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

Part 1: Specifications for pipes, fittings and the systems
English version of DIN EN 1451-1

DIN EN 1451-1

ICS 23.040.01; 91.140.80

Descriptors: Plastics, waste water pipes, specifications.

This standard, together with DIN 19560-10, March 1999 edition, supersedes DIN V 19560, September 1992 edition.

Kunststoff-Rohrleitungssysteme zum Ableiten von Abwasser (niedriger und hoher Temperatur) innerhalb der Gebäudestruktur – Polypropylen (PP) – Teil 1: Anforderungen an Rohre, Formstücke und das Rohrleitungssystem

European Standard EN 1451-1 : 1998 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 16 December 2000 DIN V 19560-10 continues to be valid in Germany. During this period polystyrene pipes for use inside buildings may be manufactured to conform either to DIN V 18560 or to the present standard, in conjunction with with DIN 19560-10.

The DIN Standards corresponding to the International Standards referred to in clause 2 of the EN are as follows:

ISO Standard	DIN Standard(s)
ISO 265-1	DIN 19531
ISO 1043-1	DIN EN ISO 1043-1*)
ISO 1133	DIN EN ISO 1133*)
ISO/TR 10358	DIN 8061, DIN 8075*) and DIN 8078

Amendments

DIN V 19560, September 1992 edition, has been superseded by the specifications of EN 1451-1.

Previous editions

DIN 19560: 1977-03, 1980-03; DIN V 19560: 1992-09.

National Annex NA

Standard referred to

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

DIN 8061	Unplasticized polyvinylchloride (PVC-U) pipes – General quality requirements and testing
DIN 8075	Polyethylene (PE, PE 63, PE 80, PE 100 and PE-HD) pipes – General quality requirements and testing*)
DIN 8078	Types 1, 2 and 3 polypropylene (PP) pipes – General quality requirements and testing
DIN 19531	Unplasticized polyvinyl chloride (PVC) socket pipes and fittings for sewers inside buildings – Dimensions and technical delivery conditions
DIN 19560-10	Polypropylene (PP) socket pipes and fittings for hot water resistant drainage systems inside buildings - Dimensions and technical delivery conditions

*) At present at draft stage.

EN comprises 32 pages.

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EN 1451-1

December 1998

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English version

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

Part 1: Specifications for pipes, fittings and the systems

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 – Polypropylène (PP) – Partie 1: Spécifications pour tubes, raccords ainsi que pour le système

Kunststoff-Rohrleitungssysteme zum Ableiten von Abwasser (niedriger und hoher Temperatur) innerhalb der Gebäudestruktur – Polypropylen (PP) – Teil 1: Anforderungen an Rohre, Formstücke und das Rohrleitungssystem

This European Standard was approved by CEN on 1998-06-01.

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

Central Secretariat: rue de Stassart 36, B-1050 Brussels

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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.

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

This European Standard is one Part of EN 1451 for plastics piping systems in the field of soil and waste discharge (low and high temperature) within the building structure made of polypropylene (PP), which consists of the following parts:

Part 1: Specifications for pipes, fittings and the system
Part 7: Guidance for the assessment of conformity.

Following a decision of CEN/TC 155 after the CEN enquiry, this part 1 is the result of merging of the following parts of the draft standard prEN 1451:

Part 1: General (published for CEN enquiry as prEN 1451-1);
Part 2: Pipes (published for CEN enquiry as prEN 1451-2);
Part 3: Fittings (published for CEN enquiry as prEN 1451-3);
Part 5: Fitness for purpose of the system (published for CEN enquiry as prEN 1451-5).

Part 6: Recommended practice for installation (published for CEN enquiry as prEN 1451-6) is intended to be included in a merged document for the recommended practice for installation of plastics piping systems in the field of soil and waste discharge (low and high temperature) within the building structure. For this document the type of publication as European Prestandard (ENV) was approved by the CEN members.

For Part 7: Assessment of conformity (published for CEN enquiry as prEN 1451-7) the type of publication as European Prestandard (ENV) was approved by the CEN members.

This standard series is 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 Standard.

This Part of EN 1451 includes the following annex:

- Annex A (informative): General characteristics of PP pipes and fittings

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 polypropylene (PP) solid-wall 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").

NOTE 1: The application area "inside buildings" according to this standard, applies to the interior area of the building only. The application area "within the building structure" conforms to the requirements for "inside buildings" according to prEN 12056-1.

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

This standard is applicable to PP pipes and fittings, their joints and to joints with components of other plastics and non-plastics materials intended to be used for 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.

It applies to pipes and fittings, marked with "B", which are intended to be used inside buildings and outside buildings fixed onto the wall.

It applies to pipes and fittings, marked with "BD", which are intended to be used for both inside buildings and buried in ground within the building structure.

NOTE 2: Only components marked with "BD" are generally to be used buried in ground within the building structure; these are required to have a nominal ring stiffness of at least SN 4 and a nominal outside diameter equal to or greater than 75 mm.

NOTE 3: Pipes and fittings of the pipe series S 20 are intended to be used for application area "B" only.

This standard is applicable to PP pipes and fittings of the following types:

- plain-ended;
- with integral elastomeric ring seal socket;
- for butt fusion joints;

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

NOTE 4: Components conforming to any of the Product Standards listed in clause bibliography can be used with pipes and fittings conforming to this standard, provided they conform to the requirements for joint dimensions and to the functional requirements given in this standard.

This standard covers a range of nominal sizes, a range of pipe series and gives recommendations concerning colours.

NOTE 5: It is the responsibility of the purchaser or specifier to make the appropriate selection from these aspects, taking into account their particular requirements and any relevant national regulations and installation practices codes.

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 – Measurements of dimensions and visual inspection of surfaces

EN 681-1
Elastomeric seals – Materials requirements for pipe joint seals used in water and drainage applications – Part 1: Vulcanized rubber

prEN 681-2
Elastomeric seals – Materials requirements for pipe joint seals used in water and drainage applications – Part 2: Thermoplastic elastomers

EN 728
Plastics piping and ducting systems - Polyolefin pipes and fittings - Determination of oxidation induction time

EN 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
Plastics piping systems – Thermoplastics pipes – Determination of resistance to internal pressure at constant temperature

EN 1053
Plastics piping systems – Thermoplastics piping systems for non-pressure applications – Test method for watertightness

EN 1054
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 methods for leaktightness of elastomeric sealing ring type joints

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

prEN 1451-7
Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure – Polypropylene (PP) – Part 7: Assessment of conformity

prEN 1989
Thermoplastics piping and ducting systems – Joints for buried non-pressure applications – Test method for long-term sealing performance of joints with thermoplastic elastomer (TPE) seals by estimating the sealing pressure

EN ISO 9969
Thermoplastics pipes – Determination of ring stiffness (ISO 9969 : 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)

ISO 472 : 1988
Plastics – Vocabulary

ISO 1043-1 : 1997
Plastics – Symbols – Part 1: Basic polymers and their special characteristics

ISO 1133 : 1997
Plastics – Determination of the melt mass-flow rate (MFR) and the melt volume-flow rate (MVR) of thermoplastics

ISO 4065 : 1996
Thermoplastics pipes – Universal wall thickness table

ISO 4440-1 : 1994
Thermoplastics pipes and fittings – Determination of melt mass-flow rate – Part 1: Test method

ISO 4440-2 : 1994
Thermoplastics pipes and fittings – Determination of melt mass-flow rate – Part 2: Test conditions

3 Definitions, symbols and abbreviations

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

3.1 Definitions

The definitions given in ISO 472 : 1988 and ISO 1043-1 : 1997 and the following apply:

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

"B": code for the application area inside buildings and outside buildings fixed onto the wall;

"D": code for the application area under and within one metre from the building where the pipes and fittings are buried in ground.

