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EAST AFRICAN STANDARD

Plastics piping systems — Polyethylene (PE) pipes and fittings for water supply — Part 2: Pipes

EAST AFRICAN COMMUNITY

First Edition 2010

Foreword

Development of the East African Standards has been necessitated by the need for harmonizing requirements governing quality of products and services in East Africa. It is envisaged that through harmonized standardization, trade barriers which are encountered when goods and services are exchanged within the Community will be removed.

In order to meet the above objectives, the EAC Partner States have enacted an East African Standardization, Quality Assurance, Metrology and Test Act, 2006 (EAC SQMT Act, 2006) to make provisions for ensuring standardization, quality assurance, metrology and testing of products produced or originating in a third country and traded in the Community in order to facilitate industrial development and trade as well as helping to protect the health and safety of society and the environment in the Community.

East African Standards are formulated in accordance with the procedures established by the East African Standards Committee. The East African Standards Committee is established under the provisions of Article 4 of the EAC SQMT Act, 2006. The Committee is composed of representatives of the National Standards Bodies in Partner States, together with the representatives from the private sectors and consumer organizations. Draft East African Standards are circulated to stakeholders through the National Standards Bodies in the Partner States. The comments received are discussed and incorporated before finalization of standards, in accordance with the procedures of the Community.

Article 15(1) of the EAC SQMT Act, 2006 provides that "Within six months of the declaration of an East African Standard, the Partner States shall adopt, without deviation from the approved text of the standard, the East African Standard as a national standard and withdraw any existing national standard with similar scope and purpose".

East African Standards are subject to review, to keep pace with technological advances. Users of the East African Standards are therefore expected to ensure that they always have the latest versions of the standards they are implementing.

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Introduction

In the preparation of this East African Standard, the following source was consulted extensively:

ISO 4427-2:2007, *Plastics piping systems — Polyethylene (PE) pipes and fittings for water supply — Part 2: Pipes*

Assistance derived from this source and others inadvertently not mentioned is hereby acknowledged.

INTERNATIONAL STANDARD

ISO 4427-2

First edition
2007-08-01

Plastics piping systems — Polyethylene (PE) pipes and fittings for water supply —

Part 2: Pipes

Systèmes de canalisations en plastique — Tubes et raccords en polyéthylène (PE) destinés à l'alimentation en eau —

Partie 2: Tubes

Reference number
ISO 4427-2:2007(E)

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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 4427-2 was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Subcommittee SC 2, *Plastics pipes and fittings for water supplies*.

This first edition, together with ISO 4427-1, cancels and replaces ISO 4427:1996, of which it constitutes a technical revision.

ISO 4427 consists of the following parts, under the general title *Plastics piping systems — Polyethylene (PE) pipes and fittings for water supply*:

— *Part 1: General*

— *Part 2: Pipes*

— *Part 3: Fittings*

— *Part 5: Fitness for purpose of the system*

Introduction

ISO 4427, the system standard, specifies the requirements for a piping system and its components when made from polyethylene (PE). The piping system is intended to be used for water supply intended for human consumption, including the conveyance of raw water prior to treatment and that of water for general purposes.

In respect of potential adverse effects on the quality of water intended for human consumption caused by the products covered by ISO 4427:

a) ISO 4427 provides no information as to whether the products may be used without restriction;

b) existing national regulations concerning the use and/or the characteristics of these products are in force.

NOTE Guidance for assessment of conformity can be found in Bibliographical references [5] and [6].

Plastics piping systems — Polyethylene (PE) pipes and fittings for water supply —

Part 2: Pipes

1 Scope

This part of ISO 4427 specifies the pipes made from polyethylene (PE) intended for the conveyance of water for human consumption, including raw water prior to treatment and water for general purposes.

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

In conjunction with the other parts of ISO 4427, it is applicable to PE pipes, their joints, to joints with components of PE and to mechanical joints with components of other materials, intended to be used under the following conditions:

a) a maximum operating pressure (MOP) up to and including 25 bar[1)];

b) an operating temperature of 20 °C as the reference temperature.

NOTE 1 For applications operating at constant temperatures greater than 20 °C and up to 40 °C, see ISO 4427-1:2007, Annex A.

NOTE 2 ISO 4427 covers a range of maximum operating pressures and gives requirements concerning colours and additives. It is the responsibility of the purchaser or specifier to make the appropriate selections from these aspects, taking into account their particular requirements and any relevant national guidance or regulations and installation practices or codes.

