Organización de Aviación Civil Internacional

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**NOTA DE ESTUDIO**

# GRUPO EXPERTO EN MERCANCÍAS PELIGROSAS (DGP)

## TRIGÉSIMA REUNIÓN

**Montreal, 6 - 10 de octubre de 2025**

**Cuestión 4: Gestión de los riesgos de seguridad operacional que plantea el transporte de dispositivos de almacenamiento de energía por vía aérea (*Ref.: Ficha de trabajo DGP.003.05*)**

# INFORME DEL EQUIPO ESPECIAL SOBRE AYUDAS MOTRICES DEL GRUPO EXPERTO EN MERCANCÍAS PELIGROSAS (DGP) DE LA OACI

(Nota presentada por el Relator del Equipo Especial sobre Ayudas Motrices del DGP)

**RESUMEN**

En esta nota de estudio se resume el trabajo realizado por el Equipo Especial sobre Ayudas Motrices del DGP (DGP-TF/MA). El equipo especial llevó a cabo una evaluación de riesgos de seguridad operacional que dio lugar a un conjunto consolidado de propuestas de enmienda de las partes 7 y 8 de las Instrucciones Técnicas de la OACI.

**Medidas propuestas al DGP:** Se invita al DGP a:

a) tomar nota del trabajo realizado por el DGP-TF/MA durante el bienio 2024-2025;

b) hacer suyas las propuestas de enmienda de las partes 7 y 8 de las Instrucciones Técnicas que figuran en el apéndice de la presenta nota de estudio;

c) convenir en que continúen los trabajos en el próximo bienio, lo que incluye:

   1) elaborar textos de orientación sobre la aprobación del transporte de ayudas motrices accionadas por batería por el público pasajero; y

   2) considerar la aprobación de medidas de mitigación adicionales en materia de seguridad operacional.

* Solo se han traducido el resumen y el apéndice.

## 1. INTRODUCTION

1.1 Concerns were raised at the 2024 Dangerous Goods Panel Working Group Meeting (DGP-WG/24, 21 to 25 October 2024, Montreal) (paragraph 4.4.2 of the DGP-WG/24 report) regarding safety risks associated with lithium ion powered mobility aids carried by passengers. Airline operators had expressed particular concern with the increase in energy storage capacity of lithium ion batteries that often power mobility devices and the limited ability to manage a thermal runaway event involving those batteries. The Technical Instructions impose a Watt-hour rating limit of 300 Wh for lithium ion batteries removed from the mobility aid and carried in the cabin, but not for the same batteries when installed in and protected by the mobility aid and loaded in the cargo compartment. Carriage of removed batteries in the cabin are also a concern, in particular in relation to the ability of crews to quickly respond to a thermal runaway event and subsequent fire in the cabin during flight, even more so during a critical phase of flight (i.e. take-off).

1.2 DGP-WG/24 established a DGP Task Force on Mobility Aids (DGP-TF/MA) to address the safety concerns related to high-energy lithium-ion batteries installed in mobility aids carried by passengers. The task force's mandate included the conduct of a structured safety risk assessment, the development of policy options and, if justified, the development of draft amendments to the Technical Instructions for consideration at DGP/30. The task force felt strongly that that while mitigating measures may be needed to address identified safety risks, they should not unnecessarily restrict access to air travel. It therefore emphasized the importance of balancing safety requirements with the needs of passengers with reduced mobility.

1.3 The Task Force began its work with a BowTie analysis (see DGP/30-IP/1) following DGP-WG/25. This step mapped threats, barriers, and escalation factors linked to the carriage of battery-powered mobility aids in both the cabin and in the cargo compartment. The BowTie analysis generated information used during a subsequent System-Theoretic Process Analysis (STPA) (DGP-30-IP/2). The results of the safety risk assessment are described in detail in paragraph 2.

1.4 DGP-TF/MA concluded that measures needed to be in place to mitigate the risk of thermal runaway in batteries with an unlimited energy capacity. It acknowledged the potential for one incident to result in a catastrophic loss of an airframe with everyone on board. The majority agreed that the status quo, of an unlimited watt hour rating, without any mitigating measures could not be sustained. The loss of an airframe in Korea in 2025, where the source of fire was believed to be a power-bank in the cabin, reinforced the need to act sooner. The approach preferred by the majority was to develop mechanisms that maintain current passenger access for those that require a mobility aid for movement, albeit with some additional communication and advance arrangement measures, and to only introduce mandatory additional safety risk requirements related to state of charge for devices with batteries larger than 300 Wh.

