INTERNATIONAL STANDARD

ISO 6993-2

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Buried, high-impact poly(vinyl chloride) (PVC-HI) piping systems for the supply of gaseous fuels —

Part 2: Fittings for a maximum operating pressure of 200 mbar (20 kPa)

Systèmes de canalisations enterrées en poly(chlorure de vinyle) à résistance au choc améliorée (PVC-HI) pour réseaux de combustibles gazeux —

Partie 2: Raccords pour une pression maximale de service de 200 mbar (20 kPa)

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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 6993-2 was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Subcommittee SC 4, *Plastics pipes and fittings for the supply of gaseous fuels*.

This first edition of ISO 6993-2, together with ISO 6993-1, ISO 6993-3 and ISO 6993-4, cancels and replaces ISO 6993:2001, of which it constitutes a technical revision.

ISO 6993 consists of the following parts, under the general title *Buried, high-impact poly(vinyl chloride) (PVC-HI) piping systems for the supply of gaseous fuels*:

— *Part 1: Pipes for a maximum operating pressure of 1 bar (100 kPa)*

— *Part 2: Fittings for a maximum operating pressure of 200 mbar (20 kPa)*

— *Part 3: Fittings and saddles for a maximum operating pressure of 1 bar (100 kPa)*

— *Part 4: Code of practice for design, handling and installation*

Buried, high-impact poly(vinyl chloride) (PVC-HI) piping systems for the supply of gaseous fuels —

Part 2:
Fittings for a maximum operating pressure of 200 mbar (20 kPa)

1 Scope

This part of ISO 6993 gives the requirements for non-end load-bearing fittings made of high-impact poly(vinyl chloride) (PVC-HI) intended to be used for the supply of gaseous fuels through buried pipelines having an operating temperature range of 0 °C up to and including +30 °C and a maximum operating pressure of 200 mbar (20 kPa) [1)].

It is applicable only to fittings manufactured from the high-impact PVC materials PVC-A, PVC-CPE and PVC-EPR and having joints with elastomeric sealing elements. The fittings are suitable for those gases not containing potentially damaging components in such concentrations as to impair the properties of the fitting material.

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 580:2005, *Plastics piping and ducting systems — Injection-moulded thermoplastics fittings — Methods for visually assessing the effects of heating*

ISO 2507-1, *Thermoplastics pipes and fittings — Vicat softening temperature — Part 1: General test method*

ISO 2507-2, *Thermoplastics pipes and fittings — Vicat softening temperature — Part 2: Test conditions for unplasticized poly(vinyl chloride) (PVC-U) or chlorinated poly(vinyl chloride) (PVC-C) pipes and fittings and for high impact resistance poly(vinyl chloride) (PVC-HI) pipes*

ISO 3126, *Plastics piping systems — Plastics components — Determination of dimensions*

ISO 3127, *Thermoplastics pipes — Determination of resistance to external blows — Round-the-clock method*

ISO 6993-1, *Buried, high-impact poly(vinyl chloride) (PVC-HI) piping systems for the supply of gaseous fuels — Part 1: Pipes for a maximum operating pressure of 1 bar (100 kPa)*

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

EN 682:2002, *Elastomeric seals — Material requirements for seals used in pipes and fittings carrying gas and hydrocarbon fluids*

EN 922:1994, *Plastics piping and ducting systems — Pipes and fittings of unplasticized poly(vinyl chloride) (PVC-U) — Specimen preparation for determination of the viscosity number and calculation of the K-value*

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

3 Terms, definitions, symbols and abbreviated terms

For the purposes of this document, the terms, definitions, symbols and abbreviated terms given in ISO 6993-1 and the following terms, definitions and symbols apply.

3.1 Terms and definitions

3.1.1
fitting
component, other than a pipe, used in a pipeline

EXAMPLE Bend, tee, coupler, end cap.

3.1.2
joint
connection between the ends of two components (with smooth spigot-ends and/or sockets)

NOTE In this part of ISO 6993, only joints with elastomeric sealing elements are considered.

