



**WORKING PAPER**

**DANGEROUS GOODS PANEL (DGP)  
MEETING OF THE WORKING GROUP OF THE WHOLE**

**Montréal, 15 to 19 October 2012**

**Agenda Item 2: Development of recommendations for amendments to the *Technical Instructions for the Safe Transport of Dangerous Goods by Air (Doc 9284)* for incorporation in the 2015-2016 Edition**

**2.3: Part 3 — Dangerous Goods List, Special Provisions and Limited and Excepted Quantities**

**SECONDARY LITHIUM BATTERIES**

(Presented by H. Brockhaus)

**SUMMARY**

This paper proposes a new special provision in order to enable the safe transport of lithium batteries larger than 35 kg gross mass. This proposal supersedes previous proposals to amend A99 presented during the last biennium. This working paper is presented in response to the feedback received from panel members at DGP/23 and follow-up discussions. It also considers further input received from DGP/23 as well as communication in 2012.

Action by the DGP-WG is in paragraph 2.

**1. INTRODUCTION**

1.1 Transport regulations of large lithium ion batteries were discussed at:

- a) the DGP Working Group of the Whole Meeting in Atlantic City (DGP-WG/11, 4 to 8 April 2011) (DGP-WG/11-WP/50).
- b) the Twenty-Third Meeting of the Dangerous Goods Panel in Montreal (DGP/23, 11 to 21 October 2011) (DGP/23-WP/34, see paragraph 5.1.1 of the DGP/23 Report).

1.2 This amendment is based on those discussions.

1.3 Based on discussions at DGP/23 and other input received on DGP/23-WP/34, a new working paper including a proposal for a new special provision is issued to achieve a clear understanding of which battery and packaging requirements are applicable for single packed lithium batteries larger than 35 kg gross mass. The requirement for a quality management programme is already adopted in the UN Model Regulations (paragraph 2.9.4) and the Technical Instructions.

1.4 There have been several discussions on state of charge (SOC) during transport of lithium ion batteries and cells. Types of cells and batteries which were successfully tested according to the UN *Manual of Test and Criteria*, Part III, subsection 38.3 have shown adequate safety under various transport relevant stress even at 100% SOC (i.e. fully charged). Therefore we propose not to stipulate a reduced SOC in the proposed new special provision.

1.5 Defined SOC in most cases will be hard to provide and moreover hard to test and check, in particular for large batteries which have electrical protection modes such as those listed in a) 3) of the proposed new special provision (see Appendix A). In addition, cells and batteries produced under series conditions and large production runs are also subject to high complexity logistic conditions throughout the transportation chain.

1.6 Investigations show clear evidence that reduced SOC results in smaller hazards by means of fire and explosion, even if it is hard to really quantify the effect, e.g.:

- a) **Flammability Assessment of Bulk-Packed, Rechargeable Lithium-Ion Cells in Transport Category Aircraft** (DOT/FAA/AR-06/38); and
- b) **Lithium-Ion Batteries Hazard and Use Assessment Final Report** (Exponent Failure Analysis Associates, Inc.© July 2011 Fire Protection Research Foundation ([www.nfpa.org/foundation](http://www.nfpa.org/foundation))).

1.7 Reduced state of charge, therefore, is a frequent measure in special approvals and justifies the transport of, for example, cells and batteries which have not been UN 38.3 tested accomplishing comparable transport safety. In preparation and during transport of such prototypes or small production runs, defined SOC can be easily guaranteed during the whole logistic chain. Therefore, we propose not to stipulate a reduced SOC in the proposed new special provision, but to leave it as an additional measure for special approvals for cells and batteries, which are not yet approved to meet the requirements of UN 38.3. Furthermore, the general requirement to transport under reduced SOC may lead to the overall impression that cells and batteries are generally safer under those conditions. This may easily result in losing track of fulfilling the high design standard for cells and batteries needed to fulfill the harsh conditions tested according to UN 38.3.

## 2. ACTION BY THE DGP-WG

2.1 The DGP-WG is invited to:

- a) add a new special provision as shown in the appendix to this working paper; and
  - c) issue an addendum to the 2013/2014 Edition of the Technical Instructions which would contain the equivalent amendment to the special provision as shown in the Appendix a.
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APPENDIX A

PROPOSED AMENDMENT TO THE TECHNICAL INSTRUCTIONS

Part 3

DANGEROUS GOODS LIST,  
SPECIAL PROVISIONS AND  
LIMITED AND EXCEPTED QUANTITIES

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Chapter 2

ARRANGEMENT OF THE  
DANGEROUS GOODS LIST (TABLE 3-1)

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Table 3-1. Dangerous Goods List

Name	UN No.	Class or division	Subsidiary risk	Labels	State variations	Special provisions	UN packing group	Excepted quantity	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	13
... Lithium ion batteries (including lithium ion polymer batteries)	3480	9		Miscellaneous		A51 A88 A99 A154 A164 A183 <u>AXX</u>	II	E0	See	965	See	965

