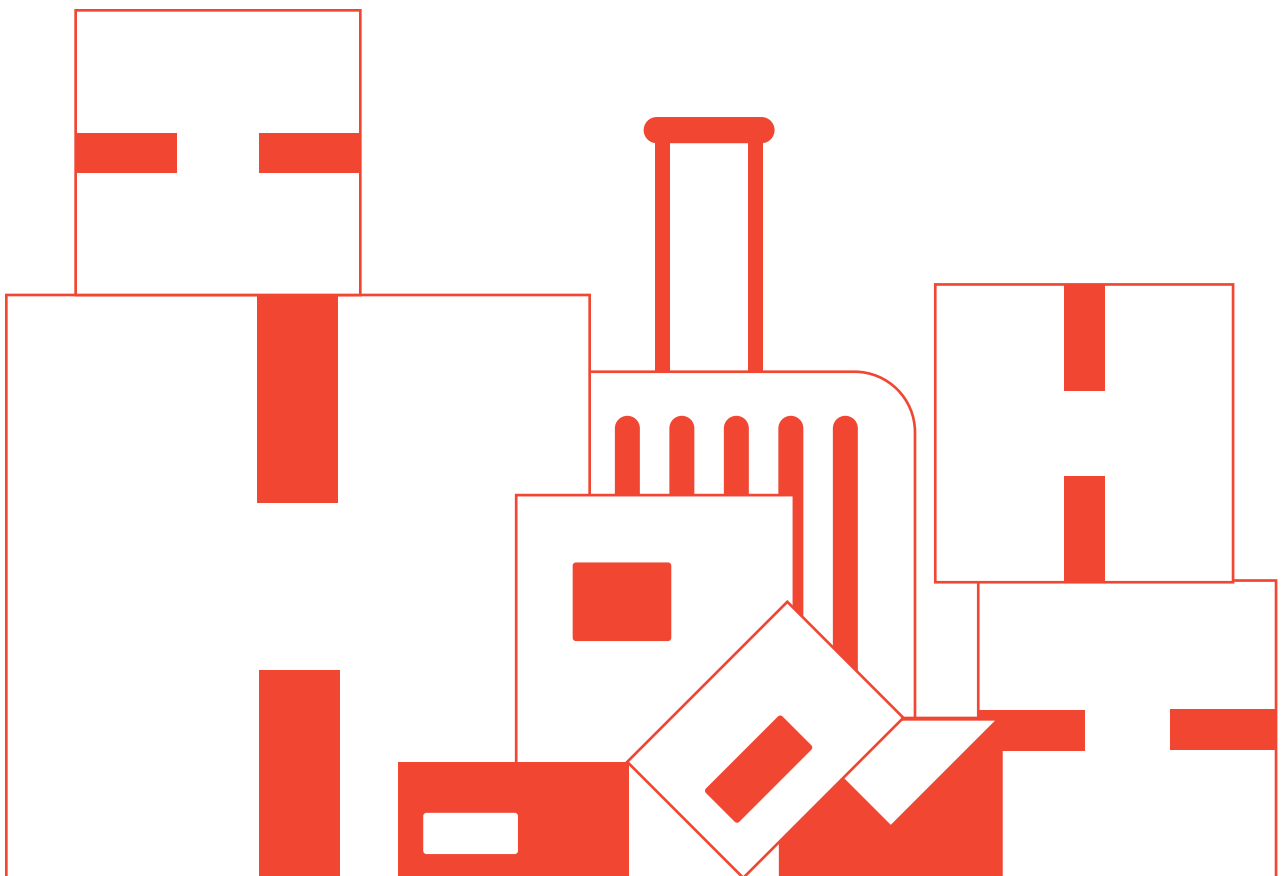


2022

# Carriage of Cargo, Mail and Baggage

## Guidance for Operators

### Edition 1



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## Introduction

In 2015, at the meeting of the International Civil Aviation Organization (ICAO) Dangerous Goods Panel Working Group (DGP-WG/15), the International Coordination Council for Aerospace Industry Association (ICCAIA) and the International Federation of Air Line Pilots' Associations (IFALPA) presented a working paper proposing changes to the ICAO *Technical Instructions for the Safe Transport of Dangerous Goods by Air* (Technical Instructions) on the provisions applicable to the transport of lithium batteries, see [DGP-WG/15-WP/4](#). Included in the working paper was the statement by ICCAIA that:

"The position of ICCAIA is that the fire protection capabilities and certification of original equipment manufacturers' (OEMs) airframes and systems were developed considering the carriage of general cargo and not the unique hazards associated with the carriage of dangerous goods, including lithium batteries."

Following DGP-WG/15 the ICAO Air Navigation Commission (ANC) charged the Flight Operations Panel with the task of introducing requirements into Annex 6 – Operation of Aircraft, for operators to conduct safety risk assessments on the transport of cargo, including the transport of dangerous goods. In support of this provision, the Panel was tasked with the creation and ongoing revision of a guidance manual. This work was conducted on behalf of the Flight Operations Panel by the multi-disciplinary Cargo Safety Sub-Group (CSSG).

The result of that work was the adoption of a new Chapter 15 – Cargo Compartment Safety into ICAO Annex 6 – *Operation of Aircraft, Part I – International Commercial Air Transport – Aeroplanes*, and the associated *Guidance for Safe Operations Involving Aeroplane Cargo Compartments* (Doc 10102).

Chapter 15 to Annex 6 requires that:

"In approving the transport of items in the cargo compartment, the State of the Operator shall ensure that the operator establishes policy and procedures for that purpose which include the conduct of a specific safety risk assessment. The safety risk assessment shall include at least the:

- a) specific hazards associated with the properties of the items to be transported;
- b) capabilities of the operator;
- c) operational considerations (e.g. passenger/cargo, area of operations, diversion time);
- d) capabilities of the aeroplane and its systems (e.g. cargo compartment fire suppression capabilities);
- e) containment characteristics of unit load devices;
- f) packing and packaging;
- g) safety of the supply chain for items to be transported; and
- h) quantity and distribution of dangerous goods items to be transported."

In the context of Annex 6, Chapter 15, and this guidance document, "items" transported in the aeroplane cargo compartment are cargo (including any company materials (COMAT)), mail and baggage.

The strategies outlined in this guidance document [are primarily directed at][include] an operator's internal risk management processes and operational procedures, [although there are strategies for engaging][including engagement] with other entities in the supply chain, such as shippers, freight forwarders, designated postal operators and the travelling public.

This guidance document is divided into cargo operations, focussing on cargo and mail transported in aeroplane cargo compartments, and passenger operations, paying particular attention to both carry-on and checked baggage carried by passengers and crew.



## Objective

The guidance contained in this document is to assist operators to address the conduct of a specific safety risk assessment on the carriage of all items in aeroplane cargo compartments and following that safety risk assessment to identify and implement mitigations that will bring the identified risks to a level that is acceptable for the operator. This is in accordance with the requirements set out in ICAO Annex 6 — *Operation of Aircraft, Part I — International Commercial Air Transport — Aeroplanes*, Chapter 15, and the associated guidance document *Guidance for Safe Operations Involving Aeroplane Cargo Compartments* (Doc 10102). The safety risk management concepts contained in the ICAO Safety Management Manual (SMM) (Doc 9859) are considered in an operationally relevant context.

**Note:**

*Throughout this guidance document, the term “aeroplane” is used consistent with the application of Annex 6, Part I which is limited to “aeroplanes”, i.e. fixed wing and does not apply to helicopters.*

The focus of this guidance is on items carried in aeroplane cargo compartments that pose a fire risk, in that the concern raised by ICCAIA to the DGP and as communicated by the OEMs to the operators, is that the aeroplane fire suppression system may not be capable of suppressing a fire involving certain dangerous goods.

## Scope

It is not intended that the operator perform the specific safety risk assessment mandated in Chapter 15 of Annex 6 for every flight. Rather the specific safety risk assessment is to address the overall operation that involves the transport of items in aeroplane cargo compartments. However, depending on the route structure and types of aeroplanes operated, i.e. passenger and/or all-cargo, the identified risks may differ for certain parts of the operation. Where there is the potential for greater risk, such a higher incidence of reports of undeclared dangerous goods from certain airports, then this should be identified during the safety risk assessment process and additional mitigations implemented to address the higher level of risk.

Where there is a change in the operation, such as the addition of new airports to the route network, revisions to the type of cargo being accepted for carriage or the addition of a new aeroplane type, then the safety risk assessment should be reviewed to ensure that any new hazards that may have been introduced with the change(s) are addressed. Similarly, the safety risk assessment should be subject to periodic review by the operator to ensure that the identified risks and associated mitigations are managed in accordance with the operator’s safety management system.

The hazards associated with the improper loading of aeroplanes when conducting operations that utilise cargo compartments, for example the inadequate securing of loads, or loading items outside of the aeroplane centre of gravity limitations are not considered in this guidance document. An operator must still consider the hazards associated with improper or inadequate loading or restraint of load as part of their ongoing safety risk management processes and must ensure that items are loaded and properly restrained in cargo compartments in accordance with the aeroplane weight and balance manual and company procedures.



# Responsibilities

## General

This guidance document is directed at operators and therefore the bulk of the content is related to actions that the operator should take to address the requirements of Annex 6, Part I, Chapter 15. However, there are responsibilities that apply to other entities in the supply chain so as to ensure that the operators have the required information to support the assessment of potential risks associated with the carriage of items in aeroplane cargo compartments and to implement effective mitigations to ensure a safe operation.

## Operators

The operator is responsible for the identification and mitigation of the risks associated with the carriage of cargo, mail and baggage, "items", that are carried in aeroplane cargo compartments. The specific areas that the operator must consider in conducting the specific safety risk assessment are set out in Annex 6, Part I, Chapter 15.

The safety risk assessment though forms just one part of the operator's overall safety management system (SMS), which must include:

- Establishment and maintenance of policies and procedures that address the carriage of cargo, mail and baggage;
- Development, implementation and maintenance and/or oversight of training programs, including for dangerous goods, for all applicable employees and/or relevant personnel;
- Development, implementation, and maintenance of an open "no fault" reporting culture and investigation process that allows for failures or weaknesses in the policies, procedures, work instructions and training to be identified and rectified.

## Aeroplane Manufacturers / Design Approval Holder

As set out in Annex 6, Part I, Chapter 15, it is the responsibility of the design approval holder (e.g. Type Certificate / Supplementary Type Certificate holder) to ensure that the documentation supporting the operation of the aeroplane, describes the elements of the design associated with cargo compartment fire protection, and a summary of the demonstrated standards that were considered in the process of certification.

This information must be provided to the operator to enable the operator to properly consider limitations or restrictions that may apply to the carriage of items in aeroplane cargo compartments.



# Safety Risk Assessment

## General

When conducting a safety risk assessment, it is essential to first identify the hazards, then assess the likelihood of occurrence, evaluate the severity of the occurrence, and finally determine the appropriate risk mitigation strategies to lower the risk to as low a level as practicable and acceptable to the operator.

The ICAO *Safety Management Manual* (Doc 9859) and ICAO *Guidance for Safe Operations Involving Aeroplane Cargo Compartments* (Doc 10102) contain guidance for both industry and regulators on the conduct of safety risk assessments.

## Identification of the Hazards

### General

The first step in conducting a safety risk assessment is to identify potential hazards associated with the carriage of items that will be loaded in the aeroplane cargo compartments. All hazards, associated with the items loaded in the cargo compartments, that may pose a risk to the safe operation of the aeroplane, must be considered.

The potential hazards will depend on the nature of the operation, which includes the type of operation (e.g. all-cargo, passenger and cargo, or passenger only), types of cargo being uplifted (e.g. general cargo only or a combination of general cargo, mail and dangerous goods), location of the operator's hub (e.g. a location from which large quantities of dangerous goods such as lithium batteries are transported or a place that has easy access to some remote areas) and locations where the operator is operating to (e.g. locations served by only a small number of operators).

Operators should consider the potential entry points for hazards associated with the carriage of cargo, mail, and baggage. These may be internal, such as for aircraft components, e.g. oxygen cylinders, used fuel control units and chemical oxygen generators or materials used to repair and maintain aircraft, e.g. adhesives, two-part epoxy resin kits and paints being shipped from the engineering or stores area. Entry points may also be external such as items presented for carriage from customers (shippers, freight forwarders, designated postal operators or passengers).

