



BS 4504 : Part 2 : 1974

UDC 621.643.4 - 034 : 669.35

Specification for



Circular flanges for pipes, valves and fittings (PN designated)

**Part 2. Copper alloy and
composite flanges**

British Standards Institution

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Committee reference PVE/11, PVE/11/1 Drafts for comment 72/31371DC and 72/31371DC

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- | | |
|---|--|
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- | | |
|---|---|
| British Industrial Measuring and Control Apparatus Manufacturers' Association | British Valve Manufacturers' Association |
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Foreword

This British Standard has been prepared under the authority of the Pressure Vessel Industry Standards Committee.

BS 4504 originally only gave coverage for copper alloy flanges of integral form in nominal pressures of 16, 25 and 40 bar and in nominal sizes 10 to 100 inclusive. In view of the extensive use of copper alloy flanges for marine sea water systems it was requested by the Marine Industry that BS 4504 be extended to give coverage for integral, bossed and composite flanges in nominal pressures 6 to 40 bar and for nominal sizes up to 1800. These requirements have been accommodated in this revised standard.

It should be noted that, with the exception of the integral flanges up to 100 nominal size and all NP6 and NP10 bossed flanges which are intended for use only in conjunction with full-faced gaskets, the flange details have been checked against the German flange calculation standard DIN 2505 and found to be adequate for use with gaskets contained within the bolts. Whilst thinner flange thicknesses could be specified in some cases it is considered impracticable, and liable to some adverse criticism, to specify copper alloy flanges with lighter scantlings than those being currently specified for ferrous flanges of identical pressure/temperature ratings and at the same time ensure their suitability for use with gaskets contained within the bolts. In view of these considerations, thicknesses specified in BS 4504 : Part 1 for steel or cast iron flanges, as may be appropriate, have been used as a basis for this standard.

It should be noted that the bossed and composite flanges for nominal sizes up to 500 are primarily intended for use with tubes with the outside diameters of those given for shipbuilding and other engineering purposes in BS 2871 'Copper and copper alloy tubes' Part 2 'Tubes for general purposes', though details are given of flanges for welding or brazing (i.e. other than soft soldering) for copper and copper alloy pipes to BS 2871 : Part 1 'Copper tubes for water, gas and sanitation' to cover nominal sizes 10 mm to 65 mm with tube outside diameters of 15 mm to 67 mm. For sizes in excess of 500 the outside diameters are in accordance with those specified for steel tubes in BS 3600 'Dimensions and masses per unit length of welded and seamless steel pipes and tubes for pressure purposes: metric units'. The foregoing follows the practice generally followed by continental countries for copper alloy flanged pipework.

NOTE 1. Pressures in this standard are given in bar (gauge) 1 bar = 10^5 kPa.

NOTE 2. All dimensions in this standard are in millimetres unless otherwise stated.



'Obsolescent (by Amendment No. 3)

This British Standard has been declared obsolescent and is not recommended for use in new equipment but needs to be retained for a period of 12 months after the date of publication of BS 4504 : Section 3.3 which replaces this standard. At the end of the 12 months period it is the intention to withdraw this British Standard.'

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British Standard Specification for Circular flanges for pipes, valves and fittings (PN designated)

Part 2. Copper alloy and composite flanges

1. Scope

This Part of this British Standard specifies requirements for a range of copper alloy flanges of the following types with the appropriate bolting:

- Integral
- Slip-on boss for brazing or welding
- Slip-on composite for brazing
- Slip-on composite for welding
- Welding neck composite.

Where slip-on flanges are required for attachment by soft soldering, reference should be made to BS 864 : Part 2.

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

2. Designation

The flanges shall be designated by the nominal size and flange table reference.

The first part of the table reference is the nominal pressure defined as the maximum permissible working pressure in bar gauge at 20 °C.

The second part of the table reference indicates the type of flange as follows:

- Type 21. Integral
- Type 22. Slip-on boss for brazing or welding
- Type 23. Slip-on composite for brazing
- Type 24. Slip-on composite for welding
- Type 25. Welding neck composite
- Type 26. Slip-on composite for welding.

