

## PRODUCT RANGE

Plain Bearings  
& Polymer Coatings

**NORTH AMERICA**



# Who we are

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GGB helps create a world of motion with minimal frictional loss through plain bearing and surface engineering technologies. With R&D, testing and production facilities in the United States, Germany, France, Brazil, Slovakia and China, 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 [www.ggbearings.com](http://www.ggbearings.com).

Our products are used in tens of thousands of critical applications every day on our planet. 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**



## MAINTENANCE-FREE

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



## LOW FRICTION, HIGH WEAR RESISTANCE

Low coefficients of friction eliminate the need for lubrication, while providing smooth operation, reducing wear and extending service life.



## 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 offers space and weight reductions and thanks to the material compositions and self-lubricating properties, less maintenance is needed.



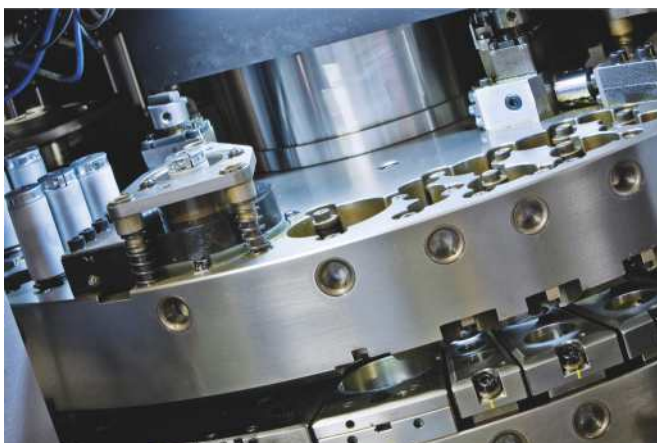
## REDUCED CO<sub>2</sub> FOOTPRINT

GGB's flexible and local production platforms assure timely deliveries and reduced CO<sub>2</sub> footprint.



## PARTNER SUPPORT

GGB offers tribological, application and design support, and partners with our customers to provide the most efficient solutions.



## The Highest Standards in Fabrication

Our world-class manufacturing plants in the United States, Brazil, China, Germany, France and Slovakia are certified in quality and excellence according to ISO 9001, IATF 16949, ISO 14001 and ISO 45001. This allows us to access the industry's best practices while aligning our management system with global standards.

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

[www.ggbearings.com/en/certificates](http://www.ggbearings.com/en/certificates)

# Bearing Selection

Plain bearings help optimise friction and minimise wear to ensure reliable lifetime performance in machines or systems with moving parts.

Selecting the right plain bearing with the appropriate material design is critical to managing friction and wear. Typically, plain bearings are made of softer materials than the shafts they support and are "sacrificial," meaning the bearing wears faster than the shaft.

Although friction and wear may be the principal design parameters for an application, other operational requirements associated with the bearing environment must be carefully considered.

An engineer must verify that the bearing properties meet application specifications for fatigue life and resistance to corrosion, chemicals, shocks, erosion, environmental contamination and debris.

GGB products are available in a broad selection of material technologies engineered to optimise the tribological layer for a complex range of operating conditions across diverse markets.

PRODUCT FAMILY	TRIBOLOGICAL LINER DESIGN	KEY VALUE PROPOSITION
<b>Metal-Polymer (MP)</b>	a) PTFE + fillers	Lowest friction & transfer film formation for self-lubrication (dry operation)
	b) Thermoplastic + fillers	Optimum maintenance free durability in greased or oiled applications
<b>Engineered Plastics (EP)</b>	Thermoplastic + fillers	Freedom of shape and corrosion resistance at a competitive price
<b>Fiber Reinforced Composites (FRC)</b>	Thermoset + fillers	Low friction and robustness for high loaded, aggressive environments (corrosion, shocks, dirt)
<b>Bimetals</b>	Metal alloy	High temperature capability

Converging on the optimum product can be complex and imprecise due to the material science and surface interactions, but in most cases can be successfully achieved with a sound knowledge of the product capabilities (outlined in GGB product datasheets and brochures) and an understanding of the application parameters and operating conditions.

## FACTORS INFLUENCING FRICTION AND WEAR

- Specific load (P)
- Speed (V)
- PV factor
- Temperature
- Lubrication
- Mating surface material, hardness, and roughness
- Other system parameters e.g., housing design, misalignment, dirt, lubrication, etc.

Each of these factors (including the choice of bearing) influence the friction and wear of the system.

# Coatings, Plain Bearings & Bearing Assemblies

## TRIBOLOGICAL COATINGS

PRODUCT NAME	POLYMER COATINGS	PAGE
<b>TriboShield® TS225</b>	Based on a nanostructured thermoset polymer designed for low friction and high wear resistance at low to medium loads in dry or lubricated conditions.	8
<b>TriboShield® TS650</b>	Based on high-performance thermoplastics specifically designed for constant low friction from low to moderately high loads in lubricated conditions. Highly suitable for process fluid or water lubricated contacts.	9
<b>TriboShield® TS651</b>	Based on high-performance thermoplastics specifically designed for constant low friction from low to moderately high loads in dry or lubricated conditions. Highly suitable for high frequency / low amplitude (HFLA) applications, particularly in dry conditions.	10
<b>TriboShield® TS742</b>	Based on latest generation high-performance thermoplastics, specifically developed for demanding and heavy-duty applications. Extreme load bearing capacity and low friction at moderate to high loads are some of its standout features.	11

## TRIBOLOGICAL BEARINGS

PRODUCT NAME	METAL-POLYMER BEARINGS	PAGE
<b>DP4</b>	Lead-free all-purpose DP4 material offering low friction and good wear resistance in both dry and lubricated applications. Suitable for linear, oscillating and rotating movements.	12
<b>DP4-B</b>	Same advantages as DP4, but bronze back offers additional corrosion resistance in humid/saline environments.	13
<b>DU®</b>	Original iconic all purpose metal-polymer product that offers exceptional wear resistance with low friction over a wide range of dry and lubricated running conditions.	14
<b>DU-B</b>	Same advantages as DU, but bronze back offers additional corrosion resistance in humid/saline environments.	15
<b>DP10</b>	DP10 offers very good performance in lubricated applications, particularly in marginally lubricated applications.	16
<b>DP11</b>	DP11 is particularly suited for dry applications with high frequency and low amplitude oscillating movements.	17
<b>DP31</b>	DP31 is ideal for oil lubricated applications as it offers superior flow erosion and cavitation resistance and fatigue strength.	18
<b>DX®</b>	DX bearing material for marginally lubricated applications. Optimum performance under relatively high loads and low speeds.	19
<b>DX®10</b>	DX10 is perfect for heavy duty and harsh environments and offers excellent abrasive and erosion resistance. Good fatigue strength.	20
<b>HI-EX®</b>	Marginally lubricated bearing material with ultimate robustness and wear performance under highly loaded, thin film conditions. Available with non-indented overlay for hydrodynamic applications.	21
<b>DTS10®</b>	DTS10 offers the ultimate performance for oil lubricated application, offering low friction and the highest level of chemical resistance, fatigue strength and wear performance. Also designed to resist cavitation and flow erosion, and good behavior in dry start-up conditions. A material that is designed to be machined after assembly for tight tolerances.	22
<b>DS</b>	DS is similar to DX but with lower friction and dry running capability. It particularly excels in humid environments with low amplitude oscillating movements, designed to minimize fretting corrosion damage of the shaft.	23

# Coatings, Plain Bearings & Bearing Assemblies

## TRIBOLOGICAL BEARINGS

PRODUCT NAME	ENGINEERED PLASTICS BEARINGS	PAGE
EP®	General purpose EP material provides good bearing performance in dry as well as lubricated or marginally lubricated working conditions. Good choice for medium working conditions compared to other Engineered Plastics materials.	24
EP®12	EP12 is a good choice for water lubricated applications, but also operates well in dry, marginally lubricated and lubricated conditions. Good choice for low temperature conditions compared to other Engineered Plastics materials.	25
EP®15	EP15 are UV-resistant bearings. The material is resistant to low temperature applications. They are lightweight with a low coefficient of friction and abrasion resistance.	26
EP®22	EP22 bearings provide a good price/performance ratio . Good performance in low load applications, also a good choice for water lubricated applications.	27
EP®30	EP30 is suitable for elasto hydrodynamic applications and is good in dry, lubricated or marginally lubricated conditions.	28
EP®43	EP43 provides a good price performance ratio for high temperature applications and is dimensionally stable. Good chemical and moisture resistance.	29
EP®44	EP44 provides a good price performance ratio. It is especially good with grease, oil, or water lubrication.	30
EP®63	EP63 is suitable for very high temperature applications and provides high mechanical strength.	31
EP®64	EP64 offers an excellent flow erosion and cavitation resistance and offers a very high mechanical performance.	32
KA Glacetal	KA-Glacetal washers provide good bearing performance in light duty working conditions and a good price and weight performance ratio.	33
Multilube	Multilube offers a good price performance ratio and operates in dry, marginally lubricated and lubricated applications.	34

