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**Plastics piping systems for water  
supply, and for drainage and sewerage  
under pressure — Polyethylene (PE) —**

**Part 3:  
Fittings**

*Systèmes de canalisations en plastique destinés à l'alimentation  
en eau et aux branchements et collecteurs d'assainissement sous  
pression — Polyéthylène (PE) —*

*Partie 3: Raccords*



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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fitting and valves for the transport of fluids*, Subcommittee SC 2, *Plastics pipes and fittings for water supplies*.

This second edition cancels and replaces the first edition (ISO 4427-3:2007), which has been technically revised.

The main changes compared to the previous edition are:

- Update of the normative references;
- Technical consistency with ISO 4437-3 (see Reference [1] in the Bibliography).

A list of all parts in the ISO 4427 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

## Introduction

The ISO 4427 series of standards are a set of system standards that specify the requirements for a piping system and its components when made from polyethylene (PE). The piping system is intended to be used in buried or above ground applications, for the conveyance of water for human consumption, raw water prior to treatment, drainage and sewerage under pressure, vacuum sewer systems, and water for other purposes.

In respect of potential adverse effects on the quality of water intended for human consumption caused by the products covered by the ISO 4427 series, it does not provide information on the restriction on the use of products.

NOTE Guidance for assessment of conformity can be found in Reference [2] in the Bibliography.

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# Plastics piping systems for water supply, and for drainage and sewerage under pressure — Polyethylene (PE) —

## Part 3: Fittings

### 1 Scope

This document specifies the fittings made from polyethylene (PE) for buried or above ground applications, intended for the conveyance of water for human consumption, raw water prior to treatment, drainage and sewerage under pressure, vacuum sewer systems, and water for other purposes.

NOTE 1 The intended uses include sea outfalls, laid in water and connection between pipes suspended below bridges.

This document also specifies the test parameters for the test methods referred to in this document.

In conjunction with the other parts of the ISO 4427 series, this document is applicable to PE fittings, to joints with components of PE or other materials, intended to be used under the following conditions:

- a) a maximum allowable operating pressure (PFA) up to and including 25 bar<sup>1)</sup>;
- b) an operating temperature of 20 °C as the reference temperature.

NOTE 2 For other operating temperatures, guidance is given in ISO 4427-1:2019, Annex A.

This document covers a range of maximum allowable operating pressures and gives requirements concerning colours.

NOTE 3 It is the responsibility of the purchaser or specifier to make the appropriate selections from these aspects, taking into account their particular requirements and installation practices or codes.

This document is applicable to fittings of the following types:

1. fusion fittings;
  - a. electrofusion fittings;
  - b. spigot end fittings (for butt fusion using heated tools and electrofusion socket fusion);
  - c. socket fusion fittings (see [Annex A](#));
2. mechanical fittings;
  - a. compression fittings;
  - b. flanged fittings;
3. fabricated fittings (see [Annex B](#)).

1) 1 bar = 0,1 MPa = 10<sup>5</sup> Pa; 1 MPa = 1 N/mm<sup>2</sup>.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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, *Pipe threads where pressure-tight joints are made on the threads — Part 1: Dimensions, tolerances and designation*

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

ISO 1133-1, *Plastics — Determination of the melt mass-flow rate (MFR) and melt volume-flow rate (MVR) of thermoplastics — Part 1: Standard method*

ISO 1167-1:2006, *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 1167-4, *Thermoplastics pipes, fittings and assemblies for the conveyance of fluids — Determination of the resistance to internal pressure — Part 4: Preparation of assemblies*

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

ISO 4427-1, *Plastics piping systems for water supply, and for drainage and sewerage under pressure — Polyethylene (PE) — Part 1: General*

ISO 4427-2, *Plastics piping systems for water supply, and for drainage and sewerage under pressure — Polyethylene (PE) — Part 2: Pipes*

ISO 4427-5, *Plastics piping systems for water supply, and for drainage and sewerage under pressure — Polyethylene (PE) — Part 5: Fitness for purpose of the system*

ISO 4433-1, *Thermoplastics pipes — Resistance to liquid chemicals — Classification — Part 1: Immersion test method*

ISO 4433-2, *Thermoplastics pipes — Resistance to liquid chemicals — Classification — Part 2: Polyolefin pipes*

ISO 9624, *Thermoplastics pipes for fluids under pressure — Mating dimensions of flange adapters and loose backing flanges*  
*Thermoplastics pipes for fluids under pressure — Mating dimensions of flange adapters and loose backing flanges*

ISO 11357-6, *Plastics — Differential scanning calorimetry (DSC) — Part 6: Determination of oxidation induction time (isothermal OIT) and oxidation induction temperature (dynamic OIT)*

ISO 12176-1, *Plastics pipes and fittings — Equipment for fusion jointing polyethylene systems — Part 1: Butt fusion*

ISO 13951, *Plastics piping systems — Test method for the resistance of plastic pipe/pipe or pipe/fitting assemblies to tensile loading*

ISO 13953, *Polyethylene (PE) pipes and fittings — Determination of the tensile strength and failure mode of test pieces from a butt-fused joint*

ISO 13954, *Plastics pipes and fittings — Peel decohesion test for polyethylene (PE) electrofusion assemblies of nominal outside diameter greater than or equal to 90 mm*

ISO 13955, *Plastics pipes and fittings — Crushing decohesion test for polyethylene (PE) electrofusion assemblies*

ISO 13956, *Plastics pipes and fittings — Decohesion test of polyethylene (PE) saddle fusion joints — Evaluation of ductility of fusion joint interface by tear test*

ISO 13957, *Plastics pipes and fittings — Polyethylene (PE) tapping tees — Test method for impact resistance*

ISO 17885, *Plastics piping systems — Mechanical fittings for pressure piping systems — Specifications*

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

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4427-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

#### 3.1

##### **electrofusion socket fitting**

polyethylene (PE) fitting which contains one or more integral heating elements that are capable of transforming electrical energy into heat to realize a fusion joint with a spigot end or pipe

#### 3.2

##### **electrofusion saddle fitting**

polyethylene (PE) fitting which contains one or more integral heating elements that are capable of transforming electrical energy into heat to realize a fusion joint onto a pipe

##### 3.2.1

##### **tapping tee**

electrofusion saddle fitting (top-loading or wraparound) which contains an integral cutter used for cutting through the wall of the main pipe, which remains in the body of the tapping tee after installation

##### 3.2.2

##### **branch saddle**

electrofusion saddle fitting (top-loading or wraparound) which requires an ancillary cutting tool for drilling the hole in the adjoining main pipe

#### 3.3

##### **spigot end fitting**

polyethylene (PE) fitting where the outside diameter of the spigot length is equal to the nominal outside diameter,  $d_n$ , of the corresponding pipe

#### 3.4

##### **socket fusion fitting**

polyethylene (PE) fitting where the socket mouth is designed to be fusion-jointed with a spigot end or a pipe using heated tools

#### 3.5

##### **fabricated fitting**

fitting produced from pipe conforming to ISO 4427-2 and/or from injection-moulded fittings in accordance with this document

### 3.6

#### **mechanical fitting**

fitting, that generally includes a compression part to provide pressure integrity, leaktightness and resistance to end loads, for assembling polyethylene (PE) pipe to another PE pipe or any other element of the piping system

Note 1 to entry: The fitting can create a radial compressive force (compression fitting) or an axial compressive force (flange connection).

Note 2 to entry: A pipe-supporting sleeve providing a permanent support for a polyethylene (PE) pipe to prevent creep in the pipe wall under radial compressive forces, can be applicable. In some cases, the supporting sleeve contributes to end load resistance.

Note 3 to entry: The fitting can allow either a dismountable or permanently assembled joint.

Note 4 to entry: The mechanical fitting can be supplied for field assembly or pre-assembled by the manufacturer.

## 4 Symbols and abbreviated terms

For the purposes of this document, the symbols and abbreviated terms given in ISO 4427-1 apply.

## 5 Material

### 5.1 PE compound

The PE compound from which the fittings are made shall be in accordance with ISO 4427-1.

The stress bearing PE parts of injection moulded fittings shall only be made from virgin material.

Non-stress bearing PE parts shall be made from virgin material or own reprocessed material from a compound with the same MRS or a mixture of both materials.

NOTE Since PE 40 is not commonly used for pressure applications, it is the intention of ISO/TC 138/SC 2 to withdraw all references to this compound at the next revision of the ISO 4427 series (all parts).

### 5.2 Material for non-polyethylene parts

#### 5.2.1 General

The materials and constituent elements used in making the fitting (including elastomers and any metal parts) shall be as resistant to the external and internal environments as the other elements of the piping system and shall have a life expectancy under the following conditions at least equal to that of the PE pipe conforming to ISO 4427-2 with which they are intended to be used:

- a) during storage;
- b) under the effect of the fluids being conveyed;
- c) with respect to the service environment and operating conditions.

Other materials used in fittings and in contact with the PE pipe (e.g. greases) shall not adversely affect the pipe performance or initiate stress cracking.

#### 5.2.2 Metal parts

All parts susceptible to corrosion shall be adequately protected, provided this is necessary for durability and function of the system.

When dissimilar metallic parts are used which may be in contact with moisture, appropriate actions shall be taken to avoid galvanic corrosion.

### 5.2.3 Elastomers

Elastomeric materials used for the manufacture of seals shall conform to EN 681-1.

### 5.2.4 Other materials

Greases or lubricants shall not exude on to the fusion areas and shall not affect the long-term performance of the pipes and fittings nor have any adverse effect on the quality of the water.

## 6 General characteristics

### 6.1 Appearance

When viewed without magnification, the internal and external surfaces of the fitting shall be smooth, clean and free from scoring, cavities and other surface defects such as would prevent conformity of the fitting to this document.

### 6.2 Design

The design of the fitting shall be such that, when assembling the fitting onto the pipe or other components in accordance with the manufacturer's recommendations, the electrical coils and/or seals are not displaced.