"BD": code for the application area for both, code "B" and code " D" application areas.

NOTE: In code "BD" application areas the existence of external forces from the surroundings in addition to hot water discharge is usual.

3.1.2 nominal size DN: A numerical designation of the size of a component, which is approximately equal to the manufacturing dimension, in millimetres.

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

3.1.4 nominal outside diameter (d_n): The specified outside diameter, in millimetres, assigned to a nominal size DN/OD.

3.1.5 outside diameter (d_e): The measured outside diameter through its cross-section at any point of a pipe or spigot end of a fitting, rounded to the next greater 0,1 mm.

3.1.6 mean outside diameter (d_{em}): The measured outer circumference of a pipe or spigot end of a fitting in any cross-section square to the pipe axis, divided by π ($\approx$ 3,142), rounded to the next greater 0,1 mm.

3.1.7 mean inside diameter of a socket (d_{sm}): The arithmetical mean of a number of measurements of the inside diameter of a socket in the same cross-section.

3.1.8 wall thickness (e): The measured 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 pipe series S: A dimensionless number for pipe designation (see ISO 4065 : 1996).

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.

3.1.12 copolymer: A polymer derived from more than one species of monomer.

3.1.13 homopolymer: A polymer derived from one species of monomer.

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

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

3.1.16 external reprocessable 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 PP-products other than pipes and fittings, regardless of where they are manufactured.

3.1.17 recyclable material: Material comprising either one of the following forms:

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

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

3.2 Symbols

A	length of engagement
B	length of lead-in
C	depth of sealing zone
DN	nominal size
DN/OD	nominal size, outside diameter related
d_e	outside diameter
d_{em}	mean outside diameter
d_n	nominal outside diameter
d_s	inside diameter of a socket
d_{sm}	mean inside diameter of a socket
e	wall thickness
e_m	mean wall thickness
e_2	wall thickness of a socket
e_3	wall thickness in the groove area
l	effective length of a pipe
l_1	length of spigot
R	radius of swept fittings
z	z-lengths of a fitting
α	nominal angle of a fitting

3.3 Abbreviations

MFR	melt mass-flow rate
OIT	oxidation induction time
PP	polypropylene
PP-H	polypropylene homopolymer
TIR	true impact rate

4 Material

4.1 PP-compound

The compound for pipes and fittings shall be PP-base material (homopolymer or copolymer) to which are added those additives that are needed to facilitate the manufacture of components conforming to the requirements given in this standard.

In order to conform to national requirements on fire regulations other additives may be used.

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

4.2 Reprocessable and recyclable material

In addition to virgin material the use of own reprocessable material obtained during the production and testing of products conforming to this standard is permitted. External reprocessable or recyclable material shall not be used.

4.3 Melt mass-flow rate

The MFR of the base material shall be tested in accordance with ISO 1133 : 1997, condition M (test temperature: 230 °C, loading mass: 2,16 kg).

Pipes and fittings intended to be used for mechanical joints shall be made from materials with an MFR as follows:

$$MFR\ (230/2{,}16) \leq 3{,}0\ g/10\ min.$$

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

Class A:			MFR	≤	0,3 g/10 min;
Class B:	0,3 g/10 min	<	MFR	≤	0,6 g/10 min;
Class C:	0,6 g/10 min	<	MFR	≤	0,9 g/10 min;
Class D:	0,9 g/10 min	<	MFR	≤	1,5 g/10 min.

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

4.4 Thermal stability

When tested in accordance with EN 728 using a test temperature of 200 °C, the oxidation induction time (OIT) of the material used for pipes and fittings intended for butt fusion shall not be less than 8 min.

4.5 Sealing ring retaining means

Sealing rings may be retained using means made from plastics other than PP, provided the joints conform to the requirements given in clause 9.

4.6 Fire behaviour

Pipes and fittings conforming to this standard shall conform to any relevant national requirements on fire regulations.

5 General characteristics

5.1 Appearance

When viewed without magnification the following requirements apply:

- the internal and external surfaces of pipes and fittings shall be smooth, clean and free from grooving, blistering, impurities and pores and any other surface irregularity likely to prevent their conformance to this standard.

- pipe ends shall be cleanly cut and the ends of pipes and fittings shall be square to each axis.

5.2 Colour

The pipes and fittings shall be uniformally coloured throughout their entire thickness. The colours of pipes and fittings should be preferably grey, black or white. Other colours may be used.

6 Geometrical characteristics

6.1 General

Dimensions shall be measured in accordance with prEN 496.

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

6.2 Dimensions of pipes

6.2.1 Outside diameters

The mean outside diameter, d_{em}, shall conform to table 1 or table 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	32,3
40	40	40,0	40,3
50	50	50,0	50,3
63	63	63,0	63,3
75	75	75,0	75,4
80	80	80,0	80,4
90	90	90,0	90,4
100	100	100,0	100,4
110	110	110,0	110,4
125	125	125,0	125,4
160	160	160,0	160,5
200	200	200,0	200,6
250	250	250,0	250,8
315	315	315,0	316,0

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	
		$d_{em,\ min}$	$d_{em,\ max}$
34	34	34,4	34,8
41	41	40,8	41,2
54	54	53,9	54,3

6.2.2 Effective length

The effective length of a pipe *l* shall not be less than that declared by the manufacturer and shall be measured as shown in figure 1.

