INTERNATIONAL STANDARD

ISO 17484-1

Second edition
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Plastics piping systems — Multilayer pipe systems for indoor gas installations with a maximum operating pressure up to and including 5 bar (500 kPa) —

Part 1: Specifications for systems

Systèmes de canalisations en matières plastiques — Tubes multicouches et leurs assemblages pour une pression maximale de service inférieure ou égale à 5 bar (500 kPa) destinés à l'alimentation en gaz à l'intérieur des bâtiments —

Partie 1: Spécifications pour les systèmes

Reference number
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Contents

Page

Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2. www.iso.org/directives

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Subcommittee SC 4, *Plastics pipes and fittings for the supply of gaseous fuels*.

This second edition cancels and replaces the first edition (ISO 17484-1:2006), which has been technically revised. It also incorporates ISO 17484-1:2006/Cor.1:2008.

ISO 17484 consists of the following parts, under the general title *Plastics piping systems — Multilayer pipe systems for indoor gas installations with a maximum operating pressure up to and including 5 bar (500 kPa)*:

— *Part 1: Specifications for systems*

— *Part 2: Code of practice*

Introduction

This part of ISO 17484 was developed in response to worldwide demand for minimum specification for multi-layered pipes for indoor gas applications.

Multi-layered pipes are delivered generally as a complete system. Pipes, fittings, tools, etc., are not compatible with components of another brand, generally. An advantage is that all components are perfectly geared to one another, but for repair, the lack of compatibility might be problematic in the future.

Safety of systems

Depending on the construction of the house, pipework layout and other local circumstances, it is possible that additional safety devices are required to fulfil the demands of fire safety. Safety aspects of the system are described in ISO 17484-2 and national regulations shall be taken into account.

Code of practice

The second part of ISO 17484 is the code of practice for installation.

Recommendations on design, construction and protection in case of fire of the gas indoor installation are given in EN 1775.

References to ISO/TC 138/SC5 work

Test methods referred to in this part of ISO 17484 have been developed by SC 5 as far as possible. However, not all test methods needed are in the working programme of SC 5. These test methods are placed in Annexes B to K of this part of ISO 17484. It is planned that these tests will be developed as International Standards in the future.

For multilayer pipe construction, consisting of a layer of a reference standard material, an adhesive and a non-stress-designed layer, procedure I and the relevant product standards are followed for all aspects, excluding the aspects of delamination and, if applicable, oxygen permeation.

For example, layers can have the following purposes:

— ability to withstand the pressure;

— ability to realize interlayer adhesion;

— ability to block or greatly diminish incoming UV and/or sunlight;

— ability to mechanically protect the outside layer;

— ability to control the longitudinal expansion;

— ability to give the multilayer pipe a colour (inside layer or outside layer).

Some characteristics can be combined in one layer.

Plastics piping systems — Multilayer pipe systems for indoor gas installations with a maximum operating pressure up to and including 5 bar (500 kPa) —

Part 1: Specifications for systems

1 Scope

This part of ISO 17484 specifies the general requirements and the performance requirements for multilayer pipe systems based on pipes, fittings and their joints intended to be used for gas supply within buildings.

PE-X and PE pipes composed of one stress-designed layer, adhesive and a barrier layer are also covered by this part of ISO 17484.

This part of ISO 17484 gives guidance for the design of piping systems consisting of multilayer pipes based on thermoplastics, for which at least 60 % of the wall thickness is polymeric material. Polymeric materials intended for stress-designed layers and all inner layers are required to be polyethylene (PE) and/or crosslinked polyethylene (PE-X) in accordance with Annex A of this part of ISO 17484. The outer layer of a metal multilayer is required to be PE or PE-X. PE-RT is considered as PE but with specific properties concerning hoop-stress performance (see 5.4.2.).

NOTE The maximum operation pressure of PE 80 may be lower than 5 bar.

This part of ISO 17484 applies to systems that operate at temperatures of −20 °C up to +60 °C.

