Technical Terms of Production and Supply for Metal Standoffs

The principles outlined below apply to the production and supply of metal standoffs. The standard is binding, provided that no deviations related to a specific order have been agreed, and applies in addition to the customer drawing in the event of missing or unclear drawing specifications.

Version: 2024-02-05

Technical changes, errors, and printing errors excepted.

Contents

1 Manufacturing Tolerances

1.1 Straightness, Evenness, Cylindrical Form, Parallelism, Perpendicularity, and Inclination

Regarding geometric tolerancing, the requirements for form tolerances and orientation tolerances from DIN EN ISO 1101:2017-09 and DIN ISO 2768-2 apply.

1.2 Coaxiality/Concentricity

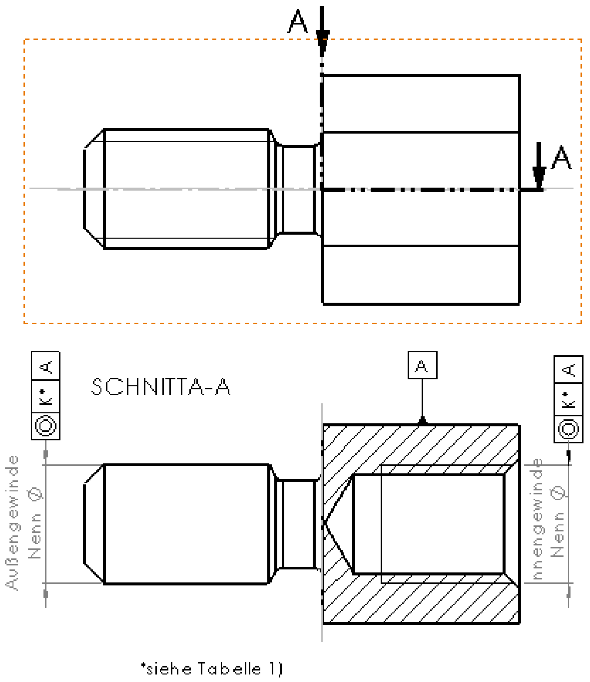


Table 1)

Thread nominal diameter	K
M 2	0.1
M 2.5	0.1
M 3	0.1
UNC 4-40	0.1
M 4	0.1
M 5	0.1
M 6	0.1
M 8	0.1

1.3 General Tolerances

Based on DIN ISO 2768-1:1991-06, previously DIN 7168-1 (extract)
Tolerance class M (medium)

1.3.1 Limits of Size for Length Dimensions

	Limit deviations in mm for nominal dimension range in mm					
	Up to 0.5	0.5 to 3	Above 3, up to 6	Above 6, up to 30	Above 30, up to 120	Above 120, up to 400
M (medium)	See below*	± 0.1	± 0.1	± 0.2	± 0.3	± 0.5

*) For nominal dimensions below 0.5 mm, the limit deviations shall be indicated adjacent to the nominal dimension.

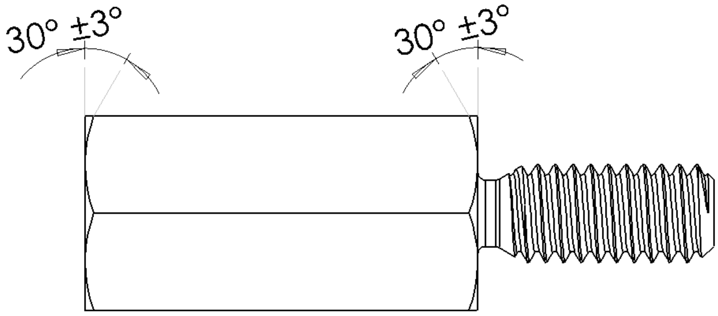
1.3.2 Limits of Size for Curve Radii

	Limit deviations in mm for nominal dimension range in mm			
	Up to 0.5	0.5 to 3	Above 3, up to 6	Above 6
M (medium)	See below*	± 0.2	± 0.5	± 1.0

*) For nominal dimensions below 0.5 mm, the limit deviations shall be indicated adjacent to the nominal dimension.

1.3.3 Limits of Size for Chamfers on Hexagonal Body

The edges on the hexagonal body must be free of burrs.



