

# ADJUSTABLE HYDRODYNAMIC GUIDE BUSHINGS

**SPIETH**



**• WITH CONTROLLED GUIDE CLEARANCE**

## 1.0 Application

SPIETH ADJUSTABLE HYDRODYNAMIC GUIDE BUSHINGS are applied for optimum guiding of axially or roto-axially moving machine components on round column axles, quills, boring bars, and similar round ways. The cylindrical shape of the bushings allow for simple machining of the mating parts, thus reducing cost by straight boring or reaming. Grinding or scraping is seldom required.

## 2.0 Construction

The SPIETH ADJUSTABLE HYDRODYNAMIC GUIDE BUSHING is made of high-quality bearing bronze. The bore and the outer diameter are accurately machined. Bore tolerance is ISO H6; O.D. tolerance is h5. Surface finish on the bore is between 16 and 32 micro inches. The series FSK-FSL adjustable bushings have built-in socket head cap screws. A radial hole at one end of the outside diameter will accept a roll or dowel pin used to orient the bushing if so required for repetitive assembly and disassembly. Internal and external predetermined grooves are required for the function of the bearing adjustment and also act as a reservoir for the lubricant. This unique design allows for precise initial adjustment of bearing play and subsequent wear adjustment when needed during the life of the bushing. The individual grooves are interconnected with an axial oil distribution hole on bushing Type FDK-FDL. On Type FSK-FSL, the axial screw holes are also used to distribute the lubricant.

## 3.0 Function

When the bushing is axially compressed, either by a retainer or by a number of built-in screws, the clearance on the outer diameter will be reduced and the bushing will lock itself in place. Additional axial tightening will reduce the clearance on the inner diameter until a proper fit is established. The bushing adjusts concentrically; therefore, grinding or scraping is not generally required. The axial force deflects the edges of the bearing lands slightly upward, forming a wedge ring. This feature allows for a hydrodynamic lubrication effect when the bushing is moved axially on the round way and lubricant is present. Good quality machine oil is recommended for higher speed. The viscosity should be selected according to the application. For low speed, grease is sufficient. The ratio between axial compression and diametrical reduction on the inner diameter is about 10-1. Thus, .010" compression of the bushing will reduce the inner diameter by .001".

## 4.0 Advantages

- 4.1 Easy bearing-play adjustment to suit requirements and to compensate for wear.
- 4.2 Hydrodynamic lubrication feature reduces friction and wear.
- 4.3 Simple machining for mating parts.
- 4.4 High degree of accuracy without expensive hand scraping and fitting.
- 4.5 Economical for precision-round sliding mechanisms.
- 4.6 Type FSK-FSL bushings allow for minor error corrections in bore alignment or in center distance alignment by discriminately tightening the adjustment screws.

## 5.0 Mating Components

- 5.1 Bore: The bore is to be machined cylindrical and round to ISO H6 tolerance and should have a maximum surface finish of 125 micro-inches. If an orientation pin is used, the end milled groove in the housing must be long enough to allow for free compression of the bushing. For accurate function of Type FDK-FDL bushings, and to avoid cocking the bushing, all mating faces must be square to the bore.
- 5.2 Shaft: The shaft is to be machined cylindrical and round to ISO tolerance g5 and should have a surface finish of 16 micro-inches.

## 6.0 Assembly and Guide Clearance Adjustment

### 6.1 Type FDK-FDL (figure 1)

6.11 Insert bushing (1) into the housing (2) using hand pressure or light tapping. Note that the orienting pin (6), if needed, must be freely movable in the groove.

6.12 Mount retainer (5) without fitting spacer (3) and lightly tighten bolts.

6.13 Insert shaft

6.14 Tighten retainer bolts evenly and crosswise until the bearing play is sufficiently reduced.

6.15 Measure carefully the gap between retainer and housing.

6.16 Remove retainer

6.17 Regrind spacer (3) to the desired thickness. (Thickness of spacer equals the measured gap plus .001 to .005", depending on bushing diameter). Note that .010" of axial compression will reduce the inner bushing diameter about .001".

