



Lithium Battery Guidance Document

Transport of lithium Metal and Lithium Ion Batteries

Revised for the 2014 Regulations



Introduction

This document is based on the provisions set out in the 2013-2014 Edition of the ICAO Technical Instruction for the Safe Transport of Dangerous Goods by Air and the 55th Edition of the IATA Dangerous Goods Regulations (DGR).

The purpose of this document is to provide guidance for complying with provisions applicable to the transport by air of lithium batteries as set out in the DGR. Specifically the document provides information on:

- Definitions;
- Classification (including classification flowcharts);
- Transport Conditions
- Exceptions;
- Special Provisions;
- Packaging provisions for lithium batteries;
- Prohibitions;
- Passenger Provisions; and
- Frequently Asked Questions

Definitions

Lithium Battery – The term “lithium battery” refers to a family of batteries with different chemistries, comprising many types of cathodes and electrolytes. For the purposes of the DGR they are separated into:

Lithium metal batteries. Are generally primary (non-rechargeable) batteries that have lithium metal or lithium compounds as an anode. Lithium metal batteries are generally used to power devices such as watches, calculators, cameras, temperature data loggers;



Figure 1 - Example of Lithium Metal Batteries

Lithium-ion batteries (sometimes abbreviated Li-ion batteries) are a type of secondary (rechargeable) battery commonly used in consumer electronics. Also included within lithium-ion batteries are lithium polymer batteries. Lithium-ion batteries are generally found in mobile telephones, laptop computers, etc.



Figure 2 - Example of a Lithium Ion Battery

The technical definition of a battery and cell, as indicated in the UN Manual of Tests and Criteria, is as follows:

“**Battery**” means two or more cells which are electrically connected together and fitted with devices necessary for use, for example, case, terminals, marking and protective devices. A single cell lithium battery is considered a “cell” and must be tested according to the testing requirements for “cells” for the purposes of these Regulations and the provisions of subsection 38.3 of the UN Manual of Tests and Criteria (see also the definition for “cell”).

Note:

Units that are commonly referred to as “battery packs”, “modules” or “battery assemblies” having the primary function of providing a source of power to another piece of equipment are for the purposes of these Regulations and the provisions of Subsection 38.3 of the UN Manual of Tests and Criteria treated as batteries.

“**Cell**” means a single encased electrochemical unit (one positive and one negative electrode) which exhibits a voltage differential across its two terminals. Under these Regulations and the *UN Manual of Tests and Criteria*, to the extent the encased electrochemical unit meets the definition of “cell” herein, it is a “cell”, not a “battery”, regardless of whether the unit is termed a “battery” or a “single cell battery” outside of these Regulations and the *UN Manual of Tests and Criteria*

Button cell or battery means a round small cell or battery when the overall height is less than the diameter.

Classification (DGR 3.9.2.6)

Lithium batteries are classified in Class 9 – Miscellaneous dangerous goods as:

- UN 3090, **Lithium metal batteries**; and
- UN 3480, **Lithium ion batteries**

or, if inside a piece of equipment or packed separately with a piece of equipment as:

- UN 3091, **Lithium metal batteries contained in equipment**; or
- UN 3091, **Lithium metal batteries packed with equipment**; and
- UN 3481, **Lithium ion batteries contained in equipment**; or
- UN 3481, **Lithium ion batteries packed with equipment**.

In the absence of exceptions, these batteries must be shipped in quantities that comply with the limitations contained in the DGR (see DGR Table 4.2 and the applicable packing instruction). They must be contained in a UN specification packaging as prescribed by the applicable packing instruction in the DGR. A completed package must display a Class 9 hazard label in addition to markings that identify the applicable proper shipping name and UN number. A shipper must document the shipment using a Shipper’s Declaration for Dangerous Goods.

Beginning 1 Jan 2013 the classification criteria for lithium batteries stipulates that cells and batteries must be manufactured under a quality management program. DGR 3.9.2.6 includes the elements that must be included in such a program.

Transport Conditions

The following information is a summary of the conditions that apply to various sizes of batteries for air transport. More details on the exceptions are found in the next section of this document.

1. Section I / IA Packing Instructions 965 – 970

Lithium ion and lithium metal cells and batteries (PI 965 & PI 968, Section IA and PI 966, PI 967, PI 969 & PI 970, Section I) are subject to all of the applicable requirements in the DGR. These requirements are as follows:

- (a) dangerous goods training (DGR 1.5);
- (b) classification (DGR 3.9.2.6);
- (c) limits on the net quantity of lithium batteries per package (DGR 4.2 and applicable packing instruction);
- (d) UN specification packaging (applicable packing instruction, see also DGR Section 6);
Note: *UN specification packaging does not apply to PI 967 and PI 970.*
- (e) marking and labelling of packages (DGR Section 7)
Note: *packages must not bear the lithium battery handling label., Packages must only bear the Class 9 hazard label and Cargo Aircraft Only label, when applicable. If packages are assembled into an overpack the requirements for overpacks in DGR 7.1.7 and 7.2.7 apply;*
- (f) Shipper's Declaration for Dangerous Goods (DGR Section 8);



2. Section IB - Packing Instructions 965 & 968

Lithium ion and lithium metal cells and batteries that meet the Watt-hour or lithium content limits set out in Section II of PI 965 and PI 968 respectively, but that exceed the weight or quantity limits set out in Table 956-II or Table 968-II are subject to all of the applicable requirements in the DGR except for the requirements for UN specification packagings.

