BRITISH STANDARD

BS EN
12666-1:2005
+A1:2011

Plastics piping systems for non-pressure underground drainage and sewerage — Polyethylene (PE) —

Part 1: Specifications for pipes, fittings and the system

ICS 23.040.01; 91.140.80; 93.030

BSI
British Standards

National foreword

This British Standard is the UK implementation of EN 12666-1:2005+A1:2011. It supersedes BS EN 12666-1:2005, which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to CEN text carry the number of the CEN amendment. For example, text altered by CEN amendment A1 is indicated by ⟦A1⟩ ⟨A1⟧.

The UK participation in its preparation was entrusted by Technical Committee PRI/88, Plastics piping systems, to Subcommittee PRI/88/1, Plastics piping for non-pressure applications.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

General

The responsible UK technical committee offers the following advice in respect of the contents of this standard.

BS EN 12666-1:2005 does not necessarily detail all the precautions necessary to meet the requirements of the Health and Safety at Work, etc. Act 1974. Attention should be paid to any appropriate safety precautions and the test methods should be operated only by trained personnel.

Selection and application of stiffness classes

This document specifies four classes of pipes and fittings of differing stiffness, designated SN16, SN 8, SN 4 and SN 2 (see Table 6).

From the viewpoint of installation, it is recommended that SN16, SN 8 or SN 4 classes are used if the system is to be installed in accordance with national codes of practice for installation in order to achieve the intended resistance to long-term deformation.

If the other, less stiff (SN 2), class of pipe or fitting is intended for use then it is recommended that the installation is first subjected to a structural design soil load calculation and the installation technique is modified to suit the results of that calculation.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 26 January 2006

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Amendments/corrigenda issued since publication

Date	Comments
31 October 2011	Implementation of CEN amendment A1:2011

The appropriate calculation method is given in the national annex to BS EN 1295-1:1997. The *E* modulus for the material can be taken as 1 000 MPa and 500 MPa, for guidance, for the short-term and long-term values respectively. However, it is preferable for the manufacturer/suppliers to be contacted for the actual values.

Attention is also drawn to the *Materials selection manual for sewers, pumping mains and manholes* (reference WSA/FWR-04).[1]

Interchangeability

For the purpose of interchangeability with non-pressure underground drainage systems of other materials, it should be noted that PE fittings conforming to BS EN 12666-1:2005 will fit PVC-U pipe conforming to BS EN 1401-1:2009, but PVC-U fittings conforming to BS EN 1401-1:2009 will not necessarily fit PE pipe conforming to BS EN 12666-1:2005.

Additional information

For swept bends and branches, it is recommended that the dimensional characteristics should also conform to the relevant parts of BS 4514. In addition, Approved Document H of the Building Regulations 2000 (amended 2002), in particular clauses **1.17** (equal bends and branches), **1.26** (long radius bends) and Diagram 2, applies.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the *BSI Catalogue* under the section entitled "International Standards Correspondence Index", or by using the "Search" facility of the *BSI Electronic Catalogue* or of British Standards Online.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

[1] Published by the Foundation for Water Research, Allen House, The Listons, Liston Road, Marlow, Bucks SL7 1FD.

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 12666-1:2005+A1

August 2011

ICS 23.040.01; 93.030

Supersedes EN 12666-1:2005

English Version

Plastics piping systems for non-pressure underground drainage and sewerage - Polyethylene (PE) - Part 1: Specifications for pipes, fittings and the system

Systèmes de canalisations en plastique pour les branchements et les collecteurs d'assainissement sans pression enterrés - Polyéthylène (PE) - Partie 1: Spécifications pour les tubes, les raccords et le système

Kunststoff-Rohrleitungssysteme für erdverlegte Abwasserkanäle und -leitungen - Polyethylen (PE) - Teil 1: Anforderungen an Rohre, Formstücke und das Rohrleitungssystem

This European Standard was approved by CEN on 24 November 2005 and includes Amendment 1 approved by CEN on 15 July 2011.

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 CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists 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 CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

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Contents

Page

Foreword

This document (EN 12666-1:2005+A1:2011) 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 February 2012, and conflicting national standards shall be withdrawn at the latest by February 2012.

This document includes Amendment 1, approved by CEN on 2011-07-15.

This document supersedes EN 12666-1:2005.

〚A1〉 The main changes in the revised document are:

— relevant test methods are changed from EN to ISO versions;

— two new dimensions, 560 mm and 710 mm are introduced;

— a new ring stiffness class SN 16 is introduced;

— updating of the references in Clause 2;

— introduction of S-series in 3.3;

— introduction of S-series, a new footnote a) and a new NOTE in Table 3;

— introduction of a new watertightness test for fabricated fittings;

— deletion of Long Term Performance of TPE seals – Table 12 and 10.3;

— corrections of misprints in Tables 13 and 14 Marking of pipes and fittings;

— introduction of a new informative Annex B Product standards of components that can be connected to components conforming to this European Standard;

— updating and modification of the Bibliography. 〈A1〛

The start and finish of text introduced or altered by amendment is indicated in the text by tags 〚A1〉 〈A1〛.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This European 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 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 general standards on functional requirements and on recommended practice for installation.

EN 12666 consists of the following parts, under the general title *Plastics piping systems for non-pressure underground drainage and sewerage - Polyethylene (PE)*

— *Part 1: Specifications for pipes, fittings and the system (this European Standard)*

— [A1] *Part 2: Guidance for the assessment of conformity (CEN Technical Specification)* [A1]

— [A1] *deleted text* [A1]

[A1] *deleted text* [A1]

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

1 Scope

This Part of EN 12666 specifies the requirements for pipes, fittings and the system of polyethylene (PE) piping systems intended to be used for

— non-pressure underground drainage and sewerage outside the building structure (application area code "U"), and

— non-pressure underground drainage and sewerage for both buried in the ground within the building structure (application area code "D") and outside the building structure.

This is reflected in the marking of products by "U" and "UD".

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

This European Standard covers a range of nominal sizes, a range of pipe series/stiffness classes and gives recommendations concerning colours.

NOTE 1 It is the responsibility of the purchaser or specifier to make the appropriate selection from these aspects, taking into account their particular requirements and any relevant national regulations and installation practices or codes.

In conjunction with CEN/TS 12666-2 [1] it is applicable to PE pipes and fittings, their joints and to joints with components of other plastics and non-plastics materials intended to be used for buried piping systems for non-pressure drainage and sewerage.

This European Standard is applicable to PE pipes with or without an integral socket.

The fittings can be manufactured by injection-moulding or be fabricated from pipes and/or mouldings.

This European Standard is applicable to PE pipes and fittings for the following types of joints:

— elastomeric ring seal joints;

— butt fused joints;

— electrofusion joints;

— mechanical joints.

NOTE 2 Requirements and limiting values for application area code "D" are given in Tables 3, 6 and Table 12.

NOTE 3 Pipes, fittings and other components conforming to any of the plastics product standards listed in the bibliography may be used with pipes and fittings conforming to this European Standard, provided they conform to the requirements for joint dimensions given in Clause 6 and to the requirements of Table 8 and Table 12.

