



WORKING PAPER

**DANGEROUS GOODS PANEL (DGP)
WORKING GROUP MEETING (DGP-WG/26)**

Centurion, South Africa, 26 to 30 October 2026

Agenda Item 6: Dangerous goods provisions to support RPAS operations (Ref: Job Card DGP.007.03)

**PROPOSED AMENDMENTS TO AC 102-37 - UNMANNED AIRCRAFT SYSTEMS (UAS)
CARRYING DANGEROUS GOODS**

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SUMMARY

This working paper provides an update on the work of the DGP Working Group on Remotely Piloted Aircraft Systems (DGP-WG/RPAS) and proposes amendments to *AC 102-37 – Unmanned Aircraft Systems (UAS) Carrying Dangerous Goods*.

Action by the DGP-WG is in paragraph 2.

1. INTRODUCTION

1.1 Amendments to the *Technical Instructions for the Safe Transport of Dangerous Goods by Air* (Doc 9284) and its Supplement to support remotely piloted aircraft system operations were endorsed by the Panel at the thirtieth meeting of the Dangerous Goods Panel (DGP/30). However, because related SARPs within other Annexes were not ready and their further development might impact on the proposed dangerous goods amendments, the ANC determined that it was premature to incorporate the amendments into the Technical Instructions, pending a more thorough review.

1.2 DGP/30 also determined that AC 102-37 – *Unmanned Aircraft Systems (UAS) Carrying Dangerous Goods* should be reviewed and modified, as necessary, to address challenges faced by States enabling the transport of dangerous goods by unmanned aircraft operating in the specific category. DGP-WG/RPAS completed this review and developed proposed amendments to the advisory circular for consideration by the 2026 DGP Working Group Meeting (DGP-WG/26).

1.3 The review of AC 102-37 focused on ensuring that the guidance remains relevant to current State authorization frameworks and operational practices and addresses areas where additional clarification or guidance may be beneficial. Several areas were identified where additional guidance or clarification would assist States authorizing the transport of dangerous goods by unmanned aircraft.

1.4 The proposed amendments:

- a) clarify the relationship between State approvals, Annex 18 — *The Safe Transport of Dangerous Goods by Air* and the Technical Instructions;
- b) strengthen guidance on dangerous goods safety risk assessments;
- c) expand guidance on dangerous goods standard operating procedures;
- d) enhance guidance on dangerous goods training, security, incident reporting and emergency response;
- e) provide additional guidance on lithium battery hazards;
- f) introduce guidance for dangerous goods intended for dropping, dispersal, release or triggering during aerial work operations; and
- g) update references and terminology to reflect current ICAO guidance material.

The proposed amendments are contained in the appendix to this working paper.

1.5 The remaining work identified by DGP/30 and resulting from the decision of the ANC to delay the amendments to the Technical Instructions includes comprehensive reviews of:

- a) *Guidance for Safe Operations Involving Aeroplane Cargo Compartments* (Doc 10102)
- b) *Emergency Response Guidance for Aircraft Incidents Involving Dangerous Goods* (Doc 9481); and
- c) The complete suite of related SARPs once ready to ensure alignment prior to coordinated publication.

DGP-WG/RPAS intends to progress this work during the current biennium for consideration by 2027 DGP Working Group Meeting (DGP-WG/27) and/or the thirty-first meeting of the Dangerous Goods Panel (DGP/31).

