



## Lithium Batteries – Significant Changes on the Way

Lithium batteries in all their forms have been the subject of regulatory review through the course of 2006 and 2007. The review process was driven in part by testing conducted by the United States Federal Aviation Administration (FAA) in 2004 to determine the behaviour of lithium metal batteries when exposed to a fire in a simulated aircraft cargo compartment. Lithium ion batteries also came under scrutiny following the in-flight fire on a UPS DC-8 freighter aircraft that was on approach to land in Philadelphia in 2006. Adding to this was a number of fires involving laptop computer batteries, which resulted in recalls of a large number of lithium ion batteries.

The fire testing conducted by the FAA identified that once ignited, lithium metal batteries have the capacity to self-propagate the fire by igniting adjacent batteries until all of the batteries were engulfed in the fire. Of greater concern was the identification that the Halon fire extinguishing system used in aircraft cargo compartments would not extinguish the fire and that the pressure pulse from the burning batteries had the ability to breach the cargo compartment liner, which would potentially result in the spread of the fire into the aircraft.

Lithium ion batteries subjected to the same fire conditions did not self-propagate the fire and Halon was able to extinguish the fire.

With the UPS DC-8 fire, the post-crash investigation identified that laptop computers and spare lithium ion batteries were in ULDs at the source of the fire. However, the investigation was unable to conclusively determine the exact cause of the fire and so suggestions that the laptop batteries were the cause of the fire is only circumstantial. Despite this, the hearing by the National Transportation Safety Board (NTSB) into the fire expressed some concern about lithium ion batteries and their fire potential, and the subsequent NTSB report on the accident has made recommendations to the US Pipeline & Hazardous Material Safety Administration (PHMSA) regarding the transport of lithium batteries.

### United Nations Subcommittee of Experts on the Transport of Dangerous Goods (UN Subcommittee)

Based on safety concerns of consignments of lithium batteries being transported “unregulated” through compliance with Special Provision A45 (UN Special Provision 188) and a desire by some regulatory authorities to regulate lithium metal batteries differently than lithium ion batteries, proposals were submitted to the UN Subcommittee of Experts on the Transport of Dangerous Goods during the 2005-2006 biennium.

Proposals submitted and agreed to by the UN Subcommittee that have been implemented into the 15<sup>th</sup> revised edition of the Model Regulations that affect lithium batteries include:

- revision to special provision 188 (the UN equivalent of Special Provision A45 in the IATA DGR) to revise the determination for exception lithium ion batteries from a lithium equivalent value to a Watt-hour value. The special provision was also changed to require cells and batteries to be in inner packagings that completely enclose the cell or battery, the standards for the outer packaging for cells and batteries was enhanced and a new requirement was introduced for each package containing lithium cells or batteries to be marked to indicate the type of battery, lithium metal or lithium ion;
- addition of new UN numbers and proper shipping names for lithium ion batteries (UN 3480) and lithium ion batteries contained in, or packed with, equipment (UN 3481). The existing lithium batteries entries have been revised to become “Lithium **metal** batteries” (UN 3090) and “Lithium **metal** batteries contained in equipment” and “Lithium **metal** batteries packed with equipment” (UN 3091).



## ICAO Dangerous Goods Panel (DGP)

In addition to the consideration of the changes adopted into the UN Model Regulations, the ICAO DGP considered other specific proposals from Panel members and industry on the provisions applicable to the transport of lithium batteries by air.

These proposals included:

- a ban on the transport of lithium metal batteries on both passenger and cargo aircraft;
- limitation of lithium metal batteries to Cargo Aircraft Only;
- removal of small lithium metal and lithium ion batteries from special provision A45 with the exception of batteries contained in, or packed with equipment;
- development of new packing instructions for small lithium batteries to incorporate all of the requirements from special provision A45.