### 6.3 Colour

The PE part of fitting shall be either black or blue. For fabricated fittings, the colour characteristics of pipes shall be in accordance with ISO 4427-2.

The blue colour is intended for the conveyance of water for human consumption only.

For above-ground installations, all components other than black should be protected from direct UV light.

### 6.4 Electrical characteristics for electrofusion fittings

The electrical protection that shall be provided by the fusion process depends on the voltage and the current used and on the characteristics of the electricity power source.

For voltages greater than 25 V, direct human contact with energized parts shall not be possible when the fitting is in the fusion cycle during assembly in accordance with the instructions of the manufacturers of the fittings and of the assembly equipment, as applicable.

NOTE 1 The fitting during the fusion process is part of an electrical system as defined in EN 60335-1, HD 60364-1, and IEC 60449 (References [3], [4] and [5] in the Bibliography).

The tolerance on the electrical resistance of the fitting at 23 °C shall be stated by the manufacturer. The resistance shall be between nominal resistance (–10 %) and nominal resistance (+10 %) + 0,1 Ω.

NOTE 2 0,1 Ω is the assumed value of the contact resistance.

The surface finish of the terminal pins shall allow a minimum contact resistance in order to satisfy the resistance tolerance requirements.

NOTE 3 See [Annex C](#) for the examples of typical electrofusion terminal connections.

## 6.5 Appearance of factory-made joints

The internal and external surfaces of the pipe and fitting after fusion jointing, examined visually without magnification, shall be free from melt exudation outside the confines of the fitting apart from that which may be declared acceptable by the fitting manufacturer or used as a fusion marker.

There shall be no wire movement leading to short circuiting when the electrofusion fittings are jointed in accordance with the manufacturer's instructions. There shall be no excessive creasing of the internal surfaces of the adjoining pipes or spigots.

## 6.6 Effect on water quality

For fittings to be used in contact with water intended for human consumption, see ISO 4427-1.

## 7 Geometrical characteristics

### 7.1 Measurement of dimensions

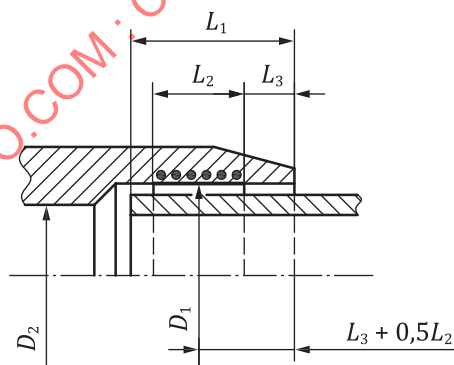
The dimensions of the fittings shall be measured in accordance with ISO 3126. In case of dispute, the measurement of dimensions shall be made not less than 24 h after manufacture and after conditioning for at least 4 h at  $(23 \pm 2) ^\circ\text{C}$ .

Indirect measurement at the stage of production is allowed at shorter time periods, provided that evidence is shown of correlation.

### 7.2 Dimensions of electrofusion socket fittings

#### 7.2.1 Diameters and lengths of electrofusion sockets

When measured in accordance with 7.1, the diameters and lengths of electrofusion sockets (see Figure 1) shall be in accordance with Table 1.



#### Key

- $D_1$  "mean inside diameter in the fusion zone" measured in a plane parallel to the plane of the mouth at a distance of  $L_3 + 0,5L_2$
- $D_2$  bore, which is the minimum diameter of the flow channel through the body of the fitting where  $D_2 \geq (d_n - 2e_{\min})$
- $L_1$  "design penetration depth" of the pipe or male end of a spigot fitting (in case of a coupling without stop, it is not greater than half the total length of the fitting)
- $L_2$  heated length within a socket as declared by the manufacturer to be the nominal length of the fusion zone
- $L_3$  distance between the mouth of the fitting and the start of the fusion zone as declared by the manufacturer to be the nominal unheated entrance length of the fitting where  $L_3$  shall be  $\geq 5$  mm

Figure 1 — Dimensions of electrofusion sockets

Table 1 — Electrofusion socket dimensions

Dimensions in millimetres

| Nominal diameter<br>of the fitting<br>$d_n$ | Depth of penetration |             | Fusion zone |
|---------------------------------------------|----------------------|-------------|-------------|
|                                             | $L_{1,min}$          | $L_{1,max}$ | $L_{2,min}$ |
| 20                                          | 25                   | 41          | 10          |
| 25                                          | 25                   | 41          | 10          |
| 32                                          | 25                   | 44          | 10          |
| 40                                          | 25                   | 49          | 10          |
| 50                                          | 28                   | 55          | 10          |
| 63                                          | 31                   | 63          | 11          |
| 75                                          | 35                   | 70          | 12          |
| 90                                          | 40                   | 79          | 13          |
| 110                                         | 53                   | 82          | 15          |
| 125                                         | 58                   | 87          | 16          |
| 140                                         | 62                   | 92          | 18          |
| 160                                         | 68                   | 98          | 20          |
| 180                                         | 74                   | 105         | 21          |
| 200                                         | 80                   | 112         | 23          |
| 225                                         | 88                   | 120         | 26          |
| 250                                         | 95                   | 129         | 33          |
| 280                                         | 104                  | 139         | 35          |
| 315                                         | 115                  | 150         | 39          |
| 355                                         | 127                  | 164         | 42          |
| 400                                         | 140                  | 179         | 47          |
| 450                                         | 155                  | 195         | 51          |
| 500                                         | 170                  | 212         | 56          |
| 560                                         | 188                  | 235         | 61          |
| 630                                         | 209                  | 255         | 67          |
| 710                                         | 220                  | 280         | 74          |
| 800                                         | 230                  | 300         | 82          |

The mean inside diameter of the fitting in the middle of the fusion zone (see  $D_1$  in [Figure 1](#)) shall be not less than  $d_n$ .

The manufacturer shall declare the actual minimum and maximum values of  $D_1$  and determine their suitability for joint assembly and check the fitness for purpose of the fitting by testing in accordance with ISO 4427-5.

In the case of a fitting having sockets of differing nominal diameters, each one shall conform to the requirements for the nominal diameter of the corresponding component.

### 7.2.2 Wall thickness

In order to prevent stress concentrations, any changes in wall thickness of the fitting body shall be gradual.

- The wall thickness of the body of the fitting at any point,  $E$ , shall be greater than or equal to  $e_{min}$  for the corresponding pipe at any part of the fitting located at a distance beyond a maximum of  $2L_1/3$  from all entrance faces if the fitting and the corresponding pipe are made from a polyethylene having the same MRS.

If the fitting is produced from a polyethylene having an MRS that is different from that of the corresponding pipe, the relationship between the wall thickness of the fitting,  $E$ , and the pipe,  $e_{\min}$ , shall be in accordance with [Table 2](#).

**Table 2 — Relationship between pipe and fitting wall thickness**

| Material |         | Relationship between fitting wall thickness, $E$ , and pipe wall thickness, $e_{\min}$ |
|----------|---------|----------------------------------------------------------------------------------------|
| Pipe     | Fitting |                                                                                        |
| PE 80    | PE 100  | $E \geq 0,8e_{\min}$                                                                   |
| PE 100   | PE 80   | $E \geq 1,25e_{\min}$                                                                  |

- b) In the case of a wall thickness design different from that according to a), fittings and associated fusion joints shall additionally meet the performance requirements given in [8.5](#).

### 7.2.3 Out-of-roundness of the bore of a fitting (at any point)

When a fitting leaves the site of the manufacturer, the out-of-roundness of the bore of a fitting at any point shall not exceed  $0,015d_n$ .

### 7.2.4 Spigots

For fittings that contain spigot outlets (e.g. electrofusion equal tee with spigotted branch), the dimensions of the spigot shall be according to [7.4](#).

NOTE For technical and design reasons, the shape of the minimum bore cross-section area can be different from the one of spigot fittings as given in [7.4](#).

### 7.2.5 Other dimensions

The dimensional characteristics appropriate to each manufacturer, such as the overall dimensions or mounting dimensions, shall be specified in a technical file.

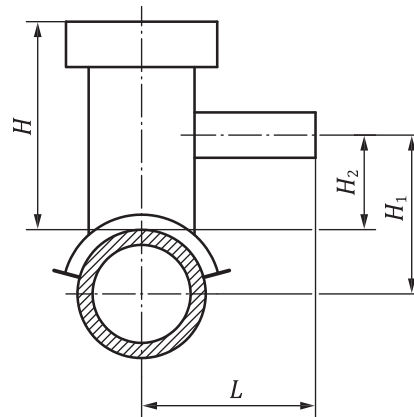
In the case of a coupling without an internal stop or with a removable centre register, the geometry of the fitting shall allow the penetration of the pipe through the fitting.

## 7.3 Dimensions of electrofusion saddle fittings

Outlets from tapping tees and branch saddles shall have spigots in accordance with [7.4](#) or electrofusion sockets in accordance with [7.2](#).

The manufacturer shall specify the overall dimensions of the fitting in the technical file. These dimensions shall include the maximum height of the saddle,  $H$ , and for tapping tees the height of the service pipe,  $H_1$  or  $H_2$  (see [Figure 2](#)).

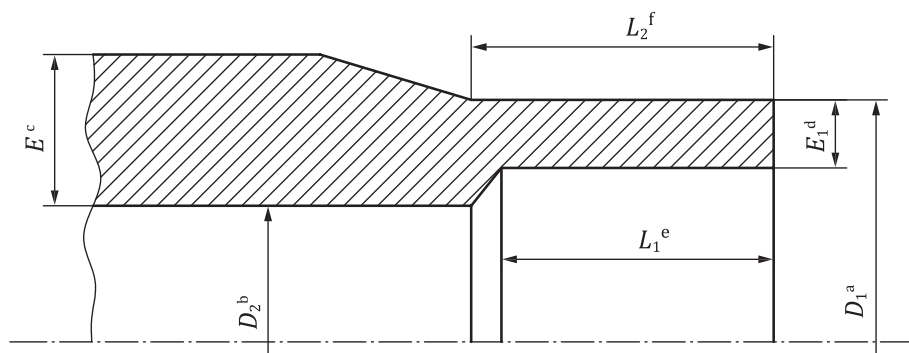
NOTE For technical and design reasons, the minimum bore diameter  $D_2$  can be different from the one of spigot fittings as given in [7.4](#).