2. ACTION BY THE DGP-WG

2.1 The DGP-WG is invited to:

- a) review the proposed amendments to AC 102-37 - Unmanned Aircraft Systems (UAS) Carrying Dangerous Goods as presented in the appendix to this working paper;
 - b) provide comments on the proposed amendments; and
 - c) note the remaining work described in paragraph 1.5.
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APPENDIX

PROPOSED AMENDMENTS TO AC 102-37 - UNMANNED AIRCRAFT SYSTEMS (UAS) CARRYING DANGEROUS GOODS

ADVISORY CIRCULAR (AC) 102-37

DESCRIPTION

This Advisory Circular (AC) was developed for ICAO Member States and interested stakeholders and provides guidance associated with the ICAO Model UAS Regulations [[Part 102]] regarding unmanned aircraft systems (UAS) operations in the Specific category. It may assist Civil Aviation Authority (CAA) personnel in the implementation and oversight of UAS operations that carry ~~hazardous~~ dangerous goods. Throughout this AC, information enclosed by brackets “[]” indicate items that CAAs may need to align with existing CAA regulatory references.

This document is designed to complement the broader ICAO Model UAS Regulations guidance suite and should be read in conjunction with companion materials, including:

- AC 102-1: Unmanned Aircraft System Operations – Certification], which provides the foundational administrative framework for an operator to obtain a UAS Operator Certificate (UOC) and establishes the initial requirement for dangerous goods risk mitigations;
- AC 101-1: Unmanned Aircraft Systems – Open Category], which details the baseline operational limitations and explicitly delineates the prohibitions regarding the carriage of dangerous goods in lower-risk flight categories; and
- ICAO U-AID Guidance, which offers specialized operational pathways for executing critical, time-sensitive cargo missions—such as transporting medical samples or response equipment—during humanitarian aid and emergency response scenarios.

Readers familiar with standard international civil aviation frameworks may notice that this Advisory Circular predominantly utilizes the terms **Unmanned Aircraft (UA)** and **Unmanned Aircraft System (UAS)** rather than **Remotely Piloted Aircraft System (RPAS)**. This choice of terminology is intentional and aligns with the specific scope of managing operational risk and the transport of goods:

- **Scope of Automation:** By definition, an RPAS is a strict regulatory subset of a UAS that legally mandates the continuous oversight of a licensed human remote pilot. However, the carriage of cargo and dangerous goods increasingly involves highly automated or fully autonomous flight profiles (pre-programmed paths with no human pilot-in-the-loop). Using UA and UAS ensures this guidance remains future-proof and comprehensively covers both remotely piloted and fully autonomous operations.
- **Risk-Based Focus on the Cargo and System:** The safety hazards associated with transporting dangerous goods (such as lithium batteries, medical samples, or chemicals) depend heavily on the physical payload integration, containment, and system-wide failure mitigations. Because these risks persist regardless of *how* the aircraft is piloted, the more inclusive UA (the physical aircraft) and UAS (the aircraft plus total supporting infrastructure) frameworks provide a more technically accurate foundation for risk assessments.

An AC provides information and guidance by describing an acceptable means, but not the only means, of demonstrating compliance with the regulations and standards. An AC does not change, create, amend or permit deviations from regulatory requirements nor does it establish minimum standards. This AC serves as guidance for consideration by ICAO member States to create, add, or amend, future or existing guidance material developed by the CAA.

| This AC, the ICAO Model UAS Regulations and the accompanying ACs, and guidance material are available for download on ICAO's public website: <https://www.icao.int/safety/UA/>. The documents on the website are intended to be living documents and are subject to change without notice.

Unmanned Aircraft Systems (UAS) Carrying Dangerous Goods

General

Civil Aviation Authority (CAA) Advisory Circulars (AC) contains information advisory in nature to provide guidance about standards, practices, and procedures resulting from rules promulgated by the CAA. This AC is not mandatory and does not constitute a regulation. This AC does not change, add to, or delete regulatory requirements or authorize deviations from regulatory requirements.

Purpose

This advisory circular provides advice on best practice to be observed when operating unmanned aircraft (UA) transporting dangerous goods, Rule [102.23].

This AC is not intended to cover every provision of [Part 102]. Rather, this AC is intended to provide guidance on this provision where additional information may be helpful. Persons subject to [Part 102] are responsible for complying with every applicable provision of [Part 102], regardless of whether the provision is discussed in this AC.