Three types of pipe are specified:

— PE pipes (outside diameter d_n), including any identification stripes;

— PE pipes with co-extruded layers on either or both the outside and/or inside of the pipe (total outside diameter d_n), as specified in Annex A, where all layers have the same MRS rating.

— PE pipes (outside diameter d_n) having a peelable, contiguous, thermoplastics additional layer on the outside of the pipe ("coated pipe"), see Annex A.

1) 1 bar = 0,1 MPa = 10^5 Pa; 1 MPa = 1 N/mm^2.

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 1133:2005, *Plastics — Determination of the melt mass-flow rate (MFR) and the melt volume-flow rate (MVR) of thermoplastics*

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 4065, *Thermoplastics pipes — Universal wall thickness table*

ISO 4427-1:2007, *Plastics piping systems — Polyethylene (PE) pipes and fittings for water supply — Part 1: General*

ISO 4427-5:2007, *Plastics piping systems — Polyethylene (PE) pipes and fittings for water supply — Part 5: Fitness for purpose of the system*

ISO 4433-1:1997, *Thermoplastics pipes — Resistance to liquid chemicals — Classification — Part 1: Immersion test method*

ISO 4433-2:1997, *Thermoplastics pipes — Resistance to liquid chemicals — Classification — Part 2: Polyolefin pipes*

ISO 6259-1:1997, *Thermoplastics pipes — Determination of tensile properties — Part 1: General test method*

ISO 6259-3:1997, *Thermoplastics pipes — Determination of tensile properties — Part 3: Polyolefin pipes*

ISO 11357-6:2002, *Plastics — Differential scanning calorimetry (DSC) — Part 6: Determination of oxidation induction time*

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

3 Terms, definitions, symbols and abbreviated terms

For the purposes of this document, the terms, definitions, symbols and abbreviated terms given in ISO 4427-1 apply.

4 Material

4.1 Compound

The material from which the pipes are made shall be in accordance with ISO 4427-1.

4.2 Identification compound

Where applicable, the compound used for identification stripes and co-extruded layers (see 5.2) shall be manufactured from a PE polymer manufactured from the same type of base polymer as used in the compound for pipe production.

For co-extruded layers used for identification purposes, Annex A applies.

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 such as would prevent conformity of the pipe to this part of ISO 4427. The pipe ends shall be cut cleanly and square to the axis of the pipe.

5.2 Colour

The pipes shall be either blue or black, or black with blue stripes. For coated pipes in accordance with Annex A, this applies to the coating.

Blue pipes or black pipes with blue stripes are intended for drinking water only.

For above-ground installations, all blue components and components with non-black layers should be protected from direct UV light.

5.3 Effect on water quality

Attention is drawn to the requirements of national regulations (see also the Introduction). See ISO 4427-1:2007, Clause 5.

6 Geometrical characteristics

6.1 Measurements

The dimensions of the pipe shall be measured in accordance with ISO 3126. In case of dispute, the measurements of dimensions shall be made not less than 24 h after manufacture and after conditioning for at least 4 h at (23 ± 2) °C.

6.2 Mean outside diameter and out-of-roundness (ovality)

The mean outside diameters, d_{em}, and the out-of-roundness (ovality) shall be in accordance with Table 1.

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

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter d_n	Mean outside diameter [a]		Maximum out-of-roundness (ovality) [b]
		$d_{em\ min}$	$d_{em\ max}$	
16	16	16,0	16,3	1,2
20	20	20,0	20,3	1,2
25	25	25,0	25,3	1,2
32	32	32,0	32,3	1,3
40	40	40,0	40,4	1,4
50	50	50,0	50,4	1,4
63	63	63,0	63,4	1,5
75	75	75,0	75,5	1,6
90	90	90,0	90,6	1,8
110	110	110,0	110,7	2,2
125	125	125,0	125,8	2,5
140	140	140,0	140,9	2,8
160	160	160,0	161,0	3,2
180	180	180,0	181,1	3,6
200	200	200,0	201,2	4,0
225	225	225,0	226,4	4,5
250	250	250,0	251,5	5,0
280	280	280,0	281,7	9,8
315	315	315,0	316,9	11,1
355	355	355,0	357,2	12,5
400	400	400,0	402,4	14,0
450	450	450,0	452,7	15,6
500	500	500,0	503,0	17,5
560	560	560,0	563,4	19,6
630	630	630,0	633,8	22,1
710	710	710,0	716,4	—
800	800	800,0	807,2	—
900	900	900,0	908,1	—
1 000	1 000	1 000,0	1 009,0	—
1 200	1 200	1 200,0	1 210,8 [c]	—
1 400	1 400	1 400,0	1 412,6 [c]	—
1 600	1 600	1 600,0	1 614,4 [c]	—
1 800	1 800	1 800,0	1 816,2 [c]	—
2 000	2 000	2 000,0	2 018,0 [c]	—

