GGB BY TIMKEN

METAFRAM RANGE

SELF-LUBRICATING SINTER BRONZE AND SINTER IRON BEARING SOLUTIONS

Who we are

GGB helps create a world of motion with minimal frictional loss through plain bearing and surface engineering technologies. With global R&D, testing, and production facilities, GGB partners with customers worldwide on customized tribological design solutions that are efficient and environmentally sustainable. GGB's engineers bring their expertise and passion for tribology to a wide range of industries, including automotive, aerospace, and industrial manufacturing. To learn more about tribology for surface engineering from GGB, visit **ggbearings.com**.

Our products are used in tens of thousands of critical applications around the world every day. It is always our goal to provide superior, high-quality solutions for our customers' needs – no matter where those demands take our products. From space vehicles to golf carts, and virtually everything in between, we offer the industry's most extensive range of high-performance, maintenance-free bearing solutions for a multitude of applications:

Aerospace

Agriculture

Automotive

Construction

E-Mobility

Energy

Exoskeletons

Fluid Power

Industrial

Medical

Mining

Oil & Gas

Primary Metals

Railway

Recreation

Robotics & Automation

The GGB Advantage

MAINTENANCE-FREE

GGB bearings are self-lubricating, making them ideal for applications requiring long bearing life without continuous lubrication.

LOW FRICTION, HIGH WEAR RESISTANCE

GGB bearings are self-lubricating, making them ideal for applications requiring long bearing life without continuous lubrication.

NVH (NOISE, VIBRATION, HARSHNESS)

Plain bearings provide a smooth sliding motion between surfaces and their material properties and simple design reduce noise, vibration and harshness.

LOWER SYSTEM COST

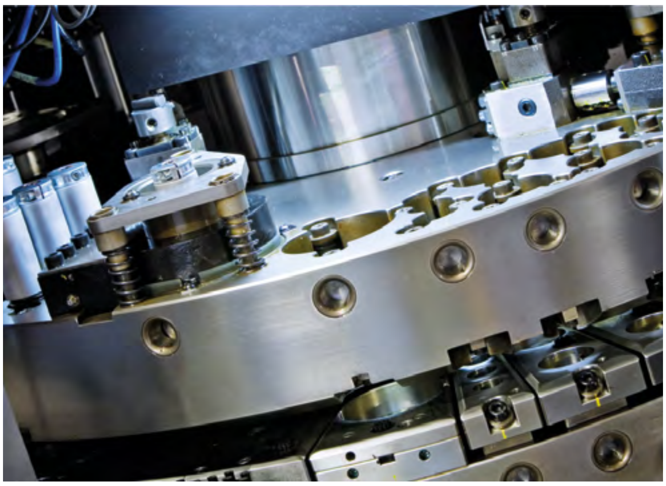
A one-piece design enables space and weight reduction. Combined with optimized material composition and self-lubricating properties, this results in reduced maintenance requirements and lower total system cost.

REDUCED CO_2 FOOTPRINT

GGB's flexible and localized production platforms ensure timely deliveries while significantly reducing the overall carbon footprint.

PARTNER SUPPORT

GGB provides comprehensive tribological, application, and design support and works closely with customers to deliver the most efficient solutions.



The Highest Standards in Fabrication

Our world-class manufacturing plants are certified according to ISO 9001, IATF 16949, ISO 14001 and ISO 45001. These certifications ensure alignment with global quality, environmental, and occupational safety standards while enabling the application of industry best practices.

For a complete listing of our certifications, please visit our website:

ggbearings.com/en/certificates

Table of Contents

1 Introduction

The increasingly demanding specifications of today’s high-performance equipment and systems require bearings that can operate under severe working conditions with minimal or no maintenance, while also offering enhanced reliability, durability, and reduced operating costs.

Self-lubricating METAFRAM sinter bronze and sinter iron bearings are designed for applications involving high sliding speeds that require a low coefficient of friction, good corrosion and seizure resistance, and suitability for frequent stop-start operation. They are also well suited for applications where conventional lubrication is not possible.

In addition, these bearings can replace previously installed, traditionally lubricated bearings in many applications.

With more than 100 years of experience and expertise in tribology, GGB offers one of the industry’s broadest portfolios of lubricated and self-lubricating bearing products, supported by comprehensive technical and application engineering knowledge.

Our Application Engineers can assist with:

- Selecting the appropriate plain bearing type
- Designing bearings to standard dimensions or customer-specific requirements
- Estimating bearing service life
- Providing assembly and installation recommendations

As a reliable supplier with flexible manufacturing capabilities, GGB responds quickly to customer needs with both standard and customized solutions.

2 Characteristics and Benefits

The GGB sinter bearings from the METAFRAM range are recommended for the following movements:

- Rotation
- Oscillation
- Linear

Other special material grades are available for specific requirements, for example:

- Higher speeds
- Higher loads

For more demanding requirements with lower or higher temperatures, increased speeds or loads, bearings can be impregnated with appropriate lubricants.

2.1 ADVANTAGES

Self-lubricating sinter bearings offer the following benefits, depending on alloy composition and lubricant type:

PERFORMANCE

A wide range of operating loads, speeds and temperatures:

- Dynamic loads from 6 to 75 MPa
- Linear speeds up to 8 m/s
- Operating temperatures from - 180°C to + 300°C

SUITABLE FOR USE IN A WIDE RANGE OF ENVIRONMENTS

- Marine environment
- Radioactive environments
- Exposure to corrosive liquids or substances incompatible with oils
- Food preparation

REDUCTION OF DESIGN AND OWNERSHIP COSTS

- Maintenance-free operation
- Lower cost compared to cast metal and machined bearings
- Capability for complex shapes and designs
- High dimensional accuracy
- Excellent surface finish
- Reduced weight compared to similar non-porous components

SAFETY

- Permanent oil-film lubrication
- Low friction coefficient
- Quiet operation
- Reliable performance at low speeds
- High corrosion resistance

2.2 AVAILABLE DESIGNS

STANDARD PRODUCTS

- Cylindrical plain bearings
- Flanged plain bearings
- Hollow and solid rod blanks for machining

SPECIAL PARTS ON REQUEST

- Cylindrical plain bearings
- Flanged plain bearings
- Hollow and solid rod blanks for machining

2.3 APPLICATIONS

INDUSTRIAL

General assembly machinery, industrial vehicles, automation, farm machinery, sewing machines, bottling machines, key duplicating machines, electrical switchgears, mobility, toys, etc.

HOUSEHOLD APPLIANCES

Washing machines, fans, woodworking machines, vacuum cleaners, extractor fans, depilators, coffee machines, juicers, rotisserie, hand tools, air conditioning, boilers, etc.

HOME APPLIANCES

Lawnmowers, roller shutters, office swivel chairs, locks, garage doors, awnings, sliding windows, hinges, furniture, gardening, etc.

3 Material Properties

3.1 MATERIAL STRUCTURE

Sinter bronze and sinter iron self-lubricating bearings are made of two components that have different functions:

- The metallic alloy structure which supports and transfers the mechanical loads
- The liquid or solid lubricant which separates the two surfaces in relative motion and reduces friction

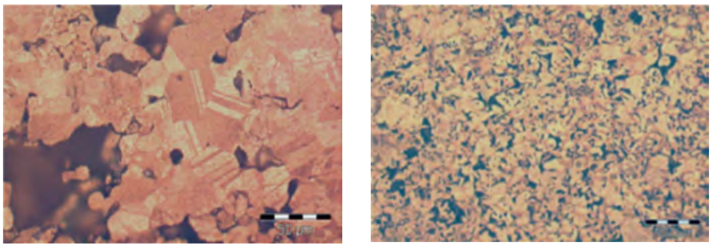


Fig. 1: Microsection of Sinter bronze (left) and Sinter iron

3.2 GRADE SELECTION

The metallic structure of the self-lubricating bearing can be made from a wide range of bronze or iron based alloys. To select the proper grade for a given application, it is necessary to check the maximum values of the material characteristics in comparison with:

- Shaft linear speed - V
- Applied load - P
- PV (load x speed) factor
- Shaft hardness and surface roughness and other parameters such as working temperature and type of lubrication, etc.

