BRITISH STANDARD

BS EN
1401-1:2009
Incorporating corrigendum October 2009

Plastic piping systems for non-pressure underground drainage and sewerage — Unplasticized poly(vinyl chloride) (PVC-U)

Part 1: Specifications for pipes, fittings and the system

ICS 23.040.20; 93.030

BSI
British Standards

National foreword

This British Standard is the UK implementation of EN 1401-1:2009. It supersedes BS EN 1401-1:1998 which is withdrawn.

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

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

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

1. Selection and application of stiffness classes

BS EN 1401-1:2009 specifies three classes of pipes and fittings of differing stiffness, designated SN 2, SN 4 and SN 8 (see Table 4 and Table 6).

From the viewpoint of installation, the SN 8 or SN 4 classes have to be used if the system is to be installed in accordance with BS EN 1610 or BS 5955-6, in order to achieve the intended resistance to long-term deformation.

If it is intended to use the other, less stiff (SN 2), class of pipe or fitting, the installation should first be subject to a structural design soil load calculation and the installation technique modified to suit the results of that calculation. The appropriate calculation method is given in the National Annex for BS EN 1295-1. The E modulus for the material should be taken as 3,000 MPa and 1,500 MPa for the short-term and long-term values respectively.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 July 2009

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Amendments/corrigenda issued since publication

Date	Comments
31 October 2009	National foreword revised

Reference material and further guidance on procedures for selecting materials for sewers and pumping mains can be found in *Materials selection manual for sewers, pumping mains and manholes* (reference WSA/FWR-04)[1]

Additional information

For swept bends and branches, the dimensional characteristics should also conform to the relevant parts of BS 4514 and in addition the Building Regulations 2000 (amended 2002) Approved Document H1 (Diagram 2 and Clauses 1.17 and 1.26).

When pipe conforming to EN 1401 is perforated for drainage applications, the perforations should additionally meet the requirements for UPVC in accordance with BS 4660, given in the DETR *Manual of Contract Documents for Highway Works (Volume 1) Specification for Highway Works — Series 500*.

This British Standard 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 in this standard should be operated only by trained personnel.

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

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EN 1401-1

March 2009

ICS 93.030

Supersedes EN 1401-1:1998

English Version

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

Systèmes de canalisations en plastique pour les branchements et les collecteurs d'assainissement enterrés sans pression - Poly(chlorure de vinyle) non plastifié (PVC-U) - Partie 1 : Spécifications pour tubes, raccords et le système

Kunststoff-Rohrleitungssysteme für erdverlegte drucklose Abwasserkanäle und-leitungen - Weichmacherfreies Polyvinylchlorid (PVC-U) - Teil 1: Anforderungen an Rohre, Formstücke und das Rohrleitungssystem

This European Standard was approved by CEN on 10 January 2009.

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 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 Management Centre has the same status as the official versions.

CEN members are the national standards bodies of 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 United Kingdom.

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Ref. No. EN 1401-1:2009: E

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Foreword

This document (EN 1401-1:2009) 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 1401-1:1998.

The main changes with respect to the previous edition are listed below:

a) addition of a definition for solid wall pipes and fittings (3.1.13);
b) updating of the references in Clause 2, Annex C and Bibliography;
c) raw material (4.1);
d) C_{max} of sockets (Table 5);
e) the SN series is extended with the sizes DN 710 (non-preferred) and DN 800 (Table 4);
f) O-ring type sockets (6.4);
g) solvent cement sockets (6.4.2.1);
h) additional mechanical requirements of pipes (7.1.2);
i) physical characteristics of pipes (Table 12 and note);
j) performance requirements (Table 15 – first row);
k) deletion of Long Term Performance of TPE seals (Table 15 and 10.3);
l) reformulated material (A.1.5 and A.3.3);
m) reprocessable and recyclable material from PVC-U products other than pipes and fittings (A.3.2 and Table A.2);
n) summary of use of non-virgin material (A.5, Table A.3);
o) compound characteristics (B.2).

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 1401 consists of the following Parts, under the general title *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* (the present standard)
— *Part 2: Guidance for assessment of conformity* (under revision)

— *Part 3: Guidance for installation* (ENV)

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 1401 specifies the requirements for solid wall pipes, fittings and the system of unplasticized poly(vinyl chloride) (PVC-U) piping systems in the field of non-pressure underground drainage and sewerage:

a) outside the building structure (application area code "U") and

b) both buried in ground within the building structure (application area code "D") and outside the building.

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 pipes and fittings series and a range of 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 prCEN/TS 1401-2 [1] and ENV 1401-3 [2] it is applicable to PVC-U 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 European Standard is applicable to non foamed PVC-U pipes without a socket as well as pipes with an integral socket.

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

Requirements and limiting values for application area code "D" are given in Table 4, Table 6, Table 13 and Table 15.

NOTE 2 Pipes, fittings and other components conforming to any of the plastics product standards listed in Annex C can 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 15.

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 580, *Plastics piping systems — Unplasticized poly(vinyl chloride)(PVC-U) pipes — Test method for the resistance to dichloromethane at a specified temperature (DCMT)*

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 727, *Plastics piping and ducting systems — Thermoplastics pipes and fittings — Determination of Vicat softening temperature (VST)*

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

EN 922, *Plastics piping and ducting systems — Pipes and fittings of unplasticized poly(vinyl chloride) (PVC-U) — Specimen preparation for determination of the viscosity number and calculation of the K-value*

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

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

EN 1277, *Plastics piping systems — Thermoplastics piping systems for buried non-pressure applications — Test method 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 1905, *Plastics piping systems — Unplasticized poly(vinyl chloride) (PVC-U) pipes, fittings and material — Method for assessment of the PVC content based on total chlorine content*

EN 10204:2004, *Metallic products — Types of inspection documents*

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, *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 1167-1:2006, *Thermoplastics pipes, fittings and assemblies for the conveyance of fluids — Determination of the resistance to internal pressure — Part 1: General method (ISO 1167:2006)*

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)*

EN ISO 2505, *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)*

3 Terms, definitions, symbols and abbreviations

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions and those given in EN ISO 472:2001 and EN ISO 1043-1:2001 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
nominal size
DN
numerical designation of the size of a component, other than a component designated by thread size, which is approximately equal to the manufacturing dimension, in millimetres (mm)

3.1.3
nominal size
DN/OD
nominal size, related to the outside diameter

3.1.4
nominal outside diameter
d_n
specified outside diameter, in millimetres, assigned to a nominal size DN/OD

3.1.5
outside diameter
d_e
value of the measurement of the outside diameter through its cross section at any point of a pipe or spigot, rounded to the next greater 0,1 mm

3.1.6
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

3.1.7
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

3.1.8
out-of-roundness
ovality
difference between the measured maximum and the measured minimum outside diameter in the same cross section of a component

3.1.9
wall thickness
e
value of the measurement of the wall thickness at any point around the circumference of a component

3.1.10
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

3.1.11
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

3.1.12
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

3.1.13
solid wall pipe and fitting
pipe or fitting with smooth internal and external surface with the same compound / formulation through the wall

3.2 Symbols

A : length of engagement

a : circumferential side cover of a saddle branch

B : length of lead-in

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

d_3 : internal diameter of the groove

e : wall thickness

e_m : mean wall thickness

e_2 : wall thickness of a socket

e_3 : wall thickness in the groove area

f : groove width

H : length of chamfer

K : K-value

L : axial cover of a saddle branch

l : effective length of a pipe

L_1 : length of spigot

L_2 : length of the solvent cement socket

M : length of spigot of a plug

R : radius of swept fittings

Z : design length of a fitting

α : nominal angle of a fitting

3.3 Abbreviations

DN : nominal size

DN/OD : nominal size, outside diameter related

PVC-U : unplasticized poly(vinyl chloride)

SDR : standard dimension ratio

SN : nominal ring stiffness

TIR : true impact rate

4 Material

4.1 Raw material

The raw material shall be PVC-U to which are added those additives that are needed to facilitate the manufacture of components conforming to the requirements of this European Standard.

