Original version of the design guide

For	Series	Components		
Spieth locknuts (precision locknuts)	MSA	MSA 20x1	MSA 25x1.5	MSA 30x1.5
		MSA 35x1.5	MSA 40x1.5	MSA 45x1.5
		MSA 50x1.5	MSA 55x1.5	MSA 60x1.5
		MSA 65x1.5	MSA 70x1.5	MSA 75x1.5
		MSA 80x2	MSA 85x2	MSA 90x2
		MSA 95x2	MSA 100x2	MSA 105x2
		MSA 110x2	MSA 120x2	MSA 130x3
		MSA 140x3	MSA 150x3	MSA 160x3
		MSA 170x3	MSA 180x3	MSA 190x3
		MSA 200x3		

The Design Guide is also available for download at www.spieth-me.de. In case of any questions, please contact Spieth-Maschinenelemente GmbH & Co. KG directly.

Legal:

Spieth-Maschinenelemente GmbH & Co. KG, Alleenstraße 41, D - 73730 Esslingen
Phone +49 711 930730 0 - Fax +49 711 930730 7
E-Mail: info@Spieth me.de - Web: www.spieth-me.de

KG: Esslingen HQ, Stuttgart county court, company register sect. A 210689
PhG: Spieth-Beteiligungs-GmbH, Esslingen HQ, Stuttgart county court, company register sect. A 210636
Managing director: Dipl.-Ing. Alexander Hund

About the design guide for Spieth Locknuts

This design guide enables safe and efficient handling of Spieth locknuts and provides valuable information on choice, dimensioning, and assembly of your locknut connection.

Notices

This design guide is based on the operating instructions whose recommendations and notices must be followed for dimensioning and design.

Please visit www.spieth-me.de for design guide and operating instructions.

For machine documentation you can use component-specific design and/or assembly data sheets as a template. These are also available at www.spieth-me.de.

The basic requirement for working safely is compliance with all safety notices. They can be identified by the following symbols:

> Caution!

In addition to the notices in these instructions, local accident prevention guidelines and national health and safety regulations also apply.

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Spieth locknut bodies

Spieth clamping screws

Radial boreholes for pin spanner DIN 1810 - B

Axial boreholes for face spanner

Identifying features (for original Spieth locknuts)

Spieth logo

Name

Batch number

Locking torque M_S for clamping screws

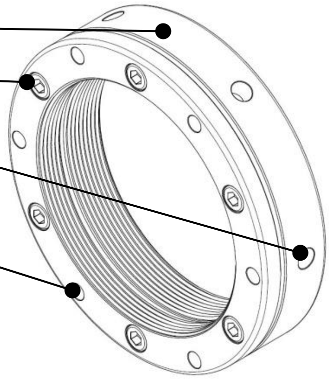

Fig. 1: Schematic representation similar to Spieth MSA series locknuts

Spieth MSA series locknuts are assemblies consisting of locknut bodies and clamping screws. The thread inside the locknut body is interrupted by a groove, separating the locknut body into a load and a locking part. A diaphragm connects load and locking part.

1.2 Mode of action

Spieth locknuts are precision locknuts. Due to their design they provide a maximum of precision, combined with utmost locking properties.

Spieth MSA series locknuts have been designed as all-purpose precision locknuts (e.g., for locking high-quality fastenings, shaft bearings, or spindle bearings).

Despite their compact design and the high axial loads occurring here, Spieth-locknuts guarantee permanent pretension and a rigid and precisely aligned contact with the bearing for an immaculately supported spindle.

Fig. 2: Illustration similar to Spieth MSA locknuts

Spieth MSA series locknuts are frictionally engaged one-piece locknuts. Load part and locking part of the locknut body approach each other purely along an axis via the elastic diaphragm. Actuating the tensioning / clamping screws arranged in axial direction causes load part and locking part to approach each other purely along an axis. Since the locking part has been designed as a stable ring, a 360° tessellation using several thread turns is used to achieve a frictionally engaged clamping on the shaft thread. Tessellation converts the bolt force directly into a contact force evenly distributed across the entire circumference. Owing to system characteristics, this automatically aligns the end face at a right angle.

