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Agricultural irrigation equipment — Volumetric valves — General requirements and test methods

Matériel agricole d'irrigation — Vannes volumétriques — Exigences générales 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.

International Standard ISO 7714 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 18, *Irrigation and drainage equipment and systems*.

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Agricultural irrigation equipment — Volumetric valves — General requirements and test methods

1 Scope

This International Standard specifies general requirements and test methods for volumetric valves capable of delivering automatically preset quantities of water for agricultural irrigation purposes, at various flowrates, by measuring the quantities of water flowing through the valves at temperatures of up to 50 °C.

It applies to volumetric valves which are actuated by pipeline pressure and flow alone, and which do not require any other external source of energy.

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 7-1:1994, *Pipe threads where pressure-tight joints are made on the threads — Part 1: Dimensions, tolerances and designation.*

ISO 228-1:1994, *Pipe threads where pressure-tight joints are not made on the threads — Part 1: Dimensions, tolerances and designation.*

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 4064-1:1993, *Measurement of water flow in closed conduits — Meters for cold potable water — Part 1: Specifications.*

ISO 4064-3:1983, *Measurement of water flow in closed conduits — Meters for cold potable water — Part 3: Test methods and equipment.*

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.*

3 Definitions

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

3.1 volumetric valve: Valve capable of automatically delivering preset quantities of water for agricultural irrigation purposes, at various flowrates, by measuring the quantities of water flowing through the valve.

3.2 serial volumetric valve: Volumetric valve intended for operation in series in a system of volumetric valves.

3.2.1 two-way serial volumetric valve: Volumetric valve with one inlet and one outlet, intended for connection in parallel in a system of volumetric valves, designed to be opened by means of a hydraulic command when preset to the open position and which, on closing, after delivering the preset quantity of water, transmits a hydraulic command to the next volumetric valve in the system so as to bring it into operation.

3.2.2 three-way serial volumetric valve: Valve with one inlet and two outlets which is normally open (when the pressure at the inlet is atmospheric pressure) and which is so designed that, when a preset quantity of water has passed through the first outlet, this outlet shuts off automatically, the second outlet opens automatically and all the flow is passed through the second outlet to the next volumetric valve in the system.

NOTE 1 The opening and closing commands of the water in the inlet of the first valve in the system may be either manual or automatic.

3.3 non-serial volumetric valve: Volumetric valve intended to operate by itself and not in series.

3.4 maximum flowrate, q_{max}: Highest flowrate at which a volumetric valve is required to operate without deteriorating.

3.5 nominal flowrate, q_{nom}: Convenient flowrate within the range of flowrates, specified by the manufacturer for operation for a period of about 2 000 h under normal service conditions.

NOTE 2 This is used to designate the approximate capacity of the valve and to designate the valve.

3.6 minimum flowrate, q_{min}: Lowest flowrate at which a volumetric valve is required to operate within the maximum error tolerance under normal service conditions.

3.7 range of flowrates: Range of flowrates between the minimum flowrate and the maximum flowrate (q_{min} and q_{max}, respectively).

3.8 nominal pressure: Highest pressure immediately upstream of a volumetric valve at which the valve is recommended by the manufacturer to operate under normal service conditions.

3.9 minimum working pressure: Minimum pressure immediately upstream of a volumetric valve at which the valve is required to operate.

3.10 range of working pressures: Range of pressures between the minimum working pressure and the nominal pressure.

4 Classification

Volumetric valves are classified in two ways: see 4.1 and 4.2.

4.1 According to accuracy of cumulative counter

Class 1: Volumetric valve containing a control mechanism with a cumulative volume counter, and having an accuracy as required by water meters complying with ISO 4064-1.

Class 2: Volumetric valve containing a control mechanism with a cumulative counter and having an accuracy less than that required for water meters complying with ISO 4064-1.

Class 3: Volumetric valve containing a control mechanism, but without a cumulative volume counter.

4.2 According to method of operation as system of volumetric valves

Class 4.1: Non-serial volumetric valve.

Class 4.2: Serial volumetric valve.

Class 4.2.1: Two-way serial volumetric valve.

Class 4.2.2: Three-way serial volumetric valve.

