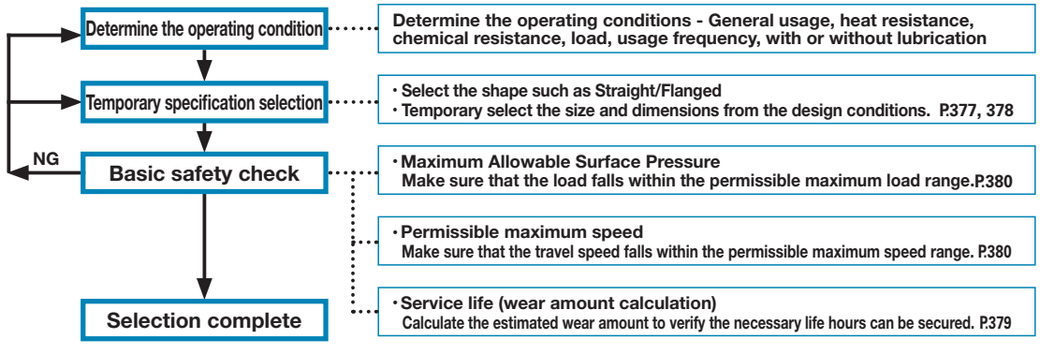
Oil Free Bushings - Technical Information

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) $W=K^{*1}xPxVxT$

Specific Wear Rate K : mm/(N/mm²·m/s·Hr)
Design Surface Pressure P : N/mm²
Sliding Speed V : m/s
Friction Time T : Hr-hr

*1 Specific wear rate range

Lubrication	mm/(N/mm²·m/s·Hr)	mm/(kgf/cm²·m/min·Hr)
Unlubricated	$3x10^{-3}$~$6x10^{-4}$	$1~5x10^{-6}$
Regular	$3x10^{-4}$~$6x10^{-5}$	$1~5x10^{-7}$
Oil	$3x10^{-5}$~$6x10^{-6}$	$1~5x10^{-8}$

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

$$W = K \times P \times V \times T$$

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

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

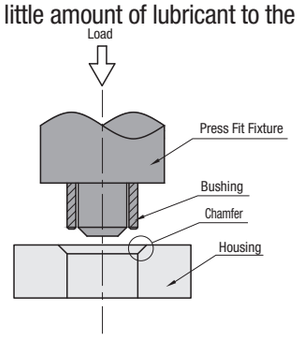
$$= 0.0028(\text{mm})$$

Oil Free Bushings Securing Method

①Press-Fit

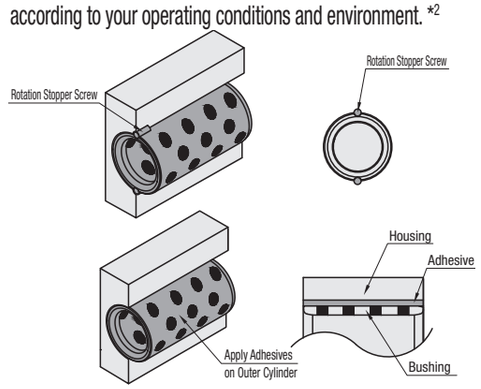
To press-fit the Oil Free Bushings, make sure to do it gently using a vise or a press.

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.



