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Agricultural and forestry machinery — Environmental requirements for sprayers —

Part 4: Fixed and semi-mobile sprayers

Matériel agricole et forestier — Exigences environnementales pour les pulvérisateurs —

Partie 4: Pulvérisateurs fixes et semi-mobiles

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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).

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 on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword — Supplementary information.

ISO 16119-4 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 144, *Tractors and machinery for agriculture and forestry*, in collaboration with ISO Technical Committee TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 6, *Equipment for crop protection*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

ISO 16119 consists of the following parts, under the general title *Agricultural and forestry machinery — Environmental requirements for sprayers*:

— *Part 1: General*

— *Part 2: Horizontal boom sprayers*

— *Part 3: Sprayers for bush and tree crops*

— *Part 4: Fixed and semi-mobile sprayers*

Introduction

The requirements of this part of ISO 16119 are based on the test methods given in ISO 5682-2:1997, which were primarily developed for hydraulic sprayers. For other types of sprayers, other test methods and/or test criteria may be needed and may be the subject of future investigation/revision of this part of ISO 16119.

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

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

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.

Agricultural and forestry machinery — Environmental requirements for sprayers —

Part 4:
Fixed and semi-mobile sprayers

1 Scope

This part of ISO 16119 specifies requirements and the means for their verification for the design and performance of fixed and semi-mobile sprayers, as defined in 3.1 and 3.2, with regard to minimizing the potential risk of environmental contamination during use, including misuse foreseeable by the manufacturer.

This type of spraying system is generally a combination of separate elements (main tank, pump and application unit) that can be assembled in fixed installations (fixed sprayers) or with moving parts (semi-mobile sprayers).

It does not apply to application equipment for space/spatial treatments.

It is intended to be used with ISO 16119-1, which gives general requirements common to all the sprayer types covered by ISO 16119. When requirements of this part of ISO 16119 are different from those stated in ISO 16119-1, the requirements of this part of ISO 16119 take precedence over the requirements of ISO 16119-1 for machines within the scope of this part of ISO 16119. This part of ISO 16119 does not cover safety aspects (see ISO 4254-6).

This part of ISO 16119 is not applicable to sprayers manufactured before the date of its publication.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 837-1, *Pressure gauges – Part 1: Bourdon tube pressure gauges – Dimensions, metrology, requirements and testing*

ISO 4102:1984, *Equipment for crop protection — Sprayers — Connection threading*

ISO 4254-6:2009, *Agricultural machinery — Safety — Part 6: Sprayers and liquid fertilizer distributors*

ISO 4288:1996, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Rules and procedures for the assessment of surface texture*

ISO 5681, *Equipment for crop protection — Vocabulary*

ISO 5682-1:1996, *Equipment for crop protection — Spraying equipment — Part 1: Test methods for sprayer nozzles*

ISO 5682-2:1997, *Equipment for crop protection — Spraying equipment — Part 2: Test methods for hydraulic sprayers*

ISO 5682-3:1996, *Equipment for crop protection — Spraying equipment — Part 3: Test method for volume/hectare adjustment systems of agricultural hydraulic pressure sprayers*

ISO 8169:1984, *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 9898:2000, *Equipment for crop protection — Test methods for air-assisted sprayers for bush and tree crops*

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

ISO 13457:2008, *Agricultural irrigation equipment — Water-driven chemical injector pumps*

ISO 16119-1:2013, *Agricultural and forestry machinery — Environmental requirements for sprayers — Part 1: General*

ISO 16236, *Crop protection equipment — Test method for the determination of drainable volume and its concentration*

ISO 19932-1:2013, *Equipment for crop protection — Knapsack sprayers — Part 1: Safety and environmental requirements*

ISO 21278-1:2008, *Equipment for crop protection — Induction hoppers — Part 1: Test methods*

ISO 21278-2:2008, *Equipment for crop protection — Induction hoppers — Part 2: General requirements and performance limits*

ISO 22368-1:2004, *Crop protection equipment — Test methods for the evaluation of cleaning systems — Part 1: Internal cleaning of complete sprayers*

ISO 22368-3:2004, *Crop protection equipment — Test methods for the evaluation of cleaning systems — Part 3: Internal cleaning of tank*

3 Terms and definitions

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

3.1
fixed sprayer
machine primarily for spraying plant protection products in covered structures, and where the *pump/tank unit* (3.3) and/or *application unit* (3.4) do not move

3.2
semi-mobile sprayer
machine primarily for spraying plant protection products on crops grown in covered structures, and where the *pump/tank unit* (3.3) and *application unit* (3.4) are separately moveable

3.3
pump/tank unit
device comprising at least the pump and the spray liquid tank

Note 1 to entry: They can be built together as one unit or separate units.