1.4 Stem Length

The tolerance for stem length in the case of male threads is ± 0.15 mm.

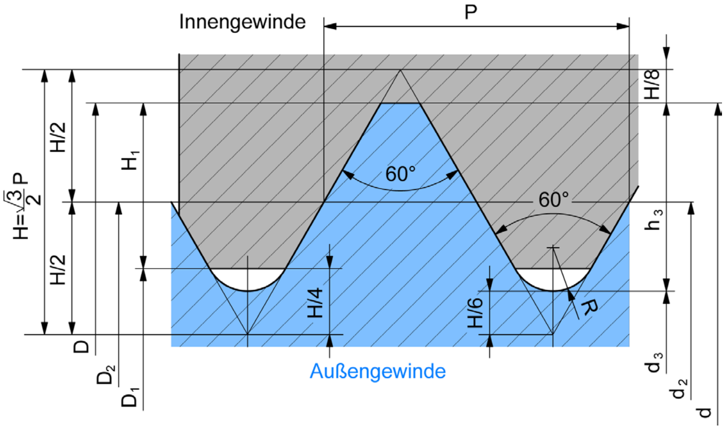
1.5 Nominal Dimensions for Metric ISO Thread

Standard thread in accordance with DIN 13-1:1999-11 (extract)

Material	Thread nominal diameter $d = D$	Pitch P	Pitch diameter $d_2=D_2$	Core diameter		Depth of thread		Curve R	Stress area S [mm^2]	Drill bit diameter for thread hole	Width of hexagonal wrench / nominal diameter range
				Male thread d_3	Female thread D_1	Male thread h_3	Female thread H_1				
Hexagonal material / Round material	M 2	0.4	1.74	1.51	1.57	0.25	0.22	0.06	2.07	1.6	4
Hexagonal material / Round material	M 2.5	0.45	2.21	1.95	2.01	0.28	0.24	0.07	3.39	2.05	5
Hexagonal material / Round material	M 3	0.5	2.68	2.39	2.46	0.31	0.27	0.07	5.03	2.5	5.5
Hexagonal material / Round material	M 4	0.7	3.55	3.14	3.24	0.43	0.38	0.10	8.78	3.3	7
Hexagonal material / Round material	M 5	0.8	4.48	4.02	4.13	0.49	0.43	0.12	14.2	4.2	8
Hexagonal material / Round material	M 6	1	5.35	4.77	4.92	0.61	0.54	0.14	20.1	5.0	10
Hexagonal material / Round material	M 7	1	6.35	5.77	5.92	0.61	0.54	0.14	28.84	6.0	11
Hexagonal material / Round material	M 8	1.25	7.19	6.47	6.65	0.77	0.68	0.18	36.6	6.8	13
Hexagonal material / Round material	M 10	1.5	9.03	8.16	8.38	0.92	0.81	0.22	58.0	8.5	16**
Hexagonal material / Round material	M 12	1.75	10.86	9.85	10.11	1.07	0.95	0.25	84.3	10.2	18**
Round material	M 14	2	12.70	11.55	11.84	1.23	1.08	0.29	115.47	12	Ø 14–20
Round material	M 16	2	14.70	13.55	13.84	1.23	1.08	0.29	157	14	Ø 16–20
Round material	M 20	2.5	18.38	16.93	17.29	1.53	1.35	0.36	245	17.5	Ø 20

**) Special sizes

Specifications in mm.



1.6 Nominal Dimensions for UNC Thread

Thread	Pitch	Outer diameter	Threads per 1 inch	Pitch diameter	Core diameter		Width across flats
					Standoff	Nut	
UNC 4-40	0.635	2.845	40	2.433	2.065	2.156	4.75 / 5
UNC 6-32***	0.794	3.505	32	2.990	2.532	2.647	6.4
UNC 8-32***	0.794	4.166	32	3.650	3.193	3.307	6.4

***) Special thread

Specifications in mm.

