

# KOENIG EXPANDER®

## Anchorage Principle

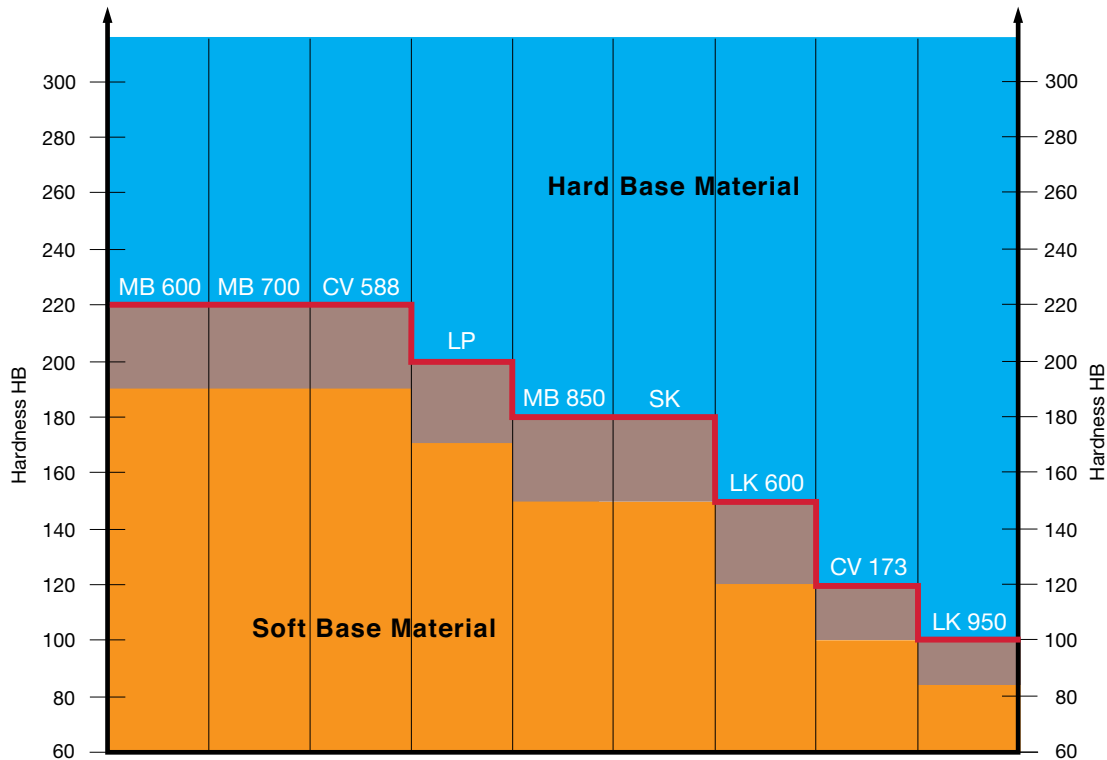
The required bore roughness is directly related to the hardness and the mechanical characteristics of the base material. Depending on the combination of sealing plug and base material, anchorage takes place either by the groove profile of the expander sleeve biting into the base material or on anchorage to the surface roughness of the bore.

### Note:

When selecting a KOENIG EXPANDER® the bore roughness must always be adjusted according to the hardness of the base material.

Anchorage between sleeve and base material is achieved when the sleeve is a minimum of HB = 30 greater than the base material. If the hardness difference is less, hole roughness of 10 to 30 µm is needed to achieve indicated working pressures.

### Anchorage Principle Related to the Base Material



### KOENIG EXPANDER®

**Hard Base Material:** To achieve the allowable working pressure, anchorage to the bore roughness of the base material is required.  
Roughness  $R_z = 10 - 30 \mu\text{m}$ .

**Soft Base Material:** Anchorage to the bore of the base material occurs automatically due to the serrations on the sleeve of the KOENIG EXPANDER®.

**Transition Zone:** To achieve the allowable working pressure, anchorage to the bore roughness of the base material is required.  
Roughness  $R_z = 10 \text{ to } 30 \mu\text{m}$ .

