BS EN 1453-1:2017

BSI Standards Publication

Plastics piping systems with structured-wall pipes for soil and waste discharge (low and high temperature) inside buildings - Unplasticized poly(vinyl chloride) (PVC-U) -

Part 1: Specifications for pipes and the system

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National foreword

This British Standard is the UK implementation of EN 1453-1:2017. It supersedes BS EN 1453-1:2000 which is withdrawn.

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

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

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Published by BSI Standards Limited 2017

ISBN 978 0 580 87651 6

ICS 23.040.01; 23.040.05; 91.140.80

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

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 January 2017.

Amendments/corrigenda issued since publication

Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 1453-1

January 2017

ICS 23.040.01; 23.040.05; 91.140.80

Supersedes EN 1453-1:2000

English Version

Plastics piping systems with structured-wall pipes for soil and waste discharge (low and high temperature) inside buildings - Unplasticized poly(vinyl chloride) (PVC-U) - Part 1: Specifications for pipes and the system

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

Kunststoff-Rohrleitungssysteme mit Rohren mit profilierter Wandung zum Ableiten von Abwasser (niedriger und hoher Temperatur) innerhalb von Gebäuden - Weichmacherfreies Polyvinylchlorid (PVC-U) - Teil 1: Anforderungen an Rohre und das Rohrleitungssystem

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Ref. No. EN 1453-1:2017 E

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European foreword

This document (EN 1453-1:2017) has been prepared by Technical Committee CEN/TC 155 "Plastics piping systems and ducting systems", the secretariat of which is held by NEN.

This document supersedes EN 1453-1:2000.

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 July 2017, and conflicting national standards shall be withdrawn at the latest by July 2017.

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

This standard is a part of a System Standard for plastics piping systems of a particular material for a specified application. There are a number of such System Standards.

System Standards are based on the results of the work 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 1453 consists of the following parts, under the general title *Plastics piping systems with structured-wall pipes for soil and waste discharge (low and high temperature) inside building — Unplasticized poly(vinyl chloride) (PVC-U)* [1)]:

— *Part 1: Requirements for pipes and the system* (the present standard)

— *Part 2: Guidance for the assessment of conformity* (under preparation)

According to the CEN-CENELEC Internal Regulations, the national standards organisations 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, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1) EN 1453 does not cover a recommended practice for installation. A recommended practice for installation is covered by the following European Technical Report: CEN/TR 13801, *Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure — Thermoplastics — Recommended practice for installation*.

1 Scope

This part of EN 1453 specifies the requirements for structured-wall unplasticized poly(vinyl chloride) (PVC-U) pipes and the system intended to be used for soil and waste discharge applications (low and high temperature) inside buildings (application area code "B")

NOTE 1 The intended use is reflected in the marking of products by "B".

This part of EN 1453 is also applicable to structured-wall unplasticized poly(vinyl chloride) (PVC-U) pipes, and the system intended for the following purposes:

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

— rainwater pipework inside building.

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

NOTE 2 Single layer foamed PVC-U pipes and spirally-formed PVC-U pipes are not covered by this standard.

This standard covers a range of nominal sizes 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 climatic conditions should be agreed between the manufacturer and the user.

NOTE 4 Pipes conforming to this standard are normally associated with fittings conforming to EN 1329–1 [1]. Pipes, fittings and components conforming to any of the product standards listed in Annex C can also be used with pipes conforming to this standard, provided they conform to the requirements for joint dimensions given in Clause 6 and to the requirements in Table 11.

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

NOTE 6 Products conforming to this standard may be submitted to national requirements on fire regulation.

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 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 thermoplastics piping systems - Specifications*

EN 15346:2014, *Plastics - Recycled plastics - Characterization of poly(vinyl chloride) (PVC) recyclates*

EN ISO 306, *Plastics - Thermoplastic materials - Determination of Vicat softening temperature (VST) (ISO 306:2013)*

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

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

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 3451-5, *Plastics - Determination of ash - Part 5: Poly(vinyl chloride) (ISO 3451-5)*

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 11173:1994, *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 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

Note 1 to entry: Other application area codes D, BD, U and UD not covered by this standard are defined elsewhere, e.g. in EN 1329–1 [1] and EN 1401–1 [2].

