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 managememt systems.

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/mm²**	Specific load
$\bar{p}_{sta,max}$	**N/mm²**	Maximum static load
$\bar{p}_{dyn,max}$	**N/mm²**	Maximum dynamic load
$\bar{p}U$	**N/mm² x m/s**	Maximum p̄U 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_1	**1/10⁶K**	Coefficient of linear thermal expansion parallel to face
γ	**g/cm³**	Density
σ_C	**N/mm²**	Compressive yield strength
σ_S	**N/mm²**	Shear strength
σ_T	**N/mm²**	Tensile strength
λ	**W/mK**	Thermal conductivity

Content

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.

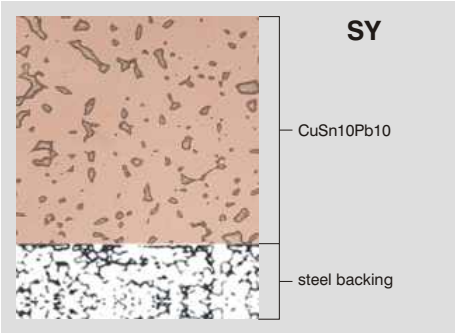


Fig. 1: SY Microsection

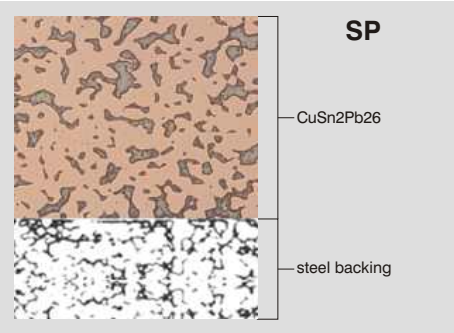


Fig. 2: SP Microsection

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.

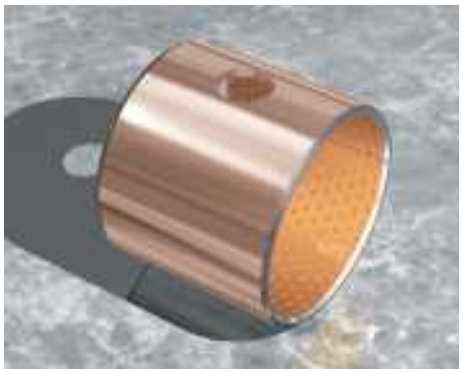


Fig. 3: SY metric bush

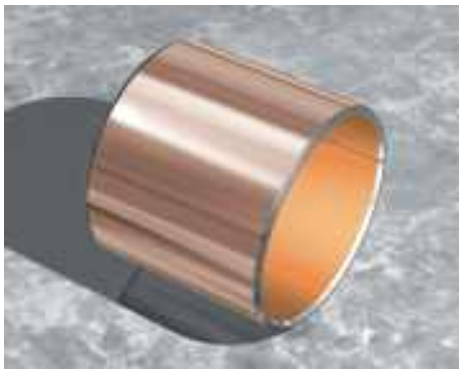


Fig. 4: SP metric bush

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	Unit SP
Ultimate tensile strength		σ_T	N/mm²	185	180
Shear strength		σ_S	N/mm²	170	70
%-elongation		-	-	8	5
Hardness		-	-	-	40 - 55
Hardness skin rolled		-	-	80 - 130	-
Density		γ	g/cm³	8,94	9,56
Coefficient of linear thermal expansion		$\alpha 1$	$1/10^6$K	18	19
Thermal conductivity		λ	-	47	60
Specific load		$\bar{p}$	N/mm²	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/mm² · 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

GGB SY

- 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

GGB SP

- Bush bore may 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

GGB SY

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

GGB SP

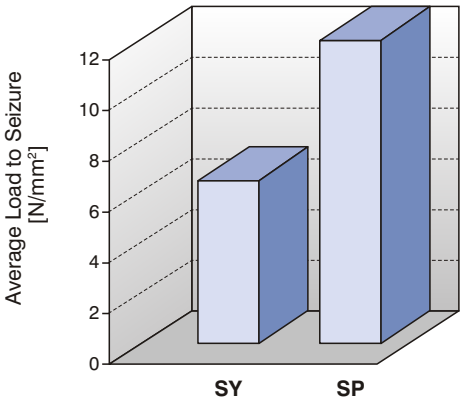
High speed applications where good emergency running is required as for example in oil pump bearings, gearbox bushes, steering gear, power steering, pedal bushes, king-pin bushes, tailgate pivots, brake caliper bushes, mechanical handling and lifting equipment, machine slides, hydraulic cylinders, hydraulic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