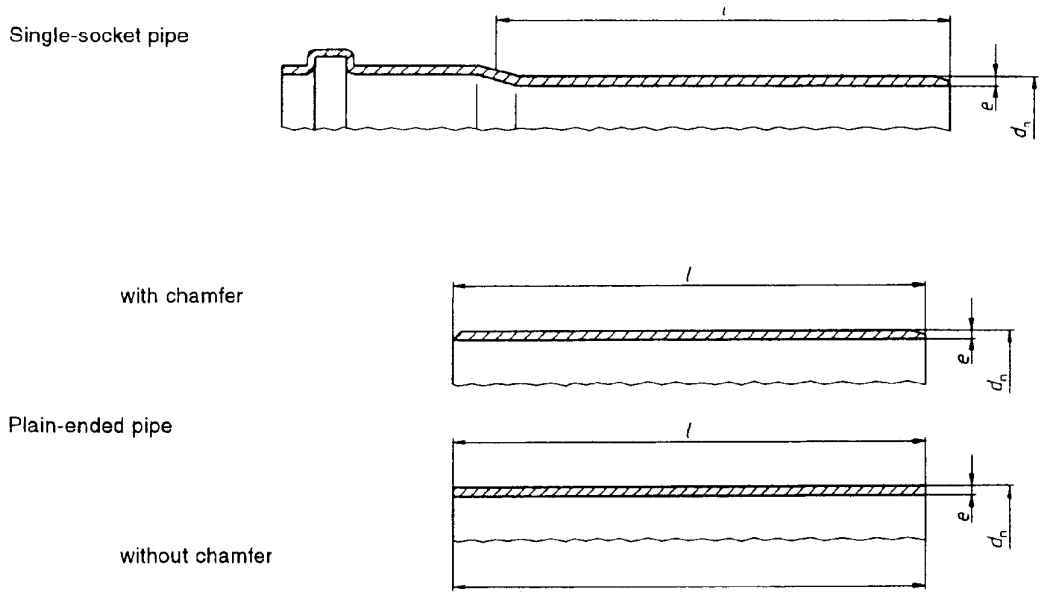


Figure 1: Effective length of pipes

6.2.3 Chamfering

If a chamfer is required, the angle of chamfering shall be between 15° and 45° to the axis of the pipe (see figure 3). When pipes without chamfer are used, the pipe ends shall be deburred.

The remaining wall thickness of the end of the pipe shall be at least ⅓ of e_{min}.

6.2.4 Wall thickness

The wall thickness *e* shall conform to table 3 or table 4, as applicable, where for metric series a maximum wall thickness at any point up to $1{,}25e_{min}$ is permitted, provided that the mean wall thickness 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	Pipe series					
		S 20[1]		S 16		S 14	
		Wall thickness					
	d_n	e_{min}	$e_{m,\,max}$	e_{min}	$e_{m,\,max}$	e_{min}	$e_{m,\,max}$
32	32	1,8	2,2	1,8	2,2	1,8	3,0
40	40	1,8	2,2	1,8	2,2	1,8	3,0
50	50	1,8	2,2	1,8	2,2	1,8	3,0
63	63	1,8	2,2	2,0	2,4	2,2	3,1
75	75	1,9	2,3	2,3	2,8	2,6	3,1
80	80	2,0	2,4	2,5	3,0	2,8	3,3
90	90	2,2	2,7	2,8	3,3	3,1	3,7
100	100	2,5	3,0	3,2	3,8	3,5	4,1
110	110	2,7	3,2	3,4	4,0	3,8	4,4
125	125	3,1	3,7	3,9	4,5	4,3	5,0
160	160	3,9	4,5	4,9	5,6	5,5	6,3
200	200	4,9	5,6	6,2	7,1	–	–
250	250	–	–	7,7	8,7	–	–
315	315	–	–	9,7	10,9	–	–

1) For application area "B" only.

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

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter	Wall thickness [1]	
	d_n	e_{min}	$e_{m,\,max}$
34	34	1,8	2,2
41	41	1,9	2,3
54	54	2,0	2,4

1) For application area "B" only.

6.3 Dimensions of fittings

6.3.1 Outside diameters

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

6.3.2 *z*-lengths

The *z*-length(s) of fittings (see figure 6 to figure 19) shall be given by the manufacturer.

NOTE: The *z*-length of a fitting is intended to assist in the design of moulds and is not intended to be used for quality control purposes. ISO 265-1 : 1988 can be used as a guideline.

6.3.3 Wall thickness

The minimum wall thickness e_{min} of the body or the spigot end of a fitting shall conform to table 3 or table 4, as applicable, except that a reduction of 5 % resulting from core shifting is permitted. In such a case the average of two opposite wall thicknesses shall be equal to or exceed the values given in table 3 or table 4, as applicable.

Where a fitting or adaptor provides for a transition between two nominal sizes, the wall thickness of each connecting part shall conform to the requirements for the applicable nominal size. In such a case the wall thickness of the fitting body is permitted to change gradually from the one wall thickness to the other.

Where a sealing ring is located by means of a retaining cap or ring (see figure 2) 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.

The wall thickness of fabricated fittings, except for spigot end and socket, may be changed locally by the fabrication process, provided that the minimum wall thickness of the body conforms to $e_{3,min}$ as given in table 7 or table 8, as appropriate for the pipe series S concerned.

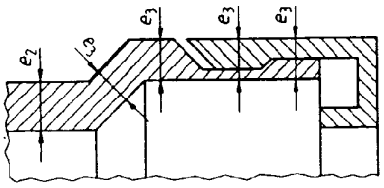


Figure 2: Example for calculation of the wall thickness of sockets with retaining cap

6.4 Dimensions of sockets and pipe ends

6.4.1 Dimensions of ring seal sockets and spigot ends

6.4.1.1 Diameters and lengths

The diameters and lengths of ring seal sockets and spigot ends (see figure 3, figure 4 or figure 5) shall conform to table 5 or table 6, as applicable, and shall be in accordance with the following conditions:

a) Where sealing rings are firmly retained, the dimensions for the minimum value for *A* and the maximum value for *C* shall be measured to the effective sealing point (see figure 5 as an example). This point shall give a full sealing action.

b) Where sealing rings are firmly retained, requirements for dimension *B* (see figure 4) do not apply.

Different designs of ring seal sockets (see figure 4) are permitted, provided the joints conform to the requirements given in clause 9.

Table 5: Diameters and lengths of ring seal sockets and spigot ends
(metric series)

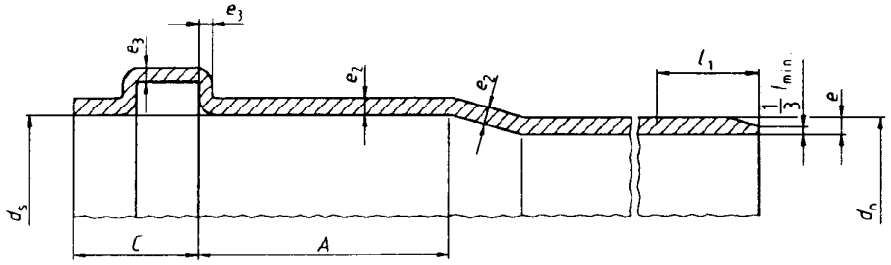
Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter	Socket				Spigot end
	d_n	$d_{sm,min}$	A_{min}	B_{min}	C_{max}	$l_{1,min}$
32	32	32,3	24	5	18	42
40	40	40,3	26	5	18	44
50	50	50,3	28	5	18	46
63	63	63,3	31	5	18	49
75	75	75,4	33	5	18	51
80	80	80,4	34	5	19	53
90	90	90,4	34	5	20	54
100	100	100,4	35	5	21	56
110	110	110,4	36	6	22	58
125	125	125,4	38	7	26	64
160	160	160,5	41	9	32	73
200	200	200,6	45	12	40	85
250	250	250,8	68	15	50	118
315	315	316,0	81	19	63	144