For coiled pipe and for straight lengths with diameters $\geqslant$ 710, the maximum out-of-roundness shall be agreed between manufacturer and purchaser.

[a] In accordance with ISO 11922-1:1997, grade B, for sizes $\leqslant$ 630 and grade A for sizes $\geqslant$ 710.

[b] In accordance with ISO 11922-1:1997, grade N, for sizes $\leqslant$ 630, is measured at the point of manufacture.

[c] Tolerance calculated as 0,009 d_{em} and does not conform to grade A in ISO 11922-1:1997.

NOTE Tolerance bands in accordance with ISO 11922-1 are calculated as follows, as applicable.

a) Grade A: $0{,}009 d_n$ rounded to the next greater 0,1 mm with a minimum value of 0,3 mm and a maximum value of 10,0 mm.

b) Grade B: $0{,}006 d_n$ rounded up to the next greater 0,1 mm with a minimum value of 0,3 mm and a maximum value of 4,0 mm.

c) Grade N:

— for diameters $\leqslant$ 75 mm $(0{,}008\ d_n + 1)$ mm,

— for diameters $\geqslant$ 90 mm and $\leqslant$ 250 mm $(0{,}02\ d_n)$ mm,

— for diameters $>$ 250 mm $(0{,}035\ d_n)$ mm,

rounded up to the next 0,1 mm.

6.3 Wall thicknesses and their tolerances

The wall thickness shall be in accordance with Table 2.

NOTE The relationship between PN, MRS, S and SDR is given in Annex B.

Table 2 — Wall thicknesses

	Pipe series											
	SDR 6		SDR 7,4		SDR 9		SDR 11		SDR 13,6		SDR 17	
	S 2,5		S 3,2		S 4		S 5		S 6,3		S 8	
	Nominal pressure (PN) [a] bar											
PE 40	—		PN 10		PN 8		—		PN 5		PN 4	
PE 63	—		—		—		PN 10		PN 8		—	
PE 80	PN 25		PN 20		PN 16		PN 12,5		PN 10		PN 8	
PE 100	—		PN 25		PN 20		PN 16		PN 12,5		PN 10	
Nominal size	Wall thicknesses [b] mm											
	e_{min}	e_{max}	e_{min}	e_{max}	e_{min}	e_{max}	e_{min}	e_{max}	e_{min}	e_{max}	e_{min}	e_{max}
16	3,0	3,4	2,3 [c]	2,7	2,0 [c]	2,3	—	—	—	—	—	—
20	3,4	3,9	3,0	3,4	2,3 [c]	2,7	2,0 [c]	2,3	—	—	—	—
25	4,2	4,8	3,5	4,0	3,0	3,4	2,3 [c]	2,7	2,0 [c]	2,3	—	—
32	5,4	6,1	4,4	5,0	3,6	4,1	3,0	3,4	2,4	2,8	2,0 [c]	2,3
40	6,7	7,5	5,5	6,2	4,5	5,1	3,7	4,2	3,0	3,5	2,4	2,8
50	8,3	9,3	6,9	7,7	5,6	6,3	4,6	5,2	3,7	4,2	3,0	3,4
63	10,5	11,7	8,6	9,6	7,1	8,0	5,8	6,5	4,7	5,3	3,8	4,3
75	12,5	13,9	10,3	11,5	8,4	9,4	6,8	7,6	5,6	6,3	4,5	5,1
90	15,0	16,7	12,3	13,7	10,1	11,3	8,2	9,2	6,7	7,5	5,4	6,1
110	18,3	20,3	15,1	16,8	12,3	13,7	10,0	11,1	8,1	9,1	6,6	7,4
125	20,8	23,0	17,1	19,0	14,0	15,6	11,4	12,7	9,2	10,3	7,4	8,3
140	23,3	25,8	19,2	21,3	15,7	17,4	12,7	14,1	10,3	11,5	8,3	9,3
160	26,6	29,4	21,9	24,2	17,9	19,8	14,6	16,2	11,8	13,1	9,5	10,6
180	29,9	33,0	24,6	27,2	20,1	22,3	16,4	18,2	13,3	14,8	10,7	11,9
200	33,2	36,7	27,4	30,3	22,4	24,8	18,2	20,2	14,7	16,3	11,9	13,2
225	37,4	41,3	30,8	34,0	25,2	27,9	20,5	22,7	16,6	18,4	13,4	14,9
250	41,5	45,8	34,2	37,8	27,9	30,8	22,7	25,1	18,4	20,4	14,8	16,4
280	46,5	51,3	38,3	42,3	31,3	34,6	25,4	28,1	20,6	22,8	16,6	18,4
315	52,3	57,7	43,1	47,6	35,2	38,9	28,6	31,6	23,2	25,7	18,7	20,7
355	59,0	65,0	48,5	53,5	39,7	43,8	32,2	35,6	26,1	28,9	21,1	23,4