3.1.3
socket
end of the fitting in which the elastomeric sealing element is fixed and into which a smooth spigot-end can be inserted

3.2 Symbols

d	depth/total depth of cracks, delaminations, blisters, or open yield seam, as applicable
d_{im}	mean inside diameter of socket-end
e_1, e_2, e_3, e_4	minimum wall thicknesses of fitting
T_{s}	depth of engagement
L	crack/blister length
L_{max}	maximum length of depth of engagement of socket
L_{min}	minimum length of spigot-end

4 Material

4.1 Material for fittings

4.1.1 Composition

The fittings shall be made of high-impact PVC, to which only such additives are added that are necessary to facilitate conformity of the components to this part of ISO 6993.

The impact-resistant modified PVC shall be one of the following compositions:

a) a mixture based on PVC;

b) a blend based on PVC;

c) a copolymer based on PVC;

d) a combination of these types.

The proportion of the impact modifier in the composition shall be at least 7 % by mass.

4.1.2 Long-term strength

The MRS value of the injection-moulding material shall be at least 14 MPa. Conformity to this requirement shall be proven using a long-term evaluation in accordance with ISO 9080. Testing is to be carried out at 20 °C, 40 °C and 60 °C, for periods up to 10 000 h. At 60 °C no knee shall occur before 5 000 h.

For injection-moulding compounds, this test shall be carried out on test pieces in the form of an injection moulded or extruded sample in solid wall pipe form made from the relevant injection-moulding material.

NOTE The MRS evaluation is used for a material qualification and is not intended to be used for a pressure rating.

4.1.3 Vicat softening temperature

The Vicat softening temperature of the injection-moulding material shall be not less than 74 °C when determined in accordance with ISO 2507-1 and ISO 2507-2.

4.1.4 K-value

The K-value of the unplasticized polyvinyl chloride (PVC-U) resin in the injection-moulding material shall exceed 57, when measured in accordance with EN 922.

4.2 Material for elastomeric sealing elements

The material of the elastomeric sealing elements shall conform to EN 682:2002, type G.

The elastomeric sealing element shall have no detrimental effects on the properties of the components.

5 General characteristics of fittings

5.1 Contaminants

The material of the fitting shall not be shown to contain any contaminants, such as inorganic particles or agglomerations thereof, exceeding 50 µm in size, when measured in accordance with 11.1 and 11.2.

5.2 Appearance and finish

The appearance and finish of the fittings shall be examined visually without magnification.

Internal and external surfaces shall be free from grooves, pits, blisters, indications of burning, an unacceptable form of cold-flow and other irregularities that could have a detrimental effect on the mechanical properties of the material and/or on the functional quality of the component.

Transitions in the form shall be smooth, in order to avoid notch influence. The corners in the grooves, in particular for the fixing of the elastomeric sealing elements, shall be rounded.

6 Geometrical characteristics

6.1 Measurements

All dimensions shall be measured in accordance with ISO 3126.

6.2 Fittings

6.2.1 Fittings with socket-ends

6.2.1.1 Mean inside diameter of socket-end

The mean inside diameter of the socket-end, d_{im}, shall be in accordance with Table 1.

Table 1 — Minimum values of mean inside diameter of socket-end

Nominal outside diameter of connecting pipe d_n	Mean inside diameter of socket-end d_{im}
	Minimum
mm	
50	50,4
63	63,4
75	75,5
90	90,5
110	110,6
125	125,6
140	140,7
160	160,7
180	180,8
200	200,8
225	225,9
250	251,0
280	281,1
315	316,3
355	356,3
400	401,3

6.2.1.2 Out-of-roundness of socket-end

The difference between the greatest and the smallest measured inside diameter in the socket-end shall be, in any cross-section, not greater than $0{,}007 \times d_n$, where d_n is the nominal outside diameter of the connecting pipe, expressed in millimetres. The calculated value shall be rounded off to the next higher 0,1 mm.