1.5 DGP-TF/MA developed draft amendments to Parts 7 (Operator's responsibilities) and 8 (Provisions concerning passengers and crew) of the Technical Instructions as shown in the appendix. Agreement was reached on all amendments except for the treatment of batteries above 300 Wh when installed in mobility aids. For this provision, two bracketed options are presented in Table 8-1, paragraph e) ii), for the panel's consideration.

## 2. SAFETY RISK ASSESSMENT

### 2.1 BowTie Analysis

2.1.1 The Task Force first conducted a BowTie analysis for mobility aids carried in the cabin and in the cargo compartment. The bowtie diagrams mapped the cause of a thermal runaway and identified barriers that prevent a thermal runaway and escalation factors that weaken the barriers. Consequences

linked to lithium battery thermal runaway and factors that mitigate those consequences were also identified. The analysis identified that the extant controls designed to prevent a lithium battery thermal runaway rely on training and instructions provided to passenger check-in staff and ground handling personnel, and requirements for securing a mobility aid on the aircraft. Notably, smaller aircraft that require the mobility aid to be loaded directly into the cargo compartment places the mobility aid near other baggage that can potentially damage the mobility aid or provide a source of combustible material in the event of a thermal runaway event further weakening barriers to thermal runaway. Recovery barriers designed to mitigate the consequences of a thermal runaway were also identified and include fire detection and suppression systems, flight crew procedures in the event of a fire, the use of fire-resistant containers and fire containment covers, and airport emergency services available after landing. The analyses identified the following factors that weaken existing recovery controls: ineffectiveness of halon fire suppression systems against lithium ion battery fires, varying responses by flight crew, the propensity of thermal runaway to propagate in the battery and spread to adjacent combustible material, and a lack of standards for fire resistant containers and cabin fire containment bags.

2.1.2 The BowTie analysis also highlighted that vulnerabilities from device condition, poor design or the use of batteries not intended for the device could result in a thermal runaway. Non-OEM batteries, ageing cells, and inadequate protection create weak points. If a mobility aid does not shield the battery, damage during handling or stowage can trigger failure. Information flow was another critical barrier. Last-minute disclosures by passengers or incomplete details on device type often undermined risk controls. This was reflected in STPA derived causal scenarios where poor information led to unsafe acceptance or stowage decisions. The BowTie indicated, reducing state-of-charge, and requiring protective design are possible barriers for managing these risks.

## 2.2 System-Theoretic Process Analysis

2.2.1 After the Bowtie Analysis, DGP-TF/MA conducted a System-Theoretic Process Analysis (STPA). This method examined unsafe control actions in the system of passengers, operators, mobility aids, and aircraft. It was conducted through a series of four working group sessions led by a systems safety specialist from the Secretariat between June and August 2025, with experts from regulatory oversight, occurrence investigation, air operations, ground handling services, and dangerous goods. The STPA process followed four steps:

1) Identifying potential losses (life, aircraft, cargo, mission, reputation);

2) Defining hazards that could lead to those losses;

3) Modelling control structures (passenger → operator → ground staff → aircraft systems); and

4) Identifying unsafe control actions and causal scenarios.

2.2.2 Relevant interactions and scenarios that lead to unsafe actions were identified during the workshop sessions. For example, ground staff accepting a mobility aid with a damaged battery due to poor training or time pressure to load an aircraft. Another scenario involved passengers providing incomplete or misleading information at the time of booking, leading to passenger check-in staff relying on faulty information. Stowage practices were also flagged: overtightened straps or poor placement that could damage batteries, while reliance on halon suppression was seen as inadequate if a large battery failed in the cargo compartment. The STPA's findings included:

a) Acceptance personnel often lack the ability to determine the actual safety condition of a mobility aid. Information provided by passengers is frequently incomplete, late, or misleading.

b) Inspection and acceptance protocols are inadequate. They rely heavily on passenger declarations and visual checks, which are not sufficient in most cases to detect damaged or substituted batteries.

c) Stowage practices can introduce additional risks. Incorrect handling or securement may damage the energy source or allow carriage of mobility aids with damaged batteries.

d) Battery energy and fire suppression capabilities are not always aligned. Larger batteries may exceed aircraft fire suppression systems or cabin crew response capacity.

