

Circular flanges for pipes, valves and fittings (Class designated) —

**Part 3: Steel, cast iron and copper alloy
flanges —**

**Section 3.1 Specification for steel
flanges**

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Committees responsible for this British Standard

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- British Chemical Engineering Contractors' Association
- British Compressed Gases Association
- British Fluid Power Association
- British Foundry Association
- British Gas plc
- British Malleable Tube Fittings' Association
- British Maritime Technology
- British Non-ferrous Metals Federation
- British Pump Manufacturers' Association
- British Steel Industry
- British Valve and Actuator Manufacturers' Association Ltd.
- Combustion Engineering Association
- Copper Development Association
- Department of Trade and Industry (National Engineering Laboratory)
- Ductile Iron Producers' Association
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- Engineering Equipment and Materials Users' Association
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- High Pressure Pipework Consultative Committee
- Institution of Gas Engineers
- Institution of Mechanical Engineers
- Institution of Production Engineers
- Institution of Water and Environmental Management (IWEM)
- Water Authorities Association

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Foreword

This Section of BS 1560 has been prepared under the direction of the Piping Systems Components Standards Policy Committee and constitutes the first revision of BS 1560-2:1970. BS 1560-2 will be withdrawn 12 months after the publication of this Section of BS 1560. For PN designated steel flanges, reference should be made to BS 4504-3.1.

It was originally intended that BS 1560-2:1970 would be superseded by a British Standard technically equivalent (or identical) to an International Standard for a single series of flanges when finalized by ISO¹⁾/TC 5/SC 10, Metallic flanges and their joints. However, the International Standard has not been finalized but this revision of BS 1560-2:1970 incorporates the principles of the international work.

To align with the format of ISO 7005, BS 1560-3 will be published in three Sections.

- *Section 3.1: Specification for steel flanges;*
- *Section 3.2: Specification for cast iron flanges²⁾;*
- *Section 3.3: Specification for copper alloy and composite flanges.*

BS 1560-2:1970 was based on American standard ANSI B16.5 published by the American National Standards Institute, and, until such time as ISO 7005-1²⁾, Steel flanges is published, and BS 1560 is further revised, this Part of BS 1560 continues to specify steel flanges that are interchangeable with flanges made to ANSI B16.5.

In ANSI B16.5 some dimensions are rounded decimal inches; however, in Section of BS 1560, all metric dimensions have been calculated from the original ANSI B16.5 fractional inch sizes.

The flanges specified in this Section of BS 1560 are intended to be interchangeable with, but not necessarily identical in every detail to, steel flanges manufactured to BS 1560-2:1970.

This Section of BS 1560 differs from BS 1560-2:1970 for the content covering the steel flange requirements in the following respects.

- a) In this Section of BS 1560 the descriptions of the various types of flanges have been augmented with code numbers. The code numbers adopted are based on the type numbers specified in ISO 7005-1.
- b) Plate flanges for welding, for Class 150 designations only, are included for the first time.
- c) The 3¹/₂ in nominal size has been omitted.
- d) Class 400 flanges have been omitted.
- e) The pressure/temperature ratings are based on ANSI B16.5 and it should be noted that there are some differences to the ratings given in BS 1560-2:1970.
- f) Materials specified have been revised, new materials added and reference is made to comparable ASTM³⁾ materials. Generally, the range of materials corresponds to those given in ISO 7005-1.
- g) All flange dimensions are within approximately 0.5 mm of the proposed International Standard and ANSI B16.5 metric dimensions so the flange dimensions of BS 1560-2:1970 generally have been retained. Inch dimensions have been retained for bolt holes to accommodate inch dimensioned bolts.
- h) Due to minor differences in the dimensions of ring joint facings between BS 1560-2:1970, ANSI B16.5 and ISO 7005-1, the ring joint dimensions in this Section of BS 1560 have been re-calculated from the ANSI fractional inch sizes.

¹⁾ International Organization for Standardization.

²⁾ In preparation.

³⁾ American Society for Testing and Materials.

- i) Tolerances have been compiled from requirements given in BS 1560-2:1970 and ISO 7005-1.
- j) Requirements for the surface finish of flange faces have been given in greater detail.
- k) The small spigot and recess flange facings (previously designated as small male and small female) and small tongue and groove facings have been omitted from this Section of BS 1560 since no requirements exist nationally. Therefore throughout this Section of BS 1560 reference is made to spigot/recess facings which correspond to the previously designated large male and large female and to tongue and groove facings which correspond to the previously designated large tongue and groove.
- l) Spot facing or back facing complies with ISO 7005-1.
- m) The marking of flanges is basically in accordance with the principles of ISO 7005-1 but limitations on the methods are included.
- n) For threaded flanges, BS 21 thread form is specified in addition to ANSI/ASME B1.20.1 and API 5B.
- o) Appendix A lists information that should be supplied by the purchaser when ordering flanges.
- p) Guidance notes and recommendations contained in BS 1560-2:1970 and similar notes in ISO 7005-1 have been included in Appendix B. Appendix B is not intended to be exhaustive.
- q) Since BS 1560-2:1970 was published the lengths of stud bolts and headed bolts have been increased by $\frac{1}{4}$ inch in ANSI B16.5 in many cases. These revised lengths have been incorporated in this Section of BS 1560 (see Appendix D). Furthermore, since bolt sizes are expressed in inches in this Section of BS 1560, it has been agreed that it is more logical to express the lengths of bolts in inches also.
- r) For information, pipe dimensions for flanges are given in Appendix F. The nominal size of a flange is the same as the corresponding nominal pipe size.
- s) Details of minimum hub radius after back facing are included.
- t) This Section of BS 1560 specifies inch bolting only and the use of metric bolting is outside the scope of this Section of BS 1560. Appendix G gives the proposed metric bolt sizes to be used in lieu of the inch sizes specified, together with appropriate warnings.
- u) The specification of gasket types, materials and dimensions previously contained in BS 1560-2:1970 have been omitted from this Section of BS 1560.

