INTERNATIONAL STANDARD

ISO 8026

Second edition
1995-04-15

Agricultural irrigation equipment — Sprayers — General requirements and test methods

Matériel agricole d'irrigation — Diffuseurs — Exigences générales et méthodes d'essai

Reference number
ISO 8026:1995(E)

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.

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 8026 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 18, *Irrigation and drainage equipment and systems.*

This second edition cancels and replaces the first edition (ISO 8026:1985), of which it constitutes a technical revision.

International Organization for Standardization
Case Postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

Agricultural irrigation equipment — Sprayers — General requirements and test methods

1 Scope

This International Standard specifies the general requirements and test methods for irrigation sprayers.

It applies to sprayers intended for assembly in pipeline networks for irrigation and for operation with irrigation water.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this 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 7-1:1994, *Pipe threads where pressure-tight joints are made on the threads — Part 1: Dimensions, tolerances and designation.*

ISO 2859-1:1989, *Sampling procedures for inspection by attributes — Part 1: Sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection.*

ISO 3951:1989, *Sampling procedures and charts for inspection by variables for percent nonconforming.*

ISO 7749-2:1990, *Irrigation equipment — Rotating sprinklers — Part 2: Uniformity of distribution and test methods.*

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 irrigation sprayer: Device which sprays water, without rotational movement of the sprayer parts, in the form of fine jets or in a fan shape.

3.2 regulated sprayer; pressure-compensated sprayer: Sprayer with a relatively constant flowrate at varying water pressures at the sprayer inlet within the limits specified by the manufacturer as the regulating range (3.5).

3.3 non-regulated sprayer; non-pressure-compensating sprayer: Sprayer with a variable flowrate at varying water pressures at the sprayer inlet.

3.4 nominal flowrate: Quantity of water discharged by a sprayer with a certain nozzle per unit of time at ambient temperature at the test pressure declared by the manufacturer in the manufacturer's data sheets.

3.5 regulating range: Range of pressure at the inlet of a regulated sprayer within which the sprayer is designed to operate and discharge within 5 % of its nominal flowrate (3.4).

3.6 test pressure, p

(1) 200 kPa at the sprayer inlet.

(2) Any pressure at the sprayer inlet, specifically declared by the manufacturer to be a test pressure.

3.7 minimum effective pressure, p_{min}**:** Lowest working pressure declared by the manufacturer measured near the base of the sprayer at a point situated about 0,2 m below the main nozzle of the sprayer but with the pressure gauge situated in the same plane as the main nozzle. (See figure 1).

3.8 maximum effective pressure, p_{max}: Highest working pressure declared by the manufacturer measured near the base of the sprayer at a point situated about 0,2 m below the main nozzle of the sprayer but with the pressure gauge situated in the same plane as the main nozzle. (See figure 1.)

3.9 range of effective pressure: Pressure range between the minimum effective pressure, p_{min}, and the maximum effective pressure, p_{max}, declared by the manufacturer as the pressure range in which the sprayer operates effectively measured near the base of the sprayer at a point situated about 0,2 m below the main nozzle of the sprayer but with the pressure gauge situated in the same plane as the main nozzle. (See figure 2.)

3.10 ambient temperature: Temperature of the surroundings in the range of 25 °C ± 5 °C.

3.11 spray coverage pattern: Area wetted by the sprayer and described by an angular part-circle pattern.

NOTE 1 This may be, for example, full-circle, 360° pattern; half-circle, 180° pattern; two circular sectors, such as the sector between 0° and 90° and the sector between 180° and 270°.

3.12 water distribution curve: Curve of application rates measured in collectors laid out along the wetted radius, as a function of the distances of the collectors from the sprayer.

3.13 radius of throw: Furthest distance measured from the sprayer centreline to the point at which the sprayer deposits water at the minimum rate of 0,25 mm/h for a sprayer whose discharge exceeds 75 l/h, and 0,13 mm/h for a sprayer whose discharge is equal to or less than 75 l/h, typically measured at any arc of coverage except at the arc extremes for part-circle sprayers.

NOTE 2 The respective values relate only to sprayers in continuous operation.

3.14 diameter of coverage: Twice the radius of throw (3.13).

3.15 trajectory angle: Angle of the water spray above a horizontal plane, as discharged from the sprayer nozzle operating at the test pressure.

