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Introduction

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



DRAFT International Standard

ISO/DIS 23665

Uncrewed aircraft systems — Training for personnel involved in UAS operations

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ISO/TC 20/SC 16

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 16, *Uncrewed aircraft systems*.

This third edition cancels and replaces the second edition (ISO 23665:2023), which has been technically revised.

The main changes are as follows:

- alignment with three risk-based categories for UAS operations enshrined by the International Civil Aviation Organisation (ICAO);
- addition of training requirements for pilot courses qualifying for BVLOS operations in the specific category of UAS operations;
- addition of training requirements for visual observers.
- Addition of training requirements for fleet managers (FM).

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Uncrewed aircraft (UA) have rapidly increased in number, applications and types within recent decades. UA are commonly utilized for filming, agricultural spraying, inspection, security activities and are expected to be also employed for transportation.

Because of the myriad of possible applications, several regulatory aviation authorities, starting with the International Civil Aviation Organization (ICAO), use a holistic taxonomy [Reference [8](#)] of UAS operations, based on safety risk perceived by the society.

These three risk-based categories of UAS operations are:

- Low-risk open category, limited to VLOS operations.
- Medium-risk specific category which permits also EVLOS and BVLOS and entering controlled airspace.
- High-risk certified category which permits also long-range international flights under IFR in controlled airspace.

In all categories the UAS operator is responsible to train, qualify and maintain the competence of all personnel involved in the operations, including, but not limited to remote pilots. In several jurisdictions, the aviation authorities promulgate rules on the competence of remote pilots (i.e. regulated profession, reference [11](#)). For other jobs (e.g. visual observers) no rules exist in several jurisdictions on any mandatory training. However, the UAS operator is still responsible for ensuring the competence of such personnel.

This document may help operators and training organisations to develop, purchase and deliver courses not only for the regulated professions, but even for other jobs related UAS operations. The resulting attestations may be useful for the career development and mobility of related personnel.

The required knowledge, attitude and skill levels for personnel who are involved in uncrewed aircraft system (UAS) operations need to be clearly defined. When unskilled persons operate a UA, the risk of an accident or serious incident will increase. Discrepancies in qualification criteria among countries or organizations will also prevent the international exchange of workers.

This document helps to ensure that personnel who are involved in UAS operations receive appropriate education and obtain essential knowledge and skill. Training organizations and individuals qualified according to this document will be internationally recognized. It will enhance the international operation of UAS, enable personal exchange, and encourage international trade.

The main body of this document defines the procedures for the operation of a training organization, which is the entity that delivers training to UAS remote pilots.

This third edition comprises requirements for the following specific courses:

- UAS remote pilot in the open category in [Annex A](#).
- VLOS UAS remote pilot in the specific category in [Annex B](#).
- EVLOS and BVLOS UAS remote pilot in [Annex C](#).
- Visual observers (VO) in [Annex D](#)
- Flight Operation Officer and Fleet Manager (FM) in [Annex E](#).

It is envisioned that further courses (e.g. UAS Flight Instructor. UFI, and examiner – UFE) will be included in future editions of this document.

Uncrewed aircraft systems — Training for personnel involved in UAS operations

1 Scope

This document describes the procedures for training personnel who will be involved in the operation of uncrewed aircraft systems (UAS).

This document defines:

- a) knowledge, skill, attitude and qualification criteria that are needed for UAS remote pilots (RP), remote pilot in command(r-PIC) and UAS training organizations (UTO) that provide training to UAS remote pilots and other personnel involved in UAS operations;
- b) training curriculum and contents for specific learning courses;
- c) qualification and criteria for verification of achieved competence by the training organizations;
- d) general procedures for providing training of UAS personnel; the requirements for a specific courses as described in [Annexes A](#) to [C](#) for RPs, [Annex C](#) for VO and [Annex D](#) for fleet managers (FM).

Nothing prevents an UTO to include additional topics or learning objectives, such as when required by legally binding rules in the applicable jurisdiction.

Nothing prevents the UAS operator to act also as UTO, providing that possible conflict of interest between training and operations is properly managed.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

5015-2:2022, Uncrewed aircraft systems Part 2: Operation of vertiports for vertical take-off and landing (VTOL) uncrewed aircraft (UA)

ISO 21384-3:2023, *Unmanned aircraft systems — Part 3: Operational procedures*

ISO 21384-4, *Uncrewed aircraft systems — Part 4: Vocabulary*

ISO 21895, *Categorization and classification of civil unmanned aircraft systems*

ISO 23629-12:2022, *UAS traffic management (UTM) — Part 12: Requirements for UTM service providers*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 21384-4 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

Airspace observer

remote crew member who assists the *remote pilot* (3.7) by performing unaided visual scanning of the airspace in which the uncrewed aircraft is operating for any potential hazard in the air.

Note 1 to entry: The definition is adapted from Reference [9].

Note 2 to entry: airspace observer is one of the possible qualifications of the generic term visual observer [3.10].

Note 3 to entry: One or more airspace observers are typically employed in EVLOS operations.

3.2

controlled ground area

ground area where the UAS is operated and within which the UAS operator can ensure that *uninvolved persons* (3.9) would not be present.

Note 1 to entry: The definition is adapted from Reference [9].

3.3

Fleet manager

Person designated by the operator to execute specific functions associated with the operational control system of the UAS operator.

Note 1 to entry: The definition is adapted from Reference [13].

Note 2 to entry: the tasks of the fleet manager are specified in ISO 21384-3, including planning, control and supervision of flight operations.

Note 3 to entry: FM qualification requires an initial *Flight Operation Officer (FOO)* (3.4) qualification followed by an advanced role-specific training.

Note 4 to entry: If a RP in command is required for the operation, the fleet manager supports, briefs and/or assists the remote pilot-in-command in the safe conduct of the flight.

Note 5 to entry: In case of autonomous operations, as defined in reference 10, for which the RP is not required, the fleet manager remains responsible to obtain the necessary authorisation, to monitor the outcome of the mission and, should it be necessary, to activate the emergency response plan.

Note 6 to entry: this role is traditionally called Flight dispatcher (FD) in crewed aviation and also, under some jurisdictions for RPAS/UAS operations.

3.4

Flight operations officer

generic function or role associated with the operational control system of the UAS operator, supporting the preparation and execution of a flight,

Note 1 to entry: The definition is adapted from Reference [13].

Note 2 to entry: FOO qualification does not require advanced role-specific training, being an initial qualification sufficient.

3.5

Ground observer

remote crew member who assists the remote pilot by contributing to maintain the controlled area on the ground void of *uninvolved persons* (3.9) or monitoring the position and behaviour of such uninvolved persons, to minimise risks for them and to minimise the possibility that they would jeopardise safety of flight.

Note 1 to entry: The definition is adapted from Reference [12].

Note 2 to entry: ground observer is one of the possible qualifications of the generic term visual observer [3.10],

Note 3 to entry: The presence of the ground observer has no effect on the range of the operation.

3.6

national (or civil or competent) aviation authority

government statutory authority in each ICAO contracting state that regulates and oversees safety of civil aviation

3.7

remote pilot

person charged by the operator with duties essential to the operation of an uncrewed aircraft and who manipulates the flight controls, as appropriate, during flight time

Note 1 to entry: The definition is adapted from Reference [5].

3.8

Uncrewed aircraft observer

remote crew member, positioned alongside the remote pilot, who, by unaided visual observation of the uncrewed aircraft, assists the remote pilot in keeping the uncrewed aircraft in VLOS and safely conducting the flight.

Note 1 to entry: The definition is adapted from Reference [9].

Note 2 to entry: uncrewed aircraft observer is one of the possible qualifications of the generic term visual observer [3.10].

Note 3 to entry: UA observers do not enable extending the range of operations. Beyond VLOS

3.9

Uninvolved persons

persons who are not participating in the UAS operation or who are not aware of the instructions and safety precautions given by the UAS operator.

Note 1 to entry: The definition is adapted from Reference [9].

3.10

visual line-of-sight operation

VLOS

operation in which the *remote pilot* (3.3) or uncrewed aircraft observer maintains direct unaided visual contact with the uncrewed aircraft system

Note 1 to entry: The definition is adapted from Reference [4].