NOTE. Type 26 flanges are applicable to nominal pressure 6 bar only and have mating dimensions equal to nominal pressure 10 bar.

3. Summary of flange tables

Table 1 gives a summary of the flanges covered by this standard in regard to nominal pressure, type and nominal size range.

4. Pressure/temperature ratings

4.1 The pressure/temperature ratings of the flanges are given in Table 2.

4.2 The pressure ratings given in Table 2 are maximum permissible working pressures. Where a system is subject to shock the purchaser should consider the advisability of applying an appropriate de-rating factor.

4.3 Where there is an appropriate application standard it is the responsibility of the purchaser to ensure that the requirements of that standard are complied with.

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Table 1. Summary of flange tables

Nominal size range (mm)	Nominal pressure (bar)																
	6						10				16			25		40	
	Table reference																
	6/21	6/22	6/23	6/24	6/25	6/26*	10/21	10/22	10/23	10/25	16/21	16/22	16/23	16/25	25/21	25/22	40/21
10 to 50	X	X	X							X		X		X	X	X	
65 to 100	X	X	X		X			X		X	X	X	X	X	X	X	
125 to 175	X	X	X		X			X		X	X	X	X	X	X		
200 to 250	X	X	X		X		X	X	X	X	X	X	X	X	X		
300 to 500	X	X	X		X		X	X	X								
600 to 800	X			X	X	X	X		X								
900 to 1800	X			X		X	X										

* These flanges have mating dimensions to nominal pressure 10 bar. See Clause 2.

Table 2. Pressure/temperature ratings

Nominal pressure (bar)	Temperature °C						
	-200 to 120	150	180	200	220	250	260
	Maximum permissible working pressure bar gauge						
6	6	6	6	5	4	2.5	2
10	10	10	10	8.5	7	5	4
16	16	16	16	13.5	11.3	8	7
25	25	25	25	21.2	17.5	12.2	10.5
40	40	38.5	34	30	25.5	19.5	17.5

NOTE 1. Intermediate values may be obtained by linear interpolation.

NOTE 2. Pressure/temperature ratings above 120 °C are not applicable to flanges above nominal size 250.

NOTE 3. Pressure ratings of welding neck composite flanges are dependent on the material of the collar and the thickness of the welding ends which are matched to the preferred range of pipe thicknesses given in Table 3 of BS 2871 : Part 2 : 1972.

The maximum working pressures shall not however exceed those given in Table 2.

NOTE 4. Minimum temperature for composite type flanges is minus 10 °C.

5. Materials

The flanges shall be manufactured from materials specified in Table 3. Other materials may be used provided they are at least as suitable for the intended duty and are equally acceptable to the purchaser. Where there is an appropriate application standard it is the responsibility of the purchaser to ensure that the requirements of that standard are complied with.

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Table 3. Materials

Materials (see Clause 5)									
Non-ferrous parts*						Ferrous parts†			
Plates		Forging stock and forgings		Castings		Plates		Forgings	
BS No.	Designation	BS No.	Designation	BS No.	Designation	BS No.	Designation	BS No.	Designation
2875	CZ110 CN102 CN107	2872	CA104	1400	LG2‡ LG4‡ AB2§	1501	151 Grade 23A	1503	161 Grade 26A
						4360	Grade 40A or 43A		

* Where collars of composite type flanges are fabricated from rolled shapes the filler metal shall be compatible with the material of the collar.

† Applicable to the backing flange of composite type flanges.

‡ The leaded gunmetals LG2 and LG4 are not in general recommended for attachment by welding.

§ When castings are to be welded, lead not to exceed 0.01 %.

6. Dimensions and tolerances

6.1 Dimensions. The dimensions of flanges shall comply with the appropriate dimensional table except that:

(1) For integral flanges up to nominal size 100 the d_3 dimension may be increased where necessary to meet the requirements of BS 759.

(2) The backing flange of Type 23 composite flanges may be supplied plain, without a recess, provided due regard is given to maintaining the same degree of concentricity between collar and flange as that with the recessed form. Flange designs incorporating plain backing flanges shall have the b_1 and h_1 dimensions increased by an amount equal to dimension h_4 .

