SPIETH
Adjustable Guide Bushings

Series FAK – FAL

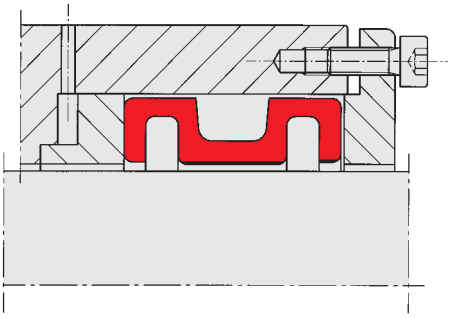
Round guiding and clamping elements with adjustable play

Works standard SN 02.04

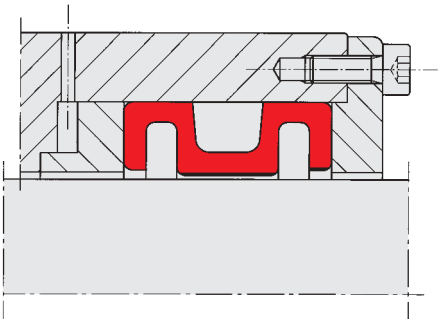
SPIETH Adjustable Guide Bushings Series FAK - FAL

- Low-cost, ready-to-mount guide and clamping bushing.
- Existing assembling play ensures simple mounting even with large dimensions.
- Metallic support between clamped sleeve and housing affords high radial rigidity.
- Provides the typical high damping performance characteristic for slideways.
- Optimum guide play adjustment possible for any operating status.
- Precisely central play restriction and clamping of the sleeve or column.

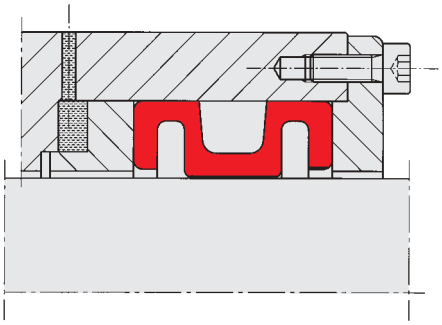
Functional principle:



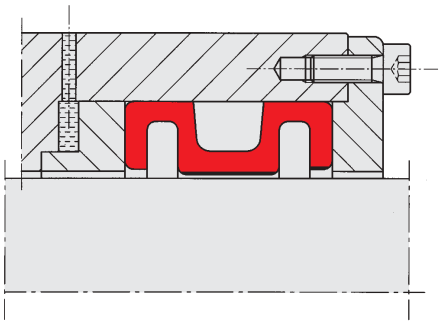
Mounting situation
Connection with assembling play between the housing, guide bushing and centre sleeve.



Play adjusted
Firm fit of the guide bushing in the housing, the guide play between guide bushing and sleeve is ideally adjusted.



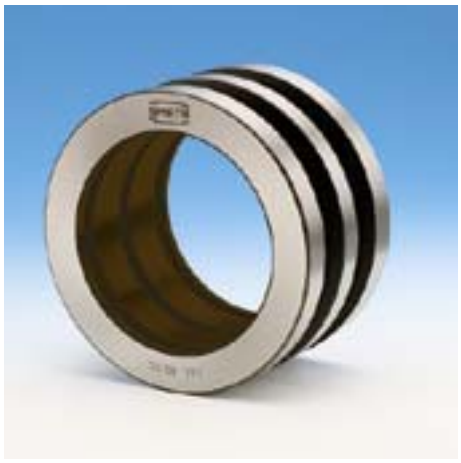
Sleeve clamped
Absolutely freedom from play between the sleeve and housing due to tensioned guide bushing.



Sleeve released for free movement
The guide bushing has released the sleeve with the previously set degree of guide play.

The principle is shown in a simplified diagram with enlarged play.

SPIETH guide bushing
Series FAK



SPIETH guide bushing
Series FAL

Fields of application:

Series FAK-FAL guiding bushes are round linear guiding and clamping elements for all fields of precise mechanical engineering.
The use of guiding bushes is called for wherever precise sleeve or column guidance is required and the sleeve/column has to be additionally precisely centrally clamped in any optional position.
This is required, for example, for sleeves on machine tools in which absolute freedom from play at standstill is called after positioning. The sequence of clamping and release can be repeated as often as required.

