International Standard 5682/1

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Equipment for crop protection — Spraying equipment — Part 1 : Test methods of sprayer nozzles

Matériel de traitement agropharmaceutique — Équipements de pulvérisation — Partie 1 : Méthodes d'essai des buses de pulvérisation

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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.

International Standard ISO 5682/1 was developed by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, and was circulated to the member bodies in November 1977.

It has been approved by the member bodies of the following countries :

Australia	Germany, F. R.	Poland
Austria	India	Romania
Belgium	Iran	South Africa, Rep. of
Bulgaria	Ireland	Spain
Canada	Italy	Sweden
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The member body of the following country expressed disapproval of the document on technical grounds :

USA

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Equipment for crop protection — Spraying equipment — Part 1 : Test methods of sprayer nozzles

1 Scope and field of application

This International Standard specifies methods for estimating the accuracy of spraying of hydraulic sprayer nozzles, for hydraulic spraying.

It applies to the sprayer nozzles of mounted, towed and self-propelled agricultural sprayers used for crop protection and fertilization.

2 References

ISO 3339/0, *Agricultural tractors and machinery — Classification and terminology — Part 0 : Principles for classification and general definitions.*

ISO 3339/3, *Agricultural tractors and machinery — Classification and terminology — Part 3 : Equipment for sowing, planting and distributing fertilizers.*[1)]

3 Test liquids

3.1 Clean water, free from solids in suspension (see tests 6.1, 6.2, 6.3, 6.5).

3.2 Clean water, with the addition of abrasive or corrosive material (see test 6.4).

3.3 Clean water with the addition, if necessary, of a soluble colouring agent (dark coloured aniline dye or similar product) the surface tension of the mixture shall be measured at 20 °C (see test 6.6) and stated in the test report.

