



**WORKING PAPER**

**DANGEROUS GOODS PANEL (DGP)  
WORKING GROUP MEETING (DGP-WG/20)**

**Montréal, 19 to 23 October 2020**

- Agenda Item 3: Managing safety risks posed by the carriage of lithium batteries by air**
- 3.3: Consider the need for amendments to address impact from proposed amendment to Annex 6, Volume I on cargo compartment safety (Ref: Job Cards DGP.003.02 and FLTOSP.043)**
  - 3.4 Consider measures to mitigate safety risks posed by lithium batteries carried and/or used by passengers, crew and the operator (Ref: Job Card DGP.003.02)**
  - 3.5: Consider the need for specific measures to mitigate safety risks posed by lithium batteries packed with or contained in equipment**

**AMENDMENT TO THE GUIDANCE TO STATES ON THE TRANSPORT OF LITHIUM BATTERIES AS CARGO CONTAINED IN THE SUPPLEMENT TO THE TECHNICAL INSTRUCTIONS**

(Presented by the Secretary)

**SUMMARY**

This working paper presents draft amendments to the guidance material for States on the transport of lithium batteries contained in Part S-1;4 of the Supplement to the Technical Instructions.

**Action by the DGP-WG:** DGP-WG/20 is invited to finalize amendments to the guidance material for States on the transport of lithium batteries contained in Part S-1;4 of the Supplement to the Technical Instructions based on the material presented in the appendix to this working paper.

**1. INTRODUCTION**

1.1 The twenty-seventh meeting of the DGP (DGP/27, Montréal, 16 to 20 September 2019) was presented with amendments to the guidance material for States on the transport of lithium batteries contained in Part S-1;4 of the Supplement to the Technical Instructions. The amendments were developed for the sake of alignment with safety risk assessment provisions contained in an amendment to Annex 6 on cargo compartment safety (new Chapter 15 to Annex 6, Part I) and to highlight the hazards associated with electronic devices powered by lithium batteries in checked baggage, recalled batteries or devices,

and undeclared lithium batteries. A breakout working group was tasked with reviewing the material. The following is an extract from the DGP/27 Report describing the feedback from this group and the discussion that ensued:

3.6.1.1.1 ... The breakout group supported the intent of the amendments, but identified a number of areas that would need to be refined. One area was the guidance related to recalled batteries or devices; the group considered it to be too prescriptive and was concerned that it implicitly obliged a ban on their carriage by passengers or crew regardless of the outcome of a safety risk assessment. Another area related to the criteria to be identified as part of a safety risk assessment. The existing text referred to it as the criteria that would need to be taken into account when considering whether or not to grant an approval or an exemption to transport lithium batteries as cargo on passenger aircraft under Special Provision A201. The intent of the proposed amendment was to align the list with the elements listed in the amendment to Annex 6. Reference to Special Provision A201 was removed, recognizing that the amendment to Annex 6 would require a safety risk assessment irrespective of the need for an approval or exemption. The breakout group believed the list of criteria, while appropriate for a State in considering whether or not to grant an approval, was inappropriate for an operator conducting a risk assessment under normal conditions. They noted that criteria such as the specific hazards of the batteries and their chemical composition would be impossible for the operator to determine. The Secretariat noted that the FLTOPSP had listed these elements as necessary criteria for safety risk management activities for the transport of lithium batteries in its statement to DGP/25 without differentiating between passenger and cargo aircraft (see the report of the second meeting of the FLTOPSP). This statement had contributed to the Council's decision to ban their transport as cargo on passenger aircraft and was the impetus for the request to the UN Sub-committee to develop a more granular hazard classification system for lithium batteries. The elements in the Annex 6 amendment were based on the list from the FLTOPSP statement. They were generalized because the Annex 6 provisions applied to all items in a cargo compartment, not just lithium batteries. The Secretariat suggested the fact that an operator could not know the chemical composition of the batteries did not necessarily mean they couldn't transport them, they would just need to take this into account and implement appropriate risk mitigation measures.

3.6.1.1.2 Despite the concerns raised, there was support for further developing the material. It was suggested that a website might be a more appropriate place for some of the material, as it would make it more visible and provide a more flexible mechanism for ensuring up-to-date guidance. A working group through correspondence would take on the task of refining the material and considering where to publish it. The Secretariat noted the work would need to be done in the near term in order for it to be considered by the ANC with all of the recommendations from DGP/27.

