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Agricultural and forestry machinery — Inspection of sprayers in use —

Part 4: Fixed and semi-mobile sprayers

Matériel agricole et forestier — Contrôle des pulvérisateurs en service —

Partie 4: Pulvérisateurs fixes et semi-mobiles

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Foreword

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

This second edition cancels and replaces the first edition (ISO 16122-4:2015), which has been technically revised.

The main changes are as follows:

— removed errors and resolve contradictions to the ISO 16119 series which specifies environmental requirements for new sprayers;

— updated the normative references;

— modified the terms and definitions;

— modified requirements on filling high capacity spray-tanks during leak test;

— modified tank filling strainer/filling hole;

— modified tank emptying;

— modified pressure indicators;

— modified diameter analogue pressure indicators;

— modified maximum error flow-meters for controlling the volume/hectare rate;

— modified Figure 1;

— modified dripping;

— modified spray guns and lances;

— modified pump capacity test.

A list of all parts in the ISO 16122 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

There are two main reasons for the inspection of sprayers:

— reducing the potential risk of environmental contamination by plant protection products;

— good control of the pest with the minimum possible input of plant protection product.

In order to use plant protection products in agricultural production safely, it is necessary to define the requirements and test methods for sprayers in use. This is a relevant step after having standardized minimum requirements for new sprayers, in respect of safety hazards (see ISO 4254-6) and potential risks of environmental contamination (see ISO 16119 series).

Standardising the requirements and methods for inspection of sprayers in use takes into consideration not only the original performance of the sprayer but also its use, care and maintenance. This is a logical link to ensure the continued benefit arising from the supply of new sprayers of good quality.

The inspection of sprayers in use can be a mandatory requirement or adopted on a voluntary basis. In both cases further requirements, outside the scope of this document, are necessary for the management of inspections. These include, for example, requirements for the competence of persons carrying out inspections and the frequency of inspections.

The terms and definitions for specific sprayers are given in the relevant specific parts.

NOTE National or local regulations concerning the qualifications and competence of inspectors can apply.

Agricultural and forestry machinery — Inspection of sprayers in use —

Part 4:
Fixed and semi-mobile sprayers

1 Scope

This document, when used together with ISO 16122-1:2024, specifies the requirements and test methods for the inspection of fixed and semi-mobile sprayers, when in use.

The requirements relate mainly to the condition of the sprayer with respect to its potential risk for the environment and its performance to achieve good application.

NOTE Requirements for the protection of inspectors during an inspection are given in ISO 16122-1:2024.

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 5681:2020, *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 12809:2020, *Crop protection equipment — Reciprocating positive displacement pumps and centrifugal pumps — Test method*

ISO 16122-1:2024, *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 5681:2020 apply.

ISO and IEC maintain terminological 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/

4 Requirements and method of verification

4.1 General

Before starting the inspection, the pre-inspection requirements of ISO 16122-1:2024, Clause 5, shall be met.

4.2 Leaks and dripping

4.2.1 Static leaks

The sprayer shall be filled with water to its nominal tank volume.

With the pump not running and the sprayer parked on a level horizontal surface (in case of semi-mobile sprayer), a visual inspection for any leakage from the tank, pump and associated pipes shall be carried out: and there shall be no visible leakage from any part of the sprayer.

For tanks with a volume > 2 000 l, water filling may be reduced to half the nominal volume or to 2 000 l, whichever is the greater. For these cases, an additional visual inspection of the tank shall be carried out in order to identify any cracks, holes or other damage that can cause leakage.

Compliance shall be checked by inspection.

4.2.2 Dynamic leaks

4.2.2.1 Leak test when not spraying

With the sprayer running at a pressure which is equal to the maximum working pressure as specified in the sprayer instruction manuel, or if this is not known, max. 20 bar (10 bar for sprayers with the pneumatic nozzles), with the section valves closed, there shall be no visible leakage from any part of the sprayer.

Compliance shall be checked by inspection.

4.2.2.2 Leak test while spraying

While spraying at a pressure that is equal to the maximum working pressure as specified in the sprayer or the nozzle recommendations for the nozzles mounted on the sprayer if lower, there shall be no leakage from any part of the sprayer or spray boom.

Compliance shall be checked by inspection.

4.2.3 Spraying and dripping on parts

Regardless of the distance between the spray boom to the target to be sprayed, in the range between the nozzles and the target surface, no liquid shall be sprayed directly on to the sprayer itself (for example parts of the sprayer, hoses). This does not apply if needed by function (for example sensors) and if dripping is minimised.

