BRITISH STANDARD

BS EN
1852-1:2009

Plastics piping systems for non-pressure underground drainage and sewerage — Polypropylene (PP)

Part 1: Specifications for pipes, fittings and the system

ICS 23.040.01; 23.040.20; 93.030

BSI
British Standards

National foreword

This British Standard is the UK implementation of EN 1852-1:2009. It supersedes BS EN 1852-1:1998 which is withdrawn.

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

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

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

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Foreword

This document (EN 1852-1:2009) 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of an identical text or by endorsement, at the latest by September 2009, and conflicting national standards shall be withdrawn at the latest by September 2009.

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 document supersedes EN 1852-1:1997.

The 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).

The System Standards 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 1852 consists of the following parts, under the general title *Plastics piping systems for non-pressure underground drainage and sewerage – Polypropylene (PP)*

— *Part 1: Specifications for pipes, fittings and the system* (the present standard);

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

— *Part 3: Guidance for installation* (CEN Technical Specification).

This part of EN 1852 includes Annex A (normative): Geometrical characteristics of pipes following S-series 11,2, Annex B (informative): General characteristics of PP pipes and fittings and Annex C (informative): Product standards of components that can be connected to components conforming to this standard.

Plastics piping systems made of PP with mineral modifiers (PP-MD) are covered by EN 14758-1 [1].

The main change in the revised document is: EN 1852 gave wall thicknesses for two different E-modulus and S-series, and for E-modulus above 1 700 MPa the designation PP-HM was used. In this revised document the following changes are made:

— new S-series for SN 8 are introduced replacing the previous S-series;

— the previous S-series 11,2 for SN 8 is given in Annex A;

— new ring stiffness class SN 16 is introduced;

— the wall thickness table for fittings is modified;

— designation PP-HM is no longer used;

— impact resistance (staircase method) test temperature changed from 0 °C to −10 °C.

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, 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 the United Kingdom.

1 Scope

This part of EN 1852 specifies the requirements for solid wall pipes, fittings and the system of polypropylene (PP) piping systems intended for use 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 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".

This standard covers PP materials without mineral modifiers.

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

This standard covers a range of nominal sizes, and pipe series 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 Part 2 and Part 3 of EN 1852 it is applicable to PP 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 underground drainage and sewerage.

This standard is applicable to PP pipes and fittings with or without an integral socket.

NOTE 2 The fittings can be manufactured by injection-moulding or be fabricated from pipes and/or mouldings.

NOTE 3 Requirements and limiting values for application area code "D" are given in Table 4, Table 7 and Table 14.

NOTE 4 Pipes, fittings and other components conforming to any of the plastics product standards listed in Annex C can be connected to pipes and fittings conforming to this standard, when they conform to the requirements for joint dimensions given in Clause 6 and to the requirements of Table 14.

2 Normative references

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

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*

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

EN 744:1995, *Plastics piping and ducting systems — Thermoplastics pipes — Test method for resistance to external blows by the round-the-clock method*

EN 1053, *Plastics piping systems — Thermoplastics piping systems for non-pressure applications — Test method for watertightness*

EN 1055:1996, *Plastics piping systems — Thermoplastics piping systems for soil and waste discharge inside buildings — Test method for resistance to elevated temperature cycling*

EN 1277:2003, *Plastics piping systems — Thermoplastics piping systems for buried non-pressure applications — Test methods for leaktightness of elastomeric sealing ring type joints*

EN 1411:1996, *Plastics piping and ducting systems — Thermoplastics pipes — Determination of resistance to external blows by the staircase method*

EN 12061, *Plastics piping systems — Thermoplastics fittings — Test method for impact resistance*

EN 12256, *Plastics piping systems — Thermoplastics fittings — Test method for mechanical strength or flexibility of fabricated fittings*

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

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

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)*

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 9969, *Thermoplastics pipes — Determination of ring stiffness (ISO 9969:2007)*

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

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of this document, 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: application area code for the area more than 1 m from the building to which the buried piping system is connected

D: application area code for the area under and within 1 m from the building where the pipes and the fittings are buried in 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 the surroundings is usual.

3.1.2 Geometrical definitions

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

3.1.2.2
nominal outside diameter
d_n
specified outside diameter, in millimetres, assigned to a nominal size DN/OD

3.1.2.3
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

3.1.2.4
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 to the next greater 0,1 mm

3.1.2.5
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

3.1.2.6
wall thickness
e
value of the measurement of the wall thickness at any point around the circumference of a component

3.1.2.7
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

3.1.2.8
pipes series S
number for pipe designation (see ISO 4065:1996 [2])

3.1.2.9
standard dimension ratio SDR
numerical designation of a pipe series, which is a convenient round number approximately equal to the ratio of the nominal outside diameter, d_n, and the minimum wall thickness, e_{min}

3.1.2.10
nominal ring stiffnesss 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

3.1.2.11
design length
Z
length of a fitting (e.g. the main pipe of a branch) excluding any spigot or socket length. In case of a change in direction (e.g. in case of a bend or the service pipe of a branch), it is the length from one end to the intersection of the straight axis of this end with the straight axis of the other end of the fitting, excluding any spigot or socket length (see the dimensions Z_1 and Z_2 in e.g. Figure 7 and Figure 11)

3.1.3 Material definitions

3.1.3.1
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

3.1.3.2
own reprocessable material
material prepared from rejected unused pipes or fittings, including trimmings from the production of pipes or 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

3.1.3.3
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 PP products other than pipes and fittings, regardless of where they are manufactured

3.1.3.4
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 PP products other than pipes or fittings which have been cleaned and crushed or ground

3.1.4
solid wall pipe
smooth internal and external surface with same compound/formulation throughout the wall

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 : wall thickness

e_m : mean wall thickness

e_2 : wall thickness of a socket

e_3 : wall thickness in the groove area

l : effective length of a pipe

L_1 : length of spigot

M : length of spigot of a plug

R : radius of swept fittings

Z : design length of (a part of) a fitting

α : 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

PP : polypropylene

S : pipes series

SDR : standard dimension ratio

SN : nominal ring stiffness

TIR : true impact rate

4 Material

4.1 PP compound

The compound for pipes and fittings shall be PP base material without mineral modifiers, to which are added those additives that are needed to facilitate the manufacture of components conforming to the requirements of this standard.

