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General requirements for tethered unmanned aircraft systems

Exigences générales relatives aux aéronefs sans pilote captifs

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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 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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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*.

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 purpose of this document is to describe a general technical architecture for tethered unmanned aircraft systems (*t*UAS). It addresses the general requirements for components and subsystems, functions and performance. The objective is to promote international trade, provide a technical basis for related industrial applications, a guidance for development and manufacturing, and to promote safe operations.

General requirements for tethered unmanned aircraft systems

1 Scope

This document specifies general and manufacturing requirements for tethered unmanned aircraft systems (*t*UAS), including heavier-than-air tethered unmanned aircraft (*t*UA), which are powered by equipment on the ground. The specifications are intended for *t*UAS where the purpose for the tether is to supply power to the *t*UA as well as to provide a mechanical restraint. Unmanned aircrafts (UAs) that are not receiving power from and only restrained by the tether are referred to ISO 21384-2; however, there are clauses in this document that apply to the tethering equipment (e.g. winches and cables).

This document is applicable to the development, manufacturing, industrial applications and delivery of *t*UAS.

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 21384-2, *Unmanned aircraft systems — Part 2: UAS components*

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

ISO 23629 (all parts), *UAS traffic management (UTM)*

IEC 60228, *Conductors of insulated cables*

IEC 60811, *Common test methods for insulating and sheathing materials of electric cables and optical cables*

IEC 60885-1, *Electrical test methods for electric cables — Part 1: Electrical tests for cables, cords and wires for voltages up to and including 450/750 V*

IEC 61076-1, *Connectors for electronic equipment — Product requirements — Part 1: Generic specification*

IEC 61076-2, *Connectors for electronic equipment — Product requirements — Part 2: Circular connectors*

IEC 62133, *Secondary cells and batteries containing alkaline or other non-acid electrolytes — Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications*

IEC 62197-1, *Connectors for electronic equipment — Product requirements — Part 1: Generic specification*

IEC 62197-2, *Connectors for electronic equipment — Product requirements — Part 2: Sectional specification for circular connectors*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 21384-2, 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
winch
ground device which is able to automatically or manually coil and uncoil the cables

3.2
heavier-than-air tethered unmanned aircraft
heavier-than-air *t*UA
*t*UA (3.5), with a take-off weight that is more than the air it displaces

3.3
uninterruptible power supply
UPS
power supply system that provides emergency power to the unmanned aircraft system when the main power supply is disrupted

3.4
tethering cable
cable that provides power and a mechanical constraint to an unmanned aircraft, and may also be able to exchange data with the unmanned aircraft

3.5
tethered unmanned aircraft
***t*UA**
unmanned aircraft with range of movement limited by a *tethering cable* (3.4) and electrical power supplied by ground equipment conveyed through the tethering cable

3.6
tethered unmanned aircraft system
***t*UAS**
UAS comprised of a *t*UA (3.5) and associated components (e.g. *tethering cable* (3.4), *winches* (3.1), ground-based electrical system and with a potential for data exchange)

4 Abbreviated terms

GNSS	global navigation satellite system
RPS	remote pilot station
*t*UA	tethered unmanned aircraft
*t*UAS	tethered unmanned aircraft system
UA	unmanned aircraft
UPS	uninterruptible power supply
UTM	UAS traffic management

5 System general requirements

5.1 General requirements

General requirements for the *t*UAS shall be consistent with the general requirements for multirotor UAS given in ISO 21384-2, including but not limited to requirements for avionics, propulsion, navigation, flight control system, command and control link, RPS and mission payload interface. Additional requirements are specified in this document.

5.2 Composition of *t*UAS

A system shall be considered as a *t*UAS when consisting of a minimum of the following components:

a) *t*UA, including the airframe, avionics, propulsion, and electrical, navigation and flight control systems;

b) command and control link, using either wireless or wired (tether-based) technology;

c) communication system, via voice or datalink

d) mission payloads;

e) RPS;

f) ground support equipment, including ground-based electrical power supply, tethering cable and winches.

