INTERNATIONAL STANDARD

ISO 1452-3

First edition
2009-12-01

Corrected version
2010-03-01

Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure — Unplasticized poly(vinyl chloride) (PVC-U) —

Part 3: **Fittings**

Systèmes de canalisations en plastique pour l'alimentation en eau, pour branchements et collecteurs d'assainissement enterrés et aériens avec pression — Poly(chlorure de vinyle) non plastifié (PVC-U) —

Partie 3: Raccords

Reference number
ISO 1452-3:2009(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 1452-3 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 155, *Plastics piping systems and ducting systems*, in collaboration with ISO Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Subcommittee SC 2, *Plastics pipes and fittings for water supplies*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This first edition cancels and replaces ISO 4422-3:1996, ISO 264:1976, ISO 264:1976/Add.1:1982, ISO 2045:1988, ISO 2048:1990, ISO 3460:1975, ISO 4434:1977 and ISO 6455:1983, which have been technically revised.

ISO 1452 consists of the following parts, under the general title *Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure — Unplasticized poly(vinyl chloride) (PVC-U)*:

— *Part 1: General*

— *Part 2: Pipes*

— *Part 3: Fittings*

— *Part 4: Valves*

— *Part 5: Fitness for purpose of the system*

Guidance for the assessment of conformity is to form the subject of a part 7.

This corrected version of ISO 1452-3:2009 incorporates the correction of Figure 8 c).

Introduction

The System Standard, of which this is Part 3, specifies the requirements for a piping system and its components made from unplasticized poly(vinyl chloride) (PVC-U). The piping system is intended to be used for water supply and for buried and above-ground drainage and sewerage under pressure.

In respect of potential adverse effects on the quality of water intended for human consumption, caused by the products covered by this part of ISO 1452, the following are relevant.

a) This part of ISO 1452 provides no information as to whether the products may be used without restriction.

b) Existing national regulations concerning the use and/or the characteristics of these products remain in force.

Requirements and test methods for material and components, other than fittings, are specified in ISO 1452-1, ISO 1452-2 and ISO 1452-4. Characteristics for fitness for purpose (mainly for joints) are established in ISO 1452-5.

This part of ISO 1452 specifies the characteristics of fittings.

Guidance for installation is given in ISO/TR 4191[1].

Guidance for the assessment of conformity is provided in ENV 1452-7[2].

For the convenience of users of this part of ISO 1452, marking on fittings and flanges according to withdrawn International Standards (e.g. ISO 4422-3:1996) may be considered valid for a period, e.g. up to three years from the date of publication of this part of ISO 1452.

Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure — Unplasticized poly(vinyl chloride) (PVC-U) —

Part 3: Fittings

1 Scope

This part of ISO 1452 specifies the characteristics of fittings made from unplasticized poly(vinyl chloride) (PVC-U) for piping systems intended for water supply and for buried and above-ground drainage and sewerage under pressure.

It also specifies the test parameters for the test methods referred to in this part of ISO 1452.

In conjunction with ISO 1452-1, ISO 1452-2 and ISO 1452-5, it is applicable to PVC-U fittings and to joints with components of PVC-U, other plastics and non-plastics materials intended to be used for the following:

a) water mains and services buried in the ground;

b) conveyance of water above ground for both outside and inside buildings;

c) buried and above-ground drainage and sewerage under pressure.

It is applicable to fittings in piping systems intended for the supply of water under pressure up to and including 25 °C (cold water), intended for human consumption and for general purposes as well as for waste water under pressure.

This part of ISO 1452 is also applicable to components for the conveyance of water and waste water up to and including 45 °C. For temperatures between 25 °C and 45 °C, Figure A.1 of ISO 1452-2:2009 applies.

NOTE 1 The producer and the end-user can come to agreement on the possibilities of use for temperatures above 45 °C on a case-by-case basis.

Depending on the jointing method, this part of ISO 1452 is applicable to the following types of fittings:

— fittings for solvent cementing;

— elastomeric ring seal fittings.

PVC-U fittings can be manufactured by injection-moulding and/or be fabricated from pipe.

This part of ISO 1452 is also applicable to PVC-U flange adapters and to the corresponding flanges made from various materials.

This part of ISO 1452 covers a range of fitting sizes and pressure classes and gives requirements concerning colours.

NOTE 2 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.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 7-1:1994, *Pipe threads where pressure-tight joints are made on the threads — Part 1: Dimensions, tolerances and designation*

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

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

ISO 1167-3, *Thermoplastics pipes, fittings and assemblies for the conveyance of fluids — Determination of the resistance to internal pressure — Part 3: Preparation of components*

ISO 1183-1:2004, *Plastics — Methods for determining the density of non-cellular plastics — Part 1: Immersion method, liquid pyknometer method and titration method*

ISO 1452-1:2009, *Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure — Unplasticized poly(vinyl chloride) (PVC-U) — Part 1: General*

ISO 1452-2:2009, *Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure — Unplasticized poly(vinyl chloride) (PVC-U) — Part 2: Pipes*

ISO 1452-5, *Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure — Unplasticized poly(vinyl chloride) (PVC-U) — Part 5: Fitness for purpose of the system*

ISO 2507-1:1995, *Thermoplastics pipes and fittings — Vicat softening temperature — Part 1: General test method*

ISO 2507-2:1995, *Thermoplastics pipes and fittings — Vicat softening temperature — Part 2: Test conditions for unplasticized poly(vinyl chloride) (PVC-U) or chlorinated poly(vinyl chloride) (PVC-C) pipes and fittings and for high impact resistance poly(vinyl chloride) (PVC-HI) pipes*

ISO 3126, *Plastics piping systems — Plastics components — Determination of dimensions*

ISO 7686, *Plastics pipes and fittings — Determination of opacity*

ISO 13783, *Plastics piping systems — Unplasticized poly(vinyl chloride) (PVC-U) end-load-bearing double-socket joints — Test method for leaktightness and strength while subjected to bending and internal pressure*

EN 802, *Plastics piping and ducting systems — Injection-moulded thermoplastics fittings for pressure piping systems — Test method for maximum deformation by crushing*

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms, definitions, symbols and abbreviated terms given in ISO 1452-1 and the following apply.

3.1.1
laying length
Z-length
⟨socketed outlet⟩ distance from the inserted tube or spigot end to the intersection point of the fitting/valve axis (fitting or valve centre)

3.1.2
laying length
Z-length
⟨spigot outlet⟩ distance from the outlet end to the intersection point of the fitting/valve axis (fitting or valve centre)

3.1.3
laying length
Z-length
⟨socket with parallel outlets⟩ distance between the ends of the inserted tubes or spigots

3.1.4
laying length
Z-length
⟨one socket and one spigot with parallel outlets⟩ distance from the inserted tube or spigot end to the end of the spigot outlet

3.1.5
design length of bends
Z_d-length
length of an outlet, excluding any socket length or insert length of spigot

3.2 Symbols

Z Laying length (*Z*-length)

Z_d *Z*-design length (Z_d-length)

r bend radius

4 Material

4.1 Fitting material

The fitting material used shall conform to ISO 1452-1 and to the requirements given in 4.2 and 4.3.

4.2 Density

The density, ρ, at 23 °C of the fitting, when measured in accordance with ISO 1183-1, shall be between the following limits:

$$1\,350\ \text{kg/m}^3 \leqslant \rho \leqslant 1\,460\ \text{kg/m}^3$$

4.3 MRS-value

The fitting material shall have a minimum required strength, MRS, as defined in ISO 1452-1:2009, 4.4.1.

The manufacturer of the compound or formulation shall confirm the MRS by testing as described in ISO 1452-1:2009, 4.4.1, 4.4.2 or 4.4.3, respectively.

The MRS value of the fitting material shall be declared by the fitting manufacturer in its technical file.

5 General characteristics

5.1 Appearance

When viewed without magnification, the internal and external surfaces of fittings shall be smooth, clean and free from scoring, cavities and other surface defects to an extent that would prevent conformity to this part of ISO 1452.

Each end of a fitting shall be square to its axis.

5.2 Colour

The colour of injection-moulded fittings shall be grey throughout the wall for water supply, and grey or brown for drainage and sewerage under pressure.

The colour of fittings made from pipes shall be grey, blue or cream throughout the wall for water supply, and grey or brown for drainage and sewerage under pressure.

5.3 Opacity of fittings intended for the above-ground conveyance of water

The wall of the fittings shall be opaque and shall not transmit more than 0,2 % of visible light when measured in accordance with ISO 7686.

6 Geometrical characteristics

6.1 Measurement of dimensions

Dimensions shall be measured in accordance with ISO 3126.

6.2 Nominal diameters

The nominal inside diameter(s), d_n, of a fitting shall correspond to, and be designated by, the nominal outside diameter(s) of the pipe(s) for which the fitting is designed.

6.3 Fittings for solvent cementing

6.3.1 Socket and spigot dimensions

The socket dimensions of the fittings shall be the same as for sockets on pipes and shall conform to ISO 1452-2:2009.

The spigot length(s) shall be at least equal to the corresponding socket length(s).

The tolerance on the diameter of the spigot ends, d_2, of reducing bushes (see Table 7) shall always be positive and be as follows:

— maximum 0,2 mm for diameters equal to or less than 90 mm;

— maximum 0,3 mm for diameters 110 mm to 160 mm;

— maximum 0,4 mm for diameters 180 mm to 225 mm;

— maximum 0,5 mm for diameters 250 mm to 315 mm.

6.3.2 Diameters, laying lengths, bend radii and angles

6.3.2.1 For the following types of injection-moulded fittings, the Z-lengths shall be calculated using one of Equations (1), (2), (3), (4), (5), (6), (7) or (8), as applicable, where α is the angle of the elbow and r is the radius of the bend.

a) 90° elbows, 90° tees (see Table 1): $$Z = \frac{d_n}{2} + 1 \quad (1)$$

b) 45° elbows (see Table 1): $$Z = \frac{d_n}{2} \tan\frac{\alpha}{2} + 1 \quad (2)$$

c) 45° tee (see Table 1): $$Z = \frac{d_n}{2} \cot\frac{\alpha}{2} + t \quad (3)$$

with d_n, $\leqslant$ 90 mm, 110 mm, 125 mm, 140 mm, 160 mm and t = 3, 4, 6, 6, 7

$$Z_1 = \frac{d_n}{2} \tan\frac{\alpha}{2} + 1 \quad (4)$$

d) bends (see Table 2) $$Z = r = 2d_n \quad (5)$$

e) short bends (see Table 5) $$Z = r = 0{,}75 d_n \quad (6)$$

f) reducing bushes, long (see Table 6) $$Z = 0{,}75\ d_2 + 6 \quad (7)$$

g) reducing bushes, short (see Table 7) $$Z = \left(\frac{d_2}{2} + 6\right) - \left(\frac{d_1}{2} + 6\right) \quad (8)$$

The calculated values are given in Table 1 to Table 7. The calculated values may be adapted by the manufacturer.

The manufacturer's information (e.g. catalogues) shall state the exact value(s) of the Z-length(s).

The deviation from the calculated values are recommended to be not greater than the values given in Table 1, Table 2, Table 5, Table 6 and Table 7, as applicable.

6.3.2.2 For bends made from pipe, the Z-design-lengths, Z_d, and the bend radii shall be equal to or greater than the values given in Table 3 and Table 4, as applicable.

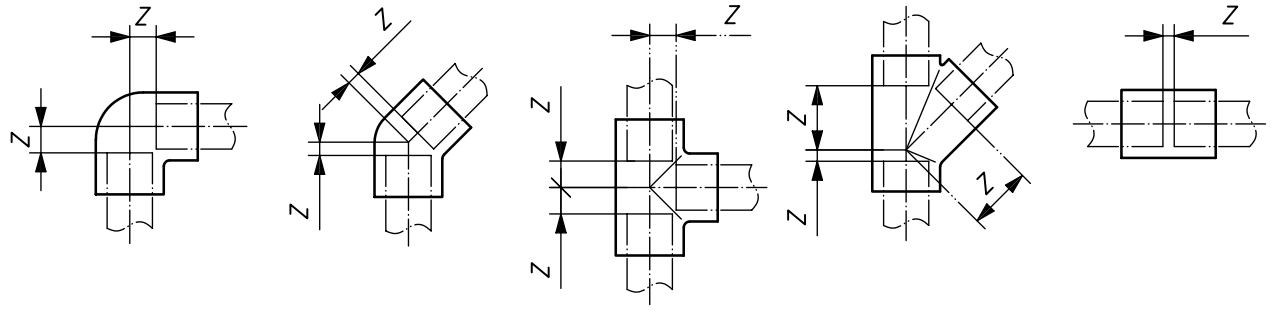
NOTE 1 The Z_d-lengths are always greater than the corresponding socket lengths.