3.11

visual observer

remote crew member who, by visual observation of the remotely piloted aircraft, assists the *remote pilot* (3.3) in the safe conduct of the flight

Note 1 to entry: The definition is adapted from Reference [6].

Note 2 to entry: Visual observer is a generic term referring either to *Airspace Observer* (3.1), *Ground Observer* (3.4) or uncrewed aircraft observer (3.7).

4 Abbreviated terms

AGL	above ground level
AO	Airspace Observer
ATC	air traffic control
ATS	air traffic service
ATZ*	aerodrome traffic zone

Baro-VNAV	barometric-vertical navigation
BVLOS	beyond visual line-of-sight
CRM	crew resource management
CTR*	control zone
EVLOS	extended visual line-of-sight
FD	Flight Dispatcher
FIR	flight information region
FM	Fleet Manager
FOO	Flight Operation Officer
GNSS	global navigation satellite system
GO	Ground Observer
GPS	global positioning system
ICAO	International Civil Aviation Organization
IFR	instrument flight rules
NOTAM	notice to airmen
SD card	secure digital card
TEM	threat and error management
UO	Uncrewed aircraft Observer
VFR	visual flight rules
VLOS	visual line-of-sight
VO	Visual Observer

*NOTE: There are the other designations depend on each operational regions (e.g. Control Zones (CZ) Terminal Control Areas (TCA), Control Area Extensions (CAE))

5 UAS Training organization (UTO)

5.1 Responsibilities

- a) The UTO shall offer one of more of the following courses:
 - (1) courses of one or more of the learning objectives in the Annexes to this document, grouped in one or more clearly identified modules ,
 - (2) courses covering a specific UAS model or use of specific equipment,
 - (3) theoretical knowledge instruction
 - (4) Practical skill training.
- b) The training organization shall identify the person(s) responsible for the following areas: the person who is responsible for the following areas shall be independent from other responsibilities.

- 1) training and assessment;
- 2) safety.

Note Which function cannot be combined into a single person is described in ISO 21384-3.

- c) The UTO may contract elements of training to a third party training provider.

Through procedures ensuring that the standard of training intended to be provided by the third party meets the requirements of this document.

Note_ in case of c) the UTO retains responsibility for the whole course or module, including for the elements contracted to a third party.

5.2 Documentation for staff members

The training organization shall maintain, at least, the following documentation for all staff members delivering training services:

- a) name, address and date of birth;
- b) training/qualification, experience;
- c) duties assigned to the individual staff member.

The training organization shall have documentary evidence that all staff members hold relevant and current qualifications for their duties. Proof of qualifications shall be updated at least every two years and made available to the clients upon request.

5.3 Display of certificate

The training organization shall display a current certificate of accreditation (where applicable) showing that it meets the requirements of this document in a position visible to members of the public entering the premises.

5.4 Records

The training organization shall retain, at least, the following records of trainee training and certification in paper or electric format for a minimum of 7 years:

- a) trainee name;
- b) trainee address;
- c) trainee email address;
- d) trainee telephone number;
- e) trainee date of birth;
- f) course(s) taken;
- g) pass or fail and date;
- h) instructor details.

The training organization should follow the general protocols for data management outlined in ISO 15489-1 as far as possible.

5.5 Emergency procedures and equipment

For all locations where UAS are to be operated, the training organization shall ensure the availability of the following:

- a) a first aid kit suitable for the planned activities;
- b) a communication system suitable for alerting emergency services;
- c) firefighting equipment;
- d) identification of an evacuation location for personnel;
- e) a means for contacting the appropriate air traffic control (ATC), e.g. telephone, radio.

5.6 Introductory information

The training organization shall provide the following information to trainees:

- a) conditions regarding the responsibilities of each party related to commencement, delivery and termination of the service;
- b) consequences for the training organization and the trainee should either party choose to cancel the service;
- c) prerequisites and any qualification requirements to obtain the service (e.g. prerequisite certifications);
- d) equipment requirements;
- e) costs;
- f) insurance requirements;
- g) any legislation and legal requirements relevant to the specific kind of service;
- h) limitations of eventual qualification;
- i) scope of the training course;
- j) course procedures;
- k) means and methods for assessment and criteria for successful completion;
- l) records of their personal data will be kept for 7 years, and that these records may be passed on to a central training authority or national aviation authority;
- m) specification of duration, modules, matters and contents delivered in the course;
- n) specification of language or languages of the course delivery.

6 Training resources

6.1 Teaching aids

The training organization shall provide the necessary resources for training such as instructors, trainee reference materials, facility equipment.

6.2 Instructor requirements

The instructor must be capable of conducting training on the specific requirements detailed in each Annex.

6.3 Theoretical training

6.3.1 Theory knowledge delivery methods

Required theory knowledge can be introduced using instructor-delivered sessions, via internet, virtual reality, applications or any similar mechanisms if the trainee can subsequently prove mastery of the required information.

6.3.2 Theory presentations

In the case that theory teaching is conducted by training organization instructor-delivered sessions, it shall be conducted in an environment such as a dedicated classroom that is free from significant distractions to learning. This shall provide trainees with sufficient working facilities and training aids (e.g. writing surfaces, reference materials, computers, visual or audio materials) to ensure that trainees are able to understand the information being presented.

6.4 Flight training

6.4.1 Training environment

Where the training organization provides flight training with real UA, it shall secure an appropriate flight training airspace. The training environment shall be suitably designated and equipped for trainees. The airspace shall be designated as a reserved airspace for training, if possible.

The training organization shall ensure the training environment is appropriate and safe, including taking reasonable steps to consider such factors as:

- a) potential conflict with other aircraft;
- b) risk to third parties, including to members of the public;
- c) ensuring the area is cleared of any unnecessary hazards to trainees, instructors and other personnel involved in the training operations.

Electromagnetic interference including from other communications and sources in the environment (e.g. other emitter, power lines) should be prevented as far as can be reasonably achieved.

NOTE Applicable radio interference assessment methods are described in Reference [2] and Reference [3].

6.4.2 Training aircraft

The training organization shall provide appropriate uncrewed aircraft of an appropriate kind, number and quality for the training courses being offered to trainees to ensure all trainees have sufficient experience and airtime with the necessary aircraft types. Dual control systems for training aircraft may be beneficial in some circumstances and may be used when appropriate.

6.4.3 Simulators

The training organization should use training simulators wherever possible and appropriate, particularly when demonstrating serious emergency actions.

6.4.4 Risk management

The training organization shall ensure that a risk assessment is conducted before each flight training activity and shall adopt procedures to ensure that all risks are controlled as far as is reasonably possible. All relevant factors shall be considered as part of this assessment including the capability of trainees, the weather conditions, likely air traffic movement and the available equipment.

7 Training content delivery

The training organization shall provide training covering the theoretical knowledge and practical skills as defined in relevant normative [Annex A](#), [B](#), [C](#), [D](#) or [E](#). If trainees are taking multiple curricula such as [Annex A](#) and [Annex B](#), the items already covered in [Annex A](#) may be omitted during the training for [Annex B](#). The quality and effectiveness of the training content shall be evaluated and maintained periodically.

Before a qualification is issued to a trainee, the training organization shall assess the trainee's knowledge and practical competence to ensure all the required competencies defined in this document have been met.

The training organization should meet the general requirements for learning services described in ISO 29993:2017, Clause 12 "Assessment of learning" and Clause 13 "Monitoring and evaluation of the learning service", as far as possible.

8 Final qualification

The training organization shall issue diplomas, or other means of recognition, to certify when trainees have met the requisite knowledge and practical skills as defined in [Annex A](#), [B](#), [C](#), [D](#) or [E](#). The diplomas shall include the following data:

- a) trainee name;
- b) serial number of the diploma, given by the training organization issuing the diploma;
- c) course name and version information;
- d) UAS classification/category covered by course;
- e) issue date;
- f) expiration date (where applicable);
- g) training organization name;
- h) qualifying instructor's name;
- i) any special endorsements, e.g. including night operations.

9 Evaluation protocols

Trainees shall be evaluated in their theoretical and practical skills to demonstrate their competency according to this document before being issued with any qualification.

Prior to final evaluation, trainees shall either complete all the training described in the Annexes or, in the case of experienced but unqualified UAS pilots, demonstrate equivalent existing abilities.