3.4
application unit
device consisting of one or more nozzles/spray generators with or without air-assistance, and used with a separate pump/tank unit to which it is connected by a pipeline

Note 1 to entry: There are sprayers where the application unit moves in the crop rows or over the target independently from the pump/tank unit and others where the application unit is stationary and the target is moved.

Note 2 to entry: The application unit can be a spray gun/lance or a horizontal and/or vertical spray boom. The application unit can be equipped with a fan to provide air to transport the spray droplets to the target. The application unit can be moved in the row or over the target (manually or motorized). The spray application controls can be manual or automatic.

4 List of significant hazards

Table 1 specifies the significant hazards, the significant hazardous situations and significant hazardous event(s) covered by this part of ISO 16119 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 manufacturer to eliminate or to reduce environmental contamination.

Attention is drawn to the necessity to verify that the environmental requirements specified in both ISO 16119-1 and this part of ISO 16119 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**	**Subclause of this part of** ISO 16119
4.1	Spillages	Filling	5.1.3.2; 8
		Induction of plant protection product	5.1.3.2; 5.5 ;8
4.2	Contamination of the water supply	Filling	5.1.3.2; 5.5
4.3	Leakages	Transport and application	5.1.1; 5.1.3.2; 5.1.5
4.4	Overfilling	Filling	5.1.3.2; 5.1.3.4; 8
4.5	Dispersal of spray mix residues or plant protection products	Drainage	5.1.2; 5.1.3.3; 5.1.3.4; 8
		Cleaning and rinsing	5.1.3.1;5.1.6; 5.4; 5.5; 8
4.6	Accidental leakages	Accidental opening of tank outlet	5.1.3.3
4.7	Over-dosing	Heterogeneous mixing	5.1.3.5; 5.1.4;5.2.3; 8
		Overlapping	5.3.4.1; 5.3.5.1
		Sprayer adjustment / control	5.1.3.4; 5.1.8; 5.2; 5.3.4.2; 5.3.3; 5.3.6; 5.3.7; 8
		Sprayer maintenance / service	5.1.8; 7; 8
		Unintended deposition	5.3.4.1; 5.3.4.3; 5.3.3; 5.3.6; 5.3.7.1
		Direct Injection system	5.2.3
4.8	Unintended spraying outside the target area	Deposition outside the target area	5.3.4.1; 5.3.5.1; 5.3.8
		Spraying stop control	5.1.8; 5.3.6; 5.3.7.1
4.9	Drift	Spraying	5.3.4.1; 5.3.5.1; 5.3.8
4.10	Dispersal of spray mix	Intervention on the sprayer during application or service	5.1.6; 5.1.7; 7; 8
4.11	Dripping	Spraying stop control	5.3.3

5 Requirements

5.1 Pump/tank unit

5.1.1 Static leaks

With the spray tank filled to its nominal capacity and placed on a horizontal surface (in the case of non-fixed installations) and without running the pump, there shall be no leakage from the tank, pump and associated pipes.

5.1.2 Residual volume

The volume of total residual as defined in ISO 13440:1996, 2.1 shall not exceed:

— 4 % of the nominal tank volume for a tank volume of less than 400 l;

— 3 % of the nominal tank volume for a tank volume of between 400 l (included) and 1 000 l (included);

— 2 % for a tank volume of more than 1 000 l.

The volume of total residual shall be determined in accordance with ISO 13440.

5.1.3 Spray tank(s)

5.1.3.1 Surfaces

The depth of roughness, *Rz*, (see ISO 4287) of the inner walls of the spray tank shall be such that $Rz \leq 100$ µm, measured according to ISO 4288.

For semi-mobile sprayers, this requirement applies also for the outer walls of the spray tank.