6.2.1.3 Height of stop shoulder or dead stop

At installation or at maximum allowable angular deflection, fittings with a stop shoulder or dead stop shall not allow any further pushing of the connecting pipe.

The minimum and maximum inside diameter of the socket at the stop shoulder or dead stop shall not be less than the values according to Table 2.

Table 2 — Mean inside diameter of socket at stop shoulder or dead stop

Dimensions in millimetres

Nominal outside diameter of connecting pipe d_n	Mean inside diameter of socket at stop shoulder or dead stop	
	Minimum	Maximum
50	45,2	47,2
63	56,9	60,2
75	67,8	72,3
90	81,3	87,0
110	99,4	106,3
125	112,9	120,7
140	126,4	135,3
160	144,5	154,5
200	180,6	193,2
225	203,2	217,4
250	225,8	241,5
280	252,7	270,5
315	284,5	304,4
355	320,5	342,9
400	361,0	386,3

6.2.1.4 Wall thickness and depth of engagement

The minimum wall thickness, and the depth of engagement, T_s, as shown in Figure 1, shall be in accordance with Table 3.

The lengths, L_{min} and L_{max}, as shown in Figure 1, shall be less than or equal to the values according to Table 3.

6.2.2 Fittings with smooth spigot-ends

The lengths, L_{min} and L_{max}, as shown in Figure 1, shall be greater than or equal to the values according to Table 3.

The minimum wall thicknesses, e_1, e_2, e_3 and e_4, of a fitting fabricated from pipe or of an injection moulded fitting shall be in accordance with Table 3.

The dimensions of fittings with a spigot-end shall be in accordance with the requirements of 6.2 for connecting pipes, over a length L_{min} (see Table 3 and Figure 1).

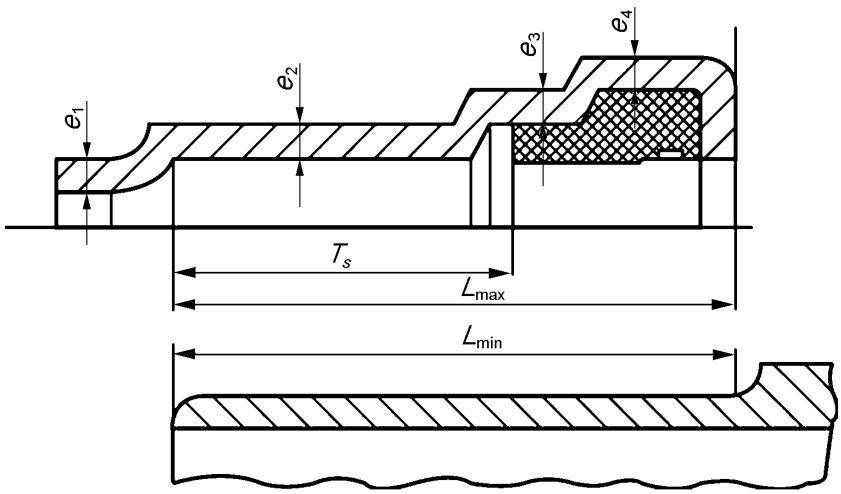


Figure 1 — Dimensions of fittings (see Table 3)

Table 3 — Wall thickness and depth of engagement of fittings

Dimensions in millimetres

d_n	Fittings fabricated from pipes		Injection moulded fittings		T_s	L_{max}
	Minimum wall thickness				Minimum	L_{min}
	e_1, e_2, e_3	e_4	e_1, e_2, e_3	e_4		
50	2,0	1,5	2,5	2,0	38	89
63	2,0	1,5	2,5	2,0	40	96
75	2,0	1,5	2,9	2,3	42	102
90	2,2	1,7	3,5	2,8	44	108
110	2,7	2,1	4,3	3,4	47	115
125	3,1	2,4	4,9	3,9	49	123
140	3,5	2,6	5,4	4,3	52	127
160	3,9	3,0	6,2	4,9	54	131
180	4,4	3,3	6,9	5,5	57	136
200	4,9	3,7	7,8	6,2	60	143
225	5,5	4,1	8,6	6,9	64	154
250	6,1	4,6	9,7	7,7	68	166
280	6,9	5,2	10,7	8,6	73	175
315	7,7	5,8	12,2	9,7	78	184
355	8,7	6,6	13,7	10,9	84	200
400	9,8	7,4	15,4	12,3	90	210

L_{max} is the maximum length of the depth of engagement of the socket.

