
**Plastics piping systems — Multilayer
pipes and their joints, based on
thermoplastics, for water supply**

*Systèmes de canalisations en plastique — Tubes multicouches et
leurs assemblages, à base de thermoplastiques, pour l'alimentation
en eau*

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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 21004 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*.

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Introduction

An overview of standards to be applied for multilayer pipes and their joints, based on thermoplastics, for water supply, is given hereafter.

Parts	Applicable standards
Materials	Relevant reference product standards (see 4.2 and Clause 5 of this International Standard)
Pipes	This International Standard
Fittings	Relevant reference product standards (see Clause 9 of this International Standard)
Valves	Relevant reference product standards (see Clause 9 of this International Standard)
Fitness for purpose	This International Standard (see Clause 10)

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Plastics piping systems — Multilayer pipes and their joints, based on thermoplastics, for water supply

1 Scope

This International Standard specifies the general requirements and the performance requirements for multilayer pipes based on thermoplastics intended to be used for water supply outside buildings, for buried water mains and services and for water supplies above ground.

It gives guidance for the design of piping systems consisting of multilayer pipes based on thermoplastics or, for which at least 60 % of the wall thickness is polymeric material, and the inner layer in contact with water is made of polymeric material.

The polymeric layers used for the stress-bearing layers are selected from polybutylene (PB), polyethylene (PE), crosslinked polyethylene (PE-X), polypropylene (PP), chlorinated poly(vinyl chloride) (PVC-C) and unplasticized poly(vinyl chloride) (PVC-U).

NOTE 1 For the purpose of this document, crosslinked polyethylene (PE-X) as well as adhesives are to be considered as thermoplastic materials, and polyethylene of raised temperature resistance (PE-RT) is to be considered as polyethylene (PE).

This document is applicable to piping systems used for the conveyance under pressure of cold water (up to approximately 20 °C) for drinking. It is also applicable to piping systems for the conveyance of water (up to and including 40 °C) for general purposes.

It applies where special functional requirements are needed.

NOTE 2 As an example, the different pipe layers can provide information on colour, barrier and mechanical properties, according to the intended application.

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 161-1, *Thermoplastics pipes for the conveyance of fluids — Nominal outside diameters and nominal pressures — Part 1: Metric series*

ISO 161-2, *Thermoplastics pipes for the conveyance of fluids — Nominal outside diameters and nominal pressures — Part 2: Inch-based series*

ISO 472, *Plastics — Vocabulary*

ISO 527-1, *Plastics — Determination of tensile properties — Part 1: General principles*

ISO 527-1:1993/Cor.1:1994, *Plastics — Determination of tensile properties — Part 1: General principles*

ISO 527-2, *Plastics — Determination of tensile properties — Part 2: Test conditions for moulding and extrusion plastics*

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

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 3126, *Plastics piping systems — Plastics components — Determination of dimensions*

ISO 3213, *Polypropylene (PP) pipes — Effect of time and temperature on expected strength*

ISO 3459, *Polyethylene (PE) pressure pipes — Joints assembled with mechanical fittings — Internal under-pressure test method and requirement*

ISO 3501, *Assembled joints between fittings and polyethylene (PE) pressure pipes — Test of resistance to pull out*

ISO 3503, *Assembled joints between fittings and polyethylene (PE) pressure pipes — Test of leakproofness under internal pressure when subjected to bending*

ISO 4422-1, *Pipes and fittings made of unplasticized poly(vinyl chloride) (PVC-U) for water supply — Specifications — Part 1: General*

ISO 4422-2, *Pipes and fittings made of unplasticized poly(vinyl chloride) (PVC-U) for water supply — Specifications — Part 2: Pipes (with or without integral sockets)*

ISO 4422-3, *Pipes and fittings made of unplasticized poly(vinyl chloride) (PVC-U) for water supply — Specifications — Part 3: Fittings and joints*

ISO 4422-4, *Pipes and fittings made of unplasticized poly(vinyl chloride) (PVC-U) for water supply — Specifications — Part 4: Valves and ancillary equipment*

