BS EN 1329-1:2014

Incorporating corrigendum July 2014

BSI Standards Publication

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

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National foreword

This British Standard is the UK implementation of EN 1329-1:2014. It supersedes BS EN 1329-1:2000 which is withdrawn.

It is complemented by BS 4514:2001.

The UK participation in its preparation was entrusted by Technical Committee PRI/88, Plastics piping systems to Subcommittee PRI/88/1, Plastics piping for non-pressure applications, who wish to bring the following important information to the attention of readers of this standard.

Except for nominal size DN/OD 82, products conforming to BS EN 1329-1 will be generally compatible with those of the same size in accordance with BS 4514:2001 and BS 5255:1989. The DN/OD sizes 36, 43 and 56 correspond exactly with the 1 1/4, 1 1/2 and 2 sizes respectively in BS 5255:1989.

In the case of nominal size DN/OD 82 as specified in EN 1329-1:2014, the minimum mean outside diameter is 82.0 mm. Existing installed piping systems conforming to BS 4514 are based on a nominal pipe size 82 having a minimum diameter of 82.4 mm. The UK committee has concluded that joints comprising direct connection of two components conforming respectively to these two different size ranges are unlikely to remain effective and safe. The UK committee therefore advises purchasers and installers not to regard these two sizes (i.e. DN/OD 82 conforming to EN 1329-1:2014 and nominal size 82 according to BS 4514:2001) as mutually compatible unless the manufacturer specifically declares otherwise and/or connections between zones of differing pipework are clear and effected via appropriate adapters or seals.

The UK committee gives the following advice concerning the specification of piping components used with piping systems conforming to this British Standard but not detailed in EN 1329-1:2014.

1. BS 4514:2001 remains valid to cater for system components or requirements not covered by EN 1329-1:2014, including the 82.4 mm minimum o.d. size, the minimum opening dimensions of access fittings, design of swept fittings, connectors to WC pans and stand-off dimensions of pipe and fitting clips.
2. No advice is given in EN 1329-1:2014 in respect of threaded components. The UK committee recommends that the current requirements in BS 5255:1989 are retained, i.e. if the PVC fitting is intended to adapt to a threaded metal component then the thread form should conform to either BS EN 10226-1 or BS EN ISO 228-1.
3. Although general advice is given for the specification of swept bends and branch connections by suggesting that they follow ISO 265-1 (see clause 6.3.4), when used in England and Wales all such products must conform to the requirements of The Building Regulations 2002 (amended 2013) Approved Document H1, 1.17 and 1.26. Analogous provisions apply in Scotland and Northern Ireland. To this end, more specific detail is given in BS 4514:2001.

EN 1329-1:2014 is specific to internal installations and does not include requirements necessary for external installation, which is commonplace and remains allowed in the UK. Pipes and fittings intended for outdoor use should additionally conform to the weathering resistance requirement specified in BS 4514:2001. The responsible UK committee gives the following advice concerning the selection and installation of piping components and systems conforming to this British Standard.

1. In respect of fire regulations, the components and systems should be installed as though comprising PVC products conforming to BS 4514 or BS 5255 and hence The Building Regulations Approved Document B 2006 (amended 2013), B3 will apply in England and Wales. Analogous provisions apply in Scotland and Northern Ireland.
2. The products should only be used in application area B, i.e. suspended from brackets above ground and installed in accordance with BS EN 12056-2 and its National Annex using the M or L socket variants as specified.

For underground installations, see BS EN 1401-1 or equivalent product specifications for such situations and take account of current national installation practices, e.g. BS EN 1610 and BS EN 752.

CAUTION EN 1329-1:2014 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 referred to in EN 1329-1 should be operated only by trained personnel.

A list of organizations represented on this subcommittee 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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Compliance with a British Standard cannot confer immunity from legal obligations.

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Amendments/corrigenda issued since publication

Date	Text affected
31 July 2014	Additional national foreword text inserted

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 1329-1

February 2014

ICS 23.040.01

English Version

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

Systèmes de canalisations en plastique pour l'évacuation des eaux-vannes et des eaux usées (à basse et à haute température) à l'intérieur de la structure des bâtiments - Poly(chlorure de vinyle) non plastifié (PVC-U) - Partie 1: Spécifications pour tubes, raccords et le système

Kunststoff-Rohrleitungssysteme zum Ableiten von Abwasser (niedriger und hoher Temperatur) innerhalb der Gebäudestruktur - Weichmacherfreies Polyvinylchlorid (PVC U) - Teil 1: Anforderungen an Rohre, Formstücke und das Rohrleitungssystem

This European Standard was approved by CEN on 1 December 2013.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This document (EN 1329-1:2014) 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 August 2014, and conflicting national standards shall be withdrawn at the latest by August 2014.

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 1329-1:1999.

EN 1329 consists of the following parts:

— 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* [the present document];

— CEN/TS 1329-2, *Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure — Unplasticized poly(vinyl chloride) (PVC-U) — Part 2: Guidance for the assessment of conformity* [Technical Specification].

The main changes are:

— specification of the scope with restriction to solid wall;

— updating of the normative references;

— alignments of products characteristics for BD applications with UD applications (EN 1401-1) for $d_n \geq 110$ mm;

— introduction of alternative test methods to DCMT for the evaluation of the gelation of PVC;

— explicit integration of designs of fittings.

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 method 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.

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

1 Scope

This part of EN 1329 specifies the requirements for solid wall unplasticized poly(vinyl chloride) (PVC-U) pipes, fittings and the system intended for:

— soil and waste discharge applications (low and high temperature) inside buildings (application area code “B”);

— soil and waste discharge applications (low and high temperature) for both inside buildings and buried in ground within the building structure (application area code “BD”).

NOTE 1 The intended use is reflected in the marking of products by “B” or “BD”.

NOTE 2 For use buried in ground within the building structure are intended only those components (marked with “BD”) with nominal outside diameters equal to or greater than 75 mm.

This part of EN 1329 is also applicable to PVC-U pipes, fittings and the system intended for the following purposes:

— ventilating part of the pipework in association with discharge applications;

— rainwater pipework within the building structure.

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

This European Standard covers a range of nominal sizes, a range of pipes and fittings series and gives recommendations concerning colours.

NOTE 3 It is the responsibility of the purchaser or specifier to make the appropriate selections from these aspects, taking into account their particular requirements and any relevant national regulations and installation practices or codes.

For external above ground application additional requirements depending on the climate should be agreed between the manufacturer and the user.

NOTE 4 Pipes, fittings and other components conforming to any of the plastics product standards listed in Annex B 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 24.

NOTE 5 Joints and adhesives are considered to be part of the system as covered in the scope.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 1401-1:2009, *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 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 14680, *Adhesives for non-pressure thermoplastic piping systems - Specifications*

EN 14814, *Adhesives for thermoplastic piping systems for fluids under pressure - Specifications*

EN ISO 472, *Plastics - Vocabulary (ISO 472)*

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

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

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)*

EN ISO 1167-2, *Thermoplastics pipes, fittings and assemblies for the conveyance of fluids - Determination of the resistance to internal pressure - Part 2: Preparation of pipe test pieces (ISO 1167-2)*

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)*

EN ISO 2505, *Thermoplastics pipes - Longitudinal reversion - Test method and parameters (ISO 2505)*

EN ISO 3126, *Plastics piping systems - Plastics components - Determination of dimensions (ISO 3126)*

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

EN ISO 13229, *Thermoplastics piping systems for non-pressure applications - Unplasticized poly(vinyl chloride) (PVC-U) pipes and fittings - Determination of the viscosity number and K-value (ISO 13229)*

ISO 2507-1, *Thermoplastics pipes and fittings - Vicat softening temperature - Part 1: General test method*

ISO 3127, *Thermoplastics pipes - Determination of resistance to external blows - Round-the-clock method*

ISO 6259-2, *Thermoplastics pipes - Determination of tensile properties - Part 2: Pipes made of unplasticized poly(vinyl chloride) (PVC-U), chlorinated poly (vinyl chloride) (PVC-C) and high-impact poly (vinyl chloride) (PVC-HI)*

ISO 9852, *Unplasticized poly(vinyl chloride) (PVC-U) pipes - Dichloromethane resistance at specified temperature (DCMT) - Test method*

ISO 11173, *Thermoplastics pipes - Determination of resistance to external blows - Staircase method*

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

ISO 13255, *Thermoplastics piping systems for soil and waste discharge inside buildings - Test method for airtightness of joints*

ISO 13257:2010, *Thermoplastics piping systems for non-pressure applications - Test method for resistance to elevated temperature cycling*

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

ISO 18373-1, *Rigid PVC pipes - Differential scanning calorimetry (DSC) method - Part 1: Measurement of the processing temperature*

3 Terms and definitions, symbols and abbreviations

3.1 Terms and definitions

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

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

— B: application area code for components intended for use above ground inside the building, or for components outside buildings fixed onto the wall;

— D: application code for the area under and within 1 m from the building where the pipes and fittings are buried in ground and are connected to the underground drainage and sewerage system;

— BD: application area code for components intended for use for both code B and code D application areas

Note 1 to entry: In D application areas the existence of external forces from the surroundings in addition to the hot water discharge is usual.

