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Plastics piping systems for water supply – Polyethylene (PE)

Part 1: General

English version of DIN EN 12201-1

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ICS 23.040.01; 91.140.60

Kunststoff-Rohrleitungssysteme für die Wasserversorgung – Polyethylen (PE) – Teil 1: Allgemeines

This standard, together with DIN EN 12201-2, DIN EN 12201-3, and DIN EN 12201-5, June 2003 editions, supersedes DIN 19533, March 1976 edition.

European Standard EN 12201-1 : 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DIN 19533, March 1976 edition, has been superseded by the specifications of the EN 12201 series.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.

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EN 12201-1

March 2003

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English version

Plastics piping systems for water supply – Polyethylene (PE)

Part 1: General

Systèmes de canalisations en plastique pour l'alimentation en eau – Polyéthylène (PE) – Partie 1: Généralités

Kunststoff-Rohrleitungssysteme für die Wasserversorgung – Polyethylen (PE) – Teil 1: Allgemeines

This European Standard was approved by CEN on 2002-12-27.

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

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Contents

Foreword

This document EN 12201-1:2003 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 practice 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* (this standard).

— *Part 2: Pipes.*

— *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): Pressure reduction coefficients;

— Bibliography.

System Standards for piping systems of other plastics materials used for the conveyance of water under pressure 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 resin (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 Technical Specification

Introduction

The System Standard, of which this is Part 1, 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 products covered by EN 12201:

a) this standard provides no information as to whether the products 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 these products remain in force.

Requirements and test methods for components of the piping system are specified in EN 12201-2, EN 12201-3 and EN 12201-4.

Characteristics for fitness for purpose are covered in EN 12201-5. PrCEN/TS 12201-7 gives guidance for the assessment of conformity.

This Part of EN 12201 covers the general aspects of the plastics piping system.

1 Scope

This Part of this European Standard specifies the general aspects of polyethylene (PE) piping systems (mains and service pipes) 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 it is applicable to PE pipes, fittings, valves, their joints and to joints with components of 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.

EN 12201 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.

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 1056, *Plastics piping and ducting systems — Plastics pipes and fittings - Method for exposure to direct (natural) weathering.*

EN 12099, *Plastics piping systems — Polyethylene piping materials and components — Determination of volatile content.*

EN 12107, *Plastics piping systems — Injection-moulded thermoplastics fittings, valves and ancillary equipment — Determination of the long-term hydrostatic strength of thermoplastics materials for injection moulding of piping components.*

EN 12118, *Plastics piping systems — Determination of moisture content in thermoplastics by coulometry.*

EN 12201-2:2003, *Plastics piping systems for water supply — Polyethylene (PE) — Part 2: Pipes.*

EN ISO 472:2001, *Plastics —Vocabulary (ISO 472:1999).*

EN ISO 1043-1:2001, *Plastics – Symbols and abbreviated terms — Part 1: Basic polymers and their special characteristics (ISO 1043-1:2001).*

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).*

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

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

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

EN ISO 13478:1997, *Thermoplastics pipes for the conveyance of fluids — Determination of resistance to rapid crack propagation (RCP) — Full-scale test (FST) (ISO 13478:1997).*

EN ISO 13479:1997, *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 13479:1997).*

ISO 3:1973, *Preferred numbers — Series of preferred numbers.*

ISO 1183:1987, *Plastics — Methods for determining the density and relative density of non-cellular plastics.*

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

ISO 6259-3:1997, *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 11414:1996, *Plastics pipes and fittings — Preparation of polyethylene (PE) pipe/pipe or pipe/fitting test piece assemblies by butt fusion.*

ISO 13477:1997, *Thermoplastics pipes for the conveyance of fluids — Determination of resistance to rapid crack propagation (RCP) — Small-scale steady-state test (S4 test).*

ISO 13953:2001, *Polyethylene (PE) pipes and fittings — Determination of the tensile strength and failure mode of test pieces from a butt-fused joint.*

ISO 18553:2002, *Method for the assessment of the degree of pigment or carbon black dispersion in polyolefin pipes, fittings and compounds.*

3 Terms and definitions, symbols and abbreviations

3.1 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in ISO 3:1973, EN ISO 472:2001, and EN ISO 1043-1:2001 together with the following apply.

