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Agricultural irrigation equipment — Irrigation valves —

Part 1: General requirements

Matériel agricole d'irrigation — Vannes d'irrigation —

Partie 1: Exigences générales

Reference number
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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.

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 9635-1 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 first edition of ISO 9635-1, together with ISO 9635-2, ISO 9635-3, ISO 9635-4 and ISO 9635-5, cancels and replaces ISO 9635:1990, of which it constitutes a technical revision.

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*

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 15 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 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 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, *Metallic flanges — Part 1: Steel flanges*

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 9635-2:2006, *Agricultural irrigation equipment — Irrigation valves — Part 2: Isolating valves*

ISO 9635-3:2006, *Agricultural irrigation equipment — Irrigation valves — Part 3: Check valves*

ISO 9635-4:2006, *Agricultural irrigation equipment — Irrigation valves — Part 4: Air valves*

ISO 9635-5:2006, *Agricultural irrigation equipment — Irrigation valves — Part 5: Control valves*

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

ISO 9911:—[1], *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
maximum limit of torque which, when applied at the shaft, operates the valve and ensures compliance with the required leakage rate

3.2
minimum strength torque
minimum limit of 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
point where the load (torque) is applied in order to change the position of the valve obturator, which may be the end of the stem, or the input shaft of the reducer when the reducer is an integral part of the valve

3.4
type test
test made to prove that the design meets the corresponding performance requirements in this part of ISO 9635 and the part of ISO 9635 related to the specific valve being tested

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

[EN 736-2]

3.6
operating device
manual or power operated device used to operate the bare valve

[EN 736-2]

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

[EN 736-2]

1) To be published. (Revision of ISO 9911:1993)

3.8
DN
alphanumeric designation of the size of pipe work components, used for reference purposes, comprising the letters DN followed by a dimensionless round number which is loosely related to the effective dimensions, in millimetres, of the bore or external diameter of the end connections

NOTE Adapted from ISO 6708:1995, definition 2.1.

3.9
nominal pressure
PN
numerical designation which is a convenient rounded number for reference purposes, designated by the letters PN followed by a dimensionless round number which is loosely related to the pressure, expressed in bars

NOTE 1 1 bar = 0,1 MPa = 10^5 Pa; 1 MPa = 1 N/mm^2.

NOTE 2 Adapted from ISO 7268:1983/Amd 1:1984.

3.10
allowable operating pressure
PFA
maximum hydrostatic pressure that a component is capable of withstanding continuously in service

3.11
maximum allowable pressure
PMA
maximum pressure occurring from time to time, including surge, that a component is capable of withstanding in service

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

3.13
obturator
movable component of the valve whose position in the fluid flow path restricts or obstructs the fluid flow

4 Design requirements

4.1 Materials

4.1.1 Components and coating materials

Components and coating materials shall be selected from those conforming to the relevant standards, where existent. They shall also be in accordance with 4.9, 4.10 and 4.11, either alone or in combination with coating materials.

4.1.2 Elastomers

Elastomers shall be in accordance with ISO 4633 or EN 681-1 and 4.10 of this part of ISO 9635.

4.2 DN

The DN values shall be selected from the preferred values given in ISO 6708, with an upper limit of DN 2 000. The manufacturer shall indicate 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 (PFA), maximum allowable pressure (PMA) and allowable site test pressure (PEA) are in accordance with Table 1 for the corresponding PN (see also 4.4).

Table 1 — Valve pressures

PN	**Pressure** bar		
	PFA[a]	**PMA**[a]	**PEA**[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 PMA and PEA. 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, PEA shall not be less than the lesser of 1,5 PMA or (PMA + 5) bar.

4.4 Temperatures

Valves shall be designed for service temperatures from 1 °C to 60 °C and for storage temperatures between –40 °C and 70 °C. For valves made from materials with temperature-dependent mechanical behaviour, the PFA, PMA and PEA shall be established at (23 ± 3) °C and, if applicable, a factor (temperature/pressure table) for higher temperatures shall be given by the product standards and/or the manufacturer.