Compliance shall be checked by inspection and function test.

4.3 Pump(s)

4.3.1 Capacity

4.3.1.1 General

The pump capacity shall be suited to the needs of the sprayer.

4.3.1.2 Sprayers built according to ISO 16119-4:2014

The agitation capacity (liquid backflow in the tank) of the pump shall be at least equal to the value given in the instruction handbook.

Compliance shall be checked by measurement according to 5.2.1.2.

4.3.1.3 Other sprayers

a) The pump capacity shall be at least 90 % of its original nominal flow as specified in the sprayer instruction manual or another minimum pump capacity as specified in the sprayer instruction manual.

Compliance shall be checked by measurement according to 5.2.1.2.3.

Or for sprayers not fitted with a test adapter:

b) The pump(s) shall have sufficient flow rate capacity in order to be able to spray while maintaining a visible agitation as specified in 4.4.1 or 4.4.2.

Compliance shall be checked following 5.2.1.2.2.

4.3.2 Pulsations

The pulsations shall not exceed 10 % of the working pressure.

Compliance shall be checked by measurement and function test according to 5.2.2.

4.3.3 Air chamber

If an air chamber is present the membrane shall not be damaged, there shall be no appearance of liquid when operated at the maximum pressure as specified in the sprayer instruction manual. The air pressure shall be the pressure as specified in the sprayer instruction manual, or between 30 % and 70 % of the working pressure for the nozzles in use.

Compliance shall be checked by function test and measurement.

4.4 Spray mix agitation

4.4.1 Hydraulic

A clearly visible agitation shall be maintained:

— when spraying with a working pressure within the pressure range as recommended in the sprayer instruction manual or the nozzle recommendations;

— when spraying at the maximum working pressure as recommended in the sprayer instruction manual or the nozzle recommendations (whichever is lower);

— with the nozzles with the highest flow rate mounted on the application unit;

— with pump rotation speed as indicated in the sprayer instruction manual;

— with the tank filled to half its nominal tank volume.

Compliance shall be checked by inspection.

4.4.2 Mechanical

A clearly visible agitation shall be maintained when the agitation system is working as specified in the sprayer instruction manual, with the tank filled to half its nominal tank volume.

Compliance shall be checked by inspection.

4.5 Spray tank(s)

4.5.1 Lid

The tank shall be provided with a lid that shall be suited to the tank and without visible damage or permanent deformation.

It shall be possible to seal the lid tightly to prevent leakage and unintended opening. This requirement does not apply to fixed installations.

If a vent is fitted in the lid (according to 4.5.3), it shall prevent spillage.

Compliance shall be checked by inspection.

4.5.2 Tank filling strainer(s)

Strainers shall be installed in filling openings. The strainer(s) shall be without visible damage or permanent deformation and shall have a mesh width less than 2 mm. Any gaps between the tank filling hole and the strainer shall not exceed 2 mm.

Compliance shall be checked by inspection.

4.5.3 Pressure compensation

There shall be a pressure compensation device present, such as a tank vent, to avoid over-pressure and under-pressure in the tank.

Compliance shall be checked by inspection.

4.5.4 Tank content indicator(s)

The volume of liquid in the tank shall be clearly readable from where the tank is filled.

Compliance shall be checked by inspection.

4.5.5 Tank emptying

It shall be possible to

— empty the tank using, for example, a tap, and;

— collect the liquid without contamination of the environment and without potential risk of exposure of the operator.

Compliance shall be checked by inspection.

4.5.6 Tank filling

If there is a water filling device on the sprayer or a connection on the sprayer to fill the sprayer from an external source, there shall be a provision that prevent the liquid in the sprayer from returning to the water source, for example by means of a non-return valve.

Compliance shall be checked by inspection and function test.

4.5.7 Induction hopper

If there is an induction hopper, it shall:

— function and not leak;

— prevent any object greater than a ball of 20 mm diameter from entering the sprayer tank.

Compliance shall be checked by measurement:

— function and not leak.

Compliance shall be checked by function test.

4.5.8 Cleaning device for plant protection product containers

If provided, the cleaning device for plant protection product containers shall function.

Compliance shall be checked by inspection and function test.

4.5.9 Cleaning equipment

If provided, tank cleaning devices, devices for external cleaning, devices for cleaning of induction hoppers, and devices for the internal cleaning of the complete sprayer, shall function.

Compliance shall be checked by inspection and function test.

