

# 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 (ISO 1452-3:2009)

ICS 23.040.20; 23.040.45; 91.140.60; 93.025

# National foreword

This British Standard is the UK implementation of EN ISO 1452-3:2009. Together with BS EN ISO 1452-1:2009, BS EN ISO 1452-2:2009, BS EN ISO 1452-4:2009 & BS EN ISO 1452-5:2009, it supersedes BS EN 1452-3:1999 and 1456-1:2001 which are withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PRI/88/2, Plastics piping for pressure applications.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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

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 Unplasticized poly(vinyl chloride) (PVC-U) - Part 3: Fittings (ISO  
 1452-3:2009)

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 (ISO 1452-  
 3:2009)

Kunststoff-Rohrleitungssysteme für die Wasserversorgung  
 und für erdverlegte und nicht erdverlegte Entwässerungs-  
 und Abwasserdruckleitungen - Weichmacherfreies  
 Polyvinylchlorid (PVC-U) - Teil 3: Formstücke (ISO 1452-  
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This European Standard was approved by CEN on 4 November 2009.

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## Foreword

This document (EN ISO 1452-3:2009) has been prepared by Technical Committee CEN/TC 155 "Plastics piping systems and ducting systems", the secretariat of which is held by NEN, in collaboration with Technical Committee ISO/TC 138 "Plastics pipes, fittings and valves for the transport of fluids".

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of an identical text or by endorsement, at the latest by June 2010, and conflicting national standards shall be withdrawn at the latest by June 2010.

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

This document supersedes EN 1452-3:1999, EN 1456-1:2001.

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

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## 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.

## 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<sup>[1]</sup>.

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

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 pycnometer 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,  $\rho$ , at 23 °C of the fitting, when measured in accordance with ISO 1183-1, shall be between the following limits:

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

### 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  $\alpha$  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  $d_n \leq 90$  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) 
$$Z = r = 0,75d_n \quad (6)$$

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.

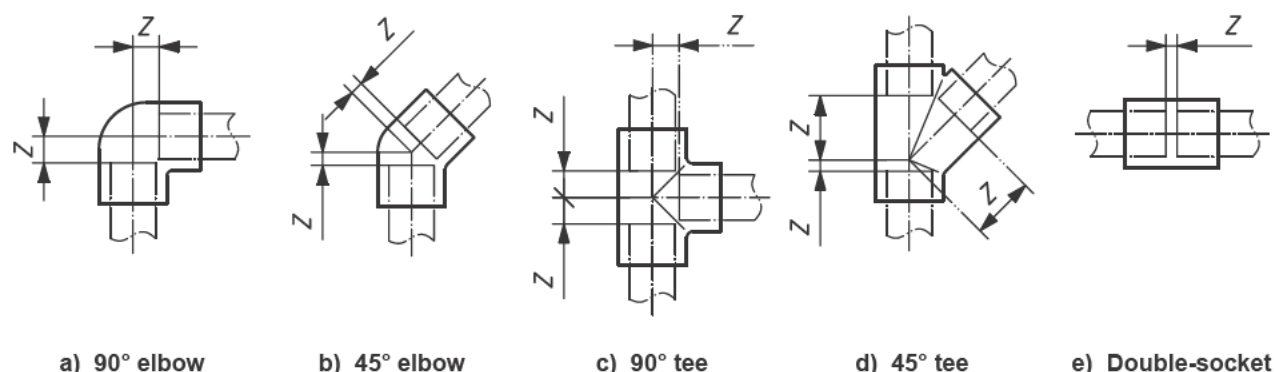


Figure 1 — Types of fittings: Typical elbows, tees and double-socket

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                                |                    |                    |                  |                | Double-socket   |
|                  | 90° elbow                                      | 45° elbow          | 90° tee            | 45° tee          |                |                 |
| $d_n$            | Z                                              | Z                  | Z                  | Z                | $Z_1$          | Z               |
| 12               | $7 \pm 1$                                      | $3,5 \pm 1$        | $7 \pm 1$          | —                | —              | $3 \pm 1$       |
| 16               | $9 \pm 1$                                      | $4,5 \pm 1$        | $9 \pm 1$          | —                | —              | $3 \pm 1$       |
| 20               | $11 \pm 1$                                     | $5 \pm 1$          | $11 \pm 1$         | $27 \pm 3$       | $6^{+2}_{-1}$  | $3 \pm 1$       |
| 25               | $13,5^{+1,2}_{-1}$                             | $6^{+1,2}_{-1}$    | $13,5^{+1,2}_{-1}$ | $33 \pm 3$       | $7^{+2}_{-1}$  | $3^{+1,2}_{-1}$ |
| 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.

See Figure 1.

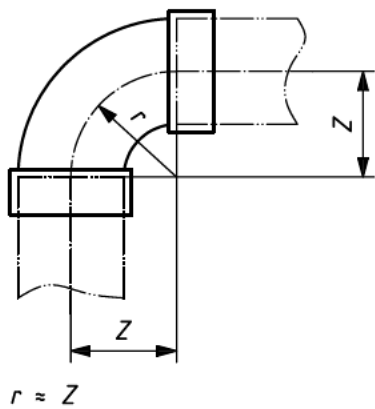


Figure 2 — Bends, injection-moulded

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

Dimensions in millimetres

| Calculated Z-lengths and recommended deviations |                 |                 |                  |                  |                 |                   |
|-------------------------------------------------|-----------------|-----------------|------------------|------------------|-----------------|-------------------|
| Nominal diameter<br>$d_n$                       |                 |                 |                  |                  |                 |                   |
| 12                                              | 16              | 20              | 25               | 32               | 40              | 50                |
| $24 \pm 1$                                      | $32 \pm 1$      | $40 \pm 1$      | $50^{+1,2}_{-1}$ | $64^{+1,6}_{-1}$ | $80^{+2}_{-1}$  | $100^{+2,5}_{-1}$ |
| Nominal diameter<br>$d_n$                       |                 |                 |                  |                  |                 |                   |
| 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.                                   |                 |                 |                  |                  |                 |                   |

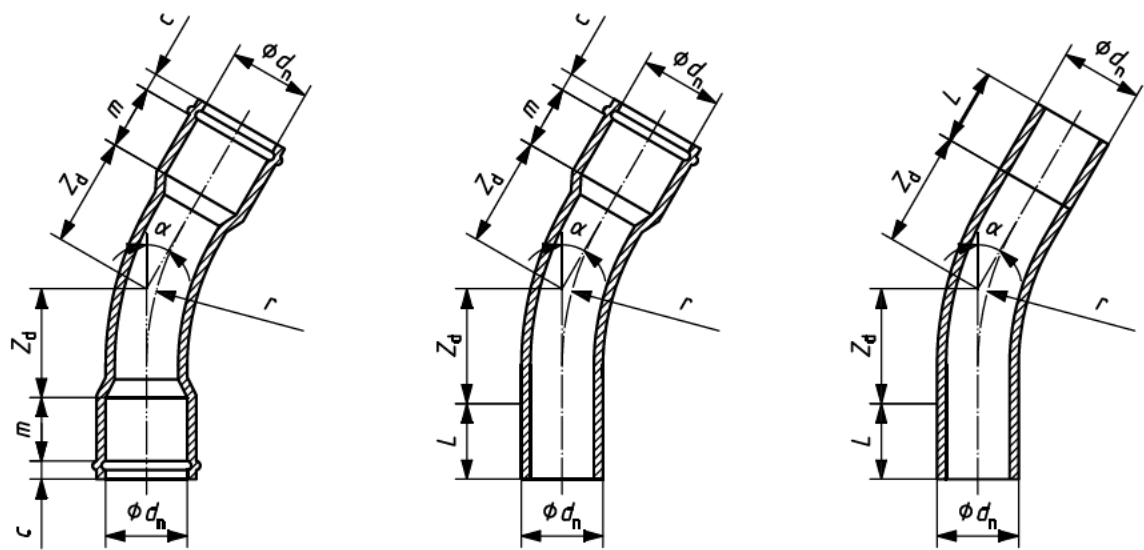


Figure 3 — Bends made from pipes

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

Dimensions in millimetres

| Nominal diameter<br>$d_n$ | Minimum bend radius<br>$r_{\min}^b$ | Minimum design length <sup>a</sup><br>$Z_{d, \min}$ |     |     |       |       |       |
|---------------------------|-------------------------------------|-----------------------------------------------------|-----|-----|-------|-------|-------|
|                           |                                     | Angle, $\alpha$                                     |     |     |       |       |       |
|                           |                                     | 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.

