INTERNATIONAL STANDARD

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Plastics piping systems for hot and cold water installations — Chlorinated poly(vinyl chloride) (PVC-C) —

Part 2: **Pipes**

Systèmes de canalisations en plastique pour les installations d'eau chaude et froide — Poly(chlorure de vinyle) chloré (PVC-C) —

Partie 2: Tubes

Reference number
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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 15877-2 was prepared by the European Committee for Standardization (CEN) in collaboration with 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*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Throughout the text of this document, read "...this European Standard..." to mean "...this International Standard...".

ISO 15877 consists of the following parts, under the general title *Plastics piping systems for hot and cold water installations — Chlorinated poly(vinyl chloride) (PVC-C)*:

— *Part 1: General*

— *Part 2: Pipes*

— *Part 3: Fittings*

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

— *Part 7: Guidance for the assessment of conformity* [Technical Specification]

Contents

Foreword

This document (EN ISO 15877-2:2003) has been prepared by Technical Committee CEN/TC 155 “Plastics piping systems and ducting systems”, the secretariat of which is held by NEN, in collaboration with Technical Committee ISO/TC 138 “Plastics pipes, fittings and valves for the transport of fluids”

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2004, and conflicting national standards shall be withdrawn at the latest by December 2005.

NOTE This draft was submitted for CEN enquiry as prEN 12731-2:1995.

This standard is a Part of a System Standard for plastics piping systems of a particular material for a specified application. There are a number of such System Standards.

System Standards are based on the results of the work undertaken in ISO/TC 138 "Plastics pipes, fittings and valves for the transport of fluids", which is a Technical Committee of the International Organization for Standardization (ISO).

They are supported by separate standards on test methods to which references are made throughout the System Standard.

The System Standards are consistent with general standards on functional requirements and recommended practices for installation.

EN ISO 15877:2003 consists of the following Parts [1)], under the general title *Plastics piping systems for hot and cold water installations - Chlorinated poly(vinyl chloride) (PVC-C)*

— *Part 1: General*

— *Part 2: Pipes (the present standard)*

— *Part 3: Fittings*

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

— *Part 7 Guidance for the assessment of conformity (CEN ISO/TS 15877-7).*

This Part of EN ISO 15877 includes the following :

— Annex A (informative): Derivation of the maximum calculated pipe value, $S_{calc,max}$;

— Bibliography.

At the date of publication of this standard, System Standards for piping systems of other plastics materials used for hot and cold water installations are the following:

EN ISO 15874, *Plastics piping systems for hot and cold water installations — Polypropylene (PP) (ISO 15874:2003)*

EN ISO 15875, *Plastics piping systems for hot and cold water installations — Crosslinked polyethylene (PE-X) (ISO 15875:2003)*

EN ISO 15876, *Plastics piping systems for hot and cold water installations — Polybutylene (PB) (ISO 15876:2003)*

For pipes and fittings which have conformed to the relevant national standard before 1st November 2003, as shown by the manufacturer or by a certification body, the national standard may continue to apply until 30th November 2005.

1) This System Standard does not incorporate Part 4: *Ancillary equipment* and Part 6: *Guidance for installation.* For ancillary equipment separate standards can apply. Guidance on installation of plastics piping systems made from different materials, intended to be used for hot and cold water installations, is given by ENV 12108 [1].

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

The System Standard, of which this is Part 2, specifies the requirements for a piping system when made from chlorinated poly(vinyl chloride) (PVC-C). The piping system is intended to be used for hot and cold water installations.

In respect of potential adverse effects on the quality of water intended for human consumption, caused by the product covered by this standard:

— This standard provides no information as to whether the product may be used without restriction in any of the Member States of the EU or EFTA;

— It should be noted that, while awaiting the adoption of verifiable European criteria, existing national regulations concerning the use and/or the characteristics of this product remain in force.

When using solvent cement, relevant national safety rules or regulations concerning their use (e.g. protection of workers) are to be observed.

Requirements and test methods for material and components, other than pipes are specified in Part 1 and Part 3 of EN ISO 15877:2003. Characteristics for fitness for purpose (mainly for joints) are covered in Part 5. Part 7 (CEN ISO/TS 15877-7) gives guidance for the assessment of conformity.

This Part of EN ISO 15877 specifies the characteristics of pipes.

1 Scope

This Part of EN ISO 15877:2003 specifies the requirements of pipes made from chlorinated poly(vinyl chloride) (PVC-C) for piping systems intended to be used for hot and cold water installations within buildings for the conveyance of water, whether or not intended for human consumption (domestic systems), under design pressures and temperatures appropriate to the class of application (see Table 1 of EN ISO 15877-1:2003).