Related Rules

This advisory circular relates specifically to Civil Aviation Rule [Part 102.23(11)].

Change Notice

This document is the ~~initial~~second issue of this advisory circular. ~~June-XXXX~~23XX, ~~2020~~202X.

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Dangerous Goods: Understanding the Risks and the Responsibilities

Introduction

Unmanned Aircraft (UA) are being used to transport goods. See Appendix 2 for examples of dangerous goods that may, potentially, be carried on UA. ~~Some of these goods have one or more inherent hazards and are therefore classified as dangerous goods.~~ ICAO develops international Standards and Recommended Practices (SARPs) which govern the safe transport of dangerous goods on civil aircraft. Most States adopt these Standards into their national legislation for both international and domestic operations. ~~T~~There may be circumstances when full compliance ~~with these SARPs~~ is inappropriate or unnecessary for UA operations. Conversely, there may be hazards unique to UA operations that are not addressed by these SARPs. The State of the Operator should ensure that both are taken into account before approving transport operations involving the carriage of dangerous goods on UA.

An operator holding a UAS Authorization or UAS Operator Certificate from their home state that includes procedures for handling dangerous goods can conduct operations domestically. The operator must obtain explicit permission from other States prior to international (e.g. cross-border) operations and Likewise, the States where operations occur, if different, should review the approval issued by the State of the Operator prior to granting permission. See Appendix 2 for examples of dangerous goods that may, potentially, be carried.

Scope

This guidance applies to circumstances when a State has determined that the use of UA to transport dangerous goods is appropriate. If delivery of dangerous goods to or from the location of the UA by other modes of transport is necessary, all appropriate provisions of the national or international regulations by those modes of transport apply.

Regulatory Requirements for the International Transport of Dangerous Goods by Air on Civil Aircraft

The broad principles governing the international transport of dangerous goods by air are contained in Annex 18 to the Convention on International Civil Aviation — *The Safe Transport of Dangerous Goods by Air*. These broad provisions are amplified by detailed specifications contained in the *Technical Instructions for the Safe Transport of Dangerous Goods by Air* (Technical Instructions, Doc 9284). States are obliged to take the necessary measures to achieve compliance with these documents for international civil aircraft operations and are encouraged to do the same for domestic civil aircraft operations.

Dangerous Goods — Description

Dangerous goods are articles or substances that are capable of posing a hazard to health, safety, property or the environment and which are shown in the list of dangerous goods (Table 3-1) provided in the Technical Instructions or which are classified according to Part 2 of the Technical Instructions. Dangerous goods are classified according to nine classes based on their potential consequences. Some classes are further divided into divisions. Dangerous goods can have two or more potential consequences. Identifying dangerous goods is the first step towards safely transporting them. Based on this, the safety risks posed can be reduced through proper packaging, communication, handling, and stowage. The scope of dangerous goods needed for carriage aboard UA may be limited to specific items and classes. The operator should identify these items and classes in their safety risk assessment. Dangerous goods classes and divisions are outlined in Appendix 1.

Transport of Dangerous Goods on UA

To the extent possible, the full scope of Annex 18 and the Technical Instructions should be complied with when transporting dangerous goods on UA. However, there may be circumstances when the full provisions of the Technical Instructions are not appropriate or necessary, due to the nature of UA operations. When appropriate, the State of the Operator may grant an approval to permit the carriage of dangerous goods without complying with the requirements of the Technical Instructions, provided they are satisfied with the operator's safety risk assessment and that the operator has made reasonable effort to identify all hazards and that the safety risks associated with the foreseeable consequences have been mitigated to an acceptable level. There may be hazards unique to UA operations that are not addressed in the Technical Instructions. The CAA should ensure these hazards are also addressed through the operator's safety risk assessment.

The State of the Operator should establish documented criteria for evaluating whether the proposed mitigations reduce safety risks to a level that is acceptable to the State.

