COMMITTEE OF EXPERTS ON THE TRANSPORT OF DANGEROUS GOODS AND ON THE GLOBALLY HARMONIZED SYSTEM OF CLASSIFICATION AND LABELLING OF CHEMICALS

Sub-Committee of Experts on the
Transport of Dangerous Goods

Thirty-third session
Geneva, 30 June-9 July (a.m) 2008
Item 4 of the provisional agenda

LISTING, CLASSIFICATION, PACKING

Lithium batteries – packing instructions

Transmitted by the International Civil Aviation Organization (ICAO)

BACKGROUND

1. At DGP/21, new packing instructions for lithium batteries were developed for incorporation into the ICAO *Technical Instructions for the Safe Transport of Dangerous Goods by Air* (2009-2010 edition). They are presented here for the information of the Sub-Committee.

— — — — — — — —

Packing Instruction 965

Passenger and cargo aircraft for UN 3480

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

SECTION I

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

Each cell or battery must:

1) be of the type proven to meet the requirements of each test in the UN *Manual of Tests and Criteria*, Part III, section 38.3; and

2) incorporate a safety venting device or be designed to preclude a violent rupture under conditions normally incident to transport and be equipped with an effective means of preventing external short circuits.

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

General requirements

Part 4;1 requirements must be met.

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

ADDITIONAL PACKING REQUIREMENTS

— Lithium ion cells and batteries must be protected against short circuits.
— Packagings must meet the Packing Group II performance requirements.
— Lithium ion batteries with a mass of 12 kg or greater and having a strong, impact-resistant outer casing, or assemblies of such batteries, may be transported when packed in strong outer packagings and protective enclosures not subject to the requirements of Part 6 of these Instructions, if approved by the appropriate authority of the State of Origin. A copy of the document of approval must accompany the consignment.

OUTER PACKAGINGS

Boxes	*Drums*	*Jerricans*
Aluminium (4B)	Aluminium (1B2)	Aluminium (3B2)
Fibreboard (4G)	Fibreboard (1G)	Plastic (3H2)
Natural wood (4C1, 4C2)	Plastic (1H2)	Steel (3A2)
Plastic (4H2)	Plywood (1D)	
Plywood (4D)	Steel (1A2)	
Reconstituted wood (4F)		
Steel (4A)		

SECTION II

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

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

1) for lithium ion cells, the Watt-hour rating 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;
3) each cell or battery is of the type proven to meet the requirements of each test in the UN *Manual of Tests and Criteria*, Part III, section 38.3.

General requirements

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

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

ADDITIONAL PACKING REQUIREMENTS

- Cells and batteries must be packed in inner packagings that completely enclose the cell or battery.
- Cells and batteries must be protected so as to prevent short circuits. This includes protection against contact with conductive materials within the same packaging that could lead to a short circuit.
- Each package must be capable of withstanding a 1.2 m drop test in any orientation without:
  - damage to cells or batteries contained therein;
  - shifting of the contents so as to allow battery to battery (or cell to cell) contact;
  - release of contents.
- Each consignment must be accompanied with a document such as an air waybill with an indication that:
  - the package contains lithium ion cells or batteries;
  - the package must be handled with care and that a flammability hazard exists if the package is damaged;
  - special procedures should be followed in the event the package is damaged, to include inspection and repacking if necessary; and
  - a telephone number for additional information.
- Each package must be labelled with a lithium battery handling label (Figure 5-30).
- Any person preparing or offering cells or batteries for transport must receive adequate instruction on these requirements commensurate with their responsibilities.

OUTER PACKAGINGS

Boxes *Drums* *Jerricans*

Strong outer packagings

Packing Instruction 966

Passenger and cargo aircraft for UN 3481, packed with equipment

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

SECTION I

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

Each cell or battery must:

1) be of the type proven to meet the requirements of each test in the UN *Manual of Tests and Criteria*, Part III, section 38.3; and

2) incorporate a safety venting device or be designed to preclude a violent rupture under conditions normally incident to transport and be equipped with an effective means of preventing external short circuits.

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

General requirements

Part 4;1 requirements must be met.

