heating value [ $\text{kJ kg}^{-1}$ ], thermal conductivity [ $\text{W m}^{-1}\text{K}^{-1}$ ], melting temperature and flammability temperature [ $\text{K}$ ], heat transfer coefficient of the outer packaging [ $\text{W m}^{-2}\text{K}^{-1}$ ], ...);*
- (d) *The test and any supporting calculations shall assess the result of a thermal run-away of the cell or battery inside the packaging in the normal conditions of carriage;*
- (e) *In case the SOC of the cell or battery is not known, the assessment used, shall be done with the higher possible SOC corresponding to the cell or battery use conditions;*
- (f) *The surrounding conditions in which the packaging may be used and transported shall be described (including for possible consequences of gas or smoke emissions on the environment, such as ventilation or other methods) according to the gas management system of the packaging;*
- (g) *The tests or the model calculation shall consider the worst case scenario for the thermal run-away triggering and propagation inside the cell or battery: this scenario includes the worst possible failure in the normal transport condition, the maximum heat and flame emissions for the possible propagation of the reaction;*
- (h) *The scenario consequences shall be assessed over a period covering all possible consequences to occur (e.g. 24 hours)*

LP903	PACKING INSTRUCTION	LP903
This instruction applies to UN Nos. 3090, 3091, 3480 and 3481.		
<p>The following large packaging are authorized for a single battery, including for a battery contained in equipment, provided that the general provisions of 4.1.1 and 4.1.3 are met:</p> <p>Rigid large packaging conforming to the packing group II performance level, made of:</p> <ul style="list-style-type: none"> <li>steel (50A);</li> <li>aluminium (50B);</li> <li>metal other than steel or aluminium (50N);</li> <li>rigid plastics (50H);</li> <li>natural wood (50C);</li> <li>plywood (50D);</li> <li>reconstituted wood (50F);</li> <li>rigid fibreboard (50G).</li> </ul> <p>The battery or equipment shall be packed so that the battery or the equipment is protected against damage that may be caused by its movement or placement within the large packaging.</p>		
<p><b>Additional requirement:</b> Batteries shall be protected against short circuit.</p>		

LP904	PACKING INSTRUCTION	LP904
This instruction applies to single damaged or defective batteries or defective cells and batteries contained in a single item of equipment of UN Nos. 3090, 3091, 3480 and 3481.		
<p>The following large packaging are authorized for a single damaged or defective battery and for damaged or defective cells and batteries contained in a single item of equipment, provided the general provisions of 4.1.1 and 4.1.3 are met.</p> <p>For batteries and equipment containing cells and batteries:</p> <p>Rigid large packagings conforming to the packaging group II performance level, made of:</p> <ul style="list-style-type: none"> <li>steel (50A)</li> <li>aluminium (50B)</li> <li>metal other than steel or aluminium (50N)</li> <li>rigid plastics (50H)</li> <li>plywood (50D)</li> </ul> <ol style="list-style-type: none"> <li>1. The damaged or defective battery or equipment containing such a battery shall be individually packed in an inner packaging and placed inside an outer packaging. The inner packaging shall be leakproof to prevent the potential release of electrolyte.</li> <li>2. The inner packaging shall be surrounded by sufficient non-combustible and electrically non-conductive thermal insulation material to protect against a dangerous evolution of heat.</li> <li>3. Sealed packaging shall be fitted with a venting device when appropriate.</li> <li>4. Appropriate measures shall be taken to minimize the effects of vibrations and shocks, prevent movement of the battery or equipment within the package that may lead to further damage and a dangerous condition during carriage. Cushioning material that is non-combustible and electrically non-conductive may also be used to meet this requirement.</li> <li>5. Non combustibility shall be assessed according to a standard recognized in the country where the packaging is designed or manufactured.</li> </ol> <p>For leaking batteries, sufficient inert absorbent material shall be added to the inner or outer packaging to absorb any release of electrolyte.</p>		
<p><b>Additional requirement:</b> Batteries shall be protected against short circuit.</p>		



LP905	PACKING INSTRUCTION	LP905
<p>This instruction applies to UN Nos. 3090, 3091, 3480 and 3481 production runs consisting of not more than 100 cells and batteries and to pre-production prototypes of cells and batteries when these prototypes are carried for testing.</p>		
<p>The following large packagings are authorized for a single battery and for cells and batteries contained in a single item of equipment, provided that the general provisions of <b>4.1.1</b> and <b>4.1.3</b> are met:</p>		
<p>(1) For a single battery:</p>		
<p>Rigid large packagings conforming to the packing group II performance level, made of:</p>		
<ul style="list-style-type: none"><li>steel (50A);</li><li>aluminium (50B);</li><li>metal other than steel or aluminium (50N);</li><li>rigid plastics (5011);</li><li>natural wood (50C);</li><li>plywood (50D);</li><li>reconstituted wood (50F);</li><li>rigid fibreboard (50G).</li></ul>		
<p>Large packagings shall also meet the following requirements:</p>		
<ul style="list-style-type: none"><li>(a) A battery of different size, shape or mass may be packed in an outer packaging of a tested design type listed above provided the total gross mass of the package does not exceed the gross mass for which the design type has been tested;</li><li>(b) The battery shall be packed in an inner packaging and placed inside the outer packaging;</li><li>(c) The inner packaging shall be completely surrounded by sufficient non-combustible and electrically non-conductive thermal insulation material to protect against a dangerous evolution of heat;</li><li>(d) Appropriate measures shall be taken to minimize the effects of vibration and shocks and prevent movement of the battery within the package that may lead to damage and a dangerous condition during carriage. When cushioning material is used to meet this requirement it shall be non-combustible and electrically non-conductive; and</li><li>(e) Non-combustibility shall be assessed according to a standard recognized in the country where the large packaging is designed or manufactured.</li></ul>		
<p>(2) For a single item of equipment containing cells or batteries:</p>		
<p>Rigid large packagings conforming to the packing group IF performance level, made of:</p>		
<ul style="list-style-type: none"><li>Steel (50A);</li><li>Aluminium (50B);</li><li>Metal other than steel or aluminium (50N);</li><li>Rigid plastics (5011);</li><li>Natural wood (50C);</li><li>Plywood (50D);</li><li>Reconstituted wood (50F);</li><li>Rigid fibreboard (50G).</li></ul>		
<p>Large packagings shall also meet the following requirements:</p>		
<ul style="list-style-type: none"><li>(a) A single item of equipment of different size, shape or mass may be packed in an outer packaging of a tested design type listed above provided the total gross mass of the package does not exceed the gross mass for which the design type has been tested;</li><li>(b) The equipment shall be constructed or packed in such a manner as to prevent accidental operation during transport;</li><li>(c) Appropriate measures shall be taken to minimize the effects of vibration and shocks and prevent movement of the equipment within the package that may lead to damage and a dangerous condition during carriage. When cushioning material is used to meet this requirement, it shall be non-combustible and electrically non-conductive; and</li><li>(d) Non-combustibility shall be assessed according to a standard recognized in the country where the large packaging is designed or manufactured.</li></ul>		

**Additional requirement:**

Cells and batteries shall be protected against short circuit.

LP906	PACKING INSTRUCTION	LP906
<p>This instruction applies to single damaged or defective batteries of UN Nos. 3090, 3091, 3480 and 3481 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 carriage.</p>		
<p>The following large packaging are authorized for a single damaged or defective battery and for damaged or defective cells and batteries contained in a single item of equipment, provided the general provisions of 4.1.1 and 4.1.3 are met.</p> <p>For batteries and equipment containing cells and batteries:</p> <ul style="list-style-type: none"> <li>steel (50A);</li> <li>aluminium (50B);</li> <li>metal other than steel or aluminium (50N);</li> <li>rigid plastics (50H);</li> <li>plywood (50D);</li> <li>rigid fibreboard (50G)</li> </ul> <p>(1) The large packaging has to be capable of meeting the following additional performance requirements in case of rapid disassembly, dangerous reaction, production of a flame or a dangerous evolution of heat or a dangerous emission of toxic, corrosive or flammable gases or vapours of the battery:</p> <ul style="list-style-type: none"> <li>(a) 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;</li> <li>(b) No flame shall occur outside the package;</li> <li>(c) No projectiles shall exit the package;</li> <li>(d) The structural integrity of the package shall be maintained; and</li> <li>(e) The large packagings shall have a gas management system (e.g. filter system, air circulation, containment for gas, gas tight packaging etc.), as appropriate.</li> </ul> <p>(2) The additional large packaging performance requirements shall be verified by a test as specified by the competent authority of any ADR Contracting Party provided that this test has been specified in accordance with the procedures applicable according to RID, ADR, AND, the IMDG Code or the ICAO Technical Instructions<sup>a</sup>.</p> <p>A verification report shall be available on request. As a minimum requirement, the battery name, the battery number, the mass, type, energy content of the batteries, the large packaging identification and the test data according to the verification method as specified by the competent authority shall be listed in the verification report.</p> <p>(3) 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.</p>		

**Additional requirement:**

Batteries shall be protected against short circuit.

<sup>a</sup> The following criteria, as relevant, may be considered to assess the performance of the packaging:

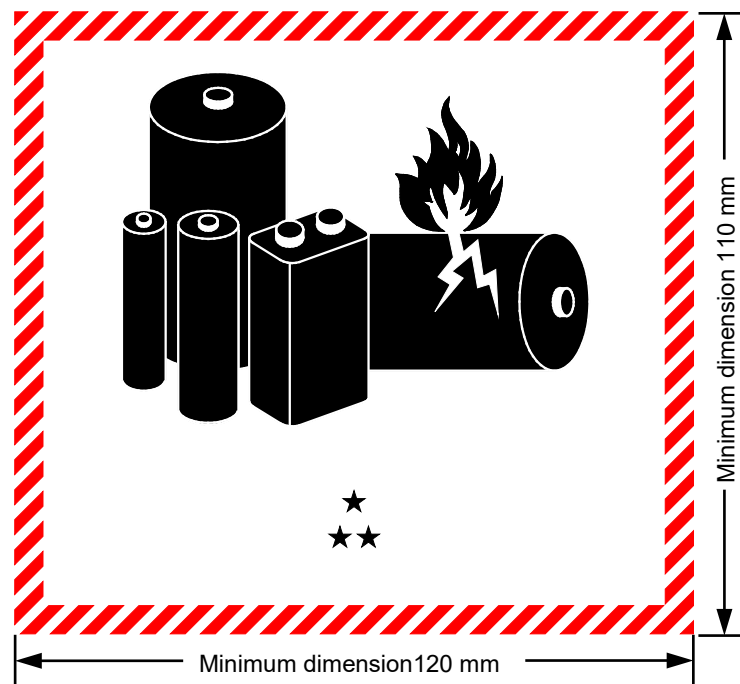
- (a) The assessment shall be done under a quality management system (as described e.g. in section 2.9.4 (e)) allowing for the traceability of tests results, reference data and characterization models used;
- (b) The list of hazards expected in case of thermal runaway for the cell or battery type, in the condition it is transported (e.g. usage of an inner packaging, state of charge (SOC), use of sufficient non-combustible, electrically non-conductive and absorbent cushioning material etc.), shall be clearly identified and quantified; the reference list of possible hazards for lithium cells or batteries (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) can be used for this purpose. The quantification of this hazards shall rely on available scientific literature;
- (c) The mitigations effects of the packaging shall be identified and characterized, based on the nature of the protections provided and the construction material properties. A list of technical characteristics and drawings shall be used to support this assessment (Density [ $\text{kg m}^{-3}$ ], specific heat capacity [ $\text{J kg}^{-1}\text{K}^{-1}$ ] heating value [ $\text{kJ kg}^{-1}$ ], thermal conductivity [ $\text{W m}^{-1} \text{K}^{-1}$ ], melting temperature and flammability temperature [ $\text{K}$ ], heat transfer coefficient of the outer packaging [ $\text{W m}^{-2} \text{K}^{-1}$ ], ...);
- (d) The test and any supporting calculations shall assess the result of a thermal run-away of the battery inside the packaging in the normal conditions of carriage;
- (e) In case the SOC of the battery is not known, the assessment used, shall be done with the higher possible SOC corresponding to the cell or battery use conditions;
- (f) The surrounding conditions in which the packaging may be used and transported shall be described (including for possible consequences of gas or smoke emissions on the environment, such as ventilation or other methods) according to the gas management system of the packaging;
- (g) The tests or the model calculation shall consider the worst case scenario for the thermal runaway triggering and propagation inside the cell or battery: this scenario includes the worst possible failure in the normal transport condition, the maximum heat and flame emissions for the possible propagation of the reaction;
- (h) These scenario shall be assessed over a period of long enough covering to allow all the possible consequences to occur (i.e. 24 hours).

