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Agricultural and forestry machines — Inspection of sprayers in use —

Part 5: Aerial spray systems — Environmental protection

*Matériel agricole et forestier — Contrôle des pulvérisateurs en service —
Partie 5: Titre manque*

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

For an explanation on 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 the following URL: 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 16122 series can be found on the ISO website.

Introduction

Significant areas are sprayed globally by fixed wing and rotary aircraft in order to overcome serious pest threats to agriculture and forestry. Aerial application is used where difficult terrain or crop (forests) dictate as well as for timely application to large areas in order to maximize efficient use of crop protection products and minimize environmental impact. This standard specifies requirements and methods for their inspection in use of such spray systems.

Agricultural and forestry machines — Inspection of sprayers in use —

Part 5: Aerial spray systems — Environmental protection

1 Scope

This International Standard specifies the requirements and test methods for their verification for inspection in use for aerial fixed wing and rotary aircraft spray systems for agriculture, forestry, turf, and vegetation control in transport access ways (such as gas and electric lines) with regard to minimizing the potential risk of environmental contamination during use.

This document applies only to manned aerial aircraft. It does not cover aircraft safety and design criteria for air worthiness and aircraft registration nor pilot or operator requirements all of which will be specified separately by countries or regions.

This part of ISO 16122 relates mainly to the condition of the equipment with respect to its potential risk for the environment and its performance to achieve good applications.

NOTE Requirements for the protection of inspectors during an inspection are given in ISO 16122-1.

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 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 16122-1:2015, *Agricultural and forestry machinery — Inspection of sprayers in use — Part 1: General*

3 Terms and definitions

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

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

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1

fixed wing aircraft

fixed wing aircraft approved by local or national authority equipped for the application of plant protection products including fertilizers on crops, including forestry and grasslands

3.2

rotary aircraft

helicopter (rotary) aircraft approved by local or national authority, equipped for the application of plant protection products and fertilizers on crops, including forestry and grasslands

3.3

global navigation satellite system (GNSS)

generic term for satellite navigation systems that provide autonomous geospatial positioning with global coverage

[SOURCE: ISO/TS 11356:2011, 3.4]

4 Requirements

4.1 General requirements

The sprayer should be free from any damage that could cause spray liquid to leak from the tank, its' lid (which should be in good condition), its fittings, the pump, pipework and nozzles. A test for static leaks shall be performed with the tank filled to its nominal capacity with the aircraft parked on a level horizontal surface and the pump not running.

Compliance shall be checked by: visual check.

4.2 Sprayer tanks

The tank surface shall be at free from cuts or abrasion externally and internal that may compromise wall integrity. There should be no loose apparatus or blockage in the spray tank.

Compliance shall be checked by measurement, visual inspection.

4.2.1 Lid – Filling hole

For any tank opening greater than 400 mm in diameter it shall be provided with a secured grating which can only be removed by the use of tools. The openings in the grating shall not exceed the above-mentioned dimensions. Any opening lid shall be tightly sealed to avoid spillage.

Compliance shall be checked by: measurement test and visual inspection.

4.2.2 Strainers

Minimum 20 mesh strainers are recommended prior to transfer into the tank and mesh strainers should be per recommendations of spray system manufactures and observed to be free from cuts or blockage.

Compliance shall be checked by: visual check.

4.2.3 Emptying

No puddling of liquid visible in bottom of spray tank after draining or cleaning procedure.

Compliance shall be checked by: visual check.

4.2.4 Tank emptying device

It shall be possible to use an emptying device while aircraft is parked such that emptying of the residual is achieved.

It shall be possible to collect the liquid at the outlet without contaminating the environment. Compliance shall be checked by: visual check.

4.2.5 Tank contents indicator(s)

The indication of contents shall be easily readable from the pilot or operators position and from where the tank is filled. Turning of the head and the upper body is acceptable.

Compliance shall be checked by: visual check

4.2.6 Tank Agitation

Spray tanks shall include operational recirculation / agitation systems. Compliance shall be checked by: visual check

4.3 Hoses and lines

All pressurized hoses shall be clearly marked with the maximum working pressure. Hoses shall not have any deformation which can disturb the liquid flow. Also, hoses and their connecting devices shall be protected by impermeate screens, so that leakage within the cockpit cannot come into contact with the pilot or operator.

Spray boom shall be equipped with quick-acting shut-off valve that allow suction back return to the spray tank for rapid de-pressurization of the spray boom unless liquid flow is controlled by starting and stopping the pump.

Compliance shall be checked by: visual check and function test.

4.3.1 Leakage

There shall be no visible leakage from pipes or hoses including their couplings when tested up to the maximum obtainable pressure from the system.

Compliance shall be checked by: visual check and function test.

4.3.2 Bending/abrasion

Hoses shall not show excessive bending and abrasion through contact with surrounding surfaces. They shall be free from defects such as excessive surface wear, cuts or cracks.

