BRITISH STANDARD

BS EN ISO
21003-5:2008

# Multilayer piping systems for hot and cold water installations inside buildings —

## Part 5: Fitness for purpose of the system

ICS 23.040.01; 91.140.60

# National foreword

This British Standard is the UK implementation of EN ISO 21003-5:2008.

The UK participation in its preparation was entrusted by Technical Committee PRI/88, Plastics piping systems, to Subcommittee PRI/88/2, Plastic piping for pressure applications.

The UK Committee would like to emphasise that compliance with this British Standard does not necessarily mean that products are fit for non-potable hot water pipes.

The requirements contained in this standard are not necessarily indicative of all the performance requirements, or the suitability of pipework for the service conditions likely to be encountered in a particular pipework application in the UK. In particular:

(i) The normal maximum operating cold water supply pressure in the UK is 12.5 bar, a pressure that some application classes of pipe in this standard do not meet.

(ii) This standard does not specifically describe push-fit joints that are the predominant jointing method in the UK but defines mechanical fittings in general.

(iii) There is a disparity between the malfunction temperature (100 °C) quoted in Table 1 of Part 1 of this standard and the malfunction temperatures applicable to boilers (110 °C) conforming to BS EN 297:1994, BS EN 483:2000 and BS EN 625:1996. Current UK practice can be found in BS 7291-1 which should be consulted when applying this standard. Pipe systems not conforming to BS 7291-1 could be subjected to temperatures in service for which they have not been tested.

(iv) The unique and traditional practice in the UK is to use products certified to BS 7291 Class S for all applications, as defined in BS 7291-1. This is recognized in the National Annex to BS EN 12828 that requires the use of systems suitable for the maximum temperatures and pressures for their intended application specified in BS 7291-1.

This standard does not replace BS 7291 Parts 1, 2 and 3 (Class "S") which contain detailed requirements for performance and contact with drinking water for pipes, fittings and joints manufactured from Polybutylene and PEX materials.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 29 August 2008



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|---|---|
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| | |

In addition to the above, pipes conforming to this standard may also be required to convey water intended for human consumption. The legislation setting out the requirements for water supply installations in the UK is as follows:

— the Water Supply (Water Quality) Regulations 2000, Regulation 31 (England);

— the Water Supply (Water Quality) Regulations 2001, Regulation 31 (Wales);

— the Water Supply (Water Quality) Regulations 2001, Regulation 27 (Scotland);

— the Water Supply (Water Quality) Regulations 2007, Regulation 30 (Northern Ireland) for installations for public water supplies;

— the Water Supply (Water Fittings) Regulations 1999 (England and Wales);

— the Water Byelaws 2000 (Scotland); and

— the current requirements for Northern Ireland for installations for consumers' premises.

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

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

**Compliance with a British Standard cannot confer immunity from legal obligations.**

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EUROPEAN STANDARD

NORME EUROPÉENNE

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# EN ISO 21003-5

July 2008

ICS 23.040.01; 91.140.60

English Version

# Multilayer piping systems for hot and cold water installations inside buildings - Part 5: Fitness for purpose of the system (ISO 21003-5:2008)

Systèmes de canalisations multicouches pour installations d'eau chaude et froide à l'intérieur des bâtiments - Partie 5: Aptitude à l'emploi du système (ISO 21003-5:2008)

Mehrschichtverbund-Rohrleitungssysteme für die Warm- und Kaltwasserinstallation innerhalb von Gebäuden - Teil 5: Gebrauchstauglichkeit des Systems (ISO 21003-5:2008)

This European Standard was approved by CEN on 15 June 2008.

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Ref. No. EN ISO 21003-5:2008: E

# Foreword

This document (EN ISO 21003-5:2008) has been prepared by Technical Committee ISO/TC 138 "Plastics pipes, fittings and valves for the transport of fluids" in collaboration with Technical Committee CEN/TC 155 “Plastics piping systems and ducting systems” the secretariat of which is held by NEN.

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 January 2009, and conflicting national standards shall be withdrawn at the latest by January 2009.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

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For relationship with EC Directive(s), see informative Annex ZA, B, C or D, which is an integral part of this document.

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**Endorsement notice**

The text of ISO 21003-5:2008 has been approved by CEN as a EN ISO 21003-5:2008 without any modification.

# Contents

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## Introduction

The system standard of which this is Part 5 specifies the requirements for a multilayer piping system.