Dangerous Goods Intended for Dropping or Release During Specialized Aerial Work Activities

The Technical Instructions contain specific provisions for dangerous goods carried for the purpose of being dropped, dispersed, released or triggered during certain specialized aerial work activities, including:

- a) agricultural, horticultural, forestry, ice jam control, landslide clearance, pollution control and pest management activities; and
- b) avalanche control activities.

Notwithstanding these provisions, the intentional dropping, dispersal, release or triggering of dangerous goods from a UAS remains subject to the applicable requirements of Part 102 and any conditions specified by the CAA. The operator should demonstrate that:

- a) the dangerous goods are authorized for the intended purpose under the Technical Instructions;
- b) the method of carriage, containment and release provides an acceptable level of safety;
- c) the operation will not create an undue hazard to persons, property, other aircraft or the environment;
- d) procedures are established to address malfunctions, inadvertent release and emergency situations; and
- e) the operation is conducted within the limitations and conditions specified in the operational approval.

The Technical Instructions also permit dangerous goods carried under these provisions to remain on board the aircraft during associated flights where immediate loading or unloading is impracticable, subject to specified conditions relating to identification, inspection, secure stowage, operator approval, personnel training and notification of the pilot-in-command.

The CAA may wish to establish separate requirements for the **transport** of dangerous goods by UAS and the **intentional dropping, dispersal, release or triggering** of dangerous goods, recognizing that the hazards and operational considerations associated with each activity may differ.

Dangerous Goods Standard Operating Procedures

The State of the Operator, when granting ~~an operator an~~ approval for ~~the~~ carriage of dangerous goods, must ensure that the operator establishes standard operating procedures (DG-SOP) for the safe transport of dangerous goods on the UA, including the conduct of a specific safety risk assessment addressing both compliance with Annex 18 and the Technical Instructions and any hazards unique to UA operations. The operator should ensure that dangerous goods are loaded, secured and carried in a manner that does not adversely affect the safe operation of the UAS, including compliance with any applicable payload, weight, balance and attachment limitations specified by the manufacturer, operational approval or CAA.

If operations are conducted in other than the State of the Operator, the ~~CAA States~~ where the operations occur must determine if the SOP are acceptable or whether additional operational restrictions or mitigations are necessary.

The extent of the DG-SOP will depend on the size of the organization, the nature of the operation and on the level of safety risk. At a minimum, the DG-SOP should include:

- a) The operator's policy for the safe transport of dangerous goods on UA, including any restrictions on the dangerous goods permitted for transport such as permitted classes/specific commodities and quantity limitations; and operating restrictions such as population density, avoiding critical infrastructure, weather limitations, daylight-only restrictions, segregated operating areas, etc.
- b) Assignment of responsibilities for safety risk management and the procedures for ~~how to~~ conducting and maintaining the dangerous goods ~~a safety risk assessment; procedures to identify hazards, determine their potential consequences and ensure the risk can be managed to an acceptable level;~~
- c) Identification of an individual responsible for ensuring compliance with the dangerous goods approval and applicable regulations;
- d) Detailed assignment of responsibilities associated with the transport of dangerous goods including their acceptance, loading, transport, unloading and emergency response actions, to the personnel involved;
- e) Procedures of the operator to ensure the safe transport of dangerous goods in compliance with the Technical Instructions, except as otherwise approved by the State of the Operator, including any specific mitigations established through the dangerous goods safety risk assessment;
- f) Instructions for attaching contact information and instructions for persons outside of the operation to inform the operator and appropriate authorities, including public health authorities, in the event that the dangerous goods are discovered following an accident, incident or inadvertent/emergency dropping;
- dg) Actions to be taken in the event of emergencies involving dangerous goods including communicating information to relevant persons about the dangerous goods being transported in case of an accident or incident; ~~and~~
- h) Measures to be taken to minimize theft or misuse of dangerous goods that may endanger persons or property (especially relevant to explosives, radioactive material, toxic substances, infectious substances);

