International Civil Aviation Organization

**WORKING PAPER**

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# DANGEROUS GOODS PANEL (DGP)

## TWENTY-FIFTH MEETING

**Montréal, 19 to 30 October 2015**

**Agenda Item 5: Development of a comprehensive strategy to mitigate risks associated with the transport of lithium batteries including development of performance-based packaging standards and efforts to facilitate compliance**

## LITHIUM METAL BUTTON CELLS

(Presented by B. Firkins)

**SUMMARY**

At the Second International Multi-Disciplinary Lithium Battery Transport Coordination Meeting (SIMDLBTCM); the Battery Association of Japan submitted the results of tests that had been conducted on Lithium Metal Button Cells which had been put into thermal runaway.

The results were described by others present at the meeting as being consistent with tests conducted by other parties. It was accepted that the risk presented by lithium button cells, of up to 0.3g lithium content, was not unsafe.

Recommendation 14 from the the SIMDLBTCM dealt with making provision for lithium metal button cells.

**Action by the DGP:** The panel is invited to:

a) consider the proposals and discussion points raised in this paper and to provide comments;

b) accept the proposed definition for button cells shown in Appendix A to this working paper;

c) provide comments on creating provisions for de minimis quantities of lithium metal batteries (button cells) as shown in Appendix B to this working paper;

d) provide comments on creating an entry in the dangerous goods lists for lithium metal button cells as shown in Appendix C to this working paper;

e) provide comments on creating a special provision for comparatively small quantities of lithium metal batteries (button cells), as shown in Appendix D to this working paper;.

f) provide comments on creating a packing instruction for larger quantities of lithium metal batteries (button cells), as shown in Appendix E to this working paper.

## 1. INTRODUCTION

1.1 During the Second International Multi-Disciplinary Lithium Battery Transport Coordination Meeting (SIMDLBTCM) held in Cologne, Germany in September 2014; the Battery Association of Japan submitted tests that had been conducted on Lithium Metal Button Cells which had been put into thermal runaway.

1.2 The results were described by other persons present at the meeting as being consistent with tests that they had conducted.

1.3 It was accepted that the risk presented by lithium button cells, of up to 0.3g lithium content, was proving to be not unsafe. The button cells may disassemble, melt down or partially combust; however the effects did not propagate from one button cell to the next.

1.4 In the context of overheating of lithium metal batteries, and the potential threats to aviation safety caused by a bulk shipment of lithium metal button cells to sympathetically react to the point that an aircraft's fire suppression system would be overwhelmed; the threat was found not to exist.

1.5 There was discussion of, and consideration given to, whether small lithium metal batteries, of the same aggregate lithium content as button cells, could be shipped as having an equivalent package of energy; despite having potentially a different chemistry and properties of combustion.

1.6 It was generally considered that the form factor (shape) of button cells was adequately defined and documented in the UN Manual of Tests and Criteria. Should someone wish to consign lithium cells or batteries with a different shape, but the same lithium content as button cells, then objective testing and evidence would need to be produced before any expansion beyond button cells could be considered.

1.7 The SIMDLBTCM report summarised the discussion and the resultant recommendation as:

> *"3.2.4 Lithium metal button cells, with a lithium content not exceeding 0.3 grams, may not present a significant hazard and should have a separate UN classification to facilitate shipments."*
>
> ***"Recommendation 14/14 — Lithium Metal Button Cells:***
>
> *That method be established to distinguish lithium metal button cells from other types of lithium metal cells."*

## 2. METHODS TO DISTINGUISH LITHIUM METAL BUTTON CELLS

2.1 Several options for distinguishing lithium metal button cells were briefly considered. One option was to make application to the UN Committee of Experts on Dangerous Goods, seeking a new UN Number and proper shipping name for lithium button cells. This does introduce a relatively lengthy timeframe.