6.2 Machining of slip-on boss flange joint faces after attachment. It should be noted that the flange thicknesses given in the dimensional tables of this standard are a minimum and due allowance should be made in the case of slip-on boss type flanges for any machining that may subsequently be necessary to the joint face after attachment. It is recommended that slip-on boss type flanges be supplied with the following machining allowances on the jointing face:

Nominal size	65 to 250	+1
	300 to 500	+2

6.3 Tolerances. In addition to the tolerances shown in the individual dimensional tables, the general tolerances quoted in 6.3.1, 6.3.2 and 6.3.3 are to be applied.

6.3.1 Outside diameter (D)

Diameter	Machined	Not machined
Up to and including 200	±1	±2
Over 200 up to and including 300	±1.5	±2
Over 300 up to and including 400	±2	±3
Over 400	±2	±5

6.3.2 Thickness (b)

Thickness	Machined at back	Not machined at back
Up to 35 inclusive	+1.5 -0	+3 -0
Over 35	+3 -0	+5 -0

6.3.3 Length of welding neck flange (h_1)

Length	Machined end
Up to and including 80 nominal size	±1.5
Over 80 up to and including 250 nominal size	±2
Over 250 nominal size	±3

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7. Machining and finish of flanges

7.1 All flanges shall be free from laminations and surface defects.

7.2 Flanges shall be finished as follows.

(1) All flanges shall have their jointing surfaces machine finished. The finish of jointing surfaces shall not be coarser than that given in Table 4 appropriate to method of machining.

(2) Flange outside diameters may be un-machined unless a machine finish is specified by the purchaser.

(3) Composite type flanges shall be machine finished, or have a surface equal to that produced by machining, on all locating diameters, bore and abutment faces. The abutment faces shall be flat and square to the bore axis.

(4) Unless otherwise specified by the purchaser all bolt holes shall be drilled, shall be equally spaced on the pitch circle diameter, and in the case of integral flanges the bolt holes shall be drilled off centre.

(5) Bearing surfaces for nuts shall be parallel to the flange jointing face within 1° and shall be capable of accepting a normal series washer complying with the requirements of BS 4320. Any back-facing or spot-facing required to accomplish this shall not reduce the flange thickness to less than the minimum specified. When a bossed or integral flange is back-faced the fillet radii may be reduced but shall not be less than 3 mm.

Table 4. Jointing surface finish

Method of machining	R_a μm	R_a μin	R_z μm	BS 1134 Grade Ref.
Turning	12.5	500	50 to 87.5	N.10
Other than turning	3.2	125	12.5 to 21.85	N.8

NOTE. The term 'turning' includes any method of machining producing concentric or spiral grooves.

8. Joint faces

8.1 Integral and boss flanges shall have flat joint faces. Where any of the flanges indicated in Table 5 as being suitable only for use with full face gaskets is to be bolted to a flange with a raised face, the raised face on that flange shall be removed, otherwise the requirements of 8.2 shall apply.

8.2 When the following conditions of use are applicable, and when specified by the purchaser, the flange thickness specified in table 40/21 shall apply to tables 16/21 and 25/21.

(1) Mating flanges with raised face.

(2) Flanges with inside bolt gaskets.

(3) Flanges in piping systems subject to abnormally high mechanical strain.

8.3 Composite flanges shall not be used with flanges indicated as being suitable only for full face gaskets.

NOTE. It is the responsibility of the user to select gasket material which is suitable for the intended working and test conditions.

Table 5. Type of joint face

Nominal size range (DN)	Type of flange							
	Integral			Slip-on boss				Composite
	Full face	Full face or raised face*	Full face			Full face or raised face*	Raised face*	
	Nominal pressure (PN)							
	6 to 40	6 and 10	16 and 25	6	10	16 and 25	16 and 25	6 to 16
10 to 50	X			X		X		X
65 to 100	X			X	X		X	X
125 to 250		X	X	X	X		X	X
300 to 1800		X		X	X			X

* The raised face may be of spigot form or created by an inside bolt gasket.