3.1.2
structured-wall pipe
pipe with smooth internal and smooth external surfaces, with two solid PVC layers, or in which the inner and outer solid PVC layers are connected by foamed or non-foamed PVC intermediate layers

Note 1 to entry: Pipe in which the inner and outer solid PVC layers are connected by foamed PVC intermediate layers is also called foam core pipe.

3.1.3
solid layer
layer made of non-foamed PVC

3.1.4
foamed PVC
poly(vinyl chloride) which contains numerous small gas cells distributed throughout the mass

Note 1 to entry: Foam layers have a density less than 1,37 g/cm^3 when measured according to EN ISO 1183-1.

3.1.5
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

3.1.6
nominal size
DN/OD
nominal size, related to the outside diameter

3.1.7
nominal outside diameter
d_n
specified outside diameter, in millimetres, assigned to a nominal size DN/OD

3.1.8
outside diameter
d_e
value of the measurement of the outside diameter through its cross-section at any point of a pipe or spigot end of a fitting, rounded up to the next greater 0,1 mm

3.1.9
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 (≈ 3,142), rounded up to the next greater 0,1 mm

3.1.10
inside diameter of a socket
d_s
value of measurement of the inside diameter through its cross-section at any point of a socket, rounded up to the next greater 0,1 mm

3.1.11
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

3.1.12
out-of-roundness
ovality
difference between the measured maximum and the measured minimum outside diameter in the same cross-section of a component

3.1.13
wall thickness
e
value of the measurement of the overall wall thickness at any point around the circumference of a component

3.1.14
mean wall thickness
e_m
arithmetical mean of a number of measurements of the overall wall thickness, regularly spaced around the circumference and in the same cross-section of a component, including the measured minimum and the measured maximum value of the overall wall thickness in that cross-section

3.1.15
wall thickness of inside layer
e_4
thickness at any point of the inside layer

3.1.16
Wall thickness of outside layer
e_5
thickness at any point of the outside layer

3.1.17
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 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.

3.1.18
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

3.1.19
external reprocessed material
material prepared from unused thermoplastics products regardless of where those products were manufactured

3.1.20
recycled material
material from used thermoplastics products which have been cleaned and crushed or ground

3.1.21
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.

3.1.22
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 (at any point)

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 (at any point)

e_m mean wall thickness

e_2 wall thickness of a socket

e_3 wall thickness at the groove

e_4 wall thickness of the inside layer

e_5 wall thickness of the outside layer

L_1 length of a spigot

L_2 length of a socket

l effective length of a pipe

3.3 Abbreviations

DN nominal size

DN/OD nominal size, outside diameter related

PVC-U unplasticized poly(vinyl chloride)

TIR true impact rate

4 Material

4.1 Raw material

The compound/formulation shall be PVC, to which are added additives intended to facilitate the manufacture of pipes conforming to the requirements of this standard.

When calculated on the basis of a known formulation or, in case of dispute/unknown formulation, when determined in accordance with EN 1905, the PVC content shall be at least 80 % by mass.

When PVC is substituted by $CaCO_3$, a further reduction of the PVC content is permitted for pipes to the following levels:

— Intermediate layer: ≥ 60 % by mass;

— External layers: ≥ 75 % by mass.

Guidance for calcium carbonate additives is given in Annex A.

4.2 Utilization of non-virgin material

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

4.3 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 Table 11.

5 General characteristics

5.1 Appearance

When viewed without magnification the following requirements apply:

— the internal and external surfaces of pipes shall be smooth, clean and free from grooving, blistering, impurities, pores or other surface irregularity likely to prevent performance of pipes with this standard;

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

5.2 Colour

The recommended colour for the outside layer of pipes is grey.

6 Geometrical characteristics

6.1 General

Dimensions shall be measured in accordance with EN ISO 3126.

