INTERNATIONAL STANDARD

ISO 4427

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Polyethylene (PE) pipes for water supply — Specifications

Tubes en polyéthylène (PE) destinés à l'alimentation en eau — Spécifications

Reference number
ISO 4427:1996(E)

Contents

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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.

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.

International Standard ISO 4427 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*.

Annex A forms an integral part of this International Standard.

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Polyethylene (PE) pipes for water supply — Specifications

1 Scope

This International Standard specifies the required properties of pipes made from polyethylene (PE) to be used for buried water mains and services and for water supply above ground both inside and outside buildings. In addition, it specifies some general properties of the material from which these pipes are made, including a classification scheme.

This International Standard applies to pipes with a nominal pressure of PN 3,2, PN 4, PN 6, PN 8, PN 10, PN 12,5 and PN 16, and nominal outside diameters from 16 to 1 600 (see ISO 161-1), intended to be used for the conveyance of water under pressure at temperatures between 0 °C and 40 °C for general purposes, as well as for the supply of drinking water.

NOTE 1 — Some countries may require specific colour identification for pipes for water intended for human consumption.

For temperatures between 20 °C and 40 °C, the working pressure factor given in figure 1 shall be applied, provided that extrapolation results obtained in accordance with ISO/TR 9080 show this to be possible.

If PE pipes are used above ground, they should preferably be physically protected against UV light in accordance with recommended practice.

NOTE 2 — For information, certain requirements, figures or remarks are given, which have been extracted from appropriate International Standards.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 161-1:1996, *Thermoplastics pipes for the conveyance of fluids — Nominal outside diameters and nominal pressures — Part 1: Metric series.*

ISO 1133:1996, *Plastics — Determination of the melt mass-flow rate (MFR) and the melt volume-flow rate (MVR) of thermoplastics.*

ISO 1167:1996, *Thermoplastics pipes for the conveyance of fluids — Resistance to internal pressure — Test method.*

ISO 2505-1:1994, *Thermoplastics pipes — Longitudinal reversion — Part 1: Determination methods.*

ISO 2505-2:1994, *Thermoplastics pipes — Longitudinal reversion — Part 2: Determination parameters.*

ISO 3126:1974, *Plastic pipes — Measurement of dimensions.*

ISO 4065:1996, *Thermoplastic pipes — Universal wall thickness table.*

ISO 4607:1978, *Plastics — Methods of exposure to natural weathering.*

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

ISO 6259-3:— [1], *Thermoplastics pipes — Determination of tensile properties — Part 3: Polyolefin pipes.*

ISO 6964:1986, *Polyolefin pipes and fittings — Determination of carbon black content by calcination and pyrolysis— Test method and basic specification.*

ISO/TR 9080:1992, *Thermoplastics pipes for the transport of fluids — Methods of extrapolation of hydrostatic stress rupture data to determine the long-term hydrostatic strength of thermoplastics pipe materials.*

ISO/TR 10837:1991, *Determination of the thermal stability of polyethylene (PE) for use in gas pipes and fittings.*

ISO 11420:1996, *Method for the assessment of the degree of carbon black dispersion in polyolefin pipes, fittings and compounds.*

ISO 11922-1:— [2], *Thermoplastics pipes for the conveyance of fluids — Dimensions and tolerances — Part 1: Metric series.*

ISO 12162:1995, *Thermoplastics materials for pipes and fittings for pressure applications — Classification and designation — Overall service (design) coefficient.*

ISO 13761:1996, *Plastics pipes and fittings — Pressure reduction factors for polyethylene pipeline systems for use at temperatures above 20 °C.*

ISO 13949:— [1], *Method for the assessment of the degree of pigment dispersion in polyolefin pipes, fittings and compounds.*

Guidelines for drinking water quality, Volume 1: Recommendations, WHO, Geneva, 1984.

EEC Council Directive of 15th July 1980 on the quality of water intended for human consumption, Official Journal of the European Communities, L229, pp.11 to 29.

3 Material

3.1 Compounds

3.1.1 General

The pipes shall be manufactured from polyethylene containing only those antioxidants, UV stabilizers and pigments necessary for the manufacture of pipes conforming to this specification and for its end use, including weldability when it is possible. The pipes for drinking water shall be either black or blue or black with blue stripes.

1) To be published.