The multilayer piping system is intended to be used for hot and cold water installations inside buildings.

In respect of potential adverse effects on the quality of water intended for human consumption caused by the products covered by ISO 21003:

— no information is provided as to whether the products 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 these products remain in force.

Requirements and test methods for components of the piping system are specified in ISO 21003-1, ISO 21003-2 and ISO 21003-3. ISO/TS 21003-7 gives guidance on the assessment of conformity.

This part of ISO 21003 specifies the characteristics for fitness for purpose.

For ancillary equipment, separate standards can apply.

Guidance on installation of plastics piping systems made from various materials intended to be used for hot and cold water installations is given in ENV 12108.

Other system standards which, at the date of publication of this part of ISO 21003, had been published for plastics piping systems used for the same application are listed in Annex A.

# Multilayer piping systems for hot and cold water installations inside buildings —

# Part 5:
# Fitness for purpose of the system

## 1 Scope

This part of ISO 21003 specifies the characteristics for the fitness for purpose of multilayer piping systems intended to be used for hot and cold water installations inside buildings for the conveyance of water — whether or not the water is intended for human consumption (domestic systems) or for heating systems — under specified design pressures and temperatures appropriate to the class of application (see Table 1 of ISO 21003:2008).

It also specifies the test parameters for the test methods referred to in this part of ISO 21003.

ISO 21003 is a reference product standard. It is applicable to multilayer pipes, fittings, their joints, and also to joints with components made of other plastics and non-plastics materials intended to be used for hot and cold water installations. This part of ISO 21003 is intended for use only in conjunction with all the other parts of ISO 21003.

ISO 21003 covers a range of service conditions (application classes) and design pressures. It is not applicable for values of design temperature, $T_D$, maximum design temperature, $T_{max}$, and malfunction temperature, $T_{mal}$, in excess of those in Table 1 of ISO 21003-1:2008.

NOTE 1 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.

The polymeric materials used for the stress-designed layers are the following: polybutylene (PB), polyethylene of raised temperature resistance (PE-RT), crosslinked polyethylene (PE-X), polypropylene (PP) and chlorinated poly(vinyl chloride) (PVC-C).

The PE-X used shall be fully crosslinked and shall comply with the requirements of the relevant reference product standard (ISO 15875).

NOTE 2 For the purposes of this ISO 21003, crosslinked polyethylene (PE-X) as well as adhesives are considered as thermoplastic materials.

## 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 1167-3, *Thermoplastics pipes, fittings and assemblies for the conveyance of fluids — Determination of the resistance to internal pressure — Part 3: Preparation of components*

ISO 1167-4, *Thermoplastics pipes, fittings and assemblies for the conveyance of fluids — Determination of the resistance to internal pressure — Part 4: Preparation of assemblies*

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

ISO 15874-5, *Plastics piping systems for hot and cold water installations — Polypropylene (PP) — Part 5: Fitness for purpose of the system*

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

ISO 15876-5, *Plastics piping systems for hot and cold water installations — Polybutylene (PB) — Part 5: Fitness for purpose of the system*

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

ISO 17456, *Plastics piping systems — Multilayer pipes — Determination of long-term strength*

ISO 21003-1:2008, *Multilayer piping systems for hot and cold water installations inside buildings — Part 1: General*

ISO 21003-2:2008, *Multilayer piping systems for hot and cold water installations inside buildings — Part 2: Pipes*

ISO 21003-3, *Multilayer piping systems for hot and cold water installations inside buildings — Part 3: Fittings*

ISO 22391-5, *Plastics piping systems for hot and cold water installations — Polyethylene of raised temperature resistance (PE-RT) — Part 5: Fitness for purpose of the system*

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 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 methods for resistance of joints to pressure cycling*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 21003-1 apply.

## 4 Symbols and abbreviated terms

For the purposes of this part of ISO 21003, the symbols and abbreviated terms given in ISO 21003-1 apply.

# 5 Fitness for purpose of the joints and the piping system

## 5.1 General

When tested in accordance with the applicable methods as specified in Table 1, using the parameters given in 5.2 to 5.7, the joints and the piping system shall have characteristics conforming to the requirements given in the applicable subclauses.

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 part of ISO 21003.

