

Butt-welding pipe fittings

Part 3: Wrought austenitic and austenitic-ferritic (duplex) stainless steels without specific inspection requirements

ICS 23.040.40; 77.140.20

National foreword

This British Standard is the UK implementation of EN 10253-3:2008. It supersedes BS 1640-2:1962 and BS 1640-4:1968 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee ISE/19, Pipe fittings (other than cast iron).

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

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Butt-welding pipe fittings - Part 3: Wrought austenitic and austenitic-ferritic (duplex) stainless steels without specific inspection requirements

Raccords à souder bout à bout - Partie 3: Aciers
inoxydables austénitiques et austéno-ferritiques sans
contrôle spécifique

Formstücke zum Einschweißen - Teil 3: Nichtrostende
austenitische und austenitisch-ferritische (Duplex-) Stähle
ohne besondere Prüfanforderungen

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Foreword

This document (EN 10253-3:2008) has been prepared by Technical Committee ECISS/TC 29 "Steel tubes and fittings for steel tubes", the secretariat of which is held by UNI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 2009, and conflicting national standards shall be withdrawn at the latest by May 2009

EN 10253 comprises a series of European Standards about *Butt-welding pipe fittings*, namely:

Part 1: Wrought carbon steel for general use and without specific inspection requirements

Part 2: Non alloy and ferritic alloy steels with specific inspection requirements

Part 3: Wrought austenitic and austenitic-ferritic (duplex) stainless steels without specific inspection requirements

Part 4: Wrought austenitic and austenitic-ferritic (duplex) stainless steels with specific inspection requirements

Part 5: Wrought austenitic and austenitic-ferritic (duplex) stainless steels for use as construction products

In writing EN 10253 the competent committee recognized that there are two broad types of products commonly used for stainless steels, and decided to reflect these in the standard by differentiating between two parts.

EN 10253-1 describes fittings without formal reference to the pressure resistance, which are not intended to be used in applications covered by the Pressure Equipment Directive (97/23/EC).

EN 10253-2 defines two types of fittings : Type A fittings have the same wall thickness at the welding ends and at the body of the fitting than a pipe having the same specified wall thickness. Their resistance to internal pressure is, in general, less than that of a straight pipe with the same dimensions. Type B fittings showing increased wall thickness at the body of the fitting are designed to resist the same internal pressure as a straight pipe with same dimensions. These two types of fittings are intended to be used in applications covered by the EU Directive 97/23/EC. According to this Directive and further interpretation guidelines (e.g. guideline 7/19), seamless fittings are considered as materials whereas welded fittings are considered as components. Therefore, in some areas of this European Standard, provisions for seamless and welded fittings are different.

The committee recognized the need to provide a basic type in which the minimum wall thickness of the fitting is guaranteed without formal reference to the pressure resistance. This type is considered in Part 3 and includes products not intended for use in applications covered by the Pressure Equipment Directive (97/23/EC) except applications according to Article 3 Paragraph 3.

The application standards for the Pressure Equipment Directive category I - IV will require that the fitting is designed to withstand a defined resistance to internal pressure. This approach is considered in Part 4.

Information about structural dimensions of fittings is given in Annex A and commonly used dimensions and wall thicknesses are given in Annex B.

The selection of steel type and requirement level depend on many factors; the properties of the fluid to be conveyed, the service conditions, the design code and any statutory requirements should all be taken into consideration. Therefore this standard gives no detailed guidelines for the application of different parts. It is the ultimate responsibility of the user to select the appropriate part for the intended application.

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

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Introduction

The European Organisation for Standardization (CEN) draws attention to the fact that it is claimed that compliance with this document may involve the use of patents applied to steel grade 1.4410, the compositions of which is given in Table 3.

CEN takes no position concerning the evidence, validity and scope of these patent rights.

The holder of these patent rights has assured CEN that he/she are willing to negotiate licences, under reasonable and non-discriminatory terms and conditions, with applicants throughout the world. In this respect, the statements of the holders of these patent rights are registered with CEN. Information may be obtained from:

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Attention is drawn to the possibility that some of the elements within this document may be the subject of patent rights other than those indicated above. CEN shall not be responsible for identifying any or all such patents rights.

1 Scope

1.1 This part of EN 10253 specifies the technical delivery requirements for seamless and welded butt-welding fittings (elbows, concentric and eccentric reducers, equal and reducing tees, caps) made of austenitic and austenitic–ferritic (duplex) stainless steel without specific inspection requirements.

It specifies:

- steel grades;
- mechanical properties;
- dimensions and tolerances;
- requirements for inspection and testing;
- inspection documents;
- marking;
- handling and packaging.

1.2 Limitation of use

The allowed pressures and temperatures are the responsibility of the customer according to the state of the art and in application of the safety coefficients in the application regulations, codes and standards.

In common, joint coefficient is used in the calculation of the thicknesses of components which include one or several butt welds, other than circumferential:

- for equipment subject to random non-destructive testing: 0,85;
- for equipment not subject to non-destructive testing other than visual inspection: 0,7.

1.3 Unless otherwise specified in this part of EN 10253 the general technical delivery requirements in EN 100021 apply.

2 Normative references

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

EN 287-1, *Qualification test of welders — Fusion welding — Part 1: Steels*

EN ISO 15609-1, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 1: Arc welding (ISO 15609-1:2004)*

EN 910, *Destructive tests on welds in metallic materials — Bend tests*

EN 1418, *Welding personal — Approval testing of welding operators for fusion welding and resistance weld setters for fully mechanized and automatic welding of metallic materials*

EN 10002-1, *Metallic materials — Tensile testing — Part 1: Method of test at ambient temperature*

- EN 10002-5, *Metallic materials — Tensile testing — Part 5: Method of testing at elevated temperature*
- EN 10020:2000, *Definition and classification of grades of steel*
- EN 10021:2006, *General technical delivery conditions for steel products*
- EN 10027-1, *Designation systems for steel — Part 1: Steel names*
- EN 10027-2, *Designation systems for steel — Part 2: Numerical system*
- EN 10028-7, *Flat products made of steels for pressure purposes — Part 7: Stainless steels*
- EN 10052, *Vocabulary of heat treatment terms for ferrous products*
- EN 10079:2007, *Definition of steel products*
- EN 10088-2, *Stainless steels — Part 2: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes*
- EN 10088-3, *Stainless steels — Part 3: Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resisting steels for general purposes*
- EN 10168, *Steel products — Inspection documents — List of information and description*
- EN 10204, *Metallic products — Types of inspection documents*
- EN 10216-5, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 5: Stainless steel tubes*
- EN 10217-7, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 7: Stainless steel tubes*
- EN ISO 8493, *Metallic materials — Tubes — Drift-expanding test (ISO 8493:1998)*
- EN ISO 8495, *Metallic materials — Tubes — Ring expanding test (ISO 8495:1998)*
- EN 10266, *Steel tubes, fittings and structural hollow sections — Symbols and definitions of terms for use in product standards*
- EN 10272, *Stainless steel bars for pressure purposes*
- EN 10296-2, *Welded circular steel tubes for mechanical and general engineering purposes — Technical delivery conditions — Part 2: Stainless steel*
- EN 10297-2, *Seamless steel tubes for mechanical and general engineering purposes — Technical delivery conditions — Part 2: Stainless steel*
- EN 13445-3, *Unfired pressure vessels — Part 1: Design*
- EN 13480-1, *Metallic industrial piping — Part 1: General*
- EN ISO 377, *Steel and steel products — Location and preparation of samples and test pieces for mechanical testing (ISO 377:1997)*
- EN ISO 2566-2, *Steel — Conversion of elongation values — Part 2: Austenitic steels (ISO 2566-2:1984)*
- EN ISO 3166-1, *Codes for the representation of names of countries and their subdivisions — Part 1: Country codes (ISO 3166-1:2006)*

EN ISO 3651-2, *Determination of resistance to intergranular corrosion of stainless steels — Part 2: Ferritic, austenitic and ferritic-austenitic (duplex) stainless steels — Corrosion test in media containing sulfuric acid* (ISO 3651-2:1998)

EN ISO 9001, *Quality management systems — Requirements* (ISO 9001:2000)

EN ISO 14284, *Steel and iron — Sampling and preparation of samples for the determination of chemical composition* (ISO 14284:1996)

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purpose of this document, the relevant terms and definitions given in EN 10020:2000, EN 10021:2006, EN 10052:1993, EN 10079:2007 and EN ISO 377:1997 apply, except as defined below.

3.1.1

model

for elbows and return bends, the model defines the bending radius of the piece

3.1.2

welded fitting

fittings made from welded tubes or fittings made from plate/sheet or strip where welding is a part of the manufacturing process

3.1.3

seamless fitting

fittings manufactured without welding from starting material which is not welded

3.1.4

purchaser

person or organisation that orders products in accordance with this European Standard

3.1.5

employer

organisation for which a person works on a regular basis. The employer can be either the fitting manufacturer or supplier or a third party organisation providing a service, e.g. NDT

3.2 Symbols

For the purpose of this document, the symbols given in EN 10266 and the following apply.