2) To be published. (Revision of ISO 3606:1976, ISO 3607:1977, ISO 3608:1976 and ISO 3609:1977)

3.1.2 Black pipes

For black pipes, the carbon black content in the compound shall be (2,25 ± 0,25) % by mass, when measured in accordance with ISO 6964.

3.1.3 Blue pipes and stripes

The use of the colour blue or black with blue stripes shall be specified in accordance with national requirements.

The material for the stripes shall be of the same type of resin as used in the base compound for the pipe.

3.2 Dispersion of pigments in compounds

3.2.1 Dispersion of carbon black

When determined in accordance with ISO 11420, the dispersion of the carbon black shall be equal to or less than grade 3.

3.2.2 Dispersion of blue pigments

When determined in accordance with ISO 13949, the dispersion of blue pigment shall be equal to or less than grade 3.

3.3 Thermal stability

When determined in accordance with ISO/TR 10837, the induction time for materials PE 63, PE 80 and PE 100 shall be either at least 20 min when tested at 200 °C, or an equivalent period when tested at 210 °C, provided the equivalence is supported by a clear correlation between results obtained at 200 °C or 210 °C, respectively.

In cases of dispute, the test temperature shall be 200 °C.

3.4 Reworked material

Clean reworked material generated from a manufacturer's own production of pipe in accordance with this specification may be used if it is derived from the same resin as used for the relevant production.

3.5 Effects on water quality of pipes intended for the conveyance of water for human consumption

When used under conditions for which they are designed, materials in contact with or likely to come into contact with drinking water shall not constitute a toxic hazard, shall not support microbial growth and shall not give rise to unpleasant taste or odour, cloudiness or discoloration of the water.

The concentrations of substances, chemicals and biological agents leached from materials in contact with drinking water, and measurements of the relevant organoleptic/physical parameters, shall not exceed the maximum values recommended by the World Health Organization in its publication *Guidelines for drinking water quality*, Volume 1: *Recommendations*, or as required by the EEC Council Directive of 15 July 1980 on the quality of water intended for human consumption, whichever is the more stringent in each case.

NOTE — Certain additional requirements may apply, as required, due to local water quality and safety regulations.

3.6 Designation and classification

The compound shall be designated by the material type (e.g. PE 80) conforming to the applicable level of minimum required strength (MRS) specified in table 1, when the lower confidence limit σ_{LCL} for the compound is determined in accordance with ISO/TR 9080 and this σ_{LCL} is classified in accordance with ISO 12162 to obtain the MRS.

The validity of the designation shall be certified by the compound manufacturer or, in the case of master-batches, by the pipe manufacturer.

The design stress σ_s of a pipe shall be obtained by applying a design coefficient C of not less than 1,25 to the MRS value for the material.

NOTE — Engineers may wish to apply a greater design coefficient in accordance with ISO 12162, depending on operating conditions and environmental considerations.

Table 1 — Designation of material

Designation of material	MRS at 50 years and 20 °C MPa	Maximum allowable hydrostatic design stress, σ_s MPa
PE 100	10	8
PE 80	8	6,3
PE 63	6,3	5
PE 40	4	3,2
PE 32	3,2	2,5

The relationship between MRS and σ_s for various design coefficients is given in table 2.

Table 2 — Relationship between MRS, σ_s and design coefficient C at 20 °C

Hydrostatic design stress of pipe, σ_s MPa	Minimum required strength of material MPa				
	10	8	6,3	4	3,2
	Design coefficient, C				
8	1,25				
6,3	1,6	1,25			
5	2	1,6	1,25		
4	2,5	2	1,6		
3,2	3,2	2,5	2	1,25	
2,5	—	3,2	2,5	1,6	1,25

3.7 Melt flow rate and density

The pipe manufacturer shall provide evidence of the density and the melt flow rate of the raw compound.

When measured in accordance with ISO 1133, the melt flow rate shall conform to the following conditions:

a) the melt flow rate of the compound shall not deviate by more than ± 30 % from the value specified by the manufacturer;

b) the change in MFR caused by processing, i.e. the difference between the measured value for material from the pipe and the measured value for the compound, shall not be more than 25 %.

4 Geometrical characteristics

4.1 Dimensions of pipes: outside diameters, nominal pressures and wall thicknesses

4.1.1 The dimensions of pipes shall be measured in accordance with ISO 3126.

4.1.2 Nominal outside diameters shall conform to ISO 161-1. The selected nominal outside diameters and the wall thicknesses in accordance with the selected nominal pressures are given in table 3 (σ_s = 8 MPa), table 4 (σ_s = 6,3 MPa), table 5 (σ_s = 5 MPa) and table 6 (σ_s = 2,5 MPa and 3,2 MPa).