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 PFA, PMA and PEA 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 either one or the other 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 fifty-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 in accordance with ISO 9080.

— An experimental method, by means of pressure tests on valve shells subjected to a constant hydrostatic pressure equal to PMA 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 account of its fifty-year extrapolated minimum strength and of 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 be in accordance 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 be in accordance 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 the values given in Table 2 in steady flow conditions.

Table 2 — Maximum water flow velocity

PFA 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.

4.9.1 Plastic valves

Plastic valves shall be in accordance with ISO 9911.

Plastics 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. Plastics parts that enclose waterways shall be opaque or 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 shall be designed to permit internal repair and maintenance without removing the valve body from the line.

5 Performance requirements

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

5.1 Mechanical strength

5.1.1 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: PEA or 1,5 × PFA.

In order to verify this requirement, the valve, as delivered, shall be tested 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.

5.1.2 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 × PFA or PFA + 5. If the PMA indicated for the valves is higher than this value, the differential pressure applied shall be equal to PMA.

In order to verify this requirement, the valve shall be tested according to the test method given in Annex B, following which it shall pass the seat tightness test according to 5.2.2.

5.1.3 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, the valve shall be tested using the test method and with a bending moment M in accordance with Annex C at a differential pressure across the obturator equal to PFA ± 5 %. It shall, under the bending test load:

— show no visually detectable external leakage;

— exhibit a leakage rate at the obturator (see 5.2.2) not higher than that immediately above the seat leakage rate specified for new valves (e.g. rate B if the specified rate is rate A according to Annex G).

5.1.4 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 minimum strength torque (mST) without any damage likely to impair their functional capabilities beyond the limits specified in Annex B.

The test method, the mST to be applied and the acceptance criteria shall be in accordance with Annex C.

5.2 Watertightness

5.2.1 Watertightness of shell and all pressure-containing components

5.2.1.1 Internal pressure

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

In order to verify this requirement, the valve shall be subjected to a water pressure test in accordance with 5.1.1, or to an air pressure test at (6 ± 1) bar in accordance with Annex F, following which there shall be no visually detectable leakage.

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

5.2.1.2 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.

5.2.2 Seat tightness

5.2.2.1 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 × PFA for water, or (6 ± 1) bar for air. The measured leakage rate shall not exceed the allowed leakage rate.

5.2.2.2 Seat tightness at low differential pressure

The requirement shall be in accordance with 5.2.2.1.

The test shall be carried out in accordance with 5.2.2.1, but under a differential water pressure of 0,5 bar.

5.3 Hydraulic characteristics

5.3.1 Pressure loss

Carry out this test in accordance with ISO 9644. The pressure loss measured at a particular flow rate shall not exceed the pressure loss declared by the manufacturer at that same flow rate by more than +5 %.

5.3.2 Other

Other hydraulic characteristics of control valves shall be given in the manufacturer's catalogues and shall be tested in accordance with ISO 9635-5:2006, Annex B.

5.4 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, the valve, as delivered, shall be tested in accordance with Annex E, following which it shall not exhibit any deterioration of its components and shall pass the seat tightness test in accordance with 5.2.2.1 and 5.2.2.2.

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

5.5 Endurance test

The endurance of each type valve shall be carried out in accordance with the specific test specified in the relevant part of ISO 9635.

6 Conformity assessment

6.1 General

The conformity of products to the relevant parts of ISO 9635 shall be demonstrated 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, it shall be made by carrying out the corresponding type test.

6.2 Type tests

The type tests shall 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. Type tests shall be carried out on valves, which are representative of the current production.

The applicant shall set the sample size for the type tests in accordance with a quality assurance program.

Type test results shall be recorded 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 of the two DNs immediately below are presumed to have passed the same tests.

The type tests shall be carried out by the manufacturer or, at his request, by a competent testing institute. The manufacturer shall retain full reports of these tests as evidence of conformity. The appropriate type tests shall be repeated 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 his products during manufacture by a system of process control to ensure that the manufactured products meet the performance requirements of this part of ISO 9635.