For the purpose of this part of ISO 17484, crosslinked polyethylene (PE-X) and adhesive layers are considered as thermoplastic materials.

For sizes greater than 63 mm the requirements of ISO 18225 have to be fulfilled in addition.

This part of ISO 17484 is applicable for piping systems used in buildings to supply gas with a maximum operating pressure up to and including 500 kPa (5 bar)[1)].

This standard applies to the following fuels:

— Category D gaseous fuel: natural gas; see ISO 13623;

— Category E gaseous fuel: LPG vapour, and natural gas or LPG vapour; see ISO 13623.

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 3:1973, *Preferred numbers — Series of preferred numbers*

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

1) 1 bar = 0,1 MPa = 10^5 Pa; 1 MPa = 1 N/mm^2.

ISO 497:1973, *Guide to the choice of series of preferred numbers and of series containing more rounded values of preferred numbers*

ISO 1167 (all parts), *Thermoplastics pipes for the conveyance of fluids — Resistance to internal pressure — Test method*

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

ISO 4437-1, *Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) — Part 1: General*

ISO 4437-2, *Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) — Part 2: Pipes*

ISO 4437-3, *Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) — Part 3: Fittings*

ISO 4437-4, *Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) — Part 4: Valves*[2)]

ISO 4437-5, *Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE) —Part 5: Fitness for purpose of the system*

ISO 9080, *Plastics piping and ducting systems — Determination of the long-term hydrostatic strength of thermoplastics materials in pipe form by extrapolation*

ISO 10146, *Crosslinked polyethylene (PE-X) pipes — Effect of time and temperature on the expected strength*

ISO 10838 (all parts), *Mechanical fittings for polyethylene piping systems for the supply of gaseous fuels*[3)]

ISO 11357-6, *Plastics — Differential scanning calorimetry (DSC) — Part 6: Determination of oxidation induction time (isothermal OIT) and oxidation induction temperature (dynamic OIT)*

ISO 13480, *Polyethylene pipes — Resistance to slow crack growth — Cone test method*

ISO 13623:2000, *Petroleum and natural gas industries — Pipeline transportation systems*

ISO 13951, *Plastics piping systems — Test method for the resistance of polyolefin pipe/pipe or pipe/fitting assemblies to tensile loading*

ISO 14531-1, *Plastics pipes and fittings — Crosslinked polyethylene (PE-X) pipe systems for the conveyance of gaseous fuels — Metric series — Specifications — Part 1: Pipes*

ISO 14531-2, *Plastics pipes and fittings — Crosslinked polyethylene (PE-X) pipe systems for the conveyance of gaseous fuels — Metric series — Specifications — Part 2: Fittings for heat-fusion jointing*

ISO 17454:2006, *Plastics piping systems — Multilayer pipes — Test method for the adhesion of the different layers using a pulling rig*

ISO 17456:2006, *Plastics piping systems — Multilayer pipes — Determination of long-term strength*

ISO 18225, *Plastics piping systems — Multilayer piping systems for outdoor gas installations — Specifications for systems*

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 1555-3, *Plastics piping systems for the supply of gaseous fuels — Polyethylene(PE) — Part 3: Fittings*

3 Terms, definitions and symbols

For the purposes of this document, the following terms, definitions and symbols apply.

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2) ISO 4437-4 will be published in the near future.

3) ISO 10838 (all parts) is currently being revised and will be replaced by ISO 17885.

3.1 Structural definitions

3.1.1
multilayer pipe
pipe comprised of several stress-designed layers

3.1.2
multilayer M-pipe
pipe comprised of stress-designed polymeric layers and one or more stress-designed metallic layers

Note 1 to entry: The wall thickness of the pipe consists of at least 60 % of polymeric materials (e.g. PEX/Al/PEX or PE-RT/Al/PEX).

