

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 It supersedes BS 1560-3.1:1989 which is withdrawn.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.

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EUROPEAN STANDARD

EN 1759-1

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English version

**Flanges and their joints - Circular flanges for pipes, valves,
fittings and accessories, Class designated - Part 1: Steel
flanges, NPS 1/2 to 24**

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of an identical text or by endorsement, at the latest by May 2005, and conflicting national standards shall be withdrawn at the latest by May 2005.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 6708:1995)*

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 calculation 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);

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- 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 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:

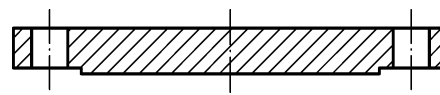
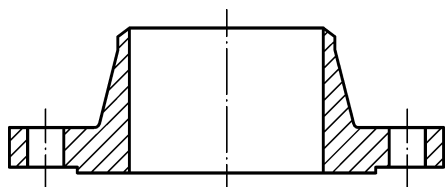
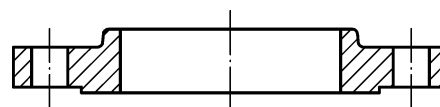
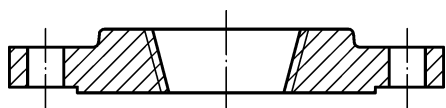
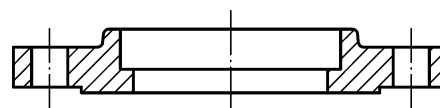
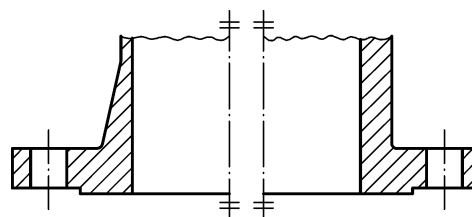
- a) Flange manufacturer's name or trademark;
- b) Letters "EN";
- c) Class designation;
- d) Either the symbol or the number or the grade of the material or the material group;
- e) Cast number or melt identification or suitable control number.

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.

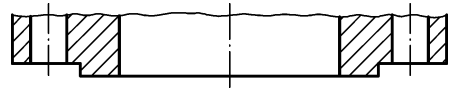
NOTE 3 Type 21 is an integral part of some other equipment or component.

NOTE 4 Flanges are designated by type numbers.

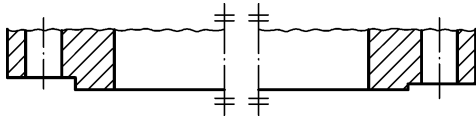
Figure 1 — Flange types



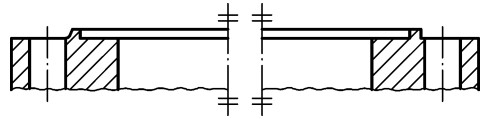
Type A, Flat face



Type E, Spigot



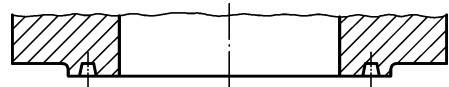
Type B, Raised face



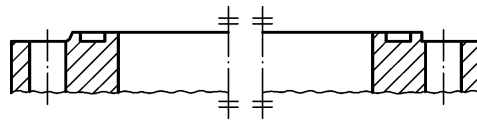
Type F, Recess



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)																				
			1/2 (15)	3/4 (20)	1 (25)	1 1/4 ^a (32)	1 1/2 (40)	2 (50)	2 1/2 ^a (65)	3 (80)	4 (100)	5 ^a (125)	6 (150)	8 (200)	10 (250)	12 (300)	14 (350)	16 (400)	18 (450)	20 (500)	24 (600)		
Plate	01	150	X	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	X	X
		300	X	X	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	X	X
		900	Use Class 1500																				
		1500	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Weld-neck	11	2500	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		150	X	X	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	X	X
		600	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		900	Use Class 1 500																				
Hubbed slip-on	12	1 500	X	X	X	X	X	X	X	X	X	X	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	X	X
		2 500	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		150	X	X	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	X	X

Table 2 (concluded)

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

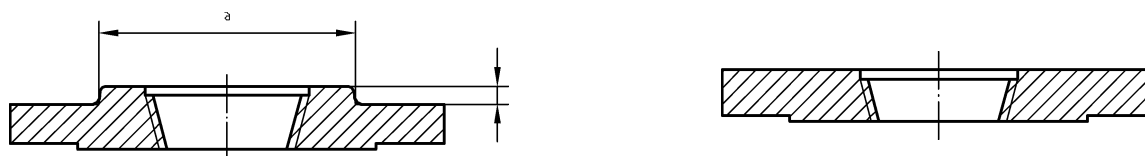
h Permissible but not recommended for prolonged use above about 590 °C.

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	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	—	—	—	—	—	—
3E1	P280GH	EN 10222-2	1.0426	—	—	—	P265GH	EN 10028-2	1.0425	—	—	—
4E0	16Mo3	EN 10222-2	1.5445	G20Mo5	EN 10213-2	1.5419	P295GH	EN 10028-2	1.0481	—	—	—
5E0	13CrMo4-5	EN 10222-2	1.7335	G17CrMo5-5	EN 10213-2	1.7357	16Mo3	EN 10028-2	1.5415	—	—	—
6E0	11CrMo9-10	EN 10222-2	1.7383	G17CrMo9-10	EN 10213-2	1.7379	13CrMo4-5	EN 10028-2	1.7335	—	—	—
6E1	X16CrMo5-1+NT	EN 10222-2	1.7366	GX15CrMo5	EN 10213-2	1.7365	11CrMo9-10	EN 10028-2	1.7383	—	—	—
7E0	13MnNi6-3	EN 10222-3	1.6217	G17Mn5	EN 10213-3	1.1131	—	—	—	—	—	—
	—	—	—	G20Mn5	EN 10213-3	1.6220	P275NL1	EN 10028-3	1.0488	—	—	—
	—	—	—	—	—	—	P275NL2	EN 10028-3	1.1104	—	—	—
	—	—	—	—	—	—	11MnNi5-3	EN 10028-4	1.6212	—	—	—
7E1	15NiMn6	EN 10222-3	1.6228	—	—	—	P355NL1	EN 10028-3	1.0566	—	—	—
	12Ni14	EN 10222-3	1.5637	—	—	—	P355NL2	EN 10028-3	1.1106	—	—	—
	12Ni19	EN 10222-3	1.5680	G9Ni14	EN 10213-3	1.5638	P355NL2	EN 10028-3	1.1106	—	—	—
	X8Ni9	EN 10222-3	1.5662	—	—	—	15NiMn6	EN 10028-4	1.6228	—	—	—
7E2	13MnNi6-3	EN 10222-3	1.6217	—	—	—	12Ni14	EN 10028-4	1.5637	—	—	—
	12Ni14	EN 10222-3	1.5637	—	—	—	12Ni19	EN 10028-4	1.5680	—	—	—
7E3	—	EN 10222-3	1.5680	—	—	—	X8Ni9	EN 10028-4	1.5662	—	—	—
	X8Ni9	EN 10222-3	1.5662	—	—	—	11MnNi5-3	EN 10028-4	1.6212	—	—	—
8E0	—	—	—	—	—	—	12Ni14	EN 10028-4	1.5637	—	—	—
8E1	—	—	—	—	—	—	12Ni19	EN 10028-4	1.5680	—	—	—
8E2	P285NH	EN 10224-4	1.0487	—	—	—	X8Ni9	EN 10028-4	1.5662	—	—	—
8E3	P355NH	EN 10222-4	1.0565	—	—	—	P275N	EN 10028-3	1.0486	—	—	—
9E0	X20CrMoV11-1	EN 10222-2	1.4922	—	—	—	P355N	EN 10028-3	1.0562	—	—	—
10E0	X2CrNi18-9	EN 10222-5	1.4307	GX23CrMoV12-1	EN 10213-2	1.4931	P275NH	EN 10028-3	1.0487	—	—	—
10E1	X2CrNi18-10	EN 10222-5	1.4311	GX2CrNi19-11	EN 10213-4	1.4309	P355NH	EN 10028-3	1.0565	—	—	—
11E0	X5CrNi18-10	EN 10222-5	1.4301	—	—	—	—	—	—	—	—	—
12E0	X6CrNiTi18-10	EN 10222-5	1.4541	GX5CrNi19-10	EN 10213-4	1.4308	X2CrNi18-9	EN 10028-7	1.4306	—	—	—
	—	—	—	—	—	—	X2CrNi18-10	EN 10028-7	1.4311	—	—	—
	—	—	—	—	—	—	X5CrNi18-10	EN 10028-7	1.4301	—	—	—
13E0	X2CrNiMo17-12-2	EN 10222-5	1.4404	GX5CrNiNb19-11	EN 10213-4	1.4552	X6CrNiTi18-10	EN 10028-7	1.4541	—	—	—
13E1	X2CrNiMoN17-11-2	EN 10222-5	1.4406	GX2CrNiMo19-11-2	EN 10213-4	1.4409	X6CrNiNb18-10	EN 10028-7	1.4550	—	—	—
14E0	X5CrNiMo17-12-2	EN 10222-5	1.4401	—	—	—	X2CrNiMo17-12-2	EN 10028-7	1.4404	—	—	—
15E0	X6CrNiMoTi17-12-2	EN 10222-5	1.4571	GX5CrNiMo19-11-2	EN 10213-4	1.4408	—	—	—	—	—	—
	—	—	—	—	—	—	X5CrNiMo17-12-2	EN 10028-7	1.4401	—	—	—
	—	—	—	—	—	—	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).

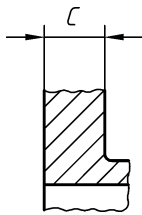
NOTE The threading and counterbore etc., should be in accordance with 5.6.3

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

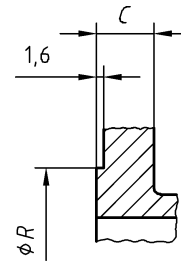
Nominal pipe size appropriate to the diameter of the flange		Smallest nominal size of reduced bore requiring hub (see explanation in Figure 3)
NPS	DN	For thread ASME B1.20.1
1	25	½
1¼ ^a	32	½
1½	40	½
2	50	1
2½ ^a	65	1¼
3	80	1¼
4	100	1½
5 ^a	125	1½
6	150	2½
8	200	3
10	250	4
12	300	4
14	350	4
16	400	4
18	450	4
20	500	4
24	600	4

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

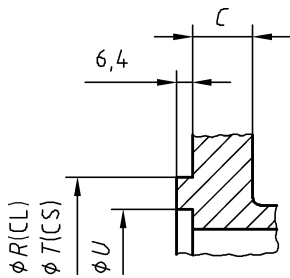
Dimensions in millimetres



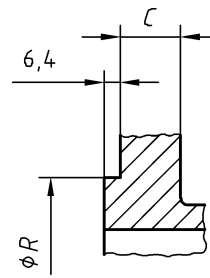
Type A (Flat face)



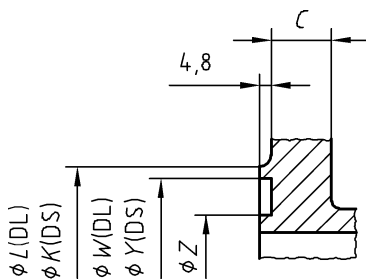
Type B 1,6 mm (Raised face)



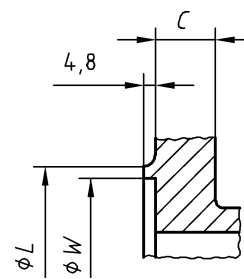
Type CL (Large tongue face) or type CS (Small tongue face)



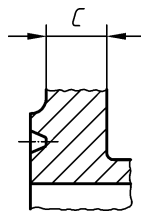
Type E (Spigot face (Large male))



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



Type FC (Recess face (Large female))

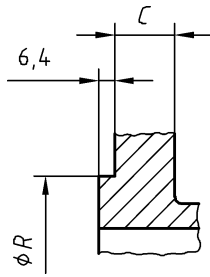


Type J (Ring-joint face)

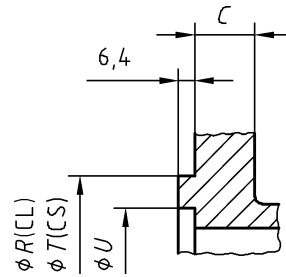
- NOTE 1 For dimensions X, O, M, W, Z and other details for facings other than ring-joint, see Table 5.
 NOTE 2 For other dimensions and details of ring-joint facings, see Table 6.
 NOTE 3 C is the minimum flange thickness, see Tables 9 and 10.
 NOTE 4 Dotted lines indicate full-face.
 NOTE 5 Spigot/recess 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

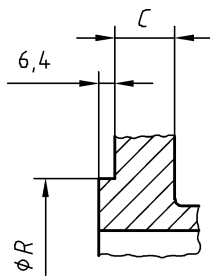
Dimensions in millimetres



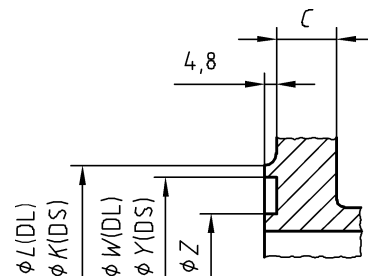
Type B (6,4 mm Raised face)



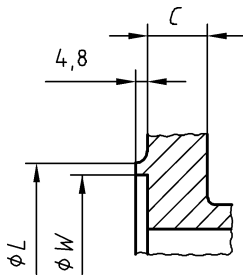
Type CL (Large tongue face) or type CS (Small tongue face)



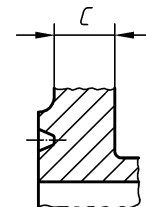
Type E (Spigot face (Large male))



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



Type F (Recess face (Large female))

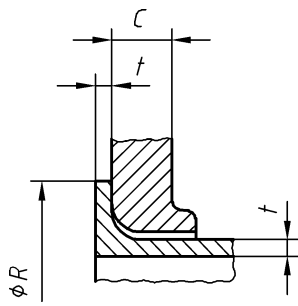


Type J (Ring-joint face)

- 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 11, 12, 13 and 14.
- NOTE 4 Dotted lines indicate full-face.

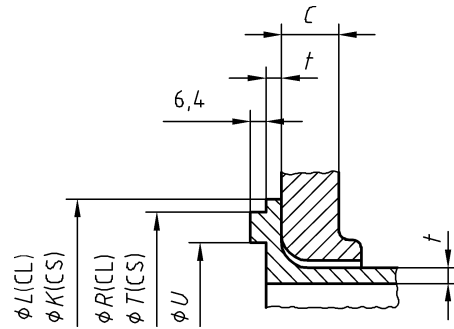
Figure 5 — Flange facings, Classes 600 to 2 500, for other than lapped-type joints

Dimensions in millimetres

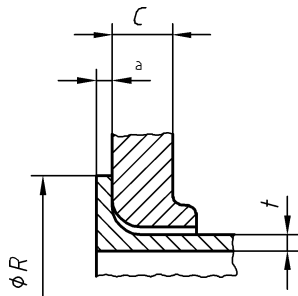


6,4 or t which ever is greater

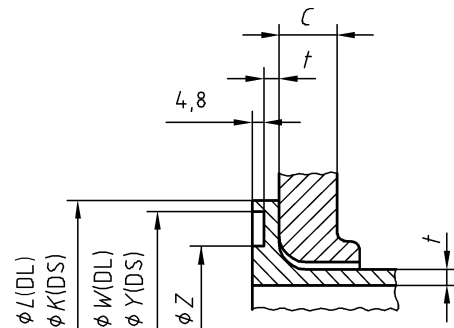
Type B (Raised face)



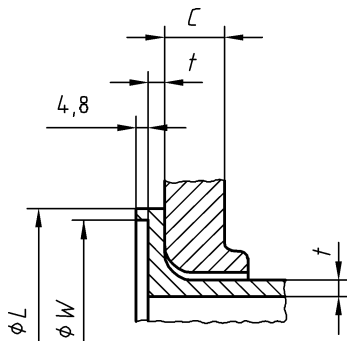
Type CL (Large tongue face) or type CS (Small tongue face)



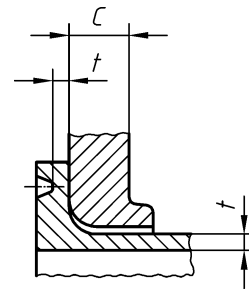
Type E (Spigot face (Large male))



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



Type F (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 to 14.

NOTE 4 t = thickness of barrel of stub-end (see 5.7.2).

Figure 6 — Facings for lapped-type joints

Table 5 — Facing dimensions for flanges other than ring-joint, all Classes

Nominal size		Outside diameter of small tongue and groove type		Outside diameter of raised face, spigot		Inside diameter of tongue		Outside diameter of recess		Inside diameter		Height of raised face		Depth of recess or groove		Type F, DL, DS outside diameter raised portion			
												Classes 150 and 300 ^b						Classes 600 to 2 500 ^c	
												CS	DS					Type B, E, CL	Type CL, CS
NPS	DN	T	Y	R	U	W	Z			L	K								
		mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm		
1/2	15	35,1	36,6	35,1	25,4	36,6	23,9	1,6	6,4	46,0	44,5	4,8	4,8	46,0	44,5				
3/4	20	42,9	44,5	42,9	33,3	44,5	31,8	1,6	6,4	53,8	52,3	4,8	4,8	53,8	52,3				
1	25	47,8	49,3	50,8	38,1	52,3	36,6	1,6	6,4	62,0	57,2	4,8	4,8	62,0	57,2				
1 1/4 ^a	32	57,2	58,7	63,5	47,8	65,0	46,0	1,6	6,4	74,7	66,5	4,8	4,8	74,7	66,5				
1 1/2	40	63,5	65,0	73,2	53,8	74,7	52,3	1,6	6,4	84,1	73,2	4,8	4,8	84,1	73,2				
2	50	82,6	84,1	91,9	73,2	93,7	71,4	1,6	6,4	103,1	91,9	4,8	4,8	103,1	91,9				
2 1/2 ^a	65	95,3	96,8	104,6	85,9	106,4	84,1	1,6	6,4	115,8	104,6	4,8	4,8	115,8	104,6				
3	80	117,3	119,1	127,0	108,0	128,5	106,4	1,6	6,4	138,2	127,0	4,8	4,8	138,2	127,0				
4	100	144,5	146,1	157,2	131,8	158,8	130,0	1,6	6,4	168,1	157,2	4,8	4,8	168,1	157,2				
5 ^a	125	173,0	174,8	185,7	160,3	187,5	158,8	1,6	6,4	196,9	185,7	4,8	4,8	196,9	185,7				
6	150	203,2	204,7	215,9	190,5	217,4	189,0	1,6	6,4	227,1	215,9	4,8	4,8	227,1	215,9				
8	200	254,0	255,5	269,7	238,3	271,5	236,5	1,6	6,4	280,9	269,7	4,8	4,8	280,9	269,7				
10	250	304,8	306,3	323,9	285,8	325,4	284,2	1,6	6,4	335,0	323,9	4,8	4,8	335,0	323,9				
12	300	362,0	363,5	381,0	342,9	382,5	341,4	1,6	6,4	392,9	381,0	4,8	4,8	392,9	381,0				
14	350	393,7	395,2	412,8	374,7	414,3	373,1	1,6	6,4	423,9	412,8	4,8	4,8	423,9	412,8				
16	400	447,5	449,3	469,9	425,5	471,4	423,9	1,6	6,4	481,1	469,9	4,8	4,8	481,1	469,9				
18	450	511,0	512,8	533,4	499,0	534,9	487,4	1,6	6,4	544,6	533,4	4,8	4,8	544,6	533,4				
20	500	558,8	560,3	584,2	533,4	585,7	531,9	1,6	6,4	595,4	584,2	4,8	4,8	595,4	584,2				
24	600	666,8	668,3	692,2	641,4	693,7	639,8	1,6	6,4	703,3	692,2	4,8	4,8	703,3	692,2				

NOTE 1 This Table should be read in conjunction with 5.7 and Figure 4, 5 and 6.

NOTE 2 For ring-joint facing dimensions, see Table 6.

NOTE 3 For tolerances, see Table 15.

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

b Raised face height is included in the flange thickness.

c Raised face height is additional to the minimum flange thickness.