- i) Procedures for the collection of safety data related to dangerous goods accidents, dangerous goods incidents and other dangerous goods occurrences including reporting to the State where the event occurred. States may consider expanding the scope of incident reporting to ensure unintended releases observed by consignee can be readily shared with the operator (and in turn the State in which the incident occurred), as a condition of the approval; and
- b) Description of the ~~a~~-dangerous goods training program established in accordance with Part 1, Chapter 4 of the Technical Instructions and the level of competency achieved once training is completed. The training must be structured, documented, and formally integrated into the operator's Operational Exposition Manual. ; providing adequate instruction ensures that individuals handling dangerous goods are competent to perform the function commensurate with their responsibilities taking into account the level of safety risk;.
- ~~e) instructions for communicating information to relevant persons related to the dangerous goods being transported in case of an accident or incident;~~
- ~~d) action to be taken in the event of emergencies involving dangerous goods; and~~
- ~~e) instructions for the collection of safety data related to dangerous goods accidents and dangerous goods incidents.~~

Appendix 3 to this document provides further guidance on elements that should be included in the SOP.

The safety risk assessment should include at least the:

- a) identification of hazards associated with the dangerous goods;
- b) type of operation;
- c) containment characteristics of the UA;
- d) packing and packaging;
- e) quantity and type of dangerous goods to be transported; and
- f) level of competence of those handling the dangerous goods (including the external supply chain when applicable).

Appendix 4 provides further guidance on elements that should be considered as part of a specific safety risk assessment for the carriage of dangerous goods by UA.

Note.— The Safety Management Manual (SMM) (Doc 9859, 4th edition) contains general guidance on implementation of Annex 19 — Safety Management, including the conduct of safety risk assessments. A new manual entitled Guidance for Safe Operations Involving Aeroplane Cargo Compartments (Doc 10102) provides guidance on specific safety risk assessments on the transport of items in the cargo compartments of an aeroplane, including dangerous goods, which may be useful for UA operations.

APPENDIX 1

Classes and Divisions of Dangerous Goods

The following classes and divisions are used to identify hazards associated with the transport of articles and substances by all modes of transport based on the product's specific chemical and physical properties. They are named in accordance with the United Nations Recommendations Transport of Dangerous Goods (Model Regulations). The classification of an article or substance for transport by air ~~needs to be done~~must be performed by ~~competently trained~~competently trained individuals competent to perform this function in accordance with the Technical Instructions. Competence must be achieved through training and assessment. A good starting point for determining if your product might be dangerous is by obtaining a Safety Data Sheet (SDS) from the manufacturer and checking the "Transportation Information." This can provide valuable information on the transport risks related to your materials.

The numerical order of the classes and divisions is not that of the degree of danger.

Class 1: Explosives

Division 1.1: Substances and articles which have a mass explosion hazard

Division 1.2: Substances and articles which have a projection hazard but not a mass explosion hazard

Division 1.3: Substances and articles which have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard

Division 1.4: Substances and articles which present no significant hazard

Division 1.5: Very insensitive substances which have a mass explosion hazard

Division 1.6: Extremely insensitive articles which do not have a mass explosion hazard

Class 2: Gases

Division 2.1: Flammable gases

Division 2.2: Non-flammable, non-toxic gases

Division 2.3: Toxic gases

Class 3: Flammable liquids

Class 4: Flammable solids; substances liable to spontaneous combustion; substances which, on contact with water, emit flammable gases

Division 4.1: Flammable solids, self-reactive and related substances and solid desensitized explosives and polymerizing substances

Division 4.2: Substances liable to spontaneous combustion

Division 4.3: Substances which, in contact with water, emit flammable gases

Class 5: Oxidizing substances and organic peroxides

Division 5.1: Oxidizing substances

Division 5.2: Organic peroxides

Class 6: Toxic and infectious substances

Division 6.1: Toxic substances

Division 6.2: Infectious substances

Class 7: Radioactive material

Class 8: Corrosive substances

Class 9: Miscellaneous dangerous substances and articles, including environmentally hazardous substances