6.18 Assemble spacer (3) and retainer (5) and tighten bolts.

6.19 Recheck desired guide clearance. If necessary, correct by machining spacer or retainer. Watch parallelism.

6.20 Compensate for wear by regrinding the spacer (3).

### 6.2 Type FSK-FSL (figure 2)

6.21 Assemble bushing (1) in the housing (2) and tighten the adjustment screws evenly and crosswise until the bushing is fixed in the housing. Use the same amount of turn on each screw (about 30 degrees). Note that for free axial bushing movement, the orienting pin (if needed) must not bottom out in the groove.

6.22 Blue the surface of the shaft and insert into the bushing. Proceed to tighten the screws as mentioned above until the shaft moves hard (check for bearing pattern).

6.23 Mark the position of the screw heads for subsequent final bearing adjustment. Rotate and push the shaft in and out to print the bearing pattern on the bushing bore. Remove the shaft and check the bearing pattern in the bore.

6.24 Loosen screws about 1/4 turn to increase the bore diameter.

6.25 Reinsert the shaft and adjust the desired bearing clearance as mentioned above. If the bearing pattern is uneven, tighten the screws that need to be tightened and recheck. The bearing clearance is usually greater than the fit for establishing the bearing pattern. The marked portion of the screws will therefore not be reached. Note: Since each mating component has slightly different actual dimensions within the tolerance field, the adjustment for each bushing will differ. Therefore, recommendations for a specific screw torque cannot be given.

Figure 1:  
Guiding with  
Bushing Type FDK-FDL

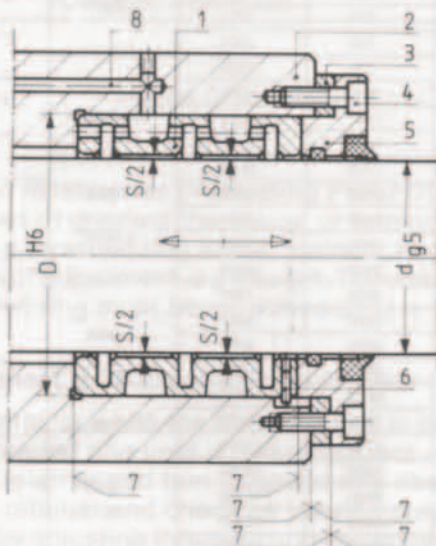
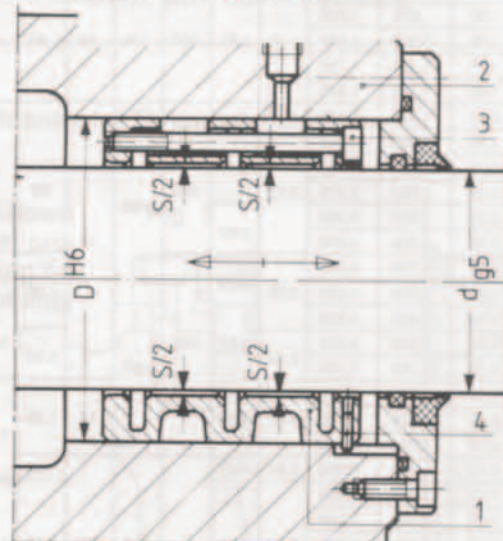


Figure 2:  
Guiding with  
Bushing Type FSK-FSL



- |                    |  |
|--------------------|--|
| 1. Guide Bushing   | 6. Orienting Pin (if needed)                       |
| 2. Housing         | 7. Surfaces to be machined;<br>square to the bore. |
| 3. Spacer          | 8. Lube Hole                                       |
| 4. Retainer Screws | 9. Shaft   |
| 5. Retainer        | S Guide Clearance                                  |

- |                              |
|------------------------------|
| 1. Guide Bushing             |
| 2. Housing                   |
| 3. Adjustment Screw          |
| 4. Orienting Pin (if needed) |
| 5. Lube Hole                 |
| S Guide Clearance            |

