Design Guide

DSM

SPIETH
Aus Prinzip präziser

Original version of the design guide

HOISI PRECISION 凱獅精密 ISO 7372 9830

For	Components					
Spieth clamping set (precision clamping sets)	Short	Long	Compact	Short	Long	Compact
	-	DSM 14.2	-	DSM 40.1	DSM 40.2	DSM 40.56
	DSM 16.1	DSM 16.2	DSM 16.28	DSM 42.1	DSM 42.2	DSM 42.58
	DSM 18.2	-	DSM 18.30	DSM 45.1	DSM 45.2	DSM 45.62
	DSM 19.1	DSM 19.2	DSM 19.32	DSM 48.1	DSM 48.2	DSM 48.65
	DSM 20.1	DSM 20.2	DSM 20.32	DSM 50.1	DSM 50.2	-
Series	DSM 22.1	DSM 22.2	DSM 22.35	DSM 55.1	DSM 55.2	-
	DSM 24.1	DSM 24.2	DSM 24.36	DSM 60.1	DSM 60.2	-
DSM	DSM 25.1	DSM 25.2	DSM 25.37	DSM 65.1	DSM 65.2	-
	DSM 28.1	DSM 28.2	DSM 28.40	DSM 70.1	DSM 70.2	-
	DSM 30.1	DSM 30.2	DSM 30.42	DSM 75.1	DSM 75.2	-
	DSM 32.1	DSM 32.2	DSM 32.48	DSM 80.1	-	-
	DSM 35.1	DSM 35.2	DSM 35.52	DSM 85.1	-	-
	DSM 38.1	DSM 38.2	DSM 38.55			

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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About the design guide for Spieth clamping sets

This design guide enables safe and efficient handling of Spieth clamping sets and provides valuable information on choice, dimensioning, and assembly of your friction-locked shaft-hub 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.

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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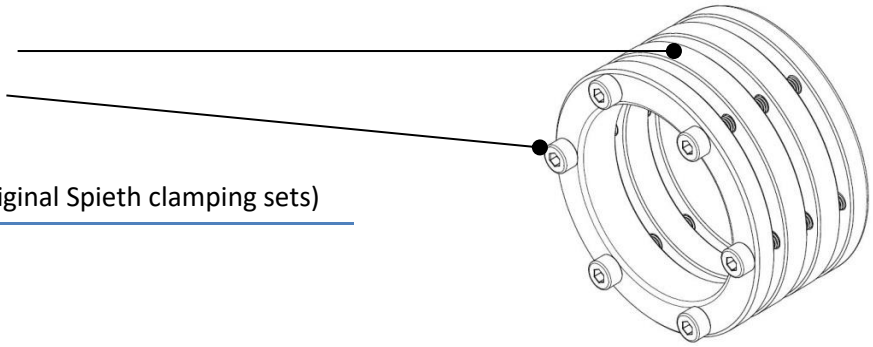
1 Description of Spieth Clamping Sets

1.1 Structure

Spieth clamping sleeve
Spieth clamping screws



Identifying features (for original Spieth clamping sets)

Spieth logo
Name
Batch number

Pretensioning torque M_V of the clamping screws

Fig. 1: Schematic representation similar to Spieth DSM series clamping sets

Spieth DSM series clamping sets have been designed according to DIN 748 for use on motor shafts with k6- and/or m6-tolerance zone. The assembly consists of a clamping sleeve and clamping screws for integrated clamping initiation. In contrast to tapered clamping sets, the one-piece cylindrical clamping sleeve has no tolerance-heavy joints and can therefore achieve a higher degree of precision.

1.2 Mode of action

Spieth clamping sets are precision clamping sets. Due to their design, they provide a maximum of precision, combined with utmost resilience.

Spieth DSM series clamping sets have been designed as precision clamping sets especially for use on motor shafts. This makes them an ideal solution for applications with a high level of replacements and adjustments.

Despite their compact design they can ensure continuous load transmission and rigid connections together with precise, centering and optimum concentricity for applications with high torques and axial forces.

