International Civil Aviation Organization

DGP/26-WP/44
7/9/17

WORKING PAPER

DANGEROUS GOODS PANEL (DGP)

TWENTY-SIXTH MEETING

Montréal, 16 to 27 October 2017

Agenda Item 6: Resolution, where possible, of the non-recurrent work items identified by the Air Navigation Commission or the panel:
6.3: Mitigating risks posed by the carriage of lithium batteries by air *(Job card DGP.003.01)*

APPROVALS FOR LITHIUM BATTERIES ON PASSENGER AIRCRAFT

(Presented by A. Stubblefield)

SUMMARY

This working paper proposes to amend Special Provision A201 of the Technical Instructions and Parts S-1;4 and S-3;4 of the Supplement to the Technical Instructions (Doc 9284SU) to authorize transport of lithium batteries on passenger aircraft with approval by the appropriate authority of the State of Origin and the State of the Operator.

Action by the DGP: The DGP is invited to consider the proposed amendment to Special Provision A201 and Parts S-1;4 and S-3;4 of the Supplement to the Technical Instructions as shown in Appendices A and B to this working paper.

1. INTRODUCTION

1.1. In March 2016, the ICAO Council approved amendments to the 2015-2016 Edition of the *Technical Instructions for the Safe Transport of Dangerous Goods by Air* (Technical Instructions, Doc 9284) which prohibit the transport of lithium ion batteries as cargo on passenger aircraft and incorporate additional requirements to mitigate risks posed by lithium batteries as cargo on cargo aircraft. These amendments became effective from 1 April 2016.

1.2. The amendments approved by the ICAO Council included an amendment to existing Special Provision A201 that authorizes States concerned to grant an exemption from the prohibition to transport **lithium metal batteries** (UN3090) or **lithium ion batteries** (UN3480) on passenger aircraft in accordance with Part 1;1.1.3 of the Technical Instructions. The Council has also approved amendments to the Supplement to the Technical Instructions (Supplement, Doc 9284SU) to provide guidance for States on the transport of lithium batteries.

1.3. Special Provision A201 was introduced into the Technical Instructions in the 2015-2016 Edition of the Technical Instructions concurrent with the panel's decision to prohibit lithium metal batteries (UN 3090) from carriage as cargo on passenger carrying aircraft. Special Provision A201 provided an approval provision recognizing the potential need to transport lithium metal batteries in situations that were not limited to the strict conditions of Part 1;1.1.3, and that could be proven safe for transport under conditions specified by the States of Origin and Operator.

1.4. The proposed amendments in this working paper address concerns raised by stakeholders regarding impacts on the timely transport of certain lithium batteries when transportation by cargo aircraft is not an option. The intent of the paper is to provide an approval mechanism and guidance for the State of Origin and the State of the Operator in instances where other forms of transport (including cargo aircraft) are impracticable.

1.5. Recognizing that the goal of the Technical Instructions is to provide for the safe transport of dangerous goods by air, this working paper proposes to amend Special Provision A201 and make corresponding changes within the Supplement to recommend minimum criteria for use by the State of Origin and the State of the Operator when considering exemptions or approvals to authorize the transport of lithium batteries on passenger aircraft. Further, this working paper proposes revisions to the text of Special Provision A201 to provide specific quantity limitations, as no limitations are provided by the Dangerous Goods List in Table 3-1. These limits are designed to control the risk for passenger aircraft. This control is essential as we are proposing to establish an approval provision to allow an otherwise forbidden shipment aboard passenger aircraft. The specific quantity limits (Packing Instruction 965, Table 965-II and Packing Instruction 968, Table 968-II) were introduced in the approval process in Special Provision A201 due to the fact that the a) – e) risk mitigation criteria in Special Provision A3XX does not currently have any industry standards or testing procedures to validate the mitigation results, as is required for other dangerous goods packaging. Specific size and package limits are included to control the size and overall number of cells or batteries per package and promote consistency in the issuance of approvals. These amendments would maintain appropriate safety oversight should there be a need to transport lithium batteries on passenger aircraft while facilitating international transport.

1.6 In the current version of the Supplement, under Part S-1;4.1.4, minimum criteria are provided for consideration in a safety risk assessment to determine if an exemption to transport UN 3480 **— Lithium ion batteries** as cargo on passenger aircraft under Special Provision A201 would be appropriate. This working paper proposes to revise the text in S-1;4.1.4 to include both exemptions and approvals and include an allowance for both lithium metal and lithium ion batteries.