L_{min} is the minimum length for the spigot-end.

6.2.3 Bends with smooth spigot-ends

The following requirements are in addition to those of 6.2.2:

— for fabricated bends from pipe, the deviation from the declared angle shall not be more than 3°.

— for injection moulded bends, the deviation from the declared angle shall not be more than 0,5°.

The admissible tolerances on the outside diameter and the wall thickness of the bended part shall be in accordance with Table 4.

Table 4 — Admissible tolerances at the bended part

Dimension	Admissible tolerance
mm	
$d_{min} \leqslant 200$	$d_n + 0{,}025 \times d_n$
$d_{min} > 200$	$d_n + 0{,}035 \times d_n$
$d_{max} - d_{min}$	$\leqslant 0{,}12 \times d_n$
e	$> 0{,}93 \times e_{min}$

7 Physical characteristics

When tested in accordance with 11.1 and 11.3 at 150 °C (oven test), injection moulded fittings shall meet the following requirements (see Figures 2 and 3).

The depth, d, of all cracks, delaminations or blisters occurring within a distance of 1,5 times the wall thickness measured at the injection point, with a minimum of 20 mm, shall not be greater then 30 % of the wall thickness at that point.

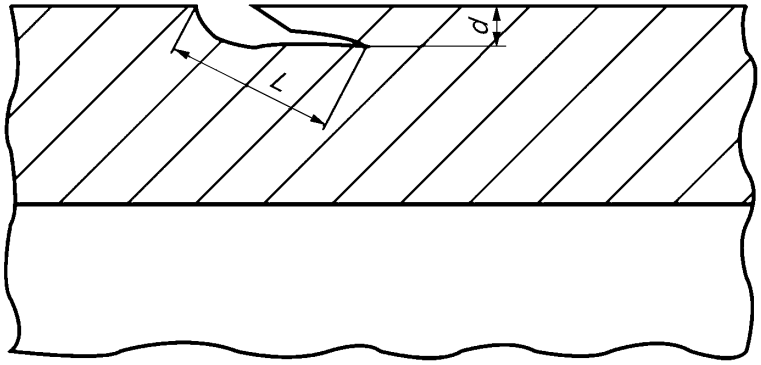
For diaphragm-gated injection moulded fittings, the depth, d, of all cracks, delaminations or blisters occurring within a distance of 1,0 times the wall thickness of the diaphragm zone shall not be greater than 30 % of the wall thickness at that point.

For ring-injected fittings, the depth, d, of all cracks, delaminations or blisters occurring within a distance of 1,0 times the wall thickness at the ring gate zone shall not be greater than 30 % of the wall thickness at that point.

For fittings with a yield seam, the total depth, d, of the opened yield seam shall not be greater than 10 % of the wall thickness at that point.

For all other parts of the surface outside the injection zone, the total depth, d, of cracks or delaminations shall not be greater than 10 % of the wall thickness at that point.

Blisters in the wall shall not be longer than twice the wall thickness at that point, with a maximum length, L, of 20 mm (see Figure 3).



d shall be a maximum of 30 % of the wall thickness.

