INTERNATIONAL STANDARD

ISO 9635-5

Second edition
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Agricultural irrigation equipment — Irrigation valves —

Part 5: Control valves

Matériel agricole d'irrigation — Vannes d'irrigation —

Partie 5: Vannes de contrôle

Reference number
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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the 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 Technical Committee 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 9635-5:2006), 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*

Agricultural irrigation equipment — Irrigation valves —

Part 5: Control valves

1 Scope

This part of ISO 9635 specifies construction and performance requirements and test methods for control 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 hydraulically-operated control irrigation valves of DN 15 (1/2 inch) diameter or greater, designed to operate in any position, from fully open to fully closed. The valves can either be directly operated (i.e. the force applied via a spring or diaphragm to the obturator), or pilot-operated (i.e. the force is applied through an adjustable pilot valve via a diaphragm). These valves can also function as check valves.

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 9635-1:2014, *Agricultural irrigation equipment — Irrigation valves — Part 1: General requirements*

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

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 9635-1 and the following apply.

3.1
control valve
device intended to regulate, within specified limits, one or more functions

Note 1 to entry: The functions are flow rate, water level, and pressure control (upstream or downstream). The valves are also used to start or terminate irrigation system operation.

3.1.1
autonomous control valve
control valve (3.1) that uses the energy from the conveyed water to adjust the position of the obturator for the regulation of a specific function

3.1.2
non-autonomous control valve
control valve (3.1) that requires external power to adjust the position of the obturator for the regulation of a specific function

3.1.3
pressure-reducing valve
control valve (3.1) that reduces a higher inlet pressure to a constant lower outlet pressure regardless of variations in the flow rate or variations of the inlet pressure

3.1.4
pressure-sustaining valve
control valve (3.1) that maintains a constant pressure at the inlet regardless of variations in the flow rate or variations in the outlet pressure

3.2
flow coefficient
K_V
number equal to the flow rate of water, in cubic metres per hour, that will flow through a fully open valve with a 100 kPa pressure loss across the valve

Note 1 to entry: $Q = K_V \sqrt{\Delta p}$, where Q is the flow rate in cubic metres per hour (m^3/h), and Δp is the pressure in bar.

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

Note 3 to entry: Adapted from EN 736–3.

3.3
maximum differential pressure
highest differential pressure of the control valve in operation

Note 1 to entry: It is a value given by the manufacturer.

4 Design requirements

Control valves shall be designed in accordance with ISO 9635-1:2014, Clause 4.

Control valves designed to control pressure or water level shall be tightly seated when closed (see ISO 9635-1:2014, Table G.2, Rate A).

The manufacturer shall indicate in the relevant technical documentation the working limits of the valve and any special conditions for installation and commissioning.

5 Performance requirements

Perform all tests on the valve as delivered to the test facility.

5.1 Mechanical strength

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

Carry out testing in accordance with ISO 9635-1:2014, 5.1.1.

If the manufacturer indicates that any feature of the control valve is not designed to withstand a high pressure, the technical documentation shall indicate the appropriate means to be used (for example, isolating valves of the control system), in order to protect that feature during the test.

Test the features protected by these means to the pressure given in ISO 9635-1:2014, 5.1.2.

Test results shall comply with the requirements of ISO 9635-1:2014, 5.1.1.

5.1.2 Resistance of obturator to differential pressure

The valve shall comply with the requirement and test in ISO 9635-1, 5.1.2.

If a control valve is designed not to seat tightly, the requirement and test for the obturator shall be modified as follows: the differential pressure which the obturator shall withstand shall be the lower of (1,5 × PM) bar and (PM + 5) bar where PM is the maximum differential pressure of the control valve in

operation (value to be given by the manufacturer). After the test, the valve shall comply with the control performances of this part of ISO 9635 (see 5.2).

After the test, the valve shall meet the performance requirements of 5.3.

5.1.3 Resistance of valves to bending

Carry out testing in accordance with ISO 9635-1:2014, 5.1.3.

The bending moment, *M*, to be applied during the test shall be as set out for the appropriate value of DN as set out in Table 1.

Test results shall comply with the requirements of ISO 9635-1:2014, 5.1.3.

Table 1 — Bending moments

DN	Bending moment *M* N · m
8	610
10	615
20	640
25	670
32	730
40	825
50	525
65	700
80	750
100	1 100
125	1 600
150	2 400
200	3 600
250	5 500
300	7 500
350	9 500
400	12 000
450	14 000
500	16 500

5.1.4 Resistance of valves to operating loads

Carry out testing in accordance with ISO 9635-1:2014, 5.1.4 or in accordance with the manufacturer's instructions.

Test results shall comply with the requirements of ISO 9635-1:2014, 5.1.4.