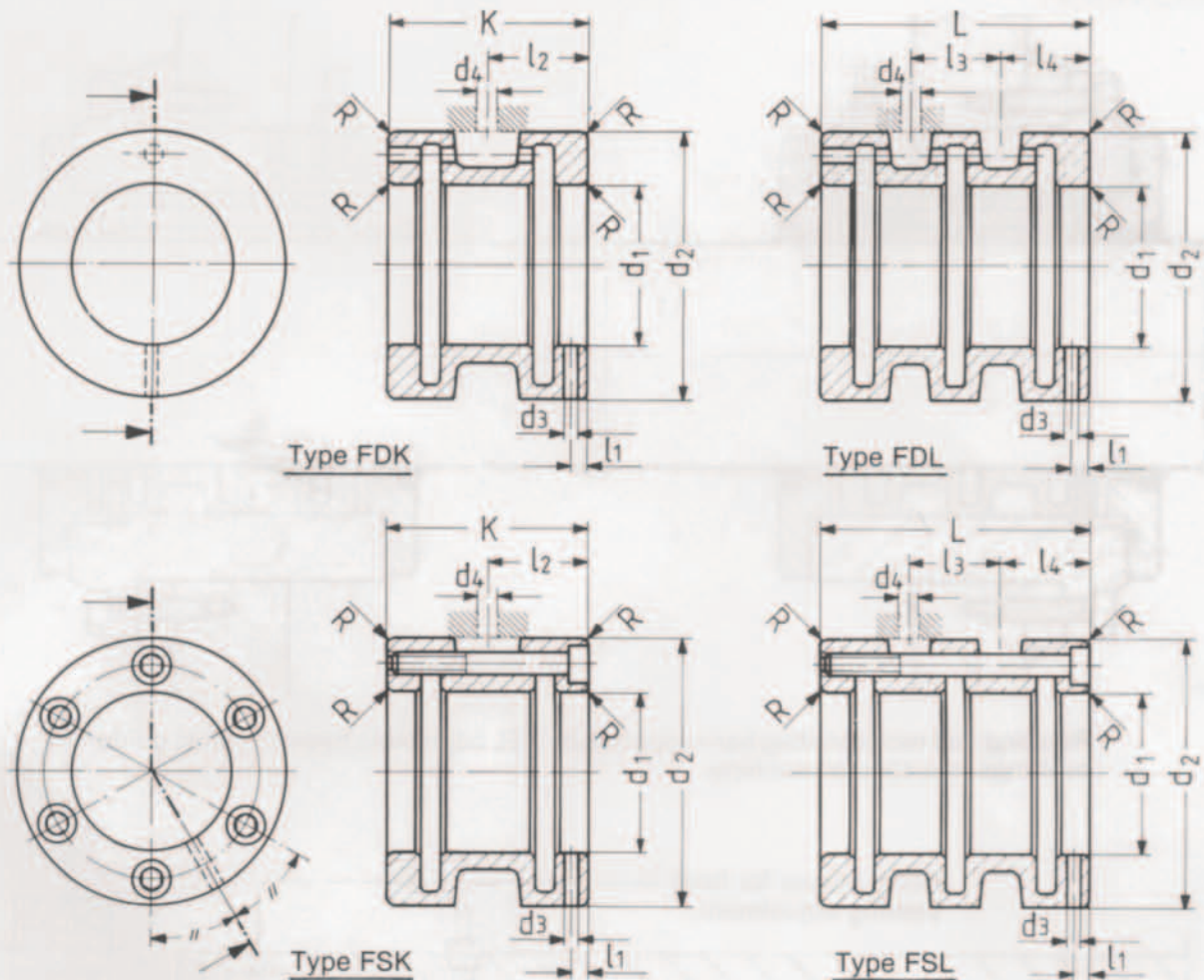


PATENTED

CATALOG NUMBER	METRIC SERIES											SOCKET HEAD CAP SCREWS		ALLOWABLE RADIAL LOAD (LBS.)		TOLERANCE OF MATING PARTS					
	FDK	FDL	d <sub>1</sub>	d <sub>2</sub>	K	L	R	d <sub>3</sub>	l <sub>1</sub>	l <sub>2</sub>	l <sub>3</sub>	l <sub>4</sub>	d <sub>4</sub>	FSK	FSL	FDK	FDL	SHAFT DIA. in 1/1000's g5		HUB BORE in 1/1000's H6	
	FSK	FSL	H6	h5				H7					max.	FSK/FSL	Q'Y	FSK	FSL				
20 - 37	20	37														400	800	-7	-16	+16	-0
25 - 42	25	42	30	46	0.8	3	2.5	15	15	16	6			M4		500	1000	-7	-16	+16	-0
30 - 47	30	47														650	1300	-7	-16	+16	-0
35 - 55	35	55														1200	2000	-9	-20	+19	-0
40 - 62	40	62														1350	2300	-9	-20	+19	-0
45 - 68	45	68		62						20	22	10				1500	2600	-9	-20	+19	-0
50 - 72	50	72	42		1			21								1700	2900	-9	-20	+19	-0
55 - 80	55	80														1900	3700	-10	-23	+19	-0
60 - 85	60	85		68		4	3.5		21.5	25	12			M5		2050	4000	-10	-23	+22	-0
65 - 90	65	90														2800	4500	-10	-23	+22	-0
70 - 100	70	100														2700	5600	-10	-23	+22	-0
75 - 105	75	105	48	78				24	24	30	14				6	2900	6000	-10	-23	+22	-0
80 - 110	80	110														3100	6500	-10	-23	+22	-0
85 - 120	85	120														4700	8000	-12	-27	+22	-0
90 - 125	90	125	60	92	1.5		4.5	30	28.5	35						4900	8500	-12	-27	+25	-0
95 - 130	95	130					5									5200	9000	-12	-27	+25	-0
100 - 140	100	140					5.5	33	31.5	39						5800	10500	-12	-27	+25	-0
110 - 150	110	150	66	102				36	36	42				M6		6400	11500	-12	-27	+25	-0
120 - 165	120	165	72	114												7700	13700	-12	-27	+25	-0
130 - 180	130	180														9200	16000	-14	-32	+25	-0
140 - 190	140	190	78	124	2	6	6	39	39	46				8	10000	18000	-14	-32	+25	-0	
150 - 200	150	200														11000	20000	-14	-32	+29	-0

CATALOG NUMBER	INCH SERIES											SOCKET HEAD CAP SCREWS		ALLOWABLE RADIAL LOAD (LBS.)		TOLERANCE OF MATING PARTS					
	FDK	FDL	d <sub>1</sub>	d <sub>2</sub>	K	L	R	d <sub>3</sub>	l <sub>1</sub>	l <sub>2</sub>	l <sub>3</sub>	l <sub>4</sub>	d <sub>4</sub>	FSK	FSL	FDK	FDL	SHAFT DIAMETER g5		HUB BORE H6	
