

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
English version of DIN EN 1329-1

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ICS 23.040.01; 91.140.80

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 standard, together with DIN 19531-10, December 1999 edition, supersedes DIN 19531, November 1987 edition.

European Standard EN 1329-1 : 1999 has the status of a DIN Standard.

A comma is used as the decimal marker.

National foreword

This standard has been prepared by CEN/TC 155.

The responsible German body involved in its preparation was the *Normenausschuß Wasserwesen* (Water Practice Standards Committee), Technical Committee *Kunststoffrohre in der Abwassertechnik*.

It should be noted that for a period ending 31 January 2001 DIN 19531 continues to be valid in Germany. During this period poly(vinyl chloride) pipes for use inside buildings may be manufactured to conform either to DIN 19531 or to the present standard, in conjunction with DIN 19531-10.

DIN EN ISO 1043-1*) and DIN 53479 are the standards corresponding to International Standards ISO 1043-1 and ISO 1183, respectively, referred to in clause 2 of the EN.

Amendments

DIN 19531, November 1987 edition, has been superseded by the specifications of EN 1329-1.

Previous editions

DIN 19531: 1964-09, 1968-01, 1977-03, 1980-03, 1987-11.

National Annex NA

Standard referred to

(and not included in **Normative references** and **Annex B**)

DIN 53479 Determination of density of plastics and elastomers

*) At present at draft stage.

EN comprises 34 pages.

ICS 23.040.01; 91.140.80

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 1998-11-01.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

The European Standards exist in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

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Foreword

This European Standard has been prepared by Technical Committee CEN/TC 155 "Plastics piping systems and ducting systems", the secretariat of which is held by NNI.

It has been prepared in liaison with CEN/TC 165 "Waste water engineering".

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 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.

EN 1329 consists of the following Parts, under the general title 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 standard)*
- Part 2: *Guidance for the assessment of conformity*
- Part 3: *Guidance for installation.*

This Part of EN 1329 includes the following annexes:

- Annex A (normative) : Utilisation of non-virgin material
- Annex B (informative): Bibliography.

At the date of publication of this standard, System Standards for piping systems of PVC-U with structured-wall pipes and other plastics materials used for the same application are the following:

NOTE All listed System Standards have reached the Enquiry stage.

prEN 1451, *Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure – Polypropylene (PP)*

prEN 1453, *Plastics piping systems with structured-wall pipes for soil and waste discharge (low and high temperature) inside building – Unplasticized poly(vinyl chloride) (PVC-U)*

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

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

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

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

For pipes and fittings which have conformed to the relevant national standard before the date of availability January 1999, as shown by the manufacturer or by a certification body, the national standard may continue to be applied until the January 2001.

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 1999, and conflicting national standards shall be withdrawn at the latest by January 2001.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European standard specifies the requirements for pipes, fittings and the system of unplasticized poly(vinyl chloride) (PVC-U) piping systems in the field of soil and waste discharge (low and high temperature) inside buildings (marked with "B") and for soil and waste discharge systems for both inside buildings and buried in ground within the building structure (marked with "BD").

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

This standard covers a range of pipes and fittings sizes and gives recommendations concerning colours.

NOTE 1 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.

This standard does not cover requirements for K-value of the raw material.

This standard is applicable to PVC-U pipes and fittings, their joints and to joints with components of other plastics (marked with "B" or "BD") intended to be used for the following purposes:

- a) soil and waste discharge pipework for the conveyance of domestic waste waters (low and high temperature);
- b) ventilation pipework associated with a);
- c) rainwater pipework within the building structure.

This standard is applicable to pipes and fittings, marked with "B", which are intended to be used inside building only and to pipes and fittings, marked with "BD", which are intended to be used inside building and buried in ground within the building structure.

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.

NOTE 3 For external above ground application additional requirements depending on the climate should be agreed between the manufacturer and the user.

NOTE 4 Components conforming to other standards on plastics piping systems can be used with pipes and fittings conforming to this standard, provided they conform to the requirements for joint dimensions and functional requirements given in this standard.

2 Normative references

This Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

prEN 496 *Plastics piping systems — Plastics pipes and fittings — Measurement of dimensions and visual inspection of surfaces*

EN 580:1994, *Plastics piping systems — Unplasticized poly(vinyl chloride) (PVC-U) pipes — Test method for the resistance to dichloromethane at a specified temperature (DCMT)*

EN 681-1:1996, *Elastomeric seals — Material requirements for pipe joint seals used in water and drainage applications — Part 1: Vulcanized rubber*

prEN 681-2, *Elastomeric seals — Material requirements for pipe joint seals used in water and drainage applications — Part 2: Thermoplastics elastomers*

EN 727:1994, *Plastics piping and ducting systems — Thermoplastics pipes and fittings — Determination of Vicat softening temperature (VST)*

EN 743:1994, *Plastics piping and ducting systems — Thermoplastics pipes — Determination of the longitudinal reversion*

- EN 744:1995, *Plastics piping and ducting systems — Thermoplastics pipes — Test method for resistance to external blows by the round-the-clock method*
- EN 763:1994, *Plastics piping and ducting systems — Injection-moulded thermoplastics fittings — Test method for visually assessing effects of heating*
- EN 921:1995, *Plastics piping systems — Thermoplastics pipes — Determination of resistance to internal pressure at constant temperature*
- EN 922:1994, *Plastics piping and ducting systems — Pipes and fittings of unplasticized poly(vinyl chloride) (PVC-U) — Specimen preparation for determination of the viscosity number and calculation of the K-value*
- EN 1053:1995, *Plastics piping systems — Thermoplastics piping systems for non-pressure applications — Test method for watertightness*
- EN 1054:1995, *Plastics piping systems — Thermoplastics piping systems for soil and waste discharge — Test method for airtightness of joints*
- EN 1055:1996, *Plastics piping systems — Thermoplastics piping systems for soil and waste discharge inside buildings — Test method for resistance to elevated temperature cycling*
- EN 1277:1996, *Plastics piping systems — Thermoplastics piping systems for buried non-pressure applications — Test method for leaktightness of elastomeric sealing ring type joints*
- EN 1401-1:1998, *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 1411:1996, *Plastics piping and ducting systems — Thermoplastics pipes — Determination of resistance to external blows by the staircase method*
- EN 1905, *Plastics piping systems — Unplasticized poly(vinyl chloride) (PVC-U) pipes, fittings and material — Method for assessment of the PVC content based on total chlorine content*
- prEN 1989, *Thermoplastics piping and ducting systems — Joints for buried non-pressure applications — Test method for long-term sealing performance of joints with thermoplastics elastomer (TPE) seals by estimating the sealing pressure"*
- EN 10204:1995, *Metallic products — Types of inspection documents*
- ISO 472:1988, *Plastics — Vocabulary*
- ISO 1043-1:1990, *Plastics — Symbols — Part 1: Basic polymers and their special characteristics*
- ISO 1183:1987, *Plastics — Methods for determining the density and relative density of non-cellular plastics*