5.1.3.2 Filling

5.1.3.2.1 Semi-mobile sprayers

Filling devices shall be designed to avoid any return of liquid from the spray tank to the filling supply.

The filling hole diameter shall comply with ISO 9357. The opening lid shall seal sufficiently to prevent leakage/spillage when closed, both with the strainer in position and removed. The lid shall be lockable to avoid unexpected opening. If a vent is provided in the lid, spillage shall be avoided.

The total tank volume shall be at least 5 % more than the nominal volume, to prevent spillage as a result of overfilling. Tanks with a nominal volume greater than 200 l shall have a nominal volume which is a multiple of 100 l.

Strainers shall be installed in filling openings and shall have a mesh size less than 2 mm. Any gap(s) between the tank filling hole and the strainer shall not exceed 2 mm (see Figure 1).

Strainers shall have a minimum depth, *d*, as given in Table 2 and measured according to Figure 1.

The filling capacity of the tank with strainer when filled with water shall be at least 100 l/min for tanks with a nominal volume of 100 l or more. For tanks with a nominal volume of less than 100 l, it shall be possible to fill the tank within 1 min.

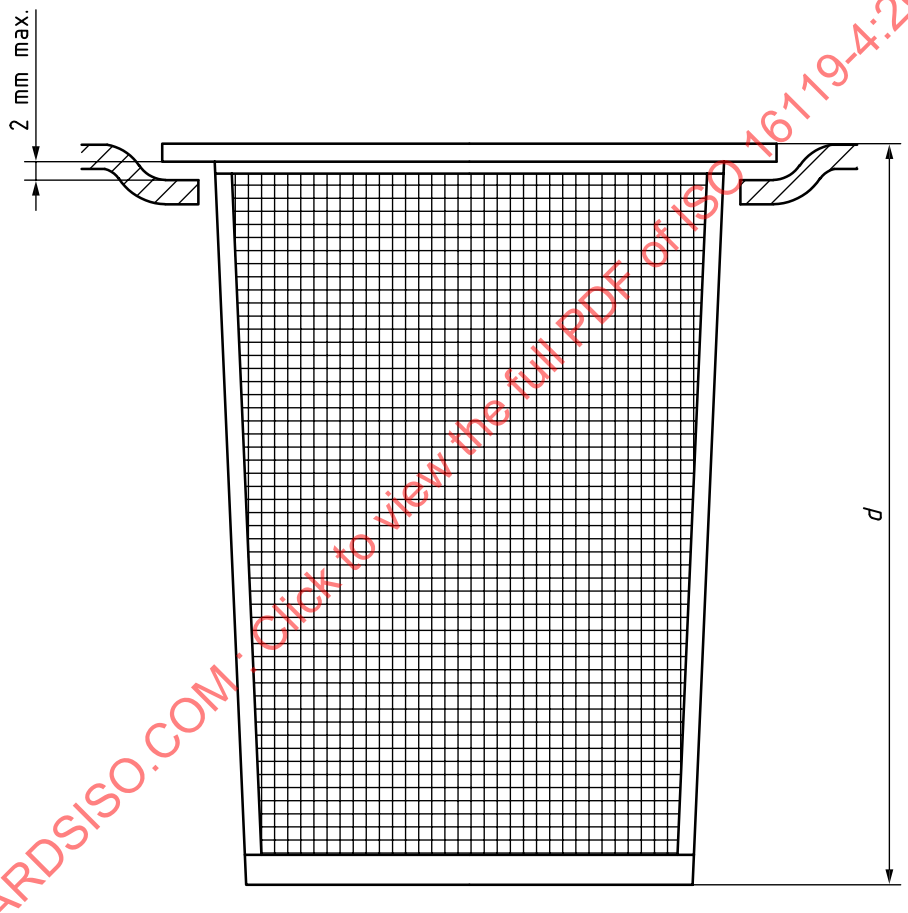
Induction hoppers, if any, shall comply with ISO 21278-2.

Table 2 — Minimum depth of strainers

Nominal tank capacity C l	Minimum depth [a] d mm
$C \leq 150$	60
$150 < C \leq 400$	100
$400 < C \leq 600$	150
$C > 600$	250

[a] Measured from the upper edge of the strainer down to its bottom.

