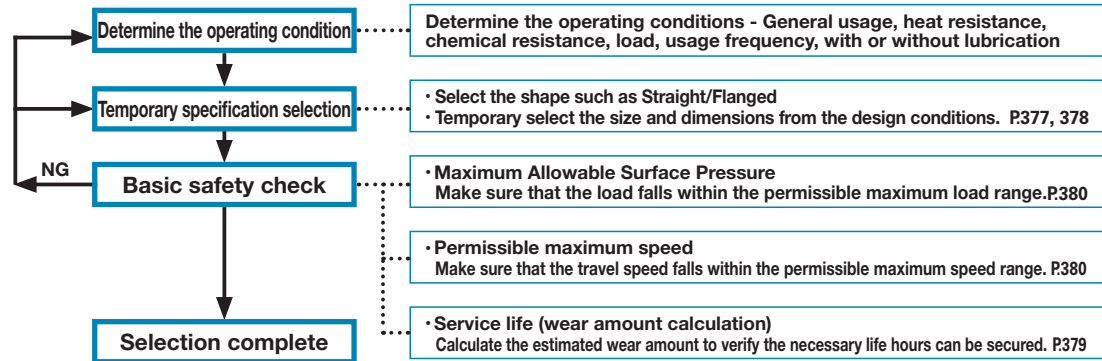


# Oil Free Bushings - Technical Information

## Oil Free Bushings Selection Procedure



## Calculating Oil Free Bushings Service Life (Wear)

The service life of Oil Free Bushings is determined by the wear amount. The wear amount calculated will greatly differ by the conditions, such as surface pressure, sliding speed, movement type, lubrication, surface roughness of the mating shaft, etc.

Provided that the wear amount is proportional to the load and the sliding distance, the following formula is generally used to calculate the wear amount. Use this as an indication for you to select a specification.

### Estimated wear amount (mm) $W=K^*1 \times P \times V \times T$

Specific Wear Rate K : mm/(N/mm<sup>2</sup> · m/s · Hr)  
 Design Surface Pressure P : N/mm<sup>2</sup>  
 Sliding Speed V : m/s  
 Friction Time T : Hr-hr

\*1 Specific wear rate range

Lubrication	mm/(N/mm <sup>2</sup> · m/s · Hr)	mm/(kgf/cm <sup>2</sup> · m/min · Hr)
Unlubricated	3x10 <sup>-3</sup> ~6x10 <sup>-4</sup>	1~5x10 <sup>-6</sup>
Regular	3x10 <sup>-4</sup> ~6x10 <sup>-5</sup>	1~5x10 <sup>-7</sup>
Oil	3x10 <sup>-5</sup> ~6x10 <sup>-6</sup>	1~5x10 <sup>-8</sup>

**Calculation Example**  
 Bearing of I.D. 20mm/Length 10mm, Load 1000N without lubricant, Rotational speed 2r/min  
 When used for 100 hours of friction time

$$W = K \times \frac{P}{I.D. \times Length} \times \frac{V}{1000} \times T$$

$$= \text{Specific Wear Rate} \times \frac{\text{Load}}{I.D. \times Length} \times \frac{\pi \times I.D. \times \text{Rotational Speed}}{1000} \times \text{Operating Time}$$

$$= \frac{3}{1000} \times \frac{1000}{20 \times 10} \times \frac{\pi \times 20 \times 2}{1000} \times 100$$

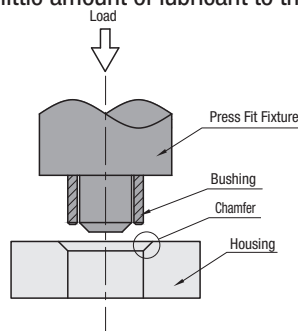
$$= 0.0028(\text{mm})$$

## Oil Free Bushings Securing Method

### ① Press-Fit

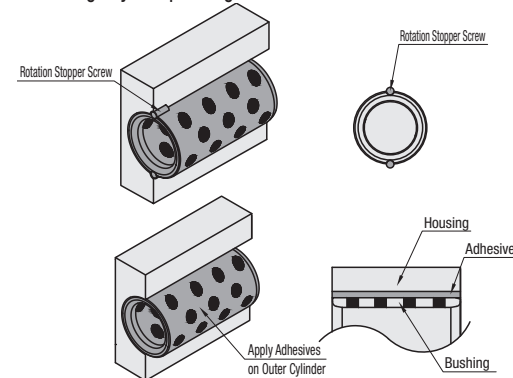
To press-fit the Oil Free Bushings, make sure to do it gently using a vise or a press.