**Key**

- $H$  height of the saddle, which comprises the distance from the top of the main pipe to the top of the tapping tee or saddle
- $H_1$  height of service pipe, which comprises the distance from the axis of the main pipe to the axis of the service pipe
- $H_2$  height of service pipe, which comprises the distance from the top of the main pipe to the axis of the service pipe
- $L$  width of the tapping tee, which comprises the distance between the axis of the pipe and the plane of the mouth of the service tee

**Figure 2 — Dimensions of electrofusion saddle fittings****7.4 Dimensions of spigot end fittings****7.4.1 Diameter and length**

When measured according to 7.1, the dimensions of spigot end fittings (see Figure 3) shall conform to the values given in Table 3.



**Key**

- $D_1$  mean outside diameter of fusion end piece
- $D_2$  bore comprising minimum diameter of flow channel through body of fitting
- $E$  body wall thickness of fitting
- $E_1$  fusion face wall thickness
- $L_1$  cut-back length of fusion end piece
- $L_2$  tubular length of fusion end piece
- <sup>a</sup>  $D_1$  is measured in any plane parallel to the plane of the entrance face at a distance not greater than  $L_2$  (tubular length) from the plane of the entrance face.
- <sup>b</sup> The measurement of this diameter does not include the fusion bead, if any.
- <sup>c</sup> It comprises the thickness measured at any point of the wall of the fitting.
- <sup>d</sup> It is measured at any point at a maximum distance of  $L_1$  (cut back length) from the entrance face and shall be equal to the pipe wall thickness and tolerance to which it is intended to be butt fused, as specified in ISO 4427-2:2019, Table 2.  $E_1$  for small dimensions is at least 3 mm.
- <sup>e</sup> It comprises the initial depth of the spigot end necessary for butt fusion or reweld and may be obtained by joining a length of pipe to the spigot end of the fitting provided the wall thickness of the pipe is equal to  $E_1$  for its entire length.
- <sup>f</sup> It comprises the initial length of the fusion end piece and shall allow the following (in any combination): the use of clamps required in the case of butt fusion; assembly with an electrofusion fitting; assembly with a socket fusion fitting; the use of a mechanical scraper.

**Figure 3 — Dimensions of spigot fittings**

Table 3 — Spigot dimensions

Dimensions in millimetres

| Nominal outside diameter of spigot<br>$d_n$ | Mean outside diameter of fusion end <sup>a</sup><br>$D_1$ |       | Min. bore <sup>b</sup><br>$D_2$ | Electrofusion <sup>c</sup> |                          |                                      | Socket fusion           | Butt fusion      |                          |                         |                      |
|---------------------------------------------|-----------------------------------------------------------|-------|---------------------------------|----------------------------|--------------------------|--------------------------------------|-------------------------|------------------|--------------------------|-------------------------|----------------------|
|                                             |                                                           |       |                                 | Out-of-roundness           | Cut-back length<br>$L_1$ | Tubular length <sup>d</sup><br>$L_2$ | Tubular length<br>$L_2$ | Out-of-roundness | Cut-back length<br>$L_1$ | Tubular length<br>$L_2$ |                      |
|                                             | min                                                       | Max.  | min                             | Max.                       | min                      | min                                  | min                     | Max.             | min                      | Normal <sup>e</sup>     | Special <sup>f</sup> |
| 20                                          | 20,0                                                      | 20,3  | 13                              | 0,3                        | 25                       | 41                                   | 11                      | —                | —                        | —                       | —                    |
| 25                                          | 25,0                                                      | 25,3  | 18                              | 0,4                        | 25                       | 41                                   | 12,5                    | —                | —                        | —                       | —                    |
| 32                                          | 32,0                                                      | 32,3  | 25                              | 0,5                        | 25                       | 44                                   | 14,6                    | —                | —                        | —                       | —                    |
| 40                                          | 40,0                                                      | 40,4  | 31                              | 0,6                        | 25                       | 49                                   | 17                      | —                | —                        | —                       | —                    |
| 50                                          | 50,0                                                      | 50,4  | 39                              | 0,8                        | 25                       | 55                                   | 20                      | —                | —                        | —                       | —                    |
| 63                                          | 63,0                                                      | 63,4  | 49                              | 0,9                        | 25                       | 63                                   | 24                      | 1,5              | 5                        | 16                      | 5                    |
| 75                                          | 75,0                                                      | 75,5  | 59                              | 1,2                        | 25                       | 70                                   | 25                      | 1,6              | 6                        | 19                      | 6                    |
| 90                                          | 90,0                                                      | 90,6  | 71                              | 1,4                        | 28                       | 79                                   | 28                      | 1,8              | 6                        | 22                      | 6                    |
| 110                                         | 110,0                                                     | 110,7 | 87                              | 1,7                        | 32                       | 82                                   | 32                      | 2,2              | 8                        | 28                      | 8                    |
| 125                                         | 125,0                                                     | 125,8 | 99                              | 1,9                        | 35                       | 87                                   | 35                      | 2,5              | 8                        | 32                      | 8                    |
| 140                                         | 140,0                                                     | 140,9 | 111                             | 2,1                        | 38                       | 92                                   | —                       | 2,8              | 8                        | 35                      | 8                    |
| 160                                         | 160,0                                                     | 161,0 | 127                             | 2,4                        | 42                       | 98                                   | —                       | 3,2              | 8                        | 40                      | 8                    |
| 180                                         | 180,0                                                     | 181,1 | 143                             | 2,7                        | 46                       | 105                                  | —                       | 3,6              | 8                        | 45                      | 8                    |
| 200                                         | 200,0                                                     | 201,2 | 159                             | 3,0                        | 50                       | 112                                  | —                       | 4,0              | 8                        | 50                      | 8                    |
| 225                                         | 225,0                                                     | 226,4 | 179                             | 3,4                        | 55                       | 120                                  | —                       | 4,5              | 10                       | 55                      | 10                   |
| 250                                         | 250,0                                                     | 251,5 | 199                             | 3,8                        | 60                       | 129                                  | —                       | 5,0              | 10                       | 60                      | 10                   |
| 280                                         | 280,0                                                     | 281,7 | 223                             | 4,2                        | 75                       | 139                                  | —                       | 9,8              | 10                       | 70                      | 10                   |
| 315                                         | 315,0                                                     | 316,9 | 251                             | 4,8                        | 75                       | 150                                  | —                       | 11,1             | 10                       | 80                      | 10                   |
| 355                                         | 355,0                                                     | 357,2 | 283                             | 5,4                        | 75                       | 164                                  | —                       | 12,5             | 10                       | 90                      | 12                   |
| 400                                         | 400,0                                                     | 402,4 | 319                             | 6,0                        | 75                       | 179                                  | —                       | 14,0             | 10                       | 95                      | 12                   |
| 450                                         | 450,0                                                     | 452,7 | 359                             | 6,8                        | 100                      | 195                                  | —                       | 15,6             | 15                       | 60                      | 15                   |
| 500                                         | 500,0                                                     | 503,0 | 399                             | 7,5                        | 100                      | 212                                  | —                       | 17,5             | 20                       | 60                      | 15                   |
| 560                                         | 560,0                                                     | 563,4 | 447                             | 8,4                        | 100                      | 235                                  | —                       | 19,6             | 20                       | 60                      | 15                   |
| 630                                         | 630,0                                                     | 633,8 | 503                             | 9,5                        | 100                      | 255                                  | —                       | 22,1             | 20                       | 60                      | 20                   |
| 710                                         | 710,0                                                     | 714,9 | 567                             | 10,6                       | 125                      | 280                                  | —                       | 24,8             | 20                       | 60                      | 20                   |
| 800                                         | 800,0                                                     | 805,0 | 639                             | 12,0                       | 125                      | 300                                  | —                       | 28,0             | 20                       | 60                      | 20                   |

<sup>a</sup> Tolerance are in accordance with ISO 11922-1:2018, grade B (see Reference [6] in the Bibliography).

<sup>b</sup> The requirement on  $D_2$  are only applicable for SDR 11 or higher.

<sup>c</sup> Spigot fittings designed for electrofusion are also suitable for butt fusion.

<sup>d</sup> The values of  $L_2$  (electrofusion) are based on the following equations:

— for  $d_n \leq 90$ ,  $L_2 = 0,6d_n + 25$  mm;

— for  $d_n \geq 110$  to  $d_n \leq 710$ ,  $L_2 = d_n/3 + 45$  mm.

<sup>e</sup> Used by preference.

<sup>f</sup> Used for fittings fabricated in the factory.

#### 7.4.2 Wall thickness of the fusion end

The wall thickness of the fusion end,  $E_1$ , shall be at least equal to the minimum wall thickness of the pipe, with a minimum value of 3 mm.

A thickness reduction, for example a chamfered edge, is permitted. between the plane of the entrance face and a plane parallel to it, located at a distance not greater than  $(0,01 d_e + 1 \text{ mm})$ .

The permissible tolerance of the wall thickness,  $E_1$ , at any point shall conform to the tolerance given in ISO 4427-2:2019, Table 2 for the same wall thicknesses.

#### 7.4.3 Wall thickness of the fitting body

The wall thickness,  $E$ , of the fitting body measured at any point, shall be at least equal to the nominal wall thickness,  $e_n$ , of the pipe.

Any changes in wall thickness inside the body of the fitting shall be gradual in order to prevent stress concentrations.

#### 7.4.4 Other dimensions

The dimensional characteristics appropriate to each manufacturer, such as overall dimensions or clamping requirements, shall be stated in a technical file.

