SLOVENSKI STANDARD

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Oprema za namakanje kmetijskih površin - Izgube tlaka na ventilih cevovodov - Metoda preskušanja

Agricultural irrigation equipment -- Pressure losses in irrigation valves -- Test method

Matériel agricole d'irrigation -- Pertes de pression dans les vannes d'irrigation -- Méthode d'essai

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INTERNATIONAL STANDARD

ISO 9644

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Agricultural irrigation equipment — Pressure losses in irrigation valves — Test method

Matériel agricole d'irrigation — Pertes de pression dans les vannes d'irrigation — Méthode d'essai

Reference number
ISO 9644:1993(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 9644 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*.

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Agricultural irrigation equipment — Pressure losses in irrigation valves — Test method

1 Scope

This International Standard specifies a test method to determine the pressure loss in irrigation valves under steady-state conditions when water flows through them. The valve performance specifications presented are of such scope and accuracy as to assist irrigation system designers when comparing pressure losses through various types of irrigation valves.

The measurement of pressure losses provides a means for determining the relationship between pressure loss and flow-rate through the valve.

This International Standard also describes the method of reporting pertinent test data.

No attempt is made to define product use, design or applications.

NOTE 1 The equations relate to SI units unless otherwise specified and not to practical units. (See table 1.)

2 Definitions

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

2.1 nominal size, D_{nom}: Conventional numerical designation used to indicate the size of an irrigation valve. This designation equals the nominal diameter or thread size of the pipe to which the valve can be connected without intermediate fittings.

NOTE 2 A single number designation is adequate if the inlet and outlet ports are the same size.

2.2 flow-rate, q_V: Volume of water flowing through the valve per unit time.

2.3 pressure loss, Δp: Difference in pressure due to water flow between two specified points in a system, or in part of a system.

2.4 piping pressure loss, Δp_p: Pressure loss in the upstream and downstream portions of the test bench piping between the pressure tappings, but excluding the pressure loss in the valve tested.

2.5 bench pressure loss, Δp_b: Pressure loss in the test bench between the pressure tappings upstream and downstream of the valve tested.

2.6 valve pressure loss, Δp_v: Pressure loss in the valve tested.

2.7 reference velocity, v_{ref}: Velocity of flow through the valve calculated from the actual flow-rate through the valve divided by the reference cross-section of the component.

2.8 reference cross-section, A_{ref}: Cross-section of the valve, in square metres, calculated from the equation:

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

where D_{nom} is the nominal size of the valve, in millimetres.

2.9 steady flow: State of flow where the flow-rate through a cross-section does not vary with time.

2.10 valve flow coefficient, k_v: Number equal to the flow-rate of water, in cubic metres per hour, that will flow through a fully open valve with a one bar pressure loss across the valve.

2.11 valve pressure loss coefficient, k: Coefficient used in non-dimensional presentation of valve loss. It is defined by the equation:

$$k = \frac{2\Delta p_v}{\varrho \times v_{ref}^2} \qquad \ldots (2)$$

where

Δp_v is the valve pressure loss (2.6);

ϱ is the mass density;

v_{ref} is the reference velocity (2.7).

3 Symbols and units

The symbols and units used in this International Standard are shown in table 1.

4 Test installation

4.1 Permissible deviation of measuring devices

The permissible deviation of the measuring devices from the measured value shall be as follows:

Flow-rate	± 2 %
Differential and actual pressure	± 2 %
Temperature	± 1 °C

The measuring devices shall be calibrated according to the existing calibration rules in the country concerned.

4.2 Test equipment

4.2.1 Piping

Upstream and downstream piping shall be the same diameter as that of the test valve connection. The lengths of the straight, uniform-bore pipe shall be as specified in figure 1 or 2. The inside surface of the piping shall be free of flaking rust, mill scale and irregularities which might cause excessive turbulence.

