INTERNATIONAL STANDARD

ISO 7714

Fourth edition
2008-09-01

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

Matériel agricole d'irrigation — Vannes volumétriques — Exigences générales et méthodes d'essai

Reference number
ISO 7714:2008(E)

Contents

Page

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

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.

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*.

This fourth edition cancels and replaces the third edition (ISO 7714:2000), which has been technically revised.

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

1 Scope

This International Standard specifies general requirements and test methods for volumetric valves able to automatically deliver preset quantities of water. It is applicable to valves actuated by pipeline pressure and flow alone, and which do not need any other, external, source of energy.

NOTE Volumetric valves are typically required to operate correctly with different qualities of irrigation water at a variety of flow rates and at temperatures between 5 °C and 50 °C.

2 Normative references

The following referenced documents are indispensable for the application 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 9644: *Agricultural irrigation equipment — Pressure losses in irrigation valves — Test method*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
volumetric valve
valve capable of automatically delivering preset volumes of irrigation water at various flow rates, by measuring the volume of water flowing through the valve

3.2
serial volumetric valve
volumetric valve designed to operate in a sequence of volumetric valves

3.2.1
single outlet serial volumetric valve
serial 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 a preset volume of water, transmits a hydraulic command to the next volumetric valve in the system to bring it into operation

3.2.2
single outlet “skip over” serial volumetric valve
serial 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 a preset volume of water, skips over the next volumetric valve in the system and transmits a hydraulic command to the second next volumetric valve to bring it into operation

3.2.3
dual outlet serial volumetric valve
serial volumetric valve with one inlet and two outlets, normally open when the pressure at the inlet is the atmospheric pressure and designed so that, when a preset volume of water has passed through the first outlet, this outlet closes automatically, the second outlet opens automatically and all the flow is passed through the second outlet to the next volumetric valve in the series

3.3
non-serial volumetric valve
volumetric valve designed to operate alone

3.4
permanent flow rate
q_{V3}
highest flow rate under normal service conditions at which the volumetric valve can be operated in a satisfactory manner within the maximum permissible error

3.5
overload flow rate
q_{V4}
highest flow rate at which the volumetric valve does not exceed the maximum permissible pressure loss and can be operated for a short period of time within its maximum permissible error, whilst maintaining its metrological performance when it is subsequently operated under normal service conditions

3.6
minimum flow rate
q_{V1}
lowest flow rate at which the volumetric valve can be operated within the maximum permissible error

3.7
range of flow rates
flow rates ranging from the minimum flow rate to the overload flow rate, inclusive of limits

3.8
range of working flow rates
flow rates ranging from the minimum flow rate to the permanent flow rate, inclusive of limits

3.9
relative error
ε
error, expressed as a percentage, defined by the equation:

$$\varepsilon = \frac{V_\mathrm{i} - V_\mathrm{a}}{V_\mathrm{a}} \times 100$$

where

V_i is the indicated volume;

V_a is the actual volume.

[ISO 4064-3:2005, definition 3.3]

3.10
maximum working pressure
highest water pressure at the inlet to a volumetric valve at which it performs satisfactorily the functions specified by the manufacturer

3.11
minimum working pressure
lowest water pressure at the inlet to a volumetric valve at which it operates satisfactorily and performs the mechanical and hydraulic functions as specified by the manufacturer

3.12
range of working pressures
all pressures ranging from the minimum working pressure to the maximum working pressure, inclusive of limits

3.13
nominal pressure
highest pressure at the inlet to a volumetric valve at which the volumetric valve should be operated under normal service conditions, as specified by the manufacturer

3.14
accuracy
the quality which characterizes the ability of a measuring instrument to give indications approximating to the true value of the quantity measured

3.15
uncertainty of measurement
parameter associated with the result of a measurement, obtained using an appropriate mathematical formula which takes into account all sources of error, that characterizes the dispersion of values that could reasonably be attributed to the measurement result

3.16
pattern approval
certification bestowed by an authorized and accepted body, recognizing that the pattern of a measuring instrument conforms to the requirements of accepted International Standards

3.17
granulometry
measure of the particle (grain) content of irrigation water, as characterized by size dispersion and total amount of solids

4 Classification

4.1 According to accuracy of cumulative volume counter

Class 1: volumetric valve containing a control mechanism with a cumulative volume counter and having an accuracy of volume measurement of ± 2 %, within the range of flow rates.

