

Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, Class designated —

Part 1: Steel flanges, NPS 1/2 to 24

The European Standard EN 1759-1:2004 has the status of a British Standard

ICS 23.040.60

National foreword

This British Standard is the official English language version of EN 1759-1:2004. It supersedes BS 1560-3.1:1989 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PSE/15, Flanges, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

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

Cross-references

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Brides et leurs assemblages - Brides circulaires pour tubes,
appareils de robinetterie, raccords et accessoires,
désignées Class - Partie 1 : Brides en acier NPS 1/2 à 24

Flansche und ihre Verbindungen - Runde Flansche für
Rohre, Armaturen, Formstücke und Zubehörteile, nach
Class bezeichnet - Teil 1: Stahlflansche, NPS 1/2 bis 24

This European Standard was approved by CEN on 30 September 2004.

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Foreword

This document (EN 1759-1:2004) has been prepared by Technical Committee CEN/TC 74 "Flanges and their joints" the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by May 2005, and conflicting national standards shall be withdrawn at the latest by May 2005.

EN 1759 consists of the following parts:

- Part 1: Steel flanges;
- Part 3: Copper alloy flanges¹;
- Part 4: Aluminium alloy flanges¹.

This document includes a Bibliography.

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

¹ To be published

Introduction

When Technical Committee, CEN/TC 74, commenced its work of producing this European standard it took as its basis, the International Standard, ISO 7005-1, Steel flanges.

In taking this decision, CEN/TC 74, agreed that this standard would differ significantly from the ISO standard in respect of the following:

- a) Whereas ISO 7005-1 included in its scope both the original DIN based flanges and also the original ANSI/ASME based flanges, EN 1759-1 contains only the flanges with ANSI/ASME origin (ASME B16.5). CEN/TC 74 has produced a separate series of standards, EN 1092 Parts 1, 2, 3 and 4, dealing with the DIN based flanges in PN designations;
- b) In this standard, the flanges are Class designated (not PN designated as in the ISO standard) and those dimensions taken from ASME B16.5 are hard metricated.

Consequently, whilst the mating dimensions, the flange and facing types and designations are compatible with those given in ISO 7005-1, it is important to take account of the following differences which exist in EN 1759-1:

- 1) The use of inch bolting requires the use of suitable gaskets, not necessarily compatible with the gaskets used with ISO 7005-1 flanges (for metric bolts).
- 2) This standard specifies grades of ASTM steels similar to those specified in ISO 7005-1, but in addition permits the use of grades of European steels according to EN 1092-1;

1 Scope

This European Standard for a single system of flanges specifies requirements for circular steel flanges in Class designations Class 150 to Class 2 500 and nominal sizes from NPS ½ to NPS 24.

NOTE The relationship between nominal size (DN) and nominal size (NPS) is given for reference purposes in Tables 9 to 14.

This standard specifies the flange types and their facings, dimensions, tolerances, threading, bolt sizes, flange jointing face surface finish, marking, materials and pressure/temperature ratings.

This standard does not apply to flanges made from bar stock by turning, or to flanges of types 11, 12, 13, 14 and 15 made from plate material.

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 1515-1, *Flanges and their joints — Bolting — Part 1: Selection of bolting*

prEN 1515-3, *Flanges and their joints — Bolting — Part 3: Classification of bolt materials for steel flanges, class designated*

EN 10025, *Hot rolled products of non-alloy structural steels — Technical delivery conditions*

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 10028-7, *Flat products made of steels for pressure purposes — Part 7: Stainless steels*

EN 10213-2, *Technical delivery conditions for steel castings for pressure purposes — Part 2: Steel grades for use at room temperature and elevated temperatures*

EN 10213-3, *Technical delivery conditions for steel castings for pressure purposes — Part 3: Steel grades for use at low temperatures*

EN 10213-4, *Technical delivery conditions for steel castings for pressure purposes — Part 4: Austenitic and austenitic-ferritic steel grades*

EN 10222-2, *Steel forgings for pressure purposes — Part 2: Ferritic and martensitic steels with specified elevated temperature properties*

EN 10222-3, *Steel forgings for pressure purposes — Part 3: Nickel steels with specified low temperature properties*

EN 10222-4, *Steel forgings for pressure purposes — Part 4: Weldable fine grain steels with high proof strength*

EN 10222-5, *Steel forgings for pressure purposes - Part 5: Martensitic, austenitic and austenitic-ferritic stainless steels*

EN ISO 887, *Plain washers for metric bolts, screws and nuts for general purposes - General plan (ISO 887:2000)*

EN ISO 6708, *Pipe components — Definition and selection of DN (nominal size) (ISO 6708:1999)*

ISO 4955, *Heat-resisting steels and alloys*

ISO 4991, *Steel castings for pressure purposes*

ISO 9327-1, *Steel forgings and rolled or forged bars for pressure purposes — Technical delivery conditions —Part 1: General requirements*

ISO 9327-2, *Steel forgings and rolled or forged bars for pressure purposes —Technical delivery conditions — Part 2: Non-alloy and alloy (Mo, Cr and CrMo) steels with specified elevated temperature properties*