When calculated on the basis of a known formulation, or in case of dispute or unknown formulation, determined in accordance with EN 1905, the PVC-content shall be at least 80 % by mass for pipes and 85 % by mass for injection-moulded fittings.

A further reduction of the PVC-U content to ≥ 75 % by mass for pipes only is permitted provided the PVC-U is substituted by coated or uncoated $CaCO_3$ conforming to the following.

a) The composition of the CaCO3, before coating if any, shall conform to the following:
   - content of $CaCO_3$ ≥ 96 % by mass;
   - content of $MgCO_3$ ≤ 4 % by mass;
   - content of $CaCO_3$ and $MgCO_3$ in total ≥ 98 % by mass.

b) The physical properties of the material shall conform to the following:
   - mean particle size D50 ≤ 2,5 μm;
   - top cut D98 ≤ 20 μm.

4.2 Pipe material

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

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

Table 1 — Material characteristics of pipes

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 conforming to EN ISO 1167-1:2006 60 °C Free 3 10 MPa 1 h Water-in-water 1 000 h	EN ISO 1167-1:2006

4.3 Fitting material

When tested in accordance with the test method as specified in Table 2, using the indicated parameters, the fitting material shall have characteristics conforming to the requirements given in Table 2.

The fitting material shall be tested, in the actual formulation, in the form of an extruded or injection-moulded pipe.

Fabricated fittings or parts of fabricated fittings shall be made from pipes conforming to this European Standard, except for the requirements for the wall thickness, and/or mouldings from PVC-U which conform to material, mechanical and physical characteristics as required in this European Standard.

Table 2 — Material characteristics of fittings

Characteristic	Requirements	Test parameters		Test method
Resistance to internal pressure	No failure during the test period	End caps Dimensions Free length for injection-moulded pipe Test temperature Orientation Number of test pieces Circumferential (hoop) stress Conditioning period Type of test Test period	Type A or B conforming to EN ISO 1167-1:2006 50 mm ≤ d_n ≤ 110 mm 3 mm ≤ e ≤ 5 mm ≥ 140 mm 60 °C Free 3 6,3 MPa 1 h Water-in-water 1 000 h	EN ISO 1167-1:2006

4.4 Utilisation of non-virgin materials

Conditions and requirements for the utilisation of non-virgin materials are given in Annex A.

4.5 Sealing ring retaining means

It is permitted that sealing rings are retained using means made from polymers other than PVC-U.

5 General characteristics

5.1 Appearance

When viewed without magnification, the following requirements apply:

a) 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 European Standard;

b) 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 the fittings shall be coloured through the wall.

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

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 necessary represent the manufactured components.

6.2 Dimensions of pipes

6.2.1 Outside diameters

The mean outside diameter, d_{em}, shall conform to Table 3.

[1)] According to RAL 840-HR, *Colour register*.

Table 3 — Mean outside diameters

Dimensions in millimetres

Nominal size DN/OD [a]	Nominal outside diameter	Mean outside diameter	
	d_n	$d_{em,min}$	$d_{em,max}$
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
(710)	710	710,0	711,2
800	800	800,0	801,3
(900)	900	900,0	901,5
1000	1 000	1 000,0	1 001,6

[a] Non-preferred sizes are indicated in parenthesis.

6.2.2 Out of roundness

The out-of-roundness, measured directly after production, shall be less than or equal to $0{,}024 d_n$.

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.

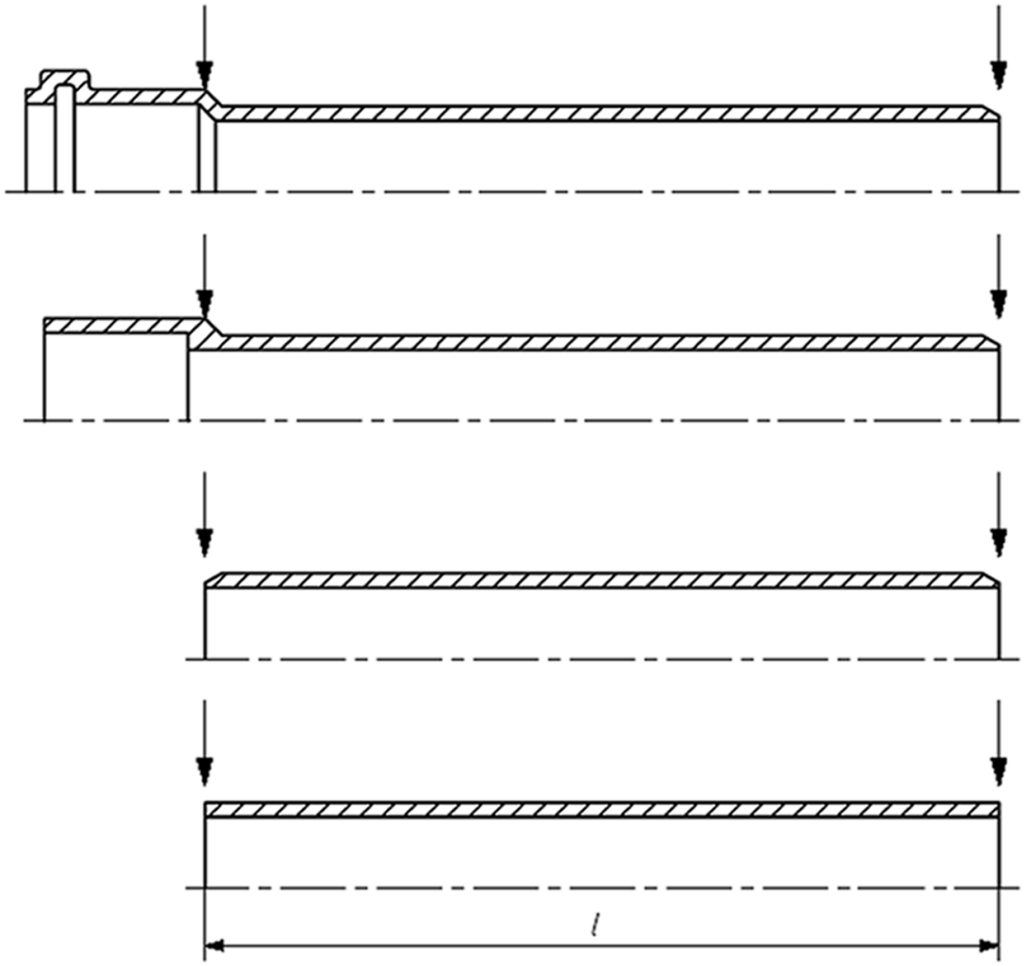


Figure 1 — Effective length of pipes

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 (see Figure 2 and Table 5 or Figure 7 and Table 8, as applicable).

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

6.2.5 Wall thickness

The wall thickness, e, shall conform to Table 4, where a maximum wall thickness at any point up to $1{,}2e_{min}$ is permitted provided that the mean wall thickness, e_m, is less than or equal to the specified $e_{m,max}$.

For U application, DN 200 and greater, a reduction of e_{min} up to 5 % is permitted, provided e_m is equal or exceeds the values of e_{min} given in Table 4. In such case, the ring stiffness shall be measured according to EN ISO 9969 and shall be greater than or equal to the nominal value.

NOTE For the calculation of the pipe stiffness the values of e_{min} as given in Table 4 should be used.