Note 2 to entry: Other application area codes U and UD not covered by this standard are defined elsewhere, e.g. in EN 1401–1.

3.1.2
nominal size
3.1.2.1
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

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

3.1.3
nominal outside diameter
d_n
specified outside diameter, in millimetres, assigned to a nominal size DN/OD

3.1.4
outside diameter
d_e
value of the measurement of the outside diameter through its cross section at any point of a pipe or spigot of a fitting, rounded to the next greater 0,1 mm

3.1.5
mean outside diameter
d_{em}
value of the measurement of the outer circumference of a pipe or spigot of a fitting in any cross section, divided by π (≈ 3,142), rounded to the next greater 0,1 mm

3.1.6
inside diameter
d_s
value of the measurement of the inside diameter through its cross section at any point of a socket, 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 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
nominal ratio of the outside diameter, d_n, to the minimum wall thickness, e_{min}

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, indicating the minimum ring stiffness of a pipe or fitting

3.1.13
assembled fittings
fittings which are made from several injection moulded parts to be assembled together by screwing or clipping

Note 1 to entry: Such fittings can incorporate rubber membranes or joints.

3.1.14
fabricated fittings
fittings produced from pipe and/or from injection-moulded fittings by thermoforming, solvent-cementing or welding

Note 1 to entry: Fabricated fittings need an additional fabrication step.

3.1.15
solid wall pipe and fitting
pipe or fitting with smooth internal and external surface with the same compound / formulation through the wall

3.1.16
material definitions
3.1.16.1
virgin material
material in the 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 reprocessed or recycled material has been added

Note 1 to entry: It is understood that the addition of additives such as stabilizers and pigments is still resulting into a virgin material.

3.1.16.2
own reprocessed material
material prepared from rejected unused pipes, gutters or fittings and ancillaries, including trimmings from the production of pipes or fittings, that has been 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

3.1.16.3
external reprocessed material
material prepared from unused thermoplastics products regardless of where those products were manufactured

3.1.16.4
recycled material
material from used thermoplastic products which have been cleaned and crushed or ground

3.1.16.5
reformulated material
recycled/reprocessed material that has been reformulated, by additives and processing techniques, to meet an agreed specification

Note 1 to entry: Typically the additives used would be stabilizers, pigments etc.; the reformulation material: homogeneous pellets, granules, powder etc., with the produced batch having consistent physical properties.

3.1.16.6
agreed specification
specification of the relevant material characteristics agreed between the supplier of the non-virgin material and the pipe, fitting and/or ancillary manufacturer

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_s : inside diameter of a socket

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_1 : length of spigot

L_2 : length of socket

l : effective length of a pipe

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 : Unplasticised 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.

The PVC content shall be at least 80 % by mass for pipes and 85 % by mass for injection-moulded fittings and shall be determined by calculation. In case of dispute, the PVC content can also be determined in accordance with EN 1905.

For pipes ≥ 110 mm and intended for BD applications, 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 $CaCO_3$, before coating if any, shall conform to the following:

   1) content of $CaCO_3$ ≥ 96 % by mass;

   2) content of $MgCO_3$ ≤ 4 % by mass;

   3) content of $CaCO_3$ and $MgCO_3$ in total ≥ 98 % by mass.

b) The physical properties of the material shall conform to the following:

   1) mean particle size D50 ≤ 2,5 µm;

2) top cut D98 ≤ 20 µm.

4.2 Additional requirement for pipe material for BD application

The material of pipes intended to be used in application area BD shall comply with the additional requirement given in Table 1, when tested in accordance with the methods and the parameters indicated in Table 1.

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

Table 1 — Material characteristics of pipes intended for BD application

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 60 °C Free 3 10,0 MPa 1 h Water-in-water 1 000 h	EN ISO 1167-1 and EN ISO 1167-2

4.3 Additional requirement for fitting material for BD application

The material of fittings intended to be used in application area BD shall comply with the additional requirement given in Table 2, when tested in accordance with the methods and the parameters indicated in Table 2.

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

Table 2 — Material characteristics of fittings intended for BD application

Characteristic	Requirements	Test parameters		Test method
Resistance to internal pressure	No failure during the test period	End caps Dimensions Test temperature Orientation Free length for injection-moulded pipe Number of test pieces Circumferential (hoop) stress Conditioning period Type of test Test period	Type A or B 50 mm ≤ d_n ≤ 110 mm 60 °C Free ≥ 140 mm 3 6,3 MPa 1 h Water-in-water 1 000 h	EN ISO 1167-1 and EN ISO 1167-2

4.4 Utilization of non-virgin material

Conditions and requirements for the utilization of non-virgin material are given in Annex A.

4.5 Sealing ring retaining means

Sealing rings may be retained using means made from polymers other than PVC-U, provided the joints conform to the requirements given in Clause 9.

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, pores or other surface irregularity likely to prevent performance of pipes and fittings with this standard;

— each end of a pipe or a fitting shall be cleanly cut, if applicable, and shall be square to its axis.

5.2 Colour

The pipes and the fittings shall be coloured through the wall.

The recommended colour of pipes and fittings is grey.

6 Geometrical characteristics

6.1 General

Dimensions shall be measured in accordance with EN ISO 3126.

NOTE The figures given in this European Standard are only schematic sketches intended to indicate the relevant dimensions. They do not necessarily represent manufactured components.

6.2 Dimensions of pipes

6.2.1 Outside diameter

The mean outside diameter, $d_{em,}$ shall conform to Tables 3 or 4 as applicable.

Table 3 — Mean outside diameters (metric series)

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter	Mean outside diameter	
	d_n	$d_{em,min}$	$d_{em,max}$
32	32	32,0	32,2
40	40	40,0	40,2
50	50	50,0	50,2
63	63	63,0	63,2
75	75	75,0	75,3
80	80	80,0	80,3
82	82	82,0	82,3
90	90	90,0	90,3
100	100	100,0	100,3
110	110	110,0	110,3
125	125	125,0	125,3
140	140	140,0	140,4
160	160	160,0	160,4
180	180	180,0	180,4
200	200	200,0	200,5
250	250	250,0	250,5
315	315	315,0	315,6

Table 4 — Mean outside diameters (series based on inch dimensions)

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter	Mean outside diameter	
	d_n	$d_{em,min}$	$d_{em,max}$
36	36	36,2	36,5
43	43	42,8	43,1
56	56	55,8	56,1