To make this operation easier, install a chamfering on the edge of the housing I.D. We recommend that you apply a little amount of lubricant to the housing.



### ② Rotation Stopper Screw/Bonding

If you want to emphasize on preventing Oil Free Bushings from falling off or rotating, we recommend the following methods according to your operating conditions and environment. \*2



\*2 Using the rotation stopper screw is recommended for a heavy load at a high temperature.

## Material Properties and Environmental Tolerances (Reference Value)

Page	P381-390	P391, 392	P398-400	P399	P401		P397		
Type	Copper Alloy	Bronze	Multi-Layer LF	High Precision	Resin Type (Polyacetal Resin)		Resin Type (PTFE)		
Shape									
Material Properties	Composite products with embedded solid lubricant in high-tensile brass.	Porous bronze casting soaked in lubricant	Composite product consisting of three layers: steel-backed metal layer, sintered bronze layer and filler added PTFE layer.	Fluororesin is bonded on duralumin (A2017).	Polyacetal resin with added lubricant and special fillers.		PTFE with added friction-resisting filler and solid lubricant		
Lubrication	Regular   Unlubricated	Regular   Oil	Unlubricated	Unlubricated	Unlubricated		Unlubricated		
Rotation	○		○	○	○		○		
Oscillating Motion	○		○	○	○		○		
Reciprocating Motion	○		○	○	○		○		
Operating Temp. Range (°C)	-40~150	-40~200	-40~150	-195~280	-50~140	-40~80		-200~200	
Electrical Conductivity	Provided		Provided	Provided	Not provided		Volume Resistivity: 3x10 <sup>10</sup> Ω·cm <sup>2</sup>		
Environmental Conditions	In Air	○		○	○	○		○	
	In Oil	○		○	○	○		○	
	In Water	-	×	×	△	×	△		×
	In Seawater	-	×	×	×	×	△		×
	In Chemical	-	×	×	△	×	△		×
In Corrosive Atmosphere	△	△	×	△	△	○		△	
Maximum Allowable Surface Pressure (Bottom C-VALUE Products Specifications)	29.0(98.0) / 20.0(68.6) N/mm <sup>2</sup> 296(1,000) / 297 (700) kgf/cm <sup>2</sup>		10N/mm <sup>2</sup>	49.0(137)N/mm <sup>2</sup>	6N/mm <sup>2</sup>	17.5N/mm <sup>2</sup>	7N/mm <sup>2</sup>	8N/mm <sup>2</sup>   5N/mm <sup>2</sup>	
Maximum Allowable Velocity (Bottom C-VALUE Products Specifications)	1.00 / 0.7 m/s 60 / 42 m/min		0.35 / 0.30 m/s 21 / 18 m/min	1.66m/s   5.0m/s	0.65m/s	3.33m/s	0.85m/s	1.65m/s   0.25m/s   0.15m/s	
Maximum Allowable PV Value (Bottom C-VALUE Products Specifications)	3.25 / 2.28 N/mm <sup>2</sup> · m/s 1,990 / 1,393 kgf/cm <sup>2</sup> · m/min		1.65 / 1.16 N/mm <sup>2</sup> · m/s 1,010 / 707 kgf/cm <sup>2</sup> · m/min	1.65 / 3.25 N/mm <sup>2</sup> · m/s 1,000 / 2,000 kgf/cm <sup>2</sup> · m/min	3.60 / 0.98 N/mm <sup>2</sup> · m/s 2,200 / 600 kgf/cm <sup>2</sup> · m/min	2.45 / 1,500 N/mm <sup>2</sup> · m/s 1,500 / 612 kgf/cm <sup>2</sup> · m/min	1 / 612 N/mm <sup>2</sup> · m/s 612 / 245 kgf/cm <sup>2</sup> · m/min	0.8 / 490 N/mm <sup>2</sup> · m/s 490 / 306 kgf/cm <sup>2</sup> · m/min	

Environmental Condition Δ - Applicable only under certain conditions. Some values for Casting Type are for reference only. Values for High Precision Type are values for the sliding material. Values in ( ): Allowable Static Surface Pressure (no sliding motion or sliding at extremely low speed) \* Listed values are not standard values but reference values.