Because of the complex nature of all of the proposed changes to lithium batteries, the ICAO DGP established an ad hoc working group on lithium batteries to consider these proposals and to develop recommendations to the 21<sup>st</sup> Meeting of the ICAO Dangerous Goods Panel (DGP/21) that was scheduled to meet in November 2007.

The ad hoc working group met for two days in Montreal in October 2007. In addition to Panel members and advisors, there were a number of representatives from the battery associations of Germany, Japan and the United States.

While the ad hoc working group was able to make some progress, there was no final conclusion. Further work was then undertaken at DGP/21 to discuss the proposals to conclusion and to develop recommendations for adoption into the 2009-2010 edition of the ICAO Technical Instructions and consequently the 50<sup>th</sup> edition of the DGR.

The result of these extensive considerations is that from 1 January 2009 there will be extensive changes to the requirements for shippers of lithium batteries. These changes can be summarised as follows:

1. **General.** The packing instructions for lithium batteries have been reformatted, new packaging, documentation, labelling requirements (the new lithium battery handling label is shown below), and new weight limitations have been adopted for small lithium batteries that meet the requirements of Special Provision A45. In addition, the detailed requirements of Special Provision A45 have been incorporated into the applicable packing instructions. There is a requirement for shippers of small, excepted cells and batteries, as follows: *“Any person preparing or offering cells or batteries for transport must receive adequate instruction on these requirements commensurate with their responsibilities.”*

In addition, the following new packaging and documentation requirements apply:

- cells and batteries must be packed in inner packagings that completely enclose the cell or battery (retail type plastic blister packs meet this requirement);
- 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 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.



### Lithium Battery Label (DGR Figure 7.4.I)



\* Place for "Lithium ion battery" or "Lithium metal battery", as applicable

Minimum dimensions: 120 x 110 mm

Colour: Black with red hatching on a contrasting background

#### 2. **Lithium ion batteries** (see [Packing Instruction 965](#)).

- a) there are no changes to the provisions for fully regulated batteries assigned to Class 9 except the change to the packing instruction number and the format of the packing instruction;
- b) for shippers of small, excepted lithium ion cells and batteries currently not regulated for transport in accordance with A45, in addition to the general requirements above, there is a reduction in the package weight limitation from 30 kg to 10 kg on both passenger and cargo aircraft; a change from equivalent lithium content to Watt-hours (1.5 g is now 20 watt-hours; 8 g is now 100 watt-hours); the Watt-hour rating must be marked on the outside of the battery case except those manufactured before 1 January 2009, which may be transported without this marking until 31 December 2010.

#### 3. **Lithium ion batteries packed with equipment** (see [Packing Instruction 966](#)).

- a) there are no changes to the provisions for fully regulated batteries assigned to Class 9 except the change to the packing instruction number and the format of the packing instruction;
- b) for small, excepted lithium ion cells and batteries packed with equipment, in addition to the general requirements shown in Item 2, the maximum number of batteries in each package is limited to the minimum number required to power the equipment, plus two spares and the exception level for the batteries is changed from equivalent lithium content to Watt-hours.

#### 4. **Lithium ion batteries contained in equipment** (see [Packing Instruction 967](#)).

- a) for fully regulated batteries assigned to Class 9 there is an increase to 35 kg per battery on Cargo Aircraft Only from the current 5 kg limit; there is a change to the packing instruction number and the format of the packing instruction;
- b) for small, excepted lithium ion cells and batteries contained in equipment the general requirements shown in Item 2 apply, the exception level is changed from lithium equivalent to Watt-hours. However, single packages containing no more than four cells installed in equipment or no more than two batteries installed in equipment are not subject to the labelling requirement, and consignments of such packages are not subject to the documentation requirements.