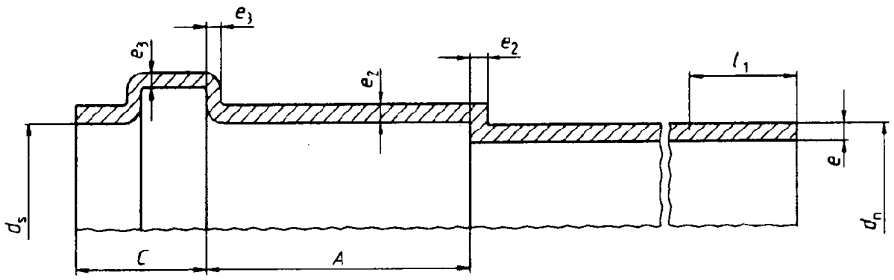
Table 6: Diameters and lengths of ring seal sockets and spigot ends
(series based on inch dimensions)

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter	Socket				Spigot end
	d_n	$d_{sm,min}$	A_{min}	B_{min}	C_{max}	$l_{1,min}$
34	34	34,8	25	3,8	12	37
41	41	41,2	25	3,8	15	40
54	54	54,3	25	3,8	18	43



Ring seal socket with chamfer



Ring seal socket without chamfer

Figure 3: Dimensions of sockets and spigot ends for ring seal joints

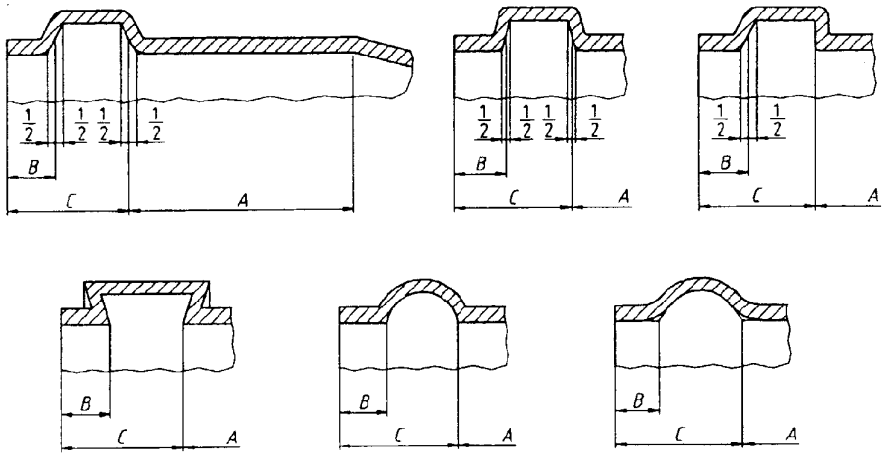


Figure 4: Typical groove designs for ring seal sockets

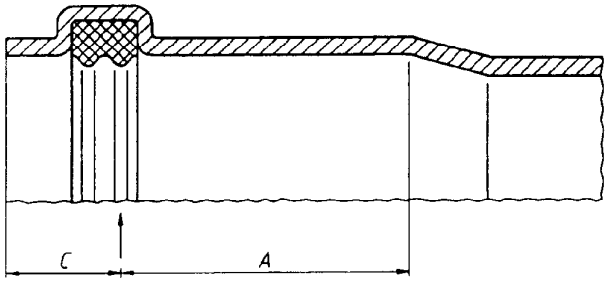


Figure 5: Effective sealing point

6.4.1.2 Wall thickness of ring seal sockets

The wall thickness of the socket e_2 and the wall thickness in the groove area e_3 shall conform to table 7 or table 8, as applicable.

Table 7: Wall thickness of sockets
(metric series)

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter	Pipe series					
		S 20[1)]		S 16		S 14	
		Wall thickness					
	d_n	$e_{2,\,min}$	$e_{3,\,min}$	$e_{2,\,min}$	$e_{3,\,min}$	$e_{2,\,min}$	$e_{3,\,min}$
32	32	1,6	1,0	1,6	1,0	1,6	1,0
40	40	1,6	1,0	1,6	1,0	1,6	1,0
50	50	1,6	1,0	1,6	1,0	1,6	1,0
63	63	1,6	1,0	1,7	1,1	2,0	1,3
75	75	1,7	1,1	2,1	1,3	2,4	1,5
80	80	1,7	1,1	2,3	1,4	2,6	1,6
90	90	2,0	1,3	2,6	2,1	2,8	2,4
100	100	2,3	1,4	2,8	2,4	3,2	2,7
110	110	2,4	1,5	3,1	2,6	3,5	2,9
125	125	2,8	1,8	3,6	3,0	3,9	3,3
160	160	3,5	2,2	4,5	3,7	5,0	4,2
200	200	4,4	2,7	5,6	4,7	–	–
250	250	–	–	7,0	5,8	–	–
315	315	–	–	8,8	7,3	–	–

1) For application area "B" only.

Table 8: Wall thicknesses of sockets
(series based on inch dimensions)

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter d_n	Wall thicknesses[1)]	
		$e_{2,\,min}$	$e_{3,\,min}$
34	34	1,7	1,0
41	41	1,8	1,1
54	54	1,8	1,1
1) For application area "B" only.			

6.4.2 Dimensions of pipe ends for butt fusion joints

The mean outside diameter d_{em} and the wall thickness e of pipes with plain ends intended to be used for butt fusion joints shall conform to the same pipe series S, as specified in this standard.

6.5 Types of fittings

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

a) Bends (see figures 6, 7, 8, 9, 10 or 11)

- unswept or swept angle (see ISO 265-1 : 1988);
- spigot/socket or socket/socket;
- butt fused from segments.

The fixed nominal angle α should be as follows: 15°, 22,5°, 30°, 45°, 67,5°, 80° or 87,5° to 90°.

b) Branches and reducing branches (branching single or multiple)
(see figures 12, 13, 14, 15, 16 or 17)

- unswept or swept angle (see ISO 265-1 : 1988);
- spigot/socket or socket/socket.

The fixed nominal angle α should be as follows: 45°, 67,5° or 87,5° to 90°.

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

c) Reducers (see figure 18);

d) Access fittings (see figure 19);

The inside diameter of the cleaning hole shall be as specified by the manufacturer.

e) Couplers

- Double socket (see figure 20);
- Repair collar (see figure 21);

f) Push-fit socket for butt fusion for pipe ends (see figure 22)

g) Plugs (see figure 23).