### 7.5 Dimensions of socket fusion fittings

Where the description and dimensions of fittings of this type is required, [Annex A](#) applies.

### 7.6 Dimensions of fabricated fittings

Where the description and dimensions of fittings of this type is required, [Annex B](#) applies.

### 7.7 Design and dimensions of mechanical fittings

#### 7.7.1 General

Mechanical fittings shall conform to ISO 17885.

Mechanical fittings shall allow installation with pipes according to ISO 4427-2.

If mechanical fittings are intended for jointing with spigot ends of fittings, spigot length ( $L_2$ ) and cut back length ( $L_1$ ) should be considered (see [Table 3](#)).

The fittings shall be designed and manufactured in such a way that they can be used buried or above ground. Pre-assembled mechanical fittings shall not be capable of being dismantled.

The fittings shall be designed to avoid twisting of the PE pipe during assembly.

The fittings shall not be assembled by thread cutting the PE pipe.

#### 7.7.2 Mechanical fittings with polyethylene spigot ends

Polyethylene spigot ends shall conform to [7.4](#).

#### 7.7.3 Mechanical fittings with polyethylene electrofusion sockets

Electrofusion sockets shall conform to [7.2](#).

#### 7.7.4 Threads

Threads on metal ends shall conform to ISO 7-1 or ISO 228-1, as applicable.

#### 7.8 Dimensions of loose backing flanges and flange adapters

Dimensions of loose backing flanges and flange adapters shall be in accordance with ISO 9624.

### 8 Mechanical characteristics

#### 8.1 General

Fittings shall be tested assembled with pipes conforming to ISO 4427-2 and/or fittings conforming to this document.

Jointed pipe and fitting test pieces shall be assembled in accordance with the technical instructions of the manufacturer, taking into account the manufacturing and assembly tolerances and the extreme conditions of utilization described in ISO 4427-5.

#### 8.2 Conditioning

Unless otherwise specified in the applicable test method, the test pieces shall be conditioned at  $(23 \pm 2) ^\circ\text{C}$  prior to testing.

#### 8.3 Requirements

When tested in accordance with the test methods as specified in [Table 4](#) using the indicated parameters, the fittings shall have mechanical characteristics conforming to the requirements given in [Table 4](#), as applicable to the following types of fitting:

- (A) electrofusion socket fitting and socket fusion fitting;
- (B) electrofusion saddle fitting;
- (C) spigot end fitting.

For mechanical fittings, the requirements of ISO 17885 shall apply.

Table 4 — Mechanical characteristics

| Characteristic                                                                                                                                                                                                                                                                                                                                                                                        | Requirements                                                 | Test parameters                                         |                                  | Test method                    |          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|---------------------------------------------------------|----------------------------------|--------------------------------|----------|
|                                                                                                                                                                                                                                                                                                                                                                                                       |                                                              | Parameter                                               | Value                            |                                |          |
| Hydrostatic strength<br>(20 °C, 100 h)                                                                                                                                                                                                                                                                                                                                                                | No failure during test period of any test piece              | End caps                                                | Type A of ISO 1167-1:2006        | ISO 1167-1:2006 and ISO 1167-4 |          |
|                                                                                                                                                                                                                                                                                                                                                                                                       |                                                              | Orientation                                             | Free                             |                                |          |
|                                                                                                                                                                                                                                                                                                                                                                                                       |                                                              | Conditioning time                                       | Shall conform to ISO 1167-1:2006 |                                |          |
|                                                                                                                                                                                                                                                                                                                                                                                                       |                                                              | Number of test pieces <sup>a</sup>                      | 3                                |                                |          |
|                                                                                                                                                                                                                                                                                                                                                                                                       |                                                              | Type of test <sup>b</sup>                               | Water-in-water                   |                                |          |
|                                                                                                                                                                                                                                                                                                                                                                                                       |                                                              | Circumferential (hoop) stress in pipe <sup>c</sup> for: | PE 80                            |                                | 10,0 MPa |
|                                                                                                                                                                                                                                                                                                                                                                                                       |                                                              |                                                         | PE 100                           |                                | 12,0 MPa |
|                                                                                                                                                                                                                                                                                                                                                                                                       |                                                              | Test period                                             | 100 h                            |                                |          |
| Test temperature                                                                                                                                                                                                                                                                                                                                                                                      | 20 °C                                                        |                                                         |                                  |                                |          |
| Hydrostatic strength<br>(80 °C, 165 h)                                                                                                                                                                                                                                                                                                                                                                | No failure during test period of any test piece <sup>d</sup> | End caps                                                | Type A of ISO 1167-1:2006        | ISO 1167-1:2006 and ISO 1167-4 |          |
|                                                                                                                                                                                                                                                                                                                                                                                                       |                                                              | Orientation                                             | Free                             |                                |          |
|                                                                                                                                                                                                                                                                                                                                                                                                       |                                                              | Conditioning time                                       | Shall conform to ISO 1167-1:2006 |                                |          |
|                                                                                                                                                                                                                                                                                                                                                                                                       |                                                              | Number of test pieces <sup>a</sup>                      | 3                                |                                |          |
|                                                                                                                                                                                                                                                                                                                                                                                                       |                                                              | Type of test <sup>b</sup>                               | Water-in-water                   |                                |          |
|                                                                                                                                                                                                                                                                                                                                                                                                       |                                                              | Circumferential (hoop) stress in pipe <sup>c</sup> for: | PE 80                            |                                | 4,5 MPa  |
|                                                                                                                                                                                                                                                                                                                                                                                                       |                                                              |                                                         | PE 100                           |                                | 5,4 MPa  |
|                                                                                                                                                                                                                                                                                                                                                                                                       |                                                              | Test period                                             | 165 h                            |                                |          |
| Test temperature                                                                                                                                                                                                                                                                                                                                                                                      | 80 °C                                                        |                                                         |                                  |                                |          |
| <b>NOTE</b> Each assembly shall be prepared from components (pipes and fittings) of the same pressure class.                                                                                                                                                                                                                                                                                          |                                                              |                                                         |                                  |                                |          |
| <sup>a</sup> The number of test pieces given indicates the number required to establish a value for the characteristic described in Table 4. The number of test pieces required for factory production control and process control should be listed in the manufacturer's quality plan. Guidance on assessment of conformity can be found in CEN/TS 12201-7. (See Reference [2] in the Bibliography). |                                                              |                                                         |                                  |                                |          |
| <sup>b</sup> Alternatively, for $d_n > 450$ mm, the test can also be performed in air. In case of dispute, water-in-water test shall be used. For fitting type (B) $d_n > 450$ mm, alternative testing is allowed (e.g. pressurization through saddle outlet).                                                                                                                                        |                                                              |                                                         |                                  |                                |          |
| <sup>c</sup> The test pressure shall be calculated using the design standard dimension ratio (SDR) of the fitting.                                                                                                                                                                                                                                                                                    |                                                              |                                                         |                                  |                                |          |
| <sup>d</sup> Only brittle failures shall be taken into account. If a ductile failure occurs before 165 h, the test can be repeated according to 8.4.                                                                                                                                                                                                                                                  |                                                              |                                                         |                                  |                                |          |
| <sup>e</sup> Longest length of brittle failure in any of the test samples.                                                                                                                                                                                                                                                                                                                            |                                                              |                                                         |                                  |                                |          |
| <sup>f</sup> Test sample can be mechanically reduced in wall thickness for testing purpose of large diameter fittings by keeping a minimum of 15 mm wall thickness of each component.                                                                                                                                                                                                                 |                                                              |                                                         |                                  |                                |          |
| <sup>g</sup> Alternatively, for fittings type (B) $d_n > 450$ mm, this characteristic can be checked by the strip-bend test according to ISO 21751. (See Reference [7] in the Bibliography)                                                                                                                                                                                                           |                                                              |                                                         |                                  |                                |          |
| <sup>h</sup> Applicable to $d_n$ 90 mm and above.                                                                                                                                                                                                                                                                                                                                                     |                                                              |                                                         |                                  |                                |          |

Table 4 (continued)