	FSK	FSL	H6	h5				H7					max.	FSK/FSL	Q'Y	FSK	FSL				
.75 - 1.38	.75	1.375														400	750				
.88 - 1.50	.875	1.500														450	900	-.0003			+.0006
1.00 - 1.63	1.000	1.625	1.22	1.81	.020	.125	.10	.61	.63	.59	.25			8-32		550	1050	-.0007			-.0000
1.13 - 1.75	1.125	1.750														700	1300				
1.25 - 1.88	1.250	1.875														800	1500				
1.38 - 2.13	1.375	2.125														1000	1800	-.0004			+.0007
1.50 - 2.38	1.500	2.375														1100	2000	-.0008			-.0000
1.75 - 2.75	1.750	2.750		2.44					.90	.77	.39					1400	2500				
2.00 - 2.88	2.000	2.875	1.75		.040		.156	.88								1700	3100				
2.25 - 3.25	2.250	3.250														2100	3700	-.0004			
2.50 - 3.50	2.500	3.500			2.69			.13		1.00	.84			10-32	6	2400	4500	-.0009			+.0009
2.75 - 4.00	2.750	4.000														2800	5300				-.0000
3.00 - 4.25	3.000	4.250	2.00	3.06					1.00	1.14	.96					3300	6200				
3.25 - 4.50	3.250	4.500														3900	7200				
3.50 - 4.88	3.500	4.875		3.63	.060					1.33	1.15					4500	8200				
3.75 - 5.13	3.750	5.125	2.38			.187			1.19					1/4-20		5200	9200	-.0005			+.0010
4.00 - 5.50	4.000	5.500														5800	10500	-.0011			-.0000
4.25 - 5.75	4.250	5.750	2.50	4.00			.15	1.25	1.56	1.25						6500	11500				
4.50 - 6.00	4.500	6.000														7000	12700				
4.75 - 6.50	4.750	6.500	2.81	4.50					1.40		1.47					7700	13800				
5.00 - 7.00	5.000	7.000														8400	15000				
5.50 - 7.50	5.500	7.500														9600	17200	-.0006			
6.00 - 8.00	6.000	8.000	3.13	5.13		.250	.25	1.56	1.75	1.69				1/4-18	8	10800	19800	-.0013			
6.50 - 8.50	6.500	8.500														11800	21200				
7.00 - 9.00	7.000	9.000			.080											12800	22900				+.0012
7.50 - 9.50	7.500	9.500														13800	24700				-.0000
8.00 - 10.25	8.000	10.250														14800	26400	-.0006			
8.50 - 10.75	8.500	10.750														15800	28100	-.0014			
9.00 - 11.25	9.000	11.250	3.50	6.00		.312	.31	1.75	2.00	2.00				1/4-16	10	16800	29800				
9.50 - 11.75	9.500	11.750														17800	31600				
10.00 - 12.25	10.000	12.250														18800	33300	-.0008			-.0017