NOTE The symbols d_e, e, e_{min} and e_{max} in EN 12201 are equivalent to d_{ey}, e_y, $e_{y,min}$ and $e_{y,max}$ respectively in ISO 11922-1 [1].

3.1.1 Geometrical characteristics

3.1.1.1
nominal size DN
numerical designation of the size of a component, other than a component designated by a thread size, which is a convenient round number, approximately equal to the manufacturing dimension in millimetres (mm)

3.1.1.2
nominal size DN/OD
nominal size, related to the outside diameter

3.1.1.3
nominal outside diameter (d_n)
specified outside diameter, in millimetres, assigned to a nominal size DN/OD

3.1.1.4
outside diameter at any point (d_e)
value of the measurement of the outside diameter through its cross-section at any point of the pipe, rounded to the next greater 0,1 mm

3.1.1.5
mean outside diameter (d_{em})
value of the measurement of the outer circumference of the pipe or spigot end of a fitting in any cross section divided by π (= 3,142), rounded to the next greater 0,1 mm

3.1.1.6
minimum mean outside diameter ($d_{em,min}$)
minimum value of the outside diameter as specified for a given nominal size

3.1.1.7
maximum mean outside diameter ($d_{em,max}$)
maximum value of the outside diameter as specified for a given nominal size

3.1.1.8
out-of-roundness (ovality)
difference between the measured maximum outside diameter and the measured minimum outside diameter in the same cross-section of the pipe or spigot end of a fitting

3.1.1.9
nominal wall thickness (e_n)
numerical designation of the wall thickness of a component, which is a convenient round number, approximately equal to the manufacturing dimension in millimetres

3.1.1.10
wall thickness at any point (e)
value of the measurement of the wall thickness at any point around the circumference of a component

3.1.1.11
minimum wall thickness at any point (e_{min})
minimum value of the wall thickness at any point around the circumference of a component as specified

3.1.1.12
maximum wall thickness at any point (e_{max})
maximum value of the wall thickness at any point around the circumference of a component as specified

3.1.1.13
mean wall thickness (e_m)
arithmetic mean of a number of measurements regularly spaced around the circumference of the component in the same cross section of the component, including the measured minimum and the measured maximum values of the wall thickness

3.1.1.14
pipe series S
number for pipe designation conforming to ISO 4065 [2]

NOTE The relationship between the pipe series S and the standard dimension ratio SDR is given by the following equation as specified in ISO 4065 [2].

$$S = \frac{SDR - 1}{2}$$

3.1.1.15
standard dimension ratio (SDR)
ratio of the nominal outside diameter d_n of a pipe to its nominal wall thickness e_n

3.1.1.16
tolerance
permissible variation of the specified value of a quantity expressed as the difference between the permissible maximum and permissible minimum values

3.1.2 Terms and definitions related to service conditions

3.1.2.1
nominal pressure (PN)
numerical designation used for reference purposes related to the mechanical characteristics of the component of a piping system

For plastic piping systems conveying water it corresponds to the maximum continuous operating pressure in bar, which can be sustained with water at 20 °C, based on the minimum design coefficient

3.1.2.2
maximum operating pressure (MOP)
maximum effective pressure of the fluid in the piping system, expressed in bar, which is allowed in continuous use

It takes into account the physical and the mechanical characteristics of the components of a piping system

NOTE It is calculated using the following equation:

$$MOP = \frac{20 \times MRS}{C \times (SDR - 1)}$$

3.1.2.3
allowable operating pressure (PFA)
maximum hydrostatic pressure that a component is capable of withstanding continuously in service

3.1.3 Terms and definitions related to material characteristics

3.1.3.1
lower confidence limit at 20 °C for 50 years (σ_{LCL})
quantity, with the dimensions of stress in megapascals, which can be considered as a property of the material, and represents the 97,5 % lower confidence limit of the mean long-term strength at 20 °C for 50 years with internal water pressure

3.1.3.2
minimum required strength (MRS)
value of σ_{LCL}, rounded down to the next smaller value of the R10 series or of the R20 series depending on the value of σ_{LCL}

NOTE R10 and R20 series are the Renard number series according to ISO 3 and ISO 497 [3].

