



Steel butt-welding pipe fittings

Part 2: Elbows and bends for use at full service pressure

DIN
2605-2

ICS 23.040.40

Supersedes DIN 2605-2,
February 1991 edition.

Descriptors: Elbows, bends, pipe fittings, dimensions, steel, butt welding.

Formstücke zum Einschweißen – Rohrbogen – Teil 2: Voller Ausnutzungsgrad

In keeping with current practice in standards published by the International Organization for Standardization (ISO), a comma has been used throughout as the decimal marker.

Foreword

This standard has been prepared by Technical Committee *Einschweiß fittings* of the *Normenausschuß Rohrverbindungen und Rohrleitungen* (Pipes, Pipe Joints and Pipelines Standards Committee).

Amendments

In comparison with the July 1991 edition of DIN 2605-2, the following amendments have been made:

- a) for wall thickness series 5, dimensions s_1 and s_2 of fittings designed for pipes of sizes DN 15 to DN 600 have been reduced (cf. table 1);
- b) in table 3, limit deviations for fittings designed for pipes of size diameter DN 300 have been included.

Previous edition

DIN 2605-2: 1991-02.

1 Scope and field of application

This standard specifies the design and dimensions of seamless and welded steel elbows and bends rated for the same internal pressure as the pipes to which they are to be connected (cf. clause 6). As the pressure rating of pipes is a function of their wall thickness, fittings have been classified according to wall thickness series (cf. table 1).

2 Normative references

This standard incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the titles of the publications are listed below. For dated references, subsequent amendments to or revisions of any of these publications apply to this standard only when incorporated into it by amendment or revision. For undated references, the latest edition of the publication referred to applies.

DIN 2609	Steel butt-welding pipe fittings – Technical delivery conditions
ISO 3419 : 1981*)	Non-alloy and alloy steel butt-welding fittings
ISO 4200 : 1985*)	Plain end steel tubes, welded and seamless – General tables of dimensions and masses per unit length
TRD 301*)	<i>Zylinderschalen unter innerem Überdruck</i> (Cylindrical shells subject to internal pressure)

*) Obtainable from *Beuth Verlag GmbH*, Burggrafenstraße 6, D-10787 Berlin.

www.stfitting.com	www.bwfitting.com
www.st-pipefittings.com	www.stgjjt.com
www.topfitting.com	www.stting.com

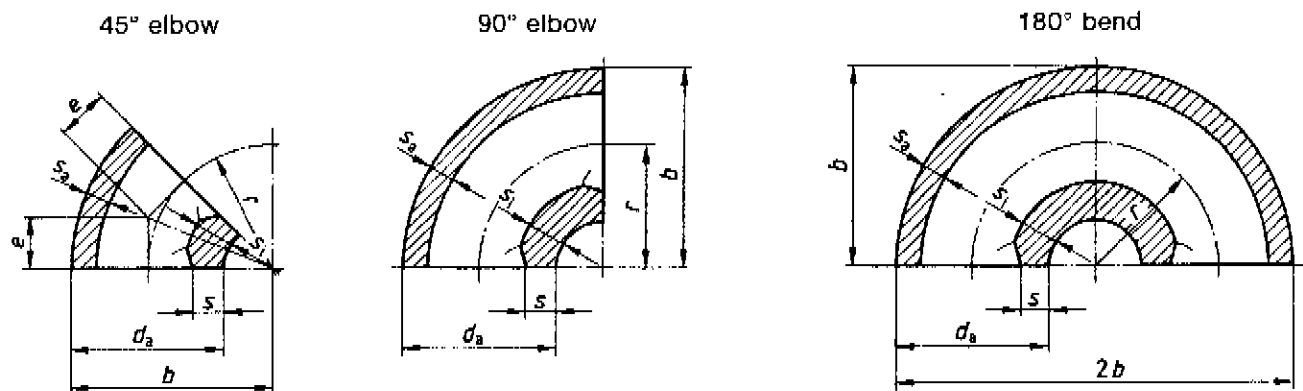
Continued on pages 2 to 9.

Translation by DIN-Sprachendienst.

In case of doubt, the German-language original should be consulted as the authoritative text.

