
**Irrigation equipment — Irrigation
sprinklers —**

Part 4:
Test methods for durability

*Matériel d'irrigation — Sprinklers d'irrigation —
Partie 4: Méthodes d'essai concernant la durabilité*

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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).

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For an explanation of 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 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 18, *Irrigation and drainage equipment and systems*.

A list of all parts in the ISO 15886 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Irrigation equipment — Irrigation sprinklers —

Part 4: Test methods for durability

1 Scope

This document specifies the conditions and methods for testing the durability of rotating sprinklers for irrigation.

The term sprinkler is used here in a broad generic sense and is meant to cover a wide variety of products as classified in ISO 15886-1, which applies to all irrigation sprinkler classifications having both static parts and moving parts during operation, as defined by the manufacturer.

For any given sprinkler, a wide range of nozzle configurations, operating conditions, and adjustments generates at least a theoretical need for a correspondingly large number of tests. Testing agencies and manufacturers can use interpolation techniques to reduce the number of actual test runs, provided accuracy standards are still being met.

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 15886-3:2012, *Agricultural irrigation equipment — Sprinklers — Part 3: Characterization of distribution and test methods*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1 ambient temperature

temperature of the air surrounding a sprinkler

3.2 area of coverage

area within the wetted boundary from a sprinkler operated within the range of effective application rates specified in the manufacturer's literature

3.3 clean water

water processed, if necessary, so as to contain suspended particles no larger than 74 microns (200 mesh) equivalent and to contain no dissolved chemicals known to have short-term effects on sprinkler materials

**3.4
distribution curve**

graphical plot of water application depth as a function of distance from a sprinkler along a specified radius

**3.5
distribution uniformity**

DU
coefficient using the lowest 25 % of water application depths to characterize the uniformity of field-measured or simulated water application from a grid of sprinklers

**3.6
flow rate**
volume of water passing through a device per unit of time

**3.7
full grid collector arrays**
collectors located at the intersections of a two-dimensional geometric grid pattern sufficient in number to give a desired statistical basis for determining water *distribution uniformity* (3.5)

**3.8
inlet connection size**
nominal pipe size designation for commercial purposes or for manufacturer's declaration defined by reference to a recognized standard

**3.9
maximum working pressure**
 P_{\max}
highest water pressure at the inlet to a sprinkler recommended by the manufacturer to ensure proper operation

**3.10
minimum working pressure**
 P_{\min}
lowest pressure at the inlet to a sprinkler recommended by the manufacturer to ensure proper operation

**3.11
nozzle**
aperture of a sprinkler through which the water is discharged

**3.12
nozzle pressure**
pressure measured immediately upstream from a *nozzle* (3.11) or as inferred by a Pitot tube measurement at the nozzle orifice

**3.13
nozzle size**
numerical size designation used for commercial purposes with no specific relationship to the actual dimensions of a nozzle

**3.14
part-circle sprinkler**
sprinkler with an adjustable feature that enables it to irrigate a sector of a circular area, either with or without an attachment which enables it to be adjusted to irrigate another sector or the entire circular area

**3.15
regulated sprinkler**
sprinkler that maintains a relatively constant flow rate at varying water pressures at the sprinkler inlet within the limits specified by the manufacturer

3.16**radius of throw**

distance measured from a centreline of a continuously operating sprinkler to the most remote point at which the sprinkler deposits water at the minimum effective application rate, measured at any arc of coverage except near the arc extremes for *part-circle sprinklers* (3.14), also called wetted radius

3.17**rotating sprinkler**

water distribution device which, as a result of rotating motion around its axis, distributes water over a circular area, part of a circular area or a non-circular area

3.18**statistical uniformity coefficient****UCS**

coefficient using standard deviation as a measure of dispersion in statistical theory to characterize the uniformity of field-measured water application from a full grid of sprinklers

3.19**test pressure**

pressure at the inlet of a sprinkler declared by the manufacturer as the pressure to be used for test purposes

3.20**working pressure**

water pressure recommended by the manufacturer to ensure proper operation of a sprinkler

4 Installation of sprinklers under test

The sprinkler selected for testing shall be representative of general production capabilities particularly as it relates to speed of rotation.

Mount the test sprinkler in accordance with the manufacturer's installation instructions for normal operation in the field including the manner of installation, tightening torque, maximum/minimum force required to assemble.