3.16 trajectory height: Maximum height of the spray above the sprayer nozzle when operating at test pressure.

3.17 water outlet height: Height above ground level of the water outlet from the sprayer when the sprayer is installed as indicated in the manufacturer's instructions.

3.18 nozzle: Aperture or adjutage of the sprayer through which the water spray is discharged.

3.19 collector: Receptacle into which the water discharged by the sprayer is deposited during the test for spray distribution.

3.20 irrigation lateral: Branch supply line on which water distribution devices (sprayers, emitters, drippers) are mounted directly or by means of a suitable fitting, riser or tube.

Dimensions in metres

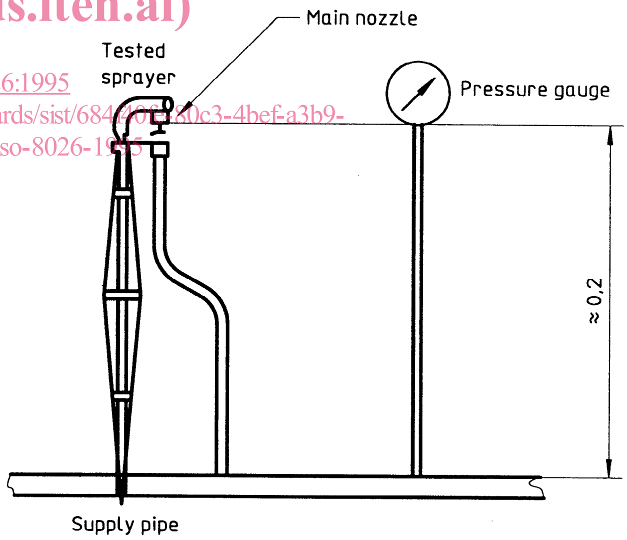

Figure 1 — Measurement of sprayer pressure

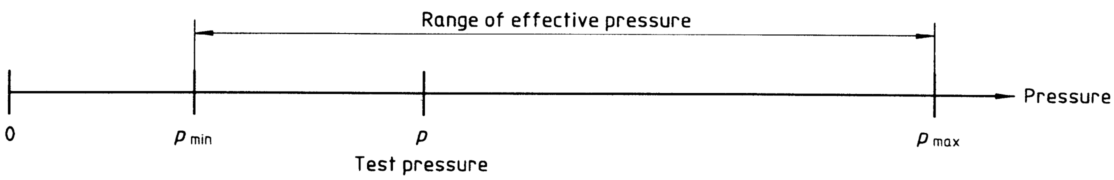

Figure 2 — Range of effective pressure

4 Classification

Sprayers are classified in two ways: see 4.1 and 4.2.

4.1 Performance characteristics (flowrate in relation to pressure)

Class 4.1.1: Regulated sprayers

Class 4.1.2: Non-regulated sprayers

4.2 Spray characteristics

Class 4.2.1: Relatively uniform spray coverage pattern in all directions as, for example, the pattern of some full-circle 360° sprayers with a fan-shape coverage pattern.

Class 4.2.2: Non-uniform spray coverage pattern, as, for example, that obtained from fine jet sprayers.

5 Marking

Each sprayer shall be clearly and permanently marked with the following information:

a) name of manufacturer or the manufacturer's registered trademark;

b) catalogue identification symbol;

c) nozzle size or nominal flowrate;

d) indication of the correct operating position, if necessary.

Replaceable parts, affecting sprayer performance, shall be marked separately. Colours may be used as identifying marks.

If the space on the sprayer is insufficient for all required markings, identification of the manufacturer and the catalogue identification symbol is acceptable, provided that the unmarked specifications are available from the manufacturer.

6 General requirements

6.1 Materials

Sprayers shall be made of metals or plastics. Metal sprayers shall be made from a copper alloy or of other metals whose mechanical properties and resistance to corrosion when used with irrigation water are not less suitable than those of copper alloys.

Plastics parts of the sprayers which conduct water and which are exposed to sunlight shall be opaque. Plastics parts of sprayers exposed to ultraviolet (UV) radiation shall contain an additive resistant to UV radiation.

On request, the manufacturer shall provide information as to the resistance of the sprayer to chemicals used in agriculture.

6.2 Construction and workmanship

6.2.1 Individual parts of a sprayer shall show no visible cracks, holes, air bubbles or other defects that may impair the performance and durability of the sprayer, its operation and suitability for installation.