2.2.3 DGP previously reviewed research indicating Watt-hour (Wh) rating and state of charge both influence the likelihood and severity of thermal runaway in lithium-ion batteries (see Report: Summary of FAA Studies Related to the Hazards Produced by Lithium Cells in Thermal Runaway in Aircraft Cargo Compartments (www.fire.tc.faa.gov/pdf/TC-16-37.pdf), DGP-WG/22-IP/9, DGP/28-IP/9):

a) Higher Wh rating means more stored energy. If thermal runaway occurs, the energy released is greater, leading to more intense heat, gas generation, and potential fire or explosion.

b) Higher SoC increases the likelihood and severity of thermal runaway. Fully charged cells have more reactive material, which accelerates exothermic reactions and lowers the onset temperature for runaway events.

2.2.4 Together, the BowTie and STPA provided a structured view of the main hazards, barriers and operational challenges associated with the carriage of passenger owned lithium ion battery powered mobility aids. The findings were organized into a Policy Options Paper, which set out a range of possible measures for consideration. Drawing on this work, the Task Force prepared a draft package of amendments to the Technical Instructions (DGP-30-IP/3). These amendments, described in paragraph 3, translate the analytical results into specific provisions for passengers, operators and States. The Task Force consider the proposed actions ‘first steps’ to address the concerns raised and further work is needed aimed at implementing comprehensive measures to address the risks involved.

## 3. TASK FORCE’S PROPOSAL

3.1 Based on the outcomes of the safety risk assessment and the policy options paper, the Task Force developed proposed amendments to Parts 7 and 8 of the Technical Instructions as presented in the appendix to this working paper. They are intended to improve safety and predictability in the carriage of battery-powered mobility aids.

### 3.2 Part 7 – Operator responsibilities

3.2.1 **Operator approval (7;5.1).** The BowTie analysis showed that lithium ion batteries may exceed aircraft fire suppression capability, and the STPA found that acceptance staff cannot always determine the safety condition of a device. The proposed amendment would require operator approvals to be based on criteria and procedures supported by a safety risk assessment within the safety management system.

3.2.2 **Information to passengers (7;5.2)**. The STPA highlighted late or incomplete information as one factor leading to an operator accepting a potentially damaged or unsafe mobility aid. The proposed amendment would require operators to publish their conditions of carriage, with a recommendation that this information be made available prior to the boarding-pass issuance process, for example on their websites or other sources.

3.3 **Part 8 – General framework for passengers and crew**

3.3.1 **Proof of approval (8;1.1.1).** STPA causal scenarios showed unsafe outcomes when devices were accepted without full attention and examination by the operator. The proposed amendment therefore clarifies that carriage is only permitted once approval has been granted.

3.3.2 **Cross-references (8;1.1.2).** The BowTie and the STPA identified that an absence of specific acceptance and loading practices by the operator can lead to the loading of damaged batteries or damage to mobility aids during the loading process. The proposed amendment clarifies that operator approval, loading, staff information, and reporting requirements in Part 7 remain applicable.

3.4 **Part 8, Table 8-1 – Entry Mobility aids**

3.4.1 **Advance arrangements (paragraph b).** The STPA showed that lack of advance notice can lead to rushed acceptance. The proposed amendment would convert an existing recommended practice in the Technical Instructions for passengers to make advance arrangements with each operator and to provide details of the aid, the battery type, and handling instructions to a requirement. This aligns with existing frameworks such as existing EU Regulation 1107/2006, as the reference to "operator's conditions of carriage" naturally incorporates those obligations.