The following tables give the main physical and mechanical characteristics of GGB self-lubricating sinter bearings from the METAFRAM range.

3.3 BRONZE BASED AND IRON BASED GRADES

STANDARD MATERIAL GRADES		UNITS	BRONZE GGB-BP25	IRON ALLOY GGB-FP20	IRON ALLOY GGB-S016 (blanks only)
Similar to AFNOR			FU-E10-62	FC10-U3-56	F50-U20-60
Similar to DIN 30910			Sint A50	Sint A10	N/A
Minimum density		g/cm³	6.2	5.6	6.0
Maximum load P	- static - dynamic	MP a	20.0 10.0	45.0 22.5	120.0 60.0
Maximum sliding speed V		m/s	6.0	4.0	0.3
Maximum PV factor		MPa x m/s	1.8	1.8	0.9
Operating temperatures		°C	-5 / 90	-5 / 90	0 / 105
Impregnation oil			MT100	MT100	METADOP
Minimum open porosity		%	23	20	16

Table 1: Standard material grades

MATERIAL GRADE SELECTION

BRONZE GGB-BP25	IRON ALLOY GGB-FP20	IRON ALLOY GGB-S016
Good coefficient of friction	Recommended for medium or low speeds	Recommended for medium or low speeds
Good corrosion resistance	Good bearing strength	Good bearing strength
Recommended for high speeds	Recommended for high loads	Recommended for very high loads
Shaft surface finish Ra ≤ 0.6 µm	Shaft surface finish Ra ≤ 0.2 µm	Shaft surface finish Ra ≤ 0.2 µm
Shaft hardness HB > 240	Shaft hardness HB > 355	Shaft hardness HB > 355

Table 2: Material grade selection

4 Lubrication

4.1 LUBRICANT SELECTION

Significant development and improvement of lubricants allow the use of METAFRAM bearings in more and more applications and to comply with a wide range of working conditions in terms of temperature range and environment.

UNDER HIGH LOADS

The use of lubricants using MoS_2 additives such as METADOP (Shell OM460 + MoS2) is recommended.

TEMPERATURE RANGE

These lubricants are suitable for a temperature range from - 40°C to 150°C.
Lubricants offering a wider temperature range are available on request.

ENVIRONMENT

The lubricant PE1152 is compliant with FDA (Food and Drug Administration) regulation.

IMPREGNATION LUBRICANTS

PRODUCER	DESIGNATION	TYPE	POUR POINT °C	FLASH POINT °C	VISCOSITY cSt at 40°C	VISCOSITY cSt at 100°C	TEMPERATURE RANGE °C	
Shell	MT100	Mineral	- 9	255	100	11.5	- 5	90
Lubrilog	PE1116	Synthetic	- 50	255	65	9.5	- 40	150
Shell	OM460	High pressure	- 12	238	460	29	0	105
Lubrilog	PE1152	FDA	- 18	252	68	9	- 18	120

Table 3: most common oils. More oil grades are available on request for specific applications.
For further information please contact our application engineering department.

CHEMICAL AND PHYSICAL CHARACTERISTICS OF OIL

Lubricants based on mineral oils comprise of an organic and inorganic compounds and their physical and chemical characteristics vary considerably.

A good understanding of the main characteristics hereafter mentioned is necessary to study difficult lubrication cases. The stability under oxidation and the viscosity are particularly important.

STABILITY UNDER OXIDATION

Oxidation is a chemical reaction resulting from the combination of the oxygen contained in the air and with the mineral oil. The oxidized compounds can have an adverse effect on bearing operation. If soluble, they transform into acids and can generate corrosion on the metallic sliding counter face of the bearing. They can also form a resilient varnish which fills the bearing porosities.

ACIDITY

Low acidity of the mineral oils is acceptable. However, the acidity will increase when running at high temperature for long periods of time due to oxidation.

VISCOSITY

The viscosity of a liquid can be defined as a resistance to pouring, or as a measure of the friction between the molecules of the liquid in relative motion.

In the oil industry, the two common measurements are the kinematic viscosity in centistokes (cSt) or in Engler degrees.

VISCOSITY INDEX (VI)

An increase in temperature leads to weaker intermolecular links inside the fluid and a decrease in viscosity. The viscosity index indicates the evolution of the viscosity with temperature. The higher the index, the less sensitive is the oil to increases in temperature.

POUR POINT

A mineral oil does not change directly from a liquid state to a solid state when it is cooled down. It exhibits a plastic intermediate phase due to the crystallization of paraffin and the freezing of the different elements.

The pour point is approximately the lowest temperature at which the pouring of the liquid can be observed.

4 Lubrication

4.2 PRINCIPLES OF LUBRICATION

HYDRODYNAMIC LUBRICATION (HIGH SPEED - LOW LOAD)

Stationary position (1)

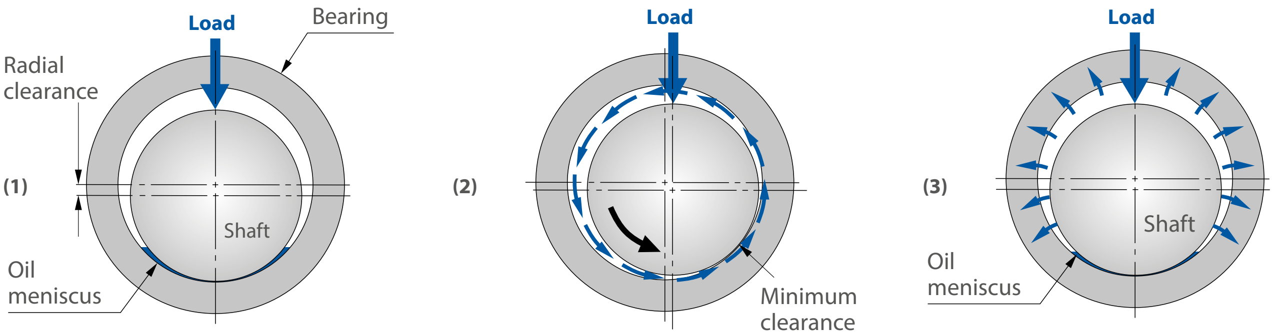
- The shaft is in contact with the bearing
- An oil meniscus is present at the contact point resulting from capillary forces.
- This oil meniscus assists in instant lubrication during startup.

Rotating shaft (2)

- Oil is drawn out of the bearing in the upper suction zone.
- Oil is driven around by the rotation of the shaft and forms an oil wedge which produces the necessary pressure to lift the shaft.
- Part of the circulating oil is forced, under the action of the pressure, in the pores of the bearing.

After operation (3)

The oil is reabsorbed by the porous bearing, under the action of capillary forces.
The oil meniscus remains at the contact point ready for instant lubrication at start-up.



BOUNDARY LUBRICATION (LOW SPEED - HIGH LOAD)

The features of this lubrication mode are as follows:

- Lubrication is provided by a lubricant film composed of molecular layers, with a strong force of adhesion to the surface and a low shear strength.
- Presence of metallic contact between the friction surfaces. Surface wear can be minimized using extreme pressure oils (eg. Shell OM460).

