Sliding

Techné

LA PERFORMANCE AU QUOTIDIEN

Techné

Sliding

editorial

Every day for the past 30 years, Techné has developed its knowledge in sealing and sliding parts.

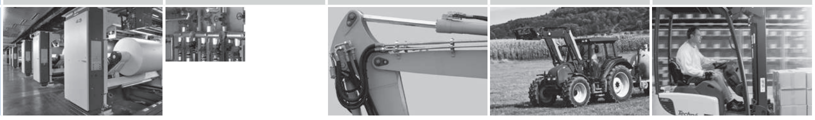
Technical and human investments coupled with external growth allow us today, to be a reliable partner for many renowned companies, without compromising the historical values of a family group.

We invest in Asia as well as in Europe to be able to continually modernise our production units, in order to keep up with the evolution of our customers.
We implement the most advanced technologies like surface treatments to increase the eco-efficiency of your systems.
We set up a development policy which is respectful both of employees and of the environment.
We are developing today the technical know-how that you will need tomorrow.

From the part's design to the delivery, a whole team is in motion to ensure daily performance.

Marie Fontaines,
CEO of Techné group

Techné – LA PERFORMANCE AU QUOTIDIEN			TU	TI	TX	TY	TZ
Standard use			Dry	Dry	First greased	First greased	Greased
Load	Static	N/mm^2	250	250	250	250	120
Load	Dynamic Static load	N/mm^2	140	100	140	150	75
Load	Dynamic Oscillation	N/mm^2	60	40	70	70	40
Speed	Standard use	m/s	2,5	2	2,5	2.5	2
Speed	Oil lubrication	m/s	> 3	> 3	> 3	> 3	> 3
PV factor maximum	Peak use	$N/mm^2.m/s$ (W/mm^2)	3,6	1	2,8	2.8	2.8
PV factor maximum	Continuous use	$N/mm^2.m/s$ (W/mm^2)	1,8	0,8	2,8	2.8	2.8
PV factor maximum	Oil lubrication	$N/mm^2.m/s$ (W/mm^2)	> 10	> 10	> 10	> 10	> 10
Friction coefficient	Dry or first greased		0,20 0,08	0,18 0,03	0,25 0,15	0,15 0,05	0,20 0,05
Friction coefficient	Oil lubrication		0,07 0,02	0,07 0,02	0,15 0,05	0,12 0,05	0,12 0,05
Shaft hardness		HB	>120	>120	>270	> 53 HRc	> 50 HRc
Shaft roughness		µm (Ra)	1,25 0,40	0,90 0,30	0,80 0,20	0,63 0,16	1,00 0,40
Temperature		°C	+280 -200	+280 -200	+120 -40	+250 -40	+150 -40
Thermal conductivity		$W(m.K)^{-1}$	40	10	52	47	58
Coef. of thermal expansion		K^{-1}	11.10^{-6}	16.10^{-6}	11.10^{-6}	18.10^{-6}	$18,5.10^{-6}$
Techné profiles	Cylindrical		69.0003	69.0035	69.0021	**TY-AS** 69.0008 **TY-AL** 69.0009	**TZ-AS** 69.0011 **TZ-AL** 69.0012 **TZ-T** 69.0025
Techné profiles	Flanged		69.0002	69.0016	69.2021	**TY-AS** 69.0019	**TZ-AL** 69.0015 **TZ-T** 69.0251
Techné profiles	Washer		69.0004	69.0039	69.0040	**TY-AS** 69.0060	**TZ-AS** 69.4002 **TZ-AL** 69.4012 **TZ-T** 69.4072
Page			10	38	46	66	82



1 minimal values shown ; it depends on the materials used

TA	TR	TBL	PLB[1]	PLA[1]	TCT	CFB	CFF
Greased	Dry	Dry	Greased	Greased	Dry	Dry	Dry
250	100	100	90	100	240	10	22
100	80	100	60	100	140	10	22
60	80	100	60	100	100	10	22
2	1	0,5	1,5	0,1	0,2	6	4
> 3	/	> 3	> 3	/	/	/	/
2	1.6	1,6	2,8	1,2	1,8	1,8	1,8
2	1.6	1,6	2,8	1,2	1,8	1,8	1,8
> 10	/	> 10	> 10	/	/	/	/
0,20 0,05	0,25 0,05	0,25 0,16	0,20	0,25	0,12 0,03	0,20 0,05	0,20 0,05
0,12 0,05	/	0,12 0,05	0,12 0,05	0,12 0,05	/	/	/
> 56 HRc	> 53 HRc	> 30 HRc	> 50 HRc	> 55 HRC	> 35 HRc	> 30 HRc	> 50 HRc
0,80 0,40	0,60 0,30	0,80 0,20	0,80 0,20	0,80 0,20	0,40 0,20	0,60 0,10	0,30 0,10
+150 -40	+260 -200	+300 -40	+225 -40	250 -100	+160 -100	+90 -5	+90 -5
46	/	38	58	16	0,3	32	37
12.10^{-6}	/	18.10^{-6}	18.10^{-6}	11.10^{-6}	Rad. 13.10^{-6} Axial 27.10^{-6}	/	/
TA-T 69.3000 **TA-AL** 69.3100	69.7003	69.0100	On drawing	On drawing	68.5010	50.2000	50.1000
TA-T 69.2672	69.7002	69.0110	On drawing	On drawing	On drawing	50.2001	50.1001
	69.7004	(Plate) 69.0120	On drawing	On drawing	On drawing	/	/
96	104	120	128	136	144	158	158

Table content

Part I Wrapped bushings

Part II Plain bearings

Part III Sintered parts

Part I

Wrapped bushings

Techné II - Morancé

The information in this catalogue is based on the experience gained by Techné in the last decade of research on the development and manufacture of sliding products. It represents the current state of our knowledge and know-how.
The sliding function of the products in this catalogue do no rely only on the component itself, but on the other parameters such as the assembly, the applied pressure, contact area, operating temperature, mechanical stress, media, liquids in contact, lubrication and any kind of outside dirt. Because of those high numbers of parameters, it is not possible to give general statements on the function of the products in this catalogue. The information in this catalogue only represents recommended values that are not true in every application that is why we recommend contacting us. In cases with high or special loads we strongly recommend to contact our technical department. Moreover it will be essential to perform checking trials in order to approve the good functionality of the sliding system.

In the context of product optimisation, we reserve the right to change, without prior notice, our product range, tolerances, materials and manufacturing process as well as the information mentionned in this catalogue.

All previous issues become obsolete on publication of this issue of catalogue.

TU & TU-B

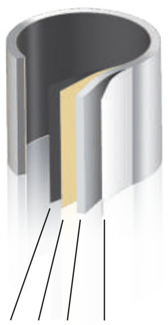
10

TU & TU-B

TU ▯ 69.0003 ▯ 69.0002 ○ 69.0004

TU-B ▯ 69.0010 ▯ 69.0017 ○ 69.0032

1] Structure



✓ TU

Multipurpose and self-lubricant, TU bushes are composed with 4 layers:

- A solid lubricant layer **(1)** in PTFE, from 0,01 to 0,05 mm thick provides a very high performance against wear and friction.
- A porous sintered bronze sliding layer (**2**), from 0,20 to 0,35 mm thick, for heat conductivity, dimensional stability and bonding of the solid lubricant.
- A steel backing (**3**) for an optimal mechanical resistance.
- For standard parts, external diameters are protected with a 0,005mm thick tin plating **(4)**.

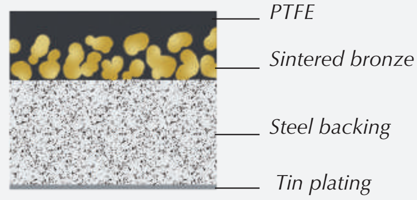
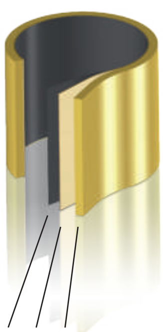


fig.1 • Micrographic structure of TU

For a better temperature resistance, bushes can be protected with a copper plating.



✓ TU-B

Self-lubricant TU bushes are composed with 3 layers:

- A solid lubricant layer **(1)** in PTFE, from 0,01 to 0,05 mm thick provides a very high performance against wear and friction.
- A porous sintered bronze sliding layer (**2**), from 0,20 to 0,35 mm thick, for heat conductivity, dimensional stability and bonding of the solid lubricant.
- A bronze layer (**3**) for a better mechanical resistance. Bronze material offers very good heat conductivity and a high resistance against corrosion. Tinning is therefore not necessary.

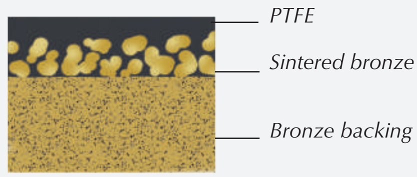


fig.2 • Micrographic structure of TU-B

2) Mechanical characteristics

Properties	Type	TU	TU-B	Units
Load	Static	250	250	N/mm²
	Dynamic	140	140	N/mm²
	Oscillation	60	60	N/mm²
Speed	Dry	2.5	2.5	m/s
	Oil lubrication	> 3	> 3	m/s
PV factor Maximum	Dry, peak	3.6	3.6	N/mm².m/s (W/mm²)
	Dry, continuous	1.8	1.8	N/mm².m/s (W/mm²)
	Oil lubrication	> 10	> 10	N/mm².m/s (W/mm²)
Friction coefficient	Dry	0,08 ; 0,2	0,08 ; 0,2	
	Oil lubrication	0,02 ; 0,07	0,02 ; 0,07	
Shaft hardness		>120	>120	HB
Shaft roughness	Dry (Ra)	0,4 ; 1,25	0,4 ; 1,25	µm
	Lubricated (Ra)	0,05 ; 0,2	0,05 ; 0,2	µm
Temperature		-200 ; +280[1]	-200 ; +280	°C
Thermal conductivity		40	60	$W(m.K)^{-1}$
Coef. of thermal expansion		11.10^{-6}	18.10^{-6}	K^{-1}

1. 220°C max, for TU bush with tin plating.

3) Chemical characteristics

After analysis of each layer, Techné provides data about chemical resistance. However, considering the wide variety of available materials and grades, compatibility tests before final selection are recommended.

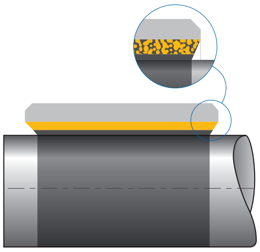
✓ Chemical resistance

TU bushes resist to water, alcohols, glycols, solvents, gasoline, diesel, kerosene and most of mineral oils (T° lower than 100°C). However they can be damaged in some acid or alkaline solutions such as chloric, nitric, sulfuric, acetic and formic acids. Techné also recommends not using them in contact with HFC oils and in navy environment.

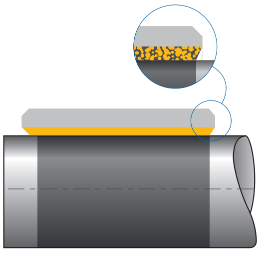
TU-B bushes offer a better resistance against steam water and are suitable for navy environment. Nevertheless, bronze can be damaged in strong acids such as chloric, nitric, sulfuric acids and some gases such as free halogen or ammoniac, especially when these gases are humid. Finally, TU-B bushes cannot be assembled in aluminum housing, because of electrochemical corrosion risk in a humid environment.

PTFE based lubricant layer avoids corrosion between the contact surfaces and the bush's internal diameter. However in case of oxidation risk, Techné advises to use stainless steel, chrome plating steel or anodizing aluminum.

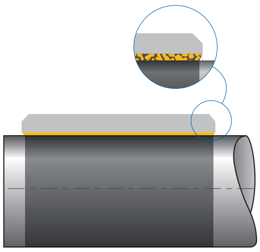
4) Sliding performance



Running-in period



Intermediate period



Maintenance period

✓Wear mechanism

During its lifetime, TU bushes undergo 3 different periods ( ):

Running-in period

After assembly, the sliding surface of TU bushes quickly runs in. The surplus of PTFE-based lubricant is planed down in favor of the sintered bronze sliding layer. Techné considers that the running-in period is over when the bronze layer appears for about 10 to 15% of the sliding surface.

Apparent bronze turns to a verdigris color, due to the fretting corrosion phenomenon.

Wear rate depends on PV factor, the running-in period varies according to the application constraints ( ).

Running-in advantages

A part of the PTFE-based solid lubricant physically binds to the shaft in contact with the bush by transfer. It fills in the shaft' gaps and roughness defects, letting on the contact surface a film which improves the sliding coefficient.

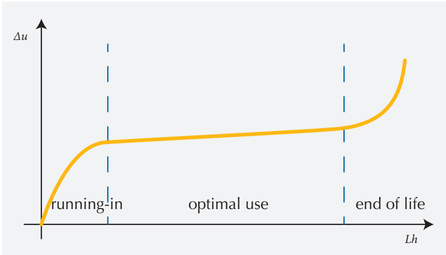


fig.3 • Wear rate Δu depending on Lifetime L_h

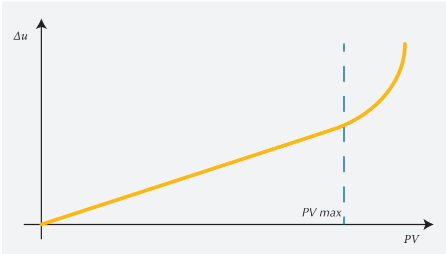


fig.4 • Wear rate Δu depending on PV factor

Intermediate period

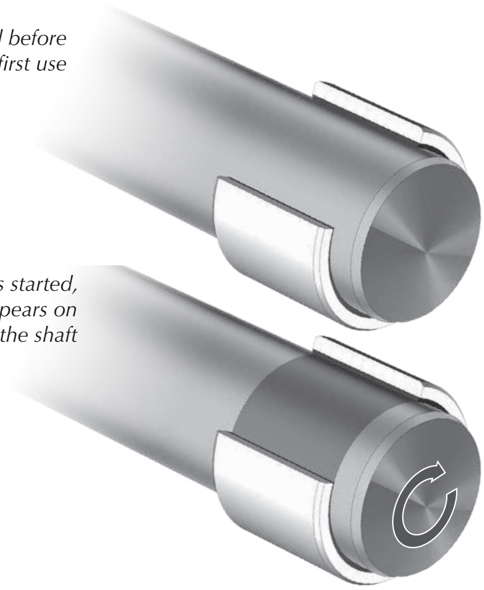
Optimal period: wear rate of the sliding layer is at the minimum and sliding coefficient is at the maximum.

Maintenance period

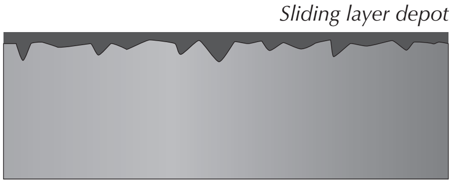
Wear rate does quickly increase: end of the bush life. 70% of the sintered bronze layer is apparent.

After fitting and before first use

Running-in period has started, the sliding layer appears on the shaft



Sliding layer depot



Macrographic section of the shaft

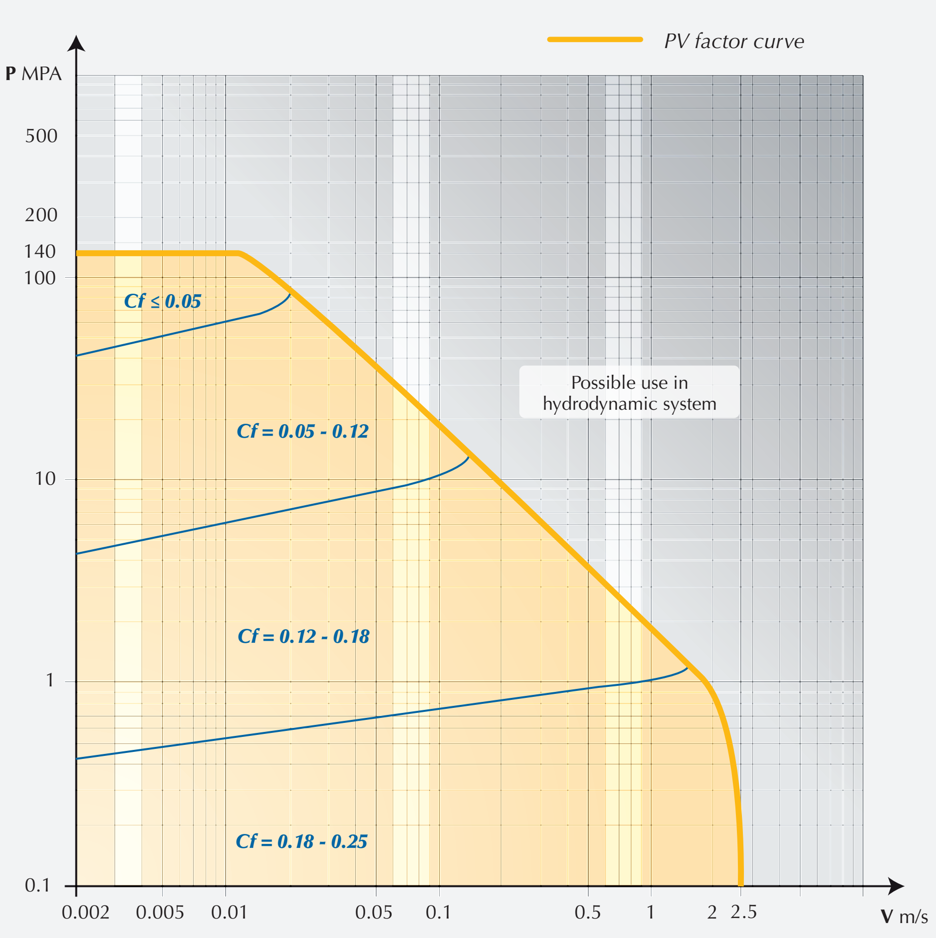


fig.5 • Data about variation of sliding coefficient Cf with PV factor

✓ Sliding coefficient

Sliding coefficient of TU bushes (between 0,08 and 0,02) depends on several parameters. It first depends on the above mentioned wear periods: during running-in period and at the end of lifetime, sliding coefficient is at its highest level. During intermediate period, sliding coefficient is at its lowest level and sliding function is optimal ( ). Moreover, pressure, speed and temperature constraints impact directly the sliding function of the bush. See in order to get an indication of the friction coefficient in relation with pressure and speed.
Generally speaking, the higher the temperature, the better the sliding.

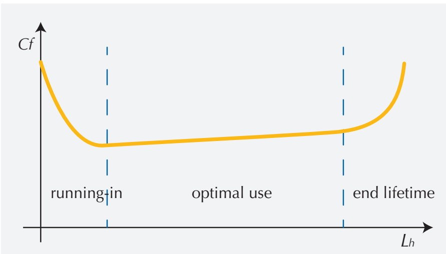
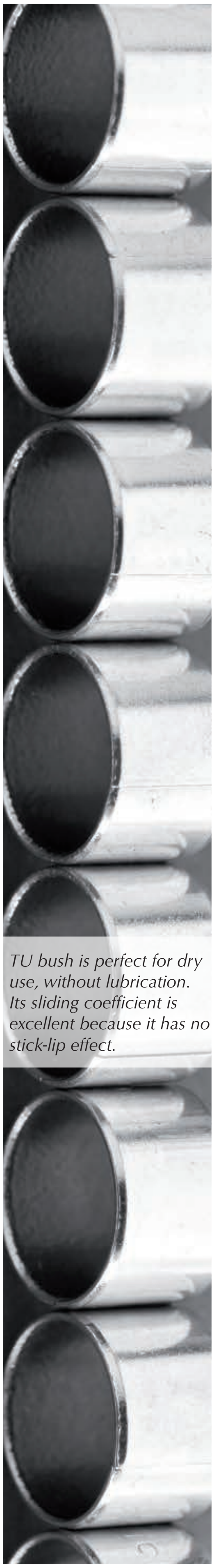


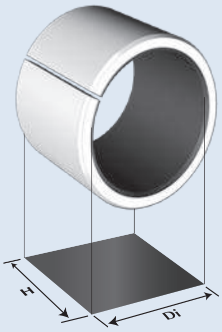
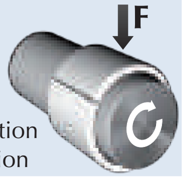
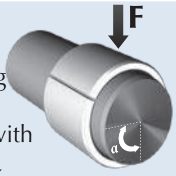
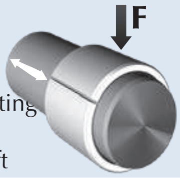
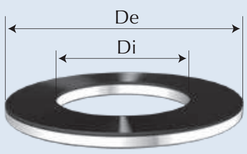
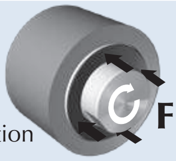
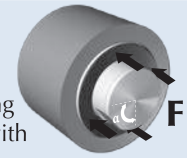
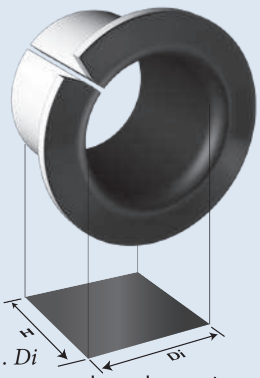
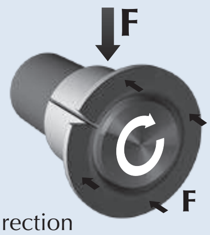
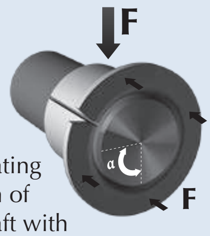
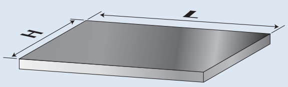
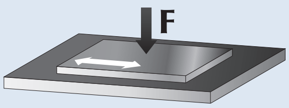
fig.6 • Sliding coefficient Cf depending on lifetime L_h

When the sliding coefficient is a critical parameter, it can be determined with the help of samples.



TU bush is perfect for dry use, without lubrication. Its sliding coefficient is excellent because it has no stick-lip effect.

5) $\overline{PV}$ factor

Type	Motion & load	Load $\overline{P}$ N.mm² (MPA)	Speed $\overline{V}$ m/s	$\overline{PV}$ factor N.mm².m/s (W.mm²)
Cylindrical bushing  $H \, . \, Di$ corresponds to the projected area of the bushing	 One direction shaft rotation	$\frac{F}{Di \, . \, H}$	$\frac{\pi \, . \, Di \, . \, N}{6.10^4}$	$\frac{\pi \, . \, F \, . \, N}{H \, . \, 6.10^4}$
	 Oscillating motion of the shaft with an angle α	$\frac{F}{Di \, . \, H}$	$\frac{\pi \, . \, Di}{6.10^4} \cdot \frac{4\alpha \, . \, N_f}{360}$	$\frac{\pi \, . \, F}{H \, . \, 6.10^4} \cdot \frac{4\alpha \, . \, N_f}{360}$
	 Reciprocating motion of the shaft	$\frac{F}{Di \, . \, H}$	$\frac{2S \, . \, N_t}{6.10^4}$	$\frac{2S \, . \, N_t \, . \, F}{H \, . \, 6.10^4 \, . \, Di}$
Washer  $\pi(Di^2 - De^2)/4$ corresponds to the area of the washer	 One direction rotation	$\frac{4F}{\pi(De^2 - Di^2)}$	$\frac{\pi \, . \, De \, . \, N}{6.10^4}$	$\frac{4F \, . \, De \, . \, N}{6.10^4(De^2 - Di^2)}$
	 Oscillating motion with an angle α	$\frac{4F}{\pi(De^2 - Di^2)}$	$\frac{\pi \, . \, De}{6.10^4} \cdot \frac{2\alpha \, . \, N_f}{360}$	$\frac{4F \, . \, De \, . \, 2\alpha \, . \, N_f}{2{,}16.10^7(De^2 - Di^2)}$
Flanged bushing  $H \, . \, Di$ corresponds to the projected area of the bushing $\pi(Dc^2 - (De+4)^2)/24$ corresponds to the area of the flange	 One direction shaft rotation	Radial load $\frac{F}{Di \, . \, H}$ Axial load $\frac{24F}{\pi(Dc^2 - (De+4)^2)}$	$\frac{\pi \, . \, Di \, . \, N}{6.10^4}$ $\frac{\pi \, . \, Dc \, . \, N}{6.10^4}$	Radial PV $\frac{\pi \, . \, F \, . \, N}{H \, . \, 6.10^4}$ Axial PV $\frac{F \, . \, Dc \, . \, N}{2{,}5.10^3(Dc^2 - (De+4)^2)}$
	 Oscillating motion of the shaft with an angle α	Radial load $\frac{F}{Di \, . \, H}$ Axial load $\frac{24F}{\pi(Dc^2 - (De+4)^2)}$	$\frac{\pi \, . \, Di}{6.10^4} \cdot \frac{2\alpha \, . \, N_f}{360}$ $\frac{\pi \, . \, Dc}{6.10^4} \cdot \frac{2\alpha \, . \, N_f}{360}$	Radial PV $\frac{\pi \, . \, F}{H \, . \, 6.10^4} \cdot \frac{2\alpha \, . \, N_f}{360}$ Axial PV $\frac{F \, . \, Dc \, . \, 2\alpha \, . \, N_f}{2{,}25.10^5(Dc^2 - (De+4)^2)}$
Plate  $H \, . \, L$ corresponds to the area of the plate	 Plate reciprocating motion	$\frac{F}{L \, . \, H}$	$\frac{2S \, . \, N_t}{6.10^4}$	$\frac{2S \, . \, N_t \, . \, F}{H \, . \, 6.10^4 \, . \, L}$

The calculation of $\overline{PV}$ factor (pressure $\overline{P}$ multiplied by speed $\overline{V}$) is specific to the application. It allows to determine if the dimensions of the chosen TU-bush are appropriate for the constraints.
Use formula on the previous page to determine the $\overline{PV}$ factor.

Calculated $\overline{PV}$ factor has to be lower than PV max of the bush :

$$\overline{PV}_{max} < PV_{max}$$

So for TU bushes: $PV_{max} < 1.8$ (see table page 11 et , page 13)
Also pressure $\overline{P}$ and speed $\overline{V}$ values must be lower than the acceptable ones of the TU bush, see table on page 11.

Note: Maximal pressure $\overline{P}_{max}$ and maximal speed $\overline{V}_{max}$ of a given application may not be used simultaneously. In such a case, calculation of $\overline{PV}_{max}$ factor must not be $\overline{P}_{max}$ by $\overline{V}_{max}$, but pressure $\overline{P}_t$ by speed $\overline{V}_t$ at time t, and depending on t, chose the $\overline{PV}_{t\,max}$ factor.

✓ Examples

Cylindrical bushing

Radial load : 90 kg
Speed N : 400 tr/min
Di : 50
H : 60

$F = 90kg . 10 = 900N$

Pressure $\overline{P}$:

$$\overline{P} = \frac{900}{50 . 60} = 0,3 \text{ MPa}$$

Speed $\overline{V}$:

$$\overline{V} = \frac{\pi . 50 . 400}{6 . 10^4} = 1,04 \text{ m/s}$$

$\overline{PV}$ Factor:

$$\overline{PV} = 0,3 . 1,04 = 0,31$$

$$\text{or } \overline{PV} = \frac{\pi . 900 . 400}{60 . 6 . 10^4} = 0,31$$

Washer

Axial load : 2000 kg
Oscillating motion
Frequency N_f : 30
Angle α : 20°
Di : 20
De : 36

$F = 2000kg . 10 = 20000N$

Pressure $\overline{P}$:

$$\overline{P} = \frac{20000}{\pi(36^2 - 20^2)} = 28,42 \text{ MPa}$$

Speed $\overline{V}$:

$$\overline{V} = \frac{\pi . 36}{6.10^4} \cdot \frac{40 . 30}{360} = 0,006 \text{ m/s}$$

$\overline{PV}$ factor:

$$\overline{PV} = 28,42 . 0,006 = 0,17$$

$$\text{or } \overline{PV} = \frac{2.10^4 . 36 . 40 . 30}{2,16.10^7 (36^2 - 20^2)} = 0,17$$

Flanged bushing

Radial load: 600 kg
Axial load : 20kg
Speed N : 50 tr/min
Di : 50
De : 55
Dc : 65
H : 32.5

$F = 600kg . 10 = 6000N$
$F = 20kg . 10 = 200N$

Axial $\overline{PV}$ factor:

$$\overline{PV} = \frac{\pi . 6000 . 50}{32,5 . 6 . 10^4} = 0,48$$

Radial $\overline{PV}$ factor:

$$\overline{PV} = \frac{200 . 65 . 50}{2,5.10^3 (65^2 - (55+4)^2)} = 0,35$$

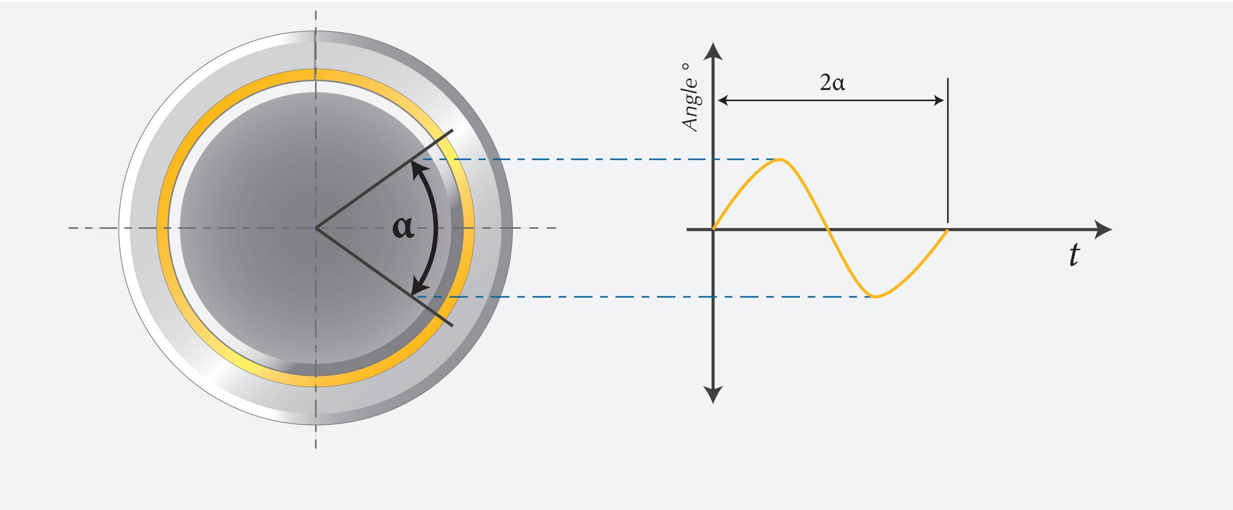


fig.7 • Oscillation angle α - one oscillation cycle = 2 α

6) Lifetime

A bush lifetime depends on several parameters. Based on its experience, Techné suggests corrective factors according to pressure, speed, temperature, load, roughness and material of the shaft. However other unknown and uncountable parameters, which are specific to the application, can interfere. So the lifetime indicated hereafter remains for indication only.

✓ Adjustment factors

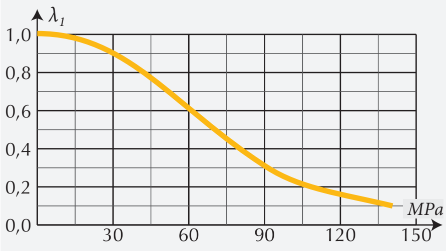


fig.8 • Load adjustment factor λ_1

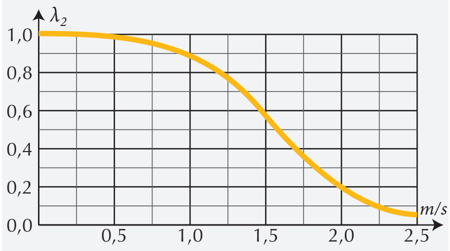


fig.9 • Speed adjustment factor λ_2

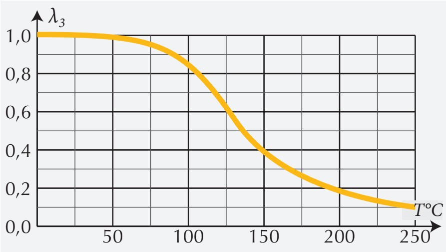


fig.10 • Temperature °C adjustment factor λ_3

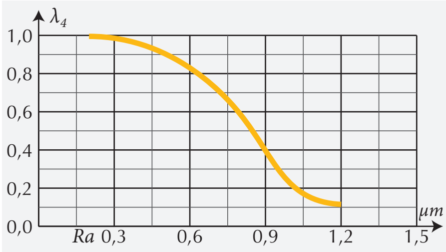
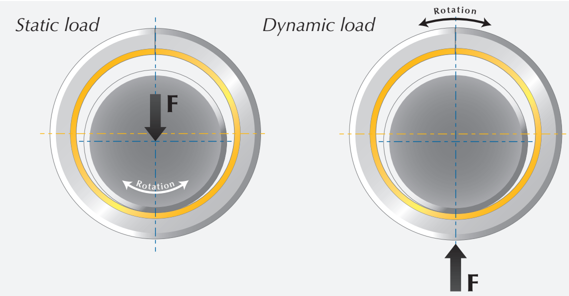


fig.11 • Roughness adjustment factor λ_4



Static load : λ_5 = 1
Dynamic load : λ_5 = 2

For reciprocating motion or for washer profile, ignore this factor

fig.12 • Factor λ_5 depending on loads on the cylindrical bushing

Shaft material	λ_6
Carbon steel (ex: C35)	1
Alloy steel	1
Hardened steel, nitrided or carbo-nitrided	1
Chrome steel	1
Stainless steel	2
Cast iron (maxi. Ra 0.3 µm)	1
Alloy aluminium	0.4
Bronze, brass	0.2
Hard anodized aluminum (min. 25µm, hardness min. 450 HV)	3
Steel plated (min. 13µm)	
Cadmium, nickel, phosphating or zinc	0.2
Hard Chrome	2
Titanium nitride	1

✓ Calculation

Rotation and oscillation movement

$$L_h = \lambda_1 . \lambda_2 . \lambda_3 . \lambda_4 . \lambda_5 . \lambda_6 . 4.10^2 . (\overline{PV})^{-1}$$

Linear movement

An additional factor λ_7 for correction of translation length S must be taken into account:

$$\lambda_7 = 0,6 . \frac{H}{S + H}$$

$$L_h = \lambda_1 . \lambda_2 . \lambda_3 . \lambda_4 . \lambda_6 . \lambda_7 . 4.10^2 . (\overline{PV})^{-1}$$

✓ Examples

Let's take examples from the previous page.

Cylindrical bushing

Load: 90 kg
speed *N*: 400 tr/min
Di: 50
H: 60
$\overline{PV}$ calculated on previous page: 0,31
Temperature: 40°C
Roughness: Ra 0,6
Static load
Shaft material: Chrome steel

$L_h = 1 . 0,9 . 1 . 0,84 . 1 . 1 . 4.10^2 . (0,31)^{-1}$

L_h = 970 hours

Washer

Load : 2000 kg
Oscillating motion,
Frequency N_f: 30
Angle α: 20°
Di: 20
De: 36
$\overline{PV}$ calculated on previous page: 0,17
Temperature: 20°C
Roughness: Ra 0,8
Material of the friction part: carbon steel

$L_h = 0.92 \ . 1 . 1 . 0,6 . 1 . 4.10^2 . (0,17)^{-1}$

L_h = 1290 hours

Flanged bushing

Axial load: 600 kg
Radial load: 20 kg
Speed *N*: 50 tr/min
Di: 50
De: 55
Dc: 65
H: 32.5
$\overline{PV}$ calculated on prev. page: 0,48 & 0,35
Temperature : 20°C
Roughness : Ra 0,4
Material of the friction part : carbon steel.
Following loads, set the smallest life duration.

$L_{h1} = 1 . 1 . 1 . 0,95 . 1 . 4.10^2 . 1 . (0,48)^{-1}$
L_{h1} = 790 hours

$L_{h2} = 1 . 1 . 1 . 0,95 . 1 . 4.10^2 . (0,35)^{-1}$
L_{h2} = 1080 hours

L_h = 790 hours

7] Lubrication

TU bushes are designed as self-lubricant bushes, so they are clearly appropriate for a dry use. Techné recommends not adding grease or oil during assembly. During running-in period, oil or grease mix together with particles of the sliding layer creates an abrasive paste. As a consequence bush lifetime is reduced. If for external pollution reasons, the application system requires greasing, this latter must be recurrent and regular.

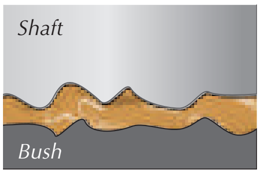
TU bushes are compatible with some liquids, such as oil, refrigerants or water. In case of doubt concerning the use of a specific liquid, the best way to deal with it is to make a trial by immersing a TU-bush into this liquid at a temperature 20°C higher than the operating temperature. TU bushes cannot be used in this liquid, if after about 15 days a significant change of the sliding surface is noticeable.

✓ Oil lubrication

When used with regular oil lubrication, sliding properties and lifetime of the bush are modified.

Tribology defines lubricating mode, depending on the thickness of the lubricant film between the bearing and the shaft: hydrodynamic, mixed and boundary lubrication.

HYDRODYNAMIC LUBRICATION



Hydrodynamic system no contact between shaft and bush

Load displaces the bush from the concentric position and forms a converging gap between the bush and the shaft. The pumping action of the shaft forces the oil to squeeze through the wedge shaped gap generating a pressure. The pressure falls to the cavitation pressure in the diverging gap zone where cavitation forms. When two mating surfaces are completely separated, hydrodynamic (Full Film) lubrication is obtained. The thickness of the lubrication film thus exceeds the combined roughness of the surfaces.
So sliding coefficient is excellent (0.001 and 0.1) and there is no wear.
To reach the hydrodynamic lubrication, following conditions are necessary: high speed rotation of the shaft, high oil viscosity and wide feeding.

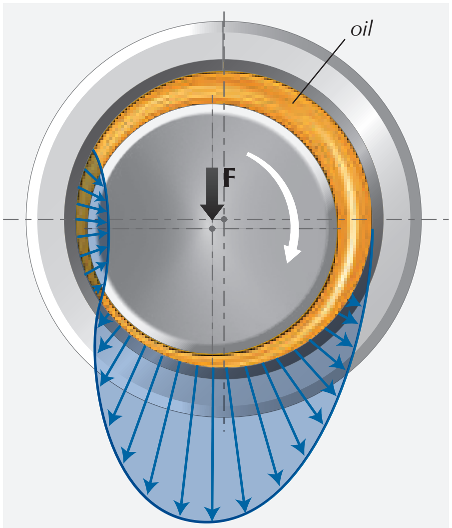
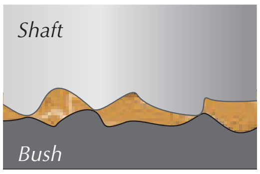


fig.13 • Hydrodynamic lubrication - pressure distribution

MIXED-FILM LUBRICATION

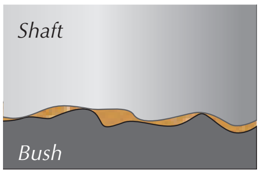


Mixed-film lubrication The shaft locally touches the bush

It is a combination of hydrodynamic and boundary lubrication. Part of the load is carried by localized areas of self-pressurized lubricant and the remainder supported by boundary lubrication.

Oil film is not enough to fill in all the asperities of the in contact materials, especially in case of frequent stops and starts. Hydrodynamic lubrication is not continuous. However wear remains very low and sliding properties remain good thanks to the TU-bush sliding layer properties.

BOUNDARY LUBRICATION



Boundary lubrication the shaft completly touches the bush

Boundary lubrication happens when there is little lubricant between the two in-contact surfaces. Friction of the shaft against the bearing is high. In such case, TU-bush behaves as in a dry application. The excellent self-lubricating and sliding properties of the TU-bush minimize wear. Anyway, a particular attention must be paid on the oil quality and its continuous renewal.

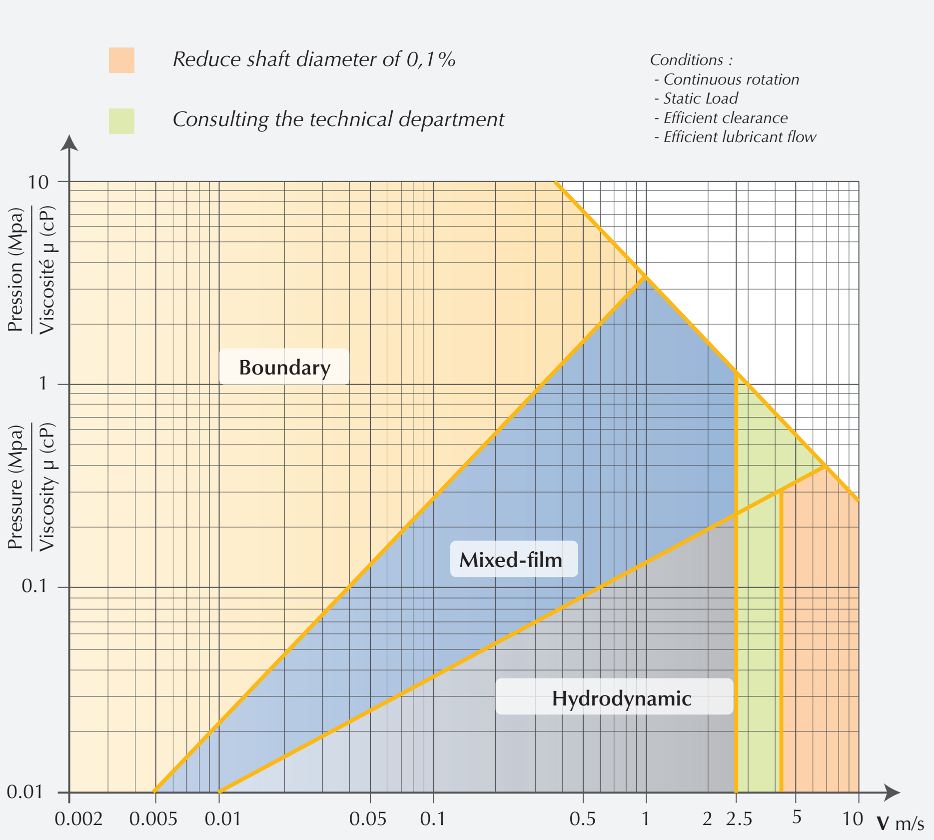


fig.14 • Indicative use of TU bushes in lubricated applications

✓ Oil viscosity

Diagram below indicates the different type of lubrication depending on the dynamic viscosity μ.

To determine this viscosity, the kinematic viscosity ν and the density of the fluid ρ must be known:

$$\mu = \rho \,.\, \nu$$

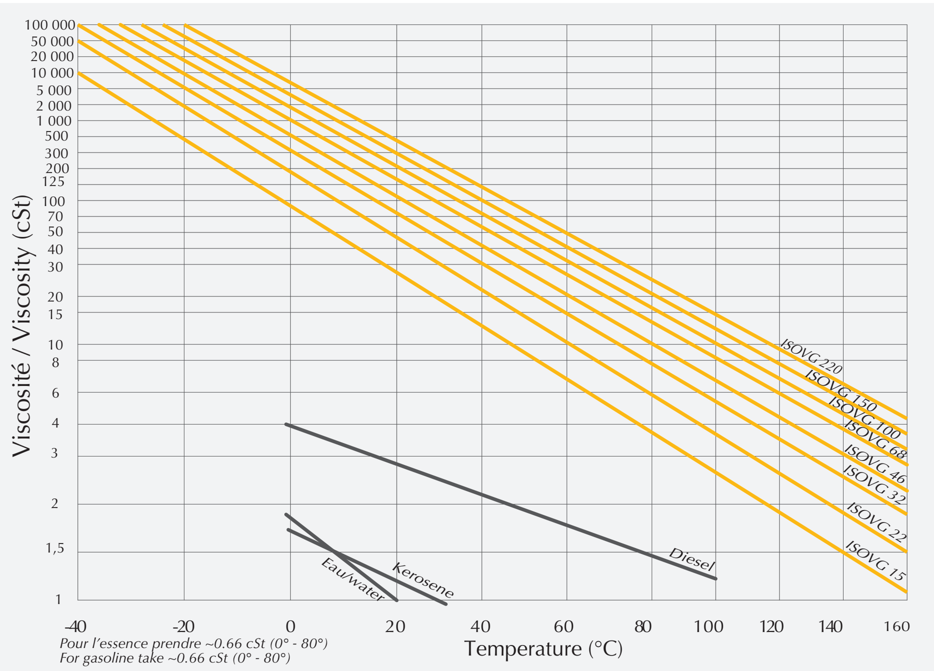
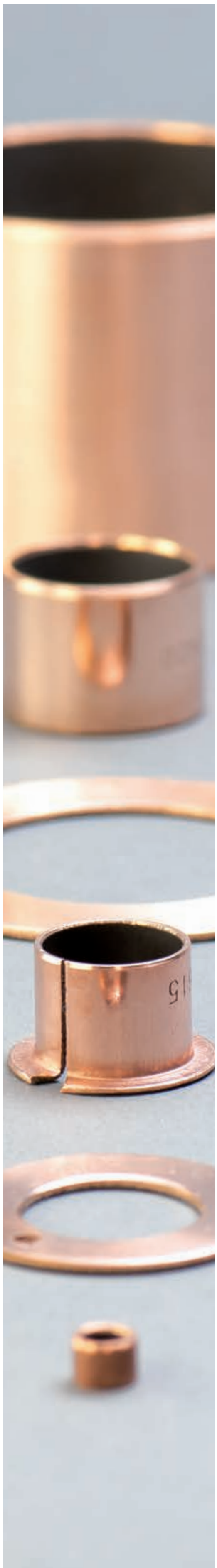


fig.15 • Indicative use of TU bushes in lubricated applications



8) Shaft and housing design

✓ Roughness

Shaft D_A	Dry	Lubricated		
Lubrication	/	Boundary	Mixed-film	Hydrodynamic
Ra (µm)	0,3 -1,2	≤ 0,4	0,1 - 0,2	0,05 - 0,16
Rz (µm)	2 - 6,5	≤ 2	0,5 - 1	0,25 - 0,8

For a lubricated application, the lower the roughness, the easier it will be to create a hydrodynamic film. So the more severe the application is, the better roughness must be.

For housing D_L Techné recommends a roughness value of Rz 10.

✓ Bushing cleareance

TU bushes are assembled tightened in the housing, so it is unnecessary to use clamp or ring spacer to avoid TU bush movement. For a standard use in a steel housing, Techné recommends the following tolerances for housing D_L:

However there must be a gap between the shaft and the bush. This gap is essential for the lifetime and performance of the bush. For the shaft, Techné recommends the following tolerances for shaft D_A:

Tolerances	Shaft D_A	Housing D_L
Ø2 - Ø4.9	h6	H6
Ø5 - Ø75	f7	H7
Ø80 - Ø300	h8	H7

Application and specific housing

When a bush is assembled in housing made of another material than steel, clearance must be adapted to absorb potential deformation.

Clearance must also be adapted in applications with high temperature or with a low load and a low torque.