NOTE PP-based materials with mineral modifiers (PP-MD) are covered in EN 14758-1 [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 standard is permitted.

External reprocessable and recyclable material of pipes and fittings with agreed specification is permitted according to the rules in CEN/TS 14541 provided it originates from products in accordance with this European Standard and national standards replaced by this European Standard. Such materials can only be used for S 20 and S 16 and S 12,5/SN 8.

4.3 Melt mass-flow rate

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

MFR (230/2,16) ≤ 1,5 g/10 min.

The MFR of the base material shall be tested in accordance with EN ISO 1133, using the test parameters: temperature 230 °C and loading mass 2,16 kg.

Materials for pipes and fittings for butt fusion joints shall be designated by the following classes with regard to the MFR:

Class A: MFR ≤ 0,3 g/10 min;

Class B: 0,3 g/10 min < MFR ≤ 0,6 g/10 min;

Class C: 0,6 g/10 min < MFR ≤ 0,9 g/10 min;

Class D: 0,9 g/10 min < MFR ≤ 1,5 g/10 min.

Only pipes and fittings made from materials of the same or an adjacent MFR-class may be fused together.

4.4 Resistance to internal pressure

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 type B 80 °C free 3 4,2 MPa 1 h Water-in-water 140 h	EN ISO 1167-1
		End caps Test temperature Orientation Number of test pieces Circumferential (hoop) stress Conditioning period Type of test Test period	Types A or B 95 °C free 3 2,5 MPa 1 h Water-in-water 1 000 h	

4.5 Thermal stability (OIT)

The OIT test shall be carried out on components intended for jointing by fusion or welding.

The test shall be carried out in accordance with EN 728 using a test temperature of 200 °C. The oxidation induction time of the material shall not be less than 8 min.

4.6 Sealing ring retaining means

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

5 General characteristics

5.1 Appearance

When viewed without magnification, the following requirements apply.

The 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 conformity to this standard.

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

5.2 Colour

The pipes and fittings shall be coloured through the wall.

The colour should preferably be black, orange-brown (approximately RAL 8023[1]) or dusty grey (approximately RAL 7037[1]). Other colours may be used.

1 See colour register RAL 840-HR [3].

6 Geometrical characteristics

6.1 General

Dimensions shall be measured in accordance with EN ISO 3126.

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

6.2 Dimensions of pipes

6.2.1 Outside diameters

The mean outside diameter, d_{em}, shall conform to Table 2 or Table 3, as applicable.

Table 2 — Mean outside diameters

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter	Mean outside diameter [a]	
	d_n	$d_{em,min}$	$d_{em,max}$
110	110	110,0	110,4
125	125	125,0	125,4
160	160	160,0	160,5
200	200	200,0	200,6
250	250	250,0	250,8
315	315	315,0	316,0
355	355	355,0	358,2
400	400	400,0	403,6
450	450	450,0	454,1
500	500	500,0	504,5
630	630	630,0	635,7
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

[a] The tolerances for mean outside diameters up to and including 315 mm conform to ISO 11922-1:1997 [4], grade C.
The tolerances for mean outside diameters greater than 315 mm conform to ISO 11922-1:1997 [4], grade A.

6.2.2 Outside diameters with close tolerances (CT)

For the purposes of this standard in addition to the dimensions and tolerances given in Table 2 for spigot ends of pipes and fittings, tolerances which are in accordance with EN 1401-1 [5] may be used.

If these tolerances, classified as close tolerance (CT), are required, the mean outside diameter, d_{em}, and the tolerances shall conform to Table 3.

Table 3 — Mean outside diameters with close tolerances type CT

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter	Mean outside diameter	
	d_n	$d_{em,min}$	$d_{em,max}$
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

NOTE Spigot ends of pipes and fittings with maximum mean outside diameters conforming to Table 3 can be used with pipes and fittings conforming to EN 1401-1 [5] provided that the socket(s) for these pipes and fittings are intended to be used for elastomeric ring seal joints.

6.2.3 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.