NOTE The figures given in this 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 Table 1.

Table 1 — Mean outside diameter

Dimensions in millimetres

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

Nominal size DN/OD	Nominal outside diameter d_n	Mean outside diameter $d_{em,min}$	$d_{em,max}$
180	180	180,0	180,4
200	200	200,0	200,5
250	250	250,0	250,5
315	315	315,0	315,6

6.2.2 Out-of-roundness (Ovality)

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

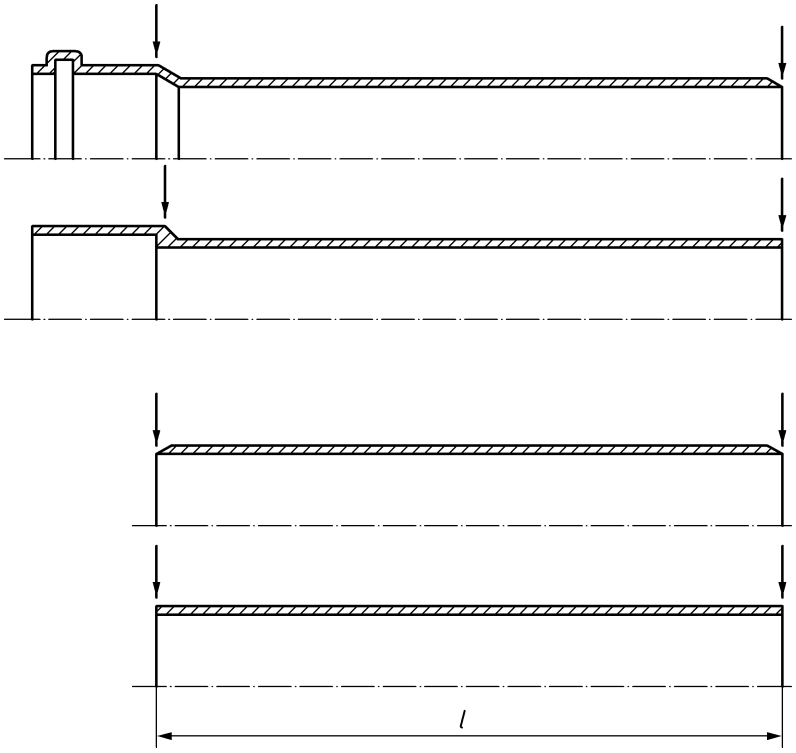


Figure 1 — Effective length of pipes

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 ⅓ of e_{min} (see Table 2).

6.2.5 Wall thicknesses

6.2.5.1 General

The wall thickness, e shall conform to Table 2. Localized wall thickness of up to $1{,}2 e_{min}$ is permitted provided that the mean wall thickness, e_m, is less than or equal to the specified $e_{m,max}$.

Table 2 —Wall thicknesses

Dimensions in millimetres

Nominal size	**Nominal outside diameter**	**Wall thickness**	
DN/OD	d_n	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
80	80	3,0	3,5
82	82	3,0	3,5
90	90	3,0	3,5
100	100	3,0	3,5
110	110	3,2	3,8
125	125	3,2	3,8
140	140	3,2	3,8
160	160	3,2	3,8
180	180	3,6	4,2
200	200	3,9	4,5
250	250	4,9	5,6
315	315	6,2	7,1

6.2.5.2 Minimum wall thickness for foam core pipe

Wall thicknesses of a foam core pipe shall be measured according to Figure 2.

The wall thickness of the inside layer (e_4) shall not be less than 0,2 mm. For the outside layer, the mean wall thickness (e_5) shall be at least 0,2 mm with a minimum of 0,1 mm at any point.