<sup>a</sup>  $Z_{d, \min}$  is calculated using Equation (9):

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

<sup>b</sup>  $r_{\min}$  is calculated using Equation (10):

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

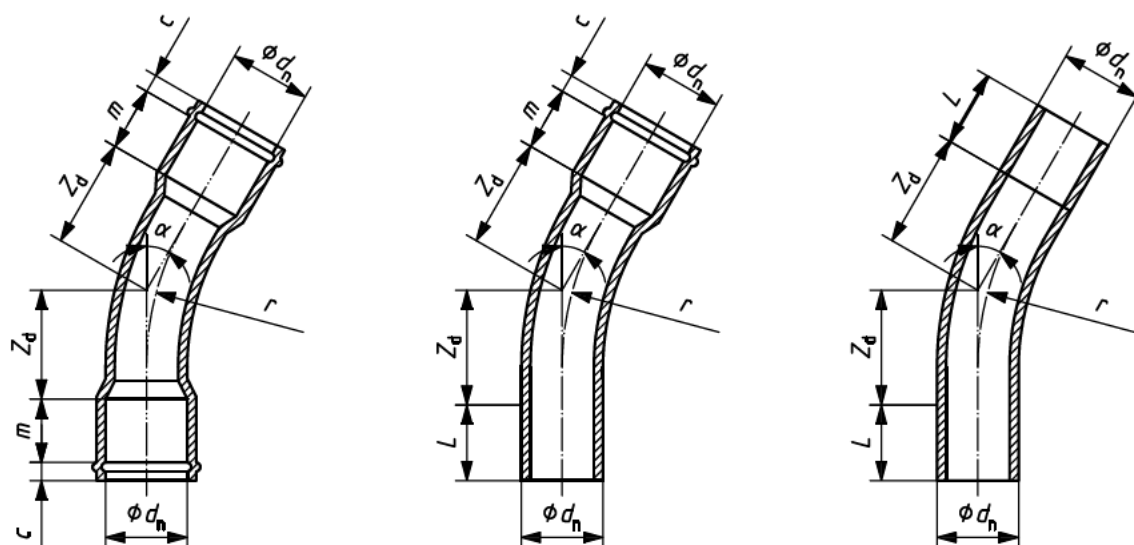


Figure 4 — Short bends made from pipes

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

Dimensions in millimetres

| Nominal diameter<br>$d_n$ | Minimum bend radius<br>$r_{\min}^b$ | Minimum design length <sup>a</sup><br>$Z_{d, \min}$ |     |     |     |       |       |
|---------------------------|-------------------------------------|-----------------------------------------------------|-----|-----|-----|-------|-------|
|                           |                                     | Angle $\alpha$                                      |     |     |     |       |       |
|                           |                                     | 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.

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

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

<sup>b</sup>  $r_{\min}$  is calculated using Equation (12):

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

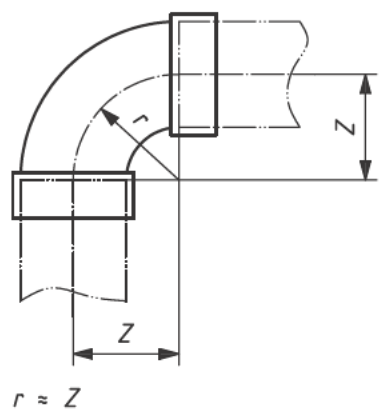


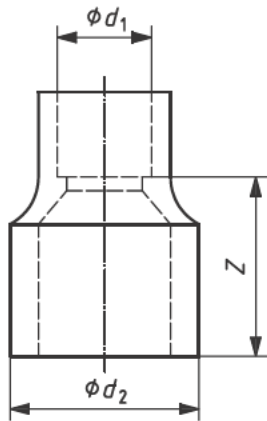
Figure 5 — Short bends, injection-moulded

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

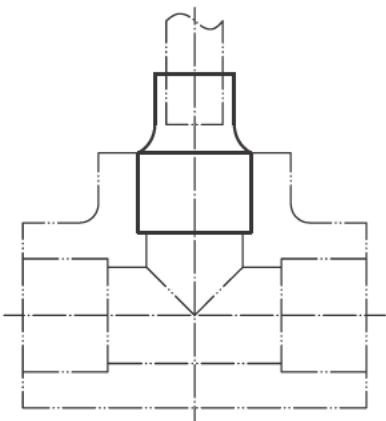
Dimensions in millimetres

| Calculated laying length, Z, and recommended deviations |                 |                 |                 |                 |                 |                  |                  |
|---------------------------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|
| Nominal diameter                                        |                 |                 |                 |                 |                 |                  |                  |
| 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

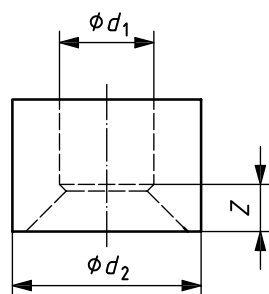
**Table 6 — Calculated Z-lengths and recommended deviations for reducing bushes, long**

Dimensions in millimetres

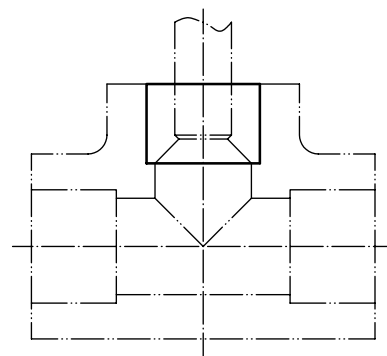
| Nominal<br>socket<br>diameter<br><br>$d_1$ | Nominal diameter of spigot<br>$d_2$  |    |    |    |    |           |    |    |    |    |         |     |     |     |
|--------------------------------------------|--------------------------------------|----|----|----|----|-----------|----|----|----|----|---------|-----|-----|-----|
|                                            | 12                                   | 16 | 20 | 25 | 32 | 40        | 50 | 63 | 75 | 90 | 110     | 125 | 140 | 160 |
|                                            | Recommended deviations for Z-lengths |    |    |    |    |           |    |    |    |    |         |     |     |     |
|                                            | $\pm 1$                              |    |    |    |    | $\pm 1,5$ |    |    |    |    | $\pm 2$ |     |     |     |
| 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.

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<br>socket<br>diameter<br><br>$d_1$              | Calculated Z-lengths <sup>a</sup> |    |    |     |     |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|---------------------------------------------------------|-----------------------------------|----|----|-----|-----|-----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
|                                                         | Nominal diameter of spigot        |    |    |     |     |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|                                                         | 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.                                           |                                   |    |    |     |     |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| <sup>a</sup> The recommended deviations are $\pm 1$ mm. |                                   |    |    |     |     |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      |