1.7 SAE International is leading an effort to develop an Aerospace Standard (AS) to specify minimum performance package standards that would support the safe shipment of lithium batteries as cargo on aircraft. This standard would provide a test method to demonstrate and document the mitigation of the potential hazards from lithium metal cells or batteries (UN 3090) and lithium ion cells or batteries (UN 3480) when transported as cargo on aircraft. The standard is expected to address the need to mitigate the hazards which might arise from a failure of an individual cell by containing the hazards within the package. Mitigating the consequences of a failure within the package is intended to prevent uncontrolled fire and pressure pulses that may compromise current fire suppression systems within the cargo compartment. Although the standard is not yet complete, many of the principles outlined for consideration in the SAE effort are recommended for consideration as in proposed Special Provision A3XX. The proposed Special Provision A3XX is intended to apply control measures that will achieve a level of safety equivalent to that provided by the Technical Instructions. We are aware of packaging that can meet the proposed requirements in this working paper. Several packaging manufacturers presented their packages at ICAO on 24 October 2015, during but separate to the ICAO DGP/25 meeting.

2. ACTION BY THE DGP

2.1 The DGP is invited to agree to the revisions to the Technical Instructions and the Supplement as shown in Appendices A and B to this working paper.

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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

Table 3-2. Special provisions

TIs	*UN*	
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A201		~~States concerned may grant an exemption from the prohibition to transport lithium metal or lithium ion batteries on passenger aircraft in accordance with Part 1;1.1.3.~~ With the prior approval of the appropriate authority of the State of Origin and the State of the Operator, under the written conditions established by those authorities, States may authorize the following types and quantities of lithium cells or batteries to be transported on passenger aircraft: a) quantities of lithium metal cells or batteries (UN 3090) are limited to the allowance permitted in Table 968-II of Packing Instruction 968; and b) quantities of lithium ion cells or batteries (UN 3480) are limited to the allowance permitted in Table 965-II of Packing Instruction 965. When States, other than the State of Origin and the State of the Operator, have notified ICAO that they require prior approval of shipments made under this special provision, approval must also be obtained from these States, as appropriate. If transport in accordance with this special provision is not possible, States concerned may grant an exemption from the prohibition to transport lithium metal or lithium ion batteries on passenger aircraft in accordance with Part 1;1.1.3. Authorities issuing exemptions or approvals in accordance with this special provision must provide a copy to the Chief of the Cargo Safety Section within three months via email at CSS@icao.int, via facsimile at +1 514-954-6077 or via post to the following address: Chief, Cargo Safety Section International Civil Aviation Organization 999 Robert-Bourassa Boulevard Montréal, Quebec CANADA H3C 5H7 *Note.— Guidance for the processing of exemptions or approvals from the prohibition to transport lithium batteries may be found in Part S-1;4 and Table S-3-1, Special Provision A3XX of the Supplement to the Technical Instructions.*

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APPENDIX B

PROPOSED AMENDMENT TO PART S-1 OF THE SUPPLEMENT TO THE TECHNICAL INSTRUCTIONS

Part S-1

GENERAL

(ADDITIONAL INFORMATION FOR PART 1 OF THE TECHNICAL INSTRUCTIONS)

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Chapter 4

GUIDANCE TO STATES ON THE TRANSPORT OF LITHIUM BATTERIES AS CARGO

4.1 INTRODUCTION

4.1.1 Lithium batteries have the potential to create thermal runaway, a chain reaction which leads to repeated self-heating and the release of a battery's stored energy. Once one battery experiences thermal runaway, it can generate enough heat to trigger thermal runaway in adjacent batteries. Thermal runaway can occur for a number of reasons, including poor cell design, cell manufacturing flaws and external abuse. It has been demonstrated through testing that thermal runaway can result in fire and/or explosion.

