DEUTSCHE NORM June 2003

Plastics piping systems for water supply – Polyethylene (PE)

Part 2: Pipes

English version of DIN EN 12201-2

DIN EN 12201-2

ICS 23.040.20; 91.140.60

Kunststoff-Rohrleitungssysteme für die Wasserversorgung – Polyethylen (PE) – Teil 2: Rohre

This standard, together with DIN EN 12201-1, DIN EN 12201-3, and DIN EN 12201-5, June 2003 editions, supersedes DIN 19533, March 1976 edition.

European Standard EN 12201-2 : 2003 has the status of a DIN Standard.

A comma is used as the decimal marker.

National foreword

This standard has been prepared by CEN/TC 155 'Plastics piping systems and ducting systems' (Secretariat: The Netherlands).

The responsible German body involved in its preparation was the *Normenausschuss Wasserwesen* (Water Practice Standards Committee), Technical Committee *Kunststoffrohre in der Trinkwasserversorgung/PE-, PP-Wasserversorgung.*

It should be noted that DIN 19533 continues to be valid in Germany until 31 March 2005.

Amendments

DIN 19533, March 1976 edition, has been superseded by the specifications of the EN 12201 series.

Previous editions

DIN 19533: 1966-05, 1976-03.

EN comprises 17 pages.

Ref. No. DIN EN 12201-2 : 2003-06
English price group 10 *Sales No. 1110*
10.03

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 12201-2

March 2003

ICS 23.040.20; 91.140.60

English version

Plastics piping systems for water supply – Polyethylene (PE)

Part 2: Pipes

Systèmes de canalisations en plastique pour l'alimentation en eau – Polyéthylène (PE) – Partie 2: Tubes

Kunststoff-Rohrleitungssysteme für die Wasserversorgung – Polyethylen (PE) – Teil 2: Rohre

This European Standard was approved by CEN on 2002-12-04.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Management Centre or to any CEN member.

The European Standards exist in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Management Centre has the same status as the official versions.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Management Centre: rue de Stassart 36, B-1050 Brussels

Ref. No. EN 12201-2 : 2003 E

Contents

Foreword

This document EN 12201-2:2003 has been prepared by Technical Committee CEN /TC 155, "Plastics piping systems and ducting systems" the secretariat of which is held by NEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 2003, and conflicting national standards shall be withdrawn at the latest by March 2005.

This standard is a Part of a System Standard for plastics piping systems of a particular material for a specified application. There are a number of such System Standards.

System Standards are based on the results of the work being undertaken in ISO/TC 138 "*Plastics pipes, fittings and valves for the transport of fluids*", which is a Technical Committee of the International Organization for Standardization (ISO).

They are supported by separate standards on test methods to which references are made throughout the System Standard.

The System Standards are consistent with standards on general functional requirements and standards on recommended practices for installation.

This European Standard consists of the following Parts, under the general title *Plastics piping systems for water supply — Polyethylene (PE).*

— *Part 1: General.*

— *Part 2: Pipes* (this standard).

— *Part 3: Fittings.*

— *Part 4: Valves.*

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

— *Part 7: Guidance for the assessment of conformity.*[1])

NOTE It was decided not to publish a Part 6: Recommended practice for installation. Instead, existing national practices would be applicable.

This Part of this European Standard includes the following:

— Annex A (informative): Relationship between PN, MRS, S and SDR;

— Bibliography.

System Standards for piping systems of other plastics materials used for the conveyance of water include the following:

— EN 1452, Plastics piping systems for water supply — Unplasticized poly(vinyl chloride) (PVC-U);

— prEN 1796, Plastics piping systems for water supply with or without pressure — Glass-reinforced thermosetting plastics (GRP) based on polyester resins (UP).

For components which have conformed to the relevant national standard before [DAV], as shown by the manufacturer or by a certification body, the national standard may continue to be applied until the [DAV + 24 months].

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard : Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovak Republic, Spain, Sweden, Switzerland and the United Kingdom.

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[1]) to be published as a CEN/TS.

Introduction

The System Standard, of which this is Part 2, specifies the requirements for a piping system and its components when made from polyethylene (PE). It is intended to be used for water supply intended for human consumption, including the conveyance of raw water prior to treatment.

