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Plastics piping systems for industrial applications — Unplasticized polyamide (PA-U) — Metric series for specifications for components and system

Systèmes de canalisations en matières plastiques pour les applications industrielles — Polyamide non plastifié (PA-U) — Séries métriques pour les spécifications pour les composants et le système

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Foreword

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This document was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Subcommittee SC 3, *Plastics pipes and fittings for industrial applications*.

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 characteristics and requirements for a piping system and its components made from unplasticized polyamide (PA-U), as applicable, intended to be used for industrial applications above ground or below ground by authorities, design engineers, certification bodies, inspection bodies, testing laboratories, manufacturers, and users.

At the date of publication of this document, standards for piping systems of other plastics used for industrial applications include the following:

ISO 10931, *Plastics piping systems for industrial applications — Poly(vinylidene fluoride) (PVDF) — Specifications for components and the system*

ISO 15493, *Plastics piping systems for industrial applications — Acrylonitrile-butadiene-styrene (ABS), unplasticized poly(vinyl chloride) (PVC-U) and chlorinated poly(vinyl chloride) (PVC-C) — Specifications for components and the system — Metric series*

ISO 15494, *Plastics piping systems for industrial applications — Polybutene (PB), polyethylene (PE), polyethylene of raised temperature resistance (PE-RT), crosslinked polyethylene (PE-X), polypropylene (PP) — Metric series for specifications for components and the system*

Plastics piping systems for industrial applications — Unplasticized polyamide (PA-U) — Metric series for specifications for components and system

1 Scope

This document specifies the characteristics and requirements for a piping system and its components, made from unplasticized polyamide (PA-U) intended to be used for thermoplastics piping systems in industrial applications above and below ground.

NOTE 1 Requirements applying to industrial valves are given in this document and in other standards.

This document is applicable to PA-U pipes, fittings, valves and their joints, and to joints with components of other plastics and non-plastic materials, depending on their suitability, intended to be used for the conveyance of liquid and gaseous fluids as well as solid matter in fluids for industrial applications such as the following:

— transport of oil, gaseous fuels and multiphase mixtures (exploration and production; general purpose hydrocarbon-based fluids);

— transport of renewable gases (hydrogen, biomethane);

— transport of contaminated sewer (e.g. contaminated with hydrocarbons);

— transport of CO_2 [carbon capture and utilisation or storage (CCUS)].

NOTE 2 National regulations can apply.

NOTE 3 Other application areas are possible if the requirements of this document and/or applicable national requirements are fulfilled.

Characteristics and requirements which are applicable for PA-U are covered by the relevant clauses of this document. Those characteristics and requirements which are dependent on the material are given in the relevant normative Annex A.

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 7-1, *Pipe threads where pressure-tight joints are made on the threads — Part 1: Dimensions, tolerances and designation*

ISO 228-1, *Pipe threads where pressure-tight joints are not made on the threads — Part 1: Dimensions, tolerances and designation*

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

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

ISO 472, *Plastics — Vocabulary*

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

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

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 1167-3, *Thermoplastics pipes, fittings and assemblies for the conveyance of fluids — Determination of the resistance to internal pressure — Part 3: Preparation of components*

ISO 1167-4, *Thermoplastics pipes, fittings and assemblies for the conveyance of fluids — Determination of the resistance to internal pressure — Part 4: Preparation of assemblies*

ISO 1183-1, *Plastics — Methods for determining the density of non-cellular plastics — Part 1: Immersion method, liquid pyknometer 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 3126, *Plastics piping systems — Plastics components — Determination of dimensions*

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

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

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 15512:2019, *Plastics — Determination of water content*

ISO 15853, *Thermoplastics materials — Preparation of tubular test pieces for the determination of the hydrostatic strength of materials used for injection moulding*

ISO 16135, *Industrial valves — Ball valves of thermoplastics materials*

ISO 16486-4, *Plastics piping systems for the supply of gaseous fuels — Unplasticized polyamide (PA-U) piping systems with fusion jointing and mechanical jointing — Part 4: Valves*

ISO 18553, *Method for the assessment of the degree of pigment or carbon black dispersion in polyolefin pipes, fittings and compounds*

IEC 60529, *Degrees of protection provided by enclosures (IP-code)*

EN 12099, *Plastics piping systems — Polyethylene piping materials and components — Determination of volatile content*

3 Terms and definitions

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

3.1 Geometrical definitions

3.1.1
nominal outside diameter
d_n
specified outside diameter assigned to a nominal size, DN/OD

Note 1 to entry: The nominal inside diameter of a socket is equal to the nominal outside diameter of the corresponding pipe.

Note 2 to entry: It is expressed in millimetres.

3.1.2
outside diameter
d_e
value of the measurement of the outside diameter through its cross-section at any point of the pipe, rounded to the next greater 0,1 mm

Note 1 to entry: The symbol d_e corresponds to d_{ey} given in other International Standards such as ISO 11922-1.

