BS ISO 9635-1:2014

BSI Standards Publication

Agricultural irrigation equipment — Irrigation valves

Part 1: General requirements

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National foreword

This British Standard is the UK implementation of ISO 9635-1:2014. It supersedes BS ISO 9635-1:2006 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee AGE/30, Irrigation and drainage equipment.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

ISBN 978 0 580 80728 2

ICS 65.060.35

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 November 2014.

Amendments issued since publication

Date	Text affected

BS ISO 9635-1:2014

INTERNATIONAL STANDARD

ISO 9635-1

Second edition
2014-11-15

Agricultural irrigation equipment — Irrigation valves —

Part 1: General requirements

Matériel agricole d'irrigation — Vannes d'irrigation —

Partie 1: Exigences générales

Reference number
ISO 9635-1:2014(E)

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Published in Switzerland

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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 (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 (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 on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword — Supplementary information.

The committee responsible for this document is 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 9635-1:2006), which has been technically revised.

ISO 9635 consists of the following parts, under the general title *Agricultural irrigation equipment — Irrigation valves*:

— *Part 1: General requirements*

— *Part 2: Isolating valves*

— *Part 3: Check valves*

— *Part 4: Air valves*

— *Part 5: Control valves*

INTERNATIONAL STANDARD **ISO 9635-1:2014(E)**

Agricultural irrigation equipment — Irrigation valves —

Part 1: General requirements

1 Scope

This part of ISO 9635 specifies construction and performance requirements and test methods for valves, intended for operation in irrigation systems with water at temperatures not exceeding 60 °C, which can contain fertilizers and other chemicals of the types and concentrations used in agriculture.

It is applicable to irrigation valves of 8 mm diameter or greater, designed to operate in the fully open and fully closed positions, but which can also operate for extended time periods in any intermediate position.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4633, *Rubber seals — Joint rings for water supply, drainage and sewerage pipelines — Specification for materials*

ISO 5209, *General purpose industrial valves — Marking*

ISO 5752, *Metal valves for use in flanged pipe systems — Face-to-face and centre-to-face dimensions*

ISO 6708:1995, *Pipework components — Definition and selection of DN (nominal size)*

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 7005-3, *Metallic flanges — Part 3: Copper alloy and composite flanges*

ISO 9227, *Corrosion tests in artificial atmospheres — Salt spray tests*

ISO 9635-2:2014, *Agricultural irrigation equipment — Irrigation valves — Part 2: Isolating valves*

ISO 9635-5:2014, *Agricultural irrigation equipment — Irrigation valves — Part 5: Control valves*

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

ISO 9911:2006, *Agricultural irrigation equipment — Manually operated small plastics valves*

ISO 9080, *Plastics piping and ducting systems — Determination of the long-term hydrostatic strength of thermoplastics materials in pipe form by extrapolation*

EN 681-1, *Elastomeric seals — Materials requirements for pipe joint seals used in water and drainage applications — Part 1: Vulcanized rubber*

EN 12627, *Industrial valves — Butt welding ends for steel valves*

EN 12982, *Industrial valves — End-to-end and centre-to-end dimensions for butt welding end valves*

3 Terms and definitions

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

3.1
maximum operating torque
MOT
fixed upper limit for the torque which, when applied at the shaft, operates the valve and ensures compliance with the required leakage rate

3.2
minimum strength torque
mST
fixed lower limit for the torque which, when applied at the shaft, with the obturator either totally open or totally closed, causes no alteration to the functional capability of the valve

3.3
shaft
component of an obturator on which the actuating thread is formed and by which control of the closing component is effected

3.4
type test
test to prove that the design of a valve meets the general and specific performance requirements of the valve

3.5
operating mechanism
mechanism which translates the motion of the operating device to the motion of the obturator

[SOURCE: EN 736-2]

3.6
operating device
manual or power-operated device used to operate the non-pressurized valve

[SOURCE: EN 736-2]

3.7
operating element
component of the operating device by which the mechanical power is introduced

[SOURCE: EN 736-2]

3.8
nominal diameter
DN
parameter used for reference purposes to indicate the size of a valve abbreviated to DN and usually followed by a dimensionless round number which is loosely related to the effective dimensions of the bore or external diameter of the end connections of the valve

Note 1 to entry: It is expressed in millimetres.

Note 2 to entry: Adapted from ISO 6708:1995, definition 2.1.

3.9
nominal pressure
PN
parameter, used for reference purposes in describing a valve, abbreviated to PN and usually followed by a dimensionless round number which is loosely related to the maximum allowable working pressure of the valve

Note 1 to entry: PN is expressed in bars.