Fig. 2: Illustration similar to Spieth DSM clamping sets

Spieth DSM series clamping sets are classified as friction-locked shaft-hub connections. Using clamping screws to initiate axial clamping achieves a uniform lateral contraction thanks to the base body's special geometry. The diaphragms are raised, widening the outer diameter and reducing the inner diameter, to create the required contact with shaft and hub for transmitting torques and axial forces. Thanks to this diaphragm principle, the connection is easy to assemble and quick to undo without the need for applying additional force.

2 Choice for Your Use Case

The values specified in Table 1 apply to exclusively acting maximum transmittable torques and axial forces. The admissible torques and axial forces refer to the recommended tolerances of the connecting components.

They also apply to static and pulsating, alternating, or impact loads, provided the occurring peak forces stay below the specified maximum values. Alternating torsion stress or rotating bending stress is an exception for friction-locked connections because it may cause fretting corrosion. To avoid complicating the disassembly process, pay attention to the following details:

Admissible strain	For alternating torsion	$\widetilde{T}_{zul} \leq 0{,}6\ M_{max}$	[Nm]
	For rotating flex	$\widetilde{M}_{b,zul} \leq 0{,}3\ M_{max}$	[Nm]

The specified performance data are subject to the dispersion of the friction values of the different contact partners. The components are designed to be reusable, with frequent assembly and disassembly we recommend reducing the tightening torque. Please note that this can also reduce the transmissible torque.

> 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. Plastic deformation can complicate the disassembly process for precision clamping sets. With shaft-hub connections 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 clamping sets

DSM		Transmittable forces		Precision
Order-No.	Name	Axial force $F_{ax,max}$ [N]	Torque T_{max} [Nm]	Run-out accuracy [µm] /IT4
K-11301401	DSM 14.2	7100	50	8
K-11301602	DSM 16.1	12500	100	8
K-11301603	DSM 16.2	24400	195	8
K-11301601	DSM 16.28	8800	70	8
K-11301802	DSM 18.2	24900	224	8
K-11301801	DSM 18.30	10200	92	8
K-11301902	DSM 19.1	14200	135	8
K-11301903	DSM 19.2	25600	243	8
K-11301901	DSM 19.32	10500	100	8
K-11302002	DSM 20.1	21500	215	8
K-11302003	DSM 20.2	38600	386	8
K-11302001	DSM 20.32	10900	109	8
K-11302202	DSM 22.1	23300	256	8
K-11302203	DSM 22.2	40500	445	8
K-11302201	DSM 22.35	11200	123	8
K-11302402	DSM 24.1	24900	299	8
K-11302403	DSM 24.2	42100	505	8
K-11302401	DSM 24.36	12800	153	8
K-11302502	DSM 25.1	31200	390	8
K-11302503	DSM 25.2	49800	622	8
K-11302501	DSM 25.37	14700	184	8
K-11302802	DSM 28.1	32500	455	8
K-11302803	DSM 28.2	51700	724	8
K-11302801	DSM 28.40	14600	205	8
K-11303002	DSM 30.1	60000	900	8
K-11303003	DSM 30.2	63300	950	8
K-11303001	DSM 30.42	14900	223	8
K-11303202	DSM 32.1	62500	1000	8
K-11303203	DSM 32.2	65600	1050	8
K-11303201	DSM 32.48	35600	570	8
K-11303502	DSM 35.1	74300	1300	8
K-11303503	DSM 35.2	75400	1320	8

DSM		Transmittable forces		Precision
Order-No.	Name	Axial force $F_{ax,max}$ [N]	Torque T_{max} [Nm]	Run-out accuracy [µm] /IT4
K-11303501	DSM 35.52	38300	670	8
K-11303802	DSM 38.1	77900	1480	8
K-11303803	DSM 38.2	79500	1510	8
K-11303801	DSM 38.55	39500	750	8
K-11304002	DSM 40.1	91000	1820	8
K-11304003	DSM 40.2	92700	1854	8
K-11304001	DSM 40.56	40300	805	8
K-11304202	DSM 42.1	92900	1950	8
K-11304203	DSM 42.2	95200	2000	8
K-11304201	DSM 42.58	40500	850	8
K-11304502	DSM 45.1	93300	2100	8
K-11304503	DSM 45.2	100000	2250	8
K-11304501	DSM 45.62	40900	920	8
K-11304802	DSM 48.1	98800	2370	8
K-11304803	DSM 48.2	108300	2600	8
K-11304801	DSM 48.65	40800	980	8
K-11305001	DSM 50.1	104000	2600	8
K-11305002	DSM 50.2	108000	2700	8
K-11305501	DSM 55.1	109100	3000	8
K-11305502	DSM 55.2	112700	3100	8
K-11306001	DSM 60.1	118300	3550	8
K-11306002	DSM 60.2	118300	3550	8
K-11306501	DSM 65.1	123100	4000	8
K-11306502	DSM 65.2	123100	4000	8
K-11307001	DSM 70.1	128600	4500	8
K-11307002	DSM 70.2	128600	4500	8
K-11307501	DSM 75.1	133300	5000	8
K-11307502	DSM 75.2	133300	5000	8
K-11308001	DSM 80.1	162500	6500	8
K-11308501	DSM 85.1	168200	7150	nach IT4

