

GGB SY™/SP™

Bimetal bearings



Technical Information

 **GGB**
BEARING TECHNOLOGY

an EnPro Industries company

Quality

All the products described in this brochure are manufactured under ISO/TS 16949 and ISO 14001 approved quality management systems.



AF AQ Certificat Certificate
N° 2006/21265b

AFNOR Certification certifie que le système de management mis en place
AFNOR Certification certifies that the management system implemented is

GGB France EURL
pour les activités suivantes :
CONCEPTION, INDUSTRIALISATION, FABRICATION ET VENTE DE SYSTEMES ANTI-FRICTION, INDUSTRIALISATION, FABRICATION ET VENTE DE PALLES DE POMPES HYDRAULIQUES A ENGRENAGES.

DESIGN, PRODUCTION ENGINEERING, MANUFACTURING AND SALE OF ANTI-FRICTION SYSTEMS, PRODUCTION ENGINEERING, MANUFACTURING AND SALE OF HYDRAULIC GEAR PUMP BEARINGS.

a été évalué et jugé conforme aux exigences requises par :
has been assessed and found to meet the requirements of:

ISO 9001 : 2008
et est déployé sur les sites suivants :
and is developed on the following locations:

85, chemin de la Prairie BP n° 2074 FR-74009 ANNECY
Rouie de Saint-Avois Zone Industrielle FR-87260 DIEUZE
2228, rue Henri Barbusse FR-82210 CLUCHY

2009-10-15

F. HEAUX



SKQS CERTIFIKÁT
SLOVENSKÁ SPOLOČNOSŤ PRE SYSTÉMY RIADENIA A SYSTÉMY KVALITY
Areál VÚD Veľký Diel 3323, 010 08 Žilina

SKQS na základe certifikačného auditu potvrdzuje týmto, že:

GGB BEARING TECHNOLOGY
GGB Slovakia s.r.o.
Hlavná 1910
038 52 Sučany/Slovenská republika

rozsah platnosti:
Applikácia, výroba a predaj rôznych systémov pre automobilovú a inu priemernú odvetvu

na systém environmentálneho manažérstva
účelne vybudovaný, udržiavaný a je v súlade s modelom a požiadavkami medzinárodnej normy

ISO 14001:2004
Číslo odberu 17, 14

Certifikát č.: 379-2008
Datum platnosti: 28.03.2010
Žena: 12.04.2008

Ing. J. M. H. Vedecký certifikátny orgán

IAF SNAS Reg. No. 0219/023



CERTIFICATE
UL DQS Inc.
Management Systems Solutions

herby certifies that the company:

GGB, LLC
700 Mid Atlantic Parkway
Thorofare, NJ 08086

has implemented and maintains a **Quality Management System**.

Scope:
The manufacture of metal-backed bearings, flannel wound bearings and washers.

Through an audit, performed in accordance with the latest version of AS9104 and AS 9104, it was verified that the management system fulfills the requirements of the following technically equivalent standards:

AS 9100, Rev. B
Aerospace - Quality Management Systems - Requirements
(based on ISO 9001:2000)

Certification Registration No.: 10001136 ASH
Date of Certification: 2009-01-08
Valid until: 2012-01-07

ANAB

James R. Kim
General Manager
President

1190 West Lake Cook Road, Suite 340, Buffalo Grove, IL 60089 USA



AF AQ Certificat Certificate
N° 2003/21286b-1
N° IATF : 0090328

AFNOR Certification certifie que le système de management mis en place
AFNOR Certification certifies that the management system implemented is

GGB France EURL
pour les activités suivantes :
for the following activities:
CONCEPTION, INDUSTRIALISATION, FABRICATION ET VENTE DE SYSTEMES ANTI-FRICTION.

DESIGN, PRODUCTION ENGINEERING, MANUFACTURING AND SALE OF ANTI-FRICTION SYSTEMS.

a été évalué et jugé conforme aux exigences requises par :
has been assessed and found to meet the requirements of:

ISO/TS 16949 : 2009
Sans restriction au chapitre 7.3 de la application technique
Without the restriction of chapter 7.3 of the technical specification

et est déployé sur les sites suivants :
and is developed on the following locations:

85, chemin de la Prairie BP n° 2074 FR-74009 ANNECY
Fonctions supports (Agence commerciale) : 2228, rue Henri Barbusse F

2009-10-17

F. HEAUX



ZERTIFIKAT
Die
DQS GmbH
Deutsche Gesellschaft zur Zertifizierung von Managementsystemen

bescheinigt hiermit, dass das Unternehmen

GGB Heilbronn GmbH
Ochsenrainstraße 9
74078 Heilbronn

ein **Qualitätsmanagementsystem** eingeführt hat und anwendet.