## 6.4 Adapter fittings

### 6.4.1 Designation of adapter fittings

Adapter fittings are designated by

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

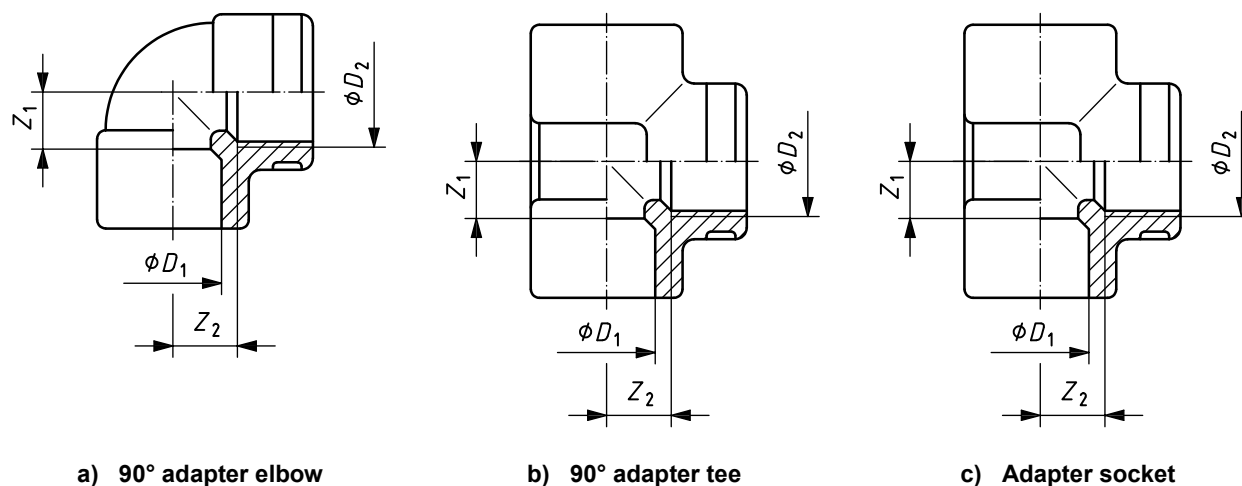
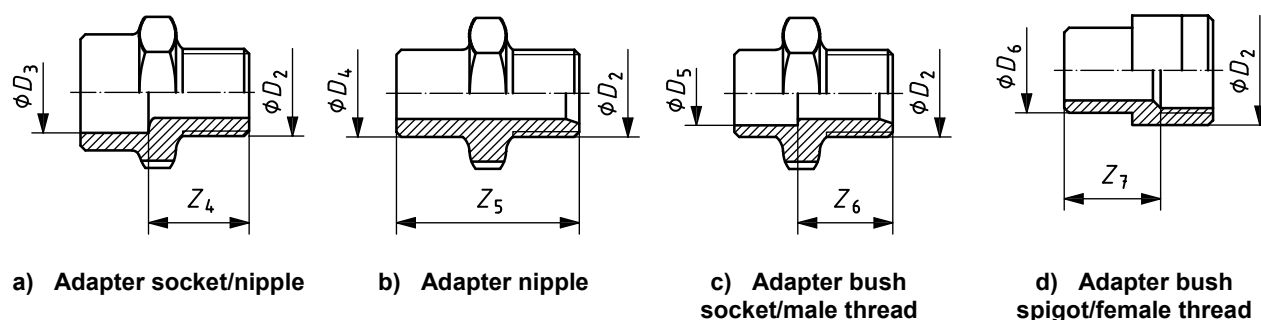


Figure 8 — Typical adapter fittings - Equal

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

| Dimensions in millimetres                                                                                                                                                                                                                                                                                                                                                                                                  |                           |                      |         |         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|----------------------|---------|---------|
| Diameter of socket<br>$D_1^a$                                                                                                                                                                                                                                                                                                                                                                                              | Size of thread<br>$D_2^b$ | Laying length<br>$Z$ |         |         |
|                                                                                                                                                                                                                                                                                                                                                                                                                            |                           | $Z_1^c$              | $Z_2^d$ | $Z_3^e$ |
| 12                                                                                                                                                                                                                                                                                                                                                                                                                         | R 1/4"                    | 7                    | 9       | 4       |
| 16                                                                                                                                                                                                                                                                                                                                                                                                                         | R 3/8"                    | 9                    | 13      | 5       |
| 20                                                                                                                                                                                                                                                                                                                                                                                                                         | R 1/2"                    | 11                   | 14      | 5       |
| 25                                                                                                                                                                                                                                                                                                                                                                                                                         | R 3/4"                    | 13,5                 | 17      | 5       |
| 32                                                                                                                                                                                                                                                                                                                                                                                                                         | R 1"                      | 17                   | 22      | 5       |
| 40                                                                                                                                                                                                                                                                                                                                                                                                                         | R 1 1/4"                  | 21                   | 28      | 5       |
| 50                                                                                                                                                                                                                                                                                                                                                                                                                         | R 1 1/2"                  | 26                   | 38      | 7       |
| 63                                                                                                                                                                                                                                                                                                                                                                                                                         | R 2"                      | 32,5                 | 47      | 7       |
| See Figure 8.                                                                                                                                                                                                                                                                                                                                                                                                              |                           |                      |         |         |
| <sup>a</sup> Tolerances of diameters and length of sockets in accordance with ISO 1452-2.<br><sup>b</sup> Sizes and length of pipe thread in accordance with ISO 7-1.<br><sup>c</sup> Laying length $Z_1$ and tolerances in accordance with Table 1 (90° elbow).<br><sup>d</sup> Tolerances of laying length $Z_2$ equal to $Z_1$ .<br><sup>e</sup> Tolerances of laying length $Z_3$ in accordance with Table 1 (socket). |                           |                      |         |         |



**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/<br>nipple                                                                                                                                                                                                                                                                                                         |         | Adapter nipple |         | Adapter bush<br>Socket/male<br>thread |         | Adapter bush<br>Spigot/female<br>thread |         | Size of<br>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.<br>b Tolerances of laying length $Z_4$ , $Z_5$ , $Z_6$ and $Z_7$ in accordance with Table 1 (90° elbow).<br>c Tolerances of diameters in accordance with Table 1 (reducing bush).<br>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.