ISO 9328-2, *Steel flat products for pressure purposes — Technical delivery conditions —Part 2: Non-alloy and alloy steels with specified elevated temperature properties*

ISO 9328-3, *Steel flat products for pressure purposes — Technical delivery conditions — Part 3: Weldable fine grain steels, normalized*

ISO 9328-5, *Steel flat products for pressure purposes — Technical delivery conditions — Part 5: Weldable fine grain steels, thermomechanically rolled*

ASME B16.5: 1996 *Pipe flanges and flanged fittings — NPS ½ through NPS 24*

ASME/ANSI B1.20.1, *Pipe threads, general purpose (inch)*

ASTM A105/A105M, *Forgings, Carbon Steel, for Piping Component*

ASTM A182/A182M, *Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service*

ASTM A203/A203M, *Pressure Vessel Plates, Alloy Steel, Nickel*

ASTM A204/A204M, *Specification for pressure vessel plates, alloy steel, molybdenum*

ASTM A216/A216M, *Steel Castings, Carbon Suitable for Fusion Welding for High-Temperature Service*

ASTM A217/A217M, *Steel Castings, Martensitic Stainless and Alloy, for Pressure-Containing Parts Suitable for High-Temperature Service*

ASTM A240/A240M, *Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels*

ASTM A325, *High-Strength Bolts for Structural Steel Joints*

ASTM A350/A350M, *Forgings, Carbon and Low-Alloy Steel, Requiring Notch Toughness Testing for Piping Components*

ASTM A351/A351M, *Castings, Austenitic, Austenitic-Ferritic (Duplex) for Pressure-Containing Parts*

ASTM A352/A352M, *Steel Castings, Ferritic and Martensitic, for Pressure-Containing Parts Suitable for Low-Temperature Service*

ASTM A387/A387M, *Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum*

ASTM A515/A515M, *Pressure Vessel Plates, Carbon Steel, for Intermediate and Higher-Temperature Service*

ASTM A516/A516M, *Pressure Vessel Plates, Carbon Steel, for Moderate and Lower-Temperature Service*

ASTM A537/A537M, *Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon Steel*

3 Terms and definitions

For the purposes of this European Standard, the following terms and definitions apply.

3.1

Class

alphanumeric designation used for reference purposes related to a combination of mechanical and dimensional characteristics of a component of a pipework system. It comprises the word Class followed by a dimensionless whole number

NOTE 1 The number following the word Class does not represent a measurable value and should not be used for comparison purposes except where specified in the relevant standard.

NOTE 2 The designation Class is not meaningful unless it is related to the relevant component standard number.

NOTE 3 It is intended that all components with the same Class and NPS (see below) designations should have the same mating dimensions for compatible flange types.

3.2

DN

see EN ISO 6708

3.3

NPS

alphanumeric designation of size for components of a pipework system, which is used for reference purposes. It comprises, for the purpose of Class designated flanges according to this standard, the letters NPS followed by a dimensionless number which is indirectly related to the physical size of the bore or outside diameter of the end connections

NOTE The number following the letters NPS does not represent a measurable value and should not be used for calculation purposes except where specified in the relevant standard.

3.4

maximum allowable pressure, *PS*

means the maximum pressure for which the equipment is designed, as specified by the equipment manufacturer

3.5

maximum allowable temperature, *TS*

means the maximum temperature for which the equipment is designed, as specified by the equipment manufacturer

4 Designation

4.1 General

Table 1 and Figure 1 show the flange types and their relevant type numbers. Flanges shall be denoted with "flange type" and "flange number".

Figure 2 shows flange facing types, which may be used with the flanges shown in Figure 1. Flange facings shall be denoted with "type" and the relevant symbol.

The range of NPS, applicable to each flange type and each Class designation shall be as given in Table 2.

4.2 Information to be supplied by the equipment manufacturer

The following information should be supplied by the equipment manufacturer in the enquiry and/or order.

Flanges and ancillary components in accordance with this standard shall be designated with the following:

- a) Designation, e.g. flange, lapped or collar;
- b) Number of this standard, EN 1759-1;
- c) Flange type number (see Table 1);
- d) Facing type number (see Figure 2);
- e) Nominal size (NPS or DN);
- f) Class designation followed by the appropriate number;
- g) The bore for weld-neck (type 11) and hubbed slip-on (type 12) flanges, if different from those specified in this standard (see notes to Tables of flange dimensions).
- h) Weld end preparation required (see Annex A);

- i) Either the symbol or the number or the grade of the material (see 5.1 and Tables 3a and 3b);
- j) Any heat treatment required
- k) Material certificate, if required (see 5.1.1);

EXAMPLE 1

Designation of a flange type 01 with facing type A of nominal size DN 400 and Class number 150, made of material of group 1.1

Flange EN 1759-1 / 01 / A/DN 400 / Class 150 / material group 1.1

EXAMPLE 2

Designation of a flange type 05 with facing type C of nominal size NPS 6 and Class number 600, made of material ASTM A105 with certificate 3.1B

Flange EN 1759-1 / 05 / C / NPS 6 / Class 600 / A105 / 3.1B

EXAMPLE 3

Designation of a flange type 11 with facing type B of nominal size DN 300 and Class number 900, bore B3 = 298 mm, made of material of group 6E0

Flange EN 1759-1 / 11 / B / DN 300 / Class 900 / 298 / material group 6E0

5 General requirements

5.1 Flange materials

5.1.1 General

Flanges shall be manufactured from materials given in Tables 3a and 3b. Flanges type 11, 12, 13, 14, 15 and 21 shall be made from forgings. Flanges type 21 shall be made from forgings or steel castings.