The requirements applicable are as follows:

- (a) dangerous goods training (DGR 1.5);
- (b) classification (DGR 3.9.2.6);
- (c) limits on the total weight per package (applicable packing instruction);
- (d) strong outer packagings (see Section IB of applicable packing instruction);
- (e) marking and labelling of packages (DGR Section 7)
Note: *packages must bear both the lithium battery handling label and the Class 9 hazard label. If packages are assembled into an overpack the requirements for overpacks in DGR 7.1.7 and 7.2.7 apply;*
- (f) Shipper's Declaration for Dangerous Goods (Section IB of PI 965 or PI 968);
Note 1: *"IB" must be added to the DGD following the packing instruction number. This can be done either with the PI number, e.g. 965 IB, or as shown in Dangerous Goods Regulations Figure 8.1.P, in the authorisations column. Refer to Section 8 of the IATA Dangerous Goods Regulations for full details.*
Note 2: *if packages of Section IB are consolidated with other cargo, the*

provisions of DGR 1.3.3.3 and 1.3.3.6 apply. If packages are assembled into an overpack the requirements for overpacks in DGR 8.1.6.9.3, Step 7 apply.

Note 3: *Until 31 March 2014 the shipper may, provide the information set out below on an air waybill or on an alternative transport documentation in lieu of using a Shipper's Declaration.*

When the transitional provisions are applied and an air waybill is used, the information required by 2, 3 and 4 below must be shown in the "Nature and Quantity of Goods" box of the air waybill and the air waybill must clearly identify the name and address of the shipper and of the consignee. Where an agreement exists with the operator, the shipper may provide the information by electronic data processing (EDP) or electronic data interchange (EDI) techniques. The information required is as follows and should be shown in the following order:

- 1) the name and address of the shipper and consignee;*
- 2) UN 3480 or UN 3090, as applicable;*
- 3) Lithium ion batteries PI 965 IB, or lithium metal batteries PI 968 IB;*
- 4) the number of packages and the gross weight of each package.*

3. Section II - Packing Instructions 965 – 970

"Small" Lithium ion and lithium metal cells and batteries that meet the Watt-hour or lithium content limits set out in Section II of PI 965 to PI 970 are only subject to certain parts of the DGR when shipped as cargo. The bulk of the requirements for these small lithium batteries are contained within the General Requirements at the start of each packing instruction which apply to all lithium batteries and then the specific requirements set out in Section II of each packing instruction, which are as follows:

- (a) classification (DGR 3.9.2.6);
- (b) limits on the quantity of lithium cells or batteries per package (Table II of the applicable packing instruction);
- (c) strong outer packagings (see Section II of applicable packing instruction);
- (d) marking and labelling of packages (Additional Requirements of Section II of the applicable packing instruction);
- (e) the details of the consignment must be described (Additional Requirements of Section II of the applicable packing instruction).

Exceptions

Small lithium metal and lithium ion batteries are not subject to all of the provisions of the DGR provided that they comply with all of the requirements set out in Section II of Packing Instructions 965, 966 and 967 for lithium ion batteries and Section II of Packing Instructions 968, 969 and 970 for lithium metal batteries in the 55th Edition of the IATA DGR.

Packages containing lithium batteries, or lithium batteries contained in, or packed with, equipment that meet the provisions of Section II of these packing instructions are not required to have a Class 9 hazard label and there is no requirement for a Shipper's Declaration for Dangerous Goods for consignments of these batteries.

However, in the event of an incident involving these batteries, the incident reporting requirements apply.

Note:

Only batteries that have successfully passed the test procedures of Part III, Sub-Section 38.3 of the UN Manual of Tests and Criteria qualify under this exception. This is also true for so-called “OEM” or “aftermarket” batteries. Any battery manufacturer or distributor should be able to provide documentation confirming that the batteries have been so tested.



Quantities of Lithium metal and lithium ion cells and batteries that exceed the “per package” limits described in Section II of the packing instruction 965 (Table 965-II) and 968 (Table 968-II) must be assigned to class 9 and shipped as “Section IB”. All applicable requirements contained in the IATA Dangerous Goods Regulations relating to these commodities must be complied with, including the training requirements, except that UN Specification packaging is not required.

Packages must bear the Class 9 hazard label in addition to the lithium battery handling label.

Lithium metal and lithium ion batteries larger than those permitted by Section II of the applicable packing instruction must be assigned to Class 9 and consigned as UN 3090 (Lithium metal batteries), UN 3480 (Lithium ion batteries), UN 3091 (Lithium metal batteries contained in equipment or Lithium metal batteries packed with equipment) or UN 3481 (Lithium ion batteries contained in equipment or Lithium ion batteries packed with equipment). All applicable requirements contained in the IATA Dangerous Goods Regulations relating to these commodities must be complied with, including the training requirements; a “Shipper’s Declaration for Dangerous Goods” must be issued, and packages must bear the Class 9 hazard label.

Special Provisions

There are a number of special provisions which may allow for the transport of lithium batteries other than in accordance with the defined conditions or limits, or which require the shipper to take additional precautions when preparing batteries for transport. The special provisions applicable to lithium batteries are set out following.