2.2 Another option is to seek a solution that could be implemented within the ICAO Technical Instructions: such as introducing a light typeface entry as explanatory text for UN3090 Lithium Metal Battery. This would take the form of:

**UN 3090 Lithium metal battery** (button cells);.or

**UN 3090 Lithium metal battery,** button cells.

2.3 Such an approach would be consistent with other entries in the Technical Instructions, such as UN 1950, **Aerosols.**

2.4 The text for Aerosols in the UN Model Regulations is:

| UN No | Name and Description | Class or Division | Subsidiary Risk | UN Packing Group | Special provisions | Limited and Excepted Quantities | | Packing Instruction | Special Packing Provisions |
|---|---|---|---|---|---|---|---|---|---|
| 1950 | AEROSOLS | 2 | | | 63<br>190<br>277<br>327<br>344 | See SP 277 | E0 | P207<br>LP02 | Pp87<br>L2 |

2.5 The corresponding text in the Technical Instructions is:

| *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* |
| **Aerosols**, flammable | 1950 | 2.1 | | Gas<br>Flammable | | A145<br>A167 | | E0 | 203<br>Y203 | 75kg<br>30 Kg<br>G | 203 | 150 Kg |
| **Aerosols**, flammable containing substances in Division 6.1, Packing Group II | 1950 | 2.1 | 6.1 | | | | | | FORBIDDEN | | FORBIDDEN | |
| **Aerosols**, flammable containing substances in Division 6.1, Packing Group III and substances in Class 8, Packing Group III | 1950 | 2.1 | 6.1<br>8 | Gas<br>flammable<br>&<br>Toxic<br>&<br>Corrosive | | A145<br>A167 | | E0 | 203<br>Y203 | 75kg<br>30 Kg<br>G | 203 | 150 Kg |
| . . . | | | | | | | | | | | | |

## 3. IDENTIFICATION OF ISSUES

### 3.1 Definitions:

3.1.1 It will be necessary to define Button Cells within the Technical Instructions, either in the Glossary of Terms in Appendix A2, or in the definitions at Part 1;Chapter 3; section 1.3. The definition in the Technical Instructions will need to correspond with the definition contained in the UN Manual of Tests and Criteria at Section 38.3. The preferred option is to capture the definition within Part 1; Chapter 3, Section 1.3. The proposed amendment is at Appendix A.

### 3.2 Limitations based on current knowledge

3.2.1 Consideration also needs to be given to the future. Currently testing, and button cell manufacture, is in respect of batteries with less than 0.3g lithium content; this covers the existing range of lithium button cells. The UN definition does not limit the lithium content. It would therefore be appropriate for the Technical Instructions to specify an upper limit based on the current situation. The method of providing the upper limit should be flexible enough to be amended, without a significant bureaucratic impost.

3.2.2 One method of setting an upper limit, is via a Special Provision. This could take the form of:

> A2xx This entry applies to Button cells, as defined in 1;1.3, Each cell is to 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. Each cell must not have a lithium content exceeding 0.3 grams. Lithium metal button cells with a lithium content exceeding 0.3g are to be consigned as UN3090 Lithium Metal Batteries in accordance with packing Instruction 968.

3.2.3 An alternative, and preferred option from the point of allowing greater future flexibility, is an expansion of the light typeface entry i.e.

**UN 3090 Lithium Metal Battery** (Button cells not exceeding 0.3g lithium content).

3.2.4 Should larger format lithium button cells be produced and have similar properties on combustion and propagation to existing button cells, then the light type entry can be progressively increased. If the combustion and propagation properties of larger button cells are different, then relevant entries can be created when the need arises.

### 3.3 Packing Instruction

3.3.1 The current detail of Packing Instruction 968 is already complex enough with Section 1A, IB and II. The addition of what could be a Section III, regarding the packing of lithium metal batteries (button cells) would bring additional complexity. It is therefore proposed that any packaging and packing requirements should stand separate to Packing Instruction 968, and would be limited to lithium metal button cells only.