5.2 Watertightness

5.2.1 Watertightness of shell and all pressure-containing components

5.2.1.1 Internal pressure

Carry out testing in accordance with ISO 9635-1:2014, 5.2.1.1. Test results shall comply with the requirements of ISO 9635-1:2014

5.2.1.2 External pressure

Carry out testing in accordance with ISO 9635-1:2014, 5.2.1.2.

Test results shall comply with the requirements of ISO 9635-1:2014, 5.2.1.2.

5.2.2 Seat tightness

This test is applicable only to control valves where seat tightness is a requirement or is claimed by the manufacturer (see Clause 4).

For level control and pressure control valves, select rate A for the leakage rate not to be exceeded (see ISO 9635-1:2014, Table G.2), for the conditions defined in the manufacturer's documentation. For other valves, select a leakage rate as specified in the manufacturer's documentation.

Check the seat tightness at the highest and lowest values of the differential pressure, as follows:

a) 1,1 × allowable operating pressure;

b) the lowest differential pressure allowed as specified in manufacturer's documentation.

For both cases, carry out the testing in accordance with ISO 9635-1:2014, 5.2.2.1, with the values of the differential pressure as defined in a) and b), above.

Test results shall comply with the requirements of ISO 9635-1:2014, 5.2.2.1.

5.2.3 Maximum operating torque for operation and watertightness

This test is applicable only to control valves whose main obturator can be operated manually to override or limit the control function.

Carry out tests in accordance with ISO 9635-2:2014, 5.2.3. Test results shall comply with the requirements of ISO 9635-2:2014, 5.2.3.

If the required maximum operating torque exceeds the limits according to this part of ISO 9635, this should be specified in the manufacturer's product literature.

5.2.4 Watertightness and air-tightness of gearboxes to external pressure

Carry out testing in accordance with ISO 9635-1:2014, 5.2.1.2.

Test results shall comply with the requirements of ISO 9635-1:2014, 5.2.1.2.

5.3 Hydraulic characteristics

5.3.1 Flow coefficient, K_V

The manufacturer shall give the flow coefficient, K_V, obtained from the head loss curve performed in accordance with ISO 9644.

— For both autonomous and non-autonomous control valves, K_V shall be given as a function of the fully open position.

When measured in accordance with ISO 9644, the flow coefficient shall be within a range of ±5 % of the value given by the manufacturer.

5.3.2 Regulation hydraulic characteristics

This test is applicable to both autonomous control valves and to non-autonomous control valves where the manufacturer claims specific hydraulic characteristics linked to a designated control system.

5.3.2.1 Control valves providing flow regulation function

Test the control valve as set out in Annex A. The values obtained shall be within the tolerances given in the manufacturer's documentation or if not indicated, within ±10 % of the values given in the manufacturer's documentation.

5.3.2.2 Control valves providing pressure regulation function

Test the control valve as set out in Annex B. The values obtained shall be within the tolerances given in the manufacturer's documentation or if not indicated, within ±10 % of the values given in the manufacturer's documentation.

5.3.2.3 Control valves providing level regulation function

Test the control valve as set out in Annex C. The values obtained shall be within the tolerances given in the manufacturer's documentation or if not indicated, within ±10 % of the values given in the manufacturer's documentation.

5.4 Resistance to chemicals and fertilizers

Carry out testing in accordance with ISO 9635-1:2014, 5.4.

Test results shall comply with the requirements of ISO 9635-1:2014, 5.4.

5.5 Endurance

After completion of the endurance test as set out in Annex D, the valve shall pass the following:

— the hydraulic tests as set out in 5.3, with values within the range of ±5 % of those measured before the endurance test;

— the tests as set out in 5.2.1 and 5.2.2, with the same leakage rate.

6 Conformity assessment

6.1 General

Test results shall comply with the requirements of ISO 9635-1:2014, 6.1.

6.2 Type tests

Perform type tests as indicated in Table 2.

Test results shall comply with the requirements of ISO 9635-1:2014, 6.2.

6.3 Control of production process and quality system

Test results shall comply with the requirements of ISO 9635-1:2014, 6.3.

NOTE The production control tests given in Table 2 are for information only.

