

Transport of Lithium Batteries in Accordance with the ICAO Technical Instructions

Guidance Document

Foreword

The 2009-2010 ICAO Technical Instructions for the Safe Transport of Dangerous Goods by Air incorporated a number of revisions to requirements for the transport of lithium batteries. Revisions included:

- Development of new Packing Instructions 965, 966, 967, 968, 969 and 970 to more clearly state requirements for the various types of lithium batteries.
- Incorporation of the requirements formerly in Special Provision A45 within the new packing instructions.
- Application of a new lithium battery handling label for certain lithium batteries.
- Enhanced packaging and revised quantity limits for lithium batteries as shown in Table 3-1 and in the new Packing Instructions.

This guidance is intended to address commonly asked questions regarding these provisions. In an effort to continually improve this guidance, comments or additional questions are welcome and will be used to update the guidance periodically. Comments may be submitted at:

www.icao.int/anb/FLS/DangerousGoods/ICAOLithiumBatteryGuidance.

The guidance is divided into several parts as follows:

- Part 1 – Questions Related to Definitions
- Part 2 – Questions Related to Transport Provisions
- Part 3 – Questions Related to Design Type Testing Provisions
- Part 4 – Questions Related to State and Operator Variations

This guidance addresses only the baseline provisions of the ICAO Technical Instructions. The ICAO Technical Instructions also contain State and Operator variations which should be consulted to determine any additional requirements imposed by a particular State or Operator (see Attachment 3 of the ICAO Technical Instructions – “Notified Variations from the Instructions”).

Part 1 – Questions Related to Definitions

A. What are the various types of lithium batteries?

Lithium batteries fall into two broad classifications; lithium metal batteries and lithium ion batteries. Lithium metal batteries are generally non-rechargeable and contain metallic lithium. Lithium ion batteries do not contain metallic lithium and are rechargeable.

B. What are lithium polymer batteries?

A lithium polymer battery is a type of lithium ion battery. Generally, the main difference is lithium ion polymer batteries contain a polymer electrolyte.

C. What is the difference between a lithium cell and a lithium battery?

A lithium cell is a single encased electrochemical unit consisting of one positive and one negative electrode that exhibits a voltage differential across the two terminals. A lithium battery is one or more cells electrically connected. A single cell battery is considered a cell and not a battery.

D. How are component cells connected to form a battery?

Cells in batteries may be connected in parallel, in series, or in a combination of the two. When cells are connected in series the voltage of the battery increases but the capacity in ampere-hours (Ah) does not change. By contrast, when cells are connected in parallel the capacity in ampere-hours of the battery (Ah) increases but the voltage stays the same.

E. How do I determine the watt hour rating for a particular lithium ion battery?

The watt hour (Wh) rating is a measure by which lithium ion batteries are regulated. Lithium ion batteries manufactured after 1 January 2009 are required to be marked with the watt hour rating.

You can also arrive at the number of watt-hours your battery provides if you know the battery's nominal voltage (V) and capacity in ampere-hours (Ah):

$$\text{Ah} \times \text{V} = \text{Wh}$$

This information is often marked on the battery.

Note that if only the milli-ampere-hours (mAh) are marked on the battery then divide that number by 1000 to get ampere-hours (Ah) (i.e., 4400 mAh / 1000 = 4.4. Ah).

Most lithium ion batteries marketed to consumers are below 100 watt-hours. If you are unsure of the watt-hour rating of your lithium ion battery, contact the manufacturer.

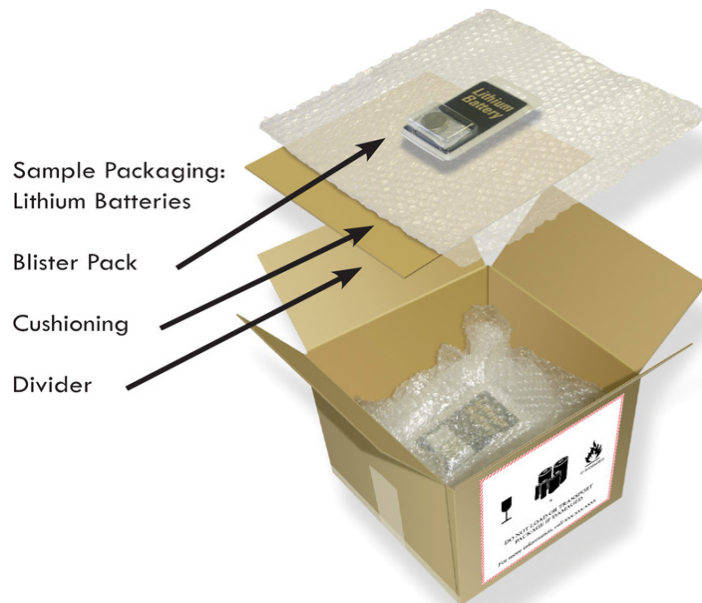
F. What is a button cell battery?

A button cell battery is a round small cell or battery where the overall height is less than the diameter.

Part 2 – Questions related to Packaging and Transport Provisions

A. How do I safely package lithium batteries for transport?

One of the major risks associated with the transport of batteries and battery-powered equipment is short-circuit of the battery as a result of the battery terminals coming into contact with other batteries, metal objects, or conductive surfaces. Packaged batteries or cells must be separated in a way to prevent short circuits and damage to terminals. They must be packed in a strong outer packaging or be contained in equipment. Sample packaging meeting these requirements is shown below:



B. How can batteries be effectively protected against short circuit?

Methods to protect against short circuit include, but are not limited to, the following methods:

- a) Packing each battery or each battery-powered device when practicable, in fully enclosed inner packagings made of non-conductive material (such as a plastic bag);
- b) Separating or packing batteries in a manner to prevent contact with other batteries, devices or conductive materials (e.g., metal) in the packagings; and

- c) Ensuring exposed terminals or connectors are protected with non-conductive caps, non-conductive tape, or by other appropriate means.