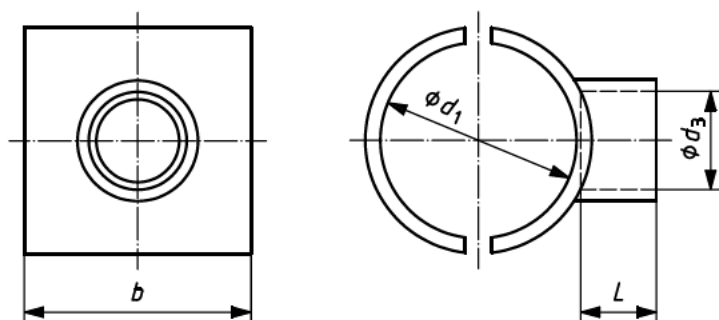


Figure 10 — Typical socket saddle with solvent cement type socket

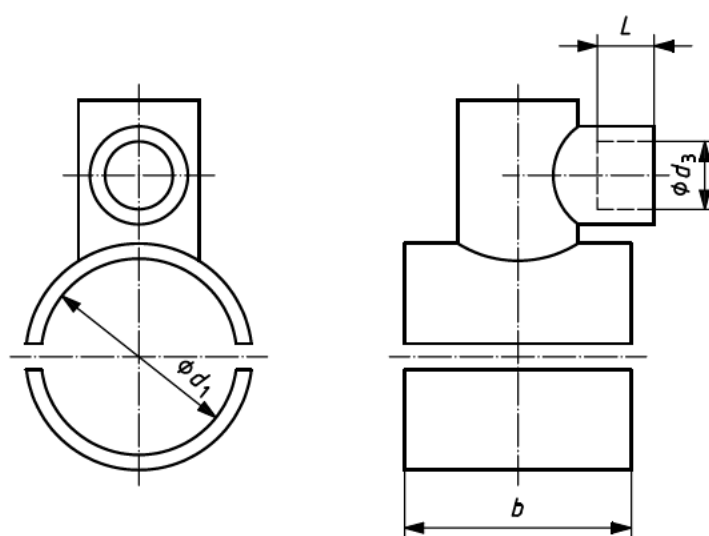


Figure 11 — Typical tee saddle with parallel, solvent cement type socket

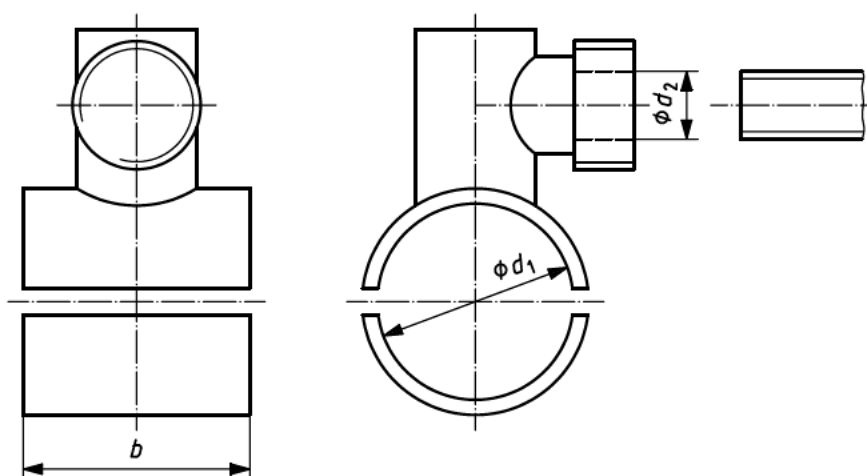


Figure 12 — Typical tee saddle with right-angled, mechanical joint

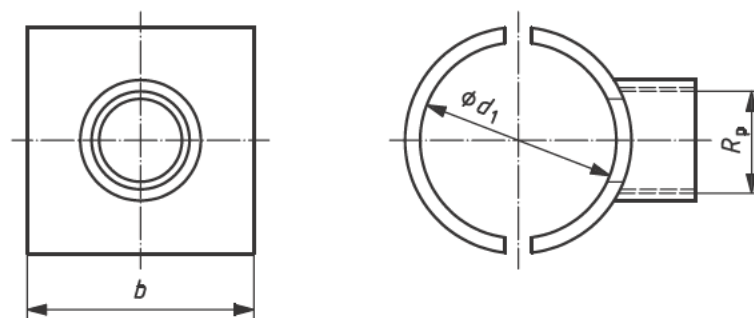


Figure 13 — Typical socket saddle with internally threaded socket

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 <sup>a</sup> | Solvent cementing length | Internal pipe thread <sup>b</sup> |
| $d_n$                            | $d_1$                     | $d_2$                                       | $d_3$                                                      | $L$                      | $R_p$                             |
| 32                               | 32                        | 20                                          | 20                                                         | 16                       | $\frac{1}{2}$                     |
|                                  |                           | 25                                          | 25                                                         | 19                       | $\frac{3}{4}$                     |
| 40                               | 40                        | 20                                          | 20                                                         | 16                       | $\frac{1}{2}$                     |
|                                  |                           | 25                                          | 25                                                         | 19                       | $\frac{3}{4}$                     |
|                                  |                           | 32                                          | 32                                                         | 22                       | 1                                 |
| 50                               | 50                        | 20                                          | 20                                                         | 16                       | $\frac{1}{2}$                     |
|                                  |                           | 25                                          | 25                                                         | 19                       | $\frac{3}{4}$                     |
|                                  |                           | 32                                          | 32                                                         | 22                       | 1                                 |
| 63                               | 63                        | 20                                          | 20                                                         | 16                       | $\frac{1}{2}$                     |
|                                  |                           | 25                                          | 25                                                         | 19                       | $\frac{3}{4}$                     |
|                                  |                           | 32                                          | 32                                                         | 22                       | 1                                 |
|                                  |                           | 40                                          | 40                                                         | 26                       | $1 \frac{1}{4}$                   |
|                                  |                           | 50                                          | 50                                                         | 31                       | $1 \frac{1}{2}$                   |
| 75                               | 75                        | 20                                          | 20                                                         | 16                       | $\frac{1}{2}$                     |
|                                  |                           | 25                                          | 25                                                         | 19                       | $\frac{3}{4}$                     |
|                                  |                           | 32                                          | 32                                                         | 22                       | 1                                 |
|                                  |                           | 40                                          | 40                                                         | 26                       | $1 \frac{1}{4}$                   |
|                                  |                           | 50                                          | 50                                                         | 31                       | $1 \frac{1}{2}$                   |
| 90                               | 90                        | 20                                          | 20                                                         | 16                       | $\frac{1}{2}$                     |
|                                  |                           | 25                                          | 25                                                         | 19                       | $\frac{3}{4}$                     |
|                                  |                           | 32                                          | 32                                                         | 22                       | 1                                 |
|                                  |                           | 40                                          | 40                                                         | 26                       | $1 \frac{1}{4}$                   |
|                                  |                           | 50                                          | 50                                                         | 31                       | $1 \frac{1}{2}$                   |
| 110                              | 110                       | 20                                          | 20                                                         | 16                       | $\frac{1}{2}$                     |
|                                  |                           | 25                                          | 25                                                         | 19                       | $\frac{3}{4}$                     |
|                                  |                           | 32                                          | 32                                                         | 22                       | 1                                 |
|                                  |                           | 40                                          | 40                                                         | 26                       | $1 \frac{1}{4}$                   |
|                                  |                           | 50                                          | 50                                                         | 31                       | $1 \frac{1}{2}$                   |
|                                  |                           | 63                                          | 63                                                         | 38                       | 2                                 |

Table 10 (continued)

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 <sup>a</sup> | Solvent cementing length | Internal pipe thread <sup>b</sup> |
| $d_n$                            | $d_1$                     | $d_2$                                       | $d_3$                                                      | $L$                      | $R_p$                             |
| 125                              | 125                       | 32                                          | 32                                                         | 22                       | 1                                 |
|                                  |                           | 50                                          | 50                                                         | 31                       | 1 ½                               |
|                                  |                           | 63                                          | 63                                                         | 38                       | 2                                 |
| 140                              | 140                       | 25                                          | 25                                                         | 19                       | ¾                                 |
|                                  |                           | 32                                          | 32                                                         | 22                       | 1                                 |
|                                  |                           | 50                                          | 50                                                         | 31                       | 1 ½                               |
|                                  |                           | 63                                          | 63                                                         | 38                       | 2                                 |
| 160                              | 160                       | 20                                          | 20                                                         | 16                       | ½                                 |
|                                  |                           | 25                                          | 25                                                         | 19                       | ¾                                 |
|                                  |                           | 32                                          | 32                                                         | 22                       | 1                                 |
|                                  |                           | 40                                          | 40                                                         | 26                       | 1 ¼                               |
|                                  |                           | 50                                          | 50                                                         | 31                       | 1 ½                               |
|                                  |                           | 63                                          | 63                                                         | 38                       | 2                                 |
| 200                              | 200                       | 20                                          | 20                                                         | 16                       | ½                                 |
|                                  |                           | 25                                          | 25                                                         | 19                       | ¾                                 |
|                                  |                           | 32                                          | 32                                                         | 22                       | 1                                 |
|                                  |                           | 40                                          | 40                                                         | 26                       | 1 ¼                               |
|                                  |                           | 50                                          | 50                                                         | 31                       | 1 ½                               |
|                                  |                           | 63                                          | 63                                                         | 38                       | 2                                 |
|                                  |                           | 90                                          | 90                                                         | 51                       | 3                                 |
| 225                              | 225                       | 32                                          | 32                                                         | 22                       | 1                                 |
|                                  |                           | 40                                          | 40                                                         | 26                       | 1 ¼                               |
|                                  |                           | 50                                          | 50                                                         | 31                       | 1 ½                               |
|                                  |                           | 63                                          | 63                                                         | 38                       | 2                                 |
|                                  |                           | 90                                          | 90                                                         | 51                       | 3                                 |
| 250                              | 250                       | 20                                          | 20                                                         | 16                       | ½                                 |
|                                  |                           | 25                                          | 25                                                         | 19                       | ¾                                 |
|                                  |                           | 32                                          | 32                                                         | 22                       | 1                                 |
|                                  |                           | 40                                          | 40                                                         | 26                       | 1 ¼                               |
|                                  |                           | 50                                          | 50                                                         | 31                       | 1 ½                               |
| 315                              | 315                       | 20                                          | 20                                                         | 16                       | ½                                 |
|                                  |                           | 25                                          | 25                                                         | 19                       | ¾                                 |
|                                  |                           | 32                                          | 32                                                         | 22                       | 1                                 |
|                                  |                           | 40                                          | 40                                                         | 26                       | 1 ¼                               |
|                                  |                           | 50                                          | 50                                                         | 31                       | 1 ½                               |

See Figures 10 to 13.

<sup>a</sup> For diameters  $d_3$ , the tolerance is  $^{+0,3}_0$  mm.

<sup>b</sup> Joining pipe thread,  $R_p$ , shall conform to ISO 7-1.

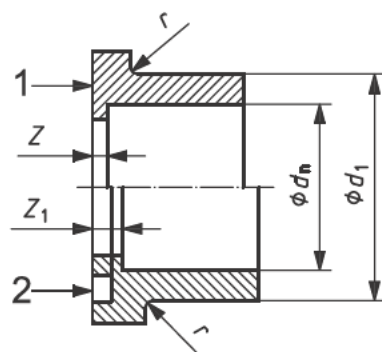
The length of the saddle,  $b$ , shall be specified in the technical file of the manufacturer.