In respect of potential adverse effects on the quality of water intended for human consumption, caused by the product covered by this standard:

a) this standard provides no information as to whether the product may be used without restriction in any of the Member States of the EU or EFTA;

b) it should be noted that, while awaiting the adoption of verifiable European criteria, existing national regulations concerning the use and/or the characteristics of this product remain in force.

Requirements and test methods for material and components, other than pipes, are specified in EN 12201-1, EN 12201-3 and EN 12201-4. Characteristics for fitness of purpose are covered in EN 12201-5 and prCEN/TS 12201-7 gives guidance for the assessment of conformity.

This Part of this European Standard covers the characteristics of pipes.

1 Scope

This Part of this European Standard specifies the characteristics of pipes made from polyethylene (PE) intended for the conveyance of water for human consumption, including raw water prior to treatment.

It also specifies the test parameters for the test methods referred to in this standard.

In conjunction with other Parts of this European Standard (see Foreword) it is applicable to PE pipes, their joints and to joints with components of PE and other materials intended to be used under the following conditions:

a) a maximum operating pressure, MOP, up to 25 bar [2)];

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

NOTE 1 For applications operating at constant temperatures greater than 20 °C and up to 40 °C, see annex A of EN 12201-1:2003.

This European Standard covers a range of maximum operating pressures and gives requirements concerning colours and additives.

NOTE 2 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.

NOTE 3 Assessment of the resistance to slow crack growth of the PE pipe compound used for the manufacture of products to this specification is required in accordance with Table 2 of EN 12201-1:2003.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 728, *Plastics piping and ducting systems — Polyolefin pipes and fittings — Determination of oxidation induction time.*

EN 921:1994, *Plastics piping systems — Thermoplastics pipes — Determination of resistance to internal pressure at constant temperature.*

EN 12201-1:2003, *Plastics piping systems for water supply — Polyethylene (PE) — Part 1: General.*

EN 12201-5, *Plastics piping systems for water supply — Polyethylene (PE) — Part 5: Fitness for purpose of the system.*

EN ISO 1133:1999, *Plastics — Determination of the melt mass-flow rate (MFR) and the melt volume-flow rate (MVR) of thermoplastics (ISO 1133:1997).*

prEN ISO 3126:1999, *Plastics piping systems — Plastics piping components — Measurement and determination of dimensions (ISO/DIS 3126:1999).*

EN ISO 6259-1:2001, *Thermoplastics pipes — Determination of tensile properties — Part 1: General test method (ISO 6259-1:1997).*

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

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2) 1 bar = 10^5 N/m^2

3 Terms and definitions, symbols and abbreviations

For the purposes of this European Standard, the terms and definitions, symbols and abbreviations given in EN 12201-1:2003 apply.

4 Material

4.1 Compound

The material from which the pipes are made shall conform to the requirements as specified in EN 12201-1:2003.

4.2 Identification compound

Where applicable, the compound used for identification stripes (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.

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 to an extent that would prevent conformity of the pipe to this standard. The pipe ends shall be cut cleanly and square to the axis of the pipe.

5.2 Colour

The pipes shall be blue or black with blue stripes.

NOTE For above ground installations, all blue components should be protected from direct UV light.

5.3 Effect on water quality

Attention is drawn to the requirements of National regulations (see introduction).

6 Geometrical characteristics

6.1 Measurements

The dimensions of the pipe shall be measured in accordance with prEN ISO 3126:1999. In the case of dispute the measurements of dimensions shall be made not less than 24 h after manufacture after being conditioned 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	—
1000	1000	1000,0	1009,0	—
1200	1200	1200,0	1210,8 [c]	—
1400	1400	1400,0	1412,6 [c]	—
1600	1600	1600,0	1614,4 [c]	—

[a] In accordance with ISO 11922-1:1997[1] grade B for sizes ≤ 630 and grade A for sizes ≥ 710.
[b] In accordance with ISO 11922-1:1997[1] grade N for sizes ≤ 630 and 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[1]. For coiled pipe and straight lengths with diameters ≥ 710 the maximum out-of-roundness shall be agreed between the manufacturer and the purchaser.

NOTE Tolerance bands in accordance with ISO 11922-1[1] are calculated using the following formulae, 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 $\leq$ 75 mm: $(0{,}008\ d_n + 1)$ mm;
- for diameters $\geq$ 90 mm and $\leq$ 250 mm: $(0{,}02 d_n)$ mm
- for diameters > 250 mm: $(0{,}035\ d_n)$ mm,

rounded to next greater 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 Table A.1.

