BRITISH STANDARD

BS 1560-3.3: 1989

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

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

Section 3.3 Specification for copper alloy and composite flanges

UDC 621.643.4 – 034.14:621.643.411.412.8:669.35:620.168:001.4:006.3/.8

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Piping Systems Components Standards Policy Committee (PSE/-) to Technical Committee PSE/15, upon which the following bodies were represented:

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
Electricity Supply Industry in England and Wales
Energy Industries Council
Engineering Equipment and Materials Users' Association
GAMBICA (BEAMA Ltd.)
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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Amendments issued since publication

Amd. No.	Date of issue	Comments

Contents

Foreword

This Section of BS 1560 has been prepared under the direction of the Piping Systems Components Standards Policy Committee and constitutes a new Section of BS 1560 for Class designated copper alloy and composite flanges. For PN designated copper alloy and composite flanges reference should be made to BS 4504-3.3.

This Section of BS 1560 is related to ISO 7005-3 published by the International Organization for Standardization (ISO) in respect of flanges having nominal pressures PN 20 and PN 50 covered by the International Standard. The types of flanges and their size ranges are limited when compared to those flanges of the equivalent nominal pressure given in ISO 7005-3.

The PN 6, PN 10, PN 16, PN 25 and PN 40 flanges given in ISO 7005-3 are related to PN designated flanges specified in BS 4504-3.3.

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

— *Section 3.1: Specification for steel flanges;*

— *Section 3.2: Specification for cast iron flanges*[1)]*;*

— *Section 3.3: Specification for copper alloy and composite flanges;*

This Section of BS 1560 specifies copper alloy and composite flanges which have compatible mating dimensions with steel flanges complying with BS 1560-3.1. In addition ANSI B16.24 published by the American National Standards Institute has been taken into account together with ISO 7005-3. Until such time as all three parts of ISO 7005 are published and this Section of BS 1560 is revised, this Section of BS 1560 specifies flanges having inch bolt sizes and bolt holes as specified in BS 1560-3.1.

The flanges specified, with the exception of integral (code 321) flanges, are for attachment to copper or copper alloy tubes complying with BS 2871.

The principles adopted in the preparation of this Section of BS 1560 are in accordance with the following.

a) Dimensions, other than mating dimensions, are based on ISO 7005-3 for PN 20 (Class 150) and PN 50 (Class 300) flanges.

b) Mating dimensions, including outside diameters, pitch circle diameters, bolt holes and bolt sizes, comply with BS 1560-3.1.

c) Tolerances are generally in accordance with ISO 7005-3.

d) Pressure/temperature ratings are in accordance with ISO 7005-3.

e) Surface finish and spot facing or back facing are in accordance with ISO 7005-3.

f) Flanges have been additionally designated by code numbers to maintain harmonization with BS 4504-3.3 and BS 1560-3.1 which are based on the principles agreed internationally for designating flanges by type numbers.

It should be noted that the thicknesses of code 305 blank flanges have nominal thicknesses different to those specified in the related specification ANSI B16.24; the thicknesses specified in ANSI B16.24 are minimum values.

Guidance notes and recommendations have been included in Appendix B. Appendix B is not intended to be exhaustive.

The various gasket types, dimensions, design characteristics and materials are outside the scope of this Section of BS 1560. For dimensions of gaskets reference should be made to BS 3381 for spiral wound gaskets and to BS 7076-1, BS 7076-3 and BS 7076-4 for other types of gaskets.

[1)] In preparation.

This standard specifies inch bolting only and the use of metric bolting is outside the scope of this Section of BS 1560. However, for information Appendix C gives the proposed metric bolt sizes to be used in lieu of the inch sizes specified. Users of metric bolting should note that bolt hole clearances may be reduced or increased.

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.

NOTE For the purposes of this Section of BS 1560 no difference is intended in the meaning between pipe and tube although idiomatic use prefers sometimes the one and sometimes the other.

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 iv, pages 1 to 16, 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.

blank

1 Scope

This Section of BS 1560 specifies requirements for Class designated circular copper alloy and composite flanges in Class 150 and Class 300 ratings and in nominal sizes up to 36 in of the type given in Table 1.

Table 1 — Types of copper alloy and composite flanges

Code no.[a]	Description
301	Plate flange in copper alloy (for brazing or welding)
304	Loose flange in steel with a weld-neck collar in copper alloy (for welding)
305	Blank flange in copper alloy or in steel clad with the jointing face in copper alloy
307	Loose flange in steel with a slip-on collar in copper alloy (for brazing or welding)
311	Weld-neck flange in copper alloy (for welding)
312	Hubbed slip-on flange in copper alloy (for brazing or welding)
314	Hubbed slip-on flange in copper alloy supplied with tube stops (for brazing or welding)
321	Integral flange in copper alloy as part of some other equipment or component

NOTE 1 Figure 1 illustrates flanges according to description and code numbers.
NOTE 2 Flanges may be designated by description or code numbers.
[a] Code numbers have been made non-consecutive to permit possible future additions.

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

NOTE 1 Details of the tube stops used in conjunction with code 314 flanges are outside the scope of this Section of BS 1560.
NOTE 2 To assist purchasers Appendix A lists information which should be supplied when ordering flanges.
NOTE 3 The routine inspection and pressure testing are outside the scope of this Section of BS 1560 but some guidance is given in Appendix B.
NOTE 4 The titles of the publications referred to in this standard are listed on the inside back cover.

2 Ranges of nominal sizes

The ranges of nominal sizes from ½ in to 36 in applicable to each flange code and for each Class designation shall be as given in Table 2, Table 6 and Table 7.

3 Class designations and pressure/temperature ratings

3.1 Class designations

The Class designation of flanges shall be either:

a) Class 150, or

b) Class 300.

3.2 Pressure/temperature ratings

The pressure/temperature ratings of flanges manufactured from the materials specified in Table 3 shall be as given in Table 9, Table 10 and Table 11 for the applicable materials and shall be the maximum allowable non-shock working gauge pressure at the temperatures shown.

NOTE 1 Linear interpolation is permitted for intermediate temperatures. The relevant pressures and temperatures are those of the fluid in the pipe or fitting.
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 flange ratings.

4 Materials

4.1 Flange materials

Copper alloy components of flanges shall be manufactured from the materials given in Table 3 and steel components of flanges shall be manufactured from the materials given in Table 4.