Note 2 to entry: 1 bar = 0,1 MPa = 105 Pa; 1 MPa = 1 N/mm^2.

Note 3 to entry: Adapted from ISO 7268:1983/Amd, 1:1984.

3.10
allowable operating pressure
AOP
maximum hydrostatic pressure that a valve is capable of withstanding in continuous service

[SOURCE: EN 805]

3.11
maximum allowable pressure
MAP
maximum pressure occurring from time to time, including average surge pressures, that a valve is capable of withstanding in service

[SOURCE: EN 805]

3.12
allowable site test pressure
ASTP
maximum hydrostatic pressure that a newly-installed valve is capable of withstanding for a relatively short duration, in order to ensure integrity and tightness of the pipeline

[SOURCE: EN 805]

3.13
obturator
moving member in a valve that operates to close the valve and, where applicable, contains a washer or similar sealing device

4 Design requirements

4.1 Materials

4.1.1 Components and coating materials

Select components and coating materials from those conforming to the relevant standards, where standards exist. Ensure that they meet the requirements of 4.9, 4.10, and 4.11, either alone or in combination with coating materials.

4.1.2 Elastomers

Ensure that elastomers comply with ISO 4633 or EN 681-1 and 4.10 of this part of ISO 9635.

4.2 DN

Select DN values from the preferred values given in ISO 6708, with an upper limit of DN 2 000. Confirm with the manufacturer whether a DN value is from the DN/ID series or from the DN/OD series.

4.3 Pressures

Valves intended for irrigation systems come under the nominal pressure (PN) designation and shall be designed in such a way that their characteristic pressures, allowable operating pressure, maximum allowable pressure, and allowable site test pressure are as set out in Table 1 for the corresponding PN (see also 4.4).

Table 1 — Valve pressures

PN	Pressure bar		
	AOP[a]	MAP[a]	ASTP[b]
6	6	8	12
10	10	12	17
16	16	20	25
25	25	30	35

[a] Applicable to valves in all positions, from fully closed to fully open.

[b] Applicable only to valves not in the closed position.

Table 1 gives minimum values of allowable site test pressure. The manufacturer's catalogue can indicate higher values on the condition that the requirements of this part of ISO 9635 have been verified with these higher values. In this case, allowable site test pressure shall not be less than 1,5 maximum allowable pressure or (maximum allowable pressure +5 bar).

4.4 Temperatures

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 tests and the endurance tests shall be carried out at a water temperature of 4 °C to 35 °C.

4.5 Design of shell and obturator

Valves shall be designed to ensure a safety factor against short-term and long-term shell and obturator rupture, taking account of allowable operating pressure, maximum allowable pressure, and allowable site test pressure according to 4.3. This requirement shall not preclude any of the performance requirements given in Clause 5.

The design shall be carried out using one of the following methods.

— A calculation method using the tensile strength of the material (as defined in the relevant material standards) divided by a safety factor. For materials with time-dependent mechanical behaviour (such as plastic materials), the tensile strength shall be the 20 °C 50-year extrapolated minimum strength obtained from pressure tests on injection moulded or extruded pipes subjected to constant hydrostatic pressure at various temperatures and for different lengths of time to comply with ISO 9080.

— An experimental method, relying on pressure tests on valve shells subjected to a constant hydrostatic pressure equal to maximum allowable pressure times a safety factor. For materials with time-dependent mechanical behaviour (such as plastic materials), the test pressure shall be further multiplied by a coefficient specific to each material in order to take into account its 50-year extrapolated minimum strength and the slope of its strength regression line.

4.6 End types and interchangeability

Valves can be designed with various types of end connections adapted to specific pipe systems. The connections shall fulfil the standardized requirements of the relevant pipe systems.

In order to ensure interchangeability of flanged valves, their face-to-face or centre-to-face dimensions shall comply with ISO 5752 and their flanges with ISO 7005-1, ISO 7005-2, or ISO 7005-3 (depending on the flange material). In the case of steel valves with welded ends, the end-to-end and centre-to-end dimensions shall comply with EN 12982 or EN 12627.

4.7 Operating direction

For valves with an operating mechanism, the preferred direction of closure is clockwise.

Valves, designed for anti-clockwise closure, shall be marked to indicate the closing direction.

4.8 Maximum water velocity

Valves shall be designed for water flow velocities that can reach at least the values given in Table 2 in steady flow conditions.