Bearbeitet: **Normung****18.3.01**

3 Types and designation



r is a design dimension, to be calculated as follows:

type 2: $r = 1,0 \cdot d_a$;

type 3: $r \approx 1,5 \cdot d_a$;

type 5: $r \approx 2,5 \cdot d_a$;

type 10: $r \approx 5,0 \cdot d_a$;

type 20: $r = 10,0 \cdot d_a$.

Figure 1

The standard designation for a type 3 (3), welded (W) 90° (90) elbow as specified in this standard (2) with d_a equal to 88,9 mm and s equal to 5,6 mm, made of material group F steel as specified in DIN 2609 (F) shall read:

Elbow DIN 2605 – 2 – 90 – 3 – 88,9 × 5,6 W – F

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www.st-pipefittings.com

www.topfitting.com

www.bwfitting.com

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4 Dimensions

Table 1: Dimensions (For tolerances, see table 2.)

Nominal size DN	Pipe outside diameter, $d_a^{1)}$	Pipe type	Wall thickness series															r	b	e					
			1			2			3			4			5										
			s	s_1	$s_a^{2)}$	s	s_1	$s_a^{2)}$	s	s_1	$s_a^{2)}$	s	s_1	$s_a^{2)}$	s	s_1	$s_a^{2)}$								
15	21,3	2	3,1	1,3	—	—	—	3,8	1,7	—	—	—	5,6	2,6	—	—	—	6,7	3,2	—	—	—	17,5	28	7
		3	2,2	1,4	—	—	—	2,0	—	—	—	—	4,2	2,8	—	—	—	5,2	3,4	—	—	—	28	38	12
		5	1,9	1,5	—	—	—	—	—	—	—	—	3,8	2,9	—	—	—	4,7	3,6	—	—	—	42,5	53	18
20	26,9	2	2,7	1,4	—	—	—	3,7	1,9	—	—	—	5,1	2,7	—	—	—	6,2	3,3	—	—	—	25	39	10
		3	2,4	1,4	—	—	—	2,3	—	—	—	—	4,6	2,7	—	—	—	5,6	3,3	—	—	—	29	43	12
		5	1,9	1,5	—	—	—	—	—	—	—	—	3,7	2,9	—	—	—	4,6	3,6	—	—	—	57,5	71	24
25	33,7	2	4,2	1,6	—	—	—	5,3	2,1	—	—	—	6,3	2,6	—	—	—	7,5	3,1	—	—	—	25	42	10
		3	2,9	1,7	—	—	—	2,6	—	—	—	—	4,5	2,7	—	—	—	5,5	3,4	—	—	—	38	56	16
		5	2,4	1,9	—	—	—	—	—	—	—	—	3,0	2,4	—	—	—	4,6	3,6	—	—	—	72,5	90	30
32	42,4	2	4,1	1,6	—	—	—	5,2	2,1	—	—	—	6,9	2,9	—	—	—	7,5	3,1	—	—	—	32	53	13
		3	2,9	1,7	—	—	—	2,6	—	—	—	—	5,0	3,1	—	—	—	5,5	3,4	—	—	—	48	69	20
		5	2,3	1,9	—	—	—	—	—	—	—	—	3,0	2,4	—	—	—	4,6	3,6	—	—	—	92,5	114	38
40	48,3	2	3,9	1,6	—	—	—	4,9	2,1	—	—	—	7,3	3,2	—	—	—	8,8	3,9	—	—	—	38	62	16
		3	2,8	1,7	—	—	—	2,6	—	—	—	—	5,5	3,4	—	—	—	6,8	4,2	—	—	—	57	82	24
		5	2,3	1,9	—	—	—	—	—	—	—	—	3,0	2,4	—	—	—	5,7	4,5	—	—	—	107,5	132	45
50	60,3	2	3,5	1,7	—	—	—	5,0	2,4	—	—	—	7,6	3,7	—	—	—	9,2	4,5	—	—	—	51	81	21
		3	2,7	1,8	—	—	—	—	—	—	—	—	6,0	3,9	—	—	—	7,4	4,8	—	—	—	76	106	32
		5	2,0	1,9	—	—	—	2,9	—	—	—	—	5,2	4,1	—	—	—	6,4	5,1	—	—	—	135	166	56
65	76,1	10	2,2	1,9	—	—	—	—	—	—	—	—	4,9	4,3	—	—	—	6,0	5,3	—	—	—	254	284	105
		20	2,1	2,0	—	—	—	—	—	—	—	—	3,0	2,9	—	—	—	5,8	5,4	—	—	—	508	538	210
		2	4,1	1,9	—	—	—	—	—	—	—	—	5,1	2,4	—	—	—	11,8	5,6	—	—	—	63	102	26
65	76,1	3	3,1	2,0	—	—	—	—	—	—	—	—	6,7	4,3	—	—	—	9,3	6,0	—	—	—	95	133	39
		5	2,7	2,1	—	—	—	—	—	—	—	—	5,7	4,6	—	—	—	8,1	6,5	—	—	—	175	213	73
		10	2,5	2,2	—	—	—	—	—	—	—	—	5,4	4,8	—	—	—	7,6	6,7	—	—	—	318	356	132
20	2,4	2,3	—	—	—	—	—	—	—	—	3,0	2,9	—	—	—	7,3	6,9	—	—	—	635	673	268		

