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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 1: General

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 1: Généralités

ISO/CEN PARALLEL PROCESSING

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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).

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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 16486-1:2012), which has been technically revised. It also replaces ISO 16486-1:2012/Amd 1:2014.

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

— In subclause 5.2.5 characteristics include the need to saturate pipes for LTHS testing;

— In Table 1 the Carbon black content is changed to (1,0 to 2,5) % (by mass);

— In Table 2 former 6 hours has been changed to 16 hours for conditioning before hydrostatic strength testing in line with the phrasing in the table header;

— In subclause 5.2.6 change of compound refers to PPI TR-3 as guidance;

— A new informative Annex D – Continuous liquid hydrocarbon exposure from transported fluid or soil contamination – has been added;

— A new informative Annex E – Permeation resistance against different gases – 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 general requirements for a piping system and its components made from unplasticized polyamide (PA-U), which are intended to be used for the supply of gaseous fuels.

Requirements and test methods for components of the piping system are specified in ISO 16486-2, 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 the future ISO/TS 16486-7[1)].

NOTE 1 Recommended practice for installation is also given in CEN/TS 12007-6, *Gas infrastructure — Pipelines for maximum operating pressure up to and including 16 bar — Part 6: Design, handling, installation and operation of unplasticized polyamide (PA-U) piping systems with fusion joining and mechanical jointing — Functional recommendation*, which has been prepared by Technical Committee CEN/TC 234, *Gas infrastructure*.

NOTE 2 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 (this document), 2, 3, 5 and 6 (and future Part 7) have been prepared by ISO/TC 138/SC 4. Part 4 has been prepared by ISO/TC 138/SC 7.

1) Under preparation. Stage at the time of publication: ISO/NP TS 16486-7:2020.

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

Part 1: General

1 Scope

This document specifies the general properties of unplasticized polyamide (PA-U) compounds for the manufacture of pipes, fittings and valves made from these compounds, 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 is applicable to PA-U piping systems, the components of which are connected by fusion jointing and/or mechanical jointing.

This document establishes a calculation and design scheme on which to base the maximum operating pressure (MOP) of a PA-U piping system.

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 179-1, *Plastics — Determination of Charpy impact properties — Part 1: Non-instrumented impact test*

ISO 291, *Plastics — Standard atmospheres for conditioning and testing*

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

ISO 472, *Plastics — Vocabulary*

ISO 527-1, *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*

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

ISO 1110, *Plastic — Polyamides — Accelerated conditioning of test specimens*

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 1183-1, *Plastics — Methods for determining the density of non-cellular plastics — Part 1: Immersion method, liquid pycnometer method and titration method*

ISO 1183-2, *Plastics — Methods for determining the density of non-cellular plastics — Part 2: Density gradient column method*

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

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 6964, *Polyolefin pipes and fittings — Determination of carbon black content by calcination and pyrolysis — Test method*

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

ISO 12162, *Thermoplastics materials for pipes and fittings for pressure applications — Classification, designation and design coefficient*

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 13478, *Thermoplastics pipes for the conveyance of fluids — Determination of resistance to rapid crack propagation (RCP) — Full-scale test (FST)*

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 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 15512, *Plastics — Determination of water content*

ISO 16396-1, *Plastics — Polyamide (PA) moulding and extrusion materials — Part 1: Designation system, marking of products and basis for specifications*

ISO 16396-2, *Plastics — Polyamide (PA) moulding and extrusion materials — Part 2: Preparation of test specimens and determination of properties*

ISO 16486-5, *Plastics piping systems for the supply of gaseous fuels — Unplasticized polyamide (PA-U) piping systems with fusion jointing and mechanical jointing — 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*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 472, ISO 1043-1 and ISO 16396-1 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 Geometrical characteristics

3.1.1
nominal outside diameter
d_n
specified outside diameter of a component, which is identical to the *minimum mean outside diameter* (3.1.4), $d_{em,min}$

Note 1 to entry: Expressed in millimetres.

