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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
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Foreword

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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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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*.

This second edition cancels and replaces the first edition (ISO 10522:1993), which has been technically revised.

The main changes compared to the previous edition are as follows.

— The range of pressure regulators sizes has been extended up to DN 100 (4").

— The water temperature of the irrigation system has been harmonized to 60 °C.

— The normative references have been updated.

— The terms and definitions have been updated.

— The testing water temperature range has been updated to 4 °C to 35 °C.

— The face-to-face distance of the flanged bodies of the pressure regulators has been updated to ±4 mm for plastics-body regulators.

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.

Agricultural irrigation equipment — Direct-acting pressure-regulating valves

1 Scope

This document 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 60 °C, which can contain fertilizers and chemicals of types and in concentrations commonly used in agricultural irrigation.

This document applies to pressure regulators in nominal sizes up to and including 100 mm (4 in).

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 7-1, *Pipe threads where pressure-tight joints are made on the threads — Part 1: Dimensions, tolerances and designation*

ISO 7005-1, *Pipe flanges — Part 1: Steel flanges for industrial and general service piping systems*

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

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

ISO 24649:—,[1)] *Agricultural irrigation equipment — Manually and hydraulically operated plastics valves*

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 https://www.electropedia.org/

3.1
direct-acting pressure-regulating valve
pressure regulator
valve in which the water passage widens or narrows automatically without an external device to maintain the pressure at the outlet of the valve close to a pre-set value under varying pressures or flow rates at the inlet of the valve

Note 1 to entry: It is also called direct-acting pressure regulator.

3.2
ordinary pressure regulator
pressure regulator intended for installation upstream from an irrigation device and not integrated into the irrigation device or fitted specifically to it

1) Under preparation. Stage at the date of publication: ISO/DIS 24649:2021.

3.3
single-range pressure regulator
pressure regulator with a fixed non-adjustable pressure setting which cannot be varied

Note 1 to entry: See also see Annex A, Figure A.1.

3.4
multi-range pressure regulator
pressure regulator with alternative pressure settings and regulation ranges that may be changed by replacing pressure regulator components such as springs and discs but not by external adjustment

3.5
adjustable pressure regulator
pressure regulator in which the pressure setting can be adjusted externally without requiring replacement of parts in the regulation assembly

3.6
integral pressure regulator
pressure-regulating valve which is an integral part of an irrigation device or is fitted specifically to the particular irrigation device

3.7
regulated pressure
water pressure at the outlet of a pressure regulator

3.8
regulation range
all of the working pressures at the inlet of a pressure regulator within which the pressure regulator is declared by the manufacturer to regulate pressure within a specified accuracy

Note 1 to entry: See also Annex A, Figure A.2.

3.9
nominal pressure
PN
maximum static working pressure at which a piping component is stated to operate under normal service conditions

3.10
nominal diameter
DN
numerical designation used to refer to the size of a pressure regulator approximately equal to the diameter of the pipe or pipes to which the pressure regulator is to be connected directly

3.11
minimum flow rate
q_{min}
lowest flow rate at which the pressure regulating valve is designed to operate within the maximum permissible error

3.12
initial regulation pressure
lowest pressure at the inlet of a pressure regulator at which the *regulated pressure* (3.7) is within the range of regulation

3.13
declared pre-set pressure
P_s
pressure at the outlet of a pressure regulator pre-set and declared by the manufacturer using a *reference velocity* (3.16) of 1 m/s

3.14
regulated pressure at zero flow
regulated pressure (3.7) when pressure is applied at the inlet of a pressure regulator and the outlet of the pressure regulator is closed

3.15
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

3.16
reference velocity
v_{ref}
velocity of flow through the valve calculated from the actual flow rate through the valve divided by the area of a circle with diameter equal to the nominal DN

3.17
accuracy level
deviation of the outlet pressure from the pressure setting or from the setting declared by the manufacturer

3.18
adjustable stop
device used for adjusting the range of movement of the operating mechanism up to full opening or closing of a hydraulically operated valve

4 Pressure regulator classification

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 7.5.2.4 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 pre-set pressure;

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

h) allowable temperature range.

