INTERNATIONAL STANDARD

ISO 13693-1

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Irrigation equipment — Safety devices for chemigation —

Part 1: Small plastics valves for chemigation

Matériel d'irrigation — Dispositifs de sécurité pour l'application de produits chimiques par irrigation —

Partie 1: Petites vannes en matière plastique pour l'application de produits chimiques par irrigation

Reference number
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Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 13693-1 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 18, *Irrigation and drainage equipment and systems*.

ISO 13693 consists of the following parts, under the general title *Irrigation equipment — Safety devices for chemigation*:

— *Part 1: Small plastics valves for chemigation*

Chemigation valve assemblies from DN 75 to DN 350 are to form the subject of a future part 2.

Irrigation equipment — Safety devices for chemigation —

Part 1:
Small plastics valves for chemigation

1 Scope

This part of ISO 13693 specifies the general requirements and test methods for small plastics-bodied valves used for chemigation, hereinafter referred to as "the device", intended for operation in irrigation pipe systems which may contain fertilizers and chemicals of the type and concentration used in agriculture.

It is applicable to controllable safety devices (also known as backflow preventers) with a reduced pressure zone (RPZ), intended to prevent backflow by back-siphonage or backpressure of irrigation water into an upstream potable water distribution system, whenever the pressure in the latter is lower than that in the system located downstream.

It is applicable to such devices of nominal size up to and including DN 50 (2"), with a nominal pressure of PN10, that are capable of working without modification or adjustment

— at any pressure up to 1 MPa (10 bar),

— with any pressure variation up to 1 MPa (10 bar), and

— in permanent duty at temperatures up to 45 °C and for 1 h at 65 °C.

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

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

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
controllable safety device with a reduced pressure zone
controllable safety device with RPZ
device containing two independently-acting *check valves* (3.7) together with a hydraulically operated, mechanically independent pressure relief valve located between the check valves

3.2
backflow
flow against the intended direction of flow

3.3
back-siphonage
backflow (3.2) due to a reduction in system pressure, which causes a sub-atmospheric pressure at a site in the system

3.4
backpressure
elevation above the supply pressure of the pressure downstream in a piping system which could cause a reversal of the flow from its intended direction

3.5
nominal pressure
PN
maximum static water pressure, immediately upstream of a small plastics valve used for *chemigation* (3.6), at which the valve is required to operate

3.6
chemigation
application of any chemical through an irrigation system

3.7
check valve
valve which automatically opens by fluid flow in a defined direction and which automatically closes to prevent fluid flow in the reverse direction

4 Classification

The nominal and connection sizes of the device shall be in accordance with Table 1.

Table 1 — Connection sizes of threaded and flanged devices

Nominal size DN, mm	**8**	**10**	**15**	**20**	**25**	**32**	**40**	**50**
Nominal diameter of threaded connections (in accordance with ISO 7-1), inches	1/4	3/8	1/2	3/4	1	1¼	1½	2
Nominal diameter of flanged connections, mm	—	—	—	—	—	—	40	50

5 Designation

The device shall be designated as follows:

a) type;

b) nominal size (DN) (see Table 1);

c) nominal pressure (PN);

d) connection type;

e) type of plastics material (generic);

f) reference to this part of ISO 13693.

6 Materials

The manufacturer shall state, in the technical and sales literature on the device, the types of materials from which the device is made.

The device shall be corrosion-resistant.

The materials from which the device is manufactured shall be compatible with chemicals normally used in irrigation systems.

Where the device may come into contact with potable water, the device and the materials from which it is manufactured shall comply with national standards for potable water.

7 Design requirements

7.1 General

The design characteristics (see Figure 1) of the device shall be as follows:

a) three pressure zones — upstream, intermediate and downstream — such that the pressure, P_1, in the upstream zone is greater than the pressure, P_i, in the intermediate zone, which is greater than the pressure, P_2, in the downstream zone, under static (no flow) and flow conditions;

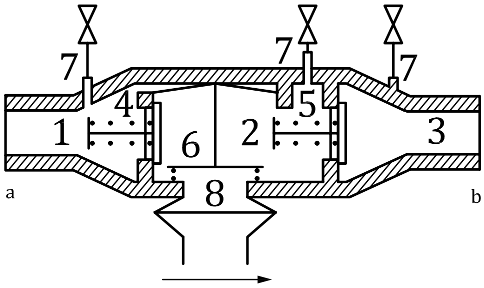
b) $P_1 - P_i > 14$ kPa (140 mbar);

c) intermediate pressure zone connected to the atmosphere, when $P_1 - P_i \leq 14$ kPa (140 mbar);

d) intermediate pressure zone disconnected from the atmosphere, when $P_1 \leq 14$ kPa (140 mbar);

e) minimum set discharge flow (backflow rate);

f) allows verification, in every zone, of disconnection and sealing of the protection devices (obturators, discharge valves).



Key

1 upstream pressure (P_1) zone
2 intermediate pressure (P_i) zone
3 downstream pressure (P_2) zone
4 upstream check valve
5 downstream check valve
6 relief valve
7 pressure tap orifice
8 funnel

a Upstream.
b Downstream.

Figure 1 — Design principle

The internal components of the device shall be accessible for inspection, repair or replacement. These operations shall be possible even when the device is installed. The components shall be able to be replaced without removing the device, without ambiguity (impossibility of reversal or interchange of obturators, diaphragms, springs, etc.). A visible mark is not sufficient.

The settings of the springs shall be fixed and not adjustable.

Only the water pressure of the supply network shall be able to operate the control of the internal components of the device.

Possible additional control devices (electric, pneumatic, etc.) shall not adversely affect the backflow protection function.

The device shall be installed horizontally, except where the manufacturer states that it can also be installed in the vertical position. The tests shall be carried out in the prescribed position.

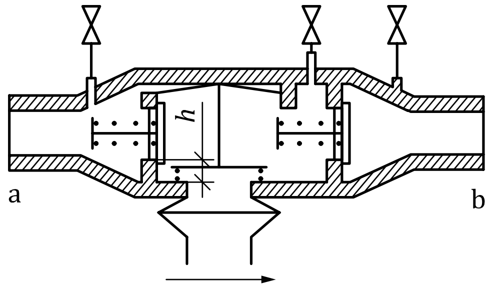
7.2 Relief valve

When the differential pressure between the upstream and downstream check valves is less than 14 kPa (140 mbar), the relief valve shall be open to ensure positive safety (draining the intermediate pressure zone to the atmosphere).