PRODUCT NAME	FIBER REINFORCED COMPOSITE BEARINGS	PAGE
GAR-MAX®	GAR-MAX is known for its high load capacity and excellent shock and misalignment resistance.	35
GAR-FIL®	GAR-FIL provides a machinable bearing surface for more precise assembly tolerances and offers a high rotational speed capacity. Excellent contamination resistance.	36
HSG	HSG offers twice as much high load capacity and excellent shock and misalignment resistance.	37
MLG	MLG provides high load capacity, suitable for lighter duty applications.	38
HPM	HPM is designed for hydropower applications, dimensionally stable with very low water absorption and low swelling.	39
HPMB®	HPMB provides machinable inner and outer diameters for application precision, circularity and cylindricity tolerances.	40
HPF®	HPF is designed for hydropower applications and provides a machinable bearing surface.	41
GGB-MEGALIFE® XT	GGB-Megalife XT thrust washers offer excellent contamination resistance.	42
Multifil	Multifil is a sliding bearing material which can easily be bonded to any clean, rigid substance.	43
SBC with GAR-MAX®	Sealed GAR-MAX bearing to exclude contamination, offering extended service life.	44
SBC with HSG	Sealed HSG bearing to exclude contamination, offering extended service life.	45

# Coatings, Plain Bearings & Bearing Assemblies

## TRIBOLOGICAL BEARINGS

PRODUCT NAME	METAL AND BIMETAL BEARINGS	PAGE
GGB-CSM®	Thick-walled monometal GGB-CSM bearings are maintenance-free and offer a high load capacity and a temperature range of up to 600°C.	46
GGB-CBM®	Thin-walled bimetal GGB-CBM bearings are maintenance-free and offer high load capacity and are suited for a broad temperature range.	47
GGB-BP25	Maintenance-free GGB-BP25 oil impregnated sintered bronze bearings offer optimum performance in low temperature applications with relatively light loads and high speeds.	48
GGB-FP20	Maintenance-free GGB-FP20 oil impregnated sintered iron bearings are available in complex shapes for general industrial applications.	49
GGB-SO16	Maintenance-free GGB-SO16 oil impregnated sintered iron rods offer higher performance compared to GGB-FP20 under high loads and low speeds.	50
GGB-SHB	GGB-SHB cast hardened steel bearings are available with plain or grooved sliding layer. Suitable for low rotation speed with high specific pressure.	51
AuGlide®	Lead-free bimetal AuGlide bearings are machinable and capable of supporting high specific loads and high temperatures.	52
SY	Bimetal SY (SAE standard 792) bearings are particularly suitable for high specific loads with oscillating motion and low frequency for rough operating conditions.	53
SP	Bimetal SP (SAE standard 794) bearings are suitable for oil and grease lubrication.	54
GGB-DB®	GGB-DB cast bronze bearings are suitable for heavy duty applications. Available with PTFE or graphite inserts.	55

## BEARING ASSEMBLIES

PRODUCT NAME	BEARING ASSEMBLIES	PAGE
UNI	Self-aligning pillow block assembly designed for universal	56
MINI	Self-aligning pillow block assembly designed for universal	57
EXALIGN	Self-aligning pedestal or flanged bearings housing assemblies for specific assembly requirements.	58

## ADDITIONAL INFORMATION

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Product Information	60

## TriboShield® TS225



### NANOSTRUCTURED COATING FOR LOW TO MEDIUM LOADS

TS225 is based on a nanostructured thermoset polymer designed for low-friction and high wear resistance at low to medium loads in dry or lubricated conditions. TS225 is part of the standard TriboShield® product range.

#### UNIQUE CHARACTERISTICS

- Excellent friction at high sliding speeds
- Very good friction in lubricated conditions
- Applicable to heat-sensitive substrates
- High surface hardness

#### AVAILABILITY

TriboShield coatings are applied directly to the customer's part and are suitable for complex geometries as well as various substrates e.g. steel, stainless steel, Al, Ti, Mg, etc. They can be used for both interacting surfaces that are in relative motion

#### TYPICAL APPLICATIONS

- Piston skirts for internal combustion engines
- Garden and DIY tools

#### TRIBOMATE® UPGRADE AVAILABLE

Yes

BEARING PROPERTIES	UNITS	VALUE
<b>GENERAL</b>		
Color		Black
Max. continuous service temperature	°C / °F	120 / 248
Max. short-term peak temperature	°C / °F	130 / 266
Friction coefficient, typical range*		0.04 - 0.25
Food contact compliant**		No

\* Dependent on contact pressure, sliding speed and contact geometry.  
 \*\* Your specific food contact condition may require additional approval.  
 Please contact your GGB representative for more information.

### STANDARD COATINGS RANGE

For optimized performance in regard of

- significant reduction of friction in dry conditions
- improved wear life
- stable performance

we offer TriboMate® paired coatings which are specifically designed to work with and enhance the performance of our polymer coating products.

Pairing a TriboShield® coating with another TriboShield® coating solution or with a GGB bearing material, offers significantly reduced friction and can further extend system lifetime.





# TriboShield® TS650



## HIGH PERFORMANCE POLYMER SURFACE COATING FOR LUBRICATED APPLICATIONS

TS650 is based on high-performance thermoplastics specifically designed for constant low friction from low to moderately high loads in lubricated conditions.

Highly suitable for process fluid or water lubricated contacts. TS650 is part of the standard TriboShield® product range.

### UNIQUE CHARACTERISTICS

- Excellent performance in lubricated conditions
- Excellent cavitation resistance
- Excellent wear resistance up to moderately high loads
- Good performance in contaminated environment

BEARING PROPERTIES	UNITS	VALUE
<b>GENERAL</b>		
Color		Dark grey
Max. continuous service temperature	°C / °F	260 / 500
Max. short-term peak temperature	°C / °F	280 / 536
Friction coefficient, typical range*		0.08 - 0.35
Food contact compliant**		Yes

\* Dependent on contact pressure, sliding speed and contact geometry.  
 \*\* Your specific food contact condition may require additional approval.  
 Please contact your GGB representative for more information.

### AVAILABILITY

TriboShield coatings are applied directly to the customer's part and are suitable for complex geometries as well as various substrates e.g. steel, stainless steel, Al, Ti, Mg, etc. They can be used for both interacting surfaces that are in relative motion.

### TYPICAL APPLICATIONS

- Hydraulic pumps and motors
- Hydraulic cylinders
- Fluid valves
- Thrust surfaces in gearboxes

### TRIBOMATE® UPGRADE AVAILABLE

Yes

## STANDARD COATINGS RANGE

For optimized performance in regard of

- significant reduction of friction in dry conditions
- improved wear life
- stable performance

we offer TriboMate® paired coatings which are specifically designed to work with and enhance the performance of our polymer coating products.

Pairing a TriboShield® coating with another TriboShield® coating solution or with a GGB bearing material, offers significantly reduced friction and can further extend system lifetime.



## TriboShield® TS651



### HIGH PERFORMANCE LOW-FRICTION COATING

TS651 is based on high-performance thermoplastics specifically designed for constant low-friction from low to moderately high loads in dry or lubricated conditions. Highly suitable for high-frequency/ low amplitude (HFLA) applications, particularly in dry conditions. TS651 is part of the standard TriboShield® product range.

#### UNIQUE CHARACTERISTICS

- Excellent performance in dry conditions
- Good performance in lubricated condition
- Very low stick-slip characteristic
- Excellent wear resistance up to moderately high loads

#### AVAILABILITY

TriboShield coatings are applied directly to the customer's part and are suitable for complex geometries as well as various substrates e.g. steel, stainless steel, Al, Ti, Mg, etc. They can be used for both interacting surfaces that are in relative motion.

