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Third edition
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Equipment for crop protection — Spraying equipment —

Part 2: Test methods to assess the horizontal transverse distribution for hydraulic sprayers

Matériel de protection des cultures — Équipement de pulvérisation —

Partie 2: Méthodes d'essai pour évaluer la distribution transversale horizontale des pulvérisateurs à jet projeté

Reference number
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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 voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 6, *Equipment for crop protection.*

This third edition cancels and replaces the second edition (ISO 5682-2:1997), which has been technically revised as follows:

— addition of a spray flow transverse volume distribution test method;

— addition of a spray pressure transverse distribution test method;

— clarification for nozzle positioning;

— addition of an annex;

— agitation method removed;

— suppression of fill from the tank filling device;

— suppression of capacity of the tank;

— suppression of head losses in the delivery piping;

— suppression of discharge from the pump.

A list of all the parts in the ISO 5682 series can be found on the ISO website.

Equipment for crop protection — Spraying equipment —

Part 2: Test methods to assess the horizontal transverse distribution for hydraulic sprayers

1 Scope

This document is applicable for sprayers intended to apply liquid over a horizontal surface.

This document specifies test methods to assess sprayed liquid horizontal transverse distribution. Methods are based on sprayed liquid volume measurement, nozzle flow rate measurement or nozzle tip pressure measurement.

This document does not cover aerial sprayers.

Hydraulic sprayers use a range of design features to deliver and control spray. The test methods provided in this document are all useful but don't give the same information. They are complementary. Some test methods are not suitable for all sprayer types. Applicable test methods are described in an informative annex.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 5681, *Equipment for crop protection — Vocabulary*

ISO 5682-1:2017, *Equipment for crop protection — Spraying equipment — Part 1: Test methods for sprayer nozzles*

3 Terms and definitions

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

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

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

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

4 Measuring equipment

Measuring equipment shall conform to ISO 5682-1:2017, Clause 4.

The horizontal patternator shall be in accordance with ISO 5682-1:2017, 4.2.

In the case of a horizontal patternator comprised of grooves spaced at intervals of 50 mm or 25 mm, summing of two or four adjacent grooves, respectively, to derive an equivalence to 100 mm grooves is acceptable.

Low flow rate measurements may not be possible directly with available flow meters. In this case, a volume collected over measured time may be used.

5 Test conditions

5.1 General

The sprayer is to be operated per sprayer manufacturer's instructions. All operational conditions and test parameters shall be indicated in the test report. Clean water used for testing shall be free from solids in suspension.

If an adjuvant, plant protection product or other chemical is added, its identity, properties and concentration shall be documented in the test report.

5.2 Temperature and relative humidity

The temperature of the test liquid and the air temperature of the test premises shall be between 5 °C and 35 °C during the test.

The temperature and the relative humidity of the test premises shall be stated in the test report. Relative humidity is recorded for information only.

5.3 Choice of nozzles for the tests

The spray boom shall be equipped with nozzles, including nozzle filters and anti-drip devices, according to the relevant specifications provided by the sprayer manufacturer's instruction manual. The nozzle type that is used shall be documented by nozzle manufacturer, model and size.

Nozzle size may be chosen for very high flow if the purpose of the evaluation is to determine maximum variation of the sprayer transverse distribution.

Nozzle size may be chosen to provide lower flow, more representative of a common application practice.

5.4 Control pressure

The control pressure is to be chosen according to the operating characteristic of the nozzle. During the test period, the pressure shall not deviate by more than 5 % from the intended pressure.

The control pressure shall be stated in the test report.

6 Test methods

6.1 General

Sprayed liquid volume horizontal transverse distribution (6.3), nozzle volume transverse distribution (6.5), and nozzle tip pressure transverse distribution (6.6) are three methods that evaluate differently horizontal transverse liquid distribution.

When nozzle volume or nozzle tip pressure methods are used to evaluate horizontal transverse liquid distribution, nozzle tip position, nozzle orientation (verticality of the nozzle and twist of the nozzle from perpendicular) and nozzle tip spray pattern of all nozzles shall also be verified. It shall also be verified that no objects occur in the sprayed liquid stream.

For nozzle tip position requirements, see 6.4.

Annex B identifies tests or test methods typically applicable to different sprayer types.

6.2 Standard conditions

Test conditions shall conform to ISO 5682-1:2017, Clause 5.