Dimensions in millimetres



Key

d Minimum depth

Figure 1 — Determination of the depth of the strainer and width of gap(s)

5.1.3.2.2 Fixed sprayers

Filling devices shall be designed to avoid any return of liquid from the tank to the filling supply.

A tank cover shall be present to prevent objects falling in. The tank cover may be provided with a filling hole. Any filling hole shall be designed in such a way that splashing and spillage of the spray liquid during filling is avoided. The tank cover shall be lockable to avoid unexpected opening.

Strainers shall be installed in filling openings and shall have a mesh size less than 2 mm. Any gap(s) between the tank filling hole and the strainer shall not exceed 2 mm (see Figure 1).

Strainers shall have a minimum depth, *d,* as given in Table 2 and measured according to Figure 1.

The total tank volume shall be at least 5 % more than its nominal volume, to prevent spillage as a result of overfilling. Tanks with a nominal volume greater than 200 l shall have a nominal volume which is a multiple of 100 l.

The filling capacity of the tank when filled with water shall be at least 100 l/min for tanks with a nominal volume of 100 l or more. For tanks with a nominal volume of less than 100 l, it shall be possible to fill the tank within 1 min.

Induction hoppers, if any, shall comply with ISO 21278-2.

5.1.3.3 Tank emptying device

An emptying device in accordance with ISO 4254-6:2009, 5.4.3 shall allow the complete emptying of the residual in the tank when the sprayer is in a horizontal position. Complete emptying of the residual is considered to have been achieved when there are no visible puddles at the bottom of the tank after 5 min drainage.

It shall be possible to collect the liquid at the outlet without contaminating the environment or equipment part, e.g. stays.

The tank outlet shall be guarded against accidental opening.

5.1.3.4 Tank contents indicator(s)

The indication of contents shall correspond to ISO 9357. It shall be durable and easily readable from where the tank is filled.

The acceptable tolerances of the indication are:

a) ±15 % for each graduation mark/read-out for volumes up to 10 % of the nominal tank volume;

b) ±7,5 % for each graduation mark/read-out for volumes from 10 % to 20 % of the nominal tank volume; and

c) ±5 % for each graduation mark/read-out for volumes above 20 % of the nominal tank volume.

Other means of visually checking the contents of the tank are allowed if they achieve equivalent accuracy.

The tolerances shall be measured with a maximum error on measurement of ±1 %, with the sprayer in a horizontal position.

5.1.3.5 Mixing

Tanks shall be designed (e.g. including agitators) to ensure an even concentration of mixture.

The maximum allowable relative deviation is ±15 %, tested in accordance with ISO 5682-2:1997, 8.9. When pump backflow is necessary to meet this requirement, the minimum value to meet this requirement shall be measured according to Annex A and specified in the instruction handbook.

NOTE Other procedures for measuring the homogeneity of the spray mixture can be used, provided that the same accuracy is achieved.

5.1.4 Pump

The capacity of the pump shall be suited to the needs of the sprayer. The pump shall have sufficient flow rate capacity in order to be able to spray within the operating limits specified in the sprayer instruction handbook and maintaining good mixing as specified in 5.1.3.5.

The pump (including air chamber if present) shall not cause pulsations that exceed 5 % of the working pressure, measured on the application unit at nominal rotation speed of the pump at the intended working pressure.

Verification method is given in Annex B.

5.1.5 Lines (hoses and pipes)

The bending radius of hoses shall be within the limits recommended by the hose manufacturer. Pipes and hoses shall not have any deformation which could disturb the liquid flow.

Pressure lines shall be equipped with quick-acting shut-off devices (e.g. tip-over lever valves).

The maximum working pressure of hoses and the maximum working pressure of connecting devices shall be at least equal to the maximum working pressure of the circuit. See also ISO 16119-1:2013, Clause 6 h).

5.1.6 Filters

Sprayers equipped with a positive displacement pump shall have a suction filter.

On the pressure side, the liquid flowing to the nozzles shall be filtered by means of central filters or filters in the lines of boom sections. These pressure filters shall be mounted on the application unit unless the application unit is a spray gun or lance when this requirement does not apply. The size of all filters shall correspond to the size of nozzles fitted on the sprayer.