3.1.3
mean outside diameter
d_{em}
value of the measurement of the outer circumference of the pipe or spigot end of a fitting in any cross-section divided by π (= 3,142), rounded to the next greater 0,1 mm

3.1.4
nominal size
DN/OD
numerical designation of the size of a component, other than a component designated by thread size, which is a convenient round number, approximately equal to the manufacturing dimension in millimetres (mm) and related to the outside diameter

3.1.5
nominal size of flange
DN
numerical designation of the size of a flange for reference purposes and related to the manufacturing dimension in millimetres

3.1.6
out-of-roundness
ovality
difference between the maximum and the minimum outside diameter in the same cross-section of a pipe or spigot

3.1.7
nominal wall thickness
e_n
numerical designation of the wall thickness of a component, which is a convenient round number, approximately equal to the manufacturing dimension in millimetres (mm)

Note 1 to entry: For thermoplastics components conforming to Annexes A and B, the value of the nominal wall thickness, e_n, is identical to the specified minimum wall thickness at any point, e_{min}.

Note 2 to entry: The symbol e_n corresponds to e_{ey} given in other International Standards, such as ISO 11922-1.

3.1.8
wall thickness at any point
e
wall thickness at any point around the circumference of a component, rounded to the next greater 0,1 mm

3.1.9
minimum wall thickness at any point
e_{min}
minimum value for the wall thickness at any point around the circumference of a component, as specified

3.1.10
pipe series
S
dimensionless number for pipe designation

Note 1 to entry: The pipe series, S, conforms to ISO 4065.

Note 2 to entry: The relationship between the pipe series, S, and the standard dimension ratio, SDR, is given by the following formula as specified in ISO 4065:

$$S = \frac{\mathrm{SDR} - 1}{2}$$

Note 3 to entry: Flanges are designated on the basis of nominal pressure, PN.

3.1.11
standard dimension ratio
SDR
numerical designation of a pipe series, which is a convenient round number, approximately equal to the dimension ratio of the nominal outside diameter, d_n, and the nominal wall thickness, e_n

3.2 Material definitions

3.2.1
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 materials have been added

3.2.2
reworked material
plastics material from rejected unused products or trimmings capable of being reclaimed within the same process that generated it

Note 1 to entry: Previously referred to as “own reprocessed material”.

3.3 Definitions related to 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, T, and time, t

Note 1 to entry: It is expressed in megapascals.

3.3.2
minimum required strength
MRS
value of σ_{LPL} (lower confidence limit of the predicted hydrostatic strength) 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 and the R20 series conforms to ISO 497.

3.3.3
design stress
σ_S
allowable stress for a given application at 20 °C that is derived from the minimum required strength (MRS) by dividing it by the coefficient C

Note 1 to entry: Design stress can be calculated using the following formula:

$$\sigma_s = \frac{\mathrm{MRS}}{C}$$

Note 2 to entry: It is expressed in megapascals.

3.3.4
design coefficient
C
coefficient with a value greater than one which takes into consideration service conditions as well as the properties of the components of a piping system other than those represented in the lower confidence limit

3.4 Definitions related to service conditions

3.4.1
nominal pressure
PN
numerical designation used for reference purposes related to the mechanical characteristics of the components of a piping system

Note 1 to entry: A pressure, in bar, with the numerical value of PN is identical with the pressure, PS, as defined by Reference [19] if both pressures are taken at 20 °C.

Note 2 to entry: For plastics piping systems conveying water, PN corresponds to the maximum continuous operating pressure in bar, which can be sustained for water at 20 °C for 50 years, based on the following minimum design coefficient:

$$\mathrm{PN} = \frac{10\sigma_s}{[S]} = \frac{20\sigma_s}{\mathrm{SDR}-1}$$

where

σ_S is expressed in MPa;

PN is expressed in bar.

Note 3 to entry: 1 bar = 0,1 MPa = 10^5 Pa; 1 MPa= 1 N/mm^2.

3.4.2
hydrostatic stress
σ
stress induced in the wall of a pipe when an internal hydrostatic pressure is applied

Note 1 to entry: The hydrostatic stress is related to the applied internal hydrostatic pressure (in bar), p, the wall thickness at any point, e, and the mean outside diameter, d_{em}, of a pipe. It is calculated using the following formula:

$$\sigma = p\frac{d_{\mathrm{em}} - e_{\mathrm{min}}}{20e_{\mathrm{min}}}$$

Note 2 to entry: This formula is applicable for pipes only.

Note 3 to entry: The value is expressed in megapascals.

4 Symbols and abbreviated terms

4.1 Symbols

C design coefficient (design factor)

D_1 mean inside diameter in the fusion zone

D_2 minimum diameter of the flow channel through the body of the fitting

d_e outside diameter (at any point)

d_{em} mean outside diameter

d_n nominal outside diameter

D_{f1} outside diameter of chamfer on shoulder

D_{f2} outside diameter of flange adaptor

DN nominal size of flange

e wall thickness (at any point)

e_n nominal wall thickness

h height of the service pipe

H height of the saddle

L width of the tapping tee

L_1 depth of penetration of the pipe or male end of a spigot end fitting

L_2 nominal length of the fusion zone

L_3 nominal unheated entrance length of the fitting

L_{b2} outside tubular length

p internal hydrostatic pressure

p_c critical pressure

$p_{c,REF}$ critical reference pressure

p_s maximum allowable pressure

r_f radius of chamfer on shoulder

T temperature

t time