The internal vertical distance, *h* (in the disconnected position), between the highest point of the seat of the relief valve and the lowest point of the seat of the upstream check valve (see Figure 2) shall be

— $h \geq 5$ mm, for DN ≤ 15, and

— $h \geq 10$ mm, for 15 < DN ≤ 50.



a Upstream.
b Downstream.

Figure 2 — Relief valve

In all installation positions indicated by the manufacturer, no water retention shall be permitted within the intermediate pressure zone.

The cross-section of the passage orifices shall be ≥45 mm^2 with DN > 15, or 12,5 mm^2 with DN ≤ 15; no dimension for the calculation of the cross-section shall be less than 4 mm.

A device fitted with a funnel shall evacuate at the full relief flow rate defined in Table 6.

The funnel to the drain shall be

— directly incorporated into the device,

— factory fitted, or

— supplied with the device.

The structure of the relief orifice of the device shall be such that neither the fitting of a standardized threaded pipe, nor the connection of a standardized pipe or shape — be it by glue, welding or interlocking — is useable.

7.3 Pressure taps

The device shall include three pressure taps to permit periodic verification that the device is functioning properly, which shall be placed

— upstream from the first check valve,

— in the intermediate pressure zone, and

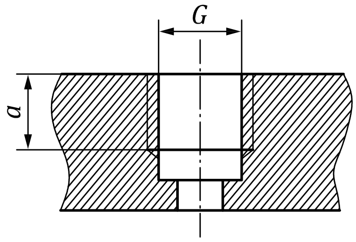
— downstream from the second check valve.

They shall be dimensioned as shown in Figure 3 and as given in Table 2.

The bores for the pressure taps shall have, over their full length, a minimum cross-section of 12,5 mm^2. Their smallest dimension shall not be less than 4 mm.

Table 2 — Pressure-tap thread dimensions

Nominal size **DN,** mm	**Thread designation,** *G* (in accordance with ISO 7-1)	**Thread depth** *a*, mm
DN ≤ 10	G1/8 or G1/4	≥ 6,5
10 < DN ≤ 50	G1/4	≥ 6,5



Key

G thread size

a thread depth

Figure 3 — Pressure-tap thread dimensions

Each pressure tap shall be fitted with a 1/4 turn cock of size

— DN 6 (G1/8 connection) female outlet, for devices of DN ≤ 10, or

— DN 8 (G1/4 connection) female outlet, for devices of 10 < DN ≤ 50.

8 Characteristics and tests

8.1 General test conditions

Carry out the performance tests on the device installed in accordance with the manufacturer's technical documents.

If not specified, perform all tests with water at an ambient temperature not exceeding 40 °C.

In the absence of particular specifications, ensure that measurement accuracy is as follows:

— flow rate: ± 2 % of the value specified;

— pressure: ± 2 % of the value specified;

— water temperature: ± 5 °C of the value specified;

— time: 0 to +10 % of the measured value.

All other measuring instruments shall have an accuracy of ± 2 % of the measured value.

8.2 Expression of the results

Record the measured values. These results may be graphically expressed as a function of pressure, flow rate or time. For examples, see Annex A.

8.3 Order of testing

Execute all tests on one device, except for the test of long-term pressure endurance (8.7), which may be performed on another device without internal parts.

Perform the tests in the sequence according to Table 3.

Table 3 — Test sequence

Order of sequence	Test	Subclause of this part of ISO 13693
1	Resistance of body to short-term pressure	8.4.2
2	Closing pressure and tightness of downstream check valve	8.5.2
3	Tightness of downstream check valve	8.5.1
4	Tightness of upstream check valve at low pressure	8.5.3
5	Pressure loss as function of flow rate	8.6.1
6	Pressure difference between upstream and intermediate pressure zones	8.6.2
7	Venting to atmospheric pressure of intermediate pressure zone when upstream pressure drops	8.6.3
8	Pressures at opening and closing of relief valve	8.6.4
9	Relief valve tightness in case of fluctuation of upstream pressure	8.6.5
10	Pressure in intermediate pressure zone under backflow conditions	8.6.6
11	Short-term endurance tests	8.4.3
12	Tightness of downstream check valve	8.5.1
13	Closing pressure and tightness of downstream check valve	8.5.2
14	Tightness of upstream check valve at low pressure	8.5.3
15	Venting to atmospheric pressure of intermediate pressure zone when upstream pressure drops	8.6.3
16	Tightness of upstream check valve under vacuum	8.5.4

8.4 Mechanical characteristics

8.4.1 General

Ensure that the test equipment allows the device to be tested in accordance with the requirements.

NOTE The examples shown in the figures are for guidance only.

8.4.2 Resistance of body to short-term pressure

Apply an increase of static water pressure at the inlet of the device in increments of 0,1 MPa (1 bar) per 5 s, up to 2,5 MPa (25 bar).

Hold this pressure for 5 min.

Record any observations.

Neither visual permanent deformation, nor rupture of the body or internal parts of the device shall occur.

8.4.3 Short-term endurance tests

8.4.3.1 Behaviour at elevated temperature

Place the fully assembled device in an environment of temperature 65 °C and relative humidity (50 ± 5) % for 72 h.

8.4.3.2 Thermal shock

Following the test according to 8.4.3.1, immerse the device in a water bath at a temperature of 65 °C for 60 min, so that the water reaches all parts of the device that are in contact with water during normal operation.

After 60 min, immerse the device in a bath of temperature 15 °C for 10 min.

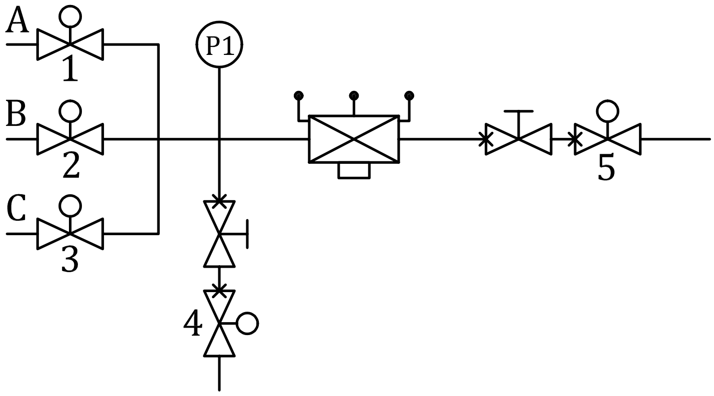
At the conclusion of this test, disassemble the device and examine it.

