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Agricultural irrigation equipment — Direct-acting pressure-regulating valves

Matériel agricole d'irrigation — Vannes de régulation de la pression à action directe

Reference number
ISO 10522:1993(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 10522 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Sub-Committee SC 18, *Irrigation and drainage equipment and systems*.

Annex A of this International Standard is for information only.

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Agricultural irrigation equipment — Direct-acting pressure-regulating valves

1 Scope

This International Standard specifies construction and performance requirements and test methods for direct-acting pressure-regulating valves (hereinafter "pressure regulators") intended for operation in irrigation systems, with water at temperatures not exceeding 50 °C, which may contain fertilizers and chemicals of types and in concentrations commonly used in agricultural irrigation. This International Standard applies to pressure regulators in nominal sizes up to and including 80 mm (3 in).

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 7-1:1982, *Pipe threads where pressure-tight joints are made on the threads — Part 1: Designation, dimensions and tolerances.*

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 7005-1:1992, *Metallic flanges — Part 1: Steel flanges.*

ISO 7005-2:1988, *Metallic flanges — Part 2: Cast iron flanges.*

ISO 9644:1993, *Agricultural irrigation equipment — Pressure losses in irrigation valves — Test method.*

ISO 9911:1993, *Agricultural irrigation equipment — Manually operated small plastics valves.*

3 Definitions

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

3.1 direct-acting pressure-regulating valve; pressure regulator: Valve in which the water passage widens or narrows automatically to maintain a relatively constant pressure at the outlet of the pressure regulator under varying pressures or flowrates at the inlet of the pressure regulator.

3.2 ordinary pressure regulator: Pressure regulator intended for installation upstream from an irrigation device, and constituting an independent unit.

3.3 single-range pressure regulator: Pressure regulator with a fixed pressure setting which cannot be varied.

3.4 multi-range pressure regulator: Pressure regulator with alternative pressure settings that may be changed by replacing regulating components (springs, discs, etc.), but not by external adjustment.

3.5 adjustable pressure regulator: Pressure regulator whose pressure setting can be adjusted externally without requiring replacement of parts in the regulation assembly.

3.6 integral pressure regulator: Pressure regulator which is an integral part of an irrigation device or is fitted specifically to a particular irrigation device.

3.7 regulated pressure: Water pressure at the outlet of a pressure regulator (p_1 in figure A.2).

3.8 regulation range: Range of water pressure at the inlet of the pressure regulator (starting at the initial regulation pressure) including the regulated pressures within the accuracy range specified in this International Standard.

3.9 comprehensive regulation range: All the possible regulated pressures or regulation ranges that can be obtained with a pressure regulator by the addition, reduction or replacement of regulating components (springs, discs, etc.).

3.10 nominal pressure: Maximum static working pressure at which a piping component is stated to operate under normal service conditions.

3.11 nominal size: Conventional numerical designation used to indicate the size of the pressure regulator. This designation represents the nominal diameter or thread size of the pipe which can be connected to the pressure regulator without an intermediate fitting.

NOTE 1 A single number designation is adequate if the inlet and outlet ports are the same size.

3.12 minimum flowrate, q_{min}: Lowest flowrate at which the regulated water pressure is within the range of accuracy specified by this International Standard.

3.13 initial regulation pressure: Lowest pressure at the inlet of the pressure regulator at which the regulated water pressure within the accuracy permissible by this International Standard is attained (p_i in figure A.2).

3.14 declared preset pressure, p_D: Preset water pressure at the outlet of the pressure regulator as preset and declared by the manufacturer using a reference velocity of 1 m/s (see figure A.2).

3.15 regulated pressure at zero flow: Regulated water pressure when pressure is applied at the inlet of the pressure regulator and the pressure regulator outlet is closed.

3.16 regulation assembly: Portion of the pressure regulator consisting mainly of working parts that narrow or widen the water passages in the pressure regulator to maintain a constant pressure.

3.17 reference velocity, v_{ref}: Velocity of flow through the pressure regulator calculated by dividing the actual flowrate through the pressure regulator by the reference cross-section of the pressure regulator.

3.18 reference cross-section, A_{ref}: Cross-section of the pressure regulator, in square metres, calculated from the formula:

$$A_{ref} = \frac{\pi}{4}\left(\frac{D_{nom}}{1\,000}\right)^2$$

where D_{nom} is the nominal diameter of the pressure regulator which is the subject of this International Standard, in millimetres.

3.19 accuracy level: Deviation of the outlet pressure from the pressure setting or setting declared by the manufacturer.

3.20 adjustable stop: Device used to adjust the movement range of the operating mechanism up to full opening or closing of the valve.