3.4.2 **Installed batteries above 300 Wh (paragraph e).** The BowTie showed that halon fire suppression systems are ineffective against a lithium ion battery in thermal runaway. Higher battery energy can result in prolonged fires and increased accumulation of gas that exceed what can be managed by suppression systems in either the cabin or the cargo compartment. The STPA confirmed that when mobility aids are carried without any controls, damaged or otherwise unsafe battery powered mobility aids can be loaded onto aircraft. To address this, the Task Force examined different ways of conditioning the carriage of larger batteries. Members agreed that 300 Wh is an appropriate threshold to consider additional controls as a first step. The task force recognized that while a thermal runaway event involving a 300Wh lithium ion battery presents a significant hazard, this is the limit applied to a single removed battery for carriage in the cabin. This presents a straightforward limit on the size of an installed mobility aid battery that can be applied in the Technical Instructions and implemented by operators. However, the Task Force did not reach consensus on how batteries above 300 Wh should be treated. Two possible formulations are therefore presented for the Panel's decision.

a) **Option 1** introduces a condition based on state-of-charge (SoC). Installed batteries above 300 Wh may be accepted provided the indicated SoC does not exceed 25%, unless the operator granting approval agrees to a higher charge or the device has no indicator (some mobility aids do not feature a charge indicator). This would be based on robust safety risk assessment and mitigations deemed necessary by the operator and in the case of a device without a charge indicator, a presumption that the batteries are at or near full charge. This approach introduces a practical control on available energy and provides a pathway for devices with higher-capacity batteries to continue travelling under defined conditions.

b) **Option 2** sets a clear threshold for installed energy. Only batteries up to 300 Wh, or two up to 160 Wh each, may remain installed in the mobility aid. This approach emphasizes predictability and ease of application at acceptance but removes the possibility of carriage of mobility aids with installed batteries exceeding 300 Wh. Clear limits would be easier to communicate to passengers and apply to interline operations but would not provide flexibility to operators that could accept more powerful devices based on a robust safety risk assessment and resultant procedures. Evidence presented by one operator, with a database of 3000 mobility devices, indicates that introducing a hard 300Wh limit would affect less than 3% of mobility devices; the number of affected passengers will be much less than 3% of those who require a mobility aid.

3.4.3 The panel is invited to consider these two formulations, noting that Option 1 provides a conditional pathway for higher-capacity devices, while Option 2 establishes a defined limit on installed battery energy.

## 4. ACTION BY THE DGP

4.1 The DGP is invited to:

a) note the work undertaken by DGP-TF/MA during the 2024–2025 biennium, including the BowTie analysis (IP/1), the STPA (IP/2) and the policy options paper (IP/3);

b) endorse the proposed amendments to Parts 7 and 8 of the Technical Instructions provided in the appendix to this working paper;

c) agree that further work in the next biennium should include:

1) development of guidance material on the approval for carriage of passenger battery powered mobility aids; and

2) consideration of additional safety mitigations such as requiring battery powered mobility aids to have certain design features (charge indicators, battery management systems, circuit breakers, etc), SoC requirements on removed batteries carried in the passenger cabin and the Wh-limit of installed batteries.

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**APÉNDICE**

**PROPUESTAS DE ENMIENDA DE LAS PARTES 7 Y 8 DE LAS INSTRUCCIONES TÉCNICAS**

# Parte 7

# OBLIGACIONES DEL EXPLOTADOR

## Capítulo 5

## DISPOSICIONES RELATIVAS A LOS PASAJEROS Y A LA TRIPULACIÓN

### 5.1 MERCANCÍAS PELIGROSAS PERMITIDAS CON LA APROBACIÓN DEL EXPLOTADOR

5.1.1 El explotador debe establecer criterios y procedimientos operacionales asociados para autorizar a una persona pasajera o miembro de la tripulación a transportar de manera segura mercancías que, según lo dispuesto en la parte 8 de las Instrucciones Técnicas, solo se permiten con la aprobación del explotador. Dichos criterios y procedimientos deben otorgar certeza razonable de que, en el caso de un incendio que involucre las mercancías peligrosas, este pueda detectarse y suprimirse o confinarse suficientemente hasta que el avión lleve a cabo un aterrizaje seguro. La idoneidad de los procedimientos debe demostrarse mediante una evaluación de riesgos de seguridad operacional realizada de conformidad con el sistema de gestión de la seguridad operacional.

