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Agricultural irrigation equipment — Emitters — Specification and test methods

Matériel agricole d'irrigation — Goutteurs — Spécifications et méthodes d'essai

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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.

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.

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Agricultural irrigation equipment — Emitters — Specification and test methods

1 Scope

This International Standard specifies mechanical and functional requirements of agricultural irrigation emitters, test methods and the data to be supplied by the manufacturer to permit correct installation and operation in the field.

It applies to emitters, with or without pressure regulation, intended for irrigation; it does not apply to emitters which form an integral part of the pipe during manufacture.

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 3501:1976, *Assembled joints between fittings and polyethylene (PE) pressure pipes — Test of resistance to pull out.*

ISO 8779:—[1], *Polyethylene (PE) pipes for irrigation laterals — Specifications.*

3 Definitions

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

3.1 emitter: Device fitted to an irrigation lateral and intended to emit water in the form of drops or continuous flow at emission rates not exceeding 15 l/h per outlet, except during flushing.

3.2 in-line emitter: Emitter intended for installation between two lengths of pipe (irrigation lateral).

3.3 on-line emitter: Emitter intended for direct or indirect (e.g. by means of tubing) installation in the wall of the irrigation lateral.

3.4 multiple-outlet emitter: Emitter in which the output flow is divided and directed to several distinctly different locations.

3.5 unregulated [non-compensating] emitter: Emitter of varying emission rate at varying water pressures at emitter inlet.

3.6 regulated [pressure-compensating] emitter: Emitter of relatively constant emission rate at varying water pressures at the emitter inlet within the limits specified by the manufacturer.

3.7 emitter inlet: Point at which water enters the emitter.

3.8 emitter outlet: Opening, or group of all the openings in an emitter, from which water is emitted and directed to one clearly distinguishable location.

3.9 irrigation lateral: Branch supply pipe or tubing fitted with emitters.

3.10 nominal test pressure, p_n: Reference pressure of 100 kPa at the inlet of the unregulated emitter, or any other pressure so designated in manufacturer publications.

3.11 range of working pressures: Range of water pressures at the emitter inlet, between and including the minimum working pressure, p_{min}, and the maximum working pressure, p_{max}, recommended by the emitter manufacturer to ensure proper operation.

1) To be published.

3.12 range of regulation: Range of pressures at the inlet of the regulated emitter in which the emitter discharges water within the range of the emission rates, as specified by the manufacturer.

3.13 nominal emission rate, q_n:

(1) Unregulated emitter: Emission rate, in litres per hour, of the emitter at nominal test pressure and at a water temperature of 23 °C, as specified by the manufacturer.

(2) Regulated emitter: Emission rate, in litres per hour, of the emitter operating in the range of regulation and at a water temperature of 23 °C, as specified by the manufacturer.

(3) Multiple-outlet emitter: Emission rate of each outlet.

4 Classification

Emitters are classified, according to their uniformity of emission rate of regulation, into two uniformity categories.

a) Uniformity category A: Emitters having higher uniformity of emission rates and smaller deviations from the specified nominal emission rate (and for regulated emitters, better regulation of emission rates).

b) Uniformity category B: Emitters having lower uniformity of emission rates and greater deviations from the specified nominal emission rate (and for regulated emitters, inferior regulation of emission rates).

NOTE 1 The requirements for each category are defined in 9.1 and 9.2.

5 Marking

Each emitter shall bear clear and permanent markings including the following details:

a) name of manufacturer or his registered trademark;

b) nominal emission rate, in litres per hour;

c) arrow indicating the direction of flow (if important for proper operation).

Nominal emission rate [see b)] may be indicated by the colour of any part of the emitter, or by any other method described in the manufacturer's literature.

6 Construction and materials

6.1 Connections

Emitter connections to the supply shall be as required by the manufacturer, provided that the connection complies with the requirements of this International Standard relating to resistance to internal hydraulic pressure and to pull-out force. The manufacturer shall supply any special tools required for installation.

6.2 Emitter ends

When polyethylene (PE) pipe is used, in-line emitter ends shall not increase the diameter of the polyethylene (PE) pipe by more than 20 %.

NOTE 2 Dimensions of the polyethylene (PE) pipe laterals are specified in ISO 8779.

6.3 Materials

The materials used in emitter construction shall be suitable for use with water, fertilizers and chemicals commonly used in irrigation, including treated sewage water.

The materials shall, insofar as possible, not support the growth of algae and bacteria, nor be of metal which will corrode. Plastics parts of the emitter that are exposed to light shall be opaque and protected against UV degradation.

7 Test specimens and conditions

7.1 Test specimens

Test specimens shall be selected at random by the representative of the test laboratory from a lot of at least 500. The total number of test specimens shall be at least 25. The number of test specimens required for each test is specified in the relevant clause.

7.2 Test conditions

For test purposes, test specimens shall be assembled on a pipe, following the recommendations of the manufacturer as to type of pipe, assembly tools and connection. When polyethylene (PE) pipe is used, the pipe shall comply with the requirements of ISO 8779.

