BRITISH STANDARD

BS 5276-4: 1977

Specification for

Pressure vessel details (dimensions) —

Part 4: Standardized pressure vessels

UDC 621.772.4:621.642:66.023

Cooperating organizations

The Pressure Vessel Standards Committee, under whose direction this British Standard was prepared, consists of representatives from the following Government departments and industrial and professional organizations:

Associated Offices Technical Committee*
Association of Shell Boilermakers
British Chemical Engineering Contractors' Association*
British Compressed Gases Association
British Gas Corporation*
British Insurance (Atomic Energy) Committee
British Steel Industry*
CBMPE*
Chemical Industries Association*
Department of Trade (Marine Division)
Electricity Supply Industry in England and Wales*
Engineering Equipment Users' Association*
Health and Safety Executive
Institution of Chemical Engineers
Institution of Gas Engineers*
Institution of Mechanical Engineers*
Lloyd's Register of Shipping*
Oil Companies Materials Association*
Process Plant Association*
The Welding Institute
United Kingdom Atomic Energy Authority
University of Manchester — Institute of Science and Technology
Water-tube Boilermakers' Association

The organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:

Association of Consulting Engineers
Association of Hydraulic Equipment Manufacturers
British Valve Manufacturers' Association
National Association of Drop Forgers and Stampers

This British Standard, having been prepared under the direction of the Pressure Vessel Standards Committee, was published under the authority of the Executive Board on 31 August 1977

The following BSI references relate to the work on this standard:
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Contents

Foreword

This British Standard has been prepared under the direction of the Pressure Vessel Standards Committee to cover the dimensions of pressure vessel details. It has been arranged in Parts as follows:

— *Part 1: Davits for branch covers;*

— *Part 2: Saddle supports for horizontal cylindrical pressure vessels (in course of preparation);*

— *Part 3: Dimensional tolerances for pressure vessels (currently Draft for Development DD 42);*

— *Part 4: Standardized pressure vessels.*

This Part replaces BS 3161 and is confined to unfired cylindrical pressure vessels for horizontal and vertical use in the chemical and allied industries. Only one of the shapes of domed ends previously shown in BS 1966 is specified; this is the torispherical 2 : 1 radius/height ratio in terms of the inner profile (domed ends with 6 % and 10 % knuckle radii are not currently included).

It is intended that the module system adopted for the shell cylinder lengths will lead to economies in the manufacture of carbon steel and carbon manganese steel vessels by reducing the number of plate sizes used and minimizing the equipment required for fabrication.

This Part covers dimensions and pressure ratings for basic unpierced vessels thereby providing an aid to selection of standardized vessels and is intended for use in conjunction with BS 5500 "*Unfired fusion welded pressure vessels*".

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 and ii, pages 1 to 12, 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 Part of this British Standard specifies requirements for cylindrical vessels with torispherical domed ends. The lengths and thicknesses of the shell cylinders are based on standard carbon and carbon manganese steel plates. Permissible internal pressures for the domed ends and shell cylinders, not taking account of openings, can be calculated using the dimensions and pressure coefficients stated in this standard together with the relevant stress values obtained from BS 5500.

The overall design of vessels, their fabrication and testing shall be in accordance with BS 5500.

For vessels that are outside the range of sizes covered, it is recommended that shell cylinder lengths should be derived using the modular method described in **5.2.1**.

2 References

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

3 Terms and symbols

For the purposes of this British Standard the terms and symbols illustrated in Figure 1 apply.

4 Shapes

4.1 Standard diameters and lengths of shell cylinders shall be as shown in Table 1 and Table 2 together with the nominal volumes contained within the vessels and their aspect ratios (length : diameter). Table 1 facilitates the selection of a standardized vessel for a required capacity, diameter and aspect ratio.

4.2 Domed ends shall be torispherical as defined in Table 4 in terms of inner profile.

5 Dimensions

5.1 General. Linear dimensions are specified in millimetres, volumes in cubic metres.

Diameters of vessels are based on metric inside diameters and, in order to enable manufacturers to utilize existing "inch size" forming tools for the domed ends, a variation of ± 12 mm is permissible on diameters up to and including 1 300 mm. This is a temporary measure and manufacturers are strongly recommended to adopt nominal sizes when re-tooling.

5.2 Shell cylinders

5.2.1 *Modular lengths.* A standardized range of modular lengths shall be as given in Table 1 and Table 2. These lengths are based on the use of a single standard width of plate, purchased 2 500 mm wide. Shell cylinder lengths are built up in modular form using full plate widths where possible and fractions of these where necessary. Allowance is made for edge preparation, resulting in fabrication strakes of 2 480 mm (full plate), 1 860 mm (¾ plate), 1 235 mm (½ plate) and 610 mm (¼ plate). The use of alternative widths to achieve the overall shell cylinder lengths is not, however, precluded.

5.2.2 *Thicknesses.* Shell cylinder thicknesses e_{cyl}, which include 1.5 mm corrosion allowance, associated with each diameter shall be as given in Table 3.

5.3 Domed ends

5.3.1 *Profile.* The dimensions of the inner profile shall be as given in Table 4.

It is permissible to use any values of crown and knuckle radii between the stated limits provided that the head height is as specified. Appropriate values may be selected using Appendix A. For practical purposes the profiles headed "ellipsoidal" are indistinguishable from ellipsoids of vessel radius/height ratio 2 : 1, which are also acceptable.