DN, DN ₁	Conventional dimension used in piping; non measurable value (see EN ISO 6708)
D	Specified outside diameter for elbows, return ends, equal tees, caps and the major outside diameter for reducers and reducing tees, expressed in millimetres
D ₁	Specified minor outside diameter for reducers and reducing tees, expressed in millimetres
T	Specified wall thickness at the welding ends for elbows, return bends and equal tees or on the D end for reducers and reducing tees, expressed in millimetres
T ₁	Specified wall thickness on the D ₁ welding end of reducers and reducing tees, expressed in millimetres

ID	Internal diameter at the welding ends of elbows, return bends, equal tees and at the major welding end of reducers and reducing tees ($ID = D - 2T$)
ID ₁	Internal diameter at the minor welding end of reducers and reducing tees ($ID_1 = D_1 - 2T_1$)
C	Centre to centre distance for return bends ($C = 2R$), expressed in millimetres
B	Back to face distance for return bends, expressed in millimetres
F	Distance from the axis of the branch outlet to the face of the centre body of tees, expressed in millimetres
G	Distance from the axis of the centre line to the face of the branch outlet of reducing tees, expressed in millimetres
H	Face to centre distance for 45° elbows, expressed in millimetres
K	Total height for caps, expressed in millimetres
L	Face to face distance for reducers, expressed in millimetres
Q	Tolerance on the form of fittings
r	Inside knuckle radius of cap
R	Bending radius of elbows and return bends, expressed in millimetres
R _m	Tensile strength at room temperature, expressed in MPa
R _{p0,2}	Minimum 0,2 % proof strength at room temperature, expressed in MPa
R _{p1,0}	Minimum 1,0 % proof strength at room temperature, expressed in MPa
A	Percentage of elongation at rupture, with reference to gauge length of $5,65 \sqrt{S_0}$
HBW	Brinell hardness
W0	Welded from hot or cold rolled plate, sheet or strip 1D, 2D, 2E, 2B (symbols of flat products according to EN 10088-2)
W1	Welded from hot rolled plate, sheet or strip 1D, descaled
W2	Welded from cold rolled plate, sheet or strip 2D, 2E, 2B, descaled

4 Classification of grades and designation

4.1 Classification of grades

Steels covered in this European Standard are classified according to their structure into:

- austenitic steels;
- austenitic–ferritic (duplex) steels.

For more details see EN 10088-1.

4.2 Designation

For the fittings covered by this European Standard the designation shall consist of:

number of this European Standard (EN 10253-3);

plus either:

steel name in accordance with EN 10027-1;

or:

steel number allocated in accordance with EN 10027-2.

5 Information to be obtained from the purchaser

5.1 Mandatory information

The following information shall be obtained from the purchaser, at the time of enquiry and/or order:

5.1.1 Designation of fittings

5.1.1.1 Elbows and return bends

Elbows and return bends are designated by the model (2D, 3D, 5D, D+100 and so on), the angle and the outside diameter D.

5.1.1.2 Reducers

Reducers are designated by the model (concentric or eccentric), the major diameter D and the minor diameter D_1 .

5.1.1.3 Tees

Equal tees are designated by the outside diameter D.

Reducing tees are designated by the major diameter D and by the minor diameter D_1 .

5.1.1.4 Caps

Caps are designated by the outside diameter D.

5.1.2 Information

The following information shall be obtained from the purchaser at the time of enquiry and order:

- quantity required (number of pieces);
- designation of fittings (see 5.1.1) and the wall thickness T (T_1);
- designation of the steel grade according to this European Standard;
- reference to this European Standard.

5.2 Options

A number of options are specified in this European Standard and these are listed below. In the event that the purchaser does not indicate a wish to implement any of these options at the time of enquiry and order, the fittings shall be supplied in accordance with the basic specification (see 5.1).

- 1) steelmaking process (see 6.1);
- 2) heat treatment of the fittings (see 6.2.3.1);
- 3) additional testing of the fittings shall be agreed at the time of enquiry and order (7.3);
- 4) agreed mechanical properties for wall thicknesses greater than 60 mm apply (see Table 4);
- 5) intergranular corrosion test (see 7.5);
- 6) surface treatment (see 7.6.1.9);
- 7) non-destructive testing of the weld area (see 7.6.2);
- 8) structural dimensions of fittings not covered by Annex A (see 7.7.2.2);
- 9) fittings are ordered with tolerance class D3 or D4 (see Table 6);
- 10) end bevelling shall be agreed at the time of enquiry and order (see 7.7.4);
- 11) the test unit size shall be as specified on the purchase order (see Table 9);
- 12) weld bend test (welded fittings) (see Table 10);
- 13) tensile test on the weld at room temperature (see Table 10);
- 14) liquid penetrant examination of welds and weld ends (see 10.8.2);
- 15) liquid penetrant examination of surfaces, extent shall be specified at the time if the enquiry (see 10.8.2);
- 16) additional marking (see 11.1);
- 17) special packaging, coating or end plugs as agreed at the time of enquiry or order shall be applied (see Clause 12).

5.3 Examples of an order

5.3.1 Example 1

1 000 elbows in accordance with this European Standard of type 3D with angle 90°, dimensions 60,3 × 2,9, made of steel grade 1.4436 and with a joint coefficient 0,7.

1 000 elbows – EN 10253-3 – type 3D – 90° – 60,3 × 2,9 – 1.4436

5.3.2 Example 2

1 000 elbows in accordance with this European Standard of type 3D with angle 90°, dimensions 60,3 × 2,9, made of steel grade 1.4436 and with non-destructive testing of the weld area (joint coefficient 0,85).

1 000 elbows – EN 10253-3 – type 3D – 90° – 60,3 × 2,9 – 1.4436 – Option 9

5.3.3 Example 3

2 000 concentric reducers in accordance with this European Standard with dimensions $219,1 \times 6,3 - 139,7 \times 4,0$, with a length according to Annex A made of steel grade X2CrNi19-11 and with a joint coefficient 0,7.

2 000 concentric reducers – EN 10253-3 – $219,1 \times 6,3 - 139,7 \times 4,0$ – X2CrNi19-11

5.3.4 Example 4

3 000 equal tees in accordance with this European Standard with dimension ID $40,0 \times 2,0$ made of steel grade 1.4301, with a joint coefficient 0,85, with a non-destructive testing of the weld area and with an inspection certificate 3.1.

3 000 equal tees – EN 10253-3 – ID $40,0 \times 2,0$ – 1.4301 – Option 9 – Option 13

6 Manufacturing process

6.1 Steelmaking process

The steelmaking process is left to the discretion of the steel manufacturer.

The manufacturer shall operate a quality management system according to or equivalent to EN ISO 9001 and an environmental management system according to or equivalent to EN ISO 14001.

Option 1: *The purchaser shall be informed about the steelmaking process used. The process shall be reported in the inspection document.*

NOTE The purchaser can receive information on environmental aspects of the steelmaking process; for example, the operation of the manufacturer under an environmental management system.

6.2 Product making process for fittings and heat treatment

6.2.1 Product making process

The method of manufacturing is left to the discretion of the manufacturer.

The manufacturer shall operate a quality management system according to or equivalent to EN ISO 9001.

The product making process shall be so applied that it will not produce injurious imperfections in the fittings.

Where tubes are used as starting material, following conditions shall apply:

- choice of the tubes (seamless or welded) is left at the discretion of the manufacturer;
- material according to EN 10216-5 or EN 10297-2 (seamless) and EN 10217-7 or EN 10296-2 (welded) shall be used.

Material according to EN 10028-7 or EN 10088-2 shall be used if plate/sheet or strip is used as starting material.

Material according to EN 10272 or EN 10088-3 shall be used if bars are used as starting material.

NOTE The purchaser can receive information on environmental aspects of the product making process; for example, the operation of the manufacturer under an environmental management system.

6.2.2 Welding

6.2.2.1 General

When producing fittings from plate or strip, welding is considered being a part of the manufacturing of fittings, the following criteria are valid:

- welding process/procedures shall be in accordance with EN ISO 15609-1;
- welders and/or welding operators shall be in accordance with EN 287-1 and/or EN 1418.

All welds carried out during the manufacture of the fitting shall be fusion weld type. All welds shall have complete penetration.

Local repair of weld seam which have been made with filler metal is permitted provided that the repair procedure/welders are qualified in accordance with the relevant part the above mentioned standards.

If heat treatment is required, the repair welding shall be carried out in advance.

6.2.2.2 Finished joint requirement

Welded surfaces are permitted provided the surface imperfections permit proper interpretation of radiographic or other non destructive examination.

A reduction in thickness due to the welding process is acceptable provided that the material of the joining surfaces shall not be reduced below minimum required thickness at any point.

Concavity due to the welding process on the root side of a single welded joint is permitted when the resulting thickness of the weld is at least equal to the minimum thickness of the thinner part of the parts being joined and the contour of the concavity is smooth.

The height of the reinforcement on each face of the weld shall not exceed the values specified in Table 1.

Table 1 — Height of reinforcement

Base metal thickness (T)	Reinforcement
$T < 2,5 \text{ mm}$	1,0 mm
$2,5 \leq T \leq 5,0 \text{ mm}$	1,5 mm
$5,0 < T \leq 10,0 \text{ mm}$	2,0 mm
$10,0 < T \leq 25,0 \text{ mm}$	2,5 mm
$25,0 < T \leq 50,0 \text{ mm}$	3,5 mm

6.2.3 Heat treatment

6.2.3.1 Cold forming

Fittings, produced from solution annealed and quenched or stabilised materials using cold forming as manufacturing method, do not require heat treatment.

If heat treatment is still demanded, this shall be agreed at the time of enquiry and order.

Option 2: *Heat treatment of the fittings shall be carried out.*

6.2.3.2 Hot forming

Fittings manufactured by hot forming shall be solution annealed.

7 Technical requirements

7.1 General

Fittings supplied and inspected in accordance with Clauses 6, 10 and 11, shall comply with the requirements of this European Standard.

In addition to the requirements of this European Standard, the general technical delivery requirements specified in EN 10021 shall apply.

7.2 Chemical composition - Cast analysis

The cast analysis reported by the steel manufacturer shall apply and comply with the requirements of Table 2 for austenitic steels and of Table 3 for austenitic-ferritic steels.

