INTERNATIONAL STANDARD

ISO 4422-2

First edition
1996-12-15

Pipes and fittings made of unplasticized poly(vinyl chloride) (PVC-U) for water supply — Specifications —

Part 2:
Pipes (with or without integral sockets)

Tubes et raccords en poly(chlorure de vinyle) non plastifié (PVC-U) pour l'adduction d'eau — Spécifications —

Partie 2: Tubes (avec ou sans emboîtures incorporées)

Reference number
ISO 4422-2:1996(E)

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.

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.

International Standard ISO 4422-2 was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Subcommittee SC 2, *Plastics pipes and fittings for water supplies*.

Together with the other parts, this part of ISO 4422 cancels and replaces ISO 4422:1990, which has been technically revised.

ISO 4422 consists of the following parts, under the general title *Pipes and fittings made of unplasticized poly(vinyl chloride) (PVC-U) for water supply — Specifications*:

— *Part 1: General*

— *Part 2: Pipes (with or without integral sockets)*

— *Part 3: Fittings and joints*

— *Part 4: Valves and ancillary equipment*

— *Part 5: Fitness for purpose of the system*

ISO 4422 is one of a series of system standards for plastics piping systems which are being prepared within ISO/TC 138. Each system standard is based on a specific material for a specific application.

They conform to a standard multi-part format, each part dealing with a specific aspect of the overall system.

International Organization for Standardization
Case Postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

NOTE 1 At the present time, the reference document for the installation code is ISO/TR 4191, and this document will ultimately form part 6 of this International Standard.

This page intentionally left blank

Pipes and fittings made of unplasticized poly(vinyl chloride) (PVC-U) for water supply — Specifications —

Part 2:
Pipes (with or without integral sockets)

1 Scope

This part of ISO 4422 specifies the characteristics and properties of extruded pipes made of unplasticized poly(vinyl chloride) (PVC-U), with or without socket(s) (integral or not), and intended to be used for buried water mains and services and for water supplies above ground, both inside and outside buildings.

The pipes covered by this part of ISO 4422 are intended for the conveyance of cold water under pressure at temperatures up to approximately 20 °C, for general purposes and for the supply of drinking water. This part of ISO 4422 is also applicable to water up to and including 45 °C (see figure 1).

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 4422. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 4422 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 161-1:1996, *Thermoplastics pipes for the conveyance of fluids — Nominal outside diameters and nominal pressures — Part 1: Metric series.*

ISO 727:1985, *Fittings of unplasticized polyvinyl chloride (PVC-U), chlorinated polyvinyl chloride (PVC-C) or acrylonitrile/butadiene/styrene (ABS) with plain sockets for pipes under pressure — Dimensions of sockets — Metric series.*

ISO 1167:1996, *Thermoplastics pipes for the conveyance of fluids — Resistance to internal pressure — Test method.*

ISO 1628-2:1988, *Plastics — Determination of viscosity number and limiting viscosity number — Part 2: Poly(vinyl chloride) resins.*

ISO 2045:1988, *Single sockets for unplasticized poly(vinyl chloride) (PVC-U) and chlorinated poly(vinyl chloride) (PVC-C) pressure pipes with elastic sealing ring type joints — Minimum depths of engagement.*

ISO 2505-1:1994, *Thermoplastics pipes — Longitudinal reversion — Part 1: Determination methods.*

ISO 2505-2:1994, *Thermoplastics pipes — Longitudinal reversion — Part 2: Determination parameters.*

ISO 2507-1:1995, *Thermoplastics pipes and fittings — Vicat softening temperature — Part 1: General test method.*

ISO 2507-2:1995, *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 3126:1974, *Plastics pipes — Measurement of dimensions.*

ISO 3127:1994, *Thermoplastics pipes — Determination of resistance to external blows — Round-the-clock method.*

ISO 3474:1976, *Unplasticized polyvinyl chloride (PVC) pipes — Specification and measurement of opacity.*

ISO 3606:1976, *Unplasticized polyvinyl chloride (PVC) pipes — Tolerances on outside diameters and wall thicknesses.*

ISO 4065:1996, *Thermoplastics pipes — Universal wall thickness table.*

ISO 4422-1:1996, *Pipes and fittings made of unplasticized poly(vinyl chloride) (PVC-U) for water supply — Specifications — Part 1: General.*