The wall thickness in the bend area of bends made from pipe shall be not less than the specified minimum wall thickness for the corresponding pipe given in ISO 1452-2.

NOTE 2 If needed, the next pipe series with the smaller S-number can be used. See also 7.2.

6.3.2.3 The following are the figures and tables for fittings for solvent cementing.

The types of fittings are shown in Figure 1.



a) 90° elbow **b) 45° elbow** **c) 90° tee** **d) 45° tee** **e) Double-socket**

Figure 1 — Types of fittings: Typical elbows, tees and double-socket

Table 1 — Calculated Z-lengths and recommended deviations for elbows, tees and double-sockets

Dimensions in millimetres

Nominal diameter	Calculated Z-length and recommended deviations					
	Type of fitting					
	90° elbow	45° elbow	90° tee	45° tee		Double-socket
d_n	Z	Z	Z	Z	Z_1	Z
12	7 ± 1	$3{,}5 \pm 1$	7 ± 1	—	—	3 ± 1
16	9 ± 1	$4{,}5 \pm 1$	9 ± 1	—	—	3 ± 1
20	11 ± 1	5 ± 1	11 ± 1	27 ± 3	6^{+2}_{-1}	3 ± 1
25	$13{,}5^{+1{,}2}_{-1}$	$6^{+1{,}2}_{-1}$	$13{,}5^{+1{,}2}_{-1}$	33 ± 3	7^{+2}_{-1}	$3^{+1{,}2}_{-1}$
32	$17^{+1{,}6}_{-1}$	$7{,}5^{+1{,}6}_{-1}$	$17^{+1{,}6}_{-1}$	42^{+4}_{-3}	8^{+2}_{-1}	$3^{+1{,}6}_{-1}$
40	21^{+2}_{-1}	$9{,}5^{+2}_{-1}$	21^{+2}_{-1}	51^{+5}_{-3}	10^{+2}_{-1}	3^{+2}_{-1}
50	$26^{+2{,}5}_{-1}$	$11{,}5^{+2{,}5}_{-1}$	$26^{+2{,}5}_{-1}$	63^{+6}_{-3}	12^{+2}_{-1}	3^{+2}_{-1}
63	$32{,}5^{+3{,}2}_{-1}$	$14^{+3{,}2}_{-1}$	$32{,}5^{+3{,}2}_{-1}$	79^{+7}_{-3}	14^{+2}_{-1}	3^{+2}_{-1}
75	$38{,}5^{+4}_{-1}$	$16{,}5^{+4}_{-1}$	$38{,}5^{+4}_{-1}$	94^{+9}_{-3}	17^{+2}_{-1}	4^{+2}_{-1}
90	46^{+5}_{-1}	$19{,}5^{+5}_{-1}$	46^{+5}_{-1}	112^{+11}_{-3}	20^{+3}_{-1}	5^{+2}_{-1}
110	56^{+6}_{-1}	24^{+6}_{-1}	56^{+6}_{-1}	137^{+13}_{-4}	24^{+3}_{-1}	6^{+3}_{-1}
125	$63{,}5^{+6}_{-1}$	27^{+6}_{-1}	$63{,}5^{+6}_{-1}$	157^{+15}_{-4}	27^{+3}_{-1}	6^{+3}_{-1}
140	71^{+7}_{-1}	30^{+7}_{-1}	71^{+7}_{-1}	175^{+17}_{-5}	30^{+4}_{-1}	8^{+3}_{-1}
160	81^{+8}_{-1}	34^{+8}_{-1}	81^{+8}_{-1}	200^{+20}_{-6}	35^{+4}_{-1}	8^{+4}_{-1}
180	91^{+8}_{-1}	39^{+8}_{-1}	91^{+8}_{-1}	—	—	8^{+4}_{-1}
200	101^{+9}_{-1}	43^{+9}_{-1}	101^{+9}_{-1}	—	—	8^{+5}_{-1}
225	114^{+10}_{-1}	48^{+10}_{-1}	114^{+10}_{-1}	—	—	10^{+5}_{-1}
250	—	53^{+10}_{-1}	126^{+10}_{-1}	—	—	12^{+5}_{-2}
280	—	59^{+10}_{-1}	141^{+10}_{-1}	—	—	12^{+5}_{-2}
315	—	63^{+10}_{-1}	159^{+10}_{-1}	—	—	14^{+5}_{-2}

See Figure 1.

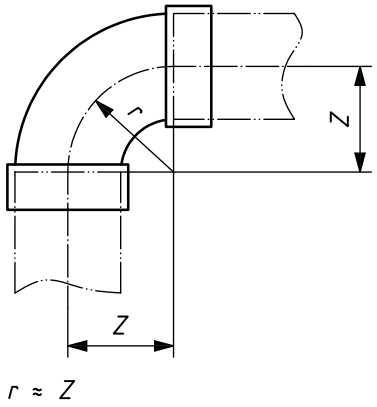


Figure 2 — Bends, injection-moulded

Table 2 — Calculated Z-lengths and recommended deviations for bends, injection-moulded

Dimensions in millimetres

Calculated Z-lengths and recommended deviations						
Nominal diameter d_n						
12	16	20	25	32	40	50
24 ± 1	32 ± 1	40 ± 1	$50^{+1,2}_{-1}$	$64^{+1,6}_{-1}$	80^{+2}_{-1}	$100^{+2,5}_{-1}$
Nominal diameter d_n						
63	75	90	110	125	140	160
$126^{+3,2}_{-1}$	150^{+4}_{-1}	180^{+5}_{-1}	220^{+6}_{-1}	250^{+6}_{-1}	280^{+7}_{-1}	320^{+8}_{-1}
See Figure 2.						

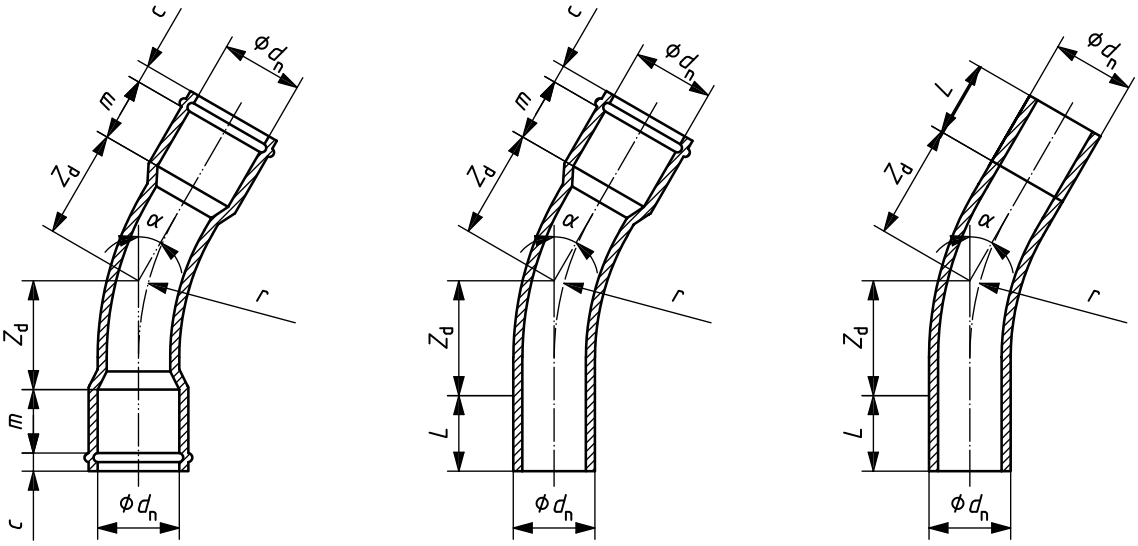


Figure 3 — Bends made from pipes

Table 3 — Calculated minimum bend radii and minimum design lengths for bends made from pipes

Dimensions in millimetres

Nominal diameter	Minimum bend radius	Minimum design length[a] $Z_{d,\,min}$					
		Angle, α					
d_n	r_{min}[b]	11°	22°	30°	45°	60°	90°
63	221	46	68	84	117	153	246
75	263	55	81	100	139	182	293
90	315	66	97	120	166	218	351
110	385	81	119	147	203	266	429
125	438	92	135	167	231	303	488
140	490	103	151	187	259	339	546
160	560	118	173	214	296	387	624
180	630	133	194	241	333	436	702
200	700	147	216	268	370	484	780
225	788	166	243	301	416	545	878
250	875	184	270	334	462	605	975
280	980	206	302	375	518	678	1 092
315	1 103	232	340	421	583	763	1 229
355	1 243	262	384	475	656	859	1 385
400	1 400	295	432	535	740	968	1 560
450	1 575	332	486	602	832	1 089	1 755
500	1 750	369	540	669	925	1 210	1 950
560	1 960	413	605	749	1 036	1 356	2 184
630	2 205	464	681	843	1 165	1 525	2 457

See Figure 3.

[a] $Z_{d,\,min}$ is calculated using Equation (9):

$$Z_{d,\,min} = (3{,}5 d_n \times \tan \tfrac{\alpha}{2}) + 0{,}4 d_n. \quad (9)$$

[b] r_{min} is calculated using Equation (10):

$$r_{min} = 3{,}5 d_n. \quad (10)$$

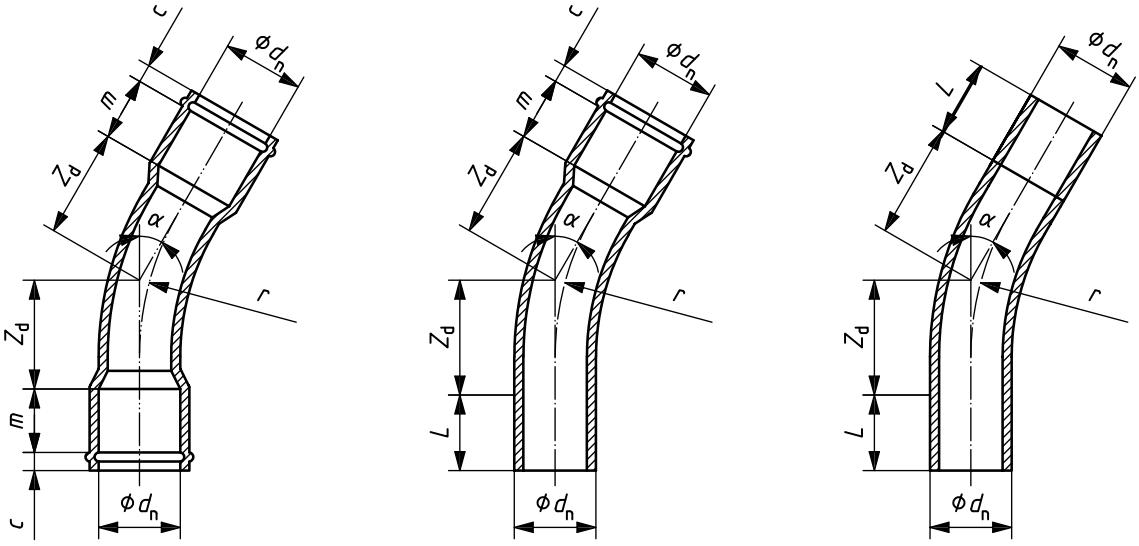


Figure 4 — Short bends made from pipes

Table 4 — Calculated minimum bend radii and minimum design lengths for short bends made from pipes