When the TU bush anti-corrosion layer is higher than standard (maximum : 0.008), increase $ØD_L$ with augmentation equal to 2 times the additional layer thickness. example : if the layer is 0.015, housing equal to $ØD_L$ + 2 x 0.007

Environment	modification of Ø	Information
Steel or cast iron housing	$D_L = D_L - 0{,}008$ mm	by range of 100°C higher than usual T°
Light alloy housing or small thickness housing	Reduction of D_L	Fitting test must be performed
Copper alloy housing	$D_L = D_L - (D_L \,.\, 5.10^{-4})$ $D_A = D_A - (D_A \,.\, 5.10^{-4})$	by range of 100°C higher than usual T°
Aluminium alloy housing	$D_L = D_L - (D_L \,.\, 1.10^{-3})$ $D_A = D_A - (D_A \,.\, 1.10^{-3})$	by range of 100°C higher than usual T°
Loads < 0.1 MPa, Low torque engine	$D_A = D_A - 0{,}025$ mm	

✓ Clearance calculation

Maximal clearance J_{MAX}:

$J_{max} = D_{L\,max} - 2 \cdot e - D_{A\,min}$

Minimal clearance J_{MIN}:

$J_{mini} = D_{L\,mini} - 2 \cdot e - D_{A\,max}$

Clearance calculation does not include the potential deformation of the housing. To determine D_L, D_A and e values please check dimension tables on page 13.

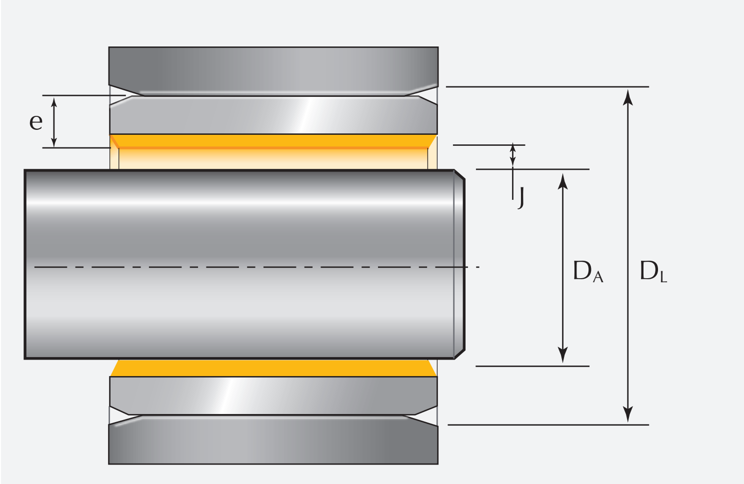


fig.16 • Clearance J

✓ Fitting chamfers

Cylindrical bushes

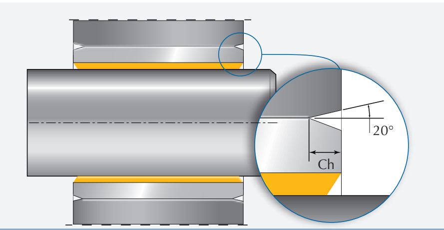


fig.17 • Chamfers Ch for a cylindrical bush

D_A	Ch ±0,5
2 - 30	0,8
30 - 80	1.2
80 - 180	1,8
> 180	2,5

Flanged bushes

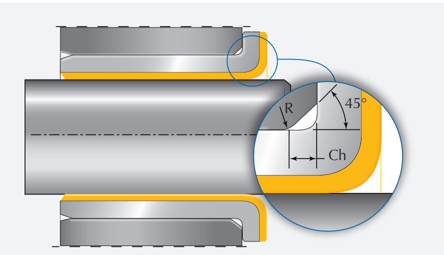


fig.18 • Chamfers Ch for a flanged bush

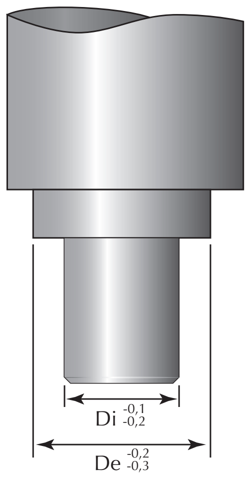
D_A	Ch ±0,5
2 - 20	1,2
20 - 28	1,7
28 - 45	2,2
> 45	2,7

R : the chamfer edge must be rounded

9) Fitting

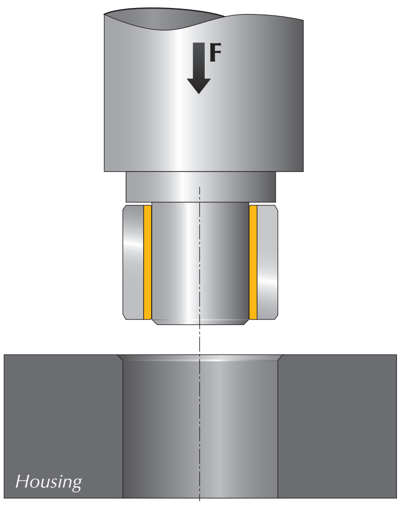
✓ Cylindrical bush

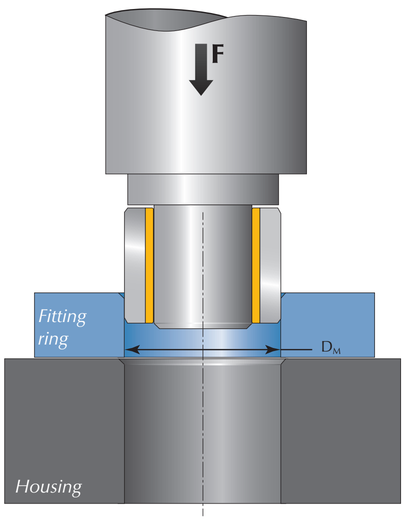
Chuck:
De : bush external Ø
Di : bush internal Ø



Before fitting, the bush back must be lubricated. It is important to avoid any lubricant overflow on the inner sliding layer. The bush must be fitted with the help of a press. For an external diameter De <55, it is unnecessary to use a fitting ring.

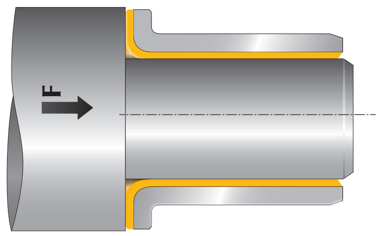
De	D_M
55 - 100	De $^{+0,28}_{+0,25}$
100 - 200	De $^{+0,4}_{+0,36}$
200 - 310	De $^{+0,5}_{+0,46}$

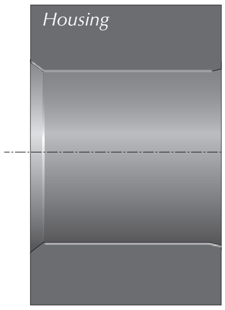




✓ Flanged bush

Before fitting, the bush back must be lubricated.





✓ Fitting force

To determine the maximum fitting force, multiply the value found on diagram (fig.19) by the height of the bush

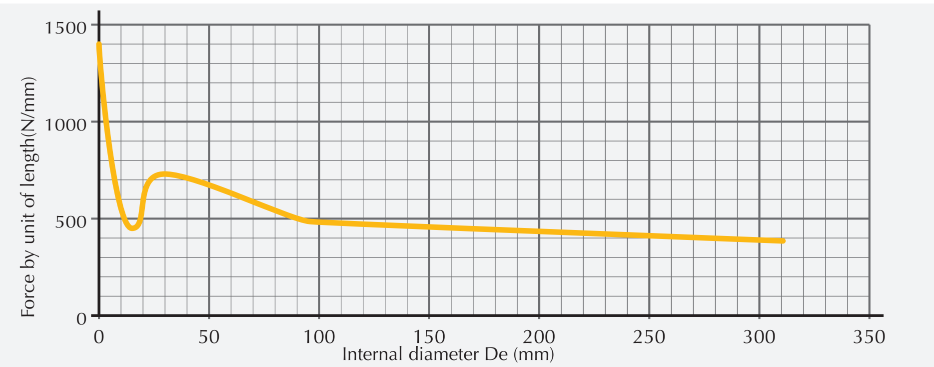
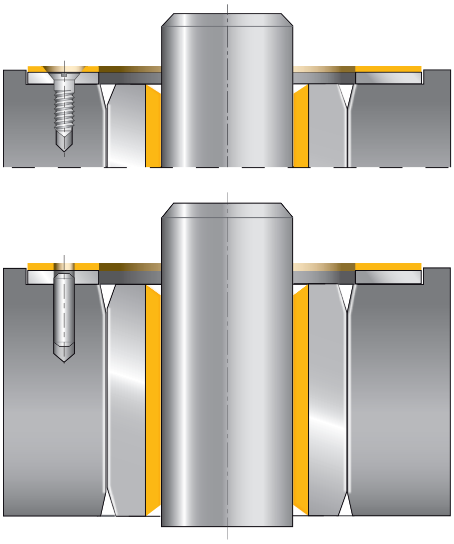


fig.19 • Indicative values of fitting force

✓Washer

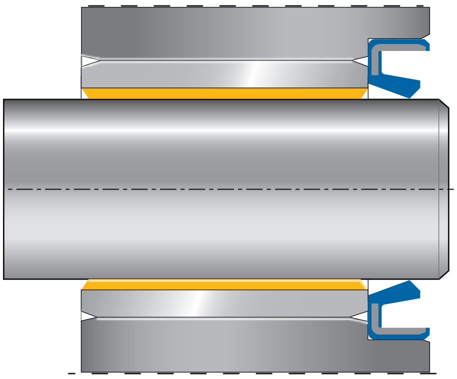
To make sure that the washer is well centered, Techné advises to spot-face with diameter equal to De + 0.2mm and a depth of half thickness of the bush.
To avoid the rotation, put a split pin or a screw in the fixation hole. If spot-facing is not possible, washer can also be blocked with the help of 2 screws.
The head of the screw or of the split pin must not be over the sliding layer.



We can notice that the screw or the split pin position is under the sliding surface of the washer

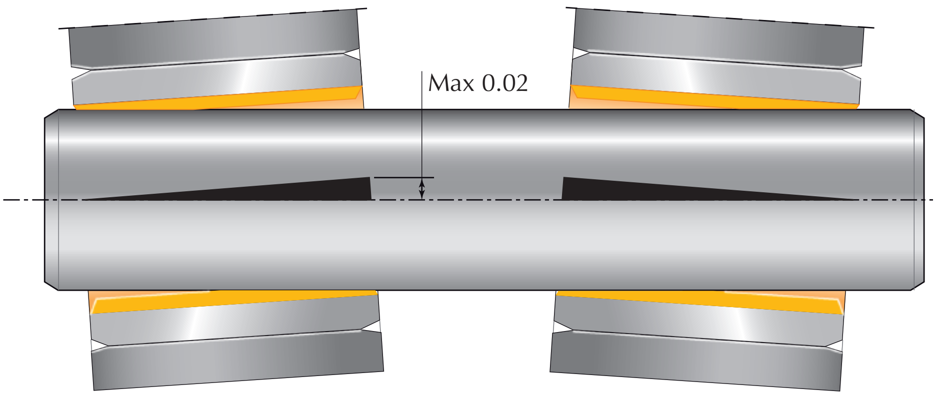
✓Bush sealing

TU bush can bear some pollution without reducing its lifetime. However when it is used in environmental abrasive conditions, it is recommended to protect it with a seal. Indeed, abrasive dusts get embedded into the sliding layer and may damage the shaft. Then lifetime quickly decreases.
For an optimal sealing, please see Techné catalogue "Rotary seals".



Techné rotary shaft seal protecting the TU bush from the outside pollution

✓Coaxiality



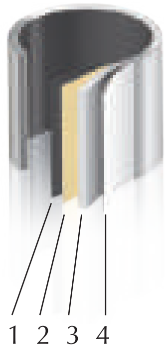
A good alignment of the TU-bush is important. Misalignment defect of the bush axis and of the shaft axis must remain under 0.02mm, no matter if TU bush is assembled alone or with another bush.

This fitting data can be used for all wrapped bushes.

10) Others

For specific applications, Techné offers bushes that meet customer's requirements.

Only TP4, TU-SP and TU-ISP Techné bushes are hereafter detailed. However Techné's R&D department can develop specific designs on request.



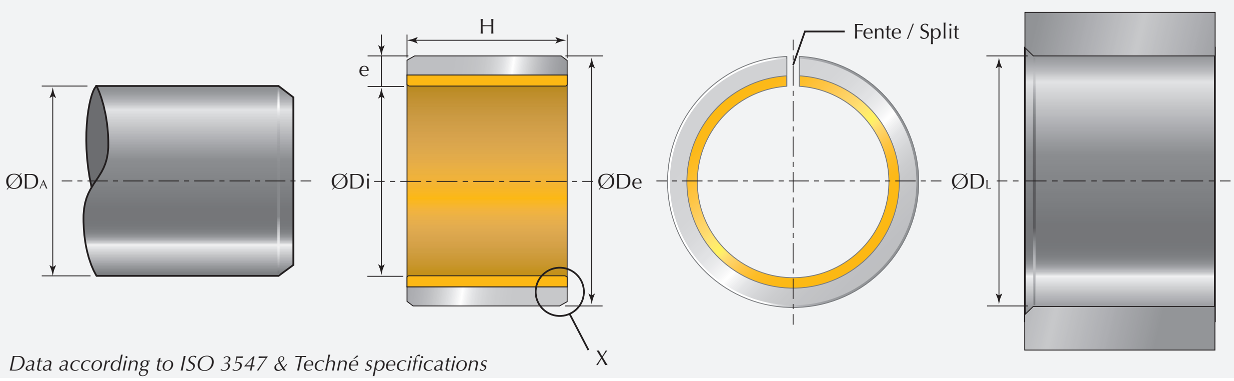
Characteristics	TP4	TU-SP	TU-ISP
Layer 1 (0,01 - 0,03)	PTFE + polymers + loads	PTFE + polymers	PTFE + polymers
Layer 2 (0,2 - 0,3)	Sintered bronze	Sintered bronze	Sintered bronze
Layer 3 (0,7 - 2,3)	Steel	Steel	Stainless steel
Layer 4 (0,005 - 0,008)	Zinc or copper plating	Zinc or copper plating	/
Cylindrical bush	69.0034	69.0030	69.0005
Flanged bush	69.2043	69.0301	/
Advantages	Better mechanical characteristics. Suitable for oscillating and reciprocating motion. Environmental standard compliance	Environmental standards compliance	Best chemical resistance. Environmental standard compliance
Use	Mainly in automotive application: Damper, gears, boxes, wipers	Food, medical and chemical applications	Food, medical and chemical applications
Picture			

Bush without lead, in compliance with European directives, such as 2000/53/CE on end of life vehicles (ELV Directive) and 2002/95/CE restriction of the use of hazardous substance in electrical and electronic equipment (RoHS Directive).

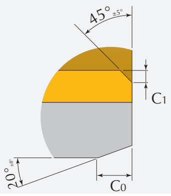
Applications

TU bushes are used in industrial applications, as well as professional and general public materials: printing, robotics, handling, car industry, home appliances, bodybuilding bench…

11] Dimensional list



Data according to ISO 3547 & Techné specifications



e	C_0	C_1
0,75	0,5 ±0,3	0,3 ±0,2
1	0,6 ±0,3	0,3 ±0,2
1,5	0,6 ±0,4	0,4 ±0,3

e	C_0	C_1
2	1,2 ±0,4	0,6 ±0,3
2.5	1,8 ±0,4	0,6 ±0,4

Non exhaustive list, other dimensions on demand

ØDi	ØDe	Shaft ØDA		Housing ØDL		e	j	H	Techné reference	
		Tol	max min	Tol	max min	max min	max min		TU 69.0003	TU-B 69.0010
2	3,5	h6	2 1,994	H6	3,508 3,5	0,745 0,725	0,064 0,01	5±0.25	2355	
3	4,5		3 2,994		4,508 4,5	0,75 0,73	0,054 0	3	0303	
								4	0304	
								5	0305	
								6	0306	
4	5,5		4 3,992		5,508 5,5	0,75 0,73	0,056 0	3	0403	
								4	0455	
								6	0406	
								10	0410	
5	7	f7	4,99 4,978	H7	7,015 7	1,005 0,98	0,077 0	4	0504	
								5	0505	0505
								6	0576	
								8	0508	
								10	0510	
6	8		5,990 5,978		8,015 8	1,005 0,98	0,077 0	4	0064	
								5	0605	
								6	0606	0606
								8	0006	
								10	0610	0610
7	9		6,987 6,972		9,015 9	1,005 0,98	0,083 0,003	10	0710	
8	10		7,987 7,972		10,015 10	1,005 0,98	0,083 0,003	6	8106	
								8	0808	8108
								10	0810	0810
								12	0812	0812

ØDi	ØDe	Shaft ØDA		Housing ØDL		e	j	H	Techné reference	
		Tol	max min	Tol	max min	max min	max min		TU 69.0003	TU-B 69.0010
9	**11**	f7	8,987 8,972	H7	11,018 11	1,005 0,98	0,086 0,003	**10**	0910	
10	**12**		9,987 9,972		12,018 12	1,005 0,98	0,086 0,003	**5**	0105	
								8	1008	1008
								10	1010	1010
								12	1012	
								15	1015	1015
								20	1020	
12	**14**		11,984 11,966		14,018 14	1,005 0,98	0,092 0,006	**6**	0004	
								8	1208	
								10	1210	1214
								12	1212	1212
								15	1215	1215
								20	1220	1220
								25	1225	
13	**15**		12,984 12,966		15,018 15	1,005 0,98	0,092 0,006	**5**	1305	
								10	1310	
								20	1320	
14	**16**		13,984 13,966		16,018 16	1,005 0,98	0,092 0,006	**5**	0145	
								10	1410	1410
								15	1415	1415
								18	1416	
								20	1420	
								25	1425	
15	**17**		14,984 14,966		17,018 17	1,005 0,98	0,092 0,006	**6**	0156	
								10	1510	
								12	1512	
								15	1515	1515
								20	1520	
								25	1525	
16	**18**		15,984 15,966		18,018 18	1,005 0,98	0,092 0,006	**8**	1618	1608
								10	1610	1618
								12	1612	1612
								15	1615	1615
								20	1620	1620
								25	1625	1625
17	**19**		16,984 16,966		19,021 19	1,005 0,98	0,095 0,006	**10**	1710	
								15	1715	
								20	1720	
18	**20**		17,984 17,966		20,021 20	1,005 0,98	0,095 0,006	**10**	1810	
								15	1815	
18	**20**		17,984 17,966		20,021 20	1,005 0,98	0,95 0,06	**20**	1820	
								25	1825	
								30	1830	

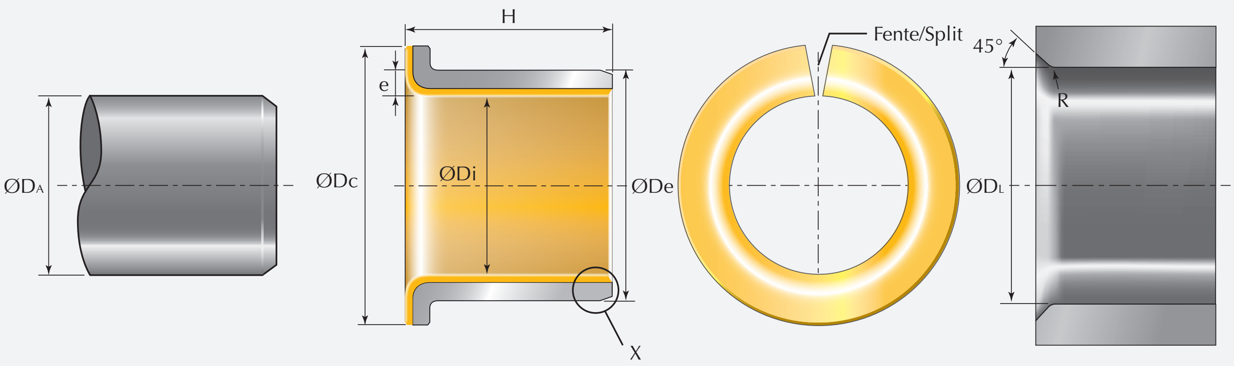
ØDi	ØDe	Shaft ØDA		Housing ØDL		e	j	H	Techné reference	
		Tol	max min	Tol	max min	max min	max min		TU 69.0003	TU-B 69.0010
20	22	f7	19,98 19,959	H7	22,021 22	1,005 0,98	0,102 0,01	10	2010	
								15	0215	
								20	2020	2020
20	23		19,98 19,959		23,021 23	1,505 1,475	0,112 0,01	8	2008	
								10	2310	
								15	2015	2015
								20	2320	2023
								25	2025	2025
								30	2030	
								35	0011	
20	24		19,98 19,959		24,021 24	2,005 1,97	0,122 0,01	12,25	2024	
22	25		21,98 21,959		25,021 25	1,505 1,475	0,112 0,01	10	2210	
								15	2215	2215
								20	2220	2225
								25	2225	
								30	2230	
24	27		23,98 23,959		27,021 27	1,505 1,475	0,112 0,01	13	2413	
								15	2415	2415
								20	2420	2420
								25	2425	
								30	2430	2430
24	28		23,98 23,959		28,021 28	2,005 1,97	0,122 0,01	15	0415	
								20	0420	
								25	0425	
								30	0430	
								50	2824	
25	28		24,98 24,959		28,021 28	1,505 1,475	0,112 0,01	10	2510	
								15	2815	2515
								20	2520	
								25	2525	2525
								30	2830	2530
								40	2528	
								50	2550	
28	32		27,98 27,959		32,025 32	2,005 1,97	0,126 0,01	15	0815	
								20	2820	2820
								25	2825	
								30	0283	
30	34		29,980 29,959		34,025 34	2,005 1,97	0,126 0,01	10	3010	
								15	3015	3015
30	34		29,980 29,959		34,025 34	2,005 1,97	0,126 0,010	20	3020	3020
								25	3025	3024
								30	3030	3030
								35	3035	

ØDi	ØDe	Shaft ØDA		Housing ØDL		e	j	H	Techné reference	
		Tol	max min	Tol	max min	max min	max min		TU 69.0003	TU-B 69.0010
30	34	f7	29,980 29,959	H7	34,025 34	2,005 1,97	0,126 0,010	40	3040	3040
								50	3050	
32	36		31,975 31,95		36,025 36	2,005 1,97	0,135 0,015	20	3220	
								30	3230	
								40	3240	
35	39		34,975 34,95		39,025 39	2,005 1,97	0,135 0,015	15	3515	
								20	3520	3520
								25	3525	3525
								30	3530	3530
								35	3535	
								40	3940	
								45	3545	
								50	3550	
36	40		35,975 35,95		40,025 40	2,005 1,97	0,135 0,015	20	3620	
								30	3630	
								40	3640	
37	41		36,975 36,95		41,025 41	2,005 1,97	0,135 0,015	20	3720	
40	44		39,975 39,95		44,025 44	2,005 1,97	0,135 0,015	10	0032	
								15	4015	
								20	4020	4020
								25	4025	4025
								30	4030	4030
								40	4040	
								45	4045	
								50	4050	4050
								55	4055	
								60	4060	4060
45	50		44,975 44,95		50,025 50	2,505 2,46	0,155 0,015	20	4520	
								30	4530	
								40	4540	4540
								45	4545	
								50	4550	4550
								60	4560	4560
50	55		49,97 49,95		55,03 55	2,505 2,46	0,160 0,015	20	5020	5020
								25	5025	
								30	5030	5030
								40	5040	5040
								50	5050	
								60	5060	5060
55	60		54,97 54,94		60,03 60	2,505 2,46	0,17 0,02	20	5520	
								25	5525	
								30	5530	5530

ØDi	ØDe	Shaft ØDA		Housing ØDL		e	j	H	Techné reference	
		Tol	max min	Tol	max min	max min	max min		TU 69.0003	TU-B 69.0010
55	60	f7	54,97 54,94	H7	60,03 60	2,505 2,46	0,17 0,02	40	5540	
								50	5550	
								60	5560	
60	65		59,97 59,94		65,03 65	2,505 2,46	0,17 0,02	15	6015	6015
								20	6020	
								30	6030	
								40	6040	6040
								50	6050	6050
								60	6060	6060
								70	6070	6070
65	70		64,97 64,94		70,03 70	2,505 2,46	0,17 0,02	15	6515	
								30	6530	
								40	6540	6540
								50	6550	
								70	6570	
70	75		69,97 69,94		75,03 75	2,505 2,46	0,17 0,02	25	7025	7025
								30	7030	7030
								40	7040	7040
								50	7050	7050
								60	7060	7060
								80	7080	7080
75	80		74,97 74,94		80,03 80	2,505 2,46	0,176 0,02	30	7530	
								40	7540	
								45	7545	7540
								50	7550	
								60	7560	
								80	7580	
80	85	h8	80 79,954		85,035 85	2,49 2,44	0,201 0,02	20 ±0.5	8020	
80	85		80 79,946		85,035 85	2,49 2,44	0,209 0,02	25	8025	
								45	8045	8045
								50	8050	
								60	8060	8060
								80	8080	8080
								100	8010	8010
85	90		85 84,946		90,035 90	2,49 2,44	0,209 0,02	30	8530	
								60	8560	
								100	8510	
90	95		90 89,946		95,035 95	2,49 2,44	0,209 0,02	50	9050	
								60	9060	9060
								70	9070	
								100	9010	9010
95	100		95 94,946		100,035 100	2,49 2,44	0,209 0,02	50	9550	
								60	9560	
								100	9510	

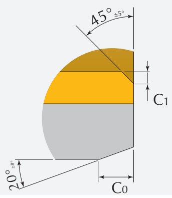
ØDi	ØDe	Shaft ØDA Tol	Shaft ØDA max / min	Housing ØDL Tol	Housing ØDL max / min	e max / min	j max / min	H	Techné reference TU 69.0003	Techné reference TU-B 69.0010
100	105	h8	100 / 99,946	H7	105,035 / 105	2,49 / 2,44	0,209 / 0,02	50	1005	
								60	1060	1006
								80	1080	1080
								100	0100	
								115	1001	1001
105	110		105 / 104,946		110,035 / 110	2,49 / 2,44	0,209 / 0,02	60	1056	1056
								100	5100	
								115	1051	
110	115		110 / 109,946		115,035 / 115	2,49 / 2,44	0,209 / 0,02	30	1103	1130
								60	1106	
								80	1108	
								100	1100	
								115	1101	
115	120		115 / 114,946		120,035 / 120	2,49 / 2,44	0,209 / 0,02	50	1155	
								60	1156	
								70	1157	
								115	1151	
120	125		120 / 119,946		125,04 / 125	2,465 / 2,415	0,264 / 0,07	50	1205	
								60	1206	
								100	1201	
125	130		125 / 124,937		130,04 / 130	2,465 / 2,415	0,273 / 0,07	60	1256	
								100	1251	
130	135		130 / 129,937		135,04 / 135	2,465 / 2,415	0,273 / 0,07	60	1306	
								100	1301	
135	140		135 / 134,937		140,04 / 140	2,465 / 2,415	0,273 / 0,07	60	1356	
								80	1358	
								100	1351	
140	145		140 / 139,937		145,04 / 145	2,465 / 2,415	0,273 / 0,07	60	1406	
								80	1408	
								100	1401	1401
145	150		145 / 144,937		150,04 / 150	2,465 / 2,415	0,273 / 0,07	60	1456	
								100	1451	
150	155		150 / 149,937		155,04 / 155	2,465 / 2,415	0,273 / 0,07	60	1506	
								80	1508	
								100	1501	
160	165		160 / 159,937		165,04 / 165	2,465 / 2,415	0,273 / 0,07	15	1605	
								60	0160	
								80	1608	1680
								100	1601	
								160	1616	
170	175		170 / 169,937		175,04 / 175	2,465 / 2,415	0,273 / 0,07	60	1706	
170	175		170 / 169,937		175,04 / 175	2,465 / 2,415	0,273 / 0,07	80	1780	
								100	1701	

ØDi	ØDe	Shaft ØDA		Housing ØDL		e	j	H	Techné reference	
		Tol	max min	Tol	max min	max min	max min		TU 69.0003	TU-B 69.0010
180	**185**	h8	180 179,937	H7	185,046 185	2,465 2,415	0,279 0,07	**60**	1806	
								80	1808	
								100	1801	1801
								120	0180	
190	**195**		190 189,928		195,046 195	2,465 2,415	0,288 0,07	**40**	1904	
								55	1905	1955
								60	1906	
								85	1919	
								90	0190	
								100	1901	
200	**205**		200 199,928		205,046 205	2,465 2,415	0,288 0,07	**100**	2001	2000
								200	0200	
210	**215**		210 209,928		215,046 215	2,465 2,415	0,288 0,07	**60**	2106	
								100	2101	
220	**225**		220 219,928		225,046 225	2,465 2,415	0,294 0,07	**60**	2206	
								100	2201	
								150	2150	
250	**255**		250 249,928		255,052 255	2,465 2,415	0,303 0,07	**80**	0250	
								100	2501	
280	**285**		280 279,919		285,052 285	2,465 2,415	0,303 0,07	**60**	2806	
								100	2801	
290	**295**		290 289,919		295,052 295	2,465 2,415	0,303 0,07	**80**	2908	
								100	2901	
300	**305**		300 299,919		305,052 305	2,465 2,415	0,303 0,07	**60**	3006	
								100	3001	
320	**325**		320 319,911		325,057 325	2,465 2,415	0,316 0,07	**100**	0320	
360	**365**		360 359,911		365,057 365	2,465 2,415	0,316 0,07	**18**	0360	
380	**385**		380 379,911		385,057 385	2,465 2,415	0,316 0,07	**100**	0010	0380
438	**443**		438 437,903		443,063 443	2,465 2,415	0,33 0,07	**20**	0438	0438
530	**535**		530 529,89		535,07 535	2,465 2,415	0,35 0,07	**28**	0530	
550	**555**		550 549,89		555,07 555	2,465 2,415	0,35 0,07	**80**	0550	
560	**565**		560 559,89		565,07 565	2,465 2,415	0,35 0,07	**28**	5324	
585	**590**		585 584,89		590,07 590	2,465 2,415	0,35 0,07	**28**	0585	
620	**625**		620 619,89		625,07 625	2,465 2,415	0,35 0,07	**18**	0620	
630	**635**		630 629,89		635,08 635	2,465 2,415	0,36 0,07	**30**	0630	



Data according to ISO 3547 & Techné specifications

Detail X



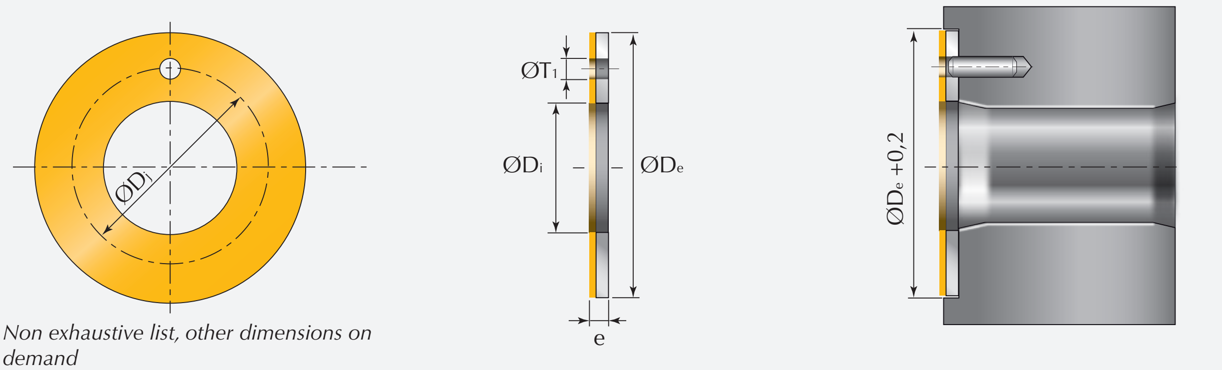
e	C_0	C_1
0,75	0,5 ±0,3	0,3 ±0,2
1	0,6 ±0,3	0,3 ±0,2
1,5	0,6 ±0,4	0,4 ±0,3

e	C_0	C_1
2	1,2 ±0,4	0,6 ±0,3
2.5	1,8 ±0,4	0,6 ±0,4

Non exhaustive list, other dimensions on demand

ØDi	ØDe	ØDc	Shaft ØDA		Housing ØDL		e	j	H	Techné reference	
			Tol	max min	Tol	max min	max min	max min		TU 69.0002	TU-B 69.0017
4	**6**	**10**	h6	4 3,992	H6	6,008 6	1,005 0,98	0,056 -0,01	4,5	4645	
									6	0466	
6	**8**	**12**	f7	5,990 5,978	H7	8,015 8	1,005 0,98	0,077 0,000	4	0604	
									7	0612	
									8	0608	
									10	6810	
									5	8101	
									6,5	0810	
8	**10**	**15**		7,987 7,972		10,015 10	1,005 0,98	0,083 0,003	5,5	0805	0855
									7,5	0807	
									8	8108	
									9	8109	
									9,5	0809	0810
10	**12**	**18**		9,987 9,972		12,018 12	1,005 0,98	0,086 0,003	7	1007	1007
									9	1009	1009
									12	1012	0010
									17	1017	1012
12	**14**	**20**		11,984 11,966		14,018 14	1,005 0,98	0,092 0,006	7	1207	0127
									9	1209	0129
									12	1212	
									15	1215	
									17	1217	
12	**14**	**24**		11,984 11,966		14,018 14	1,005 0,98	0,092 0,006	12	0012	
14	**16**	**22**		13,984 13,966		16,018 16	1,005 0,98	0,092 0,006	12	1412	1412
									17	1417	1417
15	**17**	**23**		14,984 14,966		17,018 17	1,005 0,98	0,092 0,006	9	1509	

ØDi	ØDe	ØDc	Shaft ØDA		Housing ØDL		e	j	H	Techné reference	
			Tol	max min	Tol	max min	max min	max min		TU 69.0002	TU-B 69.0017
15	17	23		14,984 14,966		17,018 17	1,005 0,98	0,092 0,006	12	1512	
									17	1517	
16	18	24		15,984 15,966		18,018 18	1,005 0,98	0,092 0,006	12	1612	1612
									17	1617	1617
18	20	26		17,984 17,966		20,021 20	1,005 0,98	0,095 0,006	7	1807	
									8	1808	
									12	1812	0011
									17	1817	
									22	1822	
20	23	30		19,98 19,959		23,021 23	1,505 1,475	0,112 0,01	11,5	2011	2023
									15	2015	
									16,5	2016	2016
									21,5	2021	2021
25	28	35		24,98 24,959		28,021 28	1,505 1,475	0,112 0,01	7,5	2575	
									9,5	2595	
									11,5	2511	
									16,5	2516	2516
									21,5	2521	2521
26	30	35	f7	25,98 25,959	H7	30,021 30	2,005 1,97	0,122 0,01	57	2657	
30	34	42		25,98 25,959		34,025 34	2,005 1,97	0,126 0,01	16	3016	3016
									26	3026	
35	39	47		34,975 34,95		39,025 39	2,005 1,97	0,135 0,015	16	3516	
									26	3526	3526
40	44	25		39,975 39,95		44,025 44	2,005 1,97	0,135 0,015	25	4025	
40	44	53		39,975 39,95		44,025 44	2,005 1,97	0,135 0,015	14	4014	
									16	4043	
									16	4053	
									26	4026	
40	44	55		39,975 39,95		44,025 44	2,005 1,97	0,135 0,015	40	4040	
45	50	58		44,975 44,95		50,03 50	2,505 2,46	0,155 0,015	16	4558	
									26	4526	4526
50	55	65		49,97 49,94		55,03 55	2,505 2,46	0,16 0,015	12	5055	
									32,5	5030	
70	75	90		69,97 69,94		75,03 75	a2,505 2,46	0,17 0,02	20	7090	
									100	7075	
100	105	120	h8	100 99,946		105,035 105	2,49 2,44	0,209 0,02	20	0002	
									30	0003	



Non exhaustive list, other dimensions on demand

ØDi +0,25 / +0	ØDe +0 / - 0,25	$ØD_j$ ±0,125	$ØT_1$ +0,375 / +0,125	e +0 / - 0,05	Techné reference	
					TU 69.0004	TU-B 69.0032
10	20	15	2	1,5	0004	
10	20	15	2	1,5	1015	
12	24	18	2	1,5	1215	1224
14	26	20	2	1,5	1415	
14	60	37	2	2	1460	
14	80	47	2	2	1480	
16	30	23	2	1,5	1615	
18	32	25	2	1,5	1832	
20	36	28	3	1,5	0020	2036
22	34	28	3	1,5	2234	
22	38	30	3	1,5	2238	2238
24	42	33	3	1,5	2415	2442
25	36	30,5	3	1,5	0002	2515
26	44	35	3	1,5	2644	2644
28	48	38	4	1,5	2848	2848
30	62	46	4	1,5	3062	
30,2	48	39,1	4	1,5	3048	
32	54	43	4	1,5	3254	3215
32,2	48	40,1	4	1,5	3248	
35	45	40	4	2	3545	
38	62	50	4	1,5	0035	3862
38	62	50	4	1,5	3862	
41	54,8	47,9	4	2,5	4154	
42	66	54	4	1,5	0040	4266
45	66	55,5	4	1,5	4566	
46	59	52,5	4	2,5	4659	
48	74	61	4	2	4820	
50	61	55,5	4	1,5	5061	
52	78	65	4	2	5278	5278
62	90	/	/	2	6290	
62	90	76	4	2	0060	6290
65	80	72,5	4	2,5	6525	
65	90	77,5	4	2	9065	

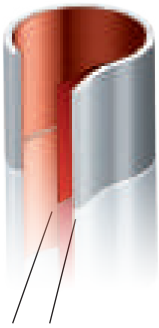
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250

1/8″ 1/4″ 3/8″ 1/2″ 5/8″ 3/4″ 7/8″ 1″
1″1/8 1″1/4 1″3/8 1″1/2 1″5/8 1″3/4 1″7/8 2″
2″1/8 2″1/4 2″3/8 2″1/2 2″5/8 2″3/4 2″7/8 3″
3″1/8 3″1/4 3″3/8 3″1/2 3″5/8 3″3/4 3″7/8 4″
4″1/8 4″1/4 4″3/8 4″1/2 4″5/8 4″3/4 4″7/8 5″
5″1/8 5″1/4 5″3/8 5″1/2 5″5/8 5″3/4 5″7/8 6″
6″1/8 6″1/4 6″3/8 6″1/2 6″5/8 6″3/4 6″7/8 7″
7″1/8 7″1/4 7″3/8 7″1/2 7″5/8 7″3/4 7″7/8 8″
8″1/8 8″1/4 8″3/8 8″1/2 8″5/8 8″3/4 8″7/8 9″
9″1/8 9″1/4 9″3/8 9″1/2 9″5/8 9″3/4

TI

1] Structure

TI 69.0035 69.0016 69.0039



✓ TI

Self-lubricant, TI bushes are composed with 2 layers:

- A sliding layer (**1**) made of PTFE fiber. Its thickness is between 0.01 to 0.03mm.
- A stainless steel (**2**) AISI 316 backing which improves its mechanical and thermic properties

TI bushes do not contain any bronze, so it significantly improves their corrosion resistance.

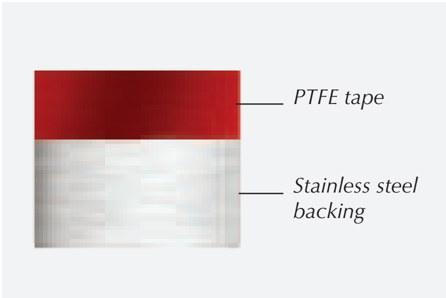


fig.20 • Micrographic structure of TI

✓ TI advantages

Though its maximum load is lower than the one of a TU bush (100 Mpa instead of 140 Mpa for dynamic use), TI bush offers an ideal corrosion resistance. Its PTFE layer resists to almost all chemical products and stainless steel AISI 316 is used in highly corrosive applications.
Moreover TI bush is recommended for medical and food industries, where cleanliness requirements are high.
TI bush complies with European directives, such as 2000/53/CE on end of life vehicles (ELV Directive) and 2002/95/CE restriction of the use of hazardous substance in electrical and electronic equipment (RoHS Directive).
TI behavior is very similar to TU's one, so please check page 20 to design housing. However TI's lifetime is not as long as TU's one because there is no sintered bronze layer.

2) Mechanical characteristics

Properties	Type	TI	Units
Load	Static	250	N/mm²
	Dynamic	100	N/mm²
	Oscillating	40	N/mm²
Speed	Dry	2	m/s
	Oil lubrication	> 3	m/s
Maximum PV factor	Dry, in peak	1	N/mm².m/s (W/mm²)
	Dry, continuous	0.8	N/mm².m/s (W/mm²)
	Oil lubrication	> 10	N/mm².m/s (W/mm²)
Friction Coefficient	Dry	0,03 ; 0,18	
	Oil lubrication	0,02 ; 0,07	
Shaft hardness		>120	HB
Shaft roughness	Dry	Ra : 0,3 ; 0,9	µm
	Oil lubrication	Ra : 0,05 ; 0,2	µm
Temperature		-200 ; 280	°C
Thermal conductivity		10	$W(m.K)^{-1}$
Coef. of thermal expansion		16.10^{-6}	K^{-1}

3) Chemical characteristics

After analysis of each layer of the bush, Techné gives indication about chemical resistance. However, because of the wide variety of available materials and grades, compatibility tests before final selection of the material are recommended.

✓ Chemical resistance

TI bushes resist to water, alcohols, glycols, solvents, gasoline, diesel, kerosene and most of oils (T° lower than 100°C). TI bushes can also be used in aquatic and marine environments. TI bushes also resist to most of the acids such as chloric, nitric, sulfuric acids as well as gases such as free halogen or ammoniac. Only chloro-sulfonated, hydrofluoric and chromic acids are not recommended.

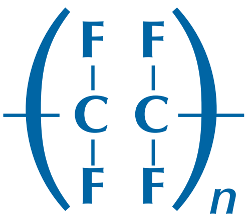
The antifriction layer made of PTFE provides a good protection against corrosion.

4] Materials

✓ Stainless steel 316

Molybdenum steel provides a good corrosion resistance, good resistance towards warm chlorinated, marine and non-magnetic environments.

Afnor	EN 10027	AISI	% C	% Mn	% P	% S	% Si	% Ni	% Cr	% Mo
Z6CND17-11	X5CrNiMo18-10 1.4401	316	0,07	2	0,04	0,03	1	10 à 12,5	16 à 18	2 à 2,5



✓ PTFE

PTFE material has a very good stability in contact with oxygen, chemical products and solvents. It is also weatherproof and flame resistant.

Its stability mainly comes from its steric hindrance combined with a higher C-F covalent bond (485 Kj/mol in CH3-F) than C-H bond and also much higher than all other carbon-halogen bonds.

Moreover PTFE has an excellent sliding coefficient, which strongly reduces the torque force generated by the friction between all parts. Also additional lubrication becomes useless.

5] ASSEMBLY

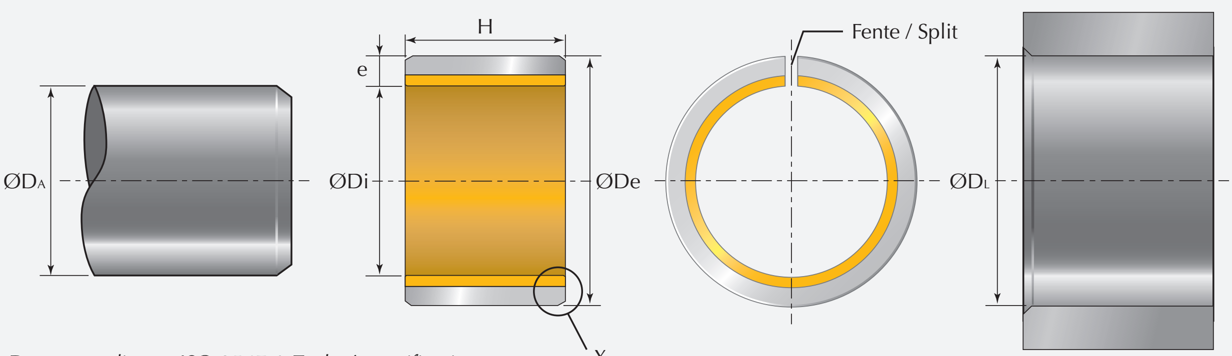
Because of its thicker stainless steel backing, installation of TI bush is less easy than the one of TU bush. That is why Techné provides TI bushes with a lower developed length. So after fitting, split of TI bush remains open.

Concerning assembly recommendations please check page 22. No matter the diameter, Techné advises to use a fitting ring, to make the installation easier.

Applications

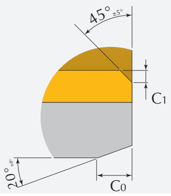
TI bushes do not contain any bronze (risk with oxygen). That is why it is commonly used in chemical industry. Its corrosion resistance also enables its installation in swimming-pool or marine environments. TI bush is also often used in food industry.