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 Effective length of pipes

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

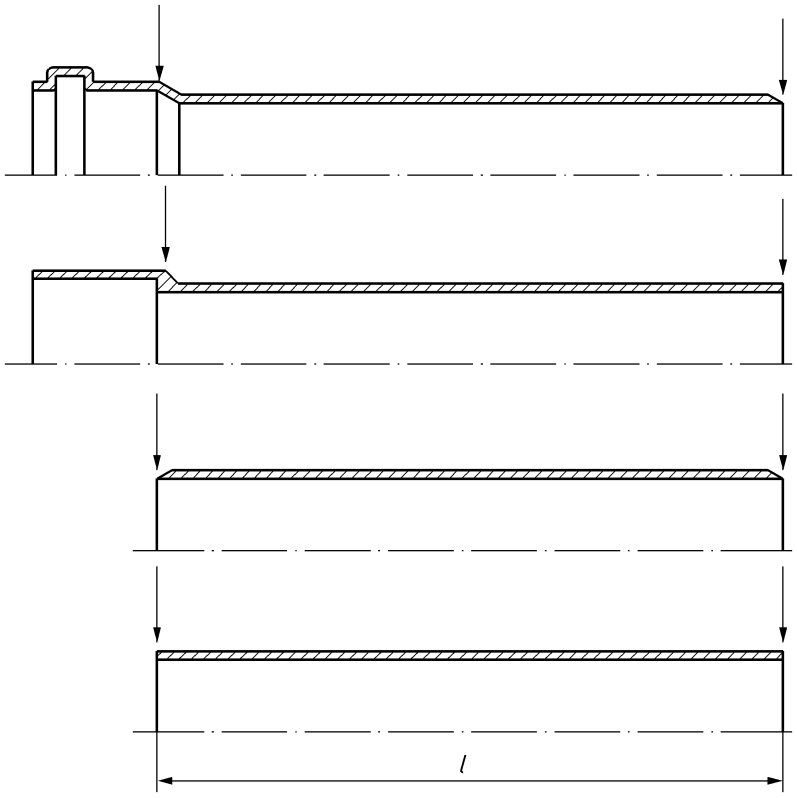


Figure 1 — Effective length of pipes

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 thickness

The wall thickness shall conform to Table 5 or Table 6 respectively, where for metric series a wall thickness at any point up to $1{,}2e_{min}$ is permitted provided that the mean value, e_m, is less than or equal to the specified $e_{m,max}$.

Table 5 — Wall thickness (metric series)

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter	Wall thickness Application area			
		B [a]		BD [b]	
	d_n	e_{min}	$e_{m,max}$	e_{min}	$e_{m,max}$
32	32	3,0	3,5	—	—
40	40	3,0	3,5	—	—
50	50	3,0	3,5	—	—
63	63	3,0	3,5	—	—
75	75	3,0	3,5	3,0	3,5
80	80	3,0	3,5	3,0	3,5
82	82	3,0	3,5	3,0	3,5
90	90	3,0	3,5	3,0	3,5
100	100	3,0	3,5	3,0	3,5
110	110	3,2	3,8	3,2	3,8
125	125	3,2	3,8	3,2	3,8
140	140	3,2	3,8	3,5	4,1
160	160	3,2	3,8	4,0	4,6
180	180	3,6	4,2	4,4	5,0
200	200	3,9	4,5	4,9	5,6
250	250	4,9	5,6	6,2	7,1
315	315	6,2	7,1	7,7	8,7

a This serie results from a SDR 51.

b This serie results from a SDR 41, which is classified SN4.

Table 6 — Wall thickness (series based on inch dimensions)

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter	Wall thickness Application area B	
	d_n	e_{min}	$e_{m,max}$
36	36	3,0	3,5
43	43	3,0	3,5
56	56	3,0	3,5

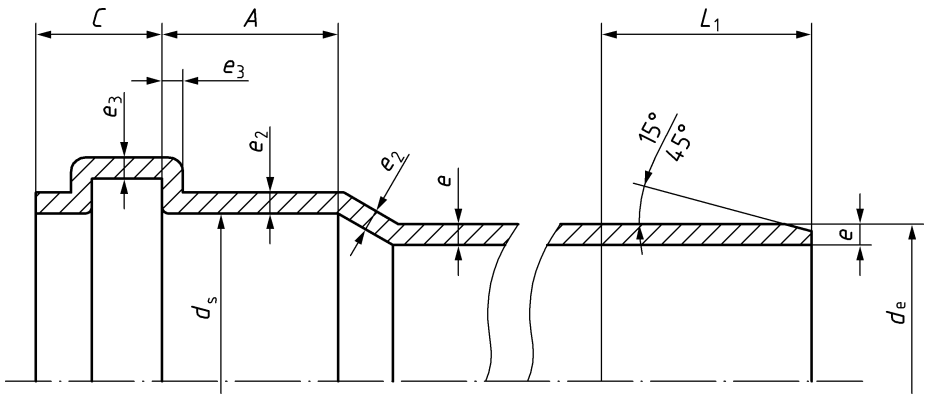
6.2.6 Dimensions of sockets

When applicable, the dimensions of pipes sockets shall comply with the relevant requirements of sockets as specified in 6.4.

6.3 Dimensions of fittings

6.3.1 General

The dimensions of the fittings shall be measured according to Figures 2 and 3 and shall comply with the requirements given in 6.3 and 6.4.



Key

A length of engagement

C depth of sealing zone

d_e outside diameter of a spigot

d_s inside diameter of a socket

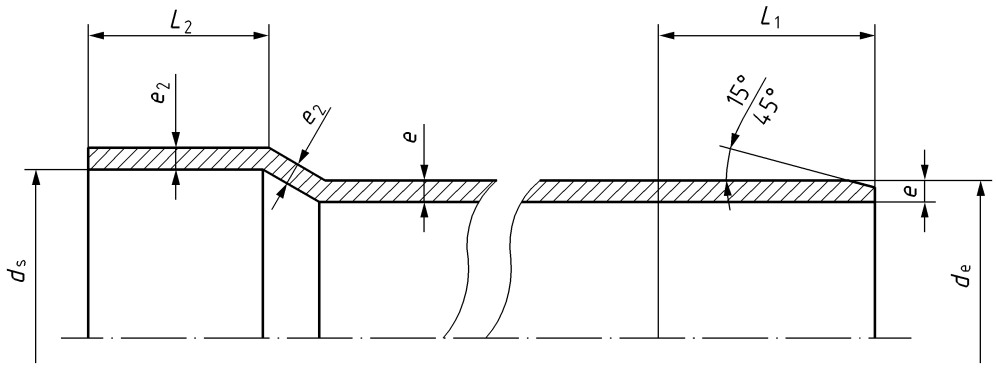
e wall thickness

e_2 wall thickness of socket

e_3 wall thickness at the groove

L_1 length of spigot

Figure 2 — General dimensions of sockets and spigots for elastomeric sealing joints



Key

d_e outside diameter of a spigot

d_s inside diameter of a socket

e wall thickness

e_2 wall thickness of socket

L_1 length of spigot

L_2 length of socket

Figure 3 — Basic dimensions of sockets and spigots for adhesive joints

6.3.2 Outside diameters

The mean outside diameter, d_{em}, of the spigot shall conform to Table 3 or Table 4, as applicable.

6.3.3 Wall thicknesses

6.3.3.1 General

Fittings and those parts of fittings not intended to come into contact with the fluid being conveyed are not required to conform to the wall thickness given in Table 5, Table 6 or Table 7, as applicable.

6.3.3.2 Adhesive joint fittings

For adhesive joint fittings the wall thicknesses, e and e_2 (see Figure 3) shall comply with the requirements given in Table 7 or Table 8, as applicable.

For adhesive joint fittings a reduction of 5 % of the wall thickness resulting from core shifting is permitted. In such case the average of two opposite wall thicknesses shall be equal to, or exceed, the values given in Table 7 or Table 8, as applicable.

Table 7 — Wall thicknesses for adhesive joint fittings (metric series)

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter	Wall thickness Application area		Wall thickness of sockets [a] (e_2 = 0,75e) Application area	
		B	BD	B	BD
	d_n	e_{min}	e_{min}	$e_{2,min}$	$e_{2,min}$
32	32	3,0	—	2,0 [b]	—
40	40	3,0	—	2,0 [b]	—
50	50	3,0	—	2,0 [b]	—
63	63	3,0	—	2,0 [b]	—
75	75	3,0	3,0	2,0 [b]	2,0 [b]
80	80	3,0	3,0	2,3	2,3
82	82	3,0	3,0	2,3	2,3
90	90	3,0	3,0	2,3	2,3
100	100	3,0	3,0	2,3	2,3
110	110	3,2	3,2	2,4	2,4
125	125	3,2	3,2	2,4	2,4
140	140	3,2	3,5	2,4	2,6
160	160	3,2	4,0	2,4	3,0
180	180	3,6	4,4	2,7	3,3
200	200	3,9	4,9	2,9	3,7
250	250	4,9	6,2	3,7	4,7
315	315	6,2	7,7	4,7	5,8

a This requirement is also applicable to the wall thickness of the spigot.

b e_2 = 0,65e. This kind of fittings may only be used in an adhesive joint system and shall be marked accordingly.