Analysis of reports of dangerous goods accidents and dangerous goods incidents should be used as part of the safety risk assessment process. These may identify issues such as incorrect handling of liquids in single packagings (e.g., drums and jerricans), damage to packages from insufficient strapping or lack of restraint in unit load devices (ULD) or bulk loaded cargo compartments. Reports where undeclared or misdeclared dangerous goods were identified in cargo, mail or baggage may indicate that the barriers to the introduction of undeclared dangerous goods are insufficient and should be reviewed and strengthened.

The process of identifying the potential hazards should consider the processes applicable to carriage of cargo, mail, and baggage separately as the hazards and potential risks will differ. In this respect the operator personnel responsible for the safety risk assessment process should include those responsible for the oversight of cargo, mail, and passenger operations. The operator should also ensure that the process for shipping of company materials (COMAT) including the process for the uplift of "aircraft on ground" (AOG) spares is included in the safety risk assessment as there have been many incidents where aircraft components classified as dangerous goods or with residues of dangerous goods (e.g., fuel control units) were loaded onto an aeroplane without being processed through the cargo system as is required for dangerous goods offered as cargo.

Where there is a change to the operation on which the initial safety risk assessment was based, then the operator should re-evaluate the safety risk assessment to determine if the change to the operation may have introduced new hazards. Examples of changes to an operation that may have an impact on a previous safety risk assessment include:

1. a new destination is to be introduced;



2. a new aeroplane type is to be introduced;
3. a new commodity is to be carried / or new business to be commenced;
4. a new operation type (e.g., freighter, charter) is to be commenced;
5. a new ground service provider is contracted;
6. new ULDs or accessories (e.g., fire containment covers, fire-resistant containers) are introduced.

## Specific Hazards

In most cases it will be the inherent properties of the item that will identify it as posing a hazard in transport. In this respect dangerous goods by their definition will form a significant focus of the hazard identification for the items carried in cargo, mail and baggage. For the purposes of the safety risk assessment, the potential hazards in cargo, mail and baggage should be considered separately as the mitigation strategies to address the identified hazards will differ.

## Dangerous Goods

The provisions that apply to the transport of dangerous goods by air, as set out in the IATA Dangerous Goods Regulations (DGR), are intended to facilitate air transport while giving a level of safety such that dangerous goods can be carried without placing an aircraft or its occupants at risk, providing all the applicable requirements in the DGR are fulfilled.

The focus of this guidance document is on dangerous goods that have an inherent hazard that can start or contribute to the intensity of a fire such that the fire may overwhelm the capabilities of the aeroplane fire suppression system. Operators should, in their safety risk assessment also consider other items that can pose a hazard to the health of passengers, crew or other persons such as loading personnel. An example of this is dry ice, which poses an asphyxiation risk in enclosed spaces such as an aeroplane cargo compartment.

Operators that do not hold a specific approval from their civil aviation authority to carry dangerous goods as cargo, as set out in ICAO Annex 6, Part I, Chapter 14 – Dangerous Goods, or that restrict the types of dangerous goods they may transport, should factor this into their safety risk assessment, as that will reduce or eliminate the hazards posed by known dangerous goods in cargo. However, operators must still consider the potential for undeclared dangerous goods to be introduced into cargo and the impact on risk.

## Lithium Batteries

All lithium batteries are classified as dangerous goods. That applies even where the lithium batteries meet the requirements to be prepared in accordance with Section II of the lithium battery packing instructions and are excepted from most of the provisions of the DGR.

Lithium batteries are one example of an item that has the capacity to act as both the ignition (heat source) and the fuel for a subsequent fire, and therefore represent a specific hazard that must be considered. Another unique and significant hazard that may result from a lithium battery thermal runaway event (uncontrollable self-heating), 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 that may cause a failure in the cargo compartment liners exposing the aeroplane systems and structure to the fire.

The risks posed by lithium batteries are not limited to those offered in cargo. Lithium batteries in passenger baggage are also a risk. There continue to be reports of thermal events caused by e-cigarettes, power banks and spare lithium batteries in passenger checked baggage.

Below are some examples of potential hazards that can be found in passenger operations:

- portable electronic devices (PEDs) that are not switched off or in hibernation mode in checked baggage;
- passengers not complying with the regulations, such as by carrying a large number of spare batteries and PEDs in their carry-on and/or checked baggage that are not for personal use or by placing items in their checked bags when they are restricted to carry-on baggage only;



- spare batteries, e-cigarettes or power banks which are contained in carry-on baggage but which due to insufficient space in the overhead bin of the passenger cabin results in the bag being moved to the cargo compartment without removal of the spare batteries, e-cigarettes or power banks.

It is not just shipments of lithium batteries shipped on their own which can pose a hazard, but also other business behaviours associated with consigning these shipments which can also result in significant hazards, such as undeclared or mis-declared consignments containing lithium batteries.

Lithium batteries have become such a common, everyday commodity that they have been taken for granted by consumers, with little thought given to the precautions that need to be taken to ensure lithium batteries do not pose a risk in air transport. This is an issue for passenger checked baggage as well as cargo and mail. Experience has shown that there are shippers who, either deliberately or through ignorance, do not follow the requirements set out in the DGR. Consequently, thermal events involving lithium batteries (including fire) in aeroplane cargo compartments have occurred. It is not always possible to determine the cause of such incidents, but where a cause has been determined, they would appear to be almost invariably due to non-compliance with the Regulations.



Figure 1 – Fire damage to a package of incorrectly packed lithium metal button cells, which occurred after unloading from an aeroplane

## Airmail

Safety concerns are not restricted to baggage and cargo. Mail is carried extensively on board passenger and cargo aeroplanes, both internationally and on relatively short regional and domestic flights. Lithium batteries, whether shipped on their own or packed with equipment, are not permitted in airmail. Lithium batteries are only permitted in airmail services when contained in equipment under specific regulatory exceptions (see "Section II" of Packing Instructions 967 and 970).

Nevertheless, numerous websites advertise lithium batteries for sale with delivery by airmail as an option. Couple this with the fact that many of these batteries may not comply with the regulatory requirements, with the batteries not meeting the testing requirements of subsection 38.3 of the United Nations (UN) *Manual of Tests and Criteria*, incorrectly packaged or lithium ion batteries being shipped alone with the state of charge exceeding 30% of the rated capacity, it is not surprising that there have been a number of incidents involving non-compliant lithium batteries in airmail.



Figure 2 – A non-compliant laptop battery ordered online and sent by airmail, which caught fire shortly after being unloaded from a passenger aircraft

There are provisions that allow for lithium batteries when contained in equipment to be sent by airmail providing the civil aviation authority (CAA) of the State (country) has approved the designated postal operator (DPO) in which the airmail is offered for carriage. However, in many parts of the world, there is a lack of communication between the DPO and the CAA and so the approval system may not be in place in some countries. There may also be other problems, such as:

- the CAA may not have authority over airmail or the DPO, and is therefore unable to exercise the necessary oversight; and
- the DPO may not be subject to the civil aviation regulations.

Consequently, it is recommended that operators carrying airmail should liaise closely with the CAA and DPO in their State and in States where airmail is accepted.

The Universal Postal Union (UPU) provides a list of designated postal operators that have received approval to accept equipment containing lithium batteries in airmail. The dates from which these DPOs have been authorised to accept these mail packages and other related information can be found on the UPU website at the following link:

[https://www.upu.int/en/Postal-Solutions/Programmes-Services/Postal-Supply-Chain/Security#scroll-nav\\_2](https://www.upu.int/en/Postal-Solutions/Programmes-Services/Postal-Supply-Chain/Security#scroll-nav_2)

It is important to note that the approval for the DPO is only valid for international airmail offered in that State. Some of the approved DPOs may have satellite branches established in States outside of their own for which they have received the approval. This practice is commonly known as Extraterritorial Office of Exchange (ETOE), which is a facility in another country belonging to a postal operator outside its national territory. However, an ETOE without an approval granted by the State in which they operate is not permitted to accept equipment containing lithium batteries in airmail.

## **E-commerce**

E-commerce has grown at an unprecedented rate in recent years and is expected to continue to grow by 14.5% year on year globally with some regions having even more significant growth. This rapid growth can be attributed to the maturity of technology, special offers from online vendors, change of purchase behaviour and the wide availability of products to consumers.

The growth of e-commerce not only offers a business opportunity for small start-up companies and retailers, but also logistics players in the supply chain, such as operators as well as freight forwarders. E-commerce is slightly different from the mail business, which primarily handles letters and small parcels, and have limitations on the types of lithium batteries (contained in equipment only) that can be accepted. E-commerce packages are very often transported as traditional air cargo, containing various products (including lithium batteries shipped alone and packed with equipment), consolidated from different sources and these may also be transported in a comparably less rigid and robust packaging. From experience, some of these shipments are initially consigned as a shipper-built unit (BUP), and on arrival at the destination, the units will be broken down by freight forwarders or logistics providers and the individual packages will be re-consigned as domestic postal parcels through local mail service for delivery to the consumer.



The combination of the complexity of e-commerce combined with the vast range of products being offered through e-commerce platforms implies that these packages might have a potentially higher risk level than traditional cargo.

## Assessment of Risk

### General

Following initial identification of the individual hazards and their associated consequences, a safety management system requires an assessment of the risk(s) associated with each of those hazards. This involves ascertaining the probability that a consequence of the identified hazard will occur, and an assessment of the severity, considering all the potential consequences that may occur related to that specific hazard. Operators should have established processes and procedures to assess risk, and these should be used in the first instance. Guidance on these steps, and one example of assessing them, is provided in the subsequent sections of this chapter.

It is essential that operators conduct and document their own safety risk assessments based on their own operational realities. The risks and their severity, the effectiveness of mitigations and controls, as well as the overall risk tolerance, will be unique to each operation. As such, it is important to stress that this document is just guidance and should not be considered as an actual assessment of an operation. In keeping with safety management system (SMS) requirements, it is important to note that any safety risk assessment completed should be regularly reviewed and updated accordingly. This is to ensure that any operational or regulatory changes as well as advances in industry technology are reflected in the final assessment.

### Assess the Likelihood of Occurrence

After identifying the potential hazards, assess the likelihood of the hazards to occur. In this example, there are five levels of occurrence probability:

Likelihood	Description	Value
<b>Frequent</b>	Likely to occur many times (has occurred frequently)	5
<b>Occasional</b>	Likely to occur sometimes (has occurred infrequently)	4
<b>Remote</b>	Unlikely to occur, but possible (has occurred rarely)	3
<b>Improbable</b>	Very unlikely to occur (not known to have occurred)	2
<b>Extremely improbable</b>	Almost inconceivable that the event will occur	1

Table 1 – Possible risk probability



## Evaluate the Severity of the Occurrence

Once the likelihood of occurrence is determined, move forward to evaluate the severity of the hazards in conjunction with the potential consequences caused by the hazards. In a similar way to occurrence probability, there are generally five levels of risk severity:

Severity	Description	Value
<b>Catastrophic</b>	<ul style="list-style-type: none"><li>▪ Aircraft / equipment destroyed</li><li>▪ Multiple deaths</li></ul>	A
<b>Hazardous</b>	<ul style="list-style-type: none"><li>▪ A large reduction in safety margins, physical distresses or a workload such that operational personnel cannot be relied upon to perform their tasks accurately or completely</li><li>▪ Serious injury</li><li>▪ Major equipment damage</li></ul>	B
<b>Major</b>	<ul style="list-style-type: none"><li>▪ A significant reduction in safety margins, a reduction in the ability of operational personnel to cope with adverse operating conditions as a result of an increase in workload or as a result of conditions impairing their efficiency</li><li>▪ Serious incident</li><li>▪ Injury to persons</li></ul>	C
<b>Minor</b>	<ul style="list-style-type: none"><li>▪ Nuisance</li><li>▪ Operating limitations</li><li>▪ Use of emergency procedures</li><li>▪ Minor incident</li></ul>	D
<b>Negligible</b>	<ul style="list-style-type: none"><li>▪ Few consequences</li></ul>	E

Table 2 – Possible safety risk severity

## Risk Index Rating

By combining the occurrence probability and the severity of the risk (i.e. likelihood x severity), a risk index rating can be assigned. This risk index rating will give an indication on how tolerable the risk is and can assist and guide an operator to put more focus and investment on risk mitigation measures for the high-risk areas.

