INTERNATIONAL STANDARD

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Equipment for crop protection — Spraying equipment —

Part 2:
Test methods for hydraulic sprayers

Matériel de protection des cultures — Équipements de pulvérisation —
Partie 2: Méthodes d'essai des pulvérisateurs à jet projeté

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 5682-2 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 6, *Equipment for crop protection.*

This second edition cancels and replaces the first edition (ISO 5682-2:1986), of which it constitutes a technical revision.

Annexes A and B form an integral part of this part of ISO 5682.

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Equipment for crop protection — Spraying equipment —

Part 2:
Test methods for hydraulic sprayers

1 Scope

This part of ISO 5682 specifies the methods of testing and assessing the performance and accuracy of distribution of hydraulic sprayers for field crops.

It is applicable to agricultural hydraulic sprayers for field crops, except for manual sprayers and aircraft-mounted sprayers.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of the publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on the International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 5681:1992, *Equipment for crop protection — Vocabulary.*

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

3 Definitions

For the purposes of this part of ISO 5682, the definitions given in ISO 5681 and the following definition apply.

3.1 reference level
level of liquid when the tank is filled to its nominal capacity and the sprayer is in a horizontal position

4 Test liquids

4.1 Clean water, with no solids in suspension, except for the agitating test (see 8.9).

5 Apparatus

NOTE — Measuring equipment other than those described in sections 5.1 and 5.2 are allowed providing that the same accuracy and the same resolution are achieved.

5.1 Measuring equipment

For measurements relating to nozzles and for the test equipment, see ISO 5682-1:1996, subclause 5.1.

5.2 Distribution bench

The distribution bench shall be in accordance with ISO 5682-1:1996, figure 1.

5.2.1 Groove characteristics

The walls of the grooves shall be vertical.

The upper edges of the walls shall form a plane with, in the longitudinal direction (perpendicular to the grooves), a tolerance of ± 1 % on the horizontal and, in the lateral direction (parallel with the grooves), a tolerance of ± 2 % (see ISO 5682-1:1996, figure 2).

The maximum thickness of the groove walls shall be 4 mm.

The distance between two consecutive ridges shall be (100 ± 1) mm.

NOTE — In the case of a distribution bench composed of grooves spaced at intervals of 50 mm or 25 mm, the following conditions apply by comparing two or four adjacent grooves with one 100 mm groove.

The height of the vertical walls of the grooves shall be at least twice the width of the grooves.

The total width of the distribution bench shall not be affected by the sum of the tolerances permitted for the upper part of each ridge.

5.2.2 Upper part of the walls

The upper part of the walls is formed by a symmetrical chamfered edge which may be rounded off and which shall have the following characteristics:

a) the height of chamfered edge shall be at least three times the thickness of the wall;

b) the thickness of upper part of the chamfered edge shall be at most 1 mm;

c) the rounding-off radius shall be at most 0,5 mm;

d) no point of the ridges shall be more than 2 mm above or below the mean plane of the ridges.

6 Accuracy of the measurements

6.1 The time measured shall be not less than 60 s and the measurements shall be made to an accuracy of ± 1 s.

6.2 Volumes of liquid shall be measured to an accuracy of ± 0,5 %.

6.3 Pressures shall be measured to an accuracy of ± 2,5 % of the test pressure.

6.4 The accuracy of mass, length and volume measurements shall be specified in the test report.

6.5 Angles shall be measured to an accuracy of ± 1°.

6.6 Temperatures shall be measured to an accuracy of ± 0,5 °C.

7 General test conditions

All operational conditions and test parameters shall be indicated in the test report.

7.1 Power take-off rotational frequency

All the tests shall be made with a power take-off rotational frequency of 540 min^{-1}, or 1 000 min^{-1} or the rotational frequency recommended by the manufacturer.

7.2 Temperature and relative humidity

The temperature of the test liquid and the air temperature of the test premises shall be between 10 °C and 25 °C during the test. The relative humidity of the test premises shall be normally not less than 50 %. The temperature and the relative humidity shall be stated in the test report.

7.3 Pressures

During the test period, the pressure used shall not vary more than ± 2,5 % from the mean pressure. The test pressures shall be stated in the test report.

Before each test, the pressure shall be established using a standard pressure gauge mounted alongside the sprayer pressure gauge. The pressure checking assembly shall not be changed during the test.

A sufficient number of pressure gauges shall be inserted to indicate the pressure of the liquid at the inlet and at the end of each spray boom section. If necessary, there shall be also a pressure gauge at the inlet and outlet of each line filter.

Optionally, the pressure may be measured at intake and discharge from the pump and hydraulic injector, as close as possible to these devices.

7.4 Choice of nozzles for the tests

A sufficient number of complete nozzles shall be taken to equip the boom. The deviation in the discharge from each nozzle, expressed as a percentage of the mean discharge of the sample, shall not exceed ± 2,5 % in accordance with ISO 5682-1:1996, subclause 6.2.