#### TYPICAL APPLICATIONS

- Solenoid armatures
- Seat mechanisms, struts and shock absorbers...
- Compressors and radial piston pumps
- Hydraulic pumps and motors

#### TRIBOMATE® UPGRADE AVAILABLE

Yes

BEARING PROPERTIES	UNITS	VALUE
<b>GENERAL</b>		
Color		Dark brown
Max. continuous service temperature	°C / °F	260 / 500
Max. short-term peak temperature	°C / °F	280 / 536
Friction coefficient, typical range*		0.06 - 0.30
Food contact compliant**		Yes

\* Dependent on contact pressure, sliding speed and contact geometry.

\*\* Your specific food contact condition may require additional approval. Please contact your GGB representative for more information.

### STANDARD COATINGS RANGE

For optimized performance in regard of

- significant reduction of friction in dry conditions
- improved wear life
- stable performance

we offer TriboMate® paired coatings which are specifically designed to work with and enhance the performance of our polymer coating products.

Pairing a TriboShield® coating with another TriboShield® coating solution or with a GGB bearing material, offers significantly reduced friction and can further extend system lifetime.



# TriboShield® TS742



## LOW FRICTION POLYMER COATING FOR HEAVY DUTY APPLICATIONS

TS742 is based on latest generation high-performance thermoplastics, specifically developed for demanding and heavy-duty applications. Extreme load bearing capacity and low friction at moderate to high loads are some of its standout features. TS742 is part of the standard TriboShield® product range.

### UNIQUE CHARACTERISTICS

- Extreme load bearing capacity
- Excellent wear resistance and sliding properties
- Very low friction in medium to high load conditions
- Anti-static

BEARING PROPERTIES	UNITS	VALUE
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#### GENERAL

Color		Dark grey
Max. continuous service temperature	°C / °F	260 / 500
Max. short-term peak temperature	°C / °F	270 / 518
Friction coefficient, typical range*		0.04 - 0.25
Food contact compliant**		Yes

\* Dependent on contact pressure, sliding speed and contact geometry.  
 \*\* Your specific food contact condition may require additional approval.  
 Please contact your GGB representative for more information.

### AVAILABILITY

TriboShield coatings are applied directly to the customer's part and are suitable for complex geometries as well as various substrates e.g. steel, stainless steel, Al, Ti, Mg, etc. They can be used for both interacting surfaces that are in relative motion.

### TYPICAL APPLICATIONS

- Highly loaded mechanisms
- Mechanisms requiring lifetime lubrication in dry or lubricated conditions
- Fretting prevention
- Harsh chemical environments
- Mechanical couplings, linear guides, cutting tools, etc.

### TRIBOMATE® UPGRADE AVAILABLE

Yes

## STANDARD COATINGS RANGE

For optimized performance in regard of

- significant reduction of friction in dry conditions
- improved wear life
- stable performance

we offer TriboMate® paired coatings which are specifically designed to work with and enhance the performance of our polymer coating products.

Pairing a TriboShield® coating with another TriboShield® coating solution or with a GGB bearing material, offers significantly reduced friction and can further extend system lifetime.



## DP4<sup>®</sup> Bearing Material



### METAL-POLYMER ANTI-FRICTION PLAIN BEARINGS

#### CHARACTERISTICS

- DP4 anti-friction bushings offer good wear and low-friction performance over a wide range of loads, speeds and temperatures in dry running conditions
- Very good performance in lubricated applications
- Good performance in greased applications
- Suitable for linear, oscillating and rotating movements
- Lead-free material compliant to ELV, WEEE, and RoHS specifications
- Approved to standard DIN EN 1797: 2002-02 and ISO 21010: 2004-04 (Cryogenic Vessels – Gas/Material Compatibility) for piping, valves, fittings and other components in both gaseous and liquid oxygen for up to maximum temperature of 60°C and oxygen pressure of 25 bars. Contact GGB for further details.

#### AVAILABILITY

##### Bearing forms available in standard dimensions:

- Cylindrical bushes
- Flanged bushes
- Flanged washers
- Sliding plates
- Thrust washers

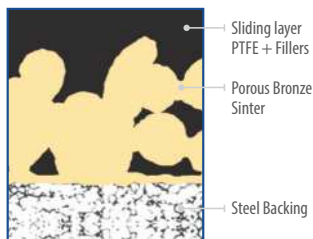
**Bearing forms made-to-order:** Standard forms in special dimensions, half-bearings, special shapes obtained by stamping or deep drawing, bearings with locating notches, lubricant holes and machined/stamped grooves, customized bearing designs

#### APPLICATIONS

**Automotive:** Braking systems, clutches, gearbox and transmissions, hinges: door, bonnet, boot, cabriolet roof tops, pedals; pumps: axial piston, radial piston, gear and vane; seat mechanisms, steering systems, struts and shock absorbers, wiper systems, etc.

**Industrial:** Aerospace, agricultural equipment, construction equipment, food and beverage, material handling equipment, forming machines: metal, plastic and rubber; office equipment, medical and scientific equipment, packaging equipment, pneumatic and hydraulic cylinders, pumps and motors, railroad and tramways, textile machinery, valves, etc.

#### MICROSECTION



#### OPERATING PERFORMANCE

Dry	Good
Oil lubricated	Very good
Grease lubricated	Good
Water lubricated	Fair
Process fluid lubricated	Good

#### FOR SUPERIOR PERFORMANCE

Water lubricated	DP4-B
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#### BEARING PROPERTIES

##### GENERAL

		UNITS	VALUE
Maximum load, P	Static	N/mm <sup>2</sup>	250
	Dynamic	N/mm <sup>2</sup>	140
Operating temperature	Min	°C	-200
	Max	°C	280
Coefficient of linear thermal expansion	Parallel to the surface	10 <sup>-6</sup> /K	11
	Normal to the surface	10 <sup>-6</sup> /K	30

##### DRY

Maximum sliding speed, V	m/s	2,5
Maximum PV factor	N/mm <sup>2</sup> x m/s	1,0
Coefficient of friction, f		0,04 - 0,25*

##### OIL LUBRICATED

Maximum sliding speed, V	m/s	5,0
Maximum PV factor	N/mm <sup>2</sup> x m/s	10,0
Coefficient of friction, f		0,02 - 0,08

##### RECOMMENDATIONS

Shaft surface roughness, Ra	Dry	µm	0,3 - 0,5
	Lubricated	µm	≤ 0,05 - 0,4*
Shaft surface hardness	Unhardened acceptable, improved bearing life	HB	> 200

\* Depending on operating conditions

# DP4-B Bearing Material



## METAL-POLYMER BRONZE BACKED PTFE PLAIN BEARINGS

### CHARACTERISTICS

- Good wear and low-friction performance over a wide range of loads, speeds and temperatures in dry running conditions
- Very good performance in lubricated applications
- Good performance in greased applications
- Suitable for linear, oscillating and rotating movements
- Bronze back offers improved corrosion-resistance in humid/saline environments
- Lead-free material

### AVAILABILITY

#### Bearing forms available in standard dimensions:

- Cylindrical bushes
- Flanged bushes
- Sliding plates

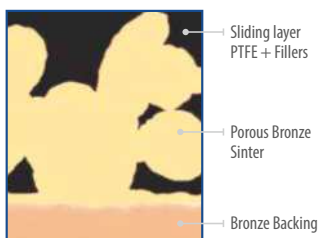
**Bearing forms made-to-order:** Standard forms in special dimensions, thrust washers, flanged-thrust washers, halfbearings, special shapes obtained by stamping or deep drawing, bearings with locating notches, lubricant holes and machined / stamped grooves

### APPLICATIONS

**Industrial:** Aerospace, agricultural equipment, construction equipment, material handling equipment, forming machines - metal, plastic and rubber; office equipment, medical and scientific equipment, packaging equipment, pneumatic and hydraulic cylinders, pumps and motors, railroad and tramways, textile machinery, valves, etc.

**Others:** Civil engineering, marine and offshore equipment, other applications in water or in outdoor environments, etc.