## 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

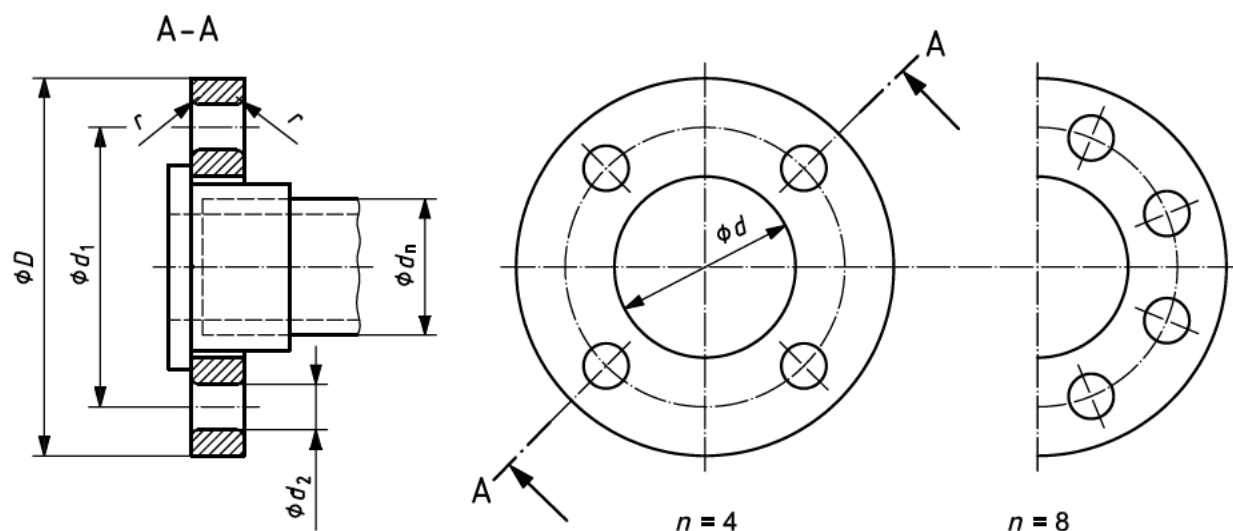
| Adapters                                                                   |                   |                |               |                      | Flanges                |
|----------------------------------------------------------------------------|-------------------|----------------|---------------|----------------------|------------------------|
| Nominal diameter of socket <sup>a</sup>                                    | External diameter | Contour radius | Jointing face |                      | Nominal size of flange |
| $d_n$                                                                      | $d_1$             | $r_{\max}$     | flat<br>$Z$   | with groove<br>$Z_1$ | DN                     |
| 16                                                                         | $22 \pm 0,1$      | 1              | 3             | 6                    | 10                     |
| 20                                                                         | $27 \pm 0,15$     | 1              | 3             | 6                    | 15                     |
| 25                                                                         | $33 \pm 0,15$     | 1,5            | 3             | 6                    | 20                     |
| 32                                                                         | $41 \pm 0,2$      | 1,5            | 3             | 6                    | 25                     |
| 40                                                                         | $50 \pm 0,2$      | 2              | 3             | 8                    | 32                     |
| 50                                                                         | $61 \pm 0,2$      | 2              | 3             | 8                    | 40                     |
| 63                                                                         | $76 \pm 0,3$      | 2,5            | 3             | 8                    | 50                     |
| 75                                                                         | $90 \pm 0,3$      | 2,5            | 3             | 8                    | 65                     |
| 90                                                                         | $108 \pm 0,3$     | 3              | 5             | 10                   | 80                     |
| 110                                                                        | $131 \pm 0,3$     | 3              | 5             | 11                   | 100                    |
| 125                                                                        | $148 \pm 0,4$     | 3              | 5             | 11                   | 125                    |
| 140                                                                        | $165 \pm 0,4$     | 4              | 5             | 11                   | 125                    |
| 160                                                                        | $188 \pm 0,4$     | 4              | 5             | 11                   | 150                    |
| See Figure 14.                                                             |                   |                |               |                      |                        |
| <sup>a</sup> 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<br>$d_n$ | Nominal size of flange<br>DN | Outside diameter of flange<br>$D$ | Inside diameter of flange <sup>a</sup><br>$d$ | Pitch circle diameter of bolt holes<br>$d_1$ | Radius<br>$r$ | Number of bolt holes<br>$n$ | Diameter of bolt holes<br>$d_2$ | Metric thread of bolt |
|---------------------------------------------------------|------------------------------|-----------------------------------|-----------------------------------------------|----------------------------------------------|---------------|-----------------------------|---------------------------------|-----------------------|
| 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.

<sup>a</sup> Tolerance on  $d$ : -0,5 for  $d \leq 62$  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<sup>[1]</sup>.

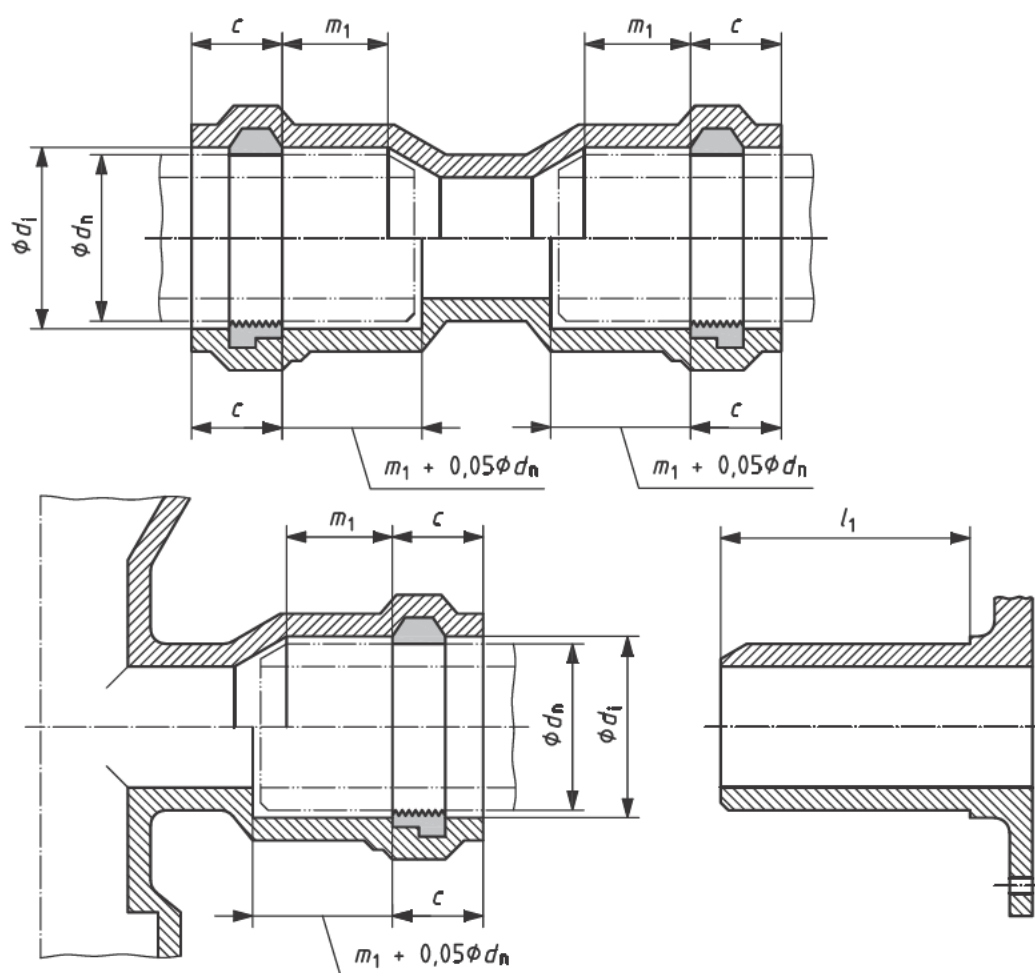


Figure 16 — Engagement of sockets and spigots

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                                                                                                                                                                   | Minimum depth of engagement <sup>a</sup> | Minimum length of fitting spigot <sup>b</sup> |
| $d_n$                                                                                                                                                                                               | $m_{1, \min}$                            | $l_{1, \min}$                                 |
| 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.                                                                                                                                                                                      |                                          |                                               |
| <sup>a</sup> $m_{1, \min}$ is calculated using Equation (14): $m_{1, \min} = 30 \text{ mm} + 0,15d_n - 2e_n$ , where $e_n$ is the nominal wall thickness of the corresponding pipes of series S 10. |                                          |                                               |
| <sup>b</sup> $l_{\min}$ 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

