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General requirements for the payload interface of civil unmanned aircraft systems

Exigences générales relatives à l'interface de la charge utile des aéronefs sans pilote civils

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Foreword

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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.

General requirements for the payload interface of civil unmanned aircraft systems

1 Scope

This document specifies the composition, functional and performance requirements for a payload interface of civil unmanned aircraft systems (UAS), with the maximum take-off mass of 0,25 kg to 25 kg which relates to level II through IV according to ISO 21895.

This document is applicable to the design and manufacture of physically independent payload interfaces which connect an external payload to an unmanned aircraft (UA).

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.

EIA/CEA-861, *A DTV Profile for Uncompressed High Speed Digital Interfaces*

IEEE 802.3, *IEEE Standard for Ethernet*

ISO 11898, *Road vehicles — Controller area network (CAN)*

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

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

USB 2.0, *The second major version of the Universal Serial Bus (USB) standard for interfacing computers and electronic devices*

USB 3.0, *The third major version of the Universal Serial Bus (USB) standard for interfacing computers and electronic devices*

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:

— IEC Electropedia: available at https://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1
payload interface
mechanism which connects an unmanned aircraft (UA) and its payload, comprised of an aircraft part and a payload part, including mechanical, electrical and communication interfaces

3.2
locking mechanism
mechanism that keeps the payload part of the interface in proper position and prevents it from falling off when the payload is connected

3.3
plug-and-play
ability to automatically detect and configure the payload hardware resources without the need to reconfigure or install using a manual driver, when the payload is connected to an unmanned aircraft (UA) via the *payload interface* (3.1)

3.4
hot-swap
act of removing payloads from or plugging them into an unmanned aircraft (UA) while the power remains switched on, so that payloads can be changed without shutting down or rebooting the UA

4 Abbreviated terms

HDMI high definition multimedia interface

CAN controller area network

UART universal asynchronous receiver-transmitter

USB universal serial bus

TTL transistor-transistor logic

5 Overall requirements

5.1 General

The payload interface on a UA shall ensure that mechanical connections physically support the payload, that electrical connections reliably support either digital or analogue communications, or both, and facilitate ease of payload connection and removal. The payload interface shall conform to correspondent general payload requirements in ISO 21384-2.

According to the type of the payloads that are connected, the payload interfaces can include, but not be limited to, the types shown in Table 1. The design life span of any type of payload interface shall meet the requirement of its specific operating environment.

Table 1 — Type of payload interface

Number	Type	Description
1	Photoelectric	To connect payloads that perform image recording
2	Audio	To connect payloads that perform audio play
3	Delivery	To connect payloads that perform item delivery
4	Trigger	To connect payloads that perform specified actions
5	Radar	To connect payloads that perform radar detection

5.2 Mechanical interface

5.2.1 Connection method

The payload interface shall have mating alignment mechanisms that prevent incorrect connections from being made, and a locking mechanism with an indication of positive lock.

5.2.2 Interface installation and removal

The installation strengths of the aircraft part and the payload part of the interface shall both be greater than the maximum load requirement of the payload. The interface parts, both on the UA and the payload, should be installed and removed with standard tools. The mechanical structure of the payload interface shall ensure that the installation and removal of the payload assembly do not damage the UA.

5.2.3 Payload attachment and detachment

The attachment and detachment of the two parts of the interface should be able to be completed without special tools.

5.2.4 Mechanical strength

The mechanical strength of the payload interface shall ensure that it can withstand the weight of the payload, the additional dynamic load generated by acceleration, hard landing and the inertial loads due to manoeuvring. The maximum allowable deformation of a payload interface should not reduce the performance of the payload and flight safety.

5.2.5 Mechanical life

The attach-detach cycles of a payload interface assembly shall meet the designed lifespan of the interface, during which the interface shall be free from failures and corrosion.

5.3 Electrical interface

5.3.1 General

A connector should be used as electrical interface for electrical connection between the UA and the payload.

5.3.2 Contact materials

The contact parts of the payload interface connector shall be made from anti-corrosion and abrasion-resistant metal. Materials shall be non-corroding or applied with a corrosion-resistant surface.

5.3.3 Connector

The connector shall conform to the intended operating environment of the UA and meet the requirements of power supply, control and digital or analogue signal transmission, or both.

The mating cycles of a payload interface assembly should meet the design lifespan of the interface.

The connector shall be capable of power transmission for power required by specified payloads. Power and signals of the electrical interface shall be protected from unintentional short-circuit and mating at wrong orientation or position. Thermal expansion due to power transmission should not reduce the mechanical and electrical performances of the payload interface.

5.3.4 Anti-electric-shock structure

The electrified parts of the connector shall not be accessible when operating or equipping the payload according to the procedures specified in the user's manual (or an equivalent document).

