INTERNATIONAL STANDARD

ISO 15439-1

First edition
2007-12-15

Plastics piping systems for the supply of gaseous fuels for maximum operating pressure up to and including 0,4 MPa (4 bar) — Polyamide (PA) —

Part 1: General

Systèmes de canalisations en matières plastiques pour la distribution de combustibles gazeux pour une pression maximale de service inférieure ou égale à 0,4 MPa (4 bar) — Polyamide (PA) —

Partie 1: Généralités

Reference number
ISO 15439-1:2007(E)

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Published in Switzerland

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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 15439-1 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*.

ISO 15439 consists of the following parts, under the general title *Plastics piping systems for the supply of gaseous fuels for maximum operating pressure up to and including 0,4 MPa (4 bar) — Polyamide (PA)*:

— *Part 1: General*

— *Part 2: Pipes*

— *Part 3: Fittings*

Introduction

A list of standards related to polyamide pipes and fittings for the supply of gas is given in the Bibliography. See [1] to [8].

Plastics piping systems for the supply of gaseous fuels for maximum operating pressure up to and including 0,4 MPa (4 bar) — Polyamide (PA) —

Part 1: General

1 Scope

This part of ISO 15439 specifies the general properties of polyamide (PA) compounds for the manufacturing of pipes, fittings and valves made from such compounds, intended to be buried and used for the supply of gaseous fuels for maximum operating pressure up to and including 4 bar.

It also specifies the test parameters for the test methods to which it refers.

This part of ISO 15439 specifies a calculation and design scheme on which the maximum operating pressure (MOP) of piping systems is based.

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 179-1:2000, *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 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 1167-4, *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 1874-1, *Plastics — Polyamide (PA) moulding and extrusion materials — Part 1: Designation*

ISO 1874-2, *Plastics — Polyamide (PA) moulding and extrusion materials — Part 2: Preparation of test specimens and determination of properties*

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 and basic specification*

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

ISO 12162:1995, *Thermoplastics materials for pipes and fittings for pressure applications — Classification and designation — Overall service (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 13478:1997, *Thermoplastics pipes for the conveyance of fluids — Determination of resistance to rapid crack propagation (RCP) — Full scale test (FST)*

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

ISO 15512:—[1)], *Plastics — Determination of water content*

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 1874-1 and the following apply.

3.1 Geometrical definitions

NOTE The symbols d_e and e correspond to d_{ey} and e_y given in other International Standards such as ISO 11922-1[9].

1) To be published. (Revision of ISO 15512:1999)

3.1.1
nominal outside diameter
d_n
specified outside diameter of a component, identical to the minimum mean outside diameter, $d_{em,min}$, in millimetres

NOTE The nominal inside diameter of a socket is equal to the nominal outside diameter of the corresponding pipe.

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 as specified for a given nominal size

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

3.1.6
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, or the difference between the measured maximum inside diameter and the measured minimum inside diameter in the same cross-sectional plane of a socket

3.1.7
nominal wall thickness
e_n
wall thickness, in millimetres, corresponding to the minimum wall thickness, e_{min}

3.1.8
wall thickness at any point
e
measured wall thickness at any point around the circumference of a component, rounded up to the nearest 0,05 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
standard dimension ratio
SDR
ratio of the nominal outside diameter, d_n, of a pipe to its nominal wall thickness, e_n

3.2 Definitions of materials

3.2.1
compound
homogenous mixture of base polymer (PA) and additives, i.e. anti-oxidants, pigments, UV-stabilizers and others, at a dosage level necessary for the processing and use of components conforming to the requirements of this part of ISO 15439

3.2.2
virgin material
material in a form such as granules or powder, which has not been previously processed other than for compounding and to which no rework or recyclable materials have been added

3.2.3
rework material
material from a manufacturer's own production, which has been reground or pelletized for re-use by that same manufacturer

NOTE This definition applies to either the production of compounds or the production of pipe fittings or valves.

3.3 Definitions related to material characteristics

3.3.1
lower confidence limit of the predicted hydrostatic strength
σ_{LPL}
quantity, in megapascals, 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 It is given by $\sigma_{LPL} = \sigma_{(T, t, 0,975)}$

3.3.2
minimum required strength
MRS
value of σ_{LPL} at 20 °C and 50 years, rounded down to the next lower value in the R 10 series when σ_{LCL} is less than 10 MPa, or to the next lower value in the R 20 series when σ_{LPL} is greater than or equal to 10 MPa

NOTE The R 10 and R 20 series are the Renard number series as defined in ISO 3[10] and ISO 497[11].

3.3.3
overall service (design) coefficient
C
overall 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, σ_{LPL}

3.3.4
design stress
σ_s
allowable stress, in megapascals, for a given application or set of service conditions

NOTE It is derived by dividing the MRS by the coefficient C, as in Equation (1), then rounding to the next lower value in the R 10 or R 20 series, as applicable:

$$\sigma_s = \frac{MRS}{C} \quad (1)$$

3.4 Definitions related to service conditions

3.4.1
gaseous fuel
any fuel that is in a gaseous state at a temperature of 15 °C, at a pressure of one bar

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 and which 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

C	overall service (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
σ_s	design stress
σ_{LPL}	lower confidence limit of the predicted hydrostatic strength

4.2 Abbreviations

MOP	maximum operating pressure
MRS	minimum required strength
PA	polyamide
R	series of preferred numbers, conforming to the Renard series
SDR	standard dimension ratio

5 Material

5.1 Material of the components

The material from which the components, i.e. the pipes, fittings and valves, are made shall be polyamide PA designated in accordance with ISO 1874-1.

5.2 Compound

5.2.1 Additives

The compound shall be made of the polyamide base polymer to which are added only those additives that are needed to facilitate the manufacture of pipes and fittings conforming to the applicable parts of ISO 15439.

All additives shall be used according to the national regulations.

5.2.2 Colour

The colour of the compound shall be yellow, black or natural. The natural colour is admitted only for compounds intended to be used for manufacturing fittings and valves.

5.2.3 Identification compound

When applicable, the compound used for identification stripes shall be manufactured from a PA polymer manufactured from the same type of base polymer as used in the compound for pipe production.

When applicable, the compound used for an identification layer shall be of the same base polymer and of the same MRS as the compound used for pipe production.

5.2.4 Rework material

Rework material shall not be used.

5.2.5 Characteristics

The compounds from which the components are manufactured shall conform to the requirements given in Table 1 and Table 2.

Unless otherwise specified by the applicable test method, the test pieces shall be conditioned for at least 16 h at 23 °C and 50 % relative humidity in accordance with ISO 291 before testing in accordance with Table 2.

Table 1 — Characteristics of the compound in the form of granules

Characteristic	Requirements	Test parameters		Test method
Density	PA 11 compound: (1 020 to 1 050) kg/m^3 PA 12 compound: (1 000 to 1 040) kg/m^3	Test temperature	23 °C	ISO 1183-1 ISO 1183-2
Viscosity number	$\geqslant$ 180 ml/g	Solvent	m-Cresol	ISO 307
Water content	$\leqslant$ 0,10 %			ISO 15512:1999, Method B
Carbon black content [a]	(0,5 to 1,0) % (by mass)			ISO 6964
Pigment or carbon black dispersion	Clause A.3			Annex A

[a] Only for black compound.