②Rotation 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	P.381~390		P.391, 392		P.398~400	P.399	P.401		P.397	
Type	Copper Alloy		Bronze		Multi-Layer LF	High Precision	Resin Type (Polyacetal Resin)	Resin Type (PTFE)	Casting	
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 Aluminium Alloy 2000 series.	Polyacetal resin with added lubricant and special fillers.	PTFE with added friction-resisting filler and solid lubricant	Molybdenum Disulfide is embedded spirally in FC250.	
Lubrication	Regular	Unlubricated	Regular	Oil	Unlubricated	Unlubricated	Unlubricated	Unlubricated	Regular	Unlubricated
Rotation	○		○		○	○	○	○	○	
Oscillating Motion	○		○		○	○	○	○	○	
Reciprocating Motion	○		○		○	○	○	○	○	
Operating Temp. Range (°C)	-40~150	-40~200	-40~150		-195~280	-50~140	-40~80	-200~200	-40~150	
Electrical Conductivity	Provided		Provided		Provided	Not provided	Not provided	Volume Resistivity: $3x10^2\Omega \cdot cm^2$	Provided	
Environmental Conditions: In Air	○		○		○	○	○	○	○	
Environmental Conditions: In Oil	○		○		○	×	○	○	○	
Environmental Conditions: In Water	-	×	×		△	×	△	○	×	
Environmental Conditions: In Seawater	-	×	×		×	×	△	○	×	
Environmental Conditions: In Chemical	-	×	×		△	×	△	○	×	
Environmental Conditions: In Corrosive Atmosphere	△	△	×		△	○	△	○	×	
Maximum Allowable Surface Pressure (Bottom C-VALUE Products Specifications)	29.0(98.0) 20.3(68.6) N/mm² / 296(1,000) 207 (700) kgf/cm²		10N/mm² / 102kgf/cm²		49.0(137)N/mm² / 500(1400)kgf/cm²	6N/mm² / 61kgf/cm²	17.5N/mm² / 179kgf/cm²	7N/mm² / 71kgf/cm²	8N/mm² / 82kgf/cm²	5N/mm² / 51kgf/cm²
Maximum Allowable Velocity (Bottom C-VALUE Products Specifications)	1.00 0.7 m/s / 60 42 m/min	0.5 0.35 m/s / 30 21 m/min	1.66m/s / 100m/min	5.0m/s / 300m/min	0.65m/s / 39m/min	3.33m/s / 200m/min	0.85m/s / 51m/min	1.65m/s / 99m/min	0.25m/s / 15m/min	0.15m/s / 9m/min
Maximum Allowable PV Value (Bottom C-VALUE Products Specifications)	3.25 2.28 N/mm²·m/s / 1,990 1,393 kgf/cm²·m/min	1.65 1.16 N/mm²·m/s / 1,010 707 kgf/cm²·m/min	1.65 N/mm²·m/s / 1,000 kgf/cm²·m/min	3.25 N/mm²·m/s / 2,000 kgf/cm²·m/min	3.60 N/mm²·m/s / 2,200 kgf/cm²·m/min	0.98 N/mm²·m/s / 600 kgf/cm²·m/min	2.45 N/mm²·m/s / 1,500 kgf/cm²·m/min	1 N/mm²·m/s / 612 kgf/cm²·m/min	0.8 N/mm²·m/s / 490 kgf/cm²·m/min	0.5 N/mm²·m/s / 306 kgf/cm²·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/cm³	7.8	-	8.5	-	-	-	-	-	-	-	-	-	-	-
Tensile Strength	N/mm² {kgf/mm²}	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/mm² {kgf/mm²}	-	-	-	-	-	-	-	-	76.5{7.8}	ASTM D 790	-	-	-	-
Flexural Modulus	N/mm² {kgf/mm²}	-	-	-	-	-	-	-	-	2,650{270.2}	ASTM D 790	-	-	-	-
Compression Strength	N/mm² {kgf/mm²}	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Compression Yield Strength	N/mm² {kgf/mm²}	345 {35.0}	-	-	-	-	-	-	-	-	-	-	-	-	-
Compression Stress 1% Deformation	N/mm² {kgf/mm²}	-	-	-	-	-	-	-	-	21.1 {2.2}	ASTM D 695	10.5 {1.1}	ASTM D 695	-	-
Compression Stress 10% Deformation	N/mm² {kgf/mm²}									81.9 {8.4}		23.0 {2.3}	ASTM D 695		
Impact Strength	J/cm {kgfm/cm}	19{1.9}	JIS Z 2242	-	-	-	-	-	-	58.8 {6.0}	ASTM D 256	-	-	-	-
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/mm² {kgf/mm²}	105,000 {10,700}	JIS Z 2241	-	-	-	-	-	-	-	-	-	-	-	-
Linear Thermal Expansion Coefficient	$x10^{-5}$°C^{-1}	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°C {cal/sec°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	-	-	-	-