NOTE 1 Where there is an appropriate application standard it is the responsibility of the purchaser to ensure that the requirements of that standard are met.
NOTE 2 If a protective coating such as zinc coating or painting on steel components is required, the purchaser should state the requirements on the enquiry and/or order (see Appendix A).

4.2 Bolting materials

Materials for bolting shall be as follows:

a) materials specified in BS 1768, BS 1769 and BS 4882 (inch);

b) materials specified in ASTM A193 and ASTM A194;

c) BS 2872 and BS 2874, grades CA 104 and CA 105;

d) proprietary high strength cupro-nickel alloys.

5 Bolting

5.1 Bolt sizes shall be as given in Table 6 and Table 7, as appropriate.

5.2 Studbolts shall comply with BS 4882 except that form shown in Figure 3(b) of BS 4882:1978 shall apply only to studbolts of material other than alloy steel.

5.3 The mating surfaces of all bolt heads and nuts shall be full faced.

6 Dimensions

6.1 Flange dimensions

Flanges shall have the dimensions appropriate to their nominal sizes, types and Class designations as given in Table 6 and Table 7 and clause **9**, if appropriate.

NOTE 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.

6.2 Tube sizes

Dimensions of flanges shall be compatible with the tube sizes given in Table 6 and Table 7.

NOTE Alternative values are specified for tube outside diameters for 10 in (DN 250) and it is therefore essential that the purchaser should specify the tube size for which the flange is required (see Appendix A).

6.3 Hubs

The hub of hubbed slip-on copper alloy flanges (code 312) and hubbed slip-on copper alloy flanges with tube stops (code 314) shall be either:

a) parallel; or

b) have a draft angle of not more than 4° on the outside surface for forging or casting purposes.

6.4 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.

7 Flange facings

Plate flanges (code 301), copper alloy (unclad) flanges (code 305), copper alloy weld-neck flanges (code 311), hubbed slip-on flanges (code 312), hubbed slip-on flanges supplied with tube stops (code 314) and integral flanges (code 321) shall be supplied with flat faces for use with full face gaskets.

NOTE When codes 301, 305 (unclad), 311, 312, 314 and 321 flanges are required to be bolted to existing raised face type steel or cast iron flanges, then the raised face on the steel or iron flange should be removed.

8 Facing finishes

8.1 All flange jointing faces shall be machine finished and when compared by visual or tactile means with reference specimens, the surface finish shall comply with the values given in Table 5.

NOTE 1 It is not intended that instrument measurements be taken on the faces themselves and the $\boldsymbol{R}_a$ and $\boldsymbol{R}_z$ 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).

8.2 Composite flanges shall be machined on all locating diameters, bores and abutment faces in accordance with Table 5.

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 washer 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 8.

10 Tolerances

Flanges shall comply with the tolerances specified in Table 8.

11 Marking

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

a) number of this British Standard, i.e. BS 1560[2)];

b) flange code number, e.g. 312;

c) Class designation, e.g. 300;

d) nominal size (inch), e.g. 4;

e) material designation using the alloy designation symbols given in Table 3 and Table 4 as appropriate;

f) manufacturer's name or trade mark.

Examples:

Copper alloy component

BS 1560/304 – 150 – 6 – CZ110 – XYZ

Steel component

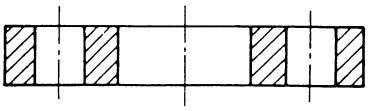
BS 1560/307 – 150 – 6 – 43A – XYZ

Copper alloy flanges shall be clearly and permanently marked but stamping with steel stamps is not permitted.

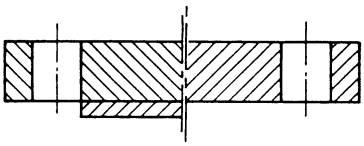
NOTE 1 The manufacturer's name or trade mark together with other relevant marking may be produced during casting or forging for both copper alloy and steel components.

NOTE 2 Steel flanges may be marked round the rim of the flange with round nosed steel stamps.

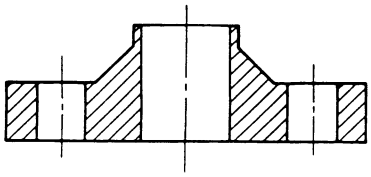
[2)] Marking BS 1560, together with the flange code number, on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of this Section of BS 1560. The accuracy of the claim is therefore 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.



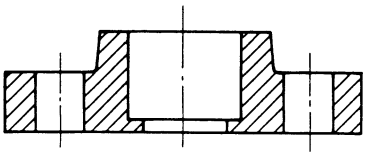
Code 301
Plate flange in copper alloy (for brazing or welding)



Code 305
Blank flange in copper alloy or in steel clad with the jointing face in copper alloy



Code 311
Weld-neck flange in copper alloy (for welding)

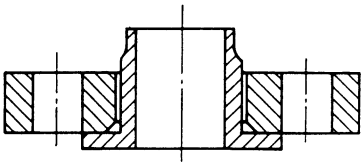


Code 314
Hubbed slip-on flange in copper alloy supplied with tube stops (for brazing or welding)

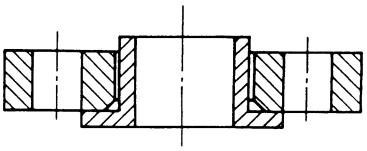
Key

Copper alloy component

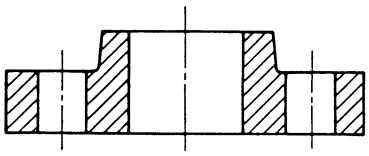
Steel component



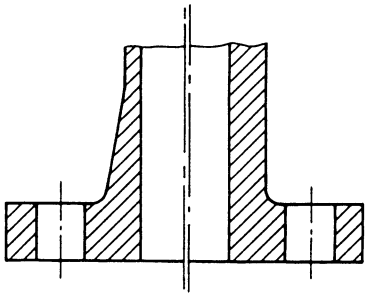
Code 304
Loose flange in steel with a weld-neck collar in copper alloy (for welding)



Code 307
Loose flange in steel with a slip-on collar (for brazing or welding)



Code 312
Hubbed slip-on flange in copper alloy (for brazing or welding)



Code 321
Integral flange in copper alloy as part of some other equipment or component

NOTE Codes 301, 311, 312, 314 and 321 comprise flanges made in copper alloy.
NOTE 2 Codes 304 and 307 comprise composite flanges where the backing flange is made of steel.
NOTE 3 Code 305 comprises either all copper alloy or copper alloy clad steel.
NOTE 4 Flanges may be designated by code numbers or by descriptions.