4.1.3 The tolerances on the outside diameters shall be in accordance with ISO 11922-1, as follows:

grade A for normal-tolerance (NT) pipes

grade B for close-tolerance (CT) pipes

Table 3 — Polyethylene pipes with a design stress σ_s of 8 MPa

Nominal outside diameter d_n	Pipe series [1]		
	S 8	S 6,3	S 5
	Standard dimension ratio		
	SDR 17	SDR 13,6	SDR 11
	Nominal pressure PN [2] for σ_s = 8 MPa		
	PN 10	PN 12,5	PN 16
	Nominal wall thickness, e_n mm		
32	—	—	3,0
40	—	—	3,7
50	—	—	4,6
63	—	4,7	5,8
75	4,5	5,6	6,8
90	5,4	6,7	8,2
110	6,6	8,1	10,0
125	7,4	9,2	11,4
140	8,3	10,3	12,7
160	9,5	11,8	14,6
180	10,7	13,3	16,4
200	11,9	14,7	18,2
225	13,4	16,6	20,5
250	14,8	18,4	22,7
280	16,6	20,6	25,4
315	18,7	23,2	28,6
355	21,1	26,1	32,2
400	23,7	29,4	36,3
450	26,7	33,1	40,9
500	29,7	36,8	45,4
560	33,2	41,2	50,8
630	37,4	46,2	57,2
710	42,1	52,2	—
800	47,4	58,8	—
900	53,3	—	—
1 000	59,3	—	—

1) The pipe series number is derived from the ratio σ_s/p_{PMS}, where σ_s is the design stress at 20 °C and p_{PMS} is the maximum allowable operating pressure of the pipe at 20 °C.

2) The nominal pressure PN corresponds to the maximum allowable operating pressure p_{PMS}, in bars, of the pipe at 20 °C.

Table 4 — Polyethylene pipes with a design stress σ_s of 6,3 MPa

Nominal outside diameter d_n	Pipe series [1]				
	S 10	S 8	S 6,3	S 5	S 4
	Standard dimension ratio				
	SDR 21	SDR 17	SDR 13,6	SDR 11	SDR 9
	Nominal pressure PN [2] for σ_s = 6,3 MPa				
	PN 6 [3]	PN 8	PN 10	PN 12,5	PN 16
	Nominal wall thickness, e_n mm				
16	—	—	—	—	2,3
20	—	—	—	—	2,3
25	—	—	—	2,3	2,8
32	—	—	—	3,0	3,6
40	—	—	—	3,7	4,5
50	—	—	—	4,6	5,6
63	—	—	4,7	5,8	7,1
75	—	4,5	5,6	6,8	8,4
90	4,3	5,4	6,7	8,2	10,1
110	5,3	6,6	8,1	10,0	12,3
125	6,0	7,4	9,2	11,4	14,0
140	6,7	8,3	10,3	12,7	15,7
160	7,7	9,5	11,8	14,6	17,9
180	8,6	10,7	13,3	16,4	20,1
200	9,6	11,9	14,7	18,2	22,4
225	10,8	13,4	16,6	20,5	25,2
250	11,9	14,8	18,4	22,7	27,9
280	13,4	16,6	20,6	25,4	31,3
315	15,0	18,7	23,2	28,6	35,2
355	16,9	21,1	26,1	32,2	39,7
400	19,1	23,7	29,4	36,3	44,7
450	21,5	26,7	33,1	40,9	50,3
500	23,9	29,7	36,8	45,4	55,8
560	26,7	33,2	41,2	50,8	—
630	30,0	37,4	46,3	57,2	—
710	33,9	42,1	52,2	—	—
800	38,1	47,4	58,8	—	—
900	42,9	53,3	—	—	—
1 000	47,7	59,3	—	—	—
1 200	57,2	—	—	—	—
1 400	—	—	—	—	—
1 600	—	—	—	—	—

1) The pipe series number is derived from the ratio σ_s/p_{PMS}, where σ_s is the design stress at 20 °C and p_{PMS} is the maximum allowable operating pressure of the pipe at 20 °C.

2) The nominal pressure PN corresponds to the maximum allowable operating pressure p_{PMS}, in bars, of the pipe at 20 °C.