The use of grease or chemicals that may affect the properties of the pipe or the emitters is prohibited when attaching emitters to pipes.

If the manufacturer supplies the emitters assembled on the pipe, the lengths of such emitter assemblies may be used as test samples.

All the tests shall be carried out at a water temperature of 23 °C ± 1 °C. The water used shall be filtered through a filter with nominal aperture of 75 µm to 100 µm (160 mesh to 200 mesh) or as recommended by the manufacturer.

7.3 Accuracy of measuring devices

The water pressure shall be measured with an error not exceeding 2 % of the actual value.

During the test, the pressure shall not vary by more than 2 %.

The emission rate of the emitter shall be measured with an error not exceeding 2 % of the actual value.

8 Mechanical tests and requirements

8.1 Construction and workmanship

If designed for disassembly, disassemble at least three emitters into their component parts. If not, prepare a cross-section of the emitters. Inspect for visual defects.

The emitter and its parts shall show no manufacturing defects, such as grooves or projections in flow path surfaces, cracks or cavities, which may adversely affect emitter operation.

8.2 Flow paths in emitter

Measure in at least three emitters, accurately to the nearest 0,02 mm and under no pressure, the smallest dimension of the flow path. (This does not apply to a dimension that varies with pressure.)

The smallest measured flow path dimension shall not be smaller than the dimension declared by the manufacturer.

8.3 Resistance to hydrostatic pressure

Connect one end of the emitter pipe assembly to a source of hydraulic pressure and plug the other end of the assembly.

Perform the test on at least five emitters connected to a lateral.

Carry out the test in two stages (8.3.1 and 8.3.2).

8.3.1 Test the watertightness of the assembly as follows.

Increase the pressure in three steps:

— 5 min at 0,4 maximum working pressure;

— then another 5 min at 0,8 maximum working pressure;

— then 60 min at 1,2 maximum working pressure.

No leakage shall occur through the emitter bodies or their connections to the pipe, except at points of emitter discharge.

8.3.2 Immediately after completion of stage 8.3.1, raise the pressure to twice the maximum working pressure and maintain for 5 min.

The emitters shall withstand the test pressure without suffering damage and without pulling out from the assembly.

8.3.3 If the emitter contains parts that can be disassembled for cleaning or replacement and reassembled, the tests in 8.3.1 and 8.3.2 shall be performed after reassembling the emitter, according to the manufacturer's instructions, three times in succession.

8.4 Emitter pull-out

This test shall be conducted at an ambient temperature of 23 °C ± 2 °C.

8.4.1 In-line emitters

Perform the test on at least three lengths of lateral, each containing one emitter. Gradually apply an axial tensile force to produce a pull-out force, F, in newtons, on the two lengths of pipe connected to the emitter, where F is calculated from the following formula, and shall not be greater than 500 N:

$$F = 1{,}5\pi\sigma_t e(D - e)$$

where

σ_t is the permissible induced stress for pipe material, in newtons per square millimetre (e.g., polyethylene PE 25: σ_t = 2,5 N/mm²);

e minimum pipe wall thickness, in millimetres;

D outside diameter of the pipe, in millimetres.

Apply this force, F, for 1 h, with the emitter vertical, by means of a weight or by the apparatus described in ISO 3501.

The emitters shall withstand the pull-out force, F, without the pipes pulling out.

8.4.2 On-line emitters

Gradually apply a pulling force of 40 N on the emitter, perpendicular to the pipe, for 1 h (see figure 1).

The emitter shall withstand the pulling force without pulling out of the pipe wall.

Dimensions in millimetres

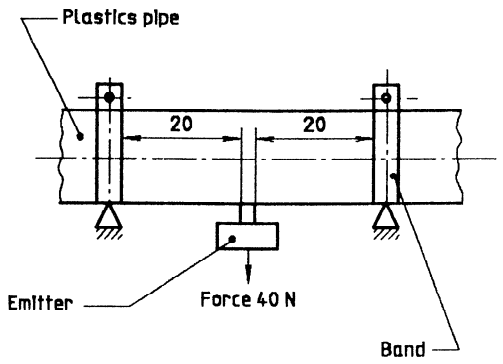

Figure 1

9 Functional tests and requirements

9.1 Uniformity of emission rate

9.1.1 Number of test samples

The number of test samples shall be as follows:

a) Single-outlet emitter: at least 25 emitters;

b) Multiple-outlet emitter: at least 25 outlets, and not less than 10 emitters. All the outlets of the emitters in the sample shall be open, and all of them shall be included in the test.

9.1.2 Unregulated emitters

Measure the emission rates of the emitters in the test sample when the water pressure at the emitter inlets equals the nominal test pressure. Record separately the measured emission rate at each emitter outlet.

If the emitter contains movable parts, condition the emitter as described in 9.1.3 before conducting the test.