Table 4 — Wall thicknesses

Dimensions in millimetres

Nominal size DN/OD [a]	Nominal outside diameter	SN 2 SDR 51 [b]		SN 4 SDR 41		SN 8 SDR 34	
	d_n	e_{min}	$e_{m,max}$	e_{min}	$e_{m,max}$	e_{min}	$e_{m,max}$
110	110	––	––	3,2	3,8	3,2	3,8
125	125	––	––	3,2	3,8	3,7	4,3
160	160	3,2	3,8	4,0	4,6	4,7	5,4
200	200	3,9	4,5	4,9	5,6	5,9	6,7
250	250	4,9	5,6	6,2	7,1	7,3	8,3
315	315	6,2	7,1	7,7	8,7	9,2	10,4
(355)	355	7,0	7,9	8,7	9,8	10,4	11,7
400	400	7,9	8,9	9,8	11,0	11,7	13,1
(450)	450	8,8	9,9	11,0	12,3	13,2	14,8
500	500	9,8	11,0	12,3	13,8	14,6	16,3
630	630	12,3	13,8	15,4	17,2	18,4	20,5
(710)	710	13,9	15,5	17,4	19,4	20,8	23,2
800	800	15,7	17,5	19,6	21,8	23,4	26,8
(900)	900	17,6	19,6	22,0	24,4	––	––
1000	1000	19,6	21,8	24,5	27,2	––	––

[a] Non-preferred sizes are indicated in parenthesis.

[b] SDR 51 is applicable for application area code "U" only.

6.3 Dimensions of fittings

6.3.1 Outside diameters

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

The out-of-roundness shall conform to the requirements given in 6.2.2.

6.3.2 Design lengths (*Z*)

The *Z*-length(s) of fittings (see Figures 8 to 11 and Figures 13 to 18) shall be given by the manufacturer.

NOTE The *Z*-lengths are intended to assist in the design of moulds and are not intended to be used for quality control purposes. ISO 265-1 [3] can be used as a guideline.

6.3.3 Wall thicknesses

6.3.3.1 Minimum wall thickness, e_{min}, of the body or the spigot of a fitting shall conform to Table 4, 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 4.

6.3.3.2 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 the one wall thickness to the other.

6.3.3.3 Wall thickness of the cover of the saddle branch (see Figure 18) shall be equal or greater than e_{min} of the applicable size and series (see Table 4) of the inlet.

6.3.3.4 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 $e_{3,min}$, as given in Table 6, as appropriate for the SDR 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 spigots shall conform to Table 5 (see Figures 2, 3 or 4, 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 and spigots are permitted, provided the joints conform to the requirements given in Table 15.

Table 5 — Diameters and lengths of elastomeric ring seal sockets and spigots

Dimensions in millimetres

Nominal size DN/OD [a]	Nominal outside diameter	Socket			Spigot	
	d_n	$d_{sm,min}$	A_{min}	C_{max}	$L_{1,min}$	H [b]
110	110	110,4	32	26	60	6
125	125	125,4	35	26	67	6
160	160	160,5	42	32	81	7
200	200	200,6	50	40	99	9
250	250	250,8	55	70	125	9
315	315	316,0	62	70	132	12
(355)	355	356,1	66	70	136	13
400	400	401,2	70	80 [c]	150	15
(450)	450	451,4	75	80 [c]	155	17
500	500	501,5	80	80 [c]	160	18
630	630	631,9	93	95 [c]	188	23
(710)	710	712,1	101	109 [c]	210	28
800	800	802,4	110	110 [c]	220	32
(900)	900	902,7	120	125 [c]	245	36
1 000	1 000	1 003,0	130	140 [c]	270	41

[a] Non-preferred sizes are indicated in parenthesis.

[b] Approximate values, when a 15 ° chamfer is applied.

[c] Higher values for C are allowed, provided the manufacturer states in his documentation the actual required $L_{1,min}$ according to the equation $L_{1,min} = A_{min} + C$.

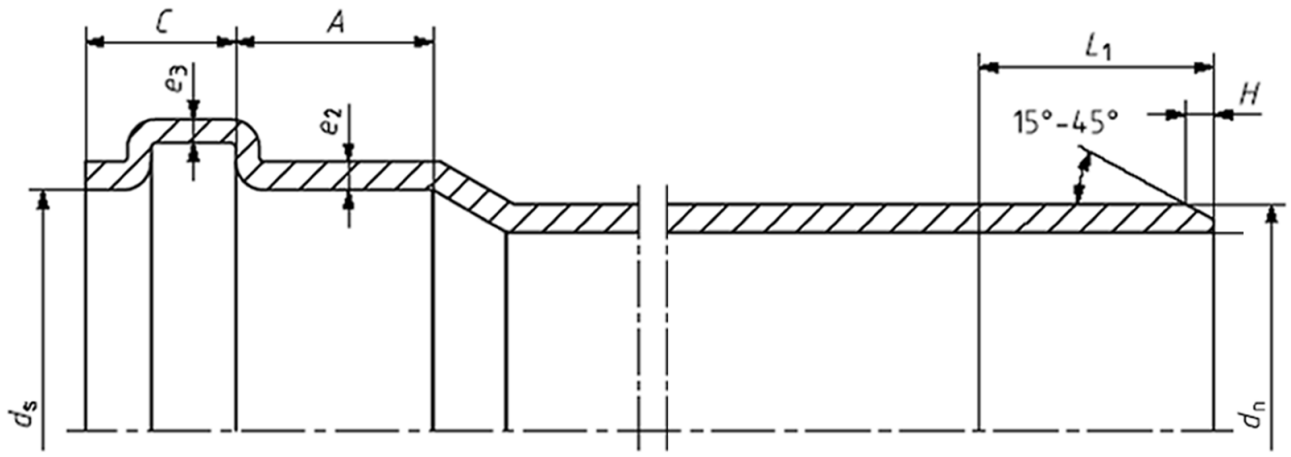


Figure 2 — Basic dimensions of sockets and spigots for elastomeric ring seal joints

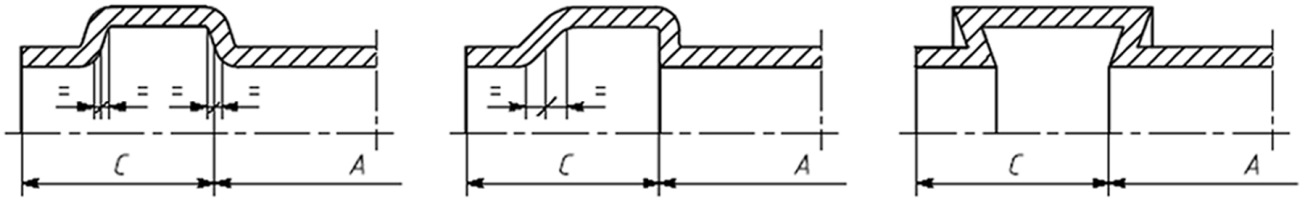


Figure 3 — Typical groove designs for elastomeric ring seal sockets

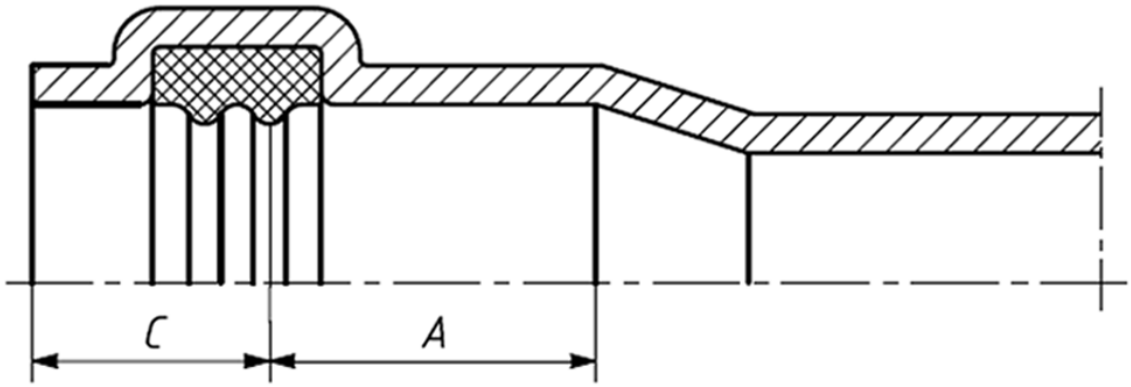


Figure 4 — Example for measuring the effective sealing point

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 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 6.