3.1.2
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, rounded up to the nearest 0,1 mm

3.1.3
mean outside diameter
d_{em}
measured length of the outer circumference of a pipe, or the spigot end of a fitting, divided by π (≈3,142), rounded up to the nearest 0,1 mm

3.1.4
minimum mean outside diameter
$d_{em,min}$
minimum value for the *mean outside diameter* (3.1.3) as specified for a given nominal size

3.1.5
maximum mean outside diameter
$d_{em,max}$
maximum value for the *mean outside diameter* (3.1.3) as specified for a given nominal size

3.1.6
nominal wall thickness
e_n
wall thickness, in millimetres, corresponding to the minimum wall thickness, e_{min}

3.1.7
wall thickness at any point
e
measured wall thickness at any point around the circumference of a component, rounded up to the nearest 0,1 mm

3.1.8
minimum wall thickness at any point
e_{min}
minimum value for the *wall thickness at any point* (3.1.8) around the circumference of a component, as specified

3.1.9
standard dimension ratio
SDR
ratio of the *nominal outside diameter* (3.1.1), d_n, of a pipe to its nominal wall thickness, e_n

3.2 Materials

3.2.1
compound
homogenous mixture of base polymer (PA-U) and additives, i.e. antioxidants, pigments, UV stabilisers, at a dosage level necessary for the processing and use of components conforming to the requirements of this document

3.2.2
rework material
material from a manufacturer's own production (of *compounds* [3.2.1] and of pipes, fittings or valves) that has been reground or pelletized for reuse by that same manufacturer

3.3 Material characteristics

3.3.1
lower confidence limit of the predicted hydrostatic strength
σ_{LPL}
quantity, with the dimensions of stress, which represents the 97,5 % lower confidence limit of the predicted hydrostatic strength at a temperature θ and time t

Note 1 to entry: The quantity is expressed in megapascals (MPa).

Note 2 to entry: Temperature, θ, is expressed in degrees Celsius and time, t, is expressed in years.

3.3.2
minimum required strength
MRS
value of σ_{LPL} (3.3.1) at 20 °C and 50 years, rounded down to the next smaller value of the R10 series or the R20 series

Note 1 to entry: The R10 series conforms to ISO 3[5] and the R20 series conforms to ISO 497[6].

3.3.3
categorized required strength at temperature θ and time t
$CRS_{\theta,t}$
value of σ_{LPL} (3.3.1) at temperature θ and time t, rounded down to the next smaller value of the R10 series or the R20 series

Note 1 to entry: $CRS_{\theta,t}$ at 20 °C and 50 years equals MRS (3.3.2).

Note 2 to entry: Temperature, θ, is expressed in degrees Celsius and time, t, is expressed in years.

Note 3 to entry: The R10 series conforms to ISO 3[5] and the R20 series conforms to ISO 497[6].

3.3.4
design coefficient
C
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

3.3.5
design stress
σ_s
$\sigma_{s,\theta,t}$
stress derived by dividing the MRS (3.3.2) or CRSθ,t (3.3.3) by the *design coefficient* (3.3.4), C, i.e. $\sigma_s = MRS/C$, or $\sigma_{s,\theta,t} = CRS_{\theta,t}/C$

3.4 Related to service conditions

3.4.1
gaseous fuel
any fuel which is in a gaseous state at a temperature of 15 °C, at a pressure of one bar (0,1 MPa)

3.4.2
maximum operating pressure
MOP
maximum effective pressure of the gas in the piping system, expressed in bar, which is allowed in continuous use

Note 1 to entry: The MOP takes into account the physical and the mechanical characteristics of the components of a piping system and the influence of the gas on these characteristics.

4 Symbols and abbreviated terms

4.1 Symbols

a_{cN}	charpy notched impact strength
C	design coefficient
d_e	outside diameter at any point
d_{em}	mean outside diameter
$d_{em,max}$	maximum mean outside diameter
$d_{em,min}$	minimum mean outside diameter
d_n	nominal outside diameter
E	wall thickness at any point
e_{min}	minimum wall thickness at any point
e_n	nominal wall thickness
L	Length
P	pressure at burst
p_c	critical pressure
Σ	is the hoop stress to be induced by the pressure at burst
σ_{LPL}	lower confidence limit of the predicted hydrostatic strength
σ_s	design stress

NOTE 1 The symbols d_e and e correspond to d_{ey} and e_y given in other International Standards, e.g. ISO 11922-1[7].

4.2 Abbreviated terms

$CRS_{\theta,t}$	categorized required strength at temperature, θ, and time, t
MOP	maximum operating pressure
MRS	minimum required strength
PA-U	unplasticized polyamide
R	series of preferred numbers, conforming to the Renard series
RT	room temperature
SDR	standard dimension ratio