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## Chapter 3

### SPECIAL PROVISIONS

*Parts of this Chapter are affected by State Variations AU 1, AU 2, CA 7, HR 3, IR 3, JM 1, KP 2, NL 1, US 11, ZA 1; see Table A-1*

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**Table 3-2. Special provisions**

*TIs UN*

AXX Irrespective of the quantity limits for cargo aircraft specified in column 13 of Table 3-1 and in Section I of Packing Instruction 965, a lithium ion or lithium polymer battery (UN 3480) with a mass exceeding 35 kg that meets the requirements of this special provision may be offered for transport on cargo aircraft only, if the following requirements are met:

a) requirements for batteries:

- 1) each cell and each battery is of the type proven to meet the requirements of 2;9.3.1;
- 2) each battery must have a strong, impact-resistant outer casing; and
- 3) each battery or battery assembly must provide a means of fully disconnecting the external battery terminals from the internal electrical components (e.g. service disconnect, circuit breaker, removable fuse);

b) packing requirements:

- 1) lithium ion or lithium polymer batteries must be protected against short circuits;
- 2) the packaging must be UN type approved and meet the requirements of Packing Group I;
- 3) packagings must be fire and flame resistant;

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To be discussed: whether a specific packaging material is to be specified or whether a packaging material coating is acceptable.

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- 4) only one battery per package is permitted;
- 5) the battery must be surrounded by cushioning material that is non-combustible and non-conductive and must be secured to prevent inadvertent movement during transport; and
- 6) in addition to the requirements of 5;2, the package must be marked with the words "Single battery per package, transport in accordance with Axxx". Letters and numerals must be at least 12 mm high. This marking must be reproduced on an overpack, if used;

c) documentation and handling requirements:

- 1) the use of Axxx must be documented on the shipper's declaration in the "Additional Handling Information" field with the following sentence:

"Single battery per package, transport in accordance with Axxx"

All other requirements of these Instructions regarding marking, labelling, documentation and handling apply.

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## APPENDIX B

### BACKGROUND INFORMATION FOR PROPOSED AMENDMENT TO THE TECHNICAL INSTRUCTIONS

#### 1. JUSTIFICATION AND FURTHER EXPLANATION

- a) The packaging for a battery larger than 35kg is limited to type approved Packing Group I, which means that the net weight of the battery is limited to 400 kg. Batteries heavier than these limits must have an approval from the State of Origin in accordance with Special Provision A99
- b) The definition of battery and battery assembly from the *UN Manual of Test and Criteria*, 5th revised Edition Amendment 1, Part III, subsection 38.3, (38.3.2.3) applies:

*Battery means two or more cells which are electrically connected together and fitted with devices necessary for use, for example, case, terminals, marking and protective devices”.*

*NOTE: Units that are commonly referred to as “battery packs”, “battery assemblies” having the primary function or providing a source of power to another piece of equipment are for the purpose of the Model Regulations and this manual treated as batteries.*

#### 2. LISTING OF REQUIREMENTS FOR LITHIUM CELLS AND BATTERIES ACCORDING TO PART 2;9.3.1 OF THE TECHNICAL INSTRUCTIONS

DGP/23 agreed to add the requirement of a quality management programme for the manufacturing of lithium batteries. The proposal in this working paper need therefore not include provisions for the quality management programme.

Lithium battery provisions have been summarized in Part 2, Chapter 9.3 and will be incorporated in the 2013-2014 Edition of the Technical Instructions. These requirements are not part of Packing Instructions 965-970 and therefore apply to all lithium batteries offered for transport including those transported according to special provisions, unless stated otherwise (e.g. A88).

#### 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;

*Note 1.— Batteries must be of a design 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 design type.*

*Note 2.— Batteries and cells manufactured before 1 January 2014 conforming to a design type tested according to the requirements of the fifth revised edition of the UN Manual of Tests and Criteria, Part III, subsection 38.3 may continue to be transported.*

- 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.);
- 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.*

**Additional note:** A visible marking to show compliance with UN 38.3 tests is being considered for the UN Model Regulations (see ST/SG/AC.10/C.3/2011/35 presented at the UNECE TDG meeting in December 2011).

### 3. LISTING OF TEST REQUIREMENTS OF THE UN MANUAL OF TEST AND CRITERIA, PART 3, SUBSECTION 38.3

Cells and batteries of a type proven to meet the requirements of each test in the *UN Manual of Test and Criteria*, Part III, section 38.3 have passed the following tests.

- a) Test T.1: Altitude simulation — applicable to cells and batteries;
- b) Test T.2: Thermal test — applicable to cells and batteries;
- c) Test T.3: Vibration — applicable to cells and batteries;

- d) Test T.4: Shock — applicable to cells and batteries;
- e) Test T.5: External short circuit — applicable to cells and batteries;
- f) Test T.6: Impact — applicable to cells or component cells;
- g) Test T.7: Overcharge — applicable to batteries; and
- h) Test T.8: Forced discharge — applicable to cells.

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