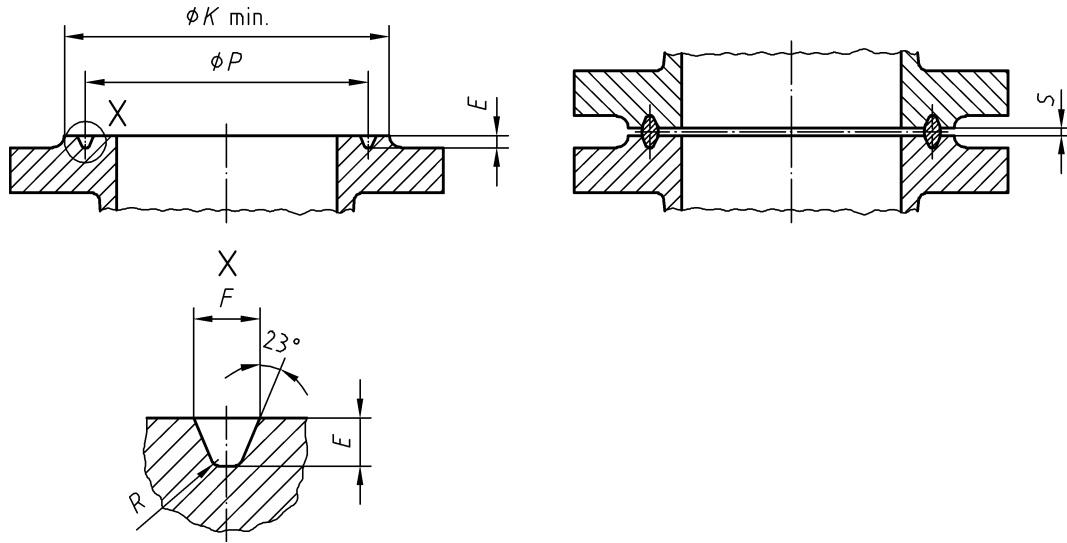


Figure 7 — Dimensions of ring-joint facings Type J (all Classes) (see Table 6)

Table 6 — Dimensions of ring-joint facings Type J, all Classes (see Figure 7)

Nominal size (NPS)				Groove number				Groove dimensions				Diameter of raised portion, K _{min}				Approximate distance between flanges S, when ring is compressed								
Class 150	Class 300		Class 600		Class 900		Class 1 500		Class 2 500		Pitch dia.	Depth Width	Radius at bottom	Class 150	Class 300 and Class 600	Class 900	Class 1 500	Class 2 500	Class 300	Class 600	Class 900	Class 1 500	Class 2 500	
	DN	in	DN	in	DN	in	DN	in	DN	in														mm
—	—	1/2	15	1/2	15	—	—	—	—	—	R11	5,56	7,14	0,8	—	50,8	—	—	—	3	3	—	—	—
—	—	—	—	—	—	1/2	15	—	—	—	R12	6,35	8,73	0,8	—	—	60,3	—	—	—	—	—	4	—
—	—	3/4	20	3/4	20	—	—	1/2	15	—	R13	6,35	8,73	0,8	—	63,5	—	65,1	—	—	4	4	—	4
—	—	—	—	—	—	—	—	3/4	20	—	R14	6,35	8,73	0,8	—	—	66,7	—	—	—	—	—	4	—
1	25	—	—	—	—	—	—	—	—	—	R15	6,35	8,73	0,8	63,5	—	—	—	4	—	—	—	—	—
—	—	1	25	1	25	—	1 25 3/4	20	—	—	R16	6,35	8,73	0,8	—	69,8	—	71,4	73,0	—	4	4	—	4
1 1/4	32	—	—	—	—	—	—	—	—	—	R17	6,35	8,73	0,8	73,0	—	—	—	4	—	—	—	—	—
—	—	1 1/4	32	1 1/4	32	—	1 1/4	32	1	25	R18	6,35	8,73	0,8	—	79,4	—	81,0	82,5	—	4	4	—	4
1 1/2	40	—	—	—	—	—	—	—	—	—	R19	6,35	8,73	0,8	82,6	—	—	—	4	—	—	—	—	—
—	—	1 1/2	40	1 1/2	40	—	1 1/2	40	—	—	R20	6,35	8,73	0,8	—	90,5	—	92,1	—	—	4	4	—	4
—	—	—	—	—	—	—	—	—	1 1/4	32	R21	7,94	11,91	0,8	—	—	—	101,6	—	—	—	—	—	3
2	50	—	—	—	—	—	—	—	—	—	R22	6,35	8,73	0,8	101,6	—	—	—	4	—	—	—	—	—
—	—	2	50	2	50	—	—	—	1 1/2	40	R23	7,94	11,91	0,8	—	108,0	—	114,3	—	—	6	5	—	3
—	—	—	—	—	—	—	—	—	2	50	R24	7,94	11,91	0,8	—	—	123,8	—	—	—	—	—	—	—
2 1/2	65	—	—	—	—	—	—	—	—	—	R25	6,35	8,73	0,8	120,6	—	—	—	4	—	—	—	—	—
—	—	2 1/2	65	2 1/2	65	—	—	—	—	—	R26	7,94	11,91	0,8	—	127,0	—	133,4	—	—	6	5	—	3
—	—	—	—	—	—	—	2 1/2	65	—	—	R27	7,94	11,91	0,8	—	—	136,5	—	—	—	—	—	—	3
—	—	—	—	—	—	—	—	—	—	—	R28	9,52	13,49	1,6	—	—	—	149,2	—	—	—	—	—	3
3	80	—	—	—	—	—	—	—	—	—	R29	6,35	8,73	0,8	133,4	—	—	—	4	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	R30	7,94	11,91	0,8	—	—	—	—	—	—	—	—	—	—

Table 6 (continued)

Nominal size (NPS)				Groove number	Groove dimensions				Diameter of raised portion, K						Approximate distance between flanges S , when ring is compressed												
Class 150	Class 300		Class 600		Class 900		Class 1 500		Class 2 500		Pitch dia.	Depth	Width	Radius at bottom	Class 150	Class 300 and Class 600	Class 900	Class 1 500	Class 2 500	Class 150	Class 300	Class 600	Class 900	Class 1 500	Class 2 500		
	DN	in	DN	in	DN	in	DN	in	DN	in																DN	in
—	3	80	3	80	3	80	—	—	—	—	—	123,83	7,94	11,91	0,8	—	146,0	155,6	—	—	—	6	5	4	—	—	—
—	—	—	—	—	—	—	3	80	—	—	—	127,00	9,52	13,49	1,6	—	—	—	—	168,3	—	—	—	—	—	—	3
—	—	—	—	—	—	—	—	—	—	—	131,76	6,35	8,73	0,8	154,0	—	—	—	—	—	4	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	131,76	7,94	11,91	0,8	—	158,8	—	—	—	—	—	6	5	—	—	—	—
—	—	—	—	—	—	—	3	80	—	—	—	136,53	7,94	11,91	0,8	—	—	168,3	—	—	—	—	—	—	—	3	—
4	100	—	—	—	—	—	—	—	—	—	149,23	6,35	8,73	0,8	171,4	—	—	—	—	—	4	—	—	—	—	—	—
—	—	4	100	4	100	4	100	—	—	—	149,23	7,94	11,91	0,8	—	174,6	181,0	—	—	—	6	5	4	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	157,16	11,11	16,67	0,8	—	—	—	—	203,2	—	—	—	—	—	—	—	4
—	—	—	—	—	—	—	4	100	—	—	—	161,93	7,94	11,91	0,8	—	—	—	—	—	—	—	—	—	—	—	—
5	125	—	—	—	—	—	—	—	—	—	171,45	6,35	8,73	0,8	193,7	—	—	—	—	—	—	—	—	—	—	—	—
—	—	5	125	5	125	—	—	—	—	—	180,98	7,94	11,91	0,8	—	209,6	215,9	—	—	—	—	6	5	4	—	—	—
—	—	—	—	—	—	—	—	—	—	—	190,50	12,70	19,84	1,6	—	—	—	—	—	241,3	—	—	—	—	—	—	4
6	150	—	—	—	—	—	—	—	—	—	193,68	6,35	8,73	0,8	219,1	—	—	—	—	—	4	—	—	—	—	—	—
—	—	—	—	—	—	—	5	125	—	—	193,68	7,94	11,91	0,8	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	6	150	6	150	—	—	—	—	—	211,14	7,94	11,91	0,8	—	241,3	241,3	—	—	—	—	6	5	4	—	—	—
—	—	—	—	—	—	—	—	—	—	—	211,14	9,53	13,49	1,6	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	228,60	12,70	19,84	1,6	—	—	—	—	—	—	—	—	—	—	—	—	—
8	200	—	—	—	—	—	—	—	—	—	247,65	6,35	8,73	0,8	273,0	—	—	—	—	—	4	—	—	—	—	—	—
—	—	8	200	8	200	—	—	—	—	—	269,88	7,94	11,91	0,8	—	301,6	308,0	—	—	—	—	6	5	4	—	—	—
—	—	—	—	—	—	—	8	200	—	—	269,88	11,11	16,67	1,6	—	—	—	—	—	—	—	—	—	—	—	—	4

Table 6 (continued)

Nominal size (NPS)					Groove dimensions							Diameter of raised portion, K_{min}							Approximate distance between flanges S , when ring is compressed																			
Class 150	Class 300		Class 600		Class 900		Class 1500		Class 2500		Groove number	Pitch dia.	Depth	Width	Radius at bottom	Class 150		Class 300 and Class 600		Class 900		Class 1500		Class 2500		Class 1500	Class 1500	Class 2500	Class 2500									
	DN	in	DN	in	DN	in	DN	in	DN	in						DN	in	P	E	F	R_{max}	mm	mm	mm	mm					mm	mm	mm	mm	mm	mm	mm	mm	mm
—	—	—	—	—	—	—	—	—	—	—	R51	279,40	14,29	23,02	1,6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—							
10	250	—	—	—	—	—	—	—	—	—	R52	304,80	6,35	8,73	0,8	330,2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—						
—	—	10	250	10	250	10	250	—	—	—	R53	323,85	7,94	11,91	0,8	—	—	355,6	362,0	—	—	—	—	—	—	—	—	—	—	—	—	—	—					
—	—	—	—	—	—	—	—	—	—	—	R54	323,85	11,11	16,67	1,6	—	—	—	—	371,5	—	—	—	—	—	—	—	—	—	—	—	—	—	—				
—	—	—	—	—	—	—	—	—	—	—	R55	342,90	17,46	30,16	2,4	—	—	—	—	—	—	425,4	—	—	—	—	—	—	—	—	—	—	—	—	—			
12	300	—	—	—	—	—	—	—	—	—	R56	381,00	6,35	8,73	0,8	406,4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—			
—	—	12	300	12	300	12	300	—	—	—	R57	381,00	7,94	11,91	0,8	—	—	412,8	419,1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—			
—	—	—	—	—	—	—	—	—	—	—	R58	381,00	14,29	23,02	1,6	—	—	—	—	438,1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
14	350	—	—	—	—	—	—	—	—	—	R59	396,88	6,35	8,73	0,8	425,4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
—	—	—	—	—	—	—	—	—	—	—	R60	406,40	17,46	33,34	2,4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
—	—	14	350	14	350	—	—	—	—	—	R61	419,10	7,94	11,91	0,8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
—	—	—	—	—	—	—	—	—	—	—	R62	419,10	11,11	16,67	1,6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	R63	419,10	15,88	26,99	2,4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
16	400	—	—	—	—	—	—	—	—	—	R64	454,03	6,35	8,73	0,8	482,6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
—	—	16	400	16	400	—	—	—	—	—	R65	469,90	7,94	11,91	0,8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
—	—	—	—	—	—	—	—	—	—	—	R66	469,90	11,11	16,67	1,6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	R67	469,90	17,46	30,16	2,4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
18	450	—	—	—	—	—	—	—	—	—	R68	517,53	6,35	8,73	0,8	546,1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
—	—	18	450	18	450	—	—	—	—	—	R69	533,40	7,94	11,91	0,8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
—	—	—	—	—	—	—	—	—	—	—	R70	533,40	12,70	19,84	1,6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	

EN 1759-1:2004 (E)

Table 6 (concluded)

Nominal size (NPS)			Groove dimensions										Diameter of raised portion, K_{min}						Approximate distance between flanges S_1 , when ring is compressed					
Class 150	Class 300	Class 600	Class 900		Class 1500		Class 2500	Groove number	Pitch dia.	Depth	Width	Radius at bottom	Class 150	Class 300 and Class 600	Class 900	Class 1500	Class 2500	Class 300	Class 150	Class 300	Class 600	Class 900	Class 1500	Class 2500
			in	DN	in	DN							mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
									P	E	F	R_{max}												
—	—	—	—	—	—	—	R71	533,40	17,46	30,16	2,4	—	—	—	612,8	—	—	—	—	—	—	—	—	—
20	500	—	—	—	—	—	R72	558,80	6,35	8,73	0,8	596,9	—	—	—	—	—	—	—	—	—	—	—	—
—	—	20	500	20	500	—	R73	584,20	9,53	13,49	1,6	—	635,0	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	20	500	584,20	12,70	19,84	1,6	—	—	647,7	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	R75	584,20	17,46	33,34	2,4	—	—	—	673,1	—	—	—	—	—	—	—	—	—
24	600	—	—	—	—	—	R76	673,10	6,35	8,73	0,8	711,2	—	—	—	—	—	—	—	—	—	—	—	—
—	—	24	600	24	600	—	R77	692,15	11,11	16,67	1,6	—	749,3	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	24	600	692,15	15,88	26,99	2,4	—	—	771,5	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	R79	692,15	20,64	36,51	2,4	—	—	—	793,8	—	—	—	—	—	—	—	—	—

NOTE 1 For ring-joints with lapped flanges in Class 300 and 600, ring and groove number R 30 are used instead of R 31.

NOTE 2 For facing requirements for lapped joints, see Figure 6.

NOTE 3 Height of raised portion is equal to the depth of groove E but is not subject to the tolerance for E . The former full face contour may be used.

NOTE 4 For sizes ½ in (DN 15) to 2½ in (DN 65) Class 1 500 flanges are used instead of Class 900.

NOTE 5 Tolerances are given in Table 15.

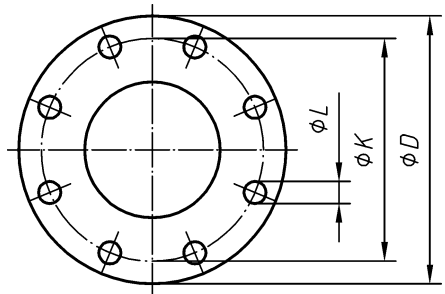
NOTE 6 Small deviations against ASME B16.5 are caused by conversion.

Table 7 — Surface finish for jointing faces (facing types A, B1, B2, E and F)

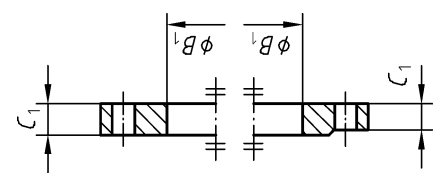
Flange rating	Method of machining	Approximate depth of serration mm	Approximate radius of tool nose mm	Approximate pitch of serration mm	R_z^a μm		R_a^a μm	
					min.	max.	min.	max.
Class 150 to Class 2 500	Turning ^b	0,05	1,6	0,8	12,5	50	3,2	12,5
Facing types B1 and B2: B1 is the standard finish, B2 is to be agreed in the order.								
NOTE For certain applications, e.g. for searching media such as low temperature gases and for flanges of Class 900 and above, it may be necessary to stipulate closer control on the surface finish.								
^a R_a and R_z are defined in EN ISO 4287.								
^b The term "turning" includes any method of machine operation producing either serrated concentric or serrated spiral grooves.								

Table 8 — Surface finish for jointing faces (facing types C, D and J)

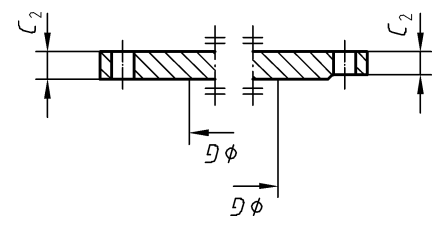
Facing	R_z μm		R_a μm	
	min.	max.	min.	max.
Type C and D Tongue and groove	3,2	12,5	0,8	3,2
Type J Ring-joint groove (including side walls)	1,6	6,3	0,4	1,6



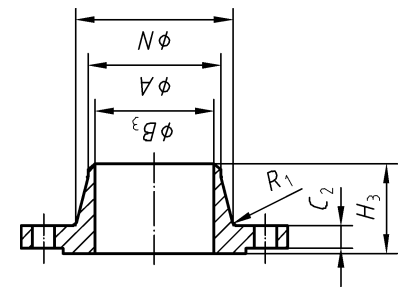
NOTE 1 This diagram illustrates the arrangement but not necessarily the correct number of bolt holes



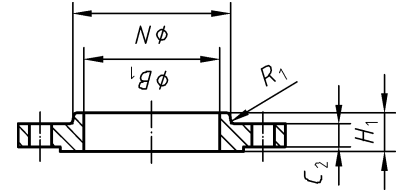
Type 01, Plate flange for welding



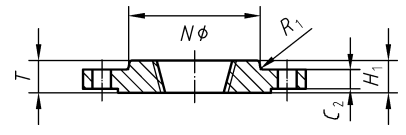
Type 05, Blank flange



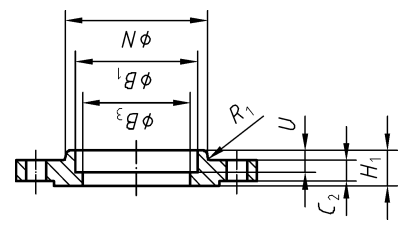
Type 11, Weld-neck flange



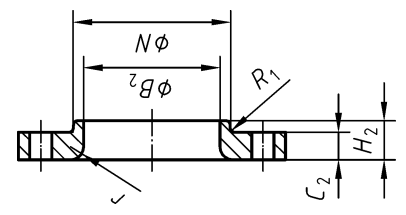
Type 12, Hubbed slip-on flange for welding



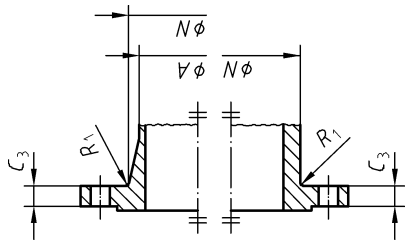
Type 13, Hubbed threaded flange



Type 14, Hubbed socket weld flange



Type 15, Loose hubbed flange for lapped pipe end



Type 21, Integral flange

NOTE 2 The C_1 and C_2 dimensions include the 1,6 mm raised face but other facings will increase the thickness (see Figure 4).
 NOTE 3 Dimensions N is measured at the intersection of the projections of the hub draft angle and the back face of the flange.
 NOTE 4 Alternative forms are indicated by the use of dotted lines.
 NOTE 5 For dimensions G refer to note 2 of 5.6.1.

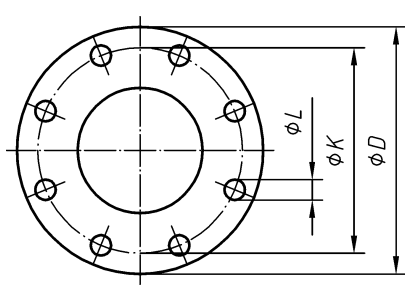
Figure 8 — Dimensions of Class 150 flanges (see Table 9)

Table 9 — Dimensions of Class 150 flanges (see Figure 8)

Nominal size	Outside diameter of flange				Mating dimensions					Hub diameter at weld end	Length through hub			Minimum thread length of threaded flange	Bore			Corner radius of bore of lapped flange and pipe	Depth of socket	Shoulder diameter	Hub radius (min.)						
	D	K	L		Diameter of bolt circle	Diameter of bolt holes	Number of bolts	Nominal diameter of bolts	C ₁		C ₂	C ₃	N		A	Threaded; slip-on; socketed weld	H ₁					H ₂	H ₃	T	Plate; slip-on; socket weld	Lapped socket weld	Weld neck socket weld
Types affected	01, 05, 11, 12, 13, 14, 15, 21																										
NPS	mm	in (mm)			mm	in			mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
1/2	89	60,3	3/8 (15,9)		12,0	1/2	4	1/2	11,1	11,1	11,1	30	21,3	15,9	15,9	15,9	47,6	15,9	22,4	23,0	15,8	11, 14	9,5	—	—	3	
3/4	98	69,8	3/8 (15,9)		14,0	1/2	4	1/2	12,7	11,1	11,1	38	26,7	15,9	15,9	52,4	15,9	27,7	28,0	20,8	11, 14	11,0	—	—	3		
1	108	79,4	1/2 (15,9)		16,0	1/2	4	1/2	14,3	11,1	11,1	49	33,4	17,5	17,5	55,6	17,5	34,5	35,0	26,7	—	12,5	—	—	3		
1 1/4 ^a	117	88,9	3/4 (19,0)		18,0	1/2	4	1/2	15,9	12,7	12,7	59	42,2	20,6	20,6	57,2	20,6	43,2	43,5	35,1	—	14,5	—	—	3		
1 1/2	127	98,4	3/4 (19,0)		19,0	1/2	4	1/2	17,5	14,3	14,3	65	48,3	22,2	22,2	61,9	22,2	49,5	50,0	40,9	—	16,0	—	—	3		
2	152	120,6	1/2 (19,0)		21,0	3/4 (19,0)	4	3/4	19,0	15,9	15,9	78	60,3	25,4	25,4	63,5	25,4	62,0	62,5	52,6	—	17,5	—	—	3		
2 1/2 ^a	178	139,7	3/4 (19,0)		24,0	3/4 (19,0)	4	3/4	22,2	17,5	17,5	90	73,0	28,6	28,6	69,9	28,6	74,7	75,5	62,7	—	19,0	—	—	3		
3	190	152,4	3/4 (19,0)		26,0	3/4 (19,0)	4	3/4	23,8	19,0	19,0	108	88,9	30,2	30,2	69,9	30,2	90,7	91,5	78,0	—	20,5	—	—	3		
4	229	190,5	3/4 (19,0)		27,0	3/4 (19,0)	8	3/4	23,8	23,8	23,8	135	114,3	33,3	33,3	76,2	33,3	116,1	117,0	102,4	—	76	—	—	3		
5 ^a	254	215,9	7/8 (22,2)		28,0	7/8 (22,2)	8	3/4	23,8	23,8	23,8	164	141,3	36,5	36,5	88,9	36,5	143,8	145,0	128,3	—	102	—	—	6,5		
6	279	241,3	7/8 (22,2)		31,0	7/8 (22,2)	8	3/4	25,4	25,4	25,4	192	168,3	39,7	39,7	88,9	39,7	170,7	171,0	154,2	—	127	—	—	6,5		
8	343	298,4	7/8 (22,2)		34,0	7/8 (22,2)	8	3/4	28,6	28,6	28,6	246	219,1	44,5	44,5	101,6	—	221,5	222,0	202,7	—	200	—	—	6,5		
10	406	362,0	1 (25,4)		38,0	1 (25,4)	12	7/8	30,2	30,2	30,2	305	273,0	49,2	49,2	101,6	—	276,4	277,0	254,5	—	225	—	—	6,5		
12	483	431,8	1 (25,4)		42,0	1 (25,4)	12	7/8	31,8	31,8	31,8	365	323,9	55,6	55,6	114,3	—	327,2	328,0	304,8	—	279	—	—	9,5		
14	533	476,2	1 1/8 (28,6)		43,0	1 1/8 (28,6)	12	1	34,9	34,9	34,9	400	355,6	57,2	57,2	127,0	—	359,2	360,0	360,0	—	311	—	—	9,5		
16	597	539,8	1 1/8 (28,6)		48,0	1 1/8 (28,6)	16	1	36,5	36,5	36,5	457	406,4	63,5	63,5	127,0	—	410,5	411,0	411,0	—	362	—	—	9,5		
18	635	577,8	1 1/4 (31,8)		56,0	1 1/4 (31,8)	16	1 1/8	39,7	39,7	39,7	505	457,2	68,3	68,3	139,7	—	461,8	462,0	462,0	—	413	—	—	9,5		
20	698	635,0	1 1/4 (31,8)		59,0	1 1/4 (31,8)	20	1 1/8	42,9	42,9	42,9	559	508,0	73,0	73,0	144,5	—	513,1	514,0	514,0	—	463	—	—	9,5		
24	813	749,3	1 1/2 (34,9)		62,0	1 1/2 (34,9)	20	1 1/4	47,6	47,6	47,6	664	609,6	82,6	82,6	152,4	—	616,0	616,0	616,0	—	565	—	—	9,5		

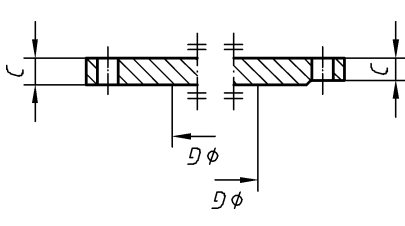
See the notes to this Table on page 43.