Table 2 — Requirements and testing

Subclause of ISO 9635-1:2014	Corresponding requirement	Type tests[a]	Production tests (informative)
4.1	Materials	See drawings and part lists	—
4.2	DN	See drawings	—
4.3	Pressures	See technical documentation	—
4.4	Temperatures	See materials	—
4.5	Design of the shell and obturator	See test report or calculation report	—
4.6	End types and interchangeability	See drawings and marking	—
4.7	Operating direction	See drawings	—
4.8	Maximum water velocity	See Clause 4	—
4.9	All wetted valve part materials, including lubricants, in contact with water intended for human consumption	See test reports in accordance with national regulations	—
4.10	Internal corrosion and ageing resistance	See drawings, part lists, and technical documentation	Visual inspection of coatings
4.11	External corrosion and ageing resistance	See drawings, part list,s and technical documentation	Visual inspection of coatings
5.1.1	Resistance of shell and all pressure containing components to internal pressure	See 5.1.1	See 5.1.1
5.1.2	Resistance of obturator to differential pressure	See 5.1.2	—
5.1.3	Resistance of valves to bending	See 5.1.3	—
5.1.4	Resistance of valves to operating loads	See 5.1.4	—
5.2.1.1	Leak-tightness to internal pressure	See 5.2.1.1	See 5.2.1.1
5.2.1.2	Leak-tightness to external pressure	See 5.2.1.2	—
5.2.2	Seat tightness	See 5.2.2	See 5.2.2
5.2.1.2	Leak-tightness of gearboxes to external pressure	See 5.2.4	—
5.3.1	Flow coefficient, K_V	See 5.3.1	—
5.3.2	Regulation hydraulic characteristics	See 5.3.2	—
5.4	Resistance to chemicals and fertilizers	See 5.4	—
5.5	Endurance	5.5	—

[a] References to subclauses in this column are to this part of ISO 9635.

7 Marking

Requirements shall be in accordance with ISO 9635-1:2014, Clause 7. In addition, the direction of flow shall be marked.

8 Packaging

Requirements shall be in accordance with ISO 9635-1:2014, Clause 8.

Annex A
(normative)

Test method for hydraulic characteristics of control valves providing flow regulation function

A.1 General

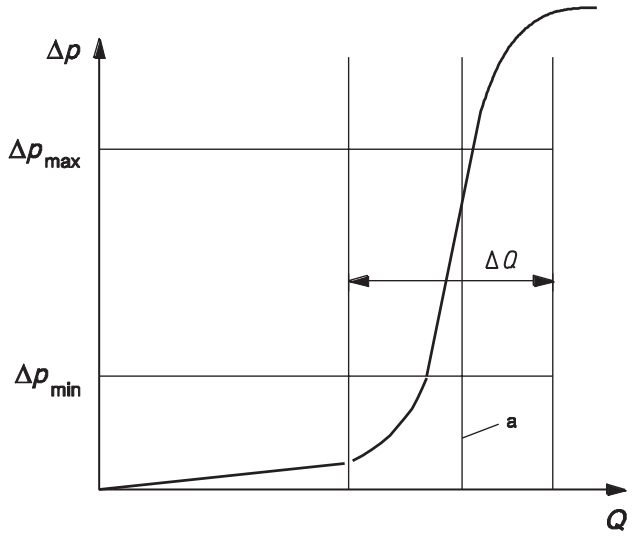
Perform the test at ambient temperature.

A.2 Test procedure (see Figure A.1)

At flow Q equal to the minimum allowed flow value as given by the manufacturer, apply four different values of differential pressure, Δp, to the valve (Δp_{min}, Δp_{max}, and two intermediate values), while measuring the controlled flow.

The difference between the measured flow rate corresponding to the maximum differential pressure, Δp_{max}, and the measured flow rate corresponding to the minimum differential pressure, Δp_{min}, shall be within the tolerance ΔQ given in the manufacturer's documentation.

Repeat the same procedure, choosing a flow equal to the maximum flow as given by the manufacturer.



Key

a Set point Q.

Figure A.1 — Hydraulic characteristics

Annex B
(normative)

Test method for hydraulic characteristics of control valves providing pressure regulation function

B.1 General

Perform the test at ambient temperature avoiding cavitation while doing so.

B.2 Test procedure (see Figures B.1 and B.2)

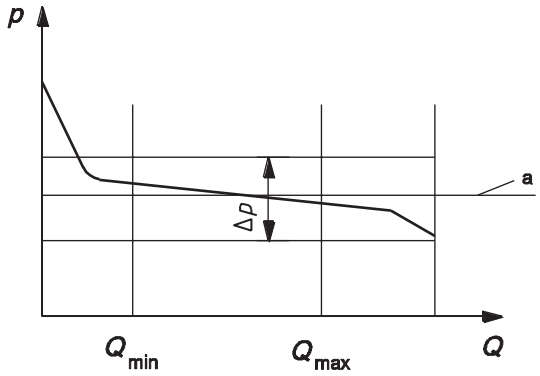
The test procedure is the following.

At set point p of a controlled pressure equal to the minimum pressure as given by the manufacturer, establish four different values of flow (Q_{min}, Q_{max}, and two intermediate values), while measuring the controlled pressure.

Maintain the differential pressure at the minimum value allowed by the manufacturer's documentation.

The absolute difference between the measured controlled pressure corresponding to the maximum flow rate, Q_{max}, and the measured controlled pressure corresponding to the minimum flow rate, Q_{min}, shall be within the tolerance Δp given in the manufacturer's documentation.