4 Apparatus

4.1 Equipment

4.1.1 Pressure gauge, with an accuracy of ± 1 % at the effective working pressure.

4.1.2 Rubber or **plastics hose** for each nozzle.

4.1.3 Collecting vessel for each nozzle.

4.1.4 Measuring tube or **balance**, for measuring the quantity of liquid collected.[2)]

4.1.5 Watch, with an accuracy of ± 0,5 s.

4.1.6 Scale, with an accuracy of ± 1 mm.

4.1.7 Angle meter, with an accuracy of ± 0,5°.

4.1.8 Device enabling the nozzles to be moved at a given speed.

4.1.9 Petri dishes.

4.1.10 Microscope, with an measuring accuracy of 10 µm.

4.1.11 Photographic device with electronic flash.

4.1.12 A liquid or **solid surface** suitable for collecting the drops.

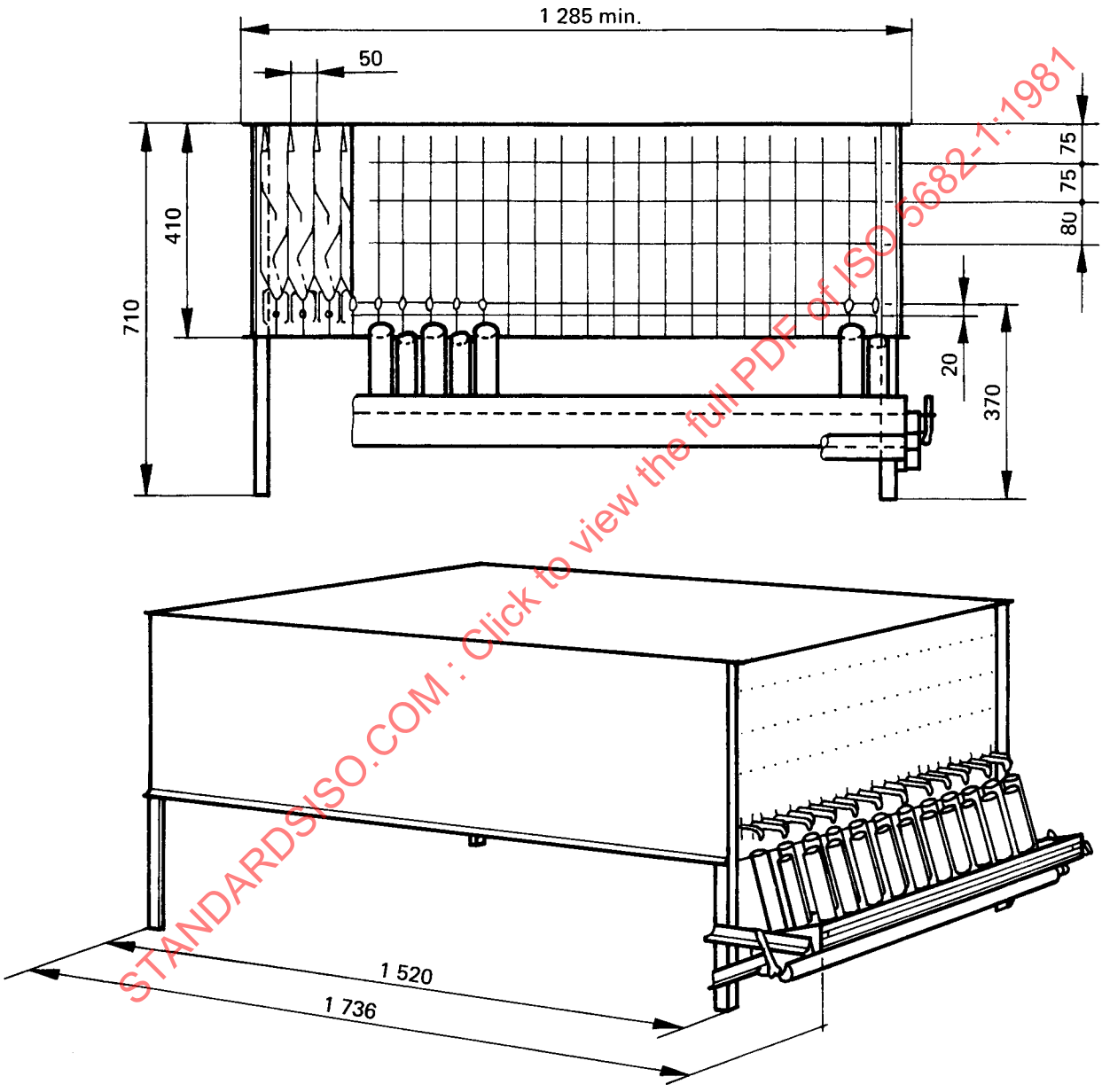
1) At present at the stage of draft.

2) The dimensions of the tube shall be compatible with the requirements of 6.3.4.

4.2 Distribution bench

See figure 1 for an example.

Dimensions in millimetres



NOTE — The distribution bench shall be equipped with a device allowing collection of the liquid when the test pressure is stabilised and the sprayer nozzles are supplied normally.

Figure 1 — Example of a distribution bench

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 a longitudinal direction (perpendicular to the grooves), a tolerance of 1 % (10 mm/1 m) on the horizontal and, in the lateral direction (parallel with the grooves), a tolerance of 2 % (see figure 2).

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

d) Distance between two consecutive ridges shall be 50 ± 0,5 mm.

e) 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 25 mm intervals, these conditions apply by comparing two adjacent grooves with one 50 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 and shall have the following characteristics :

a) Minimum height of the chamfered edge shall be three times the thickness of the wall.

b) Maximum thickness of the chamfered edge at its upper part shall be 1 mm.

c) Maximum rounding-off radius shall be 0,5 mm.

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

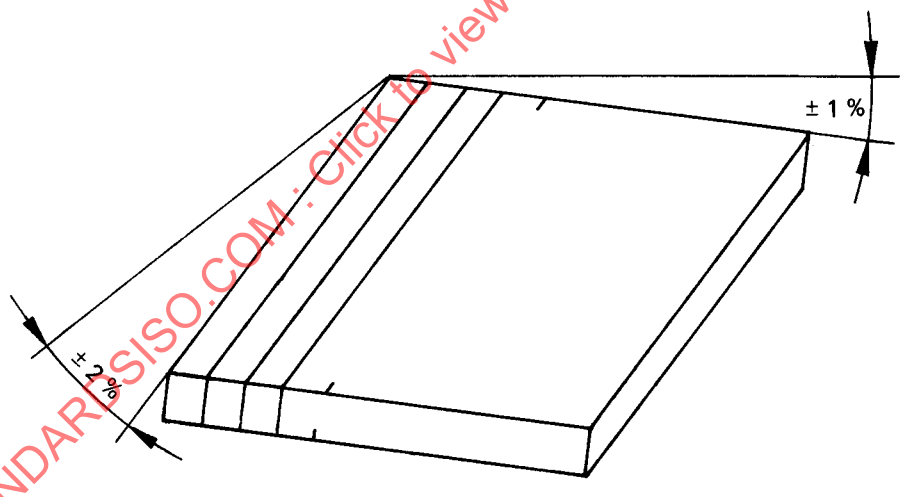


Figure 2 — Groove characteristics

5 General test conditions

All the operational data and test parameters shall be stated in the test report.