The quality 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 in accordance with ISO 9635 shall be marked in a durable and clearly visible manner in accordance with 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, e.g. 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, e.g. 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, the test fluid shall be water at any temperature in the range of service temperatures given in 4.4.

Seal the ends of the valve. The test pressure shall be simultaneously applied to the inside of all cavities of the assembled valve. If necessary, the obturator shall be in a partially open position.

The test pressure shall be maintained for 10 min to 12 min.

A.1.2 Materials with time-dependent mechanical behaviour

For shells manufactured from plastic materials, the fifty-year resistance to the pressure given in 5.1.1 shall be demonstrated by type testing of the resistance to internal pressure of the valve body in accordance with 4.3 and ISO 9911:—, A.1 and A.2.

Each test shall be carried out with the relevant combination of pressure, temperature and duration, in accordance with ISO 9911:—, Annex A.

Seal the ends of the valve. The test pressure shall be simultaneously applied to the inside of all cavities of the assembled valve. If necessary, the obturator shall be in a partially open position.

For on-line production tests, the test duration can be fixed by the production cycle, but then the test pressure shall be increased by a factor specific to each material in order to take account of its fifty-year extrapolated strength and of its strength regression line (see also 4.5).

A.2 Test procedure

The number of specimens should be in accordance with ISO 9911:—, 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 in approximately 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, the test fluid shall be water at any temperature in the range of service temperatures given in 4.4. The test pressure shall be maintained for at least 10 min.

The valve shall be in the closed position. The differential test pressure shall be applied for flow in each direction unless otherwise specified in 5.1.2.

When a valve has a mechanically operated obturator, it shall be closed by application of a torque not exceeding the maximum operating torque (MOT) (see 5.1.2).

A leak from the seat during the test is not a cause for rejection.

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, the fifty-year resistance to the pressure given in 5.1.2 shall be demonstrated by testing of the resistance to internal pressure of the valve body in accordance with 4.3 and ISO 9911, Annex A.

The valve shall be in the closed position. The differential test pressure shall be applied successively for each direction of fluid flow unless otherwise specified in 5.1.2.

When a valve has a mechanically operated obturator, it shall be closed by application of a torque not exceeding MOT.

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

B.2 Test procedure

The number of specimens should be in accordance with ISO 9911:—, 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 5.2.2).

i) For valves having a mechanically operated obturator, perform the operating test (see 5.1.4).

j) Record the test conditions and test results.

Annex C
(normative)

Test method for resistance of valves to bending

C.1 General

The test fluid shall be water at a temperature in the range of service temperatures given in 4.4.

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

The new valve shall be mounted between two pipes and the test assembly placed on simple supports. Dimension L [see Equation (C.1) and Figure C.1] shall be a minimum of 0,005 × DN, in metres, and the overhangs outside the supports shall not exceed 0,001 × DN, in metres.

The load for establishing a bending moment, M, expressed in newton metres (N · m), greater than or equal to the requirement, shall be determined with 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 Equation (C.1):

$$F = \frac{1}{2\ L + b - 2a}\left[2M - m_\mathrm{P} \times L \times \left(\frac{L+b}{2L+b}\right)\right] \quad \text{(C.1)}$$

where

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

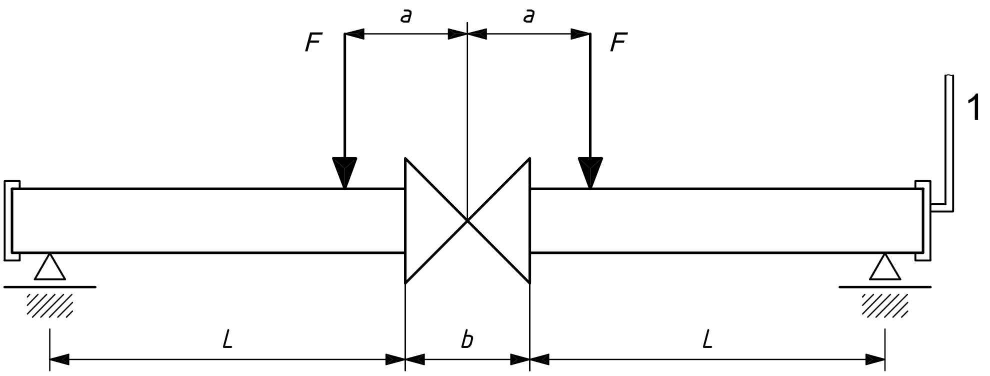
a is half the distance between the points of application of forces F and where

