INTERNATIONAL STANDARD

ISO 21003-1

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

Part 1: General

Systèmes de canalisations multicouches pour installations d'eau chaude et froide à l'intérieur des bâtiments —

Partie 1: Généralités

Reference number
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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 21003-1 was prepared by 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*.

ISO 21003 consists of the following parts, under the general title *Multilayer piping systems for hot and cold water installations inside buildings*:

— *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]

NOTE ISO 21003 does not include a Part 4: *Ancillary equipment*, or a Part 6: *Guidance for installation*.

Introduction

The system standard of which this is Part 1 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 potentially 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 21003-2 and ISO 21003-3. Characteristics relating to fitness for purpose (mainly for joints) are covered in ISO 21003-5. ISO/TS 21003-7 gives guidance on the assessment of conformity.

This part of ISO 21003 specifies the general aspects of multilayer piping systems.

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 1: General

1 Scope

This part of ISO 21003 specifies the general aspects 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 heating systems — under specified design pressures and temperatures appropriate to the class of application (see Table 1).

ISO 21003 is a reference product standard (see 3.4.3). 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 applies only to multilayer pipes with their inner layer made of plastics.

It 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.

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 ISO 21003, crosslinked polyethylene (PE-X) as well as adhesives are considered as thermoplastic materials.

Solid-wall pipes with thin outer layers (applied as protection layers or barrier layers, for instance) are not covered by ISO 21003 but are specified in the Amendments to ISO 15874-2, ISO 15875-2 and ISO 15876-2. The total thickness of such outer layers, including the thickness of the adhesives used, shall be $\leqslant$ 0,4 mm.

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 3, *Preferred numbers — Series of preferred numbers*

ISO 472, *Plastics — Vocabulary*

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

ISO 15874-1, *Plastics piping systems for hot and cold water installations — Polypropylene (PP) — Part 1: General*

ISO 15874-2, *Plastics piping systems for hot and cold water installations — Polypropylene (PP) — Part 2: Pipes*

ISO 15874-3, *Plastics piping systems for hot and cold water installations — Polypropylene (PP) — Part 3: Fittings*

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

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

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

ISO 15875-3, *Plastics piping systems for hot and cold water installations — Crosslinked polyethylene (PE-X) — Part 3: Fittings*

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 15876-1, *Plastics piping systems for hot and cold water installations — Polybutylene (PB) — Part 1: General*

ISO 15876-2, *Plastics piping systems for hot and cold water installations — Polybutylene (PB) — Part 2: Pipes*

ISO 15876-3, *Plastics piping systems for hot and cold water installations — Polybutylene (PB) — Part 3: Fittings*

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

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

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

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

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 21003-2, *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 21003-5, *Multilayer piping systems for hot and cold water installations inside buildings — Part 5: Fitness for purpose of the system*

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

ISO 22391-1, *Plastics piping systems for hot and cold water installations — Polyethylene of raised temperature resistance (PE-RT) — Part 1: General*

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

ISO 22391-3, *Plastics piping systems for hot and cold water installations — Polyethylene of raised temperature resistance (PE-RT) — 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*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 3 and ISO 472, and the following, apply.

3.1 Definitions related to construction

3.1.1
multilayer pipe
pipe comprised of different stress-designed layers

3.1.2
multilayer M-pipe
pipe comprised of polymeric stress-designed layers and one or more metallic stress-designed layers (e.g. PE-Xb/Al/PE-Xb or PE-RT/Al/PE-Xb)

NOTE The wall thickness of the pipe consists of at least 60 % of polymeric material.

3.1.3
multilayer P-pipe
pipe comprised of more than one polymeric stress-designed layer (e.g. PVC-C/PE-Xb or PE-Xb/EVOH/PE-Xb)

NOTE Pipes consisting of one polymeric stress-designed layer and an outer polymeric layer which is not stress-designed are covered by the appropriate reference product standard (see Annex A).

3.1.4
inner layer
layer in contact with the fluid which is conveyed

3.1.5
outer layer
layer exposed to the outer environment

3.1.6
embedded layer
layer between the outer and inner layers

3.1.7
application layer
layer which provides a specific property linked to the conditions of use of the pipe

3.2 Definitions related to geometry

3.2.1
nominal diameter
d_n
specified outside diameter, in millimetres, assigned to a nominal size (DN/OD or DN/ID)

3.2.2
outside diameter
d_e
outside diameter measured through the pipe cross-section at any point on the pipe, or the spigot end of a fitting, rounded up to the nearest 0,1 mm

3.2.3
inside diameter
d_i
inside diameter measured through the pipe cross-section at any point on the pipe, rounded up to the nearest 0,1 mm

3.2.4
wall thickness
e
measured wall thickness at any point around the circumference of a component, rounded up to the nearest 0,1 mm

3.2.5
minimum wall thickness
e_{min}
minimum value of the measured wall thickness at any point around the circumference of a component, rounded up to the nearest 0,1 mm

3.2.6
metal layer standard dimension ratio
SDR_m
outside diameter of the metal layer of a pipe divided by the wall thickness of the metal layer