The declared pre-set 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 Technical characteristics

6.1 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 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.

6.2 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 for metal-body regulators or ±4 mm for plastics-body regulators.

6.3 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 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.

6.4 Connections

The manufacturer shall use one of the following connection methods:

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

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

c) other suitable means of connection.

6.5 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.

7 Mechanical and functional tests

7.1 Overview

Integral pressure regulators shall be tested only according to 7.2, 7.3, 7.4, 7.8, 7.9, 7.10 and 7.11.

The test sample size and the acceptance number shall be in accordance with Table 1.

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
7.3	Regulation uniformity	3	1
7.4	Tightness of pressure regulator with adjustable stop	3	1
7.5	Regulation curve	2	0
7.6	Regulated pressure as function of pressure regulator adjustment	2	0
7.7	Regulated pressure at zero flow	2	0
7.8	Regulated pressure as function of inlet pressures, at constant flow rate	2	0
7.9	Regulation curve of integral pressure regulator	2	0
7.10	Pressure loss	2	0
7.11	Resistance of pressure regulator body to internal hydrostatic pressure	5	0
Clause 8	Durability	2	0

7.2 General

It is considered that, with the exception of the test where work is done with small volumes of water, it is possible to control the water temperature. The hydraulic characteristics test and the endurance test shall be carried out at a water temperature of 4 °C to 35 °C.

Clean water shall be used in tests. 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 7.3, 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 pre-set pressure, using a flow rate equivalent to a reference velocity of 1 m/s.

7.3 Regulation uniformity (in non-adjustable pressure regulators)

7.3.1 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 pre-set pressure and at a flow rate equivalent to a reference velocity of 1 m/s.

b) For integral pressure regulators (class 4.2.2), measure the flow rate through each pressure regulator at an inlet pressure of 1,5 times the declared pre-set pressure.

7.3.2 From the results obtained in the tests in 7.3.1, calculate the coefficient of variation, CV, Formula (1) for ordinary pressure regulators:

$$CV = \frac{s_p \times 100}{p} \tag{1}$$

or Formula (2) for integral pressure regulators:

$$CV = \frac{s_q \times 100}{q} \tag{2}$$

where

s_p is the sample standard deviation of the regulated pressures;

s_q is the sample standard deviation of the flow rates;

p is the mean regulated pressure of the sample;

q is the mean flow rate 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 pre-set pressure by more than 7 %.

b) For integral pressure regulators, the average flow rate of the sample shall not deviate from the flow rate 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 %.

7.4 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, metrically 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.

7.5 Regulation curve

7.5.1 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.

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.

7.5.2 Test results and requirements

7.5.2.1 Test the pressure regulator and plot a curve of the regulated pressure as a function of the flow rate through the pressure regulator at a constant inlet pressure.

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

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

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

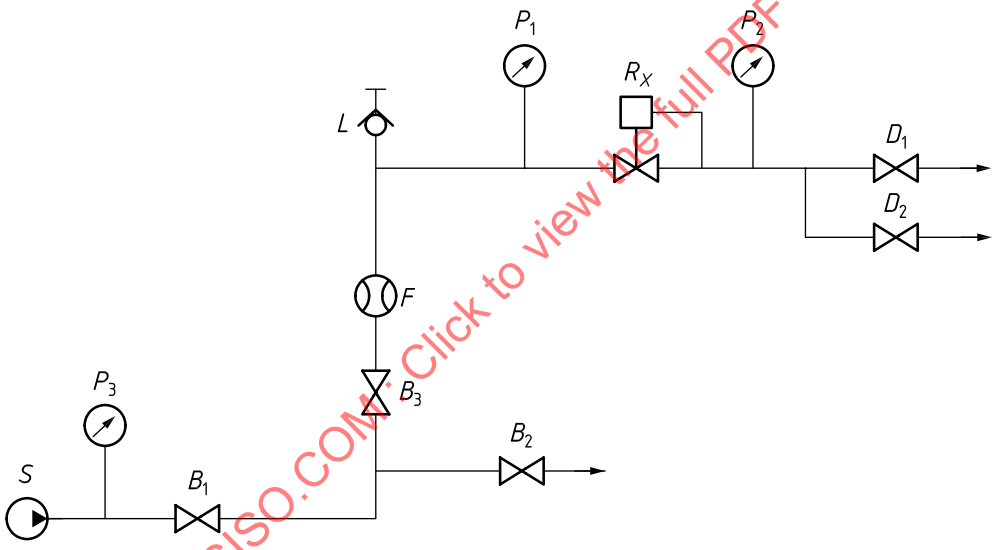
7.5.2.2 The flow during the course of the test shall not vary by more than ±2 %.