The surfaces of the sprayer shall be smooth and free from projections or sharp edges that may cause injury or poor operation.

6.2.2 If the construction of the sprayer permits replacement or change of parts (e.g. the nozzle), it shall be possible to replace the parts with standard tools; if special tools are required, the manufacturer shall be capable of supplying them.

Sprayer parts of the same make, type and model shall be replaceable, if applicable.

6.2.3 The design and manufacture of the sprayer shall enable proper operation of the sprayer when installed and operated in accordance with the manufacturer's instructions.

6.2.4 Metal sprayers intended for threaded connection (see 6.3) to a pipeline or to risers shall be equipped with a hexagon, two parallel surfaces, or some other configuration suitable for gripping with a standard open or adjustable wrench. Sprayers having a plastics part for connection to risers may have other configurations (projections, slots, etc.) to facilitate manual assembly and removal.

6.3 Threaded connections

For sprayers designed for threaded connection to pipelines, the screw threads shall comply with ISO 7-1. Alternatively, other threads may be allowed provided that a suitable adaptor shall be supplied with each threaded connection, making it comply with ISO 7-1.

7 General test conditions

7.1 General

Unless otherwise noted, perform the tests with water at a temperature of 25 °C ± 5 °C.

7.2 Sampling and acceptance requirements

7.2.1 Type tests

Take the test specimens at random from a quantity of at least 500 sprayers. The number of test specimens required for each test shall be as specified in table 1.

If the number of defective specimens in the sample is equal to or less than the acceptance number specified in table 1, the sample shall be considered as complying with the requirements of this International Standard. If the number of defective specimens in the sample is greater than the acceptance number, the sample shall be considered as not complying with the requirements of this International Standard.

7.2.2 Acceptance tests

When acceptance of manufacturing lots or shipments is required, perform the sampling in accordance with ISO 2859-1:1989, based on acceptable quality level (AQL) 2,5 and special inspection level S-4.

Test all test specimens in the sample, selected at random as provided for in table II-A ISO 2859-1:1989, as specified in 8.2.

The shipment or manufacturing lot complies with this International Standard if the number of defective specimens found in the test does not exceed the acceptance number specified in ISO 2859-1:1989.

For the other tests, select the test specimen at random to conform with the number specified in table 1.

Table 1 — Required number of test specimens and acceptance number

Clause No.	Name of test	No. of test specimens	Acceptance No.
6.2	Construction and workmanship	10	1
8.1	Resistance of threaded connections	10	1
8.2	Resistance to hydrostatic pressure at ambient temperature	5	0
8.3	Resistance to hydrostatic pressure at high temperature	5	0
9.2	Uniformity of flowrate	1)	1)
9.3	Performance characteristics	5	2)
9.4.2	Water distribution curves	3	2)
9.4.3	Diameter of coverage	3	2)
9.4.4	Spray coverage pattern	3	2)
9.4.5	Trajectory height	3	0
10	Durability	5	1

1) Number of test specimens and acceptance conditions in accordance with ISO 3951.

2) Acceptance conditions as specified in the relevant clause.

The shipment or manufacturing lot is considered to comply with this International Standard if the number of defective specimens found in the other tests does not exceed the acceptance number specified in table 1.

It is not necessary to perform the tests in 9.4 and clause 10 within the framework of the acceptance tests if a type test has been carried out for the same sprayer model and provided that the manufacturer has not introduced structural changes in the sprayer since the type test.

The manufacturer shall give proof that no changes have been made in the product to obviate the need to perform type tests.

7.3 Accuracy of measuring devices

The allowable deviation of the measuring devices from their true values shall be as follows:

pressure: ± 2 %

flowrate: ± 1 %

8 Strength tests

Test sprayers while attached to an irrigation lateral. Test sprayers of the same type, but with different means of attachment, separately for each combination for sprayer and means of attachment.

8.1 Test of resistance of threaded connections

For sprayers made of metal, the threaded connection shall withstand a torque of 20 N·m without showing signs of damage. For sprayers made of plastics, the threaded parts shall withstand a torque of 7 N·m, applied for 1 h, without showing signs of damage.