Table 8 — Wall thicknesses for adhesive joint fittings (series based on inch dimensions)

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter	Wall thickness [a]	Wall thickness of sockets [a b] (e_2 = 0,75e)
		Application area B	Application area B
	d_n	e_{min}	$e_{2,min}$
36 43 56	36 43 56	3,0 3,0 3,0	2,3 2,3 2,3
a For existing tools the following values for the wall thickness are allowed, provided that the deviating value for the wall thickness, e, is marked on the fitting:			
	d_n	e_{min}	$e_{2,min}$
	36 43 56	2,7 2,7 2,7	2,0 2,0 2,0
b This requirement is also applicable to the wall thickness of the spigot.			

6.3.3.3 Ring seal fittings

For ring seal fittings the wall thicknesses e, e_2 and e_3 (see Figure 2), shall comply with the requirements given in Table 9 or Table 10, as applicable.

For ring seal fittings a reduction of 5 % of the wall thickness resulting from core shifting is permitted. In such case the average of two opposite wall thicknesses shall be equal to, or exceed, the values given in Table 9 or Table 10, as applicable.

Where a sealing ring is located by means of a retaining cap or ring (see Figure 4) 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.

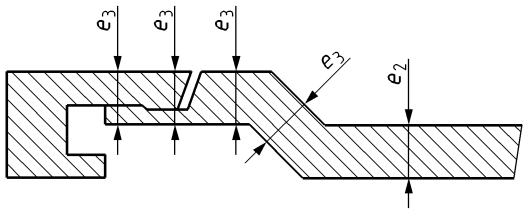


Figure 4 — Example for calculation of the wall thickness of sockets with retaining cap

Table 9 — Wall thicknesses for ring seal fittings including expansion coupling (metric series)

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter	Wall thickness		Wall thickness of sockets ($e_2 = 0{,}9e$)		Wall thickness in the groove area ($e_3 = 0{,}75e$)	
		Application area		Application area		Application area	
	d_n	B e_{min}	BD e_{min}	B $e_{2,min}$	BD $e_{2,min}$	B $e_{3,min}$	BD $e_{3,min}$
32	32	3,0	—	2,7	—	2,3	—
40	40	3,0	—	2,7	—	2,3	—
50	50	3,0	—	2,7	—	2,3	—
63	63	3,0	—	2,7	—	2,3	—
75	75	3,0	3,0	2,7	2,7	2,3	2,3
80	80	3,0	3,0	2,7	2,7	2,3	2,3
82	82	3,0	3,0	2,7	2,7	2,3	2,3
90	90	3,0	3,0	2,7	2,7	2,3	2,3
100	100	3,0	3,0	2,7	2,7	2,3	2,3
110	110	3,2	3,2	2,9	2,9	2,4	2,4
125	125	3,2	3,2	2,9	2,9	2,4	2,4
140	140	3,2	3,5	2,9	3,1	2,4	2,6
160	160	3,2	4,0	2,9	3,6	2,4	3,0
180	180	3,6	4,4	3,2	4,0	2,7	3,3
200	200	3,9	4,9	3,5	4,4	2,9	3,7
250	250	4,9	6,2	4,5	5,6	3,7	4,7
315	315	6,2	7,7	5,6	6,9	4,7	5,8

Table 10 — Wall thicknesses for expansion coupling (series based on inch dimensions)

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter	Wall thickness [a]	Wall thickness of sockets [a] ($e_2 = 0{,}9e$)	Wall thickness in the groove area [a] ($e_3 = 0{,}75e$)
		Application area	Application area	Application area
	d_n	B e_{min}	B $e_{2,min}$	B $e_{3,min}$
36	36	3,0	2,7	2,2
43	43	3,0	2,7	2,2
56	56	3,0	2,7	2,2

[a] For existing tools the following values for the wall thickness are allowed, provided that the deviating value for the wall thickness, e, is marked on the fitting:

d_n	e_{min}	$e_{2,min}$	$e_{3,min}$
36	2,7	2,4	2,0
43	2,7	2,4	2,0
56	2,7	2,4	2,0

6.3.4 Types of fittings

This standard is applicable to the following types of fittings. Other types and/or designs of fittings (e.g. plugs, access fittings, etc.) are permitted.

a) bends (see Figures 5, 6, 7 or 8)

   1) unswept or swept angle (see ISO 265-1 [18]);

   2) spigot/socket and socket/socket;

   the nominal angle, α, shall be selected from the following: 15°, 22°30′, 30°, 45°, 67°30′, 80°, or 87°30′ to 90°;

b) couplers (see Figure 9).

c) reducers (see Figure 10).

d) branches and reducing branches (single or multiple) (see for example Figures 11, 12, 13, or 14):

   1) unswept or swept angle (see ISO 265-1 [18]);

   2) spigot/socket and socket/socket;

   the nominal angle, α, shall be selected from the following: 45°, 67°30′, 87°30′ to 90°.

If other nominal angles are required they shall be agreed between manufacturer and purchaser and be identified accordingly.

6.3.5 Design lengths

The design length(s) [*Z*-length(s)] of fittings (see Figures 5 to 8 and Figures 10 to 14) 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 [18] can be used as a guideline.

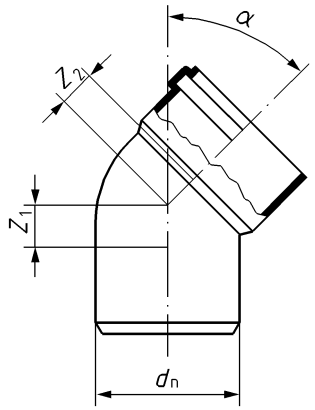


Figure 5 — Bend with single socket (unswept)

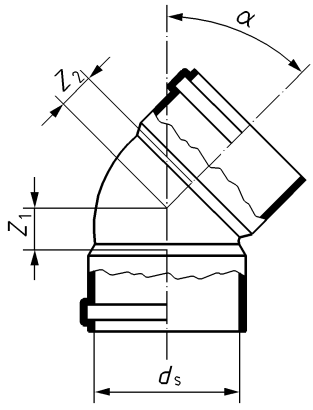


Figure 6 — Bend with all sockets (unswept)

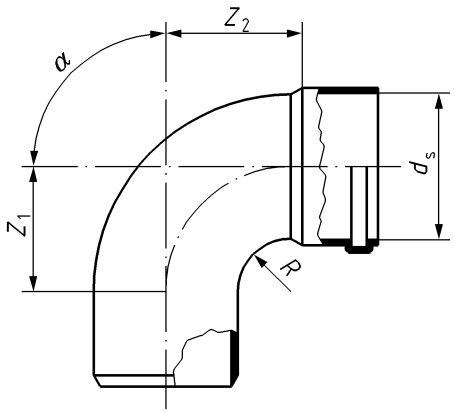


Figure 7 — Bend with single socket (swept)

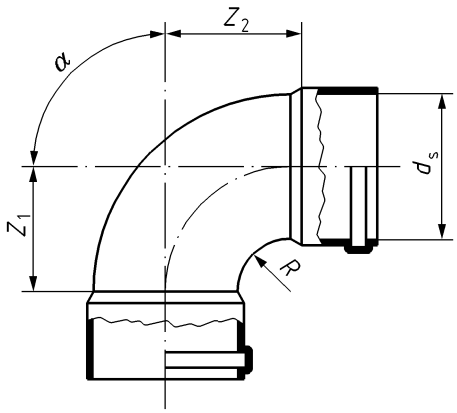


Figure 8 — Bend with all sockets (swept)