Figure 1 — Flange codes

Table 2 — Synoptic table

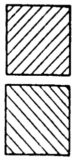
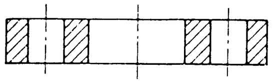
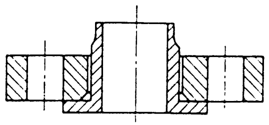
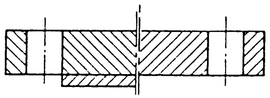
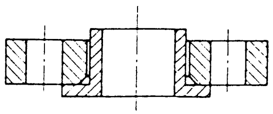
Flange	Code number	(DN) in / Class designation	½ (10)	¾ (20)	1 (25)	1¼ (32)	1½ (40)	2 (50)	2½ (65)	3 (80)	4 (100)	5 (125)	6 (150)	8 (200)	10 (250)	12 (300)	14 (350)	16 (400)	18 (450)	20 (500)	24 (600)	28 (700)	32 (800)	36 (900)
																								
 Plate flange in copper alloy	301	150	×	×	×	×	×	×	×	×	×	×	×	×										
 Loose flange in steel with weld-neck collar in copper alloy	304	150	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
		300	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×			
 Blank flange	305	150	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
		300	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×			
 Loose flange in steel slip-on collar in copper alloy	307	150	×	×	×	×	×	×	×															
		300	×	×	×	×	×	×	×															

Table 2 — Synoptic table

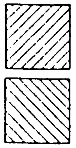
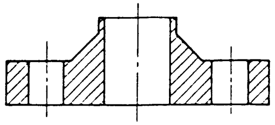
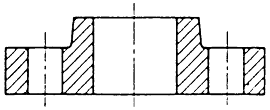
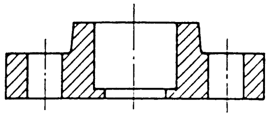
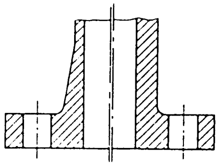
Flange	Code number	(DN) in / Class designation	½ (10)	¾ (20)	1 (25)	1¼ (32)	1½ (40)	2 (50)	2½ (65)	3 (80)	4 (100)	5 (125)	6 (150)	8 (200)	10 (250)	12 (300)	14 (350)	16 (400)	18 (450)	20 (500)	24 (600)	28 (700)	32 (800)	36 (900)
 copper alloy / steel																								
 Weld-neck flange in copper alloy	311																							
		150	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
		300	×	×	×	×	×	×	×	×	×	×	×	×										
 Hubbed slip-on flange in copper alloy																								
	312																							
		150	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
		300	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×			
 Hubbed slip-on flange in copper alloy supplied with tube stops	314																							
		150	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
		300	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×			
 Integral flange in copper alloy	321																							
		150	×	×	×	×	×	×	×	×	×	×	×	×	×	×								
		300	×	×	×	×	×	×	×	×	×	×	×	×										

Table 3 — Copper alloy materials

Material			Flange types and codes				
Form	Copper alloy standard	Alloy designation	Loose flanges or collars for composite flanges		Blank		Integral
			301, 307, 312, 314	301, 304, 307, 311, 312, 314	305		321
			Methods of attachment		Without cladding	Cladding	
			Silver[ab] brazing (Slip-on)	Fusion welding (Slip-on or butt-weld)			
Castings	BS 1400	LG 2	×		×		×
		LG 4	×		×		×
		AB 1		×			×
		AB 2		×			×
	ASTM B61 UNS C92200	C922	×		×		×
	ASTM B62 UNS C83600	C836	×		×		×
Forging	BS 2872	CA 104		×	×	×	
Plate	BS 2875	CZ 110	×	×	×	×	
		CN 102	×	×	×	×	
		CN 107	×	×	×	×	

[a] For all flanges attached by silver brazing to copper alloy tubes the maximum operating temperature should not exceed 200 °C.
[b] For the purposes of this Section of BS 1560 silver brazing is synonymous with brazing with silver alloy filler material. Reference should be made to BS 1723 for information on brazing techniques.

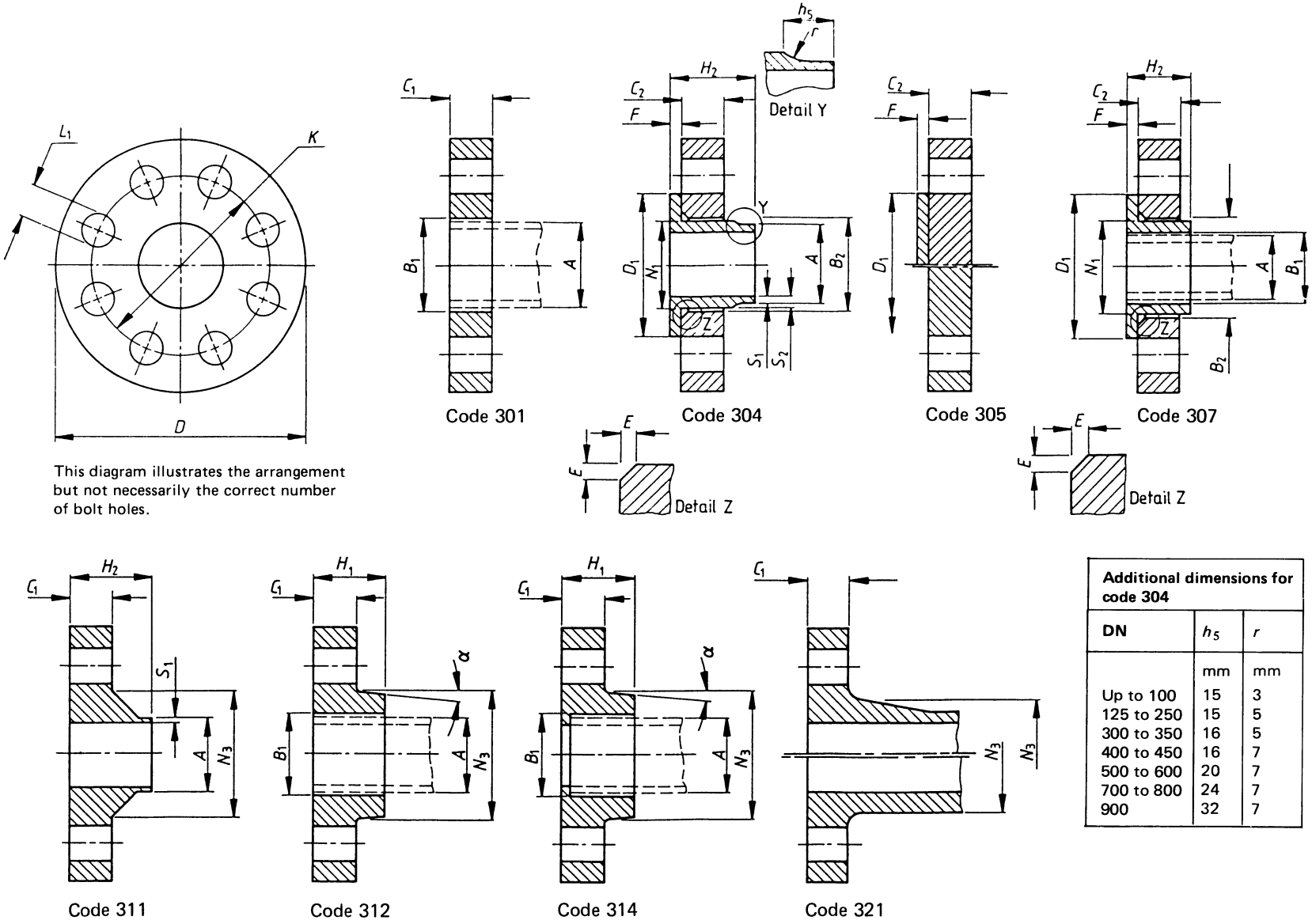
Table 4 — Steel materials for composite and clad blank flanges