# SFC-KOENIG

Leader in  
Sealing & Flow Control  
Technology

[www.sfckoenig.com](http://www.sfckoenig.com)

**Headquarters – Switzerland**  
SFC KOENIG AG  
Lagerstrasse 8  
8953 Dietikon  
Tel. +41 44 743 46 00  
Fax +41 44 743 46 01  
info-ch@sfckoenig.com

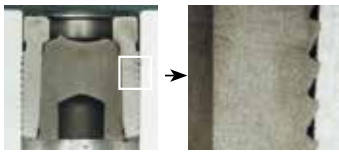
**USA**  
SFC KOENIG LLC  
73 Defco Park Road  
North Haven, CT 06473  
Phone +1 203 245 1100  
Fax +1 203 245 3072  
info-us@sfckoenig.com

**Germany**  
SFC KOENIG GmbH  
Max-Eyth-Strasse 14  
89186 Illerrieden  
Phone +49 7306 2062 300  
Fax +49 7306 2062 399  
info-de@sfckoenig.com

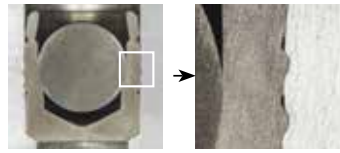
**China**  
SFC KOENIG Flow Control (Suzhou) Co., Ltd.  
Room NW02-211, Nanopolis Suzhou  
99 Jinji Lake Avenue, Suzhou Industrial  
Park, Jiangsu Prov. P.R.China. 215123  
Phone +86 512 6585 9515  
Fax +86 512 6561 1718  
info-cn@sfckoenig.com

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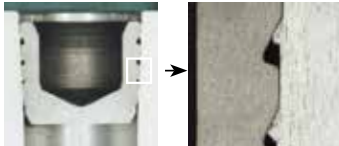
## Anchorage Principle



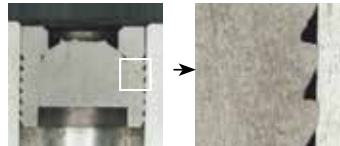
Anchorage due to plug sleeve serrations  
KOENIG EXPANDER® Series SK  
In aluminum-alloy HB = 90



Anchorage due to plug sleeve serrations  
KOENIG EXPANDER® Series MB 850  
In aluminum-alloy HB = 90

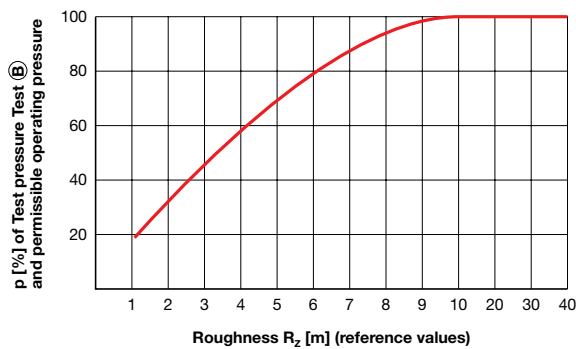


Anchorage due to plug sleeve serrations  
KOENIG EXPANDER® Series LP  
In aluminum-alloy HB = 90



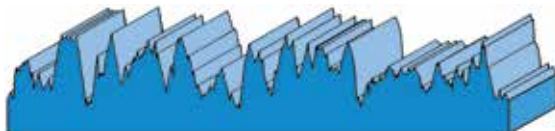
Sufficient anchorage due to plug sleeve serrations  
KOENIG EXPANDER® Series LK 950  
In aluminum-alloy HB = 90

Pressure depending on the bore roughness



### BORE ROUGHNESS REQUIREMENTS

When installing KOENIG EXPANDER® plugs in hard base material positive anchoring is not possible. To attain suitable working pressures and anchorage, it is necessary to have a bore roughness of  $R_z = 10\text{--}30\ \mu\text{m}$ . At a roughness greater than  $R_z = 30\ \mu\text{m}$  leakage might occur.



### ROUGHNESS PROFILE

#### Required Roughness Profile

The ideal bore roughness for anchorage is attained by drilling with a twist drill or a core drill.



#### Undesirable Roughness Profile

By reaming, a one-sided, smooth roughness profile is created. This is not desirable.