### MICROSECTION



### OPERATING PERFORMANCE

Dry	Good
Oil lubricated	Very good
Grease lubricated	Good
Water lubricated	Good
Process fluid lubricated	Good

### FOR SUPERIOR PERFORMANCE

Water lubricated	DP4-B
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### BEARING PROPERTIES

### UNITS

### VALUE

#### GENERAL

Maximum load, P	Static	N/mm <sup>2</sup>	140
	Dynamic	N/mm <sup>2</sup>	140
Operating temperature	Min	°C	-200
	Max	°C	280
Coefficient of linear thermal expansion	Parallel to the surface	10 <sup>-6</sup> /K	18
	Normal to the surface	10 <sup>-6</sup> /K	36

#### DRY

Maximum sliding speed, V	m/s	2,5
Maximum PV factor	N/mm <sup>2</sup> x m/s	1,0
Coefficient of friction, f		0,02 - 0,25*

#### OIL LUBRICATED

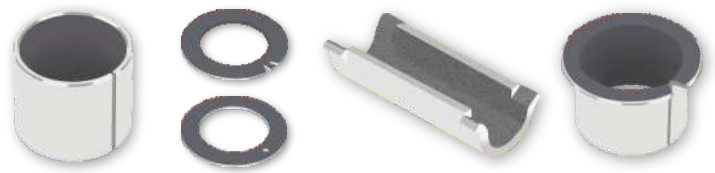
Maximum sliding speed, V	m/s	5,0
Maximum PV factor	N/mm <sup>2</sup> x m/s	10,0
Coefficient of friction, f		0,02 - 0,08*

#### RECOMMENDATIONS

Shaft surface roughness, Ra	Dry	µm	0,3 - 0,5
	Lubricated	µm	≤ 0,05 - 0,4*
Shaft surface hardness	Unhardened acceptable, improved bearing life	HB	> 200

\* Depending on operating conditions

## DU<sup>®</sup> Bearing Material



### METAL-POLYMER ANTI-FRICTION PLAIN BEARINGS

#### CHARACTERISTICS

- Very good wear and low-friction performance over a wide range of loads, speeds and temperatures in dry running conditions
- Suitable for lubricated applications
- Suitable for linear, oscillating and rotating movements

#### AVAILABILITY

##### Bearing forms available in standard dimensions:

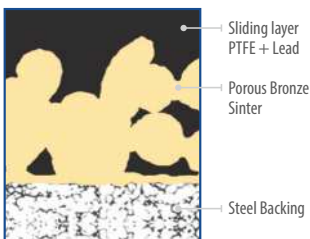
- Cylindrical bushes
- Flanged bushes
- Flanged washers
- Sliding plates
- Thrust washers

**Bearing forms made-to-order:** Standard forms in special dimensions, half-bearings, special shapes obtained by stamping or deep drawing, customized bearing designs

#### APPLICATIONS

**Industrial:** Aerospace, agricultural equipment, construction equipment, food and beverage, material handling equipment, forming machines: metal, plastic and rubber; office equipment, medical and scientific equipment, packaging equipment, pneumatic and hydraulic cylinders, pumps and motors, railroad and tramways, textile machinery, valves, etc.

#### MICROSECTION



#### OPERATING PERFORMANCE

Dry	Very good
Oil lubricated	Good
Grease lubricated	Fair
Water lubricated	Fair
Process fluid lubricated	Fair

#### FOR SUPERIOR / LEAD-FREE PERFORMANCE

Dry	DP4 / DP11
Oil lubricated	DP4 / DP31
Grease lubricated	DP4 / DX
Water lubricated	DP4-B
Process fluid lubricated	DP4 / DP31

#### BEARING PROPERTIES UNITS VALUE

##### GENERAL

Maximum load, P	Static	N/mm <sup>2</sup>	250
	Dynamic	N/mm <sup>2</sup>	140
Operating temperature	Min	°C	-200
	Max	°C	280
Coefficient of linear thermal expansion	Parallel to the surface	10 <sup>-6</sup> /K	11
	Normal to the surface	10 <sup>-6</sup> /K	30

##### DRY

Maximum sliding speed, V	m/s	2,5
Maximum PV factor	N/mm <sup>2</sup> x m/s	1,8
Coefficient of friction, f		0,02 - 0,25*

##### OIL LUBRICATED

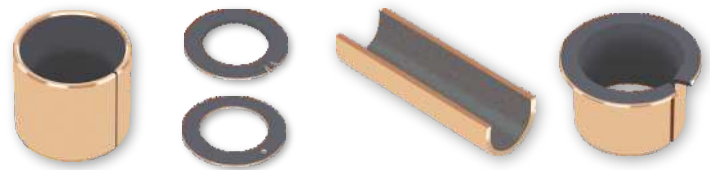
Maximum sliding speed, V	m/s	5,0
Maximum PV factor	N/mm <sup>2</sup> x m/s	5,0
Coefficient of friction, f		0,02 - 0,12

##### RECOMMENDATIONS

Shaft surface roughness, Ra	Dry Lubricated	µm µm	0,3 - 0,5 ≤ 0,05 - 0,4*
Shaft surface hardness	Unhardened acceptable, improved bearing life	HB	> 200

\* Depending on operating conditions

# DU-B Bearing Material



## METAL-POLYMER BRONZE BACKED PTFE PLAIN BEARINGS

### CHARACTERISTICS

- Very good wear and low-friction performance over a wide range of loads, speeds and temperatures in dry running conditions
- Suitable for lubricated applications
- Suitable for linear, oscillating and rotating movements
- Bronze back offers improved corrosion-resistance in humid/saline environments
- Approved to standard EN1337-2 for structural bearings for civil engineering

### AVAILABILITY

#### Bearing forms available in standard dimensions:

- Cylindrical bushes
- Flanged bushes
- Sliding plates

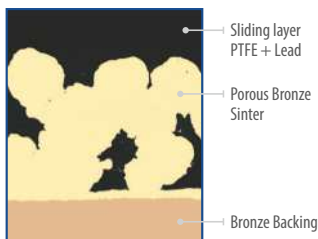
**Bearing forms made-to-order:** Standard forms in special dimensions, thrust washers, flanged-thrust washers, half-bearings, special shapes obtained by stamping or deep drawing, customized bearing designs

### APPLICATIONS

**Industrial:** Aerospace, agricultural equipment, construction equipment, material handling equipment, forming machines -metal, plastic and rubber; office equipment, medical and scientific equipment, packaging equipment, pneumatic and hydraulic cylinders, pumps and motors, railroad and tramways, textile machinery, valves, etc.

**Others:** Marine and offshore equipment, other applications in water or in outdoor environments

### MICROSECTION



### OPERATING PERFORMANCE

Dry	Very good
Oil lubricated	Good
Grease lubricated	Fair
Water lubricated	Good
Process fluid lubricated	Fair

### FOR SUPERIOR / LEAD-FREE PERFORMANCE

Dry	DP4-B
Oil lubricated	DP4-B
Grease lubricated	DP4-B
Water lubricated	DP4-B
Process fluid lubricated	DP4-B

### BEARING PROPERTIES

#### GENERAL

		UNITS	VALUE
Maximum load, P	Static	N/mm <sup>2</sup>	140
	Dynamic	N/mm <sup>2</sup>	140
Operating temperature	Min	°C	-200
	Max	°C	280
Coefficient of linear thermal expansion	Parallel to the surface	10 <sup>-6</sup> /K	18
	Normal to the surface	10 <sup>-6</sup> /K	36

#### DRY

Maximum sliding speed, V	m/s	2,5
Maximum PV factor	N/mm <sup>2</sup> x m/s	1,8
Coefficient of friction, f		0,02 - 0,25*

#### OIL LUBRICATED

Maximum sliding speed, V	m/s	5,0
Maximum PV factor	N/mm <sup>2</sup> x m/s	5,0
Coefficient of friction, f		0,02 - 0,12

#### RECOMMENDATIONS

Shaft surface roughness, Ra	Dry Lubricated	µm µm	0,3 - 0,5 ≤ 0,05 - 0,4*
Shaft surface hardness	Unhardened acceptable, improved bearing life	HB	> 200

\* Depending on operating conditions

## DP10 Bearing Material



### METAL-POLYMER ANTI-FRICTION PLAIN BEARINGS

#### CHARACTERISTICS

- Good wear and low-friction performance over a wide range of loads, speeds and temperatures in dry running conditions
- Very good performance in lubricated applications particularly in marginally lubricated applications
- Suitable for linear, oscillating and rotating movements
- Lead-free material compliant to ELV, WEEE, and RoHS specifications

#### AVAILABILITY

##### Bearing forms available in standard dimensions:

- Cylindrical bushes
- Flanged bushes
- Sliding plates
- Thrust washers

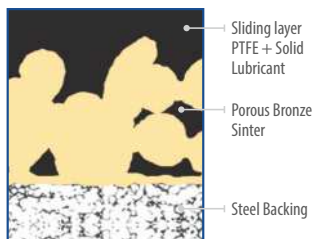
**Bearing forms made-to-order:** Standard forms in special dimensions, half-bearings, special shapes obtained by stamping or deep drawing, bearings with local notches, lubricant holes and machined/stamped grooves, customized bearing designs

#### APPLICATIONS

**Automotive:** Braking systems, clutches, hinges – door, bonnet, boot, cabriolet roof tops, pedals, pumps – axial, piston, gear, vane, seat mechanisms, steering systems, struts and shock absorbers, wiper systems, etc.

