International Standard 5682/2

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Equipment for crop protection — Spraying equipment — Part 2 : Test methods for agricultural sprayers

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 5682/2 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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Equipment for crop protection — Spraying equipment — Part 2 : Test methods for agricultural sprayers

1 Scope and field of application

This part of ISO 5682 specifies the methods of test and assessment for non-air-assisted sprayers for field crops from the points of view of performance and precision of distribution.

This part of ISO 5682 applies to agricultural sprayers with the exception of manual sprayers and of aircraft-mounted sprayers.

Definitions are given in ISO 5681.

2 References

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

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

3 Test liquids

Clean water with no solids in suspension, with the exception of the mixing test (see 7.9).

4 Apparatus

4.1 Measuring equipment

For measurements relating to nozzles and for equipment, see ISO 5682/1.

4.2 Distribution bench (see figures 1 and 2 of ISO 5682/1).

4.2.1 Groove characteristics

a) The walls of the grooves shall be vertical.

b) 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 %.

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

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

e) The minimum height of the vertical walls of the grooves shall be twice the width of the grooves.

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

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

4.2.2 Upper part of the walls

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

a) minimum height of chamfered edge : three times the thickness of the wall;

b) maximum thickness of upper part of the chamfered edge : 1 mm;

c) maximum rounding-off radius : 0,5 mm;

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

5 Precision of the measurements

5.1 Time measurements shall be not less than 60 s and shall be made to a precision of ± 1 s.

5.2 Volumes of liquid shall be measured to a precision of ± 0,5 %.

5.3 Pressures shall be measured to a precision of ± 2,5 %.

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

5.5 Angles shall be measured to a precision of ± 1°.

5.6 Temperatures shall be measured to a precision of ± 0,5 °C.

6 General test conditions

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

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.

6.1 Temperature and relative humidity

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

6.2 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.

Pressure gauges shall be inserted to indicate the pressure of the liquid at the inlet and at the end of each section of boom; if necessary there shall also be 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.

6.3 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 clause 6.2 of ISO 5682/1.

7 Testing

7.1 Uniformity of output from the nozzles mounted on the boom

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

7.1.1 Test pressure

The maximum pressure indicated by the manufacturer to the operator for the type of nozzle mounted on the boom shall be used, if it is less than the maximum service pressure of the sprayer; if not, the maximum service pressure shall be used.

7.1.2 Measurements

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

Any equivalent method needing special measuring equipment may be used.

7.1.3 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.

7.2 Discharge from the spray boom

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

7.2.1 Test pressure

The pressures specified in 6.2.2 of ISO 5682/1 shall be used.

7.2.2 Measurements

The total discharge from the spray boom shall be measured during a period of at least 60 s.

7.2.3 Results

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

The volume per hectare for different forward speeds can also be indicated in the form of a graph or table.

7.3 Spacing of nozzles and directions of their axes

7.3.1 Spacing

The spaces between nozzles along the spray boom shall be measured to a precision of ± 1 mm.

7.3.2 Direction of the axes of the nozzles

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

7.3.3 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 of angle, with the nozzles arranged in the order specified in 7.4.5.

7.4 Spray distribution

7.4.1 Pressure

The maximum pressure and the minimum pressure indicated by the manufacturer of the sprayer shall be used and also, if this is specified, the optimum pressure.

The test shall be made at least on one half of the spray boom.

In the case of a test made section by section (of the spray boom), the following conditions shall be respected :

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

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

7.4.2 Positioning of the spray boom

The spray boom shall be in its normal working position.

7.4.3 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 the following heights (in millimetres) : 400, 500, 600 and 700, and optionally also at 300 and 800 mm.

NOTE — The heights shall be measured from the ridges of the distribution bench to the nozzle orifices.

7.4.4 Measurements

The liquid from each 100 mm groove shall be collected during a period which is determined according to the discharge from the nozzle which has the greatest discharge.

7.4.5 Results

The results shall be given 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.

7.5 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.

7.5.1 Measurements

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 agitation).

7.5.2 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 in front at the output from the pump and those read on the subsequent pressure gauges shall be given in a table.

For the positioning of the pressure gauges, see 6.2.

7.6 Discharge from the pump

7.6.1 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.

7.6.2 Results

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

7.7 Discharge from the tank filling device

7.7.1 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.

7.7.2 Results

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

7.8 Capacity of the tank

7.8.1 Measurements

The total volume of the tank shall be measured.

The volume corresponding to the centre-line of the marks on the tank contents gauge shall be compared with the volumes indicated on this gauge.

7.8.2 Results

The test report shall indicate 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 in relation to the actual volume shall be expressed as a percentage of the latter, in a table.

7.9 Mixing

7.9.1 Test conditions

The mixing shall be tested using a 1 % suspension of copper oxychloride (see composition in the annex). The copper oxychloride shall be mixed at a rate of 2,5 l of water per kilogram and placed in the almost full spray tank. When the test begins, the tank shall be filled to its maximum capacity and mixed for a period of 10 min.

Immediately afterwards, two "zero samples" each of 60 ml shall be taken at three levels, for example at 50 mm below the level of the liquid, at the mid-point of the column of liquid and 50 mm above the bottom of the tank.

Immediately before drying, take 20 ml of liquid from one sample using a pipette and filter it, for example on an evaporator.

Each sample shall be assessed individually (see 7.9.2) and the mean value shall be calculated from these results. In the case of large variations for the "zero sample" the test shall be repeated with a longer mixing time.

The samples shall be dried at a temperature between 105 and 110 °C.

7.9.2 Measurement

After 10 min of mixing, the suspension shall be allowed to stand for 16 h.

Then restart the mixing, and after 2 min take a sample from the tank, as indicated in 7.9.1 (at three levels).

Continue mixing in order to take four more samples at intervals of 2 min during mixing. The samples shall be compared with the zero sample.

7.9.3 Results

The concentration of the five samples taken shall be given in a graph with the time indicated on the x-axis.

Annex

Composition of the test powder[1] containing copper oxychloride

(This annex forms an integral part of the Standard.)

A.1 Composition

Copper in the form of copper oxychloride trihydrate ($3CuO \cdot CuCl_2 \cdot 3H_2O$) :	45 %
Lignosulfonate :	5 %
Calcium carbonate ($CaCO_3$) :	8 %
Sodium sulfate decahydrate ($Na_2SO_4 \cdot 10H_2O$) :	11 %

A.2 Size of the particles

< 20 µm : 98 % min.

< 10 µm : 90 % min.

< 5 µm : 70 % min.

A.3 Impurities in the technically active material (3,5 % max.)

Water : 2 % max.

Ash : 1,5 % max. (in addition to the 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) Known under the trade name of Cupravit.