Benefits:

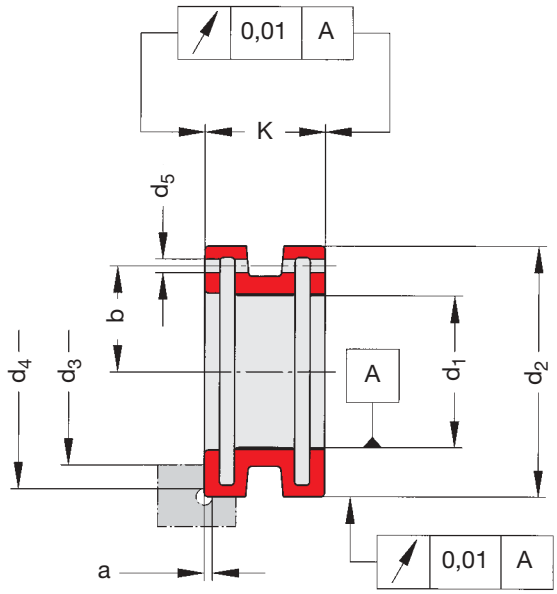
The simple to produce surrounding components can be done with common ISO tolerance levels. The existing assembling play always permits easy mounting even for large dimensions. The required narrow guidance play for the sleeve/column can be ideally adjusted during the mounting process. After clamping is complete, absolute freedom from play exists between the sleeve and housing.
The metallic support located between the sleeve and housing then ensures maximum radial rigidity.

Execution:

The guide bushings are made of (spring hardened) steel. The borehole has a plastic slide coating. The outside diameter is configured to ISO tolerance h5, the borehole is machined to ISO tolerance G6.
The maximum borehole / outside diameter / end face run-out is 0.01 mm.
The plastic coating has a high-level of wear resistance and good emergency running properties, however, it may not be used without a lubricant. Suitable for this purpose are normal petroleum-based lubricants in accordance with DIN 51 502 and 51 517 (circulation lubricants and gliding oils).

Connecting components:

The cylindrical borehole and the outside surface of the guide bushing must be completely covered by the connecting components.
The production tolerance for the housing borehole is H6, concentricity and cylindricity within IT 3,
Surface roughness Rz max. 6.3 µm.
All contact end faces of the connecting components which represent functional surfaces must be configured precisely at right angles to the axis.
Production tolerance of the shaft: h5, concentricity and cylindricity within IT 3, max. surface roughness Rz max. 6.3 µm.
We recommend the following experience value for the minimum housing wall thickness.
C 45 = 0.4 (D - d)
GG 22 = 0.7 (D - d)



SPIETH Guide bushings Series FAK

Designation of a guide bushing with d_1 = 50 mm and K = 26 mm: Guide bushing FAK 50.72

Subject to changes.
Special versions:
On request, by sending of an explanatory sketch.

Code	Dimensions in mm					Clamping initiation		Transmittable forces		Dim. connect. elem. in mm		
FAK	d_1	d_2	K	Fixing hole		F	s	M	Fa	d_3	d_4	a
	G6	h5		d_5	b	N	mm	Nm	N	max.	min.	max.
35 · 52	35	52	21	3.8	22	22900	0.4	100	5710	43	50	2.2
40 · 56	40	56	21	3.8	24	25900	0.4	131	6550	48	54	2.2
45 · 68	45	68	26	3.8	28	29800	0.4	180	8000	58	65	3
50 · 72	50	72	26	3.8	30	32900	0.4	221	8840	62	69	3
55 · 80	55	80	31	3.8	33	39300	0.5	295	10730	70	77	3
60 · 85	60	85	31	4.8	36	42200	0.5	352	11730	75	82	3
65 · 90	65	90	31	4.8	38	45100	0.5	421	12950	80	87	3
70 · 100	70	100	38	4.8	42	52500	0.5	546	15600	88	96	4
75 · 105	75	105	38	4.8	44	55600	0.5	619	16510	93	101	4
80 · 110	80	110	38	4.8	46	58700	0.5	709	17730	98	106	4
85 · 115	85	115	38	4.8	50	61800	0.6	793	18660	103	111	4
90 · 120	90	120	38	4.8	53	64800	0.6	909	20200	108	116	4
100 · 130	100	130	38	5.8	58	71000	0.6	1123	22460	118	126	4
110 · 140	110	140	38	5.8	63	77100	0.6	1342	24400	128	136	4
120 · 150	120	150	38	5.8	68	83300	0.6	1606	26770	138	146	4
130 · 160	130	160	38	5.8	73	89500	0.6	1869	30290	148	156	4
140 · 170	140	170	38	5.8	78	95700	0.6	2185	31210	158	166	4
150 · 180	150	180	38	5.8	83	101900	0.6	2491	33210	168	176	4

Transmittable forces:
In conjunction with the lubrication, the plastic coating of the guide bushings ensures easy-running, low-wear guidance. However, the good sliding properties of the bushing have a detrimental effect on the transmittable forces. Therefore the table values „transmittable forces“ are guideline values without commitment.

