



ICAO

Doc 10102

Guidance for Safe Operations Involving Aeroplane Cargo Compartments

First Edition, 2020



Approved by and published under the authority of the Secretary General



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INTERNATIONAL CIVIL AVIATION ORGANIZATION

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AMENDMENTS

Amendments are announced in the supplements to the *Products and Services Catalogue*; the Catalogue and its supplements are available on the ICAO website at www.icao.int. The space below is provided to keep a record of such amendments.

RECORD OF AMENDMENTS AND CORRIGENDA

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FOREWORD

This manual, referenced in ICAO Annex 6 — *Operation of Aircraft*, Part I — *International Commercial Air Transport — Aeroplanes*, provides guidance material that addresses the safety risks associated with operations that involve the transport of items in the cargo compartments of an aeroplane. It also provides guidance material to assist States, civil aviation authorities, and the operators under their jurisdiction, in the development and/or implementation of prescriptive regulations and processes to address the provisions detailed in Chapter 15 of Annex 6, Part I.

The technological leaps in aviation made over the last century would not have been possible without parallel achievements in the control and reduction of safety risks. It is only through the disciplined application of the best safety risk management practices that the frequency and severity of aviation occurrences can continue to decline. Guidance for the hazards associated with the transport of items in aeroplane cargo compartments was previously not provided in ICAO Annex 6, Part I, and while the subject of dangerous goods was addressed in Chapter 14, other items regularly transported were not considered, and the functional capabilities of cargo compartments themselves were not directly addressed. This lack of detail in Annex 6 may have resulted in levels of risk that were higher than an operator realized, due to a lack of awareness of the limitations of the relevant aeroplane systems.

Provisions introduced through Amendment 44 to Annex 6, Part I establish the responsibility of operators to fully understand the risks associated with any items transported in the cargo compartments of their aeroplanes, while identifying the need for Type Certificate (TC) holders, Supplemental Type Certificate (STC) holders, and the original equipment manufacturers (OEM) to provide the necessary information on relevant aircraft systems and additional equipment to operators for them to adequately assess risks. Many civil aviation authorities are increasing emphasis on a risk-based approach to regulatory compliance. Many operators have the capability and resources necessary to analyse operational hazards, manage safety risks to levels as low as reasonably practicable and achieve target levels of safety performance. Together, these elements provide operational flexibility and form the framework for a proactive, self-correcting and continually improving safety system.

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EXECUTIVE SUMMARY

Various stakeholders within the global aviation community have highlighted that risks posed by the transport of cargo by air may not be sufficiently mitigated. In particular, the hazards and risks associated with items to be transported contributing to an overwhelming situation for the aircraft or aircraft systems during any potential incident are not fully considered. During discussions on risks posed by the transport of lithium batteries by air, it was identified that the safety capabilities of aircraft systems may not be fully considered in either the dangerous goods regulations or operator procedures. A need for provisions and guidance material for operators to conduct safety risk assessments on the transport of cargo was therefore determined.

Consequently, the Air Navigation Commission charged the Flight Operations Panel (FLTOSP) with the task of introducing provisions into Annex 6 — *Operation of Aircraft* for operators to conduct safety risk assessments on the transport of cargo, including the transport of dangerous goods. The provisions developed by FLTOSP were subsequently adopted by the ICAO Council through Amendment 44 to Annex 6, Part I — *International Commercial Air Transport — Aeroplanes*. The FLTOSP was also tasked with the creation and ongoing revision of this manual to support these provisions. Work was conducted on behalf of the FLTOSP by the multi-disciplinary Cargo Safety Sub-Group (CSSG).

The primary goal in formulating this manual is to maintain the safety of flight operations. First and foremost, the manual provides guidance material to support operators in the conduct of a safety risk assessment for operations that utilize the cargo compartments of their aeroplanes, from hazard identification and an assessment of the probability and severity, to the consideration of mitigation strategies. Second, the manual provides guidance for Type Certificate (TC) holders, Supplemental Type Certificate (STC) holders, or original equipment manufacturers (OEMs) regarding technical information (specifications, capabilities and certification requirements of pertinent aircraft systems) they should provide to operators in order for it to be adequately considered by an operator in a risk assessment process.

Although all hazards must be considered, special focus is given to hazards with the consequence of fire, as this can have a significant impact on the airworthiness of the aeroplane. The risk assessment is not intended to be conducted on a flight-by-flight basis, but should be revisited periodically as part of the operator's overall safety management activities. It should consider risks associated with any item transported in the cargo compartment, irrespective of whether it is contained in cargo, baggage, or mail.