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

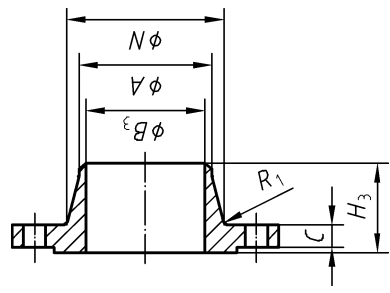


NOTE 1 This diagram illustrates the arrangement but not necessarily the correct number of bolt holes

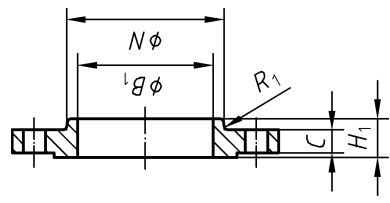
Arrangement of bolt holes



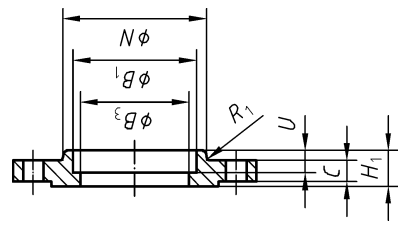
Type 05, Blank flange



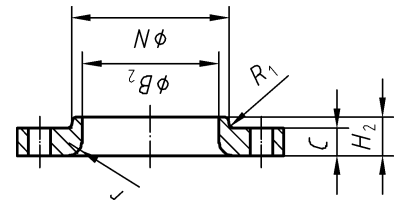
Type 11, Weld-neck flange



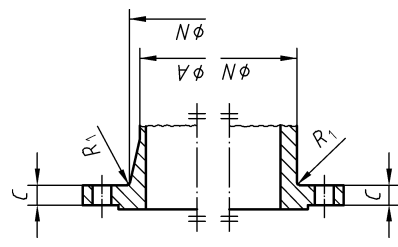
Type 12, Hubbed slip-on flange for welding



Type 14, Hubbed socket weld flange

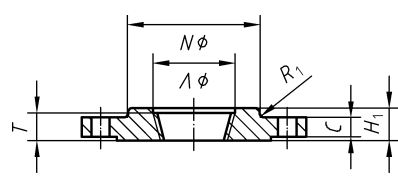


Type 15, Loose hubbed flange for lapped pipe end



Type 21, Integral flange

Type 13, Hubbed threaded flange



- NOTE 2 The C_1 and C_2 dimensions include the 1,6 mm raised face but other facings will increase the thickness (see Figure 4).
- NOTE 3 Dimension N is measured at the intersection of the projections of the hub draft angle and the back face of the flange.
- NOTE 4 Alternative forms are indicated by the use of dotted lines.
- NOTE 5 For dimension G refer to note 2 of 5.6.1

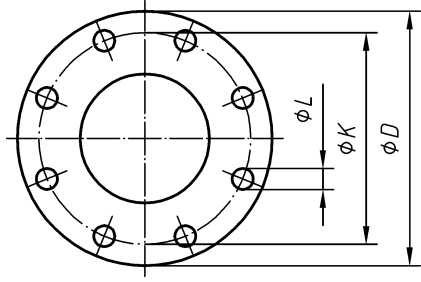
Figure 9 — Dimensions of Class 300 flanges (see Table 10)

Table 10 — Dimensions of Class 300 flanges (see Figure 9)

Nominal size	Outside diameter of flange	Mating dimensions				Flange thickness diameter	Hub diameter	Length through hub			Minimum thread length of threaded flange	Bore			Corner radius of bore of lapped flange and pipe	Dept of socket threaded flange	Minimum diameter of counter-bore threaded flange	Shoulder diameter	Hub radius (min.)
		Diameter of bolt circle	Diameter of bolt holes	Number of bolts	Nominal diameter of bolts			Threaded; slip-on; socketed weld	Lapped	Weld neck		Slip-on; socketed weld	Lapped	Weld neck socket weld					
	<i>D</i>	<i>K</i>	<i>L</i>		<i>C</i>	<i>N</i>	<i>A</i>	<i>H</i> ₁	<i>H</i> ₂	<i>H</i> ₃	<i>T</i>	<i>B</i> ₁	<i>B</i> ₂	<i>B</i> ₃	<i>r</i>	<i>U</i>	<i>V</i>	<i>G</i>	<i>R</i> ₁
Types affected		05, 11, 12, 13, 14, 15, 21			05, 11, 12, 13, 14, 15, 21	11, 12, 13, 14, 15, 21	11, 21	12, 13, 14	15	11	13	12, 14, 15	15	11, 14	15	14	13	05	11, 14, 12, 15, 13, 21
NPS	mm	mm	in (mm)	in	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
1/2	95	66,7	5/8 (15,9)	4	1/2	38	21,3	22,2	22,2	52,4	16	22,4	23,0	15,8	3,0	9,5	23,5	—	3
3/4	117	82,6	5/8 (19,0)	4	5/8	48	26,7	25,4	25,4	57,2	16	27,7	28,0	20,8	3,0	11,0	29,0	—	3
1	124	88,9	3/4 (19,0)	4	3/4	54	33,4	27,0	27,0	61,9	17	34,5	35,0	26,7	3,0	12,5	36,0	—	3
1 1/4 ^a	133	98,4	3/4 (19,0)	4	3/4	64	42,2	27,0	27,0	65,1	21	43,2	43,5	35,1	5,0	14,5	44,5	—	3
1 1/2	156	114,3	7/8 (22,2)	4	3/4	70	48,3	30,2	30,2	68,3	22	49,5	50,0	40,9	6,5	16,0	50,5	—	3
2	165	127,0	3/4 (19,0)	8	5/8	84	60,3	33,3	33,3	69,9	29	62,0	62,5	52,6	8,0	17,5	63,5	—	3
2 1/2 ^a	190	149,2	7/8 (22,2)	8	3/4	100	73,0	38,1	38,1	76,2	32	74,7	75,5	62,7	8,0	19,0	76,0	38	3
3	210	168,3	7/8 (22,2)	8	3/4	117	88,9	42,9	42,9	79,4	32	90,7	91,5	78,0	9,5	20,5	92,0	51	3
4	254	200,0	7/8 (22,2)	8	3/4	146	114,3	47,6	47,6	85,7	37	116,1	117,0	102,4	9,5	—	118,0	76	3
5 ^a	279	235,0	7/8 (22,2)	8	3/4	178	141,3	50,8	50,8	98,4	43	143,8	145,0	128,3	11,0	—	145,0	102	6,5
6	318	269,9	7/8 (22,2)	12	3/4	206	168,3	52,4	52,4	98,4	46	170,7	171,0	154,2	12,5	—	171,0	127	6,5
8	381	330,2	1 (25,4)	12	7/8	260	219,1	61,9	61,9	111,1	—	221,5	222,0	202,7	12,5	—	—	200	6,5
10	444	387,4	1 1/8 (28,6)	16	1	321	273,0	66,8	66,8	117,5	—	276,4	277,0	254,5	12,5	—	—	225	6,5
12	521	450,8	1 1/4 (31,8)	16	1 1/8	375	323,9	73,0	73,0	130,2	—	327,2	328,0	304,8	12,5	—	—	279	9,5
14	584	514,4	1 1/4 (31,8)	20	1 1/8	425	355,6	76,2	76,2	142,9	—	359,2	360,0	—	12,5	—	—	311	9,5
16	648	571,5	1 3/8 (34,9)	20	1 1/4	483	406,4	82,6	82,6	146,1	—	410,5	411,0	—	12,5	—	—	362	9,5
18	711	628,6	1 3/8 (34,9)	24	1 1/4	533	457,2	88,9	88,9	158,8	—	461,8	462,0	—	12,5	—	—	406	9,5
20	775	685,8	1 3/8 (34,9)	24	1 1/4	587	508,0	95,3	95,3	162,0	—	513,1	514,0	—	12,5	—	—	457	9,5
24	914	812,8	1 5/8 (41,3)	24	1 1/2	702	609,6	106,4	106,4	168,3	—	616,0	616,0	—	12,5	—	—	559	9,5

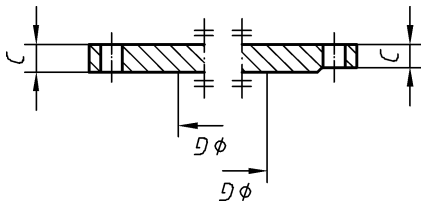
See the notes to this Table on page 43.

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

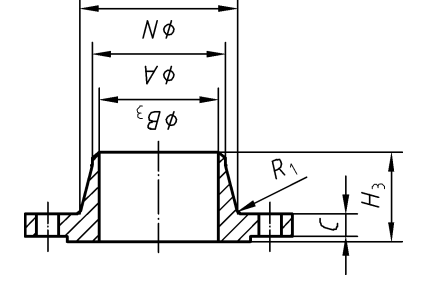


NOTE 1 This diagram illustrates the arrangement but not necessarily the correct number of bolt holes

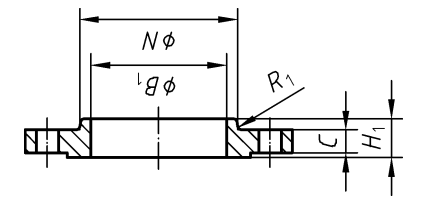
Arrangement of bolt holes



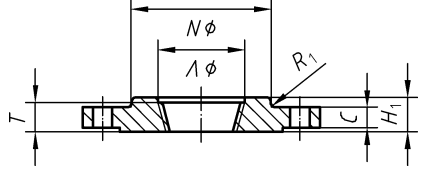
Type 05, Blank flange



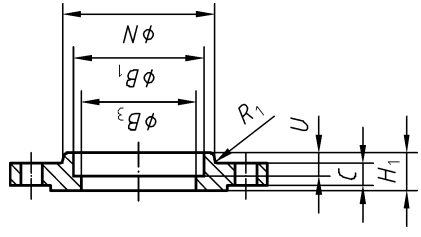
Type 11, Weld-neck flange



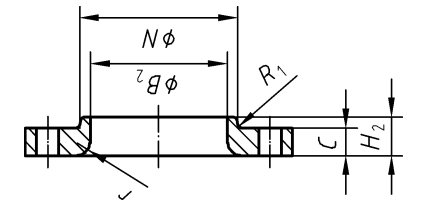
Type 12, Hubbed slip-on flange for welding



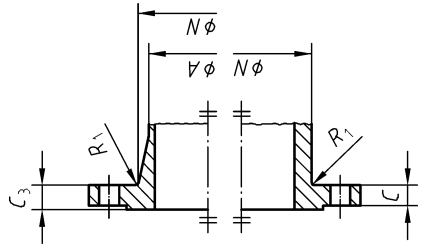
Type 13, Hubbed threaded flange



Type 14, Hubbed socket weld flange



Type 15, Loose hubbed flange for lapped pipe end



Type 21, Integral flange

NOTE 2 Dimension N is measured at the intersection of the projections of the hub draft angle and the back face of the flange.
 NOTE 3 Alternative forms are indicated by the use of dotted lines.
 NOTE 4 For dimension G refer to note 2 of 5.6.1

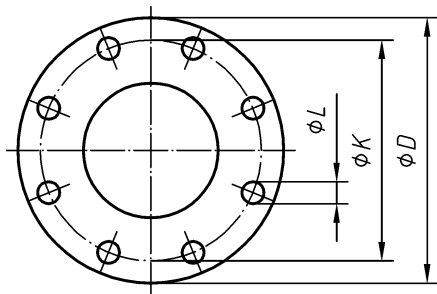
Figure 10 — Dimensions of Class 600 flanges (see Table 11)

Table 11 — Dimensions of Class 600 flanges (see Figure 10)

Nominal size	Outside diameter of flange	Mating dimensions				Flange thickness diameter	Hub diameter	Length through hub			Minimum thread length of threaded flange	Bore			Corner radius of bore of lapped flange and pipe	Depth of socket threaded flange	Minimum diameter of counter-bore threaded flange	Shoulder diameter	Hub radius (min.)
		Diameter of bolt circle	Diameter of bolt holes	Number of bolts	Nominal diameter of bolts			Threaded; slip-on; socketed weld	Lapped	Weld neck		Slip-on; socketed weld	Lapped	Weld neck socket weld					
	<i>D</i>	<i>K</i>	<i>L</i>		<i>C</i>	<i>N</i>	<i>A</i>	<i>H</i> ₁	<i>H</i> ₂	<i>H</i> ₃	<i>T</i>	<i>B</i> ₁	<i>B</i> ₂	<i>B</i> ₃	<i>r</i>	<i>U</i>	<i>V</i>	<i>G</i>	<i>R</i> ₁
Types affected		05, 11, 12, 13, 14, 15, 21			05, 11, 12, 13, 14, 15, 21	11, 12, 13, 14, 15, 21	11, 21	12, 13, 14	15	11	13	12, 14	15	11, 14	15	14	13	05	11, 14, 12, 15, 13, 21
NPS	mm	in (mm)			in	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
1/2	95	66,7	1/2 (15,9)	4	1/2	38	21,3	22,2	22,2	52,4	16	22,4	23,0		3,0	9,5	23,5	—	3
3/4	117	82,6	3/4 (19,0)	4	5/8	48	26,7	25,4	25,4	57,2	16	27,7	28,0		3,0	11,0	29,0	—	3
1	124	88,9	1 (19,0)	4	3/4	54	33,4	27,0	27,0	61,9	17	34,5	35,0		3,0	12,5	36,0	—	3
1 1/4 ^a	133	98,4	1 1/4 (19,0)	4	3/4	64	42,2	28,6	28,6	66,8	21	43,2	43,5		5,0	14,5	44,5	—	3
1 1/2	156	114,3	1 1/2 (22,2)	4	3/4	70	48,3	31,8	31,8	69,9	22	49,5	50,0		6,5	16,0	50,5	—	3
2	165	127,0	2 (19,0)	8	5/8	84	60,3	36,5	36,5	73,0	29	62,0	62,5		8,0	17,5	63,5	—	3
2 1/2 ^a	190	149,2	2 1/2 (22,2)	8	3/4	100	73,0	41,3	41,3	79,4	32	74,7	75,5		8,0	19,0	76,0	38	3
3	210	168,3	3 (22,2)	8	3/4	117	88,9	46,0	46,0	82,6	35	90,7	91,5		9,5	20,5	92,0	51	3
4	273	215,9	4 (25,4)	8	7/8	152	114,3	54,0	54,0	101,6	41	116,1	117,0		9,5	—	118,0	76	3
5 ^a	330	266,7	5 (28,6)	8	1	189	141,3	60,3	60,3	114,3	48	143,8	145,0		11,0	—	145,0	102	6,5
6	356	292,1	6 (28,6)	12	1	222	168,3	66,8	66,8	117,5	51	170,7	171,0		12,5	—	171,0	127	6,5
8	419	349,2	8 (31,8)	12	1 1/8	273	219,1	76,2	76,2	133,4	—	221,5	222,0		12,5	—	—	175	6,5
10	508	431,8	10 (34,9)	16	1 1/4	343	273,0	85,7	111,1	152,4	—	276,4	277,0		12,5	—	—	222	6,5
12	559	489,0	12 (34,9)	20	1 1/4	400	323,9	92,1	117,5	155,6	—	327,2	328,0		12,5	—	—	273	11
14	603	527,0	14 (38,1)	20	1 1/2	432	355,6	93,7	127,0	165,1	—	359,2	360,0		12,5	—	—	302	11
16	686	603,2	16 (41,3)	20	1 1/2	495	406,4	106,4	139,7	177,8	—	410,5	411,0		12,5	—	—	349	11
18	743	654,0	18 (44,4)	20	1 5/8	546	457,2	117,5	151,4	184,2	—	461,8	462,0		12,5	—	—	394	11
20	813	723,9	20 (44,4)	24	1 5/8	610	508,0	127,0	165,1	190,5	—	513,1	514,0		12,5	—	—	438	11
24	940	838,2	24 (50,8)	24	1 7/8	718	609,6	139,7	184,2	203,2	—	616,0	616,0		12,5	—	—	533	11

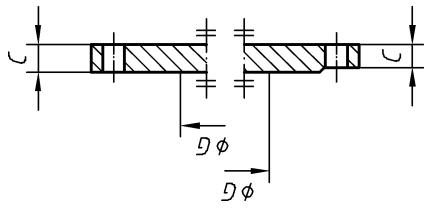
See the notes to this Table on page 43.

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

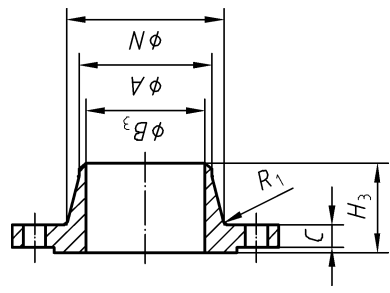


NOTE 1 This diagram illustrates the arrangement but not necessarily the correct number of bolt holes

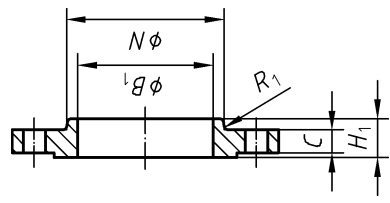
Arrangement of bolt holes



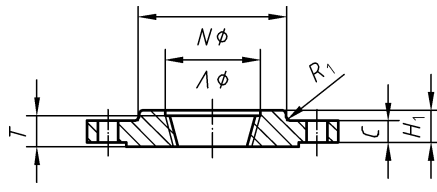
Type 05, Blank flange



Type 11, Weld-neck flange

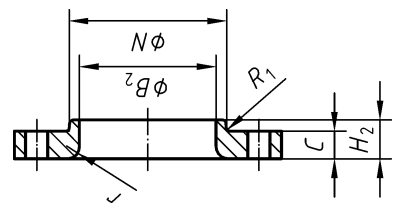


Type 12, Hubbed slip-on flange for welding

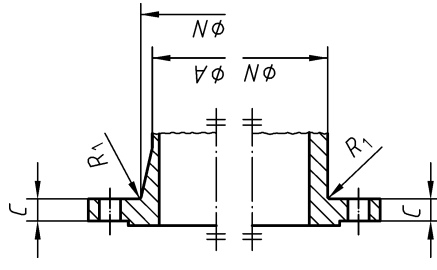


Type 13, Hubbed threaded flange

NOTE 2 Dimension N is measured at the intersection of the projections of the hub draft angle and the back face of the flange.
NOTE 3 Alternative forms are indicated by the use of dotted lines.
NOTE 4 For dimension G refer to note 2 of 5.6.1



Type 15, Loose hubbed flange for lapped pipe end



Type 21, Integral flange

Figure 11 — Dimensions of Class 900 flanges (see Table 12)

Table 12 — Dimensions of Class 900 flanges (see Figure 11)

