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Plastics piping systems for the supply of gaseous fuels — Unplasticized polyamide (PA-U) piping systems with fusion jointing and mechanical jointing —

Part 2: **Pipes**

Systèmes de canalisations en matières plastiques pour la distribution de combustibles gazeux — Systèmes de canalisations en polyamide non plastifié (PA-U) avec assemblages par soudage et assemblages mécaniques —

Partie 2: Tubes

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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.

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 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee 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,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 155, *Plastics piping systems and ducting systems,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 16486-2:2012), which has been technically revised. It also incorporates ISO 16486-2:2012/Amd 1: 2014.

The main changes compared to the previous edition are as follows:

— Tables 1 and 2 are extended with nominal outside diameters up to and including 630 mm;

— In Table 2, former 6 hours has been changed to 16 hours in line with the phrasing in the table header;

— In Table 3, the range for the minimum wall thickness is extended up to and including 37 mm;

— Table 4 allows for $e > 12$ mm to use Type 3 specimen with 10 mm/min for the determination of the elongation at break;

— Informative Annex A – Butt fusion procedure for jointing PA-U pipes – has been deleted;

— A new normative Annex A – Squeeze-off technique – has been added;

— A new informative Annex B – Examples of the water uptake over time as a function of the sample thickness – has been added.

A list of all parts in the ISO 16486 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document specifies the requirements for a piping system and its components made from unplasticized polyamide (PA-U), which is intended to be used for the supply of gaseous fuels.

Requirements and test methods for material and components, other than pipes of the piping system are specified in ISO 16486-1, ISO 16486-3, and ISO 16486-4.

Characteristics for fitness for purpose of the system and generic fusion parameters are covered in ISO 16486-5.

Recommended practice for installation is given in ISO 16486-6, which will not be implemented as a European Standard under the Vienna Agreement.

Assessment of conformity of the system is to form the subject of prEN ISO 16486-7.

Recommended practice for installation is also given in CEN/TS 12007-6, which has been prepared by Technical Committee CEN/TC 234, *Gas infrastructure*.

A list of ASTM standards related to polyamide pipes and fittings for the supply of gas is given in the Bibliography [1][2][3][4].

Parts 1 to 7 of the ISO 16486 series have been prepared by ISO/TC 138/SC4, with the exception of Part 4, which has been prepared by ISO/TC 138/SC 7.

Plastics piping systems for the supply of gaseous fuels — Unplasticized polyamide (PA-U) piping systems with fusion jointing and mechanical jointing —

Part 2: Pipes

1 Scope

This document specifies the physical and mechanical properties of pipes made from unplasticized polyamide (PA-U) in accordance with ISO 16486-1, intended to be buried and used for the supply of gaseous fuels. It also specifies the test parameters for the test methods to which it refers.

The ISO 16486 series of standards is applicable to PA-U piping systems, the components of which are connected by fusion jointing and/or mechanical jointing.

In addition, it lays down dimensional characteristics and requirements for the marking of pipes.

Pipes conforming to this document are jointed typically by using mechanical, electrofusion or butt fusion techniques.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 291, *Plastics — Standard atmospheres for conditioning and testing*

ISO 307, *Plastics — Polyamides — Determination of viscosity number*

ISO 1133-2, *Plastics — Determination of the melt mass-flow rate (MFR) and melt volume-flow rate (MVR) of thermoplastics — Part 2: Method for materials sensitive to time-temperature history and/or moisture*

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 2505, *Thermoplastics pipes — Longitudinal reversion — Test method and parameters*

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

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

ISO 6259-3, *Thermoplastics pipes — Determination of tensile properties — Part 3: Polyolefin pipes*

ISO 11922-1, *Thermoplastics pipes for the conveyance of fluids — Dimensions and tolerances — Part 1: Metric series*

ISO 12176-4, *Plastics pipes and fittings — Equipment for fusion jointing polyethylene systems — Part 4: Traceability coding*

ISO 13477, *Thermoplastics pipes for the conveyance of fluids — Determination of resistance to rapid crack propagation (RCP) — Small-scale steady-state test (S4 test)*

ISO 13479, *Polyolefin pipes for the conveyance of fluids — Determination of resistance to crack propagation — Test method for slow crack growth on notched pipes*

ISO 16486-1:2020, *Plastics piping systems for the supply of gaseous fuels — Unplasticized polyamide (PA-U) piping systems with fusion jointing and mechanical jointing — Part 1: General*

EN 12106, *Plastics piping systems - Polyethylene (PE) and crosslinked polyethylene (PE-X) pipes - Test method for the resistance to internal pressure after application of squeeze-off*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 16486-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1.1
out-of-roundness
⟨pipe or fitting⟩ difference between the measured maximum outside diameter and the measured minimum outside diameter in the same cross-sectional plane of a pipe or spigot end of a fitting

3.1.2
virgin material
material in a form such as granules or powder that has not been previously processed other than for compounding and to which no rework material or recyclable material has been added

3.1.3
squeeze-off
gas flow restricted by squeezing the pipe when compressed between two clamps in such a way that the distance between both clamps is less than twice the nominal wall thickness

3.2 Abbreviated terms

MVR melt volume-flow rate

SDR standard dimension ratio

4 Compound

The compound from which the pipes are made shall be in accordance with ISO 16486-1.