### 5.2.1.9 Lithium battery mark

Packages containing lithium cells or batteries prepared in accordance with special provision 188 shall be marked as shown in Figure 5.2.1.9.2.

The mark shall indicate the UN number preceded by the letters "UN", i.e. 'UN 3090' for lithium metal cells or batteries or 'UN 3480' for lithium ion cells or batteries. Where the lithium cells or batteries are contained in, or packed with, equipment, the UN number preceded by the letter "UN", i.e. 'UN 3091' or 'UN 3481' as appropriate shall be indicated. Where a package contains lithium cells or batteries assigned to different UN numbers, all applicable UN numbers shall be indicated on one or more marks.

Abbildung 5.2.1.9.2



Lithium battery mark

\* Place for UN number(s)

\*\* Place for telephone number für additional information

The mark shall be in the form of rectangle with hatched edging. The dimensions shall be a minimum of 120 mm wide x 110 mm high and the minimum width of the hatching shall be 5 mm. The symbol (group of batteries, one damaged and emitting flame, above the UN number for lithium ion or lithium metal batteries or cells) shall be black on white or suitable contrasting background. The hatching shall be red. If the size of the packages so requires, the dimensions/ line thickness may be reduced to not less than 105 mm wide x 74 mm high. Where dimensions are not specified, all features shall be in approximate proportion to those shown.

## Transport Regulations Aircraft

## IATA DGR 2020

## Overview

UN 3090	LITHIUM METAL BATTERIES						see Chapter
UN 3091	LITHIUM METAL BATTERIES CONTAINED IN EQUIPMENT or						
	LITHIUM METAL BATTERIES PACKED WITH EQUIPMENT						
Class	9	Miscellaneous dangerous goods	x	x	x	3.9	
Sub risk	-						
Classification		Lithium batteries	x	x	x	3.9.2.6	
Packing Group		See packing instructions				3.0.3	
Packing instructions	968	Lithium batteries			x	5.9	
	970	Lithium batteries contained in equipment		x		5.9	
	969	Lithium batteries packed with equipment	x			5.9	
Hazard label	9	Lithium batteries	x	x	x	7.3.18.2	
Exempted Quantity	E0	No	x	x	x	2.6	
Limited Quantity	-	Forbidden	x	x	x	2.7	
Max. Net mass	5 kg	See packing instructions	<sup>3)</sup>	<sup>3)</sup>	<sup>3)</sup> x		
Cargo aircraft	Max. Net mass	35 kg	See packing instructions	<sup>3)</sup>	<sup>3)</sup>	<sup>3)</sup> x	
	Handling label	Yes	Cargo Aircraft Only	x	x	x	7.4.2
Special Provisions	A48	Packaging tests		x		4.4	
	A88	Prototypes	x	x	x		
	A99	Over 35 kg	x	x	x		
	A154	Defective batteries	x	x	x		
	A164	Heat development	x	x	x		
	A181	Various combinations	x	x			
	A182	Equipment containing only lithium batteries	<sup>4)</sup>	<sup>4)</sup>			
	A183	No waste batteries			x		
	A185	Battery powered vehicles	x	x			
	A201	Special Exemptions			x		
	A206	Transition period	x	x	x		
	A213	Hybrid batteries	x	x	x		
	A334	Transport with permission			x		
	A802	Packaging group			x		
ERG <sup>1</sup> Code	12FZ		x	x	x	ICAO <sup>2</sup>	

<sup>1)</sup> Emergency Response Drill Code

<sup>2)</sup> Doc 9481-AN/928

<sup>3)</sup> see applicable packing instruction

<sup>4)</sup> must be classified as either UN 3091 or UN 3481

### 3.9.2.6 Lithium Batteries

#### 3.9.2.6.0 Assigned entries

- UN 3090 **Lithium metal batteries**
- UN 3091 **Lithium metal batteries contained in equipment** or **Lithium metal batteries packed with equipment**
- UN 3480 **Lithium ion batteries**
- UN 3481 **Lithium ion batteries contained in equipment** or **Lithium ion batteries packed with equipment**
- UN 3536 **Lithium batteries installed in cargo transport units**

**3.9.2.6.1** Cells and batteries, cells and batteries contained in equipment, or cells and batteries packed with equipment, containing lithium in any form must be assigned to UN 3090, UN 3091, UN 3480 or UN 3481, as appropriate. 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 each test of the UN Manual of Tests and Criteria, Part III, subsection 38.3. Cells and batteries manufactured according to a type meeting the requirements of subsection 38.3 of the UN Manual of Tests and Criteria, Revision 3, Amendment 1 or any subsequent revision and amendment applicable at the date of the type testing may continue to be transported, unless otherwise provided in these Regulations. Cell and battery types only meeting the requirements of the UN Manual of Tests and Criteria, Revision 3, are no longer valid. However, cells and batteries manufactured in conformity with such types before 1 July 2003 may continue to be transported if all other applicable requirements are fulfilled.

**Note:**

*Batteries, including those which have been refurbished or otherwise altered, must be of a type proved to meet the testing requirements of the Manual of Tests and Criteria, Part III, subsection 38.3, irrespective of whether the cells of which they are composed are of a tested type.*

- (b) each cell and battery incorporates a safety venting device or is designed to preclude a violent rupture under conditions normally incident to transport;
- (c) each cell and battery is equipped with an effective means of preventing external short circuits;
- (d) each battery containing cells or 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 that includes:
1. a description of the organizational structure and responsibilities of personnel with regard to design and product quality;
  2. the relevant inspection and test, quality control, quality assurance, and process operation instructions that will be used;
  3. process controls that should include relevant activities to prevent and detect internal short circuit failure during manufacture of cells;
  4. quality records, such as inspection reports, test data, calibration data and certificates. Test data must be kept and made available to the appropriate national authority upon request;
  5. management reviews to ensure the effective operation of the quality management programme;
  6. a process for control of documents and their revision;
  7. a means for control of cells or batteries that are not conforming to the type tested as mentioned in (a) above;
  8. training programmes and qualification procedures for relevant personnel; and
  9. procedures to ensure that there is no damage to the final product.

**Note:**

*In house quality management programmes may be accepted. Third party certification is not required, but the procedures listed in 1. to 9. above must be properly recorded and traceable. A copy of the quality management programme must be made available to the appropriate national authority upon request.*

- (f) lithium batteries, containing both primary lithium metal cells and rechargeable lithium ion cells, that are not designed to be externally charged (see Special Provision A213) must meet the following conditions:
1. the rechargeable lithium ion cells can only be charged from the primary lithium metal cells;
  2. overcharge of the rechargeable lithium ion cells is precluded by design;
  3. the battery has been tested as a lithium primary battery;
  4. component cells of the battery must be of a type proved to meet the respective testing requirements of the UN Manual of Tests and Criteria, Part III, sub-section 38.3.
- (g) manufacturers and subsequent distributors of cells or batteries manufactured after 30 June 2003 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.

**IATA Special Provision A48**

Packaging tests are not considered necessary.

**IATA Special Provision A88**

Pre-production prototypes of lithium batteries or cells, when these prototypes are transported for testing, or low production runs, (i.e. annual production runs consisting of no more than 100 lithium cells or batteries) of lithium cells or batteries that have not been tested to the requirements in 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 requirements in Packing Instruction 910 of the Supplement to the Technical Instructions 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 Shipper's Declaration.

Irrespective of the limit specified in Column L of Table 4.2, the battery or battery assembly as prepared for transport may have a mass exceeding 35 kg.

**IATA Special Provision A99**

Irrespective of the per package quantity limit for cargo aircraft specified in Column L of the List of Dangerous Goods (Subsection 4.2) and in Section I of Packing Instructions 965, 966, 967, 968, 969 or 970, a lithium battery or battery assembly (UN 3090 or UN 3480), including when packed with, or contained in equipment (UN 3091 or UN 3481) 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. A copy of the document of approval must accompany the consignment.

**IATA Special Provision A154**

Lithium batteries identified by the manufacturer as being defective for safety reasons, or that have been damaged, 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 damaged or defective prior to transport).

**IATA Special Provision A164**

Any electrical battery or battery powered device, equipment or vehicle having the potential of a dangerous evolution of heat must be prepared for transport so as to prevent:

- (a) a short circuit (e.g. in the case of batteries by the effective insulation of exposed terminals; or in the case of equipment, by disconnection of the battery and protection of exposed terminals); and
- (b) unintentional activation.

**IATA Special Provision A181**

When a package contains a combination of lithium batteries contained in equipment and lithium batteries packed with equipment, the following requirements apply:

- (a) the shipper must ensure that all applicable parts of both packing instructions are met. The total weight of lithium batteries contained in any package must not exceed the limits for passenger aircraft or cargo aircraft, as applicable;
- (b) the package must be marked UN 3091 **Lithium metal batteries packed with equipment**, or UN 3481 **Lithium ion batteries packed with equipment** as appropriate. If a package contains both lithium ion batteries and lithium metal batteries packed with and contained in equipment, the package must be marked as required for both battery types. However, button cell batteries installed in equipment (including circuit boards) need not be considered.
- (c) the Shipper's Declaration must indicate UN 3091 **Lithium metal batteries packed with equipment** or UN 3481 **Lithium ion batteries packed with equipment**, as appropriate. If a package contains both lithium metal batteries and lithium ion batteries packed with and contained in equipment, then the dangerous goods transport document must indicate both UN 3091 **Lithium metal batteries packed with equipment** and UN 3481 **Lithium ion batteries packed with equipment**.

**IATA Special Provision A182**

Equipment containing only lithium batteries must be classified as either UN 3091 or UN 3481

**IATA Special Provision A183**

Waste batteries and 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.