This standard covers a range of service conditions (application classes), design pressures and pipe series. For values of T_D, T_{max} and T_{mal} in excess of those in Table 1 of Part 1, this standard does not apply.

NOTE It is the responsibility of the purchaser or specifier to make the appropriate selections from these aspects, taking into account their particular requirements and any relevant national regulations and installation practices or codes.

It also specifies the test parameters for the test methods referred to in this standard.

In conjunction with the other Parts of EN ISO 15877 (see Foreword) it is applicable to PVC-C pipes, their joints and to joints with components of PVC-C, other plastics and non-plastics materials intended to be used for hot and cold water installations.

2 Normative references

This standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to, or revisions of, any of these publications apply to this standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 578, *Plastics piping systems — Plastics pipes and fittings — Determination of the opacity*

EN 727, *Plastics piping and ducting systems — Thermoplastics pipes and fittings — Determination of Vicat softening temperature (VST)*

EN 743:1994, *Plastics piping and ducting systems — Thermoplastics pipes — Determination of the longitudinal reversion*

EN 744, *Plastics piping and ducting systems — Thermoplastics pipes — Test method for resistance to external blows by the round-the-clock method*

EN 921:1994, *Plastics piping systems — Thermoplastics pipes — Determination of resistance to internal pressure at constant temperature*

EN ISO 6259-1, *Thermoplastics pipes — Determination of tensile properties — Part 1: General test method (ISO 6259-1:1997)*

EN ISO 9080, *Plastics piping and ducting systems - Determination of the long-term hydrostatic strength of thermoplastics materials in pipe form by extrapolation (ISO 9080:2003)*

EN ISO 15877-1:2003, *Plastics piping systems for hot and cold water installations — Chlorinated poly(vinyl chloride) (PVC-C) — Part 1: General (ISO 15877-1:2003)*

EN ISO 15877-3:2003, *Plastics piping systems for hot and cold water installations — Chlorinated poly(vinyl chloride) (PVC-C) — Part 3: Fittings (ISO 15877-3:2003)*

EN ISO 15877-5, *Plastics piping systems for hot and cold water installations — Chlorinated poly(vinyl chloride) (PVC-C) — Part 5: Fitness for purpose of the system (ISO 15877-5:2003)*

EN ISO 3126, *Plastics piping systems — Plastics components — Determination of dimensions (ISO 3126:2003)*

ISO 6259-2:1997, *Thermoplastics pipes — Determination of tensile properties — Part 2: Pipes made of unplasticized poly(vinyl chloride) (PVC-U), chlorinated poly(vinyl chloride) (PVC-C) and high-impact poly(vinyl chloride) (PVC-HI)*

3 Terms and definitions, symbols and abbreviated terms

For the purposes of this standard the terms and definitions, symbols and abbreviated terms given in EN ISO 15877-1:2003 apply, together with the following symbols:

l : length of pipe

σ_y : tensile strength at yield point.

4 Material

4.1 General

The PVC-C material from which the pipes are made shall conform to this standard and to the relevant requirements of EN ISO 15877-1:2003.

4.2 Pipe material

The material from which the pipes are made shall be a chlorinated poly(vinyl chloride) (PVC-C) resin to which are added those additives that are needed to facilitate the manufacture of pipes conforming to this standard.

4.3 Evaluation of σ_{LCL}-values

The pipe material shall be evaluated in accordance with EN ISO 9080 or equivalent, where an internal pressure test is made in accordance with EN 921:1994 to find the σ_{LCL}-values. The σ_{LCL}-values thus determined shall be at least as high as the corresponding values of the reference curves given in Figure 1 over the complete range of times.

NOTE 1 One equivalent way of evaluation is to calculate the σ_{LCL} -values for each temperature (e.g. for 20 °C, 60 °C and 95 °C) individually.

NOTE 2 The reference curves in Figure 1 in the temperature range of 10 °C to 95 °C are derived from the following equation (1):

$$\log t = -109{,}95 - \frac{21897{,}4}{T} \times \log \sigma + \frac{43702{,}87}{T} + 50{,}74202 \times \log \sigma \qquad (1)$$

To demonstrate conformance to the reference lines pipe samples should be tested at following temperatures and at various hoop stresses such that, at each of the tempeatures given, at least three failure times fall in each of the following time intervals:

Tempertures 20; 60-70; 95; °C

Time intervals 10-100 h, 100-1000 h,1000-8760 h and above 8760 h

In tests lasting more than 8760 h, once failure is reached at a stress and time at least on or above the reference line, any time after that can be considered as the failure time. Testing should be carried out in accordance with EN 921.
Conformance to the reference lines should be demonstrated by plotting the individual experimental results on the graph. At least 97.5% of them should lie on or above the reference line.