In that part of the test apparatus shown within the frame, in figures 1 and 2, the order of the fittings/devices shown in the key and the distances between them shall be adhered to, with the exception that the lengths indicated as $5d$ and $10d$ shall be understood to be the minimum allowable length.

4.2.2 Throttling valve

A downstream throttling valve shall be used to control the flow through the test specimen. There are no restrictions as to the size or type of this valve. The whole test system up to the downstream throttling valve shall be made to run full. The throttling valve shall be located downstream of the downstream pressure tapping (used for measuring bench pressure).

4.2.3 Flow measuring device

Any device to measure flow with acceptable accuracy may be used. If a closed measuring device (such as a rotameter, a venturi meter or similar device) is used, it shall be located either upstream of the upstream pressure tapping or downstream of the downstream pressure tapping.

Table 1 — Symbols and units

Definition clause	Term	Symbol	SI unit[1]	Practical unit(s)
2.2	Flow-rate	q_V	m^3/s	l/s, m^3/h
2.1	Nominal size (of valve)	D_{nom}	m	mm
2.7	Reference velocity	v_{ref}	m/s	m/s
2.3, 2.4, 2.5, 2.6	Pressure loss	Δp	Pa[2]	kPa, bar
2.10	Valve flow coefficient	k_v	—	m^3/h
2.11	Valve pressure loss coefficient	k	—	—
—	Mass density	ϱ	kg/m^3	kg/l

1) In accordance with ISO 1000:1992, *SI units and recommendations for the use of their multiples and of certain other units.*

2) 1 Pa = 1 N/m^2

If an open measuring device (such as a calibrated volumetric tank) is used, it shall be located at the downstream end of the assembly, that is, downstream of the downstream throttling valve.

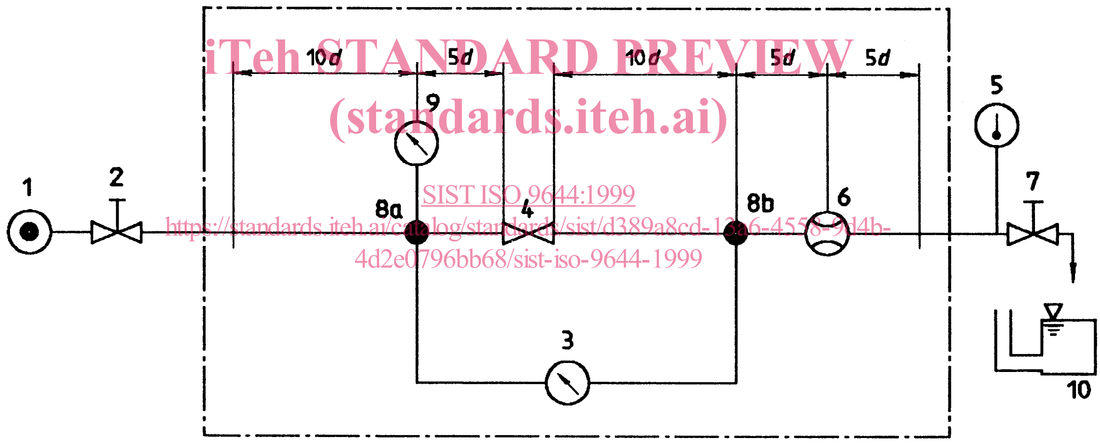
The flow-measuring device shall be installed in accordance with its specific installation instructions. Where it is necessary, the flow-measuring device shall be installed with the required length of straight piping before and/or after the device, according to the installation instructions.

4.2.4 Pressure differential measuring device

Any device capable of measuring pressure differential may be used.