If not impact resistant, the outer packaging should not be used as the sole means of protecting the battery terminals from damage or short circuiting. Batteries should be securely cushioned and packed to prevent shifting which could loosen terminal caps or reorient the terminals to produce short circuits.

Terminal protection methods include but are not limited to the following:

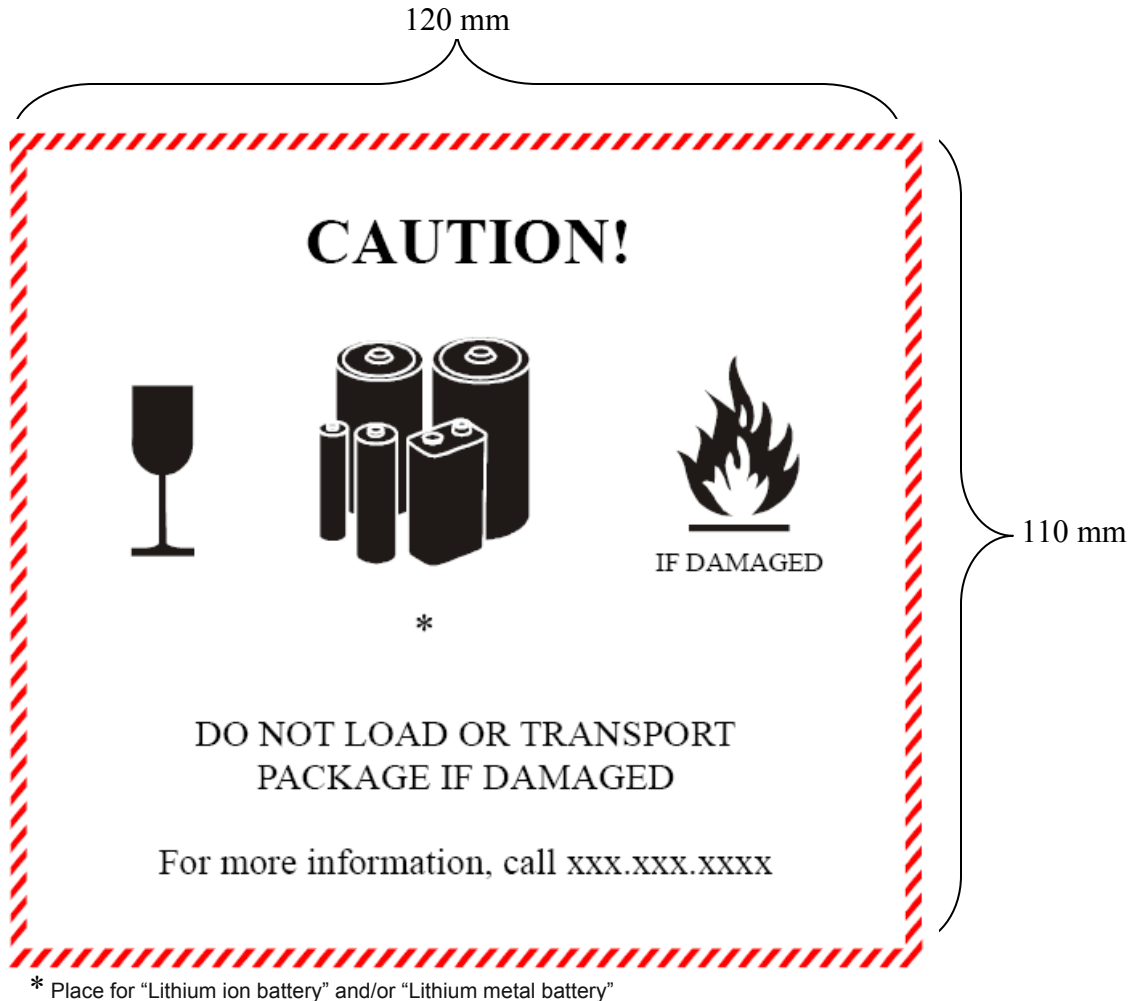
- a) Securely attaching covers of sufficient strength to protect the terminals;
- b) Packaging the battery in a rigid plastic packaging; and
- c) Constructing the battery with terminals that are recessed or otherwise protected so that the terminals will not be subjected to damage if the package is dropped.

C. How do I protect against “inadvertent activation”?

When batteries are contained in equipment, the equipment should be packaged in a manner that prevents unintentional activation or should have an independent means of preventing unintentional activation (e.g., packaging restricts access to activation switch, switch caps or locks, recessed switches, trigger locks, temperature sensitive circuit breakers, etc.). This requirement does not apply to devices which are intentionally active in transport (RFID transmitters, watches, sensors etc.) and which are not capable of generating a quantity of heat sufficient to be dangerous to packaging or personal safety.

D. What does the new lithium battery handling label look like and when is it required?

The new lithium battery handling label is required as specified in the additional requirements of Section II of packing instructions 965, 966, 967, 968, 969 and 970. The new label is as shown in Figure 5-31 of Part 5 of the ICAO Technical Instructions. The border of the label must have red diagonal hatchings with text and symbols in black on a contrasting background. The lithium battery handling label may be printed directly on the outer packaging provided that there is sufficient contrast between the elements of the lithium battery label and the colour of the packaging material.