4 Classification

Pressure regulators are classified as in 4.1 to 4.4.

4.1 According to construction of regulation assembly

Class 4.1.1 Single-range pressure regulator

Class 4.1.2 Multi-range pressure regulator

Class 4.1.3 Single-range adjustable pressure regulator

Class 4.1.4 Multi-range adjustable pressure regulator

4.2 According to construction of pressure regulator

Class 4.2.1 Ordinary pressure regulator

Class 4.2.2 Integral pressure regulator

4.3 According to regulated pressure at zero flow

Class 4.3.1 Pressure regulator in which the regulated pressure equals the inlet pressure at zero flow

Class 4.3.2 Pressure regulator in which the regulated pressure does not equal (is less than) the inlet pressure at zero flow

4.4 According to accuracy level [see 8.4.2.4 b)]

Class 4.4.1 Pressure regulators with accuracy level A (± 10 %)

Class 4.4.2 Pressure regulators with accuracy level B (± 20 %)

5 Marking

With the exception of integral pressure regulators (which are an integral part of the irrigation device and bear its marking), each pressure regulator shall bear readily visible, clear and durable marking including the following:

a) manufacturer's name and/or trademark;

b) nominal size;

c) nominal pressure;

d) arrow indicating direction of flow;

e) markings to indicate direction of adjustment, for classes 4.1.3 and 4.1.4:

+ to increase regulated pressure,

– to reduce regulated pressure.

In addition, each pressure regulator or package of pressure regulator(s) shall carry a label specifying:

f) the declared preset pressure;

g) the accuracy level — A or B — of the regulator (see 4.4);

h) allowable temperature range.

The declared preset pressure given on the attached label or on the label to the packaging may be indicated by colour or by any other marking, as explained in the manufacturer's catalogue.

In multi-range pressure regulators (class 4.1.2) and in multi-range adjustable pressure regulators (class 4.1.4), the parts that can be replaced to vary the regulated pressure shall be marked by colour or by any other marking, as explained in the manufacturer's catalogue.

6 Sampling and acceptance requirements

6.1 Type tests

The sample of test specimens shall be taken at random by a representative of the test laboratory from a quantity of at least 20 pressure regulators. The number of test specimens required for each test shall be as specified in table 1.

If the pressure regulators are not produced as a regular production series and the number of pressure regulators produced is less than 50, no requirement is stipulated as to the sampling procedure.

The size of the sample for pressure regulators of a nominal size of up to 15 mm (1/2 in) inclusive shall be 25.

The size of the sample for pressure regulators with a nominal size of 20 mm (3/4 in) or greater shall be 10.

The tests shall be performed as prescribed in table 1.

If the number of defective test specimens is equal to or less than the acceptance number given in table 1, the lot shall be acceptable. If the number of defective test specimens found in the test is greater than the acceptance number given in table 1, the lot shall be rejected.

6.2 Acceptance tests

When acceptance of manufacturing lots or of shipments of pressure regulators is required, the sampling shall be conducted according to ISO 2859-1:1989, based on acceptable quality level (AQL) 2,5 and inspection level S-4.

All test specimens in the sample selected at random according to table II-A of ISO 2859-1:1989 shall be tested according to 8.3 and 8.10. The shipment or manufacturing lot complies with this International Standard and is acceptable 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, the number of test specimens shall be selected at random from the sample according to table 1. The shipment or manufacturing lot complies with this International Standard and is acceptable if the number of defective test specimens found in the other tests does not exceed the acceptance number specified in table 1.

Tests specified in 8.10 and clause 9 may be performed on the same specimens as those used for previous tests.

7 Technical characteristics

7.1 General

The parts of the pressure regulator that are in contact with water shall be of non-toxic materials, and shall be resistant to, or protected against, corrosion in the working conditions for which the pressure regulator is intended.

All parts belonging to pressure regulators of the same size, type and model designed so as to allow dismantling and produced by the same manufacturer shall be interchangeable.

Plastics parts of the pressure regulator that are exposed to ultraviolet (UV) radiation in the normal working conditions under which the pressure regulators operate shall include additives to improve their resistance to UV radiation. Plastics parts that enclose waterways shall be opaque or shall be provided with an opaque cover designed to block all light from reaching clear waterway enclosures.