F: Maximum admissible clamping force

s: Required clamping path (guideline value). The optimum function of the sleeve clamp is only guaranteed if the clamping force F is able to act on the guide bushing. The clamping path specification is an indication for the design. It must not be used to assist the limitation of clamping force instead of a defined clamping force specification.

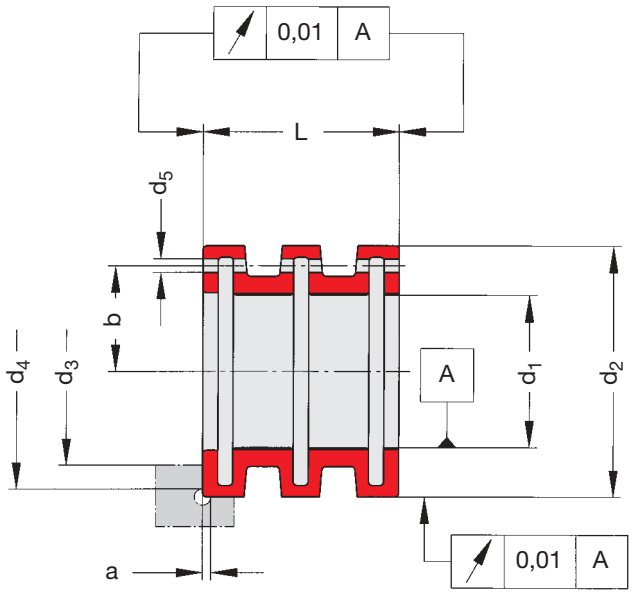
M: Transmittable torque at $F_a = 0$.

F_a: Transmittable axial force at M = 0. The F_a values are calculated in accordance with

$$F_a = 2000 \cdot \frac{M}{d_1} \text{ [N]}$$

M und F_a: If both torque and axial force act simultaneously on a clamping sleeve, the following formula must be used to check whether the resulting torque Mr can be transmitted:

$$M \geq Mr = \sqrt{Me^2 + \left(\frac{Fae \cdot d_1}{2000}\right)^2} \text{ [Nm]}$$



SPIETH Guide bushings Series FAL

Designation of a guide bushing with d_1 = 80 mm and L = 62 mm:
Guide bushing FAL 80.110

Subject to changes.
Special versions:
On request, by sending of an explanatory sketch.

Code	Dimensions in mm					Clamping initiation		Transmittable forces		Dim. connect. elem. in mm		
FAL	d_1	d_2	L	Fixing hole		F	s	M	Fa	d_3	d_4	a
	G6	h5		d_5	b	N	mm	Nm	N	max.	min.	max.
35 · 52	35	52	35	3.8	22	22900	0.6	149	8510	43	50	2.2
40 · 56	40	56	35	3.8	24	25900	0.6	195	9750	48	54	2.2
45 · 68	45	68	42	3.8	28	29800	0.6	261	11600	58	65	3
50 · 72	50	72	42	3.8	30	32900	0.6	321	12840	62	69	3
55 · 80	55	80	52	3.8	33	39300	0.8	427	15530	70	77	3
60 · 85	60	85	52	4.8	36	42200	0.8	506	16870	75	82	3
65 · 90	65	90	52	4.8	38	45100	0.8	600	18460	80	87	3
70 · 100	70	100	62	4.8	42	52500	0.8	770	22000	88	96	4
75 · 105	75	105	62	4.8	44	55600	0.8	874	23310	93	101	4
80 · 110	80	110	62	4.8	46	58700	0.8	995	24880	98	106	4
85 · 115	85	115	62	4.8	50	61800	0.9	1113	26190	103	111	4
90 · 120	90	120	62	4.8	53	64800	0.9	1234	27420	108	116	4
100 · 130	100	130	62	5.8	58	71000	0.9	1521	30420	118	126	4
110 · 140	110	140	62	5.8	63	77100	0.9	1817	33040	128	136	4
120 · 150	120	150	62	5.8	68	83300	0.9	2165	36080	138	146	4
130 · 160	130	160	62	5.8	73	89500	0.9	2520	38770	148	156	4
140 · 170	140	170	62	5.8	78	95700	0.9	2935	41930	158	166	4
150 · 180	150	180	62	5.8	83	101900	0.9	3349	44650	168	176	4