*Nota.— Las mercancías peligrosas transportadas en el avión como equipaje facturado están sujetas a la evaluación específica de riesgos de seguridad operacional en el transporte de artículos en el compartimento de carga con arreglo al anexo 6, parte I, capítulo 15.*

### 5.1~~2~~ INFORMACIÓN A LOS PASAJEROS

5.2.1 El explotador debe establecer los requisitos que debe cumplir el público pasajero que solicite la aprobación para transportar mercancías peligrosas cuando esta se requiera según la tabla 8-1 e incluir dichos requisitos en sus condiciones de transporte.

~~5.1.1~~5.2.2 Los explotadores deben informar a los pasajeros acerca de las mercancías peligrosas que está prohibido que transporten a bordo de las aeronaves. El sistema de notificación debe describirse en sus manuales de operaciones y/o en otros manuales pertinentes. Si los pasajeros pueden completar la compra del billete y/o la emisión de la tarjeta de embarque sin que intervenga otra persona, el sistema de notificación debe incluir una confirmación de los pasajeros de que se les ha presentado la información pertinente. La información debe proporcionarse a los pasajeros:

a) en el punto de compra del billete o, si esto no es factible, debe ponerse a disposición de los pasajeros de otra manera antes de que se emita la tarjeta de embarque; y

b) al emitirse la tarjeta de embarque o, cuando no se emite tarjeta de embarque, antes del embarque.

*Nota.— La información puede proporcionarse como texto o en forma gráfica, electrónicamente, u oralmente, conforme a lo descrito en los manuales del explotador.*

~~5.1.25~~5.2.3 El explotador o el agente de despacho del explotador y el explotador de aeropuerto deben asegurarse de que se transmita de manera efectiva a los pasajeros información sobre los tipos de mercancías peligrosas que está prohibido que transporten a bordo de las aeronaves. Esta información debe presentarse en cada lugar del aeropuerto en que se emitan pasajes, se emitan tarjetas de embarque, se reciba el equipaje de los pasajeros, y en las zonas de embarque a las aeronaves; y en cualquier otro lugar en que se emitan tarjetas de embarque para los pasajeros y/o se acepte el equipaje facturado. Esta información debe incluir ejemplos visuales de mercancías peligrosas cuyo transporte a bordo de una aeronave esté prohibido.

~~5.1.35~~5.2.4 El explotador de aeronaves de pasajeros debería proporcionar información sobre las mercancías peligrosas que pueden transportar los pasajeros de conformidad con 8;1.1.2, así como sobre el proceso para solicitar la aprobación de transporte cuando esta se requiera según la tabla 8-1, de modo que la misma esté disponible mediante su sitio web u otras fuentes de información antes de que los pasajeros procedan con la emisión de la tarjeta de embarque.

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# Parte 8

# DISPOSICIONES RELATIVAS A LOS PASAJEROS Y A LA TRIPULACIÓN

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## Capítulo 1

## DISPOSICIONES PARA MERCANCÍAS PELIGROSAS TRANSPORTADAS POR LOS PASAJEROS Y LA TRIPULACIÓN

*Partes de este capítulo resultan afectadas por las discrepancias estatales BR 10, MO 3, US 15, VE 9, VE 10; véase la tabla A-1*

### 1.1 MERCANCÍAS PELIGROSAS TRANSPORTADAS POR LOS PASAJEROS O LA TRIPULACIÓN

1.1.1 Se prohíbe a los pasajeros o la tripulación transportar mercancías peligrosas en el equipaje de mano, el equipaje facturado o en su persona, a menos que las mercancías peligrosas:

a) estén permitidas conforme a la tabla 8-1; ~~y~~

b) sean para uso personal únicamente; y

c) hayan recibido la aprobación de transporte, en caso de que esta sea necesaria.

