

Butt-welding pipe fittings —

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

The European Standard EN 10253-2:2007 has the status of a
British Standard

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National foreword

This British Standard is the UK implementation of EN 10253-2:2007. Together with BS EN 10253-1:1999 it supersedes BS 1965-1:1963, which is withdrawn. It partially supersedes BS 1640-1:1962, and BS 1640-3:1968, which will be withdrawn upon publication of BS EN 10253-3 and BS EN 10253-4.

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.

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

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Foreword

This document (EN 10253-2:2007) has been prepared by Technical Committee ECISS/TC 29 “Steel tubes and fittings for steel tubes”, the secretariat of which is held by UNI/UNSIDER.

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of an identical text or by endorsement, at the latest by May 2008, and conflicting national standards shall be withdrawn at the latest by May 2008.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive (97/23/EC).

For relationship with EU Directive, see informative Annex ZA, which is an integral part of this document.

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*

In writing this European Standard the competent committee recognized that there are two broad types of products commonly used, 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 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.

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

1 Scope

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 carbon and alloy steel which are intended for pressure purposes at room temperature, at low temperature or at elevated temperatures, and for the transmission and distribution of fluids and gases.

It specifies:

- type of fittings ;
 - type A : Butt-welding fittings with reduced pressure factor ;
 - type B : Butt-welding fittings for use at full service pressure ;
- steel grades ;
- mechanical properties ;
- dimensions and tolerances ;
- requirements for inspection and testing ;
- inspection documents ;
- marking ;
- protection and packaging.

NOTE In the case of a harmonised supporting standard for materials, presumption of conformity to the ESRs is limited to technical data of materials in the standard and does not presume adequacy of the material to a specific item of equipment. Consequently it is essential that the technical data stated in the material standard be assessed against the design requirements of this specific item of equipment to verify that the ESRs of the PED are satisfied.

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

EN 1418, *Welding personnel — 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 steels — Part 1: Steel names*

EN 10027-2, *Designation systems for steels — Part 2: Numerical system*

EN 10028-2, *Flat products made of steels for pressure purposes — Part 2: Non-alloy and alloy steels with specified elevated temperature properties*

EN 10028-3, *Flat products made of steels for pressure purposes — Part 3: Weldable fine grain steels, normalized*

EN 10028-4, *Flat products made of steels for pressure purposes — Part 4: Nickel alloy steels with specified low temperature properties*

EN 10045-1, *Metallic materials - Charpy impact test — Part 1: Test method*

EN 10052:1993, *Vocabulary of heat treatment terms for ferrous products*

EN 10168, *Steel products — Inspection documents — List of information and description*

EN 10204, *Metallic products — Types of inspection documents*

EN 10217-1, *Welded steel tubes for pressure purposes — Part 1: Non-alloy steel tubes with specified room temperature properties*

EN 10217-2, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 2: Electric welded non-alloy and alloy steel tubes with specified elevated temperature properties*

EN 10217-3, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 3: Alloy fine grain steel tubes*

EN 10217-4, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 4: Electric welded non-alloy steel tubes with specified low temperature properties*

EN 10217-5, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 5: Submerged arc welded non-alloy and alloy steel tubes with specified elevated temperature properties*

EN 10217-6, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 6: Submerged arc welded non-alloy steel tubes with specified low temperature properties*

EN 10246-10, *Non-destructive testing of steel tubes — Part 10: Radiographic testing of the weld seam of automatic fusion arc welded steel tubes for the detection of imperfections*

EN 10246-11, *Non-destructive testing of steel tubes — Part 11: Liquid penetrant testing of seamless and welded steel tubes for the detection of surface imperfections*

EN 10246-12, *Non-destructive testing of steel tubes — Part 12: Magnetic particle inspection of seamless and welded ferromagnetic steel tubes for the detection of surface imperfections*

EN 10266:2003, *Steel tubes, fittings and structural hollow sections — Symbols and definitions of terms for use in product standards*

EN 10273, *Hot rolled weldable steel bars for pressure purposes with specified elevated temperature properties*

EN 13480-3:2002, *Metallic industrial piping — Part 3: Design and calculation*

EN ISO 377:1997, *Steel and steel products — Location and preparation of samples and test pieces for mechanical testing (ISO 377:1997)*

EN ISO 2566-1, *Steel — Conversion of elongation values — Part 1: Carbon and low alloy steels (ISO 2566-1:1984)*.

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 6708, *Pipe work components — Definition and selection of DN (nominal size) (ISO 6708:1995)*

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

EN ISO 15614-1, *Specification and qualification of welding procedures for metallic materials - Welding procedure test — Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys (ISO 15614-1:2004)*

ISO 1027, *Radiographic image quality indicators for non-destructive testing — Principles and identification*

3 Terms and definitions

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

3.1

carbon steel grade

in this part of EN 10253, the following grades :

P235TR2 - P265TR2 - P235GH - P265GH - P355N - P355NH - P355NL1 - P215NL - P265NL

3.2

employer

organisation for which a person works on a regular basis

NOTE The employer may be either the fitting manufacturer or supplier or a third party organisation providing a service, e.g. NDT.

3.3

model

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

3.4

purchaser

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

NOTE 1 The purchaser is not necessarily, but may be, a manufacturer of pressure equipment in accordance with the EU Directive listed in Annex ZA.

NOTE 2 Where a purchaser has responsibilities under this EU Directive, this standard will provide a presumption of conformity with the essential requirements of the Directive so identified in Annex ZA.

3.5

weld during manufacture

weld made for obtaining a fitting

NOTE This term does not include the tube welds when a tube is used as starting material.

3.6

seamless fitting

fitting manufactured without welding from starting material which is not welded

3.7

welded fitting

3.7.1

fitting made from welded tubes

3.7.2

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

4 Symbols

For the purposes of this document, the symbols defined in EN 10266:2003 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, equal tees and bends 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 ($C \approx 2R$), 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 ;
k	Total height for caps, expressed in millimetres ;
L	Face to face distance for reducers, expressed in millimetres ;
X	Tolerance on the form of fittings ;
r	Inside knuckle radius of cap ;
R	Bending radius of elbows and return bends, expressed in millimetres ;
R_1	Inside spherical radius of cap ;
P	Tolerance on the form of elbows ;
W	Distance from the extrados to the centre of a 90° elbow at the welding ends ;

Z	Distance from the extrados to the centre of a 45° elbow at the welding ends ;
R_m	Tensile strength at room temperature, expressed in megapascals ;
$R_{p0,2}$	Minimum 0,2 % proof strength at room temperature, expressed in megapascals ;
A	Percentage of elongation at rupture, with reference to gauge length of $5,65 \sqrt{S_0}$.

5 Designations

5.1 Designation of steel grades

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

— number of this European Standard (EN 10253-2) ;

plus either :

— steel name in accordance with EN 10027-1 ;

or

— steel number allocated in accordance with EN 10027-2.