2 Choice for Your Use Case

The material’s yield strength with a safety margin of 1.6 is used for the admissible static axial load.

In general, a locknut is compatible with a bearing load if it can absorb the permanent axial limit load which is specified on the bearings and based on the yield strength.

> Please note:
>
> The details about the maximum load capacity of all Spieth products are based on the material's yield strength. The reason for this is that Spieth-Maschinenelemente GmbH & Co. KG only accepts elastic deformation of its products. In particular with precision locknuts, ductile deformation causes a loss of pretensioning and/or safety and therefore means that the connection failed. With products from other manufacturers, calculations are often based on tensile strength so a direct comparison of performance data is not possible.

Table 1: Application-relevant data of Spieth locknuts

Order No.	Name	Geometry	Load capacity	Precision
		Thread Ø d_1 5H x pitch [-]x[mm]	Adm. stat. axial load $F_{ax,stat}$ [kN]	Axial run-out t_{plan} (=IT4) [µm]
K-10202001	MSA 20x1	M20x1	31	6
K-10202501	MSA 25x1.5	M25x1.5	49	6
K-10203001	MSA 30x1.5	M30x1.5	56	6
K-10203501	MSA 35x1.5	M35x1.5	66	7
K-10204001	MSA 40x1.5	M40x1.5	68	7
K-10204501	MSA 45x1.5	M45x1.5	78	7
K-10205001	MSA 50x1.5	M50x1.5	85	7
K-10205501	MSA 55x1.5	M55x1.5	79	8
K-10206001	MSA 60x1.5	M60x1.5	81	8
K-10206501	MSA 65x1.5	M65x1.5	124	8
K-10207001	MSA 70x1.5	M70x1.5	178	8
K-10207501	MSA 75x1.5	M75x1.5	183	8
K-10208001	MSA 80x2	M80x2	196	8
K-10208501	MSA 85x2	M85x2	228	10
K-10209001	MSA 90x2	M90x2	230	10
K-10209501	MSA 95x2	M95x2	232	10
K-10210001	MSA 100x2	M100x2	271	10
K-10210501	MSA 105x2	M105x2	274	10
K-10211001	MSA 110x2	M110x2	280	10
K-10212001	MSA 120x2	M120x2	408	10

Order No.	Name	Geometry	Load capacity	Precision
		Thread Ø d_1 5H x pitch [-]x[mm]	Adm. stat. axial load $F_{ax,stat}$ [kN]	Axial run-out t_{plan} (=IT4) [µm]
K-10213001	MSA 130x3	M130x3	405	12
K-10214001	MSA 140x3	M140x3	476	12
K-10215001	MSA 150x3	M150x3	489	12
K-10216001	MSA 160x3	M160x3	552	12
K-10217001	MSA 170x3	M170x3	560	12
K-10218001	MSA 180x3	M180x3	648	12
K-10219001	MSA 190x3	M190x3	656	14
K-10220001	MSA 200x3	M200x3	578	14

Axial loads $F_{ax,stat}$ apply for shaft threads with a tolerance of 6g or higher and a minimum material strength of 700 N/mm².

In case of dynamic loads, approx. 75% of the static axial load $F_{ax,stat}$ is admissible.

3 Design of Spieth Locknuts

Spieth MSA series locknuts are made of steel with high material strength (approx. 225N/mm²). The body is bronzed with fine-turned, bare functional surfaces.

The contact surface is produced together with the thread in one process to ensure maximum form and location quality.

The metric ISO thread is produced as per the "fine" tolerance class (tolerance zone 5H, DIN 13 Part 21 ... 25) and needs to cover the entire thread length of the shaft thread.

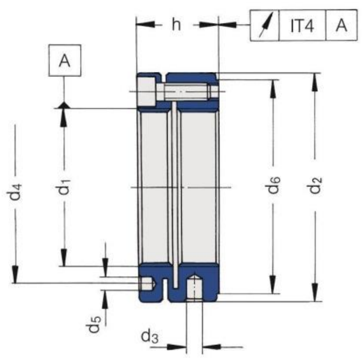

Fig. 3: Sectional view of Spieth locknut > M80

Caution!