Notwithstanding the general requirement that prior to being transported each type of lithium battery must have successfully passed the UN test requirements, there is provision for prototype lithium batteries that have not yet passed the UN test requirements to be shipped for testing purposes, this testing includes pre-production or product compatibility testing, in accordance with Special Provision A88, as follows:

A88 Prototype or low production, (i.e. annual production runs consisting of no more than 100 lithium cells or batteries) lithium cells or batteries that have not been tested to the requirements in subsection 38.3 of the *UN Manual of Tests and Criteria* may be transported aboard cargo aircraft, if approved by the appropriate authority of the State of origin and the following requirements are met:

- a) except as provided in paragraph (c), the cells or batteries must be transported in an outer packaging that is a metal, plastic or plywood drum or a metal, plastic or wooden box and that meets the criteria for Packing Group I packagings;

- b) except as provided in paragraph (c), each cell or battery must be individually packed in an inner packaging inside an outer packaging and surrounded by cushioning material that is non-combustible, and non-conductive. Cells or batteries must be protected against short-circuiting;
- c) 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 packed in strong outer packagings or protective enclosures not subject to the requirements of Section 6 of these Regulations. The batteries or battery assemblies must be protected against short circuiting; and
- d) a copy of the document of approval showing the quantity limitations must accompany the consignment.

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

For air transport, specific quantity limits apply to the net weight of lithium batteries in a package. The maximum net weight of lithium batteries per package for Cargo Aircraft Only is 35 kg. However, there is provision for large lithium batteries that have a net weight exceeding 35 kg to be consigned on a cargo aircraft in accordance with Special Provision A99 as follows:

A99 Irrespective of the per package quantity limit for cargo aircraft specified in Column L of the List of Dangerous Goods (Subsection 4.2), and in Section I of Packing Instructions 965, 966, 967, 968, 969 or 970, a lithium battery or battery assembly (UN 3090 or UN 3480), including when packed with, or contained in equipment (UN 3091 or UN 3481) that meets the other requirements of Section I of the applicable packing instruction may have a mass exceeding 35 kg, if approved by the appropriate authority of the State of origin. A copy of the document of approval must accompany the consignment.

There will be occasion where a manufacturer may wish to have a defective battery returned for analysis. However, where such batteries may pose a safety risk they are prohibited from transport by air as set in Special Provision A154, as follows:

A154 Lithium batteries identified by the manufacturer as being defective for safety reasons, or that have been damaged, that have the potential of producing a dangerous evolution of heat, fire or short circuit are forbidden for transport (e.g. those being returned to the manufacturer for safety reasons).

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 or metal objects. Special Provision A164 requires that all batteries and battery-powered equipment must be packed to prevent short circuit an inadvertent operation as follows:

A164 Any electrical battery or battery-powered device, equipment of vehicle having the potential of a dangerous evolution of heat must be prepared for transport so as to prevent:

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

When a shipment of a combination of lithium batteries contained in equipment and lithium batteries packed with equipment is presented for transport, the classification is to be lithium batteries packed with equipment as indicated by special provision A181.

A181 When a package contains a combination of lithium batteries contained in equipment and lithium batteries packed with equipment, the package must be marked UN 3091 Lithium metal batteries packed with equipment, or UN 3481 Lithium ion batteries packed with equipment as appropriate. If a package contains both lithium ion batteries and lithium metal batteries, the package must be marked as required for both battery types. However, button cell batteries installed in equipment (including circuit boards) need not be considered.

Questions have been asked regarding whether to classify equipment with lithium batteries as battery-powered equipment, or only lithium batteries contained in equipment. Special Provision A182 makes it clear that the requirement is to use the lithium battery specific entries when only those batteries are present.

A182 Equipment containing only lithium batteries must be classified as either UN 3091 or UN 3481.

It has been clarified that waste batteries are not permitted in air transport with the addition of Special Provision A183.