The operator shall be able to detect blockages, for example, by an appropriate positioning of the central pressure filters and pressure indicator.

Filters shall be easily accessible and filter inserts shall be removable. For quick cleaning, the filter tissue of the insert shall be easily accessible.

It shall be possible, with the spray 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 connected suction or pressure lines.

5.1.7 Measuring systems

Sprayers shall be fitted with a pressure indicator complying with ISO 4254-6:2009, 5.5. A pressure indicator shall be present on the pump/tank unit.

Sprayers equipped with twin fluid nozzles shall also have pressure indicator(s) for the air-pressure.

The accuracy of the pressure indicators shall be[1)]:

— ±0,2 bar for working pressures between 1,0 bar (included) and 8 bar (included);

— ±0,5 bar for working pressures between 8 bar and 20 bar (included); and

— ±1 bar for working pressures more than 20 bar.

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

— 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.

1) 1 bar = 0,1 MPa = 0,1 N/mm^2 = 10^5 N/m^2.

Unless otherwise specified in this part of ISO 16119, each measuring system of the sprayer, e.g. for flow rate, forward speed, pressure or air speed, except for the tank indicator (see 5.1.3.4), shall be measured within a maximum error of ±5 % of the measured value.

5.1.8 Provisions for connecting testing equipment

Means shall be provided to test the pressure indicator(s):

— on the sprayer with a connection having a 1/4 inch or 1/2 inch inner thread according to ISO 4102; or

— it shall be possible to dismount the pressure indicator from the sprayer, without the need to dismount other parts of the sprayer.

Means shall also be provided to connect a flow meter between the pump and the pressure regulator without damaging any hoses or removing the couplers from the hoses.

If the sprayer is equipped with a flow meter, the sprayer shall be equipped with a connecting device allowing the fitting of a test flow meter without the need to dismount the sprayer flow meter.

5.2 Adjustment of the dose/volume application rate

5.2.1 General

The maximum error for all the measurements specified in 5.2.2, shall be ±2,5 %.

5.2.2 Pressure adjustment devices

Pressure adjustment devices shall maintain a constant working pressure at constant revolutions of the pump. After switching off/on the application unit and its individual sections during spraying operations, the working pressure shall return to its original value within ±7,5 %.

5.2.3 Direct injection system (if provided)

For direct injection systems, the following requirements shall apply:

a) Water driven direct injection pumps shall comply with ISO 13457.

b) For other types of direct injection systems (for example metering pump + water meter or venturi + water pump), the following requirements shall apply:

   1) The direct injection system shall employ means, such as a check valve, to prevent spraying water passing through the direct injection system from entering the plant protection product tank.

   2) It shall be possible to disassemble and clean those parts of the direct injection system subject to clogging by the plant protection product or by debris in the spraying water. These parts may be fitted with a sustainable filtration device accessible for the purpose of cleaning.

   3) The injection rate at any inlet pressure shall not deviate by more than ±10 % from that declared by the manufacturer.

   4) The drive water flow rate shall comply with the flow declared by the manufacturer within an allowable deviation of ±10 %.

   5) In no case shall the measured mixing ratio (plant protection product / water) obtained by this other type of direct injection system deviate by more than ±10 % from the requested and set

mixing ratio declared by the manufacturer. Verification shall be made with the following three mixing ratios:

i) the minimum mixing ratio declared by the manufacturer;

ii) the maximum mixing ratio declared by the manufacturer;

iii) a mixing ratio midway between i and ii.

c) The concentration of applied plant protection product measured in the flow of spray mix after the plant protection products are injected shall be stable at the set mixing ratio and shall not vary more than ±10 % of this ratio.

NOTE Subclause 5.2.3 c) can be checked by continuous measuring of the electrical conductivity during a test.

If separate mixing tanks are provided, they shall comply with 5.1.3.5.

5.2.4 Calibration aids

Appropriate calibration aids (at least a measuring jar with a capacity of 1 l and an accuracy of ±2,5 % and with a scale marked every 20 ml) shall be supplied together with the sprayer.

5.3 Application unit

5.3.1 Controls

A pressure indicator complying with requirements of 5.1.7 shall be present on the application unit.

If the application unit is a spray gun or lance, see 5.3.6.

