ICAO Training on Lithium Batteries

July 2015

Bangkok, Thailand

OVERVIEW

Overview

- Background on Lithium Batteries in Air Transport
- International Standards for the Transport of Dangerous Goods (DG) – Annex 18

Overview

- Dangerous Goods Air Carrier Inspections
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- Lithium Battery Packing Instructions
- Dangerous Goods Transport Documentation
- Dangerous Goods Markings
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Overview

- Passenger Exceptions for Lithium Batteries
- Lithium Battery Air Transport Regulation Compliance Concerns

BACKGROUND

Background

- In 1999, a pallet of lithium metal cells in cargo was transported on a passenger flight from Japan to Los Angeles, CA, US. The pallet of batteries was mishandled after it was off-loaded from the aircraft. Several hours later it caught on fire and burned to the ground. The fire department was not able to put out the fire.

Background

- This incident was the beginning of major concerns with the hazards of transporting lithium metal and lithium ion batteries in air transportation
- Based on that incident, the US FAA started conducting fire safety testing on lithium metal batteries

Background

- It has been over 16 years since that incident, and the international standards and air transport community has been working to better understand the hazards with lithium batteries as well as mitigate the risks with this evolving technology.

Background

- The current regulations on lithium batteries that will be covered in this training are an evolution and reaction to the information gathered in incidents and laboratory testing that has been obtained in the previous 16 years.

INTERNATIONAL STANDARDS FOR THE SAFE TRANSPORT OF DANGEROUS GOODS

International Standards for the Safe Transport of Dangerous Goods

Annex 18:

- Requires that dangerous goods are carried in accordance with the ICAO Technical Instructions for the Safe Transport of Dangerous Goods by Air (the “Technical Instructions”).

International Standards for the Safe Transport of Dangerous Goods

Annex 18:

- States are required by Annex 18 to have inspection and enforcement procedures to ensure that dangerous goods are being carried in compliance with the requirements.

International Standards for the Safe Transport of Dangerous Goods

Annex 18:

- To ensure DG does not put an aircraft and its occupants at risk there are international Standards which each State, under the provisions of the Chicago Convention, are required to introduce into national legislation. This system ensures governmental control over the carriage of dangerous goods by air and gives world-wide harmonization of safety standards.

DANGEROUS GOODS AIR CARRIER INSPECTIONS

Dangerous Goods Air Carrier Inspections

- Air Carrier Manuals specific to Dangerous Goods
  - Comprehensive & Current Manuals are critical to the safe transport of DG at an air carrier
  - Review of the manuals can be a very good first step in the preparation of a dangerous goods inspection of an air carrier

Dangerous Goods Air Carrier Inspections

- Air Carrier Training Programmes specific to Dangerous Goods
  - Comprehensive and Current Training Programmes is a key building block to success in an air carrier's promotion of both safety & compliance
  - Review of the Training Programmes and auditing training courses specific to DG is a great way to evaluate the air carriers implementation of their approved training.

Dangerous Goods Air Carrier Inspections

- Dangerous Goods Acceptance – Passenger Service
  - Clear training and policy in manuals helps keep this potentially complicated subject clear to air carrier staff always short on time
  - With the many dangerous items that passengers bring in their baggage, an air carrier must constantly reinforce the rules

Dangerous Goods Air Carrier Inspections

- Dangerous Goods Acceptance – Cargo
  - When an air carrier choses to transport DG, the acceptance process is the most critical aspect in ensuring safe transport
  - An air carrier needs current and proper training, policies, & support for its acceptance staff to be successful

Dangerous Goods Air Carrier Inspections

- Dangerous Goods Storage – Warehouse
  - Even though the storage of DG in the warehouse does not seem that critical, mishandling a DG package could lead to a delay in an incident while it is on board the aircraft in flight
  - Following proper handling and storage procedures in regards to DG in the warehouse is important

Dangerous Goods Air Carrier Inspections

- Dangerous Goods Loading – Pallets, ULDs, carts/dollies, Aircraft
  - The proper segregation of DG on a pallet, cart/dolly, and an aircraft is very important to the safety while in-flight
  - The proper acceptance and transport of Cargo Aircraft Only (CAO) DG shipments is a critical function to ensure safety is maintained

Dangerous Goods Air Carrier Inspections

- Air Carrier Dangerous Goods Training Records
  - An air carriers DG Training Records for all its staff should be organized, accurate, & current.
  - Problems with DG training records could indicate an air carriers lack of support of the implementation of their entire Training Programme

Dangerous Goods Air Carrier Inspections

- Air Carrier Offering of Dangerous Goods Company Material (COMAT)
  - For both air carriers that transport and air carriers that do not transport DG, preparing DG COMAT for transport is an important safety function
  - The air carrier should have detailed policies and procedures on the storage, processing and transport of DG COMAT

Dangerous Goods Air Carrier Inspections

- Air Carrier Compliance with the Provision of Information
  - Policy, procedures, and training is the key to successful completion of the Part 7, Chapter 4 requirements
  - Items required: Info to Pilot-in-Command, Emergency Response Info, reporting of DG accidents, incidents, undeclared, & occurrences, and the retention of documents

CLASSIFICATION OF DANGEROUS GOODS

Classification of Dangerous Goods

- Technical Instructions, Part 2, Chapter 9
  - Lithium battery classification is in 2;9.3

9.3 LITHIUM BATTERIES

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

a) each cell or battery is of the type proved to meet the requirements of each test of the UN *Manual of Tests and Criteria*, Part III, subsection 38.3;

\+ Cells and batteries manufactured according to a type meeting the requirements of subsection 38.3 of the UN *Manual of Tests and Criteria*, Revision 3, Amendment 1 or any subsequent revision and amendment applicable at the date of the type testing may continue to be transported, unless otherwise provided in these Instructions.

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

≠ *Note.— Batteries must be of a type proved to meet the testing requirements of the UN Manual of Tests and Criteria, Part III, subsection 38.3, irrespective of whether the cells of which they are composed are of a tested type.*

>

b) each cell and battery incorporates a safety venting device or is designed to preclude a violent rupture under conditions normally incident to transport;

c) each cell and battery is equipped with an effective means of preventing external short circuits;

d) each battery containing cells or a series of cells connected in parallel is equipped with effective means as necessary to prevent dangerous reverse current flow (e.g. diodes, fuses, etc.);

Classification of Dangerous Goods

- Quality Management Programme requirements for the lithium cell and battery manufacturer
- Part 2, 2;9.3.1 e)

e) cells and batteries must be manufactured under a quality management programme that includes:

1) a description of the organizational structure and responsibilities of personnel with regard to design and product quality;

2) the relevant inspection and test, quality control, quality assurance, and process operation instructions that will be used;

3) process controls that should include relevant activities to prevent and detect internal short circuit failure during manufacture of cells;

4) quality records, such as inspection reports, test data, calibration data and certificates. Test data must be kept and made available to the appropriate national authority upon request;

5) management reviews to ensure the effective operation of the quality management programme;

6) a process for control of documents and their revision;

7) a means for control of cells or batteries that are not conforming to the type tested in accordance with Part III, subsection 38.3 of the UN *Manual of Tests and Criteria*;

8) training programmes and qualification procedures for relevant personnel; and

9) procedures to ensure that there is no damage to the final product.

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

Classification of Dangerous Goods

- 2;9.3.1 a) states that “each cell and battery is of a type proved to meet the requirements of each test of the UN *Manual of Tests and Criteria,* Part III, Section 38.3;”
- Section 38.3 covers the classification testing criteria for lithium batteries.

UN Manual of Test and Criteria (MoTC)

- UN MoTC, Revision 5, Amendment 1

http://www.unece.org/fileadmin/DAM/trans/danger/publi/manual/Rev5_Amend1/ST-SG-AC10-11-Rev5-Amend1e.pdf

- Also some minor changes were made to Section 38.3 in UN MoTC, Revision 5, Amendment 2

http://www.unece.org/fileadmin/DAM/trans/danger/publi/manual/Rev.5_Amend.2/ST-SG-AC10-11-Rev5-Amend2e.pdf

UN Manual of Test and Criteria (MoTC)

- Sections to Review in the UN MoTC, Section 38.3, Rev. 5, Amendments 1 & 2:
  - 38.3.1 Purpose
  - 38.3.2.1, 38.3.2.2 Scope
  - 38.3.2.3 Definition of cell and battery
  - 38.3.3 (a)-(f)
  - 38.3.4 Brief overview of Procedures and T.1-T.8 testing titles

DANGEROUS GOODS LIST: LITHIUM BATTERIES

Dangerous Goods List: Lithium Batteries

- Technical Instructions, Part 3, Table 3-1
- Six (6) Proper Shipping Name (PSN) listings for lithium batteries in Table 3-1

	Name	UN No.	Class or division	Subsidiary risk	Labels	State variations	Special provisions	UN packing group	Excepted quantity	Passenger and cargo aircraft		Cargo aircraft only	
										Packing instruction	Max. net quantity per package	Packing instruction	Max. net quantity per package
	1	2	3	4	5	6	7	8	9	10	11	12	13
≠	**Lithium ion batteries** (including lithium ion polymer batteries)	3480	9		Miscellaneous	US 3	A88 A99 A154 A164 A183		E0	See 965		See 965	
≠	**Lithium ion batteries contained in equipment** (including lithium ion polymer batteries)	3481	9		Miscellaneous	US 3	A48 A99 A154 A164 A181 A185		E0	967	5 kg	967	35 kg
≠	**Lithium ion batteries packed with equipment** (including lithium ion polymer batteries)	3481	9		Miscellaneous	US 3	A88 A99 A154 A164 A181 A185		E0	966	5 kg	966	35 kg

	Name	UN No.	Class or division	Subsidiary risk	Labels	State variations	Special provisions	UN packing group	Excepted quantity	Passenger and cargo aircraft		Cargo aircraft only	
										Packing instruction	Max. net quantity per package	Packing instruction	Max. net quantity per package
	1	2	3	4	5	6	7	8	9	10	11	12	13
≠	**Lithium metal batteries** (including lithium alloy batteries) †	3090	9		Miscellaneous	US 2 US 3	A88 A99 A154 A164 A183 A201		E0	FORBIDDEN		See	968
≠	**Lithium metal batteries contained in equipment** (including lithium alloy batteries) †	3091	9		Miscellaneous	US 2 US 3	A48 A99 A154 A164 A181 A185		E0	970	5 kg	970	35 kg
≠	**Lithium metal batteries packed with equipment** (including lithium alloy batteries) †	3091	9		Miscellaneous	US 2 US 3	A99 A154 A164 A181 A185		E0	969	5 kg	969	35 kg

DANGEROUS GOODS SPECIAL PROVISIONS: LITHIUM BATTERIES

Dangerous Goods Special Provisions: Lithium Batteries

- Technical Instructions, Part 3, Table 3-2
- Special Provisions (SP) listed against the Lithium Battery Proper Shipping Names in Table 3-1

Special Provisions

A48 Packaging tests are not considered necessary.