3 Definitions, symbols and abbreviations

For the purposes of this standard, the following definitions, symbols and abbreviations apply.

3.1 Definitions

In addition to the definitions given below, the definitions given in ISO 472:1988 and ISO 1043-1:1990 apply.

3.1.1 application area code

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

NOTE 2 Other application area codes U and UD not covered by this standard are defined elsewhere, e.g. in EN 1401-1:1998.

3.1.2 Nominal size

3.1.2.1 nominal size DN

A numerical designation of the size of a component, other than a component designated by thread size, which is approximately equal to the manufacturing dimension, in millimetres (mm).

3.1.2.2 nominal size DN/OD

Nominal size, related to the outside diameter.

3.1.3 nominal outside diameter (d_n)

The specified outside diameter, in millimetres, assigned to a nominal size DN/OD.

3.1.4 outside diameter (d_e)

The 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})

The value of the measurement of the outer circumference of a pipe or spigot of a fitting in any cross section, divided by π ($\approx 3,142$), rounded to the next greater 0,1 mm.

3.1.6 mean inside diameter of a socket (d_{sm})

The arithmetical mean of a number of measurements of the inside diameter of a socket in the same cross section.

3.1.7 out-of-roundness (ovality)

The difference between the measured maximum and the measured minimum outside diameter in the same cross section of a component.

3.1.8 wall thickness (e)

The value of measurement of the wall thickness at any point around the circumference of a component.

3.1.9 mean wall thickness (e_m)

The 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.

3.1.10 standard dimension ratio (SDR)

A nominal ratio of the outside diameter, d_n , to the minimum wall thickness, e_{min} .

3.1.11 nominal ring stiffness (SN)

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

3.2 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 the socket
d_{sm}	: mean inside diameter of the socket
DN	: nominal size
DN/OD	: nominal size, outside diameter related
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
L_1	: length of spigot
L_2	: length of socket
l	: effective length of a pipe
R	: radius of swept fittings
Z_d	: design length of a fitting
α	: nominal angle of a fitting

3.3 Abbreviations

PVC-U	: Unplasticized poly(vinyl chloride)
SDR	: Standard dimension ratio
SN	: Nominal ring stiffness
TIR	: True impact rate
TPE	: Thermoplastics elastomers

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 standard.

When calculated on the basis of a known formulation or in case of dispute or not known formulation, determined in accordance with prEN 1905 the PVC content shall be at least 80 % by mass for pipes and 85 % by mass for injection-moulded fittings.

4.2 Utilisation of non-virgin material

Requirements for the utilisation of non-virgin material are given in Annex A.

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 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 prEN 496.

In case of dispute the reference temperature is (23 ± 2) °C.

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

6.2 Dimensions of pipes

6.2.1 Outside diameter

The mean outside diameter, d_{em} , shall conform to tables 1 or 2 as applicable.

Table 1 — Mean outside diameters (metric series)

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
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 2 — Mean outside diameters (series based on inch dimensions)

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter d_n	Mean outside diameter	
		$d_{em,min}$	$d_{em,max}$
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 $0,024d_n$.

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.

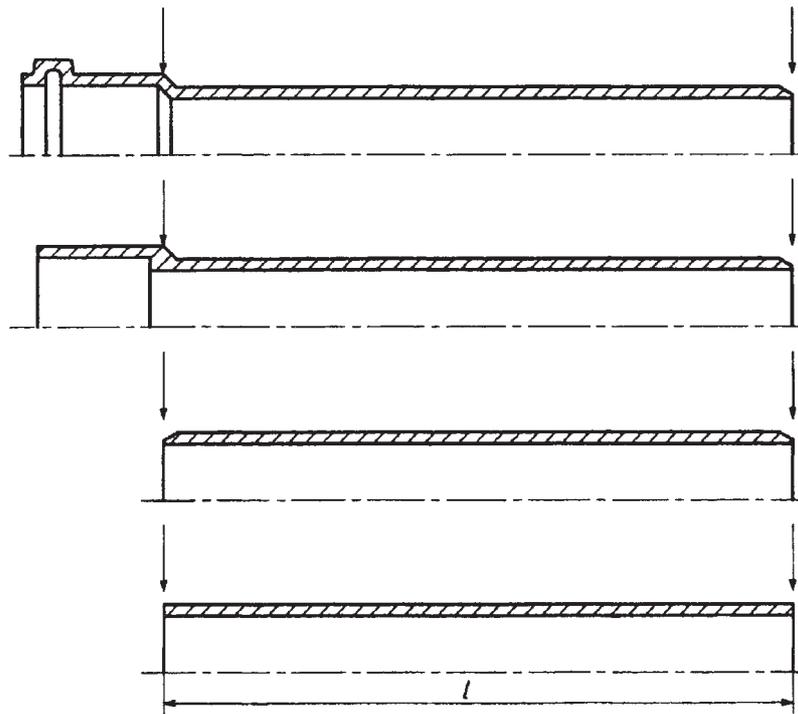


Figure 1 — Effective length of pipes

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 $\frac{1}{3}$ of e_{\min} .