SOLID LUBRICANTS

In certain applications where the use of oil is not permitted (water presence, galvanic issues etc.) it is recommended to use solid lubricants such as molybdenum disulfide MoS_2, graphite Cg or fluoropolymers PTFE.

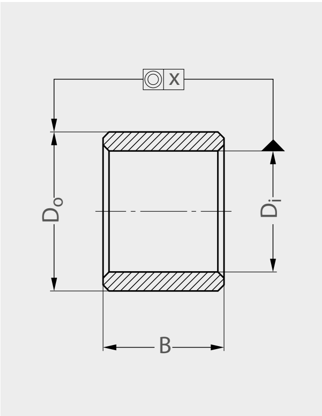
DESIGNATION	max. SPEED m/s	max. LOAD MPa	PV LOAD x SPEED MPa x m/s	TEMPERATURE RANGE °C	LOAD V= 0 MPa	SHAFT R_a max. µm	HB min.
GGB-BP25 + PTFE	1.0	10.0	0.3	- 180 / 180	20	0.3	240
GGB-FP20 + PTFE	1.0	22.5	0.3	- 180 / 180	45	0.3	300
GGB-BP25 + MoS_2	0.1	10.0	0.1	- 180 / 180	20	0.3	355
GGB-FP20 + MoS_2	0.1	22.5	0.1	- 180 / 300	45	0.3	355

Table 4: Grades proposed with solid lubricants.

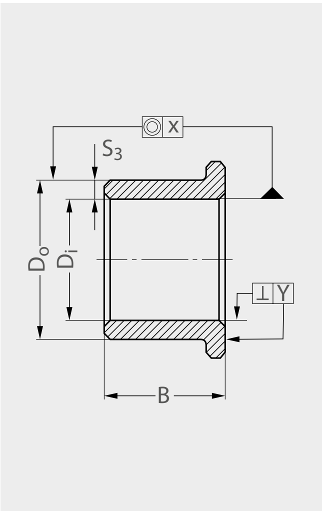
5 Dimensions and Tolerances

The following tables indicate the size of the cylindrical or flanged bearings, and give the tolerances of the main dimensions.

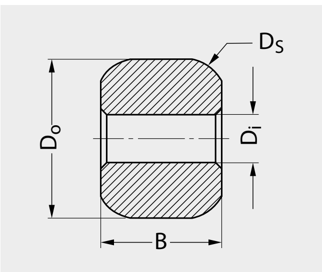
In case reduced tolerances are required due to working requirements such as noise or vibration reduction, please contact your local GGB representative.



CYLINDRICAL BEARINGS		TOLERANCE D_i	TOLERANCE D_o	TOLERANCE B	TOLERANCE X
B/Do < 1.5 and B/S3 < 15	D < 6	IT6	IT6	IT12	IT9
	6 < D ≤ 10	IT6	IT6		
	10 < D ≤ 18	IT6	IT6		
	18 < D ≤ 30	IT6	IT7		
	30 < D ≤ 50	IT7	IT7	IT13	
1.5 < B < 2 and B/S3 < 20	D < 6	IT6	IT6	IT12	
	6 < D ≤ 10	IT6	IT6		
	10 < D ≤ 18	IT6	IT7		
	18 < D ≤ 30	IT7	IT7		
	30 < D ≤ 50	IT7	IT7	IT13	



FLANGED BEARINGS		TOLERANCE D_i	TOLERANCE D_o	TOLERANCE B	TOLERANCE X	TOLERANCE Y
B/Do < 0.5 and B/S3 < 5	D < 10	IT6	IT6	IT12	IT9	0.05
	10 < D ≤ 18	IT6	IT6			
	18 < D ≤ 30	IT6	IT6			0.07
	30 < D ≤ 50	IT7	IT7	IT13		
0.5 < B D_o < 1 and B/S3 < 10	D < 10	IT6	IT6	IT12		0.05
	10 < D ≤ 18	IT6	IT7			
	18 < D ≤ 30	IT7	IT7			0.07
	30 < D ≤ 50	IT7	IT8	IT13		
1 < B D_o < 2 and B/S3 < 15	D < 10	IT6	IT7	IT12		0.05
	10 < D ≤ 18	IT7	IT7			
	18 < D ≤ 30	IT7	IT8			0.07
	30 < D ≤ 50	IT8	IT8	IT13		



SPHERICAL BEARINGS	TOLERANCE D_i	TOLERANCE D_S	TOLERANCE D_o	TOLERANCE B	CONCENTRICITY D_i / D_o
	IT6	± 0.05	± 0.2	± 0.1	0.05

Minimum weight per bearing: 0.2 g   Minimum thickness: 1 mm

B = bearing length (mm) D_i = bearing bore (mm)

D_o= bearing outer Ø (mm) D_S = sphere Ø (mm)   S3 = wall thickness: $\frac{D_o - D_i}{2}$ (mm)

Flange tolerances: Flange outside diameter: js13 - Flange thickness: js14

SURFACE ROUGHNESS

The surface roughness Ra of the inside diameter of a self-lubricated sinter bearing is between 1.2 µm and 3.2 µm, depending on the powder type (grain size) and on the density.

For standard grades (GGB-BP25, GGB-FP20), the surface roughness is between 2.5 µm and 3.2 µm.

6 Bearing Installation

Fitting with a stepped mandrel (Ground carbon steel – Surface finish: polished - Hardness > 60 RC)

The bearing is inserted into the housing with a press, using a stepped mandrel made to the recommended tolerances in order to avoid damage to the bearing and to obtain:

- A good guidance of the bearing which must be square to the housing
- The correct tolerance of the inside diameter of the bearing after assembly

Insertion forces

Estimated value with m6 mandrel, H7 housing with Ra < 3.2 µm and housing considered as rigid*: 10 MPa (surface equal to D x B of the bearing)

*Housing considered as rigid: steel or cast iron housing with thickness at least 3 times the wall thickness of the bearing.

Steel housing (rigid)

The inner diameter tolerances of the assembled bearing and the final tolerances of the inner diameter of the bearing are determined assuming a rigid housing made of steel or in cast iron.

Housing made of light alloys (aluminium, zamak etc.)

The interference fit is to be increased to compensate for the deformation of the housing. Tests are required to define the tolerances of the housing.

In certain conditions, housing ID / mandrel OD fits of J7 / s7 or K7 / s7 enable a H7 tolerance of the inner diameter of the bearing after assembly.

In the case of an assembly into light alloys and to minimize the risks due to creep deformation, it is sometimes necessary to design special shapes.

Shafts recommendations

Mechanical recommendations of steel shaft according to bearing grades:

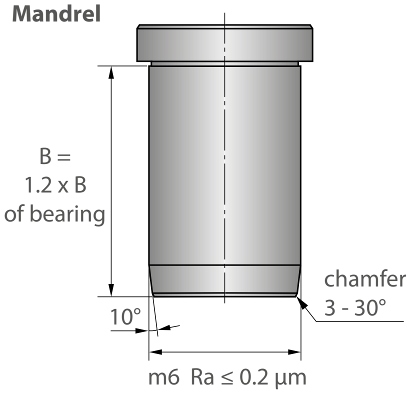
For GGB-BP25 Sinter Bronze bearings:

- Steel hardness HB > 240
- Surface roughness Ra < 0.6 µm

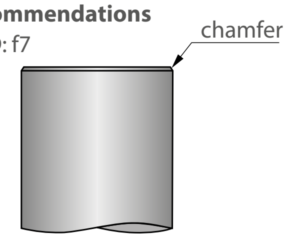
For GGB-FP20 Sinter Iron bearings:

- Steel hardness HB > 355
- Surface roughness Ra < 0.2 µm

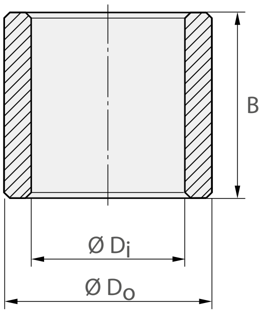
Mandrel



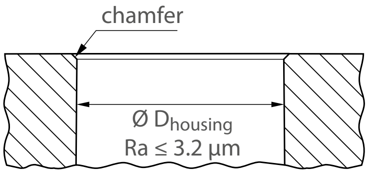
Shafts recommendations
Tolerance D: f7



Bearing in free state
(Standard bearings)
Tolerance D_i: F7 (for D_i > 50 mm: F8)
Tolerance D_o: s7 (for D_i > 50 mm: s8)

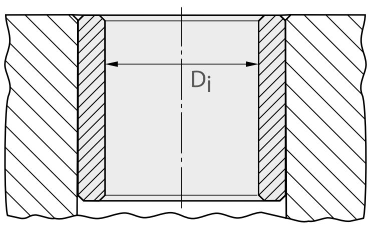


Steel housing (rigid)
Tolerance $D_{housing}$: H7



Bearing after assembly
(Standard bearings)

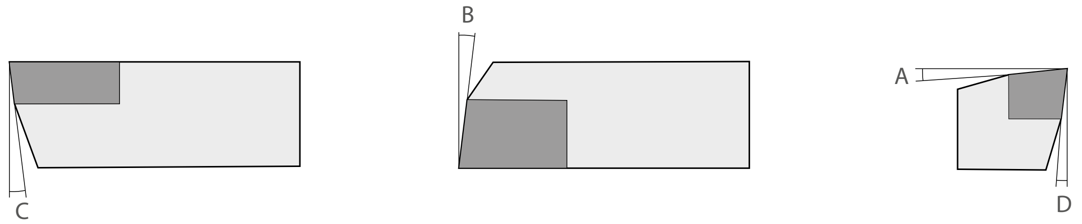
Tolerance D_i: H7 for D_i > 50 mm: H8
Tolerance D_i: H8 for flanged bearings
Tolerance D_o: H8



7 Machining

7.1 MACHINING OF SELF-LUBRICATING BLANKS

Self-lubricating sinter materials can be machined under conditions similar to those used for solid metals. To preserve the integrity of surface porosity, specific machining recommendations must be followed. However, to protect the integrity of the porosities on the sliding surfaces (inner diameter or flange faces) it is recommended to apply the following specific machining conditions:



MACHING CONDITIONS FOR BRONZE BASED GGB-BP25

ANGLE	ROUGH / FINISH
A	0 - 3°
B	5 - 7°
C	5 - 7°
D	5 - 7°

	ROUGH	FINISH
Tool grade	K10 / K20	K10 / K20
Cutting speed (m/min)	120 - 200	140 - 200
Feed rate (mm/rotation)	0.1 - 0.2	0.1 max
Feed (mm)	≤ 1.0	0.1 - 0.4

MACHING CONDITIONS FOR IRON BASED GGB-FP20 AND GGB-SO16

ANGLE	ROUGH	FINISH
A	3 - 7°	7 - 10
B	5	10
C	5 - 7°	12 - 15
D	5 - 7°	12 - 15

	ROUGH	FINISH	
Tool grade	K10 / K20	K10	5015 (cermet*)
Cutting speed (m/min)	140	160	200 - 250
Feed rate (mm/rotation)	0.2 - 0.3	0.035	0.035 - 0.06
Feed (mm)	1 - 5	0.3 - 0.5	0.3 - 0.5

TURNING

Fixing

To avoid any deformation, especially for thin wall bearings, the machining of the inner diameters will be performed by fixing the part between grip clamps or soft jaws. For machining the outer diameter, the blanks must be fixed either on cantilevered mandrels or between centers mandrels (mandrel conicity 0.01%).

Facing and chamfering

After machining the faces with a very sharp tool, it is recommended to cut an internal and external chamfer in the range of 0.5 mm at 45˚.

DRILLING

When drilling through the bore, it is necessary to slow down the feed rate at the time of the release.

Bronze based GGB-BP25: no specific requirement.

Iron based GGB-FP20: HSS drill with 5% cobalt, with cutting speed between 25 and 30 m/min and feed rate of 0.1 to 0.3 mm/min.

TAPPING

Bronze based GGB-BP25: no specific requirement.

Iron based GGB-FP20: nitrided taps with 5% cobalt, with cutting speed between 8 and 12 m/min.

7 Machining

GRINDING

This machining type is not recommended for the finishing of the inner diameters. The reason is that the abrasive particles coming from the grinding wheels will be embedded in the sliding surface porosities and will accelerate the wear of the surfaces in motion.

CUTTING OIL

The use of cutting oil is not necessary for the machining of the METAFRAM blanks as the blank is impregnated with oil and therefore oil is present in the porosities of the sinter material. However, if the parts need to be cooled down, especially in the case of machining of high volumes, it is recommended to use the same oil as the one initially used for impregnation, or to use an air jet.

Any other cooling fluid should be avoided as it would risk to be incompatible with the original impregnation oil.

RE-IMPREGNATION AFTER USE

All standard METAFRAM blanks are supplied impregnated with mineral oils with a viscosity index higher than 95 cSt.

- To eliminate chips and dust, quickly wash the part with a volatile solvent such as Heptane or Biosane ECO 60R, then dry.
- Depending on the volume immerse the bearing for one or two hours in an oil bath at a temperature between 60°C and 120°C, depending on the oil viscosity.

However, to compensate the loss of oil during machining and handling, a re-impregnation is mandatory according to the following process:

- Cool down the part in this bath for a perfect saturation of porosities. It is recommended to use the same oil as the one used originally for the impregnation, or otherwise, engine oil type SAE 30.

IMPREGNATION OILS

When the linear speed of the shaft is higher than 0.3 m/s, the standard impregnation oil is Shell Turbo T100 with a viscosity index equal to 98 cSt.

For rotational speeds lower than 0.3 m/s, for linear or angular movements, specific impregnation can be made on request (extreme pressure oil, molybdenum disulfide additives).

CONTROL OF SURFACE POROSITIES

In practice, it is accepted that any machining will slightly diminish the porosities of the sliding surfaces without impacting the performance of the self-lubricating material if the above machining instructions are respected. The control after machining of the residual porosities should be performed:

- Either by a comparative examination of the machined surface versus the non-machined surface under magnification.
- Or by a temperature increase of the machined part by 30°C on a heating source.

The large difference of coefficient of thermal expansion between the sinter metal and the impregnation oil generates the exudation of the lubricant.

The formation of a uniformly distributed oil film is the indication that the self-lubricating properties of the material are preserved.

7.2 DE-IMPREGNATION AND RE-IMPREGNATION OF SELF-LUBRICATING BEARINGS

DE-IMPREGNATION

To de-impregnate a self-lubricating bearing, the process is the following:

- Degrease and wash in appropriate solvent
- Eliminate the lubricant in an apparatus such as Soxbelt or in a furnace heated around 400°C for 40 minutes under a neutral atmosphere such as N_2, or with reducing agent such as $N_2 + H_2$

RE-IMPREGNATION

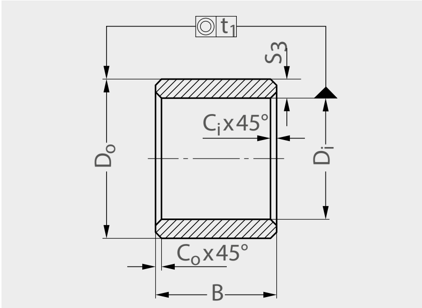
Simple method:

- Immerge during one hour the parts in an oil bath heated at a temperature between 60°C and 120°C, depending on oil viscosity.
- Let them cool down in an oil bath back to room temperature.
- Drain and dry the self-lubricating bearings.