5.2 Designation of fittings

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

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

Equal tees are designated by the outside diameter D .

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

Caps are designated by the outside diameter D .

6 Information to be supplied by the purchaser

6.1 Mandatory information

The following information shall be supplied by the purchaser at the time of enquiry and order:

- quantity required (number of pieces) ;
- reference to this European Standard ;
- type of fitting, A or B ;
- designation of fittings (see 5.2) and the wall thickness $T(T_1)$;
- designation of the steel grade (see 5.1) ;

6.2 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 6.1).

- 1) Steelmaking process (see 8.1) ;
- 2) method of manufacture of the fitting (see 8.2) ;
- 3) starting product form and /or delivery condition (see 8.2.1) ;
- 4) information about the product-making process (see 8.2.1) ;
- 5) type of heat treatment (see 8.2.3) ;
- 6) other grades as specified on the purchase order (see 9.2.1) ;
- 7) product analysis (see 9.2.2) ;
- 8) verification of the proof strength at elevated temperature (see 9.3) ;
- 9) tolerance to be applied to the outside diameter (see 11.2.1.1) ;
- 10) special ID tolerances for pigging (see 11.2.1.2) ;
- 11) plus tolerances on the body of the fitting (see 11.2.2) ;
- 12) end finishing (see 11.3) ;
- 13) inspection document 3.2 (see 12.2.1) ;
- 14) mechanical properties determined on the finished product (see 9.2) ;
- 15) hardness testing of each fitting (see Table 20) ;
- 16) impact testing for grades listed in footnote ^e of Table 20 (see Table 20) ;
- 17) registration records of the heat treatment temperatures (see 13.1.1) ;
- 18) size of the test unit per Table 21 (see 13.1.1) ;
- 19) size of the test unit per Table 22 (see 13.1.1) ;
- 20) special test unit size (see 13.1.1) ;
- 21) impact test of the heat affected zone (see 13.2.6) ;
- 22) NDT of welds after forming (see 14.9.2.1) ;
- 23) NDT of welds mandatory after forming (see 14.9.2.1) ;

- 24) NDT of the starting material for the detection of laminar imperfections (see 14.9.4) ;
- 25) method of marking to be applied (see 15.2) ;
- 26) special provisions concerning marking (see 15.2) ;
- 27) protection to be applied (see Clause 16).

6.3 Examples of an order

6.3.1 Example 1

1 000 elbows in accordance with this European Standard, of type A (not having an increased wall thickness for the body of the fitting) and model 3D, with angle 90°, having an outside diameter 114, and a wall thickness 6,3, made of steel grade P265GH.

1000 elbows - EN 10253-2 - Type A – Model 3D - 90° - 114,3 X 6,3 - P265GH

6.3.2 Example 2

500 reducing tees in accordance with this European Standard of type B (having an increased wall thickness for the body of the fitting), with dimensions 114,3 X 6,3 - 88,9 X 4,0 and made of steel grade P265GH.

500 reducing tees - EN 10253-2 – Type B - 114,3 X 6,3 - 88,9 X 4,0 - P265GH

7 Resistance to internal pressure

7.1 General

The Pressure Equipment Directive (EU Directive 97/23/EC — Annex I — subclause 2.2.2) imposes that the design for adequate strength shall be based on a calculation method or, with restrictions, on an experimental method.

The resistance to internal pressure of a fitting conforming to this European Standard shall be determined according to the relevant design rules laid down in e.g. EN 13480-3.

The selection of the appropriate fitting (material, thickness) is the ultimate responsibility of the manufacturer of the pressure equipment (See Annex ZA for presumption of conformity of the material to the ESR's of Directive 97/23/EC).

For fittings of type A in carbon steel grades, when the manufacturer is able to guarantee that the minimum yield strength of the delivered products is higher than the specified minimum yield strength, the wall thickness may be reduced such as the product of the reduced thickness times the minimum product yield strength shall at least equal the product of the specified wall thickness times the specified minimum yield strength of the specified grade. For such products the mechanical properties shall be determined on the finished product and they shall be clearly identified on the inspection documents and by specific marking. See 12.2 for relevant documents, 12.3 for testing and Clause 15 for relevant information on marking.

7.2 Fittings of type A

Type A fitting 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 less than that of a pipe with the same specified diameter, wall thickness and of the same steel grade. The determination of the reducing pressure factor is given in Annex A and tables of pressure factors are given in Annex B.

For reducers the wall thickness at the conical section shall be the specified wall thickness at the major end.

7.3 Fittings of type B

Fittings of type B have increased wall thickness at the body of the fitting. They will, in general, withstand the same pressure than a pipe having the same specified diameter, wall thickness and the same steel grade.

Wall thickness requirements for this type of fittings are defined by the calculation procedures given in Annex A. For some preferred, specified wall thicknesses the resulting wall thicknesses at the body of the fitting are listed in the tables given in Annex C.

8 Manufacturing process

8.1 Steelmaking process

The steelmaking process is left at the discretion of the manufacturer and shall be reported. The steels shall be fully killed.

Option 1 : *The steelmaking process shall be as specified on the purchase order.*

8.2 Product making process for fittings and heat treatment

8.2.1 Product making process

The different allowed processes and the relevant starting product forms are listed in Table 1. Differing starting materials and production routes are associated with variations in the types of controls applied. The method of manufacturing is left at the discretion of the manufacturer. When choosing the method the manufacturer shall take suitable precautions to prevent the occurrence of ageing problems in the final product form.

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

- unless otherwise specified, the choice of the tubes (seamless or welded) is left at the discretion of the manufacturer ;
- when manufacturing fittings from welded tubes, only tubes according to EN 10217, Parts 1 to 6 shall be used. Tubes marked "C1" and/or " C2" are not allowed ;
- helical SAW tubes are not permitted ;
- after forming, repair of the pipe weld seam is only permitted for weld seams made with filler metal. These repairs shall be carried out as described in 8.2.2.

Where plate/strip are used as starting material for welded fittings, the following condition shall apply :

- only plate / strip according to EN 10028-2 to -4 shall be used.

Where bars are used as starting material for welded or machined fittings, the following condition shall apply :

- only bars according to EN 10273 shall be used.

Table 1 — Product making process – Starting product forms ^a

Process	Hot deformation			Cold deformation		Machining from round bars (DN < 50) ^d
	Bending ^b	Pressed in die ^c	Rolled, forged followed by machining	Bending ^b	Pressed in die ^c	
Elbows	1, 2, 4, 5	1, 2, 3, 4, 5	-	1, 2, 4, 5	1, 2, 3, 4, 5	-
Tees	-	1, 2, 3, 4, 5	4, 5	-	1, 2, 3, 4, 5	-
Reducers	-	1, 2, 3, 4, 5	4, 5	-	1, 2, 3, 4, 5	5
Caps	-	1, 2, 3, 4, 5	4, 5	-	1, 2, 3, 4, 5	5

^a Starting material :

- 1 seamless pipe ;
- 2 welded pipe ;
- 3 plate and strip ;
- 4 forging ;
- 5 bar.

