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Agricultural and forestry machinery — Inspection of sprayers in use —

Part 2: Horizontal boom sprayers

Matériel agricole et forestier — Contrôle des pulvérisateurs en service —

Partie 2: Pulvérisateurs à rampe horizontale

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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 16122-2:2015), which has been technically revised.

The main changes are as follows:

— removed errors and resolved 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 the testing capacity of the spraying pump;

— modified the tank filling strainer/filling hole (see 4.5.2);

— modified the tank emptying;

— modified controls;

— modified diameter analogue pressure indicators;

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

— modified Figure 1;

— modified similarity nozzles;

— modified dripping;

— modified blower;

— modified spray guns and lances;

— modified 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.

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

Agricultural and forestry machinery — Inspection of sprayers in use —

Part 2: Horizontal boom sprayers

1 Scope

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

The requirements relate 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, a visual inspection for any leakage from the tank, pump and associated pipes shall be carried out and there shall be no 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 specified in the sprayer instruction manual, or if this is not known, max 10 bar, 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 recommended in the sprayer instruction manual, or in the nozzle recommendation for the nozzles mounted on the sprayer if lower, there shall be no visible 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 height of the boom above the ground, in the height 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

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

a) The pump capacity shall be at least 90 % of its original nominal flow as given in the sprayer instruction manual, or another minimum pump capacity given in the sprayer instruction manual. It shall be measured at the free outlet of the pump (with the lowest possible pressure), and with a pressure of 8 bar to 10 bar, or the maximum pressure specified in the sprayer instruction manual, whichever is lower.

   Compliance of all spray pumps present on the machine shall be checked according to 5.2.1.1.3.

b) Or, alternatively, in case method a) it is not possible on sprayers not fitted with a test adapter, when the pump capacity is not given in the sprayer instruction manual for the pump mounted on the sprayer or for pumps for which the maximum working pressure is not known, for example for sprayers built before

ISO 16119-1, published in 2013. 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 5.2.1.1.2.

4.3.2 Pulsations

The pulsations shall not exceed ±10 % of the working pressure (excluding peristaltic metering pumps).

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 recommended in the sprayer instruction manual. The air pressure shall be the pressure recommended 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 and/or in the nozzle recommendation;

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

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

— with pump rotation speed as recommended 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 recommended 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 well adapted 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

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 the driver's position and 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 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 prevents the liquid in the sprayer tank from returning to the filling supply 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 into 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.

Switching on and off individual boom sections shall be possible.

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. This includes at minimum: Main valve, section valves, pressure adjusting devices and pressure indicator.

NOTE Turning of the head and the upper body is acceptable to achieve these requirements.

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)

At least one digital or analogue pressure indicator shall be fitted at a position where it is clearly readable from the operator's position. Pressure indicators shall be suitable for the working pressure range used.

Compliance shall be checked by inspection.

4.6.2.2 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.

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

Compliance shall be checked by inspection.

4.6.2.3 Accuracy of pressure indicator

The maximum error 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 working pressure range suitable for the nozzles mounted on the sprayer under test.

Compliance shall be checked by measurement according to 5.3.

4.6.2.4 Diameter of analogue pressure indicator

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

Compliance shall be checked by measurement.

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 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 4.10.3.2), only one measuring point at one outer end of the boom is required.

Compliance shall be checked by measurement according to 5.7.

4.6.6 Spray boom section pressure equalizer

For sprayers equipped with section 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, 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.

Compliance shall be checked by measurement according to 5.9.

4.7 Lines (pipes and hoses)

4.7.1 Lines

Lines shall not show wear and tear that goes beyond normal or expected levels such as bending, corrosion and abrasion through contact with surrounding surfaces. Likewise, lines shall be free from defects such as surface wear, 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 on the pressure side of the pump and in the case of positive displacement pumps, one 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 sprayer instruction manual or the nozzle recommendations, whichever is smaller.

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 Spray boom

4.9.1 Stability/Alignment

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

The right and the left parts of the boom shall be of the same length except when the boom is intended for a special function, for example over beds in nurseries.

Compliance shall be checked by inspection and measurement.

4.9.2 Damping, slope compensation and stabilization

When provided, devices for damping unintended boom movements, slope compensation and stabilization systems shall function.

Compliance shall be checked by inspection and function test.

4.9.3 Automatic resetting

When provided, the automatic resetting of booms shall operate to move backwards and/or forwards, in case of contact with obstacles.

Compliance shall be checked by inspection and function test.

4.9.4 Nozzle 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 when folding/unfolding the boom.

Compliance shall be checked by inspection and measurement.