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Lagerstrasse 8  
8953 Dietikon  
Tel. +41 44 743 46 00  
Fax +41 44 743 46 01  
info-ch@sfckoenig.com

#### USA

SFC KOENIG LLC  
73 Defco Park Road  
North Haven, CT 06473  
Phone +1 203 245 1100  
Fax +1 203 245 3072  
info-us@sfckoenig.com

#### Germany

SFC KOENIG GmbH  
Max-Eyth-Strasse 14  
89186 Illerrieden  
Phone +49 7306 2062 300  
Fax +49 7306 2062 399  
info-de@sfckoenig.com

#### China

SFC KOENIG Flow Control (Suzhou) Co., Ltd.  
Room NW02-211, Nanopolis Suzhou  
99 Jinji Lake Avenue, Suzhou Industrial  
Park, Jiangsu Prov. P.R.China. 215123  
Phone +86 512 6585 9515  
Fax +86 512 6561 1718  
info-cn@sfckoenig.com

# KOENIG EXPANDER®

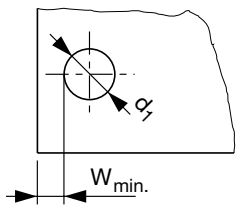
## Design Guidelines

### WALL THICKNESS / DISTANCE FROM EDGE

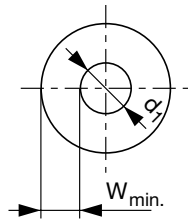
As the radial expansion of the KOENIG EXPANDER® sleeve occurs, the base material in which it will be anchored plastically deforms. The resultant strength, as well as the hydraulic pressure and temperature service conditions depending on the expander type and characteristics of the base material, require minimum wall thickness, or distance from edge.

The guideline values for minimum wall thickness and distance from edge ( $W_{min.}$ ) express these influencing factors. At these minimum values, only slight deformation on the exterior profile of the base material of less than 20 µm is likely. This does not affect the function of the KOENIG EXPANDER®. Below the guideline values ( $W_{min.}$ ) the possibility of overloading the base material exists, which can adversely influence the function of the KOENIG EXPANDER®. In such cases tests must be conducted.

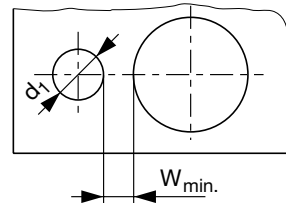
Distance to External Wall



Distance to Exterior Wall



Wall Thickness Between Bores



		1	2	3	4	5	6	7
Base Material	Description	ETG100	C15Pb	EN-GJS-600-3	EN-GJL-250	AlCu4Mg1	AlMgSiPb	G-AlSi7Mg
	Avg. Tensile Strength Rm [N/mm²]	1000	560	650	250	480	340	300
	Minimum Elongation A5 [%]	6	10	3	0.3	8	8	4
	Avg. Ultimate Strength Rp 0,2 [N/mm²]	865	300	425	200	380	300	250
KOENIG EXPANDER® Series		Factor $f_{min.}$						
MB 600		0,6	0,8	1,0	0,8	0,8	1,0	1,0
MB 600, Inch-Version		0,6	0,8	1,0	0,8	0,8	1,0	1,0
MB 700		0,6	0,8	1,0	0,8	0,8	1,0	1,0
MB 850		0,5	0,6	1,0	0,6	0,6	1,0	1,0
CV 173		0,5	0,6	0,8	0,7	0,7	0,8	0,8
CV 588		0,6	0,8	1,0	0,8	0,8	1,0	1,0
SK		0,5	0,6	1,0	0,6	0,6	1,0	1,0
LP		0,3	0,3	0,5	0,3	0,4	0,5	0,5
LK 600		0,4	0,5	0,8	0,5	0,7	0,7	0,7
LK 950		0,3	0,3	0,6	0,5	0,4	0,5	0,5

### Guideline values $W_{min.}$ for wall thickness and distance from edge

KOENIG EXPANDER® diameters

Series MB / SK and LP

$$d_1 \geq 4 \text{ mm: } W_{min.} = f_{min.} \times d_1$$

$$d_1 < 4 \text{ mm: } W_{min.} = f_{min.} \times d_1 + 0,5 \text{ mm}$$

KOENIG EXPANDER® diameters

Series LK

$$d_1 \geq 5 \text{ mm: } W_{min.} = f_{min.} \times d_1$$

$$d_1 = 4 \text{ mm: } W_{min.} = f_{min.} \times d_1 + 0,5 \text{ mm}$$

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#### Headquarters – Switzerland