7.3 Weldability

Fittings covered by this European Standard are weldable, however account should be taken of the fact that the behaviour of the steel during and after welding is dependent not only on the steel, but also essentially on the conditions of preparing and carrying out the welding and on the final use of the fitting.

Table 2 — Chemical composition (cast analysis)^a of austenitic stainless steels, in % by mass

Steel grade		C	Si	Mn	P	S	N	Cr	Cu	Mo	Nb	Ni	Ti	Others
Steel name	Steel number	max	max	max	max	max								
X2CrNi18-9	1.4307	0,030	1,00	2,00	0,045 ^b	0,015 ^b	≤ 0,11	17,50 to 19,50	—	—	—	8,00 to 10,50	—	—
X2CrNi19-11	1.4306	0,030	1,00	2,00	0,045 ^b	0,015 ^b	≤ 0,11	18,00 to 20,00	—	—	—	10,00 to 12,00	—	—
X2CrNiN18-10	1.4311	0,030	1,00	2,00	0,045 ^b	0,015 ^b	0,12 to 0,22	17,00 to 19,50	—	—	—	8,50 to 11,50	—	—
X5CrNi18-10	1.4301	0,07	1,00	2,00	0,045 ^b	0,015 ^b	≤ 0,11	17,00 to 19,50	—	—	—	8,00 to 10,50	—	—
X6CrNiTi18-10	1.4541	0,08	1,00	2,00	0,045 ^b	0,015 ^b	—	17,00 to 19,00	—	—	—	9,00 to 12,00	5xC to 0,70	—
X6CrNiNb18-10	1.4550	0,08	1,00	2,00	0,045 ^b	0,015 ^b	—	17,00 to 19,00	—	—	10xC to 1,00	9,00 to 12,00	—	—
X1CrNi25-21	1.4335	0,020	0,25	2,00	0,025	0,010	≤ 0,11	24,00 to 26,00	—	≤ 0,20	—	20,00 to 22,00	—	—
X2CrNiMo17-12-2	1.4404	0,030	1,00	2,00	0,045 ^b	0,015 ^b	≤ 0,11	16,50 to 18,50	—	2,00 to 2,50	—	10,00 to 13,00	—	—
X5CrNiMo17-12-2	1.4401	0,07	1,00	2,00	0,045 ^b	0,015 ^b	≤ 0,11	16,50 to 18,50	—	2,00 to 2,50	—	10,00 to 13,00	—	—
X6CrNiMoTi17-12-2	1.4571	0,08	1,00	2,00	0,045 ^b	0,015 ^b	—	16,50 to 18,50	—	2,00 to 2,50	—	10,50 to 13,50	5xC to 0,70	—
X2CrNiMo17-12-3	1.4432	0,030	1,00	2,00	0,045 ^b	0,015 ^b	≤ 0,11	16,50 to 18,50	—	2,50 to 3,00	—	10,50 to 13,00	—	—
X2CrNiMoN17-13-3	1.4429	0,030	1,00	2,00	0,045 ^b	0,015 ^b	0,12 to 0,22	16,50 to 18,50	—	2,50 to 3,00	—	11,00 to 14,00	—	—
X3CrNiMo17-13-3	1.4436	0,05	1,00	2,00	0,045 ^b	0,015 ^b	≤ 0,11	16,50 to 18,50	—	2,50 to 3,00	—	10,50 to 13,00	—	—
X2CrNiMo18-14-3	1.4435	0,030	1,00	2,00	0,045 ^b	0,015 ^b	≤ 0,11	17,00 to 19,00	—	2,50 to 3,00	—	12,50 to 15,00	—	—

(to be continued)

Table 2 — (concluded)

Steel grade		C	Si	Mn	P	S	N	Cr	Cu	Mo	Nb	Ni	Ti	Others
Steel name	Steel number	max	max	max	max	max								
X2CrNiMoN17-13-5	1.4439	0,030	1,00	2,00	0,040 ^b	0,015 ^b	0,12 to 0,22	16,50 to 18,50	—	4,00 to 5,00	—	12,50 to 14,50	—	—
X2CrNiMo18-15-4	1.4438	0,030	1,00	2,00	0,040 ^b	0,015 ^b	≤ 0,11	17,50 to 19,50	—	3,00 to 4,00	—	13,00 to 16,00	—	—
X1NiCrMoCu31-27-4	1.4563	0,020	0,70	2,00	0,030	0,010	≤ 0,11	26,00 to 28,00	0,70 to 1,50	3,00 to 4,00	—	30,00 to 32,00	—	—
X1NiCrMoCu25-20-5	1.4539	0,020	0,70	2,00	0,030	0,010	≤ 0,15	19,00 to 21,00	1,20 to 2,00	4,00 to 5,00	—	24,00 to 26,00	—	—
X1CrNiMoCuN20-18-7	1.4547	0,020	0,70	1,00	0,030	0,010	0,18 to 0,25	19,50 to 20,50	0,50 to 1,00	6,00 to 7,00	—	17,50 to 18,50	—	—
X1NiCrMoCuN25-20-7	1.4529	0,020	0,50	1,00	0,030	0,010	0,15 to 0,25	19,00 to 21,00	0,50 to 1,50	6,00 to 7,00	—	24,00 to 26,00	—	—

^a Elements not listed in this table shall not be intentionally added to the steel without the agreement of the purchaser except for finishing the cast. All appropriate precautions are to be taken to avoid the addition of such elements from scrap and other materials used in production which would impair mechanical properties and the suitability of the steel.

^b For fittings welded without filler material the sum of sulphur and phosphorus shall be maximum 0,040 %.

Table 3 — Chemical composition (cast analysis) ^a of austenitic-ferritic stainless steels, in % by mass

Steel grade		C	Si max	Mn max	P max	S max	N	Cr	Cu	Mo	Ni	Others
Steel name	Steel number											
X2CrNiMoN22-5-3	1.4462	0,030	1,00	2,00	0,035	0,015	0,10 to 0,22	21,00 to 23,00	—	2,50 to 3,50	4,50 to 6,50	—
X2CrNiN23-4	1.4362	0,030	1,00	2,00	0,035	0,015	0,05 to 0,20	22,00 to 24,00	0,10 to 0,60	0,10 to 0,60	3,50 to 5,50	—
X2CrNiMoN25-7-4 ^b	1.4410	0,030	1,00	2,00	0,035	0,015	0,20 to 0,35	24,00 to 26,00	—	3,00 to 4,50	6,00 to 8,00	—
X2CrNiMoCuWN25-7-4	1.4501	0,030	1,00	1,00	0,035	0,015	0,20 to 0,30	24,00 to 26,00	0,50 to 1,00	3,00 to 4,00	6,00 to 8,00	W 0,50 to 1,00
X2CrNiMoCuN25-6-3	1.4507	0,030	0,70	2,00	0,035	0,015	0,15 to 0,30	24,00 to 26,00	1,00 to 2,50	2,70 to 4,00	5,50 to 7,50	—

^a Elements not listed in this table shall not be intentionally added to the steel without the agreement of the purchaser except for finishing the cast. All appropriate precautions are to be taken to avoid the addition of such elements from scrap and other materials used in production which would impair mechanical properties and the suitability of the steel.

^b Patented steel grade.

7.4 Mechanical properties at room temperature

The mechanical properties at room temperature of the starting material of this part of EN 10253 shall conform to the requirements given in Tables 4 and 5.

Option 3: Tensile test on the base material shall be carried out in accordance with 10.2.

Option 4 (see Table 4, footnote a).

Table 4 — Mechanical properties for wall thicknesses up to 60 mm at room temperature of austenitic stainless steels in the solution annealed condition (+AT), heat treatment and information about resistance to intergranular corrosion

Steel grade	Steel number	Hardness HB max	Tensile properties at room temperature ^a					Reference heat treatment		Resistance to		Limit temp °C ^h	
			Proof strength		Tensile strength	Elongation ^b		Conditions		Intergranular corrosion			
			R _{p0,2} min MPa	R _{p1,0} min MPa	R _m ^g MPa	A min (%)		Solution temperature ^c	Cooling in ^d		e		Method in EN ISO 3651-2
						I	t						
X2CrNi18-9	1.4307	200	180	215	470 to 670	40	35	1 000 to 1 100	w, a	yes	A	350	
X2CrNi19-11	1.4306	200	180	215	460 to 680	40	35	1 000 to 1 100	w, a	yes	A	350	
X2CrNiN18-10	1.4311	210	270	305	550 to 760	35	30	1 000 to 1 100	w, a	yes	A	400	
X5CrNi18-10	1.4301	200	195	230	500 to 700	40	35	1 000 to 1 100	w, a	yes ^f	A	300	
X6CrNiTi18-10	1.4541	210	200	235	500 to 730	35	30	1 020 to 1 120	w, a	yes	A	400	
X6CrNiNb18-10	1.4550	210	205	240	510 to 740	35	30	1 020 to 1 120	w, a	yes	A	400	
X1CrNi25-21	1.4335	220	180	210	470 to 670	45	40	1 030 to 1 110	w, a	yes	A	400	
X2CrNiMo17-12-2	1.4404	200	190	225	490 to 690	40	30	1 020 to 1 120	w, a	yes	A	400	
X5CrNiMo17-12-2	1.4401	200	205	240	510 to 710	40	30	1 020 to 1 120	w, a	yes ^f	A	300	
X6CrNiMoTi17-12-2	1.4571	210	210	245	500 to 730	35	30	1 020 to 1 120	w, a	yes	A	400	
X2CrNiMo 17-12-3	1.4432	200	190	225	490 to 690	40	30	1 020 to 1 120	w, a	yes	A	400	
X2CrNiMoN17-13-3	1.4429	220	295	330	580 to 800	35	30	1 020 to 1 120	w, a	yes	A	400	
X3CrNiMo17-13-3	1.4436	200	205	240	510 to 710	40	30	1 020 to 1 120	w, a	yes ^f	A	300	
X2CrNiMo18-14-3	1.4435	200	190	225	490 to 690	40	30	1 020 to 1 120	w, a	yes	A	400	
X2CrNiMoN17-13-5	1.4439	200	285	315	580 to 800	35	30	1 100 to 1 140	w, a	yes	C	400	
X2CrNiMo18-15-4	1.4438	200	220	250	490 to 690	35	30	1 100 to 1 160	w, a	yes	C	400	
X1CrMoCu31-27-4	1.4563	220	215	245	500 to 750	40	35	1 100 to 1 160	w, a	yes	C	400	

