Distributions Class 1 General

Technical Notice

Transport Regulations for Sea Transport - Overview

UN 3090 LITHIUM METALL BATTERIES UN 3091 LITHIUM METAL BATTERIES CONTAINED IN EQUIPMENT and LITHIUM METAL BATTERIES PACKED WITH EQUIPMENT					see chapter
Class	9	Miscellaneous dangerous substances and articles	X	X	2.9
Packing group					2.0.1.3
Special provisions	188	Exemptions	X	X	3.3
	230	Requirements	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	
	387	Hybrid batteries subject to SP 188	X	X	
	390	Combination of Lithium batteries contained and packed with equipment	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.
	P908	Damaged or defective lithium batteries	X	X	
	P909	Lithium batteries for disposal or recycling	X	X	
	P910	Prototypes and small series	X	X	
	P911	Damaged or defective batteries	X	X	
	LP903	Large packaging	X	X	
	LP904	LP for damaged/defective batteries	X	X	
	LP905	LP for prototypes/small series	X	X	
	LP906	LP for dangerously damaged/defective batteries	X	X	
EmS [1)]	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.				

[1)] Contains the corresponding number of the tremcard (EmS) for the "Accident measures for vessels carrying dangerous goods"

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, subsection 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, subsection 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 is 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 or 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.

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.

.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 proved 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 manufactured after 30 June 2003 shall make available the test summary as specified in the *Manual of Tests and Criteria*, part III, subsection 38.3, paragraph 38.3.5.

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 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 packaging 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;

.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 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.;

.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.

When packages are placed in an overpack, the lithium battery mark shall either be clearly visible or be 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;

.7 Except when cells or 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

.8 Except when cells or 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 cell or battery as defined in part III, subsection 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 transported under this entry if they meet the provisions of 2.9.4.

Special Provision 310

The testing requirements in the *Manual of Tests 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 LP905 of 4.1.4.3, as applicable.

The transport document 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.

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 assigned to the entry UN 3171 BATTERY POWERED VEHICLE. Lithium batteries installed in cargo transport units, designed only to provide power external to the transport unit shall be assigned to entry UN 3536 LITHIUM BATTERIES INSTALLED IN CARGO TRANSPORT UNIT.

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 cell or battery as damaged or defective, an assessment or evaluation shall be performed based on safety criteria from the cell, battery or product manufacturer or by a technical

expert with knowledge of the cell`s or battery´s safety features. An assessment or evaluation may include, but is not limited to, the following criteria:

.1 acute hazard, such as gas, fire or electrolyte leaking;

.2 the use or misuse of the cell or battery;

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

.4 external and internal short circuit protection, such as voltage or isolation measures;

.5 the condition of the cell or battery safety features; or

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

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.

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.

Special Provision 390

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

.1 the package shall 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 shall be marked as required for both battery types. However, button cell batteries installed in equipment (including circuit boards) need not to be considered.

.2 the transport document shall 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 transport document shall indicate both "UN 3091 Lithium metal batteries packed with equipment" and "UN 3481 Lithium ion batteries packed with equipment".

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 that the general provisions of 4.1.1 and 4.1.3 are met:

(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).

Cells or batteries shall be packed in packagings 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.

Packagings 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:

(a) Strong outer packagings,

(b) Protective enclosures (e.g. fully enclosed or wooden slatted crates); or

(c) Pallets or other handling devices.

Cells or batteries shall be secured to prevent inadvertent movement, and the terminals shall not support the weight of other superimposed elements.

Packagings need not meet the requirements of 4.1.1.3.

(3) For cells or batteries packed with equipment:

Packagings conforming to the requirements in paragraph (1) of this packing instruction, then placed with the equipment in an outer packaging; or

Packagings 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 packagings 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. Packagings need not meet the requirements of 4.1.1.3.

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.

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 in strong outer packaging.

(5) For Packaging containing both cells or batteries packed with equipment and contained in equipment:

(a) For cells and batteries, packagings 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; or

(b) Packagings conforming to the requirements in paragraph (1) of this packing instruction, then packaging shall be constructed in such a manner as to prevent accidental operation during transport and need not meet the requirements of 4.1.1.3.

The equipment shall be secured against movement within the outer packaging.

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 in strong outer packagings. When active, these devices shall meet defined standards for electromagnetic radiation to ensure that the operation of the devices does not interfere with aircraft systems
Additional requirement: Cells or batteries shall be protected against short circuit.

P908	PACKING INSTRUCTION	P908
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.		
The following packagings 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) Packagings shall conform to the packing group II performance level. (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. (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. (3) Sealed packagings shall be fitted with a venting device when appropriate. (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. (5) Non combustibility shall be assessed according to a standard recognized in the country where the packaging is designed or manufactured. For leaking cells or batteries, sufficient inert absorbent material shall be added to the inner or outer packaging to absorb any release of electrolyte. A cell or battery with a net mass of more than 30 kg shall be limited to one cell or battery per outer packaging.		
Additional requirement: Cells or batteries shall be protected against short circuit.		