A88 Prototype or low production (i.e., annual production runs consisting of not more than 100 lithium batteries or cells) lithium batteries or cells 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), 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 Part 6 of these Instructions. 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.

A99 Irrespective of the quantity limits for cargo aircraft specified in column 13 of Table 3-1, and in Section I of Packing Instructions 965, 966, 967, 968, 969 and 970, a lithium battery or battery assembly (i.e. UN 3090 or UN 3480), including when packed with equipment or contained in equipment (i.e. 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.

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).

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

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

b) unintentional activation.

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 metal batteries and lithium ion 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.

Special Provisions

A185 (360) Vehicles only powered by lithium metal batteries or lithium ion batteries must be consigned under the entry UN 3171 **Battery-powered vehicle**.

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

LITHIUM BATTERY PACKING INSTRUCTIONS

Lithium Battery Packing Instructions

- Technical Instructions, Part 4, Chapter 11
- 4;11 contains 6 packing instructions on Lithium Batteries (PI-965, 966, 967, 968, 969, & 970)

Lithium Battery Packing Instructions

- Packing Instruction 965 – Lithium ion batteries

Packing Instruction 965

Passenger and cargo aircraft for UN 3480

1. Introduction

This entry applies to lithium ion or lithium polymer batteries. This packing instruction is structured as follows:

— Section IA applies to lithium ion cells with a Watt-hour rating in excess of 20 Wh and lithium ion batteries with a Watt-hour rating in excess of 100 Wh, which must be assigned to Class 9 and are subject to all of the applicable requirements of these Instructions;
— Section IB applies to lithium ion cells with a Watt-hour rating not exceeding 20 Wh and lithium ion batteries with a Watt-hour rating not exceeding 100 Wh packed in quantities that exceed the allowance permitted in Section II, Table 965-II; and
— Section II applies to lithium ion cells with a Watt-hour rating not exceeding 20 Wh and lithium ion batteries with a Watt-hour rating not exceeding 100 Wh packed in quantities not exceeding the allowance permitted in Section II, Table 965-II.

2. Lithium batteries forbidden from transport

The following applies to all lithium ion cells and batteries in this packing instruction:

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

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

PI-965, Lithium ion batteries

IA. **SECTION IA**

Each cell or battery must meet all the provisions of 2;9.3.

1A.1 **General requirements**

Part 4;1 requirements must be met.

Table 965-IA

UN number and proper shipping name	*Net quantity per package*	
	Passenger	*Cargo*
UN 3480 **Lithium ion batteries**	5 kg	35 kg

PI-965, Lithium ion batteries

IA.2 **Additional requirements**

— Lithium ion cells and batteries must be protected against short circuits.
— Lithium ion cells and batteries must be placed in inner packagings that completely enclose the cell or battery then placed in an outer packaging. The completed package for the cells or batteries must meet the Packing Group II performance requirements.
— Lithium ion batteries with a mass of 12 kg or greater and having a strong, impact-resistant outer casing, or assemblies of such batteries, may be transported when packed in strong outer packagings or protective enclosures (e.g. in fully enclosed or wooden slatted crates) not subject to the requirements of Part 6 of these Instructions, if approved by the appropriate authority of the State of Origin. A copy of the document of approval must accompany the consignment.
— Batteries manufactured after 31 December 2011 must be marked with the Watt-hour rating on the outside case.

IA.3 **Outer packagings**

Boxes	*Drums*	*Jerricans*
Aluminium (4B)	Aluminium (1B2)	Aluminium (3B2)
Fibreboard (4G)	Fibre (1G)	Plastics (3H2)
Natural wood (4C1, 4C2)	Other metal (1N2)	Steel (3A2)
Other metal (4N)	Plastics (1H2)	
Plastics (4H1, 4H2)	Plywood (1D)	
Plywood (4D)	Steel (1A2)	
Reconstituted wood (4F)		
Steel (4A)		

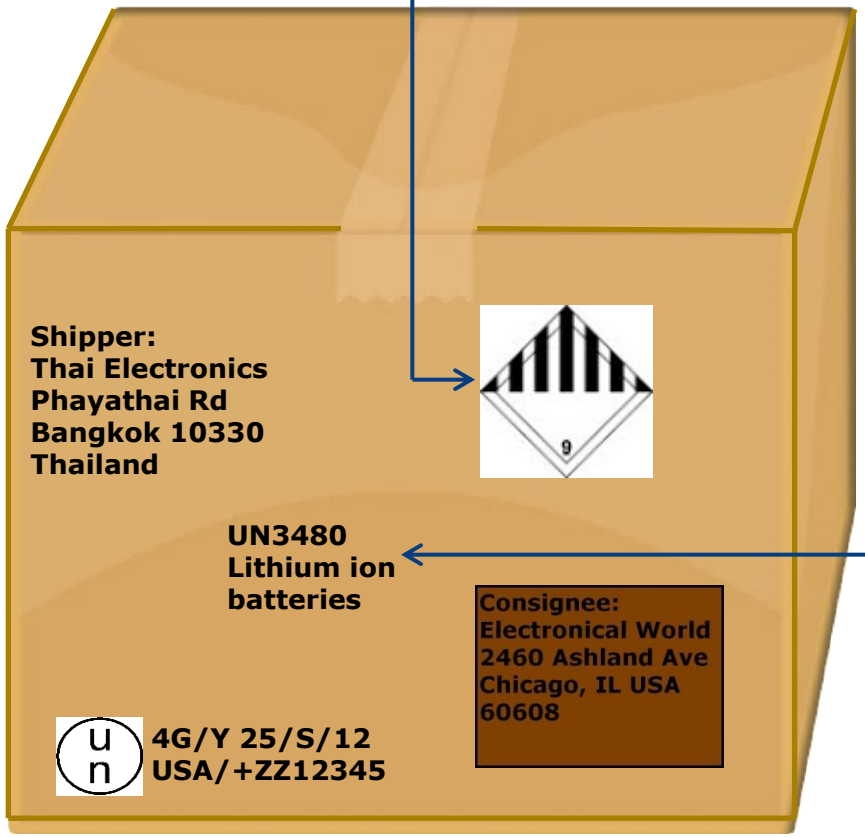
Lithium Ion Batteries: Section IA

Hazard Label

PACKAGE LIMITS

Passenger = 5kg

CAO = 35kg



Proper Shipping Name & UN Number

UN Package Specification Number

PI-965, Lithium ion batteries

IB. **SECTION IB**

Quantities of lithium ion cells or batteries that exceed the allowance permitted in Section II, Table 965-II are subject to all of the applicable provisions of these Instructions (including the requirements in paragraph 2 of this packing instruction and of this section) except for the the provisions of Part 6.

Lithium ion cells or batteries shipped in accordance with the provisions of Section IB must be described on a dangerous goods transport document as set in Part 5;4. The packing instruction number "965" required by 5;4.1.5.8.1 a) must be supplemented with "IB". All other applicable provisions of Part 5;4 apply.

Lithium ion cells and batteries may be offered for transport provided that each cell and battery meets the provisions of 2;9.3.1 a) and e) and the following:

1) for lithium ion cells, the Watt-hour rating (see the Glossary of Terms in Attachment 2) is not more than 20 Wh;

2) for lithium ion batteries, the Watt-hour rating is not more than 100 Wh;
   — the Watt-hour rating must be marked on the outside of the battery case except for those batteries manufactured before 1 January 2009;

PI-965, Lithium ion batteries

IB.1 **General requirements**

Cells and batteries must be packed in strong outer packagings that conform to Part 4;1.1.1, 1.1.3.1 and 1.1.10 (except 1.1.10.1).

Table 965-IB

≠

Contents	*Net quantity per package*	
	Passenger	*Cargo*
Lithium ion cells and batteries	10 kg	10 kg

PI-965, Lithium ion batteries

IB.2 **Additional requirements**

- Cells and batteries must be packed in inner packagings that completely enclose the cell or battery then placed in a strong outer packaging.
- Cells and batteries must be protected so as to prevent short circuits. This includes protection against contact with conductive materials within the same packaging that could lead to a short circuit.
- Each package must be capable of withstanding a 1.2 m drop test in any orientation without:
  - damage to cells or batteries contained therein;
  - shifting of the contents so as to allow battery to battery (or cell to cell) contact;
  - release of contents.
- Each package must be labelled with a lithium battery handling label (Figure 5-32) in addition to the Class 9 hazard label.
- Each consignment must be accompanied with a document 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 must be followed in the event the package is damaged, to include inspection and repacking if necessary; and
  - a telephone number for additional information.

Note.— This information may be provided on the dangerous goods transport document.