	Package quantity per overpack (excluding equipment) (Section I)	
Package contents	*Passenger*	*Cargo*
Lithium ion cells and batteries	5 kg	35 kg

ADDITIONAL PACKING REQUIREMENTS

— Lithium ion cells and batteries must be protected against short circuits.
— The completed package for the cells or batteries must meet the Packing Group II performance requirements.
— The equipment and the packages of lithium cells or batteries must be placed in an overpack. The overpack must bear applicable marks and labels as set out in Part 5;1 and 5;2.4.9.
— For the purpose of this packing instruction, “equipment” means apparatus requiring the lithium ion batteries with which it is packed for its operation.

OUTER PACKAGINGS

Boxes	*Drums*	*Jerricans*
Aluminium (4B) Fibreboard (4G) Natural wood (4C1, 4C2) Plastic (4H2) Plywood (4D) Reconstituted wood (4F) Steel (4A)	Aluminium (1B2) Fibreboard (1G) Plastic (1H2) Plywood (1D) Steel (1A2)	Aluminium (3B2) Plastic (3H2) Steel (3A2)

SECTION II

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

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

1) for lithium ion cells, the Watt-hour rating 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;
3) each cell or battery is of the type proven to meet the requirements of each test in the UN *Manual of Tests and Criteria*, Part III, section 38.3.

General requirements

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

ADDITIONAL PACKING REQUIREMENTS

— Cells and batteries must be packed in inner packagings that completely enclose the cell or battery.
— Cells and batteries must be protected so as to prevent short circuits. This includes protection against contact with conductive materials within the same packaging that could lead to a short circuit.
— The maximum number of batteries in each package must be the minimum number required to power the equipment, plus two spares.
— Each package must be capable of withstanding a 1.2 m drop test in any orientation without:
   — damage to cells or batteries contained therein;
   — shifting of the contents so as to allow battery to battery (or cell to cell) contact;
   — release of contents.
— Each consignment must be accompanied with a document such as an air waybill with an indication that:
   — the package contains lithium ion cells or batteries;
   — the package must be handled with care and that a flammability hazard exists if the package is damaged;
   — special procedures should be followed in the event the package is damaged, to include inspection and repacking if necessary; and
   — a telephone number for additional information.
— Each package must be labelled with a lithium battery handling label (Figure 5-30).
— Any person preparing or offering cells or batteries for transport must receive adequate instruction on these requirements commensurate with their responsibilities.

OUTER PACKAGINGS

Boxes	*Drums*	*Jerricans*
	Strong outer packagings	

Packing Instruction 967

Passenger and cargo aircraft for UN 3481, contained in equipment

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

SECTION I

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

Each cell or battery must:

1) be of the type proven to meet the requirements of each test in the UN *Manual of Tests and Criteria*, Part III, section 38.3; and

2) incorporate a safety venting device or be designed to preclude a violent rupture under conditions normally incident to transport and be equipped with an effective means of preventing external short circuits.

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

General requirements

Part 4;1 requirements must be met.

	Net quantity per piece of equipment (Section I)	
	Passenger	*Cargo*
Lithium ion batteries contained in equipment	5 kg	35 kg

ADDITIONAL PACKING REQUIREMENTS

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

OUTER PACKAGINGS

Boxes *Drums* *Jerricans*

Strong outer packagings

SECTION II

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

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

1) for lithium ion cells ,the Watt-hour rating 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;
3) each cell or battery is of the type proven to meet the requirements of each test in the UN *Manual of Tests and Criteria*, Part III, section 38.3.

General requirements

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

ADDITIONAL PACKING REQUIREMENTS

— The equipment must be equipped with an effective means of preventing accidental activation.
— Cells and batteries must be protected so as to prevent short circuits.
— The equipment must be packed in strong outer packagings constructed of suitable material of adequate strength and design in relation to the packaging's capacity and its intended use unless the battery is afforded equivalent

protection by the equipment in which it is contained.
— Each consignment with packages bearing the lithium battery handling label must be accompanied with a document such as an air waybill with an indication that:
  — the package contains lithium ion cells or batteries;
  — the package must be handled with care and that a flammability hazard exists if the package is damaged;
  — special procedures should be followed in the event the package is damaged, to include inspection and repacking if necessary; and
  — a telephone number for additional information.
— 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 5-30).
— Any person preparing or offering cells or batteries for transport must receive adequate instruction on these requirements commensurate with their responsibilities.