Safety Risk		Severity				
Probability		Catastrophic A	Hazardous B	Major C	Minor D	Negligible E
Frequent	5	5A	5B	5C	5D	5E
Occasional	4	4A	4B	4C	4D	4E
Remote	3	3A	3B	3C	3D	3E
Improbable	2	2A	2B	2C	2D	2E
Extremely improbable	1	1A	1B	1C	1D	1E

Table 3 – Example of a safety risk matrix

Safety Risk Index Range	Safety Risk Description	Recommended Action
5A, 5B, 5C, 4A, 4B, 3A	<b>INTOLERABLE</b>	Take immediate action to mitigate the risk or stop the activity. Perform priority safety risk mitigation to ensure additional or enhanced preventative controls are in place to bring down the safety risk index to tolerable.
5D, 5E, 4C, 4D, 4E, 3B, 3C, 3D, 2A, 2B, 2C, 1A	<b>TOLERABLE</b>	Can be tolerated based on the safety risk mitigation. It may require management decision to accept the risk.
3E, 2D, 2E, 1B, 1C, 1D, 1E	<b>ACCEPTABLE</b>	Acceptable as is. No further safety risk mitigation required.

Table 4 – Possible safety risk tolerability

### Example 1

Below is an example on conducting safety risk assessments with respect to lithium batteries consigned as cargo.

An operator of all-cargo aeroplanes wishes to assess the risk associated with the carriage of cargo from Airport X.

**Likelihood** – A review of dangerous goods incident data shows that there have been a number of reports of dangerous goods incidents where Airport X was the point of origin related to undeclared or non-compliant lithium battery shipments. Consequently, a fire in cargo is possible and likelihood should be Level 4.

**Severity level** – If the cargo catches fire on the main deck of a cargo aeroplane, this may become uncontrollable, resulting in a catastrophic situation. Therefore, the severity level should be catastrophic (A).

Therefore, the risk index would be likelihood (4: Occasional) x severity (A: Catastrophic) = 4A Intolerable.

In this case, the operator should implement additional mitigations to reduce the safety risk into at least the tolerable range although it is preferable to try to achieve a level of risk that is acceptable. Given that the safety risk level is intolerable, all risk mitigations in place should be reviewed. This process should in this case involve



senior representatives from the cargo, engineering, flight operations and safety departments. In considering the review, the following factors should be considered:

**Preventative controls** – lithium batteries must comply with very stringent regulatory requirements before being offered for carriage by air.

**Escalation factors** – shippers' inadvertent or wilful non-compliance with the regulations.

**Escalation controls** – operator considers a system whereby lithium batteries will only be accepted from freight forwarders or shippers who have been previously vetted by the operator.

Despite preventive controls being in place, there is always the possibility that an unsafe event (in this case a lithium battery thermal event) can occur. Consequently, "recovery measures" must be considered (i.e., what can be done to prevent the unsafe event developing into the ultimate consequence, the loss of life or loss of the aeroplane). However, as with preventive controls, recovery measures can also be weakened by escalation factors that need to be controlled.

The following may apply for the example:

**Recovery measure** – fire containment covers (FCC) on all pallets or use of fire-resistant containers (FRC).

**Escalation factor** – FCCs incorrectly applied, reducing their effectiveness.

**Escalation control** – FCCs to be only applied by trained and qualified personnel, and the correct deployment of FCCs verified [and documented] by another qualified staff member.

## Example 2

Below is an example on conducting safety risk assessments with respect to spare lithium batteries, power banks and e-cigarettes carried by passengers that may get into checked baggage.

An operator of passenger aeroplanes within Europe wishes to risk assess the possible risk of spare lithium batteries, power banks and e-cigarettes in checked baggage.

**Likelihood** – Looking at available incident data and the operator's own incident experience, it would be reasonable to assume that spare lithium batteries, power banks and e-cigarettes carried by passengers may get into checked baggage, and so the likelihood in this example is Level 4 (occasional).

**Severity level** – If a lithium battery has a thermal event in checked baggage, the smoke detectors in the cargo compartment will detect if there is any smoke and/or fire. The Halon fire suppression system should be able to adequately suppress any fire and the flight crew will have time to land the aeroplane. Therefore, on the basis that an abnormal flight operations incident procedure would be applied (activation of fire suppression system and diversion to the nearest adequate airport), with few other consequences, it may be appropriate to assign a severity level of C (Major).

Therefore, the risk index would be likelihood (4: Occasional) x severity (C: Major) = 4C "Tolerable"

The following factors should be considered:

**Preventative control** – there is an existing regulatory prohibition on the transport of spare lithium batteries, including power banks and e-cigarettes in checked baggage.

**Escalation factor** – passengers' ignorance of the regulations.

**Escalation control** – operator has a robust process to ensure that all passengers are made aware of the regulatory requirement (e.g., by questioning of passengers at check-in kiosks and / or counters) and where items of carry-on baggage are surrendered to be loaded in the cargo compartment, that ground staff are trained to ask passengers specifically if the baggage item contains any lithium batteries.

Despite preventive controls being in place, there is always the possibility that an unsafe event (in this case a lithium battery thermal event) can occur. Consequently, the operator may consider additional preventative measures (i.e., what additional controls can be implemented to prevent the unsafe event from occurring). The operator may also look at possible recovery measures to prevent a potential fire from developing into the ultimate negative consequence, the loss of life or of the aeroplane.

In the example above, the following may apply:

**Additional preventative control** – the operator requests that the airport operator upgrade the baggage screening process to also detect the presence of lithium batteries in checked baggage.

**Recovery measure** – purchase of FRCs that are to be used for passenger baggage;

**Escalation factor** – damaged FRCs do not properly contain a fire;

**Escalation control** – robust process in place to ensure that all FRCs used for passenger baggage are checked for damage prior to use.

The above elements can be more easily demonstrated, for example, by use of a bowtie risk analysis model, which has been adopted by some operators and regulators. The strength of a bowtie model is that it allows users to easily visualise the assessment and identify the safety barriers that are in place, or lack of them, to minimise the likelihood of an occurrence developing into an unsafe event.

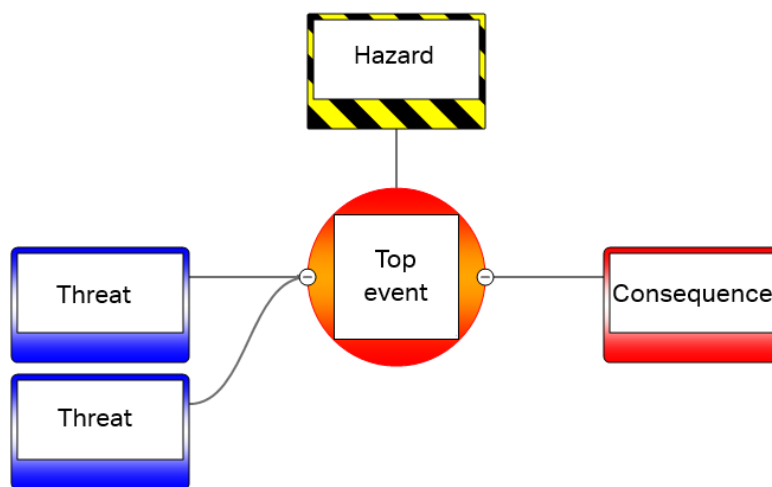


Figure 3 – An example of a bowtie risk analysis model

The bowtie risk analysis model puts the focus around the "Hazard" that can potentially cause damage to the organisation and the "Top event" that will be led by the identified hazard. The threats that can contribute to the top event as well as the ultimate consequence that is to be caused by the top event shall be laid out to the left and right respectively.

This process can stimulate the identification of preventative measures which can eliminate or reduce the threat or prevent the threat from triggering the occurrence of the top event, and allows for the exploration of potential measures to reduce the likelihood of an event or mitigate the severity of the consequence should the top event occur.

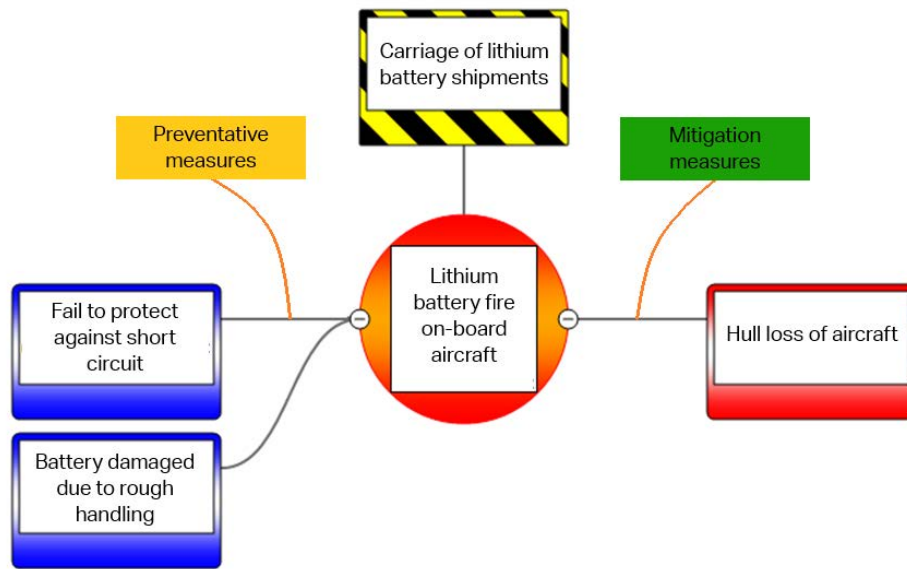


Figure 4 – An example of a bowtie risk analysis model for the carriage of lithium battery shipments

An example of a completed bowtie risk model developed by the UK Civil Aviation Authority can be [downloaded](#) for reference.

The determination of severity levels and likelihood of events can be subjective but it is important that the safety culture of an operator embraces the concept that many activities associated with air transport, such as the carriage of dangerous goods, including lithium batteries, involve risks that must be identified and mitigated by the operator to achieve an acceptable level of safety.





## Mitigation Strategies

Following the completion of the safety risk assessment that identified the hazards and associated risks on the acceptance and carriage of cargo, mail and passenger baggage, the operator then needs to identify appropriate mitigation strategies that will reduce the risks to a level that is acceptable to the operator.

The actions to mitigate an event from potentially resulting in damage to an aeroplane, injury to passengers or crew or hull loss are divided into:

- Preventative actions. The purpose of these is to prevent an event from occurring. Examples of preventative actions include:
  - o dangerous goods training provided to employees responsible for accepting and handling cargo and mail;
  - o signage at cargo acceptance areas giving information about the transport of dangerous goods to alert shippers/agents;
  - o dangerous goods training for employees responsible for passenger check-in and passenger boarding;
  - o signage at passenger check-in and boarding areas to alert passengers about dangerous goods that may be contained in their baggage.
- Recovery actions. These are to try to limit the impact of an event once it has occurred. Examples of recovery actions include the use of fire containment covers on pallets of cargo and the installation of smoke displacement systems on the flight deck. For events in the passenger cabin, well trained cabin crew with documented procedures and equipment to deal with a fire or thermal event involving a portable electronic device.

## Capabilities of the Operator

### General

The operator must assess the robustness of the policies, training, procedures and management controls to ensure that risks associated with the carriage of cargo, mail and baggage are mitigated to the lowest practicable and acceptable level to ensure that the operation is safe.

### Responsibilities

An operator must be able to demonstrate that it exerts sufficient organizational control over internal systems and processes and the use of resources. This is important as compliance with regulation relies heavily on process management to control operational outcomes based on performance. As such, the ability of an operator to control the outcome of key organizational and operational processes becomes integral to the production of services as well as the effective management of the safety risks associated with those services. To achieve these aims, the operator must:

- a) Develop, document and implement appropriate policies and procedures to perform operational processes;
- b) develop and deliver training appropriate to the job function being performed;
- c) allocate appropriate resources to ensure training and processes are effective;
- d) ensure the development, documentation and delivery of an occurrence reporting and investigation system;
- e) ensure that employees are appropriately supervised; and
- f) ensure employees adhere to the operator's documented policies and procedures by use of an internal audit program, with appropriate follow-up, as needed.