3.1.3.3
design stress (σ_S)
allowable stress for a given application
It is derived by dividing the MRS by the coefficient *C*, then rounding to the next lower value in R20 series
It is expressed in megapascals: $\sigma_S = \frac{MRS}{C}$

3.1.3.4
overall service (design) coefficient (*C*)
overall coefficient with a value greater than one, which takes into consideration service conditions as well as properties of the components of a piping system other than those represented in the lower confidence limit

3.1.3.5
melt mass-flow rate (MFR)
value in gramme per time unit (g/10 min) relating to the viscosity of the molten material at a specified temperature and load

3.2 Symbols

For the purposes of this European Standard, the following symbols apply.

C	overall service (design) coefficient
d_{em}	mean outside diameter
$d_{em,min}$	minimum mean outside diameter
$d_{em,max}$	maximum mean outside diameter
d_e	outside diameter at any point
d_n	nominal outside diameter
E	wall thickness at any point of a fitting or valve body
e	wall thickness (at any point)
e_m	mean wall thickness
e_{max}	maximum wall thickness (at any point)
e_{min}	minimum wall thickness (at any point)
e_n	nominal wall thickness
σ_{LCL}	lower confidence limit at 20 °C for 50 years
σ_s	design stress

3.3 Abbreviations

For the purposes of this European Standard, the following abbreviations apply.

DN/OD	nominal size, outside diameter related
LCL	lower confidence limit
MFR	melt mass-flow rate
MRS	minimum required strength
OIT	oxidation induction time
PE	polyethylene
PFA	allowable operating pressure
PN	nominal pressure
S	pipe series as defined in ISO 4065 [2]
SDR	standard dimension ratio

4 Material

4.1 Compound

The compound from which the products are produced shall be made by adding to the polyethylene base polymer only those additives necessary for the manufacture and end use of the products, conforming to the requirements of the applicable Parts of EN 12201.

All additives shall be uniformly dispersed.

NOTE Components manufactured from PE 32 materials are not covered by this standard.

4.2 Colour

4.2.1 General

The colour of the compound shall be blue or black.

4.2.2 Black compound

The carbon black used in the production of black compound shall have an average (primary) particle size of 10 nm to 25 nm.

4.3 Use of reprocessable and recyclable material

Clean reprocessable material generated from a manufacturer's own production and works testing of products to EN 12201 may be used if it is derived from the same compound as used for the relevant production. Reprocessable material obtained from external sources and recyclable material shall not be used.

4.4 Physical characteristics of the compound

The compound used for the manufacture of pipes, fittings and valves shall conform to the requirements given in Table 1 as granules and Table 2 in the form of pipe.

Table 1 — Characteristics of the PE compound as granules

Characteristics	Requirements [a]	Test parameters		Test method
Compound density	≥ 930 kg/m³ [b]	Test temperature Number of Samples	23 °C Shall conform to ISO 1183:1987	ISO 1183:1987
Carbon black content (black compound)	(2 to 2,5) % by mass	Shall conform to ISO 6964:1986		ISO 6964:1986
Carbon black dispersion (black compound)	≤ grade 3	Shall conform to ISO 18553:2002 [c]		ISO 18553:2002
Pigment dispersion (blue compound)	≤ grade 3	Shall conform to ISO 18553:2002 [c]		ISO 18553:2002
Water content [b]	≤ 300 mg/kg	Number of test pieces [d]	1	EN 12118
Volatile content	≤ 350 mg/kg	Number of test pieces [d]	1	EN 12099
Oxidation induction time	≥ 20 min	Test temperature Number of test pieces [d]	200 °C [e] 3	EN 728
Melt mass-flow rate (MFR) for PE 40	0,2 to 1,4 g/10 min Maximum deviation of ± 20 % of the nominated value [f]	Load Test temperature Time Number of test pieces [d]	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, 80 and PE 100	0,2 to 1,4 g/10min Maximum deviation of ± 20 % of the nominated value [f]	Load Test temperature Time Number of test pieces [d]	5 kg 190 °C 10 min Shall conform to EN ISO 1133:1999	EN ISO 1133:1999 condition T

