FINAL
DRAFT

INTERNATIONAL
STANDARD

**ISO/FDIS
23117-1**

ISO/TC **23**/SC **6**

Secretariat: **AFNOR**

Voting begins on:
2023-03-02

Voting terminates on:
2023-04-27

Agricultural and forestry machinery — Unmanned aerial spraying systems —

Part 1: Environmental requirements

Matériel agricole et forestier — Systèmes de pulvérisation aériens sans pilote —

Partie 1: Exigences environnementales

Reference number
ISO/FDIS 23117-1:2023(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 23, *Tractors and machinery for agriculture and forestry,* Subcommittee SC 6, *Equipment for crop protection.*

A list of all parts in the ISO 23117 series can be found on the ISO website.

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 increased popularity of unmanned aircraft systems (UAS), also known as unmanned aerial vehicles (UAV) or drones, and the continued advances in flight control, flight duration, and payload potential are improving the utility of UAS for agricultural purposes. UAS use in agriculture is a rapidly changing field, with unmanned aerial spraying systems (UASS) already in use in East-Asian applications, for example in rice, bush and tree crops. UASS has the potential to provide an aerial spray system when handheld/portable, terrestrial vehicles, or manned aircraft would be hazardous. However, spraying from UASS can impact the surrounding environment in various ways such as misapplication, accidents during the application, improper design, inadequate weather condition, etc. It is important to consider biological and ecological considerations in plant protection. This document gives the minimum requirements for UASS with particular emphasis on minimizing the potential risk of environmental contamination. This document does not cover UAS safety and design, requirements for registration of UAS or requirements for the remote pilot: these are specified by individual countries or regions. However, where UAS design is closely related to the environment protection limited technical information is included.

This document is a type C-standard as stated in ISO 12100.

The structure of safety standards in the field of machinery is as follows:

— type-A standards (basis safety standards) giving basic concepts, principle for design, and general aspects that can be applied to machinery;

— type-B standards (generic safety standards) dealing with one safety aspect or one type of safeguards that can be used across a wide range of machinery:

  — type-B1 standards on particular safety aspects (e.g. safety distances, surface temperature, noise);

  — type-B2 standards on safeguards (e.g. two-hands controls, interlocking devices, pressure sensitive devices, guards);

— type-C standards (machinery safety standards) dealing with detailed safety requirements for a particular machine or group of machines.

When provisions of this type C standard are different from those which are stated in type A or B standards, the provisions of this type C standard take precedence over the provisions of the other standards for machines that have been designed and built according to the provisions of this type C standard.

The machinery concerned and the extent to which hazards, hazardous situations and events are covered are indicated in the scope of this document.

Agricultural and forestry machinery — Unmanned aerial spraying systems —

Part 1: Environmental requirements

1 Scope

This document, when used together with ISO 16119-1, specifies the requirements and the means for verification of the design and performance of unmanned aerial spraying systems (UASS) mounted on unmanned aircraft systems (UAS) for application of plant protection products (PPPs) in agriculture, forestry, turf and amenity areas, with regard to minimising the potential risk of environmental contamination during use, including misuse foreseeable by the UASS manufacturer.

The requirements of this document take precedence over those of ISO 16119-1. The ISO 23117 series does not cover human safety aspects of UASS's or safety aspects concerning UAS's, remote pilots or bystanders.

This document is not applicable to UASSs manufactured before the date of its publication.

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 4102, *Equipment for crop protection — Sprayers — Connection threading*

ISO 5681, *Equipment for crop protection — Vocabulary*

ISO 5682-2:2017, *Equipment for crop protection — Spraying equipment — Part 2: Test methods to assess the horizontal transverse distribution for hydraulic sprayers*

ISO 8169, *Equipment for crop protection — Sprayers — Connecting dimensions for nozzles and manometers*

ISO 9357:1990, *Equipment for crop protection — Agricultural sprayers — Tank nominal volume and filling hole diameter*

ISO 10626, *Equipment for crop protection — Sprayers — Connecting dimensions for nozzles with bayonet fixing*

ISO 13440:1996, *Equipment for crop protection — Agricultural sprayers — Determination of the volume of total residual*

ISO 16119-1, *Agricultural and forestry machinery — Environmental requirements for sprayers — Part 1: General*

ISO 19932-2:2013, *Equipment for crop protection — Knapsack sprayers — Part 2: Test methods*

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

ISO 25358:2018, *Crop protection equipment — Droplet-size spectra from atomizers — Measurement and classification*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5681, ISO 21384-4 and the following apply.

