



WORKING PAPER

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

Abu Dhabi, United Arab Emirates, 7 to 11 November 2010

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

5.2: Review of provisions for dangerous goods relating to batteries

**PROTOTYPE LITHIUM BATTERY APPROVALS ISSUED IN ACCORDANCE WITH
SPECIAL PROVISION A88**

(Presented by J. McLaughlin)

SUMMARY

This paper provides information related to the granting of approvals issued on the basis of Special Provision A88 (prototype/low production lithium batteries), and provides technical background relevant to the corresponding equivalent level of safety determination.

Action by the DGP-WG is in paragraph 2.

1. INTRODUCTION

1.1 During its 22nd meeting, the Dangerous Goods Panel adopted a number of amendments to the provisions related to approvals and exemptions in the Supplement to the Technical Instructions (see DGP/22-WP/100 pages 5C-1 to 5C-3). The amendments enhanced the guidance given to States relevant to the issuance of approvals and exemptions.

1.2 A key requirement in the issuance of an approval or exemption is ensuring that any alternative conditions authorized by the approval or exemption provide for a level of safety at least equivalent to the level provided by the Technical Instructions. In this respect, a new paragraph 1.2.3 was added to Part S-1 of the Supplement to the Technical Instructions to provide additional guidance to States in making such a determination of equivalency.

1.3 An example of a commodity which has been the subject of a number of State approvals is prototype lithium batteries. At a previous panel meeting (see DGP/21-WP/56), States with experience in issuing approvals for the transport of prototype lithium batteries were asked to share their experience with the panel.

1.4 The intent of this paper is to provide information related to the granting of an approval issued on the basis of Special Provision A88 (prototype/low production lithium batteries), and to provide technical background relevant to the equivalent level of safety determination. The information included in this paper should be considered in relation to the specific request, although some factors likely will be applicable to other approvals issued in accordance with Special Provision A88. To facilitate discussion, this paper includes an appendix with the considerations for an example approval request as follows:

- a) a summary of the specific approval request considered;
- b) a brief synopsis of the approval basis (in this case Special Provision A88);
- c) a summary of the considerations made in determining an equivalent level of safety;
and
- d) an example of the language that would be found in such an approval if issued.

2. ACTION BY THE DGP-WG

2.1 The DGP-WG is invited to consider the information related to evaluating lithium battery prototype approvals and consider if such guidance should be further developed for inclusion within the Supplement.

APPENDIX

EXAMPLE APPROVAL REQUEST

1. SUMMARY OF APPROVAL REQUEST

1.1 In the request considered in this example, approval is sought to transport prototype lithium battery assemblies which have not been subjected to all tests normally required by the UN Manual of Tests and Criteria. Specifically, relief from tests T5 (External Short Circuit) and T7 (Overcharge) is considered.

2. APPROVAL BASIS

2.1 The basis for the approval is special provision A88 of the Technical Instructions which provides the following:

A88 Prototype or low production (i.e., annual production runs consisting of not more than 100 lithium batteries or cells) lithium batteries or cells 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) except as provided in paragraph c), cells or 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;

b) except as provided in paragraph c), each cell or 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 or batteries must be protected against short circuiting;

c) 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 packed in strong outer packagings or protective enclosures not subject to the requirements of Part 6 of these Instructions. The batteries or battery assemblies must be protected against short circuiting; and

d) a copy of the document of approval showing the quantity limitations must accompany the consignment.

Irrespective of the limit specified in column 13 of Table 3-1, the battery or battery assembly as prepared for transport may have a mass exceeding 35 kg G.

3. SAFETY EQUIVALENCY DETERMINATION

3.1 In accordance with the Part S-1 of the Supplement, the party requesting the approval must show what measures have been taken to ensure a level of safety equivalent to that of the Technical Instructions. Specific to this request, the applicant must show what additional safety factors have been put in place to justify relief from tests T5 and T7 (external short circuit and overcharge tests) of the UN Manual of Tests and Criteria.

3.2 The following is a summary of additional requirements that are imposed to ensure an equivalent level of safety. It should be noted that considerations differ for each test and take into account variations for the module assemblies, sub-pack assemblies, and completed battery pack assemblies. More specific details are provided in the attached sample approval (see Annex).

Relief from T5

- The individual cells comprising all assemblies have passed the requirements in the UN Manual of Tests and Criteria;
- The cells and battery assemblies are designed to protect against short circuiting (i.e. terminals have an insulating cap attached to prevent short-circuits); and
- All battery modules and assemblies are secured to prevent inadvertent movement during transportation.
- The terminals may not support the weight of other superimposed elements.

Relief from T7

- Battery assemblies are equipped with a Battery Management System that monitors, overcharging, over discharging and current overdraw;
- A battery-specific charger is designed in such a way that charging can only occur through the use of the charger;
- The charging mechanism cannot be connected in the packaged state; and
- All batteries must be transported at no more than 50% state of charge.

Packaging Requirements

- Cells and battery assemblies must be individually packaged in inner packagings and surrounded by cushioning material that is non-combustible and non-conductive, and must be further packaged in a metal outer packaging that meets Packing Group I performance criteria in accordance with Special Provision A88;
- With an equivalent lithium content greater than 25 grams in a battery, the number of batteries may not exceed 6 per outer package; and
- With an equivalent lithium content less than 25 grams in a battery, the number of batteries may not exceed 12 per outer package.
- Prototype lithium batteries with a mass exceeding 12 kg or assemblies of such batteries may be packed in a strong outer packaging or protective enclosures provided the lithium batteries and assemblies of such batteries have a strong, impact resistant outer casing.