8.2 Test of resistance to hydrostatic pressure at ambient temperature

8.2.1 Connect the sprayer to the test rig according to the recommendation of the manufacturer for field assembly and plug the nozzle such that no leakage occurs at the connection during the test.

Check that no air remains in the system, then gradually increase the water pressure in stages of 100 kPa, holding the system pressure for 5 s at each pressure stage.

Increase the water pressure gradually from zero up to twice the maximum effective pressure, p_{max}, but to a pressure not less than 600 kPa. Maintain this pressure for a period of 1 h.

8.2.2 The sprayer and its parts shall withstand the test pressure without being damaged, no leakage shall occur through the sprayer body or its connections and the sprayer shall not separate from the assembly.

8.3 Test of resistance to hydrostatic pressure at high temperature

8.3.1 Connect the sprayer to the test rig in accordance with the recommendations of the manufacturer for field assembly and plug the nozzle. Ensure that all connections are tight, so that no leakage occurs during the test.

While the sprayer is immersed in water at 60 °C ± 5 °C, allow it to fill with water and check that no air remains in the system.

Connect the test assembly to a source of hydraulic pressure and increase the water pressure from zero up to the maximum effective pressure p_{max} within a period of about 15 s.

Maintain the maximum effective pressure for a period of

1 h for sprayers made of metal;

24 h for sprayers made of plastics.

8.3.2 The sprayer and its parts shall withstand the test pressure without being damaged, no leakage shall occur through the sprayer body or its connections and the sprayer shall not separate from the assembly.

9 Functional and operational tests

9.1 General test conditions

9.1.1 Perform the tests on sprayers which have previously been examined visually (without disassembly) for satisfactory workmanship and quality.

Attach test sprayers to the supply line according to the recommendations of the manufacturer for field assembly.

Test sprayers of the same type, but with different nozzles or different means of attachment, separately for each combination of sprayer and nozzle, or sprayer and means of attachment.

Prior to conducting the functional and operational tests, operate each test sprayer for 1 h at the test pressure.

9.1.2 Specifications for the test liquid shall be as defined in ISO 7749-2.

9.2 Uniformity of flowrate

9.2.1 Measure the flowrate of a test sprayer at the test pressure.

9.2.2 The sprayers tested shall meet the sample requirements of ISO 3951 for an acceptable lower quality level (AQL) of 2,5 % and shall have upper and lower specification limits as follows:

a) 10 % for regulated sprayers (4.1.1);

b) 7 % for non-regulated sprayers (4.1.2).

9.3 Performance characteristics

9.3.1 General

Arrange the sprayers tested in 9.2 in ascending order according to their measured flowrate, and number them from 1 to n, with 1 being the number of the sprayer with the lowest flowrate and n that with the highest flowrate.

Select the four sprayers with numbers 2; $(n/2) - 1$; $(n/2) + 1$; and $n - 1$ for further testing.

NOTE 3 If n is an odd number, round $(n/2)$ downwards to a whole number.

Measure the flowrate when the pressure varies from $0{,}8p_{min}$ to $1{,}2p_{max}$ by constant increments not greater than 50 kPa. Plot the results on a curve of flowrate as a function of pressure at the inlet.

9.3.2 Regulated sprayers

9.3.2.1 When measuring the flowrate of regulated sprayers, record the results and determine the maximum flowrate, q_{max}, and the minimum flowrate, q_{min}, from among the different flowrates within the regulated range for each sprayer.

Calculate the average flowrate, $\bar{q}$, from the results obtained for the four sprayers.

9.3.2.2 The maximum and minimum flowrates, q_{max} and q_{min}, shall not deviate by more than ± 10 % from the nominal flowrate, q_{nom}, within the regulation range. The average flowrate, $\bar{q}$, shall not deviate by more than ± 2,5 % from the nominal flowrate, q_{nom}.

9.3.3 Non-regulated sprayers

9.3.3.1 When testing non-regulated sprayers, calculate the average of the flowrates, $\bar{q}$, obtained for the four sprayers at a specified pressure. Plot the values obtained for the average flowrate graphically as a function of the pressure.

9.3.3.2 The performance characteristics (flowrate as a function of pressure) shall conform to the performance characteristics shown in the manufacturer's data sheets within a permissible deviation of ± 5 %.