**Industrial:** Agricultural equipment, compressors – scroll and reciprocating, construction equipment, food and beverage, material handling equipment, forming machines – metal, plastic and rubber, office equipment, medical and scientific equipment, packaging equipment, pneumatic and hydraulic cylinders, pumps and motors, railroad and tramways, textile machinery, valves, etc.

#### MICROSECTION



#### OPERATING PERFORMANCE

Dry	Good
Oil lubricated	Good
Grease lubricated	Fair
Water lubricated	Not recommended
Process fluid lubricated	Fair

#### FOR SUPERIOR PERFORMANCE

Grease lubricated	DP4 / DX
Water lubricated	DP4-B
Process fluid lubricated	DP4 / DP31

#### BEARING PROPERTIES

##### GENERAL

		UNITS	VALUE
Maximum load, P	Static	N/mm <sup>2</sup>	250
	Dynamic	N/mm <sup>2</sup>	140
Operating temperature	Min	°C	-200
	Max	°C	280
Coefficient of linear thermal expansion	Parallel to the surface	10 <sup>-6</sup> /K	11
	Normal to the surface	10 <sup>-6</sup> /K	30

##### DRY

Maximum sliding speed, V	m/s	2,5
Maximum PV factor	N/mm <sup>2</sup> x m/s	1,0
Coefficient of friction, f		0,03 - 0,25*

##### OIL LUBRICATED

Maximum sliding speed, V	m/s	5,0
Maximum PV factor	N/mm <sup>2</sup> x m/s	10,0
Coefficient of friction, f		0,02 - 0,08

##### RECOMMENDATIONS

Shaft surface roughness, Ra	Dry Lubricated	µm	0,3 - 0,5
		µm	≤ 0,05 - 0,4*
Shaft surface hardness	Unhardened acceptable, improved bearing life	HB	> 200

\* Depending on operating conditions



# DP11 Bearing Material



## METAL-POLYMER ANTI-FRICTION PLAIN BEARINGS

### CHARACTERISTICS

- Very good wear and low-friction performance over a wide range of loads, speeds and temperatures in dry running conditions
- Particularly suited to dry applications with high frequency and low amplitude oscillating movements
- Suitable for linear, oscillating and rotating movements
- Lead-free material compliant to ELV, WEEE, and RoHS specifications
- Approved to standard FMVSS 302 - Federal Motor Vehicle Safety Standard concerning the flammability of materials used in the occupant compartments of motor vehicles



### AVAILABILITY

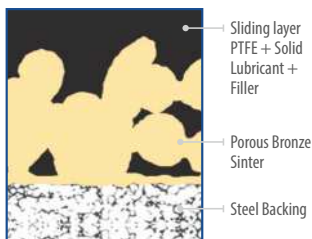
**Bearing forms made-to-order:** Cylindrical bushes, flanged bushes, thrust washers, flanged-thrust washers, sliding plates, half-bearings, special shapes obtained by stamping or deep drawing, customized bearing designs

### APPLICATIONS

**Automotive:** Belt tensioners, clutches, dual mass fly-wheels, pulley dampers, etc.

**Industrial:** Applications with high frequency and low amplitude oscillating movements

### MICROSECTION



### OPERATING PERFORMANCE

Dry	Very good
Oil lubricated	Good
Grease lubricated	Fair
Water lubricated	Not recommended
Process fluid lubricated	Fair

### FOR SUPERIOR PERFORMANCE

Grease lubricated	DP4 / DX
Water lubricated	DP4-B
Process fluid lubricated	DP4 / DP31

### BEARING PROPERTIES

#### UNITS

#### VALUE

#### GENERAL

Maximum load, P	Static	N/mm <sup>2</sup>	250
	Dynamic	N/mm <sup>2</sup>	140
Operating temperature	Min	°C	-200
	Max	°C	280
Coefficient of linear thermal expansion	Parallel to the surface	10 <sup>-6</sup> /K	11
	Normal to the surface	10 <sup>-6</sup> /K	30

#### DRY

Maximum sliding speed, V	m/s	2,5
Maximum PV factor	N/mm <sup>2</sup> x m/s	1,0
Coefficient of friction, f		0,04 - 0,25*

#### OIL LUBRICATED

Maximum sliding speed, V	m/s	5,0
Maximum PV factor	N/mm <sup>2</sup> x m/s	10,0
Coefficient of friction, f		0,02 - 0,08

#### RECOMMENDATIONS

Shaft surface roughness, Ra	Dry Lubricated	µm	0,3 - 0,5
		µm	≤ 0,05 - 0,4*
Shaft surface hardness	Unhardened acceptable, improved bearing life	HB	> 200

\* Depending on operating conditions

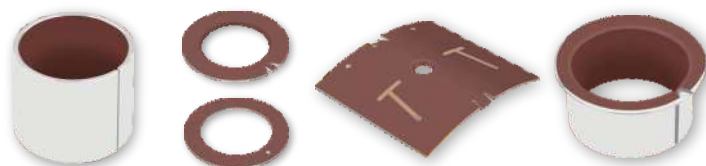
## DP31 Bearing Material



### METAL-POLYMER HYDRODYNAMIC COMPOSITE BEARINGS

#### CHARACTERISTICS

- Excellent low-friction and wear resistance performance in lubricated applications
- Excellent flow erosion and cavitation resistance
- Very good fatigue strength
- Lead-free material compliant to ELV, WEEE, and RoHS specifications



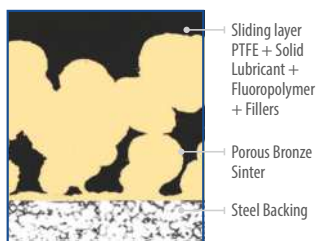
#### AVAILABILITY

**Bearing forms made-to-order:** Cylindrical bushes, flanged bushes, thrust washers, flanged-thrust washers, sliding plates, half-bearings, bearings with locating notches, lubricant holes and machined/stamped grooves, customized bearing designs

#### APPLICATIONS

**Automotive:** Air conditioning compressors, gearbox and transmissions, heavy duty struts and shock absorbers, high performance pumps: axial piston, radial piston, gear, vane, etc.  
**Industrial:** Compressors: scroll and reciprocating; pneumatic and hydraulic cylinders, high performance pumps axial piston, radial piston, gear, vane, etc.

#### MICROSECTION



#### OPERATING PERFORMANCE

Dry	Fair
Oil lubricated	Very good
Grease lubricated	Fair
Water lubricated	Fair
Process fluid lubricated	Good

#### FOR SUPERIOR PERFORMANCE

Dry	DP4 / DP11
Grease lubricated	DP4 / DX
Water lubricated	DP4-B

#### BEARING PROPERTIES

##### GENERAL

		UNITS	VALUE
Maximum load, P	Static	N/mm <sup>2</sup>	250
	Dynamic	N/mm <sup>2</sup>	140
Operating temperature	Min	°C	-200
	Max	°C	280
Coefficient of linear thermal expansion	Parallel to the surface	10 <sup>-6</sup> /K	11
	Normal to the surface	10 <sup>-6</sup> /K	30

##### OIL LUBRICATED

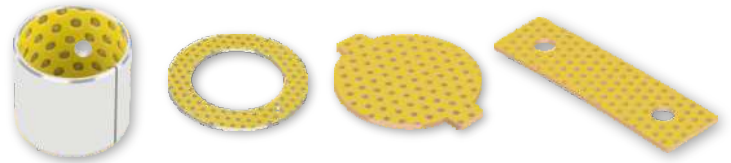
Maximum sliding speed, V		m/s	10,0
Maximum PV factor		N/mm <sup>2</sup> x m/s	10,0
Coefficient of friction, f			0,01 - 0,05

##### RECOMMENDATIONS

Shaft surface roughness, Ra	Lubricated	µm	≤ 0,05 - 0,4*
Shaft surface hardness	Unhardened acceptable, improved bearing life	HB	> 200

\* Depending on operating conditions

# DX<sup>®</sup> Bearing Material



## METAL-POLYMER PLAIN BEARINGS GREASE LUBRICATED

### CHARACTERISTICS

- Marginally lubricated bearing material for grease or oil lubricated applications
- Standard parts contain grease indents in the sliding layer; plain sliding layer available by request
- Optimum performance under relatively high loads and low speeds
- Suitable for linear, oscillating and rotating movements
- Wide range of parts available from stock

### AVAILABILITY

#### Bearing forms available in standard dimensions:

- Cylindrical bushes
- Thrust washers
- Sliding plates

**Bearing forms made-to-order:** Standard forms in special dimensions, half-bearings, special shapes obtained by stamping, bearings with locating notches, lubricant holes and machined grooves, customized bearing designs

### APPLICATIONS

**Automotive:** Steering gear, power steering, pedal bushes, seat slides, king-pin bushes, tailgate pivots, brake caliper bushes, etc.