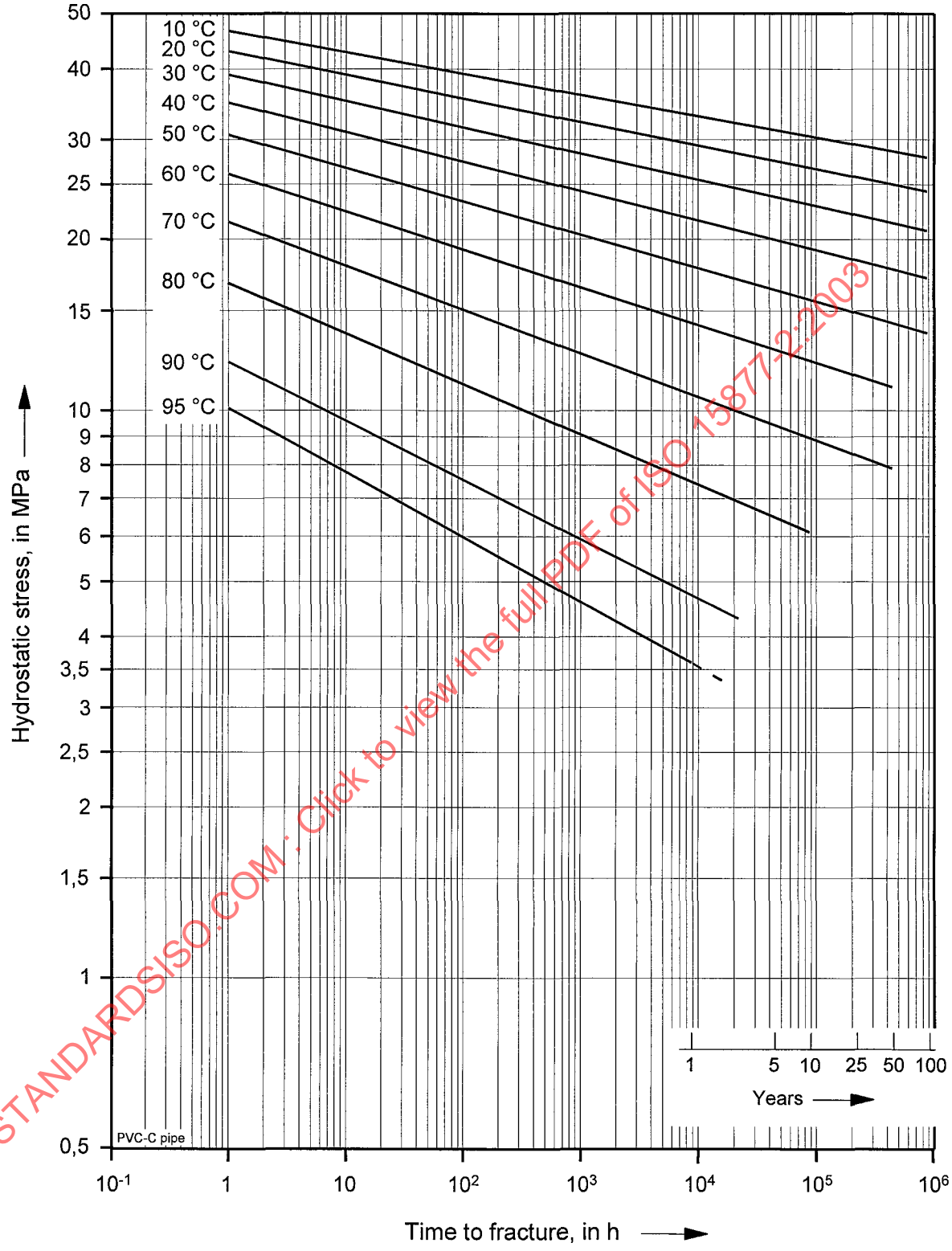

Figure 1 — Reference curves for the expected hydrostatic strength of PVC-C pipe material

4.4 Influence on water intended for human consumption

The material shall conform to EN ISO 15877-1:2003.

