INTERNATIONAL STANDARD

ISO 15439-2

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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 2: Pipes

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 2: Tuyauteries

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Foreword

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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 15439-2 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*

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 2: Pipes

1 Scope

This part of ISO 15439 specifies the physical and mechanical properties of pipes made from polyamide in accordance with Part 1, 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.

In addition, this part of ISO 15439 lays down dimensional characteristics and requirements for the marking of pipes.

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

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

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

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 3127, *Thermoplastics pipes — Determination of resistance to external blows — Round-the-clock method*

ISO 4065, *Thermoplastics pipes — Universal wall thickness table*

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 11922-1:1997, *Thermoplastics pipes for the conveyance of fluids — Dimensions and tolerances — Part 1: Metric series*

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 (notch test)*

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

ISO 15439-1:2007, *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*

3 Terms and definitions, symbols and abbreviated terms

For the purposes of this document, the terms and definitions, symbols and abbreviated terms given in ISO 15439-1 apply.

4 Compound

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

The compound from which the pipes are made shall conform to ISO 15439-1.

5 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 may affect pipe performance. The pipe ends shall be cut cleanly and square to the axis of the pipe.

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 diameters of the pipe d_{em} and their tolerances shall conform to Table 1.

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

The maximum absolute out-of-roundness is not applicable for this part of ISO 15439 because the socket re-rounds the pipe spigot when solvent cement jointed.

Table 1 — Mean outside diameters

Dimensions in millimetres

Nominal outside diameter	Mean outside diameter	
d_n	$d_{em,min}$	$d_{em,max}$
12	12,0	12,2
16	16,0	16,3
18	18,0	18,2
20	20,0	20,3
23	23,0	23,2
25	25,0	25,3
32	32,0	32,3
40	40,0	40,4
50	50,0	50,4
63	63,0	63,4
75	75,0	75,5
90	90,0	90,6
110	110,0	110,7
125	125,0	125,8
140	140,0	140,9
160	160,0	161,0
180	180,0	181,1
200	200,0	201,2
225	225,0	226,4
250	250,0	251,5

6.3 Wall thicknesses and tolerances

6.3.1 Minimum wall thickness

The minimum wall thickness e_{min} shall conform to Table 2. Small diameter pipes are characterized by wall thickness. Large diameter pipes are characterized by SDR.

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

NOTE To minimize the possibility of damage to small diameter gas pipes by external influences, the use of pipes with a wall thickness not less than 1,0 mm — even if this is a higher value than according to the minimal SDR value — can be considered.

Table 2 — Minimum wall thickness

Dimensions in millimetres

Nominal outside diameter	Minimum wall thickness e_{min}	
d_n	SDR 26	SDR 33
12	1,0	1,0
16	1,0	1,0
18	1,0	1,0
20	1,0	1,0
23	1,0	1,0
25	1,0	1,0
32	1,3	1,0
40	1,6	1,3
50	1,9	1,6
63	2,5	2,0
75	2,9	2,3
90	3,5	2,8
110	4,3	3,4
125	4,9	3,8
140	5,4	4,2
160	6,2	4,9
180	7,0	5,5
200	7,7	6,1
225	8,7	6,9
250	9,7	7,6

6.3.2 Tolerances on the wall thickness at any point

The tolerances on the wall thickness at any point shall conform to Grade V of ISO 11922-1:1997. The maximum permissible variation between the nominal wall thickness e_n and the wall thickness at any point e shall conform to Table 3.

Table 3 — Tolerances on wall thickness at any point

Dimensions in millimetres

Minimum wall thickness e_{min}		Permitted positive deviation
>	⩽	
1,0	1,5	0,2
1,5	2,5	0,3
2,5	3,5	0,4
3,5	4,4	0,5
4,4	5,0	0,6
5,0	6,4	0,7
6,4	7,5	0,8
7,5	8,0	0,9
8,0	9,0	1,0
9,0	10,0	1,1
10,0	11,0	1,2

Table 4 — Mechanical characteristics

Characteristic	Requirements	Test parameters		Test method
Hydrostatic strength (20 °C, 1 000 h)	No failure during the test period of any test piece	End caps Orientation Conditioning time Type of test Circumferential (hoop) stress: PA 11 160 and PA 12 160 PA 11 180 and PA 12 180 Test period Test temperature	Type a) Free 6 h Water-in-water 19,0 MPa 20,0 MPa 1 000 h 20 °C	ISO 1167-1 ISO 1167-2
Hydrostatic strength (80 °C, 165 h)	No failure during the test period of any test piece	End caps Orientation Conditioning time Type of test Circumferential (hoop) stress: PA 11 160 and PA 12 160 PA 11 180 and PA 12 180 Test period Test temperature	Type a) Free 6 h Water-in-water 10,0 MPa 11,5 MPa 165 h 80 °C	ISO 1167-1 ISO 1167-2
Elongation at break	$\geqslant$ 200 %	Test speed	25 mm/min	ISO 6259-1 ISO 6259-3
Resistance to external blows (Round-the-clock method)	No fracture in any test piece	Conditioning time Number of test pieces Type of test Test temperature Type of striker Striker mass and drop height	4 h 6 Air (– 20 ± 2) °C d25 as specified in Table 5	ISO 3127
Resistance to slow crack growth for $e \leqslant 5$ mm (Cone test)	$v \leqslant$ 10 mm/day			ISO 13480
Resistance to slow crack growth for $e > 5$ mm (Notch test)	No failure during the test period of any test piece	Test temperature Test pressure (see NOTE): - SDR PA 11 160 and PA 12 160 PA 11 180 and PA 12 180 Test period Type of test	80 °C 26 | 33 7,2 bar | 5,6 bar 8,0 bar | 6,2 bar 500 h Water-in-water	ISO 13479
Resistance to rapid crack propagation (Critical pressure, p_c)[a]	$p_c \geqslant$ 1.5 MOP with $p_c = 7{,}8\ p_{c,S4} + 6{,}8$ [b]	Test temperature	0 °C	ISO 13477

[a] Testing is only required when the wall thickness of the pipe is greater than the wall thickness of the pipe used in the RCP test to qualify the compound (see Table 2 of ISO 15439-1:2007). For severe conditions (e.g. sub-zero temperatures) RCP testing is also recommended to establish the critical pressure of the working temperature.

[b] Alternatively the full-scale test method according to Annex C of ISO 15439-1:2007 may be used. The relation between the full-scale test and the S4 test is defined by the formula $p_{C,FS} + p_{atm} = 7{,}8\ (p_{C,S4} + p_{atm})$. In this case: $p_C = p_{C,FS}$. In case of dispute, the full-scale test is decisive.

NOTE These pressure levels are calculated to give nominal pipe hydrostatic levels of either 9 MPa in PA 11 160 and PA12 160 materials or 10 MPa in PA 11 180 and PA 12 180 materials by using the following equation:

$$p = \frac{20\sigma}{\mathrm{SDR} - 1}$$

where

σ is the hydrostatic stress, in megapascals;

SDR is the standard dimension ratio.