2 Normative references

The following referenced documents are indispensable for the application of this European Standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 681-1, *Elastomeric seals — Materials requirements for pipe joint seals used in water and drainage applications — Part 1: Vulcanized rubber*

EN 681-2, *Elastomeric seals — Materials requirements for pipe joint seals used in water and drainage applications — Part 2: Thermoplastic elastomers*

〖A1〗 *deleted text* 〖A1〗

EN 1401-1, *Plastics piping systems for non-pressure underground drainage and sewerage — Unplasticized poly(vinyl chloride) (PVC-U) — Part 1: Specifications for pipes, fittings and the system*

EN 1519-1:1999, *Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure — Polyethylene (PE) — Part 1: Specifications for pipes, fittings and the system*

[A1] *deleted text* [A1]

[A1] CEN/TS 14541:2007, *Plastics pipes and fittings for non-pressure applications — Utilisation of non-virgin PVC-U, PP and PE materials* [A1]

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

EN ISO 580:2005*, Plastics piping and ducting systems - Injection-moulded thermoplastics fittings - Methods for visually assessing the effects of heating (ISO 580:2005)*

EN ISO 1043-1:2005, *Plastics — Symbols and abbreviated terms — Part 1: Basic polymers and their special characteristics (ISO 1043-1:2005)*

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

[A1] EN 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 1167-1:2006)* [A1]

EN ISO 2505:2005, *Thermoplastics pipes — Longitudinal reversion — Test method and parameters (ISO 2505:2005)*

EN ISO 3126, *Plastics piping systems — Plastics components — Determination of dimensions (ISO 3126:2005)*

EN ISO 1183-1, *Plastics — Methods for determining the density of non-cellular plastics — Part 1: Immersion method, liquid pyknometer method and titration method (ISO 1183-1:2004)*

[A1] EN ISO 9969:2007 [A1], *Thermoplastics pipes — Determination of ring stiffness ([A1] ISO 9969:2007 [A1])*

[A1] ISO 11357-6, *Plastics — Differential scanning calorimetry (DSC) — Part 6: Determination of oxidation induction time (isothermal OIT) and oxidation temperature (dynamic OIT)*

ISO 13254, *Thermoplastics piping systems for non-pressure applications — Test method for watertightness*

ISO 13257, *Thermoplastics piping systems for non-pressure applications — Test method for resistance to elevated temperature cycling*

ISO 13259, *Thermoplastics piping systems for non-pressure applications — Test method for leaktightness for elastomeric sealing ring type joints*

ISO 13263, *Thermoplastics piping systems for non-pressure underground drainage and sewerage — Thermoplastics fittings — Test method for impact strength*

ISO 13264, *Thermoplastics piping systems for non-pressure underground drainage and sewerage — Thermoplastics fittings — Test method for mechanical strength or flexibility of fabricated fittings* [A1]

3 Terms, definitions, symbols and abbreviations

3.1 Terms and definitions

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

3.1.1
application area code
code used in the marking of pipes and fittings to indicate the application area for which they are intended, as follows:

— U: code for the area more than one meter from the building to which the buried piping system is connected;

— D: code for the area under and within one metre from the building where the pipes and the fittings are buried in the ground and are connected to the soil and waste discharge system of the building

NOTE In code D application areas, the existence of hot water discharge in addition to the external forces from surroundings is usual.

3.1.2 Geometrical definitions

3.1.2.1
nominal size DN
numerical designation of the size of a component, which is a convenient round number approximately equal to the manufacturing dimension, in millimetres

3.1.2.2
nominal size DN/OD
nominal size, related to the outside diameter

3.1.2.3
nominal outside diameter
d_n
specified outside diameter, in millimetres, assigned to a nominal size DN/OD

3.1.2.4
outside diameter
d_e
value of the measurement of the outside diameter through its cross-section at any point of a pipe or spigot end of a fitting, rounded up to the next greater 0,1 mm

3.1.2.5
mean outside diameter
d_{em}
value of the measurement of the outer circumference of a pipe or spigot end of a fitting in any cross-section, divided by π ($\approx$ 3,142), rounded up to the next greater 0,1 mm

3.1.2.6
mean inside diameter of a socket
d_{sm}
arithmetical mean of a number of measurements of the inside diameter of a socket in the same cross-section

3.1.2.7
wall thickness
e
value of the measurement of the wall thickness at any point around the circumference of a component

3.1.2.8
mean wall thickness
e_m
arithmetical mean of a number of measurements of the wall thickness, regularly spaced around the circumference and in the same cross-section of a component, including the measured minimum and the measured maximum values of the wall thickness in that cross-section

3.1.2.9
pipe series S
number for pipe designation (conforming to ISO 4065:1996 [2])

3.1.2.10
standard dimension ratio (SDR)
numerical designation of a pipe series, which is a convenient round number approximately equal to the dimension ratio of the nominal outside diameter, d_n and the nominal wall thickness, e_n

3.1.3 Mechanical definitions

3.1.3.1
nominal ring stiffness (SN)
numerical designation of the ring stiffness of a pipe or fitting, which is a convenient round number, relative to the determined stiffness in kiloNewtons per square metre (kN/m^2), indicating the minimum ring stiffness of a pipe or fitting

3.1.4 Material definitions

3.1.4.1
virgin material
material in a form such as granules or powder that has not been subjected to use or processing other than that required for its manufacture and to which no reprocessable or recyclable material has been added

3.1.4.2
own reprocessable material
material prepared from rejected unused pipes and fittings, including trimmings from the production of pipes and fittings, that will be reprocessed in a manufacturer's plant after having been previously processed by the same manufacturer by a process such as moulding or extrusion, and for which the complete formulation is known

3.1.4.3
external reprocessable material
material comprising either one of the following forms:

a) material from rejected unused pipes or fittings or trimmings there from, that will be reprocessed and that were originally processed by another manufacturer;

b) material from the production of unused PE products other than pipes and fittings regardless of where they were manufactured

3.1.4.4
recyclable material
material comprising either one of the following forms:

a) material from used pipes or fittings which have been cleaned and crushed or ground;

b) material from used PE products other than pipes or fittings which have been cleaned and crushed or ground

3.2 Symbols

A : length of engagement

C : depth of sealing zone

d_e : outside diameter

d_{em} : mean outside diameter

d_n : nominal outside diameter

d_{sm} : mean inside diameter of a socket

e_m : mean wall thickness

e_n : nominal wall thickness

e_2 : wall thickness of a socket

e_3 : wall thickness in the groove area

l : effective length of pipe

L_1 : length of spigot

M : length of spigot of a plug

R : radius of swept fittings

Z_d : design length (Z_d-length)

α_n : nominal angle of a fitting

3.3 Abbreviations

CT : close tolerance

DN : nominal size

DN/OD : nominal size, outside diameter related

MFR : melt mass-flow rate

OIT : oxidation induction time

PE : polyethylene

〚A1〛 S : pipe series 〚A1〛

SDR : standard dimension ratio

SN : nominal ring stiffness

4 Material

4.1 Base material

The base material shall be polyethylene (PE) to which are added those additives that are needed to facilitate the manufacture of pipes and fittings conforming to this European Standard.

The reference density of the base material (resin) shall be at least 930 kg/m^3 when determined according to EN ISO 1183-1.

4.2 Reprocessable and recyclable material

In addition to virgin material the use of the manufacturer's own reprocessable material obtained during the production and testing of products conforming to this European Standard is permitted.

External reprocessable material and recyclable material of pipes and fittings is permitted [A1] according to the rules in CEN/TS 14541 [A1] provided it originates from products in accordance with this European Standard or EN 1519, EN 12201 [3], EN 13244 [4] and EN 1555 [5] or national standards replaced by these European Standards.

4.3 Melt mass-flow rate

Pipes and fittings shall be made from PE materials with a MFR as follows:

0,2 g/10 min ≤ MFR $_{(190/5)}$ ≤ 1,4 g/10 min

[A1] The MFR of the base material shall be tested in accordance with EN ISO 1133, using the test parameters: temperature 190 °C and loading mass 5 kg. [A1]

4.4 Resistance to internal pressure (long-term behaviour)

When tested in accordance with the test method as specified in Table 1, using the indicated parameters, the material shall have characteristics conforming to the requirements given in Table 1.

The material shall be tested in the form of a pipe.

