



DANGEROUS GOODS PANEL (DGP)

TWENTY-FOURTH MEETING

Montréal, 28 October to 8 November 2013

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

5.1: Review of provisions for the transport of lithium batteries

TRANSPORTING DAMAGED OR DEFECTIVE LITHIUM BATTERIES AND LITHIUM BATTERIES CONTAINED IN EQUIPMENT

(Presented by the PRBA — The Rechargeable Battery Association)

SUMMARY

This working paper contains revisions to Special Provision A154 of the Technical Instructions and a new packing instruction for incorporation into the Supplement to provide for the transport of damaged or defective lithium ion and lithium metal cells and batteries and equipment containing them under approvals issued by the State of Origin. The proposed packing instruction includes a thermal packaging test for lithium batteries.

Action by the DGP: The DGP is invited to amend:

- a) amend Special Provision A154 of the Technical Instructions; and
- b) add new Packing Instruction XXX to the Supplement to the Technical Instructions that includes the thermal packaging test for lithium batteries

as shown in the appendices to this working paper.

1. INTRODUCTION

1.1 During the 2013 Meeting of the Dangerous Goods Panel Working Group of the Whole (DGP-WG/13, Montreal, 15 to 19 April 2013), the issue of transporting damaged or defective lithium batteries was discussed. It was noted that packing instructions and special provisions were added to the 18th Revised Edition of the Model Regulations for the transport of these batteries.

1.2 Special Provision A154 of the Technical Instructions prohibits the transport of 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. Currently the transport of damaged or defective lithium batteries can only be carried out under an exemption.

1.3 At DGP-WG/13, DGP members indicated that additional requirements would need to be added to the new packing instructions from the 18th Revised Edition of the Model Regulations in order to transport damaged or defective lithium batteries by air.

1.4 This paper proposes amendments to Special Provision A154 and a new packing instruction for incorporation into the Supplement to the Technical Instructions based on the 18th Revised Edition of the UN Model Regulation which includes a requirement for thermal resistant packaging or overpack and performance criteria and test method for the packaging or overpack that can be used as a basis for the issuance of approvals. The proposed performance criteria and test method — listed in the proposed packing instruction and identified as a thermal packaging test for lithium batteries — will ensure that any packaging used to transport damaged or defective lithium batteries or equipment containing them is capable of containing a potential thermal event.

1.5 The thermal packaging test for lithium batteries would be conducted with the lithium cells, batteries or equipment, or with cells, batteries or equipment that simulate the intended contents to be transported in the packaging or overpack. Cells or batteries would be tested at 100% state of charge. The test requires that no flames or sparks escape from any part of the container throughout the test period although smoke may vent from the container. The container must maintain its integrity until the end of the test. No projectiles may puncture the container and the container must be capable of withstanding a pressure pulse from the thermal event either by being fitted with a venting device or through design of the packaging without loss of integrity or containment functions.

APPENDIX A

PROPOSED AMENDMENT TO PART 3 OF THE TECHNICAL 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

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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) unless approved by the State of Origin and transported in packaging that meets the requirements of the thermal packaging test for lithium batteries identified in Packing Instruction 9XX of the Supplement to these Instructions.

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— END —

APPENDIX B

PROPOSED AMENDMENT TO PART S-4 OF THE SUPPLEMENT TO THE TECHNICAL
INSTRUCTIONS

Part S-4

PACKING INSTRUCTIONS

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Chapter 11

CLASS 9 — MISCELLANEOUS DANGEROUS GOODS

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Packing Instruction 9XX

Cargo aircraft only for UN Nos. 3090, 3091, 3480 and 3481 that are damaged or defective

This packing instruction applies to damaged or defective lithium ion batteries (UN 3480), lithium metal batteries (UN 3090), lithium ion batteries contained in equipment (UN 3481), and lithium metal batteries contained in equipment (UN 3091) (see Special Provision A154 of the Technical Instructions).

1. General requirements

Part 4.1 requirements must be met.

2. Outer Packagings

For cells and batteries and equipment containing cells and batteries:

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

3. Additional requirements

Packagings must conform to the Packing Group II performance level.

The packaging or overpack, if applicable, must be capable of successfully meeting the thermal packaging test for lithium batteries in Section 4 of this packing instruction.

In addition each cell or battery or equipment containing such cells or batteries:

- a) must be individually packed in inner packaging and placed inside of an outer packaging. The inner packaging or outer packaging must be leak-proof to prevent the potential release of electrolyte.
- b) each inner packaging must be surrounded by sufficient non-combustible and non-conductive thermal insulation material to protect against a dangerous evolution of heat.