Table 2 — Maximum water flow velocity

Allowable operating pressure bar	**Flow velocity** m/s
6	2,5
10	3
16	4
25	5

4.9 Valve parts

Valve parts that are in contact with water shall be of non-toxic materials. All parts belonging to valves of the same size, type and model, and produced by the same manufacturer, shall be interchangeable.

Plastic valves shall comply with ISO 9911:2006.

Plastic parts of the valve that are exposed to ultraviolet (UV) radiation under normal field conditions in which the valve operates shall include additives to improve their resistance to UV radiation. Plastic parts that enclose waterways shall be opaque or they shall be provided with an opaque cover, designed to block all light from reaching clear waterway enclosures.

4.10 Internal corrosion and ageing resistance

Valve parts that are in contact with water shall be resistant to, or protected against, corrosion under the working conditions for which the valve is intended. The valve body shall meet the salt spray test requirements in accordance with ISO 9227.

4.11 External corrosion and ageing resistance

Under the usage conditions defined in this part of ISO 9635, all external surfaces of the valve (including bolts) which are in continuous contact with the surrounding soil, water, or atmosphere shall be resistant to corrosion and ageing by the selection of materials, or shall be protected by appropriate means. The valve body shall meet the salt spray test requirements in accordance with ISO 9227.

4.12 Repairs and maintenance

The valve, excluding butterfly valves, should be designed to permit internal repair and maintenance without removing the valve body from the line.

5 Performance requirements

5.1 General

Perform all tests at a water temperature of (23 ±3) °C, unless otherwise specified. Ensure that all tests are performed on the valve as it was delivered to the test facility.

NOTE All pressure values are in bars.

5.2 Mechanical strength

5.2.1 Resistance of shell and all pressure-containing components to internal pressure

The valves shall withstand, without visible damage, an internal pressure equal to the higher of the two values: allowable site test pressure or 1,5 × allowable operating pressure.

In order to verify this requirement, test the valve, as delivered, in accordance with the test method given in Annex A, following which there shall be no visually detectable external leakage and no other sign of defect.

5.2.2 Resistance of obturator to differential pressure

The valves in the closed position shall withstand, without visible damage, a differential pressure applied to the obturator equal to the lower of the two values: 1,5 × allowable operating pressure or allowable operating pressure +5. If the maximum allowable pressure indicated for the valves is higher than this value, apply a differential pressure equal to the maximum allowable pressure.

In order to verify this requirement, test the valve in accordance with the test method given in Annex B, following which it shall pass the seat tightness test as set out in 5.3.2.

5.2.3 Resistance of valves to bending

Valves which are designed to be rigidly connected at both ends to adjacent pipes, excluding wafer type valves, shall withstand the stresses transmitted to them without sustaining any deformation likely to alter their functional capabilities beyond the limits specified in Annex C.

In order to verify this requirement, test the valve using the test method and with a bending moment, *M*, as set out in Annex C, at a differential pressure across the obturator equal to allowable operating pressure ±5 %. It shall, under the bending test load

— show no visually detectable external leakage, and

— exhibit a leakage rate at the obturator (see 5.3.2) not higher than that immediately above the seat leakage rate specified for new valves (for example, rate B if the specified rate is rate A as set out in Annex G).

5.2.4 Resistance of valves to operating loads

Valves having a mechanically-operated obturator shall withstand, in the fully open and in the fully closed positions, the torque (mST) without any damage likely to impair their functional capabilities beyond the limits specified in other parts of this International Standard.

The test method, the torques (mST) to be applied, and the acceptance criteria shall be those given in ISO 9635-2:2014, Clause A2.

5.3 Watertightness

5.3.1 Watertightness of shell and all pressure-containing components

5.3.1.1 Internal pressure

The valves shall be leak-tight under an internal water pressure equal to the higher of the two values: allowable site test pressure or 1,5 × allowable operating pressure.

In order to verify this requirement, subject the valve to a water pressure test as set out in 5.2.1, or to an air pressure test at (6 ±1) bar as set out in Annex F, following which there shall be no visually detectable leakage.

NOTE Air testing is applicable only when pressure vessel regulations permit.

5.3.1.2 External pressure

Valves shall be watertight to ingress of air, water, or any foreign matter.

In order to verify this requirement, the valve shall be tested in accordance with the method given in Annex D. Any variation of pressure during the test shall not exceed 0,02 bar.

5.3.2 Seat tightness

5.3.2.1 Seat tightness at high differential pressure

The seat of valves in the fully closed position shall be watertight within a defined leakage rate, selected from rate A to rate F according to Annex G. The allowed leakage rate shall be given in the manufacturer's technical data.