Dimensions in millimetres

Nominal diameter	Minimum bend radius	Minimum design length[a] $Z_{d,\,min}$					
		Angle α					
d_n	r_{min}[b]	11°	22°	30°	45°	60°	90°
63	157	31	46	58	81	107	173
75	187	37	55	69	96	127	206
90	225	44	66	83	116	152	248
110	275	54	81	101	141	186	303
125	312	61	92	115	161	212	344
140	350	69	103	129	180	237	385
160	400	79	118	147	206	271	440
180	450	88	133	166	231	305	495
200	500	98	147	184	257	339	550
225	562	110	166	207	289	381	619
250	625	123	184	230	321	423	688
280	700	137	206	258	360	474	770
315	787	155	232	290	405	533	866
355	887	174	261	327	456	601	976
400	1 000	196	294	368	514	677	1 100
450	1 125	221	331	414	578	762	1 238
500	1 250	245	368	460	643	847	1 375
560	1 400	275	412	515	720	948	1 540
630	1 575	309	464	580	810	1 067	1 733

See Figure 4.

a $Z_{d,\,min}$ is calculated using Equation (11):

$$Z_{d,\,min} = (2{,}5 d_n \times \tan \tfrac{\alpha}{2}) + 0{,}25 d_n. \quad (11)$$

b r_{min} is calculated using Equation (12):

$$r_{min} = 2{,}5 d_n. \quad (12)$$

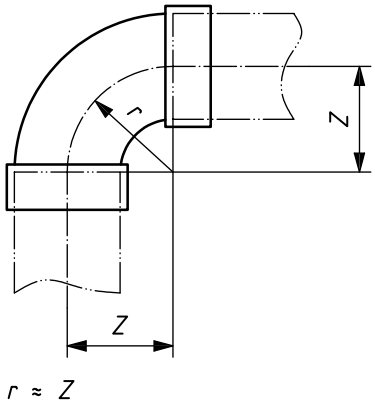
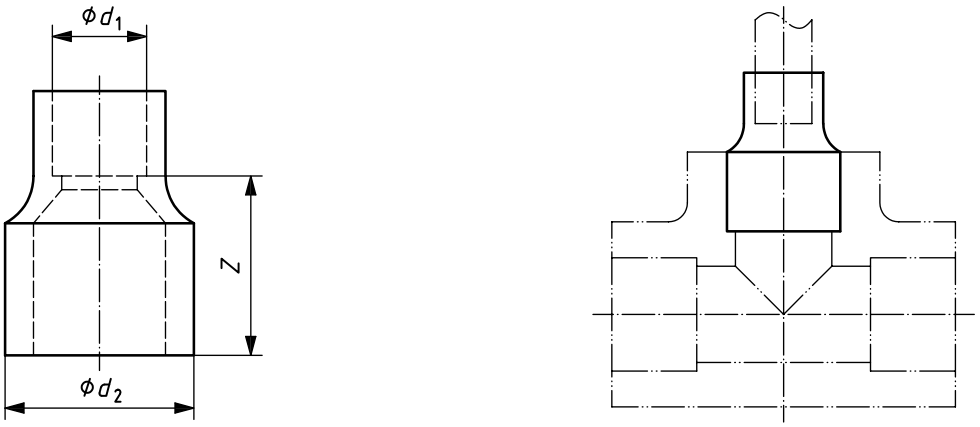


Figure 5 — Short bends, injection-moulded

Table 5 — Calculated Z-lengths and recommended deviations for short bends, injection-moulded

Dimensions in millimetres

Calculated laying length, Z, and recommended deviations							
Nominal diameter d_n							
140	160	180	200	225	250	280	315
105^{+7}_{-1}	120^{+8}_{-1}	135^{+8}_{-1}	150^{+9}_{-1}	168^{+9}_{-1}	187^{+9}_{-1}	210^{+10}_{-1}	236^{+10}_{-1}
See Figure 5.							



a) Reducing bush, long **b) Practical application**

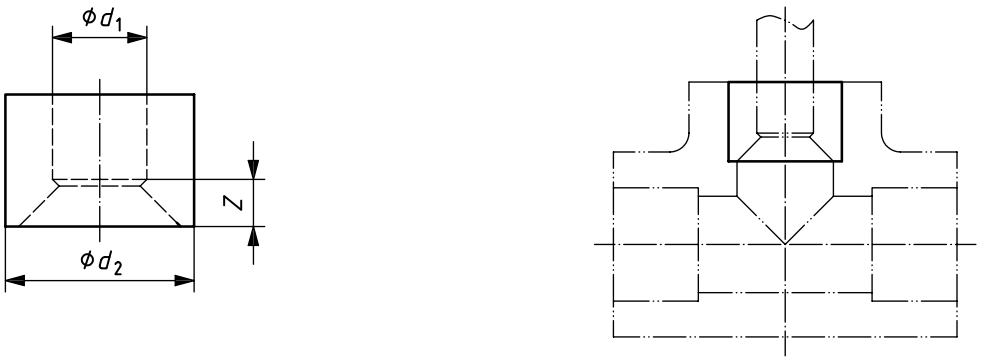
NOTE Other designs of reducing bushes are allowed.

Figure 6 — Reducing bushes, long and example of application

Table 6 — Calculated Z-lengths and recommended deviations for reducing bushes, long

Dimensions in millimetres

Nominal socket diameter	**Nominal diameter of spigot** d_2													
	12	16	20	25	32	40	50	63	75	90	110	125	140	160
	Recommended deviations for Z-lengths													
	± 1					± 1,5				± 2				
d_1	**Calculated Z-lengths**													
12	—	18	21	25	30	—	—	—	—	—	—	—	—	—
16	—	—	21	25	30	36	—	—	—	—	—	—	—	—
20	—	—	—	25	30	36	44	—	—	—	—	—	—	—
25	—	—	—	—	30	36	44	54	—	—	—	—	—	—
32	—	—	—	—	—	36	44	54	62	—	—	—	—	—
40	—	—	—	—	—	—	44	54	62	74	—	—	—	—
50	—	—	—	—	—	—	—	54	62	74	88	—	—	—
63	—	—	—	—	—	—	—	—	62	74	88	100	—	—
75	—	—	—	—	—	—	—	—	—	74	88	100	111	—
90	—	—	—	—	—	—	—	—	—	—	88	100	111	126
110	—	—	—	—	—	—	—	—	—	—	—	100	111	126
125	—	—	—	—	—	—	—	—	—	—	—	—	111	126
140	—	—	—	—	—	—	—	—	—	—	—	—	—	126
See Figure 6.														



a) **Reducing bush, short** b) **Practical application**

Figure 7 — Reducing bushes, short and example of application

Table 7 — Calculated Z-lengths and recommended deviations for reducing bushes, short

Dimensions in millimetres

Nominal socket diameter	Calculated Z-lengths[a]																			
	Nominal diameter of spigot d_2																			
d_1	12	16	20	25	32	40	50	63	75	90	110	125	140	160	180	200	225	250	280	315
12	—	2	4	6,5	10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
16	—	—	2	4,5	8	12	—	—	—	—	—	—	—	—	—	—	—	—	—	—
20	—	—	—	2,5	6	10	15	—	—	—	—	—	—	—	—	—	—	—	—	—
25	—	—	—	—	3,5	7,5	12,5	19	—	—	—	—	—	—	—	—	—	—	—	—
32	—	—	—	—	—	4	9	15,5	21,5	—	—	—	—	—	—	—	—	—	—	—
40	—	—	—	—	—	—	5	11,5	17,5	25	—	—	—	—	—	—	—	—	—	—
50	—	—	—	—	—	—	—	6,5	12,5	20	30	—	—	—	—	—	—	—	—	—
63	—	—	—	—	—	—	—	—	6	13,5	23,5	31	—	—	—	—	—	—	—	—
75	—	—	—	—	—	—	—	—	—	7,5	17,5	25	32,5	—	—	—	—	—	—	—
90	—	—	—	—	—	—	—	—	—	—	10	17,5	25	35	—	—	—	—	—	—
110	—	—	—	—	—	—	—	—	—	—	—	7,5	15	25	35	—	—	—	—	—
125	—	—	—	—	—	—	—	—	—	—	—	—	7,5	17,5	27,5	37,5	—	—	—	—
140	—	—	—	—	—	—	—	—	—	—	—	—	—	10	20	30	42,5	—	—	—
160	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	20	32,5	45	—	—
180	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	22,5	35	50	—
200	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	12,5	25	40	57,5
225	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	12,5	27,5	45
250	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	15	32,5
280	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	17,5

See Figure 7.

[a] The recommended deviations are ± 1 mm.

6.4 Adapter fittings

6.4.1 Designation of adapter fittings

Adapter fittings are designated by

a) the nominal inside diameter of the fitting socket or the nominal outside diameter of the fitting spigot according to ISO 1452-2;

b) the nominal size of the threaded part in accordance with ISO 7-1.

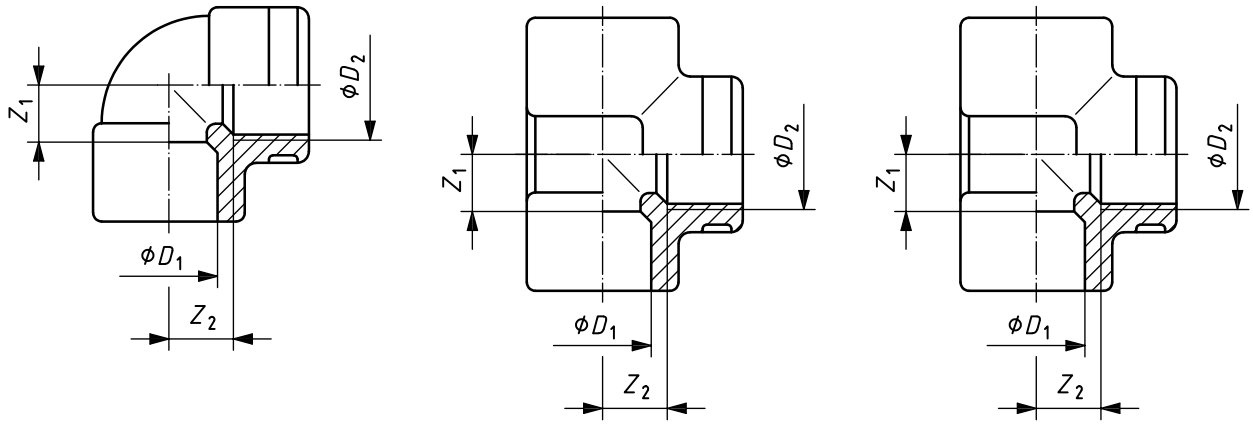
6.4.2 Reinforcement of adapter fittings

Adapter fittings with female threaded sockets for jointing to threaded metal pipes or fittings shall be reinforced at the threaded outlets by any suitable method to prevent splitting of the threaded portion during assembly.

6.4.3 Dimensions of adapter fittings

The dimensions of plain sockets and/or spigots of the adapter fittings shall conform to ISO 1452-2. The threaded parts of the fitting shall conform to ISO 7-1. The calculated values of the Z-length(s) are given in Table 8 and Table 9.

The manufacturer's information (e.g. catalogues) shall state the exact value(s) of the Z-length(s).



a) 90° adapter elbow **b) 90° adapter tee** **c) Adapter socket**

Figure 8 — Typical adapter fittings - Equal

Table 8 — Calculated Z-lengths and recommended deviations for adapter fittings — Equal

Dimensions in millimetres

Diameter of socket	Size of thread	Laying length Z		
D_1[a]	D_2[b]	Z_1[c]	Z_2[d]	Z_3[e]
12	R ¼"	7	9	4
16	R ⅜"	9	13	5
20	R ½"	11	14	5
25	R ¾"	13,5	17	5
32	R 1"	17	22	5
40	R 1 ¼"	21	28	5
50	R 1 ½"	26	38	7
63	R 2"	32,5	47	7

See Figure 8.

