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Vertiports — Infrastructure and equipment for vertical take-off and landing (VTOL) of electrically powered cargo unmanned aircraft systems (UAS)

Vertiports — Infrastructure et équipements pour le décollage et l'atterrissage vertical (VTOL) des aéronefs cargo sans pilote (UAS) à propulsion électrique

Contents

Foreword

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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 documents 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 17, *Airport infrastructure*.

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

The demand for unmanned aircraft has been increasing in recent years for a variety of applications, including military and civilian [personal (hobby) and commercial] applications.

Particular focus has been placed on the logistics sector. The most difficult part of these operations is the departure and approach of the unmanned aircraft; and a vertiport is a device to support this. This document defines the requirements for constructing a vertiport. The components of the vertiport are assumed to be the following.

A vertiport system consists of two elements: a vertiport and a vertiport information system. The vertiport is connected to the vertiport information system; the vertiport information system is connected to the external system, and external system is connected to the unmanned aircraft system. In some cases, the unmanned aircraft system is directly connected to the vertiport to ensure safety during approach. The vertiport consists of software and hardware. The external system is responsible for assisting the unmanned aircraft system operator in making decisions and communicating with the vertiport information system and the unmanned aircraft system.

The vertiport communicates only with the vertiport information system and does not communicate directly with the external system; but it transmits information via the vertiport information system.

In addition, the use cases covered in this document are assumed to be logistics based on automatic navigation by non-visual flight; and where the cargo is stored at the landing site. However, this does not imply that the document cannot be applied to other use cases. This document does not cover vertiport operations and services covered by ISO 5015-2, developed by ISO/TC 20/SC 16 (UAS), which includes ground handling, interface with external systems, such as unmanned aircraft system traffic management service providers, and safety and quality of vertiport operators.

Vertiports — Infrastructure and equipment for vertical take-off and landing (VTOL) of electrically powered cargo unmanned aircraft systems (UAS)

1 Scope

This document defines the requirements for constructing a vertiport.

This document applies to vertiports of type A (micro) as defined in ISO 5015-2.

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

ISO 5015-2, *Unmanned aircraft systems — Part 2: Operation of vertiports for vertical take-off and landing (VTOL) unmanned aircraft (UA)*

ISO 23629-5, *UAS Traffic Management (UTM) — Part 5: UTM functional structure*

ISO 23629-12, *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, ISO 5015-2 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
vertiport information system
VIS
system for centralized management of all information necessary for unmanned aircraft system (UAS) operations at the vertiports

Note 1 to entry: It manages the operational status of each vertiport.

Note 2 to entry: It communicates with the vertiport and the *external system (ES)* (3.2), and serves as an intermediary between them, but does not communicate with the UAS. It is assumed that there are cases where vertiport information system functions are included in the ES.

Note 3 to entry: The system composition including the vertiport information system and other systems is shown in Figure 1.
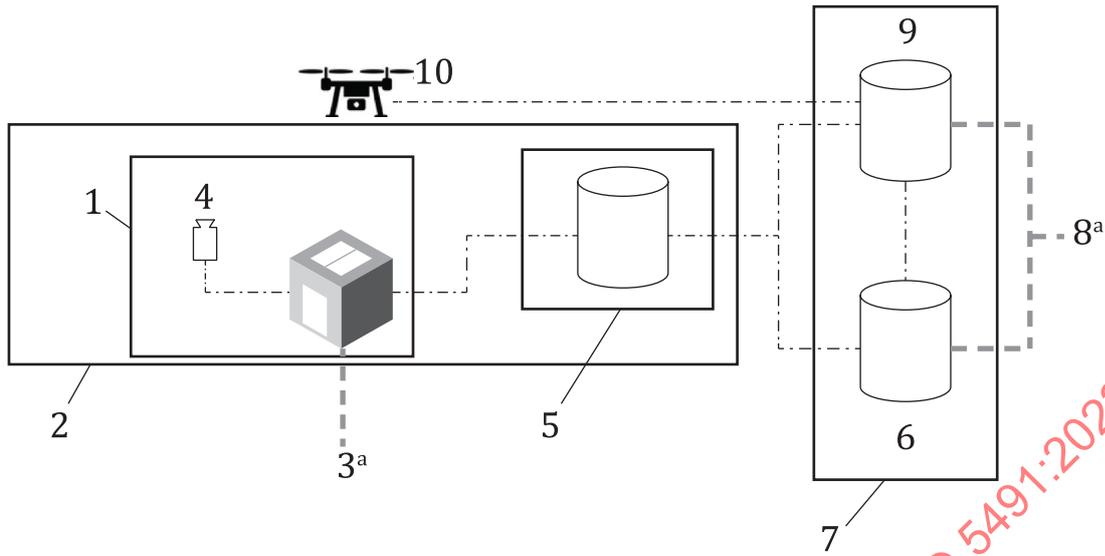
Key