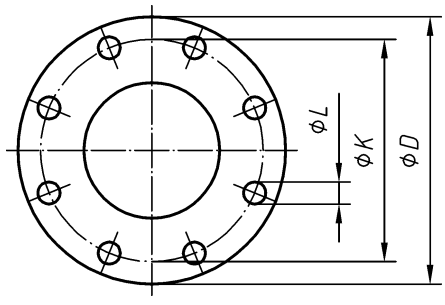
Nominal size	Outside diameter of flange		Mating dimensions			Flange thickness diameter	Hub diameter	Length through hub			Minimum thread length of threaded flange	Bore			Corner radius of bore of lapped flange and pipe	Minimum diameter of counter-bore threaded flange	Shoulder diameter	Hub radius (min.)	
	mm	in	Diameter of bolt circle	Diameter of bolt holes	Number of bolts			Nominal diameter of bolts	Hub diameter at weld end	Threaded; slip-on; socketed weld		Lapped	Weld neck	Slip-on; socket weld					Lapped
DN	mm	in (mm)	K	L		C	N	A	H ₁	H ₂	H ₃	T	B ₁	B ₂	B ₃	V	G	R ₁	
Types affected			05, 11, 12, 13, 15, 21			05, 11, 12, 13, 15, 21	11, 12, 13, 15, 21	11, 21	12, 13	15	11	13	12	15	11	13	05	11, 15, 12, 21, 13	
NPS	mm	in (mm)				mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
1/2	15																		
3/4	20																		
1	25																		
1 1/2 ^a	32																		
1 1/2	40																		
2	50																		
2 1/2 ^a	65																		
3	80	241	190,5	1 (25,4)	8	38,1	127	88,9	54,0	54,0	101,6	41	90,7	91,5	92	92	48	3	
4	100	292	235,0	1 1/4 (31,8)	8	44,4	159	114,3	69,9	69,9	114,3	48	116,1	117,0	118	118	73	5	
5 ^a	125	349	279,4	1 3/8 (34,9)	8	50,8	190	141,3	79,4	79,4	127,0	54	143,8	145,0	145	145	95	6,5	
6	150	381	317,5	1 1/2 (31,8)	12	55,6	235	168,3	85,7	85,7	139,7	57	170,7	171,0	171	171	121	6,5	
8	200	470	393,7	1 1/2 (38,1)	12	63,5	298	219,1	101,6	114,3	162,0	—	221,5	222,0	—	—	165	6,5	
10	250	546	469,9	1 1/2 (38,1)	16	69,8	368	273,0	108,0	127,0	184,2	—	276,4	277,0	—	—	213	6,5	
12	300	610	533,4	1 1/2 (38,1)	20	79,4	419	323,9	117,5	142,9	200,0	—	327,2	328,0	—	—	257	9,5	
14	350	641	558,8	1 5/8 (41,3)	20	85,7	451	355,6	130,2	155,6	212,8	—	359,2	360,0	—	—	286	11,5	
16	400	705	616,0	1 3/4 (44,4)	20	88,9	508	406,4	133,4	165,1	215,9	—	410,5	411,0	—	—	381	11	
18	450	787	685,8	2 (50,8)	20	101,6	565	457,2	152,4	190,5	228,6	—	461,8	462,0	—	—	419	11	
20	500	857	749,3	2 1/8 (54,0)	20	108,0	622	508,0	158,8	209,6	247,7	—	513,1	514,0	—	—	451	11	
24	600	1 041	901,7	2 5/8 (66,7)	20	139,7	749	609,6	203,2	266,7	292,1	—	616,0	616,0	—	—	508	11	

see flanges Class 1 500

To be supplied by purchaser

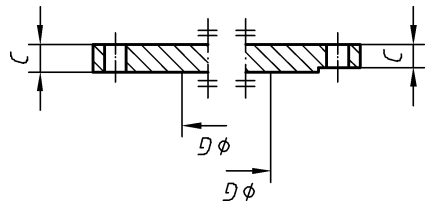
See the notes to this Table on page 43

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

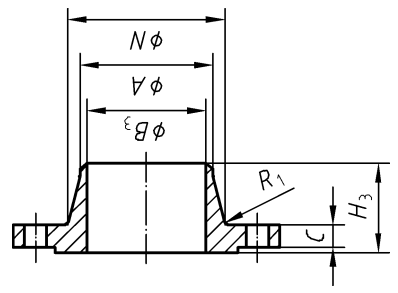


NOTE 1 This diagram illustrates the arrangement but not necessarily the correct number of bolt holes

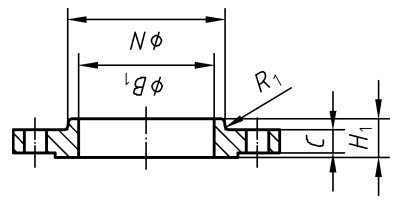
Arrangement of bolt holes



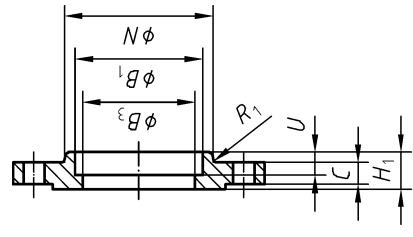
Type 05, Blank flange



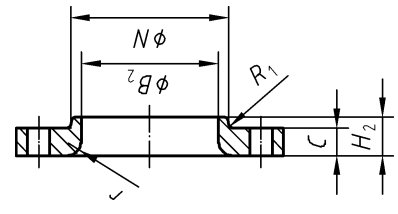
Type 11, Weld-neck flange



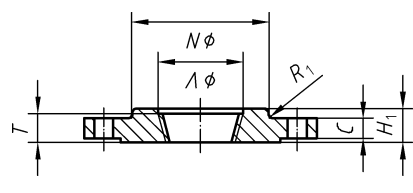
Type 12, Hubbed slip-on flange for welding



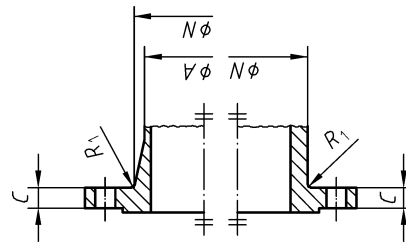
Type 14, Hubbed socket weld flange



Type 15, Loose hubbed flange for lapped pipe end



Type 13, Hubbed threaded flange



Type 21, Integral flange

NOTE 2 Dimension N is measured at the intersection of the projections of the hub draft angle and the back face of the flange.

NOTE 3 Alternative forms are indicated by the use of dotted lines.

NOTE 4 For dimension G refer to note 2 of 5.6.1

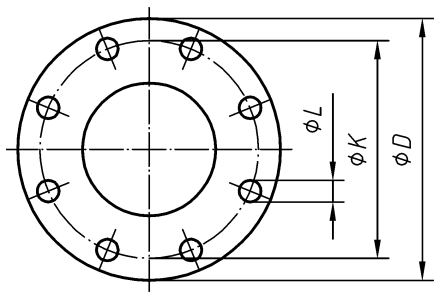
Figure 12 — Dimensions of Class 1 500 flanges (see Table 13)

Table 13 — Dimensions of Class 1 500 flanges (see Figure 12)

Nominal size	Outside diameter of flange	Mating dimensions			Flange thickness diameter	Hub diameter	Length through hub			Minimum thread length of threaded flange	Bore			Corner radius of bore of lapped flange and pipe	Dept of socket threaded flange	Minimum diameter of counter-bore threaded flange	Shoulder diameter	Hub radius (min.)
		Diameter of bolt circle	Diameter of bolt holes	Number of bolts			Nominal diameter of bolts	Threaded; slip-on; socketed weld	Lapped		Weld neck	Slip-on; socket weld	Lapped					
	D	K	L		C	N	H ₁	H ₂	H ₃	T	B ₁	B ₂	B ₃	r	U	V	G	R ₁
Types affected					05, 11, 12, 13, 14, 15, 21	11, 12, 13, 14, 15, 21	12, 13, 14	15	11	13	12, 14	15	11, 14	15	14	13	05	11, 14, 12, 15, 13, 21
NPS	DN	mm	in (mm)		mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
1/2	15	82,6	7/8 (22,2)	4	22,2	38	31,8	31,8	60,3	22	22,4	23,0		3,0	9,5	23,5	—	5
3/4	20	88,9	7/8 (22,2)	4	25,4	44	34,9	34,9	69,9	25	27,7	28,0		3,0	11,0	29,0	—	5
1	25	149	1 (25,4)	4	28,6	52	41,3	41,3	73,0	29	34,5	35,0		3,0	12,5	36,0	—	5
1 1/4 ^a	32	159	1 (25,4)	4	28,6	64	41,3	41,3	73,0	30	43,2	43,5		5,0	14,5	44,5	—	5
1 1/2	40	178	1 1/8 (28,6)	4	31,8	70	44,5	44,5	82,6	32	49,5	50,0		6,5	16,0	50,5	—	5
2	50	216	1 (25,4)	8	38,1	105	57,2	57,2	101,6	38	62,0	62,5		8,0	17,5	63,5	—	5
2 1/2 ^a	65	244	1 1/8 (28,6)	8	41,3	124	63,5	63,5	104,8	48	74,7	75,5		8,0	19,0	76,0	32	5
3	80	267	1 1/4 (31,8)	8	47,6	133	73,0	73,0	117,5	51	—	91,5		9,5	—	92,0	44	5
4	100	311	1 3/8 (34,9)	8	54,0	162	90,5	90,5	123,8	57	—	117,0		11,0	—	118,0	66	5
5 ^a	125	375	1 1/2 (41,3)	8	73,0	197	104,8	104,8	155,6	64	—	145,0		11,0	—	145,0	86	6,5
6	150	394	1 1/2 (38,1)	12	82,6	229	119,1	119,1	171,5	70	—	171,0		12,5	—	171,0	111	6,5
8	200	483	1 3/4 (44,4)	12	92,1	292	142,9	142,9	212,7	—	—	222,0		12,5	—	—	152	6,5
10	250	584	2 (50,8)	12	108,0	368	158,8	177,8	254,0	—	—	277,0		12,5	—	—	197	9,5
12	300	673	2 1/8 (54,0)	16	123,8	451	181,0	219,1	282,6	—	—	328,0		12,5	—	—	238	11
14	350	749	2 1/4 (60,3)	16	133,4	495	—	241,3	298,5	—	—	360,0		12,5	—	—	263	11
16	400	826	2 1/2 (66,7)	16	146,1	552	—	260,4	311,2	—	—	411,0		12,5	—	—	305	11
18	450	914	2 3/8 (73,0)	16	161,9	597	—	276,2	327,0	—	—	462,0		12,5	—	—	346	11
20	500	984	3 (79,4)	16	178,0	641	—	292,1	355,6	—	—	514,0		12,5	—	—	390	11
24	600	1 168	3 3/8 (92,0)	16	203,0	762	—	330,2	406,4	—	—	616,0		12,5	—	—	473	11

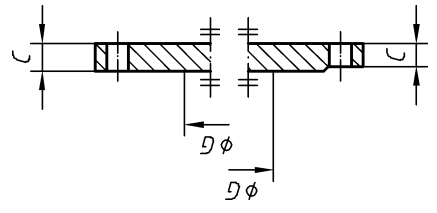
See the notes to this Table on page 43.

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

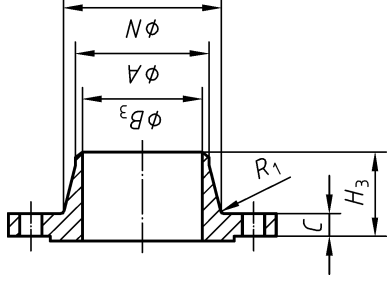


NOTE 1 This diagram illustrates the arrangement but not necessarily the correct number of bolt holes

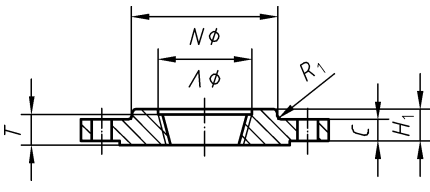
Arrangement of bolt holes



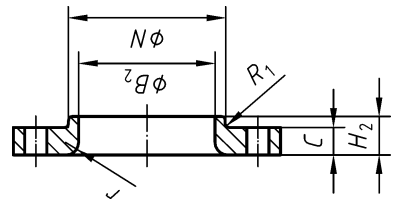
Type 05, Blank flange



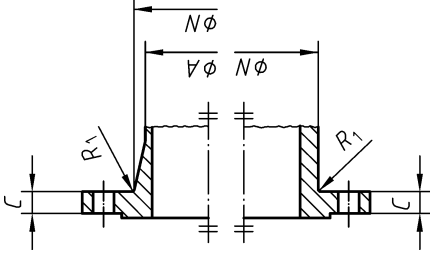
Type 11, Weld-neck flange



Type 13, Hubbed threaded flange



Type 15, Loose hubbed flange for lapped pipe end



Type 21, Integral flange

- NOTE 2 Dimension N is measured at the intersection of the projections of the hub draft angle and the back face of the flange.
- NOTE 3 Alternative forms are indicated by the use of dotted lines.
- NOTE 4 For dimension G refer to note 2 of 5.6.1

Figure 13 — Dimensions of Class 2 500 flanges (see Table 14)

Table 14 — Dimensions of Class 2 500 flanges (see Figure 13)

Nominal size	Outside diameter of flange		Mating dimensions				Flange thickness	Hub diameter	Hub diameter at weld end	Length through hub			Minimum thread length of threaded flange		Bore		Corner radius of bore of lapped flange and pipe	Minimum diameter of counter-bore threaded flange	Shoulder diameter	Hub radius (min.)			
	D	K	Diameter of bolt circle	Diameter of bolt holes	Number of bolts	Nominal diameter of bolts				C	N	A	Threaded	Lapped	Weld neck	H ₁					H ₂	H ₃	T
Types affected	05, 11, 13, 15, 21																						
NPS	DN	mm	in (mm)	mm	in (mm)	in	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
1/2	15	133	88,9	7/8 (22,2)	4	3/8	30,2	43	21,3	39,7	39,7	39,7	73,0	29	23,0	23,0	3,0	23,5	—	—	—	5	5
3/4	20	140	95,2	7/8 (22,2)	4	3/4	31,7	51	26,7	42,9	42,9	42,9	79,4	32	28,0	28,0	3,0	29,0	—	—	—	5	5
1	25	159	107,9	1 (25,4)	4	7/8	34,9	57	33,4	47,6	47,6	47,6	88,9	35	35,0	35,0	3,0	35,0	—	—	—	5	5
1 1/4 ^a	32	184	130,2	1 1/8 (28,6)	4	1	38,1	73	42,2	52,4	52,4	52,4	95,3	38	43,5	43,5	5,0	44,5	—	—	—	5	5
1 1/2	40	203	146,0	1 1/4 (31,8)	4	1 1/8	44,4	79	48,3	60,3	60,3	60,3	111,1	44	50,0	50,0	6,5	50,5	—	—	—	9,5	9,5
2	50	235	171,4	1 1/2 (28,6)	8	1	50,8	95	60,3	69,9	69,9	69,9	127,0	51	62,5	62,5	8,0	63,5	—	—	—	9,5	9,5
2 1/2 ^a	65	267	196,8	1 3/4 (31,8)	8	1 1/8	57,1	114	73,0	79,4	79,4	79,4	142,9	57	75,5	75,5	8,0	76,0	22	22	22	9,5	9,5
3	80	305	228,6	1 7/8 (34,9)	8	1 1/4	66,7	133	88,9	92,1	92,1	92,1	166,3	64	91,5	91,5	9,5	92,0	32	32	32	9,5	9,5
4	100	356	273,0	1 7/8 (41,3)	8	1 1/2	76,2	165	114,3	108,0	108,0	108,0	190,5	70	117,0	117,0	11,0	118,0	48	48	48	9,5	9,5
5 ^a	125	419	323,8	1 7/8 (47,6)	8	1 3/4	92,1	203	141,3	130,2	130,2	130,2	228,6	76	145,0	145,0	11,0	145,0	67	67	67	9,5	9,5
6	150	483	368,3	2 (54,0)	8	2	108,0	235	168,3	152,4	152,4	152,4	273,1	83	171,0	171,0	12,5	171,0	86	86	86	15,5	15,5
8	200	552	438,1	2 1/8 (54,0)	12	2	127,0	305	219,1	—	—	177,8	317,5	—	222,0	222,0	12,5	—	96	96	96	15,5	15,5
10	250	673	539,7	2 3/8 (66,7)	12	2 1/2	165,1	375	273,0	—	—	228,6	419,1	—	277,0	277,0	12,5	—	159	159	159	15,5	15,5
12	300	762	619,1	2 7/8 (73,0)	12	2 3/4	184,1	441	323,9	—	—	254,0	463,6	—	328,0	328,0	12,5	—	193	193	193	15,5	15,5

See the notes to this Table on page 43.

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

Notes to Tables 9 to 14

NOTE 1 For tolerances see Table 15.

NOTE 2 For facings see 5.7, Figures 4 to 7.

NOTE 3 For facing dimensions see Tables 5 and 6.

NOTE 4 For spot facing or back facing see 5.8.

NOTE 5 For threads in threaded flanges see 5.6.3.

NOTE 6 Neck diameter N , is the theoretical maximum which will permit the use of ring spanners or the fitting, if required, of the normal series of washers without some form of additional machining such as spot facing (see 5.8).

NOTE 7 The bore sizes of type 21 flanges are usually equal to the nominal size of the pipe, valve or fitting to which they form a part and the actual bore sizes are usually given, in the appropriate standard(s) for the component.

NOTE 8 For reducing threaded and slip-on flanges see Figure 3 and Table 4.

NOTE 9 When Class 150 and class 300 flanges are required with flat face, either the full thickness C or thickness with the raised face removed may be supplied. Users are reminded that removing the raised face will mean that the thickness and length through the hub could no longer be in accordance with this standard.

Table 15 — Tolerances

Dimension	Flange types		Tolerance mm	Size in
Hub diameter at weld end <i>A</i>	11, 21		+2,4 -0,8	≤ 5
			+4,0 -0,8	> 5
Bore diameter <i>B</i> ₁ , <i>B</i> ₂	01, 12, 14, 15		+0,8 -0	≤ 10
			+1,6 -0	> 10
Bore diameter <i>B</i> ₃	11, 14		± 0,8	≤ 10
			± 1,6	> 10 ≤ 18
			+3,2 -1,6	> 18
Length through hub <i>H</i> ₁ , <i>H</i> ₂ , <i>H</i> ₃	11, 12, 13, 14, 15		± 1,6	≤ 10
			± 3,2	> 10
Flange thickness <i>C</i>	All		+3,2 0	≤ 18
			+4,8 0	>18
Outside diameter of raised face <i>Ø</i>	All	1,6 mm raised face	± 0,8 mm	All sizes
		6,4 mm raised face	± 0,4 mm	
Facing dimensions <i>M</i> , <i>Q</i> , <i>W</i> , <i>Y</i> and <i>Z</i>	All	facing types C, D, E and F	± 0,4 mm	All sizes
Ring-joint depth <i>E</i>	All	facing type J	+4,8 -0	All sizes
Ring-joint width <i>F</i>			± 0,2 mm	
Ring-joint pitch <i>P</i>			± 0,13 mm	
23° angle			± ½°	
Diameter of bolt circle <i>K</i>	All		± 1,6 mm	All sizes
Centre-to-centre of adjacent bolt holes	All		± 0,8 mm	All sizes
Eccentricity of bolt circle and machined facing diameters	All		0,8 mm	≤ 2½
			1,6 mm	> 2½
Parallelism between bolting bearing surfaces and flange jointing face	All		1°	All sizes

Table 16 — Class 150 Pressure/temperature ratings for ASTM materials

Maximum allowable temperature <i>T</i> _S		Material groups																
		1,1	1,2	1,3	1,4	1,5	1,9	1,10	1,13	1,14	2,1	2,2	2,3	2,4	2,5	2,6	2,7	
°F		Maximum allowable pressure <i>P</i> _S (in bar ^a)																
-20 up to 100	-29 up to 38	19,7	20,0	18,3	16,2	18,3	20,0	18,3	20,0	20,0	20,0	19,0	19,0	19,0	19,0	19,0	17,9	17,9
		122	19,3	18,0	15,9	18,2	19,5	18,2	19,5	19,5	19,5	18,3	18,4	15,3	18,5	18,7	17,5	17,5
200	93	17,9	17,9	17,2	14,8	17,9	17,9	17,9	17,9	17,9	15,9	16,2	13,4	16,9	17,6	15,9	16,2	
	212	17,7	17,7	17,1	14,8	17,7	17,7	17,7	17,7	17,7	15,7	16,0	13,3	16,8	17,4	15,8	16,1	
300	149	15,9	15,9	15,9	14,5	15,9	15,9	15,9	15,9	15,9	14,1	14,8	12,1	15,9	15,9	15,2	15,2	
	302	15,8	15,8	15,8	14,5	15,8	15,8	15,8	15,8	15,8	14,1	14,8	12,0	15,8	15,8	15,1	15,1	
	392	14,0	14,0	14,0	13,8	14,0	14,0	14,0	14,0	14,0	13,2	13,6	11,1	14,0	14,0	13,9	13,9	
400	204	13,8	13,8	13,8	13,8	13,8	13,8	13,8	13,8	13,8	13,1	13,4	11,0	13,8	13,8	13,8	13,8	
	482	12,1	12,1	12,1	12,1	12,1	12,1	12,1	12,1	12,1	12,0	12,0	10,2	12,1	12,1	12,1	12,1	
500	260	11,7	11,7	11,7	11,7	11,7	11,7	11,7	11,7	11,7	11,7	11,7	10,0	11,7	11,7	11,7	11,7	
	572	10,2	10,2	10,2	10,2	10,2	10,2	10,2	10,2	10,2	10,2	10,2	9,7	10,2	10,2	10,2	10,2	
600	316	9,7	9,7	9,7	9,7	9,7	9,7	9,7	9,7	9,7	9,7	9,7	9,7	9,7	9,7	9,7	9,7	
650	343	8,6	8,6	8,6	8,6	8,6	8,6	8,6	8,6	8,6	8,6	8,6	8,6	8,6	8,6	8,6	8,6	
	662	8,4	8,4	8,4	8,4	8,4	8,4	8,4	8,4	8,4	8,4	8,4	8,4	8,4	8,4	8,4	8,4	
700	371	7,6	7,6	7,6	7,6	7,6	7,6	7,6	7,6	7,6	7,6	7,6	7,6	7,6	7,6	7,6	7,6	
	707	7,4	7,4	7,4	7,4	7,4	7,4	7,4	7,4	7,4	7,4	7,4	7,4	7,4	7,4	7,4	7,4	
750	399	6,6	6,6	6,6	6,6	6,6	6,6	6,6	6,6	6,6	6,6	6,6	6,6	6,6	6,6	6,6	6,6	
	752	6,5	6,5	6,5	6,5	6,5	6,5	6,5	6,5	6,5	6,5	6,5	6,5	6,5	6,5	6,5	6,5	
	797	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	
800	427	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	
	842	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6	
850	454	4,5	4,5	4,5	4,5	4,5	4,5	4,5	4,5	4,5	4,5	4,5	4,5	4,5	4,5	4,5	4,5	

Table 16 (*concluded*)

Maximum allowable temperature <i>T_S</i>		Material groups															
		1,1	1,2	1,3	1,4	1,5	1,9	1,10	1,13	1,14	2,1	2,2	2,3	2,4	2,5	2,6	2,7
°F	°C	Maximum allowable pressure <i>P_S</i> (in bar^a)															
	887	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,7
900		3,4	3,4	3,4	3,4	3,4	3,4	3,4	3,4	3,4	3,4	3,4	3,4	3,4	3,4	3,4	3,4
	932	2,8	2,8	2,8	2,8	2,8	2,8	2,8	2,8	2,8	2,8	2,8	2,8	2,8	2,8	2,8	2,8
950		2,4	2,4	2,4	2,4	2,4	2,4	2,4	2,4	2,4	2,4	2,4	2,4	2,4	2,4	2,4	2,4
	977	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9
1 000		1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4

NOTE 1 For limitations of temperature for individual materials see notes to Table 3a.