(to be continued)

(to be continued)

Table 4 — (concluded)

Steel grade		Hardness HB max	Tensile properties at room temperature ^a				Reference heat treatment Conditions		Resistance to Intergranular corrosion	Limit temp °C ^h				
			Proof strength		Tensile strength	Elongation ^b								
			R _{p0,2} min MPa	R _{p1,0} min MPa		R _m ^g MPa					A min (%)	Solution temperature ^c	Cooling in ^d	e
Steel name	Steel number													
X1NiCrMoCu25-20-5	1.4539	220		220	250	520 to 720	35	30	1100 to 1150	w, a	yes	C	400	
X1CrNiMoCuN20-18-7	1.4547	220		220	300	340	650 to 850	35	30	1180 to 1230	w, a	yes	C	400
X1NiCrMoCuN25-20-7	1.4529	220		220	300	340	600 to 800	40	40	1120 to 1180	w, a	yes	C	400

^a For wall thicknesses greater than 60 mm the mechanical properties are subject to agreement at the time of enquiry and order. **Option 4:** Agreed mechanical properties for wall thicknesses greater than 60 mm apply.

^b l = longitudinal ; t = transverse.

^c The maximum temperatures are for guidance only.

^d w = water; a = air; cooling sufficiently rapid.

^e When tested in accordance with EN ISO 3651-2 (Appropriate method, A or B or C, shall be as indicated) up to the limit temperatures indicated in the last column of Table 8.

^f In delivery condition. (Normally not fulfilled in the sensitized condition).

^g For the delivery conditions W 0, W 1 and W 2 which do not include solution annealing, the upper R_m limit may be exceeded by 70 MPa.

^h Up to these temperatures, the material should, within 100 000 h, not have changed so as to show susceptibility of intergranular corrosion, when tested in conformity with EN ISO 3651-2.

Table 5 — Mechanical properties for wall thicknesses up to 30 mm at room temperature of austenitic-ferritic stainless steel in the solution annealed condition (+AT), heat treatment and information about resistance to intergranular corrosion

Steel grade		Hardness HB max.	Tensile properties at room temperature			Reference heat treatment		Resistance to		Limit temp °C e	
			Proof strength	Tensile strength	Elongation ^a A min (%)	Conditions		Intergranular corrosion			
						Solution temperature ^b	Cooling in ^c		d		Method in EN ISO 3651-2
Steel name	Steel number		R _{p0.2} min.	R _m							
X2CrNiMoN22-5-3	1.4462	290	450	700 to 920	25	20	1 020 to 1 100	w, a	yes	B	250
X2CrNiN23-4	1.4362	290	400	600 to 820	25	25	950 to 1 050	w, a	yes	A	250
X2CrNiMoCuN25-6-3	1.4507	310	500	700 to 900	20	20	1 080 to 1 160	w	yes	B	250
X2CrNiMoN25-7-4	1.4410	310	550	800 to 1 000	20	20	1 040 to 1 120	w	yes	B or C	250
X2CrNiMoCuWN 25-7-4	1.4501	310	550	800 to 1 000	20	20	1 080 to 1 160	w	yes	B or C	250

^a l = longitudinal ; t = transverse.

^b The maximum temperatures are for guidance only.

^c w = water; a = air; cooling sufficiently rapid.

^d When tested in accordance with EN ISO 3651-2 (Appropriate method, A or B or C, shall be as indicated) up to 250 °C.

^e Up to these temperatures, the material should, within 100 000 h, not have changed so as to show susceptibility of intergranular corrosion, when tested in conformity with EN ISO 3651-2.

7.5 Corrosion resistance

The information given in Tables 4 and 5 refer to the resistance of the steels to intergranular corrosion when tested according to EN ISO 3651-2 to the indicated method A or B or C.

Guideline values for the limit temperature for susceptibility to intergranular corrosion are indicated in Tables 4 and 5.

Option 5: *A test for the resistance to intergranular corrosion shall be carried out.*

If other specific corrosion tests are required, they shall be agreed at the time of enquiry and order.

7.6 Appearance and internal soundness

7.6.1 Appearance

7.6.1.1 Fittings shall be free from internal and external surface defects that can be detected by visual inspection in accordance with this European Standard.

7.6.1.2 Fittings shall have a finish and internal and external surface condition typical of the manufacturing process and, where applicable, the heat treated condition. The finish and surface condition shall permit surface imperfections or marks requiring dressing to be identified.

7.6.1.3 It shall be permissible to dress, by grinding or machining, surface marks and imperfections provided that, the finished wall thickness of the fitting in the dressed area is not less than the specified minimum wall thickness.

7.6.1.4 All dressed areas shall blend smoothly into the contour of the fitting.

7.6.1.5 Any surface imperfection, which demonstrates to be deeper than 5 % of the nominal thickness or 3 mm whichever is the lesser, but not less than 0,3 mm, shall be dressed. For mechanical marks the acceptance limit is 1,5 mm.

7.6.1.6 Surface imperfections which encroach on the minimum wall thickness shall be considered defects and shall be deemed not to comply with this European Standard.

7.6.1.7 If surface imperfections acceptable under 7.6.1.5 are not scattered and appear over a large area and not acceptable as "workmanlike finish", the fittings shall be rejected or alternatively subject to dressing as agreed between purchaser and manufacturer.

7.6.1.8 Repairs of the fitting parent metal shall only be carried out by grinding or machining.

7.6.1.9 Surface of the fittings shall be metallically clean by a method suitable to stainless steels (by pickling, bright annealing or shot blasting).

Option 6: *Surface treatment shall be agreed at the time of enquiry and order.*

7.6.2 Internal soundness

For the internal soundness, where appropriate, requirements together with the conditions for their verification shall be agreed at the time of enquiry and order.

The weld area shall be free from cracks, lack of fusion and lack of penetration.

When option 7 is specified, the weld area of fittings shall pass a non-destructive test of the weld.

Option 7: *Non-destructive testing of the weld area of the fittings shall be carried out in accordance with 10.8.2.*

7.7 Dimensions and tolerances

7.7.1 General

NOTE It may be of importance to reduce the weight of the product within the rank provided by the standard. This should only be done when both technically and economically feasible and as a way to reduce the environmental burdens associated with the product.

7.7.2 Dimensions

7.7.2.1 Diameter and wall thickness

Commonly used outside diameters and wall thicknesses covered by this European Standard are given in EN ISO 1127.

Commonly used inside diameters (and wall thicknesses) covered by this European Standard are listed in Annex B.

7.7.2.2 Structural dimensions of fittings

For reducers and tees it is not mandatory that the produced pieces correspond to the exact representation in the figures. Only the dimensions given in the relevant tables shall be respected.

The structural dimensions:

- F for elbows 90°;
- C and B for elbows 180°;
- F and H for elbows 45°;
- L for reducers;
- F and G for tees;
- K, R, r for caps;

covered by this European Standard and specified by their outside diameter shall, unless option 8 is specified, be according to Annex A.

Option 8: *The structural dimensions of fittings specified by their outside diameter and not covered by Annex A, shall be agreed at the time of enquiry and order.*

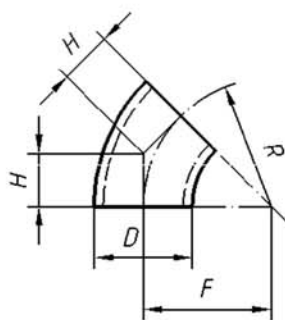


Figure 1 — 45° Elbow

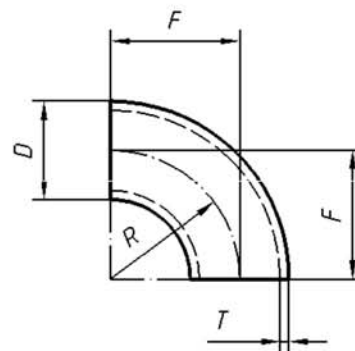


Figure 2 — 90° Elbow

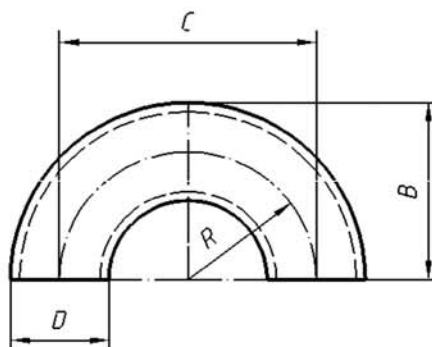


Figure 3 — Return bend

Key

- D specified outside diameter
- H face to centre distance for 45° elbows
- C centre to centre distance for return bends ($C = 2R$)
- F distance from the axis to the centre body
- R bending radius of elbows and return bends
- B back to face distance for return bends
- T specified wall thickness at the welding ends for elbows and return bends

Elbows and return bends are produced according to Figures 1, 2 and 3 (45° – 90° – 180°). Structural dimensions are listed in Annex A.