5 General characteristics

5.1 Appearance

When viewed without magnification the internal and external surfaces of pipes shall be smooth, clean and free from scoring, cavities and other surface defects to an extent that would prevent conformance with this standard. The material shall not contain visible impurities.

The ends of the pipe shall be cleanly cut and square to the axis of the pipe.

5.2 Chamfering

If a chamfer is required, the angle of chamfering shall be between 15° and 45° to the axis of the pipe. When pipes without chamfer are used, the pipe ends shall be deburred.

5.3 Opacity

PVC-C pipes that are declared to be opaque shall not transmit more than 0,2 % of visible light, when tested in accordance with EN 578.

6 Geometrical characteristics

6.1 General

6.1.1 Dimensions shall be measured in accordance with EN ISO 3126.

NOTE Figure 2 covers schematic sketches only, to indicate the relevant dimensions. It does not necessarily represent the manufactured components.

6.1.2 The maximum calculated pipe value, $S_{calc,max}$, for the applicable class of service conditions and design pressure, p_D, shall conform to Table 1.

Table 1 — $S_{calc,max}$-values

Design pressure p_D bar	Application class	
	Class 1	Class 2
	$S_{calc,max}$-values [a]	
4	10,0	10,0
6	7,3	6,9
8	5,5	5,2
10	4,4	4,2
[a] The values are rounded to the first place of decimals.		

NOTE The derivation of $S_{calc,max}$ is provided in Annex A. The method described takes account of the properties of PVC-C under the service conditions for the classes given in Table 1 of EN ISO 15877-1:2003.

6.2 Dimensions of pipes

6.2.1 Outside diameters

The mean outside diameter, d_{em}, of a pipe shall conform to Table 2.

6.2.2 Wall thicknesses and their tolerances

For any particular class of service conditions, design pressure and nominal size, the minimum wall thickness, e_{min} shall be chosen in such a way that the corresponding pipe series S is not greater than the values of $S_{calc,max}$ as given in table 1.

The wall thickness, e, shall conform to Table 2 in relation to the pipe series S.

The tolerance on the wall thickness, e, shall conform to Table 3.

Table 2 — Diameters and wall thicknesses

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter	Mean outside diameter		Pipe series		
				S 6,3	S 5	S 4
				Minimum wall thickness		
	d_n	$d_{em,min}$	$d_{em,max}$	e_{min}		
12	12	12,0	12,2	1,4	1,4	1,4
14	14	14,0	14,2	1,4	1,4	1,6
16	16	16,0	16,2	1,4	1,5	1,8
20	20	20,0	20,2	1,5	1,9	2,3
25	25	25,0	25,2	1,9	2,3	2,8
32	32	32,0	32,2	2,4	2,9	3,6
40	40	40,0	40,2	3,0	3,7	4,5
50	50	50,0	50,2	3,7	4,6	5,6
63	63	63,0	63,3	4,7	5,8	7,1
75	75	75,0	75,3	5,6	6,8	8,4
90	90	90,0	90,3	6,7	8,2	10,1
110	110	110,0	110,4	8,1	10,0	12,3
125	125	125,0	125,4	9,2	11,4	14,0
140	140	140,0	140,5	10,3	12,7	15,7
160	160	160,0	160,5	11,8	14,6	17,9

Table 3 — Tolerances on wall thicknesses

Dimensions in millimetres

Minimum wall thickness e_{min}		Tolerance [a] x
>	≤	
1,0	2,0	0,4
2,0	3,0	0,5
3,0	4,0	0,6
4,0	5,0	0,7
5,0	6,0	0,8
6,0	7,0	0,9
7,0	8,0	1,0
8,0	9,0	1,1
9,0	10,0	1,2
10,0	11,0	1,3
11,0	12,0	1,4
12,0	13,0	1,5
13,0	14,0	1,6
14,0	15,0	1,7
15,0	16,0	1,8
16,0	17,0	1,9
17,0	18,0	2,0

[a] The tolerance is expressed in the form $^{+x}_{0}$ mm, where x is the value of the tolerance given. The level of the tolerances conforms to Grade W of ISO 11922-1:1997 [2].

6.2.3 Length of pipes

The effective length, l, of a pipe shall not be less than specified by the manufacturer when measured as shown in Figure 2.