5.1 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 test premises shall be normally not less than 50 %. The temperature and the relative humidity shall be stated in the test report.

5.2 Pressures

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

NOTE — The general test conditions shall be resumed for tests 6.1 to 6.6.

6 Determination of the characteristics of the sprayer nozzles

The general test conditions shall be in conformity with those specified in clause 5. For each set, the nozzle with the discharge rate closest to the average value following test 6.1 shall be used for tests 6.2 to 6.6.

6.1 Uniformity of discharge rate of the nozzles

6.1.1 Sampling

Take 20 complete nozzles of the same type at random. The sampling conditions shall be stated in the test report and in particular the size of the stock, the place of sampling, etc.

The complete designation of nozzle discs and tips shall be indicated in the test report.

6.1.2 Test liquid

Use test liquid 3.1.

6.1.3 Measurements

Measure for each complete nozzle the volume discharged at the maximum working pressure indicated by the manufacturer with an error of less than 1 %. The measuring time shall be greater than or equal to 60 s and be measured with an error of less than 1 s.

6.1.4 Results

The result shall be shown in the test report by means of a graph (100 % represented by 50 mm) or table in which the discharge rate of each nozzle is expressed as a percentage of the mean discharge rate of 20 complete nozzles.

6.2 Discharge rates (variations in discharge rate according to the pressure)

6.2.1 Test liquid

Use test liquid 3.1.

6.2.2 Pressure

Use the maximum and minimum pressures indicated by the manufacturer and at least two intermediate pressures. The differences between two consecutive pressures shall be equal and not greater than 0,5 MPa (5 bar).

6.2.3 Measurements

Measure the discharge rate in litres per minute at the pressures indicated in 6.2.2.

6.2.4 Results

The result shall be given in the test report in the form of a graph (the discharge rate shall be indicated on the y-axis and the pressure on the x-axis) or table with the accuracy stated in 6.1.3.

6.3 Distribution of the spray

6.3.1 Test liquid

Use test liquid 3.1.

6.3.2 Pressure

The tests shall be carried out at the maximum and minimum pressures stated by the manufacturer.

6.3.3 Position of the nozzle

During the test, the nozzle shall be positioned vertically above a ridge of the distribution bench and in its normal working attitude to direct its spray onto the bench.

NOTE — If the manufacturer indicates one position, the test shall be made in this position.

The height is measured between the edge of the ridge and the orifice of the nozzle.

If the manufacturer states an optimum height for use, carry out the test at the height stated and at 150 mm above and below. If the manufacturer does not indicate any height for use, carry out the tests at the following heights in millimetres : 400 — 500 — 600 — 700 and if necessary at 300 and 800 mm.

Fan spray nozzles shall be positioned for test so that the longest dimension of the spray pattern is at right angles to the grooves.

Cone spray nozzles shall be tested in two or three positions (see figure 3) :

— in their initial position;

— in a second position resulting from a 90° rotation of the nozzle disc or nut in its assembly;

— in a third position when the spiral can turn in relation to the disc, the nozzle shall be reassembled with the swirl plate turned through 90° in relation to the disc as mounted in position (2) below.