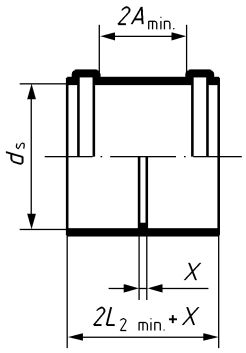


Figure 9 — Coupler

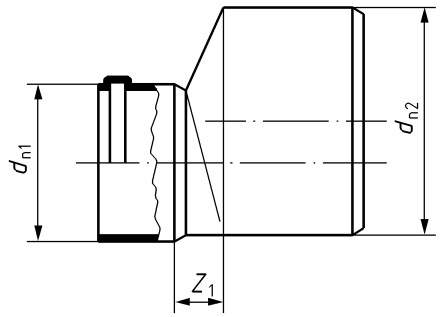


Figure 10 — Reducer

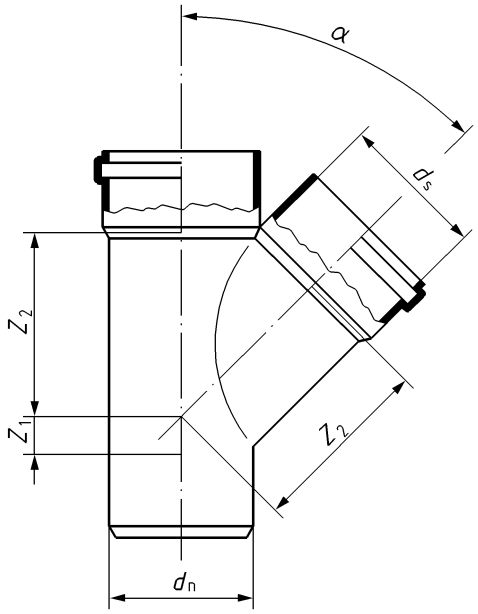


Figure 11 — Branch with single socket (unswept)

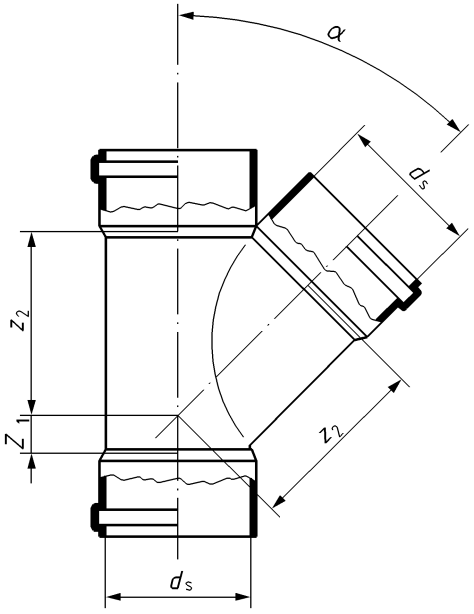


Figure 12 — Branch with all sockets (unswept)

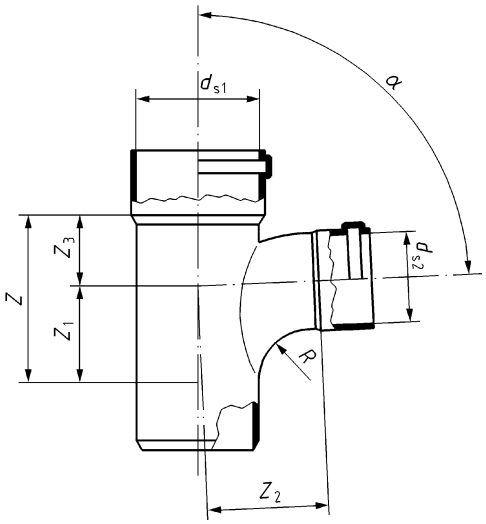


Figure 13 — Reducing branch with single socket (swept)

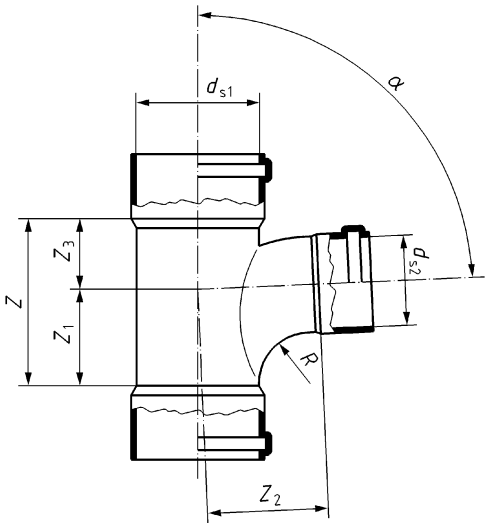


Figure 14 — Reducing branch with all sockets (swept)

6.4 Diameters and lengths of sockets and spigot

6.4.1 Adhesive joint sockets and spigot

The diameters and lengths of adhesive joint sockets and spigot shall conform to Table 11 or Table 12, as applicable (see Figure 3).

Table 11 — Diameters and lengths of adhesive joint sockets and spigots (metric series)

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter	Mean outside diameter of spigot		Mean inside diameter of socket[a]		Length of socket and spigot [b]
	d_n	$d_{em,min}$	$d_{em,max}$	$d_{sm,min}$	$d_{sm,max}$	$L_{2,min}$ *and* $L_{1,min}$
32	32	32,0	32,2	32,1	32,4	22
40	40	40,0	40,2	40,1	40,4	26
50	50	50,0	50,2	50,1	50,4	30
63	63	63,0	63,2	63,1	63,4	36
75	75	75,0	75,3	75,2	75,5	40
80	80	80,0	80,3	80,2	80,5	42
82	82	82,0	82,3	82,2	82,5	43
90	90	90,0	90,3	90,2	90,5	46
100	100	100,0	100,3	100,2	100,5	46
110	110	110,0	110,3	110,2	110,6	48
125	125	125,0	125,3	125,2	125,7	51
140	140	140,0	140,4	140,3	140,8	54
160	160	160,0	160,4	160,3	160,8	58
180	180	180,0	180,4	180,3	180,8	60
200	200	200,0	200,5	200,4	200,9	60
250	250	250,0	250,5	250,4	250,9	60
315	315	315,0	315,6	315,5	316,0	60

[a] The manufacturer shall state whether the fittings are designed with a tapered or parallel socket. If they are tapered, then the minimum and maximum values given for d_{sm} shall apply at the mid mean point of the socket with a maximum taper angle of 0°30′ per side. Otherwise these values for d_{sm} shall apply over the entire length of the socket

[b] For joints intended for fabrication within a workshop L_2-values may be reduced to the C_{max} values (see Table 13).

Table 12 — Diameters and lengths of adhesive joint sockets and spigot (series based on inch dimensions)

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter	Mean outside diameter of spigot		Mean inside diameter of socket		Length of socket and spigot
	d_n	$d_{em,min}$	$d_{em,max}$	$d_{sm,min}$	$d_{sm,max}$	$L_{2,min}$ and $L_{1,min}$
36	36	36,1	36,5	36,1	36,7	18
43	43	42,7	43,1	42,7	43,3	21
56	56	55,7	56,1	55,7	56,3	27

Tolerances apply to the complete length of the socket. If a taper is incorporated, it shall not exceed 0°30′.

6.4.2 Ring seal sockets and spigot

The diameters and lengths of ring seal sockets and spigots type S I (short type system I), type S II (short type system II) and type M (medium type) shall conform to Tables 13 to 15, as applicable (see Figure 2).

An example of designs for grooves for elastomeric ring seal sockets is given in Figure 15. Other designs are permitted.

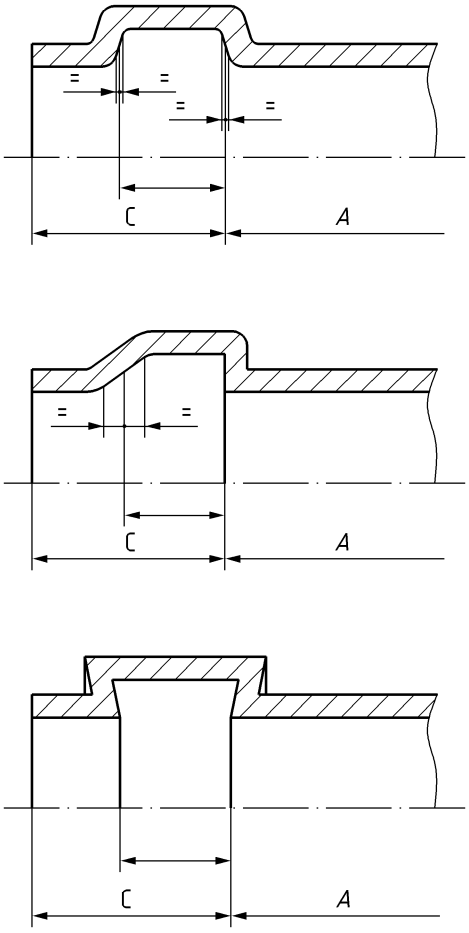


Figure 15 — Typical groove designs for elastomeric ring seal sockets

Where sealing rings are firmly retained, the minimum value for A and the maximum value for C (see Figure 15) shall be measured to the effective sealing point (see Figure 16) as specified by the manufacturer and, if applicable, in agreement with a certification body.