| Characteristic                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Requirements                                                                   | Test parameters                                         |                                          | Test method                    |         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|---------------------------------------------------------|------------------------------------------|--------------------------------|---------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                | Parameter                                               | Value                                    |                                |         |
| Hydrostatic strength<br>(80 °C, 1 000 h)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | No failure during test period of any test piece                                | End caps                                                | Type A of ISO 1167-1:2006                | ISO 1167-1:2006 and ISO 1167-4 |         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                | Orientation                                             | Free                                     |                                |         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                | Conditioning time                                       | Shall conform to ISO 1167-1:2006         |                                |         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                | Number of test pieces <sup>a</sup>                      | 3                                        |                                |         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                | Type of test <sup>b</sup>                               | Water-in-water                           |                                |         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                | Circumferential (hoop) stress in pipe <sup>c</sup> for: | PE 80                                    |                                | 4,0 MPa |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                |                                                         | PE 100                                   |                                | 5,0 MPa |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                | Test period                                             | 1 000 h                                  |                                |         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                | Test temperature                                        | 80 °C                                    |                                |         |
| Decohesive resistance<br>(A)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Length of initiation rupture $\leq L_2/3$ in brittle failure <sup>e</sup>      | Test temperature                                        | 23 °C                                    | ISO 13954<br>ISO 13955         |         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                | Number of test pieces <sup>a,f</sup>                    | Shall conform to ISO 13954 and ISO 13955 |                                |         |
| Evaluation of ductility of fusion joint interface<br>(B) <sup>g</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Surface of rupture<br>$L_d \leq 50\%$ and<br>$A_d \leq 25\%$ , brittle failure | Test temperature                                        | 23 °C                                    | ISO 13956                      |         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                | Number of test pieces <sup>a,f</sup>                    | Shall conform to ISO 13956               |                                |         |
| Tensile strength for butt fusion<br>(C) <sup>h</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Test to failure: ductile – pass brittle – fail                                 | Test temperature                                        | 23 °C                                    | ISO 13953                      |         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                | Number of test pieces <sup>a,f</sup>                    | Shall conform to ISO 13953               |                                |         |
| Impact resistance<br>(B: Tapping tees only)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | No failure, no leakage                                                         | Test temperature                                        | 0 °C                                     | ISO 13957                      |         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                | Falling height                                          | 2 m                                      |                                |         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                | Mass of the striker                                     | 2,5 kg                                   |                                |         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                | Number of test pieces <sup>a</sup>                      | 1                                        |                                |         |
| <p>NOTE Each assembly shall be prepared from components (pipes and fittings) of the same pressure class.</p> <p><sup>a</sup> The number of test pieces given indicates the number required to establish a value for the characteristic described in Table 4. The number of test pieces required for factory production control and process control should be listed in the manufacturer's quality plan. Guidance on assessment of conformity can be found in CEN/TS 12201-7. (See Reference [2] in the Bibliography).</p> <p><sup>b</sup> Alternatively, for <math>d_n &gt; 450</math> mm, the test can also be performed in air. In case of dispute, water-in-water test shall be used. For fitting type (B) <math>d_n &gt; 450</math> mm, alternative testing is allowed (e.g. pressurization through saddle outlet).</p> <p><sup>c</sup> The test pressure shall be calculated using the design standard dimension ratio (SDR) of the fitting.</p> <p><sup>d</sup> Only brittle failures shall be taken into account. If a ductile failure occurs before 165 h, the test can be repeated according to 8.4.</p> <p><sup>e</sup> Longest length of brittle failure in any of the test samples.</p> <p><sup>f</sup> Test sample can be mechanically reduced in wall thickness for testing purpose of large diameter fittings by keeping a minimum of 15 mm wall thickness of each component.</p> <p><sup>g</sup> Alternatively, for fittings type (B) <math>d_n &gt; 450</math> mm, this characteristic can be checked by the strip-bend test according to ISO 21751. (See Reference [7] in the Bibliography)</p> <p><sup>h</sup> Applicable to <math>d_n</math> 90 mm and above.</p> |                                                                                |                                                         |                                          |                                |         |

## 8.4 Retest conditions

A fracture in a brittle mode in less than 165 h shall constitute a failure; however, if a sample in the 165 h test fails in a ductile mode in less than 165 h, a retest shall be performed at a selected lower stress in

order to achieve the minimum required time for the selected stress obtained from the line through the stress/time points in accordance with [Table 5](#).

**Table 5 — Circumferential (hoop) stress at 80 °C and associated minimum test period**

| PE 80         |                          | PE 100        |                          |
|---------------|--------------------------|---------------|--------------------------|
| Stress<br>MPa | Minimum test period<br>h | Stress<br>MPa | Minimum test period<br>h |
| 4,5           | 165                      | 5,4           | 165                      |
| 4,4           | 233                      | 5,3           | 256                      |
| 4,3           | 331                      | 5,2           | 399                      |
| 4,2           | 474                      | 5,1           | 629                      |
| 4,1           | 685                      | 5,0           | 1 000                    |
| 4,0           | 1 000                    | —             | —                        |

## 8.5 Performance requirements

Where [7.2.2 b\)](#) applies, electrofusion socket fittings shall, additionally, be in accordance with [Table 6](#).

**Table 6 — Performance requirements**

| Characteristic                          | Requirement                                                                                                                                                 | Test parameters        |                           | Test method             |
|-----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|-------------------------|
|                                         |                                                                                                                                                             | Parameter              | Value                     |                         |
| Short-term internal pressure resistance | Failure pressure shall be greater than pressure equivalent of $2 \times \text{MRS}$ calculated for thickest-walled pipe for which fitting has been designed | End caps               | Type A of ISO 1167-1:2006 | <a href="#">Annex D</a> |
|                                         |                                                                                                                                                             | Orientation            | free                      |                         |
|                                         |                                                                                                                                                             | Conditioning time      | 12 h                      |                         |
|                                         |                                                                                                                                                             | Type of test           | Water-in-water            |                         |
|                                         |                                                                                                                                                             | Minimum pressure:      |                           |                         |
|                                         |                                                                                                                                                             | PE 80 pipe, SDR 11     | 32 bar                    |                         |
|                                         |                                                                                                                                                             | PE 100 pipe, SDR 11    | 40 bar                    |                         |
|                                         |                                                                                                                                                             | Pressure increase rate | 5 bar/min                 |                         |
|                                         |                                                                                                                                                             | Test temperature       | 20 °C                     |                         |
| Resistance to tensile load              | Minimum elongation shall be 25 % before pipe yields                                                                                                         | Test temperature       | 23 °C                     | <a href="#">Annex E</a> |

1 bar = 0,1 MPa =  $10^5$  Pa; 1 MPa = 1 N/mm<sup>2</sup>.

## 9 Physical characteristics

### 9.1 Conditioning

Unless otherwise specified in the applicable test method, the test pieces shall be conditioned at  $(23 \pm 2)$  °C prior to testing.

### 9.2 Requirements

When tested in accordance with the test methods as specified in [Table 7](#) using the indicated parameters, the fittings shall have physical characteristics conforming to the requirements given in [Table 7](#).

For mechanical fittings, the requirements of ISO 17885 shall apply.

Table 7 — Physical characteristics

| Characteristic                               | Requirements                                                                                                   | Test parameters                    |                             | Test method |
|----------------------------------------------|----------------------------------------------------------------------------------------------------------------|------------------------------------|-----------------------------|-------------|
|                                              |                                                                                                                | Parameter                          | Value                       |             |
| Oxidation induction time (Thermal stability) | ≥20 min                                                                                                        | Test temperature                   | 200 °C <sup>b</sup>         | ISO 11357-6 |
|                                              |                                                                                                                | Number of test pieces <sup>a</sup> | 3                           |             |
|                                              |                                                                                                                | Test environment                   | Oxygen                      |             |
| Melt mass-flow rate (MFR)                    | After processing maximum deviation of ±20 % of the value measured on the batch used to manufacture the fitting | Loading mass                       | 5 kg                        | ISO 1133-1  |
|                                              |                                                                                                                | Test temperature                   | 190 °C                      |             |
|                                              |                                                                                                                | Time                               | 10 min                      |             |
|                                              |                                                                                                                | Number of test pieces <sup>a</sup> | Shall conform to ISO 1133-1 |             |

<sup>a</sup> The number of test pieces given indicates the number required to establish a value for the characteristic described in [Table 7](#). The number of test pieces required for factory production control and process control should be listed in the manufacturer's quality plan. Guidance on assessment of conformity can be found in CEN/TS 12201-7 (Reference [2] in the Bibliography).

<sup>b</sup> Test can be carried out at 210 °C or 220 °C provided that there is a clear correlation to the results at 200 °C; in case of dispute, the reference temperature shall be 200 °C.

## 10 Chemical resistance of fittings in contact with chemicals

If, for a particular application, it is necessary to evaluate the chemical resistance of the fitting, then the fitting shall be classified in accordance with ISO 4433-1 and ISO 4433-2.

NOTE Guidance for the resistance of polyethylene products to chemicals is given in ISO/TR 10358 (Reference [8] in the Bibliography). This guidance only addresses chemical resistance of products not submitted to any stress, and can need to be completed to additional testing.

## 11 Performance requirements

When fittings conforming to this document are assembled to each other or to components conforming to other parts of the ISO 4427 series, the joints shall be in accordance with ISO 4427-5.

## 12 Marking

### 12.1 General

All fittings shall be marked according to 12.2.

The marking on the product shall be permanent, legible and shall not initiate cracks or other types of failure.

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

The marking shall be such that it is legible without magnification.

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

There shall be no marking over the minimum spigot length of the fitting.

### 12.2 Minimum required marking

The minimum required marking shall be in accordance with Table 8.

For fabricated fittings, marking shall at least mention manufacturer's identification (by name or code) on the product or on a label. Further elements may be agreed between the manufacturer and purchaser.

**Table 8 — Minimum required marking**

| Aspect                                                                                                                                                                                                                                                                                                                                                                                                                       | Marking                         |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| Reference to this document                                                                                                                                                                                                                                                                                                                                                                                                   | ISO 4427-3 <sup>a</sup>         |
| Manufacturer's identification                                                                                                                                                                                                                                                                                                                                                                                                | Name or code                    |
| Manufacturer's information                                                                                                                                                                                                                                                                                                                                                                                                   | b                               |
| Nominal diameter of pipe, $d_n$                                                                                                                                                                                                                                                                                                                                                                                              | e.g. 110                        |
| Material and designation                                                                                                                                                                                                                                                                                                                                                                                                     | e.g. PE 100                     |
| Nominal pressure                                                                                                                                                                                                                                                                                                                                                                                                             | e.g. PN 16a                     |
| Design application series                                                                                                                                                                                                                                                                                                                                                                                                    | e.g. SDR 11 or S5               |
| Applicable SDR fusion range of pipe (only for electrofusion fittings)                                                                                                                                                                                                                                                                                                                                                        | e.g. SDR 11–SDR 26 <sup>a</sup> |
| <sup>a</sup> This information may be printed on a label, with one label attached to the fitting or to the individual bag. The label shall be of sufficient quality as to be intact and legible at the time of installation.<br><sup>b</sup> In clear figures or in code providing traceability to the production period within year and month and, if the manufacturer is producing at different sites, the production site. |                                 |

### 12.3 Fusion system recognition

Fusion fittings should have a system, either numerical, electromechanical or self-regulatory as described in ISO 13950, for recognizing the fusion parameters and facilitating the fusion process.

Where bar codes are used for the numerical recognition, the bar-code label shall be stuck to the fitting and shall be protected against deterioration.

NOTE ISO 12176-5 (Reference [9] in the Bibliography), defines a 2D code which will also enable the recognition of the fusion parameters.

## 13 Packaging

The fitting shall be packaged in bulk or individually protected where necessary in order to prevent deterioration and contamination.