OUTER PACKAGINGS

Boxes	*Drums*	*Jerricans*
Strong outer packagings		

Packing Instruction 968

Passenger and cargo aircraft for UN 3090

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

SECTION I

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

Each cell or battery must:

1) be of the type proven to meet the requirements of each test in the UN *Manual of Tests and Criteria*, Part III, section 38.3; and

2) incorporate a safety venting device or be designed to preclude a violent rupture under conditions normally incident to transport and be equipped with an effective means of preventing external short circuits.

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

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

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

are forbidden from transport.

General requirements

Part 4;1 requirements must be met.

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

ADDITIONAL PACKING REQUIREMENTS

— Lithium metal cells and batteries must be protected against short circuits.
— Packagings must meet the Packing Group II performance requirements.
— Lithium batteries with a mass of 12 kg or greater and having a strong, impact-resistant outer casing, or assemblies of such batteries, may be transported when packed in strong outer packagings and protective enclosures not subject to the requirements of Part 6 of these Instructions, if approved by the appropriate authority of the State of Origin. A copy of the document of approval must accompany the consignment.
— For lithium metal cells and batteries prepared for transport on passenger aircraft as Class 9:
  — Cells and batteries offered for transport on passenger aircraft must be packed in intermediate or outer rigid

metal packaging.
— Cells and batteries must be surrounded by cushioning material that is non-combustible and non-conductive, and placed inside an outer packaging.

OUTER PACKAGINGS

Boxes	*Drums*	*Jerricans*
Aluminium (4B)	Aluminium (1B2)	Aluminium (3B2)
Fibreboard (4G)	Fibreboard (1G)	Plastic (3H2)
Natural wood (4C1, 4C2)	Plastic (1H2)	Steel (3A2)
Plastic (4H2)	Plywood (1D)	
Plywood (4D)	Steel (1A2)	
Reconstituted wood (4F)		
Steel (4A)		

SECTION II

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

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

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

General requirements

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

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

ADDITIONAL PACKING REQUIREMENTS

— Cells and batteries must be packed in inner packagings that completely enclose the cell or battery.
— Cells and batteries must be protected so as to prevent short circuits. This includes protection against contact with conductive materials within the same packaging that could lead to a short circuit.
— Each package must be capable of withstanding a 1.2 m drop test in any orientation without:
  — damage to cells or batteries contained therein;
  — shifting of the contents so as to allow battery to battery (or cell to cell) contact;
  — release of contents.
— Each consignment must be accompanied with a document such as an air waybill with an indication that:
  — the package contains lithium metal cells or batteries;
  — the package must be handled with care and that a flammability hazard exists if the package is damaged;
  — special procedures should be followed in the event the package is damaged, to include inspection and repacking if necessary; and
  — a telephone number for additional information.
— Each package must be labelled with a lithium battery handling label (Figure 5-30).
— Any person preparing or offering cells or batteries for transport must receive adequate instruction on these requirements commensurate with their responsibilities.

OUTER PACKAGINGS

Boxes	*Drums*	*Jerricans*
	Strong outer packagings	

Packing Instruction 969

Passenger and cargo aircraft for UN 3091, packed with equipment

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

SECTION I

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

Each cell or battery must:

1) be of the type proven to meet the requirements of each test in the UN *Manual of Tests and Criteria*, Part III, section 38.3; and

2) incorporate a safety venting device or be designed to preclude a violent rupture under conditions normally incident to transport and be equipped with an effective means of preventing external short circuits.

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

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

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

are forbidden from transport.

General requirements

Part 4;1 requirements must be met.