In order to verify this requirement, the valve as delivered shall be subjected to the test in accordance with Annex G under a differential pressure equal to 1,1 × AOP for water, or (6 ±1) bar for air. The measured leakage rate shall not exceed the allowed leakage rate.

5.3.2.2 Seat tightness at low differential pressure

Carry out the test as set out in 5.3.2.1, but under a differential water pressure of 0,5 bar.

The requirement shall be as set out in 5.3.2.1.

5.4 Hydraulic characteristics

5.4.1 Pressure loss

Carry out this test as set out in ISO 9644. The pressure loss measured at a particular flow rate in the fully open position shall not exceed the pressure loss declared by the manufacturer at that same flow rate by more than +10 %.

5.4.2 Other

Other hydraulic characteristics of control valves shall be given in the manufacturer's catalogues. Test them as set out in ISO 9635-5:2014, Annex B.

5.5 Resistance to chemicals and fertilizers

The functional capabilities of the valves shall not be impaired after prolonged use with fertilizers and other chemicals of the types and concentrations used in agriculture.

In order to verify this requirement, test the valve, as delivered, as set out in Annex E, following which it shall not exhibit any deterioration of its components and it shall pass the seat tightness test as set out in 5.3.2.1 and 5.3.2.2.

Perform the test on a valve with a DN that is representative of the range between two DNs of adjacent smaller diameters (of the same design, same materials, and produced by the same manufacturer).

5.6 Endurance test

Test the endurance of each type of valve as set out in the relevant part of ISO 9635.

6 Conformity assessment

6.1 General

Demonstrate the conformity of products to the relevant parts of ISO 9635 by

— carrying out all the type tests (see 6.2) in order to ensure that all fitness for purpose criteria are met, and

— controlling the production process (see 6.3) in order to ensure that the required performance levels are continuously reached.

The manufacturer shall ensure that all delivered valves are in accordance with the relevant part of ISO 9635. Should the verification of a requirement be necessary on a supplied product, verify that requirement by carrying out the corresponding type test.

6.2 Type tests

The type tests comprise the tests corresponding to all the requirements, as given in this part of ISO 9635 and the requirements of that part of the standard related to the specific valve being tested. Carry out type tests on valves, which are representative of the current production.

Set the sample size for the type tests in accordance with a quality assurance program.

Record type test results in a test report giving the type, quantity, DN, and PN of the valves tested, and indicating the test apparatus and measuring devices used, as well as their calibration criteria.

In order to qualify a range of valves of the same design, manufactured by the same process and from the same materials or equivalent materials, the type tests can be carried out on a reduced number of DNs by application of the following rule: when the type tests on one DN have given results in accordance with the standard, then the valves with the two DNs immediately smaller are presumed to have passed the same tests.

The type tests shall be carried out by the manufacturer or, at the manufacturer's request, by a competent testing institute. The manufacturer shall retain full reports of these tests as evidence of conformity. Repeat the appropriate type tests when the design or the production process has been modified in a way likely to negatively affect its functional capacities.

6.3 Control of production process and quality system

The manufacturer shall control the quality of products during manufacture by employing a process control system that ensures that the manufactured products meet the performance requirements of this part of ISO 9635.

The quality control system of the manufacturer shall be in conformity with an internationally-accepted quality system, such as ISO 9001. In addition, it is recommended that the quality system be approved by a competent third-party certification body, accredited, for example, according to ISO/IEC Guide 62.

7 Marking

Valves complying with ISO 9635 shall be marked in a durable and clearly visible manner in accordance with the requirements of ISO 5209, as follows.

a) Valves whose DN value is ≥50:

   — DN;

   — identification of the shell material(s);

   — PN;

— identification of the manufacturer;

— identification of the year of manufacture;

— number of the relevant part of ISO 9635, for example, ISO 9635-1.

b) Valves smaller than DN 50 need only be marked as follows:

— PN;

— identification of the manufacturer;

— number of the relevant part of ISO 9635, for example, ISO 9635-1.

8 Packaging

Valves shall be packaged and/or protected against mechanical damage and ingress of foreign matter during handling, transport, and storage, in accordance with the manufacturer's instructions, except when otherwise agreed between manufacturer and purchaser.

Annex A
(normative)

Test method for resistance to internal pressure of shell and all pressure-containing components

A.1 General

A.1.1 Materials with non-time-dependent mechanical behaviour

For shells from materials such as metals, use water as the test fluid at any temperature in the range of service temperatures given in 4.4.

Seal the ends of the valve. Apply the test pressure simultaneously to the inside of all cavities of the assembled valve. If necessary, adjust the obturator to a partially open position.