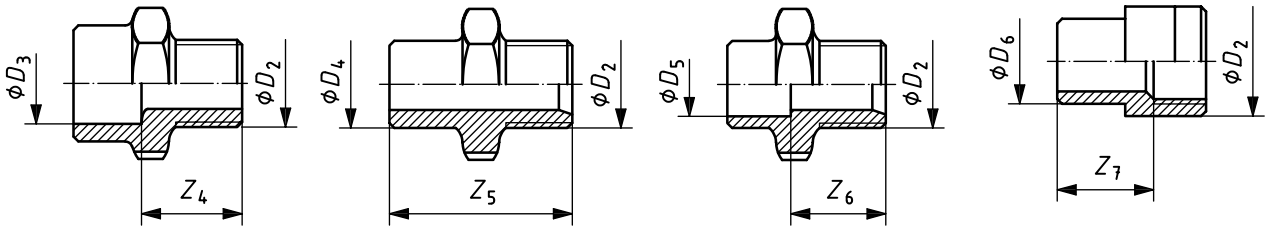
[a] Tolerances of diameters and length of sockets in accordance with ISO 1452-2.

[b] Sizes and length of pipe thread in accordance with ISO 7-1.

[c] Laying length Z_1 and tolerances in accordance with Table 1 (90° elbow).

[d] Tolerances of laying length Z_2 equal to Z_1.

[e] Tolerances of laying length Z_3 in accordance with Table 1 (socket).



a) Adapter socket/nipple **b) Adapter nipple** **c) Adapter bush socket/male thread** **d) Adapter bush spigot/female thread**

Figure 9 — Typical adapter fittings — Nipples and bushes

Table 9 — Calculated Z-lengths and recommended derivations for adapter fittings - Nipples and bushes

Dimensions in millimetres

Adapter socket/ nipple		Adapter nipple		Adapter bush Socket/male thread		Adapter bush Spigot/female thread		Size of thread
D_3[a]	Z_4[b]	D_4[c]	Z_5[b]	D_5[a]	Z_6[b]	D_6[c]	Z_7[b]	D_2[d]
—	—	12	32	—	—	—	—	R ¼"
16	19	16	35	12	15	20	24	R ⅜"
20	23	20	42	16	22	25	27	R ½"
25	25	25	47	20	22	32	32	R ¾"
32	28	32	54	25	27	40	38	R 1"
40	31	40	60	32	29	50	46	R 1 ¼"
50	32	50	66	40	29	63	57	R 1 ½"
63	38	63	78	50	34	—	—	R 2"

See Figure 9.

[a] Tolerances of diameters and length of sockets in accordance with ISO 1452-2.

[b] Tolerances of laying length Z_4, Z_5, Z_6 and Z_7 in accordance with Table 1 (90° elbow).

[c] Tolerances of diameters in accordance with Table 1 (reducing bush).

[d] Sizes and length of pipe thread in accordance with ISO 7-1.

6.5 Tapping saddles

Tapping saddles, with or without a shut-off device, shall be fixed onto the water supply mains by solvent cementing or mechanical fixing with elastomeric sealing. Typical tapping saddles are shown in Figures 10, 11, 12 and 13. Their dimensions shall conform to Table 10. Other designs are allowed.

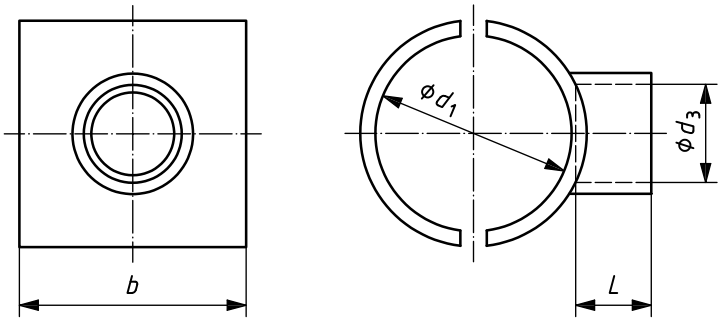


Figure 10 — Typical socket saddle with solvent cement type socket

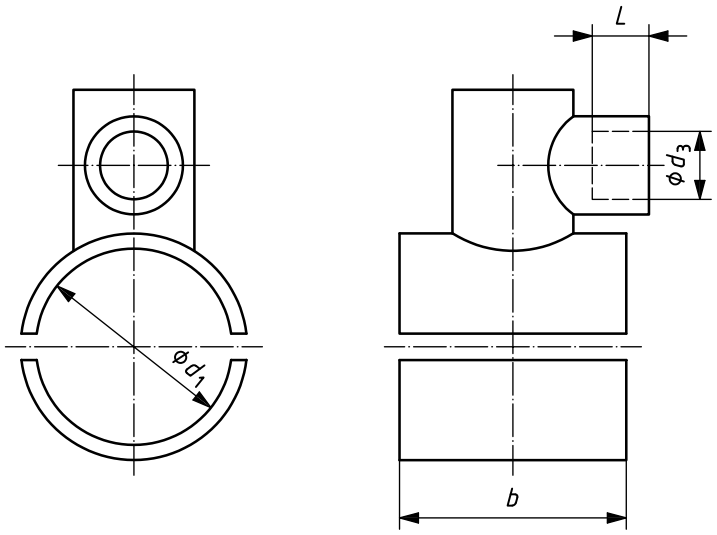


Figure 11 — Typical tee saddle with parallel, solvent cement type socket

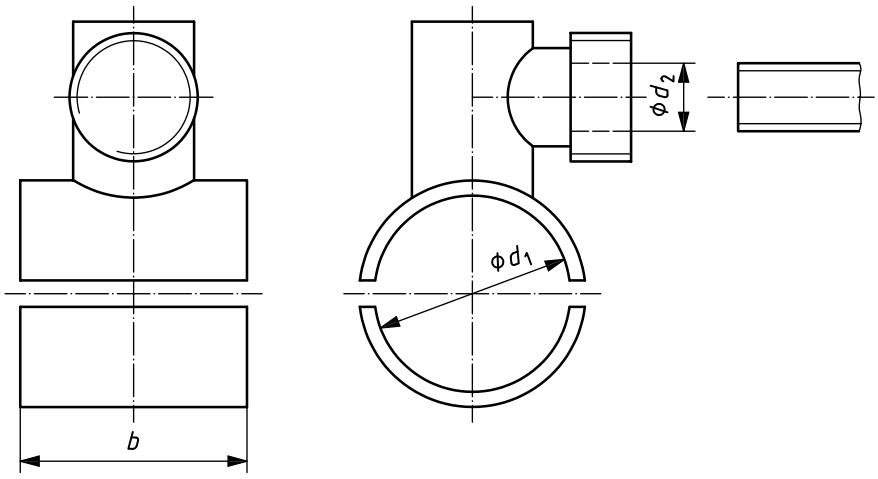


Figure 12 — Typical tee saddle with right-angled, mechanical joint

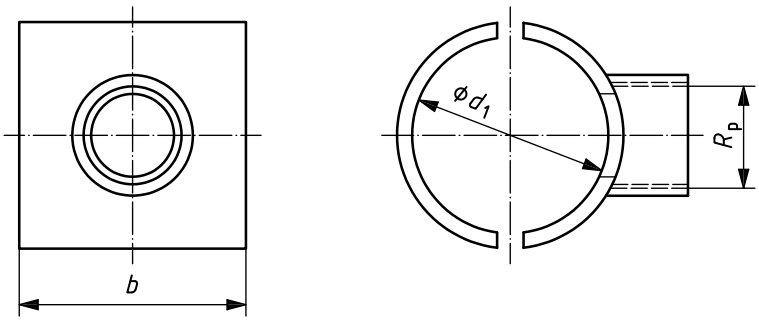


Figure 13 — Typical socket saddle with internally threaded socket

Table 10 — Tapping saddle dimensions

Dimensions in millimetres

Water supply mains		Outlet connection			
Nominal outside diameter of pipe	Inside diameter of saddle	Nominal outside diameter of connecting pipe	Solvent cementing socket mean inside diameter[a]	Solvent cementing length	Internal pipe thread[b]
d_n	d_1	d_2	d_3	L	R_p
32	32	20 25	20 25	16 19	½ ¾
40	40	20 25 32	20 25 32	16 19 22	½ ¾ 1
50	50	20 25 32	20 25 32	16 19 22	½ ¾ 1
63	63	20 25 32 40 50	20 25 32 40 50	16 19 22 26 31	½ ¾ 1 1 ¼ 1 ½
75	75	20 25 32 40 50	20 25 32 40 50	16 19 22 26 31	½ ¾ 1 1 ¼ 1 ½
90	90	20 25 32 40 50	20 25 32 40 50	16 19 22 26 31	½ ¾ 1 1 ¼ 1 ½
110	110	20 25 32 40 50 63	20 25 32 40 50 63	16 19 22 26 31 38	½ ¾ 1 1 ¼ 1 ½ 2

Table 10 (*continued*)

Dimensions in millimetres

Water supply mains		Outlet connection			
Nominal outside diameter of pipe d_n	**Inside diameter of saddle** d_1	**Nominal outside diameter of connecting pipe** d_2	**Solvent cementing socket mean inside diameter**[a] d_3	**Solvent cementing length** L	**Internal pipe thread**[b] R_p
125	125	32 50 63	32 50 63	22 31 38	1 1 ½ 2
140	140	25 32 50 63	25 32 50 63	19 22 31 38	¾ 1 1 ½ 2
160	160	20 25 32 40 50 63	20 25 32 40 50 63	16 19 22 26 31 38	½ ¾ 1 1 ¼ 1 ½ 2
200	200	20 25 32 40 50 63 90	20 25 32 40 50 63 90	16 19 22 26 31 38 51	½ ¾ 1 1 ¼ 1 ½ 2 3
225	225	32 40 50 63 90	32 40 50 63 90	22 26 31 38 51	1 1 ¼ 1 ½ 2 3
250	250	20 25 32 40 50	20 25 32 40 50	16 19 22 26 31	½ ¾ 1 1 ¼ 1 ½
315	315	20 25 32 40 50	20 25 32 40 50	16 19 22 26 31	½ ¾ 1 1 ¼ 1 ½

See Figures 10 to 13.

[a] For diameters d_3, the tolerance is $^{+0,3}_{0}$ mm.

[b] Jointing pipe thread, R_p, shall conform to ISO 7-1.

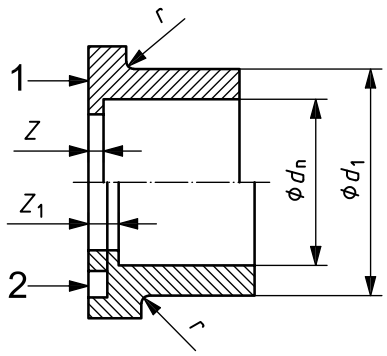
The length of the saddle, b, shall be specified in the technical file of the manufacturer.

6.6 Flange adapters and flanges

6.6.1 Adapters for backing flange

Adapters for PN 10 and PN 16 flanges shall conform to the dimensions given in Table 11, where the dimensions d_1, Z, Z_1, and r are as indicated in Figure 14.

NOTE These dimensions have been chosen to ensure practical interchangeability.



Key

1 jointing face for flask gasket

2 jointing face with O-ring groove

Figure 14 — Dimensions of adapters for backing flanges

Table 11 — Dimensions of adapters for PN 10 and PN 16 flanges

Dimensions in millimetres

Adapters					Flanges
Nominal diameter of socket[a]	External diameter	Contour radius	Jointing face		Nominal size of flange
			flat	with groove	
d_n	d_1	r_{max}	Z	Z_1	DN
16	22 ± 0,1	1	3	6	10
20	27 ± 0,15	1	3	6	15
25	33 ± 0,15	1,5	3	6	20
32	41 ± 0,2	1,5	3	6	25
40	50 ± 0,2	2	3	8	32
50	61 ± 0,2	2	3	8	40
63	76 ± 0,3	2,5	3	8	50
75	90 ± 0,3	2,5	3	8	65
90	108 ± 0,3	3	5	10	80
110	131 ± 0,3	3	5	11	100
125	148 ± 0,4	3	5	11	125
140	165 ± 0,4	4	5	11	125
160	188 ± 0,4	4	5	11	150

See Figure 14.