Annex A (normative)

VLOS UAS pilot courses (open category)

A.1 Overview

This annex specifies requirements for UAS remote pilot training programs and the verification of the competencies achieved by the trainee by the UTO. The training organization shall ensure the trainee is able to demonstrate sufficient knowledge or competence for all the items listed in this Annex.

Once the UTO is satisfied that a trainee has achieved a sufficient level of competence, the UTO issues a VLOS UAS pilot certification attesting the competence to act as remote pilot-in-command, subject to the applicable jurisdiction.

This qualification is typically applicable to the open category of UAS operations, but it may in some cases be sufficient for VLOS operations even in the specific category.

Although in some jurisdiction demonstration of practical skill in the open category is not required, this document specifies two stages of pilot training:

- theory knowledge (see [A.4](#));
- practical skills (see [A.5](#)).

A.2 Competencies

A trainee who successfully completes the training course that satisfies the requirements of this document shall be able to conduct the flights indicated below with an uncrewed aircraft that is operated within their visual line of sight. If the training course is for a specific configuration (par. 5.1 in 23665) or type of UA, this shall be specified.

Achieved competencies for a trainee who completes the training course.

A.3 Fitness to act as remote pilot

To operate the UAS in a safe manner, the trainee shall be able to recognise any health issues that would likely impede the control of the aircraft.

In particular, the trainee shall be able to:

- a) clearly see with naked eyes or corrected vision the aircraft at all times and be able to judge its orientation at any distance at which it is likely to be operated;
- b) identify any other air users or obstructions that can pose a collision risk for the UA;
- c) communicate with other crew members, operators and stakeholders.

A.4 Theory knowledge

A.4.1 Air law/responsibilities

A.4.1.1 Terminology

The trainee shall be able to explain the relevant air law and regulatory terminology.

A.4.1.2 Legislation

A.4.1.2.1 Relevant articles and definitions

The trainee shall be able to summarise:

- a) the legal framework that governs airspace in the regulatory environment or jurisdiction of operation;
- b) the legal articles or regulations relevant to UA flight in that jurisdiction.

A.4.1.2.2 Use of airspace

A.4.1.2.2.1 General

The trainee shall be able to:

- a) explain the limitations and conditions to enter airspace in the open category in the relevant jurisdiction;
- b) identify the rules and regulatory processes for UAS operations in the open risk-based category;
- c) identify the rules and regulatory processes for UAS operations in the specific risk-based category;
- d) identify the rules and regulatory processes for UAS operations in the certified risk-based category.

Note 3 risk based categories, based on ICAO provision, are described in ISO 21384-3.

A.4.1.2.2.2 Avoidance of collisions ("see and avoid")

The trainee shall be able to explain:

- a) the PIC's responsibility for "see and avoid" and how this relates to avoidance of collisions with crewed/uncrewed aircraft;
- b) the procedures that the UA should follow in a conflict situation according to the information provided by the manufacturer or required by regulations or by the procedures of the UAS operator.

A.4.2 UAS rules and regulatory guidance applicable in the jurisdiction of operation

The trainee shall be able to summarise:

- a) the legally binding rules and related guidance material;
- b) taxonomy of categories and sub-categories of UAS operation;
- c) mass grades eligible for operations in the sub-categories of the open category;
- d) restrictions, limitations and conditions applicable in different operating environments, including, if applicable in the relevant jurisdiction, UAS geozones.

A.4.3 Incident and accident reporting

A.4.3.1 General

The trainee shall be able to explain:

- a) the definition of "accident" as it regards to uncrewed aviation;
- b) the definition of "incident" as it regards to uncrewed aviation;
- c) the responsibility of the PIC as it regards to mandatory reporting of UAS incidents and accidents;
- d) the relevant agencies to whom to address different types of reports;
- e) the mechanisms for reporting;
- f) the procedures for voluntary reporting of UAS incidents and accidents.

A.4.3.2 Aircraft proximity reporting

The trainee shall be able to explain the definition of an aircraft proximity situation (airprox).

A.4.3.3 Investigation handling/assistance

The trainee shall be able to explain the legal obligations to assist any accident or incident investigation including presentation of logs, records and documentation.

A.4.4 Insurance

The trainee shall be able to summarise the need for insurance based on national requirements or international recommendations relevant to UAS operations and able to list the items to checked before flight (e.g. validity of the insurance policy).

A.4.5 UAS airspace operating principles

A.4.5.1 Flight information region (FIR)

The trainee shall be able to list:

- a) Flight Information Region, CTR, ATZ;
- b) airspace sovereignty;
- c) national or host nation source of airspace information.

A.4.5.2 Airspace classifications

A.4.5.2.1 General

The trainee shall be able to explain:

- a) TMA, CTR and ATZ and limits;
- b) difference between controlled and noncontrolled airspace;
- c) classes of airspace;
- d) airspace restrictions and UAS geozones;
- e) 3D nature of airspace;

- f) IFR and VFR rules;
- g) ATS units.

A.4.5.2.2 Differing considerations

The trainee shall be able to explain likely traffic considerations for the UAS pilot to be concerned about.

A.4.5.2.3 Controlled airspace

The trainee shall be able to demonstrate understanding of ;

- a) how airspace responsible body is assigned;
- b) when authorization from air traffic control is required and/or appropriate for specific airspace types.
- c) Aerodrome traffic zone (ATZ):
 - 1) factors to be considered when operating in liaison with airspace owners;
 - 2) typical or likely traffic flow or operations close to airfields;
 - 3) how to recognize ATZs on airspace charts.
- d) Control zone (CTR):
 - 1) how to act in high-traffic areas;
 - 2) likely traffic flow in high-traffic areas;
 - 3) how to recognize CTR zones on airspace charts.

A.4.6 Unclassified airspace volumes

The trainee shall be able to explain:

- a) the definitions, avoidance criteria and risks associated with danger areas and where to find information on them;
- b) the definition of prohibited areas, their meaning for UAS pilots and where to find information on them;
- c) the definition of restricted areas, their meaning for UAS pilots and where to find information on them, including for possible UAS geozones established by the State.

A.4.7 Obtaining information/approvals

The trainee shall be able to summarise when it is appropriate to contact other parties and the information needed, for example (but not limited to):

- a) air traffic service (ATS);
- b) national aviation authority;
- c) police;
- d) landowner;
- e) neighbouring property owners;
- f) bystanders.

A.4.8 UAS operations

The trainee shall be able to explain the meaning of each of these terms and their operating limitations:

- a) visual line of sight (VLOS);
- b) extended visual line-of-sight (EVLOS);
- c) beyond visual line-of-sight (BVLOS).

A.4.9 Airmanship and aviation safety

A.4.9.1 Good airmanship principles

A.4.9.1.1 General

Airmanship comprises a sound acquaintance with the principles of flight, the ability to operate an aircraft with competence and precision both on the ground and in the air, and the exercise of sound judgment that results in optimal operational safety and efficiency.

The trainee shall be able to explain:

- a) how airmanship is a range of skills, knowledge and attitudes and is not limited to the motor skills of flying an aircraft;
- b) how airmanship principles can contribute to aviation safety and risk management in the uncrewed aircraft environment;
- c) how to put into practice good airmanship principles in real operational situations.

A.4.9.1.2 Aircraft safe to operate

The trainee shall be able to explain:

- a) the requirement to conduct appropriate maintenance checks on the aircraft;
- b) the appropriate action when an aircraft requires repairs or maintenance;
- c) interpretation of the records on maintenance and repairs;
- d) the need to stop the operation if the aircraft is not safe to operate at any point in the operation (go/no go decision);
- e) the need to conduct pre-flight checks to ensure the aircraft is safe to operate and airworthy before each.

A.4.9.1.3 Planning

The trainee shall be able to demonstrate the basic principles of the following:

- a) planning and preparation of the flight to remain compliant with the limitations and conditions to operate in the open category;
- b) building situational awareness using thorough planning and applicable checklist prior to the UAS flight;
- c) determining the workload of a particular operation prior to the flight and allocating correct resources; and
- d) conducting effective briefing of normal and emergency actions immediately prior to the flight to help perform the UAS flight successfully.