E. When is a lithium battery handling label not required?

A lithium battery handling label is not required for packages prepared in accordance with Section I of Packing Instructions 965-970 (i.e. bearing a Class 9 label) or when a package contains no more than 4 cells or 2 batteries installed in equipment prepared in accordance with Section II of Packing Instructions 967 and 970. This applies to UN 3481 Lithium ion batteries contained in equipment (see Section II of Packing Instruction 967) and UN3091 Lithium metal batteries contained in equipment (see section II of Packing Instruction 970), except that button cells installed in equipment (including circuit boards) need not be considered. As these packages do not require a lithium battery handling label, the accompanying document mentioned in the Additional Packing Requirements of Section II of Packing Instructions 967 and 970 is not required.

F. Is there a requirement for the Lithium Battery Handling Label to be available in languages other than English?

English is generally the standard language accepted in international aviation. However, the State of Origin where offering the package for shipment may require their official

language. Part 5;2.5 of the ICAO TI specifies that in addition to the languages which may be required by the State of Origin, English should be used.

G. Section II in Packing Instructions 967 and 970 states that "Each package containing more than four cells or more than two batteries installed in equipment must be labelled with a lithium battery handling label." What is the intent of this provision?

This provision authorizes packages with equipment containing no more than 2 batteries or 4 cells to be offered for transport without the lithium battery handling label. For example, a package containing a notebook computer may have 1 lithium ion battery and 2 small lithium metal coin cells installed in the product. This single package does not require the lithium battery handling label. The number of cells contained inside the lithium ion battery are NOT counted towards the 4 cell limitation because it is the battery installed in the equipment being presented for transport. In addition, multiple packages each containing no more than 2 batteries or 4 cells may be overpacked and neither the individual packages nor the overpack would require the label.

H. I have an MP3 player that contains one single-cell lithium ion battery pack. Do I have to label the shipping box that contains each MP3 player? What if I place five MP3 players in a shipping box? Does this require a label?

For packages of single MP3 players, no lithium battery label would be required since you can place up to 4 of these single-cell batteries in a box without labelling the outer box. In the case where 5 MP3 players are in a shipping package, a lithium battery label on the outer shipping package would be required.

I. Can a single label be used to identify that both lithium metal and lithium ion batteries are contained inside the package?

Yes. A single label identifying both lithium ion and lithium metal batteries may be used.

J. What are the requirements for the telephone number on the lithium battery handling label?

The telephone number should be of a person knowledgeable about the shipment but is not intended to be for the purposes of obtaining immediate emergency response guidance, and is therefore not required to be monitored at all times that the package is in transit. It is acceptable for the number to be monitored during the company's normal business hours in order to provide product-specific information relative to the shipment. However, it also is acceptable to use an emergency response, 24-hour phone number on the label.

K. For the purposes of the lithium battery packing instructions, what is considered the "package"?

The package is the complete product of the packing operation that satisfies the requirement of the packing instruction. The package may contain multiple batteries or

pieces of equipment provided the limitations set out in the Packing Instruction are not exceeded. The package must be marked and labelled as required by the Packing Instruction. A single package may be offered for transport, or one or more packages may then be placed into an overpack for ease of handling or transport purposes. When an overpack is used, the package markings and labels must be duplicated on the overpack unless the markings and labels required on individual packages are visible, or are not required by the Packing Instruction (i.e. less than 4 cells or 2 batteries when contained in equipment).

L. Please explain the documentation requirements for consignments of lithium batteries which are required to have the lithium battery handling label.

Each consignment of packages with lithium batteries that is required to have the lithium battery handling label must be accompanied by a document such as an airway bill or other document that indicates:

- The package contains lithium ion cells or batteries;
- The package must be handled with care and that a flammability hazard exists if the package is damaged;
- Special procedures should be followed in the event the package is damaged, to include inspection and repacking if necessary; and
- A telephone number for additional information.

This document may be in any form provided it contains all the appropriate information and accompanies the consignment. For example, the document may be provided separately to the carrier or in a pouch attached to the package.

M. Does ICAO require an MSDS containing the UN test data?

No. ICAO does not require the use of MSDS and test data is not part of the required documentation requirements when offering lithium batteries for transport.

N. Under Packing Instructions 966 and 969, it states that “The maximum number of batteries in each package must be the minimum number required to power the equipment, plus two spares”. If a package contains 4 power tools (each tool contains a lithium ion battery), can 2 extra lithium ion batteries be placed in the package for each piece of equipment for a total of 8 batteries?

Yes. The 8 batteries reflect two spares for each of the 4 power tools in the outer package.

O. May lithium battery packages be placed in an overpack in accordance with the new ICAO Technical Instructions?

Yes. The overpack may also contain packages of dangerous goods or goods not subject to these Instructions provided there are no packages enclosing different substances which might react dangerously with each other. An overpack must be labelled with the lithium battery label (Figure 5-31) of the ICAO Technical Instructions unless the label(s) on the

package(s) inside the overpack are visible. In addition, the word “overpack” must be marked on overpacks containing packages transported in accordance with Section I of the applicable Packing Instructions (i.e. bearing Class 9 labels).

P. Do the quantity limits shown in the ICAO packing instructions apply to overpacks containing lithium batteries?

The quantity limits shown in packing instructions 965 and 968, refer to the package. Provided each package remains under the limit specified in the packing instruction, the overpack may exceed the specified limits.

Q. Packing Instructions 966 and 969 Section II include a requirement for a 1.2 meter drop test. What portion or portions of the package are subject to this test?