Table 1 — Material characteristics (long-term behaviour)

Characteristic	Requirements	Test parameters		Test method
Resistance to internal pressure	No failure during the test period	End caps Test temperature Orientation Number of test pieces Circumferential (hoop) stress Conditioning period Type of test Test period	Type a) or b) 80 °C Free 3 4,0 MPa 1 h Water-in-water 165 h	[A1] EN ISO 1167-1 [A1]
Resistance to internal pressure	No failure during the test period	End caps Test temperature Orientation Number of test pieces Circumferential (hoop) stress Conditioning period Type of test Test period	Type a) or b) 80 °C Free 3 2,8 MPa 1 h Water-in-water 1 000 h	[A1] EN ISO 1167-1 [A1]

4.5 Thermal stability (OIT)

When tested in accordance with [A1] ISO 11357-6 [A1] using a test temperature of 200 °C, the oxidation induction time of the material used for pipes or fittings shall not be less than 20 min.

4.6 Fusion compatibility

Materials fulfilling the longterm behaviour requirements given in 4.4 and having an MFR (190/5) within the range given in 4.3 shall be considered to be compatible for fusion to each other.

4.7 Sealing ring retaining means

Sealing rings may be retained using means made from polymers other than PE.

5 General requirements

5.1 Appearance

When viewed without magnification, the following requirements apply:

— internal and external surfaces of pipes and fittings shall be smooth, clean and free from grooving, blistering, impurities and pores and any other surface irregularity likely to prevent their conformance with this European Standard;

— pipe ends shall be cleanly cut and the ends of pipes and fittings shall be square to their axis.

Electrofusion fittings may feature exposed metallic components.

5.2 Colour

The pipes and fittings shall be coloured through the wall. The colour should preferably be black or as agreed between manufacturer and purchaser.

A deviating colour for a co-extruded inner layer is permitted provided the material of this layer conforms to Clause 4.

6 Geometrical characteristics

6.1 General

Dimensions shall be measured according to EN ISO 3126.

NOTE The figures are schematic sketches only, to indicate the relevant dimensions. They do not necessarily represent manufactured components.

6.2 Dimensions of pipes

6.2.1 Outside diameter

The mean outside diameter, d_{em}, shall conform to Table 2.

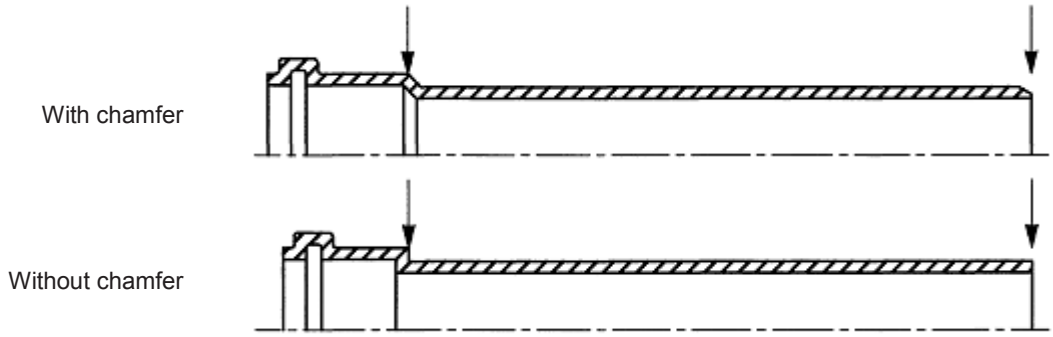
Table 2 — Mean outside diameters

Dimensions in millimetres

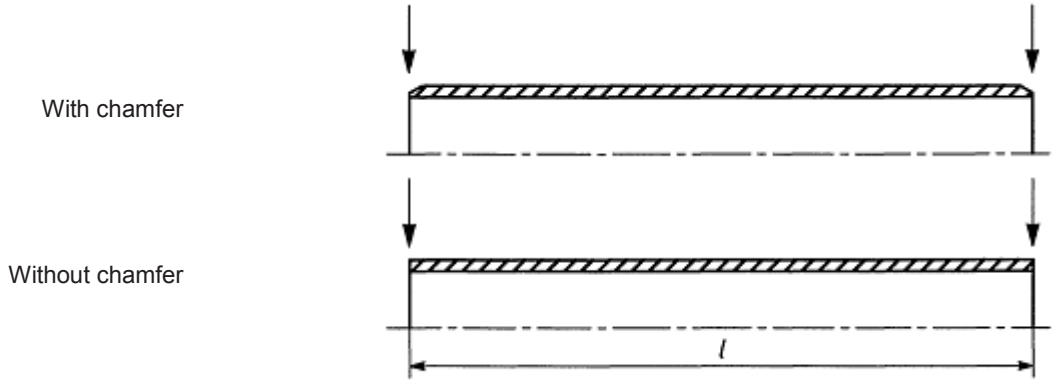
Nominal size DN/OD	Nominal outside diameter	Mean outside diameter	
	d_n	$d_{em,min}$	$d_{em,max}$
110	110	110,0	111,0
125	125	125,0	126,2
160	160	160,0	161,5
200	200	200,0	201,8
250	250	250,0	252,3
315	315	315,0	317,9
355	355	355,0	358,2
400	400	400,0	403,6
450	450	450,0	454,1
500	500	500,0	504,5
[A1] 560	560	560,0	565,0 [A1]
630	630	630,0	635,7
[A1] 710	710	710,0	716,4 [A1]
800	800	800,0	807,2
1 000	1 000	1 000,0	1 009,0
1 200	1 200	1 200,0	1 210,0
1 400	1 400	1 400,0	1 410,0
1 600	1 600	1 600,0	1 610,0

6.2.2 Length of pipes

The effective length of a pipe, l, shall be not less than that declared by the manufacturer when measured as shown in Figure 1.



a) Single-socketed pipe with ring seal



b) Plain-ended pipe

Figure 1 — Effective length of pipes

6.2.3 Wall thicknesses

The wall thickness, e, shall conform to Table 3, where a maximum wall thickness at any point of $1{,}25e_{min}$ is permitted provided that the mean wall thickness, e_m, is less than or equal to the specified $e_{m,max}$. The e_m value needs not to be determined if the e_{max} value is less than or equal to $e_{m,max}$ in Table 3.

[A1] Table 3 — Wall thicknesses

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter	Wall thickness [a]							
		SN 2 [b] S 16 SDR 33		SN 4 S 12,5 SDR 26		SN 8 S 10 SDR 21		SN 16 S 8 SDR 17	
	d_n	e_{min} [c]	$e_{m,max}$	e_{min} [c]	$e_{m,max}$	e_{min} [c]	$e_{m,max}$	e_{min} [c]	$e_{m,max}$
110	110	– [d]	– [d]	4,2	4,9	5,3	6,1	6,6	7,5
125	125	– [d]	– [d]	4,8	5,5	6,0	6,9	7,4	8,4
160	160	– [d]	– [d]	6,2	7,1	7,7	8,7	9,5	10,7
200	200	– [d]	– [d]	7,7	8,7	9,6	10,8	11,9	13,3
250	250	7,7	8,7	9,6	10,8	11,9	13,3	14,8	16,5
315	315	9,7	10,9	12,1	13,6	15,0	16,8	18,7	21,7
355	355	10,9	12,2	13,6	15,2	16,9	19,7	21,1	24,5
400	400	12,3	13,8	15,3	17,1	19,1	22,2	23,7	27,5
450	450	13,8	15,4	17,2	20,0	21,5	24,8	26,7	30,9
500	500	15,3	17,1	19,1	22,2	23,9	27,4	29,7	34,4
560	560	17,2	20,0	21,4	24,9	26,7	30,9	33,2	38,4
630	630	19,3	22,5	24,1	28,0	30,0	34,7	37,4	43,3
710	710	21,8	25,3	27,2	31,5	33,9	39,2	42,1	48,7
800	800	24,5	28,4	30,6	35,4	38,1	44,1	47,4	54,8
1 000	1 000	30,6	35,4	38,2	44,2	47,7	55,1	-	-
1 200	1 200	36,7	42,4	45,9	53,0	57,2	66,0	-	-
1 400	1 400	42,9	49,6	53,5	61,8	–	–	-	-
1 600	1 600	49,0	56,6	61,2	70,6	–	–	-	-

[a] The tolerances for wall thicknesses conform to ISO 11922-1 grade W for wall thickness equal to or less than 16 mm and grade X for wall thickness larger than 16 mm.