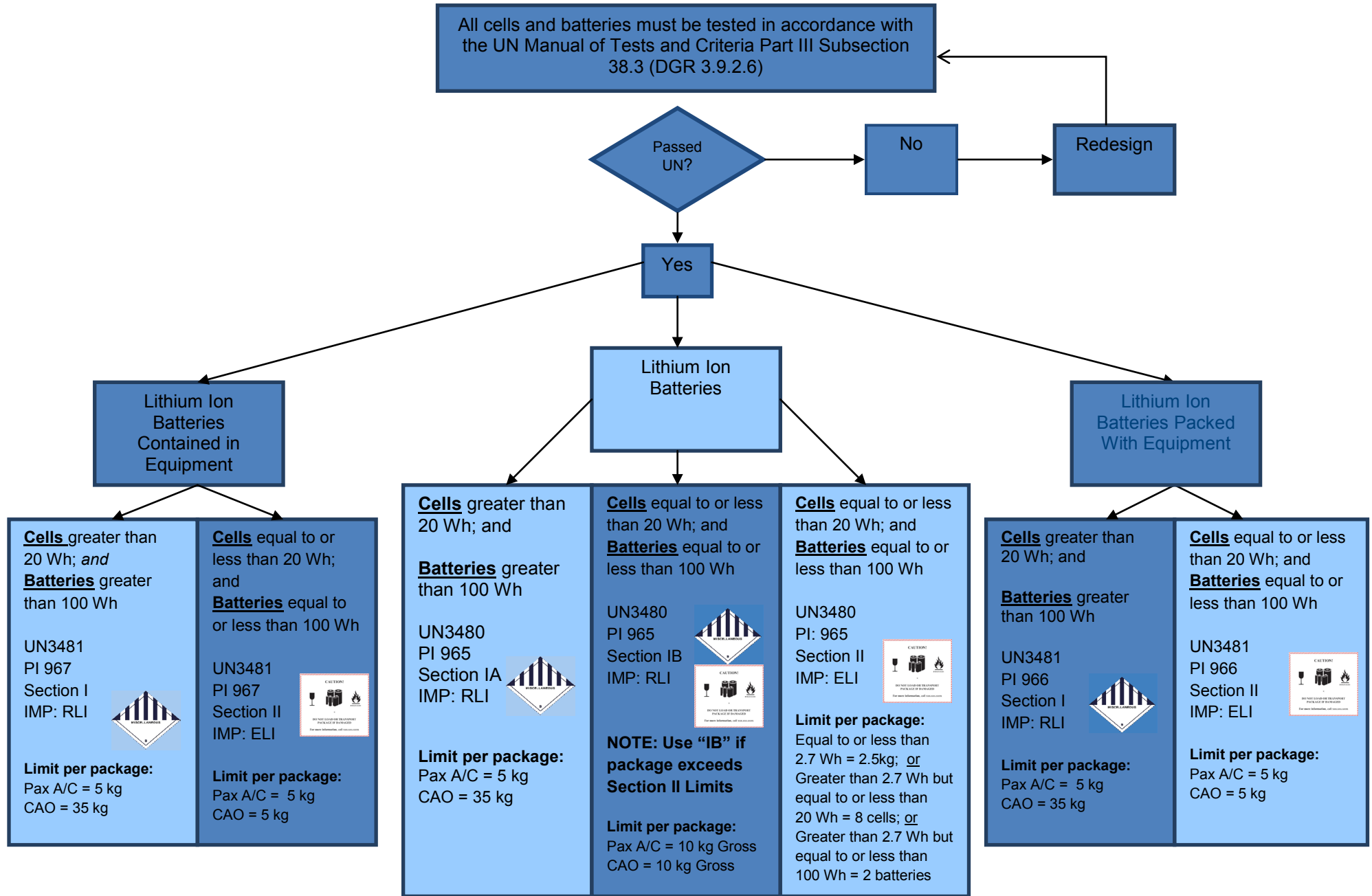
A183 Waste batteries and batteries being shipped for recycling or disposal are prohibited from air transport unless approved by the appropriate national authority of the State of Origin and the State of the Operator.

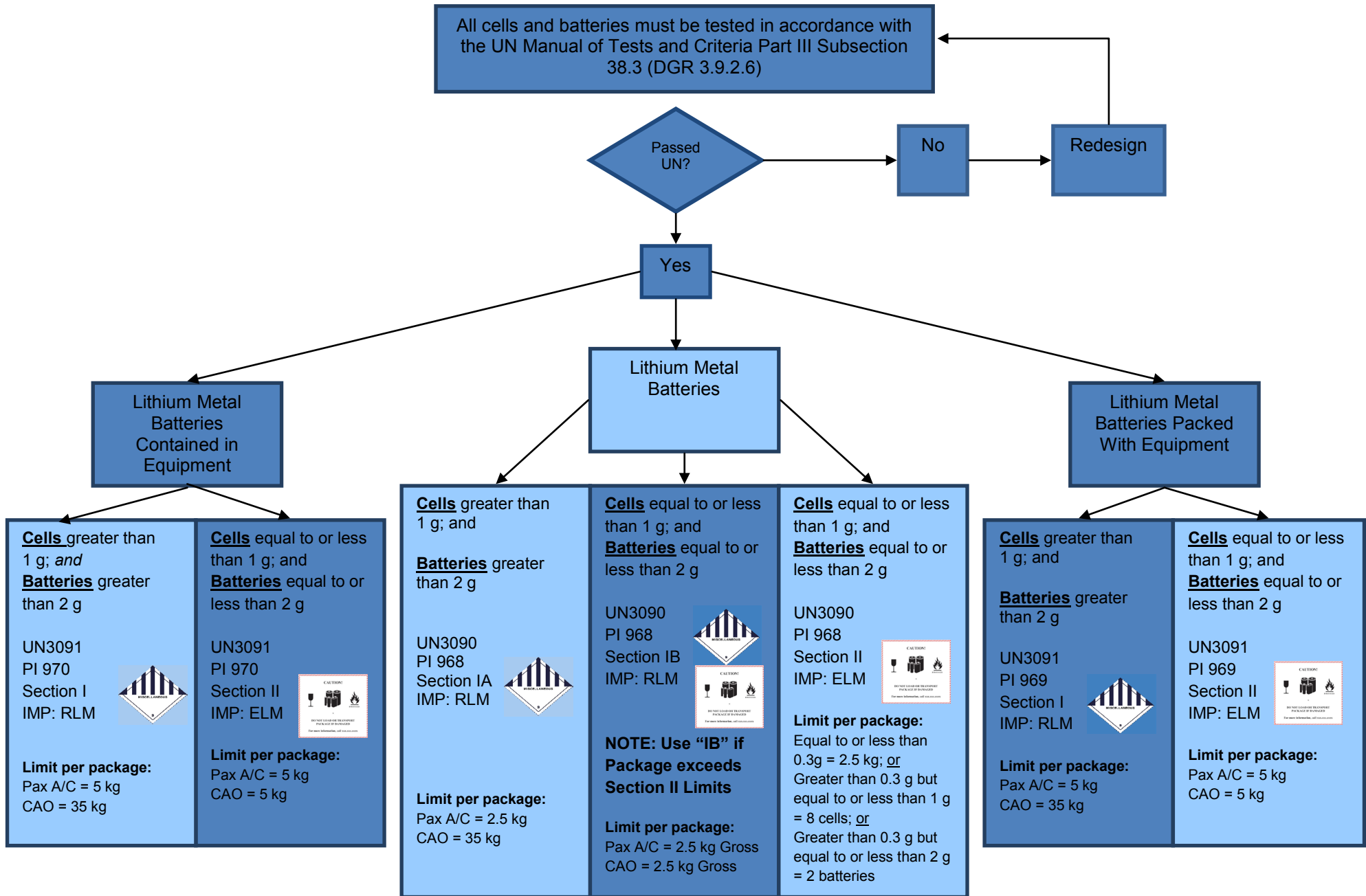
Questions have been asked regarding whether to classify vehicles powered only by lithium batteries as vehicles, or using a lithium battery entry. Special Provision A185 makes it clear that the requirement is to use the battery-powered vehicle entry.