A.4.9.1.4 Hazard identification

The trainee shall be able to:

- a) explain the hazards and risks at the planning stage, on which the pre-flight checklist is based;
- b) use and generate risk assessments at an appropriate level of detail;
- c) continually assess emerging hazards during the flight and take appropriate actions throughout the flight as the operating environment changes.

A.4.9.2 Flight safety

A.4.9.2.1 Avoiding collisions

The trainee shall be able to explain maintaining situational awareness of the operating environment so that collisions with people, vehicles, vessels, structures and any obstacles are avoided.

A.4.9.2.2 Perception

The trainee shall be able to explain the following items.

- a) Distance:
 - 1) using onboard sensors or other means to assess distance;
 - 2) making effective use of remote flight crew members, e.g. visual observer.
- b) Height:
 - 1) using onboard sensors to assess height;
 - 2) making effective use of remote flight crew members.
- c) Speed:
 - 1) correctly using onboard sensors to assess speed;
 - 2) making effective use of remote flight crew members to determine speed and rates of closure.

A.4.9.2.3 Go/no go decisions

The trainee shall be able to explain that:

- a) the remote pilot-in-command has responsibility to determine for when it is safe to operate;
- b) the remote pilot-in-command's assessment of whether to operate or not cannot be overruled;
- c) the remote pilot-in-command holds ultimate responsibility for the flight, from pre-flight checks to post flight records.

A.4.9.3 Remote pilot logbooks

The trainee shall be able to demonstrate understanding of effective logging of pilot records using traditional or electronic methods.

A.4.9.4 Overflight of people, crowds and gatherings

The trainee shall be able to:

- a) explain the requirements for minimum distance from involved people in the subcategories of the open category;

- b) explain restrictions for overflying assemblies of people;
- c) explain how to obtain information regarding expected people movement, crowds, gatherings or sensitive structure and events.

A.4.9.5 Third-party liability

The trainee shall be able to list the consequences of UAS operations damaging third-party property or injuring persons and the requirement for insurance under State regulations.

A.4.10 Human factors

A.4.10.1 Medical fitness

A.4.10.1.1 General

The training organization shall ensure the trainee is able to demonstrate understanding of:

- a) appropriate medical fitness for the operation;
- b) assessment of medical fitness and record keeping;
- c) awareness of regulatory requirements relating to medical fitness.

A.4.10.1.2 Alcohol, drugs, medication

The training organization shall ensure the trainee is able to demonstrate understanding of:

- a) appropriate organization policies regarding alcohol and drugs;
- b) the incompatibility of alcohol and drugs with UAS operations;
- c) regulatory requirements regarding alcohol and drugs;
- d) unwanted side effects of medications and their impact on performance.

A.4.10.2 Fatigue

The trainee shall be able to explain:

- a) the definition of fatigue and its serious effects on remote flight crew performance;
- b) how to recognize appropriate workload and the resource plan prior to the flight.

A.4.10.3 Effects of weather

The trainee shall be able to explain:

- a) the effects of cold weather, including icing, on the remote flight crew and on aircraft performance;
- b) the effects of hot weather on the remote flight crew and on aircraft performance;
- c) the effects of wind on aircraft performance;
- d) the effects of low atmospheric pressure when flying in mountainous areas, on aircraft performance;
- e) the effects of humidity or atmospheric phenomena on the remote flight crew and on aircraft performance.

A.4.10.4 Crew/colleague management

The trainee shall be able to explain:

- a) effective team working with colleagues, including effective briefing;
- b) the content of briefing, including normal operation and emergency situations and including briefing of involved persons;
- c) effective briefing prior to the UAS flight;
- d) allocation of tasks and management of multiple crew remote crews, including visual observers.

A.4.10.5 Depth perception

The trainee shall be able to:

- a) use all available data to maintain an accurate mental model of the operating environment;
- b) explain the benefit of using visual observers.

A.4.10.6 Public/third parties

The trainee shall be able to summarise:

- a) how to recognize the hazards and threats that the public and third parties can bring to an operation;
- b) the need for assertiveness to maintain operational safety.

A.4.10.7 Stress/pressure

The trainee shall be able to explain:

- a) how to recognize the stress and pressure that third parties, including customers and clients, can bring to an operation and the hazards and threats that these can introduce;
- b) the need for assertiveness by the pilot to maintain operational safety.

A.4.11 Meteorology

A.4.11.1 Obtaining and interpreting weather information

The trainee shall be able to explain:

- a) sources, original information and interpretation of weather reporting sources;
- b) the use of aviation weather, limits, units and timescales;
- c) typical abbreviations and terms used in weather data.

A.4.11.2 Local weather assessments

The trainee shall be able to explain:

- a) the need for an onsite weather assessment coupled with the forecast;
- b) the signs of approaching poor weather;
- c) the signs of approaching frontal activity.

A.4.11.3 Operational envelope

A.4.11.3.1 General

The trainee shall be able to list:

- a) the UAS manufacturer's stated operating limits;
- b) legal/national limits.

A.4.11.3.2 Effects on the UAS

The trainee shall be able to explain the significance of the following factors with respect to UAS operations according to the applicable conditions for the type of UAS in use and the manufacturer's instructions.

- a) wind:
 - 1) variation of performance with altitude;
 - 2) synoptic charts, and how they can be used to estimate wind;
 - 3) UA behaviour near ground obstacles in windy weather;
 - 4) UA behaviour on take-off and landing in conditions of wind shear in the surface layer.
 - 5) ascending and descending air flows; their impact on take-off and landing performance;
- b) cloud cover:
 - 1) the effect of clouds on the range of visual observation of UA;
 - 2) ascending and descending air flows under and in the clouds;
- c) urban effects:
 - 1) behaviour of wind near buildings;
 - 2) effect of lowered pressure;
 - 3) areas of lee caused by buildings;
- d) gradients:
 - 1) change in wind over a given area;
 - 2) causes and effects of pressure gradients;
- e) masking:
 - 1) effect of terrain;
 - 2) urban weather masking (e.g. in lee of buildings);
- f) icing:
 - 1) causes and symptoms;
- g) temperature:
 - 1) effect on battery performance;
 - 2) precipitation:

- 3) effect on visibility and crew;
- h) turbulence:
 - 1) identifying and avoiding areas of likely turbulence;
 - 2) natural and manmade features likely to affect turbulence;
 - 3) aircraft response.

A.4.11.4 Visibility factors

The trainee shall be able to explain the factors affecting safe UAS operations, with particular regard to:

- a) general factors:
 - 1) changes in visibility due to moisture, pollution, dust, etc.;
 - 2) formation of radiation, advection, upslope, precipitation and ice fog;
- b) clouds:
 - 1) low-level clouds;
 - 2) likely weather phenomena;
- c) cumulonimbus (CB) hazards (including lightning):
 - 1) identification and hazards;
 - 2) when to cancel flights.

A.4.12 Geographical information

A.4.12.1 Understanding of basic terms

The trainee shall be able to recognise all relevant terms and to explain their relevance to the UAS RP, including but not limited to:

- a) nautical miles;
- b) kilometres;
- c) feet;
- d) elevation;
- e) altitude;
- f) above ground level (AGL).

A.4.12.2 GNSS (including GPS)

The trainee shall be able to recognise the following terms and to explain their relevance to UAS and geo location.

- a) GNSS concepts;
- b) accuracy;
- c) dilution of precision.

A.4.13 Aircraft knowledge

A.4.13.1 Basic principles of flight

The trainee shall be able to explain the following items, depending on the model used.

- a) forces and their inter-relationship affecting flight, including lift, drag, thrust and weight;
- b) how lift is generated using rotary and fixed wings;
- c) wing's angle of attack and how this can affect lift generation and efficiency;
- d) difference between airspeed and ground speed;
- e) basic wing and thrust components of a fixed-wing, rotary and multirotor aircraft needed to achieve aircraft lift and manoeuvre;
- f) manoeuvres pitch, roll and yaw;
- g) with reference to an aircraft's wings and means of generating thrust, how rotary, fixed wing and multirotor aircraft achieve pitch, roll and yaw;
- h) difference in flight characteristics between rotary and fixed wing aircraft;
- i) with reference to single- and multi-rotor systems, torque and anti-torque controls;
- j) basics of vortex ring state and how to recover from settling-with-power condition.