[b] SN 2 is applicable for application area "U" only.

[c] The e_{min}-values are in conformance with ISO 4065:1996 [2].

[d] For sizes DN 110 to 200 in SN 2 reference is made to EN 1519-1:1999, Table 3, pipe series S16. Such pipes may be used outside the application area B when encased in concrete or laid in ducts.

NOTE SN 16 is only needed where the installation and soil conditions require high ring stiffness

[A1]

NOTE For components conforming to this European Standard, the standard dimension ratio, SDR, and the values of the pipe series S specified in Table 3 are calculated from the equation SDR = 2S + 1 [A1] *deleted text* [A1].

6.3 Dimensions of fittings

6.3.1 Outside diameter

The mean outside diameter, d_{em}, of the spigot shall conform to Table 2.

6.3.2 Outside diameter for spigots with close tolerances (Type CT)

For the purposes of this European Standard in addition to the dimensions and tolerances given in Table 2 for spigot ends of fittings, tolerances that are in accordance with EN 1401-1 may be used.

If these tolerances, classified as close tolerances (CT), are required the mean outside diameter, d_{em}, of the spigot and the tolerances shall conform to Table 4.

Table 4 — Mean outside diameters for spigots with close tolerances type CT

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter d_n	Mean outside diameter	
		$d_{em,min}$	$d_{em,max}$
110	110	110,0	110,3
125	125	125,0	125,3
160	160	160,0	160,4
200	200	200,0	200,5
250	250	250,0	250,5
315	315	315,0	315,6
355	355	355,0	355,7
400	400	400,0	400,7
450	450	450,0	450,8
500	500	500,0	500,9
630	630	630,0	631,1

Spigot ends of fittings with mean outside diameters conforming to Table 4 may be used with pipes and fittings conforming to EN 1401-1 provided that the socket(s) for these pipes and fittings are intended to be used with elastomeric ring seal joints.

NOTE Spigots ends of fittings with mean outside diameters conforming to Table 4 are normally injection-moulded or machined.

6.3.3 Design lengths

The design lengths, Z_d, shall be declared by the manufacturer.

NOTE The design lengths (see the dimensions Z_d in Figures 8 to 12 and Figures 15 to 20) are intended to assist in the design of moulds and are not intended to be used for quality control purposes. ISO 265-1:1988 [6] may be used as a guideline.

6.3.4 Wall thicknesses of the body of a fitting

6.3.4.1 The minimum wall thickness, e_{min}, of the body or the spigot of a fitting shall conform to Table 3, except that a reduction of 5 % resulting from core shift is permitted. In such a case, the mean of two opposite wall thicknesses shall be equal to or exceed the values given in this table.

6.3.4.2 Where a fitting or adaptor provides for a transition between two nominal sizes, the wall thickness of each connecting part shall conform to the requirements for the applicable nominal size. In such a case the wall thickness of the fitting body is permitted to change gradually from one wall thickness to the other.

6.3.4.3 The wall thickness of fabricated fittings, except for spigot and socket, may be changed locally by the fabrication process, provided that the minimum wall thickness of the body conforms to $e_{3,min}$ as given in Table 6 for the size and pipe series concerned.

6.4 Dimensions of sockets and spigots

6.4.1 Elastomeric ring seal sockets and spigots

6.4.1.1 Diameters and lengths

The diameters and lengths of elastomeric ring seal sockets and lengths of spigots shall conform to Table 5 (see Figures 2, 3, 4 or 5, as applicable).

Where sealing rings are firmly retained, the dimensions for the minimum value for A and the maximum value for C shall be measured to the effective sealing point (see Figure 4) as specified by the manufacturer. This point shall give a full sealing action.

Different designs of elastomeric ring seal sockets are permitted, provided they conform to the requirements given in Table 12.

Table 5 — Socket diameters and lengths of sockets and spigots

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter	Socket			Spigot
	d_n	$d_{sm,min}$	A_{min} [a]	C_{max}	$L_{1,min}$
110	110	111,1	40	40	62
125	125	126,3	43	43	68
160	160	161,6	50	50	82
200	200	201,9	58	58	98
250	250	252,4	68	68	118
315	315	318,0	81	81	144
355	355	358,3	89	89	160
400	400	403,7	98	98	178
450	450	454,2	108	108	198
500	500	504,6	118	118	218
[A1] 560	560	565,1	130	130	242 [A1]
630	630	635,8	144	144	270

[a] The socket is designed for an effective length of pipe of 6 m.

For sockets and spigots that have a nominal outside diameter greater than 630 mm, the values of $d_{sm,min}$, A_{min}, C_{max} and $L_{1,min}$ shall be calculated using the following equations:

A_{min} = (0,2d_n + 18) mm;

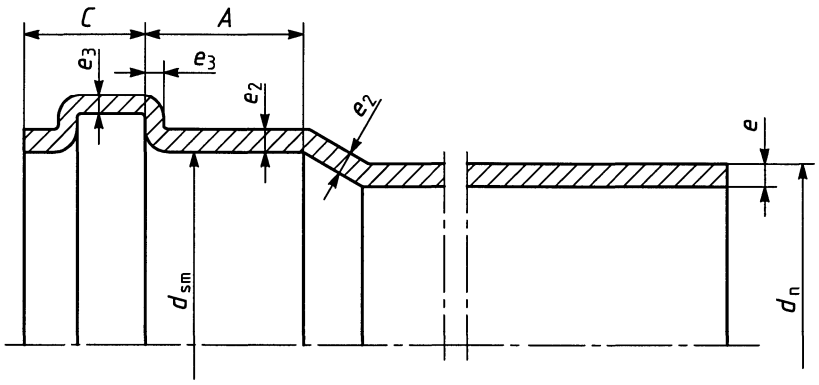
C_{max} = (0,2d_n + 18) mm;

$d_{sm,min}$ = 1,0092d_n mm;

$L_{1,min}$ = (0,4d_n + 18) mm.

For pipe lengths longer than 6 m the length of engagement, A, in the socket shall be calculated from the equation: A = (0,2d_n + 3 × l) mm, where l is the pipe length, in metres.