Fig. 6: Typical Applications

4.3 Bearing Performance

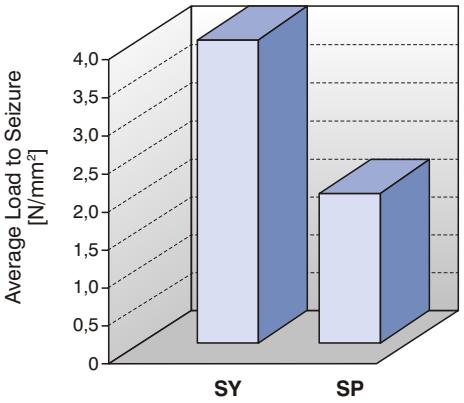
Oil and Grease Lubrication

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



Test Conditions
Bush: D_i = 16 mm, B_1 = 20 mm
Speed rev/min: 1500
Start-stop running cycle:
Specific bearing load increased by 3 N/mm² after each 144 cycles until seizure occured

Figure 7: Relative Seizure Resistance - Oil Lubrication



Test Conditions
Bush: D_i = 16 mm, B_1 = 20 mm
Speed rev/min: 800
Continuous running:
Specific bearing load increased by 1 N/mm² after every 96 hrs until seizure occured

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.

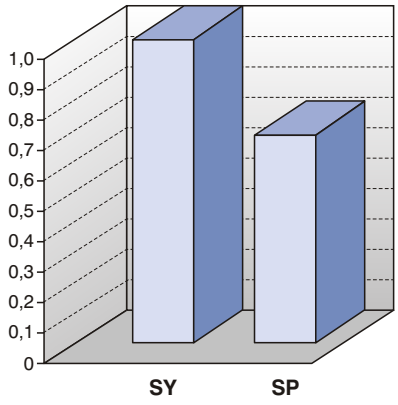


Figure 9: Relative Fatigue Strength

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.

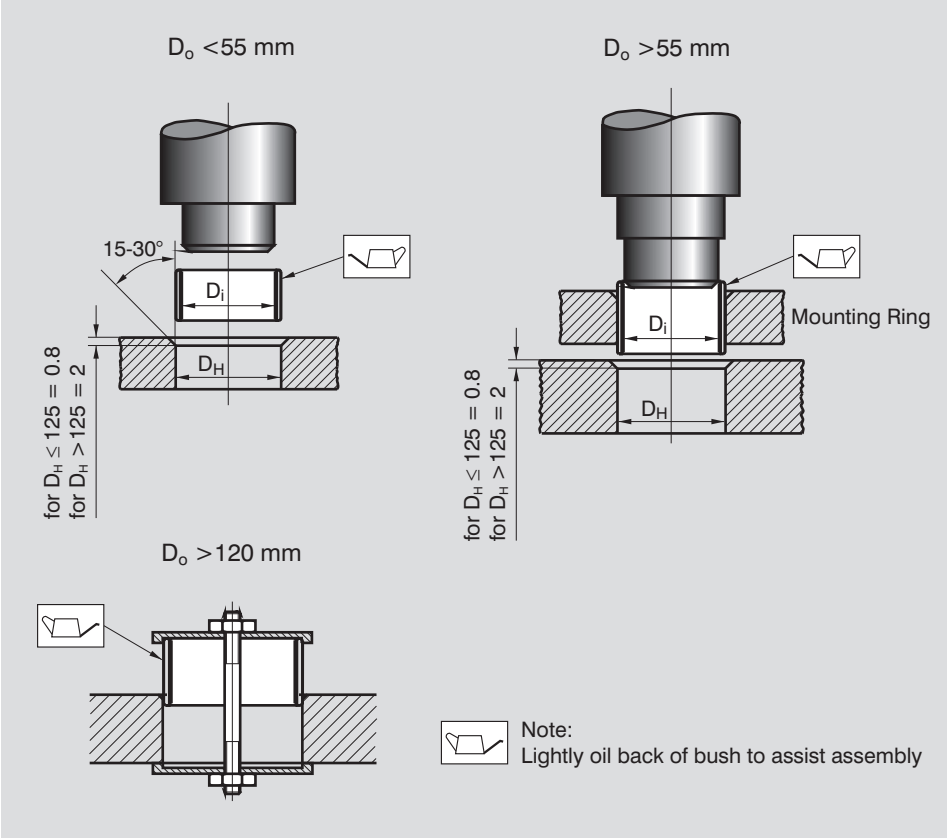


Figure 10: Fitting of cylindrical bushes

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 (d1) of the burnishing tool are as follows:

d_1 calibration tool = D_i + 0.0015 mm

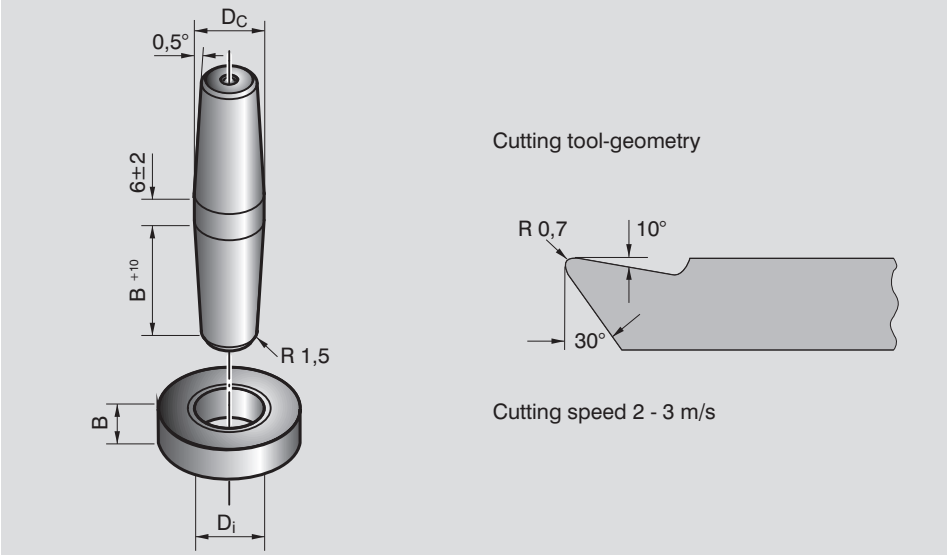


Figure 11: Burnishing tool

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 housing. 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 MoS_2 or graphite.

SY

Suitable for use with oil or grease lubrication.

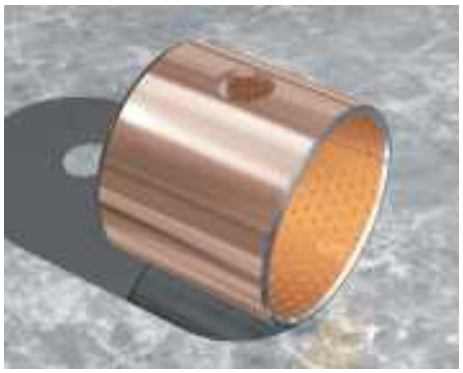
For use with grease lubrication, the most common situation, the bearing surface is manufactured with a uniform pattern of indents which form a reservoir for the lubricant and provide the optimum distribution within the loaded area of the bearing.

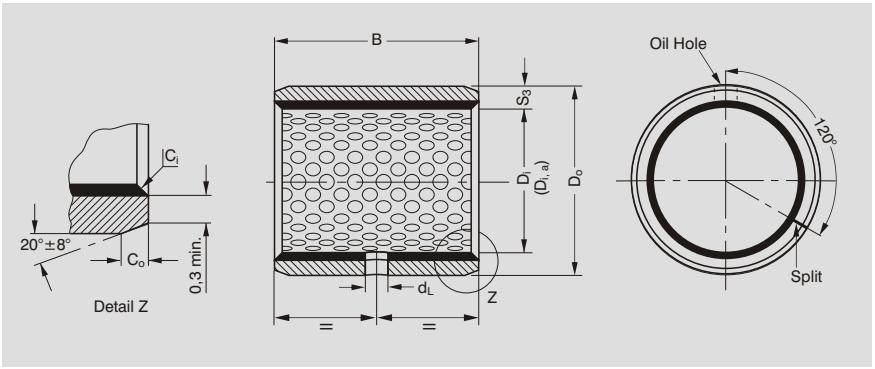
SP

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

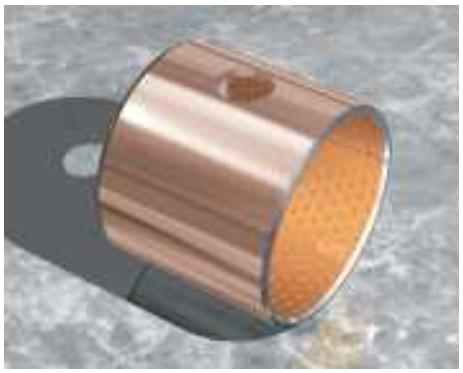
Wall thickness s_3	C_o (a) machined	C_o (a) rolled	C_i (b)
0.75	0.5±0.3	0.5±0.3	-0.1 to -0.4
1	0.5±0.3	0.5±0.3	-0.1 to -0.4
1.5	0.5±0.3	0.5±0.3	-0.1 to -0.4
2	0.5±0.3	0.5±0.3	-0.1 to -0.4
2.5	0.5±0.3	0.5±0.3	-0.1 to -0.4