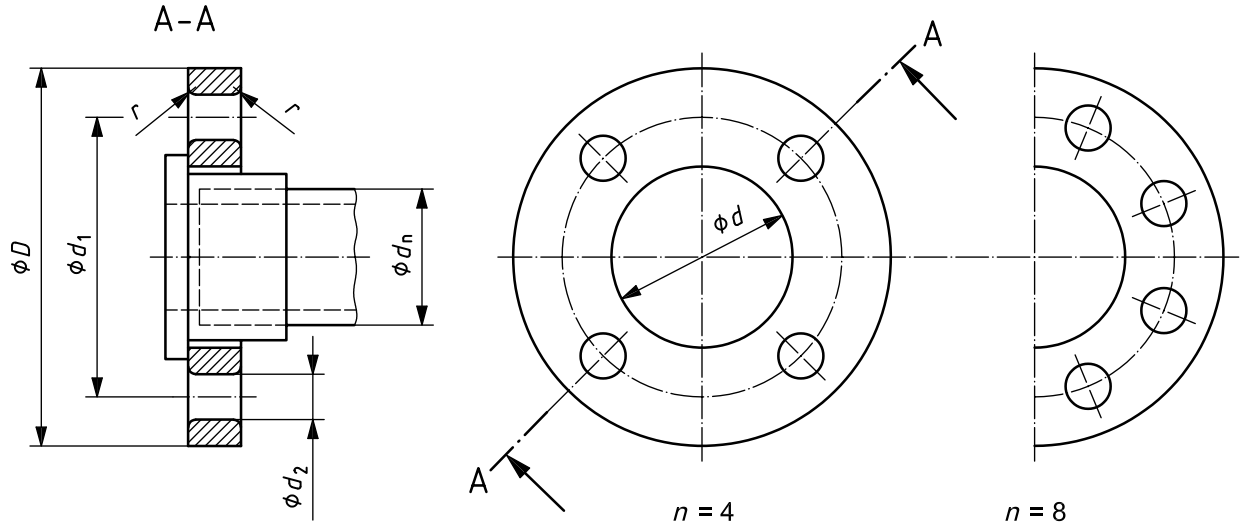
[a] Socket dimensions and tolerances shall conform to ISO 1452-2.

6.6.2 Flanges

The nominal pressure, PN, of a flange shall be not less than the PN of the connecting pipe.

The flange dimensions shown in Figure 15 shall conform to the requirements in Table 12 for PN 10 and PN 16.

NOTE The thickness of the flange depends on the PN and on the strength of the material used.



Key

D outside diameter of flange
d inside diameter of flange
d_1 pitch circle diameter of bolt holes
d_2 diameter of a bolt hole
d_n nominal outside diameter of pipe
n number of bolt holes
r radius

Figure 15 — Dimensions of flanges

Table 12 — Dimensions of PN 10 and PN 16 flanges

Dimensions in millimetres

Nominal outside diameter of corresponding pipe	Nominal size of flange	Outside diameter of flange	Inside diameter of flange[a]	Pitch circle diameter of bolt holes	Radius	Number of bolt holes	Diameter of bolt holes	Metric thread of bolt
d_n	DN	D	d	d_1	r	n	d_2	
16	10	90	23	60	1	4	14	M12
20	15	95	28	65	1	4	14	M12
25	20	105	34	75	1,5	4	14	M12
32	25	115	42	85	1,5	4	14	M12
40	32	140	51	100	2	4	18	M16
50	40	150	62	110	2	4	18	M16
63	50	165	78	125	2,5	4	18	M16
75	65	185	92	145	2,5	4	18	M16
90	80	200	110	160	3	8	18	M16
110	100	220	133	180	3	8	18	M16
125	125	250	150	210	4	8	18	M16
140	125	250	167	210	4	8	18	M16
160	150	285	190	240	4	8	22	M20

See Figure 15.

[a] Tolerance on d: −0,5 for $d \leqslant 62$ and −1 for $d > 62$, where d matches with the diameter of the flange adapter.

6.7 Elastomeric ring seal fittings

6.7.1 Socket and spigot dimensions

The socket inside diameter, d_i, the tolerance for out-of-roundness, the length of socket entrance and sealing area, c, and the chamfer of the fitting spigot shall conform to the same requirements as for sockets for elastomeric ring seal jointing of pipes given in ISO 1452-2.

Elastomeric ring seal fittings made from other materials than PVC-U shall conform to the same geometric requirements.

6.7.2 Minimum depth of engagement for socketed fittings and length of fitting spigots

Figure 16 shows the engagement when the male end is pushed to the socket bottom.

NOTE 1 For assembly instructions, see ISO/TR 4191[1].

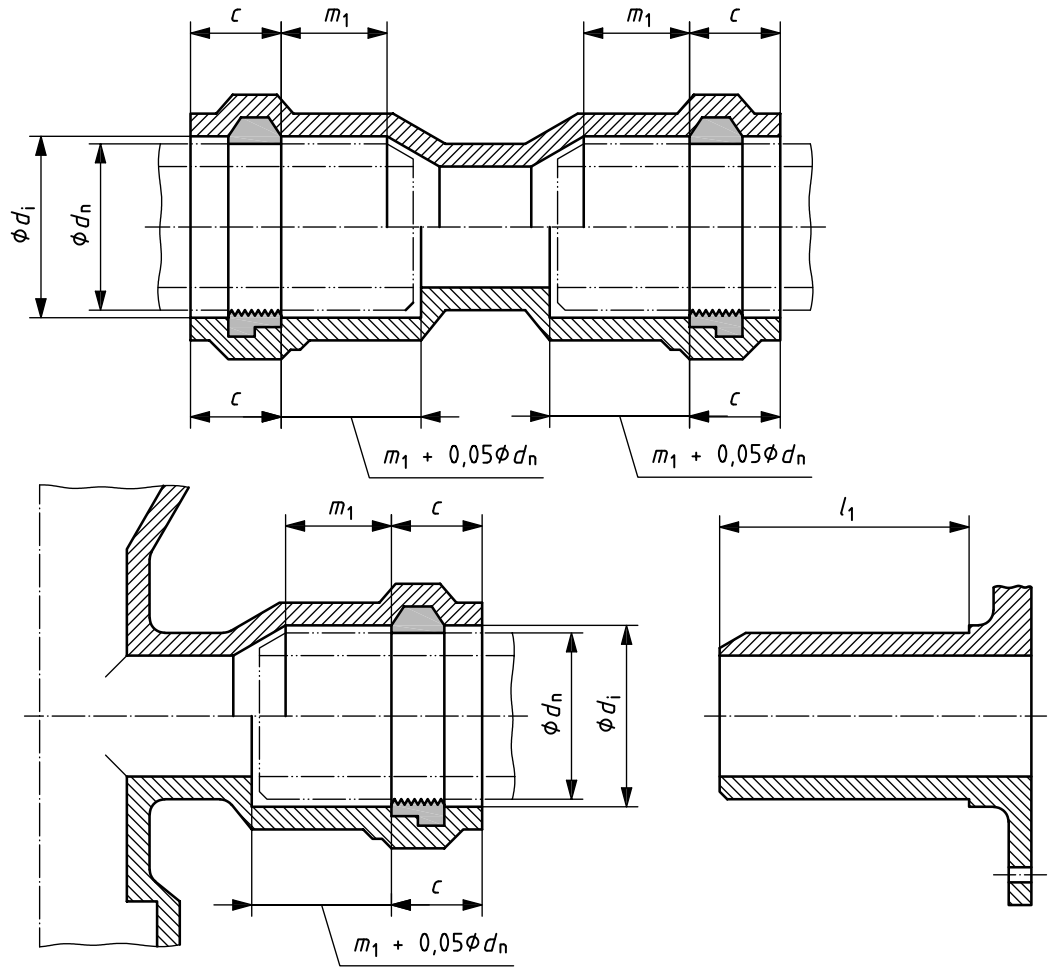


Figure 16 — Engagement of sockets and spigots

The minimum value for the depth of engagement, $m_{1,\,min}$, of double-sockets shall conform to Table 13.

The minimum value for the depth of engagement, m_{min}, of socketed fittings (other than double-sockets) shall be the same as for sockets for elastomeric ring seal joints of pipes and shall conform to ISO 1452-2.

The manufacturer's information (e.g. catalogues) shall state the actual length of fitting spigots, l_1, based on Equation (13):

$$l_1 > m_1 + c + 0{,}05d_n \quad (13)$$

where the minimum values for m_1 are given in Table 13 and c conforms to ISO 1452-2.

NOTE 2 The minimum length of fitting spigots, l_{min}, is given in Table 13 for guidance.

Table 13 — Minimum depth of engagement for double-sockets and minimum length of fitting spigots

Dimensions in millimetres

Nominal inside diameter of socket d_n	Minimum depth of engagement[a] $m_{1,\,min}$	Minimum length of fitting spigot[b] $l_{1,\,min}$
32	32	84
40	33	85
50	33	89
63	34	93
75	35	98
90	35	102
110	36	110
125	37	114
140	38	119
160	39	127
180	40	133
200	41	139
225	42	147
250	44	156
280	45	166
315	48	176
355	50	187
400	52	198
450	55	212
500	57	224
560	61	241
630	65	260
710	69	281

See Figure 16.

[a] $m_{1,\,min}$ is calculated using Equation (14): $m_{1,\,min} = 30\ mm + 0{,}15d_n - 2e_n$, where e_n is the nominal wall thickness of the corresponding pipes of series S 10.

[b] l_{min} is calculated using Equation (15): $l_{min} = m_{min} + c + 0{,}05d_n$, where m_{min} and c are given in ISO 1452-2.

6.7.3 Diameters, laying lengths, design lengths, bend radii and angles

The relevant dimensions are shown in Figures 17, 18, 19, 20, 21, 22, 23 and 24, as applicable.

The laying lengths (Z-lengths) shall be equal to or greater than the applicable minimum values given in Tables 16, 17, 18 and 19, and Table 21 for injection-moulded fittings and for fittings made from pipe.

The manufacturer's information (e.g. catalogue) shall state the actual Z-lengths.

For bends made from pipe and for spigot fittings, the Z_d (Z-design lengths) and the bend radii shall be equal to or greater than the applicable values given in Table 14 and Table 15.

NOTE The Z_d-lengths are always greater than the corresponding socket lengths.

The following figures and tables apply for elastomeric ring seal fittings

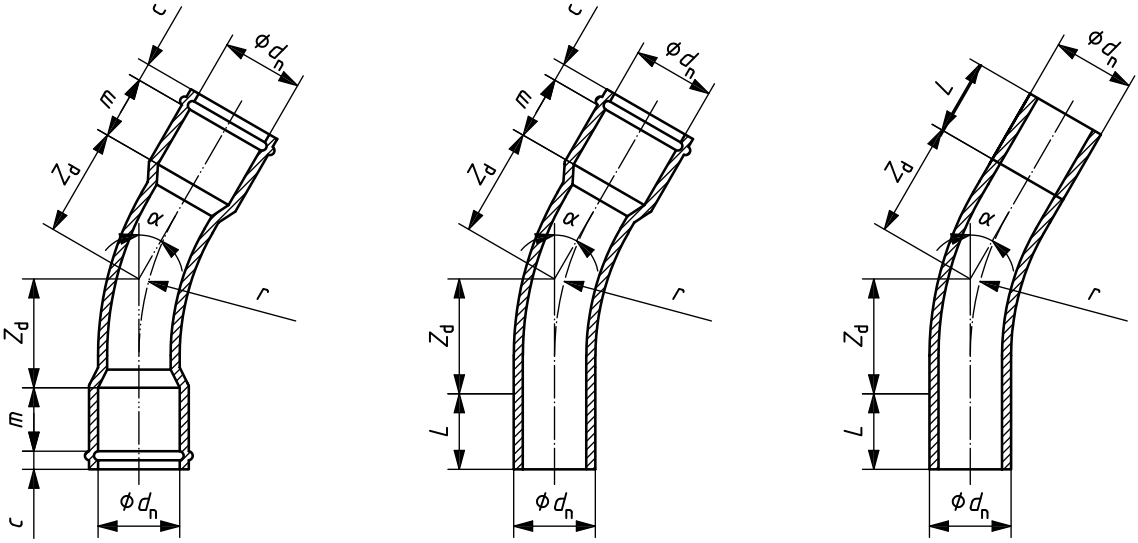


Figure 17 — Typical bends made from pipes

Table 14 — Calculated minimum bend radii and minimum Z_d-lengths for bends made from pipes

Dimensions in millimetres

Nominal diameter	Minimum bend radius [a]	Minimum design length [b] $Z_{d,\,min}$					
		Angle α					
d_n	r_{min}	11°	22°	30°	45°	60°	90°
63	221	46	68	84	117	153	246
75	263	55	81	100	139	182	293
90	315	66	97	120	166	218	351
110	385	81	119	147	203	266	429
125	438	92	135	167	231	303	488
140	490	103	151	187	259	339	546
160	560	118	173	214	296	387	624
180	630	133	194	241	333	436	702
200	700	147	216	268	370	484	780
225	788	166	243	301	416	545	878
250	875	184	270	334	462	605	975
280	980	206	302	375	518	678	1 092
315	1 103	232	340	421	583	763	1 229
355	1 243	262	384	475	656	859	1 385
400	1 400	295	432	535	740	968	1 560
450	1 575	332	486	602	832	1 089	1 755
500	1 750	369	540	669	925	1 210	1 950
560	1 960	413	605	749	1 036	1 356	2 184
630	2 205	464	681	843	1 165	1 525	2 457

See Figure 17.

