BRITISH STANDARD

BS EN ISO
15875-5:2003

Plastics piping systems for hot and cold water installations — Crosslinked polyethylene (PE-X) —

Part 5: Fitness for purpose of the system

The European Standard EN ISO 15875-5:2003 has the status of a British Standard

ICS 23.040.01; 91.140.60

BSI
British Standards

National foreword

This British Standard is the official English language version of EN ISO 15875-5:2003. It is identical with ISO 15875-5:2003.

The UK participation in its preparation was entrusted by Technical Committee PRI/88, Plastics piping systems, to Subcommittee PRI/88/2, Plastics piping systems for pressure applications, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

Additional information

The UK voted against the acceptance of this standard at the CEN Formal Vote, and PRI 88/2 will maintain BS 7291-1:2001[1)], BS 7291-2:2001[2)] and BS 7291-3:2001[3)] and strongly recommends the continued use of polybutylene (PB) and crosslinked polyethylene (PE-X) piping systems certified to BS 7291-2 or BS 7291-3, Class S, for the following reasons.

a) Attention is drawn to the statement in the Scope of BS EN ISO 15875-1 relating to the exclusion from it of piping systems having service conditions in excess of those quoted in BS EN ISO 15875-1, Table 1. Central heating systems in the UK fall into this category. BS 7291-1 states the service conditions for UK systems where the maximum system service temperature for sealed central heating systems, designated as Class S, is 105 ºC and the system malfunction temperature is 114 ºC. Both these temperatures are significantly in excess of those specified in BS EN ISO 15875-1, Table 1 and these UK systems are therefore not covered by this standard.

1) BS 7291-1:2001, *Thermoplastics pipes and associated fittings for hot and cold water for domestic purposes and heating installations in buildings — Part 1: General requirements.*
2) BS 7291-2:2001, *Thermoplastics pipes and associated fittings for hot and cold water for domestic purposes and heating installations in buildings — Part 2: Specification for polybutylene (PB) pipes and associated fittings.*
3) BS 7291-3:2001, *Thermoplastics pipes and associated fittings for hot and cold water for domestic purposes and heating installations in buildings — Part 3: Specification for cross-linked polyethylene (PE-X) pipes and associated fittings.*

Amendments issued since publication

Amd. No.	Date	Comments

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b) In addition to the above:

1) The normal maximum operating cold water supply pressure in the UK is 12.5 bar[4] which some categories of piping systems in the BS EN ISO 15875 series of standards do not meet.

2) The BS EN ISO 15875 series of standards does not specifically describe push fit joints, which are the predominant jointing method in the UK.

3) There is a disparity between the malfunction temperature quoted in BS EN ISO 15875-1, Table 1 (100 °C) and the malfunction temperatures applicable to boilers (110 °C) conforming to BS EN 297:1994[5], BS EN 483:2000[6] and BS EN 625:1996[7]. Consequently piping systems could be subjected to temperatures in service for which they have not been tested.

4) The unique and traditional practice in the UK is to use products certified to BS 7291-2 or BS 7291-3, Class S, for all applications, as defined in BS 7291-1. This is recognized in the national annex to BS EN 12828[8], which recommends the use of systems suitable for the maximum temperatures and pressures for their intended application specified in BS 7291-1.

Updated versions of BS 7291-1, BS 7291-2 and BS 7291-3 are being prepared, which maintain these traditional UK operating conditions, and measures are being taken to address this issue in appropriate harmonized European Standards.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the *BSI Catalogue* under the section entitled "International Standards Correspondence Index", or by using the "Search" facility of the *BSI Electronic Catalogue* or of British Standards Online.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN ISO title page, pages 2 to 10, an inside back cover and a back cover.

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[4] 1 bar = 100 kPa.
[5] BS EN 297:1994, *Gas-fired central heating boilers — Type B_{11} and B_{11BS} boilers fitted with atmospheric burners of nominal heat input not exceeding 70 kW.*
[6] BS EN 483:2000, *Gas-fired central heating boilers — Type C boilers of nominal heat input not exceeding 70 kW.*
[7] BS EN 625:1996, *Gas-fired central heating boilers — Specific requirements for the domestic hot water operation of combination boilers of nominal heat input not exceeding 70 kW.*
[8] BS EN 12828, *Heating systems in buildings — Design for water-based heating systems.*

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN ISO 15875-5

December 2003

ICS 23.040.01; 91.140.60

English version

Plastics piping systems for hot and cold water installations - Crosslinked polyethylene (PE-X) - Part 5: Fitness for purpose of the system (ISO 15875-5:2003)

Systèmes de canalisations en plastique pour les installations d'eau chaude et froide - Polyéthyène réticulé (PE-X) - Partie 5: Aptitude à l'emploi du système (ISO 15875-5:2003)

Kunststoff-Rohrleitungssysteme für die Warm- und Kaltwasserinstallation - Vernetztes Polyethylen (PE-X) - Teil 5: Gebrauchstauglichkeit des Systems (ISO 15875-5:2003)

This European Standard was approved by CEN on 17 March 2003.