1.2 The amendments were not finalized prior to the Air Navigation Commission. The ANC was advised that the panel had reviewed draft amendments to the Supplement, but concluded that more work was necessary and agreed to finalize the material through correspondence.

**2. ACTION BY THE DGP-WG**

2.1 DGP-WG/20 is invited to finalize amendments to the guidance material for States on the transport of lithium batteries contained in Part S-1;4 of the Supplement to the Technical Instructions based on the draft amendment presented in the appendix to this working paper.

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## APPENDIX

### PROPOSED AMENDMENT TO PART S-1;4 OF THE SUPPLEMENT

#### Part S-1. GENERAL

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#### Chapter 4

### GUIDANCE TO STATES ON THE TRANSPORT OF LITHIUM BATTERIES AS CARGO

#### 4.1 INTRODUCTION

4.1.2 This chapter provides an overview of the hazards associated with the transport of lithium batteries by air and information related to restrictions on their transport. States should ensure that operators are taking this information into account when conducting their specific safety risk assessments for the transport of items in the cargo compartment required by Annex 6 — Operation of Aircraft, Part I — International Commercial Air Transport — Aeroplanes, Chapter 15 — Cargo Compartment Safety.

4.1.3 The requirement for operators to conduct specific safety risk assessments for the transport of items in the cargo compartment and related Standards and Recommended Practices (SARPs) on cargo compartment safety were introduced through Amendment 44 to Annex 6, Part I which became applicable on 5 November 2020. The SARPs were developed in response to concerns raised by airframe manufacturers that a fire involving high-density packages of lithium batteries could exceed the ability of cargo compartment fire protection systems to suppress or extinguish it. This led to the introduction of more restrictive requirements in the Technical Instructions for the transport of lithium batteries as cargo and the identification of a need for SARPs and supporting guidance material on conducting safety risk assessments for cargo compartment safety. Although the impetus for the amendment was the safety concerns related to lithium batteries, the need to consider the risks associated with all items transported in the cargo compartment was identified. The SARPs include a general list of items operators are required to consider as part of their safety risk assessment, i.e. the hazards associated with the properties of the items to be transported, capabilities of the operator, operational considerations, capabilities of the aeroplane and its systems, containment characteristics of unit load devices, packing and packaging, safety of the supply chain for items to be transported, and quantity and distribution of dangerous goods items to be transported. The list of items is intended as a minimum requirement; items may need to be further specified and the list may need to be expanded depending on the operator's unique operations.

Note 1.— Guidance to support the implementation of the SARPs contained in Annex 6, Part I, Chapter 15 is provided in the Cargo Compartment Operational Safety Manual [working title] (Doc 10102), including guidance on conducting a specific safety risk assessment in accordance with the Safety Management Manual (SMM) (Doc 9859).

Note 2.— Annex 19 — Safety Management contains SARPs intended to assist States in managing aviation safety risks. Supporting guidance is provided in the Safety Management Manual (SMM) (Doc 9859).

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*Editorial Note.*— The replacement of current S-1;4.1.1 (below) is proposed for the sake of alignment with the description of lithium battery hazards in the *Cargo Compartment Operational Safety Manual* [working title] (Doc 10102).

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#### 4.2 LITHIUM BATTERY HAZARDS

4.1.1 Lithium cells 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 cell experiences thermal runaway, it can generate enough heat to trigger thermal runaway in adjacent cells. Thermal runaway can occur for a number of reasons, including poor cell design, cell manufacturing flaws and external abuse. Lithium batteries pose a unique hazard to transport because they are capable of providing both fuel for a fire and an ignition source. They differ from other conventional batteries in that the cells are constructed with a flammable electrolyte which can be forcibly released when a cell is in a state of thermal runaway. Thermal runaway is a chemical reaction within the cell that results in a dramatic and uncontrolled rise in both temperature and pressure. This results in the battery expelling its contents, including the flammable electrolyte and flammable gas, which may then be ignited by the associated heat or burning surroundings of the battery. A cell in thermal runaway produces

enough heat to cause adjacent cells to enter thermal runaway, a process known as thermal runaway propagation. Typical fibreboard packaging does not prevent the propagation of thermal runaway to other packages. Another unique and significant hazard that may result from a lithium battery thermal runaway event is the expulsion of large quantities of flammable gas. The flammable gas has the potential to collect and ignite, resulting in a significant overpressure event.