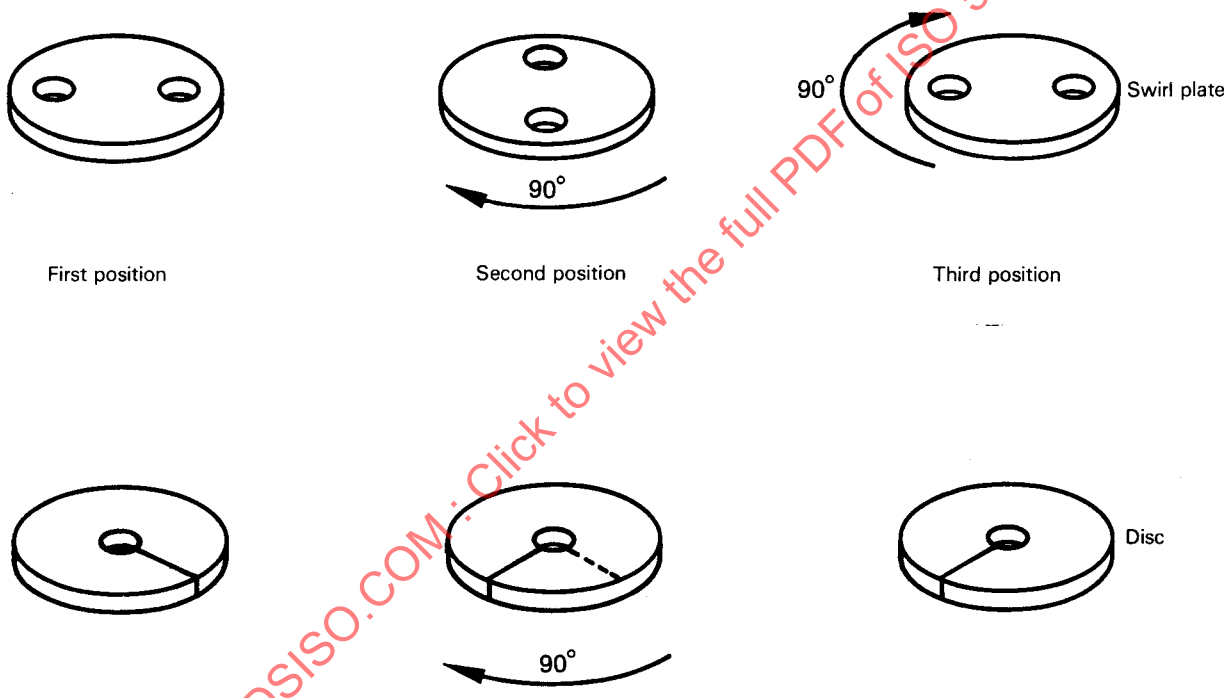


Figure 3 — Test position for cone spray nozzles

6.3.4 Measurements

Discontinue collection as soon as the amount of liquid collected in one of the tubes has reached 90 % of its capacity. Record the quantities collected in each tube.

6.3.5 Results

The distribution of the spray shall be represented by a graph (recommended for the scale : on the y-axis 50 mm represents the 100 % line and on the x-axis 10 mm represents 100 mm) or a table indicating the percentage of the values relating to the mean value of the quantity of liquid collected in all the grooves.

6.4 Variations in the distribution due to abrasion or corrosion[1)]

This test shall be carried out on five nozzles

6.4.1 Test liquid

Use the test liquid 3.2, the temperature of which shall be 20 ± 3 °C throughout the test.

Ensure that the abrasive material is always well dispersed throughout the liquid.[2)] Ascertain, if need be by preliminary tests[3)], that the test liquid retains its effectiveness in relation to the material of the nozzles throughout the duration of the test defined in 6.4.3. If it does not, replace the abrasive liquid as often as necessary.

6.4.2 Test pressure

The test pressure used is the minimum pressure indicated by the manufacturer.

6.4.3 Measurements

Measure the discharge rate at the beginning of the test and then every hour or at regular intervals chosen according to the speed of wear of the nozzle. Carry out the spray distribution test (see 6.3) at the beginning and end of the test and at about 10, 15 and 20 % of increase in discharge rate if these values are reached.

6.4.4 Results

State in the test report the increase in discharge rate thus obtained, expressed as a percentage of the initial discharge rate and also give the spray distribution observed at the various degrees of wear indicated in 6.4.3 and according to the type of graph mentioned in 6.3.5.

6.5 Spray angle

Using suitable equipment, measure the spray angle, i.e. the angle at the top of the jet made by the straight outside parts of the jet (see figure 4). This angle will be measured at the pressure recommended by the nozzle manufacturer.

6.6 Size of the droplets

This test which only ensures minimum accuracy will be reviewed when the technology of droplet size determination is more developed.

6.6.1 Test liquid

Use test liquid 3.3.

6.6.2 Pressure

Use at least :

— either the maximum and minimum pressures indicated by the manufacturer of the sprayer and/or the manufacturer of the nozzle;

— or the optimum pressure for use recommended by the manufacturer of the sprayer and/or the manufacturer of the nozzle.

6.6.3 Speed of movement of the nozzle

If the nozzle moves, this shall be at a horizontal speed chosen so as to allow a sufficient number of droplets to be collected, while avoiding the merging of the droplets collected. The maximum speed of the nozzle in this case is fixed at 3 m/s.