Mount the sprinkler on a riser with nominal size designation the same as the sprinkler inlet connection. Ensure that the riser is fixed rigidly vertically and that it does not vibrate enough to cause a visual effect on the sprinkler operation, bend or deviate from the vertical position during the test. The maximum allowable deviation from the vertical position during the test is 2°.

The use of a steel pipe or a rigid plastic riser is recommended to provide the required mechanical strength and facilitate the installation of a standard pressure tap.

If the manufacturer specifies any special operating conditions on items that are provided as standard equipment with the sprinkler, they shall be used.

For a sprinkler which is not riser-mounted as described above, the test mounting shall be as specified by the manufacturer.

5 Measurements**5.1 Accuracy of measurements**

Pressure shall be measured with an accuracy of $\pm 1,0$ %.

Flow rate through the sprinkler shall be measured with an accuracy of $\pm 2,0$ %.

Temperature shall be measured with an accuracy of $\pm 0,5$ °C.

Time shall be measured with a stop watch.

The accuracy required for other measurements not specifically specified in this document is $\pm 3,0$ %.

5.2 Pressure measurement

The test pressure shall be measured at the height of the main nozzle. Refer to ISO 15886-3 for pressure tap construction. There shall be no flow obstructions between the pressure tap and the sprinkler base.

6 Test conditions

Clean water shall be used for the test and be filtered through a 130 micron (120 mesh) filter.

The test pressure shall not change by more than 5 %. The water temperature during the test shall be 5 °C to 35 °C.

Chemicals may be added to the water to prevent the precipitation of scale in the test sprinkler provided they do no harm to the sprinkler construction, water passages, nozzle or to the operating properties of the sprinkler. If, at the end of the durability test, scale was deposited on the sprinkler parts, it may be removed chemically or mechanically provided that no damage, as mentioned above, will happen to the sprinkler.

The test shall be performed in an installation fulfilling the following conditions.

- There shall be no effect of atmospheric conditions (rain, wind, solar radiation) on the operation of the sprinkler.
- There shall be no algae or other microorganism growth in the water and on the test sprinkler.
- The water flow from the sprinkler shall not affect its operation, e.g. return spray from the test facility walls on the operating mechanism of the sprinkler.

For part circle sprinklers, see ISO 15886-3:2012, Annex B.

7 Tests to be performed before durability test

7.1 Resistance to hydrostatic pressure at ambient temperature

7.1.1 General

Connect the sprinkler to the test bench and plug the outlet of the nozzles in such a manner that no leakage occurs at the connection during the test. For nozzles that cannot be plugged, perform the test in the operating position of the sprinkler. The sprinkler may be prevented from rotating during the test by mechanical means. The connection of the sprinkler to the supply line shall be made according to recommendations of the manufacturer for field assembly.

Check that no air remains in the system then gradually increase the water pressure beginning with one quarter of the nominal working pressure in stages of 100 kPa holding the system pressure for 5 s at each pressure stage.

7.1.2 Metal sprinklers

Raise the water pressure to 2 times the maximum working pressure, P_{\max} , and maintain that level for 10 min at ambient temperature.

7.1.3 Plastic sprinklers

Raise the water pressure to 2,4 times the maximum working pressure, P_{\max} , and maintain that level for 1 h at ambient temperature.

7.1.4 Requirements

To comply with this document, no defects in the sprinkler body shall appear during the test and no leakage shall occur through the sprinkler body or its gaskets. Leakage through the sliding bearings of the rotating sprinklers is permitted.

7.2 Water tightness

The test shall be performed as follows:

Connect the sprinkler with its nozzles to the supply pipeline according to the service conditions recommended by the manufacturer.

Increase the water pressure from P_{\min} to P_{\max} in steps of 100 kPa and maintain the pressure at each step for 1 min. Throughout the test, the total leakage of the sprinkler shall be collected by suitable means.

The tightness test shall be performed after 24 h of sprinkler operation at the maximum test pressure.

To comply with this document:

- a) the total leakage rate shall not exceed 2 % of the sprinkler flow rate at the test pressure;
- b) for sprinkler nominal flowrate ≤ 250 l/h the leakage rate shall not exceed 5 l/h; and
- c) there shall be no leakage through the threaded connection to the supply line.

7.3 Flow rate as a function of inlet pressure

7.3.1 General

The test shall be performed on a sample of five sprinklers of the same model and of the same nominal flow rate.

7.3.2 Test method

Test each sprinkler in pressure increments not greater than 50 kPa, from 0 to 1,2 P_{\max} , such that at least four values at four different pressures are obtained. Wait at least 3 min after reaching the test pressure to measure the flow rate.