4.9.5 Boom deformation

4.9.5.1 Vertical position

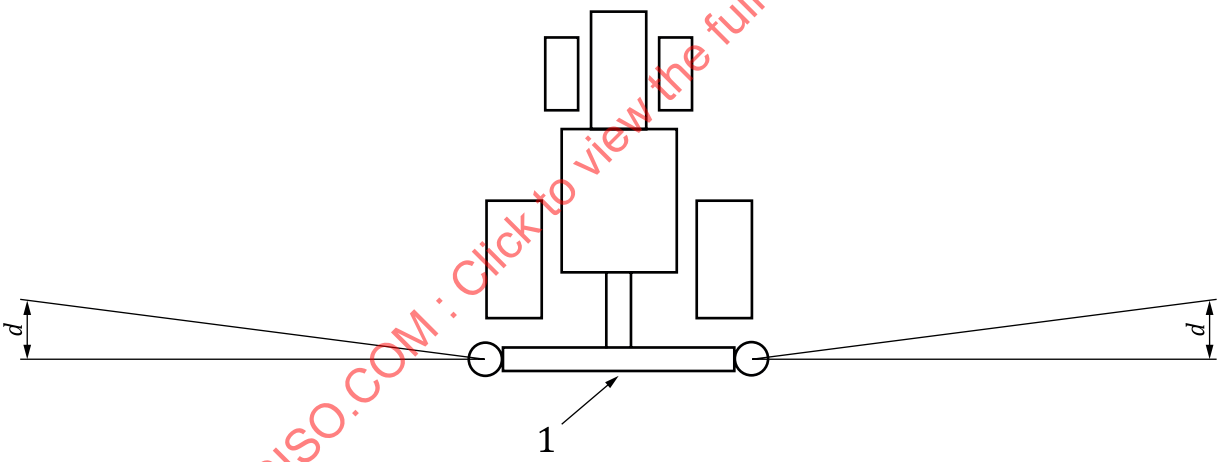
When measured with the sprayer stationary, the vertical distance between the lower edges of each nozzle and a horizontal reference line shall not vary more than ±10 cm or ±0,5 % of the working width, whichever is the highest.

Compliance shall be checked by inspection and measurement.

4.9.5.2 Horizontal position

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

4.9.6 Prevention of nozzle damage

Booms ≥ 10 m in working width shall have a device to prevent damage of the nozzles if the boom hits the ground.

Compliance shall be checked by inspection.

4.9.7 Height adjustment

If provided, height adjustment devices shall function.

Compliance shall be checked by inspection and function test.

4.10 Nozzles

4.10.1 Similarity

All nozzles fitted to the booms shall be of the same type, size, material and produced by the same manufacturer, except where they are intended for a special function, such as the end nozzles for border spraying, bed spraying or band spraying or to avoid contamination of the sprayer.

Compliance shall be checked by inspection.

4.10.2 Dripping

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

Compliance shall be checked by inspection.

4.10.3 Transverse distribution

4.10.3.1 General

If hydraulic pressure nozzles are used on a boom to form a uniform spray, 4.10.3.2 or 4.10.3.3 applies; in other cases, 4.10.3.3 applies.

4.10.3.2 Measurement on a horizontal patternator

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

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.

4.10.3.3 Flow rate measurements

4.10.3.3.1 General

For sprayers with only one spray liquid output, with adjustable flow rate nozzle, the flow rate shall be measured but no indication of wear can be provided.

Compliance shall be checked by measurement according to 5.7.

4.10.3.3.2 Nominal nozzle flow rate

The deviation of the flow rate of each nozzle of the same type and size shall not exceed:

— ±10 % of the nominal flow rate indicated in the nozzle recommendations, and a flow rate more than or equal to 1 l/min for the maximum working pressure given in the nozzle recommendations, or

— ±15 % of the nominal flow rate indicated in the nozzle recommendations and with a flow rate less than 1 l/min for the maximum working pressure given 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.

Compliance shall be checked by measurement according to 5.7.

4.10.3.3.3 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 5.11.

4.11 Blower (if present)

4.11.1 Condition

The blower system present (e.g. fan, air guide, screen/cloth) shall be complete, functioning and be without visible damage, wear or tear, that goes beyond the normal or expected level, or permanent deformation.

Compliance shall be checked by inspection and function test.

4.11.2 Adjustability

Any adjustment options available for example adjustable air guide plates, blower casing) on the system shall function properly.

Compliance shall be checked by inspection and function test.

4.12 Spray guns and lances (if present)

4.12.1 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.

4.12.2 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.

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 be applied.

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 r/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 Pumps

5.2.1 Pump capacity test

5.2.1.1 Test method

5.2.1.1.1 General

The pump capacity nom 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. The pressure indication shall be placed at an end nozzle at the maximum working pressure as recommended in the sprayer instruction manual, or in 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.

5.2.2 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.

5.4 Flow meters for controlling the volume/area rate

5.4.1 General

The error of the measuring instruments in the test equipment shall not exceed ±2 % of the measured value with a minimum of 2 l/min

During the test, the flow rate shall be steady, as indicated by the output of the flow rate sensor or the pressure indicator.

5.4.2 Operating procedure No. 1: Verification by nozzle flow rate measurement

The inspection shall be conducted as follows.

— The spray control shall be set to the correct PTO speed and at a pressure within the working range of the sprayer.

— For each of the following three tests, the average flow rate of at least 5 nozzles shall be measured with a measuring cylinder, or the single flow rate values for each nozzle obtained from the test in 5.7 shall be used in order to calculate the average value of a single nozzle.