If it is not possible to apply the clamping force F, the following formula is used to determine approximately which torque Mred can be transmitted with the given clamping force Fgeg (<F).

$$Mred = \frac{M\ (Fgeg - 0.05\ F)}{0.95\ F}\ [Nm]$$

If you wish to determine the necessary clamping force for a transmittable torque Mred <M, the following approximated relation applies:

$$Ferf = \frac{Mred \cdot 0.95\ F}{M} + 0.05\ F\ [N]$$

M = Transmittable torque (table) [Nm]
Me = Required torque [Nm]
Mr = Resulting torque [Nm]
Mred = Reduced transmittable torque [Nm]
F = Max. adm. clamping force (Table) [N]
Fae = Required axial force [N]
Ferf = Required clamping force [N]
Fgeg = Given clamping force (< F) [N]
d_1 = Shaft diameter [mm]

Application:

The guide bushing may only be clamped if its borehole and outer surfaces are covered by the connecting components. Plastic deformation can otherwise result in destruction of the guide bushing.
Before assembly, all components must be carefully cleaned and slightly wet using a low-viscosity machine oil.

Assembly

1. Insert the guide bushing and ring piston into the housing borehole without exerting force.

2. Mount the flange cover loosely without the shim ring.

3. Insert the sleeve.

4. Tighten the clamping screws at the flange cover evenly crosswise until loss of play is indicated by stiffer sliding action of the sleeve.

5. Precisely gauge the mounting gap for the shim ring, remove the cover.

6. Adjust the high of the shim ring. Recommendation: Measured mounting gap + approx. 0.02 mm for contact surface compression.

7. Mount the flange cover and the underneath shim ring, tighten the screws crosswise.

8. Check the guide play. If necessary, correct by reworking the shim ring (reducing guide play) or the flange cover (increasing guide play). Guideline value: 0.1 mm alteration of the height corresponds to ~0.01 mm alteration in diameter.

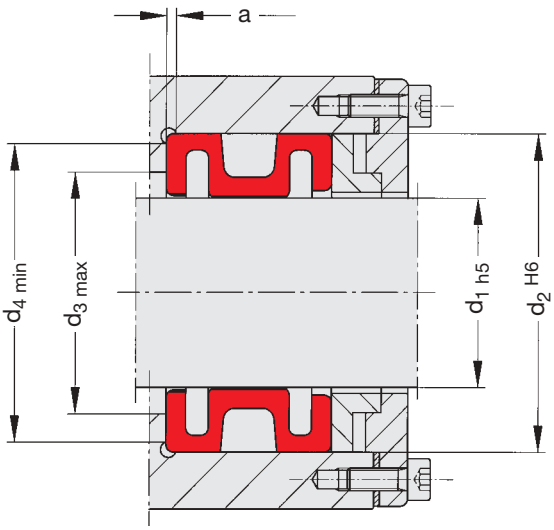


Fig. 1:
Execution of connecting components

Clamping

In order to obtain complete freedom from play between the sleeve and housing, the guide bushing once adjusted for optimum guide play is hydraulically clamped by the ring piston.

For further arrangements with mechanical or hydraulic clamping, see the assembly examples on page 7.

Please note:

The length of the guide bushing is reduced during the clamping process by a few tenths of a mm (depending on the size of the guide bushing, the clamping force and the actual dimensions of the connecting components) and in the process, it drags the part to be clamped in the clamping direction.
If the guide bushings are arranged in pairs (e.g. Fig. 2) with opposing clamping direction, in theory this thrust effect is counteracted. However, due to minimal geometrical differences and changing coefficients of friction, even in this case a residual thrust in the range of hundredths of a mm can occur in an undetermined direction. As it is caused as a result of the actually existing circumstances, this phenomenon is reproducible.
Guide bushings series FAK can be supplied as a special version on request in a non-standard low-thrust version; But in this version the retention force only reaches 0.5 times that of the table value.

