



DANGEROUS GOODS PANEL (DGP)

TWENTY-FIRST MEETING

Montréal, 5 to 16 November 2007

Agenda Item 5: Resolution, where possible, of the non-recurrent work items identified by the Air Navigation Commission or the panel

5.4: Review of provisions for dangerous goods relating to lithium batteries

CARRIAGE OF LITHIUM BATTERIES — THE CURRENT AND PROPOSED REQUIREMENTS

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SUMMARY

This paper identifies the current requirements in the Technical Instructions for lithium batteries, and also proposed changes for the 2009-2010 edition to reflect the text of the 15th revised edition of the UN Recommendations on the Transport of Dangerous Goods.

1. INTRODUCTION

1.1 To assist in the discussion on requirements for the carriage by air of lithium batteries, this paper sets out the applicable requirements of the 2007-2008 edition of the Technical Instructions and also the proposed changes for the 2009-2010 edition, based on changes to reflect the text of the 15th revised edition of the UN Recommendations on the Transport of Dangerous Goods.

2. **TABLE 3-1 IN THE 2007-2008 EDITION OF THE TECHNICAL INSTRUCTIONS**

Name	UN No.	Class or division	Subsidiary risk	Labels	State variations	Special provisions	UN packing group	Passenger aircraft		Cargo aircraft	
								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
Lithium batteries †	3090	9		Miscellaneous		A45 A88 A99 A154	II	903	5 kg G	903	35 kg G
Lithium batteries contained in equipment †	3091	9		Miscellaneous		A45 A48 A154		see	912	see	912
Lithium batteries packed with equipment †	3091	9		Miscellaneous		A45 A154		see	918	see	918

2.1 † **Glossary of terms (Attachment A2):**

Term and explanation

LITHIUM BATTERY OR LITHIUM CELLS. A battery is two or more cells which are electrically connected together by a permanent means. A cell is a single encased electromechanical unit which exhibits a voltage differential across its two terminals.

UN Number(s), when relevant

3090, 3091

3. **TABLE 3-1 PROPOSED FOR THE 2009-2010 EDITION OF THE TECHNICAL INSTRUCTIONS**

DGP/21-WP/7, DGP-WG/07-WP/45:

Name	UN No.	Class or division	Subsidiary risk	Labels	State variations	Special provisions	UN packing group	Passenger aircraft		Cargo aircraft	
								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
Lithium metal batteries (including lithium alloy batteries)†	3090	9		Miscellaneous		A45 A88 A99 A154 A164	II	903	5 kg G	903	35 kg G
Lithium metal batteries contained in equipment (including lithium alloy batteries) †	3091	9		Miscellaneous		A45 A48 A154 A164		see	912	see	912
Lithium metal batteries packed with equipment (including lithium alloy batteries)†	3091	9		Miscellaneous		A45 A154 A164		see	918	see	918
Lithium ion batteries (including lithium ion polymer batteries)	3480	9		Miscellaneous		A45 A88 A99 A154	II	903	5 kg G	903	35 kg G
Lithium ion batteries contained in equipment (including lithium ion polymer batteries)	3481	9		Miscellaneous		A45 A48 A154	II	903	5 kg G	903	35 kg G
Lithium ion batteries packed with equipment (including lithium ion polymer batteries)	3481	9		Miscellaneous		A45 A88 A154	II	903	5 kg G	903	35 kg G

4. **APPLICABLE SPECIAL PROVISIONS, WITH CHANGES
PROPOSED FOR THE 2009-2010 EDITION OF THE
TECHNICAL INSTRUCTIONS HIGHLIGHTED**

DGP-WG/07-WP/4, DGP-WG/07-WP/11 and DGP-WG/07-WP/45:

A45 ~~Lithium cells and batteries offered for transport are not subject to other provisions of these Instructions if they meet the following:~~

- a) ~~For a lithium metal or lithium alloy cell, the lithium content is not more than 1 g, and for a lithium ion cell, the lithium equivalent content is not more than 1.5 g. Watt-hour rating is not more than 20 Wh;~~
- b) ~~For a lithium metal or lithium alloy battery, the aggregate lithium content is not more than 2 g, and for a lithium ion battery, the aggregate lithium equivalent content is not more than 8 g. Watt-hour rating is not more than 100 Wh. Lithium ion batteries subject to this provision must be marked with the Watt-hour rating on the outside case;~~
- c) ~~Each cell or battery is of the type proved to meet the requirements of each test in the UN *Manual of Tests and Criteria*, Part III, subsection 38.3;~~