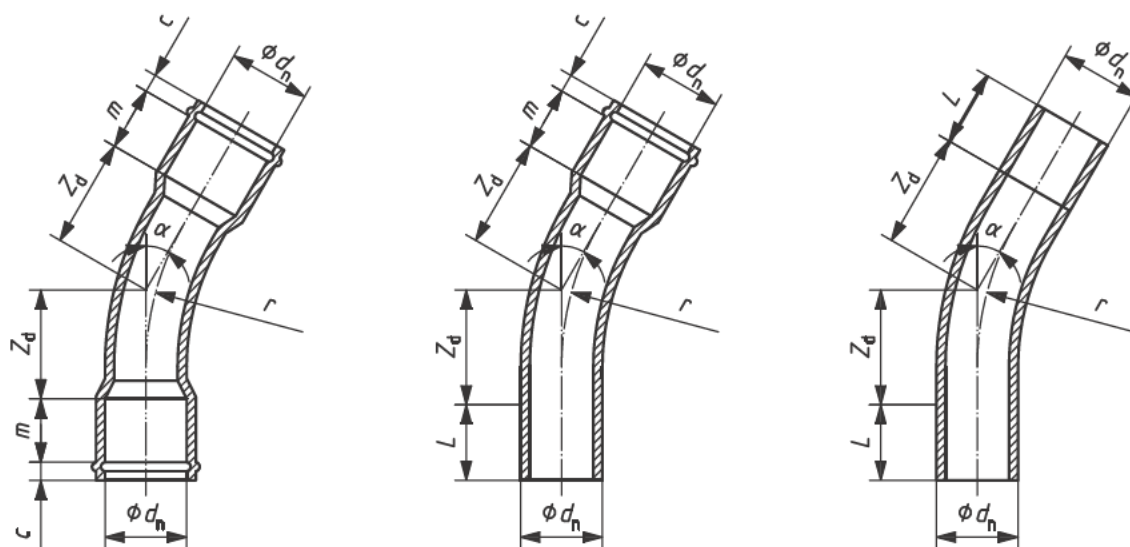


Figure 17 — Typical bends made from pipes

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

Dimensions in millimetres

| Nominal diameter<br>$d_n$ | Minimum bend radius <sup>a</sup><br>$r_{min}$ | Minimum design length <sup>b</sup><br>$Z_{d,min}$ |     |     |       |       |       |
|---------------------------|-----------------------------------------------|---------------------------------------------------|-----|-----|-------|-------|-------|
|                           |                                               | Angle $\alpha$                                    |     |     |       |       |       |
|                           |                                               | 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.

<sup>a</sup>  $r_{min}$  is calculated using Equation (16):  $r_{min} = 3,5d_n$ .

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

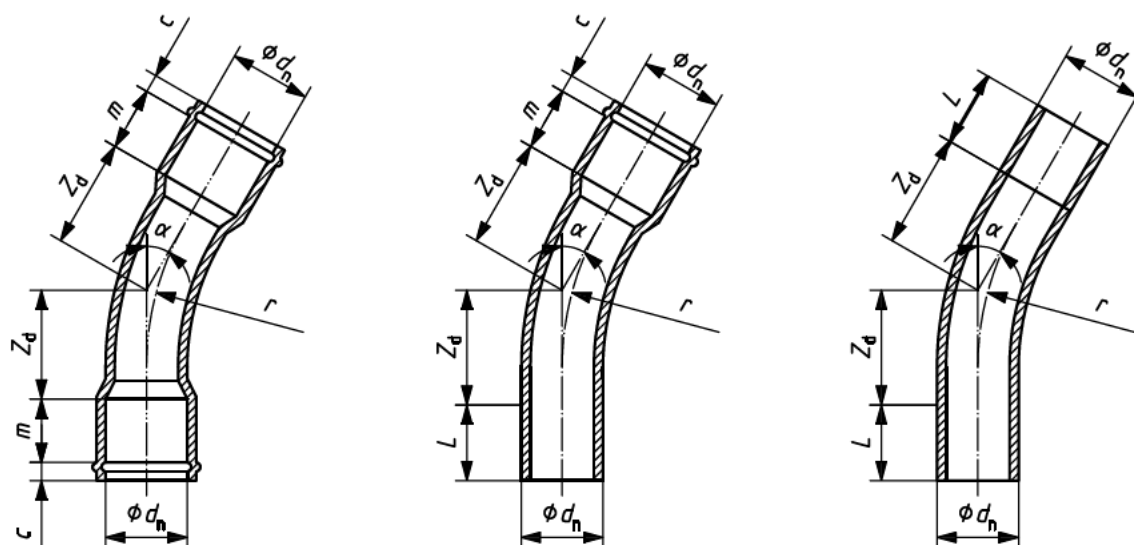


Figure 18 — Typical short bends made from pipes

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

Dimensions in millimetres

| Nominal diameter<br>$d_n$ | Minimum bend radius <sup>a</sup><br>$r_{min}$ | Minimum design length <sup>b</sup><br>$Z_{d, min}$ |     |     |     |       |       |
|---------------------------|-----------------------------------------------|----------------------------------------------------|-----|-----|-----|-------|-------|
|                           |                                               | Angle, $\alpha$                                    |     |     |     |       |       |
|                           |                                               | 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.

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

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

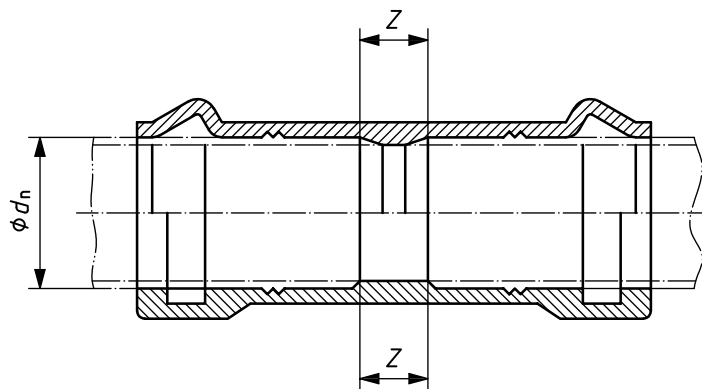


Figure 19 — Double-sockets

Table 16 —  $Z$ -lengths for double-sockets

Dimensions in millimetres

| Nominal diameter of socket<br>$d_n$ | Minimum<br>$Z$ -length | Nominal diameter of socket<br>$d_n$ | Minimum<br>$Z$ -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.

