
**Plastics piping systems for hot and cold
water installations — Chlorinated
poly(vinyl chloride) (PVC-C) —**

**Part 3:
Fittings**

*Systèmes de canalisations en plastique pour les installations d'eau
chaude et froide — Poly(chlorure de vinyle) chloré (PVC-C) —*

Partie 3: Raccords



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

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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 15877-3 was prepared by the European Committee for Standardization (CEN) in collaboration with 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).

Throughout the text of this document, read “...this European Standard...” to mean “...this International Standard...”.

ISO 15877 consists of the following parts, under the general title *Plastics piping systems for hot and cold water installations — Chlorinated poly(vinyl chloride) (PVC-C)*:

- *Part 1: General*
- *Part 2: Pipes*
- *Part 3: Fittings*
- *Part 5: Fitness for purpose of the system*
- *Part 7: Guidance for the assessment of conformity* [Technical Specification]

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Foreword

This document (EN ISO 15877-3:2003) 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 2004, and conflicting national standards shall be withdrawn at the latest by December 2005.

NOTE This draft was submitted for CEN enquiry as prEN 12731-3:1995.

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

System Standards are based on the results of the work being undertaken in ISO/TC 138 "Plastics pipes, fittings and valves for the transport of fluids", which is a Technical Committee of the International Organisation for Standardization (ISO).

They are supported by separate Standards on test methods to which references are made throughout the System Standard.

The System Standards are consistent with general standards on functional requirements and recommended practices for installation.

EN ISO 15877 consists of the following Parts ¹⁾, under the general title *Plastics piping systems for hot and cold water installations — Chlorinated poly(vinyl chloride) (PVC-C)*

- Part 1: General
- Part 2: Pipes
- Part 3: Fittings (the present standard)
- Part 5: Fitness for purpose of the system
- Part 7 Guidance for the assessment of conformity (CEN ISO/TS 15877-7).

This Part of EN ISO 15877 includes a Bibliography

At the date of publication of this standard, System Standards for piping systems of other plastics materials used for the same application include the following:

EN ISO 15874, *Plastics piping systems for hot and cold water installations — Polypropylene (PP)* (ISO 15874:2003)

EN ISO 15875, *Plastics piping systems for hot and cold water installations — Crosslinked polyethylene (PE-X)* (ISO 15875:2003)

EN ISO 15876, *Plastics piping systems for hot and cold water installations — Polybutylene (PB)* (ISO 15876:2003)

For pipes and fittings which have conformed to the relevant national standard before 1st November, 2003, as shown by the manufacturer or by a certification body, the national standard may continue to apply until 30th November 2005.

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

¹⁾ This System Standard does not incorporate a Part 4 *Ancillary equipment* or a Part 6 *Guidance for installation*. For ancillary equipment separate standards can apply. Guidance on installation of plastics piping systems made from different materials intended to be used for hot and cold water installations is given by ENV 12108 ^[1].

Introduction

The System Standard of which this is Part 3, specifies the requirements for a piping system when from chlorinated poly(vinyl chloride) (PVC-C). The piping system is intended to be used for hot and cold water installations. In respect of potential adverse effects on the quality of water intended for human consumption, caused by the product covered by this standard:

- This standard provides no information as to whether the product may be used without restriction in any of the Member States of the EU or EFTA;
- It should be noted that, while awaiting the adoption of verifiable European criteria, existing national regulations concerning the use and/or the characteristics of this product remain in force.

Requirements and test methods for materials and components, other than fittings, are specified in Part 1 and Part 2 of EN ISO 15877:2003. Characteristics for fitness for purpose (mainly for joints) are covered in Part 5. Part 7 (CEN ISO/TS 15877-7) gives guidance for the assessment of conformity.

This Part of EN ISO 15877 specifies the characteristics of the fittings.

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1 Scope

This Part of EN ISO 15877 specifies the characteristics of fittings made from chlorinated poly(vinyl chloride) (PVC-C) for piping systems intended to be used for hot and cold water installations within buildings for the conveyance of water, whether or not intended for human consumption (domestic systems) under design pressures and temperatures according to the class of application (see Table 1 of EN ISO 15877-1:2003).

This standard covers a range of service conditions (application classes) and design pressure classes. For values of T_D , T_{max} and T_{mal} in excess of those in Table 1 of Part 1, this standard does not apply.

NOTE 1 It is the responsibility of the purchaser or specifier to make the appropriate selections from these aspects, taking into account their particular requirements and any relevant national regulations and installation practices or codes.

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

In conjunction with the other Parts of EN ISO 15877:2003 (see Foreword) it is applicable to PVC-C fittings, their joints and to joints with components of PVC-C, other plastics and non-plastics materials intended to be used for hot and cold water installations.

This standard is applicable to fittings of the following types:

- fittings for solvent cement joints;
- mechanical fittings;
- fittings with incorporated inserts.

NOTE 2 Fittings made from PVC-C are manufactured by injection-moulding.