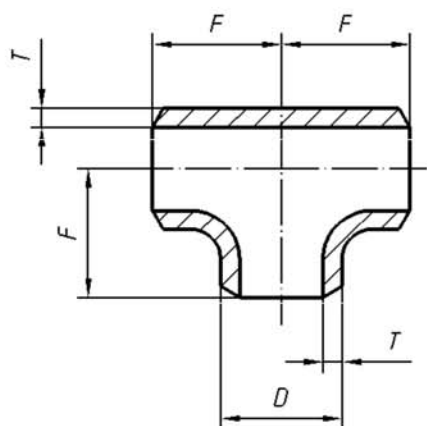


Figure 4 — Equal tee

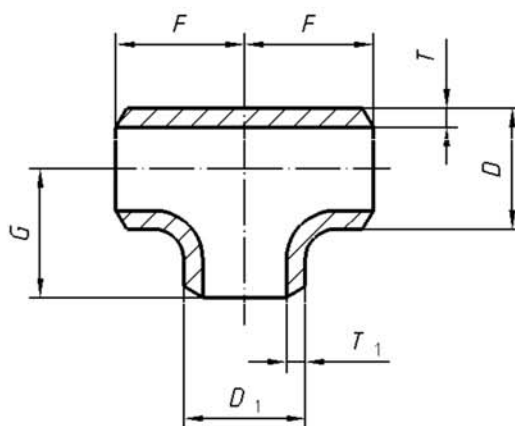


Figure 5 — Reducing tee

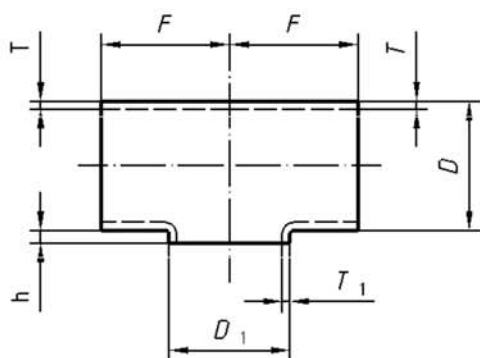


Figure 6 — Pulled tee

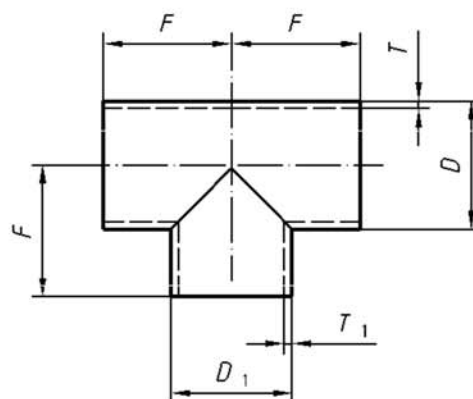


Figure 7 — Branch welded tee

Key

- D specified outside diameter
- F distance from the axis of the branch outlet to the face of the centre body of tees
- T specified wall thickness at the welding ends for equal tees or on the D end for reducing tees
- D_1 specified minor outside diameter for reducing tees
- T_1 specified wall thickness on the D_1 welding end of reducing tees
- h height

Equal tees are produced in accordance with Figure 4. Structural dimensions are listed in Annex A.

Reducing tees are produced in accordance with Figure 5. Structural dimensions are listed in Annex A.

Pulled tees are produced in accordance with Figure 6. Structural dimensions are listed in Annex A.

Branch welded tees are produced in accordance with Figure 7. Structural dimensions are listed in Annex A.

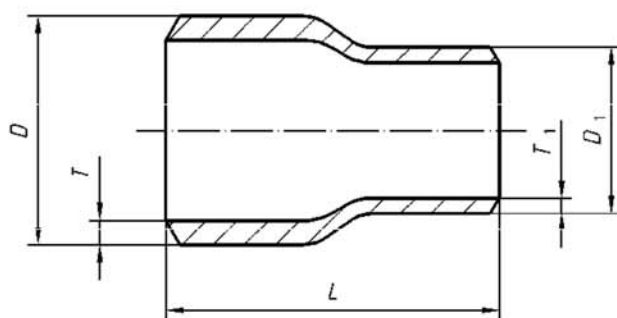


Figure 8 — Concentric reducer

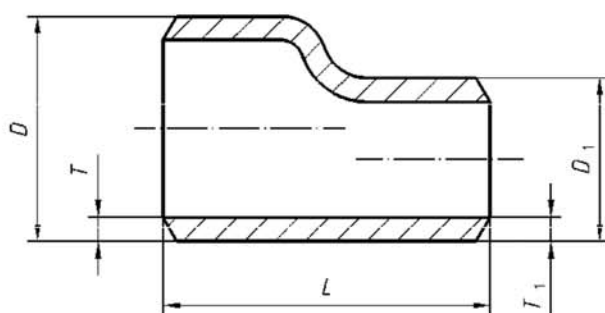


Figure 9 — Eccentric reducer

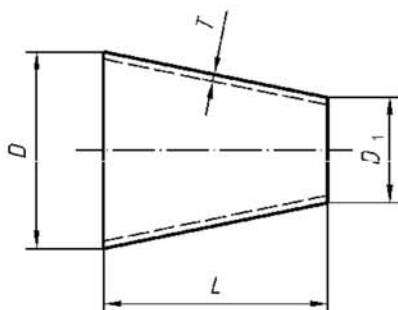


Figure 10 — Concentric reducer (straight)

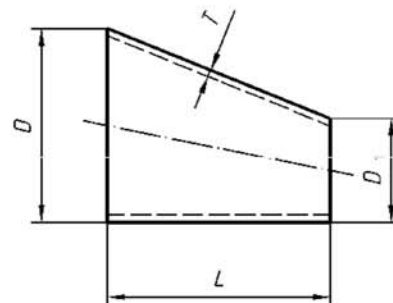
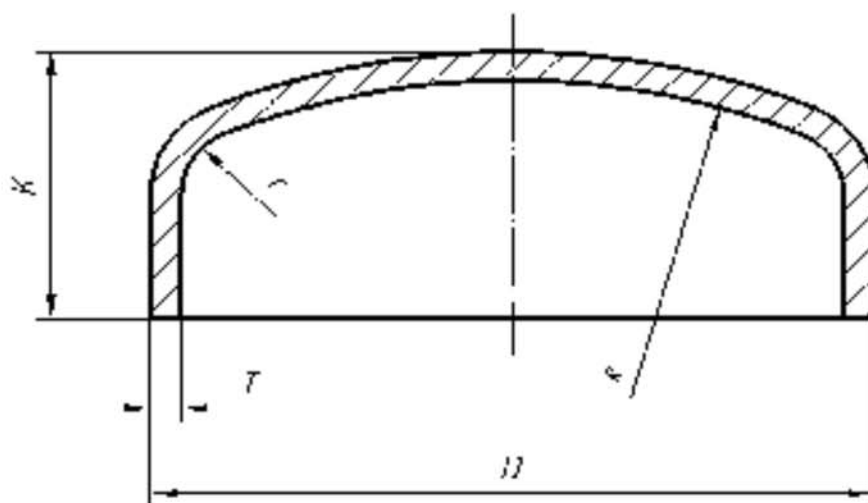


Figure 11 — Eccentric reducer (straight)

Key

- D specified outside diameter
- D_1 specified minor outside diameter for reducers
- L face to face distance for reducers
- T specified wall thickness at the welding ends for reducers
- T_1 specified wall thickness on the D_1 welding end of reducers

Concentric and eccentric reducers are produced in accordance respectively with Figures 8 to 11. Structural dimensions are listed in Annex A.



Key

R approximately equal to $0,8 D$

r approximately equal to $0,15 D$

Figure 12 — Cap

Caps are produced in accordance with Figure 12. Structural dimensions are listed in Annex A.

7.7.3 Dimensional tolerances

7.7.3.1 Tolerances on diameter

Tolerances on outside diameter shall be measured at the welding ends.

In order to guarantee the regular flow of the fluid through the fitting, the internal diameter in any section of the fitting (not applicable to caps) shall be above 80 % (for tees 70 %) of the internal diameter at the welding ends.

Internal diameter is calculated as follows:

Internal diameter = OD – 2 × nominal wall thickness

The outside diameter of fittings covered by this European Standard shall be within the tolerance limits given in Table 6.

Table 6 — Tolerances on outside diameter D

Tolerance on D	
EN tolerance class	Permissible deviation
D2	$\pm 1,0 \%$ or $\pm 0,5 \text{ mm}$ whichever is the greater
D3 ^a	$\pm 0,75 \%$ or $\pm 0,3 \text{ mm}$ whichever is the greater
D4 ^a	$\pm 0,5 \%$ or $\pm 0,1 \text{ mm}$ whichever is the greater
^a Option 9: The fittings may be ordered to tolerance classes D3 or D4.	

7.7.3.2 Out of roundness

The out-of-roundness (O) shall be calculated using the following equation:

$$O = \frac{D_{\max} - D_{\min}}{D} 100 \quad (1)$$

where

- O out-of-roundness, in %;
- $D_{\max}$ maximum outside diameter D measured in the same plane, in mm;
- $D_{\min}$ minimum outside diameter measured in the same plane, in mm;
- D specified outside diameter, in mm.

For fittings of outside diameter $D \leq 406,4$ mm, out-of-roundness, shall be included in the limits of the diameter tolerances. Measurement shall be performed at the welding ends.

For fittings of outside diameter $D > 406,4$ mm and with D/T less than or equal to 100, out-of-roundness shall not exceed 2 %.