The oil viscosity must be between 2 and 3 Engler degrees (10 to 20 cSt) at impregnation temperature.

8 Standard Dimensions

8.1 BRONZE BASED GGB-BP25 CYLINDRICAL BEARINGS



t_1 for $D_i \leq 20$ mm = 50 µm
t_1 for 20 mm < $D_i \leq 35$ mm = 70 µm
t_1 for $D_i > 35$ = 100 µm
chamfers C = (0.1 to 0.2) S_3
minimum 0.2 mm
B > 10 ± 1%
B ≤ 10 ± 0.1 mm

INSIDE Ø D_i		OUTSIDE ØD_o		LENGTH B
2	+16 / +6	5	+31 / +19	2 - 3
3	+16 / +6	6	+31 / +19	4 - 6 - 10
4	+22 / +10	7	+38 / +23	4 - 8 - 12
4	+22 / +10	8	+38 / +23	4 - 8 - 12
5	+22 / +10	8	+38 / +23	5 - 8 -10 -12 -16
5	+22 / +10	9	+38 / +23	4 - 5 - 8
6	+22 / +10	9	+38 / +23	6 - 10 - 12 - 16
6	+22 / +10	10	+38 / +23	6 - 10 - 12 - 16
6	+22 / +10	12	+46 / +28	6 - 10 - 12 - 16
7	+23 / +13	10	+38 / +23	5 - 8 - 10
8	+23 / +13	11	+46 / +28	8 - 12 - 16 - 20
8	+23 / +13	12	+46 / +28	8 - 12 - 16 - 20
8	+23 / +13	14	+46 / +28	8 - 12 - 16 - 20
9	+23 / +13	12	+46 / +28	8 - 12 - 16 - 20
10	+23 / +13	13	+46 / +28	10 - 16 - 20 - 25
10	+23 / +13	14	+46 / +28	10 - 16 - 20 - 25
10	+23 / +13	15	+46 / +28	10 - 16 - 20 - 25
10	+23 / +13	16	+46 / +28	10 - 16 - 20 - 25
12	+34 / +16	15	+46 / +28	12 - 16 - 20 - 25
12	+34 / +16	16	+46 / +28	12 - 16 - 20 - 25
12	+34 / +16	17	+46 / +28	12 - 16 - 20 - 25
12	+34 / +16	18	+46 / +28	12 - 16 - 20 - 25
14	+34 / +16	18	+46 / +28	14 - 18 - 22 - 28

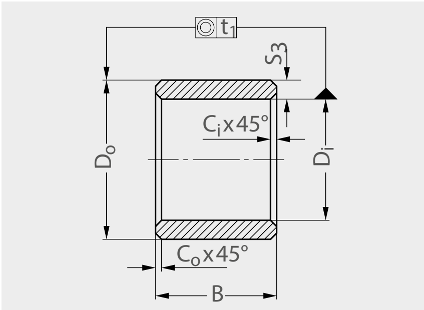
INSIDE Ø D_i		OUTSIDE ØD_o		LENGTH B
14	+56 / +35	20	+56 / +35	14 - 18 - 22 - 28
15	+56 / +35	19	+56 / +35	16 - 20 - 25 - 32
15	+56 / +35	21	+56 / +35	16 - 20 - 25 - 32
16	+56 / +35	20	+56 / +35	16 - 20 - 25 - 32
16	+56 / +35	22	+56 / +35	16 - 20 - 25 - 32
18	+56 / +35	22	+56 / +35	18 - 22 - 28 - 36
18	+56 / +35	24	+56 / +35	18 - 22 - 28 - 36
18	+56 / +35	25	+56 / +35	18 - 22 - 28 - 36
20	+56 / +35	24	+56 / +35	16 - 20 - 25 - 32
20	+56 / +35	25	+56 / +35	16 - 20 - 25 - 32
20	+56 / +35	26	+56 / +35	16 - 20 - 25 - 32
20	+41 / +20	27	+56 / +35	16 - 20 - 25 - 32
20	+41 / +20	28	+56 / +35	16 - 20 - 25 - 32
22	+41 / +20	27	+56 / +35	18 - 22 - 28 - 36
22	+41 / +20	28	+56 / +35	18 - 22 - 28 - 36
22	+41 / +20	29	+56 / +35	18 - 22 - 28 - 36
25	+41 / +20	30	+56 / +35	20 - 25 - 32 - 40
25	+41 / +20	32	+68 / +43	20 - 25 - 32 - 40
28	+41 / +20	32	+68 / +43	22 - 28 - 36 - 45
28	+41 / +20	33	+68 / +43	22 - 28 - 36 - 45
28	+41 / +20	36	+68 / +43	22 - 28 - 36 - 45
30	+41 / +20	38	+68 / +43	24 - 30 - 38
32	+50 / +25	38	+68 / +43	20 - 25 - 33 - 40 - 50

INSIDE Ø D_i		OUTSIDE ØD_o		LENGTH B
32	+50 / +25	40	+68 / +43	20 - 25 - 33 - 40 - 50
35	+50 / +25	44	+68 / +43	22 - 28 - 35
35	+50 / +25	45	+68 / +43	25 - 35 - 40 - 50
36	+50 / +25	42	+68 / +43	22 - 28 - 36 - 45
36	+50 / +25	45	+68 / +43	22 - 28 - 36 - 45
38	+50 / +25	44	+68 / +43	25 - 35 - 45
40	+50 / +25	46	+68 / +43	25 - 32 - 40 - 50
40	+50 / +25	50	+68 / +43	25 - 32 - 40 - 50
45	+50 / +25	51	+99 / +53	28 - 36 - 45 - 56
45	+50 / +25	55	+99 / +53	35 - 45 - 55 - 65
45	+50 / +25	56	+99 / +53	28 - 36 - 45 - 56
50	+50 / +25	56	+99 / +53	32 - 40 - 50 - 63
50	+50 / +25	60	+99 / +53	32 - 40 - 50 - 63
55	+76 / +30	65	+99 / +53	40 - 55 - 70
60	+76 / +30	70	+105 / +59	50 - 60 - 90 -120
60	+76 / +30	72	+105 / +59	50 - 60 - 70
60	+76 / +30	80	+105 / +59	90 - 120
63	+76 / +30	70	+105 / +59	40 - 50
70	+76 / +30	80	+105 / +59	90 - 120
80	+90 / +36	100	+125 / +71	120
100	+90 / +36	120	+133 / +79	120
110	+90 / +36	125	+155 / +92	120
125	+106 / +43	150	+163 / +100	120

All tolerances in µm

Cylindrical bushes with H7 (H8 for Ø ≥ 50 mm) and flanged bushes with H8 inner diameter tolerance after being pressed into a housing with an inner diameter with H7 tolerance using a mandrel with m6 outer diameter tolerance. Delivery tolerance in accordance with ISO standard F7/s7 for cylindrical bushes (for D_i > 50 mm and D_o > 50 mm F8/s8) and F8/s8 for flanged bushes.