APPENDIX 2**Examples of Dangerous Goods that may, potentially, be carried on UA**

The following are examples of dangerous goods that might be transported by UA:

- a) compressed gases such as aerosols and gas cartridges;
- b) flammable liquids, such as ethanol, ether;
- c) sterilization materials such as ethylene oxide;
- d) infectious substances such as samples for analysis;
- e) toxic substances such as certain medicines;
- f) first aid kits;
- g) pharmaceuticals and radiopharmaceuticals;
- h) medical or clinical waste such as used needles and blood samples;
- hi) safety devices;
- ij) lithium batteries; ~~and~~
- jk) carbon dioxide, solid (dry ice-); and

This list is not exhaustive. Provisions for identifying and classifying dangerous goods are contained in the Technical Instructions.

APPENDIX 3

UA Operator's Dangerous Goods Standard Operating Procedures (DG-SOP) Manual for Safe Transport

This guidance provides recommended elements to be included in the UA operator's standard operating procedures manual for the transport of dangerous goods (DG-SOP).

At a minimum, the DG-SOP should include:

The operator's policy for the safe transport of dangerous goods on UA, including any restrictions on the dangerous goods permitted for transport such as permitted classes/specific commodities and quantity limitations; and operating restrictions such as population density, avoiding critical infrastructure, weather limitations, daylight-only restrictions, segregated operating areas, etc.

Assignment of responsibilities for safety risk management and the procedures for conducting and maintaining the dangerous goods safety risk assessment

Identification of an individual responsible for ensuring compliance with the dangerous goods approval and applicable regulations;

Detailed assignment of responsibilities associated with the transport of dangerous goods including their acceptance, loading, transport, unloading and emergency response actions, to the personnel involved;

Procedures of the operator to ensure the safe transport of dangerous goods in compliance with the Technical Instructions, except as otherwise approved by the State of the Operator, including any specific mitigations established through the dangerous goods safety risk assessment;

Instructions for attaching contact information and instructions for persons outside of the operation to inform the operator and appropriate authorities, including public health authorities, in the event that the dangerous goods are discovered following an accident, incident or inadvertent/emergency dropping;

Actions to be taken in the event of emergencies involving dangerous goods including communicating information to relevant persons about the dangerous goods being transported in case of an accident or incident;

Measures to be taken to minimize theft or misuse of dangerous goods that may endanger persons or property (especially relevant to explosives, radioactive material, toxic substances, infectious substances);

Procedures for the collection of safety data related to dangerous goods accidents, dangerous goods incidents and other dangerous goods occurrences including reporting to the State where the event occurred; and

Description of the dangerous goods training program established in accordance with Part 1, Chapter 4 of the Technical Instructions and the level of competency achieved once training is completed.

Policy for the Safe Transport of Dangerous Goods on UA

The operator should establish a policy for the safe transport of dangerous goods on UA. The policy should include the practice of conducting a safety risk assessment. Safety Risk Assessments should include:

- a) identification of hazards associated with the dangerous goods;
- b) type of operation;
- c) containment characteristics of the UA;
- d) packing and packaging;
- e) quantity and type of dangerous goods to be transported; and
- f) level of competence of those handling the dangerous goods (including the external supply chain when applicable).

Also including any restrictions on the dangerous goods permitted for transport such as permitted classes/specific commodities and quantity limitations; and operating restrictions such as population density, avoiding critical infrastructure, weather limitations, daylight-only restrictions, segregated operating areas, etc.

Procedures for Carrying Out Responsibilities Including Mitigation Measures to Proactively Manage Risks

The DG-SOP should include measures taken and an indication of how these measures mitigate the potential consequences of identified hazards to an acceptable level. Procedures to mitigate hazards unique to UA operations should also be included to ensure the dangerous goods are capable of withstanding the normal conditions of transport involving the type of UA being used.