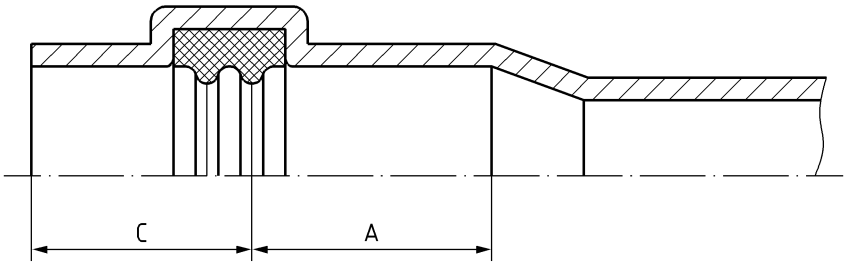


Figure 16 — Example for measuring the effective sealing point

Table 13 — Diameters and lengths of ring seal sockets and spigot type S I (short type, system I) for application area B

Dimensions in millimetres

Nominal size	Mean outside diameter of spigot		Mean inside diameter of socket	Lengths of socket and spigot		
DN/OD	$d_{em,min}$	$d_{em,max}$	$d_{sm,min}$	A_{min}	C_{max}	$L_{1,min}$
32	32,0	32,2	32,3	16	18	34
40	40,0	40,2	40,3	18	18	36
50	50,0	50,2	50,3	20	18	37
63	63,0	63,2	63,3	22	20	37
75	75,0	75,3	75,4	25	20	43
80	80,0	80,3	80,4	26	21	44
82	82,0	82,3	82,4	26	21	44
90	90,0	90,3	90,4	28	22	46
100	100,0	100,3	100,4	30	22	46
110	110,0	110,3	110,4	32	26	54
125	125,0	125,3	125,4	35	26	60
140	140,0	140,4	140,5	38	26	60
160	160,0	160,4	160,5	42	32	60
180	180,0	180,4	180,5	46	36	60
200	200,0	200,5	200,6	50	40	60

Table 14 — Diameters and lengths of ring seal sockets and spigot type S II (short type, system II) for application areas B and BD

Dimensions in millimetres

Nominal size	Mean outside diameter of spigot		Mean inside diameter of socket	Lengths of socket and spigot		
DN/OD	$d_{em,min}$	$d_{em,max}$	$d_{sm,min}$	A_{min}	C_{max}	$L_{1,min}$
32	32,0	32,2	32,3	16	18	42
40	40,0	40,2	40,3	18	18	44
50	50,0	50,2	50,3	20	18	46
63	63,0	63,2	63,3	22	20	49
75	75,0	75,3	75,4	25	20	51
80	80,0	80,3	80,4	26	21	52
82	82,0	82,3	82,4	26	21	52
90	90,0	90,3	90,4	28	22	56
100	100,0	100,3	100,4	30	22	56
110	110,0	110,3	110,4	32	26	60
125	125,0	125,3	125,4	35	26	67
140	140,0	140,4	140,5	38	26	70
160	160,0	160,4	160,5	42	32	81
180	180,0	180,4	180,5	46	36	90
200	200,0	200,5	200,6	50	40	99
250	250,0	250,5	250,8	55	70	125
315	315,0	315,6	316,0	62	70	132

Table 15 — Diameters and lengths of ring seal sockets and spigot type M (medium type) for application areas B and BD

Dimensions in millimetres

Nominal size	Mean outside diameter of spigot		Mean inside diameter of socket	Lengths of socket and spigot		
DN/OD	$d_{em,min}$	$d_{em,max}$	$d_{sm,min}$	A_{min}	C_{max}	$L_{1,min}$
32	32,0	32,2	32,3	24	18	42
40	40,0	40,2	40,3	26	18	44
50	50,0	50,2	50,3	28	18	46
63	63,0	63,2	63,3	31	20	49
75	75,0	75,3	75,4	33	20	51
80	80,0	80,3	80,4	34	21	52
82	82,0	82,3	82,4	34	21	52
90	90,0	90,3	90,4	36	22	56
100	100,0	100,3	100,4	38	22	56
110	110,0	110,3	110,4	40	26	60
125	125,0	125,3	125,4	43	26	67
140	140,0	140,4	140,5	46	26	70
160	160,0	160,4	160,5	50	32	81
180	180,0	180,4	180,5	54	36	90
200	200,0	200,5	200,6	58	40	99

6.4.3 One-piece expansion couplings for adhesive joint sockets and spigot

The diameters and lengths of one-piece expansion couplings shall conform to Table 16 (type M, medium type) or Table 17 (type L, long type), as applicable.

Table 16 — Diameters and lengths for one-piece expansion coupling type M (medium type) for adhesive joint sockets and spigot for application area B (series based on inch dimensions)

Dimensions in millimetres

Nominal size	Mean outside diameter of spigot		Mean inside diameter of socket	Lengths of socket and spigot	
DN/OD	$d_{em,min}$	$d_{em,max}$	$d_{sm,min}$	A_{min}	$L_{1,min}$
36	36,2	36,5	36,6	25	37
43	42,8	43,1	43,2	25	40
56	55,8	56,1	56,2	25	43

Table 17 — Diameters and lengths for one-piece expansion coupling type L (long type) for adhesive joint sockets and spigot for application area B (metric series)

Dimensions in millimetres

Nominal size	Mean outside diameter of spigot		Mean inside diameter of socket	Lengths of socket and spigot	
DN/OD	$d_{em,min}$	$d_{em,max}$	$d_{sm,min}$	A_{min}	$L_{1,min}$
32	32,0	32,2	32,3	65	22
40	40,0	40,2	40,3	65	26
50	50,0	50,2	50,3	65	31
63	63,0	63,2	63,3	65	37
75	75,0	75,3	75,4	65	43
80	80,0	80,3	80,4	65	44
82	82,0	82,3	82,4	65	46
90	90,0	90,3	90,4	65	46
100	100,0	100,3	100,4	65	54
110	110,0	110,3	110,4	65	60
125	125,0	125,3	125,4	65	60
140	140,0	140,4	140,5	65	60
160	160,0	160,4	160,5	65	60
180	180,0	180,4	180,5	65	60
200	200,0	200,5	200,6	65	60

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 18, using the indicated parameters, the pipe shall have mechanical characteristics conforming to one of the requirements given in Table 18.

Table 18 — Mechanical characteristics of pipes

Characteristics	Requirements	Test parameters		Test method
Impact resistance (Round-the-clock method)	TIR ≤ 10 %	Type of striker for: d_n < 110 mm d_n ≥ 110 mm Mass of striker Fall height of striker Conditioning medium Conditioning and test temperature [a]	 d25 d90 see Table 19 or Table 20, as applicable see Table 19 or Table 20, as applicable water or air 0 °C	ISO 3127
Impact resistance (Stair-case method) [b]	H 50 ≥ 1 m max. 1 break below 0,5 m	Conditioning and test temperature Mass of striker for: 32 mm ≤ d_n ≤ 43 mm 50 mm ≤ d_n ≤ 63 mm 75 mm ≤ d_n ≤ 82 mm 90 mm ≤ d_n ≤ 100 mm d_n = 110 mm d_n = 125 mm d_n = 140 mm d_n = 160 mm d_n = 180 mm d_n = 200 mm d_n ≥ 250 mm	0 °C 1,25 kg 2,00 kg 2,50 kg 3,20 kg 4,00 kg 5,00 kg 6,30 kg 8,00 kg 8,00 kg 10,00 kg 12,50 kg	ISO 11173

[a] If a manufacturer chooses to use indirect testing (see CEN/TS 1329–2 [9]), the preferred temperature is (23 ± 2) °C.