IB.3 **Outer packagings**

Boxes *Drums* *Jerricans*

Strong outer packagings

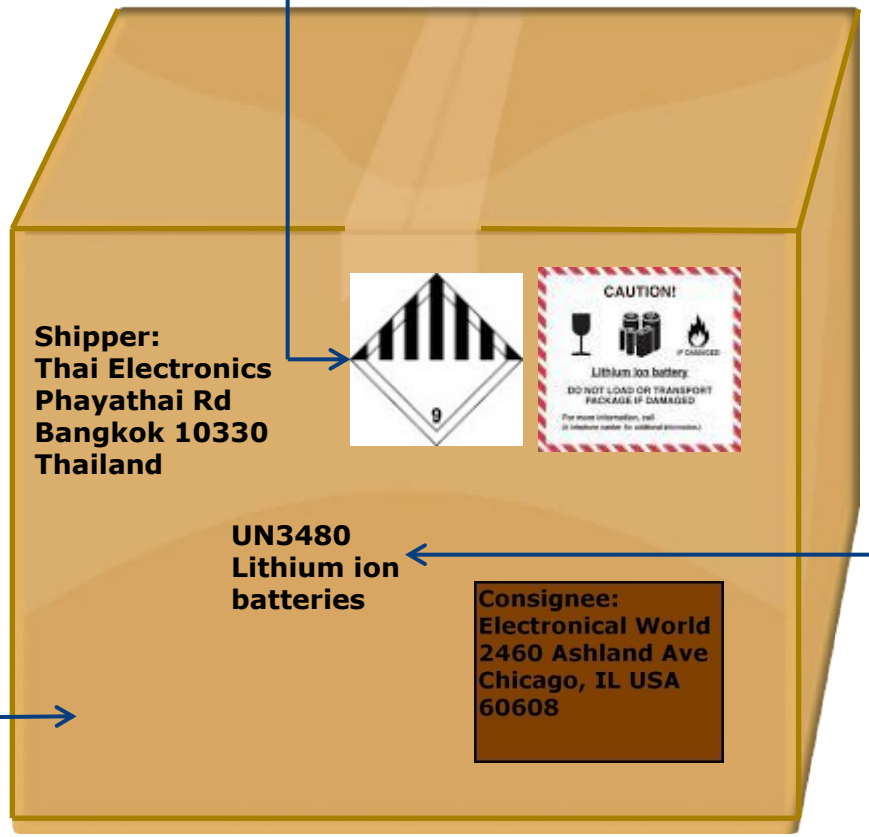
Lithium Ion Batteries: Section IB

Hazard and Handling Labels

PACKAGE LIMITS

Passenger = 10kgG

CAO = 10kgG



Proper Shipping Name & UN Number

Strong Outer Packaging

PI-965, Lithium ion batteries

II. **SECTION II**

With the exception of Part 1;2.3 (General — Transport of dangerous goods by post), 7;4.4 (Operator's responsibilities — Reporting of dangerous goods accidents and incidents), 8;1.1 (Provisions concerning passengers and crew — Dangerous goods carried by passengers or crew) and paragraph 2 of this packing instruction, lithium ion cells and batteries offered for transport are not subject to other additional requirements of these Instructions if they meet the requirements of this section.

≠ Lithium ion cells and batteries may be offered for transport provided that each cell and battery meets the provisions of 2;9.3.1 a) and e) and the following:

1) for lithium ion cells, the Watt-hour rating (see the Glossary of Terms in Attachment 2) is not more than 20 Wh;
2) for lithium ion batteries, the Watt-hour rating is not more than 100 Wh;
   — the Watt-hour rating must be marked on the outside of the battery case except for those batteries manufactured before 1 January 2009.

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PI-965, Lithium ion batteries

II.1 **General requirements**

Cells and batteries must be packed in strong outer packagings that conform to Part 4;1.1.1, 1.1.3.1 and 1.1.10 (except 1.1.10.1).

Table 965-II

Contents	*Lithium ion cells and/or batteries with a Watt-hour rating not more than 2.7 Wh*	*Lithium ion cells with a Watt-hour rating more than 2.7 Wh, but not more than 20 Wh*	*Lithium ion batteries with a Watt-hour rating more than 2.7 Wh, but not more than 100 Wh*
1	*2*	*3*	*4*
Maximum number of cells / batteries per package	No limit	8 cells	2 batteries
Maximum net quantity (mass) per package	2.5 kg	n/a	n/a

The limits specified in columns 2, 3 and 4 of Table 965-II must not be combined in the same package.

II.2 Additional requirements

- Cells and batteries must be packed in inner packagings that completely enclose the cell or battery then placed in a strong outer packaging.
- Cells and batteries must be protected so as to prevent short circuits. This includes protection against contact with conductive materials within the same packaging that could lead to a short circuit.
- Each package must be capable of withstanding a 1.2 m drop test in any orientation without:
  - damage to cells or batteries contained therein;
  - shifting of the contents so as to allow battery to battery (or cell to cell) contact;
  - release of contents.
- Each package must be labelled with a lithium battery handling label (Figure 5-32).
- Each consignment must be accompanied with a document 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 must be followed in the event the package is damaged, to include inspection and repacking if necessary; and
  - a telephone number for additional information.
- The words "lithium ion batteries, in compliance with Section II of PI965" must be placed on the air waybill, when an air waybill is used.
- Any person preparing or offering cells or batteries for transport must receive adequate instruction on these requirements commensurate with their responsibilities.

II.3 Outer packagings

Boxes *Drums* *Jerricans*

Strong outer packagings

II.4 Overpacks

When packages are placed in an overpack, the lithium battery handling label required by this packing instruction must either be clearly visible or the label must be affixed on the outside of the overpack and the overpack must be marked with the word "Overpack".

Packing Instruction 965

What Section Does my Shipment Fall Under?

Type of Lithium Ion Cell or Battery	Cells/Batteries under 2.7 Wh	Cells with a Watt-hour rating over 2.7 Wh, but less than 20 Wh	Batteries over 2.7 Wh, But not more than 100 Wh
Max number per pkg	No limit	8 cells	2 batteries
Max net quantity (mass) per pkg	2.5 kg	n/a	n/a

The limits specified in each column must not be combined in the same package.

Packing Instruction 965

	Cells	Batteries
Section IA	> 20 Wh (5 kg PAX) (35 kg Cargo)	> 100 Wh (5 kg PAX) (35 kg Cargo)
Section IB	< 20 Wh **and** < 10 kg but **Above Section II Limits**	<100 Wh **and** < 10 kg but **Above Section II Limits**
Section II	< 20 Wh **and within limits**	< 100 Wh, **and within limits**

Packing Instruction 965 -- SECTION IB

What's the Difference with IA?

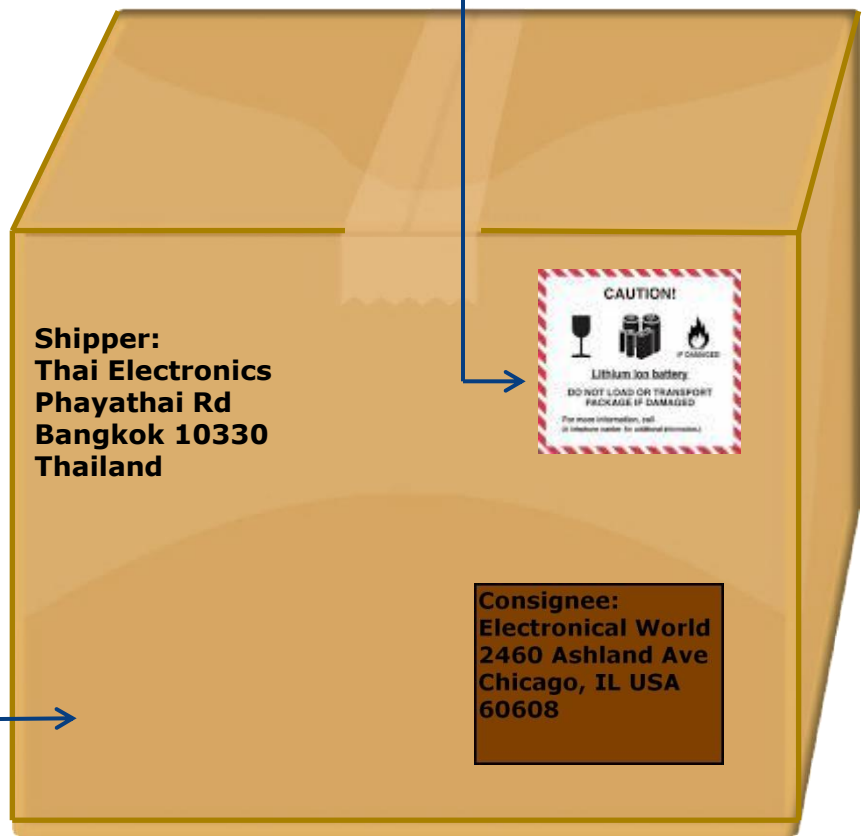
Qty Limit	Passenger Aircraft	Cargo Aircraft
Section IA *Net Qty/Package*	5 kg	35 kg
Section IB *Package Qty*	10 kg G	10 kg G

And…

- No specification packaging for IB
- Require a Lithium Battery handling label in addition to a Class 9 label for IB

Lithium Ion Batteries: Section II

Handling Label



Strong Outer Packaging

PACKAGE LIMITS

Button cells = 2.5kg

or

8 cells

or

2 Batteries

Lithium Battery Packing Instructions

- Packing Instruction 966 – Lithium ion batteries, packed with equipment

PI-966, Lithium ion batteries

Packing Instruction 966

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

1. **Introduction**

This entry applies to lithium ion or lithium polymer batteries packed with equipment.

Section I of this packing instruction applies to lithium ion and lithium polymer cells and batteries that are assigned to Class 9. Certain lithium ion and lithium polymer cells and batteries offered for transport and meeting the requirements of Section II of this packing instruction, subject to paragraph 2 below, are not subject to other additional requirements of these Instructions.

2. **Lithium batteries forbidden from transport**

The following applies to all lithium ion cells and batteries in this packing instruction:

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

PI-966, Lithium ion batteries packed with equipment

I. SECTION I

Each cell or battery must meet all the provisions of 2;9.3.

I.1 General requirements

Part 4;1 requirements must be met.

UN number and proper shipping name	*Package quantity (Section I)*	
	Passenger	*Cargo*
UN 3481 **Lithium ion batteries packed with equipment**	5 kg of lithium ion cells or batteries	35 kg of lithium ion cells or batteries

PI-966, Lithium ion batteries

I.2 Additional requirements

- Lithium ion cells and batteries must be protected against short circuits.
- Lithium ion cells or batteries must:
  - be placed in inner packagings that completely enclose the cell or battery then placed in an outer packaging. The completed package for the cells or batteries must meet the Packing Group II performance requirements; or
  - be placed in inner packagings that completely enclose the cell or battery, then placed with equipment in a packaging that meets the Packing Group II performance requirements.
- The equipment must be secured against movement within the outer packaging and must be equipped with an effective means of preventing accidental activation.
- The number of cells or batteries in each package must not exceed the appropriate number for the equipment's operation, plus two spares.
- For the purpose of this packing instruction, "equipment" means apparatus requiring the lithium ion batteries with which it is packed for its operation.
- Batteries manufactured after 31 December 2011 must be marked with the Watt-hour rating on the outside case.

I.3 Outer packagings

Boxes	*Drums*	*Jerricans*
Aluminium (4B)	Aluminium (1B2)	Aluminium (3B2)
Fibreboard (4G)	Fibre (1G)	Plastics (3H2)
Natural wood (4C1, 4C2)	Other metal (1N2)	Steel (3A2)
Other metal (4N)	Plastics (1H2)	
Plastics (4H1, 4H2)	Plywood (1D)	
Plywood (4D)	Steel (1A2)	
Reconstituted wood (4F)		
Steel (4A)		

PI-966, Lithium ion batteries packed with equipment

II. **SECTION II**

With the exception of Part 1;2.3 (Transport of dangerous goods by post), 7;4.4 (Reporting of dangerous goods accidents and incidents), 8;1.1 (Dangerous goods carried by passengers or crew) and paragraph 2 of this packing instruction, lithium ion cells and batteries packed with equipment offered for transport are not subject to other additional requirements of these Instructions if they meet the requirements of this section.