Geburtsort/ort:
Herstellung von Gleitlagern für die Automobilindustrie

Durch ein Audit, dokumentiert in einem Bericht, wurde der Nachweis erbracht, dass das Qualitätsmanagementsystem die Anforderungen der folgenden Technischen Spezifikation erfüllt:

ISO/TS 16949 : 2009
(mit Produktentwicklung)

Zertifizierungsentscheidung: 2010-02-09
Dieses Zertifikat ist gültig bis: 2013-02-08
Zertifikat-Registrier-Nr.: 062772 T5009
IATF-Nr.: 0097525
Frankfurt am Main: 2010-02-09

Michael Drechsel
Geschäftsführer
August-Schanz-Strasse 21, 90533 Frankfurt am Main

Jan-Steph
Geschäftsführer



CERTIFICADO
DQS do Brasil Ltda.

certifica que a empresa
GGB BRASIL INDÚSTRIA DE MANCAIS E COMPONENTES LTDA,
Avenida Duque, 10767
08422-120 Barueri - SP
Brasil

Implementou e mantém um
Sistema de Gestão Ambiental.

com o escopo:
Manufatura e distribuição de buchas de metalização de deslizeamento para indústria automotiva, aplicações industriais e montagem de subconjuntos com design de GGB France EURL - Arnebec, França; GGB North America - Thorofare, EUA; GGB Germany GmbH & Co. KG - Heilbronn, Alemanha

Através de uma auditoria, documentada em um relatório, foi comprovado que o sistema de gestão cumpre os requisitos da seguinte norma:

ISO 14001 : 2004

Número de certificado: 32001 UM
Data de certificação: 26-03-2010
Válido até: 25-03-2013

IAF TQA-204-11-01-02

Michael Drechsel
Diretor Executivo

Diana Moreira
Diretora Executiva

R. Adolfo Pires, 901 - 7º andar - 04733-361 - São Paulo - SP - Brasil

Formula Symbols and Designations

Formula Symbol	Unit	Designation
B	mm	Nominal bush width
C_i	mm	ID chamfer length
C_o	mm	OD chamfer length
D_i	mm	Nominal bush and washer ID
D_o	mm	Nominal bush and washer OD
f	-	Friction
HB	-	Shaft hardness
L	mm	Strip length
\bar{p}	N/mm ²	Specific load
$\bar{p}_{sta,max}$	N/mm ²	Maximum static load
$\bar{p}_{dyn,max}$	N/mm ²	Maximum dynamic load
$\bar{p}U$	N/mm ² × m/s	Maximum $\bar{p}U$ factor
R_a	μm	Surface roughness (DIN 4768, ISO 4287/1)
S_3	mm	Bush wall thickness
S_s	mm	Strip thickness
T	°C	Temperature
T_{max}	°C	Maximum temperature
T_{min}	°C	Minimum temperature
U	m/s	Sliding speed
U_{max}	m/s	Maximum sliding speed
W	mm	Strip width
W_u	mm	Minimum usable strip width
α_T	1/10 ⁶ K	Coefficient of linear thermal expansion parallel to face
γ	g/cm ³	Density
σ_c	N/mm ²	Compressive yield strength
σ_s	N/mm ²	Shear strength
σ_T	N/mm ²	Tensile strength
λ	W/mK	Thermal conductivity

Content

Quality	I
Formula Symbols and Designations	II
1 Introduction.....	4
2 Material	5
2.1 Composition	5
2.2 Forms Available.....	5
3 Properties	6
3.1 Physical and Mechanical Properties	6
4 Performance	7
4.1 Characteristics.....	7
4.2 Typical Applications	7
4.3 Bearing Performance	8
5 Design and Installation.....	9
5.1 Cutting and Machining	10
5.2 Lubrication.....	10
6 Standard Products	11
6.1 SY Cylindrical Bushes.....	11
6.2 SY Thrust Washers	13
6.3 SP Cylindrical Bushes.....	13
7 Data Sheet.....	14
8 Product Information	15
8.1 Trademarks	15

1 Introduction

The purpose of this brochure is to provide technical information on the characteristics of GGB SY™ and GGB SP™ bearing materials.

GGB SY and GGB SP are lead bronze lined bimetal bearing materials suitable for a wide range of lubricated general engineering applications. GGB SY is available from stock in standard ranges of thin wall wrapped bushes, and in addition to being an economic alternative, offers space and weight savings compared to conventional cast and machine bronze bearings.

GGB SY is particularly suitable for applications under high specific load and oscillating movement with grease lubrication, while GGB SP offers superior performance under conditions of moderate load and fairly high speed with oil lubrication.

All the products described in this brochure are manufactured under DIN ISO 9001, TS 16949 and ISO 14001 approved quality and environmental management systems.

2 Material

2.1 Composition

GGB SY and GGB SP are bimetal plain bearing materials each consisting of a steel backing to which is sintered a lead bronze bearing lining. The bearing lining material

in each case is homogeneous with a uniform distribution of the lead within the bronze matrix and is fully compacted by rolling.