3 Design of Spieth Clamping sets

Spieth DSM series clamping sets are made of steel with high material strength (approx. 650 N/mm²). The surface is bronzed with grinded functional surfaces.

The run-out accuracy of borehole / outside diameter is 0.008 mm and/or starting from d_2 > 80 mm, a concentricity accuracy as per IT4.

The outer diameter is machined as per ISO tolerance h5, inner diameters have been machined to fit motor shafts according to DIN 748.

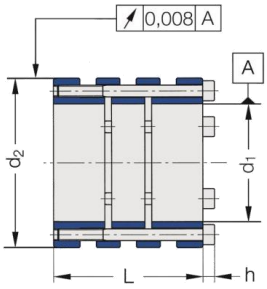


Fig. 3: Sectional view

Caution!

The clamping set is ductile in axial direction; therefore, handle it with care. Only actuate the clamping screws if the functional surfaces of the clamping set are fully covered by the connecting components. Otherwise, damage such as plastic deformation may occur on the clamping set and render it unusable.In such a case, Spieth-Maschinenelemente GmbH und Co. KG assumes no liability or warranty.

Caution!

Only use Spieth clamping sets with original Spieth clamping screws; otherwise, malfunctions with far-reaching consequences of loss may result. In such a case, Spieth-Maschinenelemente GmbH und Co. KG assumes no liability or warranty.

Table 2: Design data for dimensioning Spieth clamping sets

Name	Dimensions				Mass-related properties	
	Length L [mm]	Length of-screw head h [mm	Inner Ø d_1 [mm]	Outer Ø d_2 h5 [mm]	Weight m [kg]	Mass moment of inertia J [Kg cm²]
DSM 14.2	26	3	14	26	0,050	0,055
DSM 16.1	26	4	16	32	0,090	0,138
DSM 16.2	36	4	16	32	0,114	0,178
DSM 16.28	26	3	16	28	0,056	0,071
DSM 18.2	36	4	18	34	0,122	0,222
DSM 18.30	26	3	18	30	0,060	0,091
DSM 19.1	26	4	19	35	0,098	0,192
DSM 19.2	36	4	19	35	0,126	0,247
DSM 19.32	26	3	19	32	0,068	0,118