[a] r_{min} is calculated using Equation (16): $r_{min} = 3{,}5d_n$.

[b] $Z_{d,\,min}$ is calculated using Equation (17): $Z_{d,\,min} = (3{,}5d_n \times \tan\frac{\alpha}{2}) + 0{,}4d_n$.

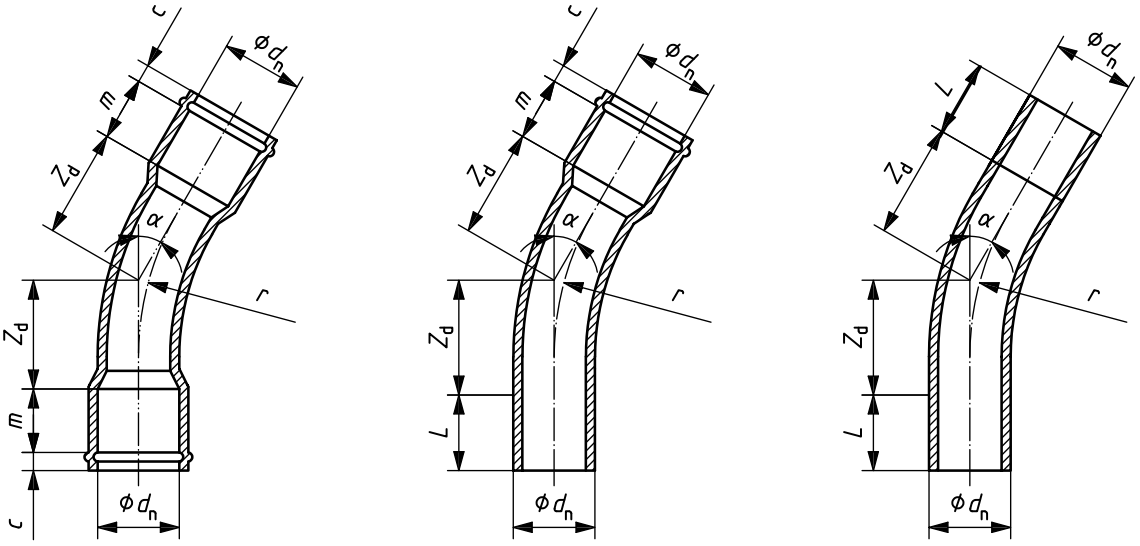


Figure 18 — Typical short bends made from pipes

Table 15 — Calculated minimum bend radii and minimum Z_d-lengths for short bends made from pipes

Dimensions in millimetres

Nominal diameter	Minimum bend radius[a]	Minimum design length[b] $Z_{d,\,min}$					
		Angle, α					
d_n	r_{min}	11°	22°	30°	45°	60°	90°
63	157	31	46	58	81	107	173
75	187	37	55	69	96	127	206
90	225	44	66	83	116	152	248
110	275	54	81	101	141	186	303
125	312	61	92	115	161	212	344
140	350	69	103	129	180	237	385
160	400	79	118	147	206	271	440
180	450	88	133	166	231	305	495
200	500	98	147	184	257	339	550
225	562	110	166	207	289	381	619
250	625	123	184	230	321	423	688
280	700	137	206	258	360	474	770
315	787	155	232	290	405	533	866
355	887	174	261	327	456	601	976
400	1 000	196	294	368	514	677	1 100
450	1 125	221	331	414	578	762	1 238
500	1 250	245	368	460	643	847	1 375
560	1 400	275	412	515	720	948	1 540
630	1 575	309	464	580	810	1 067	1 733

See Figure 18.

a r_{min} is calculated using Equation (18): $r_{min} = 2{,}5d_n$.

b $Z_{d,\,min}$ is calculated using Equation (19): $Z_{d,\,min} = (2{,}5d_n \times \tan\frac{\alpha}{2}) + 0{,}25d_n$.

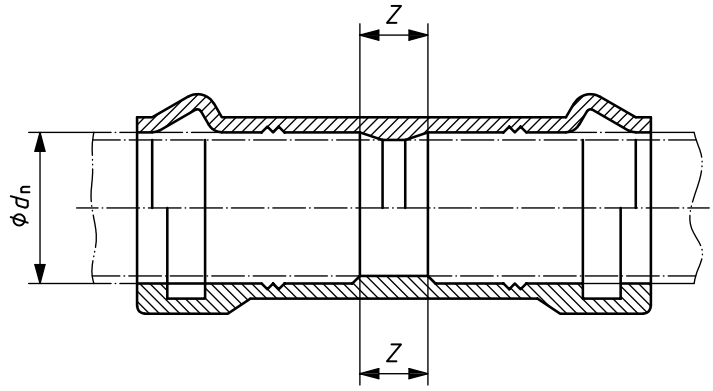


Figure 19 — Double-sockets

Table 16 — Z-lengths for double-sockets

Dimensions in millimetres

Nominal diameter of socket d_n	**Minimum Z-length**	**Nominal diameter of socket** d_n	**Minimum Z-length**
32	2	200	6
40	2	225	7
50	2	250	8
63	2	280	8
75	3	315	8
90	3	355	8
110	4	400	8
125	4	450	8
140	5	500	8
160	5	560	8
180	5	630	8
See Figure 19.			

NOTE Double-sockets without central register are intended to be used for repair purposes.

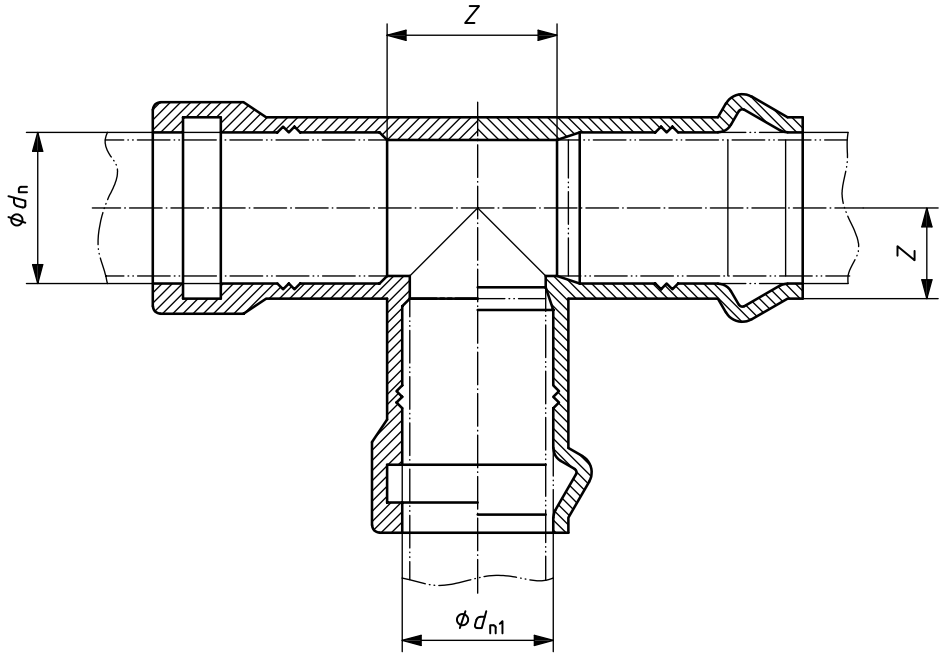


Figure 20 — Typical tee with sockets, injection-moulded

Table 17 — Calculated minimum laying lengths for injection-moulded tees with sockets (equal and with branch reduced)

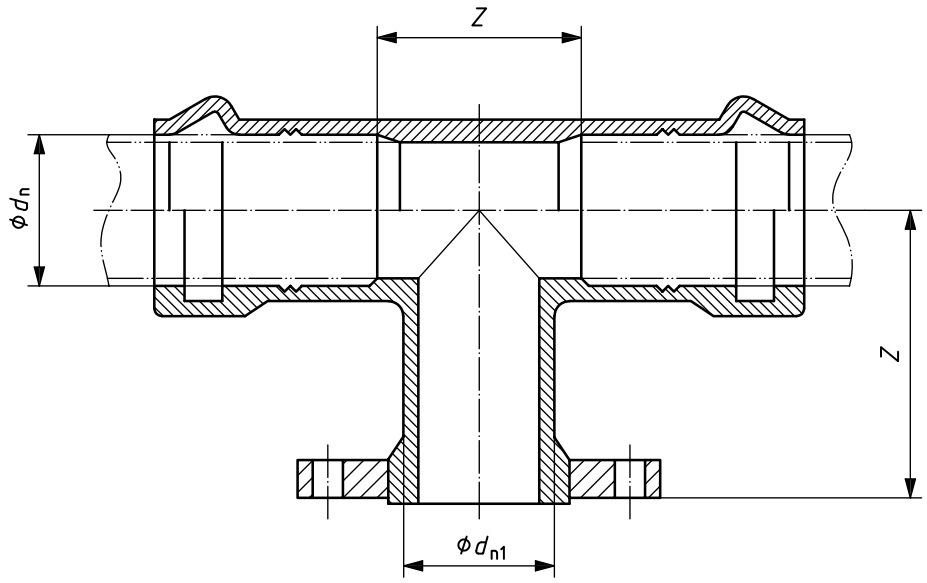
Dimensions in millimetres

Nominal diameters		Minimum laying lengths		Nominal diameters		Minimum laying lengths	
d_n	d_{n1}	Z_{min} [a]	$Z_{1,\,min}$ [b]	d_n	d_{n1}	Z_{min} [a]	$Z_{1,\,min}$ [b]
63	63	63	32	160	63	63	80
75	63	63	38		75	75	80
	75	75	38		90	90	80
90	63	63	45		110	110	80
	75	75	45		125	125	80
	90	90	45		140	140	80
110	63	63	55		160	160	80
	75	75	55	200	90	90	100
	90	90	55		110	110	100
	110	110	55		125	125	100
125	63	63	63		140	140	100
	75	75	63		160	160	100
	90	90	63		200	200	100
	110	110	63	225	63	63	113
	125	125	63		75	75	113
140	63	63	70		90	90	113
	75	75	70		110	110	113
	90	90	70		125	125	113
	110	110	70		140	140	113
	125	125	70		160	160	113
	140	140	70		200	200	113
					225	225	113

See Figure 20.

[a] $Z_{min} = d_{n1}$.

[b] $Z_{1,\,min} = 0{,}5 d_n$, rounded to the next greater millimetre.



NOTE For flange dimensions, see Table 12; for collar dimensions, see Table 11.