6.2.5 Wall thickness

The wall thickness shall conform to table 3 or 4 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 3 — Wall thickness (metric series)

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter d_n	Wall thickness Application area			
		B		BD	
		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

Table 4 — Wall thickness (series based on inch dimensions)

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter d_n	Wall thickness Application area B	
		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

The dimensions of solvent cement sockets (see figure 4) and ring seal sockets for pipes (see figure 5) shall be the same as for fittings (see 6.4).

6.3 Dimensions of fittings

6.3.1 Outside diameters

The mean outside diameter, d_{em} , of the spigot shall conform to tables 1 or 2, as applicable.

6.3.2 Design lengths

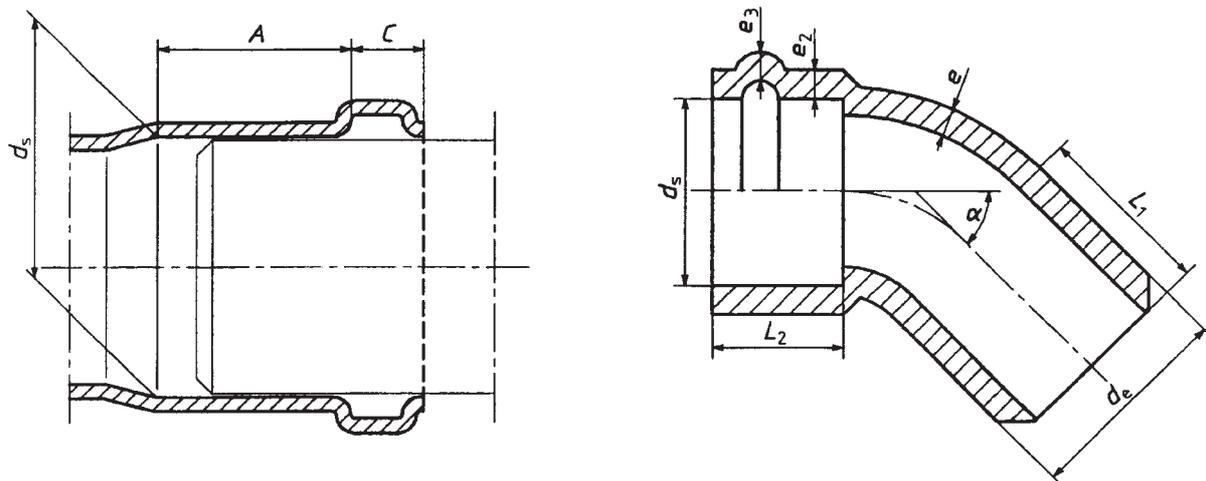
The design length(s) [Z_d -length(s)] of fittings (see figures 8 to 11 and figures 13 to 17) shall be given by the manufacturer.

NOTE The Z_d -lengths are intended to assist in the design of moulds and are not intended to be used for quality control purposes. ISO 265-1:1988 can be used as a guideline.

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.



- A length of engagement
- C depth of sealing zone
- d_e outside diameter of the spigot
- d_s inside diameter of the socket
- e wall thickness
- e_2 wall thickness of socket
- e_3 wall thickness at the groove
- L_1 length of spigot
- L_2 length of socket
- α nominal angle

Figure 2 — Points of measurement of spigot and typical types of sockets

6.3.3.2 Solvent cement fittings

For solvent cement fittings the wall thicknesses, e and e_2 (see figure 2) shall be equal to, or greater than, the values given in tables 5 or 6, as applicable.

For solvent cement 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 tables 5 or 6, as applicable.

Table 5 — Wall thicknesses for solvent cement fittings (metric series)

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter d_n	Wall thickness		Wall thickness of sockets ($e_2 = 0,75e$)	
		Application area		Application area	
		B e_{min}	BD e_{min}	B $e_{2,min}$	BD $e_{2,min}$
32	32	3,0	—	2,0 ^{*)}	—
40	40	3,0	—	2,0 ^{*)}	—
50	50	3,0	—	2,0 ^{*)}	—
63	63	3,0	—	2,0 ^{*)}	—
75	75	3,0	3,0	2,0 ^{*)}	2,0 ^{*)}
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

^{*)} $e_2 = 0,65e$. This kind of fittings may only be used in a solvent cement system and shall be marked accordingly.

Table 6 — Wall thicknesses for solvent cement fittings (series based on inch dimensions)

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter d_n	Wall thickness ¹⁾	Wall thickness of sockets and spigot ¹⁾
		Application area	
		B e_{min}	B $e_{2,min}$
36	36	3,0	2,3
43	43	3,0	2,3
56	56	3,0	2,3

1) 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	2,7	2,0
43	2,7	2,0
56	2,7	2,0

6.3.3.3 Ring seal fittings

For ring seal fittings the wall thicknesses e , e_2 and e_3 (see figure 2), shall be equal to, or greater than, the values given in tables 7 or 8, 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 tables 7 or 8, as applicable.

Table 7 — Wall thicknesses for ring seal fittings including expansion coupling (metric series)

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter d_n	Wall thickness		Wall thickness of sockets ($e_2 = 0,9e$)		Wall thickness at the groove ($e_3 = 0,75e$)	
		Application area		Application area		Application area	
		B	BD	B	BD	B	BD
		e_{min}	e_{min}	$e_{2,min}$	$e_{2,min}$	$e_{3,min}$	$e_{3,min}$
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 8 — Wall thicknesses for expansion coupling
(series based on inch dimensions)**

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter d_n	Wall thickness 1) Application area B e_{min}	Wall thickness of sockets 1) ($e_2 = 0,9e$) Application area B $e_{2,min}$	Wall thickness at the groove 1) ($e_3 = 0,75e$) Application area 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

1) 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

Where a sealing ring is located by means of a retaining cap or ring (see figure 3) 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.