8.2 IRON BASED GGB-FP20 CYLINDRICAL BEARINGS



t_1 for $D_i \leq 20$ mm = 50 µm
t_1 for 20 mm < $D_i \leq 35$ mm = 70 µm
t_1 for $D_i > 35$ = 100 µm
chamfers C = (0.1 to 0.2) S_3
minimum 0.2 mm
B > 10 ± 1%
B ≤ 10 ± 0.1 mm

INSIDE Ø D_i		OUTSIDE ØD_o		LENGTH B
3	+16 +6	6	+31 +19	4 - 10
4	+22 +10	8	+38 +23	8
6	+22 +10	9	+38 +23	6 - 10 - 12 - 16
6	+22 +10	10	+38 +23	6 - 10 - 16
6	+22 +10	12	+46 +28	6
8	+23 +13	11	+46 +28	8 - 12 - 16
8	+23 +13	12	+46 +28	8 - 12 - 16 - 20
10	+23 +13	13	+46 +28	10 - 20 - 25
10	+23 +13	14	+46 +28	10 - 16 - 20
10	+23 +13	15	+46 +28	10
12	+34 +16	15	+46 +28	12 - 16 - 20
12	+34 +16	16	+46 +28	12 - 16 - 20 - 25
12	+34 +16	17	+46 +28	12
14	+34 +16	18	+46 +28	14 - 18 - 22

INSIDE Ø D_i		OUTSIDE ØD_o		LENGTH B
14	+34 +16	20	+56 +35	14 - 28
15	+34 +16	19	+56 +35	16 - 20
16	+34 +16	20	+56 +35	16 - 20 - 25 - 32
16	+34 +16	22	+56 +35	16 - 20 - 25
18	+34 +16	22	+56 +35	18 - 22
18	+34 +16	24	+56 +35	22
20	+41 +20	24	+56 +35	16 - 20 - 25 - 32
20	+41 +20	26	+56 +35	16 - 20 - 25 - 32
22	+41 +20	27	+56 +35	18 - 22
25	+41 +20	30	+56 +35	20 - 25 - 32
25	+41 +20	32	+68 +43	20 - 25 - 32
30	+41 +20	38	+68 +43	24 - 30 - 38
32	+50 +25	38	+68 +43	32
35	+50 +25	44	+68 +43	22 - 28 - 35

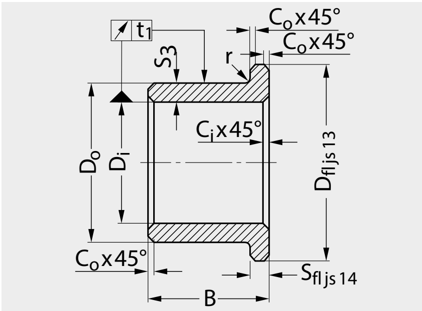
INSIDE Ø D_i		OUTSIDE ØD_o		LENGTH B
36	+50 +25	42	+68 +43	22
40	+50 +25	46	+68 +43	25 - 32 - 40
40	+50 +25	50	+68 +43	25 - 32 - 40 - 50
45	+50 +25	51	+99 +53	28 - 45
45	+50 +25	55	+99 +53	35
45	+50 +25	56	+99 +53	36
50	+50 +25	56	+99 +53	32
50	+50 +25	60	+99 +53	30 - 50
60	+76 +30	70	+105 +59	60 - 90
70	+76 +30	80	+105 +59	120
80	+90 +36	100	+125 +71	120
100	+90 +36	120	+133 +79	120

All tolerances in µm

Cylindrical bushes with H7 (H8 for Ø ≥ 50 mm) and flanged bushes with H8 inner diameter tolerance after being pressed into a housing with an inner diameter with H7 tolerance using a mandrel with m6 outer diameter tolerance.
Delivery tolerance in accordance with ISO standard F7/s7 for cylindrical bushes (for $D_i > 50$ mm and $D_o > 50$ mm F8/s8) and F8/s8 for flanged bushes.

8 Standard Dimensions

8.3 BRONZE BASED GGB-BP25 FLANGED BEARINGS



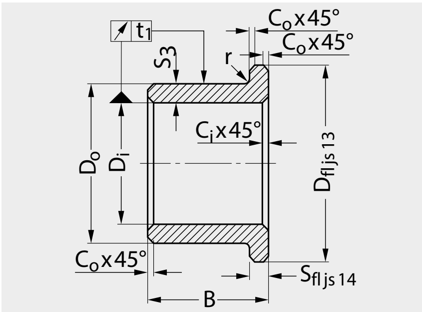
t_1 for $D_i \leq 20$ mm = 60 µm
t_1 for 20 mm < $D_i \leq 35$ mm = 80 µm
t_1 for $D_i > 35$ = 100 µm
chamfers C = (0.1 to 0.2) S_3
minimum 0.2 mm
r = max. 0.3 x S_3
B > 10 ± 1%
B ≤ 10 ± 0.1 mm

INSIDE Ø D_i		OUTSIDE ØD_o		FLANGE Ø D_{fl}	FLANGE THICKNESS S_{fl}	LENGTH B
3	+20 +6	6	+37 +19	9	1.5	4 - 6 - 10
4	+28 +10	8	+45 +23	12	2	4 - 8 - 12
6	+28 +10	10	+45 +23	14	2	6 - 10 - 16
8	+35 +13	12	+55 +28	16	2	8 - 12 - 16
9	+35 +13	14	+55 +28	19	2.5	6 - 10 - 14
10	+35 +13	13	+55 +28	16	1.5	10 - 16 - 20
10	+35 +13	15	+55 +28	20	2.5	10 - 16 - 20
10	+35 +13	16	+55 +28	22	3	9 - 10 - 16
12	+43 +16	15	+55 +28	18	1.5	12 - 16 - 20
12	+43 +16	17	+55 +28	22	2.5	12 -16 - 20 - 25
12	+43 +16	18	+55 +28	24	3	8 - 12 - 20
14	+43 +16	18	+55 +28	22	2	14 - 18 - 22
14	+43 +16	20	+68 +35	26	3	14 - 18 - 22 - 28
15	+43 +16	19	+68 +35	23	2	16 - 20 - 25
15	+43 +16	21	+68 +35	27	3	16 - 20 - 25 - 32
16	+43 +16	20	+68 +35	24	2	16 - 20 - 25
16	+43 +16	22	+68 +35	28	3	16 - 20 - 25 - 32
18	+43 +16	22	+68 +35	26	2	18 - 22 - 28
18	+43 +16	24	+68 +35	30	3	18 - 22 - 28
20	+53 +20	24	+68 +35	28	2	16 - 20 - 25
20	+53 +20	26	+68 +35	32	3	16 - 20 - 25 - 32
22	+53 +20	27	+68 +35	32	2.5	18 - 22 - 28
22	+53 +20	28	+68 +35	34	3	15 - 20 - 25 - 30
22	+53 +20	29	+68 +35	36	3.5	18 - 22 - 28 - 36
25	+53 +20	30	+68 +35	35	2.5	20 - 25 - 32
25	+53 +20	32	+82 +43	39	3.5	20 - 25 - 32
28	+53 +20	33	+82 +43	38	2.5	22 - 28 - 36
28	+53 +20	36	+82 +43	44	4	22 - 28 - 36
30	+53 +20	38	+82 +43	46	4	20 - 25 - 30
32	+64 +25	38	+82 +43	44	3	20 - 25 - 32
32	+64 +25	40	+82 +43	48	4	20 - 25 - 30 - 32
36	+64 +25	42	+82 +43	48	3	22 - 28 - 36
36	+64 +25	45	+82 +43	54	4.5	22 - 28 - 36
40	+64 +25	46	+82 +43	52	3	25 - 32 - 40
40	+64 +25	50	+82 +43	60	5	25 - 32 - 40
45	+64 +25	51	+99 +53	57	3	28 - 36 - 45
45	+64 +25	56	+99 +53	67	5.5	28 - 36 - 45
50	+64 +25	56	+99 +53	62	3	32 - 40 - 50
50	+64 +25	60	+99 +53	70	5	32 - 40 - 50
60	+64 +25	70	+105 +59	80	5	50 - 60

All tolerances in µm

Cylindrical bushes with H7 (H8 for Ø ≥ 50 mm) and flanged bushes with H8 inner diameter tolerance after being pressed into a housing with an inner diameter with H7 tolerance using a mandrel with m6 outer diameter tolerance. Delivery tolerance in accordance with ISO standard F7/s7 for cylindrical bushes (for D_i > 50 mm and D_o > 50 mm F8/s8) and F8/s8 for flanged bushes.