Dimensions of gaskets for use with steel flanges to BS 1560-3.1 are specified in the following British Standards.

BS 3381, *Specification for spiral-wound gaskets for use with steel flanges to BS 1560.*

BS 7076, *Dimensions of gaskets for flanges to BS 1560 — Part 1 Specification for non-metallic flat gaskets — Part 2 Specification for metallic ring-joint gaskets — Part 3 Specification for non-metallic envelope gaskets — Part 4 Specification for corrugated, flat or grooved metallic and filled metallic gaskets.*

For comparison purposes, the descriptions of flanges used in this Section of BS 1560 are compared with the descriptions given in Appendix H of BS 1560-2:1970.

Assessed capability. Users of this Section of BS 1560 are advised to consider the desirability of assessment and registration of a supplier's quality systems against the appropriate Part of BS 5750 by a third party certification body.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to vi, pages 1 to 48, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This Section of BS 1560 specifies requirements for Class designated circular steel flanges of Class 150 to Class 2500 and in nominal sizes up to 24 in of the type given in Table 1.

Table 1 — Types of steel flange

Code no. ^a	Description
101	Plate flange for welding
105	Blank flange
111	Weld-neck flange
112	Hubbed slip-on flange for welding
113	Hubbed threaded flange
114	Hubbed socket-weld flange
115	Loose hubbed flange for lapped pipe end ^b
121	Integral flange
NOTE Flanges and facings may be designated by code number and facing letter or by description as given in Figure 1 and Figure 2 respectively.	
^a Code numbers have been made non-consecutive to permit possible future additions.	
^b Sometimes referred to in industry as lapped flange.	

This Section of BS 1560 specifies types of steel flanges and their facings, dimensions, tolerances, threading, bolt sizes, flange face surface finish, marking, materials for bolting and flange materials together with associated pressure/temperature ratings.

The weld end preparation of weld-neck (code 111) flanges (see 7.4) and the routine inspection and testing of flanges are outside the scope of this Section of BS 1560 but some guidance on maximum test pressure is given in Appendix B.

NOTE 1 To assist purchasers Appendix A lists information which should be supplied when ordering flanges.

NOTE 2 The titles of publications referred to in this standard are listed on the inside back cover.

2 Ranges of nominal sizes

The ranges of nominal sizes from $\frac{1}{2}$ to 24 applicable to each flange type and for each Class designation shall be as given in Table 2.

3 Class designations and pressure/temperature ratings

3.1 Class designations

The range of Class designations shall be as follows:

Class 150;
Class 300;
Class 600;
Class 900;
Class 1500;
Class 2500.

3.2 Pressure/temperature ratings

The pressure/temperature ratings of the flanges manufactured from the materials specified in Table 3 shall be as given in Table 16 to Table 21 for applicable materials and shall be the maximum allowable non-shock working gauge pressure at the temperature shown.

NOTE 1 Linear interpolation is permitted for intermediate temperatures. The relevant pressures and temperatures are those of the fluid in the pipework system.

NOTE 2 The rating of flanges is not necessarily the rating of the whole pipework system. Gasket materials can also impose limitations on the pressure/temperature rating of a flanged joint and the gasket manufacturer should be consulted when selecting the material of the gasket.

3.3 Rating of flanged joints

If two flanges in a flanged joint do not have the same pressure/temperature rating, the maximum permissible working pressure of the joint at any temperature shall not exceed the lower of the two pressure ratings.

4 Materials

4.1 Flange materials

Flanges shall be manufactured from materials selected from Table 3 except that codes 111, 112, 113, 114 and 115 flanges shall be manufactured from a forging or casting.

NOTE 1 The materials specified in Table 3 are tabulated in groups having common pressure/temperature ratings as given in Table 16 to Table 21.

NOTE 2 The purchaser should state in the enquiry and/or order if a certificate is required for the flange material (see Appendix A).

4.2 Requirements governing the use of ASTM materials

4.2.1 General. Flanges manufactured from materials conforming to ASTM specifications shall comply with the following additional requirements.