Ring seal socket with chamfer



Ring seal socket without chamfer

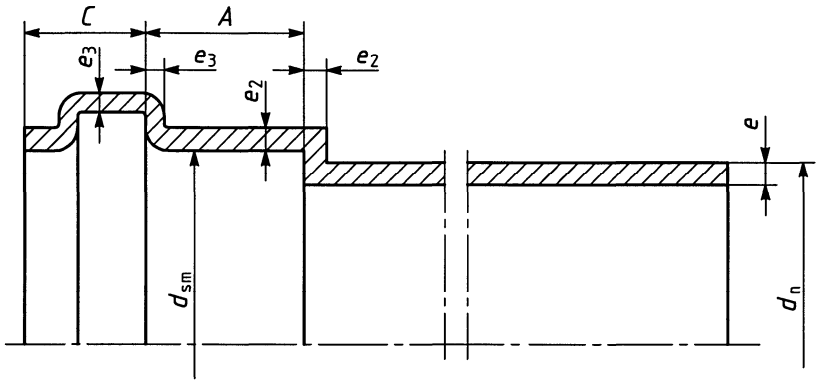


Figure 2 — Dimensions of sockets for elastomeric ring seal joints

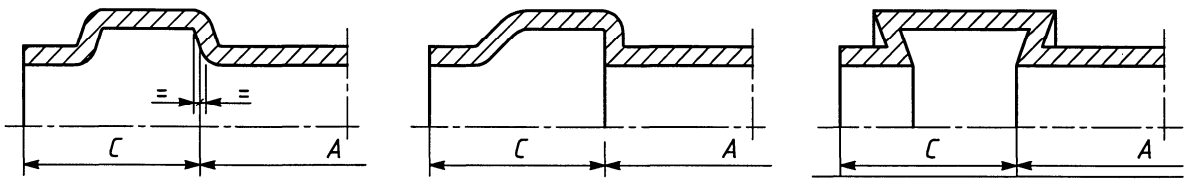


Figure 3 — Typical groove designs for elastomeric ring seal sockets

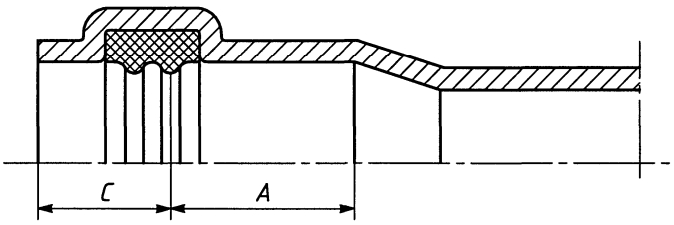


Figure 4 — Example for measuring the effective sealing point

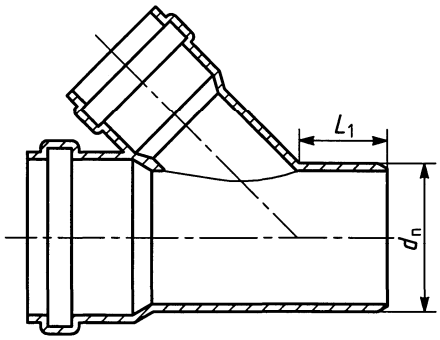


Figure 5 — Spigot lengths

6.4.1.2 Wall thicknesses of sockets

The wall thicknesses of sockets, e_2 and e_3 (see Figure 2), except the socket mouth, shall conform to Table 6.

A reduction of 5 % of e_2 and e_3 resulting from core shift is permitted. In such a case the mean of two opposite wall thicknesses shall be equal to or exceed the applicable values given in Table 6.

〚A1〛 Table 6 — Wall thicknesses of sockets

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter	Wall thickness							
		SN 2 [a] S 16 SDR 33		SN 4 S 12,5 SDR 26		SN 8 S 10 SDR 21		SN 16 S 8 SDR 17	
	d_n	$e_{2,min}$	$e_{3,min}$	$e_{2,min}$	$e_{3,min}$	$e_{2,min}$	$e_{3,min}$	$e_{2,min}$	$e_{3,min}$
110	110	-	-	3,8	3,2	4,8	4,0	6,0	5,0
125	125	-	-	4,4	3,6	5,4	4,5	6,7	5,6
160	160	-	-	5,6	4,7	7,0	5,8	8,6	7,2
200	200	-	-	7,0	5,8	8,7	7,2	10,8	9,0
250	250	7,0	5,8	8,7	7,2	10,8	9,0	13,4	11,1
315	315	8,8	7,3	10,9	9,1	13,5	11,3	16,9	14,1
355	355	9,9	8,2	12,3	10,2	15,3	12,7	17,8	18,4
≥ 400	≥ 400	11,1	9,3	13,8	11,5	17,2	14,4	21,4	17,8

[a] SN 2 is applicable for application area "U" only.

〈A1〉

Where a sealing ring is located by means of a retaining cap or ring (see Figure 6) the wall thickness in this area shall be calculated by the addition of the wall thickness of the socket and the wall thickness of the retaining ring or cap at corresponding places in the same cross section.

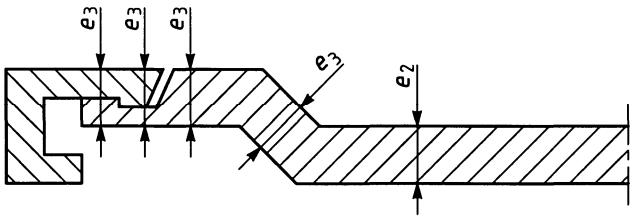


Figure 6 — Example for calculation of the wall thickness of sockets with retaining cap

6.4.2 Butt fusion spigot ends

The mean outside diameters, d_{em}, and wall thicknesses, e, of spigots intended for butt fusion shall conform to the diameters and corresponding pipe size and series as given in Tables 2 and 3 respectively.

6.4.3 Electrofusion sockets

The dimensions of electrofusion sockets shall conform to the values given in Table 7 (see Figure 7).

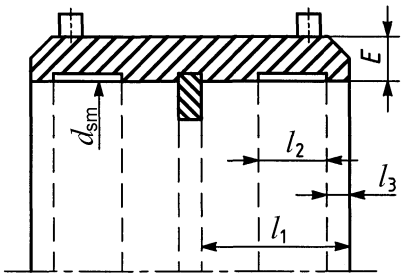


Figure 7 — Electrofusion socket

Table 7 — Dimensions of electrofusion sockets

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter d_n	Mean inside diameter d_{sm}	Minimum depth of penetration $l_{1,min}$	Minimum length of fusion zone $l_{2,min}$	Minimum unheated entrance length $l_{3,min}$	Wall thickness E
110	110		28	15	5	
125	125		28	15	5	
160	160		28	15	5	
200	200		50	25	5	
250	250		60	25	5	
315	315		70	25	5	
355	355		100	25	8	
400	400	a	100	25	8	b
450	450		100	25	8	
500	500		100	25	8	
A1 560	560		100	25	8 A1	
630	630		120	30	8	
A1 710	710		120	30	12 A1	
800	800		120	30	12	
1 000	1 000		120	35	12	

a The mean inside diameter of the socket, d_{sm}, shall be measured in a plane which is parallel to the plane of the socket mouth at a distance of $l_3 + 0{,}5l_2$. The mean inside diameter of a socket shall be specified by the manufacturer in such a way that after assembling and fusion of the pipes and fittings the joints conform to the requirements of Clause 9.

b The wall thickness E of the electrofusion socket shall be at least equal to the minimum wall thickness for the corresponding pipe size and series conforming to Table 3.

6.4.4 Flange joints

Flange joints consisting of butt fused stub end(s), flange adaptors and matching flanges in accordance with ISO 9624 [7] may be used for pipe systems following this European Standard. Normally flange adaptors of the lowest available pressure class are preferred.

6.5 Types of fittings

This European Standard covers the following typical types of fittings, but other designs are permitted.

a) Bends (see Figures 8, 9, 10, 11, 12):

- unswept and swept angle (see ISO 265-1:1988 [6]);
- spigot/socket and socket/socket;
- butt fused from segments;
- heat formed without socket/with socket butt-fused on;

NOTE 1 Preferred nominal angles α_n: 15°, 30°, 45°, 87,5° to 90°.

b) Couplers and slip couplers (see Figure 13, 14);

c) Reducers (see Figure 15);

d) Branches and reducing branches (see Figures 16, 17, 18, 19):

— unswept and swept angle (see ISO 265-1:1988 [4]);

— spigot/socket and socket/socket;

NOTE 2 Preferred nominal angles α_n: 45°, 87,5° to 90°.

e) Branches with flange and collar (see Figure 20);

f) Plugs (see Figure 21):

— minimum length of spigot, M = (C_{max} + 10) mm (see Table 5);

g) Push-fit sockets for butt fusion to pipe end (see Figure 22).