P909	PACKING INSTRUCTION	P909
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: (a) The following packagings 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). (b) Packagings shall conform to the packing group II performance level. (c) Metal packagings shall be fitted with an electrically non-conductive lining material (e.g. plastics) of adequate strength for the intended use.	
(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: (a) In strong outer packagings up to 30 kg gross mass meeting the general provisions of 4.1.1, except 4.1.1.3, and 4.1.3. (b) Metal packagings shall be fitted with an electrically non-conductive lining material (e.g. plastics) of adequate strength for the intended use.	
(3)	For cells or batteries contained in equipment, strong outer packagings constructed of suitable material, and of adequate strength and design in relation to the packaging capacity and its intended use, may be used. Packagings 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 packagings constructed of suitable material and of adequate strength and design in relation to the packagings 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 a 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 transport (e.g. by using a non-combustible and non-conductive cushioning material or through the use of a tightly closed plastics bag).	

P910	PACKING INSTRUCTION	P910

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.

The following packagings are authorized provided that the general provisions of 4.1.1 and 4.1.3 are met:

(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).

Packagings shall conform to the packing group II performance level and shall meet the following requirements:

(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;

(b) Each cell or battery shall be individually packed in an inner packaging and placed inside an outer packaging;

(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;

(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;

(e) Non-combustibility shall be assessed according to a standard recognized in the country where the packaging is designed or manufactured;

(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.

(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).

Packagings shall conform to the packing group II performance level and shall meet the following requirements:

(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.

(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 a non-combustible and electrically non-conductive; and

	(d)	Non-combustibility shall be assessed according to a standard recognized in the country where the packaging the designed or manufactured.
(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:
	(a)	The equipment or the battery shall be strong enough to withstand the shocks and loadings normally encountered during transport, including transhipment 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 transport.

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 of an electrically non-conductive and non-combustible cushioning material to fill empty space between the cells or batteries in the packaging.

P911	PACKING INSTRUCTION	P911

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 packagings 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, 4H1, 4H2);

Jerricans (3A2, 3B2, 3H2)

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:
	(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;
	(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 packing 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 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 refrigerant used as well as the temperatures and the pressures which could result if refrigeration were lost.

Additional requirement:
Cells or batteries shall be protected against short circuit.

*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 2.9.4.5) 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 if 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; 8ii8

(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 [$kg \cdot m^{-3}$], specific heat capacity [$J \cdot kg^{-1} \cdot K^{-1}$], heating value [$kJ \cdot kg^{-1}$], thermal conductivity [$W \cdot m^{-1} \cdot K^{-1}$], melting temperature and flammability temperature [K], heat transfer coefficient of the outer packaging [$W \cdot m^{-2} \cdot K^{-1}$], ...);

(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).

LP903	PACKING INSTRUCTION	LP903

This instruction applies to UN Nos. 3090, 3091, 3480 and 3481.

The following large packagings are authorized for a single battery and for a single item of equipment containing batteries, provided that the general provisions of **4.1.1** and **4.1.3** are met:

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 (50H);

natural wood (50C);

plywood (50D);

reconstituted wood (50F);

rigid fibreboard (50G).

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.
Additional requirement: Batteries shall be protected against short circuit.

LP904	PACKING INSTRUCTION	LP904
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.		
The following large packagings 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: For batteries and equipment containing cells and batteries: Rigid large packagings conforming to the packaging group II performance level, made of: steel (50A) aluminium (50B) metal other than steel or aluminium (50N) rigid plastics (50H) plywood (50D) 1. The damaged or defective battery or equipment containing such cells or batteries shall be individually packed in an 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. 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. 3. Sealed packagings shall be fitted with a venting device when appropriate. 4. Appropriate measures shall be taken to minimize the effects of vibrations and shocks, prevent movement of the battery or the equipment 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. 5. Non combustibility shall be assessed according to a standard recognized in the country where the packaging is designed or manufactured. For leaking batteries or cells, sufficient inert absorbent material shall be added to the inner or outer packaging to absorb any release of electrolyte.		
Additional requirements: Batteries and cells shall be protected against short circuit.		

LP905	PACKING INSTRUCTION	LP905
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 transported for testing.		
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: (1) For a single battery: 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 (50H);
natural wood (50C);
plywood (50D);
reconstituted wood (50F);
rigid fibreboard (500).

Large packagings shall also meet the following requirements:

(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;

(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

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.

The following large packagings are authorized, provided that the general provisions of **4.1.1** and **4.1.3** are met:

For a single battery and for a single item of equipment containing batteries:

Rigid large packagings conforming to the packing group I performance level, made of:

steel (50A);

aluminium (50B);

metal other than steel or aluminium (50N);

rigid plastics (50H); plywood (50D);

rigid fibreboard (50G).

(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:

(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:
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 [$kg \bullet m^{3}$], specific heat capacity [$J \bullet kg^{-1} \bullet K^{-1}$], heating value [$kJ \bullet kg^{-1}$], thermal conductivity [$W \bullet m^{1} \bullet K^{1}$], melting temperature and flammability temperature [K], heat transfer coefficient of the outer packaging [$W \bullet m^{-2} \bullet K^{-1}$], ...);

(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).

Stowage Code	Description
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.
	Packages	Create water spray from as many hoses as possible.
Cargo on fire on deck	Cargo Transport Units	
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	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	Packages (small spillage)	Collect spillage and repack if practicable.
	Cargo Transport Units (large spillage)	