Dashes stand for non-standardized sizes.

1) Pipe outside diameters have been selected in accordance with series 1 as specified in ISO 4200.

2) For butt joints to be made properly, the outer bend thickness, s_a , at the abutting edge shall at least be equal to the pipe wall thickness, s.

(continued)

Table 1 (continued)

Nominal size DN	Pipe outside diameter, $d_a^{(1)}$	Pipe type	Wall thickness series															r	b	e
			1			2			3			4			5					
			s	s_1	$s_a^{(2)}$	s	s_1	$s_a^{(2)}$	s	s_1	$s_a^{(2)}$	s	s_1	$s_a^{(2)}$	s	s_1	$s_a^{(2)}$			
300	323,9	2	4,6	8,8	4,7	11,1	5,9	15,6	8,3	24,6	13,1	30,5	46,7	126						
		3	3,7	7,2	4,9	9,1	6,2	12,8	8,7	20,3	13,9	45,7	61,9	189						
		5	2,9	6,4	5,2	8,1	6,5	11,4	9,2	16	18,1	14,6	7,75	9,37	321					
		10	3,1	6,0	5,4	7,6	6,8	10,7	9,6	17,1	15,3	15,24	16,26	6,31	12,61					
		20	3,0	5,8	5,5	7,4	7,0	10,3	9,8	16,5	15,6	30,48	32,10	1,261						
350	355,6	2	4,9	8,4	4,7	12,0	6,7	16,4	9,2	25,8	14,5	35,6	53,3	148						
		3	4,1	7,0	4,9	10,0	7,0	13,8	9,7	21,8	15,3	53,3	71,1	221						
		5	3,2	6,4	5,2	8,0	7,4	12,5	10,1	17,5	16,0	8,50	10,28	3,52						
		10	3,4	6,0	5,4	8,5	7,7	11,7	10,6	18,6	16,8	17,78	19,56	7,37						
		20	3,3	5,8	5,5	8,3	7,9	11,3	10,8	18,0	17,1	35,56	37,34	1,473						
400	406,4	2	4,9	9,5	5,3	13,2	7,4	18,7	10,4	29,5	16,5	40,6	61,0	168						
		3	4,0	7,9	5,5	11,0	7,7	15,6	11,0	24,9	17,4	61,0	81,3	253						
		5	3,2	7,2	5,8	10,0	8,1	14,2	11,5	20	22,6	18,2	9,70	11,73	4,02					
		10	3,4	6,7	6,1	9,4	8,5	13,3	12,0	21,2	19,2	20,32	22,35	8,42						
		20	3,3	6,8	6,2	9,1	8,6	12,9	12,3	20,6	19,5	40,64	42,67	1,683						
450	457	2	6,1	9,5	5,3	15,0	8,4	21,1	11,8	32,7	18,3	45,7	68,6	189						
		3	5,0	7,9	5,6	12,5	8,8	17,7	12,4	27,6	19,4	68,6	91,4	284						
		5	4,0	7,1	5,8	11,3	9,2	16,0	13,0	22,2	25,0	20,3	1,122	1,350	4,65					
		10	4,3	6,7	6,1	10,7	9,6	15,1	13,6	23,6	21,3	22,86	25,15	9,47						
		20	4,2	6,5	6,2	10,3	9,8	14,6	13,9	22,8	21,7	45,72	48,01	1,894						
500	508	2	6,1	9,5	5,3	16,5	9,2	23,8	13,3	36,8	20,7	50,8	76,2	210						
		3	5,0	7,9	5,6	13,8	9,7	20,0	14,0	31,1	21,8	76,2	101,6	316						
		5	4,0	7,2	5,8	12,5	10,1	18,1	14,7	25	28,2	22,9	1,245	1,500	5,16					
		10	4,3	6,7	6,1	11,7	10,6	17,0	15,4	26,5	23,9	25,40	27,94	10,52						
		20	4,2	6,5	6,2	11,3	10,8	16,5	15,7	25,7	24,4	50,80	53,34	2,104						
600	610	2	7,6	9,5	5,3	18,7	10,4	26,1	14,6	44,1	24,8	61,0	91,4	253						
		3	6,3	7,9	5,6	15,7	11,0	21,9	15,3	37,3	26,2	91,4	121,9	379						
		5	5,0	7,1	5,8	14,1	11,5	19,7	16,1	30	33,7	27,5	1,525	1,830	6,32					
		10	5,4	6,7	6,1	13,3	12,0	18,6	16,8	31,9	28,7	30,50	33,55	12,63						
		20	5,2	6,5	6,2	12,9	12,3	18,0	17,1	30,8	29,3	61,00	64,05	2,527						
700	711	2	7,4	10,7	6,0	18,5	10,5	29,5	16,7	46,8	26,5	71,1	106,6	295						
		3	6,2	8,8	6,3	15,5	11,0	24,8	17,6	39,7	28,0	106,6	142,2	442						
		5	5,0	8,0	6,6	14,0	11,5	22,5	18,4	32	35,9	29,4	1,778	2,133	7,37					
		10	5,3	7,6	6,9	13,3	12,0	19,3	17,5	35,9	32,5	39,11	42,73	14,73						
		20	5,2	7,3	7,0	12,9	12,3	18,9	17,9	35,9	34,4	71,10	74,66	9,45						