4.6 Measuring systems, controls and regulation systems

4.6.1 General

All devices for measuring, indicating and/or adjusting the pressure and/or flow rate shall function.

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

Switching on and off of all nozzles shall be possible simultaneously.

The controls to be operated during spraying shall be operable from the operator's position and the instrument displays shall be readable from this position.

If using a spray boom, switching on and off individual boom sections shall be possible.

Compliance shall be checked by inspection and function test.

4.6.2 Pressure indicator for spray liquid

4.6.2.1 Quantity, position and range of pressure indicator(s)

A pressure indicator shall be present on the tank/pump unit.

An additional pressure indicator shall be present on the application unit, except for spray guns and lances.

The pressure indicators shall be fitted at a position where they are clearly readable. Pressure indicators shall be suitable for the working pressure range used.

Compliance shall be checked by inspection.

4.6.2.2 Diameter of analogue pressure indicator

For analogue pressure indicators the minimum diameter shall be 63 mm.

Compliance shall be checked by measurement.

4.6.2.3 Scale of analogue pressure indicator

The scale of analogue pressure indicators shall provide graduations:

— at least every 0,2 bar for working pressures < 5 bar;

— at least every 1,0 bar for working pressures ≥5 bar and < 20 bar;

— at least every 2,0 bar for working pressures ≥ 20 bar and < 40 bar;

— every 5 bar for working pressures ≥ 40 bar.

NOTE 1 bar = 0,1 MPa = 0,1 N/mm_2 = 105 N/m^2.

Compliance shall be checked by inspection.

4.6.2.4 Accuracy of pressure indicator

The accuracy of the pressure indicator shall be:

— ±0,2 bar for working pressures at ≤ 2 bar,

— ±10 % of the real value for working pressures ≥ 2 bar.

This requirement shall be achieved within the normal working pressure range of the pump and the nozzles mounted on the application unit under test.

Compliance shall be checked by measurement according to 5.3.

4.6.3 Other measuring devices

If flow meters and speed sensors are present for controlling the volume/area rate, flow meters shall measure within a maximum error of ±10 % of the value read on the reference instrument within the range of the measuring device. Speed sensors shall measure within a maximum error of ±5 % of the value read on the reference instrument within the range of the measuring device.

If other measuring devices other than pressure indicators are present, they shall measure within a maximum error of ±5 % of the value read on the reference instrument within the range of the measuring device.

Compliance shall be checked by measurement according to 5.4 for flow meters and 5.5. for speed sensors.

4.6.4 Pressure adjusting devices

All devices for adjusting pressure shall function properly so the spray pressure can be adjusted smoothly and maintain a constant pressure with a tolerance of ±10 % at constant setting and shall return within 10 s to the original working pressure ±10 % after the sprayer has been switched off and on again.

Compliance shall be checked by function test and measurement according to 5.10.

4.6.5 Direct injection systems

Direct injection systems shall:

— not leak;

— have no backflow leakage though the chemical pathway or water inlet of the dosing unit;

— have a mixing chamber on the outlet side.

The injection rate of the chemical shall not deviate from what is set on the dosing device by more than ±10 %.

Compliance shall be checked by inspection, function test and measurement according to 5.11.

4.7 Lines (pipes and hoses)

4.7.1 Lines

Lines shall not show wear and tear that goes beyond normal or expected levels of bending, corrosion and abrasion through contact with surrounding surfaces. Likewise, lines shall be free from defects such as surface wear, and/or cuts or cracks that goes beyond normal or expected levels of wear and tear.

Compliance shall be checked by inspection.

4.8 Filters

4.8.1 Filter presence

There shall be at least one filter to be placed either:

— on the pressure side of the pump, on the application unit;

or

— on the tank unit, when the application unit is a spray gun or lance.

In the case of sprayers with positive displacement pumps and fixed sprayers, there shall also be a filter on the suction side.

NOTE Nozzle filters are not considered as pressure side filters.

The filter(s) shall be without visible damage or permanent deformation, and the mesh size shall correspond to the nozzles fitted in accordance with the nozzle recommendations.

Compliance shall be checked by examination of specification and inspection.

4.8.2 Isolating device

It shall be possible, with the tank filled to its nominal volume, to clean filters without any leakage with the exception of any spray liquid that can be present in the filter casing and the suction lines.

Compliance shall be checked by function test.

4.8.3 Filter insert changeability

Filter inserts shall be changeable in accordance with the sprayer instruction manual.