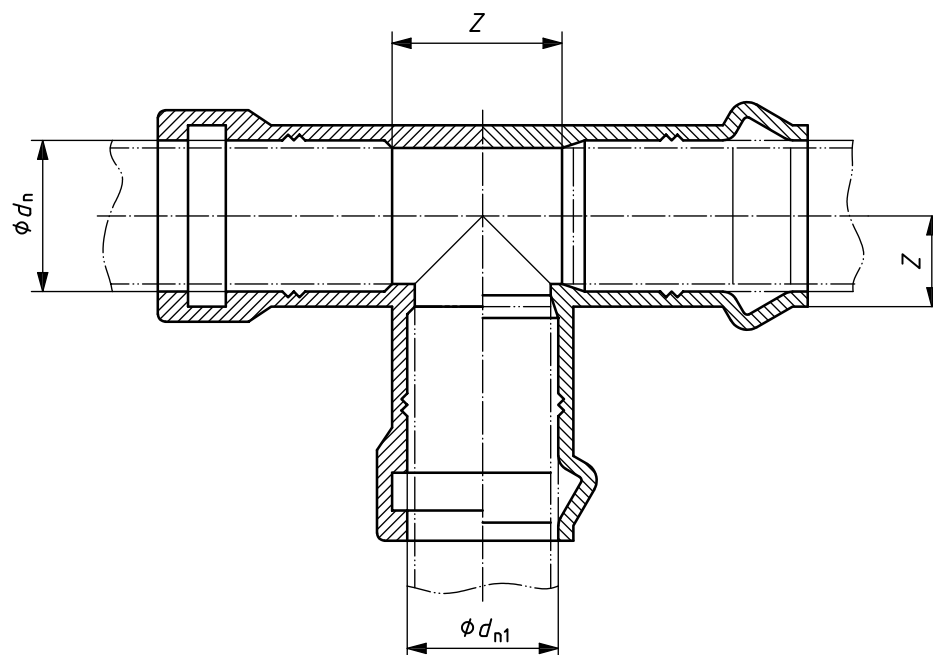
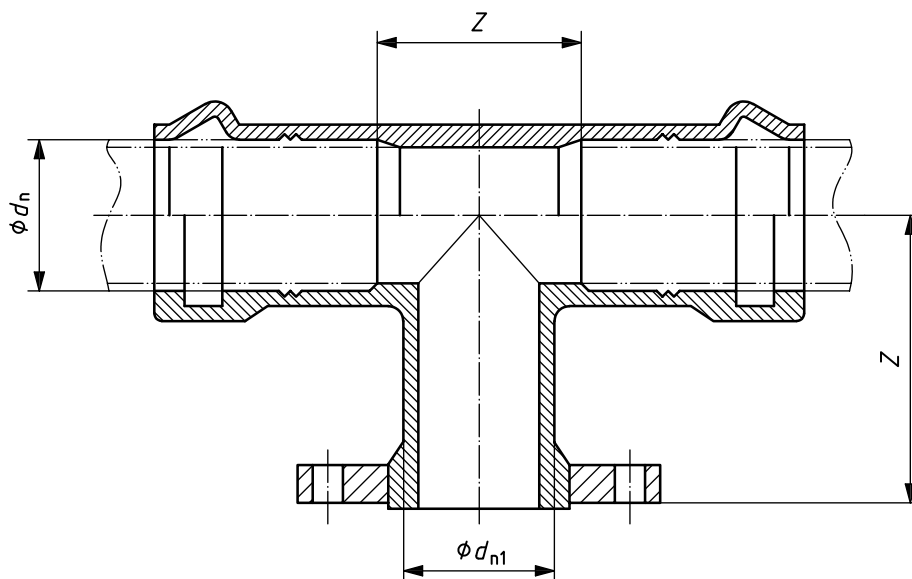


Figure 20 — Typical tee with sockets, injection-moulded

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              | 200               | 160      | 160                    | 80              |     |     |     |
|                                                                               | 75       | 75                     | 55              |                   | 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.                                                                |          |                        |                 |                   |          |                        |                 |     |     |     |
| <sup>a</sup> $Z_{\min} = d_{n1}$ .                                            |          |                        |                 |                   |          |                        |                 |     |     |     |
| <sup>b</sup> $Z_{1, \min} = 0,5d_n$ , rounded to the next greater millimetre. |          |                        |                 |                   |          |                        |                 |     |     |     |



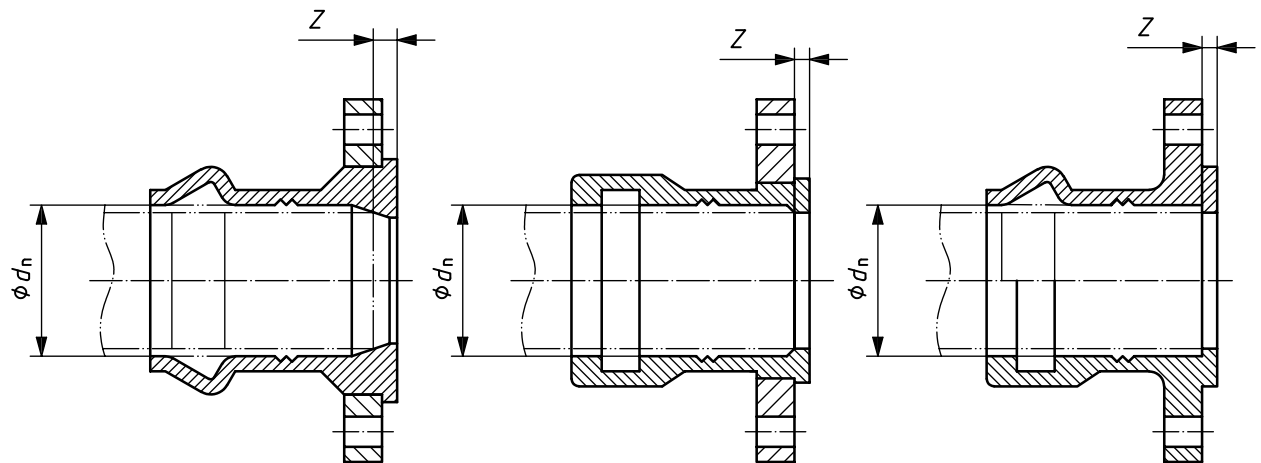
NOTE For flange dimensions, see Table 12; for collar dimensions, see Table 11.

**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           | 200               | 160      | 160                    | 230           |
|                                    | 75       | 75                     | 160           |                   | 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.                     |          |                        |               |                   |          |                        |               |
| <sup>a</sup> $Z_{\min} = d_{n1}$ . |          |                        |               |                   |          |                        |               |

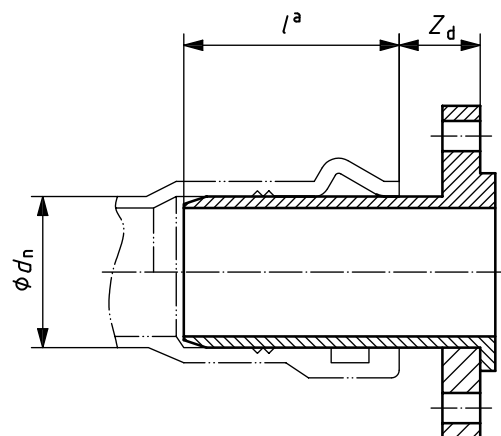


NOTE For flange dimensions, see Table 12; for collar dimensions, see Table 11.

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.                       |    |    |    |     |     |     |     |     |     |



<sup>a</sup>  $l_{\min}$  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.                                       |    |    |    |     |     |     |     |     |     |
| <sup>a</sup> $Z_{d, \min} = 0,1d_n + 26 \text{ mm.}$ |    |    |    |     |     |     |     |     |     |

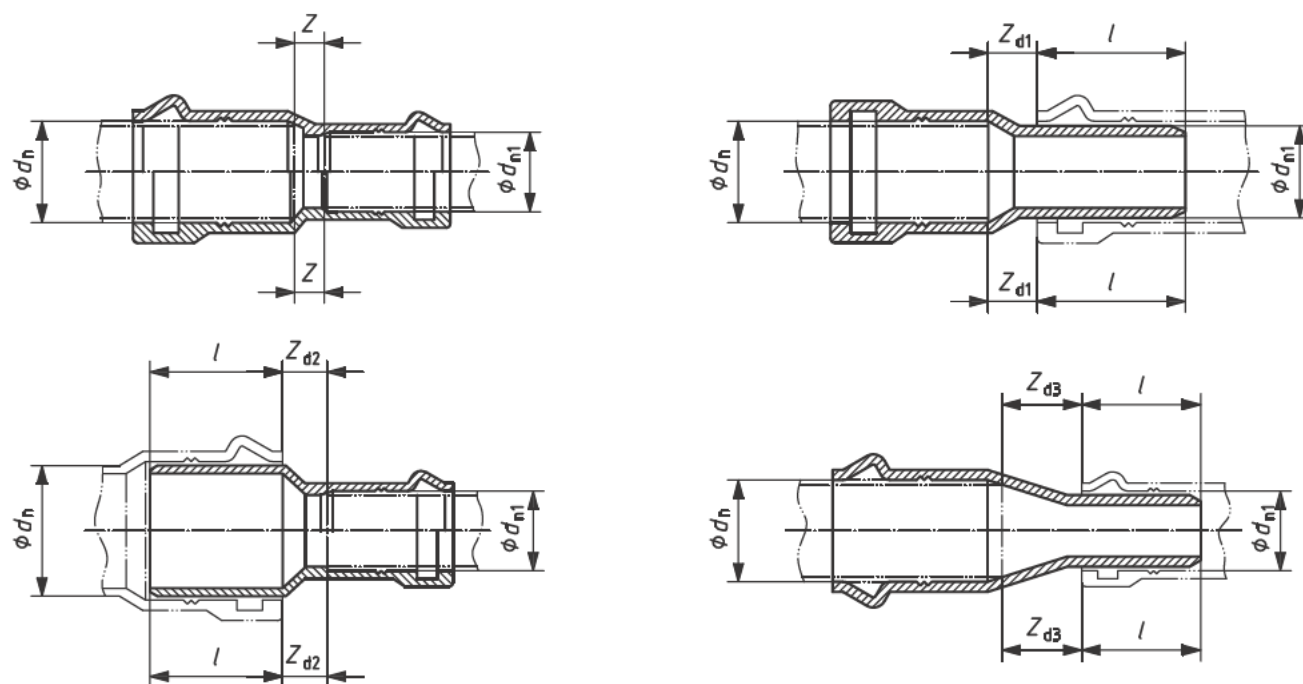


Figure 24 — Typical reducers

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. |          |                                   |                |                |                |