### 3.4 Packaging

3.4.1 There are several options for consideration of the risks being presented by button cells and what would be the least stringent method of packaging, whilst still maintaining an appropriate margin of safety. The three main options would appear to be:

a) an entry into the text for de minimis consideration. An example is set out at Appendix B

b) a special provision which specifies minimum packaging conditions and imposes no further requirements. An example is set out at Appendix D.

c) the creation of a separate packing instruction. A representative packing instruction is provided in Appendix E as “Packing Instruction 97x”.

3.5 The difficulty in alignment with the UN Model recommendations; yet achieving an equivalent scalable framework as “De Minimis – Excepted Quantity – Limited Quantity – Fully Regulated” is that excepted quantity provisions and E1-E5 codes are not applied to articles. De Minimis provisions are also based around the excepted quantity codes; but does offer some scope for consideration within the air mode of transportation of dangerous goods.

## 4. ACTION BY THE DGP-WG

4.1 The panel is invited to:

a) consider the proposals and discussion points raised in this paper and to provide comments;

b) accept the proposed definition for button cells shown in Appendix A to this working paper;

c) provide comments on creating provisions for de minimis quantities of lithium metal batteries (button cells) as shown in Appendix B to this working paper;

d) provide comments on creating an entry in the dangerous goods lists for lithium metal button cells as shown in Appendix C to this working paper

e) provide comments on creating a special provision for comparatively small quantities of lithium metal batteries (button cells), as shown in Appendix D to this working paper;.

f) provide comments on creating a packing instruction for larger quantities of lithium metal batteries (button cells), as shown in Appendix E to this working paper.

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**APPENDIX A**

**PROPOSED AMENTDMNET TO PART 1 OF THE TECHINICAL INSTRUCTIONS**

# Part 1

# GENERAL

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## Chapter 3

## GENERAL INFORMATION

*Parts of this Chapter are affected by State Variation BE 1; see Table A-1*

### 3.1 DEFINITIONS

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***Bundle of cylinders.*** Not permitted for air transport. An assembly of cylinders that are fastened together and which are interconnected by a manifold and transported as a unit.

***Button Cell.*** A round small cell or battery when the overall height is less than the diameter.

***Cargo.*** For the purposes of these Instructions, any property carried on an aircraft other than mail and accompanied or mishandled baggage.

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**APPENDIX B**

**PROPOSED AMENTDMNET TO PART 3 OF THE TECHINICAL INSTRUCTIONS**

# Part 3

# DANGEROUS GOODS LIST, SPECIAL PROVISIONS AND LIMITED AND EXCEPTED QUANTITIES

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## Chapter 5

## DANGEROUS GOODS PACKED IN EXCEPTED QUANTITIES

*Parts of this Chapter are affected by State Variation JP 23; see Table A-1*

### 5.1 EXCEPTED QUANTITIES

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### 5.6 DE MINIMIS QUANTITIES

5.6.1 Dangerous goods assigned to codes E1, E2, E4 or E5 are not subject to these Instructions when carried as cargo provided that:

a) the maximum net quantity of material per inner packaging is limited to 1 mL for liquids and gases and 1 g for solids;

b) the provisions of 5.2 are met, except that an intermediate packaging is not required if the inner packagings are securely packed in an outer packaging with cushioning material in such a way that, under normal conditions of transport, they cannot break, be punctured, or leak their contents; and for liquid dangerous goods, the outer packaging contains sufficient absorbent material to absorb the entire contents of the inner packagings;

c) the provisions of 5.3 are complied with; and

d) the maximum net quantity of dangerous goods per outer packaging does not exceed 100 g for solids or 100 mL for liquids and gases.

5.6.2 Dangerous goods assigned to UN 3090 — Lithium metal batteries, buttons cells are not subject to these Instructions when carried as cargo provided that:

a) the maximum net quantity of material per inner packaging is limited to 0.3 g of lithium;

b) where there are multiple button cells within one inner packaging, the button cells cannot come into contact with each other;

c) the provisions of 5.2 are met, except that an intermediate packaging is not required if the inner packagings are securely packed in an outer packaging in such a way that, under normal conditions of transport, they cannot break, be punctured, leak their contents or come into direct contact with other button cells;

d) the provisions of 5.3 are complied with;

e) are packaged in a manner that prevents moisture or humidity causing a short-circuit between button cells within the package and

f) the maximum net quantity of dangerous goods per outer packaging does not exceed 100 g.