SPECIFICATIONS AND DIMENSIONS SUBJECT TO CHANGE WITHOUT NOTICE. LARGER OR SPECIAL SIZES AVAILABLE UPON REQUEST.



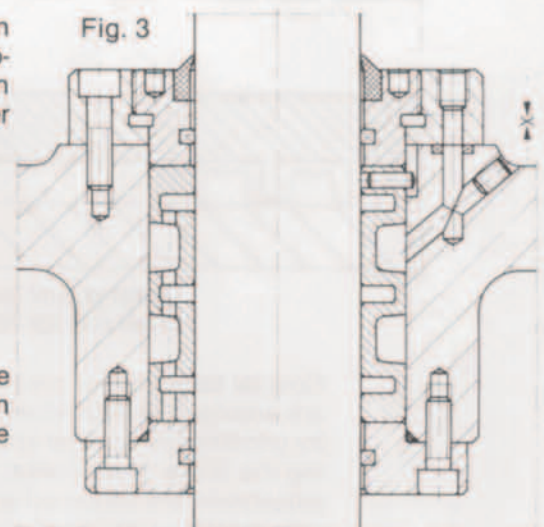
ORDER EXAMPLE:  
To order Guide Bushing  $d_1 = 60\text{mm}$ ,  $d_2 = 85\text{mm}$ , and  $K = 42\text{mm}$ , with built-in screws,  
ORDER: FSK 60.85