8 Testing

8.1 Uniformity of output from the nozzles mounted on the boom

The test shall be made with each type of complete nozzle.

8.1.1 Test pressure

Use as the test pressure the maximum pressure indicated by the manufacturer to the operator for the type of nozzle mounted on the boom, if it is less than the maximum service pressure of the sprayer; otherwise, use the maximum service pressure.

8.1.2 Measurements

Collect the liquid discharged by each nozzle on the boom for a chosen period and measure the volumes obtained.

Any equivalent method may be used.

8.1.3 Results

The volume of liquid collected for each nozzle shall be indicated, in a table or graph, as a percentage of the mean volume for the nozzle type mounted.

8.2 Discharge from the spray boom

The test shall be made with each type of complete nozzle.

8.2.1 Test pressure

Use the pressures specified in of ISO 5682-1:1996, subclause 7.2.2.

8.2.2 Measurements

Measure the total discharge from the spray boom during a period of at least 60 s.

8.2.3 Results

Indicate the total discharge from the spray boom in the test report, in litres per minute, in the form of a graph or table.

The volume/hectare for various forward speeds may also be indicated in the form of a graph or table.

8.3 Spacing of nozzles and direction of their axes

8.3.1 Spacing

The spacing between nozzles along the spray boom shall be measured to an accuracy of ± 1 mm.

8.3.2 Direction of the axes of the nozzles

The direction of the axes of the nozzles shall be measured in relation to the vertical and in accordance with the recommendations of the manufacturer. It may, for example, be shown by inserting a rod in the nozzle nut.

8.3.3 Results

Indicate in the test report the position of the nozzles along the spray boom, in millimetres, and the angular deviation of their axes in relation to the vertical and to the travel direction, in degrees, with the nozzles numbered from left to right on the horizontal axis viewed by an observer located behind the sprayer.

8.4 Spray distribution

8.4.1 Pressure

Use the maximum and minimum pressures indicated by the manufacturer of the sprayer used and, if it is specified, the optimum pressure.

The test shall be carried out on a complete spray boom, or in the case of a symmetrical design, on at least one half of the spray boom.

In the case of a test carried out spray boom section by spray boom section, the following conditions shall be respected:

— the whole spray boom shall discharge during a test on one spray boom section;

— the time of the test shall be the same for each spray boom section.

8.4.2 Positioning of the spray boom

The spray boom shall be in its normal working position.

8.4.3 Height of the spray boom

If the manufacturer indicates an optimum working height, the test shall be made at this height as well as at 150 mm above and below this working height.

If the manufacturer does not indicate a working height, the tests shall be made at 400 mm, 500 mm, 600 mm and 700 mm, and optionally at 300 mm and 800 mm. These heights shall be measured from the ridges of the distribution bench to the nozzle orifices.

8.4.4 Measurements

Collect the liquid from each 100 mm groove during a period which is determined according to the discharge from the nozzle having the greatest discharge.

8.4.5 Results

Indicate the results in the test report, for each boom height, in the form of a graph or table, with the grooves numbered from left to right on the horizontal axis viewed by an observer located behind the sprayer. The volume collected for each groove shall be indicated on the vertical axis as a percentage of the mean volume. The coefficient of variation for each height shall also be indicated in the form of a graph or table. Only those grooves located in the area completely covered by the jets shall be taken into account in the calculations. The coefficient of variation shall be calculated for the 100 mm grooves and also for the 50 mm or 25 mm grooves if these are used.

8.5 Head losses in the delivery piping

Position the adjustment system of the sprayer so as to obtain the maximum discharge which can be achieved from the spray boom.

8.5.1 Measurements

For the positioning of the pressure gauges, see 7.3.

Mount the largest output nozzles supplied.

Adjust the pressure to the maximum value indicated for these nozzles by the manufacturer.

Switch on any hydraulic mixing device which is operated by the discharge from the pump (for example, hydraulic injector or hydraulic agitator).

8.5.2 Results

The pressures indicated by the pressure gauges, the differences between the pressures indicated by successive pressure gauges and the differences between the pressure read on the pressure gauge placed upstream of the pump output and those read on the subsequent pressure gauges shall be given in a table.

8.6 Discharge from the pump

8.6.1 Measurements

The discharge from the pump shall be measured at the pump speed indicated by the manufacturer, and at the maximum and minimum service pressures. In addition, the discharge from the pump shall be measured in its normal mounting on the sprayer at the intake height corresponding to a half-full tank during the test.

8.6.2 Results

The results of these tests shall be given in the form of a graph or a table, in litres per minute.

