Design Guide

MSF

SPIETH
Aus Prinzip präziser

Original version of the design guide

HOISI PRECISION 凯狮精密 180 7312 9830

For	Series	Components		
Spieth locknuts (precision locknuts)	MSF	MSF 25x1.5	MSF 30x1.5	MSF 35x1.5
		MSF 40x1.5	MSF 45x1.5	MSF 50x1.5
		MSF 55x1.5	MSF 55x2	MSF 60x1.5
		MSF 60x2	MSF 65x1.5	MSF 65x2
		MSF 70x1.5	MSF 70x2	MSF 75x1.5
		MSF 75x2	MSF 80x2	MSF 90x2
		MSF 100x2		

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.

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Previous document: ka-msf-en1604
Successive document: N/A
Created: 27 Apr 2018/Fd
Checked: 27 Spr 2018/Ax

See
www.spieth-me.de/english/service-download/catalogue-instructions/

For any questions, requests or suggestions, please contact
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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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1 Description of Spieth Locknuts

1.1 Structure

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

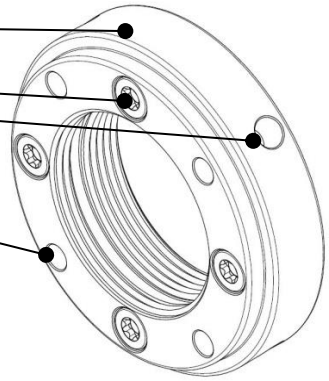

Fig. 1: Schematic representation similar to Spieth MSF series locknuts

Spieth MSF 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 MSF 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 MSF locknuts

Spieth MSF 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	Resilience	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-10302501	MSF 25x1.5	M25x1.5	26	7
K-10303001	MSF 30x1.5	M30x1.5	40	8
K-10303501	MSF 35x1.5	M35x1.5	49	8
K-10304001	MSF 40x1.5	M40x1.5	57	8
K-10304501	MSF 45x1.5	M45x1.5	60	8
K-10305001	MSF 50x1.5	M50x1.5	80	8
K-10305501	MSF 55x1.5	M55x1.5	120	10
K-10305502	MSF 55x2	M55x2	116	10
K-10306001	MSF 60x1.5	M60x1.5	131	10
K-10306002	MSF 60x2	M60x2	126	10
K-10306501	MSF 65x1.5	M65x1.5	144	10
K-10306502	MSF 65x2	M65x2	139	10
K-10307001	MSF 70x1.5	M70x1.5	155	10
K-10307002	MSF 70x2	M70x2	150	10
K-10307501	MSF 75x1.5	M75x1.5	178	10
K-10307502	MSF 75x2	M75x2	172	10
K-10308001	MSF 80x2	M80x2	186	10
K-10309001	MSF 90x2	M90x2	214	12
K-10310001	MSF 100x2	M100x2	242	12

Axial loads $F_{ax,stat}$ apply for shafts threads with a tolerance of 6g or higher and a minimum stability 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 MSF series locknuts are made of steel with high material strength (approx. 225N/mm²). The surface is bronzed with fine-turned, bare functional surfaces.

The contact surface is produced in one process together with the thread 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.

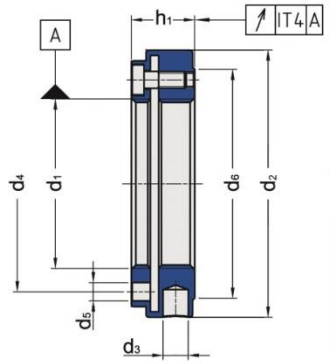

Fig. 3: Sectional view Spieth locknut > M80

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]
MSF 25x1.5	M25x1.5	48	14	39	0.107	0.338
MSF 30x1.5	M30x1.5	53	15	44	0.136	0.624
MSF 35x1.5	M35x1.5	58	15	49	0.154	0.876
MSF 40x1.5	M40x1.5	63	15	54	0.170	1.19
MSF 45x1.5	M45x1.5	70	15	59	0.197	1.7
MSF 50x1.5	M50x1.5	75	16	64	0.237	2.39

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]
MSF 55x1.5	M55x1.5	80	16	69	0.258	3.02
MSF 55x2	M55x2	80	16	69	0.262	3.02
MSF 60x1.5	M60x1.5	89	18	77	0.370	5.34
MSF 60x2	M60x2	89	18	77	0.375	5.34
MSF 65x1.5	M65x1.5	94	18	82	0.387	6.51
MSF 65x2	M65x2	94	18	82	0.392	6.51
MSF 70x1.5	M70x1.5	99	18	87	0.414	7.55
MSF 70x2	M70x2	99	18	87	0.419	7.55
MSF 75x1.5	M75x1.5	106	20	94	0.529	11.2
MSF 75x2	M75x2	106	20	94	0.536	11.2
MSF 80x2	M80x2	111	20	99	0.570	13.4
MSF 90x2	M90x2	121	20	109	0.637	18.1
MSF 100x2	M100x2	131	20	119	0.705	24

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 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 nut (if it is 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.