Lithium ion cells and batteries may be offered for transport provided that each cell and battery meets the provisions of 2;9.3.1 a) and e) and the following:

1) for lithium ion cells, the Watt-hour rating (see the Glossary of Terms in Attachment 2) is not more than 20 Wh;

2) for lithium ion batteries, the Watt-hour rating is not more than 100 Wh;
   — the Watt-hour rating must be marked on the outside of the battery case except for those batteries manufactured before 1 January 2009.

PI-966, Lithium ion batteries packed with equipment

II.1 **General requirements**

Cells and batteries must be packed in strong outer packagings that conform to Part 4;1.1.1, 1.1.3.1 and 1.1.10 (except 1.1.10.1).

Contents	*Package quantity (Section II)*	
	Passenger	*Cargo*
Net quantity of lithium ion cells or batteries per package	5 kg	5 kg

PI-966, Lithium ion batteries

II.2 **Additional requirements**

- Lithium ion cells and batteries must:
  - be placed in inner packagings that completely enclose the cell or battery, then placed in a strong outer packaging; or
  - be placed in inner packagings that completely enclose the cell or battery, then placed with the equipment in a strong outer packaging.
- 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 equipment must be secured against movement within the outer packaging and must be equipped with an effective means of preventing accidental activation.
- The number of cells or batteries in each package must not exceed the appropriate number for the equipment's operation, plus two spares.
- Each package of cells or batteries, or the completed package, must be capable of withstanding a 1.2 m drop test in any orientation without:
  - damage to cells or batteries contained therein;
  - shifting of the contents so as to allow battery to battery (or cell to cell) contact;
  - release of contents.
- Each package must be labelled with a lithium battery handling label (Figure 5-32).
- Each consignment must be accompanied with a document 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 must be followed in the event the package is damaged, to include inspection and repacking if necessary; and
  - a telephone number for additional information.
- The words "lithium ion batteries, in compliance with Section II of PI966" must be placed on the air waybill, when an air waybill is used.
- Any person preparing or offering cells or batteries for transport must receive adequate instruction on these requirements commensurate with their responsibilities.

PI-966, Lithium ion batteries packed with equipment

II.3 Outer packagings

Boxes	*Drums*	*Jerricans*
	Strong outer packagings	

II.4 Overpacks

When packages are placed in an overpack, the lithium battery handling label required by this packing instruction must either be clearly visible or the label must be affixed on the outside of the overpack and the overpack must be marked with the word “Overpack”.

Lithium Battery Packing Instructions

- Packing Instruction 967 – Lithium ion batteries, contained in equipment

PI-967, Lithium ion batteries contained in equipment

Packing Instruction 967

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

1. **Introduction**

This entry applies to lithium ion or lithium polymer batteries contained in equipment.

Section I of this packing instruction applies to lithium ion and lithium polymer cells and batteries that are assigned to Class 9. Certain lithium ion and lithium polymer cells and batteries offered for transport and meeting the requirements of Section II of this packing instruction, subject to paragraph 2 below, are not subject to other additional requirements of these Instructions.

2. **Lithium batteries forbidden from transport**

The following applies to all lithium ion cells and batteries in this packing instruction:

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

PI-967, Lithium ion batteries contained in equipment

I. **SECTION I**

Each cell or battery must meet all the provisions of 2;9.3.

I.1 **General requirements**

Equipment must be packed in strong outer packagings that conform to Part 4;1.1.1, 1.1.3.1 and 1.1.10 (except 1.1.10.1).

UN number and proper shipping name	*Package quantity (Section I)*	
	Passenger	*Cargo*
UN 3481 **Lithium ion batteries contained in equipment**	5 kg of lithium ion cells or batteries	35 kg of lithium ion cells or batteries

PI-967, Lithium ion batteries contained in equipment

I.2 **Additional requirements**

- The equipment must be secured against movement within the outer packaging and be packed so as to prevent accidental operation during air transport.
- 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.
- Batteries manufactured after 31 December 2011 must be marked with the Watt-hour rating on the outside case.

I.3 **Outer packagings**

Boxes	*Drums*	*Jerricans*
	Strong outer packagings	

PI-967, Lithium ion batteries contained in equipment

II. **SECTION II**

With the exception of Part 1;2.3 (Transport of dangerous goods by post), 7;4.4 (Reporting of dangerous goods accidents and incidents), 8;1.1 (Dangerous goods carried by passengers or crew) and paragraph 2 of this packing instruction, lithium ion cells and batteries contained in equipment offered for transport are not subject to other additional requirements of these Instructions if they meet the requirements of this section.

Lithium ion cells and batteries may be offered for transport provided that each cell and battery meets the provisions of 2;9.3.1 a) and e) and the following:

1) for lithium ion cells, the Watt-hour rating (see the Glossary of Terms in Attachment 2) is not more than 20 Wh;

2) for lithium ion batteries, the Watt-hour rating is not more than 100 Wh;
   — the Watt-hour rating must be marked on the outside of the battery case except for those batteries manufactured before 1 January 2009.

Devices such as radio frequency identification (RFID) tags, watches and temperature loggers, which are not capable of generating a dangerous evolution of heat, may be transported when intentionally active. When active, these devices must meet defined standards for electromagnetic radiation to ensure that the operation of the device does not interfere with aircraft systems. The devices must not be capable of emitting disturbing signals (such as buzzing alarms, strobe lights, etc.) during transport.

PI-967, Lithium ion batteries contained in equipment

II.1 **General requirements**

Equipment must be packed in strong outer packagings that conform to Part 4;1.1.1, 1.1.3.1 and 1.1.10 (except 1.1.10.1).

Contents	*Package quantity (Section II)*	
	Passenger	*Cargo*
Net quantity of lithium ion cells or batteries per package	5 kg	5 kg

PI-967, Lithium ion batteries contained in equipment

II.2 **Additional requirements**

- The equipment must be secured against movement within the outer packaging and must be equipped with an effective means of preventing accidental activation.
- Cells and batteries must be protected so as to prevent short circuits.
- The equipment must be packed in strong outer packagings constructed of suitable material of adequate strength and design in relation to the packaging's capacity and its intended use unless the battery is afforded equivalent protection by the equipment in which it is contained.
- Each package containing more than four cells or more than two batteries installed in equipment must be labelled with a lithium battery handling label (Figure 5-32) (except button cell batteries installed in equipment (including circuit boards)).
- Each consignment with packages bearing the lithium battery handling label must be accompanied with a document 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 must be followed in the event the package is damaged, to include inspection and repacking if necessary; and
  - a telephone number for additional information.
- Where a consignment includes packages bearing the lithium battery handling label, the words "lithium ion batteries, in compliance with Section II of PI967" must be placed on the air waybill, when an air waybill is used.
- Any person preparing or offering cells or batteries for transport must receive adequate instruction on these requirements commensurate with their responsibilities.

PI-967, Lithium ion batteries contained in equipment

II.3 **Outer packagings**

Boxes	*Drums*	*Jerricans*
	Strong outer packagings	

II.4 **Overpacks**

When packages are placed in an overpack, the lithium battery handling label required by this packing instruction must either be clearly visible or the label must be affixed on the outside of the overpack and the overpack must be marked with the word “Overpack”.

Lithium Battery Packing Instructions

- Packing Instruction 968 – Lithium metal batteries

Packing Instruction 968

Cargo aircraft only for UN 3090

1. Introduction

This entry applies to lithium metal or lithium alloy batteries. This packing instruction is structured as follows:

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

2. Lithium batteries forbidden from transport

The following applies to all lithium metal cells and batteries in this packing instruction:

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

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

PI-968, Lithium metal batteries

IA. **SECTION IA**

Each cell or battery must meet all the provisions of 2;9.3.

IA.1 **General requirements**

Part 4;1 requirements must be met.

Table 968-IA

	UN number and proper shipping name	*Net quantity per package*	
		Passenger	*Cargo*
≠	UN 3090 **Lithium metal batteries**	Forbidden	35 kg

PI-968, Lithium metal batteries

IA.2 Additional requirements

- Lithium metal cells and batteries must be protected against short circuits.
- Lithium metal cells and batteries must be placed in inner packagings that completely enclose the cell or battery, then placed in an outer packaging. The completed package for the cells or batteries must meet the Packing Group II performance requirements.
- Lithium metal 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 or protective enclosures (e.g. in fully enclosed or wooden slatted crates) not subject to the requirements of Part 6 of these Instructions, if approved by the appropriate authority of the State of Origin. A copy of the document of approval must accompany the consignment.

IA.3 Outer packagings

Boxes

Aluminium (4B)
Fibreboard (4G)
Natural wood (4C1, 4C2)
Other metal (4N)
Plastics (4H1, 4H2)
Plywood (4D)
Reconstituted wood (4F)
Steel (4A)

Drums

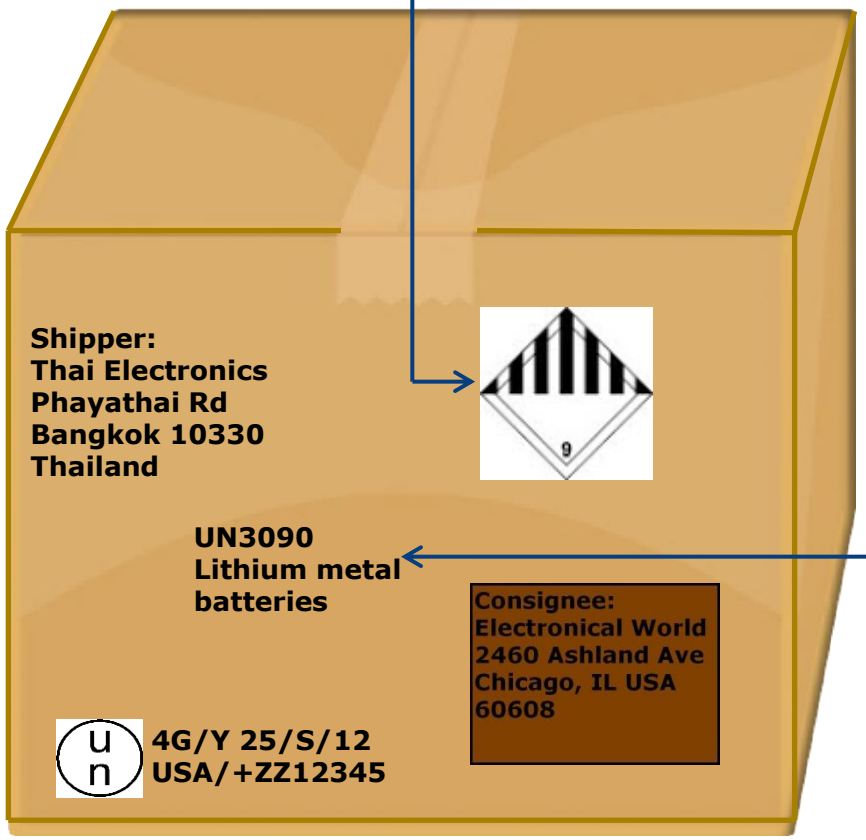
Aluminium (1B2)
Fibre (1G)
Other metal (1N2)
Plastics (1H2)
Plywood (1D)
Steel (1A2)

Jerricans

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

Lithium Metal Batteries: Section IA

Hazard Label



PACKAGE LIMITS

Passenger = Forbidden in US

CAO = 35kg

Proper Shipping Name & UN Number

UN Package Specification Number

PI-968, Lithium metal batteries

IB. **SECTION IB**

Quantities of lithium metal cells or batteries that exceed the allowance permitted in Section II, Table 968-II, are subject to all of the applicable provisions of these Instructions (including the requirements in paragraph 2 of this packing instruction and of this section) except for the provisions of Part 6.