1	vertiport
2	vertiport system
3	vertiport operator
4	peripheral devices (detectors, sensors)
5	vertiport information system (VIS)
6	vertiport booking system
7	external system
8	UAS operator
9	UTM/GCS
10	UAS
– – – –	relation between subsystems and stakeholders
–·–·–	relation between subsystems
a	Stakeholders (SH).

Figure 1 — System composition

3.2
external system
ES
all actors related to vertiport operations other than the *vertiport operator* (3.3) and possible additional logistics management systems

Note 1 to entry: All actors (i.e. either users or service providers of digital information) necessary for unmanned aircraft system traffic management, shall be encompassed by the functional architecture in ISO 23629-5.

Note 2 to entry: The ES communicate directly with the *vertiport information system* (3.1).

3.3
vertiport operator
legal or natural person ensuring safe and secure functionality of the *vertiport system (VIS)* (3.1)

Note 1 to entry: Vertiport operators shall follow the requirements of ISO 23629-12.

3.4
operation interface
interface at the vertiport that is operated by the *vertiport operator* (3.3) to monitor and control the vertiport

3.5
dynamic information
information necessary for unmanned aircraft system operations at the vertiport, which is subject to frequent changes over time

Note 1 to entry: Dynamic information includes the operational status of the vertiport, the measured sensor information, and the availability of the storage location.

3.6
static information
information necessary for unmanned aircraft system operations at the vertiport, which is not subject to frequent changes over time

Note 1 to entry: Static information includes manufacturer information, administrator information, connectable *vertiport information systems (VIS)* (3.1) or other unmanned aircraft system traffic management actors, and other information that is initially configured and stable over time.

Note 2 to entry: Static information may be updated by the *vertiport operator* (3.3) or vertiport manufacturer through an established process.

3.7
obstacle
fixed (whether temporary or permanent) and mobile object, or parts thereof, that:

a) is located on an area intended for the surface movement of unmanned aircraft;

b) extends above a defined surface intended to protect unmanned aircraft in flight; or

c) stands outside those defined surfaces and that has been assessed as being a hazard to air navigation

4   Abbreviated terms

ES   external system

GCS   ground control system

GNSS   global navigation satellite system

SP   service provider

RTK   real time kinematics

UAS   unmanned aircraft system

UTM   UAS traffic management

VIS   vertiport information system

VTOL   vertical take-off and landing

5 Requirements for the vertiport, under the responsibility of the manufacturer

5.1 Design

5.1.1 Functional requirements

5.1.1.1 General and operation

The vertiport shall:

a) be able to detect abnormalities in the vertiport's surrounding environment, climate, and vertiport function operation, which can be used to respond to emergencies;

   The vertiport operator should address the operational safety aspects of an emergency, taking into account the legitimate interests of other statutory bodies such as the police and emergency services.

b) be highly visible, and uninvolved person shall know that it is a vertiport (e.g. it shall have an airplane warning light);

   The vertiport operator may use lights other than those used by airports, heliports or military airfields.

c) have its bearing load and shock resistance specified and clearly marked on the vertiport at the time of manufacture;

d) have its weathering resistance with respect to operational weather conditions specified and clearly marked on the vertiport at the time of manufacture;

e) be fixed to the intended surface independent of weather requirements;

f) be able to be used at the level of locally available electricity grid supply;

g) be able to detect the orientation and coordinates of the installation site;

h) be able to detect obstacles on the vertiport and, within the range that affect flight, surrounding the vertiport and send the information to the VIS;

i) be able to monitor weather conditions such as wind speed, wind direction, rainfall, and temperature;

   It shall be able to confirm the altitude of the wind speed measurement.