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**APPENDIX C**

**PROPOSED AMENTDMNET TO PART 3 OF THE TECHINICAL 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* |
| | | | | | | | | | See 9XX | | See 965 | |
| **Lithium metal batteries** (button cells cells not exceeding 0.3g lithium content) | 3090 | 9 | | Miscellaneous — Lithium batteries | US 2<br>US 3 | A2XX | | | See 9XX | 5 kg | See 9XX | 35 kg |

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**APPENDIX D**

**PROPOSED AMENTDMNET TO PART 3 OF THE TECHINICAL INSTRUCTIONS**

# Part 3

# DANGEROUS GOODS LIST, SPECIAL PROVISIONS AND LIMITED AND EXCEPTED QUANTITIES

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## Chapter 3

## SPECIAL PROVISIONS

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**Table 3-2. Special provisions**

| | *TIs* | *UN* | |
|---|---|---|---|
| ≠ | A2XX | | Lithium metal batteries (button cells) are not subject to the Technical Instructions when consigned as cargo. Each cell must:<br><br>a) be of the type proven to meet the requirements of each test in the UN Manual of Tests and Criteria, Part III, subsection 38.3;<br><br>b) be packed in inner packagings that completely enclose the cell,<br><br>c) 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 including where the inner packaging materials may become conductive when wet or exposed to increased humidity.<br><br>Inner packaging must be placed into then placed into a strong outer packaging.<br><br>Each package must:<br><br>a) be capable of withstanding a 1.2 m drop test in any orientation without:<br><br>1) damage to cells or batteries contained therein;<br><br>2) shifting of the contents so as to allow battery to battery (or cell to cell) contact;<br><br>3) release of contents.<br><br>b) be labelled with a lithium battery handling label (Figure 5-31) that includes a reference to “button cells”.<br><br>c) The maximum net quantity (weight) per package shall not exceed 1 Kg<br><br>Any person preparing or offering cells or batteries for transport must receive adequate instruction on these requirements commensurate with their responsibilities. |

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**APPENDIX E**

**PROPOSED AMENTDMNET TO PART 4 OF THE TECHINICAL INSTRUCTIONS**

# Part 4

# PACKING INSTRUCTIONS

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## Chapter 11

## CLASS 9 — MISCELLANEOUS DANGEROUS GOODS

*Insert* the following new packing instruction:

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| Packing Instruction 97x<br>Passenger and cargo aircraft for<br>UN 3090 Lithium Metal Batteries (button cells not exceeding 0.3g lithium content) |
|---|
| I. **Introduction**<br><br>This entry applies to lithium metal batteries (button cells not exceeding 0.3g lithium content).<br><br>2. **Lithium batteries forbidden from transport**<br><br>The following applies to all lithium metal button cells in this packing instruction:<br><br>Cells, 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).<br><br>Waste lithium button cells and lithium button cells 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. |

| *UN number and proper shipping name* | *Package quantity (Section I)* | |
|---|---|---|
| | *Passenger* | *Cargo* |
| UN 3090 **Lithium metal batteries** (button cells not exceeding 0.3g lithium content) | 5 kg of lithium metal button cells | 35 kg of lithium metal button cells |

3. **Requirements**

Each cell must:
— be of the type proven to meet the requirements of each test in the UN Manual of Tests and Criteria, Part III, subsection 38.3;
*Note.— 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.*
— be manufactured under a quality management programme as described in 2;9.3.1 e).
— have a lithium content of less than or equal to 0.3 g,
— be packed in inner packagings that completely enclose the cell or battery,
— 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 5-31) that includes a reference to “button cells”.
— The exterior of the package is to be marked

**Outer packagings**

*Boxes* *Drums* *Jerricans*

Strong outer packagings

**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”.

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