Where a sealing ring is located by means of a retaining cap or ring (see Figure 5) 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.

Table 6 — Wall thicknesses of sockets

Dimensions in millimetres

Nominal size DN/OD [a]	Nominal outside diameter	SN 2 SDR 51 [b]		SN 4 SDR 41		SN 8 SDR 34	
	d_n	$e_{2,min}$	$e_{3,min}$	$e_{2,min}$	$e_{3,min}$	$e_{2,min}$	$e_{3,min}$
110	110	––	––	2,9	2,4	2,9	2,4
125	125	––	––	2,9	2,4	3,4	2,8
160	160	2,9	2,4	3,6	3,0	4,3	3,6
200	200	3,6	3,0	4,4	3,7	5,4	4,5
250	250	4,5	3,7	5,5	4,7	6,6	5,5
315	315	5,6	4,7	6,9	5,8	8,3	6,9
(355)	355	6,3	5,3	7,8	6,6	9,4	7,8
400	400	7,1	6,0	8,8	7,4	10,6	8,8
(450)	450	8,0	6,6	9,9	8,3	11,9	9,9
500	500	8,9	7,4	11,1	9,3	13,2	11,0
630	630	11,1	9,3	13,9	11,6	16,6	13,8
(710)	710	12,6	10,5	15,7	13,1	18,7	15,6
800	800	14,1	11,8	17,7	14,7	21,1	17,6
(900)	900	16,0	13,2	19,8	16,5	––	––
1000	1000	17,8	14,7	22,0	18,4	––	––

[a] Non-preferred sizes are indicated in parenthesis.

[b] SDR 51 is applicable for application area code "U" only.

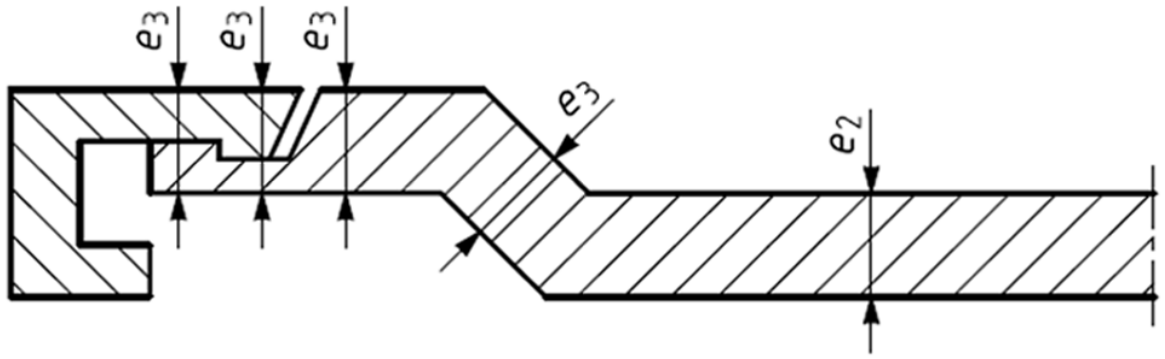


Figure 5 — Example for calculation of the wall thickness of sockets with retaining cap

6.4.1.3 Dimensions for "O-ring type" sockets

The dimensions of "O-ring type" sockets with a nominal diameter, d_n, up to and including 710 shall conform to Table 7 (see Figure 6). For higher diameters, dimensions shall be given by the manufacturer.

Table 7 — Dimensions of "O-ring type" sockets

Dimensions in millimetres

Nominal size DN/OD [a]	Nominal outside diameter	Socket		Groove			
	d_n	$d_{sm,max}$	B_{min}	$d_{3,min}$	$d_{3,max}$	f_{min}	f_{max}
110	110	110,9	6	120,3	121,3	9,1	11,1
125	125	125,9	7	137,1	138,2	10,4	12,6
160	160	161,0	9	173,8	175,0	11,7	14,1
200	200	201,1	12	215,6	217,0	13,0	15,8
250	250	252,0	18	272,9	274,5	19,5	26,7
315	315	317,3	20	338,9	340,9	20,8	28,4
(355)	355	357,5	22	383,0	385,2	22,5	30,5
400	400	402,8	24	427,1	429,5	24,1	32,6
(450)	450	453,5	26	480,2	482,8	27,0	36,3
500	500	503,5	28	533,2	536,0	29,9	39,9
630	630	633,9	34	669,6	673,0	34,4	46,4
(710)	710	714,1	38	753,8	757,0	39,0	52,1

[a] Non-preferred sizes are indicated in parenthesis.

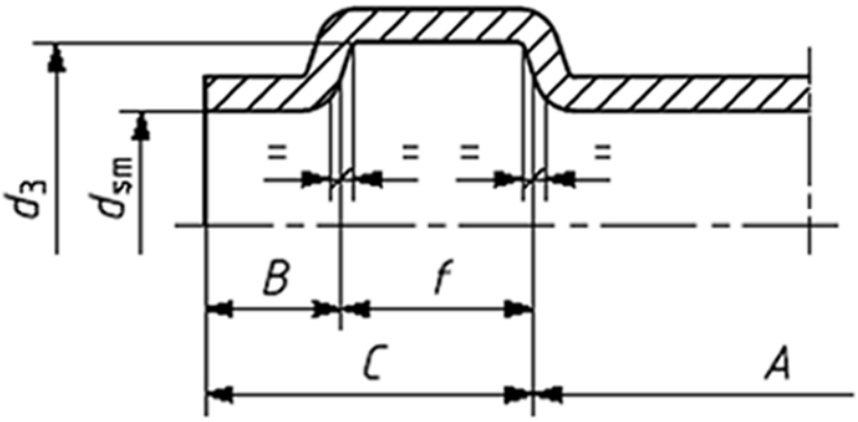


Figure 6 — Basic dimensions for "O-ring type" sockets

6.4.2 Solvent cement sockets and spigots

6.4.2.1 Diameters and lengths

The diameters and lengths of solvent cement sockets and spigots (see Figure 7) shall conform to Table 8.

The manufacturer shall declare whether the socket is designed tapered or parallel. If parallel or near parallel, the mean inside diameter of the socket, d_{sm}, shall apply over the entire length of the socket. If the socket is tapered, then the limits for d_{sm} shall apply at the mid point of the socket with a maximum taper angle of 20' (minutes) per side to the axis of the socket.

Table 8 — Diameters and lengths of solvent cement sockets and spigots

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter	Socket			Spigot	
	d_n	$d_{sm,min}$	$d_{sm,max}$	$L_{2,min}$	$L_{1,min}$	H [a]
110	110	110,2	110,6	48	54	6
125	125	125,2	125,7	51	61	6
160	160	160,3	160,8	58	74	7
200	200	200,4	200,9	66	90	9

[a] Approximate values, when a 15 ° chamfer is applied.