## Mechanical Properties (Reference Value)

Characteristics	Unit	Copper Alloy		Bronze		Multi-Layer LF		High Precision		Resin Type (Polyacetal Resin)		Resin Type (PTFE)		Casting	
		Value	Testing Method	Value	Testing Method	Value	Testing Method	Value	Testing Method	Value	Testing Method	Value	Testing Method	Value	Testing Method
Density	g/cm <sup>3</sup>	7.8	-	8.5	-	-	-	-	-	-	-	-	-	-	-
Tensile Strength	N/mm <sup>2</sup> (kgf/mm <sup>2</sup> )	755 (77.0)	JIS Z 2241	150 (15.0)	JIS Z 2241	380 (38.7)	JIS Z 2241	12 (1.2)	ASTM D 638	51.0 (5.2)	ASTM D 638	13.1 (1.3)	ASTM D 638	245 (25.0)	-
Tensile Elongation after Fracture	%	12	JIS Z 2241	-	-	-	-	-	-	60	ASTM D 638	150	ASTM D 638	-	-
Elongation	%	-	-	-	-	27	JIS Z 2241	171	ASTM D 638	-	-	-	-	-	-
Flexural Strength	N/mm <sup>2</sup> (kgf/mm <sup>2</sup> )	-	-	-	-	-	-	-	-	76.5(7.8)	ASTM D 790	-	-	-	-
Flexural Modulus	N/mm <sup>2</sup> (kgf/mm <sup>2</sup> )	-	-	-	-	-	-	-	-	2,650(270.2)	ASTM D 790	-	-	-	-
Compression Strength	N/mm <sup>2</sup> (kgf/mm <sup>2</sup> )	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Compression Yield Strength	N/mm <sup>2</sup> (kgf/mm <sup>2</sup> )	345 (35.0)	-	-	-	-	-	-	-	-	-	-	-	-	-
Compression Stress	N/mm <sup>2</sup> (kgf/mm <sup>2</sup> )	-	-	-	-	-	-	-	-	21.1 (2.2)	ASTM D 695	10.5 (1.1)	ASTM D 695	-	-
	1% Deformation	-	-	-	-	-	-	-	-	81.9 (8.4)	ASTM D 695	23.0 (2.3)	ASTM D 695	-	-
	10% Deformation	-	-	-	-	-	-	-	-	58.8 (6.0)	ASTM D 256	-	-	-	-
Impact Strength	J/cm	19(1.9)	JIS Z 2242	-	-	-	-	-	-	-	-	-	-	-	-
Hardness	-	HB210	JIS Z 2243, 2245	HB 60	JIS Z 2243	-	-	HDD62	ASTM D 2240	HRM72	ASTM D 785	HRR25	ASTM D 785	HB240	-
Young's Modulus	N/mm <sup>2</sup> (kgf/mm <sup>2</sup> )	105,000 (10,700)	JIS Z 2241	-	-	-	-	-	-	-	-	-	-	-	-
Linear Thermal Expansion Coefficient	x10 <sup>-5</sup> /°C	2.2	-	-	-	-	-	9~9.75	ASTM D 696	8~13	ASTM D 696	9~11	ASTM D 696	0.92~1.18	-
Thermal Conductivity	W/m <sup>2</sup> °C (cal/sec <sup>2</sup> °C cm)	90 (0.21)	-	-	-	-	-	-	-	-	-	-	-	-	-
Melting Point	°C	-	-	-	-	-	-	-	-	165	DSC	327	DSC	-	-
Specific Gravity	-	-	-	-	-	-	1.98	ASTM D 792	1.39	ASTM D 792	2.25	ASTM D 792	7.1	-	
UL Flammability	-	-	-	-	-	-	-	-	-	HB	UL94	-	-	-	-