ISO/TR 9080:1992, *Thermoplastics pipes for the transport of fluids — Methods of extrapolation of hydrostatic stress rupture data to determine the long-term hydrostatic strength of thermoplastics pipe materials.*

ISO 9852:1995, *Unplasticized poly(vinyl chloride) (PVC-U) pipes — Dichloromethane resistance at specified temperature (DCMT) — Test method.*

ISO 11673:—[1], *Determination of the fracture toughness of unplasticized poly(vinyl chlorid) (PVC-U) pipes.*

ISO 11922-1:—[2], *Thermoplastics pipes for the transport of fluids — Dimensions and tolerances — Part 1: Metric series.*

ISO 12162:1995, *Thermoplastics materials for pipes and fittings for pressure applications — Classification and designation — Overall service (design) coefficient.*

Guidelines for drinking water quality, Vol. 1: Recommendations, (WHO, Geneva, 1984).

3 Definitions

For the purposes of this part of ISO 4422, the definitions given in ISO 4422-1 apply.

NOTE 2 See also clause 5.

4 Material

4.1 The material from which the pipes are made shall conform to the applicable requirements specified in ISO 4422-1 in addition to those specified in 4.2.

4.2 The material from which the pipes are made shall have a minimum required strength (MRS) of not less than 25 MPa, when determined in accordance with ISO/TR 9080 and ISO 12162 (see also 3.6 and 3.7 of ISO 4422-1:1996).

NOTE 3 As a general guide, it will be found that the material used to manufacture pipes to conform to this part of ISO 4422 will need to be based on a PVC-U resin having a viscosity number greater than 64 when tested in accordance with ISO 1628-2.

5 Nominal pressures and overall service (design) coefficient

5.1 The nominal pressure PN of a pipe is related to the pipe series S values given in tables 1 and 2 by the following equation:

$$PN = 10 \times \frac{\sigma_s}{S}$$

NOTE 4 When the design stress σ_s is expressed in megapascals, the value of the nominal pressure PN corresponds to a pressure in bars.

5.2 The design stress shall be based on the value of the lower confidence limit σ_{LCL} of the long-term hydrostatic strength for the resistance to internal pressure as determined in accordance with ISO/TR 9080. This value of σ_{LCL} shall be converted into a minimum required strength (MRS) in accordance with ISO 12162. The MRS shall be divided by an overall service (design) coefficient C to give the design stress σ_s which is expressed by the following equation:

$$\sigma_s = \frac{MRS}{C}$$

5.3 The overall service (design) coefficient for PVC-U pipes shall be equal to 2,5 for pipes of nominal outside diameter 90 or less, and 2,0 for pipes of nominal outside diameter 110 and above, resulting in a design stress σ_s of 10 MPa or 12,5 MPa, respectively.

1) To be published.

2) To be published. (Revision of ISO 3606:1976, ISO 3607:1977, ISO 3608:1976 and ISO 3609:1977)

5.4 A supplementary derating factor f_T shall be applied for operating temperatures between 25 °C and 45 °C. Values of this factor for different temperatures are given in figure 1. The maximum working pressure is given by multiplying the nominal pressure PN by the derating factor f_T.

NOTE 5 Figure 1 is based on satisfactory long-term experience and test results. However long-term tests are recommended to be carried out in order to determine the MRS values for PVC-U pipes intended for use at temperatures above 30 °C.

6 General requirements for pipes

6.1 Appearance

When viewed without magnification, the internal and external surfaces of the pipe shall be smooth, clean and free from scoring, cavities and other surface defects which would prevent conformity with this part of ISO 4422. The material shall not contain visible impurities. The ends of the pipe shall be cut cleanly and square to the axis of the pipe.

6.2 Opacity

If a pipe is required to be opaque for use in above-ground applications, the wall of the pipe shall not transmit more than 0,2 % of visible light falling on it when tested in accordance with ISO 3474.

7 Geometrical characteristics

7.1 Measurement

The dimensions of pipes shall be measured in accordance with ISO 3126.

NOTE 6 It is recommended that pipes are supplied in one or more of the following lengths:

4 m, 6 m, 10 m, 12 m

where these lengths do not include the depth of any socket(s).