- c) sealed packagings must be fitted with a venting device when appropriate.
- d) appropriate measures must be taken to minimize the effects of vibrations and shocks, prevent movement of the cells or batteries within the package that may lead to further damage and a dangerous condition during transport. Cushioning material that is non-combustible and non-conductive may also be used to meet this requirement.
- e) for leaking cells or batteries, sufficient inert absorbent material must be added to the inner or outer packaging to absorb any release of electrolyte.
- f) a cell or battery with a net mass of more than 35 kg must be limited to one cell or battery per outer packaging.

4. Thermal packaging test for lithium batteries

a) Scope

This test method evaluates the thermal containment capabilities of a packaging or overpack, if applicable, intended for the transport of damaged or defective lithium cells and batteries and equipment containing them. The test must be conducted with cells, batteries or equipment, or utilize those that simulate the intended contents to be transported in the packaging. A larger number of cells or batteries or cells or batteries contained in equipment with a higher Watt-hour rating may be tested to validate that the packaging or overpack are capable of containing a smaller number of cells or batteries with a lower Watt-hour rating or lithium content, as applicable. Cells and batteries must be tested at 100 per cent state of charge.

b) Apparatus

- i) Test Area. The test area must be large enough in size to fully house the testing apparatus and the outer package or overpack with sufficient clearance and provide adequate safety for the test operator(s).
- ii) Heating Element(s). Appropriate heater(s) must be used that have the capacity to force cells or batteries into thermal runaway within the outer package or overpack. Various types of heater cartridges or thermal tape may be appropriate for certain applications depending on the lithium chemistries and cell and battery form factors.
- iii) Thermal runaway refers to a situation where an increase in temperature changes the conditions in a way that causes a further increase in temperature, often leading to a destructive result.
- iv) Instrumentation (optional). A calibrated recording device or a computerized data acquisition system with an appropriate range may be utilized to measure and record the outputs of the thermocouples. Instrumentation is optional, but can be useful in determining whether the cells have vented or were forced into thermal runaway as well as indicating when it is safe to open the tested outer packaging or overpack.

c) Test specimen

Specimen configuration. Each outer package or overpack material type and design must be tested, including any features such as handles, latches or fastening systems that may compromise the ability of the outer package or overpack to provide thermal protection.

d) Preparation for testing

- i) Position the heating element in the package or overpack so that the test cells, batteries or cells or batteries contained in equipment can be positioned directly in contact with or attached to the heating element (e.g. thermal tape).
- ii) Insulate the terminals and leads from the heating element from short circuit during the test and configure the leads to exit the package with as little effect on the package closure as possible.
- iii) Ensure that the position of loose cells, batteries, or equipment is maintained on or attached to the heating element. This may be accomplished using other packaging, housings, steel banding, etc.
- iv) Close the package or overpack per the closure instructions.
- v) Position the package or overpack in the test area and connect the heating element leads to a switched power source.

e) Test procedure

- i) Prepare data collection equipment (if used) and check for proper reading on thermocouples, as applicable.

- ii) Turn on power to heating element(s) and increase temperature until thermal runaway occurs (a forced external short circuit, use of a spark ignitor or similar device may be used to force a thermal runaway event). Thermal runaway can typically be determined by the sounds emitted from the tested package or overpack and by the observation of temperature spikes when thermocouples are used.
- iii) Maintain power to the heating element for a minimum of thirty minutes after thermal runaway occurs.
- iv) Turn off power to heating element(s).
- v) Allow the package or overpack and contents to cool naturally for a minimum of one hour and until a safe inner temperature has been reached before concluding the test.
- vi) Once the contents have reached a safe temperature, inspect the outer package or overpack to the requirements listed below.

f) Recordkeeping

- i) Record a complete description of the package or overpack and contents being tested.
- ii) Record any observations regarding the behaviour of the test specimen during the test, such as smoke production, structural changes, and time of occurrence of each event.
- iii) If thermocouples were used, record the temperature and time history. Record the maximum temperatures achieved at all thermocouple locations and the corresponding time.

g) Requirements

No flames or sparks may escape from any part of the outer packaging although smoke may vent from the outer packaging or overpack. The outer packaging or overpack must maintain its integrity until the end of the test. No projectiles may puncture the outer packaging or overpack.

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