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

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

M is the applied bending moment in accordance with ISO 9635-2:2006, Table 1.

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



Key

1 standpipe

Figure C.1 — Test assembly

C.2 Test procedure

The number of specimens should be in accordance with ISO 9911:—, 5.1.

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

b) Fill the test assembly with water, the obturator being in 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 torque MOT.

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 we need to test valves designed to be used in both directions, we need to have a standpipe 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

The valve to be tested shall be free from water.

The test shall be carried out 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.

c) Close the ends of the valve.

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

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

The test solution temperature shall be (23 ± 3) °C.

The test solution shall be an aqueous solution of NaClO or $Ca(ClO)_2$ containing 50 mg/l of active chlorine (expressed as Cl_2).

The same sealants as used by the manufacturer shall be used for the test.

E.2 Test procedure

The number of specimens should be in accordance with ISO 9911:—, 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 5.2.2).

g) Record the test conditions and test results.

Annex F
(normative)

Test method for water or air tightness of valve body

F.1 General

This test shall be carried out to confirm the water or air tightness of the valve body, including the operating mechanism sealing, against internal pressure.

The test fluid shall be either air or water. The choice of the test fluid is at the discretion of the applicant.

The obturator of isolating and control valves shall be in a partially open position.

The end connections of the shell shall be blanked off and all cavities filled 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, the pressure shall be as specified in 5.2.1.1;

— if the fluid is air, the pressure shall be the lower of 1,5 times the allowable pressure at ambient temperature or (6 ± 1) bar.

b) Maintain the test pressure for a minimum test duration in accordance with 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, the shell shall be tested for the time of the production cycle. In that case, statistical process control tests shall be carried out 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,

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

2) 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 times the allowable pressure at ambient temperature.

Annex G
(normative)

Test method for seat tightness

G.1 General

This test shall be carried out 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.

The test fluid shall be a liquid or gas. The choice of the test fluid is at the discretion of the applicant.

G.2 Test pressure

The test pressure shall be as specified in 5.2.2.1, except that if the test fluid is a gas, the test pressure may be the lower of 1,1 times 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

The test pressure shall be maintained for a duration not less than that specified in Table G.1.

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

Nominal size	Min. test duration			
	Production and acceptance tests s			Type testing min
	Metal seated valves		Soft-seated valves	All valves
	Liquid	Gas	Liquid or gas	Liquid or 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, the seat tightness shall be tested for the time of the production cycle. In that case, statistical process control tests shall be carried out confirming that all valves are capable of meeting the requirements of G.5.

G.4 Test procedures

G.4.1 General

The test procedure shall be in accordance with G.4.2 to G.4.6, depending on the particular type or types of valve being tested.

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 “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 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.

NOTE 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 charged 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 for each leakage rate

Test fluid	**Rate of leakage**[a] mm³/s						
	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
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 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	—	—

Bibliography

[1] ISO 7268, *Pipe components — Definition of nominal pressure*

[2] ISO 9001, *Quality management systems — Requirements*

[3] ISO/TR 15155, *Test facilities for agricultural irrigation equipment*

[4] ISO/IEC Guide 62:1996, *General requirements for bodies operating assessment and certification/registration of quality systems*

[5] IEC 60529, *Degrees of protection afforded by enclosures (IP code)*

[6] EN 736-2, *Valves — Terminology — Part 2: Definition of components of valves*

[7] EN 805, *Water supply — Requirements for systems and components outside buildings*

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