ZEDEX®

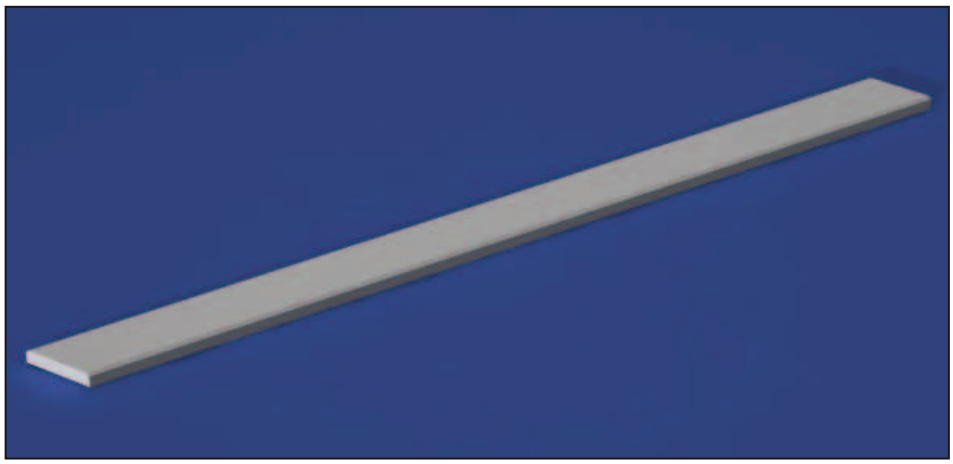
Tribological Polymer Solutions

ZX-100K

Plastic foil bearing

EN 1.0

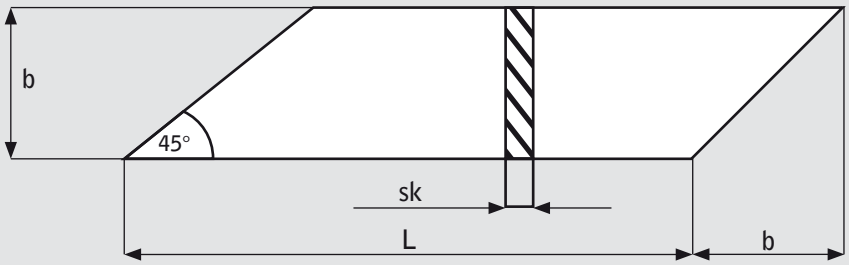
The cost-effective alternative to a cylindrical pressed bushing



Sketch 1

sk *Bushing's wall thickness*
b *Bushing's width*
L *Bushing's circumference*

The slot's angle is normally 45°



Customers can manufacture foil bearings by cold forming of sheet strips (Sketch 1). This type of plain bearing bush is particularly suitable when semi-finished products with large diameters are required and they are no available in the product range. In comparison to a milled out of a sheet bushing, there is a significantly low material waste, and by it an enormous cost advantage. The larger the diameter, the greater is the cost advantage. Diagram 1 shows the relative comparison of a foil bearing and an equal big cylindrical bushing milled from a sheet.

When foil bearing are suitable?
- For big diameters.
- If costs are to be saved.
- At high temperatures and/or if a small operating clearance is required.
- If the bearing has to be quick replaced without complicated tools

When foil bearing are not suitable?
- If in the housing an axial fixing cannot be done
- If the bushing cannot turn it self in the housing

Please take into account, that sheet strips for foil bearings are exclusively available for the material ZX-100K.

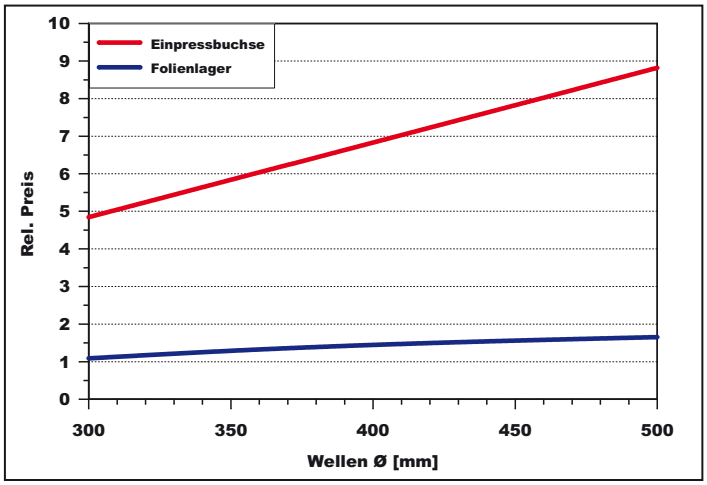


Diagram 1

Possible diameters for cold forming, bushing's width and wall thickness [mm].
The slot is designed with an angle of 45°. Depending on the strip's width, an outside diameter up to 610 mm is possible.