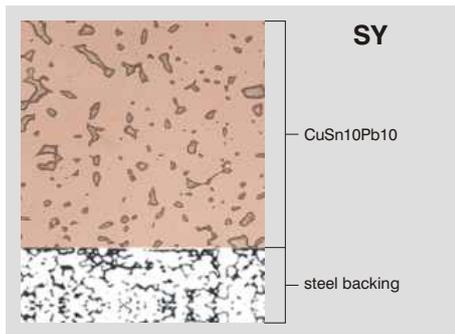


Fig. 1: SY Microsection

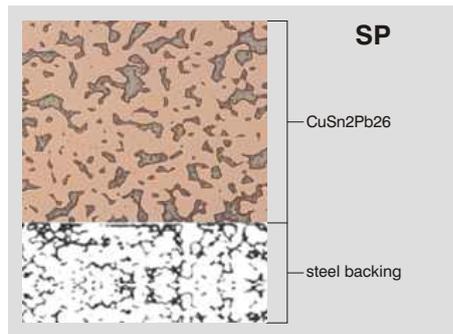


Fig. 2: SP Microsection

2.2 Forms Available

GGB SY is available as a standard range of cylindrical wrapped bushes in metric sizes and thrust washers.

Non standard parts, strip and special forms to order.

GGB SP can be ordered as metric and inch bushes, strip and special forms.

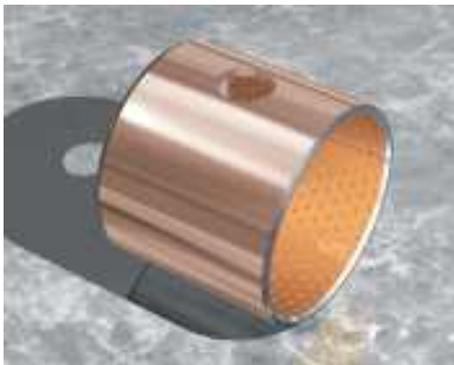


Fig. 3: SY metric bush

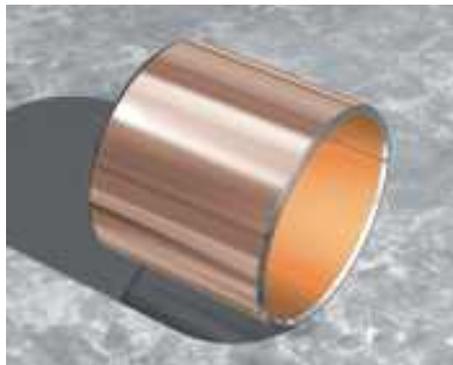


Fig. 4: SP metric bush



Fig. 5: SP inch bush

3 Properties

3.1 Physical and mechanical properties

The data given are typical values for the bearing lining material, and not intended to be a specification.

Properties	Symbol	Value	Unit		
			SY	SP	
Ultimate tensile strength	σ_T	N/mm ²	185	180	
Shear strength	σ_S	N/mm ²	170	70	
%-elongation	-	-	8	5	
Hardness	-	-	-	40 - 55	
Hardness skin rolled	-	-	80 - 130	-	
Density	γ	g/cm ³	8,94	9,56	
Coefficient of linear thermal expansion	α_1	1/10 ⁶ K	18	19	
Thermal conductivity	λ	-	47	60	
Specific load	\bar{p}	N/mm ²	300	250	
Maximum sliding speed, grease lubricated	U_{max}	m/s	2,5	2,5	
Maximum $\bar{p}U$ factor	- grease lubricated - oil lubricated	$\bar{p}U$	N/mm ² · m/s	2,8 10	2,8 10
Max. temperature	- grease lubricated - oil lubricated	T_{max}	°C	150 250	150 250
Friction	- grease lubricated - oil lubricated	f	-	0,05-0,12 0,04-0,12	0,05-0,12 0,04-0,12

Table 1: Physical and Mechanical Properties of SY and SP

4 Performance

4.1 Characteristics

GGBSY

- Capable of supporting high specific loads
- Excellent fatigue strength under dynamic and shock load conditions
- Superior performance under oscillating movement
- Steel backing provides strength and rigidity
- Thin wall construction permits compact bearing assembly
- Indents in the bearing surface provide a reservoir for grease and thus allow extended re-greasing intervals
- Tolerant of relatively poor mating surface finish

GGBSP

- Bush bore may be bored, reamed, broached or ball burnished in situ to control the assembled bearing clearance
- Suitable for oil or grease lubrication
- Steel backing provides strength and rigidity
- Hardened shafts are not required
- Thin wall construction permits compact bearing assembly

4.2 Typical Applications

GGBSY

High load, oscillating conditions as for example agricultural machinery, earthmovers, small end bushes, mechanical handling and lifting equipment, hydraulic cylinders, off highway equipment etc.

GGBSP

High speed applications where good emergency running is required as for example in oil pump bearings, gearbox bushes, steering gear, power steering, pedal bushes, king-pin bushes, tailgate pivots, brake caliper bushes, mechanical handling and lifting equipment, machine slides, hydraulic cylinders, hydraulic motors, pneumatic equipment, medical equipment, textile machinery, agricultural equipment etc.



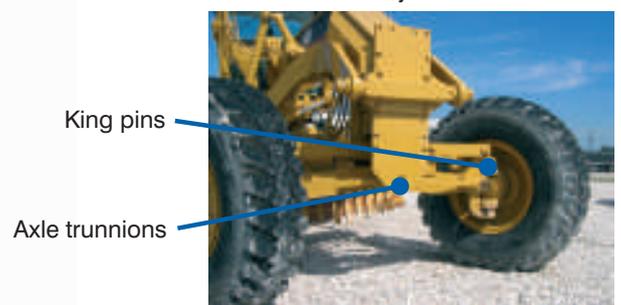
Articulating joints



Steering cylinders



Critical clearance joints



King pins

Axle trunnions

Fig. 6: Typical Applications

4.3 Bearing Performance

Oil and Grease Lubrication

Figures 7 and 8 show the relative compatibility or seizure resistance of SY and SP with oil and grease lubrication.