Calculate the coefficient of variation, C_v, from the following formula:

$$C_v = \frac{s_q}{\bar{q}} \times 100$$

where

s_q is the standard deviation of the emission rates for the sample;

$\bar{q}$ is the mean emission rate of the sample.

The following requirements shall be met:

a) The mean emission rate of the test sample shall not deviate from the nominal emission rate, q_n, by more than 5 % for category A, nor more than 10 % for category B.

b) The coefficient of variation, C_v, of the emission rate of the test sample shall not exceed 5 % for category A nor 10 % for category B.

For multiple-outlet emitters, the requirements in a) and b) shall apply both to the emission rates of the individual outlets and to the emission rates of the complete emitters.

9.1.3 Regulated emitters

Condition the emitters in the test sample by operating them for 1 h minimum at an emitter inlet pressure equal to the pressure at the middle of the working pressure range. At the beginning of conditioning, the emitters shall be operated three times at about p_{max} and three times at about p_{min}, each operation to be maintained for at least 3 min. During the last 10 min of conditioning, the pressure shall be maintained at the mid-point of the regulation range.

Immediately afterwards, and without altering the inlet pressure, test the emitters according to 9.1.2, but at the mid-point of the regulation range.

The emitters shall comply with the requirements of 9.1.2.

9.2 Emission rate as function of inlet pressure

The tests to be performed to determine emission rate as a function of pressure shall be made in continuation of the tests performed in accordance with 9.1.

9.2.1 Selection of test samples

Number the emitters tested according to 9.1, in ascending order according to the measured emission rate, No. 1 being the lowest emission rate emitter, No. 25 the highest.

Take four emitters from the series obtained — Nos. 3, 12, 13, 23 — and measure their change in emission rate as a function of the inlet pressure.

Test each emitter in steps not greater than 50 kPa, from zero pressure up to 1,2 p_{max}. Regulated emit-

ters shall be tested at three or more different pressures within the range of regulation, at rising and falling inlet pressures. The reading of the results shall be taken at least 3 min after reaching the test pressure.

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

9.2.2 Unregulated emitters

Calculate, for each pressure level, the average emission rate $\bar{q}$ obtained by measuring the emission rates of the four emitters at rising pressure.

Plot the curve $\bar{q}$ as a function of inlet pressure.

The curve of $\bar{q}$ shall conform to the curve presented in manufacturer publications within an allowable deviation of ± 5 % at any pressure.

9.2.3 Regulated emitters

Calculate for each inlet pressure level, p, the average emission rate, $\bar{q}$, obtained by measuring the emission rates of the four emitters at rising and falling pressure (the average of eight emission rate measurements).

The value of $\bar{q}$ shall not deviate from the nominal emission rate, q_n, by more than 5 % for category A, nor more than 10 % for category B.

9.3 Determination of emitter exponent

This determination applies only to regulated emitters.

The relation between the emission rate, q, in litres per hour, and the inlet pressure in an emitter, p, in kilopascals, is given by the formula:

$$q \simeq k \times p^m$$

where

k is a constant;

m is the emitter exponent.

Using all the $\bar{q}$ and p values obtained in 9.2.3, calculate the emitter exponent, m, from the following formula:

$$m = \frac{\sum (\lg p_i)(\lg \bar{q}_i) - \frac{1}{n}\left(\sum \lg p_i\right)\left(\sum \lg \bar{q}_i\right)}{\sum (\lg p_i)^2 - \frac{1}{n}\left(\sum \lg p_i\right)^2}$$

where

i is 1, 2, 3, ..., n;

n is the number of pressure values used in 9.2.3;

$\bar{q}$ is the average emission rate, in litres per hour;

p is the inlet pressure level, in kilopascals.

The value of the emitter exponent m shall not exceed 0,2.

10 Data supplied by manufacturer

The manufacturer shall make available to the user, together with the emitters, catalogues or information sheets that include the following data:

a) catalogue number of irrigation emitter;

b) the words "Uniformity category A" or "Uniformity category B" as applicable, including the relevant values given in table 1;

c) type of pipes suitable for use with the emitter and their dimensions;

d) type of connection of emitter to pipe;

e) the dimensions of the smallest flow path in the emitter;

f) nominal emission rate;

g) nominal test pressure;

h) range of working pressures;

i) range of regulation (if any);

j) emission rates as function of inlet pressures at different water temperatures;

k) regulation characteristics (for regulated emitters);

l) instructions for emitter assembly on pipe;

m) instructions for cleaning and replacement of emitters;

n) instructions for prevention of clogging of emitters;

o) limitations of emitter use (fertilizers, chemicals, etc.);

p) filtration requirements;

q) maintenance and storage requirements;

r) nominal emission rate during flushing, if applicable.

Table 1 — Uniformity values (according to 9.1)

Category	Parameter	
	Deviation of $\bar{q}$ from q_n max. %	Coefficient of variation, C_v max. %
A	± 5	± 5
B	± 10	± 10

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