The operator's process management should be performance-based taking into account the specific operating environment and operational requirements, ensuring that operational and safety performance alerts and target levels are achieved.

Ultimately, the operator is responsible for all items that are transported on their aeroplane, and this responsibility cannot be transferred. Applicable systems or processes include but are not limited to:

- a) acceptance and handling of cargo, mail and baggage for transport;
- b) loading, stowage, segregation and securing of cargo, mail and baggage;
- c) in flight emergency procedures;
- d) appointment and oversight (audit) of contractors, such as ground service providers;
- e) oversight and audit of implemented processes to ensure compliance; and
- f) occurrence reporting and analysis.

Operators should be mindful that threats may arise due to external factors that are beyond their control. Not all safety risks can be eliminated entirely but operators can consider various approaches to mitigate the risks to as low a level as practicable and acceptable.

Below are some risk mitigation areas that operators should consider:

- training and competency of employees;
- acceptance and handling procedures for cargo, mail, passengers and their baggage;
- outreach and awareness; and
- future asset investment, for example the use of FRC and/or FCC.

## Training and Competency

With the increase in the transport of dangerous goods and the prevalence of lithium batteries and their inherent properties, incidents may occur in cargo, mail and/or baggage, whether through non-compliance with the regulatory requirements, or through damage caused by mishandling during transport. One of the most effective mitigation measures is the appropriate training of employees so they are able to intervene and mitigate an incident or, better still, prevent an incident from occurring.

Employees are required to be competent to perform any function for which they are responsible prior to performing any of these functions. This must be achieved through training and assessment commensurate with the functions for which they are responsible.

With respect to dangerous goods, training can be:

Preventative (i.e. to stop an incident from occurring) and is generally relevant to staff accepting and/or handling cargo, mail and baggage before flight (e.g. dangerous goods and cargo acceptance staff, check-in staff and loaders). Other staff (e.g. sales and reservation staff) can also have a preventative role. Training should concentrate on detection of:

- undeclared dangerous goods shipments;
- damaged packages; and
- mis-declared shipments containing dangerous goods but not in compliance with the regulations (e.g. mis-declaring a power bank (battery) shipment as lithium batteries contained in equipment).

Reactive (i.e. response to an incident involving fire, smoke or fumes) for example for flight and cabin crew or cargo handling employees. It is essential that, in addition to general dangerous goods familiarisation training, these employees receive comprehensive safety training to cover the hazards presented by dangerous goods, including, lithium batteries, including for example the safe handling of cargo and mail and associated emergency procedures.



Incidents also provide data on the effectiveness of the deployed preventative barriers. For this reason, it is critical that operators implement a “just culture” approach to the reporting of dangerous goods incidents. All staff should be encouraged to report all dangerous goods incidents, even when the incident may have occurred as a result of an error or mistake by the staff member, e.g., a unit load device (ULD) falling off a dolly due to the locks not being properly deployed / raised.

Incident reporting and subsequent investigation allows the operator to identify the possible root cause for the incident. This then may lead to a revision of policies, training, procedures or work instructions to strengthen the preventative barriers, which are in place to reduce the exposure to risk.

For operators that have their operational functions outsourced to GSPs, they should ensure that their GSPs follow the same operator principles and their employees are trained and competent prior to performing the functions for which they are responsible on behalf of the operator. To achieve this, operators should implement periodic audit programs and carry out random checks on shipments which have been accepted by GSPs on their behalf.

### **Training for Flight Crew**

If there is a fire in the cargo compartment of the aeroplane, the options available to flight crew are severely limited. During the flight, it is impossible for flight crew to determine whether dangerous goods, including lithium batteries, are involved, or indeed, whether the smoke / fire warning is genuine. It must be appreciated that the notification to captain (NOTOC) will only detail the declared fully regulated dangerous goods being carried as cargo. It should never be assumed that any dangerous goods, including lithium batteries, mentioned on the NOTOC are the source of the fire. Similarly, the absence of dangerous goods on the NOTOC does not necessarily mean that none are being carried; there is always the possibility of undeclared dangerous goods in cargo.

Flight crew should be trained to respond to an emergency suspected of involving lithium batteries carried in the cargo compartment of the aeroplane by following the standard operating procedure for smoke or fire events, the most important aspect of which is: **LAND AS SOON AS POSSIBLE**.

Flight crew of cargo only aeroplanes (freighters) have options not available to those of passenger aeroplanes. Experience has shown that once a fire has become uncontrollable, a catastrophic situation can quickly develop, and it may not be possible to reach a suitable airport in time to land. Should a suitable airport not be within reach, it may be necessary to verify that the smoke / fire warning on the main cargo deck is genuine by visual inspection. Flight crew can also establish the extent and severity of the fire at this time. If this cannot be achieved from the flight deck (e.g., through a porthole), it may be necessary to investigate further. Ideally, someone other than a member of the operating crew should do this, but this may not always be possible (i.e. the operating crew may be the only occupants). If a closer visual inspection is required, this should be done with extreme caution. Flight crew may achieve this by opening the flight deck door as little as possible to obtain a view of the cargo compartment. However, if this is not possible, it may be necessary to access the cargo compartment wearing appropriate personal protective equipment (PPE) such as fire gloves and portable breathing equipment (PBE).

The following are the objectives of visual inspection:

- determine whether smoke or fire is present. Even if there are no signs of smoke or fire, it must not be assumed that the warning was false, and the appropriate procedures, including landing as soon as possible, should still be followed. The situation should be monitored regularly for the remainder of the flight;
- if smoke is present, and a small fire is the obvious source, it may be possible to extinguish the fire using a portable on-board fire extinguisher. After the fire is extinguished, if it is apparent that lithium batteries were involved, they should be doused with copious amounts of water to cool the batteries and prevent reignition. After this has been done, the crew member should return to the flight deck and the appropriate procedures for smoke / fire on the main deck should be followed, with the affected cargo being regularly monitored for the remainder of the flight for any signs of smoke or fire;



- if it is apparent that a large fire is present, no attempt should be made to enter the main deck cargo compartment. In this instance, as well as following the appropriate procedures, consideration should be given to the possibility that continued flight may not be possible and other options (e.g. ditching, forced landing) may need to be considered.

Clearly, the presence of fire on board an aeroplane is an extremely stressful situation for flight crew, which can be made worse should smoke penetrate the flight deck. Consequently, practical emergency training should address the difficulties that will be encountered in continuing to control an aeroplane if there is smoke on the flight deck.

## Acceptance & Handling Procedures – Cargo and Mail

### Acceptance

All cargo must be subject to an acceptance process that determines that the cargo is in a suitable condition for air transport. For other than declared dangerous goods this should include a check of documentation, including for example, house waybills and master air waybills, to check for any indication of the presence of dangerous goods that have not been correctly declared.

The exterior of packages offered as general cargo should also be checked for indications that there are dangerous goods present. The indications could include UN numbers marked on packages, or keywords such as “paint” or “adhesives” printed on packages. However, it is recognised that cargo may be tendered by freight forwarders as a shipper-built unit (BUP) and in these cases it is not possible to physically inspect all of the packages.

Most dangerous goods offered for air transport must be accompanied by a Shipper's Declaration for Dangerous Goods and are subject to a formal acceptance check by the operator to verify, as far as possible, that the information provided on the Shipper's Declaration is in accordance with the DGR requirements for the dangerous goods described, that the packagings are permitted by the applicable packing instruction(s) and that all packages, and overpacks are correctly marked and labelled in accordance with the applicable requirements in the DGR.

### Handling

Operators must implement policies and procedures that ensure that packages are not damaged during handling, including loading into ULDs and aeroplane cargo compartments. This is particularly important for packages containing dangerous goods. Packages must be:

- secured in a ULD or cargo compartment in a manner that will prevent movement;
- protected against damage:
  - during their preparation for transport, for example during handling after acceptance and prior to loading;
  - during flight, for example by the movement of baggage, mail, stores or other cargo.

Whilst an acceptance check is only required when fully regulated dangerous goods are first accepted for carriage by air, when packages are transhipped, operators should verify packages are free from damage or leakage and the marks and labels are still intact (labels and certain marks must be replaced by the operator if they have become lost, detached or illegible after acceptance).

## Outreach & Awareness – Cargo

### Engagement with Shippers

As the originators of cargo, shippers offering compliant shipments are first and foremost key entities for safety compliance. Most operators seldom have direct contact with shippers. However, should there be opportunities to interact with shippers, particularly on the shipping of dangerous goods, including lithium batteries, it is appropriate to remind them that they must have relevant dangerous goods training and must always only offer compliant shipments.



## Warning Notices

Sufficient notices must be prominently displayed at locations where cargo is accepted to alert shippers and freight forwarders about any dangerous goods that may be contained in their shipments. As shippers do not tend to tender shipments to operators directly in traditional cargo operations, it is also worth of displaying similar notices in the premises of freight forwarders and integrators' drop-off counters or service points.

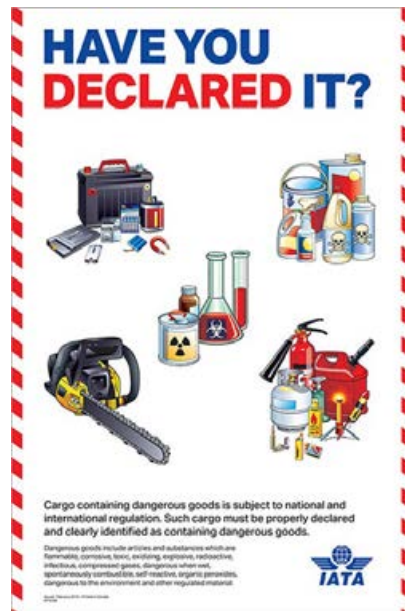


Figure 5 – Dangerous goods warning notice

## Websites

Operators can also inform shippers about dangerous goods transport compliance requirements, the operator's policies and develop their own guidance documents to assist shippers in understanding regulatory requirements related to the transport of dangerous goods, including lithium batteries.

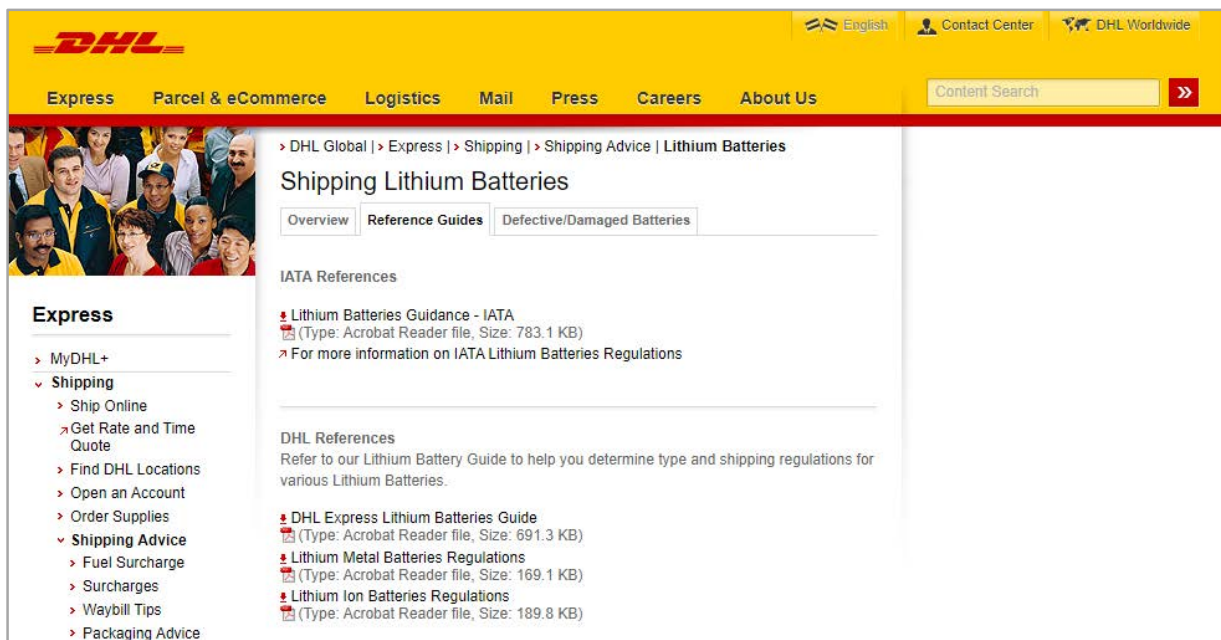


Figure 6 – Website showing additional lithium battery shipment related guidelines

[https://www.dhl.com/en/express/shipping/shipping\\_advice/lithium\\_batteries.html#guides\\_materials](https://www.dhl.com/en/express/shipping/shipping_advice/lithium_batteries.html#guides_materials)



## Passenger Check-in & Handling Procedures

The DGR permits passengers to carry certain dangerous goods in their baggage. Depending on the type of dangerous goods, these may be limited to just carry-on baggage or just checked baggage or may be permitted in both checked and carry-on baggage.