The completed package containing batteries as prepared for transport in accordance with the relevant packing instruction must be capable of withstanding the 1.2 meter drop test. This could apply to a package solely containing batteries that is packaged in full compliance with the provisions of the packing instruction (to include the 1.2 meter drop test capability requirement) and is then overpacked with equipment and offered for transport (see item 2M for additional information related to overpacks). Or, it could apply to a package that includes batteries properly packed in inner packaging and equipment or other non-dangerous goods that are placed in a single outer packaging. The package that includes both the inner packaging containing batteries and the equipment must comply with the packing instruction to include meeting the capability to pass the 1.2 meter drop test.

R. How do I transport prototype lithium cells and batteries that have not been UN Tested?

Prototype lithium batteries may be transported by cargo aircraft if you do the following:

1. Obtain approval by the competent authority of the origin country prior to transport;
2. Place no more than 12 batteries or 24 cells in a package;
3. Protect the cells and batteries from short circuiting;
4. Pack each of the cells or batteries in an inner packaging inside an outer packaging that completely surrounds the cells and batteries. All packaging and cushioning material must be non-conductive and non-combustible
5. Place the cells and batteries in an outer drum or box made of metal, plastic or plywood that meets Packing Group I performance requirements.

S. Can I ship recalled, damaged or non-conforming cells or batteries?

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). The U.S. DOT has developed guidance for consumers and manufacturers for shipping recalled batteries. http://safetravel.dot.gov/Battery_Recall_Guidance.pdf

Batteries which have some other defective feature (e.g., LEDs not showing charge, incorrect model number on label, or batteries not holding enough charge) could still be shipped by air. Also, laptops being returned may not have a defective battery, it may not meet the needs of the customer, may be defective itself (but not the battery), etc. In these situations air transport would be permitted. The battery or equipment manufacturer should be contacted to determine the appropriate shipping method.

Part 3 – Questions Related to Design Type Testing Provisions

A. Where can I find requirements related to testing of battery design types?

The UN Manual of Tests and Criteria sets out specific tests that must be conducted on each lithium cell or battery design type. Each test is intended to either simulate a common transportation occurrence such as vibration or changes in altitude or to test the integrity of a cell or battery. You may obtain a copy of these testing requirements via the following website: http://www.unece.org/trans/danger/publi/manual/manual_e.html.

B. What constitutes a design change requiring renewed design type testing?

A cell or battery that differs from a tested design by more than 0.1 grams or 20 % to the anode, cathode or electrolyte is considered to be a design change. A change that would materially affect the test results is also a design change.

Examples of design changes may include the use of a different type of cathode material or a change in the battery's geometry.

Part 4 – Questions Related to State and Operator Variations

A. What additional requirements are imposed by US Variation 2?

The United States restricts the transport of certain primary (non-rechargeable) lithium metal batteries, both packaged batteries and those packed with our contained in equipment, from transport on passenger carrying aircraft. In accordance with US Variation 2, primary (non-rechargeable) lithium metal batteries and cells (UN3090) are forbidden for transportation aboard passenger-carrying aircraft. Such batteries transported in accordance with Section I of Packing Instruction 968 must be labelled with the cargo aircraft only label. Such batteries transported in accordance with Section II of Packing Instruction 968 must be marked "PRIMARY LITHIUM BATTERIES — FORBIDDEN FOR TRANSPORT ABOARD PASSENGER AIRCRAFT" or "LITHIUM METAL

BATTERIES — FORBIDDEN FOR TRANSPORT ABOARD PASSENGER AIRCRAFT”.

Primary (non-rechargeable) lithium metal batteries and cells contained in or packed with equipment (UN3091) are forbidden for transportation aboard passenger-carrying aircraft unless:

- 1) The equipment and the batteries and cells are transported in accordance with Packing Instruction 969 or 970, as appropriate;
- 2) The package contains no more than the number of lithium metal batteries or cells necessary to power the intended piece of equipment;
- 3) The lithium content of each cell, when fully charged, is not more than 5 grams;
- 4) The aggregate lithium content of the anode of each battery, when fully charged, is not more than 25 grams; and
- 5) The net weight of lithium batteries does not exceed 5 kg (11 pounds).

Primary (non-rechargeable) lithium metal batteries and cells contained in or packed with equipment (UN3091) and transported in accordance with Section I of Packaging Instruction 969 or 970 that do not conform to the above provisions are forbidden for transportation aboard passenger carrying aircraft and must be labelled with the cargo aircraft only label.

Primary (non-rechargeable) lithium metal batteries and cells contained in or packed with equipment (UN3091) and transported in accordance with Section II of Packaging Instruction 969 or 970 that do not conform to the above provisions are forbidden for transportation aboard passenger carrying aircraft and must be marked “PRIMARY LITHIUM BATTERIES — FORBIDDEN FOR TRANSPORT ABOARD PASSENGER AIRCRAFT” or “LITHIUM METAL BATTERIES — FORBIDDEN FOR TRANSPORT ABOARD PASSENGER AIRCRAFT”.

ATTACHMENT

LITHIUM BATTERY PACKING INSTRUCTIONS

PACKING INSTRUCTION 965

Passenger and cargo aircraft for UN 3480

This entry applies to lithium ion or lithium polymer batteries in Class 9 (Section I) and lithium ion or lithium polymer batteries subject to specific requirements of these Instructions (Section II).

SECTION I

Section I requirements apply to each cell or battery type that has been determined to meet the criteria for assignment to Class 9.

Each cell or battery must:

- 1) be of the type proven to meet the requirements of each test in the UN *Manual of Tests and Criteria*, Part III, section 38.3; and
- 2) incorporate a safety venting device or be designed to preclude a violent rupture under conditions normally incident to transport and be equipped with an effective means of preventing external short circuits.