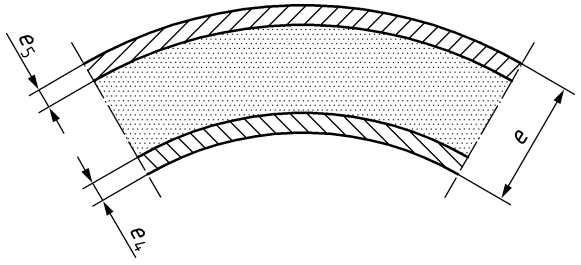


Figure 2 — Cross-section of foam core pipe walls

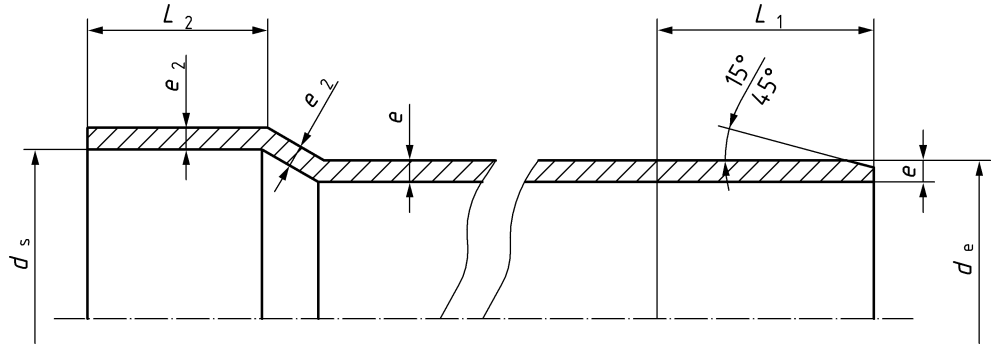
NOTE No requirements apply to structured wall pipes with non-foamed intermediate layer.

6.3 Dimensions of sockets

6.3.1 General dimensions of sockets

The dimensions of pipes with adhesive jointing sockets shall be measured according to Figure 3, and shall comply with the requirements given in 6.3.2.1 and 6.3.3.1.

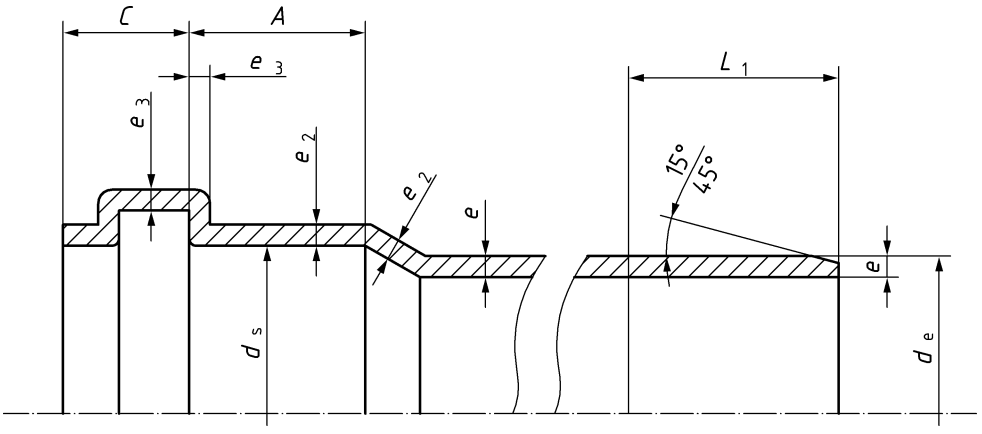
The dimensions of pipes with ring seal sockets shall be measured according to Figure 4, and shall comply with the requirements given in 6.3.2.2 and 6.3.3.2.



Key

d_e outside diameter of a spigot
d_s inside diameter of a socket
e wall thickness
e_2 wall thickness of a socket
L_1 length of a spigot
L_2 length of a socket

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



Key

A	length of engagement	e	wall thickness
C	depth of sealing zone	e_2	wall thickness of a socket
d_e	outside diameter	e_3	wall thickness at the groove
d_s	inside diameter of a socket	L_1	length of a spigot

Figure 4 — General dimensions of sockets and spigots for elastomeric sealing joints

6.3.2 Wall thicknesses

6.3.2.1 Adhesive joint sockets

The wall thicknesses e and e_2 of adhesive joint sockets (see Figure 3) shall comply with Table 3.

