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

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

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

Partie 5: Aptitude à l'emploi du système



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Published in Switzerland

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 15877-5 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 15877-5:2003) 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 12731-5:1995.

This standard is 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 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* (the present standard)
- Part 7 *Guidance for the assessment of conformity* (CEN ISO/TS 15877-7).

This Part of EN ISO 15877 includes a Bibliography.

At the date of publication of this standard, System Standards for piping systems of other plastics materials used for the same application 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.

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.

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 ^[1].

Introduction

The System Standard, of which this is Part 5, specifies the requirements for a piping system and its components 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.

Requirements and test methods for components of the piping system are specified in Part 1, 2 and 3 of this System Standard. Part 7 (CEN ISO/TS 15877-7) gives guidance for the assessment of conformity.

This Part of EN ISO 15877 specifies the characteristics of fitness for purpose of the piping systems.

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1 Scope

This Part of EN ISO 15877 specifies the characteristics of the fitness for purpose 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) and for heating systems, under design pressures and temperatures according to the class of application (see Table 1 of EN ISO 15877-1:2003).

This standard covers a range of service conditions (application classes) and design pressure classes. 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 it is applicable to PVC-C pipes, 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 712, *Thermoplastics piping systems — End-load bearing mechanical joints between pressure pipes and fittings — Test method for resistance to pull-out under constant longitudinal force*

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

EN 12293, *Plastics piping systems — Thermoplastics pipes and fittings for hot and cold water — Test method for the resistance of mounted assemblies to temperature cycling*

EN 12294, *Plastics piping systems - Systems for hot and cold water — Test method for leaktightness under vacuum*

EN 12295, *Plastics piping systems — Thermoplastics pipes and fittings for hot and cold water — Test method for resistance of joints to pressure cycling*

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 15877-2:2003, *Plastics piping systems for hot and cold water installations — Chlorinated poly(vinyl chloride) (PVC-C) — Part 2: Pipes (ISO 15877-2:2003)*

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.

4 Fitness for purpose of the joints and the piping system

4.1 General

When tested in accordance with the applicable test methods as specified in Table 1, using the indicated parameters given in 4.2 to 4.6, as applicable, the joints and the piping system shall have characteristics conforming to the requirements given in the applicable clauses.

For testing, the fittings shall be connected to the corresponding pipes for which they are intended to be used. The assembly instructions of the manufacturer of the components shall be taken into account.

Table 1 specifies the tests applicable for each different type of jointing system covered by this standard.

Table 1 — Joint tests

Test	Jointing system ^a		Test parameters	Test method
	SC	M		
Internal pressure test	Y	Y	Shall conform to 4.2	EN 921:1994
Pull-out test	N	Y	Shall conform to 4.3	EN 712
Thermal cycling test	Y	Y	Shall conform to 4.4	EN 12293
Pressure cycling test	Y	Y	Shall conform to 4.5	EN 12295
Vacuum test	Y	Y	Shall conform to 4.6	EN 12294
^a SC – Solvent cement joint M - Mechanical joint Y - denotes test applicable N - denotes test not applicable				

4.2 Internal pressure test

4.2.1 General

When tested in accordance with the test method specified in Table 2, using the indicated parameters, the joint assemblies shall not leak.

Solvent cement joints comprising PVC-C pipes and fittings shall be tested in accordance with 4.2.2. When testing mechanical joint assemblies with compression fittings the requirements given in 4.2.3 shall apply.

Table 2 — General test parameters for testing resistance to internal pressure

Characteristic	Requirements	Test parameters		Test method
		Sampling procedure	Not specified ^a	
Resistance to internal pressure	No failure during the test period	Type of end caps Orientation of test piece Type of test	Types a) or b) Vertical Water-in-air	EN 921:1994
^a For guidance see CEN ISO/TS 15877-7 [2].				

4.2.2 Solvent cement joints

The solvent cement joint shall be tested in form of test pieces comprising couplers with solvent cemented pipe sections.

The fittings shall be connected to the corresponding pipe conforming to EN ISO 15877-2:2003, using solvent cement in such a way that the required hydrostatic test pressure, p_J , given in Table 3, can be applied.

Before testing, store the fittings with solvent cemented pipe sections for setting for at least 20 days at ambient temperature and, after that, 4 days at 80 °C, unless the manufacturer of the adhesive has prescribed other setting times.

The free ends of the pipe sections shall be provided with end caps in such a way that the axial forces caused by the internal pressure are transferred to the solvent cement joint.

The hydrostatic test pressure, p_J , shall be calculated in relation to the class of service conditions and the design pressure using the following equation:

$$p_J = p_D \times \frac{\sigma_F}{\sigma_{DF}} \quad (1)$$

where

- p_J is the hydrostatic test pressure, in bars, to be applied to the solvent cement joint assembly during the test period;
- σ_F is the value of the hydrostatic stress, in megapascals, of the fitting material, corresponding to the test duration and test temperature conditions given in Table 3;
- σ_{DF} is the design stress, in megapascals, in the fitting material as determined for the appropriate class of service conditions from data produced in accordance with Table A.2 of EN ISO 15877-2:2003;
- p_D is the design pressure at 4 bar, 6 bar, 8 bar or 10 bar, as applicable.