A.4.13.2 Command and control

A.4.13.2.1 Datalink frequencies/spectrum

The trainee shall be able to recognise:

- a) which radio frequencies are permitted and which of these are commonly used to control UAS;
- b) the risks and causes of frequency interference and the effect that this can have upon UAS in flight;
- c) how to identify communication traffic or congestion on the frequencies used to control UAS;
- d) what actions to take in the event of frequency interference affecting control of the aircraft.

A.4.13.2.2 Manual intervention/override

The trainee shall be able to explain the following items according to the type of UAS in use:

- a) the circumstances when it is appropriate for a pilot to intervene and take control of a UAS during automatic flight;
- b) how to establish a switch of flight mode on the remote pilot station to allow the pilot to intervene and gain control of an aircraft during automatic flight.

A.4.13.2.3 Flight control modes

The trainee shall be able to explain the following items according to the type of UAS in use.

- a) the purpose and function of a remote pilot station (alias flight controller);
- b) the flight modes available on typical RPS;
- c) how to switch between the various flight modes.

A.4.13.3 Limitations

A.4.13.3.1 Operational envelope

The trainee shall be able to explain the meaning of an aircraft's safe operating envelope, outside of which the performance and operational safety of the aircraft can be compromised during flight.

A.4.13.3.2 Stability

The trainee shall be able to:

- a) describe what can cause flight instability in a UAS;
- b) explain what pre-flight and in-flight measures can be taken to maintain aircraft stability when in flight.

A.4.13.3.3 Flight procedures/basic skills

The trainee shall be able to:

- a) identify the appropriate checklist and execute pre-flight checks and inspection procedures for UAS;
- b) execute procedures for the safe initiation and start-up of UAS;
- c) identify the appropriate in-flight procedures under normal conditions and execute them to test, verify and monitor the correct and safe functioning of UAS;
- d) identify and execute the contingency and emergency procedures applicable in the event of incorrect or non-functioning aircraft systems or any other anomaly.

A.4.13.3.4 Contingencies and emergencies

The trainee shall be able to:

- a) describe procedures for dealing with contingencies or emergencies arising out of UAS operations;
- b) correctly use contingency and emergency procedures;
- c) list whom to contact and notify in the event of an emergency.

A.4.13.4 Maintenance of systems

A.4.13.4.1 Scheduled maintenance and repairs

The trainee shall be able to summarise:

- a) how the components which make up a UAS can be subject to damage and general wear and tear;
- b) how this could compromise the performance and safety of an aircraft during flight;
- c) how some aircraft components are at greater risk of damage and/or a higher rate of wear and tear than others, and identify which these are.

A.4.13.4.2 Safety of aircraft/attached items

The trainee shall be able to:

- a) explain the importance of ensuring that an aircraft is structurally sound, and all items fixed to the aircraft, such as payload, are safe before flight;
- b) based on appropriate procedures, conduct checks to confirm that an aircraft is structurally sound, and all components are appropriately fixed before and after flight.

A.4.13.4.3 Pre-flight assessment: "safe to be flown?"

A.4.14 Operating procedures

A.4.14.1 Planning

The trainee shall be able to:

- a) evaluate and decide upon the feasibility of the intended operation in the open category at an operating location;
- b) ascertain whether the UAS operations can be conducted at an operating location, taking into consideration all applicable laws, regulations and UAS geozones.

A.4.14.2 Site assessment

A.4.14.2.1 General

The trainee shall be able to:

- a) explain the reasons for the need to undertake a site assessment before proceeding with UAS flight operations;
- b) explain the need for, and how to prepare and document, a site assessment;
- c) explain how to apply the findings from a site assessment to decide on the safe planning and execution of UAS flight operations;
- d) describe the factors that must be included in a site survey for the operations of all small/medium RPA operations;
- e) co-ordinate procedures with aerodrome or vertiport operator when appropriate;
- f) determine suitable location for installation of docking system.

A.4.14.2.2 Establishing a safe operating environment

A.4.14.2.2.1 Hazard identification

The trainee shall be able to:

- a) explain meaning of a hazard;
- b) list examples of typical hazards which could affect the operational performance and safety of a UAS;
- c) explain how the limitations and conditions for operations in the open category mitigate the associated risks;
- d) explain the importance of recording and documenting hazards as part of the pre-flight checklist.

A.4.14.2.2.2 Risk assessment

The trainee shall be able to:

- a) select, utilize and implement an appropriate risk assessment tool for evaluating risk associated
- b) with planned UAS operations;
- c) identify risks associated with planned UAS operations;
- d) assess the probability and impact of risk occurrence;
- e) determine acceptable levels of risk to allow planned UAS operations to proceed safely.

A.4.14.2.3 Site permission

The trainee shall be able to explain:

- a) when it is mandatory to notify and seek permission from a landowner or geozone manager in relation to planned UAS operations;
- b) whether and how operating a UAS over land and/or property or inside geozones without permission of the landowner or geozone manager could constitute an offence.

A.4.14.3 Situational awareness

A.4.14.3.1 General

The trainee shall be able to explain:

- a) conducting a safe flight by maintaining a high state of situational awareness of all aspects of the operating environment;
- b) the difficulties in the perception of change in the operating environment;
- c) effective use of remote flight crew members to improve awareness of the entire team.

A.4.14.3.2 Location

The trainee shall be able to ascertain the suitability of an operating site for UAS operations, both in terms of general operational safety, taking into consideration applicable limitations and conditions for the open category.

A.4.14.3.3 Aerodromes

The trainee shall be able to ascertain whether restrictions apply in relation to UAS operations near aerodromes.

A.4.14.3.4 Obstructions

The trainee shall be able to explain:

- a) how obstructions which could impact planned UAS operations;
- b) how obstructions could impact planned UAS operations (such as risk of physical contact with UA, interruption of UAS control link and/or telemetry or causing non-compliance with applicable limitations and conditions for the open category).

A.4.14.3.5 Involved and non-involved persons

The trainee shall be able to:

- a) explain how and when public safety could be compromised by UAS operations;
- b) quote the minimum distances from people in the various subcategories of UAS operations in the open category;
- c) describe what, why and when it is appropriate or mandatory to notify the public of planned UAS operations;
- d) plan and carry out liaison and communication with involved persons for the purposes of planning and executing UAS operations.

A.4.15 Communications

A.4.15.1 Operating alone

The trainee shall be able to:

- a) explain why operating UAS alone should be avoided as much as possible;
- b) explain the operational, health and safety risks of conducting UAS operations alone;
- c) describe the measures to mitigate the health and safety risks of lone working, including means by which communications could be maintained whilst operating remotely;
- d) explain how, why and when it is appropriate to deploy hand-held radios and/or mobile telephones during UAS operations to help improve communications and UAS operational safety.

A.4.16 Pre-flight procedures

A.4.16.1 General

The trainee shall be able to explain how to safely prepare a flight of the type of UA they intend to operate, based on the pre-flight checklist.

A.4.16.2 Pre-flight checklist

The trainee shall be able to explain:

- a) what a pre-flight checklist is;
- b) why a pre-flight checklist is necessary;
- c) how a pre-flight checklist shall be used.

A.4.16.3 Security of attachments/payload

The training organization shall ensure the trainee is able to demonstrate:

- a) the correct fitment and security of any attachment/payload to the aircraft being flown prior to flight operations, including checking the recording set up (e.g. SD card), where applicable, has been formatted and fitted correctly;
- b) that the platform with payload fitted is safe to fly and does not exceed the maximum take-off mass for that aircraft.

The trainee shall be able to explain the meaning of attachments and payloads in relation to UAS operations.

A.4.16.4 Failsafe check

The trainee shall be able to explain procedure on the aircraft type being operated, including procedures in the event of remote pilot incapacitation or a loss of C2 link with the aircraft (setting safe return height, clear of obstacles).

The training organization shall ensure the trainee is able to demonstrate the safe operation of the failsafe system for the particular system in use.

A.4.16.5 Battery condition

The trainee shall be able to explain:

- a) the different types of potential damage and defects that can be found with batteries and how the different conditions can affect the safe flight of the UA;

- b) the meaning of the expression “battery management”, using safe charging procedures, battery identification and a battery log;
- c) the possibility of fire caused by faulty lithium batteries, and how to minimize and respond to such risks.

The training organization shall ensure the trainee is able to demonstrate how to check the condition and integrity of the battery/batteries.