— One or more spraying section(s) shall be turned on to give a total flow rate representing 30 % to 50 % of the full flow. The pressure value and the value displayed on the flow meter and the number of nozzles in use shall be recorded.

— Additional spraying section(s) shall be turned on to give a total flow rate representing 50 % to 75 % of the full flow. The pressure value and the value displayed on the flow meter and the number of nozzles in use shall be recorded.

— Additional spraying section(s) shall be turned on in order to reach 100 % of the full flow. The pressure value and the value displayed on the flow meter and the number of nozzles in use shall be recorded.

The pressures shall be read at the level of the sections.

For each flow rate, the reference outflow, Q, corrected for the pressure applied during the test (P_1), shall be calculated as Formula (1):

$$Q = n \times \bar{Y} \quad (1)$$

where

n is the number of nozzles;

$\bar{Y}$ is the average of single nozzle flow rates.

Formula (2) is used to calculate the adjusted single nozzle flow rate, d_1, for the applied pressure P_1:

$$d_1 = d_2 \times \sqrt{\frac{P_1}{P_2}} \quad (2)$$

where

P_1 is the applied pressure;

d_2 is the single nozzle flow rate measured in 5.7 or with the measuring cylinder and stopwatch;

P_2 is the pressure during the measurement of the single nozzle flow rate d_2.

Each value of Q shall be compared with the corresponding value reading taken from the sprayer's flow meter. The deviation between the measured value of Q and the corresponding value reading taken from the sprayer's flow meter shall be expressed as a percentage of the reference value Q.

5.4.3 Operating Procedure No. 2: Verification by installing a calibrated flow meter in the circuit of the sprayer

On the pump outlet side of the sprayer, a calibrated flow meter shall be installed in series to the flow meter to be checked.

The inspection shall be conducted as follows:

— The spray control shall be set to the correct PTO speed and at a pressure within the working pressure range of the sprayer.

— One or more spraying section(s) shall be turned on to give a total flow rate representing 30 % to 50 % of the full flow. The values displayed on the sprayer's flow meter and the calibrated flow meter shall be recorded.

— Additional spraying section(s) shall be turned on to give a total flow rate representing 50 % to 75 % of the full flow. The values displayed on the sprayer's flow meter and the calibrated flow meter shall be recorded.

— Additional spraying section(s) shall be turned on in order to reach 100 % of the full flow. The values displayed on the sprayer's flow meter and the calibrated flow meter shall be recorded.

Corresponding recorded readings from the sprayer's flow meter and the calibrated flow meter shall be compared. The deviation between both values shall be expressed as a percentage of the reading from the calibrated flow meter.

5.5 System for controlling forward speed

The actual travel speed shall be measured with an error not exceeding ±2,5 %.

The measurement shall be carried out continuously over a distance of at least 50 m located on a flat area. The beginning and the end of the test distance shall be clearly marked. A reference point shall be marked on the sprayer to assist in the identification of the start and finish of the test.

— The tractor or self-propelled sprayer shall be pre-set to achieve a constant forward speed close to the operating speed. The hand accelerator can be used to set the speed of the engine.

— The set test speed shall be achieved before the 1st mark on the test track is reached.

— Timing shall start, by means of the stop watch, when the reference point on the sprayer aligns with the 1st mark on the test track.

— During travel, the speed indicated by the sensor shall be recorded.

— Timing shall stop when the reference point on the sprayer aligns with 2nd mark on the test track.

The measured forward speed shall be calculated using Formula (3):

$$v = 3{,}6 \times \frac{d}{t} \tag{3}$$

Where

v is the measured forward speed, expressed in kilometres per hour (km/h) and compared with the speed indicated by the sprayer' sensor;

d is the distance travelled, expressed in metres (m);

t is the duration, expressed in seconds (s).

5.6 Uniformity of the transverse volume distribution with a horizontal patternator

5.6.1 Specification of the horizontal patternators used for verification

A patternator with grooves 100 mm wide and at least 80 mm deep, measured as a distance between the top and the bottom of the groove, shall be used to measure the uniformity of the transverse volume distribution of the spray.

The groove patternator shall be at least 1,5 m long. The groove width shall be 100 mm ± 2,5 mm. The groove width of a patternator working in steps with electronic data sampling (for example scanners) shall be 100 mm ± 1 mm.

Prior to the start of the test, the grooves to be used shall be checked by suitable means such as a pattern to see whether the above tolerance limits are met. The graduated spray liquid measuring cylinders shall be of the same type and size and have a capacity of at least 500 ml. Scale graduation shall be a maximum of 10 ml.

The error of measurement shall not be more than 10 ml or ±2 % of the measured value whichever is greater.

When passing the measuring track, positioning in single steps shall be completed with an accuracy of ±20 mm. The measuring error of the volume of the single grooves at a flow volume of 300 ml/min shall be less than ±4 %. The adjustment and calibration of the patternator shall be in accordance with the patternator instruction manual.

The size of the patternator shall be suited to the size of the boom to be tested and to the type of sprayer.

The patternator shall also ensure that the overlapping range of the spray is measured completely.