Lithium metal cells or batteries shipped in accordance with the provisions of Section IB must be described on a dangerous goods transport document as set in Part 5;4. The packing instruction number "968" required by 5;4.1.5.8.1 a) must be supplemented with "IB". All other applicable provisions of Part 5;4 apply.

Lithium metal or lithium alloy cells and batteries may be offered for transport provided that each cell and battery meets the provisions of 2;9.3.1 a) and e) and the following:

1) for lithium metal cells, the lithium content is not more than 1 g;
2) for lithium metal or lithium alloy batteries, the aggregate lithium content is not more than 2 g.

PI-968, Lithium metal batteries

IB.1 **General requirements**

Cells and batteries must be packed in strong outer packagings that conform to Part 4;1.1.1, 1.1.3.1 and 1.1.10 (except 1.1.10.1).

Table 968-IB

	Contents	*Net quantity per package*	
		Passenger	*Cargo*
≠ ≠	Lithium metal cells and batteries	Forbidden	2.5 kg

PI-968, Lithium metal batteries

IB.2 **Additional requirements**

- Cells and batteries must be packed in inner packagings that completely enclose the cell or battery then placed in a strong outer packaging.
- Cells and batteries must be protected so as to prevent short circuits. This includes protection against contact with conductive materials within the same packaging that could lead to a short circuit.
- Each package must be capable of withstanding a 1.2 m drop test in any orientation without:
  - damage to cells or batteries contained therein;
  - shifting of the contents so as to allow battery to battery (or cell to cell) contact;
  - release of contents.
- Each package must be labelled with a lithium battery handling label (Figure 5-32) in addition to the Class 9 hazard label and the cargo aircraft only label (Figure 5-26).
- Each consignment must be accompanied with a document 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 must be followed in the event the package is damaged, to include inspection and repacking if necessary; and
  - a telephone number for additional information.

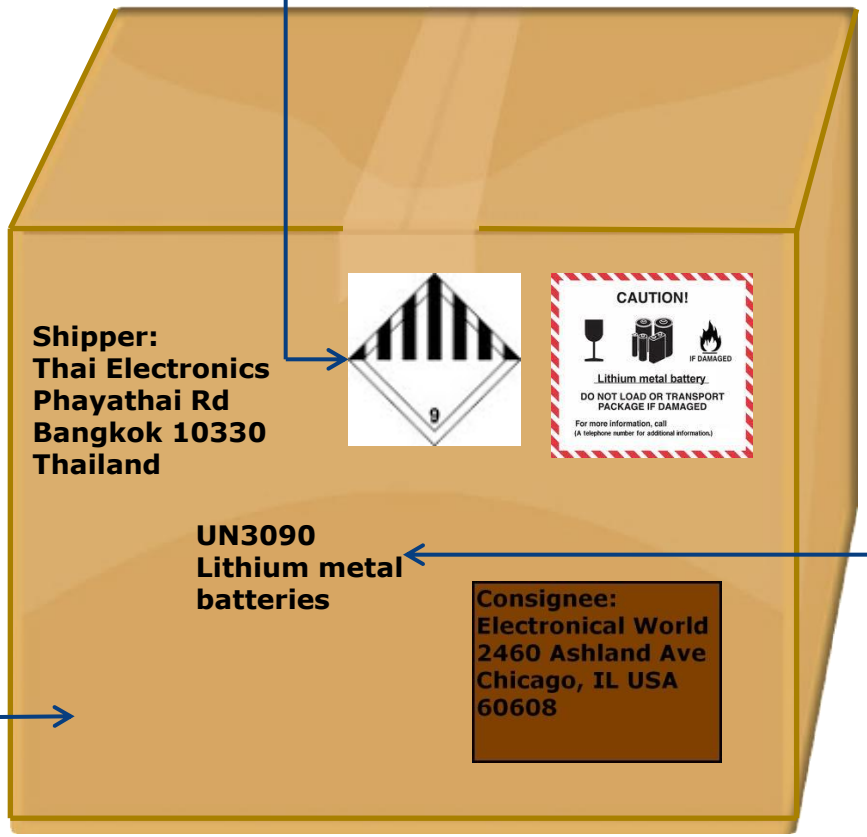
Note.— This information may be provided on the dangerous goods transport document.

IB.3 **Outer packagings**

Boxes	*Drums*	*Jerricans*
Strong outer packagings		

Lithium Metal Batteries: Section IB

Hazard and Handling Labels



PACKAGE LIMITS

Passenger = Forbidden in US

CAO = 2.5kgG

Proper Shipping Name & UN Number

Strong Outer Packaging

PI-968, Lithium metal batteries

II. **SECTION II**

With the exception of Part 1;2.3 (General — Transport of dangerous goods by post), 5;1.1 g), 5;1.1 j) (Shipper's responsibilities — General requirements), 7;2.1 (Operator's responsibilities — Loading restrictions on the flight deck and for passenger aircraft), 7;2.4.1 (Operator's responsibilities — Loading of cargo aircraft), 7;4.4 (Operator's responsibilities — Reporting of dangerous goods accidents and incidents), 8;1.1 (Provisions concerning passengers and crew — Dangerous goods carried by passengers or crew) and paragraph 2 of this packing instruction, lithium metal or lithium alloy cells and batteries offered for transport are not subject to other additional requirements of these Instructions if they meet the requirements of this section.

Lithium metal or lithium alloy cells and batteries may be offered for transport provided that each cell and battery meets the provisions of 2;9.3.1 a) and e) and the following:

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

PI-968, Lithium metal batteries

II.1 **General requirements**

Cells and batteries must be packed in strong outer packagings that conform to Part 4;1.1.1, 1.1.3.1 and 1.1.10 (except 1.1.10.1).

Table 968-II

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

The limits specified in columns 2, 3 and 4 of Table 968-II must not be combined in the same package.

PI-968, Lithium metal batteries

II.2 **Additional requirements**

- Cells and batteries must be packed in inner packagings that completely enclose the cell or battery, then placed in a strong outer packaging.
- Cells and batteries must be protected so as to prevent short circuits. This includes protection against contact with conductive materials within the same packaging that could lead to a short circuit.
- Each package must be capable of withstanding a 1.2 m drop test in any orientation without:
  - damage to cells or batteries contained therein;
  - shifting of the contents so as to allow battery to battery (or cell to cell) contact;
  - release of contents.
- Each package must be labelled with a lithium battery handling label (Figure 5-32) and the cargo aircraft only label (Figure 5-26).
  - the cargo aircraft only label must be located on the same surface of the package near the lithium battery handling label, if the package dimensions are adequate.
- Each consignment must be accompanied with a document 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 must be followed in the event the package is damaged, to include inspection and repacking if necessary; and
  - a telephone number for additional information.
- The words "lithium metal batteries, in compliance with Section II of PI968 — cargo aircraft only" or "lithium metal batteries, in compliance with Section II of PI968 — CAO" must be placed on the air waybill, when an air waybill is used.
- Consignments of lithium metal batteries prepared in accordance with the provisions of Section II must not be consolidated with other shipments of dangerous goods or non-dangerous goods and must not be loaded into a unit load device before being offered to the operator.
- Any person preparing or offering cells or batteries for transport must receive adequate instruction on these requirements commensurate with their responsibilities.

PI-968, Lithium metal batteries

II.3 **Outer packagings**

Boxes	*Drums*	*Jerricans*
	Strong outer packagings	

II.4 **Overpacks**

When packages are placed in an overpack, the lithium battery handling label and the cargo aircraft only label (Figure 5-26) required by this packing instruction must either be clearly visible or the labels must be affixed on the outside of the overpack and the overpack must be marked with the word “Overpack”.

Packing Instruction 968

What Section Does my Shipment Fall Under?

	Cells	Batteries
Section IA	> 1 g (2.5 kg PAX) (35 kg Cargo)	> 2 g (2.5 kg PAX) (35 kg Cargo)
Section IB	< 1 g lithium and <2.5 kg/package but **Above Section II Limits**	< 2 g lithium and <2.5 kg/package but **Above Section II Limits**
Section II	< 1 g, **and within limits**	< 2 g, **and within limits**

Packing Instruction 968

What Section Does my Shipment Fall Under?