Each battery containing cells or a series of cells connected in parallel must be equipped with an effective means, as necessary, to prevent dangerous reverse current flow (e.g. diodes, fuses).

General requirements

Part 4;1 requirements must be met.

Contents	Package quantity (Section I)	
	Passenger	Cargo
Lithium ion cells and batteries	5 kg G	35 kg G

ADDITIONAL PACKING REQUIREMENTS

- Lithium ion cells and batteries must be protected against short circuits.
- Packagings must meet the Packing Group II performance requirements.
- Lithium ion batteries with a mass 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 packagings and protective enclosures not subject to the requirements of Part 6 of these Instructions, if approved by the appropriate authority of the State of Origin. A copy of the document of approval must accompany the consignment.

OUTER PACKAGINGS

Boxes

Aluminium (4B)
 Fibreboard (4G)
 Natural wood (4C1, 4C2)
 Plastic (4H2)
 Plywood (4D)
 Reconstituted wood (4F)
 Steel (4A)

Drums

Aluminium (1B2)
 Fibre (1G)
 Plastic (1H2)
 Plywood (1D)
 Steel (1A2)

Jerricans

Aluminium (3B2)
 Plastic (3H2)
 Steel (3A2)

SECTION II

Lithium ion cells and batteries offered for transport are not subject to other additional requirements of these Instructions if they meet the requirements of this section.

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).

Lithium ion cells and batteries may be offered for transport if they meet the following:

- 1) for lithium ion cells, the Watt-hour rating (see Attachment 2) is not more than 20 Wh;
- 2) for lithium ion batteries, the Watt-hour rating is not more than 100 Wh;

- the Watt-hour rating must be marked on the outside of the battery case except for those batteries manufactured before 1 January 2009, which may be transported in accordance with the provisions of this section and without the marking until 31 December 2010;

- 3) each cell or battery is of the type proven to meet the requirements of each test in the UN *Manual of Tests and Criteria*, Part III, section 38.3.

General requirements

Batteries must be packed in strong outer packagings that conform to Part 4;1.1.1, 1.1.3.1 and 1.1.9 (except 1.1.9.1).

Contents	Package quantity (Section II)	
	Passenger	Cargo
Lithium ion cells and batteries	10 kg G	10 kg G

ADDITIONAL PACKING REQUIREMENTS

- Cells and batteries must be packed in inner packagings that completely enclose the cell or battery.
- 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.
- 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 labelled with a lithium battery handling label (Figure 5-31).
- Each consignment must be accompanied with a document such as an air waybill with an indication that:
 - the package contains lithium ion cells or batteries;
 - the package must be handled with care and that a flammability hazard exists if the package is damaged;
 - special procedures should be followed in the event the package is damaged, to include inspection and repacking if necessary; and
 - a telephone number for additional information.
- Any person preparing or offering cells or batteries for transport must receive adequate instruction on these requirements commensurate with their responsibilities.

OUTER PACKAGINGS

Boxes

Drums

Jerricans

Strong outer packagings

+

PACKING INSTRUCTION 966

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

This entry applies to lithium ion or lithium polymer batteries packed with equipment in Class 9 (Section I) and lithium ion or lithium polymer batteries packed with equipment subject to specific requirements of these Instructions (Section II).

SECTION I

Section I requirements apply to each cell or battery type that has been determined to meet the criteria for assignment to Class 9.

Each cell or battery must:

- 1) be of the type proven to meet the requirements of each test in the UN *Manual of Tests and Criteria*, Part III, section 38.3; and
- 2) incorporate a safety venting device or be designed to preclude a violent rupture under conditions normally incident to transport and be equipped with an effective means of preventing external short circuits.

Each battery containing cells or a series of cells connected in parallel must be equipped with an effective means, as necessary, to prevent dangerous reverse current flow (e.g. diodes, fuses).

General requirements

Part 4;1 requirements must be met.

Contents	Package quantity (Section I)	
	Passenger	Cargo
Quantity of lithium ion cells and batteries per overpack, excluding equipment	5 kg	35 kg

ADDITIONAL PACKING REQUIREMENTS

- Lithium ion cells and batteries must be protected against short circuits.
- The completed package for the cells or batteries must meet the Packing Group II performance requirements.
- The equipment and the packages of lithium cells or batteries must be placed in an overpack. The overpack must bear applicable marks and labels as set out in Part 5;1 and 5;2.4.10.
- For the purpose of this packing instruction, “equipment” means apparatus requiring the lithium ion batteries with which it is packed for its operation.

OUTER PACKAGINGS*Boxes*

Aluminium (4B)
Fibreboard (4G)
Natural wood (4C1, 4C2)
Plastic (4H2)
Plywood (4D)
Reconstituted wood (4F)
Steel (4A)

Drums

Aluminium (1B2)
Fibre (1G)
Plastic (1H2)
Plywood (1D)
Steel (1A2)

Jerricans

Aluminium (3B2)
Plastic (3H2)
Steel (3A2)

SECTION II

Lithium ion cells and batteries (including lithium polymer) packed with equipment offered for transport are not subject to other additional requirements of these Instructions if they meet the requirements of this section.

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).

Lithium ion cells and batteries may be offered for transport if they meet the following:

- 1) for lithium ion cells, the Watt-hour rating (see Attachment 2) is not more than 20 Wh;
- 2) for lithium ion batteries, the Watt-hour rating is not more than 100 Wh;
 - the Watt-hour rating must be marked on the outside of the battery case except for those batteries manufactured before 1 January 2009, which may be transported in accordance with the provisions of this section and without the marking until 31 December 2010;
- 3) each cell or battery is of the type proven to meet the requirements of each test in the UN *Manual of Tests and Criteria*, Part III, section 38.3.