Material	British Standard and grade	Alloy designation	ASTM standard	Alloy designation
Plate	BS 4360 grade 40A BS 4360 grade 43A	40A 43A	— —	— —
Forgings	BS 1503 – 221 – 430 BS 1503 – 164 – 490	430 490	– A105	– A105

Table 5 — Surface finish of flange faces

Method of machining	R_a[a]		R_z[a]	
	min.	max.	min.	max.
	µm	µm	µm	µm
Turning[b]	3.2	12.5	12.5	50
Other than turning	3.2	6.3	12.5	25

[a] R_a and R_z are defined in BS 1134.
[b] Turning includes any method of machine operation producing either serrated concentric or serrated spiral grooves.



Additional dimensions for code 304		
DN	h_5	r
	mm	mm
Up to 100	15	3
125 to 250	15	5
300 to 350	16	5
400 to 450	16	7
500 to 600	20	7
700 to 800	24	7
900	32	7

NOTE 1 For code 312 and 314 flanges, all nominal sizes $\alpha = 4°$ max.

NOTE 2 Dimension N_3 is measured at the intersection of the projections of the hub draft angle and the back face of the flange.

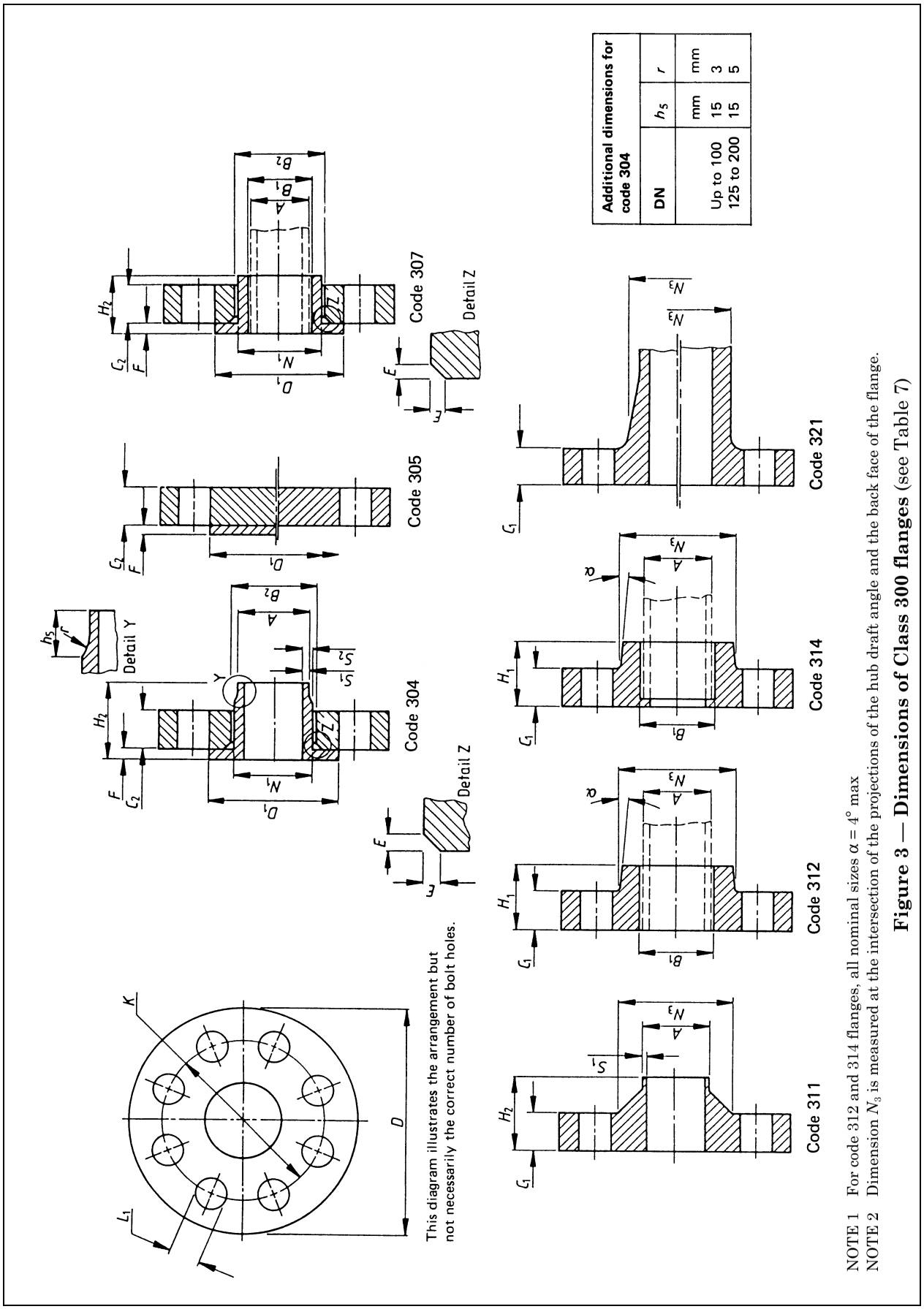
Figure 2 — Dimensions of Class 150 flanges (see Table 6)