5.3.2 Pressure drop

The pressure drop between the measuring point for spraying pressure on the application unit and at the most distant nozzle (including anti-drip device, if available) or the orifice plate shall not exceed 10 % of the pressure on the application unit.

The pressures shall be measured with a calibrated pressure indicator.

Verification shall be carried out by measurements performed at the maximum flow rate as indicated by the manufacturer in the instruction handbook.

5.3.3 Nozzles

It shall be possible to fix nozzles in predetermined positions, to ensure that the spray is correctly directed, by appropriate means such as marking, locking systems or mouldings.

When the control to stop the spraying has been activated, there shall be no dripping.

Verification of this requirement is by the following test. When the control to stop spraying has been activated, the dripping shall not exceed 2 ml per nozzle during a period of 5 min, starting 8 s after the spraying stop has been activated.

It shall be possible to measure the flow rate of each individual nozzle.

The flow rate of each individual nozzle, measured according to ISO 5682-1, shall not deviate by more than 5 % from the data of the nominal flow rate tables provided with the sprayer.

NOTE The requirements are based on the test methods given in ISO 5682-1, primarily developed for hydraulic sprayers. For other sprayers, other test methods and/or test criteria may be needed. This will be a subject for further investigation and possible amendment of this standard.

5.3.4 Horizontal spray boom

5.3.4.1 Working and spraying section widths

It shall be possible to adapt the working width of the horizontal spray boom to the width of the intended target by means of shutting off individual nozzles or sections of the boom.

5.3.4.2 Height adjustment

It shall be possible to adjust the minimum distance between the nozzles and the target according to the nozzle characteristics.

For outdoor use, it shall be possible to adjust the distance between the nozzles and ground down to 0,5 m, except when the sprayer is designed for special applications.

The boom height shall be adjustable, either continuously or by increments not exceeding 0,1 m.

Regardless of the distance of the boom above the ground and the nozzles fitted (as recommended by the manufacturer), no liquid shall be sprayed on to the application unit itself. This does not apply to components of the unit (e.g. sensors that in order to function are necessarily in contact with the spray liquid; for these, however, dripping shall be minimized.

Spray booms shall be constructed in such a way that will ensure that the boom can be positioned parallel to the target area.

When stationary on a level surface, the distance between the lower edges of the nozzles and the surface shall not vary more than 8 cm or 0,4 % of the working width, whatever is the highest.

5.3.4.3 Distribution

If nozzles are used on a boom to provide a uniform spray in the horizontal direction, the transverse volume distribution shall be measured on a 100 mm groove patternator (see ISO 5682-2). The coefficient of variation shall not exceed 7 % at one boom height and one pressure specified by the manufacturer for each nozzle set mounted on the boom. For other boom heights and pressures specified by the sprayer manufacturer, the coefficient of variation shall not exceed 9 %. This shall be measured in accordance with ISO 5682-2 for specified boom heights and pressures only. The coefficient of variation shall be calculated in accordance with ISO 5682-3.

NOTE Other systems for measuring the transverse volume distribution are allowed if the same accuracy is achieved.

For nozzles with overlapping spray patterns, this applies only for those parts of the boom where there is a total overlap.

The flow rate of each nozzle when mounted on the spray boom shall not deviate more than 10 % from the data given in the flow rate tables provided by the manufacturer.

The flow rate of each nozzle of the same type and size, when mounted on the spray boom, shall not deviate by more than 5 % from the mean flow rate of all the nozzles on the boom.

The flow rate measurements shall be carried out with the nozzle mounted on the boom and the requirements for flow rate shall be checked with a measuring error of less than 2,5 % of the measured value.

The flow rate-shall be checked in accordance with ISO 5682-2.

NOTE The requirements are based on the test methods given in ISO 5682-2, primarily developed for hydraulic sprayers. For other sprayers, other test methods and/or test criteria may be needed. This will be a subject for further investigation and possible amendment of this standard

5.3.5 Vertical spray boom and other non-horizontal spray booms

5.3.5.1 Adaptation to the crop

It shall be possible for one person to adjust the sprayer set-up to the type, size and height of the crop in a reproducible way, by appropriate means such as marking, locking systems or patterns. See also Clause 8.