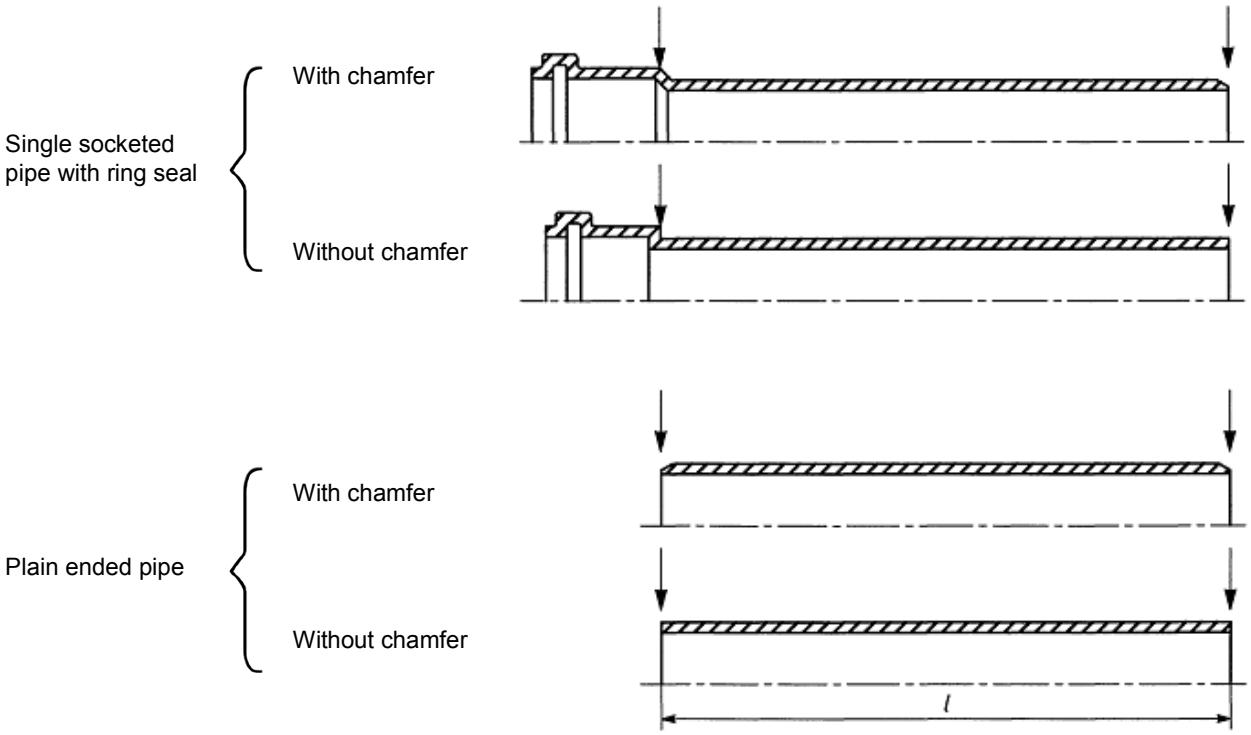


Figure 1 — Effective length of pipes

6.2.4 Chamfering

If a chamfer is applied, the angle of chamfering shall be between 15° and 45° to the axis of the pipe.

The remaining wall thickness of the end of the pipe shall be at least $^1/_3$ of e_{min}.

6.2.5 Wall thicknesses

The wall thickness, e, shall conform to Table 4, where the maximum wall thickness at any point of 1,25 e_{min} is permitted provided that the mean wall thickness, e_m, is less than or equal to the specified $e_{m,max}$.

Table 4 —Wall thicknesses

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter	Wall thickness [a,b]									
		SN 2 S 20 [c] SDR 41		SN4 S 16 SDR 33		SN8 [e] S14 [d] SDR 29		S 12,5 SDR 26		SN16 S10,5 [d] SDR22	
	d_n	e_{min}	$e_{m,max}$	e_{min}	$e_{m,max}$	e_{min}	$e_{m,max}$	e_{min}	$e_{m,max}$	e_{min}	$e_{m,max}$
110	110	–	–	3,4	4,0	3,8	4,4	4,2	4,9	5,0	5,7
125	125	–	–	3,9	4,5	4,3	5,0	4,8	5,5	5,7	6,5
160	160	–	–	4,9	5,6	5,5	6,3	6,2	7,1	7,3	8,3
200	200	–	–	6,2	7,1	6,9	7,8	7,7	8,7	9,1	10,3
250	250	6,2	7,1	7,7	8,7	8,6	9,7	9,6	10,8	11,4	12,8
315	315	7,7	8,7	9,7	10,9	10,8	12,1	12,1	13,6	14,4	16,1
355	355	8,7	9,8	10,9	12,2	12,2	13,7	13,6	15,2	16,2	18,1
400	400	9,8	11,0	12,3	13,8	13,7	15,3	15,3	17,1	18,2	20,3
450	450	11,0	12,3	13,8	15,4	15,4	17,2	17,2	19,2	20,5	22,8
500	500	12,3	13,8	15,3	17,1	17,1	19,1	19,1	21,3	22,8	25,3
630	630	15,4	17,2	19,3	21,5	21,6	24,0	24,1	26,8	28,7	31,8
800	800	19,6	21,8	24,5	27,2	27,4	30,4	30,6	33,9	36,4	40,3
1 000	1 000	24,5	27,2	30,6	33,9	34,2	37,9	38,2	42,3	45,5	50,3
1 200	1 200	29,4	32,6	36,7	40,6	41,1	45,5	45,9	50,7	54,6	60,3
1 400	1 400	34,3	38,0	42,9	47,4	47,9	52,9	53,5	59,1	63,7	70,3
1 600	1 600	39,2	43,4	49,0	54,1	54,7	60,4	61,2	67,5	72,7	80,2

a The e_{min} values are accordance with ISO 4065 [2].

b The tolerances for wall thickness conform to ISO 11922-1 [4], Grade W.

c S 20 is applicable for application area code "U" only.

d It is necessary to use PP material with high E-modulus to fulfil stiffness requirements of these pipe series, see also Table 7.

e Information about the wall thickness S-series 11,2 for SN 8 is given in Annex A.

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

6.3 Dimensions of fittings

6.3.1 Outside diameters

The mean outside diameter, d_{em}, of the spigot shall conform to Table 2 or Table 3 as applicable.

6.3.2 Design lengths

The design lengths shall be declared by the manufacturer.

NOTE The design lengths (see the dimensions Z in Figures 7 to 11 and Figures 14 to 19) 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] can be used as a guideline.

6.3.3 Wall thicknesses

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

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 the one wall thickness to the other.

The wall thickness of fabricated fittings, except for spigot and socket, may be changed locally by the fabrication process, providing that the minimum wall thickness of the body conforms to e_{min}, as given in Table 4 or Table 5 as appropriate for the pipe series concerned.

Table 5 — Wall thicknesses

Dimensions in millimetres

Nominal size DN/OD	**Nominal outside diameter,** d_n	**Minimum wall thickness,** e_{min} [a]		
		SN 2 S 20 [b] SDR 41	SN 4 S 16,0 SDR 33	SN 8 S 13,3 [c] SDR 27,6
110	110	—	3,4	4,0
125	125	—	3,9	4,6
160	160	—	4,9	5,8
200	200	—	6,2	7,3
250	250	6,2	7,7	9,1
315	315	7,7	9,7	11,4
355	355	8,7	10,9	12,9
400	400	9,8	12,3	14,5
450	450	11,0	13,8	16,3
500	500	12,3	15,3	18,1
630	630	15,4	19,3	22,8
800	800	19,6	24,5	29,0
1 000	1 000	24,5	30,6	36,2
1 200	1 200	29,4	36,7	43,4
1 400	1 400	34,3	42,9	50,6
1 600	1 600	39,2	49,0	57,9

a The e_{min} values are in accordance with ISO 4065 [2].
b S 20 is applicable for application area code "U" only.
c S 13,3 is only an injection moulded fitting series.