Table 3 — Wall thicknesses for adhesive joint sockets

Dimensions in millimetres

Nominal size DN/OD	**Nominal outside diameter** d_n	**Wall thickness** e_{min}	**Wall thickness of sockets** ($e_2 = 0{,}75e$) $e_{2,min}$
32	32	3,0	2,3
40	40	3,0	2,3
50	50	3,0	2,3
63	63	3,0	2,3
75	75	3,0	2,3
80	80	3,0	2,3
82	82	3,0	2,3
90	90	3,0	2,3
100	100	3,0	2,3
110	110	3,2	2,4
125	125	3,2	2,4
140	140	3,2	2,4
160	160	3,2	2,4
180	180	3,6	2,7
200	200	3,9	2,9
250	250	4,9	3,7
315	315	6,2	4,7

6.3.2.2 Ring seal sockets

The wall thicknesses e, e_2 and e_3 of ring seal sockets (see Figure 4) shall comply with Table 4.

Table 4 — Wall thicknesses for ring seal sockets

Dimensions in millimetres

Nominal size DN/OD	**Nominal outside diameter** d_n	**Overall wall thickness** e_{min}	**Wall thickness of sockets** ($e_2 = 0{,}9e$) $e_{2,min}$	**Wall thickness at the groove** ($e_3 = 0{,}75e$) $e_{3,min}$
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	2,7	2,3
80	80	3,0	2,7	2,3
82	82	3,0	2,7	2,3
90	90	3,0	2,7	2,3
100	100	3,0	2,7	2,3
110	110	3,2	2,9	2,4
125	125	3,2	2,9	2,4
140	140	3,2	2,9	2,4
160	160	3,2	2,9	2,4
180	180	3,6	3,2	2,7
200	200	3,9	3,5	2,9
250	250	4,9	4,5	3,7
315	315	6,2	5,6	4,7

6.3.3 Diameters and lengths

6.3.3.1 Adhesive joint sockets

The diameters and lengths of adhesive joints sockets (see Figure 3) shall comply with Table 5.

Table 5 —Diameters and length of adhesive joints sockets

Dimensions in millimetres

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

6.3.3.2 Ring seal sockets

The diameters and lengths of ring seal sockets (see Figure 4) type S (short type), type M (medium type), and type L (long type) shall conform to Table 6.

Examples of designs for grooves for elastomeric ring sockets are given in Figure 5. Others designs are permitted.