The locknut is deformable in the axial direction and must therefore be handled with care. The clamping screws may only be tightened when the locknut has been screwed completely onto the spindle thread. Otherwise, inadmissible ductile deformation may occur and render the locknut unusable.

Caution!

Only use Spieth locknuts with original Spieth clamping screws; otherwise, malfunctions with far-reaching consequences of loss may result in which case Spieth-Maschinenelemente GmbH & Co. KG assumes no liability or warranty.

Table 2: Design-relevant data of Spieth locknuts

Name	Shaft side (thread)	Access side (available space)		Bearing side	Mass-related properties	
	Thread Ø d_1 5H x pitch [-]x[mm]	Outer Ø d_2 [mm]	Length h [mm]	Supported contact Ø d_6 [mm]	Weight m [kg]	Moment of inertia J [kg cm²]
MSA 20x1	M20x1	35	17	31	0.066	0.142
MSA 25x1.5	M25x1.5	40	19	36	0.095	0.265
MSA 30x1.5	M30x1.5	45	19	41	0.109	0.4
MSA 35x1.5	M35x1.5	53	22	48	0.179	0.904
MSA 40x1.5	M40x1.5	58	22	54	0.202	1.24
MSA 45x1.5	M45x1.5	64	23	59	0.246	1.89
MSA 50x1.5	M50x1.5	69	24	64	0.281	2.56
MSA 55x1.5	M55x1.5	73	24	69	0.288	3
MSA 60x1.5	M60x1.5	78	24	74	0.313	3.76
MSA 65x1.5	M65x1.5	83	24	79	0.334	4.61
MSA 70x1.5	M70x1.5	93	27	88	0.528	9.09
MSA 75x1.5	M75x1.5	98	27	93	0.564	10.9
MSA 80x2	M80x2	103	28	98	0.638	13.4
MSA 85x2	M85x2	112	30	106	0.859	21.3
MSA 90x2	M90x2	117	30	111	0.907	24.7
MSA 95x2	M95x2	122	30	116	0.955	28.4
MSA 100x2	M100x2	130	32	123	1.223	38.6
MSA 105x2	M105x2	135	32	128	1.280	43.9
MSA 110x2	M110x2	140	32	133	1.337	49.5
MSA 120x2	M120x2	155	36	145	1.975	89.1
MSA 130x3	M130x3	165	36	155	2.171	110
MSA 140x3	M140x3	180	36	170	2.642	160
MSA 150x3	M150x3	190	36	180	2.817	192
MSA 160x3	M160x3	205	40	195	3.731	300
MSA 170x3	M170x3	215	40	205	3.949	352
MSA 180x3	M180x3	230	40	220	4.698	476
MSA 190x3	M190x3	240	40	230	4.940	548
MSA 200x3	M200x3	245	40	235	4.605	543

4 Dimensioning of Locknut Connections

Pretensioning torque M_V of the locknut induces pretension on the bearing of the associated machine part. According to the recommendations of the bearing manufacturer, add the recommended pretension to the operating load and ensure that the sum of these two forces stays below the locknut's admissible static axial load.

Normally, a design of the shaft thread as per tolerance class "medium" (tolerance zone 6g, DIN 13 Part 21 ... 25) suffices. To leverage the locknuts' capabilities with higher accuracy requirements, we recommend designing the shaft thread as per tolerance class "fine" (tolerance zone 4h, DIN 13 Part 21 ... 25).

The rigidity of the shaft influences the locknut's required assembly pretension and locking force. All the details about pretensioning and locking processes have been established using a solid shaft. If a hollow shaft is used, the resulting pretension and locking forces may deviate. In case of doubt, please contact Spieth-Maschinenelemente GmbH & Co. KG.

Normally, the contact surfaces of the bearing inner rings comply with the requirements of a precise connection. For spacer sleeves and/or other special connecting components, we recommend designing the end face as per the bearing manufacturers' requirements in terms of roughness depth and form and location tolerances. This can help to avoid unwanted surface subsidence and associated pretension loss.