3) For calculation purposes, a nominal pressure of 6,3 bar (0,63 MPa) has been used.

Table 5 — Polyethylene pipes with a design stress σ_s of 5 MPa

Nominal outside diameter d_n	Pipe series [1]							
	S 16	S 12,5	S 8,3	S 8	S 6,3	S 5	S 4	S 3,2
	Standard dimension ratio							
	SDR 33	SDR 26	SDR 17,6	SDR 17	SDR 13,6	SDR 11	SDR 9	SDR 7,4
	Nominal pressure PN [2] for σ_s = 5 MPa							
	PN 3,2	PN 4	PN 6	PN 6,3	PN 8	PN 10	PN 12,5	PN 16
	Nominal wall thickness, e_n mm							
16	—	—	—	—	—	2,3	2,3	2,3
20	—	—	—	—	2,3	2,3	2,3	2,8
25	—	—	2,3	2,3	2,3	2,3	2,8	3,5
32	—	—	2,3	2,3	2,4	2,9	3,6	4,4
40	—	2,3	2,3	2,4	3,0	3,7	4,5	5,5
50	—	2,3	2,9	3,0	3,7	4,6	5,6	6,9
63	2,3	2,5	3,6	3,8	4,7	5,8	7,1	8,6
75	2,3	2,9	4,3	4,5	5,6	6,8	8,4	10,3
90	2,8	3,5	5,1	5,4	6,7	8,2	10,1	12,3
110	3,4	4,2	6,3	6,6	8,1	10,0	12,3	15,1
125	3,9	4,8	7,1	7,4	9,2	11,4	14,0	17,1
140	4,3	5,4	8,0	8,3	10,3	12,7	15,7	19,2
160	4,9	6,2	9,1	9,5	11,8	14,6	17,9	21,9
180	5,5	6,9	10,2	10,7	13,3	16,4	20,1	24,6
200	6,2	7,7	11,4	11,9	14,7	18,2	22,4	27,4
225	6,9	8,6	12,8	13,4	16,6	20,5	25,2	30,8
250	7,7	9,6	14,2	14,8	18,4	22,7	27,9	34,2
280	8,6	10,7	15,9	16,6	20,6	25,4	31,3	38,3
315	9,7	12,1	17,9	18,7	23,2	28,6	35,2	43,1
355	10,9	13,6	20,1	21,1	26,1	32,2	39,7	48,5
400	12,3	15,3	22,7	23,7	29,4	36,3	44,7	54,7
450	13,8	17,2	25,5	26,7	33,1	40,9	50,3	61,5
500	15,3	19,1	28,3	29,7	36,8	45,4	55,8	—
560	17,2	21,4	31,7	33,2	41,2	50,8	—	—
630	19,3	24,1	35,7	37,4	46,3	57,2	—	—
710	21,8	27,2	40,2	42,1	52,2	—	—	—
800	24,5	30,6	45,3	47,4	58,8	—	—	—
900	27,6	34,4	51,0	53,3	—	—	—	—
1 000	30,6	38,2	56,6	59,3	—	—	—	—
1 200	36,7	45,9	—	—	—	—	—	
1 400	42,9	53,5	—	—	—	—	—	
1 600	49,0	61,2	—	—	—	—	—	

1) The pipe series number is derived from the ratio σ_s/p_{PMS}, where σ_s is the design stress at 20 °C and p_{PMS} is the maximum allowable operating pressure of the pipe at 20 °C.

2) The nominal pressure PN corresponds to the maximum allowable operating pressure p_{PMS}, in bars, of the pipe at 20 °C.

Table 6 — Polyethylene pipes with a design stress σ_s of 2,5 MPa and 3,2 MPa

Nominal outside diameter d_n	Pipe series [1]					
	S 8	S 6,3	S 5	S 4	S 3,2	S 2,5
	Standard dimension ratio					
	SDR 17	SDR 13,6	SDR 11	SDR 9	SDR 7,5	SDR 6
	Nominal pressure PN [2] for σ_s = 2,5 MPa					
		PN 4		PN 6 [3]		PN 10
	Nominal pressure PN [2] for σ_s = 3,2 MPa					
	PN 4		PN 6 [3]		PN 10	
	Nominal wall thickness, e_n mm					
16	—	—	—	2,3	2,3	2,7
20	—	2,3	2,3	2,3	2,8	3,4
25	2,3	2,3	2,3	2,8	3,5	4,2
32	2,3	2,4	2,9	3,6	4,4	5,4
40	2,4	3,0	3,7	4,5	5,5	6,7
50	3,0	3,7	4,6	5,6	6,9	8,3
63	3,8	4,7	5,8	7,1	8,6	10,5
75	4,5	5,6	6,8	8,4	10,3	12,5
90	5,4	6,7	8,2	10,1	12,3	15,0
110	6,6	8,1	10,0	12,3	15,1	18,3

1) The pipe series number is derived from the ratio σ_s/p_{PMS}, where σ_s is the design stress at 20 °C and p_{PMS} is the maximum allowable operating pressure of the pipe at 20 °C.