9.4 Water distribution curves, diameter of coverage, spray coverage pattern and trajectory height

9.4.1 Preparation and collectors

9.4.1.1 Perform this test only for sprayers designated as Class 4.2.1.

Perform the test indoors, in draught-free conditions, or in an outdoor area under no-wind conditions.

9.4.1.2 Level the test area evenly and divide it into squares with maximum side dimensions of 0,5 m for sprayers with an effective diameter of coverage of up to 6 m and with maximum side dimensions of 1,25 m for sprayers with an effective diameter of coverage greater than 6 m. Place collectors for collecting the water discharged by the test sprayer at the corners of each square (see figure 3).

For testing sprayers that apply the water to a sector of a circle, placement of the collectors may be limited to the wetted sector only, with the sprayer located at the geometrical centre of the sector.

9.4.1.3 The collectors shall be cylindrical, or conical with side walls at least 45° from the horizontal. The collectors shall have sharp-edged, round openings, 100 mm to 150 mm in diameter, and shall be free from deformities. When installed, the openings of all the collectors shall be in the same horizontal plane. The number of collectors shall be sufficient to cover the entire spray coverage area.

9.4.1.4 Remove one collector from the centre of the test area and install the test sprayer in its place such that its spray is discharged at a height of 20 cm above the openings of collectors (see figure 4), unless the manufacturer recommends a height other than 20 cm.

9.4.2 Water distribution curves

9.4.2.1 Operate the sprayer for a minimum period of 1 h while maintaining the test pressure at the inlet of the sprayer.

Immediately on conclusion of the test, measure the quantity of water collected in each of the collectors placed along two radii (preferably at right angles to each other) within the spray coverage area (see figure 3).

Calculate the water application rate, h, in millimetres per hour, from the equation:

$$h = \frac{V \times 10}{A} \times \frac{1}{t}$$

where

V is the volume, in cubic centimetres, collected in each collector;

A is the area, in square centimetres, of the collector opening;

t is the test duration, in hours.

Plot the water distribution curves for all the collectors which were measured as a function of the distance of each collector from the sprayer along the two radii. Calculate and plot the average water distribution curve of depths of water application rate from the above two curves (see figure 5).

9.4.2.2 The average water distribution curve of the depths of water accumulated in the collectors (the distribution curve) shall conform to the curve supplied by the manufacturer within a permissible deviation of ± 15 %.

9.4.3 Diameter of coverage

9.4.3.1 Measure the distance along two radii from the sprayer to the most remote point at which the sprayer deposits water along the two radii at the minimum rate of 0,25 mm/h for a sprayer whose discharge exceeds 75 l/h, and at the minimum rate of 0,13 mm/h for a sprayer whose discharge is equal to or less than 75 l/h, typically measured at any arc of coverage except at the arc extremes for part-circle sprayers.

The diameter of coverage is the average of the two distances multiplied by 2.

9.4.3.2 The diameter of coverage shall conform to the values supplied by the manufacturer within a permissible deviation of ± 10 %.

9.4.4 Spray coverage pattern

9.4.4.1 Operate the sprayer for a minimum period of 1 h while maintaining the test pressure at the inlet of the sprayer.

Immediately on conclusion of the test, measure the quantity of water collected in each of the collectors in the spray coverage area and mark their values on graph paper. Plot the curves (isograms) by connecting the interpolated points of equal collection rates (see figure 6).

Compare the water distribution obtained on the spray coverage pattern with that given by the manufacturer.

9.4.4.2 The spray coverage pattern obtained from the test results shall conform generally to the pattern supplied by the manufacturer.

9.4.5 Trajectory height

9.4.5.1 Measure the trajectory height.

9.4.5.2 The trajectory height shall not exceed the height declared by the manufacturer.

10 Durability test

10.1 Test the four sprayers previously tested in 9.3. Operate the sprayers for 1 500 h at an inlet pressure equal to the test pressure. Conduct the tests using water that has passed through a filter with a mesh as recommended by the manufacturer for normal field conditions or, in the absence of such a recommendation, that has passed through a filter with apertures of 0,4 mm.

10.2 After this period,

a) the measured flowrate of the test sprayer shall remain within ± 10 % of the initial flowrate; and

b) the sprayer shall show no visible defects on completion of the durability test.

11 Data to be provided by manufacturer

The manufacturer shall make available to the user appropriate information on irrigation sprayers in the form of catalogues, instructions or data sheets, all bearing marks of identification and date of issue.