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)

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 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*

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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).

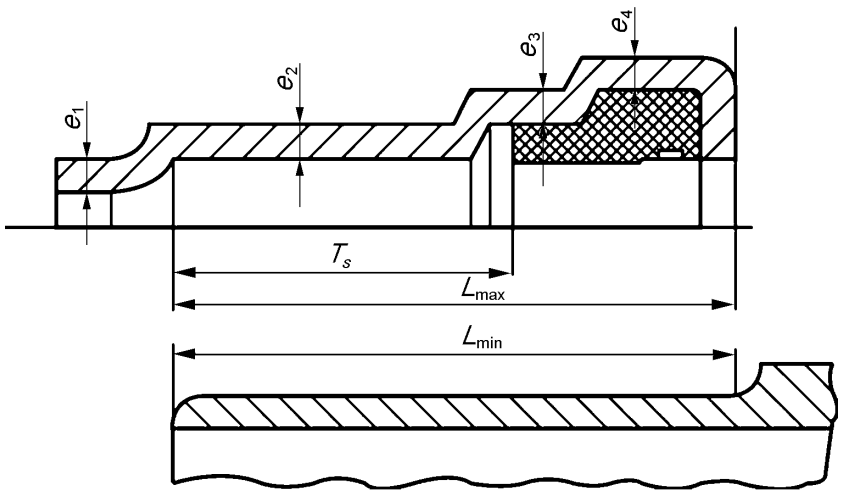

Figure 1 — Dimensions of fittings (see Table 3)

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).