2) The nominal pressure PN corresponds to the maximum allowable operating pressure p_{PMS}, in bars, of the pipe at 20 °C.

3) For calculation purposes, a nominal pressure of 6,3 bar (0,63 MPa) has been used.

4.1.4 The nominal wall thicknesses e_n in accordance with ISO 4065 (however, for reasons of jointing techniques the smallest wall thickness is limited to 2,3 mm) correspond to the selected nominal pressures given in table 3 (σ_s = 8 MPa), table 4 (σ_s = 6,3 MPa), table 5 (σ_s = 5 MPa) and table 6 (σ_s = 2,5 MPa and 3,2 MPa).

The tolerance on the minimum wall thickness permitted at any point $e_{y,min}$, corresponding to the nominal wall thickness e_n, shall conform to ISO 11922-1 as follows:

grade T for $e_{y,min} \leqslant 16$ mm

grade U for $e_{y,min} > 16$ mm

4.2 Ovality

The ovality of pipes at the manufacturer after extrusion but prior to coiling shall conform to ISO 11922-1, as follows:

grade K for PE 32 and PE 40

grade N for PE 63, PE 80 and PE 100

The minimum diameter of a drum for coiled pipe shall be $18 \times d_n$ and in any case such that kinking of the pipe is prevented.

For coiled pipes, rerounding equipment may be necessary.

4.3 Length of pipe

The length of straight pipes and coils shall be not less than that agreed between supplier and user.

4.4 Pressure reduction factors for PE pipeline systems for use at temperatures above 20 °C

Figure 1 and table 7 shall be used for the derivation of reduction factors to apply to obtain the maximum allowable operating pressure for elevated-temperature operation of PE pipes and fittings. These are applicable to the supply of water and other fluids which do not adversely affect the long-term properties of the PE material at temperatures up to 40 °C. In order to determine the category in which a material lies (i.e. type A, type B or type C), follow the instructions given in figure 2.

NOTES

1 The data used for the graph shown in figure 1 and those given in table 7 have been determined using the lowest (i.e. most unfavourable) values, rather than the best-fit values, in the analysis, in accordance with ISO/TR 9080, of hydrostatic stress rupture data for commercially available PE resins.

2 Higher factors and hence higher pressures may be applied to a material providing the analysis in accordance with ISO/TR 9080 demonstrates that less reduction is applicable.

3 A lifetime of 50 years is used as the basis for the classification of material in accordance with ISO 12162. For longer lifetimes, for instance 100 years, it is necessary to consider each case individually, taking into account the rules given in ISO/TR 9080. See also ISO 13761.

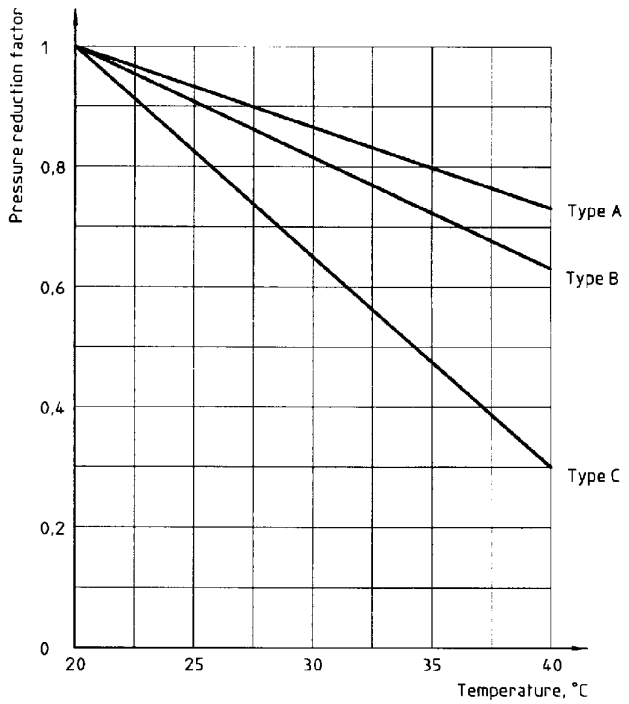

Figure 1 — Pressure reduction factor versus temperature, applicable to a 50-year lifetime