*Nota.— El proceso de evaluación y concesión de la aprobación por parte del explotador debe basarse en consideraciones relacionadas con la seguridad operacional del vuelo.*

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1.1.2 A excepción de los criterios de concesión de la aprobación establecidos en 7;5.1; las condiciones de carga que figuran en 7;2.13, la información que debe proporcionarse a los empleados conforme a 7;4.2 y las disposiciones sobre notificación previstas en 7;4.4 y 7;4.5, las disposiciones de las presentes Instrucciones no se aplican a las mercancías peligrosas permitidas conforme a la tabla 8-1 cuando dichas mercancías:

a) son transportadas por los pasajeros o la tripulación pasa uso personal únicamente;

b) están contenidas en equipaje que ha quedado separado de su propietario durante el tránsito (p. ej., equipaje extraviado, como el equipaje perdido o erróneamente encaminado); o

c) están contenidas en piezas de equipaje excedente transportado como carga, según se permite conforme a 1;1.1.5.1 h).

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**Tabla 8-1. Disposiciones relativas a mercancías peligrosas transportadas por los pasajeros y la tripulación**

| *Mercancías peligrosas* | *Ubicación* | | *Se requiere aprobación del explotador* | *Restricciones* |
|---|---|---|---|---|
| | *Equipaje facturado* | *Equipaje de mano* | | |
| . . . | | | | |
| 4) Ayudas motrices (p. ej., sillas de ruedas) accionadas por:<br>– baterías/acumuladores derramables;<br>– baterías/acumuladores inderramables de electrolito líquido;<br>– baterías secas;<br>– baterías de níquel-hidruro metálico; o<br>baterías de ion litio | Sí | [véase e)] | Sí | a) para su utilización por pasajeros de movilidad restringida debido ya sea a discapacidad, su estado de salud o edad, o un problema temporal de movilidad (p. ej., pierna fracturada);<br>b) los pasajeros deben~~erían~~ hacer arreglos por anticipado con cada explotador y proporcionar información sobre la ayuda motriz, el tipo de batería(s) instalada(s) y ~~sobre~~ la manipulación de la ayuda motriz (con las instrucciones para aislar la batería) de conformidad con las condiciones de transporte del explotador;<br>c) en el caso de baterías secas o baterías de níquel-hidruro metálico, cada batería debe cumplir la Disposición especial A123 o la A199, respectivamente;<br>d) en el caso de baterías/acumuladores inderramables de electrolito líquido:<br>i) cada batería debe cumplir la Disposición especial A67; y<br>ii) puede transportarse un máximo de una batería de repuesto por pasajero;<br>e) en el caso de baterías de ion litio:<br>i) las baterías deben ser de un tipo que satisfaga las condiciones de cada una de las pruebas del *Manual de Pruebas y Criterios* de las Naciones Unidas, Parte III, subsección 38.3;<br>Opción 1:<br>ii) las ayudas motrices que van con la(s) batería(s) instalada(s) con una potencia total superior a 300 Wh deben tener una capacidad indicada de carga que no sea superior al 25 %, salvo que:<br>1) tengan un nivel de carga mayor; o<br>2) las ayudas motrices no tengan la carga de batería indicada<br>se acepten por el explotador de conformidad con la aprobación que este haya otorgado al pasajero.<br>Opción 2:<br>ii) puede instalarse un máximo de una batería que no sea superior a 300 Wh o dos baterías que no sean superiores a 160 Wh cada una.<br>iii) cuando la ayuda motriz no proporciona protección adecuada a la batería:<br>— la batería debe extraerse conforme a las instrucciones del fabricante;<br>— la batería no debe exceder de 300 Wh;<br>— los bornes de la batería deben protegerse contra cortocircuitos (aislando los bornes, p. ej., |

| *Mercancías peligrosas* | *Ubicación* | | *Se requiere aprobación del explotador* | *Restricciones* |
|---|---|---|---|---|
| | *Equipaje facturado* | *Equipaje de mano* | | |
| | | | | cubriendo con cinta adhesiva los bornes expuestos);<br>— la batería debe protegerse contra daños (p. ej., poniéndola individualmente en una funda protectora); y<br>— la batería debe transportarse en la cabina;<br>iii) puede transportarse un máximo de una batería de repuesto que no exceda de 300 Wh o dos baterías de repuesto que no excedan de 160 Wh cada una. Las baterías de repuesto deben transportarse en la cabina.<br>~~*Nota. — Cuando la(s) batería(s) de litio permanece(n) instalada(s) en la ayuda motriz, no hay límite de vatio/hora.*~~ |

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