2 Normative references

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

EN 578, *Plastics piping systems — Plastics pipes and fittings — Determination of the opacity*

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

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

EN 763:1994, *Plastics piping and ducting systems — Injection-moulded thermoplastics fittings — Test method for visually assessing effects of heating*

EN 921:1994, *Plastics piping systems — Thermoplastics pipes — Determination of resistance to internal pressure at constant temperature*

EN 1254-3, *Copper and copper alloys — Plumbing fittings — Part 3: Fittings with compression ends for use with plastics pipes*

EN 10088-1, *Stainless steels — Part 1: List of stainless steels*

prEN 10226-1, *Pipe threads where pressure tight joints are made on the threads — Part 1: Taper external threads and parallel internal threads - Dimensions, tolerances and designation*

EN 12107, *Plastics piping systems — Injection-moulded thermoplastics fittings, valves and ancillary equipment — Determination of long-term hydrostatic strength of thermoplastics materials used for injection moulding of piping components*

EN ISO 3126, *Plastics piping systems — Plastics components — Determination of dimensions (ISO 3126:2003)*

ISO 15877-3:2003(E)

EN ISO 9080, *Plastics piping and ducting systems – Determination of the long-term hydrostatic strength of thermoplastics materials in pipe form by extrapolation (ISO 9080:2003)*

EN ISO 15877-1:2003, *Plastics piping systems for hot and cold water installations — Chlorinated poly(vinyl chloride) (PVC-C) — Part 1: General (ISO 15877-1:2003)*

EN ISO 15877-2:2003, *Plastics piping systems for hot and cold water installations — Chlorinated poly(vinyl chloride) (PVC-C) — Part 2: Pipes (ISO 15877-2:2003)*

EN ISO 15877-5, *Plastics piping systems for hot and cold water installations — Chlorinated poly(vinyl chloride) (PVC-C) — Part 5: Fitness for purpose of the system (ISO 15877-5:2003)*

ISO 228-1, *Pipe threads where pressure-tight joints are not made on the threads — Part 1: Dimensions, tolerances and designation*

ISO 12092, *Fittings, valves and other piping system components made of unplasticized poly(vinyl chloride) (PVC-U), chlorinated poly(vinyl chloride) (PVC-C), acrylonitrile-butadiene-styrene (ABS) and acrylonitrile-styrene-acrylester (ASA) for pipes under pressure — Resistance to internal pressure — Test method*

3 Terms and definitions, symbols and abbreviated terms

For the purposes of this standard, terms and definitions, symbols and abbreviations given in EN ISO 15877-1:2003 apply together with the following terms and definitions:

3.1 Terms and definitions

3.1.1

fitting for solvent cement joints

fitting in which the joint with the pipe or another component is made by means of an adhesive

3.1.2 Mechanical fittings

3.1.2.1

compression fitting

fitting in which the joint is made by the compression of a ring or sleeve on the outside wall of the pipe with or without additional sealing elements and with internal support

3.1.2.2

flanged fitting

fitting in which the pipe connection consists of two mating flanges which are mechanically pressed together and sealed by the compression of an elastomeric sealing element between them

3.1.2.3

flat seat union fitting

fitting in which the pipe connection consists primarily of two components, at least one of which normally incorporates a flat seating surface, which are mechanically pressed together by means of a screwed nut or similar and sealed by the compression of an elastomeric sealing element between them

3.1.2.3

fitting with incorporated inserts

fitting in which the joint is made by means of connecting threads or other outlets, inserted in the injection-moulded fitting body, combined with at least one solvent cement socket injection-moulded fitting body, combined with at least one solvent cement socket

3.2 Symbols

d_{s1} : inside diameter of the socket at entry

d_{s2} : inside diameter of the socket at shoulder

d_1 : nominal diameter of the socket

d_2 : nominal diameter of the spigot

L : socket length

l_0 : free length

r : bending radius

Z : laying length (Z-length)

α_n : nominal angle of fitting

4 Material characteristics

4.1 General

The PVC-C material from which the fittings are made shall conform to this standard and to the relevant requirements of EN ISO 15877-1:2003.

4.2 Fitting material

The material from which the fittings are made shall be a chlorinated poly(vinyl chloride) (PVC-C) resin to which are added those additives that are needed to facilitate the manufacture of fittings conforming to this standard.

When tested in accordance with the test method as specified in Table 12 using the indicated parameters, injection moulded tubular test pieces shall withstand the hydrostatic (hoop) stress without bursting or leakage.

4.3 Evaluation of σ_{LCL} -values

The fitting material shall be evaluated in accordance with EN ISO 9080 or equivalent, where an internal pressure test is made in accordance with EN 921:1994 (together with EN 12107) to find the σ_{LCL} -values. The σ_{LCL} -values thus determined shall be at least as high as the corresponding values of the reference curves given in Figure 1 over the complete range of times.

NOTE 1 One equivalent way of evaluation is to calculate the σ_{LCL} -values for each temperature (e.g. for 20 °C, 60 °C and 90 °C) individually.

Equation (1) shall be used to determine the design stress, σ_{DF} , in the fitting material (see Annex A of EN ISO 15877-2:2003), as well as the values of the hydrostatic stress, σ_F , of the fitting material corresponding to the temperature and time control points given in Table 14.

$$\log t = -121,699 - \frac{25985}{T} \times \log \sigma + \frac{47143,18}{T} + 63,03511 \times \log \sigma \quad (1)$$

NOTE 2 The reference curves in Figure 1 in the temperature range of 10 °C to 90 °C are derived from equation (1).

NOTE 3 Resistance to T_{mal} of PVC-C material is verified by testing in accordance with Annex A of EN ISO 15877-1:2003.