Table 6 — Dimensions of Class 150 flanges (see Figure 2)

Nominal size		Tube outside diameter	Outside diameter of flange	Mating dimensions: Pitch circle diameter	Mating dimensions: Diameter of bolt holes	Mating dimensions: No. of holes	Mating dimensions: Nominal size of bolts	Flange thickness					Hub diameter	Neck diameter	Stub end diameter		Length through hub or collar				Collar flange thickness		Cladding thickness	Collar wall thickness		Collar or cladding diameter	Bore of flange or collar	Bore of backing flange		Chamfer
		A	*D*	*K*	*L*			C_2	C_2	C_1	C_1	C_1	N_3	N_3	N_1	N_1	H_1	H_2	H_2	H_2	*F*	*F*	*F*	S_1 min.	S_2 min.	D_1	B_1	B_2		*E*
Codes affected		**All codes**						304 305	307	301	311 312 314	321	311 312 314	321	304	307	312 314	304	307	311	304	307	305	304 311	304	304 305 307	301 307 312 314	304	307	304 307
in	DN	mm	mm	mm	in (mm)		in	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
½	10[a]	16.0	89	60.3	⅝ (15.9)	4	½	11.1	11.1	8	8	8	21	30	18.0	21	21	35	16	48	5.0	5	5	1.0	2.0	40	16.07	19	23	2
¾	20	25.0	98	69.8	⅝ (15.9)	4	½	12.7	12.7	8	8	9	31	38	27.0	31	24	40	16	52	5.0	5	5	1.0	2.5	53	25.08	28	33	2
1	25	30.0	108	79.4	⅝ (15.9)	4	½	14.3	14.3	9	9	10	36	49	32.0	36	24	40	18	56	5.0	5	5	1.5	2.5	60	30.08	33	38	3
1¼	32	38.0	117	88.9	⅝ (15.9)	4	½	15.4	15.4	10	10	10	45	59	40.0	45	26	40	18	57	5.0	5	5	1.5	2.5	70	38.08	41	47	3
1½	40	44.5	127	98.4	⅝ (15.9)	4	½	17.5	17.5	11	11	11	51	65	46.5	51	26	45	19	62	5.0	5	5	1.5	2.5	80	46.60	48	53	3
2	50	57.0	152	120.6	¾ (19.0)	4	⅝	19.0	19.0	13	13	13	67	78	59.0	67	28	45	19	64	6.0	6	5	1.5	2.5	99	57.23	62	69	3
2½	65	76.1	178	139.7	¾ (19.0)	4	⅝	23.8	23.8	20	20	14	85	90	78.0	87	32	45	19	70	6.0	6	5	2.0	3.0	120	76.33	81	89	3
3	80	88.9	190	152.4	¾ (19.0)	4	⅝	24.0	—	20	20	16	103	108	91.0	—	34	50	—	70	7.0	—	5	2.5	3.5	130	89.18	94	—	3
4	100	108.0	229	190.5	¾ (19.0)	8	⅝	24.0	—	20	20	17	134	135	110.0	—	40	50	—	76	7.0	—	5	2.5	3.5	158	108.38	113	—	3
5	125	133.0	254	215.9	⅞ (22.2)	8	¾	24.4	—	22	22	19	159	164	135.5	—	44	50	—	89	7.0	—	5	2.5	3.5	188	133.63	138	—	4
6	150	159.0	279	241.3	⅞ (22.2)	8	¾	25.5	—	22	22	21	183	192	161.5	—	44	50	—	89	9.0	—	5	2.5	3.5	212	159.63	164	—	4
8	200	219.1	343	298.4	⅞ (22.2)	8	¾	29.0	—	26	26	24	238	246	222.0	—	46	50	—	102	9.0	—	5	3.5	5.0	268	220.03	225	—	5
10	250	267.0	406	362.0	1 (25.4)	12	⅞	30.5	—	—	28	25	287	305	269.0	—	48	50	—	102	9.0	—	5	4.0	5.5	320	268.13	278	—	5
10	250	273.0	406	362.0	1 (25.4)	12	⅞	30.5	—	—	28	25	287	305	275.0	—	48	50	—	102	9.0	—	5	4.0	5.5	320	274.13	278	—	7
12	300	323.9	483	431.8	1 (25.4)	12	⅞	32.0	—	—	40	27	344	365	327.0	—	66	50	—	114	11.0	—	5	5.0	6.5	370	325.03	330	—	7
14	350	368.0	533	476.2	1⅛ (28.6)	12	1	35.0	—	—	41	—	395	—	371.0	—	67	50	—	127	11.0	—	5	5.5	7.0	430	369.13	374	—	7
16	400	419.0	597	539.8	1⅛ (28.6)	16	1	37.0	—	—	45	—	446	—	422.0	—	73	50	—	127	12.0	—	5	6.0	7.5	482	420.13	426	—	7
18	450	457.2	635	577.8	1¼ (31.8)	16	1⅛	40.0	—	—	48	—	508	—	460.0	—	77	50	—	140	12.0	—	5	7.0	8.5	530	458.33	465	—	7
20	500	508.0	698	635.0	1¼ (31.8)	20	1⅛	45.0	—	—	49	—	559	—	511.0	—	80	50	—	144	12.0	—	5	7.5	9.0	585	509.13	517	—	7
24	600	610.0	813	749.3	1⅜ (34.9)	20	1¼	48.0	—	—	50	—	665	—	613.0	—	86	60	—	152	14.0	—	5	9.0	10.5	685	611.13	618	—	9
28	700	711.0	927	863.6	1⅜ (34.9)	28	1¼	72.0	—	—	52	—	775	—	719.0	—	94	60	—	152	19.0	—	5	10.5	14.5	800	712.13	727	—	9
32	800	813.0	1060.3	977.9	1⅝ (41.3)	28	1½	81.0	—	—	56	—	879	—	821.0	—	98	60	—	144	20.5	—	5	12.0	16.0	905	814.13	829	—	9
36	900	914.0	1168.3	1085.9	1⅝ (41.3)	32	1½	90.5	—	—	60	—	988	—	921.0	—	105	60	—	157	22.0	—	5	13.5	17.5	1 000	915.13	921	—	9

NOTE The bore sizes of code 321 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 for components.