Table 2 — Wall thicknesses

Dimensions in millimetres

	Pipe series											
	SDR 6 S 2,5		SDR 7,4 S 3,2		SDR 9 S 4		SDR 11 S 5		SDR 13,6 S 6,3		SDR 17 S 8	
	Nominal pressure, PN [a] in 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	
Nom. Size	Wall thicknesses [b]											
	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 [c]	3,4	2,3 [c]	2,7	2,0 [c]	2,3	-	-	-	-	-	-
20	3,4	3,9	3,0 [c]	3,4	2,3	2,7	2,0 [c]	2,3	-	-	-	-
25	4,2	4,8	2,5	4,0	3,0 [c]	3,4	2,3	2,7	2,0 [c]	2,3	-	-
32	5,4	6,1	4,4	5,0	3,6	4,1	3,0 [c]	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
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	-	-	-	-	-	-	50,8	56,0	41,2	45,5	33,2	36,7
630	-	-	-	-	-	-	57,2	63,1	46,3	51,1	37,4	41,3
710	-	-	-	-	-	-	-	-	52,2	57,6	42,1	46,5
800	-	-	-	-	-	-	-	-	58,8	64,8	47,4	52,3
900	-	-	-	-	-	-	-	-	-	-	53,3	58,8
1000	-	-	-	-	-	-	-	-	-	-	59,3	65,4
1200	-	-	-	-	-	-	-	-	-	-	-	-
1400	-	-	-	-	-	-	-	-	-	-	-	-
1600	-	-	-	-	-	-	-	-	-	-	-	-

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

[b] Tolerances in accordance with grade V of ISO 11922-1:1997[1].

[c] The calculated value of $e_{min.}$ (ISO 4065 [2]) is rounded up to the nearest value of either 2,0, 2,3 or 3,0. This is to satisfy certain national requirements.

continued

Table 2 — Wall thicknesses (continued)

Dimensions in millimetres

	Pipe series									
	SDR 17,6 S 8,3		SDR 21 S 10		SDR26 S 12,5		SDR 33 S 16		SDR 41 S 20	
	Nominal pressure. PN[a] in bar									
PE 40	-		PN 3,2		PN 2,5		-		-	
PE 63	PN 6		PN 5		PN 4		PN 3,2		PN 2,5	
PE 80	-		PN 6 [c]		PN 5		PN 4		PN 3,2	
PE 100	-		PN 8		PN 6 [c]		PN 5		PN 4	
Nom. size	Wall thicknesses[b]									
	e_{min}	e_{max}	e_{min}	e_{max}	e_{min}	e_{max}	e_{min}	e_{max}	e_{min}	e_{max}
16	-	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-
25	-	-	-	-	-	-	-	-	-	-
32	2,0 [d]	2,3	-	-	-	-	-	-	-	-
40	2,3	2,7	2,0 [d]	2,3	-	-	-	-	-	-
50	2,9	3,3	2,4	2,8	2,0	2,3	-	-	-	-
63	3,6	4,1	3,0	3,4	2,5	2,9	-	-	-	-
75	4,3	4,9	3,6	4,1	2,9	3,3	-	-	-	-
90	5,1	5,8	4,3	4,9	3,5	4,0	-	-	-	-
110	6,3	7,1	5,3	6,0	4,2	4,8	-	-	-	-
125	7,1	8,0	6,0	6,7	4,8	5,4	-	-	-	-
140	8,0	9,0	6,7	7,5	5,4	6,1	-	-	-	-
160	9,1	10,2	7,7	8,6	6,2	7,0	-	-	-	-
180	10,2	11,4	8,6	9,6	6,9	7,7	-	-	-	-
200	11,4	12,7	9,6	10,7	7,7	8,6	-	-	-	-
225	12,8	14,2	10,8	12,0	8,6	9,6	-	-	-	-
250	14,2	15,8	11,9	13,2	9,6	10,7	-	-	-	-
280	15,9	17,6	13,4	14,9	10,7	11,9	-	-	-	-
315	17,9	19,8	15,0	16,6	12,1	13,5	9,7	10,8	7,7	8,6
355	20,1	22,3	16,9	18,7	13,6	15,1	10,9	12,1	8,7	9,7
400	22,7	25,1	19,1	21,2	15,3	17,0	12,3	13,7	9,8	10,9
450	25,5	28,2	21,5	23,8	17,2	19,1	13,8	15,3	11,0	12,2
500	28,3	31,3	23,9	26,4	19,1	21,2	15,3	17,0	12,3	13,7
560	31,7	35,0	26,7	29,5	21,4	23,7	17,2	19,1	13,7	15,2
630	35,7	39,4	30,0	33,1	24,1	26,7	19,3	21,4	15,4	17,1
710	40,2	44,4	33,9	37,4	27,2	30,1	21,8	24,1	17,4	19,3
800	45,3	50,0	38,1	42,1	30,6	33,8	24,5	27,1	19,6	21,7
900	51,0	56,2	42,9	47,3	34,4	38,3	27,6	30,5	22,0	24,3
1000	56,6	62,4	47,7	52,6	38,2	42,2	30,6	33,5	24,5	27,1
1200	-	-	57,2	63,1	45,9	50,6	36,7	40,5	29,4	32,5
1400	-	-	-	-	53,5	59,0	42,9	47,3	34,3	37,9
1600	-	-	-	-	61,2	67,5	49,0	54,0	39,2	43,3