^b When producing elbows from welded pipe, the position of the weld is at the discretion of the manufacturer.

^c For these processes welding with or without filler metal may be used (see 8.2.2.1). When filler metal is used it shall be compatible with the parent metal.

^d The method of manufacture shall be reported.

Option 2 : *The method of manufacturing and/or details of the manufacturing process, e.g. welding operations or position of the weld before forming shall be as specified on the purchase order.*

Option 3 : *The starting product form to be used and/or its delivery condition shall be as specified on the purchase order.*

Option 4 : *The method of manufacture shall be reported.*

8.2.2 Welding as part of the manufacturing process of the fitting

8.2.2.1 General

When producing fittings from plate or strip, welding is considered being a part of the manufacturing of fittings, and :

- welding process/procedures shall be qualified in accordance with EN ISO 15614-1 ;
- welders and/or welding operators shall be qualified in accordance with EN 287-1 and/or EN 1418.

For pressure equipment in categories II, III, and IV, (of Directive 97/23 EC) the operating procedures and the personnel shall be approved by a competent third-party.

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 of the above mentioned standards and the repaired area is heat treated and non destructively tested in the same way as the original weld.

All joints welded with filler metal shall be finished in accordance with the requirements in 8.2.2.1 and 8.2.2.2.

When taking into account the conditions specified for the manufacture of fittings and for the testing of the welds, a weld efficiency factor of 1,0 can be used in design calculations.

8.2.2.2 Alignment tolerances

Alignments of sections at edges to be butt-welded shall be such that the maximum offset does not cause the effective wall thickness to be less than the specified minimum and is not greater than :

$$t / 20 + 1 \text{ mm}$$

where:

t is the nominal wall thickness of the thinner section to be joined.

8.2.2.3 Finished joint requirement

As welded surfaces are permitted provided the surface imperfections permit proper interpretation of radiographic or other non-destructive examination. If there is a question regarding the surface condition of the weld when interpreting the radiographic film, the film shall be compared to the actual weld surface for determination of acceptability.

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

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.

To assure that the weld grooves are completely filled the reinforcement on each face of the weld is permitted provided that it does not exceed the values specified in Table 2.

Table 2 — Height of reinforcement

Dimensions in millimetres

Base metal thickness (T)	Reinforcement
$T < 5$	1,0
$5 \leq T \leq 10$	0,2t
$10 < T \leq 25$	3,0
$25 < T \leq 50$	3,0 inside 5,0 outside
$50 < T$	5,0 inside 6,0 outside

The finished joint criteria for the fittings made from welded pipe without filler metal shall be governed by the standard defining the starting material.

8.2.3 Heat treatment condition

The fittings shall be delivered in one of the final heat-treated conditions given in Table 3. Recommended heat treatment temperatures are given in Annex D.

In case of hot deformation fittings in carbon steel grades (see Clause 3) and steel grade 16Mo3 may be delivered without heat treatment if hot deformation produces a technically equivalent metallurgical structure with the corresponding mechanical characteristics.

This condition is regarded as satisfied when the final forming operation is completed at a temperature between 750 °C and 980 °C.

When welding is part of the manufacturing process of the fitting, the final heat treatment shall be carried out after welding.

Option 5 : *The heat treatment to be applied shall be as specified on the purchase order.*

Table 3 — Steel grades — Heat treatment conditions

Steel grade	Heat treatment condition ^a
P235TR2	N
P265TR2	N
P235GH	N
P265GH	N
16Mo3	N
10CrMo5-5	NT ^b
13CrMo4-5	NT ^b
10CrMo9-10	NT ^b
X11CrMo5	I or NT
X11CrMo9-1	I or NT
X10CrMoVNb9-1	NT ^b
P355N	N
P355NH	N
P355NL1	N
P215NL	N
P265NL	N
12Ni14	NT or QT
X10Ni9	NT or QT
L290NB	N
L360NB	N
L360QB	QT
L415NB	N
L415QB	QT
L450QB	QT

N = Normalized or normalized formed ; NT = Normalized and tempered.
 QT = Quenched and tempered ; I = Isothermal annealing.

^a These heat treatments are identical to those described in the corresponding tube standards.

^b For these steel grades it may be necessary in the case of wall thickness T above 25 mm or T/D > 0,15 to apply quenching and tempering in order to achieve the intended structure and material properties. The decision shall be left to the discretion of the manufacturer but shall be stated to the customer at the time of enquiry and order. Steel tubes treated in such a way shall be designated by the steel name supplemented by the symbol "+QT".

9 Technical requirements

9.1 General

Fittings supplied and inspected in accordance with Clauses 8, 11 and 12, shall comply with the requirements of this Part of EN 10253.

In addition to the requirements of this Part of EN 10253, the general technical delivery requirements specified in EN 10021 shall apply.

The requirements for the base material of the seamless fittings are left at the discretion of the manufacturer provided the requirements defined in Clauses 8 and 9 are fulfilled.

9.2 Chemical composition

9.2.1 Cast analysis

The cast analysis reported by the steel manufacturer shall apply and comply with the requirements of Table 4.

Option 6 : *Other grades, as specified on the purchase order, may be agreed.*

9.2.2 Product analysis

Option 7 : *A product analysis shall be supplied.*

Table 5 specifies the permissible deviations of the product analysis from the specified cast analysis given in Table 4.

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Table 4 — Chemical composition (cast analysis), in % by mass ^a