NOTE 2 Pressures and temperatures shown in bold type are conversions from ratings given in ANSI B16.5 — 1981: intermediate values shown in lighter type have been obtained by linear interpolation. For other intermediate values, it is recommended that they are obtained by linear interpolation using the original ANSI B16.5 figures shown in bold type.

NOTE 3 Temperature conversions from degrees Fahrenheit to degrees Celsius have been rounded to the nearest whole degree: pressure conversions from lbf/in² to bar have used a conversion factor of 1 lbf/in² = 0,0689476 bar and have been rounded to the nearest 0,1 bar.

a 1 bar = 10⁵ N/m² = 10⁵ pa.

Table 17— Class 300 Pressure/Temperature ratings for ASTM materials

Maximum allowable temperature <i>T_S</i>		Material groups																			
		1,1	1,2	1,3	1,4	1,5	1,9	1,10	1,13	1,14	2,1	2,2	2,3	2,4	2,5	2,6	2,7				
°F		Maximum allowable pressure <i>P_S</i> (in bar ^a)																			
Up to		Up to																			
-20 up to 100	-29 up to 38	51,0	51,7	47,9	42,7	47,9	42,7	47,9	51,7	51,7	51,7	51,7	51,7	51,7	49,6	49,6	41,4	49,6	49,6	46,2	46,2
	50	50,0	51,7	47,3	41,8	47,7	41,8	47,7	51,7	51,7	51,7	51,7	51,7	51,7	48,1	48,1	39,9	48,5	48,7	45,2	45,2
200	93	46,5	51,7	45,2	38,6	46,9	38,6	46,9	51,7	51,7	51,7	51,7	51,7	51,7	42,7	42,7	34,8	44,5	45,5	41,7	41,7
	100	46,4	51,5	45,0	38,5	46,7	38,5	46,7	51,5	51,5	51,5	51,5	51,5	51,5	42,3	42,3	34,4	44,1	45,1	41,4	41,4
300	149	45,2	50,3	44,1	37,9	45,2	37,9	45,2	49,6	49,6	49,6	49,6	49,6	49,6	37,2	38,6	31,4	41,0	42,4	39,3	39,3
	150	45,1	50,3	44,1	37,9	45,1	37,9	45,1	49,6	50,3	50,3	50,3	50,3	50,3	37,2	38,6	31,3	41,0	42,3	39,3	39,3
	200	43,9	48,7	42,9	36,7	44,2	36,7	44,2	48,1	48,7	48,7	48,7	48,7	48,7	34,4	35,8	28,8	38,2	39,9	37,1	37,1
400	204	43,8	48,6	42,7	36,5	44,1	36,5	44,1	47,9	48,6	48,6	48,6	48,6	48,6	34,1	35,5	28,6	37,9	39,6	36,9	36,9
	250	41,8	46,3	40,8	34,8	43,0	34,8	43,0	46,2	46,3	46,3	46,3	46,3	46,3	32,4	33,5	26,6	35,9	37,7	35,2	35,2
500	260	41,4	45,9	40,3	34,5	42,7	34,5	42,7	45,9	45,9	45,9	45,9	45,9	45,9	32,1	33,1	26,2	35,5	37,2	34,8	34,8
	300	38,9	42,9	37,9	32,2	42,0	32,2	42,0	42,9	42,9	42,9	42,9	42,9	42,9	30,6	31,6	25,2	34,0	36,0	33,6	33,6
600	316	37,9	41,7	36,9	31,4	41,7	31,4	41,7	41,7	41,7	41,7	41,7	41,7	41,7	30,0	31,0	24,8	33,4	35,5	33,1	33,1
650	343	36,9	40,7	36,2	31,0	40,7	31,0	40,7	40,7	40,7	40,7	40,7	40,7	40,7	29,6	30,7	24,1	33,1	34,8	32,1	32,4
	350	36,9	40,4	36,1	31,0	40,4	31,0	40,4	40,4	40,4	40,4	40,4	40,4	40,4	29,6	30,4	24,1	32,8	34,7	31,9	32,2
700	371	36,9	39,3	35,9	31,0	39,3	31,0	39,3	39,3	39,3	39,3	39,3	39,3	39,3	29,3	29,6	23,8	32,1	34,1	31,4	31,4
	375	36,6	38,7	35,4	31,0	38,9	31,0	38,9	38,9	38,9	38,9	38,9	38,9	38,9	29,2	29,6	23,7	32,0	34,1	31,3	31,3
750	399	34,8	34,8	32,8	30,7	36,5	30,7	36,5	36,5	36,5	36,5	36,5	36,5	36,5	28,6	29,3	23,1	31,7	33,8	30,7	31,0
	400	34,6	34,6	32,5	30,5	36,5	30,5	36,5	36,5	36,5	36,5	36,5	36,5	36,5	28,6	29,3	23,1	31,7	33,8	30,7	31,0
	425	28,7	28,7	27,2	25,8	35,2	25,8	35,2	35,2	35,2	35,2	35,2	35,2	35,2	28,0	29,0	22,8	31,1	33,5	30,0	30,1
800	427	28,3	28,3	26,9	25,5	35,2	25,5	35,2	35,2	35,2	35,2	35,2	35,2	35,2	27,9	29,0	22,8	31,0	33,4	30,0	30,0
	450	20,2	20,2	19,9	19,7	33,7	19,7	33,7	33,7	33,7	33,7	33,7	33,7	33,7	27,3	29,0	22,2	30,7	33,4	29,4	29,4
850	454	18,6	18,6	18,6	18,6	33,4	18,6	33,4	33,4	33,4	33,4	33,4	33,4	33,4	27,2	29,0	22,1	30,7	33,4	29,3	29,3
	475	13,5	13,5	13,5	13,5	31,7	13,5	31,7	31,7	31,7	31,7	31,7	31,7	31,7	27,0	28,7	—	30,4	31,7	28,8	29,0
900	482	11,7	11,7	11,7	11,7	31,0	11,7	31,0	31,0	31,0	31,0	31,0	31,0	31,0	26,9	28,6	—	30,3	31,0	28,6	29,0
	500	8,9	8,9	8,9	8,9	23,5	8,9	23,5	25,3	27,7	21,3	27,7	21,3	27,7	26,4	27,3	—	27,9	28,2	27,3	27,4

Table 17 (concluded)

Maximum allowable temperature <i>T_S</i>		Material groups															
		1,1	1,2	1,3	1,4	1,5	1,9	1,10	1,13	1,14	2,1	2,2	2,3	2,4	2,5	2,6	2,7
°F	°C	Maximum allowable pressure <i>P_S</i> (in bar ^a)															
Up to	Up to																
950	510	7,2	7,2	7,2	7,2	19,3	22,1	25,9	19,0	25,9	26,2	26,5	—	26,5	26,5	26,5	26,5
977	525	5,2	5,2	5,2	5,2	15,0	18,2	21,6	16,2	21,4	24,0	25,2	—	25,4	25,8	24,7	25,1
1 000	538	3,4	3,4	3,4	3,4	11,4	14,8	17,9	13,8	17,6	22,1	24,1	—	24,5	25,2	23,1	23,8
1 022	550	—	—	—	—	—	12,7	15,3	12,1	15,0	21,8	24,0	—	23,3	25,0	21,7	23,5
1 050	566	—	—	—	—	—	10,0	12,1	10,0	11,7	21,4	23,8	—	21,7	24,8	20,0	23,1
1 067	575	—	—	—	—	—	8,8	10,5	8,9	10,4	20,1	22,9	—	20,7	24,0	18,5	21,3
1 100	593	—	—	—	—	—	6,6	7,6	6,9	7,9	17,6	21,0	—	18,6	22,4	15,5	17,9
1 112	600	—	—	—	—	—	6,0	6,9	6,2	7,3	16,7	19,9	—	18,0	21,6	14,6	16,8
1 150	621	—	—	—	—	—	4,1	4,8	4,1	5,2	13,8	16,2	—	16,2	19,0	11,7	13,1
1 157	625	—	—	—	—	—	3,9	4,5	3,9	4,9	13,4	15,7	—	15,7	17,9	11,3	12,6
1 200	649	—	—	—	—	—	2,8	2,8	2,4	3,4	10,7	12,8	—	12,8	11,7	9,0	9,3
1 202	650	—	—	—	—	—	—	—	—	—	10,6	12,6	—	12,6	11,6	8,9	9,2
1 247	675	—	—	—	—	—	—	—	—	—	8,1	10,2	—	9,8	8,8	7,0	7,4
1 250	677	—	—	—	—	—	—	—	—	—	7,9	10,0	—	9,7	8,6	6,9	7,2
1 292	700	—	—	—	—	—	—	—	—	—	6,2	8,3	—	7,9	6,9	5,7	5,5
1 300	704	—	—	—	—	—	—	—	—	—	5,9	7,9	—	7,6	6,6	5,5	5,2
1 337	725	—	—	—	—	—	—	—	—	—	4,6	6,9	—	6,3	5,3	4,5	4,4
1 350	732	—	—	—	—	—	—	—	—	—	4,1	6,6	—	5,9	4,8	4,1	4,1
1 382	750	—	—	—	—	—	—	—	—	—	3,7	5,7	—	5,0	4,2	3,5	3,5
1 400	760	—	—	—	—	—	—	—	—	—	3,4	5,2	—	4,5	3,8	3,1	3,1
1 427	775	—	—	—	—	—	—	—	—	—	2,9	4,6	—	3,9	3,2	2,5	2,7
1 450	788	—	—	—	—	—	—	—	—	—	2,4	4,1	—	3,4	2,8	2,1	2,4
1 472	800	—	—	—	—	—	—	—	—	—	2,1	3,5	—	3,1	2,6	1,9	2,1
1 500	816	—	—	—	—	—	—	—	—	—	1,7	2,8	—	2,8	2,4	1,7	1,7

NOTE 1 For limitations of temperature for individual materials see notes to Table 3a.

NOTE 2 Pressures and temperatures shown in bold type are conversions from ratings given in ANSI B16.5 — 1981: intermediate values shown in lighter type have been obtained by linear interpolation. For other intermediate values, it is recommended that they are obtained by linear interpolation use in the original ANSI B16.5 figures shown in bold type.

NOTE 3 Temperature conversions from degrees Fahrenheit to degrees Celsius have been rounded to the nearest whole degree; pressure conversions from lbf/in² to bar have used a conversion factor of 1 lbf/in² = 0,0689476 bar and have been rounded to the nearest 0,1 bar.

a 1 bar = 10⁵ N/m² = 10⁵ pa.

Table 18 — Class 600 Pressure/temperature ratings for ASTM materials

Maximum allowable temperature <i>T_S</i>		Material groups																			
		1,1	1,2	1,3	1,4	1,5	1,9	1,10	1,13	1,14	2,1	2,2	2,3	2,4	2,5	2,6	2,7				
°F		Maximum allowable pressure <i>P_S</i> (in bar ^a)																			
Up to																					
-20 up to 100	Up to	102,0	103,4	95,8	85,2	95,8	103,4	103,4	103,4	103,4	103,4	103,4	103,4	103,4	99,3	99,3	82,7	99,3	99,3	92,7	92,7
		122	100,1	103,4	94,7	83,5	95,4	103,4	103,4	103,4	103,4	103,4	103,4	103,4	95,6	96,3	79,9	97,0	97,5	90,7	90,8
200	93	93,1	103,4	90,7	77,6	93,8	103,4	103,4	102,7	103,4	82,7	85,5	70,0	88,9	91,0	83,4	83,8	83,8	83,8	83,8	
	212	92,8	103,1	90,3	77,3	93,3	103,0	103,1	102,2	103,1	81,7	84,5	69,1	88,1	90,3	82,9	83,2	83,2	83,2	83,2	
300	149	90,7	100,3	87,9	75,5	90,0	99,6	100,3	98,6	100,3	74,5	77,2	62,7	82,1	84,8	78,6	78,6	78,6	78,6	78,6	
	302	90,6	100,3	87,9	75,5	89,9	99,6	100,3	98,6	100,3	74,4	77,1	62,6	81,9	84,7	78,5	78,5	78,5	78,5	78,5	
	392	87,8	97,5	85,4	73,3	88,4	95,8	97,5	97,3	97,5	69,1	71,2	57,4	76,7	79,4	73,8	74,2	74,2	74,2	74,2	
400	204	87,6	97,2	85,2	73,1	88,3	95,5	97,2	97,2	97,2	68,6	70,7	56,9	76,2	78,9	73,4	73,8	73,8	73,8	73,8	
	482	83,6	92,7	81,2	69,4	86,3	92,4	92,7	92,7	92,7	64,9	66,7	53,5	72,0	75,3	70,3	70,7	70,7	70,7	70,7	
500	260	82,7	91,7	80,3	68,6	85,8	91,7	91,7	91,7	91,7	64,1	65,8	52,7	71,0	74,5	69,6	70,0	70,0	70,0	70,0	
	572	77,5	85,7	75,4	64,6	84,1	85,7	85,7	85,7	85,7	61,4	63,1	50,5	68,3	71,7	66,9	67,3	67,3	67,3	67,3	
600	316	75,5	83,4	73,4	63,1	83,4	83,4	83,4	83,4	83,4	60,3	62,1	49,6	67,2	70,7	65,8	66,2	66,2	66,2	66,2	
650	343	74,1	81,0	72,1	61,7	81,0	81,0	81,0	81,0	81,0	59,3	61,4	48,3	65,8	69,6	64,1	64,5	64,5	64,5	64,5	
	662	74,0	80,4	71,9	61,7	80,4	80,4	80,4	80,4	80,4	59,1	61,0	48,0	65,4	69,3	63,8	64,1	64,1	64,1	64,1	
700	371	73,4	78,3	71,4	61,7	78,3	78,3	78,3	78,3	78,3	58,6	60,0	47,2	64,1	68,3	62,7	62,7	62,7	62,7	62,7	
	707	72,9	77,1	70,5	61,6	77,6	77,6	77,6	77,6	77,6	58,4	59,8	47,1	64,0	68,2	62,6	62,6	62,6	62,6	62,6	
750	399	69,6	69,6	65,2	61,0	73,4	73,4	73,4	73,4	73,4	57,2	59,0	46,2	63,1	67,9	61,7	62,1	62,1	62,1	62,1	
	752	69,1	69,1	64,7	60,6	73,3	73,3	73,3	73,3	73,3	57,2	58,9	46,2	63,0	67,9	61,6	62,0	62,0	62,0	62,0	
	797	57,7	57,7	54,5	51,6	70,2	70,2	70,2	70,2	70,2	55,6	58,3	45,5	62,1	67,3	60,1	60,4	60,4	60,4	60,4	
800	427	56,9	56,9	53,8	51,0	70,0	70,0	70,0	70,0	70,0	55,5	58,3	45,5	62,1	67,2	60,0	60,3	60,3	60,3	60,3	
	842	40,1	40,1	39,6	39,2	67,7	67,7	67,7	67,7	67,7	54,6	57,7	44,6	61,8	66,9	58,8	59,2	59,2	59,2	59,2	
850	454	36,9	36,9	36,9	36,9	67,2	67,2	67,2	67,2	67,2	54,5	57,6	44,5	61,7	66,9	58,6	59,0	59,0	59,0	59,0	
	887	27,2	27,2	27,2	27,2	63,4	63,4	63,4	63,4	63,4	54,0	57,3	—	61,2	63,3	57,6	57,9	57,9	57,9	57,9	
900	482	23,8	23,8	23,8	23,8	62,1	62,1	62,1	62,1	62,1	53,8	57,2	—	61,0	62,1	57,2	57,6	57,6	57,6	57,6	
	932	17,6	17,6	17,6	17,6	47,1	50,6	55,7	55,7	55,7	53,1	54,8	—	56,2	56,5	54,8	54,9	54,9	54,9	54,9	

Table 18 (concluded)

Maximum allowable temperature <i>T_S</i>		Material groups															
		1,1	1,2	1,3	1,4	1,5	1,9	1,10	1,13	1,14	2,1	2,2	2,3	2,4	2,5	2,6	2,7
°F	°C	Maximum allowable pressure <i>P_S</i> (in bar ^a)															
Upto	Upto																
950	510	14,1	14,1	14,1	14,1	38,6	44,1	52,1	37,9	52,1	52,7	53,4	—	53,4	53,4	53,4	53,4
977	525	10,4	10,4	10,4	10,4	30,0	36,3	43,3	32,3	42,7	48,1	50,6	—	51,2	51,6	49,5	50,1
1 000	538	7,2	7,2	7,2	7,2	22,8	29,6	35,9	27,6	34,8	44,1	48,3	—	49,3	50,0	46,2	47,2
1 022	550	—	—	—	—	—	25,4	30,7	24,2	30,0	43,4	47,8	—	46,6	49,8	43,6	46,8
1 050	566	—	—	—	—	—	20,0	24,1	20,0	23,8	42,4	47,2	—	43,1	49,6	40,3	46,2
1 067	575	—	—	—	—	—	17,7	21,1	17,9	21,0	40,1	45,5	—	41,2	47,9	37,1	42,7
1 100	593	—	—	—	—	—	13,1	15,2	13,8	15,5	35,5	42,1	—	37,6	44,5	30,7	35,9
1 112	600	—	—	—	—	—	12,0	13,8	12,5	14,3	33,6	39,8	—	36,4	42,9	29,0	33,5
1 150	621	—	—	—	—	—	8,6	9,3	8,6	10,3	27,6	32,8	—	32,8	37,9	23,8	25,9
1 157	625	—	—	—	—	—	8,1	8,8	8,1	9,9	26,7	31,7	—	31,7	35,9	23,0	24,9
1 200	649	—	—	—	—	—	5,2	5,5	4,8	7,2	21,4	25,5	—	25,5	23,8	17,9	19,0
1 202	650	—	—	—	—	—	—	—	—	—	21,1	25,3	—	25,3	23,5	17,8	18,8
1 247	675	—	—	—	—	—	—	—	—	—	15,9	20,7	—	19,7	17,3	14,0	14,4
1 250	677	—	—	—	—	—	—	—	—	—	15,5	20,3	—	19,3	16,9	13,8	14,1
1 292	700	—	—	—	—	—	—	—	—	—	12,3	16,9	—	15,8	13,4	11,5	10,9
1 300	704	—	—	—	—	—	—	—	—	—	11,7	16,2	—	15,2	12,8	11,0	10,3
1 337	725	—	—	—	—	—	—	—	—	—	9,4	13,9	—	12,6	10,2	8,7	8,6
1 350	732	—	—	—	—	—	—	—	—	—	8,6	13,1	—	11,7	9,3	7,9	7,9
1 382	750	—	—	—	—	—	—	—	—	—	7,1	11,3	—	10,0	8,2	6,8	6,8
1 400	760	—	—	—	—	—	—	—	—	—	6,2	10,3	—	9,0	7,6	6,2	6,2
1 427	775	—	—	—	—	—	—	—	—	—	5,5	9,0	—	8,0	6,5	5,1	5,3
1 450	788	—	—	—	—	—	—	—	—	—	4,8	7,9	—	7,2	5,5	4,1	4,5
1 472	800	—	—	—	—	—	—	—	—	—	4,4	7,0	—	6,3	5,2	3,8	4,0
1 500	816	—	—	—	—	—	—	—	—	—	3,8	5,9	—	5,2	4,8	3,4	3,4

NOTE 1 For limitations of temperature for individual materials see notes to Table 3a.

NOTE 2 Pressures and temperatures shown in bold type are conversions from ratings given in ANSI B16.5 — 1981: intermediate values shown in lighter type have been obtained by linear interpolation. For other intermediate values, it is recommended that they are obtained by linear interpolation use in the original ANSI B16.5 figures shown in bold type.

NOTE 3 Temperature conversions from degrees Fahrenheit to degrees Celsius have been rounded to the nearest whole degree; pressure conversions from lbf/in² to bar have used a conversion factor of 1 lbf/in² = 0,0689476 bar and have been rounded to the nearest 0,1 bar.

a 1 bar = 10⁵ N/m² = 10⁵ pa.