6.4 Dimensions of sockets and spigots

6.4.1 Diameters and lengths of elastomeric ring seal sockets and spigots

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 5) as specified by the manufacturer.

This point shall give a full sealing action.

Different designs of elastomeric ring seal sockets and spigots are permitted, provided the joints conform to the requirements given in Table 14.

Table 6 —Socket diameters and lengths of sockets and spigot

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter	Minimum mean inside diameter of the socket	Socket [a]		Spigot
	d_n	$d_{sm,min}$ [b]	A_{min}	C_{max}	$L_{1,min}$
110	110	110,4	40	22	62
125	125	125,4	43	26	68
160	160	160,5	50	32	82
200	200	200,6	58	40	98
250	250	250,9	68	50	118
315	315	316,1	81	63	144
355	355	358,3	89	71	160
400	400	403,7	98	80 [c]	178
450	450	454,2	108	90 [c]	198
500	500	504,6	118	100 [c]	218
630	630	635,8	144	126 [c]	270

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

b For nominal sizes DN/OD ≤ 200, $d_{sm,min}$ conforms to EN 1401-1 [5].

c Higher values for C are allowed. In that case the manufacturer shall state in his documentation the actual required $L_{1,min}$ according to the equation $L_{1,min} = A_{min} + C$.

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

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

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

C_{max} = 0,2 d_n.

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

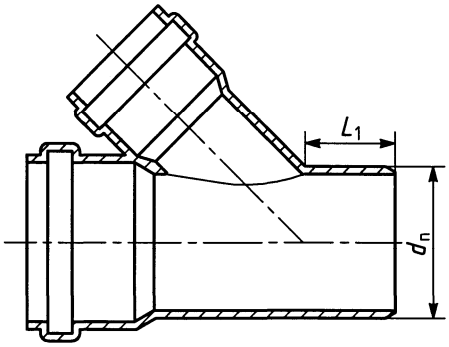
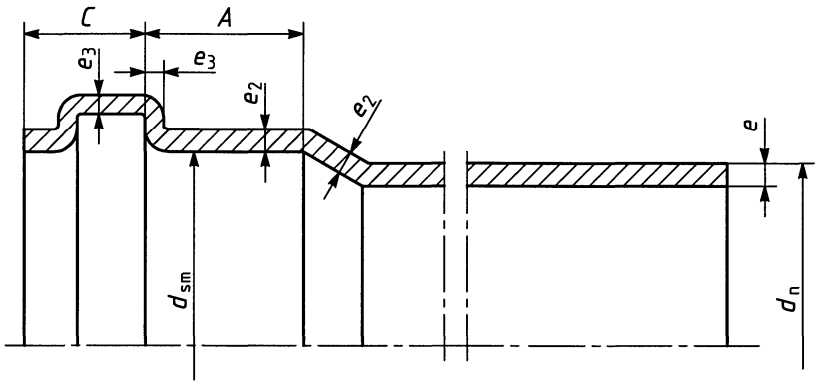
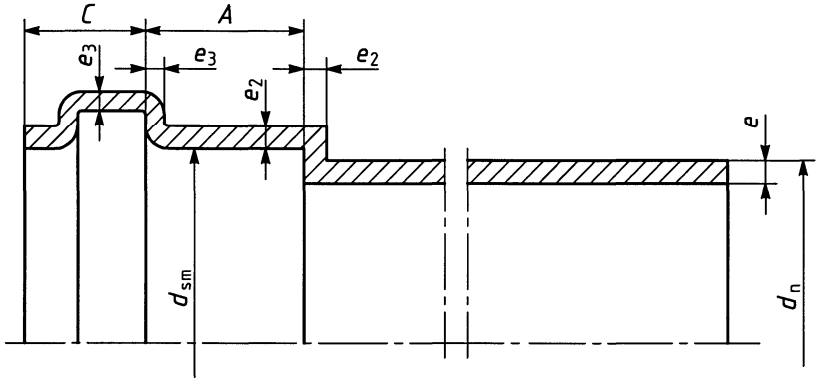


Figure 2 — Spigot length



a) Ring seal socket with chamfer



b) Ring seal socket without chamfer

Figure 3 — Basic dimensions of sockets for elastomeric ring seal joints

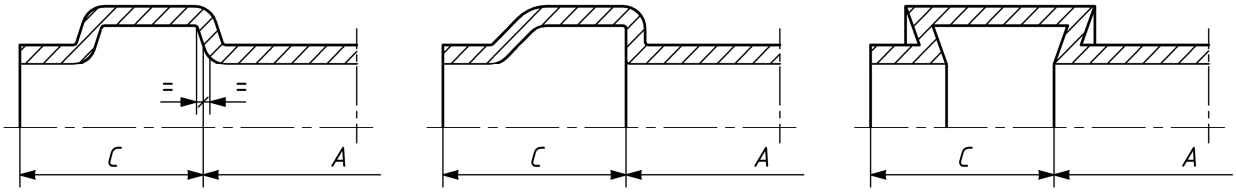


Figure 4 — Typical groove designs for elastomeric ring seal sockets

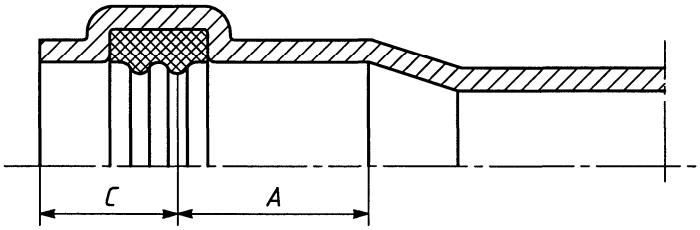


Figure 5 — Example for measuring the effective sealing point

6.4.2 Wall thicknesses of sockets

The wall thicknesses of sockets, e_2 and e_3 (see Figure 3), excluding the socket mouth, shall conform to Table 7, as applicable, except that a reduction of 5 % of e_2 and e_3 resulting from core shifting is permitted. In such a case the average of two opposite wall thicknesses shall be equal to or exceed the values in Table 7.