6) Dimensional list



Data according to ISO 3547 & Techné specifications

Detail X



e	C_0	C_1
0,75	0,5 ±0,3	0,3 ±0,2
1	0,6 ±0,3	0,3 ±0,2
1,5	0,6 ±0,4	0,4 ±0,3

e	C_0	C_1
2	1,2 ±0,4	0,6 ±0,3
2.5	1,8 ±0,4	0,6 ±0,4

Non exhaustive list, other dimensions on demand

ØDi	ØDe	Shaft $ØD_A$		Housing $ØD_L$		e	J	H	Techné reference
		Tol	max min	Tol	max min	max min	max min		TI 69.0035
10	12	f7	9,987 9,972	H7	12,018 12	1,005 0,98	0,086 0,003	10	1010
12	14		11,984 11,966		14,018 14	1,005 0,98	0,092 0,006	15	1215
13	15		12,984 12,966		15,018 15	1,005 0,98	0,092 0,006	13	1313
14	16		13,984 13,966		16,018 16	1,005 0,98	0,092 0,006	10	1410
								15	1415
								20	1420
								36	1436
15	17		14,984 14,966		17,018 17	1,005 0,98	0,092 0,006	15	1515
16	18		15,984 15,966		18,018 18	1,005 0,98	0,092 0,006	10	1610
17	19		16,984 16,966		19,021 19	1,005 0,98	0,095 0,006	17	1717
18	20		17,984 17,966		20,021 20	1,005 0,98	0,095 0,006	10	1820
								15	1815
								20	0018
								25	1825
								48	1848
19	21		18,98 18,959		21,021 21	1,005 0,98	0,102 0,01	18	1918
20	22		19,98 19,959		22,021 22	1,005 0,98	0,102 0,01	15	2015
								58	2058
20	23		19,98 19,959		23,021 23	1,505 1,475	0,112 0,01	10	2010
								20	2020

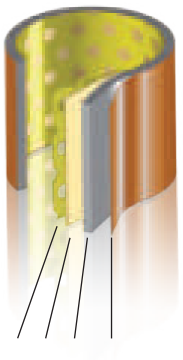
ØDi	ØDe	Shaft ØD_A		Housing ØD_L		e	J	H	Techné reference
		Tol	max min	Tol	max min	max min	max min		TI 69.0035
21	23	f7	20,98 20,959	H7	23,021 23	1,005 0,98	0,102 0,01	26	2126
22	24		21,98 21,959		24,021 24	1,005 0,98	0,102 0,01	15	2215
								54	2254
22	25		21,98 21,959		25,021 25	1,505 1,475	0,112 0,01	15	2225
								20	0024
24	26		23,98 23,959		26,021 26	1,005 0,98	0,102 0,01	36	2426
24	27		23,98 23,959		27,021 27	1,505 1,475	0,112 0,01	25	2427
25	27		24,98 24,959		27,021 27	1,005 0,98	0,102 0,01	20	2520
								64	2527
25	28		24,98 24,959		28,021 28	1,505 1,475	0,112 0,01	15	2515
								20	2528
								30	2530
28	32		27,98 27,959		32,025 32	2,005 1,97	0,126 0,01	20	2820
30	34		29,98 29,959		34,025 34	2,005 1,97	0,126 0,01	15	3015
								20	3020
								25	3025
								30	3030
								40	3040
31	33		30,975 30,95		33,025 33	1,005 0,98	0,115 0,015	42	3142
32	34		31,975 31,95		34,025 34	1,005 0,98	0,115 0,015	20	3220
								72	3272
35	37		34,975 34,95		37,025 37	1,005 0,98	0,115 0,015	53	3553
35	39		34,975 34,95		39,025 39	2,005 1,97	0,135 0,015	30	3530
								35	3535
								40	3540
36	38		35,975 35,95		38,025 38	1,005 0,98	0,115 0,015	20	3620
								80	3680
40	44		39,975 39,95		44,025 44	2,005 1,97	0,135 0,015	25	0025
								30	4030
								40	4040
								50	4050
42	44		41,975 41,95		44,025 44	1,005 0,98	0,115 0,015	25	4244
								94	4294
45	50		44,975 44,95		50,025 50	2,505 2,46	0,155 0,015	30	4530
								40	4540
48	50		47,975 47,95		50,025 50	1,005 0,98	0,115 0,015	25	4850
								92	4892
50	55		49,975 49,95		55,03 55	2,505 2,46	0,16 0,015	20	5020
								40	5040
								50	0023

ØDi	ØDe	Shaft $ØD_A$		Housing $ØD_L$		e	J	H	Techné reference
		Tol	max min	Tol	max min	max min	max min		TI 69.0035
55	**57**	f7	54,97 54,94	H7	57,03 57	1,005 0,98	0,13 0,02	30	5557
								94	5594
55	**60**		54,97 54,94		60,03 60	2,505 2,46	0,17 0,02	50	5550
60	**62**		59,97 59,94		62,03 62	1,005 0,98	0,13 0,02	30	6030
								102	6010
60	**65**		59,97 59,94		65,03 65	2,505 2,46	0,17 0,02	22	6022
								40	6040
								70	6070
65	**70**		64,97 64,94		70,03 70	2,505 2,46	0,17 0,02	40	6540
66	**68**		65,97 65,94		68,03 68	1,005 0,98	0,13 0,02	24	6624
70	**72**		69,97 69,94		72,03 72	1,005 0,98	0,13 0,02	110	7011
								30	7030
70	**75**		69,97 69,94		75,03 75	2,505 2,46	0,17 0,02	30	0026
								50	7050
75	**80**		74,97 74,94		80,03 80	2,505 2,46	0,17 0,02	40	8040
								50	7550
								65	8075
80	**85**	h8	80 79,954		85,035 85	2,49 2,44	0,201 0,02	40	0027
								60	8060
								70	8580
85	**90**		85 84,946		90,035 90	2,49 2,44	0,209 0,02	40	8540
								70	9085
90	**95**		90 89,946		95,035 95	2,49 2,44	0,209 0,02	40	9040
								72,5	0022
								145	0021
95	**100**		95 94,946		100,035 100	2,49 2,44	0,209 0,02	75	0020
								150	0019
105	**110**		105 104,946		110,035 110	2,49 2,44	0,209 0,02	170	0105
150	**155**		150 149,937		155,04 155	2,465 2,415	0,273 0,07	60	0150

TX

1) Structure

TX 69.0021 69.2021 69.0040



✓ TX

Self-lubricant TX bushes are composed with 4 layers:

- An acetal resin (POM) layer (**1**) that provides excellent properties against wear and friction. Its thickness is between 0.3 and 0.5 mm. Spherical pockets are used as lubricant stocks (oil or grease). During the running-in period, lubricant reduces the friction coefficient and thus increases the lifetime of the bush.
- A porous sintered bronze layer (**2**) that plays a major role in thermal conductivity, dimensional stability and grip of the sliding layer. Its thickness is between 0.20 mm and 0.35 mm.
- A steel backing (**3**) that improves its mechanical resistance.

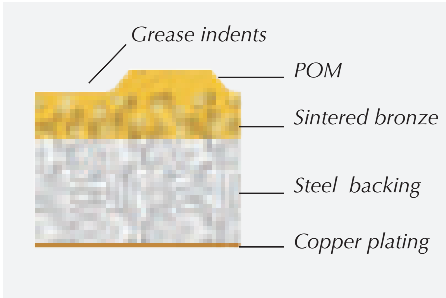
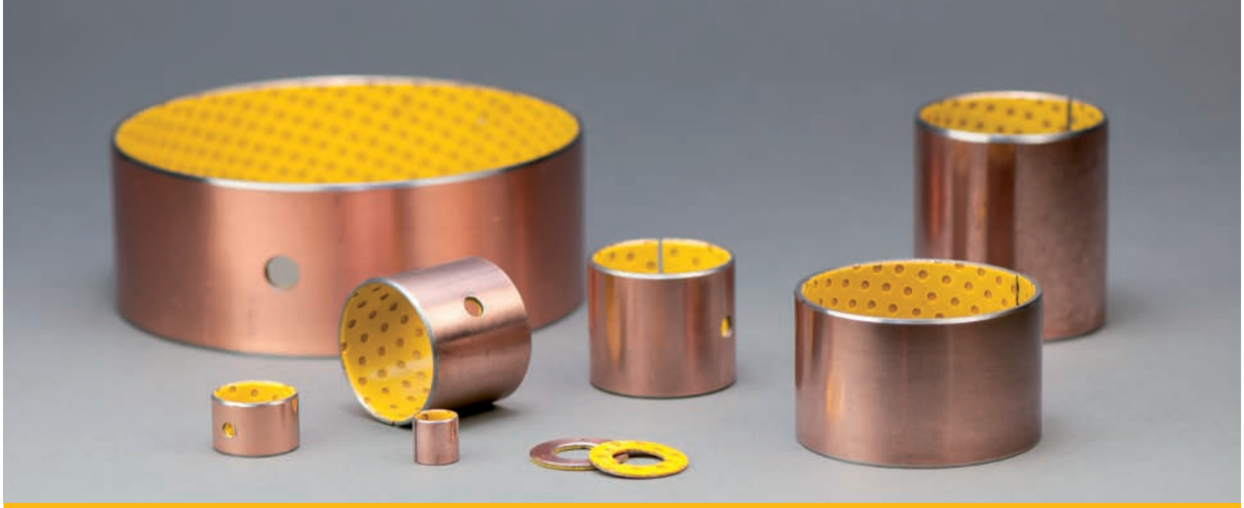


fig.21 • Micrographic structure of TX

- For standard parts, backing of TX bush is plated with a thin copper layer (**4**) which protects the steel layer. Its thickness is about 0.008 mm.

✓ Advantages

Thanks to the abrasion resistance of its sliding layer, TX-bush can be used in low maintenance applications and high polluted environments. Its shock resistance is also excellent.
Moreover TX bush complies with European directives, such as 2000/53/CE on end of life vehicles (ELV Directive) and 2002/95/CE restriction of the use of hazardous substance in electrical and electronic equipment (RoHS Directive).



2) Mechanical characteristics

Properties	Type	TX	Units
Load	Static	250	N/mm²
	Dynamic	140	N/mm²
	Oscillation	70	N/mm²
Speed	Greased	2,5	m/s
	Oil lubrication	> 3	m/s
Maximum PV factor	Greased	2,8	N/mm².m/s (W/mm²)
	Oil lubrication	> 10	N/mm².m/s (W/mm²)
Friction coefficient	Greased	0,15 ; 0,25	
	Oil lubrication	0,05 ; 0,015	
Shaft Hardness		>270	HB
Shaft roughness	Greased	Ra : 0,2 ; 0,8	μm
	Lubricated	Ra : 0,05 - 0,2	μm
Temperature		-40 - 120	°C
Thermal conductivity		52	$W(m.K)^{-1}$
Coef. of thermal expansion		11.10^{-6}	K^{-1}

3) Chemical characteristics

After analysis of each layer of the bush, Techné gives indication about chemical resistance. However because of the wide variety of available materials and grades, compatibility tests before final selection of the material are recommended.

POM anti-friction layer prevents from corrosion with the contact surface. However for applications with corrosion risk between shaft and bush, Techné advises to use shaft made of stainless steel with chrome plating or made with aluminum and anodizing

✓ Chemical resistance

TX bush resists to water (without swelling), alcohols, glycols, gasoline, diesel, kerosene and solvents such as acetone or carbon tetrachloride. Its resistance to ammoniac is also good. However it can be damaged by acid or alkaline solutions such as hydrochloric, nitric, sulfuric, acetic and formic acids. It is not recommended for marine environment.

✓ Oil resistance

TX bush is appropriate to contact with HFD oils. However for contact with HFA or HFC oils, the temperature must remain lower than 100°C. Compatibility tests are recommended.

4] Wear mechanism

TX bush does not react as TU bush. During its running-in period, wear is very poor: only 2 or 3 µm. Abrasion resistance of TX sliding layer depends on the grease rate hold into the bush. During working conditions, grease is either polluted or flows away. When grease quantity reaches a critical threshold, bush starts being worn very quickly.

Thus it is recommended to plan regular greasing, to increase lifetime, to improve the sealing function and prevent sliding surface of the shaft from corrosion.

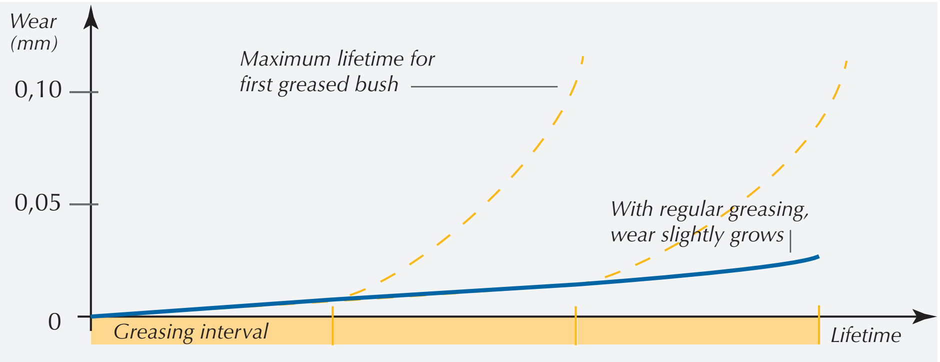


fig.22 • Wear and greasing interval

✓ Small oscillation

When amplitude of the oscillation is lower than the diameter of the pockets, a local wear of the shaft can be noticed. To avoid this problem Techné advises to use TS bush (see page 54).

✓ Type of grease

For working conditions up to 80°C, Techné advises to use grease with lithium additives. Above 80°C, it is better to use silicone grease.

It is not recommended to use MoS2 or graphite fillers that can wear the shaft. Also shock absorber oils are not appropriate with TX bushes.

✓ Oil lubrication

For oil working conditions (continuous lubrication) sliding and lifetime of the bush are modified. Three different kinds of lubrication are well known. For more details please see page 18.

5) PV factor

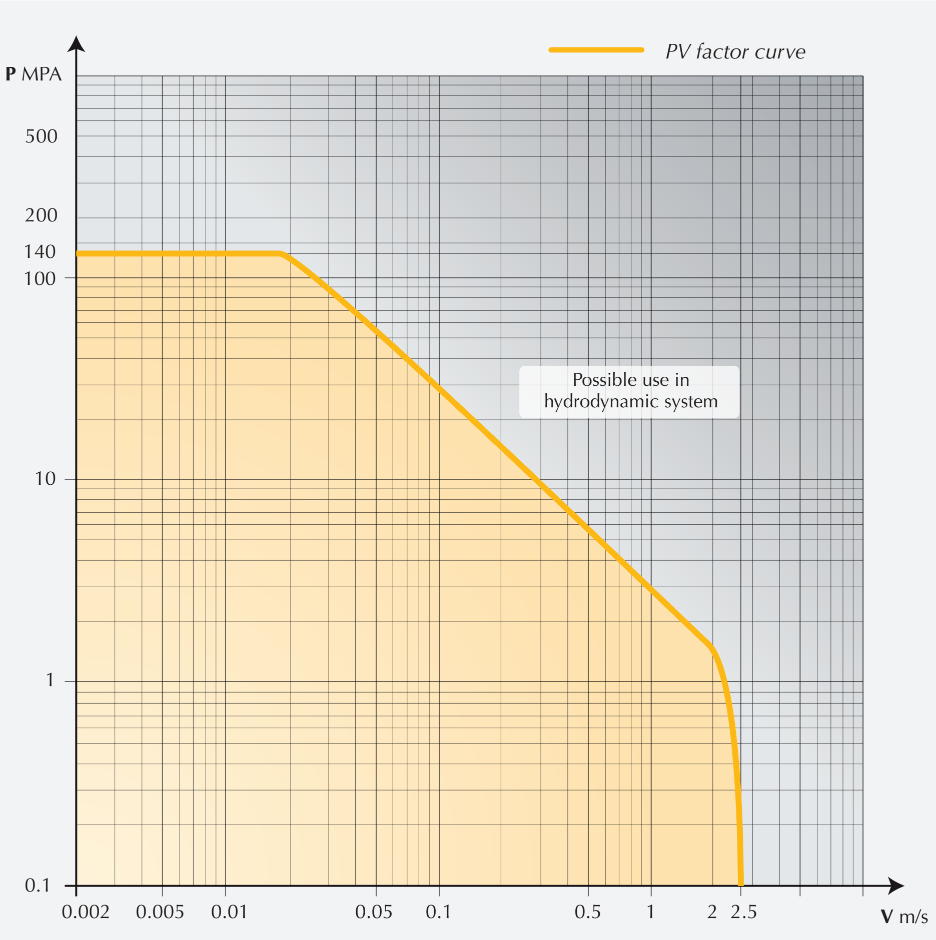
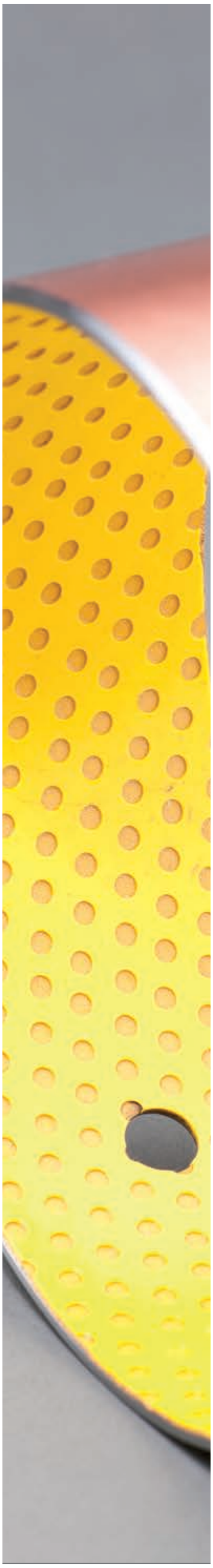


fig.23 • PV factor chart



6) Lifetime

Bush lifetime depends on several parameters. Based on its experience, Techné suggests corrective factors according to pressure, speed, temperature, load, roughness and material of the shaft. However other unknown and uncountable parameters, which are specific to the application, can interfere. So the lifetime indicated hereafter remains for indication only

✓ Adjustment factors

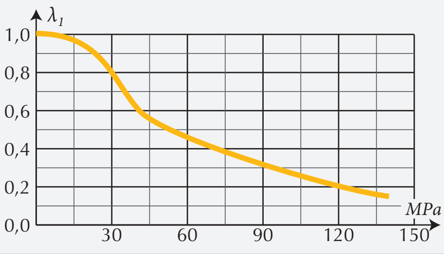


fig.24 • Load adjustment factor λ_1

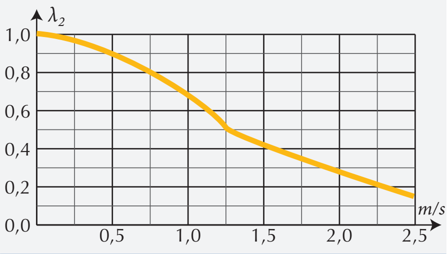


fig.27 • Speed adjustment factor λ_2

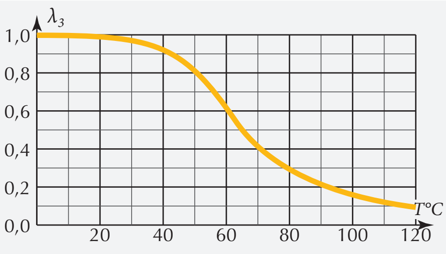


fig.25 • Temperature °C adjustment factor λ_3

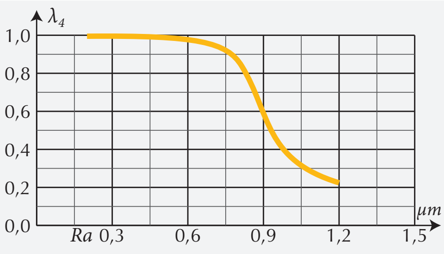
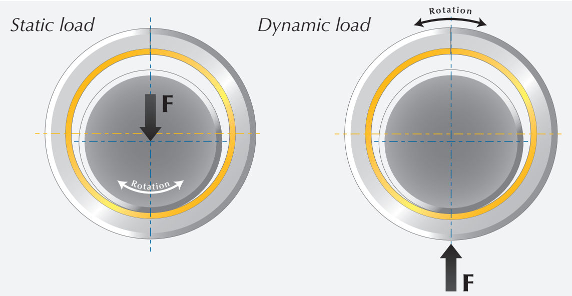


fig.28 • Roughness adjustment factor λ_4



Static load : $\lambda_5 = 1$
Dynamic load : $\lambda_5 = 2$

For reciprocating motion or for washer profile, ignore this factor

fig.26 • Factor λ_5 about loads on the cylindrical bushing

Shaft material	λ_6
Carbon steel (ex: C35)	1
Alloy steel	1
Hardened steel, nitrided or carbo-nitrided	1
Chrome steel	1
Stainless steel	2
Cast iron (maxi. Ra 0.3 µm)	1
Alloy aluminium	0.4
Bronze, brass	0.2
Hard anodized aluminum (min. 25µm, hardness min. 450 HV)	3
Steel plated (min. 13µm)	
Cadmium, nickel, phosphating or zinc	0.2
Hard Chrome	2
Titanium nitride	1

✓ Calculation

Calculated $\overline{PV}$ factor has to be lower than PV_{max} of the bush :

$$\overline{PV}_{max} < PV_{max}$$

So for TX bushes: $PV_{max} < 2.8$ (see table page 47 et , page 49)
Also pressure $\overline{P}$ and speed $\overline{V}$ values must be lower than the acceptable ones of the TX bush.

Note: Maximal pressure $\overline{P}_{max}$ and maximal speed $\overline{V}_{max}$ of a given application may not be used simultaneously. In such a case, calculation of $\overline{PV}_{max}$ factor must not be $\overline{P}_{max}$ by $\overline{V}_{max}$, but pressure $\overline{P}_t$ by speed $\overline{V}_t$ at time t, and depending on t, chose the $\overline{PV}_{t\,max}$ factor.

✓ Oscillation and rotation motions

$$L_h = \lambda_1 . \lambda_2 . \lambda_3 . \lambda_4 . \lambda_5 . \lambda_6 . 3.10^3 . (\overline{PV})^{-1}$$

Linear movements

For translation length correction, an additional factor must be taken into account:

$$\lambda_7 = 0,6 . \frac{H}{S + H}$$

$$L_h = \lambda_1 . \lambda_2 . \lambda_3 . \lambda_4 . \lambda_6 . \lambda_7 . 3.10^3 . (\overline{PV})^{-1}$$

✓ Examples

Cylindrical bush

Load : 2000 kg
Speed N : 55 tr/min
Di : 40
H : 30
$\overline{PV}$ calculated page 14 : 1,75
Temperature : 20°C
Roughness : Ra 0,3
Static load
Shaft material : steel

$$L_h = 0.97 . 0,98 . 1 . 1 . 1 . 1 . 3.10^3 . (1.75)^{-1}$$

L_h = 1640 hours

Washer

Load : 1000 kg
Oscillating motion,
Frequency N_f : 30
Angle α : 20°
Di : 28
De : 48
$\overline{PV}$ calculated page 14 : 0,07
Temperature : 20°C
Roughness : Ra 0,4
Material of the friction piece: carbon steel

$$L_h = 0.98 . 1 . 1 . 1 . 1 . 3.10^3 . (0,07)^{-1}$$

L_h = 5600 hours

Bague cylindrique

Axial load: 4000 kg
Dynamic load
Speed N : 15 rpm
Di : 90
H : 60
$\overline{PV}$ calculated page 14 : 0,7
Temperature : 80°C
Roughness : Ra 0,4
Material of the friction piece: Chrome steel

$$L_{h1} = 0,97 . 0,98 . 0,28 . 1. 2 . 1 . 4.10^2 . (0,7)^{-1}$$

L_h = 2280 hours

7) Shaft and housing design

✓ Roughness

Shaft D_A	Dry	Lubricated		
Lubrication	/	Boundary	Mixed-film	Hydrodynamic
Ra (µm)	0.2 -0.4	≤ 0.4	0.1 - 0.2	0.05 - 0.16
Rz (µm)	1 - 4	≤ 2	0.5 - 1	0.25 - 0.8

For a lubricated application, the lower the roughness, the easier it will be to create a hydrodynamic film. So the more severe the application is, the better roughness must be.

For housing D_L Techné recommends a roughness value of Rz 10.

✓ Bushing clearance

TX bushes are assembled tightened in the housing, so it is unnecessary to use clamp or ring spacer to avoid TX bush movement. For a standard use in a steel housing, Techné recommends the following tolerances for housing D_L:

However there must be a clearance between the shaft and the bush. This clearance is essential for the lifetime and performance of the bush. For the shaft, Techné recommends the following tolerances for shaft D_A:

Tolerances	Shaft D_A	Housing D_L
Ø5 - Ø300	h8	H7

Bearing clearance calculation depending on $\overline{PV}_c$ factor

Bearing clearance must be adjusted to load and speed. Techné suggests hereunder bearing clearance values compared to standard ones.

To use the following chart, the corrected speed factor $\overline{V}_c$ must be calculated according to the speed service $\overline{V}$:

$$\overline{V}_c = 0{,}5 \cdot \overline{V} + 0.75$$

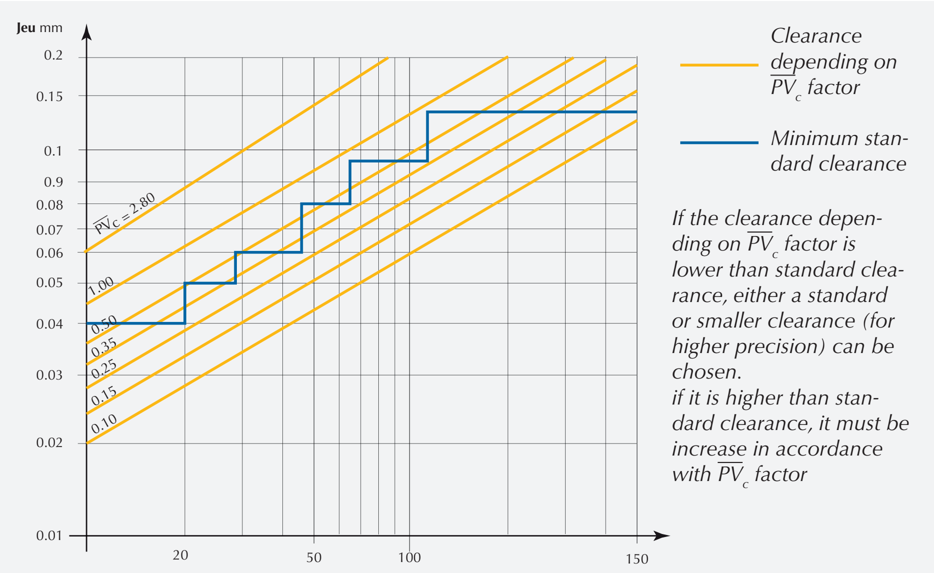


fig.29 • Clearance depending on $\overline{PV}_c$ factor

Clearance and temperature

From 20°C, clearance between shaft and bush must be corrected according to the temperature using the following equation:

$$j_c = j + 0{,}0025 \,.\, T° - 0.05$$

On the other hand, when temperature reaches 100°C, some shafts and housings made from high expansion coefficient materials must be modified:

Housing	Ø D_L at 100°C	Ø D_A at 100°C
Steel and cast steel	without	without
Zinc alloy	$D_L = D_L - (D_L \,.\, 1{,}5.10^{-3})$	$D_A = D_A - (D_A \,.1{,}5.10^{-3})$
Bronze or coper alloy	$D_L = D_L - (D_L \,.\, 5.10^{-4})$	$D_A = D_A - (D_A \,.\, 5.10^{-4})$
Aluminium alloy	$D_L = D_L - (D_L \,.\, 1.10^{-3})$	$D_A = D_A - (D_A \,.\, 1.10^{-3})$

✓ Clearance calculation

Maximum clearance :

$$J_{max} = D_{L\,max} - 2 \,.\, e - D_{A\,min}$$

minimum clearance :

$$J_{mini} = D_{L\,mini} - 2 \,.\, e - D_{A\,max}$$

Clearance calculation does not include the potential deformation of the housing. In order to know D_L, D_A and e values, please check dimension table on page 56.

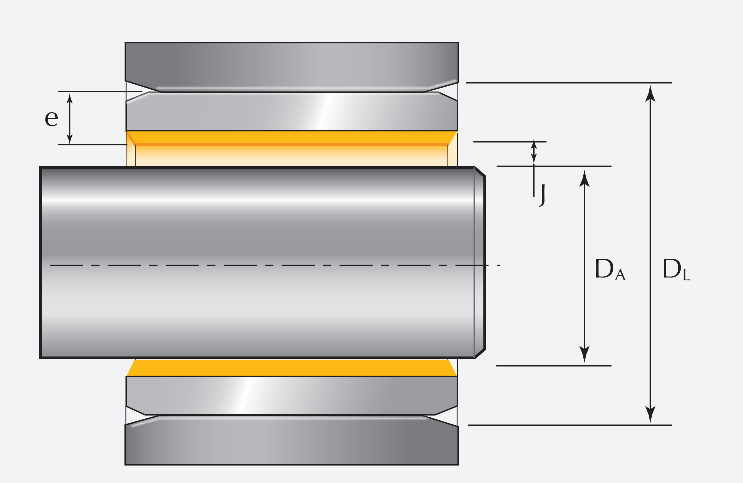
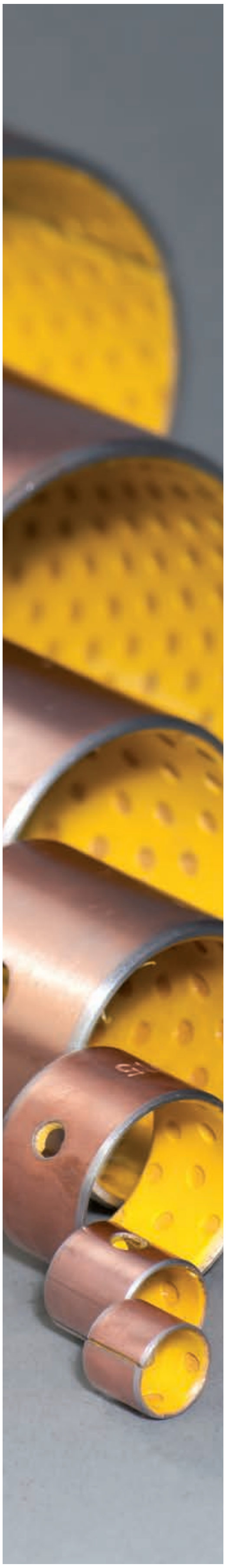


fig.30 • Clearance J

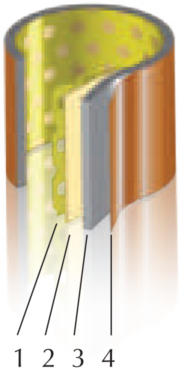
✓ Assembly

Assembly of TX-bushes is the same as for TU bushes. For more details please check page 22.

8) Others



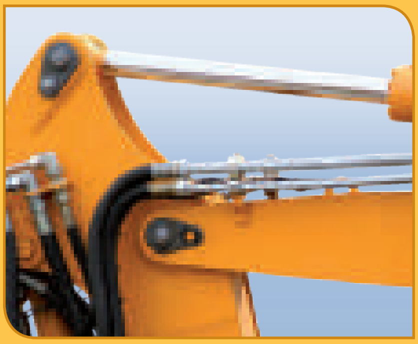
For specific application or environment, Techné offers bushes that meet customers' requirements.
Only Techné TS and TX-PK are hereafter described. However Techné's R&D department can develop specific design on request.



Characteristics	TS	TX-PK
Layer 1 (0,01 - 0,03)	POM + load (without pockets) Orange colored	PEEK Black colored
Layer 2 (0,2 - 0,3)	Sintered bronze	Sintered bronze
Layer 3 (0,7 - 2,3)	Steel	Steel
Layer 4 (0,005 - 0,008)	Tin or copper plating	Tin or copper plating
Cylindrical bush	69.0033	69.0071
Flanged bush	/	69.2071
Advantages	Suitable for small oscillating and reciprocating motion. Environmental standards compliance	Temperature range -150° to 250°C PV factor = 3,6 Environmental standards compliance
Use	Ski lifts	Press Rolling mill
Picture		

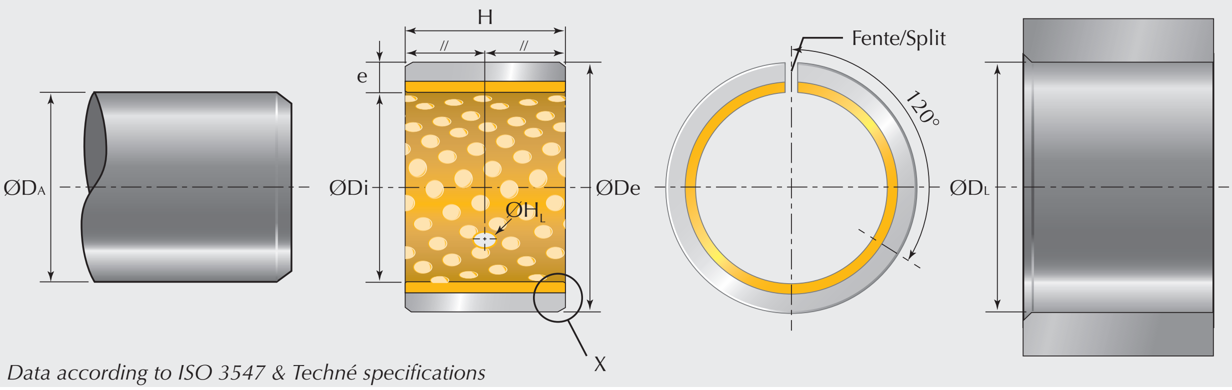
Bush without lead, in compliance with European directives, such as 2000/53/CE on end of life vehicles (ELV Directive) and 2002/95/CE restriction of the use of hazardous substance in electrical and electronic equipment (RoHS Directive).

Applications



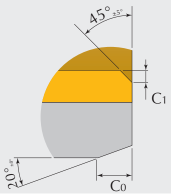
TX bushes are often used under severe working conditions especially for construction machines and agricultural vehicles. It can also be used for handling systems, ski lifts or office furniture equipment.

9) Dimensional list



Data according to ISO 3547 & Techné specifications

Detail X



e	C_0	C_1
0,75	0,5 ±0,3	0,3 ±0,2
1	0,6 ±0,3	0,3 ±0,2
1,5	0,6 ±0,4	0,4 ±0,3

e	C_0	C_1
2	1,2 ±0,4	0,6 ±0,3
2.5	1,8 ±0,4	0,6 ±0,4

Non exhaustive list, other dimensions on demand

ØDi	ØDe	Shaft $ØD_A$		Housing $ØD_L$		e	j	H_L	H	Techné reference
		Tol	max min	Tol	max min	max min	max min			TX 69.0021
3,5	5	h8	3,5 3,482	H7	5,012 5	0,73 0,705	0,12 0,04	sans	8±0.25	3558
5	7		5 4,982		7,015 7	0,98 0,955	0,123 0,04		5	0507
									8	5078
									10	0510
6	8		6 5,982		8,015 8	0,98 0,955	0,123 0,04		6	0606
									8	0608
									10	0810
7	9		7 6,978		9,015 9	0,98 0,955	0,127 0,04		10	0709
8	10		8 7,978		10,015 10	0,98 0,955	0,127 0,04	(4)	8	1008
									10	1010
									12	1012
10	12		10 9,978		12,018 12	0,98 0,955	0,13 0,04		8	1208
									10	0001
									12	1212
									15	1015
									20	1020
12	14		12 11,973		14,018 14	0,98 0,955	0,135 0,04	4	8	1214
									10	1210
									12	0002
									15	1215
									20	1220
									25	1225
13	15		13 12,973		15,018 15	0,98 0,955	0,135 0,04		10	1310
									20	1320

ØDi	ØDe	Shaft $ØD_A$		Housing $ØD_L$		e	j	H_L	H	Techné reference
		Tol	max min	Tol	max min	max min	max min			TX 69.0021
14	16	h8	14 13,973	H7	16,018 16	0,98 0,955	0,135 0,04	4	10	1416
									12	1412
									15	1415
									20	1420
									25	1425
15	17		15 14,973		17,018 17	0,98 0,955	0,135 0,04		6	0156
									10	1517
									12	1512
									15	1515
									20	1520
									25	1525
16	18		16 15,973		18,018 18	0,98 0,955	0,135 0,04		10	1610
									12	1612
									15	1615
									20	1620
									25	1625
17	19		17 16,973		19,021 19	0,98 0,955	0,138 0,04		15	1715
									20	1720
18	20		18 17,973		20,021 20	0,98 0,955	0,138 0,04		15	1815
									20	1820
									25	1825
20	22		20 19,967		22,021 22	0,98 0,955	0,144 0,04		10	2010
20	23		20 19,967		23,021 23	1,475 1,445	0,164 0,05		10	2023
									15	2015
									20	2020
									25	2025
									30	2030
									40	2040
22	25		22 21,967		25,021 25	1,475 1,445	0,164 0,05	6	15	2215
									20	2220
									25	2225
									30	2230
24	27		24 23,967		27,021 27	1,475 1,445	0,164 0,05		15	2415
									20	2420
									25	2425
									30	2430
25	28		25 24,967		28,021 28	1,475 1,445	0,164 0,05		12	2512
									15	2515
									20	2520
									25	2525
									30	2530
									50	2550
28	31		28 27,967		31,025 31	1,475 1,445	0,168 0,05		30	2831

ØDi	ØDe	Shaft $ØD_A$ Tol	Shaft $ØD_A$ max / min	Housing $ØD_L$ Tol	Housing $ØD_L$ max / min	e max / min	j max / min	H_L	H	Techné reference TX 69.0021
28	32	h8	28 27,967	H7	32,025 32	1,97 1,935	0,188 0,06	6	20	2820
									25	2825
									30	2830
30	34		30 29,967		34,025 34	1,97 1,935	0,188 0,06		15	3015
									20	3020
									25	3025
									28	3028
									30	3030
									35	3035
									40	3040
32	36		32 31,961		36,025 36	1,97 1,935	0,194 0,06		20	3220
									30	3230
									35	3235
									40	3240
35	39		35 34,961		39,025 39	1,97 1,935	0,194 0,06		15	3515
									20	3520
									25	3525
									30	3530
									35	3535
									40	3540
									50	3550
36	40		36 35,961		40,025 40	1,97 1,935	0,194 0,06		35	3640
37	41		37 36,961		41,025 41	1,97 1,935	0,194 0,06		20	3741
38	44		38 37,961		44,025 44	2,96 2,915	0,234 0,08		50	3850
40	44		40 39,961		44,025 44	1,97 1,935	0,194 0,06	8	12	4012
									20	4020
									30	4030
									35	4035
									40	4040
									50	4050
45	50		45 44,961		50,025 50	2,46 2,415	0,234 0,08		20	4520
									30	4530
									40	4540
									45	4545
									50	4550
50	55		50 49,961		55,03 55	2,46 2,415	0,239 0,08		20	5020
									25	5025
									30	5030
									40	5040
									45	5045
									50	5050
									60	5060

ØDi	ØDe	Shaft $ØD_A$ Tol	Shaft $ØD_A$ max min	Housing $ØD_L$ Tol	Housing $ØD_L$ max min	e max min	j max min	H_L	H	Techné reference TX 69.0021
55	**60**	h8	55 54,954	H7	60,03 60	2,46 2,415	0,246 0,08	8	**20**	5520
									25	5525
									30	5530
									40	5540
									50	5550
									60	5560
60	**65**		60 59,954		65,03 65	2,46 2,415	0,246 0,08		**20**	6020
									25	6025
									30	6030
									40	6040
									45	6045
									60	6060
									70	6070
65	**70**		65 64,954		70,03 70	2,46 2,415	0,246 0,08		**30**	6530
									40	6540
									50	6550
									60	6560
									70	6570
68	**73**		68 67,954		73,03 73	2,46 2,415	0,246 0,08		**60**	6860
70	**75**		70 69,954		75,03 75	2,46 2,415	0,246 0,08		**18**	7018
									30	7030
									40	7040
									45	7045
									50	7050
									60	7060
									65	7065
									70	7070
									80	7080
75	**80**		75 74,954		80,03 80	2,46 2,415	0,246 0,08	9,5	**40**	7540
									50	7550
									60	7560
									80	7580
80	**85**		80 79,954		85,035 85	2,45 2,385	0,311 0,1		**18±0.5**	8018
									25	8025
									30	8030
									40	8040
									50	8050
									60	8060
									80	8080
									100	8010
85	**90**		85 84,946		90,035 90	2,45 2,385	0,319 0,1		**30**	8530
									40	8540
									60	8560
									70	8570

ØDi	ØDe	Shaft $ØD_A$ Tol	Shaft $ØD_A$ max min	Housing $ØD_L$ Tol	Housing $ØD_L$ max min	e max min	j max min	H_L	H	Techné reference TX 69.0021
85	**90**	h8	85 84,946	H7	90,035 90	2,45 2,385	0,319 0,1	9,5	**80**	8580
									100	8510
90	**95**		90 89,946		95,035 95	2,45 2,385	0,319 0,1		**40**	9040
									60	9060
									80	9080
									90	9090
									100	9010
95	**100**		95 94,946		100,035 100	2,45 2,385	0,319 0,1		**30**	9530
									40	9540
									60	9560
									90	9590
									100	0951
100	**105**		100 99,946		105,035 105	2,45 2,385	0,319 0,1		**40**	0112
									47	0047
									50	1005
									60	1056
									65	1065
									70	1057
									80	1058
									95	1095
									100	1000
									115	1011
									120	1002
105	**110**		105 104,946		110,035 110	2,45 2,385	0,319 0,1		**50**	0111
									60	1060
									110	0110
									115	1045
110	**115**		110 109,946		115,035 115	2,45 2,385	0,319 0,1		**30**	1103
									60	1156
									80	1108
									100	1101
									110	0115
									115	1111
									125	1105
115	**120**		115 114,946		120,035 120	2,45 2,385	0,319 0,1		**50**	1150
									60	1160
									70	1170
120	**125**		120 119,946		125,04 125	2,435 2,38	0,334 0,13		**40**	1201
									50	1250
									60	1260
									100	0100
									110	0120
									140	1202
124	**129**		124 123,937		129,04 129	2,435 2,38	0,343 0,13		**40**	0011

ØDi	ØDe	Shaft $ØD_A$ Tol	Shaft $ØD_A$ max / min	Housing $ØD_L$ Tol	Housing $ØD_L$ max / min	e max / min	j max / min	H_L	H	Techné reference TX 69.0021
125	130	h8	125 / 124,937	H7	130,04 / 130	2,435 / 2,38	0,343 / 0,13	9,5	25	1255
									50	1253
									60	0004
									100	0005
									110	0125
130	135		130 / 129,937		135,04 / 135	2,435 / 2,38	0,343 / 0,13		50	0130
									60	0006
									80	0135
									100	0007
									125	1301
135	140		135 / 134,937		140,04 / 140	2,435 / 2,38	0,343 / 0,13		30	1353
									60	1054
									80	0140
									100	5154
140	145		140 / 139,937		145,04 / 145	2,435 / 2,38	0,343 / 0,13		50	1405
									60	1004
									80	1408
									100	1554
145	150		145 / 144,937		150,04 / 150	2,435 / 2,38	0,343 / 0,13		60	0410
									100	8474
150	155		150 / 149,937		155,04 / 155	2,435 / 2,38	0,343 / 0,13		50	0150
									60	1560
									80	0155
									100	1510
									110	1501
155	160		155 / 154,937		160,04 / 160	2,435 / 2,38	0,343 / 0,13		60	1550
									100	0008
160	165		160 / 159,937		165,04 / 165	2,435 / 2,38	0,343 / 0,13		50	0160
									60	1660
									80	1608
									95	1695
									100	4541
160	165		160 / 159,937		165,04 / 165	2,435 / 2,38	0,343 / 0,13		145	1614
165	170		165 / 164,937		170,04 / 170	2,435 / 2,38	0,343 / 0,13	sans	60	8456
									100	0165
170	175		170 / 169,937		175,04 / 175	2,435 / 2,38	0,343 / 0,13		50	0170
									60	1756
									80	0175
									100	1710
175	180		175 / 174,937		180,04 / 180	2,435 / 2,38	0,343 / 0,13		60	1785
									100	1770
180	185		180 / 179,937		185,046 / 185	2,435 / 2,38	0,349 / 0,13		50	0180
									60	1481
									80	0185

ØDi	ØDe	Shaft $ØD_A$		Housing $ØD_L$		e	j	H_L	H	Techné reference
		Tol	max min	Tol	max min	max min	max min			TX 69.0021
180	185	h8	180 179,937	H7	185,046 185	2,435 2,38	0,349 0,13	sans	85	1885
									100	0010
									130	1813
190	195		190 189,928		195,046 195	2,435 2,38	0,358 0,13		50	0190
									60	0195
									80	1908
									100	1910
									120	1912
200	205		200 199,928		205,046 205	2,435 2,38	0,358 0,13		50	0205
									60	0200
									80	2058
									100	0201
									120	2012
220	225		220 219,928		225,046 225	2,435 2,38	0,358 0,13		50	0225
									60	0220
									80	2258
									100	0222
									120	2212
240	245		240 239,928		245,046 245	2,435 2,38	0,358 0,13		50	0240
									60	0245
									80	2408
									100	2401
									120	2412
250	255		250 249,928		255,052 255	2,435 2,38	0,364 0,13		50	0255
									60	0250
									80	2508
									100	0251
									120	2551
260	265		260 259,919		265,052 265	2,435 2,38	0,373 0,13		50	0260
									60	0265
									80	2608
260	265		260 259,919		265,052 265	2,435 2,38	0,373 0,13		100	2610
									120	2612
280	285		280 279,919		285,052 285	2,435 2,38	0,373 0,13		50	0285
									60	0280
									80	2808
									100	0281
									120	2812
300	305		300 299,919		305,052 305	2,435 2,38	0,373 0,13		50	0305
									60	0300
									80	3008
									100	0301
									120	3012
340	345		340 339,911		345,057 345	2,435 2,38	0,386 0,13		100	0340

ØDi	ØDe	Shaft $ØD_A$		Housing $ØD_L$		e	j	H_L	H	Techné reference
		Tol	max min	Tol	max min	max min	max min			TX 69.0021
355	**360**	h8	355 354,911	H7	360,057 360	2,435 2,38	0,386 0,13	sans	**100**	0355
405	**410**		405 404,903		410,063 410	2,435 2,38	0,4 0,13		**100**	0405
430	**435**		430 429,903		435,063 435	2,435 2,38	0,4 0,13		**100**	4310
445	**450**		445 444,903		450,063 450	2,435 2,38	0,4 0,13		**100**	0445

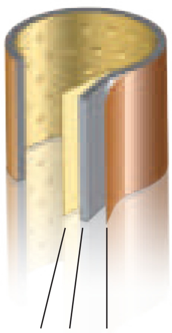
Flanged bushes and washers available on demand.

0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250

1/8"
1/4"
3/8"
1/2"
5/8"
3/4"
7/8"
1"
1"1/8
1"1/4
1"3/8
1"1/2
1"5/8
1"3/4
1"7/8
2"
2"1/8
2"1/4
2"3/8
2"1/2
2"5/8
2"3/4
2"7/8
3"
3"1/8
3"1/4
3"3/8
3"1/2
3"5/8
3"3/4
3"7/8
4"
4"1/8
4"1/4
4"3/8
4"1/2
4"5/8
4"3/4
4"7/8
5"
5"1/8
5"1/4
5"3/8
5"1/2
5"5/8
5"3/4
5"7/8
6"
6"1/8
6"1/4
6"3/8
6"1/2
6"5/8
6"3/4
6"7/8
7"
7"1/8
7"1/4
7"3/8
7"1/2
7"5/8
7"3/4
7"7/8
8"
8"1/8
8"1/4
8"3/8
8"1/2
8"5/8
8"3/4
8"7/8
9"
9"1/8
9"1/4
9"3/8
9"1/2
9"5/8
9"3/4

TY

1] Structure



✓ TY

Self-lubricant TY bushes are composed with 3 layers:

- A sliding porous sintered bronze layer (**1**) CuSN10Pb10 that plays a major role in thermal conductivity, dimensional stability and lubricant supply. Its thickness is between 0.20 to 0.6 mm.
- A steel layer (**2**) that improves mechanical resistance.
- For standard parts, backing of TY bush is plated with copper layer (**3**) which improves the heat dissipation. Its thickness is about 0.008 mm.

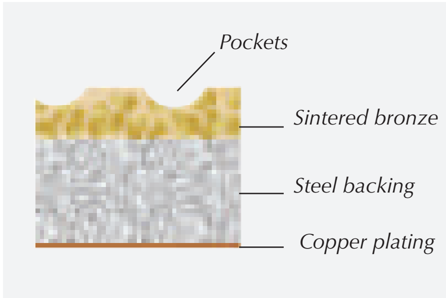


fig.31 • Micrographic structure of TY

✓ Pockets

Two different kinds of pockets: TY-AS with spherical pockets. TY-AL with diamond shaped pockets.

TY bushes can be lubricated either with grease or with oil. In order to increase lubrication supply, TY bushes have pockets on the inside of the sliding layer. These pockets allow a quick lubricant film creation and a low friction coefficient at the beginning of use. Thus TY bushes are well appropriated to oscillation motions.
Techné offers two different kinds of pockets with size from 1.5 to 3mm: spherical pockets TY-AS are usually appropriated to oil lubrication and diamond pockets TY-AL to grease lubrication.
In application with continuous oil lubrication, especially for hydrodynamic and mixed film lubrication, it is better not to have pockets, like our TY-SA type. In such case, Techné offers bushes with feeding grooves.