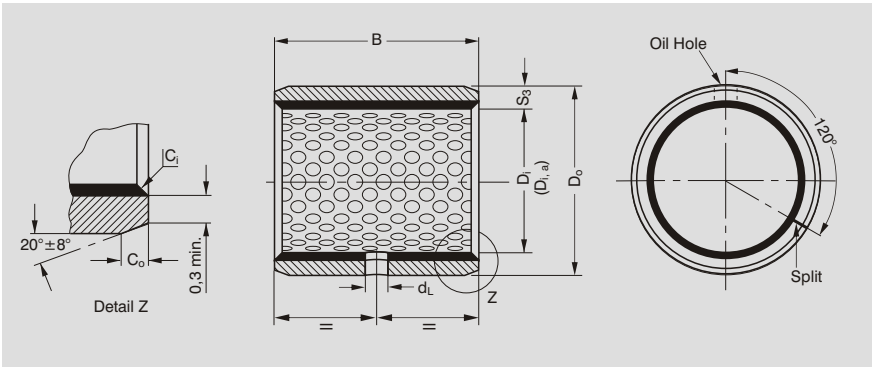
a = chamfer C_o machined or rolled at the opinion of the manufacturer
b = C_i can be a radius or a chamfer in accordance with ISO 13715

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.

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.	max. min.	max. min.	max. min.	max. min.	max. min.	d_L
PM2025SY	20	23		25	20.000	23.021			4
PM2030SY	20	23		30	19.967	23.000			
PM2215SY	22	25		15					
PM2220SY	22	25		20	22.000	25.021			
PM2225SY	22	25	1.490	25	21.967	25.000	+0.161	0.194	
PM2230SY	22	25	1.430	30			+0.020	0.020	
PM2515SY	25	28		15					
PM2520SY	25	28		20	25.000	28.021			
PM2525SY	25	28		25	24.967	28.000			
PM2530SY	25	28		30					
PM2815SY	28	32		15					
PM2820SY	28	32		20	28.000	32.025			
PM2825SY	28	32		25	27.967	32.000			
PM2830SY	28	32		30					
PM3015SY	30	34		15				0.218	
PM3020SY	30	34		20				0.040	
PM3025SY	30	34		25	30.000	34.025			6
PM3030SY	30	34	1.980	30	29.967	34.000			
PM3040SY	30	34	1.920	40					
PM3230SY	32	36		30	32.000	36.025			
PM3240SY	32	36		40	31.961	36.000			
PM3515SY	35	39		15			+0.185		
PM3520SY	35	39		20			+0.040		
PM3525SY	35	39		25					
PM3530SY	35	39		30	35.000	39.025			
PM3535SY	35	39		35	34.961	39.000		0.224	
PM3540SY	35	39		40				0.040	
PM3545SY	35	39		45					
PM3550SY	35	39		50					
PM4020SY	40	44		20					
PM4030SY	40	44		30					
PM4040SY	40	44		40	40.000	44.025			8
PM4050SY	40	44		50	39.961	44.000			
PM4060SY	40	44		60					