Figure 2 — Maximum allowable crack depth

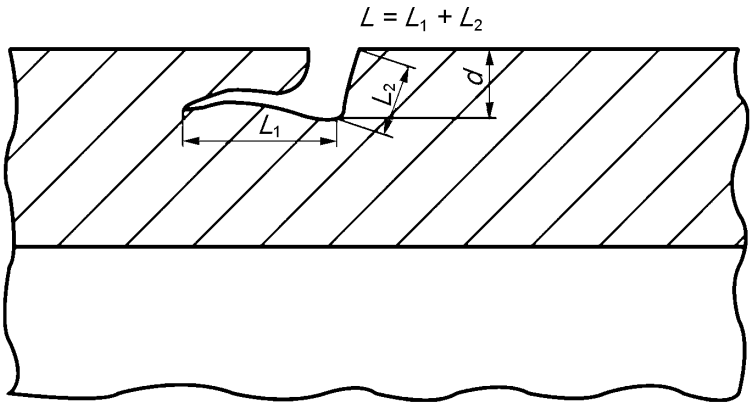


Figure 3 — Maximum allowable crack/blister length

8 Mechanical characteristics

Fittings shall be tested against their resistance to external blows at 0 °C in accordance with 11.1 and Annex A. They shall have a true impact rate (TIR) of no more than 5 % under the test conditions according to Table 5.

Table 5 — Resistance to external blows of fittings — Test conditions

Nominal outside diameter of connecting pipe d_n mm	Striker mass g	Drop height mm
50	$750\ ^{+5}_{-0}$	$2\ 000\ ^{+10}_{-0}$
63	$1\ 000\ ^{+10}_{-0}$	
75	$1\ 250\ ^{+10}_{-0}$	
90	$1\ 500\ ^{+15}_{-0}$	
110	$1\ 750\ ^{+15}_{-0}$	
125	$2\ 000\ ^{+15}_{-0}$	
140	$2\ 250\ ^{+15}_{-0}$	
160	$2\ 500\ ^{+15}_{-0}$	
180	$2\ 750\ ^{+15}_{-0}$	
$\geqslant$ 200	$3\ 000\ ^{+15}_{-0}$	

9 General requirements for fittings

The elastomeric sealing elements shall be fixed in the fitting as indicated by the manufacturer.

This fixation shall be capable of withstanding the forces used in practice for the insertion of the pipe in the socket.

The pipe shall be moved in the fitting so that the elastomeric sealing element is not pushed out of the recess.

The fixation of the elastomeric sealing element shall be realized by means of a rigid fixation ring.

10 Performance requirements

10.1 Tightness of joint with internal air pressure, with and without mechanical loading

When tested in accordance with 11.1 and Annex B, the joint between the fitting and the pipe of SDR 33 shall be tight at a temperature of 23 °C and an internal air pressure of 2,5 kPa and 100 kPa, respectively, at each of the following conditions.

a) Without mechanical loading.

b) With a diametric deflection of 10 % of the pipe at a distance d_n, in millimetres, of the socket-end.

c) With an angular deflection α in accordance with Table 6 at a distance of $10 \times d_n$, in millimetres, of the socket-end.

When the pipe in the test assembly has a length shorter than $10 \times d_n$ mm, then a proportional lower bending is applied.

The fixation of the fitting shall not restrict the diametric deflection in the socket-end to be tested.

d) A combination of b) and c), where the bending is applied in the plane of the diametric deflection.

This test is not to be performed on bends and/or reducers with spigot-ends on both sides.

Table 6 — Angular deflection, α

Nominal outside diameter of connecting pipe d_n	α **at** $10 \times d_n$ **from socket-end**
mm	
50	115
63	145
75	175
90	210
110	255
125	290
140	330
160	370
180	415
200	460
225	520
250	580
315	730
355	820
400	925

10.2 Tightness of joint under negative pressure and mechanical loading

The joint between the fitting and the pipe shall not leak internally when tested in accordance with 11.1 and Annex C at a temperature of 23 °C, with a mechanical loading in accordance with 10.1 b), and at a negative pressure of 80 kPa maintained for 2 h.

This test is not to be performed on bends and/or reducers with spigot-ends on both sides.

11 Test methods

11.1 General

Test samples shall be at least 15 h old.

Unless otherwise specified, the tests shall be carried out in triplicate.

For testing the entire programme, a representative selection of diameters and types shall be used.

11.2 Determination of particle size of contaminants

Five segments are taken at random from the fitting for testing.