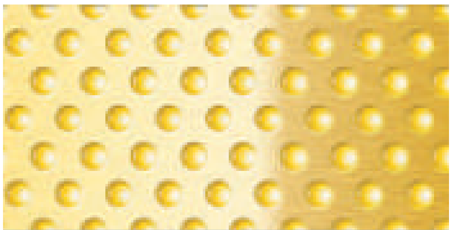


fig.32 • TY-AS plate

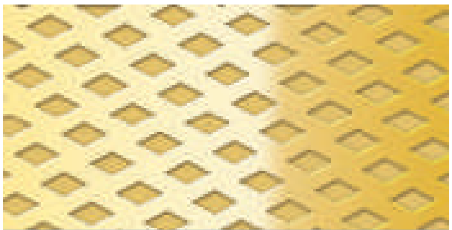


fig.33 • TY-AL plate

2) Mechanical characteristics

Properties	Type	TY	Unit
Load	Static	250	N/mm²
	Dynamic	150	N/mm²
	Oscillation	70	N/mm²
Speed	First lubricated	2,5	m/s
	Continuous lubri-cation	10	m/s
Max PV factor	lubricated (grease or oil)	2,8	N/mm².m/s (W/mm²)
	hydrodynamic lubrication (oil)[1]	> 10	N/mm².m/s (W/mm²)
Friction coefficient	Grease lubrication	0,05 ; 0,15	
	Oil lubrication	0,05 ; 0,12	
Shaft hardness		>53	HRC
Shaft roughness	lubricated	Ra : 0,16 - 0,63	µm
	Hydrodynamic	Ra : 0.05 - 0.2	µm
Temperature[2]		-40 - 250	°C
Thermal conductivity		47	$W(m.K)^{-1}$
Coef. of thermal expansion		18.10^{-6}	K^{-1}

1. Only for TY without pockets and special lubrication grooves
2. 150°C max, if TY is greased

3) Chemical characteristics

After analysis of each layer of the bush, Techné gives indication about chemical resistance. However because of the wide variety of available materials and grades, compatibility tests before final selection of the material are recommended.

✓ Chemical resistance

TY bushes resist to water, alcohols, glycols, solvents, gasoline, diesel, kerosene and most of mineral oils (T° lower than 100°C). However it can be damaged by some strong acids, such as chloric, nitric, sulfuric acid and some gases such as free halogen or ammoniac, especially when these gases are humid. It is also not recommended to use it with HFC oils and in navy environment.
Finally TY bushes cannot be assembled with aluminum shaft because of electrochemical corrosion risk in humid environment.

For applications with corrosion risk between shaft and bush, Techné advises to use shaft made of stainless steel with chrome plating or made with aluminum and anodizing.

4] Performances

✓ Material

Sliding layer of TY bushes is made of sintered bronze filled with lead, CuSn10Pb10. Sintered bronze creates porosity; at stop lubricant comes through the pores by capillarity. Thus TY bushes can promptly work under strict conditions where lubrication is poor.

One the other hand lead plays a role of solid lubricant. It improves sliding coefficient and enables good heat dissipation. Finally tin content provides a good resistance to heavy pressures.

ISO	% Cu	% Sn	% Pb	% Zn	% P	% Fe	% Ni	% Sb	% other
CuSn10Pb10	bal.	9 - 11	9 - 11	0,5	0,1	0,7	0,5	0,2	0,5

On request sliding layer can be replaced by another sintered bronze CuSn4Pb24. This kind of bronze is appropriate to low load and high speed (up to 2.5 ms-1) applications.

ISO	% Cu	% Sn	% Pb	% Zn	% P	% Fe	% Ni	% Sb	% other
CuSn4Pb24	bal.	3 - 5	19-27	0,5	0,1	0,7	0,5	0,2	0,5

✓ Load calculation $\overline{P}$

Load calculation $\overline{P}$ is the same as for TU bushes, so please check formula given on page 14. However because of the pockets or greasing hole, the sliding surface is reduced, so this parameter must be taken into account.

Lets' take example with a cylindrical TY-AL bush, load calculation will be:

$$\overline{P} = \frac{F}{C_r . (Di . H)} = \frac{F}{0{,}76 . (Di . H)}$$

Techné advises to use a coefficient C_r depending on the type of pockets:

- TY-AS : $C_r = 0.79$
- TY-AL : $C_r = 0.76$

5] PV factor

Calculated $\overline{PV}$ factor has to be lower than PV max of the bush :

$$\overline{PV}_{max} < PV_{max}$$

So for TY bushes: $PV_{max} < 2.8$ (see table page 67 et , below)
Also pressure $\overline{P}$ and speed $\overline{V}$ values must be lower than the acceptable ones of the TY bush, see table on page 11.

Note: Maximal pressure $\overline{P}_{max}$ and maximal speed $\overline{V}_{max}$ of a given application may not be used simultaneously. In such a case, calculation of $\overline{PV}_{max}$ factor must not be $\overline{P}_{max}$ by $\overline{V}_{max}$, but pressure $\overline{P}_t$ by speed $\overline{V}_t$ at time t, and depending on t, chose the $\overline{PV}_{t\,max}$ factor.

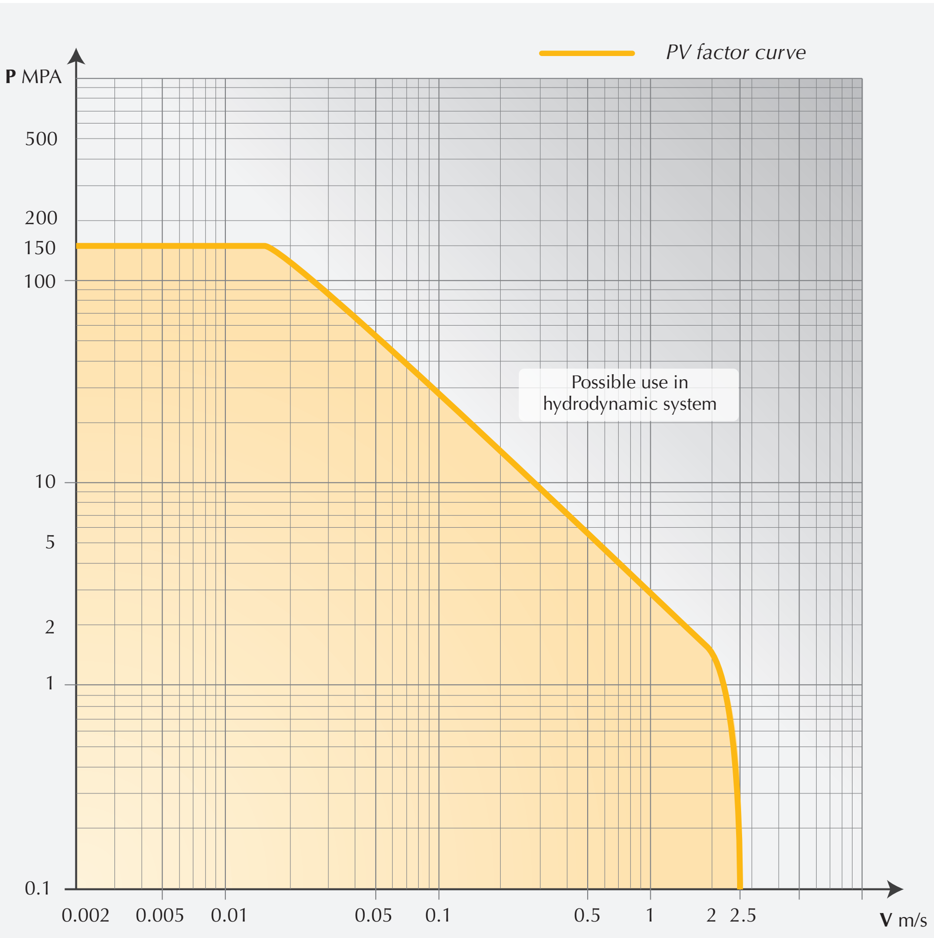


fig.34 • PV factor chart

6) Shaft and housing design

✓ Roughness

Shaft D_A	First lubricated	Constant lubrication		
Lubrication	/	Boundary	Mixed-film	Hydrodynamic
Ra (µm)	0,16 - 0,63	≤ 0.4	0.1 - 0.2	0.05 - 0.16
Rz (µm)	1 - 3	≤ 2	0.5 - 1	0.25 - 0.8

For a lubricated application, the lower the roughness, the easier it will be to create a hydrodynamic film. So the more severe the application is, the better roughness must be.

For housing D_L Techné recommends a roughness value of Rz 10.

✓ Bushing cleareance

TY bushes are assembled tightened in the housing, so it is unnecessary to use clamp or ring spacer to avoid TY bush movement. For a standard use in a steel housing, Techné recommends the following tolerances for housing D_L:

However there must be a clearance between the shaft and the bush. This clearance is essential for the lifetime and performance of the bush. For the shaft, Techné recommends the following tolerances for shaft D_A:

Tolerances	Shaft D_A	Housing D_L
Ø5 - Ø300	h8	H7

✓ Reduction of edge fringing

A good alignment of TY bushes is essential, especially when assembly is made of several bushes. Maximum misalignment defect is 0.02mm.

Load to bear can be reduced by an appropriate design. First of all, bushes must have an equal length and split must be properly aligned. Then one of the following assembly possibilities may be chosen:

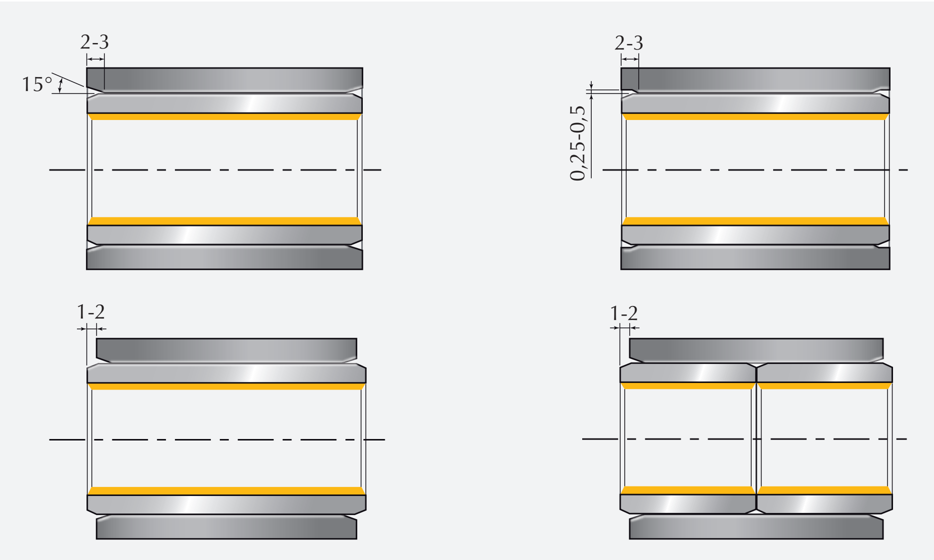


fig.35 • Different shapes in order to reduce edge fringing

✓ Clearance calculation

Maximal clearance J_{MAX}:

$$J_{max} = D_{L\,max} - 2 \,.\, e - D_{A\,min}$$

Minimal clearance J_{MIN}:

$$J_{mini} = D_{L\,mini} - 2 \,.\, e - D_{A\,max}$$

Clearance calculation does not include the potential deformation of the housing. To determine D_L, D_A and e values please check dimension table on page 74.

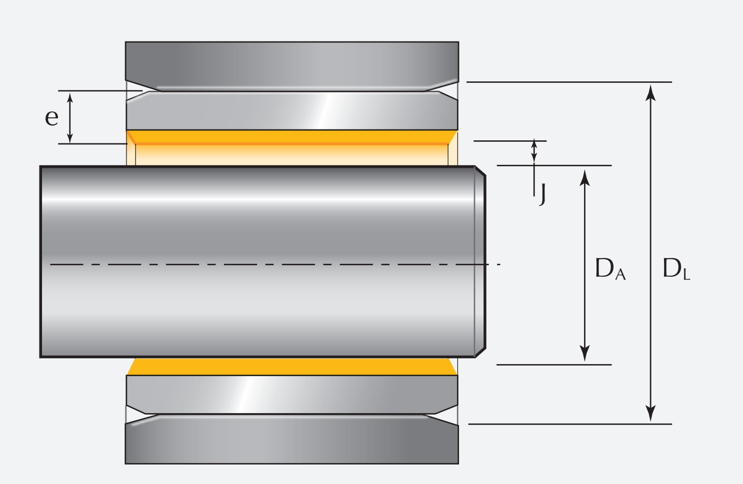


fig.38 • Clearance J

✓ Fitting chamfers

Cylindrical bushes

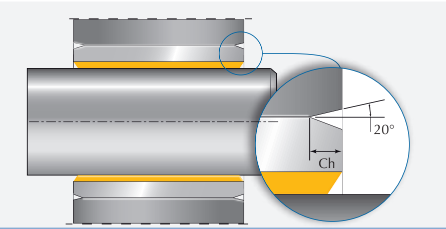


fig.36 • Chamfers Ch for a cylindrical bush

D_A	Ch ±0,5
2 - 30	0,8
30 - 80	1.2
80 - 180	1,8
> 180	2,5

Flanged bushes

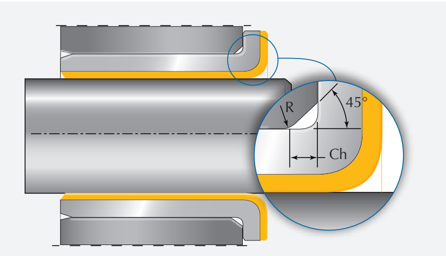


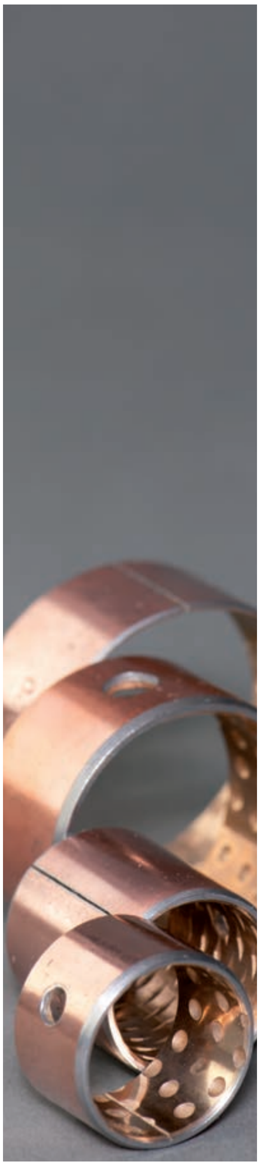
fig.37 • Chamfers Ch for a flanged bush

D_A	Ch ±0,5
2 - 20	1,2
20 - 28	1,7
28 - 45	2,2
> 45	2,7

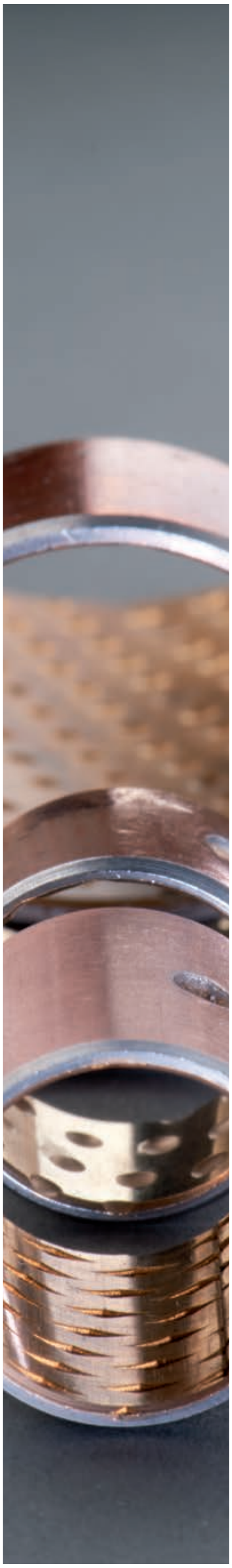
R : the chamfer edge must be rounded

✓ Assembly

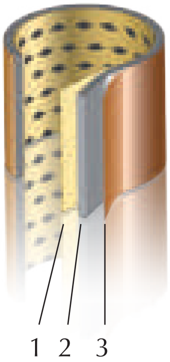
Assembly of TY-bushes is the same as for TU bushes. For more details please check page 22.



7) Others



For specific application or environment, Techné offers bushes that meet customers' requirements.
Only Techné TY-ALG bush is hereafter described. However Techné's R&D department can develop specific design on request.



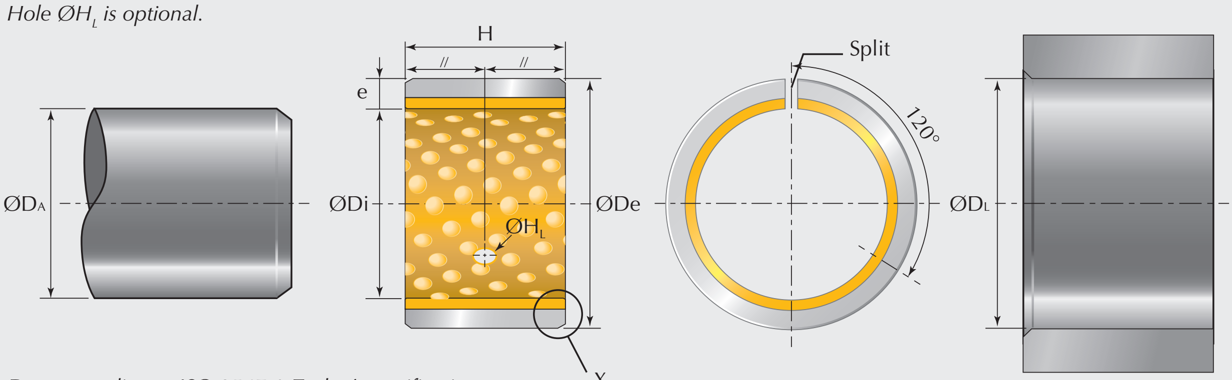
Characteristics	TY - ALG
Layer 1 (0,2 - 0,3)	Sintered bronze + graphit pellets in diamond pockets
Layer 2 (0,7 - 2,3)	Steel
Layer 3 (0,005 - 0,008)	Copper plating
Cylindrical bush	69.0091
Advantages	Possible dry use
Use	High temperature Difficult lubrication
Picture	

Applications

TY bushes are mainly used in applications with heavy loads and for which a specific greasing is needed. They are used in public works machinery, presses and mills. Thinner than bronze plain bearings, TY bushes often replace them.

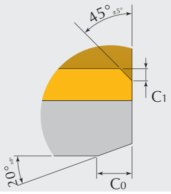
8) Dimensional list

Hole $ØH_L$ is optional.



Data according to ISO 3547 & Techné specifications

Detail X



e	C_0	C_1
0,75	0,5 ±0,3	0,3 ±0,2
1	0,6 ±0,3	0,3 ±0,2
1,5	0,6 ±0,4	0,4 ±0,3

e	C_0	C_1
2	1,2 ±0,4	0,6 ±0,3
2.5	1,8 ±0,4	0,6 ±0,4

Non exhaustive list, other dimensions on demand

ØDi	ØDe	Shaft $ØD_A$		Housing $ØD_L$		e	J	H_L	H	Techné ref.	
		Tol	max min	Tol	max min	max min	max min			TY-AS 69.0008	TY-AL 69.0009
10	12	h8	10 9,978	H7	12,018 12	0,995 0,935	0,17 0,01	4	10 ±0.25	1010	1010
									15	1015	1015
									20	1020	1020
12	14		12 11,973		14,018 14	0,995 0,935	0,175 0,01		10	1210	1210
									15	1215	1215
									20	1220	1220
									25	1225	1225
13	15		13 12,973		15,018 15	0,995 0,935	0,175 0,01		15	1315	1315
									20	1320	1320
14	16		14 13,973		16,018 16	0,995 0,935	0,175 0,01		10	1410	1410
									15	1415	1415
									20	1420	1420
									25	1425	1425
15	17		15 14,973		17,018 17	0,995 0,935	0,175 0,01		10	1510	1510
									15	1515	1515
									20	1520	1520
									25	1525	1525
16	18		16 15,973		18,018 18	0,995 0,935	0,175 0,01		10	1610	1610
									15	1615	1615
16	18		16 15,973		18,018 18	0,995 0,935	0,175 0,01		20	1620	1620
									25	1625	1625
17	19		17 16,973		19,021 19	0,995 0,935	0,178 0,01		15	1715	1715
									20	1720	1720
18	20		18 17,973		20,021 20	0,995 0,935	0,178 0,01		10	1810	
									15	1815	1815

ØDi	ØDe	Shaft $ØD_A$ Tol	Shaft $ØD_A$ max / min	Housing $ØD_L$ Tol	Housing $ØD_L$ max / min	e max / min	J max / min	H_L	H	Techné ref. TY-AS 69.0008	Techné ref. TY-AL 69.0009
18	**20**	h8	18 / 17,973	H7	20,021 / 20	0,995 / 0,935	0,178 / 0,01	4	**20**	1820	1820
									25	1825	1825
20	**22**		20 / 19,967		22,021 / 22	0,995 / 0,935	0,184 / 0,01		**10**	2010	2010
									15	2015	2015
									20	2020	2020
									25	2025	2225
20	**23**		20 / 19,967		23,021 / 23	1,49 / 1,43	0,194 / 0,02		**10**	0201	2310
									15	0205	2315
									20	2023	2320
									25	0020	2325
									30	2030	2030
22	**25**		22 / 21,967		25,021 / 25	1,49 / 1,43	0,194 / 0,02	6	**15**	2215	2215
									20	2220	2220
									25	2225	2555
									30	2230	2230
24	**27**		24 / 23,967		27,021 / 27	1,49 / 1,43	0,194 / 0,02		**15**	2415	2415
									20	2420	2420
									25	2425	2425
									30	2430	2430
25	**28**		25 / 24,967		28,021 / 28	1,49 / 1,43	0,194 / 0,02		**12**		2512
									15	2515	2528
									20	0252	2520
									25	2525	2525
									30	0002	2530
									40	2540	
									50	2550	2550
28	**32**		28 / 27,967		32,025 / 32	1,98 / 1,92	0,218 / 0,04		**15**	2815	2815
28	**32**		28 / 27,967		32,025 / 32	1,98 / 1,92	0,218 / 0,04		**20**	2820	2820
									25	2825	2825
									30	2830	2830
30	**34**		30 / 29,967		34,025 / 34	1,98 / 1,92	0,218 / 0,04		**15**	3015	3015
									20	3020	3020
									25	3022	3025
									30	3030	3030
									40	3040	3040
									50	0034	
32	**36**		32 / 31,961		36,025 / 36	1,98 / 1,92	0,224 / 0,04		**20**	3220	3220
									25	3225	3225
									30	3230	3236
									40	3240	3240
35	**39**		35 / 34,961		39,025 / 39	1,98 / 1,92	0,224 / 0,04		**20**	3520	3520
									25	3525	
									30	3530	3530
									35	3535	

ØDi	ØDe	Shaft $ØD_A$		Housing $ØD_L$		e	J	H_L	H	Techné ref.	
		Tol	max min	Tol	max min	max min	max min			TY-AS 69.0008	TY-AL 69.0009
35	39	h8	35 34,961	H7	39,025 39	1,98 1,92	0,224 0,04	6	40	3540	3540
									45	3545	3545
									50	3550	3550
									100	0004	
37	40		37 36,961		40,025 40	1,49 1,43	0,204 0,02		50	3750	
38	40		38 37,961		40,025 40	0,995 0,935	0,194 0,01		20	3840	
38	42		38 37,961		42,025 42	1,98 1,92	0,224 0,04		40	3842	
40	44		40 39,961		44,025 44	1,98 1,92	0,224 0,04	8	20	4020	4020
									25	4025	
									30	4030	4030
									40	4040	4040
									50	4050	4050
45	50		45 44,961		50,025 50	2,46 2,4	0,264 0,08		20	4520	4520
									30	4530	4530
									40	0454	4540
									45	4545	4545
									50	4550	4550
50	55		50 49,961		55,03 55	2,46 2,4	0,269 0,08		20	5020	5020
									25	5000	
									30	5030	5030
									34	5034	
									40	5055	5040
									50	5050	5050
									60	5060	5060
55	60		55 54,954		60,03 60	2,46 2,4	0,276 0,08		20	5520	5520
									30	5530	5530
									35	5535	
									40	5540	5540
									50	5550	5550
									55	5555	
									60	5560	5560
60	65		60 59,954		65,03 65	2,46 2,4	0,276 0,08		18	6018	
									20	6020	
									30	6030	6030
									35	6035	
									40	6040	6040
									50	6050	6050
									60	6065	6060
									70	6070	6070
65	70		65 64,954		70,03 70	2,46 2,4	0,276 0,08		30	6530	6530
									50	6550	6550

ØDi	ØDe	Shaft ØD$_A$		Housing ØD$_L$		e	J	H$_L$	H	Techné ref.	
		Tol	max min	Tol	max min	max min	max min			TY-AS 69.0008	TY-AL 69.0009
65	70	h8	65 64,954	H7	70,03 70	2,46 2,4	0,276 0,08	8	60	6560	6560
									70	6570	6570
70	75	h8	70 69,954	H7	75,03 75	2,46 2,4	0,276 0,08	8	40	7040	7040
									50	7050	7050
									60	7060	7060
									70	7070	7070
									80		7080
75	80	h8	75 74,954	H7	80,03 80	2,46 2,4	0,276 0,08	9	40	7540	7540
									50	7550	7550
									60	7560	7560
									70	7570	7570
									80	7580	7580
80	85	h8	80 79,954	H7	85,035 85	2,44 2,38	0,321 0,12	9	40±0,25	8085	8040
									50	0805	
									60	8086	8060
									80	8080	8080
									100	8010	8010
85	90	h8	85 84,946	H7	90,035 90	2,44 2,38	0,329 0,12	9	30	8530	8530
									60	8560	8560
									80	8580	8580
									100	8510	8510
90	95	h8	90 89,946	H7	95,035 95	2,44 2,38	0,329 0,12	9	40	9040	9040
									50		9050
									60	9060	9060
									80	9080	9080
									100	9010	9010
95	100	h8	95 94,946	H7	100,035 100	2,44 2,38	0,329 0,12	9	60	9560	9560
									100	9510	9510
100	105	h8	100 99,946	H7	105,035 105	2,44 2,38	0,329 0,12	9	20		1002
									35		1003
									50	0100	
									54		
									60	1006	1060
									80	1008	0100
									100	1001	1001
									115	1005	1115
105	110	h8	105 104,946	H7	110,035 110	2,44 2,38	0,329 0,12	9	60	1056	1056
									100	1051	1051
									115	0105	1055
110	115	h8	110 109,946	H7	115,035 115	2,44 2,38	0,329 0,12	9	60	1106	1106
									100	1100	1101
									115	0110	0115
115	120	h8	115 114,946	H7	120,035 120	2,44 2,38	0,329 0,12	9	12		1151

ØDi	ØDe	Shaft $ØD_A$		Housing $ØD_L$		e	J	H_L	H	Techné ref.	
		Tol	max min	Tol	max min	max min	max min			TY-AS 69.0008	TY-AL 69.0009
115	120	h8	115 114,946	H7	120,035 120	2,44 2,38	0,329 0,12	9	15		1152
									40		1154
									50	0115	1155
									60	1156	1156
									70	0120	1157
									100	1151	1112
120	125		120 119,946		125,04 125	2,44 2,38	0,334 0,12		50	0125	1205
									60	1206	1206
									100	1201	1201
125	130		125 124,937		130,04 130	2,44 2,38	0,343 0,12		25	0130	
									60	1256	1256
									100	1251	1251
130	135		130 129,937		135,04 135	2,44 2,38	0,343 0,12		60	1306	1306
									100	1301	0135
135	140		135 134,937		140,04 140	2,44 2,38	0,343 0,12		60	1356	1356
									80	0135	1358
									100	1351	1351
140	145		140 139,937		145,04 145	2,44 2,38	0,343 0,12		60	1406	1406
									100	1401	1401
145	150		145 144,937		150,04 150	2,44 2,38	0,343 0,12		60	1456	1456
									100	1451	1451
150	155		150 149,937		155,04 155	2,44 2,38	0,343 0,12		60	1506	1506
									80	0150	1508
									100	1501	1501
155	160		155 154,937		160,04 160	2,44 2,38	0,343 0,12		60	1556	1556
									100	1551	1551
160	165		160 159,937		165,04 165	2,44 2,38	0,343 0,12		60	1606	1606
									100	1601	1601
165	170		165 164,937		170,04 170	2,44 2,38	0,343 0,12		60	1656	1656
									100	1651	1651
170	175		170 169,937		175,04 175	2,44 2,38	0,343 0,12		60	1706	1706
									100	1701	1701
175	180		175 174,937		180,04 180	2,44 2,38	0,343 0,12		60	1756	
									100	1751	
180	185		180 179,937		185,046 185	2,44 2,38	0,349 0,12		60	1806	1806
									100	1801	1801
185	190		185 184,928		190,046 190	2,44 2,38	0,358 0,12		60	1856	
									100	1851	
190	195		190 189,928		195,046 195	2,44 2,38	0,358 0,12		60	1906	
									100	1901	
195	200		195 194,928		200,046 200	2,44 2,38	0,358 0,12		60	1956	
									100	1951	
200	205		200 199,928		205,046 205	2,44 2,38	0,358 0,12		60	2006	
									100	2001	

ØDi	ØDe	Shaft $ØD_A$		Housing $ØD_L$		e	J	H_L	H	Techné ref.	
		Tol	max min	Tol	max min	max min	max min			TY-AS 69.0008	TY-AL 69.0009
205	**210**	h8	205 204,928	H7	210,046 210	2,44 2,38	0,358 0,12	9	**60**	2056	
									100	2051	
210	**215**		210 209,928		215,046 215	2,44 2,38	0,358 0,12		**60**	2106	
									100	2101	
215	**220**		215 214,928		220,046 220	2,44 2,38	0,358 0,12		**60**	2156	
									100	2151	
220	**225**		220 219,928		225,046 225	2,44 2,38	0,358 0,12		**60**	2206	
									100	2201	
225	**230**		225 224,928		230,046 230	2,44 2,38	0,358 0,12		**60**	2256	
225	**230**		225 224,928		230,046 230	2,44 2,38	0,358 0,12		**100**	2251	
230	**235**		230 229,928		235.046 235	2.44 2.38	0.358 0.12		**60**	2306	
									100	2301	
235	**240**		235 234,928		240,046 240	2,44 2,38	0,358 0,12		**100**		
240	**245**		240 239,928		245,046 245	2,44 2,38	0,358 0,12		**60**	2406	
									100	2401	
250	**255**		250 249,928		255,052 255	2,44 2,38	0,364 0,12		**60**	2506	
									100	2501	
265	**270**		265 264,919		270,052 270	2,44 2,38	0,373 0,12		**15**		
280	**285**		280 279,919		285,052 285	2,44 2,38	0,373 0,12		**60**	2806	
									100	2801	
285	**290**		285 284,919		290,052 290	2,44 2,38	0,373 0,12		**100**		
300	**305**		300 299,919		305,052 305	2,44 2,38	0,373 0,12		**60**	3006	
									100	3001	

Flanged bushes and washers available on demand.

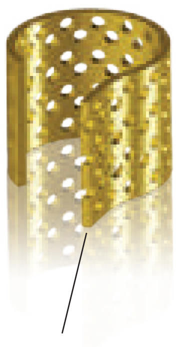
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250

1/8''
1/4''
3/8''
1/2''
5/8''
3/4''
7/8''
1''
1''1/8
1''1/4
1''3/8
1''1/2
1''5/8
1''3/4
1''7/8
2''
2''1/8
2''1/4
2''3/8
2''1/2
2''5/8
2''3/4
2''7/8
3''
3''1/8
3''1/4
3''3/8
3''1/2
3''5/8
3''3/4
3''7/8
4''
4''1/8
4''1/4
4''3/8
4''1/2
4''5/8
4''3/4
4''7/8
5''
5''1/8
5''1/4
5''3/8
5''1/2
5''5/8
5''3/4
5''7/8
6''
6''1/8
6''1/4
6''3/8
6''1/2
6''5/8
6''3/4
6''7/8
7''
7''1/8
7''1/4
7''3/8
7''1/2
7''5/8
7''3/4
7''7/8
8''
8''1/8
8''1/4
8''3/8
8''1/2
8''5/8
8''3/4
8''7/8
9''
9''1/8
9''1/4
9''3/8
9''1/2
9''5/8
9''3/4

Techné

TZ

TZ-T	69.0025	69.0251	69.4072
TZ-AS	69.0011	voir Techné	69.4002
TY-AL	69.0012	69.0015	69.4012


1

3 different kinds:
TZ-T with holes
TZ-AS with spherical pockets
TA-AL with diamond shaped pockets.

✓ TZ

TZ sliding bushes are composed with only one layer:

- A bronze layer (**1**) CuSn8P for sliding and loading support function. It also provides a good thermal conductivity and dimensional stability. To maintain a good lubrication and a long lifetime, TZ bushes' design can have holes or pockets.

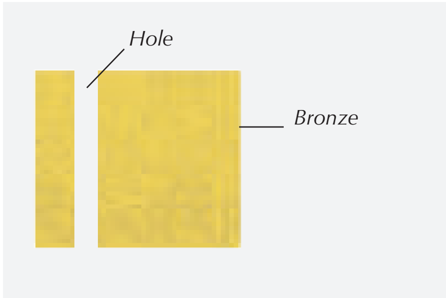


fig.39 • Micrographic structure of TZ

✓ Lubrication

TZ bushes can be lubricated either with grease or with oil. In order to increase lubrication supply, TZ bushes have holes. These holes allow a quick lubricant film creation and a low friction coefficient at the beginning of use. Thus TZ bushes are well appropriated to oscillation motions.
Holes can hold a larger quantity of grease than pockets. Thus they are well appropriate to severe environments where time between two lubrications is quite long.
Techné offers two different kinds of pockets with sizes from 1.5 to 3mm: spherical pockets TZ-AS for oil lubrication and diamond shaped pockets TZ-AL for grease lubrication.
When used with continuous oil lubrication, especially for hydrodynamic and mixed film lubrication, it is better not to have pockets, like our TZ-SA type. In such case, Techné offers bushes with feeding grooves.

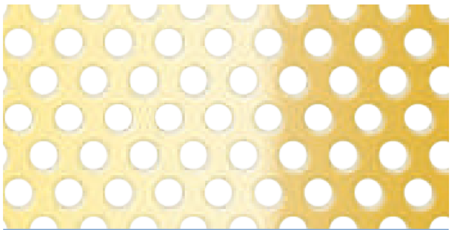


fig.41 • TZ-T plate

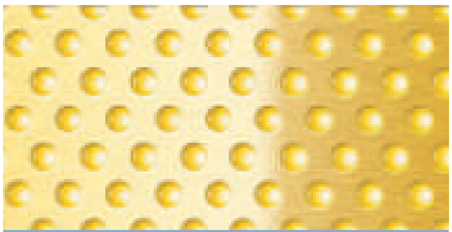


fig.40 • TZ-AS plate

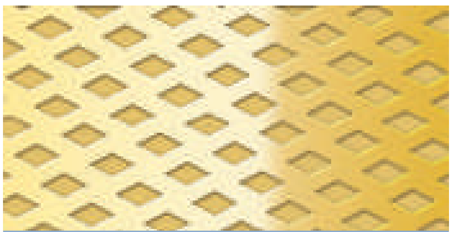


fig.42 • TZ-AL plate

1] Mechanical characteristics

Properties	Type	TZ	Unit
Load	Static	200	N/mm²
	Dynamic	100	N/mm²
	Oscillation	70	N/mm²
Speed	Greased	2	m/s
	Oil lubrication	> 3	m/s
Maximum PV factor	Greased	2,8	N/mm².m/s (W/mm²)
	Oil lubrication	> 10	N/mm².m/s (W/mm²)
Friction coefficient	Greased	0,05 ; 0,2	
	Oil lubrication	0,05 ; 0,12	
Shaft Hardness		>50	HRC
Shaft roughness	Greased	Ra : 0,4 - 1	µm
	Lubricated	Ra : 0.05 - 0.2	µm
Temperature		-40 ; +150	°C
Thermal conductivity		58	$W(m.K)^{-1}$
Coef. of thermal expansion		$18,5.10^{-6}$	K^{-1}

1. 150°C max, if the TZ is greased

2] Chemical characteristics

After analysis of each layer of the bush, Techné gives indication about chemical resistance. However because of the wide variety of available materials and grades, compatibility tests before final selection of the material are recommended.

✓ Chemical resistance

TZ bushes resist to water, alcohols, glycols, solvents, gasoline, diesel, kerosene and most of mineral oils (T° lower than 100°C). However sliding layer can be damaged by some strong acids, such as chloric, nitric, sulfuric acid and some gases such as free halogen or ammoniac, especially when these gases are humid. It is also not recommended to use them with HFC oils and in navy environment.
Finally TZ bushes cannot be assembled with aluminum shaft because of electrochemical corrosion risk in humid environment.

For applications with corrosion risk between shaft and bush, Techné advises to use shaft made of stainless steel with chrome plating or made with aluminum and anodizing.

3) Performances

✓ Material

TZ bushes are made from a rolled CuSn8P bronze strip. This material is well appropriate to support heavy loads even with oscillation motions.

It can bear a traction pressure up to 460 N/mm². Its yield strength is 260 N/mm².

ISO	% Cu	% Sn	% P
CuSn8P	91,3	8,3	0,1-0,3

✓ Load calculation $\overline{P}$

Load calculation P is the same as the one of TU bushes, so please check formula given page 14. However because of the pockets or holes, the sliding surface is reduced, so this parameter must be taken into account.

Lets' take example with a cylindrical TZ-AL bush, load calculation will be:

$$\overline{P} = \frac{F}{C_r\,.\,(Di\,.\,H)} = \frac{F}{0{,}76\,.\,(Di\,.\,H)}$$

Techné advises to use a coefficient C_r depending on the type of pockets:

- TZ-T : $C_r = 0.85$
- TZ-AS : $C_r = 0.79$
- TZ-AL : $C_r = 0.76$

✓ Circumference

For standard parts, Techné can provide TZ bushes with pockets or holes located on the split (see). However on request, Techné can also provide TZ bushes without any pockets or holes located on the split (see)

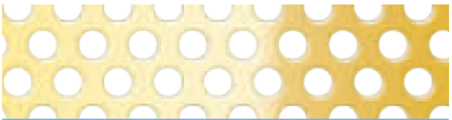


fig.43 • Standard TZ-T, with hole in edge

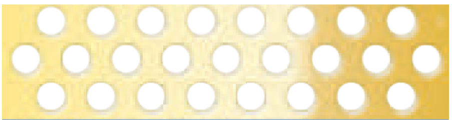


fig.44 • Special TZ-T, without hole in edge

4] PV factor

Calculated $\overline{PV}$ factor has to be lower than PV max of the bush :

$$\overline{PV}_{max} < PV_{max}$$

So for TZ bushes: $PV_{max} < 2.8$ (see table page 83 et , below)
Also pressure $\overline{P}$ and speed $\overline{V}$ values must be lower than the acceptable ones of the TZ bush.

Note: Maximal pressure $\overline{P}_{max}$ and maximal speed $\overline{V}_{max}$ of a given application may not be used simultaneously. In such a case, calculation of $\overline{PV}_{max}$ factor must not be $\overline{P}_{max}$ by $\overline{V}_{max}$, but pressure $\overline{P}_t$ by speed $\overline{V}_t$ at time t, and depending on t, chose the $\overline{PV}_{t\,max}$ factor.

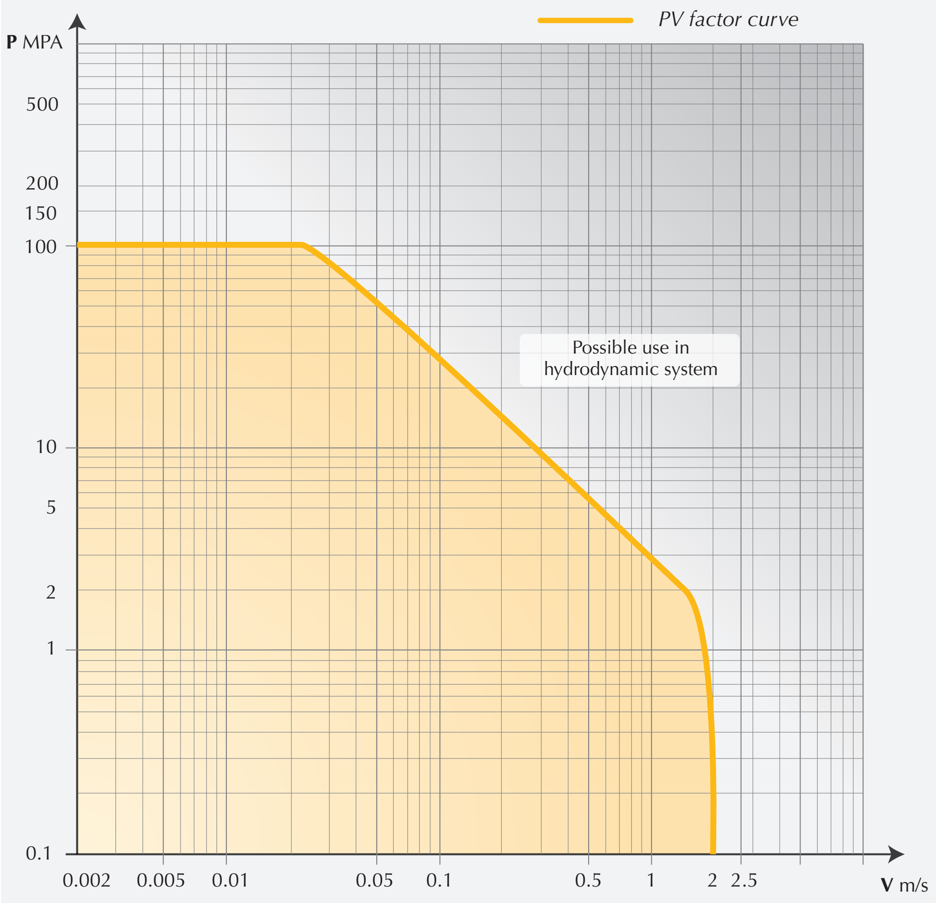


fig.45 • PV factor chart

5] Shaft and housing design

✓ Roughness

Shaft D_A	First lubricated	Constant lubrication		
Lubrication	/	Boundary	Mixed-film	Hydrodynamic
Ra (µm)	0,4 - 1	≤ 0.4	0.1 - 0.2	0.05 - 0.16
Rz (µm)	2 - 6	≤ 2	0.5 - 1	0.25 - 0.8

For a lubricated application, the lower the roughness, the easier it will be to create a hydrodynamic film. So the most severe the application is, the best roughness must be.

For housing D_L Techné recommends a roughness value of Rz 10.

✓ Bushing clearance

TZ bushes are assembled tightened in the housing, so it is unnecessary to use clamp or ring spacer to avoid TZ bush movement. For a standard use in a steel housing, Techné recommends the following tolerances for housing D_L:

However there must be a clearance between the shaft and the bush. This clearance is essential for the lifetime and performance of the bush. For the shaft, Techné recommends the following tolerances for shaft D_A:

Tolerances	Shaft D_A	Housing D_L
Ø5 - Ø300	f7	H7

✓ Reduction of edge fringing

A good alignment of TZ bushes is essential, especially when assembly is made of several bushes. Maximum misalignment defect is 0.02mm.

Load to bear can be reduced by an appropriate design. First of all, bushes must have an equal length and split must be properly aligned. Then one of the following assembly possibilities may be chosen:

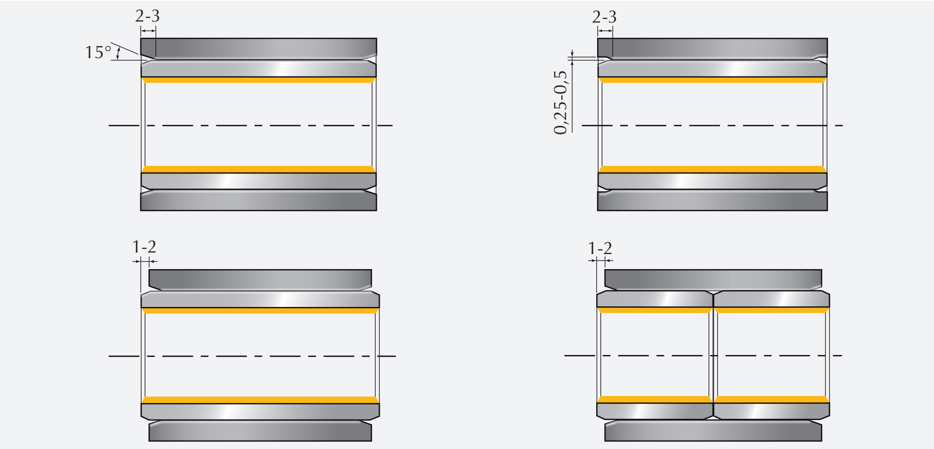


fig.46 • Different shapes in order to reduce edge fringing

✓ Clearance calculation

Maximal clearance J_{MAX}:

$J_{max} = D_{L\,max} - 2 . e - D_{A\,min}$

Minimal clearance J_{MIN}:

$J_{mini} = D_{L\,mini} - 2 . e - D_{A\,max}$

Clearance calculation does not include the potential deformation of the housing. To determine D_L, D_A and e values please check dimension table on page 74.

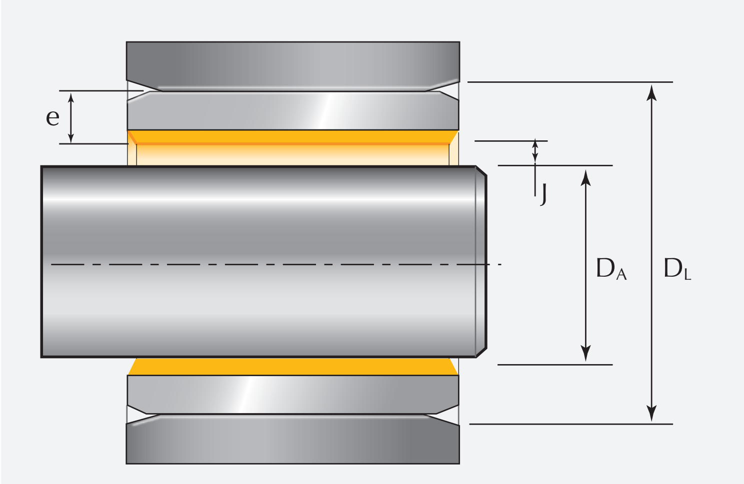


fig.49 • Clearance J

✓ Fitting chamfers

Cylindrical bushes

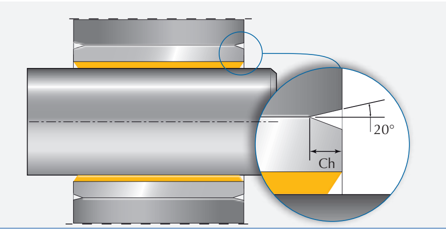


fig.47 • Chamfers Ch for a cylindrical bush

D_A	Ch ±0,5
2 - 30	0,8
30 - 80	1.2
80 - 180	1,8
> 180	2,5

Flanged bushes

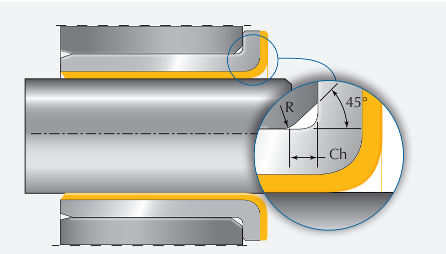


fig.48 • Chamfers Ch for a flanged bush

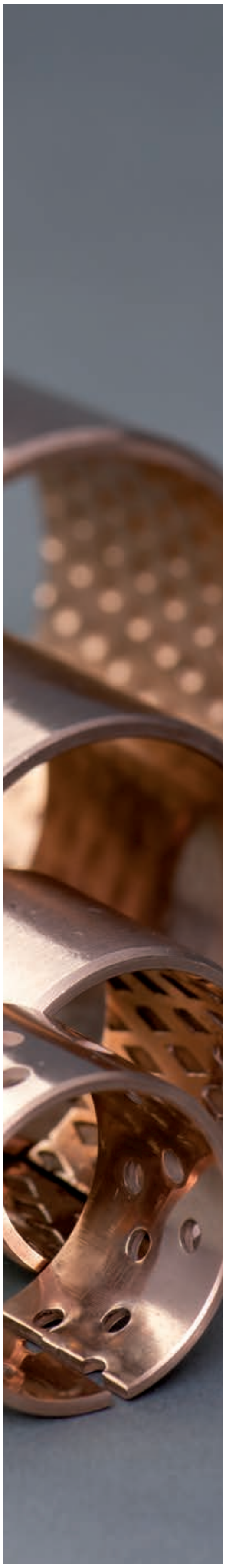
D_A	Ch ±0,5
2 - 20	1,2
20 - 28	1,7
28 - 45	2,2
> 45	2,7

R : the chamfer edge must be rounded

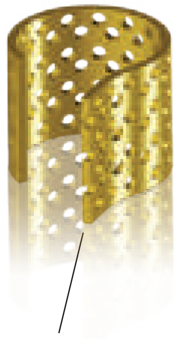
✓ Assembly

Assembly of TZ bushes is the same as for TU bushes. For more details please check page 22.

