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

Part 1: General

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

Partie 1: Généralités

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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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 15877-1 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]

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Foreword

This document (EN ISO 15877-1:2003) 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 standard was submitted for CEN enquiry as prEN 12731-1:1995

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* (the present standard)

— *Part 2: Pipes*

— *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 1 of EN ISO 15877includes the following:

— Annex A (normative): Test method for the verification of the malfunction temperature, T_{mal}, of PVC-C material;

— 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 a Part 4: *Ancillary equipment* or a 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 1, 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 EN ISO 15877:

— 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 components of the piping system are specified in Part 2 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 general aspects of the plastics piping system.

1 Scope

This Part of EN ISO 15877 specifies the general requirements of chlorinated poly(vinyl chloride) (PVC-C) 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).

This standard covers a range of service conditions (classes of application), design pressures and pipe dimension classes. For values of T_D, T_{max} and T_{mal} in excess of those in Table 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 and fittings, their joints and to joints with components of 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 ISO 15877-2:2003, *Plastics piping systems for hot and cold water installations — Chlorinated poly(vinyl chloride) (PVC-C) — Part 2: Pipes (ISO 15877-2:2003)*

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 1158, *Plastics — Vinyl chloride homopolymers and copolymers — Determination of chlorine content (ISO 1158:1998)*

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)*

ISO 472:1999, *Plastics — Vocabulary*

ISO 1043-1:2001, *Plastics — Symbols and abbreviated terms — Part 1: Basic polymers and their special characteristics*

ISO 3514, *Chlorinated polyvinyl chloride (CPVC) pipes and fittings — Specification and determination of density*

3 Terms and definitions, symbols and abbreviated terms

For the purposes of this standard, the following terms and definitions, symbols and abbreviated terms apply.

3.1 Terms and definitions

In addition to the terms and definitions given below, the terms and definitions given in ISO 472:1999 and ISO 1043-1:2001 apply.

3.1.1 Geometrical terms and definitions

3.1.1.1 Nominal size

3.1.1.1.1
nominal size DN
numerical designation of the size of a component, which is a convenient round number, approximately equal to the manufacturing dimensions in millimetres (mm)

3.1.1.1.2
nominal size DN/OD
nominal size, related to outside diameter

3.1.1.2
nominal outside diameter (d_n)
specified diameter, in millimetres, assigned to a nominal size DN/OD

NOTE According to EN ISO 15877, the nominal outside diameter, d_n, of a pipe or spigot end of a fitting is equal to its minimum mean outside diameter, $d_{em,min}$.

3.1.1.3
outside diameter (at any point) (d_e)
measured outside diameter through the cross-section at any point of a pipe or spigot end of a fitting, rounded up to the nearest 0,1 mm

3.1.1.4
mean outside diameter (d_{em})
measured length of the outer circumference of a pipe or spigot end of a fitting in any cross section divided by π ($\approx$ 3,142) rounded up to the nearest 0,1 mm

3.1.1.5
minimum mean outside diameter ($d_{em,min}$)
minimum value of the mean outside diameter as specified for a given nominal size

3.1.1.6
maximum mean outside diameter ($d_{em,max}$)
maximum value of the mean outside diameter as specified for a given nominal size

3.1.1.7
mean inside diameter of socket (d_{sm})
arithmetical mean of two measured inside diameters perpendicular to each other at the midpoint of the socket length

3.1.1.8
out-of-roundness (ovality)
difference between the measured maximum outside diameter and the measured minimum outside diameter in the same cross-sectional plane of a pipe or spigot end of a fitting, or the difference between the measured maximum inside diameter and the measured minimum inside diameter in the same cross-sectional plane of a socket

3.1.1.9
nominal wall thickness (e_n)
numerical designation of the wall thickness of a component, approximately equal to the manufacturing dimension in millimetres (mm)

NOTE According to EN ISO 15877, the nominal wall thickness, e_n, of a pipe or spigot end of a fitting is equal to the specified minimum wall thickness, e_{min}.

3.1.1.10
wall thickness (at any point) (e)
measured wall thickness at any point around the circumference of a component, rounded up to the nearest 0,1 mm

3.1.1.11
minimum wall thickness (at any point) (e_{min})
minimum wall thickness at any point around the circumference of a component, as specified

3.1.1.12
maximum wall thickness at any point (e_{max})
maximum wall thickness at any point around the circumference of a component, as specified

3.1.1.13
tolerance
permitted variation of the specified value of a quantity, expressed as the difference between the permitted maximum and the permitted minimum value

3.1.1.14
pipe series (S)
dimensionless number for pipe designation conforming to ISO 4065 [2]

NOTE According to EN ISO 15877 the pipe series S is used as a means for selecting pipe sizes for practical purposes (see EN ISO 15877-2:2003).