Table 1 — Required number of test specimens and acceptance number for mechanical, functional and durability tests

Clause number	Name of test	Number of test specimens	Acceptance number
8.2	Regulation uniformity	(see 8.2)	
8.3	Tightness of pressure regulator with adjustable stop	3	1
8.4	Regulation curve	2	0
8.5	Regulated pressure as function of pressure regulator adjustment	2	0
8.6	Regulated pressure at zero flow	2	0
8.7	Regulated pressure as function of inlet pressures, at constant flowrate	2	0
8.8	Regulation curve of integral pressure regulator	2	0
8.9	Pressure loss	2	0
8.10	Resistance of pressure regulator body to internal hydrostatic pressure	5	0
clause 9	Durability	2	0

7.2 Pressure regulator body

Pressure regulators with threaded ends shall be provided with a hexagonal boss or with other means for gripping. The face-to-face distance of the flanged bodies of the pressure regulators shall not deviate from the length declared by the manufacturer in his catalogue, or other material describing the specifications of the pressure regulator, by more than ± 2 mm.

7.3 Adjustment assembly

Balancing the regulated pressure to the pressure regulator set point is accomplished by means of a spring. The chamber containing the spring shall be sealed to prevent entry of water except in those cases where all the components within the chamber are constructed from corrosion-resistant materials. The housing of the adjustment assembly shall be constructed so as to prevent locking of the pressure regulator due to entry of water.

If the housing of the adjustment assembly is threaded to the pressure regulator body, it shall be equipped with a hexagonal boss or similar means to facilitate disassembly and reassembly.

The adjustment assembly of the pressure regulators shall be equipped with a handle, slot, a polygonal part, or similar means to permit adjustment.

7.4 Connections

The manufacturer may use one of the following connection methods:

a) threaded ends for direct connection to the supply line: these shall comply with ISO 7-1; however, other threads shall be allowed, provided that a suitable adaptor is supplied with each threaded connection making it comply with ISO 7-1;

b) flanged connections: these shall comply with ISO 7005-1 or ISO 7005-2;

c) other suitable means of connection.

7.5 Adjustable stop

Where the pressure regulator has an adjustable stop, it shall permit adjustment of the regulation assembly to full opening and full closing of the water passages.

The adjustable stop shall be easily adjusted, positive, and not subject to loosening by vibration. When assembled on a stem, the handle shall be mechanically secured to the stem.

The adjustable stop and its parts shall effectively resist an opening or a closing torque, in newton metres, numerically equal to the nominal size in millimetres or to 25 times the nominal size in inches.

8 Mechanical and functional tests

Integral pressure regulators shall be tested only according to 8.1, 8.2, 8.3, 8.7, 8.8, 8.9 and 8.10.

8.1 General

Unless otherwise specified, perform all tests with fresh, debris-free water, at a water temperature of 10 °C to 30 °C. Pass the water used in the mechanical and functional tests through a strainer filter with a 120 µm strainer element. The permissible deviation of the measuring devices from the actual value shall be ± 2 %. Calibrate the measuring devices according to the existing calibration rules of the country concerned.

Before performing the functional tests, beginning with 8.2, condition the pressure regulator by operating it for 5 min at the initial regulation pressure, for 5 min at nominal pressure, and then for 10 min at 1,5 times the declared preset pressure, using a flowrate equivalent to a reference velocity of 1 m/s.

8.2 Regulation uniformity (in non-adjustable pressure regulators)

The test sample size shall be in accordance with 6.1.

8.2.1 Conduct the test according to the class of pressure regulator as follows.

a) For ordinary pressure regulators (class 4.2.1), measure the regulated pressure in each pressure regulator of the sample at an inlet pressure of 1,5 times the declared preset pressure and at a flowrate equivalent to a reference velocity of 1 m/s.

b) For integral pressure regulators (class 4.2.2), measure the flowrate through each pressure regulator at an inlet pressure of 1,5 times the declared preset pressure.

8.2.2 From the results obtained in the tests in 8.2.1, calculate the coefficient of variation, CV, from the following formulae:

for ordinary pressure regulators:

$$CV = \frac{s_p \times 100}{p}$$

for integral pressure regulators:

$$CV = \frac{s_q \times 100}{q}$$

where

s_p is the sample standard deviation of the regulated pressures;

s_q is the sample standard deviation of the flowrates;

p is the mean regulated pressure of the sample;

q is the mean flowrate of the sample.

The pressure regulators shall meet the following criteria.

a) For ordinary pressure regulators, the average regulated pressure of the sample shall not deviate from the declared preset pressure by more than 7 %.

b) For integral pressure regulators, the average flowrate of the sample shall not deviate from the flowrate declared by the manufacturer by more than 5 %.

c) For ordinary pressure regulators, the coefficient of variation, CV, shall not be greater than 10 %.

d) For integral pressure regulators, the coefficient of variation, CV, shall not be greater than 7 %.