5.3 Design for long-duration reliability

The corresponding technical measures are considered in the design and manufacturing process to improve long-duration reliability. Technical measures shall:

a) apply proven technology using mature design solutions and components;

b) simplify the design by reducing the complexity of the equipment;

c) meet the functional requirements of the product with as few components as possible;

d) minimize the power requirements to reduce the failure rate of components;

e) include fault-tolerant circuits and software in the design to avoid effects due to transient processes and accidental errors or faults;

f) design with components with a long lifetime or known failure lifetimes specified by manufacturers or suppliers.

In order to improve the long-duration flight reliability of the *t*UAS, a high precision positioning system (e.g. GNSS) tracking function and signal quality alerting function shall be included.

6 Operator's manual requirements

6.1 System performance

The following characteristics and performance parameters of the *t*UAS shall be published in the operator's manual:

a) maximum climb speed;

b) maximum descent speed;

c) maximum hovering height;

d) maximum operational height;

e) maximum flight time;

f) take-off and landing speeds;

g) take-off and landing wind limits;

h) hovering accuracy (altitude and horizontal control accuracies);

i) hovering wind limits;

j) glide distance;

k) winch uncoiling time;

l) winch coiling time;

m) *t*UA folded dimension;

n) *t*UA unfolded dimension.

6.2 Weight limits

The following weight limits of the *t*UAS shall be published in the operator's manual:

a) tethering cable;

b) maximum payload for the maximum operational height;

c) UA maximum take-off weight for the maximum operational height;

d) UA empty weight.

6.3 Electrical characteristics

The following electrical characteristics of the *t*UAS shall be published in the operator's manual:

a) system total rated power;

b) system maximum power;

c) onboard input voltage;

d) onboard input current;

e) onboard emergency power duration for the main power system;

f) onboard emergency power duration for the flight control system;

g) RPS power requirement.

6.4 Environmental characteristics

Environmental conditions that affect the storage, transportation and ground handling of the *t*UAS shall be listed in the operator's manual.

For the *t*UAS, data links and mission equipment shall be designed to withstand a variety of natural and induced conditions under launch, flight and recovery conditions. As a minimum, limitations incurred by the following operating conditions within the specified flight envelope that can affect *t*UAS components shall be addressed in the operator's manual:

a) temperature;

b) atmospheric pressure;

c) humidity;

d) impact;

e) vibration;

f) lightning;

g) rain;

h) icing;

i) mildew;

j) salt spray;

k) sand and dust;

l) sheltered from wind;

m) sound noise level.

NOTE The test methods for humidity, vibration, salt spray are recommended to refer to IEC 60068[2].

6.5 Fatigue endurance and life characteristics

Requirements for fatigue endurance and life characteristics of the *t*UAS shall ensure:

a) the fatigue life of the system meets the requirements given in ISO 21384-2;

b) the fatigue life of tether components is defined in the design document.

6.6 Paintings and markings for *t*UAS safety

The following requirements apply:

a) The tethering cable shall be painted with either a high-visibility pattern or fluorescent colours, or both.

b) The propellers/rotor blades shall be marked with high-visibility colours on the tip.

c) The high-voltage power supplies and transporting sub-systems shall be made highly visible on the outer casing.

6.7 Lighting

The following requirements apply:

a) The *t*UAS shall be equipped with a flashing white or red anti-collision strobe light.

b) The tethering cable shall be equipped with lighting devices if the system is to be operated at night.

6.8 Others

Maintainability, testability, interchangeability, package, storage and transportation, ground support and maintenance shall meet the requirements given in ISO 21384-2.

7 Airborne monitoring system

7.1 System functions

The airborne monitoring system shall:

a) detect conditions that are outside acceptable ranges or other faults;

b) automatically trigger to alarm thresholds (from user or manufacturer pre-sets);

c) send warning information to the remote pilot;