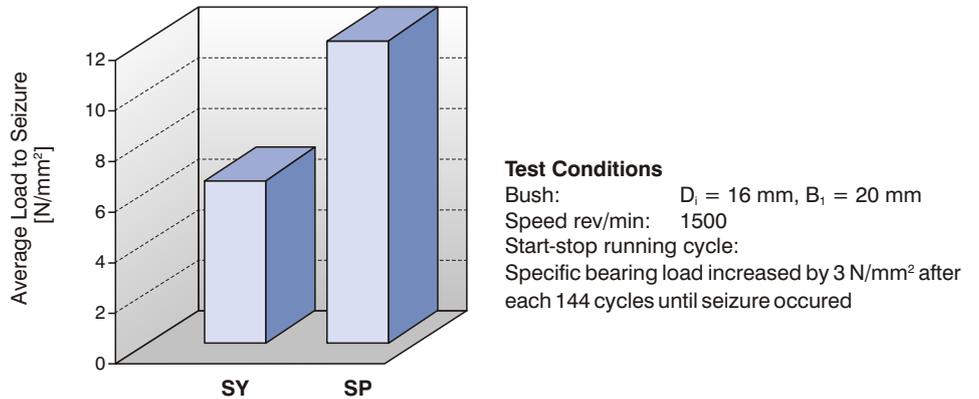


Figure 7: Relative Seizure Resistance - Oil Lubrication

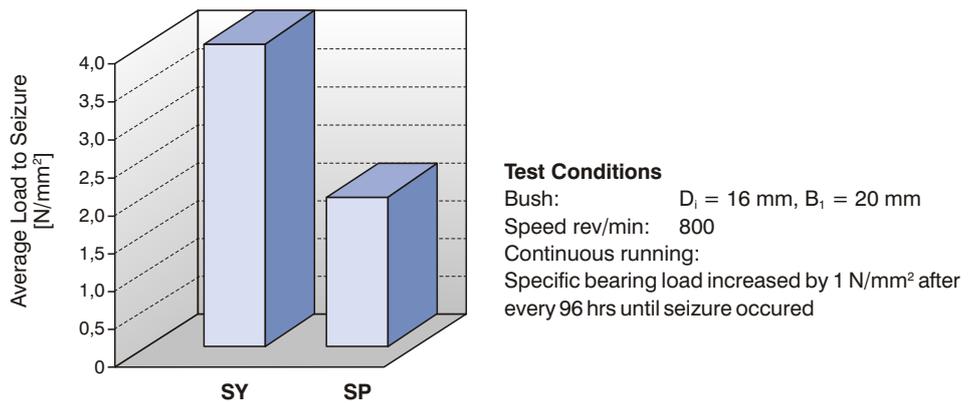


Figure 8: Relative Seizure Resistance - Grease Lubrication

Fatigue Performance under dynamic load conditions

Figure 9 shows the relative fatigue properties of SY and SP under dynamic load conditions.

Actual maximum loads are not quoted since these will vary greatly depending on the application and the operating conditions.

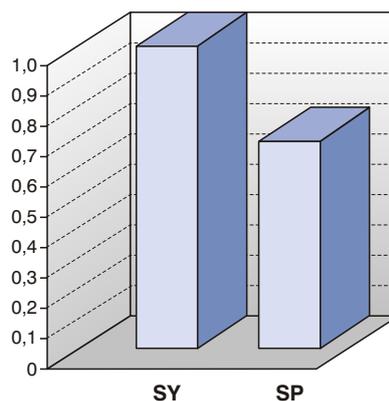


Figure 9: Relative Fatigue Strength

5 Design and Installation

Recommendations	Symbol	Value	Unit	
			SY	SP
Shaft hardness	HB	-	250	250
Shaft surface finish	Ra	μm	0,8 - 1,6	0,2 - 0,8
Housing tolerance	-	-	H7	H8
Shaft tolerance	-	-	h8	e8

Table 2: Installation Recommendations for SY and SP

GGB SY and GGB SP bushes should be inserted into the bearing housing with the aid of a stepped mandrel. Care must be taken to insert the bush squarely into the housing to avoid damage to the bearing lining material. A slight lead-in chamfer

should be machined in the housing and a smear of oil applied to the outside surface of the bush to assist the fitting operation. Recommended mandrel and chamfer dimensions are given in the following drawing.