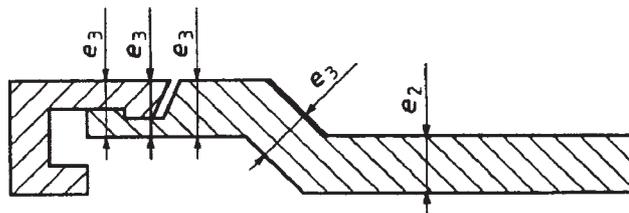


Figure 3 — Example for calculation of the wall thickness of sockets with retaining cap

6.4 Diameters and lengths of sockets and spigot

6.4.1 Solvent cement sockets and spigot

The diameters and lengths of solvent cement sockets and spigot shall conform to tables 9 or 10, as applicable (see figure 4).

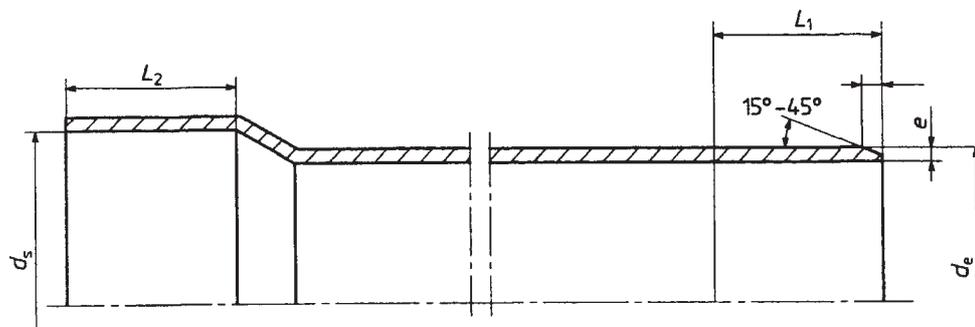


Figure 4 — Basic dimensions of sockets and spigot for solvent cement joints

**Table 9 — Diameters and lengths of solvent cement sockets and spigots
(metric series)**

Nominal size DN/OD	Nominal outside diameter d_n	Mean outside diameter of spigot		Mean inside diameter of socket		Length of socket and spigot $L_{2,min}^*)$ and $L_{1,min}$
		$d_{em,min}$	$d_{em,max}$	$d_{sm,min}$	$d_{sm,max}$	
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

*) For joints intended for fabrication within a workshop L_2 -values may be reduced to the C_{max} values (see table 11).

**Table 10 — Diameters and lengths of solvent cement sockets and spigot
(series based on inch dimensions)**

Nominal size DN/OD	Nominal outside diameter d_n	Mean outside diameter of spigot		Mean inside diameter of socket		Length of socket and spigot $L_{2,min}$ and $L_{1,min}$
		$d_{em,min}$	$d_{em,max}$	$d_{sm,min}$	$d_{sm,max}$	
36	36	36,2	36,5	36,3	36,6	18
43	43	42,8	43,1	42,9	43,2	21
56	56	55,8	56,1	55,9	56,2	27

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 20' per side. Otherwise these values for d_{sm} shall apply over the entire length of the socket.

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 11 to 13, as applicable (see figure 5).

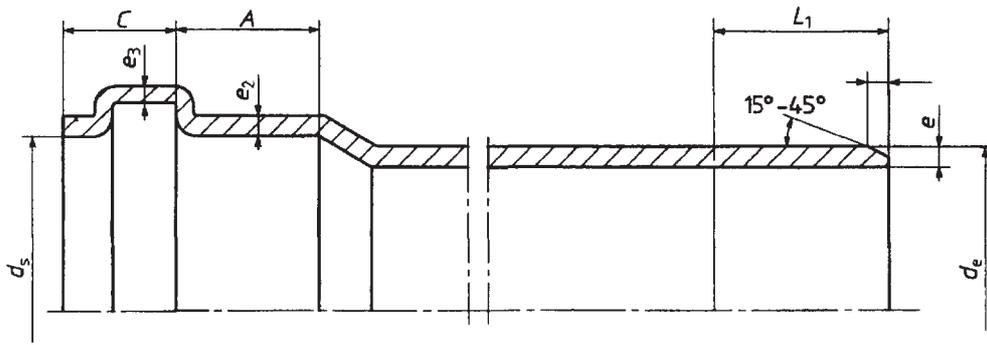


Figure 5 — Basic dimensions of sockets and spigot for elastomeric ring seal joints

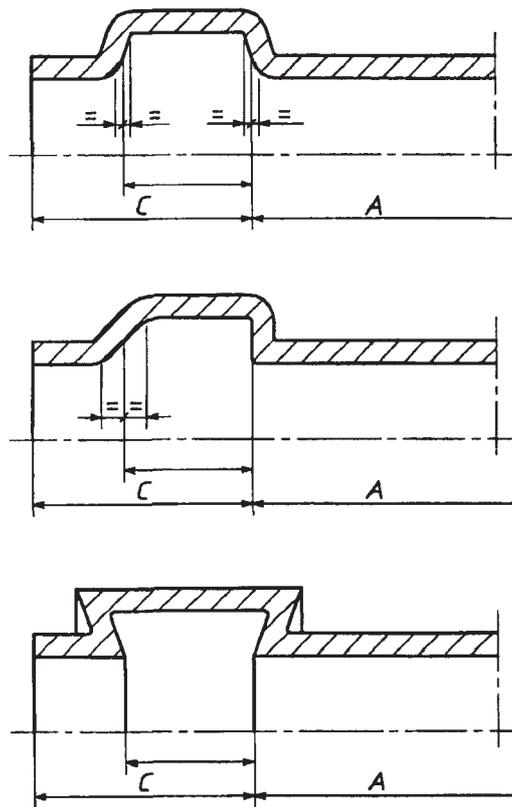


Figure 6 — Typical groove designs for elastomeric ring seal sockets

Where sealing rings are firmly retained, the minimum value for A and the maximum value for C (see figure 7) shall be measured to the effective sealing point (see figure 7) as specified by the manufacturer and, if applicable, in agreement with a certification body.

