



Curved heads DIN 28011/cap form

measure in mm

1 Coverage

This norm is to use for curved heads in cap form (bumped boiler heads) with following connections:

$$r_1 = d_a \quad r_2 = 0,1 d_a \quad h_1 \geq 3,5 s^{(1)} \quad h_2 = 0,1935 d_a - 0,455 s$$

This norm consider for one piece heads with and without weld seam with a external diameter $d_a \geq 4000$ mm and a wall thickness $s \leq 50$ mm.

#For heads in larger dimensional range consider analogously the Scope of this norm, at which the tolerance -

especially at heads of sections- have to arrange extra. Curved heads, elliptical head see DIN 28013.

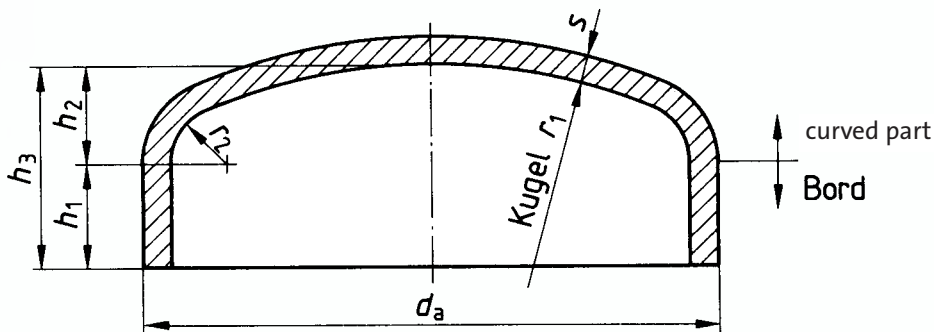
The calculation of the necessary wall thickness results for example:

- for pressure tanks according to the technical rules of pressure tanks (TRB, AD-leaflets)

- for steam boilers according to the technical rules of steam boilers (TRD)

2 Type of design, description

2.1 Geometrical connections



picture 1

s = wall thickness, see Section 3.4.5

Capacity of the curved part (without boarding height h_1) $V \approx 0,1 (d_a - 2s)^3$

External surface of the curved part (without boarding height h_1) $A_a \approx 0,99 \cdot d_a^2$

Internal surface of the curved part (without boarding height h_1) $A_i \approx 0,99 \cdot (d_a - 2s)^2$

Reference line will be measured out of the finished kerb with h_1 according to table 1

At the order the designation of the reference line can be arrange.



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Table 1.