Table 2 (*continued*)

	Pipe series											
	SDR 6		SDR 7,4		SDR 9		SDR 11		SDR 13,6		SDR 17	
	S 2,5		S 3,2		S 4		S 5		S 6,3		S 8	
	Nominal pressure (PN) [a] bar											
PE 40	—		PN 10		PN 8		—		PN 5		PN 4	
PE 63	—		—		—		PN 10		PN 8		—	
PE 80	PN 25		PN 20		PN 16		PN 12,5		PN 10		PN 8	
PE 100	—		PN 25		PN 20		PN 16		PN 12,5		PN 10	
Nominal size	Wall thicknesses [b] mm											
	e_{min}	e_{max}	e_{min}	e_{max}	e_{min}	e_{max}	e_{min}	e_{max}	e_{min}	e_{max}	e_{min}	e_{max}
400	—	—	54,7	60,3	44,7	49,3	36,3	40,1	29,4	32,5	23,7	26,2
450	—	—	61,5	67,8	50,3	55,5	40,9	45,1	33,1	36,6	26,7	29,5
500	—	—	—	—	55,8	61,5	45,4	50,1	36,8	40,6	29,7	32,8
560	—	—	—	—	62,5	68,9	50,8	56,0	41,2	45,5	33,2	36,7
630	—	—	—	—	70,3	77,5	57,2	63,1	46,3	51,1	37,4	41,3
710	—	—	—	—	79,3	87,4	64,5	71,1	52,2	57,6	42,1	46,5
800	—	—	—	—	89,3	98,4	72,6	80,0	58,8	64,8	47,4	52,3
900	—	—	—	—	—	—	81,7	90,0	66,2	73,0	53,3	58,8
1 000	—	—	—	—	—	—	90,2	99,4	72,5	79,9	59,3	65,4
1 200	—	—	—	—	—	—	—	—	88,2	97,2	67,9	74,8
1 400	—	—	—	—	—	—	—	—	102,9	113,3	82,4	90,8
1 600	—	—	—	—	—	—	—	—	117,6	129,5	94,1	103,7
1 800	—	—	—	—	—	—	—	—	—	—	105,9	116,6
2 000	—	—	—	—	—	—	—	—	—	—	117,6	129,5

Table 2 (*continued*)

	Pipe series			
	SDR 21	**SDR 26**	**SDR 33**	**SDR 41**
	S 10	**S 12,5**	**S 16**	**S 20**
	Nominal pressure (PN) [a] bar			
PE 40	**PN 3,2**	**PN 2,5**	**—**	**—**
PE 63	**PN 5**	**PN 4**	**PN 3,2**	**PN 2,5**
PE 80	**PN 6** [d]	**PN 5**	**PN 4**	**PN 3,2**
PE 100	**PN 8**	**PN 6** [c]	**PN 5**	**PN 4**