1) This test does not prejudge the life of a nozzle in the actual conditions of use, but is used to compare the resistance to wear of the nozzles and the resulting deterioration in their distribution. The procedure for this test will be completed when the abrasive has been chosen.

2) For example, by means of a controlled escape of compressed air with a pressure such that after 5 min of operation, there is no longer any deposit at the bottom of the tank.

3) It is possible to proceed using identical metering orifices from the same batch made from a suitable material in relation to the nozzles being tested, measuring the increase in discharge rate after passing through a given volume of the test liquid at the specified pressure.

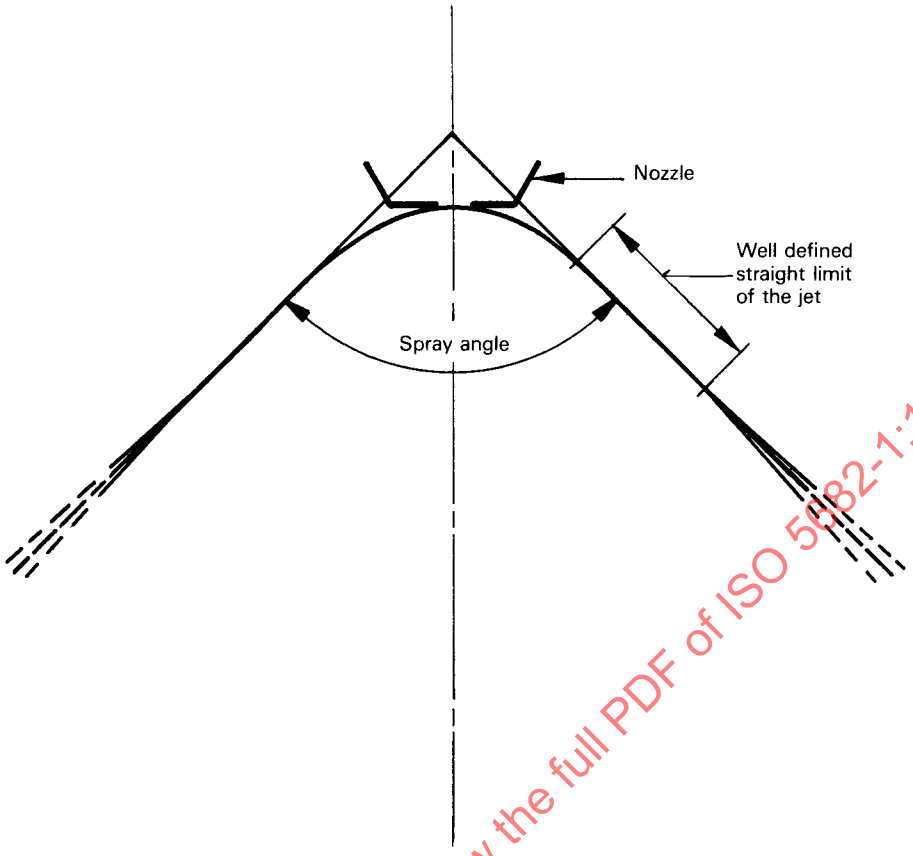


Figure 4 — Diagram of the principle for measuring the spray angle

6.6.4 Number of droplets and range of the size classes

Collect a sufficient number of droplets to make up a representative sample, i.e. 2 000 droplets at the minimum.

The range of the classes shall be chosen according to the dimensions of the droplets collected without it being greater than 100 µm.

6.6.5 Test device

The device used may be the following or any other device which can show and give comparative results.

Glass microscope slides (25 mm × 75 mm) covered with a film of silicone are fixed horizontally on rods 0,5 m above the ground and aligned lengthwise along a line perpendicular to the axis of advancement of the nozzle and regularly spaced along the whole width of the strip being treated. The vertical distance between the nozzles and the collectors is the distance specified by the manufacturer or chosen for sampling. This distance shall be given in the test report.

The dimensional analysis concerns equal rectangles with the same axes as the slides and a minimum length of 50 mm.

6.6.6 Measurements

As an example the following method may be used :

The size of the droplets is determined by moving the nozzle above a line of Petri dishes or slides each of which receives some of the droplets from the jet.

All the droplets in each of the Petri dishes with an equal surface area shall be measured and recorded according to class sizes. The total volume of the droplets collected and the distribution as a percentage of the size classes shall be calculated.