5 Marking

Each volumetric valve shall bear clear and permanent marking including the following information:

a) name of manufacturer or its registered trademark;

b) nominal flowrate, q_{nom};

c) serial number;

d) arrow indicating the direction of flow;

e) arrow indicating the direction of setting the control device, if necessary;

f) nominal pressure;

g) for Class 4.2 valves, a mark identifying the points of connection for serial operation which shall also be explained in the manufacturer's catalogue.

6 Technical requirements

6.1 General

6.1.1 All parts of volumetric valves of the same size, type and model intended for disassembly, maintenance and repair produced by the same manufacturer shall be interchangeable.

Upon request, the manufacturer shall supply information on the resistance of the valve to chemicals used in agriculture and on the operation of the valve with water that does not comply with the properties specified in 7.1.

All parts of volumetric valves which are made from plastics and which are exposed to ultraviolet (UV) radiation shall contain additives to improve their resistance to UV radiation under the normal operating conditions of the valve. Plastics parts of the valve which serve as water passages shall be opaque or shall be protected in some other manner (for instance, by a closed cover) against penetration of light to the water passages.

The flow control mechanism of the volumetric valve shall allow a manual override so that the flow can be stopped at any time by some means such as returning the setting device to zero.

6.1.2 The manufacturer shall ensure the regular supply of spare parts for a minimum of five years after cessation of production of the specified model of the volumetric valve.

6.2 Flowrates and dimensions

The nominal flowrate of the valve and the dimensions of end connections shall be as specified in table 1.

Table 1 — Flowrates and dimensions

Nominal flowrate m^3/h	Designation of thread[1)]	Nominal diameter of flanges[2)] mm
1,5	G 3/4 B	—
3	G 3/4 B	—
5	G 1 B	—
12	G 1 1/2 B	—
25	G 2 B	50
40	G 3 B	80
60	G 4 B	100
150	—	150
250	—	200
400	—	250
600	—	300

1) In accordance with ISO 228-1.
2) In accordance with ISO 7005-1 and ISO 7005-2.

6.3 Threaded and flanged connections

In volumetric valves with threaded ends intended for direct connection to the pipeline, the threads shall comply with ISO 7-1. Alternatively, other threads may be allowed provided that a suitable adaptor shall be supplied with each threaded connection, making it comply with ISO 7-1.

Volumetric valves with threaded ends shall be provided with spanner flats on the body, or other means of preventing rotation of the valve during connection or disconnection. The manufacturer shall supply special tools, if required.

7 Mechanical, functional and accuracy tests

7.1 General

The water used for the tests shall not contain solids larger than those capable of passing a 200 mesh screen, nor shall it contain dissolved solids exceeding 2 g/l.

All tests shall be performed with water at a temperature of 25 °C ± 5 °C, unless otherwise specified in the specific test, and at a water pressure between the minimum working pressure and the nominal pressure of the valve.

7.2 Accuracy of measuring devices

If not otherwise specified, the measuring devices shall allow the determination of the following quantities to within an accuracy of the specified level, relative to the determined value:

flowrate: ± 2 %

differential and actual pressure: ± 2 %

temperature: ± 2 %

volume: ± 2 %

7.3 Sampling and acceptance requirements

7.3.1 Type tests

The test specimens shall be taken at random by the test laboratory representative from a quantity of 20 valves. The number of test specimens required for each test shall be as specified in table 2.

If the number of defectives found in the sample is equal to or less than the acceptance number shown in table 2, the sample shall be considered to comply with the requirements of this International Standard. If the number of defective specimens in the sample is greater than the acceptance number, the sample shall be considered not to comply with the requirements of this International Standard.

7.3.2 Acceptance tests

When acceptance of manufacturing lots or of shipments is required, the sampling shall be conducted according to ISO 2859-1:1989, based on acceptable quality level (AQL) 2,5 and special 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 7.4.

The shipment or manufacturing lot complies with this International Standard 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 test specimens shall be selected at random to conform with the number specified in table 2. The shipment or manufacturing lot is considered to comply with this International Standard if the number of defective specimens found in the other tests does not exceed the acceptance number specified in table 2.

Durability tests performed in accordance with 7.8 shall not be performed within the framework of the acceptance test if the type test in 7.3.1 has been carried out for the same valve model and provided that the manufacturer has not introduced changes in the structure of the valve since the type test.

7.4 Test of resistance of volumetric valve to hydrostatic pressure

7.4.1 General

Perform the test in 7.4.2 and 7.4.3 once with the valve open with its outlet(s) closed, and once with the valve closed with its outlet(s) open.