GLOSSARY

ACRONYMS AND ABBREVIATIONS

ANC	Air Navigation Commission
CAA	Civil Aviation Authority
COMAT	Operator material
CSSG	Cargo Safety Sub-Group
DG	Dangerous goods
DPO	Designated postal operator
EDTO	Extended diversion time operations
FCC	Fire containment cover
FRC	Fire-resistant container
OEM	Original equipment manufacturer
PED	Portable electronic device
SRM	Safety risk management
SMM	<i>Safety Management Manual</i> (Doc 9859)
STC	Supplemental Type Certificate
TC	Type Certificate
Technical Instructions	<i>Technical Instructions for the Safe Transport of Dangerous Goods by Air</i> (Doc 9284)
ULD	Unit load device
UPU	Universal Postal Union

DEFINITIONS

When the following terms are used in this manual, they have the following meanings:

Note.— Where an asterisk appears beside a term, the term has already been defined as such in Annexes and Procedures for Air Navigation Services (PANS).

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

Cargo. For the purposes of this manual, 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. Receptacles and any other components or materials necessary for the receptacle to perform its containment function.

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.

***Stores (Supplies).** a) Stores (supplies) for consumption; and b) Stores (supplies) to be taken away.

Stores (Supplies) for consumption. Goods, whether or not sold, intended for consumption by the passengers and the crew on board aircraft, and goods necessary for the operation and maintenance of aircraft, including fuel and lubricants.

Stores (Supplies) to be taken away. Goods for sale to the passengers and the crew of aircraft with a view to being landed.

***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.

Chapter 1

INTRODUCTION AND OVERVIEW OF THE MANUAL

1.1 HISTORY

1.1.1 Various stakeholders within the global aviation community have highlighted that risks posed by the transport of cargo by air may not be sufficiently mitigated. In particular, specific hazards and risks associated with items to be transported that could contribute to an overwhelming situation for the aircraft or aircraft systems during any potential incident, are not fully considered. Research on the risks posed by the transport of lithium batteries by air led aeroplane manufacturers to expressly state that cargo compartments are not designed to contain the consequences of the unique hazards associated with the carriage of dangerous goods, including lithium batteries (see the reports of the Dangerous Goods Panel Working Group Meeting, 27 April to 1 May 2015, and the Twenty-Fifth Meeting of the Dangerous Goods Panel, 19 to 30 October 2015). With this in mind, experts in the fields of dangerous goods, operations, airworthiness, safety management and aircraft cargo fire safety research recommended that operators perform safety risk assessments in order to establish if they could manage the risks associated with the transport of lithium batteries on aircraft to an acceptable level of safety. These experts also recommended that guidance on how to conduct and evaluate a safety risk assessment be developed for operators and regulators.

1.1.2 When reviewing these recommendations, the Air Navigation Commission considered that lithium batteries might be representative of other items that may present unmitigated hazards to aircraft operations. Consequently, it charged the Flight Operations Panel (FLTOSP) with the task of developing provisions for Annex 6 — *Operation of Aircraft* for operators to conduct safety risk assessments on the transport of cargo, including the transport of dangerous goods. This work culminated with the adoption by the ICAO Council of new provisions incorporated through Amendment 44 to Annex 6, Part I — *International Commercial Air Transport — Aeroplanes*. To support these provisions, the panel was also tasked with the creation and ongoing revision of guidance material in the form of this manual. This work was conducted on behalf of the FLTOSP by the multi-disciplinary Cargo Safety Sub-Group (CSSG).

1.2 SCOPE AND OBJECTIVE

1.2.1 First and foremost, this manual provides guidance material to operators for the conduct of a risk assessment for operations that involve aeroplane cargo compartments. This is in accordance with the International Standards and Recommended Practices (SARPs) of Annex 6, Part I. It places the safety risk management (SRM) concepts espoused in ICAO's *Safety Management Manual* (SMM, Doc 9859) into an operationally relevant context. Second, it provides guidance on what information related to technical specifications, capabilities, and certification requirements of pertinent aircraft systems a Type Certificate (TC) holder, Supplemental Type Certificate (STC) holder, or original equipment manufacturer (OEM) should provide to the operator for it to conduct a risk assessment meeting the minimum requirements of Annex 6. The provisions and guidance are intended to be universal and flexible so that they remain applicable to goods and products that may be invented, manufactured, and presented for air transport in the future.