In the manufacture of domed ends where advantage is taken of the permissible variation of ± 12 mm on the nominal diameter (see **5.1**) the inside crown radius shall be between $0.75D_i$ and $0.95D_i$, the inside knuckle radius shall be between $0.125D_i$ and $0.1805D_i$ and the inside height shall be not less than $0.25D_i$ where D_i is equal to the inside diameter, as manufactured, of the end concerned.

5.3.2 *Lengths of straight flanges.* The straight flanges shall be 50 mm long for vessels up to and including 1 700 mm diameter and 65 mm long for vessels above 1 700 mm diameter.

5.3.3 *Thicknesses.* Minimum thicknesses e_{end}, which include 1.5 mm corrosion allowance, associated with each diameter shall be as given in Table 3. These have been calculated to match the corresponding thickness e_{cyl} of the shell cylinder on the basis of equivalent strength. It is the responsibility of the manufacturer to select a suitable plate thickness to ensure that, after forming, the thickness shall at no point in the profile be less than e_{end} and that the thickness of the straight flange when prepared for welding shall be not less than the thickness e_{cyl} of the shell cylinder.

5.4 Dimensional tolerances. These shall be in accordance with BS 5500 except that the tolerance on the circumference (**4.2.4.1.1** of BS 5500:1976) shall be increased by ± 38 mm for diameters up to and including 1 300 mm (see **5.1**).

General dimensional tolerances for completed vessels shall be in accordance with DD 42.

6 Internal pressure rating of basic unpierced vessels

6.1 Procedure. To determine the shell cylinder and domed end thicknesses for a given pressure and stress, calculate the ratio $p \div f$ to find the value of the pressure coefficient, k.

$$k = \frac{p}{f}$$

where

p is the maximum permissible gauge pressure (in bar[a]) for vessel (including static head where significant).

f is the maximum allowable design stress in material (in N/mm^2).

[a] 1 bar = 10^5 N/m^2 = 100 kPa.

Enter Table 3 at the appropriate diameter and find a value of k equal to or greater than the calculated value.

Read off e_{cyl} and e_{end} for the thicknesses of the shell cylinder and the domed end respectively.

6.2 Derivation of pressure coefficient k (see Table 3). Coefficients are based on calculations to BS 5500:1976 as follows:

Shell cylinders, **3.5.1.2** a)

Unpierced ends, **3.5.2.3**

The calculations include a corrosion allowance of 1.5 mm. In the case of vessels up to and including 1 300 mm diameter calculations are made for diameters inclusive of tolerance and variation (see **5.1**).

7 Other requirements

Irrespective of the category of vessel, if the ends are made from more than one plate, the welds within each end shall be completely radiographed or examined ultrasonically before the end is formed. After forming, the knuckle region of these welds shall be examined by radiography or ultrasonic means.

The following information shall be supplied by the vessel fabricator when ordering ends.

a) Inside diameter.

b) Minimum thickness (e_{end}).

c) End preparation of the straight flange and the associated shell cylinder thickness (e_{cyl}).

d) The material specified in accordance with the appropriate British Standard.

e) Any heat treatment requirements.

f) Any further inspection requirements.

g) Surface finish, if necessary.

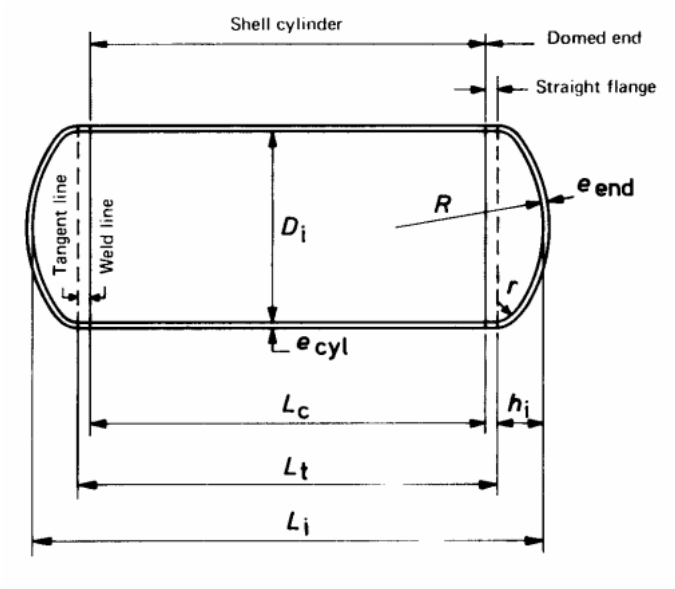


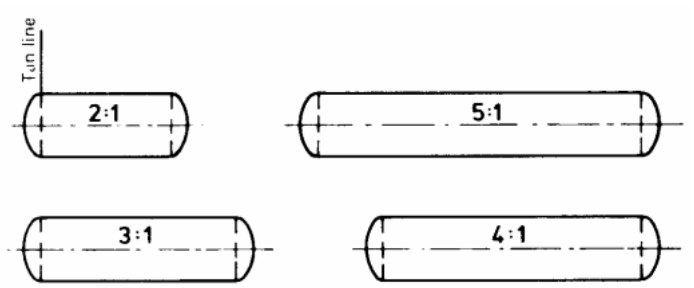
Figure 1 — Terms and symbols for basic unpierced vessels