1.7 Thread Tolerances

Based on DIN ISO 965-1 and DIN ISO 965-2:1999-11, previously DIN 13-13:1983-10 (extract)
Tolerance class M (medium)

1.7.1 Tolerances for Female and Male Threads

Applies to types: uncoated or with thin galvanic protective layers

Thread type	Standard thread	Test
Female thread	M 2 – M 3	Trueness to gauge size using plug gauge with tolerance quality 6H
	From M 4	Screw-in ability
	UNC 4-40	Trueness to gauge size using plug gauge with tolerance quality 2B
Male thread	M 2 – M 3	Trueness to gauge size using screw ring gauge with tolerance quality 6g
	From M 4	Nut mobility
	UNC 4-40	Trueness to gauge size using screw ring gauge with tolerance quality 2A

1.7.2 Limits of Size for Female and Male Threads

Based on DIN ISO 965-2 (extract)

Standard thread		**Female thread: tolerance class 6H**					**Male thread: tolerance class 6g**					
		Outer diameter	Pitch diameter D_2		Core diameter D_1		Outer diameter d		Pitch diameter d_2		Core diameter d_3	
		Min.	Min.	Max.	Min.	Max.	Max.	Min.	Max.	Min.	Max.	Min.
Standard sizes	M 2	2.0	1.740	1.830	1.567	1.679	1.981	1.886	1.721	1.654	1.490	1.407
	M 2.5	2.5	2.208	2.303	2.013	2.138	2.480	2.380	2.188	2.117	1.928	1.840
	M 3	3.0	2.675	2.775	2.459	2.599	2.980	2.874	2.655	2.580	2.367	2.273
	M 4	4.0	3.545	3.663	3.242	3.422	3.978	3.838	3.523	3.433	3.119	3.002
	M 5	5.0	4.480	4.605	4.134	4.334	4.976	4.826	4.456	4.361	3.995	3.869
	M 6	6.0	5.350	5.500	4.917	5.135	5.974	5.794	5.324	5.212	4.747	4.596
	M 8	8.0	7.188	7.348	6.647	6.912	7.972	7.760	7.160	7.042	6.438	6.272
Special sizes	M 10	10.0	9.026	9.206	8.376	8.676	9.968	9.732	8.994	8.862	8.128	7.938
	M 12	12.0	10.863	11.063	10.106	10.441	11.966	11.701	10.829	10.679	9.819	9.602
	M 14	14.0	12.701	12.913	11.835	12.210	13.962	13.682	12.663	12.503	11.508	11.271
	M 16	16.0	14.701	14.913	13.385	14.210	15.962	15.682	14.663	14.503	13.508	13.271
	M 20	20.0	18.376	18.600	17.294	17.744	19.958	19.623	18.334	18.164	16.891	16.625

The thread tolerances apply to uncoated parts as well as coated parts following application of the galvanic coatings.

1.7.3 Limits of Size for Chamfers on Metric and Inch (UNC) Female and Male Threads

On male threads, **Dimension 1** shall be used.

On female threads, **Dimension 2** shall be used.

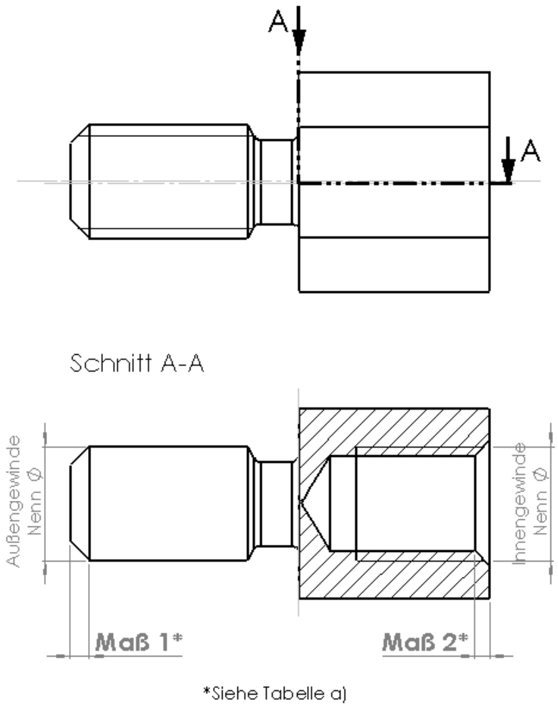


Table a)