[a] For the copper and copper alloy tube industry the normal designation for ½ in nominal size is DN 10 but for ferrous tubes the normal designation is DN 15.



NOTE 1 For code 312 and 314 flanges, all nominal sizes $\alpha = 4°$ max

NOTE 2 Dimension N_3 is measured at the intersection of the projections of the hub draft angle and the back face of the flange.

Figure 3 — Dimensions of Class 300 flanges (see Table 7)

Table 7 — Dimensions of Class 300 flanges (see Figure 3)

Nominal size		Tube outside diameter	Outside diameter of flange	Mating dimensions				Flange thickness				Hub diameter	Neck diameter	Stub end diameter		Length through hub or collar				Collar flange thickness	Cladding thickness	Collar wall thickness		Collar or cladding diameter	Bore of flange or collar	Bore of backing flange		Chamfer
				Pitch circle diameter	Diameter of bolt holes	No. of holes	Nominal size of bolts																					
		A	*D*	*K*	*L*			C_2	C_2	C_1	C_1	N_3	N_3	N_1	N_1	H_1	H_2	H_2	H_2	*F*	*F*	S_1 min.	S_2 min.	D_1	B_1	B_2		*E*
Codes affected		**All codes**						304 305	307	311 312 314	321	311 312 314	321	304	307	312 314	304	307	311	304 307	305	304 311	304	304 305 307	307 312 314	304	307	304 307
in	DN	mm	mm	mm	in (mm)		in	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
½	10[a]	16.0	95	66.7	⅝ (15.9)	4	½	14.5	14.5	9	13	21	30	18.0	21	21	35	16	52	5	5	1.5	2.0	40	16.07	19.0	23	2
¾	20	25.0	117	82.6	¾ (19.0)	4	⅝	16.0	16.0	11	13	31	38	27.0	31	21	40	16	57	5	5	1.5	2.5	58	25.08	28.0	33	2
1	25	30.0	124	88.9	¾ (19.0)	4	⅝	17.5	17.5	11	15	36	49	32.0	36	27	40	18	62	5	5	1.5	2.5	68	30.08	33.0	38	3
1¼	32	38.0	133	98.4	¾ (19.0)	4	⅝	19.5	19.5	12	16	45	59	40.0	45	28	40	20	65	5	5	1.5	2.5	78	38.08	41.5	47	3
1½	40	44.5	156	114.3	⅞ (22.2)	4	¾	21.0	21.0	13	18	51	65	46.5	51	28	45	22	68	6	5	1.5	2.5	88	46.60	48.0	53	3
2	50	57.0	165	127.0	¾ (19.0)	8	⅝	22.5	22.5	13	19	67	78	59.0	67	28	45	23	70	6	5	2.0	3.0	102	57.23	62.0	69	3
2½	65	76.1	190	149.2	⅞ (22.2)	8	¾	25.5	25.5	22	21	103	90	78.0	86	32	45	25	76	6	5	2.5	3.5	122	76.33	81.0	89	3
3	80	88.9	210	168.3	⅞ (22.2)	8	¾	29.0	—	24	23	114	108	91.0	—	36	50	—	79	7	5	2.5	3.5	138	89.18	94.0	—	3
4	100	108.0	254	200.0	⅞ (22.2)	8	¾	32.0	—	26	27	137	135	110.0	—	40	50	—	86	7	5	3.0	4.0	158	108.38	113.0	—	3
5	125	133.0	279	235.0	⅞ (22.2)	8	¾	35.0	—	26	28	160	164	135.5	—	44	50	—	98	7	5	3.0	4.0	188	133.63	138.5	—	3
6	150	159.0	318	269.9	⅞ (22.2)	12	¾	37.0	—	28	30	186	192	161.5	—	48	50	—	98	9	5	3.5	4.5	212	159.63	164.0	—	4
8	200	219.1	381	330.2	1 (25.4)	12	⅞	41.5	—	30	35	246	246	222.0	—	50	50	—	111	9	5	4.5	6.0	268	220.03	225.0	—	4
10	250	267.0	444	387.4	1⅛ (28.6)	16	1	48.0	—	36	—	296	—	269.0	—	58	50	—	117	9	5	5.5	7.0	320	268.13	278.0	—	5
10	250	273.0	444	387.4	1⅛ (28.6)	16	1	48.0	—	36	—	296	—	275.0	—	58	50	—	117	9	5	5.5	7.0	320	274.13	278.0	—	5
12	300	323.9	521	450.8	1¼ (31.8)	16	1⅛	51.0	—	42	—	360	—	327.0	—	68	50	—	130	11	5	7.0	8.5	370	325.03	330.0	—	7
14	350	368.0	584	514.4	1¼ (31.8)	20	1⅛	54.0	—	46	—	430	—	371.0	—	78	50	—	143	11	5	8.0	9.5	480	369.13	374.0	—	7
16	400	419.0	648	571.5	1⅜ (34.9)	20	1¼	57.5	—	52	—	480	—	422.0	—	82	50	—	146	12	5	9.0	10.5	482	420.13	426.0	—	7
18	450	457.2	711	628.6	1⅜ (34.9)	24	1¼	60.5	—	54	—	540	—	460.0	—	86	50	—	159	12	5	9.5	11.0	530	458.33	465.0	—	7
20	500	508.0	775	685.8	1⅜ (34.9)	24	1¼	63.5	—	56	—	595	—	511.0	—	90	50	—	162	12	5	11.0	12.5	585	509.13	517.0	—	7
24	600	610.0	914	812.8	1⅝ (41.3)	24	1½	70.0	—	58	—	710	—	613.0	—	105	60	—	168	14	5	13.0	14.5	685	611.13	618.0	—	9

NOTE The bore sizes of code 321 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 for components.