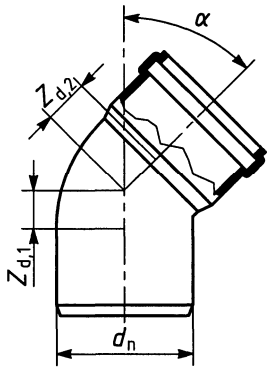


Figure 8 — Bend with single socket (unswept)

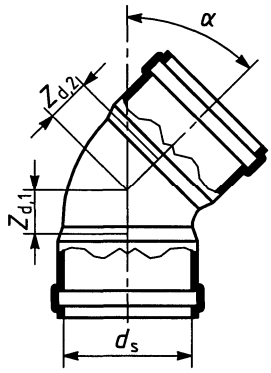


Figure 9 — Bend with all sockets (unswept)

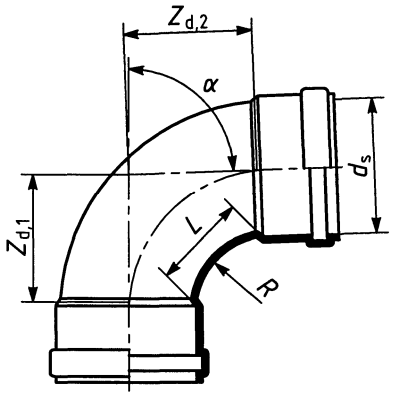


Figure 10 — Bend with all sockets (swept)

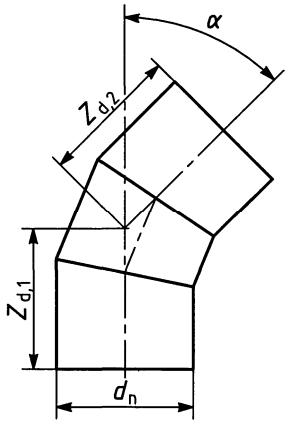


Figure 11 — Bend for butt fusion, butt fused from segments

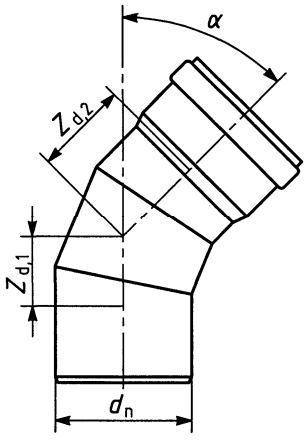


Figure 12 — Bend with socket and spigot end, butt fused from segments

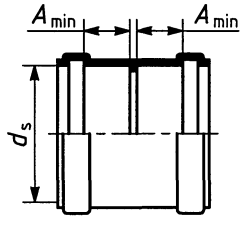


Figure 13 — Coupler

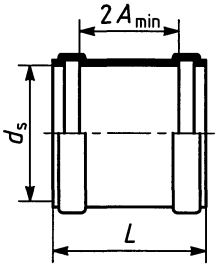


Figure 14 — Slip coupler

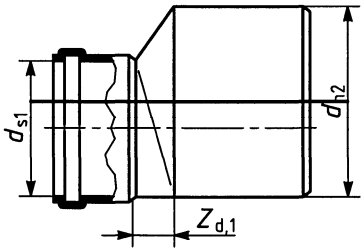


Figure 15 — Reducer

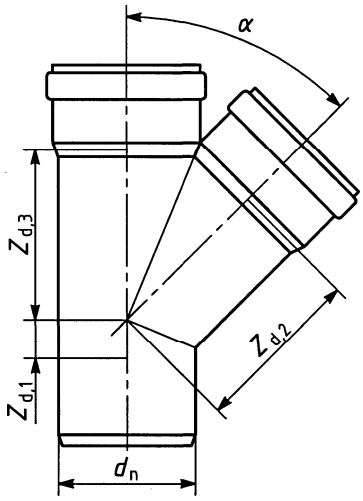


Figure 16 — Branch (unswept)

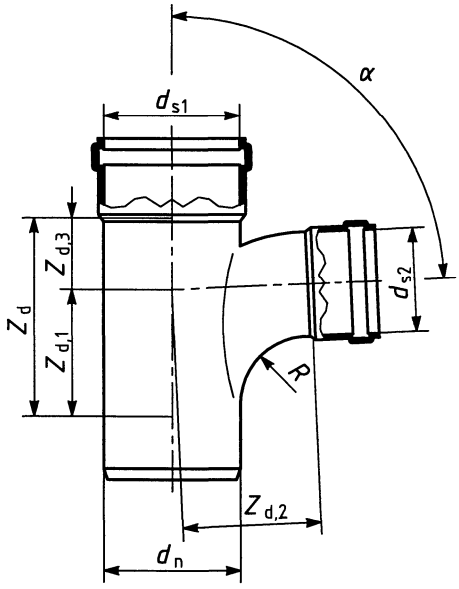


Figure 17 — Reducing branch (swept)

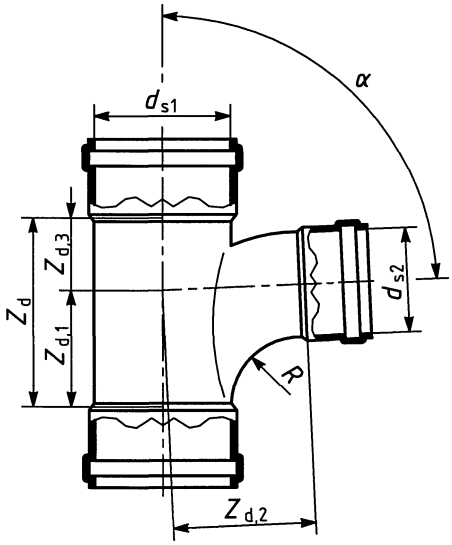


Figure 18 — All socket reducing branch (swept)

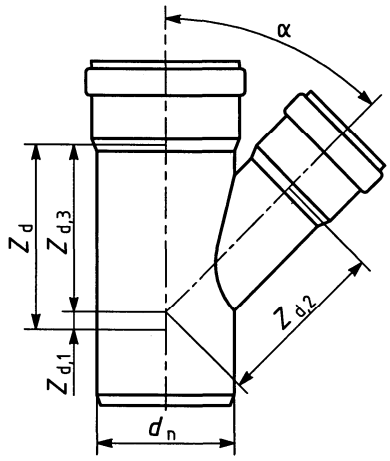


Figure 19 — Reducing branch

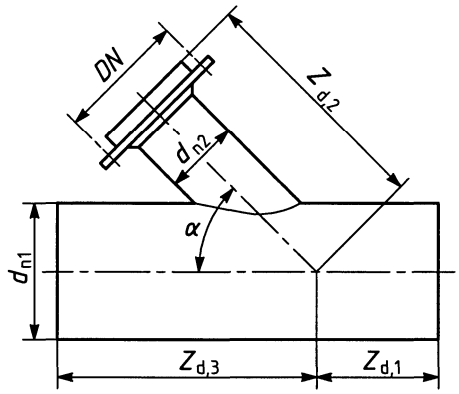


Figure 20 — Branch for butt fusion with flange and collar

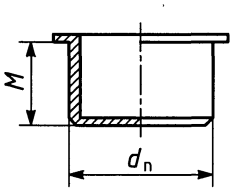


Figure 21 — Plug

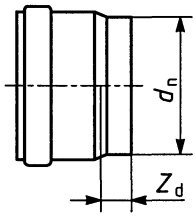


Figure 22 — Push-fit socket for butt fusion to pipe-end

7 Mechanical characteristics

7.1 Mechanical characteristics of pipes

When tested in accordance with the test method as specified in Table 8 using the indicated parameters, the pipe shall have mechanical characteristics conforming to the requirements given in Table 8.