Thread nominal diameter	Dimension 1 *tolerances see below* [mm]	Dimension 2 *tolerances +0.1 mm / ± 3°* [mm]
M 2	$0.3^{+0.3}$ x45°$_{-15°}$	0.4x45°
M 2.5	$0.4^{+0.3}$ x45°$_{-15°}$	0.4x45°
M 3	$0.4^{+0.3}$ x45°$_{-15°}$	0.4x45°
UNC 4-40	$0.5^{+0.3}$ x45°$_{-15°}$	0.5x45°
M 4	$0.5^{+0.3}$ x45°$_{-15°}$	0.5x45°
M 5	$0.6^{+0.4}$ x45°$_{-15°}$	0.6x45°
M 6	$0.8^{+0.5}$ x45°$_{-15°}$	0.8x45°
M 8	$1.1^{+0.5}$ x45°$_{-15°}$	1.1x45°

1.7.4 Limits of Size for Chamfers on Self-Tapping Male Threads (ST)

Thread ends as per Table c).

Type C with cone end, type F with flat end, or type R with rounded end in accordance with DIN EN ISO 1478:1999 is hereby rescinded.

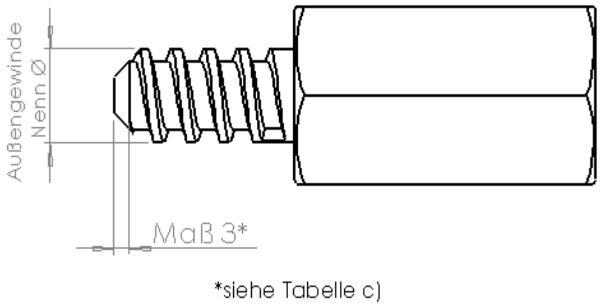


Table c)

Thread nominal diameter	Dimension 3 *tolerances +0.1 mm /+/ -5°* [mm]
ST 2.2	0.6x45°
ST 2.6	0.75x45°
ST 2.9	0.8x45°
ST 3.3	0.9x45°
ST 3.5	1.0x45°
ST 3.9	1.2x45°
ST 4.2	1.3x45°

1.7.5 Limits of Size for Max. Tapping Hole Depth on Female Threads with M/F Standoffs (Male-Female)

Dimension X is defined to prevent the male threaded bolt from shearing off in the case of M/F standoffs.
Dimension X applies equally to standoffs with and without undercut on the male thread.

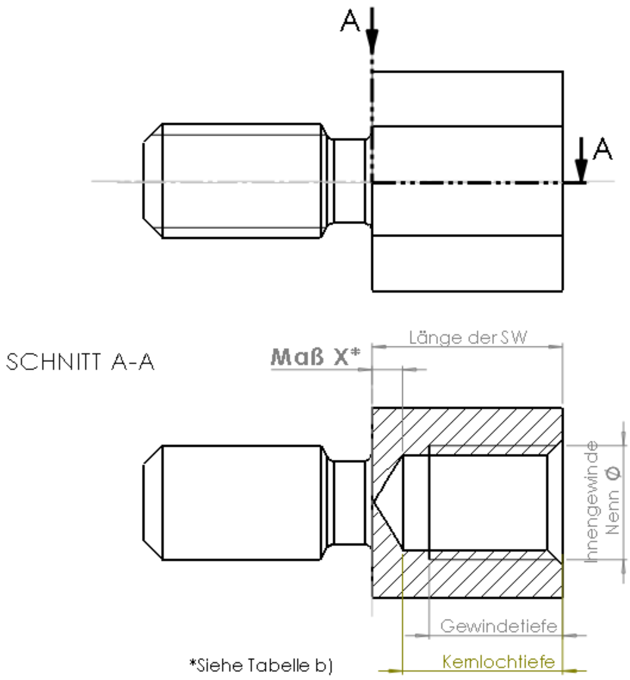
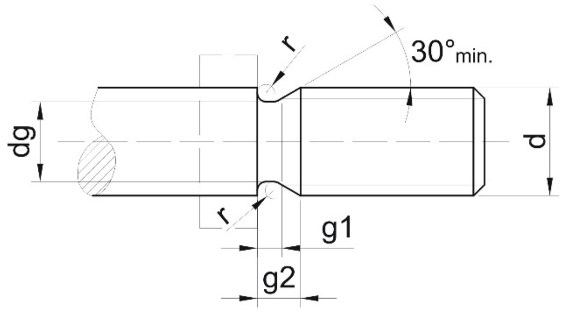