Steel name	Steel number	C	Si	Mn	P	S	Al tot	Cr	Cu	Mo	Nb	Ni	Ti	V	Others
P235TR2	1.0255	0,16	0,35	1,20	0,025	0,020	≥ 0,020 ^c	0,30 ^b	0,30 ^b	0,08 ^b	0,01 ^b	0,30 ^b	0,04 ^b	0,02 ^b	Cr+Cu+Mo+Ni ≤ 0,70
P265TR2	1.0259	0,20	0,40	1,40	0,025	0,020	≥ 0,020 ^c	0,30 ^b	0,30 ^b	0,08 ^b	0,01 ^b	0,30 ^b	0,04 ^b	0,02 ^b	«
P235GH	1.0345	0,16	0,35	1,20	0,025	0,020	≥ 0,020 ^c	0,30	0,30	0,08	0,01 ^b	0,30	0,04 ^b	0,02 ^b	«
P265GH	1.0425	0,20	0,40	1,40	0,025	0,020	≥ 0,020 ^c	0,30	0,30	0,08	0,01 ^b	0,30	0,04 ^b	0,02 ^b	«
16Mo3	1.5415	0,12-0,20 ^d	0,35	0,40-0,90	0,025	0,020	≤ 0,040	0,30	0,30	0,25-0,35	-	0,30	-	-	-
10CrMo5-5	1.7338	0,15	0,50-1,00	0,30-0,60	0,025	0,020	≤ 0,040	1,00-1,50	0,30	0,45-0,65	-	0,30	-	-	-
13CrMo4-5	1.7335	0,10-0,17 ^d	0,35	0,40-0,70	0,025	0,020	≤ 0,040	0,70-1,15	0,30	0,40-0,60	-	0,30	-	-	-
10CrMo9-10	1.7380	0,08-0,14	0,50	0,30-0,70	0,025	0,020	≤ 0,040	2,00-2,50	0,30	0,90-1,10	-	0,30	-	-	-
X11CrMo5	1.7362	0,08-0,15	0,15-0,50	0,30-0,60	0,025	0,020	≤ 0,040	4,00-6,00	0,30	0,45-0,65	-	-	-	-	-
X11CrMo9-1	1.7386	0,08-0,15	0,25-1,00	0,30-0,60	0,025	0,020	≤ 0,040	8,00-10,00	0,30	0,90-1,10	-	-	-	-	-
X10CrMoV Nb9-1	1.4903	0,08-0,12	0,20-0,50	0,30-0,60	0,020	0,010	≤ 0,040	8,00-9,50	0,30	0,85-1,05	0,06-0,10	0,40	-	0,18-0,25	N : 0,030-0,070
P355N P355 NH	1.0562 1.0565	0,20	0,50	0,90-1,70	0,025	0,020	≥ 0,020 ^c	0,30 ^b	0,30 ^e	0,08 ^e	0,05	0,50	0,04	0,10	N ≤ 0,02 Nb+Ti+V ≤ 0,12
P355NL1	1.0566	0,18	0,50	0,90-1,70	0,025	0,020	≥ 0,020 ^c	0,30 ^b	0,30 ^e	0,08 ^e	0,05	0,50	0,04	0,10	N ≤ 0,02 Nb+Ti+V ≤ 0,12
P215NL	1.0451	0,15	0,35	0,40-1,20	0,025	0,020	≥ 0,020 ^c	0,30	0,30	0,08	0,10	0,30	0,04	0,02	-
P265NL	1.0453	0,20	0,40	0,60-1,40	0,025	0,020	≥ 0,020 ^c	0,30	0,30	0,08	0,10	0,30	0,04	0,02	-
12Ni14	1.5637	0,15	0,15-0,35	0,30-0,80	0,025	0,010	-	-	0,30	-	-	3,25-3,75	-	0,05	-
X10Ni9	1.5682	0,13	0,15-0,35	0,30-0,80	0,020	0,010	-	-	0,30	0,10	-	8,50-9,50	-	0,05	-
L290NB	1.0484	0,17	0,40	1,20	0,025	0,020	0,015-0,060	0,30	0,25	0,10 ^f	0,05	0,30	0,04	0,05	N ≤ 0,012 CEV ≤ 0,42
L360NB	1.0582	0,20	0,45	1,60	0,025	0,020	0,015-0,060	0,30	0,25	0,10 ^f	0,05	0,30	0,04	0,15	N ≤ 0,012 V+Nb+Ti ≤ 0,15 CEV ≤ 0,45
L360QB	1.8948	0,16	0,45	1,40	0,025	0,020	0,015-0,060	0,30	0,25	0,10 ^f	0,05	0,30	0,04	0,05	N ≤ 0,012 CEV ≤ 0,42
L415NB	1.8972	0,21	0,45	1,60	0,025	0,020	0,015-0,060	0,30	0,25	0,10 ^f	0,05	0,30	0,04	0,15	N ≤ 0,012 V+Nb+Ti ≤ 0,15
L415QB	1.8947	0,16	0,45	1,60	0,025	0,020	0,015-0,060	0,30	0,25	0,10 ^f	0,05	0,30	0,04	0,08	N ≤ 0,012 V+Nb+Ti ≤ 0,15 CEV ≤ 0,43
L450QB	1.8952	0,16	0,45	1,60	0,025	0,020	0,015-0,060	0,30	0,25	0,10 ^f	0,05	0,30	0,06	0,09	N ≤ 0,012 V+Nb+Ti ≤ 0,15 CEV ≤ 0,45

Elements not included in this table shall not be intentionally added to the steel without the agreement of the purchaser, except for elements which may be added for finishing the cast. All appropriate measures shall be taken to prevent the addition of undesirable elements from scrap or other materials used in the steelmaking process.

For elements where only one value is indicated without further information, this value shall be regarded as a maximum.

The content of these elements need not be reported unless intentionally added to the cast.

^c This requirement is not applicable provided the steel contains a sufficient amount of other nitrogen binding elements which shall be reported.

^d For wall thicknesses greater than 30 mm, the carbon content may be increased by 0,02% for cast and product analysis.

^e The sum of the percentage by mass of the three elements chromium, copper and molybdenum shall not exceed 0,45 %.

^f Al / N ≤ 2.

Table 5 — Permissible deviations of the product analysis from specified limits on cast analysis given in Table 4

Element	Limiting value for the cast analysis in accordance with Table 4 % by mass	Permissible deviation of the product analysis % by mass
C	$\leq 0,21$	$\pm 0,02$
Si	$\leq 0,40$	$\pm 0,05$
	$> 0,40$ to $\leq 1,00$	$\pm 0,06$
Mn	$\leq 1,00$	$\pm 0,05$
	$> 1,00$ to $\leq 1,70$	$\pm 0,10$
P	$\leq 0,025$	$+ 0,005$
S	$\leq 0,010$	$+ 0,003$
	$> 0,010$ to $\leq 0,020$	$+ 0,005$
Al	$\leq 0,060$	$\pm 0,005$
Cr	$\leq 1,00$	$\pm 0,05$
	$> 1,00$ to $\leq 10,00$	$\pm 0,10$
Cu	$\leq 0,30$	$\pm 0,05$
Mo	$\leq 0,35$	$\pm 0,03$
	$> 0,35$ to $\leq 1,10$	$\pm 0,04$
N	$\leq 0,012$	$\pm 0,01$
Nb	$\leq 0,10$	$\pm 0,005$
Ni	$\leq 0,35$	$\pm 0,05$
	$> 0,35$ to $\leq 9,50$	$\pm 0,07$
Ti	$\leq 0,060$	$+ 0,010$
V	$\leq 0,10$	$+ 0,01$
	$> 0,10$ to $\leq 0,25$	$\pm 0,03$
^a If several product analyses are carried out on one cast, and the contents of an individual element determined lie outside the permissible range of the chemical composition specified for the cast analysis, then it is only allowed to exceed the permissible maximum		

9.3 Mechanical properties

The mechanical properties of the finished product shall conform to the requirements given in Tables 6 to 9. For the impact properties in the weld (where applicable), the values of the relevant grade in the transverse direction shall apply.