4.1.2 A prohibition on the transport of UN 3090 — **Lithium metal batteries** as cargo on passenger aircraft was introduced into the 2015-2016 Edition of the Technical Instructions with the knowledge that aircraft cargo fire protection systems could not control a lithium metal fire. More recent test results demonstrate that a fire involving high-density packages of UN 3480 — **Lithium ion batteries** may exceed the capability of aircraft cargo fire protection systems. High-density packages of lithium ion batteries may consist of any number of batteries or cells having the potential to overwhelm cargo compartment fire protection features. The potential is dependent on a number of variables including the battery or cell chemistry, size, design type, quantities and the cargo compartment configuration. The inability to determine an absolute safe quantity limit for lithium ion batteries and the absence of a packaging standard to mitigate the risks has led to the decision to introduce a prohibition on the transport of UN 3480 — **Lithium ion batteries** as cargo on passenger aircraft.

4.1.3 Development of a performance-based packaging standard for lithium ion batteries is currently under way. It is anticipated that once this standard is completed and any additional controls necessary to mitigate risks are established, an amendment to the Technical Instructions will be made to allow for their transport as cargo on passenger aircraft.

4.1.4 At a minimum, the following criteria should be identified as part of a safety risk assessment when considering whether or not to grant an approval or an exemption to transport UN 3480 — **Lithium ion batteries** or UN 3090 — **Lithium metal batteries** as cargo on passenger aircraft under Special Provision A201:

a) capabilities of the operator;

b) overall capability of the aircraft and its systems;

c) packing and packaging;

d) quantity of batteries and cells;

e) containment characteristics of unit load devices;

f) specific hazards and safety risks associated with each battery and cell type to be carried alone or in combination; and

g) chemical composition of the batteries and cells.

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Part S-3

DANGEROUS GOODS LIST, SPECIAL PROVISIONS AND QUANTITY LIMITATIONS

(ADDITIONAL INFORMATION FOR PART 3 OF THE TECHNICAL INSTRUCTIONS)

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Chapter 4

SUPPLEMENTARY DANGEROUS GOODS LIST

Classes 3 to 9

Table S-3-1. Supplementary Dangerous Goods List (Classes 3 to 9)

									Passenger aircraft		Cargo aircraft	
Name	*UN No.*	*Class or division*	*Subsidiary risk*	*Labels*	*State variations*	*Special provisions*	*UN packing group*	*Excepted quantity*	*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 — Lithium batteries	US 3	A88 A99 A154 A164 A183 A201 A206 A331 A3XX		E0	FORBIDDEN		See 965	
Lithium metal batteries (including lithium alloy batteries) †	3090	9		Miscellaneous — Lithium batteries	US 2 US 3	A88 A99 A154 A164 A183 A201 A206 A3XX		E0	FORBIDDEN		See 965	
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Chapter 6

SPECIAL PROVISIONS

Against the entries in the Supplementary Dangerous Goods List (Table S-3-1), column 7 shows any special provisions that are applicable. Where these special provisions have not been listed in Table 3-2 of the Technical Instructions, they are listed in Table S-3-4 below.

Table S-3-4. Special Provisions

Supplementary special provisions

A3XX a) In instances where other forms of transport (including cargo aircraft) is impracticable, lithium cells or batteries may be transported on passenger aircraft with the prior approval of the authority of the State of Origin and the State of the Operator under the written conditions established by those authorities, provided that the following types and quantities are met:

1) quantities of lithium metal cells or batteries (UN 3090) are limited to the allowance permitted in Table 968-II of Packing Instruction 968; and

2) quantities of lithium ion cells or batteries (UN 3480) are limited to the allowance permitted in Table 965-II of Packing Instruction 965.

b) When considering an approval, at a minimum, the following criteria should be considered to mitigate risks posed by a lithium cell or battery heat, smoke or fire event inside a package at the cell, battery or package level:

1) no amount of flame is allowed outside the package;

2) the external surface temperature of the package cannot exceed the amount that would ignite adjacent packing material or cause batteries or cells in adjacent packages to go into thermal runaway;

3) no fragments can exit the package and the package must maintain structural integrity;

4) the quantity of flammable vapour emitted must be less than the amount of gas that when mixed with air and ignited could cause a pressure pulse that could dislodge the overpressure panels of the aircraft cargo compartment or damage the aircraft cargo compartment liners; and

5) when the package or overpack is exposed to an external fire (e.g. five-minute oil burner flame penetration resistance test) or elevated temperature environment (e.g. oven thermal resistance test) the lithium cell or battery contained in the package must not initiate thermal runaway.

Adequate information and documentation on the above criteria (b)1) through 5)) must be provided to the appropriate authority of the State issuing the approval upon request.

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