Design Guide

MSR from M58 to M200

Aus Prinzip präziser

Original version of the design guide

HOISI PRECISION 凱獅精密 180 7312 9830

For	Series	Components		
Spieth locknuts (precision locknuts)	MSR from M58 to M200	MSR 58x1.5	MSR 60x1.5	MSR 60x2
		MSR 62x1.5	MSR 65x1.5	MSR 65x2
		MSR 68x1.5	MSR 70x1.5	MSR 70x2
		MSR 72x1.5	MSR 75x1.5	MSR 75x2
		MSR 80x2	MSR 85x2	MSR 90x2
		MSR 95x2	MSR 100x2	MSR 105x2
		MSR 110x2	MSR 115x2	MSR 120x2
		MSR 125x2	MSR 130x3	MSR 140x3
		MSR 150x3	MSR 160x3	MSR 170x3
		MSR 180x3	MSR 190x3	MSR 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.

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Design Guide

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SPIETH
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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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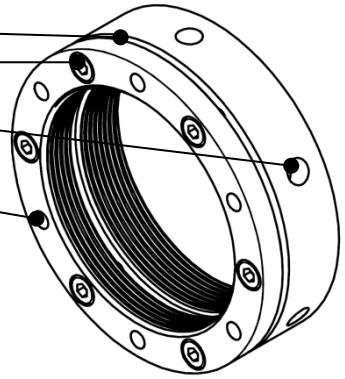
1 Description of Spieth Locknuts

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 MSR series locknuts

Spieth MSR 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 MSR 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 MSR locknuts

Spieth MSR 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-10105801	MSR 58x1.5	M58x1.5	161	8
K-10106001	MSR 60x1.5	M60x1.5	163	8
K-10106002	MSR 60x2	M60x2	163	8
K-10106201	MSR 62x1.5	M62x1.5	186	8
K-10106501	MSR 65x1.5	M65x1.5	177	8
K-10106502	MSR 65x2	M65x2	177	8
K-10106801	MSR 68x1.5	M68x1.5	223	8
K-10107001	MSR 70x1.5	M70x1.5	203	8
K-10107002	MSR 70x2	M70x2	203	8
K-10107201	MSR 72x1.5	M72x1.5	170	8
K-10107501	MSR 75x1.5	M75x1.5	160	8
K-10107502	MSR 75x2	M75x2	160	8
K-10108001	MSR 80x2	M80x2	258	8
K-10108501	MSR 85x2	M85x2	262	10
K-10109001	MSR 90x2	M90x2	265	10
K-10109501	MSR 95x2	M95x2	268	10
K-10110001	MSR 100x2	M100x2	271	10
K-10110501	MSR 105x2	M105x2	274	10
K-10111001	MSR 110x2	M110x2	280	10
K-10111501	MSR 115x2	M115x2	329	10
K-10112001	MSR 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-10112501	MSR 125x2	M125x2	412	12
K-10113001	MSR 130x3	M130x3	405	12
K-10114001	MSR 140x3	M140x3	476	12
K-10115001	MSR 150x3	M150x3	489	12
K-10116001	MSR 160x3	M160x3	552	12
K-10117001	MSR 170x3	M170x3	560	12
K-10118001	MSR 180x3	M180x3	648	12
K-10119001	MSR 190x3	M190x3	656	14
K-10120001	MSR 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 MSR series locknuts are made of steel with high material strength (approx. 550N/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.