5.3.5 Electrical compatibility

The payload interface shall be electrically compatible with the UA. The power connector shall be selected to meet the power requirements of the payload; and the voltage fluctuation shall meet the requirements of the payload.

5.3.6 Electromagnetic compatibility

The payload interface shall be electromagnetically compatible with the UA. The interface shall not cause UA compass deviation.

5.4 Communication protocol

The communication protocol of the payload interface shall support various functions of the payload.

The payload interface should support communication protocols of different rates.

The payload interface communication protocol should meet the requirements of payload identification, status feedback and control, and should have the following functions:

a) broadcast mechanism;

b) data retransmission mechanism;

c) message integrity check and cyclic redundancy check;

d) multi-node data transmission.

6 Detailed requirements

6.1 Types of payload data

The data transmitted by the payload interface should include one or more of the following types:

a) Image data

Including uncompressed videos, compressed videos, uncompressed images and compressed images.

b) Audio data

Including uncompressed audio and compressed audio.

c) Target information data

Including data such as distance, angle and reflectivity, which are typically encapsulated into data packs in radar applications.

d) Command data

The commands sent by the remote pilot station to the payload.

e) Response data

The data returned to the UA from the payload after the payload receives and executes commands sent by the UA.

f) Status data

The working status of the payload and the execution status responding to command data.

g) Geospatial location data

Position and orientation data with regard to time. The data are sent from the UA to payload via the payload interface.

h) Clock synchronization data

The data to coordinate the clocks of the UAS and payload. The clock synchronization data are typically sent from the UAS to the payload.

6.2 Types of communication interface

A payload interface should include, but not limited to, one or more of the following types of communication interfaces.

a) HDMI interface

When an HDMI interface is provided, the electrical characteristics of the interface shall meet the requirements of EIA/CEA-861 standards.

b) UART interface

When a UART interface is provided, TTL, RS-232, RS-422 and RS-485 may be used.

c) Ethernet interface

When an Ethernet interface is provided, the electrical characteristics of the interface shall meet the requirements of IEEE 802.3.

d) USB interface

When a USB interface is provided, the electrical characteristics of the interface shall meet the requirements of the specific USB standard, e.g. USB 2.0 or USB 3.0.

e) CAN interface

When a CAN interface is provided, the electrical characteristics of the interface shall meet the requirements of the ISO 11898 series.

6.3 Payload interface requirements for different types of payloads

6.3.1 Photoelectric payload

6.3.1.1 General

Photoelectric payload interface should be plug-and-play and hot-swap capable.

6.3.1.2 Mechanical interface

The damping structure should be used between the interface and the payload or between the UA and the interface, or both, to reduce vibrations, in terms of frequencies and maximum amplitudes, up to an acceptable level; to ensure flight safety and function and performance of the photoelectric payload and its interface.

6.3.1.3 Communication interface

The photoelectric payload should use one of HDMI, Ethernet or USB interfaces for image data transmission.

Photoelectric payloads should use one of UART, CAN, USB or Ethernet interfaces to transmit command data, response data, status data, geospatial location data and clock synchronization data.

6.3.2 Audio payload

6.3.2.1 General

Audio payload interface should be plug-and-play and hot-swap capable.

6.3.2.2 Electrical characteristics

The frequency of the audio signals transmitted by the payload interface shall be electromagnetically compatible with the UA.

6.3.2.3 Communication interface

Uncompressed audio data should use one of Ethernet or USB interfaces for data transmission.

Compressed audio data, command data, response data and status data should use one of UART, CAN, USB, or Ethernet interfaces for data transmission.

6.3.3 Delivery payload

6.3.3.1 Mechanical interface

A reinforced structure should be added between either the UA and the aircraft part of the payload interface or the payload and the payload part of the interface, or both, to ensure the installation strength of either the aircraft part or the payload part, or both, of the interface meet the requirements in 5.2.2 and ensure safe deliveries.

6.3.3.2 Communication interface

The command data, response data and status data of the delivery payload should be transmitted using one of UART, CAN, USB or Ethernet interfaces.

6.3.4 Trigger payload

6.3.4.1 Mechanical interface

The trigger payload interface should have a damping structure to reduce the vibrations, in terms of frequencies and maximum amplitudes, up to an acceptable level; to ensure flight safety and function and performance of the trigger payload and its interface.

6.3.4.2 Communication interface

The triggering should be triggered by a pulse signal and the interface should be able to transmit the pulse signal.

The command data, response data and status data of the trigger payload should use one of UART, CAN, USB or Ethernet interfaces for data transmission.

6.3.5 Radar payload

6.3.5.1 General

Radar payload interface should be plug-and-play and hot-swap capable.

6.3.5.2 Mechanical interface

The mechanical interface of a radar payload should use a rigid connection with minimal deformation.