Class 2: volumetric valve containing a control mechanism with a cumulative volume counter and having an accuracy of volume measurement of ± 4 %, within the range of flow rates.

Classes 1 and 2 are recommended for water measurement in agricultural irrigation applications.

Class 3: volumetric valve containing a preset volume mechanism but without a cumulative volume counter.

4.2 According to method of operation as a system of volumetric valves

4.2.1 Non-serial volumetric valve.

4.2.2 Serial volumetric valve:

- single outlet serial volumetric valve;
- single outlet "skip over" serial volumetric valve;
- dual outlet serial volumetric valve.

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

5 Markings

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

- name of manufacturer or the manufacturer's registered trademark;
- permanent flow rate, q_{V3};
- ratio q_{V3}/q_{V1};
- serial number;
- arrow indicating the direction of flow;
- arrow indicating the direction of setting of the control device, if necessary;
- nominal pressure;
- for serial volumetric valves, a mark identifying the points of connection for serial operation, which shall be explained in the manufacturer's catalogue;
- accuracy class (1, 2 or 3).

6 Technical requirements

6.1 General

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.

All parts of the volumetric valve shall be resistant to chemicals normally used in agriculture in their conventional concentrations, and shall operate smoothly for the water quality defined in 7.1.

Upon request, the manufacturer shall supply information pertaining to the operation and safety of the valve with water of purity levels not conventionally found in agriculture, such as corrosive water.

All non-metallic parts of the volumetric valves which are exposed to sunlight shall be protected against degradation from ultraviolet (UV) radiation under the normal operating conditions of the valve.

Non-metallic 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 means of manual override to stop the flow at any time, such as returning the setting device to zero.

6.2 Threaded and flanged connections

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

Volumetric valves with threaded ends shall be equipped with a hexagonal section, or at least a section with two parallel surfaces on the valve body, suitable for gripping with a standard open wrench, in order to prevent rotation of the volumetric valve during connection or disconnection. The manufacturer shall supply special tools if needed.

6.3 Metrological requirements

6.3.1 General

Volumetric valves are designated according to the permanent flow rate, q_{V3}, in cubic metres per hour, and by the ratio q_{V3}/q_{V1}, which represents the range of working flow rates.

6.3.2 Class 1, Class 2 and Class 3 — Sizes DN16, DN20 and DN25

The minimum value of the permanent flow rate, q_{V3}, with respect to volumetric meter size (nominal diameter, DN, in millimetres) shall be in accordance with Table 1.

Table 1 — Minimum value of permanent flow rate — Sizes DN16, DN20 and DN25

Volumetric meter size mm	**Minimum q_{V3}** m^3/h
DN16	1,6
DN20	2,5
DN25	4,0

Higher values of the permanent flow rate, q_{V3}, in cubic metres per hour, may be chosen from the following list: 2,5; 4,0; 6,3; 10.

The value of q_{V3}/q_{V1}, in cubic metres per hour, shall be chosen from the following list: 8; 10; 12,5; 16; 20; 25; 31,5.

6.3.3 Class 1 and Class 2 — Sizes DN40 to DN300

The minimum value of the permanent flow rate, q_{V3}, with respect to volumetric meter size shall be in accordance with Table 2.

Higher values of the permanent flow rate, q_{V3}, in cubic metres per hour, may be chosen from the following list: 25; 40; 63; 100; 160; 250; 400; 630; 1 000; 1 600.

The value of q_{V3}/q_{V1}, in cubic metres per hour, shall be chosen from the following list: 10; 12,5; 16; 20; 25; 31,5; 40; 50; 63; 80; 100.