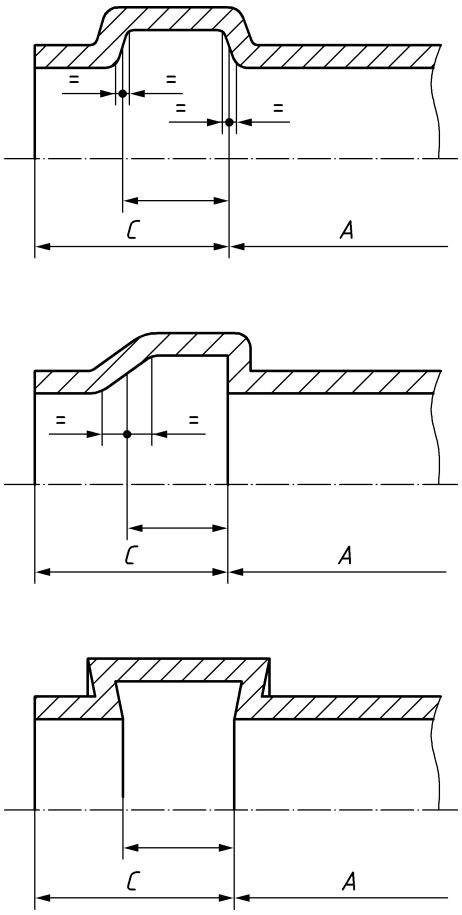


Figure 5 — Typical groove designs for elastomeric ring seal sockets

Table 6 —Diameters and lengths of ring seal sockets

Dimensions in millimetres

Nominal size	Mean inside diameter of socket	Lengths of sockets				
		Type S		Type M		Type L
DN/OD	d_{sm}	A_{min}	C_{max}	A_{min}	C_{max}	A_{min}
32	32,3	16	18	24	18	65
40	40,3	18	18	26	18	65
50	50,3	20	18	28	18	65
63	63,3	22	20	31	20	65
75	75,4	25	20	33	20	65
80	80,4	26	21	34	21	65
82	82,4	26	21	34	21	65
90	90,4	28	22	36	22	65
100	100,4	30	22	38	22	65
110	110,4	32	26	40	26	65
125	125,4	35	26	43	26	65
140	140,5	38	26	46	26	65
160	160,5	42	32	50	32	65
180	180,5	46	36	54	36	65
200	200,6	50	40	58	40	65
250	250,8	55	70			
315	316,0	62	70			

Where sealing rings are firmly retained, the dimensions for the values for *A* and *C* shall be measured to the effective sealing point (see Figure 6) as specified by the manufacturer. This point shall give a full sealing action.

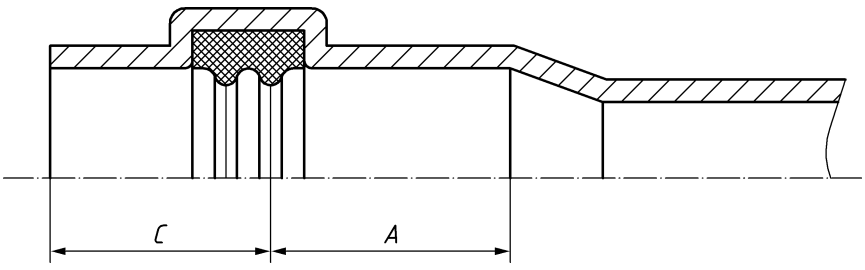


Figure 6 — Example for measuring the effective sealing point

7 Mechanical characteristics

7.1 General requirements

When tested in accordance with Table 7, using the test conditions as defined in Table 8, the pipe shall have general mechanical characteristics conforming to the requirements given in Table 7.

NOTE The round-the-clock impact resistance is a characteristic which is regarded as resulting from the material properties and the good processing of pipes. It is considered to provide sufficient robustness in transport, storage and handling of pipes.

Table 7 —General mechanical characteristics

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]	 d 25 d 90 see Table 8 see Table 8 water 0 °C	ISO 3127
[a] If a manufacturer chooses to use indirect testing, the preferred temperature is (23 ± 2) °C.				

Table 8 —Fall heights and masses for impact strength (Round-the-clock-method)

Nominal size DN/OD	Test conditions	
	Mass of striker kg	Fall height of striker mm
32	0,25	500
40	0,25	500
50	0,25	500
63	0,25	1 000
75	0,25	1 500
80	0,25	1 500
82	0,25	1 500
90	0,25	2 000
100	0,35	2 000
110	0,35	2 000
125	0,5	2 000
140	0,5	2 000
160	0,75	2 000
180	0,75	2 000
200	1,0	2 000
250	1,6	2 000
315	2,5	2 000

7.2 Additional requirements

Pipes intended to be used in areas where installation is carried out at low temperature, may be required in the national foreword to comply with the requirements of an impact test (stair-case-method) as specified in Table 9.