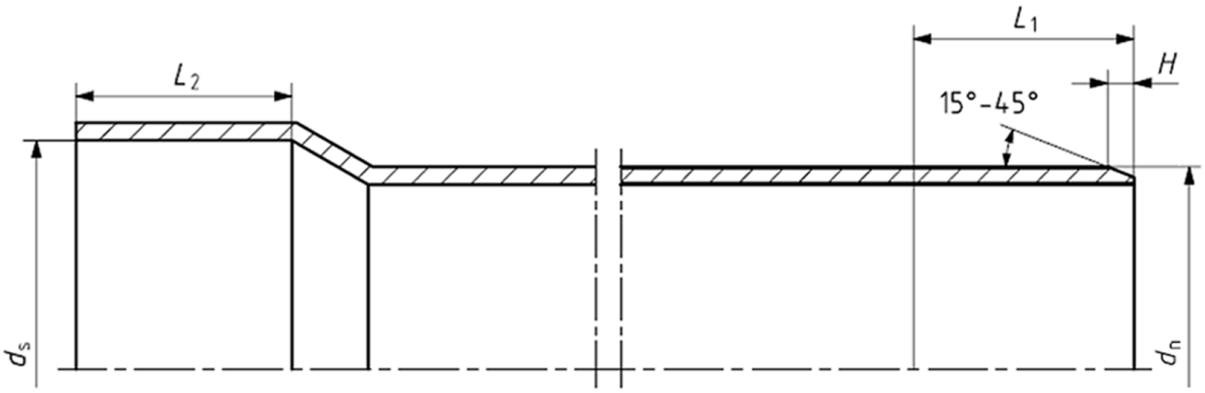


Figure 7 — Basic dimensions of sockets and spigots for solvent cement joints

6.4.2.2 Wall thicknesses of sockets

The wall thicknesses of sockets, e_2 (see Figure 7), shall conform to Table 6.

6.5 Types of fittings

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

a) bends (see Figures 8, 9, 10 or 11)
   1) unswept or swept angle (see ISO 265-1 [3]);
   2) spigot/socket and socket/socket;

NOTE 1 Preferred nominal angles α are the following: 15°, 30°, 45°, 67°30', 87°30' to 90°.

b) couplers and slip couplers (see Figure 12);

c) reducers (see Figure 13);

d) branches and reducing branches (see Figures 14, 15, 16 or 17)
   1) unswept or swept angle (see ISO 265-1 [3]);
   2) spigot/socket and socket/socket;

NOTE 2 Preferred nominal angles α are the following: 45°, 67°30', 87°30' to 90°.

e) saddle branches (see Figure 18)
   1) nominal angle α may be equal to 87°30' to 90° only when $d_{n2}/d_{n1} \leq 2/3$;
   minimum axial cover L:

Dimensions in millimetres

d_{n2}	110	125	160	200
L_{min}	50	60	70	80

2) for saddles having $d_{n1} < 315$ mm, the cover shall be not less than half a circumference;

3) for saddles having $d_{n1} \geq 315$ mm, the side cover a shall not be less than 80 mm;

NOTE 3 Preferred nominal angle α is: 45°.

f) plugs (see Figure 19)

1) minimum length of spigot, $M_{min} = (C_{max} + 10)$ mm (see Table 5).

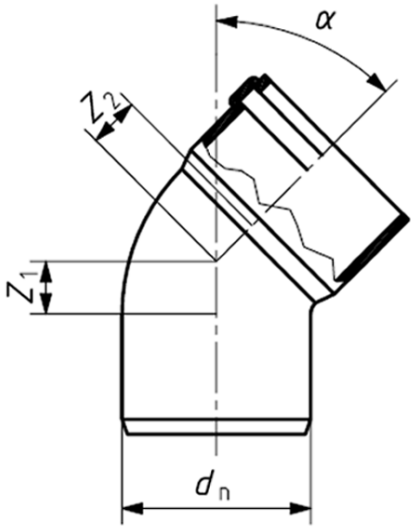


Figure 8 — Bend with single socket (unswept)

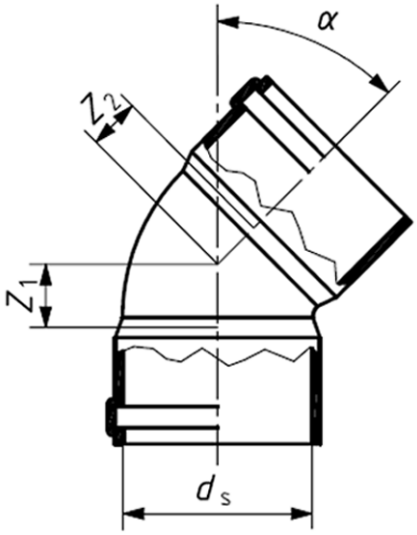


Figure 9 — Bend with all sockets (unswept)

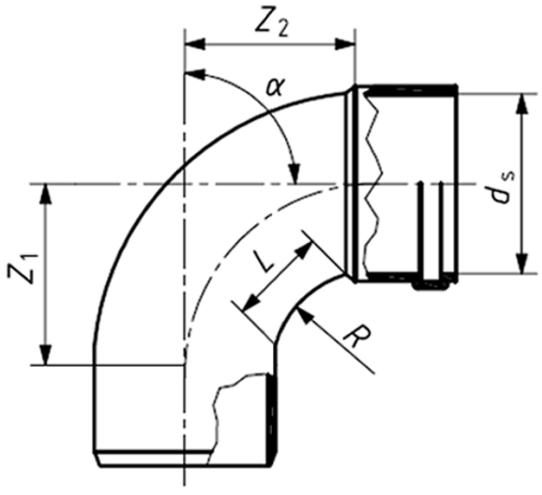


Figure 10 — Bend with single socket (swept)

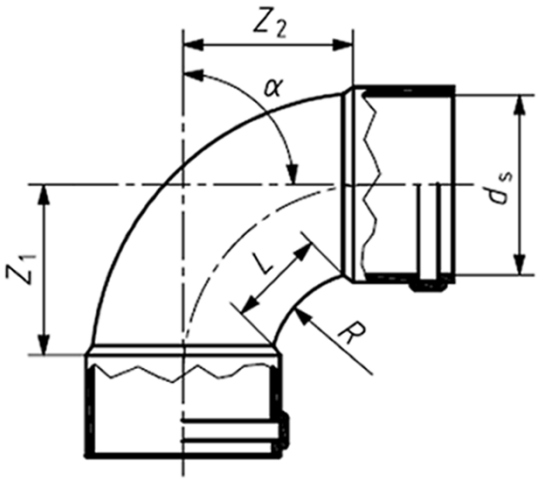


Figure 11 — Bend with all sockets (swept)

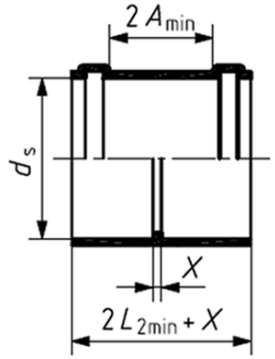


Figure 12 — Coupler

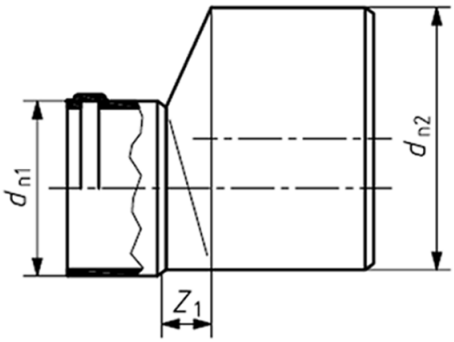


Figure 13 — Reducer

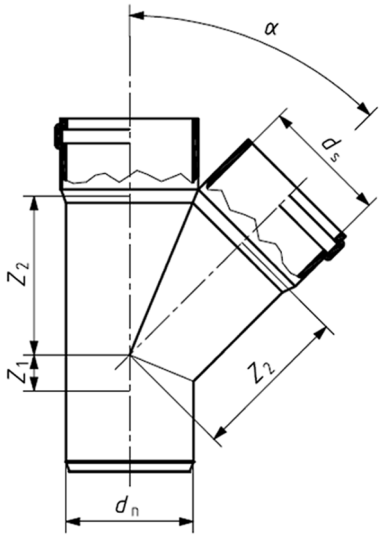


Figure 14 — Branch (unswept)