Option 8 : For the grades listed in Table 7, the proof strength at elevated temperature shall be verified. The test temperature shall be specified at the time of enquiry and order.

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Table 6 — Mechanical properties

Steel grade		Upper yield strength or proof strength ReH or R _{p0,2} min. for wall thicknesses T in mm N/mm ²				Tensile strength Rm for wall thicknesses T in mm N/mm ²			Elongation A min. %	
Name	Number	T ≤ 16	16 < T ≤ 40	40 < T ≤ 60	60 < T ≤ 100	T ≤ 16	16 < T ≤ 60	60 < T ≤ 100	Longitudinal	Transverse
P235TR2	1.0255	235	225	215	-	360-500	360-500	-	25	23
P265TR2	1.0259	265	255	245	-	410-570	410-570	-	21	19
P235GH	1.0345	235	225	215	-	360-500	360-500	-	25	23
P265GH	1.0425	265	255	245	-	410-570	410-570	-	23	21
16Mo3	1.5415	280	270	260	-	450-600	450-600	-	22	20
10CrMo5-5	1.7338	275	275	265	-	410-560	410-560	-	22	20
13CrMo4-5	1.7335	290	290	280	-	440-590	440-590	-	22	20
10CrMo9-10	1.7380	280	280	270	-	480-630	480-630	-	22	20
X11CrMo5+I	1.7362	175	175	175	175	430-580	430-580	430-580	22	20
X11CrMo5+NT1	1.7362	280	280	280	280	480-640	480-640	480-640	20	18
X11CrMo5+NT2	1.7362	390	390	390	390	570-740	570-740	570-740	18	16
X11CrMo9-1+ I	1.7386	210	210	210	-	460-640	460-640	-	20	18
X11CrMo9-1+NT	1.7386	390	390	390	-	590-740	590-740	-	18	16
X10CrMoV Nb9-1	1.4903	450	450	450	450	630-830	630-830	630-830	19	17
P355N	1.0562	355	345	325	305	490-650	490-630	450-590	22	20
P355NH	1.0562									
P355NL1	1.0566	355	345	325	305	490-650	490-630	450-590	22	20
P215NL	1.0451	215 ^a	-	-	-	360-480	360-480	-	25	23
P265NL	1.0453	265	265 ^b	-	-	410-570	410-570	-	24	22
12Ni14	1.5637	345	345	-	-	440-590	440-590	-	22	20
X10Ni9	1.5682	510	510	-	-	690-840	690-840	-	20	18
L290NB	1.0484	290-440	290-440	-	-	≥ 415	-	-	23	21
L360NB	1.0582	360-510	360-510	-	-	≥ 460	-	-	22	20
L360QB	1.8948	360-510	360-510	-	-	≥ 460	-	-	22	20
L415NB	1.8972	415-565	415-565	-	-	≥ 520	≥ 520	-	20	18
L415QB	1.8947	415-565	415-565	-	-	≥ 520	≥ 520	-	20	18
L450QB	1.8952	450-570	450-570	-	-	≥ 535	≥ 535	-	20	18
For wall thicknesses equal to or smaller than 10 mm.										
For wall thicknesses equal to or smaller than 25 mm.										

Table 7 — Minimum proof strength $R_{p0,2}$ at elevated temperature

Grade		Minimum proof strength R _{p0,2} N/mm ² at temperature of (°C)										
		100	150	200	250	300	350	400	450	500	550	600
P235GH		198	187	170	150	132	120	112	108	-	-	-
P265GH		226	213	192	171	154	141	134	128	-	-	-
16Mo3		243	237	224	205	173	159	156	150	146	-	-
10CrMo5-5		240	228	219	208	165	156	148	144	143	-	-
13CrMo4-5		264	253	245	236	192	182	174	168	166	-	-
10CrMo9-10		249	241	234	224	219	212	207	193	180	-	-
X11CrMo5+I		156	150	148	147	145	142	137	129	116	-	-
X11CrMo5+NT1		245	237	230	223	216	206	196	181	167	-	-
X11CrMo5+NT2		366	350	334	332	309	299	289	280	265	-	-
X11CrMo9-1+I		187	186	178	177	175	171	164	153	142	120	-
X11CrMo9-1+NT		363	348	334	330	326	322	316	311	290	235	-
X10CrMoV Nb9-1		410	395	380	370	360	350	340	320	300	270	215
P355NH	T ≤ 16	304	284	255	235	216	196	167	-	-	-	-
	16 < T ≤ 40	294	275	255	235	216	196	167	-	-	-	-
	40 < T ≤ 60	284	265	245	226	206	186	157	-	-	-	-
	60 < T ≤ 100	265	245	226	206	186	167	137	-	-	-	-

Table 8 — Minimum tensile strength values at elevated temperature for grade P355NH

Temperature in °C	Rm for wall thickness T in mm			
	T ≤ 30	30 < T ≤ 50	50 < T ≤ 80	80 < T ≤ 100
100	440	420	400	390
150	430	410	390	380
200	410	390	370	360
250	410	390	370	360
300	410	390	370	360
350	400	380	360	350
400	390	370	350	340

Table 9 — Impact properties

Grade		Minimum average absorbed energy KV, in J											
		longitudinal direction						transverse direction					
		at a temperature of (°C)											
-50	-40	-20	-10	0	20	-50	-40	-20	-10	0	20		
P235TR2		-	-	-	-	40	-	-	-	-	27	-	
P265TR2		-	-	-	-	40	-	-	-	-	27	-	
P235GH		-	-	-	-	40	-	-	-	-	27	-	
P265GH		-	-	-	-	40	-	-	-	-	27	-	
16Mo3		-	-	-	-	-	40	-	-	-	-	27	
10CrMo5-5		-	-	-	-	-	40	-	-	-	-	27	
13CrMo4-5		-	-	-	-	-	40	-	-	-	-	27	
10CrMo9-10		-	-	-	-	-	40	-	-	-	-	27	
X11CrMo5		-	-	-	-	-	40	-	-	-	-	27	
X11CrMo9-1		-	-	-	-	-	40	-	-	-	-	27	
X10CrMoVNb9-1		-	-	-	-	-	40	-	-	-	-	27	
P355N P355NH		-	-	40	43	47	55	-	-	27	31	35 39	
P355NL1		-	40	53	60	65	70	-	27	35	39	43 47	
P215NL		-	40	45	-	-	55	-	-	-	-	-	
P265NL		-	40	45	-	-	50	-	27	30	-	35	
12Ni14 ^a	T ≤ 25	55	55	60	-	-	65	35	40	45	45	45	
	25 < T ≤ 40	50	50	55	-	-	65	30	35	40	40	45	
X10Ni9 ^a		70	70	70	-	-	70	50	50	50	50	50	
L290NB		-	-	-	-	60	-	-	-	-	40	-	
L360NB		-	-	-	-	60	-	-	-	-	40	-	
L360QB		-	-	-	-	60	-	-	-	-	40	-	
L415NB		-	-	-	-	60	-	-	-	-	40	-	
L415QB		-	-	-	-	60	-	-	-	-	40	-	
L450QB		-	-	-	-	60	-	-	-	-	40	-	
For lower temperatures, the applicable values are those of the corresponding grade in EN 10216-4.													