Nominal size	**Wall thicknesses** [b] mm							
	e_{min}	e_{max}	e_{min}	e_{max}	e_{min}	e_{max}	e_{min}	e_{max}
16	—	—	—	—	—	—	—	—
20	—	—	—	—	—	—	—	—
25	—	—	—	—	—	—	—	—
32	—	—	—	—	—	—	—	—
40	2,0 [c]	2,3	—	—	—	—	—	—
50	2,4	2,8	2,0	2,3	—	—	—	—
63	3,0	3,4	2,5	2,9	—	—	—	—
75	3,6	4,1	2,9	3,3	—	—	—	—
90	4,3	4,9	3,5	4,0	—	—	—	—
110	5,3	6,0	4,2	4,8	—	—	—	—
125	6,0	6,7	4,8	5,4	—	—	—	—
140	6,7	7,5	5,4	6,1	—	—	—	—
160	7,7	8,6	6,2	7,0	—	—	—	—
180	8,6	9,6	6,9	7,7	—	—	—	—
200	9,6	10,7	7,7	8,6	—	—	—	—
225	10,8	12,0	8,6	9,6	—	—	—	—
250	11,9	13,2	9,6	10,7	—	—	—	—
280	13,4	14,9	10,7	11,9	—	—	—	—
315	15,0	16,6	12,1	13,5	9,7	10,8	7,7	8,6
355	16,9	18,7	13,6	15,1	10,9	12,1	8,7	9,7

Table 2 (*continued*)

	Pipe series							
	SDR 21		**SDR 26**		**SDR 33**		**SDR 41**	
	S 10		**S 12,5**		**S 16**		**S 20**	
	Nominal pressure (PN) [a] bar							
PE 40	**PN 3,2**		**PN 2,5**		**—**		**—**	
PE 63	**PN 5**		**PN 4**		**PN 3,2**		**PN 2,5**	
PE 80	**PN 6** [d]		**PN 5**		**PN 4**		**PN 3,2**	
PE 100	**PN 8**		**PN 6** [c]		**PN 5**		**PN 4**	
Nominal size	**Wall thicknesses** [b] mm							
	e_{min}	e_{max}	e_{min}	e_{max}	e_{min}	e_{max}	e_{min}	e_{max}
400	19,1	21,2	15,3	17,0	12,3	13,7	9,8	10,9
450	21,5	23,8	17,2	19,1	13,8	15,3	11,0	12,2
500	23,9	26,4	19,1	21,2	15,3	17,0	12,3	13,7
560	26,7	29,5	21,4	23,7	17,2	19,1	13,7	15,2
630	30,0	33,1	24,1	26,7	19,3	21,4	15,4	17,1
710	33,9	37,4	27,2	30,1	21,8	24,1	17,4	19,3
800	38,1	42,1	30,6	33,8	24,5	27,1	19,6	21,7
900	42,9	47,3	34,4	38,3	27,6	30,5	22,0	24,3
1 000	47,7	52,6	38,2	42,2	30,6	33,5	24,5	27,1
1 200	57,2	63,1	45,9	50,6	36,7	40,5	29,4	32,5
1 400	66,7	73,5	53,5	59,0	42,9	47,3	34,3	37,9
1 600	76,2	84,0	61,2	67,5	49,0	54,0	39,2	43,3
1 800	85,7	94,4	69,1	76,2	54,5	60,1	43,8	48,3
2 000	95,2	104,9	76,9	84,7	60,6	66,8	48,8	53,8

NOTE 1 bar = 0,1 MPa = 10^5 Pa; 1 MPa = 1 N/mm^2.

[a] PN values are based on $C = 1{,}25$.

[b] Tolerances in accordance with ISO 11922-1:1997, grade V, calculated from $(0{,}1e_{min} + 0{,}1)$ mm rounded up to the next 0,1 mm. For certain applications for $e > 30$ mm, ISO 11922-1:1997, grade T, tolerances may be used calculated from 0,15 e_{min} rounded up to the next 0,1 mm.

[c] The calculated value of e_{min} according to ISO 4065 is rounded up to the nearest value of either 2,0, 2,3 or 3,0. This is to satisfy certain national requirements. For practical reasons, a wall thickness of 3,0 mm is recommended for electrofusion jointing and lining applications.

[d] Actual calculated values are 6,4 bar for PE 100 and 6,3 bar for PE 80.

6.4 Coiled pipe

The pipe shall be coiled such that localized deformation, e.g. buckling and kinking, is prevented.

The minimum internal diameter of the coil shall be not less than $18d_n$.

6.5 Lengths

No requirements have been set concerning particular lengths of coiled or straight pipe or the tolerance thereon; hence, it is necessary for lengths of pipe to be supplied by agreement between purchaser and manufacturer.

7 Mechanical characteristics

7.1 Conditioning

Unless otherwise specified in the applicable test method, the test pieces shall be conditioned at (23 ± 2) °C prior to testing.