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Management Centre has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN ISO 15875-5:2003 E

Contents

Foreword

This document (EN ISO 15875-5:2003) 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 1 This draft was submitted for CEN enquiry as prEN 12318-5:1996.

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 15875 consists of the following Parts [1)], under the general title *Plastics piping systems for hot and cold water installations — Crosslinked Polyethylene (PE-X)*

— *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* (intended to be published as CEN ISO/TS 15875-7).

This Part of EN ISO 15874:2003 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 15875:2003)*

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

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

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.

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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 5, specifies the requirements for a piping system and its components when made from crosslinked polyethylene (PE-X). 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 15875;

— 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 15875-7) gives guidance for the assessment of conformity.

This Part of EN ISO 15875 specifies the characteristics of fitness for purpose of the piping systems.

1 Scope

This Part of EN ISO 15875 specifies the characteristics of the fitness for purpose of crosslinked polyethylene (PE-X) 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 15875-1:2003).

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 1of 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 15875:2003 (see Foreword) it is applicable to PE-X 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 713, *Plastics piping systems — Mechanical joints between fittings and polyolefin pressure pipes — Test method for leaktightness under internal pressure of assemblies subjected to bending*

EN 921, *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 associated fittings for hot and cold water — Test method for resistance of joints to pressure cycling*

EN ISO 15875-1:2003, *Plastics piping system for hot and cold water installations — Crosslinked polyethylene (PE-X) — Part 1: General (ISO 15875-1:2003)*

EN ISO 15875-2:2003, *Plastics piping system for hot and cold water installations — Crosslinked polyethylene (PE-X) — Part 2: Pipes (ISO 15875-2:2003)*

3 Terms and definitions, symbols and abbreviated terms

For the purpose of this standard, the terms and definitions, symbols and abbreviated terms given in EN ISO 15875-1:2003 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 4.7, as applicable, the joints and the piping system shall have characteristics conforming to the requirements given in the applicable clauses.

For the tests described the fittings shall be connected to the pipe with which they are intended to be used.

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
	EF	M		
Internal pressure test	Y	Y	Shall conform to 4.2	EN 921
Bending test	N	Y	Shall conform to 4.3	EN 713
Pull-out test	N	Y	Shall conform to 4.4	EN 712
Thermal cycling test	Y	Y	Shall conform to 4.5	EN 12293
Pressure cycling test	N	Y	Shall conform to 4.6	EN 12295
Vacuum test	N	Y	Shall conform to 4.7	EN 12294

[a] EF : Electrofusion joint
M : Mechanical joint
Y : denotes test applicable
N : denotes test not applicable

4.2 Internal pressure test

When tested in accordance with EN 921 using the test parameters given in Table 2 for the relevant classes the joint assemblies shall not leak.

The test pressure, p_J, for a given time to failure and test temperature shall be determined by the following equation:

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

where

p_J is the hydrostatic test pressure, in bars, to be applied to the joint assembly during the test period;

σ_p are the hydrostatic stress values, in megapascals, of the pipe material corresponding to time to failure/test temperature points given in Table 2;

σ_{DP} are the design stress values, in megapascals, for the pipe material as determined for each class and listed in Table A.2 of EN ISO 15875-2:2003;

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

Table 2 — Derivation of test pressure p_J

	Application class J			
	Class 1	Class 2	Class 4	Class 5
Max. Design temperature, T_{max}, in °C	80	80	70	90
Design stress of pipe material, σ_{DP}, in MPa	3,85	3,54	4,00	3,24
Test temperature [a] , T_{test}, in °C	95 [a]	95 [a]	80	95
Test duration, t , in h	1000	1000	1000	1000
Hydrostatic stress of pipe material, σ_P, in MPa	4,4	4,4	5,2	4,4
Test pressure, p_J, in bars, for a design pressure, p_D, of: 4 bar	5,8 [b]	5,8 [b]	6,9 [b]	5,8 [b]
6 bar	6,9	7,5	7,8	8,2
8 bar	9,2	10,0	10,4	10,9
10 bar	11,5	12,5	13,0	13,6
Number of test pieces	3	3	3	3

[a] Generally the highest test temperature is taken to be (T_{max} + 10) °C with an upper limit of 95 °C. However to match existing test facilities the highest test temperature for classes 1 and 2 is also set at 95 °C. The hydrostatic stresses given correspond to the given test temperatures.

[b] The 20 °C, 10 bar, 50 years, cold water requirement, being higher, determines this value (see clause 4 of EN ISO 15875-1:2003).

In special circumstances, if joint tests according to this clause cause leaks 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 Bending test

When tested in accordance with EN 713 to the applicable pressure for the 20 °C, 1 h condition given in Table 3, using a bending radius equal to the minimum radius of bending for the pipes as recommended by the system supplier, the joint assembly shall not leak.