Maintain the test pressure for 10 min.

A.1.2 Materials with time-dependent mechanical behaviour

For shells manufactured from plastic materials, demonstrate the 50-year resistance to the pressure given in 5.2.1 by type testing of the resistance to internal pressure of the valve body in accordance with 4.3 and ISO 9911:2006, A.1 and A.2.

Carry out each test with the relevant combination of pressure, temperature, and duration, in accordance with ISO 9911:2006, Annex A.

Seal the ends of the valve. Apply the test pressure simultaneously to the inside of all cavities of the assembled valve. If necessary, adjust the obturator to partially open position.

For online production tests, the test duration can be fixed by the production cycle but, in that case, increase the test pressure by a factor specific to each material in order to take account of its 50-year extrapolated strength and of its strength regression line (see also 4.5).

A.2 Test procedure

The number of specimens shall be in accordance with ISO 9911:2006, Clause 5.1.

a) Close the ends of the valve.

b) Fill the valve with water and vent the air.

c) The pressure should be raised progressively and smoothly by increasing it every 15 s for every bar from zero to the test pressure.

d) Maintain the pressure for the required duration (see A.1.1 and A.1.2).

e) Check visually that there is no detectable external leakage and no other sign of defect during the specified test duration.

f) Terminate the test and record the test conditions and test results.

Annex B
(normative)

Test method for resistance of obturator to differential pressure

B.1 General

B.1.1 Materials with non-time-dependent mechanical behaviour

For shells manufactured from metals, use water as the test fluid at any temperature in the range of service temperatures given in 4.4. Maintain the test pressure for at least 10 min.

Ensure that the valve is in the closed position. Apply the differential test pressure in each flow direction unless otherwise specified in the relevant part of the International Standard.

When a valve has a mechanically-operated obturator, close it by applying a torque not exceeding the maximum operating torque .

See Table G.2 for the allowable seat leakage rate.

B.1.2 Materials with time-dependent mechanical behaviour

For shells manufactured from plastic materials, demonstrate the 50-year resistance to the pressure given in 5.2.2 by testing of the resistance to internal pressure of the valve body in accordance with 4.3 and ISO 9911:2006, Annex A.

Ensure that the valve is in the closed position. Apply the differential test pressure successively for each direction of fluid flow unless otherwise specified in the relevant part of the International Standard.

When a valve has a mechanically-operated obturator, close it by applying a torque not exceeding the maximum operating torque.

See Table G.2 for the allowable seat leakage rate.

B.2 Test procedure

The number of specimens shall be in accordance with ISO 9911:2006, 5.1.

a) Close one end of the valve.

b) Close the obturator.

c) Fill the space between the obturator and one end of the valve with water and vent the air.

d) The pressure should be raised progressively and smoothly by increasing it in approximately 15 s for every bar from zero to the test pressure.

e) Maintain the pressure for the required duration (see B.1.1 and B.1.2).

f) Terminate the test and empty the valve.

g) For valves designed to be used in both directions, a standpipe is required on each end.

h) Perform the seat tightness test (see 5.3.2).

i) For valves having a mechanically-operated obturator, perform the operating test (see 5.2.4).

j) Record the test conditions and test results.

Annex C
(normative)

Test method for resistance of valves to bending

C.1 General

Use water as the test fluid at a temperature in the range of service temperatures given in 4.4.

Carry out the test on a test assembly as shown on Figure C.1, with the valve installed as intended in the service position.

Mount the valve to be tested between two pipes and place the test assembly on simple supports. Ensure that dimension, L [see Formula (C.1) and Figure C.1] is a minimum of 0,005 × DN, in metres, and the overhangs outside the supports shall not exceed 0,001 × DN, in metres.

Determine the load for establishing a bending moment, M, expressed in Newton metres (N · m), greater than or equal to the requirement, using the following:

— the total mass, m_P, of the valve, test pipes, and the water, in kilograms (kg);

— two supplementary vertical forces, F, expressed in newtons, applied symmetrically to each side of the valve as shown in Figure C.1 and causing a pure bending moment, M, in the central part.