[a] Conformity to these requirements shall be proved by the compound manufacturer.

[b] Only applicable if the measured volatile content is not in conformity with its specified requirement. In case of dispute the requirement for water content shall apply. An alternative test method ISO 760:1978 [2] [7] may be used.

[c] In case of dispute the test pieces for carbon black dispersion and pigment dispersion shall be prepared by the compression method.

[d] 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/TS12201-7 [4].

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

[f] Nominated value given by the compound producer.

Table 2 — Characteristics of the PE compound in the form of pipe

Characteristics	Requirements [a]	Test parameters		Test method
Tensile strength for butt-fusion [b]	Test to failure: ductile: pass brittle: fail	Pipe diameter Pipe diameter ratio Test temperature Number of test pieces [c]	110 mm SDR 11 23 °C Shall conform to ISO 13953:2001	ISO 13953:2001
Slow crack growth-pipe size 110 or 125 mm SDR11	No failures during test period	Test temperature Internal test pressure for PE 63 PE 80 PE 100 Test period Type of test Number of test pieces [c]	80 °C 6,4 bar 8,0 bar 9,2 bar 165 h Water in water Shall conform to EN ISO 13479:1997	EN ISO 13479:1997
Effect on water quality [d]	Shall conform to existing national regulations			
Resistance to weathering Blue compounds only	The weathered test pieces shall fulfil the requirements of the following characteristics	Cumulative solar radiation	≥ 3,5 GJ/m^2	EN 1056
a) Oxidation induction time [e]	Shall conform to Table 1 of this standard			EN 728
b) Elongation at break	Shall conform to Table 5 of EN 12201-2:2003			EN ISO 6259-1:2001 and ISO 6259-3: 1997
c) Hydrostatic strength at 80 °C	Shall conform to Table 3 of EN 12201-2:2003			EN 921:1994

Table 2 — Characteristics of the PE compound in the form of pipe (continued)

Characteristics	Requirements	Parameters		Test method
		Parameters	Value	
Resistance to rapid crack propagation [f,g,h,i]	Arrest	Pipe diameter d_n Pipe dimension ratio Test temperature Test medium Internal test pressure for PE 100 PE 80 Number of test pieces [c]	250 mm SDR 11 0 °C Air 10,0 bar 8,0 bar Shall conform to ISO 13477:1997	ISO 13477:1997 (S4 test)
OR				
Resistance to rapid crack propagation [f, g, h, i]	Arrest	Pipe diameter d_n Pipe dimension ratio Test temperature Test medium Internal test pressure for PE 100 PE 80 Number of test pieces [c]	500 mm SDR 11 0 °C Air 24,0 bar 20,0 bar Shall conform to EN ISO 13478:1997	EN ISO 13478:1997 (FST)

[a] Conformity to these requirements shall be proved by the compound manufacturer.

[b] Preparation of samples in accordance with ISO 11414:1996, normal conditions at 23 °C.

[c] 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 [4]).

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

[e] For samples after weathering the exposed surface shall be removed up to a depth of 0,2 mm. The sample shall be taken from this surface.

[f] To be taken into account for pipe having a wall thickness ≥ 32 mm.

[g] If the requirements are met, the material is qualified for the full range of pipe produced in accordance with the scope of EN 12201.