NOTE The materials given in Tables 3a and 3b are tabulated in groups having common pressure/temperature ratings as given in Tables 16 to 22.

The flange manufacturer shall provide documentation to ensure traceability of material. An equipment manufacturer may require a material certificate in accordance with EN 10204, which is suitable for the category of equipment to which the flange is fitted.

5.1.2 Non alloy steels

The carbon content by ladle analysis of the materials specified in Tables 3a and 3b shall not exceed 0,23 % for plate and for forgings and 0,25 % for castings.

The steel manufacturer shall ensure on a basis of regular production checks that the carbon equivalent (CEV) by cast analysis does not exceed 0,45 % where:

$$CEV = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$$

NOTE The above carbon equivalents do not apply to flange types 01, 05 and 21 manufactured from plate material.

5.2 Repairs

No repair welding shall be permitted without prior approval of the equipment manufacturer and when prohibited by the applicable material standard.

Where permitted, repair welding shall be carried out by a proven method and shall be in accordance with a written procedure.

Material repaired by welding shall be marked with the letter W following the specification number.

NOTE For approval of welding procedures, see EN ISO 15607. For approval of welders, see EN 287-1.

5.3 Bolting

5.3.1 General

Flanges shall be suitable for use with the nominal size and number of bolts specified in Tables 9 to 14 as appropriate.

The bolting shall be chosen according to the pressure, temperature, flange material and gasket so that the flanged joint remains tight under the expected operating conditions.

5.3.2 Selection of bolting

For selection of bolting, see EN 1515-1, for classification of bolting materials see prEN 1515-3 and Annex B.

Bolting of other materials should be chosen according to the parameters above.

NOTE For use of metric bolting see Annex C.

5.4 Gaskets

The various gasket types, dimensions, design characteristics and materials used are not within the scope of this standard. Dimensions of gaskets are given in EN 12560 Parts 1 to 7.

5.5 Pressure/temperature (p/T) ratings

The pressure/temperature ratings of the flanges manufactured from the materials specified in Tables 3a and 3b shall be as given in Tables 16, 17, 18, 19, 20, 21 and 22 for the applicable materials, and shall not exceed the value of the Class shown.

NOTE 1 Linear interpolation is permitted for intermediate temperatures.

NOTE 2 The pressure/temperature ratings of flanges depend upon the properties of the materials specified in Tables 3a and 3b.

For determination of p/T ratings for EN materials see Annex D.

5.6 Dimensions

5.6.1 Flanges

The dimensions of flanges shall be as given in Tables 9 to 14, and as qualified by 5.8 and the notes to Tables 9 to 14, if appropriate. The diameter of shoulder, dimension G , may be varied from the given value (see note 2), which is a maximum limit.

NOTE 1 The equipment manufacturer should specify in the enquiry and/or order if dimensions of flanges are to be affected by 5.8 and/or the notes to Tables 9 to 14.

NOTE 2 The centre portion of the face of a blank flange (type 05) need not be machined provided that the diameter of the unmachined portion does not exceed the recommended shoulder diameter, G , given in Tables 9 to 14.

NOTE 3 A summary of the various types of flanges specified showing the nominal sizes applicable to each type and to each class is given in Table 2.

5.6.2 Hubs

The hubs of slip-on for welding (type 12) and threaded (type 13) flanges shall be either:

- a) parallel; or
- b) have a draft angle of not exceeding 7° on the outside surface for forging or casting purposes.

For details of the weld preparation for weld-neck flanges (type 11) see Annex A.

5.6.3 Threaded flanges

5.6.3.1 The threads of hubbed threaded flanges (type 13) shall be taper according to ASME/ANSI B1.20.1.

5.6.3.2 The thread shall be concentric with the axis of the flange and misalignments shall not exceed 5 mm per metre.

Class 150 flanges shall be manufactured without a counterbore, but to protect the thread they shall be chamfered to the major diameter of the thread at the hubbed side of the flange, at an angle between 30° and 50° with the axis of the thread. The chamfer shall be concentric with the thread and shall be included in the measurement of the thread length provided that the chamfer does not exceed one pitch in length.

Class 300, 600, 900, 1 500 and 2 500 flanges shall be provided with a counterbore as indicated in Tables 10 to 14 and the thread shall be chamfered to an angle between 30° and 50° at the bottom of the counterbore. The chamfer shall be concentric with the thread and shall have a major diameter equal to that of the counterbore.

5.6.4 Bolt holes

Bolt holes shall be equally spaced on the pitch circle diameter. In the case of type 21 flanges they shall be positioned such that they are symmetrical to the principal axes and such that no holes fall on these axes i.e. positioned "off-centre", see Figures 5 to 12.