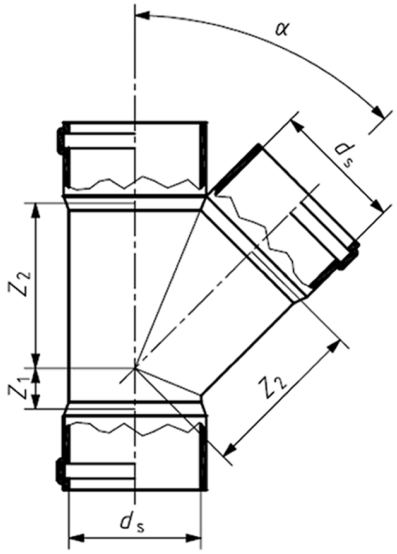


Figure 15 — Branch with all sockets (unswept)

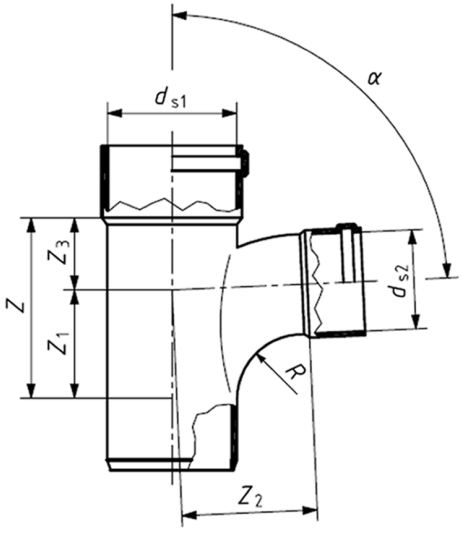


Figure 16 — Reducing branch (swept)

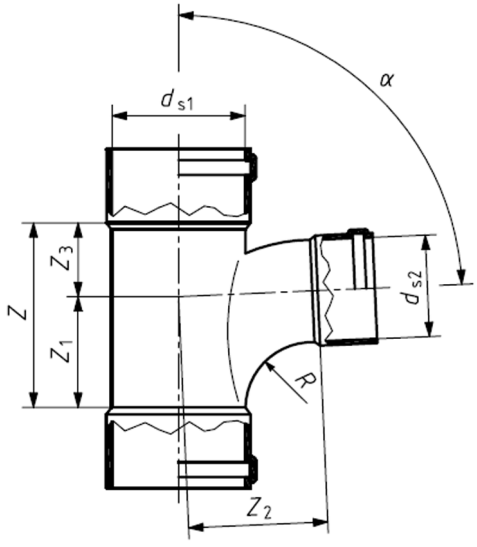


Figure 17 — Reducing branch with all sockets (swept)

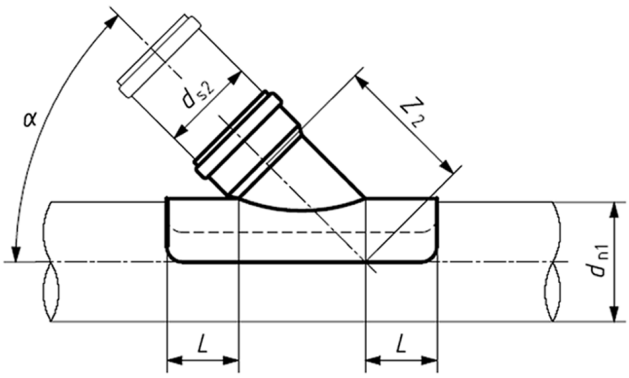
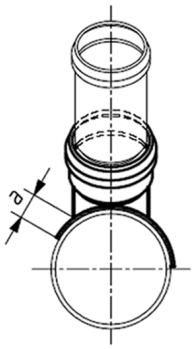


Figure 18 — Saddle branch



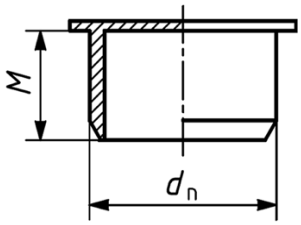


Figure 19 — Plug

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 9 using the indicated parameters, the pipe shall have general mechanical characteristics conforming to the requirements given in Table 9.

Table 9 — 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 $d_n \geq$ 315 mm Fall height of striker for: d_n = 110 mm $d_n \geq$ 125 mm	0 °C Water or air d90 conforming to 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 744:1995

[a] If the manufacturer chooses to use indirect testing (see prCEN/TS 1401-2:2007 [1]), the preferred temperature is (23 ± 2) °C.

7.1.2 Additional mechanical requirements

Pipes intended to be used in areas where installation is usually carried out at temperatures below –10 °C, may be required, in the national foreword, to conform to the requirements of an impact test (staircase method) as specified in Table 10 and shall be marked with the symbol of an ice crystal in accordance with Table 16.

Table 10 — Additional mechanical characteristics of pipes

Characteristic	Requirements	Test parameters		Test method
Impact resistance (staircase method)	H50 ≥ 1m 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 d90 conforming to EN 1411:1996 4 kg 5 kg 8 kg 10 kg 12,5 kg	EN 1411:1996

7.2 Mechanical characteristics of fittings

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

Table 11 — Mechanical characteristics of fittings

Characteristic	Requirements	Test parameters		Test method
Mechanical strength or flexibility [a]	No sign of splitting, cracking, separation, and/or leakage	Test period Minimum moment for [DN] ≤ 250 [DN] > 250 or Minimum displacement	15 min $0{,}15[DN]^3 \times 10^{-6}$ kNm 0,01[DN] kNm 170 mm	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 12 using the indicated parameters, the pipe shall have physical characteristics conforming to the requirements given in Table 12.

Table 12 — Physical characteristics of pipes

Characteristic	Requirements	Test parameters		Test method
Vicat softening temperature (VST)	≥ 79 °C	Shall conform to EN 727		EN 727
Longitudinal reversion	≤ 5 % The pipe shall exhibit no bubbles or cracks	Test temperature Immersion time for: $e \leq 8$ mm $e > 8$ mm	150 °C 15 min 30 min	EN ISO 2505: Liquid bath
		or		
		Test temperature Immersion time for: $e \leq 4$ mm 4 mm < $e \leq 16$ mm $e > 16$ mm	150 °C 30 min 60 min 120 min	EN ISO 2505: Air oven
Resistance to dichloromethane at a specified temperature	No attack [a]	Test temperature Immersion time	15 °C 30 min	EN 580
[a] Isolated spots less than 2 mm shall not be considered an attack.				
NOTE if a more detailed investigation on the gelation level is wanted, ISO 18373-1 and ISO 18373-2 [4] can be used.				

8.2 Physical characteristics of fittings

When tested in accordance with the test methods as specified in Table 13 and Table 14 if applicable using the indicated parameters, the fitting shall have physical characteristics conforming to the requirements given in Table 13 and/or Table 14, as applicable.