Name	Dimensions				Mass-related properties	
	Length L [mm]	Length of-screw head h [mm	Inner Ø d_1 [mm]	Outer Ø d_2 h5 [mm]	Weight m [kg]	Mass moment of inertia J [Kg cm²]
DSM 20.1	36	5	20	40	0,178	0,437
DSM 20.2	46	5	20	40	0,216	0,534
DSM 20.32	26	3	20	32	0,064	0,115
DSM 22.1	36	5	22	42	0,190	0,524
DSM 22.2	46	5	22	42	0,230	0,639
DSM 22.35	26	3	22	35	0,076	0,162
DSM 24.1	36	5	24	44	0,202	0,621
DSM 24.2	46	5	24	44	0,242	0,757
DSM 24.36	26	3	24	36	0,074	0,174
DSM 25.1	41	5	25	45	0,236	0,755
DSM 25.2	52	5	25	45	0,286	0,925
DSM 25.37	26	3	25	37	0,076	0,191
DSM 28.1	41	5	28	48	0,254	0,954
DSM 28.2	52	5	28	48	0,310	1,170
DSM 28.40	26	3	28	40	0,084	0,251
DSM 30.1	57	6	30	52	0,414	1,850
DSM 30.2	62	6	30	52	0,432	1,920
DSM 30.42	26	3	30	42	0,088	0,297
DSM 32.1	57	6	32	55	0,458	2,290
DSM 32.2	62	6	32	55	0,482	2,370
DSM 32.48	36	4	32	48	0,184	0,754
DSM 35.1	57	6	35	58	0,494	2,790
DSM 35.2	62	6	35	58	0,512	2,880
DSM 35.52	36	4	35	52	0,208	1,020
DSM 38.1	57	6	38	60	0,496	3,080
DSM 38.2	62	6	38	60	0,526	3,180
DSM 38.55	36	4	38	55	0,226	1,240
DSM 40.1	77	8	40	70	1,000	7,800
DSM 40.2	92	8	40	70	1,135	9,080
DSM 40.56	36	4	40	56	0,220	1,290
DSM 42.1	77	8	42	72	1,020	8,630
DSM 42.2	92	8	42	72	1,180	10,000
DSM 42.58	36	4	42	58	0,228	1,460
DSM 45.1	77	8	45	75	1,075	10,000

Name	Dimensions				Mass-related properties	
	Length L [mm]	Length of-screw head h [mm	Inner Ø d_1 [mm]	Outer Ø d_2 h5 [mm]	Weight m [kg]	Mass moment of inertia J [Kg cm²]
DSM 45.2	92	8	45	75	1,250	11,600
DSM 45.62	36	4	45	62	0,260	1,900
DSM 48.1	77	8	48	78	1,115	11,500
DSM 48.2	92	8	48	78	1,290	13,400
DSM 48.65	36	4	48	65	2,680	2,250
DSM 50.1	77	8	50	80	1,175	12,600
DSM 50.2	92	8	50	80	1,375	14,700
DSM 55.1	77	8	55	85	1,260	15,600
DSM 55.2	92	8	55	85	1,460	18,200
DSM 60.1	92	8	60	90	1,565	22,300
DSM 60.2	122	8	60	90	2,350	34,300
DSM 65.1	92	8	65	95	1,660	26,900
DSM 65.2	122	8	65	95	2,495	41,400
DSM 70.1	92	8	70	100	1,750	30,000
DSM 70.2	122	8	70	100	2,650	49,400
DSM 75.1	92	8	75	105	1,890	38,100
DSM 75.2	122	8	75	105	2,840	58,700
DSM 80.1	122	8	80	110	2,980	69,000
DSM 85.1	122	8	85	115	3,150	80,000

4 Dimensioning of Clamping set Connection

The overall rigidity of the connection between hub, clamping set, 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 clamping sets depend on the case at hand. In case of any questions, please contact Spieth-Maschinenelemente GmbH & Co. KG.

4.1 Transmittable forces and torques

The values specified in table 1 for transmissible torque M_{max} have been established from test series with connecting components made from steel C45 and manufactured in the prescribed surface quality. The values apply for a single/exclusively acting axial force at $F_{ax} = 0$ N and/or for a single acting torque at M = 0 Nm.

If both torque and axial force act on a clamping set at the same time, use Formula 1 to check whether transmissible torque M_{max} specified in Table 1 is greater than the calculated resultant torque M_r. Resultant torque M_r can be calculated from required torque M_{erf} and required axial force $F_{ax,erf}$.

$$M_{max} \geq M_r = \sqrt{{F_{erf}}^2 + \left(\frac{F_{ax,erf} \cdot d_1}{2000}\right)^2} \; [Nm] \qquad \text{(Formula 1)}$$

with	M_{max}	[Nm]	Maximum transmissible torque	Table value; Table 2
	M_{erf}	[Nm]	Required torque	
	M_r	[Nm]	Resultant torque	
	$F_{ax,erf}$	[N]	Required axial force	
	d_1	[mm]	Shaft diameter	

4.2 Provided functional space and tolerances to be designed

Ensure that the cylindrical borehole and outer surface of the clamping set are fully covered by the connecting components. Machine cylindrical shaft and borehole with a mean roughness depth of Rz = 2.5 … 6.3µm.