[a] For the copper and copper alloy tube industry the normal designation for ½ in nominal size is DN 10 but for ferrous tubes the normal designation is DN 15.

Table 8 — Tolerances

Dimension	Flange code	Tolerance	Size
		mm	in
Bore diameter B_1	301, 307, 312, 314	$^{+0.05}_{-0}$	⩽ 2½
		$^{+0.1}_{-0}$	> 2½ ⩽ 8
		$^{+0.25}_{-0}$	> 8 ⩽ 20
		$^{+1.5}_{-0}$ [a]	> 8 ⩽ 14
		$^{+2.0}_{-0}$ [a]	> 14 ⩽ 20
		$^{+3.0}_{-0}$	> 20
Bore diameter B_2	304, 307	$^{+1.0}_{-0}$	⩽ 4
		$^{+1.5}_{-0}$	> 4 ⩽ 12
	304	$^{+2.0}_{-0}$	> 12 ⩽ 32
		$^{+4.0}_{-0}$	> 32
	307	$^{+2.0}_{-0}$	> 12
Length through hub H_2	312, 314	$^{+1.5}_{-0}$	⩽ 4
		$^{+2.5}_{-0}$	> 4 ⩽ 32
		$^{+3.5}_{-0}$	> 32
Length through collar H_2	304	± 1.5	⩽ 2½
		± 2	> 2½
	307, 311	$^{+1.5}_{-0}$	⩽ 8
		$^{+2.5}_{-0}$	> 8 ⩽ 32
		$^{+3.5}_{-0}$	> 32
Hub neck or collar diameter N_1, N_3	304	± 0.5	⩽ 2½
		± 1.0	> 2½ ⩽ 6
		± 1.5	> 6 ⩽ 12
		± 2	> 12
	307, 311, 312, 314	± 0.5	⩽ 2½
		± 1.0	> 2½ ⩽ 16
		± 2.0	> 6 ⩽ 16
		± 3.0	> 16 ⩽ 32
		± 4.0	> 32
	321	$^{+1.5}_{-0}$	⩽ 2½
		$^{+2.5}_{-0}$	> 2½ ⩽ 6
		$^{+3.5}_{-0}$	> 6 ⩽ 16
		$^{+5.0}_{-0}$	> 16 ⩽ 32
		$^{+10.0}_{-0}$	> 32

Table 8 — Tolerances

Dimension	Flange code	Tolerance	Size
		mm	in
Outside diameter D	All codes (machined)	± 1.0	⩽ 8
		± 1.5	> 8 ⩽ 12
		± 2.0	> 12
	All codes (unmachined)	± 2.0	⩽ 12
		± 3.0	> 12 ⩽ 16
		± 5.0	> 16
Flange thickness C_1, C_2	All codes	$^{+3.5}_{-0}$	⩽ 25 mm thickness
		$^{+5.0}_{-0}$	> 25 mm ⩽ 50 mm thickness
		$^{+7.5}_{-0}$	> 50 mm ⩽ 75 mm thickness
		$^{+10.0}_{-0}$	> 75 mm thickness
Collar or cladding diameter D_1	304, 305	± 1.0	⩽ 3
		± 2.0	> 3
	307	$^{+1.0}_{-0}$	⩽ 2½
		$^{+2.0}_{-0}$	> 2½ ⩽ 16
		$^{+3.0}_{-0}$	> 16
Facing height F	304	± 0.5	⩽ 5
		± 1.0	> 5 ⩽ 20
		± 1.5	> 20
	305	± 0.3	⩽ 10
		± 0.6	> 10
	307	$^{+1.0}_{-0}$	⩽ 2½
		$^{+2.0}_{-0}$	> 2½ ⩽ 20
		$^{+3.0}_{-0}$	> 20
Diameter of bolt circle K	All codes	± 0.9	Bolt sizes ½ to ⅞
		± 1.4	Bolt sizes 1 to 1½
Centre-to-centre of adjacent bolt holes	All codes	± 0.45	Bolt sizes ½ to ⅞
		± 0.7	Bolt sizes 1 to 1½
Concentricity (see note 1)	All codes	1.0	⩽ 4
		2.0	> 4
Parallelism between bolting bearing surfaces and flange jointing faces	All codes (machined surfaces)	1°	All sizes
	All codes (unmachined surfaces)	2°	

NOTE 1 Concentricity is between K and any machined diameter. This tolerance does not apply if a suitable machined diameter does not exist.

NOTE 2 Miscellaneous radii chamfers should be regarded as maximum unless otherwise specified. Tolerances on the pitch circle diameter and centre-to-centre of adjacent bolt holes are determined by the difference between the bolt and the bolt hole diameter and thus in conjunction cannot exceed the clearance together with any tolerance on the diameter of the bolt hole.

[a] The tolerances apply only to code 301, 307, 312 and 314 flanges intended for attachment by fusion welding.

Table 9 — Pressure/temperature ratings for copper alloys other than AB2 and CN 107

Class	Temperature °C (see notes)								
	− 10 to 66	100	120	150	180	200	220	250	260[b]
	Maximum permissible working pressure								
	bar[c]	bar	bar	bar	bar	bar	bar	bar	bar
150	15.5	14.6	13.9	13.3	12.4	11.8	11.3	10.7	10.3
300	34.5	32.3	31.1	29.3	27.4	26.2	24.9	23.1	22.4

NOTE 1 This table is not applicable to flanges larger than 12 in (DN 300) for Class 150 and larger than 8 in (DN 200) for Class 300 (see Table 11).
NOTE 2 For the suitability of steel components and bolting at low temperatures reference should be made to the appropriate application standard.
[a] Flanges in alloy CZ 110 are limited to a maximum temperature of 200 °C.
[b] Flanges in alloy CA 104 may be used up to and including 350 °C at the ratings quoted for 260 °C.
[c] 1 bar = 10^5 N/m^2 = 10^5 Pa.