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

a) 1,5 times the declared pre-set 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	flow meter
S	source of water
P_3	pressure gauge at source
D_1 , D_2	flow rate control device as follows: — for ordinary pressure regulators: valves for varying the flow rate 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

7.5.2.4 The pressure regulators shall meet the following criteria.

a) The regulation curve (see Annex A, Figure A.2) 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 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 pre-set pressure for accuracy level A regulators, and 20 % from the declared pre-set pressure for accuracy level B regulators.

7.5.3 Single-range pressure regulators (class 4.1.1)

Test the pressure regulator and plot the three curves as described in 7.5.2.3.

7.5.4 Multi-range pressure regulators (class 4.1.2)

Test the pressure regulator and plot the three curves as described in 7.5.2.3 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).

7.5.5 Single-range adjustable pressure regulators (class 4.1.3)

Test the pressure regulator and plot the three curves as described in 7.5.2.3 described for each of the following pre-set pressures:

a) minimum pre-set pressure [pressure regulator set to extreme minus (–) position];

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

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

7.5.6 Multi-range adjustable pressure regulators (class 4.1.4)

Test the pressure regulator and plot the curves specified in 7.5.5 for each spring or other replaceable part listed in the manufacturer's catalogue (with the exception of the spacing discs).

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

7.6.1 Install the pressure regulator in the test assembly shown in Figure 1 and set the pressure to the minimum setting of the regulation range. At the inlet of the pressure regulator, apply a pressure equal to 1,25 times the maximum pre-set pressure and adjust the flow rate to a reference velocity of 1 m/s. Vary the pressure in equal steps and measure the regulated pressure at each step up to the maximum setting of the regulation range. Plot the curve of the regulated pressure as a function of the pressure setting.

7.6.2 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 %.

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

7.7.1 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 pre-set pressure and then close the valve downstream of the pressure regulator. The duration of the test 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.

7.7.2 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.

7.8 Regulated pressure as function of inlet pressure at constant flow rate

7.8.1 General

7.8.1.1 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 pre-set 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 flow rate in the pressure regulator corresponds to a reference velocity of 1 m/s and is constant throughout the test.

7.8.1.2 Plot the pressure curves of the regulators as described in 7.8.2.1, 7.8.2.2, 7.8.2.3 or 7.8.2.4. The pressures shall meet the following criteria.

a) Within the entire range of regulation, the regulated pressure shall not vary from the declared pre-set 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 pre-set pressure plus 2 % of the inlet pressure.

The pressure curves shall be prepared in accordance with 7.8.2.

7.8.2 Plotting pressure curves

7.8.2.1 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 flow rate, for the single pre-set pressure attainable in this pressure regulator.

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

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

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

Plot the curves for each of the following pressures:

a) minimum pre-set pressure [pressure regulator set to extreme minus (–) position];

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

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

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

Plot the curves specified in 7.8.2.3 for each of the pre-set pressures attainable in the pressure regulator by replacing the springs or by other means (but not by addition of discs, etc.).

7.9 Regulation curve of integral pressure regulators (class 4.2.2)

7.9.1 Install the integral pressure regulator together with the irrigation device for which it is specifically fitted in the test assembly. At the inlet of the pressure regulator, apply gradually increasing

pressures, rising from zero, through the declared pre-set 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 flow rate in the pressure regulator at each step.