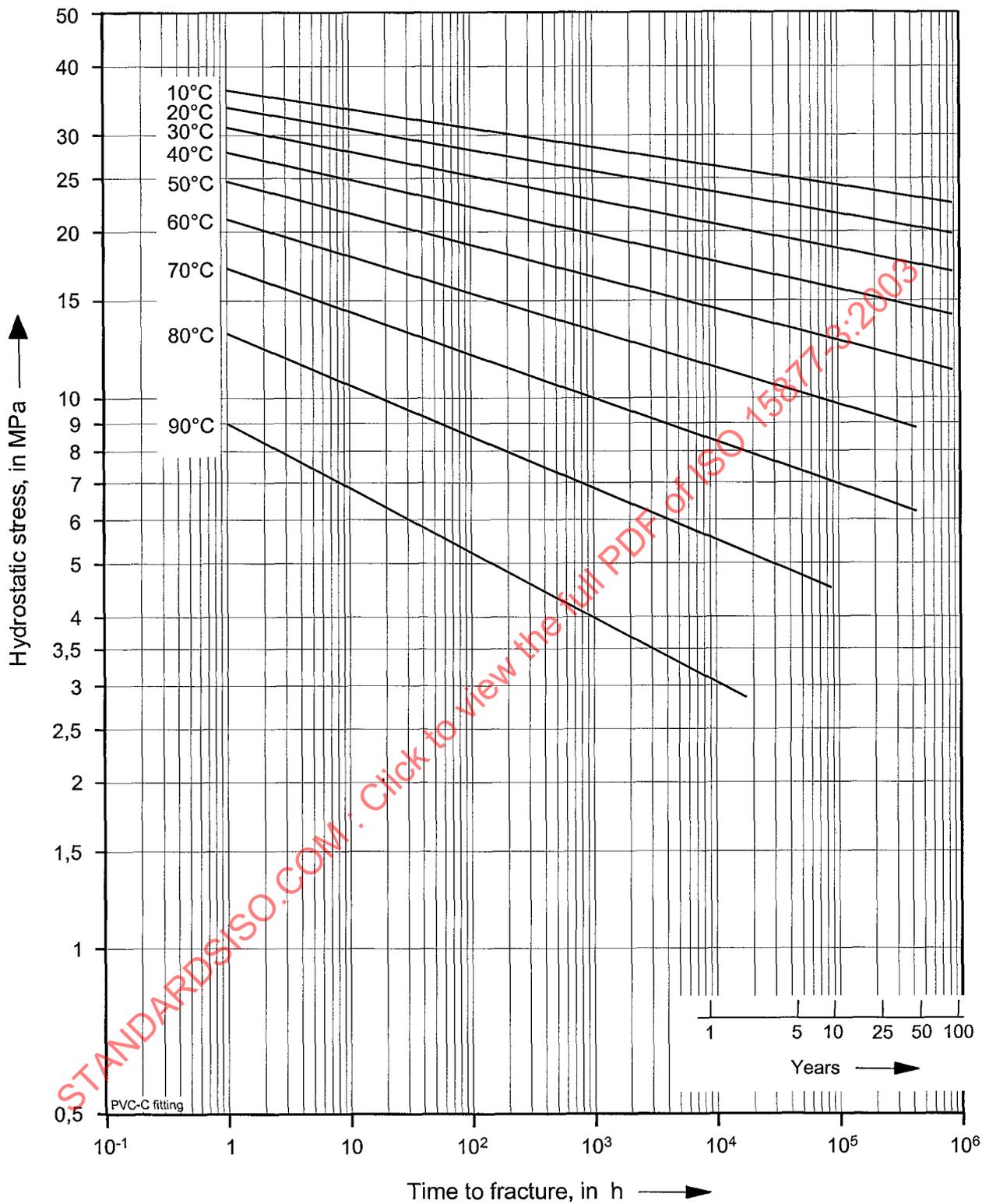


Figure 1 — Reference curves for the expected hydrostatic strength of PVC-C fitting material

4.4 Metallic material

Metallic material for fittings, intended to be used with components conforming to EN ISO 15877, shall conform to the requirements given in EN 1254-3 or EN 10088-1, as applicable.

4.5 Influence on water intended for human consumption

The material from which the fittings are made shall conform to EN ISO 15877-1:2003.

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 conformance with this standard. The material shall not contain visible impurities.

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

5.2 Opacity

PVC-C fittings that are declared to be opaque shall not transmit more than 0,2 % of visible light, when tested in accordance with EN 578.

6 Geometrical characteristics

6.1 General

Dimensions shall be measured in accordance with EN ISO 3126.

NOTE Figure 2 to Figure 9 cover schematic sketches only, to indicate the relevant dimensions. They do not necessarily represent the manufactured components.

6.2 Dimensions of fittings

6.2.1 Nominal diameter(s)

The nominal diameter(s), d_n , of a fitting shall correspond to and be designated by the nominal outside diameter(s) of the pipe(s) conforming to EN ISO 15877-2:2003 for which they are designed.

6.2.2 Wall thicknesses

The wall thickness, e , of the fitting body shall conform to Table 1 in relation to the pipe series S.

NOTE Compared with the wall thickness of the corresponding pipe conforming to EN ISO 15877-2:2003 the wall thickness, e , of the fitting body is increased by the factor 1,35.

Table 1 — Wall thicknesses of fitting bodies

Dimensions in millimetres

Nominal diameter	Pipe series		
	S 6,3	S 5	S 4
d_n	Minimum wall thickness ^a		
	e_{min}		
12	1,9	1,9	1,9
14	1,9	1,9	2,2
16	1,9	2,1	2,5
20	2,1	2,6	3,2
25	2,6	3,2	3,8
32	3,3	4,0	4,9
40	4,1	5,0	6,1
50	5,0	6,3	7,6
63	6,4	7,9	9,6
75	7,6	9,2	11,4
90	9,1	11,1	13,7
110	11,0	13,5	16,7
125	12,5	15,4	18,9
140	14,0	17,2	21,2
160	16,0	19,8	24,2

^a The values are rounded up to the first place of the decimals (i.e. the nearest 0,1 mm).

6.2.3 Angles

The preferred nominal angle, α_n , of non-straight fittings is 45° and 90°.

6.2.4 Threads

Threads used for jointing shall conform to prEN 10226-1. Where a thread is used as a fastening thread for jointing an assembly (e.g. union nuts) it shall conform to ISO 228-1 except that these requirements need not apply to the threads used by the manufacturer to join component parts of a fitting together.