Table 1 — Volumes, diameters and aspect ratios of standard vessels

Volume range m^3	D_i mm	Modular plate length																			
		¼	½	¾	1	1¼	1½	1¾	2	2¼	2½	3	3½	4	4½	5	5½	6	6½	7	7½	8
< 1	600[a]	**0.26**	0.43	**0.61**	0.78	**0.96**																
	650	**0.31**	0.51	**0.72**	**0.93**	1.13	**1.34**															
	700	**0.36**	**0.6**	0.84	**1.08**	1.32	**1.56**															
	750[a]	**0.42**	**0.7**	0.97	**1.25**	1.52	**1.79**															
	800	**0.49**	**0.8**	1.12	**1.43**	**1.73**	2.05	**2.36**														
	850	**0.56**	**0.91**	1.27	**1.62**	**1.97**	2.32	**2.68**														
	900[a]	**0.64**	**1.04**	1.43	1.83	**2.22**	2.61	3.01	**3.41**													
	950	**0.72**	**1.17**	1.61	2.05	**2.48**	2.92	3.37	**3.81**													
	1 000[a]	**0.81**	**1.3**	**1.79**	2.28	**2.76**	**3.25**	3.74	**4.23**													
	1 050	**0.91**	**1.45**	**1.99**	2.53	**3.06**	**3.6**	4.14	4.68	**5.21**												
1 < 2	1 100		**1.61**	**2.2**	2.79	3.37	**3.97**	4.56	5.15	**5.73**												
	1 150[a]		**1.77**	**2.42**	3.07	3.7	**4.35**	**5**	5.64	6.28	**6.93**											
	1 200		**1.95**	**2.66**	3.36	4.05	**4.76**	**5.46**	6.16	6.85	**7.56**											
2 < 3	1 250		**2.14**	**2.9**	3.66	4.41	**5.18**	**5.95**	6.71	7.46	**8.22**											
	1 300[a]		**2.33**	**3.16**	**3.99**	4.79	5.62	**6.45**	**7.28**	8.09	8.92	**10.6**										
	1 400		**2.76**	**3.72**	**4.67**	5.61	6.57	**7.54**	**8.49**	9.43	10.4	**12.3**										
3 < 5	1 500[a]		**3.22**	**4.32**	**5.42**	6.5	7.6	8.71	**9.8**	**10.9**	12	**14.2**	**16.4**									
	1 600		**3.73**	**4.99**	**6.23**	**7.46**	8.72	9.97	**11.2**	**12.4**	**13.7**	16.2	**18.7**									
	1 700		**4.28**	**5.7**	**7.11**	**8.49**	9.91	11.3	12.7	**14.1**	**15.5**	18.4	**21.2**									
	1 800[a]		**4.96**	**6.55**	**8.13**	**9.68**	11.3	12.9	14.4	**16**	**17.6**	20.8	23.9	**27.1**								
5 < 10	1 900			**7.39**	**9.15**	**10.9**	12.7	14.4	16.2	**17.9**	**19.7**	**23.2**	26.7	**30.2**								
	2 000[a]			**8.29**	**10.2**	**12.2**	**14.1**	16.1	18	19.9	**21.9**	**25.8**	29.7	**33.6**								
	2 100			**9.26**	**11.4**	**13.5**	**15.7**	17.8	20	22.1	**24.3**	**28.6**	32.9	37.2	**41.4**							
10 < 15	2 200			**10.3**	**12.6**	**15**	**17.3**	19.7	22.1	24.4	26.8	**31.5**	36.2	40.9	**45.6**							
	2 300[a]			**11.4**	**13.9**	**16.5**	**19.1**	**21.7**	24.3	26.8	29.4	**34.6**	**39.7**	44.9	50	**55.2**						
15 < 25	2 400				**15.3**	**18.1**	**20.9**	**23.7**	26.6	29.3	32.1	**37.8**	**43.4**	49	54.6	**60.2**						
	2 500				**16.8**	**19.8**	**22.9**	**25.9**	29	32	35	**41.1**	**47.2**	53.3	59.4	**65.5**						
	2 600[a]				**18.3**	**21.6**	**24.9**	**28.2**	**31.5**	34.7	38.1	44.7	**51.2**	**57.8**	64.4	71	**77.6**					
	2 700				**20**	**23.5**	**27**	**30.6**	**34.2**	37.7	41.2	48.4	**55.4**	**62.6**	69.6	76.8	**83.8**					
	2 800				**21.7**	**25.4**	**29.3**	**33.1**	**36.9**	40.7	44.5	52.2	**59.8**	**67.5**	75.1	82.8	90.4	**98**				
24 < 40	2 900					**27.5**	**31.6**	**35.7**	**39.8**	**43.9**	48	56.2	**64.4**	**72.6**	**80.8**	89	97.1	**105**				
	3 000[a]					**29.6**	**34.1**	**38.5**	**42.9**	**47.2**	51.6	60.4	69.1	**77.9**	**86.7**	95.5	104	**113**	**122**			
	3 100					**31.9**	**36.6**	**41.3**	**46**	**50.6**	55.3	64.7	74.1	**83.5**	**92.8**	102	111	121	**130**			
	3 200					**34.3**	**39.3**	**44.3**	**49.3**	**54.2**	**59.2**	69.2	79.2	**89.2**	**99.1**	**109**	119	129	**139**			
	3 300					**36.7**	**42.1**	**47.4**	**52.7**	**57.9**	**63.3**	73.9	84.5	**95.1**	**106**	**116**	127	138	148	**159**		
	3 400					**39.3**	**44.9**	**50.6**	**56.2**	**61.8**	**67.5**	78.8	90	101	**112**	**124**	135	146	158	**169**		
40 < 60	3 500						**47.9**	**53.9**	**59.9**	**65.8**	**71.8**	83.8	95.7	108	**120**	**131**	**143**	155	167	179	**191**	
	3 600[a]						**51**	**57.4**	**63.7**	**69.9**	**76.3**	89	102	114	**127**	**139**	**152**	165	177	190	**203**	
	3 700						**54.3**	**61**	**67.7**	**74.2**	**80.9**	94.3	108	121	**134**	**148**	**161**	174	188	201	**214**	
	3 800						**57.6**	**64.7**	**71.7**	**78.6**	**85.7**	**99.9**	114	128	142	**156**	**170**	**184**	198	212	226	**240**
⩾ 60	3 900						**61.1**	**68.5**	**75.9**	**83.2**	**90.7**	**106**	120	135	150	**165**	**180**	**194**	209	224	239	**254**
	4 000[a]						**64.6**	**72.5**	**80.3**	**88**	**95.8**	**111**	127	143	158	**174**	**189**	**205**	220	236	252	267
Aspect ratio		< 2 : 1											2 : 1 < 3 : 1 Shown in light type			3 : 1 < 4 : 1			4 : 1 < 5 : 1 Shown in light type			