It shall be possible to switch off each nozzle and to adjust the direction of their spray independently.

For multi side application, it shall be possible to switch off the spray of each side independently.

5.3.5.2 Distribution of liquid and air

5.3.5.2.1 Liquid

The flow rate of each nozzle of the same type and size, when mounted on the spray boom, shall not deviate by more than 10 % from the data given in the flow rate tables provided by the sprayer manufacturer.

The flow rate measurements shall be carried out with the nozzle mounted on the boom and the requirements for flow rate shall be checked with a measuring error of less than 2,5 % of the measured value.

The flow rate shall be checked in accordance with ISO 5682-2.

NOTE The requirements are based on the test methods given in ISO 5682-2, primarily developed for hydraulic sprayers. For other sprayers, other test methods and/or test criteria may be needed. This will be a subject for further investigation and possible amendment of this standard.

5.3.5.2.2 Air (if any)

The air flow rate of the fan, measured according to ISO 9898, shall not deviate by more than 10 % from the nominal output specified by the sprayer manufacturer.

For air-assisted sprayers intended for symmetrical application, the sprayer shall be designed so that the air flow produced by the fan is symmetrical at the right and left sides with respect to direction, velocity and air volume (according to ISO 9898:2000, 5.2.3.). Deviation between left and right shall not be more than 25 % when measured according to ISO 9898:2000, Clause 6, with the sprayer adjusted according to the instructions given in the sprayer manufacturer's instruction handbook (see Clause 8).

NOTE Other systems for measuring air volume and distribution are allowed if the same accuracy is achieved.

The direction of air shall be adjustable (for example air guide blades) and the different positions shall be clearly identified.

5.3.6 Spray gun and lance

Spray guns and lances shall be provided with a quick-acting start/stop valve positioned so that it can be easily reached by the operator in the normal working position. A locking device to hold the spraying control in the spraying position is not allowed.

Compliance shall be checked by inspection and function test.

The shut-off device shall not leak after 25 000 duty cycles. Compliance shall be tested according to ISO 19932-1.

If the spray gun or lance flow rate is adjustable, a clear marking indicating different flow rate setting shall be provided. The instruction handbook shall provide a table of the flow rates in relation to markings on the spray gun or lance.

If the pressure indicator of the sprayer cannot be easily read from the operator's position by an operator with 80 % of full visual acuity, then a pressure indicator shall be provided on the application unit. The

pressure indicator shall have at least a nominal size of 40 mm according to EN 837-1 for the spray gun or lance.

It shall be possible to adjust spray characteristics to different application conditions to minimize the use and/or environmental impact of plant protection products by mounting nozzles of dimensions complying with ISO 8169.

5.3.7 Autonomous application units

5.3.7.1 Control system

The control system of the sprayer shall automatically:

a) stop movement of the application unit when the flow of spray liquid ceases;

b) terminate the spraying operation by stopping the flow of spray liquid and the movement of the application unit when the spray liquid pressure rises above or falls below the permitted range of working pressures specified by the manufacturer;

c) stop the flow of spray liquid and movement of the application unit when the travel speed of the application unit rises above or falls below the permitted range of speeds specified by the manufacturer.

NOTE For additional information on control systems, see the ISO 25119 series.

5.3.7.2 Volume per area adjustment system

For an automatic controlled application, during spraying and independently of the volume of liquid in the tank, the measured volume application rate (volume per area unit) shall be within ±10 % of the average value calculated from 5 measurements. This shall be checked in accordance with ISO 5682-3.

5.3.7.3 Forward speed during application

If the forward speed is adjustable, the minimum and maximum forward speeds shall be specified by the manufacturer in the instruction handbook.

The required speed shall be achieved within 2 m after the start of the movement, to avoid overdosing.

The required speed when achieved shall be constant with a margin of 10 %.

NOTE A test method is under development.

5.3.8 Control of spray drift

The sprayer shall reduce spray drift as far as practicable especially for outdoor spraying.

NOTE Measurement methods are given in ISO 22856 and ISO 22866.

Methods for reducing the risk of spray drift shall be specified in the instruction handbook.