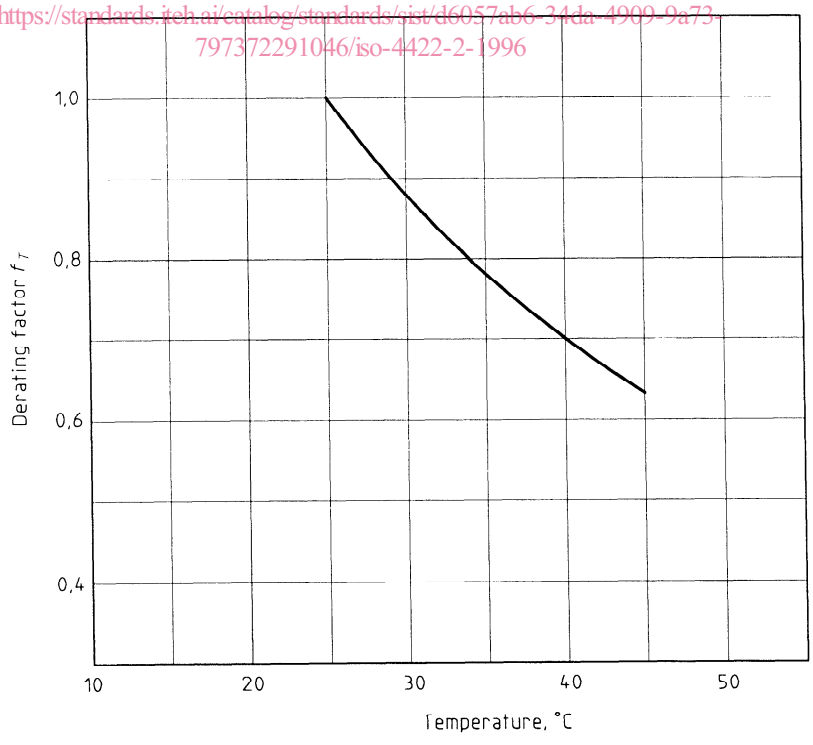

Figure 1 — Derating factor as a function of operating temperature

7.2 Outside diameters and wall thicknesses

The nominal outside diameter of pipes in accordance with ISO 161-1, and the corresponding wall thickness in accordance with ISO 4065, or with an additional series (S 16,7), shall be selected from table 1 or table 2 as appropriate for size.

The tolerances on mean outside diameters shall conform to grade C of ISO 11922-1.

The tolerances on the wall thickness at any point shall conform to grade T of ISO 11922-1 and the tolerance on the mean wall thickness shall conform to grade W of ISO 11922-1.

The tolerance on out-of-roundness shall conform to grade N of ISO 11922-1 for nominal outside diameters up to and including 250 and to grade M of ISO 11922-1 for nominal outside diameters greater than 250.

NOTE 7 For pipes in series S 20, S 16,7 and S 16, there is no out-of-roundness tolerance requirement.

7.3 Sockets

The minimum depth of engagement of integral sockets with elastomeric sealing ring type joints shall conform to ISO 2045.

The wall thickness of sealing ring type sockets at any point, except the sealing ring groove, shall not be less than the minimum wall thickness of the connecting pipe. The wall thickness of the sealing ring groove shall not be less than 0,8 times the minimum wall thickness of the connecting pipe.

Dimensions of sockets for solvent-cementing shall conform to ISO 727.

The wall thickness of sockets for solvent-cementing shall be not less than 75 % of the nominal wall thickness of the pipe, i.e. $0{,}75e_n$.

7.4 Plain ends

Pipes with plain end(s) to be used with elastomeric sealing ring type joints shall have a chamfer conforming to ISO 2045.

Any sharp edges shall be removed from the ends of pipes to be used for solvent-cementing.