General requirements

Batteries must be packed in strong outer packagings that conform to Part 4;1.1.1, 1.1.3.1 and 1.1.9 (except 1.1.9.1).

ADDITIONAL PACKING REQUIREMENTS

- Cells and batteries must be packed in inner packagings that completely enclose the cell or battery.
- 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.
- The maximum number of batteries in each package must be the minimum number required to power the equipment, plus two spares.
- 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 labelled with a lithium battery handling label (Figure 5-31).
- Each consignment must be accompanied with a document such as an air waybill with an indication that:
 - the package contains lithium ion cells or batteries;

- the package must be handled with care and that a flammability hazard exists if the package is damaged;
 - special procedures should be followed in the event the package is damaged, to include inspection and repacking if necessary; and
 - a telephone number for additional information.
- Any person preparing or offering cells or batteries for transport must receive adequate instruction on these requirements commensurate with their responsibilities.

OUTER PACKAGINGS*Boxes**Drums**Jerricans*

Strong outer packagings

PACKING INSTRUCTION 967

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

This entry applies to lithium ion or lithium polymer batteries contained in equipment in Class 9 (Section I) and lithium ion or lithium polymer batteries contained in equipment subject to specific requirements of these Instructions (Section II).

SECTION I

Section I requirements apply to each cell or battery type that has been determined to meet the criteria for assignment to Class 9.

Each cell or battery must:

- 1) be of the type proven to meet the requirements of each test in the UN *Manual of Tests and Criteria*, Part III, section 38.3; and
- 2) incorporate a safety venting device or be designed to preclude a violent rupture under conditions normally incident to transport and be equipped with an effective means of preventing external short circuits.

Each battery containing cells or a series of cells connected in parallel must be equipped with an effective means, as necessary, to prevent dangerous reverse current flow (e.g. diodes, fuses).

General requirements

Part 4;1 requirements must be met.

<i>Contents</i>	<i>Net quantity per piece of equipment (Section I)</i>	
	<i>Passenger</i>	<i>Cargo</i>
Lithium ion batteries contained in equipment	5 kg	35 kg

ADDITIONAL PACKING REQUIREMENTS

- Outer packaging must be waterproof or made waterproof through the use of a liner, such as a plastic bag unless the equipment is made waterproof by nature of its construction.
- The equipment must be secured against movement within the outer packaging and be packed so as to prevent accidental operation during air transport.

OUTER PACKAGINGS*Boxes**Drums**Jerricans*

Strong outer packagings

SECTION II

Lithium ion cells and batteries (including lithium polymer) contained in equipment offered for transport are not subject to other additional requirements of these Instructions if they meet the requirements of this section.

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).

Lithium ion cells and batteries may be offered for transport if they meet the following:

- 1) for lithium ion cells, the Watt-hour rating (see Attachment 2) is not more than 20 Wh;
- 2) for lithium ion batteries, the Watt-hour rating is not more than 100 Wh;
 - the Watt-hour rating must be marked on the outside of the battery case except for those batteries manufactured before 1 January 2009, which may be transported in accordance with the provisions of this section and without the marking until 31 December 2010;
- 3) each cell or battery is of the type proven to meet the requirements of each test in the UN *Manual of Tests and Criteria*, Part III, section 38.3.

General requirements

Equipment must be packed in strong outer packagings that conform to Part 4;1.1.1, 1.1.3.1 and 1.1.9 (except 1.1.9.1).

ADDITIONAL PACKING REQUIREMENTS

- The equipment must be equipped with an effective means of preventing accidental activation.
- Cells and batteries must be protected so as to prevent short circuits.
- The equipment must be packed in strong outer packagings constructed of suitable material of adequate strength and design in relation to the packaging's capacity and its intended use unless the battery is afforded equivalent protection by the equipment in which it is contained.
- Each package containing more than four cells or more than two batteries installed in equipment must be labelled with a lithium battery handling label (Figure 5-31).
- Each consignment with packages bearing the lithium battery handling label must be accompanied with a document such as an air waybill with an indication that:
 - the package contains lithium ion cells or batteries;
 - the package must be handled with care and that a flammability hazard exists if the package is damaged;
 - special procedures should be followed in the event the package is damaged, to include inspection and repacking if necessary; and
 - a telephone number for additional information.
- Any person preparing or offering cells or batteries for transport must receive adequate instruction on these requirements commensurate with their responsibilities.

OUTER PACKAGINGS

Boxes

Drums

Jerricans

Strong outer packagings

+

PACKING INSTRUCTION 968

Passenger and cargo aircraft for UN 3090

This entry applies to lithium metal or lithium alloy batteries in Class 9 (Section I) and lithium metal or lithium alloy batteries subject to specific requirements of these Instructions (Section II).

SECTION I

Section I requirements apply to each cell or battery type that has been determined to meet the criteria for assignment to Class 9.

Each cell or battery must:

- 1) be of the type proven to meet the requirements of each test in the UN *Manual of Tests and Criteria*, Part III, section 38.3; and
- 2) incorporate a safety venting device or be designed to preclude a violent rupture under conditions normally incident to transport and be equipped with an effective means of preventing external short circuits.

Each battery containing cells or a series of cells connected in parallel must be equipped with an effective means, as necessary, to prevent dangerous reverse current flow (e.g. diodes, fuses).