Compliance shall be checked by inspection and function test.

4.9 Application unit

4.9.1 Dripping

8 s after the spray section has been switched off, there shall be no continuous dripping.

Compliance shall be checked by inspection.

4.9.2 Horizontal spray booms

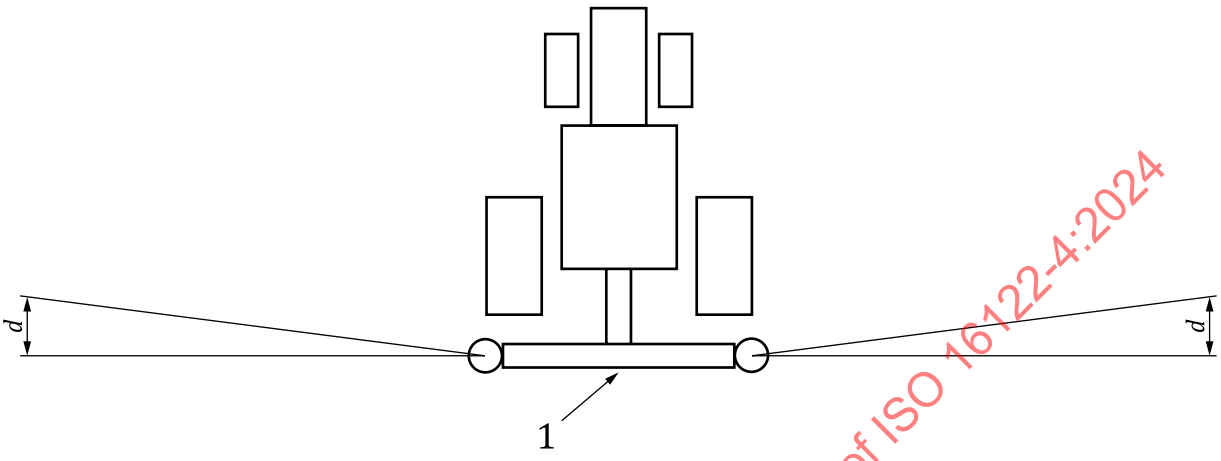
4.9.2.1 Stability / Alignment (not for hand-held or carried booms)

The boom shall be stable in all directions, i.e., no movement caused by wear and tear that goes beyond the normal expected levels, and/or permanent deformation.

When measured with the horizontal spray boom stationary, the vertical distance between the lower edges of each nozzle and a horizontal reference line (for example on level horizontal surface) shall not vary more than ±10 cm or ±0,5 % of the working width, whichever is the highest.

The boom shall not be bent in the horizontal plane: the maximum deformation d from the rotating point to the boom end nozzle shall not exceed ±2,5 % of the boom width, for both spray booms. See Figure 1.

Compliance shall be checked by inspection and measurement.



Key

1 boom centre

d maximum deformation from centre-frame ≤ 2,5 % of boom width

Figure 1 — Horizontal deviation of boom

4.9.2.2 Nozzles

4.9.2.2.1 Similarity

Nozzles fitted to the booms shall be of the same type, size, and material. Nozzles intended for a special function, such as the end nozzles for border spraying, bed spraying or band spraying, may be of different type, sizes, and material.

Compliance shall be checked by inspection.

4.9.2.2.2 Spacing/orientation

The nozzle spacing and their orientation shall be uniform along the boom.

The nozzle spacing (adjacent nozzle centre to centre distance) shall be within ±5 % of their nominal distance.

The verticality of the nozzle body shall be achieved with a maximum deviation of 10°.

In case of special design or applications (for example border spraying), nozzle body spacing, orientation and configuration shall correspond to the design specification.

It shall not be possible to unintentionally modify the position of the nozzles in working conditions, for example by folding/unfolding the boom.

Compliance shall be checked by inspection and measurement.

4.9.2.3 Height adjustment

If provided, height adjustment devices shall function.

Compliance shall be checked by inspection and function test.

4.9.2.4 Damping

When provided, devices for damping unintended boom movements shall function (for example well-functioning and not damaged springs, gas dampers or rubber buffers).

Compliance shall be checked by inspection and function test.

4.9.2.5 Spray boom section pressure equalizer

When measured at the inlet of each boom section or read on the sprayer pressure indicator, 10 s after a section has been closed, the pressure shall not vary more than 10 %, when the sections are closed one by one.

This requirement is only applicable for sprayers equipped with boom valves which can be set to return the same liquid volume to the tank when closed that would otherwise go through the nozzles on that boom section when the valve is open.