[a] Preferred rationalized diameters

Aspect ratio (i.e. Length between tan lines : diameter)



In calculating volumes of vessels “ellipsoidal” values from Table 4 are used for inside crown radii and inside knuckle radii of domed ends.

Table 2 — Lengths of vessels

Internal length of vessel L_i, mm																					
Modular plate length		¼	½	¾	**1**	**1¼**	**1½**	**1¾**	**2**	**2¼**	**2½**	**3**	**3½**	**4**	**4½**	**5**	**5½**	**6**	**6½**	**7**	**7½**	**8**
D_i	**Lc**	**610**	**1 235**	**1 860**	**2 480**	**3 090**	**3 715**	**4 340**	**4 960**	**5 570**	**6 195**	**7 440**	**8 675**	**9 920**	**11 155**	**12 400**	**13 635**	**14 880**	**16 115**	**17 360**	**18 595**	**19 840**
mm	**Lt**	**710**	**1 335**	**1 960**	**2 580**	**3 190**	**3 815**	**4 440**	**5 060**	**5 670**	**6 295**	**7 540**	**8 775**	**10 020**	**11 255**	**12 500**	**13 735**	**14 980**	**16 215**	**17 460**	**18 695**	**19 940**
600		1 010	1 635	2 260	2 880	3 490																
650		1 035	1 660	2 285	2 905	3 515	4 140															
700		1 060	1 685	2 310	2 930	3 540	4 165															
750		1 085	1 710	2 335	2 955	3 565	4 190															
800		1 110	1 735	2 360	2 980	3 590	4 215	4 840														
850		1 135	1 760	2 385	3 005	3 615	4 240	4 865														
900		1 160	1 785	2 410	3 030	3 640	4 265	4 890	5 510													
950		1 185	1 810	2 435	3 055	3 665	4 290	4 915	5 535													
1 000		1 210	1 835	2 460	3 080	3 690	4 315	4 940	5 560													
1 050		1 235	1 860	2 485	3 105	3 715	4 340	4 965	5 685	6 195												
1 100			1 885	2 510	3 130	3 740	4 365	4 990	5 610	6 220												
1 150			1 910	2 535	3 155	3 765	4 390	5 015	5 635	6 245	6 870											
1 200			1 935	2 560	3 180	3 790	4 415	5 040	5 660	6 270	6 895											
1 250			1 960	2 585	3 205	3 815	4 440	5 065	5 685	6 295	6 920											
1 300			1 985	2 610	3 230	3 840	4 465	5 090	5 710	6 320	6 945	8 190										
1 400			2 035	2 660	3 280	3 890	4 515	5 140	5 760	6 370	6 995	8 240										
1 500			2 085	2 710	3 330	3 940	4 565	5 190	5 810	6 420	7 045	8 290	9 525									
1 600			2 135	2 760	3 380	3 990	4 615	5 240	5 860	6 470	7 095	8 340	9 575									
1 700			2 185	2 810	3 430	4 040	4 665	5 290	5 910	6 520	7 145	8 390	9 625									