Compliance shall be checked by: visual check.

4.4 Spray boom

4.4.1 Spraying section

Spray booms shall have the option for non-uniform location of nozzles to adjust for propeller or rotor wash and fuselage air turbulence on the spray.

Spray boom shall not be warped or twisted, so that orientation of all the nozzles are within 5 degrees of desired nominal angle to the application in forward flight.

Compliance shall be checked by measurement and visual check.

4.4.2 Nozzle orientation

The spray boom and nozzle location should be appropriate for the application intended. Nozzles shall be positioned to avoid wing tip or rotor vortices for agricultural applications. Deep canopy spraying, such as forestry spraying, may require nozzles and boom be positioned to utilize wake turbulence to achieve penetration and deposition on interior surfaces.

Compliance shall be checked by: visual check.

4.5 Pressure Drop

The pressure drop between the point on the sprayer where the indicated spray pressure is measured during working and the outermost end of each boom section shall not exceed 10 %.

The test shall be carried out with the highest flow rate nozzle provided on the sprayer and at a pressure within the working pressure range given by the nozzle manufacturer.

A calibrated test pressure indicator (see 5) shall be fitted at the same position as a nozzle at the outermost end of each boom section.

Measurements shall be made at two pressures at the pressure indicator of the sprayer using the calibrated test pressure indicator.

The values indicated by the pressure indicator of the sprayer shall be compared with values measured by the calibrated test pressure indicator.

For each section, the pressure drop PD between the inlet and the indicated spray pressure and the outermost end shall be calculated using the following formula:

$$PD = 100 \times (P1 - P0) / P$$

where

P0 is the reading of the pressure indicator of the sprayer;

P1 is the outermost end pressure of the same section.

This test may be conducted with the spray boom dismantled from the aircraft, an external pump and recirculation system may be used to supply flow rate.

Compliance shall be checked by: visual check and function test.

4.6 Filters

Filters shall not be at individual nozzles, rather in mainlines instead. Maximum filter/ strainer opening shall not exceed 2 mm.

Filters shall be accessible and filter insets shall be removable or flushable. It shall be possible, with the tank filled to its nominal volume, to clean central filters without any spray liquid leaking out except for that which may be present in the filter casing and any connected lines.

Integrity of screens must be free of damage such as distortion or blockage.

Compliance shall be checked by: Visual Check.

4.7 Nozzles

4.7.1 Mounting

It shall be possible to fix nozzles in predetermined positions. Each nozzle shall be equipped with a fast closing anti-drip device (e.g. a check-valve). It shall be possible to shut off the flow from each nozzle immediately, in flight.

The orientation of all nozzles (per ISO 5682-2, 6,4,2) should be the same for the same spray quality category intended and appropriate for the type and configuration of nozzles used.

For rotary atomizers check that they can rotate freely and for any damage or wear.

Compliance shall be checked by: visual check, measurement and function test.

4.7.2 Flow rate and Spray Quality

The flow rate of each individual nozzle, measured according to Clause 6 of ISO 5682-1:2017 when demounted from the aircraft, shall not deviate by more than $\pm 10\%$ from the data of the manufacturers published flow rate tables. Where nozzles must be tested off the sprayer a test bench consisting of pump supplying water at needed pressure, a pressure regulator, pressure indicator (analogue or digital, meeting 5.1 requirements) to monitor actual pressure, and flow meter to measure actual flow.

Nozzles of unknown orifice size (flowrate) shall be replaced.

Compliance shall be tested according to principles of Clause 6 of ISO 5682-1:2017 except for 6.3.

Nozzle spray quality (drop size) category shall be available for nominal operational speeds.

NOTE This information can be obtained from the nozzle manufacturer's published material or other publications (see [Annex A](#)).

Compliance shall be checked by visual check of records.

4.8 Measuring systems

4.8.1 General

All devices for measuring and/or adjusting the pressure and/or flow rate shall operate properly. There shall be no leakage.

Compliance shall be checked by: visual check and function test.

4.8.2 Control

All devices for measuring, indicating and/or adjusting the pressure and/or flow rate shall function with a tolerance of $\pm 10\%$ at constant setting and shall return within 10 s to the original working pressure $\pm 10\%$ after the sprayer has been switched off and on again.

The valves for switching on or off the spray shall function.

Control of the working pressure, atomizer RPM (if appropriate), the volume application rate (in l/ha), where relevant, the adjustment controls shall be operable from the pilot's or operator's position. Turning of the head is tolerable.

Aircraft GNNS swath displays should be located within pilot's line of sight.

Sprayers shall be fitted with a spray boom pressure indicator.

Flow rate meters shall have flow rate verified per the applicable methodology of 16122-2 Clause 5.4.

Compliance shall be checked by: visual check and function test.