8.7 Rate of fill from the tank filling device

8.7.1 Measurements

The discharge from the system for filling the tank shall be measured for:

a) a water surface kept at the level of the opening in the filler;

b) a water surface kept 3 m below the horizontal plane passing through the intake opening of the pump;

c) a water surface kept 5 m below the horizontal plane passing through the intake opening of the pump.

The hoses, connectors and strainers supplied by the manufacturer shall be used.

8.7.2 Results

The results of the measurements shall be indicated in the test report. An accuracy of ± 5 % is sufficient for these discharge measurements. The discharge rate shall be expressed in litres per minute. Optionally, the time to fill the sprayer tank may be indicated, in minutes.

8.8 Capacity of the tank

8.8.1 Measurements

The total volume of the tank shall be measured.

Compare the actual volume in the tank corresponding to the centre-line of each mark on the scale of the contents gauge with the volume indicated on the gauge.

8.8.2 Results

The test report shall mention the total volume of the tank, in litres and as a percentage of the nominal volume.

For each mark on the scale of the gauge, the volume indicated and the deviation with respect to the actual volume shall be expressed in a table, as a percentage of the actual volume.

8.9 Agitating

8.9.1 Preliminary test

Carry out the agitating test using a 1 % suspension of copper oxychloride in accordance with annex A (this concentration is considered to be the basis concentration). Fill the tank to the nominal capacity whilst agitating.

Before stopping the agitating, take two samples of at least 20 ml each at 90 %, 50 % and 10 % of the reference level (3.1).

Assess each sample individually and calculate the mean for each level.

NOTE — The samples can be analysed by a drying technique at a temperature between 105 °C and 110 °C. Another technique may be used providing that the same values and the same accuracy are obtained.

If the mean values at each level are not between 0,95 % and 1,05 %, repeat the test with more effective agitating.

Calculate the mean of all three levels, which will be used later as the basis concentration for the calculation of deviations.

8.9.2 Re-agitating test

After the sampling period, allow the suspension to stand for 16 h.

Then restart the agitating and, after 10 min, take two samples in accordance with 8.9.1. Evaluate the concentration of each sample individually. For each level, calculate the mean and the relative deviation with respect to the basis concentration determined in 8.9.1.

8.9.3 Concentration uniformity during the emptying process

Empty the tank by opening one of the spray feeders and connecting it to a valve which lets out the same amount of liquid as is applied by all nozzles together during normal spraying. Close all other feeders.

Use a test pressure which is equal to the average of the minimum and maximum operating pressure indicated by the manufacturer to the operator for the type of nozzles mounted on the sprayer. If there are several nozzle sets, use the nozzle set giving the greatest amount of spray liquid.

At the outlet of the sprayer, take two samples at the beginning of the test, then according to the frequency indicated in table 1 until spraying is finished. Take the last sample from the residue of the tank content.

Table 1 — Sampling frequency

Nominal tank capacity	Take samples every
≤ 400 l	50 l
> 400 but ≤ 1000 l	100 l
> 1000 l	200 l

8.9.4 Results

The test results shall be indicated in the test report presented in annex B.

Annex A
(normative)

Composition of the test powder containing copper oxychloride[1)]

A.1 Composition

Copper in the form of copper oxychloride trihydrate:

Compound	Content
($3CuO \cdot CuCl_2 \cdot 3H_2O$)	45 %
Lignosulfonate	5 %
Calcium carbonate ($CaCO_3$)	8 %
Sodium sulfate decahydrate ($Na_2SO_4 \cdot 10H_2O$)	11 %

A.2 Size of the particles

Size	Volume distribution
< 20 µm	98 % min.
< 10 µm	90 % min.
< 5 µm	70 % min.

A.3 Impurities in the technically active material

Total impurities: 3,5 % max.

Water: 2 % max.

Ash: 1,5 % max. (in addition to copper)

A.4 Solubility

Slowly soluble in water and organic solvents.

Soluble in strong mineral acids.

Soluble in solutions of ammonia and amines through the formation of complexes.

[1)] This test powder is also known under the trade name of Cupravit. This information is given for the convenience of the users of this part of ISO 5682 and does not constitute an endorsement by ISO of this product.

Annex B
(normative)

Agitating test report

B.1 Preliminary test

Sampling level	Measured concentration, %		
	First sample	Second sample	Average
top (90 % of reference level)			
middle (50 % of reference level)			
bottom (10 % of reference level)			

Basis concentration (average of the three levels): ..... %

B.2 Re-agitating test

Sampling level	Measured concentration, %			Relative deviation with respect to the basis concentration
	First sample	Second sample	Average	
top (90 %)				
middle (50 %)				
bottom (10 %)				

B.3 Concentration uniformity during the emptying process

Test pressure:..... MPa

Sampling level	Relative deviation with respect to the basis concentration
nominal capacity	
level according to table 1	
residue	

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Descriptors: agricultural machinery, crop protection, crops treatment equipment, agricultural sprayers, tests, performance tests, test report sheets.

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