7.2 Requirements

The test pieces shall be tested in accordance with Table 3. When tested using the test method and parameters specified therein, the pipe shall have mechanical characteristics conforming to the requirements of Table 3.

Table 3 — Mechanical characteristics

Characteristic	Requirement	Test parameters		Test method(s)
		Parameter	Value	
Hydrostatic strength at 20 °C	No failure of any test piece during test period	End caps	Type a) [a]	ISO 1167-1 ISO 1167-2
		Conditioning period	According to ISO 1167-1	
		Number of test pieces [b]	3	
		Type of test	Water-in-water	
		Test temperature	20 °C	
		Test period	100 h	
		Circumferential (hoop) stress for:		
		PE 40	7,0 MPa	
		PE 63	8,0 MPa	
		PE 80	10,0 MPa	
		PE 100	12,4 MPa	

Table 3 (*continued*)

Characteristic	Requirement	Test parameters		Test method(s)
		Parameter	Value	
Hydrostatic strength at 80 °C	No failure of any test piece during test period	End caps	Type a) [a]	ISO 1167-1 ISO 1167-2
		Conditioning period	According to ISO 1167-1	
		Number of test pieces [b]	3	
		Type of test	Water-in-water	
		Test temperature	80 °C	
		Test period	165 h [c]	
		Circumferential (hoop) stress for:		
		PE 40	2,5 MPa	
		PE 63	3,5 MPa	
		PE 80	4,5 MPa	
		PE 100	5,4 MPa	
Hydrostatic strength at 80 °C	No failure of any test piece during test period	End caps	Type a) [a]	ISO 1167-1 ISO 1167-2
		Conditioning period	According to ISO 1167-1	
		Number of test pieces [b]	3	
		Type of test	Water-in-water	
		Test temperature	80 °C	
		Test period	1 000 h	
		Circumferential (hoop) stress for:		
		PE 40	2,0 MPa	
		PE 63	3,2 MPa	
		PE 80	4,0 MPa	
		PE 100	5,0 MPa	

NOTE The characteristic resistance to slow crack growth is dealt with in ISO 4427-1 as a material property measured in the form of pipe.

[a] Type b) end caps may be used for batch release tests for diameters $\geqslant$ 500 mm.

[b] The number of test pieces given indicates the quantity required to establish a value for the characteristic described in this table. The number of test pieces required for factory production control and process control should be listed in the manufacturer's quality plan.

[c] Premature ductile failures are not to be taken into account. For retest procedure, see 7.3.

7.3 Retest in case of failure at 80 °C

A fracture in a brittle mode in less than 165 h shall constitute a failure; however, if a sample in the 165 h test fails in a ductile mode in less than 165 h, a retest shall be performed at a selected lower stress in order to achieve the minimum required time for the selected stress obtained from the line through the stress/time points given in Table 4.

Table 4 — Test parameters for the retest of the hydrostatic strength at 80°C

PE 40		PE 63		PE 80		PE 100	
Stress MPa	**Test period** h	**Stress** MPa	**Test period** h	**Stress** MPa	**Test period** h	**Stress** MPa	**Test period** h
2,5	165	3,5	165	4,5	165	5,4	165
2,4	230	3,4	295	4,4	233	5,3	256
2,3	323	3,3	538	4,3	331	5,2	399
2,2	463	3,2	1 000	4,2	474	5,1	629
2,1	675			4,1	685	5,0	1 000
2,0	1 000			4,0	1 000		

8 Physical characteristics

8.1 Conditioning

Unless otherwise specified in the applicable test method, the test pieces shall be conditioned at (23 ± 2) °C prior to testing.

8.2 Requirements

The test pieces shall be tested in accordance with Table 5. When tested using the test method and parameters specified therein, the pipe shall have physical characteristics conforming to the requirements of Table 5.