5.7 Flange facings

5.7.1 Types of facings

The types of flange facings and flange face designations shall be as given in Figure 2. Dimensions of facings shall be as given in Figures 4, 5, 6, and 7 and Tables 5 and 6.

For facings types B, D and F the transition from the edge of the raised face to the flange face shall be by:

- a) radius; or
- b) chamfer.

5.7.2 Lapped type joints

Facings for lapped type joints (Figure 6) shall be one of the following types:

B, C, D, E, F and J.

The facings shall be in accordance with 5.7.1. The dimension t , indicated in Figure 6 shall be not less than the minimum thickness of the barrel of the stub-end, except that in the case of a spigot or tongue facing, the dimension t shall be not less than 6,4 mm.

5.7.3 Jointing face finish

5.7.3.1 All flange jointing faces shall be machine finished and shall have a surface finish in accordance with the values given in Tables 7 and 8 when compared with reference specimens by visual or tactile means.

NOTE It is not intended that instrument measurements be taken on the faces themselves: the R_a and R_z values as defined in EN ISO 4287 relate to the reference specimens.

5.7.3.2 For flanges with facing types A, B, E and F turning shall be carried out with a round-nosed tool in accordance with Table 7.

5.7.3.3 For tongue and groove and ring-joint facing types C, D and J the gasket contact surfaces shall be machined to produce a surface finish in accordance with Table 8.

5.8 Spot facing or back facing of flanges

Any spot facing or back facing shall not reduce the flange thickness to less than the thickness specified.

When spot facing is used, the diameter shall be large enough to accommodate the outside diameter of the equivalent normal series of washers in accordance with EN ISO 887 for the bolt size being fitted. The bearing surfaces for the bolting shall be parallel to the flange face within the limits given in Table 15.

When a flange is back faced a minimum fillet radius at the hub, R_2 (see Figure 14) in accordance with Table 23, shall be maintained.

5.9 Tolerances

Tolerances on dimensions of flanges shall be as specified in Table 15.

5.10 Marking

5.10.1 Other than integral flanges

All flanges, other than integral shall be marked as follows:

- a) Flange manufacturer's name or trademark, e.g. X;
- b) Number of this standard, i.e. EN 1759-1;
- c) Flange type number, e.g. 11;
- d) Nominal size (DN) or NPS, e.g. DN 150;
- e) Class designation, e.g. Class 150;
- f) Nominal size (DN) or NPS e.g. DN 150 or 6; Bore diameter B if necessary, e.g. 146 mm;
- g) Either material symbol or material number or material group (see Tables 3a and 3b), e.g. A 105;
- h) Cast number of melt identification or suitable quality control number traceable to the cast number, e.g. 12345;
- i) Flanges grooved for standard ring type joints shall be marked with the letter "R" and the corresponding ring number;

EXAMPLE xxx/EN 1759-1/11/DN150//Class 150/146/A105/12345.

For material repaired by welding see 5.2.

5.10.2 Stamping

Where steel stamps are used, the marking shall be positioned on the outer rim of the flange.

NOTE Care should be taken to ensure that steel stamp markings are not liable to cause cracks in the flange material.

5.10.3 Omission of markings

If a flange is too small to enable all the markings required then the minimum marking required shall be:

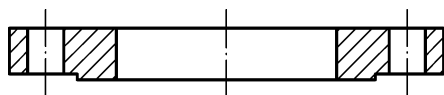
- a) Flange manufacturer's name or trademark;
- b) Letters "EN";
- c) Class designation;
- d) Either the symbol or the number or the grade of the material or the material group;
- e) Cast number or melt identification or suitable control number.

5.10.4 Declaration of compliance

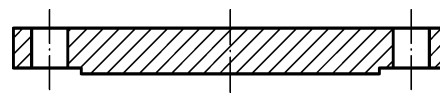
Marking EN 1759-1, together with the flange manufacturer's name or trademark on or in relation to a product represents a flange manufacturer's declaration of compliance, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of this standard.

Table 1 — Types of flange

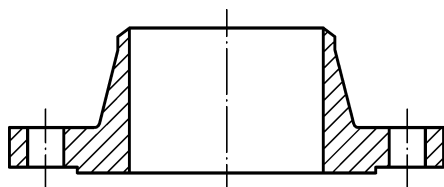
Type no. ^a	Description
01	Plate flange for welding
05	Blank flange
11	Weld-neck flange
12	Hubbed slip-on flange for welding
13	Hubbed threaded flange
14	Hubbed socket-weld flange
15	Loose hubbed flange for lapped pipe end ^b
21	Integral flange
NOTE Flanges and facings may be designated by type number and facing letter or by description as given in Figures 1 and 2 respectively.	
^a Type numbers have been made non-consecutive to permit possible future additions.	
^b Sometimes referred to in industry as lapped flange.	