3.2.7
polymeric layer standard dimension ratio
SDR_p
outside diameter of the polymeric layer of a pipe divided by the wall thickness of the polymeric layer

3.3 Definitions related to service conditions

3.3.1
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, p_{LPL}

3.4 Definitions related to materials

3.4.1
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

3.4.2
own reprocessable material
single 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 method such as moulding or extrusion and for which the complete formulation is known

3.4.3
reference product standard
International Standard or draft International Standard, prepared by ISO/TC 138/SC 2, applicable to non-multilayer pipes, to which this International Standard can refer for clauses related to the materials, components (e.g. fittings) and fitness for purpose of the system

3.4.4
stress-designed polymeric layer
polymeric layer which is designed to be stress-bearing

NOTE The material used in such layers is restricted to those in the reference product standards (see Annex A).

3.5 Definitions related to material characteristics

3.5.1
application class
class related to a typical field of application and a design period of 50 years

NOTE The classification is taken from ISO 10508.

3.5.2
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.

3.5.3
long-term pressure strength
lower confidence limit of the predicted hydrostatic pressure
p_{LPL}
quantity, with the dimensions of pressure, which represents the 97,5 % (one-sided) lower confidence limit of the predicted hydrostatic pressure at a temperature T and time t

3.6 Definitions related to temperature

3.6.1
design temperature
T_D
temperature, or a combination of temperatures, of the conveyed water related to the circumstances for which the system has been designed

3.6.2
maximum design temperature
T_{max}
highest design temperature, T_D, occurring for short periods only

3.6.3
malfunction temperature
T_{mal}
highest temperature that can be reached when the control limits are exceeded

NOTE This may occur during a total of up to 100 h over a period of 50 years.

3.6.4
cold water
water at a temperature of up to approximately 25 °C

NOTE For design purposes, 20 °C is used.

4 Symbols and abbreviated terms

4.1 Symbols

d_i inside diameter

d_e outside diameter

d_n nominal diameter

e_n nominal wall thickness

e_{min} minimum wall thickness

F_{pull} adhesive strength

p_C calculated value of the pressure (in bars) of the pipe construction corresponding to time to failure/test temperature in accordance with ISO 21003-2

p_{CD} calculated value of the design pressure (in bars) of the pipe construction, determined for the appropriate service condition class from data obtained in accordance with ISO 21003-2

p_F hydrostatic test pressure (in bars) to be applied to the assembly during the test period

p_D design pressure (in bars)

p_{LPL} long-term pressure strength (lower confidence limit of the predicted hydrostatic pressure)

T temperature

T_D design temperature

T_{mal} malfunction temperature

T_{max} maximum design temperature

t time

σ hydrostatic stress

σ_F hydrostatic stress (in megapascals) for the fitting body material, determined for the appropriate service condition class from data obtained in accordance with the reference product standard or ISO 9080

σ_{DF} design stress (in megapascals) for the fitting body material, determined for the appropriate service condition class from data obtained in accordance with the reference product standard or ISO 9080

4.2 Abbreviated terms

For the purposes of this document, the abbreviated terms given in ISO 1043-1 apply.

5 Classification of service conditions

The performance requirements for multilayer piping systems conforming to ISO 21003 are specified for four different application classes as shown in Table 1.

For any application, the selection of the applicable class conforming to Table 1 shall be agreed by the parties concerned. Each application class shall be combined with a design pressure, p_D, of 4 bar, 6 bar, 8 bar or 10 bar, as applicable (1 bar = 0,1 MPa).

Table 1 — Classification of service conditions

Application class	Design temperature T_D °C	Time [b] 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)
4 [b]	20 plus cumulative 40 plus cumulative 60	2,5 20 25	70	2,5	100	100	Underfloor heating and low-temperature radiators
5 [b]	20 plus cumulative 60 plus cumulative 80	14 25 10	90	1	100	100	High-temperature radiators

[a] A country may select either class 1 or class 2 in conformity with its national regulations.

[b] Where more than one design temperature for time and associated temperature appears for any class, they should be aggregated. “Plus cumulative” in the table implies a temperature profile of the mentioned temperature over time (e.g. the design temperature profile for 50 years for class 5 is 20 °C for 14 years followed by 60 °C for 25 years, 80 °C for 10 years, 90 °C for 1 year and 100 °C for 100 h).

NOTE For values of T_D, T_{max} and T_{mal} in excess of those in the table, this International Standard does not apply.

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

All heating installations shall only use water or treated water as the transfer fluid.

6 Material

6.1 General

The material characteristics of stress-designed materials shall be evaluated in accordance with the reference product standard.

6.2 Influence on water intended for human consumption

All materials of the multilayer piping system, when in contact with water which is intended for human consumption, shall not affect the quality of the drinking water and shall be in compliance with national regulations.

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 497, *Guide to the choice of series of preferred numbers and of series containing more rounded values of preferred numbers*

[2] ISO 10508, *Plastics piping systems for hot and cold water installations — Guidance for classification and design*

[3] EN 806-1, *Specifications for installations inside buildings conveying water for human consumption — Part 1: General*

[4] 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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