9.4 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.

10 Appearance and internal soundness

10.1 The fittings shall be free from surface defects as can be established by visual inspection in accordance with this European Standard.

10.2 The 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.

10.3 It shall be permissible to dress by grinding or machining surface marks or imperfections provided that the wall thickness of the fitting after dressing does not fall below the minimum permitted wall thickness.

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

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

10.6 The manufacturer shall explore by grinding a sufficient number of surface marks and imperfections identified during visual inspection to provide assurance that these have been evaluated to ensure compliance with 10.7.

10.7 The manufacturer shall, subject to the limitations given in 10.8 and 10.10, dress surface marks and imperfections found by exploration in accordance with 10.6 to be deeper than 5 % of the specified wall thickness or 3 mm, whichever is the lesser, but not less than 0,5 mm.

10.8 If surface imperfections acceptable under 10.7 are not scattered and appear over a large area in excess of what is considered to be an acceptable surface condition then fittings shall be rejected or alternatively subjected to dressing as agreed between purchaser and manufacturer.

10.9 Repairs to fittings shall only be carried out by grinding or machining, and hammering is not permitted. Welding as a mean of repair may be only be carried out in specific instances agreed between manufacturer and purchaser.

10.10 Score marks (linear mechanical scratches) shall not have a depth greater than 1,6 mm or 12,5 % of the nominal wall thickness, whichever is the smaller, provided that the bottom of the marks are rounded and not sharp. Excessive numbers of score marks, even within these limits, may constitute an unacceptable condition, and is dependent upon agreement between manufacturer and purchaser.

Sharp bottom scores shall be considered as defects and treated in accordance with 10.7.

10.11 Localised or generalised scale up to 0,8 mm thick is permissible provided the scale is tightly adherent to the fitting and does not readily flake off.

11 Dimensions and tolerances

11.1 Dimensions

11.1.1 General

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.

11.1.2 Elbows

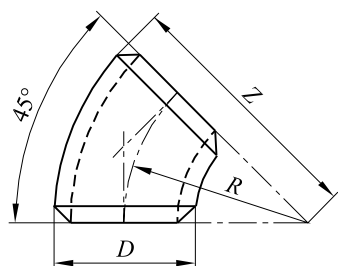


Figure 1 — 45° elbow

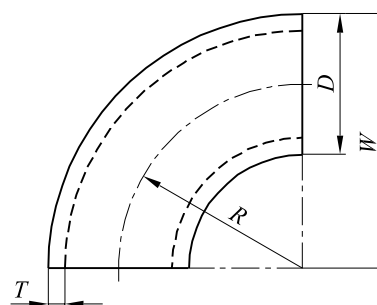


Figure 2 — 90° elbow

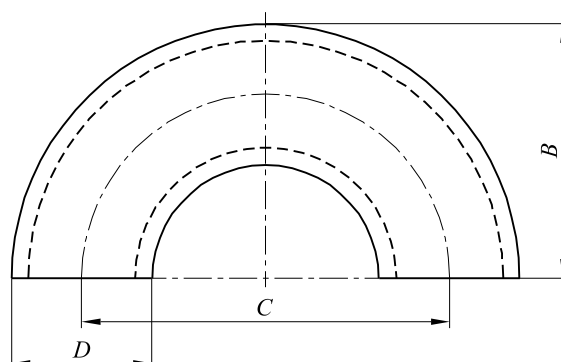


Figure 3 — Return bend

Elbows and return bends are produced according to Figures 1, 2 and 3 (45° - 90° - 180°). Specific dimensions are listed in Tables 10, 11 and 12.

The values given for W and Z in addition to those for R have been calculated from the values of R and shall be used to verify conformance of the elbow because measurement of R is not possible in practice.

Table 10 — Elbows model 2D — Dimensions

Dimensions in millimetres

<i>DN</i>	<i>D</i>	<i>R</i>	<i>C</i>	<i>B - W</i>
15	21,3	25	50	36
20	26,9	25	50	39
25	33,7	25	50	42
32	42,4	32	64	53
40	48,3	38	76	62
50	60,3	51	102	81
65	76,1	63	127	102
80	88,9	76	152	121
100	114,3	102	203	159
125	139,7	127	254	197
150	168,3	152	305	237
200	219,1	203	406	313
250	273	254	508	391
300	323,9	305	610	467
350	355,6	356	711	533
400	406,4	406	813	610
450	457	457	914	686
500	508	508	1 016	762
550	559	559	1 118	838
600	610	610	1 220	914
650	660	660	1 320	990
700	711	711	1 422	1 066
750	762	762	1 524	1 143
800	813	813	1 626	1 220
850	864	864	1 728	1 296
900	914	914	1 828	1 371
1 000	1 016	1 016	2 032	1 524
1 050	1 067	1 067	2 134	1 600
1 100	1 118	1 118	2 236	1 677
1 150	1 166	1 166	2 332	1 749
1 200	1 219	1 219	2 438	1 830

Table 11 — Elbows model 3D — Dimensions

Dimensions in millimetres

<i>DN</i>	<i>D</i>	<i>R</i>	<i>C</i>	<i>B – W – Z</i>
15	21,3	38	76	49
20	26,9	38	76	51
25	33,7	38	76	56
	38	45	90	64
32	42,4	48	96	69
40	48,3	57	114	82
	51	63	126	88
	57	72	144	100
50	60,3	76	152	106
	70	92	184	127
65	76,1	95	190	133
80	88,9	114	228	159
	101,6	133	267	184
	108	142,5	285	196
100	114,3	152	304	210
	133	181	362	247
125	139,7	190	380	260
	159	216	432	295
150	168,3	229	457	313
	193,7	270	540	367
200	219,1	305	610	414
	244,5	340	680	462
250	273	381	762	518
300	323,9	457	914	619
350	355,6	533	1 066	711
400	406,4	610	1 220	813
450	457	686	1 372	914
500	508	762	1 524	1 016
550	559	838	1 676	1 118
600	610	914	1 828	1 219
650	660	990	1 980	1 320
700	711	1 067	2 134	1 422
750	762	1 143	2 286	1 524
800	813	1 219	2 438	1 626
850	864	1 296	2 592	1 728
900	914	1 372	2 744	1 829
1 000	1 016	1 524	3 048	2 032
1 050	1 067	1 600	3 201	2 134
1 100	1 118	1 677	3 354	2 236
1 150	1 168	1 752	3 504	2 336
1 200	1 219	1 829	3 658	2 438