ISO 4422-5, *Pipes and fittings made of unplasticized poly(vinyl chloride) (PVC-U) for water supply — Specifications — Part 5: Fitness for purpose of the system*

ISO 4427-1¹⁾, *Plastics piping systems — Polyethylene (PE) pipes and fittings for water supply — Part 1: General*

ISO 4427-2¹⁾, *Plastics piping systems — Polyethylene (PE) pipes and fittings for water supply — Part 2: Pipes*

ISO 4427-3¹⁾, *Plastics piping systems — Polyethylene (PE) pipes and fittings for water supply — Part 3: Fittings*

ISO 4427-5¹⁾, *Plastics piping systems — Polyethylene (PE) pipes and fittings for water supply — Part 5: Fitness for purpose of the system*

ISO 6259-1, *Thermoplastics pipes — Determination of tensile properties — Part 1: General test method*

ISO 6259-2, *Thermoplastics pipes — Determination of tensile properties — Part 2: Pipes made of unplasticized poly(vinyl chloride) (PVC-U), chlorinated poly(vinyl chloride) (PVC-C) and high-impact poly(vinyl chloride) (PVC-HI)*

1) To be published.

- ISO 6259-3, *Thermoplastics pipes — Determination of tensile properties — Part 3: Polyolefin pipes*
- ISO 9080, *Plastics piping and ducting systems — Determination of long-term hydrostatic strength of thermoplastics material in pipe form by extrapolation*
- ISO 9969, *Thermoplastics pipes — Determination of ring stiffness*
- ISO 10146, *Crosslinked polyethylene (PE-X) pipes — Effect of time and temperature on the expected strength*
- ISO 11413:1996, *Plastics pipes and fittings — Preparation of test piece assemblies between a polyethylene (PE) pipe and an electrofusion fitting*
- ISO 11414:1996, *Plastics pipes and fittings — Preparation of polyethylene (PE) pipe/pipe or pipe/fitting test piece assemblies by butt fusion*
- ISO 12230, *Polybutene (PB) pipes — Effect of time and temperature on the expected strength*
- ISO 13761, *Plastics pipes and fittings — Pressure reduction factors for polyethylene pipeline systems for use at temperatures above 20 degrees C*
- ISO 13783, *Plastics piping systems — Unplasticized poly(vinyl chloride) (PVC-U) end-load-bearing double-socket joints — Test method for leaktightness and strength while subjected to bending and internal pressure*
- ISO 13844, *Plastics piping systems — Elastomeric-sealing-ring-type socket joints of unplasticized poly(vinyl chloride) (PVC-U) for use with PVC-U pipes — Test method for leaktightness under negative pressure*
- ISO 13845, *Plastics piping systems — Elastomeric-sealing-ring-type socket joints for use with unplasticized poly(vinyl chloride) (PVC-U) pipes — Test method for leaktightness under internal pressure and with angular deflection*
- ISO 13846, *Plastics piping systems — End-load-bearing and non-end-load-bearing assemblies and joints for thermoplastics pressure piping — Test method for long-term leaktightness under internal water pressure*
- ISO 13953, *Polyethylene (PE) pipes and fittings — Determination of the tensile strength and failure mode of test pieces from a butt-fused joint*
- ISO 13954, *Plastics pipes and fittings — Peel decohesion test for polyethylene (PE) electrofusion assemblies of nominal outside diameter greater than or equal to 90 mm*
- ISO 13955, *Plastics pipes and fittings — Crushing decohesion test for polyethylene (PE) electrofusion assemblies*
- ISO 13968, *Plastics piping and ducting systems — Thermoplastics pipes — Determination of ring flexibility*
- 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*

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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 16871, *Plastics piping and ducting systems — Plastics pipes and fittings — Method for exposure to direct (natural) weathering*

ISO 17454, *Plastics piping systems — Multilayer pipes — Test method for the adhesion of the different layers using a pulling rig*