*Note.— Information related to the hazards produced by lithium cells in thermal runaway in aircraft cargo compartments has been derived from research at the United States Federal Aviation Administration (FAA) William J. Hughes Technical Center Aviation Research Division. A compilation of test data and results of this research is provided in a report available at <http://www.fire.tc.faa.gov/pdf/TC-16-37.pdf>.*

#### 4.23 LITHIUM METAL AND LITHIUM ION BATTERIES TRANSPORTED AS CARGO

4.4.23.1 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~~ Later test results demonstrated 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.

~~4.4.3 — Development of a performance-based packaging package standard for lithium ion batteries and a risk-based hazard classification system for lithium batteries is currently under way. It is anticipated that these elements, coupled with additional controls, once this standard is completed and any additional controls established by the operator through its safety risk assessment process, will allow for the removal of certain restrictions on the transport of lithium batteries. 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.~~

4.3.2 The transport of UN 3090 — **Lithium metal batteries** and UN 3480 — **Lithium ion batteries** is permitted as cargo on cargo aircraft. While the specific requirements for transporting lithium batteries contained in the Technical Instructions provide significant improvements to safety, they do not eliminate all risks and should be coupled with other mitigation strategies as part of a layered approach to safety. States should ensure cargo operators perform safety risk assessments to establish whether they can manage the risks posed. The transport of UN 3090 — **Lithium metal batteries** and UN 3480 — **Lithium ion batteries** may be transported on passenger aircraft under certain conditions through an approval or an exemption in accordance with Special Provision A201 of the Technical Instructions.

4.3.3 ~~4.4.4~~—At a minimum, the following criteria should be identified as part of a safety risk assessment involving lithium batteries 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:

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*Editorial Note.—* The following list has been reordered to align with the order of the risk assessment provisions in new Chapter 15 to Annex 6, Part I. Amendments to the text have also been made for the sake of alignment with the Annex 6 provisions.

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- a) specific hazards and safety risks associated with each battery and cell type to be carried alone or in combination; and
- gb) chemical composition of the batteries and cells;
- ~~ac)~~ capabilities of the operator;
- d) operational considerations (e.g. area of operations, diversion time);
- ~~be)~~ overall capability ~~capabilities~~ of the aircraft aeroplane and its systems (e.g. cargo compartment fire suppression capabilities);
- ef) containment characteristics of unit load devices;
- ~~eg)~~ packing and packaging;
- h) safety of the supply chain for lithium batteries or cells to be transported; and
- ~~— di)~~ quantity and distribution of batteries and cells to be transported;
- ~~— 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.~~

#### **4.3 LITHIUM METAL AND LITHIUM ION BATTERIES PACKED WITH OR CONTAINED IN EQUIPMENT TRANSPORTED AS CARGO**

~~UN 3091 — Lithium metal batteries contained in equipment, UN 3091 — Lithium metal batteries packed with equipment, UN 3481 — Lithium ion batteries contained in equipment and UN 3481 — Lithium ion batteries packed with equipment pose less of a risk than batteries on their own because of the level of protection which may be provided by the equipment. They are therefore permitted for transport as cargo on both passenger and cargo aircraft in accordance with the Technical Instructions. Although a lesser risk, there are still hazards associated with the transport of lithium batteries contained in or packed with equipment, including non-compliant shipments (see paragraph 4.6) and damaged or defective batteries (see paragraph 4.7). States should ensure the hazards associated with lithium batteries packed with or contained in equipment are addressed as part of their safety risk assessments.~~

