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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

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

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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 on 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 the following URL: 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 third edition cancels and replaces the second edition (ISO 9644:2008), which has been technically revised. The main changes compared to the previous edition are as follows:

— addition of Annexes A and B.

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

1 Scope

This document applies to manually-activated valves only.

This document specifies a test method for determining the pressure loss in agricultural irrigation valves under steady-state conditions when water flows through them. The scope and accuracy of the valve performance specifications presented will assist agricultural irrigation system designers in comparing pressure losses through various types of valves.

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

This document also describes the method of reporting pertinent test data.

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

The test method is suitable for valves with equal inlet and outlet nominal sizes.

2 Normative references

There are no normative references in this document.

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
nominal size
DN
conventional numerical designation used to indicate the size of an irrigation valve

3.2
volume flow rate
flow rate
q_V
volume of water flowing through the valve per unit time

3.3
pressure loss
Δp
difference in pressure due to water flow between two specified points in a system or in part of a system

3.4
piping pressure loss
Δp_p
pressure loss in the upstream and downstream portions of the test bench piping between the pressure taps, but excluding the pressure loss in the valve tested (see 5.4.4)

3.5
bench pressure loss
Δp_b
head loss between the pressure taps upstream and downstream from the measurement area without the device being tested

3.6
valve pressure loss
Δp_v
pressure loss in the valve tested

3.7
reference velocity
v_{ref}
velocity of flow through the valve calculated from the actual flow rate through the valve divided by the reference cross-sectional area of the valve

3.8
steady-state flow
state of flow where the flow rate through a cross-section does not vary with time

3.9
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

3.10
flow resistance coefficient
ζ
coefficient used in non-dimensional presentation of valve loss

4 Test installation

4.1 Permissible deviation of measuring devices

The permissible deviation of the reading indicated on the measuring devices from the actual 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 performing the test.

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. 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 Figure 1, 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 5*d* and 10*d* shall be understood to be the minimum allowable lengths.

4.2.2 Throttling valve

A downstream throttling valve shall be used to control the flow through the test specimen. There are no restrictions on the size or type of this valve. The throttling valve shall be located downstream of the downstream pressure tap (used for measuring bench pressure).

4.2.3 Flow measuring device

Locate the measuring device at the head of the system.

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

The flow-measuring device shall be installed in accordance with the specific installation instructions and, where applicable, shall be installed with the required length of straight piping before and after the device.

The accuracy of the measuring device shall be ±2 %.

4.2.4 Pressure differential measuring device

Any device capable of measuring pressure differential with acceptable accuracy may be used.

4.2.5 Pressure taps

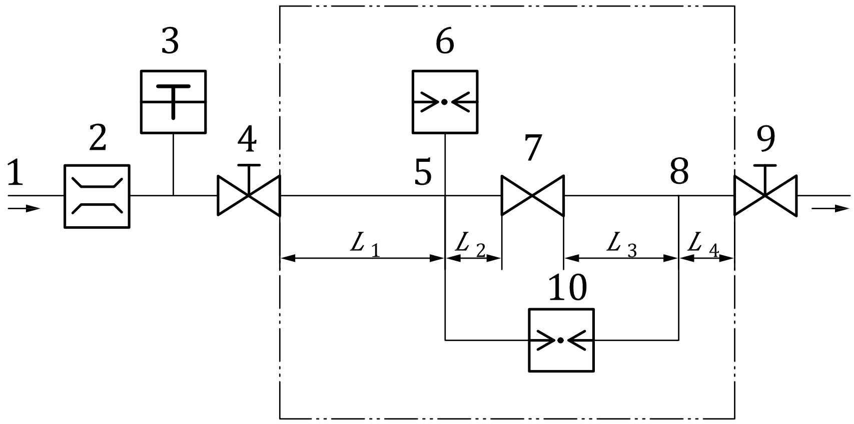
Pressure taps (see Figure 2) shall be provided on piping for measurement of static pressure, and spaced as shown in Figure 1. The drilling centreline of the taps shall intersect the centreline of the pipe perpendicularly, as shown in Figure 2. The diameter shall depend on the DN of the valve, see Table 1.

Table 1 — Pressure tap hole diameter

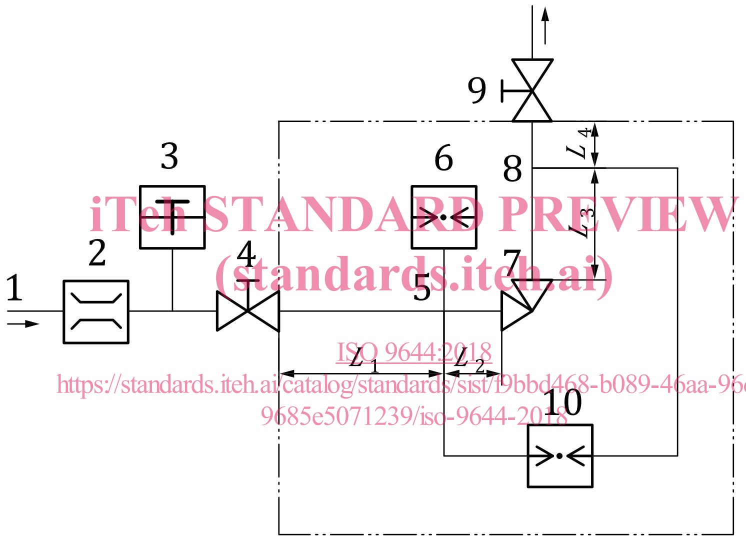
DN	Minimum hole diameter mm	Maximum hole diameter mm
<20	1,5	2
20 to 50	2	3
>50	3	5

The length, *l*, of the tap bore shall be not less than twice the diameter of the bore. For thin-walled pipes where the wall thickness is less than $2d_1$, a boss may be added to the pipe wall where the pressure taps are to be located (see Figure 2).