	Maximum allowable foil bearing's width			
Wall thickness / Outer Ø	3	4	5	6
390	140,00	78,75	49,00	35,00
400	146,40	82,35	51,24	36,60
410	193,20	108,68	67,62	48,30
420	160,00	90,00	56,00	40,00
430	166,40	93,60	58,24	41,60
440	173,20	97,43	60,62	43,30
450	180,00	101,25	63,00	45,00
460	186,40	104,85	65,24	46,60
470	193,20	108,68	67,62	48,30
480	200,00	112,50	70,00	50,00
490	205,00	115,31	71,75	51,25
500	210,00	118,13	73,50	52,50
510	215,00	120,94	75,25	53,75
520	220,00	123,75	77,00	55,00
530	226,64	127,49	79,32	56,66
540	233,20	131,18	81,62	58,30
550	240,00	135,00	84,00	60,00
560	-	138,75	86,33	61,67
570	-	142,43	88,62	63,30
580	-	146,25	91,00	65,00
590	-	-	93,24	66,60
600	-	-	-	68,33
610	-	-	-	70,00

Remark:
The customer has to place at our disposal the appropriate housing before the foil bearing manufacturing, in order to adjust it to the housing.

Application example:
Foil bearing in the swing kinematics for Vario Shuttle

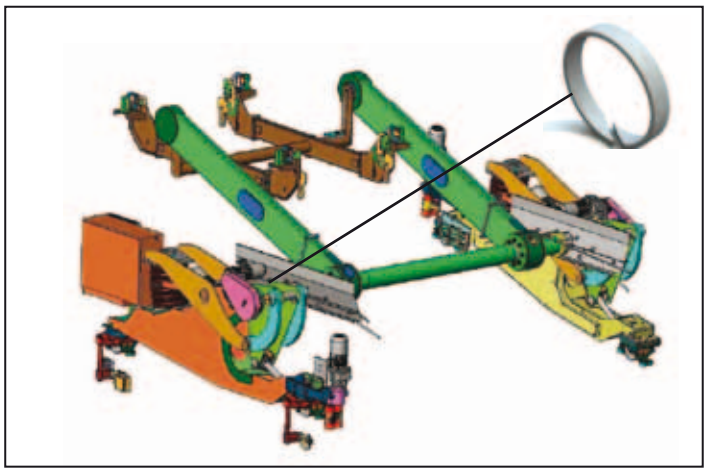


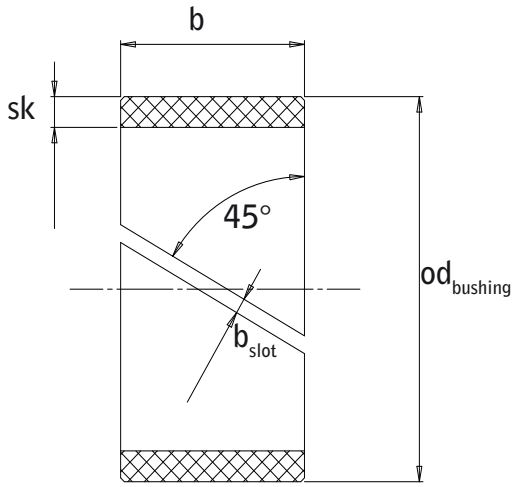
Figure 1

Figure 2

Description of the application
The Vairo Shuttle is used for the pre-treatment of the coach-work. It transports and pivots the car body during the pre-treatment in purification tanks, in which sometimes some aggressive chemicals are used. The bushings are assembled as standard features in the arrow marked positions.

Application parameters
Foil bearing made of ZX-100K
0Ø 180 mm, width 60 mm
Shaft: ST44, Ø172 mm, Rz 6,3 mm
Load: 9000 N
Number of revolution: n= 1 rpm
Pivot angle of 210 °C
Requested working life: 16000 h
Only 0,03 mm wear after the requested working life in dry-running conditions.