There shall be no visible deformation of the elastomeric and plastic parts.

8.4.3.3 Cyclic pressure test

Following the tests of 8.4.3.1 and 8.4.3.2, place the device in the test setup shown in Figure 4 and submit it to (5 000 ± 50) cycles, at a water temperature of 45 °C, with each cycle comprising the following stages, in the sequence given:

- open valve 5, then valve 1; maintain circulation at ± 5 % of the flow rate given in Table 4 for (6 ± 2) s;
- close valve 5, then valve 1;
- open valve 3, maintaining a static pressure of 0,3 MPa (3 bar) for (6 ± 2) s;
- close valve 3, open valve 4, then drain the device (by opening the relief valve) for (6 ± 2) s;
- close valve 4;
- open valve 5, then valve 1, maintain circulation at ± 5 % of the flow rate given in Table 4 for (6 ± 2) s;
- close valve 5, then valve 1;
- open valve 2, maintaining a static pressure of 1 MPa (10 bar) for (6 ± 2) s;
- close valve 2, open valve 4, then drain the device by opening the relief valve for (6 ± 2) s;
- close valve 4.

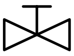


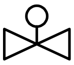
Key

A supply flow; maximum pressure of 0,3 MPa (3 bar) at zero flow

B supply pressure: 1 MPa ± 0,05 MPa (10 bar ± 0,5 bar)

C supply pressure: 0,3 MPa ± 0,03 MPa (3 bar ± 0,3 bar)

 adjusting valve

 valve with time control of opening and closing

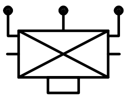
 tested safety device

Figure 4 — Cyclic pressure test setup

Divide the 5 000 cycles into four periods, each of 1 250 cycles, as follows.

a) **1 250 cycles**

Allow the device to remain at rest for 14 h at ambient temperature, before proceeding to the next period.

b) **1 250 cycles**

Maintain the device at a static pressure of 1 MPa (10 bar) for 14 h at ambient temperature, before proceeding to the next period.

c) **1 250 cycles**

Submit the device to an upstream pressure of 0,3 MPa (3 bar) and to a downstream pressure of 1 MPa (10 bar) for 14 h at ambient temperature, before proceeding to the final period.

d) **1 250 cycles.**

At the conclusion of the test, the device shall be capable of meeting the requirements of 8.5 and 8.6 without replacement of any component.

Table 4 — Cyclic pressure test — Flow rate

Nominal size **DN**, mm	**8**	**10**	**15**	**20**	**25**	**32**	**40**	**50**
Flow rate m^3/h	0,4	0,6	1,3	2,2	3,5	5,8	9	14

8.5 Tightness tests

8.5.1 Tightness of downstream check valve

The test comprises the following steps:

a) using the equipment setup shown in Figure 4, apply a pressure of 1,6 MPa (16 bar) downstream from the device, in increments of 0,1 MPa (1 bar) per 5 s, with ambient water, while maintaining the upstream pressure zone at atmospheric pressure;

b) hold the pressure for 2 min;

c) isolate the device from the supply pressure by closing valve 2 and valve 5 for 10 min.

No leakage, permanent deformation or deterioration of the downstream check valve shall occur.

8.5.2 Closing pressure and tightness of downstream check valve

The verification requires measurement of the difference, Δh, in the height of the water between two level tubes (Figure 5).

The test comprises the following steps:

a) ensure that the inside diameter of the level tubes is (10 ± 0,2) mm;

b) admit water to the device so that the height, h, of the water column in tube C is sufficient to carry out the two measurements;

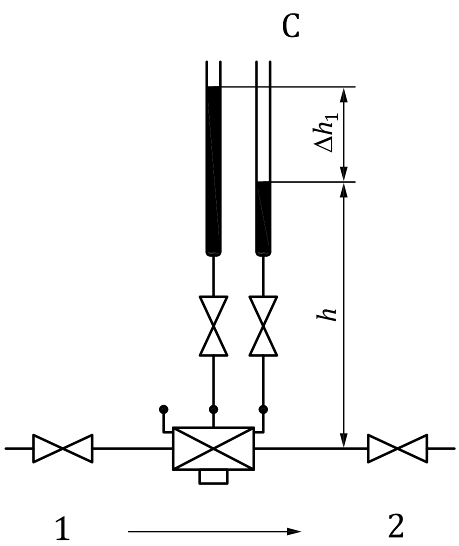
c) isolate the device for 5 min ± 30 s;

d) note height Δh_1, see Figure 5 a);

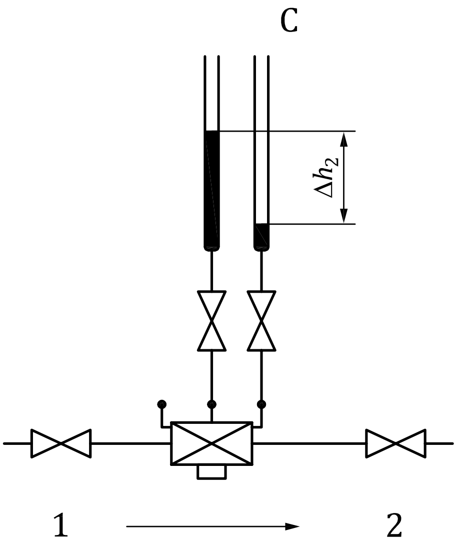
e) drain slightly downstream;

f) isolate the device for 5 min ± 30 s;

g) note height Δh_2, see Figure 5 b).



a)



b)

Figure 5 — Closing pressure test equipment

The closing pressure of the check valve shall be greater than 7 kPa (70 mbar), which equals 70 cm; Δh_1 and Δh_2 shall be above 70 cm. The results may be expressed as a curve (for an example, see Figure A.1).