- a) For material to ASTM A105;
 - 1) when specified all forgings shall be normalized;
 - 2) subclauses 4.2.2.1, 4.2.2.2 and 4.2.2.3 shall apply.
- b) For material to ASTM A182;
 - 1) the carbon content, by ladle analysis, of grades F304L and F316L shall not exceed 0.030 %;
 - 2) subclause 4.2.2.3 shall apply.

- c) For material to ASTM A350;
subclauses 4.2.2.1 and 4.2.2.2 shall apply only to carbon manganese steels (grades LF1 and LF2).
Subclause 4.2.2.3 shall apply to carbon manganese and low-alloy steels (grade LF1, LF2 and LF3).
- d) For material to ASTM A387;
1) when specified, all flanges and flanged fittings shall be supplied in the normalized and tempered condition;
2) subclause 4.2.2.3 shall apply.

NOTE The purchaser should state any specific requirements for the heat treatment condition on the enquiry and/or order (see Appendix A).

4.2.2 Carbon manganese and low alloy steels

4.2.2.1 The carbon content by ladle analysis of the materials specified in 4.2.1 shall not exceed 0.23 % for plate and 0.25 % for forgings.

4.2.2.2 The carbon equivalent (CE_1) by ladle analysis of the materials specified in 4.2.1 shall not exceed 0.42

where:

$$CE_1 = C + \frac{Mn}{6}$$

The manufacturer shall ensure on a basis of regular production checks that the carbon equivalent (CE_2) by ladle analysis does not exceed 0.45 where:

$$CE_2 = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Cu + Ni}{15}$$

4.2.2.3 The actual tensile strength of the steel of any component shall not exceed the minimum required by the relevant specification by more than 150 N/mm².

4.2.3 Chromium-molybdenum steels. [Applicable to material groups 1.9, 1.10, 1.13 and 1.14 (see Table 3).] For chromium-molybdenum steels the contents of carbon and residual elements shall be restricted as follows.

a) Carbon content:

steels with less than 2 % Cr (nominal):

0.17 % max. (plate)

0.20 % max. (forgings and castings)

steels with more than 2 % Cr (nominal):

0.15 % max. (plate)

0.15 % max. (forgings and castings)

b) Residual elements:

Copper 0.30 % max.

Nickel 0.40 % max.

Tungsten 0.10 % max.

Tin 0.03 % max.

4.3 Non-metallic materials

For flanges which are lined, or otherwise coated, with non-metallic materials and if the non-metallic materials come, or are likely to come, into contact with potable water then these materials shall comply with BS 6920-1.

NOTE Users should be aware that thread sealants or lubricants, for example, should also comply with BS 6920-1 if used in potable water applications.

5 Bolting

5.1 Materials, dimensions and finish for bolting shall comply with BS 1768, BS 1769 or BS 4882.

NOTE Where Class 150 or Class 300 steel flanges are bolted to cast iron flanges, the specified minimum yield strength of the bolt material should not exceed 240 N/mm².

5.2 Studbolts shall comply with BS 4882 except that the form shown in Figure 3 (b) of BS 4882 shall only apply to studbolts of materials other than alloy steel.

5.3 Bolt diameters shall be as given in Table 9 to Table 14. Appendix C gives a method for determining the recommended bolt length for lapped-type joints.

Appendix D gives recommended bolt lengths for flanges other than lapped-type.

6 Repairs

Repairs by welding shall be permitted unless otherwise prohibited by the applicable material standard, or product standard in the case of integral flanges, and shall comply with BS 2633, BS 4570 or BS 5135 as appropriate.

NOTE The welding procedure should be such as to produce a weld having characteristics in accordance with the parent material.

Flanges should be heat treated after repair by welding when the material specification requires such treatment.

7 Dimensions

7.1 Flange dimensions

Dimensions [except for dimension G (see note 4)] for each type of flange, other than reducing flanges for each Class designation shall be as given in Table 9 to Table 14, as qualified by clause 9 and the notes to Table 9 to Table 14, if appropriate.

NOTE 1 For reducing flanges see 7.5.

NOTE 2 It is incumbent upon the purchaser to specify in the enquiry and/or order if dimensions of flanges are to be affected by clause 9 and/or the notes to Table 9 to Table 14.

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

NOTE 4 The centre portion of the face of a blank flange (code 105) need not be machined, provided that the diameter of the unmachined portion does not exceed the recommended shoulder diameter, G , given in Table 9 to Table 14.

7.2 Hubs

The hubs of slip-on flanges for welding (code 112), threaded flanges (code 113), socket-weld flanges (code 114) and loose flanges for lapped pipe end (code 115) shall be either:

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

7.3 Threaded flanges

7.3.1 The threads of hubbed threaded flanges (code 113) shall be taper or parallel complying with BS 21, or taper complying with ANSI/ASME B1.20.1 or API Std.5B.

NOTE ANSI/ASME B1.20.1 threads will be supplied unless the purchaser specifies otherwise (see Appendix A).