These segments shall be cooled during 20 min in liquid nitrogen in order to prevent deformation while making microtome slices from the segments.

Microtome slices shall be made using a diamond knife.

The microtome slices shall be assessed with a light transmittance microscope with a measuring ocular (0,01 mm division).

The particle size of contaminants in the microtome slices shall not be greater than 50 µm.

11.3 Determination of influence of heat for injection moulded fittings

The injection moulded fittings shall be tested in accordance with ISO 580:2005, method A.

12 Marking

Fittings shall be marked clearly and durably, in accordance with national regulations, with the word “Gas” and the following information:

a) manufacturer’s name or trademark;

b) material designation “PVC-HI”;

c) manufacturing information in clear figures or in a code providing traceability to the

   1) production period,

   2) cavity number for injection moulded fittings (if relevant), and

   3) production site, if the manufacturer is producing in different sites, nationally and/or internationally.

The marking shall be applied such that the properties of the fittings are not adversely affected.

Additionally, the following marking shall be added to the fittings:

d) nominal jointing diameter;

e) for fittings fabricated out of pipe, the SDR designation (SDR 33 and/or SDR 41) of the piping for which the fitting is intended to be used.

Annex A
(normative)

Determination of resistance to gas constituents

A.1 Principle

A striker of a defined mass is launched from a defined height to determine the impact resistance of the fitting.

A.2 Test and conditioning

The test shall be carried out using apparatus and procedures in accordance with ISO 3127, with the exception of the striker nose, which shall be in the form of a hemisphere having a diameter of (25 ± 0,5) mm.

The test shall be carried out using a test and conditioning temperature of (0 ± 1) °C.

A minimum number of 60 blows shall be struck.

A.3 Additional test requirements

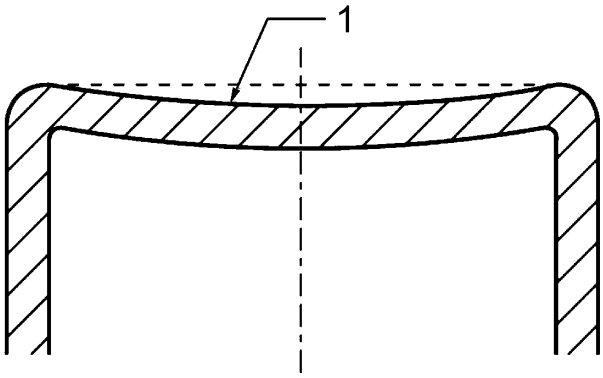
All blows shall be struck “at random”, taking into account those points expected to be sensitive to impact. Such points could be, for example, injection points, yield seams or (sharp) transitions in the construction.

For testing T-pieces, when all three socket-ends are situated in a horizontal plate the support shall be a flat plate.

In all other positions the support shall be an adjusted V-block. In this case, sockets are permitted to be supported only in the axial direction.

For reducers and T-pieces, the striker mass taken shall be that belonging to the respective nominal diameter of the socket. In the transition area the test is performed with the striker mass belonging to the socket with the smallest nominal diameter.

NOTE For end caps with a profile, the bottom is excluded from testing (see Figure A.1).