6.6.7 Results

Prepare a distribution graph, on gausso-logarithmic graph paper, showing the cumulative volumes on the x-axis (gaussian scale) and the diameters on the y-axis (logarithmic scale).

In particular, the values of the diameters corresponding to the 16 %, 50 % (volume median diameter) and 84 % cumulative volumes shall be indicated.

The Sauter figures (SMD) can also be drawn up if required.

7 Test report

See model in the annex.

Annex

Example of a test report for sprayer nozzles

1 Description of the nozzles tested

Complete designation :

— Address of the manufacturer : .....
— Trademark : .....
— Type of nozzle : .....
— Catalogue reference (Dimensions) : .....
— Material : .....
— Batch number : .....
— Date of manufacture : .....

2 Results of tests to determine the characteristics of the nozzles

NOTE — The pressures were kept stable at least to within 2,5 % for tests 2.1 to 2.6.

2.1 Uniformity of discharge

Temperature and relative humidity :

— Temperature of the test liquid : ..... °C
— Temperature of the ambient air : ..... °C
— Relative humidity of the air : ..... %

2.1.1 Sampling of the nozzles tested

The tests were carried out on 20 complete nozzles taken at random from a batch of . . . . . (*n*) nozzles.

Place of sampling : .....
Date of sampling : .....

2.1.2 Test liquid

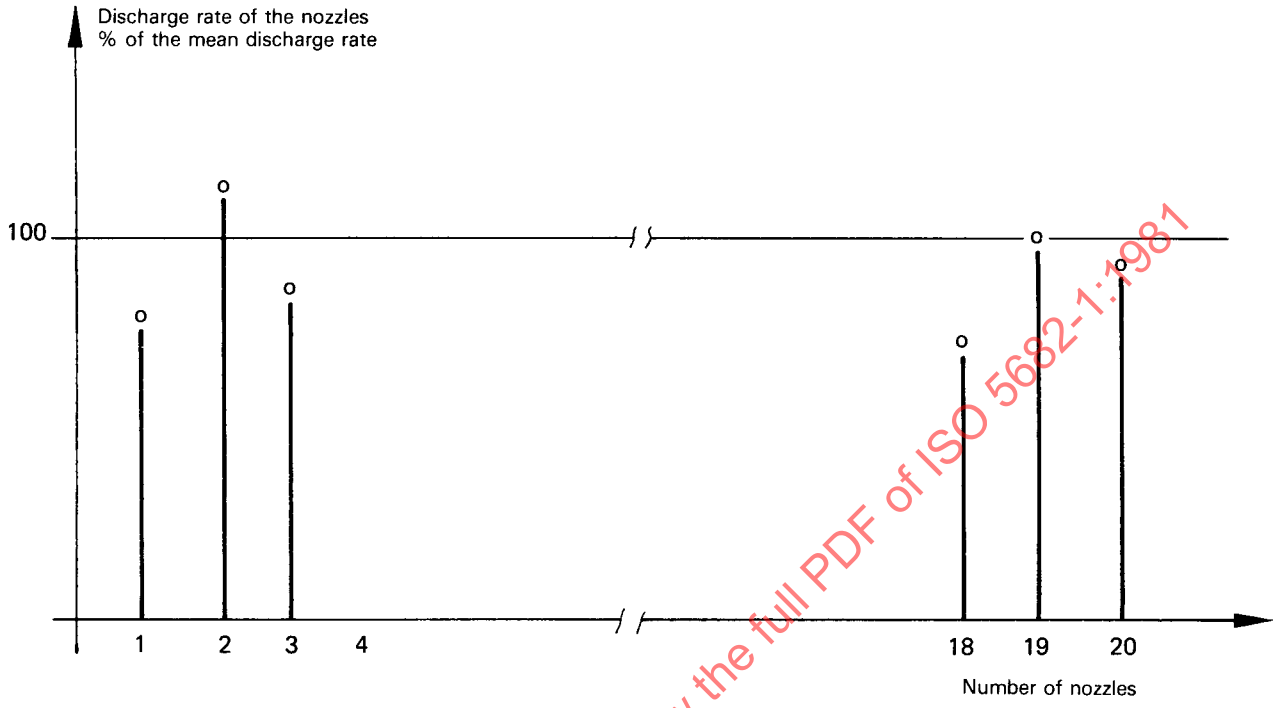
Clean water, free from solids in suspension.