3.1.1.15
calculated pipe value (S_{calc})
value for a specific pipe calculated according to the following equation, rounded up to the nearest 0,1 mm:

$$S_{calc} = \frac{d_n - e_n}{2e_n}$$

where:

d_n is the nominal outside diameter, in millimetres;

e_n is the nominal wall thickness, expressed in millimetres

3.1.2 Terms and definitions related to service conditions

3.1.2.1
design pressure (p_D)
highest pressure related to the circumstances for which the system has been designed and is intended to be used

NOTE The design pressure (p_D) is equal to the maximum design pressure (MDP), as specified in EN 806-1 [3].

3.1.2.2
hydrostatic stress (σ)
stress, expressed in megapascals, induced in the wall of a pipe when a pressure is applied using water as a medium. It is calculated using the following approximate equation:

$$\sigma = p \times \frac{(d_{em} - e_{min})}{2e_{min}}$$

where:

p is the applied pressure, in megapascals;

d_{em} is the mean outside diameter of the pipe, in millimetres;

e_{min} is the minimum wall thickness, in millimetres.

3.1.2.3
design temperature(T_D)
a temperature or a combination of temperatures of the conveyed water dependent on the service conditions for which the system has been designed

3.1.2.4
maximum design temperature (T_{max})
highest design temperature, T_D, occurring for short periods only

3.1.2.5
malfunction temperature (T_{mal})
highest temperature that can be reached when the control limits are exceeded

3.1.2.6
cold water temperature (T_{cold})
temperature of conveyed cold water of up to approximately 25 °C

NOTE For design purposes 20 °C is used.

3.1.3 Terms and definitions related to material characteristics

3.1.3.1
lower confidence limit (LCL)
quantity, expressed in megapascals (MPa), which can be considered as a material property, representing the 97,5 % lower confidence limit of the predicted average long-term hydrostatic strength at the given temperature, T, and time, t

3.1.3.2
design stress (σ_D)
allowable stress, in megapascals (MPa), in the pipe material, σ_{DP}, or in the plastics fitting material, σ_{DF}, for a given application or service condition, respectively

NOTE See also annex A of EN ISO 15877-2:2003.

3.1.3.3
overall service (design) coefficient (C)
overall coefficient with a value greater than one, which takes into consideration service conditions as well as properties of the components of a piping system other than those represented in the lower confidence limit, LCL

3.1.3.4
virgin material
material in a form such as granules or powder that has not been subjected to use or processing other than that required for its manufacture and to which no reprocessable or recyclable material has been added

3.1.3.5
own reprocessable material
material prepared from rejected unused pipes and fittings, including trimmings from the production of pipes and fittings, that will be reprocessed in a manufacturer's plant after having been previously processed by the same manufacturer by a process such as moulding or extrusion and for which the complete formulation or material specification is known

3.1.3.6
pipes with barrier layer
plastics pipes provided with a thin barrier layer, e.g. to prevent or greatly diminish the diffusion of gases and the transmission of light through the pipe wall and where the design stress requirements are totally met by the base polymer (PVC-C)

3.2 Symbols

C	overall service (design) coefficient
d_e	outside diameter (at any point)
d_{em}	mean outside diameter
$d_{em,min}$	minimum mean outside diameter
$d_{em,max}$	maximum mean outside diameter

d_n	nominal outside diameter
d_{sm}	mean inside diameter of the socket
e	wall thickness (at any point)
e_{max}	maximum wall thickness (at any point)
e_{min}	minimum wall thickness (at any point)
e_n	nominal wall thickness
p	internal hydrostatic pressure
p_D	design pressure
S_{calc}	calculated pipe value
$S_{calc,max}$	maximum calculated pipe value
T	temperature
T_{cold}	cold water temperature
T_D	design temperature
T_{mal}	malfunction temperature
T_{max}	maximum design temperature
t	time
ρ	density
σ	hydrostatic stress
σ_{cold}	design stress at 20 °C
σ_D	design stress
σ_{DF}	design stress in the fitting material
σ_{DP}	design stress in the pipe material
σ_F	hydrostatic stress values of fitting material
σ_P	hydrostatic stress values of pipe material
σ_{LCL}	lower confidence limit of long-term hydrostatic strength

3.3 Abbreviated terms

DN	nominal size
DN/OD	nominal size, outside diameter related
LCL	lower confidence limit
MDP	maximum design pressure
PVC-C	chlorinated poly(vinyl chloride)
S	pipe series S
TIR	true impact rate

4 Classification of service conditions

The performance requirements for piping systems conforming to EN ISO 15877 are specified for two different application classes and are shown in Table 1.