7.3.2 Threads shall extend to the flange face and shall be concentric with the axis of the flange. Misalignment shall not exceed 5 mm/m.

Class 150 flanges shall be manufactured without a counterbore, but to protect the threads, the threads shall be chamfered to the major diameter of the thread at the back of the flange at an angle between 40° 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, 1500 and 2500 flanges shall be provided with a counterbore as indicated in Table 10 to Table 14, and the thread shall be chamfered to an angle between 40° 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.

7.3.3 Gauging shall comply with BS 21, ANSI/ASME B1.20.1 or API Std.5B, as appropriate.

7.4 Weld-neck flanges

For weld-neck flanges (code 111) the thickness of the hub at the welding end shall never be less than 87.5 % of the nominal thickness of the pipe to which the flange is attached (see Appendix A).

NOTE The weld end preparation of weld-neck flanges is outside the scope of this Section of BS 1560. However, Appendix E gives details of various weld end preparations and it is incumbent upon the purchaser to specify a particular weld end preparation, if required. The weld end preparation shown in Figure 16(a) or Figure 16(b) is the type of preparation normally supplied.

7.5 Reducing flanges (flanges of reduced bore)

7.5.1 General. Flange bolt holes, outside diameters, thickness and the facings of reducing flanges shall be the same as those of the normal flange of the size from which the reduction is being made.

7.5.2 Hub dimensions

7.5.2.1 Threaded and slip-on flanges. The hub dimensions of hubbed threaded (code 113) and slip-on flanges for welding (code 112) shall be at least as large as those of the normal flange of the size to which the reduction is being made. It shall be permitted for the hub to be omitted in certain reducing flanges (see Figure 3).

7.5.2.2 Weld-neck flanges. The hub dimensions of weld-neck flanges (code 111) having a reduced bore shall be the same as those of the normal flange of the size to which the reduction is being made.

7.6 Bolt holes

Bolt holes shall be equally spaced on the pitch circle diameter, and in the case of integral flanges, shall be positioned off-centre.

8 Flange facings

8.1 Range of facings

The range of flange facings and flange face designations are given in Figure 2. Dimensions of facings shall be as given in Figure 4, Figure 5, Figure 6 and Figure 7 and Table 5 and Table 6.

8.2 Facing dimensions for other than lapped-type joints

NOTE Facing dimensions for other than lapped-type flange joints apply to flange facings of the 1.6 mm and 6.4 mm high raised face types, the spigot/recess type and tongue/groove type and the ring-joint type (see Figure 4 and Figure 5).

Flanges with recess or groove facing or ring-joint groove shall be either raised face or flat face (see Appendix A and Appendix B).

8.3 Facing dimensions for lapped-type joints

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

- a) raised face (type B),
- b) tongue/groove (types C and D);
- c) spigot/recess (types E and F);
- d) ring-joint (type J).

The facings shall comply with 8.1. 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.

Stub-ends for lapped-type joints shall comply with BS 1640 or ANSI B16.9, as appropriate.

8.4 Flange thickness

In no case, regardless of the type of facing and the tolerances permitted, shall the thickness of a flange be reduced at any point in order to provide adequate height for the facing or adequate depth for the groove.

For Class 150 and Class 300 flanges the 1.6 mm raised face is included in the flange thickness and the heights of other types of faces or depth of groove shall be additional to and shall not reduce the minimum thickness of these flanges (see Figure 4).

8.5 Facing finishes

8.5.1 All flange jointing faces shall be machine finished and, when compared by visual or tactile means with reference specimens, shall comply with the values given in Table 7 and Table 8.

NOTE 1 It is not intended that instrument measurements be taken on the faces themselves and the R_a and R_z values as defined in BS 1134 relate to the reference specimens.

NOTE 2 Requirements for special coatings or finishes should be stated in the enquiry and/or order so that an appropriate allowance may be incorporated in the machining of any relevant mating dimensions (see Appendix A).

8.5.2 Flat face, raised face and spigot/recess facings types A, B, E and F shall be machined to comply with Table 7.

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

9 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 complying with BS 3410 for the inch 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, as shown in Figure 14, shall be maintained as given in Table 22.

10 Tolerances

Flanges shall comply with the tolerances specified in Table 15.

11 Marking

11.1 Flanges other than integral flanges (see also 11.5)

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

- a) the number of this British Standard, i.e. BS 1560⁴⁾;
- b) flange code number, e.g. 112;

- c) Class designation, e.g. 300;
- d) nominal size (inch), e.g. 4. Both sizes shall be included for reducing flanges, e.g. 4/3;
- e) material designation using the material group, British Standard grade of material or identification symbols given in Table 3;
- f) manufacturer's name or trade mark;
- g) cast number or melt identification or suitable quality control number traceable to the cast number;
- h) thread identification (see 11.2).

Example. BS 1560/111 – 150 – 2 – 1.2 – XXX – 12345.