The packaging shall have at least one label with the manufacturer's name, type and dimensions of the part, number of units and any special storage conditions.

## Annex A (normative)

### Socket fusion fittings

As applicable, the dimensions of socket fusion fittings shall be in accordance with [Tables A.1](#) and [A.2](#). The diameter at the root shall not be greater than the diameter at the mouth. See [Figure A.1](#).

**Table A.1 — Socket dimensions — Nominal sizes 16 to 63 inclusive**

Dimensions in millimetres

| Nom.<br>size<br>DN/<br>OD | Nom.<br>inside<br>diam.<br>of<br>socket | Mean inside diameter of<br>socket |                   |             |             | Out-of-<br>round-<br>ness | Min.<br>bore | Socket<br>refer-<br>ence<br>length | Heated socket<br>length |       | Penetration of<br>pipe into<br>socket |             |
|---------------------------|-----------------------------------------|-----------------------------------|-------------------|-------------|-------------|---------------------------|--------------|------------------------------------|-------------------------|-------|---------------------------------------|-------------|
|                           |                                         | Mouth                             |                   | Root        |             |                           |              |                                    | (L – 2,5)               | (L)   | (L – 3,5)                             | (L – 1)     |
|                           |                                         | $D_{1,min}$                       | $D_{1,max}$       | $D_{2,min}$ | $D_{2,max}$ |                           |              |                                    | max.                    | $D_3$ | $L_{min}$                             | $L_{2,min}$ |
| 16                        | 16                                      | 15,2                              | 15,5              | 15,1        | 15,4        | 0,4                       | 9            | 13,3                               | 10,8                    | 13,3  | 9,8                                   | 12,3        |
| 20                        | 20                                      | 19,2                              | 19,5              | 19,0        | 19,3        | 0,4                       | 13           | 14,5                               | 12,0                    | 14,5  | 11,0                                  | 13,5        |
| 25                        | 25                                      | 24,1                              | 24,5              | 23,9        | 24,3        | 0,4                       | 18           | 16,0                               | 13,5                    | 16,0  | 12,5                                  | 15,0        |
| 32                        | 32                                      | 31,1                              | 31,5              | 30,9        | 31,3        | 0,5                       | 25           | 18,1                               | 15,6                    | 18,1  | 14,6                                  | 17,1        |
| 40                        | 40                                      | 39,0                              | 39,4              | 38,8        | 39,2        | 0,5                       | 31           | 20,5                               | 18,0                    | 20,5  | 17,0                                  | 19,5        |
| 50                        | 50                                      | 48,9                              | 49,4              | 48,7        | 49,2        | 0,6                       | 39           | 23,5                               | 21,0                    | 23,5  | 20,0                                  | 22,5        |
| 63                        | 63                                      | 62,0 <sup>a</sup>                 | 62,4 <sup>a</sup> | 61,6        | 62,1        | 0,6                       | 49           | 27,4                               | 24,9                    | 27,4  | 23,9                                  | 26,4        |

Maximum  $L_2 = L$  mm; minimum  $L_2$  calculated from  $(L - 2,5)$  mm.

Maximum  $L_3 = (L - 1)$  mm; minimum  $L_3 = (L - 3,5)$  mm.

<sup>a</sup> Where rerounding clamps are used, the maximum diameter of 62,4 mm may be increased by 0,1 mm to 62,5 mm. Conversely, where a peeling technique is used, the minimum diameter of 62,0 mm may be reduced by 0,1 mm to 61,9 mm.

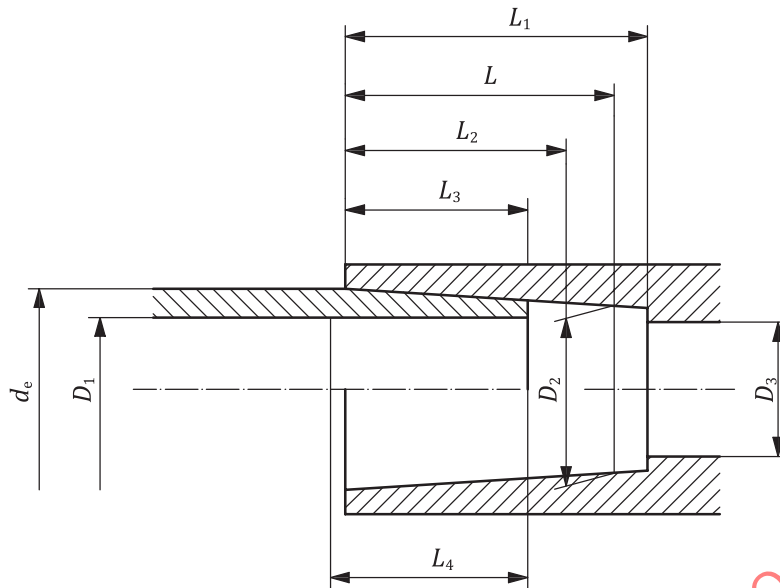
**Table A.2 — Socket dimensions — Nominal sizes 75 to 125 inclusive**

Dimensions in millimetres

| Nom.<br>size<br>DN/OD | Mean outside<br>diameter of<br>pipe |               | Nom.<br>inside<br>diam.<br>of<br>socket | Mean inside diameter<br>of socket |             |             |             | Out-<br>of-<br>round-<br>ness | Min.<br>bore | Socket<br>ref.<br>length | Heated<br>socket<br>length |      | Penetration<br>of pipe into<br>socket |           |
|-----------------------|-------------------------------------|---------------|-----------------------------------------|-----------------------------------|-------------|-------------|-------------|-------------------------------|--------------|--------------------------|----------------------------|------|---------------------------------------|-----------|
|                       |                                     |               |                                         | Mouth                             |             | Root        |             |                               |              |                          | (L - 4)                    | (L)  | (L - 5)                               | (L - 1)   |
|                       | $d_{em\ min}$                       | $d_{em\ max}$ |                                         | $d_n$                             | $D_{1,min}$ | $D_{1,max}$ | $D_{2,min}$ |                               |              |                          | $D_{2,max}$                | max. | $D_3$                                 | $L_{min}$ |
| 75                    | 75,0                                | 75,5          | 75                                      | 74,3                              | 74,8        | 73,0        | 73,5        | 0,7                           | 59           | 30                       | 26                         | 30   | 25                                    | 29        |
| 90                    | 90,0                                | 90,6          | 90                                      | 89,3                              | 89,9        | 87,9        | 88,5        | 1,0                           | 71           | 33                       | 29                         | 33   | 28                                    | 32        |
| 110                   | 110,0                               | 110,6         | 110                                     | 109,4                             | 110,0       | 107,7       | 108,3       | 1,0                           | 87           | 37                       | 33                         | 37   | 32                                    | 36        |
| 125                   | 125,0                               | 125,6         | 125                                     | 124,4                             | 125,0       | 122,6       | 123,2       | 1,0                           | 99           | 40                       | 36                         | 40   | 35                                    | 39        |

Maximum  $L_2 = L$  mm; minimum  $L_2$  calculated from  $(L - 4)$  mm.

Maximum  $L_3 = (L - 1)$  mm; minimum  $L_3 = (L - 5)$  mm.



**Key**

$D_1$  mean inside diameter of socket<sup>a</sup>

$D_2$  mean inside root diameter<sup>b</sup>

$D_3$  minimum bore<sup>c</sup>

$d_e$  outside diameter

$L$  reference socket length<sup>d</sup>

$L_1$  actual length of socket from mouth to shoulder (if present)

$L_2$  heated length of fitting<sup>e</sup>

$L_3$  insertion depth<sup>f</sup>

$L_4$  heated length of pipe<sup>g</sup>

<sup>a</sup> It is the mean diameter of the circle at the intersection of the extension of the socket with the plane of the socket mouth.

<sup>b</sup> It is the mean diameter of the circle in a plane parallel to the plane of the mouth and separated from it by distance  $L$ , which is the reference length of the socket.

<sup>c</sup> It is the minimum diameter of the flow channel through the body of the fitting.

<sup>d</sup> It is the theoretical minimum socket length used for the purpose of calculation.

<sup>e</sup> It is the length of penetration of the heated tool into the socket.

<sup>f</sup> It is the depth of the heated pipe end into the socket.

<sup>g</sup> It is the depth of penetration of the pipe end into the heated tool.

**Figure A.1 — Socket and pipe dimensions**

## Annex B (normative)

### Fabricated fittings

#### B.1 General

The fabricated fittings shall be in accordance with [Tables B.1](#) and [B.2](#), as applicable.

For dimensions above and including DN630, the requirements on hydrostatic strength at 20°C and 80°C in [Table B.1](#) may be assessed by indirect testing. The indirect test method used and the correlation or safe relationship of the indirect testing to the specification of [Table B.1](#) shall be documented in the manufacturer's quality plan. The indirect test method shall be agreed between the manufacturer and the end user.

The pipes used for manufacturing these fittings shall be in accordance with ISO 4427-2 and the butt fusion machine shall be in accordance with ISO 12176-1.

This annex applies only to fabricated fittings obtained by the butt fusion process. If other fusion techniques are used (e.g. extrusion welding), additional derating factors will have to be taken into account.

The PN rating of fabricated fittings shall be derived from the PN of the used pipes and the geometry derating factors given in [B.3](#) and [B.5](#).

The manufacturer shall be responsible for the design and the pressure rating of the fittings. It is his responsibility to demonstrate conformity to the declared PN. The pressure rating as well as the applicable derating factor,  $f$ , shall be recorded in the manufacturer's technical file. The minimum testing to demonstrate the performance of the fitting design is given in [Table B.1](#).

In some cases, fabricated fittings are made out of injection moulded fittings or pipes of the next lower SDR series where the wall thickness is internally machined back to the next higher SDR. For such fittings, the derating factors may differ from those given in this annex.

Special requirements concerning the appearance of fabricated fittings, e.g. bead removal, shall be agreed between the manufacturer and purchaser.