Compliance shall be checked by measurement according to 5.9.

4.9.2.6 Pressure drop

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

In case of using measurement on a patternator (see 4.11.3), only one measuring point at one outer end of the boom is required.

Compliance shall be checked by measurement according to 5.8.

4.9.3 Vertical spray boom

4.9.3.1 Symmetry

The nozzle arrangement, nozzle types, sizes, and material, shall be symmetrical on the left and right hand sides. If the nozzles are intended for a special function, such as spraying on one side or fitting of nozzles to compensate the air distribution asymmetry, etc., they may deviate from the symmetry requirement.

Compliance shall be checked by inspection.

4.9.3.2 Switching off

If provided, the system to switch off each nozzle separately shall function.

In the case of multi-head nozzles, this requirement applies to each multi-head nozzle.

Compliance shall be checked by inspection and function test.

4.9.3.3 Adjustment

It shall be possible to adjust the position of the nozzles in a symmetric and reproducible manner.

Compliance shall be checked by inspection.

4.9.3.4 Pressure drop

The pressure drop between the measuring point for pressure on the application unit and pressure measured at the nozzle which is the furthest from the feeding point of the spray line, shall not exceed 15 % of the pressure shown on the pressure indicator.

Compliance shall be checked by measurement according to 5.8.

4.9.3.5 Spray boom section pressure equalizer

When measured at the inlet of each boom sections or read on the spray pressure indicator, 10 s after a section has been closed, the pressure shall not vary more than 10 %, when the sections are closed one by one.

This requirement is only applicable for sprayer equipped with boom valves which can be set to return the same liquid volume to the tank when closed that would otherwise go through the nozzles on that boom section when the valve is open.

Compliance shall be checked by measurement according to 5.9.

4.9.4 Spray guns and lances

4.9.4.1 Trigger

The trigger shall function. It shall be lockable in the closed position.

The opening and closing system installed on the gun shall have a quick stop and opening. There shall be no continuous dripping when the trigger is in closed position.

Compliance shall be checked by inspection and function test.

4.9.4.2 Adjustment of flow rate and angle

If the flow rate and/or spray angle of the spray gun is adjustable, the adjustment device shall function.

Compliance shall be checked by inspection and function test.

4.10 Blower

4.10.1 Condition

The blower system present (e.g. fan, air guide, screen/cloth) shall be complete, functioning and be without visible wear, damage or deformation.

Compliance shall be checked by inspection and function test.

4.10.2 Adjustability

Adjustable air guide plates on the blower and on an additional blower casing shall function.

Compliance shall be checked by inspection and function test.

4.11 Distribution

4.11.1 Uniformity of spray jet

With the blower switched off in the case of hydraulic nozzles and switched on in the case of other nozzles (for example pneumatic nozzles), each nozzle shall form a uniform spray jet (for example uniform shape, homogeneous spray).

Compliance shall be checked by inspection and function test.

4.11.2 Nozzle output

4.11.2.1 Nominal nozzle flow rate known

The deviation of the flow rate of each nozzle of the same type and size shall not exceed ±15 % of the nominal flow rate for the maximum working pressure as specified in the in the nozzle recommendations.

When the nominal nozzle flow rate is unknown:

The flow rate of a single nozzle shall not exceed ±5 % of the average flow rate of the nozzles of the same type and size mounted on the sprayer.

In case of only two nozzles of a same type and size, the average value is not considered but the deviation between the two nozzles.

For sprayers with only one spray liquid output, or with adjustable flow rate nozzles, the flow rate has to be measured but no indication of wear can be provided.

Compliance shall be checked by measurement according to 5.7.

4.11.3 Spray distribution measurement on a patternator (optional)

4.11.3.1 General

a) The transverse distribution, within the total overlapped range, shall be uniform. The transverse distribution is evaluated on the basis of the coefficient of variation which shall not exceed 10 %

and

b) the amount of liquid collected by each patternator groove within the overlapped range shall not deviate more than ±20 % of the total average value.

Compliance shall be checked by measurement according to 5.6.

4.11.3.2 Pressure distribution

When the nozzle flow rate is measured according to 5.7.2 or 5.7.3:

— the pressure at each boom section inlet shall not exceed ±10 % of the average pressure measured on all boom section inlets

— the pressure at the inlet and outer end of each boom section shall not drop more than 10 %, when spraying with the largest nozzle set mounted on the sprayer.