11.2 Thread identification

Threaded flanges shall be marked to indicate the type of thread used. Flanges with threads to BS 21 shall be marked Rc or Rp as appropriate followed by the nominal size of the thread, e.g. Rc $\frac{3}{4}$. Flanges with threads to ANSI/ASME B1.20.1 shall be marked with the nominal size of thread, number of threads per inch and the letters NPT, e.g. $\frac{3}{4}$ -14 NPT. Flanges with threads to API Std 5B shall be marked with API.

11.3 Ring groove number

Flanges grooved for standard ring-joints shall be marked with the letter R and the corresponding ring groove number (see Table 6).

11.4 Stamping

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

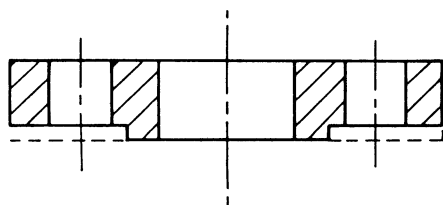
NOTE Care should be taken to ensure that steel stamp markings are not liable to cause cracks in the flange material.

11.5 Omission of markings

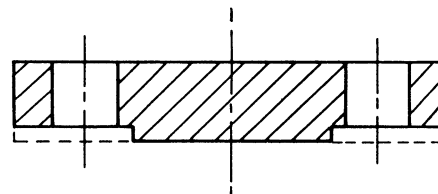
If a flange is too small to enable all the markings required in 11.1 to be marked on the flange, then it is permitted to omit some of the markings. The order in which the markings are omitted shall be as follows:

- a) size;
- b) thread type and designation;
- c) Class designation;
- d) manufacturer's name or trade mark.

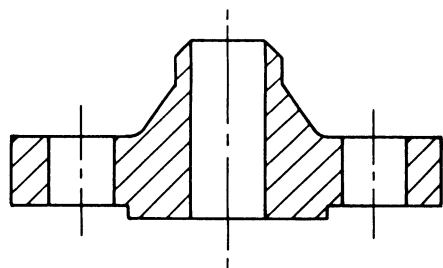
⁴⁾ Marking BS 1560, together with the flange code number, on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of this Section of BS 1560. The accuracy of the claim is therefore solely the responsibility of the person making the claim. Such a declaration is not to be confused with third party certification of conformity, which may also be desirable.



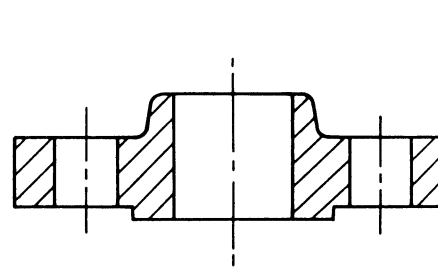
Code 101
Plate flange for welding



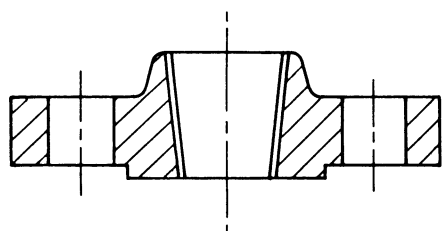
Code 105
Blank flange



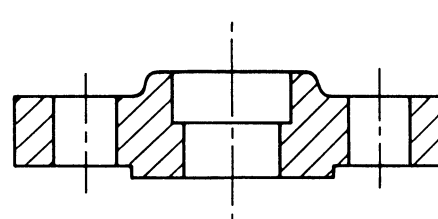
Code 111
Weld-neck flange



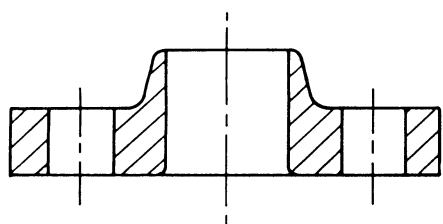
Code 112
Hubbed slip-on flange for welding



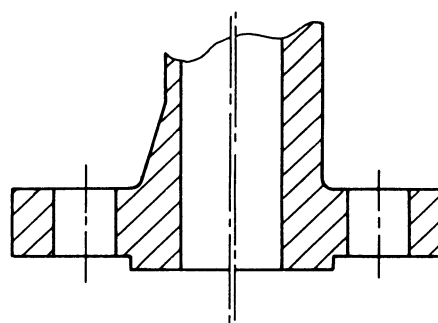
Code 113
Hubbed threaded flange



Code 114
Hubbed socket weld flange



Code 115
Loose hubbed flange for lapped pipe end



Code 121
Integral flange

NOTE These sketches are diagrammatic only.

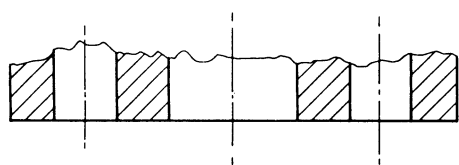
NOTE 1 Codes 101 and 105 comprise flanges that do not incorporate a hub or weld-neck.

NOTE 2 Codes 111 to 115 comprise flanges incorporating a hub or weld-neck and manufactured from forgings or castings.