Table 1 — Nominal outside diameters d_n and nominal wall thicknesses e_n [based on an overall service (design) coefficient of $C = 2{,}5$]

Dimensions in millimetres

Nominal outside diameter d_n	Pipe series S, SDR series and nominal pressure PN equivalents							
	S 20 SDR 41 PN 5	S 16,7 SDR 34,4 PN 6	S 16 SDR 33 PN 6,3	S 12,5 SDR 26 PN 8	S 10 SDR 21 PN 10	S 8 SDR 17 PN 12,5	S 6,3 SDR 13,6 PN 16	S 4 SDR 9 PN 25
	Nominal wall thickness, e_n							
10								1,5
12								1,5
16							1,5	1,8
20							1,5	2,3
25						1,5	1,9	2,8
32					1,6	1,9	2,4	3,6
40			1,5	1,6	1,9	2,4	3	4,5
50			1,6	2	2,4	3	3,7	5,6
63	1,6	1,9	2	2,5	3	3,8	4,7	7,1
75	1,9	2,2	2,3	2,9	3,6	4,5	5,6	8,4
90	2,2	2,7	2,8	3,5	4,3	5,4	6,7	10,1

NOTES

1 S is the pipe series and equals $\frac{d_n - e_n}{2e_n}$

2 SDR is the standard dimension ratio and equals $\frac{d_n}{e_n}$

3 S and SDR are related by the equation [SDR] = 2[S] + 1

Table 2 — Nominal outside diameters d_n and nominal wall thicknesses e_n [based on an overall service (design) coefficient of $C = 2,0$]

Dimensions in millimetres

Nominal outside diameter d_n	Pipe series S, SDR series and nominal pressure PN equivalents						
	S 20 SDR 41 PN 6,3	S 16 SDR 33 PN 8	S 12,5 SDR 26 PN 10	S 10 SDR 21 PN 12,5	S 8 SDR 17 PN 16	S 6,3 SDR 13,6 PN 20	S 5 SDR 11 PN 25
	Nominal wall thickness, e_n						
110	2,7	3,4	4,2	5,3	6,6	8,1	10
125	3,1	3,9	4,8	6	7,4	9,2	11,4
140	3,5	4,3	5,4	6,7	8,3	10,3	12,7
160	4	4,9	6,2	7,7	9,5	11,8	14,6
180	4,4	5,5	6,9	8,6	10,7	13,3	16,4
200	4,9	6,2	7,7	9,6	11,9	14,7	18,2
225	5,5	6,9	8,6	10,8	13,4	16,6	
250	6,2	7,7	9,6	11,9	14,8	18,4	
280	6,9	8,6	10,7	13,4	16,6	20,6	
315	7,7	9,7	12,1	15	18,7	23,2	
355	8,7	10,9	13,6	16,9	21,1	26,1	
400	9,8	12,3	15,3	19,1	23,7	29,4	
450	11	13,8	17,2	21,5	26,7	33,1	
500	12,3	15,3	19,1	23,9	29,7	36,8	
560	13,7	17,2	21,4	26,7			
630	15,4	19,3	24,1	30			
710	17,4	21,8	27,2				
800	19,6	24,5	30,6				
900	22	27,6					
1 000	24,5	30,6					

NOTE — To apply an overall design (service) coefficient C of 2,5 for pipes with nominal diameters in this table, the next-higher nominal pressure PN shall be selected, e.g. an S 10 series pipe rated at PN 12,5 will be selected for PN 10 applications when a C of 2,5 is required.

8 Mechanical characteristics

8.1 Resistance to hydrostatic pressure

8.1.1 When tested in accordance with ISO 1167, using the combinations of test temperatures and induced stresses given in table 3, the pipe shall not fail in less than the time given in table 3.

8.1.2 When tested in accordance with ISO 1167, using the combinations of test temperatures and test pressures given in table 4, integral sealing ring sockets formed on pipes shall not fail in less than the time given in table 4.

8.2 Resistance to external blows at 0 °C

Pipes with a nominal wall thickness of 14,9 mm or less shall be tested at 0 °C in accordance with ISO 3127, and shall have a true impact rate (TIR) of not more than 10 % when using the conditions given in table 5. Pipes in the series S 4 to S 10 shall be tested at the M level and pipes in the series S 12,5 to S 20 shall be tested at the H level.

8.3 Fracture toughness

When tested in accordance with ISO 11673, pipes with a wall thickness of not less than 4 mm but less than 6 mm shall have a fracture toughness value of not less than 3,25 $MN \cdot m^{-\frac{3}{2}}$, and pipes with a wall thickness of 6 mm or greater shall have a fracture toughness value of not less than 3,75 $MN \cdot m^{-\frac{3}{2}}$.

NOTES

8 This test is not applicable to pipes with a wall thickness of less than 4 mm.

9 The fracture toughness test is a type test to be carried out whenever a change is made to the formulation or tooling to produce the pipe.