The total mass, m_P, and vertical forces, F, are related to the bending moment, M, by Formula (C.1):

$$F = \frac{1}{2L+b-2a}\left[2M - m_p \times g \times L \times \left(\frac{L+b}{2L+b}\right)\right] \tag{C.1}$$

where

g is the acceleration of the gravity, equal to 9,81 m/s^2;

L is the distance between one end of the valve and the nearest support, in metres (m);

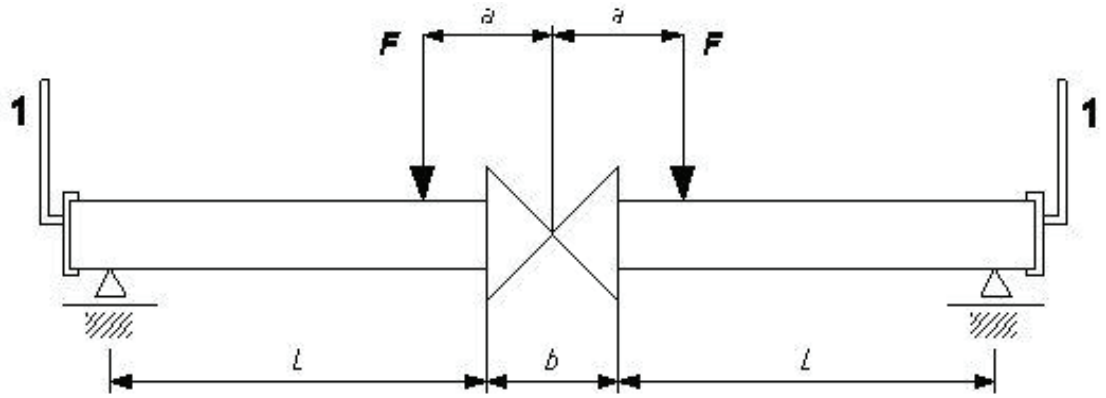
a is half the distance between the points of application of forces in metres (m), F, and where

$$\left(\frac{b}{2} < a < \frac{L}{2}\right);$$

b is the face-to-face dimension of the valve, in metres (m);

M is the applied bending moment in accordance with the other parts of the ISO 9635.

In order to allow a correct measurement of the leakage rate by means of the standpipe, ensure that the test assembly, the water, and the surrounding atmosphere are in thermal equilibrium throughout the test.



Key

1 standpipe

Figure C.1 — Test assembly

C.2 Test procedure

The number of specimens shall be in accordance with ISO 9911:2006, 5.1.

a) Position the test assembly (Figure C.1) on the supports, closing off both ends.

b) Fill the test assembly with water, adjusting the obturator to a partially open position if applicable, and vent the air.

c) Apply the calculated forces, *F*, in order to achieve the bending moment, *M*.

d) If applicable, close the obturator by application of the maximum operating torque.

e) The pressure should be raised progressively and smoothly in the pipe opposite to where the standpipe is placed by increasing it in approximately 15 s for every bar from zero to the test pressure.

f) Maintain the test pressure for at least 10 min after the required test pressure is established. If there is a need to test valves designed to be used in both directions, a standpipe is required in both pipes.

g) Check visually that there is no detectable external leakage for the test duration.

h) At the end of the test, read on the standpipe the amount of water that has leaked from the pressurized pipe to the unpressurized pipe and calculate the leakage rate.

i) Release the forces, *F*, and the pressure and terminate the test.

j) For valves designed to be used in both directions, repeat the test by pressurizing the other pipe.

k) Record the test conditions and test results.

Annex D
(normative)

Minimal test method for watertightness to external pressure of shell and all pressure-containing components

D.1 General

Ensure that the valve to be tested is free from water.

Carry out the test at ambient temperature.

D.2 Test procedure

The test procedure is the following.

a) Operate the obturator at least five times (from fully open to fully closed and back).

b) Set the obturator in a partially open position (on check valves and control valves, apply a vacuum on both sides.

c) Close the ends of the valve.

d) Lower the pressure in the valve to (−0,8 ±0,02) bar gauge.

e) Isolate the valve from the vacuum pump for 2 h, with the valve temperature constant within ±2 °C.

f) Note the internal pressure at the end of the 2 h and calculate the pressure variation with respect to the initial pressure.

g) Record the test conditions and test results.

Annex E
(normative)

Test method for resistance to chemicals and fertilizers

E.1 General

Ensure that the test solution temperature is (23 ±3) °C.

Use a test solution that is an aqueous solution of NaClO or $Ca(ClO)_2$ containing 50 mg/l of active chlorine (expressed as Cl_2).

Use the same sealants used by the manufacturer for the test.

E.2 Test procedure

The number of specimens shall be in accordance with ISO 9911:2006, 5.1.

a) Close the ends of the valve.

b) Set the obturator in a partially open position.

c) Fill the valve with the test solution and vent the air.

d) Let the valve stand for 48 h.

e) Empty the valve and inspect visually to detect any deterioration of its components.

f) Perform the seat tightness test (see 5.3.2).

g) Record the test conditions and test results.