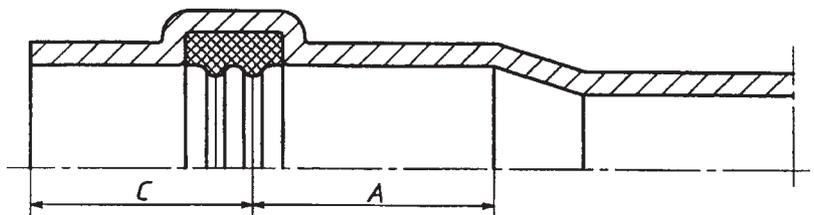


Figure 7 — Example for measuring the effective sealing point

Table 11 — 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 DN/OD	Mean outside diameter of spigot		Mean inside diameter of socket $d_{sm,min}$	Lengths of socket and spigot		
	$d_{em,min}$	$d_{em,max}$		A_{min}	C_{max}	L_{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 12 — 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 DN/OD	Mean outside diameter of spigot		Mean inside diameter of socket $d_{sm,min}$	Lengths of socket and spigot		
	$d_{em,min}$	$d_{em,max}$		A_{min}	C_{max}	L_{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 13 — Diameters and lengths of ring seal sockets and spigot type M (medium type) for application areas B and BD

Dimensions in millimetres

Nominal size DN/OD	Mean outside diameter of spigot		Mean inside diameter of socket $d_{sm,min}$	Lengths of socket and spigot		
	$d_{em,min}$	$d_{em,max}$		A_{min}	C_{max}	L_{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 solvent cement sockets and spigot

The diameters and lengths of one-piece expansion couplings shall conform to table 14 (type M, medium type) or table 15 (type L, long type), as applicable.

Table 14 — Diameters and lengths for one-piece expansion coupling type M (medium type) for solvent cement sockets and spigot for application area B (series based on inch dimensions)

Dimensions in millimetres

Nominal size DN/OD	Mean outside diameter of spigot		Mean inside diameter of socket $d_{sm,min}$	Lengths of socket and spigot	
	$d_{em,min}$	$d_{em,max}$		A_{min}	L_{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 15 — Diameters and lengths for one-piece expansion coupling type L (long type) for solvent cement sockets and spigot for application area B (metric series)

Dimensions in millimetres

Nominal size DN/OD	Mean outside diameter of spigot		Mean inside diameter of socket	Lengths of socket and spigot	
	$d_{em,min}$	$d_{em,max}$	$d_{sm,min}$	A_{min}	L_{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

6.5 Types of fittings

This standard is applicable for the following types of fittings.

- a) Bends (see figures 8, 9, 10 or 11)
 - unswept or swept angle (see ISO 265-1:1988);
 - 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 12).
- c) Reducers (see figure 13).
- d) Branches and reducing branches (single or multiple) (see for example figures 14, 15, 16, or 17):
 - unswept or swept angle (see ISO 265-1:1988);
 - 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.

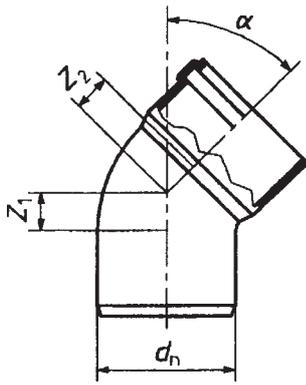


Figure 8 — Bend with single socket (unswept)

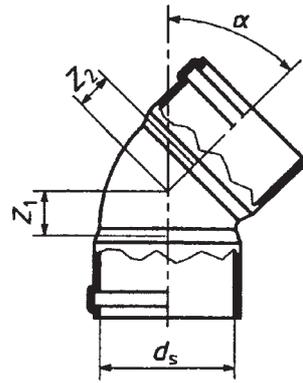


Figure 9 — Bend with all sockets (unswept)

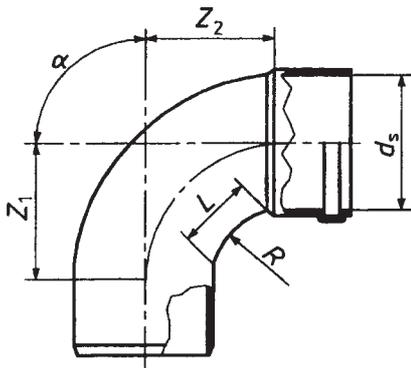


Figure 10 — Bend with single socket (swept)

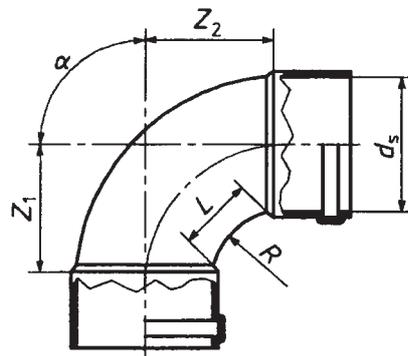


Figure 11 — Bend with all sockets (swept)

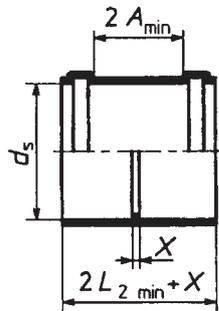


Figure 12 — Coupler

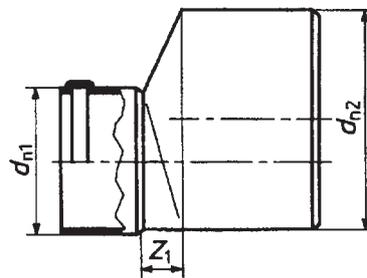


Figure 13 — Reducer

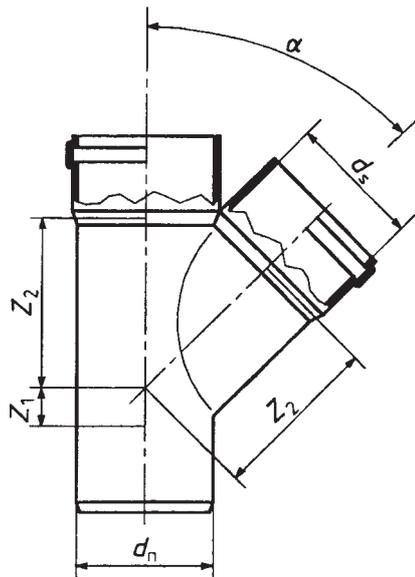


Figure 14 — Branch with single socket (unswept)