Pressure taps 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 taps shall be made, situated 90° ± 5° apart on the circumference so that no tap is located on the lowest point of the pipe circumference. For pipe diameters of less than 50 mm, two taps will suffice. All taps, whether two or four in number, shall be connected by a conduit whose bore shall not be less than two pressure-tap cross-sections. The pressure taps shall provide appropriate values of d_1 and l, and may be made as illustrated in Figure 2.



a) Straight valves



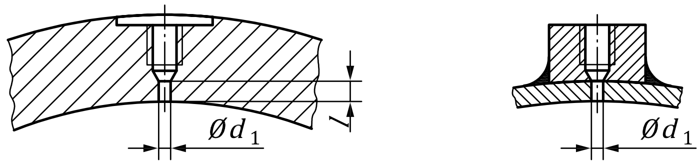
b) Angle or multiport valves

Key

1 water supply
2 flow meter
3 temperature measurement
4 regulating valve
5 upstream pressure tapping point
6 upstream pressure measuring point
7 valve under test
8 downstream pressure tapping point
9 regulating valve
10 differential pressure measuring device

NOTE In subfigures a) and b), L_1 and $L_3 \geq 10d$ and L_2 and $L_4 \geq 2d$.

Figure 1 — Test installation



a) Thick wall   b) Thin wall

Figure 2 — Static pressure taps in thick and thin-wall piping

4.2.6 Temperature sensors

Any temperature-sensing device that is capable of measuring water temperature with acceptable accuracy (see 4.1) shall 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 Test installation

Install the test specimen on a suitable test bench for testing valves, as shown in Figure 1. Ensure that the water temperature during the test is between 5 °C and 50 °C.

5.2 Test conditions

5.2.1 Permissible fluctuations in measurements

For each quantity to be measured, the permissible fluctuation is given in Table 2 and Table 3.

If fluctuations of greater than the values in Table 2 and Table 3 are present, measurements may be carried out by providing a damping device. The installation of the damping device shall not affect the accuracy of the readings. Symmetrical and linear damping devices shall be used.

Table 2 — Differential pressure fluctuation

Flow resistance coefficient [a] ζ	Δp fluctuation %
$\zeta > 20$	±6
$4 < \zeta \leq 20$	±10
$1 < \zeta \leq 4$	±17
$0,1 \leq \zeta \leq 1$	±26

[a] See 6.2.2.

Table 3 — Flowrate and pressure fluctuations

Quantity	Fluctuation %
Flow rate, q_V	5
Upstream pressure, p_1	5

NOTE More information about accuracy is given in Annex B.

5.2.2 Steady conditions

Test conditions are steady if the variations of each quantity, observed at the test operating point for at least 10 s, do not exceed a value of 1,2 % (the difference between the largest and the smallest readings of the quantity related to the mean value).

If this condition is met and if the fluctuations are less than the permissible values given in 5.2.1, only one set of readings of individual quantities is to be recorded for the test point.

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

5.2.3 Unsteady conditions

Test conditions are unsteady when variations exceed the limits of 5.2.2. In unsteady conditions, the following procedure shall be followed.

At each test point, repeated readings of the measured quantities shall be made at random intervals of time, but not less than 10 s. A minimum of three sets of readings shall be taken at each test point, with more sets required as the fluctuation increases, as indicated in Table 4.

Table 4 — Minimum reading set requirements

Number of sets	Permissible difference between largest and smallest values of readings of each quantity, related to mean value %
3	1,8
5	3,5
7	4,5
9	5,8
13	5,9
>30	6,0

The arithmetic mean of all the readings for each quantity shall be taken as the actual value for the purposes of the test.

If the excessive variation cannot be eliminated, the limits of error shall be calculated by statistical analysis.

5.3 Test bench pressure loss

Measure the bench pressure loss, 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 operating instructions.

The bench pressure loss measured shall include the loss through the throttling valve (see 3.2.2), Δp_v, and the loss through the piping, Δp_p, of the test set-up:

$$\Delta p_b = \Delta p_v + \Delta p_p \quad (1)$$

5.4 Test of valve

5.4.1 The test specimen shall be installed, opened or operated as in normal agricultural irrigation practice. Valve to be tested at the full open position as defined by the manufacturer or inherent mechanical limitations.

5.4.2 The pressure loss curve shall be confirmed by testing at least five flow rates within the flow range declared by manufacturer. The test shall be conducted at an approximate pressure of at least 3 bar higher than the pressure loss declared at a pressure rate that is higher by at least 3 bar than the pressure loss declared by the manufacturer of the valve.

The manufacturer's published head loss should not vary by more than ±10 % from the test results.

5.4.3 Tests of pressure loss shall be conducted successively in progressive steps — first, with increasing flow rates, followed by decreasing flow rates.

5.4.4 Calculate the valve pressure loss, Δp_v, of the test specimen by subtracting the piping pressure loss, Δp_p, from the bench pressure loss, Δp_b, measured by the differential pressure measuring device:

$$\Delta p_v = \Delta p_b - \Delta p_p \quad (2)$$

The piping pressure loss, Δp_p, is determined by the following method.

— Remove the test specimen from the test bench.

— Connect pipe sections either directly or by means of a fitting that does not introduce significant pressure losses.

— Measure the piping pressure loss separately.

5.4.5 When the test specimen is supplied together with special fittings for connection to the water line, the connecting fittings are considered to be 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 4, shall be presented by one or both of the following:

a) by means of a table listing values of pressure loss and other coefficients at corresponding flow rates, q_V (see Table 5);

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

If only one of the above means is presented, b) is the one that is recommended.

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 [a)], or only one curve shall be shown [b)].