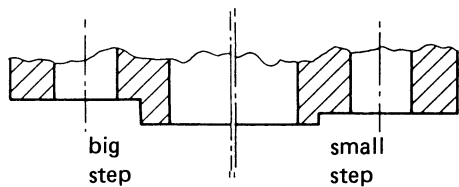
NOTE 3 Code 121 is an integral part of some other equipment or component.

NOTE 4 Flanges may be designated by code numbers or by descriptions.

Figure 1 — Flange codes

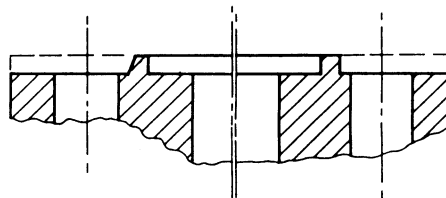
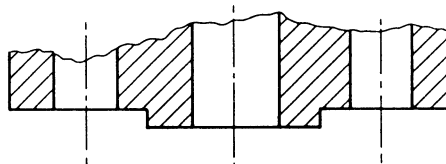


Type A
Flat face



Type B
Raised face

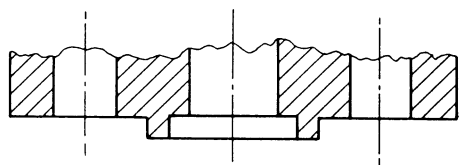
Type E
Spigot



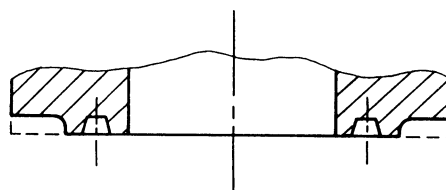
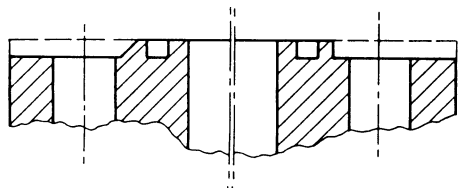
Type F
Recess

NOTE 1 When provided with a 6.4 mm raised face, type B is identical to type E.

Type C
Tongue



Type D
Groove



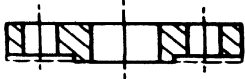
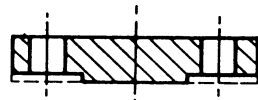
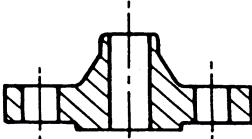
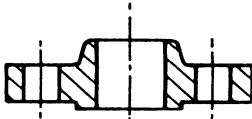
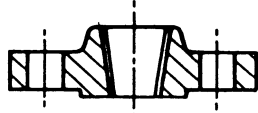
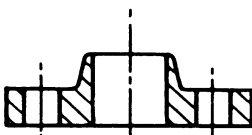
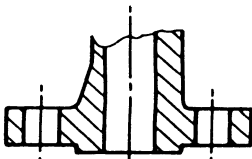
Type J
Ring-joint

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

NOTE 3 Facings may be designated by type letters or by descriptions.

Figure 2 — Facings of types A to F and J

Table 2 — Synoptic table

Flange	Code number	(DN) in	(15)	(20)	(25)	(32)	(40)	(50)	(65)	(80)	(100)	(125)	(150)	(200)	(250)	(300)	(350)	(400)	(450)	(500)	(600)
		Class designation	1/2	3/4	1	1 1/2 ^a	1 1/2	2	2 1/2 ^a	3	4	5 ^a	6	8	10	12	14	16	18	20	24
 Plate	101	150	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
 Blank	105	150	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
		300	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
		600	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
		900	Use Class 1500							x	x	x	x	x	x	x	x	x	x	x	x
		1500	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
		2500	x	x	x	x	x	x	x	x	x	x	x	x	x	x					
 Weld-neck	111	150	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
		300	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
		600	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
		900	Use Class 1500							x	x	x	x	x	x	x	x	x	x	x	x
		1500	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
		2500	x	x	x	x	x	x	x	x	x	x	x	x	x	x					
 Hubbed slip-on	112	150	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
		300	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
		600	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
		900	Use Class 1500							x	x	x	x	x	x	x	x	x	x	x	x
		1500	x	x	x	x	x	x	x												
 Hubbed threaded	113	150	x	x	x	x	x	x	x	x	x	x									
		300	x	x	x	x	x	x	x	x	x	x									
		600	x	x	x	x	x	x	x	x	x	x									
		900	Use Class 1500							x	x	x	x								
		1500	x	x	x	x	x	x	x	x	x	x	x								
		2500	x	x	x	x	x	x	x	x	x	x	x								
 Hubbed socket-weld	114	150	x	x	x	x	x	x	x												
		300	x	x	x	x	x	x	x	x											
		600	x	x	x	x	x	x	x	x											
		1500	x	x	x	x	x	x	x												
 Loose hubbed for lapped pipe end	115	150	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
		300	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
		600	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
		900	Use Class 1500							x	x	x	x	x	x	x	x	x	x	x	x
		1500	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
		2500	x	x	x	x	x	x	x	x	x	x	x	x	x	x					
 Integral	121	150	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
		300	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
		600	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
		900	Use Class 1500							x	x	x	x	x	x	x	x	x	x	x	x
		1500	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
		2500	x	x	x	x	x	x	x	x	x	x	x	x	x	x					

^a These sizes should be avoided in new constructions.