A185 Vehicles only powered by lithium metal batteries or lithium ion batteries must be consigned under the entry UN 3171, **Battery-powered vehicle**

Classification Flowcharts

The following (2) classification flowcharts are intended to provide guidance on the classification for lithium metal and lithium ion batteries.





Prohibitions

Transport to, from or through the United States

Lithium metal batteries shipped to, from or through the United States are subject to additional limitations specified in the US national dangerous goods regulations contained in Code of Federal Regulations Title 49 (49 CFR). The basis of these limitations is reflected in State Variation USG-02, which states that:

Primary (non-rechargeable) lithium metal batteries and cells, (UN 3090), 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 (UN 3091) 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 lb).

Primary (non-rechargeable) lithium metal batteries and cells contained in or packed with equipment (UN 3091) and transported in accordance with Section I of Packing 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 (UN 3091) and transported in accordance with Section II of Packing 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".

Passenger Provisions

Transport within Passenger Baggage

Certain restrictions apply to the carriage of lithium metal and lithium ion batteries even when carried by passengers as baggage. Once again, only batteries that have successfully passed the Tests outlined in Part III, Sub-Section 38.3 of the UN Manual of tests and criteria may be carried.

As said before batteries manufactured, distributed or sold by major companies do meet this requirement, however, certain replacement batteries which are not OEM or aftermarket batteries but simply low-cost copies of those – also called “fakes” – may not have undergone the required tests. Untested batteries are consequently excluded from air transport.

Users of equipment powered by lithium metal and lithium ion batteries should therefore be vigilant when buying replacement batteries from unknown sources, such as on markets or Internet auction platforms. The differences between genuine and copied battery types may not be visible but could be very dangerous; such untested batteries may have a risk of overheating or causing fires.

Because of the risks associated with the carriage of spare batteries these may not be transported within passenger checked baggage. Spare batteries must be in carry-on baggage.

These requirements are stipulated by subparagraph 2.3.5.9 of the IATA Dangerous Goods Regulations:



2.3.5.9 Portable Electronic Devices (including medical devices) containing Batteries

2.3.5.9.1 Portable electronic devices (including medical devices) (such as watches, calculating machines, cameras, cellular phones, lap-top computers, camcorders, etc.) containing batteries when carried by passengers or crew for personal use, which should be carried in carry-on baggage. 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, and carried in carry-on baggage only. In addition, lithium batteries are subject to the following conditions:

- (a) each installed or spare battery must not exceed:
 1. for lithium metal or lithium alloy batteries, a lithium content of not more than 2 g; or
 2. for lithium ion batteries, a watt-hour rating of not more than 100 Wh.
- (b) batteries and cells must be of a type that meets the requirements of the UN *Manual of Tests and Criteria*, Part III, subsection 38.3;
- (c) if devices are carried in checked baggage the passenger/crew member must take measures to prevent unintentional activation.

There is also provision, with the approval of the airline, for larger lithium ion batteries with a watt-hour rating in excess of 100 Wh, but not more than 160 Wh in equipment and no more than two spare lithium ion batteries as set out in subparagraph 2.3.3.2 as follows:

2.3.3.2 Lithium ion batteries exceeding a watt-hour rating of 100 Wh but not exceeding 160 Wh may be carried as spare batteries in carry-on baggage, or in equipment in either checked or carry-on baggage. Batteries must be of a type that meets the requirements of the UN *Manual of Tests and Criteria*, Part III, subsection 38.3. No more than two individually protected spare batteries per person may be carried.

Although the text provided above does not impose a limit on the number of lithium metal and lithium ion batteries that fall under the 2 g or 100 Wh limitation (See 2.3.5.9) being carried as spares within a passenger's carry-on baggage it must be emphasized that the number of spares must be "reasonable" in the context of the equipment used by the passenger and his or her itinerary. Furthermore, these must be intended to power portable electronic devices (including, but not limited to, cameras and professional film equipment, laptop computers, MP3 players, cell phones, Personal Digital Assistants (PDA's), pocket calculators etc).