Annex F
(normative)

Test method for water or air tightness of valve body

F.1 General

Carry out this test to confirm the water or air tightness of the valve body, including the sealing of the operating mechanism, against internal pressure.

Use either air or water as the test fluid. The choice of the test fluid is at the discretion of the client.

Adjust the obturator for isolating and control valves to a partially open position.

Blank off the end connections of the shell and fill all cavities with the test fluid.

F.2 Test procedure

The test procedure is the following.

a) Apply the test pressure to the test fluid:

   — if the fluid is water, ensure that the pressure is as specified in 5.3.1.1;

   — if the fluid is air, ensure that the pressure is the lower of 1,5 × the allowable operating pressure at ambient temperature or (6 ±1) bar.

b) Maintain the test pressure for a minimum test duration as set out in Table F.1.

c) Examine the shell for water or air tightness, as follows:

   — if the test fluid is water, check the complete external surface of the shell visually for leakage;

   — if the test fluid is air,

      i) immerse the valve in water with the upper surface of the valve not more than 50 mm below the surface of the water and check for bubbles breaking the surface of the water, or

      ii) alternatively, coat the valve with a leak detection fluid and check for the continuous formation of bubbles.

Table F.1 — Minimum test duration for shell tests

Nominal size	Minimum test duration	
	Production and acceptance tests s	Type test min
Up to DN 50	15	10
DN 65 to DN 200	60	10
DN 250 and above	180	10

When the shell is tested in a production line and the time of one production cycle is shorter than the production test time specified in Table F.1, test the shell for the time of the production cycle. In that case, carry out statistical process control tests confirming that all valves are capable of meeting the acceptance criteria in accordance with F.3.

F.3 Acceptance criteria

The acceptance criteria are the following:

— if the test fluid is water, there shall be no visually detectable leakage from any external surface of the shell;

— if the test fluid is air,

a) no bubbles shall break the surface of the water when the valve is immersed in water, or

b) there shall be no continuous formation of bubbles when the valve is coated with a leak detection fluid.

Leakage from the operating mechanism sealing is permitted, provided that there is no visually detectable leakage when the test pressure is 1,1 × the allowable operating pressure at ambient temperature.

Annex G
(normative)

Test method for seat tightness

G.1 General

Carry out this test to confirm the capability of the seat(s) to conform to the specified leakage rate

— at the time of manufacture, and

— in the direction(s) for which the valve is designed.

Use either a liquid or gas for the test fluid. The choice of the test fluid is at the discretion of the client.

G.2 Test pressure

Use a test pressure as specified in 5.3.2.1, except that, if the test fluid is a gas, the test pressure may be the lower of 1,1 × the allowable differential pressure at ambient temperature or (6 ±1) bars for valves of

— sizes up to DN 80 for all pressure ratings, and

— sizes above DN 80 and up to DN 2 000 for pressure ratings up to PN 40.

G.3 Test duration

Maintain the test pressure for a duration not less than that specified in Table G.1.

Table G.1 — Minimum test duration for seat tightness tests

Nominal size	Minimum test duration			
	Production and acceptance tests s			Type testing min
	Metal-seated valves		Soft-seated valves (Liquid or gas)	All valves (Liquid or gas)
	Liquid	Gas		
Up to DN 50	15	15	15	10
DN 65 to DN 200	30	15	15	10
DN 250 to DN 450	60	30	30	10
DN 500 and above	120	30	60	10

When the seat tightness is tested in a production line and the time of one production cycle is shorter than the production test time specified in Table G.1, test the seat tightness for the time of the production cycle. In that case, carry out statistical process control tests confirming that all valves are capable of meeting the requirements of G.5.

G.4 Test procedures

G.4.1 General

When a valve has a mechanically-operated obturator, close it by applying the torque defined by the manufacturer and, in any case, a torque not exceeding the maximum operating torque.

G.4.2 Gate valves, ball valves, and plug valves

The procedure for testing the seat tightness of gate, ball, and plug valves is the following.

a) Fill the valve cavity, including, if appropriate, the cover cavity, with the test fluid.

b) Move the obturator to the closed position.

c) Apply the test pressure specified in G.2 and maintain the test pressure for the test duration specified in G.3.

d) Determine the rate of leakage.

e) Repeat steps c) and d) for the other side of the valve.

This procedure might not ensure pressurization of the intergate space of double-seated valves and therefore not permit verification of the leakage rate of the downstream seat. Where such pressurization is a requirement of the product or performance standard, or is required by the purchaser, when necessary, step c) may be carried out before step b).