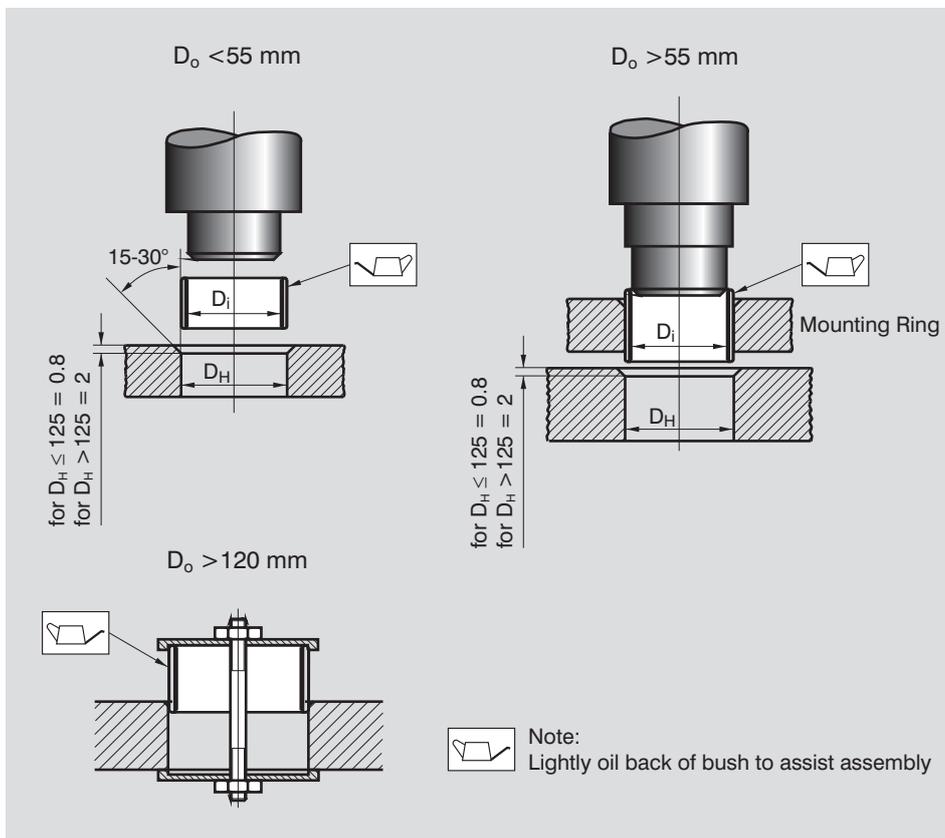


Figure 10: Fitting of cylindrical bushes

5.1 Cutting and Machining

GGB SY

GGB SY bushes do not normally require sizing after assembly.

Should machining of the bearing lining be required then care should be taken to avoid any burrs around the edges of the indents in the bearing surface.

A diamond tipped boring tool should be used with a fine feed of 0.1 mm / rev. and a cutting speed of 2 - 3 m/s.

GGB SP

The bushes must be finish sized after assembly. This may be done by burnishing, broaching or boring as described below.

For many applications burnishing with a hardened sphere or spherically ended or ribbed tool will give adequate bore size. The required diameter (d_1) of the burnishing tool are as follows:

$$d_1 \text{ calibration tool} = D_i + 0.0015 \text{ mm}$$

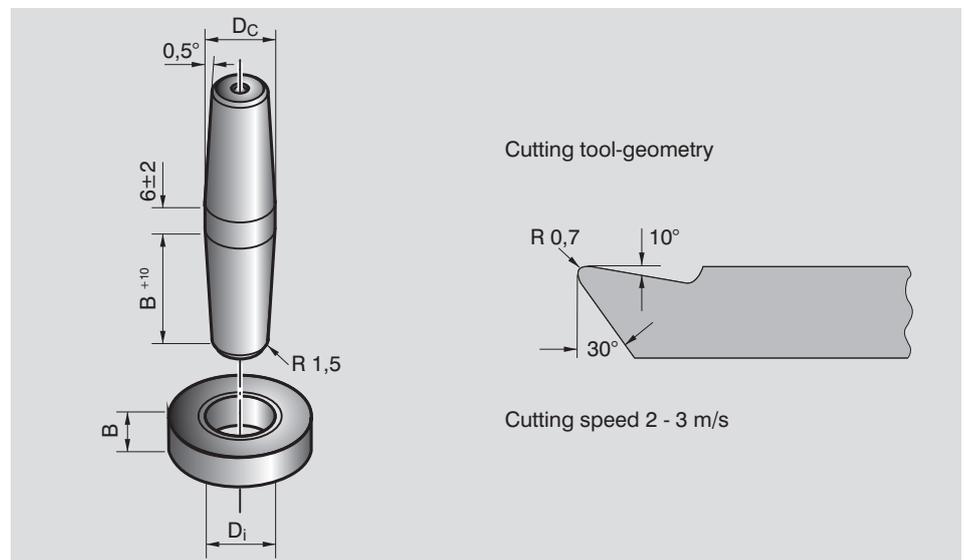


Figure 11: Burnishing tool

to allow for recovery of the bearing bore after sizing.

Reaming is a suitable sizing method, although the bore may not completely clean up, by a few micrometers, due to the cumulative tolerances.

If boring is carried out, care must be taken to maintain good concentricity with the hou-

sing. It is advisable to use H6 limits and work towards the maximum bore size.

The cutting tool should have a small point radius, approximately 1.0 mm, an approach angle of 30°, primary angle of 10° and a cutting speed of 2 - 3 m/s, with a fine speed of 0.1 mm/rev.