Table 5 — Physical characteristics — All pipes

Characteristic	Requirement	Test parameters		Test method(s)
		Parameter	Value	
Elongation at break for $e \leqslant 5$ mm	$\geqslant 350$ %	Test piece shape Test speed Number of test pieces [b]	Type 2 100 mm/min According to ISO 6259	ISO 6259-1 ISO 6259-3
Elongation at break for 5 mm $< e \leqslant 12$ mm	$\geqslant 350$ %	Test piece shape Test speed Number of test pieces [b]	Type 1 [a] 50 mm/min According to ISO 6259	ISO 6259-1 ISO 6259-3
Elongation at break for $e > 12$ mm	$\geqslant 350$ %	Test piece shape Test speed Number of test pieces [b] OR Test piece shape Test speed Number of test pieces [b]	Type 1 [a] 25 mm/min According to ISO 6259 Type 3 [a] 10 mm/min According to ISO 6259	ISO 6259-1 ISO 6259-3
Longitudinal reversion	$\leqslant 3$ % No effect on surface	Shape and number of test pieces [c] Test temperature: PE 40 PE 63, PE 80, PE 100 Time	According to ISO 2505 100 ± 2 °C 110 ± 2 °C See ISO 2505	ISO 2505
Melt mass-flow rate MFR for PE 40	Change of MFR by processing ± 20 % [d]	Load Test temperature Time Number of test pieces [b]	2,16 kg 190 °C 10 min According to ISO 1133	ISO 1133:2005, Condition D
Melt mass-flow rate MFR for PE 63, PE 80, PE 100	Change of MFR by processing ± 20 % [d]	Load Test temperature Time Number of test pieces [b]	5,0 kg 190 °C 10 min According to ISO 1133	ISO 1133:2005, Condition T
Oxidation induction time	$\geqslant 20$ min	Test temperature Number of test pieces [b, f]	200 °C [e] 3	ISO 11357-6:2002
Effect on water quality	National regulations apply			

[a] Where practical, machined type 2 test pieces may be used for pipe wall thicknesses $\leqslant 25$ mm. The test may be terminated when the requirement is met, without continuing until the rupture of the test piece.

[b] The number of test pieces given indicates the quantity required to establish a value for the characteristic described in this table. The number of test pieces required for factory production control and process control should be listed in the manufacturer's quality plan.

[c] For pipes with an outside diameter > 200 mm, longitudinally cut segments may be used.

[d] Value as measured on the pipe relative to the value measured on the compound used.

[e] The test may be carried out as an indirect test at 210 °C provided there is a clear correlation to the results at 200 °C. In case of dispute, the reference temperature shall be 200 °C.

[f] Samples are to be taken from the inner wall surface.

9 Chemical characteristics of pipes in contact with chemicals

If, for a particular installation, it is necessary to evaluate the chemical resistance of the pipe, then the pipe shall be classified in accordance with ISO 4433-1 and ISO 4433-2.

NOTE Guidance for the resistance of polyethylene pipes to chemicals is given in ISO/TR 10358 [1].

10 Performance requirements

When pipes conforming to this part of ISO 4427 are assembled to each other or to components conforming to other parts of ISO 4427, the joints shall be in accordance with ISO 4427-5.

11 Marking

11.1 General

All pipes shall be permanently and legibly marked in such a way that the marking does not initiate cracks or other types of failure and such that normal storage, weathering, handling, installation and use does not affect the legibility of the marking.

If printing is used, the colour of the printed information shall differ from the basic colour of the product.

The marking shall be such that it is legible without magnification.

11.2 Minimum required marking of pipes

The minimum required marking shall be in accordance with Table 6, with the frequency of marking being not less than once per metre.

Table 6 — Minimum required marking

Aspect	Marking
Standard number	ISO 4427
Manufacturer's identification	Name or symbol
Dimensions ($d_n \times e_n$)	e.g. 110 × 10
SDR series (for DN > 32)	e.g. SDR 11
Material and designation	e.g. PE 80
Pressure rating in bar	e.g. PN 12,5
Production period (date or code)	e.g. 0204 [a]
Coils shall be sequentially marked with the metreage, indicating the length remaining on the coil. The word “water” or code “W” may also be included if the pipe is intended for drinking water.	

[a] In clear figures or in code providing traceability to the production period within year and month and, if the manufacturer is producing at different sites, the production site.

Annex A
(normative)

Layered pipes

A.1 General

This annex specifies the additional geometrical, mechanical and physical properties of layered polyethylene (PE) pipes intended to be used for the supply of water. Additional marking requirements are given in A.3.4.

Two types of layered pipes are covered:

a) PE pipes with a co-extruded black or pigmented layer of the same MRS rating on the outside of the pipe (total outside diameter d_n) (see A.2);

b) PE pipes (outside diameter d_n) with a non-bonded, contiguous, thermoplastics additional layer on the outside of the pipe ("coated pipe") and thus having a total outside diameter of $d_n + 2e_{coating}$ (see A.3).