For fittings with a D/T ratio > 100 the values for out-of-roundness shall be agreed at the time of enquiry and order.

For elbows, the out-of-roundness on the body of the fitting shall not exceed 4 %.

7.7.3.3 Wall thickness tolerances

Wall thickness tolerances of fittings covered by this European Standard are given in Table 7.

Table 7 — Wall thickness tolerances

T mm	Tolerance	
	Minus	Plus
≤ 4	- 12,5 %	+ 20 %
> 4	- 12,5 %	+ 15 %

7.7.3.4 Tolerances on structural dimensions

For the dimensions specific to fittings, the tolerances are given in Table 8.

Table 8 — Tolerances on structural dimensions in millimetres

D	F – G – H – L	B	C	K_2
$\leq 114,3$	± 2	± 7	± 7	± 4
$114,3 < D \leq 219,1$	± 2	± 7	± 7	± 7
$219,1 < D \leq 406,4$	± 3	± 7	± 10	± 7
$406,4 < D \leq 762$	± 5	± 10	± 10	± 7
$762 < D \leq 1\,219$	± 10	± 10	± 10	± 10

7.7.3.5 Tolerances on the form of fittings

The tolerances on the form of every type of fitting (out-of-squareness, alignment) is as follows:

$X = 1\%$ of the outside diameter at the point measured or 1 mm, whichever is the greater (see Figure 13).

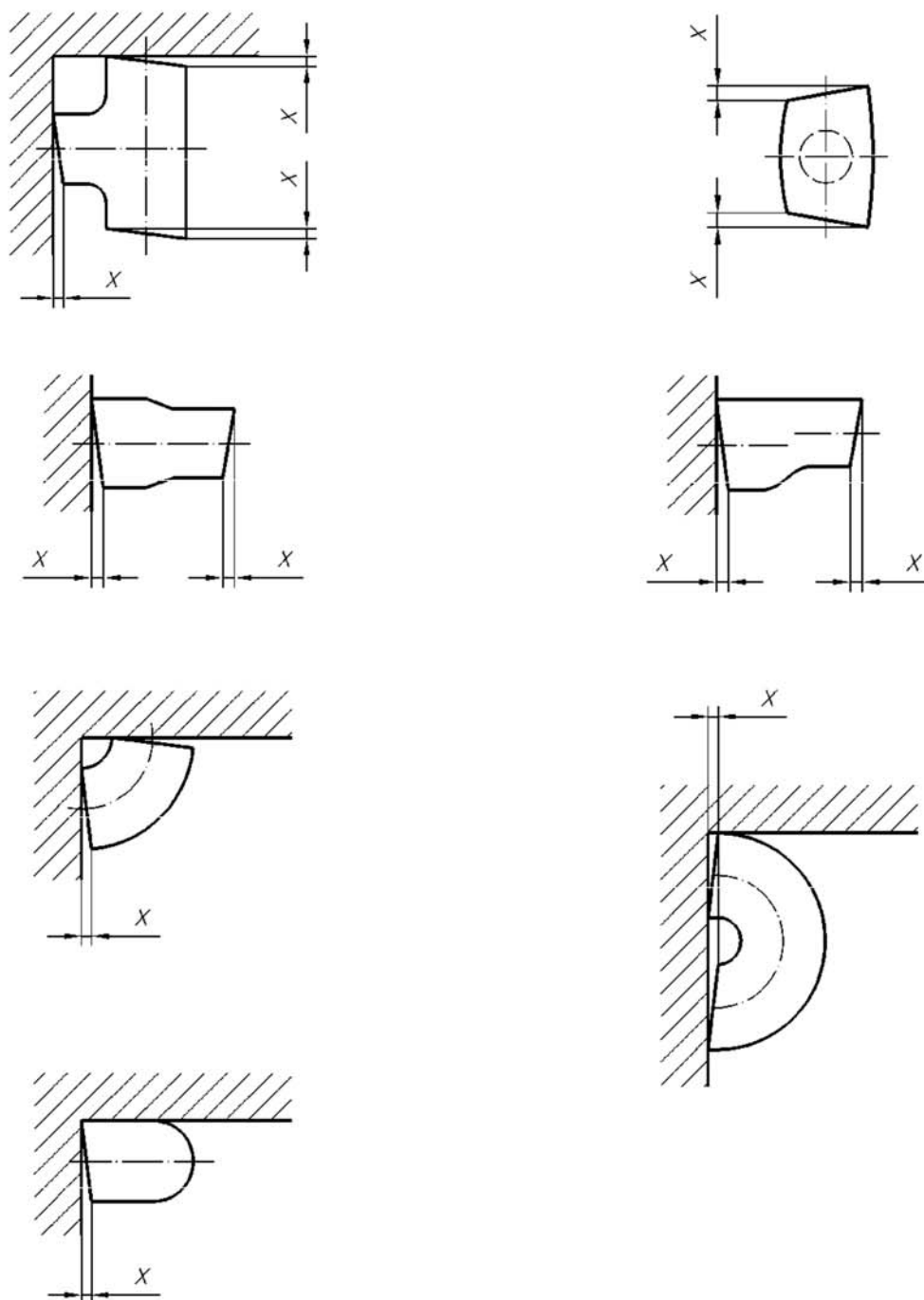


Figure 13 — Determination of the tolerance on the form of fittings

7.7.4 Performance of the end bevelling

Fittings covered by this European Standard shall be delivered with square cut ends.

Option 10: *End bevelling shall be agreed at the time of enquiry and order.*

7.8 Leak tightness

All fittings shall be leak tight.

8 Inspection

8.1 Inspection documents

8.1.1 Types of inspection documents

A test report 2.2, in accordance with EN 10204, shall be issued. Other inspection documents may be issued if agreed at the time of enquiry and order. The agreement shall include the tests to be reported.

8.1.2 Content of inspection documents

The content of the inspection document shall be in accordance with EN 10168.

In all types of inspection documents a statement on the conformity of the products delivered with the requirements of the specification and the order shall be included.

The inspection certificate or inspection report shall contain the following codes and/or information:

A – commercial transactions and parties involved;

B – description of products to which the inspection document applies;

C01-C03 – location of the samples and direction of the test pieces and testing temperature;

C10-C13 – tensile test;

C60-C69 – other tests (e.g. weld bend test);

C71-C92 – chemical composition on cast analysis;

D01 – marking and identification, surface appearance, shape and dimensional properties;

D02-D99 – leak-tightness, NDT, material identification;

Z – validation.

In addition to inspection certificate 3.1 the manufacturer shall state the references to the certificate of the appropriate “quality-assurance system” and environmental management system, if applicable.

8.2 Summary of inspection and testing

The fittings shall be inspected and tested as specified at the time of enquiry and order.

Inspection and testing to be carried out are summarised in Table 10.

9 Sampling

9.1 Frequency of tests

9.1.1 Test unit

A test unit shall consist of:

- same type;
- same specified dimensions;
- same manufacturing process;
- same steel grade;
- same welding process (welded fittings);
- same cast;
- same heat treatment batch;
- same production lot.

If fittings fulfil above description but are heat treated in several batches depending on dimension or number of pieces, it may be regarded as one test unit provided that following conditions are obtained:

- temperature may be controlled within a range of 15 °C;
- cooling conditions are similar;
- furnace is equipped with recording devices so that complete records of heat treatment are available.

The test unit size shall be as indicated in Table 9.

Table 9 — Test unit

Diameter (D) in mm	Maximum number of pieces in a test unit
$D < 60,3$	2 500
$60,3 \geq D < 114,3$	1 000
$114,3 \geq D \leq 219,1$	500
$219,1 < D \leq 323,9$	100
$323,9 < D \leq 610$	50
$610 < D \leq 1\,219$	25
$1\,219 < D$	10

Option 11: *The test unit size shall be as specified on the purchase order.*

Table 10 — Summary of inspection and testing

Type of inspection and test		Frequency of testing	Reference to
Mandatory tests	Cast analysis of the starting material	One per cast	10.1
	Dimensional testing	See 10.6	
	Visual inspection	See 10.7	
	Material identification	See 10.9	
Optional tests	NDT of the weld area (10 %) (Option 7)	See 7.6.2, 10.8.2	
	Tensile test at room temperature (Option 3)	One per each sample of test unit	7.4, 10.2.1
	Weld bend test (welded fittings) (Option 12) ^a	One per each sample of test unit	10.4
	Tensile test on the weld at room temperature (Option 13) ^b	One per each sample of test unit	10.3
	Intergranular corrosion test (Option 5)	One per each sample of test unit	7.5, 10.5
	Liquid penetrant of weld and weld ends (Option 14)	Agreement	10.8.2
	Liquid penetrant of surfaces (Option 15)	Agreement	10.8.2
^a Option 12: <i>Weld bend test (welded fittings) shall be carried out.</i> ^b Option 13: <i>Tensile test on the weld shall be carried out at room temperature</i>			

9.2 Preparation of samples and test pieces

9.2.1 Samples and test pieces for mechanical tests

The samples for the mechanical testing shall be taken and the corresponding test pieces prepared in accordance with the general conditions of EN ISO 377, as far as applicable. The test pieces may be taken from the fitting itself or from excess material, or shall be one that is produced from the same semi-finished product and has undergone the same heat treatment as the fitting.

9.2.2 Test piece for the tensile test on the base material

The test piece for the tensile test on the base material at room temperature shall consist of longitudinal segment, over length of the fitting or representative sample. The test shall be according to EN 10002-1.

9.2.3 Test piece for the tensile test on the weld

The test piece for the tensile test on the weld shall be taken transverse to the weld with the weld at the centre of the test piece.