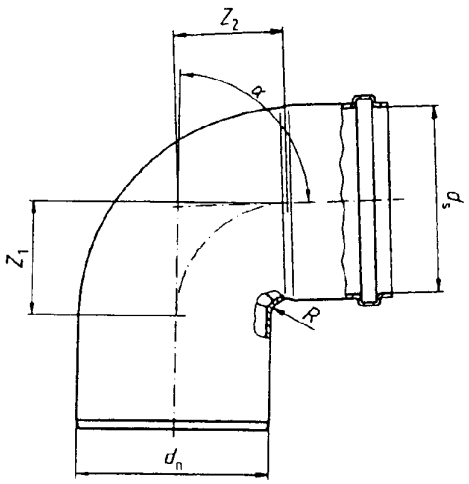


Figure 6: Bend with single socket
(unswept)

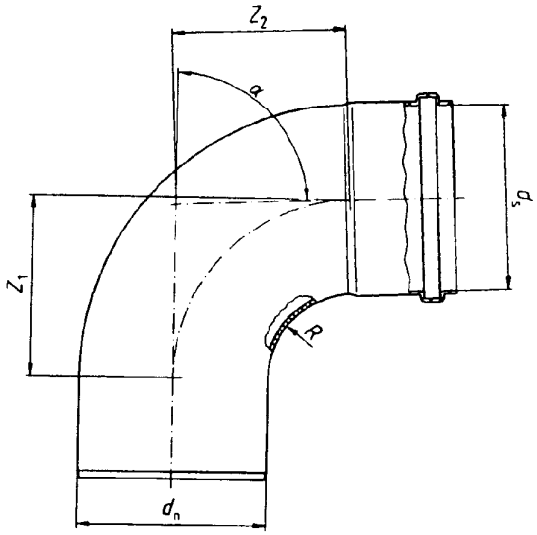


Figure 7: Bend with single socket
(swept)

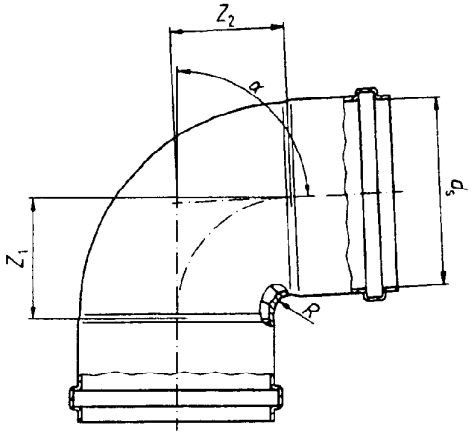


Figure 8: Bend with all sockets
(unswept)

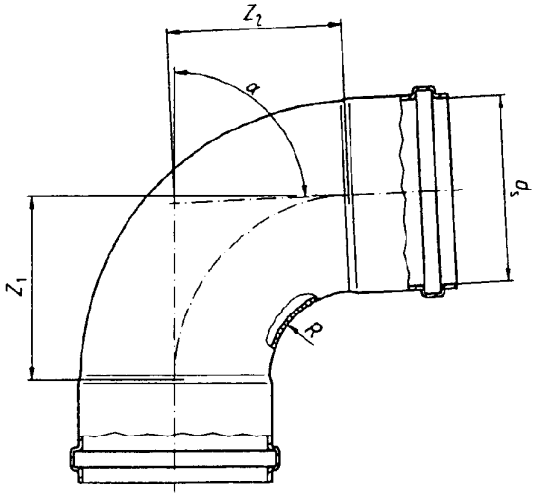


Figure 9: Bend with all sockets
(swept)

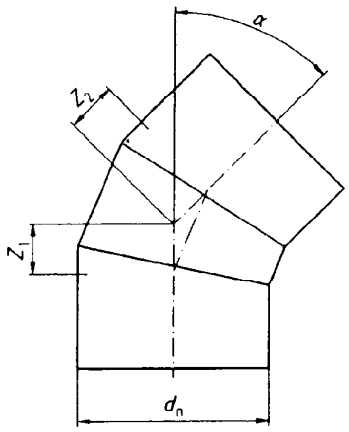


Figure 10: Bend, butt fused from segments

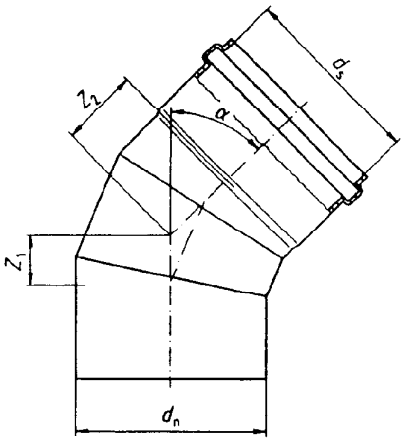


Figure 11: Bend with single socket, butt fused from segments

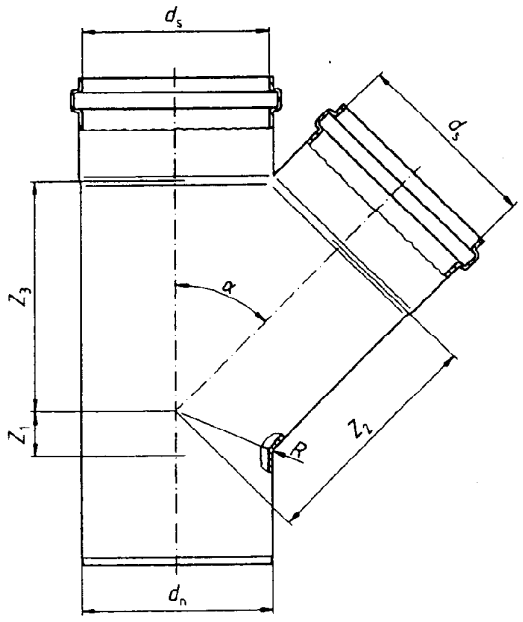


Figure 12: Branch (unswept)

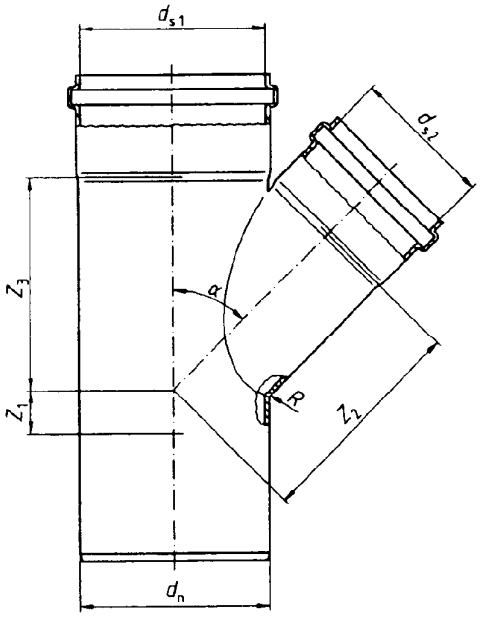


Figure 13: Reducing branch (unswept)

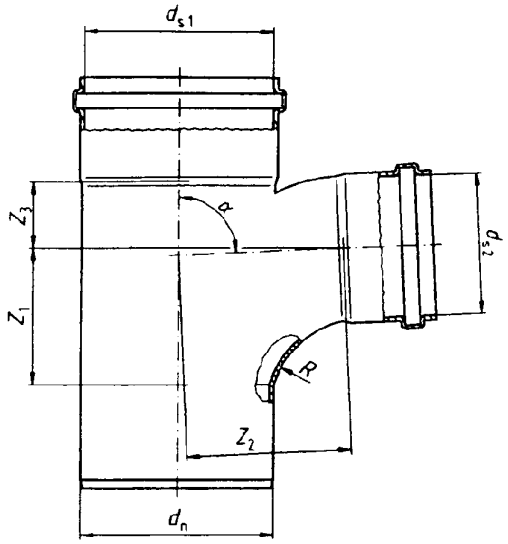


Figure 14: Reducing branch (swept)