8.5.3 Tightness of upstream check valve at low pressure

The test comprises the following steps:

a) fill the device with water so that the water column has a height of (200 ± 50) mm in the level tube [inside diameter (10 ± 0,2) mm], as shown in Figure 6;

b) isolate the device for 5 min ± 30 s;

c) raise the water level in the level tube to (1 000 ± 50) mm;

d) isolate the device for 5 min ± 30 s;

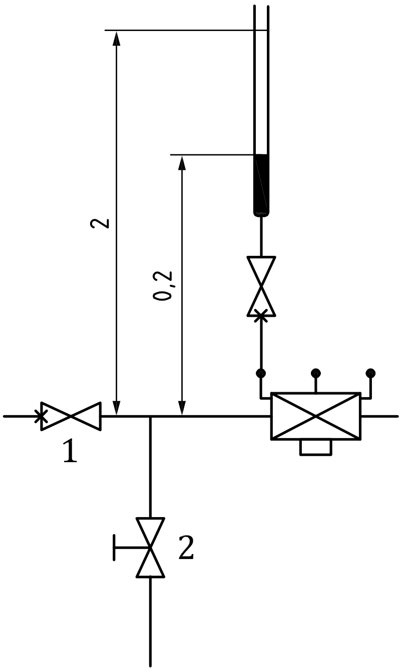
e) raise the water level in the level tube to (2 000 ± 50) mm;

f) isolate the device for 5 min ± 30 s.

The water level in the level tube shall be constant at each step, thereby verifying the tightness of the upstream check valve at low pressure.

No lowering of the water level in the tube shall be noted at any step.

Dimensions in metres



Key

 isolating valve

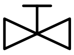
 adjusting valve

Figure 6 — Tightness test equipment — Low pressure

8.5.4 Tightness of upstream check valve under vacuum

The test comprises the following steps:

a) dismantle the downstream check valve;

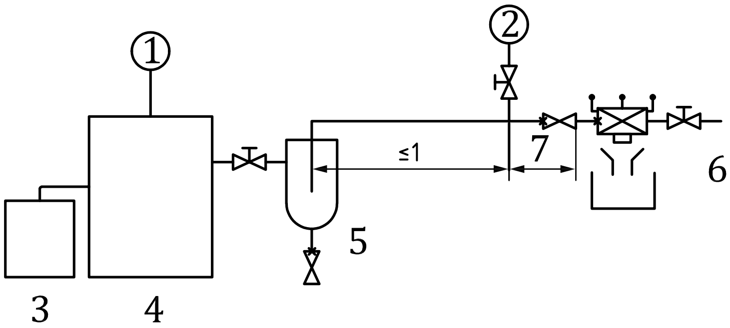
b) place the device in the test bench (see Figure 7);

c) adjust the relief flow rate to obtain a pressure in the intermediate pressure zone of 14 kPa (140 mbar);

d) quickly apply a vacuum of 0,025 MPa (0,25 bar) upstream of the device and maintain the vacuum for 5 min.

No water shall collect in the water trap, thus verifying the tightness of the upstream check valve under vacuum.

Dimensions in metres



Key

1 vacuum gauge

2 vacuum gauge

3 vacuum pump

4 vacuum vessel

5 water trap

6 water supply

7 distance between end of valve to vacuum gauge 2 (5 DN to 10 DN)

 isolating valve

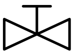
 adjusting valve

Figure 7 — Tightness test equipment — Vacuum

8.6 Hydraulic characteristics

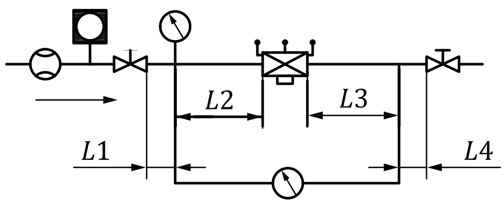
8.6.1 Pressure loss as function of flow rate

8.6.1.1 Test bench

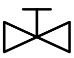
The setup of the test equipment shown in Figure 8 is based upon horizontal installation:

— *L*1 and *L*3 ≥ 10 DN;

— *L*2 and *L*4 ≥ 2 DN.



Key

 adjusting valve

 differential pressure gauge

 thermometer

 flow meter

Figure 8 — Pressure loss test bench

8.6.1.2 Test method

The test comprises the following steps:

a) record the pressure loss over the full range of flow rates for the device between 0 and the flow rate given in Table 5. Wait for stabilization at each measuring point (for a graphic example, see Figure A.2);

b) verify the tightness of the relief valve during the entire pressure loss test.

The pressure loss in the piping lengths between the device and the pressure taps should be taken into account (see ISO 9644).

8.6.1.3 Requirement

For flow rates between 0 and those given in Table 5, the maximum value of pressure loss indicated in Table 5 shall not be exceeded.

Table 5 — Maximum pressure loss

Nominal size **DN,** mm	**Flow rate,** m^3/h	**Pressure loss max.,** MPa		**Flow rate,** m^3/h	**Pressure loss max.,** MPa
8	0,54	0,1		0,81	0,15
10	0,86	0,1		1,27	0,15
15	1,9	0,1		2,9	0,15
20	3,4	0,1		5,1	0,15
25	5,3	0,1		7,9	0,15
32	8,7	0,1		13	0,15
40	13,6	0,1		20,3	0,15
50	21,2	0,1		31,8	0,15

8.6.2 Pressure difference between upstream and intermediate pressure zones

8.6.2.1 Dynamic test

Set up as in Figure 4.

Record the pressure difference between the upstream pressure zone and the intermediate pressure zone over flow rates varying between 0 and the maximum flow rate given in Table 5 (for a graphic example, see Figure A.3).

The pressure difference between the upstream pressure zone and the intermediate pressure zone shall be greater than 14 kPa (140 mbar).

8.6.2.2 Static test

Set up as in Figure 4.

The test comprises the following steps:

a) close valve 5;

b) record the pressure difference between the upstream and intermediate pressure zones for upstream pressures ranging between 0,1 MPa and 1 MPa (1 bar to 10 bar) (for a graphic example, see Figure A.4).

The pressure difference between the upstream pressure zone and the intermediate pressure zone shall be greater than 14 kPa (140 mbar).

8.6.3 Venting to atmospheric pressure of intermediate pressure zone when upstream pressure drops

Set up as in Figure 4.

The test comprises the following steps:

a) leave valve 5 in the open position;

b) record the pressure difference between the upstream and intermediate pressure zones over an upstream pressure from 0,175 MPa to 0 MPa (1,75 bar to 0 bar) (for a graphic example, see Figure A.5).

The discharge system shall open to connect the intermediate pressure zone to atmospheric pressure before the pressure differential between the inlet and the pressure intermediate zone drops to 14 kPa (140 mbar).