Dashes stand for non-standardized sizes.
For ¹⁾ and ²⁾, see page 3.

(continued)

Table 1 (concluded)

Nominal size	Pipe outside diameter, $d_a^{1)}$	Pipe type	Wall thickness series																		r	b	e
			1			2			3			4			5								
			s	s_1	$s_a^{2)}$	s	s_1	$s_a^{2)}$	s	s_1	$s_a^{2)}$	s	s_1	$s_a^{2)}$	s	s_1	$s_a^{2)}$						
DN		2	8,3	4,8	12,0	6,8	18,5	10,5	32,8	18,5	52,8	32,8	18,5	52,8	29,9	813	1220	337					
		3	7,0	5,0	10,0	7,1	15,5	11,0	27,6	19,5	44,7	27,6	19,5	44,7	31,5	1219	1626	505					
		5	6,3	5,2	9,0	7,4	14,0	11,5	24,9	20,4	22,2	24,9	20,4	36	33,0	2033	2439	842					
		10	6,0	5,4	8,5	7,7	13,3	12,0	—	—	—	—	—	—	—	4065	4472	1684					
		20	5,8	5,5	8,3	7,9	12,9	12,3	—	—	—	—	—	—	—	8130	8537	3368					
900		2	9,3	5,3	15,0	8,4	18,5	10,5	36,9	20,9	58,6	36,9	20,9	58,6	33,2	914	1371	379					
		3	7,8	5,6	12,6	8,8	15,5	11,0	31,1	21,9	49,6	31,1	21,9	35,0	1372	1829	568						
		5	6,3	5,8	11,4	9,2	14,0	11,5	28,1	23,0	25	28,1	23,0	40	2285	2742	947						
		10	6,7	6,1	10,8	9,6	13,3	12,0	—	—	—	—	—	—	4570	5027	1893						
		20	6,5	6,2	10,5	9,8	12,9	12,3	—	—	—	—	—	—	9140	9597	3768						
1000		2	9,3	5,3	15,0	8,4	18,5	10,5	41,3	23,3	65,9	41,3	23,3	37,3	1016	1524	421						
		3	7,8	5,6	12,6	8,8	15,5	11,0	34,8	24,6	55,8	34,8	24,6	39,3	1524	2032	631						
		5	6,3	5,8	11,4	9,2	14,0	11,5	31,5	25,7	28	31,5	25,7	41,3	2540	3048	1052						
		10	6,7	6,1	10,8	9,6	13,3	12,0	—	—	—	—	—	—	5080	5588	2104						
		20	6,5	6,2	10,5	9,8	12,9	12,3	—	—	—	—	—	—	10160	10668	4208						
1200		2	9,3	5,4	18,5	10,5	—	—	—	—	—	—	—	—	1220	1830	505						
		3	7,8	5,6	15,5	11,0	—	—	—	—	—	—	—	—	1830	2440	758						
		5	6,3	5,8	14,0	11,5	—	—	—	—	—	—	—	—	3050	3660	1263						
		10	6,7	6,1	13,3	12,0	—	—	—	—	—	—	—	—	6100	6710	2527						
		20	6,5	6,2	12,9	12,3	—	—	—	—	—	—	—	—	12200	12810	5058						
1400		2	9,3	5,4	18,5	10,5	—	—	—	—	—	—	—	—	1420	2130	588						
		3	7,8	5,6	15,5	11,0	—	—	—	—	—	—	—	—	2130	2840	882						
		5	6,3	5,8	14,0	11,5	—	—	—	—	—	—	—	—	3550	4260	1471						
		10	6,7	6,1	13,3	12,0	—	—	—	—	—	—	—	—	7100	7810	2941						
		20	6,5	6,2	12,9	12,3	—	—	—	—	—	—	—	—	14200	14910	5882						
1600		2	9,3	5,3	18,5	10,5	—	—	—	—	—	—	—	—	1620	2430	671						