From a risk perspective, lithium batteries are probably dangerous goods that operators should specifically consider in their safety risk assessment. The prevalence of lithium batteries in consumer electronics as well as their use in small vehicles such as hover boards, e-skateboards and e-bikes means that operators should put additional focus on preventative barriers to entry of lithium batteries installed in equipment to ensure that the limits that apply to passenger baggage are enforced. This will require that employees that interact with passengers, such as reservations, check-in and boarding gates have appropriate training on the requirements and restrictions that apply to lithium batteries and equipment containing lithium batteries. These employees should also have easy access to company policies and procedures on the acceptance and handling of such items.

### Check-in

All types of spare batteries (including power banks), including dry batteries (alkaline, zinc carbon, nickel-metal hydride and nickel cadmium) as well as lithium batteries, are forbidden in checked baggage and must only be carried in the passenger cabin. Consequently, if there is a need for carry-on baggage to be loaded in the cargo compartment, e.g., due to a lack of space in the overhead bins, ground staff or cabin crew must ask the passenger to remove spare lithium batteries, including power banks and e-cigarettes, from the baggage before transferring it to the cargo compartment. Batteries removed from baggage must only be carried in the passenger cabin.

Details of the check-in and handling procedures for battery-powered mobility aids can be found in [Battery Powered Wheelchair and Mobility Air Guidance Document \(www.iata.org/dgr-guidance\)](http://www.iata.org/dgr-guidance).

## Outreach & Awareness – Passengers

### Warning Notices

Warning notices must be displayed at check-in counters and self-service check-in and baggage drop locations at airports, warning passengers of the types of dangerous goods prohibited in passenger baggage. It should be noted that these warning notices are often generic in nature and some passengers may simply ignore them. However, it is essential to remind and raise the awareness of passengers to remove any of the prohibited items from their baggage. This applies to both baggage offered at check-in and carry-on baggage.

Check-in staff should seek confirmation from any passenger where there are suspicions that an item of baggage may contain dangerous goods that are not permitted.

Operators should consider specific warnings at airports where there are known problems, such as locations where cheap lithium batteries and lithium battery powered equipment, which be or contain counterfeit or substandard lithium batteries, are widely available for purchase in street markets. At those airports, displaying warning notices at the baggage reclaim areas to warn passengers may also be effective.



## IS YOURS SAFE TO CARRY?

### If in doubt, ASK!

Almost every passenger carries a portable electronic device (PED) with them wherever they travel. Some passengers require a portable medical electronic device (PMED). PED's and PMED's use batteries and the most common type are lithium batteries. There are specific limits covering the types and number of lithium batteries you may carry onboard an aircraft, and these limits are set based on the watt-hour (Wh) rating for lithium ion (rechargeable) batteries or the lithium content for lithium metal (non-rechargeable) batteries.

Passengers also carry spare batteries. The terminals on all spare batteries must be protected to prevent a short circuit. You can do this by taping the terminals, putting batteries individually into plastic bags or using the original battery packaging.

#### Which lithium batteries can I carry and how many can I take?

BATTERY TYPE	BATTERIES POSITION	CARRY-ON BAGGAGE	DAMAGED BAGGAGE	NUMBER OF DEVICES/ SPARE BATTERIES
<b>Rechargeable: up to 100 Wh</b> <b>Non-rechargeable: up to 2 grams</b> • PED or PMED • mobile phones • laptops/tablets/Smart TVs • drones • cameras	Contained within the device	✓	✗	<b>Limits may apply</b> Check with your airline.
<b>Rechargeable: 101-100 Wh</b> • PED or PMED • commercial cameras and video equipment • drones	Contained within the device	✓	✗	<b>Operator approval required—checked carry baggage</b> Limit of two spare batteries: • in original packaging • or with terminals taped
<b>Non-rechargeable: 2 to 8 grams</b> • PMED only	Contained within the device	✓	✗	<b>Operator approval required—checked carry baggage</b> Limit of two spare batteries: • in original packaging • or with terminals taped
<b>Rechargeable: up to 2.7 Wh</b> <b>Non-rechargeable: up to 0.3 grams</b>	Smart luggage Smart Bag Bag tag	✓	✓	Limit one per bag

Wh: Watt-hour (Wh) = Amp-hour (Ah) x Voltage (V)

**Portable electronic devices (PED)**  
 PED include items such as cameras, mobile phones, laptop computers, tablets, shavers and many other devices that contain batteries. When carried by passengers for personal use, these should be carried in carry-on baggage. However, if a PED is carried in checked baggage:  
 • you must take measures to prevent unintentional activation and damage;  
 • your device must be completely switched off (not in sleep or hibernation mode).

**DRONES—RPAS (Remotely Piloted Aircraft Systems)**  
 The same conditions applying to PED's apply to drones. Additional protection from damage may be required for batteries and spare batteries used for drones as these are sometimes gel-type batteries with thicker casings that make them lighter but at the same time they can be more easily damaged.

**Spare lithium batteries—including 'power banks'**  
 Spare batteries must be individually protected to prevent short circuits by placement in the original retail packaging or by otherwise insulating terminals e.g. by taping over exposed terminals or placing each battery in a separate plastic bag or protective pouch.  
 Spare batteries must be carried in carry-on baggage only.  
 'Power banks' and similar articles containing lithium cells or batteries, the primary purpose of which is to provide power to another device, are 'spare batteries' and are restricted to carry-on baggage only.  
 Batteries and cells must be of a type that meets the requirements of the UN Manual of Tests and Criteria, Part II, subsection 38.3.

**Portable electronic smoking devices containing batteries—'e-cigarettes, e-cigs, e-pipes, personal vaporisers, electronic nicotine delivery systems, etc.'**  
 These devices containing batteries, when carried by passengers for personal use, must be in carry-on baggage only. Recharging of these devices and/or their batteries on board an aircraft is not permitted and the passenger must take measures to prevent accidental activation. Spare batteries for these devices are treated the same as all spare lithium batteries.

**Baggage with integrated lithium batteries—'smart luggage'**  
 Baggage with integrated lithium metal batteries with a lithium metal content exceeding 0.3 grams and/or lithium ion batteries with a watt-hour (Wh) rating exceeding 2.7 Wh are forbidden as checked baggage.  
 These devices could include integrated lithium batteries, power banks, motors, GPS, GSM, Bluetooth, RFID or Wi-Fi technology. The presence of the lithium batteries, such as non-removable power banks, can be a breach of various regulatory requirements.  
 Examples of 'smart' luggage include features such as:  
 • Lithium ion battery and motor allowing it to be used as a personal transportation device;  
 • Lithium ion battery power bank that allows charging of other electronic devices;  
 • GPS tracking devices with or without GSM capability;  
 • Bluetooth, RFID and Wi-Fi capability.  
 All PED's carried on an aircraft are subject to specific requirements to ensure that they do not pose a hazard to aircraft systems due to electromagnetic interference.  
 Baggage equipped with a lithium battery are subject to the following:  
 • If checked in, the lithium battery must be removed from the baggage and the lithium battery must be carried in the cabin; or  
 • The baggage must be carried in the cabin.  
 • If the baggage includes a lithium battery or power bank, designed to charge other devices and the battery cannot be removed, the baggage is forbidden in checked baggage and must be carried in the cabin.

dangerous goods. visit [www.casa.gov.au/dg](http://www.casa.gov.au/dg)

Figure 7 – Warning notice aimed at passengers ([http://www.casa.gov.au/wcmswr/assets/main/dg/luggage/lithium\\_battery\\_poster.pdf](http://www.casa.gov.au/wcmswr/assets/main/dg/luggage/lithium_battery_poster.pdf))

In addition to the general warning notices, operators should also consider displaying topical warning notices based on the rising trend of certain items being carried by passengers.

**Federal Aviation Administration**

## Keep them with you!

# ELECTRONIC CIGARETTES & SPARE LITHIUM BATTERIES FORBIDDEN IN CHECKED BAGGAGE

Also remove them from any carry-on bags that are checked at the gate or planeside.

[www.faa.gov/go/PackSafe](http://www.faa.gov/go/PackSafe)

**USING OR CHARGING E-CIGARETTES ONBOARD THE AIRCRAFT IS FORBIDDEN**

Figure 8 – Warning notice on e-cigarettes and spare lithium batteries



Figure 9 – Warning notice on smart bags at check-in counters

## Websites

It is important to warn passengers about the restrictions that apply to dangerous goods in baggage at the earliest opportunity, ideally before they leave home. There are regulatory requirements that online ticket purchases can only be completed once information about dangerous goods has been displayed and an acknowledgement by the passenger that this information has been read and understood. Similar requirements apply to online check-in. These requirements are not fool proof, as the person purchasing the ticket or checking in may not necessarily be the person travelling or may click that they have read the information without actually reading it.

Beyond these specific regulatory requirements for passengers, websites present other excellent opportunities to educate passengers on the limitations regarding the carriage of dangerous goods in baggage.

It is very common for operators to be in commercial alliances with other airlines, or to have code share arrangements to sell space on other operators or for other operators to sell space on their flights. Passengers buying tickets may not be aware of the possible different baggage restrictions for different operators, especially if one operator is imposing a more restrictive policy on dangerous goods permitted in passenger baggage. Operators in an alliance with other operators or with code share agreements are encouraged to include information of each other's policies and requirements on their website and with ticket information.



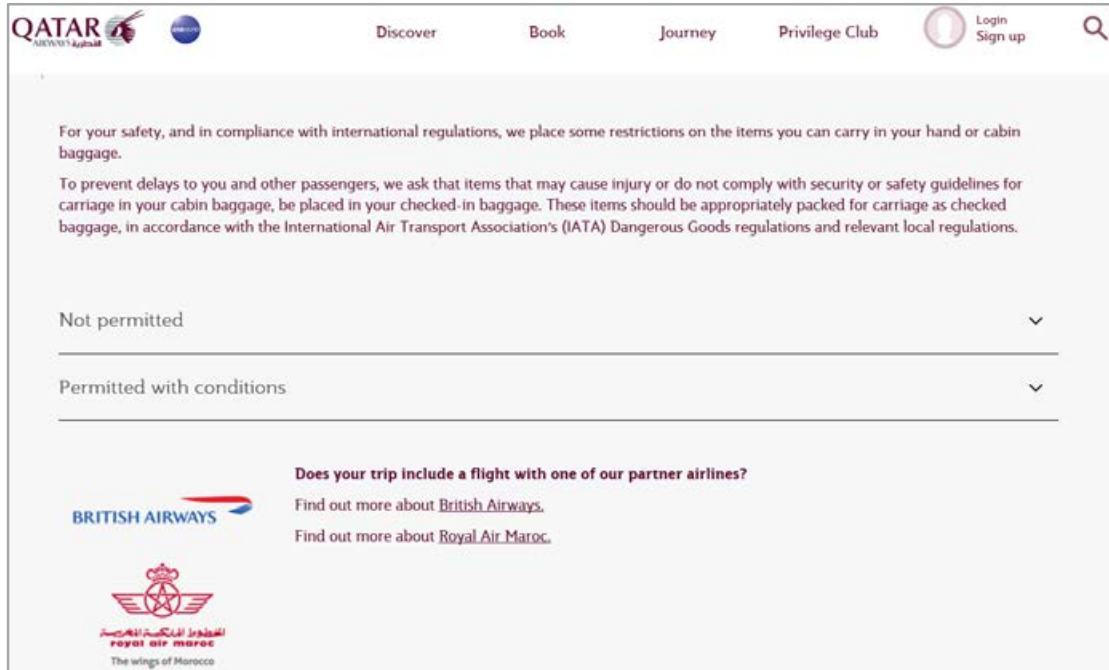


Figure 10 – A website including other operators' baggage restrictions (<https://www.qatarairways.com/en-gb/baggage.html>)

## In-flight Magazines / Entertainment System

Although it is too late to prevent dangerous goods from being carried in a manner that does not comply with the regulatory requirements, an article in an in-flight magazine or a short video clip on the in-flight entertainment system may help passengers pay more attention when packing their baggage for a subsequent flight.