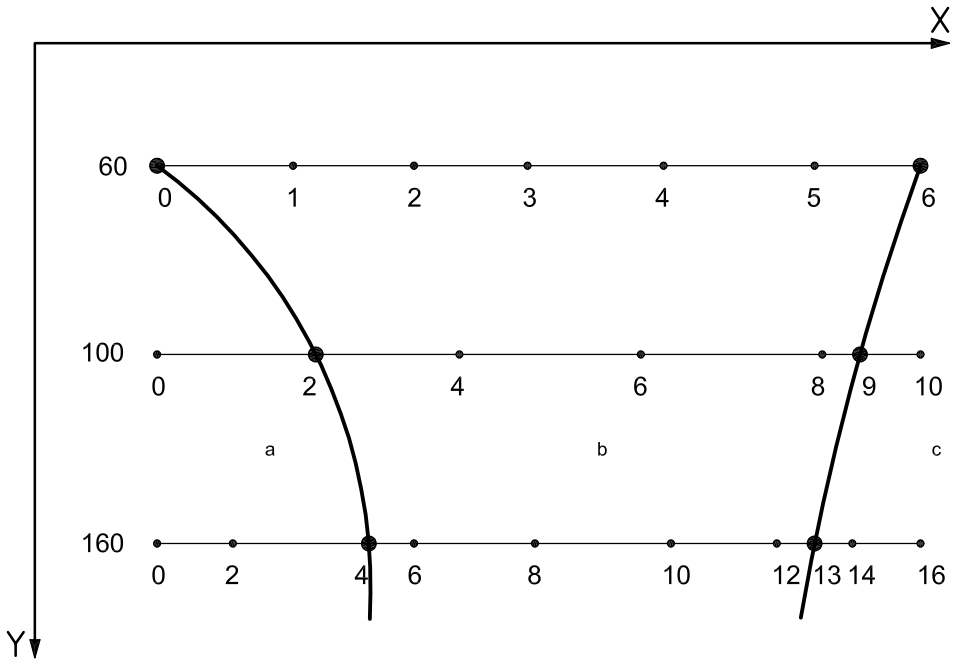


Key
1 profiled bottom

Figure A.1 — Example of profiled bottom

A.4 Interpretation of results

Figure A.2 gives the different areas for the number of failures in relation to the number of blows for which the tested lot with a confidence limit of 90 % has a true impact rate (TIR) smaller than 5 %, or a TIR greater than 5 % and the area where no decision can be taken.



Key

X no. of fractured samples

Y total no. of blows

a Lot has TIR < 5 %.

b No decision can be taken in this area.

c Lot has TIR > 5 %.

Figure A.2 — Number of samples for determination of TIR less than 5 % with confidence limit of 90 %

Annex B
(normative)

Determination of leaktightness of fitting joints by internal air pressure, with and without mechanical loading

B.1 Principle

The leaktightness of the joints is determined by subjecting the test piece to internal air pressure.

NOTE Tightness testing is performed on test pieces subjected to a diametrical deflection by mechanical loading and without deflection.

B.2 Apparatus

B.2.1 Air pressure equipment capable of applying and maintaining the air pressure at (2,5 $\pm$ 0,5) kPa and (100 $\pm$ 2) kPa.

B.2.2 Pressure gauge having an accuracy of $\pm$ 1 % of the measured values.

B.2.3 Loading jig capable of applying a diametrical deflection of (10 $\pm$ 2) % at a distance of ($d_n \pm 2$) mm from the socket-end, and of applying at the same time an indicated angular deflection α in the plane of the diametrical deflection at a distance of ($10 \times d_n \pm 5$) mm.

B.3 Test piece

A test piece consisting of an assembly of SDR 33 pipes jointed by a fitting shall be assembled in accordance with the manufacturer's instructions.

The free length of pipe on one end of the fitting shall be at least ($3 \times d_n$) mm and at least ($10 \times d_n$) mm on the other end, with a maximum of 1,0 m.

B.4 Test temperature and conditioning

The test and conditioning temperature shall be (23 $\pm$ 5) °C.

B.5 Test procedure

The test shall be performed in accordance with Table B.1.

End caps shall be tested only for the first five steps.

Table B.1 — Procedure for determining leaktightness of joints with internal air pressure