Tests shall be carried out on a complete spray boom. Measurements may occur on only one section or with a few nozzles at a time; however, the whole boom shall be spraying during all of the measurements.

Tests shall be performed at pressure(s) chosen that are consistent with the ranges recommended by the nozzle tip manufacturer and the sprayer manufacturer.

6.3 Transverse distribution evaluation by means of sprayed liquid volume measurement – sprayed liquid volume measurement method

6.3.1 Setup

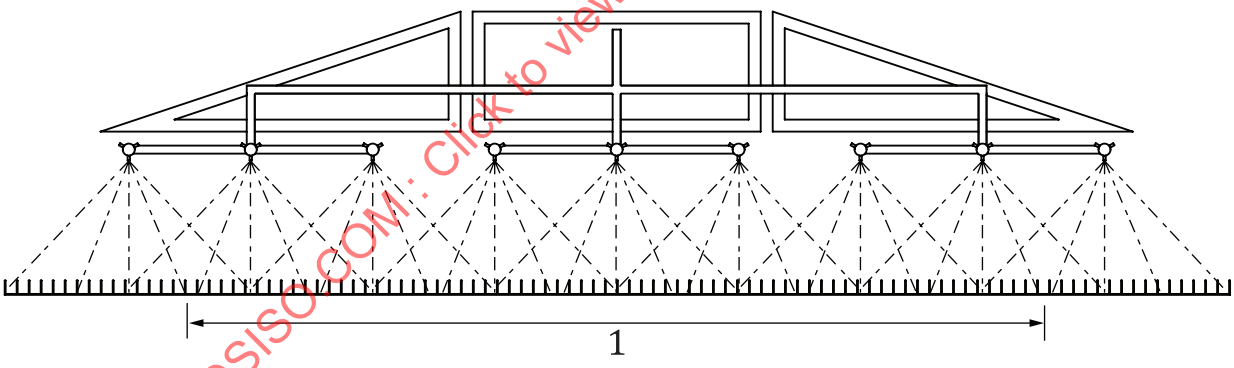
The method shall conform to ISO 5682-1:2017, 6.4.

The spray boom height shall be measured vertically between the top of the groove wall of the patternator and the orifice of the lowest nozzle.

Flat fan nozzle(s) shall be positioned for the test so that the widest dimension of the spray pattern is perpendicular to the grooves or in its normal working position as defined by the nozzle manufacturer.

A normal working position may for example have a spray angle offset of 5° to 15° from perpendicular to avoid spray pattern interference of adjacent nozzles.

Figure 1 shows a spray boom with a horizontal patternator collecting the spray. This method measures volume or mass distribution, in a horizontal plane, transverse to the intended direction of travel.



Key

1 verification area

Figure 1 — Horizontal patternator method

6.3.2 Measurement

The liquid shall be measured by graduated volume, by weight or by other equivalent method. If weight is chosen, the collection container shall be weighed prior to collecting the samples and the difference used in calculating the net weights.

The liquid shall be collected from each nozzle on the boom for a chosen collection period while spraying with the complete boom.

The collection period shall be chosen to ensure 1,0 % maximum measurement error of the liquid. Factors such as collection device volume, graduations and operator capability should be taken into consideration. The collection period should be chosen to ensure overall accuracy based on these factors.

6.3.3 Results

The grooves shall be identified from left to right as viewed from behind the sprayer. The results shall indicate the total sprayer flow rate in l/min as well as the number of nozzles spraying.

The results shall be indicated in the test report, for each boom height, in the form of a graph or table. See Annex A and Table A.1 for an example of a table showing the result. The coefficient of variation for each height shall also be indicated in the form of a graph or table.

The volume collected for each groove shall be indicated on the vertical axis as a percentage of the mean volume. Only the grooves located in the area of the patternator corresponding to fully developed spray pattern shall be used in calculating the coefficient of variation. For typical 100 % overlap pattern, the area to verify the coefficient of variation is from the midpoint between the centre of the outermost nozzle and the centre of the penultimate nozzle on one side of the boom to the midpoint between the centre of the outermost nozzle and the centre of the penultimate nozzle on the other side of the boom. Figure 1 shows the typical verification area for a complete boom.

6.4 Nozzle tip position

6.4.1 Spacing

Nozzle spacing shall be verified by measuring the distances between nozzle tips (adjacent nozzle centre to centre distance).