This test is only applicable to pipes of nominal diameter greater than or equal to 32 mm.

Table 3 — Test parameters for bending test

	Application class			
	Class 1	Class 2	Class 4	Class 5
Max. design temperature, T_{max}, in °C	80	80	70	90
Design stress of pipe material, σ_{DP}, in MPa	3,85	3,54	4,00	3,24
Test temperature, T_{test}, in °C	20	20	20	20
Test duration, t , in h	1	1	1	1
Hydrostatic stress of pipe material, σ_P, in MPa	12	12	12	12
Test pressure, p_J, in bars, for a design pressure, p_D, of: 4 bar	15,8 [a]	15,8 [a]	15,8 [a]	15,8 [a]
6 bar	18,7	20,4	18,0	22,3
8 bar	25,0	27,2	24,0	29,7
10 bar	31,2	33,9	30,0	37,1
Number of test pieces	3	3	3	3

[a] The 20 °C, 10 bar, 50 years, cold water requirement, being higher, determines this value (see clause 4 of EN ISO 15875-1:2003).

4.4 Pull-out test

When tested in accordance with EN 712 using the parameters given in Table 4, the joint assemblies shall withstand the pull-out force, without being separated.

The force, *F*, shall be calculated from the following equation:

$$F = \frac{\pi}{4} \times d_n^{\,2} \times p_D$$

where:

F is the force, expressed in newtons (N);

d_n is the nominal outside diameter of the pipe, expressed in millimetres (mm);

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

Table 4 — Test parameters for pull-out test

	All application classes	Application class			
		Class 1	Class 2	Class 4	Class 5
Max design temperature, T_{max}, in °C	—	80	80	70	90
Test temperature, in °C	23	90	90	80	95
Test period, in h	1	1	1	1	1
Pull-out force, in N	$1{,}5 \times F$	F	F	F	F
Number of test pieces	3	3	3	3	3

4.5 Thermal cycling test

When tested in accordance with EN 12293 using the parameter given in Table 5 the pipes, fittings or joints, as applicable, shall withstand the test without leakage.

The test for flexible pipes shall only be used when the manufacturer declares that the pipe can be bent to the configuration shown. The bending radius shall not be smaller than the minimum declared bending radius. In all other cases the test for rigid pipes shall apply.

Table 5 — Test parameters for thermal cycling

	Application class			
	Class 1	Class 2	Class 4	Class 5
Max design temperature, T_{max}, in °C	80	80	70	90
Highest test temperature, in °C	90	90	80	95
Lowest test temperature, in °C	20	20	20	20
Test pressure, in bars	p_D	p_D	p_D	p_D
Number of cycles [a]	5000	5000	5000	5000
Number of test pieces	One set of fittings in accordance with the configuration shown in EN 12293.			

[a] Each cycle shall comprise $15\,^{+1}_{0}$ min at the highest test temperature and $15\,^{+1}_{0}$ min at the lowest (i.e. the duration of one cycle is $30\,^{+2}_{0}$ min).

The tensile stress, σ_t, used to calculate the pre-stress force required in EN 12293 shall be 1,8 MPa.

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

$$\sigma_t = \alpha \times \Delta T \times E$$

where:

σ_t is the tensile stress, expressed in megapascals (MPa);

α is the coefficient of thermal expansion, expressed in reciprocal kelvins (1/K);

ΔT is the temperature difference, expressed in kelvins (K);

E is the modulus of elasticity, expressed in megapascals (MPa).

In this standard the following values apply:

$\alpha = 1{,}5 \times 10^{-4}$ K^{-1};

ΔT =20 K;

E = 600 MPa.

4.6 Pressure cycling test

When tested for leaktightness under pressure cycling in accordance with EN 12295 using the parameters given in Table 6, the pipes, fittings or joints, as applicable, shall not leak.

Table 6 — Test parameters for pressure cycling

Characteristics	Requirement	Test parameters			Test method
Pressure cycling	No leakage	Test temperature Number of test pieces Frequency of test cycles Number of cycles	23 °C 3 (30 ± 5) cycles per min 10 000		EN 12295
		Test pressure limits for a design pressure of:	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	

4.7 Leaktightness under vacuum

When tested the leaktightness under vacuum in accordance with EN 12294 using the parameters given in Table 7, the change in vacuum pressure shall not be greater than 0,05 bar.

Table 7 — Test parameters for leaktightness under vacuum

Characteristics	Requirements	Test parameters		Test method
Leaktightness under vacuum	Change in vacuum pressure ≤ 0,05 bar	Test temperature Test duration Test pressure Number of test pieces	23 °C 1 h –0,8 bar 3	EN 12294

Bibliography

[1] ENV 12108:2001, *Plastics piping systems — Guidance for the installation inside buildings of pressure piping systems for hot and cold water intended for human consumption*

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