**Industrial:** Mechanical handling and lifting equipment, machine slides, hydraulic cylinders, hydraulic motors, ski-lifts, pneumatic equipment, medical equipment, textile machinery, agricultural equipment, scientific equipment, etc.

### MICROSECTION



- Sliding layer POM with or without Lubricant Indents for Machining
- Porous Bronze Sinter
- Steel Backing

### OPERATING PERFORMANCE

Dry	Poor
Oil lubricated	Good
Grease lubricated	Very good
Water lubricated	Poor
Process fluid lubricated	Poor

### FOR SUPERIOR PERFORMANCE

Dry	GAR-MAX / HSG / GAR-FIL / MLG
Water lubricated	HPM / HPF / DP4-B
Process fluid lubricated	DP4 / HI-EX / GAR-FIL

### BEARING PROPERTIES

### UNITS

### VALUE

#### GENERAL

Maximum load, P	Static	N/mm <sup>2</sup>	140
	Dynamic	N/mm <sup>2</sup>	140
Operating temperature	Min	°C	-40
	Max	°C	130
Coefficient of linear thermal expansion	Parallel to the surface	10 <sup>-6</sup> /K	11
	Normal to the surface	10 <sup>-6</sup> /K	29

#### OIL LUBRICATED

Maximum sliding speed, V	m/s	2,5
Maximum PV factor	N/mm <sup>2</sup> x m/s	2,8
Coefficient of friction, f		0,06 - 0,12

#### RECOMMENDATIONS

Shaft surface roughness, Ra	µm	≤ 0,4	
Shaft surface hardness	Unhardened acceptable,	HB	> 200
	improved bearing life	HB	> 350

\* Depending on operating conditions

## DX<sup>®</sup>10 Bearing Material



### METAL-POLYMER PLAIN BEARINGS GREASE LUBRICATED

#### CHARACTERISTICS

- Perfect for heavy duty and harsh environments
- Excellent chemical resistance
- Excellent erosion resistance
- Good fatigue strength
- Good wear performance
- Can be broached for tighter tolerance
- Lead-free material compliant to ELV, RoHS and WEEE specifications

#### AVAILABILITY

**Bearing forms made-to-order:** Cylindrical bushes, thrust washers, sliding plates, half-bearings, special shapes obtained by stamping, bearings with locating notches, lubricant holes and machined grooves, customized bearing designs

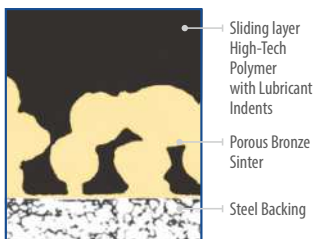
#### APPLICATIONS

**General:** Greased or oiled applications with high load, high temperature, and contamination; ideal for replacing bi-metal or bronze bushings to achieve improved wear performance

**Automotive:** King pins, oil pumps

**Industrial:** Piston pumps, agriculture equipment, construction, lift and cranes, small reciprocating bushing

#### MICROSECTION



Sliding layer  
High-Tech  
Polymer  
with Lubricant  
Indents

Porous Bronze  
Sinter

Steel Backing

#### OPERATING PERFORMANCE

Dry	Fair
Oil lubricated	Very good
Grease lubricated	Very good
Water lubricated	Poor
Process fluid lubricated	Fair

#### FOR SUPERIOR PERFORMANCE

Dry	GAR-MAX / HSG / GAR-FIL / MLG
Water lubricated	HPM / HPF / DP4-B
Process fluid lubricated	DP4 / HI-EX / GAR-FIL

#### BEARING PROPERTIES

#### UNITS

#### VALUE

##### GENERAL

Maximum load, P	Static	N/mm <sup>2</sup>	250
	Dynamic	N/mm <sup>2</sup>	140
Operating temperature	Min	°C	-40
	Max	°C	175

##### GREASE LUBRICATED

Maximum sliding speed, V	m/s	2,5
Maximum PV factor	N/mm <sup>2</sup> x m/s	2,8
Coefficient of friction, f		0,01 - 0,10

##### OIL LUBRICATED

Maximum sliding speed, V	m/s	10,0
Maximum PV factor	N/mm <sup>2</sup> x m/s	2,8
Coefficient of friction, f		0,01 - 0,06

##### RECOMMENDATIONS

Shaft surface roughness, Ra		µm	≤ 0,4
Shaft surface hardness	Normal	HB	> 200
	For longer service life	HB	> 350

# HI-EX<sup>®</sup> Bearing Material



## METAL-POLYMER HYDRONAMIC COMPOSITE BEARINGS

### CHARACTERISTICS

- Marginally lubricated bearing material with good wear resistance under thin film conditions
- Standard bearings supplied with indents for optimum retention and distribution of the lubricant over the sliding layer
- Available with non-indented overlay for hydrodynamic applications
- Rated for high temperature use up to 250°C / 480°F
- Suitable for use with low viscosity fluids
- Good chemical resistance
- Lead-free material compliant to ELV, RoHS and WEEE specifications

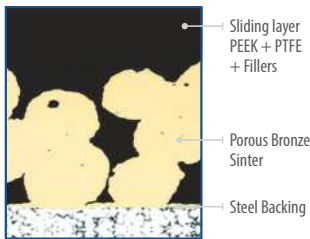
### AVAILABILITY

**Bearing forms made-to-order:** Cylindrical bushes, thrust washers, sliding plates, half-bearings, special shapes obtained by stamping, bearings with locating notches, lubricant holes and machined grooves, customized bearing designs

### APPLICATIONS

**Automotive:** Diesel fuel pumps, heavy duty brakes, heavy duty axles  
**Industrial:** Hydraulic motors, axial and radial piston pumps, agricultural equipment, wind energy equipment, yaw and teeter bearings

### MICROSECTION



Sliding layer  
PEEK + PTFE  
+ Fillers

Porous Bronze  
Sinter

Steel Backing

### OPERATING PERFORMANCE

Dry	Fair
Oil lubricated	Good
Grease lubricated	Very good
Water lubricated	Good
Process fluid lubricated	Good

### FOR SUPERIOR PERFORMANCE

Dry	GAR-MAX / HSG / GAR-FIL / MLG
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### BEARING PROPERTIES

#### GENERAL

		UNITS	VALUE
Maximum load, P	Static	N/mm <sup>2</sup>	140
	Dynamic	N/mm <sup>2</sup>	140
Operating temperature	Min	°C	-150
	Max	°C	250
Coefficient of linear thermal expansion	Parallel to the surface	10 <sup>-6</sup> /K	11
	Normal to the surface	10 <sup>-6</sup> /K	29

#### GREASE LUBRICATED

Maximum sliding speed, V	m/s	2,5
Maximum PV factor	N/mm <sup>2</sup> x m/s	2,8
Coefficient of friction, f		0,08 - 0,12

#### OIL LUBRICATED

Maximum sliding speed, V	m/s	10,0
Maximum PV factor	N/mm <sup>2</sup> x m/s	10,0
Coefficient of friction, f		0,03 - 0,08

#### RECOMMENDATIONS

Shaft surface roughness, Ra		µm	≤ 0,05 - 0,4*
Shaft surface hardness	Normal	HB	> 200
	For longer service life	HB	> 350

\* Depending on operating conditions

## DTS10<sup>®</sup> Bearing Material



### METAL-POLYMER HYDRONAMIC COMPOSITE BEARINGS

#### CHARACTERISTICS

- The first polymer-lined bearing for lubricated conditions offering low-friction and high wear resistance that is designed to be machined on-site for tight tolerances
- Excellent wear resistance and low-friction in lubricated hydraulic applications
- Excellent chemical resistance, fatigue strength, cavitation and flow erosion resistance, and good behavior in dry start-up conditions
- A minimum overlay thickness of 0,1 mm permits, under carefully controlled conditions, machining of the assembled bore for improved dimensional tolerance and reduced geometric defects, while retaining a thin layer of PTFE sliding surface
- Compatible with most standard machining processes including turning, broaching, reaming, and milling
- Lead-free material compliant to ELV, RoHS and WEEE specifications