Drawing specifications

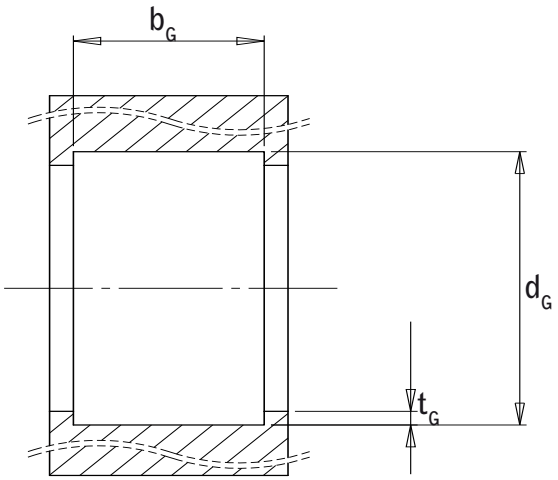


Sketch 2

Foil bearing

sk	*Bushing's wall thickness*
b	*Bushing's width*
$od_{bushing}$	*Bushing's outer Ø*
b_{slot}	*Slot's width*

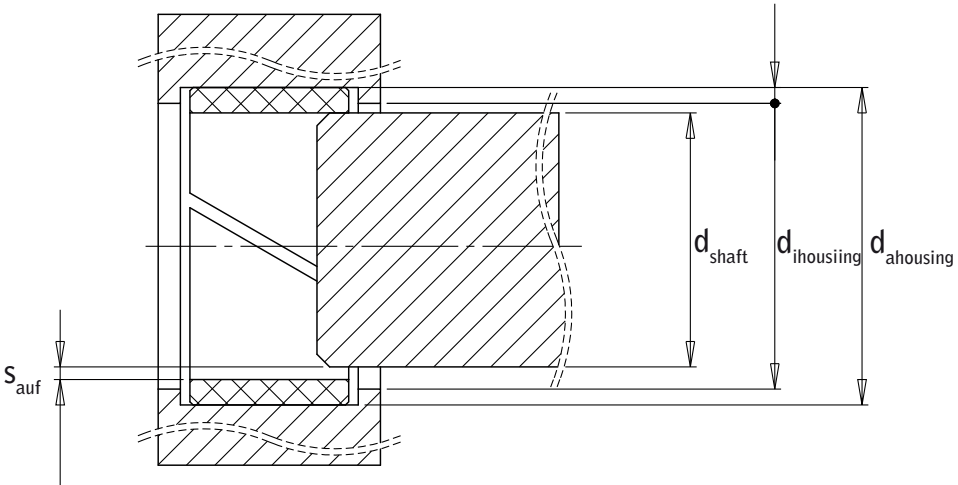
The slot's angle is normally 45°



Sketch 3

Housing

b_G	*Groove's width*
d_G	*Groove's Ø*
t_G	*Groove's depth*
	(=0,5 x sk; however min. 2 mm)



Sketch 4

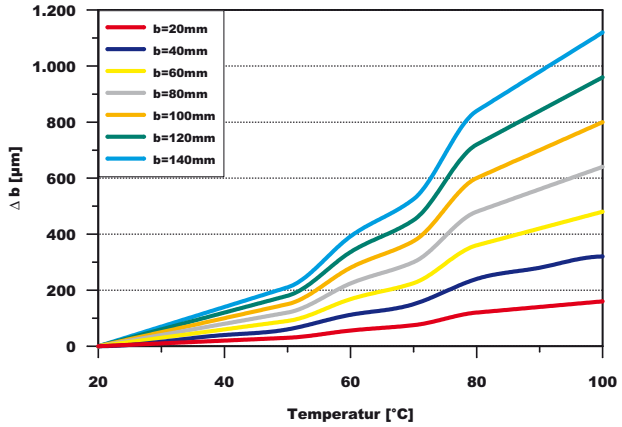
Assembly

d_{shaft}	*Shaft's Ø*
$d_{ihousing}$	*Housing's innerØ*
$d_{ahousing}$	*Groove's Ø*
s_{auf}	*Clearance*

The foil bearing is simply inserted in its seat (housing's groove) which also operates as axial fixing. The foil bearing can rotate into the bearing seat.

By bending arise in transversal direction, a concave curvature on the foil bearing outer diameter, which, however, will be equalised through the low pressure generated from the shaft's weight.