**Table 1 — Joint tests**

| Test | Jointing system [a] | | | Test parameters | Test method |
|---|---|---|---|---|---|
| | Solvent-cemented | Fusion socket Electrofusion | Mechanical | | |
| Internal pressure test | Y | Y | Y | Shall conform to 5.2 | Relevant parts of ISO 1167 |
| Bending test | Y | Y | Y | Shall conform to 5.3 | EN 713 |
| Pull-out test | Y | Y | Y | Shall conform to 5.4 | EN 712 |
| Thermal cycling test | Y | Y | Y | Shall conform to 5.5 | EN 12293 |
| Pressure cycling test | Y | Y | Y | Shall conform to 5.6 | EN 12295 |
| Vacuum test | Y | Y | Y | Shall conform to 5.7 | EN 12294 |

[a] Y denotes test applicable.

## 5.2 Internal pressure test

When tested in accordance with the relevant parts of ISO 1167, using the test parameters given in Table 2 for the relevant classes, the joint assembly shall not leak.

The test pressure shall be calculated using the following equation:

$$p_F = p_D \times \frac{p_C}{p_{CD}} \quad (1)$$

where

$p_F$ is the hydrostatic test pressure, in bars, to be applied to the assembly during the test period;

$p_C$ is the value of the pressure, in bars, of the pipe construction corresponding to the time to failure/test temperature specified in ISO 21003-2;

$p_{CD}$ is the design pressure value, in bars, of the pipe construction, calculated in accordance with Annex E of ISO 21003-2:2008;

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

**Table 2 — Derivation of test pressure, $p_F$**

| | Application class | | | |
|---|---|---|---|---|
| | **Class 1** | **Class 2** | **Class 4** | **Class 5** |
| Maximum design temperature, $T_{max}$ (°C) | 80 | 80 | 70 | 90 |
| Design pressure of the pipe construction, $p_{CD}$ (MPa) | b | b | b | b |
| Test temperature, $T_{test}$ (°C) [a] | 95 | 95 | 80 | 95 |
| Test duration, $t$ (h) | 1 000 | 1 000 | 1 000 | 1 000 |
| Hydrostatic pressure of the pipe construction, $p_C$ (MPa) | b | b | b | b |
| Test pressure, $p_F$ (bar) | | | | |
| for a design pressure, $p_D$, of: 4 bar | b | b | b | b |
| 6 bar | b | b | b | b |
| 8 bar | b | b | b | b |
| 10 bar | b | b | b | b |
| Number of test pieces | 3 | 3 | 3 | 3 |

NOTE 1 bar = 0,1 MPa.

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

[b] The values of $p_{CD}$, $p_C$ and $p_F$ result from the long-term strength data for the individual construction.

If joint tests carried out in accordance with this subclause cause leaks resulting from deformation 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.

## 5.3 Bending test

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

The test pressure shall be calculated using the following equation:

$$p_F = p_D \times \frac{p_C}{p_{CD}} \quad (2)$$

where

$p_F$ is the hydrostatic test pressure, in bars, to be applied to the assembly during the test period;

$p_C$ is the value of the pressure, in bars, of the pipe construction corresponding to the time to failure/test temperature specified in ISO 21003-2;

$p_{CD}$ is the design pressure value, in bars, of the pipe construction, calculated in accordance with Annex E of ISO 21003-2:2008;

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

**Table 3 — Test parameters for bending test**

| | Application class | | | |
|---|---|---|---|---|
| | Class 1 | Class 2 | Class 4 | Class 5 |
| Maximum design temperature, $T_{max}$ (°C) | 80 | 80 | 70 | 90 |
| Design pressure of the pipe construction, $p_{CD}$ (MPa) | a | a | a | a |
| Test temperature, $T_{test}$ (°C) | 20 | 20 | 20 | 20 |
| Test duration, $t$ (h) | 1 | 1 | 1 | 1 |
| Hydrostatic pressure of the pipe construction, $p_C$ (MPa) | a | a | a | a |
| Test pressure, $p_F$ (bar) | | | | |
| for a design pressure, $p_D$, of: 4 bar | a | a | a | a |
| 6 bar | a | a | a | a |
| 8 bar | a | a | a | a |
| 10 bar | a | a | a | a |
| Number of test pieces | 3 | 3 | 3 | 3 |
| NOTE 1 bar = 0,1 MPa. | | | | |
| a The values of $p_{CD}$, $p_C$ and $p_F$ result from the long-term strength data for the individual construction. | | | | |

## 5.4 Pull-out test

When tested in accordance with EN 712, using the test 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:

$$F = \frac{\pi}{4} \times {d_n}^2 \times p_D \tag{3}$$

where

$F$ is the force, in N;

$d_n$ is the nominal outside diameter of the pipe, in mm;

$p_D$ is the design pressure of 4 bar, 6 bar, 8 bar or 10 bar, as applicable, expressed in MPa. In the case of the classification “all classes”, the design pressure shall be 10 bar, expressed in MPa.