4.2.1 Shaft

The rigidity of the shaft influences the required assembly pretension of the clamping set. All the details about pretensioning processes have been established using a solid shaft. If a hollow shaft is used, the resulting pretension may deviate.

Design the motor shaft according to DIN 748:

Motor shaft Ø [mm]	Tolerance zone [-]
≤ 50	k6
≥ 55	m6

4.2.2 Hub

For hub boreholes, a manufacturing tolerance of H7 (or H6 for high concentricity requirements) applies.

To ensure that hub strain remains within the elastic range, the following recommendations apply for minimum shaft wall thickness:

Recommended minimum wall thickness	for steel C45:	0.6 ($d_2 - d_1$)	[mm]
	for AL alloy Minimum stability F38:	1.0 ($d_2 - d_1$)	[mm]
	for grey iron GG-25 void free cast	1.0 ($d_2 - d_1$)	[mm]

5 How to Assemble Spieth Clamping sets

5.1 Precision-centering and aligning Spieth clamping sets

Following joining and positioning, slightly tighten all the clamping screws to reduce the installation play. Tighten evenly, stepwise and crosswise to achieve precise centering. Therefore, this stage of play removal is of particular importance for the concentricity result. You need a commercial-grade screwdriver, a screw bit, or a spanner with hexagon socket.

5.2 Interlocking Spieth clamping sets

Continue to tighten the clamping screws to create the required seating stress between clamping set and hub / shaft. To do so, tighten the clamping screws evenly, stepwise and crosswise until the full pretensioning torque M_V (written on the component and/or as per Table 3).

As the power transmission of the clamping sets depends on the exerted clamping force, the clamping screws should be tightened using a torque wrench.

During this process, the clamping set shrinks by a few tenths of a mm, which, despite a symmetrically acting operating force from the clamping screws, can result in a minor axial displacement of the clamped part in undefined direction.

Afterwards, check the tightening torque of the clamping screws all across.

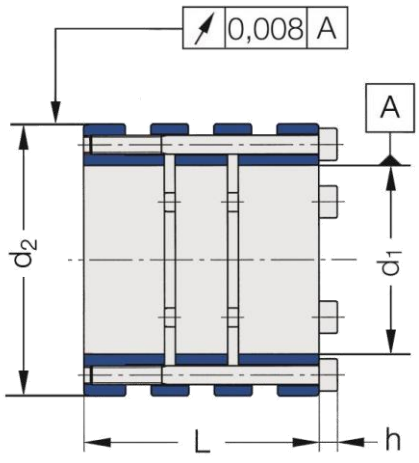


Fig. 4: Sectional view of Spieth DSM clamping sets

Table 3: Assembly-related data for tightening the clamping screws to lock the clamping set

Name	Pretensioning torque M_V			Tool	Clamping screws
	Step 1 = 50% M_{V050} [Nm]	Step 2 = 75% M_{V075} [Nm]	Final torque =100% M_{V100} [Nm]	ISK size [-]	Amount x thread [-] x [-]
DSM 14.2	1	1.5	2	2.5	4xM3
DSM 16.1	2.5	3.75	5	3	6xM4
DSM 16.2	2.5	3.75	5	3	6xM4
DSM 16.28	1	1.5	2	2.5	6xM3
DSM 18.2	2.5	3.75	5	3	6xM4
DSM 18.30	1	1.5	2	2.5	6xM3
DSM 19.1	2.5	3.75	5	3	6xM4
DSM 19.2	2.5	3.75	5	3	6xM4
DSM 19.32	1	1.5	2	2.5	6xM3
DSM 20.1	5	7.5	10	4	5xM5
DSM 20.2	5	7.5	10	4	5xM5
DSM 20.32	1	1.5	2	2.5	6xM3
DSM 22.1	5	7.5	10	4	5xM5
DSM 22.2	5	7.5	10	4	5xM5
DSM 22.35	1	1.5	2	2.5	6xM3
DSM 24.1	5	7.5	10	4	5xM5
DSM 24.2	5	7.5	10	4	5xM5
DSM 24.36	1	1.5	2	2.5	6xM3
DSM 25.1	5	7.5	10	4	6xM5
DSM 25.2	5	7.5	10	4	6xM5
DSM 25.37	1	1.5	2	2.5	6xM3
DSM 28.1	5	7.5	10	4	6xM5
DSM 28.2	5	7.5	10	4	6xM5
DSM 28.40	1	1.5	2	2.5	6xM3
DSM 30.1	8.5	12.75	17	5	5xM6
DSM 30.2	8.5	12.75	17	5	5xM6
DSM 30.42	1	1.5	2	2.5	6xM3
DSM 32.1	8.5	12.75	17	6	5xM6
DSM 32.2	8.5	12.75	17	6	5xM6
DSM 32.48	2.5	3.75	5	3	6xM4
DSM 35.1	8.5	12.75	17	5	6xM6
DSM 35.2	8.5	12.75	17	5	6xM6