At least the pressure rating PN of the fitting shall be marked on the fitting, on a label or the packaging.

Table B.1 — Performance requirements — Fabricated fittings

| Characteristic                                                                                                                                                                                                                                                                               | Requirement                                          | Test parameters                                  |                             | Test method              |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|--------------------------------------------------|-----------------------------|--------------------------|
|                                                                                                                                                                                                                                                                                              |                                                      | Parameter                                        | Value                       |                          |
| Hydrostatic strength at 20 °C                                                                                                                                                                                                                                                                | No failure of any test piece during test period      | End caps                                         | Type A <sup>a</sup>         | ISO 1167-1<br>ISO 1167-3 |
|                                                                                                                                                                                                                                                                                              |                                                      | Conditioning period                              | According to ISO 1167-1     |                          |
|                                                                                                                                                                                                                                                                                              |                                                      | Number of test pieces <sup>b</sup>               | 3                           |                          |
|                                                                                                                                                                                                                                                                                              |                                                      | Type of test <sup>c</sup>                        | Water-in-water              |                          |
|                                                                                                                                                                                                                                                                                              |                                                      | Test temperature                                 | 20 °C                       |                          |
|                                                                                                                                                                                                                                                                                              |                                                      | Test period                                      | 100 h                       |                          |
|                                                                                                                                                                                                                                                                                              |                                                      | Circumferential (hoop) stress for <sup>d</sup> : |                             |                          |
|                                                                                                                                                                                                                                                                                              |                                                      | PE 40                                            | 7 MPa × <i>f</i>            |                          |
| Hydrostatic strength at 80 °C                                                                                                                                                                                                                                                                | No failure of any test piece during test period      | End caps                                         | Type A <sup>a</sup>         | ISO 1167-1<br>ISO 1167-3 |
|                                                                                                                                                                                                                                                                                              |                                                      | Conditioning period                              | According to ISO 1167-1     |                          |
|                                                                                                                                                                                                                                                                                              |                                                      | Number of test pieces <sup>b</sup>               | 3                           |                          |
|                                                                                                                                                                                                                                                                                              |                                                      | Type of test                                     | Water-in-water <sup>c</sup> |                          |
|                                                                                                                                                                                                                                                                                              |                                                      | Test temperature                                 | 80 °C                       |                          |
|                                                                                                                                                                                                                                                                                              |                                                      | Test period                                      | 1 000 h                     |                          |
|                                                                                                                                                                                                                                                                                              |                                                      | Circumferential (hoop) stress for <sup>d</sup> : |                             |                          |
|                                                                                                                                                                                                                                                                                              |                                                      | PE 40                                            | 2 MPa × <i>f</i>            |                          |
| Tensile strength for fabricated fittings <sup>e</sup>                                                                                                                                                                                                                                        | Test to failure:<br>Ductile — Pass<br>Brittle — Fail | Test temperature                                 | 23 °C                       | ISO 13953                |
|                                                                                                                                                                                                                                                                                              |                                                      | Number of test pieces <sup>b</sup>               | According to ISO 13953      |                          |
|                                                                                                                                                                                                                                                                                              |                                                      |                                                  |                             |                          |
| NOTE <i>f</i> is the declared derating factor related to the fitting to be tested.                                                                                                                                                                                                           |                                                      |                                                  |                             |                          |
| <sup>a</sup> Type B end caps may be used for batch release tests for diameters ≥500 mm.                                                                                                                                                                                                      |                                                      |                                                  |                             |                          |
| <sup>b</sup> The number of test pieces given indicates the quantity 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. |                                                      |                                                  |                             |                          |
| <sup>c</sup> Alternatively, for <i>d</i> <sub>n</sub> > 450 mm, the test can also be performed in air. In case of dispute, water-in-water test shall be used.                                                                                                                                |                                                      |                                                  |                             |                          |
| <sup>d</sup> The stress shall be calculated using the nominal dimensions of the pipe used in the test assembly.                                                                                                                                                                              |                                                      |                                                  |                             |                          |
| <sup>e</sup> Samples are to be taken from joints between longitudinal aligned segments to produce a flat specimen geometry.                                                                                                                                                                  |                                                      |                                                  |                             |                          |

## B.2 Dimensions

See [Table B.2](#).

Larger nominal outside diameters are permitted and dimensions shall be agreed between the manufacturer and the end-user.

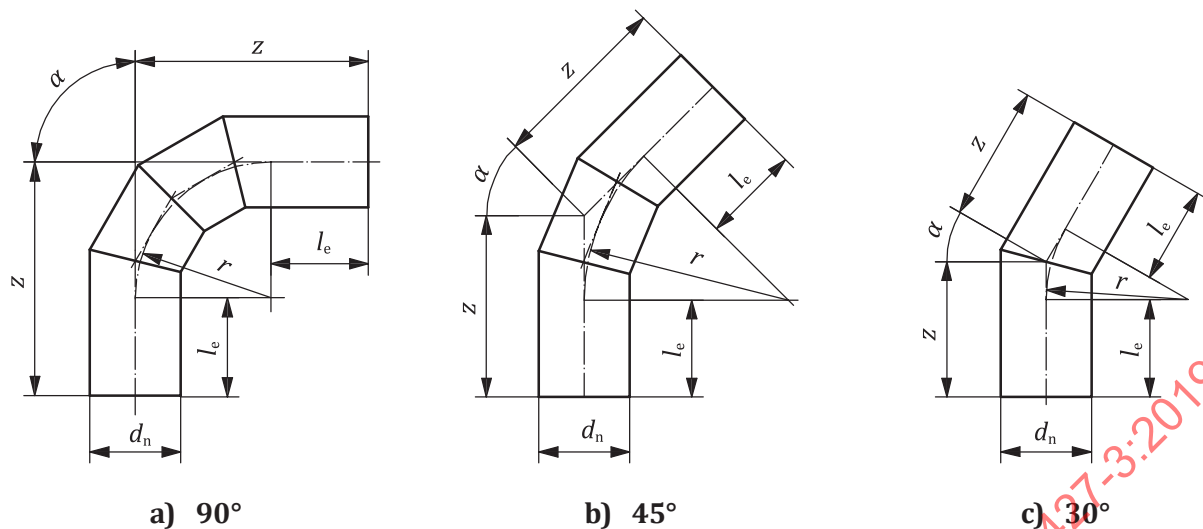
Table B.2 — Fabricated fitting dimensions

Dimensions in millimetres

| Nominal outside diameter<br>$d_n$ | Minimum tubular length of fitting<br>$l_e$ | Nominal bend radius<br>$r$                                                                                        | Nominal branch length<br>$z$         | Nominal angle of fitting<br>$\alpha$                                                                                                             |
|-----------------------------------|--------------------------------------------|-------------------------------------------------------------------------------------------------------------------|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| 90                                | 150                                        | Declared by the fitting manufacturer<br><br>e.g. $1,5 \times d$<br>$2 \times d$<br>$2,5 \times d$<br>$3 \times d$ | Declared by the fitting manufacturer | Declared by the fitting manufacturer<br><br>With a tolerance of $\pm 2^\circ$<br><br>The maximum tolerance for pipe bends shall be $\pm 5^\circ$ |
| 110                               | 150                                        |                                                                                                                   |                                      |                                                                                                                                                  |
| 125                               | 150                                        |                                                                                                                   |                                      |                                                                                                                                                  |
| 140                               | 150                                        |                                                                                                                   |                                      |                                                                                                                                                  |
| 160                               | 150                                        |                                                                                                                   |                                      |                                                                                                                                                  |
| 180                               | 150                                        |                                                                                                                   |                                      |                                                                                                                                                  |
| 200                               | 150                                        |                                                                                                                   |                                      |                                                                                                                                                  |
| 225                               | 150                                        |                                                                                                                   |                                      |                                                                                                                                                  |
| 250                               | 250                                        |                                                                                                                   |                                      |                                                                                                                                                  |
| 280                               | 250                                        |                                                                                                                   |                                      |                                                                                                                                                  |
| 315                               | 300                                        |                                                                                                                   |                                      |                                                                                                                                                  |
| 355                               | 300                                        |                                                                                                                   |                                      |                                                                                                                                                  |
| 400                               | 300                                        |                                                                                                                   |                                      |                                                                                                                                                  |
| 450                               | 300                                        |                                                                                                                   |                                      |                                                                                                                                                  |
| 500                               | 350                                        |                                                                                                                   |                                      |                                                                                                                                                  |
| 560                               | 350                                        |                                                                                                                   |                                      |                                                                                                                                                  |
| 630                               | 350                                        |                                                                                                                   |                                      |                                                                                                                                                  |
| 710                               | 350                                        |                                                                                                                   |                                      |                                                                                                                                                  |
| 800                               | 350                                        |                                                                                                                   |                                      |                                                                                                                                                  |
| 900                               | 400                                        |                                                                                                                   |                                      |                                                                                                                                                  |
| 1 000                             | 400                                        |                                                                                                                   |                                      |                                                                                                                                                  |
| 1 200                             | 400                                        |                                                                                                                   |                                      |                                                                                                                                                  |
| 1 400                             | 550                                        |                                                                                                                   |                                      |                                                                                                                                                  |
| 1 600                             | 550                                        |                                                                                                                   |                                      |                                                                                                                                                  |

### B.3 Segmented bends

Examples of typical fabricated bends made out of pipe segments are shown in [Figures B.1](#) and [B.2](#). Only indicated dimensions shall be considered. A full set of dimensions shall be provided by the technical documentation of the fitting manufacturer.



**Key**

$d_n, l_e$  and  $r$  and  $\alpha$  shall be in accordance with [Table B.2](#)

$d_n$  nominal outside diameter

$l_e$  tubular length of fusion end piece<sup>a</sup>

$r$  nominal bend radius of fitting

$z$  nominal length of fitting branch to axis

$\alpha$  nominal angle of fitting

<sup>a</sup> The length shall allow the following (in any combination): the use of clamps required in the case of butt fusion; assembly with an electrofusion fitting; assembly with a socket fusion fitting; the use of a mechanical scraper.