**5. Lithium metal batteries** ([see Packing Instruction 968](#)).

- a) there are no changes to the provisions for fully regulated lithium metal batteries assigned to Class 9 when shipped as Cargo Aircraft Only except the change to the packing instruction number and the format of the packing instruction. Fully regulated lithium metal batteries shipped on passenger aircraft:
  - 1. must be packed in a rigid metal intermediate or metal outer packaging. Cells and batteries must be surrounded by cushioning material that is non-combustible and non-conductive before being placed in either the metal intermediate or metal outer packaging;
  - 2. packages cannot exceed 2.5 kg gross weight (this is a reduction of 2.5 kg from the current 5 kg G weight limitation).
- b) for shippers of small, excepted lithium metal cells and batteries currently not regulated for transport in accordance with A45, in addition to the general requirements above, there is a reduction in the package weight limitation from 30 kg to 2.5 kg on both passenger and cargo aircraft.

**6. Lithium metal batteries packed with equipment** ([see Packing Instruction 969](#)).

- a) there are no changes to the provisions for fully regulated lithium metal batteries assigned to Class 9 packed with equipment when shipped as Cargo Aircraft Only except the change to the packing instruction number and the format of the packing instruction. Fully regulated lithium metal batteries packed with equipment shipped on passenger aircraft:
  - 1. the batteries must be packed in a rigid metal intermediate or metal outer packaging. Cells and batteries must be surrounded by cushioning material that is non-combustible and non-conductive before being placed in either the metal intermediate or metal outer packaging.
- b) for small, excepted lithium metal cells and batteries packed with equipment, in addition to the general requirements shown in Item 2, the maximum number of batteries in each package is limited to the minimum number required to power the equipment, plus two spares.

**7. Lithium metal batteries contained in equipment** ([see Packing Instruction 970](#)).

- a) for fully regulated batteries assigned to Class 9 there is an increase to 35 kg per battery on Cargo Aircraft Only from the current 5 kg limit; there is a change to the packing instruction number and the format of the packing instruction;
- b) for small, excepted lithium metal cells and batteries contained in equipment the general requirements shown in Item 2 apply. However, single packages containing no more than four cells installed in equipment or no more than two batteries installed in equipment are not subject to the labelling requirement and consignments of such packages are not subject to the documentation requirements.

**8. Lithium batteries in passenger baggage**

Passengers are permitted to carry onboard aircraft consumer electronic devices (watches, calculating machines, cameras, cellular phones, lap-top computers, camcorders, etc.) containing lithium metal and lithium ion batteries and spare lithium ion batteries for personal use. From 1 January 2009, the Regulations will recommend that these devices should be in carry-on baggage rather than in checked baggage.

There will also be a change for spare batteries. Spare batteries must be individually protected to prevent short circuits by placement in the original retail packaging or by otherwise insulating terminals, e.g. by taping over exposed terminals or placing each battery in a separate plastic bag or protective pouch. Spare lithium batteries must be in carry-on baggage, and are forbidden in a passenger's checked baggage.

The limits applied to lithium ion batteries in passenger baggage will also be revised from lithium equivalent to Watt-hours. The standard limit for lithium ion batteries installed in consumer electronic equipment or carried as spares will be a rating of 100 Wh.



## New Lithium Battery Packing instructions

### PACKING INSTRUCTION 965

This instruction applies to lithium ion or lithium polymer cells and batteries (UN 3480) on passenger and Cargo Aircraft Only.

#### Part 1

Lithium ion cells and batteries offered for transport are not subject to other additional requirements of these Regulations if they meet the requirements in Part 1.

Lithium batteries identified by the manufacturer as being defective for safety reasons, that have been damaged or 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 cells, the Watt-hour rating is not more than 20 Wh;
2. for batteries, Watt-hour rating is not more than 100 Wh. The Watt-hour rating must be marked on the outside of the battery case except those manufactured before 1 January 2009 which may be transported without this 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, subsection 38.3.

	Quantity per package Passenger aircraft	Quantity per package Cargo Aircraft Only
Lithium ion cells and batteries	10 kg G	10 kg G

#### General requirements

Cells and batteries must be packed in strong outer packagings that conform to 5.0.2.4, 5.0.2.6.1 and 5.2.12.1.