[h] If the requirements are not met for a given PE material, the critical pressure pc can be established and used to determine the PFA for a material relative to diameter. ([PFA] ≤ pc, where the pc is determined in accordance with EN ISO 13478 or [PFA] ≤ 3,6 · $p_{c,S4}$ + 2,6, where $p_{c,S4}$ is determined in accordance with ISO 13477). Attention is drawn to note 2 in clause 1. Air, or a mixture of air and water (with the air content being ≥ 5 %) at a temperature of ≤ 3 °C may be used.

[i] PE 40 and PE 63 materials are not intended to be used to manufacture pipes with a diameter ≥ 250 mm.

4.5 Fusion compatibility

The compound manufacturer shall demonstrate that each compound conforming to Table 1 is fusible by testing the tensile strength of a butt fusion joint of pipes manufactured from the compound as specified in Table 2.

Compounds conforming to Table 1 are considered fusible to each other. If requested, the compound manufacturer shall demonstrate this on compounds from his own product range by testing a butt fusion joint for tensile strength as specified in Table 2.

4.6 Classification and designation

Compounds shall be designated by the material type (PE) and the level of minimum required strength (MRS), in accordance with Table 3.

The compound shall have a minimum required strength (MRS) equal to or greater than the values specified in Table 3 when evaluated according to ISO/TR 9080:1992 where the pressure test is done in accordance with ISO 1167 [5] to find the σ_{LCL}. The MRS value shall be derived from the σ_{LCL} and the compound shall be classified in accordance with EN ISO 12162:1995.

The classification of the compound in accordance with ISO/TR 9080:1992 shall be certified by the compound producer.

NOTE Where fittings are manufactured from the same compound as pipe then the material classification will be the same as for the pipe.

When a compound is intended only to be used for the manufacture of fittings, the compound shall be classified using test pieces prepared in accordance with EN 12107.

Table 3 — Material designation and corresponding maximum design stress values

Designation	Minimum required strength (MRS) MPa	σ_S [a] MPa
PE 100	10,0	8,0
PE 80	8,0	6,3
PE 63	6,3	5,0
PE 40	4,0	3,2

[a] The design stress σ_S is derived from the MRS by application of the overall service (design) coefficient $C = 1,25$.

NOTE A higher value for C can be used, for example if $C = 1,6$ this gives a design stress of 5,0 MPa for PE 80 materials. A higher value for C can also be obtained by choosing a higher PN class.

5 Effect on water quality

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

Annex A
(informative)

Pressure reduction coefficients

When a PE piping system is to be operated at a continuous constant temperature higher than 20 °C, up to 40 °C, a pressure reduction coefficient as given in Table A.1 may be applicable.

Table A.1 — Pressure reduction coefficients

Temperature [a]	Coefficient
20 °C	1,00
30 °C	0,87
40 °C	0,74
[a] For other temperatures between each step, interpolation is permitted (see also ISO 13761 [6]).	
NOTE 1 Unless analysis according to ISO/TR 9080:1992 demonstrates that less reduction is applicable, in which case higher factors and hence higher pressures may be applied.	
NOTE 2 The above coefficients refer to PE 100 and PE 80. For coefficients for PE 40 and PE 63 refer to ISO 13761 [6]	

NOTE The allowable operating pressure (PFA) is derived from the following equation:

$$PFA = f_T \times f_A \times PN$$

where

f_T is the coefficient in Table A.1;

f_A is the derating factor (or uprating factor) related to the application (for the conveyance of water $f_A = 1$);

PN is the nominal pressure.

Bibliography

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

[2] ISO 760, *Determination of water - Karl Fischer method (General method).*

[3] ISO 497, *Guide to the choice of series of preferred numbers and of series containing more rounded values of preferred numbers.*

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

[5] ISO 1167, *Thermoplastics pipes for the conveyance of fluids - Resistance to internal pressure - Test method.*

[6] ISO 13761 *Plastics pipes and fittings -- Pressure reduction factors for polyethylene pipeline systems for use at temperatures above 20 degrees C.*