**IATA Special Provision A185**

Vehicles only powered by lithium metal batteries or lithium ion batteries must be consigned under the entry UN 3171, **Battery-powered vehicles**.

**IATA Special Provision A201**

In instances where other forms of transport (including cargo aircraft) is impracticable, lithium cells or batteries may be transported as Class 9 (UN 3480 or UN 3090) on passenger aircraft with the prior approval of the authority of the State of Origin, the State of the Operator and the State of Destination under the written conditions established by those authorities, provided that the quantities per package do not exceed:

(a) for lithium metal cells or batteries:

1. up to 2 batteries with a lithium content more than 0.3 g but not more than 2 g per battery; or
2. up to 8 cells with a lithium content more than 0.3 g but not more than 1 g per cell; or
3. up to 2.5 kg of cells and/or batteries with a lithium content not more than 0.3 g per cell or battery; or

(b) for lithium ion cells or batteries:

1. up to 2 batteries with a Watt-hour (Wh) rating more than 2.7 Wh but not more than 100 Wh per battery; or
2. up to 8 cells with a Watt-hour rating more than 2.7 Wh but not more than 20 Wh per cell; or
3. up to 2.5 kg of cells and/or batteries with a Watt-hour rating not more than 2.7 Wh per cell or battery.

When States, other than the State of Origin, the State of the Operator or State of Destination have lodged a variation advising that they require prior approval of shipments made under this special provision, approval must also be obtained from these States, as appropriate. The marking and labelling requirements of Section 7 for Class 9 (UN 3090 or UN 3480) lithium metal and lithium ion batteries apply. 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 Shipper's Declaration.

If transport in accordance with this special provision is not possible, States concerned may grant an exemption from the prohibition to transport lithium metal or lithium ion batteries on passenger aircraft in accordance with 1.2.6.

Authorities issuing approvals or exemptions in accordance with this special provision must provide a copy to the Chief of the Cargo Safety Section within three months of issuance via email at: [CSS@icao.int](mailto:CSS@icao.int), via facsimile at +1 514-954-6077 or via post to the following address:

Chief, Cargo Safety Section  
International Civil Aviation Organization  
999 Robert Bourassa Boulevard  
Montreal, Quebec  
CANADA H3C 5H7

**Note:** *Guidance for the processing of approvals or exemptions from the prohibition to transport lithium batteries may be found in Part S-1;4 of the ICAO Supplement to the Technical Instructions, see also special provision A334.*

**IATA Special Provision A206**

The hazard label must conform to that shown in Figure 7.3.X.

**IATA Special Provision A213**

Lithium batteries in conformity with 3.9.2.6.1(f) containing both primary lithium metal cells and rechargeable lithium ion cells must be assigned to UN 3090 or UN 3091, as appropriate. When such batteries are transported in accordance with Section II of Packing Instruction 968, 969, or 970, the total lithium content of all lithium metal cells contained in the battery must not exceed 1.5 g and the total capacity of all lithium ion cells contained in the battery must not exceed 10 Wh.

**IATA Special Provision A334**

In instances where other forms of transport (including cargo aircraft) is impracticable, lithium cells or batteries may be transported on passenger aircraft with the prior approval of the authority of the State of Origin, the State of the Operator and the State of Destination under the written conditions established by those authorities, provided that the following types and quantities are met:

- (a) quantities of lithium metal cells or batteries (UN 3090) are limited to the allowance permitted in Table 968-II of Packing Instruction 968; and
- (b) quantities of lithium ion cells or batteries (UN 3480) are limited to the allowance permitted in Table 965-II of Packing Instruction 965.

When considering an approval, at a minimum, authorities should consider the following criteria to mitigate risks posed by a lithium cell or battery heat, smoke or fire event inside a package at the cell, battery or package level:

- (a) no amount of flame is allowed outside the package;
- (b) the external surface temperature of the package cannot exceed the amount that would ignite adjacent packing material or cause batteries or cells in adjacent packages to go into thermal runaway;
- (c) no fragments can exit the package and the package must maintain structural integrity;
- (d) the quantity of flammable vapour emitted must be less than the amount of gas that when mixed with air and ignited could cause a pressure pulse that could dislodge the overpressure panels of the aircraft cargo compartment or damage the aircraft cargo compartment liners; and



- (e) when the package or overpack is exposed to an external fire (e.g. five-minute oil burner flame penetration resistance test) or elevated temperature environment (e.g. oven thermal resistance test), any hazardous effects caused by thermal runaway of the lithium cell or battery must be contained within the package.

Adequate information and documentation on the above criteria (a) through (e) must be provided to the appropriate authority of the State issuing the approval upon request.

**IATA Special Provision 802**

Notwithstanding the absence of a packing group in column E, substances and articles assigned to these entries must be packed in UN Specification packaging that meet packing group II performance standards. This does not apply when aerosols are prepared for transport in accordance with the limited quantity provisions or for lithium batteries prepared in accordance with Section IB of Packing Instruction 965 or 968.

**Note:** For the purposes of identification and documentation the packing group as shown in table 4.2 applies and is to be used in the completion of the Shipper's Declaration, regardless of a packaging required to meet higher packing group performance standard as indicated above.

## PACKING INSTRUCTION 968

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STATE VARIATION and OPERATOR VARIATIONS have to be considered

### Introduction

This instruction applies to lithium metal or lithium alloy cells and batteries (UN 3090) on Cargo Aircraft Only.

The general requirements apply to all lithium metal batteries prepared for transport according to this packing instruction:

- Section IA applies to lithium metal cells with a lithium metal content in excess of 1 g and lithium metal batteries with an aggregate lithium content in excess of 2 g, or to quantities of lithium metal cells or batteries in excess of those permitted in Section IB of this packing instruction which must be assigned to Class 9 and are subject to all of the applicable requirements of these Regulations;
- Section IB applies to lithium metal cells with a lithium metal content not exceeding 1 g and lithium metal batteries with an aggregate lithium content not exceeding 2 g packed in quantities that exceed the allowance permitted in Section II, Table 968-II; and
- Section II applies to lithium metal cells with a lithium metal content not exceeding 1 g and lithium metal batteries with an aggregate lithium content not exceeding 2 g packed in quantities not exceeding the allowance permitted in Section II, Table 968-II.

A single cell battery as defined in Part III, subsection 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.

**Note:** A lithium battery guidance document is available at the following link –  
<http://www.iata.org/whatwedo/cargo/dgr/Documents/lithium-battery-shipping-guidelines.pdf>

### General Requirements

The following requirements apply to all lithium metal or lithium alloy cells and batteries:

- (a) cells and batteries identified by the manufacturer as being defective for safety reasons, or that have been damaged, 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);
- (b) waste batteries and batteries being shipped for recycling or disposal are prohibited from air transport unless approved by the appropriate national authority of the State of origin and the State of the operator;
- (c) cells and batteries must be protected so as to prevent short circuits. This includes protection against contact with electrically conductive materials within the same packaging that could lead to a short circuit.

### Section IA

These requirements apply to lithium metal cells with a lithium metal content in excess of 1 g and lithium metal batteries with an aggregate lithium content in excess of 2 g that have been determined to meet the criteria for assignment to Class 9.

The General Packing Requirements of 5.0.2 must be met.

Each cell or battery must:

- (a) meet the provisions of 3.9.2.6.1; and
- (b) meet the General Requirements, above.

### Additional Requirements - Section IA

- cells and batteries must be placed in inner packaging 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 standards;
- cells and batteries must not be packed in the same outer packaging with dangerous goods classified in 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);
- batteries with a weight of 12 kg or greater and having a strong, impact-resistant outer casing, or assemblies of such batteries, may be transported when packed in strong outer packaging or protective enclosures (e.g. in fully enclosed or wooden slatted crates) not subject to the requirements of Section 6 of these Regulations, if approved by the appropriate national authority of the State of origin. A copy of the document of approval must accompany the consignment.
- packages containing cells or batteries must not be placed in an overpack with packages containing dangerous goods classified in Class 1 other than Division 1.4S, Division 2.1, Class 3, Division 4.1 or Division 5.1.

TABLE 968-IA

UN number	Net quantity per package Passenger aircraft	Net quantity per package Cargo Aircraft Only
UN 3090 <b>Lithium metal batteries</b>	Forbidden	35 kg

**OUTER PACKAGING**

Type	Drums						Jerricans			Boxes							
Desc.	Steel	Alu- minium	Ply- wood	Fibre	Plastic	Other metal	Steel	Alu- minium	Plastic	Steel	Alu- minium	Wood	Ply- wood	Recon- stituted wood	Fibre- board	Plastic	Other metal
Spec.	1A2	1B2	1D	1G	1H2	1N2	3A2	3B2	3H2	4A	4B	4C1 4C2	4D	4F	4G	4H2	4N

**Section IB**

Lithium metal or lithium alloy cells and batteries may be offered for transport provided that each cell and battery meets the provisions of 3.9.2.6.1(a), (e), (f) if applicable and (g) and they meet all of the following:

- (a) for a lithium metal cell, the lithium content is not more than 1 g; and
- (b) for a lithium metal or lithium alloy battery, the aggregate lithium content is not more than 2 g.

Section IB requirements apply to cells and batteries packed in quantities that exceed the allowance permitted in Section II, Table 968-II.

Quantities of lithium metal cells or batteries prepared in accordance with this section are subject to all of the applicable provisions of these Regulations (including the General Requirements of this packing instruction), except for the provisions of Section 6.

Cells or batteries shipped under the provisions of Section IB must be described on a Shipper's Declaration as set out in Section 8 and the air waybill, when used, must contain the applicable information required by 8.2.1 and 8.2.2.

Cells and batteries must be packed in strong outer packaging that conform to 5.0.2.4, 5.0.2.6.1 and 5.0.2.12.1.

**Additional Requirements - Section IB**

Cells and batteries must be packed in inner packagings that completely enclose the cell or battery. To provide protection from damage or compression to the batteries, the inner packagings must be placed in a strong rigid outer packaging of one of the packaging types shown below.

Cells and batteries must not be packed in the same outer packaging with dangerous goods classified in 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).

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.

Packages containing cells or batteries must not be placed in an overpack with packages containing dangerous goods classified in Class 1 other than Division 1.4S, Division 2.1, Class 3, Division 4.1 or Division 5.1.

Each package must be durably and legibly marked with the mark shown in Figure 7.1C in addition to the Class 9 - Lithium Battery hazard label (Figure 7.3.X) and the Cargo Aircraft Only label (Figure 7.4.B).

Each package must be marked in accordance with the requirements of 7.1.4.1(a) and (b) and in addition the net weight when required by 7.1.4.1(c) must be marked on the package.