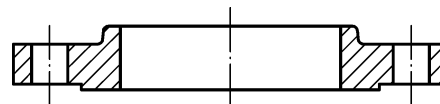
Type 01, Plate flange for welding



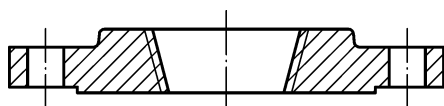
Type 05, Blank flange



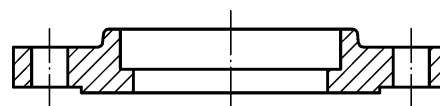
Type 11, Weld-neck flange



Type 12, Hubbed slip-on flange for welding



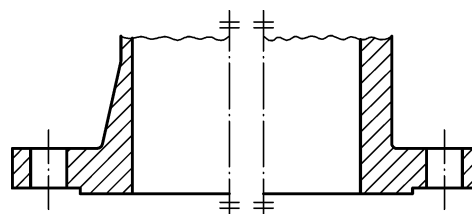
Type 13, Hubbed threaded flange



Type 14, Hubbed socket weld flange



Type 15, Loose hubbed flange for lapped pipe end



Type 21, Integral flange

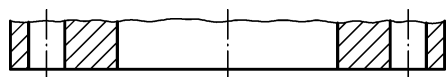
NOTE 1 Types 01 and 05 comprise flanges that do not incorporate hub or weld-neck.

NOTE 2 Types 11 to 15 comprise flanges incorporating a hub or weld-neck and are manufactured from forgings or castings.

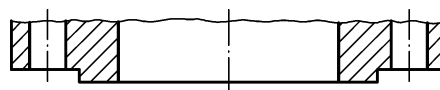
NOTE 3 Type 21 is an integral part of some other equipment or component.

NOTE 4 Flanges are designated by type numbers.

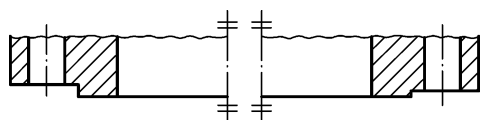
Figure 1 — Flange types



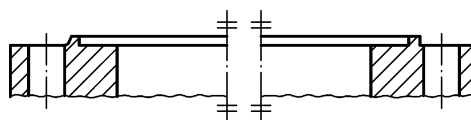
Type A, Flat face



Type E, Spigot



Type B, Raised face



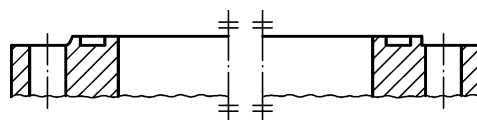
Type F, Recess



Type CL (Large tongue) and type CS (Small tongue)



Type J, Ring-joint



Type DL (Large groove) and type DS (small groove)

NOTE 1 When provided with a 6,4 mm raised face, type B is identical to type E

NOTE 2 Sketches designated A,B,C,D,E,F and J illustrate the various types of flanges which may be used in conjunction with the flanges shown in Figure 1.

NOTE 3 Facings are designated by type letters.

Figure 2 — Facing of types A to F and J

Table 2 — Synoptic table

Flange	Type number	Class	Nominal size, NPS (DN)																		
			½	¾	1	1¼ ^a	1½	2	2½ ^a	3	4	5 ^a	6	8	10	12	14	16	18	20	24
			(15)	(20)	(25)	(32)	(40)	(50)	(65)	(80)	(100)	(125)	(150)	(200)	(250)	(300)	(350)	(400)	(450)	(500)	(600)
Plate	01																				
		150	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Blank	05	150	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		300	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		600	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		900	Use Class 1500							X	X	X	X	X	X	X	X	X	X	X	
		1500	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		2500	X	X	X	X	X	X	X	X	X	X	X	X	X	X					
Weld-neck	11	150	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		300	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		600	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		900	Use Class 1 500							X	X	X	X	X	X	X	X	X	X	X	
		1 500	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		2 500	X	X	X	X	X	X	X	X	X	X	X	X	X	X					
Tabbed on	12	150	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		300	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		600	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		900	Use Class 1 500							X	X	X	X	X	X	X	X	X	X	X	
		1 500	X	X	X	X	X	X	X												

Table 2 (concluded)

Flange	Type number	Class	Nominal size, NPS (DN)																			
			½	¾	1	1¼ ^a	1½	2	2½ ^a	3	4	5 ^a	6	8	10	12	14	16	18	20	24	
			(15)	(20)	(25)	(32)	(40)	(50)	(65)	(80)	(100)	(125)	(150)	(200)	(250)	(300)	(350)	(400)	(450)	(500)	(600)	
Hubbed threaded	13	150	X	X	X	X	X	X	X	X	X	X	X									
		300	X	X	X	X	X	X	X	X	X	X	X									
		600	X	X	X	X	X	X	X	X	X	X	X									
		900	Use Class 1 500								X	X	X									
		1 500	X	X	X	X	X	X	X	X	X	X	X									
		2 500	X	X	X	X	X	X	X	X	X	X	X									
Hubbed socket-weld	14	150	X	X	X	X	X	X	X	X												
		300	X	X	X	X	X	X	X	X												
		600	X	X	X	X	X	X	X	X												
		1 500	X	X	X	X	X	X	X													
Loose hubbed for lapped pipe end	15	150	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
		300	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
		600	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
		900	Use Class 1 500							X	X	X	X	X	X	X	X	X	X	X		
		1 500	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
		2 500	X	X	X	X	X	X	X	X	X	X	X	X	X							
Integral	21	150	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
		300	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
		600	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
		900	Use Class 1 500							X	X	X	X	X	X	X	X	X	X	X		
		1 500	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
		2 500	X	X	X	X	X	X	X	X	X	X	X	X	X							
a. These sizes should be avoided in new constructions																						