Table b)

Thread nominal diameter	**Dimension X** *tolerance +0.1 mm*
M 2	0.8
M 2.5	0.8
M 3	0.8
UNC 4-40	0.8
M 4	1.0
M 5	1.0
M 6	1.5
M 8	1.8

1.8 Thread Undercut

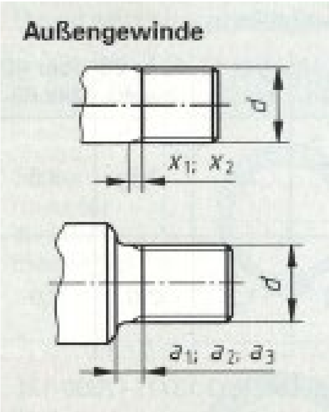
Thread undercut for male threads, form B (short), extract from DIN 76-1 (2016-08)
Tolerance quality d_g: h13



	Standard ISO thread d	d_g	r	g_1 Min.	g_2 Max.
Standard sizes	M 2	d – 0.7	0.2	0.5	1.0
	M 2.5	d – 0.7	0.2	0.5	1.1
	M 3	d – 0.8	0.2	0.5	1.25
	M 4	d – 1.1	0.4	0.8	1.75
	M 5	d – 1.3	0.4	0.9	2.0
	M 6	d – 1.6	0.6	1.1	2.5
	M 8	d – 2.0	0.6	1.5	3.2
Special sizes	M 10	d – 2.3	0.8	1.8	3.8
	M 12	d – 2.6	1.0	2.1	4.3
	M 14	d – 3.0	1.0	2.5	5.0
	M 16	d – 3.0	1.0	2.5	5.0
	M 20	d – 3.6	1.2	3.2	6.3

1.9 Thread Run-Outs

Thread run-outs for male threads based on DIN 76-1 (2016-08)



	Standard ISO thread d	* x_1 Max.	* a_1 Max.
Standard sizes	M 2	1.0	1.2
	M 2.5	1.1	1.35
	M 3	1.25	1.5
	M 4	1.75	2.1
	M 5	2	2.4
	M 6	2.5	3
	M 8	3.2	3.75
Special sizes	M 10	3.8	4.5
	M 12	4.3	5.25
	M 16	5.0	6.0
	M 20	6.3	7.5

- Standard case: applies whenever no other specifications are provided.
  If a short thread run-out is required, the following applies:
  $x_2 \sim 0.5 \cdot x_1$; $a_2 \sim 0.67 \cdot a_1$ → ETTINGER standard
  If a long thread run-out is required, the following applies:
  $a_3 \sim 1.3 \cdot a_1$

2 Materials

The materials listed are preferred materials. The materials used for metal standoffs in the ETTINGER standard range meet the requirements of Directive 2011/65/EU (RoHS II).

2.1 Free-Cutting Steel

Material designation: **11SMnPb30+C**
Material no. 1.0718
Chemical composition (mass percentages)

C	P	S	N	Mn	Si	Pb	Compliant with RoHS II
≤ 0.14	≤ 0.11	0.27–0.33	Max. 0.05	0.90–1.30	≤ 0.05	0.25–0.35	

Material designation: **11SMn37**
Material no. 1.0736
Chemical composition (mass percentages)

C	Si	Mn	P	S	Compliant with RoHS II
≤ 0.14	≤ 0.05	1.0–1.5	≤ 0.11	0.34–040	

Material designation: **11SMn30**
Material no. 1.0715
Chemical composition (mass percentages)

C	Si	Mn	P	S	Compliant with RoHS II
≤ 0.14	≤ 0.05	0.90–1.30	≤ 0.11	0.27–0.33	

2.2 Stainless Steel

Material designation: **X8CrNiS18-9**
EN 10088-3 and material no. 1.4305
Chemical composition (mass percentages)