Batteries which are carried for the purpose of resale or beyond personal needs are clearly not covered.

The regulations imposed on these commodities by the United States competent authorities (Department of Transportation and FAA) match the ICAO / IATA regulations addressed in this document.

Lithium-ion battery powered wheelchairs or other similar mobility aids for use by passengers whose mobility is restricted by either a disability, their health or age, or a temporary mobility problem (e.g. broken leg), are permitted in air transport but subject to the following conditions:

- (a) the batteries must be of a type which meets the requirements of each test in the UN Manual of Tests and Criteria, Part III, subsection 38.3;
- (b) the operator must verify that:
 - (1) battery terminals are protected from short circuits, e.g. by being enclosed within a battery container,
 - (2) the battery must be securely attached to the wheelchair or mobility aid; and
 - (3) electrical circuits have been inhibited.
- (c) the mobility aids must be carried in a manner such that they are protected from being damaged by the movement of baggage, mail, or other cargo;
- (d) where a battery powered or other similar mobility aid is specifically designed to allow its battery(ies) to be removed by the user (e.g. collapsible)
 - (1) the battery(ies) must be removed. The wheelchair / mobility aid may then be carried as checked baggage without restriction;
 - (2) the battery(ies) must be protected from short circuit by insulating the terminals (e.g. by taping over exposed terminals);
 - (3) the removed battery(ies) must be protected from damage (e.g.) by placing each battery in a protective pouch. The battery(ies) must be carried in the passenger cabin;
 - (4) removal of the battery from the device must be performed by following the instructions of the manufacturer or device owner;

- (5) the battery must not exceed 300 Wh;;
- (6) a maximum of one spare battery not exceeding 300 Wh or two spares each not exceeding 160 Wh may be carried; and
- (e) the pilot-in-command must be informed of the location of the mobility aid with an installed battery or the location of the lithium battery when removed and carried in the cabin.
- (f) It is recommended that passengers make advance arrangements with each operator.

Note: *most scooters have a key which can be switched to the off position, removed and given to the passenger for safe keeping. However, most power chairs are switched on and off with a push-button which could be reactivated in flight by the inadvertent movement of baggage or cargo. Accordingly, further steps are required to inhibit the circuits of such devices, for example separating the power supply between the batteries and the control mechanism by disconnecting cable plugs or connectors, or inserting an inhibiting plug. Any exposed electrical terminals must be insulated to prevent short circuit. Batteries should not be routinely disconnected or removed, since this is often very difficult to do, and if not done properly can increase the risk of a fire.*

To check that electrical circuits have been inhibited, prior to loading place the device into drive mode (i.e. not freewheel mode), try to power up the device by pressing the on/off switch and see if use of the joystick results in the mobility aid moving. A check should also be made that batteries are securely attached to the mobility aid and battery terminals are protected from short circuit. If it is evident that an electric mobility aid has not been made safe, it must not be loaded.

Once loaded onboard the aircraft or into a ULD, the electric mobility aid should be returned to drive mode as this will help prevent it moving with the potential for damage. Devices must be secured to prevent movement and may require load-spreading (consult the airline ground handling manual for details).

Frequently Asked Questions

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 two or more cells electrically connected. A single cell battery is considered a cell and not a battery for the purposes of the limitations set out in the DGR.

Note: Units that are commonly referred to as “battery packs” having the primary function of providing a source of power to another piece of equipment are for the purposes of these Regulations treated as batteries. Refer to the section on Definitions for complete details.

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. Section II Lithium ion batteries manufactured after 1 January 2009 are required to be marked with the watt-hour rating. Section I Lithium ion batteries manufactured after 31 December 2011 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.

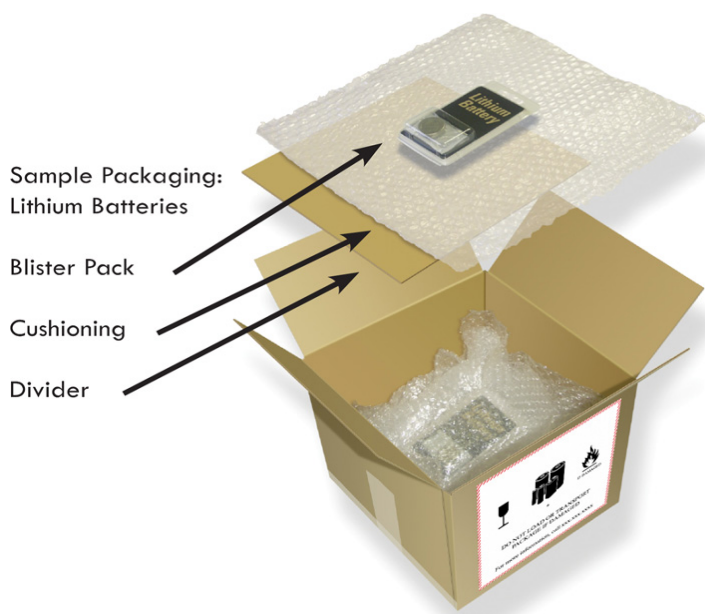
F. What is a button cell battery?