Table 3a — Reference standards for ASTM materials

Material group	Description	ASTM specification and grade	Remarks	ISO standard and grade	Remarks
1.1	Casting	ASTM A216 WCB	a, b	ISO 4991 C26-52H	a, b
	Forging	ASTM A105 ASTM A350 LF2	a, b c	ISO 9327-1 F22 F13 F18	a, b c c
	Plate	ASTM A515 70 ASTM A516 70 ASTM A537 CL1	a, b a, d c	ISO 9328-2 PH315 PH355	a, d a, d c
1.2	Casting	ASTM A216 WCC ASTM A352 LC2 LC3 LCC	a, b c c c	ISO 4991 C26-52H, N (+T) C26-52L C43L	a, b c c
	Forging	ASTM A350 LF3	c	ISO 9327-1 F44	c
	Plate	ASTM A203 B E	a, b a, b	ISO 9328-3 12 Ni 14 G1	a, b
1.3	Casting	ASTM A352 LCB	a	ISO 4991 C23-46BL	a
	Plate	ASTM A203 A D ASTM A515 65 ASTM A516 65	a, b a, b a, b a, d	ISO 9328-2 PH290 PH315 ISO 9328-3 12 Ni 14 G1	a, d a, d a, b
1.4	Forging	ASTM A350 LF1	c	ISO 9327-1 F9	c
	Plate	ASTM A515 60 ASTM A516 60	a, b a, d	ISO 9328-2 PH235 PH265 PH290	a, d a, d a, d
1.5	Casting	ASTM A217 WC1 ASTM A325 LC1	b, e c	ISO 4991 C28H	b, e
	Forging	ASTM A182 F1	b, e	ISO 9327-2 F28	b, e
	Plate	ASTM A204 A B	b, e b, e	ISO 9328-2 16 Mo 3	b, e

Table 3a (continued)

Material group	Description	ASTM specification and grade	Remarks	ISO standard and grade	Remarks
1.7	Casting	ASTM A217 WC4 WC5	b f	—	—
	Forging	ASTM A182 F2	b	—	—
	Plate	ASTM A204 C	d	—	—
1.9	Casting	ASTM A217 WC6	g	ISO 4991 C32H	g
	Forging	ASTM A182 F11 F12	h h	—	—
	Plate	ASTM A387 11 CL2	h	—	—
1.10	Casting	ASTM A217 WC9	g	ISO 4991 C34AH	g
	Forging	ASTM A182 F22	g	ISO 9327-2 F34Q	h
	Plate	ASTM A387 22 CL2	h	ISO 9328-2 13 CrMo 9 10 T2	h
1.13	Casting	ASTM A217 C5	—	ISO 4991 C37H	—
	Forging	ASTM A182 F5 F5a	— —	ISO 9327-2 F37	—
1.14	Casting	ASTM A217 C12	—	ISO 4991 C38H	—
	Forging	ASTM A182 F9	—	—	—
2.1	Casting	ASTM A351 CF8 CF3	— j	ISO 4991 C46 C47	j —
	Forging	ASTM A182 F304 F304H	— —	ISO 9327-2 F49	—
	Plate	ASTM A240 304 304H	— j	ISO 9328-5 X 5 CrNi 18 9	—
2.2	Casting	ASTM A351 CF8M CF3M	— d	ISO 4991 C57 C61LC C60 C61	d d d d
	Forging	ASTM A182 F316 F316H	— —	ISO 9327-2 F62 F64	— —
	Plate	ASTM A240 316 317 316H	— — d	ISO 9328-5 X 5 CrNiMo 17 12 — X 7 CrNiMo 17 12	d

Table 3a (concluded)

Material group	Description	ASTM specification and grade	Remarks	ISO standard and grade	Remarks
2.3	Forging	ASTM A182 F304L F316L	j d	ISO 9327-2 F46 F59	— —
	Plate	ASTM A240 304L 316L	j d	ISO 9328-5 X 2 CrNi 18 10 X 2 CrNiMo 17 12 X 2 CrNiMo 17 13	j d d
2.4	Forging	ASTM A182 F321 F321H	b —	ISO 9327-2 F53 F54B	b —
	Plate	ASTM A240 321 321H	b —	ISO 9328-5 X 6 CrNiTi 18 10 X 7 CrNiTi 18 10	b —
2.5	Forging	ASTM A182 F347 F347H F348 F348H	b — b —	ISO 9327-2 F50 F51 — —	b — — —
	Plate	ASTM A240 347 347H 348 348H	b — b —	ISO 9328-5 X 6 CrNiNb 18 10 X 7 CrNiNb 18 10 — —	b — — —
2.6	Casting	ASTM A351 CH8 CH20	— —	— —	— —
	Plate	ASTM A240 309S	—	ISO 4955 H14	—
2.7	Casting	ASTM A351 CK20	—	—	—
	Forging	ASTM A182 F310	k	ISO 9327-2 F68	k
	Plate	ASTM A240 310S	k	ISO 4955 H15	k

a Permissible but not recommended for prolonged use above about 425 °C.

b Not to be used over 540 °C.

c Not to be used over 345 °C.

d Not to be used over 455 °C.

e Permissible but not recommended for prolonged use above about 455 °C.

f Not to be used over 565 °C.

g Not to be used over 590 °C.