8.3 Tightness of pressure regulator with adjustable stop

Move the adjustable stop to its fully closed position. When the adjustable stop is actuated by rotating the stem, apply a closing torque, in newton metres, numerically equal to the nominal size in millimetres. Apply a hydraulic pressure at the inlet of the pressure regulator, and raise it gradually to the nominal pressure declared by the manufacturer. Maintain this pressure for 1 min.

The pressure regulator shall show no signs of leakage at the outlet of the pressure regulator.

8.4 Regulation curve

8.4.1 Installation

Install the pressure regulator in a test assembly similar to that shown in figure 1. Take any steps necessary to avoid air pockets in the test apparatus.

NOTE 2 If difficulties arise in regulating the flow with valves D_1 and D_2, an additional pressure regulator or a flow regulator may be installed after the test specimen, R_x.

8.4.2 Test results and requirements

8.4.2.1 Test the pressure regulator and plot a curve of the regulated pressure as a function of the flowrate through the pressure regulator at a constant inlet pressure.

Each curve shall represent the measured regulated pressure at five different flowrates (reference velocities), as follows:

a) the regulated pressure at: 0,5 m/s; 1 m/s; 1,5 m/s; and 2 m/s;

b) in addition, record the regulated pressure at zero flow.

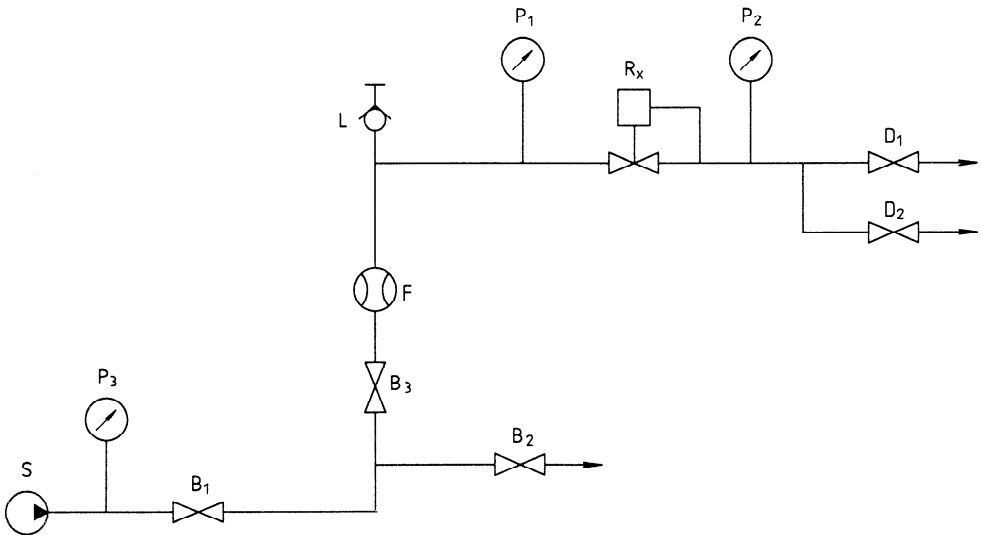
8.4.2.2 The flow during the course of the test shall not vary by more than ± 2 %.

8.4.2.3 Test the pressure regulator and plot the curves for three different inlet pressures, as follows:

a) 1,5 times the declared preset pressure;

b) 0,8 times the nominal pressure;

c) the inlet pressure at the middle of the regulation range.



Key

R_x	Test specimen
P_1	Pressure gauge inlet of pressure regulator
P_2	Pressure gauge at outlet of pressure regulator (optional for integrated pressure regulator)
F	Flowrate meter
S	Source of water
P_3	Pressure gauge at source
D_1 , D_2	A flowrate control device as follows: — for ordinary pressure regulators: valves for varying the flowrate at outlet — for integral pressure regulators: a device for which they are specifically fitted
L	Air release valve
B_1 , B_2 , B_3	Auxiliary valves for control of test conditions

Figure 1 — Test assembly

8.4.2.4 The pressure regulators shall meet the following criteria.

a) The regulation curve shall at each point match the regulation curve given in the manufacturer's catalogue within a permissible deviation of ± 5 %.

b) Increasing the reference velocity of the water by 1 m/s, from 0,5 m/s to 1,5 m/s and from 1 m/s to 2 m/s, shall not cause the measured regulated pressure to vary by more than 10 % from the declared preset pressure for accuracy level A regulators, and 20 % from the declared preset pressure for accuracy level B regulators.

8.4.3 Single-range pressure regulators (class 4.1.1)

Test the pressure regulator and plot the three curves as described in 8.4.2.3.