wall thickness s ²⁾			3	4	5	3	4	5	6	7	8	9	10
height h_1 ¹⁾			11	14	18	20			25		30	35	
d_a ³⁾	r_1	r_2	weight in kg ⁴⁾										
● 26,9	26,9	2,7	0,06	—									
30	30	3	0,06	0,07									
31,8	31,8	3,2	0,07	0,09									
● 33,7	33,7	3,4	0,07	0,09	—								
38	38	3,8	0,08	0,1									
● 42,4	42,4	4,2	0,08	0,11									
44,5	44,5	4,5	0,1	0,13									
● 48,3	48,3	4,8	0,11	0,14		—	—	—	—				
51	51	5,1	0,13	0,17	0,21								
57	57	5,7	0,15	0,21	0,26					—	—		
● 60,3	60,3	6	0,17	0,23	0,26								
63,5	63,5	6,4	0,17	0,23	0,29							—	—
70	70	7	0,21	0,28	0,34								
● 76,1	76,1	7,6	0,25	0,33	0,38								
82,5	82,5	8,3	0,29	0,39	0,44								
● 88,9	88,9	8,9	—	—	—	0,32	0,43	0,53	0,68				
101,6	101,6	10	—	—	—	0,38	0,51	0,76	0,85				
108	108	11	—	—	—	0,46	0,61	0,71	0,91				
● 114,3	114,3	11	—	—	—	0,49	0,66	0,82	0,98				
127	127	13	—	—	—	0,59	0,78	0,98	1,17				
133	133	13	—	—	—	0,63	0,84	1,04	1,25	1,46	1,91		
● 139,7	139,7	14	—	—	—	0,72	0,96	1,2	1,44	1,67	2,1		
152,4	152,4	15	—	—	—	0,8	1,06	1,32	1,58	1,85	2,47		
159	159	16	—	—	—	0,88	1,2	1,4	1,9	2,2	2,8		
● 168,3	168,3	17	—	—	—	1	1,3	1,7	2,1	2,4	3,1	3,4	3,7
177,8	177,8	18	—	—	—	1,1	1,4	1,8	2,3	2,6	3,3	3,7	4
193,7	193,7	20	—	—	—	1,2	1,7	2,1	2,6	3,1	3,9	4,3	4,7
● 219,1	219,1	22	—	—	—	1,5	2,1	2,5	3,3	3,7	4,7	5,3	5,8
244,5	244,5	25	—	—	—	1,9	2,5	3,2	4	4,6	5,7	6,4	7
● 273	273	28	—	—	—	2,3	3,1	3,9	4,8	5,6	6,9	7,8	8,6
300	300	30	—	—	—	2,8	3,6	4,6	5,7	6,6	8,1	9,1	10,1
● 323,9	323,9	32	—	—	—	3,2	4,2	5,3	6,6	7,6	9,4	10,5	11,6
350	350	35	—	—	—	3,6	4,8	6,1	7,6	8,8	10,8	12,1	13,3
● 355,6	355,6	36	—	—	—	3,7	5,1	6,3	7,8	9,2	11	12,4	13,7
400	400	40	—	—	—	4,7	6,3	7,8	9,7	11,2	13,6	15,4	16,9
● 406,4	406,4	41	—	—	—	4,8	6,5	8	9,9	11,5	14,1	15,7	17,5
450	450	45	—	—	—	5,8	7,8	9,8	12	14	16,9	18,9	21
● 457	457	46	—	—	—	6,1	8	10,1	12,3	14,4	17,4	19,5	21,7
500	500	50	—	—	—	7,2	9,6	11,9	14,6	17,1	20,5	23	25,5
● 508	508	51	—	—	—	7,4	9,8	12,2	15,1	17,6	21,2	23,6	26,3
550	550	55	—	—	—	8,6	11,4	14,3	17,5	20,4	24,4	27,2	30,4
559	559	56	—	—	—	8,8	11,8	14,7	18,1	21	25,2	28,3	31,4
600	600	60	—	—	—	10,1	13,5	16,8	20,7	24,1	28,7	32,2	35,8

• external diameter of the tube of the line 1 according to DIN 2448

1) The height of the cylindrical collar at caps averages $h_1 = < 3,5 s$, but it does not need to exceed the following dimensions:

wall thickness s	height h_1
$s \leq 50$	150
$50 < s \leq 80$	120
$80 < s \leq 100$	100
$100 < s \leq 120$	75
$120 < s \leq$	50

Other board heights are to be agreed.

2) See chapter 3.4.5

3) At heads with an external diameter $d_a > 4000$ mm the values have to calculate according to chapter 1 and 2

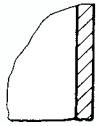


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2.2 Angles

form R
(as yet IR)

raw



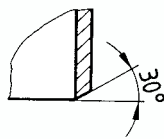
form I
(as yet IP)

I-seam
plan



form VA

V-seam
outside

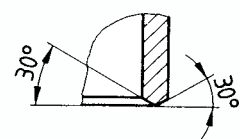


form VI

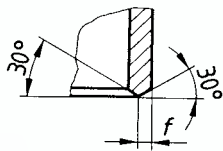
V-seam
inside



form DV
(as yet XS)
DV-seam
(symmetrical)

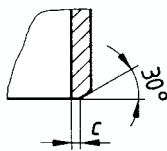


form 2/3 DV
(as yet XA)
2/3-DV-seam
(asymmetrical)



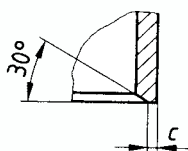
form YA

Y-seam
outside

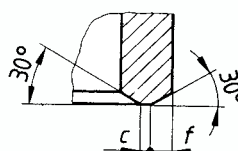


form YI

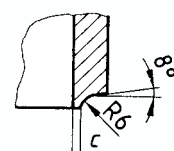
Y-seam
inside



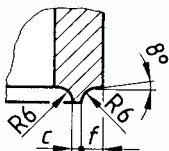
form DY
(as yet YD)
double Y-seam



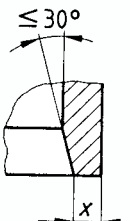
form U
(as yet US)
U-seam
(bevel) bell seam



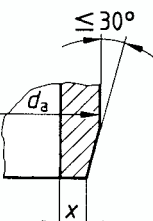
form DU
(as yet ID)
double-U-seam



form BI
refilling
inside



form BA
refilling
outside



picture 2

Processing of the angles mechanical or by flame cut. The dimensions c , f and x have to arrange at the order, also the angle and radii as far as they don't comply to picture 2. Other preparation for the weldseam have to arrange with outlines at the order.