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

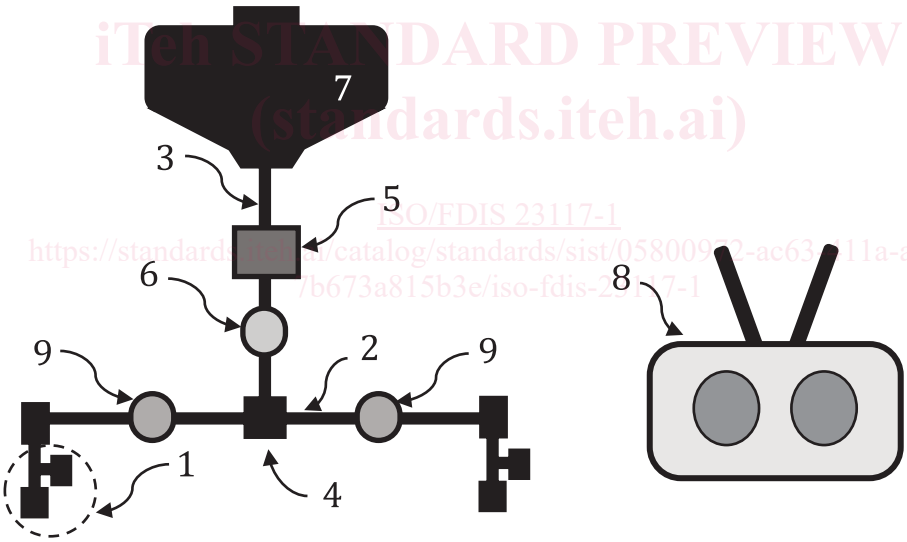
— ISO Online browsing platform: available at https://www.iso.org/obp

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

3.1
unmanned aircraft system
UAS
aircraft and its associated elements which are operated remotely or automatically

3.2
unmanned aerial spraying system
UASS
spraying system, including hardware such as spray tank, pump, hoses, nozzles/atomizers etc., necessary for the application of a spray liquid from a UAS, as well as hardware and software necessary for the remote and/or automatic control of the application

Note 1 to entry: See Figure 1.



Key

1	nozzle/atomizer, and anti-drip device	6	pump
2	spray boom	7	spray tank
3	hose	8	remote control device
4	hose connector	9	spray pressure/flow rate control device
5	valves		

Figure 1 — Example for layout of an unmanned aerial spraying system(UASS)

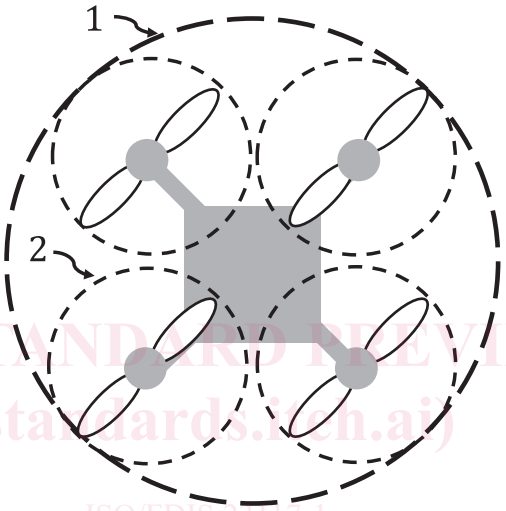
3.3
manual spray control mode
mode of UASS operation in which a remote UASS operator controls the spray application in real time using a remote control device

3.4
automatic spray control mode
mode of UASS operation in which an automatic device controls the spray application based on pre-determined spray application parameters and automatic navigation of the UAS

3.5
characteristic dimension
diameter of the smallest circle, the circumference of which envelops the paths of all the rotor tips placed on the horizontal plane

Note 1 to entry: See Figure 2.

Note 2 to entry: In case of a single rotor UAS, the characteristic dimension is equal to the diameter of the main rotor. In case of a fixed wing UAS, the characteristic dimension is equal to the wing span.



Key
1 characteristic dimension
2 path of rotor tip

Figure 2 — Definition of characteristic dimension

3.6
maximum mass of UASS
mass of UASS when the spray tank is filled to its nominal tank volume of PPPs as stated in the Instruction handbook

Note 1 to entry: Mass of UASS is changing as spraying PPPs is progressed:

Max. mass of PPPs ≤UAS payload – dry mass of UASS

4 List of significant hazards

Table 1 specifies the significant hazards, the significant hazardous situations and significant hazardous event(s) covered by this document that have been identified by risk assessment as being relevant for this type of machine with regard to environmental contamination, and which require specific action by the designer or UASS manufacturer to eliminate or to reduce environmental contamination.

Verify that the environmental requirements specified in both ISO 16119-1 and this document apply to each significant hazard presented by a given machine and to validate that the risk assessment is complete.