7.4.2 Metal valves

7.4.2.1 Apply a hydraulic pressure at the valve inlet and increase it gradually to 1,6 times the nominal working pressure declared by the manufacturer. Maintain this pressure for 1 min.

7.4.2.2 No signs of leakage shall appear through the body of the valve, its joints or outlet(s).

Slight leakage through the control ports is acceptable, provided that it does not exceed 1 drop in 5 s.

The volumetric valve shall withstand the test without incurring damage or malfunctioning.

Table 2 — Required number of test specimens and acceptance number

Subclause	Subject of test	No. of specimens	Acceptance No.
7.4	Resistance of volumetric valve to hydrostatic pressure	5	1 [1]
7.5	Manual opening and closing	5	1
7.6	Accuracy	3	0
7.7	Pressure loss	2	0
7.8	Durability	2	0

1) Refers only to leakage; damage to valve body or valve operation is cause for rejection of lot.

7.4.3 Plastics valves

Plastics valves shall be tested as stipulated in 7.4.2.

NOTE 3 Test methods and requirements for resistance to hydrostatic pressure of plastics valves are under study and will be added at a later stage.

7.5 Test of manual opening and closing

7.5.1 Preconditioning

Precondition the valve by passing water through the valve at a flowrate of half its nominal flowrate at a temperature of 50 °C to 55 °C for a period of 24 h. Then carry out the test in 7.5.2, 7.5.3 or 7.5.4 as appropriate.

7.5.2 Test of non-serial volumetric valves (Class 4.1)

7.5.2.1 Open the volumetric valve by means of its setting device while the water pressure at the valve inlet is at the minimum working pressure. Wait until the valve is fully opened. Return the setting device to the closed position and ascertain that the valve has actually closed.

Repeat the test procedure with the water pressure at the valve inlet at the nominal pressure.

Perform this series of test procedures three times.

7.5.2.2 The valve shall open and close satisfactorily during all three tests.

7.5.3 Test of two-way serial volumetric valves (Class 4.2.1)

7.5.3.1 Main test

7.5.3.1.1 Adjust the setting device to the open position. Apply a pressure at the valve inlet equal to the minimum working pressure. Apply a pressure equal to the minimum working pressure also at the inlet which is intended for receipt of the opening command.

Wait until the valve is fully open. Return the setting device to the closing position and ascertain that the valve has actually closed.

Repeat the test procedure with the water pressure at the valve inlet equal to the nominal pressure.

Perform this series of tests three times.

7.5.3.1.2 The valve shall open and close satisfactorily on all three occasions.

7.5.3.2 Series operation

For volumetric valves intended to operate in series by transmitting a hydraulic command via a control tube, the following requirement shall apply, in addition to the requirements specified in 7.5.3.1.

When the valve outlet opens, the orifice intended for transmitting the hydraulic command to the next valve in the series shall remain closed. When the valve outlet closes, the orifice intended for transmitting the hydraulic command shall open and water shall flow through it.

7.5.4 Test of three-way serial volumetric valves (Class 4.2.2)

7.5.4.1 Adjust the setting device to the open position. Apply a pressure at the valve inlet equal to the minimum working pressure.

Water shall flow from the first outlet, while the second outlet shall remain watertight.

7.5.4.2 Adjust the setting device to the shut-off position.

The first outlet of the valve shall close and be watertight, while the second outlet shall open to the atmosphere.

7.5.4.3 Reduce the pressure at the valve inlet to atmospheric pressure.

The second outlet of the valve shall shut off and the first outlet shall open to the atmosphere.

7.5.4.4 Repeat this test procedure with the pressure at the nominal pressure. Perform this series of tests three times.

The valve shall open and close satisfactorily on all three occasions.

7.6 Tests of accuracy

7.6.1 General

These tests are performed according to the class of valve. Volumetric valves with a cumulative volume counter (Classes 1 and 2) are subjected to two tests of accuracy:

a) accuracy of measurement;

b) accuracy of dosing.

Volumetric valves without a cumulative volume counter (Class 3) are subjected only to the test of accuracy of dosing.

Perform the accuracy test(s) on the same valves which were tested according to 7.5 and which withstood the test.

7.6.2 Tests of Classes 1 and 2 volumetric valves

7.6.2.1 Accuracy of measurement

7.6.2.1.1 Class 1 volumetric valves

Determine the accuracy of measurement according to ISO 4064-3:1983, clause 5.