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 addition of the wall thickness of the socket and the wall thickness of the retaining cap or ring at the corresponding places in the same cross section.

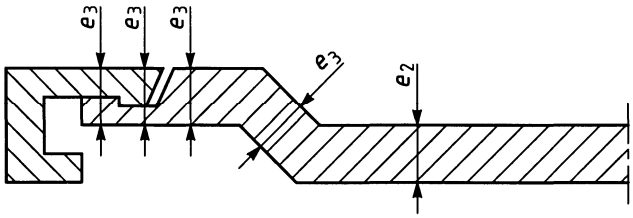


Figure 6 — Example for calculation of the wall thickness of sockets with retaining cap

Table 7 — Wall thicknesses of sockets

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter	Wall thickness											
		SN 2		SN 4		SN 8 [c]						SN 16	
		S 20 [a]		S 16		S 14		S 13,3 [b]		S 12,5		S 10,5	
	d_n	$e_{2,min}$	$e_{3,min}$	$e_{2,min}$	$e_{3,min}$	$e_{2,min}$	$e_{3,min}$	$e_{2,min}$	$e_{3,min}$	$e_{2,min}$	$e_{3,min}$	$e_{2,min}$	$e_{3,min}$
110	110	–	–	3,1	2,6	3,5	2,9	3,6	3,0	3,8	3,2	4,5	3,8
125	125	–	–	3,6	3,0	3,9	3,3	4,2	3,5	4,4	3,6	5,2	4,3
160	160	–	–	4,5	3,7	5,0	4,2	5,3	4,4	5,6	4,7	6,6	5,5
200	200	–	–	5,6	4,7	6,3	5,2	6,6	5,5	7,0	5,8	8,2	6,9
250	250	5,6	4,7	7,0	5,8	7,8	6,5	8,2	6,9	8,7	7,2	10,3	8,6
315	315	7,0	5,8	8,8	7,3	9,7	8,1	10,3	8,6	10,9	9,1	13,0	10,8
355	355	7,9	6,6	9,9	8,2	11,0	9,2	11,7	9,7	12,3	10,2	14,6	12,2
≥ 400	≥ 400	8,9	7,4	11,1	9,3	12,4	10,3	13,1	10,9	13,8	11,5	16,4	13,7

[a] S 20 is applicable for application area code "U" only.
[b] S 13,3 is only an injection moulded fitting series
[c] Information about the wall thickness S-series 11,2 for SN 8 is given in Annex A.

6.5 Types of fittings

This standard is applicable for the following types of fittings. Other designs of fittings are permitted.

a) Bends (see Figures 7, 8, 9, 10 and 11):
   1) unswept and swept angle (see ISO 265-1:1988 [6]);
   2) spigot/socket and socket/socket;
   3) butt fused from segments;

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

b) Couplers and slip couplers (see Figures 12 and 13);
c) Reducers (see Figure 14);
d) Branches and reducing branches (see Figures 15, 16, 17 and 18):
   1) unswept and swept angle;
   2) spigot/socket and socket/socket.

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

e) Branches with flange and collar (see Figure 19);
f) Plugs (see Figure 20): minimum length of spigot, M_{min} = (C_{max} + 10) mm (see Table 5);
g) Push-fit sockets for butt fusion for pipe end (see Figure 21).

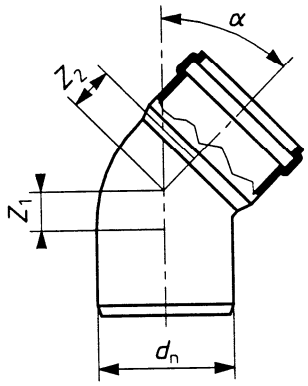


Figure 7 — Bend with single socket (unswept)

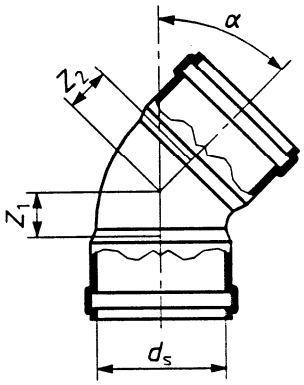


Figure 8 — Bend with all sockets (unswept)

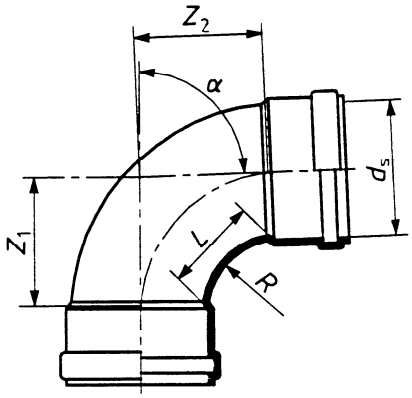


Figure 9 — Bend with all sockets (swept)