^a These sizes should be avoided in new constructions.

Table 3 — Material

Material	Plate				Forgings				Castings				Material group (see note 5)
	ASTM standards	British Standard (see note 1)	Identification symbol	Elevated temperature service (see item in note 3)	ASTM standards	British Standard (see note 1)	Identification symbol	Elevated temperature service (see item in note 3)	ASTM standards	British Standard (see note 1)	Identification symbol	Elevated temperature service (see item in note 3)	
Carbon steel	A515 grade 70	BS 1501-1 164-400	515-70	1,6	A105	BS 1503-164-490	A105	1,7	A216 grade WCB	BS 1504-161 Gr 480	WCB	1,7	1.1
	A516 grade 70		516-70	1,6	A350 grade LF2		LF2	4					
	A537 Class 1		537 C1	4									
									A216 grade WCC		WCC	1,7	1.2
									A352 grade LCC		LCC	4	
2 ¹ / ₂ % nickel steel	A203 grade B		203 B	1,7					A352 grade LC2		LC2	4	1.2
3 ¹ / ₂ % nickel steel	A203 grade E		203 E	1,7	A350 grade LF3		LF3	4	A352 grade LC3		LC3	4	1.2
Carbon steel	A515 grade 65	BS 1501-1 151-430	515-65	1,7					A352 grade LCB	BS 1504-161 Gr 480	LCB	1	1.3
	A516 grade 65	BS 1501-1 161-430	516-65	1,6									
	A515 grade 60		515-60	1,7	A350 grade LF1		LF1	4					1.4
	A516 grade 60		516-60	1,6									
Carbon 1/2 % molybdenum steel	A204 grade B		204 B	2,7					A352 grade LC1		LC1	4	1.5
	A204 grade A		204 A	2,7	A182 grade F1		F1	2,7	A217 grade WC1	BS 1504-245	WC1	2,7	
1 % chromium 1/2 % molybdenum steel					A182 grade F12	BS 1503-620-440 ^a	F12	3,10					1.9
1 1/4 % chromium 1/2 % molybdenum steel	A387-11 Cl.2	BS 1501-2 621	11Cl2	3, 10	A182 grade F11	BS 1503-621-460	F11	3, 10	A217 grade WC6	BS 1504-621	WC6	8, 10	1.9
2 1/4 % chromium 1 % molybdenum steel	A387-22 Cl.2	BS 1501-2 622-515	22Cl2	3, 10	A182 grade F22	BS 1503 622-490	F22	3, 10	A217 grade WC9	BS 1504-622	WC9	8, 10	1.10
5 % chromium 1/2 % molybdenum steel					A182 grade F5a	BS 1503-625-590	F5a		A217 grade C5	BS 1504-625	C5		1.13
9 % chromium 1 % molybdenum steel					A182 grade F9		F9		A217 grade C12	BS 1504-629	C12		1.14
Austenitic-chromium-nickel steel	A240 grade 304	BS 1501-3 304S15 ^b	304	11	A182 grade F304	BS 1503 304S31 ^b	F304	11	A351 grade CF8	BS 1504 304C15 ^b	CF8	11	2.1
	A240 grade 304H	BS 1501-3 304S49 ^b	304H	11	A182 grade F304H	BS 1503 304S51 ^b	F304H	11					
Austenitic-chromium-nickel-molybdenum steel	A240 grade 316	BS 1501-3 316S16 ^b	316	12	A182 grade F316	BS 1503 316S31	F316	12	A351 grade CF8M	BS 1504 316C16 ^b	CF8M	12	2.2
	A240 grade 316H	BS 1501-3 316S49 ^b	316H	12	A182 grade F316H	BS 1503 316S51	F316H	12					
Austenitic-chromium-nickel (low carbon) steel	A240 grade 304L	BS 1501-3 304S12 ^c	304L	5	A182 grade F304L	BS 1503 304S11 ^c	F304L	5					2.3
Austenitic-chromium-nickel-molybdenum (low carbon) steel	A240 grade 316L	BS 1501-3 316S12 ^c	316L	6	A182 grade F316L	BS 1503 316S11	F316L	6					2.3
Austenitic-chromium-nickel (titanium stabilized) steel	A240 grade 321	BS 1501-3 321S12 ^b	321	7	A182 grade F321	BS 1503 321S31 ^b	F321	7					2.4
	A240 grade 321H		321H		A182 grade F321H		F321H						
Austenitic-chromium-nickel (niobium stabilized) steel	A240 grade 347	BS 1501-3 347S171	347	7	A182 grade F347	BS 1503 347S31 ^b	F347	7	A351 grade CF8C	BS 1504 347C17 ^b	CF8C		2.5
	A240 grade 347H	BS 1501-3 347S49 ^c	347H		A182 grade F347H	BS 1503 347S51 ^b	F347H						
Austenitic-chromium-nickel (25/12 and 23/12 types)	A240 grade 309S	BS 1449-2 309S24 ^b	309S						A351 grade CH8		CH8		2.6
									A351 grade CH20		CH20		
Austenitic-chromium-nickel (25/20 type)	A240 grade 310S	BS 1501-3 301S24 ^b	310S	9	A182 grade F310	BS 1503 310S31 ^b	F310	9	A351 grade CK20		CK20		2.7

^a R_e min 275 N/mm²^b 0.2 % proof stress 205 N/mm² min.^c 0.2 % proof stress 175 N/mm² min.