Table 12 — Elbows model 5D — Dimensions

Dimensions in millimetres

<i>DN</i>	<i>D</i>	<i>R</i>	<i>C</i>	<i>B – W – Z</i>
15	21,3	42,5	85	53
20	26,9	57,5	115	71
25	33,7	72,5	145	89
	38	82,5	165	101
32	42,4	92,5	185	114
40	48,3	109,5	219	134
	51	122,5	245	149
	57	130	260	158
50	60,3	137,5	275	168
	70	160	320	195
65	76,1	175	350	213
80	88,9	207,5	415	252
	101,6	235	470	286
	108	253	506	306
100	114,3	270	540	327
	133	311,5	623	378
125	139,7	330	660	400
	159	375	750	454
150	168,3	390	780	474
200	219,1	515	1030	624
	244,5	580	1160	702
250	273	650	1300	786
300	323,9	770	1540	932
350	355,6	850	1700	1 028
400	406,4	970	1940	1 173
450	457	1 122	2 244	1 350
500	508	1 245	2 490	1 500
550	559	1 398	2 796	1 677
600	610	1 525	3 050	1 830
650	660	1 650	3 300	1 980
700	711	1 778	3 556	2 133
750	762	1 905	3 810	2 286
800	813	2 033	4 066	2 439
850	864	2 155	4 310	2 587
900	914	2 285	4 570	2 742
1 000	1 016	2 540	5 080	3 048
1 050	1 067	2 665	5 335	3 201
1 100	1 118	2 790	5 580	3 354
1 150	1 168	2 915	5 830	3 504
1 200	1 219	3 050	6 100	3 657

11.1.3 Tees

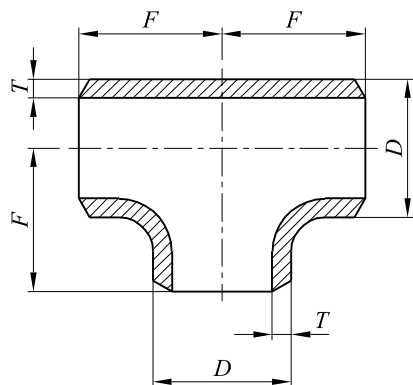


Figure 4 — Equal tee

Equal tees are produced in accordance with Figure 4. Specific dimensions are listed in Table 13.

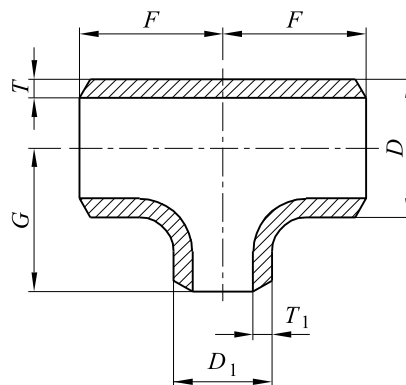


Figure 5 — Reducing tee

Reducing tees are produced in accordance with Figure 5. Specific dimensions are listed in Table 14.

Table 13 — Equal Tees — Dimensions

Dimensions in millimetres

<i>DN</i>	<i>D</i>	<i>F</i>
15	21,3	25
20	26,9	29
25	33,7	38
32	42,4	48
40	48,3	57
50	60,3	64
65	76,1	76
80	88,9	86
90	101,6	95
100	114,3	105
125	139,7	124
150	168,3	143
200	219,1	178
250	273	216
300	323,9	254
350	355,6	279
400	406,4	305
450	457	343
500	508	381
550	559	419
600	610	432
650	660	495
700	711	521
750	762	559
800	813	597
850	864	635
900	914	673
1 000	1 016	749
1 050	1 067	762 ^a
1 100	1 118	813 ^a
1 150	1 166	851 ^a
1 200	1 219	889 ^a

^a For these dimensions, the length of the outlet branch is not equal to the length of the run *F*. The applicable values for the length of the outlet branch are respectively : 711 for *DN* 1050, 762 for *DN* 1100, 800 for *DN* 1150 and 838 for *DN* 1200.

Table 14 — Reducing Tees — Dimensions

Dimensions in millimetres

Side <i>D</i>		Side <i>D</i> ₁			
<i>DN</i>	<i>D</i>	<i>DN</i> ₁	<i>D</i> ₁	<i>F</i>	<i>G</i>
20	26,9	15	21,3	29	29
25	33,7	15	21,3	38	38
		20	26,9		
32	42,4	15	21,3	48	48
		20	26,9		
		25	33,7		
40	48,3	15	21,3	57	57
		20	26,9		
		25	33,7		
		32	42,4		
50	60,3	20	26,9	64	44
		25	33,7		51
		32	42,4		57
		40	48,3		60
65	76,1	25	33,7	76	57
		32	42,4		64
		40	48,3		67
		50	60,3		70
80	88,9	32	42,4	86	70
		40	48,4		73
		50	60,3		76
		65	76,1		83
100	114,3	40	48,3	105	86
		50	60,3		89
		65	76,1		95
		80	88,9		98
125	139,7	50	60,3	124	105
		65	76,1		108
		80	88,9		111
		100	114,3		117
150	168,3	65	76,1	143	121
		80	88,9		124
		100	114,3		130
		125	139,7		137
200	219,1	100	114,3	178	156
		125	139,7		162
		150	168,3		168
250	273,1	100	114,3	216	184
		125	139,7		191
		150	168,3		194
		200	219,1		203
300	323,9	150	168,3	254	219
		200	219,1		229
		250	273		241

Table 14 (continued)

Side <i>D</i>		Side <i>D</i> ₁			
<i>DN</i>	<i>D</i>	<i>DN</i> ₁	<i>D</i> ₁	<i>F</i>	<i>G</i>
350	355,6	150	168,3	279	238
		200	219,1		248
		250	273		257
		300	323,9		270
400	406,4	150	168,3	305	264
		200	219,1		273
		250	273		283
		300	323,9		295
		350	355,6		305
450	457	200	219,1	343	298
		250	273		308
		300	323,9		321
		350	355,6		330
		400	406,4		330
500	508	250	273	381	333
		300	323,9		346
		400	406,4		356
		450	457,0		368
550	559	250	273	419	359
		300	323,9		371
		400	406,4		381
		500	508,0		406
600	610	250	273	432	384
		300	323,9		397
		400	406,4		406
		500	508,0		432
650	660	300	323,9	495	422
		350	355,6		432
		400	406,4		432
		500	508		457
700	711	300	323,9	521	448
		400	406,4		457
		500	508,0		483
		600	610,0		508
750	762	400	406,4	559	483
		500	508,0		508
		600	610,0		533
800	813	400	406,4	602	508
		500	508,0		533
		600	610,0		559
		700	711,0		572
850	864	400	406,4	635	533
		500	508,0		559
		600	610,0		584
		700	711,0		597