The pipes complying with the requirements of this clause shall be marked with an “ice crystal” symbol in accordance with Table 12

Table 9 — Improved impact resistance

Characteristics	Requirements	Test parameters		Test method
Impact resistance (Stair-case method)	H 50 ≥ 1 m	Conditioning and test temperature	0 °C	ISO 11173:1994
	max. 1 break below 0,5 m	Type of striker	d 90	
		Mass of striker for:		
		32 mm ≤ d_n ≤ 40 mm	1,25 kg	
		50 mm ≤ d_n ≤ 63 mm	2,00 kg	
		75 mm ≤ d_n ≤ 82 mm	2,50 kg	
		90 mm ≤ d_n ≤ 100 mm	3,20 kg	
		d_n = 110 mm	4,00 kg	
		d_n = 125 mm	5,00 kg	
		d_n = 140 mm	6,30 kg	
		d_n = 160 mm	8,00 kg	
		d_n = 180 mm	8,00 kg	
		d_n = 200 mm	10,00 kg	
		d_n ≥ 250 mm	12,50 kg	

8 Physical characteristics

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

Table 10 —Physical characteristics

Characteristic	Requirements	Test parameters		Test method
Vicat softening temperature (VST) [a]	≥ 79 °C	Shall conform to ISO 2507-1		ISO 2507-1
Longitudinal reversion [b]	≤ 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 [c] (Alternative test method to degree of gelation)	No attack [d]	Temperature of bath Immersion time	(15 ± 1) °C 30 min	ISO 9852
Uniaxial tensile test [c] (Alternative test method to degree of gelation)	Strain at break ≥ 80 %	Test speed Test temperature	5 ± 1 mm/min (23 ± 2) °C	EN ISO 6259-1 and ISO 6259-2
DSC [c e] (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] Not applicable to the foamed part of a pipe. If e_4 (resp. e_5) is less than 1,8 mm, the test shall be carried out on a profile extruded from the material. Indirect testing may be carried out using the pipe sample.

[b] In case of dispute, method "liquid bath" shall be used.

[c] Not applicable to foam core pipes. If applicable, the appropriate test method shall be chosen by the producer for factory production control, taking in account National regulation or internal health and safety policy. In case of dispute, the DSC method shall be used.

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

[e] This test is not intended to be used for factory production control.

9 Performance requirements

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

Table 11 — 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	No leakage before and after the test; Sagging: DN ≤ 50: ≤ 3 mm DN > 50: 0,05d_n mm	Shall conform to ISO 13257	Test assembly in accordance with ISO 13257:2010, Clause 7, Figure 1 and/or 3.

10 Sealing rings

The sealing ring shall have no detrimental effect on the properties of the pipes and shall not cause the test assembly to fail to conform to Table 11.

Materials for sealing rings shall comply with EN 681-1 or EN 681-2, as applicable.

11 Adhesives

The adhesive shall have no detrimental effects on the properties of the pipes and shall not cause the test assembly to fail when tested according to Table 11.

The adhesive shall comply with EN 14680.

As an alternative, adhesive complying with EN 14814 [4] are deemed to be suitable.

12 Marking

12.1 General

Marking elements shall be labelled or printed or formed directly on the pipe 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 aspects given in the column “Minimum durability of legibility of marking” in Table 12, where the required durability of marking is coded with decreasing stringency as follows:

— A: Durable in use

— B: Legible until the system is installed

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

Marking by indentation reducing the wall thickness not more than 0,25 mm shall be deemed to conform to this clause without infringing the requirements for the wall thickness given in 6.2.5.

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

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

12.2 Minimum required marking

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

The minimum required marking shall conform to Table 12.

Table 12 —Minimum required marking

Aspect	Marking or symbol	Minimum durability of legibility of marking
- Number of this standard	EN 1453	A
- Manufacturer's name and/or trade mark	XXX	A
- Nominal size	e.g. DN 110	A
- Minimum wall thickness	e.g. 3,2	A
- Material	PVC or PVC-U	A
- Application area code	B	A
- Manufacturer's information	[a]	A
- Cold climate performance[b]	❄ (ice crystal)	B

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

[b] This marking is only applicable for pipes which have proved by testing to conform to 7.2.

12.3 Additional marking

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

Pipes 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
(informative)

Guidance for calcium carbonate additives

A.1 Composition of calcium carbonate additives

The composition of the calcium carbonate additive, before coating if any, should 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.

A.2 Physical properties of calcium carbonate additive

The physical properties of the calcium carbonate additive should conform to the following:

— Mean particle size, D50: ≤ 2,5 μm;

— Top cut, D98: ≤ 20 μm.