Table 19 — Class 900 Pressure/temperature ratings for ASTM materials

Maximum allowable temperature <i>T_S</i>		Material groups																
		1,1	1,2	1,3	1,4	1,5	1,9	1,10	1,13	1,14	2,1	2,2	2,3	2,4	2,5	2,6	2,7	
°F		Maximum allowable pressure <i>P_S</i> (in bar ^a)																
Up to																		
-20 up to 100	Up to	-29 up to 38	153,1	155,1	143,8	127,6	143,8	155,1	155,1	155,1	155,1	155,1	148,9	148,9	124,1	148,9	148,9	138,9
		50	150,1	155,1	142,0	125,1	143,0	155,1	155,1	154,9	155,1	143,5	144,4	119,9	145,5	146,2	135,9	136,0
200	93	139,6	155,1	135,8	116,2	140,3	155,1	155,1	154,1	155,1	124,1	128,2	104,8	133,4	136,5	125,1	125,5	
		100	139,2	154,6	135,4	115,8	139,7	154,4	154,6	153,4	154,6	122,6	126,8	103,5	132,2	135,4	124,2	124,5
300	149	135,8	150,7	132,0	113,1	134,8	149,3	150,7	148,2	150,7	111,7	115,8	93,8	123,1	127,2	117,6	117,6	
		150	135,7	150,6	132,0	113,0	134,8	149,2	150,6	148,2	150,6	111,5	115,6	93,6	122,9	127,0	117,4	117,4
400	204	131,0	145,8	127,6	109,3	132,4	143,4	145,8	145,8	145,8	102,7	106,2	85,5	114,1	118,6	110,3	110,7	
		250	125,1	139,0	121,6	104,2	129,3	138,6	139,0	139,0	139,0	97,4	100,2	80,1	107,9	112,9	105,2	105,9
500	260	123,8	137,6	120,3	103,1	128,6	137,6	137,6	137,6	137,6	96,2	98,9	78,9	106,5	111,7	104,1	104,8	
		300	116,1	128,6	113,1	96,9	126,1	128,6	128,6	128,6	128,6	92,0	95,0	75,7	102,3	107,7	100,4	100,8
600	316	113,1	125,1	110,3	94,5	125,1	125,1	125,1	125,1	125,1	90,3	93,4	74,5	100,7	106,2	98,9	99,3	
		350	111,0	121,7	108,3	92,7	121,7	121,7	121,7	121,7	121,7	88,9	91,7	72,4	98,9	104,1	96,2	96,9
700	371	110,3	117,6	107,2	92,7	117,6	117,6	117,6	117,6	117,6	87,9	90,0	71,0	96,2	102,4	94,5	94,5	
		375	109,5	115,7	105,9	92,5	116,5	116,5	116,5	116,5	116,5	87,6	89,7	70,8	96,0	102,3	94,2	94,2
750	399	104,1	104,1	97,9	91,4	110,0	110,0	110,0	110,0	110,0	85,8	88,3	69,6	94,8	101,7	92,4	92,7	
		400	103,4	103,4	97,2	90,8	109,8	109,8	109,8	109,8	109,8	85,7	88,2	69,6	94,8	101,7	92,3	92,6
800	427	86,3	86,3	82,0	77,4	105,4	105,4	105,4	105,4	105,4	83,6	87,3	68,0	93,5	100,7	90,1	90,5	
		450	85,2	85,2	81,0	76,5	105,2	105,2	105,2	105,2	105,2	83,4	87,2	67,9	93,4	100,7	90,0	90,3
850	454	60,2	60,2	59,6	58,9	101,4	101,4	100,8	101,4	100,8	82,3	86,6	66,8	92,6	100,4	88,2	88,6	
		475	55,5	55,5	55,5	55,5	100,7	100,7	100,7	100,7	100,7	82,1	86,5	66,5	92,4	100,3	87,9	88,3
900	482	40,7	40,7	40,7	40,7	95,1	95,1	95,1	95,1	95,1	80,8	86,0	—	91,6	95,0	86,4	87,0	
		500	35,5	35,5	35,5	35,5	93,1	93,1	93,1	93,1	93,1	80,3	85,8	—	91,4	93,1	85,8	86,5
	932	26,5	26,5	26,5	26,5	70,8	75,7	83,4	64,0	83,4	79,4	82,1	—	84,1	84,7	82,1	82,3	

Table 19 (concluded)

Maximum allowable temperature <i>T_S</i>		Material groups																
		1,1	1,2	1,3	1,4	1,5	1,9	1,10	1,13	1,14	2,1	2,2	2,3	2,4	2,5	2,6	2,7	
°F	°C	Maximum allowable pressure <i>P_S</i> (in bar ^a)																
Upto	Upto																	
950	510	21,4	21,4	21,4	21,4	58,3	77,9	65,8	77,9	56,9	77,9	80,0	80,0	80,0	80,0	80,0	80,0	
977	525	15,6	15,6	15,6	15,6	45,2	64,9	54,5	64,9	48,3	64,1	72,2	75,9	76,6	77,4	74,4	75,1	
1 000	538	10,7	10,7	10,7	10,7	34,1	44,8	44,8	53,8	41,0	52,4	66,5	72,4	73,8	75,2	69,6	71,0	
1 022	550	—	—	—	—	—	38,1	38,1	46,0	36,0	45,0	65,3	71,8	69,8	74,9	65,5	70,4	
1 050	566	—	—	—	—	—	29,6	29,6	36,2	29,6	35,5	63,8	71,0	64,8	74,5	60,3	69,6	
1 067	575	—	—	—	—	—	26,4	26,4	31,6	26,6	31,4	60,1	68,3	61,9	71,8	55,5	64,2	
1 100	593	—	—	—	—	—	20,0	20,0	22,8	20,7	23,4	53,1	63,1	56,2	66,5	46,2	53,8	
1 112	600	—	—	—	—	—	18,3	18,3	20,7	18,8	21,5	50,2	59,7	54,5	64,2	43,6	50,2	
1 150	621	—	—	—	—	—	12,8	12,8	14,1	12,8	15,5	41,0	49,0	49,0	56,9	35,5	39,0	
1 157	625	—	—	—	—	—	12,1	12,1	13,4	12,0	14,8	39,8	47,5	47,5	53,9	34,3	37,5	
1 200	649	—	—	—	—	—	7,9	7,9	8,6	7,2	10,7	32,1	38,3	38,3	35,5	26,9	28,3	
1 202	650	—	—	—	—	—	—	—	—	—	—	31,7	38,0	37,9	35,1	26,6	28,0	
1 247	675	—	—	—	—	—	—	—	—	—	—	24,0	30,8	29,5	26,1	21,1	21,8	
1 250	677	—	—	—	—	—	—	—	—	—	—	23,4	30,3	29,0	25,5	20,7	21,4	
1 292	700	—	—	—	—	—	—	—	—	—	—	18,5	25,1	23,7	20,3	16,9	16,5	
1 300	704	—	—	—	—	—	—	—	—	—	—	17,6	24,1	22,8	19,3	16,2	15,5	
1 337	725	—	—	—	—	—	—	—	—	—	—	14,0	21,1	18,9	15,5	13,1	13,0	
1 350	732	—	—	—	—	—	—	—	—	—	—	12,8	20,0	17,6	14,1	12,1	12,1	
1 382	750	—	—	—	—	—	—	—	—	—	—	11,0	17,1	14,9	12,4	10,3	10,3	
1 400	760	—	—	—	—	—	—	—	—	—	—	10,0	15,5	13,4	11,4	9,3	9,3	
1 427	775	—	—	—	—	—	—	—	—	—	—	8,5	13,7	12,0	9,9	7,8	8,0	
1 450	788	—	—	—	—	—	—	—	—	—	—	7,2	12,1	10,7	8,6	6,6	6,9	
1 472	800	—	—	—	—	—	—	—	—	—	—	6,5	10,5	9,5	8,0	5,8	6,1	
1 500	816	—	—	—	—	—	—	—	—	—	—	5,5	8,6	7,9	7,2	4,8	5,2	

NOTE 1 For limitations of temperature for individual materials see notes to Table 3a.

NOTE 2 Pressures and temperatures shown in bold type are conversions from ratings given in ANSI B16.5 — 1981: intermediate values shown in lighter type have been obtained by linear interpolation. For other intermediate values, it is recommended that they are obtained by linear interpolation use in the original ANSI B16.5 figures shown in bold type.

NOTE 3 Temperature conversions from degrees Fahrenheit to degrees Celsius have been rounded to the nearest whole degree; pressure conversions from lbf/in² to bar have used a conversion factor of 1 lbf/in² = 0,0689476 bar and have been rounded to the nearest 0,1 bar.

a 1 bar = 10⁵ N/m² = 10⁵ pa.

Table 20 — Class 1 500 Pressure/temperature ratings for ASTM materials

Maximum allowable temperature <i>T_S</i>		Material groups															
		1,1	1,2	1,3	1,4	1,5	1,9	1,10	1,13	1,14	2,1	2,2	2,3	2,4	2,5	2,6	2,7
°F		Maximum allowable pressure <i>P_S</i> (in bar ^a)															
Up to																	
-20 up to 100	-29 up to 38	255,5	258,6	239,3	212,7	239,3	258,6	258,6	258,6	258,6	248,2	248,2	206,9	248,2	248,2	231,7	231,7
		50	250,5	258,6	236,4	208,5	238,1	258,6	258,6	258,6	258,6	239,1	240,6	199,7	242,6	243,7	226,6
200	93	232,7	258,6	226,2	193,8	234,1	258,6	258,6	258,6	206,9	213,4	174,4	222,7	227,5	208,6	209,3	
		231,9	257,7	225,4	193,1	233,0	257,4	255,6	257,7	204,4	210,9	172,3	220,6	225,6	207,1	207,7	
300	149	226,2	251,0	220,0	188,6	224,8	248,9	251,0	246,8	186,2	192,7	156,5	205,1	211,7	196,2	196,2	
		226,0	250,8	219,8	188,5	224,7	248,7	250,8	246,8	185,9	192,4	156,2	204,8	211,4	195,9	195,9	
		219,2	244,0	213,3	182,9	221,0	239,7	244,0	243,7	172,5	178,4	143,5	191,5	199,0	184,7	185,4	
400	204	218,6	243,4	212,7	182,4	220,6	238,9	243,4	243,4	171,3	177,2	142,4	190,3	197,9	183,8	184,4	
		208,7	231,8	202,8	173,6	215,3	231,0	231,8	231,8	162,6	167,0	133,6	179,6	188,3	175,6	176,2	
500	260	206,5	229,3	200,6	171,7	214,1	229,3	229,3	229,3	160,7	164,8	131,7	177,2	186,2	173,8	174,4	
		193,6	214,4	188,5	161,5	210,1	214,4	214,4	214,4	153,5	158,1	126,2	170,5	179,7	167,3	168,0	
600	316	188,6	208,6	183,8	157,6	208,6	208,6	208,6	208,6	150,7	155,5	124,1	167,9	177,2	164,8	165,5	
650	343	185,1	202,7	180,3	154,8	202,7	202,7	202,7	202,7	148,2	153,1	120,7	164,8	173,8	160,7	161,3	
		184,8	201,1	179,9	154,8	201,1	201,1	201,1	201,1	147,8	152,2	120,1	163,8	172,9	159,8	160,4	
700	371	183,8	195,8	178,6	154,8	195,8	195,8	195,8	195,8	146,5	149,6	118,3	160,7	170,3	157,2	157,2	
		182,4	192,7	176,4	154,5	194,1	194,1	194,1	193,9	146,0	149,3	117,9	160,3	170,2	156,7	156,9	
750	399	173,8	173,8	163,1	152,4	183,4	183,4	183,4	182,0	143,1	147,2	115,8	157,9	169,6	153,8	154,8	
		172,5	172,5	161,9	151,4	183,1	183,1	183,1	181,8	142,9	147,1	115,7	157,8	169,6	153,6	154,6	
		143,9	143,9	136,5	129,0	175,6	175,6	175,6	175,5	139,2	145,6	113,6	155,6	168,0	149,9	150,9	
800	427	142,0	142,0	134,8	127,6	175,1	175,1	175,1	175,1	138,9	145,5	113,4	155,5	167,9	149,6	150,7	
		100,3	100,3	99,2	98,0	169,1	169,1	169,1	167,9	136,9	144,3	111,4	154,0	167,3	147,0	147,8	
850	454	92,4	92,4	92,4	92,4	167,9	167,9	167,9	166,5	136,5	144,1	111,0	153,8	167,2	146,5	147,2	
		67,9	67,9	67,9	67,9	158,2	158,2	158,2	137,7	134,7	143,3	—	152,7	158,0	144,0	144,9	
900	482	59,3	59,3	59,3	59,3	154,8	154,8	154,8	127,6	134,1	143,1	—	152,4	154,8	143,1	144,1	
		44,1	44,1	44,1	44,1	117,7	126,1	138,9	106,4	138,9	132,6	—	140,0	140,9	136,7	137,0	

Table 20 (concluded)

Maximum allowable temperature <i>T_S</i>		Material groups															
		Maximum allowable pressure <i>P_S</i> (in bar ^a)															
°F	°C	1,1	1,2	1,3	1,4	1,5	1,9	1,10	1,13	1,14	2,1	2,2	2,3	2,4	2,5	2,6	2,7
Upto	Upto																
950	510	35,5	35,5	35,5	35,5	96,9	110,0	130,0	94,5	130,0	131,7	133,1	—	133,1	133,1	133,1	133,1
	977	26,0	26,0	26,0	26,0	75,3	90,8	108,4	80,5	107,1	120,3	126,4	—	127,7	129,0	123,8	125,3
1 000	538	17,9	17,9	17,9	17,9	56,9	74,5	90,0	68,6	87,6	110,7	120,7	—	123,1	125,5	115,8	118,6
	1 022	—	—	—	—	—	63,5	76,9	60,3	75,0	108,8	119,8	—	116,4	124,9	109,2	117,4
1 050	566	—	—	—	—	—	49,6	60,3	49,6	59,0	106,5	118,6	—	107,9	124,1	100,7	115,8
	1 067	—	—	—	—	—	44,0	52,7	44,4	52,2	100,4	114,0	—	103,1	119,7	92,6	107,0
1 100	593	—	—	—	—	—	33,1	37,9	34,1	39,0	88,6	105,2	—	93,8	111,0	76,9	90,0
	1 112	—	—	—	—	—	30,3	34,5	31,1	35,8	83,8	99,5	—	90,9	107,0	72,7	84,0
1 150	621	—	—	—	—	—	21,4	23,8	21,4	25,9	68,6	81,7	—	81,7	94,5	59,3	65,2
	1 157	—	—	—	—	—	20,2	22,4	20,0	24,7	66,4	79,2	—	79,2	89,5	57,3	62,6
1 200	649	—	—	—	—	—	13,1	14,1	11,7	17,6	53,1	63,8	—	63,8	59,0	44,8	47,2
	1 202	—	—	—	—	—	—	—	—	—	52,5	63,3	—	63,2	58,3	44,4	46,8
	1 247	—	—	—	—	—	—	—	—	—	39,8	51,5	—	49,5	43,4	34,8	36,2
1 250	677	—	—	—	—	—	—	—	—	—	39,0	50,7	—	48,6	42,4	34,1	35,5
	1 292	—	—	—	—	—	—	—	—	—	31,1	42,0	—	39,6	33,7	28,3	27,4
1 300	704	—	—	—	—	—	—	—	—	—	29,6	40,3	—	37,9	32,1	27,2	25,9
	1 337	—	—	—	—	—	—	—	—	—	23,5	35,0	—	31,8	25,9	21,9	21,5
1 350	732	—	—	—	—	—	—	—	—	—	21,4	33,1	—	29,6	23,8	20,0	20,0
	1 382	—	—	—	—	—	—	—	—	—	18,3	28,7	—	25,0	20,7	17,1	17,1
1 400	760	—	—	—	—	—	—	—	—	—	16,5	26,2	—	22,4	19,0	15,5	15,5
	1 427	—	—	—	—	—	—	—	—	—	13,9	22,9	—	19,8	16,4	12,9	13,3
1 450	788	—	—	—	—	—	—	—	—	—	11,7	20,0	—	17,6	14,1	10,7	11,4
	1 472	—	—	—	—	—	—	—	—	—	10,7	17,4	—	15,6	13,1	9,6	10,3
1 500	816	—	—	—	—	—	—	—	—	—	9,3	14,1	—	13,1	11,7	8,3	9,0

NOTE 1 For limitations of temperature for individual materials see notes to Table 3a.

NOTE 2 Pressures and temperatures shown in bold type are conversions from ratings given in ANSI B16.5 — 1981: intermediate values shown in lighter type have been obtained by linear interpolation. For other intermediate values, it is recommended that they are obtained by linear interpolation use in the original ANSI B16.5 figures shown in bold type.

NOTE 3 Temperature conversions from degrees Fahrenheit to degrees Celsius have been rounded to the nearest whole degree; pressure conversions from lbf/in² to bar have used a conversion factor of 1 lbf/in² = 0,0689476 bar and have been rounded to the nearest 0,1 bar.

a 1 bar = 10⁵ N/m² = 10⁵ pa.

Table 21 — Class 2 500 Pressure/temperature ratings for ASTM materials

Maximum allowable temperature <i>T_S</i>		Material groups																	
		1,1	1,2	1,3	1,4	1,5	1,9	1,10	1,13	1,14	2,1	2,2	2,3	2,4	2,5	2,6	2,7		
°F		Maximum allowable pressure <i>P_S</i> (in bar ^a)																	
Up to																			
-20 up to 100	Up to	-29 up to 38	425,4	430,9	398,9	354,8	398,9	430,9	430,9	430,9	430,9	430,9	413,7	413,7	344,8	413,7	413,7	386,1	386,1
		122	417,2	430,9	394,1	347,7	397,0	430,9	430,9	430,9	430,9	430,9	398,5	401,0	332,9	404,3	406,1	377,6	377,9
200	93	93	387,9	430,9	377,1	322,7	390,3	430,9	430,9	427,8	430,9	344,8	355,8	291,0	371,0	379,2	347,5	348,9	
		212	386,6	429,5	377,2	321,7	388,4	429,0	429,5	425,9	429,5	340,6	351,7	287,3	367,5	376,1	345,0	346,2	
300	149	149	377,2	418,5	366,5	314,4	374,8	414,7	418,5	411,3	418,5	310,3	321,3	260,6	342,0	353,0	326,8	326,8	
		302	376,9	418,3	366,2	314,2	374,6	414,4	418,3	411,2	418,3	309,8	320,8	260,2	341,5	352,6	326,4	326,4	
400	204	204	365,1	406,5	355,7	304,6	368,1	399,5	406,5	405,9	406,5	287,4	297,2	239,1	319,2	331,5	307,8	309,1	
		482	364,1	405,4	354,8	303,7	367,5	398,2	405,4	405,4	405,4	285,5	295,1	237,2	317,2	329,6	306,1	307,5	
500	260	260	347,7	386,2	338,1	289,3	359,0	384,9	386,2	386,2	386,2	270,8	278,1	222,5	299,4	313,8	292,6	294,0	
		572	344,1	382,0	334,4	286,1	357,2	382,0	382,0	382,0	382,0	267,5	274,4	219,3	295,5	310,3	289,6	291,0	
600	316	316	322,7	357,2	314,1	269,0	350,2	357,2	357,2	357,2	357,2	255,6	263,5	210,3	284,3	299,4	278,7	280,1	
		662	314,4	347,5	306,1	262,4	347,5	347,5	347,5	347,5	347,5	251,0	259,3	206,9	279,9	295,1	274,4	275,8	
700	343	343	308,6	338,2	300,3	257,9	338,2	338,2	338,2	338,2	338,2	246,8	255,1	201,3	274,4	289,6	267,5	268,9	
		707	308,0	335,3	299,7	257,9	335,3	335,3	335,3	335,3	335,3	246,2	253,8	200,3	272,8	288,3	266,2	267,3	
750	371	371	306,1	326,1	297,9	257,9	326,1	326,1	326,1	326,1	326,1	244,1	249,6	197,2	267,5	284,1	262,0	262,0	
		842	303,8	321,0	294,2	257,3	323,2	323,2	323,2	323,2	323,2	243,3	249,0	196,6	267,0	283,9	261,2	261,4	
800	427	427	289,6	289,6	272,0	254,1	305,5	305,5	305,5	305,5	305,5	238,6	245,5	193,1	263,4	282,7	256,5	257,9	
		887	287,5	287,5	270,1	252,4	304,9	304,9	304,9	304,9	304,9	238,3	245,4	192,9	263,2	282,6	256,2	257,6	
850	454	454	239,7	239,7	227,6	215,2	292,5	292,5	292,5	292,5	292,5	232,1	242,9	189,2	259,5	280,1	250,0	251,4	
		932	236,5	236,5	224,8	212,7	291,7	291,7	291,7	291,7	291,7	231,7	242,7	188,9	259,3	279,9	249,6	251,0	
900	482	482	167,0	167,0	165,1	163,2	281,8	281,8	281,8	281,8	281,8	228,2	240,4	185,4	256,9	278,8	245,0	246,3	
		932	153,8	153,8	153,8	153,8	279,9	279,9	279,9	279,9	279,9	227,5	240,0	184,8	256,5	278,6	244,1	245,5	
950	500	500	112,9	112,9	112,9	112,9	263,9	263,9	263,9	263,9	263,9	224,5	238,9	—	254,5	263,5	240,0	241,4	
		950	98,6	98,6	98,6	98,6	258,2	258,2	258,2	258,2	258,2	223,4	238,6	—	253,7	258,2	238,6	240,0	
1000	550	550	73,4	73,4	73,4	73,4	196,4	210,1	231,7	177,4	231,7	220,8	228,0	—	233,4	235,1	228,0	228,5	
		1000	73,4	73,4	73,4	73,4	196,4	210,1	231,7	177,4	231,7	220,8	228,0	—	233,4	235,1	228,0	228,5	