Step	Time min	Procedure
1	0	Apply smoothly for 30 s a pressure of (2,5 ± 0,5) kPa. Check for leakage.
2	10	Increase the pressure smoothly for 30 s to (100 ± 2) kPa. Check for leakage.
3	20	Reduce the pressure to atmospheric pressure. Apply a diametrical deflection of (10 ± 2) % at a distance of (d_n ± 2) mm from the socket-end.
4	25	Apply smoothly for 30 s a pressure of (2,5 ± 0,5) kPa. Check for leakage.
5	35	Increase the pressure smoothly for 30 s to (100 ± 2) kPa. Check for leakage.
6	45	Reduce the pressure to atmospheric pressure. Release the diametrical deflection and apply an angular deflection α in accordance with Table 6 at a distance of (10 × d_n ± 5), in millimetres, from the socket-end. [a] [b] Apply smoothly for 30 s a pressure of (2,5 ± 0,5) kPa. Check for leakage.
7	50	Increase the pressure smoothly for 30 s to (100 ± 2) kPa. Check for leakage.
8	60	Reduce the pressure to atmospheric pressure. Apply, in addition to angular deflection α, a diametrical deflection of (10 ± 2) % at a distance of (d_n ± 2) mm from the socket-end.
9	70	Apply smoothly for 30 s a pressure of (2,5 ± 0,5) kPa. Check for leakage.
10	75	Increase the pressure smoothly for 30 s to (100 ± 2) kPa. Check for leakage.
11	85	Reduce the pressure to atmospheric pressure.
12	95	Release the test piece from both loading conditions.
13	100	Apply smoothly for 30 s a pressure of (2,5 ± 0,5) kPa. Check for leakage.
14	110	Increase the pressure smoothly for 30 s to (100 ± 2) kPa. Check for leakage.
15	120	Reduce the pressure to atmospheric pressure and take the piece out of the test rig.

— A tolerance of 20 % is permitted on the time per step.

— End the testing when leakage occurs and note the test time (and step).

— Leakage can be detected by using a soap solution on the joint or by placing the test piece in a water bath. When a soap solution is used, the leakage shall be detected at the start or end of the period when the pressure is applied.

[a] When the pipe in the test assemblies has a shorter length than (10 × d_n) mm, apply a proportional lower bending (see 10.1 c).

[b] When the free length (10 × d_n) mm obtained is greater than 1,0 m, a maximum of 1,0 m applies.

Annex C
(normative)

Determination of leaktightness of fitting joints under negative pressure and mechanical loading

C.1 Principle

The leaktightness of a fitting's joints against the ingress of water is determined by subjecting the test piece to a negative internal air pressure.

NOTE Tightness testing is performed on test pieces subjected to a diametrical deflection by mechanical loading and without deflection.

C.2 Apparatus

C.2.1 Vacuum gauge having an accuracy of ± 1 % of the measured value.

C.2.2 Vacuum pump capable of maintaining the required level of negative pressure of − (80 ± 2) kPa for 2 h + [(20 ± 2) kPa absolute].

C.2.3 Loading jig capable of applying a diametric deflection of (10 ± 2) % at a distance of (d_n ± 2) mm from, and on both sides of, the socket-end.

C.2.4 Water bath of sufficient size to keep the test piece completely submersed at a temperature of (23 ± 5) °C.

C.3 Test piece

The test piece, which shall consist of an assembly of pipes jointed by a fitting, shall be assembled in accordance with the manufacturer's instructions.

The free length on either end of the fitting shall be at least (3 × d_n) mm with a minimum of 250 mm.

C.4 Test temperature and conditioning

The test and conditioning temperature shall be (23 ± 5) °C.

C.5 Test procedure

The test shall be performed in accordance with Table C.1.

Table C.1 — Procedure for determining leaktightness of joints under negative pressure and mechanical loading

Step	Procedure
1	Choose the SDR class of the connecting pipe and assemble the test piece in accordance with C.3.
2	Apply, on both sides of the test piece and a distance of ($d_n \pm 2$) mm from the socket-end, a diametrical deflection of (10 ± 2) %.
3	Place the test pieces in the water bath at 23 °C, completely submersed.
4	Apply a negative pressure of $-$ (80 ± 2) kPa $+$ [(20 ± 2) kPa absolute] to the test piece.
5	Maintain this negative pressure for (120 ± 5) min.
6	After this time, return the pressure to atmospheric pressure.
7	Take the test piece out of the water bath.
8	Check the inside of the test piece for leakage from water ingress at the socket-ends.

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