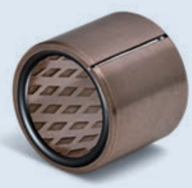
6) Others



For specific application or environment, Techné offers bushes that meet customers' requirements.
Only Techné TZ-ALG bush and TZ + O-Ring are hereafter described. However Techné's R&D department can develop specific design on request.



1

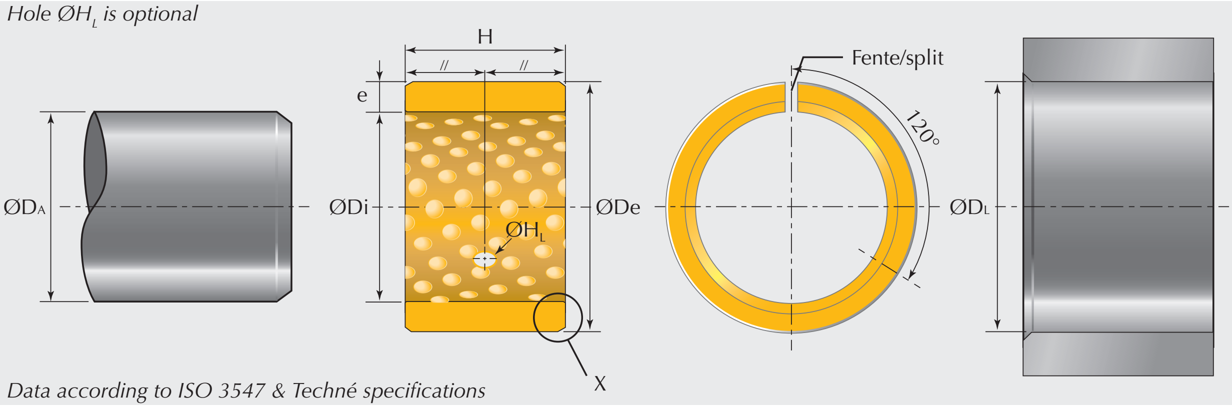
Characteristics	TZ - ALG	TZ + o-ring
Layer 1	Bronze with diamond pockets & graphite pellets	Bronze
Cylindrical bush	69.0092	on demand
Washer	69.4062	on demand
Advantage	Possible dry use	External pollution can't come inside
Use	High temperature Difficult lubrication	can be used with high pollution (dust, mud, etc.)
Picture		

Applications

TZ designs are perfectly appropriate to heavy loads especially for transportation vehicles, presses, mills, as well as all industrial systems.

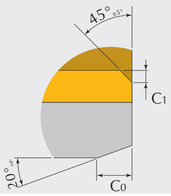
7) Dimensional list

Hole $ØH_L$ is optional



Data according to ISO 3547 & Techné specifications

Detail X



e	C_0	C_1
0,75	0,5 ±0,3	0,3 ±0,2
1	0,6 ±0,3	0,3 ±0,2
1,5	0,6 ±0,4	0,4 ±0,3

e	C_0	C_1
2	1,2 ±0,4	0,6 ±0,3
2.5	1,8 ±0,4	0,6 ±0,4

Non exhaustive list, other dimensions on demand

ØDi	ØDe	Shaft $ØD_A$ Tol	Shaft $ØD_A$ max / min	Housing $ØD_L$ Tol	Housing $ØD_L$ max / min	ØDi after fitting Tol	ØDi after fitting max / min	J max / min	(H_L)	H	Techné ref. TZ-AS 69.0011	Techné ref. TZ-AL 69.0012	Techné ref. TZ-T 69.0025
8	10	f7	7,987 / 7,972	H7	10,015 / 10	H9	8,036 / 8	0,103 / 0,013	4	8 ±0,25		0808	
10	12		9,987 / 9,972		12,018 / 12		10,036 / 10	0,106 / 0,013		10		1010	
										15		1015	
										20		1020	
12	14		11,984 / 11,966		14,018 / 14		12,043 / 12	0,112 / 0,016		10		1210	
										15		1215	
										20		1220	
										25		1225	
13	15		12,984 / 12,966		15,018 / 15		13,043 / 13	0,112 / 0,016		10		1310	
14	16		13,984 / 13,966		16,018 / 16		14,043 / 14	0,112 / 0,016		10		1410	
										15		1415	
										20		1420	
										25		1425	
15	17		14,984 / 14,966		17,018 / 17		15,043 / 15	0,112 / 0,016		10		1510	
										15		1515	
										20		1520	
										25		1525	
16	18		15,984 / 15,966		18,018 / 18		16,043 / 16	0,112 / 0,016		10		1610	
										12,5		1618	
										15		1615	
										20		1620	
										25		1625	
17	19		16,984 / 16,966		19,021 / 19		17,043 / 17	0,115 / 0,016		15		1715	

ØDi	ØDe	Shaft $ØD_A$		Housing $ØD_L$		ØDi after fitting		J	(H_L)	H	Techné ref.		
		Tol	max min	Tol	max min	Tol	max min	max min			TZ-AS 69.0011	TZ-AL 69.0012	TZ-T 69.0025
18	**20**	f7	17,984 17,966	H7	20,021 20	H9	18,043 18	0,115 0,016	4	**10**		1810	
										15		1815	
										20		1820	
										25		1825	
20	**22**		19,98 19,959		22,021 22		20,052 20	0,122 0,020		**10**		2010	
										15		0215	
										20		2020	
										25		2025	
20	**23**		19,98 19,959		23,021 23		20,052 20	0,132 0,020		**10**		0201	
										15	2015	2015	2015
										20		0202	2020
										25		0225	
										30		0203	2030
22	**25**		21,98 21,959		25,021 25		22,052 22	0,132 0,020	6	**15**		2215	
										20		2220	2220
										25		2225	
										30		2230	
24	**27**		23,98 23,959		27,021 27		24,052 24	0,132 0,020		**15**		2415	
										20		2420	
										25		2425	
										30		2430	
25	**28**		24,98 24,959		28,021 28		25,052 25	0,132 0,020		**12**		2512	
										15	2515	2515	2515
										20	2520	2520	2520
										25		2525	2525
										30		2530	2530
										40		2528	
25	**30**		24,98 24,959		30,021 30		25,052 25	0,162 0,020		**29**		2529	
28	**32**		27,98 27,959		32,025 32		28,052 28	0,146 0,020		**20**		2820	
										25		2825	
										30		2830	
30	**34**		29,98 29,959		34,025 34		30,052 30	0,146 0,020		**15**		3015	
										20		3020	3020
										25		3025	
										30	3030	3030	3030
										40		3040	3040
										50			3050
32	**36**		31,975 31,95		36,025 36		32,062 32	0,155 0,025		**20**		3220	
										30		3230	3230
										40		3240	
35	**39**		34,975 34,95		39,025 39		35,062 35	0,155 0,025		**15**		3515	
										20		3520	3520
										30		3530	3530
										35		3535	

ØDi	ØDe	Shaft ØD$_A$		Housing ØD$_L$		ØDi after fitting		J	(H_L)	H	Techné ref.		
		Tol	max min	Tol	max min	Tol	max min	max min			TZ-AS 69.0011	TZ-AL 69.0012	TZ-T 69.0025
35	39	f7	34,975 34,95	H7	39,025 39	H9	35,062 35	0,155 0,025	6	40		3540	3540
										50		3550	
40	44		39,975 39,95		44,025 44		40,062 40	0,155 0,025	8	20		4020	4020
										30	4430	4430	4030
										40		4040	4044
										50		4050	4050
45	49		44,975 44,95		49,025 49		45,062 45	0,155 0,025		20		4520	
										45		0002	
45	50		44,975 44,95		50,025 50		45,062 45	0,175 0,025		20		0452	452
										30	4530	4530	4530
										40	4540	4540	4540
										50		4550	4550
										55		4555	
50	55		49,975 49,95		55,03 55		50,062 50	0,180 0,025		20		5020	
										30		5030	5030
										40	5040	5040	5040
										50		5050	5050
										60		5060	5060
										65		5055	
55	60		54,97 54,94		60,03 60		55,074 55	0,190 0,030		10		5510	
										20		5520	
										30	5530	5530	
										40		5540	5560
										50	5550	5550	
										60		5560	
60	65		59,97 59,94		65,03 65		60,074 60	0,190 0,030		15		6015	
										30		6030	6030
										40		6040	6040
										50	6050	6050	6050
										60		6060	6060
										70		6070	6070
65	70		64,97 64,94		70,03 70		65,074 65	0,190 0,030		30		6530	
										50		6550	
										60		6560	6570
										70		6570	
70	75		69,97 69,94		75,03 75		70,074 70	0,190 0,030		40		7040	7075
										50		7050	
										60		7060	7060
										70		7070	7070
75	80		74,97 74,94		80,03 80		75,074 75	0,190 0,030	9,5	40		7540	7540
										50		7550	
										60		7560	
										70		7570	
										80		7580	7580

ØDi	ØDe	Shaft ØD$_A$ Tol	Shaft ØD$_A$ max / min	Housing ØD$_L$ Tol	Housing ØD$_L$ max / min	ØDi after fitting Tol	ØDi after fitting max / min	J max / min	(H$_L$)	H	Techné ref. TZ-AS 69.0011	Techné ref. TZ-AL 69.0012	Techné ref. TZ-T 69.0025
80	85	f7	79,97 79,94	H7	85,035 85	H9	80,074 80	0,195 0,030	9,5	40 ±0,5		8040	8040
										60		8060	8086
										80		8080	8080
85	90		84,964 84,929		90,035 90		85,087 85	0,206 0,036		60		8560	
										80		8580	
90	95		89,964 89,929		95,035 95		90,087 90	0,206 0,036		40		9040	9040
										60		9060	9060
										80		9080	
										100		9010	
95	100		94,964 94,929		100,035 100		95,087 95	0,206 0,036		60		9560	
100	105		99,964 99,929		105,035 105		100,087 100	0,206 0,036		50		1005	1005
										54		1054	
										60		1006	1006
										80		1008	1008
105	110		104,964 104,929		110,035 110		105,087 105	0,206 0,036		60		1056	
										100		1051	
110	115		109,964 109,929		115,035 115		110,087 110	0,206 0,036		60		1106	
										100		1101	
115	120		114,964 114,929		120,035 120		115,087 115	0,206 0,036		30		0115	
										60		1156	
										100		1151	
120	125		119,964 119,929		125,04 125		120,087 120	0,211 0,036		60		1206	
										100		1201	
125	130		124,957 124,917		130,04 130		125,1 125	0,223 0,043		55		0125	
										60		1256	125
										100		1251	
130	135		129,957 129,917		135,04 135		130,1 130	0,223 0,043		60		1306	
										100		1301	
135	140		134,957 134,917		140,04 140		135,1 135	0,223 0,043		60		1356	
										100		1351	
140	145		139,957 139,917		145,04 145		140,1 140	0,223 0,043		60		1406	
										100		1401	
145	150		144,957 144,917		150,04 150		145,1 145	0,223 0,043		60		1456	145
										100		1451	
150	155		149,957 149,917		155,04 155		150,1 150	0,223 0,043		60		1506	
										100		1501	
155	160		154,957 154,917		160,04 160		155,1 155	0,223 0,043		60		1556	
										100		1551	
160	165		159,957 159,917		165,04 165		160,1 160	0,223 0,043		60		1606	
										100		1601	
165	170		164,957 164,917		170,04 170		165,1 165	0,223 0,043		60		1656	
										100		1651	

ØDi	ØDe	Shaft $ØD_A$		Housing $ØD_L$		ØDi after fitting		J	(H_L)	H	Techné ref.		
		Tol	max min	Tol	max min	Tol	max min	max min			TZ-AS 69.0011	TZ-AL 69.0012	TZ-T 69.0025
170	**175**		169,957 169,917		175,04 175		170,1 170	0,223 0,043		**60**		1706	170
										100		1701	
175	**180**		174,957 174,917		180,04 180		175,1 175	0,223 0,043		**60**		1756	
										100		1751	
180	**185**		179,957 179,917		185,046 185		180,1 180	0,249 0,063		**60**		1806	
										100		1801	
185	**190**		184,95 184,904		190,046 190		185,115 185	0,262 0,070		**60**		1856	
										100		1851	
190	**195**		189,95 189,904		195,046 195		190,115 190	0,262 0,070		**60**		1906	
										100		1901	
195	**200**		194,95 194,904		200,046 200		195,115 195	0,262 0,070		**60**		1956	
										100		1951	
200	**205**		199,95 199,904		205,046 205		200,115 200	0,262 0,070		**60**		2006	
										100		2001	
205	**210**		204,95 204,904		210,046 210		205,115 205	0,262 0,070		**60**		2056	
										100		2051	
210	**215**		209,95 209,904		215,046 215		210,115 210	0,262 0,070		**60**		2106	
										100		2101	
215	**220**		214,95 214,904		220,046 220		215,115 215	0,262 0,070		**60**		2156	
										100		2151	
220	**225**	f7	219,95 219,904	H7	225,046 225	H9	220,115 220	0,262 0,070	9,5	**60**		2206	
										100		2201	
225	**230**		224,95 224,904		230,046 230		225,115 225	0,262 0,070		**60**		2256	
										100		2251	
230	**235**		229,95 229,904		235,046 235		230,115 230	0,262 0,070		**60**		2306	
										100		2301	
235	**240**		234,95 234,904		240,046 240		235,115 235	0,262 0,070		**100**		2351	
240	**245**		239,95 239,904		245,046 245		240,115 240	0,262 0,070		**60**		2406	
										100		2401	
250	**255**		249,95 249,904		255,052 255		250,115 250	0,288 0,090		**60**		2506	
										100		2501	
265	**270**		264,944 264,892		270,052 270		265,13 265	0,300 0,096		**15**		0270	
280	**285**		279,944 279,892		285,052 285		280,13 280	0,300 0,096		**60**		2806	
										100		2801	
285	**290**		284,944 284,892		290,052 290		285,13 285	0,300 0,096		**100**		0285	
300	**305**		299,944 299,892		305,052 305		300,13 300	0,300 0,096		**60**		3006	
300	**305**		299,944 299,892		305,052 305		300,13 300	0,300 0,096		**100**		3001	

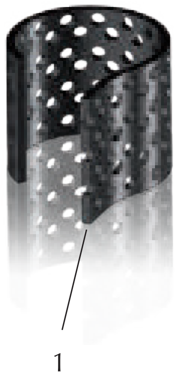
Flanged bushes and washers available on demand.

TA

TA-T 69.3000 69.2672

TA-AL 69.3100

1] Structure



✓ TA

Cost saving alternative of TZ bushes, TA sliding bushes are composed with only one layer:

- A DC01 steel layer (**1**) for sliding and loading support function. It also provides a good thermal conductivity and dimensional stability. To maintain a good lubrication and a long lifetime, TA bushes' design can have holes or pockets.

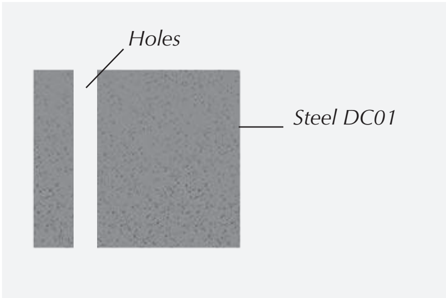


fig.50 • Micrographic structure of TA

3 different kinds:
TA-T with holes
TA-AS with spherical pockets
TA-AL with diamond shaped pockets

✓ Lubrication

TA bushes can be lubricated either with grease or with oil. In order to increase lubrication supply, TA bushes have holes. These holes allow a quick lubricant film creation and a low friction coefficient at the beginning of use. Thus TA bushes are well appropriate to oscillation motions.
Holes can hold a larger quantity of grease than pockets. Thus they are well appropriate to severe environments where time between two lubrications is quite long.
Techné offers two different kinds of pockets with sizes from 1.5 to 3mm: spherical pockets TA-AS that are appropriate to oil lubrication and diamond shaped pockets TA-AL that are appropriate to grease lubrication.
In application with continuous oil lubrication, especially for hydrodynamic and mixed film lubrication, it is better not to have pockets, like our TA-SA type. In such case, Techné offers bushes with feeding grooves.

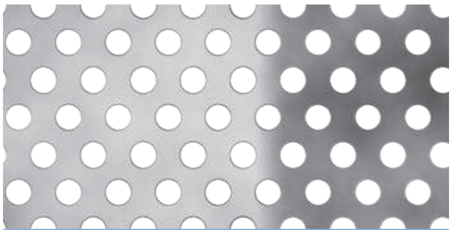


fig.52 • TA-T plate

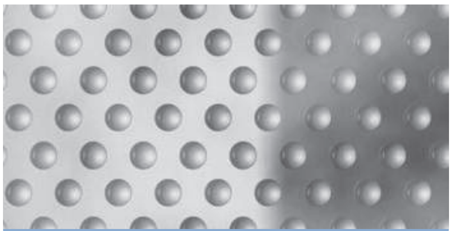


fig.51 • TA-AS plate

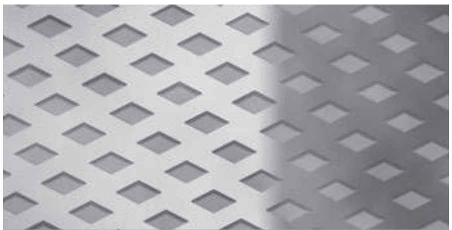


fig.53 • TA-AL plate

2) Mechanical characteristics

Properties	Type	TA	Unit
Load	Static	250	N/mm^2
	Dynamic	100	N/mm^2
	Oscillation	60	N/mm^2
Speed	Greased	2	m/s
	Oil lubrication	> 3	m/s
Maximum PV factor	Greased	2	$N/mm^2.m/s$ (W/mm^2)
	Oil lubrication	> 10	$N/mm^2.m/s$ (W/mm^2)
Friction coefficient	Greased	0,05 ; 0,2	
	Oil lubrication	0,05 ; 0,12	
Shaft Hardness		>56	HRC
Shaft roughness	Greased	Ra : 0,4 ; 0,8	µm
	Lubricated	Ra : 0.05 ; 0.2	µm
Temperature		-40 ; +150	°C
Thermal conductivity		46	$W(m.K)^{-1}$
Coef. of thermal expansion		12.10^{-6}	K^{-1}

1. 150°C max, if TA is greased

3) Chemical characteristics

After analysis of each layer of the bush, Techné gives indication about chemical resistance. However because of the wide variety of available materials and grades, compatibility tests before final selection of the material are recommended.

Chemical resistance

TA bushes resist to water, alcohols, glycols, solvents, gasoline, diesel, kerosene and most of mineral oils (T° lower than 100°C). However sliding layer can be damaged by some strong acids, such as chloric, nitric, sulfuric, acetic and formic acids. It is also not recommended to use them with HFC oils and in navy environment.
If used in a humid application, TA bush shall be greased carefully to protect it from rust.

For applications with corrosion risk between shaft and bush, Techné advises to use shaft made of stainless steel with chrome plating or made with aluminum and anodizing.

4] Performances

✓ Material

TA bushes are made from a rolled DC01 steel strip. This material is well appropriate to support heavy loads even with oscillation movements.

It can bear a traction pressure up to 270 N/mm². Its yield strength is 260 N/mm².

EN 10139	Nb	% Fe	% C	% Mn	% P	% S
DC01-270	1.0330	balance	max 0,12	max 0,6	max 0,045	max 0,045

After wrapping, the bush is carbonitrided.
The carbonitriding is a projection of carbon atoms on the bush at temperature range 800 and 850°C in nitrogen atmosphere. Then the bush is quenched.

✓ Load calculation $\overline{P}$

Load calculation P is the same as the one of TU bushes, so please check formula given page 14. However because of the pockets or holes, the sliding surface is reduced, so this parameter must be taken into account.

Lets' take example with a cylindrical TA-AL bush, load calculation will be:

$$\overline{P} = \frac{F}{C_r \cdot (Di \cdot H)} = \frac{F}{0{,}76 \cdot (Di \cdot H)}$$

Techné advises to use a coefficient C_r depending on the type of pockets:

- TA-T : $C_r = 0.85$
- TA-AS : $C_r = 0.79$
- TA-AL : $C_r = 0.76$

✓ Circumference

For standard parts, Techné can provide TA bushes with pockets or holes located on the split (see).
However on request, Techné can also provide TA bushes without any pockets or holes located on the split (see)

fig.54 • Standard TA-T, with hole in edge

fig.55 • Special TA-T, without hole in edge

5) Facteur PV

Calculated $\overline{PV}$ factor has to be lower than PV max of the bush :

$$\overline{PV}_{max} < PV_{max}$$

So for TA bushes: $PV_{max} < 2$ (see table page 83 et , below)
Also pressure $\overline{P}$ and speed $\overline{V}$ values must be lower than the acceptable ones of the TA bush.

Note: Maximal pressure $\overline{P}_{max}$ and maximal speed $\overline{V}_{max}$ of a given application may not be used simultaneously. In such a case, calculation of $\overline{PV}_{max}$ factor must not be $\overline{P}_{max}$ by $\overline{V}_{max}$, but pressure $\overline{P}_t$ by speed $\overline{V}_t$ at time t, and depending on t, chose the $\overline{PV}_{t\,max}$ factor.

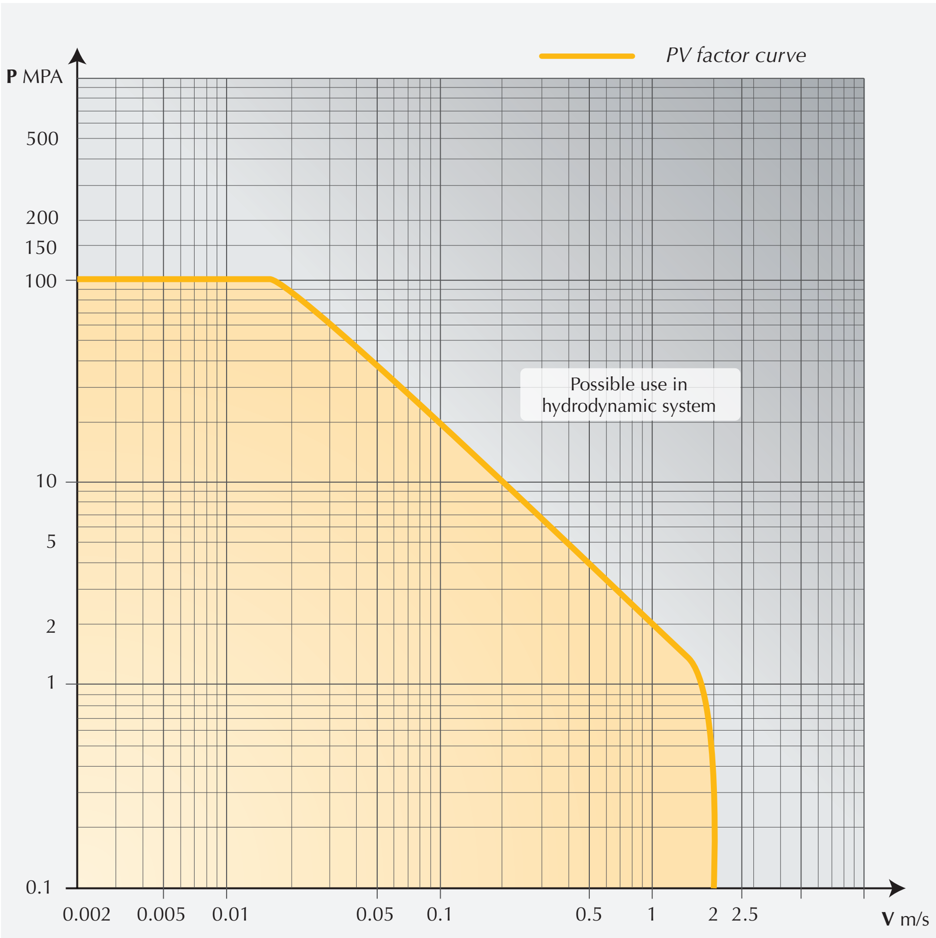
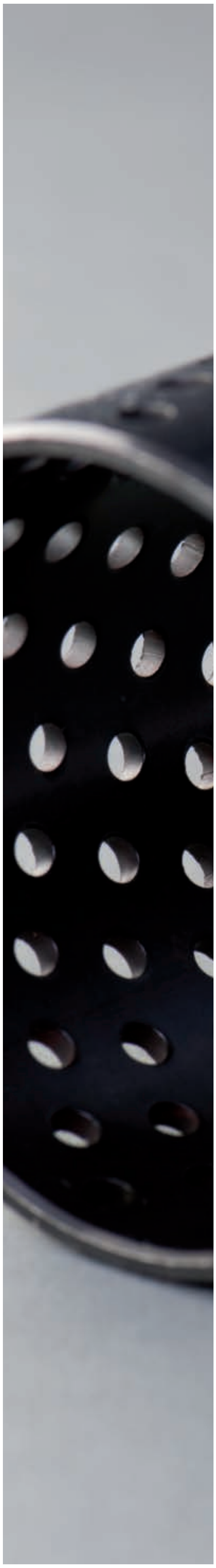


fig.56 • PV factor chart



6) Shaft and housing design

✓ Roughness

Shaft D_A	First lubricated	Constant lubrication		
Lubrication	/	Boundary	Mixed-film	Hydrodynamic
Ra (µm)	0,4 - 0,8	≤ 0.4	0.1 - 0.2	0.05 - 0.16
Rz (µm)	2 - 4	≤ 2	0.5 - 1	0.25 - 0.8

For a lubricated application, the lower the roughness, the easier it will be to create a hydrodynamic film. So the most severe the application is, the best roughness must be.

For housing D_L Techné recommends a roughness value of Rz 10.

✓ Bushing clearance

TA bushes are assembled tightened in the housing, so it is unnecessary to use clamp or ring spacer to avoid TA bush movement. For a standard use in a steel housing, Techné recommends the following tolerances for housing D_L:

However there must be a clearance between the shaft and the bush. This clearance is essential for the lifetime and performance of the bush. For the shaft, Techné recommends the following tolerances for shaft D_A:

Tolerance	Shaft D_A	Housing D_L
Ø5 - Ø300	f7	H7

On request, Techné provides TA bushes with clearance according customers' specification.

✓ Assembly

Assembly of TA bushes is the same as for TU bushes. For more details please check page 22. Techné advises to use lithium grease for TA lubrication.

Applications

TA bushes are perfectly appropriate to heavy loads, especially for transportation vehicles, presses, mills, as well as all industrial systems.

0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250

1/8" 1/4" 3/8" 1/2" 5/8" 3/4" 7/8" 1" 1"1/8 1"1/4 1"3/8 1"1/2 1"5/8 1"3/4 1"7/8 2" 2"1/8 2"1/4 2"3/8 2"1/2 2"5/8 2"3/4 2"7/8 3" 3"1/8 3"1/4 3"3/8 3"1/2 3"5/8 3"3/4 3"7/8 4" 4"1/8 4"1/4 4"3/8 4"1/2 4"5/8 4"3/4 4"7/8 5" 5"1/8 5"1/4 5"3/8 5"1/2 5"5/8 5"3/4 5"7/8 6" 6"1/8 6"1/4 6"3/8 6"1/2 6"5/8 6"3/4 6"7/8 7" 7"1/8 7"1/4 7"3/8 7"1/2 7"5/8 7"3/4 7"7/8 8" 8"1/8 8"1/4 8"3/8 8"1/2 8"5/8 8"3/4 8"7/8 9" 9"1/8 9"1/4 9"3/8 9"1/2 9"5/8 9"3/4

Techné

TR

1] Structure

TR 69.7003 69.7002 69.7004

1 2

✓ TR

Self-lubricant, TR bushes are composed with 2 layers:

- A solid lubricant layer (**1**) made of a mix of PTFE and lead. It offers very high performance against wear and friction. Its thickness is between 0.01 and 0.05mm.

A bronze mesh (CuSn6) (**2**), which provides mechanical resistance and flexibility.

Standard thickness of TR Bushes are $0{,}5^{0}_{-0.05}$ and $1^{0}_{-0.05}$ mm. Other thicknesses are available on demand (maxi 1mm).

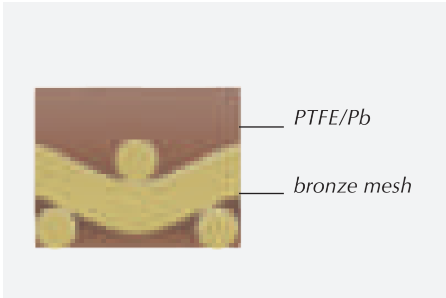


fig.57 • Micrographique structure of TR

✓ Advantages

Thanks to its reduced thickness, TR-bush can be set up in very tight systems, providing good sliding properties. It is malleable and easy to assembly. After being assembled in its housing, a flange can even be easily created.

✓ Dimensions

TR bushes are produced according customers' demand. Techné does not provide any dimensional list.

2) Mechanical characteristics

Properties	Type	TR	Unit
Load	Static	100	N/mm²
	Dynamic	80	N/mm²
	Oscillation	80	N/mm²
Speed	First lubricated	1	m/s
	Continuous lubrication	> 3	m/s
Max PV factor	Dry	1,6	N/mm².m/s (W/mm²)
	hydrodynamic lubrication (oil)	> 10	N/mm².m/s (W/mm²)
Friction coefficient	Dry	0,05 ; 0,25	
	Oil lubrication	0,05 ; 0,12	
Shaft hardness		>53	HRC
Shaft roughness	lubricated	Ra : 0,3 - 0,6	µm
	Hydrodynamic	Ra : 0.05 - 0.2	µm
Temperature		-200 ; +260	°C

3) Chemical characteristics

After analysis of each layer of the bush, Techné gives indication about chemical resistance. However because of the wide variety of available materials and grades, compatibility tests before final selection of the material are recommended.

✓ Chemical resistance

TR bushes resist to water, alcohols, glycols, solvents, gasoline, diesel, kerosene and most of mineral oils (T° lower than 100°C). However sliding layer can be damaged by some strong acids, such as chloric, nitric, sulfuric acid and some gases such as free halogen or ammoniac, especially when these gases are humid. It is also not recommended to use it with HFC oils and in navy environment.

Finally TR bushes shall not be assembled with aluminum shaft because of electrochemical corrosion risk in humid environment.

For applications with corrosion risk between shaft and bush, Techné advises to use shaft made of stainless steel with chrome plating or made with aluminum and anodizing

4) Sliding performance

✓ Friction coefficient

Wear coefficient Δu of TR bushes fluctuates depending of the application. It decreases when the working pressure P is high and the speed V is low. TR bushes are therefore adapted to low speed applications (see diagram). Moreover, TR bushes have a running in period to be taken into account: at the beginning of use, the sliding surface quickly runs in. (see TU bushes page 12).

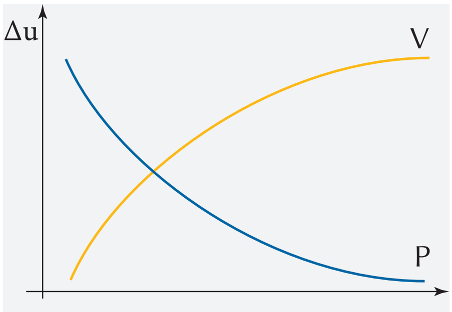
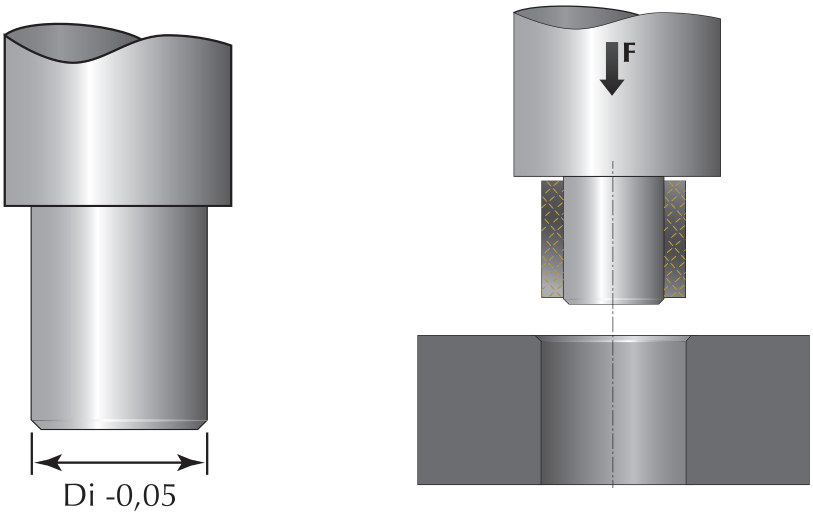


fig.58 • Wear coef. Δu, fonction of V or P

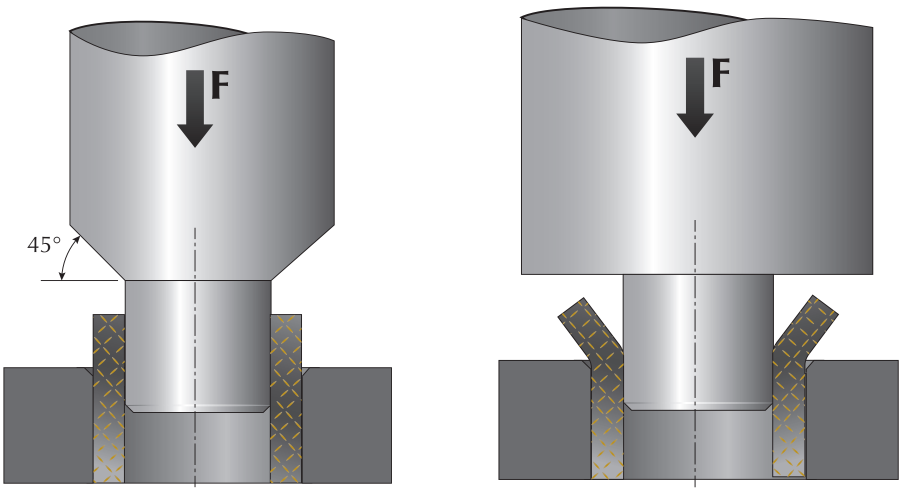
✓ Assembly

Because of its meshed structure and its tight thickness, a particular attention must be paid during assembly: mandrel diameter must be < Di-0.05.

It is not necessary to use a press to set up TR-bushes. Chamfers must be made on the rod and on the housing.



A flange can be formed with the help of 2 mandrels: a conical one for the first bend and a shouldered one to definitely form the flange.



5) PV factor

Calculated $\overline{PV}$ factor has to be lower than PV max of the bush :

$$\overline{PV}_{max} < PV_{max}$$

So for TR bushes: $PV_{max} < 1.6$ (see table page 105 et , below)
Also pressure $\overline{P}$ and speed $\overline{V}$ values must be lower than the acceptable ones of the TA bush.

Note: Maximal pressure $\overline{P}_{max}$ and maximal speed $\overline{V}_{max}$ of a given application may not be used simultaneously. In such a case, calculation of $\overline{PV}_{max}$ factor must not be $\overline{P}_{max}$ by $\overline{V}_{max}$, but pressure $\overline{P}_t$ by speed $\overline{V}_t$ at time t, and depending on t, chose the $\overline{PV}_{t\,max}$ factor.

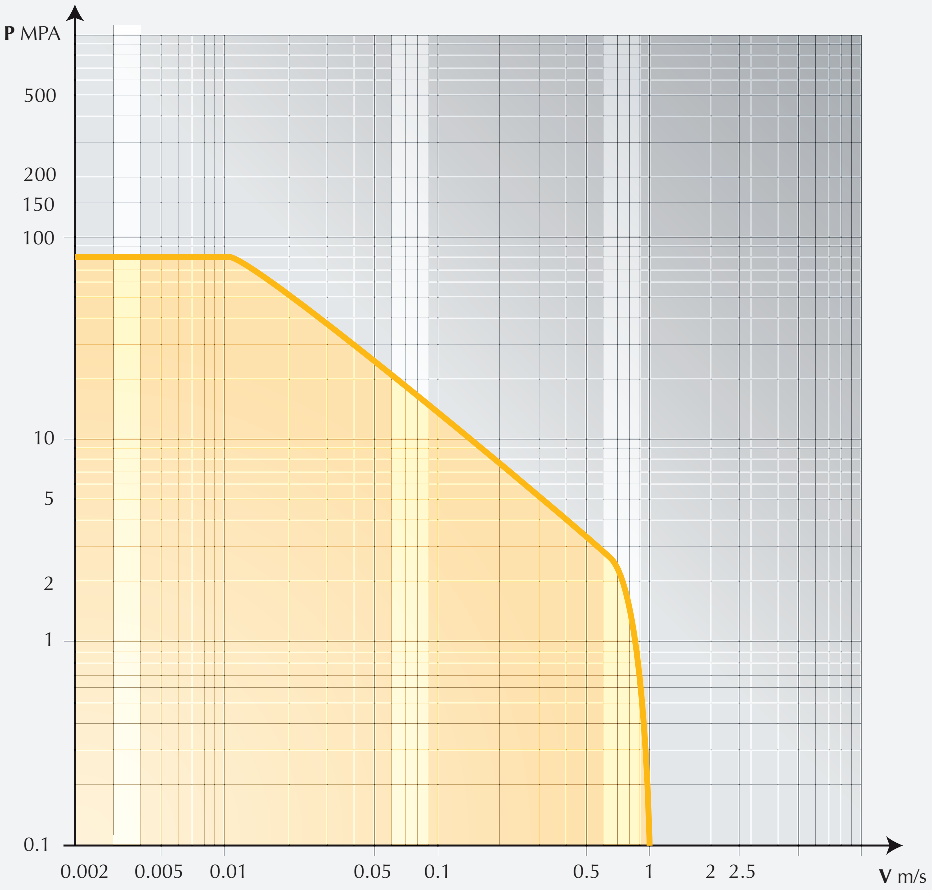
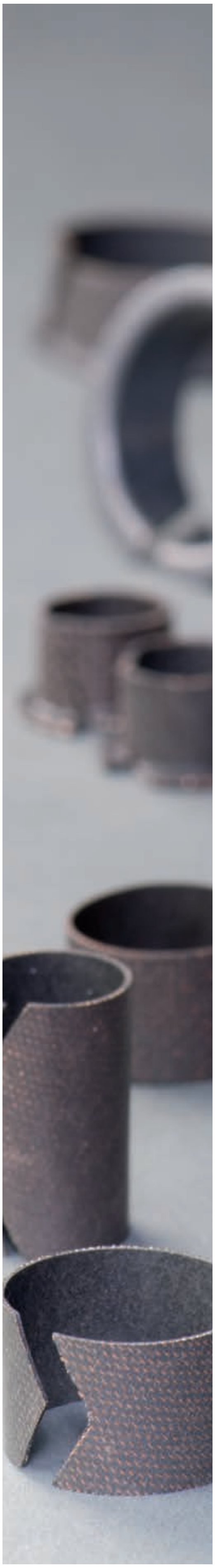
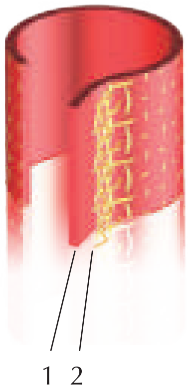


fig.59 • PV factor chart



6) Others

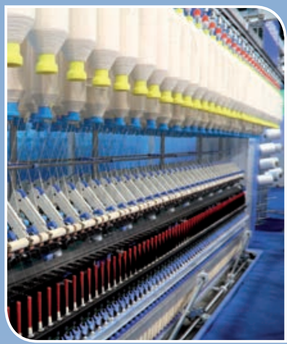
For specific application or environment, Techné offers bushes that meet customer's requirements.
Only TR4 Techné bushes are hereafter described. However Techné's R&D department can develop specific design on request.



Caracteristiques	TR4
Layer 1	PTFE + polymer
Layer 2	Bronze mesh CuSn6
Cylindrical bushing	69.7013
Flange bushing	69.7012
Washer	69.7014
Advantages	Better mechanical resistance. Suitable for oscillating and reciprocating motion. Environmental standard compliance
Use	Automotive market: seatbelt, door hinge, mechanism seat
picture	

Applications

TR bushes are mainly used in automotive systems such as door hinges, seats and safety belt mechanisms. They are also used in sport benches and in many industrial applications.



0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250

1/8"
1/4"
3/8"
1/2"
5/8"
3/4"
7/8"
1"
1"1/8
1"1/4
1"3/8
1"1/2
1"5/8
1"3/4
1"7/8
2"
2"1/8
2"1/4
2"3/8
2"1/2
2"5/8
2"3/4
2"7/8
3"
3"1/8
3"1/4
3"3/8
3"1/2
3"5/8
3"3/4
3"7/8
4"
4"1/8
4"1/4
4"3/8
4"1/2
4"5/8
4"3/4
4"7/8
5"
5"1/8
5"1/4
5"3/8
5"1/2
5"5/8
5"3/4
5"7/8
6"
6"1/8
6"1/4
6"3/8
6"1/2
6"5/8
6"3/4
6"7/8
7"
7"1/8
7"1/4
7"3/8
7"1/2
7"5/8
7"3/4
7"7/8
8"
8"1/8
8"1/4
8"3/8
8"1/2
8"5/8
8"3/4
8"7/8
9"
9"1/8
9"1/4
9"3/8
9"1/2
9"5/8
9"3/4

Techné

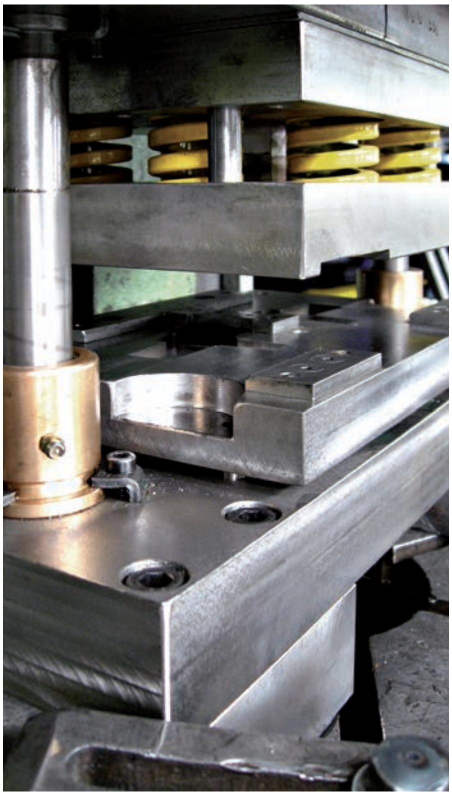
Special parts

Special parts

1] Adaptation of a Techné standard

✓ Dimensions

Techné bushes are manufactured according ISO 3547-1 :2006. Nevertheless, a standard bush can be adapted to a specific request. Dimensions and tolerances can be adjusted. Moreover, bushes produced for automotive purposes are made according to automotive standards with reinforced quality controls. Thanks to its know-how, Techné meets customers' specifications in providing material certificates, tractability and PPAP documentation.



✓ Material

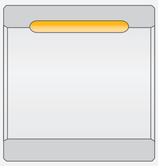
As well as dimensions, bushes' material can be adapted: specific compounds can even be developed to meet customers' specifications (to extend product's life for instance).

2) Oil grooves

Grooves are often machined in plain bushes to improve the lubricant flow and therefore the sliding properties of the bush. Grooves also aim at carrying of the wear wastes from the sliding surface.

Grooves are machined according DIN ISO 12128:1998 and according Techné specifications. Their shapes can be summarized into 9 different types. Some can also be combined (type E and L for instance).