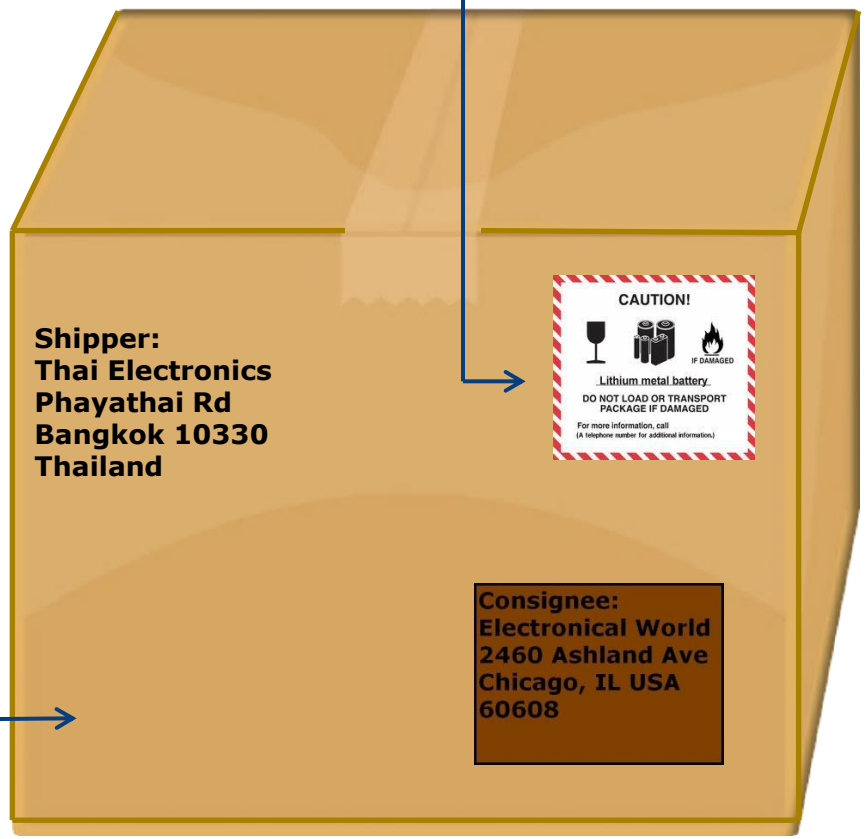
First see if the package is within Section II

Type of Lithium Metal Cell or Battery	Cells/Batteries under 0.3 g	Cells with a lithium content over 0.3 g but less than 1 g	Batteries with a lithium content over 0.3 g but less than 2 g
Max number per pkg	No limit	8 cells	2 batteries
Max net quantity (mass) per pkg	2.5 kg	n/a	n/a

The limits specified in each column must not be combined in the same package.

Lithium Metal Batteries: Section II

Handling Label



Strong Outer Packaging

PACKAGE LIMITS

Button cells = 2.5kg

or

8 cells

or

2 Batteries

Lithium Battery Packing Instructions

- Packing Instruction 969 – Lithium metal batteries, packed with equipment

PI-969, Lithium metal batteries contained in equipment

Packing Instruction 969

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

1. **Introduction**

This entry applies to lithium metal or lithium alloy batteries packed with equipment.

Section I of this packing instruction applies to lithium metal and lithium alloy cells and batteries that are assigned to Class 9. Certain lithium metal and lithium alloy cells and batteries offered for transport and meeting the requirements of Section II of this packing instruction, subject to paragraph 2 below, are not subject to other additional requirements of these Instructions.

2. **Lithium batteries forbidden from transport**

The following applies to all lithium metal cells and batteries in this packing instruction:

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

PI-969, Lithium metal batteries contained in equipment

I. **SECTION I**

Each cell or battery must meet all the provisions of 2;9.3.

I.1 **General requirements**

Part 4;1 requirements must be met.

UN number and proper shipping name		*Package quantity (Section I)*	
		Passenger	*Cargo*
UN 3091	**Lithium metal batteries packed with equipment**	5 kg of lithium metal cells or batteries	35 kg of lithium metal cells or batteries

PI-969, Lithium metal batteries contained in equipment

I.2 **Additional requirements**

- Lithium metal cells and batteries must be protected against short circuits.
- Lithium metal cells or batteries must:
  - be placed in inner packagings that completely enclose the cell or battery, then placed in an outer packaging. The completed package for the cells or batteries must meet the Packing Group II performance requirements; or
  - be placed in inner packagings that completely enclose the cell or battery, then placed with equipment in a packaging that meets the Packing Group II performance requirements.
- The equipment must be secured against movement within the outer packaging and must be equipped with an effective means of preventing accidental activation.
- The number of cells or batteries in each package must not exceed the appropriate number for the equipment's operation, plus two spares.
- For the purpose of this packing instruction, "equipment" means apparatus requiring the lithium batteries with which it is packed for its operation.
- For lithium metal cells and batteries prepared for transport on passenger aircraft as Class 9:
  - cells and batteries offered for transport on passenger aircraft must be packed in intermediate or outer rigid metal packaging surrounded by cushioning material that is non-combustible and non-conductive and placed inside an outer packaging.

PI-969, Lithium metal batteries contained in equipment

I.3 **Outer packagings**

Boxes

Aluminium (4B)
Fibreboard (4G)
Natural wood (4C1, 4C2)
Other metal (4N)
Plastics (4H1, 4H2)
Plywood (4D)
Reconstituted wood (4F)
Steel (4A)

Drums

Aluminium (1B2)
Fibre (1G)
Other metal (1N2)
Plastics (1H2)
Plywood (1D)
Steel (1A2)

Jerricans

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

PI-969, Lithium metal batteries contained in equipment

II. **SECTION II**

With the exception of Part 1;2.3 (Transport of dangerous goods by post), 7;4.4 (Reporting of dangerous goods accidents and incidents),8;1.1 (Dangerous goods carried by passengers or crew) and paragraph 2 of this packing instruction, lithium metal cells and batteries packed with equipment offered for transport are not subject to other additional requirements of these Instructions if they meet the requirements of this section.

Lithium metal cells and batteries may be offered for transport provided that each cell and battery meets the provisions of 2;9.3.1 a) and e) and the following:

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

II.1 **General requirements**

Cells and batteries must be packed in strong outer packagings that conform to Part 4;1.1.1, 1.1.3.1 and 1.1.10 (except 1.1.10.1).

Contents	*Package quantity (Section II)*	
	Passenger	*Cargo*
Net quantity of lithium metal cells or batteries per package	5 kg	5 kg

II.2 **Additional requirements**

- Lithium metal cells or batteries must:
  - be placed in inner packagings that completely enclose the cell or battery, then placed in a strong outer packaging; or
  - be placed in inner packagings that completely enclose the cell or battery, then placed with the equipment in a strong outer packaging.
- 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 equipment must be secured against movement within the outer packaging and must be equipped with an effective means of preventing accidental activation.
- The number of cells or batteries in each package must not exceed the appropriate number for the equipment's operation, plus two spares.
- Each package of cells or batteries, or the completed package, must be capable of withstanding a 1.2 m drop test in any orientation without:
  - damage to cells or batteries contained therein;
  - shifting of the contents so as to allow battery to battery (or cell to cell) contact;
  - release of contents.
- Each package must be labelled with a lithium battery handling label (Figure 5-32).
- Each consignment must be accompanied with a document 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 must be followed in the event the package is damaged, to include inspection and repacking if necessary; and
  - a telephone number for additional information.
- The words "lithium metal batteries, in compliance with Section II of PI969" must be placed on the air waybill, when an air waybill is used.
- Any person preparing or offering cells or batteries for transport must receive adequate instruction on these requirements commensurate with their responsibilities.

PI-969, Lithium metal batteries contained in equipment

II.3 **Outer packagings**

Boxes	*Drums*	*Jerricans*
	Strong outer packagings	

II.4 **Overpacks**

When packages are placed in an overpack, the lithium battery handling label required by this packing instruction must either be clearly visible or the label must be affixed on the outside of the overpack and the overpack must be marked with the word “Overpack”.

Lithium Battery Packing Instructions

- Packing Instruction 970 – Lithium metal batteries, contained in equipment

PI-970, Lithium metal batteries packed with equipment

Packing Instruction 970

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

1. **Introduction**

This entry applies to lithium metal or lithium alloy batteries contained in equipment.

Section I of this packing instruction applies to lithium metal and lithium alloy cells and batteries that are assigned to Class 9. Certain lithium metal and lithium alloy cells and batteries offered for transport and meeting the requirements of Section II of this packing instruction, subject to paragraph 2 below, are not subject to other additional requirements of these Instructions.

2. **Lithium batteries forbidden from transport**

The following applies to all lithium metal cells and batteries in this packing instruction:

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

PI-970, Lithium metal batteries packed with equipment

I. **SECTION I**

Each cell or battery must meet all the provisions of 2;9.3.

I.1 **General requirements**

Equipment must be packed in strong outer packagings that conform to Part 4;1.1.1, 1.1.3.1 and 1.1.10 (except 1.1.10.1).

UN number and proper shipping name		*Package quantity (Section I)*	
		Passenger	*Cargo*
UN 3091	**Lithium metal batteries contained in equipment**	5 kg of lithium metal cells or batteries	35 kg of lithium metal cells or batteries

PI-970, Lithium metal batteries packed with equipment

I.2 **Additional requirements**

- The equipment must be secured against movement within the outer packaging and must be equipped with an effective means of preventing accidental activation.
- 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.
- The quantity of lithium metal contained in any piece of equipment must not exceed 12 g per cell and 500 g per battery.

I.3 **Outer packagings**

Boxes	*Drums*	*Jerricans*
	Strong outer packagings	

PI-970, Lithium metal batteries packed with equipment

II. **SECTION II**

With the exception of Part 1;2.3 (Transport of dangerous goods by post), 7;4.4 (Reporting of dangerous goods accidents and incidents), 8;1.1 (Dangerous goods carried by passengers or crew) and paragraph 2 of this packing instruction, lithium metal cells and batteries contained in equipment offered for transport are not subject to other additional requirements of these Instructions if they meet the requirements of this section.

Lithium metal cells and batteries may be offered for transport provided that each cell and battery meets the provisions of 2;9.3.1 a) and e) and the following:

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

Devices such as radio frequency identification (RFID) tags, watches and temperature loggers, which are not capable of generating a dangerous evolution of heat, may be transported when intentionally active. When active, these devices must meet defined standards for electromagnetic radiation to ensure that the operation of the device does not interfere with aircraft systems. The devices must not be capable of emitting disturbing signals (such as buzzing alarms, strobe lights, etc.) during transport.

PI-970, Lithium metal batteries packed with equipment

II.1 **General requirements**

Equipment containing batteries must be packed in strong outer packagings that conform to Part 4;1.1.1, 1.1.3.1 and 1.1.10 (except 1.1.10.1).