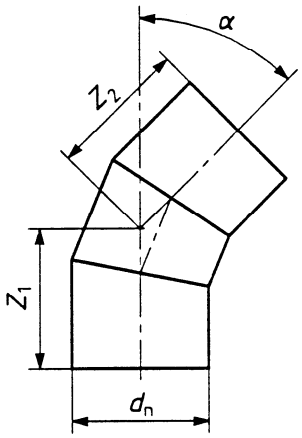


Figure 10 — Bend, butt fused from segments

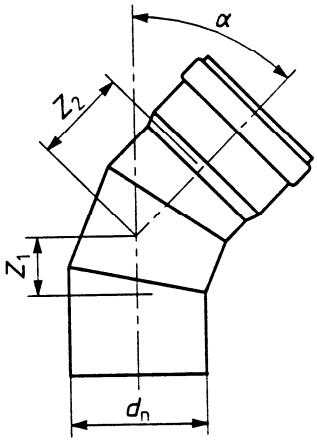


Figure 11 — Bend with socket and spigot end, butt-fused from segments

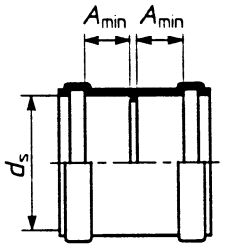


Figure 12 — Coupler

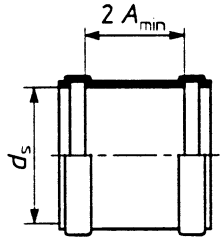


Figure 13 — Slip coupler

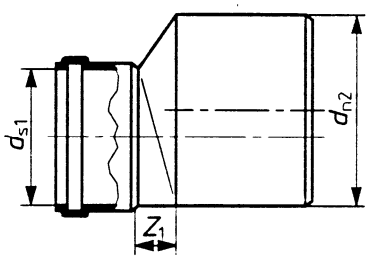


Figure 14 — Reducer

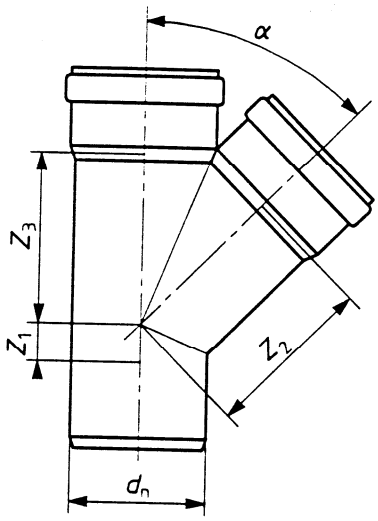


Figure 15 — Branch (unswept)

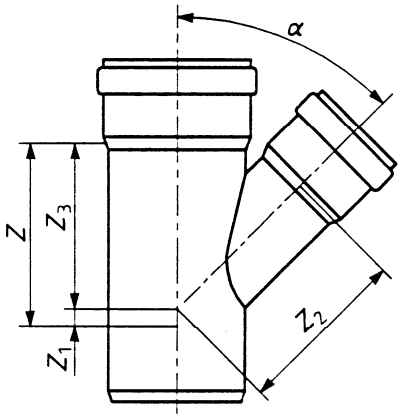


Figure 16 — Reducing branch

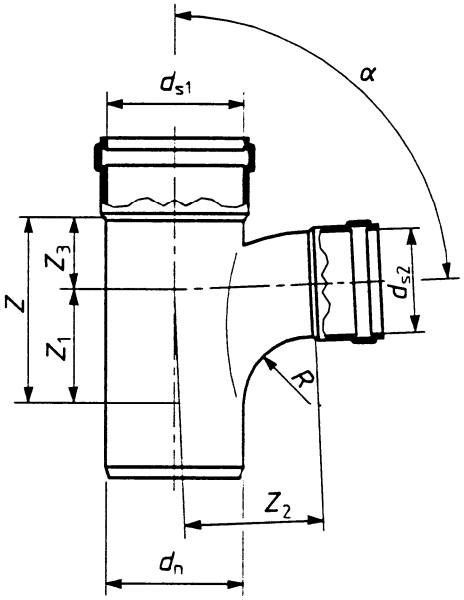


Figure 17 — Reducing branch (swept)

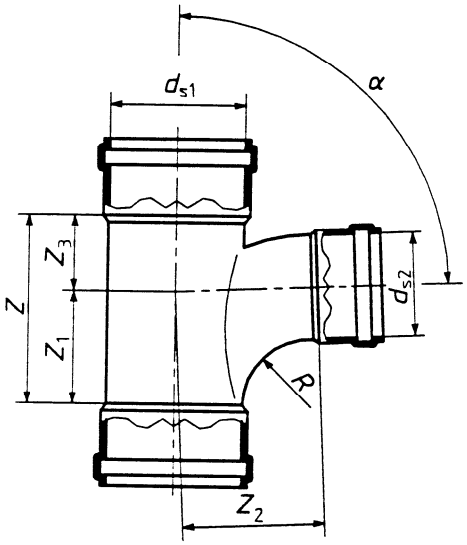


Figure 18 — All socket reducing branch (swept)

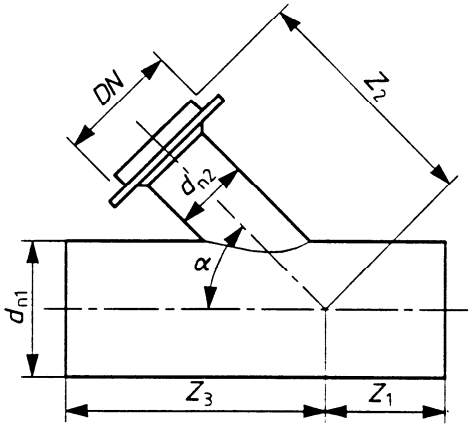


Figure 19 — Branch with flange and collar

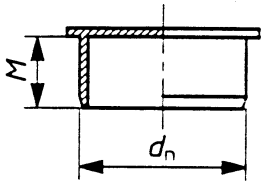


Figure 20 — Plug

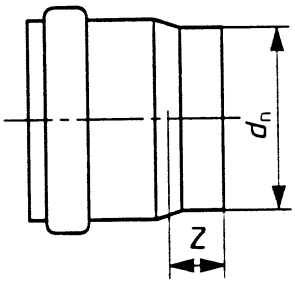


Figure 21 — Push fit socket for butt fusion for pipe end

7 Mechanical characteristics

7.1 Mechanical characteristics of pipes

7.1.1 General requirements

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

Table 8 — General mechanical characteristics of pipes

Characteristic	Requirements	Test parameters		Test method
Impact resistance [a] (round-the-clock method)	TIR ≤ 10 %	Test/conditioning temperature Conditioning medium Type of striker Mass of striker for: d_n = 110 mm d_n = 125 mm d_n = 160 mm d_n = 200 mm d_n = 250 mm d_n ≥315 mm Fall height of striker for: d_n = 110 mm d_n ≥ 125 mm	0 °C Water or air Shall conform to type d90 of EN 744:1995 1,0 kg 1,25 kg 1,6 kg 2,0 kg 2,5 kg 3,2 kg 1 600 mm 2 000 mm	EN 744
Ring stiffness	S 20 ≥ 2 kN/m² S 16 ≥ 4 kN/m² S 14 ≥ 8 kN/m² S12,5 ≥ 8 kN/m² S 10,5 ≥ 16 kN/m²	Test temperature Deflection Deflection speed for: d_n ≤ 100 mm 100 mm < d_n ≤ 200 mm 200 mm < d_n ≤ 400 mm 400 mm < d_n ≤ 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 [b] ± 5 %) mm/min	EN ISO 9969

[a] If the manufacturer chooses to use indirect testing (see prCEN/TS 1852-2 [7]), the preferred temperature is (23 ± 2) °C.