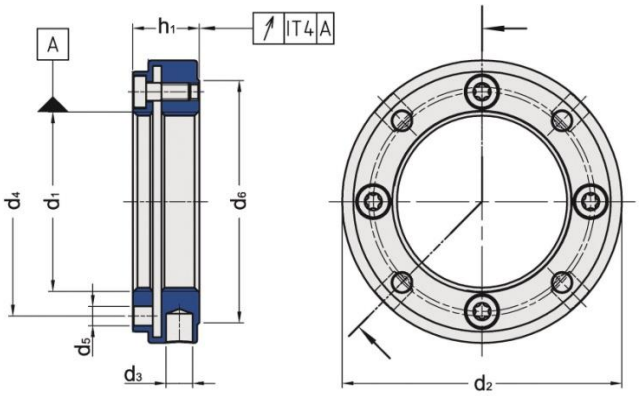

Fig. 4: Sectional view of Spieth locknut > M80

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]
MSF 25x1.5	B 45-50	36	4x5	4x4.3		1.633	0	
MSF 30x1.5	B 52-55	41	4x5	4x4.3		1.921	0	
MSF 35x1.5	B 58-62	46	4x5	4x4.3		2.21	0	
MSF 40x1.5	B 58-62	51	4x6	4x4.3		2.5	0	
MSF 45x1.5	B 68-75	56	6x6	6x4.3		2.789	0	
MSF 50x1.5	B 68-75	61	6x6	6x4.3		3.079	0	
MSF 55x1.5	B 80-90	66	6x6	6x4.3		3.369	0	
MSF 55x2	B 80-90	66	6x6	6x4.3		3.43	0	
MSF 60x1.5	B 80-90	74	6x6	6x5.3		3.655	0	
MSF 60x2	B 80-90	74	6x6	6x5.3		3.719	0	
MSF 65x1.5	B 80-90	79	6x8	6x5.3		3.948	0	
MSF 65x2	B 80-90	79	6x8	6x5.3		4.008	0	
MSF 70x1.5	B 95-100	84	6x8	6x5.3		4.238	0	
MSF 70x2	B 95-100	84	6x8	6x5.3		4.297	0	
MSF 75x1.5	B 110-115	89	6x8	6x6.4		4.525	0	
MSF 75x2	B 110-115	89	6x8	6x6.4		4.587	0	
MSF 80x2	B 110-115	94	6x8	6x6.4		4.873	0	
MSF 90x2	B 120-130	104	6x8	6x6.4		5.453	0	
MSF 100x2	B 120-130	114	6x8	6x6.4		6.033	0	

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		
	ISR size [-]	Amount x thread [-]x[-]	1. Step (= 50%) M_{S050} [Nm]	2. Step (= 75%) M_{S075} [Nm]	Final torque (=100%) M_{S100} [Nm]
MSF 25x1.5	20	4xM4	1.5	2.2	2.9
MSF 30x1.5	20	4xM4	1.5	2.2	2.9
MSF 35x1.5	20	4xM4	1.5	2.2	2.9
MSF 40x1.5	20	4xM4	1.5	2.2	2.9
MSF 45x1.5	20	6xM4	1.5	2.2	2.9
MSF 50x1.5	20	6xM4	1.5	2.2	2.9
MSF 55x1.5	20	6xM4	1.5	2.2	2.9
MSF 55x2	20	6xM4	1.5	2.2	2.9
MSF 60x1.5	25	6xM5	3.0	4.5	6.0
MSF 60x2	25	6xM5	3.0	4.5	6.0
MSF 65x1.5	25	6xM5	3.0	4.5	6.0
MSF 65x2	25	6xM5	3.0	4.5	6.0
MSF 70x1.5	25	6xM5	3.0	4.5	6.0
MSF 70x2	25	6xM5	3.0	4.5	6.0
MSF 75x1.5	30	6xM6	5.0	7.5	10.0
MSF 75x2	30	6xM6	5.0	7.5	10.0
MSF 80x2	30	6xM6	5.0	7.5	10.0
MSF 90x2	30	6xM6	5.0	7.5	10.0
MSF 100x2	30	6xM6	5.0	7.5	10.0

Use a commercial-grade screwdriver, a screw bit or a spanner with hexalobular socket as drive geometry (as for eliminating the nut'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