Compliance shall be checked by measurement according to 5.12.

4.11.4 Optional vertical distribution information

In case of vertical boom sprayers and similar, in order to provide the owner/operator with further information, the vertical spray distribution information may be provided for example by measurement, using a vertical patternator; or by other visualization means.

NOTE Test method and vertical patternator specifications are still under development

4.12 Autonomous application units

4.12.1 Drive system

The drive system (drive wheels/rolls, motor, battery, etc.) shall be functioning and without visible damage or permanent deformation.

Compliance shall be checked by inspection and function test.

4.12.2 Travel speed spray robots

Travel speed shall not deviate more than ±10 % from those specified in the instruction manual.

Compliance shall be checked by measurement according to 5.5.

4.13 Cleaning equipment

If provided cleaning devices shall function.

Compliance shall be checked by inspection and function test.

5 Test methods

5.1 Test facilities and equipment

5.1.1 General

In addition to the test methods and requirements for testing equipment described in ISO 16122-1:2024, Clause 5, 5.1 and 5.2 shall also apply.

5.1.2 Test facilities

In complement to the test equipment in Clause 5, the following test apparatus are needed for the inspection:

— tachometer (PTO) (with max error of ±10 rpm/min);

— measuring tape (nozzle spacing and height);

— stopwatch (flow rate; distribution);

— measuring cylinder (with measuring range 2 l, maximum error ±20 ml; scale graduation 20 ml);

— air pressure indicator (pressure pulsation damper).

Different test equipment and methods may be used, if at least the same measuring results and accuracy are achieved.

5.2 Spray agitation pumps

5.2.1 Pump capacity test

5.2.1.1 Test method

5.2.1.1.1 General

The pump capacity shall be measured using one of the following procedures.

5.2.1.1.2 Sprayers not fitted with a test adapter

A calibrated pressure indicator shall be established and used. It shall be placed at an end nozzle and with the maximum working pressure as recommended in the sprayer instruction manual or the nozzle recommendations.

5.2.1.1.3 Other sprayers

The method as described in ISO 12809: 2020, Clauses 4, 5, 6, 7.3, 7.3.1 and 7.3.2, shall be used.

5.2.1.2 Backflow for agitation

5.2.1.2.1 General

The spray tank shall be filled with clean water to half its nominal volume. A correct and clean filter shall be placed on suction side of the pump in accordance with the sprayer instructions.

The measurement shall be carried out:

— when spraying at maximum working pressure as specified in the sprayer instruction manual or the nozzle recommendations (whichever is the highest);

— with the largest nozzles recommended;

— with the nominal pump rotation speed as recommended in the sprayer instruction manual;

— with the maximum number of application units connected;

— following one of the methods given in 5.2.1.2.2 or 5.2.1.2.3.

There shall be neither leakage nor air inlet from any connection.

5.2.1.2.2 Measuring the backflow for agitation

The measuring device shall be connected on all return/agitation line(s) separately or together in order to determine the total backflow.

The measured value(s) shall be recorded.

Water discharged from the measuring device should be fed back into the spray tank.

The recorded values shall be added to determine the total backflow.

5.2.1.2.3 Calculating the backflow for agitation

Connect the measuring device close to the pump outlet, or at a position as provided in the sprayer instruction manual.

In case of multiple pump outlets, the measuring device shall be connected, either on each outlet separately or all outlets connected together.

Calculate the total capacity of the pump(s).

Water discharged from the measuring device should be fed back into the spray tank.

Measure or calculate the total discharge from the application unit(s) (TD).

Calculate the back flow (i.e. agitation capacity) in the tank using Formula (1):

$$F_B = C_P - D_T \quad (1)$$

where

F_B is the back flow (l/min);

C_P is the measured pump capacity (l/min);

D_T is the total discharge from application units(s) (l/min).

5.2.2 Pump pulsations

Pulsations shall be checked:

— with the nominal rotation speed of the pump;

— at the location of the sprayer's pressure indicator (with the calibrated test pressure indicator or the pressure indicator of the sprayer if the requirement of 4.6.2 is met);

— with the intended working pressure.

5.3 Sprayer´s pressure indicators

5.3.1 Specification of pressure indicators used for verification

Analogue 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[a]

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

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

[a] Values in accordance with EN 837-1.

5.3.2 Verification method of the sprayer pressure indicator

The pressure indicator(s) of the sprayer shall be tested mounted on the sprayer 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, for example no influence from pump rotation or pulsations.