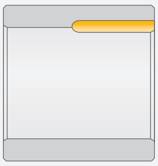
Type C



Longitudinal shape, non-outgoing

For TX, TY, TZ and TA bushes

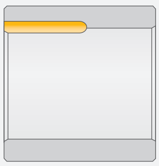
Type G



Longitudinal shape, outgoing (opposite to the fitting direction)

For TX, TY, TZ and TA bushes

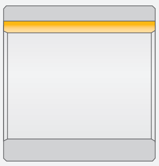
Type H



Longitudinal shape, outgoing (fitting direction)

For TX, TY, TZ and TA bushes

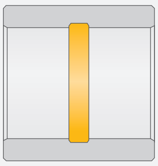
Type J



Longitudinal shape, outgoing

For TU, TX, TY, TZ and TA bushes

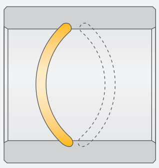
Type E



Circumferential shape

For TX, TY, TZ and TA bushes

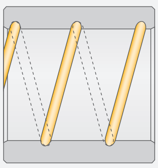
Type N



Oval shape

For TY, TZ and TA bushes

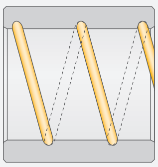
Type K



Screw shaped, right thread

For TY, TZ et TA bushes

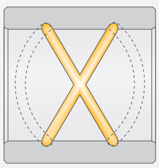
Type L



Screw shaped, left thread

For TY, TZ et TA bushes

Type M

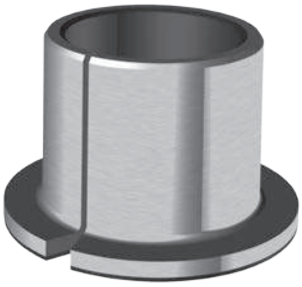


Eight-angled shaped

For TY, TZ et TA bushes

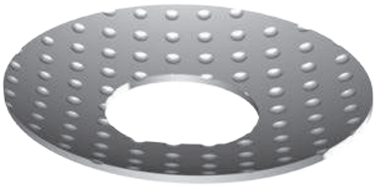
3) Examples

Wrapped bush
Flanged bush

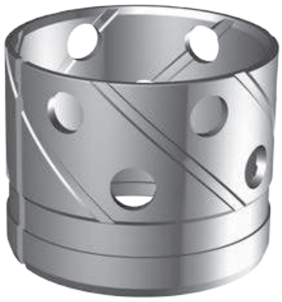



Washer
Plate


Differential bush TY
Half bush TU



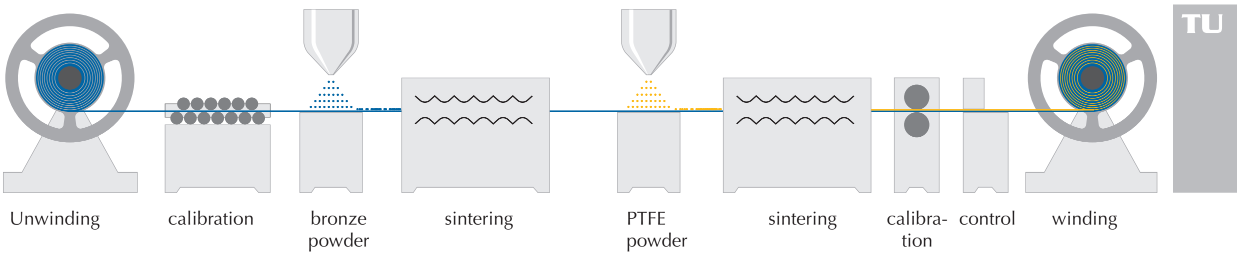

Drive axle bush TZ
Half washer TU

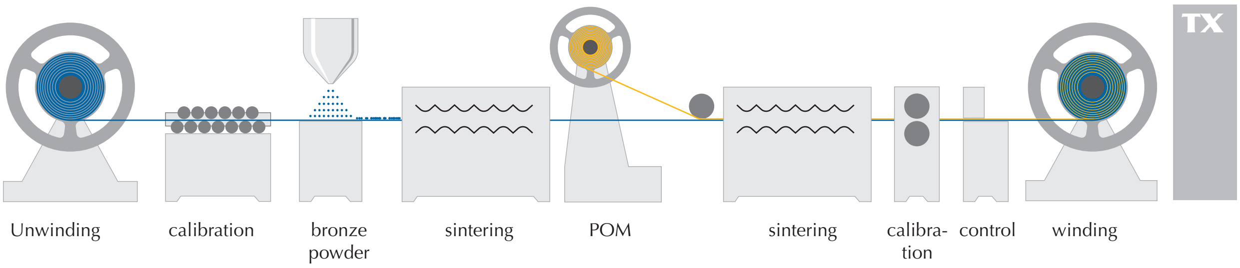


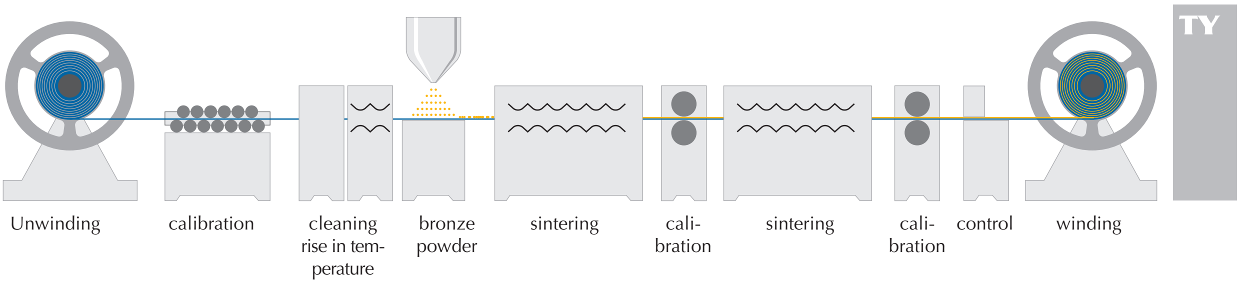

Rear hatches bush TZ
Bearing TU

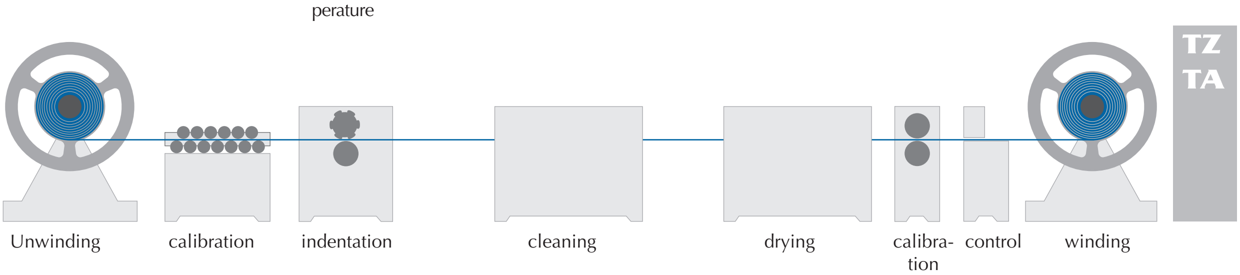

4) Process flow

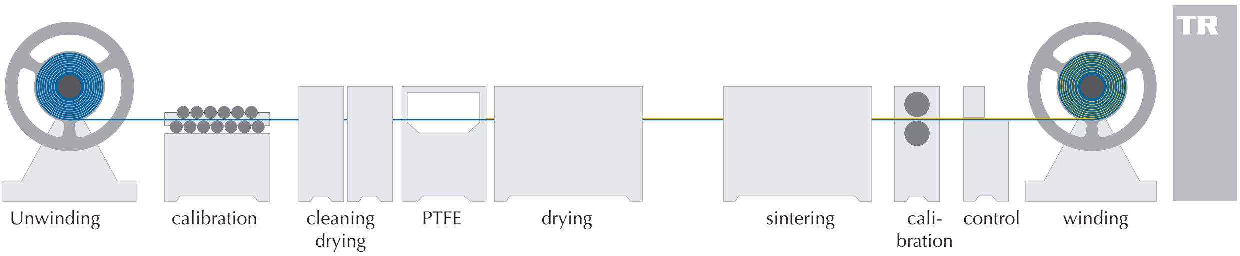
✓ Plate



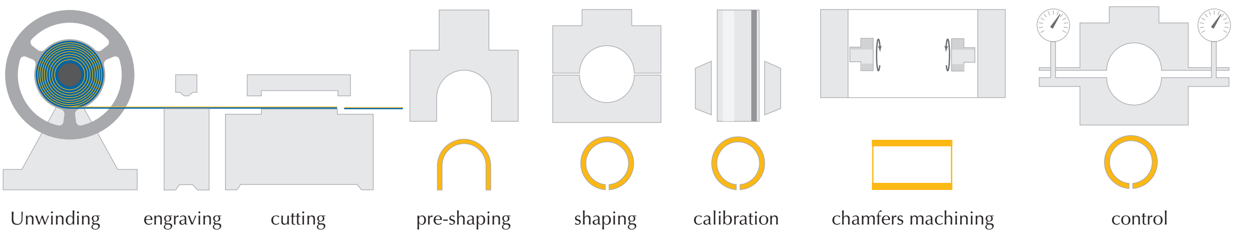








✓ Bush



0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250

1/8" 1/4" 3/8" 1/2" 5/8" 3/4" 7/8" 1" 1"1/8 1"1/4 1"3/8 1"1/2 1"5/8 1"3/4 1"7/8 2" 2"1/8 2"1/4 2"3/8 2"1/2 2"5/8 2"3/4 2"7/8 3" 3"1/8 3"1/4 3"3/8 3"1/2 3"5/8 3"3/4 3"7/8 4" 4"1/8 4"1/4 4"3/8 4"1/2 4"5/8 4"3/4 4"7/8 5" 5"1/8 5"1/4 5"3/8 5"1/2 5"5/8 5"3/4 5"7/8 6" 6"1/8 6"1/4 6"3/8 6"1/2 6"5/8 6"3/4 6"7/8 7" 7"1/8 7"1/4 7"3/8 7"1/2 7"5/8 7"3/4 7"7/8 8" 8"1/8 8"1/4 8"3/8 8"1/2 8"5/8 8"3/4 8"7/8 9" 9"1/8 9"1/4 9"3/8 9"1/2 9"5/8 9"3/4

Techné

Plain **Bearings**

Techné I - Morancé

0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250

1/8" 1/4" 3/8" 1/2" 5/8" 3/4" 7/8" 1"
1"1/8 1"1/4 1"3/8 1"1/2 1"5/8 1"3/4 1"7/8 2"
2"1/8 2"1/4 2"3/8 2"1/2 2"5/8 2"3/4 2"7/8 3"
3"1/8 3"1/4 3"3/8 3"1/2 3"5/8 3"3/4 3"7/8 4"
4"1/8 4"1/4 4"3/8 4"1/2 4"5/8 4"3/4 4"7/8 5"
5"1/8 5"1/4 5"3/8 5"1/2 5"5/8 5"3/4 5"7/8 6"
6"1/8 6"1/4 6"3/8 6"1/2 6"5/8 6"3/4 6"7/8 7"
7"1/8 7"1/4 7"3/8 7"1/2 7"5/8 7"3/4 7"7/8 8"
8"1/8 8"1/4 8"3/8 8"1/2 8"5/8 8"3/4 8"7/8 9"
9"1/8 9"1/4 9"3/8 9"1/2 9"5/8 9"3/4

Techné

TBL 120

TBL

1] Structure

TBL 69.0100 69.0110 69.0120

✓ TBL

TBL bushes are made of 2 compounds:

- A high resistant CuZn25Al6Mn4 brass structure (**1**). It offers very good mechanical characteristics, a good wear and friction resistance for an extended lifetime.
- Solid lubricant pellets (**2**) composed with graphite, which provide a dry lubrication, even used with very high temperature.

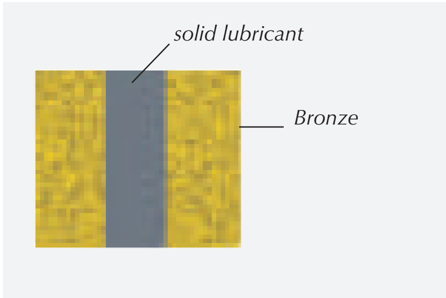
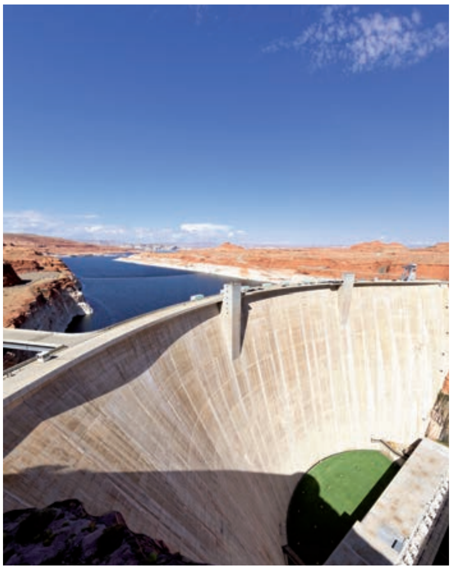


fig.60 • Micrographic structure of TBL

✓ Advantages

TBL bushes are suitable for heavy loads, especially with periodic motions. Their structure provides a low wear rate. They are self-lubricant and maintenance free. They can be used up to 300°C.

In case TBL bushes would be used with oil or grease, temperature resistance of the oil must be taken into account (usually around 150°C).



2) Mechanical characteristics

Properties	Type	TBL	Unit
Load	Static	100	N/mm^2
	Dynamic	100	N/mm^2
	Oscillation	100	N/mm^2
Speed	Dry	0,5	m/s
	Oil lubrication	> 3	m/s
Maximum PV factor	Dry	1,6	$N/mm^2.m/s$ (W/mm^2)
	Oil lubrication	> 10	$N/mm^2.m/s$ (W/mm^2)
Friction coefficient	Dry	0,16	
	Oil lubrication	0,05	
Bush hardness		> 210	HB
Shaft hardness		>30	HRc
Shaft roughness	Dry	Ra : 0,2 - 0,8	µm
	Lubricated	Ra : 0.05 - 0.2	µm
Temperature	Dry	-40 ; 300	°C
Thermal conductivity		121	$W(m.K)^{-1}$
Coef. of thermal expansion		18.10^{-6}	K^{-1}

1. if lubricated, 150° max

3) Chemical characteristics

After analysis of each layer of the bush, Techné gives indication about chemical resistance. However because of the wide variety of available materials and grades, compatibility tests before final selection of the material are recommended.

✓ Chemical resistance

TBL bushes resist to water, alcohols, glycols, solvents, gasoline, diesel, kerosene and most of mineral oils (T° lower than 100°C). However sliding layer can be damaged by some strong acids, such as chloric, nitric, sulfuric acid and some gases such as free halogen or ammoniac, especially when these gases are humid. It is also not recommended to use it with HFC oils and in navy environment. Finally TR bushes shall not be assembled with aluminum shaft because of electrochemical corrosion risk in humid environment.

For applications with corrosion risk between shaft and bush, Techné advises to use shaft made of stainless steel with chrome plating or made with aluminum and anodizing.

4) Sliding performance

✓ Material

TBL bushes are made of a CuZn25Al6 structure. This material resists to high and very high loads, especially with oscillating motions.

With a 8.2 density, it provides following characteristics:

- Yield stress up to 755N/mm2
- Yield strength: 400 N/mm2
- Elongation rate: 12% (measured on 50mm)

ISO	% Cu	% Zn	% Al	% Fe	% Mn	% Si	% Ni	% Sn	% Pb
CuZn25Al6	60-65	22-28	5-8	2-4	2.5-5	< 0,1	< 0,5	< 0,2	< 0,2

On demand, Techné offers alternative materials with specific properties.

✓ Solid lubricant

Graphite can be defined as a black colored, price competitive solid lubricant. Its hexagonal structure is made of strong homopolar linkages between the carbon atoms of a same layer, but also of weak linkages (type Van der Waals) between the carbon atoms of the different layers. This entails a weak shearing resistance and friction properties. Sliding properties of graphite result from its ability to absorb steam and gas (like CO2) and to condense them between its layers. Graphite is therefore mainly used in the hydro-electrical industry.

In a humid air, its friction coefficient varies between 0.05 (under high pressure) and 0.20 (under low pressure). It remains weak up to the higher recommended working temperature of TBL bushes (300°C).

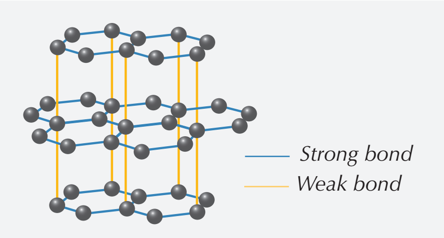


fig.61 • Structure of graphite

Less sticky to sliding surfaces than MoS2, graphite creates under friction films which resist to pressure up to 70 Mpa under reasonable speed. It has a high electrical and heat conductivity and can thus be used with a higher speed than other solid lubricants. Its load factor is even increased when used in combination with oil.

5) Conception

✓ Roughness

Shaft D_A	Dry	Lubricated		
Lubrication	/	Boundary	Mixed-film	Hydrodynamic
Ra (µm)	0,2 - 0,8	≤ 0.4	0.1 - 0.2	0.05 - 0.16
Rz (µm)	1 - 4	≤ 2	0.5 - 1	0.25 - 0.8

For a lubricated application, the lower the roughness, the easier it will be to create a hydrodynamic film. So the most severe the application is, the best roughness must be.

For housing D_L Techné recommends a roughness value of Rz 10.

✓ Bushing clearance

TBL bushes are assembled tightened in the housing, so it is unnecessary to use clamp or ring spacer to avoid TBL bush movement. For a standard use in a steel housing, Techné recommends the following tolerances for housing D_L:

However there must be a clearance between the shaft and the bush. This clearance is essential for the lifetime and performance of the bush. For the shaft, Techné recommends the following tolerances for shaft D_A:

Housing	Shaft D_A			Housing D_L
Use	High load	Low load	High precision	/
Ø30 - Ø160	d8	e7	f7	H7

For the Bush itself, Techné advises the following tolerances:

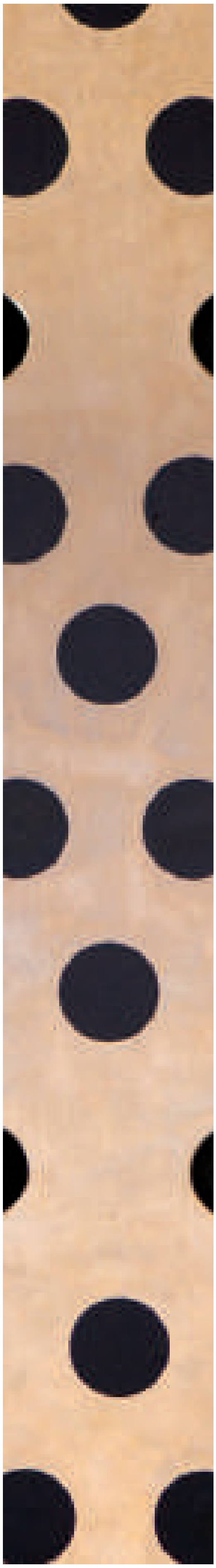
Bushing	ØDi		ØDe	
Profile	Cylindrical	Flanged	Cylindrical	Flanged
Ø30 - Ø160	F7	E7	m6	r6

✓ Dimensions

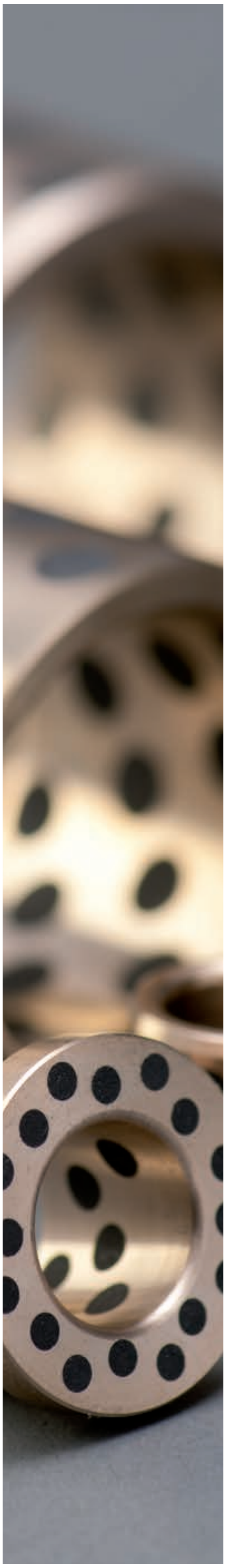
For any pivot linking new conception including TBL bushes, a minimum thickness of 5mm is needed.

With a smaller thickness, TBL bushes lose their load resistance. The table below advises thickness values for TBL bushes, regarding their internal diameters.

ØDi	Thickness e
from 30 to 60	5
from 60 to 70	7,5
from 70 to 80	8 ou 10
from 80 to 160	10



6) Others

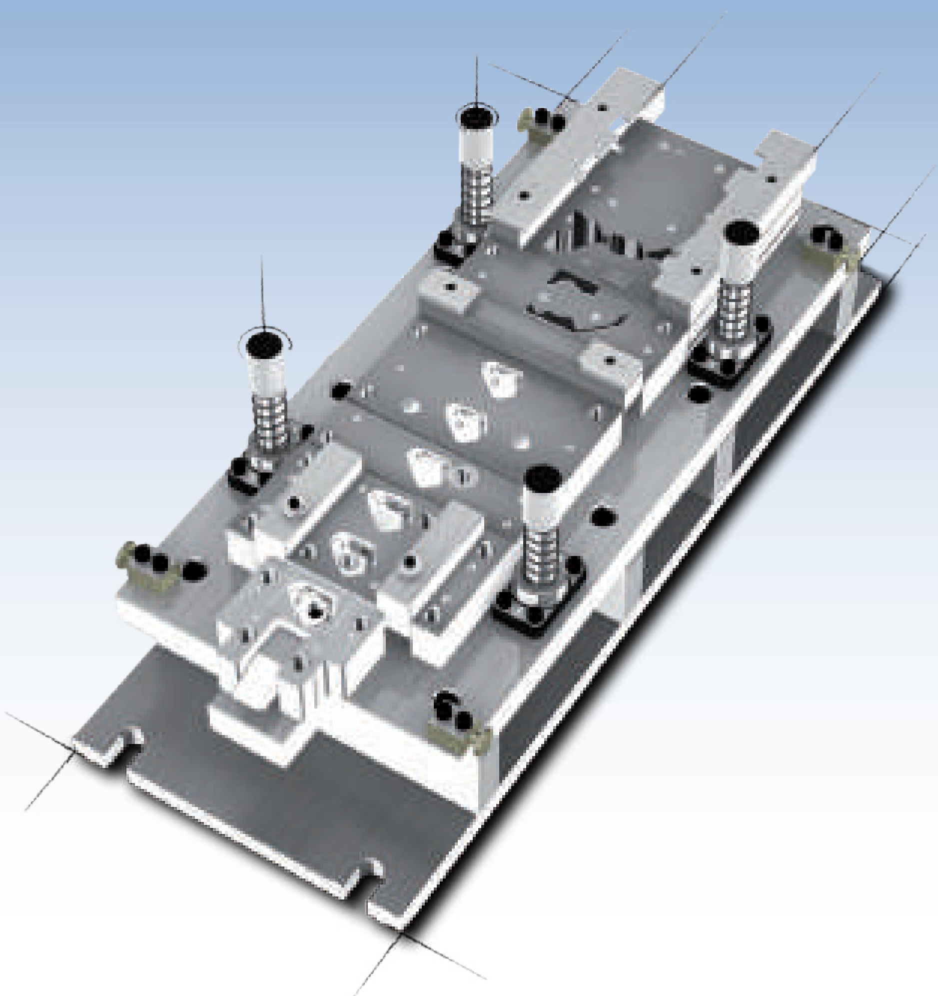


For specific application or environment, Techné offers bushes that meet customer's requirements.
Only TAL Techné bushes are hereafter described. However Techné's R&D department can develop specific design on request.

Characteristics	TAL
Structure	Steel
Pellets	Graphite
Cylindrical bushing	69.0092
Washer	69.4062
Advantages	Cost saving alternative of TBL
Use	Injection press
Picture	

Applications

TBL bushes are widely used for hydroelectric applications. They are also suitable for the heavy industry (steel mills), for valves, injection presses and applications in contact with chemicals.



0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250

1/8" 1/4" 3/8" 1/2" 5/8" 3/4" 7/8" 1"
1"1/8 1"1/4 1"3/8 1"1/2 1"5/8 1"3/4 1"7/8 2"
2"1/8 2"1/4 2"3/8 2"1/2 2"5/8 2"3/4 2"7/8 3"
3"1/8 3"1/4 3"3/8 3"1/2 3"5/8 3"3/4 3"7/8 4"
4"1/8 4"1/4 4"3/8 4"1/2 4"5/8 4"3/4 4"7/8 5"
5"1/8 5"1/4 5"3/8 5"1/2 5"5/8 5"3/4 5"7/8 6"
6"1/8 6"1/4 6"3/8 6"1/2 6"5/8 6"3/4 6"7/8 7"
7"1/8 7"1/4 7"3/8 7"1/2 7"5/8 7"3/4 7"7/8 8"
8"1/8 8"1/4 8"3/8 8"1/2 8"5/8 8"3/4 8"7/8 9"
9"1/8 9"1/4 9"3/8 9"1/2 9"5/8 9"3/4

Bronze plain bearing

1] Structure

✓ PLB

Widely used in industrial applications, PLB bush offers a good load resistance and a good shock resistance in dusty environment. Its bronze structure provides good friction properties and resistance towards corrosion.
When regularly greased, lifetime of PLB bush is optimized.
Depending on customers' requests, oil grooves can be added on both sides of PLB Bush, see groove types page 131.
Even if Techné can offer standard PLB bushes, this product range is most of the time produced according customers' drawings and/or specifications.

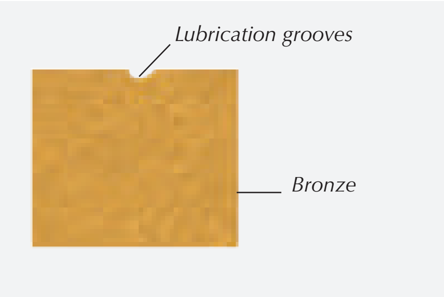


fig.62 • Micrographic structure of PLA

2) Mechanical characteristics

Properties	Type	PLB[1]	Unit
Tensile strength	Rm	230 - 600	N/mm^2
Load	Oscillation	90 - 150	N/mm^2
Speed	Greased	1,5 - 2	m/s
PV factor Maximum	Dry, in peak	3 - 5	$N/mm^2.m/s$ (W/mm^2)
	Dry, continuous	2,5 - 5	$N/mm^2.m/s$ (W/mm^2)
	Oil lubrication	> 10	$N/mm^2.m/s$ (W/mm^2)
Friction coef.	Dry	0,20	
	Oil lubrication	0,05 ; 0,015	
Shaft hardness		> 50	HRc
Shaft roughness (Ra)	Dry	0,20 ; 0,80	µm
	Oil lubrication	0,05 ; 0,2	µm
Temperature		-40 ; +225	°C
Thermal conductivity		58	$W(m.K)^{-1}$
Coef. of thermal expansion		18.10^{-6}	K^{-1}

1. Following used material, values can be changed, see next page

3) Chemical characteristics

After analysis of each layer of the bush, Techné gives indication about chemical resistance. However because of the wide variety of available materials and grades, compatibility tests before final selection of the material are recommended.

✓ Chemical resistance

PLB bush resists to water, alcohols, glycols, solvents, gasoline, diesel, kerosene and most of mineral oils (T° lower than 100°C). However sliding layer can be damaged by some strong acids, such as chloric, nitric, sulfuric acid and some gases such as free halogen or ammoniac, especially when these gases are humid. It is also not recommended to use it with HFC oils and in navy environment.

Finally PLB bushes shall not be assembled with aluminum shaft because of electrochemical corrosion risk in humid environment.

For applications with corrosion risk between shaft and bush, Techné advises to use shaft made of stainless steel with chrome plating or made with aluminum and anodizing.

4] Alloys

✓ CuSn12

CuSn12 bronze compound features excellent friction properties under heavy loads. (Rm>230 MPa).

This alloy is mainly used in hydraulic systems and in injection presses.

EN	Nb.	UNS	% Cu	% Sn	% Pb	% Zn	% Ni	% P
CuSn12	2.1053	C90800	Reste	10,5-13	< 2,5	< 2	< 2	< 0,3

✓ CuZn37Mn3Al2PbSi

CuZn37Mn3Al2PbSi is a copper alloy developed for very high loads. (Rm>345 MPa).

Its coefficient of friction remains excellent. It is mainly used for excavators, valve seats, etc.

EN	Nb.	UNS	% Cu	% Zn	% Mn	% Al	% Pb	% Si	% Autres
CuZn37Mn3Al2PbSi	2.0550	C67400	57-59	reste	1,5-3	1,3-2,3	0,2-0,8	0,3-1,3	< 0,4

✓ CuAl10Ni5Fe4

CuAl10Ni5Fe4 is a copper-aluminum alloy with very high mechanical and corrosion resistance (Rm>590 MPa).

Its compounds warrant a good abrasion resistance with a good ductility.

EN	Nb.	UNS	% Cu	% Al	% Fe	% Mn	% Ni	% Autre (Si Sn Zn)
CuAl10Ni5Fe4	2.0966	C63000	82	9-11	2-4	1,5	4-5,5	< 0,3

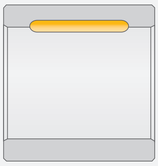
These materials are standards one from Techné. PLB bushes can also be manufactured according customers' material specifications.

5) Oil grooves

Grooves are often machined in plain bushes to improve the lubricant flow and therefore the sliding properties of the bush. Grooves also aim at carrying of the wear wastes from the sliding surface.

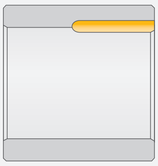
Grooves are machined according DIN ISO 12128:1998 and according Techné specifications. Their shapes can be summarized into 9 different types. Some can also be combined (type E and type L for instance).

Type C



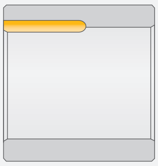
Longitudinal shape, non-outgoing

Type G



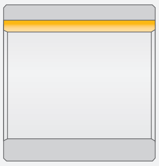
Longitudinal shape, outgoing (opposite to the fitting direction)

Type H



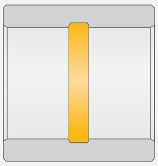
Longitudinal shape, outgoing (fitting direction)

Type J



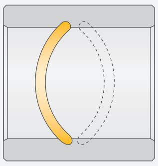
Longitudinal shape, outgoing

Type E



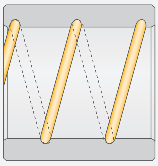
Circumferential shape

Type N



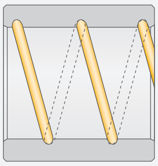
Oval shape

Type K



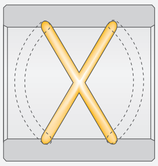
Screw shaped, right thread

Type L



Screw shaped, left thread

Type M



Eight-angled shaped

6) Shat and housing design

PLB bushes are assembled tightened in the housing, so it is unnecessary to use clamp or ring spacer to avoid PLB bush movement. For a standard use in a steel housing, Techné recommends the following tolerances for housing D_L:

However there must be a clearance between the shaft and the bush. This clearance is essential for the lifetime and performance of the bush. For the shaft, Techné recommends the following tolerances for shaft D_A:

Tolerances	Shaft D_A	Housing D_L
Low load	e7	H7
High load	g7	H7

Without any particular customers' request, bushes are produced according DIN ISO 4379:

Tolerances	ØDi	ØDe
Ø < 120	E6	s6
Ø > 120	E6	r6

7) New developments

PLB bushes are more and more substituted with TCT bushes (see page). TCT are indeed lighter, suitable for heavy loads and maintenance free.

For any new development, do not hesitate to contact Techné technical team.

Applications

PLB bushes are widely used in industrial pumps, conveyors, presses and mills, heavy industries like foundries or hard materials crushing. They are also used in public works machines and in transportation means.

0
1/8"
1/4"
10
3/8"
1/2"
5/8"
20
3/4"
7/8"
1"
1"1/8
30
1"1/4
1"3/8
1"1/2
40
1"5/8
1"3/4
1"7/8
50
2"
2"1/8
2"1/4
60
2"3/8
2"1/2
2"5/8
70
2"3/4
2"7/8
3"
80
3"1/8
3"1/4
3"3/8
90
3"1/2
3"5/8
3"3/4
3"7/8
100
4"
4"1/8
4"1/4
110
4"3/8
4"1/2
4"5/8
120
4"3/4
4"7/8
5"
130
5"1/8
5"1/4
5"3/8
140
5"1/2
5"5/8
5"3/4
150
5"7/8
6"
6"1/8
6"1/4
160
6"3/8
6"1/2
6"5/8
170
6"3/4
6"7/8
7"
180
7"1/8
7"1/4
7"3/8
190
7"1/2
7"5/8
7"3/4
200
7"7/8
8"
8"1/8
210
8"1/4
8"3/8
8"1/2
220
8"5/8
8"3/4
8"7/8
230
9"
9"1/8
9"1/4
9"3/8
240
9"1/2
9"5/8
9"3/4
250

Steel plain bearing

1] Structure

✓ PLA

Designed for pivot connections with high load and high shock frequency, PLA plain bush is made of a steel structure hardened to improve its abrasion properties. When greased before assembly, it can be used with reduced maintenance. According customers' request, PLA bush can be manufactured with additional oil grooves and/or oil pockets. Techné manufactures PLA bush according to its own standards or according customers' specifications.
Hardening depth is between 1 and 3 mm.

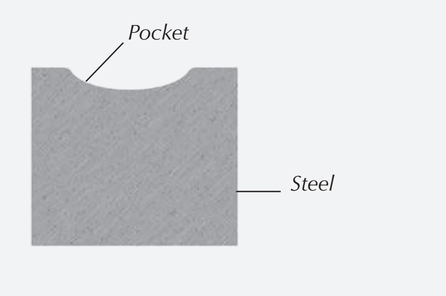


fig.63 • Micrographic structure of PLA

2) Mechanical characteristics

Properties	Type	C45	42CrMo4	100Cr6	Unit
Maxi load		150	100	250	N/mm²
Speed	Greased	0,17	0,5	0,1	m/s
Maximum PV factor	Greased	1,2	1,5	1,5	N/mm².m/s (W/mm²)
	Oil lubrication	/	/	/	N/mm².m/s (W/mm²)
Friction coefficient	Greased	0,25	0,25	0,25	
	Oil lubrication	0,05 ; 0,12	0,05 ; 0,12	0,05 ; 0,12	
Bush Hardness		> 52	55	55	HRc
Shaft Hardness		> 55	> 60	> 60	HRc
Shaft roughness Ra	Greased	0,4 ; 0,8	0,4 ; 0,8	0,4 ; 0,8	µm
	Oil lubrication	0,05 ; 0,2	0,05 ; 0,2	0,05 ; 0,2	µm
Temperature[1]		-100 ; +300	-100 ; +250	-100 ; +350	°C
Thermal conductivity		50	43	43	$W(m.K)^{-1}$
Coef. of thermal expansion		11.10^{-6}	12.10^{-6}	11.10^{-6}	/°K

1. Check the limit temperature of the grease

3) Chemical characteristics

After analysis of each layer of the bush, Techné gives indication about chemical resistance. However because of the wide variety of available materials and grades, compatibility tests before final selection of the material are recommended.

✓ Chemical resistance

PLA bush resists to water, alcohols, glycols, solvents, gasoline, diesel, kerosene and most of mineral oils (T° lower than 100°C). However sliding layer can be damaged by some strong acids, such as chloric, nitric, sulfuric acid. It is also not recommended to use it with HFC oils and in navy environment.

Maintenance must be reinforced when PLA bush is used in a humid environment to avoid corrosion.

For applications with corrosion risk between shaft and bush, Techné advises to use stainless steel material with hard chrome plating.

4] Alloy

✓ C45

C45 is a cost-effective half-hard steel, which provides good mechanical properties (Rm> 700 MPa) and a weak hardenability. It is well adapted to thin bushes.

Cr + Mo + Ni = max 0.63

EN 10083	Nb.	AISI	SAE	% C	% Si	% Mn	% Ni	% P	% S	% Cr	% Mo
C45	1.0503	1042 / 1045	J 403	0,42-0,5	< 0,4	0,5-0,8	< 0,4	< 0,045	< 0,045	< 0,4	< 0,1

✓ 42CrMo4

42CrMo4 hard steel is widely used for bushes. It provides excellent mechanical properties (Rm>700 MPa) and good hardenability thanks to the addition of Cr and Mo elements. This alloy is adapted to thick bushes.

EN 10083	Nb.	AISI	autre	% C	% Si	% Mn	% P	% S	% Cr	% Mo
42CrMo4	1.7225	4140 / 4142	42CrMo	0,38-0,45	< 0,4	0,6-0,9	< 0,025	< 0,035	0,9-1,2	0,15-0,3

✓ 100Cr6

100Cr6 very hard steel is mainly used in bearings. It provides excellent mechanical properties (Rm>900MPa). Its hardness varies between 55 and up to 60 HRc.

EN 10083	Nb.	AISI	autre	% C	% Si	% Mn	% P	% S	% Cr	% Mo
100Cr6	1.3505	5210	GCr15	0,95-1,05	0,15-0,35	0,25-0,45	< 0,025	< 0,015	1,35-1,6	< 0,1

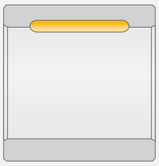
On demand, Techné also manufactures bushes in 16MnCr5 cemented steel, with a hardness of 58 HRc.

5) Oil grooves

Grooves are often machined in plain bushes to improve the lubricant flow and therefore the sliding properties of the bush. Grooves also aim at carrying of the wear wastes from the sliding surface.

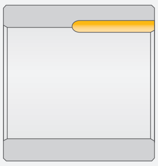
Grooves are machined according DIN ISO 12128:1998 and according Techné specifications. Their shapes can be summarized into 9 different types. Some can also be combined (type E and L for instance).

Type C



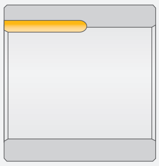
Longitudinal shape, non-outgoing

Type G



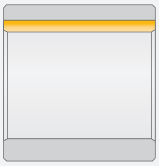
Longitudinal shape, outgoing (opposite to the fitting direction)

Type H



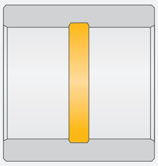
Longitudinal shape, outgoing (fitting direction)

Type J



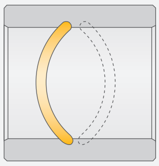
Longitudinal shape, outgoing

Type E



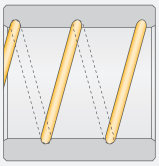
Circumferential shape

Type N



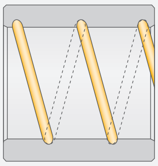
Oval shape

Type K



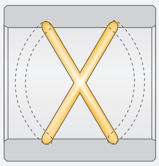
Screw shaped, right thread

Type L



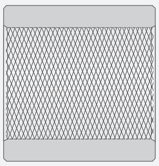
Screw shaped, left thread

Type M

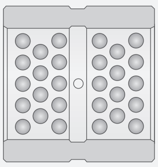


Eight-angled shaped

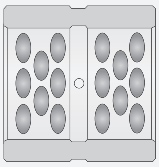
6) Indentations



Grooving



Round pockets



Elliptic pockets

7) Shaft and housing design

PLA bushes are assembled tightened in the housing, so it is unnecessary to use clamp or ring spacer to avoid PLA bush movement. For a standard use in a steel housing, Techné recommends the following tolerances for housing D_L:

However there must be a clearance between the shaft and the bush. This clearance is essential for the lifetime and performance of the bush. For the shaft, Techné recommends the following tolerances for shaft D_A:

Tolerances	Shaft D_A	Housing D_L
Ø30 - Ø120	f7	H7

Without any particular customers' request, bushes are produced according following tolerances:

PLA bushes must be greased before assembly. Techné advises to use a C45 hardened shaft.

Tolérances	ØDi	ØDe
Ø30 - Ø120	H9/H10	p6

8) PLA with joint

PLA plain bushes can also be shaped from a steel strip. Techné then advises to use wave shaped slit. Assembly will be easier and the housing quality can be reduced. It is therefore cost effective.
Techné advises an elastic steel according DIN EN 65M4. Oil grooves can be added but no indentation. Techné advises housing tolerance H8 with shaft f8. Recommended roughness Ra 1,6 maxi.

Applications

PLA bushes are mostly used in heavy load applications with dusty environment: tipper trucks, agricultural machineries, public works machineries, cement works, steel industry, etc.

0
1/8''
1/4''
10
3/8''
1/2''
5/8''
20
3/4''
7/8''
1''
1''1/8
30
1''1/4
1''3/8
1''1/2
40
1''5/8
1''3/4
1''7/8
50
2''
2''1/8
2''1/4
60
2''3/8
2''1/2
2''5/8
70
2''3/4
2''7/8
3''
80
3''1/8
3''1/4
3''3/8
90
3''1/2
3''5/8
3''3/4
3''7/8
100
4''
4''1/8
4''1/4
110
4''3/8
4''1/2
4''5/8
120
4''3/4
4''7/8
5''
130
5''1/8
5''1/4
5''3/8
140
5''1/2
5''5/8
5''3/4
150
5''7/8
6''
6''1/8
6''1/4
160
6''3/8
6''1/2
6''5/8
170
6''3/4
6''7/8
7''
180
7''1/8
7''1/4
7''3/8
190
7''1/2
7''5/8
7''3/4
200
7''7/8
8''
8''1/8
210
8''1/4
8''3/8
8''1/2
220
8''5/8
8''3/4
8''7/8
9''
230
9''1/8
9''1/4
9''3/8
240
9''1/2
9''5/8
9''3/4
250

Techné

TCT

1] Structure

TCT 68.5010

Easier to assembly than a bronze bush, TCT is self-lubricant..

✓ TCT

TCT sliding bushes are composed with 2 layers:

- A self-lubricant sliding layer (**1**) made of a mesh of PTFE and high resistant synthetic fibers reinforced with a PTFE based solid lubricant.
- A structure (**2**) made of epoxy resin, glass fiber reinforced, which provides excellent mechanical resistance.

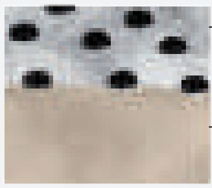


fig.64 • Micrographic structure of TA

✓ Advantages

TCT bushes are self-lubricant, no need to machine oil grooves. They are therefore cost effective. They are mainly used to replace bronze plain bushes in new conceptions, to avoid maintenance.

TCT bushes have an excellent load resistance. They are at least equivalent to metal bushes. Moreover, they can be set up in corrosive environment thanks to their superior chemical resistance. Finally, their weight is about ¼ of a metal bush of the same size.

2) Mechanical characteristics

Properties	Type	TCT	Unit
Load	Static	240	N/mm^2
	Dynamic	140	N/mm^2
	Oscillation	100	N/mm^2
Speed	Dry	0.2	m/s
	Constant lubrication	/	m/s
Max PV factor	Dry, continuous	1,8	$N/mm^2.m/s$ (W/mm^2)
	Oil lubrication	/	$N/mm^2.m/s$ (W/mm^2)
Friction coef.	Dry	0,03 ; 0,12	
	Oil lubrication	/	
Shaft hardness		>35	HRC
Shaft roughness	Dry	Ra : 0,2 - 0,4	µm
	Lubricated	Ra : 0.05 - 0.2	µm
Temperature		-100 ; 160	°C
Thermal conductivity		0.3	$W(m.K)^{-1}$
Coef. of thermal expansion	Radial	13.10^{-6}	K^{-1}
	Axial	27.10^{-6}	K^{-1}

3) Chemical characteristics

After analysis of each layer of the bush, Techné gives indication about chemical resistance. However because of the wide variety of available materials and grades, compatibility tests before final selection of the materials are recommended.

✓ Chemical resistance

TCT bushes resist to water, sea water, alcohols, glycols, solvents, gasoline, diesel, kerosene and most of mineral oils (T° lower than 100°C). However sliding layer can be damaged by some strong acids, such as arsenic, nitric, carbonic, hydro-fluoric acid. Use with allyl alcohols, butyl, benzene, trichloroethane, brominated acetylene, chlorine, fluor and ammoniac shall be avoided. Finally, use in contact with steam is not recommended.

With TCT bushes, no risk of oxidation between the shaft and the bush.

4] Physical properties

✓ Wear rate

For heavy load applications, TCT wear rate is linked with several factors: number of abrasive particles, deformation due to the shaft misalignment, temperature, shaft material, etc.

The following diagram shows the reduced wear rate of TCT bushes.

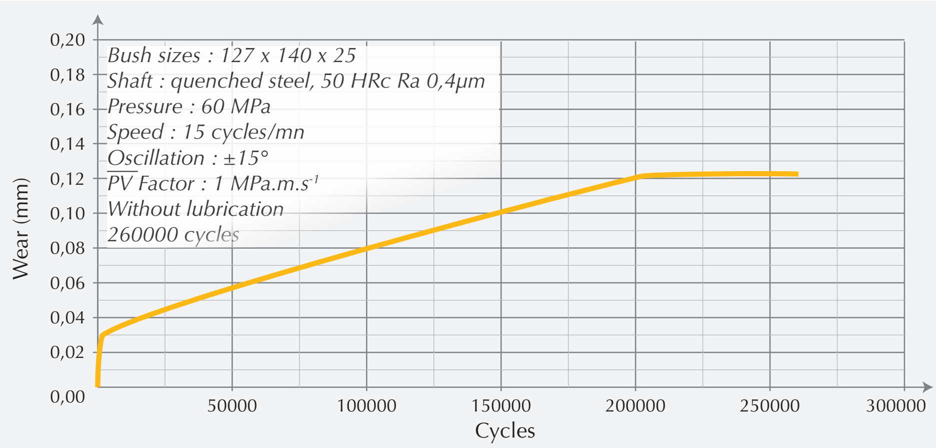


fig.65 • TCT wear rate fonction cycles number

✓ Sliding performance

Sliding rate of TCT bushes depends on several parameters: temperature, shaft roughness and pressure. Usually, pressure is the most important one. The diagram below shows the evolution of the sliding with an increased pressure.

Used with oscillation movements, or in dynamic use with frequent stops and starts, friction coefficient can increase significantly. This must be taken into account, especially in conceptions with long time applications with a low engine torque.

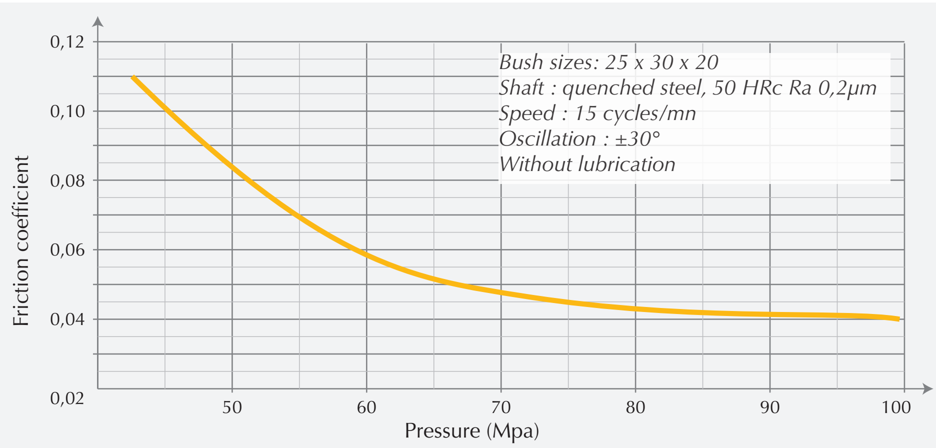


fig.66 • TCT friction coeficient fonction pressure

5) PV Factor

Calculated $\overline{PV}$ factor has to be lower than PV max of the bush :

$$\overline{PV}_{max} < PV_{max}$$

So for TCT bushes: $PV_{max} < 2$ (see table page 83 et , below)
Also pressure $\overline{P}$ and speed $\overline{V}$ values must be lower than the acceptable ones of the TCT bush.

Note: Maximal pressure $\overline{P}_{max}$ and maximal speed $\overline{V}_{max}$ of a given application may not be used simultaneously. In such a case, calculation of $\overline{PV}_{max}$ factor must not be $\overline{P}_{max}$ by $\overline{V}_{max}$, but pressure $\overline{P}_t$ by speed $\overline{V}_t$ at time t, and depending on t, chose the $\overline{PV}_{t\ max}$ factor.