The overall rigidity of the connection between bearing, locknut, and shaft is influenced by a large number of parameters. They include not only characteristic material values but also the actual dimensions of the components used. Therefore, connection rigidity and resulting suitable revolution speed for locknuts depend on the case at hand. In case of any questions, please contact Spieth-Maschinenelemente GmbH & Co. KG.

5 How to Assemble Spieth Locknuts

5.1 Precision-centering and aligning Spieth Locknuts

Reduce the assembly clearanceby slightly tightening all clamping screws. This automatically centers the locknut and aligns the end face in a right angle to the shaft axis.

Use a commercial-grade screwdriver, a screw bit or a spanner with hexagon socket as drive geometry for removing the locknut's clearance and for tightening it.

The low tightening torque of the clamping screws while eliminating play has no influence on the acting axial load.

5.2 Tightening Spieth Locknuts

Tightening the locknut axially interlocks the connecting components. Normally, pretensioning torque M_V is based on the bearing's pretension force F_V, specified by the manufacturer. If custom pretension force is given for the thread drive, adjust pretensioning torque M_V of the locknut accordingly.

For custom pretensioning (e.g., a bearing or a hub), calculate required pretensioning torque M_V according to Formula 1 in Section 9 for your custom use case and enter it in Table 3.

To reduce subsidence in general, first tighten the locknut with an increased pretensioning torque $M_V = (1.2 \text{ to } 1.5) \cdot M_V$ against the planar support and then undo it before then using the relevant pretensioning torque M_V.

To tighten the locknut (if accessible radially), you need a commercial-grade hook spanner DIN 1810 Shape B (see Table 3 for size recommendations).

If the locknut is only accessible axially (because of your available space), use axial assembly boreholes d_5 for a tool customised to your shaft geometry or for an adjustable face spanner.

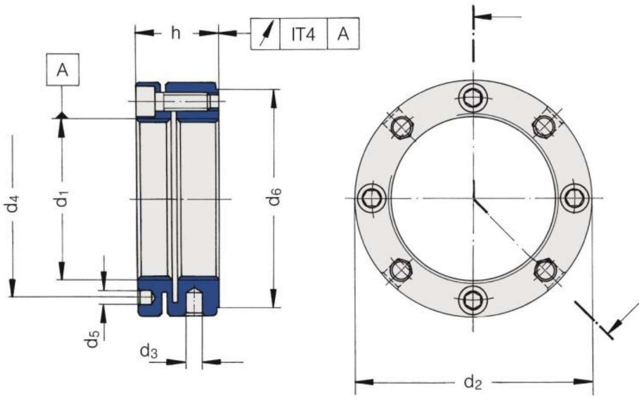

Fig. 4: Sectional view of Spieth locknut > M80

Table 3: Assembly-related data for tightening Spieth locknuts to pretension the bearings

Name	Tool for radial boreholes	Divided circle for axial boreholes	Radial boreholes for tool	Axial boreholes for tool	Your custom use case (please fill in all applicable fields)			
	Hook spanner DIN 1810 [-]	Ø d_4 [mm]	Amount x Ø n x d_3 [-]x[mm]	Amount x Ø n x d_5 [-]x[mm]	Required pretension F_V [kN]	Factor A [mm]	Factor B [N]	Calculated pretensioning torque M_V [Nm]
MSA 20x1	B 34-36	27.5	5x4	5x3.2		1.281	3938	
MSA 25x1.5	B 40-42	32.5	5x4	5x3.2		1.633	3859	
MSA 30x1.5	B 45-50	37.5	5x5	5x3.2		1.921	3780	
MSA 35x1.5	B 52-55	45.5	4x5	4x4.3		2.21	3666	
MSA 40x1.5	B 58-62	50.5	4x5	4x4.3		2.5	3588	
MSA 45x1.5	B 58-62	54	5x6	5x4.3		2.789	4388	
MSA 50x1.5	B 68-75	59	6x6	6x4.3		3.079	5148	
MSA 55x1.5	B 68-75	64	6x6	6x4.3		3.369	5031	
MSA 60x1.5	B 68-75	69	6x6	6x4.3		3.655	4914	
MSA 65x1.5	B 80-90	74	7x6	7x4.3		3.948	5597	
MSA 70x1.5	B 80-90	83	6x8	6x5.3		4.238	7620	
MSA 75x1.5	B 95-100	88	6x8	6x5.3		4.525	7430	
MSA 80x2	B 95-100	93	6x8	6x5.3		4.873	7239	
MSA 85x2	B 110-115	100	6x8	6x6.4		5.168	9990	
MSA 90x2	B 110-115	105	6x8	6x6.4		5.453	9720	
MSA 95x2	B 120-130	110	6x8	6x6.4		5.744	9450	
MSA 100x2	B 120-130	118	6x8	6x6.4		6.033	9180	
MSA 105x2	B 135-145	123	6x8	6x6.4		6.321	8910	