8.6.4 Pressures at opening and closing of relief valve

Set up as in Figure 4.

Record the pressure difference between the upstream and intermediate pressure zones for each of the following upstream pressures: 0,175 MPa, 0,3 MPa, 0,6 MPa and 1,0 MPa (1,75 bar, 3 bar, 6 bar and 10 bar).

The test comprises the following steps.

a) Apply the given static pressure upstream of the device.

b) Reduce this upstream pressure slowly.

c) Record the value of the pressure difference between the upstream and intermediate pressure zones when the relief valve opens (drop by drop).

d) The relief valve shall start opening at a pressure difference between the upstream and intermediate pressure zones greater than 14 kPa (140 mbar).

e) Bring the upstream pressure back to its initial value.

f) The relief valve shall again close tightly.

8.6.5 Relief valve tightness in case of fluctuation of upstream pressure

Set up as in Figure 4.

The test comprises the following steps, for each of the pressures, 0,175 MPa, 0,3 MPa, 0,6 MPa and 1,0 MPa (1,75 bar, 3 bar, 6 bar and 10 bar):

a) apply the given static pressure upstream from the device,

b) in a time interval of 10 s, increase this pressure by 10 kPa (100 mbar), then decrease it by 10 kPa (100 mbar),

c) in a time interval of 10 s, decrease this pressure by 10 kPa (100 mbar), then increase it by 10 kPa (100 mbar), and

d) repeat steps b) and c) twice.

No discharge at the relief valve shall occur for an increasing or decreasing upstream pressure in a range of 10 kPa (100 mbar).

8.6.6 Pressure in intermediate pressure zone under backflow conditions

This test is performed with the downstream check valve removed.

Set up as in Figure 7.

Record the variation of pressure in the intermediate pressure zone for a constant relief valve flow rate, as given in Table 6, with an upstream pressure varying between 0 MPa and 1 MPa (0 bar and 10 bar) (for a graphic example, see Figure A.6).

Table 6 — Minimum relief flow rate

Nominal size **DN**, mm	8 to 10	15	20	25	32	40	50
Relief low rate m^3/h	0,54	0,72	1,08	1,08	2,34	2,34	4,5

For an upstream pressure up to 14 kPa (140 mbar), the pressure in the intermediate pressure zone shall be less than 10,5 kPa (105 mbar) at the flow rate given in Table 6.

The funnel to the drain shall evacuate the full relief valve flow rate, without spillage, to the outside.

8.7 Long-term pressure endurance

At ambient room temperature,

a) remove all internal parts from the device,

b) apply a hydrostatic pressure of 2 MPa (20 bar), and

c) maintain the pressure for 1 000 h.

The device shall withstand the hydrostatic pressure without any leakage or distortion.

9 Marking

The device shall be marked permanently and visibly on its body and cover or on a fixed identification plate. This marking shall include the following information:

a) manufacturer's name, brand or logo;

b) nominal size (DN);

c) nominal pressure (PN), in pascals, bar or psi;

d) maximum operating temperature, in °C or °F;

e) an arrow indicating normal direction of flow;

f) manufacturer's reference code;

g) unit identification number;

h) reference to this part of ISO 13693.

10 Packaging

The device shall be protected, from the time of manufacture to the time of its installation, against

a) damage to threaded ends, and

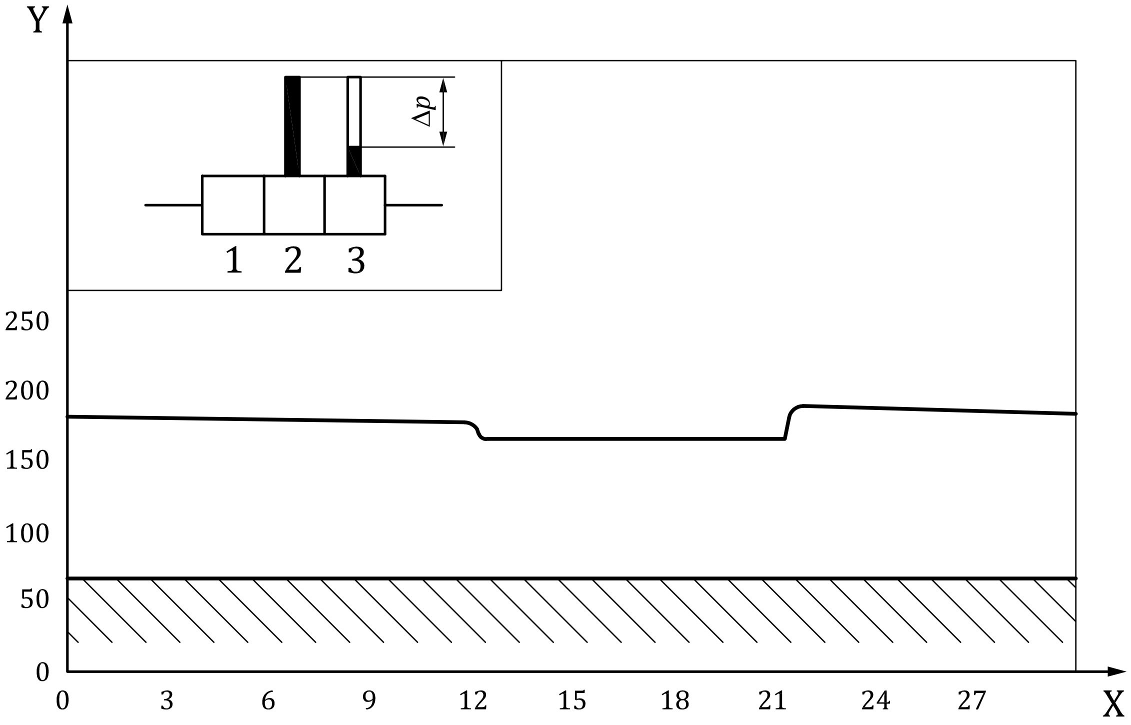
b) outside contamination.

A device packed in a watertight package is considered to be adequately protected.

Annex A
(informative)

Examples of presentation of test results

See Figures A.1 to A.6.