8.4.4 Multi-range pressure regulators (class 4.1.2)

Test the pressure regulator and plot the three curves as described in 8.4.2.3 for each spring or other replaceable part affecting the regulation pressure and listed in the manufacturer's catalogue (with the exception of the spacing discs).

8.4.5 Single-range adjustable pressure regulators (class 4.1.3)

Test the pressure regulator and plot the three curves as described in 8.4.2.3 described for each of the following preset pressures:

a) minimum preset pressure (pressure regulator set to extreme minus [−] position);

b) maximum preset pressure (pressure regulator set to extreme plus [+] position);

c) pressure regulator set to the arithmetic mean of the minimum and maximum preset pressures.

8.4.6 Multi-range adjustable pressure regulators (class 4.1.4)

Test the pressure regulator and plot the curves specified in 8.4.5 for each spring or other replaceable part listed in the manufacturer's catalogue (with the exception of the spacing discs).

8.5 Regulated pressure as function of pressure regulator adjustment in pressure regulators of classes 4.1.3 and 4.1.4

8.5.1 Install the pressure regulator in the test assembly shown in figure 1 and set the presetting assembly to its extreme minus (−) position. At the inlet of the pressure regulator, apply a pressure equal to 1,25 times the maximum preset pressure and adjust the flowrate to a reference velocity of 1 m/s. Vary the means of presetting in equal steps and measure the regulated pressure at each step up to the extreme plus (+) position of the presetting means. Plot the curve of the regulated pressure as a function of the pressure-regulating adjustment.

8.5.2 The curve of the pressure regulators shall at any point match the curve appearing in the manufacturer's catalogue within a permissible deviation of ± 10 %.

8.6 Regulated pressure at zero flow (in pressure regulators of class 4.3.2)

8.6.1 Install the pressure regulator in the test assembly shown in figure 1. At the inlet of the pressure regulator, apply a pressure equal to 1,5 times the declared preset pressure, and then close the valve downstream of the pressure regulator. The duration of closing shall be about 5 s. Then 10 min after closing, measure the pressure at the pressure regulator inlet and outlet. Repeat the test with the maximum inlet pressure and with the pressure at the middle of the regulation range.

8.6.2 The regulated pressure of the pressure regulators at zero flow shall not exceed the sum of the nominal regulated pressure and 25 % of the pressure at the inlet of the pressure regulator during the test.

8.7 Regulated pressure as function of inlet pressure at constant flowrate

8.7.1 General

8.7.1.1 Install the pressure regulator in the test assembly shown in figure 1. At the inlet of the pressure regulator, apply gradually increasing pressures rising from zero, through the declared preset pressure, up to the nominal pressure of the pressure regulator, in steps of 50 kPa, then decreasing in steps of 50 kPa back to zero, and measuring the regulated pressure at each step. Ensure that the flowrate in the pressure regulator corresponds to a reference velocity of 1 m/s and is constant throughout the test.

8.7.1.2 Plot the pressure curves of the regulators as described in 8.7.2.1, 8.7.2.2, 8.7.2.3 or 8.7.2.4. The pressures shall meet the following criteria.

a) Within the entire range of regulation, the regulated pressure shall not vary from the declared preset pressure by more than ± 10 % for accuracy level A pressure regulators, and by more than ± 20 % for accuracy level B pressure regulators.

b) The variations in regulated pressure during pressure rise and fall at the inlet of the pressure regulator shall not exceed 10 % of the declared preset pressure plus 2 % of the inlet pressure.

The pressure curves shall be prepared in accordance with 8.7.2.

8.7.2 Plotting pressure curves

8.7.2.1 Pressure curves for single-range pressure regulators (class 4.1.1)

Plot the curve of the regulated pressure as a function of the inlet pressure, at a constant flowrate, for the single preset pressure attainable in this pressure regulator.

8.7.2.2 Pressure curves for multi-range pressure regulators (class 4.1.2)

Plot the curve of each of the preset pressures attainable in the pressure regulator by replacing the springs or by other means (but not by addition of discs, etc.).

8.7.2.3 Pressure curves for single-range adjustable pressure regulators (class 4.1.3)

Plot the curves for each of the following pressures:

a) minimum preset pressure (pressure regulator set to extreme minus [−] position);

b) maximum preset pressure (pressure regulator set to extreme plus [+] position);

c) pressure regulator set to the arithmetic mean of the minimum and maximum preset pressures.

8.7.2.4 Pressure curves for multi-range adjustable pressure regulators (class 4.1.4)

Plot the curves specified in 8.7.2.3 for each of the preset pressures attainable in the pressure regulator by replacing the springs or by other means (but not by addition of discs, etc.).