6.2.5 Laying lengths (Z-lengths)

For the following types of injection-moulded fittings the Z-lengths shall be calculated using one of the following equations (2) to (10), as applicable, where α is the angle of the fitting and r is the bending radius:

a) 90° elbow (see Figure 2 and Table 2) : $Z = \frac{d_n}{2} + 1$ (2)

b) 45° elbow (see Figure 2 and Table 2) : $Z = \left(\frac{d_n}{2} \times \tan \frac{\alpha}{2} \right) + 1$ (3)

c) 90° tee (see Figure 2 and Table 2) : $Z = \frac{d_n}{2} + 1$ (2)

d) 45° tee (see Figure 2 and Table 2) : $Z = \left(\frac{d_n}{2} \times \cot \frac{\alpha}{2} \right) + t$ (4)

with

d_n	t
≤ 90	3
110	4
125	6
140	6
160	7

$Z_1 \approx \left(\frac{d_n}{2} \times \tan \frac{\alpha}{2} \right) + 1$ (5)

e) bends (see Figure 3 and Table 3) : $Z \approx r = 2d_n$ (6)

f) reducing bushes, long type (see Figure 4):
 - with conical sockets (see Table 4) : $Z_{con.} = 0,3 \times (d_2 - d_1) + L_{d2}$ (7)

- with cylindrical sockets (see Table 5) : $Z_{zyl.} = 0,75d_2 + 6$ (8)

g) reducing bushes, short type (see Figure 5):
 - with conical sockets (see Table 6) : $Z_{kon.} = L_{d2} - L_{d1}$ (9)

- with cylindrical sockets (see Table 7) : $Z_{zyl.} = \left(\frac{d_2}{2} + 6 \right) - \left(\frac{d_1}{2} + 6 \right)$ (10)

The calculated values of the Z-lengths are given in Table 2 to Table 7, as applicable. These values may be adopted by the manufacturer. The manufacturer shall state the exact values for the Z-lengths in his documents (e.g. catalogues).

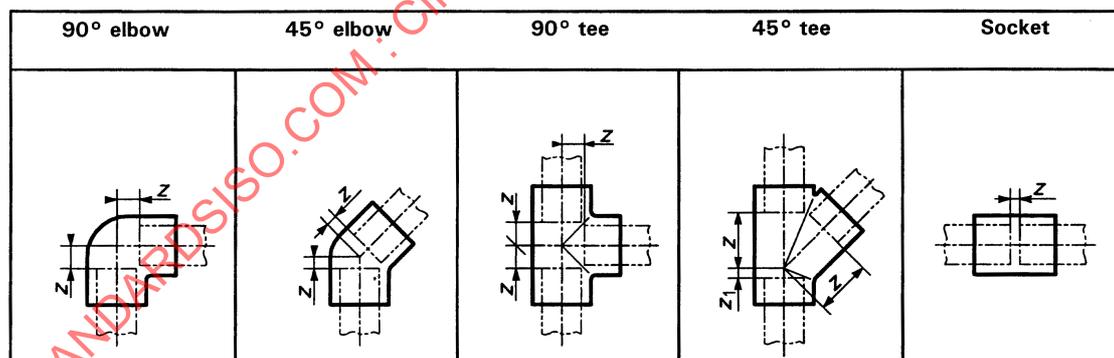


Figure 2 — Z-lengths of elbows, tees and couplers (double-sockets)

Table 2 — Calculated laying lengths (Z-lengths) and related tolerances of elbows, tees and couplers (double-sockets)

Dimensions in millimetres

Nominal diameter d_n	Type of fitting					Double-socket
	90° elbow	45° elbow	90° tee	45° tee		
	Calculated Z-length and recommended deviations					
	Z	Z	Z	Z	Z ₁	Z
12	7 ±1	3,5 ±1	7 ±1	—	—	3 ±1
14	8 ±1	4 ±1	8 ±1	—	—	3 ±1
16	9 ±1	4,5 ±1	9 ±1	—	—	3 ±1
20	11 ±1	5 ±1	11 ±1	27 ±3	6 ⁺² ₋₁	3 ±1
25	13,5 ^{+1,2} ₋₁	6 ^{+1,2} ₋₁	13,5 ^{+1,2} ₋₁	33 ±3	7 ⁺² ₋₁	3 ^{+1,2} ₋₁
32	17 ^{+1,6} ₋₁	7,5 ^{+1,6} ₋₁	17 ^{+1,6} ₋₁	42 ⁺⁴ ₋₃	8 ⁺² ₋₁	3 ^{+1,6} ₋₁
40	21 ⁺² ₋₁	9,5 ⁺² ₋₁	21 ⁺² ₋₁	51 ⁺⁵ ₋₃	10 ⁺² ₋₁	3 ⁺² ₋₁
50	26 ^{+2,5} ₋₁	11,5 ^{+2,5} ₋₁	26 ^{+2,5} ₋₁	63 ⁺⁶ ₋₃	12 ⁺² ₋₁	3 ⁺² ₋₁
63	32,5 ^{+3,2} ₋₁	14 ^{+3,2} ₋₁	32,5 ^{+3,2} ₋₁	79 ⁺⁷ ₋₃	14 ⁺² ₋₁	3 ⁺² ₋₁
75	38,5 ⁺⁴ ₋₁	16,5 ⁺⁴ ₋₁	38,5 ⁺⁴ ₋₁	94 ⁺⁹ ₋₃	17 ⁺² ₋₁	4 ⁺² ₋₁
90	46 ⁺⁵ ₋₁	19,5 ⁺⁵ ₋₁	46 ⁺⁵ ₋₁	112 ⁺¹¹ ₋₃	20 ⁺³ ₋₁	5 ⁺² ₋₁
110	56 ⁺⁶ ₋₁	24 ⁺⁶ ₋₁	56 ⁺⁶ ₋₁	137 ⁺¹³ ₋₄	24 ⁺³ ₋₁	6 ⁺³ ₋₁
125	63,5 ⁺⁶ ₋₁	27 ⁺⁶ ₋₁	63,5 ⁺⁶ ₋₁	157 ⁺¹⁵ ₋₄	27 ⁺³ ₋₁	6 ⁺³ ₋₁
140	71 ⁺⁷ ₋₁	30 ⁺⁷ ₋₁	71 ⁺⁷ ₋₁	175 ⁺¹⁷ ₋₅	30 ⁺⁴ ₋₁	8 ⁺³ ₋₁
160	81 ⁺⁸ ₋₁	34 ⁺⁸ ₋₁	81 ⁺⁸ ₋₁	200 ⁺²⁰ ₋₆	35 ⁺⁴ ₋₁	8 ⁺⁴ ₋₁