5.2 Lubrication

GGB SY and GGB SP bearings must be lubricated. Care should be taken at temperatures above 100 °C to avoid attack of the bearing lining by any acidic degradation products from the lubricant.

Unlike polymer composite bearing materials these materials are suitable for use with lubricants containing MoS₂ or graphite.

SY

Suitable for use with oil or grease lubrication.

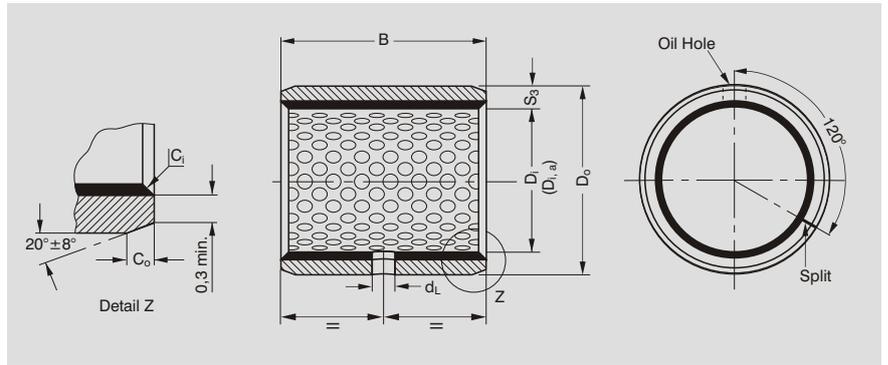
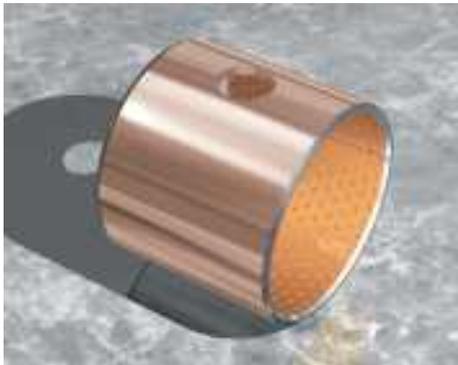
For use with grease lubrication, the most common situation, the bearing surface is manufactured with a uniform pattern of indents which form a reservoir for the lubricant and provide the optimum distribution within the loaded area of the bearing.

SP

Suitable for use with oil or grease lubrication.

Particularly suitable for high speed applications with oil lubrication.

6.1 SY Cylindrical Bushes



All dimensions in mm

Dimensions and tolerances follow ISO 3547 and GSP specifications

Outside C_o and Inside C_i chamfers

Wall thickness s_3	C_o (a)		C_i (b)
	machined	rolled	
0.75	0.5±0.3	0.5±0.3	-0.1 to -0.4
1	0.5±0.3	0.5±0.3	-0.1 to -0.4
1.5	0.5±0.3	0.5±0.3	-0.1 to -0.4
2	0.5±0.3	0.5±0.3	-0.1 to -0.4
2.5	0.5±0.3	0.5±0.3	-0.1 to -0.4

Additional standard parts, not currently specified in this technical information brochure, are available to order, please

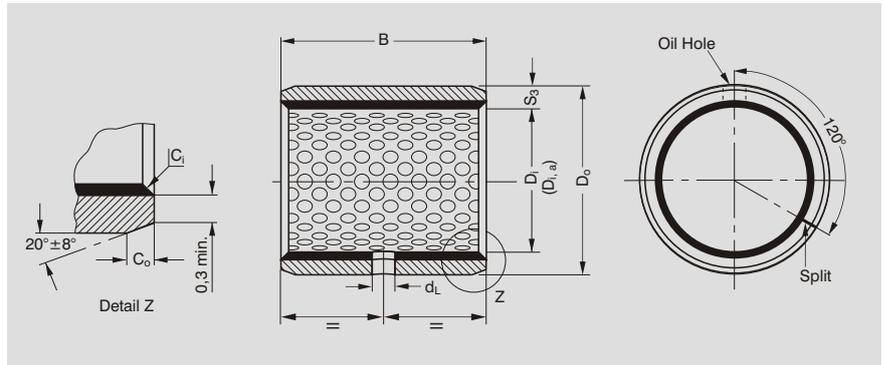
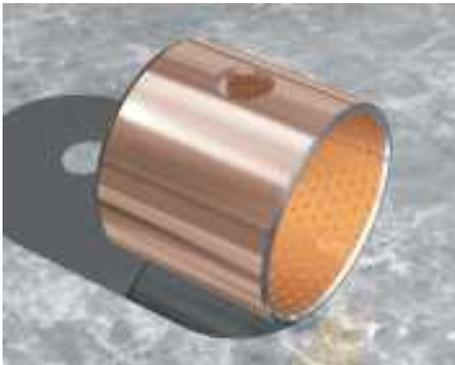
refer to GGB Sales. All enquiries for non-standard SY parts should be referred to GGB sales.

a = chamfer C_o machined or rolled at the opinion of the manufacturer
 b = C_i can be a radius or a chamfer in accordance with ISO 13715