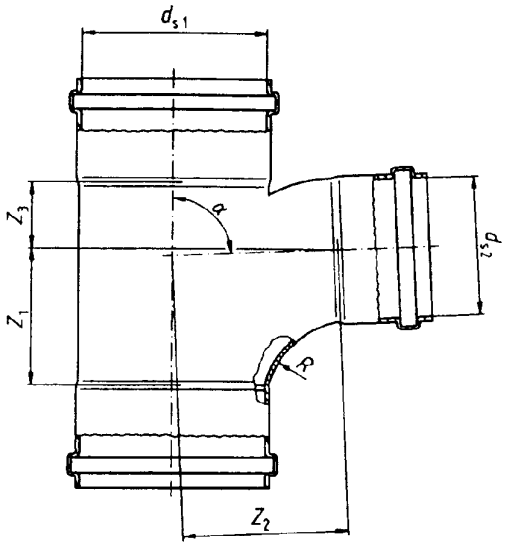


Figure 15: Reducing branch with all sockets (swept)

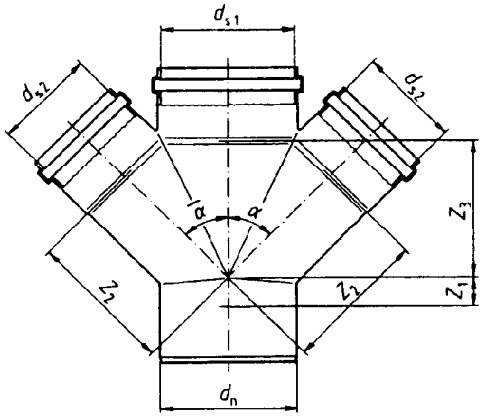


Figure 16: Double branch

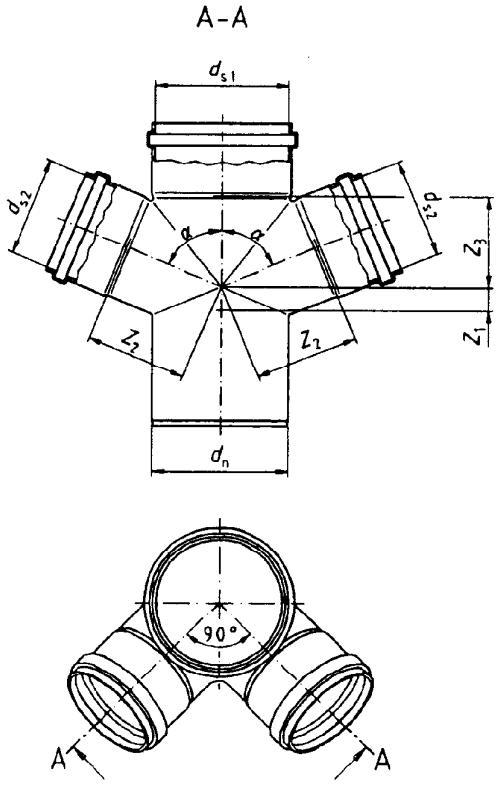


Figure 17: Angular double branch

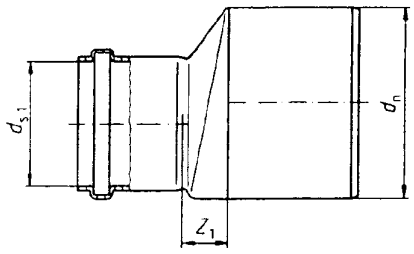


Figure 18: Reducer

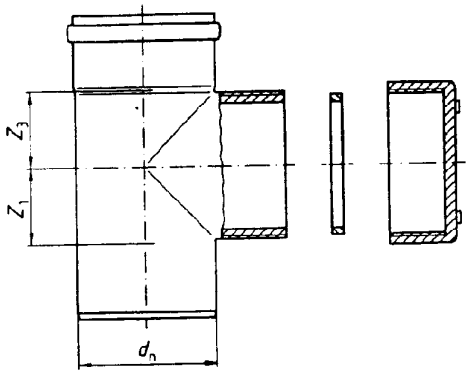


Figure 19: Access fitting with round cleaning hole

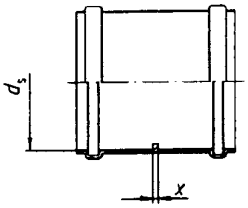


Figure 20: Double socket

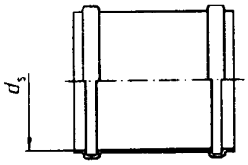


Figure 21: Repair collar

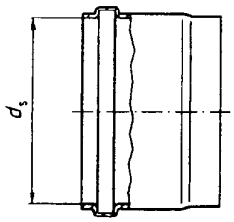


Figure 22: Push-fit socket for butt fusion of pipe ends

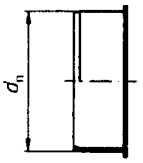


Figure 23: Plug

7 Mechanical characteristics of pipes

7.1 General characteristics

When tested in accordance with the test method as specified in table 9 using the indicated parameters, the pipe shall have general mechanical characteristics conforming to the requirements given in table 9.

The mass and fall height of striker for determining the impact resistance (round-the-clock method) as specified in table 9 are given in table 10 or table 11, as applicable.

Table 9: General mechanical characteristics of pipes

Characteristic	Requirement	Test parameters		Test method
PP-copolymer: Impact resistance [1] (round-the-clock method)	TIR ≤ 10 %	Mass of striker Fall height of striker Type of striker for: d_n < 110 mm d_n ≥ 110 mm Conditioning medium Conditioning temperature Conditioning period Sampling procedure	Tables 10 or 11 Tables 10 or 11 d 25 d 90 Water or air (0 ± 1) °C 60 min prEN 1451-7	EN 744 : 1995
PP-H: Impact resistance (round-the-clock method)	TIR ≤ 10 %	Mass of striker Fall height of striker Type of striker for: d_n < 110 mm d_n ≥ 110 mm Conditioning medium Conditioning temperature Conditioning period Sampling procedure	Tables 10 or 11 Tables 10 or 11 d 25 d 90 Air (23 ± 2) °C 60 min prEN 1451-7	EN 744 : 1995

1) In case of indirect testing (see prEN 1451-7) the preferred temperature is (23 ± 2) °C.