Influence of temperature on the bushing's width

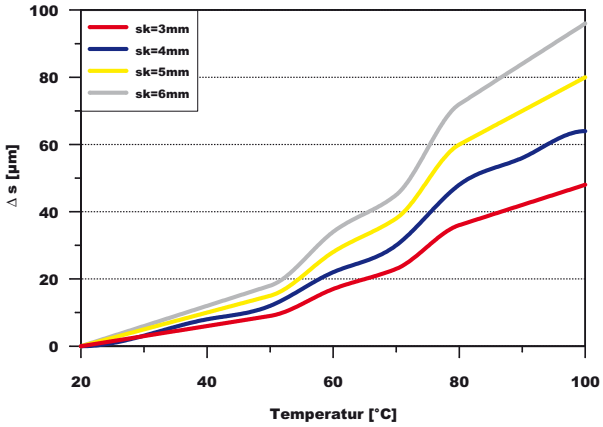


At a temperature of 100 °C (temperature difference: 80 °C), a foil bearing with a width of 100 mm expands its self of 0,8 mm. (see ochre line)

$$\Delta b = b \cdot \Delta\vartheta \cdot \alpha_{Buchse}$$

Δb *Width dimensional change [µm]*
b *Width [mm]*
Δϑ *Temperature change [°C]*
$\alpha_{bushing}$ *Bushing's thermal expansion coeff. [10⁻⁵x1/K]*

Clearance change depending on temperature

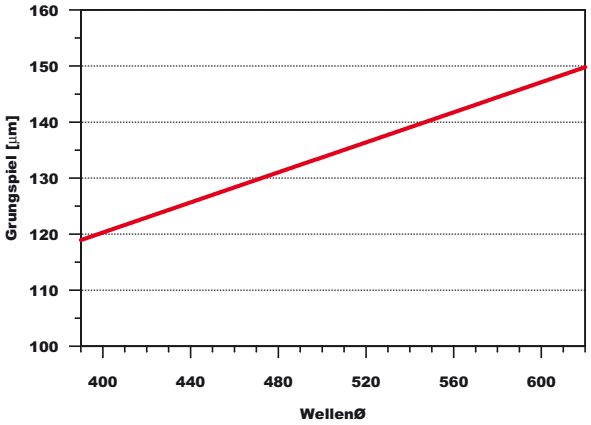


By temperature increase, the foil bearing expands its self into the slot, and thereby the internal diameter and thus the clearance will be not reduced. Only the bushing's wall thickness (2 x sk), the housing's Ø and the shaft's Ø have influence on the clearance, although housing's Ø and the shaft's Ø almost compensate their self.

$$\Delta s = \Delta\vartheta \cdot (d_{aBuchse} \cdot \alpha_{Gehäuse} - d_{iBuchse} \cdot \alpha_{Welle} - 2 \cdot sk \cdot \alpha_{Buchse})$$

sk *Wall thickness [mm]*
$\alpha_{bushing}$ *Bushing's thermal expansion coeff. [10⁻⁵x1/K]*
α_{shaft} *Shaft's thermal expansion coeff. [10⁻⁵x1/K]*
$\alpha_{housing}$ *Housing's thermal expansion coeff. [10⁻⁵x1/K]*
$di_{bushing}$ *Bushing's innerØ [mm]*
$da_{bushing}$ *Bushing's outerØ [mm]*
Δϑ *Temperature change [°C]*
Δs *Clearance change [mm]*

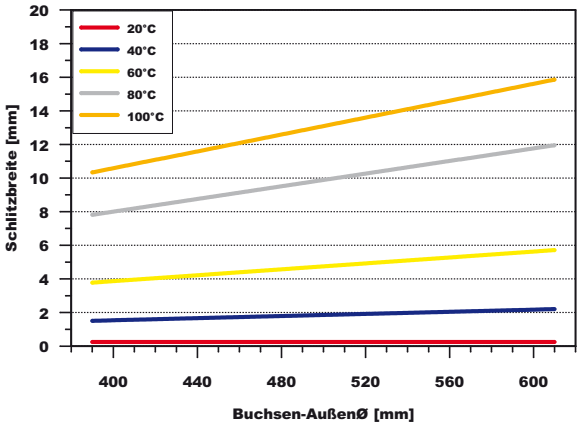
Basic clearance depending on shaft's diameter



$$s_{Grund} = \sqrt{d_{Welle}} \cdot 0{,}006$$

s_{basic} *Basic clearance [mm]*
d_{shaft} *Shaft's diameter [mm]*

Influence of temperature on the slot's width



To prevent that the slot closes it self by a temperature increment, and through it generating a press-fit, the slot's width has to be designed as in the diagram.

$$b_{Schlitz} = \pi \cdot di_{Gehäuse} \cdot \Delta\vartheta \cdot \alpha_{Buchse} + 0{,}25$$

b_{slot} *Slot's width [mm]*
$di_{housing}$ *Housing's innerØ [mm]*
Δϑ *Temperature change [°C]*
$\alpha_{bushing}$ *Bushing's thermal expansion coeff. [10⁻⁵x1/K]*

Diagrams: all information are related to an ambient temperature of 20 °C and to the material ZX-100K.

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