TABLE 968-IB

	Net quantity per package Passenger aircraft	Net quantity per package Cargo Aircraft Only
Lithium metal cells and batteries	Forbidden	2.5 kg

**OUTER PACKAGING**

Type	Drums						Jerricans			Boxes							
Desc.	Steel	Alu- minium	Ply- wood	Fibre	Plastic	Other metal	Steel	Alu- minium	Plastic	Steel	Alu- minium	Wood	Ply- wood	Recon- stituted wood	Fibre- board	Plastic	Other metal

## Section II

Lithium metal or lithium alloy cells and batteries meeting the requirements in this section are not subject to other additional requirements of these Regulations except for:

- (a) restrictions on dangerous goods in consolidations (1.3.3.2.3 and 1.3.3.2.6);
- (b) provision of adequate instruction (1.6);
- (c) dangerous goods in passenger and crew baggage (Subsections 2.3.). Only those lithium metal batteries as specifically permitted may be carried in carry-on baggage;
- (d) dangerous goods in air mail (Subsection 2.4);
- (e) use of unit load devices (5.0.1.3);
- (f) marking of packages (7.1.5.5);
- (g) loading of cargo aircraft (9.3.4);
- (h) reporting of dangerous goods accidents, incidents and other occurrences (9.6.1 and 9.6.2).

Cells and batteries offered for transport must meet the provisions of 3.9.2.6.1(a), (e), (f) if applicable and (g), the General Requirements of this packing instruction and:

- (a) for cells, the lithium content is not more than 1 g; and
- (b) for batteries, the aggregate lithium content is not more than 2 g.

Cells and batteries must be packed in strong outer packaging that conform to 5.0.2.4, 5.0.2.6.1 and 5.0.2.12.1.

### Additional Requirements - Section II

Cells and batteries must be packed in inner packaging that completely enclose the cell or battery. To provide protection from damage or compression to the batteries, the inner packaging must be placed in a strong rigid outer packaging of one of the packaging types shown below.

Cells and batteries must not be packed in the same outer packaging with other dangerous goods.

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 durably and legibly marked with the lithium battery mark, Figure 7.1.C, as required by 7.1.5.5 and the Cargo Aircraft Only label (Figure 7.4.B). The package must be of such size that there is adequate space to affix the mark on one side of the package without the mark being folded. When the package dimensions are adequate, the Cargo Aircraft Only label must be located on the same surface of the package near the lithium battery mark.

A Shipper's Declaration for Dangerous Goods is not required.

A shipper is not permitted to offer for transport more than one (1) package prepared according to this section in any single consignment.

The words "Lithium metal batteries in compliance with Section II of PI 968" and "Cargo Aircraft Only" or "CAO" must be included on the air waybill, when an air waybill is used. The information should be shown in the "Nature and Quantity of Goods" box of the air waybill.

Packages and overpacks containing lithium batteries prepared in accordance with the provisions of Section II must be offered to the operator separately from cargo that is not subject to these Regulations and must not be located into a unit load device before being offered to the operator.

Any person preparing or offering cells or batteries for transport must receive adequate instruction on these requirements commensurate with their responsibilities. Information on adequate instruction can be found in subsection 1.6.

### Overpack - Section II

Not more than one (1) package complying with the requirements of Section II may be placed in an overpack. The overpack may also contain packages of dangerous goods, other than dangerous goods classified in Class 1 other than Division 1.4S, Division 2.1, Class 3, Division 4.1 and Division 5.1, or goods not subject to these Regulations provided that the packages do not contain substances which might react dangerously with each other. An overpack must be marked with the word "Overpack" in lettering at least 12 mm high and durably and legibly marked with the mark shown in Figure 7.1C and the Cargo Aircraft Only label (Figure 7.4.B), unless the mark and label representative of those on the package inside the overpack are visible.

#### Note:

*For the purpose of Section II, an overpack is an enclosure used by a single shipper that contains no more than one package prepared in accordance with this section. For shipments prepared in accordance with Section IA and/or IB, this limit of one package of Section II batteries per overpack still applies.*

TABLE 968-II

Contents	Lithium metal cells and/or batteries with a lithium content of 0.3 g or less	Lithium metal cells with a lithium content of more than 0.3 g but not more than 1 g	Lithium metal batteries with a lithium content of more than 0.3 g but not more than 2 g
1	2	3	4
Maximum number of cells/batteries per package	No limit	8 cells	2 Batteries
Maximum net quantity (weight) per package	2.5 kg	N/A	N/A

Cells and/or batteries specified in columns 2, 3 and 4 of Table 968-II must not be combined in the same package.

**OUTER PACKAGINGS**

Type	Drums						Jerricans			Boxes							
Desc.	Steel	Alu-minium	Ply-wood	Fibre	Plastic	Other metal	Steel	Alu-minium	Plastic	Steel	Alu-minium	Wood	Ply-wood	Reconstituted wood	Fibre-board	Plastic	Other metal

**PACKING INSTRUCTION 969**

STATE VARIATION and OPERATOR VARIATIONS have to be considered

**Introduction**

This instruction applies to lithium metal or lithium alloy cells and batteries packed with equipment (UN 3091) on passenger and Cargo Aircraft Only.

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

The general requirements apply to all lithium metal batteries packed with equipment prepared for transport according to this packing instruction:

- Section I applies where equipment is packed with lithium metal cells with a lithium metal content in excess of 1 g or lithium metal batteries with an aggregate lithium content in excess of 2 g which must be assigned to Class 9 and are subject to all of the applicable requirements of these Regulations; and
- Section II applies where equipment is packed with lithium metal cells with a lithium metal content not exceeding 1 g or lithium metal batteries with an aggregate lithium content not exceeding 2 g.

A single cell battery as defined in Part III, of subsection 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.

**Note:** A lithium battery guidance document is available at the following link – <http://www.iata.org/whatwedo/cargo/dgr/Documents/lithium-battery-shipping-guidelines.pdf>

**General Requirements**

The following requirements apply to all lithium metal or lithium alloy cells and batteries:

- cells and batteries identified by the manufacturer as being defective for safety reasons, or that have been damaged, 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);
- cells and batteries must be protected so as to prevent short circuits. This includes protection against contact with electrically conductive materials within the same packaging that could lead to a short circuit.

**Section I**

These requirements apply to lithium metal cells with a lithium metal content in excess of 1 g and lithium metal batteries with an aggregate lithium content in excess of 2 g that been determined to meet the criteria for assignment to Class 9.

The General Packing Requirements of 5.0.2 must be met.

Each cell or battery must:

- meet the provision of 3.9.2.6.1; and
- meet the General Requirements, above;

**Additional Requirements - Section I**

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:

- cells and/or batteries must:
  - be completely enclosed in inner packagings then placed in an outer packaging. The completed package for the cells or batteries must meet the Packing Group II performance standards; or
  - be completely enclosed in inner packagings then placed with equipment in a package that meets the Packing Group II performance standards.
- the equipment must be secured against movement within the outer packaging and must be equipped with an effective means of preventing accidental activation.

**Lithium metal and lithium alloy cells and batteries prepared for transport on Passenger Aircraft as Class 9:**

- must be packed in either a rigid metal intermediate or a metal outer packaging;
- cells and batteries must be surrounded by cushioning material that is non-combustible and non-conductive and being placed in either the metal intermediate or metal outer packaging;
- when the package does not meet the above requirements, the package(s) must bear the "Cargo Aircraft Only" label and the Shipper's Declaration must indicate "Cargo Aircraft Only".

**TABLE 969-I**

UN number	Net quantity per package Passenger aircraft	Net quantity per package Cargo Aircraft Only
UN 3091 <b>Lithium metal batteries packed with equipment</b>	5 kg	35 kg

**OUTER PACKAGING**

Type	Drums						Jerricans			Boxes							
Desc.	Steel	Alu- minium	Ply- wood	Fibre	Plastic	Other metal	Steel	Alu- minium	Plastic	Steel	Alu- minium	Wood	Ply- wood	Recon- stituted wood	Fibre- board	Plastic	Other metal
Spec.	1A2	1B2	1D	1G	1H2	1N2	3A2	3B2	3H2	4A	4B	4C1 4C2	4D	4F	4G	4H2	4N

**Section II**

Lithium metal or lithium alloy cells and batteries meeting the requirements in this section are not subject to other additional requirements of these Regulations except for:

- (a) provision of adequate instruction (1.6);
- (b) dangerous goods in passenger and crew baggage (Subsection 2.3). Only those lithium metal batteries as specifically permitted may be carried in carry-on baggage;
- (c) dangerous goods in air mail (Subsection 2.4);
- (d) marking of packages (7.1.5.5);
- (e) reporting of dangerous goods accidents, incidents and other occurrences (9.6.1 and 9.6.2).

Cells and batteries offered for transport must meet the provisions of 3.9.2.6.1(a), (e), (f) if applicable and (g), the General Requirements of this packing instruction; and:

- (a) for cells, the lithium content is not more than 1g; and
- (b) for batteries, the aggregate lithium content is not more than 2 g;

Cells and batteries must be packed in strong outer packaging that conform to 5.0.2.4, 5.0.2.6.1 and 5.0.2.12.1.

**Additional Requirements - Section II**

Cells and/or batteries must:

- be completely enclosed in inner packagings then placed in a strong rigid outer packaging; or
- be completely enclosed in inner packagings then placed with equipment in a strong rigid outer packaging.

The equipment must be secured against movement within the outer packaging and must be equipped with an effective means of preventing accidental activation.

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 durably and legibly marked with the lithium battery mark, Figure 7.1.C, as required by 7.1.5.5. The package must be of such size that there is adequate space to affix the mark on one side of the package without the mark being folded.

A Shipper's Declaration for Dangerous Goods is not required.

The words "Lithium metal batteries in compliance with Section II of PI 969" must be included on the air waybill, when an air waybill is used. The information should be shown in the "Nature and Quantity of Goods" box of the air waybill.

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 weight of lithium batteries contained in any package must not exceed 5 kg;
- the words "lithium metal batteries, in compliance with Section II of PI 969" 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 their responsibilities. Information on adequate instruction can be found in subsection 1.6.

**Overpacks - Section II**

Individual packages each complying with the requirements of Section II may be placed in an overpack. The overpack may also contain packages of dangerous goods or goods not subject to these Regulations provided that the packages do not contain substances which might react dangerously with each other. An overpack must be marked with the word "Overpack" in lettering at least 12 mm high and durably and legibly marked with the mark shown in Figure 7.1.C, unless the marks representative of those on the package(s) inside the overpack are visible.

**TABLE 969-II**

		Passenger aircraft						Cargo Aircraft									
Net quantity of lithium metal cells or batteries per package		5 kg						5 kg									
<b>OUTER PACKAGING</b>																	
Type	Drums						Jerricans			Boxes							
Desc.	Steel	Alu-minium	Ply-wood	Fibre	Plastic	Other metal	Steel	Alu-minium	Plastic	Steel	Alu-minium	Wood	Ply-wood	Recon-stituted wood	Fibre-board	Plastic	Other metal

## PACKING INSTRUCTION 970

STATE VARIATION and OPERATOR VARIATIONS have to be considered

### Introduction

This instruction applies to lithium metal or lithium alloy cells and batteries contained in equipment (UN 3091) on passenger and Cargo Aircraft Only.

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

The general requirements apply to all lithium metal and lithium alloy cells and batteries contained in equipment prepared for transport according to this packing instruction:

- Section I applies where equipment contains lithium metal cells with a lithium metal content in excess of 1 g or lithium metal batteries with an aggregate lithium content in excess of 2 g which must be assigned to Class 9 and are subject to all of the applicable requirements of these Regulations; and
- Section II applies where equipment contains lithium metal cells with a lithium metal content not exceeding 1 g or lithium metal batteries with an aggregate lithium content not exceeding 2 g.