Key

X time, min

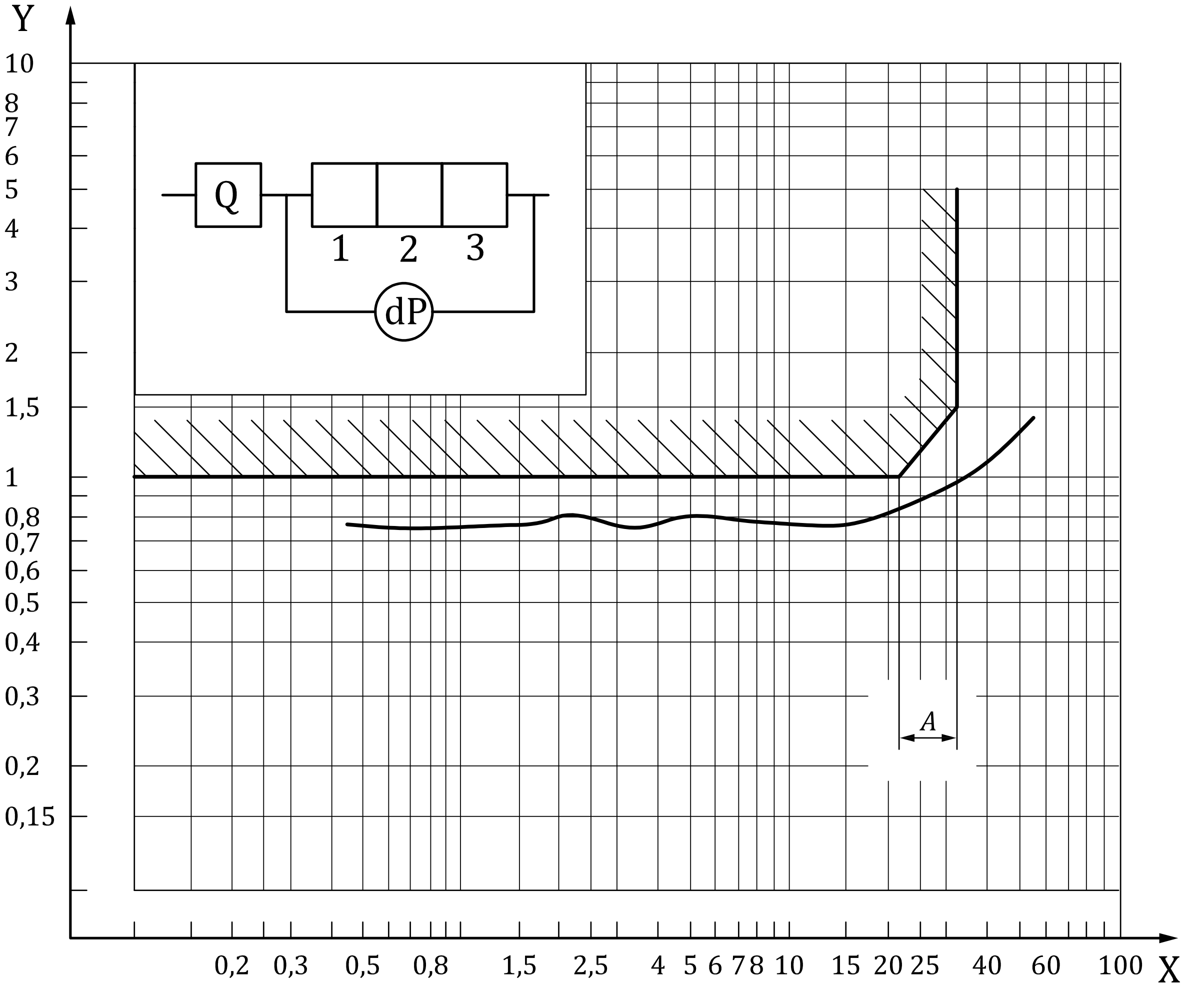
Y pressure difference, Δ*p*, between intermediate and downstream pressure zones, mbar