Table 2 — Minimum value of permanent flow rate — Sizes DN40 to DN300

Volumetric meter size mm	Minimum q_{V3} m^3/h
DN40	16
DN50	25
DN65	40
DN80	63
DN100	100
DN125	160
DN150	250
DN200	400
DN250	630
DN300	1 000

6.3.4 Overload flow rate (q_{V4})

The overload flow rate is defined as follows:

$$q_{V4} = 1{,}25 q_{V3}$$

This definition applies to all volumetric valve sizes and classes.

7 Mechanical, functional and accuracy tests

7.1 General

Use water for the test which is either clean or of an irrigation water quality, as defined in Annex A (see Table A.1).

Perform all tests with water at a temperature between 5 °C and 50 °C, unless otherwise specified, and at a hydrostatic pressure within the range of working pressures.

7.2 Accuracy of measuring devices

Pressure and differential pressure measuring devices shall have an accuracy of ± 1 % of the measured value.

Flow rate shall be measured to within ± 2,5 %.

Temperature measuring devices shall have an accuracy of ± 0,5 °C.

Volume shall be measured either with a calibrated master water meter or with a calibrated tank (volumetric or weighing type).

The expanded relative uncertainty of the volume measurement test shall not exceed 1/5 of the maximum permissible accuracy error for pattern approval and 1/3 of the maximum permissible accuracy error for initial and subsequent verifications. See 7.6.2.1 and 7.6.2.2 for the maximum permissible errors for accuracy of measurement and accuracy of dosing, respectively.

7.3 Sampling and minimum acceptance requirements

7.3.1 Pattern approval tests

Test specimens should be taken at random from a lot of 20 volumetric valves. The minimum number of test specimens to be taken for each test and the minimum number of samples which should pass the test to qualify for International Standards shall be as specified in Table 3.

Table 3 — Minimum number of test specimens and acceptance limit

Subclause	Subject of test	Minimum number of specimens to be tested	Minimum number of samples which shall pass the test
7.4	Resistance to hydrostatic pressure	5	4[a]
7.5	Manual opening and closing	4	3
7.6	Accuracy	3	3
7.7	Pressure loss	2	2
7.8	Endurance	2	2

[a] Defect in one sample is allowed only with respect to leakage. Damage to valve body or deleterious effect on the operation of the volumetric valve is cause for rejection of the lot.

Endurance tests performed in accordance with 7.8 are not required to be performed within the framework of the acceptance tests if the pattern approval test in Table 3 has been carried out for the same volumetric valve model, provided that the manufacturer has not introduced changes in the structure of the volumetric valve since the pattern approval test.

7.3.2 Thermal preconditioning

Thermal preconditioning shall be performed before pattern approval tests.

Subsequent thermal preconditioning shall be performed after substantial mechanical, structural, or material modification of the volumetric valve.

Precondition the volumetric valve at a temperature of 50 °C to 55 °C for a period of 24 h using one of the following methods:

a) immersing it in water;

b) passing water through it at a sufficiently low flow rate to maintain the preconditioning temperature;

c) placing it in an air oven.

After thermal preconditioning, proceed with the tests.

7.4 Test of resistance to hydrostatic pressure

Connect the valve inlet to a pressure source and increase the pressure gradually to 1,6 times the maximum working pressure. Maintain this pressure for 2 min.

Perform the test procedure twice: once with the valve open and its outlet or outlets closed, and a second time with the valve closed and its outlet or outlets open.

The volumetric valve shall withstand the test without incurring damage and without malfunctioning. No signs of leakage shall appear through the valve body, its joints or outlets. The test is applicable to plastic as well as metal valves.

7.5 Test of manual opening and closing

7.5.1 Non-serial volumetric valves

7.5.1.1 Open the volumetric valve using the dial while the hydrostatic pressure at the valve inlet is at the minimum working pressure. Wait until the valve is fully opened. Return the dial to the closed position and ensure that the volumetric valve has fully closed.