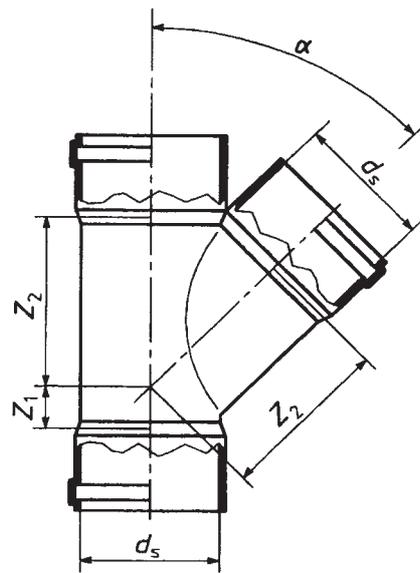


Figure 15 — Branch with all sockets (unswept)

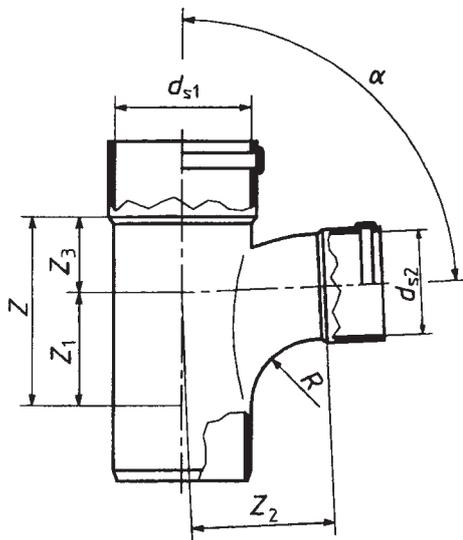


Figure 16 — Reducing branch with single socket (swept)

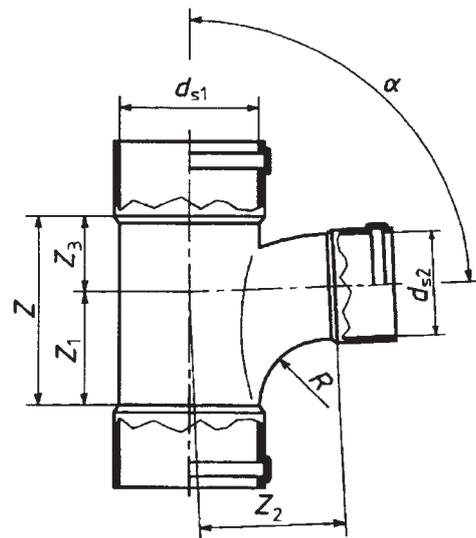


Figure 17 — Reducing branch with all sockets (swept)

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 16, using the indicated parameters, the pipe shall have mechanical characteristics conforming to one of the requirements given in table 16.

Table 16 — Mechanical characteristics of pipes

Characteristics	Requirements	Test parameters		Test method
Impact resistance (Round-the-clock method)	$TIR \leq 10 \%$	Type of striker for $d_n < 110 \text{ mm}$ $d_n \geq 110 \text{ mm}$ Mass of striker Fall height of striker Conditioning medium Conditioning and test temperature ¹⁾	d 25 d 90 see table 17 or 18, as applicable see table 17 or 18, as applicable water 0 °C	EN 744: 1995
Impact resistance (Stair-case method)	$H 50 \geq 1 \text{ m}$ max. 1 break below 0,5 m	Conditioning and test temperature Mass of striker for: 32 mm $\leq d_n \leq$ 43 mm 50 mm $\leq d_n \leq$ 63 mm 75 mm $\leq d_n \leq$ 82 mm 90 mm $\leq d_n \leq$ 100 mm $d_n = 110 \text{ mm}$ $d_n = 125 \text{ mm}$ $d_n = 140 \text{ mm}$ $d_n = 160 \text{ mm}$ $d_n = 180 \text{ mm}$ $d_n = 200 \text{ mm}$ $d_n \geq 250 \text{ mm}$	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	EN 1411: 1996
1) If a manufacturer chooses to use indirect testing (see prEN 1329-2), the preferred temperature is $(23 \pm 2) \text{ °C}$.				

Table 17 — Fall heights and masses for impact strength (metric series)

Nominal size DN/OD	Nominal outside diameter d_n	Mass of striker kg	Dimensions in millimetres
			Fall height of striker
32	32	0,5	600
40	40	0,5	800
50	50	0,5	1000
63	63	0,8	1000
75	75	0,8	1000
80	80	0,8	1000
82	82	0,8	1000
90	90	0,8	1200
100	100	0,8	1200
110	110	1,0	1600
125	125	1,25	2000
140	140	1,6	1800
160	160	1,6	2000
180	180	2,0	1800
200	200	2,0	2000
250	250	2,5	2000
315	315	3,2	2000

**Table 18 — 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
43	43	0,5	800
56	56	0,5	1000

7.1.2 Additional requirements

Pipes intended to be used in areas where installation is usually carried out at temperature below -10 °C, shall conform to the requirements of an impact test (stair-case-method) as specified in table 16.

The pipes shall be marked in accordance with table 24.

7.1.3 Mechanical characteristics of fittings

For application area BD the fittings shall have mechanical characteristics conforming to the requirements as specified in EN 1401-1:1998 for fittings of SDR 41 or SDR 34, as applicable.

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

Consequently fittings are classified with the corresponding pipe stiffness.

8 Physical characteristics

8.1 Physical characteristics of pipes

When tested in accordance with the test method as specified in table 19 using the indicated parameters, the pipe shall have physical characteristics conforming to the requirements given in table 19.