#### Additional 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 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.

Each package must be labelled with a lithium battery handling label (Figure 7.4.I);

Any person preparing or offering cells or batteries for transport must receive adequate instruction on these requirements commensurate with their responsibilities.

#### OUTER PACKAGINGS

Type	Drums	Jerricans	Boxes
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#### Part 2

Part 2 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, subsection 38.3.
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).

	Quantity per package Passenger aircraft	Quantity per package Cargo Aircraft Only
Lithium ion cells and batteries	5 kg G	35 kg G

**General requirements**

The General Packing Requirements of 5.0.2 must be met.

**Additional requirements**

- all lithium ion cells and batteries prepared for transport as Class 9 must be protected against short circuits;
- packagings must meet Packing Group II performance standards;
- 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 Section 6 of these Regulations, if approved by the appropriate authority of the State of origin. A copy of the document of approval must accompany the consignment.

**OUTER PACKAGINGS**

Type	Drums						Jerricans			Boxes						
Desc	Steel	Alum- inium	Ply- wood	Fibre	Plastic	Other metal	Steel	Alum- inium	Plastic	Steel	Alum- inium	Wood	Ply- wood	Recon- stituted wood	Fibre- board	Plastic
Spec	1A2	1B2	1D	1G	1H2	1N2	3A2	3B2	3H2	4A	4B	4C1 4C2	4D	4F	4G	4H1 4H2

**PACKING INSTRUCTION 966**

This instruction applies to lithium ion or lithium polymer cells and batteries packed with equipment (UN 3481) on passenger and Cargo Aircraft Only.

**Part 1**

Lithium ion or lithium polymer cells and batteries offered for transport are not subject to other additional requirements of these Regulations if they meet the requirements in Part 1.

Lithium batteries identified by the manufacturer as being defective for safety reasons, that have been damaged or have the potential for 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 alloy cells and batteries may be offered for transport if they meet the following:

1. for cells, the Watt-hour rating is not more than 20 Wh;
2. for batteries, Watt-hour rating is not more than 100 Wh. The Watt-hour rating must be marked on the outside of the battery case except those manufactured before 1 January 2009 which may be transported without this 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, subsection 38.3.

**General requirements**

Cells and batteries must be packed in strong outer packagings that conform to 5.0.2.4, 5.0.2.6.1 and 5.2.12.1.



The current exception for the larger lithium ion batteries with a lithium equivalent of more than 8 grams up to 25 grams will be revised as follows:

- the 8 – 25 gram equivalent lithium content limitation will be eliminated and replaced with 100 – 160 Watt hours (this equates to 8 – 12.8 grams lithium equivalent);
- the 100 – 160 Wh exception will apply to batteries installed in equipment which may be in either checked or carry-on baggage;
- passengers may also carry two of these larger lithium ion batteries as spares, but the spare batteries must be in carry-on baggage;
- **in order to carry these larger batteries, either installed in equipment or as spares, passengers must first secure approval from the airline or airlines on which they are travelling.**



### Additional 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 of batteries 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 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.

Each package must be labelled with a lithium battery handling label (Figure 7.4.I);

Any person preparing or offering cells or batteries for transport must receive adequate instruction on these requirements commensurate with their responsibilities.

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### OUTER PACKAGINGS

Type	Drums	Jerricans	Boxes
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#### Part 2

Part 2 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, subsection 38.3.
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.

	Quantity per package Passenger aircraft	Quantity per package Cargo Aircraft Only
Quantity of lithium ion cells and batteries per overpack, excluding weight of equipment	5 kg	35 kg

#### General requirements

The General Packing Requirements of 5.0.2 must be met.