1.2.2 While the original mandate for the CSSG referred specifically to *cargo* operations, it became apparent as the work progressed that the provisions should seek to address *all* items that may be transported in an aeroplane cargo compartment. While the transport of lithium batteries as cargo had been identified as a major safety concern, it was important to ensure that safety risk assessments conducted by operators considered the risks associated with *any* item transported in the cargo compartment, irrespective of whether it was contained in cargo, baggage, or mail. The use of the

term “items” in Annex 6 and this manual is therefore specifically intended so that operators address all the following categories in their subsequent risk assessments:

- a) cargo (including COMAT/stores);
- b) passenger and crew checked baggage;
- c) mail; and
- d) other equipment used in the transport of cargo, baggage, or mail (e.g. unit load devices).

1.2.3 The provisions developed are included in Annex 6, Part I, Chapter 15, Cargo compartment safety, which includes the following Standard:

“The State of the operator shall ensure that the operator establishes policies and procedures for the transport of items in the cargo compartment, which include the conduct of a specific safety risk assessment. The risk assessment shall include at least the:

- a) hazards associated with the properties of the items to be transported;
- b) capabilities of the operator;
- c) operational considerations (e.g. 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.”

1.2.4 This manual provides guidance on how an operator may consider each of these factors in the conduct of their specific safety risk assessment. This list is not exhaustive, and operators may need to consider other factors as part of their specific safety risk assessment.

1.2.5 It should be noted that the development of the provisions in Annex 6, Part I, Chapter 15 was driven by the need to consider the inherent hazardous properties of the items being transported. There are clearly hazards associated with the improper loading of aeroplanes when conducting operations that utilize cargo compartments, for example, the inadequate securing of loads, or loading items outside of the aeroplane centre of gravity limitations. However, these apply equally regardless of the properties of the items themselves, and hence fall outside the scope of this manual. An operator must still consider those hazards as part of their ongoing safety risk management processes, and ensure that items are loaded and properly restrained in cargo compartments in accordance with their mass and balance manuals.

1.2.6 It is important to note that the risk assessment mandated in Annex 6, Part I, Chapter 15 is not intended to be conducted by the operator on a flight-by-flight basis. Rather, it should be applied to all operations that involve the transport of items in the cargo compartment, based on the specific type of operations that the operator conducts. If an operator were to deviate from the operations that defined the initial risk assessment, then it must be revisited to ensure new hazards have not been introduced by the change in operations. Even if there are no changes to operations, the risk assessment should be revisited periodically as part of the operator's overall safety management activities, as safety management seeks to proactively mitigate safety risks before they result in aviation accidents and incidents.

1.3 STRUCTURE OF THE MANUAL

1.3.1 This manual is structured to follow the process of conducting a risk assessment, in order to provide the most benefit to operators in terms of guidance. It is based on the principles of the SMM, but also recognizes different methods for conducting a risk assessment, providing details of the commonly used “bowtie” method. The subsequent chapters are then structured in accordance with the process, beginning with hazard identification and the associated consequences, then addressing the assessment of the actual risk involved in terms of probability of occurrence and severity of outcome, before then considering mitigating strategies that may address both.

1.3.2 Fire represents one event with significant consequences for an aeroplane during operation, with the potential of having a major impact on its airworthiness. Furthermore, there can be many possible causes of a fire, or “pathways” to the development of a fire on board. As such, the discussion of hazards that may lead to a fire comprise a major portion of this manual and the guidance contained herein.

1.4 RISK ASSESSMENT AND SAFETY RISK MANAGEMENT

Annex 6, Part I, Chapter 15 mandates the conduct of a specific safety risk assessment. In accordance with Annex 19 — *Safety Management*, this represents one part of SRM, which is itself a key component of a safety management system (SMS), representing a systematic approach to managing safety, including the necessary organizational structures, accountability, responsibilities, policies and procedures. As such, SRM includes hazard identification, safety risk assessment, safety risk mitigation and risk acceptance. SRM is a continuous activity because the aviation system is constantly changing, where new hazards can be introduced, and some hazards and associated safety risks may change over time. In addition, the effectiveness of implemented safety risk mitigation strategies needs to be monitored to determine if further action is required. The specific safety risk assessment on the transport of items in the cargo compartment is part of this SMS, and may be based on the safety risk management guidance contained in the SMM. Hazards should be identified, risks assessed, and specific mitigation measures established, according to predicted probability and the severity of the consequences based on the worst foreseeable situation.