Name	Tool for radial boreholes	Divided circle for axial boreholes	Radial boreholes for tool	Axial boreholes for tool	Your custom use case (please fill in all applicable fields)			
	Hook spanner DIN 1810 [-]	Ø d_4 [mm]	Amount x Ø n x d_3 [-]x[mm]	Amount x Ø n x d_5 [-]x[mm]	Required pretension F_V [kN]	Factor A [mm]	Factor B [N]	Calculated pretensioning torque M_V [Nm]
MSA 110x2	B 135-145	128	6x8	6x6.4		6.616	8640	
MSA 120x2	B 155-165	140	6x8	6x6.4		7.193	8100	
MSA 130x3	B 155-165	153	6x8	6x6.4		7.895	7560	
MSA 140x3	B 180-195	165	8x10	8x6.4		8.475	9360	
MSA 150x3	B 180-195	175	8x10	8x6.4		9.05	8640	
MSA 160x3	B 205-220	185	8x10	8x8.4		9.633	14520	
MSA 170x3	B 205-220	195	8x10	8x8.4		10.213	13200	
MSA 180x3	B 230-245	210	8x10	8x8.4		10.789	11880	
MSA 190x3	B 230-245	224	8x10	8x8.4		11.362	10560	
MSA 200x3	B 230-245	229	8x10	8x8.4		11.948	9240	

5.3 Locking Spieth Locknuts

Lock the locknut by tightening the clamping screws stepwise and crosswise until you have reached specified locking torque M_S (written on the component and/or in Table 4). This interlocks the thread flanks of the locknut's locking part and load part with the shaft thread. Intense clamping of the thread flanks during the locking process causes a high level of axial rigidity on the locknut.

This slightly reduces the pretension. However, the degree of this end face strain relief is reproducible and is easily compensated by using a pretensioning torque M_V to be calculated as per Formula 1 (see Section 9).

Table 4: Assembly-related data for tightening the clamping screws to lock the locknuts

Name	Tool	Clamping screws	Locking torque M_S		
	ISK size [-]	Amount x thread [-]x[-]	1. Step (= 50%) M_{S050} [Nm]	2. Step (= 75%) M_{S075} [Nm]	Final torque (=100%) M_{S100} [Nm]
MSA 20x1	2.5	5xM3	1.0	1.5	2.0
MSA 25x1.5	2.5	5xM3	1.0	1.5	2.0
MSA 30x1.5	2.5	5xM3	1.0	1.5	2.0
MSA 35x1.5	3	4xM4	1.5	2.2	2.9
MSA 40x1.5	3	4xM4	1.5	2.2	2.9
MSA 45x1.5	3	5xM4	1.5	2.2	2.9