4.8.3 Accuracy of Pressure Indicator

The pressure indicator shall be clearly readable. The pressure indication shall be stable. The scale of the pressure indicator shall be marked:

- every 0,2 bar for working pressures less than 5 bar;
- every 1,0 bar for working pressures between 5 bar (included) and 20 bar (included);
- every 2,0 bar for working pressures more than 20 bar.

The pressure indicator will be readable from the pilot's or operator's position and operational for the working pressures required.

Compliance shall be checked by: visual check.

4.9 Distribution

Any automated flow control and/or application rate controller shall be shown to be within less than 10 % of application rate aim points.

To measure the amount discharged over a measured time, the time interval shall be sufficient to permit accurate measurement of liquid discharged and to minimize errors due to turning the system on and off. Run the spray system for at least 30 s +/- 0,5 s. Measure the amount of liquid used by either refilling the tank to the initial level or by measuring the amount remaining in the tank and subtracting from the initial amount. Measurement precision shall be +/- 2 % of the amount discharged in the test. If the spray system can be operated with the aircraft stationary the test can be accomplished without flying the aircraft. This test may be conducted with the spray boom dismantled from the aircraft, an external pump and recirculation system may be used to supply flow rate.

NOTE Aircraft spray systems shall be calibrated on a regular basis as per local or national regulations or requirements.

Compliance shall be checked by measurement via functional test.

4.10 Operator Safety / Exposure

Cockpit seals shall be functional and secure, and free from visual defects.

Compliance shall be checked by: visual check.

4.11 Flow Control

Aircraft GNNS system, if present, shall provide location time stamped report, and the flow control system, if present, shall be capable of providing application rate output report, and match the flow rate in [4.9](#).

Compliance shall be checked by: visual check.

5 Validation Pressure Indicator(s)

5.1 Specifications

Analog pressure indicators used for verification shall have a minimum diameter of 100 mm. Other minimum requirements on pressure indicators used for verification are given in [Table 1](#).

Table 1 — Characteristics of pressure indicators used for verification

(Values in accordance with EN 837-1)

Pressure to measure Δp bar	Scale unit max. bar	Accuracy bar	Class required	Scale end value bar
$0 < \Delta p \leq 6$	0,1	0,1	1,6	6
			1,0	10
			0,6	16
$6 < \Delta p \leq 16$	0,2	0,25	1,6	16
			1,0	25
$\Delta p > 16$	1,0	1,0	2,5	40
			1,6	60
			1,0	100

1 bar = 0,1 MPa = 0,1 N/mm² = 105 N/m² = 14.5psi

5.2 Verification method of the sprayer pressure indicator

The pressure indicator(s) of the sprayer shall be tested mounted on the aircraft spray system or on a test bench by comparison with a calibrated test pressure indicator.

Measurements shall be carried out with both increasing and decreasing pressure. In each case the accuracy of the pressure indicator of the sprayer shall be checked at a minimum of 4 equally spaced points within the relevant working pressure range. The pressure shall be stable during measurement, e.g. no influence from pump rotation or pulsations.

6 Inspection Report

Inspection report shall record:

- aircraft registration number for the inspected spray system;
- owner identity;
- inspection results;
- the type(s) of application(s).

Any defects should be noted and report signed and dated.

Annex A (informative)

Nozzle drop size category websites and Aerial deposition models

- USDA (US Dept. of Agriculture) ARS; Aerial nozzle drop size spectra categories models / database app. Website : <http://www.agaviation.org/spraynozzlemodels> or iTunes or android store search for “Aerial Spray App”.
- “Aerial AgDRIFT and AGDISP™ deposition models; useful for swath widths and pattern scenarios; (see US EPA web site: <http://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment>).

Annex ZA

Relationship between this European Standard and the essential requirements of EC Directive 2009/128/EC aimed to be covered

This European Standard has been prepared under a Commission's standardization request „M/435 Mandate to CEN, CENELEC and ETSI for the development of a standards on inspection of pesticide application equipment in use to provide one voluntary means of conforming to essential requirements of Directive 2009/128/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for Community action to achieve the sustainable use of pesticides

Once this standard is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of this standard given in Table ZA.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding essential requirements of that Directive and associated EFTA regulations.

Table ZA — Correspondence between this European Standard and Clauses of Annex 2 of Directive 2009/128/EC

Essential Requirements of Directive 2009/128/EC	Clause(s)/sub-clause(s) of this EN	Remarks/Notes
Within the limits of the scope all relevant essential requirements are covered	All normative clauses	

WARNING 1 — Presumption of conformity stays valid only as long as a reference to this European Standard is maintained in the list published in the Official Journal of the European Union. Users of this standard should consult frequently the latest list published in the Official Journal of the European Union.

WARNING 2 — Other Union legislation may be applicable to the product(s) falling within the scope of this standard.