Table 13 — Physical characteristics of fittings

Characteristic	Requirements	Test parameters		Test method
Vicat softening temperature (VST)	≥ 77 °C [a]	Shall conform to EN 727		EN 727
Effects of heating	[b] and [c]	Test temperature Heating time for: $e \leq 10$ mm $e > 10$ mm	150 °C 30 min 60 min	EN ISO 580: Air oven

[a] VST ≥ 79 °C for application area code "D" and for d_n less than or equal to 200 mm.

[b] 1) within a radius of 15 times the wall thickness around the injection point(s), the depth of cracks, delamination or blisters shall not exceed 50 % of the wall thickness at that point;
2) within a distance of 10 times the wall thickness from the diaphragm zone, the depth of cracks, delamination or blisters shall not exceed 50 % of the wall thickness at that point;
3) within a distance of 10 times the wall thickness from the ring gate, the length of cracks shall not exceed 50 % of the wall thickness at that point;
4) the weld line shall not have opened more than 50 % of the wall thickness at the line;
5) in all other parts of the surface the depth of cracks and delaminations shall not exceed 30 % of the wall thickness at that point. Blisters shall not exceed a length 10 times the wall thickness.

[c] After cutting through the fitting, the cut surfaces shall show no foreign particles, when viewed without magnification.

Table 14 — Physical characteristics of fabricated fittings

Characteristic	Requirements	Test parameters		Test method
Watertightness [a]	No leakage	Water pressure Duration	0,5 bar 1 min	EN 1053

[a] Only for 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 15 using the indicated parameters, the joints and the system shall have fitness for purpose characteristics conforming to the requirements given in Table 15.

Table 15 — Performance requirements

Characteristic	Requirements	Test parameters		Test method
Tightness of elastomeric sealing ring joints		Test temperature Spigot deflection Socket deflection	(23 ± 5) °C 10 % 5 %	EN 1277, Condition B
	No leakage	Water pressure	0,05 bar	
	No leakage	Water pressure	0,5 bar	
	≤ –0,27 bar	Air pressure	–0,3 bar	
		Test 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, 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		EN 1055 using test assembly b) (Figure 2)

[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 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 15.

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

11 Adhesives

The adhesive shall be solvent cement and shall be as specified by the manufacturer of pipes or fittings.

The adhesive shall have no detrimental effects on the properties of the pipe and of the fitting and shall not cause the test assembly to fail to conform to Table 15.

12 Marking

12.1 General

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

One of the following three levels of legibility of the marking on components is specified for the individual marking aspects given in the column “Minimum durability of legibility of marking” in Tables 16 and 17. The required durability of marking is coded with decreasing stringency as follows:

a) durable in use;

b) legible until the system is installed;

c) marking on the packaging, legible until the component 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.

12.1.2 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.

12.1.3 If printing is used, the colouring of the printed information shall differ from the basic colouring of the pipe or fitting.

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

12.2 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 16.

Table 16 — Minimum required marking of pipes

Aspects	Marking or symbols	Minimum durability of legibility of marking
– Number of standard	EN 1401	a
– Application area code	Either U or UD	a
– Manufacturer's name and/or trade mark	XXX	a
– Nominal size	e.g. 200	a
– Minimum wall thickness or SDR	e.g. either 4,9 or SDR 41	a
– Material	Either PVC-U or PVC	a
– Nominal ring stiffness	e.g. SN 4	a
– Manufacturer's information	[a]	a
– Cold climate performance [b]	❄ (ice crystal)	b

[a] 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.

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

12.3 Minimum required marking of fittings

The minimum required marking of fittings shall conform to Table 17.

Table 17 — Minimum required marking of fittings

Aspects	Marking or symbols	Minimum durability of legibility of marking
– Number of standard	EN 1401	b
– Application area code	Either U or UD	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 SDR	e.g. either 4,9 or SDR 41	b
– Material	Either PVC-U or PVC	a
– Manufacturer's information	[a]	b

[a] 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.

12.4 Additional marking

12.4.1 Pipes and fittings conforming to this European Standard, which also conform to other standard(s), may be additionally marked with the minimum required marking in accordance with this/those other standard(s).

12.4.2 Pipes and fittings conforming to this European 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)

Utilisation of non-virgin material

A.1 Material definitions

A.1.1
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

A.1.2
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

A.1.3
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 PVC-U products other than pipes and fittings, regardless of where they are manufactured.

A.1.4
recyclable material
material comprising either of the following forms:

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

b) material from used PVC-U products other than pipes or fittings which have been cleaned and crushed or ground.

NOTE For the purposes of this clause, the term pipes means extruded pipes and any parts of a fabricated fitting which is made from an extruded pipe. The term fitting means injection-moulded fittings and injection-moulded parts of a fabricated fitting.

A.1.5
reformulated material
recyclable/reprocessable material that has been reformulated, by additives and processing techniques, to meet an agreed specification

NOTE Typically the additives used would be stabilisers, pigments etc.; the reformulation material: homogeneous pellets, granules, powder etc., with the produced batch having consistent physical properties.

A.2 Own reprocessable material

The use of clean own reprocessable material for the production of pipes and fittings is permitted without limitations. If fitting material is used for the production of pipes it shall be considered as recyclable material.

A.3 External reprocessable and recyclable materials with agreed specification

A.3.1 Material from PVC-U pipes and fittings

External reprocessable and recyclable material with an agreed specification from PVC-U pipes and fittings that are available in relevant quantities and intervals of time is permitted to be added to virgin or own reprocessable material or a mixture of those two materials for the production of pipes provided that all the following conditions are met.

a) A specification for each material shall be agreed between the supplier of external reprocessable or recyclable material and the pipe manufacturer. It shall at least cover the characteristics given in Table A.1. When determined in accordance with the test methods given in Table A.1, the actual values for these characteristics shall conform to the agreed value and the permitted deviations shall conform to those given in Table A.1.

   The quality plan of the supplier of external reprocessable or recyclable material should conform to EN ISO 9001 [5].

NOTE For the purposes of A.3.1, the manufacturer is responsible for claiming and ensuring that the quality plan conforms to or is no less stringent than the relevant requirements of EN ISO 9001 [5]: it is not essential for the manufacturer to be approved and registered for operation in accordance with EN ISO 9001 [5].

Table A.1 — Specification of characteristics to be covered by the agreement and permitted deviations for these characteristics

Characteristic	Permitted deviations	Test method
PVC-content [a]	± 4 % absolute by mass	EN 1905
K-value [a]	± 3 units	EN 922
Density [a]	± 20 kg/m^3	EN ISO 1183-1
Vicat softening temperature (VST) [a]	± 2 °C	EN 727
Particle size [b]	Requirements and test method shall be agreed and stated in the specification.	
Type of stabilizer [a b]	Requirements and test method shall be agreed and stated in the specification.	
Impurities [b]	Based on the source of material and the recycling process a relevant test method and requirements shall be agreed and stated in the specification. Both the test method and the requirements shall be published.	
[a] If the source of the material is pipes and fittings produced under a European nationally recognised quality mark or a European quality mark, it is not required to test these material characteristics if the requirement covered by the quality mark conforms to the requirement given in this table. [b] The relevant requirements and test method depend on the recycling process and on the end product.		

b) Each delivery shall be covered by a certificate conforming to 3.1 of EN 10204:2004, showing conformity to the agreed specification.

c) The maximum quantity of external reprocessable and recyclable material that is intended to be added may be up to 100 %.

d) The quantity of external reprocessable and recyclable material that is actually added in each production series shall be recorded by the pipe manufacturer.

e) The PVC content of the end product shall conform to the requirements specified in 4.1.

f) Type testing shall be carried out on the end product with the maximum specified amount and with each form of external reprocessable or recyclable material with an agreed specification. Approved results shall be taken as proving conformity also of components containing lower levels of external or recyclable material.