Table 2 — Lengths of vessels

Internal length of vessel L_i, mm																					
Modular plate length		¼	½	¾	**1**	**1¼**	**1½**	**1¾**	**2**	**2¼**	**2½**	**3**	**3½**	**4**	**4½**	**5**	**5½**	**6**	**6½**	**7**	**7½**	**8**
D_i	**Lc**	**610**	**1 235**	**1 860**	**2 480**	**3 090**	**3 715**	**4 340**	**4 960**	**5 570**	**6 195**	**7 440**	**8 675**	**9 920**	**11 155**	**12 400**	**13 635**	**14 880**	**16 115**	**17 360**	**18 595**	**19 840**
mm	**Lt**	**740**	**1 365**	**1 990**	**2 610**	**3 220**	**3 845**	**4 470**	**5 090**	**5 700**	**6 325**	**7 570**	**8 805**	**10 050**	**11 285**	**12 530**	**13 765**	**15 010**	**16 245**	**17 490**	**18 725**	**19 970**
1 800			2 265	2 890	3 510	4 120	4 745	5 370	5 990	6 600	7 225	8 470	9 705	10 950								
1 900				2 940	3 560	4 170	4 795	5 420	6 040	6 650	7 275	8 520	9 755	11 000								
2 000				2 990	3 610	4 220	4 845	5 470	6 090	6 700	7 325	8 570	9 805	11 050								
2 100				3 040	3 660	4 270	4 895	5 520	6 140	6 750	7 375	8 620	9 855	11 100	12 335							
2 200				3 090	3 710	4 320	4 945	5 570	6 190	6 800	7 425	8 670	9 905	11 150	12 385							
2 300				3 140	3 760	4 370	4 995	5 620	6 240	6 850	7 475	8 720	9 955	11 200	12 435	13 680						
2 400					3 810	4 420	5 045	5 670	6 290	6 900	7 525	8 770	10 005	11 250	12 485	13 730						
2 500					3 860	4 470	5 095	5 720	6 340	6 950	7 575	8 820	10 055	11 300	12 535	13 780						
2 600					3 910	4 520	5 145	5 770	6 390	7 000	7 625	8 870	10 105	11 350	12 585	13 830	15 065					
2 700					3 960	4 570	5 195	5 820	6 440	7 050	7 675	8 920	10 155	11 400	12 635	13 880	15 115					
2 800					4 010	4 620	5 245	5 870	6 490	7 100	7 725	8 970	10 205	11 450	12 685	13 930	15 165	16 410				
2 900						4 670	5 295	5 920	6 540	7 150	7 775	9 020	10 255	11 500	12 735	13 980	15 215	16 460				
3 000						4 720	5 345	5 970	6 590	7 200	7 825	9 070	10 305	11 550	12 785	14 030	15 265	16 510	17 745			
3 100						4 770	5 395	6 020	6 640	7 250	7 875	9 120	10 355	1 1600	12 835	14 080	15 315	16 560	17 795			
3 200						4 820	5 445	6 070	6 690	7 300	7 925	9 170	10 405	1 1650	12 885	14 130	15 365	16 610	17 845			
3 300						4 870	5 495	6 120	6 740	7 350	7 975	9 220	10 455	11 700	12 935	14 180	15 415	16 660	17 895	19 140		
3 400						4 920	5 545	6 170	6 790	7 400	8 025	9 270	10 505	11 750	12 985	14 230	15 465	16 710	17 945	19 190		
3 500							5 595	6 220	6 840	7 450	8 075	9 320	10 555	11 800	13 035	14 280	15 515	16 760	17 995	19 240	20 475	
3 600							5 645	6 270	6 890	7 500	8 125	9 370	10 605	11 850	13 085	14 330	15 565	16 810	18 045	19 290	20 525	
3 700							5 695	6 320	6 940	7 550	8 175	9 420	10 655	11 900	13 135	14 380	15 615	16 860	18 095	19 340	20 575	