1 upstream pressure zone

2 intermediate pressure zone

3 downstream pressure zone

Figure A.1 — Closing pressure of downstream check valve



Key

X flow rate, m^3/h

Y pressure loss, bar

1 upstream pressure zone

2 intermediate pressure zone

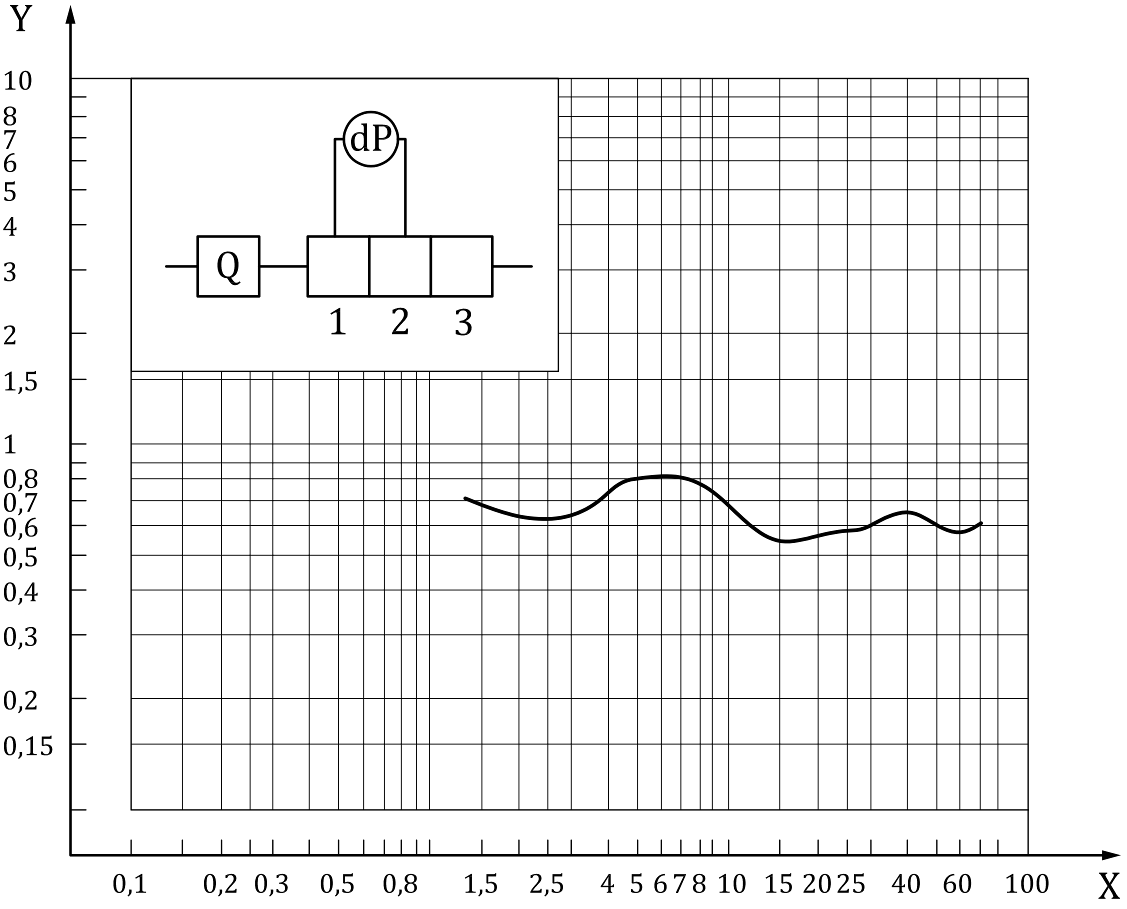
3 downstream pressure zone

A nominal flow rates (21,2 m^3/h and 31,8 m^3/h)

dP pressure difference

Q relief valve flow rate

Figure A.2 — Pressure loss as function of flow rate (for DN 50)