For regulated sprinklers, continue the test by decreasing the pressure from 1,2 P_{\max} to 0 in the same increments used during testing at increasing pressures.

If the actual inlet pressure exceeds the desired inlet pressure by more than 10 kPa during its rise and fall, return to zero pressure and repeat the test.

7.3.3 Non-regulated sprinklers

Calculate the average flow rate \bar{q} for each pressure level, in litres per hour, by measuring the flow rate of the sprinkler at increasing pressures.

Plot the curve of \bar{q} as a function of the inlet pressure. The curve shall conform to the manufacturer's published curve within an allowable deviation of not more than ± 7 %.

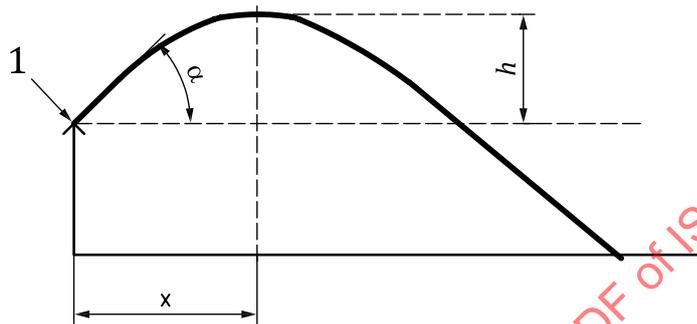
7.3.4 Regulated sprinklers

Calculate the average flow rate \bar{q} for each inlet pressure, in litres per hour, by measuring the flow rates of the sprinklers at increasing and decreasing pressure (the average of eight flow rate measurements).

Plot the curve of \bar{q} as a function of inlet pressure. The curve shall not deviate from the nominal flow rate by more than $\pm 7\%$.

7.4 Trajectory height

The test shall be performed according to ISO 15886-3:2012, 7.2, with reference to [Figure 1](#).



Key

- 1 sprinkler nozzle
- α trajectory angle
- h trajectory height

Figure 1 — Trajectory height

The trajectory height shall conform to the manufacturer’s declared height within an allowable deviation of $\pm 5\%$.

7.5 Radius of throw and water distribution curve

7.5.1 Perform the test as specified in ISO 15886-3. Test 3 similar sprinklers.

Perform the test along one radius at no wind conditions.

Operate the sprinkler for 1 h maintaining the test pressure at the inlet to the sprinkler.

Measure the quantity of water collected in each of the collectors to the most remote point at which the sprinkler deposited water at one of the following minimum rates:

- a) 0,26 mm/h, for a sprinkler whose flow rate exceeds 120 l/h;
- b) 0,13 mm/h, for a sprinkler whose flow rate is equal to or less than 120 l/h.

Measure the distance to the collector corresponding to condition a) or b).

Repeat the test and calculate r_t , the average of the two distances measured in the two tests.

7.5.2 Radius of throw

The radius of throw of the sprinkler is the average of four measurements of r_t , made when the sprinkler base is rotated a quarter revolution about its axis for each measurement, or by placing the collectors along four radii perpendicular to each other.

A single radius may be used when testing indoor under no wind conditions.

The radius of throw shall conform to the values supplied by the manufacturer within a permissible deviation of $\pm 10\%$.

7.5.3 Distribution curve

Calculate the water application rate, h (mm/h), using [Formula \(1\)](#):

