CD/K/092-2:2009
ICS 91.140.60; 23.040.20

EAST AFRICAN STANDARD

Plastics piping systems for hot and cold water installations — Chlorinated poly(vinyl chloride) (PVC-C) — Part 2: Pipes

EAST AFRICAN COMMUNITY

First Edition 2010

Foreword

Development of the East African Standards has been necessitated by the need for harmonizing requirements governing quality of products and services in East Africa. It is envisaged that through harmonized standardization, trade barriers which are encountered when goods and services are exchanged within the Community will be removed.

In order to meet the above objectives, the EAC Partner States have enacted an East African Standardization, Quality Assurance, Metrology and Test Act, 2006 (EAC SQMT Act, 2006) to make provisions for ensuring standardization, quality assurance, metrology and testing of products produced or originating in a third country and traded in the Community in order to facilitate industrial development and trade as well as helping to protect the health and safety of society and the environment in the Community.

East African Standards are formulated in accordance with the procedures established by the East African Standards Committee. The East African Standards Committee is established under the provisions of Article 4 of the EAC SQMT Act, 2006. The Committee is composed of representatives of the National Standards Bodies in Partner States, together with the representatives from the private sectors and consumer organizations. Draft East African Standards are circulated to stakeholders through the National Standards Bodies in the Partner States. The comments received are discussed and incorporated before finalization of standards, in accordance with the procedures of the Community.

Article 15(1) of the EAC SQMT Act, 2006 provides that "Within six months of the declaration of an East African Standard, the Partner States shall adopt, without deviation from the approved text of the standard, the East African Standard as a national standard and withdraw any existing national standard with similar scope and purpose".

East African Standards are subject to review, to keep pace with technological advances. Users of the East African Standards are therefore expected to ensure that they always have the latest versions of the standards they are implementing.

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Introduction

In the preparation of this East African Standard, the following source was consulted extensively:

ISO 15877-2:2009, *Plastics piping systems for hot and cold water installations — Chlorinated poly(vinyl chloride) (PVC-C) — Part 2: Pipes*

Assistance derived from this source and others inadvertently not mentioned is hereby acknowledged.

INTERNATIONAL STANDARD

ISO 15877-2

Second edition
2009-03-15

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
ISO 15877-2:2009(E)

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Published in Switzerland

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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) Technical Committee CEN/TC 155, *Plastics piping systems and ducting systems*, in collaboration with ISO 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).

This part of ISO 15877 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.

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

This second edition cancels and replaces the first edition (ISO 15877-2:2003).

ISO 15877 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*

— *Part 3: Fittings*

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

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

1) This System Standard does not incorporate a Part 4: *Ancillary equipment* or a Part 6: *Guidance for installation*. For ancillary equipment, separate standards can apply. Guidance for installation of plastics piping systems made from different materials, intended to be used for hot and cold water installations, is covered by ENV 12108 [5].

At the date of publication of this part of ISO 15877, System Standards Series for piping systems of other plastics materials used for hot and cold water installations are the following:

ISO 15874 (all parts), *Plastics piping systems for hot and cold water installations — Polypropylene (PP)*

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

ISO 15876 (all parts), *Plastics piping systems for hot and cold water installations — Polybutylene (PB)*

ISO 22391:— [2)] (all parts), *Plastics piping systems for hot and cold water installations — Polyethylene of raised temperature resistance (PE-RT)*

2) To be published. (Revisions of ISO 22391-1:2007, ISO 22391-2:2007, ISO 22391-3:2007, ISO 22391-5:2007.)

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 and for heating system installations.

In respect of potential adverse effects on the quality of water intended for human consumption caused by the product covered by this part of ISO 15877, the following are relevant.

a) This part of ISO 15877 provides no information as to whether the product may be used without restriction in any of the Member States of the EU or EFTA.

b) 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 ISO 15877-1 and ISO 15877-3. Characteristics for fitness for purpose (mainly for joints) are covered in ISO 15877-5. ISO/TS 15877-7 gives guidance for the assessment of conformity.

This part of ISO 15877 specifies the characteristics of pipes.

