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Unmanned aircraft systems — Training for personnel involved in UAS operations

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National foreword

This British Standard is the UK implementation of ISO 23665:2023. It supersedes BS ISO 23665:2021, which is withdrawn.

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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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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

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

This second edition cancels and replaces the first edition (ISO 23665:2021), which has been technically revised.

The main changes are as follows:

— addition of normative references;

— addition of training requirements for low-risk VLOS operation pilot courses;

— changes to Annex A: transfer of training requirements from continuous text to table format to accommodate the requirements for the training curriculum for both the VLOS UAS r-PIC course and the newly added low-risk VLOS operation pilot course.

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.

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Introduction

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

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

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. The requirements for a specific course (VLOS UAS remote pilot-in-command) are in Annex A. It is envisioned that further courses will be defined later and that these will be added as additional annexes in the future.

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Unmanned 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 unmanned aircraft systems (UAS).

This document defines:

a) knowledge, skill, attitude and qualification criteria that are needed for UAS pilots and training organizations 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 confirmation criteria for the training organizations;

d) general procedures for providing training of UAS personnel; the requirements for a specific course as described in Annex A can be more restrictive in some cases.

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.

ISO 21384-3:2019, *Unmanned aircraft systems — Part 3: Operational procedures*

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

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

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
national aviation authority
government statutory authority in each country that oversees the approval and regulation of civil aviation

3.2
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

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3.3
remote pilot
person charged by the operator with duties essential to the operation of an unmanned aircraft and who manipulates the flight controls, as appropriate, during flight time

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

3.4
visual line-of-sight operation
VLOS
operation in which the *remote pilot* (3.3) or unmanned aircraft observer maintains direct unaided visual contact with the unmanned aircraft system

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

4 Abbreviated terms

AGL	above ground level
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
FIR	flight information region
GNSS	global navigation satellite system
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
VFR	visual flight rules

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5 Training organization

5.1 Responsibilities

The training organization shall designate each different person who will be responsible for at least each of the following areas:

a) training and assessment;

b) safety.

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 service provider 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.

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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) that 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, 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.

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6.2 Instructor requirements

Instructors shall be competent to deliver the training in accordance with the specific requirements detailed in Annex A.

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, 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 unmanned 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.

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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 Annex A. 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. 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 Annex A or, in the case of experienced but unqualified UAS pilots, demonstrate equivalent existing abilities.

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Annex A
(normative)

VLOS UAS pilot courses

A.1 Overview

This annex specifies requirements for UAS pilot training programs and the competencies that a training organization is expected to deliver to a trainee to achieve a VLOS UAS pilot certification who can act as remote pilot-in-command and as pilot of low-risk operation using VTOL UA in VLOS operations respectively. The trainee shall be trained to be able to operate a following VTOL UA according to ISO 21895.

Their qualification shall state the grades of UA they can operate:

a) remote pilot-in-command: grade 2, 3 or 4;

b) low-risk VLOS operation pilot: grade 1.

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 act as the roles indicated in the Table A.1 of an unmanned aircraft that is operated within their visual line-of-sight. If the training course is for a specific category or class of UA, this shall be specified.

Table A.1 — A.2 Competencies

Training curriculum	VLOS UAS r-PIC course	low-risk VLOS operation pilot course
Achieved roles for a trainee who completes the raining course	r-PIC (remote PIC)	Pilot

A.3 Fitness to act as remote pilot-in-command

In order to operate the UAS in a safe manner, the trainee shall not have any health issues that are likely to impede their control of the aircraft. In particular, the trainee shall be able to do the items in Table A.2.

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Table A.2 — Fitness to act as remote pilot-in-command

Training curriculum	VLOS UAS r-PIC course	low-risk VLOS operation pilot course
a) be able to 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;	X	X
b) be able to identify any other air users or obstructions that can pose a collision risk for the UA;	X	X
c) be able to correctly interpret all safety critical data displayed on the UAS controller display unit;	X	
d) be able to hear sufficiently to be aware of the approach of other aircraft or to be warned verbally of a safety concern;	X	
e) not have any known condition that could cause sudden loss of consciousness or concentration;	X	
f) be able to handle the remote-control station and to manipulate the equipment installed therein;	X	
g) be able to communicate with other crew members, operators and stakeholders.	X	X
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.	X	

A.4 Theory knowledge

A.4.1 Air law/responsibilities

A.4.1.1 Terminology

The training organization shall ensure the trainee is able to demonstrate understanding of the relevant air law and regulatory terminology.

A.4.1.2 Legislation

A.4.1.2.1 Relevant articles and definitions

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

a) the legal framework that governs airspace in the regulatory environment or jurisdiction of operation;

b) the legal articles or regulation relevant to UA flight in that jurisdiction.

A.4.1.2.2 Rules of the air

A.4.1.2.2.1 General

The training organization shall ensure the trainee is able to demonstrate understanding of the rules of the air relevant to UAS operation.

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