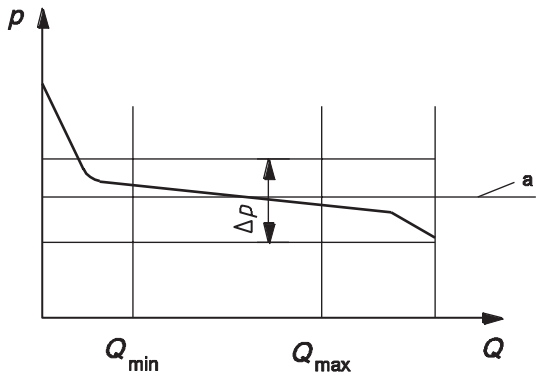
Repeat the same procedure at the maximum pressure as given by the manufacturer.



Key

a Set point Q.

Figure B.1 — Pressure-reducing valve



Key

a Set point Q.

Figure B.2 — Pressure-sustaining valve

Annex C
(normative)

Test method for hydraulic characteristics of control valves providing level regulation

C.1 General

Perform the test at ambient temperature on a valve, avoiding cavitation while doing so.

C.2 Test procedure (see Figure C.1)

The test procedure is the following.

a) Open the valve and fill the tank up to the set point, H_{max}.

b) Increase the pressure to 1,1 × the allowable operating pressure, checking that the flow has stopped and that the height in the tank is not higher than H_{max}.

c) Decrease the upstream pressure of the valve to zero, then decrease the level in the tank by the value ΔH given in the manufacturer's documentation.

d) Increase the upstream pressure until the flow starts again and note the value of the pressure.

e) Allow the tank to fill to H_{max}.

f) Increase the pressure to 1,1 × the allowable operating pressure and check that the height in the tank is not higher than H_{max} when the flow stops. If the manufacturer claims an adjustable value of H_{max}, perform the test at both limits of the range.

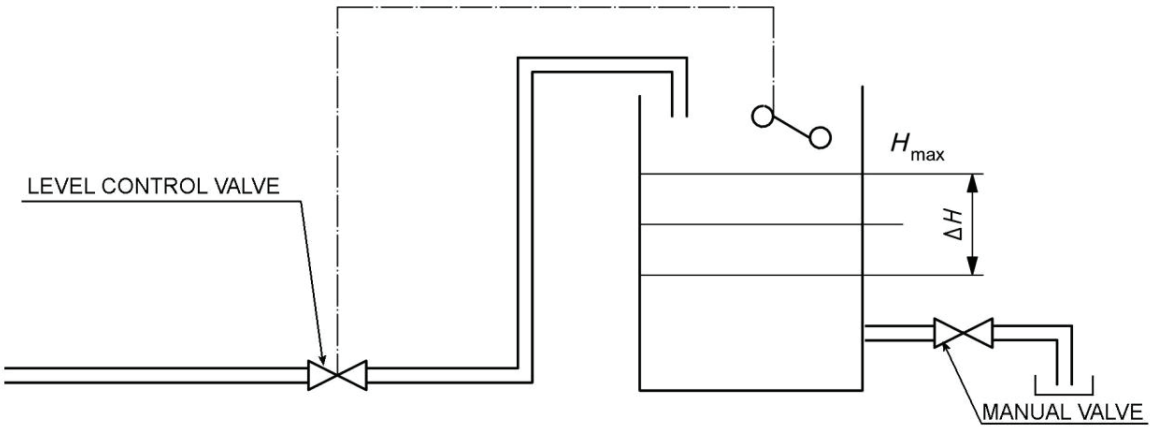


Figure C.1 — Test installation

Annex D
(normative)

Test method for endurance of control valves

D.1 General

Perform the test at ambient temperature on a valve which has passed the tests in accordance with Annex A, B, or C.

For valves equipped with a pilot, the pilot and the main valve may be tested separately.

D.2 Test procedure

The test procedure is the following.

a) Set the control valve to its open position as given in the manufacturer's technical documentation and maintain it in this position for a minimum of 15 s with a pressure equal to the maximum allowable pressure ±10 %.

b) Set the control valve to its maximum closed position as given in the manufacturer's technical documentation and increase the differential pressure up to the maximum allowable pressure ±10 %.

c) Maintain in this position for a minimum of 15 s. Repeat the procedure for 5 000 cycles.

d) On completion of the test, subject the valve to a re-test in accordance with Annex A, Annex B, or Annex C at a single test setting point.

The result of the re-test shall be within ±5 % of the original test result.

Bibliography

[1] EN 736-1, *Valves — Terminology — Part 1: Definition of types of valves*

[2] EN 736-3, *Valves — Terminology — Part 3: Definition of terms*

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

[4] EN 1074 (all parts), *Valves for water supply — Fitness for purpose requirements and appropriate verification tests*

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