Table 10: Masses and fall heights of striker for impact resistance
(round-the-clock method)
(metric series)

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter d_n	Mass of striker kg $^{+0,01}_{0}$	Fall height of striker $^{+20}_{0}$
32	32	0,5	600
40	40	0,5	800
50	50	0,5	1 000
63	63	0,8	1 000
75	75	0,8	1 000
80	80	0,8	1 000
90	90	0,8	1 200
100	100	0,8	1 200
110	110	1,0	1 600
125	125	1,25	2 000
160	160	1,6	2 000
200	200	2,0	2 000
250	250	2,5	2 000
315	315	3,2	2 000

Table 11: Masses and fall heights of striker for impact resistance
(round-the-clock method)
(series based on inch dimensions)

Dimensions in millimetres

Nominal size DN/OD	Nominal outside diameter d_n	Mass of striker kg $^{+0,01}_{0}$	Fall height of striker $^{+20}_{0}$
34	34	0,5	600
41	41	0,5	800
54	54	0,5	1000

7.2 Additional characteristics

Pipes made from PP-copolymers intended to be used in areas where installation is usually carried out at temperatures below -10 °C, shall additionally conform to the requirements of an impact test (staircase method) as specified in table 12.

The pipes shall be marked in accordance with table 19.

Table 12: Additional mechanical characteristics of pipes

Characteristic	Requirements	Test parameters		Test method
Impact resistance[1)] (staircase method)	$H_{50} \geq 1$m max one break below 0,5 m	Conditioning and test temperature Type of striker Mass of striker for: 32 mm ≤ d_n ≤ 41 mm 50 mm ≤ d_n ≤ 63 mm 75 mm ≤ d_n ≤ 80 mm 90 mm ≤ d_n ≤ 100 mm d_n = 110 mm d_n = 125 mm d_n = 160 mm d_n = 200 mm $d_n \geq$ 250 mm	(0 ± 1) °C d 90 kg: 1,25 2,0 2,5 3,2 4,0 5,0 8,0 10,0 12,5	EN 1411
1) For PP-copolymer only.				

8 Physical characteristics

8.1 Physical characteristics of pipes

When tested in accordance with the test methods as specified in table 13 using the indicated parameters, the pipe shall have physical characteristics conforming to the requirements given in table 13.

Table 13: Physical characteristics of pipes

Characteristic	Requirements	Test parameters		Test method
Longitudinal reversion	≤ 2 % The pipe shall exhibit no bubbles or cracks	Test temperature Immersion time	(150 ± 2) °C 30 min	EN 743 : 1994 Method A[1)] Liquid
		or		
		Test temperature Immersion time	(150 ± 2) °C 60 min	EN 743 : 1994 Method B[1)] Air
Melt mass-flow rate (MFR-value)	Permitted max. deviation when processing the compound into a pipe: 0,2 g/10 min	Condition 12: Test temperature Reference time Loading mass	 230 °C 10 min 2,16 kg	ISO 4440-1 : 1994 together with ISO 4440-2 : 1994
1) The choice of method A or method B is in the responsibility of the manufacturer.				

8.2 Physical characteristics of fittings

When tested in accordance with the test methods as specified in table 14 and table 15 using the indicated parameters, the fittings shall have physical characteristics conforming to the requirements given in table 14 or table 15, as applicable.

Table 14: Physical characteristics of fittings

Characteristic	Requirements	Test parameters		Test method
Effects of heating	1) 2) 3)	Test temperature Heating time	(150 ± 2) °C 30 min	EN 763 : 1994 Method A Air oven
1) The depth of cracks, delamination or blisters shall not be more than 20 % of the wall thickness around the injection point(s). No part of the weld line shall be open to a depth of more than 20 % of the wall thickness. 2) When fittings are manufactured from pipes, the pipes shall conform to the requirements given in table 9 and table 13. 3) Mouldings that are used for fabricated fittings may be tested separately.				

Table 15: Physical characteristics of fabricated fittings

Characteristic	Requirement	Test parameters		Test method
Watertightness[1)]	No leakage	Water pressure Duration	0,5 bar [2)] 1 min	EN 1053
1) Only for fabricated fittings made from more than one piece. A sealing ring retaining mean is not considered as a piece. 2) 1 bar = 100 kPa				

9 Performance requirements

When tested in accordance with the test methods as specified in table 16 using the indicated parameters, the joints and the system shall have fitness for purpose characteristics conforming to the requirements given in table 16.

Table 16: Fitness for purpose characteristics of the system

Characteristic	Requirements	Test parameters		Test method
Watertightness[1)]	No leakage	Shall conform to EN 1053		EN 1053
Airtightness[1)]	No leakage	Shall conform to EN 1054		EN 1054
Application area "B": Elevated temperature cycling	No leakage before and after the test; Sagging: DN ≤ 50: ≤ 3 mm DN > 50: 0,05d_n	Shall conform to EN 1055		EN 1055 : 1996 Test assembly a) (figure 1 and/or figure 3)
Application area "BD": Elevated temperature cycling	No leakage before and after the test; Sagging: DN ≤ 50: ≤ 3 mm DN > 50: 0,05d_n	Shall conform to EN 1055		EN 1055 : 1996 Test assembly b) (figure 2)
Application area "BD": Tightness of elastomeric ring seal joints		Test temperature Spigot deflection Socket deflection Difference	(23 ± 5)°C ≥ 10% ≥ 5% ≥ 5%	EN 1277 : 1996 Method 4 Condition B
	No leakage	Water pressure	0,05 bar	
	No leakage	Water pressure	0,5 bar	
	≤ - 0,27 bar	Air pressure	- 0,3 bar	
		Test temperature Angular deflection	(23 ± 5)°C 2°	EN 1277 : 1996 Method 4 Condition C
	No leakage	Water pressure	0,05 bar	
	No leakage	Water pressure	0,5 bar	
	≤ - 0,27 bar	Air pressure	- 0,3 bar	
Application area "BD": Long-term performance of TPE seals	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
1) Not required for butt fusion joints.				

10 Requirements for application area "BD"

10.1 General

Pipes and fittings intended to be used for application area "BD" shall conform to the requirements for application area "B" and additionally to the requirements given in this clause.

If national regulations require for use buried in ground within the building structure greater nominal outside diameters than 75 mm, these dimensions shall be taken into account.

For butt fusion joints, only those pipes and fittings (marked with "BD") shall be used which are suitable for use inside buildings and buried in ground within the building structure.

10.2 Material characteristics

The material for pipes and fittings used for application area "BD" shall conform to the requirements for resistance to internal pressure as specified in table 17. The material shall be tested in the form of a pipe.

Table 17: Material characteristics

Characteristic	Requirement	Material type and test designation	Test parameters		Test method
Resistance to internal pressure	No failure during the test period	PP-H: Test at 140 h at 80 °C	End caps Test temperature Orientation Sampling sizes and series Number of test pieces Circumferential (hoop) stress Conditioning period Type of test Test period	Types a or b (80 ± 1) °C free prEN 1451-7 3 6,0 MPa 60 min Water- in -water ≥ 140 h	EN 921
		PP-H: Test at 1000 h at 95 °C	End caps Test temperature Orientation Sampling sizes and series Number of test pieces Circumferential (hoop) stress Conditioning period Type of test Test period	Types a or b (95 ± 1) °C free prEN 1451-7 3 3,5 MPa 60 min Water- in- water ≥ 1000 h	
		PP- copolymer: Test at 140 h at 80 °C	End caps Test temperature Orientation Sampling sizes and series Number of test pieces Circumferential (hoop) stress Conditioning period Type of test Test period	Types a or b (80 ± 1) °C free prEN 1451-7 3 4,2 MPa 60 min Water- in- water ≥ 140 h	
		PP- copolymer: Test at 1000 h at 95 °C	End caps Test temperature Orientation Sampling sizes and series Number of test pieces Circumferential (hoop) stress Conditioning period Type of test Test period	Types a or b (95 ± 1) °C free prEN 1451-7 3 2,5 MPa 60 min Water- in- water ≥ 1000 h	

10.3 Mechanical characteristics

Pipes used for application area "BD" shall conform to the requirements for ring stiffness as specified in table 18.