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

Part 2: Pipes

1 Scope

This part of ISO 15877 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) and for heating systems, under design pressures and temperatures appropriate to the class of application (see Table 1 of ISO 15877-1:2009).

This part of ISO 15877 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 ISO 15877-1:2009, this part of ISO 15877 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 part of ISO 15877.

In conjunction with the other parts of ISO 15877, it is applicable to PVC-C pipes, their joints and 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

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 1167-1, *Thermoplastics pipes, fittings and assemblies for the conveyance of fluids — Determination of the resistance to internal pressure — Part 1: General method*

ISO 1167-2, *Thermoplastics pipes, fittings and assemblies for the conveyance of fluids — Determination of the resistance to internal pressure — Part 2: Preparation of pipe test pieces*

ISO 2505, *Thermoplastics pipes — Longitudinal reversion — Test methods and parameters*

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

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

ISO 6259-2, *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)*

ISO 7686, *Plastics pipes and fittings — Determination of opacity*

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

ISO 15877-1:2009, *Plastics piping systems for hot and cold water installations — Chlorinated poly(vinyl chloride) (PVC-C) — Part 1: General*

ISO 15877-3:2009, *Plastics piping systems for hot and cold water installations — Chlorinated poly(vinyl chloride) (PVC-C) — Part 3: Fittings*

ISO 15877-5:2009, *Plastics piping systems for hot and cold water installations — Chlorinated poly(vinyl chloride) (PVC-C) — Part 5: Fitness for purpose of the system*

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

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

3 Terms, definitions and symbols

For the purposes of this document, the terms and definitions given in ISO 15877-1 and the following symbols apply.

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 part of ISO 15877 and to the relevant requirements of ISO 15877-1.

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 part of ISO 15877.

4.3 Evaluation of σ_{LPL}-values

The pipe material should be evaluated in accordance with ISO 9080 or equivalent, where internal pressure tests are made in accordance with ISO 1167-1 and ISO 1167-2 to find the σ_{LPL}-value. The σ_{LPL}-value thus determined shall be at least as high as the corresponding values of the reference curves given in Figure 1 or Figure 2, as applicable, over the complete range of times.

NOTE 1 One equivalent way of evaluation is to calculate the σ_{LPL}-value for each temperature (e.g. for 20 °C, 60 °C and 95 °C or 100 °C) individually.

NOTE 2 The reference curves in Figure 1 for Type I PVC-C in the temperature range of 10 °C to 95 °C are derived from Equation (1):

$$\log t = -109{,}95 - \frac{21\,897{,}4}{T} \times \log\sigma + \frac{43\,702{,}87}{T} + 50{,}742\,02 \times \log\sigma \qquad (1)$$

The reference curves in Figure 2 for Type II PVC-C in the temperature range of 10 °C to 100 °C are derived from Equation (2):

$$\log t = -115,839 - \frac{22\,980}{T} \times \log\sigma + \frac{45\,647,94}{T} + 54,732\,19 \times \log\sigma \quad (2)$$