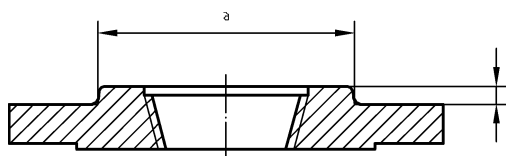
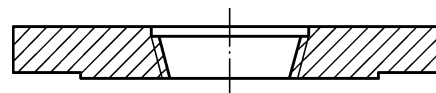
h Permissible but not recommended for prolonged use above about 590 °C.

j Not to be used over 425 °C.

k For service temperature 565 °C and above, should be used only when assurance is provided that grain size is not finer than ASTM No.6.

Table 3b — Reference standards for EN materials

Group	Forgings			Castings			Hot rolled products		
	Symbol	Standard	Material number	Symbol	Standard	Material number	Symbol	Standard	Material number
1E0	S235JR	EN 10025	1.0037	—	—	—	S235JR	EN 10025	1.0037
1E1	S235JRG2	EN 10025	1.0038	—	—	—	S235JRG2	EN 10025	1.0038
2E0	—	—	—	GP240GR	EN 10213-2	1.0621	—	—	—
3E0	P245GH	EN 10222-2	1.0352	GP240GH	EN 10213-2	1.0619	P265GH	EN 10028-2	1.0425
3E1	P280GH	EN 10222-2	1.0426	—	—	—	P295GH	EN 10028-2	1.0481
4E0	16Mo3	EN 10222-2	1.5445	G20Mo5	EN 10213-2	1.5419	16Mo3	EN 10028-2	1.5415
5E0	13CrMo4-5	EN 10222-2	1.7335	G17CrMo5-5	EN 10213-2	1.7357	13CrMo4-5	EN 10028-2	1.7335
6E0	11CrMo9-10	EN 10222-2	1.7383	G17CrMo9-10	EN 10213-2	1.7379	11CrMo9-10	EN 10028-2	1.7383
6E1	X16CrMo5-1+NT	EN 10222-2	1.7366	GX15CrMo5	EN 10213-2	1.7365	—	—	—
7E0	13MnNi6-3	EN 10222-3	1.6217	G17Mn5	EN 10213-3	1.1131	P275NL1	EN 10028-3	1.0488
	—	—	—	G20Mn5	EN 10213-3	1.6220	P275NL2	EN 10028-3	1.1104
	—	—	—	—	—	—	11MnNi5-3	EN 10028-4	1.6212
7E1	—	—	—	—	—	—	P355NL1	EN 10028-3	1.0566
	15NiMn6	EN 10222-3	1.6228	—	—	—	P355NL2	EN 10028-3	1.1106
	12Ni14	EN 10222-3	1.5637	G9Ni14	EN 10213-3	1.5638	15NiMn6	EN 10028-4	1.6228
7E2	12Ni19	EN 10222-3	1.5680	—	—	—	12Ni14	EN 10028-4	1.5637
	X8Ni9	EN 10222-3	1.5662	—	—	—	12Ni19	EN 10028-4	1.5680
	13MnNi6-3	EN 10222-3	1.6217	—	—	—	X8Ni9	EN 10028-4	1.5662
7E3	12Ni14	EN 10222-3	1.5637	—	—	—	11MnNi5-3	EN 10028-4	1.6212
	—	EN 10222-3	1.5680	—	—	—	12Ni14	EN 10028-4	1.5637
	X8Ni9	EN 10222-3	1.5662	—	—	—	12Ni19	EN 10028-4	1.5680
8E0	—	—	—	—	—	—	P275N	EN 10028-3	1.0486
8E1	—	—	—	—	—	—	P355N	EN 10028-3	1.0562
8E2	P285NH	EN 10224-4	1.0487	—	—	—	P275NH	EN 10028-3	1.0487
8E3	P355NH	EN 10222-4	1.0565	—	—	—	P355NH	EN 10028-3	1.0565
9E0	X20CrMoV11-1	EN 10222-2	1.4922	GX23CrMoV12-1	EN 10213-2	1.4931	—	—	—
10E0	X2CrNi18-9	EN 10222-5	1.4307	GX2CrNi19-11	EN 10213-4	1.4309	X2CrNi18-9	EN 10028-7	1.4306
10E1	X2CrNiN18-10	EN 10222-5	1.4311	—	—	—	X2CrNiN18-10	EN 10028-7	1.4311
11E0	X5CrNi18-10	EN 10222-5	1.4301	GX5CrNi19-10	EN 10213-4	1.4308	X5CrNi18-10	EN 10028-7	1.4301
12E0	X6CrNiTi18-10	EN 10222-5	1.4541	—	—	—	X6CrNiTi18-10	EN 10028-7	1.4541
—	—	—	—	GX5CrNiNb19-11	EN 10213-4	1.4552	X6CrNiNb18-10	EN 10028-7	1.4550
13E0	X2CrNiMo17-12-2	EN 10222-5	1.4404	GX2CrNiMo19-11-2	EN 10213-4	1.4409	X2CrNiMo17-12-2	EN 10028-7	1.4404
13E1	X2CrNiMoN17-11-2	EN 10222-5	1.4406	—	—	—	—	—	—
4E0	X5CrNiMo17-12-2	EN 10222-5	1.4401	GX5CrNiMo19-11-2	EN 10213-4	1.4408	X5CrNiMo17-12-2	EN 10028-7	1.4401
5E0	X6CrNiMoTi17-12-2	EN 10222-5	1.4571	—	—	—	X6CrNiMoTi17-12-2	EN 10028-7	1.4571
—	—	—	—	GX5CrNiMoNb19-11-2	EN 10213-4	1.4581	X6CrNiMoNb17-12-2	EN 10028-7	1.4580