3.1.3
multilayer P-pipe
pipe comprised of more than one stress-designed polymeric layer (e.g. PE/PE-X)

3.1.4
layer
homogeneous circumferential section of pipe wall that has chemical and/or mechanical and/or physical characteristics different from those of its immediate neighbours

3.1.5
inner layer
layer in contact with the conveyed fluid

3.1.6
outer layer
layer exposed to the external environment

3.2 Geometrical definitions

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

Note 1 to entry: The nominal diameter is expressed in units of millimetres.

3.2.2
outside diameter
d_e
diameter, measured through its cross section at any point of a pipe or the fitting end of a fitting, rounded to the next greater 0,1 mm

3.2.3
mean outside diameter
measured length of the outer circumference of the pipe divided by π, rounded up to the nearest 0,1 mm

Note 1 to entry: The value for π is taken to be 3,142.

3.2.4
inside diameter
value of the measurement of the diameter through its cross section at any point of a pipe, rounded to the next greater 0,1 mm

3.2.5
SDR_m
metal layer standard dimension ratio, the nominal outside diameter (DN or OD) divided by the nominal wall thickness of the metal layer

3.2.6
wall thickness
difference between the pipe outside diameter used for joining and the pipe bore divided by 2

3.2.7
nominal wall thickness
e_n
wall thickness, corresponding to the minimum wall thickness at any point

Note 1 to entry: The nominal wall thickness is expressed in units of millimetres.

3.2.8
mean wall thickness
e_m
arithmetic mean of at least four measurements regularly spaced around the same cross-sectional plane of the pipe, including the measured minimum and maximum values obtained, rounded up to the nearest 0,1 mm

3.3 Definitions related to pressure

3.3.1
design pressure
p_D
highest pressure related to the circumstances for which the system has been designed and intended to be used

3.3.2
predicted design pressure
p_{CD}
pressure that represents the predicted design pressure after a lifetime of 50 years, using the 97,5 % reference line

Note 1 to entry: The predicted design pressure is expressed in units of kilopascals (bars).

3.4 Materials definitions

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
material prepared from rejected unused pipes and fittings, including trimmings from the production of pipes and fittings that can be reprocessed in a manufacturer's plant after having been previously processed by the same manufacturer by a process 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 Technical Committee ISO/TC 138/SC 4, applicable for non-multilayer pipes, to which this part of ISO 17484 can refer for clauses related to the materials, components (e.g. fittings), and fitness for purpose of the system

3.4.4
stress-designed layer
plastics materials used for layers intended to be stress bearing shall be restricted to the reference material standards

3.5 Definitions related to material characteristics

3.5.1
long-term hydrostatic strength
long-term pressure strength
quantity with the dimensions of stress, which represents the predicted mean strength at a temperature *T* and a time *t*

Note 1 to entry: The long-term hydrostatic strength is expressed in units of megapascals.

3.5.2
P_{LPL}
lower confidence limit of the predicted hydrostatic pressure, which represents the 97,5 % (one-sided) lower confidence limit of the predicted hydrostatic pressure at a temperature *T* and a time *t*

Note 1 to entry: The lower confidence limit of the predicted hydrostatic pressure is expressed in units of kilopascals (bars).

3.5.3
MRP
minimum required pressure, equal to the estimated long-term pressure resistance of a pipe at a temperature of 20 °C and a time 50 years, rounded to the nearest lower value of the R10 series of ISO 3:1973 and ISO 497:1973

3.5.4
design coefficient
C factor
design coefficient with a value greater than 1, 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

Note 1 to entry: The minimum value of *C* for various materials is given in 5.2.3.

3.6 Terms related to service conditions

3.6.1
gaseous fuel
any fuel which is in the gaseous state at a temperature of 15 °C and a pressure of 100 kPa (1 bar)

3.6.2
category D gaseous fuels
natural gas

Note 1 to entry: Categories of gaseous fuels and liquid fuel are defined in detail in ISO 13623:2000.

3.6.3
category E gaseous fuels
LPG vapour

Note 1 to entry: Categories of gaseous fuels and liquid fuel are defined in detail in ISO 13623:2000.