The measurement error shall not exceed that specified in ISO 4064-1:1993, subclause 5.1.

7.6.2.1.2 Class 2 volumetric valves

Determine the measurement error by the method described in ISO 4064-3:1983, clause 5.

The measurement error shall not exceed ± 4 %.

7.6.2.2 Accuracy of dosing

7.6.2.2.1 Allow water to flow through the valve at a flowrate of q_{nom} with the dose of the valve set to 50 % of the maximum scale value. Then allow water to flow through the valve at q_{min} with the dose of the valve set to 20 % of the maximum scale value. Compare the volume set on the control mechanism with the volume of water which flowed through the valve up to its automatic closure, as measured and indicated on the cumulative volume counter, and compute the error.

7.6.2.2.2 The maximum error shall not exceed 2 % of the maximum scale value of the volumetric valve.

7.6.3 Tests of volumetric valves of Class 3

7.6.3.1 Allow water to flow through the valve at the nominal flowrate and the minimum flowrate. Measure the volume of water which flowed through the valve up to its automatic closure and compare it with the volume set on the control mechanism, using any means available with an accuracy of ± 2 %. Compute the error.

7.6.3.2 The error shall not exceed the sum of 2 % of the maximum scale value of the volumetric valve plus 4 % of the set volume.

7.7 Test of pressure loss

7.7.1 Measure the pressure loss of the valve in accordance with the method specified in ISO 9644 at least at the minimum, nominal and maximum flowrates.

Test the pressure loss for three-way serial volumetric valves (Class 4.2.2) separately between the inlet and each of the valve outlets.

7.7.2 The measured pressure losses shall not exceed the values declared by the manufacturer.

7.8 Durability tests

7.8.1 Durability of measuring mechanism

7.8.1.1 Operate the valve at the nominal flowrate and at an inlet pressure of 300 kPa for 2 000 h. Adjust the volume periodically to the maximum setting of the scale.

For the purposes of this test, it is permissible to disconnect the control mechanism from the closing mechanism. The disconnection shall be performed by the manufacturer or according to the manufacturer's instructions and approval.

At the completion of the test, repeat the tests in 7.6.2 for Classes 1 and 2 volumetric valves and the tests described in 7.6.3 for Class 3 volumetric valves.

7.8.1.2 The total error after testing of durability shall be no greater than 1,5 times the original error obtained prior to the start of the durability test for the same valve.

7.8.2 Durability of operating mechanism

7.8.2.1 Activate the operating mechanism through 10 000 cycles.

Each cycle shall consist of the following steps.

a) Set the operating mechanism to opening position. For Class 4.2.1 valves apply a pressure at the inlet, intended to receive the opening command, a pressure equal to the pressure at the valve inlet.

b) Wait for full opening of the valve and steadying of the flow.

c) Maintain the operating mechanism in the open position for 5 s.

d) Return the operating mechanism to the closed position.

e) Wait for full closure of the valve.

f) Maintain the operating mechanism in the closed position for 5 s, while applying a pressure equal to the nominal pressure.

Upon completion of the test, subject the valve to the hydrostatic pressure test (see 7.4) in the closed position and to the manual opening and closing test (see 7.5).

7.8.2.2 The valve shall pass both tests satisfactorily.

7.9 Test of water hammer

NOTE 4 Test methods and requirements for the water hammer test are under study and will be added to the Standard at a later stage.

8 Information to be supplied by manufacturer

The manufacturer shall include at least the information in 8.1 to 8.3 with each valve.

8.1 General information

a) name and address of manufacturer;

b) installation instructions;

c) instructions for connecting and operating serial volumetric valves (Class 4.2).

8.2 Operational data

a) nominal pressure, in kilopascals;

b) minimum working pressure, in kilopascals;

c) maximum flowrate, in litres per minute (or in cubic metres per hour);

d) nominal flowrate, in litres per minute (or in cubic metres per hour);

e) minimum flowrate, in litres per minute (or in cubic metres per hour);

f) pressure loss curves; for Class 4.2.2 valves, the pressure losses between the inlet and each of the outlets;

g) accuracy of measurement (according to class of volumetric valve);

h) class of valve according to clause 4.

8.3 Maintenance and spare parts

a) the recommended frequency for the various maintenance operations;

b) the recommended frequency for replacement of spare parts.

See also 6.1.2.