## Arrival Videos

Toward the end of a flight, passengers may be shown an informational video about the city or country that they are visiting. This provides a unique opportunity to inform a "captive" audience about dangerous goods restrictions, including possibly the perils of purchasing cheap, possibly counterfeit and substandard portable electronic devices powered by lithium batteries from market stalls, highlighting the potential safety risks that these devices and batteries can pose.

It is essential for operators to conduct their own safety risk assessment based on their own operational needs and environment, to identify various risk mitigation measures that will reduce the identified risks to as low as practicable to achieve an acceptable level of safety.

## Future Asset Investment

In considering the identified risks resulting from the carriage of cargo, mail and baggage that could include declared and undeclared dangerous goods, operators may wish to consider the adoption of additional measures that will enhance the detection of dangerous goods, including lithium batteries, offered in cargo, mail or passenger checked baggage or that provide flight crew of cargo aeroplane with additional resources to support recovery actions in the event of a fire. Examples of these include:

## Enhanced Security Screening

X-ray screening can be an effective tool in identifying undeclared dangerous goods offered in cargo. However, the algorithms used by x-ray machines in security screening are usually just set to automatically detect explosives. Lithium batteries in small packages are more recognisable through visual x-ray screening techniques compared to those contained in large overpacks or on pallets. Due to the need to better detect undeclared lithium batteries in cargo consignments, work has been carried out in recent years to evaluate the feasibility of detecting lithium batteries in cargo using existing x-ray technology. Some manufacturers of x-ray

screening equipment have developed algorithms that can be incorporated into the machines to offer automated detection of lithium batteries.

### Alkaline



### Nickel Metal Hydride



### Lithium



Figure 11 – X-ray images of different battery types

It is important to note that although the technology is available to detect lithium batteries, authorised airport security companies traditionally and primarily focus on identifying security related items, such as an improvised explosive device (IED), rather than undeclared dangerous goods, including lithium batteries. Therefore, if operators have expectations of being able to detect undeclared lithium batteries in packages, they are encouraged to liaise with the security companies locally to ensure that their expectations are well defined, communicated and executed.

## Smoke Displacement Systems

A smoke-filled cockpit can restrict or completely block a pilot's view of the outside world and essential cockpit instrumentation. Vision can be restored by smoke displacement systems, which use self-inflating transparent plastic envelopes to provide a clear space through which a pilot can see flight instruments and the outside world.



Figure 12 – Smoke displacement system (EVAS – Enhanced vision assurance system)

In February of 2015, the VisionSafe Corporation received Supplemental Type Certification (STC) for the Emergency Vision System (EVAS) Cockpit Smoke Displacement equipment applicable to the Boeing 777. The Boeing 777 is the latest aircraft to get US Federal Aviation Administration (FAA) certified equipment and

includes models B777-200, -200LR, -300, -300LR and the B777F. The company now has EVAS STC's for over 80 aircraft types.

The FAA recommends that aircraft meet higher standards for continuous cockpit smoke protection (FAA AC25.109).

The FAA's concern about cockpit smoke events continues to be a serious problem with event statistics essentially unchanged. The Flight Safety Foundation ranks smoke / fire emergencies as the third highest cause of fatalities. Smoke events are also a leading cause of diversions of extended diversion time operations.

### **Quick-Donning Full-Face Oxygen Masks**

Unlike traditional flight crew oxygen masks, which require two hands to don, newer design oxygen face masks can be donned with just one hand and in a couple of seconds. These newer masks can be used in conjunction with smoke displacement systems.



Figure 13 – Quick-donning full-face oxygen mask

## Operational Considerations

In conducting their specific safety risk assessment, the operator must consider the types of aeroplanes they operator, route structure and their hub(s) of operations through which they operate. The distance to a suitable (diversion) airport required in the case of an emergency during any flight will have an impact on overall risk exposure. In the case of an emergency, the length of time a fire may need to be suppressed until a safe landing can be performed is directly linked to the diversion time.

The longer the delay in landing, the greater the potential for the fire to develop and overwhelm the cargo compartment fire suppression system. For example, an operator with only a short-haul regional or domestic network where flights are largely over land, where all routes have quick and easy access to alternate airports, may reasonably conclude that the overall risk is lower when compared to that of a long-haul operator where the majority of flights may be over oceanic or remote areas.

The mitigations considered in the risk assessment should include the implications of the procedures specific to the class or classes of cargo compartments on the aeroplanes associated with the type of operation.



## Capabilities of the Aeroplane and its Systems

An operator can only conduct a safety risk assessment on the transport of items in an aeroplane cargo compartment if they fully understand the performance capability of the cargo compartment and overall aeroplane systems to handle any identified hazard associated with those items.

As stated in ICAO Annex 6, Part I, Chapter 15, it is the responsibility of the aeroplane manufacturer / design approval holder(s) to provide a core set of technical information to aeroplane operators regarding the technical capabilities of the elements of the aeroplane related to fire detection, suppression, and extinguishing as required by the applicable certification requirements.

It is the elements of the aeroplane fire suppression system, smoke detection, fire suppression agent (Class C cargo compartment only), cargo liners and ventilation controls, that are considered as part of the certification of the aeroplane. It is important for operators to understand that the performance of these elements may be degraded once the aeroplane is in service. For example, the cargo liners may be damaged by improper loading of heavy or bulky items of cargo into the cargo compartment.

The operator must in their safety risk assessment consider the potential for this damage and ensure that the condition of the cargo liners and cargo door seals are addressed in the reporting system for ramp staff and are part of the pre-loading checks by ramp staff for every flight.

To properly risk assess the capabilities of the aeroplane and its systems, the operator must consider the class of cargo compartment(s) in each applicable aeroplane type in their fleet. The current definitions are drawn from European Aviation Safety Agency (EASA) and Federal Aviation Administration (FAA) regulations. Representative aeroplane types that have the class of cargo compartment are provided for information.

A **Class A compartment** is one in which:

- a) the presence of a fire would be easily discovered by a crew member while at their station; and
- b) each part of the compartment is easily accessible in flight.

**Note:**

*Class A cargo compartments were originally intended as storage for crew baggage, rather than for the carriage of cargo, mail or passenger baggage. They are more like stowage compartments than other classes of cargo compartment. Therefore, it is highly unlikely that Class A cargo compartments will need to be part of a formal risk assessment.*

A **Class B compartment** is one in which:

- a) there is sufficient access in flight to enable a crewmember, standing at any one access point and without stepping into the compartment, to extinguish a fire occurring in any part of the compartment using a hand-held fire extinguisher;
- b) when the access provisions are being used, no hazardous quantity of smoke, flames, or extinguishing agent, will enter any compartment occupied by the crew or passengers;
- c) there is a separate approved smoke detector or fire detector system to give warning at a flight crewmember station.

An example is the ATR-72 where the forward and aft cargo compartments are classified as Class B.

A **Class C compartment** is one not meeting the requirements for either a Class A or B, but in which:

- a) there is a separate approved smoke detector or fire detector system to give warning at a flight crewmember station;
- b) there is an approved built-in fire extinguishing or suppression system controllable from the cockpit;
- c) there are means to exclude hazardous quantities of smoke, flames, or extinguishing agent, from any compartment occupied by the crew or passengers;
- d) there are means to control ventilation and drafts within the compartment so that the extinguishing agent used can control any fire that may start within the compartment.

The underfloor cargo compartments on large passenger aeroplanes currently in production, e.g. Airbus A321, A330, Boeing B737-800, B777 are classified as Class C cargo compartments.



A **Class D compartment** is one in which:

- a) a fire occurring in it will be completely confined without endangering the safety of the aircraft or the occupants;
- b) there are means to exclude hazardous quantities of smoke, flames, or other noxious gases, from any compartment occupied by the crew or passengers;
- c) ventilation and drafts are controlled within each compartment so that any fire likely to occur in the compartment will not progress beyond safe limits;
- d) compartment volume cannot exceed 28.3 m<sup>3</sup>.

The underfloor cargo compartments on older model narrow-body passenger aeroplanes, e.g. early build Airbus A320, Boeing B737 and Fokker F28 were classified as Class D cargo compartments. Many of these aircraft have now been upgraded to Class C standard, although in some States there are still aeroplanes operating that still have Class D underfloor cargo compartments.

**Note:**

*Certain Class D cargo compartments were provided with ventilation, in which case a fire detector has also been required. In addition, Class D compartments were historically permitted to be larger, if the volume and the ventilation rate per hour sum to less than 56.6 m<sup>3</sup>.*

A **Class E compartment** is one on aeroplanes used *only* for the carriage of cargo, and in which:

- a) there is a separate approved smoke or fire detector system to give warning at the crewmember station;
- b) there are means to shut off the ventilating airflow to, or within, the compartment, and the controls for these means are accessible to the flight crew in the crew compartment;
- c) there are means to exclude hazardous quantities of smoke, flames, or noxious gases, from the flight crew compartment;
- d) the required crew emergency exits are accessible under any cargo loading condition.

The main-deck cargo compartment on cargo aeroplanes, e.g. Airbus A330-200F and Boeing B747-400F, is classified as Class E. In addition, some cargo aeroplanes have Class E underfloor cargo compartments, e.g. Boeing B767-300F.

A **Class F compartment** must be located on the main deck and is one in which:

- a) there is a separate approved smoke detector or fire detector system to give warning at the crewmember station;
- b) there are means to extinguish or control a fire without requiring a crewmember to enter the compartment;
- c) there are means to exclude hazardous quantities of smoke, flames, or extinguishing agent from any compartment occupied by the crew or passengers.

The Class F cargo compartment is the main deck cargo compartment on a combi aeroplane, i.e. one where the main deck has both a separate passenger cabin and cargo compartment.



The following table provides a summary of the different, commonly classified cargo compartment characteristics.

	Class A	Class B	Class C	Class D	Class E	Class F
<b>Fire Detection</b>	Detection via crew/passenger	Automatic fire (smoke) detection	Automatic fire (smoke) detection	No (automatic) detection except if compartment is ventilated	Automatic fire (smoke) detection	Automatic fire (smoke) detection
<b>Principal Crew Action</b>	Hand-held fire Extinguishing.	Hand-held fire Extinguishing.	Activate fire suppression system	No action unless indication of fire is present	Depressurize and set to a prescribed flight level	Depends on design
<b>Aeroplane firefighting means</b>	Active firefighting via hand-held extinguisher	Active firefighting via hand-held extinguisher	Built-in fire suppression system	Isolation	Flight level procedure, reducing oxygen partial pressure	Depends on design
<b>Fire Fighting Principle</b>	Extinguishing	Extinguishing	Fire suppression via extinguishing agent	Fire containment and oxygen consumption	Oxygen starvation	Depends on design
<b>Post-fire suppression conditions or actions</b>	Monitoring	Monitoring	Suppressed environment until end of flight	(Small) Increase of oxygen partial pressure during descent phase	(Large) Increase of oxygen partial pressure during descent phase	Depends on design
<b>Design steady-state conditions</b>	Extinguished	Extinguished	Suppressed fire with cargo compartment temperature potentially > 200°C	Smouldering fire depending on oxygen concentration left	Similar condition as Class C cargo	Depends on design

Table 5 — Summary of the different cargo compartments characteristics

## Containment Characteristics of Unit Load Devices (ULDs)

The purpose of aircraft unit load devices (ULD), containers and pallet plus net combination, is to ensure that the items loaded into the cargo compartment of a containerised aeroplane are properly restrained in the aeroplane through all phases of flight. "Traditional" ULDs provide no additional fire protection for the items carried in the cargo compartment beyond that provided by the aeroplane fire suppression system.