   Vertiport manufacturers shall follow the requirements of ISO 23629-12.

j) be able to communicate values of parameters measured by sensors to the VIS;

k) allow the vertiport manufacturer and vertiport operator to set the initial static information of the vertiport;

   This initial static information may be divided into two categories.

   1) Initial static information set by the vertiport manufacturer that vertiport operator shall not be able to change.

      This category may include such information like vertiport's fixed ID.

   2) Initial static information set by the vertiport operator when preparing the vertiport for use.

      This category may include such information like VIS, access information, IP address, Wi-Fi connection settings, license key, etc.

l) be able to measure GNSS signal strength;

NOTE   GNSS means the data which shows position of the vertiport and the measured time.

A method with relatively high accuracy, such as RTK, should be adopted.

m) have lights installed to allow visibility of the vertiport, if the manufacturer anticipates night-time use; the lights shall turn on when an object approaches;

n) announce the approach of the unmanned aircraft to the people in to the surrounding area;

o) set and broadcast the vertiport information to the VIS to make itself visible in the network;

p) be installed in a way that guarantees safety with consideration of the impact on its vicinity, etc.

The vertiport should:

q) be able to charge, discharge or change battery.

5.1.1.2   Departure

The vertiport shall be able to:

a) measure GNSS signal strength;

b) determine whether to allow unmanned aircraft take-off based on various measurement results and communicate this information to the VIS;

c) observe weather conditions such as wind speed, wind direction, rainfall, and temperature;

d) perform take-off and landing surface preparations, according to the ES's directions.

5.1.1.3   Approach

The vertiport shall be able to:

a) observe weather conditions such as wind speed, wind direction, rainfall, and temperature;

b) measure GNSS strength;

c) determine whether to allow unmanned aircraft landing based on various measurement results and communicate this to the VIS;

d) perform take-off and landing surface maintenance based on the judgment of approach availability;

e) perform take-off and landing surface preparations in order to prepare for the next approach.

5.1.2   System reliability and conditions

Vertiport systems shall provide continuous and automatic information on their status to the VIS for monitoring purposes.

In case of a failure condition or other anomaly emerging during operation, the system shall immediately notify the VIS and relevant external parties.

NOTE   Relevant external parties can include UAS operators, ES SPs, governmental or local authorities and logistic organizations.

5.1.3   Accommodation of the cargo

The vertiport should be able to:

a) contain and protect the unmanned aircraft;

b) instruct the unmanned aircraft to release the cargo;

c)   turn on/off, charge, and check the operation of the unmanned aircraft upon receiving notification of the completion of cargo release;

d)   reserve the storage of the unmanned aircraft and its cargo.

5.2   Ensuring safety

5.2.1   System reliability

The vertiport shall:

a)   record and monitor data associated with the vertiport in operation or indicate the malfunction of an individual component or the system as a whole; the vertiport shall also communicate this information to the VIS;

b)   communicate the data when requested to the manufacturer and/or maintenance organization to serve as a basis for supplementing or modifying the vertiport planned maintenance program;

c)   collect system reliability information including, but not limited to, the following parameters:

1)   operational hours;

2)   operational cycles;

3)   technical delays;

4)   technical failure;

5)   power status and failure;

6)   scheduled and unscheduled parts removal and/or replacement;

7)   failure when supporting a departure or approach;

d)   from the viewpoint of building safety and based on the operational environment, have sufficient levels of fire resistance, earthquake resistance (if applicable), snow resistance, wind resistance, flooding resistance, etc.