Name	Tool	Clamping screws	Locking torque M_S		
	ISK size [-]	Amount x thread [-]x[-]	1. Step (= 50%) M_{S050} [Nm]	2. Step (= 75%) M_{S075} [Nm]	Final torque (=100%) M_{S100} [Nm]
MSA 50x1.5	3	6xM4	1.5	2.2	2.9
MSA 55x1.5	3	6xM4	1.5	2.2	2.9
MSA 60x1.5	3	6xM4	1.5	2.2	2.9
MSA 65x1.5	3	7xM4	1.5	2.2	2.9
MSA 70x1.5	4	6xM5	3.0	4.5	6.0
MSA 75x1.5	4	6xM5	3.0	4.5	6.0
MSA 80x2	4	6xM5	3.0	4.5	6.0
MSA 85x2	5	6xM6	5.0	7.5	10.0
MSA 90x2	5	6xM6	5.0	7.5	10.0
MSA 95x2	5	6xM6	5.0	7.5	10.0
MSA 100x2	5	6xM6	5.0	7.5	10.0
MSA 105x2	5	6xM6	5.0	7.5	10.0
MSA 110x2	5	6xM6	5.0	7.5	10.0
MSA 120x2	5	6xM6	5.0	7.5	10.0
MSA 130x3	5	6xM6	5.0	7.5	10.0
MSA 140x3	5	8xM6	5.0	7.5	10.0
MSA 150x3	5	8xM6	5.0	7.5	10.0
MSA 160x3	6	8xM8	12.5	18.8	25.0
MSA 170x3	6	8xM8	12.5	18.8	25.0
MSA 180x3	6	8xM8	12.5	18.8	25.0
MSA 190x3	6	8xM8	12.5	18.8	25.0
MSA 200x3	6	8xM8	12.5	18.8	25.0

Use a commercial-grade screwdriver, a screw bit or a spanner with hexagon socket as drive geometry (as for eliminating the locknut's play) to lock the locknut.

6 Operating Spieth Locknuts

Spieth locknuts provide permanently precise pretensioning and positioning of the bearing on a threaded spindle. Visually inspecting the locknuts and/or checking the clamping screws during general maintenance tasks means maintenance-free operation.

7 Disassembling Spieth Locknuts

If handled correctly, Spieth locknuts can be reused several times. Due to the adjustments made, once a locknut has been locked onto a spindle thread you can only reuse it on the same thread after they have been disassembled.

> Caution!
>
> Unlock all the clamping screws stepwise and crosswise to avoid overstraining the screws. Otherwise, the screws may fracture or the locknut or its adjoining components may be damaged.

To disassemble, proceed in reverse assembly order.

- 1. Unlock: Unlock by undoing the clamping screws stepwise and crosswise.
- 2. Undo: Undo locknut from system using suitable tools.
- 3. Unscrew: Unscrew locknut by hand from threaded spindle.

If used as intended the diaphragm will open the interlocked thread flanks during unlocking. This restored joint play makes it easy to unscrew the locknut manually without damaging the threaded spindle.

> Please note:
>
> Following complete disassembly, slightly (manually) tighten the loosened clamping screws until they are flush. In any case, avoid tightening the clamping screws without a fully covered nut thread.

To enable later reuse, clean, preserve, and store Spieth locknuts correctly. If non-original Spieth spare parts are used, Spieth-Maschinenelemente GmbH & Co. KG assumes no liability or warranty.

8 Disposing of Spieth Locknuts

You can easily reorder Spieth locknuts by entering the component designation imprinted on the nut body and the batch number.

Locknut body and clamping screws of a Spieth locknuts are made of steel. At the end of their operating life, clean metal parts and dispose of as scrap metal.

> Please note:
>
> For environmental reasons, please comply with applicable statutory regulations and guidelines when disposing of these products.

9 Calculating Pretensioning Torque M_V of Spieth Locknuts

Calculating pretensioning torque M_V takes into account the friction in the nominal thread and on the contact surface. It is based on a friction coefficient of $\mu_A = 0.1$. As the friction ratio occurring on the contact areas depends on a variety of factors, the calculated values are a non-committal recommendation.

Furthermore, Factor B mentioned above, specified in Table 3, and specific to the locknut, is taken into account for compensating end face strain relief.

$$T_P = \frac{(F_V + B) \cdot (A + \mu_A \cdot r_A)}{1000}$$ (Formula 1)

with	M_V	[Nm]	Pretensioning torque of the locknut
	F_V	[N]	Required axial pretensioning force of the screw connection
	B	[N]	Allowance specific for locknut, compensates end face strain relief of the locking process
	A	[mm]	Constant; includes calculation factors for the relevant thread (catalogue value)
	μ_A	[-]	Friction coefficient for the end face of the locknut (approximated value μ_A = 0.1 steel/steel)
	r_A	[mm]	Effective friction radius for end face of the locknut

> Please note:
>
> Visit www.spieth-me.de to use our online calculator and easily calculate your pretensioning torque M_V