A single cell battery as defined in Part III, of subsection 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.

**Note:** A lithium battery guidance document is available at the following link – <http://www.iata.org/whatwedo/cargo/dgr/Documents/lithium-battery-shipping-guidelines.pdf>

### General requirements

The following requirements apply to all lithium metal or lithium alloy cells and batteries:

- cells and batteries identified by the manufacturer as being defective for safety reasons, or that have been damaged, 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);
- cells and batteries must be protected so as to prevent short circuits. This includes protection against contact with conductive materials within the same packaging that could lead to a short circuit;
- equipment must be equipped with an effective means of preventing accidental activation;
- equipment containing cells or batteries must be packed in strong outer packaging that conform to 5.0.2.4, 5.0.2.6.1 and 5.0.2.12.1.
- the equipment containing the cells or batteries must be secured against movement within the outer packaging and be packed so as to prevent accidental operation during air transport.

### Section I

These requirements apply to lithium metal cells with a lithium metal content in excess of 1 g and lithium metal batteries with an aggregate lithium content in excess of 2 g that have been determined to meet the criteria for assignment to Class 9.

Each cell or battery must:

- meet the provisions of 3.9.2.6.1; and
- meet the General Requirements, above;

### Additional Requirements - Section I

- the equipment must be packed in strong rigid outer packaging 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;
- the quantity of lithium metal contained in any piece of equipment must not exceed 12 g per cell and 500 g per battery.

**TABLE 970-I**

UN number	Net quantity per package Passenger aircraft	Net quantity per package Cargo Aircraft Only
UN 3091 Lithium metal batteries contained in equipment	5 kg	35 kg

### OUTER PACKAGINGS—Strong outer packagings, such as:

Type	Drums						Jerricans			Boxes							
	Steel	Alu- minium	Ply- wood	Fibre	Plastic	Other metal	Steel	Alu- minium	Plastic	Steel	Alu- minium	Wood	Ply- wood	Recon- stituted wood	Fibre- board	Plastic	Other metal
Desc.																	

### Section II

Lithium metal or lithium alloy cells and batteries meeting the requirements in this section are not subject to other additional requirements of these Regulations except for:



- (a) provision of adequate instruction (1.6);
- (b) dangerous goods in passenger and crew baggage (Subsection 2.3). Only those lithium metal batteries as specifically permitted may be carried in carry-on and checked baggage;
- (c) dangerous goods in air mail (Subsection 2.4);
- (d) marking of packages (7.1.5.5);
- (e) reporting of dangerous goods accidents, incidents and other occurrences (9.6.1 and 9.6.2).

Cells and batteries offered for transport must meet the provisions of 3.9.2.6.1(a), (e), (f) if applicable and (g), the General Requirements of this packing instruction and:

- (a) for cells, the lithium content is not more than 1 g; and
- (b) for batteries, the aggregate lithium content is not more than 2 g.

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 transported 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.

**Additional Requirements - Section II**

The equipment must be packed in strong rigid outer packagings constructed of suitable material of adequate strength and design in relation to the packaging's capacity and its intended use unless the cell or battery is afforded equivalent protection by the equipment in which it is contained.

Each package must be durably and legibly marked with the lithium battery mark, Figure 7.1.C, as required by 7.1.5.5. The package must be of such size that there is adequate space to affix the mark on one side of the package without the mark being folded. The application of the lithium battery mark does not apply to:

- packages containing only button cell batteries installed in equipment (including circuit boards); or
- consignments of two packages or less where each package contains no more than four cells or two batteries installed in equipment.

A Shipper's Declaration for Dangerous Goods is not required.

Where a consignment includes packages bearing the lithium battery mark, the words "Lithium metal batteries in compliance with Section II of PI 970" must be included on the air waybill, when an air waybill is used. The information should be shown in the "Nature and Quantity of Goods" box of the air waybill.

Any person preparing or offering cells or batteries for transport must receive adequate instruction on these requirements commensurate with their responsibilities, Information on adequate instruction can be found in subsection 1.6.

**Overpacks - Section II**

Individual packages each complying with the requirements of Section II may be placed in an overpack. The overpack may also contain packages of dangerous goods or goods not subject to these Regulations provided that the packages do not contain substances which might react dangerously with each other. An overpack must be marked with the word "Overpack" in lettering at least 12 mm high and durably and legibly marked with the mark shown in Figure 7.1.C, unless the marks representative of those on the package(s) inside the overpack are visible, or the packages are not required to bear the lithium battery mark.

**TABLE 970-II**

	Passenger aircraft	Cargo Aircraft
Net quantity of lithium metal cells or batteries per package	5 kg	5 kg

**OUTER PACKAGINGS—Strong outer packagings, such as:**

Type	Drums						Jerricans			Boxes							
Desc.	Steel	Alu-minium	Ply-wood	Fibre	Plastic	Other metal	Steel	Alu-minium	Plastic	Steel	Alu-minium	Wood	Ply-wood	Recon-stituted wood	Fibre-board	Plastic	Other metal



Figure 7.3.X:

Class 9 hazard label for lithium batteries

*reduced size  
black on white*

Name: Lithium battery  
Cargo IMP Code: RBI, RBM, RLI, RLM  
Minimum dimensions: 100 x 100 mm

Symbol (seven vertical black stripes in upper half; battery group, one broken and emitting flame in lower half); black  
Background: White



Figure 7.4.B:

Handling Label Cargo Aircraft Only

*reduced size,  
black on orange (Pantone colour No. 151U)*

Name: Cargo Aircraft Only  
Cargo IMP Code: CAO  
Minimum dimensions: 120 x 110 mm

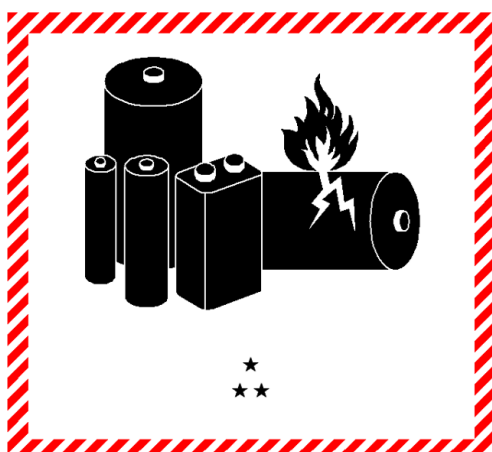


Figure 7.1.C:

Lithium Battery Mark

*reduced size,  
black on white,  
red boarder with diagonal hatchings*

\* Place for UN number(s) (rec. 12 mm high)

\*\* Place for telephone number for additional information

Minimum dimensions: 120 x 110 mm

## Transport Regulations for Sea Transport - Overview

UN 3090	LITHIUM METALL BATTERIES				see chapter
UN 3091	LITHIUM METAL BATTERIES CONTAINED IN EQUIPMENT or LITHIUM METAL BATTERIES PACKED WITH EQUIPMENT				
Class	9	Miscellaneous dangerous substances and articles	x	x	2.9
Classification		Quality Management Program	x	x	2.9.4
Packing group					2.0.1.3
Special provisions	188	Exempted if...	x	x	3.3
	230	Class 9 if...	x	x	
	310	Prototypes	x	x	
	360	Battery powered vehicles	x		
	376	Damaged or defective lithium batteries	x	x	
	377	Lithium batteries for disposal or recycling	x	x	
	384	Label 9A	x	x	
Limited Quantities	0	No	x	x	3.4
Excepted quantities	E0	No	x	x	3.5
Packing Instructions	P903	Lithium batteries	x	x	4.1.4.1
	P908	Damaged or defective lithium batteries	x	x	4.1.4.1
	P909	Lithium batteries for disposal or recycling	x	x	4.1.4.1
	P910	Prototypes and small series	x	x	
	P911	Damaged or defective batteries	x	x	
	LP903	Large packaging for single battery	x	x	4.1.4.3
	LP904	LP for single damaged/defective batteries	x	x	4.1.4.3
	LP905	Prototypes	x	x	
	LP906	Damaged/ defective batteries	x	x	
EmS <sup>1)</sup>	F-A	Fire Schedule Alfa	x	x	
	S-I	Spillage Schedule India (flammable solids, repacking possible)	x	x	
Storage and segregation	Category A SW 19	On deck or under deck	x	x	7.1, 7.2
Properties and observations	Electrical batteries containing lithium or lithium alloy encased in a rigid metallic body. Lithium batteries may also be shipped in, or packed with, equipment. Electrical lithium batteries may cause fire due to an explosive rupture of the body caused by improper construction or reaction with contaminants.				

#### 2.9.4 Lithium batteries

Cells and batteries, cells and batteries contained in equipment, or cells and batteries packed with equipment, containing lithium in any form shall be assigned to UN Nos. 3090, 3091, 3480 or 3481 as appropriate. They may be transported under these entries if they meet the following provisions:

.1 Each cell or battery is of the type proved to meet the requirements of each test of the Manual Tests and Criteria Part III, sub section 38.3. Cells and batteries manufactured according to a type meeting the requirements of subsection 38.3 of the Manual of Tests and Criteria, revision 3, amendment 1 or any subsequent revision and amendment applicable at the date of the type testing may continue to be transported, unless otherwise provided in this Code.

Cell and battery types only meeting the requirements of the Manual of Tests and Criteria, revision 3, are no longer valid. However, cells and batteries manufactured in conformity with such types before 1 July 2003 may continue to be transported if all other applicable requirements are fulfilled.

**Note:** Batteries shall be of a type proved to meet the testing requirements of the Manual of Tests and Criteria, part III, sub-section 38.3, irrespective of whether the cells of which they are composed are of a tested type.

- .2 Each cell and battery incorporates a safety venting device or is designed to preclude a violent rupture under conditions normally incident to transport.
- .3 Each cell and battery is equipped with an effective means of preventing external short circuits.
- .4 Each battery containing cells or series of cells connected in parallel is equipped with effective means as necessary to prevent dangerous reverse current flow (e.g. diodes, fuses, etc.).
- .5 Cells and batteries shall be manufactured under a quality management programme that includes:
  - .1 a description of the organizational structure and responsibilities of personnel with regard to design and product quality;
  - .2 the relevant inspection and test, quality control, quality assurance, and process operation instructions that will be used;
  - .3 process controls that should include relevant activities to prevent and detect internal short circuit failure during manufacture of cells;
  - .4 quality records, such as inspection reports, test data, calibration data and certificates. Test data shall be kept and made available to the competent authority upon request;
  - .5 management reviews to ensure the effective operation of the quality management programme;
  - .6 a process for control of documents and their revision;
  - .7 a means for control of cells of batteries that are not conforming to the type tested as mentioned in 2.9.4.1 above;
  - .8 training programmes and qualification procedures for relevant personnel; and
  - .9 procedures to ensure that there is no damage to the final product.
- .6 Lithium batteries, containing both primary lithium metal cells and rechargeable lithium ion cells, that are not designed to be externally charged (see special provision 387 of chapter 3.3) shall meet the following conditions:
  - .1 the rechargeable lithium ion cells can only be charged from primary lithium metal cells;
  - .2 overcharge of the rechargeable lithium ion cells is precluded by design;
  - .3 the battery has been tested as a lithium primary battery; and
  - .4 component cells of the battery shall be of a type proven to meet the respective testing requirements of the Manual of Tests and Criteria, part II, subsection 38.3.
- .7 Manufacturers and subsequent distributors of cells or batteries shall make available the test summary as specified in the Manual of Tests and Criteria, subsection 38.3, paragraph 38.3.5.