5.3   Communication

The vertiport shall:

a)   be able to obtain flight plans (aircraft identification number, flight start date/time, estimated time of arrival, flight start location, means of communication with the aircraft during approach preparation, etc.) via the VIS;

b)   be able to connect to a network and communicate with it;

c)   be directly controllable by the vertiport operator through an operational interface;

d)   be able to communicate to VIS with a message to abort an approach or a departure, or perform an emergency stop or loiter in flight;

e)   be able to communicate with external parties (e.g. the UAS operator) via calls;

f)   be able to specify the VIS to be connected;

g)   be able to configure the initial settings via the operation interface or a network;

h)   be able to send the take-off availability status to the ES via the VIS;

i)   be able to receive a request for departure approval via the VIS;

j) be able to communicate the departure approval via the VIS;

k) be able to communicate the status of landing availability;

l) be able to receive approach approval requests via the VIS;

m) be able to receive departure preparation instructions according to the ES's directions via the VIS;

n) be able to inform the surrounding area of the departure;

o) be able to communicate the status during departure via the VIS to the ES;

p) be able to obtain in-flight information (telemetry information) of flights bound for itself via the VIS;

q) be able to transmit the results of various measurements;

r) be able to send the completion of take-off and landing surface preparations and send approach instructions to the UAS; both transmissions shall be sent via the VIS to the ES;

s) be able to receive notification of the unmanned aircraft's landing position (command);

t) be able to, in case of an emergency occurring, communicate an emergency retreat order to the surroundings of the vertiport.

The vertiport should:

u) be able to determine whether to approve the approach from the status of the vertiport;

v) be able to communicate the approach approval via the VIS;

w) be able to guide the unmanned aircraft landing;

x) be able to obtain information regarding its booking from the VIS;

y) be able to send permission or dismissal towards the booking request sent by the vertiport booking system via the VIS.

5.4 Log

a) The vertiport shall capture the information including but not be limited to the following. However, the information that can be logged shall not be limited to the information listed below;

   1) information captured by abnormal sensor behaviour;

   2) ambient temperature to ensure the vertiport does not exceed safe minimums and maximums that undermine the integrity of the system;

   3) loss of power;

   4) damage caused by environmental effects (where relevant), e.g. sand and dust, vibration, salt spray, lightening, icing;

   5) changes to the status of obstacles surrounding the vertiport;

   6) communication availability and strength such as LTE/radio frequency surrounding the vertiport;

   7) vertiport availability;

   8) identification of the UAS operators and flight plans;

   9) local meteorological conditions (at regular intervals to satisfy safe operations), e.g. wind conditions, visibility conditions, air temperatures, precipitation types and intensity, icing conditions;

    10) noise performance;

    11) vehicle occurrences;

b)   The vertiport shall automatically log flight activities at the vertiport.

c)   Logs shall be available for review at all times by the vertiport operator.

d)   Logs should collect and retain data in original form for any audits or inspections by the NAA (national aviation authority) or aviation accident organization.

e)   Records shall allow the following to be tracked and managed:

    1) equipment reliability;

    2) maintenance schedules;

    3) track inspections;

    4) repairs and maintenance;

    5) accidents.

f)   Logs shall be stored online to inform safety management and improvement, taking into consideration local data protection laws.

5.5   Quality control

a)   Quality control standards

    The manufacturer, considering applicable legislation, shall set their own internal standards for quality control, including measurement methods, items, procedures and reference values, in order to clarify the corporate policy for quality control.

    The manufacturer shall also prepare a record of all the procedures involved in quality control.

b)   Setting the safety factor

    The manufacturer, considering applicable legislation, shall define the appropriate safety factor based on reference values and factors affecting the maximum load.

    The following are some examples of factors that affect the reference values and the maximum load:

    1) the service life of the product;

    2) the operational environment, frequency of use, period of use of the product;

    3) assumed user group;

    4) variations in dimensions and assembly accuracy.

c)   Maintenance methods

    The manufacturer, considering applicable legislation, shall define maintenance items, maintenance methods, and the frequency of maintenance.

5.6   Instruction manual

The manufacturer shall prepare an instruction manual that describes the following items:

a)   operational environmental conditions;

b)   operational procedures for UAS in-flight, departure and approach, and on-ground;