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

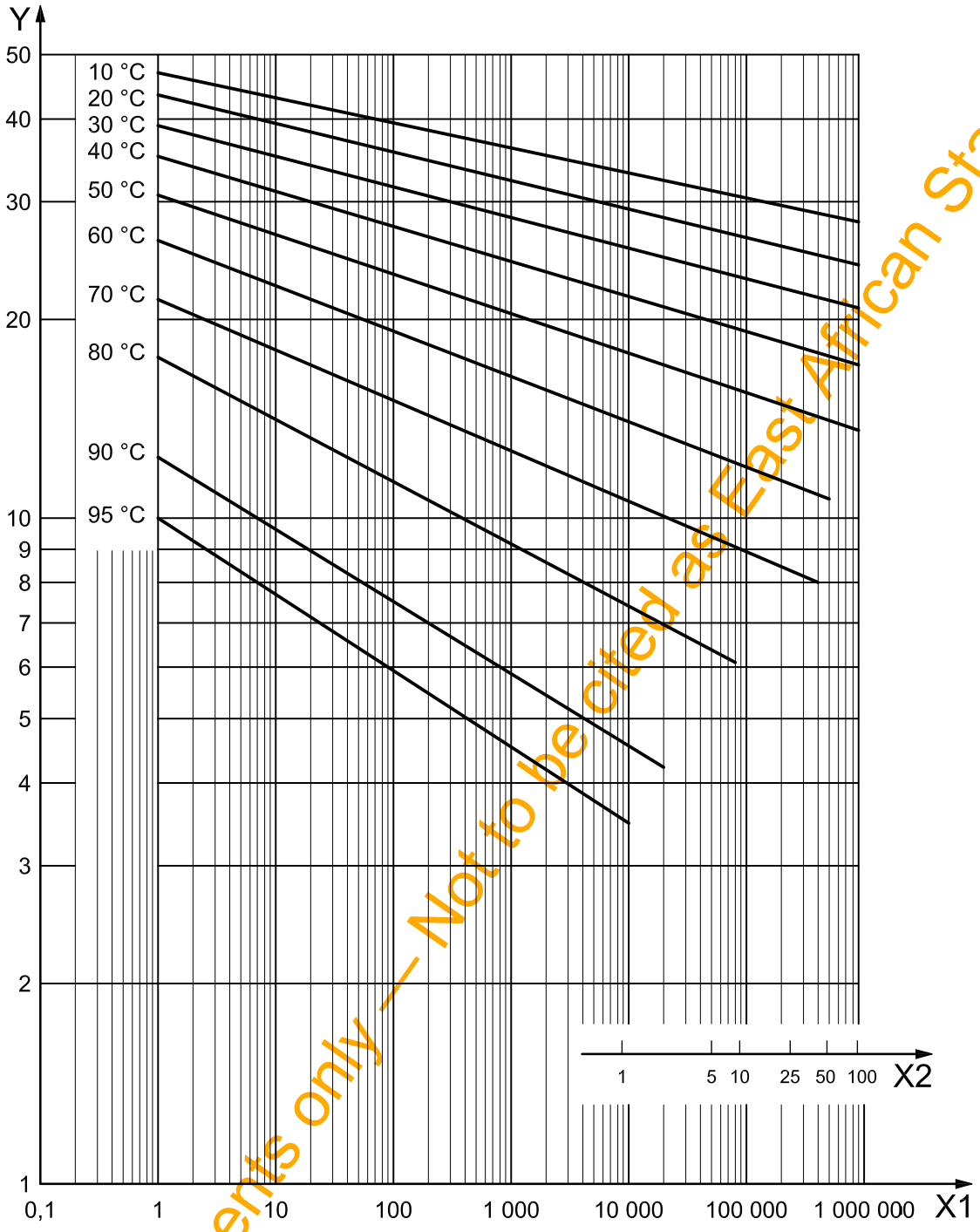
PVC-C Type I: Temperatures 20 °C; 60 °C to 70 °C; 95 °C;

PVC-C Type I: Time intervals 10 h to 100 h, 100 h to 1 000 h,1 000 h to 8 760 h and above 8 760 h;

PVC-C Type II: Temperatures 20 °C; 60 °C to 70 °C; 100 °C;

PVC-C Type II: Time intervals 10 h to 100 h, 100 h to 1 000 h,1 000 h to 8 760 h and above 8 760 h.