[a] PN values are based on $C = 1,25$.
[b] Tolerances in accordance with grade V of ISO 11922-1:1997 [1].
[c] Actual calculated values are 6,4 bar for PE 100 and 6,3 bar for PE 80.
[d] The calculated value of e_{min} (ISO 4065 [2]) is rounded up to the nearest value of either 2,0, 2,3 or 3,0. This is to satisfy certain national requirements.

NOTE Grade V tolerances are in accordance with ISO 11922-1:1997[1] and calculated from the following formula:

$(0,1 e_{min} + 0,1)$ mm, rounded to the next 0,1 mm higher.

For certain applications for $e > 30$ mm tolerance grade T in accordance with ISO 11922-1:1997[1] can be used and the tolerance calculated from the following formula: $0,15 e_{min}$, rounded to next higher 0,1 mm.

6.4 Coiled pipe

The pipe shall be coiled such that localised 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 by the applicable test method, the test pieces shall be conditioned at (23 ± 2) °C before testing in accordance with Table 3.

7.2 Requirements

When tested in accordance with the test method as specified in Table 3 using the indicated parameters, the pipe shall have mechanical characteristics conforming to the requirements given in Table 3.

Table 3 — Mechanical characteristics

Characteristics	Requirements	Test parameters		Test method
		Parameters	Value	
Hydrostatic strength at 20 °C	No failure during test period of any test pieces	End caps Conditioning period Number of test pieces[b] Type of test Test temperature Test period Circumferential (hoop) stress for: PE 40 PE 63 PE 80 PE 100	Type a) [a] Shall conform to EN 921:1994 3 Water-in-water 20 °C 100 h 7,0 MPa 8,0 MPa 10,0 MPa 12,4 MPa	EN 921:1994
Hydrostatic strength at 80 °C	No failure during test period of any test pieces	End caps Conditioning period Number of test pieces[b] Type of test Test temperature Test period Circumferential (hoop) stress for: PE 40 PE 63 PE 80 PE 100	Type a) [a] Shall conform to EN 921:1994 3 Water-in-water 80 °C 165 h [3)] 2,5 MPa 3,5,MPa 4,5 MPa 5,4 MPa	EN 921:1994
Hydrostatic strength at 80 °C	No failure during test period of any test pieces	End caps Conditioning period Number of test pieces[b] Type of test Test temperature Test period Circumferential (hoop) stress for: PE 40 PE 63 PE 80 PE 100	Type a) [a] Shall conform to EN 921:1994 3 Water-in-water 80 °C 1000 h 2,0 MPa 3,2,MPa 4,0 MPa 5,0 MPa	EN 921:1994

[a] Type b) end caps may be used for batch release tests for diameters ≥ 500 mm.
[b] The number of test pieces given indicate the quantity required to establish a value for the characteristic described in the table. The number of test pieces required for factory production control and process control should be listed in the manufacturer's quality plan.(for guidance see prCEN/TS 12201-7 [3].
[c] Premature ductile failures are not 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 by the applicable test method, the test pieces shall be conditioned at (23 ± 2) °C before testing in accordance with Table 5.

8.2 Requirements

When tested in accordance with the test methods as specified in Table 5 using the indicated parameters, the pipe shall have physical characteristics conforming to the requirements given in Table 5.