[b] d_i shall be determined in accordance with Clause 6.3 in EN ISO 9969

7.1.2 Additional mechanical requirements

Pipes intended to be used in areas where installation is usually carried out at temperatures below −10 °C, are required in the national foreword to conform to the requirements of an impact test (staircase method) as specified in Table 9.

The pipes shall be marked with an ice-crystal symbol in accordance with Table 15.

Table 9 — Additional mechanical characteristics of pipes

Characteristic	Requirements	Test parameters		Test method
Impact resistance (staircase method)	H50 ≥ 1 m max. one break below 0,5 m	Test/conditioning temperature Type of striker Mass of striker for: d_n = 110 mm d_n = 125 mm d_n = 160 mm d_n = 200 mm d_n ≥ 250 mm	−10 °C Shall conform to type d90 of EN 1411:1996 4 kg 5 kg 8 kg 10 kg 12,5 kg	EN 1411

7.2 Mechanical characteristics of fittings

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

Table 10 — 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	EN 12256
		OR		
		Minimum moment for: [DN] ≤ 250 [DN] > 250	 $0{,}15 \times [DN]^3 \times 10^{-6}$ kNm $0{,}01 \times [DN]$ kNm	EN 12256
Impact strength (Drop test)	No damage	Test/conditioning temperature Fall height for: d_n = 110 mm d_n = 125 mm d_n = 160 mm d_n = 200 mm Point of impact	0 °C 1 000 mm 1 000 mm 500 mm 500 mm Mouth of the socket	EN 12061

[a] Only for fabricated fittings made from more than one piece. A sealing ring retaining means is not considered as a piece.

8 Physical characteristics

8.1 Physical characteristics of pipes

When tested in accordance with the test methods as specified in Table 11 using the indicated parameters, the pipe shall have physical characteristics conforming to the requirements given in Table 11.

Table 11 — Physical characteristics of pipes

Characteristic	Requirements	Test parameters		Test method
Longitudinal reversion	≤ 2 % The pipe shall exhibit no bubbles or cracks	**EITHER**		
		Test temperature Immersion time	150 °C 30 min	Method A: Liquid, in accordance with EN ISO 2505:2005
		OR		
		Test temperature Immersion time for: $e \leq$ 8 mm 8 mm < $e \leq$ 16 mm $e >$ 16 mm	150 °C 60 min 120 min 240 min	Method B: Air in accordance with EN ISO 2505:2005
Melt mass-flow rate (MFR-value)	Permitted max. deviation when processing the compound into pipe: 0,2 g/10 min.	Test temperature Reference time Nominal load	230 °C 600 s 2,16 kg	EN ISO 1133

8.2 Physical characteristics of fittings

When tested in accordance with the test method as specified in Tables 12 and 13 using the indicated parameters, the fitting shall have physical characteristics conforming to the requirements given in Table 12 and Table 13, as applicable.

Table 12 — Physical characteristics of fittings

Characteristic	Requirements	Test parameters		Test method
Effects of heating	a b c	Temperature Heating time for: $e \leq$ 10 mm $e >$ 10 mm	150 °C 30 min 60 min	Method A: Air oven, in accordance with EN ISO 580:2005

a The depth of cracks, delamination 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 of more than 20 % of the wall thickness.

b Mouldings that shall be used for fabricated fittings, may be tested separately.

c For fittings manufactured from pipes, the pipes used for such fabricating shall conform to the requirements given in Table 8 and Table 11.

Table 13 — Physical characteristics of fabricated fittings

Characteristic	Requirements	Test parameters		Test method
Water tightness	No leakage	Water pressure duration	0,5 bar 1 min	EN 1053
Only fabricated fittings made from more than one piece. A sealing ring retaining means is not considered as a piece.				

9 Performance requirements

When tested in accordance with the test methods as specified in Table 14 using the indicated parameters, the joints and the system shall have fitness for purpose characteristics conforming to the requirements given in Table 14.

Table 14 — Fitness for purpose characteristics

Characteristic	Requirements	Test parameters		Test method
Tightness of elastomeric sealing ring joint		Temperature Spigot deflection Socket deflection	(23 ± 5) °C 10 % 5 %	EN 1277:2003, condition B
	No leakage	Water pressure	0,05 bar	
	No leakage	Water pressure	0,5 bar	
	≤ –0,27 bar	Air pressure	–0,3 bar	
		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°	EN 1277:2003, 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]	No leakage	Shall conform to EN 1055		Test assembly b) (Figure 2 of EN 1055:1996) in accordance with EN 1055

[a] Test required only for components intended to be used for application area code "D" and for d_n less than or equal to 200 mm.

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 14.

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

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 Tables 15 and 16. 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 0,25 mm shall be deemed to conform to this clause without infringing the requirements for the wall thickness given in 6.2.5.

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 2 m, at least once per pipe.

The minimum required marking of pipes shall conform to Table 15.

Table 15 — Minimum required marking of pipes

Aspects	Marking or symbols	Legibility code[a]
– Number of the standard	EN 1852	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 S-series	e.g. either 6,2 or S 16	a
– Material	PP	a
– Symbol for close tolerance, when applicable	CT	a
– Nominal ring stiffness	e.g. SN 4	a
– Manufacturer's information	[b]	a
– Cold climate performance [c]	❄ (Ice-crystal)	a
– MFR-class [d]	e.g. MFR-B	a

[a] See 11.1.1.