Based on the safety risk assessment process, operators may wish to consider the use of fire-resistant containers (FRC) or fire containment covers (FCC) or non-ULD type fire containment bags (FCB) as an additional recovery measure that provides additional protections to supplement the capabilities of the aeroplane fire suppression system.

### Fire-Resistant Containers

Fire-resistant containers (FRC) can be used in the same way as traditional certified aircraft containers. They are constructed of fire-resistant material, which meets the requirements of SAE Aerospace (AS) 8992 – *Fire Resistant Container Design, Performance, and Testing Requirements*. The current testing standard for FRC only addresses Class A fires (standard combustible materials such as paper, fibreboard (cardboard), wood and plastic).

There are multiple suppliers on the market, and some FRCs have been demonstrated to be able to contain an internal fire for at least six hours<sup>1</sup>. In terms of use, loading and tie-down, they are the same as the traditional certified aircraft containers.

The latest revision of SAE Aerospace Standards (AS) 8992, *Fire Resistant Container Design, Performance, and Testing Requirements*, provides requirements for the design and production approval for a FRC that can contain Class A fires. An operator may choose to utilise such ULDs to mitigate not only Class A fires, but also small fires involving dangerous goods. If an operator decides to employ FRCs to mitigate the latter, refer to

<sup>1</sup> Refer to FAA TSO-C90e and the latest version of SAE AS8992 for special requirements and fire containment characteristics of certified FRC.



research at <https://www.fire.tc.faa.gov/cargosafety> to learn more about how various FRCs have performed during research tests. An operator may elect to utilise FRCs for:

1. all cargo, mail and baggage loaded into containers;
2. specific items, such as packages containing dangerous goods and/or lithium batteries; or
3. specific flight operations, such as trans-oceanic flights.



Figure 14 – Main deck and lower deck fire-resistant containers

## Fire Containment Covers

Many operators load cargo on open aircraft pallets with nets. For palletised cargo, fire containment covers (FCC) that meet the requirements of SAE AS6453 – *Fire Containment Cover Design, Performance, and Testing Requirements* are deployed over the cargo but under the net may be appropriate.

There are different suppliers on the market and some operators have been deploying FCCs on palletised cargo for many years whilst others are considering their use. Some FCCs currently in production can contain a fire for at least six hours<sup>2</sup>, which can potentially offer more time for flight crew to find the closest suitable [adequate] airport to land should a fire occur in-flight.

In terms of deployment, FCCs can be more complex than FRCs. Depending on the design and make, they can weigh approximately 40 kg to 50 kg, and require at least two trained staff to deploy and remove the cover.

In a similar way to the use of FRC, an operator may consider the use of FCC on palletised cargo to provide enhanced fire safety for similar fires (Class A plus small dangerous goods fires). Refer to Technical Standard Order (TSO)-C203 and <https://www.fire.tc.faa.gov/cargosafety> for information on the required performance of these covers and additional research to supplement the information in the TSO. SAE Aerospace Recommended Practice (ARP) 6905 also addresses the use of these covers. An operator may elect to utilise FCCs for:

1. all cargo and mail loaded on pallets;
2. specific items, such as packages containing dangerous goods and/or lithium batteries; or
3. specific flight operations, such as trans-oceanic flights.

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<sup>2</sup> Refer to FAA TSO-C90e and the latest version of SAE AS6453 for special requirements and fire containment characteristics of certified FCC

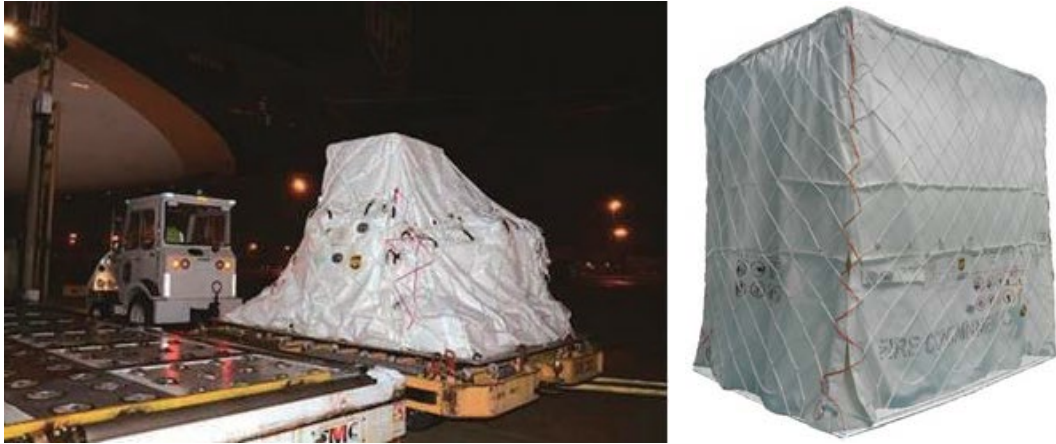


Figure 15 – Fire containment cover for lower deck and main deck deployment

## Fire Containment Bags

The same materials used for the manufacture of FCC are used to produce smaller size fire containment bags (FCB). Due to their smaller size, the deployment process of these bags is comparably simpler when compared to a FCC and can also be used to contain packages or even packages overpacked on wooden skids. Once the FCBs are deployed, they can either be loaded on aircraft pallets or into aircraft containers or even loaded into the cargo compartments of non-containerised (bulk loaded) aeroplanes.



Figure 16 – Fire containment bags loaded on a certified aircraft pallet and in a certified lower deck aircraft container

## Packing and Packaging

There are currently no international standards that apply to packing and packaging for general cargo.

Specific packing and packaging requirements apply for dangerous goods, live animals, perishable goods, pharmaceuticals and life-sciences products as described in the DGR, IATA Live Animals Regulations (LAR), IATA Perishable Cargo Regulations (PCR) and IATA Temperature Control Regulations (TCR).

The purposes of the packing and packaging requirements in these Regulations is to ensure that the particular items are contained in the packaging, which must be strong enough to withstand the shocks and loadings





normally encountered in transport, including removal from a pallet, container or overpack for subsequent manual or mechanical handling.

For dangerous goods in particular, the objective of the packing and packaging requirements is to ensure that the hazard(s) from the contents of the packaging do not pose a risk to the aeroplane or to persons (ground handling staff, air crew and passengers) or to the environment.

In considering this aspect of the specific safety risk assessment, and identified risks and therefore possible mitigations, operators should review dangerous goods incident data for reports of leaks, spillages or damage to packages to understand how the data may be interpreted to evaluate potential risks. Particular attention may need to be paid to single packagings containing liquids, for example metal or plastic drums and jerricans, where these are carried on bulk loaded (non-containerised) aeroplanes.



# Safety of the Supply Chain for Items to be Transported

## General

The operator should have policies and procedures in place to consider the hazards associated with cargo, mail and baggage that the operator will accept for transport. These policies and procedures should include specific actions to prevent undeclared or improperly prepared dangerous goods from being accepted for carriage by air in cargo or mail consignments.

The policies and procedures should also separately consider the potential risks that may be introduced by passengers in items that they pack in checked baggage.

All operators should define and document policies and procedures that address the safety risk control strategy that prevents the entry into air transport of undeclared or misdeclared dangerous goods in cargo or mail consignments.

All operators should also define and document policies and procedures to ensure that all dangerous goods accidents, dangerous goods incidents and occurrences where undeclared or misdeclared dangerous goods are discovered in cargo or mail consignments are reported to the appropriate person or department responsible for investigating safety occurrences. Such reports must also be made to the appropriate authorities of the State of the operator and the State in which this occurred in accordance with the operator's documented procedures.

Operators should also ensure that there are documented procedures to address reporting of dangerous goods incidents involving passenger baggage. This must include a process to ensure that reports are also provided to the appropriate authority of the State in which the incident occurred or was identified.

Based on occurrence reports where undeclared or misdeclared dangerous goods are discovered in cargo or mail consignments, operators should consider implementing additional controls to prevent the entry of such undeclared or misdeclared dangerous goods into air transport. These controls may include, but are not limited to, communication with shippers and/or freight forwarders that have offered undeclared dangerous goods to require that the shipper and freight forwarder develops and implements additional measures to better detect and prevent undeclared dangerous goods from being offered or accepted for air transport.

Operators must satisfy themselves that the procedures implemented by their agents and/or customers are effective in preventing the introduction of potential risks posed by the carriage of cargo and mail, including risks from dangerous goods.

Operators should work closely with their State CAA and discuss trends or areas of risk in their operations. States are responsible for appropriate surveillance, oversight, and when applicable, enforcement action on the entities in the supply chain, that do not conduct business in accordance with international rules, regulations, and applicable laws.

## Operator Approval

In order to ensure that a certain level of safety of the supply chain for items to be transported can be accomplished, operators can consider introducing an operator approval scheme for accepting items that may have greater hazards.

For instance, incidents related to lithium batteries that have occurred have usually been caused by non-compliance with the DGR, but not all have been for undeclared shipments. While they may have been accompanied by a Shipper's Declaration, the batteries may not have been adequately protected against short-circuit when packed by the shipper / packer. Consequently, operators may wish to consider, as one of the available risk mitigation measures, accepting lithium batteries, especially batteries shipped alone (without the equipment) only from pre-approved shippers and freight forwarders. When establishing the approval process, operators can consider the following factors:

- details on types and sizes of lithium batteries, Watt-hour ratings (lithium ion batteries only), and quantities to be shipped;



- confirmation that the lithium batteries are of a type that have successfully passed the UN 38.3 tests\*;
- details on how the lithium batteries are packed, including information on battery protection and terminal protection;
- the credibility of the battery manufacturers, shippers and freight forwarders; and
- the dangerous goods training and procedures applied by shippers and freight forwarders.

Such approval process could then provide better visibility to the operator on what is being accepted.

\* Manufacturers and subsequent distributors of cells or batteries manufactured after 30 June 2003 must make available the test summary as specified in the UN Manual of Tests and Criteria, Part III, sub-section 38.3, paragraph 38.3.5. This test summary can be made available electronically or in printed format and is also applicable to cells, other than button cells, and batteries that are contained in equipment. The test summary is not required to accompany every shipment, but it can be one of the documents to be considered when approving the carriage of certain battery types.

## Acceptance of General Cargo

In addition to having an established approval process with appointed cargo agents for certain dangerous goods, the potential hazard(s) posed by general cargo must not be ignored as general cargo may contain undeclared or is-declared dangerous goods. Additional efforts must therefore be made to detect any undeclared or mis-declared dangerous goods. This could include implementing:

- enhanced cargo acceptance processes and training to better detect non-compliant shipments. This could include greater scrutiny of the descriptions of goods on accompanying paperwork. For example, items described on an air waybill as “electrical / electronic equipment” or “film crew and media equipment” or “no battery” when the product described is an electronic device, which may contain lithium batteries;
- establish a system to screen the description of goods shown on both the master air waybill data (FWB) and house manifest data (FHL), if applicable, to help detect undeclared or mis-declared dangerous goods consignments;
- additional training for ground service providers and cargo terminal personnel to better detect undeclared dangerous goods shipments, raising awareness of the need to detect and remove damaged packages from the transport stream;
- carry out risk-based target or random screening, by means of x-ray technology or physical hand searching of cargo, if applicable. Coordinate with appointed security screening companies on the screening requirements to be able to detect undeclared lithium battery shipments and jointly establish a seamless communication procedure;
- in cases where dangerous goods and lithium battery shipments are not accepted (for either regulatory or operators’ policy), operators may consider other more restrictive measures, such as not allowing shipper-built units (BUP) and prohibiting the use of opaque plastic sheeting covering cargo (at package level and skid level);
- coordinate closely with competent authorities to ensure that undeclared dangerous goods, including lithium batteries, are reported to the appropriate authority of the State of the operator and the State in which it occurred in accordance with DGR paragraph 9.6.5.