		3	7,8	5,6	15,5	11,0	—	—	—	—	—	—	—	—	2430	3240	1007						
		5	6,3	5,8	14,0	11,5	—	—	—	—	—	—	—	—	4050	4860	1678						
		10	6,7	6,1	13,3	12,0	—	—	—	—	—	—	—	—	8100	8910	3355						
		20	6,5	6,2	12,9	12,3	—	—	—	—	—	—	—	—	16200	17010	6710						

Dashes stand for non-standardized sizes.
For 1) and 2), see page 3.

5 Tolerances

Table 2: Lower limit deviations for wall thicknesses
(See DIN 2609 for upper limit deviations.)

Pipe nominal size, DN	Wall thicknesses	Lower limit deviation
Up to 600	All sizes	- 12,5 %
Above 600	Up to 10 mm	- 0,35 mm
	Above 10 mm	- 0,50 mm

Table 3: Limit deviations for dimension b^3

Pipe nominal size DN	Limit deviations		
	b for 45° elbow	b for 90° elbow	$2b$ for 180° bend
15 to 65	± 6,0	± 2,5	± 8,0
80 to 100	± 7,0	± 3,0	± 9,0
125 to 200	± 8,5	± 3,5	± 10,0
250	± 9,5	± 4,0	± 14,0
300 to 450	± 12,0	± 5,0	± 14,0
500 to 600	± 14,5	± 6,0	± 16,0
700			
800 or more	± 19,0	± 8,0	To be agreed.

³⁾ Dimension b is to be measured as illustrated in figure 1. Limit deviations refer to elbows and bends designed for pipes of types 2, 3 and 5. For types 10 and 20, the limit deviations for b shall be subject to agreement.

6 Design assumptions

The wall thicknesses of elbows and bends, s_1 and s_a , have been designed so that they withstand the same internal pressure as the connecting pipes when selected in compliance with table 1. In accordance with *Technische Regel für Dampfkessel* (Code of practice for steam boilers) TRD 301, the design calculation has been based on the following assumptions:

- limit deviations for pipes and fittings as specified in table 2;
- identical materials;
- identical welding factor for longitudinal welds;
- identical outside diameters;
- no allowance included for corrosion.⁴⁾

7 Other wall thicknesses

Elbows and bends with wall thicknesses other than those specified in table 1 may also be ordered on the basis of this standard. In such cases, the next smallest pipe wall thickness, s , given in table 1 shall be used to establish the relevant conversion factor for dimensions s_1 and s_a (cf. Explanatory notes).