~~d) Cells and batteries are separated so as to prevent short circuits and are packed in strong packagings, except when installed in equipment; and~~

~~e) Except when installed in equipment, each package containing more than 24 lithium cells or 12 lithium batteries must in addition meet the following requirements:~~

- ~~i) Each package must be marked indicating that it contains lithium batteries and that special procedures should be followed in the event that the package is damaged;~~
- ~~ii) Each shipment must be accompanied with a document indicating that packages contain lithium batteries and that special procedures should be followed in the event a package is damaged;~~
- ~~iii) Each package is capable of withstanding a 1.2 m drop test in any orientation without damage to cells or batteries contained therein, without shifting of the contents so as to allow battery to battery (or cell-to-cell) contact and without release of contents; and~~
- ~~iv) Except in the case of lithium batteries packed with equipment, packages may not exceed 30 kg gross mass.~~

~~d) Cells and batteries, except when installed in equipment, 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 inner packagings must be packed in strong outer packagings which conform to the provisions of 4;1.1.1, 4;1.1.3.1, and 4;1.1.9.~~

~~e) Cells and batteries when installed in equipment must be protected from damage and short circuit, and the equipment must be equipped with an effective means of preventing accidental activation. When lithium batteries are installed in equipment, 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.~~

~~f) Except for packages containing no more than four cells installed in equipment or no more than two batteries installed in equipment, each package must be marked with the following:~~

- ~~i) an indication that the package contains "lithium metal" or "lithium ion" cells or batteries, as appropriate;~~
- ~~ii) an indication that the package must be handled with care and that a flammability hazard exists if the package is damaged;~~
- ~~iii) an indication that special procedures must be followed in the event the package is damaged, to include inspection and repacking if necessary; and~~
- ~~iv) a telephone number for additional information.~~

- g) Each consignment of one or more packages marked in accordance with paragraph (f) must be accompanied with a document including the following:
- i) an indication that the package contains "lithium metal" or "lithium ion" cells or batteries, as appropriate;
 - ii) an indication that the package must be handled with care and that a flammability hazard exists if the package is damaged;
 - iii) an indication that special procedures must be followed in the event the package is damaged, to include inspection and repacking if necessary; and
 - iv) a telephone number for additional information.
- h) Except when lithium batteries are installed in equipment, each package must be capable of withstanding a 1.2 m drop test in any orientation without damage to cells or batteries contained therein, without shifting of the contents so as to allow battery to battery (or cell to cell) contact and without release of contents; and
- i) Except when lithium batteries are installed in or packed with equipment, packages must not exceed 30 kg gross mass.

As used above and elsewhere in the Instructions, "lithium content" means the mass of lithium in the anode of a lithium metal or lithium alloy cell, ~~except in the case of a lithium ion cell the "lithium equivalent content" in grams is calculated to be 0.3 times the rated capacity in ampere hours.~~

Any lithium battery or lithium battery powered device, equipment or vehicle having the potential of 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.

A48 Packaging tests are not considered necessary.

A88 Prototype lithium batteries and cells to be tested that are packed with not more than 24 cells or 12 batteries per packaging 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) the cells and 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; and
- b) each cell and 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 and batteries must be protected against short circuiting.

A99 Irrespective of the limit specified in column 12 of Table 3-1, a lithium battery or battery assembly that has successfully passed the tests specified in the UN *Manual of Tests and Criteria*, Part III, subsection 38.3, and that meets the requirements of Packing Instruction 903 as prepared for transport may have a mass exceeding 35 kg G, 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).

DGP-WG/07-WP/45:

- 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.

5. APPLICABLE PACKING INSTRUCTIONS

DGP-WG/07-WP/5:

903	PACKING INSTRUCTION 903	903
<p>The general packing requirements of 4;1 must be met.</p> <p>This entry applies to cells and batteries containing lithium in any form, including lithium polymer and lithium ion cells and batteries.</p> <p>Lithium Cells and batteries may only be transported under this packing instruction if they meet the following requirements:</p> <ul style="list-style-type: none">a) each cell or battery type has been determined to meet the criteria for assignment to Class 9 on the basis of tests carried out in accordance with the UN <i>Manual of Tests and Criteria</i>, Part III, subsection 38.3;b) each cell and battery must incorporate a safety venting device or be designed to preclude a violent rupture under conditions normally incident to transport;c) each cell and battery must be equipped with an effective means of preventing external short circuits;d) 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);e) cells and batteries must be packed in the inner packagings to effectively prevent short circuits and to prevent movement which could lead to short circuits;f) cells and batteries must be packed in steel drums (1A2), aluminium drums (1B2), plywood drums (1D) or fibre drums (1G), plastic drums (1H2), plastic jerricans (3H2), steel jerricans (3A2), wooden boxes (4C1, 4C2), plywood boxes (4D), reconstituted wood boxes (4F), fibreboard boxes (4G), solid plastic boxes (4H2), steel or aluminium boxes (4A, 4B) of Packing Group II;g) irrespective of the requirements in e) and f), 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. <p>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:</p> <ul style="list-style-type: none">a) 2 volts; orb) two-thirds of the voltage of the undischarged cell; <p>and batteries containing one or more cells, are forbidden from transport.</p>		

912	PACKING INSTRUCTION 912	912
<p>This entry applies to cells and batteries in any form, including lithium polymer and lithium ion cells and batteries, when contained in equipment.</p> <p>Lithium batteries (liquid or solid cathode) contained in equipment must meet all the requirements of Packing Instruction 903, other than those related to packaging, be protected against short circuits and be securely held in place. Cells with a liquid cathode containing sulphur dioxide, sulphuryl chloride or thionyl chloride must not be capable of being discharged during transport to the extent that the open circuit voltage is less than the lower of:</p> <ul style="list-style-type: none"> a) 2 volts; or b) two-thirds of the voltage of the undischarged cell. <p>Equipment containing lithium batteries must be packed in accordance with the general packing requirements of 4;1 and be contained in strong outer packaging. The 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.</p> <p>The quantity of lithium metal contained in any piece of equipment must not exceed 12 g per cell and 500 g per battery.</p> <p>Not more than 5 kg of lithium batteries may be contained in any piece of equipment.</p>		

DGP-WG/07-WP/5 and WP/69:

918	PACKING INSTRUCTION 918	918
<p>This entry applies to cells and batteries containing lithium in any form, including lithium polymer and lithium ion cells and batteries, when packed with equipment.</p> <p>Lithium - Cells or batteries packed with equipment must meet the requirements of Packing Instruction 903 other than those related to packaging. Lithium cells and batteries must be packed in fibreboard boxes (4G) or fibre drums (1G) of Packing Group II and in such a manner as to effectively prevent movement which could lead to short circuits. Such packages must not exceed 5 kg gross mass for passenger aircraft or 35 kg gross mass for cargo aircraft. <u>Each completed package containing lithium cells or batteries must be marked and labelled in accordance with the applicable requirements of Part 5, Chapters 1, 2 and 3.</u></p> <p>The equipment and the packages of lithium cells or batteries must be overpacked <u>placed in an overpack. The overpack must bear applicable marks and labels as set out in Part 5;1 and 5;2.4.9.</u></p> <p>For the purpose of this packing instruction, "equipment" means apparatus requiring the lithium batteries with which it is packed for its operation.</p>		

6. PASSENGER PROVISIONS

6.1 Part 8, Chapter 1

DGP-WG/06-WP/54 and DGP-WG/07-WP/35:

1.1.2 Notwithstanding any additional restrictions which may be implemented by States in the interests of aviation security, except for the incident reporting provisions of 7.4.4, The provisions of these Instructions do not apply to the following when carried by passengers or crew members, or in baggage, ~~transported by the operator,~~ that has been separated from its owner during transit (e.g. lost baggage or improperly routed baggage):

...

DGP-WG/07-WP/54:

- q) consumer electronic devices (watches, calculating machines, cameras, cellular phones, laptop computers, camcorders, etc.) containing lithium or lithium ion cells or batteries when carried by passengers or crew for personal use. Spare batteries must be individually protected so as to prevent short circuits (e.g. by placement in original retail packaging or by taping over exposed terminals or placing each battery in a separate plastic bag or protective pouch) and carried in carry-on baggage only. In addition, each spare battery must not exceed the following quantities:
- for lithium metal or lithium alloy batteries, a lithium content of not more than 2 grams; or
 - for lithium ion batteries, an aggregate equivalent lithium content of not more than 8 grams.

DGP-WG/06-WP/29:

~~Lithium ion batteries with an aggregate equivalent lithium content of more than 8 grams but not more than 25 grams may be carried in carry-on baggage if they are individually protected so as to prevent short circuits and are limited to two spare batteries per person.~~

— END —