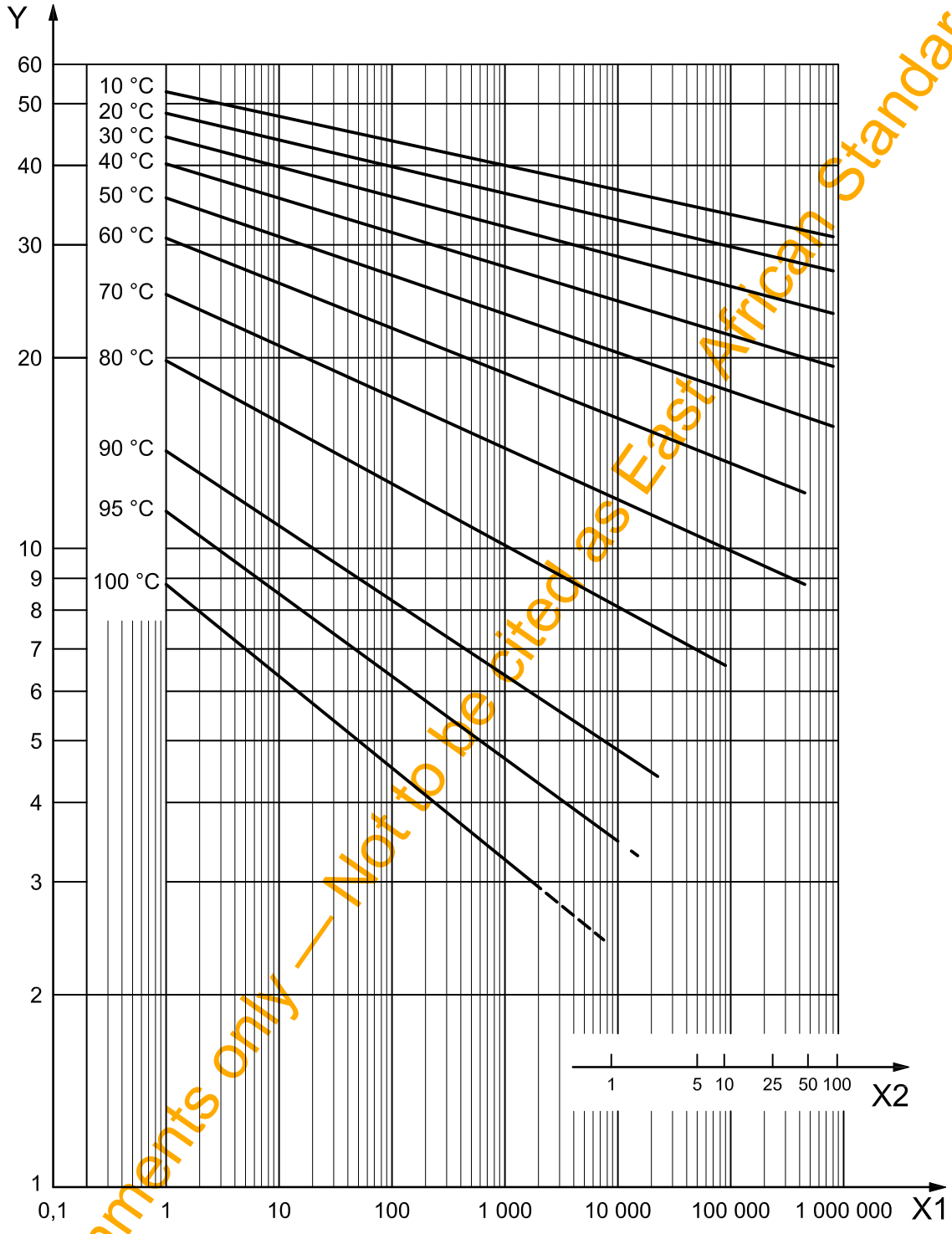
In tests lasting more than 8 760 h, once no failure is reached at a stress and time at least on or above the reference line, any time after that can be considered as the failure time. Testing should be carried out in accordance with ISO 1167-1. Conformance to the reference lines should be demonstrated by plotting the individual experimental results on the graph. At least 97,5 % of them should lie on or above the reference line.



Key

X1 time to fracture, expressed in hours
X2 time to fracture, expressed in years
Y hydrostatic stress, expressed in megapascals

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



Key

X1 time to fracture, expressed in hours
X2 time to fracture, expressed in years
Y hydrostatic stress, expressed in megapascals

Figure 2 — Reference curves for the expected hydrostatic strength of PVC-C Type II pipe material

4.4 Influence on water intended for human consumption

The material shall conform to ISO 15877-1.

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 part of ISO 15877. The material shall not contain visible impurities. Slight variations in the appearance of the colour shall be permitted.

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 ISO 7686.

6 Geometrical characteristics

6.1 General

6.1.1 Dimensions shall be measured in accordance with ISO 3126.

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 or Table 2, as applicable.