A.4.16.6 Weather

The trainee shall be able to explain:

- a) the meaning of the expression “weather”;
- b) the different types of weather conditions and their individual effects on a UAS.

The training organization shall ensure the trainee is able to demonstrate how the weather can be checked for suitability prior to flight.

A.4.17 In-flight procedures

A.4.17.1 General

The trainee shall be able to explain how to manage the safe operation of the aircraft whilst in flight, in compliance with regulatory limitations and conditions, site authorizations, manufacturer’s instructions, available information and procedures established by the UAS operator.

A.4.17.2 In-flight monitoring

The trainee shall be able to explain:

- a) the meaning of the expression "in-flight monitoring";
- b) how to continuously monitor throughout the flight, e.g. battery charge, strength of satellite navigation signals, height and distance away from the remote pilot, weather conditions, environmental conditions on the ground and in the air.

A.4.17.3 Battery status

The trainee shall be able to explain:

- a) the meaning of the expression "battery status" in relation to UAS;
- b) how to monitor the battery status both pre-flight and in-flight and the requirements and importance of a safety margin.

A.4.17.4 Visual line-of-sight (VLOS)

The trainee shall be able to explain the meaning of the expression "visual line-of-sight".

The trainee shall be able to explain how to fly the aircraft within VLOS, including weather and environmental factors, and how to use related UTM services and aircraft systems for geolimitations.

A.4.18 Post-flight procedures

A.4.18.1 General

The trainee shall be able to explain what post-flight is and which actions shall be taken post-flight, with emphasis on noting and reporting any faults or damage to the equipment.

If there are further flights subsequently planned, explain the need and content of a between-flight check which shall include as a minimum a battery status check.

A.4.18.2 Post-flight actions

The trainee shall be able to explain:

- a) the meaning of the expression "post-flight actions";
- b) how to search for a UA if the landing was behind an obstacle (out of line of sight, by accident);
- c) how to conduct a post-flight inspection paying close attention to the airframe, propellers/rotors, looking for damage or anything missing and how to notify such defects to the maintenance personnel;
- d) how to recover equipment and leave site clear.

A.4.18.3 Debrief/logging of flight details

The trainee shall be able to explain:

- a) the meaning of the expressions "debrief" and "logging" in relation to UAS flights;
- b) how to upload or log the flight data, reporting any incidents, accidents or occurrences.

A.4.18.4 Post-flight maintenance

The training organization shall ensure the trainee is able to demonstrate a basic understanding of maintenance following on from the post-flight inspection, including how they would rectify any maintenance concerns that have been found during the post-flight inspection.

A.4.19 Emergency actions

A.4.19.1 General

The trainee shall be able to explain what an emergency action is, what classifications of emergency actions there are and the actions to be taken in an emergency.

A.4.19.2 Loss of control/flyaway

The trainee shall be able to explain:

- a) the meaning of the expression "loss of control" or "flyaway";
- b) what actions are to be carried out in the event of a loss of control or flyaway, including communication with relevant authorities or entities.

A.4.19.3 Malfunctions

The trainee shall be able to explain how to recognize a malfunction of the UAS or remote pilot station and the appropriate actions to take in accordance with the procedures detailed by the manufacturer of operator, including how the aircraft itself can display certain visual clues that a malfunction is present.

A.4.19.4 Designated landing area not clear

The trainee shall be able to demonstrate understanding of the potential risks in relation to UAS operations and landing sites, including how a secure area can change quickly with ground incursions.

A.4.19.5 Incursion of other aircraft in the operating environment

The trainee shall be able to explain the need for vigilance and the actions to be taken in the event of an unplanned incursion of other aircraft, including how a visual observer can significantly improve the safe operation of UAS.

A.4.20 Privacy

The trainee shall be able to explain the actions to be taken to keep the privacy etiquette, as defined in ISO 21384-3 Annex A.

A.5 Practical skills requirements

A.5.1 General practical/management skills

The trainee shall be able to demonstrate competence in in their ability to perform the following tasks without assistance.

NOTE 1 A visual observer or payload operator can be appointed if appropriate to the operation, but they would be under the direction of the trainee for assessment purposes.

NOTE 2 In the case of a fixed-wing aircraft, the trainee can demonstrate an equivalent procedure that results in a suitable automated, low impact descent and landing.

- a) accurately conduct pre-flight actions including:
 - 1) mission planning, airspace considerations and site risk assessment;
 - 2) evaluating weather and modifying flight plan accordingly;
 - 3) aircraft pre-flight inspection and set-up (including flight controller modes and power-source hazards);
 - 4) plan in case of an aircraft emergency or a mid-air collision hazard during the flight;
- b) in-flight procedures including:
 - 1) maintaining an effective look-out and keeping the aircraft within VLOS at all times;
 - 2) performing accurate and controlled flight manoeuvres at representative heights and distances, including flight in "ATTI" mode (non-GPS assisted) or using equivalent manual override control when these option are available;
 - 3) demonstration of a "return-to-home" function following deliberate control-link transmission failure;
- c) post-flight actions including shutting down/making-safe the aircraft.

A.5.2 Flight operation skills

The trainee shall be able to master the following skills. This list of skills can be amended according to the type of missions and aircraft that the trainees are likely to fly. The listed skills shall be performed primarily in "ATTI" mode or equivalent non-assisted mode and also by automatic mode if available.

- a) take-off and landing;
- b) hovering;
- c) flying forwards and backwards at a constant altitude;
- d) flying left and right while maintaining a constant heading and altitude;

- e) turning aircraft to port and starboard while remaining at a constant altitude;
- f) flying a box pattern;
- g) ascending or descending to a specific altitude;
- h) flying a horizontal figure of eight.

Simulator training should be included since certain simulated emergencies are not possible in real flight training.

A.6 Final qualification — VLOS UAS remote pilot

The UTO shall issue a UAS remote pilot certificate to a trainee after:

- a) the trainee has passed examination of theory knowledge on all items in [A.4](#);
- b) the trainee has demonstrated her/his ability to safely and accurately perform all of the practical skills in [A.5](#).

Note Both the theory examination and the practical skill assessment can be split into different modules.

To award a r-PIC qualification to a trainee, the training organization shall ensure that the trainee demonstrates to an examiner or assessor her/his competencies in relation to knowledge, skills and attitudes, accordance with paragraphs from [A.3](#) to A.10 to demonstrate her/his ability to competently perform all of the duties assigned by the UAS operator in accordance with 21384-3.

Annex B (normative)

VLOS UAS pilot courses (specific category)

B.1 Overview

This annex specifies requirements for UAS remote pilot training programs and the verification of the competencies achieved by the trainee by the UTO. The training organization shall ensure the trainee is able to demonstrate sufficient knowledge or competence for all the items listed in this Annex,

Once the UTO is satisfied that a trainee has achieved a sufficient level of competence, the UTO issues a VLOS UAS pilot certification attesting the competence to act as remote pilot-in-command, subject to the applicable jurisdiction.

This qualification is typically applicable to VLOS operations even in the specific category.

This document specifies two stages of pilot training:

- theory knowledge (see [B.4](#));
- practical skills (see [B.5](#)).

This document defines the requirements for manual flight and automatic flight. In this document, "automatic flight" refers to flights conducted by setting waypoints on a RPS, while "manual flight" refers to flights without setting waypoints. Additionally, manual intervention by the pilot during automatic flight is not prohibited.

B.2 Competencies

A trainee who successfully completes the training course that satisfies the requirements of this document shall be able to conduct the flights indicated below with an uncrewed aircraft that is operated within their visual line of sight. If the training course is for a specific configuration (par. 5.1 in 23665) or type of UA, this shall be specified.

Achieved competencies for a trainee who completes the training course.

B.3 Fitness to act as remote pilot

To operate the UAS in a safe manner, the trainee shall be able to recognise any health issues that would likely impede the control of the aircraft. In particular, the trainee shall be able to:

- a) clearly see with naked eyes or corrected vision the aircraft at all times and be able to judge its orientation at any distance at which it is likely to be operated;
- b) identify any other air users or obstructions that can pose a collision risk for the UA;
- c) correctly interpret all safety critical data displayed on the UAS controller display unit;
- d) hear sufficiently to be aware of the approach of other aircraft or to be warned verbally of a safety concern;
- e) not have any known condition that could cause sudden loss of consciousness or concentration;
- f) handle the remote pilot station and to manipulate the equipment installed therein;

g) communicate with other crew members, operators and stakeholders.