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

The 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. It is also required as specified in the additional requirements of Section IB of packing instruction 965 and 968 in addition to the Class 9 label. The label is as shown in Figure 7.4.H of the IATA Dangerous Goods Regulations. 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 handling label and the colour of the packaging material. The minimum dimensions are 120 mm wide x 110 mm high.



* Place for “Lithium ion battery” and/or “Lithium metal battery”

D. If I have smaller packages, can I use a smaller lithium battery handling label?

Where the packages are of dimensions such that they can only bear smaller labels the label dimensions may be 105 mm wide × 74 mm high. The design specifications remain otherwise the same.



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 IA of Packing Instructions 965 and 968 and Section I of Packing Instructions 966, 967, 969 and 970. or when a package contains not 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 Requirements" of Section II of Packing Instructions 967 and 970 is not required.

Note: The Air Waybill is only required to contain the statements "Lithium [ion or metal] batteries in compliance with Section II of PI9XX" when the lithium battery label needs to be affixed.

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 the package is being offered for shipment may require their official language. Subsection 7.1.3.3 of the IATA DGR specifies that in addition to the languages which may be required by the State of origin, English must 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 requirements of the packing instruction and in a manner ready to be presented for transport (shipper/consignee information, hazard communication, etc). The package may contain multiple batteries or pieces of equipment provided the limitations set out in the applicable 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. not more than 4 cells or 2 batteries when contained in equipment).



L. Please explain the documentation requirements for consignments of lithium batteries that are required to have the lithium battery 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. The document is intended to be separate from the package as the package already contains a pictorial representation of the hazard communication in the form of the lithium battery handling label.

An example of the document has been provided at the end of this guidance document in [Appendix A](#).

This document is required for any shipment where the lithium battery handling label is required (i.e. Section IB and Section II).

The document may be modified with company specific information (e.g. logo, letterhead, etc.) and the fields marked “optional” are not required to be completed and may be left blank or removed from a modified version. Blank “optional” fields should not constitute reason for a refusal.

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

No. IATA 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 IATA Dangerous Goods Regulations?

Yes. The overpack may also contain packages of dangerous goods or goods not subject to the Regulations provided there are no packages enclosing different substances which might react dangerously with each other. An overpack must be marked with the word “overpack” and must be labelled with the lithium battery handling label (Figure 7.4.H), unless the label(s) on the package(s) inside the overpack are visible or not required by the Packing Instruction.

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 IATA packing instructions apply to overpacks containing lithium batteries?

The quantity limits shown in the packing instructions 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 metre 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 m 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 m drop test capability requirement) and is then overpacked with equipment and offered for transport (see item 2O 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 m drop test.

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

Prototype or low-production lithium batteries may be transported by cargo aircraft if you do the following (See Special Provision A88):

1. Obtain approval from the competent authority of the origin country prior to transport;
2. Protect the cells and batteries from short circuiting;
3. Individually 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
4. Place the cells and batteries in an outer drum or box made of metal, plastic or plywood that meets Packing Group I performance requirements.
 - a. 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 packed in outer packagings or protective enclosures not subject to the requirements of Section 6 of the IATA DGR.

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.

T. 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.

U. What is the maximum weight of batteries per package for fully regulated batteries contained in equipment (Section I)?

The maximum weight is 5 kg per package for passenger and cargo aircraft and 35 kg per package for cargo aircraft only

	Net Quantity per Package Passenger & Cargo Aircraft	Net Quantity per Package Cargo Aircraft Only
Lithium Ion & Lithium Metal cells and batteries contained in equipment	5 kg	35 kg

**V. Do I need to declare a gross weight or a net weight for lithium batteries (Section I)?**

All lithium battery shipments, including when packed with or contained in equipment, will need to be declared by the net weight as per the new definition of net weight (IATA DGR Appendix A).

Note: Section IB shipments (PI965 and 968) are limited by a gross weight and will need to have the gross weight indicated on the Shipper's Declaration for Dangerous Goods and package as indicated in the packing instruction.

X. I have 2kg of 2.7Wh cells and 2 batteries that meet the Section II limitations; can I place them in one package?

No. The limits found in Table 965-II and Table 968-II cannot be combined. The packages can be split, for example with 1 package of 2 kg of 2.7Wh cells and another of 2 batteries or the Section IB provisions used.

Y. I am shipping Section IB lithium [ion or metal] batteries; do I need dangerous goods training?

Yes. All the provisions of the Dangerous Goods Regulations apply to shipments of Section IB batteries except the references listed in Section IB. Therefore, dangerous goods training as indicated in Subsection 1.5 of the Dangerous Goods Regulations is required.

Z. What are the additional marking requirements for a Section IB of Packing Instruction 965 and 968 package?

Because all of the requirements of the dangerous goods regulations apply other than the exceptions listed in Section IB each package must be marked with:

- the UN Number preceded by "UN" and the Proper Shipping Name (DGR 7.1.4.1 (a));
- the shipper and consignee address (DGR 7.1.4.1 (b)); and
- in addition the gross weight as required by (DGR 7.1.4.1(c)) must be marked on the package.

Note: When using an overpack, each package must be marked in accordance with the Regulations and then, when placed in an overpack, marked as required by DGR 7.1.7.

AA. I am shipping perishable cargo with lithium battery powered temperature or data loggers; do I need to follow the Dangerous Goods Regulations?