**Hub type flange****Blank flange (threaded as Note)**

A hub is required if the nominal size of the reduced bore is equal to or greater than the size given in Table 4 for the nominal pipe size of the flange. Otherwise, a blank flange suitably tapped may be used.

The nominal size appropriate to a flange of a given outside diameter and pressure Class may be found by reference to the Table of standard flanges of the same pressure Class (see Tables 9 to 14).

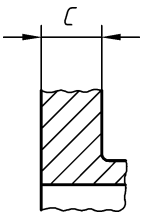
NOTE The threading and counterbore etc., should be in accordance with 5.6.3

Figure 3 — Reducing threaded and slip-on flanges, all Classes (see Table 4)**Table 4 — Reducing threaded and slip-on flanges, all Classes**

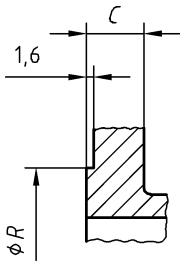
Nominal pipe size appropriate to the diameter of the flange		Smallest nominal size of reduced bore requiring hub (see explanation in Figure 3)
NPS	DN	For thread ASME B1.20.1
1	25	$\frac{1}{2}$
$1\frac{1}{4}^a$	32	$\frac{1}{2}$
$1\frac{1}{2}$	40	$\frac{1}{2}$
2	50	1
$2\frac{1}{2}^a$	65	$1\frac{1}{4}$
3	80	$1\frac{1}{4}$
4	100	$1\frac{1}{2}$
5^a	125	$1\frac{1}{2}$
6	150	$2\frac{1}{2}$
8	200	3
10	250	4
12	300	4
14	350	4
16	400	4
18	450	4
20	500	4
24	600	4

^a The use of these sizes should be avoided in new constructions

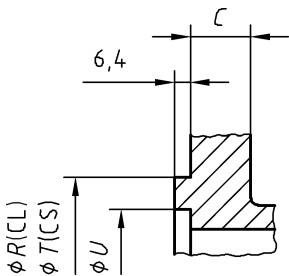
Dimensions in millimetres



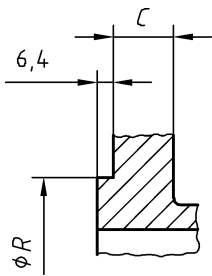
Type A (Flat face)



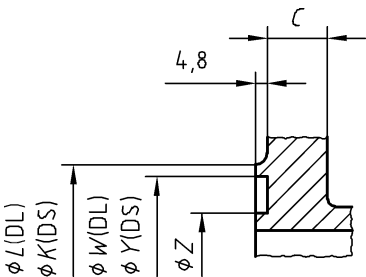
Type B 1,6 mm (Raised face)



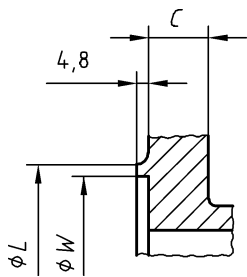
Type CL (Large tongue face) or type CS (Small tongue face)



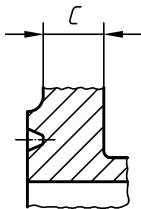
Type E (Spigot face (Large male))



Type DL (Large groove face) or type DS (Small groove face)



Type FC (Recess face (Large female))



Type J (Ring-joint face)

- NOTE 1 For dimensions X, O, M, W, Z and other details for facings other than ring-joint, see Table 5.
- NOTE 2 For other dimensions and details of ring-joint facings, see Table 6.
- NOTE 3 C is the minimum flange thickness, see Tables 9 and 10.
- NOTE 4 Dotted lines indicate full-face.
- NOTE 5 Spigot/recess and tongue/groove faces are not applicable to Class 150 because of potential dimensional conflicts.

Figure 4 — Flange facings, Classes 150 and 300 only, for other than lapped-type joints