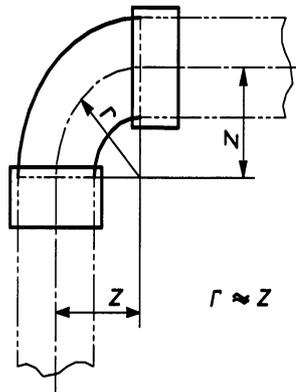


Figure 3 — Dimensions of injection-moulded bends

Table 3 — Calculated laying lengths (Z-lengths) and related tolerances of injection-moulded bends

Dimensions in millimetres

Nominal diameter d_n	Calculated laying length and related tolerances Z	Nominal diameter d_n	Calculated laying length and related tolerances Z
12	24 ±1	63	126 $\begin{matrix} +3,2 \\ -1 \end{matrix}$
14	28 ±1	75	150 $\begin{matrix} +4 \\ -1 \end{matrix}$
16	32 ±1	90	180 $\begin{matrix} +5 \\ -1 \end{matrix}$
20	40 ±1	110	220 $\begin{matrix} +6 \\ -1 \end{matrix}$
25	50 $\begin{matrix} +1,2 \\ -1 \end{matrix}$	125	250 $\begin{matrix} +6 \\ -1 \end{matrix}$
32	64 $\begin{matrix} +1,6 \\ -1 \end{matrix}$	140	280 $\begin{matrix} +7 \\ -1 \end{matrix}$
40	80 $\begin{matrix} +2 \\ -1 \end{matrix}$	160	320 $\begin{matrix} +8 \\ -1 \end{matrix}$
50	100 $\begin{matrix} +2,5 \\ -1 \end{matrix}$	—	—

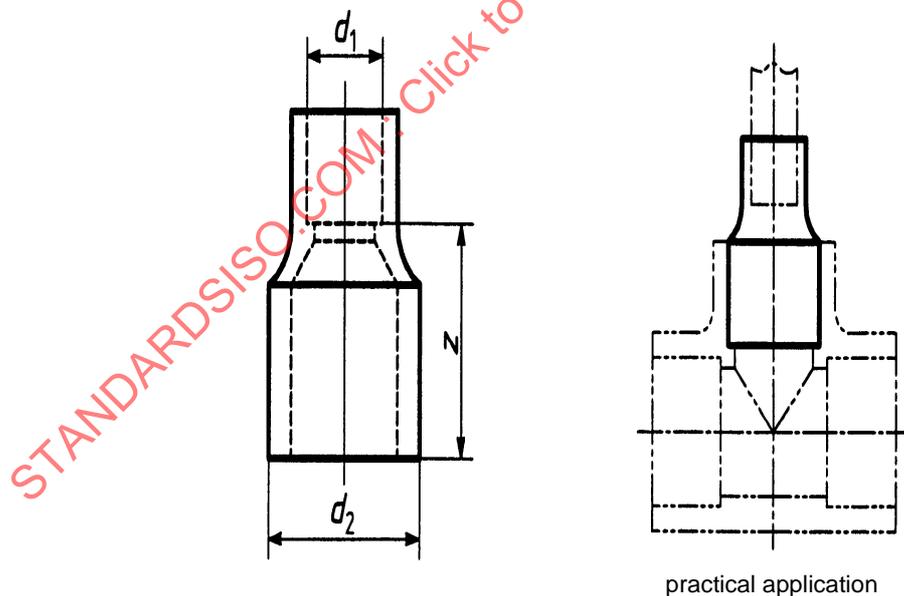


Figure 4 — Dimensions of reducing bushes, long type, and example of application

Table 4 — Calculated laying lengths (Z-lengths) and related tolerances of reducing bushes, long type, with conical sockets

Dimensions in millimetres

Nominal diameter of the socket d_1	Nominal diameter of the spigot d_2								
	20	25	32	40	50	63	75	90	110
	Calculated laying length, Z, and related tolerances								
	± 1			± 1,5			± 2		
16	21	28	35	—	—	—	—	—	—
20	—	27	34	41	—	—	—	—	—
25	—	—	32	40	49	—	—	—	—
32	—	—	—	38	46	59	—	—	—
40	—	—	—	—	44	57	71	—	—
50	—	—	—	—	—	54	68	84	—
63	—	—	—	—	—	—	64	80	102
75	—	—	—	—	—	—	—	77	99
90	—	—	—	—	—	—	—	—	94

Table 5 — Calculated laying lengths (Z-lengths) and related tolerances of reducing bushes, long type, with cylindrical sockets

Dimensions in millimetres

Nominal diameter of the socket d_1	Nominal diameter of the spigot d_2											
	20	25	32	40	50	63	75	90	110	125	140	160
	Calculated laying length, Z, and related tolerances											
	± 1			± 1,5			± 2					
14	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