Table 7 — Pressure reduction factors at temperatures up to 40 °C, applicable to a 50-year lifetime

Material	Pressure reduction factors at				
	20 °C	25 °C	30 °C	35 °C	40 °C
Type A	1	0,93	0,87	0,8	0,74
Type B	1	0,9	0,81	0,72	0,62
Type C	1	0,82	0,65	0,47	0,3

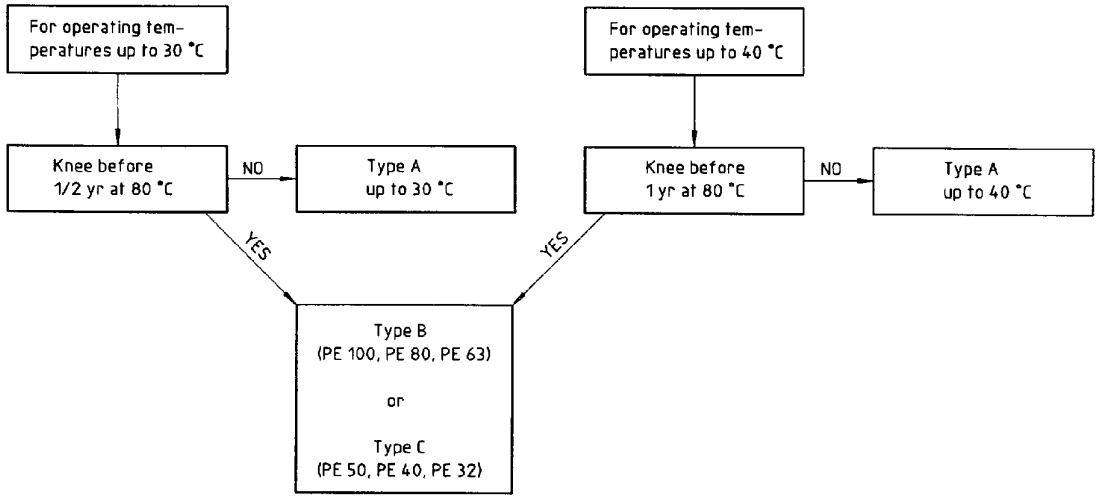

Figure 2 — Determination of type of material

5 Mechanical characteristics

5.1 Hydrostatic strength

When tested in accordance with ISO 1167, the pipes shall conform to the requirements given in table 8.

Table 8 — Hydrostatic strength of pipes

Pipe material	Test stress MPa		
	100 h at 20 °C	165 h [1] at 80 °C	1 000 h at 80 °C
PE 100	12,4	5,5	5,0
PE 80	9,0	4,6	4,0
PE 63	8,0	3,5	3,2
PE 40	7,0	2,5	2,0
PE 32	6,5	2,0	1,5

1) Only brittle failures are taken into account (see 5.2).

5.2 Retest in cases of failure at 80 °C

A brittle fracture in less than 165 h shall constitute a failure.

If, in the 165 h test, a test piece fails in a ductile mode in less than 165 h, a retest shall be performed at a lower stress. The new test stress, and the new minimum failure time, shall be selected from the line through the stress/time points given in table 9.

6 Physical characteristics

6.1 Thermal stability of pipes manufactured from PE 63, PE 80 and PE 100

When determined in accordance with ISO/TR 10837, the induction time for test specimens taken from pipes manufactured from PE 63, PE 80 and PE 100 shall be either at least 20 min when tested at 200 °C, or an equivalent period when tested at 210 °C, provided the equivalence is supported by a clear correlation between results obtained at 200 °C or 210 °C, respectively. The test specimens shall be taken from the inside surface of the pipe.