Table 19 — Physical characteristics of pipes

Characteristic	Requirements	Test parameters		Test method
Vicat softening temperature (VST)	≥ 79 °C	Shall conform to EN 727:1994		EN 727:1994
Longitudinal reversion	≤ 5 % The pipe shall exhibit no bubbles or cracks	Temperature	150 °C	Method A of EN 743:1994: liquid
		Immersion time	15 min	
or				
Resistance to dichloromethane at a specified temperature	No attack at any part of the surface of the test piece	Temperature	150 °C	Method B of EN 743:1994: air
		Immersion time	30 min	
		Temperature	15 °C	EN 580:1994
		Immersion time	30 min	

8.2 Physical characteristics of fittings

When tested in accordance with the test method as specified in table 20 using the indicated parameters, the fitting shall have physical characteristics conforming to the requirements given in table 20.

Table 20 — Physical characteristics of fittings

Characteristic	Requirements	Test parameters		Test method
Vicat softening temperature (VST)	≥ 79 °C	Shall conform to EN 727:1994		EN 727:1994
Effects of heating	1) and 2)	Temperature	150 °C	Method A of EN 763:1994: air
		Heating time	30 min	
<p>1) a) 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.</p> <p>b) 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.</p> <p>c) 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.</p> <p>d) The weld line shall not have opened more than 50 % of the wall thickness at the line.</p> <p>e) 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.</p> <p>2) After cutting through the fitting, the cut surfaces shall show no foreign particles, when viewed without magnification.</p>				

9 Performance requirements

When tested in accordance with the test method as specified in table 21 using the indicated parameters, the joints and the system shall have characteristics conforming to the requirements given in table 21.

Table 21 — Fitness for purpose requirements of the system

Characteristic	Requirements	Test parameters		Test method
Watertightness	No leakage	Shall conform to EN 1053:1995		EN 1053:1995
Airtightness	No leakage	Shall conform to EN 1054:1995		EN 1054:1995
Elevated temperature cycling for application area B	No leakage Sagging for: DN ≤ 50: ≤ 3 mm DN 50: ≤ 0,05d _n	Shall conform to EN 1055:1996		Test assembly a) (Figure 1 and/or 3 of EN 1055:1996) in accordance with EN 1055:1996
Elevated temperature cycling for application area BD	No leakage Sagging for: DN ≤ 50: ≤ 3 mm DN 50: ≤ 0,05d _n	Shall conform to EN 1055:1996		Test assembly b) (Figure 2 of EN 1055:1996) in accordance with EN 1055:1996
Combined tightness for application area BD		Test Temperature	(23 ± 5) °C	Condition B Method 4 in accordance with EN 1277:1996
		Spigot deflection	≥ 10 %	
		Socket deflection	≥ 5 %	
		Difference	≥ 5 %	
	No leakage	Water pressure	0,05 bar	
	No leakage	Water pressure	0,5 bar	
	≤ -0,27 bar	Air pressure	-0,3 bar	
		Test temperature	(23 ± 5) °C	Condition C Method 4 in accordance with EN 1277:1996
		Angular deflection	2°	
		d _n ≤ 315 mm		
	No leakage	Water pressure	0,05 bar	
	No leakage	Water pressure	0,5 bar	
	≤ -0,27 bar	Air pressure	-0,3 bar	
Long term performance of TPE seals for application area BD	Sealing pressure: a) at 90 days: ≥ 1,3 bar b) using extrapolation to 100 years: ≥ 0,6 bar	Shall conform to prEN 1989		prEN 1989

10 Requirements for application area code D

Pipes and fittings for application area D shall conform to the following requirements in addition to those necessary for application area B alone.

- Material: for material for pipes and fittings used for application D, the requirements for resistance to internal pressure (long-term behaviour) are as specified in table 22 or table 23, as applicable.
- Stiffness: the pipe and fitting shall have a nominal stiffness of not less than SN 4 in conformance with EN 1401-1:1998.

– Combined tightness test: when tested in accordance with EN 1277:1996, the joints shall conform to table 21.

Table 22 — Material characteristics of pipes

Characteristic	Requirements	Test parameters		Test method
Resistance to internal pressure	No failure during the test period	End caps Test temperature Orientation Number of test pieces Circumferential (hoop) stress Conditioning period Type of test Test period	Type a or b 60 °C Free 3 10,0 MPa 1 h Water-in-water 1000 h	EN 921: 1995

Table 23 — Material characteristics of fittings

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 $50 \text{ mm} \leq d_h \leq 110 \text{ mm}$ 60 °C Free $\geq 140 \text{ mm}$ 3 6,3 MPa 1 h Water-in-water 1000 h	EN 921: 1995

11 Sealing rings

11.1 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 21.

11.2 Materials for sealing rings shall conform to EN 681-1:1996 or prEN 681-2, as applicable.

11.3 Thermoplastics elastomer (TPE) seals shall additionally conform to the long-term performance requirements as specified in table 21.

12 Adhesives

The adhesive shall be solvent cement and shall be as specified by the manufacturer of pipes or fittings or can be covered by third party technical agreement.

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 21.

13 Marking

13.1 General

13.1.1 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 three levels of legibility of the marking is specified for the individual marking aspect in the column "Minimum durability of legibility of marking" in tables 24 and 25.

The symbols for the legibility mean the following:

- a: durable in use;
- b: legible until the system is installed;
- c: marking on the packaging, legible until the component is installed.

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

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

Marking by indentation reducing the wall thickness not more than 0,25 mm shall be deemed to conform to this clause without infringing the requirements for the wall thickness given in 6.3.3.

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

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

13.2 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 24.

Table 24 — 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	1)	a
– Cold climate performance 2)	❄ (ice crystal)	a
1) For providing traceability the following details shall be given: <ul style="list-style-type: none"> a) the production period, year and month, in figures or in code; b) a name or code for the production site if the manufacturer is producing in different sites, nationally and/or internationally. 		
2) This marking is only applicable to pipes which by testing proved to conform to 7.1.2.		

13.3 Minimum required marking of fittings

The minimum required marking shall conform to table 25.