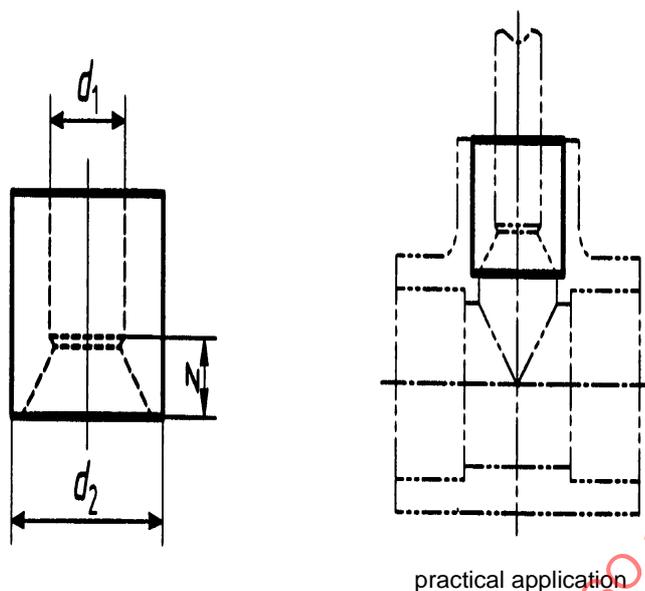


Figure 5 — Dimensions of reducing bushes, short type, and example of application

Table 6 — Calculated laying lengths (Z-lengths) and related tolerances of reducing bushes, short type, with conical sockets

Dimensions in millimetres

Nominal diameter of the socket d_1	Nominal diameter of the spigot, d_2								
	20	25	32	40	50	63	75	90	110
	Calculated laying length, Z, and related tolerances								
	± 1			± 1,5			± 2		
16	4	9	14	—	—	—	—	—	—
20	—	5	10	15	—	—	—	—	—
25	—	—	5	10	16	—	—	—	—
32	—	—	—	5	11	20	—	—	—
40	—	—	—	—	6	15	25	—	—
50	—	—	—	—	—	9	19	32	—
63	—	—	—	—	—	—	10	22	38
75	—	—	—	—	—	—	—	12	28
90	—	—	—	—	—	—	—	—	16

Table 7 — Calculated laying lengths (Z-lengths) and related tolerances of reducing bushes, short type, with cylindrical sockets

Dimensions in millimetres

Nominal diameter of the socket d_1	Nominal diameter of the spigot, d_2												
	16	20	25	32	40	50	63	75	90	110	125	140	160
	Calculated laying length, Z, and related tolerance												
	± 1												
14	1	3	5,5	9	—	—	—	—	—	—	—	—	—
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
125	—	—	—	—	—	—	—	—	—	—	—	7,5	17,5
140	—	—	—	—	—	—	—	—	—	—	—	—	10

6.3 Dimensions of sockets

6.3.1 Dimensions of cylindrical sockets

The dimensions of cylindrical sockets shall conform to Table 8.

Table 8 — Dimensions of cylindrical sockets

Dimensions in millimetres

Nominal diameter d_n	Mean inside diameter of the socket ^a		Maximum out-of-roundness (ovality)	Minimum socket length L_{\min}
	$d_{sm,\min}$	$d_{sm,\max}$		
12	12,1	12,3	0,25	12
14	14,1	14,3	0,25	13
16	16,1	16,3	0,25	14
20	20,1	20,3	0,25	16
25	25,1	25,3	0,25	18,5
32	32,1	32,3	0,25	22
40	40,1	40,3	0,25	26
50	50,1	50,3	0,3	31
63	63,1	63,3	0,4	37,5
75	75,1	75,3	0,5	43,5
90	90,1	90,3	0,6	51
110	110,1	110,4	0,7	61
125	125,1	125,4	0,8	68,5
140	140,2	140,5	0,9	76
160	160,2	160,5	1,0	86

^a The mean inside diameter of the socket, d_{sm} , shall be measured at the midpoint of the socket. The maximum internal angle of the socketed portion shall not exceed 0°30' (see ISO 727:2002 [2]).

6.3.2 Dimensions of conical sockets

The dimensions of conical sockets (see Figure 6) shall conform to Table 9.

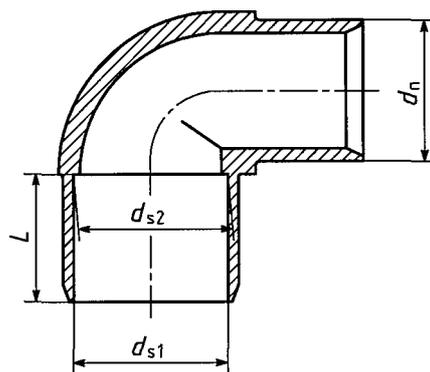


Figure 6 — Dimensions of conical sockets

Table 9 — Dimensions of conical sockets

Dimensions in millimetres

Nominal diameter d_h	Inside diameter of the socket at entry		Inside diameter of the socket at shoulder		Maximum out-of-roundness (ovality)	Minimum socket length L_{min}
	$d_{s1,min}$	$d_{s1,max}$	$d_{s2,min}$	$d_{s2,max}$		
12	12,25	12,45	11,9	12,1	0,25	12
14	14,25	14,45	13,9	14,1	0,25	14
16	16,25	16,45	15,9	16,1	0,25	16
20	20,25	20,45	19,9	20,1	0,25	20
25	25,25	25,45	24,9	25,1	0,25	25
32	32,25	32,45	31,9	32,1	0,25	30
40	40,25	40,45	39,8	40,1	0,25	35
50	50,25	50,45	49,8	50,1	0,3	41
63	63,25	63,45	62,8	63,1	0,4	50
75	75,3	75,6	74,75	75,1	0,5	60
90	90,3	90,6	89,75	90,1	0,6	72
110	110,3	110,6	109,75	110,1	0,7	88

6.4 Dimensions of flange adaptors and flanges

6.4.1 Dimensions of flange adaptors

The dimensions of flange adaptors (see Figure 7) shall conform to Table 10.