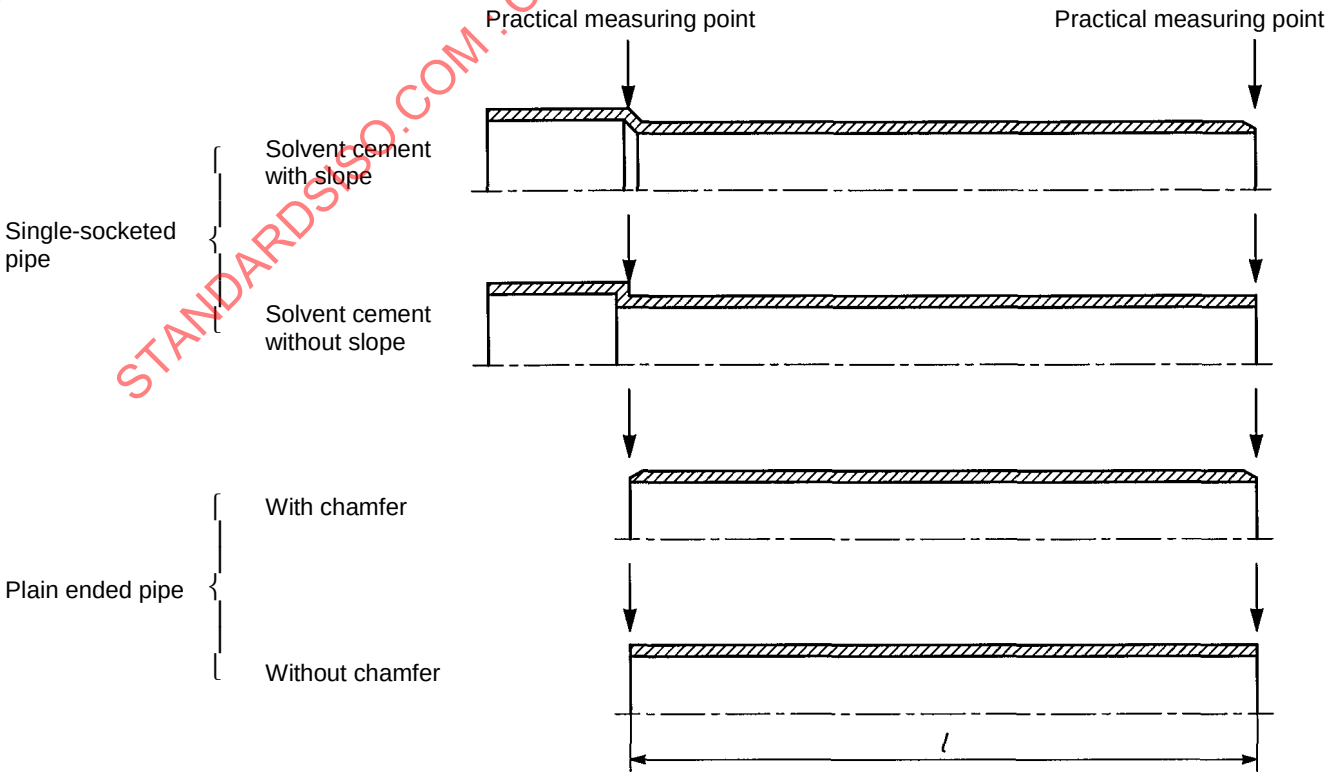

Figure 2 — Effective length of pipes

6.2.4 Pipes with sockets

When pipes with sockets are used, the dimensions of sockets shall conform to EN ISO 15877-3:2003.

7 Mechanical characteristics

7.1 Resistance to internal pressure

When tested in accordance with the test method specified in Table 4, using the indicated parameters, the pipe shall withstand the hydrostatic (hoop) stress without bursting or leakage.

Table 4 — Test parameters for testing resistance to internal pressure

Characteristic	Requirements	Test parameters for the individual tests				Test method
		Hydrostatic (hoop) stress MPa	Test temperature °C	Test period h	Number of test pieces	
Resistance to internal pressure	No failure during the test period	43,0 [a]	20	1	3	EN 921 of 1994
		5,6	95	165	3	
		4,6	95	1000	3	
		3,6	95	8760	3	
		Test parameters for all tests				
		Sampling procedure Type of end caps Orientation of test piece Type of test [c] [d]	[b] Types a) or b) Vertical Water-in-air or water-in-water			

a The test stress is above the minimum expected strength curve as the real short-term stress at 20 °C is higher than the strength curve.

b The sampling procedure is not specified. For guidance see CEN ISO/TS 15877-7 [3].

c Testing at 95 °C shall be done in water-in-air.

d In case of dispute, testing at 20 °C shall be done in water-in-water.