**Note:** In-house quality management programmes may be accepted. Third party certification is not required, but the procedures listed in .1 to .9 above shall be properly recorded and traceable. A copy of the quality management programme shall be made available to the competent authority upon request

**Special Provision 188**

Cells and batteries offered for transport are not subject to other provisions of this Code if they meet the following:

- .1 For a lithium metal or lithium alloy cell, the lithium content is not more than 1 g, and for a lithium-ion cell, the watt-hour rating is not more than 20 Wh;
- .2 For a lithium metal or lithium alloy battery, the aggregate lithium content is not more than 2 g, and for a lithium-ion battery, the watt-hour rating is not more than 100 Wh. Lithium-ion batteries subject to this provision shall be marked with the watt-hour rating on the outside case, except those manufactured before 1 January 2009;
- .3 Each cell or battery meets the provisions of 2.9.4.1 and 2.9.4.5, 2.9.4.6 if applicable and 2.9.4.7;
- .4 Cells and batteries, except when installed in equipment, shall be packed in inner packaging that completely enclose the cell or battery. Cells and batteries shall 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. The inner packaging shall be packed in strong outer packaging which conform to the provisions of 4.1.1.1, 4.1.1.2 and 4.1.1.5.
- .5 Cells and batteries when installed in equipment shall be protected from damage and short circuit, and the equipment shall be equipped with an effective means of preventing accidental activation. This requirement does not apply to devices which are intentionally active in transport (radio frequency identification (RFID) transmitters, watches, sensors, etc.) and which are not capable of generating a dangerous evolution of heat. When batteries are installed in equipment, the equipment shall be packed in strong outer packaging 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. When packages are placed in an overpack, the lithium battery mark shall either be marked with the word "OVERPACK". The lettering of the "OVERPACK" mark shall be at least 12 mm high;
- .6 Each package shall be marked with the appropriate lithium battery mark, as illustrated in 5.2.1.10;

**Note 1:** The provisions concerning marking in special provision 188 of amendment 37-14 of the Code may continue to be applied until 31 December 2018.

**Note 2:** Packages containing lithium batteries packed in conformity with the provisions of part 4, chapter 11, packing instructions 965 or 968, Section IB of the ICAO Technical Instructions for the Safe Transport of Dangerous Goods by air that bear the mark as shown in 5.2.1.10 (lithium battery mark) and the label shown in 5.2.2.2.2, Model No. 9A shall be deemed to meet the provisions of this special provisions.

This requirement does not apply to:

- .1 packages containing only button cell batteries installed in equipment (including circuit boards); and
  - .2 packages containing no more than four cells or two batteries installed in equipment, where there are not more than two packages in the consignment.
- .7 Except when batteries are installed in equipment, each package shall be capable of withstanding a 1.2 m drop test in any orientation without damage to cell 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; and
  - .8 Except when batteries are installed in or packed with equipment, packages shall not exceed 30 kg gross mass. As used in this special provision "equipment" means apparatus for which the lithium cells or batteries will provide electrical power for its operation.

As used above and elsewhere in this Code, "lithium content" means the mass of lithium in the anode of a lithium metal or lithium alloy cell.

Separate entries exist for lithium metal batteries and lithium ion batteries to facilitate the transport of these batteries for specific modes of transport and to enable the application of different emergency response actions.

A single battery as defined in part III, subsection 38.3.2.3 of the Manual of Tests and Criteria in considered a "cell" and shall be transported according to the requirements for "cells" for the purpose of this special provision.

### **Special Provision 230**

Lithium cells and batteries may be transported under this entry if they meet the provisions of 2.9.4.

### **Special Provision 310**

The testing requirements in the Manual of Testing and Criteria, part III, subsection 38.3 do not apply to production runs, consisting of not more than 100 cells and batteries, or to pre-production prototypes of cells or batteries when these prototypes are transported for testing when packaged in accordance with packing instruction P910 of 4.1.4.1 or LP 905 of 4.1.4.3, as applicable.

This transport documents shall include the following statement: "Transport in accordance with special provision 310".

Damaged or defective cells, batteries, or cells and batteries contained in equipment shall be transported in accordance with special provision 376 and packaged in accordance with packing instructions P908 of 4.1.4.1 or LP904 of 4.1.4.3, as applicable.

Cells, batteries or cells and batteries contained in equipment transported for disposal or recycling may be packaged in accordance with special provision 377 and packing instruction P909 of 4.1.4.1.

### **Special Provision 360**

Vehicles only powered by lithium metal batteries or lithium ion batteries shall be consigned under the entry UN 3171 BATTERY POWERED VEHICLE.

### **Special Provision 376**

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 identified as damaged or defective and 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 packed and transported in accordance with packing instruction P911 of 4.1.4.1 or LP906 of 4.1.4.3, as applicable. Alternative packing and/or transport conditions may be authorized by the competent authority.

Packages shall be marked "DAMAGED/DEFECTIVE" in addition to the proper shipping name, as stated in 5.2.1.

The transport document shall include the following statement "Transport in accordance with special provision 376".

If applicable, a copy of the competent authority approval shall accompany the transport.

### **Special Provision 377**

Lithium ion and lithium metal cells and batteries and equipment containing such cells and batteries transported for disposal or recycling, either packed together with or packed without non-lithium batteries, may be packaged in accordance with packing instruction P909 of 4.1.4.1.

These cells and batteries are not subject to section 2.9.4.

Packages shall be marked "LITHIUM BATTERIES FOR DISPOSAL" or "LITHIUM BATTERIES FOR RECYCLING".

Identified damaged or defective batteries shall be transported in accordance with special provision 376 and packaged in accordance with P908 of 4.1.4.1 or LP904 of 4.1.4.3, as applicable.  
The transport document shall include the following statement: "Transport in accordance with special provision 377".

**Special Provision 384**

The label to be used in Model No. 9A, see 5.2.2.2.2. However, for placarding for cargo transport units, the placard shall correspond to Model No. 9.

**Special Provision 387**

Lithium batteries in conformity with 2.9.4.6 containing both primary lithium metal cells and rechargeable lithium ion cells shall be assigned to UN 3090 or UN 3091 as appropriate. When such batteries are transported in accordance with special provision 188, the total lithium content of all lithium metal cells contained in the battery shall not exceed 1.5 g and the total capacity of all lithium ion cells contained in the battery shall not exceed 10 Wh.

P903	PACKING INSTRUCTION	P903
<p>This instruction applies to UN Nos. 3090, 3091, 3480 and 3481.</p>		
<p>For the purpose of this packing instruction, “equipment” means apparatus for which the lithium cells or batteries will provide electric power for its operation. The following packagings are authorized provided that the general provisions of 4.1.1 and 4.1.3 are met:</p>		
<p>(1) For cells and batteries: Drums (1A2, 1B2, 1N2, 1H2, 1D, 1G); Boxes (4A, 4B, 4N 4C1, 4C2, 4D, 4F, 4G, 4H1, 4H2); Jerricans (3A2, 3B2, 3H2).</p>		
<p>Cells or batteries shall be packed in packaging so that the cells or batteries are protected against damage that may be caused by the movement or placement of the cells or batteries within the packaging.</p>		
<p>Packaging shall conform to the packing group II performance level.</p>		
<p>(2) In addition for cells or batteries with a gross mass of 12 kg or more employing a strong, impact resistant outer casing, and assemblies of such cells or batteries:</p>		
<p>(a) Strong outer packaging, (b) Protective enclosures (e.g. fully enclosed or wooden slatted crates); or (c) Pallets or other handling devices.</p>		
<p>Cells or batteries shall be secured to prevent inadvertent movement, and the terminals shall not support the weight of other superimposed elements.</p>		
<p>Packaging need not meet the requirements of 4.1.1.3.</p>		
<p>(3) For cells or batteries packed with equipment:</p>		
<p>Packaging conforming to the requirements in paragraph (1) of this packing instruction, then placed with the equipment in an outer packaging; or</p>		
<p>Packaging that completely enclose the cells or batteries, then placed with equipment in a packaging conforming to the requirements in paragraph (1) of this packing instruction.</p>		
<p>The equipment shall be secured against movement within the outer packaging.</p>		
<p>(4) For cells or batteries contained in equipment:</p>		
<p>Strong outer packaging constructed of suitable material, and of adequate strength and design in relation to the packaging capacity and its intended use. They shall be constructed in such a manner as to prevent accidental operation during transport. Packaging need not meet the requirements of 4.1.1.3.</p>		
<p>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.</p>		
<p>Devices such as radio frequency identification (RFID) tags, watches and temperature loggers, which are not capable of generation a dangerous evolution of heat, may be transported when intentionally active in strong outer packaging.</p>		
<p><b>Additional requirement:</b> Cells or batteries shall be protected against short circuit.</p>		



P908	PACKING INSTRUCTION	P908
	<p>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.</p> <p>The following packaging are authorized provided the general provisions of 4.1.1 and 4.1.3 are met: For cells and batteries and equipment containing cells and batteries: Drums (1A2, 1B2, 1N2, 1H2, 1D, 1G) Boxes (4A, 4B, 4N, 4C1, 4C2, 4D, 4F, 4G, 4H1, 4H2) Jerricans (3A2, 3B2, 3H2)</p> <p>Packaging shall conform to the packing group II performance level.</p> <ol style="list-style-type: none"><li>(1) Each damaged or defective cell or battery or equipment containing such cells or batteries shall be individually packed in inner packaging and placed inside of an outer packaging. The inner packaging or outer packaging shall be leakproof to prevent the potential release of electrolyte.</li><li>(2) Each inner packaging shall be surrounded by sufficient non-combustible and electrically non-conductive thermal insulation material to protect against a dangerous evolution of heat.</li><li>(3) Sealed packaging shall be fitted with a venting device when appropriate.</li><li>(4) Appropriate measures shall be taken to minimize the effects of vibrations and shocks, prevent movement of the cells or batteries within the package that may lead to further damage and a dangerous condition during transport. Cushioning material that is non-combustible and electrically non-conductive may also be used to meet this requirement.</li><li>(5) Non combustibility shall be assessed according to a standard recognized in the country where the packaging is designed or manufactured.</li></ol> <p>For leaking cells or batteries, sufficient inert absorbent material shall be added to the inner or outer packaging to absorb any release of electrolyte.</p> <p>A cell or battery with a net mass of more than 30 kg shall be limited to one cell or battery per outer packaging.</p>	
	<p><b>Additional requirement:</b> Cells or batteries shall be protected against short circuit.</p>	