Name	Pretensioning torque M_V			Tool	Clamping screws
	Step 1 = 50% M_{V050} [Nm]	Step 2 = 75% M_{V075} [Nm]	Final torque =100% M_{V100} [Nm]	ISK size [-]	Amount x thread [-] x [-]
DSM 35.52	2.5	3.75	5	3	6xM4
DSM 38.1	8.5	12.75	17	5	6xM6
DSM 38.2	8.5	12.75	17	5	6xM6
DSM 38.55	2.5	3.75	5	3	6xM4
DSM 40.1	20	30	40	6	5xM8
DSM 40.2	20	30	40	6	5xM8
DSM 40.56	2.5	3.75	5	3	6xM4
DSM 42.1	20	30	40	6	5xM8
DSM 42.2	20	30	40	6	5xM8
DSM 42.58	2.5	3.75	5	3	6xM4
DSM 45.1	20	30	40	6	5xM8
DSM 45.2	20	30	40	6	5xM8
DSM 45.62	2.5	3.75	5	3	6xM4
DSM 48.1	20	30	40	6	5xM8
DSM 48.2	20	30	40	6	5xM8
DSM 48.65	2.5	3.75	5	3	6xM4
DSM 50.1	20	30	40	6	6xM8
DSM 50.2	20	30	40	6	6xM8
DSM 55.1	20	30	40	6	6xM8
DSM 55.2	20	30	40	6	6xM8
DSM 60.1	20	30	40	6	6xM8
DSM 60.2	20	30	40	6	6xM8
DSM 65.1	20	30	40	6	6xM8
DSM 65.2	20	30	40	6	6xM8
DSM 70.1	20	30	40	6	6xM8
DSM 70.2	20	30	40	6	6xM8
DSM 75.1	20	30	40	6	7xM8
DSM 75.2	20	30	40	6	7xM8
DSM 80.1	20	30	40	6	8xM8
DSM 85.1	20	30	40	6	8xM8

6 Operating Spieth Clamping sets

Spieth clamping sets are maintenance-free. During general maintenance work, we nevertheless recommend visually inspecting the clamping set and checking pretensioning torque M_V of the clamping screws. If used as intended, Spieth clamping sets and their high level of concentricity accuracy result in a friction-locked shaft-hub-connection for high torque values and axial forces.

7 Disassembling Spieth Clamping Sets

If handled correctly, Spieth clamping sets can be reused several times. Undo the clamping screws to return the cylindrical clamping set into its original shape.

In case you used a Spieth clamping set to friction-lock a shaft and a hub, due to the adjustments made you can only reconnect these two components after they have been disassembled.

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

To disassemble, proceed in reverse assembly order.

- 1. Remove the clamping force by undoing the clamping screws stepwise and crosswise.
- 2. After undoing the clamping screws, all parts of the connection regain their free movement.

> Please note:
> Following several assembly processes, the friction conditions on the clamping screws between upper and contact surfaces may change unfavourably. Tightening may result in stick-slip effects, resulting in erratic movements (cracking) of the clamping screws. In that case, first relubricate the screwhead support using normal machine oil without additives. If the stick-slip effects persist, replace the clamping screws by new original Spieth clamping screws.

> 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 fully covered contact surfaces of the clamping set.

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

8 Disposing of Spieth Clamping Sets

You can easily reorder Spieth clamping sets by entering the component designation imprinted on the clamping set and the batch number.

Clamping sleeve and clamping screws of a Spieth clamping set are made of steel. At the end of their operating life, clean metal parts and dispose of them as scrap metal.

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