ISO 17456:—¹⁾, *Plastics piping systems — Multilayer pipes — Determination of long-term strength*

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

ISO 22391-2 ¹⁾, *Plastics piping systems for hot and cold water installations — Polyethylene of raised temperature resistance (PE-RT) — Part 2: Pipes*

ISO 22391-3 ¹⁾, *Plastics piping systems for hot and cold water installations — Polyethylene of raised temperature resistance (PE-RT) — Part 3: Fittings*

ISO 22391-5 ¹⁾, *Plastics piping systems for hot and cold water installations — Polyethylene of raised temperature resistance (PE-RT) — Part 5: Fitness for purpose of the system*

ISO 24033 ¹⁾, *Pipes made of raised-temperature-resistance polyethylene (PE-RT) — Effect of time and temperature on the expected strength*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 472 and ISO 1043-1 and the following apply.

3.1 Terms and definitions related to construction

3.1.1

multilayer pipe

pipe comprising more than one layer in which at least 60 % of the wall thickness is a polymeric material

3.1.2

multilayer M pipe

multilayer pipe comprising layers of polymers and one or more metallic layers

NOTE The wall thickness of the pipe consists of at least 60 % of polymer layers.

3.1.3

multilayer P pipe

multilayer pipe comprising two or more polymeric layers

3.1.4

inner layer

layer in contact with the conveyed fluid

3.1.5

outer layer

layer exposed to the outer environment

3.1.6

embedded layer

layer between the outer and inner layer

3.1.7

application layer

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

3.2 Terms and definitions related to construction groups

3.2.1

reference product standard

International Standard or Draft International Standard prepared by Technical Committee ISO/TC 138, Subcommittee SC 2, applicable for non-multilayer pipes, to which this document can refer for clauses related to the materials, components (e.g. fittings), and fitness for purpose of the system

3.2.2

construction group A

group comprising multilayer pipes in which all the layers considered to be stress-bearing are made of polymeric materials selected from the list of reference product standards

3.2.3

construction group B

group comprising multilayer pipes in which all the layers considered to be stress-bearing are made of polymeric materials selected from the list of reference product standards and including a stress-bearing metallic layer

3.2.4

similar construction type

(multilayer M pipes) construction type which is the same for more than one pipe diameter under the following conditions:

- the same process technology is used (e.g. welding process for the aluminium layers, type of welding, etc.);
- materials having the same characteristics are used for each stress-bearing layer; i.e. material type and specifications;
- the layers are assembled in the same sequence for different diameters;
- for all diameters, the SDR_m of the metal layer is the same $\pm 10\%$.

NOTE If for a certain diameter range, the same metal layer thickness is used, the SDR_m value of the metal layer of all smaller diameters of this diameter range can be adapted up to the SDR_m of the metal layer for the biggest diameter of the diameter range (e.g. a diameter range from 12 mm up to 20 mm with a 0,2 mm metal layer).

3.3 Terms and definitions related to geometry

3.3.1

nominal size

DN

numerical designation of the size of a component, other than a component designated by a thread size, which is a convenient round number, approximately equal to the manufacturing dimension

NOTE The nominal size is expressed in millimetres.

3.3.2

nominal size

DN/OD

nominal size, related to the outside diameter

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3.3.3

nominal outside diameter

d_n

specified outside diameter assigned to a nominal size DN/OD

NOTE The nominal outside diameter is expressed in millimetres.

3.3.4

outside diameter at any point

d_e

outside diameter measured through the cross-section at any point on a pipe, or the spigot end of a fitting

NOTE The outside diameter at any point is rounded up to the nearest 0,1 mm.

3.3.5

mean outside diameter

d_{em}

measured length of the outer circumference of a pipe, or the spigot end of a fitting, divided by π ($\approx 3,142$)

NOTE The mean outside diameter is rounded up to the nearest 0,1 mm.

3.3.6

out-of-roundness

difference between the measured maximum outside diameter and the measured minimum outside diameter in the same cross-sectional plane of a pipe, or the spigot end of a fitting