7.9.2 The pressure regulators shall meet the following criteria.

a) Within the entire range of regulation, the flow rate in the pressure regulator during the rise in pressure shall not vary by more than ±10 % of the nominal flow rate as declared by the manufacturer.

b) The variation in flow rate at any given pressure within the regulation range during the rise and fall in pressure at the pressure regulator inlet shall not exceed ±10 % of the nominal flow rate as declared by the manufacturer.

The procedures specified in 7.8.2 should also be followed when testing the different classes of integral pressure regulators.

7.10 Pressure loss

7.10.1 Measure the pressure loss with the water passages in the fully open position, obtained by preventing compression of the spring.

For pressure regulators equipped with an adjustable stop, set the adjustable stop to the fully open position.

Conduct the test as described in ISO 9644.

7.10.2 The pressure loss of the pressure regulator measured at a particular flow rate shall not exceed the pressure loss declared by the manufacturer for the same flow rate.

7.11 Resistance of pressure regulator body to internal hydrostatic pressure

7.11.1 General

This test is performed with the pressure regulator open and the water reaching all parts which are subjected to water pressure under normal working conditions.

7.11.2 Metal-body pressure regulators

7.10.2.1 Apply a hydraulic pressure at the inlet and outlet ports of the pressure regulator, and gradually increase the pressure over a period of not less than 15 s to 1,5 times the nominal pressure declared by the manufacturer. Maintain this pressure for 5 min.

8.11.2.2 No signs of leakage through the pressure regulator body shall be visible and no water shall enter the chamber containing the spring except in those cases where all the components within the chamber are constructed from corrosion-resistant materials.

7.11.3 Plastics-body pressure regulators

7.11.3.1 Plastics moulded material of pressure regulator body

The test shall be performed according to ISO 24649:—, A.1, and shall meet the test requirements.

7.11.3.2 Shell test

With the pressure regulator open as described in 7.11.1, perform the test according to ISO 24649:—, A.2. The test specimen shall meet the requirements of ISO 24649:—.

8 Durability

The test sample size and the acceptance number shall be in accordance with Table 1.

Connect the pressure regulator to a suitable water supply source. Connect integral pressure regulators with the device for which they are specifically fitted. Operate the pressure regulators, as described in 8.1, for a duration of 2 000 cycles. The duration of each cycle should be long enough that on opening the control valve, the flow rate through the pressure regulator reaches the full value corresponding to a reference velocity of 1 m/s before the beginning of the closing portion of the cycle. A tolerance of ±15 % shall be allowed in flow rates and pressures during the durability test.

8.1 On/off cycles

8.1.1 Operate the pressure regulator at an inlet pressure equal to twice the declared pre-set pressure and at a flow rate corresponding to a reference velocity of 1 m/s.

8.1.2 After reaching the reference velocity of 1 m/s, stop the water flow through the pressure regulator as follows:

a) for ordinary pressure regulators, by closing the valve(s) downstream from the pressure regulator (the closure should be slow enough to avoid any appreciable water hammer); or

b) for integral pressure regulators, by slowly closing the valve upstream from the pressure regulator (the closure should be slow enough to avoid any appreciable water hammer).

8.2 Changing condition cycles

8.2.1 General

Adjustable pressure regulators shall be set to the middle of the regulation range before conducting the test.

Pressure regulators with springs that can be replaced to obtain different regulated pressures shall be tested for the spring that produces a regulated pressure near the middle of the range proposed by the manufacturer.

8.2.2 For ordinary pressure regulators

Set the control devices D_1 and D_2 (see Figure 1) so that when both are open, the flow through the pressure regulator corresponds to a reference velocity of 1 m/s, and when D_2 is closed but D_1 is open, the flow rate through the regulator is the minimum flow rate recommended by the manufacturer. Cycle device D_2 on and off with each cycle lasting long enough to allow the flow rate through the valve to return to the value corresponding to a reference velocity of 1 m/s.

8.2.3 For integral pressure regulators

Set the water supply conditions so that when valve B_2 (see Figure 1) is closed, the pressure at the inlet to the regulator is twice the declared pre-set pressure, but when valve B_2 is open, it is equal to the declared pre-set pressure. Cycle valve B_2 on and off, with each cycle lasting long enough to allow the desired pressure at the inlet to the pressure regulator to be achieved.