⁴⁾ If the wall thickness of pipes, s , has been designed with a significant allowance (i.e. more than 100 %) for corrosion, the outer bend thickness of fittings, s_a , must be increased accordingly. Thus, when ordering fittings, make sure that the outer bend thickness, s_a , at the abutting edge is at least equal to s .

8 Preparation of abutting edges

If required by the manufacturing process, elbows and bends may be designed with a uniform wall thickness, s_i . In such cases, the abutting edges of fittings may be bevelled to an angle of 15° to 18° on the inside and/or to an angle of 27° to 30° on the outside.

9 Technical delivery conditions

For the technical delivery conditions for fittings in compliance with this standard, see DIN 2609.

Explanatory notes

This standard has been prepared at the request of users of piping systems. The fitting dimensions are based on the pipe outside diameter as specified in ISO 4200 (series 1) and on the radii and lengths of fittings specified in ISO 3419.

The thickness of the outer bend, s_a , and that of the inner bend, s_i , have been selected so that elbows and bends withstand the same internal pressure as the connecting pipe. As illustrated in figure 2, s_i and s_a need not be continuous throughout.

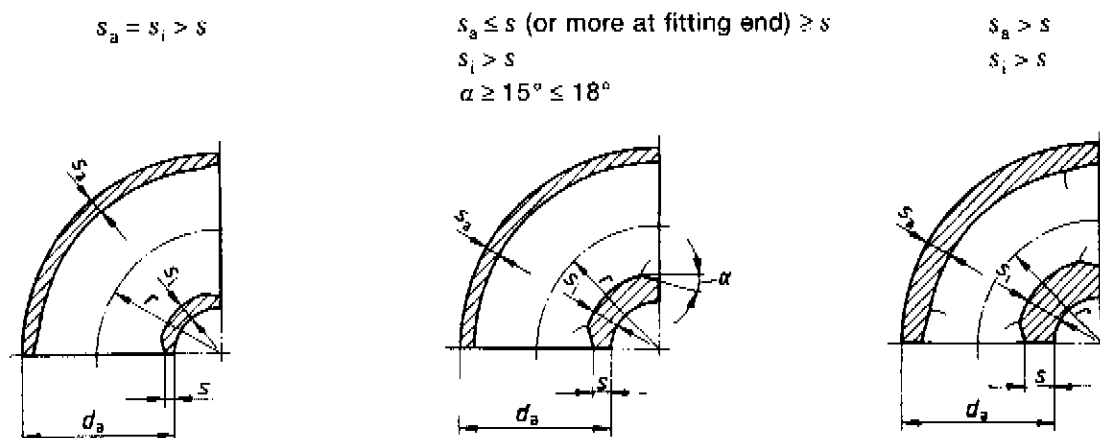


Figure 2: Welding end design

Wall thicknesses listed in table 1 take into account the geometry-related differences in stress throughout the cross sections of elbows and bends.

Figure 3 shows the measuring points for dimensions s , s_a and s_i . Intermediate values, such as s'_a and s'_i , shall be calculated based on the formulas given below. Assuming that the stress pattern (or the corresponding wall thickness) varies as a function of sine α , the following values are obtained:

$$s_a = s + (s - s_a) \cdot \cos \alpha_a \quad \text{or} \quad s_a = s + (s - s_a) \cdot \cos \text{rad} \frac{2 U_{Ta}}{d_a}$$

$$s_i = s + (s_i - s) \cdot \cos \alpha_i \quad \text{or} \quad s_i = s + (s_i - s) \cdot \cos \text{rad} \frac{2 U_{Ti}}{d_a}$$

where

α_a is the angle between the horizontal centre line and the line through the measuring point;

α_i is the angle between the vertical centre line and the line through the measuring point;

U_{Ta} and U_{Ti} are the arc lengths of angles α_a and α_i .

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