Table 9 — Hydrostatic strength at 80 °C — Retest requirements

PE 32		PE 40		PE 63		PE 80		PE 100	
Stress	**Minimum failure time**	**Stress**	**Minimum failure time**	**Stress**	**Minimum failure time**	**Stress**	**Minimum failure time**	**Stress**	**Minimum failure time**
MPa	h	MPa	h	MPa	h	MPa	h	MPa	h
2,0	165	2,5	165	3,5	165	4,6	165	5,5	165
1,9	227	2,4	230	3,4	285	4,5	219	5,4	233
1,8	319	2,3	323	3,3	538	4,4	283	5,3	332
1,7	456	2,2	463	3,2	1 000	4,3	394	5,2	476
1,6	667	2,1	675			4,2	533	5,1	688
1,5	1 000	2,0	1 000			4,1	727	5,0	1 000
						4,0	1 000		

6.2 Longitudinal reversion

When determined in accordance with ISO 2505-1, method A or B, using one of the following temperatures, as applicable:

110 °C ± 2 °C for PE 63, PE 80 and PE 100

or

100 °C ± 2 °C for PE 32 and PE 40,

and the test times given in ISO 2505-2, the value of the longitudinal reversion shall be not greater than 3 %.

For pipes with an outside diameter greater than 200 mm, longitudinally cut segments may be used.

6.3 Weathering of non-black pipes

To determine the effect of weathering, pipes shall be exposed to outdoor conditions in accordance with the procedure given in annex A.

After exposure to a total solar energy of at least 3,5 GJ/m^2, the pipe shall conform to the following requirements:

a) the hydrostatic strength, when determined in accordance with 5.1 at 80 °C for at least 165 h, shall be the minimum required;

b) the elongation at break, when determined in accordance with ISO 6259-1 and ISO 6259-3, shall not be less than 350 %;

c) the induction time, when measured in accordance with ISO/TR 10837 using a test specimen taken from the outside surface of the pipe, shall be at least 10 min at 200 °C.

7 Fusion compatibility

If pipes manufactured from PE 63, PE 80 or PE 100 are to be joined by butt fusion or using electrofusion fittings mixing different pipe materials, the joints shall conform to the requirements specified in table 8 (80 °C/165 h).

Compounds designated PE 63, PE 80 or PE 100 having an MFR (190 °C/5 kg) within the range 0,2 g/10 min to 1,3 g/10 min shall be considered compatible for fusion to each other.

8 Marking

All pipes shall be indelibly marked at maximum intervals of 1 m.

The marking shall indicate at least the following information:

— the manufacturer's name and/or trade mark;
— the dimensions (nominal outside diameter x nominal wall thickness);
— the outside-diameter tolerance (A or B);
— the designation of the pipe material (PE 100, PE 80, PE 63, PE 40 or PE 32);
— the nominal pressure (PN);
— the pipe series (S or SDR) (optional);
— the production period (date or code);
— the number of this International Standard.

The word "water" may also be included if the pipe is intended for drinking water.

Annex A
(normative)

Procedure for exposure to outdoor weathering[7)]

A.1 Exposure aspects and site

Test racks and specimen fixtures shall be made from inert materials which will not affect the test results. Wood, non-corrosive aluminium alloys, stainless steel or ceramics have been found suitable. Brass, steel or copper shall not be used in the vicinity of test specimens. The test site shall be equipped with instruments to record the solar energy received and the ambient temperature.

The equipment shall be capable of supporting specimens of pipe such that the exposed surface of the specimens is at 45° to the horizontal, facing towards the equator. Normally, the exposure site shall be on open ground well away from trees and buildings. For exposure in the northern hemisphere, no obstruction, including adjacent racks, in an easterly, southerly or westerly direction shall subtend a vertical angle greater than 20°, or in a northerly direction greater than 45°. For exposure in the southern hemisphere, corresponding provisions apply.

A.2 Test specimens

The test specimens shall be approximately 1 m long. They shall be selected from the thinnest-wall pipes within a random range of diameters. The batch of pipes from which the specimens are selected shall conform to all the requirements of this International Standard.

A.3 Procedure

Mark each pipe specimen to identify it, and record the mounting position of each.

Expose the specimens to a total solar energy of at least 3,5 GJ/m^2.

Then remove the specimens and test them in accordance with the provisions of 6.3. Where the specimen to be tested includes only part of the pipe cross-section, e.g. a tensile dumb-bell or part of the surface layer, it shall be taken from the weathered crown of the exposed specimen.

7) For additional information, see ISO 4607.

ICS 83.140.30; 91.140.60

Descriptors: plastics products, pipes (tubes), thermoplastic resins, plastic tubes, water pipes, specifications, materials specifications, mechanical properties, physical properties, dimensions, marking.

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