[b] Test only applicable according to 7.1.2. For d_n ≥ 110 mm and for BD applications, conditioning and test temperature shall be −10°C.

Table 19 — Fall heights and masses for impact strength (metric series)

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter d_n	Mass of striker kg	Fall height of striker
32	32	0,5	600
40	40	0,5	800
50	50	0,5	1 000
63	63	0,8	1 000
75	75	0,8	1 000
80	80	0,8	1 000
82	82	0,8	1 000
90	90	0,8	1 200
100	100	0,8	1 200
110	110	1,0	1 600
125	125	1,25	2 000
140	140	1,6	1 800
160	160	1,6	2 000
180	180	2,0	1 800
200	200	2,0	2 000
250	250	2,5	2 000
315	315	3,2	2 000

Table 20 — Fall heights and masses for impact strength (series based on inch dimensions)

Nominal size DN/OD	Nominal outside diameter d_n	Mass of striker kg	Fall height of striker
36	36	0,5	600
43	43	0,5	800
56	56	0,5	1 000

7.1.2 Additional requirements

Pipes intended to be used in areas where installation is usually carried out at temperature below −10 °C, may be required, in the national foreword, to conform to the requirements of an impact test (stair-case-method) as specified in Table 18, and shall be marked accordingly with the symbol of an ice crystal in accordance with 12.2.

7.2 Mechanical characteristics of fittings

For application area BD, the fittings shall comply with the requirements given in EN 1401-1:2009, 7.2. Assembled fittings are not submitted to this requirement.

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.

Fittings intended to be used in application area BD shall have a nominal stiffness not less than SN 4.

8 Physical characteristics

8.1 Physical characteristics of pipes

When tested in accordance with the test method as specified in Table 21 using the indicated parameters, the pipe shall have physical characteristics conforming to the requirements given in Table 21.

Table 21 — Physical characteristics of pipes

Characteristic	Requirements	Test parameters		Test method
Vicat softening temperature (VST)	≥ 79 °C	Shall conform to ISO 2507-1		ISO 2507-1
Longitudinal reversion [a]	≤ 5 % The pipe shall exhibit no bubbles or cracks	Temperature Immersion time	150 °C 15 min	EN ISO 2505: liquid
		Or		
		Temperature Immersion time	150 °C 30 min	EN ISO 2505: air
Resistance to dichloro-methane at a specific temperature [b] (Degree of gelation)	No attack [c]	Temperature of bath Immersion time	(15 ± 1) °C 30 min	ISO 9852
Uniaxial tensile test [b] (Alternative test method to degree of gelation)	Maximum stress ≥ 45 MPa Strain at break ≥ 80 %	Test speed Test temperature	5 ± 1 mm/min (23 ± 2) °C	EN ISO 6259-1 and ISO 6259-2
DSC [d] (Alternative test method to degree of gelation)	B-onset temperature ≥ 185 °C	Shall conform to ISO 18373-1	Number of test pieces: 4	ISO 18373-1

[a] In case of dispute, method “liquid bath” shall be used.

[b] Alternative test methods to be chosen by the producer for factory production control, taking in account National regulation or internal health and safety policy.

[c] Isolated spots less than 2 mm shall not be considered as an attack.

[d] In case of dispute, the DSC method shall be used. This test is not intended to be used for factory production. control

8.2 Physical characteristics of fittings

When tested in accordance with the test method as specified in Table 22 or Table 23 using the indicated parameters, the fitting shall have physical characteristics conforming to the requirements given in Table 22 or Table 23.

Table 22 — Physical characteristics of fittings

Characteristic	Requirements	Test parameters		Test method
Vicat softening temperature (VST)	≥ 79 °C	Shall conform to ISO 2507-1		ISO 2507-1
Effects of heating	a and b	Temperature Heating time	150 °C 30 min	EN ISO 580: air
a 1) Within a radius of 15 times the wall thickness around the injection point, 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 of the wall thickness. b After cutting through the fitting, the cut surfaces shall show no foreign particles, when viewed without magnification.				

Table 23 — Physical characteristics of fabricated fittings

Characteristic	Requirements	Test parameters		Test method
Watertightness a	No leakage	Water pressure Duration	0,5 bar 1 min	ISO 13254
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 method as specified in Table 24 using the indicated parameters, the joints and the system shall have characteristics conforming to the requirements given in Table 24.

Table 24 — Fitness for purpose requirements of the system

Characteristic	Requirements	Test parameters		Test method
Watertightness	No leakage	Shall conform to ISO 13254		ISO 13254
Airtightness	No leakage	Shall conform to ISO 13255		ISO 13255
Elevated temperature cycling [a]	No leakage Sagging for: DN ≤ 50: ≤ 3 mm DN > 50: ≤ 0,05d_n	Shall conform to ISO 13257		Test assembly a) (Figure 1 and/or 3 of ISO 13257:2010) in accordance with ISO 13257
Elevated temperature cycling [b]	No leakage Sagging for: DN ≤ 50: ≤ 3 mm DN > 50: ≤ 0,05d_n	Shall conform to ISO 13257		Test assembly b) (Figure 2 of ISO 13257:2010) in accordance with ISO 13257
Tightness of elastomeric sealing ring joints [b]		Test Temperature Spigot deflection Socket deflection Difference	(23 ± 5) °C ≥ 10 % ≥ 5 % ≥ 5 %	ISO 13259, condition B
	No leakage	Water pressure	0,05 bar	
	No leakage	Water pressure	0,5 bar	
	≤ −0,27 bar	Air pressure	−0,3 bar	
		Test temperature Angular deflection d_n ≤ 315 mm	(23 ± 5) °C 2°	ISO 13259, condition C
	No leakage	Water pressure	0,05 bar	
	No leakage	Water pressure	0,5 bar	
	≤ −0,27 bar	Air pressure	−0,3 bar	

[a] For application area B.

[b] For application area BD.

10 Sealing rings

The sealing ring shall have no detrimental effect on the properties of the pipe and of the fittings and shall not cause the test assembly to fail to conform to Table 24.

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

11 Adhesives

The adhesive shall have no detrimental effects on the properties of the pipe and of the fittings and shall not cause the test assembly to fail to conform to Table 24.

The adhesive shall comply with EN 14680.

As an alternative, adhesive complying with EN 14814 are deemed to be suitable for B and BD applications.

12 Marking

12.1 General

Marking elements shall be labelled or printed or formed directly on the pipe or the fitting, in such a way that after storage, weathering and handling, and installation, legibility is maintained in accordance with one of the following levels.

One of the following two levels of legibility of the marking is specified for the individual marking aspect in the column “Minimum durability of legibility of marking” in Table 25 and Table 26.

The symbols for the legibility mean the following:

— 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 use of detergents etc. on the components unless agreed or specified by the manufacturer.

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 6.3.3.

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

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

12.2 Minimum required marking of pipes

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

The minimum required marking shall conform to Table 25.

Table 25 — Minimum required marking on pipes

Aspects	Marking or symbol	Minimum durability of legibility of marking
− Number of this standard	EN 1329	A
− Manufacturer’s name and/or trade mark	XXX	A
− Nominal diameter	e.g. 110	A
− Minimum wall thickness	e.g. 3,2	A
− Material	PVC or PVC-U	A
− Application area code	e.g. BD	A
− For application area BD: nominal ring stiffness	e.g. SN 4	A
− Manufacturer’s information	a	A
− Cold climate performance [b]	❄ (ice crystal)	A

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 proved to conform to 7.1.2.

12.3 Minimum required marking of fittings

The minimum required marking shall conform to Table 26.

Table 26 — Minimum required marking of fittings

Aspects	Marking or symbol	Minimum durability of legibility of marking
On the fitting: − Number of this standard − Manufacturer's name and/or trade mark − Nominal diameter − Nominal angle − Material − Application area code − For application area BD: nominal ring stiffness	EN 1329 XXX e.g. 110 e.g. 67°30′ PVC or PVC-U e.g. BD e.g. SN 4	B A A B A A A
On the fitting or on the packaging: − Manufacturer's information − Adhesive joint only − Socket type for sealing ring	a [appropriate text or symbol] S or M or L	B B 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

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

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)

Utilization of non-virgin material

NOTE For the purpose of this annex, the term “pipe” means extruded pipe and any part of a fabricated fitting which is made from an extruded part. The term “fitting” means injection-moulded fitting and injection-moulded part of a fabricated fitting.