<b>P909</b>	<b>PACKING INSTRUCTION</b>	<b>P909</b>
This instruction applies to UN Nos. 3090, 3091, 3480 and 3481 transported for disposal or recycling, either packed together with or packed without non-lithium batteries:		
(1)	Cells and batteries shall be packed in accordance with the following: <ul style="list-style-type: none"> <li>(a) The following packaging are authorized, 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, 4N, 4C1, 4C2, 4D, 4F, 4G, 4H2); and                          Jerricans (3A2, 3B2, 3H2).</li> <li>(b) Packaging shall conform to the packing group II performance level.</li> <li>(c) Metal packaging shall be fitted with an electrically non-conductive lining material (e.g. plastics) of adequate strength for the intended use.</li> </ul>	
(2)	However, lithium ion cells with a Watt-hour rating of not more than 20 Wh, lithium ion batteries with a Watt-hour rating of not more than 100 Wh, lithium metal cells with a lithium content of not more than 1 g and lithium metal batteries with an aggregate lithium content of not more than 2 g may be packed in accordance with the following: <ul style="list-style-type: none"> <li>(a) In strong outer packaging up to 30 kg gross mass meeting the general provisions of 4.1.1, except 4.1.1.3, and 4.1.3.</li> <li>(b) Metal packaging shall be fitted with an electrically non-conductive lining material (e.g. plastics) of adequate strength for the intended use.</li> </ul>	
(3)	For cells or batteries contained in equipment, strong outer packaging constructed of suitable material, and of adequate strength and design in relation to the packaging capacity and its intended use, may be used. Packaging need not meet the requirements of 4.1.1.3. Equipment may also 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.	
(4)	In addition, for cells or batteries with a gross mass of 12 kg or more employing a strong, impact resistant outer casing, strong outer packaging constructed of suitable material and of adequate strength and design in relation to the packaging capacity and its intended use, may be used.  Packaging need not meet the requirements of 4.1.1.3.	
<b>Additional requirements:</b>		
1	Cells and batteries shall be designed or packed to prevent short circuits and the dangerous evolution of heat.	
2	Protection against short circuits and the dangerous evolution of heat includes, but is not limited to: <ul style="list-style-type: none"> <li>- individual protection of the battery terminals,</li> <li>- inner packaging to prevent contact between cells and batteries,</li> <li>- batteries with recessed terminals designed to protect against short circuits, or</li> <li>- the use of a non-conductive and non-combustible cushioning material to fill empty space between the cells or batteries in the packaging.</li> </ul>	
3	Cells and batteries shall be secured within the outer packaging to prevent excessive movement during transport (e.g. by using a non-combustible and non-conductive cushioning material or through the use of a tightly closed plastics bag).	

<b>P910</b>	<b>PACKING INSTRUCTION</b>	<b>P910</b>
	<p>This instruction applies to UN Nos. 3090, 3091, 3480 and 3481 production runs consisting of not more than 100 cells or batteries and to pre-production prototypes of cells and batteries when these prototypes are transported for testing.</p>	
	<p>The following packaging are authorized provided that the general provisions of 4.1.1 and 4.1.3 are met:</p> <p>(1) For cells and batteries, including when packed with equipment:                  Drums (1A2, 1B2, 1N2, 1H2, 1D, 1G);                  Boxes (4A, 4B, 4N, 4C1, 4C2, 4D, 4F, 4G, 4H1, 4H2);                  Jerricans (3A2, 3B2, 3H2).                  Packaging shall conform to the packing group II performance level and shall meet the following requirements:</p> <ul style="list-style-type: none"> <li>(a) Batteries and cells, including equipment, of different sizes, shapes or masses shall be packaged in an outer packaging of a tested design type listed above provided the total gross mass of the package does not exceed the gross mass for which the design type has been tested;</li> <li>(b) Each cell or battery shall be individually packed in an inner packaging and placed inside an outer packaging;</li> <li>(c) Each inner packaging shall be completely surrounded by sufficient non-combustible and electrically non-conductive thermal insulation material to protect against a dangerous evolution of heat</li> <li>(d) Appropriate measures shall be taken to minimize the effects of vibration and shocks and prevent movement of the cells or batteries within the package that may lead to damage and a dangerous condition during transport. Cushioning material that is non-combustible and non-conductive may be used to meet this requirement;</li> <li>(e) Non-combustibility shall be assessed according to a standard recognized in the country where the packaging is designed or manufactured;</li> <li>(f) A cell or battery with a net mass of more than 30 kg shall be limited to one cell or battery per outer packaging.</li> </ul> <p>(2) For cells and batteries contained in equipment:                  Drums (1A2, 1B2, 1N2, 1H2, 1D, 1G);                  Boxes (4A, 4B, 4N, 4C1, 4C2, 4D, 4F, 4G, 4H1, 4H2);                  Jerricans (3A2, 3B2, 3H2).                  Packaging shall conform to the packing group II performance level and shall meet the following requirements:</p> <ul style="list-style-type: none"> <li>(a) Equipment of different sizes, shapes or masses shall be packaged in an outer packaging of a tested design type listed above provided the total gross mass of the package does not exceed the gross mass for which the design type has been tested.</li> <li>(b) The equipment shall be constructed or packaged in such a manner as to prevent accidental operation during transport;</li> <li>(c) Appropriate measures shall be taken to minimize the effects of vibration and shocks and prevent movement of the equipment within the package that may lead to damage and a dangerous condition during transport. When cushioning material is used to meet this requirement it shall be a non-combustible and electrically non-conductive; and</li> <li>(d) Non-combustibility shall be assessed according to a standard recognized in the country where the packaging is designed or manufactured.</li> </ul> <p>(3) The equipment or the batteries may be transported unpackaged under conditions specified by the competent authority. Additional conditions that may be considered in the approval process include, but are not limited to:</p> <ul style="list-style-type: none"> <li>(a) The equipment or the battery shall be strong enough to withstand the shocks and loadings normally encountered during transport, including transshipment between cargo transport units and between cargo transport units and warehouses as well as any removal from a pallet for subsequent manual or mechanical handling; and</li> <li>(b) The equipment or the battery shall be fixed in cradles or crates or other handling devices in such a way that it will not become loose during normal conditions of transport.</li> </ul>	

**Additional requirements:**

The cells and batteries shall be protected against short circuit;  
 Protection against short circuits includes, but is not limited to,

- individual protection of the battery terminals,
- inner packaging to prevent contact between cells und batteries,
- batteries with recessed terminals designed to protect against short circuits or
- the use a non-conductive and non-combustible cushioning material to fill empty space between the cells or batteries in the packaging.

<b>P911</b>	<b>PACKING INSTRUCTION</b>	<b>P911</b>
This instruction applies to damaged or defective cells and batteries of UN Nos. 3090, 3091, 3480, 3481 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.		
The following large packaging are authorized, provided that the general provisions of 4.1.1 and 4.1.3 are met: <ul style="list-style-type: none"> <li>Drums (1A2, 1B2, 1N2, 1H2, 1D, 1G);</li> <li>Boxes (4A, 4B, 4N, 4C1, 4C2, 4D, 4F, 4G, 4H1, 4H2);</li> <li>Jerricans (3A2, 3B2, 3H2)</li> </ul> The packagings shall conform to the packing group I performance level.		
(1) The packaging shall be capable of meeting the following additional performance requirements in case of rapid disassembly, dangerous reaction, production of a flame or a dangerous evolution of heat or a dangerous emission of toxic, corrosive or flammable gases or vapours of the cells or batteries: <ul style="list-style-type: none"> <li>(a) 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;</li> <li>(b) No flame shall occur outside the package;</li> <li>(c) No projectiles shall exit the package;</li> <li>(d) The structural integrity of the package shall be maintained;</li> <li>(e) The packagings shall have a gas management system (e.g. filter systems, air circulation, containment for gas, gas tight packaging, etc.), as appropriate.</li> </ul> (2) The additional packing performance requirements shall be verified by a test as specified by the competent authority.* <p>A verification report shall be available on request. As a minimum requirement, the cell or battery name, the cell or battery number, the mass, type, energy content of the cells or batteries, the packaging identification and the test battery number, the mass, type, energy content of the cells or batteries, the packaging identification and the test data according to the verification method as specified by the competent authority shall be listed in the verification report.</p> (3) 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 refrigerant used as well as the temperatures and the pressures which could result in refrigeration were lost.		
<p><b>Additional requirement:</b>                      Cells or batteries shall be protected against short circuit.</p>		

\*The following criteria, may be considered to assess the performance of the packaging:

(a) The assessment shall be done under a quality management system (as described e.g. in section 2.9.4.5) allowing for the traceability of tests results, reference data and characterization models used;

(b) The list of hazards expected in case of thermal runaway for the cell or battery type, in the condition it is transported (e.g. usage of an inner packaging, state of charge (SOC), use of sufficient non-combustible, electrically non-conductive and absorbent cushioning material, etc.), shall be clearly identified and quantified; the reference list of possible hazards for lithium cells or batteries (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) can be used for this purpose. The quantification of these hazards shall rely on available scientific literature;

(c) The mitigating effects of the packaging shall be identified and characterized, based on the nature of the protections provided and the construction material properties. A list of technical characteristics and drawings shall be used to support this assessment (density [ $\text{kg}\cdot\text{m}^{-3}$ ], specific heat capacity [ $\text{J}\cdot\text{kg}^{-1}\cdot\text{K}^{-1}$ ], heating value [ $\text{kJ}\cdot\text{kg}^{-1}$ ], thermal conductivity [ $\text{W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$ ], melting temperature and flammability temperature [K], heat transfer coefficient of the outer packaging [ $\text{W}\cdot\text{m}^{-2}\cdot\text{K}^{-1}$ ], ...);

(d) The test and any supporting calculations shall assess the result of a thermal runaway of the cell or battery inside the packaging in the normal conditions of transport;

(e) In case the SOC of the cell or battery is not known, the assessment used shall be done with the highest possible SOC corresponding to the cell or battery use conditions;

(f) The surrounding conditions in which the packaging may be used and transported shall be described (including for possible consequences of gas or smoke emissions on the environment, such as ventilation or other methods) according to the gas management system of the packaging;

(g) The tests or the model calculation shall consider the worst case scenario for the thermal runaway triggering and propagation inside the cell or battery: this scenario includes the worst possible failure in the normal transport condition, the maximum heat and flame emissions for the possible propagation of the reaction;

(h) These scenarios shall be assessed over a period long enough to allow all the possible consequences to occur (e.g. 24 hours).