Annex B
(normative)

Utilization of non-virgin material

B.1 Own reprocessed material

The use of clean own reprocessed material with agreed specification for the production of pipes shall be permitted without limitations.

If fitting material is used for the production of pipes it shall be considered as recycled material.

B.2 External reprocessed and recycled materials with agreed specification

B.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, the pipe manufacturer and, if applicable, a certification body. It shall at least cover the characteristics given in Table B.1. When determined in accordance with the test methods given in Table B.1, the actual values for these characteristics shall conform to the agreed value, and the permitted deviations shall conform to those given in Table B.1.

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

   NOTE For the purposes of B.2.1, the manufacturer is responsible for claiming and ensuring that the quality plan of the supplier conforms to or is not less stringent than the relevant requirements of EN ISO 9001 [5]: it is not essential for the supplier to be approved and registered for operation in accordance with EN ISO 9001 [5].

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

Characteristic	Requirements	Test method
PVC-content [a]	±4 % absolute by mass	EN 1905
K-value [a]	±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 agreement.	
Type of stabilizer [a b]	Requirements and test method shall be agreed and stated in the agreement.	
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 methods depend on the recycling process and on the end product.

b) each delivery shall be covered by a certificate according to 3.1.B of EN 10204:2004, 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 manufacturer;

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 pipes containing lower levels of additions of external reprocessed or recycled material.

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

External reprocessed and recycled material with an agreed specification from PVC-U bottles or window frames 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 pipes provided that all of the following conditions are met:

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

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

Characteristic	Unit	Requirement	Test Method [a] [b]	Remark
Density	Kg/m³	1 390 kg/m³ ≤ density ≤ 1 500 kg /m³	EN ISO 1183-1	
Filler content by ash rest	% by mass		EN ISO 3451-5	Linked to PVC content
K-value		56 ≤ K-value ≤ 70	EN ISO 13229	
Vicat softening temperature	° C	≥ 62 °C	EN ISO 306	
Particle size	mm	> 1 000 µm: max. 15 %	Sieve analysis	
		< 1 400 µm: 100 %		
Impurities		≤ 1 500 mg/kg for particle size ≤ 1 000 μm	Annex C of EN 15346:2014 or evaluation of sheets or evaluation of micronized material	
		≤ 1 500 mg/kg for 1 000 µm < particle size < 1 400 μm		
Extraneous polymer			IR analyses or DSC	Presence

[a] Samples shall be taken from the compounded or pelletized or from each individual material batch source. The frequency of sampling shall be agreed between supplier and product manufacturer and where relevant, the certification body.

[b] If the source of the material is consistent, e.g. pipes and fittings or other products produced under quality mark. It is not required to test those material characteristics covered by quality mark.

b) the material shall be clean and dry;

c) for the specified intermediate layers of pipe up to 100 % of reprocessed and recycled materials is permitted to be added;

d) in other cases, the maximum allowed amount of external reprocessed and recycled material that may be added depends on the difference in K-value of the virgin material and the external 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.

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

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

B.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 may 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 shall be tested accordingly;

b) the material shall be clean and dry;

c) for specified intermediate layers of pipe up to 100 % of external reprocessed or recycled material is permitted to be added;

d) in other cases the maximum allowed amount of external reprocessed and recycled materials that may be added depends on the difference in K-value of the virgin material and the external 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.

e) the quantity of external reprocessed and recycled materials that is actually added in each production series shall be recorded by the pipe manufacturer.

B.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 conforming to this standard.

Annex C
(informative)

Product standards

EN 1329 (all parts), *Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure — Unplasticized poly(vinyl chloride) (PVC-U)*

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)*

Bibliography

[1] 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*

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

[3] ENV 1453-2, *Plastics piping systems with structured wall pipes for soil and waste discharge (low and high temperature) inside buildings - Unplasticized poly(vinyl chloride) (PVC-U) - Part 2: Guidance for the assessment of conformity*

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

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

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