9.2.4 Test piece for the weld bend test

The test pieces for the weld bend test at the root and face shall be taken and prepared in accordance with EN 910.

9.2.5 Test piece for the intergranular corrosion test

The test piece for the intergranular corrosion test shall be taken in accordance with the requirements of EN ISO 3651-2.

10 Test methods

10.1 Chemical analysis

The elements to be determined and reported shall be those in Table 2 or 3 in accordance with the steel grade concerned.

10.2 Tensile test on the base material

10.2.1 At room temperature

The test shall be carried out at room temperature in accordance with EN 10002-1, and the following shall be determined:

- tensile strength (R_m);
- 0,2 % proof strength ($R_{p0,2}$) and where applicable, the 1,0 % proof strength ($R_{p1,0}$);
- percentage elongation after fracture with a reference to a gauge length (L_0) of $5,65 \sqrt{S_0}$: if a non proportional test piece is used, the percentage elongation value shall be converted to the value for a gauge length $L_0 = 5,65 \sqrt{S_0}$ using the conversion tables in ISO 2566-2.

For heat treated fittings with $OD \leq 100$ mm hardness testing shall be performed on 10 % of the fittings, at least on 3 items. For these fittings tensile strength, proof strength and percentage elongation after fracture of the starting material shall be reported to the purchaser.

On cold formed fittings of $OD < 100$ mm that have not received additional heat treatment, tensile testing may be replaced by a drift expanding test in accordance with EN ISO 8493 or a ring expanding test in accordance with EN ISO 8495. To equate to the minimum post cold forming residual elongation "A", an expansion rate of 20 % shall be achieved and confirmed on at least 1 fitting per test unit.

10.2.2 At elevated temperature

The test shall be carried out in accordance with EN 10002-5 at the temperature agreed at the order, and the 0,2 % proof strength ($R_{p0,2}$) and, where applicable, the 1,0 % proof strength ($R_{p1,0}$) shall be determined.

10.3 Transverse tensile test on the weld

The test shall be carried out in accordance with EN 10002-1 at room temperature and the tensile strength (R_m) shall be determined.

10.4 Weld bend test

The test shall be carried out in accordance with EN 910 using a mandrel of a diameter of 3T. After testing the test piece shall show no cracks or flaws but slight premature failure at its edges shall not be regarded as a justification for rejection.

This test is only applicable when welding is a part of the production.

10.5 Intergranular corrosion test

The intergranular corrosion test shall be carried out in accordance with EN ISO 3651-2.

10.6 Dimensional testing

The dimension of the fittings shall conform to the requirements stated in 10.1, 10.2, 10.3 and 10.4. It is the responsibility of the manufacturers to decide the frequency of testing.

10.7 Visual inspection

Fittings shall be visually examined and shall conform to the requirements stated in Clause 9. It is the responsibility of the manufacturers to decide and document frequency of inspection.

10.8 Non destructive testing

10.8.1 Personnel

Level 1 and 2 personnel and NDT operations shall be authorised by a level 3 individual and approved by the employer.

10.8.2 NDT of the weld

10 % of the weld seams on fittings shall be non-destructively tested either prior to or after forming.

Following methods of examination can be used:

- radiographic examination;
- eddy current examination for fittings with wall thickness not greater than 6 mm;
- ultrasonic examination.

Option 14: *Liquid penetrant examination of welds and weld ends.*

Option 15: *Liquid penetrant examination of surfaces, extent shall be specified at the time if the enquiry.*

10.9 Material identification

Each fitting shall be tested by an appropriate method to assure that the correct grade is being supplied.

10.10 Leak tightness test

Each fitting shall be capable of withstanding, without any signs of leakage, a hydrostatic test at a pressure of 50 bars or a pressure P, whichever is the lower, the pressure P being calculated using the following equation:

$$P = 20 \frac{S \times T}{D} \quad (3)$$

where

- P test pressure, in bar;
- D specified outside diameter, in mm;
- T specified wall thickness, in mm;
- S stress, in MPa, corresponding to 70 % of the specified minimum yield strength (see Table 4) for the steel grade concerned.

10.11 Optional tests

These tests are carried out if agreed at the time of enquiry and order and in accordance with Table 10.

11 Marking

11.1 Marking to be applied

The marking shall include the following minimum information:

- manufacturer's mark or trade mark;
- country of deformation or the ISO code in accordance with EN ISO 3166-1 representing it;
- this European Standard, i.e. EN 10253;
- steel name or number;
- cast number or a code number which shows the correlation with the inspection document;
- welded (w) or seamless (s) fitting;
- outside diameter D ;
- wall thickness T ;
- mark of the inspection representative.

For reducing tees or reducers, the marking shall include D_1 and T_1 .

Option 16: *Additional marking and methods of marking, as agreed upon the time of enquiry or order shall be applied.*

Methods of marking may be e.g.:

- ink jet marking;
- electrochemical etching;
- fibro-marking;

— laser marking.

12 Handling and packaging

The fittings are supplied in the normal packaging by the manufacturer and without any protective coating or end plugs.

Option 17: *Special packaging, coating or end plugs as agreed at the time of enquiry or order shall be applied.*

Annex A (normative)

Structural dimensions of fittings

The structural dimensions of fittings listed below are based on ISO 5251 and ISO 3419.

Table A.1 — Structural dimensions for elbows with bending radius 2D, 3D and 5D

DN	D mm	2D			3D			5D
		F mm	C mm	B mm	F mm	C mm	B mm	F mm
15	21,3				28	56	38	45
20	26,9				29	58	43	57
25	33,7				38	76	55	72
32	42,4				48	96	69	93
40	48,3				57	114	81	108
50	60,3	51	102	81	76	152	106	135
65	76,1	63	127	102	95	190	133	175
80	88,9	76	152	121	114	228	159	205
100	114,3	102	203	159	152	304	209	270
125	139,7	127	254	197	190	380	260	330
150	168,3	152	305	237	229	458	313	390
200	219,1	203	406	313	305	610	414	510
250	273,0	254	508	391	381	762	518	650
300	323,9	305	610	467	457	914	619	775
350	355,6	356	711	533	533	1 066	711	850
400	406,4	406	813	610	610	1 220	813	970
450	457,0	457	914	686	686	1 372	914	1 122
500	508,0	508	1 016	762	762	1 524	1 016	1 245
600	610,0	610	1 220	914	914	1 828	1 219	1 524
700	711,0				1 067	2 134	1 422	1 778
800	813,0				1 219	2 438	1 625	2 033
900	914,0				1 372	2 744	1 829	2 285
1 000	1 016,0				1 524	3 048	2 032	2 540

Table A.2 — Structural dimensions for tees, equal and reduced

DN	D mm	DN ₁	D ₁ mm	F mm	G mm	DN	D mm	DN ₁	D ₁ mm	F mm	G mm
15	21,3	15	21,3	25	—	300	323,9	300	323,9	254	—
20	26,9	20	26,9	29	—			250	273		241
		15	21,3		29			200	219,1		229
25	33,7	25	33,7	38	—	350	355,6	150	168,3	279	219
		20	26,9		38			350	355,6		—
		15	21,3		38			300	323,9		270
32	42,4	32	42,4	48	—	400	406,4	250	273	305	257
		25	33,7		48			200	219,1		248
		20	26,9		48			400	406,4		—
		15	21,3		48			350	355,6		305
40	48,3	40	48,3	57	—	450	457	300	323,9	343	295
		32	42,4		57			250	273		283
		25	33,7		57			450	457		—
		20	26,9		57			400	406,4		330
50	60,3	50	60,3	64	—	500	508	350	355,6	381	330
		40	48,3		60			300	323,9		321
		32	42,4		57			500	508		—
		25	33,7		51			450	457		368
65	76,1	65	76,1	76	—	600	610	400	406,4	432	356
		50	60,3		70			350	355,6		356
		40	48,3		67			600	610		—
		32	42,4		64			500	508		432
80	88,9	80	88,9	86	—	700	711	450	457	521	419
		65	76,1		83			400	406,4		406
		50	60,3		76			800	813		—
		40	48,3		73			900	914		597
100	114,3	100	114,3	105	—	800	813	800	813	673	—
		80	88,9		98			900	914		—
		65	76,1		95			1 000	1 016		749
		50	60,3		89			1 000	1 016		—
125	139,7	125	139,7	124	—						
		100	114,3		117						
		80	88,9		111						
		65	76,1		108						
150	168,3	150	168,3	143	—						
		125	139,7		137						
		100	114,3		130						
		80	88,9		124						
200	219,1	200	219,1	178	—						
		150	168,3		168						
		125	139,7		162						
		100	114,3		156						
250	273	250	273	216	—						
		200	219,1		203						
		150	168,3		194						
		125	139,7		191						

Table A.3 — Structural dimensions for pulled tees, equal and reduced

DN	D mm	DN ₁	D ₁ mm	F mm	h mm
50	60,3	50	60,3	50	3
		40	48,3		3
		32	42,4		2
		25	33,7		2
65	76,1	65	76,1	65	4
		50	60,3		3
		40	48,3		3
		32	42,4		2
80	88,9	80	88,9	80	5
		65	76,1		4
		50	60,3		3
		40	48,3		3
100	114,3	100	114,3	100	7
		80	88,9		5
		65	76,1		4
		50	60,3		3
125	139,7	125	139,7	125	8
		100	114,3		7
		80	88,9		5
		65	76,1		4
150	168,3	150	168,3	150	10
		125	139,7		8
		100	114,3		7
		80	88,9		5
200	219,1	200	219,1	200	12
		150	168,3		10
		125	139,7		8
		100	114,3		7
250	273	250	273	250	13
		200	219,1		12
		150	168,3		10
		125	139,7		8
300	323,9	300	323,9	300	15
		250	273		13
		200	219,1		12
		150	168,3		10
350	355,6	350	355,6	350	17
		300	323,9		15
		250	273		13
		200	219,1		12
400	406,4	400	406,4	400	20
		350	355,6		15
		300	323,9		13
		250	273		13