Training Program

A training program should be established based on the functions performed by persons involved with the transport of ~~who handle~~ dangerous goods on UA, in accordance with Part 1, Chapter 4 of the Technical Instructions. Providing adequate instruction ensures that individuals are competent to perform the functions commensurate with their responsibilities, taking into account the level of safety risk involved. The program should be clear as to the competency level achieved once training is completed. A record reflecting the training and the competence level attained for each person should be maintained.

Instructions for Communicating Information Related to the Dangerous Goods Carried by the UA in the Case of an Incident or Accident

The Technical Instructions include provisions for communicating hazards of dangerous goods through marking and labelling of the package and documentation, which are well-known to those involved in their transport. Individuals who are exposed to UAs involved in an incident or accident may not be aware of these hazard communication methods. Procedures should be established by the operator

that explains the instructions for effectively communicating hazards to those not familiar with dangerous goods marking and labelling and how the instructions should be attached to the shipment. Contact information and instructions for informing the operator and appropriate authorities, including public health authorities, should also be included in the procedures.

Action to be Taken in the Event of Emergencies Involving Dangerous Goods

Procedures should be established for an emergency response plan for dangerous goods incidents or dangerous goods accidents. A current list of contacts indicating whom should be notified if either event ~~occurs~~, occurs should be maintained, including entities which may, at short notice, search for and secure an accident site before the arrival of emergency responders of the operator or external agencies (e.g. public health or environmental). The ERP should be shared with any external parties assigned responsibilities within the ERP. Procedures should ensure the availability of appropriate personal protective equipment. Where emergency response kits are used, the operator should ensure that these are available or rapidly deployable to the personnel responding to the emergency at the location where the incident or accident has occurred.

Instructions for Collection of Safety Data

Procedures should include instructions for collecting safety data related to dangerous goods accidents and dangerous goods incidents. The CAA may provide a format for submitting this data.

APPENDIX 4

Elements to consider as Part of the UA Operator's Safety Risk Management Procedures

A safety risk assessment should be ~~performed~~conducted to address potential consequences of identified hazards and associated mitigations should there be an unintentional release or fire involving the dangerous goods occur before during or after the transport by UA including accident and incident scenarios.

As hazards may originate within or externally to the operation, the operator's safety risk assessment should consider the entire supply chain associated with the dangerous goods transport operation, including any shipper, consignor, packer, freight forwarder, ground handling provider, or consignee involved in the preparation, handling, transfer or receipt of the dangerous goods.

The risk assessment should be reviewed to assess safety impacts before introducing new dangerous goods, packaging systems, aircraft types, routes, operating environments or service providers. Regardless, it should be periodically reviewed to ensure that it remains valid and that no further hazards have been introduced into the operation by internal or external factors, including entities in the supply chain.

The Safety Management Manual (SMM) (Doc 9859, 4th edition) contains general guidance on implementation of Annex 19 — Safety Management, including the conduct of safety risk assessments. A new manual entitled Guidance for Safe Operations Involving Aeroplane Cargo Compartments (Doc 10102) provides guidance on specific safety risk assessments on the transport of items in the cargo compartments of an aeroplane, including dangerous goods, which may be useful for UA operations.

The following are elements that should be included, at a minimum, in the safety risk assessment.

Risks Associated with Dangerous Goods

Risks associated with the dangerous goods to be transported should be considered in relation to their inherent hazards and also the consequences ~~of their effect~~ if they are inadvertently released.