<b>LP903</b>	<b>PACKING INSTRUCTION</b>	<b>LP903</b>
This instruction applies to UN Nos. 3090, 3091, 3480 and 3481.		
<p>The following large packaging are authorized for a single battery and for a single item of equipment containing cells or batteries, provided that the general provisions of <b>4.1.1</b> and <b>4.1.3</b> are met:</p> <p>Rigid large packaging conforming to the packing group II performance level, made of:</p> <ul style="list-style-type: none"> <li>steel (50A);</li> <li>aluminium (50B);</li> <li>metal other than steel or aluminium (50N);</li> <li>rigid plastics (50H);</li> <li>natural wood (50C);</li> <li>plywood (50D);</li> <li>reconstituted wood (50F);</li> <li>rigid fibreboard (50G).</li> </ul> <p>The battery shall be packed so that the battery is protected against damage that may be caused by its movement or placement within the large packaging.</p>		
<p><b>Additional requirement:</b>                      Batteries shall be protected against short circuit.</p>		

<b>LP904</b>	<b>PACKING INSTRUCTION</b>	<b>LP904</b>
	<p>This instruction applies to single damaged or defective batteries and to single items of equipment containing damaged or defective cells or batteries of UN 3090, 3091, 3480 and 3481.</p>	
	<p>The following large packaging are authorized for a single damaged or defective battery and for a single item of equipment containing damaged or defective cells or batteries, provided the general provisions of 4.1.1 and 4.1.3 are met:</p> <p>For batteries and equipment containing cells and batteries:</p> <p>Rigid batteries and equipment conforming to the packaging group II performance level, made of:</p> <ul style="list-style-type: none"> <li>steel (50A)</li> <li>aluminium (50B)</li> <li>metal other than steel or aluminium (50N)</li> <li>rigid plastics (50H)</li> <li>plywood (50D)</li> </ul> <ol style="list-style-type: none"> <li>1. The damaged or defective cell or battery or equipment containing such battery shall be individually packed in an inner packaging and placed inside of an outer packaging. The inner packaging or outer packaging shall be leak-proof to prevent the potential release of electrolyte.</li> <li>2. The inner packaging shall be surrounded by sufficient non-combustible and electrically non-conductive thermal insulation material to protect against a dangerous evolution of heat.</li> <li>3. Sealed packaging shall be fitted with a venting device when appropriate.</li> <li>4. Appropriate measures shall be taken to minimize the effects of vibrations and shocks, prevent movement of the battery within the package that may lead to further damage and a dangerous condition during transport. Cushioning material that is non-combustible and electrically non-conductive may also be used to meet this requirement.</li> <li>5. Non combustibility shall be assessed according to a standard recognized in the country where the packaging is designed or manufactured.</li> </ol> <p>For leaking batteries or cells, sufficient inert absorbent material shall be added to the inner or outer packaging to absorb any release of electrolyte.</p>	
	<p><b>Additional requirements:</b></p> <p>Batteries and cells shall be protected against short circuit.</p>	

<b>LP905</b>	<b>PACKING INSTRUCTION</b>	<b>LP905</b>
	<p>This instruction applies to UN Nos. 3090, 3091, 3480 and 3481 production runs consisting of not more than 100 cells and batteries and to pre-production prototypes of cells and batteries when these prototypes are transported for testing.</p>	
	<p>The following large packaging are authorized for a single battery and for a single item of equipment containing cells or batteries, provided that the general provisions of <b>4.1.1</b> and <b>4.1.3</b> are met:</p> <p>The following large packagings are authorized for a single battery and for a single item of equipment containing cells or batteries, provided that the general provisions of 4.1.1 and 4.1.3 are met:</p> <p>(1) For a single battery:</p> <p>Rigid large packagings conforming to the packing group II performance level, made of:</p> <ul style="list-style-type: none"> <li>steel (50A);</li> <li>aluminium (50B);</li> <li>metal other than steel or aluminium (50N);</li> <li>rigid plastics (50H);</li> <li>natural wood (50C);</li> <li>plywood (50D);</li> <li>reconstituted wood (50F);</li> <li>rigid fibreboard (500).</li> </ul> <p>Large packagings shall also meet the following requirements:</p> <p>(a) A battery of different size, shape or mass may be packed in an outer packaging of a tested design type listed above provided the total gross mass of the package does not exceed the gross mass for which the design type has been tested;</p>	

- (b) The battery shall be packed in an inner packaging and placed inside the outer packaging;
- (c) The inner packaging shall be completely surrounded by sufficient non-combustible and electrically non-conductive thermal insulation material to protect against a dangerous evolution of heat;
- (d) Appropriate measures shall be taken to minimize the effects of vibration and shocks and prevent movement of the battery within the package that may lead to damage and a dangerous condition during transport. When cushioning material is used to meet this requirement it shall be non-combustible and electrically non-conductive; and
- (e) Non-combustibility shall be assessed according to a standard recognized in the country where the large packaging is designed or manufactured.

(2) For a single item of equipment: Rigid large packagings conforming to the packing group II performance level, made of:

- steel (50A);
- aluminium (50B);
- metal other than steel or aluminium (50N);
- rigid plastics (5011);
- natural wood (50C);
- plywood (50D);
- reconstituted wood (50F);
- rigid fibreboard (50G).

Large packagings shall also meet the following requirements:

- (a) A single item of equipment of different size, shape or mass may be packed in an outer packaging of a tested design type listed above provided the total gross mass of the package does not exceed the gross mass for which the design type has been tested;
- (b) The equipment shall be constructed or packed in such a manner as to prevent accidental operation during transport;
- (c) Appropriate measures shall be taken to minimize the effects of vibration and shocks and prevent movement of the equipment within the package that may lead to damage and a dangerous condition during transport. When cushioning material is used to meet this requirement, it shall be non-combustible and electrically non-conductive; and
- (d) Non-combustibility shall be assessed according to a standard recognized in the country where the large packaging is designed or manufactured.

**Additional requirement:**

Cells and batteries shall be protected against short circuit.

LP906	PACKING INSTRUCTION	LP906
<p>This instruction applies to damaged or defective batteries of UN Nos. 3090, 3091, 3480 and 3481 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.</p>		
<p>The following large packagings are authorized, provided that the general provisions of <b>4.1.1</b> and <b>4.1.3</b> are met:</p> <p>For a single battery and for a single item of equipment containing cells or batteries:</p> <p>Rigid large packagings conforming to the packing group I performance level, made of:</p> <ul style="list-style-type: none"> <li>steel (50A);</li> <li>aluminium (50B);</li> <li>metal other than steel or aluminium (50N);</li> <li>rigid plastics (50H); plywood (50D);</li> <li>rigid fibreboard (50G).</li> </ul> <p>(1) The large packaging shall be capable of meeting the following additional performance requirements in case of rapid disassembly, dangerous reaction, production of a flame or a dangerous evolution of heat or a dangerous emission of toxic, corrosive or flammable gases or vapours of the battery:</p>		

- (a) 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;
- (b) No flame shall occur outside the package;
- (c) No projectiles shall exit the package;
- (d) The structural integrity of the package shall be maintained; and
- (e) The large packagings shall have a gas management system (e.g. filter system, air circulation, containment for gas, gas tight packaging etc.), as appropriate.

(2) The additional large packaging performance requirements shall be verified by a test as specified by the competent authority. A verification report shall be available on request. As a minimum requirement, the battery name, the battery number, the mass, type, energy content of the batteries, the large packaging identification and the test data according to the verification method as specified by the competent authority shall be listed in the verification report.

(3) 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.

**Additional requirement:**

Cells and batteries shall be protected against short circuit.

\* The following criteria, as relevant, may be considered to assess the performance of the large packaging:

- (a) The assessment shall be done under a quality management system (as described e.g. in section 2.9.4.5) allowing for the traceability of tests results, reference data and characterization models used;
- (b) The list of hazards expected in case of thermal runaway for the battery type, in the condition it is transported (e.g. usage of an inner packaging, state of charge (SOC), use of sufficient non-combustible, electrically non-conductive and absorbent cushioning material etc.), shall be clearly identified and quantified; the reference list of possible hazards for lithium batteries (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) can be used for this purpose. The quantification of these hazards shall rely on available scientific literature;
- (c) The mitigating effects of the large packaging shall be identified and characterized, based on the nature of the protections provided and the construction material properties. A list of technical characteristics and drawings shall be used to support this assessment (density [ $\text{kg}\cdot\text{m}^3$ ], specific heat capacity [ $\text{J}\cdot\text{kg}^{-1}\cdot\text{K}^{-1}$ ], heating value [ $\text{kJ}\cdot\text{kg}^{-1}$ ], thermal conductivity [ $\text{W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$ ], melting temperature and flammability temperature [K], heat transfer coefficient of the outer packaging [ $\text{W}\cdot\text{m}^{-2}\cdot\text{K}^{-1}$ ], ...);
- (d) The test and any supporting calculations shall assess the result of a thermal run-away of the battery inside the large packaging in the normal conditions of transport;
- (e) In case the SOC of the battery is not known, the assessment used shall be done with the highest possible SOC corresponding to the battery use conditions;
- (f) The surrounding conditions in which the large packaging may be used and transported shall be described (including for possible consequences of gas or smoke emissions on the environment, such as ventilation or other methods) according to the gas management system of the large packaging;
- (g) The tests or the model calculation shall consider the worst case scenario for the thermal runaway triggering and propagation inside the battery: this scenario includes the worst possible failure in the normal transport condition, the maximum heat and flame emissions for the possible propagation of the reaction;
- (h) These scenarios shall be assessed over a period long enough to allow all the possible consequences to occur (e.g. 24 hours).



<b>Stowage Code</b>	<b>Description</b>
SW19	For batteries transported in accordance with special provisions 376 or 377, category C, unless transported on a short international voyage.

From: **IMDG - Code Supplement – The EmS Guide**

**F-A: Fire Schedule Alfa**

**General Fire Schedule**

General comments	In a fire, exposed cargoes may explode or their containment may rupture. Fight fire from a protected position from as far away as possible.			
	<table border="1"> <tr> <td>Packages</td> <td rowspan="2">Create water spray from as many hoses as possible.</td> </tr> <tr> <td>Cargo on fire on deck</td> </tr> </table>	Packages	Create water spray from as many hoses as possible.	Cargo on fire on deck
Packages	Create water spray from as many hoses as possible.			
Cargo on fire on deck				
Cargo on fire under deck	Stop ventilation and close hatches. Use cargo space fixed fire-extinguishing system. If this is not available, create water spray using copious quantities of water.			
Cargo exposed to fire	If practicable, remove or jettison packages which are likely to be involved in fire. Otherwise, keep cool using water.			

**S-I: Spillage schedule India**

**Flammable solids (Repacking possible)**

General comments	Wear suitable protective clothing and self-contained breathing apparatus. Avoid all sources of ignition (e.g., naked lights, unprotected light bulbs, electric hand tools, friction). Wear non-sparking footwear. Stop leak if practicable.			
Spillage on deck	<table border="1"> <tr> <td>Packages (small spillage)</td> <td rowspan="2">Collect spillage and repack if practicable. Otherwise, wash overboard with copious quantities of water. Keep clear of effluent.</td> </tr> <tr> <td>Cargo Transport Units (large spillage)</td> </tr> </table>	Packages (small spillage)	Collect spillage and repack if practicable. Otherwise, wash overboard with copious quantities of water. Keep clear of effluent.	Cargo Transport Units (large spillage)
Packages (small spillage)	Collect spillage and repack if practicable. Otherwise, wash overboard with copious quantities of water. Keep clear of effluent.			
Cargo Transport Units (large spillage)				
Spillage under deck	<table border="1"> <tr> <td>Packages (small spillage)</td> <td rowspan="2">Collect spillage and repack if practicable.</td> </tr> <tr> <td>Cargo Transport Units (large spillage)</td> </tr> </table>	Packages (small spillage)	Collect spillage and repack if practicable.	Cargo Transport Units (large spillage)
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