4.2.5 Pressure tappings

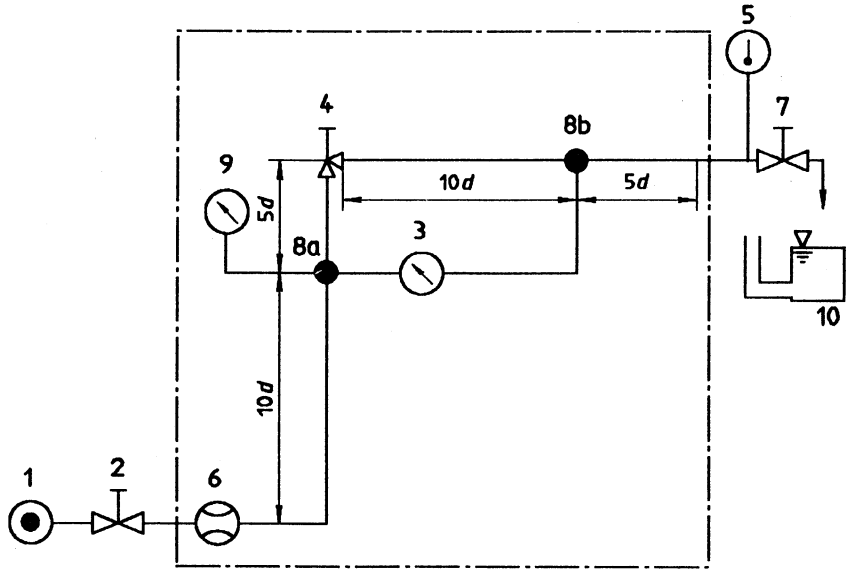
Pressure tappings (see figure 3) shall be provided on piping for measurement of static pressure, and spaced as shown in figure 1 or 2. The drilling centreline of the tappings shall intersect the centreline of the pipe perpendicularly. The tappings shall have a diameter, d_1, of no less than 2 mm and no greater than 9 mm. The length, l, of the tapping bore shall be not less than twice the diameter of the bore. For thin-wall pipes where the wall thickness is less than $2d_1$, a boss may be added to the pipe wall where the pressure tappings are to be located (see figure 3). Pressure tappings shall be free of burrs and other irregularities and the inside wall of the piping shall be machine-finished. For pipes of 50 mm diameter and larger, four tappings shall be made, situated 90° ± 5° apart on the circumference so that no tapping is located on the lowest point of the pipe circumference. For pipe diameters of less than 50 mm, two tappings will suffice. All tappings, whether two or four, shall be connected by a conduit whose bore shall not be less than two pressure tapping cross-sections. The pressure tappings shall provide appropriate values of d_1 and l, and can be made as illustrated in figure 3.



Key

1 Controllable water supply
2 Shut-off valve
3 Pressure differential measuring device
4 Test specimen, in-line valve
5 Temperature sensor
6 Flow measuring device, closed type (if used)
7 Throttling valve
8a Pressure tapping
8b Pressure tapping
9 Pressure gauge
10 Calibrated water tank (if used)
d Nominal pipe diameter

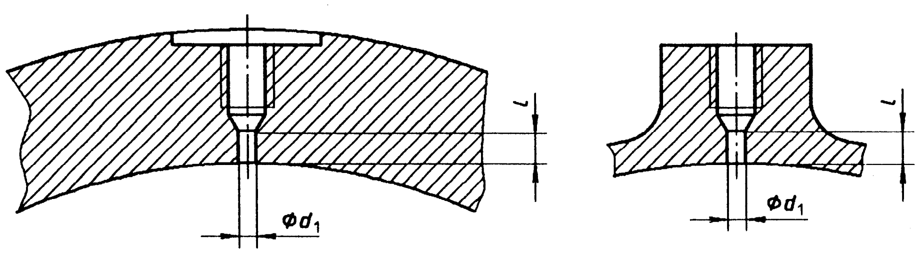
Figure 1 — Test circuit diagram for in-line valves



Key

1 Controllable water supply
2 Shut-off valve
3 Pressure differential measuring device
4 Test specimen, angle valve
5 Temperature sensor
6 Flow measuring device, closed type (if used)
7 Throttling valve
8a Pressure tapping
8b Pressure tapping
9 Pressure gauge
10 Calibrated water tank (if used)
d Nominal pipe diameter

Figure 2 — Test circuit diagram for angle valves



a) Thick wall

b) Thin wall

Figure 3 — Static pressure tappings in thick and thin wall piping

4.2.6 Temperature sensors

Any temperature-sensing device that is capable of measuring water temperature may be used. The device shall be located upstream of the throttling valve.

