CIVIL AVIATION GUIDANCE MATERIAL – 1882

CARRIAGE OF DANGEROUS GOODS FOR UNMANNED AIRCRAFT SYSTEMS (UAS)

DG – UAS

CIVIL AVIATION AUTHORITY OF MALAYSIA

ISSUE 01
REVISION 00 – 15TH NOVEMBER 2022

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Introduction

This Civil Aviation Guidance Material 1882 (CAGM – 1882) is issued by the Civil Aviation Authority of Malaysia (CAAM) to provide guidance for UAS operators on a Carriage of Dangerous Goods by air, pursuant to Civil Aviation Directives 18 – National Transport of Dangerous Goods Programme, (referred to as "CAD"). Organisations may use these guidelines to ensure compliance with the respective provisions of the relevant CAD's issued.

Notwithstanding the Regulation 204 and Regulation 205 of the Malaysian Civil Aviation Regulations 2016 (MCAR 2016), when the CAGMs issued by the CAAM are complied with, the related requirements of the CAD's may be deemed as being satisfied and further demonstration of compliance may not be required.

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Chief Executive Officer
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Civil Aviation Directive components and Editorial practices

This Civil Aviation Guidance Material is made up of the following components and are defined as follows:

Standards: Usually preceded by words such as *"shall"* or *"must"*, are any specification for physical characteristics, configuration, performance, personnel or procedure, where uniform application is necessary for the safety or regularity of air navigation and to which Operators must conform. In the event of impossibility of compliance, notification to the CAAM is compulsory.

Recommended Practices: Usually preceded by the words such as "*should"* or "*may*", are any specification for physical characteristics, configuration, performance, personnel or procedure, where the uniform application is desirable in the interest of safety, regularity or efficiency of air navigation, and to which Operators will endeavour to conform.

Appendices: Material grouped separately for convenience but forms part of the Standards and Recommended Practices stipulated by the CAAM.

Definitions: Terms used in the Standards and Recommended Practices which are not self-explanatory in that they do not have accepted dictionary meanings. A definition does not have an independent status but is an essential part of each Standard and Recommended Practice in which the term is used, since a change in the meaning of the term would affect the specification.

Tables and Figures: These add to or illustrate a Standard or Recommended Practice and which are referred to therein, form part of the associated Standard or Recommended Practice and have the same status.

Notes: Included in the text, where appropriate, Notes give factual information or references bearing on the Standards or Recommended Practices in question but not constituting part of the Standards or Recommended Practices;

Attachments: Material supplementary to the Standards and Recommended Practices or included as a guide to their application.

It is to be noted that some Standards in this Civil Aviation Guidance Material incorporates, by reference, other specifications having the status of Recommended Practices. In such cases, the text of the Recommended Practice becomes part of the Standard.

The units of measurement used in this document are in accordance with the International System of Units (SI) as specified in CAD 5. Where CAD 5 permits the use of non-SI alternative units, these are shown in parentheses following the basic units. Where two sets of units are quoted it must not be assumed that the pairs of values are equal and interchangeable. It may, however, be inferred that an equivalent level of safety is achieved when either set of units is used exclusively.

Any reference to a portion of this document, which is identified by a number and/or title, includes all subdivisions of that portion.

Throughout this Civil Aviation Guidance Material, the use of the male gender should be understood to include male and female persons.

Record of Revisions

Revisions to this CAGM shall be made by authorised personnel only. After inserting the revision, enter the required data in the revision sheet below. The *'Initials'* has to be signed off by the personnel responsible for the change.

Rev No.	Revision Date	Revision Details	Initials

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Summary of Changes

ISS/Rev No.	Item No.	Revision Details

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1 General

1.1.1 This CAGM contains information advisory in nature to provide guidance about standards, practices, and procedures resulting from rules promulgated by the Authority. This CAGM is not mandatory and does not constitute a regulation. This CAGM does not change, add to, or delete regulatory requirements or authorize deviations from regulatory requirements.

1.2 Purpose

1.2.1 This CAGM provides advice on best practice to be observed when operating unmanned aircraft (UA) transporting dangerous goods.

1.2.2 This CAGM is not intended to cover every provision of Part 102. Rather, this CAGM 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 CAGM.

1.3 Related Rules

1.3.1 This CAGM relates specifically to CAD 18 (NTDGP) and CAD 6011 Part V.

2 Understanding the Risks and the Responsibilities

2.1 Introduction

2.1.1 Unmanned Aircraft (UA) are being used to transport goods. 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) that govern the safe transport of dangerous goods on civil aircraft. CAAM adopts these Standards into the legislation for domestic operations. There may be circumstances when full compliance with these SARPs is inappropriate or unnecessary for UA operations. Conversely, any hazards unique to UA operations that are not addressed by this CAGM, CAAM will ensure to take into account before approving transport operations involving the carriage of dangerous goods on UA.

2.2 Scope

2.2.1 This guidance applies to circumstances when CAAM 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.

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

2.3.1 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).

2.4 Dangerous Goods — Description

2.4.1 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.

2.5 Transport of Dangerous Goods on UA

2.5.1 The full scope of Annex 18 and the Technical Instructions should be complied with when transporting dangerous goods on UAS.

2.6 Dangerous Goods Standard Operating Procedures (DG-SOP)

2.6.1 The UAS Operators must establish standard operating procedures (DG-SOP) for the safe transport of dangerous goods on the UA, including the conduct of a specific safety risk assessment.