Table 1 — $S_{calc,max}$-values for PVC-C Type I

Design pressure p_D bar [a]	Application class	
	Class 1	Class 2
	$S_{calc,max}$-values [b]	
4	10,0 [c]	10,0 [c]
6	7,3	7,1
8	5,5	4,8
10	4,4	4,2

[a] 1 bar = 0,1 MPa = 0,1 N/mm^2 = 10^5 N/m^2.

[b] The values are rounded to the first decimal place.

[c] The 20 °C, 10 bar, 50 years, cold water requirement, being higher, determines this value (see Clause 4 of ISO 15877-1:2009).

Table 2 — $S_{calc,max}$-values for PVC-C Type II

Design pressure p_D bar	Application class			
	Class 1	Class 2	Class 4	Class 5
	$S_{calc,max}$-values [a]			
4	11,2 [b]	11,2 [b]	11,2 [b]	7,1
6	8,0	7,6	7,5	4,8
8	6,0	5,7	[5,6] [c]	[3,6] [c]
10	4,8	4,5	[4,5] [c]	[2,9] [c]

[a] The values are rounded to the first decimal place.

[b] The 20 °C, 10 bar, 50 years, cold water requirement, being higher, determines this value (see Clause 4 of ISO 15877-1:2009).

[c] Theoretical values, see Table 4 and Table 6 of ISO 15877-5:2009.

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 ISO 15877-1:2009.

6.2 Dimensions of pipes

The mean outside diameter, d_{em}, of a pipe shall conform to Table 3.

6.3 Wall thicknesses and their tolerances

6.3.1 General

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 S series or S_{calc} value is equal to or less than $S_{calc,max}$ as given in Table 1 or Table 2, as applicable.

The wall thickness, e, shall conform to Table 3 in relation to the pipe series S.

The tolerance on the wall thickness, e, shall conform to Table 4.

Table 3 — 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
	d_n	$d_{em,min}$	$d_{em,max}$	Minimum wall thickness e_{min} and e_n		
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

NOTE Sizes conform to ISO 4065 [1] and are applicable for all classes of service conditions.

Table 4 — Tolerances on wall thicknesses

Dimensions in millimetres

Minimum wall thickness e_{min}		Tolerance x [a]
>	⩽	
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 [2].

6.3.2 Length of pipes

The effective length, l, of a pipe shall not be less than specified by the manufacturer.

7 Mechanical characteristics

7.1 Resistance to internal pressure

When tested in accordance with the test method specified in Table 5 or Table 6, as applicable, using the indicated parameters, the pipe shall withstand the hydrostatic (hoop) stress without bursting or leakage.

Table 5 — Test parameters for testing resistance to internal pressure for PVC-C Type I

Characteristic	Requirements	Test parameters for the individual tests				Test method
Resistance to internal pressure	No failure during the test period	Hydrostatic (hoop) stress MPa	Test temperature °C	Test period h	Number of test pieces	ISO 1167-1
		43	20	1	3	
		5,6	95	165	3	
		4,6	95	1 000	3	
		Test parameters for all tests				
		Sampling procedure	[a]			
		Type of end caps	Types A or B			
		Orientation of test piece	Vertical			
		Type of test [b c]	Water-in-air or water-in-water			

[a] The sampling procedure is not specified. For guidance, see ISO/TS 15877-7 [4].

[b] Testing at 95 °C shall be done in water-in-air.

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

Table 6 — Test parameters for testing resistance to internal pressure for PVC-C Type II

Characteristic	Requirements	Test parameters for the individual tests				Test method
Resistance to internal pressure	No failure during the test period	**Hydrostatic (hoop) stress** MPa	**Test temperature** °C	**Test period** h	**Number of test pieces**	ISO 1167-1
		48	20	1	3	
		5,9	95	165	3	
		4,7	95	1 000	3	
		Test parameters for all tests				
		Sampling procedure Type of end caps Orientation of test piece Type of test [b] [c]	[a] Types A or B Vertical Water-in-air or water-in-water			

[a] The sampling procedure is not specified. For guidance, see ISO/TS 15877-7 [4].

[b] Testing at 95 °C shall be done in water-in-air.