Table 21 (concluded)

Maximum allowable temperature <i>T_S</i>		Material groups																
		Maximum allowable pressure <i>P_S</i> (in bar ^a)																
°F		1,1	1,2	1,3	1,4	1,5	1,9	1,10	1,13	1,14	2,1	2,2	2,3	2,4	2,5	2,6	2,7	
°C																		
Up to																		
950	Up to																	
	510	59,3	59,3	59,3	59,3	161,7	183,1	216,9	157,6	216,9	219,3	222,0	—	222,0	222,0	222,0	222,0	222,0
1 000	977	43,3	43,3	43,3	43,3	125,4	151,2	180,5	134,1	178,5	200,5	210,7	—	212,7	214,9	206,4	208,8	
	538	29,6	29,6	29,6	29,6	94,5	124,1	149,6	114,1	145,8	184,4	201,0	—	204,8	208,9	193,1	197,5	
1 050	1 022	—	—	—	—	—	105,9	127,9	100,3	125,0	181,3	199,5	—	193,7	208,0	181,8	195,6	
	566	—	—	—	—	—	82,7	100,3	82,7	98,6	177,2	197,5	—	179,6	206,9	167,6	193,1	
1 100	1 067	—	—	—	—	—	73,4	87,7	74,1	87,2	167,2	190,0	—	171,6	199,5	154,2	178,3	
	593	—	—	—	—	—	55,2	63,1	57,2	65,2	147,9	175,5	—	156,2	185,1	128,2	149,6	
1 150	1 112	—	—	—	—	—	50,4	57,4	52,0	59,9	139,8	166,0	—	151,3	178,5	121,1	139,7	
	621	—	—	—	—	—	35,5	39,3	35,5	43,4	114,1	135,8	—	135,8	157,6	98,6	108,3	
1 200	1 157	—	—	—	—	—	33,6	37,1	33,3	41,5	110,5	131,7	—	131,7	149,3	95,3	104,2	
	649	—	—	—	—	—	21,7	23,8	19,7	29,6	88,6	106,5	—	106,5	98,6	74,8	78,9	
1 250	1 202	—	—	—	—	—	—	—	—	—	87,7	105,7	—	105,5	97,5	74,1	78,1	
	675	—	—	—	—	—	—	—	—	—	66,6	86,1	—	82,2	72,7	58,3	60,2	
1 300	1 292	—	—	—	—	—	—	—	—	—	65,2	84,8	—	80,7	71,0	57,2	59,0	
	704	—	—	—	—	—	—	—	—	—	51,8	69,8	—	65,9	56,0	47,4	45,9	
1 350	1 337	—	—	—	—	—	—	—	—	—	49,3	66,9	—	63,1	53,1	45,5	43,4	
	732	—	—	—	—	—	—	—	—	—	39,1	58,2	—	52,9	42,9	36,6	36,0	
1 400	1 382	—	—	—	—	—	—	—	—	—	35,5	55,2	—	49,3	39,3	33,4	33,4	
	760	—	—	—	—	—	—	—	—	—	30,4	47,7	—	41,8	34,2	28,4	28,4	
1 450	1 427	—	—	—	—	—	—	—	—	—	27,6	43,4	—	37,6	31,4	25,5	25,5	
	788	—	—	—	—	—	—	—	—	—	23,3	38,0	—	33,3	27,3	21,4	22,0	
1 500	1 472	—	—	—	—	—	—	—	—	—	19,7	33,4	—	29,6	23,8	17,9	19,0	
	816	—	—	—	—	—	—	—	—	—	18,0	29,2	—	26,2	22,0	16,1	17,1	
		—	—	—	—	—	—	—	—	—	15,9	23,8	—	21,7	19,7	13,8	14,8	

NOTE 1 For limitations of temperature for individual materials see notes to Table 3a.

NOTE 2 Pressures and temperatures shown in bold type are conversions from ratings given in ANSI B16.5 — 1981: intermediate values shown in lighter type have been obtained by linear interpolation. For other intermediate values, it is recommended that they are obtained by linear interpolation use in the original ANSI B16.5 figures shown in bold type.

NOTE 3 Temperature conversions from degrees Fahrenheit to degrees Celsius have been rounded to the nearest whole degree; pressure conversions from lbf/in² to bar have used a conversion factor of 1 lbf/in² = 0,0689476 bar and have been rounded to the nearest 0,1 bar.

a 1 bar = 10⁵ N/m² = 10⁵ pa.

Table 22 — Pressure/temperature ratings for EN materials

Material Group	Class	Maximum allowable temperature T_S in °C																				
		- 10 to 20 ^a	50	100	150	200	250	300	350	400	425	450	475	500	510	520	530	540	550	575	600	
1E0	Cl 150	17,7	17,7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 300	46,3	46,3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 600	92,6	92,6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 900	139	139	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 1 500	231	231	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 2 500	386	386	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1E1	Cl 150	17,7	17,7	14,2	13,2	12,2	10,7	9,2	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 300	46,3	46,3	37,0	34,5	31,9	28,0	24,1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 600	92,6	92,6	74,1	68,9	63,8	56,0	48,1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 900	139	139	111	103	95,7	83,9	72,2	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 1 500	231	231	185	172	159	140	120	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 2 500	386	386	309	287	266	233	201	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2E0	Cl 150	18,9	18,9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 300	49,4	49,4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 600	98,7	98,7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 900	148	148	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 1 500	247	247	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 2 500	411	411	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3E0	Cl 150	17,3	17,3	15,4	14,6	13,8	12,1	10,2	8,4	6,5	5,6	4,7	—	—	—	—	—	—	—	—	—	—
	Cl 300	45,3	45,3	40,1	38,1	36,0	32,9	29,8	27,8	25,7	22,2	15,8	—	—	—	—	—	—	—	—	—	—
	Cl 600	90,5	90,5	80,2	76,1	72,0	65,8	59,7	55,5	51,4	44,3	31,5	—	—	—	—	—	—	—	—	—	—
	Cl 900	136	136	120	114	108	98,7	89,5	83,3	77,1	66,5	47,3	—	—	—	—	—	—	—	—	—	—
	Cl 1 500	226	226	201	190	180	165	149	139	129	111	78,9	—	—	—	—	—	—	—	—	—	—
	Cl 2 500	377	377	334	317	300	274	249	231	214	185	131	—	—	—	—	—	—	—	—	—	—
3E1	Cl 150	20,0	19,5	17,7	15,8	14,0	12,1	10,2	8,4	6,5	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 300	51,7	51,7	51,4	48,3	46,3	42,2	38,1	35,0	31,9	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 600	103	103	103	96,7	92,6	84,3	76,1	69,9	63,8	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 900	155	155	154	145	139	127	114	105	95,7	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 1 500	259	259	257	242	231	211	190	175	159	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 2 500	431	431	429	403	386	351	317	291	266	—	—	—	—	—	—	—	—	—	—	—	—

Table 22 (continued)

Material Group	Class	Maximum allowable temperature T_S in °C																					
		- 10 to 20 ^a	50	100	150	200	250	300	350	400	425	450	475	500	510	520	530	540	550	575	600		
4E0	Cl 150	20,0	19,5	17,7	15,8	14,0	12,1	10,2	8,4	6,5	5,6	4,7	3,7	2,8	—	—	—	—	—	—	—	—	
	Cl 300	51,7	51,7	50,4	47,3	44,2	41,1	35,0	32,9	30,9	30,3	29,8	29,3	21,3	—	—	—	—	—	—	—	—	
	Cl 600	103	103,4	100,8	94,6	88,5	82,3	69,9	65,8	61,7	60,7	59,7	58,6	42,5	—	—	—	—	—	—	—	—	—
	Cl 900	155	155	151	142	133	123	105	98,7	92,6	91,0	89,5	87,9	63,8	—	—	—	—	—	—	—	—	—
	Cl 1 500	259	259	252	237	221	206	175	165	154	152	149	147	106	—	—	—	—	—	—	—	—	—
	Cl 2 500	431	431	420	394	369	343	291	274	257	253	249	244	177	—	—	—	—	—	—	—	—	—
	Cl 2 500	20,0	19,5	17,7	15,8	14,0	12,1	10,2	8,4	6,5	5,6	4,7	3,7	2,8	2,4	2,0	1,7	1,4	—	—	—	—	—
5E0	Cl 300	51,7	51,7	51,5	50,2	47,3	45,3	42,2	39,1	36,6	35,1	33,8	31,7	28,2	26,5	21,5	17,8	13,9	11,2	—	—	—	—
	Cl 600	103	103	103	100	94,6	90,5	84,3	78,2	73,1	70,2	67,6	63,3	56,4	53,0	43,0	35,7	27,9	22,4	—	—	—	—
	Cl 900	155	155	155	151	142	136	127	117	110	105	101	95,0	84,6	79,5	64,5	53,5	41,8	33,6	—	—	—	—
	Cl 1 500	259	259	258	251	237	226	211	195	183	175	169	158	141	133	107	89,1	69,7	56,0	—	—	—	—
	Cl 2 500	431	431	429	418	394	377	351	326	305	292	282	264	235	221	179	149	116	93,3	—	—	—	—
	Cl 150	20,0	19,5	17,7	15,8	14,0	12,1	10,2	8,4	6,5	5,6	4,7	3,7	2,8	2,4	2,0	1,7	1,4	—	—	—	—	—
	Cl 300	51,7	51,7	51,5	50,2	48,3	46,3	42,8	40,2	36,6	35,1	33,8	31,7	28,2	26,6	23,5	20,6	17,8	15,5	10,9	7,77	—	—
6E0	Cl 600	103	103	103	100	96,7	92,6	85,7	80,4	73,1	70,2	67,6	63,3	56,4	53,3	47,1	41,1	35,7	31,1	21,7	15,5	—	—
	Cl 900	155	155	155	151	145	139	129	121	110	105	101	95,0	84,6	79,9	70,6	61,7	53,5	46,6	32,6	23,3	—	—
	Cl 1 500	259	259	258	251	242	232	214	201	183	175	169	158	141	133	118	103	89,1	77,7	54,3	38,9	—	—
	Cl 2 500	431	431	429	418	403	386	357	335	305	292	282	264	235	222	196	171	149	130	90,5	64,8	—	—
	Cl 150	20,0	19,5	17,7	15,8	14,0	12,1	10,2	8,4	6,5	5,6	4,7	3,7	2,8	2,4	2,0	1,7	1,4	—	—	—	—	—
	Cl 300	51,7	51,7	51,5	50,2	48,8	46,3	42,8	40,2	36,6	35,1	33,8	31,7	25,8	21,9	18,5	16,0	13,5	11,4	—	—	—	—
	Cl 600	103	103	103	100	97,6	92,6	85,7	80,4	73,1	70,2	67,6	63,3	51,7	43,9	37,0	32,0	27,0	22,9	—	—	—	—
6E1	Cl 900	155	155	155	151	146	139	129	121	110	105	101	95,0	77,5	65,8	55,5	48,0	40,5	34,3	—	—	—	—
	Cl 1 500	259	259	258	251	244	232	214	201	183	175	169	158	129	110	92,6	80,0	67,4	57,1	—	—	—	—
	Cl 2 500	431	431	429	418	407	386	357	335	305	292	282	264	215	183	154	133	112	95,2	—	—	—	—
	Cl 150	20,0	19,5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 300	51,7	51,7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 600	103	103	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 900	155	155	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
7E0	Cl 1 500	259	259	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 2 500	431	431	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 2 500	431	431	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table 22 (continued)

Material Group	Class	Maximum allowable temperature T_S in °C																				
		-10 to 20 ^a	50	100	150	200	250	300	350	400	425	450	475	500	510	520	530	540	550	575	600	
7E1	Cl 150	20,0	19,5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 300	51,7	51,7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 600	103	103	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 900	155	155	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 1 500	259	259	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 2 500	431	431	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
7E2	Cl 150	20,0	19,5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 300	51,7	51,7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 600	103	103	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 900	155	155	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 1 500	259	259	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 2 500	431	431	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
7E3	Cl 150	20,0	19,5	16,6	15,0	13,4	12,1	10,2	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 300	51,7	51,7	43,2	39,1	35,0	31,9	28,8	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 600	103	103	86,4	78,2	69,9	63,8	57,6	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 900	155	155	130	117	105	95,7	86,4	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 1 500	259	259	216	195	175	159	144	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 2 500	431	431	360	326	291	266	240	—	—	—	—	—	—	—	—	—	—	—	—	—	—
8E0	Cl 150	20,0	19,5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 300	51,7	51,7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 600	103	103	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 900	155	155	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 1 500	259	259	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 2 500	431	431	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
8E1	Cl 150	20,0	19,5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 300	51,7	51,7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 600	103	103	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 900	155	155	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 1 500	259	259	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 2 500	431	431	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table 22 (continued)

Material Group	Class	Maximum allowable temperature T_S in °C																					
		- 10 to 20 ^a	50	100	150	200	250	300	350	400	425	450	475	500	510	520	530	540	550	575	600		
8E2	Cl 150	20,0	19,5	17,7	15,8	14,0	12,1	10,2	8,4	6,5	—	—	—	—	—	—	—	—	—	—	—	—	
	Cl 300	51,7	51,7	48,3	44,4	40,3	36,4	30,2	26,1	22,2	—	—	—	—	—	—	—	—	—	—	—	—	
	Cl 600	103	103	96,7	88,9	80,6	72,8	60,5	52,3	44,4	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 900	155	155	145	133	121	109	90,7	78,4	66,7	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 1 500	259	259	242	222	202	182	151	131	111	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 2 500	431	431	403	370	336	303	252	218	185	—	—	—	—	—	—	—	—	—	—	—	—	—
8E3	Cl 150	20,0	19,5	17,7	15,8	14,0	12,1	10,2	8,4	6,5	—	—	—	—	—	—	—	—	—	—	—	—	
	Cl 300	51,7	51,7	51,5	50,2	48,8	46,3	42,8	40,2	34,4	—	—	—	—	—	—	—	—	—	—	—	—	
	Cl 600	103	103	103	100	97,6	92,6	85,7	80,4	68,7	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 900	155	155	155	151	146	139	129	121	103	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 1 500	259	259	258	251	244	232	214	201	172	—	—	—	—	—	—	—	—	—	—	—	—	—
	Cl 2 500	431	431	429	418	407	386	357	335	286	—	—	—	—	—	—	—	—	—	—	—	—	—
9E0	Cl 150	20,0	19,5	17,7	15,8	14,0	12,1	10,2	8,4	6,5	5,6	4,7	3,7	2,8	2,4	2,0	1,7	1,4	—	—	—	—	—
	Cl 300	51,7	51,7	51,5	50,2	48,8	46,3	42,8	40,2	36,6	35,1	33,8	31,7	28,2	26,6	26,1	25,5	25,0	25,0	20,1	13,5	—	—
	Cl 600	103	103	103	100	97,6	92,6	85,7	80,4	73,1	70,2	67,6	63,3	56,4	53,3	52,1	51,0	50,1	49,9	40,2	27,0	—	—
	Cl 900	155	155	155	151	146	139	129	121	110	105	101	95,0	84,6	79,9	78,2	76,5	75,1	74,9	60,3	40,5	—	—
	Cl 1 500	259	259	258	251	244	232	214	201	183	175	169	158	141	133	130	127	125	125	101	67,4	—	—
	Cl 2 500	431	431	429	418	407	386	357	335	305	292	282	264	235	222	217	212	209	208	168	112	—	—
10E0	Cl 150	18,4	16,6	13,5	12,1	10,9	9,9	9,2	8,4	6,5	5,6	4,7	3,7	2,8	2,4	2,0	1,7	1,4	—	—	—	—	—
	Cl 300	48,0	43,2	35,3	31,7	28,3	25,9	24,0	22,6	21,4	20,9	20,4	19,9	19,4	19,4	16,6	16,5	16,5	16,5	—	—	—	—
	Cl 600	96,0	86,5	70,6	63,4	56,6	51,8	48,0	45,1	42,7	41,8	40,8	39,8	38,9	38,8	33,2	33,1	33,0	32,9	—	—	—	—
	Cl 900	144	130	105,8	95,0	85,0	77,8	72,0	67,7	64,1	62,6	61,2	59,8	58,3	58,2	49,7	49,6	49,5	49,4	—	—	—	—
	Cl 1 500	240	216	176	158	142	130	120	112,8	106,8	104,4	102,0	99,6	97,2	97,0	82,9	82,7	82,5	82,3	—	—	—	—
	Cl 2 500	400	360	294	264	236	216	200	188	178	174	170	166	162	162	138	138	137	137	—	—	—	—
10E1	Cl 150	20,0	19,5	17,7	15,8	14,0	12,1	10,2	8,4	6,5	5,6	4,7	3,7	2,8	2,4	2,0	1,7	1,4	—	—	—	—	—
	Cl 300	51,7	51,7	49,2	42,0	37,7	34,8	32,6	31,2	30,0	29,5	29,0	28,8	28,2	26,6	24,4	24,4	24,3	24,3	24,3	23,2	20,3	—
	Cl 600	103	103	98,4	84,0	75,4	69,6	65,3	62,4	60,0	59,0	58,1	57,6	56,4	53,3	48,8	48,7	48,6	48,5	46,4	40,7	—	—
	Cl 900	155	155	148	126	113	104	97,9	93,6	90,0	88,6	87,1	86,4	84,6	79,9	73,2	73,1	72,9	72,8	69,6	61,0	—	—
	Cl 1 500	259	259	246	210	188	174	163	156	150	148	145	144	141	133	122	122	122	121	116	102	—	—
	Cl 2 500	431	431	410	350	314	290	272	260	250	246	242	240	235	222	203	203	203	202	193	170	—	—

Table 22 (continued)

Material Group	Class	Maximum allowable temperature T_S in °C																				
		-10 to 20 ^a	50	100	150	200	250	300	350	400	425	450	475	500	510	520	530	540	550	575	600	
		Maximum allowable pressure P_S in bar																				
11E0	Cl 150	18,4	16,9	14,4	13,1	11,7	10,9	10,1	8,4	6,5	5,6	4,7	3,7	2,8	2,4	2,0	1,7	1,4	—	—	—	—
	Cl 300	48,0	44,1	37,7	34,1	30,5	28,3	26,4	25,0	23,5	23,2	22,8	22,4	22,1	22,0	18,8	18,7	18,6	18,5	—	—	—
	Cl 600	96,0	88,3	75,4	68,2	61,0	56,6	52,8	49,9	47,0	46,3	45,6	44,9	44,2	44,0	37,5	37,4	37,2	37,0	—	—	—
	Cl 900	144	132,4	113,0	102,2	91,4	85,0	79,2	74,9	70,6	69,5	68,4	67,3	66,2	66,0	56,3	56,0	55,8	55,5	—	—	—
	Cl 1 500	240	221	188	170	152	142	132	125	118	116	114	112	110	110	94	93	93	93	—	—	—
	Cl 2 500	400	368	314	284	254	236	220	208	196	193	190	187	184	183	156	156	155	154	—	—	—
12E0	Cl 150	18,4	17,6	16,2	15,4	14,0	12,1	10,2	8,4	6,5	5,6	4,7	3,7	2,8	2,4	2,0	1,7	1,4	—	—	—	—
	Cl 300	48,0	45,8	42,2	40,1	37,7	35,3	32,6	31,2	30,0	29,5	29,0	28,8	28,2	26,6	24,4	24,4	24,3	24,3	23,9	19,7	—
	Cl 600	96,0	91,7	84,5	80,2	75,4	70,6	65,3	62,4	60,0	59,0	58,1	57,6	56,4	53,3	48,8	48,7	48,6	48,5	47,9	39,3	—
	Cl 900	144	138	127	120	113	106	97,9	93,6	90,0	88,6	87,1	86,4	84,6	79,9	73,2	73,1	72,9	72,8	71,8	59,0	—
	Cl 1 500	240	229	211	200	188	176	163	156	150	148	145	144	141	133	122	122	122	121	120	98,3	—
	Cl 2 500	400	382	352	334	314	294	272	260	250	246	242	240	240	235	203	203	203	202	199	164	—
13E0	Cl 150	17,5	16,7	15,3	14,0	12,60	11,7	10,2	8,4	6,5	5,6	4,7	3,7	2,8	—	—	—	—	—	—	—	—
	Cl 300	45,6	43,4	39,8	36,5	32,9	30,5	28,3	27,1	25,9	25,3	24,7	24,4	24,0	—	—	—	—	—	—	—	—
	Cl 600	91,2	86,9	79,7	73,0	65,8	61,0	56,6	54,2	51,8	50,6	49,4	48,7	48,0	—	—	—	—	—	—	—	—
	Cl 900	137	130	120	109	98,6	91,4	85,0	81,4	77,8	76,0	74,2	73,1	72,0	—	—	—	—	—	—	—	—
	Cl 1 500	228	217	199	182	164	152	142	136	130	127	124	122	120	—	—	—	—	—	—	—	—
	Cl 2 500	380	362	332	304	274	254	236	226	216	211	206	203	200	—	—	—	—	—	—	—	—
13E1	Cl 150	20,0	19,5	17,7	15,8	14,0	12,1	10,2	8,4	6,5	5,6	4,7	3,7	2,8	—	—	—	—	—	—	—	—
	Cl 300	51,7	51,7	50,6	44,4	40,1	37,2	34,8	33,6	32,4	32,0	31,6	31,1	28,2	—	—	—	—	—	—	—	—
	Cl 600	103	103	101,3	88,8	80,2	74,4	69,6	67,2	64,8	64,0	63,1	62,3	56,4	—	—	—	—	—	—	—	—
	Cl 900	155	155	152	133	120	112	104	101	97,2	95,9	94,7	93,4	84,6	—	—	—	—	—	—	—	—
	Cl 1 500	259	259	253	222	200	186	174	168	162	160	158	156	141	—	—	—	—	—	—	—	—
	Cl 2 500	431	431	422	370	334	310	290	280	270	267	263	260	235	—	—	—	—	—	—	—	—
14E0	Cl 150	18,9	17,9	16,3	14,9	13,5	12,1	10,2	8,4	6,5	5,6	4,7	3,7	2,8	2,4	2,0	1,7	1,4	—	—	—	—
	Cl 300	49,2	46,7	42,5	38,9	35,3	32,9	30,5	28,8	27,6	27,2	26,9	26,6	26,4	26,3	22,5	22,4	22,3	22,2	—	—	—
	Cl 600	98,4	93,4	85,0	77,8	70,6	65,8	61,0	57,6	55,2	54,5	53,8	53,3	52,8	52,6	44,9	44,8	44,6	44,4	—	—	—
	Cl 900	148	140	127	117	106	98,6	91,4	86,4	82,8	81,7	80,6	79,9	79,2	78,9	67,4	67,1	66,9	66,7	—	—	—
	Cl 1 500	246	233	212	194	176	164	152	144	138	136	134	133	132	132	112	112	111	111	—	—	—
	Cl 2 500	410	389	354	324	294	274	254	240	230	227	224	222	220	219	187	187	186	185	—	—	—