NOTE 1 Each class is related to a typical field of application and for a design period of 50 years. The classification is taken from ISO 10508 [4]. The fields of application are given as a guideline and are not obligatory.

For any application the parties concerned shall agree the selection of the applicable class conforming to Table 1. Each application class shall be combined with a design pressure, p_D, of 4 bar[2)], 6 bar, 8 bar or 10 bar, as applicable.

Table 1 — Classification of service conditions

Application class	T_D °C	Time at T_D years	T_{max} °C	Time at T_{max} years	T_{mal} °C	Time at T_{mal} h	Typical field of application
1 [a]	60	49	80	1	95	100	Hot water supply (60 °C)
2 [a]	70	49	80	1	95	100	Hot water supply (70 °C)
[a] A country may select application class 1 or application class 2 to conform to its national regulations							
NOTE For values of T_D, T_{max} and T_{mal} in excess of those in this table, this standard does not apply.							

All systems which satisfy the conditions specified in Table 1 shall also be suitable for the conveyance of cold water for a period of 50 years at a temperature of 20 °C and a design pressure of 10 bar.

NOTE 2 The manufacturer of plastics pipes and fittings should give guidance on the type of treatment required and on aspects of applications such as oxygen permeation.

5 Material

5.1 General

The PVC-C material from which the pipes and fittings are made shall conform to this standard and to the relevant requirements of EN ISO 15877-2:2003 and EN ISO 15877-3:2003, as applicable.

Other materials than PVC-C used for the manufacture of fittings shall conform to EN ISO 15877-3:2003.

5.2 Density

The density of the PVC-C material used for the manufacture of pipes and fittings shall be measured in accordance with ISO 3514 and shall be at (23 ± 2) °C between the following limits:

$$1{,}45\ g/cm^3 \leq \rho \leq 1{,}65\ g/cm^3.$$

5.3 Chlorine content

The chlorine content of the PVC-C material used for the manufacture of pipes and fittings shall be determined in accordance with EN ISO 1158 and shall be at least 60 % by mass.

5.4 Hydrostatic stress properties

The material from which the pipes and fittings are made shall be evaluated in accordance with EN ISO 9080 or equivalent. The σ_{LCL}-values thus determined shall be at least as high as the corresponding values of the reference curves given in Figure 1 of EN ISO 15877-2:2003 and Figure 1 of EN ISO 15877-3:2003, as applicable.

2) 1 bar = 10^5 N/m^2 = 0,1 MPa

5.5 Verification of the malfunction temperature

The verification of the malfunction temperature, T_{mal}, of the PVC-C material shall conform to Annex A.

5.6 Influence on water intended for human consumption

All plastics and non-plastics materials for components of the PVC-C piping system, when in permanent or temporary contact with water, which is intended for human consumption, shall not adversely affect the quality of the drinking water.

NOTE European standards on test methods for the assessment of migration, odour and flavour and for microbiological assessment are under preparation.

5.7 Reprocessable and recycable material

The use of the manufacturer's own reprocessable material obtained during the production and testing of products conforming to this standard is permitted in addition to the use of virgin material. Reprocessable material obtained from external sources and recyclable material shall not be used.

Annex A
(normative)

Test method for the verification of the malfunction temperature, T_{mal}, of PVC-C material

A.1 Scope

This annex specifies a test method for verifying the malfunction temperature, T_{mal}, of chlorinated poly(vinyl chloride) (PVC-C) material for piping systems intended to be used for hot and cold water installations (classification of service conditions see clause 4).

For a period of 50 years, a malfunction temperature, T_{mal}, of 95 °C for a maximum period of 100 h is taken into account.

A.2 Principle

An assembly of pipes and fittings (see Figure A.1) for testing the material is subjected to a given internal water pressure under temperature for a given period during which the leaktightness of the system is verified by inspection.

A.3 Apparatus

A.3.1 **Pump**, capable of applying and maintaining the required pressure.

A.3.2 **Pressure measurement devices**, capable of checking conformity to the required test pressure (see clause A.5).

A.3.3 **Heating devices**, capable of applying and maintaining the required temperature (see clause A.5).

A.3.4 **Thermometer or equivalent**, capable of checking conformity to the required test temperature (see clause A.5).

A.3.5 **Timer**, capable of recording the duration of the pressure application.

A.4 Test pieces

The assembly shall comprise test pieces of the following type:

- 10 pipe sections of the same length, each of them at least 300 mm and with a nominal outside diameter, d_n, specified by the manufacturer and capable of withstanding a design pressure, p_D, of at least 10 bar;
- 7 double-sockets (couplers) of the same outside diameter as the pipe sections;
- 4 elbows, each of them with an angle of 90°.

The test pieces shall be joined to each other according to Figure A.1.