Key

X flow rate, m^3/h

Y pressure difference between upstream and intermediate pressure zones, bar

1 upstream pressure zone

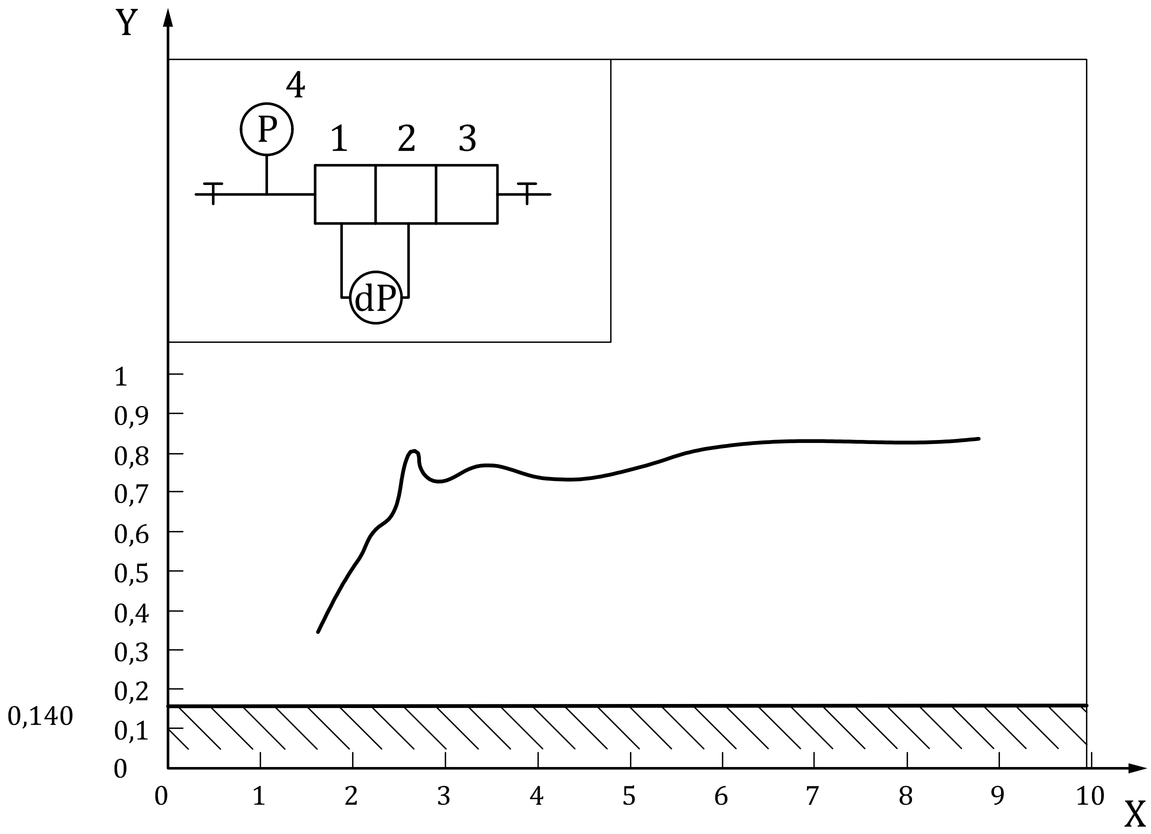
2 intermediate pressure zone

3 downstream pressure zone

dP pressure difference

Q relief valve flow rate

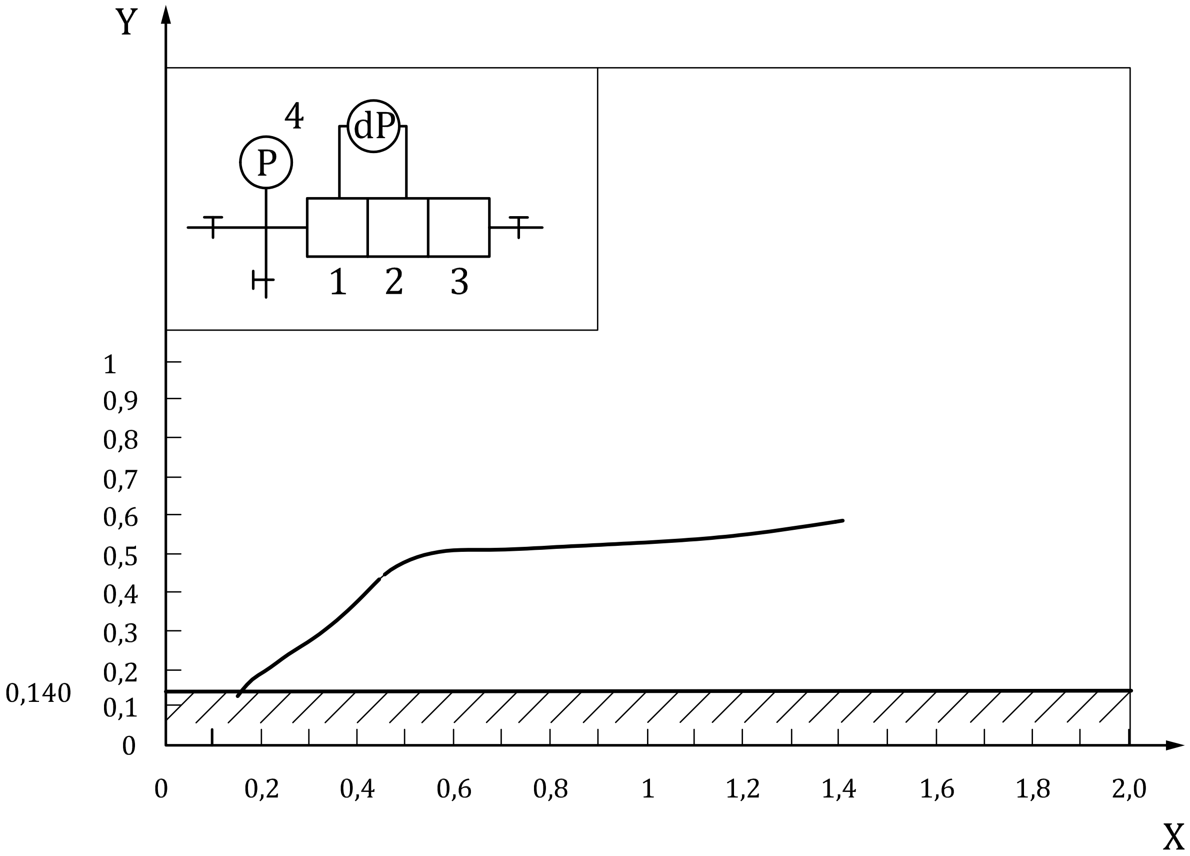
Figure A.3 — Pressure difference between upstream and intermediate pressure zones as function of flow rate



Key

X pressure in upstream pressure zone, bar
Y pressure difference between upstream and intermediate pressure zones, bar
1 upstream pressure zone
2 intermediate pressure zone
3 downstream pressure zone
4 pressure in upstream pressure zone
dP pressure difference
P pressure

Figure A.4 — Pressure difference between upstream and intermediate pressure zones as function of increasing pressure in upstream pressure zone



Key

X pressure in upstream pressure zone, bar

Y pressure difference between upstream and intermediate pressure zones, bar

1 upstream pressure zone

2 intermediate pressure zone

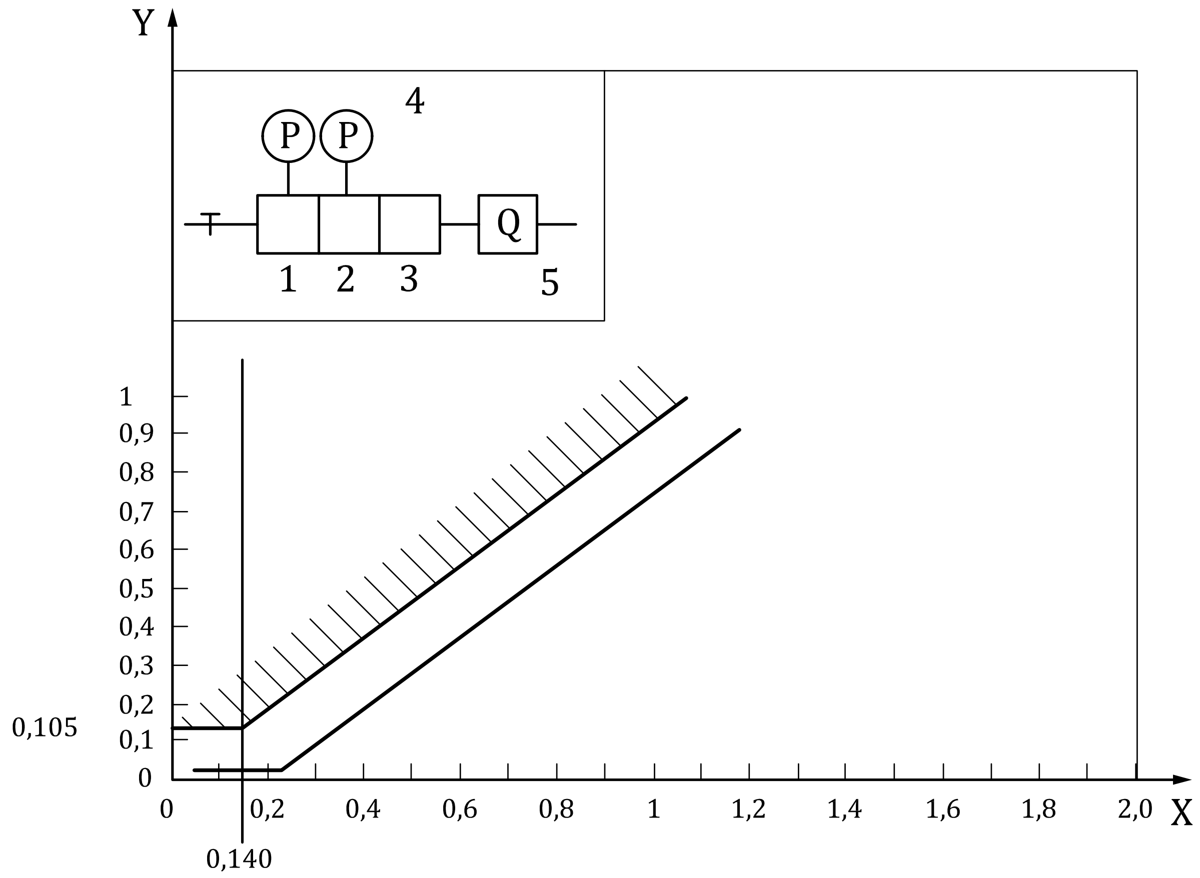
3 downstream pressure zone

4 pressure in upstream pressure zone

dP pressure difference

P pressure

Figure A.5 — Pressure difference between upstream and intermediate pressure zones as function of decreasing pressure in upstream pressure zone



Key

X pressure in upstream pressure zone, bar
Y pressure in intermediate pressure zone, bar
1 upstream pressure zone
2 intermediate pressure zone
3 downstream pressure zone
4 downstream check valve removed
5 relief valve flow rate, *Q*
P pressure

Figure A.6 — Pressure in intermediate pressure zone as function of pressure in upstream pressure zone under backflow conditions

Bibliography

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

ICS 65.060.35

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