Table 14 (continued)

Side D		Side D_1			
DN	D	DN_1	D_1	F	G
900	914	400	406,4	673	559
		500	508,0		584
		600	610,0		610
		700	711,0		622
		800	813,0		648
1 000	1 016	600	610,0	749	660
		700	711,0		673
		800	813,0		711
		900	914,0		737
1 050	1 067	600	610,0	762	660
		700	711,0		698
		800	813,0		711
		900	914,0		711
1 100	1 118	600	610,0	813	698
		700	711,0		698
		800	813,0		711
		900	914		724
1 200	1 219	700	711,0	889	762
		800	813,0		787
		900	914,0		787
		1 000	1 016,0		813

11.1.4 Reducers

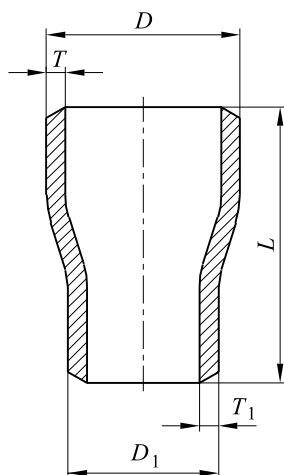


Figure 6 — Concentric reducer

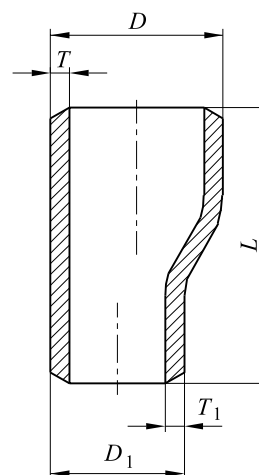


Figure 7 — Eccentric reducer

Concentric and eccentric reducers are produced in accordance respectively with Figures 6 and 7. Specific dimensions are listed in Table 15.

Table 15 — Reducers — Dimensions

Dimensions in millimetres

Side D		Side D_1		
DN	D	DN_1	D_1	Length L
20	26,9	15	21,3	38
25	33,7	20	26,9	51
		15	21,3	51
32	42,4	25	33,7	51
		20	26,9	51
		15	21,3	51
40	48,3	32	42,4	64
		25	33,7	64
		20	26,9	64
50	60,3	40	48,3	76
		32	42,4	76
		25	33,7	76
		20	26,9	76
65	76,1	50	60,3	89
		40	48,3	89
		32	42,4	89
		25	33,7	89
80	88,9	65	76,1	89
		50	60,3	89
		40	48,3	89
		32	42,4	89
100	114,3	80	88,9	102
		65	76,1	102
		50	60,3	102
		40	48,3	102
125	139,7	100	114,3	127
		80	88,9	127
		65	76,1	127
		50	60,3	127
150	168,3	125	139,7	140
		100	114,3	140
		80	88,9	140
		65	76,1	140
200	219,1	150	168,3	152
		125	139,7	152
		100	114,3	152
		80	88,9	152

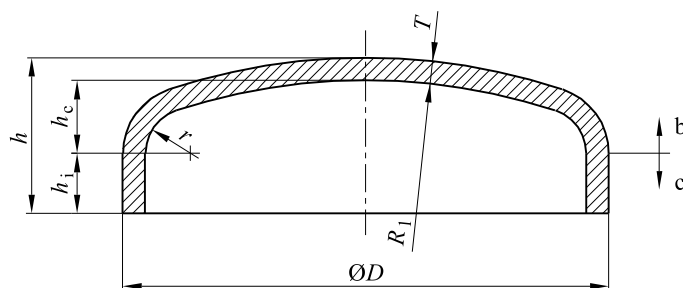
Table 15 (continued)

Side D		Side D_1		
DN	D	DN_1	D_1	Length L
250	273	200	219,1	178
		150	168,3	178
		125	139,7	178
		100	114,3	178
300	323,9	250	273	203
		200	219,1	203
		150	168,3	203
		125	139,7	203
350	355,6	300	323,9	330
		250	273	330
		200	219,1	330
		150	168,3	330
400	406,4	350	355,6	356
		300	323,9	356
		250	273	356
		200	219,1	356
450	457	400	406,4	381
		350	355,6	381
		300	323,9	381
		250	273	381
500	508	450	457	508
		400	406,4	508
		350	355,6	508
		300	323,9	508
550	559	500	508	508
		450	457	508
		400	406,4	508
		350	355,6	508
600	610	550	559	508
		500	508	508
		450	457	508
		400	406,4	508
700	711	600	610	610
		500	508	610
		450	457	610
800	813	700	711	610
		600	610	610
		550	559	610
		500	508	610

Table 15 (continued)

Side D		Side D_1		Length L
DN	D	DN_1	D_1	
900	914	800	813	610
		700	711	610
		600	610	610
1 000	1 016	900	914	610
		800	813	610
		700	711	610
1 200	1 219	1 000	1 016	711
		900	914	711
		800	813	711

11.1.5 Caps



Key

- R_1 approximately equal to $0,8 D$
 r approximately equal to $0,15 D$

Figure 8 — Cap

NOTE Some of the listed dimensions don't comply with all technical regulations, e.g. according to EN 13480-3 (see B.5). Nevertheless they are standard on the market. In these cases, it is essential that the dimensions be agreed.

Table 16 — Caps — Dimensions

Dimensions in millimetres

<i>DN</i>	<i>D</i>	<i>k</i>
15	21,3	25
20	26,9	25
25	33,7	25
32	42,4	38
40	48,3	38
50	60,3	38
65	76,1	38
80	88,9	51
	101,6	64
100	114,3	64
125	139,7	76
150	168,3	89
200	219,1	102
250	273,1	127
300	323,9	152
350	355,6	165
400	406,4	178
450	457	203
500	508	229
550	559	254
600	610	267
650	660	267
700	711	267 for $T \leq 25$
		290
750	762	267 for $T \leq 20$
		310
800	813	267 for $T \leq 17,5$
		330
850	864	267 for $T \leq 14$
		350
900	914	267 for $T \leq 10$
		370
1 000	1 016	305 for $T \leq 14,2$
		420
1 050	1 067	305 for $T \leq 13$
		405
1 100	1 118	343 for $T \leq 12$
		390
1 150	1 166	343 for $T \leq 11$
		375
1 200	1 219	343 for $T \leq 10$
		360

11.1.6 Preferred diameters and wall thicknesses

Preferred diameters and wall thicknesses have been selected to match with tube dimensions described in EN 10220 and are listed in Table 17.