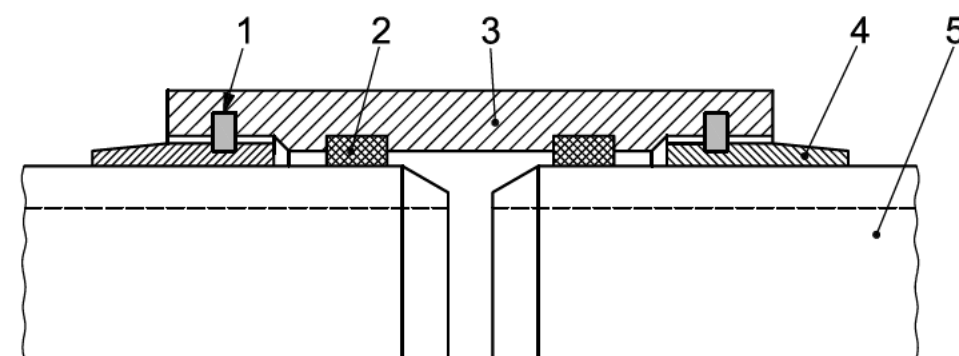
#### 6.7.4 Wall thicknesses

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  $\pm 2$  °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,  $\sigma_s$ , using as a basis, the relationship used for pipes, i.e. Equation (20):

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

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):

$$PFA = f_T \times PN \quad (21)$$

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

<sup>a</sup> 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.

<sup>b</sup> The test pressure  $p$ , shall be determined using Equation (22):

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

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

<sup>c</sup> 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  $(50 \pm 5)$  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) | $\geq 74$ °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. <sup>a</sup><br>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. <sup>b</sup> | Test temperature:<br>Test period for:<br>$e \leq 3$<br>$3 < e \leq 10$<br>$10 < e \leq 20$<br>$20 < e \leq 30$<br>$30 < e \leq 40$<br>$40 < e$<br>Number of test pieces: | $(150 \pm 2)$ °C<br><br>15 min<br>30 min<br>60 min<br>140 min<br>220 min<br>240 min<br>3 | Method A of ISO 580<br>(Air oven) |

<sup>a</sup> The weld-line is likely to become more pronounced, but this should not be taken as a sign of weld-line opening.

<sup>b</sup> 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.

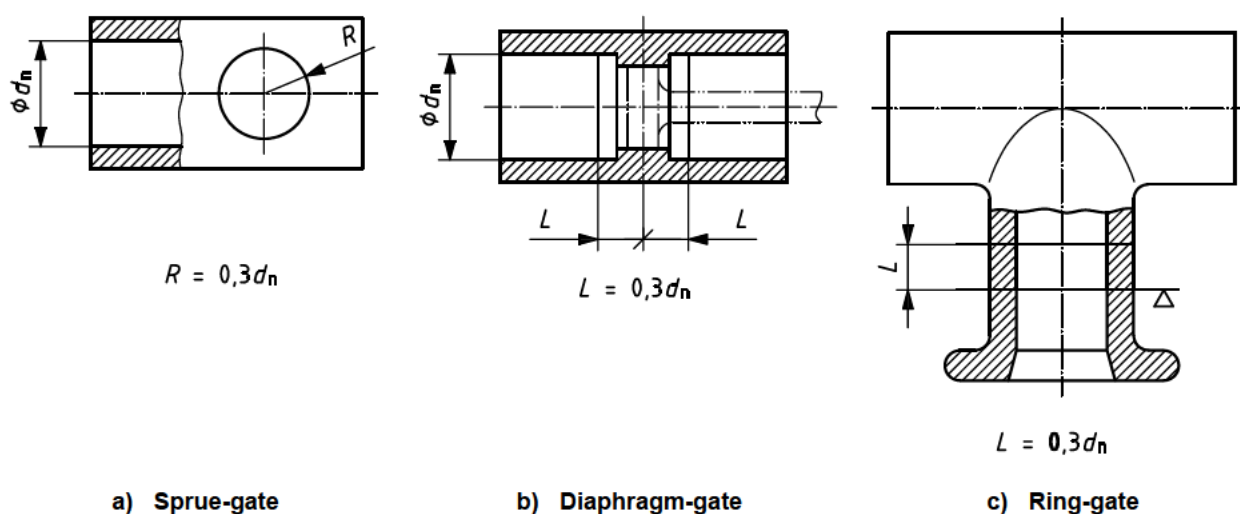


Figure 26 — Injection gating areas

## 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 <sup>a</sup><br>– Manufacturer's name and/or trade mark<br>– Nominal diameter(s) $d_n$<br>– Material<br>– Nominal pressure PN <sup>bc</sup><br>– Manufacturer's information <sup>bd</sup><br>– Intended use <sup>ae</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                           | ISO 1452<br>xyz<br>e.g. 63-32-63<br>e.g. PVC-U<br>e.g. PN 16<br>e.g. 90.66<br>e.g. W/P |
| <sup>a</sup> This information may either be marked directly on the fitting or on a label attached to the fitting or on the packaging.<br><sup>b</sup> For fittings of nominal diameters $d_n \leq 50$ mm table footnote "a" applies.<br><sup>c</sup> The marking of the pipe series S may be included, e.g. PN 16/S 8.<br><sup>d</sup> To provide traceability, the following details shall be given:<br>– the production period, the year, in figures or in code;<br>– a name or code for the production site, if the manufacturer is producing in different sites, nationally and/or internationally.<br><sup>e</sup> Information on abbreviations can be found in CEN/TR 15438 <sup>[3]</sup> and/or in national rules. |                                                                                        |

**Table 25 — Minimum required marking on flanges**

| Aspects                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Mark or symbol                                                          |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>– Number of the International Standard<sup>a</sup></li> <li>– Manufacturer's name and/or trade mark</li> <li>– Nominal size DN of flange</li> <li>– Material</li> <li>– Nominal pressure PN of flange</li> <li>– Manufacturer's information<sup>bc</sup></li> </ul>                                                                                                                                                                                                                                        | ISO 1452<br>xyz<br>e.g. DN 80<br>e.g. PVC-U<br>e.g. PN 16<br>e.g. 93.66 |
| <sup>a</sup> This information may either be marked directly on the flange, on a plate/label attached to the flange or on the packaging.<br><sup>b</sup> For flanges of DN ≤ 25 table footnote "a" applies.<br><sup>c</sup> To provide traceability, the following details shall be given: <ul style="list-style-type: none"> <li>– the production period, e.g. year, in figures or in code;</li> <li>– a name or code for the production site, if the manufacturer is producing in different sites, nationally and/or internationally.</li> </ul> |                                                                         |

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 |
|--------------|----------------------------|-------------------------------------|--------|----------------------|-----------------------------|-----------------------|
| in           | mm                         | mm                                  | mm     | <i>n</i>             | <i>d</i> <sub>2</sub><br>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    | Requirements                      | Type of test piece         | Test parameters |                                 |                  |                 | Test method                |
|-------------------|-----------------------------------|----------------------------|-----------------|---------------------------------|------------------|-----------------|----------------------------|
|                   |                                   |                            | Temp.<br>°C     | Pressure in<br>bar <sup>a</sup> | Test period<br>h | Type of<br>test |                            |
| Internal pressure | No failure during the test period | Injection-moulded fittings | 20              | $3,36 \times PN$                | 1                | Water in water  | ISO 1167-1 and ISO 1167-3  |
|                   |                                   |                            |                 | $2,56 \times PN$                | 1 000            |                 |                            |
|                   |                                   | Fittings made from pipe    | 20              | $3,36 \times PN$                | 1                |                 | 3 items per test condition |

<sup>a</sup> The values given in table footnote “b” of Table 22 in this part of ISO 1452 do not apply.

<sup>b</sup> 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*

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