Part No.	Nominal Diameter		Wall Thickness S_3	Width B	Shaft-Ø $D_j, h8$	Housing-Ø $D_H, H7$	Bush-Ø $D_{i,a}$ Ass. in H7 housing	Clearance C_D	Oil Hole Ø
	D_i	D_o							
PM2025SY PM2030SY	20	23	1.490 1.430	25	20.000	23.021	+0.161 +0.020	0.194 0.020	4
PM2215SY PM2220SY PM2225SY PM2230SY	22	25		15 20 25 30	22.000 21.967	25.021 25.000			
PM2515SY PM2520SY PM2525SY PM2530SY	25	28		15 20 25 30	25.000 24.967	28.021 28.000			
PM2815SY PM2820SY PM2825SY PM2830SY	28	32		15 20 25 30	28.000 27.967	32.025 32.000			
PM3015SY PM3020SY PM3025SY PM3030SY PM3040SY	30	34		15 20 25 30 40	30.000 29.967	34.025 34.000			
PM3230SY PM3240SY	32	36		30 40	32.000 31.961	36.025 36.000			
PM3515SY PM3520SY PM3525SY PM3530SY PM3535SY PM3540SY PM3545SY PM3550SY	35	39		15 20 25 30 35 40 45 50	35.000 34.961	39.025 39.000			
PM4020SY PM4030SY PM4040SY PM4050SY PM4060SY	40	44		20 30 40 50 60	40.000 39.961	44.025 44.000			

6 Standard Products

6.1 SY Cylindrical Bushes

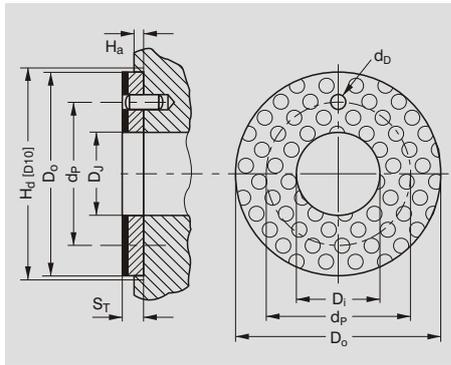


All dimensions in mm

Dimensions and tolerances follow ISO 3547 and GSP specifications

Part No.	Nominal Diameter		Wall Thickness S ₃	Width B	Shaft-Ø D _J h8	Housing-Ø D _H H7	Bush-Ø D _{i,a} Ass. in H7 housing	Clearance C _D	Oil Hole Ø																																																									
	D _i	D _o								max. min.	d _L																																																							
PM4530SY	45	50	2.460 2.400	30					8																																																									
PM4540SY	45	50		40						45.000	50.025	+0.225	0.264																																																					
PM4550SY	45	50		50						44.961	50.000	+0.080	0.080																																																					
PM4560SY	45	50		60																																																														
PM5030SY	50	55		30																																																														
PM5040SY	50	55		40											50.000	55.030		0.269																																																
PM5050SY	50	55		50											49.961	55.000		0.080																																																
PM5060SY	50	55		60																																																														
PM5535SY	55	60		35																																																														
PM5540SY	55	60		40																55.000	60.030																																													
PM5555SY	55	60		55																54.954	60.000																																													
PM5560SY	55	60		60																																																														
PM6030SY	60	65		30																																																														
PM6040SY	60	65		40																					60.000	65.030																																								
PM6060SY	60	65		60																					59.954	65.000																																								
PM6540SY	65	70		40																																																														
PM6550SY	65	70		50																										65.000	70.030	+0.230	0.276																																	
PM6560SY	65	70		60																										64.954	70.000	+0.080	0.080																																	
PM6570SY	65	70		70																																																														
PM7040SY	70	75		40																																																														
PM7045SY	70	75		45																																																														
PM7050SY	70	75		50																																			70.000	75.030																										
PM7065SY	70	75		65																																			69.954	75.000																										
PM7080SY	70	75		80																																																														
PM7540SY	75	80		40																																																														
PM7560SY	75	80		60																																								75.000	80.030																					
PM7580SY	75	80		80																																								74.954	80.000																					
PM8040SY	80	85		40																																																														
PM8060SY	80	85		60																																													80.000	85.035		0.281														
PM8075SY	80	85		75																																													79.954	85.000		0.080														
PM8080SY	80	85		80																																																														
PM8560SY	85	90		60																																													86.000	90.035																
																																																	85.946	90.000																
PM9040SY	90	95		40																																																														
PM9070SY	90	95		70																																																		90.000	95.035	+0.235										
PM9090SY	90	95		90																																																		89.946	95.000	+0.080										
PM10040SY	100	105		40																																																														
PM10050SY	100	105		50																																																														
PM10060SY	100	105		60																																																											100.000	105.035		0.289
PM10080SY	100	105		80																																																											99.946	105.000		0.080
PM10095SY	100	105		95																																																														
PM12050SY	120	125		50																																																											120.000	125.040		0.294
																																																															119.946	125.000	+0.240	0.080
PM13560SY	135	140		60																																																											135.000	140.040	+0.080	0.303
																																																															134.937	140.000		0.080