2.1.3 Measurements

The pressure used was the maximum working pressure, i.e. . . . . MPa
Error on the measurement of the volume discharged less than 1 %.
Error on the duration of the discharge less than 1 s.
Duration of discharge : . . . . . s (> 60 s).

2.1.4 Results for the discharge rates of all the nozzles in relation to their mean discharge rate

1) Graph



2) Table

No. of nozzles	1	2	3	.....	19	20
Discharge rate, % of the mean discharge rate						

2.2 Discharge rate as a function of the pressure

Temperature and relative humidity :

- Temperature of the test liquid : ..... °C
- Temperature of the ambient air : ..... °C
- Relative humidity of the air : ..... %

2.2.1 Test liquid

Clean water, free from solids in suspension.

2.2.2 Pressure

Maximum pressure indicated by the manufacturer : ..... MPa

Minimum pressure indicated by the manufacturer : ..... MPa

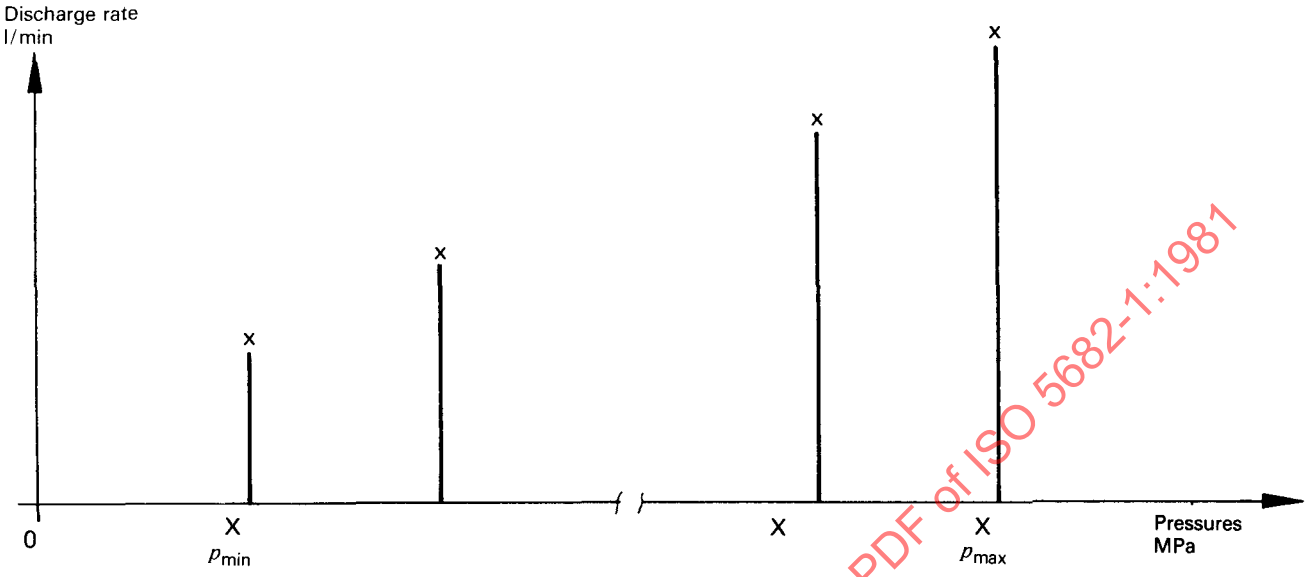
Intermediate pressures : ..... MPa

2.2.3 Measurements of the discharge rate as a function of the pressure

The measurements were carried out on selected nozzle No. . . . . the discharge rate of which is closest to the mean value (test 2.1).

2.2.4 Results for the discharge rate as a function of the pressure

1) Graph



2) Table

Pressure, MPa				.....		
Discharge rate, l/min				.....		

2.3 Distribution of the spray

Temperature and relative humidity :

- Temperature of the test liquid : ..... °C
- Temperature of the ambient air : ..... °C
- Relative humidity of the air : ..... %

2.3.1 Test liquid

Clean water, free from solids in suspension.

2.3.2 Pressures

Indicated by the manufacturer :

Maximum pressure : ..... MPa
Minimum pressure : ..... MPa

2.3.3 Position of the nozzle

Heights :

Optimum height indicated by the manufacturer h : ..... mm
$h + 150$: ..... mm
$h - 150$: ..... mm