Figure 21 — Typical tee with sockets and flanged branch, injection-moulded

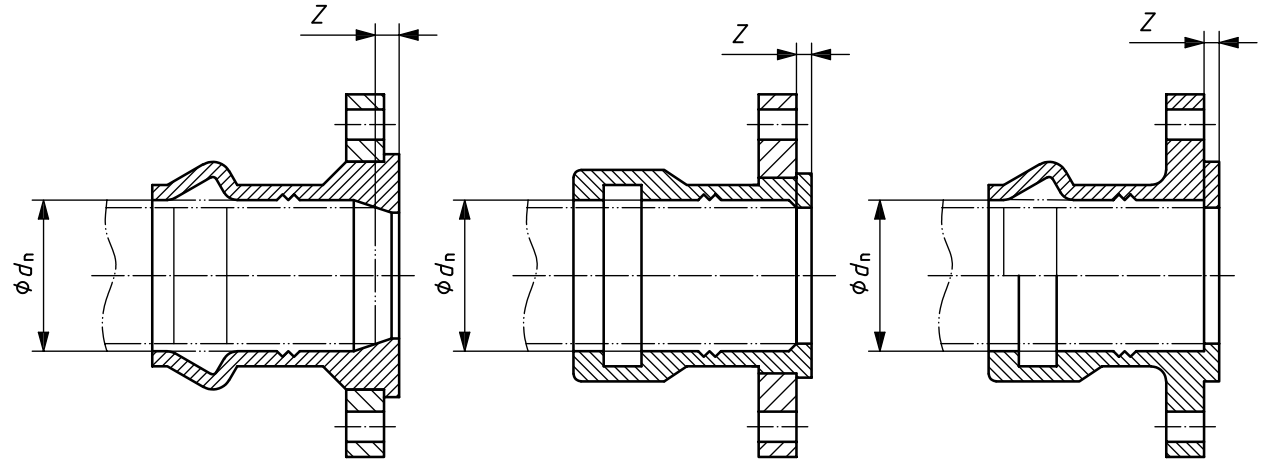
Table 18 — Calculated minimum laying lengths for injection-moulded tees with sockets and flanged branch (equal and with branch reduced)

Dimensions in millimetres

Nominal diameters		Minimum laying lengths		Nominal diameters		Minimum laying lengths	
d_n	d_{n1}	Z_{min}[a]	$Z_{1,\,min}$	d_n	d_{n1}	Z_{min}[a]	$Z_{1,\,min}$
63	63	63	130	160	63	63	190
75	63	63	140		75	75	190
	75	75	140		90	90	200
90	63	63	150		110	110	210
	75	75	150		125	125	210
	90	90	150		140	140	210
110	63	63	160		160	160	230
	75	75	160	200	90	90	225
	90	90	170		110	110	235
	110	110	180		125	125	235
125	63	63	170		140	140	235
	75	75	170		160	160	255
	90	90	180		200	200	265
	110	110	190	225	63	63	230
	125	125	190		75	75	230
140	63	63	180		90	90	240
	75	75	180		110	110	250
	90	90	190		125	125	250
	110	110	200		140	140	250
	125	125	200		160	160	270
	140	140	200		(200)	200	280
					225	225	280

See Figure 21.

[a] $Z_{min} = d_{n1}$.



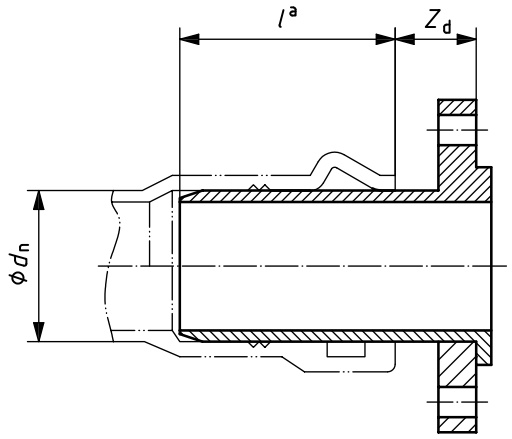
NOTE For flange dimensions, see Table 12; for collar dimensions, see Table 11.

Figure 22 — Typical flanged sockets, injection-moulded

Table 19 — Calculated minimum laying lengths for injection-moulded flanged sockets

Dimensions in millimetres

Nominal diameter of the socket d_n	63	75	90	110	125	140	160	200	225
Minimum laying length Z_{min}	3	3	5	5	5	5	5	6	6
See Figure 22.									



[a] l_{min} conforms to Table 13.

NOTE For flange dimensions, see Table 12; for collar dimensions, see Table 11.

Figure 23 — Typical flanged spigot, injection-moulded

Table 20 — Calculated minimum Z_d-lengths for injection-moulded flanged spigots

Dimensions in millimetres

Nominal diameter of the socket d_n	63	75	90	110	125	140	160	200	225
Minimum design length $Z_{d,\,min}$[a]	33	34	35	37	39	40	42	46	49
See Figure 23.									
[a] $Z_{d,\,min} = 0{,}1d_n + 26$ mm.									

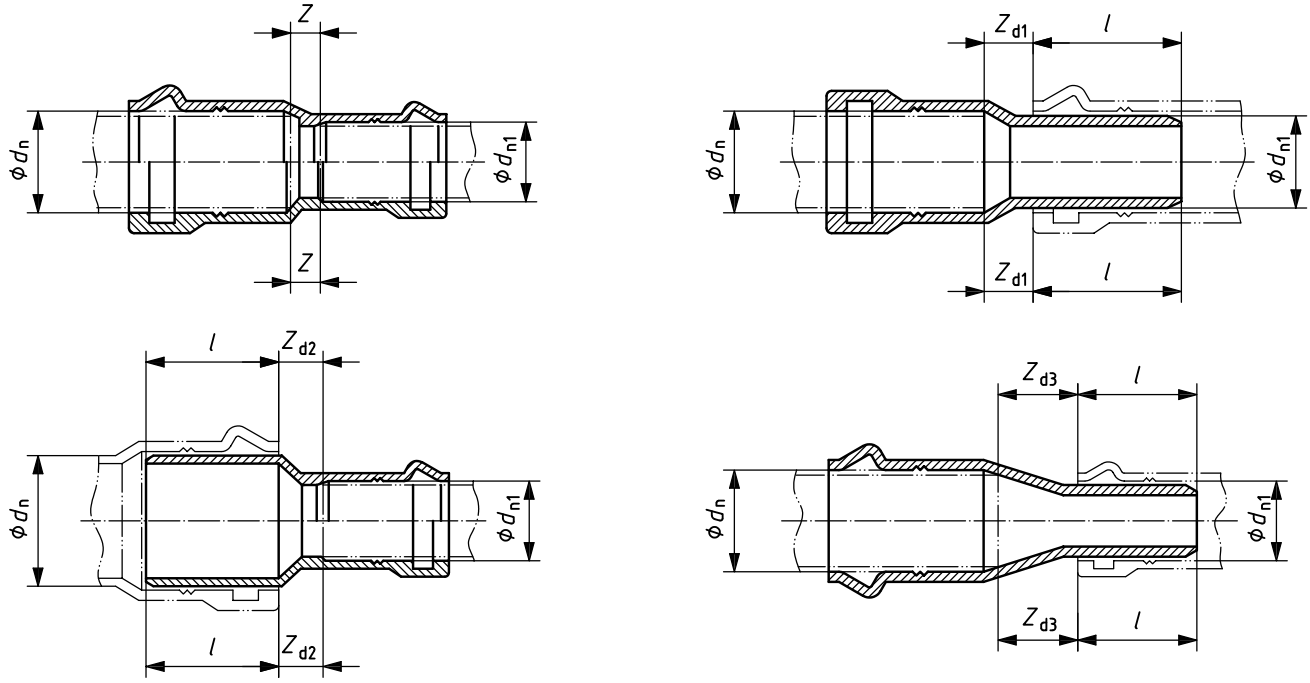


Figure 24 — Typical reducers

Table 21 — Minimum laying and design lengths for reducers

Dimensions in millimetres

Nominal diameters		Minimum laying and design lengths			
d_n	d_{n1}	Z_{min}	$Z_{d1,\ min}$	$Z_{d2,\ min}$	$Z_{d3,\ min}$
75	63	3	6	6	34
90	63	4	14	14	62
	75	4	8	8	41
110	75	5	18	18	79
	90	5	10	10	53
125	90	5	18	18	81
	110	5	8	8	47
140	90	7	25	25	109
	110	7	15	15	76
	125	7	8	8	50
160	110	7	25	25	113
	125	7	18	18	88
	140	7	10	10	62
200	140	10	30	30	137
	160	10	20	20	103
225	160	10	33	33	150
	200	10	13	13	81
See Figure 24.					
NOTE For l_{min}, see Table 13.					

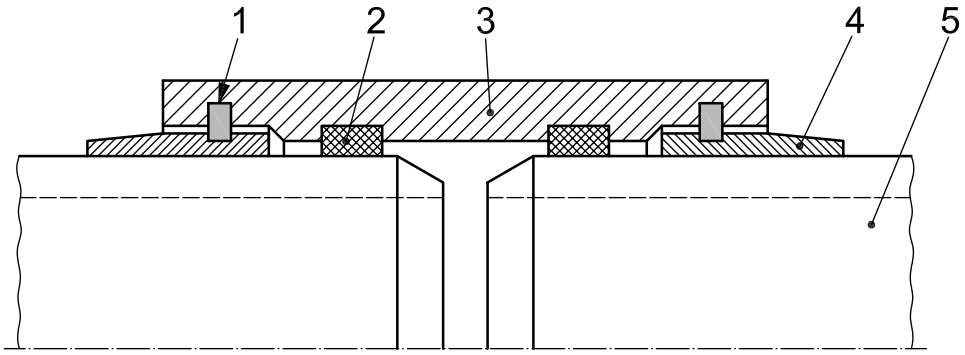
6.7.4 Wall thicknesses

The minimum wall thickness of the sockets and spigots at any point, except the sealing ring groove, shall be not less than the minimum wall thickness specified for the connecting pipe in ISO 1452-2.

A bend made from pipe shall have a wall thickness at its bent area not less than the minimum wall thickness specified for the corresponding pipe in ISO 1452-2.

6.8 End-load-bearing double-sockets with elastomeric seals

End-load-bearing double-sockets are designed to join PVC-U pipes with outside diameters conforming to ISO 1452-2 when longitudinal forces on the double-sockets shall be expected. The end-load-bearing double-sockets are provided with elastomeric seals and a locking device (see Figure 25).



Key

1 locking device
2 sealing ring
3 PVC-U coupling
4 solvent cemented PVC-U sleeve
5 PVC-U pipe

Figure 25 — Example of an end-load-bearing double-socket

When tested in accordance with ISO 13783 at any ambient temperature between 15 °C and 25 °C, but maintained within ± 2 °C, the double-socket shall remain leaktight throughout the whole of the test period.

After the test period, the assembled parts shall show no signs of cracking and the locking devices shall not be deformed by more than 30 % of their original width.

7 Classification and operating conditions

7.1 Classification

Fittings shall be classified according to their nominal pressure, PN, and the series S of the connecting pipe for which the fitting is designed.

7.2 Selection of nominal pressure and pipe series S for water up to and including 25 °C

The nominal pressure, PN, of the fitting shall be related to its material design stress, σ_s, using as a basis, the relationship used for pipes, i.e. Equation (20):

$$PN = \frac{10\sigma_s}{S} \qquad (20)$$

If the fitting is made from pipe, the mechanical and physical characteristics of the pipe shall conform to ISO 1452-2.

The PN rating of fabricated fittings shall be derived from the PN of the used pipes and the geometry derating factors as applicable.

The manufacturer of fabricated fittings shall be responsible for the design and the pressure rating of the fittings. It is up to him to demonstrate conformity to the declared PN. Pressure rating as well as applicable derating factors shall be recorded in the manufacturer's technical file.

7.3 Determination of the allowable operating pressure for water up to 45 °C

The allowable operating pressure, PFA, of fittings for temperatures up to and including 25 °C shall be equal to the nominal pressure.

To determine the allowable operating pressure of fittings for temperatures between 25 °C and 45 °C, a supplementary derating factor, f_T, shall be applied to the nominal pressure, as given in Equation (21):

$$\text{PFA} = f_T \times \text{PN} \tag{21}$$

This factor shall be derived from ISO 1452-2:2009, Figure A.1.

8 Mechanical characteristics

8.1 Resistance to internal pressure of fittings or parts of fittings

The mechanical strength of the fitting as an isolated component of a piping system can be verified by the application of internal pressure tests.

When tested in accordance with ISO 1167-3, using the test parameters given in Table 22, where the test pressures are related to the declared PN of the fitting, the fitting or parts of the fitting shall conform to the requirements given in Table 22.