**Table 4 — Test parameters for pull-out force**

| | All application classes | Application class | | | |
|---|---|---|---|---|---|
| | | Class 1 | Class 2 | Class 4 | Class 5 |
| Maximum design temperature, $T_{max}$ (°C) | — | 80 | 80 | 70 | 90 |
| Test temperature, $T_{test}$ (°C) | 23 | 95 | 95 | 80 | 95 |
| Test duration, $t$ (h) | 1 | 1 | 1 | 1 | 1 |
| Pull-out force, $F$ (N) | 1,5 × $F$ | $F$ | $F$ | $F$ | $F$ |
| Number of test pieces | 3 | 3 | 3 | 3 | 3 |
| The pull-out test shall be performed at 23 °C and at $T_{max}$ for the relevant application class. | | | | | |

## 5.5 Thermal cycling test

When tested in accordance with EN 12293, using the test parameters 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 bend radius shall not be smaller than the minimum declared bend radius. In all other cases, the test for rigid pipes shall be used.

For M-pipe systems, to pre-stress branch A the reference product standard and the dimensions of the inner layer shall be used.

**Table 5 — Test parameters for thermal cycling**

| | Application class | | | |
|---|---|---|---|---|
| | **Class 1** | **Class 2** | **Class 4** | **Class 5** |
| Maximum design temperature, $T_{max}$ (°C) | 80 | 80 | 70 | 90 |
| Highest test temperature (°C) | 90 | 90 | 80 | 95 |
| Lowest test temperature (°C) | 20 | 20 | 20 | 20 |
| Test pressure (bar) [a] | $p_D$ | $p_D$ | $p_D$ | $p_D$ |
| Number of cycles for $D \leqslant 63$ mm [b] | 5 000 | 5 000 | 5 000 | 5 000 |
| Number of cycles for $D > 63$ mm [c] | 2 500 | 2 500 | 2 500 | 2 500 |
| Number of test pieces | One set of fittings with the configuration shown in EN 12293 | | | |
| NOTE 1 bar = 0,1 MPa. | | | | |

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

[b] Each cycle shall comprise 15 min at the highest test temperature and 15 min at the lowest (i.e. the duration of one cycle is 30 min).

[c] Each cycle shall comprise 30 min at the highest test temperature and 30 min at the lowest (i.e. the duration of one cycle is 60 min).

## 5.6 Pressure cycling test

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

**Table 6 — Test parameters for pressure cycling**

| | | |
|---|---|---|
| Test temperature | 23 °C | |
| Number of test pieces | 3 | |
| Frequency of pressure cycling | (30 ± 5) cycles per minute | |
| Number of cycles | 10 000 | |
| 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 |
| NOTE 1 bar = 0,1 MPa. | | |

## 5.7 Leaktightness under vacuum

When tested for leaktightness under vacuum in accordance with EN 12294, using the test 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**

| | |
|---|---|
| Test temperature | 23 °C |
| Number of test pieces | 3 |
| Test pressure | − 0,8 bar |
| Test duration | 1 h |
| NOTE 1 bar = 0,1 MPa. | |

# Annex A
(normative)

# List of reference product standards

**Table A.1 — List of reference product standards**

| Material | Reference product standard |
|---|---|
| PB | ISO 15876-1, ISO 15876-2, ISO 15876-3, ISO 15876-5 |
| PE-RT | ISO 22391-1, ISO 22391-2, ISO 22391-3, ISO 22391-5 |
| PE-X | ISO 15875-1, ISO 15875-2, ISO 15875-3, ISO 15875-5 |
| PP | ISO 15874-1, ISO 15874-2, ISO 15874-3, ISO 15874-5 |
| PVC-C | ISO 15877-1, ISO 15877-2, ISO 15877-3, ISO 15877-5 |

# Bibliography

[1] ISO/TS 21003-7, *Multilayer piping systems for hot and cold water installations inside buildings — Part 7: Guidance for the assessment of conformity*

[2] ENV 12108, *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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