Nozzle spacing is a horizontal transverse measurement. In case all nozzles are not in line, accuracy of measurement may be improved by using a string, mounted between the first and last nozzle on the sprayer boom, as a measurement line.

6.4.2 Alignment

Verify nozzle alignment by measuring nozzle axes with the boom unfolded on a flat, level surface.

The axis of a nozzle may be identified, for example, by inserting a rod into the nozzle cap nut. Measurements may be relative to the ground or relative to the boom structure if the structure allows.

The lateral angular deviation in a transversal vertical plane (nozzle inclination angle to the right or to the left relative to vertical) and in a longitudinal vertical plane (nozzle inclination angle forward or rearward relative to vertical) shall be indicated in degrees within the test report. Spraying angles forward or to the right shall be noted positive. Spray angles rearward or to the left shall be noted negative.

For speciality situations, i.e. angled for drift reduction or directed band spraying, the operator may identify the intended direction or configuration of the nozzle for testing.

Flat fan nozzle(s) shall be positioned so that the widest dimension of the spray pattern is perpendicular to the intended direction of travel or in its normal working position as defined by the nozzle manufacturer.

A normal working position may for example have a spray angle offset of 5° to 15° from perpendicular to avoid spray pattern interference of adjacent nozzles.

6.5 Transverse distribution evaluation by means of nozzle flow rate measurement – nozzle flow rate measurement test method

6.5.1 Setup

Test equipment such as containers, graduated cylinders, flowmeter, weigh scale and nozzle testers, complying with ISO 5682-1:2017, 5.4, shall be used.

The collection device(s) shall be capable of capturing the liquid sprayed from each nozzle location with the nozzle tips mounted on the boom. The collection device shall prevent any loss due to splashes. If multiple nozzle tips spray simultaneously at one location, liquid from each nozzle tip at the location may be captured separately then summed to determine total liquid sprayed at that location.

If a flowmeter is used to measure flow rate directly, it is not necessary to collect the sprayed liquid.

Figure 2 shows a spray boom with containers collecting spray individually from each nozzle location. This method measures the volume or mass distributed through the nozzles.

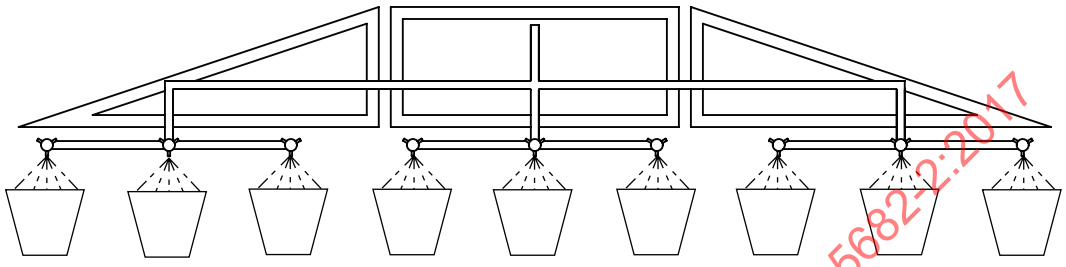


Figure 2 — Nozzle flow rate measurement test method

6.5.2 Measurements

The liquid shall be measured either by graduated volume, by flowmeter, by weight or by another equivalent method. If weight is chosen, the collection container shall be weighed prior to collecting the sample then after collecting the sample. The difference shall be calculated to obtain the liquid net weight.

Factors such as collection device volume, graduations and operator capability should be taken into consideration. The collection period should be determined to ensure accuracy based on these factors.

6.5.3 Results

The results shall be indicated in the test report in the form of a graph or table, with the nozzles numbered from left to right on the horizontal axis as viewed from behind the sprayer. The amount collected from each nozzle shall be indicated on the vertical axis as a percentage of the mean volume.

See Annex A and Table A.2 for an example of a table showing the results.