#### **4.4 LITHIUM BATTERIES CARRIED BY PASSENGERS AND CREW**

~~Lithium batteries, including portable electronic devices, are permitted for carriage by passengers and crew provided all applicable criteria listed in Part 8 of the Technical Instructions are met. Spare lithium batteries, power banks, battery-powered portable electronic smoking devices, and some other devices, in certain conditions, are forbidden in checked baggage. The Technical Instructions do not forbid the carriage of most other portable electronic devices in checked baggage, but it is recommended that they be carried in the cabin where an incident may be more readily mitigated. The risk of an event involving portable electronic devices in checked baggage was not considered high when developing the provisions for passengers to carry them, as it was assumed that most passengers would choose to carry them in the cabin. However, data collected since that time suggests there may be a much higher number of batteries and battery-powered devices being carried in checked baggage than assumed. New hazards have also been identified since that time, including the potential for an explosion if there is a thermal runaway event involving a lithium battery packed in the same checked baggage as certain items containing permitted dangerous goods, such as aerosol cans. The ability of cargo compartment fire suppressions to effectively contain such an event, particularly when occurring in a Class D compartment, has been demonstrated to be limited. States should advise operators to take this information into account when conducting safety risk assessments related to the carriage of lithium batteries by passengers and crew and to ensure they have procedures in place aimed at mitigating the risks they pose.~~

InFo and SIB Nos. to be verified to ensure still valid:

~~[ *Note 1.— More detailed information can be found through notices issued by the FAA (Information for Operators (InFO) No. 17008 dated 17 July 2017) and the European Aviation Safety Agency (EASA) (Safety Information Bulletin (SIB) No. 2017-04R1 dated 19 December 2017).*]~~

~~*Note 2.— Guidance on responding to incidents involving portable electronic devices in the cabin is contained in the Emergency Response Guidance for Aircraft Incidents Involving Dangerous Goods (Doc 9481) and the Cabin Crew Safety Training Manual (Doc 10002).*~~

#### **4.4 UNDECLARED AND MISDECLARED CONSIGNMENTS OF LITHIUM BATTERIES**

~~There have been reports of both deliberate and unintentional non-compliance with respect to the transport of lithium batteries by air. Types of non-compliance include: batteries not packed in compliance with the Technical Instructions; batteries not meeting testing requirements; batteries classified as being contained in or packed with equipment when they are, in fact, packed on their own; and undeclared shipments. States should emphasize the importance of interface management to operators as described in the Safety Management Manual (SMM) (Doc 9859) and ensure that their safety risk assessments take non-compliance into account. States should also be considering non-compliance as part of their own safety management responsibilities. This may highlight the need for increased surveillance activities based on the assessed risk and, when necessary, effective enforcement measures. States should facilitate the sharing and exchange of information involving non-compliant shipments of lithium batteries, which may involve the establishment of sharing or exchange networks among entities both within and beyond the aviation system, unless their national law provides otherwise, in accordance with Annex 19. They are also encouraged to participate in cooperative efforts with other States concerning violations of dangerous goods regulations as recommended in Annex 18.~~

~~*Note. 1— Guidance on managing aviation safety risks, including safety assurance, interface management and safety information protection, sharing and exchange, is provided in the Safety Management Manual (SMM) (Doc 9859).*~~

Note. 2— Specific guidance on managing aviation safety risks related to the safety of the supply chain, including undeclared and misdeclared consignments of dangerous goods, is provided in the Guidance for Safe Operations Involving Aeroplane Cargo Compartments (Doc 10102)

#### **4.5 DAMAGED OR DEFECTIVE LITHIUM BATTERIES OR DEVICES POWERED BY LITHIUM BATTERIES**

The Technical Instructions forbid the transport of lithium batteries and lithium batteries packed with or contained with equipment as cargo if they are identified as being damaged or defective, including those subject to a safety recall (see Special Provision A154 and paragraph 2 of Packing Instructions 965 through 970 of the Technical Instructions). Passengers should be prevented from carrying such batteries on board aircraft. If they are carried on board the aircraft, passengers should be required to keep the battery or device turned off, to protect it from unintentional activation, to not charge it, and to keep it in carry-on baggage or on the person. States are encouraged to alert operators when they have been made aware of safety recalls and to ensure they have procedures in place aimed at mitigating the risks they pose, including the need to make personnel involved with cargo or passenger processing aware of the restrictions.

SAFO and SIB Nos. to be verified to ensure still valid:

Note.— FAA Safety Alert for Operators (SAFO) No. 16011 dated 16 September 2016 and EASA SIB No. 2017-01 dated 9 February 2017 are examples of notices issued by aviation authorities alerting operators of risks associated with recalled lithium batteries, both of which include recommended action.

— END —