Valves which incorporate a “double block and bleed” design feature should have the bleed plug removed prior to the test in order to prove the “double block and bleed” capability.

Valves with independent double seating (such as valves with a two-piece obturator or double-seated valves) may be tested by applying the test pressure between the seats and checking each side of the closed valve.

Soft-seated ball valves previously subjected to a liquid seat test pressure can have a reduced performance capability in some subsequent services at low differential pressures. If a liquid seat test pressure is specified and is carried out before a low pressure gas seat test, it can be necessary to allow time for the seat material to recover.

With plug valves relying on a sealing compound to effect a seal, it is permitted that the sealing compound be changed prior to testing.

G.4.3 Globe valves

The procedure for testing the seat tightness of globe valves is the following.

a) Fill the upstream valve cavity with the test fluid.

b) Move the obturator to the closed position.

c) Apply the test pressure specified in G.2 in the direction to unseat the obturator, and maintain the test pressure for the test duration specified in G.3.

d) Determine the leakage rate.

G.4.4 Diaphragm valves

The procedure for testing the seat tightness of diaphragm valves is the following.

a) Fill the valve cavity with the test fluid.

b) Move the obturator to the closed position.

c) Apply the test pressure specified in G.2 in the direction producing the most adverse sealing condition, and maintain the test pressure for the test duration specified in G.3.

d) Determine the rate of leakage.

Valves with symmetrical seating may be tested in either direction.

G.4.5 Butterfly valves

The procedure for testing the seat tightness of butterfly valves is the following.

a) Fill the valve cavity with the test fluid.

b) Move the obturator to the closed position.

c) Apply the test pressure specified in G.2 to the disc in the direction producing the most adverse sealing condition, and maintain the test pressure for the test duration specified in G.3.

   Test double disc butterfly valves either in both directions with the body vent plug removed, or by introducing the test pressure between the discs via a shell tapping and measuring leakage on either side of the disc.

d) Determine the leakage rate.

Valves with symmetrical seating may be tested in either direction.

G.4.6 Check valves

The procedure for testing the seat tightness of check valves is the following.

a) Fill the downstream valve cavity including, if appropriate, the cover cavity, with the test fluid.

b) Apply the test pressure specified in G.2 in the direction tending to close the obturator, and maintain the test pressure for the test duration specified in G.3.

c) Determine the leakage rate.

G.5 Acceptance criteria

The leakage rates measured during the specified test duration shall not exceed the rate specified in the corresponding product or performance standards, and shall be in accordance with Table G.2.

Table G.2 — Maximum allowable seat leakage in mm^3/s for each valve leakage class

Test fluid	Leakage rate class[a]						
	A	B	C	D	E	F	G
Water	No visually detectable leakage for duration of test[b]	0,01 × DN	0,03 × DN	0,1 × DN	0,3 × DN	1,0 × DN	2,0 × DN
Air		0,3 × DN	3,0 × DN	30 × DN	300 × DN	3 000 × DN	6 000 × DN

NOTE Table G.3 should be used to establish the equivalent DN number for those valves which are designated other than by DN.

[a] The leakage rates only apply when discharging to ambient temperature.

[b] "No visually detectable leakage" means no visible weeping or formation of drops or bubbles.

For the purpose of calculating seat leakage rates and test duration times, it is necessary to establish the equivalent DN number for those valves which are designated other than by DN.

The equivalent DN numbers of valves having flanged ends, threaded ends, welded ends, capillary, or compression ends shall be in accordance with Table G.3.

Table G.3 — Equivalent DN numbers for different types of valve body end

Equivalent DN numbers	Flanged, threaded or welding ends NPS	Capillary or compression ends for copper tube mm	Compression ends for plastic tube mm
8	¼	8	—
10	—	10; 12	10; 12
15	½	14; 14,7; 15; 16; 18	14,7; 15; 16; 18
20	¾	21; 22	20; 21; 22
25	1	25; 27,4; 28	25; 27,4; 28
32	1 ¼	34; 35; 38	32; 34
40	1 ½	40; 40,5; 42	40; 40,5
50	2	53,6; 54	50; 53,6
65	2 ½	64; 66,7; 70	63
80	3	76,1; 80; 88,9	75; 90
100	4	108	110
125	5	—	—
150	6	—	—
200	8	—	—
250	10	—	—
300	12	—	—
350	14	—	—
400	16	—	—
450	18	—	—
500	20	—	—
600	24	—	—
650	26	—	—
700	28	—	—
750	30	—	—
800	32	—	—
900	36	—	—
1 000	40	—	—

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