2.6.2 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) how to conduct a safety risk assessment; procedures to identify hazards, determine their potential consequences and ensure the risk can be managed to an acceptable level;

b) a training program and the level of competency achieved once training is completed; 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;

c) 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.

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

2.6.4 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.

2.6.5 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.

2.7 Application for Approval

2.7.1 CAAM may issue a permit for carriage of dangerous goods if satisfied that the applicant has fulfilled the following requirements –

a) successfully obtained certification in accordance with Chapter 3 of CAD 6011 Part V; and

b) completed and obtained approval from CAAM for DG-SOP as specified in para 2.6 of this chapter; and

c) successfully obtained approval for the Dangerous Goods Training Program (DGTP) as specified in Chapter 5 of CAD 18 (NTDGP); and

d) comply with all the requirements in Chapter 3 of CAD 18 (NTDGP); and

e) comply with all the requirements stated in the application checklist and supporting documents of Appendix 5 of CAD 18 (NTDGP).

3 Appendices

3.1 Appendix 1 – Classes and Divisions of Dangerous Goods

3.1.1 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 by competently-trained individuals in accordance with the Technical Instructions. 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.

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

3.1.2.1 Class 1 – Explosives

a) Division 1.1 – Substances and articles which have a mass explosion hazard

b) Division 1.2 – Substances and articles which have a projection hazard but not a mass explosion hazard

c) 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

d) Division 1.4 – Substances and articles which present no significant hazard

e) Division 1.5 – Very insensitive substances which have a mass explosion hazard

f) Division 1.6 - Extremely insensitive articles which do not have a mass explosion hazard

3.1.2.2 Class 2 – Gases

a) Division 2.1 – Flammable gases

b) Division 2.2 – Non-flammable, non-toxic gases

c) Division 2.3 – Toxic gases

3.1.2.3 Class 3 – Flammable liquids

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

a) Division 4.1 – Flammable solids, self-reactive and related substances and solid desensitized explosives and polymerizing substances

b) Division 4.2 – Substances liable to spontaneous combustion

c) Division 4.3 – Substances which, in contact with water, emit flammable gases

3.1.2.5 Class 5 – Oxidizing substances and organic peroxides

a) Division 5.1 – Oxidizing substances

b) Division 5.2 – Organic peroxides

3.1.2.6 Class 6 – Toxic and infectious substances

a) Division 6.1 – Toxic substances

b) Division 6.2 – Infectious substances

3.1.2.7 Class 7 – Radioactive material

3.1.2.8 Class 8 – Corrosive substances

3.1.2.9 Class 9 – Miscellaneous dangerous substances and articles, including environmentally hazardous substances

3.2 Appendix 2 – Dangerous Goods that may, potentially, be carried on UA

3.2.1 The following are the list 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) medical or clinical waste such as used needles and blood samples;

h) safety devices;

i) lithium batteries; and

j) dry ice.

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

3.3 Appendix 3 – UA Operator's Dangerous Goods Standard Operating Procedures (DG-SOP)

3.3.1 Manual for Safe Transport

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

3.3.2 Policy for the Safe Transport of Dangerous Goods on UAS.

3.3.2.1 The operator should establish a policy for the safe transport of dangerous goods on UAS. The policy should include the practice of conducting a safety risk assessment.

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

3.3.3.1 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.

3.3.4 Training Program

3.3.4.1 A training program should be established based on the functions performed by persons who handle dangerous goods. 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.

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

3.3.5.1 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 appropriate authorities, including public health authorities, should also be included in the procedures.

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

3.3.6.1 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, should be maintained.

3.3.7 Instructions for Collection of Safety Data

3.3.7.1 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.

3.4 Appendix 4 – Elements to consider as Part of the UAS Operator's Safety

3.4.1 Risk Management Procedures

3.4.1.1 A safety risk assessment should be performed to address potential consequences of identified hazards and associated mitigations should an unintentional release occur. The following are elements that should be included, at a minimum, in the safety risk assessment.

3.4.2 Risks Associated with Dangerous Goods

3.4.2.1 Risks associated with the dangerous goods to be transported should be considered in relation to the consequence of their effect if they are released.

a) 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.

b) Infectious pathogens that are spread by ingestion, for which prophylactic treatment or a cure is available will have moderate consequences.

c) Non-communicable pathogens for which prophylactic treatment or a cure is available will have a low consequence.

d) Chemicals with high toxicity to human, animal and aquatic life will have the highest consequences, and may affect multiple persons or animals.

e) Chemicals that are highly corrosive will have a high consequence to package handlers or receivers.

3.4.3 Type of Operation

3.4.3.1 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 should also be considered. Dropping of the dangerous goods from the UA also brings with it additional potential consequences for consideration.

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

3.4.4.1 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.

3.4.5 Packing and Packaging

3.4.5.1 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.

3.4.5.2 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 leakproof liner or bag containing the dangerous goods surrounded by absorbent material and placed into a receptacle in a rigid outer packaging. Inner packagings should be packed so that the closures are upward within the package. Closures on inner packagings 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.

3.4.6 Quantity and Distribution of Dangerous Goods to be Transported

3.4.6.1 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.

3.4.7 Level of Competence of Those Handling the Dangerous Goods

3.4.7.1 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.

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