NOTE Testing at 95 °C, 8760 h and 3,6 MPa verifies the thermal stability (see clause 8).

7.2 Impact resistance

When tested in accordance with the test method specified in Table 5, using the indicated parameters, the pipe shall have a true impact rate TIR conforming to Table 5.

Table 5 — Test parameters for testing impact resistance

Characteristic	Requirements	Test parameters		Test method
Impact resistance (round-the-clock method)	TIR ≤ 10 %	Type of striker Mass of striker Fall height of striker Conditioning medium Test/conditioning temperature Sampling procedure	d25 Shall conform to Table 6 Shall conform to Table 6 Water or air [a] (0 ± 1) °C [b]	EN 744
a In case of dispute, air shall be used. b The sampling procedure is not specified. For guidance see CEN ISO/TS 15877-7 [3].				

Table 6 — Masses and fall heights of striker for testing impact resistance

Nominal size DN/OD	Nominal outside diameter (mm) d_n	Mass of striker (kg) $^{+0,01}_{0}$	Fall height of striker (m)
12	12	0,5	0,3
14	14	0,5	0,3
16	16	0,5	0,4
20	20	0,5	0,4
25	25	0,5	0,5
32	32	0,5	0,6
40	40	0,5	0,8
50	50	0,5	1,0
63	63	0,8	1,0
75	75	0,8	1,0
90	90	0,8	1,2
110	110	1,0	1,6
125	125	1,25	2,0
140	140	1,6	1,8
160	160	1,6	2,0

7.3 Tensile strength

When tested in accordance with the test method specified in Table 7, using the indicated parameters, the pipe shall have a tensile strength at yield point conforming to Table 7.

Table 7 — Test parameters for testing tensile strength

Characteristic	Requirements	Test parameters		Test method
Tensile strength at yield point	$\sigma_y \geq 50$ MPa	Speed of testing Shape and dimensions of the test piece Number of test pieces Test piece preparation Initial gauge length	5 mm/min Shall conform to ISO 6259-2:1997 5 Machining (25 ± 1) mm	EN ISO 6259-1

8 Physical characteristics

When tested in accordance with the test methods specified in Table 8, using the indicated parameters, the pipe shall have physical characteristics conforming to the requirements given in Table 8.

Table 8 — Physical characteristics

Characteristic	Requirements	Test parameters		Test method
Vicat softening temperature (VST)	VST ≥ 110 °C	Shall conform to EN 727		EN 727
Longitudinal reversion	≤ 5 % The pipe shall exhibit no bubbles or cracks	Test temperature Duration of exposure for: $e \leq$ 4 mm 4 mm < $e \leq$ 16 mm $e >$ 16 mm Number of test pieces	(150 ± 2) °C (30 ± 1) min (60 ± 1) min (120 ± 1) min 3	EN 743:1994 Method B: Air
Thermal stability by hydrostatic pressure testing [a]	No bursting or leakage during the test period	Sampling procedure Type of end caps Orientation of test piece Type of test Test temperature Hydrostatic (hoop) stress Test period Number of test pieces	[b] Types a) or b) Vertical Water-in-air 95 °C 3,6 MPa 8760 h 3	EN 921:1994

[a] Not applicable if the hydrostatic strength at 95 °C, 8760 h and 3,6 MPa have been verified by testing in accordance with 7.1.

[b] The sampling procedure is not specified. For guidance see CEN ISO/TS 15877-7 [3].

9 Performance requirements

When pipes conforming to this standard are jointed to each other or to components conforming to EN ISO 15877-3:2003, the pipes and the joints shall conform to EN ISO 15877-5.

10 Adhesives

The adhesive(s) shall be solvent cement and shall be as recommended by the manufacturer of the pipes and/or fittings.

The adhesive(s) shall have no detrimental effects on the properties of the pipe and shall not cause the test assembly to fail to conform to EN ISO 15877-5.

NOTE Relevant specifications and test methods for solvent cements are currently discussed by WG 6 "Adhesives for thermoplastics piping systems" of Technical Committee CEN/TC 193 "Adhesives".

11 Marking

11.1 General

11.1.1 Marking elements shall be printed or formed directly on the pipe not less than once per meter in such a way that after storage, handling and installation (e.g. in accordance with ENV 12108 [1]) legibility is maintained.

NOTE The manufacturer is not responsible for marking being illegible, due to actions such as painting, scratching, covering of the components or by use of detergent etc. on the components unless agreed or specified by the manufacturer.