Assembly examples

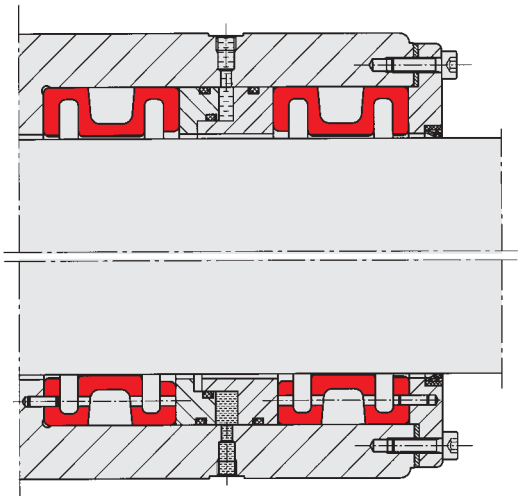


Fig. 2:
Sleeve guidance and clamping. The working sleeve of a machine tool is guided here by 2 series FAK guide bushings. In the stationary working position of the sleeve, clamping is hydraulically powered and guarantees absolute freedom from play as well as a high degree of radial rigidity.

Assembly:
The shim ring height is defined during assembly in such a way that the sleeve can be moved with the required guide play when the flange cover is tightened (upper half of the picture).
The hydraulic oil acts via the ring piston to clamp the sleeve (lower half of the picture).

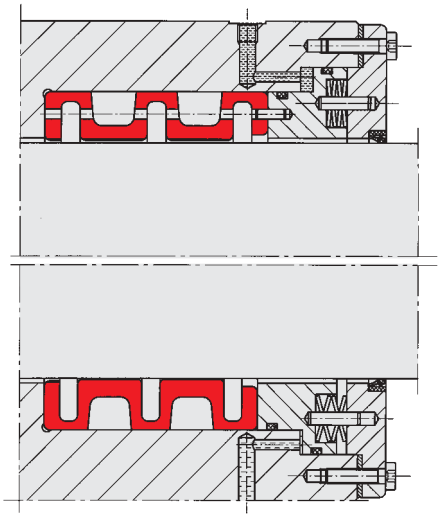
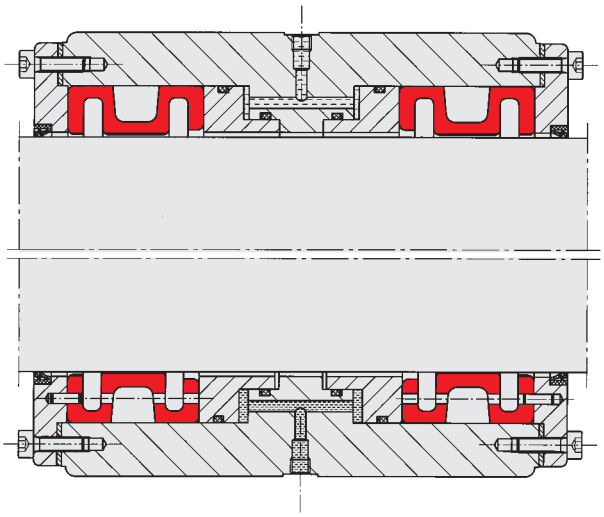


Fig. 3:
Safety requirements (power failures, oil pressure drop) or economic considerations (long clamping and short release times) often call for a mechanically acting clamp.
In this case, the FAL series guide bushing is clamped using banks of cup springs (lower half of the picture) and de-clamped hydraulically (upper half of the picture).

Assembly:
Pre-assembly without cup springs!
The shim ring height is coordinated so that the sleeve can be moved with the required guide play with the flange cover tightened.
The cup springs may only be mounted with the sleeve already inserted. Otherwise, the guide bushing clamped by the springs could be destroyed as a result of plastic deformation.



Otherwise, the remarks provided under Fig. 2 apply.

Fig. 4:
In the arrangement shown here, an independent guide play setting is possible for each guide bushing. This allows the ever-present minimal influence of the different actual guide bushing dimensions and housing boreholes to be compensated.
Where expedient for certain requirements, differing degrees of guide play can be set at the two guide bushings.

SPIETH-MASCHINENELEMENTE
GmbH & Co KG
Alleenstraße 41 · D-73730 Esslingen
phone +49 (0)711 930730-0 · fax +49 (0)711 930730-7
web: www.spieth-maschinenelemente.de
email: info@spieth-maschinenelemente.de

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