#### Additional requirements

- all lithium ion cells and batteries prepared for transport as Class 9 must be protected against short circuits;
- the completed package for the cells or batteries must meet Packing Group II packaging standards;
- each completed package containing lithium cells or batteries must be marked and labelled in accordance with the applicable requirements of Section 7;
- 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 7.1.4 and 7.2.7;
- for the purpose of this packing instruction, "equipment" means apparatus requiring the lithium batteries with which it is packed for its operation.

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### OUTER PACKAGINGS

Type	Drums	Jerricans	Boxes
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## PACKING INSTRUCTION 967

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This instruction applies to lithium ion or lithium polymer cells and batteries contained in equipment (UN 3481) on passenger and Cargo Aircraft Only.

### Part 1

Lithium ion or lithium polymer cells and batteries offered for transport are not subject to other additional requirements of these Regulations if they meet the requirements in Part 1.

Lithium batteries identified by the manufacturer as being defective for safety reasons, that have been damaged or 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 or lithium polymer cells and batteries may be offered for transport if they meet the following:

1. for cells, the Watt-hour rating is not more than 20 Wh;
2. for batteries, Watt-hour rating is not more than 100 Wh. The Watt-hour rating must be marked on the outside of the battery case except those manufactured before 1 January 2009 which may be transported without this 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, subsection 38.3.

### General requirements

Equipment containing batteries must be packed in strong outer packagings that conform to 5.0.2.4, 5.0.2.6.1 and 5.2.12.1.

### Additional 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 7.4.I);

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.

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## OUTER PACKAGINGS

Type	Drums	Jerricans	Boxes
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### Part 2

Part 2 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, subsection 38.3.
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 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).

	Passenger aircraft	Cargo Aircraft Only
Quantity of lithium ion cells and batteries per piece of equipment	5 kg	35 kg

**General requirements**

The General Packing Requirements of 5.0.2 must be met.

**Additional 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**

Type	Drums	Jerricans	Boxes
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**PACKING INSTRUCTION 968**

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

**Part 1**

Lithium metal or lithium alloy cells and batteries offered for transport are not subject to other additional requirements of these Regulations if they meet the requirements in Part 1.

Lithium batteries identified by the manufacturer as being defective for safety reasons, that have been damaged or 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. a lithium metal cell, the lithium content is not more than 1 g;
2. 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, subsection 38.3.

	Quantity per package Passenger aircraft	Quantity per package Cargo Aircraft Only
Lithium metal cells and batteries	2.5 kg G	2.5 kg G

**General requirements**

Cells and batteries must be packed in strong outer packagings that conform to 5.0.2.4, 5.0.2.6.1 and 5.2.12.1.

**Additional 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 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.

Each package must be labelled with a lithium battery handling label (Figure 7.4.I);

Any person preparing or offering cells or batteries for transport must receive adequate instruction on these requirements commensurate with their responsibilities.

## OUTER PACKAGINGS

Type	Drums	Jerricans	Boxes
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### Part 2

Part 2 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, subsection 38.3.
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 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:

- 2 volts; or
- two-thirds of the voltage of the undischarged cell;

and batteries containing one or more such cells, are forbidden for transport.

	Quantity per package Passenger aircraft	Quantity per package Cargo Aircraft Only
Lithium metal cells and batteries	2.5 kg G	35 kg G

### General requirements

The General Packing Requirements of 5.0.2 must be met.

### Additional requirements

- all lithium metal cells and batteries prepared for transport as Class 9 must be protected against short circuits;
- packagings must meet Packing Group II performance standards;
- 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 Section 6 of these Regulations, if approved by the appropriate national authority of the State of origin. A copy of the document of approval must accompany the consignment.

### Lithium metal cells and batteries prepared for transport on Passenger Aircraft as Class 9:

- must be packed in either a rigid metal intermediate or a metal outer packaging;
- cells and batteries must be surrounded by cushioning material that is non-combustible and non-conductive before being placed in either the metal intermediate or metal outer packaging.