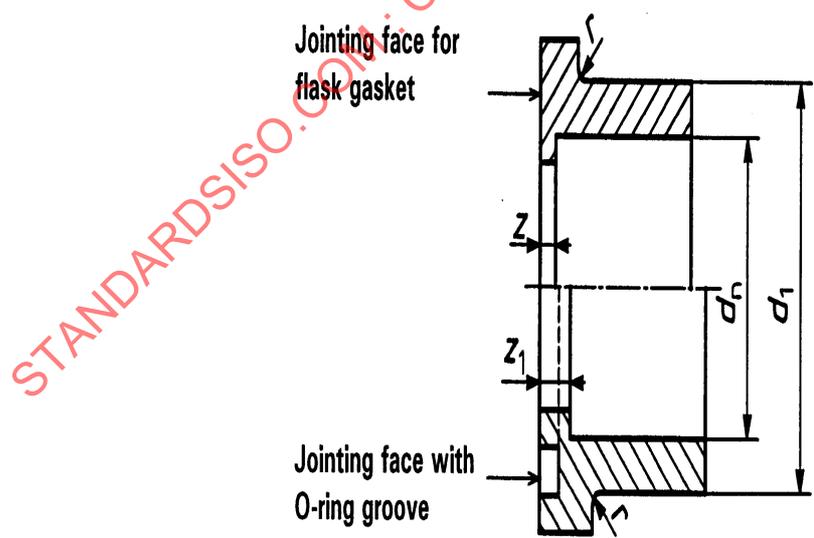


Figure 7 — Dimensions of flange adaptors

Table 10 — Dimensions of flange adaptors

Dimensions en millimetres

Flange adaptor					Nominal size of the flange ^a
Nominal outside diameter of the corresponding pipe	Outside diameter of chamfer on shoulder	Radius of chamfer on shoulder	Joining face		
d_n	d_1	r_1	for flat gasket	with O-ring groove	DN
			Z	Z ₁	
16	22 ±0,1	1	3	6	10
20	27 ±0,15	1	3	6	15
25	33 ±0,15	1,5	3	6	20
32	41 ±0,2	1,5	3	6	25
40	50 ±0,2	2	3	8	32
50	61 ±0,2	2	3	8	40
63	76 ±0,3	2,5	3	8	50
75	90 ±0,3	2,5	3	8	65
90	108 ±0,3	3	5	10	80
110	131 ±0,3	3	5	11	100
125	148 ±0,4	3	5	11	125
140	165 ±0,4	4	5	11	125
160	188 ±0,4	4	5	11	150

a In accordance with ISO 2536:1974 [3].

6.4.2 Dimensions of flanges

The dimensions of flanges (see Figure 8) shall conform to Table 11.

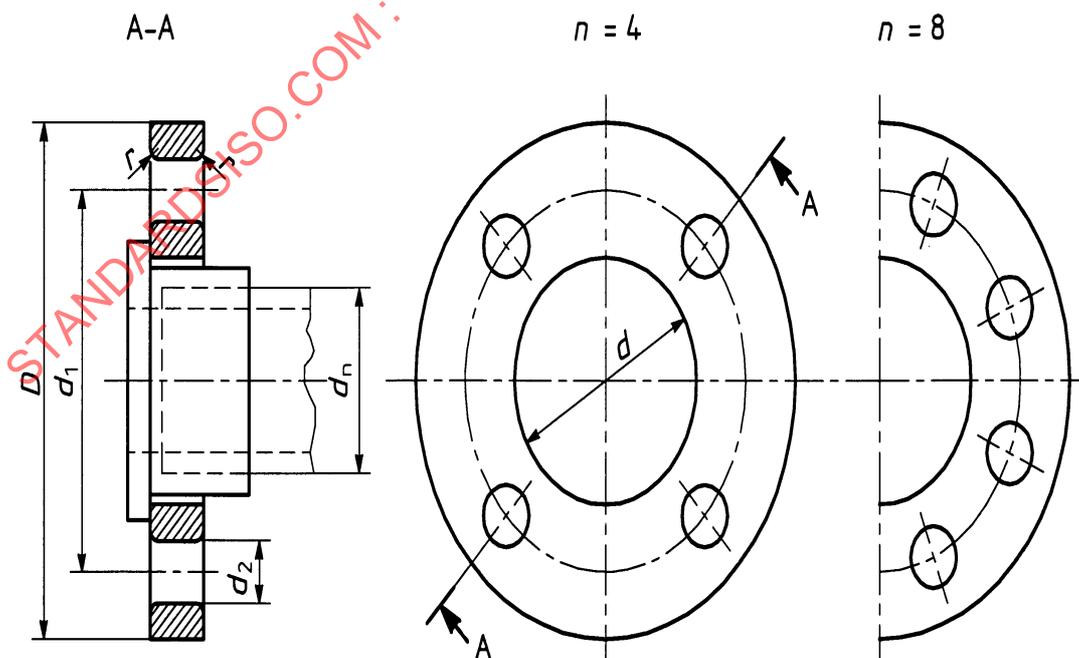


Figure 8 — Dimensions of flanges

Table 11 — Dimensions of flanges

Dimensions in millimetres

Nominal outside diameter of the corresponding pipe d_n	Nominal size of the flange DN	Outside diameter of the flange D	Inside diameter of the flange d^a	Pitch circle diameter of bolt holes d_{b1}	Diameter of bolt holes d_{b2}	Radius r	Number of bolt holes n	Thread size
16	10	90	23	60	14	1	4	M12
20	15	95	28	65	14	1	4	M12
25	20	105	34	75	14	1,5	4	M12
32	25	115	42	85	14	1,5	4	M12
40	32	140	52	100	18	2	4	M16
50	40	150	63	110	18	2	4	M16
63	50	165	78	125	18	2,5	4	M16
75	65	185	92	145	18	2,5	4	M16
90	80	200	110	160	18	3	8	M16
110	100	220	133	180	18	3	8	M16
125	125	250	150	210	18	4	8	M16
140	125	250	167	210	18	4	8	M16
160	150	285	190	240	22	4	8	M20

^a The tolerance for d : -0,5 for $d \leq 63$ mm;
 -1 for $d > 63$ mm,
 whereby d shall be compatible with the outside diameter d_1 of the flange adaptor (see Table 10).