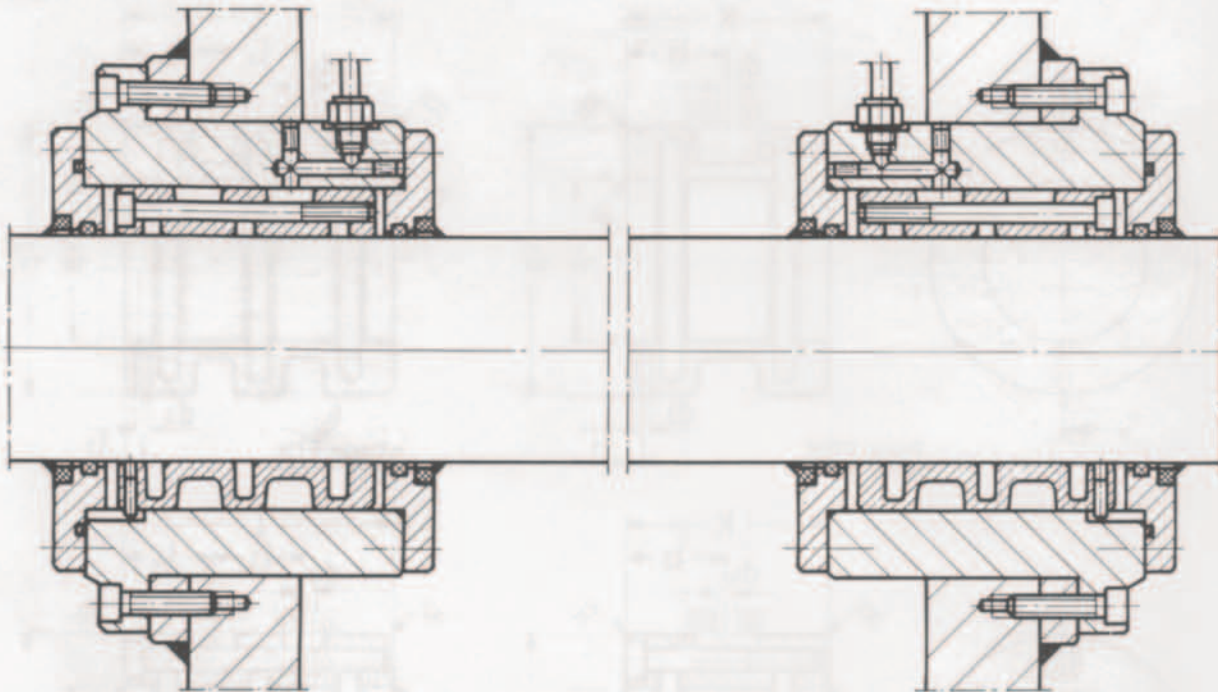
Figure 3: Adjustment of Guide Clearance by Means of a Threaded Retainer:

A quick and reliable way of adjusting FDK-FDL Guide Bushings is shown here. Instead of grinding the spacer or turning the retainer to obtain proper fitting, a threaded ring in the retainer can be adjusted. Depending on size, 2-3mm of adjustment is sufficient. The contact surfaces on the retainer and threaded ring must be machined square to the housing bore.

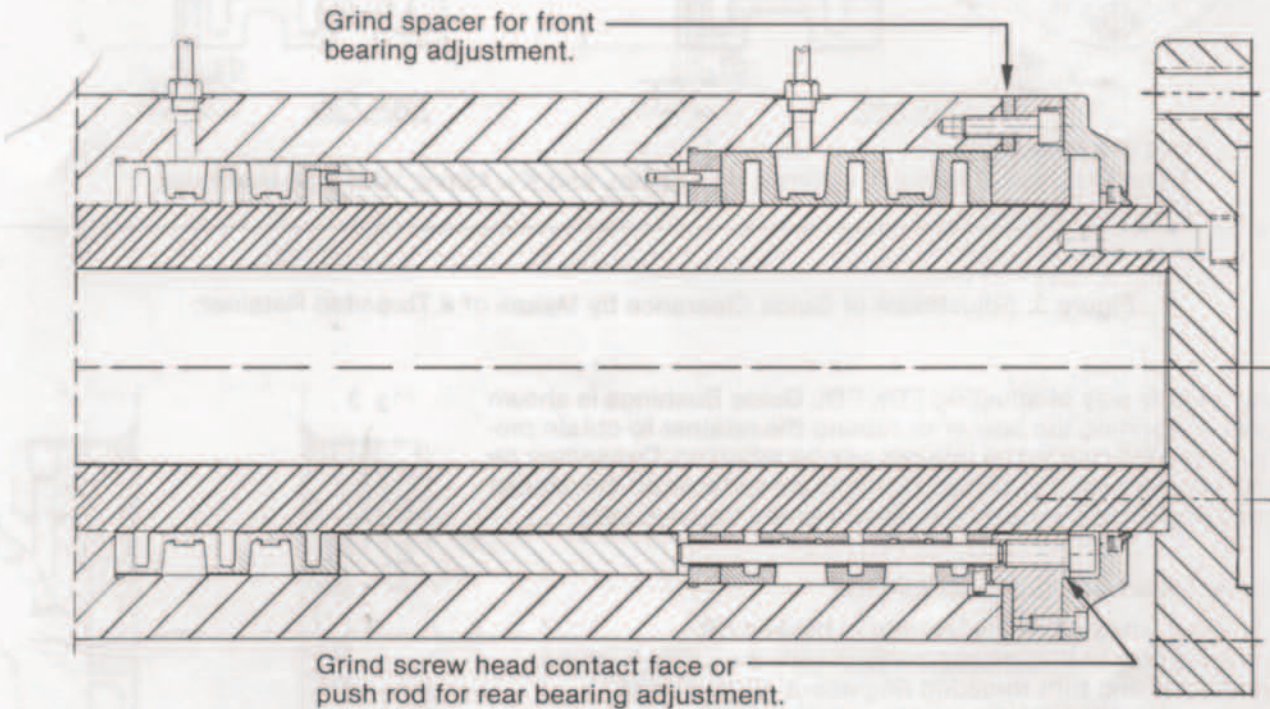
The adjustment is accomplished as follows:

1. Install retainer while the threaded ring is backed off.
2. Turn threaded ring until it makes contact with the guide bushing.
3. Loosen retainer and turn threaded ring about .010" inward.
4. Tighten retainer and check for bearing play.
5. Repeat by adjusting threaded ring inward until desired guide clearance is read. Note: To avoid misadjustment (due to high surface friction on the threaded ring), loosen the retainer when adjusting the guide clearance of the threaded ring.

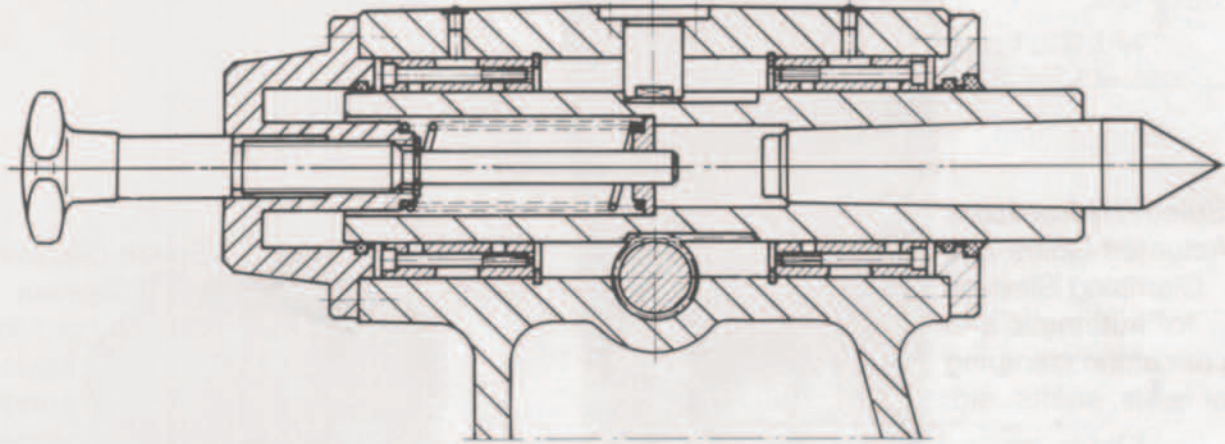




Rotating and reciprocating bar supported by FSL adjustable hydrodynamic guide bushings in a special machine.



Special tailstock for precision grinder: two FDL Hydrodynamic Bronze Bushings are arranged for individual bearing adjustment. While the front bushing is adjusted by grinding the retainer spacer, the rear bearing is independently adjusted by grinding the screw head contact face of the retainer. The heads of the (6) socket head cap screws are tightened against the retainer to prevent uneven adjustment. (6) push rods and (6) socket head cap screws must have the same length to guarantee equal pressure on the center bearing spacer.



Precision grinding machine tailstock with FSK Adjustable Hydrodynamic Guide Bushings.