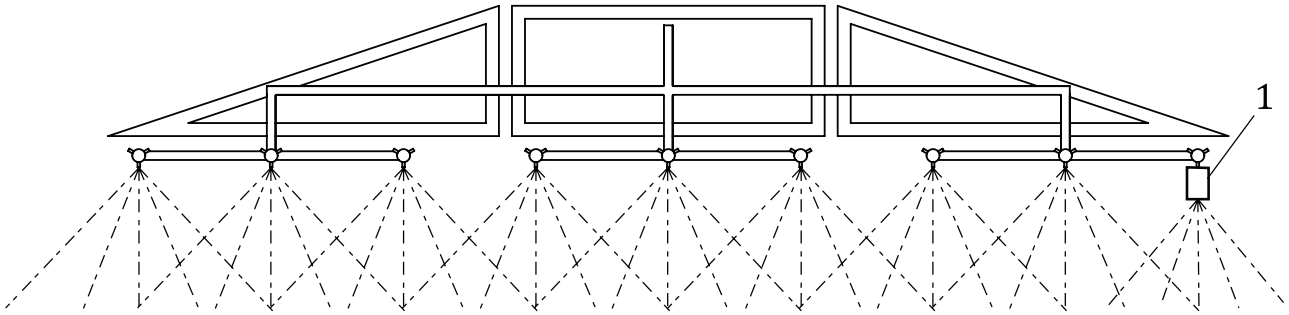
6.6 Transverse distribution evaluation by means of nozzle tip pressure measurement – nozzle tip pressure measurement test method

6.6.1 Setup

The nozzle tip pressure shall be measured between the nozzle holder and the nozzle tip, after any anti-drip device.

Figure 3 shows a spray boom with pressure gauges or transducers measuring nozzle tip pressure individually for each nozzle. Figure 4 shows a nozzle tip pressure measuring device.

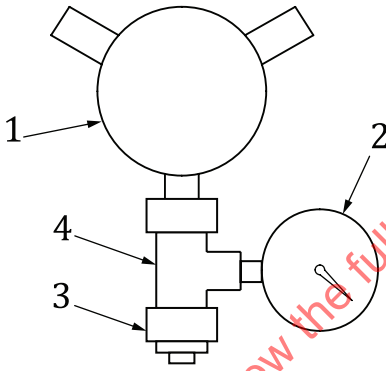
The variable encountered in this method only measures the pressure distribution of the nozzles throughout the spray boom delivery system.



Key

1 instrument arrangement for pressure measurement, for details see Figure 4

Figure 3 — Nozzle tip pressure measurement method



Key

1 nozzle holder
2 pressure indicator (test equipment)
3 nozzle tip
4 adapter tee (test equipment)

Figure 4 — Example of nozzle tip pressure measurement

6.6.2 Measurements

When moving the pressure indicator(s) to a new location during spraying, enough time shall be allowed for the reading to stabilize prior to recording the measurement. It is recommended that spraying continues during movement of the gauges from one location to another.

Moving the nozzle tip attached to the adaptor tee with the adaptor tee to each measurement location is acceptable. If the measurement is performed with several gauges, instrumented with several nozzle tips, variation of the nozzle tips should be taken into consideration.

6.6.3 Results

The results shall be indicated in the test report in the form of a graph or table, with the nozzles numbered from left to right on the horizontal axis as viewed from behind the sprayer. The pressure observed for each nozzle shall be indicated on the vertical axis as a percentage of the mean tip pressure.

See Annex A and Table A.3 for an example of a table showing the result.

Annex A
(informative)

Transverse distribution test report

Power take-off (PTO) RPM (if applicable):		
Nozzle type (include manufacturer, model, and size):		
Number of nozzles:		
Nozzle filters: (yes/no)	Type:	Mesh size:
Spray boom height (mm):		
System control pressure (bar):		
Total flow (l/min):		
Adjuvant or product added (if any):		
Temperature, test liquid (°C):		
Temperature, ambient (°C):		
Relative humidity (%):		

Table A.1 — Transverse distribution by means of sprayed liquid transverse volume measurement

	Groove location						Mean	Std dev	Coefficient of variation
	g_1	g_2	g_3	g_4	g_5	$g_{...}$			
Volume									
% of mean volume									

Table A.2 — Transverse distribution by means of nozzle flow rate measurement

	Nozzle location						Mean	Std dev	Max/min
	n_1	n_2	n_3	n_4	n_5	$n_{...}$			
Collection time									
Measured amount									
% of mean measured amount									
Spacing (mm)									
Longitudinal angle (°) (relative to travel direction)									
Transversal angle (°) (relative to travel direction)									

Table A.3 — Transverse distribution by means of nozzle tip pressure measurement

	Nozzle location						Mean	Std dev	Max/min
	n_1	n_2	n_3	n_4	n_5	$n_{...}$			
Pressure									
% of mean pressure									
Spacing									
Longitudinal angle (°) (relative to travel direction)									
Lateral angle (°) (relative to travel direction)									