7.5.1.2 Repeat the procedure with the hydrostatic pressure at the valve inlet at the maximum working pressure.

7.5.1.3 Perform the test three times. The valve shall open and close satisfactorily on each occasion.

7.5.2 Serial volumetric valves (single outlet, single outlet “skip over”, and dual outlet)

7.5.2.1 General

Different manufacturers solve the same automation problems by different means. For this reason, tests of serial volumetric valves should be performed according to the manufacturer’s instructions.

The tester should be satisfied that the test procedure presented to him by the manufacturer represents the serial function in question.

7.5.2.2 Test procedure

Perform the same operations as for the non-serial volumetric valve, as described in 7.5.1, applying any necessary modifications in accordance with the manufacturer’s instructions.

During the test, observe the orifice that transmits the hydraulic command to the next volumetric valve intended to be opened. When the tested volumetric valve is open, this orifice should freely pass water and when the tested volumetric valve is closed the orifice should close, or vice versa, depending on the logic of the hydraulic command.

7.6 Tests of accuracy

7.6.1 General

The type(s) of accuracy test performed depends on the class of volumetric valve. Volumetric valves with a cumulative volume counter (Class 1 and Class 2) shall be subjected to two tests of accuracy:

— accuracy of measurement (7.6.2.1);

— accuracy of dosing (7.6.2.2).

Volumetric valves without a cumulative volume counter (Class 3) shall be subjected to the test of accuracy of dosing only (7.6.2.2).

7.6.2 Flow rates and maximum permissible error for accuracy tests

7.6.2.1 Accuracy of measurement

Accuracy of measurement of the volumetric valve shall be tested at the following flow rates: q_{V1}; 1,6q_{V1}; 0,3q_{V3}; q_{V3}; and q_{V4}.

Determine the relative error. (See also ISO 4064-3:2005.)

The relative error shall not exceed the following:

— for Class 1, ± 2 % within the range of flow rates (q_{V1} to q_{V4});

— for Class 2, ± 4 % within the range of flow rates (q_{V1} to q_{V4}).

7.6.2.2 Accuracy of dosing

Allow water to flow through the valve at the permanent flow rate, q_{V3}, with the flow volume setting for the volumetric valve set at 50 % of the maximum scale value.

Allow water to flow through the valve at the minimum flow rate, q_{V1}, with the flow volume setting for the volumetric valve set at 20 % of the maximum scale value.

In each case, compare the flow volume set on the control mechanism with the difference between the initial and final readings on the cumulative volume counter. Here, the relative error (ε) for dosing is to be calculated as a percentage relative to the maximum scale value of the volumetric valve, using the following equation:

$$\varepsilon = \frac{V_\mathrm{s} - V_\mathrm{m}}{V_\mathrm{max}} \times 100$$

where

V_s is the flow volume set on the control mechanism;

V_m is the difference between the initial and final readings on the cumulative volume counter;

V_max is the maximum scale value.

The relative error for dosing shall not exceed the following:

— for Class 1 and Class 2, ± 2 % of the maximum scale value;

— for Class 3, 2 % of the maximum scale value of the volumetric valve plus 4 % of the preset volume.

7.7 Pressure loss

7.7.1 Requirement

The pressure loss shall not exceed 100 kPa at the overload flow rate.

7.7.2 Test procedure

As a minimum, measure the pressure loss of the volumetric valve at the minimum, permanent and overload flow rates, in accordance with the method specified in ISO 9644.

Test the pressure loss for dual outlet serial volumetric valves separately between the valve inlet and each of the valve outlets.

The measured pressure losses shall not exceed the values declared by the manufacturer by more than 5 %.

7.8 Endurance tests

7.8.1 Endurance flow conditioning

For volumetric valves of sizes DN16, DN20 and DN25, run a flow rate of q_{V4} for a period of 100 h and of q_{V3} for a period of 100 h.

For volumetric valves of sizes DN40 to DN300, run a flow rate of q_{V4} for a period of 200 h and of q_{V3} for a period of 800 h.