NOTE All joining dimensions conform to ISO 2536:1974 [3].

6.5 Dimensions of metallic fittings

The dimensions and related tolerances of metallic fittings shall correspond to the dimensions of the pipe(s) conforming to EN ISO 15877-2:2003, for which they are intended to be used.

Metallic fittings shall conform to EN 1254-3.

7 Mechanical characteristics

7.1 Resistance to internal pressure

7.1.1 Testing of material

The material shall be tested in form of tubular test pieces.

When tested in accordance with the test methods specified in Table 12, using the indicated parameters, the test pieces shall withstand the hydrostatic test pressure, p_F , given in Table 14 without bursting or leakage.

Table 12 — Test parameters for testing resistance to internal pressure

Characteristic	Requirements	Test parameters	Test method	
Resistance to internal pressure	No failure during the test period	Sampling procedure Type of end caps Orientation of test piece Diameter Free length Test temperature Type of test ^b Test period	^a Types a) or b) Vertical $d_n \geq 50$ mm $l_0 \geq 3d_n$ Shall conform to Table 14 Water-in-air or water-in-water ^c Shall conform to Table 14	EN 921:1994 (together with EN 12107)
^a The sampling procedure is not specified. For guidance see CEN ISO/TS 15877-7 [4]. ^b Testing at 80 °C (see Table 14) shall be done in water-in-air. ^c In case of dispute, testing at 20 °C shall be done in water-in-water. For temperatures greater than 20 °C, the test shall be done in water-in-air.				

For fittings made from pipes conforming to EN ISO 15877-2:2003, the requirements on hydrostatic (hoop) stress of the material are regarded as fulfilled.

7.1.2 Testing of fittings

When tested in accordance with ISO 12092, using the test parameters given in Table 14, the fitting shall withstand the hydrostatic test pressure, p_F , without bursting or leakage during the test period.

For temperatures greater than 20 °C testing shall be done in water-in-air.

The fittings shall be connected to the corresponding pipe conforming to EN ISO 15877-2:2003, either by using solvent cement or jointed by mechanical assembly, in such a way that the required hydrostatic test pressure, p_F , given in Table 14, can be applied. The free length, l_0 , of the solvent cemented pipe sections shall be chosen according to Table 13.

Before testing store the fittings with solvent cemented pipe sections for setting for at least 20 days at ambient temperature and, after that, 4 days at 80 °C, unless the manufacturer of the adhesive has prescribed other setting times.

For fittings with solvent cement joints, the free ends of the pipe sections shall be provided with end caps according to EN 921:1994 in such a way that the axial forces caused by the internal pressure are transferred to the fitting.

Components comprising parts of an elastomeric ring seal joint, such as union joints, flanged joints and joints with push-fit sockets, shall be tested within the joints.

7.2 Determination of free lengths

In relation to the nominal outside diameter, d_n , of the pipe, the free length, l_0 , shall be chosen according to Table 13.

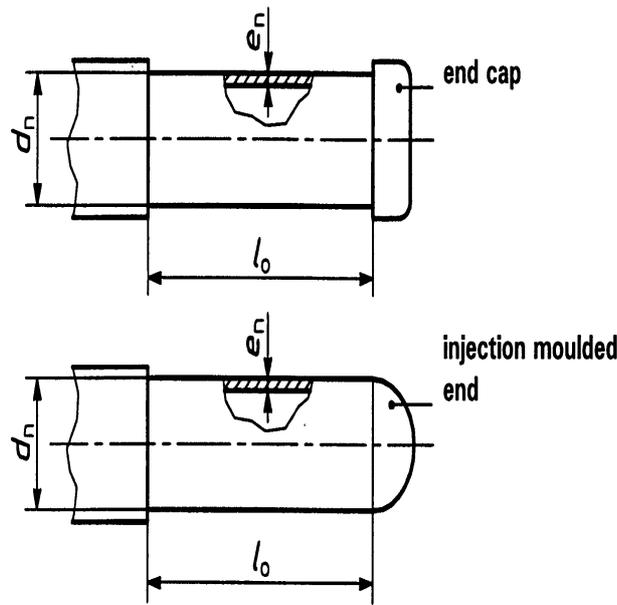


Figure 9 — Free length of tubular test pieces

Table 13 — Free lengths of solvent cemented pipe sections

Dimensions in millimetres

Nominal outside diameter of the pipe d_n	Free length of the pipe section l_0
≤ 50	150
63 and 75	200
≥ 90	300

For fittings with change in direction (e.g. tees and bends) the free length, l_0 , between the socket mouth of solvent cemented pipe and the end cap shall not exceed d_n .

7.3 Derivation of the hydrostatic test pressure

The hydrostatic test pressure, p_F , shall be calculated in relation to the class of service condition and the design pressure, using the following equation (11):

$$p_F = p_D \times \frac{\sigma_F}{\sigma_{DF}} \tag{11}$$

where

- p_F is the hydrostatic test pressure, in bar, to be applied to the fitting during the test period;
- σ_F is the value of the hydrostatic stress, in megapascals, of the fitting material corresponding to the test duration and the test temperature conditions given in Table 14;
- σ_{DF} is the design stress value, in megapascals, in the fitting material as determined for the appropriate class of service condition from data produced in accordance with 4.3 and annex A of EN ISO 15877-2:2003;