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

7.2 Impact resistance

When tested in accordance with the test method specified in Table 7, using the indicated parameters, the pipe shall have a true impact rate, TIR, conforming to Table 7. Masses and fall heights of striker for testing impact resistance are given in Table 8.

Table 7 — Test parameters for testing impact resistance

Characteristic	Requirements	Test parameters		Test method
Impact resistance (via single impact test)	TIR $\leqslant$ 10%	Type of striker Mass of striker Fall height of striker Conditioning medium Test/conditioning temperature Sampling procedure	d25 Shall conform to Table 8 Shall conform to Table 8 Water or air [a] (0 $\pm$ 1) °C [b]	EN 744

[a] In case of dispute, air shall be used.

[b] The sampling procedure is not specified. For guidance, see ISO/TS 15877-7 [4].

Table 8 — Masses and fall heights of striker for testing impact resistance

Nominal size DN/OD	Nominal outside diameter d_n mm	Mass of striker [a] kg	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

[a] The tolerance on the given mass of the striker is $^{+0,01}_{0}$.

7.3 Tensile strength

When tested in accordance with the test method specified in Table 9, using the indicated parameters, the pipe shall have a tensile strength at yield point conforming to Table 9.

Table 9 — Test parameters for testing tensile strength

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

8 Physical characteristics

When tested in accordance with the test methods specified in Table 10 or Table 11, as applicable, using the indicated parameters, the pipe shall have physical characteristics conforming to the requirements given in the applicable table.

Table 10 — Physical characteristics for PVC-C Type I

Characteristic	Requirements	Test parameters		Test method
Vicat softening temperature (VST)	VST $\geqslant$ 110 °C	Shall conform to EN 727		EN 727
Longitudinal reversion	$\leqslant$ 5 % The pipe shall exhibit no bubbles or cracks	Test temperature Duration of exposure for: $e \leqslant$ 4 mm 4 mm $< e \leqslant$ 16 mm $e >$ 16 mm Number of test pieces	(150 $\pm$ 2) °C (30 $\pm$ 1) min (60 $\pm$ 1) min (120 $\pm$ 1) min 3	ISO 2505 Air oven
Thermal stability by hydrostatic pressure testing	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	[a] Types A or B Vertical Water-in-air 95 °C 3,6 MPa 8760 h 3	ISO 1167-1
[a] The sampling procedure is not specified. For guidance, see ISO/TS 15877-7 [4].				

Table 11 — Physical characteristics for PVC-C Type II

Characteristic	Requirements	Test parameters		Test method
Vicat softening temperature (VST)	VST $\geqslant$ 115 °C	Shall conform to EN 727		EN 727
Longitudinal reversion	$\leqslant$ 5 % The pipe shall exhibit no bubbles or cracks	Test temperature Duration of exposure for: $e \leqslant$ 4 mm 4 mm $< e \leqslant$ 16 mm $e >$ 16 mm Number of test pieces	(150 $\pm$ 2) °C (30 $\pm$ 1) min (60 $\pm$ 1) min (120 $\pm$ 1) min 3	ISO 2505 Air oven
Thermal stability by hydrostatic pressure testing	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	[a] Types A or B Vertical Water-in-air 100 °C 2,4 MPa 8760 h 3	ISO 1167-1
[a] The sampling procedure is not specified. For guidance, see ISO/TS 15877-7 [4].				

9 Performance requirements

When pipes conforming to this part of ISO 15877 are jointed to each other or to components conforming to ISO 15877-3, the pipes and the joints shall conform to 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 ISO 15877-5.

NOTE Relevant specifications and test methods for solvent cements are currently being discussed by WG 6 *Adhesives for thermoplastic 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 metre in such a way that after storage, handling and installation (e.g. in accordance with ENV 12108 [5]), legibility is maintained.

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

11.1.2 Marking shall not initiate cracks or other types of defects which adversely influence the performance of the pipe.

11.1.3 If printing is used, the colouring of the printed information shall differ from the basic colouring of the pipe.

11.1.4 The size of the marking shall be such that the marking is legible without magnification.

11.2 Minimum required marking

The minimum required marking of the pipe is specified in Table 12.