SFC KOENIG AG  
Lagerstrasse 8  
8953 Dietikon  
Tel. +41 44 743 46 00  
Fax +41 44 743 46 01  
info-ch@sfckoenig.com

#### USA

SFC KOENIG LLC  
73 Defco Park Road  
North Haven, CT 06473  
Phone +1 203 245 1100  
Fax +1 203 245 3072  
info-us@sfckoenig.com

#### Germany

SFC KOENIG GmbH  
Max-Eyth-Strasse 14  
89186 Illerrieden  
Phone +49 7306 2062 300  
Fax +49 7306 2062 399  
info-de@sfckoenig.com

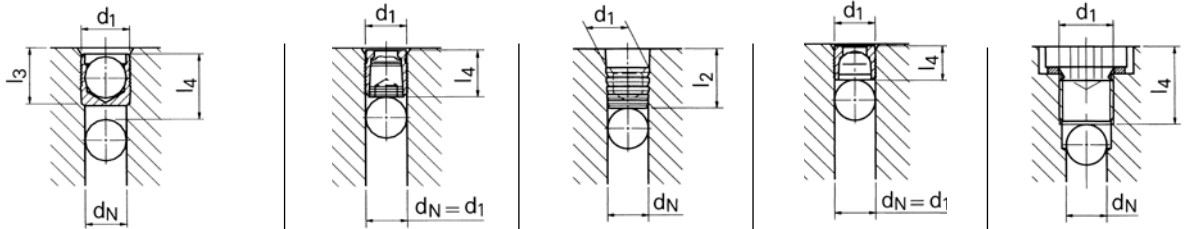
#### China

SFC KOENIG Flow Control (Suzhou) Co., Ltd.  
Room NW02-211, Nanopolis Suzhou  
99 Jinji Lake Avenue, Suzhou Industrial  
Park, Jiangsu Prov. P.R.China. 215123  
Phone +86 512 6585 9515  
Fax +86 512 6561 1718  
info-cn@sfckoenig.com

# KOENIG EXPANDER®

## Design Guidelines

### Required Installation Lengths



$d_N$	Series MB			Series SK		Series LP		Series LK		Threaded Plugs DIN 908	
	$d_1$	$l_3$ min.	$l_4$ min.	$d_1$	$l_4$ max.	$d_1$	$l_2$ min.	$d_1$	$l_4$ max.	$d_1$	$l_4$ max.
2,0	3,0	3,4	5,0								
3,0	4,0	3,8	5,5								
4,0	5,0	5,3	7,0	4,0	6,5	4,40	7,0	4,0	4,0		
5,0	6,0	6,3	8,5	5,0	7,5	5,40	8,0	5,0	4,8	M8x1,5	11,5
6,0	7,0	7,3	9,5	6,0	8,0	6,40	8,5	6,0	5,3	M8x1,5	11,5
7,0	8,0	8,3	11,0	7,0	9,0	7,40	8,5	7,0	5,8	M10x1,5	12,0
8,0	9,0	9,8	12,5	8,0	10,5	8,45	9,5	8,0	6,8	M10x1,5	12,0
9,0	10,0	10,8	13,5	9,0	11,0	9,60	10,0	9,0	6,8	M12x1,5	16,0
10,0	12,0	12,8	16,0	10,0	12,5	10,65	11,0	10,0	6,8	M12x1,5	16,0
12,0	14,0	14,5	18,0	12,0	16,5	12,75	12,0	12,0	7,8	M14x1,5	16,0
14,0	16,0	16,5	20,0					14,0	8,7	M16x1,5	16,5
16,0	18,0	18,5	22,5					16,0	11,5	M18x1,5	17,5
18,0	20,0	21,5	25,5					18,0	13,0	M20x1,5	19,5
20,0	22,0	24,5	28,5							M22x1,5	19,5

$d_N$  = Given nominal bore / system bore size

#### \*Installation Lengths Series MB

The required installation length ( $l_4$ ) min. for MB plugs is for base materials with hardness greater than HB = 90.