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9. Attachment of flanges

9.1 The pipe flanges specified in this standard are primarily intended for brazing or welding to copper and copper alloy pipes. It is the responsibility of the user to comply with the requirements of any appropriate application standard. For temperatures in excess of 200 °C pipe flanges shall be attached by welding.

9.2 Flanges shall be prepared for attachment to pipes as described in 9.2.1 to 9.2.4 unless otherwise specified.

9.2.1 Tables 6/22, 10/22, 16/22 and 25/22

- (1) Flanges shall be machined in the bore in accordance with the appropriate table.
- (2) Where flanges are to be attached by welding the purchaser shall specify any weld preparation required.
- (3) Where flanges are intended for attachment by brazing they may be supplied, at the discretion of the manufacturer or as specified by the purchaser, with a tube stop and an internal groove or grooves to accommodate brazing metal rings or inserts. The length of that surface which is designed to make close contact with the tube shall not be less than the appropriate ' h_s ' dimension given for Type 23 composite flanges.
- (4) Where flanges are supplied with brazing metal rings or inserts fitted, the rings or inserts shall comply with Type AG1 or Type AG5 as specified in BS 1845 unless otherwise agreed between purchaser and manufacturer.

NOTE. It should be noted that it may be necessary to supplement the braze obtained with the inserts by end feeding. The recommendations of the manufacturer should be followed.

9.2.2 Tables 6/23, 10/23 and 16/23

- (1) Collars should be machined in the bore in accordance with the appropriate table.
- (2) Collars may be supplied without a tube stop at the discretion of the manufacturer or as specified by the purchaser.
- (3) Collars may be supplied with an internal groove or grooves to accommodate brazing metal rings or inserts. The length of that surface which is designed to make close contact with the tube shall not be less than the dimension ' h_s ' given in the appropriate table.
- (4) Where collars are supplied with brazing metal rings or inserts fitted the rings or inserts shall comply with Type AG1 or Type AG5 as specified in BS 1845 unless otherwise agreed between purchaser and manufacturer.

NOTE. It should be noted that it may be necessary to supplement the braze obtained with the inserts by end feeding. The recommendations of the manufacturer should be followed.

9.2.3 Tables 6/24, 6/26 and 10/24

Collars shall be machined in the bore in accordance with the appropriate table. The purchaser shall specify any weld preparation required.

9.2.4 Tables 6/25, 10/25 and 16/25

Collars shall be prepared for welding in accordance with the requirements of BS MA 18 unless otherwise agreed between purchaser and manufacturer.

9.3 If specified by the purchaser, slip-on type flanges in nominal sizes 10, 15, 20, 25, 32, 40, 50 and 65 mm may be supplied to suit tubes with outside diameters of 15, 18, 22, 28, 35, 42, 54 and 67 mm respectively, i.e. complying with the requirements of BS 2871 : Part 1. When so specified, the bore dimensions d_6 and d_7 where applicable, shall be appropriate to the nominal size of the flange (see appendix A).

10. Hydraulic testing of flanges

This standard does not specify the hydraulic test pressures for flanged pipes or components, details of which should be obtained from the appropriate application or component standard. The test pressure applied to the joint shall not, however, exceed 1.5 times the nominal pressure of the flange (see Clause 2).

11. Marking

All slip-on boss flanges and collars of composite flanges suitable for welding shall have permanently marked on their rims the appropriate designation letters and numbers indicating the material of manufacture. In this respect attention is drawn to Table 3. Slip-on type flanges in the nominal size range 10 mm to 65 mm inclusive shall also be marked with their appropriate tube outside diameter and the letters O.D., e.g. 25 OD.

12. Bolting

12.1 The application of studs, bolts, stud-bolts and nuts for these flanges shall comply with the minimum requirements, corresponding to the various nominal pressures and temperature limits, specified in Table 6.

12.2 The dimensions and finish of studs and hexagon headed bolts with hexagon nuts shall comply with the requirements of BS 3692, BS 4190 or BS 4439 as appropriate.

12.3 The dimensions and finish of stud-bolts with hexagon nuts shall comply with the requirements of BS 4882, sections 1 and 2.