3.6.4
maximum operating pressure
MOP
maximum pressure at which a system can be operated continuously under normal conditions

4 Requirements for the system

4.1 Pressure drop

The manufacturer shall provide information on the pressure drop in the system.

4.2 Bending

Special attention shall be paid to the pressure drop of bends. Bending properties of the pipe shall be stated by the manufacturer.

4.3 Corrosive conditions

Components exposed to corrosive conditions shall be manufactured from a corrosion-resistant material or protected against corrosion.

5 Pipes

5.1 Materials

5.1.1 General

Materials intended for the stress-bearing layers and inner layers shall conform to the material requirements of the reference product standard(s) specified in Annex A. The pipe manufacturer shall declare the reference material standard applicable to his product, as listed in Annex A.

Adhesives are not considered as stress-bearing layers.

5.1.2 Reprocessable materials

Clean own reprocessable material (except PE-X) of the same polymer type from products manufactured to the reference product standard may be added to the virgin material.

5.1.3 Metallic materials

Aluminium materials used shall be in accordance with EN 573-3.

5.2 General characteristics

5.2.1 General

When viewed without magnification, the internal and external surfaces of pipes shall be smooth, clean and free from scoring, cavities and other surface defects to an extent that would prevent conformance with this part of ISO 17484. The ends of the pipe shall be cut cleanly and square to the axis of the pipe.

The following information shall be provided by the manufacturer:

— outside diameter;

— wall thickness;

— thickness of the inner layer;

— thickness of the metal layer;

— thickness of the outer layer;

— tolerances.

Dimensions shall be measured in accordance with ISO 3126.

5.2.2 Multilayer pipe construction

The joint line of the metallic layer shall be continuously welded.

For socket fusion joints the minimum wall thickness of the outer layer shall be > 0,45mm (pipe diameters < 20mm) and the minimum wall thickness of the outer layer shall be > 0.6 mm (pipe diameters ≥ 20mm).

5.2.3 Minimum design coefficient

The minimum design coefficient (*C* factor) shall be 2, as used to calculate the design pressure, p_{CD}, taking into account the maximum operating temperature.

5.3 Dimensions of pipes

The outside diameter should be accordance with ISO 161-1.

NOTE Although there is some demand to agree on standardized dimensions, commercially available pipes do not, at the time of publication of this standard, have standardized outside diameters.

All layers shall be of sufficient thickness so that the composite pipe fulfils the requirements of this part of ISO 17484.

5.4 Mechanical properties

5.4.1 Long-term pressure strength

5.4.1.1 General

The long-term pressure strength of the multilayer pipes shall be measured or calculated, as applicable. Consequently, two procedures for the determination of long-term pressure strength of multilayer pipes are defined in this part of ISO 17484: procedure I and procedure II.

Requirement for the predicted design pressure: p_{CD} shall be equal to or greater than the relevant p_{CD}.

The operating temperature shall be taken into account. The pipe should be designed for a maximum temperature of +60 °C.

The viscoelastic behaviour of PE-X and PE are similar; therefore, procedure I may be applied to P-pipes using layers of both materials. It shall be taken into account that the results of procedure I are generally rather conservative. Reference lines for PE-X can be found in ISO 10146.

NOTE The minimum overall service (design) coefficients for each material can be found in the relevant product standard (see Annex A). PEX and PE pipes composed of one stress-designed layer, adhesive layer and barrier layer are considered to be monolayer pipe and tested according to the relative product standards in Annex A.

5.4.1.2 Procedure I — Calculation method

This method shall only be used for multilayer P-pipes.

The long-term pressure strength shall be calculated using the reference lines of each individual pressure-bearing polymer layer according to of ISO 17456: Annex A. The addition rule related to each pressure-bearing layer assumes similar elastic behaviour of each material used and that complete interlayer adhesion exists, with design coefficients coming from the reference product standards.

The cumulative p_{CD} shall be equal to or greater than the relevant p_D.