A.1 Own reprocessed material

The use of clean own reprocessed 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 recycled material.

A.2 External reprocessed and recycled materials with agreed specifications

A.2.1 Material from PVC-U pipes and fitting

External reprocessed and recycled 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 reprocessed material or a mixture of those two materials for the production of pipes provided that all of the following conditions are met.

a) A specification for each material shall be agreed between the supplier of external reprocessed or recycled 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.

NOTE For the purposes of A.2.1, 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 [17]: it is not essential for the manufacturer to be approved and registered for operation in accordance with EN ISO 9001 [17].

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 ISO 13229
Density [a]	±20 kg/m^3	EN ISO 1183-1
Vicat softening temperature (VST) [a]	±2 °C	ISO 2507-1
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 recognized quality mark or a European quality mark, it is not required to test this material characteristic if the requirement covered by the quality mark conforms to the requirement given in this table.

[b] The relevant requirements and test method are depending on the recycling process and on the end product.

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

c) The maximum quantity of external reprocessed and recycled material that is intended to be added shall be specified by the pipe or fitting manufacturer may be up to 100 %.

d) The quantity of external reprocessed and recycled 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 of and with each form of external reprocessed or recycled material with an agreed specification.

Approved results shall be taken as proving conformity also of components containing lower levels of additions of external reprocessed or recycled material.

A.2.2 Material from PVC-U products other than pipes and fittings

External reprocessed and recycled 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 reprocessed material or a mixture of those two materials for the production of pipes and fittings provided that all of the following conditions are met.

a) The material shall conform to all of the conditions given in a) to f) inclusive, of A.2.1, and to all of the additional characteristics and requirements given in Table A.2.

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

Characteristic	Requirements	Test method
PVC-content	≥ 80 %	EN 1905
K-value	56 ≤ K-value ≤ 70	EN ISO 13229
Density	1 390 kg/m^3 ≤ density ≤ 1 500 kg/m^3	EN ISO 1183-1
Vicat softening temperature (VST)	≥ 62 °C	ISO 2507-1
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 reprocessed and recycled material shall depend on the difference in K-value of the virgin material and the reprocessed and recycled material as follows:

   1) if the difference in K-value, when determined in accordance with EN ISO 13229, 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 reprocessed and recycled 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.2.3 Reformulated material

The use of reformulated material shall follow the guidelines for recycled material with agreed specification as specified in A.2.1 and A.2.2.

A.3 External reprocessed and recycled material not covered by an agreed specification

A.3.1 Material from PVC-U pipes and fittings

External reprocessed and recycled 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 reprocessed material or a mixture of those two materials for the production of pipes provided that all of 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 reprocessed and recycled material shall depend on the difference in K-value of the virgin material and the reprocessed and recycled material as follows:

   1) if the difference in K-value, when determined in accordance with EN ISO 13229, 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 reprocessed and recycled material that is actually added in each production series shall be recorded by the pipe manufacturer.

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

External reprocessed and recycled 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.4 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 reprocessed material	**External reprocessed and recycled material with agreed specification**		**External reprocessed and recycled 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)

Product standards

EN 1451 (all parts), *Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure — Polypropylene (PP)*

EN 1453 (all parts), *Plastics piping systems with structured wall-pipes for soil and waste discharge (low and high temperature) inside buildings — Unplasticized poly(vinyl chloride) (PVC-U)*

EN 1455 (all parts), *Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure — Acrylonitrile-butadiene-styrene (ABS)*

EN 1519 (all parts), *Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure — Polyethylene (PE)*

EN 1565 (all parts), *Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure — Styrene copolymer blends (SAN+PVC)*

EN 1566 (all parts), *Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure — Chlorinated poly(vinyl chloride) (PVC-C)*

Annex C
(informative)

Correspondence between ISO test methods and CEN test methods

Table C.1 — Table of correspondence between ISO test methods and CEN test methods

ISO test method	Corresponding CEN test method
ISO 2507-1, *Thermoplastics pipes and fittings — Vicat softening temperatures — Part 1: General test method*	EN 727, *Plastics piping and ducting systems — Thermoplastics pipes and fittings — Determination of Vicat softening temperature (VST)*
ISO 3127, *Thermoplastics pipes — Determination of resistance to external blows — Round-the-clock method*	EN 744, *Plastics piping and ducting systems — Thermoplastics pipes — Test method for resistance to external blows by the round-the-clock method*
ISO 9852, *Unplasticized poly(vinyl chloride) (PVC-U) pipes — Dichloromethane resistance at specified temperature (DCMT) — Test method*	EN 580, *Plastics piping systems — Unplasticized poly(vinyl chloride) (PVC-U) pipes — Test method for the resistance to dichloromethane at a specified temperature (DCMT)*
ISO 11173, *Thermoplastics pipes — Determination of resistance to external blows — Staircase method*	EN 1411, *Plastics piping and ducting systems — Thermoplastics pipes — Determination of resistance to external blows by the staircase method*
ISO 13229, *Thermoplastics piping systems for non-pressure applications — Unplasticized poly(vinyl chloride) (PVC-U) pipes and fittings — Determination of the viscosity number and K-value*	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*
ISO 13254, *Thermoplastics piping systems for non-pressure applications — Test method for watertightness*	EN 1053, *Plastics piping systems — Thermoplastics piping systems for non-pressure applications — Test methods for watertightness*
ISO 13255, *Thermoplastics piping systems for soil and waste discharge inside buildings — Test method for airtightness of joints*	EN 1054, *Plastics piping systems — Thermoplastics piping systems for soil and waste discharge — Test methods for airtightness of joints*
ISO 13257, *Thermoplastics piping systems for non-pressure applications — Test method for resistance to elevated temperature cycling*	EN 1055, *Plastics piping systems — Thermoplastics piping systems for soil and waste discharge inside buildings — Test methods for resistance to elevated temperature cycling*
ISO 13259, *Thermoplastics piping systems for underground non-pressure applications — Test method for leaktightness of elastomeric sealing ring type joints*	EN 1277, *Plastics piping systems — Thermoplastics piping systems for buried non-pressure applications — Test methods for leaktightness of elastomeric sealing ring type joints*

Bibliography

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

[2] EN 727, *Plastics piping and ducting systems - Thermoplastics pipes and fittings - Determination of Vicat softening temperature (VST)*

[3] EN 744, *Plastics piping and ducting systems - Thermoplastics pipes - Test method for resistance to external blows by the round-the-clock method*

[4] 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*

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

[6] EN 1054, *Plastics piping systems - Thermoplastics piping systems for soil and waste discharge - Test method for airtightness of joints*

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

[8] EN 1277, *Plastics piping systems - Thermoplastics piping systems for buried non-pressure applications - Test methods for leaktightness of elastomeric sealing ring type joints*

[9] CEN/TS 1329-2, *Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure - Unplasticized poly(vinyl chloride) (PVC-U) - Part 2: Guidance for the assessment of conformity*

[10] EN 1411, *Plastics piping and ducting systems - Thermoplastics pipes - Determination of resistance to external blows by the staircase method*

[11] EN 1451 (all parts), *Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure - Polypropylene (PP)*

[12] EN 1453 (all parts), *Plastics piping systems with structured wall-pipes for soil and waste discharge (low and high temperature) inside buildings - Unplasticized poly(vinyl chloride) (PVC-U)*

[13] EN 1455 (all parts), *Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure - Acrylonitrile-butadiene-styrene (ABS)*

[14] EN 1519 (all parts), *Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure - Polyethylene (PE)*

[15] EN 1565 (all parts), *Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure - Styrene copolymer blends (SAN+PVC)*

[16] EN 1566 (all parts), *Plastics piping systems for soil and waste discharge (low and high temperature) within the building structureChlorinated poly(vinyl chloride) (PVC-C)*

[17] EN ISO 9001, *Quality management systems - Requirements (ISO 9001)*

[18] 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)*

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