For softer materials, deeper installation is required.

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SFC KOENIG AG  
Lagerstrasse 8  
8953 Dietikon  
Tel. +41 44 743 46 00  
Fax +41 44 743 46 01  
info-ch@sfckoenig.com

#### USA

SFC KOENIG LLC  
73 Defco Park Road  
North Haven, CT 06473  
Phone +1 203 245 1100  
Fax +1 203 245 3072  
info-us@sfckoenig.com

#### Germany

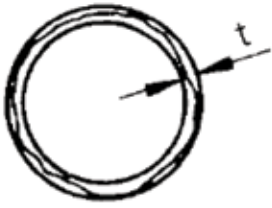
SFC KOENIG GmbH  
Max-Eyth-Strasse 14  
89186 Illerrieden  
Phone +49 7306 2062 300  
Fax +49 7306 2062 399  
info-de@sfckoenig.com

#### China

SFC KOENIG Flow Control (Suzhou) Co., Ltd.  
Room NW02-211, Nanopolis Suzhou  
99 Jinji Lake Avenue, Suzhou Industrial  
Park, Jiangsu Prov. P.R.China. 215123  
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Fax +86 512 6561 1718  
info-cn@sfckoenig.com

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## Design Guidelines



### ROUNDNESS TOLERANCE

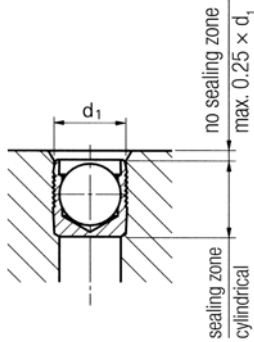
To ensure reliable functioning of the KOENIG EXPANDER® with regard to pressure performance and to ensure leak tight sealing, a **roundness tolerance of  $t = 0.05 \text{ mm}$**  must be held.

By using a double lipped twist drill, the called out hole and roundness tolerances are reached. Better tolerances, particularly for larger diameter holes, can be held by using a **triple lipped** twist drill.

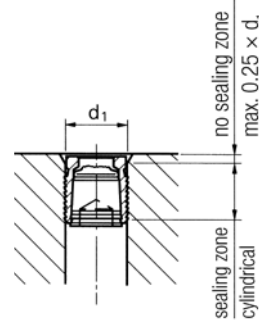
### CONICITY OF THE BORE

Within the effective sealing area of the KOENIG EXPANDER, the bore must be according to the dimensional sheets. The bore lead in can be chamfered up to a depth of  **$0.25 \times d_1$**  (**LK:  $0.15 \times d_1$** ) because this area has no significant effect on the sealing function.

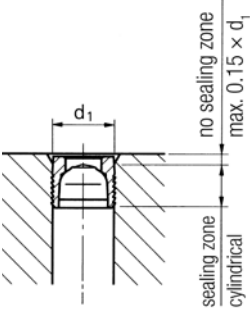
#### Series MB/CV



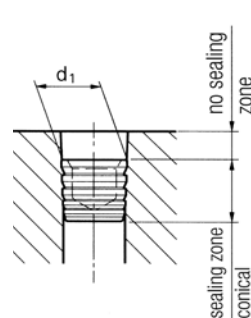
#### Series SK



#### Series LK



#### Series LP



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#### Headquarters – Switzerland

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Lagerstrasse 8  
8953 Dietikon  
Tel. +41 44 743 46 00  
Fax +41 44 743 46 01  
[info-ch@sfckoenig.com](mailto:info-ch@sfckoenig.com)

#### USA

SFC KOENIG LLC  
73 Defco Park Road  
North Haven, CT 06473  
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Fax +1 203 245 3072  
[info-us@sfckoenig.com](mailto:info-us@sfckoenig.com)

#### Germany

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89186 Illerrieden  
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Fax +49 7306 2062 399  
[info-de@sfckoenig.com](mailto:info-de@sfckoenig.com)

#### China

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99 Jinji Lake Avenue, Suzhou Industrial  
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Phone +86 512 6585 9515  
Fax +86 512 6561 1718  
[info-cn@sfckoenig.com](mailto:info-cn@sfckoenig.com)