- Infectious substances that are capable of causing permanent disability, life-threatening or fatal disease for which no vaccine or cure is available have the highest consequences. They could potentially affect multiple persons or animals.
- Infectious pathogens that are spread by ingestion, for which prophylactic treatment or a cure is available will have moderate consequences.
- Non-communicable pathogens for which prophylactic treatment or a cure is available will have a low consequence.
- Chemicals with high toxicity to human, animal and aquatic life will have the highest consequences, and may affect multiple persons or animals.
- Chemicals that are highly corrosive will have a high consequence to package handlers or receivers.
- Chemicals that may react dangerously with each other and result in combustion and/or evolution of considerable heat, evolution of flammable, toxic or asphyxiant gases, the formation of corrosive substances, or the formation of unstable substances.
- When untested or abused, lithium batteries have the capacity to act as both a source of ignition and the fuel for a subsequent fire, which could degrade the UA's ability to sustain controlled flight. A lithium battery fire will have moderate consequences to package handlers. The consequences to persons on the ground from a UA accident caused by lithium batteries are the same for any other UA accident. The risk is heightened for UA without cargo fire detection or suppression systems but can be reduced for example by state of charge limits, thermally protective packaging, and stowage away from critical systems.

Type of Operation

The safety risk assessment should consider the potential consequences related to the transport over populated areas, remote areas or environmentally sensitive land and waters. Other normal flight risks such as those associated with operating routes, obstacles, altitudes, ~~or~~ take-off and landing areas (including contingency landing sites), -lost-link events, fly-away scenarios, and autonomous recovery should also be considered. Dropping of the dangerous goods from the UA also brings with it additional potential consequences for consideration.

Containment Characteristics of the UA (e.g. inside or outside the UA)

The carriage of the dangerous goods inside or outside the UA needs assessing. The securing of the dangerous goods within the UA, by attachment directly to the UA or slung from the UA, will have varying levels of risk.

Packing and Packaging

Packaging methods used to contain dangerous goods may affect the likelihood of damage, leakages, spills or unintentional release of contents. In considering the packing and packaging requirements for dangerous goods, the provisions of the Technical Instructions should be followed to the extent possible.

If the provisions of the Technical Instructions cannot be followed, an equivalent or greater level of safety should be established in accordance with the level of risk. At a minimum, the following should be taken into account:

- a) The type of packaging should take into account the containment characteristics of the UA and damage that could be caused by exposure to airflow and weather such as rain or snow. The effects of temperature and pressure variations and vibrations which may be encountered during transport should be taken into account.
- b) Generally, dangerous goods should be packed in the lowest volume container necessary for the intended purpose.
- c) Measures to prevent leakage of liquid dangerous goods need to be taken into consideration. At a minimum, the packaging should include a leak proof liner or bag containing the dangerous goods surrounded by absorbent material and placed into a receptacle in a rigid outer packaging. Inner packaging should be packed so that the closures are upward within the package. Closures on inner packaging must be leak proof and secured against loosening. Stoppers, corks or other such friction closures must be held in place by positive means.
- d) The contents of the packages should be documented and easily accessible in case of an incident or accident requiring emergency response. At a minimum, the UN number, container type, volume and number of items should be documented. In the case of biological substances, pathogen data sheets or information about the hazards to infectious substances, including deactivation and waste disposal, should be made available.
- e) If the dangerous goods are to be dropped by the UA, additional consideration of the effects on the dangerous goods and packaging materials should be considered due to the forces and shocks encountered. The height at which the package is released should not exceed the drop height for which the package was tested.

Quantity and Distribution of Dangerous Goods to be Transported

The volume of dangerous goods to be carried coupled with packaging methods used may affect the likelihood of damage, leakages, spills or unintentional release of contents. For certain dangerous goods, the quantities may influence the severity of the identified consequence of a hazard. The potential for incompatible dangerous goods or non-dangerous goods to react dangerously when mixed needs to be taken into account.

Level of Competence of Those Handling the Dangerous Goods

The level of competence of those handling the dangerous goods needs to be taken into account in relation to the level of responsibility and risk. Without appropriately qualified personnel, there is the potential of insufficiently implementing mitigating strategies or potentially introducing additional hazards or unintended consequences.

APPENDIX 5

References

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