Table A.4 — Structural dimensions for branch welded tees, equal and reduced

DN	D mm	DN ₁	D ₁ mm	F mm	DN	D mm	DN ₁	D ₁ mm	F mm
50	60,3	50	60,3	125	450	457	450	457	450
		40	48,3				400	406,4	
		32	42,4				350	355,6	
		25	33,7				300	323,9	
65	76,1	65	76,1	140	500	508	500	508	500
		50	60,3				450	457	
		40	48,3				400	406,4	
		32	42,4				350	355,6	
80	88,9	80	88,9	150	600	610	600	610	600
		65	76,1				500	508	
		50	60,3				450	457	
		40	48,3				400	406,4	
100	114,3	100	114,3	160	700	711	700	711	700
		80	88,9				600	610	
		65	76,1				500	508	
		50	60,3				450	457	
125	139,7	125	139,7	180	800	813	800	813	800
		100	114,3				700	711	
		80	88,9				600	610	
		65	76,1				500	508	
150	168,3	150	168,3	200	900	914	900	914	900
		125	139,7				800	813	
		100	114,3				700	711	
		80	88,9				600	610	
200	219,1	200	219,1	250	1 000	1 016	1 000	1 016	1 000
		150	168,3				900	914	
		125	139,7				800	813	
		100	114,3				700	711	
250	273	250	273	300			250	273	
		200	219,1				200	219,1	
		150	168,3				150	168,3	
		125	139,7				125	139,7	
300	323,9	300	323,9	330			300	323,9	
		250	273				250	273	
		200	219,1				200	219,1	
		150	168,3				150	168,3	
350	355,6	350	355,6	360			350	355,6	
		300	323,9				300	323,9	
		250	273				250	273	
		200	219,1				200	219,1	
400	406,4	400	406,4	400			400	406,4	
		350	355,6				350	355,6	
		300	323,9				300	323,9	
		250	273				250	273	

Table A.5 — Structural dimensions for reducers, concentric and eccentric

DN	D mm	DN ₁	D ₁ mm	L mm	DN	D mm	DN ₁	D ₁ mm	L mm
20	26,9	15	21,3	38	450	457	400	406,4	381
25	33,7	20	26,9	51			350	355,6	
		15	21,3				300	323,9	
32	42,4	25	33,7	51	500	508	450	457	508
		20	26,9				400	406,4	
		15	21,3				350	355,6	
40	48,3	32	42,4	64	600	610	500	508	508
		25	33,7				450	457	
		20	26,9				400	406,4	
50	60,3	40	48,3	76	700	711	600	610	610
		32	42,4				500	508	
		25	33,7				450	457	
65	76,1	50	60,3	89	800	813	700	711	610
		40	48,3				600	610	
		32	42,4				500	508	
80	88,9	65	76,1	89	900	914	800	813	610
		50	60,3				700	711	
		40	48,3				600	610	
100	114,3	80	88,9	102	1000	1016	900	914	610
		65	76,1				800	813	
		50	60,3				700	711	
125	139,7	100	114,3	127					
		80	88,9						
		65	76,1						
150	168,3	125	139,7	140					
		100	114,3						
		80	88,9						
200	219,1	150	168,3	152					
		125	139,7						
		100	114,3						
250	273	200	219,1	178					
		150	168,3						
		125	139,7						
300	323,9	250	273	203					
		200	219,1						
		150	168,3						
350	355,6	300	323,9	330					
		250	273						
		200	219,1						
400	406,4	350	355,6	356					
		300	323,9						
		250	273						

Table A.6— Structural dimensions for reducers (straight), concentric and eccentric

DN	D mm	DN ₁	D ₁ mm	L mm	DN	D mm	DN ₁	D ₁ mm	L mm
15	21,3	10	17,2	12	350	355,6	300	323,9	94
20	26,9	15	21,3	17			250	273	244
		10	17,2	29			200	219,1	404
25	33,7	20	26,9	20	400	406,4	150	168,3	554
		15	21,3	37			350	355,6	150
32	42,4	25	33,7	26			300	323,9	244
		20	26,9	46	450	457	250	273	395
40	48,3	32	42,4	17			200	219,1	554
		25	33,7	43			400	406,4	150
		20	26,9	63	500	508	350	355,6	301
50	60,3	40	48,3	36			300	323,9	395
		32	42,4	53			250	273	545
		25	33,7	79	600	610	450	457	150
65	76,1	20	26,9	99			400	406,4	301
		50	60,3	47			350	355,6	451
		40	48,3	82	700	711	300	323,9	545
80	88,9	32	42,4	100			500	508	301
		25	33,7	126			450	457	451
		65	76,1	38	800	813	400	406,4	601
100	114,3	50	60,3	85			350	355,6	752
		40	48,3	120			600	610	301
		32	42,4	138	900	914	500	508	601
125	139,7	80	88,9	75			450	457	752
		65	76,1	113			400	406,4	902
		50	60,3	160	000	1 016	700	711	301
150	168,3	40	48,3	195			600	610	601
		100	114,3	75			500	508	902
		80	88,9	151	1 100	1 120	450	457	1 053
200	219,1	65	76,1	188			800	813	301
		50	60,3	235			700	711	601
		125	139,7	85	1 200	1 220	600	610	902
250	273	100	114,3	160			500	508	1 203
		80	88,9	235			900	914	301
		65	76,1	273	1 000	1 016	800	813	601
300	323,9	150	168,3	150			700	711	902
		125	139,7	235			600	610	1 203
		100	114,3	310	1 100	1 120	1 000	1 016	308
300	323,9	80	88,9	385			900	914	609
		200	219,1	160			800	813	909
		150	168,3	310	1 200	1 220	700	711	1 210
		125	139,7	395			1 100	1 120	296
		100	114,3	470			1 000	1 016	604
300	323,9	250	273	151	1 200	1 220	900	914	905
		200	219,1	310			800	813	1 205
		150	168,3	461					
		125	139,7	545					

Table A.7 — Structural dimensions for caps

DN	D mm	K₂ mm
15	21,3	25,0
20	26,9	25,0
25	33,7	38,0
32	42,4	38,0
40	48,3	38,0
50	60,3	38,0
65	76,1	38,0
80	88,9	51,0
100	114,3	64,0
125	139,7	76,0
150	168,3	89,0
200	219,1	102,0
250	273,0	127,0
300	323,9	152,0
350	355,6	165,0
400	406,4	178,0
450	457,0	203,0
500	508,0	229,0
600	610,0	267,0
700	711,0	267,0
800	813,0	267,0
900	914,0	267,0
1 000	1 016	305,0

Annex B (informative)

Commonly used inside diameters and wall thicknesses, metric sizes

Table B.1 — Insider diameters and wall thickness, metric sizes

ID	1	2	3	4	5	6	7	8	9	10
15,0	1,5									
16,0	1,5	2,0								
20,0	1,5	2,0								
21,0		2,0								
25,0	1,5									
26,0		2,0								
32,0	1,5									
34,0		2,0								
35,0	1,5									
40,0	1,5	2,0								
50,0	1,5	2,0								
51,0		2,0		3,0						
65,0		2,0								
75,0		2,0								
80,0		2,0	2,5	3,0						
100,0		2,0	2,5	3,0						
125,0		2,0	2,5	3,0						
150,0		2,0	2,5	3,0	4,0					
200,0		2,0	2,5	3,0	4,0	5,0				
250,0		2,0	2,5	3,0	4,0	5,0				
300,0		2,0	2,5	3,0	4,0	5,0	6,0			
350,0				3,0	4,0	5,0	6,0	8,0		
400,0				3,0	4,0	5,0	6,0	8,0		
450,0				3,0	4,0	5,0	6,0	8,0		
500,0				3,0	4,0	5,0	6,0	8,0		
600,0				3,0	4,0	5,0	6,0	8,0		
700,0					4,0	5,0	6,0	8,0	10,0	
800,0					4,0	5,0	6,0	8,0	10,0	
900,0					4,0	5,0	6,0	8,0	10,0	
1 000,0						5,0	6,0	8,0	10,0	12,0

Wall thicknesses used in ISO 5251, applicable to fittings specified by their outside or inside diameter, respectively:

Table B.2 — Dimensions used in ISO 5251

D	1	2	3	4	5	6
21,3	1,6			2	3,2	4
26,9	1,6			2	3,2	4
33,7	1,6	2		2,3	3,2	4,5
42,4	1,6	2		2,6	3,6	5
48,3	1,6	2		2,6	3,6	5
60,3	1,6	2	2,3	2,9	4	5,6
76,1	1,6	2,3	2,6	2,9	5	7,1
88,9	2	2,3	2,9	3,2	5,6	8
114,3	2	2,6	2,9	3,6	6,3	8,8
139,7	2	2,6	3,2	4	6,3	10
168,3	2	2,6	3,2	4,5	7,1	11
219,1	2	2,6	3,6	6,3	8	12,5
273	2	3,6	4	6,3	10	
323,9	2,6	4	4,5	7,1	10	
355,6	2,6	4	5	8	11	
406,4	2,6	4	5	8,8	12,5	
457	3,2	4	5	10		
508	3,2	5	5,6	11		
610	3,2	5,6	6,3	12,5		
711	4		7,1			
813	4		8			
914	4		8,8			
1 016	4		10			

Bibliography

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