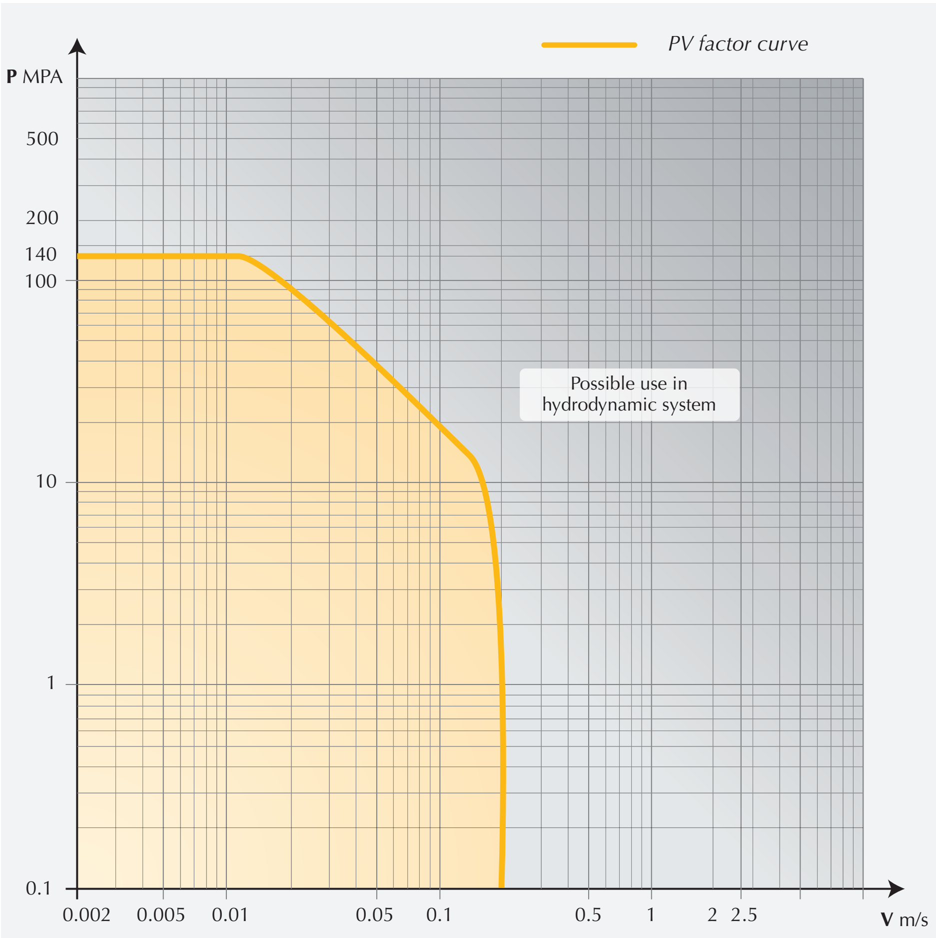


fig.67 • PV factor chart

6) Shaft and housing design

✓ Roughness

Shaft D_A	Dry	Constant lubrication		
Lubrication	/	Boundary	Mixed-film	Hydrodynamic
Ra (µm)	0,2 - 0,4	≤ 0.4	0.1 - 0.2	0.05 - 0.16
Rz (µm)	1 - 2	≤ 2	0.5 - 1	0.25 - 0.8

For a lubricated application, the lower the roughness, the easier it will be to create a hydrodynamic film. So the most severe the application is, the best roughness must be.

For housing D_L Techné recommends a roughness value of Rz 10.

✓ Bearing clearance

TCT bushes are assembled tightened in the housing, so it is unnecessary to use clamp or ring spacer to avoid TX bush movement. For a standard use in a steel housing, Techné recommends the following tolerances for housing D_L:

However there must be a clearance between the shaft and the bush. This clearance is essential for the lifetime and performance of the bush. For the shaft, Techné recommends the following tolerances for shaft D_A:

Tolerances	Shaft D_A	Housing D_L
Ø12 - Ø150	h7	H7

To warrant an optimal use of TCT bushes, the clearance J is a main characteristic: for application in oscillation or at low speed, minimum clearance J shall be 20 µm. In case of faster dynamic applications or with higher temperatures, a gap of 100 µm is recommended.

Moreover, a concentricity of 0.02mm maxi must be kept between the shaft and the housing. Otherwise, edge effects increase and the bush can be damaged (see page 23). This concentricity value is mostly difficult to be kept when the bush's length is important.

✓ Dimensions

For any pivot linking new conception including TCT bushes, a minimum thickness of 2,5 mm is needed.

With a smaller thickness, TCT bushes lose their load resistance. The file below advises thickness values for TCT bushes.

ØDi	Tickness e
de 12 à 25	2,5
de 28 à 35	3
de 40 à 55	4
de 60 à 85	5
de 90 à 150	7,5

✓ Clearance calculation

Maximal clearance J_{MAX}:

$J_{max} = D_{L\ max} - 2 . e - D_{A\ min}$

Minimal clearance J_{MIN}:

$J_{mini} = D_{L\ mini} - 2 . e - D_{A\ max}$

Clearance calculation does not include the potential deformation of the housing. For calculations, coefficient of thermal expansion of metal bushes can be considered.

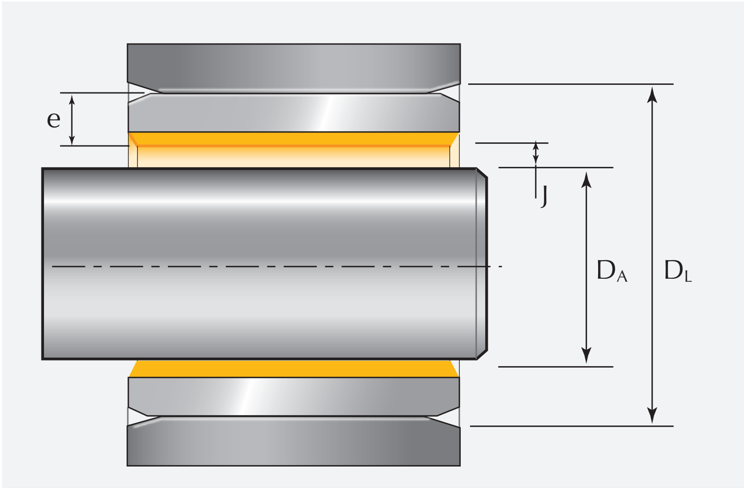


fig.70 • Clearance J

✓ Fitting chamfers

Cylindrical bushes

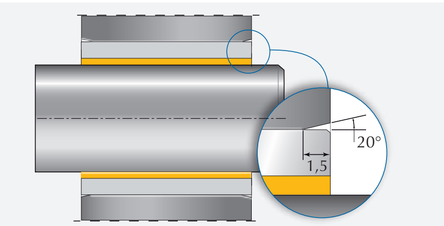


fig.68 • Chamfers Ch for a cylindrical bush

Flanged bushes

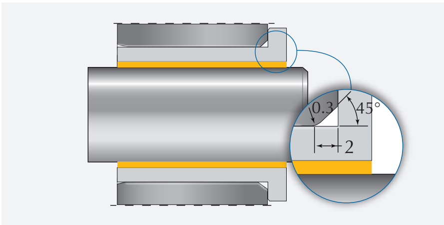
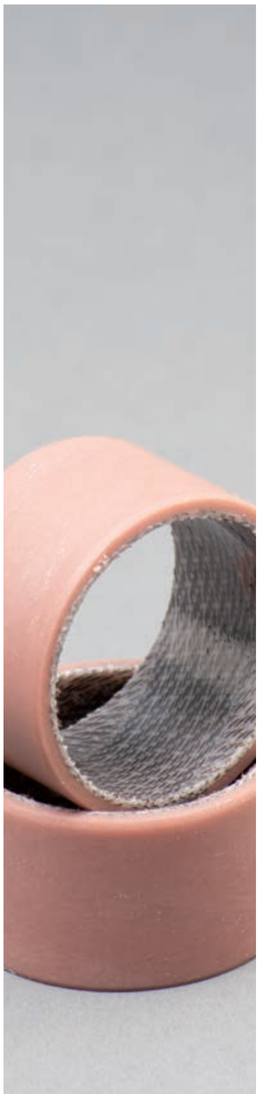
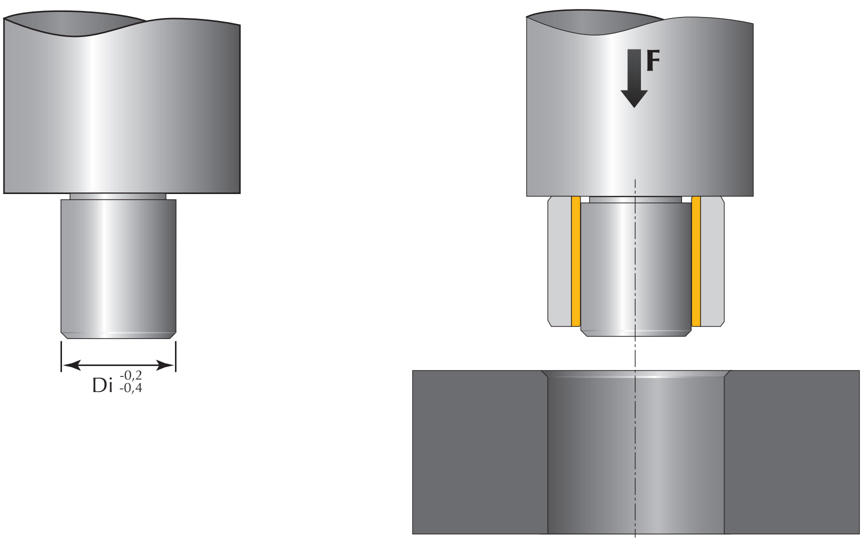


fig.69 • Chamfers Ch for a flanged bush



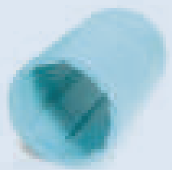
✓ Assembly

Chuck:
Di : internal Ø of TCT



7) Others

For specific application or environment, Techné offers bushes that meet customer's requirements.
Only Weartech T1 and Weartech T3 Techné bushes are hereafter described. However Techné's R&D department can develop specific design on request.

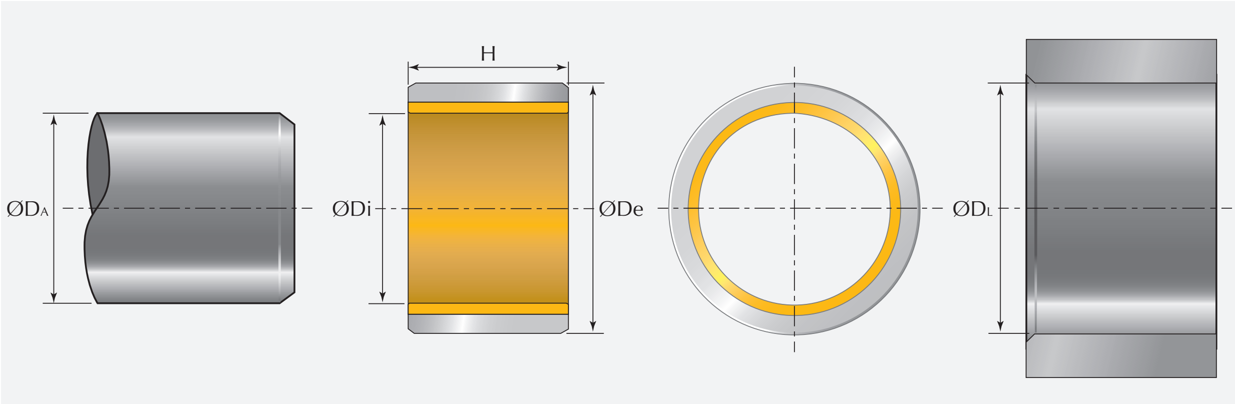
Characteristics	TCP	Weartech
Material	Similar to TCT with more solid lubricant	Weaving of natural or synthetic fiber-reinforced polyester resin with addition of solid lubricant.
Advantages	Can be use at 2,5 $m.s^{-1}$. Do not exceed 35 MPa load	Dry, this bush supports very heavy loads. Can be use with water
Use	Conveying systems	hydraulic systems, food industry, lifting equipments
Picture		

Bush without lead, in compliance with European directives, such as 2000/53/CE on end of life vehicles (ELV Directive) and 2002/95/CE restriction of the use of hazardous substance in electrical and electronic equipment (RoHS Directive).

Applications

TCT bushes are often used to replace bronze plain bushes. They are mainly used in lifting gears, construction machines, transport means, and in agricultural equipment. They are also recommended in navy applications.

8) Dimensional list



ØDi	ØDe	Shaft ØDA Tol	Shaft ØDA max / min	Housing ØDL Tol	Housing ØDL max / min	J max / min	H	Techné ref. TCT 68.5010
12	**17**	h7	12 / 11.982	H7	17.018 / 17	0.136 / 0.02	**15**	1215
							20	1220
							25	1225
15	**20**		15 / 14.982		20.021 / 20	0.139 / 0.02	**15**	1515
							20	1520
							25	1525
16	**21**		16 / 15.982		21.021 / 21	0.139 / 0.02	**15**	1615
							20	1620
							25	1625
18	**23**		18 / 17.982		23.021 / 23	0.189 / 0.02	**15**	1815
							20	1820
							25	1825
20	**25**		20 / 19.979		25.021 / 25	0.192 / 0.02	**15**	2015
							20	2020
							30	2030
22	**27**		22 / 21.979		27.021 / 27	0.192 / 0.02	**15**	2215
							20	2220
							30	2230
25	**30**		25 / 24.979		30.021 / 30	0.192 / 0.02	**25**	2525
							30	2530
							40	2540
28	**34**		28 / 27.979		34.021 / 34	0.196 / 0.02	**25**	2825
							30	2830
							40	2840
30	**36**		30 / 29.979		36.025 / 36	0.196 / 0.02	**25**	3025
							30	3030
							40	3040
35	**41**		35 / 34.979		41.025 / 41	0.2 / 0.02	**30**	3530
							40	3540
							50	3550
40	**48**		40 / 39.979		48.025 / 48	0.2 / 0.02	**30**	4030
							40	4040
							60	4060
45	**53**		45 / 44.975		53.025 / 53	0.23 / 0.025	**30**	4530

ØDi	ØDe	Shaft ØDA Tol	Shaft ØDA max min	Housing ØDL Tol	Housing ØDL max min	J max min	H	Techné ref. TCT 68.5010
45	**53**	h7	45 44.975	H7	53.025 53	0.23 0.025	**40**	4540
							60	4560
50	**58**		50 49.975		58.03 58	0.23 0.025	**40**	5040
							50	5050
							60	5060
55	**63**		55 54.97		63.03 63	0.235 0.025	**40**	5540
							55	5555
							70	5570
60	**70**		60 59.97		70.03 70	0.235 0.025	**40**	6040
							60	6060
							80	6080
65	**75**		65 64.97		75.03 75	0.235 0.025	**50**	6550
							60	6560
							80	6580
70	**80**		70 69.97		80.03 80	0.235 0.025	**50**	7050
							70	7070
							90	7090
75	**85**		75 74.97		85.03 85	0.265 0.05	**50**	7550
							70	7570
							90	7590
80	**90**		80 79.97		90.035 90	0.265 0.05	**60**	8060
							80	8080
							100	8010
85	**95**		85 84.965		95.035 95	0.27 0.05	**60**	8560
							80	8580
							100	8510
90	**105**		90 89.965		105.035 105	0.27 0.05	**60**	9060
							80	9080
							120	9012
95	**110**		95 94.965		110.035 110	0.295 0.05	**60**	9560
							80	9580
							120	9512
100	**115**		100 99.965		115.035 115	0.295 0.05	**80**	1080
							100	1010
							120	1012
110	**125**		110 109.965		125.035 125	0.3 0.05	**80**	1180
							100	1110
							120	1112
120	**135**		120 119.965		135.04 135	0.325 0.05	**100**	1210
							120	1212
							150	1216
130	**145**		130 129.96		145.04 145	0.33 0.05	**100**	1310
							120	1312
							150	1315
140	**155**		140 139.96		155.04 155	0.33 0.05	**100**	1410
							150	1415
							180	1418
150	**165**		150 149.96		165.04 165	0.33 0.05	**120**	1512
							180	1518
							150	1516

0
1/8″
1/4″
10
3/8″
1/2″
5/8″
20
3/4″
7/8″
1″
1″1/8
30
1″1/4
1″3/8
1″1/2
40
1″5/8
1″3/4
1″7/8
50
2″
2″1/8
2″1/4
60
2″3/8
2″1/2
2″5/8
70
2″3/4
2″7/8
3″
80
3″1/8
3″1/4
3″3/8
90
3″1/2
3″5/8
3″3/4
100
3″7/8
4″
4″1/8
110
4″1/4
4″3/8
4″1/2
120
4″5/8
4″3/4
4″7/8
130
5″
5″1/8
5″1/4
5″3/8
140
5″1/2
5″5/8
5″3/4
150
5″7/8
6″
6″1/8
160
6″1/4
6″3/8
6″1/2
170
6″5/8
6″3/4
6″7/8
180
7″
7″1/8
7″1/4
7″3/8
190
7″1/2
7″5/8
7″3/4
200
7″7/8
8″
8″1/8
210
8″1/4
8″3/8
8″1/2
220
8″5/8
8″3/4
8″7/8
230
9″
9″1/8
9″1/4
240
9″3/8
9″1/2
9″5/8
9″3/4
250

Techné

Sintered metal **Parts**

Techné - Morancé

0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250

1/8"
1/4"
3/8"
1/2"
5/8"
3/4"
7/8"
1"
1"1/8
1"1/4
1"3/8
1"1/2
1"5/8
1"3/4
1"7/8
2"
2"1/8
2"1/4
2"3/8
2"1/2
2"5/8
2"3/4
2"7/8
3"
3"1/8
3"1/4
3"3/8
3"1/2
3"5/8
3"3/4
3"7/8
4"
4"1/8
4"1/4
4"3/8
4"1/2
4"5/8
4"3/4
4"7/8
5"
5"1/8
5"1/4
5"3/8
5"1/2
5"5/8
5"3/4
5"7/8
6"
6"1/8
6"1/4
6"3/8
6"1/2
6"5/8
6"3/4
6"7/8
7"
7"1/8
7"1/4
7"3/8
7"1/2
7"5/8
7"3/4
7"7/8
8"
8"1/8
8"1/4
8"3/8
8"1/2
8"5/8
8"3/4
8"7/8
9"
9"1/8
9"1/4
9"3/8
9"1/2
9"5/8
9"3/4

Techné

CFB & CFF

CFB & CFF

CFB 50.2000 50.2001

CFF 50.1000 50.1001

1] Structure

✓ CFB bronze bushes

CFB Techné bushes are composed with a sintered bronze porous structure with excellent sliding properties, impregnated with mineral oil. Self-lubricant, they don't require any maintenance. Moreover, they are suitable for heavy loads and high running speed. Their mechanical characteristics are comparable to bushes made of SINT A 50 according DIN 30910.
Bronze sintered bushes are adapted to small systems with high rotation speed like drills, screwing machines, food mixers, etc.

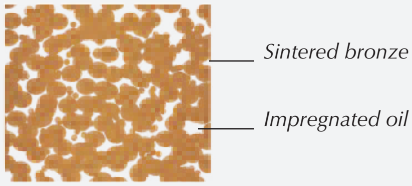


fig.71 • Micrographic structure of CFB

Techné can offer its CuSn6Zn6Pb3 standard material. Anyway, for all new conceptions, RoHs and VHU conform materials shall be recommended.

✓ CFF iron bushes

Cost saving alternative to CFB bushes, Techné CFF bushes are composed with a sintered iron porous structure impregnated with mineral oil.
CFF bushes provide a higher Load resistance than CFB, but with a lower speed performance. They are suitable for heavy applications with oscillating motions or with low rotations.

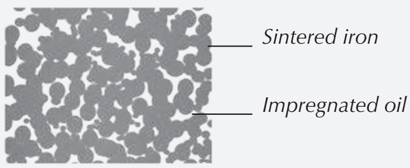


fig.72 • Micrographic structure of CFF

2) Mechanical characteristics

Properties	Type	Bronze	Iron	Unit
Crushing strength	Radial (K factor)	150	170	N/mm²
Maxi load	On bushing	10	22	N/mm²
Speed		6	4	m/s
Max PV factor	> 0.5 m.s^{-1}	1,8	1,8	N/mm².m/s (W/mm²)
Friction coef.	< 0,5 m.s^{-1}	0,05 - 0,2	0,08 - 0,025	
	> 0,5 m.s^{-1}	0,01 - 0,08	0,01 - 0,08	
Hardness	Bush	25	35	HB
	Shaft	>30	>50	HRc
Shaft roughness		Ra : 0,1 - 0,6	Ra : 0,1 - 0,3	µm
Temperature		-5 ; +90[1]	-5 ; +90[1]	°C
Porosity		22	25	%
Oil impregnation		19	22	%
Thermal conductivity		27	36	W(m.K)$^{-1}$

1. Depends on the oil temperature limitation

3) Chemical characteristics

After analysis of each layer of the bush, Techné gives indication about chemical resistance. However because of the wide variety of available materials and grades, compatibility tests before final selection of the material are recommended.

✓ Chemical resistance

Sintered iron resists to alcohols, glycols, solvents, gasoline, diesel, kerosene and most of mineral oils (T° lower than 100°C). However sliding layer can be damaged by some strong acids, such as hydrochloric, nitric, sulfuric, acetic and formic acids. . It is also not recommended to use it with HFC oils and in navy environment.
Sintered bronze bushes offer the same chemical resistance as iron bushes. They theoretically resist to water and steam, but with extreme care (see page 162). They can be damaged in contact with some gases such as free halogen or ammoniac, especially when these gases are humid. It is also not recommended to use iron with HFC oils and in navy environment.
Finally CFB bushes shall not be assembled in aluminum housing because of electrochemical corrosion risk in humid environment.

For applications with corrosion risk between shaft and bush, Techné advises to use shaft made of stainless steel with chrome plating or made with aluminum and anodizing.

4) Performances

✓ Bronze

MPIF	ISO 5755	Density	Porosity (%)	K factor (N/mm²)
CT-1000-K26	C-T-10-K140	6,4-6,8	22	> 150

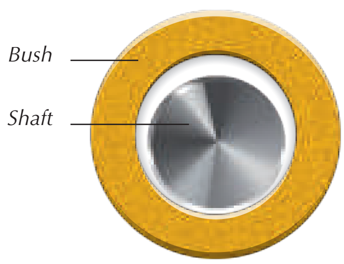
CuSn6Zn6Pb3 material provides similar mechanical characteristics as Standard Sint A50 according to DIN 30910.

✓ Iron

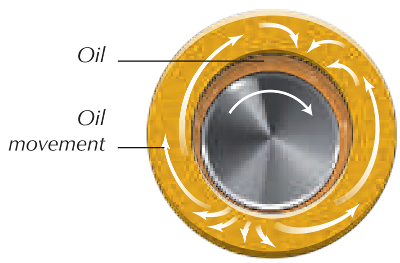
MPIF	ISO 5755	Density	Porosity (%)	K factor (N/mm²)
F-0200-K20	-F-00C2-K200	5,6-6,0	25	> 200

Techné iron material provides similar mechanical characteristics as Standard Sint A10 according DIN 30910.

✓ Principle



STATIC



DYNAMIC

Due to capillarity, oil stays in the bush. It also is in contact with shaft. At the start, there is no stick-slip effect.

when rotating, an oil film is created by a negative air pressure between the shaft and the bush. Hydrodynamic lubrication is obtained.

✓ Lubrication

The oil used for bushes impregnation is a mineral oil according ISO VG68. Working temperature: -20°C to +120°C.

For intense use, heavy load or in dusty environment, a piece of oil impregnated felt can be set up in contact with the bush' outside diameter.

5) PV factor

Calculated $\overline{PV}$ factor has to be lower than PV max of the bush :

$$\overline{PV}_{max} < PV_{max}$$

So for the sintered bush: $\overline{PV}_{max} < 1.8$ (see table page 159 et , below)
Also pressure $\overline{P}$ and speed $\overline{V}$ values must be lower than the acceptable ones of the CFB or CFF bush, see table on page 159.

Note: Maximal pressure $\overline{P}_{max}$ and maximal speed $\overline{V}_{max}$ of a given application may not be used simultaneously. In such a case, calculation of $\overline{PV}_{max}$ factor must not be $\overline{P}_{max}$ by $\overline{V}_{max}$, but pressure $\overline{P}_t$ by speed $\overline{V}_t$ at time t, and depending on t, chose the $\overline{PV}_{t\,max}$ factor.

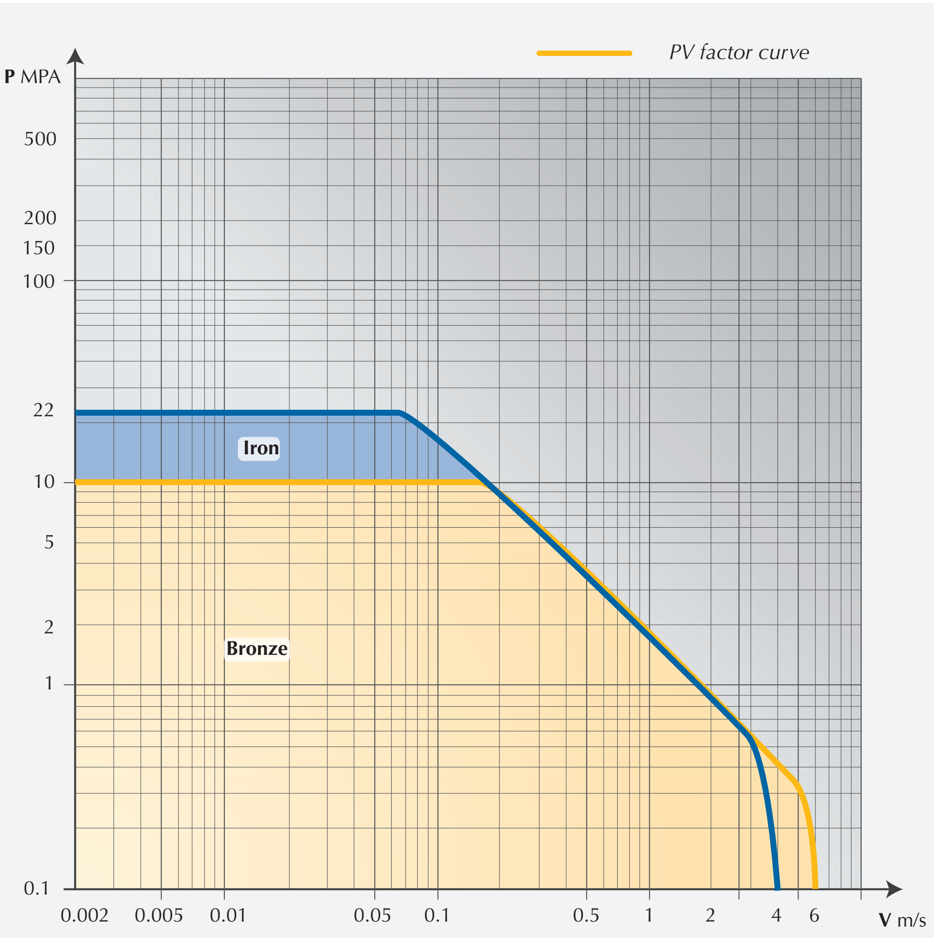
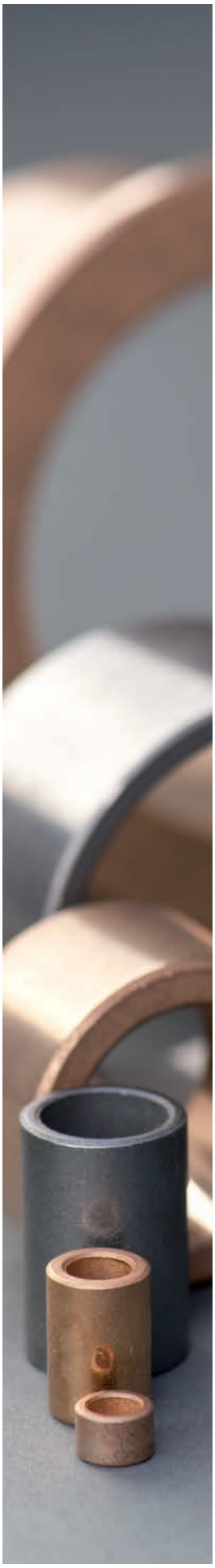


fig.73 • PV factor chart



6) Design

✓ Applications

Sintered bushes are well designed for rotating motions. They can also be used in translation but with a lower performance since they cannot reach the hydrodynamic lubrication.
To avoid any wear-out failure, eccentric loads (axial or radial) must be carefully avoided.

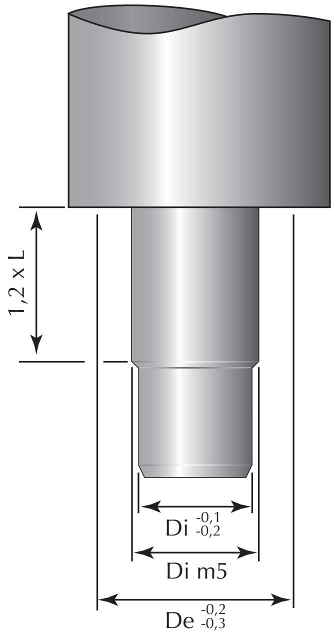
Because of its sponge structure, applications in contact with water shall be avoided. The bush would absorb and stock water, entailing a higher corrosion and a quick wear.
In new conceptions, a minimum bush thickness of 1 mm is needed to warrant its mechanical properties. See dimensional list hereafter for standard dimensions.

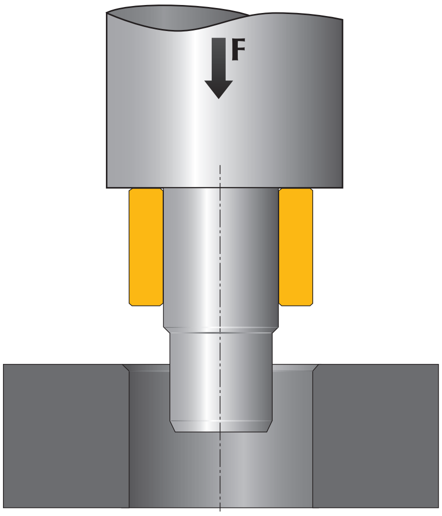
✓ Assembly

Tolerance	Shaft D_A	Housing D_L
Ø	f7[1]	H7

1 g6, for more precision

✓ Fitting





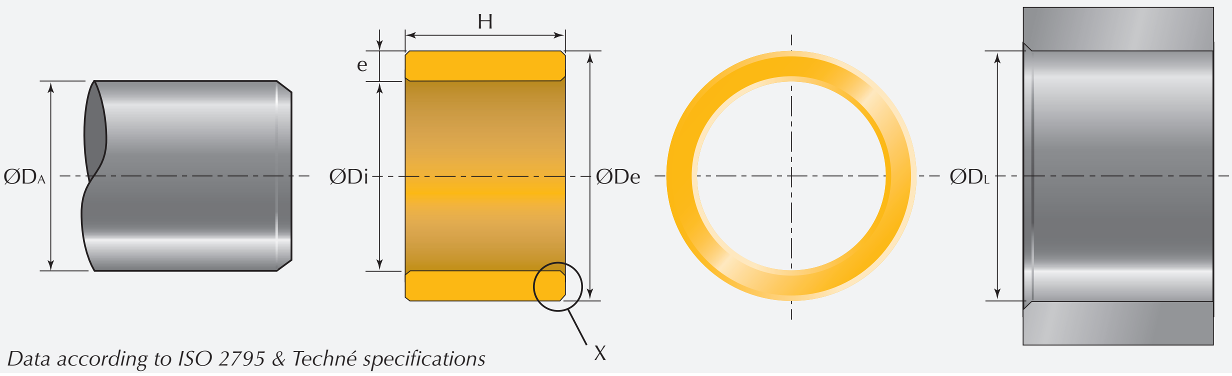
A chamfer at the housing entrance of minimum 1 mm must be machined. Sintered bushes don't need to be greased before assembly.

After installation, sintered bushes have following tolerances:
Inner diameter Di H7 until Ø50 mm and H8 over 50 mm.

Applications

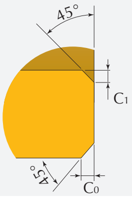
Techné sintered bushes are widely used in all kind of household and industrial applications: small household electrical appliances, portable equipment, automobile industry, electric motors, pneumatic devices, etc.

7) Dimensional list



Data according to ISO 2795 & Techné specifications

Detail X



e	C_0	C_1	e	C_0	C_1
≤ 1	0,2	0,2	3 - 4	0,6	0,6
1 - 2	0,3	0,3	4 - 5	0,7	0,7
2 - 3	0,4	0,4	> 5	0,8	0,8

Non exhaustive list, other dimensions on demand

ØDi	ØDe	Shaft $ØD_A$		Housing $ØD_L$		H	Techné ref.	
		Tol	max min	Tol	max min		CFB 50.2000	CFF 50.1000
2	5	f7	1,994 1,984	H7	5,012 5	2	0252	0008
						3	0253	0009
3	6		2,994 2,984		6,012 6	4	0364	0364
						6	0366	0010
						10	0001	0011
4	7		3,99 3,978		7,015 7	4	0002	0474
						8	0478	0012
						12	4712	0013
4	8		3,99 3,978		8,015 8	4	0484	0015
						8	0488	0017
						12	0004	0018
						5	0005	0019
5	8		4,99 4,978		8,015 8	8	0006	0020
						10	5810	5810
						12	0007	0021
						16	0008	0022
5	9		4,99 4,978		9,015 9	4	0594	0023
						5	0595	0025
						8	0598	0026
6	9		5,99 5,978		9,015 9	6	0010	0027
						10	0011	0029
						12	0012	0030
						16	6916	0031
6	10		5,99 5,978		10,015 10	4		6104
						6	0013	0032

ØDi	ØDe	Shaft $ØD_A$		Housing $ØD_L$		H	Techné ref.	
		Tol	max min	Tol	max min		CFB 50.2000	CFF 50.1000
6	10	f7	5,99 5,978	H7	10,015 10	10	0014	0033
						12	0015	0034
						16	0016	0186
6	12		5,99 5,978		12,018 12	6	0017	0035
						10	0018	0036
						12	3258	0037
						16	0019	0038
7	10		6,987 6,972		10,015 10	5	7105	0039
						8	7108	0040
						10	1010	0041
						16	0716	
8	11		7,987 7,972		11,018 11	8	0022	0187
						12	1112	0811
						16	0023	0042
						20	1120	0043
8	12		7,987 7,972		12,018 12	8	0025	0812
						10	0026	0188
						12	0027	0189
						16	0028	8121
						20	1220	8123
8	14		7,987 7,972		14,018 14	8	0581	0044
						12	0029	0256
						16	0030	0045
						20	1420	0046
9	12		8,987 8,972		12,018 12	6	9126	0047
						10	1210	0048
						14	1214	0049
						18		0190
10	13		9,987 9,972		13,018 13	10	0032	0101
						12	1013	
						16	0033	1316
						20	0034	0193
						25	1325	0050
10	14		9,987 9,972		14,018 14	10	0035	0194
						14	0037	
						15	1001	
						16	0038	0051
						20	0039	0195
						25	0040	0052
10	15		9,987 9,972		15,018 15	10	1111	0254
						16	1516	0053
						20	1520	0054
						25	1525	0055
10	16		9,987 9,972		16,018 16	10	1610	0056

ØDi	ØDe	Shaft $ØD_A$		Housing $ØD_L$		H	Techné ref.	
		Tol	max min	Tol	max min		CFB 50.2000	CFF 50.1000
10	16	f7	9,987 9,972	H7	16,018 16	12	0149	
						16	1616	0057
						20	1620	0058
						25	1625	0059
12	14		11,984 11,966		14,018 14	20	2001	
12	15		11,984 11,966		15,018 15	8		1215
						12	0136	0196
						15	0304	1115
						16	0046	0197
						20	0047	1220
						25	1225	0060
12	16		11,984 11,966		16,018 16	10	0048	
						12	0049	0198
						16	0050	1216
						20	0051	0061
						25	0052	0199
12	17		11,984 11,966		17,018 17	10		0200
						12	1712	1217
						16	1716	0062
						20	1725	0063
						25	0725	0064
12	18		11,984 11,966		18,018 18	12	0054	0201
						16	0055	0065
						20	0056	0066
						25	1825	0067
12	20		11,984 11,966		20,021 20	15	1515	
13	15		12,984 12,966		15,018 15	15	0145	
13	16		12,984 12,966		16,018 16	12	0057	
14	16		13,984 13,966		16,018 16	20	0058	
14	17		13,984 13,966		17,018 17	15	1417	
14	18		13,984 13,966		18,018 18	13	1413	
						14	0059	0202
						15	1415	
						16	1418	
						18	0060	0068
						20	1422	
						22	1822	0014
						28	0061	0141
14	20		13,984 13,966		20,021 20	14	0062	0069
						16	0150	

ØDi	ØDe	Shaft $ØD_A$ Tol	Shaft $ØD_A$ max min	Housing $ØD_L$ Tol	Housing $ØD_L$ max min	H	Techné ref. CFB 50.2000	Techné ref. CFF 50.1000
14	**20**	f7	13,984 13,966	H7	20,021 20	**18**	2018	0071
						22	0063	0203
						28	0064	0204
15	**19**		14,984 14,966		19,021 19	**10**	1510	
						16	0065	0205
						20	1920	0072
						25	1925	0073
						32	1932	0074
15	**21**		14,984 14,966		21,021 21	**6**	0066	
						8	0067	
						10	1521	
						16	0068	0075
						20	2120	0076
						25	2125	0077
						32	2132	0078
16	**19**		15,984 15,966		19,021 19	**15**	1619	
16	**20**		15,984 15,966		20,021 20	**16**	0070	0206
						20	0071	0207
						25	0072	0208
						32	2032	0209
16	**21**		15,984 15,966		21,021 21	**25**	0073	
16	**22**		15,984 15,966		22,021 22	**16**	0074	0079
						18		0210
						20	0075	0211
						25	2225	0080
						28	1622	
						32	0076	0081
						25	0077	
17	**25**		16,984 16,966		25,021 25	**10**	2510	
18	**22**		17,984 17,966		22,021 22	**12**	1812	
						18	0078	0212
						22	0079	0070
						25	0080	
						28	0081	0082
						36	2236	0083
18	**24**		17,984 17,966		24,021 24	**12**		0214
						16	0133	0215
						18	2418	0216
						22	2422	0084
						28	2428	0217
						36	2436	0085
18	**25**		17,984 17,966		25,021 25	**18**	2518	0086

ØDi	ØDe	Shaft $ØD_A$ Tol	Shaft $ØD_A$ max / min	Housing $ØD_L$ Tol	Housing $ØD_L$ max / min	H	Techné ref. CFB 50.2000	Techné ref. CFF 50.1000
18	25	f7	17,984 / 17,966	H7	25,021 / 25	22	0522	0087
						28	2528	0088
						36	2536	0089
19	23		18,98 / 18,959		23,021 / 23	10	1910	
19	24		18,98 / 18,959		24,021 / 24	28		0218
20	24		19,98 / 19,959		24,021 / 24	10	0148	
						12	0083	
						16	0084	2024
						20	0085	2020
						25	0086	0221
						26	0087	
						30	0088	0222
						32	0089	0223
20	25		19,98 / 19,959		25,021 / 25	16	2516	0160
						20	0091	0090
						25	0092	0224
						32	0093	0091
20	26		19,98 / 19,959		26,021 / 26	16	0094	0225
						20	0095	0226
						25	0096	0227
						32	0097	0228
20	27		19,98 / 19,959		27,021 / 27	16	2716	0092
						20	2720	0093
						25	2725	0094
						32	2732	2032
20	28		19,98 / 19,959		28,021 / 28	16	2816	0229
						20	0099	0230
						25	0100	0231
						32	0101	0232
20	30		19,98 / 19,959		30,021 / 30	20	0156	
						32	2030	
21	27		20,98 / 20,959		27,021 / 27	20	0098	
22	27		21,98 / 21,959		27,021 / 27	14	0102	
						18	2718	0233
						22	2722	0234
						25	2227	
						28	2728	0095
						36	2736	0096
22	28		21,98 / 21,959		28,021 / 28	18	0103	0097
						22	2822	0098
						28	0104	0099
						36	2836	0100

ØDi	ØDe	Shaft $ØD_A$		Housing $ØD_L$		H	Techné ref.	
		Tol	max min	Tol	max min		CFB 50.2000	CFF 50.1000
22	29	f7	21,98 21,959	H7	29,021 29	18	0105	0102
						22	0106	0104
						28	2928	0105
						36	0182	0106
24	30		23,98 23,959		30,021 30	14	0153	
						20	0107	0235
						25	0108	2530
						32	3032	3032
						40	0109	0410
25	32		24,98 24,959		32,025 32	20	0110	2370
						25	0111	2532
						30		0002
						32	0112	0107
						40	0113	0238
28	32		27,98 27,959		32,025 32	22	3222	2822
						28	3228	3228
						36	3236	0108
						45	3245	0109
28	33		27,98 27,959		33,025 33	22	0114	2833
						28	3328	0110
						36	3336	0111
						45	3345	0112
28	36		27,98 27,959		36,025 36	22	3622	0113
						28	0115	0114
						36	3636	0115
						45	3645	0241
28	38		27,98 27,959		38,025 38	32	0116	
30	36		29,98 29,959		36,025 36	24	3036	
30	37		29,98 29,959		37,025 37	27	3037	
30	38		29,98 29,959		38,025 38	24	0117	0242
						30	0118	0243
						38	0119	0244
32	38		31,975 31,95		38,025 38	20	0120	3238
						25	0121	0116
						32	3832	0117
						40	3840	0118
						50	0122	
32	40		31,975 31,95		40,025 40	20	4020	0120
						25	4025	0121
						32	0142	0122
						40	0141	3240
						50	4050	0123

ØDi	ØDe	Shaft $ØD_A$		Housing $ØD_L$		H	Techné ref.	
		Tol	max min	Tol	max min		CFB 50.2000	CFF 50.1000
33	40	f7	32,975 32,95	H7	40,025 40	15		0024
35	44		34,975 34,95		44,025 44	15	3544	
						22	4422	3544
						28	0123	0124
						35	0124	0251
						40		3540
35	45		34,975 34,95		45,025 45	25	4525	0125
						35	4535	0126
						40	0021	0127
						50	0125	0128
36	42		35,975 35,95		42,025 42	22	4222	0245
						28	4228	0129
						36	4236	0130
						45	4245	3642
36	45		35,975 35,95		45,025 45	22	4522	0131
						28	4528	0132
						36	4536	0133
						40	4540	
						45	0126	0134
36	46		35,975 35,95		46,025 46	32		0246
38	44		37,975 37,95		44,025 44	25	4425	0135
						35	4435	0136
						45	4445	0137
40	46		39,975 39,95		46,025 46	25	0127	0138
						32	4632	4046
						40	4640	0139
						50	4650	0140
40	50		39,975 39,95		50,025 50	25	5025	4050
						32	5032	0252
						37	0144	
						40	0128	4040
						50	0129	0247
						65	4065	
45	51		44,975 44,95		51,03 51	28	5128	5128
						35	5136	4535
						36		4551
						45	5145	0142
						56	5156	0143
45	55		44,975 44,95		55,03 55	35	5535	0144
						45	5545	0145
						55	5555	0146
						65	5565	0147

ØDi	ØDe	Shaft $ØD_A$		Housing $ØD_L$		H	Techné ref.	
		Tol	max min	Tol	max min		CFB 50.2000	CFF 50.1000
45	56	f7	44,975 44,95	H7	56,03 56	28	5628	0028
						36	5636	0148
						45	5645	4556
						56	5656	4546
						65	0082	0149
50	56		49,975 49,95		56,03 56	32	0143	0150
						40	5640	5640
						50	5650	0151
						63	5663	5056
50	60		49,975 49,95		60,03 60	32	0130	0152
						40	6040	0253
						44		5064
						50	6050	5050
						60		5060
						63	6063	5063
						69		5049
						70	5060	
50	62		49,975 49,95		62,03 62	50		0003
						70		5070
55	65		54,97 54,94		65,03 65	40	6540	0153
						48		0248
						55	6555	5565
						70	6570	0154
60	70		59,97 59,94		70,03 70	25		6025
						40	0146	
						42		0607
						45		6070
						49		6049
						50	0131	0605
						60	7060	0606
						70	0132	0004
						90	7090	
60	72		59,97 59,94		72,03 72	50	7250	
						60	7260	
						70	7270	
60	75		59,97 59,94		75,03 75	70		0005
60	80		59,97 59,94		80,03 80	90	8090	
63	70		62,97 62,94		70,03 70	40	7040	
						50	7050	
70	78		69,97 69,94		78,03 78	49		7078
70	80		69,97 69,94		80,03 80	11		0249
						45		7080

ØDi	ØDe	Shaft $ØD_A$		Housing $ØD_L$		H	Techné ref.	
		Tol	max min	Tol	max min		CFB 50.2000	CFF 50.1000
70	80	f7	69,97 69,94	H7	80,03 80	50		7050
						59		7081
						90	0809	
						120	7080	
74	90		73,97 73,94		90,035 90	10		0007
80	88		79,97 79,94		88,035 88	59		8088
80	95		79,97 79,94		95,035 95	70		0250
80	100		79,97 79,94		100,035 100	100	8010	
						120		0156
90	100		89,964 89,929		100,035 100	40		9010
						60		9016
100	120		99,964 99,929		120,035 120	120		0155

Filters

1] Principle

✓ Applications

Sintered filters are set up when a mastered flow is needed. They help protecting a system from pressure changes, filtering 2 different fluids, controlling a flow, a debit and its dispersion, without losing significant load.
Sintered filters are made of sintered metal powder, allowing mastering their filtration grade. Material is rigid, resistant to pressure and temperature changes. It can be easily cleaned with water, heated steam, solvents or ultrasounds.

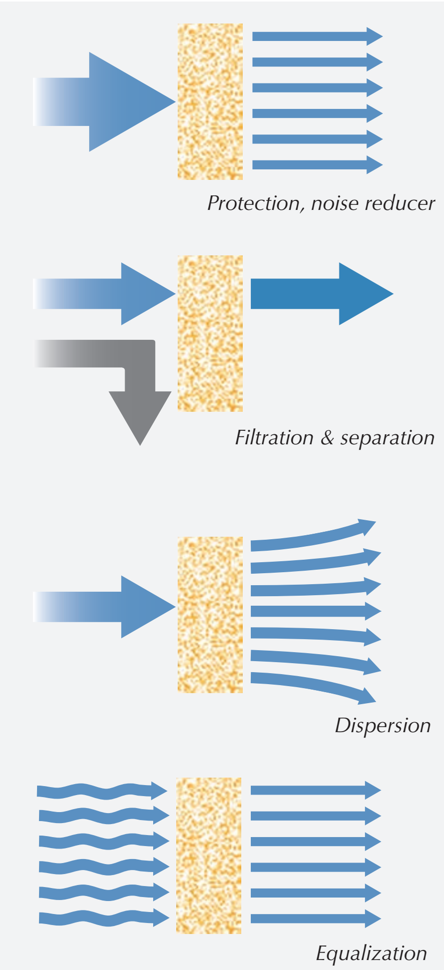


fig.74 • FIlters applications

✓ Process

Sintered filters are made with the same process as sintered bushes (see page 183). However, the powder, made of small metal balls, is not pressed before sintering. It is simply poured in a mold and heated in a sintering oven. Porosity of the filter is defined with the balls' size.