Table 22 (concluded)

Material Group	Class	Maximum allowable temperature T_S in °C																					
		- 10 to 20 ^a	50	100	150	200	250	300	350	400	425	450	475	500	510	520	530	540	550	575	600		
15E0	Cl 150	19,3	18,5	17,0	15,8	14,0	12,1	10,2	8,4	6,5	5,6	4,7	3,7	2,8	2,4	2,0	1,7	1,4	—	—	—	—	
	Cl 300	50,4	48,2	44,4	42,5	40,1	37,7	34,8	33,6	32,4	31,9	31,4	31,2	28,2	26,6	26,1	25,5	25,0	25,0	23,9	21,4	21,4	
	Cl 600	101	96,3	88,8	85,0	80,2	75,4	69,6	67,2	64,8	63,8	62,9	62,4	56,4	53,3	52,1	51,0	50,1	49,9	49,9	47,9	42,9	42,9
	Cl 900	151	144	133	127	120	113	104	101	97,2	95,8	94,3	93,6	84,6	79,9	78,2	76,5	75,1	74,9	74,9	71,8	64,3	64,3
	Cl 1 500	252	241	222	212	200	188	174	168	162	160	157	156	141	133	130	127	125	125	125	120	107	107
	Cl 2 500	420	401	370	354	334	314	290	280	270	266	262	260	235	222	217	212	209	208	208	199	179	179
16E0	Cl 150	20,0	19,5	17,7	15,8	14,0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	Cl 300	51,7	51,7	51,5	50,2	48,8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	Cl 600	103	103	103	100	97,6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	Cl 900	155	155	155	151	146	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	Cl 1 500	259	259	258	251	244	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	Cl 2 500	431	431	429	418	407	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	

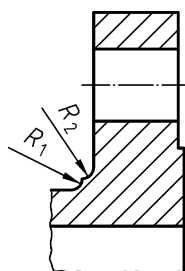
NOTE For the evaluation of the ratings the cast materials are excluded. The stresses are normally lower than those of forging and plate. As the cast flange is an integrally part of a body, so only flange thickness and mating dimensions are "fixed". Using all "open" dimensions, the flange can be individually designed to fulfill the rating of the group.

^a Interpolation for — Ferritic materials from 50 °C and next given value, for
— austenitic materials from 20 °C to next given value.

The lowest service temperature (below – 10 °C) for the materials are given in the material standards and/or application codes.

Table 23 — Minimum fillet radius at the hub after back facing

Flange size	R_2 min. mm
Up to and including DN 50	2
Over DN 50 and up to and including DN 200	3
Over DN 200	5



NOTE For dimensions of R_1 see Tables 9 to 14.

Figure 14 — Minimum fillet radius at the hub after back facing

Annex A (informative)

Recommendations for weld ends of weld-neck flanges

Recommendations for welding neck flange ends of wall thickness up to 22,2 mm and greater than 22,2 mm are given in Figures A.1 to A.4.

Additional types of welding ends are specified in EN ISO 9692-2 and example of designs in EN 1708-1 and may be used by agreement between the equipment manufacturer and the flange manufacturer.

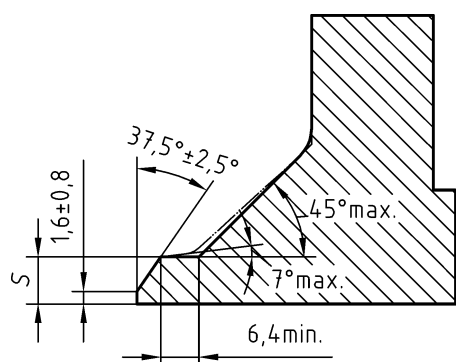


Figure A.1 — Bevel for wall thicknesses (s) up to 22,2 mm

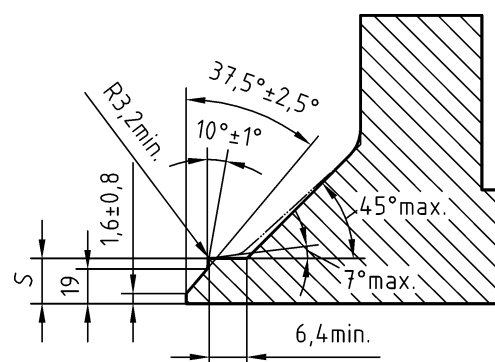


Figure A.2 — Bevel for wall thicknesses (s) greater than 22,2 mm

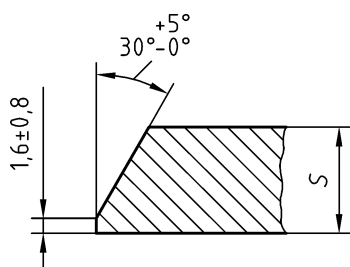


Figure A.3 — Alternative bevel for wall thicknesses (s) up to 22,2 mm

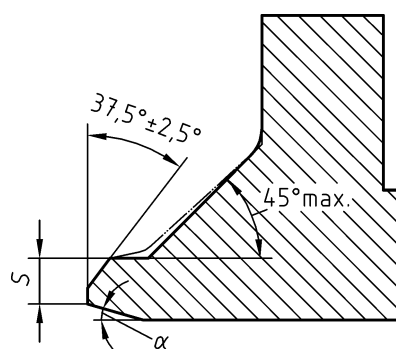


Figure A.4 — Acceptable bevel designs for unequal wall thicknesses

Linear dimensions are in millimetres.

NOTE 1 For flanges required to connect to ferritic steel pipe of nominal wall thickness less than 4,8 mm the welding ends should be finished to a slight chamfer or be square, at the option of the manufacturer.

NOTE 2 For flanges required to connect to austenitic stainless steel pipe of nominal wall thickness 3,2 mm or less, the welding ends should be finished to a slight chamfer.

NOTE 3 For dimensions of weld-neck flanges see Tables 9 to 14.

NOTE 4 s = nominal wall thickness.

Annex B (informative)

Classification of bolting materials

Table B.1 — Classification of bolting materials^a

Bolting according to EN 1515-1			Diameter mm	Classification
Line	Material	Standard		
01	4.6	EN ISO 898-1	all	Low strength
02	5.6	EN ISO 898-1	all	Intermediate strength
04	8.8	EN ISO 898-1	all	High strength
05, 07	25CrMo4	EN 10269	all	High strength
06, 08	42CrMo4	EN 10269	all	High strength
09	30CrNiMo8	EN 10269	all	High strength
10	42CrMo5-6	EN 10269	all	High strength
11	40CrMoV4-6	EN 10269	all	High strength
12	21CrMoV5-7	EN 10269	all	High strength
13	20CrMoVTiB4-10	EN 10269	all	High strength
14	X6NiCrTiMoVB 25-15-2	EN 10269	all	Intermediate strength
15	X7CrNiMoBNb16-16	EN 10269	all	High strength
16, 18	A4-50, A2-50	EN ISO 3506-1	< = 39	Low strength
17, 19	A4-70, A2-70	EN ISO 3506-1	< = 24	High strength
20	X5CrNiMo17-12-2 AT	EN 10269	all	Low strength
21	X5CrNiMo17-12-2 AT+C	EN 10269	all	Intermediate strength
22	X5CrNi18-10	EN 10269	all	Low strength
23	X5CrNi18-10 AT+C	EN 10269	all	Intermediate strength
NOTE 1	High strength bolting (allowable stress 170 N/mm ² and above) may be used in any flanged joint.			
NOTE 2	Intermediate strength bolting may be used in any flanged joint, provided the ability according to 5.3.1 is verified.			
NOTE 3	Low strength bolting (yield stress 210 N/mm ² and below) is restricted to CL 150 and CL 300.			
^a Compliance with 5.3.1 shall be verified, with special consideration of the gasket.				

Annex C (informative)

Use of metric bolting in lieu of imperial bolting

C.1 General

Whilst not recommended, if users prefer or require to use metric bolting in lieu of the imperial bolting given in Tables 9 to 14, C.3 gives the comparable metric bolt sizes that have been agreed in the preparation of ISO 7005. The guidance notes on gasket assembly given in C.2 should be carefully observed (see Tables C.1 and C.2).

C.2 Gaskets

WARNING Users should note that the centring of an inside bolt circle gasket in an assembled flange joint will be affected when using metric bolting. In bolt sizes up to and including 1½, the metric comparable sizes tend to be larger in diameter, whilst above this size they tend to be smaller. It is essential therefore that great care be taken to ensure that gaskets are centred properly.

However, dependant on the tolerances, which have been used it should be possible to fit the normal imperial dimensioned gasket when using metric bolting in existing imperial holes.

C.3 Comparable nominal bolt sizes

If metric bolting is to be used, the comparable imperial and metric nominal bolt sizes are as given in Table C.1.

Table C.1 — Nominal bolt sizes

Imperial	½	⅝	¾	⅞	1	1⅝	1¼	1½
Metric	M14	M16	M20	M24	M27	M30	M33	M39

To enable users to ascertain precisely the differences in the two systems, Table C.2 is given for reference.

Table C.2 — Imperial/metric bolt comparisons

Bolt diameter					Difference	Bolt hole diameter	Clearance
Imperial		Metric					
Size	Diameter		Size	Diameter	mm	mm	mm
	inches	mm					
½	0,50	12,70	M14	14,00	+1,30	15,88	1,88
⅝	0,63	15,88	M16	16,00	+0,13	19,05	3,05
¾	0,75	19,05	M20	20,00	+0,95	22,23	2,23
⅞	0,88	22,23	M24	24,00	+1,78	25,40	1,40
1	1,00	25,40	M27	27,00	+1,60	28,58	1,58
1⅛	1,13	28,58	M30	30,00	+1,43	31,75	1,75
1¼	1,25	31,75	M33	33,00	+1,25	34,93	1,93
1⅜	1,38	34,93	M36	36,00	+1,08	38,10	2,10
1½	1,50	38,10	M39×4	39,00	+0,90	41,28	2,28
1⅝	1,63	41,28	M42×4	42,00	+0,73	44,40	2,40
1⅞	1,88	47,63	M48×4	48,00	+0,38	50,80	2,80
2	2,00	50,80	M52×4	52,00	+1,20	54,00	2,00
2¼	2,25	57,15	M56×4	56,00	- 1,15	60,30	4,30
2½	2,50	63,50	M64×4	64,00	+0,50	66,70	2,70
2¾	2,75	69,85	M68×4	68,00	- 1,85	73,00	5,00
3	3,00	76,20	M76×4	76,00	- 0,20	79,40	3,40
3½	3,50	88,90	M90×4	90,00	+1,10	92,00	2,00

Annex D (informative)

Determination of p/T ratings for flanges using EN materials

Table D.1 — Allowable temperatures

Applicable to Groups 1E0 to 9E0	Applicable to Groups 10E0 to 16E0
Temperature – 29 °C to 375 °C The lowest of: — 60 % of the 0,2 % proof stress – $R_{p0,2}$ at RT — 60 % of the 0,2 % proof stress – $R_{p0,2}$ at T — $1,25 \times$ allowable stress at temp. T (see below)	Temperature – 29 °C to 510 °C The lowest of: — 70 % of the 0,2 % proof stress – $R_{p0,2}$ at RT — 70 % of the 0,2 % proof stress – $R_{p0,2}$ at T — $1,25 \times$ allowable stress at temp. T (see below)
Temperature > 375 °C The lowest of: — 60 % of the 0,2 % proof stress — $R_{p0,2}$ at T — $1,00 \times$ allowable stress at temp. T (see below)	Temperature > 510 °C The lowest of: — 60 % of the 0,2 % proof stress — $R_{p0,2}$ at T — $1,00 \times$ allowable stress at temp. T (see below)
allowable stress = the lowest of: $\frac{R_{m,RT}}{3}$ or $\frac{0,2 \text{ \% Proof Stress}}{1,5}$ or $\frac{\text{Stress to Rupture in 100 000 hrs.}}{1,5}$	allowable stress = the lowest of: $\frac{R_{m,RT}}{3}$ or $\frac{0,2 \text{ \% Proof Stress}}{1,5}$ or $\frac{\text{Stress to Rupture in 100 000 hrs.}}{1,5}$

D.1 Allowable pressure (bar)

- Class 2 500 Allowable Pressure = $\frac{\text{Selected Stress} \times 10 \times 2\,500}{8\,750}$
- Class 1 500 Allowable Pressure = Class 2 500 Allowable Pressure $\times \frac{1\,500}{2\,500}$
- For Class 300, 600 & 900 Allowable Pressure, use 300 etc. instead of 1 500
- Class 150 Allowable Pressure, use ASME B16.5:1996 rules.

D.2 Maximum p/T ratings

The allowable pressure shall not exceed the ceiling pressure — temperature ratings shown in Table D1 of ASME B16.5:1996, they are imposed to limit deflections.

NOTE 1 D1 is in psig/°F units and needs conversion to bar/°C using linear interpolation.

NOTE 2 The rules of this annex are given for information only.

Annex E (normative)

Approximate masses of flanges and collars

Tables E.1 to E.6 give calculated masses of raised face flanges, which may be used for guidance only.

These calculated masses are based on nominal dimensions given in Tables 9 to 14, and on densities of $7,85 \text{ g/cm}^3$ for steel materials.

The actual masses may vary from the calculated masses due to dimensional variations within the permitted tolerances given in Table 15.

Table E.1 — Masses of flanges Class 150

Masses in kilograms

DN	Type						
	01	05	11	12	13	14	15
15	0,42	0,42	0,49	0,39	0,41	0,40	0,45
20	0,61	0,61	0,72	0,56	0,57	0,57	0,62
25	0,85	0,86	1,05	0,78	0,80	0,79	0,85
32	1,11	1,16	1,38	1,02	1,05	1,05	1,10
40	1,39	1,53	1,77	1,32	1,37	1,35	1,41
50	2,18	2,41	2,64	2,05	2,12	2,10	2,17
65	3,46	3,95	4,21	3,28	3,40	3,38	3,45
80	4,05	4,90	5,04	3,83	3,99	3,96	3,99
100	5,76	7,03	7,13	5,33	5,56	—	5,53
125	6,63	8,63	8,98	6,08	6,45	—	6,26
150	8,29	11,30	11,00	7,42	7,90	—	7,67
200	13,15	19,65	18,24	12,12	—	—	12,46
250	18,39	28,74	24,94	16,46	—	—	16,87
300	29,89	43,43	38,28	26,28	—	—	26,89
350	37,48	57,99	50,35	34,49	—	—	39,47
400	50,52	76,05	62,55	44,85	—	—	51,75
450	58,99	93,72	71,07	48,89	—	—	57,13
500	72,86	122,27	87,56	61,77	—	—	71,59
600	96,74	185,27	119,59	87,17	—	—	99,52

Table E.2 — Masses of flanges Class 300

Masses in kilograms

DN	Type						
	01	05	11	12	13	14	15
15	—	0,64	0,77	0,64	0,66	0,66	0,70
20	—	1,10	1,30	1,11	1,13	1,14	1,21
25	—	1,39	1,64	1,36	1,40	1,41	1,47
32	—	1,78	2,09	1,67	1,72	1,72	1,79
40	—	2,67	3,00	2,51	2,57	2,57	2,66
50	—	3,17	3,52	2,87	2,96	2,97	3,01
65	—	4,83	5,32	4,30	4,46	4,49	4,48
80	—	6,84	7,19	5,87	6,10	6,17	6,07
100	—	11,52	11,63	9,64	9,98	—	9,94
125	—	15,51	15,52	12,14	12,65	—	12,42
150	—	20,95	19,91	15,69	16,32	—	16,14
200	—	34,35	30,89	24,21	—	—	24,77
250	—	53,23	44,34	33,97	—	—	39,23
300	—	78,86	64,04	49,92	—	—	56,60
350	—	105,40	89,10	69,51	—	—	81,63
400	—	137,77	111,00	88,49	—	—	105,12
450	—	175,18	136,08	108,38	—	—	128,16
500	—	221,43	164,68	134,30	—	—	158,03
600	—	338,78	238,07	201,06	—	—	236,32

Table E.3 — Masses of flanges Class 600

Masses in kilograms

DN	Type						
	01	05	11	12	13	14	15
15	—	0,76	0,89	0,74	0,76	0,76	0,70
20	—	1,27	1,49	1,26	1,29	1,29	1,21
25	—	1,61	1,88	1,53	1,57	1,58	1,47
32	—	2,22	2,55	2,02	2,08	2,09	1,93
40	—	3,27	3,62	2,99	3,06	3,08	2,86
50	—	4,14	4,49	3,61	3,73	3,78	3,42
65	—	6,10	6,61	5,24	5,44	5,53	5,00
80	—	8,51	8,85	7,05	7,33	7,49	6,70
100	—	17,27	17,92	14,51	14,94	—	14,00
125	—	29,38	30,01	24,38	25,05	—	23,70
150	—	36,15	36,20	28,84	29,71	—	28,10
200	—	58,89	55,59	43,37	—	—	42,33
250	—	97,54	89,52	70,26	—	—	75,37
300	—	124,21	107,02	84,25	—	—	90,66
350	—	151,00	126,83	98,87	—	—	108,32
400	—	213,77	176,16	142,20	—	—	155,50
450	—	272,28	210,79	173,52	—	—	188,28
500	—	349,81	262,82	220,69	—	—	242,23
600	—	533,60	368,57	312,90	—	—	346,29

Table E.4 — Masses of flanges Class 900

Masses in kilograms

DN	Type						
	01	05	11	12	13	14	15
80	—	13,07	14,02	11,58	11,91	—	11,22
100	—	22,10	23,12	19,73	20,27	—	19,20
125	—	36,46	37,05	31,88	32,75	—	31,17
150	—	47,44	49,23	41,14	42,25	—	40,40
200	—	82,53	84,17	70,72	—	—	72,75
250	—	122,44	122,85	100,45	—	—	105,98
300	—	173,67	162,88	133,13	—	—	141,89
350	—	206,09	186,20	153,24	—	—	162,40
400	—	259,52	224,24	185,08	—	—	200,10
450	—	366,87	301,27	258,06	—	—	279,92
500	—	463,67	373,75	316,70	—	—	351,14
600	—	875,65	681,13	604,92	—	—	672,06

Table E.5 — Masses of flanges Class 1500

Masses in kilograms

DN	Type						
	01	05	11	12	13	14	15
15	—	1,78	1,91	1,75	1,78	1,79	1,72
20	—	2,41	2,59	2,33	2,36	2,39	2,28
25	—	3,56	3,77	3,42	3,48	3,53	3,36
32	—	4,16	4,42	3,93	4,01	4,07	3,84
40	—	5,78	6,08	5,40	5,50	5,57	5,27
50	—	10,08	11,14	9,87	10,05	10,22	9,67
65	—	13,93	15,34	13,62	13,92	14,20	13,37
80	—	19,18	20,34	—	18,35	—	17,55
100	—	29,93	30,56	—	28,46	—	27,23
125	—	58,51	58,15	—	53,06	—	51,17
150	—	72,02	70,16	—	62,78	—	60,51
200	—	121,91	119,78	—	—	—	102,32
250	—	210,62	204,65	—	—	—	180,64
300	—	315,83	304,04	—	—	—	284,28
350	—	420,57	399,73	—	—	—	383,75
400	—	559,16	508,66	—	—	—	493,98
450	—	759,99	659,54	—	—	—	636,46
500	—	965,37	806,96	—	—	—	765,15
600	—	1 556,84	1 278,03	—	—	—	1 220,79

Table E.6 — Masses of flanges Class 2500

Masses in kilograms

DN	Type						
	01	05	11	12	13	14	15
15	—	2,98	3,23	—	2,97	—	2,91
20	—	3,52	3,90	—	3,51	—	3,42
25	—	4,99	5,53	—	4,91	—	4,78
32	—	7,34	8,19	—	7,23	—	7,04
40	—	10,38	11,48	—	10,12	—	9,86
50	—	15,58	17,22	—	15,05	—	14,63
65	—	22,68	25,44	—	21,88	—	21,25
80	—	34,88	38,92	—	33,18	—	32,26
100	—	54,11	60,07	—	50,74	—	49,35
125	—	90,76	100,27	—	84,40	—	82,20
150	—	141,64	156,37	—	130,14	—	127,45
200	—	214,06	233,79	—	—	—	186,30
250	—	410,84	445,71	—	—	—	353,61
300	—	592,20	628,13	—	—	—	501,81

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