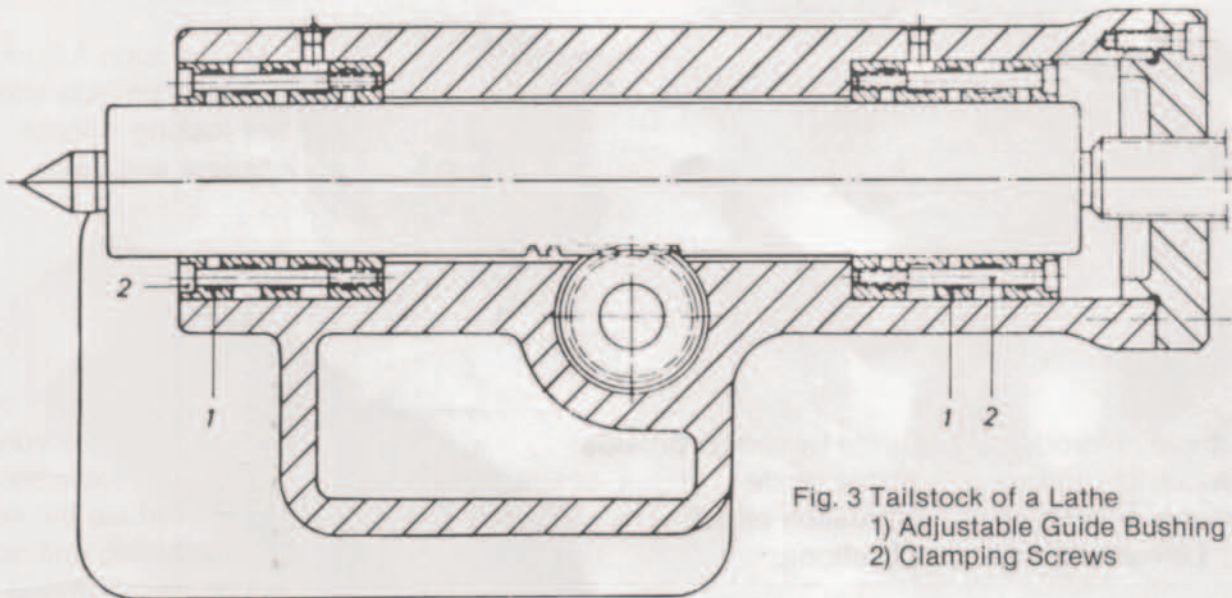



Fig. 3 Tailstock of a Lathe  
1) Adjustable Guide Bushing  
2) Clamping Screws

Precision lathe tailstock with FSL Adjustable Hydrodynamic Guide Bushings.


# The **SPIETH** Family Of Shaft Connectors & Guides




Spieth Hydraulically Actuated Guide and Clamping Sleeves for automatic and concentric clamping of quills, shafts, etc.



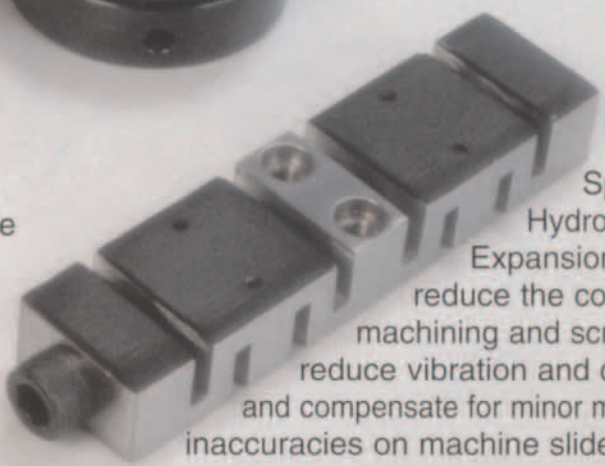
Spieth Clamping Sleeves provide keyless, shrink-fit connections.



Spieth precision Adjustable Locknuts provide vise-like locking without washers and keys.



Spieth Adjustable Hydrodynamic Guide Bushings provide accurate guiding, adjustable guide clearance, hydrodynamic lubrication effect. Linear and rotary applications.



Spieth Hydrodynamic Expansion Gibs reduce the cost of machining and scraping, reduce vibration and chatter, and compensate for minor machining inaccuracies on machine slides.

**Contact us for a free copy of any Spieth component catalog:**



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