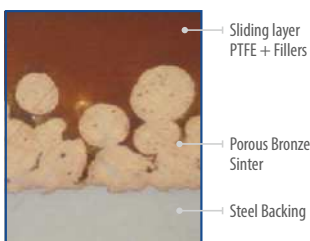
#### AVAILABILITY

**Bearing forms made-to-order:** Standard forms in special dimensions, half-bearings, special shapes obtained by stamping or deep drawing, bearings with locating notches, lubricant holes and machined/stamped grooves, customized bearing designs

#### APPLICATIONS

**Industrial:** Compressors: scroll and reciprocating, external and internal motors, external and internal pumps, vane pumps, axial and radial piston pumps, gerotor pumps, hydraulic cylinders

#### MICROSECTION



#### OPERATING PERFORMANCE

Dry	Fair
Oil lubricated	Excellent
Grease lubricated	Fair
Water lubricated	Fair
Process fluid lubricated	Good

#### FOR SUPERIOR PERFORMANCE

Dry	GAR-MAX / HSG / GAR-FIL / MLG
Grease lubricated	DX / DX10
Water lubricated	HPM / HPF / DP4-B

#### BEARING PROPERTIES

##### GENERAL

BEARING PROPERTIES		UNITS	VALUE
Maximum load, P	Static	N/mm <sup>2</sup>	140
Operating temperature	Min	°C	-200
	Max	°C	280

##### FLUID LUBRICATED

Maximum sliding speed, V		m/s	10,0
Maximum PV factor		N/mm <sup>2</sup> x m/s	100*
Coefficient of friction, f			0,01 - 0,08

##### RECOMMENDATIONS

Shaft surface roughness, Ra		µm	≤ 0,05 - 0,2*
Shaft surface hardness		HB	> 200

\* Depending on operating conditions

# DS Bearing Material



## METAL-POLYMER SELF-LUBRICATING BEARINGS

### CHARACTERISTICS

- Self-lubricating bearing material for operation in mixed film lubrication conditions
- Sliding layer is machinable (ca. 0,4 mm above bronze sinter layer)
- Resistant to fretting corrosion damage to the shaft under low amplitude oscillating movements
- Similar in performance to DX® but with lower friction

### AVAILABILITY

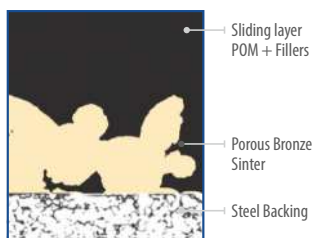
**Bearing forms made-to-order:** Cylindrical bushes, thrust washers, sliding plates, half-bearings, special shapes obtained by stamping, customized bearing designs

### APPLICATIONS

**Automotive:** Steering gear, power steering, pedal bushes, seat slides, king-pin bushes, tailgate pivots, brake caliper bushes, etc.

**Industrial:** Mechanical handling and lifting equipment, machine slides, hydraulic cylinders, hydraulic motors, ski lifts, pneumatic equipment, medical equipment, textile machinery, agricultural equipment, scientific equipment, etc.

### MICROSECTION



Sliding layer  
POM + Fillers

Porous Bronze  
Sinter

Steel Backing

### OPERATING PERFORMANCE

Dry	Good
Oil lubricated	Very good
Grease lubricated	Very good
Water lubricated	Poor
Process fluid lubricated	Poor

### FOR SUPERIOR PERFORMANCE

Water lubricated	HPM / HPF / DP4-B
Process fluid lubricated	DP4 / GAR-FIL / HI-EX

### BEARING PROPERTIES

### UNITS

### VALUE

#### GENERAL

Maximum load, P	Static	N/mm <sup>2</sup>	110
	Dynamic	N/mm <sup>2</sup>	45
Operating temperature	Min	°C	-60
	Max	°C	130

#### DRY

Maximum sliding speed, V	m/s	1,5
Maximum PV factor	N/mm <sup>2</sup> x m/s	1,4
Coefficient of friction, f		0,15 - 0,3

#### GREASE LUBRICATED

Maximum sliding speed, V	m/s	2,5
Maximum PV factor	N/mm <sup>2</sup> x m/s	2,8
Coefficient of friction, f		0,05 - 0,1

#### OIL LUBRICATED

Maximum sliding speed, V	m/s	10,0
Maximum PV factor	N/mm <sup>2</sup> x m/s	10,0
Coefficient of friction, f		0,03 - 0,08

#### RECOMMENDATIONS

Shaft surface roughness, Ra		µm	≤ 0,4
Shaft surface hardness	Normal	HB	> 200
	For longer service life	HB	> 350

## EP<sup>®</sup> Bearing Material



### SELF-LUBRICATING ENGINEERED PLASTIC BEARINGS

#### CHARACTERISTICS

- Good bearing performance in dry working conditions
- Good bearing performance in lubricated or marginally lubricated applications
- Corrosion-resistant in humid/saline environments
- Very good price performance ratio
- Very good weight performance ratio
- Within injection moulding tool feasibility unlimited dimensions and design features
- Compliant to ELV, WEEE and RoHS specifications



#### AVAILABILITY

##### Bearing forms available in standard dimensions:

- Plain cylindrical bushes
- Plain flanged bushes

**Bearing forms made-to-order:** Standard forms in special dimensions, thrust washers, half-bearings, sliding plates, customized bearing designs

#### APPLICATIONS

**General:** Generally applicable within the limits of the material properties

**Industrial:** Medical equipment, awnings and blinds, scientific equipment, gaming equipment, office equipment, etc.

#### MICROSECTION



PPA + Solid Lubricant + Fillers

#### OPERATING PERFORMANCE

Dry	Good
Oil lubricated	Good
Grease lubricated	Good
Water lubricated	Fair
Process fluid lubricated	Good after resistance testing

#### FOR SUPERIOR PERFORMANCE

Water lubricated	EP22
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#### BEARING PROPERTIES

#### UNITS

#### VALUE

##### GENERAL

Maximum load, P	Static	N/mm <sup>2</sup>	80
	Dynamic	N/mm <sup>2</sup>	40
Operating temperature	Min	°C	-40
	Max	°C	140
Coefficient of linear thermal expansion		10 <sup>-6</sup> /K	22

##### DRY

Maximum sliding speed, V		m/s	1,0
Maximum PV factor	for A <sub>H</sub> /A <sub>C</sub> = 5	N/mm <sup>2</sup> x m/s	0,06
	for A <sub>H</sub> /A <sub>C</sub> = 10	N/mm <sup>2</sup> x m/s	0,24
	for A <sub>H</sub> /A <sub>C</sub> = 20	N/mm <sup>2</sup> x m/s	1,00
Coefficient of friction, f			0,15 - 0,3

##### RECOMMENDATIONS

Shaft surface roughness, Ra		µm	0,2 - 0,8
Shaft surface hardness		HV	> 200



# EP<sup>®</sup>12 Bearing Material



## SELF-LUBRICATING ENGINEERED PLASTIC BEARINGS

### CHARACTERISTICS

- Good bearing performance in dry working conditions
- Good bearing performance in lubricated or marginally lubricated applications
- Corrosion-resistant in humid/saline environments
- Very good price performance ratio
- Very good weight performance ratio
- Within injection moulding tool feasibility unlimited dimensions and design features
- Compliant to ELV, WEEE and RoHS specifications

### AVAILABILITY

**Bearing forms made-to-order:** Cylindrical bushes, flanged bearings, thrust washers, sliding plates, half-bearings, customized bearing designs

### APPLICATIONS

**General:** Generally applicable within the limits of the material properties

**Industrial:** Domestic appliances, furniture, office equipment, sports equipment and many more

### MICROSECTION



POM + Solid Lubricant

### OPERATING PERFORMANCE

Dry	Very good
Oil lubricated	Good
Grease lubricated	Good
Water lubricated	Fair
Process fluid lubricated	Good after resistance testing

### FOR SUPERIOR PERFORMANCE

Water lubricated	EP22
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### BEARING PROPERTIES

#### UNITS

#### VALUE

#### GENERAL

Maximum load, P	Static	N/mm <sup>2</sup>	65
Operating temperature	Min	°C	-40
	Max	°C	125
Coefficient of linear thermal expansion		10 <sup>-6</sup> /K	120

#### DRY

Maximum sliding speed, V		m/s	1,0
Maximum PV factor	for A <sub>H</sub> /A <sub>C</sub> = 5	N/mm <sup>2</sup> x m/s	0,04
	for A <sub>H</sub> /A <sub>C</sub> = 10	N/mm <sup>2</sup> x m/s	0,09
	for A <sub>H</sub> /A <sub>C</sub> = 20	N/mm <sup>2</sup> x m/s	0,18