During the endurance flow conditioning, the inlet pressure shall be in the range of working pressures, and the outlet pressure shall be high enough to prevent cavitation. For volumetric valves mounted in batches on a single test bench, this applies to all of the valves.

After each automatic closure, adjust the volume to the maximum scale setting. To prevent the necessity of repeated adjustments, the control mechanism may be temporarily disconnected from the closing mechanism. The disconnection shall be performed by the manufacturer or according to the manufacturer's instructions and approval.

7.8.2 Accuracy tests after endurance conditioning

Upon completion of the endurance flow conditioning, repeat the accuracy tests of 7.6 according to the metrological requirements in 6.3.

The relative error for measurement shall not exceed the following:

— for Class 1, ± 2 % within the range of flow rates (q_{V1} to q_{V4});

— for Class 2, ± 4 % within the range of flow rates (q_{V1} to q_{V4}).

The shift in the relative error for measurement (both classes) obtained after the endurance test shall not exceed that obtained prior to the start of the endurance test by more than 2 %.

The relative error in preset volume shall not exceed the values according to 7.6.2.2.

The shift in the relative error in preset volume obtained after the endurance test shall not exceed that obtained prior to the start of the endurance test by more than 1 %.

7.8.3 Endurance of operating mechanism

7.8.3.1 Activate the operating mechanism through 10 000 cycles, each of which shall consist of the following steps.

a) Set the operating mechanism to the open position. For serial volumetric valves, at the valve port intended to receive the opening command, apply a hydrostatic pressure equal to the hydrostatic pressure at the valve inlet.

b) Wait until the volumetric valve is fully open and the flow is steady.

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 hydrostatic pressure equal to the nominal pressure.

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

The volumetric valve must pass both tests satisfactorily in order to be considered to conform to this International Standard.

8 Information to be supplied by the manufacturer

The manufacturer shall include at least the following information with each volumetric valve:

a) general information,

   1) name and address of manufacturer,

   2) installation instructions, and

   3) instructions for connecting and operating serial volumetric valves;

b) operational data,

   1) maximum working pressure, in kilopascals (kPa),

   2) minimum working pressure, in kilopascals (kPa),

   3) permanent flow rate, in cubic metres per hour or litres per minute (m^3/h or l/min),

   4) overload flow rate, in cubic metres per hour or litres per minute (m^3/h or l/min),

   5) minimum flow rate, in cubic metres per hour or litres per minute (m^3/h or l/min),

   6) curves of the pressure losses between the valve inlet and outlet, or for each of the valve outlets for dual outlet serial volumetric valves, and

   7) classification and accuracy of measurement in accordance with 4.1;

c) recommendations for maintenance and replacement of parts,

   1) recommended frequency for the various maintenance operations, and

   2) recommended frequency for replacement of parts.

Annex A
(informative)

Quality of irrigation water

Irrigation water can permanently or temporarily contain mineral or organic materials in variable proportions of particle size. Three classes of granulometry have been defined for testing purposes, classified according to loads of increasing granulometry (Classes 1, 2 and 3), to give a total allowed load of solid particles and a suitable quality of water. See Table A.1.

Table A.1 — Classes of granulometry

Material content	Solid particles
Class 1	Granulometry between 20 µm and 60 µm. Fraction by mass 25 % ± 5 % of the total content of solid particles.
Class 2	Granulometry between 60 µm and 320 µm. Fraction by mass 50 % ± 10 % of the total content of solid particles.
Class 3	Granulometry between 320 µm and 1 600 µm. Fraction by mass 25 % ± 5 % of the total content of solid particles.
Total of Classes 1, 2 and 3	2,0 g/l ± 0,2 g/l with over 95 % of silica, SiO_2.

Bibliography

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

[2] ISO 4064-3:2005, *Measurement of water flow in fully charged closed conduits — Meters for cold potable water and hot water — Part 3: Test methods and equipment*

ICS 65.060.35

Price based on 13 pages