The pipes shall be made from virgin material. Rework material shall not be used.

5 General characteristics

5.1 Appearance

When viewed without magnification, the internal and external surfaces of pipes shall be smooth, clean and free from scoring, cavities and other surface defects which can affect pipe performance. The pipe ends shall be cut cleanly and square to the axis of the pipe.

5.2 Colour

The colour of the pipes shall be yellow or black.

5.3 Fusion compatibility

Pipes made from PA-U 11 shall be heat fusion jointed only to pipes and/or components made from PA-U 11.

Pipes made from PA-U 12 shall be heat fusion jointed only to pipes and/or components made from PA-U 12.

Pipes made from PA-U are not fusion compatible with pipes and/or components made from other polymers.

NOTE Test methods for assuring fusibility are given in ISO 16486-3 and ISO 16486-5.

6 Geometrical characteristics

6.1 Measurement of dimensions

Dimensions shall be measured in accordance with ISO 3126 at (23 ± 2) °C, after being conditioned for at least 4 h. The measurement shall not be made less than 24 h after manufacture.

6.2 Mean outside diameters, out-of-roundness and their tolerances

The mean outside diameter of the pipe, d_{em}, and the out-of-roundness and their tolerances shall be in accordance with Table 1.

For maximum mean outside diameter grade B tolerances, ISO 11922-1 shall apply.

Table 1 — Mean outside diameters and out-of-roundness

Dimensions in millimetres

Nominal outside diameter	Mean outside diameter		Maximum of absolute out-of-roundness[a]	
d_n	$d_{em,min}$	$d_{em,max}$	Grade K[b]	Grade N[c]
16	16,0	16,3	1,2	1,2
20	20,0	20,3	1,2	1,2
25	25,0	25,3	1,5	1,2
32	32,0	32,3	2,0	1,3
40	40,0	40,4	2,4	1,4
50	50,0	50,4	3,0	1,4
63	63,0	63,4	3,8	1,5
75	75,0	75,5	—	1,6
90	90,0	90,6	—	1,8
110	110,0	110,7	—	2,2
125	125,0	125,8	—	2,5
140	140,0	140,9	—	2,8

[a] Measurement of out-of-roundness shall be made at the point of manufacture according to ISO 3126.

[b] For coiled pipe with $d_n \leq 63$ mm, grade K according to ISO 11922-1 applies; for pipe with $d_n \geq 75$ mm, the maximum out-of roundness shall be specified by agreement.

[c] Grade N according to ISO 11922-1.

[d] The maximum out-of-roundness shall be specified by agreement.

Table 1 *(continued)*

Nominal outside diameter	Mean outside diameter		Maximum of absolute out-of-roundness[a]	
d_n	$d_{em,min}$	$d_{em,max}$	Grade K[b]	Grade N[c]
160	160,0	161,0	—	3,2
180	180,0	181,1	—	3,6
200	200,0	201,2	—	4,0
225	225,0	226,4	—	4,5
250	250,0	251,5	—	5,0
280	280,0	281,7	—	9,8
315	315,0	316,9	—	11,1
355	355,0	357,2	—	12,5
400	400,0	402,4	—	14,0
450	450,0	452,7	—	[d]
500	500,0	503,0	—	[c, d]
560	560,0	563,4	—	[d]
630	630,0	633,8	633,8	[d]

[a] Measurement of out-of-roundness shall be made at the point of manufacture according to ISO 3126.

[b] For coiled pipe with $d_n \leq 63$ mm, grade K according to ISO 11922-1 applies; for pipe with $d_n \geq 75$ mm, the maximum out-of roundness shall be specified by agreement.

[c] Grade N according to ISO 11922-1.

[d] The maximum out-of-roundness shall be specified by agreement.

6.3 Wall thicknesses and tolerances

6.3.1 Minimum wall thickness

The minimum wall thickness, e_{min}, shall be in accordance with Table 2. Small diameter pipes are characterized by wall thickness. Large diameter pipes are characterized by their standard dimension ratio (SDR).

The use of any SDR derived from the pipe series S given according to ISO 4065 and ISO 161-1 is permitted.

NOTE In order to minimize the possibility of damage to small-diameter gas pipes by external influences, the use of pipes having a wall thickness of not less than 3,0 mm, even if higher than the minimal SDR value, can be considered.

Table 2 — Minimum wall thickness

Dimensions in millimetres

Nominal outside diameter[b] d_n	Minimum wall thickness[a] e_{min}						
	SDR 7,4	SDR 9	SDR 11	SDR 13,6	SDR 17	SDR 21	SDR 26
16	2,2	—	—	—	—	—	—
20	2,8	2,3	—	—	—	—	—
25	3,5	2,8	2,3	—	—	—	—
32	4,4	3,6	2,9	2,4	—	—	—
40	5,5	4,5	3,7	3,0	2,4	2,0	—
50	6,9	5,6	4,6	3,7	3,0	2,4	2,0
63	8,6	7,1	5,8	4,7	3,8	3,0	2,5
75	10,3	8,4	6,8	5,6	4,5	3,6	2,9

[a] For wall thickness >30 mm butt fusion jointing parameters are evaluated individually.

[b] For diameters >250 mm mechanical fittings and electrofusion methods are evaluated.