NOTE Other types of layered pipes could be covered by other standards (e.g. References [3] and [4]).

A.2 Pipe with coloured identification layer

A.2.1 Geometrical characteristics

The geometrical characteristics of the pipe, inclusive of the coloured identification layer, shall be in accordance with Clause 6.

A.2.2 Mechanical characteristics

The mechanical characteristics of the pipe, inclusive of the coloured identification layer, shall be in accordance with Clause 7.

A.2.3 Physical characteristics

The physical characteristics shall be in accordance with Clause 8. The requirements for thermal stability (OIT) and for melt-flow rate shall apply to the individual layers respectively. Longitudinal heat reversion shall be applicable to the pipe, inclusive of the coloured identification layer.

A.2.4 Marking

The marking of pipes with coloured identification layers shall be in accordance with Clause 11.

A.3 Coated pipe

A.3.1 Geometrical characteristics

The geometrical characteristics of the pipe, exclusive of the coating, shall be in accordance with Clause 6.

A.3.2 Mechanical characteristics

The mechanical characteristics of the pipe, exclusive of the coating, shall be in accordance with Clause 7. The coating shall not have a detrimental effect on the ability of the pipe to conform to Clause 7.

It is preferred that the pipe be tested exclusive of the coating. If the pipe is tested with the coating attached, it shall be ensured that the conditions selected result in the pipe being subjected to the specified test stress. In case of dispute, the pipe shall be tested exclusive of its coating.

A.3.3 Physical characteristics

The physical characteristics of the pipe, exclusive of the coating, shall be in accordance with Clause 8. The coating shall not have a detrimental effect on the pipe or vice versa.

A.3.4 Marking

Marking shall be applied to the coating and shall be in accordance with Clause 11.

In addition, the coating shall be provided with marking clearly distinguishing the pipe from non-coated pipe in service (e.g. by broad colour bands). The coating shall also carry marking warning that the coating must be removed prior to fusion and mechanical jointing.

Annex B
(informative)

Relationship between PN, MRS, S and SDR

The relationship between nominal pressure, PN, design stress, σ_s, and the series S/SDR is given by the following equation:

$$PN = \frac{10\sigma_S}{S} \text{ or } PN = \frac{20\sigma_S}{SDR - 1}$$

Examples of the relationship between PN, MRS, S, and SDR based on

$$\sigma_S = \frac{MRS}{C}$$

are given in Table B.1, where $C = 1{,}25$.

NOTE The nominal pressures (PN) given in Table B.1 are based on the use of an overall design coefficient of $C = 1{,}25$. However, if a higher value for C is required, the PN values will have to be recalculated using the above equations and based on the calculated design stress, σ_s, for each material class. A higher value for C can also be obtained by choosing a higher PN class.

Table B.1 —Examples of the relationship between PN, MRS, S and SDR at 20 °C ($C = 1{,}25$)

SDR	S	Nominal pressure for material class bar			
		PE 40	PE 63	PE 80	PE 100
41	20	—	2,5	3,2	4
33	16	—	3,2	4	5
26	12,5	2,5	4	5	6 [a]
21	10	3,2	5	6 [a]	8
17	8	4	6 [a]	8	10
13,6	6,3	5	8	10	12,5
11	5	—	10	12,5	16
9	4	8	—	16	20
7,4	3,2	10	—	20	25
6	2,5	—	—	25	—

NOTE 1 bar = 0,1 MPa = 10^5 Pa; 1 MPa = 1 N/mm^2.

[a] Actual calculated values are 6,4 bar for PE 100 and 6,3 bar for PE 80 and PE 63.

Bibliography

[1] ISO/TR 10358, *Plastics pipes and fittings — Combined chemical-resistance classification table*

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

[3] ISO 21003-2[2)], *Multilayer piping systems for hot and cold water installations inside buildings — Part 2: Pipes*

[4] ISO 21004, *Plastics piping systems — Multilayer pipes and their joints, based on thermoplastics, for water supply*

[5] CEN/TS 12201-7, *Plastics piping systems for water supply — Polyethylene (PE) — Part 7: Guidance for the assessment of conformity*

[6] CEN/TS 13244-7, *Plastics piping systems for buried and above-ground pressure systems for water for general purposes, drainage and sewerage — Polyethylene (PE) — Part 7: Guidance for the assessment of conformity*

2) To be published.

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