6.2 SY Thrust Washers

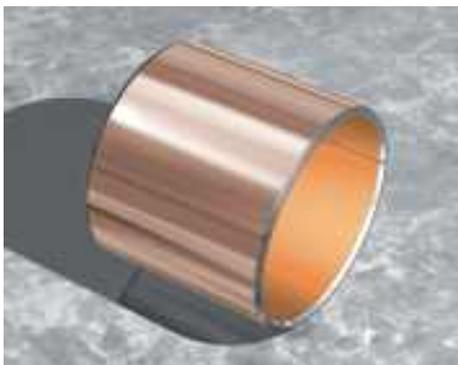


All dimensions in mm

For other standard thrust washers not mentioned in here, refer to GSP 30 Sheet 3, for non-standard thrust washers refer to the GGB Sales Department.

Part No.	Inside Ø Di	Outside Ø Do	Thickness STr	Dowel Hole Ø db	Pitch Circle Ø dp	Recess Depth Ha
	max. min.	max. min.	max. min.	max. min.	max. min.	max. min.
WC30SY	32.00 32.25	54.00 53.75	1.45 1.41	4.125 4.375	43.12 42.88	0.95 1.20
WC35SY	38.00 38.25	62.00 61.75			50.12 49.88	
WC40SY	42.00 42.25	66.00 65.75			54.12 53.88	
WC45SY	48.00 48.25	74.00 73.75	61.12 60.88		1.45 1.70	
WC50SY	52.00 52.25	78.00 77.75	65.12 64.88			

6.3 SP Metric and Inch Range Cylindrical Bushes



For standard metric SP parts please refer to GSP 08, for inch SP parts refer to GSP 07.

For non-standard parts refer to the GGB Sales Department.

Metric and inch SP parts are available on request.

Application: _____

Project / No.: _____

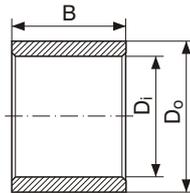
Quantity: _____

New Design

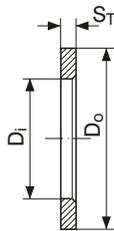
Existing Design

Bearing Type:

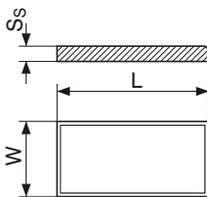
Cylindrical bushing



Thrust washer



Slideplate



Special parts (sketch)

- Rotational movement
- Steady load
- Rotating load
- Oscillating movement
- Linear movement

Dimensions [mm]	
Inside diameter	D_i
Outside diameter	D_o
Length	B
Wall thickness	S_T
Length of slideplate	L
Width of slideplate	W
Thickness of slideplate	S_s

Load	
<input type="checkbox"/> Radial load F	
- static	[N]
- dynamic	[N]
<input type="checkbox"/> Axial load F	
- static	[N]
- dynamic	[N]
<input type="checkbox"/> Specific load \bar{p}	
- radial	[MPa]
- axial	[MPa]

Movement	
Rotational speed	N [1/min]
Speed	U [ms]
Length of stroke	L_s [mm]
Frequency of stroke	[1/min]
Oscillating cycle	φ [°]
Oscillating freq.	N_{osz} [1/min]

Mating Surface	
Material	
Hardness	HB/HRC
Surface finish	Ra [μm]

Fits and Tolerances	
Shaft	D_J
Bearing housing	D_H

Operating Environment	
Ambient temperature T_{amb} [°]	
<input type="checkbox"/>	Housing with good heating transfer properties
<input type="checkbox"/>	Light pressing or insulated housing with poor heat transfer properties
<input type="checkbox"/>	Non metal housing with poor heat transfer properties
<input type="checkbox"/>	Alternate operation in water and dry

Lubrication	
<input type="checkbox"/>	Dry
<input type="checkbox"/>	Continuous lubrication
<input type="checkbox"/>	Process fluid lubrication
<input type="checkbox"/>	Initial lubrication only
<input type="checkbox"/>	Hydrodynamic conditions
Process fluid	
Lubricant	
Dynamic viscosity	η

Service Hours per Day	
Continuous operation	
Intermittent operation	
Operating time	
Days per year	

Service Life	
Required service life	L_H [h]

Customer Information	
Company	_____
Street	_____
City / Post Code	_____
Name	_____
Tel.	_____
Fax	_____
Date / Signature	_____

8 Product Information

GGB gives an assurance that the products described in this document have no manufacturing errors. The details set out in this document are registered to assist in assessing the material's suitability for the intended use. They have been developed from our own investigations as well as from generally accessible publications. They do not represent any assurance for the properties themselves.

Unless expressly declared in writing, GGB gives no warranty that the products described are suited to any particular purpose or specific operating circumstances. GGB accepts no liability for any losses, damages or costs however they may arise through direct or indirect use of these products.

GGB's sales and delivery terms and conditions, included as an integral part of quotations, stock and price lists, apply absolutely to all business conducted by GGB. Copies can be made available on request.

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

Edition 2011 (This edition replaces earlier editions which hereby lose their validity).

8.1 Trademarks

GGBTM, SYTM and SPTM are trademarks of GGB.