Table 22 — Resistance of fittings or parts of fittings to internal pressure

Characteristic	Require-ments	Test pieces		Test parameters				Test method
		Type	Nominal diameter mm	Temp. °C	Pressure in bar[b]	Test period h	Type of test	Number of test pieces [a]
Internal pressure	No break during the test period	Injection-moulded fittings	$d_n < 160$	20	$4{,}2 \times PN$	1 [c]	Water in water or Water in air	ISO 1167-1 and ISO 1167-3
					$3{,}2 \times PN$	1 000		
			$d_n \geqslant 160$	20	$3{,}36 \times PN$	1 [c]		
					$2{,}56 \times PN$	1 000		
		Fittings made from pipe	$d_n \leqslant 90$	20	$4{,}2 \times PN$	1 [c]		3 items per test condition
			$d_n > 90$	20	$3{,}36 \times PN$	1 [c]		

[a] The number of test pieces given indicate the number required to establish a value for the characteristic described in the table. The number of test pieces required for factory production control and process control should be listed in the manufacturer's quality plan.

[b] The test pressure p, shall be determined using Equation (22):

$$p = \frac{(\text{Test stress})}{(\text{Design stress})} \times \text{PN} \tag{22}$$

where the test stress shall be 42 MPa at 1 h and 32 MPa at 1 000 h.

[c] For factory production control purposes, indirect testing in the form of a short-term burst pressure test may be used.

8.2 Crushing test

Injection-moulded parts of fittings, on which hydrostatic pressure cannot be applied, shall be tested in accordance with EN 802. The tested fitting parts shall not shatter when they undergo a deformation of 20 %.

The period between manufacture and testing, t_1, and the conditioning period, t_2, shall be not less than 30 min. The closure speed of the press plates shall be (50 ± 5) mm/min.

9 Physical characteristics

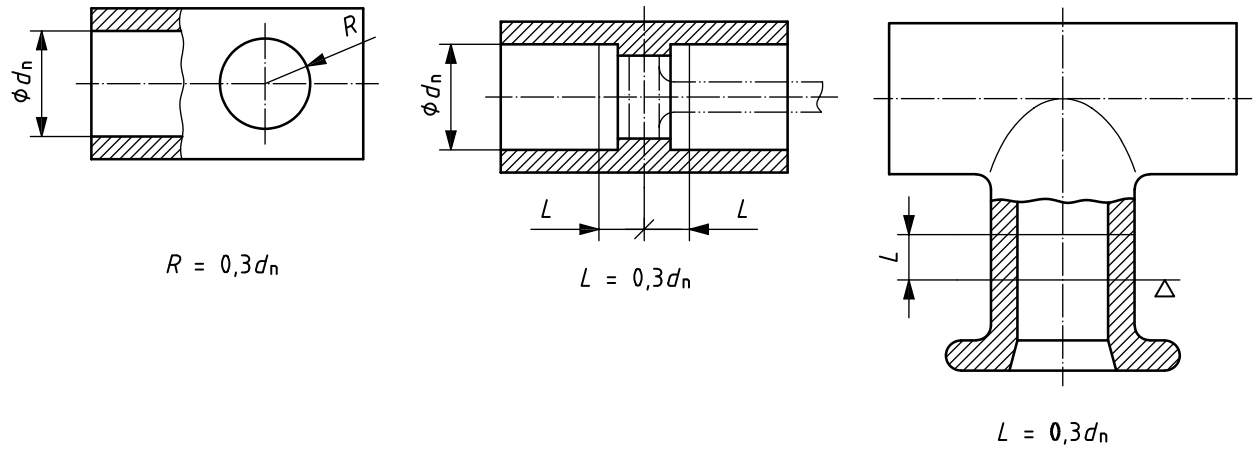
When tested in accordance with the test methods as specified in Table 23 using the indicated parameters, the fittings shall have physical characteristics conforming to the requirements given in this table.

Table 23 — Physical characteristics for injection-moulded fittings

Characteristic	Requirement	Test parameters		Test method
Vicat softening temperature (VST)	⩾ 74 °C	Shall conform to ISO 2507-2		ISO 2507-1
Effects of heating	The fittings shall not show any blisters or signs of weld-line splitting. [a] No surface damage in the area of any injection point shall penetrate deeper than 50 % of the wall thickness at that point. Outside the area of any injection point no surface damage shall occur. [b]	Test temperature: Test period for: $e \leqslant 3$ $3 < e \leqslant 10$ $10 < e \leqslant 20$ $20 < e \leqslant 30$ $30 < e \leqslant 40$ $40 < e$ Number of test pieces:	(150 ± 2) °C 15 min 30 min 60 min 140 min 220 min 240 min 3	Method A of ISO 580 (Air oven)

[a] The weld-line is likely to become more pronounced, but this should not be taken as a sign of weld-line opening.

[b] For sprue-gating, the area of the injection point shall be calculated using a radius $R = 0{,}3d_n$ with a maximum value of 50 mm. For fittings moulded by end-gating techniques, e.g. ring or diaphragm methods, the gating area shall be a cylindrical portion with a length of $L = 0{,}3d_n$ with a maximum value of 50 mm (see Figure 26). Any cracks or delamination in the wall of the fitting within to the injection area, parallel to the axis of the fitting, shall not penetrate in the axial direction more than 20 % of the length L defined in this note.



a) Sprue-gate **b) Diaphragm-gate** **c) Ring-gate**

Figure 26 — Injection gating areas

10 Sealing rings

Sealing rings shall conform to ISO 1452-2.

11 Adhesives

Adhesives shall conform to ISO 1452-2.

12 Performance requirements

When fittings conforming to this part of ISO 1452 are joined to each other or to components conforming to other parts of ISO 1452, the fittings and the joints shall conform to ISO 1452-5.

13 Marking

13.1 General

Unless otherwise specified in Table 24 or Table 25, the marking elements shall be printed or formed directly on the fitting in such a way that after storage, weathering, handling and the installation, legibility is maintained during the use of the products.

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

Marking shall not initiate cracks or other types of defects which would impair conformity to the requirements of this part of ISO 1452.

If printing is used, the colour of the printed information shall differ from the basic colour of the product.

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

13.2 Minimum required marking

The minimum required marking shall conform to Table 24 for fittings and to Table 25 for flanges.

Table 24 — Minimum required marking on fittings

Aspects	Mark or symbol
– Number of the International Standard[a] – Manufacturer's name and/or trade mark – Nominal diameter(s) d_n – Material – Nominal pressure PN[bc] – Manufacturer's information[bd] – Intended use[ae]	ISO 1452 xyz e.g. 63-32-63 e.g. PVC-U e.g. PN 16 e.g. 90.66 e.g. W/P

[a] This information may either be marked directly on the fitting or on a label attached to the fitting or on the packaging.

[b] For fittings of nominal diameters $d_n \leqslant 50$ mm table footnote "a" applies.

[c] The marking of the pipe series S may be included, e.g. PN 16/S 8.

[d] To provide traceability, the following details shall be given:

– the production period, the year, in figures or in code;

– a name or code for the production site, if the manufacturer is producing in different sites, nationally and/or internationally.

[e] Information on abbreviations can be found in CEN/TR 15438[3] and/or in national rules.

Table 25 — Minimum required marking on flanges

Aspects	Mark or symbol
– Number of the International Standard[a] – Manufacturer's name and/or trade mark – Nominal size DN of flange – Material – Nominal pressure PN of flange – Manufacturer's information[bc]	ISO 1452 xyz e.g. DN 80 e.g. PVC-U e.g. PN 16 e.g. 93.66

[a] This information may either be marked directly on the flange, on a plate/label attached to the flange or on the packaging.

[b] For flanges of DN $\leqslant$ 25 table footnote "a" applies.

[c] To provide traceability, the following details shall be given:

– the production period, e.g. year, in figures or in code;

– a name or code for the production site, if the manufacturer is producing in different sites, nationally and/or internationally.

NOTE For fittings and flanges having the former standard reference (i.e. ISO 4422-3:1996) directly engraved in the mould, see Introduction.

13.3 Additional marking

Fittings conforming to this part of ISO 1452, which also conform to other standard(s), may be additionally marked with the minimum required marking in accordance with the other standard(s), in which case table footnote "a" of Table 24 or Table 25 applies.

Fittings conforming to this part of ISO 1452, which are third party certified may be marked accordingly. For practical reasons, this should be done on a label or on the packaging.

Annex A
(normative)

Imperial(inch)-sized fittings

A.1 General

All clauses of this part of ISO 1452 shall apply, together with the following clauses. The specifications given in this annex are for the requirements which differ from those given in Clauses 1 to 13.

A.2 Nominal sizes and pressure classes

A.2.1 Nominal sizes

In place of 6.2, the following shall apply. The nominal size(s) of a fitting shall correspond to and be designated by the nominal size(s) of the pipe(s) for which the fitting is designed.

A.2.2 Pressure classes

In place of 7.1, the following shall apply.

Fittings shall be classified according to the following nominal pressures, as applicable:

PN 9, PN 12 and PN 15.

A.3 Solvent cement type fittings

For the purposes of 6.3, the following shall apply.

A.3.1 Socket and spigot dimensions

The socket dimensions of the fitting shall be the same as for pipes conforming to ISO 1452-2:2009, B.2.3.1.

A.3.2 Diameters, laying lengths and other dimensions

6.3.2 does not apply for imperial-sized fittings.

A.4 Wall thickness for bends made from pipe

A bend made from pipe shall have a wall thickness at its bent area of not less than the minimum wall thickness specified for the corresponding pipe in ISO 1452-2:2009, Table B.2.

A.5 Flanges

For imperial-sized flanges, Table A.1 and Figure 15 apply.

Table A.1 — Dimensions of flanges

Nominal Size	Outside diameter of flange	Pitch circle diameter of bolt holes	Radius	Number of bolt holes	Diameter of bolt holes	Metric thread of bolt
	D	d_1	r	n	d_2	
in	mm	mm	mm		mm	
⅜	90	60	1	4	14	M12
½	95	65	1	4	14	M12
¾	105	75	1,5	4	14	M12
1	115	85	1,5	4	14	M12
1¼	140	100	2	4	18	M16
1½	150	110	2	4	18	M16
2	165	125	2,5	4	18	M16
2½	185	145	2,5	4	18	M16
3	200	160	3	8	18	M16
4	220	180	3	8	18	M16
5	250	210	4	8	18	M16
6	285	240	4	8	22	M20

A.6 Elastomeric ring seal fittings

For the purposes of 6.7, the requirements in A.7 and A.8 shall apply.

A.7 Socket and spigot dimensions

In 6.7.1 the following applies.

The length of socket entrance and the chamfer on the spigot for fittings shall be the same as for pipes conforming to ISO 1452-2:2009, B.2.3.2.

A.8 Minimum depths of engagement for socketed fittings and lengths of fitting spigots

In 6.7.2, the following applies.

Minimum depths of engagement, m_{min}, for double and single sockets shall be the same as for pipe sockets conforming to ISO 1452-2:2009, B.2.3.2.

A.9 Mechanical characteristics

For the resistance to internal pressure of fittings or fittings components, Table A.2 shall apply in place of Table 22.

Table A.2 — Resistance of fittings to internal pressure

Characteristic	Require-ments	Type of test piece	Test parameters				Test method
			Temp. °C	Pressure in bar[a]	Test period h	Type of test	Number of test pieces[b]
Internal pressure	No failure during the test period	Injection-moulded fittings	20	3,36 × PN	1	Water in water	ISO 1167-1 and ISO 1167-3
				2,56 × PN	1 000		
		Fittings made from pipe	20	3,36 × PN	1		3 items per test condition

[a] The values given in table footnote “b” of Table 22 in this part of ISO 1452 do not apply.

[b] The number of test pieces given indicates the number required to establish a value for the characteristic described in this table. The number of test pieces required for factory production control and process control should be listed in the manufacturer’s quality plan.

Bibliography

[1] ISO/TR 4191, *Unplasticized polyvinyl chloride (PVC-U) pipes for water supply — recommended practices for laying*

[2] ENV 1452-7, *Plastics piping systems for water supply — Unplasticized poly(vinyl chloride) (PVC-U) — Part 7: Guidance for the assessment of conformity*

[3] CEN/TR 15438, *Plastics piping systems — Guidance for coding of products and their intended uses*