〈A1〉 Table 8 — Mechanical characteristics of pipes

Characteristic	Requirement	Test parameters		Test method
Ring stiffness	SDR 33: ≥ 2 kN/m^2 SDR 26: ≥ 4 kN/m^2 SDR 21: ≥ 8 kN/m^2 SDR 17: ≥ 16 kN/m^2	Test temperature Deflection Deflection speed for: $d_n \leq 100$ mm 100 mm < $d_n \leq 200$ mm 200 mm < $d_n \leq 400$ mm 400 mm < $d_n \leq 710$ mm $d_n > 710$ mm	(23 ± 2) °C 3 % (2 ± 0,1) mm/min (5 ± 0,25) mm/min (10 ± 0,5) mm/min (20 ± 1) mm/min (0,03 × d_i [a] ± 5 %) mm/min	EN ISO 9969
[a] d_i shall be determined in accordance with EN ISO 9969:2007, 6.3.				

〈A1〉

7.2 Mechanical characteristics of fittings

When tested in accordance with the test method as specified in Table 9 using the indicated parameters, the fitting shall have mechanical characteristics conforming to the requirements given in Table 9.

〚A1〛 Table 9 — Mechanical characteristics of fittings

Characteristic	Requirements	Test parameters		Test method
Flexibility or mechanical strength [a]	No sign of splitting, cracking, separation and/or leakage	**EITHER**		
		Test period Minimum displacement	15 min 170 mm	ISO 13264
		OR		
		Minimum moment for: [DN] ≤ 250 [DN] > 250,	 $0{,}15 \times [DN]^3 \times 10^{-6}$ kNm $0{,}01 \times [DN]$ kNm	
Impact strength (Drop test) [b]	No damage	Conditioning and test temperature Fall height for: d_n = 110 mm d_n = 160 mm d_n = 200 mm d_n = 250 mm Point of impact	0 °C 1 000 mm 1 000 mm 500 mm 500 mm Mouth of the socket	ISO 13263

[a] Only for fabricated fittings made from more than one piece. A sealing ring retaining means is not considered as a piece.
[b] Only for fittings where the sealing ring is located by means of a retaining ring or cap.

〈A1〉

8 Physical characteristics

8.1 Physical characteristics of pipes

When tested in accordance with the test methods as specified in Table 10 using the indicated parameters, the pipe shall have physical characteristics conforming to the requirements given in Table 10.

Table 10 — Physical characteristics of pipes

Characteristic	Requirement	Test parameters		Test method
Longitudinal reversion	≤ 3 % The pipe shall exhibit no bubbles or cracks	Test temperature Immersion time	110 °C 30 min	Method A of EN ISO 2505:2005 (liquid)
		OR		
		Test temperature Immersion time for: $e \leq 8$ mm 8 mm < $e \leq 16$ mm $e > 16$ mm	110 °C 60 min 120 min 240 min	Method B of EN ISO 2505:2005 (air)
Melt mass-flow rate (MFR-value)	Permitted max. change by processing the compound into pipe: 0,25 g/10 min	Test temperature Test period Load	190 °C 10 min 5 kg	EN ISO 1133:2005 〚A1〛 *deleted text* 〈A1〉

8.2 Physical characteristics of fittings

When tested in accordance with the test method as specified in A1 Table 11 and Table 12 A1 using the indicated parameters, the fitting or mouldings used for fabricated fittings shall have physical characteristics conforming to the requirements given in A1 Table 11 and Table 12 as applicable A1.

For fittings manufactured from pipes, the pipes used for such fabricating shall conform to the requirements given in Tables 8 and 10.

Table 11 — Physical characteristics of fittings

Characteristic	Requirements	Test parameters		Test method
Effects of heating [a]	A1 b A1	Temperature Heating time for: $e \leq 8$ mm 8 mm < $e \leq 16$ mm $e > 16$ mm	110 °C 60 min 120 min 240 min	Method A of EN ISO 580:2005 (air oven)
[a] Mouldings that shall be used for fabricated fittings may be tested individually. [b] The depth of cracks, de-lamination or blisters shall not be more than 20 % of the wall thickness around the injection point(s). No part of the weld line shall open to a depth more than 20 % of the wall thickness.				

A1 Table 12 — Physical characteristics of fabricated fittings

Characteristic	Requirements	Test parameters		Test method
Water tightness	No leakage	Water pressure duration	0,5 bar 1 min	ISO 13254
Only fabricated fittings made from more than one piece. A sealing ring retaining means is not considered as a piece.				

A1

9 Performance requirements

When tested in accordance with the test methods as specified in A1 Table 13 A1 using the indicated parameters, the joints and piping system shall have fitness for purpose characteristics conforming to the requirements given in A1 Table 13 A1.

[A1] Table 13 — Fitness for purpose characteristics

Characteristic	Requirements	Test parameters		Test method
Tightness of elastomeric sealing ring joints and electrofusion joints		Temperature Spigot deflection Socket deflection	(23 ± 5) °C 10 % 5 %	ISO 13259, condition B
	No leakage	Water pressure	0,05 bar	
	No leakage	Water pressure	0,5 bar	
	≤ –0,27 bar	Air pressure	–0,3 bar	
Tightness of elastomeric sealing ring joints and electrofusion joints		Temperature Angular deflection for: $d_n \leq 315$ mm 315 mm < $d_n \leq 630$ mm $d_n > 630$ mm	(23 ± 5) °C 2° 1,5° 1°	ISO 13259, condition C
	No leakage	Water pressure	0,05 bar	
	No leakage	Water pressure	0,5 bar	
	≤ –0,27 bar	Air pressure	–0,3 bar	
Elevated temperature cycling [a] [b]	No leakage	Shall conform to ISO 13257		ISO 13257, Test assembly b) (Figure 2 of ISO 13257)

[a] Not relevant for butt-fused joints.
[b] Test required only for components intended to be used for application area code "D" and with d_n less than or equal to 200 mm.

[/A1]

10 Sealing rings

10.1 The sealing ring shall have no detrimental effects on the properties of the pipe and the fitting and shall not cause the test assembly to fail to conform to Table 12.

10.2 Materials for sealing rings shall conform to EN 681-1 or EN 681-2, as applicable.

[A1] *deleted text* [/A1]

11 Marking

11.1 General

11.1.1 Marking elements shall be printed or formed directly on the component or be on a label, in such a way that after storage, weathering, handling and installation, the required legibility is maintained.

Two levels of legibility of the marking on components are specified for the individual marking aspects given in [A1] Tables 14 and 15 [/A1]. The required durability of marking is coded with decreasing stringency as follows:

a: durable in use;

b: legible until the system is installed.

NOTE The manufacturer is not responsible for marking being illegible due to actions caused during installation and use such as painting, scratching, covering of the components or by use of detergents etc. on the components unless agreed or specified by the manufacturer.

11.1.2 Marking shall not initiate cracks or other types of defects which adversely influence the performance of the pipe or the fitting.

Marking by indentation reducing the wall thickness not more than 0,5 mm shall be deemed to conform to this clause without infringing the requirements for the wall thickness given in 6.2.3.

11.1.3 The size of the marking shall be such that the marking is legible without magnification.

11.2 Minimum required marking of pipes

Pipes shall be marked at intervals of maximum 1 m, at least once per pipe.

The minimum required marking of pipes shall conform to [A1] Table 14 [A1].

[A1] Table 14 [A1] — Minimum required marking of pipes

Aspects	Marking or symbols	Legibility code
Number of this European Standard	EN 12666	a
Application area code	U or UD, as applicable	a
Manufacturer's name and/or trade mark	XXX	a
Nominal size	e.g. 200	a
Minimum wall thickness or [A1] SDR [A1]	e.g. either 7,7 or SDR 26	a
Material	PE	a
Nominal ring stiffness	e.g. SN 4	a
Manufacturer's information	[a]	a

[a] For providing traceability the following details shall be given:

— the production period, year and month, in figures or in code;
— a name or code for the production site if the manufacturer is producing in different sites.

11.3 Minimum required marking of fittings

The minimum required marking of fittings shall conform to [A1] Table 15 [A1].