Notes to Table 3

NOTE 1 When selecting materials for flanges the strength requirements (R_e min 275 N/mm², 0.2 % proof stress 205 N/mm² min, 0.2 % proof stress 175 N/mm² min) should be given, as appropriate, on the enquiry and/or order for the flanges (see Appendix A).

NOTE 2 For some materials listed under British Standards, testing requirements are more stringent than the comparable ASTM materials and the purchaser is advised to specify any special requirements for the material in the enquiry and/or order for flanges (see Appendix A).

NOTE 3 Design and construction standards, e.g. BS 5500 and ANSI B 31.3 differ in requirements for maximum allowable service temperature and may impose lower temperatures than those given below.

- 1) Not recommended for use above 425 °C.
- 2) Not recommended for use above 455 °C.
- 3) Not recommended for use above 590 °C.
- 4) Not to be used over 340 °C.
- 5) Not to be used over 425 °C.
- 6) Not to be used over 455 °C.
- 7) Not to be used over 540 °C.
- 8) Not to be used over 590 °C.
- 9) At service temperatures of 565 °C and above the grain size should not be finer than ASTM6.
- 10) Consideration should be given to the possibility of excessive oxidation (scaling) at temperatures above 565 °C.
- 11) The effects of carbide precipitation should be considered in the case of welded construction or use at temperatures above 480 °C.

12) The effects of sigma phase formation should be considered at temperatures above 535 °C.

For carbon and carbon-molybdenum steels [notes 1), 2), 4), 6) and 7)] the limitation of the upper temperature is intended to avoid risk of graphitization of the carbides and, also at the higher temperatures, covers the effects of oxidation and reduction in strength.

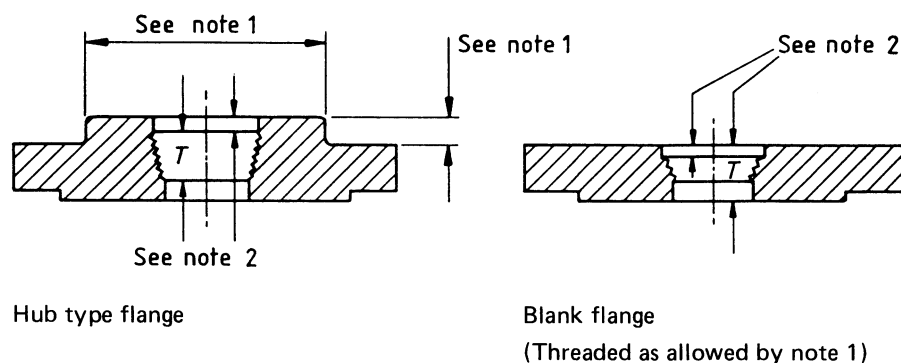
For chromium-molybdenum ferritic steels [notes 3), 8) and 10)] the limitation of the upper temperature takes account of the effects of oxidation and reduced strength (creep resistance).

For austenitic steels where the material specification states only a maximum for carbon content, e.g. C 0.08 % max, and the proposed service is at temperatures above 540 °C then the steel used should have a carbon content of 0.04 % to 0.08 %.

NOTE 4 Low temperature service [applicable to low temperature (LT) steels and austenitic chromium-nickel steels]. Design and construction standards require fracture toughness properties to be determined, usually by Charpy impact testing, on steels for low temperature service. Requirements differ according to the standard and purchasers should state their requirements on the enquiry and/or order for the flanges (see Appendix A).

The LT steels (carbon and nickel steels) included in this Section of BS 1560 have Charpy impact test requirements specified in the relevant standard for the materials. In the case of austenitic stainless steels it is not usual to require Charpy impact tests for services above – 200 °C.

NOTE 5 Material groups are those given in ANSI B16.5.



NOTE 1 A hub is required if the nominal size of the reduced bore is equal to or greater than the size given in Table 4 against the nominal pipe size appropriate to the outside diameter of the flange. Otherwise a blank flange suitably tapped may be used.

The nominal pipe 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 Table 9 to Table 14).

NOTE 2 The threading and counterbore, etc., should comply with 7.3.

Figure 3 — Reducing threaded flanges Classes 150 to 2500 (see Table 4)

Table 4 — Reducing threaded flanges
Classes 150 to 2500

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

NOTE This table should be read in conjunction with 7.5.2.1.
^a The use of these sizes should be avoided in new constructions.