$$h = \frac{V}{A} \times \frac{1}{t} \quad (1)$$

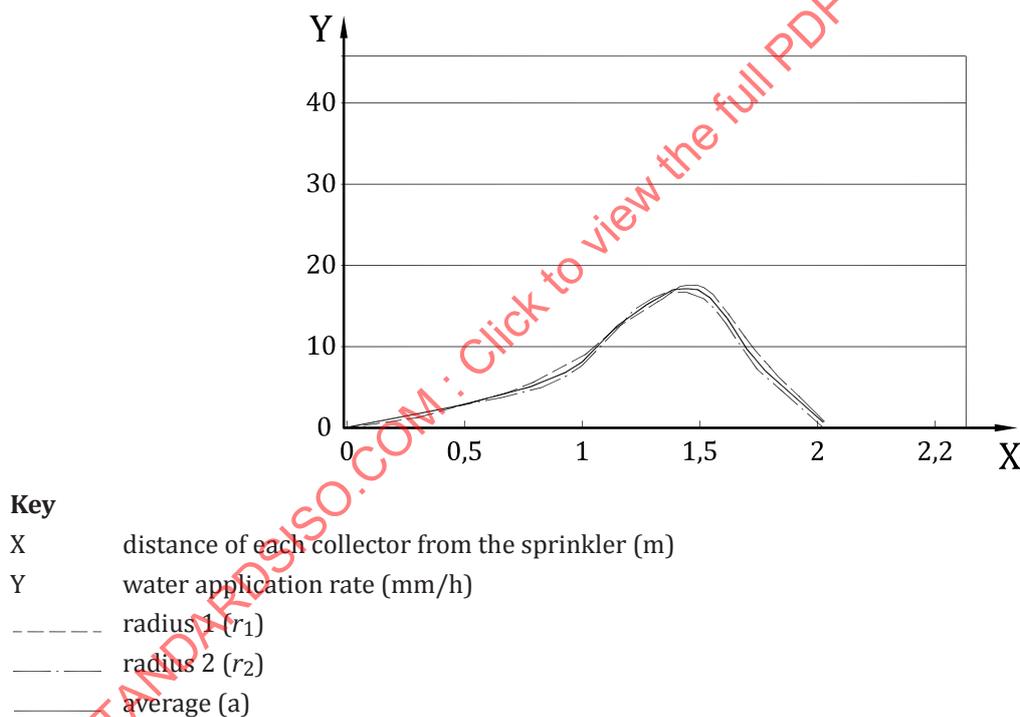
where

V is the volume, in litres, collected in each collector;

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

t is the test duration, in hours.

Plot the water distribution curve for all collectors measured as a function of the distance of the collector to the sprinkler along the radius. Calculate and plot the average water distribution curve (see [Figure 2](#)).



Key

X distance of each collector from the sprinkler (m)

Y water application rate (mm/h)

----- radius 1 (r_1)

_____ radius 2 (r_2)

_____ average (a)

Figure 2 — Water distribution curve

The sprinklers shall meet the following requirements.

- No point on the distribution curve of the tested sprinklers shall deviate by more than $\pm 0,25$ mm/h or $\pm 15\%$ from the corresponding point on the average distribution curve.
- No point on the average distribution curve shall deviate by more than $\pm 0,25$ mm/h or $\pm 15\%$ from the corresponding point on the distribution curve supplied by the manufacturer.

7.6 Uniformity of rotation (for rotating sprinklers intended to rotate in a uniform manner)

This test applies to sprinklers with a flow rate greater than 300 l/h and rotation speed lower than one revolution per 8 s.

While mounted on a vertical riser, operate the sprinkler at its nominal test pressure and measure the time required for each quarter revolution separately. Repeat the measurement five times.

Compute the average time required for a quarter revolution and the greatest deviations, expressed as a percentage, from the average.

To comply with this document, the extreme deviations from the average shall not exceed $\pm 10\%$.

8 Operating time of durability test

8.1 Operate the sprinklers for 2 000 h at the test pressure. A sprinkler that the manufacturer declares has a maximum lifetime that is less than 2 000 h shall be operated at the maximum lifetime declared by the manufacturer.

8.2 Operate the sprinklers for 5 days a week, 24 h per day, stop the operation for two days and then continue this alternating sequence until conclusion of the operating time according to [8.1](#).

8.3 For each day of operation, the following shall be recorded: operating pressure, water temperature and any irregularities.

9 Examination of sprinkler after durability test

9.1 General

The following tests shall be performed after completion of the durability test:

9.2 Construction of sprinkler and its parts

Visually examine the sprinkler, including water passages, moving parts, seals and springs, for any wear, comparing it with a new sprinkler. For sprinklers intended to be disassembled (nozzles, operating mechanism), disassemble the sprinkler prior to the visual examination.

Record any changes such as cracks, changes in water passages, abraded areas, changes in the construction, changes in the colours of plastic parts, scale sedimentation and other defects.

9.3 Resistance to hydrostatic pressure at ambient temperature

9.3.1 Repeat the test as described in [7.1](#).

9.3.2 The sprinklers shall meet the requirements in [7.1](#). However, the leakage through the sliding bearing shall not exceed 4 % of the sprinkler flow rate at the nominal pressure.

9.4 Flow rate as a function of inlet pressure

9.4.1 Repeat the test described in [7.3](#).

9.4.2 The curve \bar{q} shall not deviate more than $\pm 10\%$ from the curve provided by the manufacturer for nonregulated sprinklers.