4.2.7 Filtration

If the valve manufacturer recommends the use of filtered water, a manufacturer-recommended filter shall be installed upstream of the test circuit.

5 Test procedure

5.1 Install the test specimen in a suitable circuit for testing valves, as shown in figure 1 or 2. The water temperature during the test shall be between 10 °C and 35 °C.

5.2 Record all readings only after steady flow conditions have been reached, and the flow is free from pulsations.

5.3 Measure the bench pressure losses, Δp_b, at the fully open position of the test specimen, unless specified otherwise in a specific standard, or as recommended by the manufacturer in the installation and operation instructions.

The bench pressure loss which is measured shall include the loss through the valve and the loss through the piping of the test set-up:

$$\Delta p_b = \Delta p_v + \Delta p_p \quad \ldots (3)$$

5.4 The test specimen shall be energized, opened or operated as normally done in agricultural irrigation practice.

5.5 Pressure-loss readings shall be determined and recorded for a minimum of five flow-rates (unless otherwise specified in a specific product standard). These shall include the maximum flow-rate, $q_{V,\max}$, minimum flow-rate, $q_{V,\min}$, and at least three intermediate flow-rates at approximately equal flow-rate intervals between maximum and minimum. The flow-rate closest to the average shall be referred to as $q_{V,\text{med}}$. The tests shall be conducted at a pressure approximately two-thirds of the specific nominal pressure of the valve.

5.6 Tests of pressure loss shall be conducted successively in progressive steps, first with increasing flow-rates followed by decreasing flow-rates (unless otherwise specified in a specific product standard).

5.7 The valve pressure loss, Δp_v, of the test specimen is calculated by subtracting the piping pressure loss, Δp_p, from the bench pressure loss, Δp_b, measured by the differential pressure measuring device:

$$\Delta p_v = \Delta p_b - \Delta p_p \quad \ldots (4)$$

The piping pressure loss, Δp_p, is determined by the following method. Remove the test specimen from the test assembly and connect pipe sections either directly or by means of a fitting that does not introduce significant pressure losses, and measure the piping pressure loss separately.

5.8 When the test specimen is supplied together with special fittings for connection to the water line, the connecting fittings are considered as part of the valve.

6 Test results

6.1 Presentation of test results

The pressure loss of the valve, Δp_v, measured and calculated as described in clause 5, shall be presented by one of the following two methods:

a) by means of a table, which lists values of pressure loss at corresponding flow-rates q_V [see 6.3 h)];

b) by means of a graph of pressure loss Δp_v as a function of flow-rate q_V.

NOTE 3 It is recommended that such a graph be presented on log-log paper.

If the results from the increasing and decreasing flow-rate tests are substantially the same (within a tolerance range up to 5 % of the higher value), then only one column of pressure loss values shall be tabulated [see a) above], or only one curve shall be shown [see b) above].

If the results from the increasing and decreasing flow-rate tests differ by more than the specified tolerance range of up to 5 % of the higher value, then two columns of pressure-loss values labelled for increasing and decreasing flow-rates shall be tabulated [see a) above], or two curves labelled for increasing and decreasing flow-rates shall be shown [see b) above].

6.2 Calculated valve coefficients

For valves with fixed internal geometry, i.e., valves whose internal cross-section remains unchanged by pressure or discharge variations, the following coefficients may be calculated from the data given in the table or graph described in 6.1.

6.2.1 Valve pressure loss coefficient, k

The pressure loss coefficient, k, is calculated from equation (2).