2.3 Description

Description of a cap with a external diameter $d_a = 600$ mm and wall thickness $s = 20$ mm with a angle form VA of steel HII according to DIN 17155:

head DIN 28011 – 600 x 20 – VA – HII

Description of a cap with a external diameter $d_a = 600$ mm and a minimal wall thickness $s_{min} = 19,5$ mm with the angle form VA and BI with $x = 15$ mm of the steel breed HII according to DIN 17155:

head DIN 28011 – 600 x 219,5 MIN – VA BI – 15 HII

3 Technical conditions of delivery

3.1 material

As material can be arrange:

- hot-rolled products of unalloyed steels according to DIN EN 10025
- heat resisting steels according to DIN 17155
- non-rusting steels according to DIN 17440 or to the steel test specification 400
- fine grain steel which is able to weld according to DIN 17102

- low-temperature stells
- plated steels
- high heat resisting and heat resisting steels
- special alloys
- non-ferrous metals

according to the DIN norms, AD-leaflet, VdTUV-material sheet, steel test specification

- materials according to other national and international regulations



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3.2 Manufacturing and heat treatment

The heads will be hot or cold formed according to the choice of the manufacturer if the kind of the form was not arranged before. The heat treatment has to be arranged, for example according to the AD-leaflet of the line HP7. The manufacturer has to indicate if a head will be manufactured of several parts (before or after forming).

3.3 Surface Condition

Flanges are supplied with untreated surface. Other surface conditions, such as descaled, pickled, blasted, are to be agreed.

3.4 Limiting sizes

3.4.1 Limiting sizes for the internal height h_3

For the height $h_3 = h_1 + h_2$ the limiting sizes are:

- a) the upper dimension : + 0,015 d_a or +10 mm
- b) lower dimension: 0

These height dimensions consider for heads with arranged kerbs. At heads with crude kerbs (form R) the height h_3 has to be measured so that later all other forms of this norm have to be manufactured.

3.4.2 Limiting-size for the ad-measurement

Limiting-sizes for the ad-measurement are arranged in table 2.

Table 2. Lower limiting-sizes of the wall thickness
(upper limiting-size see DIN 2609)

material	d_a	limiting-size for the admeasurement
Hot-rolled unalloyed steels	$d_a < 100$	$\pm 3,0$ mm
Heat resisting steels	$100 \leq d_a < 300$	$\pm 4,0$ mm
Low temperature steel (ferritic untempered)	$300 \leq d_a < 1000$	$\pm 0,4$ %
Fine grained steel	$1000 \leq d_a \leq 4000$	$\pm 0,3$ %
Non-rusting steels	$d_a < 100$	$\pm 3,0$ mm
Superalloyed steels	$100 \leq d_a < 300$	$\pm 5,0$ mm
Low temperature steels (austenitic or tempered)	$300 \leq d_a \leq 4000$	+ 0,5 %
Austenitic plated steels		- 0,7 %
Plated steels	$d_a < 100$	$\pm 3,0$ mm
besides austenitic plated steels	$100 \leq d_a < 300$	$\pm 5,0$ mm
Nonferrous metals	$300 \leq d_a \leq 4000$	$\pm 1,0$ %

3.4.3 Limiting-sizes for the non-circularity u

The non-circularity $u = \frac{2 (d_{a \max} - d_{a \min})}{(d_{a \max} + d_{a \min})} \cdot 100$ in % may just have 1 % maximum;

also may the biggest diameter difference $d_{a \max} - d_{a \min} \leq d_a$ 4000 mm not be bigger than 30 mm.



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3.4.4 Restriction of the tolerances

Lower limiting-sizes for the ad-measurement or the non-circularity tolerances have to be agree in special case. The limiting-sizes have to be agree if the caps should be used in pairs or as internal or external caps.