In the event that a trainee has a condition or disability that prevents them from meeting one or more of these requirements, it can be possible to achieve a safe working protocol by using a visual observer, back-up remote PIC or other additional crew member, in which case a risk assessment shall be carried out to ensure that such a protocol is safe and effective.

B.4 Theory knowledge

B.4.1 Air law/responsibilities

B.4.1.1 Terminology

The trainee shall be able to explain the item in [Table B.1](#).

Table B.1 — Terminology

Training curriculum	Manual flight	Automatic flight
The relevant air law and regulatory terminology	X	X
The basic terms and principles for airspace management in ICAO: sovereignty, high seas, flight information regions (FIR)		X

B.4.1.2 Legislation

B.4.1.2.1 Relevant articles and definitions

The trainee shall be able to summarise:

- the legal framework that governs airspace in the regulatory environment or jurisdiction of operation;
- the legal articles or regulations relevant to UA flight in that jurisdiction.

B.4.1.2.2 Use of airspace

B.4.1.2.2.1 General

The trainee shall be able to:

- explain the limitations and conditions to enter airspace in the open category in the relevant jurisdiction;
- identify the rules and regulatory processes for UAS operations in the open risk-based category;
- identify the rules and regulatory processes for UAS operations in the specific risk-based category;
- explain conditions, restrictions and processes for standard scenarios (STS) and pre-defined risk assessments (PDRA) in the intended jurisdiction;
- identify the rules and regulatory processes for UAS operations in the specific risk-based category.

Note 3 risk based categories, based on ICAO provision, are described in ISO 21384-3.

B.4.1.2.2.2 Avoidance of collisions ("see and avoid")

The trainee shall be able to explain:

- the PIC's responsibility for "see and avoid" and how this relates to avoidance of collisions with crewed/uncrewed aircraft;

- b) the procedures that the UA should follow in a conflict situation according to the information provided by the manufacturer or required by regulations or by the procedures of the UAS operator;
- c) right of way rules and avoidance maneuver planning.

B.4.2 UAS rules and regulatory guidance applicable in the jurisdiction of operation

The trainee shall be able to summarise:

- a) the legally binding rules and related guidance material;
- b) taxonomy of categories and sub-categories of UAS operation;
- c) mass grades eligible for operations in the sub-categories of the open category;
- d) restrictions, limitations and conditions applicable in different operating environments, including, if applicable in the relevant jurisdiction, UAS geozones.

B.4.3 Incident and accident reporting

B.4.3.1 General

The trainee shall be able to explain:

- a) the definition of "accident" as it regards to uncrewed aviation;
- b) the definition of "incident" as it regards to uncrewed aviation;
- c) the responsibility of the PIC as it regards to reporting of UAS incidents and accidents;
- d) the relevant agencies to whom to address different types of reports;
- e) the time limits on reporting;
- f) the mechanisms for reporting;
- g) the types of reportable incidents and accidents;
- h) the concepts of "hazard" and "risk".

B.4.3.2 Aircraft proximity reporting

The trainee shall be able to explain the definition of an aircraft proximity situation (airprox).

B.4.3.3 Investigation handling/assistance

The trainee shall be able to explain the legal obligations to assist any accident or incident investigation including presentation of logs, records and documentation.

B.4.4 Insurance

The trainee shall be able to summarise the need for insurance based on national requirements or international recommendations relevant to UAS operations and able to list the items to checked before flight (e.g. validity of the insurance policy).

B.4.5 UAS airspace operating principles

B.4.5.1 Flight information region (FIR)

The trainee shall be able to list:

- a) Flight Information Region, CTR, ATZ;

- b) airspace sovereignty;
- c) International Civil Aviation Organization (ICAO) definitions;
- d) national or host nation source of airspace information.

B.4.5.2 Airspace classifications

B.4.5.2.1 General

The trainee shall be able to explain:

- a) TMA, CTR and ATZ and limits;
- b) difference between controlled and noncontrolled airspace;
- c) classes of airspace;
- d) airspace restrictions and UAS geozones;
- e) airspace restrictions caused by the cloud base;
- f) 3D nature of airspace;
- g) IFR and VFR rules;
- h) ATS units.

B.4.5.2.2 Differing considerations

The trainee shall be able to explain:

- a) operating restrictions in different classes of airspace and geozones;
- b) likely traffic considerations for the UAS pilot to be concerned about;
- c) responsibility of other crewed traffic under visual flight rules (VFR).

B.4.5.2.3 Controlled airspace

The training organization shall ensure the trainee is able to demonstrate understanding of the items in [Table B.2](#).

Table B.2 — Controlled airspace

Training curriculum	Manual flight	Automatic flight
e) how airspace responsible body is assigned;	X	X
f) when authorization from air traffic control is required and/or appropriate for specific airspace types.		X
g) Aerodrome traffic zone (ATZ):	X	X
1) factors to be considered when operating in liaison with airspace owners;	X	X
2) typical or likely traffic flow or operations close to airfields;	X	X
3) how to recognize ATZs on airspace charts.	X	X
h) Control zone (CTR):	X	X
1) how to act in high-traffic areas;	X	X
2) likely traffic flow in high-traffic areas;	X	X
3) how to recognize CTR zones on airspace charts.	X	X

Table B.2 (continued)

Training curriculum	Manual flight	Automatic flight
i) Gliding/parachuting/ultra-light sites:	X	X
1) how to integrate with VFR traffic according to local protocols;	X	X
2) UAS handling in uncontrolled airspace, traffic flow and yielding;	X	X
3) the importance of a good look-out given that gliders, parachutes and ultra-light emit minimal sound.	X	X
j) traffic patterns around controlled aerodromes. Show the critical elements of potential mid-air on approach and takeoff from active runways(s)		X

B.4.6 Unclassified airspace volumes

The trainee shall be able to explain:

- a) the definitions, avoidance criteria and risks associated with danger areas and where to find information on them;
- b) the definition of prohibited areas, their meaning for UAS pilots and where to find information on them;
- c) the definition of restricted areas, their meaning for UAS pilots and where to find information on them, including for possible non-classified airspace volumes relevant for UAS operation (e.g. restricted, prohibited, danger, temporally segregated or other relevant geographical zone) established by the state;
- d) when temporary airspace reservations can be applied, their purpose and interpretation;
- e) the significance of special activities (e.g. parachute jumps, aerobatic flights).

B.4.7 Obtaining information/approvals

The trainee shall be able to summarise:

- a) the purpose and use of the aeronautical information publication (AIP) of the country where the flight will be operated;
- b) the purpose, interpretation and use of aeronautical information circulars (AICs) of the country where the flight will be operated;
- c) notices to airmen (NOTAMs):
 - 1) how to obtain and interpret NOTAMs;
 - 2) how to request the addition of information regarding a UAS flight plan into a NOTAM;
- d) chart interpretation:
 - 1) how to interpret aeronautical charts, including digital information provided by the UTM geoawareness service in the region of operation;
 - 2) how to interpret surface maps;
 - 3) how charts and maps are amended;
- e) when it is appropriate to contact other parties and the information needed, for example (but not limited to):
 - 1) air traffic service (ATS);
 - 2) national aviation authority;
 - 3) police;
 - 4) landowner;

- 5) neighbouring property owners;
- 6) bystanders.
- f) determine the validity/currency of aeronautical charts or information sources
- a) give examples of the types of RPA activities that would require a special flight operations certificate
- b) extract geographical and airspace information from surface maps, aeronautical charts or equivalent digital applications, to plan, a safe and secure UAS operation, considering also all applicable regulations and current approvals ;
- c) identify from where to obtain charts or digital geographical information in the country where the UA flight will be operated ;
- d) consider cardinal points, basic geographical reference grids, related geographical coordinates, and how to obtain aeronautical charts.

B.4.8 UAS operations

The trainee shall be able to:

- a) explain the meaning of each of these terms and their operating limitations:
 - 1) visual line of sight (VLOS);
 - 2) extended visual line-of-sight (EVLOS);
 - 3) beyond visual line-of-sight (BVLOS);
 - 4) other terms, for example, VFR, as defined in ISO 21384-4;
- b) explain how segregated airspace is established and managed.