Example Lithium Battery Approval
Issued in Accordance with Special Provision A88 of the ICAO Technical Instructions

1. **APPROVAL HOLDER:** Company A
2. **REGULATORY AUTHORITY:** Special Provision A88 of the International Civil Aviation Organization's Technical Instructions for the Safe Transport of Dangerous Goods by Air (ICAO TI).
3. **SYNOPSIS:** This approval authorizes Company A to offer for transportation prototype lithium ion battery assemblies described as 80Ah battery pack assemblies, 40Ah lithium ion battery sub-pack assemblies, and 240Ah lithium ion battery module assemblies in accordance with provisions of this approval. In addition, battery shipments transported under the provisions of this approval are authorized to exceed the 35 kilogram (kg) gross weight limit for shipments by cargo aircraft.
4. **BASIS:** This approval is issued in response to Company A's application dated March 1, 2008.
5. **PERIOD OF VALIDITY AND CONDITIONS OF APPROVAL:** This approval does not provide relief from any requirements of the ICAO TI except as stated herein. This approval is valid until the posted expiration date or until terminated by the Associate Administrator for Hazardous Materials Safety.

Approved Materials: Only UN 3480, Lithium batteries, Class 9, PG II may be transported under the terms of this approval.

Description of Battery Assemblies:

- 1) The module assembly is comprised of up to 24 cells that have passed all required tests specified in the UN Manual of Tests and Criteria. The module assembly weighs up to 13.5 Kg (1.9 kWh).
- 2) The sub-pack assembly is comprised of two module assemblies and weighs up to 30 Kg (3.7 kWh).
- 3) The battery pack assembly is comprised of multiple sub-pack assemblies and weighs in the range of 150 Kg to 300 Kg (10 kWh to 30 kWh).

Safety Controls:

- 1) Only lithium ion module assemblies, sub-pack assemblies, and battery pack assemblies described in Company A's application dated March 1, 2008 may be transported under the terms of this approval.
- 2) Lithium ion batteries identified as module assembly, sub-pack assembly, and battery pack assembly may contain no more than 1.9 kWh, 3.7 kWh, and 30 kWh of energy, respectively.
- 3) To ensure that these battery assemblies are robust to withstand conditions normally incident to transportation with respect to T-5 and T-7:
 - a) Terminals of each module assembly, sub-pack assembly, or battery pack assembly must be fitted with an effective means to protect against short-circuits (i.e., the terminals must have an insulating cap attached.)

- b) All assemblies are secured to prevent inadvertent movement during transportation.
- c) The completed lithium ion battery pack assemblies must be equipped with a system capable of monitoring the battery and preventing short circuits or over discharge between the batteries in the pack and any overheat or overcharge of the battery pack.
- d) All assemblies are packaged and transported at or below 50% state of charge.

Testing:

- 1) Cells and batteries must be subjected to the following tests:
 - a) For prototype cells that have not passed all required tests as specified in the “UN Manual of Tests and Criteria,” three cells must be stored at 55°C for at least 48 hours followed by a short circuit test (connecting a conductor across the positive and negative terminals and maintain this short circuit for at least 1 hour after the case temperature has returned to 55°C);
 - b) One prototype battery assembled from the cells that have not passed the required UN tests must be stored at 55°C for at least 48 hours followed by a short circuit test (connecting a conductor across the positive and negative terminals and maintain this short circuit for at least 1 hour after the case temperature has returned to 55°C); or
 - c) If batteries comprise cells that have passed all required tests as specified in the “UN Manual of Tests and Criteria,” the batteries may be subjected to a short circuit test conducted at room temperature (approximately 23°C).

Packaging:

- 1) The prescribed packaging for the lithium ion battery assemblies (module assembly, sub-pack assembly, and battery pack assembly) must consist of specification metal packaging meeting the Packaging Group (PG) I performance standards.
- 2) The packaging must be secured to prevent inadvertent movement during transit, and the battery terminals must not support the weight of any other superimposed elements of the battery and must be protected against short circuit and discharge during transit.
- 3) All lithium ion battery assemblies must be packed with non-combustible and non-conductive material between the inner and outer packagings to effectively prevent short circuits and to prevent movement which could lead to short circuits; and
- 4) For lithium ion batteries with an equivalent lithium content of less than 25 gr (or 300 Wh), batteries per completed package may not exceed 12 per package.
- 5) For lithium ion batteries with an equivalent lithium content of greater than 25 gr (or 300 Wh), batteries per completed package may not exceed 6 per package.

6) When shipping by cargo only aircraft, the gross weight of any battery assembly may not exceed 375 kg.

7) Prototype lithium batteries with a mass exceeding 12 kg or assemblies of such batteries may be packed in a strong outer packaging or protective enclosures provided the lithium batteries and assemblies of such batteries have a strong, impact resistant outer casing.

Marking Requirements: Each outer package prepared under the provisions of this application shall be plainly marked with the approval number in addition to all required labels and markings.

6. MODES OF TRANSPORTATION AUTHORIZED: Motor vehicle, cargo only aircraft and cargo vessel.

7. SPECIAL PROVISIONS:

A current copy of this approval must be maintained and made available for examination at each location where materials are packaged and offered for transportation under its authority and a copy of this approval must accompany all shipment made under the terms of this approval.

Any person who offers for transportation or transports the above-described package(s) may do so under the authority of this approval if all requirements and conditions of this approval are met.

Any person who receives a package covered by this approval may reoffer it for transportation provided no modifications or changes are made to the package and it is reoffered for transportation in conformance with this approval.

This approval in no way affects the need to obtain any required authorizations from other agencies of the United States Government or from the competent authorities of the countries of transit, overflight or destination.

Prior to offering a hazardous material authorized under this approval, the approval holder must notify the air carrier that this approval authorizes the shipment of a prototype lithium battery and must advise the air carrier of all of the provisions of this approval prior to shipment.

— END —