Table 18: Mechanical characteristics

Characteristic	Requirement	Test parameters		Test method
Ring stiffness	SN ≥ 4 kN/m²	Test temperature	(23 ± 2) °C	EN ISO 9969
		Deflection	3 %	
		Deflection speed for:		
		75 mm ≤ d_n ≤ 110 mm	(2 ± 0,4) mm/min	
		110 mm < d_n ≤ 200 mm	(5 ± 1,0) mm/min	
		200 mm < d_n ≤ 315 mm	(10 ± 2,0) mm/min	

11 Sealing rings

11.1 Various designs of sealing rings for ring seal sockets are permitted provided that the joints conform to the requirements as specified in clause 9.

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

11.2 The sealing ring shall not have any detrimental effects on the properties of the pipe or fitting.

11.3 Thermoplastics elastomer (TPE) seals for application area "BD" shall additionally conform to the long-term performance requirements as specified in clause 9.

12 Marking

12.1 General

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

One of the following two levels of legibility of the marking on the components are specified for the individual marking aspects given in table 19 and table 20, as applicable. The required durability of marking is coded as follows:

The symbols for the legibility mean the following:

a: durable in use;
b: legible until the system is installed.

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

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

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

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

12.1.5 If pipes and fittings according to this standard are certified by an independant third party, they may be marked accordingly.

12.2 Minimum required marking of pipes

The minimum required marking of pipes shall conform to table 19.

Pipes shall be marked at intervals of maximum 1m, at least once per pipe. Pipes with a length less than 1 m may be marked with a label at least once per pipe.

Table 19: Minimum required marking of pipes

Aspects	Marking or symbol	Minimum durability of legibility of marking
– Number of the standard	EN 1451	a
– Manufacturer's name and/or trade mark	XXX	a
– Nominal size	e.g. DN 110	a
– Minimum wall thickness	e.g. 3,4	a
– Material [1]	PP or PP-H	a
– Application area code	"B" or "BD"	a
– For application area "BD": Pipe series	e.g. S 16	a
– MFR-class [2]	e.g. MFR-A	a
– Cold climate performance [3]	* (ice crystal)	b
– Manufacturer's information	[4]	a

1) Pipes which are marked "PP" are made from PP-copolymer. Pipes made from PP-homopolymer shall be marked "PP-H".
2) For pipes intended for butt fusion.
3) This marking is only applicable to pipes which by testing have proved to conform to 7.2.
4) For providing traceability the following details shall be given:
   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 at different sites.

12.3 Minimum required marking of fittings

The minimum required marking of fittings shall conform to table 20, whereby the manufacturer's information can be either on the fitting or on the packaging. If the manufacturer's information is on the packaging it shall be determined by national requirements.

Table 20: Minimum required marking of fittings

Aspects	Marking or symbol	Minimum durability of legibility of marking
– Number of the standard	EN 1451	b
– Manufacturer's name and/or trade mark	XXX	a
– Nominal size	e.g. DN 110	a
– Nominal angle	e.g. 67,5°	b
– Material[1)]	PP or PP-H	a
– Application area code	"B" or "BD"	a
– For application area "BD":		
Minimum wall thickness or pipe series	e.g. 3,4 or S 16	a
– MFR-class[2)]	MFR-A	a
– Manufacturer's information	[3)]	b

1) Fittings which are marked "PP" are made from PP-copolymer.
Fittings made from PP-homopolymer shall be marked "PP-H".
2) For fittings intended for butt fusion.
3) 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 at different sites.

13 Installation of piping systems

For the installation of pipes and fittings conforming to this standard, national and/or local requirements and relevant codes of practice apply.

In addition the pipe manufacturer may give a recommended practice for installation which refers to transport, storage and handling of the pipes and fittings as well as to the installation in accordance with the applicable national and/or local instructions.

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

Due to the limited impact strength at low temperatures pipes and fittings made from PP-homopolymer are not intended to be installed at temperatures below +5 °C.

Annex A (informative)

General characteristics of PP pipes and fittings

A.1 General

EN 476 specifies the general requirements for components used in discharge pipes, drains and sewers for gravity systems. Pipes and fittings conforming to this standard fully meet these requirements. Further the following information is given.

A.2 Material characteristics

Pipes and fittings conforming to this standard have generally these characteristics:

– Modulus of elasticity	$E_{(1\ min)} \geq 1200$ MPa;
– Average density	$\approx 0{,}9$ g/cm^3;
– Average coefficient of linear thermal expansion	$\approx 0{,}14$ mm/m·K;
– Thermal conductivity	$\approx 0{,}2$ W/m·K;
– Specific heat capacity	≈ 2000 J/kg·K;
– Surface resistance	$> 10^{13}$ Ω.

A.3 Ring stiffness

The ring stiffness of pipes conforming to this standard is determined in accordance with EN ISO 9969 and is as follows:

≥ 4 kN/m^2 for S 16;
$\geq 6{,}3$ kN/m^2 for S 14.

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

The actual value of stiffness of the fittings can be determined in accordance with ISO/DIS 13967 : 1995.

A.4 Chemical resistance

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

If piping systems conforming to this standard are to be used for chemical contaminated waste water, such as industrial discharges, chemical and temperature resistance have to be taken into account.

For information about the chemical resistance of PP guidance is given in ISO/TR 10358 : 1993 and for rubber materials in ISO 7620 : 1986.

Bibliography

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

prEN 1329
Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure – Unplasticized poly(vinyl chloride) (PVC-U)

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

prEN 1451-6
Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure – Polypropylene (PP) – Part 6: Recommended practice for installation

prEN 1453
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
Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure – Acrylonitrile-butadiene-styrene (ABS)

EN 1519
Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure – Polyethylene (PE)

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

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

EN 1852-1
Plastics piping systems for non-pressure underground drainage and sewerage - Polypropylene (PP) - Part 1: Specifications for pipes, fittings and the system

prEN 12056-1
Gravity drainage systems inside buildings – Part 1: Scope, definitions, general and performance requirements

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

ISO 7620 : 1986
Rubber materials – Chemical resistance

ISO/TR 10358 : 1993
Plastics pipes and fittings – Combined chemical resistance classification table

ISO/DIS 13967 : 1995
Plastics piping systems – Thermoplastics fittings – Determination of the short-term stiffness

RAL 840-HR[1)]
Colour register

[1)] Obtainable at the national standard institutes