B.4.9 Airmanship and aviation safety

B.4.9.1 Good airmanship principles

B.4.9.1.1 General

Airmanship comprises a sound acquaintance with the principles of flight, the ability to operate an aircraft with competence and precision both on the ground and in the air, and the exercise of sound judgment that results in optimal operational safety and efficiency.

The trainee shall be able to explain:

- a) how airmanship is a range of skills, knowledge and attitudes and is not limited to the motor skills of flying an aircraft;
- b) how airmanship principles can contribute to aviation safety and risk management in the uncrewed aircraft environment;
- c) how to put into practice good airmanship principles in real operational situations;
- d) how concepts such as threat and error management (TEM) and crew resource management (CRM) can form a part of good airmanship.

B.4.9.1.2 Aircraft safe to operate

The trainee shall be able to explain:

- a) the requirement to conduct appropriate maintenance checks on the aircraft;

- b) the requirement to develop a maintenance schedule to ensure the aircraft is properly maintained and safe to operate;
- c) the appropriate action when an aircraft requires repairs or maintenance;
- d) interpretation of the records on maintenance and repairs;
- e) the need to stop the operation if the aircraft is not safe to operate at any point in the operation (go/no go decision).
- f) the need to conduct pre-flight checks to ensure the aircraft is safe to operate and airworthy before each

B.4.9.1.3 Remote pilot fit to operate aircraft

The training organization shall ensure the trainee is able to demonstrate understanding of:

- a) how remote pilot fitness is a key part of operational safety;
- b) appropriate medical fitness levels for the remote pilot;
- c) self-check of remote pilot medical fitness before each flight and methods of accomplishing this;
- d) monitoring of remote pilot fitness.

B.4.9.1.4 Planning

The trainee shall be able to demonstrate the basic principles of the following:

- a) planning and preparation of the flight to remain compliant with the limitations and conditions to operate in the open category;
- b) building situational awareness using thorough planning and applicable checklist prior to the UAS flight;
- c) determining the workload of a particular operation prior to the flight and allocating correct resources; and
- d) conducting effective briefing of normal and emergency actions immediately prior to the flight to help perform the UAS flight successfully;
- e) appreciating any changes in the concept of an UAS operation, regulatory factors or operational environment, which may impact on the safe feasibility of the UA flight.

B.4.9.1.5 Hazard identification

The trainee shall be able to:

- a) explain the hazards and risks at the planning stage, on which the pre-flight checklist is based;
- b) use and generate risk assessments at an appropriate level of detail;
- c) continually assess emerging hazards during the flight and take appropriate actions throughout the flight as the operating environment changes.

B.4.9.2 Flight safety

B.4.9.2.1 Avoiding collisions

The trainee shall be able to explain:

- a) maintaining situational awareness of the operating environment so that collisions with people, vehicles, vessels, structures and any obstacles are avoided;

- b) maintaining a good lookout and effective scanning technique for detecting potential conflicts, including with the support of an UA observer.

B.4.9.2.2 “See and avoid” with respect to manned aircraft

The trainee shall be able to:

- a) explain how to maintain an effective lookout to avoid unplanned conflicts with other aircraft;
- b) demonstrate how to determine Air Risk Class (ARC);
- c) explain what height limitation and geo-limitation systems are and their effect to reduce the risk of airspace infringements;
- d) explain the definition of obstacle and from where to obtain information on them;
- e) list other hazards in the operating environment such as uninvolved people, animals, road vehicles, trains, vessels, power lines and other structures;
- f) give an example of an advisory describing a possible aircraft conflict;
- g) recognize and interpret clearances and instructions directed to other aircraft.

B.4.9.2.3 Perception

The training organization shall ensure the trainee is able to demonstrate understanding of the items in [Table B.3](#).

Table B.3 — Perception

Training curriculum	Manual flight	Automatic flight
Distance		
a) the operational difficulties with assessing distance with the eye alone;	X	X
b) using onboard sensors or other means to assess distance;	X	X
c) making effective use of remote flight crew members, e.g. visual observer.	X	X
Height		
d) the operational difficulties with assessing height with the eye alone;	X	X
e) using onboard sensors to assess height;	X	X
f) making effective use of remote flight crew members.	X	X
Speed		
g) the operational difficulties with assessing speed with the eye alone;	X	X
h) correctly using onboard sensors to assess speed;	X	X
i) making effective use of remote flight crew members to determine speed and rates of closure.	X	X
Recall the rules regarding the use of visual observers		X

B.4.9.2.4 Go/no go decisions

The trainee shall be able to explain that:

- a) the remote pilot-in-command has responsibility to determine for when it is safe to operate;
- b) the remote pilot-in-command’s assessment of whether to operate or not cannot be overruled;
- c) the remote pilot-in-command holds ultimate responsibility for the flight, from pre-flight checks to post flight records.

B.4.9.3 Remote pilot logbooks

The trainee shall be able to demonstrate understanding of effective logging of pilot records using traditional or electronic methods.

B.4.9.4 Overflight of people, crowds and gatherings

The trainee shall be able to:

- a) explain the requirements for minimum distance from involved people in the subcategories of the specific category;
- b) explain restrictions for overflying assemblies of people;
- c) explain how to obtain information regarding expected people movement, crowds, gatherings or sensitive structure and events.
- d) estimate expected people density and movement, crowds, gatherings or sensitive structure and events, based on available information, including from UTM service providers;
- e) characterise overflown population density, 'controlled ground area', 'sparsely populated area', 'populated area', 'gatherings of people';
- f) explain what a controlled ground area is and why is it necessary;
- g) explain the role of the ground observer;
- h) determine perimeter of the controlled ground area and how to signal it to uninvolved people;
- i) describe procedures and equipment to establish a controlled ground area;
- j) verify, through interaction with the remote crew, that the controlled ground area is in place, effective, void of uninvolved people and compliant with the prescribed minimum distances;
- k) understand how to brief involved persons;
- l) explain the procedures that UA should follow in case one or more people would penetrate the controlled ground area.

B.4.9.5 Third-party liability

The trainee shall be able to list the consequences of UAS operations damaging third-party property or injuring persons and the requirement for insurance under State regulations.

B.4.10 Human factors

B.4.10.1 Human factors and good airmanship

The trainee shall be able to:

- a) explain knowledge of human factors and the threats human factors can introduce to an operation;
- b) explain how knowledge of human factors contributes to aviation safety and good airmanship;
- c) describe the 5 Hazardous Attitudes in Aviation (Macho, Impulsivity, Resignation, Invulnerability and Anti-authority).

B.4.10.2 Medical fitness

B.4.10.2.1 General

The training organization shall ensure the trainee is able to demonstrate understanding of:

- a) appropriate medical fitness for the operation;
- b) assessment of medical fitness and record keeping;
- c) awareness of regulatory requirements relating to medical fitness.

B.4.10.2.2 Alcohol, drugs, medication

The training organization shall ensure the trainee is able to demonstrate understanding of:

- a) appropriate organization policies regarding alcohol and drugs;
- b) the incompatibility of alcohol and drugs with UAS operations;
- c) regulatory requirements regarding alcohol and drugs;
- d) unwanted side effects of medications and their impact on performance.

B.4.10.3 Fatigue

The trainee shall be able to explain:

- a) the definition of fatigue and its serious effects on remote flight crew performance;
- b) how to manage flight duration and number of flights to avoid fatigue;
- c) how to recognize appropriate workload and the resource plan prior to the flight;
- d) workload management during the flight;
- e) the effect of time of day on alertness (circadian rhythm);
- f) appropriate limitations on working and flying hours;
- g) differences between acute and chronic fatigue and the strategies to mitigate them.

B.4.10.4 Pilot currency

The trainee shall be able to explain the importance of maintaining currency through:

- a) recent UAS flying experience;
- b) experience of the UAS used for training;
- c) responses to potential emergencies;
- d) experience of the anticipated task/environment;
- e) remote flight crew experience, recency, and interactions.

B.4.10.5 Effects of weather

The trainee shall be able to explain:

- a) the effects of cold weather, including icing, on the remote flight crew and on aircraft performance;
- b) the effects of hot weather on the remote flight crew and on aircraft performance;