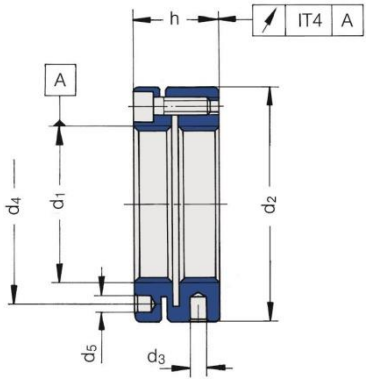


Fig. 3: Sectional view Spieth locknut > M80

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)		Mass-related properties	
	Thread Ø d_1 5H x pitch [-]x[mm]	Outer Ø d_2 [mm]	Length h [mm]	Weight m [kg]	Moment of inertia J [kg cm²]
MSR 58x1.5	M58x1.5	82	26	0.457	5.81
MSR 60x1.5	M60x1.5	84	26	0.472	6.32
MSR 60x2	M60x2	84	26	0.48	6.32
MSR 62x1.5	M62x1.5	86	28	0.532	7.33
MSR 65x1.5	M65x1.5	88	28	0.527	7.71
MSR 65x2	M65x2	88	28	0.536	7.71
MSR 68x1.5	M68x1.5	95	28	0.656	11
MSR 70x1.5	M70x1.5	95	28	0.613	10.5
MSR 70x2	M70x2	95	28	0.622	10.5
MSR 72x1.5	M72x1.5	98	28	0.636	11.8
MSR 75x1.5	M75x1.5	100	28	0.629	12.3
MSR 75x2	M75x2	100	28	0.64	12.3
MSR 80x2	M80x2	110	32	1	22
MSR 85x2	M85x2	115	32	1.058	25.7
MSR 90x2	M90x2	120	32	1.114	29.6
MSR 95x2	M95x2	125	32	1.172	34
MSR 100x2	M100x2	130	32	1.229	38.8
MSR 105x2	M105x2	135	32	1.286	44.1
MSR 110x2	M110x2	140	32	1.343	49.8
MSR 115x2	M115x2	145	36	1.6	64.2
MSR 120x2	M120x2	155	36	1.983	89.7
MSR 125x2	M125x2	160	36	2.059	99.7
MSR 130x3	M130x3	165	36	2.18	111
MSR 140x3	M140x3	180	36	2.652	161
MSR 150x3	M150x3	190	36	2.828	193
MSR 160x3	M160x3	205	40	3.742	301
MSR 170x3	M170x3	215	40	3.961	353
MSR 180x3	M180x3	230	40	4.712	478
MSR 190x3	M190x3	240	40	4.954	550
MSR 200x3	M200x3	245	40	4.619	545

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 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.