Carbon C	Phosphorus P	Sulfur S	Chromium Cr	Manganese Mn	Silicon Si	Nickel Ni	Compliant with RoHS II
≤ 0.10	≤ 0.045	0.15–0.35	17.00–19.00	≤ 2.00	≤ 1.00	8.00–10.00	

2.3 Brass

Material designation: **CuZn39Pb3**
Material no. 2.0401
Chemical composition (mass percentages)

Copper Cu	Aluminum Al	Iron Fe	Nickel Ni	Lead Pb	Tin Sn	Zinc Zn	Compliant with RoHS II
57.00–59.00	≤ 0.05	≤ 0.50	≤ 0.30	2.50–3.50	≤ 0.30	Trace	RoHS COMPLIANT

Material designation: **CuZn42**
EN material no. CW510L
Chemical composition (mass percentages)

Copper Cu	Aluminum Al	Iron Fe	Nickel Ni	Lead Pb	Tin Sn	Zinc Zn	Compliant with RoHS II
57.00–59.00	≤ 0.05	≤ 0.30	≤ 0.30	≤ 0.10	≤ 0.30	Trace	RoHS COMPLIANT

2.4 Aluminum

Material designation: **AlCu6BiPb** or **AlCuBiPb**
Material no. 3.1655
Chemical composition (mass percentages)

Silicon Si	Iron Fe	Copper Cu	Zinc Zn	Bismuth Bi	Lead Pb	Aluminum Al	Compliant with RoHS II
0.40	0.70	5.00–6.00	0.30	0.20–0.60	0.20–0.40	Trace	RoHS COMPLIANT

3 Galvanic Coatings

3.1 Types of Corrosion Protection and Coating Thicknesses

Galvanic coatings in accordance with DIN EN ISO 27830:2013-11 (previously DIN 50960-1:1986-02)
Zinc coatings in accordance with DIN 50961:2012-04
Nickel coatings in accordance with DIN EN ISO 1456:2009-12 (previously DIN 50968:1976-04)

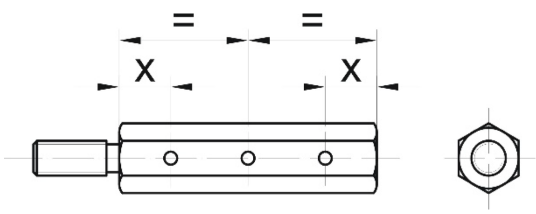
Coating metal	Coating thickness	Color	Short designation in accordance with DIN EN ISO 4042 (previously DIN 267-9)	Coating thickness tolerance	Compliant with RoHS II
Zinc (Zn)	5 µm	Bare, colorless	A2E	-2 µm / +3 µm	Yes
		Bare, bluish	A2F	-2 µm / +3 µm	Yes
		Gloss, bluish	A2K	-2 µm / +3 µm	Yes
	8 µm	Yellow (chromium VI-free)	A3G	-3 µm / +2 µm	Yes
Nickel (Ni)	3 µm	Colorless	E1E	-1 µm / +2 µm	Yes

Other metallic coatings and surface treatments on request.

3.2 Measuring Coating Thickness

Using the X-ray fluorescence method, based on DIN EN ISO 3497:2000.

When measuring coating thicknesses, an arithmetic mean is calculated from one to three individual measurements (depending on the length of a test sample) taken on five test samples. The standard deviation is also calculated. The individual values of the measurement series are documented in the measurement report. The position of the measurement points is defined as follows:



Hexagonal length	1st measurement point	2nd measurement point	3rd measurement point
L < 16 mm	Midpoint of the hexagonal body	-	-
16 mm ≤ L < 25 mm	x = 2 mm from start of hexagonal body	x = 2 mm from end of hexagonal body	-
25 mm ≤ L < 60 mm	x = 5 mm from start of hexagonal body	x = 5 mm from end of hexagonal body	Midpoint of the hexagonal body
L ≥ 60 mm	x = 10 mm from start of hexagonal body	x = 10 mm from end of hexagonal body	Midpoint of the hexagonal body

3.3 Notes on Surface Treatment

Due to the drum process method of production, it is not possible to guarantee against process-related points of impact on male threads and on the hexagonal body. In addition, blind holes will generally not be perfectly coated due to the production process.