Contents	*Package quantity (Section II)*	
	Passenger	*Cargo*
Net quantity of lithium metal cells or batteries per package	5 kg	5 kg

PI-970, Lithium metal batteries packed with equipment

II.2 **Additional requirements**

- The equipment must be secured against movement within the outer packaging and must be equipped with an effective means of preventing accidental activation.
- Cells and batteries must be protected so as to prevent short circuits.
- The equipment must be packed in strong outer packagings constructed of suitable material of adequate strength and design in relation to the packaging's capacity and its intended use unless the battery is afforded equivalent protection by the equipment in which it is contained.
- Each package containing more than four cells or more than two batteries installed in equipment must be labelled with a lithium battery handling label (Figure 5-32) (except button cell batteries installed in equipment (including circuit boards)).
- Each consignment with packages bearing the lithium battery handling label must be accompanied with a document 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 must be followed in the event the package is damaged, to include inspection and repacking if necessary; and
  - a telephone number for additional information.
- Where a consignment includes packages bearing the lithium battery handling label, the words "lithium ion batteries, in compliance with Section II of PI970" must be placed on the air waybill, when an air waybill is used.
- Any person preparing or offering cells or batteries for transport must receive adequate instruction on these requirements commensurate with their responsibilities.

PI-970, Lithium metal batteries packed with equipment

II.3 **Outer packagings**

Boxes	*Drums*	*Jerricans*
	Strong outer packagings	

II.4 **Overpacks**

When packages are placed in an overpack, the lithium battery handling label required by this packing instruction must either be clearly visible or the label must be affixed on the outside of the overpack and the overpack must be marked with the word “Overpack”.

UK CAA Video on Lithium Batteries

Lithium batteries: Guidance for cargo and ramp personnel (8m38s)

https://www.youtube.com/watch?v=puhtU0npSW0

DANGEROUS GOODS TRANSPORT DOCUMENTATION

Dangerous Goods Transport Document

- Technical Instructions, Part 5, Chapter 4 includes the requirements
- The red and white striped border is not a regulatory requirement, but has been adopted by the industry as a standard

Dangerous Goods Transport Document

- The following Lithium Battery packages need a DG Transport Document:
  - Section IA (PI-965 & 968)
  - Section IB (PI-965 & 968)
  - Section I (PI-966, 967, 969, & 970)

Proper Shipping Name	UN #	Class	Packing Instruction
Lithium ion batteries	UN3480	9	965
Lithium ion batteries contained in equipment	UN3481	9	966
Lithium ion batteries packed with equipment	UN3481	9	967

Proper Shipping Name	UN #	Class	Packing Instruction
Lithium metal batteries	UN3090	9	968
Lithium metal batteries contained in equipment	UN3091	9	969
Lithium metal batteries packed with equipment	UN3091	9	970

Dangerous Goods Transport Document

SHIPPER'S DECLARATION FOR DANGEROUS GOODS

Shipper
Thai Electronics
Phayathai Rd
Bangkok 10330
Thailand

Air Waybill No.

Page 1 of 1 Pages

Shipper's Reference Number
(optional)

Consignee
Electronical World
2460 Ashland Ave.
Chicago, IL USA
60608

For optional use for Company logo name and address

Two completed and signed copies of this Declaration must be handed to the operator.

WARNING

Failure to comply in all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties.

TRANSPORT DETAILS

This shipment is within the limitations prescribed for: *(delete non-applicable)*

PASSENGER AND CARGO AIRCRAFT | ~~CARGO AIRCRAFT ONLY~~

Airport of Departure: Bangkok

Airport of Destination: Chicago

Shipment type: *(delete non-applicable)*

NON-RADIOACTIVE | ~~RADIOACTIVE~~

NATURE AND QUANTITY OF DANGEROUS GOODS

Dangerous Goods Identification				Quantity and type of packing	Packing Inst.	Authorization
UN or ID No.	Proper Shipping Name	Class or Division (Subsidiary Risk)	Packing Group			
UN3480	Lithium ion batteries	9		1 - 4G (Fiberboard) Box	965	

Additional Handling Information

Emergency Telephone Number: +66 2 9999999

I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labelled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. I declare that all of the applicable air transport requirements have been met.

Name/Title of Signatory
Punyaa Mookjai, Transport Specialist

Place and Date
Bangkok, Thailand, July 15, 2015

Signature *(see warning above)* Punyaa Mookjai

Dangerous Goods Transport Document

SHIPPER'S DECLARATION FOR DANGEROUS GOODS

Shipper
Thai Electronics
Phayathai Rd
Bangkok 10330
Thailand

Air Waybill No.

Page 1 of 1 Pages

Shipper's Reference Number
(optional)

Consignee
Electronical World
2460 Ashland Ave.
Chicago, IL USA
60608

For optional use
for
Company logo
name and address

Two completed and signed copies of this Declaration must be handed to the operator.

WARNING

Failure to comply in all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties.

TRANSPORT DETAILS

This shipment is within the limitations prescribed for: *(delete non-applicable)*

PASSENGER AND CARGO AIRCRAFT | ~~CARGO AIRCRAFT ONLY~~

Airport of Departure: Bangkok

Airport of Destination: Chicago

Shipment type: *(delete non-applicable)*

NON-RADIOACTIVE | ~~RADIOACTIVE~~

Dangerous Goods Transport Document

NATURE AND QUANTITY OF DANGEROUS GOODS						
Dangerous Goods Identification						
UN or ID No.	Proper Shipping Name	Class or Division (Subsidiary Risk)	Pack-ing Group	Quantity and type of packing	Packing Inst.	Authorization
UN3480	Lithium ion batteries	9		1 - Fiberboard Box x 4kg	965	

Dangerous Goods Transport Document

Additional Handling Information

Emergency Telephone Number: +66 2 9999999

I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labelled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. I declare that all of the applicable air transport requirements have been met.

Name/Title of Signatory
Punyaa Mookjai, Transport Specialist

Place and Date
Bangkok, Thailand, July 15, 2015

Signature **Punyaa Mookjai**
(see warning above)

DANGEROUS GOODS MARKINGS

Dangerous Goods Markings

- Technical Instructions, Part 5, Chapter 2
- The following Lithium Battery packages need a DG Proper Shipping Name and UN Number marks:
  - Section IA (PI-965 & 968)
  - Section IB (PI-965 & 968)
  - Section I (PI-966, 967, 969, & 970)

Proper Shipping Name	UN #	Class	Packing Instruction
Lithium ion batteries	UN3480	9	965
Lithium ion batteries contained in equipment	UN3481	9	966
Lithium ion batteries packed with equipment	UN3481	9	967

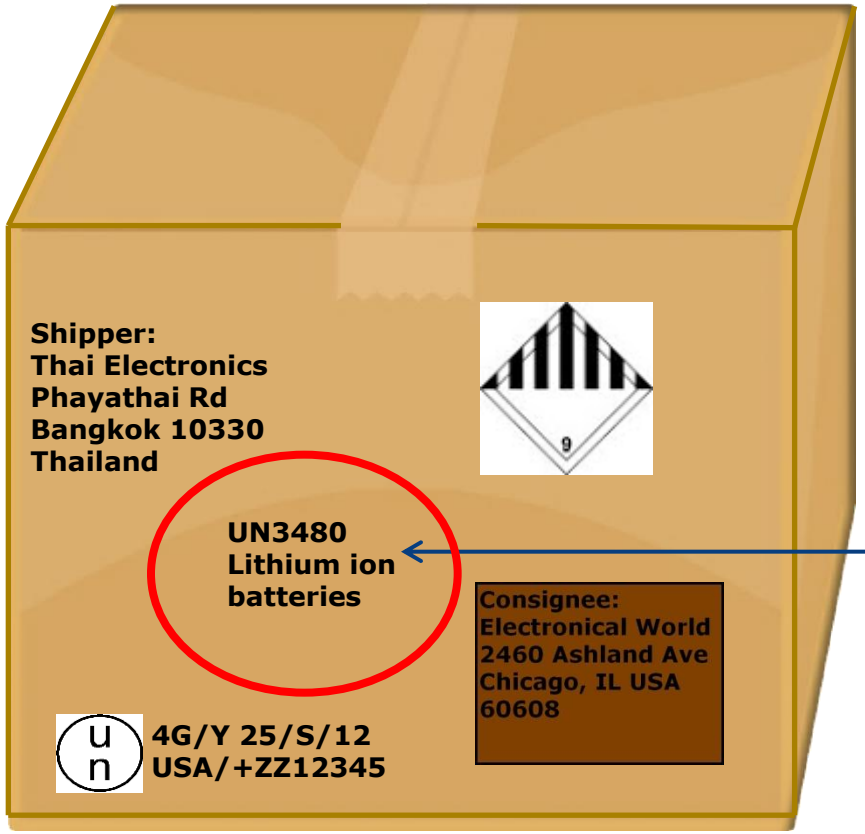
Proper Shipping Name	UN #	Class	Packing Instruction
Lithium metal batteries	UN3090	9	968
Lithium metal batteries contained in equipment	UN3091	9	969
Lithium metal batteries packed with equipment	UN3091	9	970

Lithium Ion Batteries: Section IA

PACKAGE LIMITS

Passenger = 5kg

CAO = 35kg



Proper Shipping Name & UN Number

DANGEROUS GOODS LABELS

Dangerous Goods Labels

- Technical Instructions, Part 5, Chapter 3
- The following labels may need to be utilized on a Lithium Battery package:
  - Class 9 Label
  - Cargo Aircraft Only (CAO) Label
  - Lithium Battery Handling Label
  - Reduced sized Lithium Battery Handling Label