A.3.2 Material from PVC-U products other than pipes and fittings

External reprocessable and recyclable material with an agreed specification from PVC-U products that are available in relevant quantities and intervals of time is permitted to be added to virgin or own reprocessable material or a mixture of those two materials for the production of pipes and fittings provided that all the following conditions are met:

a) the material shall conform to all the conditions given in a) to f), inclusive, of A.3.1, and to all of the additional characteristics and requirements given in Table A.2.

Table A.2 — Requirements for external reprocessable and recyclable material from PVC-U products other than pipes and fittings

Characteristic	Requirements	Test method
PVC-content	≥ 80 % by mass	EN 1905
K-value	56 ≤ K-value ≤ 70	EN 922
Density	1 390 kg/m^3 ≤ density ≤ 1 500 kg/m^3	EN ISO 1183-1
Vicat softening temperature (VST)	≥ 62 °C	EN 727
Impurities	≤ 1 500 ppm for particle size ≤ 1 000 μm ≤ 1 500 ppm for 1 000 μm < particle size < 1 400 μm	[a]
Particle size	> 1 000 μm: max. 15 % < 1 400 μm: 100 %	
Source of the material	PVC-U products	
If the source of the material is unused products for which the complete formulation is known and is such that all the requirements given in this table are fulfilled, the material does not have to be tested and does not have to meet the requirements for particle size.		
[a] Based on the source of material and the recycling process a relevant test method and requirements shall be agreed and stated in the specification. Both the test method and the requirements shall be published.		

b) the material shall be clean and dry;

c) the maximum allowed amount of reprocessable and recyclable material shall depend on the difference in K-value of the virgin material and the reprocessable and recyclable material as follows:

   1) if the difference in K-value, when determined in accordance with EN 922, is ≤ 4 units, then up to 10 % by mass may be added;

   2) if the difference in K-value is > 4 units or not determined, then up to 5 % by mass may be added;

d) the quantity of external reprocessable and recyclable material that is actually added in each production series shall be recorded by the pipe and fitting manufacturer.

NOTE Attention is drawn to possible national regulations regarding heavy metals, e.g. cadmium.

A.3.3 Reformulated material

The use of reformulated material shall follow the guidelines for recyclable material with agreed specification as specified in A.3.1 and A.3.2.

A.4 External reprocessable and recyclable materials not covered by an agreed specification

A.4.1 Material from PVC-U pipes and fittings

External reprocessable and recyclable material not covered by an agreed specification from PVC-U pipes and fittings that are available in random quantities and intervals of time is permitted to be added to virgin or own reprocessable material or a mixture of those two materials for the production of pipes provided that all the following conditions are met:

a) when this material is used, the production shall be considered as at least one batch and tested accordingly;

b) the material shall be clean and dry;

c) the maximum allowed amount of reprocessable and recyclable material shall depend on the difference in K-value of the virgin material and the reprocessable and recyclable material as follows:

   1) if the difference in K-value, when determined in accordance with EN 922, is ≤ 4 units, then up to 10 % by mass may be added;

   2) if the difference in K-value is > 4 units or not determined, then up to 5 % by mass may be added;

d) the quantity of external reprocessable and recyclable material that is actually added in each production series shall be recorded by the pipe manufacturer.

A.4.2 Material from PVC-U products other than pipes and fittings

External reprocessable and recyclable material not covered by an agreed specification from other PVC-U products than pipes and fittings shall not be used for the production of pipes and fittings conforming to this European Standard.

A.5 Summary of use of non-virgin material

The following table gives a summary of the use of non-virgin material for the production of pipes and fittings conforming to this European Standard.

Table A.3 — Summary of use of non-virgin material

	Own reprocessable material	**External reprocessable and recyclable material with agreed specification**		**External reprocessable and recyclable material without agreed specification**	
		From pipes and fittings	Not from pipes or fittings	From pipes and fittings	Not from pipes or fittings
Pipes	Up to 100 %	Up to 100 %	Up to 10 % ($\Delta K \leq 4$) Up to 5 % ($\Delta K > 4$)	Up to 10 % ($\Delta K \leq 4$) Up to 5 % ($\Delta K > 4$)	Not permitted
Fittings	Up to 100 %	Up to 100 %	Up to 10 % ($\Delta K \leq 4$) Up to 5 % ($\Delta K > 4$)	Not permitted	Not permitted

Annex B
(informative)

General characteristics of PVC-U pipes and fittings

B.1 General

EN 476 [6] 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. Further the following information is given.

B.2 Compound characteristics

The compounds of pipes and fittings conforming to this European Standard have generally these characteristics:

Modulus of elasticity	$E_{(1min)} \geq 3\ 200$ MPa
Average density	$\approx 1{,}5$ g/cm^3
Average coefficient of linear thermal expansion	$\approx 0{,}08$ mm/mK
Thermal conductivity	$\approx 0{,}16$ WK^{-1}m^{-1}
Surface resistance	$> 10^{12}\ \Omega$
Poisson ratio	0,4

B.3 Ring stiffness

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

≥ 2 kN/m^2 for SDR 51
≥ 4 kN/m^2 for SDR 41
≥ 8 kN/m^2 for SDR 34.

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. Consequently fittings are classified with the corresponding pipe stiffness. The actual value of stiffness of the fittings can be determined in accordance with ISO 13967 [7].

Fittings according to this standard, because of their geometry, have a stiffness greater than the stiffness of the corresponding pipe. Therefore the following applies:

a) fittings marked with SDR 41 may be used with pipes up to SN 8 (SDR 34) ;

b) fittings of DN ≥ 400 marked with SDR 51 may be used with pipes up to SN 4 (SDR 41).

B.4 Creep ratio

The creep ratio for pipes and fittings conforming to this European Standard, when determined in accordance with EN ISO 9967 [8], is less than 2. 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

PVC-U piping systems conforming to this European 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 1401 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 PVC-U materials guidance is given in ISO/TR 10358 [9] and for rubber materials in ISO/TR 7620 [10].

B.6 Abrasion resistance

Pipes and fittings conforming to this European Standard are resistant to abrasion. For special circumstances, the abrasion resistance can be determined from the test method given in EN 295-3 [11].

B.7 Hydraulic roughness

The internal surfaces 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 the manufacturer's information or see CEN/TS 15223 [12], Table 5.

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

Pipes and fittings conforming to the following products standards can be used conditionally in conjunction with pipes and fittings conforming to this European Standard (see Clause 1, NOTE 2):

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 12666-1, *Plastics piping systems for non-pressure underground drainage and sewerage — Polyethylene (PE) — Part 1: Specifications for pipes, fittings and the system*

EN 13476-2, *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 modifier(s) (PP-MD) — Part 1: Specifications for pipes, fittings and the system*

Bibliography

[1] prCEN/TS 1401-2, *Plastics piping systems for non-pressure underground drainage and sewerage — Unplasticized poly(vinyl chloride)(PVC-U) — Part 2: Guidance for the assessment of conformity*

[2] ENV 1401-3, *Plastics piping systems for non-pressure underground drainage and sewerage — Unplasticized poly(vinyl chloride)(PVC-U) — Part 3: Guidance for installation*

[3] ISO 265-1, *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)*

[4] ISO 18373-1, *Rigid PVC pipes — Differential scanning calorimetry (DSC) method — Part 1: Measurement of the process temperature*

[5] EN ISO 9001, *Quality management systems — Requirements (ISO 9001:2000)*

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

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

[8] EN ISO 9967, *Thermoplastics pipes — Determination of creep ratio (ISO 9967:2007)*

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

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

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

[12] CEN/TS 15223, *Plastics piping systems — Validated design parameters of buried thermoplastics piping systems*

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