3 800							5 745	6 370	6 990	7 600	8 225	9 470	10 705	11 950	13 185	14 430	15 665	16 910	18 145	19 390	20 625	21 870
3 900							5 795	6 420	7 040	7 650	8 275	9 520	10 755	12 000	13 235	14 480	15 715	16 960	18 195	19 440	20 675	21 920
4 000							5 845	6 470	7 090	7 700	8 325	9 570	10 805	12 050	13 285	14 530	15 765	17 010	18 245	19 490	20 725	21 970

Table 3 — Vessel thicknesses and pressure coefficients

Nominal diameter of vessel D_i mm	e_{cyl} mm	6	8	10	12.5	15	20	25	30	35
600	e_{end}	6.084	8	10	12.5	15	20	25	30	35
	k	0.145	0.209	0.273	0.351	0.43	0.584	0.736	0.886	1.033
650	e_{end}	6.119	8	10	12.5	15	20	25	30	35
	k	0.134	0.194	0.252	0.325	0.398	0.541	0.683	0.822	0.959
700	e_{end}	6.155	8.02	10	12.5	15	20	25	30	35
	k	0.125	0.18	0.235	0.303	0.371	0.504	0.636	0.767	0.895
750	e_{end}	6.192	8.051	10	12.5	15	20	25	30	35
	k	0.117	0.169	0.22	0.284	0.347	0.472	0.596	0.718	0.839
800	e_{end}	6.23	8.083	10	12.5	15	20	25	30	35
	k	0.11	0.158	0.206	0.266	0.326	0.444	0.561	0.676	0.79
850	e_{end}	6.269	8.116	10	12.5	15	20	25	30	35
	k	0.104	0.149	0.195	0.251	0.307	0.419	0.529	0.638	0.746
900	e_{end}	6.309	8.15	10.03	12.5	15	20	25	30	35
	k	0.098	0.141	0.184	0.238	0.291	0.396	0.501	0.604	0.706
950	e_{end}	6.349	8.185	10.06	12.5	15	20	25	30	35
	k	0.093	0.134	0.175	0.225	0.276	0.376	0.475	0.574	0.671
1 000	e_{end}	6.39	8.22	10.09	12.5	15	20	25	30	35
	k	0.088	0.127	0.166	0.214	0.263	0.358	0.453	0.546	0.639
1 050	e_{end}	6.432	8.256	10.12	12.5	15	20	25	30	35
	k	0.084	0.121	0.158	0.204	0.25	0.341	0.432	0.521	0.61
1 100	e_{end}	6.473	8.294	10.15	12.5	15	20	25	30	35
	k	0.08	0.116	0.151	0.195	0.239	0.326	0.413	0.498	0.583
1 150	e_{end}	6.515	8.33	10.19	12.53	15	20	25	30	35
	k	0.077	0.111	0.145	0.187	0.229	0.313	0.395	0.478	0.559
1 200	e_{end}	6.557	8.369	10.22	12.56	15	20	25	30	35
	k	0.074	0.106	0.139	0.179	0.22	0.3	0.379	0.458	0.537
1 250	e_{end}	6.6	8.409	10.25	12.59	15	20	25	30	35
	k	0.071	0.102	0.133	0.172	0.211	0.288	0.365	0.441	0.516
1 300	e_{end}	6.641	8.449	10.29	12.62	15	20	25	30	35
	k	0.068	0.098	0.128	0.166	0.203	0.277	0.351	0.424	0.497
1 400	e_{end}	6.714	8.519	10.35	12.68	15.02	20	25	30	35
	k	0.064	0.092	0.12	0.156	0.191	0.26	0.329	0.398	0.466
1 500	e_{end}	6.796	8.6	10.43	12.74	15.09	20	25	30	35
	k	0.06	0.086	0.112	0.145	0.178	0.243	0.308	0.372	0.436
1 600	e_{end}	6.876	8.684	10.5	12.81	15.15	20	25	30	35
	k	0.056	0.081	0.105	0.136	0.167	0.228	0.289	0.349	0.409
1 700	e_{end}	6.953	8.766	10.58	12.88	15.21	20	25	30	35
	k	0.053	0.076	0.099	0.128	0.157	0.215	0.272	0.329	0.386
1 800	e_{end}	7.028	8.85	10.66	12.95	15.27	20	25	30	35
	k	0.05	0.072	0.094	0.121	0.149	0.203	0.257	0.311	0.365
1 900	e_{end}	7.099	8.934	10.74	13.02	15.34	20.03	25	30	35
	k	0.047	0.068	0.089	0.115	0.141	0.193	0.244	0.295	0.346