Table 5 — Physical characteristics

Characteristics	Requirements	Test parameters		Test method
Elongation at break for $e \leq 5$ mm	≥ 350 %	Test piece shape Speed of test Number of test pieces [a]	Type 2 100 mm/min Shall conform to EN ISO 6259-1:2001	EN ISO 6259-1:2001 and ISO 6259-3:1997
Elongation at break for 5 mm < $e \leq 12$ mm	≥ 350 %	Test piece shape Speed of test Number of test pieces [a]	Type 1 [b] 50 mm/min Shall conform to EN ISO 6259-1:2001	EN ISO 6259-1:2001 and ISO 6259-3:1997
Elongation at break for $e > 12$ mm	≥ 350 %	Test piece shape Speed of test Number of test pieces [a]	Type 1 [b] 25 mm/min Shall conform to EN ISO 6259-1:2001	EN ISO 6259-1:2001 and ISO 6259-3:1997
		OR		
		Test piece shape Speed of test Number of test pieces [a]	Type 3 [b] 10 mm/min Shall conform to EN ISO 6259-1:2001	
Melt mass-flow rate MFR for PE 40	Change of MFR by processing ± 20 % [c]	Load Test temperature Time Number of test pieces [a]	2,16 kg 190 °C 10 min Shall conform to EN ISO 1133:1999	EN ISO 1133:1999, condition D
Melt mass-flow rate MFR for PE 63, PE 80, and PE 100	Change of MFR by processing ± 20 % [c]	Load Test temperature Time Number of test pieces [a]	5,0 kg 190 °C 10 min Shall conform to EN ISO 1133:1999	EN ISO 1133:1999, condition T
Oxidation induction time	≥ 20 min	Test temperature Number of test pieces [a,d]	200 °C [e] 3	EN 728
Effect on water quality[f]	National regulations apply			

[a] The number of test pieces given indicate the quantity required to establish a value for the characteristic described in the table. The number of test pieces required for factory production control and process control should be listed in the manufacturer's quality plan (for guidance see prCEN/TS 12201-7[3]).

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

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

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

[e] Test may be carried out as an indirect test at 210 °C providing that there is a clear correlation of the results to those at 200 °C, in cases of dispute the reference temperature shall be 200 °C.

[f] Test methods, parameters and requirements for all properties are under preparation. Until these European Standards are published National Regulations apply (see introduction).

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 4433-1:1997 and ISO 4433-2:1997.

NOTE Guidance for the resistance of polyethylene pipes to chemicals is given in ISO/TR 10358[4].

10 Performance requirements

When pipes conforming to this standard are assembled to each other or to components conforming to other Parts of this European Standard (see Foreword), the joints shall conform to the requirements of EN 12201-5.

11 Marking

11.1 General

11.1.1 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 that normal storage, weathering, handling, installation and use shall not affect the legibility of the marking.

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

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

11.2 Minimum required marking of pipes

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

NOTE Attention is drawn to the possible need to include CE marking when required for legislative purposes.

Table 6 — Minimum required marking

Aspects	Marking or symbol
Standard Number	EN 12201
Manufacturer's identification	Name or symbol
Dimensions ($d_n \cdot e_n$)	e.g. 110×10
SDR series	e.g. SDR 11
Material and designation	e.g. PE 80
Pressure rating in bars	e.g. PN 12,5
Production period (date or code)	e.g. 9302 [a]
Coils shall be sequentially marked with the length in metres, which will indicate the length remaining on the coil.	
[a] In clear figures or in code providing traceability to production period within year and month and if the manufacturer is producing at different sites, the production site.	

Annex A
(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 A.1, where $C = 1,25$.

Table A.1 — Examples of relationship between PN, MRS, S and SDR at 20 °C with the value of $C = 1,25$

SDR	S	Nominal pressure in bars for material class			
		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
17,6	8,3	-	6	-	-
17	8	4	-	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	-

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

NOTE The nominal pressures "PN" in the table are based on using an overall design coefficient $C = 1,25$. If a higher value for "C" is required the "PN" values will have to be recalculated using the above equations, based on the calculated design "σ_s" for each material class. A higher value for "C" can also be obtained by choosing a higher PN class.

Bibliography

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

[2] ISO 4065, *Thermoplastics pipes — Universal wall thickness table.*

[3] prCEN/TS12201-7, *Plastics piping systems for water supply — Polyethylene (PE) — Part 7: Guidance for the assessment of conformity.*

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