**Figure B.1 — Segmented bends**

For bends fabricated out of pipe segments, the following derating rules for the calculation of the PN shall apply:

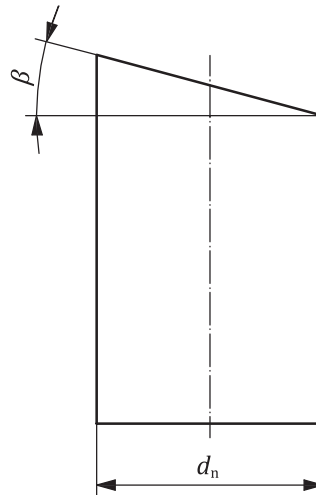
$$PN = f_B \times PN_{\text{pipe}}$$

where

$f_B$  is the derating factor related to the bend segment design (see [Table B.3](#));

$PN_{\text{pipe}}$  is the nominal pressure of the pipe.

Practice has shown that these factors are applicable. Results of testing according to [Table B.1](#) will determine the applicable factor  $f_B$ .

**Key**

$\beta$  cut angle (shall not be greater than  $15^\circ$ )

$d_n$  nominal outside diameter

**Figure B.2 — Segment design****Table B.3 — Derating factors for segmented bends**

| Cut angle<br>$\beta$              | Derating factor<br>$f_B$ |
|-----------------------------------|--------------------------|
| $\leq 7,5^\circ$                  | 1,0                      |
| $7,5^\circ < \beta \leq 15^\circ$ | 0,8 <sup>a</sup>         |

<sup>a</sup> In accordance with [B.1](#), the test results of the manufacturer may demonstrate that a derating factor of 1,0 or another factor is applicable

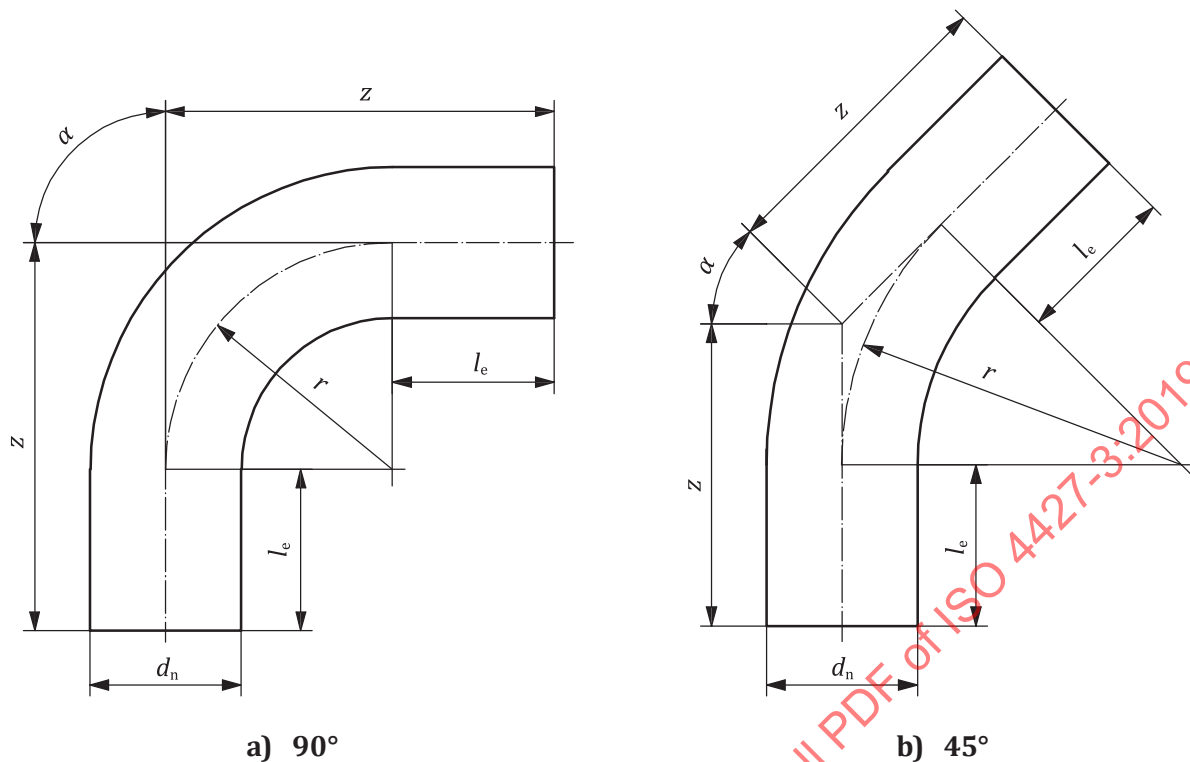
**B.4 Swept bends**

Fabricated pipe bends are not required to accord with the drawings given in [Figure B.3](#). Only indicated dimensions shall be considered. A full set of dimensions shall be provided by the fitting manufacturer in his technical literature.

The minimum wall thickness of the pipe bend after bending shall be in accordance with ISO 4427-2.

Destructive techniques may be used to demonstrate consistency of the manufacturing process.

For bends fabricated out of pipes, usually no derating factor applies. Results of testing according to [Table B.1](#) shall demonstrate this.



#### Key

$d_n, l_e$  and  $r$  and  $\alpha$  shall be in accordance with [Table B.2](#)

$d_n$  nominal outside diameter

$l_e$  tubular length of fusion end piece<sup>a</sup>

$r$  nominal bend radius of fitting

$z$  nominal length of fitting branch to axis

$\alpha$  nominal angle of fitting<sup>b</sup>

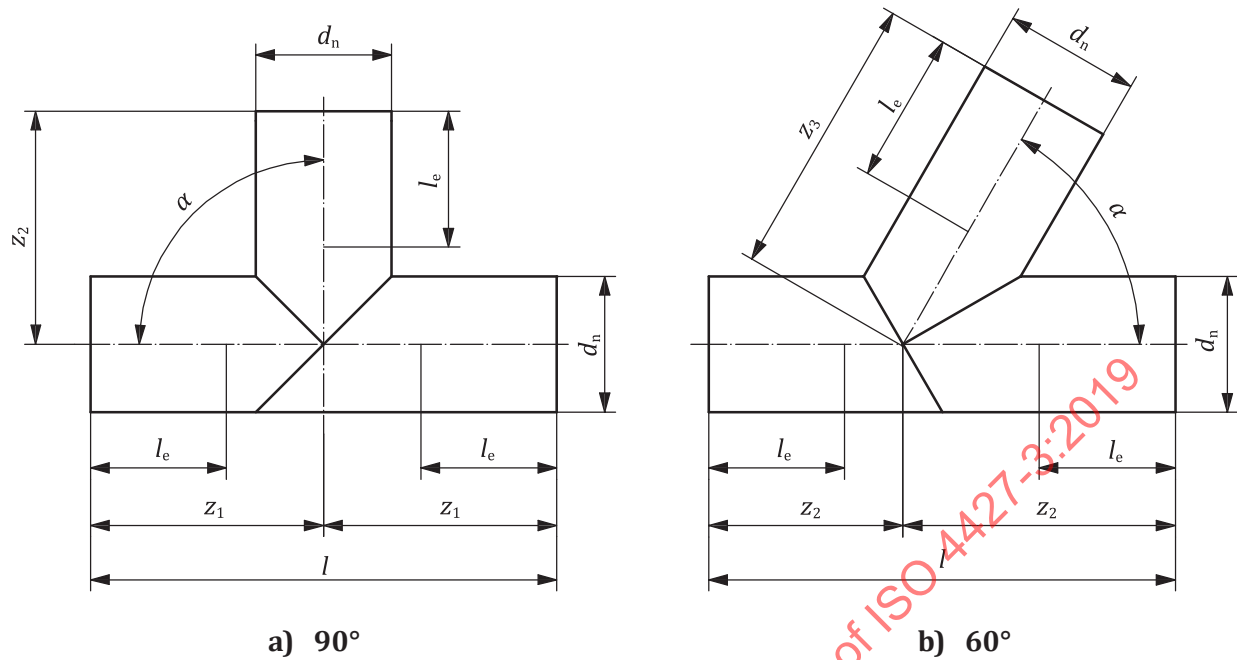
<sup>a</sup> The length shall allow the following (in any combination): the use of clamps required in the case of butt fusion; assembly with an electrofusion fitting; assembly with a socket fusion fitting; the use of a mechanical scraper.

<sup>b</sup> Special measures may be taken to keep the pipe-bend angle in place during storage and handling of the fitting.

Figure B.3 — Swept bends

## B.5 Segmented tees

Fabricated tees made out of pipe segments are not required to accord with the drawings given in [Figure B.4](#). Only indicated dimensions shall be considered. A full set of dimensions shall be provided by the technical documentation of the fitting manufacturer.

**Key**

$d_n, l_e$  and  $r$  and  $\alpha$  shall be in accordance with [Table B.2](#)

$d_n$  nominal outside diameter

$l_e$  tubular length of fusion end piece<sup>a</sup>

$z_1, z_2, z_3$  nominal lengths of fitting branch to axis

$\alpha$  nominal angle of fitting ( $\pm 2^\circ$ )

<sup>a</sup> The length shall allow the following (in any combination): the use of clamps required in the case of butt fusion; assembly with an electrofusion fitting; assembly with a socket fusion fitting; the use of a mechanical scraper.

**Figure B.4 — Segmented tees**

For tees fabricated out of pipe segments, the following derating rules for the calculation of the PN shall apply:

$$PN = f_T \times PN_{\text{pipe}}$$

where

$f_T$  is the derating factor for these tees, having a value of 0,5;

$PN_{\text{pipe}}$  is the nominal pressure of the pipe.

Practice has shown that these factors are applicable. Results of testing according to [Table B.1](#) will determine the applicable factor  $f_T$ .