Table 3 — Vessel thicknesses and pressure coefficients

Nominal diameter of vessel D_i mm	e_{cyl} mm	6	8	10	12.5	15	20	25	30	35	40	45	50	55	60	65	70
2 000	e_{end}	7.165	9.018	10.83	13.1	15.41	20.09	25	30	35	40	45	50	55	60	65	70
	k	0.045	0.065	0.085	0.109	0.134	0.183	0.232	0.281	0.329	0.377	0.425	0.473	0.52	0.568	0.615	0.661
2 100	e_{end}	7.228	9.099	10.91	13.18	15.48	20.15	25	30	35	40	45	50	55	60	65	70
	k	0.043	0.062	0.081	0.104	0.128	0.174	0.221	0.267	0.314	0.36	0.405	0.451	0.496	0.541	0.586	0.631
2 200	e_{end}	7.286	9.18	10.99	13.26	15.55	20.21	25	30	35	40	45	50	55	60	65	70
	k	0.041	0.059	0.077	0.099	0.122	0.167	0.211	0.255	0.3	0.344	0.387	0.431	0.474	0.517	0.56	0.603
2 300	e_{end}	7.341	9.26	11.08	13.34	15.62	20.28	25	30	35	40	45	50	55	60	65	70
	k	0.039	0.056	0.074	0.095	0.117	0.159	0.202	0.244	0.287	0.329	0.371	0.413	0.454	0.495	0.537	0.578
2 400	e_{end}	7.391	9.337	11.16	13.42	15.7	20.34	25.04	30	35	40	45	50	55	60	65	70
	k	0.037	0.054	0.07	0.091	0.112	0.153	0.194	0.234	0.275	0.315	0.356	0.396	0.436	0.475	0.515	0.554
2 500	e_{end}	7.435	9.414	11.24	13.5	15.77	20.41	25.1	30	35	40	45	50	55	60	65	70
	k	0.036	0.052	0.068	0.088	0.107	0.147	0.186	0.225	0.264	0.303	0.342	0.38	0.419	0.457	0.495	0.533
2 600	e_{end}	7.475	9.486	11.33	13.58	15.85	20.47	25.16	30	35	40	45	50	55	60	65	70
	k	0.035	0.05	0.065	0.084	0.103	0.141	0.179	0.217	0.254	0.292	0.329	0.366	0.403	0.44	0.476	0.513
2 700	e_{end}	7.509	9.559	11.41	13.66	15.93	20.54	25.22	30	35	40	45	50	55	60	65	70
	k	0.033	0.048	0.063	0.081	0.099	0.136	0.172	0.209	0.245	0.281	0.317	0.353	0.388	0.424	0.459	0.494
2 800	e_{end}	7.537	9.627	11.49	13.75	16.01	20.61	25.28	30	35	40	45	50	55	60	65	70
	k	0.032	0.046	0.06	0.078	0.096	0.131	0.166	0.201	0.236	0.271	0.306	0.34	0.375	0.409	0.443	0.477
2 900	e_{end}	7.561	9.693	11.57	13.83	16.09	20.68	25.34	30.05	35	40	45	50	55	60	65	70
	k	0.031	0.045	0.058	0.075	0.093	0.127	0.161	0.194	0.228	0.262	0.295	0.329	0.362	0.395	0.428	0.461
3 000	e_{end}	7.58	9.756	11.65	13.91	16.17	20.75	25.4	30.1	35	40	45	50	55	60	65	70
	k	0.03	0.043	0.056	0.073	0.09	0.122	0.155	0.188	0.221	0.253	0.286	0.318	0.35	0.382	0.414	0.446
3 100	e_{end}		9.816	11.73	14	16.25	20.82	25.47	30.16	35	40	45	50	55	60	65	70
	k		0.042	0.055	0.071	0.087	0.119	0.15	0.182	0.214	0.245	0.276	0.308	0.339	0.37	0.401	0.432
3 200	e_{end}		9.874	11.8	14.08	16.33	20.89	25.54	30.22	35	40	45	50	55	60	65	70
	k		0.041	0.053	0.068	0.084	0.115	0.146	0.176	0.207	0.238	0.268	0.298	0.329	0.359	0.389	0.419
3 300	e_{end}		9.927	11.88	14.16	16.42	20.97	25.6	30.28	35	40	45	50	55	60	65	70
	k		0.039	0.051	0.066	0.081	0.111	0.141	0.171	0.201	0.23	0.26	0.289	0.319	0.348	0.377	0.406
3 400	e_{end}		9.98	11.95	14.24	16.5	21.04	25.67	30.34	35.05	40	45	50	55	60	65	70
	k		0.038	0.05	0.064	0.079	0.108	0.137	0.166	0.195	0.224	0.252	0.281	0.31	0.338	0.366	0.395
3 500	e_{end}		10.03	12.02	14.33	16.58	21.12	25.74	30.41	35.11	40	45	50	55	60	65	70
	k		0.037	0.048	0.063	0.077	0.105	0.133	0.161	0.189	0.217	0.245	0.273	0.301	0.329	0.356	0.384
3 600	e_{end}		10.07	12.09	14.41	16.67	21.2	25.81	30.47	35.17	40	45	50	55	60	65	70
	k		0.036	0.047	0.061	0.075	0.102	0.13	0.157	0.184	0.211	0.239	0.266	0.293	0.32	0.346	0.373
3 700	e_{end}		10.12	12.16	14.49	16.75	21.28	25.87	30.53	35.23	40	45	50	55	60	65	70
	k		0.035	0.046	0.059	0.073	0.099	0.126	0.153	0.179	0.206	0.232	0.259	0.285	0.311	0.337	0.363
3 800	e_{end}		10.15	12.23	14.57	16.83	21.36	25.95	30.6	35.29	40	45	50	55	60	65	70
	k		0.034	0.045	0.058	0.071	0.097	0.123	0.149	0.175	0.2	0.226	0.252	0.277	0.303	0.328	0.354
3 900	e_{end}		10.19	12.29	14.65	16.92	21.44	26.02	30.66	35.35	40.06	45	50	55	60	65	70
	k		0.033	0.043	0.056	0.069	0.094	0.12	0.145	0.17	0.195	0.22	0.245	0.27	0.295	0.32	0.345
4 000	e_{end}		10.22	12.35	14.73	17	21.52	26.09	30.73	35.41	40.12	45	50	55	60	65	70
	k		0.032	0.042	0.055	0.067	0.092	0.117	0.141	0.166	0.191	0.215	0.239	0.264	0.288	0.312	0.336