8.4 IRON BASED GGB-FP20 FLANGED BEARINGS



t_1 for $D_i \leq 20$ mm = 60 µm
t_1 for 20 mm < $D_i \leq 35$ mm = 80 µm
t_1 for $D_i > 35$ = 100 µm
chamfers C = (0.1 to 0.2) S_3
minimum 0.2 mm
r = max. 0.3 x S_3
B > 10 ± 1%
B ≤ 10 ± 0.1 mm

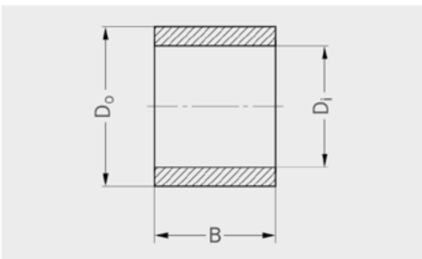
INSIDE Ø D_i	OUTSIDE ØD_o	FLANGE Ø D_{fl}	FLANGE THICKNESS S_{fl}	LENGTH B
3^{+20}_{+6}	6^{+28}_{+10}	9	1.5	4
6^{+28}_{+10}	10^{+45}_{+23}	14	2	6 - 10 - 16
8^{+35}_{+13}	12^{+55}_{+28}	16	2	8 - 12 - 16
10^{+35}_{+13}	13^{+55}_{+28}	16	1.5	10 - 16
10^{+35}_{+13}	15^{+55}_{+28}	20	2.5	10 - 16 - 20
12^{+43}_{+16}	15^{+55}_{+28}	18	1.5	12 - 16 - 20
12^{+43}_{+16}	17^{+55}_{+28}	22	2.5	12 - 16
14^{+43}_{+16}	18^{+55}_{+28}	22	2	14 - 18 - 22
16^{+43}_{+16}	20^{+68}_{+35}	24	2	16 - 20
16^{+43}_{+16}	22^{+68}_{+35}	28	3	16 - 20 - 25
18^{+43}_{+16}	24^{+68}_{+35}	30	3	18 - 22

INSIDE Ø D_i	OUTSIDE ØD_o	FLANGE Ø D_{fl}	FLANGE THICKNESS S_{fl}	LENGTH B
20^{+53}_{+20}	24^{+68}_{+35}	28	2	16 - 20 - 25
20^{+53}_{+20}	26^{+68}_{+35}	32	3	16 - 20 - 25
22^{+53}_{+20}	29^{+68}_{+35}	36	3.5	18 - 22 - 28 - 36
25^{+53}_{+20}	30^{+68}_{+35}	35	2.5	20 - 32
25^{+53}_{+20}	32^{+82}_{+43}	39	3.5	25 - 32
30^{+53}_{+20}	38^{+82}_{+43}	46	4	30
32^{+64}_{+25}	40^{+82}_{+43}	48	4	20 - 32
36^{+64}_{+25}	45^{+82}_{+43}	51	4.5	22 - 36
40^{+64}_{+25}	50^{+82}_{+43}	60	5	25 - 32 -40
50^{+64}_{+25}	60^{+99}_{+53}	70	5	50
60^{+76}_{+30}	70^{+105}_{+59}	80	5	50 - 60

All tolerances in µm

Cylindrical bushes with H7 (H8 for Ø ≥ 50 mm) and flanged bushes with H8 inner diameter tolerance after being pressed into a housing with an inner diameter with H7 tolerance using a mandrel with m6 outer diameter tolerance. Delivery tolerance in accordance with ISO standard F7/s7 for cylindrical bushes (for D_i > 50 mm and D_o > 50 mm F8/s8) and F8/s8 for flanged bushes.

8.5 CYLINDRICAL BLANKS



GGB-BP25		
INSIDE Ø D_i	OUTSIDE D_o	LENGTH B
$38^{+0.8}_{-0.8}$	$70^{+1.5}_{-1.5}$	$120^{+4.0}_{-0.0}$
$45^{+0.8}_{-0.8}$	$105^{+1.5}_{-1.5}$	$120^{+4.0}_{-0.0}$
$80^{+0.8}_{-0.8}$	$145^{+2.0}_{-2.0}$	$120^{+4.0}_{-0.0}$
$80^{+0.8}_{-0.8}$	$175^{+2.0}_{-2.0}$	$120^{+4.0}_{-0.0}$
$85^{+1.5}_{-1.5}$	$105^{+2.0}_{-2.0}$	$120^{+4.0}_{-0.0}$

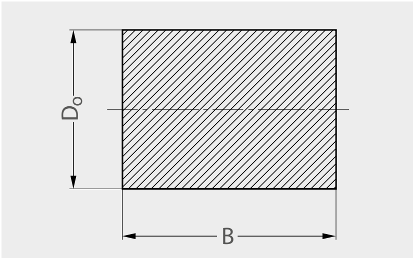
GGB-FP20		
INSIDE Ø D_i	OUTSIDE D_o	LENGTH B
$38^{+0.8}_{-0.8}$	$70^{+1.5}_{-1.5}$	$120^{+4.0}_{-0.0}$
$45^{+0.8}_{-0.8}$	$105^{+1.5}_{-1.5}$	$120^{+4.0}_{-0.0}$
$80^{+0.8}_{-0.8}$	$145^{+2.0}_{-2.0}$	$120^{+4.0}_{-0.0}$
$80^{+0.8}_{-0.8}$	$175^{+2.0}_{-2.0}$	$120^{+4.0}_{-0.0}$
$85^{+1.5}_{-1.5}$	$105^{+2.0}_{-2.0}$	$120^{+4.0}_{-0.0}$

GGB-BP25		
INSIDE Ø D_i	OUTSIDE D_o	LENGTH B
$38^{+0.8}_{-0.8}$	$70^{+1.5}_{-1.5}$	$120^{+4.0}_{-0.0}$
$45^{+0.8}_{-0.8}$	$105^{+1.5}_{-1.5}$	$120^{+4.0}_{-0.0}$
$80^{+0.8}_{-0.8}$	$145^{+2.0}_{-2.0}$	$120^{+4.0}_{-0.0}$
$80^{+0.8}_{-0.8}$	$175^{+2.0}_{-2.0}$	$120^{+4.0}_{-0.0}$
$85^{+1.5}_{-1.5}$	$105^{+2.0}_{-2.0}$	$120^{+4.0}_{-0.0}$