Table 10 — Pressure/temperature ratings for copper alloys AB2 and CN 107

Class	Temperature °C (see notes)												
	− 10 to 66	100	120	150	180	200	220	250	260	280	300	320	350
	Maximum permissible working pressure												
	bar	bar	bar	bar	bar	bar	bar	bar	bar	bar	bar	bar	bar
150	15.5	15.0	14.5	14.0	13.7	13.5	13.0	12.7	12.5	12.0	11.5	11.0	10.3
300	34.5	33.0	32.5	30.5	29.0	28.5	27.5	26.5	26.0	25.0	24.5	23.5	22.4

NOTE 1 This table is not applicable to flanges larger than 12 in (DN 300) for Class 150 and larger than 8 in (DN 200) for Class 300 (see Table 11).
NOTE 2 For the suitability of steel components and bolting at low temperatures reference should be made to the appropriate application standard.

Table 11 — Pressure/temperature ratings for all copper alloy large size flanges

Class	Temperature °C	
	− 10 to 100	200
	Maximum permissible working pressure	
	bar	bar
150	14	13.9
300	20	19.8

NOTE 1 This table applies to flanges 14 in and larger for Class 150 and for flanges 10 in and larger for Class 300.
NOTE 2 For the suitability of steel components and bolting at low temperatures reference should be made to the appropriate application standard.

Appendix A Information to be supplied by the purchaser

The following information should be supplied by the purchaser when making an enquiry or placing an order for flanges complying with this Section of BS 1560.

a) Number and Section of this British Standard.

b) Flange type, by description or code number (see clause **1** and Figure 1).

c) Size in inches (see clause **2**).

d) Class designation (see clause **3**).

e) Material designation (for both the copper alloy and steel components applicable) (see clause **4**).

f) Tube size (see **6.2**).

g) Any protective coating (zinc coating, painting) of the steel flanges (see **4.1** and **8.1**).

Appendix B Application and installation

NOTE The information in this appendix is advisory only and it is not intended to be exhaustive.

B.1 When using bolting materials of other than copper alloy the purchaser should take into account the pressure, flange material and the related gasket so that the joint remains tight under the expected operating conditions.

B.2 Application of the ratings to flanged joints at all temperatures should take into consideration the effect of the risk of leakage due to forces and movement developed in the connecting pipes.

B.3 Flanges may be required to be pressure tested after attachment of a pipe or other equipment or when forming an integral part of such equipment. The test pressure is then dependent on the requirements of the appropriate standard or code of practice in accordance with which the equipment has been manufactured or fabricated. Any test pressure should not exceed 1.5 times the allowable pressure at 20 °C rounded off to the next higher 1 bar increment.

Appendix C Use of metric bolting in lieu of inch bolting

C.1 General

If users prefer or require to use metric bolting in lieu of the inch bolting specified in this Section of BS 1560, **C.3** gives the comparable metric bolt sizes that have been agreed in ISO/TC 5/SC 10 in the preparation of ISO 7005.

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 in diameter 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, with care, and dependant on the tolerances which have been used it should be possible to fit the normal inch dimensioned gasket when using metric bolting in existing inch holes.

C.3 Comparable sizes

If metric bolting is to be used the comparable inch and metric sizes are as given in Table 12.

Table 12 — Nominal bolt diameter

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

C.4 Inch/metric bolt comparisons

To enable users to ascertain precisely the differences in the two systems, Table 13 is given for reference.

Table 13 — Inch/metric bolt comparisons

Bolt diameter				Bolt hole diameter		Clearances
Inch bolting		Metric	Difference	Inch hole		Metric bolt in an inch hole
in	mm	mm	mm	in	mm	mm
½	12.70	M14	+ 1.30	⅝	15.88	1.88
⅝	15.88	M16	+ 0.12	¾	19.05	3.05
¾	19.05	M20	+ 0.95	⅞	22.23	2.23
⅞	22.23	M24	+ 1.77	1	25.40	1.40
1	25.40	M27	+ 1.60	1⅛	28.58	1.58
1⅛	28.58	M30	+ 1.42	1¼	31.75	1.75
1¼	31.75	M33	+ 1.25	1⅜	34.93	1.93
1½	38.10	M39	+ 0.90	1⅝	41.28	2.28

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Publications referred to

BS 1134, *Method for the assessment of surface texture.*

BS 1134-1, *Method and instrumentation.*

BS 1400, *Specification for copper alloy ingots and copper alloy and high conductivity copper castings.*

BS 1503, *Specification for steel forgings (including semi-finished forged products) for pressure purposes.*

BS 1723, *Brazing.*

BS 1723-1, *Specification for brazing.*

BS 1723-2, *Guide to brazing.*

BS 1768, *Specification for Unified precision hexagon bolts, screws, & nuts (UNC & UNF threads). Normal series.*

BS 1769, *Specification. Unified black hexagon bolts, screws, nuts (UNC & UNF threads). Heavy series.*

BS 2871, *Specification for copper and copper alloys. Tubes*[3)].

BS 2872, *Specification for copper and copper alloys. Forging stock and forgings.*

BS 2874, *Specification for copper and copper alloy rods and sections (other than forging stock).*

BS 2875, *Specification for copper and copper alloys. Plate.*

BS 3381, *Specification for metallic spiral-wound gaskets for use with flanges to BS 1560-1 and BS 1560-2* [3)].

BS 3410, *Specification for metal washers for general engineering purposes (obsolescent).*

BS 4360, *Specification for weldable structural steels.*

BS 4504, *Circular flanges for pipes, valves and fittings (PN designated)*[3)].

BS 4504-3.3, *Specification for copper alloy and composite flanges.*

BS 4882, *Specification for bolting for flanges and pressure containing purposes.*

BS 7076, *Dimensions of gaskets for flanges to BS 1560.*

BS 7076-1, *Specification for non-metallic flat gaskets*[3)].

BS 7076-3, *Specification for non-metallic envelope gaskets*[3)].

BS 7076-4, *Specification for corrugated, flat or grooved metallic and filled metallic gaskets*[3)].

ANSI B16.24, *Bronze pipe flanges and flanged fittings, Class 150 and 300.*

ASTM A105, *Specification for forgings, carbon steel, for piping components.*

ASTM A193, *Specification for alloy-steel and stainless steel bolting materials for high temperature service.*

ASTM A194, *Specification for carbon and alloy steel nuts for bolts for high-pressure and high-temperature service.*

ASTM B61, *Specification for steam or valve bronze castings.*

ASTM B62, *Specification for composition bronze or ounce metal castings.*

ISO 7005, *Metallic flanges.*

ISO 7005-3, *Copper alloy and composite flanges*[3)].

[3)] Referred to in foreword only.

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