## OUTER PACKAGINGS

Type	Drums						Jerricans			Boxes						
Desc	Steel	Alum- inium	Ply- wood	Fibre	Plastic	Other metal	Steel	Alum- inium	Plastic	Steel	Alum- inium	Wood	Ply- wood	Recon- stituted wood	Fibre- board	Plastic
Spec	1A2	1B2	1D	1G	1H2	1N2	3A2	3B2	3H2	4A	4B	4C1 4C2	4D	4F	4G	4H1 4H2

## PACKING INSTRUCTION 969

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

### Part 1

Lithium metal or lithium alloy cells and batteries offered for transport are not subject to other additional requirements of these Regulations if they meet the requirements in Part 1.

Lithium batteries identified by the manufacturer as being defective for safety reasons, that have been damaged or 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. a lithium metal cell, the lithium content is not more than 1 g;
2. 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, subsection 38.3.

### General requirements

Cells and batteries must be packed in strong outer packagings that conform to 5.0.2.4, 5.0.2.6.1 and 5.2.12.1.

### Additional 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 of batteries 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 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.

Each package must be labelled with a lithium battery handling label (Figure 7.4.I);

Any person preparing or offering cells or batteries for transport must receive adequate instruction on these requirements commensurate with their responsibilities.



## OUTER PACKAGINGS

Type	Drums	Jerricans	Boxes
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### Part 2

Part 2 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, subsection 38.3.
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 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:

- 2 volts; or
- two-thirds of the voltage of the undischarged cell;

and batteries containing one or more such cells, are forbidden for transport.

	Quantity per package Passenger aircraft	Quantity per package Cargo Aircraft Only
Quantity of lithium metal cells and batteries per overpack, excluding weight of equipment	5 kg	35 kg

### General requirements

The General Packing Requirements of 5.0.2 must be met.

### Additional requirements

- all lithium metal cells and batteries prepared for transport as Class 9 must be protected against short circuits;
- the completed package for the cells or batteries must meet Packing Group II packaging standards;
- each completed package containing lithium cells or batteries must be marked and labelled in accordance with the applicable requirements of Section 7;
- 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 7.1.4 and 7.2.7;
- For the purpose of this packing instruction, "equipment" means apparatus requiring the lithium batteries with which it is packed for its operation.

### Lithium metal cells and batteries prepared for transport on Passenger Aircraft as Class 9:

- must be packed in either a rigid metal intermediate or a metal outer packaging;
- cells and batteries must be surrounded by cushioning material that is non-combustible and non-conductive, and be placed in either the metal intermediate or metal outer packaging.

## OUTER PACKAGINGS

Type	Drums	Jerricans	Boxes
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## PACKING INSTRUCTION 970

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

### Part 1

Lithium metal or lithium alloy cells and batteries offered for transport are not subject to other additional requirements of these Regulations if they meet the requirements in Part 1.

Lithium batteries identified by the manufacturer as being defective for safety reasons, that have been damaged or 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. a lithium metal cell, the lithium content is not more than 1 g;
2. 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, subsection 38.3.

### General requirements

Equipment containing batteries must be packed in strong outer packaging that conform to 5.0.2.4, 5.0.2.6.1 and 5.2.12.1.

### Additional 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 packaging constructed of suitable material of adequate strength and design in relation to the packaging's capacity and its intended use unless the battery is afforded equivalent protection by the equipment in which it is contained.

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 7.4.I);

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

Type	Drums	Jerricans	Boxes
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### Part 2

Part 2 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, subsection 38.3.
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 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:

- 2 volts; or
- two-thirds of the voltage of the undischarged cell;

and batteries containing one or more such cells, are forbidden for transport.

	Passenger aircraft	Cargo Aircraft Only
Quantity of lithium metal cells and batteries per piece of equipment	5 kg	35 kg

#### General requirements

The General Packing Requirements of 5.0.2 must be met.

#### Additional 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

Type	Drums	Jerricans	Boxes
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