Table 25 — Minimum required marking of fittings

Aspects	Marking or symbol	Minimum durability of legibility of marking
On the fitting:		
– Number of this standard	EN 1329	b
– Manufacturer's name and/or trade mark	XXX	a
– Nominal diameter	e.g. 110	a
– Nominal angle	e.g. 67°30'	b
– 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
On the fitting or on the packaging:		
– Manufacturer's information	1)	b
– Solvent cement only	S.C.O.	c
– Socket type for sealing ring	S or M or L	c
1) For providing traceability the following details shall be given:		
a) the production period, year, in figures or in code;		
b) a name or code for the production site if the manufacturer is producing in different sites, nationally and/or internationally.		

13.4 Additional marking

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

13.4.2 Pipes and fittings conforming to this standard which are third party certified, may be marked accordingly.

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

Annex A (normative)

Utilisation of non-virgin material

A.1 Material definitions

A.1.1 virgin material

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

A.1.2 own reprocessible material

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

A.1.3 external reprocessible material

Material comprising either one of the following forms:

- a) material from rejected unused pipes or fittings or trimmings therefrom, that will be reprocessed and that were originally processed by another manufacturer;
- b) material from the production of unused PVC-U products other than pipes and fittings, regardless of where they are manufactured.

A.1.4 recyclable material

Material comprising either of the following forms:

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

A.2 Reprocessible and recyclable material

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

A.2.1 Own reprocessible material

The use of clean own reprocessible material with agreed specification for the production of pipes and fittings is permitted without limitations.

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

A.2.2 External reprocessable and recyclable materials with agreed specification

A.2.2.1 Material from PVC-U pipes and fitting

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

- a) A specification for each material shall be agreed between the supplier of external reprocessable or recyclable material and the pipe manufacturer plus, if applicable, a certification body. It shall at least cover the characteristics given in table A.1. When determined in accordance with the test method 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 The quality plan of the supplier of external reprocessable or recyclable material should conform to EN ISO 9002:1994. For the purposes of A.2.2.1, 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 9002:1994: it is not essential for the manufacturer to be approved and registered for operation in accordance with EN ISO 9002:1994.

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

Characteristic	Permitted deviations	Test method
PVC-content ¹⁾	± 4 % absolute by mass	EN 1905
K-value ¹⁾	± 3 units	EN 922:1994
Density ¹⁾	± 20 kg/m ³	ISO 1183:1987
Vicat softening temperature (VST) ¹⁾	± 2 °C	EN 727:1994
Particle size ²⁾	Requirements and test method shall be agreed and stated in the specification.	
Type of stabilizer ^{1) 2)}	Requirements and test method shall be agreed and stated in the specification.	
Impurities ²⁾	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.	
<p>1) If the source of the material is pipes and fittings produced under a European nationally recognised quality mark or a European quality mark, it is not required to test this material characteristic if the requirement covered by the quality mark conforms to the requirement given in this table.</p> <p>2) The relevant requirements and test method are depending on the recycling process and on the end product.</p>		

- b) Each delivery shall be covered by a certificate according to 3.1.B of EN 10204:1995, showing conformity to the agreed specification.
- c) The maximum quantity of external reprocessable and recyclable material that is intended to be added shall be specified by the pipe or fitting manufacturer.
- d) The quantity of external reprocessable and recyclable material that is actually added in each production series shall be recorded by the pipe or fitting 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 reprocessible or recyclable material with an agreed specification.

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

A.2.2.2 Material from other PVC-U products than pipes and fittings

External reprocessible and recyclable 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 reprocessible 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) of A.2.2.1, inclusive, and to all of the additional characteristics and requirements given in table A.2.

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

Characteristic	Requirements	Test method
PVC-content	$\geq 80 \%$	EN 1905
K-value	$56 \leq K\text{-value} \leq 70$	EN 922:1994
Density	$1390 \text{ kg/m}^3 \leq \text{density} \leq 1500 \text{ kg/m}^3$	ISO 1183:1987
Vicat softening temperature (VST)	$\geq 62 \text{ }^\circ\text{C}$	EN 727:1994
Impurities	$\leq 1500 \text{ ppm}$ for particle size $\leq 1000 \text{ }\mu\text{m}$ $\leq 1500 \text{ ppm}$ for $1000 \text{ }\mu\text{m} < \text{particle size} < 1400 \text{ }\mu\text{m}$	1)
Particle size	1000 μm : max 15 % < 1400 μm : 100 %	
Application source of the material	one source: bottles or window frames	
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.		
1) 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 reprocessible and recyclable materials shall depend on the difference in K-value of the virgin material and the reprocessible and recyclable material as follows:
- 1) if the difference in K-value, when determined in accordance with EN 922:1994, 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 reprocessible and recyclable materials that is actually added in each production series shall be recorded by the pipe and fitting manufacturer.

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

A.2.3 External reprocessable and recyclable material not covered by an agreed specification

A.2.3.1 Material from PVC-U pipes and fittings

External reprocessable and recyclable material not covered by an agreed specification from PVC-U pipes and fittings that are available in random quantities and intervals of time is permitted to be added to virgin or own reprocessable material or a mixture of those two materials for the production of pipes provided that all 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) The maximum allowed amount of external reprocessable and recyclable materials that may be added shall depend on the difference in K-value of the virgin material and the external reprocessable and recyclable material as follows:
 - 1) if the difference in K-value, when determined in accordance with EN 922:1994, is ≤ 4 units, then up to 10 % by mass may be added;
 - 2) if the difference in K-value is > 4 units, or not determined, then up to 5 % by mass may be added.
- d) The quantity of external reprocessable and recyclable materials that is actually added in each production series shall be recorded by the pipe manufacturer.

A.2.3.2 Material from other PVC-U products than pipes and fittings

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

Annex B **(informative)**

Bibliography

- prEN 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*
- EN ISO 9002:1994, *Quality systems — Model for quality assurance in production, installation and servicing (ISO 9002:1994)*
- ISO 265-1:1988, *Pipes and fittings of plastics materials — Fittings for domestic and industrial waste pipes — Basic dimensions: Metric series — Part 1: Unplasticized poly(vinyl chloride) (PVC-U)*