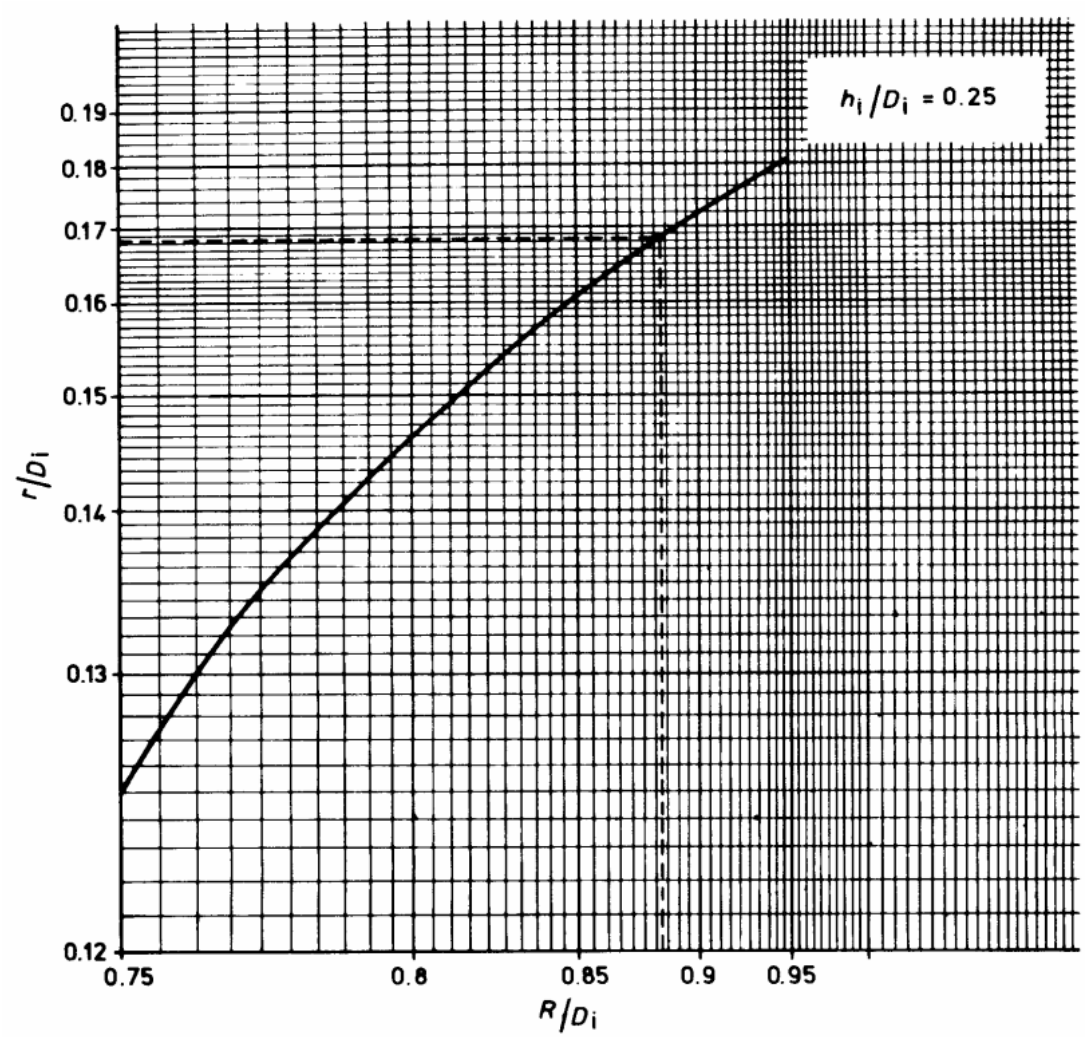
Table 4 — Dimensions of domed ends

Inside diameter D_i	Inside crown radius R			Inside knuckle radius r			Inside height h_i (0.25 D_i)
	Minimum (0.75 D_i)	"Ellipsoidal" (0.8 D_i)	Maximum (0.95 D_i)	Minimum (0.125 D_i)	"Ellipsoidal" (0.146 D_i)	Maximum (0.1805 D_i)	
mm	mm	mm	mm	mm	mm	mm	mm
600[a]	450	480	570	75	88	103	150
650	488	520	617	82	95	117	163
700	525	560	665	88	102	126	175
750[a]	563	600	712	94	110	135	188
800	600	640	760	100	117	144	200
850	638	680	807	107	124	153	213
900[a]	675	720	855	113	131	162	225
950	713	760	902	119	139	171	238
1 000[a]	750	800	950	125	146	180	250
1 050	788	840	997	132	153	189	263
1 100	825	880	1 045	138	161	198	275
1 150[a]	863	920	1 092	144	168	207	288
1 200	900	960	1 140	150	175	216	300
1 250	938	1 000	1 187	157	183	225	313
1 300[a]	975	1 040	1 235	163	190	234	325
1 400	1 050	1 120	1 330	175	204	252	350
1 500[a]	1 125	1 200	1 425	188	219	270	375
1 600	1 200	1 280	1 520	200	234	288	400
1 700	1 275	1 360	1 615	213	248	306	425
1 800[a]	1 350	1 440	1 710	225	263	324	450
1 900	1 425	1 520	1 805	238	277	342	475
2 000[a]	1 500	1 600	1 900	250	292	361	500
2 100	1 575	1 680	1 995	263	307	379	525
2 200	1 650	1 760	2 090	275	321	397	550
2 300[a]	1 725	1 840	2 185	288	336	415	575
2 400	1 800	1 920	2 280	300	350	433	600
2 500	1 875	2 000	2 375	313	365	451	625
2 600[a]	1 950	2 080	2 470	325	380	469	650
2 700	2 025	2 160	2 565	338	394	487	675
2 800	2 100	2 240	2 660	350	409	505	700
2 900	2 175	2 320	2 755	363	423	523	725
3 000[a]	2 250	2 400	2 850	375	438	541	750
3 100	2 325	2 480	2 945	388	453	559	775
3 200	2 400	2 560	3 040	400	467	577	800
3 300	2 475	2 640	3 135	413	482	595	825
3 400	2 550	2 720	3 230	425	496	613	850
3 500	2 625	2 800	3 325	438	511	631	875
3 600[a]	2 700	2 880	3 420	450	526	649	900
3 700	2 775	2 960	3 515	463	540	667	925
3 800	2 850	3 040	3 610	475	555	685	950
3 900	2 925	3 120	3 705	488	569	703	975
4 000[a]	3 000	3 200	3 800	500	584	722	1 000

NOTE 1 The manufacturer is free to select any values of R and r with in the range given to produce the specific depth of head h_i.
NOTE 2 The "ellipsoidal" values of R and r are the particular combinations of radii which produce the nearest approximation to a semi-ellipsoidal shape.
NOTE 3 For inside diameters 600 mm to 1 300 mm inclusive, a permissible variation of ± 12 mm is applicable with corresponding variation of inside crown radius, inside knuckle radius, and head height (see **5.3.1**).

[a] Preferred rationalized diameters

Appendix A Relationship between inside crown radius R and inside knuckle radius r



Graph for determining the appropriate values of R and r to give $h_i/D_i = 0.25$

Example:

If $D_i = 1\ 600$ — r can be between 200 and 288

say $r = 270$ — therefore $r/D_i = 0.1688$

From graph $R/D_i = 0.883$

Thus, $R = 1\ 413$

The equation for this curve is:

$$h_i = R - \sqrt{\left(R - \frac{D_i}{2}\right) \times \left(R + \frac{D_i}{2} - 2\,r\right)}$$

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Publications referred to

BS 5500, *Unfired fusion welded pressure vessels.*
DD 42, *Recommendations for dimensional tolerances for pressure vessels.*

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