6.1 SY Cylindrical Bushes



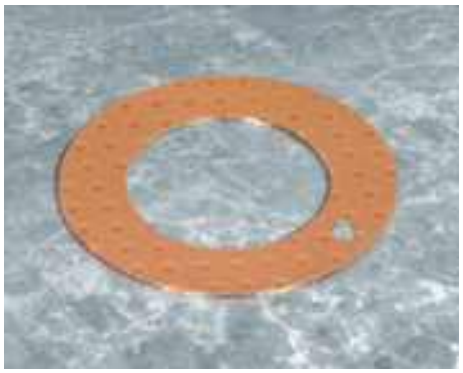


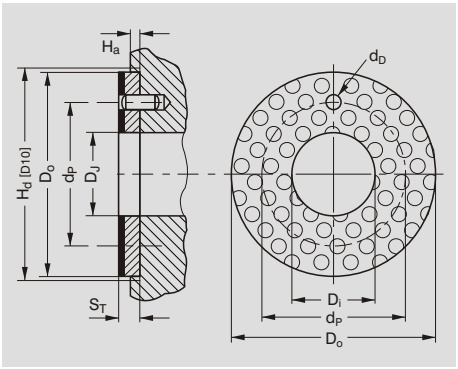
All dimensions in mm

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.	max. min.	max. min.	max. min.	max. min.	max. min.	d_L
PM4530SY	45	50	2.460 2.400	30	45.000 44.961	50.025 50.000	+0.225 +0.080	0.264 0.080	8
PM4540SY	45	50		40					
PM4550SY	45	50		50					
PM4560SY	45	50		60					
PM5030SY	,50	55		30	50.000 49.961	55.030 55.000	+0.230 +0.080	0.269 0.080	
PM5040SY	50	55		40					
PM5050SY	50	55		50					
PM5060SY	50	55		60					
PM5535SY	55	60		35	55.000 54.954	60.030 60.000		0.276 0.080	
PM5540SY	55	60		40					
PM5555SY	55	60		55					
PM5560SY	55	60		60					
PM6030SY	60	65		30	60.000 59.954	65.030 65.000			
PM6040SY	60	65		40					
PM6060SY	60	65		60					
PM6540SY	65	70		40	65.000 64.954	70.030 70.000			
PM6550SY	65	70		50					
PM6560SY	65	70		60					
PM6570SY	65	70		70					
PM7040SY	70	75		40	70.000 69.954	75.030 75.000			
PM7045SY	70	75		45					
PM7050SY	70	75		50					
PM7065SY	70	75		65					
PM7080SY	70	75		80					
PM7540SY	75	80		40	75.000 74.954	80.030 80.000			9.5
PM7560SY	75	80		60					
PM7580SY	75	80		80					
PM8040SY	80	85		40	80.000 79.954	85.035 85.000	+0.235 +0.080	0.281 0.080	
PM8060SY	80	85		60					
PM8075SY	80	85		75					
PM8080SY	80	85		80					
PM8560SY	85	90		60	86.000 85.946	90.035 90.000			
PM9040SY	90	95		40	90.000 89.946	95.035 95.000		0.289 0.080	
PM9070SY	90	95		70					
PM9090SY	90	95		90					
PM10040SY	100	105		40	100.000 99.946	105.035 105.000			
PM10050SY	100	105		50					
PM10060SY	100	105		60					
PM10080SY	100	105		80					
PM10095SY	100	105		95					
PM12050SY	120	125		50	120.000 119.946	125.040 125.000	+0.240 +0.080	0.294 0.080	
PM13560SY	135	140		60	135.000 134.937	140.040 140.000		0.303 0.080	

6.2 SY Thrust Washers



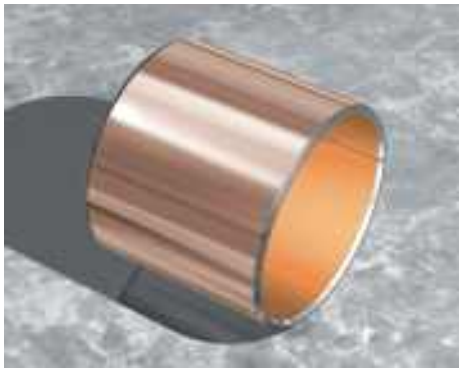


All dimensions in mm

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 D_i	Outside Ø D_o	Thickness S_T	Dowel Hole Ø d_D	Pitch Circle Ø d_P	Recess Depth H_a
	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	1.95 1.92		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.

7 Data Sheet

Application: _____

_____

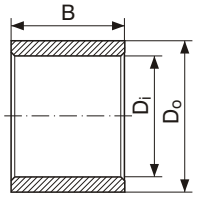
_____

Project / No.: _____

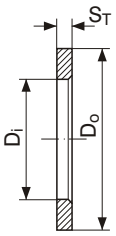
Quantity: _____ ☐ New Design ☐ Existing Design

Bearing Type:

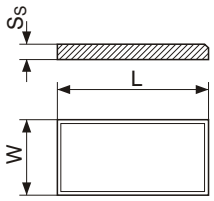
☐ Cylindrical bushing



☐ 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		
☐ Radial load F		
- static	[N]	
- dynamc	[N]	
☐ Axial load F		
- static	[N]	
- dynamic	[N]	
☐ 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}[°]	
☐ 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	

Lubrication	
☐ Dry	
☐ Continuous lubrication	
☐ Process fluid lubrication	
☐ Initial lubrication only	
☐ 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

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