## Obligations on Shippers / Freight Forwarders

Operators should require that all shippers and freight forwarders (cargo agents) appointed from which they accept cargo consignments, implement safety procedures to prevent the introduction of undeclared or misdeclared dangerous goods in cargo. These safety procedures should include as a minimum:

- Provision of dangerous goods training to all persons employed by, or contracted to, the shipper, and freight forwarders that process information or documentation on cargo consignments, or that handle



cargo. This dangerous goods training should be competency-based and commensurate with the functions for which the persons are responsible.

- That freight forwarders develop and implement policies and procedures to detect undeclared or misdeclared dangerous goods and to remove them from cargo being offered for air transport.
- Policies and procedures to ensure that all cargo offered for air transport by a shipper, or another forwarder (co-loading) includes a clear description of the contents of all pieces being offered for air transport. The description of the contents should be sufficiently detailed to permit the operator to verify that the cargo does not contain undeclared or misdeclared dangerous goods.
- Policies and procedures to ensure that all occurrences where undeclared or misdeclared dangerous goods are discovered in cargo to be offered for air transport are reported to the civil aviation authority in the State where the undeclared or misdeclared dangerous goods were discovered.
- Where undeclared or misdeclared dangerous goods are discovered in cargo consignments, implementation of additional controls and barriers to prevent the entry of undeclared or misdeclared dangerous goods.
- Policies and procedures to ensure that pre-built ULDs are offered in an airworthy condition.

Shippers and freight forwarders should confirm to the operator that safety policies and procedures as described above have been developed and implemented.

## Obligations on Designated Postal Operators

Operators should require that all designated postal operators (DPO) from which they agree to accept mail consignments implement safety procedures to prevent the introduction of undeclared or misdeclared dangerous goods in cargo. These safety procedures should include as a minimum:

- Provision of dangerous goods training to all persons employed by, or contracted to, the DPO that accept [packets][parcels], or that handle [packets][parcels],..
- Development and implementation of policies and procedures to detect undeclared or misdeclared dangerous goods and to remove these from mail to be offered for air transport.
- Policies and procedures to ensure that all occurrences where undeclared or misdeclared dangerous goods are discovered in mail offered for air transport are reported to the national aviation authority in State where the undeclared or misdeclared dangerous goods were discovered and to the Universal Postal Union.
- Where undeclared or misdeclared dangerous goods are discovered in mail, implementation of additional controls and barriers to prevent the entry of undeclared or misdeclared dangerous goods.
- Policies and procedures to ensure that where the DPO offers mail in a ULDs that the ULD is in an airworthy condition.

The DPO should confirm to the operator that safety policies and procedures as described above have been developed and implemented.

## Quantity and Distribution of Dangerous Goods Items to be Transported

The quantity and distribution of items transported in the cargo compartment of an aeroplane depends mainly on the aeroplane type and on the available cargo capacity and space on board. An operator should give consideration to the potential mitigations against the identified hazard that may be achieved by restricting the quantity of dangerous goods in a cargo compartment or by defining the distribution of items on the aeroplane.

Separation and segregation requirements are in place for declared dangerous goods, and packages of dangerous goods bearing the "Cargo Aircraft Only" label must be loaded in accordance with the paragraph 9.3.4 of the DGR, either in a Class C cargo compartment or accessible on the main deck.



There is no proven correlation between the quantity of dangerous goods and the probability of a fire or other events taking place in aeroplane cargo compartments. However, some considerations can be given to strategies to reduce the severity of a fire or other events should they occur from the items being carried in the aeroplane cargo compartments.

For example, (standalone) lithium batteries (UN 3090 or UN 3480), must be segregated from other dangerous goods classified in Class 1 (explosives) other than Division 1.4S, Division 2.1 (flammable gases), Class 3 (flammable liquids), Division 4.1 (flammable solids) and Division 5.1 (oxidizers).

There are no specific regulatory requirements addressing where lithium batteries should be loaded on an aeroplane; operators may wish to consider loading them in a Class C cargo compartment and when doing so, avoid loading near critical avionic systems.

For lithium batteries packed with equipment or contained in equipment, there are no specific regulatory requirements for segregation and loading. Operators may also wish to consider the same restrictions mentioned above for these shipments.

To identify how declared shipments, which are not required to be segregated by the DGR, can be identified and loaded, operators can identify shipments by way of the Shipper's Declaration and from information on an air waybill (AWB), if applicable.



## Appendix A – Glossary

### General

The following is a list of definitions of commonly used terms, in this guidance. Definitions of terms which have their usual dictionary meanings or are used in the common technical sense, are not included.

**Baggage.** Personal property of passengers or crew carried on an aircraft by agreement with the operator.

**Baggage, carry-on** Baggage of which the passenger or crew retains custody, also known as cabin or hand baggage.

**Baggage, checked** Baggage of which the operator takes sole custody, which is intended to be transported on the same flight(s) and for which the operator has issued a baggage check.

**Cargo** For the purposes of this guidance, any property carried on an aircraft other than mail and accompanied or mishandled baggage.

**Note:**

*This definition differs from the definition of "cargo" given in Annex 9 — Facilitation and Annex 17 - Security, which does not include stores within the definition of cargo.*

**COMAT** Operator material carried on an operator's aircraft for the operator's own purposes.

**Hazard** A condition or an object with the potential to cause or contribute to an aircraft incident or accident.

**Mail** Dispatches of correspondence and other items tendered by, and intended for delivery to, postal services in accordance with the rules of the Universal Postal Union (UPU).

**Mishandled baggage** Baggage involuntarily, or inadvertently, separated from passengers or crew.

**Overpack** An enclosure used by a single shipper to contain one or more packages and to form one handling unit for convenience of handling and stowage.

**Package** The complete product of the packing operation, consisting of the packaging and its contents prepared for transport.

**Packaging** One or more receptacles and any other components or materials necessary for the receptacles to perform their containment and other safety functions.

**Risk** See *Safety risk*.

**Risk mitigation** The process of incorporating defences, preventive controls or recovery measures to lower the severity and/or likelihood of a hazard's projected consequence.

**Safety** The state in which risks associated with aviation activities, related to, or in direct support of the operation of aircraft, are reduced and controlled to an acceptable level.

**Safety management system (SMS)** A systematic approach to managing safety, including the necessary organizational structures, accountability, responsibilities, policies and procedures.

**Safety performance** A State's or service provider's safety achievement as defined by its safety performance targets and safety performance indicators.

**Safety performance indicator.** A data-based parameter used for monitoring and assessing safety performance.

**Safety risk.** The predicted probability and severity of the consequences or outcomes of a hazard.

**Type certificate.** A document issued by a Contracting State to define the design of an aircraft, engine or propeller type and to certify that this design meets the appropriate airworthiness requirements of that State.

**Unaccompanied baggage.** Baggage that is transported as cargo and may or may not be carried on the same aircraft with the person to whom it belongs.



**Unit load device.** Any type of freight container, aircraft container, aircraft pallet with a net, or aircraft pallet with a net over an igloo.

**Note:**

*An overpack is not included in this definition.*



## Supplementary Information

### Cargo

Organisation	Subject	URL
<b>Federal Aviation Administration</b>	Lithium battery safety resources	<a href="https://www.faa.gov/hazmat/resources/lithium_batteries/">https://www.faa.gov/hazmat/resources/lithium_batteries/</a>
	Lithium battery basics	<a href="https://www.faa.gov/tv/?mediald=1951">https://www.faa.gov/tv/?mediald=1951</a>
	SafeCargo for Shippers & Startups	<a href="https://www.faa.gov/hazmat/safecargo/">https://www.faa.gov/hazmat/safecargo/</a>
<b>IATA</b>	Lithium batteries	<a href="https://www.iata.org/lithiumbatteries">https://www.iata.org/lithiumbatteries</a>
<b>Transport Canada</b>	Shipping and importing devices containing lithium batteries	<a href="https://www.tc.gc.ca/eng/tdg/shipping-importing-devices-containing-lithium-batteries.html">https://www.tc.gc.ca/eng/tdg/shipping-importing-devices-containing-lithium-batteries.html</a>
	Safety alerts: transportation of lithium ion or lithium metal batteries as cargo on aircraft	<a href="https://www.tc.gc.ca/en/services/aviation/reference-centre/safety-alerts/transportation-lithium-ion-lithium-metal-batteries-cargo-aircraft.html">https://www.tc.gc.ca/en/services/aviation/reference-centre/safety-alerts/transportation-lithium-ion-lithium-metal-batteries-cargo-aircraft.html</a>
<b>UK Royal Mail</b>	Prohibited and restricted items	<a href="https://personal.help.royalmail.com/app/answers/detail/a_id/96">https://personal.help.royalmail.com/app/answers/detail/a_id/96</a>
<b>UK Civil Aviation Authority &amp; Federal Aviation Administration</b>	Posting lithium batteries in the mail	<a href="https://www.youtube.com/watch?v=nGhLA7brx44&amp;list=PLig80S1opAEK_Ys1lmbatqCxNwEUUc0cB&amp;index=4&amp;t=0s">https://www.youtube.com/watch?v=nGhLA7brx44&amp;list=PLig80S1opAEK_Ys1lmbatqCxNwEUUc0cB&amp;index=4&amp;t=0s</a>
	Lithium batteries: guidance for cargo and ramp personnel	<a href="https://www.youtube.com/watch?v=UmESPM3U5T4&amp;list=PLig80S1opAEK_Ys1lmbatqCxNwEUUc0cB&amp;index=6">https://www.youtube.com/watch?v=UmESPM3U5T4&amp;list=PLig80S1opAEK_Ys1lmbatqCxNwEUUc0cB&amp;index=6</a>

### Passenger

Organisation	Subject	URL
<b>Australian Civil Aviation Safety Authority</b>	Least wanted dangerous goods	<a href="https://www.casa.gov.au/safety-management/dangerous-goods/least-wanted-dangerous-goods">https://www.casa.gov.au/safety-management/dangerous-goods/least-wanted-dangerous-goods</a>
	Travelling safely with batteries and portable power banks	<a href="https://www.casa.gov.au/standard-page/travelling-safely-batteries">https://www.casa.gov.au/standard-page/travelling-safely-batteries</a>
	Before you pack your bags	<a href="https://www.casa.gov.au/safety-management/dangerous-goods/you-pack-your-bags">https://www.casa.gov.au/safety-management/dangerous-goods/you-pack-your-bags</a>
<b>Federal Aviation Administration</b>	Pack Safe	<a href="https://www.faa.gov/hazmat/packsafe/">https://www.faa.gov/hazmat/packsafe/</a>
<b>IATA</b>	Travelling with portable electronic devices (PEDs)	<a href="https://www.iata.org/ped">https://www.iata.org/ped</a>
<b>Transport Canada</b>	Safety alerts: the possibility of smoke or fire from electronic flight bags (EFBs) or their lithium ion batteries	<a href="https://www.tc.gc.ca/en/services/aviation/reference-centre/safety-alerts/possibility-smoke-fire-electronic-flight-bags-lithium-ion-batteries.html">https://www.tc.gc.ca/en/services/aviation/reference-centre/safety-alerts/possibility-smoke-fire-electronic-flight-bags-lithium-ion-batteries.html</a>
<b>UK Civil Aviation Authority</b>	One team one goal – guidance on the safe loading and transport of electric mobility aids	<a href="https://www.youtube.com/watch?v=IFyEVckQEjc">https://www.youtube.com/watch?v=IFyEVckQEjc</a>
<b>UK Civil Aviation Authority &amp; Federal Aviation Administration</b>	Lithium batteries: guidance for crew	<a href="https://www.youtube.com/watch?v=pOiwEW54xL8&amp;list=PLig80S1opAEK_Ys1lmbatqCxNwEUUc0cB&amp;index=4">https://www.youtube.com/watch?v=pOiwEW54xL8&amp;list=PLig80S1opAEK_Ys1lmbatqCxNwEUUc0cB&amp;index=4</a>
	Lithium batteries: guidance for passenger handling staff	<a href="https://www.youtube.com/watch?v=cJ7r91IZYOc&amp;list=PLig80S1opAEK_Ys1lmbatqCxNwEUUc0cB&amp;index=5">https://www.youtube.com/watch?v=cJ7r91IZYOc&amp;list=PLig80S1opAEK_Ys1lmbatqCxNwEUUc0cB&amp;index=5</a>



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