[b] For providing traceability the following details shall be given:
1) the production period, year and month, in figures or in code;
2) a name or code for the production site if the manufacturer is producing in different sites, nationally and/or internationally.

[c] This marking is only applicable to pipes which by testing have proved to conform to 7.1.2.

[d] Only required marking for pipes intended for butt fusion joints.

11.3 Minimum required marking of fittings

The minimum required marking of fittings shall conform to Table 16.

Table 16 — Minimum required marking of fittings

Aspects	Marking or symbols	Legibility code[a]
– Number of the standard	EN 1852	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 S-series	e.g. either 6,2 or S 16	a
– Material	PP	a
– Symbol for close tolerance, when applicable	CT	b
– Manufacturer's information	[b]	b
– MFR class [c]	e.g. MFR-B	a

[a] See 11.1.1.

[b] For providing traceability the following details shall be given:
1) the production period, year, in figures or in code;
2) a name or code for the production site if the manufacturer is producing in different sites, nationally and/or internationally.

[c] Only required marking for fittings intended for butt fusion joints.

11.4 Additional marking

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

11.4.2 Pipes and fittings conforming to this standard which 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
(normative)

Geometrical characteristics of pipes following S-series 11,2

A.1 General

This Annex covers pipes and sockets for the S-series 11,2 for SN 8.

This S-series is intended to be withdrawn from the standard at the next revision.

A.2 Wall thickness of pipes

The wall thickness for pipes for S-series 11,2 is given in Table A.1 below.

Table A.1 — Wall thickness for pipes

Dimension in millimetres

Nominal size DN/OD	Nominal outside diameter	Wall thickness for SN 8 [a, b] S 11,2 SDR 23,4	
	d_n	e_{min}	$e_{m,max}$
110	110	4,7	5,4
125	125	5,4	6,2
160	160	6,9	7,8
200	200	8,6	9,7
250	250	10,7	12,0
315	315	13,5	15,1
355	355	15,2	17,0
400	400	17,1	19,1
450	450	19,2	21,4
500	500	21,4	23,8
630	630	26,9	29,8
800	800	34,2	37,9
1 000	1 000	38,4	42,5
1 200	1 200	42,7	47,2
1 400	1 400	51,2	56,6
1 600	1 600	68,4	75,5

a The e_{min} values are in accordance with ISO 4065 [2].

b The tolerances for wall thickness conform to ISO 11922-1 [4], Grade W.

A.3 Wall thickness of sockets

The wall thickness for sockets for S-series 11,2 is given in Table A.2 below.

Table A.2 — Wall thickness of sockets

Dimensions in millimetres

Nominal size DN/OD	**Nominal outside diameter,** d_n	**Wall thickness for** SN 8 S 11,2 SDR 23,4	
		$e_{2,min}$	$e_{3,min}$
110	110	4,3	3,6
125	125	4,9	4,1
160	160	6,3	5,2
200	200	7,8	6,5
250	250	9,7	8,1
315	315	12,2	10,2
355	355	13,7	11,4
≥400	≥400	15,4	12,9

Annex B
(informative)

General characteristics of PP pipes and fittings

B.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 standard fully meet these requirements.

Further the following information is given.

B.2 Material characteristics

The material of pipes and fittings conforming to this standard generally have these characteristics:

Modulus of elasticity of PP materials	1 250 MPa ≤ $E_{(1min)}$ < 2 500 MPa;
Average density	≈ 0,9 g/cm^3;
Average coefficient of linear thermal expansion	≈ 0,14 mm/mK;
Thermal conductivity	≈ 0,2 WK^{-1}m^{-1};
Specific heat capacity	≈ 2 000 J/kgK;
Surface resistance	> 10^{12} Ω.

Values are dependent on the material used. Therefore, it is recommended to contact the manufacturer, or see the manufacturer's documentation, for the relevant values in each individual case.

B.3 Ring stiffness

The ring stiffness of pipes conforming to this standard is determined in accordance with EN ISO 9969.

When a fitting conforming to this 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].

B.4 Creep ratio

The creep ratio for pipes and fittings conforming to this standard, when determined in accordance with EN ISO 9967 [10], is less than 4. For fittings the full cylindrical length of the socket or spigot is used as a test piece and the pre-load force, F_0, is decreased relative to the actual length of the test piece.

B.5 Chemical resistance

PP piping systems conforming to this standard are resistant to corrosion by water with a wide range of pH-values such as domestic waste water, rainwater, surface water and ground water.

If piping systems conforming to EN 1852 are to be used for chemically contaminated waste waters, such as industrial discharges, chemical and temperature resistance have to be taken into account. For information about the chemical resistance of PP materials guidance is given in ISO/TR 10358:1993 [11] and for rubber materials in ISO 7620:2005 [12].

B.6 Abrasion resistance

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

B.7 Hydraulic roughness

The internal surfaces of pipes and fittings conforming to this 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 standard refer to the manufacturer's information.

B.8 Diametric deflection

In normal installation conditions, the expected average deflection of the outside diameter of the pipes will be less than 8 %. However deflections up to 15 %, e.g. caused by soil movement, will not affect the proper functioning of the piping system.

Annex C
(informative)

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 — Acrlylonitrile-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 12666-1, *Plastics piping systems for non-pressure underground drainage and sewerage — Polyethylene (PE) — 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*

Bibliography

[1] 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*

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

[3] RAL 840-HR [2], *Colour register*

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

[5] 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*

[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] prCEN/TS 1852-2, *Plastics piping systems for non-pressure underground drainage and sewerage — Polypropylene (PP) — Part 2: Guidance for the assessment of conformity*

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

[9] ISO 13967, *Thermoplastics fittings — Determination of ring stiffness*

[10] EN ISO 9967, *Plastics pipes — Determination of creep ratio*

[11] ISO/TR 10358:1993, *Plastics pipes and fittings — Combined chemical-resistance classification table*

[12] ISO 7620:2005, *Rubber materials — Chemical resistance*

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

[2] Obtainable at the national standards institute.

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