3.4.5 Limiting-sizes for the wall-thickness

For the limiting-sizes of the wall thickness consider:

If at the order just the wall thickness is given, it can be fall below as in table 3.

Table 3.

wall thickness	lower measure
≤ 10	- 0,3
> 10 ≤ 30	- 0,5
> 30 ≤ 50	- 0,8
> 50	- 1,0

If in the order the minimum wall thickness is required, it doesn't may fall below.

(For the boarding height h_1 in such cases consider instead of the wall thickness s the minimum wall thickness s_{min} . For s_{min} consider the value without decimal places).

For the compliance of the required wall thickness or rather minimum wall thickness because of the production causes you have to provide that the accordant thickness surcharges for the slug of the sheet. Beyond that is a bigger wall thickness, especially in the area of the cylindrical board (compression) possible. A refilling has to act up in the order (form BI or BA according to chapter 2.2)

3.5 Appointment of ad-measurement

3.5.1 Position for the appointment of ad-measurement

- a) At heads with arranged kerbs at the border
- b) At heads with crude kerbs at the area between upper and lower limiting size of h_3 of the height-related tolerance, according to chapter 3.4.1.

3.5.2 Appointment of the external ad-measurement

With calibrated measuring strip according to DIN 6409, the ad-measurement will be measured at the in chapter 3.5.1 denoted area. At the calculation of the diameter you have to locate π with 3,14159.

3.5.3 Appointment of the internal ad-measurement

- a)) Measuring of the external ad-measurement how described in chapter 3.5.2, less of the middle wall thickness which will be appoint of the arithmetical media of the ad-measurement of the wall thickness at the place of the measuring of the amount but at minimal 3 points and at heads with $d_a > 500$ mm all 500 mm or
- b) with calibrated rolling dimension.

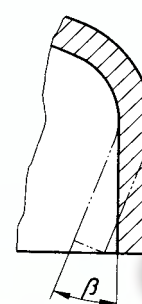
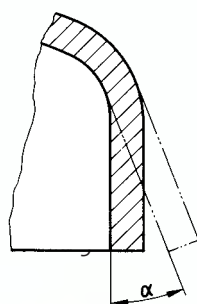
3.6 Flattening

At the area of the diameter r_1 are flattening of the meridian circle acceptable (at flat areas measured by siting of a lineal) which has a length of maximal 15% of the diameter r_1 .

3.7 Skewing of the cylindrical board

widened head

inverted head





Curved heads DIN 28011/cap form

Limiting sizes of the right angle of the cylindrical board see table 4.

Table 4.

d_a	α	β
< 1000	$\leq 4^\circ$	$\leq 2^\circ$
≥ 1000	$\leq 5^\circ$	$\leq 2^\circ$

At the arbitration the measurement has to accomplish internal (compression).

3.8 Certifications

The necessary certifications have to be arranged at the order, for example according to the technical rules of pressure tank (TRB), technical rules of steam boiler (TRD).

Cited norms and other documents

DIN 2448	Seamless steel tubes, dimensions, fibre coarseness
DIN 6403	Measuring tapes of steel
DIN 17102	Fine grained steel which is able to weld, normal annealed, technical conditions of delivery for sheet-, stripe-, wide-flat-, form- and bar steel
DIN 17155	Sheet and stripe of heat resistant steels, technical conditions of delivery
DIN 17440	Non rusting steels, technical conditions of delivery for sheet, hot rolled stripe, wire rod, drawn wire, bar steel, forgings and half finished products
DIN 28013	Arched heads, elliptical head
DIN EN 10025	Hot rolled products of unalloyed steels, technical conditions of delivery, German version EN 10025: 1990

AD-leaflet line HP7 *)

VdTÜV-material-sheet *)*)

Steel test specifications (SEW) ****)

Technical rules pressure tank (TRB) ***)

Technical rules steam boiler (TRD) *)

Earlier editions

DIN 28012: 10.70

DIN 28011: 10.70, 05.87

Modifications

Compared to edition in May 1987 were changed:

- Changed nominal width in the wall thickness s and second example of appellation for the indication of the minimum wall thickness s_{min}
- Changed capacity in volume
- Overworked editorial and technical standardisation

International patent classification

B 01 J 3/04

B 65 D 90/02

F 22 B 37/22

F 16 J 12/00