Dangerous Goods Labels

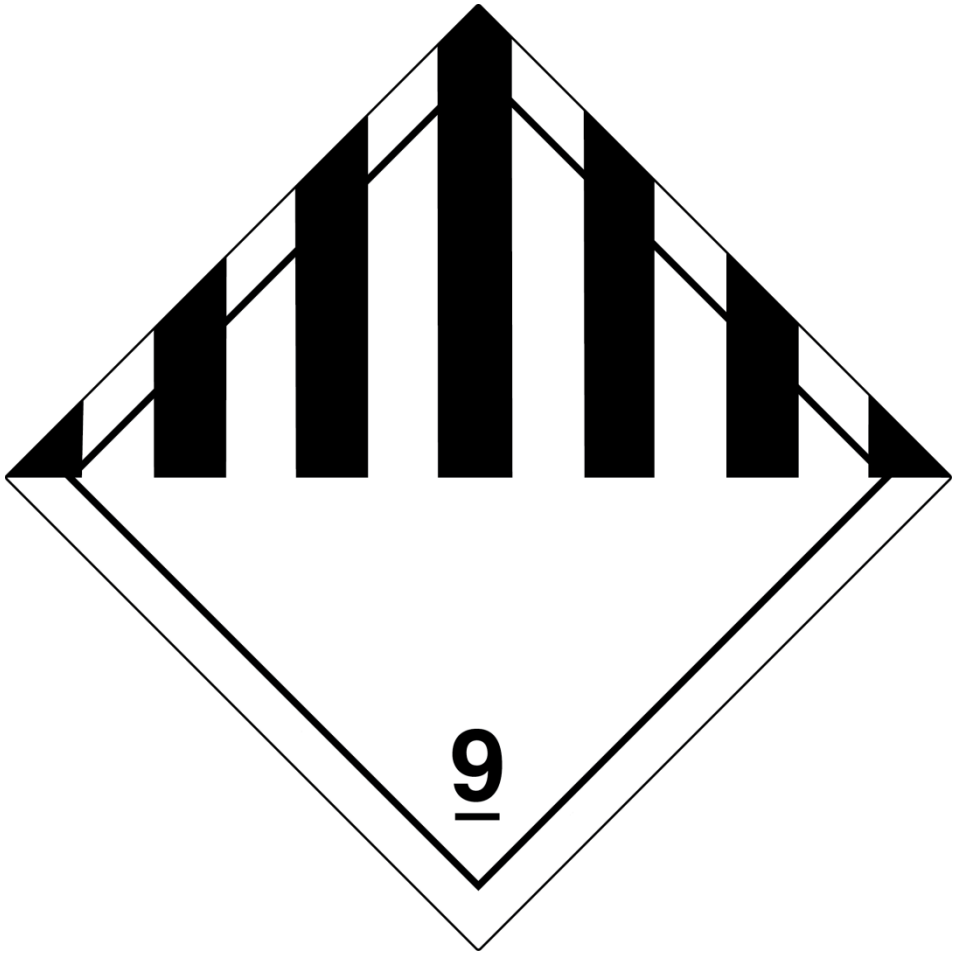
- The following Lithium Battery packages need a DG Class 9 Label:
  - Section IA (PI-965 & 968)
  - Section IB (PI-965 & 968)
  - Section I (PI-966, 967, 969, & 970)

Proper Shipping Name	UN #	Class	Packing Instruction
Lithium ion batteries	UN3480	9	965
Lithium ion batteries contained in equipment	UN3481	9	966
Lithium ion batteries packed with equipment	UN3481	9	967

Proper Shipping Name	UN #	Class	Packing Instruction
Lithium metal batteries	UN3090	9	968
Lithium metal batteries contained in equipment	UN3091	9	969
Lithium metal batteries packed with equipment	UN3091	9	970

Dangerous Goods Labels

Class 9 Label



Dangerous Goods Labels

- The following Lithium Battery packages need a DG Cargo Aircraft Only Label:
  - PI-965, Section IA; and PI-966, 967, 969, & 970, Section I: with a net weight of Lithium Batteries more than 5 kg
  - PI-968, Section IA, Section IB, & Section II

Proper Shipping Name	UN #	Class	Packing Instruction
Lithium ion batteries	UN3480	9	965
Lithium ion batteries contained in equipment	UN3481	9	966
Lithium ion batteries packed with equipment	UN3481	9	967

Proper Shipping Name	UN #	Class	Packing Instruction
Lithium metal batteries	UN3090	9	968
Lithium metal batteries contained in equipment	UN3091	9	969
Lithium metal batteries packed with equipment	UN3091	9	970

Dangerous Goods Labels

Cargo Aircraft Only (CAO) Label

Dangerous Goods Labels

- The following Lithium Battery packages need a Lithium Battery Handling Label:
  - Section IB (PI-965 & 968)
  - Section II (PI-965, 966, 967, 968, 969, & 970)

Proper Shipping Name	UN #	Class	Packing Instruction
Lithium ion batteries	UN3480	9	965
Lithium ion batteries contained in equipment	UN3481	9	966
Lithium ion batteries packed with equipment	UN3481	9	967

Proper Shipping Name	UN #	Class	Packing Instruction
Lithium metal batteries	UN3090	9	968
Lithium metal batteries contained in equipment	UN3091	9	969
Lithium metal batteries packed with equipment	UN3091	9	970

Dangerous Goods Labels

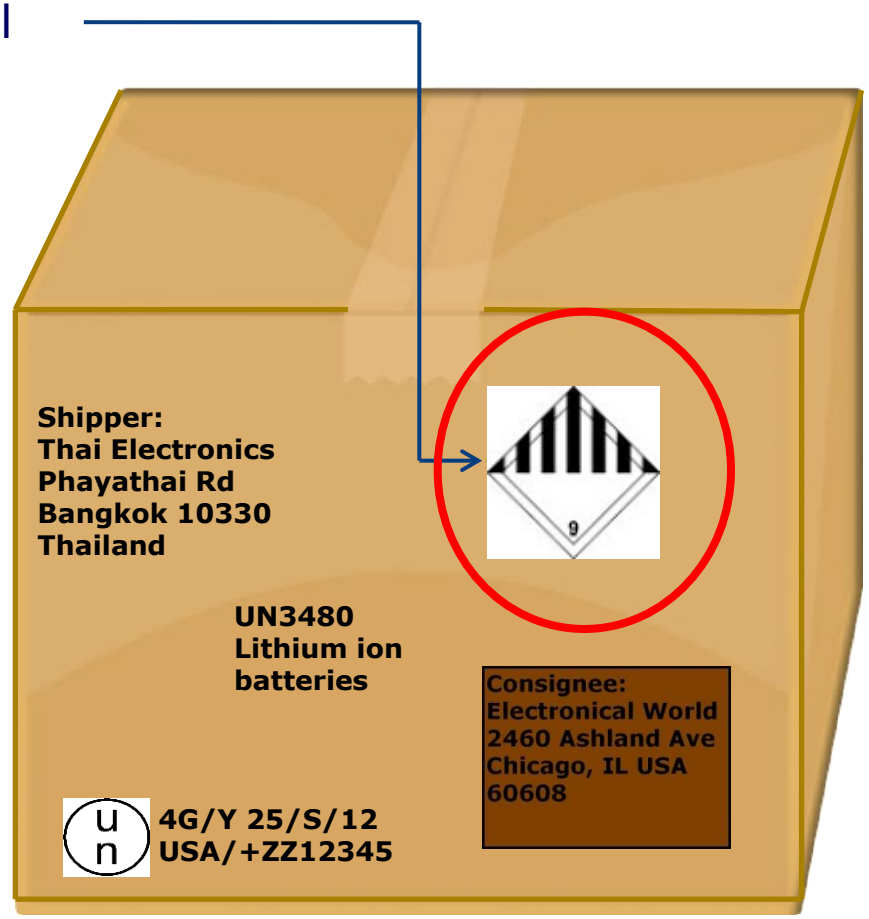
Lithium Battery Handling Label

Dangerous Goods Labels

Reduced sized
Lithium Battery
Handling Label

Lithium Ion Batteries: Section IA

Hazard Label



PACKAGE LIMITS

Passenger = 5kg

CAO = 35kg

Dangerous Goods Labels

- In December 2014, the Final UN DG meeting for the 19th Model Regulations was held
- A new Class 9 label for lithium batteries was approved
- It includes a picture in the lower half of the label

Dangerous Goods Labels

- New Class 9 Lithium Battery Label to take effect no later than 31 December 2019

Dangerous Goods Labels

- The Final UN DG Meeting also approved a new lithium battery handling mark was approved. It now will be required on all modes of transportation, not just air.
- UN number(s) would be required on the handling mark. Now you will be able to tell the difference between metals and ions, as well as bulk shipments and contained in/packed with

Dangerous Goods Labels

- New Lithium Battery Handling Mark to take effect no later than 31 December 2019

PASSENGER EXCEPTIONS FOR LITHIUM BATTERIES

Passenger Exceptions for Lithium Batteries

- Technical Instructions, Part 8, Table 8-1
  - Mobility Aids
  - Portable Medical Electronic Devices
  - Battery Powered Portable Electronic Smoking Devices
  - Portable Electronic Devices
  - Security-type Equipment

LITHIUM BATTERY AIR TRANSPORT REGULATION COMPLIANCE CONCERNS

Lithium Battery Air Transport Regulation Compliance Concerns

- Packages misdeclared as Section II (PI-965 or 968) when they are really Section IA or Section IB lithium battery packages
- It is difficult or impossible to determine if a shipment is misdelcared by the outside of the package alone

Lithium Battery Air Transport Regulation Compliance Concerns

- Two (2) types of packages are most common:

  1) A package with lithium ion cells larger than 20 Wh, lithium ion batteries larger than 100 Wh, lithium metal cells larger than 1 g, or lithium metal batteries larger than 2 g

Incident Example

- Package was labeled as PI-965 Section II.

(The phone number was present on the label, but has been obscured)

Incident Example

- Package contained 2 batteries with a Watt-hour rating of 462.5 Wh each (well over the 100 Wh limit of Section II).

Lithium Battery Air Transport Regulation Compliance Concerns

- Two (2) types of packages are most common:

  2) A package with more than 8 lithium ion cells equal to or less than 20 Wh, more than 2 lithium ion batteries equal to are less than 100 Wh, more than 8 lithium metal cells equal to or less than 1 g, or more than 2 lithium metal batteries equal to or less than 2 g

Lithium Battery Air Transport Regulation Compliance Concerns

- Falsification of the required proof that the lithium cell or battery is in conformance with requirements of each test in the UN Manual of Tests and Criteria, Part III, Section 38.3
- Difficult to determine unless a full test report is obtained on the cell or battery

CAA Oversight Challenges

- Regulations are not clear for enforcement
- Operator manuals and training may not have commodity specific procedures and training
- Passenger information
- Consolidations
- Shipped as general cargo

REFERENCES

- IATA Battery Guidance Document

https://www.iata.org/whatwedo/cargo/dgr/Documents/lithium-battery-guidance-document-2015-en.pdf

- DHL Lithium Battery Interactive Tool

http://www.dhl.com/content/dam/downloads/g0/express/shipping/lithium_batteries/lithium_batteries_interactive_tool.pdf

SUMMARY

Summary

- Background on Lithium Batteries in Air Transport
- International Standards for the Transport of Dangerous Goods (DG) – Annex 18

Summary

- Dangerous Goods Air Carrier Inspections
- Classification of Dangerous Goods
- Dangerous Goods List: Lithium Batteries
- Dangerous Goods Special Provisions: Lithium Batteries

Summary

- Lithium Battery Packing Instructions
- Dangerous Goods Transport Documentation
- Dangerous Goods Markings
- Dangerous Goods Labels

Summary

- Passenger Exceptions for Lithium Batteries
- Lithium Battery Air Transport Regulation Compliance Concerns

QUESTIONS?