Cells, and batteries containing one or more cells, with a liquid cathode containing sulphur dioxide, sulphuryl chloride or thionyl chloride which have been discharged to the extent that the open circuit voltage is less than the lower of:

- a) two volts; or
- b) two-thirds of the voltage of the undischarged cell;

are forbidden from transport.

General requirements

Part 4;1 requirements must be met.

Contents	Package quantity (Section I)	
	Passenger	Cargo
Lithium metal cells and batteries	2.5 kg G	35 kg G

ADDITIONAL PACKING REQUIREMENTS

- Lithium metal cells and batteries must be protected against short circuits.
- Packagings must meet the Packing Group II performance requirements.
- Lithium batteries with a mass 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 packagings and protective enclosures not subject to the requirements of Part 6 of these Instructions, if approved by the appropriate authority of the State of Origin. A copy of the document of approval must accompany the consignment.
- For lithium metal cells and batteries prepared for transport on passenger aircraft as Class 9:
 - Cells and batteries offered for transport on passenger aircraft must be packed in intermediate or outer rigid metal packaging.
 - Cells and batteries must be surrounded by cushioning material that is non-combustible and non-conductive, and placed inside an outer packaging.

OUTER PACKAGINGS

Boxes

Aluminium (4B)
Fibreboard (4G)
Natural wood (4C1, 4C2)
Plastic (4H2)
Plywood (4D)
Reconstituted wood (4F)
Steel (4A)

Drums

Aluminium (1B2)
Fibre (1G)
Plastic (1H2)
Plywood (1D)
Steel (1A2)

Jerricans

Aluminium (3B2)
Plastic (3H2)
Steel (3A2)

SECTION II

Lithium metal or lithium alloy cells and batteries offered for transport are not subject to other additional requirements of these Instructions if they meet the requirements of this section.

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).

Lithium metal or lithium alloy cells and batteries may be offered for transport if they meet the following:

- 1) for a lithium metal cell, the lithium content is not more than 1 g;
- 2) for a lithium metal or lithium alloy battery, the aggregate lithium content is not more than 2 g;
- 3) each cell or battery is of the type proven to meet the requirements of each test in the UN *Manual of Tests and Criteria*, Part III, section 38.3.

General requirements

Batteries must be packed in strong outer packagings that conform to Part 4;1.1.1, 1.1.3.1 and 1.1.9 (except 1.1.9.1).

Contents	Package quantity (Section II)	
	Passenger	Cargo
Lithium metal cells and batteries	2.5 kg G	2.5 kg G

ADDITIONAL PACKING REQUIREMENTS

- Cells and batteries must be packed in inner packagings that completely enclose the cell or battery.
- 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.
- 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 labelled with a lithium battery handling label (Figure 5-31).
- Each consignment must be accompanied with a document such as an air waybill with an indication that:
 - the package contains lithium metal cells or batteries;
 - the package must be handled with care and that a flammability hazard exists if the package is damaged;
 - special procedures should be followed in the event the package is damaged, to include inspection and repacking if necessary; and
 - a telephone number for additional information.
- Any person preparing or offering cells or batteries for transport must receive adequate instruction on these requirements commensurate with their responsibilities.

OUTER PACKAGINGS

Boxes

Drums

Jerricans

Strong outer packagings

PACKING INSTRUCTION 969

Passenger and cargo aircraft for UN 3091 (packed with equipment) only

This entry applies to lithium metal or lithium alloy batteries packed with equipment in Class 9 (Section I) and lithium metal or lithium alloy batteries packed with equipment subject to specific requirements of these Instructions (Section II).

SECTION I

Section I requirements apply to each cell or battery type that has been determined to meet the criteria for assignment to Class 9.

Each cell or battery must:

- 1) be of the type proven to meet the requirements of each test in the UN *Manual of Tests and Criteria*, Part III, section 38.3; and
- 2) incorporate a safety venting device or be designed to preclude a violent rupture under conditions normally incident to transport and be equipped with an effective means of preventing external short circuits.

Each battery containing cells or a series of cells connected in parallel must be equipped with an effective means, as necessary, to prevent dangerous reverse current flow (e.g. diodes, fuses).

Cells, and batteries containing one or more cells, with a liquid cathode containing sulphur dioxide, sulphuryl chloride or thionyl chloride which have been discharged to the extent that the open circuit voltage is less than the lower of:

- a) two volts; or
- b) two-thirds of the voltage of the undischarged cell;

are forbidden from transport.

General requirements

Part 4;1 requirements must be met.

Contents	Package quantity (Section I)	
	Passenger	Cargo
Quantity of lithium metal cells and batteries per overpack, excluding equipment	5 kg	35 kg

ADDITIONAL PACKING REQUIREMENTS

- Lithium metal cells and batteries must be protected against short circuits.
- The completed package for the cells or batteries must meet the Packing Group II performance requirements.
- Each completed package containing lithium cells or batteries must be marked and labelled in accordance with the applicable requirements of 5;1, 5;2 and 5;3.
- The equipment and the packages of lithium cells or batteries must be placed in an overpack. The overpack must bear applicable marks and labels as set out in 5;1 and 5;2.4.10.
- For the purpose of this packing instruction, "equipment" means apparatus requiring the lithium batteries with which it is packed for its operation.
- For lithium metal cells and batteries prepared for transport on passenger aircraft as Class 9:
 - Cells and batteries offered for transport on passenger aircraft must be packed in intermediate or outer rigid metal packaging surrounded by cushioning material that is non-combustible and non-conductive and placed inside an outer packaging.