5.4 Cleaning

5.4.1 Rinsing water tank

If a rinsing water tank is present, it shall not be combined with the clean water tank for the operator's use (see ISO 4254-6:2009, 5.10). When present it shall have a volume of at least 10 % of the nominal spray tank volume and at least 10 times the volume of residual which can be diluted, measured according to ISO 13440. In the latter case, the volume of residual of the spray tank shall be specified in the instruction handbook.

If present, rinsing water tanks shall be designed so that they can be connected with the sprayer in such a way that the rinsing of the pipes is possible even when the spray tank is filled to its nominal volume (see also Clause 8). In addition, the dilution of the volume of residual in the spray tank shall be possible.

5.4.2 Cleaning systems

5.4.2.1 General

It shall be possible to clean the internal and external surfaces of the sprayer without unnecessarily contaminating the environment.

Sprayers without a clean water tank shall be equipped with a connecting device to allow their cleaning system to be supplied with clean water without contaminating the water supply.

Internal tank cleaning systems shall reduce the quantity of plant protection products adhered to the spray tank inner surfaces by 70 % when tested in accordance with ISO 22368-3.

It shall be possible to flush the lines, hoses and application unit with clear water when the spray tank is not empty.

5.4.2.2 Residue concentration

One or the other of the following requirements, a) or b), applies:

a) after completion of the cleaning process, the concentration of the residue shall be reduced by a factor of 300 (or 99,67 %), compared with the concentration before starting the cleaning process, tested in accordance with ISO 22368-1;

b) after completion of the cleaning process as described in the instruction handbook, the concentration of the liquid drained from the main spray tank outlet shall have been reduced to 2 % of the original concentration in the tank measured in accordance with ISO 16236.

5.5 Cleaning device for plant protection product containers

Cleaning devices for plant protection product containers, when provided, shall be designed so that the volume of residue after cleaning is less than 0,01 % of the nominal container volume. Verification of this requirement shall be by means of the test method given in ISO 21278-1.

Means shall be provided for rinsing the containers with clean water and for transferring and collecting the rinsing water in the spray tank without spillage resulting in environmental contamination.

6 Verification

Verification of the requirements given in Clauses 5 and 6 may be made by means of inspection, calculation, or testing as appropriate. The means of verification is either self-evident or specified for particular requirements in Clauses 5 and 6, as summarized in Table 3.

Table 3 — List of safety requirements and/or protective measures and their verification

Subclause of this part of ISO 16119		Verification			
		Inspection	Measurement	Test	Remark
5.1	Pump/tank unit				
5.1.1	Static leaks	X		X	
5.1.2	Residual volume		X		ISO 13440
5.1.3	Spray tank				
5.1.3.1	Surfaces		X		ISO 4288

Table 3 *(continued)*

Subclause of this part of ISO 16119		Verification			
		Inspection	Measurement	Test	Remark
5.1.3.2	Filling	X	X	X	ISO 9357, ISO 21278-2
5.1.3.3	Tank emptying device	X	X	X	ISO 4254-6
5.1.3.4	Tank contents indicator(s)	X	X		ISO 9357
5.1.3.5	Mixing		X		ISO 5682-2:1997 Annex A
5.1.4	Pump	X	X		Annex B
5.1.5	Lines (hoses and pipes)	X			
5.1.6	Filters	X			
5.1.7	Measuring systems	X	X		Check of the indicators and measuring instruments shall be done by inspection of their documentation.
5.1.8	Provisions for connecting testing equipment	X			
5.2	Adjustment of the dose/volume application rate				
5.2.1	General				
5.2.2	Pressure adjustment devices	X		X	
5.2.3	Direct injection system (if provided)	X	X	X	ISO 13457
5.2.4	Calibration aids	X			
5.3	Application unit				
5.3.1	Controls	X			
5.3.2	Pressure drop		X	X	
5.3.3	Nozzles	X	X	X	ISO 5682-1
5.3.4	Horizontal spray boom				
5.3.4.1	Working and spraying section widths	X			
5.3.4.2	Height adjustment	X	X		
5.3.4.3	Distribution	X	X	X	ISO 5682-2, ISO 5682-3
5.3.5	Vertical spray boom and other non-horizontal spray booms				
5.3.5.1	Adaptation to the crop	X			
5.3.5.2	Distribution of liquid and air				