Yes. All the applicable provisions for lithium batteries will need to be followed by the shipper of such devices, including the limitations for devices that are "active" (on) during transport.

Note: The perishable cargo regulations (PCR) also apply to such shipments.

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?

The following provisions are taken from the 5th revised edition of the UN Manual of Tests and Criteria.

A cell or battery that differs from a tested design by:

- (a) For primary cells and batteries, a change of more than 0.1 g or 20% by mass, whichever is greater, to the cathode, to the anode, or to the electrolyte;
- (b) For rechargeable cells and batteries, a change in Watt-hours of more than 20% or an increase in voltage of more than 20%; or
- (c) A change that would materially affect the test results

Shall be considered a new type and shall be subjected to the required tests.

In the event that a cell or battery type does not meet one or more of the test requirements, steps shall be taken to correct the deficiency or deficiencies that caused the failure before such a cell or battery type is retested.

Part 4 – Questions Related to State and Operator Variations



A. What additional requirements are imposed by US Variation USG-02?

The United States restricts the transport of certain primary (non-rechargeable) lithium metal batteries, both packaged batteries and those packed with or contained in equipment, from transport on passenger carrying aircraft. In accordance with USG-02, primary (non-rechargeable) lithium metal batteries and cells (UN3090) are forbidden for transportation aboard passenger-carrying aircraft. Such batteries transported in accordance with Section IA or IB 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".

Additional Information

Further information can be found here:

http://www.iata.org/whatwedo/cargo/dangerous_goods/index.htm

<http://safetravel.dot.gov>

You may also contact the airline of your choice or your national civil aviation authority if you have any further concerns about travelling with lithium metal or lithium ion batteries.

You can also contact the IATA Dangerous Goods Support team if you have questions or concerns which may not have been addressed in this document: dangood@iata.org

Appendix A - Template for Accompanying Lithium Battery Document

Document Template

Reference Number (optional): _____

WARNING: LITHIUM BATTERIES THAT HAVE BEEN RECALLED BY THE MANUFACTURER FOR SAFETY REASONS **MUST NOT** BE SHIPPED BY AIR.

Terminology:

- Cell – *electrochemical unit, consisting of an anode and a cathode, capable of generating electrical current*
- Battery – *assembly of cells*
- Lithium ion cells/batteries – *rechargeable – includes lithium polymer cells/batteries*
- Lithium metal cells/batteries – *generally non-rechargeable*

This package contains lithium cells or batteries in the following configuration (check applicable):

Lithium Ion - <i>Maximum of</i>	Lithium Metal – <i>Maximum of</i>
<ul style="list-style-type: none"> • 20 Watt-hours per cell; and • 100 Watt-hours per battery <p><input type="checkbox"/> Cells or batteries <u>only</u> (ICAO/IATA Packing Instruction 965, Section II) – <i>Cells or batteries in a package, without electronic equipment</i> Package Limit: ≤2.7 Wh = 2.5 kg; <u>or</u> >2.7 Wh but ≤ 20 Wh = 8 cells; <u>or</u> >2.7 Wh but ≤ 100 Wh = 2 batteries</p>	<ul style="list-style-type: none"> • 1 gram of lithium metal per cell; and • 2 grams of lithium per battery <p><input type="checkbox"/> Cells or batteries <u>only</u> (ICAO/IATA Packing Instruction 968, Section II) – <i>Cells or batteries in a package, without electronic equipment</i> Package Limit: ≤0.3 g = 2.5 kg; <u>or</u> >0.3 g but ≤ 1 g = 8 cells; <u>or</u> >0.3 g but ≤ 2 g = 2 batteries</p>
<p><input type="checkbox"/> Cells or batteries <u>only</u> (ICAO/IATA Packing Instruction 965, Section IB) – <i>Cells or batteries in a package, without electronic equipment</i></p>	<p><input type="checkbox"/> Cells or batteries <u>only</u> (ICAO/IATA Packing Instruction 968, Section IB) – <i>Cells or batteries in a package, without electronic equipment</i></p>
<p><input type="checkbox"/> Packed <u>with equipment</u> (ICAO/IATA Packing Instruction 966, Section II) – <i>Cells or batteries contained in a package with associated electronic equipment</i></p>	<p><input type="checkbox"/> Packed <u>with equipment</u> (ICAO/IATA Packing Instruction 969, Section II) – <i>Cells or batteries contained in a package with associated battery-powered equipment – with the batteries not installed in the equipment</i></p>
<p><input type="checkbox"/> Contained <u>in equipment</u> (ICAO/IATA Packing Instruction 967, Section II) – <i>Cells or batteries installed in equipment</i></p>	<p><input type="checkbox"/> Contained <u>in equipment</u> (ICAO/IATA Packing Instruction 970, Section II) – <i>Cells or batteries installed in equipment</i></p>

- This package must be handled with care. A flammability hazard exists if the package is damaged.
- If this package is damaged in transportation, it must not be loaded until the condition of the contents can be verified. The batteries contained in this package must be inspected for damage and may only be repacked if they are intact and protected against short circuits.
- For more information about the batteries contained in this package, call the following telephone number:

_____ List telephone number here, including area code and any applicable country code

Name/Address of shipper (optional):

Name/Address of Consignee (optional):

Date (optional):