OUTER PACKAGINGS*Boxes*

Aluminium (4B)
Fibreboard (4G)
Natural wood (4C1, 4C2)
Plastic (4H2)
Plywood (4D)
Reconstituted wood (4F)
Steel (4A)

Drums

Aluminium (1B2)
Fibre (1G)
Plastic (1H2)
Plywood (1D)
Steel (1A2)

Jerricans

Aluminium (3B2)
Plastic (3H2)
Steel (3A2)

SECTION II

Lithium metal cells and batteries packed with equipment offered for transport are not subject to other additional requirements of these Instructions if they meet the requirements of this section.

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).

Lithium metal cells and batteries may be offered for transport if they meet the following:

- 1) for a lithium metal cell, the lithium content is not more than 1 g;
- 2) for a lithium metal or lithium alloy battery, the aggregate lithium content is not more than 2 g;
- 3) each cell or battery is of the type proven to meet the requirements of each test in the UN *Manual of Tests and Criteria*, Part III, section 38.3.

General requirements

Batteries must be packed in strong outer packagings that conform to Part 4;1.1.1, 1.1.3.1 and 1.1.9 (except 1.1.9.1).

ADDITIONAL PACKING REQUIREMENTS

- Cells and batteries must be packed in inner packagings that completely enclose the cell or battery.
- 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.
- The maximum number of batteries in each package must be the minimum number required to power the equipment, plus two spares.
- 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 labelled with a lithium battery handling label (Figure 5-31).

- Each consignment must be accompanied with a document such as an air waybill with an indication that:
 - the package contains lithium metal cells or batteries;
 - the package must be handled with care and that a flammability hazard exists if the package is damaged;
 - special procedures should be followed in the event the package is damaged, to include inspection and repacking if necessary; and
 - a telephone number for additional information.
- Any person preparing or offering cells or batteries for transport must receive adequate instruction on these requirements commensurate with their responsibilities.

OUTER PACKAGINGS

Boxes

Drums

Jerricans

Strong outer packagings

PACKING INSTRUCTION 970

Passenger and cargo aircraft for UN 3091 (contained in equipment) only

This entry applies to lithium metal or lithium alloy batteries contained in equipment in Class 9 (Section I) and lithium metal or lithium alloy batteries contained in equipment subject to specific requirements of these Instructions (Section II).

SECTION I

Section I requirements apply to each cell or battery type that has been determined to meet the criteria for assignment to Class 9.

Each cell or battery must:

- 1) be of the type proven to meet the requirements of each test in the *UN Manual of Tests and Criteria*, Part III, section 38.3; and
- 2) incorporate a safety venting device or be designed to preclude a violent rupture under conditions normally incident to transport and be equipped with an effective means of preventing external short circuits.

Each battery containing cells or a series of cells connected in parallel must be equipped with an effective means, as necessary, to prevent dangerous reverse current flow (e.g. diodes, fuses).

Cells, and batteries containing one or more cells, with a liquid cathode containing sulphur dioxide, sulphuryl chloride or thionyl chloride which have been discharged to the extent that the open circuit voltage is less than the lower of:

- a) two volts; or
- b) two-thirds of the voltage of the undischarged cell;

are forbidden from transport.

General requirements

Part 4;1 requirements must be met.

Package contents	Net quantity per piece of equipment (Section I)	
	Passenger	Cargo
Lithium metal batteries	5 kg	35 kg

ADDITIONAL PACKING REQUIREMENTS

- Outer packaging must be waterproof or made waterproof through the use of a liner, such as a plastic bag unless the equipment is made waterproof by nature of its construction.
- The equipment must be secured against movement within the outer packaging and be packed so as to prevent accidental operation during air transport.
- The quantity of lithium metal contained in any piece of equipment must not exceed 12 g per cell and 500 g per battery.

OUTER PACKAGINGS*Boxes**Drums**Jerricans*

Strong outer packaging

SECTION II

Lithium metal cells and batteries contained in equipment offered for transport are not subject to other additional requirements of these Instructions if they meet the requirements of this section.

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).

Lithium metal cells and batteries may be offered for transport if they meet the following:

- 1) for a lithium metal cell, the lithium content is not more than 1 g;
- 2) for a lithium metal or lithium alloy battery, the aggregate lithium content is not more than 2 g.
- 3) each cell or battery is of the type proven to meet the requirements of each test in the UN *Manual of Tests and Criteria*, Part III, section 38.3.

General requirements

Equipment containing batteries must be packed in strong outer packagings that conform to Part 4;1.1.1, 1.1.3.1 and 1.1.9 (except 1.1.9.1).

ADDITIONAL PACKING REQUIREMENTS

- The equipment must be equipped with an effective means of preventing accidental activation.
- Cells and batteries must be protected so as to prevent short circuits.
- The equipment must be packed in strong outer packagings constructed of suitable material of adequate strength and design in relation to the packaging's capacity and its intended use unless the battery is afforded equivalent protection by the equipment in which it is contained.
- Each package containing more than four cells or more than two batteries installed in equipment must be labelled with a lithium battery handling label (Figure 5-31).
- Each consignment with packages bearing the lithium battery handling label must be accompanied with a document such as an air waybill with an indication that:
 - the package contains lithium metal cells or batteries;
 - the package must be handled with care and that a flammability hazard exists if the package is damaged;
 - special procedures should be followed in the event the package is damaged, to include inspection and repacking if necessary; and
 - a telephone number for additional information.
- Any person preparing or offering cells or batteries for transport must receive adequate instruction on these requirements commensurate with their responsibilities.

OUTER PACKAGINGS*Boxes**Drums**Jerricans*

Strong outer packagings

— END —