All tolerances in mm

8 Standard Dimensions

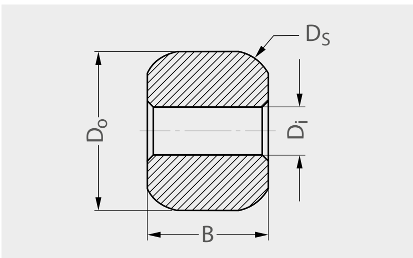
8.6 SOLID ROD BLANKS



GGB-BP25				GGB-FP20				GGB-SO16			
OUTSIDE D_o		LENGTH B		OUTSIDE D_o		LENGTH B		OUTSIDE D_o		LENGTH B	
20	+0.8 / - 0.8	40	+4.0 / - 0.0	20	+0.8 / - 0.8	40	+4.0 / - 0.0	20	+0.8 / - 0.8	40	+4.0 / - 0.0
30	+0.8 / - 0.8	50	+4.0 / - 0.0	30	+0.8 / - 0.8	50	+4.0 / - 0.0	30	+0.8 / - 0.8	50	+4.0 / - 0.0
45	+0.8 / - 0.8	90	+4.0 / - 0.0	45	+0.8 / - 0.8	90	+4.0 / - 0.0	45	+0.8 / - 0.8	90	+4.0 / - 0.0
54	+0.8 / - 0.8	110	+4.0 / - 0.0	54	+0.8 / - 0.8	110	+4.0 / - 0.0	54	+0.8 / - 0.8	110	+4.0 / - 0.0
70	+0.8 / - 0.8	120	+4.0 / - 0.0	70	+0.8 / - 0.8	120	+4.0 / - 0.0	70	+0.8 / - 0.8	120	+4.0 / - 0.0
105	+0.8 / - 0.8	120	+4.0 / - 0.0	105	+0.8 / - 0.8	120	+4.0 / - 0.0	105	+0.8 / - 0.8	120	+4.0 / - 0.0
145	+1.5 / - 1.5	120	+4.0 / - 0.0	145	+1.5 / - 1.5	120	+4.0 / - 0.0	145	+1.5 / - 1.5	120	+4.0 / - 0.0

All tolerances in mm

8.7 SPHERICAL BEARINGS



GGB-BP25 / GGB-FP20							
INSIDE Ø D_i		SPHERICAL Ø D_S		OUTSIDE Ø D_o		LENGTH B	
4	+0.012 / +0.0	10	+0.05 / - 0.05	9.5	+0.2 / - 0.2	8	+0.1 / - 0.1
5	+0.012 / +0.0	13	+0.05 / - 0.05	12.5	+0.2 / - 0.2	10	+0.1 / - 0.1
6	+0.012 / +0.0	13	+0.05 / - 0.05	12.6	+0.2 / - 0.2	8	+0.1 / - 0.1
6	+0.012 / +0.0	15	+0.05 / - 0.05	14.5	+0.2 / - 0.2	12	+0.1 / - 0.1
6	+0.012 / +0.0	16	+0.05 / - 0.05	15.5	+0.2 / - 0.2	12.5	+0.1 / - 0.1
7	+0.012 / +0.0	17	+0.05 / - 0.05	16.5	+0.2 / - 0.2	14	+0.1 / - 0.1
8	+0.012 / +0.0	16	+0.05 / - 0.05	15.5	+0.2 / - 0.2	12.5	+0.1 / - 0.1

All tolerances in mm

Bearing Application Data Sheet

Please complete the form below and share it with your sales engineer.

DATA FOR BEARING DESIGN CALCULATION

Application: ____

____

Project/No.: ____________ Quantity: ________ ☐ New Design ☐ Existing Design

☐ Steady Load ☐ Rotating Load ☐ Rotational Movement ☐ Oscillating Movement ☐ Linear Movement

DIMENSIONS [MM]

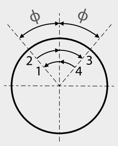
Inside diameter	D_i	
Outside diameter	D_o	
Length	B	
Flange diameter	D_{fl}	
Flange thickness	B_{fl}	
Wall thickness	S_T	
Length of slideplate	L	
Width of slideplate	W	
Thickness of slideplate	S_S	

LOAD

☐ Static load		
☐ Dynamic load		
Axial load F	[N]	
Radial load F	[N]	

MOVEMENT

Rotational speed	N [1/min]	
Speed	V [m/s]	
Length of stroke	L_S [mm]	
Frequence of stroke	[1/min]	
Oscillating cycle	ϕ[°]	
Osc. frequence	N_{osz} [1/min]	



MATING SURFACE

Material		
Hardness	HB/HRC	
Surface finish	R_a [µm]	

FITS & TOLERANCES

Shaft	D_J	
Bearing housing	D_H	

OPERATING ENVIRONMENT

Ambient temperature T_{amb} [°]	
Bearing housing material	

☐ Housing with good heating transfer properties

☐ Light pressing or insulated housing with poor heat transfer properties

☐ Non metal housing with poor heat transfer properties

☐ Alternate operation in water and dry

OPERATING ENVIRONMENT

☐ Dry

☐ Continuous lubrication

☐ Process fluid lubrication

☐ Initial lubrication only

☐ Hydrodynamic conditions

Process fluid	
Lubricant	
Dynamic viscosity η[mPas]	

SERVICE HOURS PER DAY

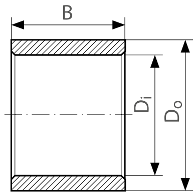
Continuous operation	
Intermittent operation	
Operating time	
Days per year	

SERVICE LIFE

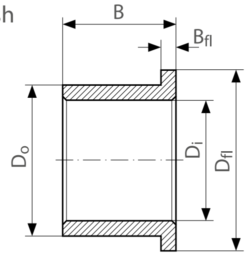
Required service life L_H [h]	

BEARING TYPE

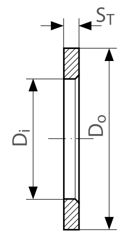
☐ Cylindrical bush



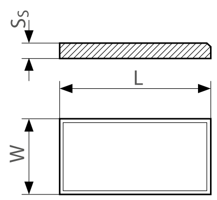
☐ Flanged bush



☐ Thrust washer



☐ Slide plate



☐ Special parts (sketch)

CUSTOMER INFORMATION

Company ____

Street ____

City / State / Province / Post Code ____________________________

Telephone ______________________ Fax ______________________

Name ____

Email Address ______________________ Date ______________________

Product Information

This document is provided to give you the analysis tools or information to assist you in product selection. Product performance is affected by many factors beyond the control of GGB. Therefore, you must validate the suitability and feasibility of all product selections for your applications.

GGB products are sold subject to GGB's Terms of Sale and Delivery, which include our limited warranty and remedy.
You can find these here: **ggbearings.com/en/terms-and-conditions**, or ask your GGB representative for a copy.

Products are subject to continual development. GGB retains the right to make specification amendments or improvements to the technical data without prior announcement.

DOCUMENT INFORMATION

Edition 2026. This edition replaces earlier editions which hereby lose their validity.

Every reasonable effort has been made to ensure the accuracy of the information in this writing, but GGB assumes no liability for errors or omissions or for any other reason.

HEALTH AND SAFETY

GGB is committed to adhering to all U.S., European and international standards and regulations with regard to lead content. We have established internal processes that monitor any changes to existing standards and regulations, and we work collaboratively with customers and distributors to ensure that all requirements are followed. This includes RoHS and REACH guidelines.GGB is committed to operating in an environmentally conscious and safe manner. We follow numerous industry best practices and are committed to meeting or exceeding a variety of internationally recognized standards for emissions control and workplace safety.

Each of our global locations has management systems in place that adhere to IATF 16949, ISO 9001, ISO 14001 and ISO 45001 quality regulations. Our certificates can be found here:

ggbearings.com/en/certificates.

A detailed explanation of our commitment to REACH and RoHS directives can be found at

ggbearings.com/en/reach-rohs.

TRADEMARKS

GGB®, METAFRAM, GGB-BP25, GGB-FP20 and GGB-SO16 are registered trademarks of GGB.
TIMKEN® is a registered trademark of The Timken Company.
Any use of GGB's trademarks without the trademark owner's prior written permission is strictly prohibited.

Stronger.**Together.**

GGB BY TIMKEN

ggbearings.com

HB119ENG04-26