Table 12 — Minimum required marking

Aspect	Marking or symbol
Number of this International Standard	ISO 15877
Manufacturer's name and/or trade mark	Name or code
Nominal outside diameter and nominal wall thickness	e.g. 32 × 3,6
Material	PVC-C-Type I or PVC-C-Type II [a]
Application class combined with design pressure	e.g. Class 2/10 bar
Opacity [b]	e.g. opaque
Manufacturer's information	[c]

[a] Systems marked PVC-C are assumed to be of PVC-C Type I.

[b] If declared by the manufacturer.

[c] To provide traceability, the following details shall be given:

a) the production period, year and month, in figures or in code;

b) a name or code for the production site if the manufacturer is producing at different sites.

11.3 Additional marking

Pipes conforming to this part of ISO 15877, which are certified by a third party, may be marked accordingly.

NOTE Attention is drawn to the possible need to include CE marking when required for legislative purposes.

Annex A
(informative)

Derivation of the maximum calculated pipe value, $S_{calc,max}$

A.1 General

Annex A specifies the principles regarding the derivation of $S_{calc,max}$-values and, hence, of minimum wall thicknesses, e_{min}, of pipes relative to the classes of service conditions given in Table 1 of ISO 15877-1:2009 and the applicable design pressure, p_D.

A.2 Design stress

The design stress, σ_D, for a particular class of service conditions is calculated from Equation (1) or Equation (2) of 4.3, or Equation (1) or Equation (2) of ISO 15877-3:2009, using Miner's rule in accordance with ISO 13760 [3] and taking into account the applicable class requirements given in Table 1 of ISO 15877-1:2009 and the service coefficients given in Table A.1.

Table A.1 — Overall service (design) coefficients

Temperature °C	Overall service (design) coefficient, C
T_D	1,8
T_{max}	1,7
T_{mal}	1,0
T_{cold}	2,5

The resulting design stress, σ_D, has been calculated relative to each class and is given in Table A.2 or Table A.3, as applicable. The design stress at 20 °C, σ_{cold}, relative to a service life of 50 years is 10,0 MPa.

Table A.2 — Design stress for PVC-C Type I

Application class	Design stress σ_D [a] MPa
1	4,38
2	4,16
20 °C/50 years	10,0
[a] Values given are rounded to the second decimal place.	

Table A.3 — Design stress for PVC-C Type II

Application class	Design stress σ_D [a] MPa
1	4,79
2	4,55
4	4,52
5	2,86
20 °C/50 years	11,2
[a] Values given are rounded to the second decimal place.	

A.3 Derivation of the maximum value of S_{calc} ($S_{calc,max}$)

$S_{calc,max}$ is the smaller value of

either $\frac{\sigma_{DP}}{p_D}$

where

σ_{DP} is the design stress in the pipe material taken from Table A.2 or Table A.3, as applicable;

p_D is the design pressure of 4 bar, 6 bar, 8 bar or 10 bar, as applicable, in megapascals.

or $\frac{\sigma_{cold}}{p_D}$

where

σ_{cold} is the design stress at 20 °C relative to a service life of 50 years;

p_D is the design pressure of 10 bar, in megapascals.

The values of $S_{calc,max}$ relative to each class of service conditions (see ISO 15877-1) are given in Table 1 or Table 2, as applicable.

A.4 Use of $S_{calc,max}$ to determine the wall thickness

The pipe series S and S_{calc}-values shall be chosen for each application class and design pressure from Table 3 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 or Table 2, as applicable.

Bibliography

[1] ISO 4065, *Thermoplastics pipes — Universal wall thickness table*

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

[3] ISO 13760, *Plastics pipes for the conveyance of fluids under pressure — Miner's rule — Calculation method for cumulative damage*

[4] ISO/TS 15877-7, *Plastics piping systems for hot and cold water installations — Chlorinated poly(vinyl chloride) (PVC-C) — Part 7: Guidance for the assessment of conformity*

[5] ENV 12108, *Plastics piping systems — Guidance for the installation inside buildings of pressure piping systems for hot and cold water intended for human consumption*

ICS 23.040.20; 91.140.60

Price based on 15 pages