[A1] Table 15 [A1] — Minimum required marking of fittings

Aspects	Marking or symbols	Legibility code
Number of this European Standard	EN 12666	b
Application area code	U or UD, as applicable	a
Manufacturer's name and/or trade mark	XXX	a
Nominal size	e.g. 200	a
Nominal angle	e.g. 45°	b
Minimum wall thickness or [A1] SDR [A1]	e.g. either 7,7 or SDR 26	a
Material	PE	a
Symbol for close tolerance on outside spigot diameter, when applicable	CT	b
Manufacturer's information	[1)]	a

[a] For providing traceability the following details shall be given:

— – the production period, year, in figures or in code;
— – a name or code for the production site if the manufacturer is producing in different sites.

11.4 Additional marking

11.4.1 Pipes and fittings conforming to this European Standard, which also conform to other standards, may be additionally marked with the required marking of those standards.

11.4.2 Pipes conforming to this European Standard that are third party certified, may be marked accordingly.

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

Annex A
(informative)

General characteristics of PE pipes and fittings

A.1 General

EN 476 [8] specifies the general requirements for components used in discharge pipes, drains and sewers for gravity systems. Pipes and fittings conforming to this European Standard fully meet these requirements. The following additional information is given.

A.2 Material characteristics

The material of pipes and fittings conforming to this European Standard have generally the following characteristics:

Modulus of elasticity	$E_{(1\ \mathrm{min})} \geq 800$ MPa
Average density	≈ 940 kg/m^3
Average coefficient of linear thermal expansion	0,18 to 0,20 mm/mK
Thermal conductivity	(0,36 to 0,50) WK^{-1}m^{-1}
Specific heat capacity	(2 300 to 2 900) Jkg^{-1}K^{-1}
Surface resistance	$> 10^{12}\ \Omega$

A.3 Ring stiffness

The ring stiffness of pipes conforming to this European Standard is determined in accordance with EN ISO 9969 and is as follows:

SDR 33 : ≥ 2 kN/m^2

SDR 26 : ≥ 4 kN/m^2

SDR 21 : ≥ 8 kN/m^2

When a fitting conforming to this European Standard has the same wall thickness as the corresponding pipe, the stiffness of this fitting because of its geometry is equal to or greater than the stiffness of that pipe.

The actual value of stiffness of the fittings can be determined in accordance with ISO 13967 [9].

A.4 Creep ratio

The creep ratio for pipes and fittings conforming to this European Standard, when determined in accordance with EN ISO 9967:1995 [10], is less than 4,5. For fittings the full cylindrical length of the socket or spigot is used as a test piece and the pre-load force, F_o, is decreased relative to the actual length of the test piece.

A.5 Chemical resistance

PE piping systems, conforming to this European Standard, are resistant to corrosion by water with a wide range of pH-values such as domestic wastewater, rainwater, surface water and ground water.

If piping systems conforming to this European Standard are intended to be used for chemically contaminated waste waters, such as industrial discharges, chemical and temperature resistance should to be taken into account. For information about the chemical resistance of PE materials guidance is given in ISO/TR 10358 [11] and for rubber materials in ISO/TR 7620 [12].

A.6 Abrasion resistance

Pipes and fittings conforming to this European Standard are resistant to abrasion. For special circumstances, the abrasion can be determined from the test method given EN 295-3:1991 [13].

A.7 Hydraulic roughness

The internal surface of pipes and fittings conforming to this European Standard are hydraulically smooth. The design of joints and fittings ensure good hydraulic performances. For further information about hydraulic capacity of pipes and fittings conforming to this European Standard refer to manufacturer's information.

A.8 Diametric deflection

In normal installation conditions, the expected average deflection of the outside diameter of the pipes will be less than 9 %. However deflections up to 15 %, e.g. caused by soil movement, will not effect the proper functioning of the piping system.

Annex B
(informative)

A1 Product standards of components that can be connected to components conforming to this standard

EN 1329-1, *Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure — Unplasticized poly(vinyl chloride) (PVC-U) — Part 1: Specifications for pipes, fittings and the system*

EN 1401-1, *Plastics piping systems for non-pressure underground drainage and sewerage — Unplasticized poly(vinyl chloride) (PVC-U) — Part 1: Specifications for pipes, fittings and the system*

EN 1451-1, *Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure — Polypropylene (PP) — Part 1: Specifications for pipes, fittings and the system*

EN 1455-1, *Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure — Acrylonitrile-butadiene-styrene (ABS) — Part 1: Specifications for pipes, fittings and the system*

EN 1519-1, *Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure — Polyethylene (PE) — Part 1: Specifications for pipes, fittings and the system*

EN 1565-1, *Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure — Styrene copolymer blends (SAN+PVC) — Part 1: Specifications for pipes, fittings and the system*

EN 1566-1, *Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure — Chlorinated poyl(vinyl chloride) (PVC-C) — Part 1: Specifications for pipes, fittings and the system*

EN 1852-1, *Plastics piping systems for non-pressure underground drainage and sewerage — Polypropylene (PP) — Part 1: Specifications for pipes, fittings and the system*

EN 13476-1, *Plastics piping systems for non-pressure underground drainage and sewerage — Structured-wall piping systems of unplasticized poly(vinyl chloride) (PVC-U), polypropylene (PP) and polyethylene (PE) — Part 1: General requirements and performance characteristics*

EN 13476-2, *Plastics piping systems for non-pressure underground drainage and sewerage — Structured-wall piping systems of unplasticized poly(vinyl chloride) (PVC-U), polypropylene (PP) and polyethylene (PE) — Part 2: Specifications for pipes and fittings with smooth internal and external surface and the system, Type A*

EN 13476-3, *Plastics piping systems for non-pressure underground drainage and sewerage — Structured-wall piping systems of unplasticized poly(vinyl chloride) (PVC-U), polypropylene (PP) and polyethylene (PE) — Part 3: Specifications for pipes and fittings with smooth internal and profiled external surface and the system, Type B*

EN 14758-1, *Plastics piping systems for non-pressure underground drainage and sewerage — Polypropylene with mineral modifiers (PP-MD) — Part 1: Specifications for pipes, fittings and the system* A1

Bibliography

[A1] *deleted text* [A1]

[1] CEN/TS 12666-2, *Plastics piping systems for non-pressure underground drainage and sewerage — Polyethylene (PE) — Part 2: Guidance for the assessment of conformity*

[2] ISO 4065:1996, *Thermoplastic pipes — Universal wall thickness table*

[3] EN 12201, *Plastics piping systems for water supply — Polyethylene (PE)*

[4] EN 13244, *Plastics piping systems for buried and above-ground pressure systems for water for general purpose, drainage and sewerage — Polyethylene (PE)*

[5] EN 1555, *Plastics piping systems for the supply of gaseous fuels — Polyethylene (PE)*

[6] ISO 265-1:1988, *Pipes and fittings of plastics materials — Fittings for domestic and industrial waste pipes — Basic dimensions: Metric series — Part 1: Unplasticized poly(vinyl chloride) (PVC-U)*

[7] ISO 9624, *Thermoplastics pipes for fluids under pressure — Mating dimensions of flange adapters and loose backing flanges*

[8] EN 476, *General requirements for components used in discharge pipes, drains and sewers for gravity systems*

[9] ISO 13967, *Thermoplastics fittings — Determination of the short-term stiffness*

[10] EN ISO 9967:1995, *Plastics pipes — Determination of creep ratio (ISO 9967:1994)*

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

[12] ISO/TR 7620, *Rubber materials — Chemical resistance*

[13] EN 295-3:1991, *Vitrified clay pipes and fittings and pipe joints for drains and sewers — Part 3: Test methods*

[14] [A1] ISO 11921, *Thermoplastics pipes for the conveyance of fluids – Dimensions and tolerances – Part 1: Metric series* [A1]

[A1] *deleted text* [A1]

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