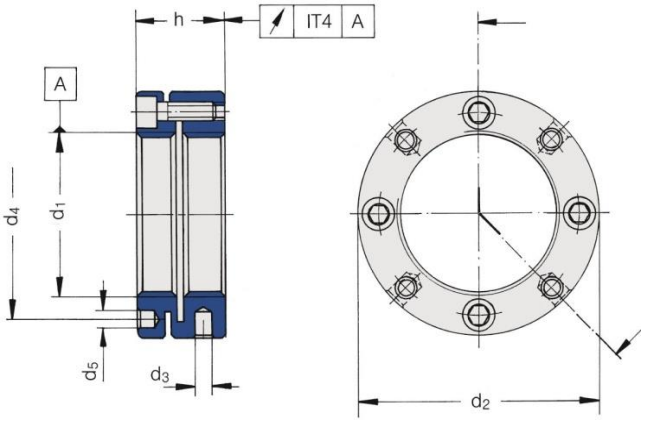


Fig. 4: Sectional view of Spieth locknut > M80

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]
MSR 58x1.5	B 80-90	72.5	6x6	6x5.3		3.541	8077	
MSR 60x1.5	B 80-90	74.5	6x6	6x5.3		3.655	8001	
MSR 60x2	B 80-90	74.5	6x6	6x5.3		3.718	8001	
MSR 62x1.5	B 80-90	76.5	6x6	6x5.3		3.774	7925	
MSR 65x1.5	B 80-90	78.5	6x6	6x5.3		3.948	7811	
MSR 65x2	B 80-90	78.5	6x6	6x5.3		4.007	7811	
MSR 68x1.5	B 95-100	83	6x8	6x5.3		4.121	7696	
MSR 70x1.5	B 95-100	85	6x8	6x5.3		4.238	7620	
MSR 70x2	B 95-100	85	6x8	6x5.3		4.297	7620	
MSR 72x1.5	B 95-100	86	6x8	6x6.4		4.354	10692	
MSR 75x1.5	B 95-100	88	6x8	6x6.4		4.525	10530	
MSR 75x2	B 95-100	88	6x8	6x6.4		4.583	10530	
MSR 80x2	B 110-115	95	6x8	6x6.4		4.873	10260	
MSR 85x2	B 110-115	100	6x8	6x6.4		5.168	9990	
MSR 90x2	B 120-130	108	6x8	6x6.4		5.453	9720	
MSR 95x2	B 120-130	113	6x8	6x6.4		5.744	9450	
MSR 100x2	B 120-130	118	6x8	6x6.4		6.033	9180	
MSR 105x2	B 135-145	123	6x8	6x6.4		6.321	8910	
MSR 110x2	B 135-145	128	6x8	6x6.4		6.616	8640	

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]
MSR 115x2	B 135-145	133	6x8	6x6.4		6.9	8370	
MSR 120x2	B 155-165	140	6x8	6x6.4		7.193	8100	
MSR 125x2	B 155-165	148	6x8	6x6.4		7.474	7830	
MSR 130x3	B 155-165	153	6x8	6x6.4		7.895	7560	
MSR 140x3	B 180-195	165	8x10	8x6.4		8.475	9360	
MSR 150x3	B 180-195	175	8x10	8x6.4		9.05	8640	
MSR 160x3	B 205-220	185	8x10	8x8.4		9.633	14520	
MSR 170x3	B 205-220	195	8x10	8x8.4		10.213	13200	
MSR 180x3	B 230-245	210	8x10	8x8.4		10.789	11880	
MSR 190x3	B 230-245	224	8x10	8x8.4		11.362	10560	
MSR 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]
MSR 58x1.5	4	6xM5	3.0	4.5	6.0
MSR 60x1.5	4	6xM5	3.0	4.5	6.0
MSR 60x2	4	6xM5	3.0	4.5	6.0
MSR 62x1.5	4	6xM5	3.0	4.5	6.0
MSR 65x1.5	4	6xM5	3.0	4.5	6.0
MSR 65x2	4	6xM5	3.0	4.5	6.0

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]
MSR 68x1.5	4	6xM5	3.0	4.5	6.0
MSR 70x1.5	4	6xM5	3.0	4.5	6.0
MSR 70x2	4	6xM5	3.0	4.5	6.0
MSR 72x1.5	5	6xM6	5.0	7.5	10.0
MSR 75x1.5	5	6xM6	5.0	7.5	10.0
MSR 75x2	5	6xM6	5.0	7.5	10.0
MSR 80x2	5	6xM6	5.0	7.5	10.0
MSR 85x2	5	6xM6	5.0	7.5	10.0
MSR 90x2	5	6xM6	5.0	7.5	10.0
MSR 95x2	5	6xM6	5.0	7.5	10.0
MSR 100x2	5	6xM6	5.0	7.5	10.0
MSR 105x2	5	6xM6	5.0	7.5	10.0
MSR 110x2	5	6xM6	5.0	7.5	10.0
MSR 115x2	5	6xM6	5.0	7.5	10.0
MSR 120x2	5	6xM6	5.0	7.5	10.0
MSR 125x2	5	6xM6	5.0	7.5	10.0
MSR 130x3	5	6xM6	5.0	7.5	10.0
MSR 140x3	5	8xM6	5.0	7.5	10.0
MSR 150x3	5	8xM6	5.0	7.5	10.0
MSR 160x3	6	8xM8	12.5	18.8	25.0
MSR 170x3	6	8xM8	12.5	18.8	25.0
MSR 180x3	6	8xM8	12.5	18.8	25.0
MSR 190x3	6	8xM8	12.5	18.8	25.0
MSR 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