2) Materials

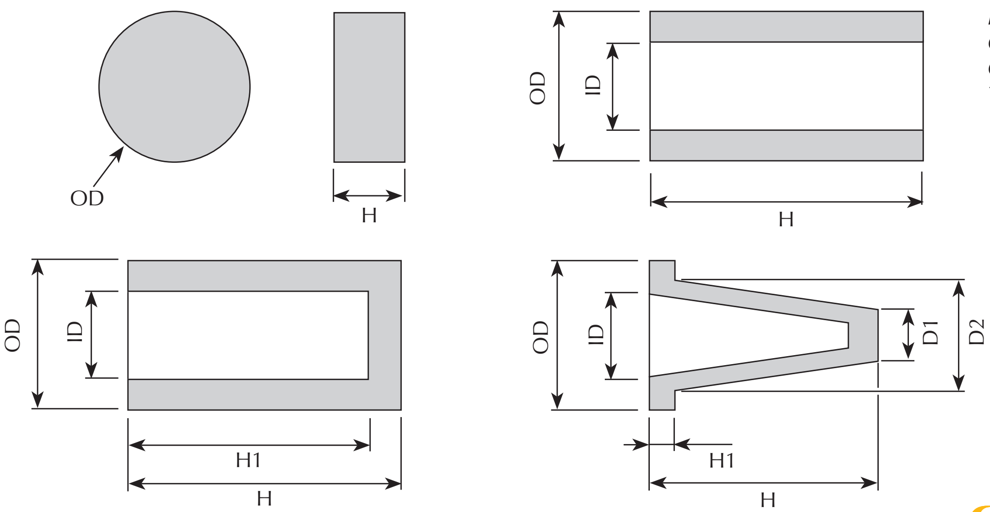
✓ Bronze

CuSn11 2.1052		Mechanical characteristics				
Cu %	Tin %	Density	Porosity %	Tensile strength MPa	Filtration µ	Maxi T°C
89	11	4,5 - 5,5	30 - 40	3 - 5	5 - 120	200° oxidizing media 300°reducing media

✓ Inox

AISI 316L 1.4404						Mechanical characteristics				
Fe %	Cr % ±1	Ni % ±2	C %	Mo % ±0,5	Div. %	Density	Porosity %	Tensile strength MPa	Filtration µ	Maxi T°C
bal	17	12	≤0,3	2,5	N≤0,1	5,5 - 6,5	25 - 40	2 - 9	2 - 60	320° oxidizing media 380° reducing media

3) Standard profiles



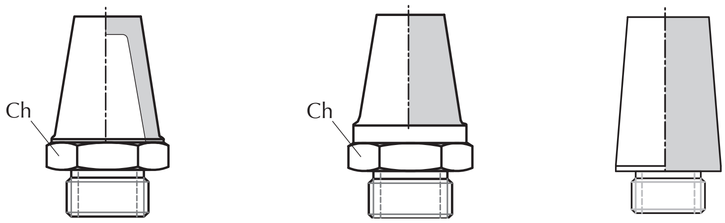
Pellet
Cylinder
Closed cylinder
Truncated Cone

4] Noise reducers

They are assembled on standard fittings in outgoing flow networks. They mostly aim at noise reducing in pneumatic installations.

They can also be used as flame-wall (in fuel boilers for instance), and to separate 2 liquids with different surface tensions.

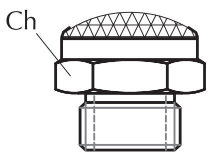
✓ Sintered noise reducers



Type	SEB		SBE		SC
	ref.	CH	ref.	CH	ref.
M5	On request	8	5420200005	8	On request
1/8″	5420210017	12	5420200006	13	5420600012
1/4″	5420210018	15	5420200007	16	5420600013
3/8″	5420210019	19	5420200008	19	5420600015
1/2″	5420210020	23	5420200009	24	5420600016
3/4″	5420210021	30	54202000010	30	On request
1″	5420210022	36	5420200011	36	On request

✓ Braided wire noise reducers

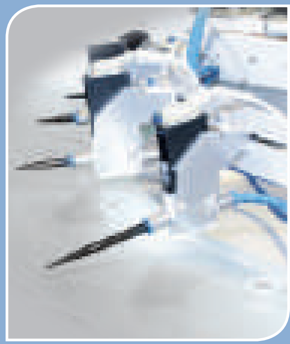
Type	SFE		
	Brass	CH	Nickel brass
M5	5440100029	8	On request
1/8″	5440100023	13	5440100018
1/4″	5440100024	16	54401000140
3/8″	5440100025	19	54401000380
1/2″	5440100026	24	54401000260
3/4″	5440100027	30	5440100034
1″	5440100028	36	On request



✓ Special noise reducers

Techné provides on customers' request specific filters / noise reducers to meet their technical specifications.

Applications



Filters/noise reducers are widely used in pneumatic aggregates, in trucks, in compressed air installations, in automated sorting devices. When used with a fluid, they filter polluting particles (in fuel boilers for instance).

0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250

1/8"
1/4"
3/8"
1/2"
5/8"
3/4"
7/8"
1"
1"1/8
1"1/4
1"3/8
1"1/2
1"5/8
1"3/4
1"7/8
2"
2"1/8
2"1/4
2"3/8
2"1/2
2"5/8
2"3/4
2"7/8
3"
3"1/8
3"1/4
3"3/8
3"1/2
3"5/8
3"3/4
3"7/8
4"
4"1/8
4"1/4
4"3/8
4"1/2
4"5/8
4"3/4
4"7/8
5"
5"1/8
5"1/4
5"3/8
5"1/2
5"5/8
5"3/4
5"7/8
6"
6"1/8
6"1/4
6"3/8
6"1/2
6"5/8
6"3/4
6"7/8
7"
7"1/8
7"1/4
7"3/8
7"1/2
7"5/8
7"3/4
7"7/8
8"
8"1/8
8"1/4
8"3/8
8"1/2
8"5/8
8"3/4
8"7/8
9"
9"1/8
9"1/4
9"3/8
9"1/2
9"5/8
9"3/4

Special sintered parts

Special
Sintered parts

1] Advantages

Sintering process consists of heating a metal powder, almost until fusion point is reached. Metal balls are welded together and form a solid structure.
This process is easier to implement and less expensive than machining a plain metal part or a foundry. In case of serial production, the process' repeatability is good and tightened tolerances can be reached (IT6 to 7). A wide range of metals can be sintered.
Sintered parts are usually lighter than plain metal parts. According their material porosity, a lubricant can be impregnated, adding so a self-lubricant characteristic.

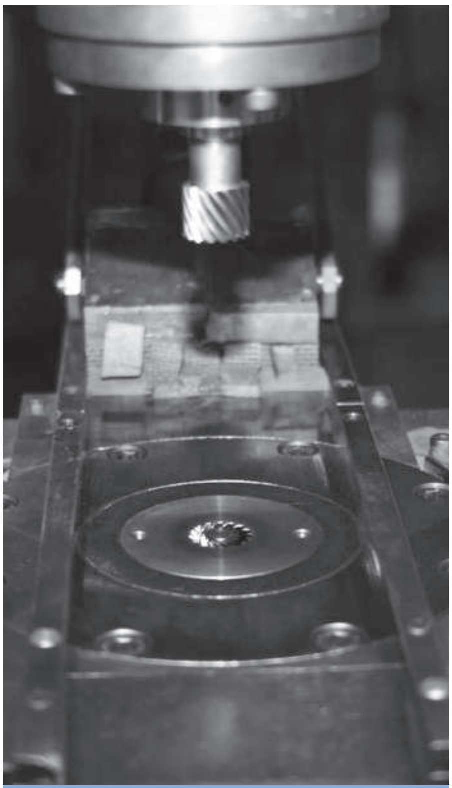
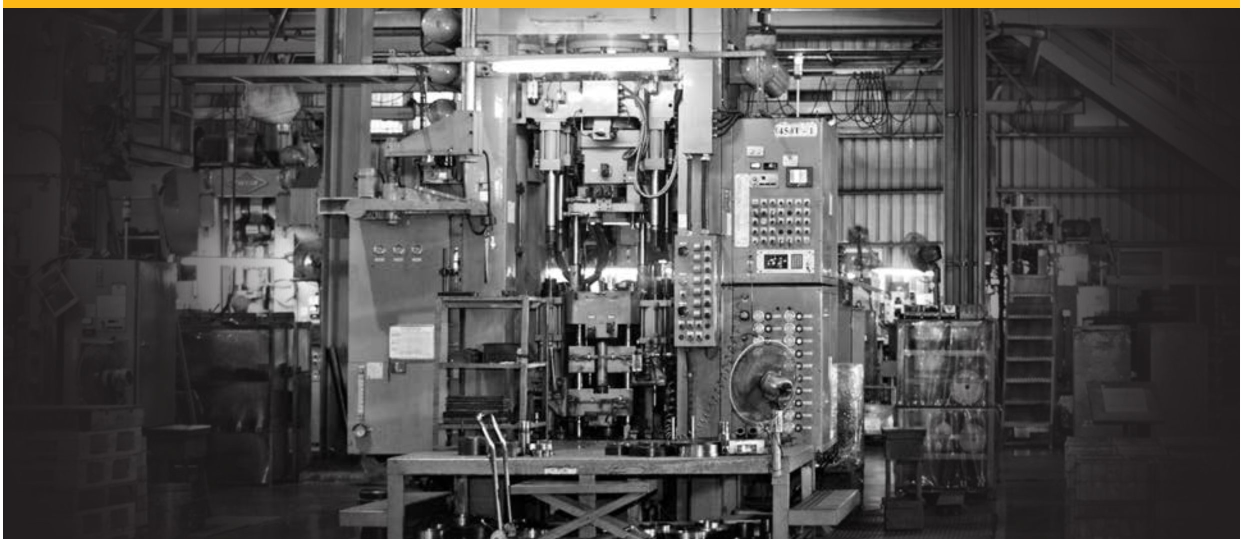


fig.75 • Table of compression press



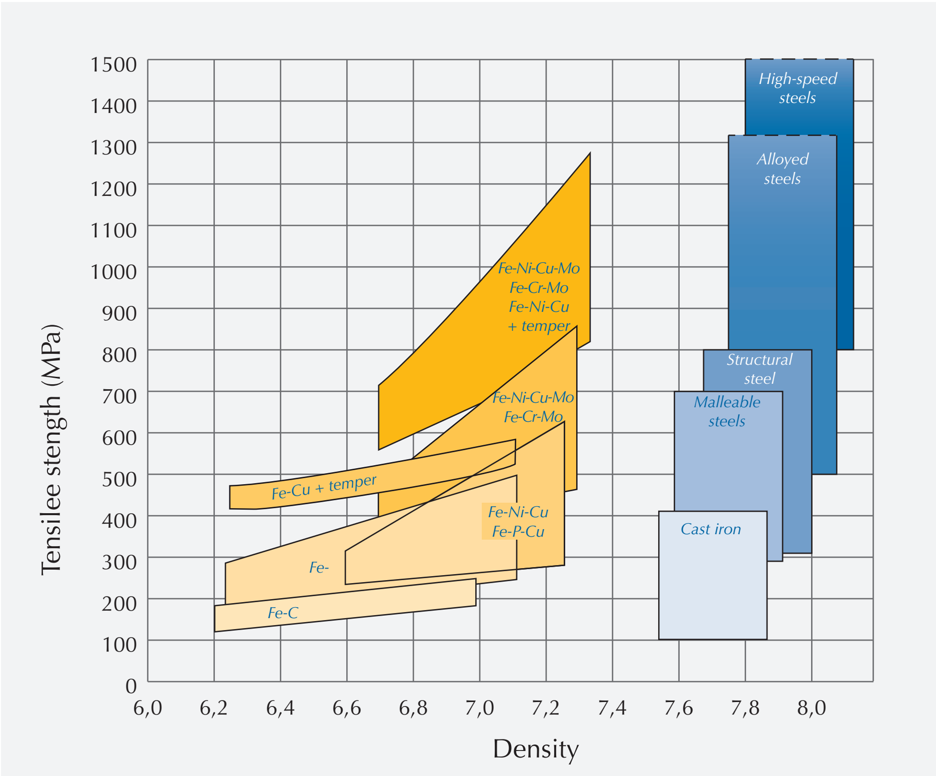


fig.76 • Indicative comparaison chart with casting metals & sintered metals

With a lower density and a lower weight, sintered parts offer an equal resistance to heavy loads in comparison to standard metal parts.

2) Materials

✓ Steels

DIN SINT	ISO	MPIF	Density	Composition type	Hardness HV	Rm MPa
C00	-F-00-100	F-0000-15	6,4-6,8	Fe	40	130
C01	-F-05-140	F-0005-20	6,4-6,8	Fe-0,5C	75	250
D00	-F-00-120	F-0000-20	6,8-7,2	Fe	50	150
D00	-F-00-120	F-0000-20	6,8-7,2	Fe-0,2C	75	230
D01	-F-05-170	F-0005-25	6,8-7,2	Fe-0,5C	90	300
/	-F-08-240	F-0008-35	6,8-7,2	Fe-0,7C	110	380
D11	-F-05C2-300	FC-0205-45	6,8-7,2	Fe2Cu-0,5C	140	500
D11[1]	-F-05C2-620H	FC-0205-90HT	6,8-7,2	Fe2Cu-0,5C	380	690
D11	-F-08C2-390	FC-0208-60	6,8-7,2	Fe2Cu-0,7C	170	560
D30	/	FD0205/FLNC4405	6,8-7,2	Fe1,5Cu1,75Ni0,5Mo-0,2C	140	470
D30	/	FD0405/FLN4C4005	6,8-7,2	Fe1,5Cu4Ni0,5Mo-0,2C	150	520
E30	/	FD0405/FLN4C4005	>7,2	Fe1,5Cu4Ni0,5Mo-0,2C	170	570
D35	-F-00P05-210	FY-4500-20W	6,8-7,2	Fe0,45P	100	380
D39	-FD-05N2C-400	FD-0205-55/FLNC4405	6,8-7,2	Fe1,5Cu1,75Ni0,5Mo-0,5C	180	540
D39[1]	-FD-05N2C-950H	FD-0205-120HT/FLNC4408-HT	6,8-7,2	Fe1,5Cu1,75Ni0,5Mo-0,5C	400	1020
D39	/	FD-0208-60/FLNC4405	6,8-7,2	Fe1,5Cu1,75Ni0,5Mo-0,7C	210	580
D39	-FD-05N4C-420	FD-0405-60/FLN4C4005	6,8-7,2	Fe1,5Cu4Ni0,5Mo-0,5C	180	620
D39[1]	-FD-05N4C-930H	FD-0405-130HT/FLN4C4005	6,8-7,2	Fe1,5Cu4Ni0,5Mo-0,5C	380	1050
D39	/	FD-0408-60/FLN4C4005	6,8-7,2	Fe1,5Cu4Ni0,5Mo-0,7C	230	610
E39	-FD-05N4C-450	FD-0405-65/FLN4C4005	>7,2	Fe1,5Cu4Ni0,5Mo-0,5C	200	700
/		FN-5000	6,9-7,4	Fe50Ni	HRb 28	240
/	/	FLC24808mod.	6,8-7,2		HRc 30	620
/	/	FLNC 4408	6.8 - 7.2		HRc 21	660

1 Quench & temper

✓ Stainless steel

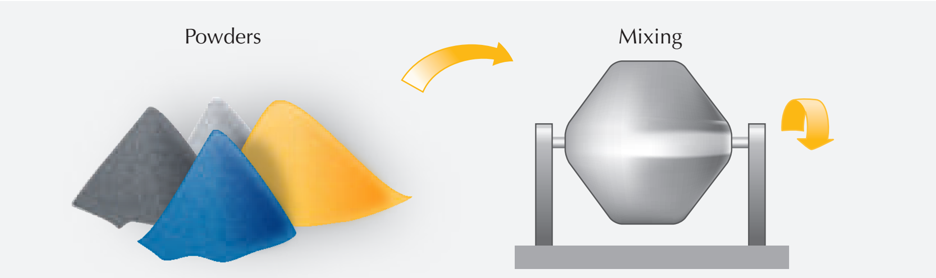
DIN SINT	ISO	MPIF	Density	Composition type	Hardness HV	Rm MPa
/		SS303N1	6,4-6,6		80	270
/	-FL304-210N	SS304N1-33	6,4-6,6	Fe18Cr10Ni	125	370
C40	-FL316-170N	SS316N1-25	6,4-6,8	Fe16Cr12Ni2,5Mo	115	280
C43	-FL410-140	SS410	6,4-6,8	Fe12Cr	220	420
C42	-FL430-170	SS430	6,4-6,8	Fe16Cr	240	450

Stainless steel sintering in nitrogen athmosphere

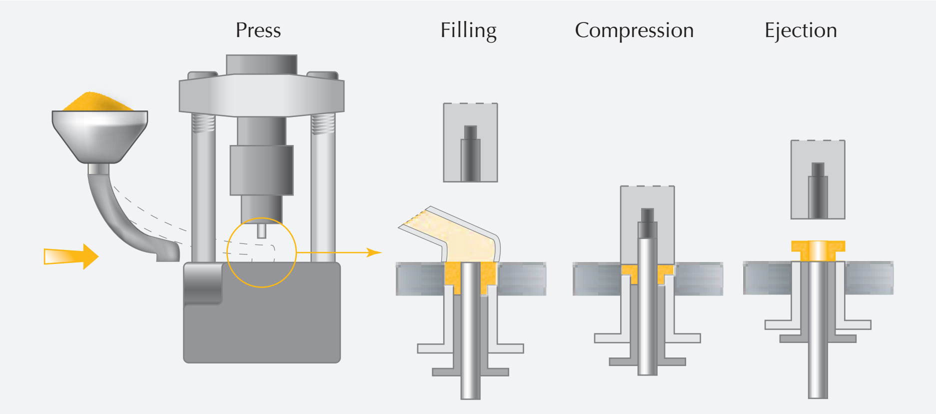
✓ Materials for bearing

DIN SINT	ISO	MPIF	Density	Composition type	Hardness HV	Rm MPa	Porosity
A00	-F-00-K170	F-0000-K15	5,6-6,0	Fe	30	170	26
B00	-F-00-K220	F-0000-K23	6,0-6,4	Fe	40	220	21
/	-F-03C36T-K90	FCTG3608-K16	5,6-6,0	Fe36Cu4Sn1C	40	90	27
/	-F-03C36T-K120	FCTG3608-K22	6,0-6,4	Fe36Cu4Sn1C	50	120	22
B11	/	FC-0205-K35	6,0-6,4	Fe2Cu0,4C	70	270	20
/	/	FC-2000-K25	5,6-6,0	Fe20Cu	30	170	22
A50	-C-T10K-140	CT-1000-K26	6,4-6,8	Cu9Sn	30	140	25
B50	-C-T10K-180	CT-1000-K37	6,8-7,2	Cu9Sn	35	180	20

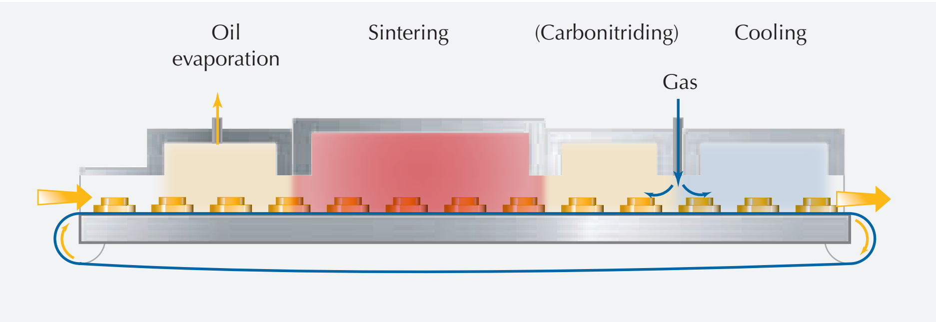
3) Process



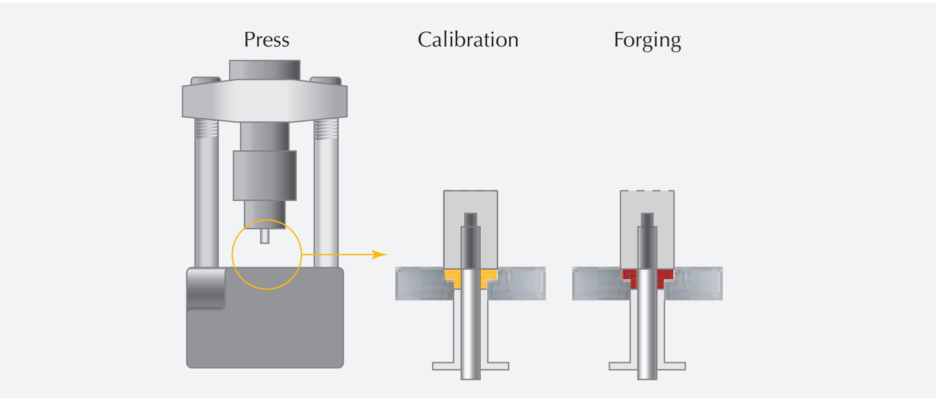
Mix:
- iron powder
- copper powder
- alloy
- Graphite
- Lubricant to reduce compression stress



cold compression: powder mix uniaxial compression with a press



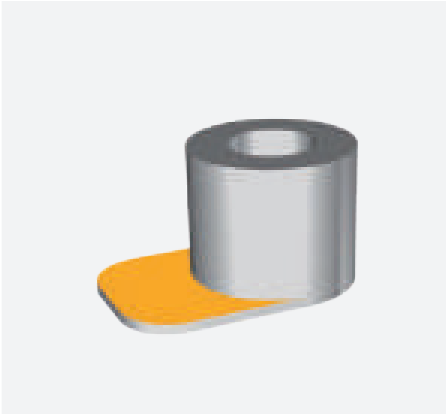
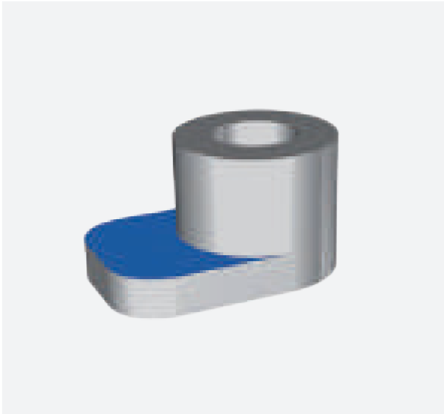
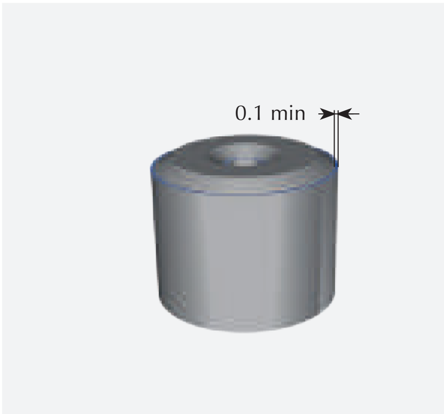
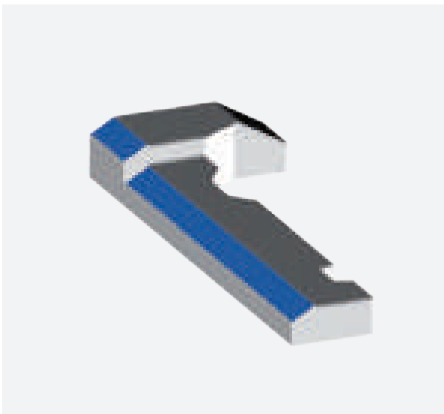
Sintering of metal powders: pressed parts go through a first oven (700°C) to eliminate remaining oils. Second oven (1100°C): metal particles are welded together. Then parts are cooled. A 3rd hoven can be added to the process when carbonitriding is needed.



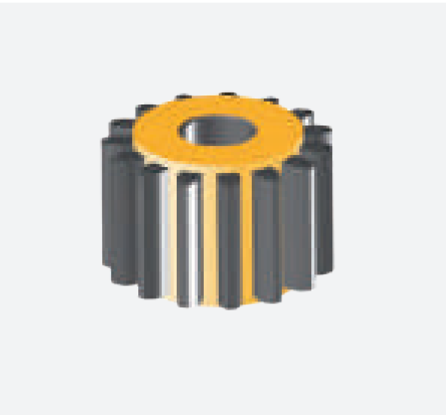
To get IT7 precision tolerances, sintered parts can be calibrated or forged.

Finish part
Additional operations:
- Vacuum oil impregnation
- Addition of solid lubricant (graphite, PTFE, etc.).
- Turning and Milling
- Cementation

4) Conception rules

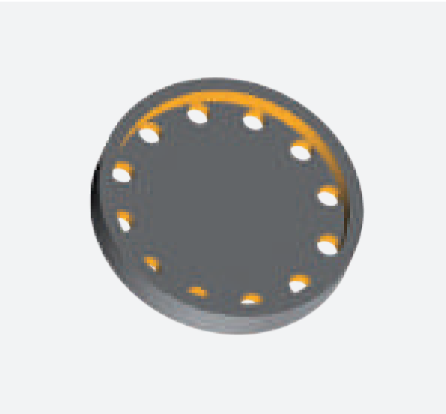
	To avoid	Recommended
Sintered parts' chamfers can be responsible of huge density differences. The stronger their angles the weaker the upper piston. The ratio of compression heights shall not exceed 80/20.		
When conceiving a part, it is better to avoid big heights differences on large surfaces. It would lead to parts 'weaknesses because of their density differences.		
Conceiving chamfered parts requires the use of fine edges pistons. Techné thus advices chamfers of maxi 30°. A small flat edge (0,1mm) shall be added to prevent tooling from breaking or being damaged during the production.		
Fine edges pistons are also needed to produce large radius on sintered parts. Techné recommends thus to replace them with chamfers.		

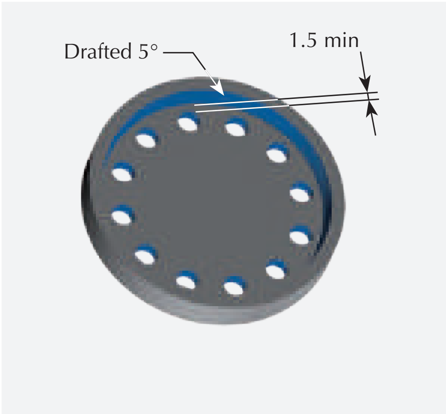
To avoid	Recommended



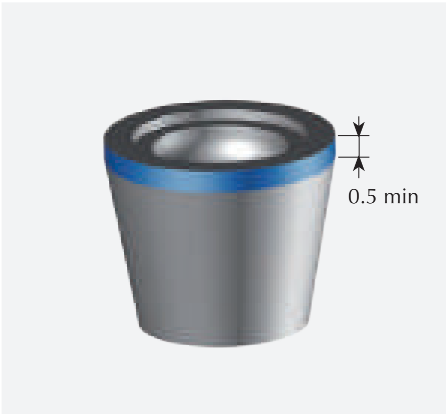
Manufacturing of toothed wheels is made with stage pistons. A gap of at least 0,5mm is required between the bottom of the teeth and the hub. Moreover, modulus m shall not be lower than 0,5. For conceptions with a keyway, 0,2mm radius shall replace sharp angles.

Tangencies between heights must be avoided. Otherwise, compression pistons would have fine and sharp angles. This shall not affect the efficiency of the parts.





For the conception of holed parts, the distance between a hole and a part edge shall be at least 1,5mm.



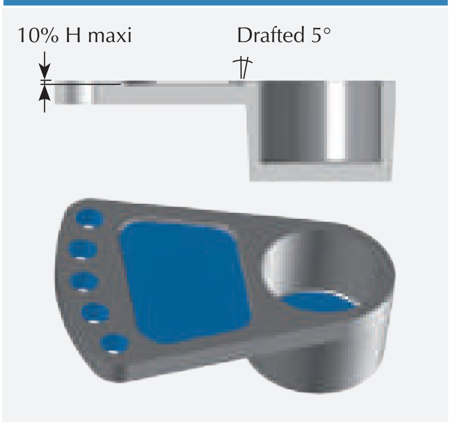
Upper edges of a conical part may lead the tooling to break. Techné recommends to add a cylindrical face of at least 0,5mm long.

	To avoid	Recommended

The thickness of a sintered part's bottom shall not be lower than 1,5mm.

Frontal clearances shall not exceed 10% of the part's height. Side clearance with a draft angle of 5° is required.

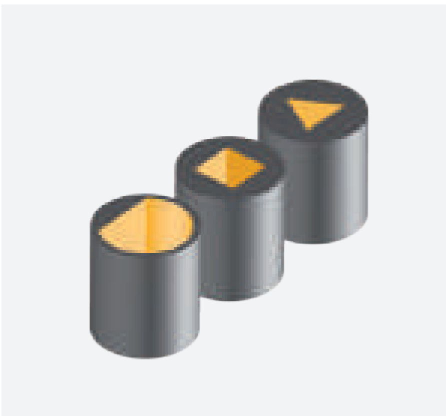
To reduce a part's weight, round holes are better than slotted holes: tooling manufacturing will be easier and thus cost saving.

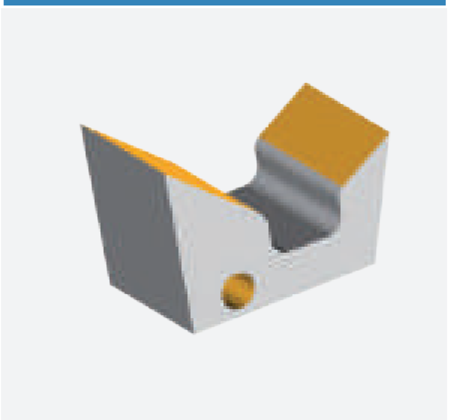
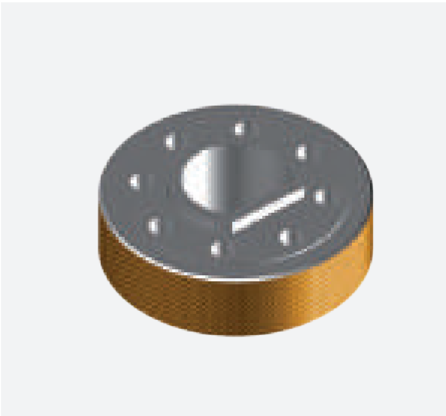
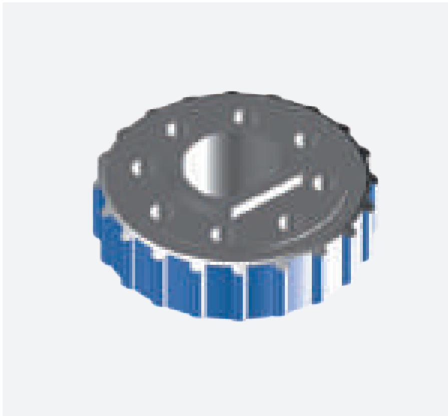
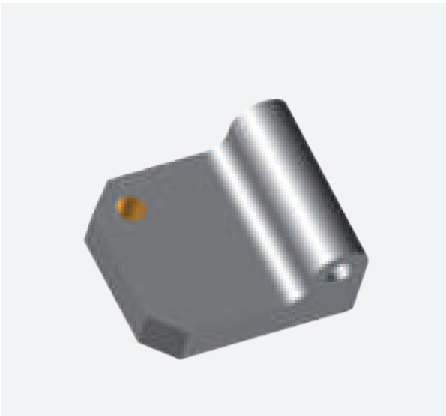
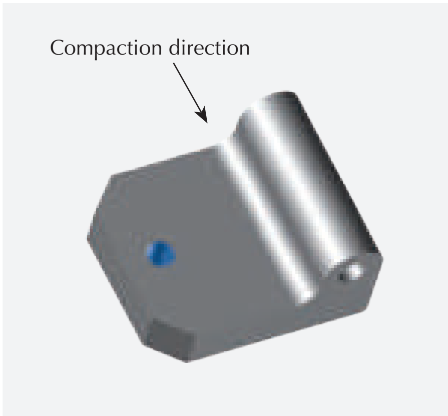


As long as it is made in the compression direction; the engraving of sintered parts is easy. Its depth shall not exceed 10% its height with a 60° draft angle.

When conceiving conical toothed wheels, a cylindrical face shall be added to avoid the use of fine edges pistons. Efficiency of parts remains unchanged.

Ratio between a sintered part's height and its thickness shall not be over 6. Conception of big and thin parts shall be avoided. For non-cylindrical inside shapes, sharp angles shall be replaced with radius.

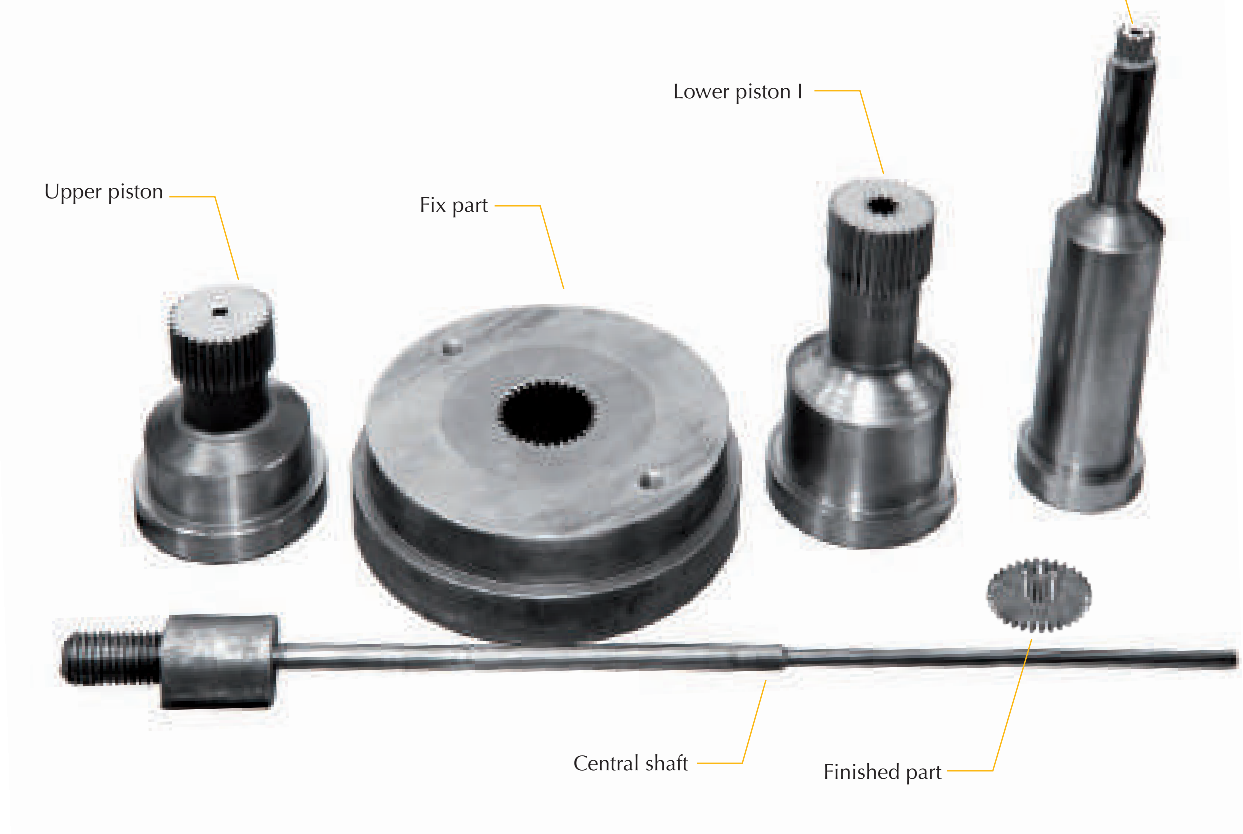


To avoid	Recommended	
		*Sharp edges shall be generally avoided. Techné recommends adding flat faces, chamfers or radius.* *Holes shall be carefully placed to avoid density differences.*
		*Parts with diamond knurling cannot be sintered. Knurling can be replaced with small regular teeth. Function remains unchanged.*
		*Holes transversal to the compaction direction are usually made by machining. For cost saving purpose, holes can also be produced by sintering as long as they are in the part's axle direction and perpendicular to the molding axle.*
		*To increase the precision during the calibration, sharp angles shall be avoided. They shall be replaced with radius.*

5) Some Examples

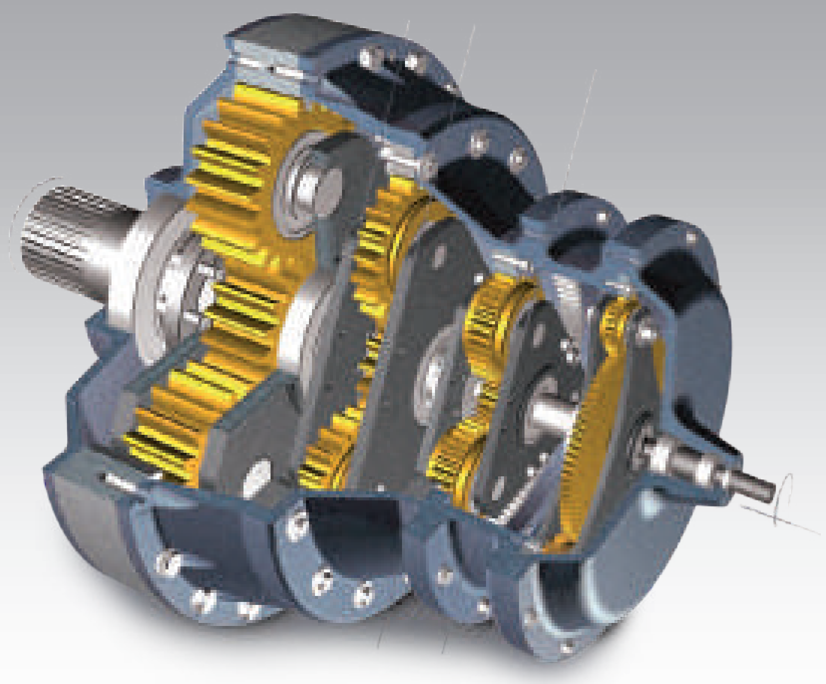
Specific flanged bush
Toothed wheel
Toothed wheel support
Pump element

A sintered part and its tooling initially installed in a compression press.



Applications

Sintered parts are mostly used in home automation and electrical applications, for instance in electrical motors, but also in the automobile industry, in pumps, robots and automatons. They usually replace mechanical machined parts with moderate constraints produced in large quantities.



0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250

1/8"
1/4"
3/8"
1/2"
5/8"
3/4"
7/8"
1"
1"1/8
1"1/4
1"3/8
1"1/2
1"5/8
1"3/4
1"7/8
2"
2"1/8
2"1/4
2"3/8
2"1/2
2"5/8
2"3/4
2"7/8
3"
3"1/8
3"1/4
3"3/8
3"1/2
3"5/8
3"3/4
3"7/8
4"
4"1/8
4"1/4
4"3/8
4"1/2
4"5/8
4"3/4
4"7/8
5"
5"1/8
5"1/4
5"3/8
5"1/2
5"5/8
5"3/4
5"7/8
6"
6"1/8
6"1/4
6"3/8
6"1/2
6"5/8
6"3/4
6"7/8
7"
7"1/8
7"1/4
7"3/8
7"1/2
7"5/8
7"3/4
7"7/8
8"
8"1/8
8"1/4
8"3/8
8"1/2
8"5/8
8"3/4
8"7/8
9"
9"1/8
9"1/4
9"3/8
9"1/2
9"5/8
9"3/4

Techné

Appendice

Standards

Standard	Year	Object	Product
ISO 3547-1	2006	Sizes	Wrapped bush
ISO 3547-2	2006	Diameters control method	Wrapped bush
ISO 3547-3	2006	Holes, indentations & oil groove	Wrapped bush
ISO 3547-4	2006	Material	Wrapped bush
ISO 3547-5	2007	Control tool for OD	Wrapped bush
ISO 3547-6	2007	Control tool for ID	Wrapped bush
ISO 3547-7	2007	Thickness control method	Wrapped bush
ISO 286-2	2010	Tolerances for housing and shaft	All products
EN 10027	1992	Steels designation	Steel
EN 10139	1997	Malleable steel strip designation	TA bush
DIN 30910-1	1990	Material for sintered parts	Bushes/sintered parts
DIN ISO 4379	1993	Copper alloy ring	PLB
ISO 12128	1998	Holes, indentations & oil groove	PLB & PLA
2000/53/CE	2000	European directives on end of life vehicles (ELV Directive)	All products
2002/95/CE	2003	European directives, restriction of the use of hazardous substance in electrical and electronic equipment (RoHS Directive).	All products
MPIF standard 35	2007	Material for sintered parts	Bushes/sintered parts
ISO 5755	2012	Material for sintered parts	Bushes/sintered parts

ISO 286	E7	F7	G6	G7	G8	H6	H7	H8	H10	js13	f7	g6	h6	h7	r6	r7	s7	s8
0 - 3	+24 +14	+16 +6	+8 +2	+12 +2	+16 +2	+24 +14	+10 0	+14 0	+40 0	+70 -70	-6 -16	-2 -8	0 -6	0 -10	+16 +10	+20 +10	+24 +14	+28 +14
3 - 6	+32 +20	+22 +10	+12 +4	+16 +4	+22 +4	+32 +20	+12 0	+18 0	+48 0	+90 -90	-10 -22	-4 -12	0 -8	0 -12	+23 +15	+27 +15	+31 +19	+37 +19
6 - 10	+40 +25	+28 +13	+14 +5	+20 +5	+27 +5	+40 +25	+15 0	+22 0	+58 0	+110 -110	-13 -28	-5 -14	0 -9	0 -15	+28 +19	+34 +19	+38 +23	+45 +23
10 - 18	+50 +32	+34 +16	+17 +6	+24 +6	+33 +6	+50 +32	+18 0	+27 0	+70 0	+135 -135	-16 -34	-6 -17	0 -11	0 -18	+34 +23	+41 +23	+46 +28	+55 +28
18 - 30	+61 +40	+41 +20	+20 +7	+28 +7	+40 +7	+61 +40	+21 0	+33 0	+84 0	+165 -165	-20 -41	-7 -20	0 -13	0 -21	+41 +28	+49 +28	+56 +35	+68 +35
30 - 50	+75 +50	+50 +25	+25 +9	+34 +9	+48 +9	+75 +50	+25 0	+39 0	+100 0	+195 -195	-25 -50	-9 -25	0 -16	0 -25	+50 +34	+59 +34	+68 +43	+82 +43
50 - 65	+90 +60	+60 +30	+29 +10	+40 +10	+56 +10	+90 +60	+30 0	+46 0	+120 0	+230 -230	-30 -60	-10 -29	0 -19	0 -30	+60 +41	+71 +41	+83 +53	+99 +53
65 - 80															+62 +43	+73 +43	+89 +59	+105 +59
80 - 100	+107 +72	+71 +36	+34 +12	+47 +12	+66 +12	+107 +72	+35 0	+54 0	+140 0	+270 -270	-36 -71	-12 -34	0 -22	0 -35	+73 +51	+86 +51	+106 +71	+125 +71
100 - 120															+76 +54	+89 +54	+114 +79	+133 +79
120 - 140	+125 +85	+83 +43	+39 +14	+54 +14	+77 +14	+125 +85	+40 0	+63 0	+160 0	+315 -315	-43 -83	-14 -39	0 -25	0 -40	+88 +63	+103 +63	+132 +92	+155 +92
140 - 160															+90 +65	+105 +65	+140 +100	+163 +100
160 - 180															+93 +68	+108 +68	+148 +108	+171 +108
180 - 200	+146 +100	+96 +50	+44 +15	+61 +15	+87 +15	+146 +100	+46 0	+72 0	+185 0	+360 -360	-50 -96	-15 -44	0 -29	0 -46	+106 +77	+123 +77	+168 +122	+194 +122
200 - 225															+109 +80	+126 +80	+176 +130	+202 +130
225 - 250															+113 +84	+130 +84	+186 +140	+212 +140
250 - 280	+162 +110	+108 +56	+49 +17	+69 +17	+98 +17	+162 +110	+52 0	+81 0	+210 0	+405 -405	-56 -108	-17 -49	0 -32	0 -52	+126 +94	+146 +94	+210 +158	+239 +158

Symbols & units

Symbole	Correspondance	Unit
α	Oscillation angle	°
Δu	Wear rate	%
ρ	Density	$g.mm^{-3}$
ν	kinematic viscosity	m^2/s ou Stocks (St)
μ	Dynamic viscosity	Pa.s, Poise ou cP
Cf	Friction coeficient	/
C_0	Bush external chanfer	mm
C_1	Bush internal chanfer	mm
Ch	Housing chanfer	mm
Cr	Reduction coef of the projected area	/
D_A	Shaft Ø	mm
Dc	Flange Ø	mm
De	External Ø	mm
Di	Internal Ø	mm
D_L	Housing external Ø	mm
e	Bush thickness	mm
H	Bush height	mm
J	Diametral clearance	mm
L_h	Lifetime	heures
N	Rotation per minute	/min
N_f	Oscillation frequency per minute	Hz
N_t	Translation per minute	/min
$\overline{PV}$	PV factor for application	$N/mm^2.m/s$ (W/mm^2)
PV	PV factor for bush	$N/mm^2.m/s$ (W/mm^2)
R	Radius (circle)	mm
S	Translation length	mm
T°	Temperature	°

Design sheet

- ☐ New project
- ☐ Existing project

Application
(Ex : conveyor chain)..
....
....
....

Company............................
M/Mrs ....
Mail..
Phone..
Adress ....
....
ZIP code..
City ....
Country ....

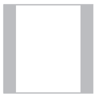
Techné customer: ☐ Yes ☐ No

Bush type

☐ TU ☐ TI ☐ TX ☐ TY ☐ TZ ☐ TA ☐ TBL ☐ PLA ☐ PLB ☐ TCT ☐ Fritté

☐ Let Techné selecting the right product

Profil



Di x De x L
..... x........x......

Di x De x L x Dc
..... x........x..... x.....

Di x De
..... x......

On Drawing ☐

Load

☐ Radial load — Static ....N — Dynamic ....N

☐ Axial load — Static ....N — Dynamic ....N

select 1kg = 10N

Speed

☐ Rotation — .... $m.s^{-1}$ or ....N/min

☐ Oscillation — α........° and........... N/min

☐ Translation — ....Nt/min — Distance S ....mm

Assembly

☐ Housing — Ø.........mm Tolerance.......... — Ra...........................N

☐ Shaft — Ø.........mm Tolerance.......... — Ra...........................N

Lubrication

- ☐ With oil, for intermittently
- ☐ With oil, continous, (oil pump)
- ☐ With grease
- ☐ Without lubrication
- ☐ Other

External media ....
....

Notes..
....
....
....
....
....

Sketch

OEM
Tel : +33 (0)4 78 43 12 72
Fax : +33 (0)4 78 43 12 77
oem@techne.fr

Industrie
Tel : +33 (0)4 78 43 78 78
Fax : +33 (0)4 78 43 16 91
industrie@techne.fr

Distribution
Tel : +33 (0)4 78 43 12 70
Fax : +33 (0)4 78 43 11 43
distribution@techne.fr

Techné Shanghai
Tél : +86 21 64 73 84 17
Fax : +86 21 64 73 84 39
techneshanghai@techne.cn

Chromex
Tel : +33 (0)1 69 92 16 30
Fax : +33 (0)1 64 94 84 02
chromex@chromex.info

Techné Turkey
Tel : +90 (0) 212 256 68 96
Fax : +90 (0) 212 255 21 92
turkey@techne.fr

Techné
GROUPE

OEM
Phone : +33 (0)4 78 43 12 72
Fax : +33 (0)4 78 43 12 77
Mail : oem@techne.fr

Industrie
Phone : +33 (0)4 78 43 78 78
Fax : +33 (0)4 78 43 16 91
Mail : industrie@techne.fr

Distribution
Phone : +33 (0)4 78 43 12 70
Fax : +33 (0)4 78 43 11 43
Mail : distribution@techne.fr

Chromex
Phone : +33 (0)1 69 92 16 30
Fax : +33 (0)1 64 94 84 02
Mail : chromex@chromex.info

Techné Shanghai
Phone : +86 21 64 73 84 17
Fax : +86 21 64 73 84 39
Mail : techneshanghai@techne.cn

Techné Turquie
Phone : +90 (0) 212 256 68 96
Fax : +90 (0) 212 255 21 92
Mail : turkey@techne.fr

Creat
Phone : +33 (0)4 37 46 20 01
Fax : +33 (0)4 37 46 20 10
Mail : creat@creat.fr

ISO 9001
ISO 14001
BUREAU VERITAS
Certification

techne.fr

Edition janvier 2019, Crédits photos : Techné, Imprimerie Pretext communication