Table 1 — List of significant hazards

Hazard		Hazardous situation/event	Clause/sub-clause
4.1	**Spillages**	Improper filling	5.1.3, 5.2.2, 5.2.3, 5.2.5.1, 5.2.5.2, 5.2.5.3
		Mishandling of spray tank and/or UASS	5.1.3, 5.2.1.1, 5.2.1.4, 5.2.1.5, 5.3.2.2, 5.4.1
		Failure of UASS	5.3.1, 5.4.1
4.2	**Leakages**	Mishandling of UASS	5.4.1, 5.4.2
		Damage and failure of UASS	5.4.1, 5.4.2, 5.4.4
		Failure of UASS	5.1.4, 5.3.1
		Failure to follow manufacturer procedures	5.2.5.3
4.3	**Dispersal of spray mixture residues**	Drainage(cleaning and rinsing)	5.1.5, 5.2.1.4
4.4	**Incorrect application rate**	Inadequate swath width	5.1.1, 5.1.2, 5.3.2.2, 5.6
		UASS maintenance/service	5.2.5.2, 5.8
		Inadequate UASS adjustment/control	5.1.1, 5.1.2, 5.2.1.2, 5.2.1.3, 5.2.3, 5.2.4, 5.2.5.2, 5.3.2.1, 5.6
		Inadequate spray pressure or nozzle flow rate control	5.1.1, 5.1.2, 5.10
4.5	**Spray drift**	Deviation from the intended spray track	5.1.1, 5.1.2, 5.6
		Environmental conditions	5.9
		Inadequate flying altitude	5.1.1, 5.1.2, 5.6, 5.9
		Too high nozzle height	5.1.1, 5.1.2, 5.6, 5.9
		Too fast flying speed	5.1.1, 5.1.2, 3, 5.6, 5.9
		Inadequate spray control/adjustment of UASS	5.1.1, 5.1.2, 5.3.2.1, 5.3.2.2, 5.4.3, 5.6, 5.10

5 Requirements

5.1 General

5.1.1 UAS

The UASS shall be attached to a UAS capable of flying in automatic spray control mode following pre-defined flight lines with pre-defined height and speed, although manual spray control mode can be used. This standard is not applicable to UASS mounted on UASs with a maximum take-off mass greater than 150 kg.

Compliance shall be checked by inspection.

5.1.2 Data logging

The UASS shall be equipped with a system capable of logging and recording its position data during all flight time as well as spray control signals, for example on/off of pump, flow rate of the spraying system.

Compliance shall be checked by functional test.

NOTE Spray control signal of UASS can differ due to local or national regulation.

5.1.3 Pre-mix filling supply

If a ground placed filling supply is used at the flight site (mixing/loading site) to enable pre-mixing of the spray liquid and filling of the UASS spray tank, the pre-mix filling supply shall be equipped with:

— measuring equipment such as appropriately scaled flow measurement device for metering the PPPs;

— a tank with an appropriate shape and filling opening suitable to mix the spray liquid without spillage, equipped with a tank content indicator corresponding to ISO 9357, clearly readable from the operator's position;

— a tank agitator providing a uniform concentration of PPPs in the spray liquid;

— tank, hoses and valves that tightly close and do not leak;

— device(s) for collecting accidental leakage.

Filling devices shall be designed to avoid any return of liquid from the tank to filling supply, e.g. include vacuum break design or air gap separation.

Compliance shall be checked by inspection.

NOTE 1 Pre-mix filling supply is not part of UASS but can be used for assisting UASS spraying in field.

NOTE 2 The small spray tank sizes of UASSs usually mean rapid emptying so a spray tank agitator to ensure an even distribution of PPPs in the spray tank whilst spraying is not generally required.

5.1.4 UASS Materials

Materials used shall be resistant to PPPs and approved by the manufacturer for intended use.

Compliance shall be certified by the UASS manufacturer.

NOTE The chemical resistance of UAS materials to PPPs is also an important factor to consider.

5.1.5 Volume of total residue

The total residual volume in the UASS shall not exceed 4 % of the nominal spray tank volume.

Compliance shall be checked on horizontal position of the UAS only, according to ISO 13440.

5.2 Spray tank

5.2.1 General

5.2.1.1 If the spray tank is designed to be replaced for refilling of spray liquid; the spray tank, filled with water to the nominal volume, shall not leak after being dropped vertically from a height of 0,7 m to a horizontal concrete surface.

Compliance shall be checked by functional test and visual inspection.

5.2.1.2 The spray tank shall be designed to reduce surging of the contained liquid by the use of baffles or appropriate design.

Compliance shall be checked by functional test.

5.2.1.3 The spray tank shall allow pressure compensation as it empties, without any leakage of spray liquid.

Compliance shall be checked by functional test.