Table 3 — Derivation of hydrostatic test pressure of solvent cement joints

	Application class 1	Application class 2
Maximum design temperature T_{max} °C	80	80
Design stress in the fitting material σ_{DF} MPa	3,17	3,08
Test temperature T_{Test} °C	80	80
Test duration t h	≥ 3000	≥ 3000
Hydrostatic stress of the fitting material σ_F MPa	6,14	6,14
Test pressure p_J in bars		
for a design pressure, p_D , of:		
4 bar	7,7	8,0
6 bar	11,6	12,0
8 bar	15,5	15,9
10 bar	19,4	19,9
Number of test pieces	3	3

If during the testing of solvent cement joints according to this clause leaks occur resulting from deformations induced by differential elongation, a test pressure may be determined from the stress and creep data (relative to a design period of 50 years) for the different materials used.

4.2.3 Mechanical joints

The mechanical joint assemblies shall be tested in form of test pieces comprising compression fittings with mounted pipe sections.

The compression fittings shall be connected to the corresponding pipe conforming to EN ISO 15877-2:2003 in such a way that the required hydrostatic test pressure, p_J , given in Table 4, can be applied.

The hydrostatic test pressure, p_J , shall be calculated in relation to the class of service conditions and the design pressure, using the following equation:

$$p_J = p_D \times \frac{\sigma_P}{\sigma_{DP}} \tag{2}$$

where

- p_J is the hydrostatic test pressure, in bars, to be applied to the mechanical joint assembly during the test period;
- σ_P is the value of the hydrostatic stress, in megapascals, of the pipe material, corresponding to the test duration and the test temperature conditions given in Table 4;
- σ_{DP} is the design stress, in megapascals, in the pipe material as determined for the appropriate class of service conditions from data produced in accordance with Table A.2 of EN ISO 15877-2:2003;
- p_D is the design pressure at 4 bar, 6 bar, 8 bar or 10 bar, as applicable.

Table 4 — Derivation of hydrostatic test pressure of mechanical joints

	Application class 1	Application class 2
Maximum design temperature T_{max} °C	80	80
Design stress in the pipe material σ_{DP} MPa	4,38	4,16
Test temperature T_{Test} °C	80	80
Test duration t h	≥ 3000	≥ 3000
Hydrostatic stress of the pipe material σ_P MPa	8,25	8,25
Test pressure p_J in bars for a design pressure, p_D , of		
4 bar	7,5	7,9
6 bar	11,3	11,9
8 bar	15,1	15,9
10 bar	18,8	19,8
Number of test pieces	3	3

If during the testing of mechanical joint assemblies according to this clause leaks occur resulting from deformations induced by differential elongation, a test pressure may be determined from the stress and creep data (relative to a design period of 50 years) for the different materials used.

4.3 Pull-out test

When tested in accordance with EN 712, using the parameters specified in Table 5, the joint assemblies shall withstand the pull-out force, F , without being separated.

The force, F , shall be calculated using the following equation:

$$F = \frac{\pi}{4} \times d_n^2 \times p_D \quad (3)$$

where

F is the force, in newtons;

d_n is the nominal outside diameter of the pipe, in millimetres;

p_D is the design pressure at 4 bar, 6 bar, 8 bar or 10 bar, as applicable, expressed in megapascals. In the case of the classification "All classes", the design pressure shall be 10 bar, in megapascals.

Table 5 — Test parameters for pull-out test

	All classes	Application class 1	Application class 2
Maximum design temperature T_{\max} °C	-	80	80
Test temperature T_{Test} °C	23	90	90
Test period t h	1	1	1
Pull-out force F N	$1,5 \times F$	F	F
Number of test pieces	3	3	3

4.4 Thermal cycling

When tested in accordance with EN 12293, using the parameters specified in Table 6, the pipes, fittings or joints, as applicable, shall withstand the test pressure without leakage.

The test shall be done with the configuration for rigid pipes.

Table 6 — Test parameters for thermal cycling

	Application class 1	Application class 2
Maximum design temperature T_{max} °C	80	80
Highest test temperature °C	90	90
Lowest test temperature C	20	20
Test pressure bar	p_D	p_D
Number of cycles ^a	5000	5000
Number of test pieces	One set of pipes and fittings in accordance with the configuration for rigid pipes given in EN 12293.	
^a Each cycle shall comprise 15 ⁺¹ ₀ min at the highest and 15 ⁺¹ ₀ min at the lowest test temperature (i.e. the duration of one cycle is 30 ⁺² ₀ min).		

The tensile stress, σ_t , to be used to calculate the pre-stress force as required in EN 12293 shall be 4,8 MPa.

NOTE The tensile stress, σ_t , is calculated using the following equation:

$$\sigma_t = \alpha_T \times \Delta T \times E \tag{4}$$

where

- σ_t is the tensile stress, in megapascals;
- α_T is the coefficient of thermal expansion, in reciprocal kelvins;
- ΔT is the temperature difference, in kelvins;
- E is the modulus of elasticity, in megapascals.

For the purposes of this standard, the following values apply:

- $\alpha_T = 0,7 \times 10^{-4} K^{-1}$;
- $\Delta T = 20 K$;
- $E = 3400 MPa$.

4.5 Pressure cycling

When tested in accordance with the test method specified in Table 7, using the indicated parameters, the pipes, fittings or joints, as applicable, shall withstand the test pressure without leakage.

Table 7 — Test parameters for pressure cycling

Characteristic	Requirements	Test parameters			Test method
Pressure cycling	No leakage	Test temperature	(23 ± 2)°C		EN 12295
		Number of test pieces	3		
		Frequency of test cycles	(30 ± 5) cycles per min		
		Number of cycles	10 000		
		Test pressure limits as follows:			
		Design pressure, p_D	Test pressure limits		
			Upper limit	Lower limit	
		4 bar	6,0 bar	0,5 bar	
		6 bar	9,0 bar	0,5 bar	
		8 bar	12,0 bar	0,5 bar	
		10 bar	15,0 bar	0,5 bar	