	Package quantity per overpack (excluding equipment) (Section I)	
Package contents	*Passenger*	*Cargo*
Lithium metal cells and batteries	5 kg	35 kg

ADDITIONAL PACKING REQUIREMENTS

- Lithium metal cells and batteries must be protected against short circuits.
- The completed package for the cells or batteries must meet the Packing Group II performance requirements.
- Each completed package containing lithium cells or batteries must be marked and labelled in accordance with the applicable requirements of 5;1, 5;2 and 5;3.
- The equipment and the packages of lithium cells or batteries must be placed in an overpack. The overpack must bear applicable marks and labels as set out in 5;1 and 5;2.4.9.
- For the purpose of this packing instruction, “equipment” means apparatus requiring the lithium batteries with which it is packed for its operation.
- For lithium metal cells and batteries prepared for transport on passenger aircraft as Class 9:
  - Cells and batteries offered for transport on passenger aircraft must be packed in intermediate or outer rigid metal packaging surrounded by cushioning material that is non-combustible and non-conductive and placed inside an outer packaging.

OUTER PACKAGINGS

Boxes	*Drums*	*Jerricans*
Aluminium (4B)	Aluminium (1B2)	Aluminium (3B2)
Fibreboard (4G)	Fibreboard (1G)	Plastic (3H2)
Natural wood (4C1, 4C2)	Plastic (1H2)	Steel (3A2)
Plastic (4H2)	Plywood (1D)	
Plywood (4D)	Steel (1A2)	
Reconstituted wood (4F)		
Steel (4A)		

SECTION II

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

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

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

General requirements

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

ADDITIONAL PACKING REQUIREMENTS

— Cells and batteries must be packed in inner packagings that completely enclose the cell or battery.
— Cells and batteries must be protected so as to prevent short circuits. This includes protection against contact with conductive materials within the same packaging that could lead to a short circuit.
— The maximum number of batteries in each package must be the minimum number required to power the equipment, plus two spares.
— Each package must be capable of withstanding a 1.2 m drop test in any orientation without:
  — damage to cells or batteries contained therein;
  — shifting of the contents so as to allow battery to battery (or cell to cell) contact;
  — release of contents.
— Each consignment must be accompanied with a document such as an air waybill with an indication that:
  — the package contains lithium metal cells or batteries;
  — the package must be handled with care and that a flammability hazard exists if the package is damaged;
  — special procedures should be followed in the event the package is damaged, to include inspection and repacking if necessary; and
  — a telephone number for additional information.
— Each package must be labelled with a lithium battery handling label (Figure 5-30).
— Any person preparing or offering cells or batteries for transport must receive adequate instruction on these requirements commensurate with their responsibilities.

OUTER PACKAGINGS

Boxes	*Drums*	*Jerricans*
Strong outer packagings		

Packing Instruction 970

Passenger and cargo aircraft for UN 3091, contained in equipment

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

SECTION I

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

Each cell or battery must:

1) be of the type proven to meet the requirements of each test in the UN *Manual of Tests and Criteria*, Part III, section 38.3; and

2) incorporate a safety venting device or be designed to preclude a violent rupture under conditions normally incident to transport and be equipped with an effective means of preventing external short circuits.

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

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

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

are forbidden from transport.

General requirements

Part 4;1 requirements must be met.

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

ADDITIONAL PACKING REQUIREMENTS

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

OUTER PACKAGINGS

Boxes *Drums* *Jerricans*

Strong outer packagings

SECTION II

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

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

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

General requirements

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

ADDITIONAL PACKING REQUIREMENTS

— The equipment must be equipped with an effective means of preventing accidental activation.
— Cells and batteries must be protected so as to prevent short circuits.
— The equipment must be packed in strong outer packagings constructed of suitable material of adequate strength and design in relation to the packaging's capacity and its intended use unless the battery is afforded equivalent protection by the equipment in which it is contained.
— Each consignment with packages bearing the lithium battery handling label must be accompanied with a document such as an air waybill with an indication that:
  — the package contains lithium metal cells or batteries;
  — the package must be handled with care and that a flammability hazard exists if the package is damaged;
  — special procedures should be followed in the event the package is damaged, to include inspection and repacking if necessary; and
  — a telephone number for additional information.
— 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 5-30).
— Any person preparing or offering cells or batteries for transport must receive adequate instruction on these requirements commensurate with their responsibilities.

OUTER PACKAGINGS

Boxes *Drums* *Jerricans*

Strong outer packagings