Coefficient of friction, f			0,18 - 0,3
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#### RECOMMENDATIONS

Shaft surface roughness, Ra		µm	0,1 - 0,5
Shaft surface hardness		HV	> 200

## EP<sup>®</sup>15 Bearing Material



### UV-RESISTANT BEARINGS FOR SUN & OUTDOOR APPLICATIONS

#### CHARACTERISTICS

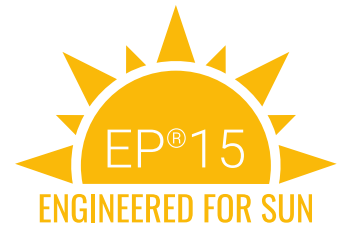
- UV-resistant bearings
- Abrasion-resistant
- Lightweight
- Low coefficient of friction
- Very good bushing performance in dry working conditions
- Good bushing performance in lubricated or marginally lubricated applications
- Corrosion-resistant in humid/ saline environments
- Very good price performance ratio
- Very good weight performance ratio
- Within injection molding tool feasibility unlimited dimensions and design features
- Compliant to ELV, WEEE and RoHS specifications

#### AVAILABILITY

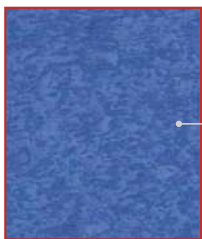
**EP<sup>®</sup>15 Bearing forms made-to-order:** Cylindrical bushings, flanged bushings, thrust washers, sliding plates, half-bushings, customized bearing designs

#### APPLICATIONS

Solar Power Equipment, Outdoor Applications, Recreational Applications



#### MICROSECTION



POM + PTFE + UV Stabilizer

#### OPERATING PERFORMANCE

Dry	Very good
Oil lubricated	Good
Grease lubricated	Good
Water lubricated	Fair
Process fluid lubricated	Good after resistance testing

#### BEARING PROPERTIES

#### STANDARD

#### UNITS

#### VALUE

#### CHARACTERISTICS

BEARING PROPERTIES	STANDARD	UNITS	VALUE
<b>CHARACTERISTICS</b>			
Charpy unnotched impact strength	ISO 179/1eU	kJ/m <sup>2</sup>	45
Charpy notched impact strength	ISO 179/1eA	kJ/m <sup>2</sup>	4,5
Coefficient of linear thermal expansion	ISO 11359-2:1999-10	x10 <sup>-6</sup>	120
Minimum temperature		°C / °F	- 40 / - 40
Maximum temperature		°C / °F	125 / 260
Maximum extended temperature limit		°C / °F	125 / 260
Density	DIN EN ISO 1183-1 :2013-04 DIN EN ISO 1183-2 :2004-10	g/cm <sup>3</sup>	1,50
Tensile strength	DIN EN ISO 527-1 :2012-06 DIN EN ISO 527-2 :2012-06 DIN EN ISO 527-3 :2003-07	N/mm <sup>2</sup> / psi	50 / 7252
Elastic modulus in tension	DIN EN ISO 178:2013-09 DIN EN ISO 527-1:2012-06 DIN EN ISO 604:2003-12	N/mm <sup>2</sup> / psi	2750 / 398854
Maximum static load		N/mm <sup>2</sup> / psi	65 / 9500
Coefficient of friction, f			0,09 - 0,15
Color			Blue

# EP<sup>®</sup>22 Bearing Material



## SELF-LUBRICATING ENGINEERED PLASTIC BEARINGS

### CHARACTERISTICS

- Good bearing performance in dry working conditions
- Very good bearing performance in lubricated or marginally lubricated applications
- Corrosion-resistant in humid/saline environments
- Very good price performance ratio
- Very good weight performance ratio
- Within injection moulding tool feasibility unlimited dimensions and design features
- Compliant to ELV, WEEE and RoHS specifications

### AVAILABILITY

#### Bearing forms available in standard dimensions:

- Plain cylindrical bushes
- Plain flanged bushes

**Bearing forms made-to-order:** Standard forms in special dimensions, thrust washers, half-bearings, sliding plates, customized bearing designs

### APPLICATIONS

**General:** Generally applicable within the limits of the material properties

**Industrial:** Domestic appliances, chemical equipment, office equipment, sports equipment and many more

### MICROSECTION



PBT + Solid Lubricant

### OPERATING PERFORMANCE

Dry	Very good
Oil lubricated	Good
Grease lubricated	Good
Water lubricated	Very good
Process fluid lubricated	Good after resistance testing

### BEARING PROPERTIES

### UNITS

### VALUE

#### GENERAL

Maximum load, P	Static	N/mm <sup>2</sup>	50
Operating temperature	Min	°C	-50
	Max	°C	170
Coefficient of linear thermal expansion		10 <sup>-6</sup> /K	90

#### DRY

Maximum sliding speed, V		m/s	1,0
Maximum PV factor	for A <sub>H</sub> /A <sub>C</sub> = 5	N/mm <sup>2</sup> x m/s	0,05
	for A <sub>H</sub> /A <sub>C</sub> = 10	N/mm <sup>2</sup> x m/s	0,10
	for A <sub>H</sub> /A <sub>C</sub> = 20	N/mm <sup>2</sup> x m/s	0,20
Coefficient of friction, f			0,22 - 0,37

#### RECOMMENDATIONS

Shaft surface roughness, Ra		µm	0,1 - 0,5
Shaft surface hardness		HV	> 200

## EP<sup>®</sup>30 Bearing Material



### SELF-LUBRICATING ENGINEERED PLASTIC BEARINGS

#### CHARACTERISTICS

- Good bearing performance in dry working conditions
- Very good bearing performance in lubricated or marginally lubricated applications
- Corrosion-resistant in humid/saline environments
- Very good price performance ratio
- Very good weight performance ratio
- Very good in elasto hydrodynamic applications
- Within injection moulding tool feasibility unlimited dimensions and design features
- Compliant to ELV, WEEE and RoHS specifications

#### AVAILABILITY

##### Bearing forms available in standard dimensions:

- Plain cylindrical bushes
- Plain flanged bushes

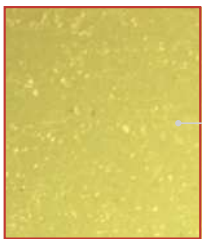
**Bearing forms made-to-order:** Standard forms in special dimensions, thrust washers, half-bearings, sliding plates, customized bearing designs

#### APPLICATIONS

**General:** Generally applicable within the limits of the material properties

**Industrial:** Domestic appliances, chemical equipment, office equipment, sports equipment and many more

#### MICROSECTION



PA 6.6 + AF  
Solid Lubricant

#### OPERATING PERFORMANCE

Dry	Very good
Oil lubricated	Good
Grease lubricated	Good
Water lubricated	Very good
Process fluid lubricated	Good after resistance testing

#### BEARING PROPERTIES

#### UNITS

#### VALUE

##### GENERAL

Maximum load, P	Static	N/mm <sup>2</sup>	65
Operating temperature	Min	°C	-50
	Max	°C	200
Coefficient of linear thermal expansion		10 <sup>-6</sup> /K	40

##### DRY

Maximum sliding speed, V		m/s	1,0
Maximum PV factor	for A <sub>H</sub> /A <sub>C</sub> = 5	N/mm <sup>2</sup> x m/s	0,05
	for A <sub>H</sub> /A <sub>C</sub> = 10	N/mm <sup>2</sup> x m/s	0,10
	for A <sub>H</sub> /A <sub>C</sub> = 20	N/mm <sup>2</sup> x m/s	0,20
Coefficient of friction, f			0,08 - 0,16

##### RECOMMENDATIONS

Shaft surface roughness, Ra		µm	0,1 - 0,5
Shaft surface hardness		HV	> 200

# EP<sup>®</sup>43 Bearing Material



## SELF-LUBRICATING ENGINEERED PLASTIC BEARINGS

### CHARACTERISTICS

- Good bearing performance in dry working conditions
- Good bearing performance in lubricated or marginally lubricated applications
- Corrosion-resistant in humid/saline environments
- Very good price performance ratio for high temperature applications
- Very good weight performance ratio
- Within injection moulding tool feasibility unlimited dimensions and design features
- Compliant to ELV, WEEE and RoHS specifications

### AVAILABILITY

#### Bearing forms available in standard dimensions:

- Plain cylindrical bushes
- Plain flanged bushes

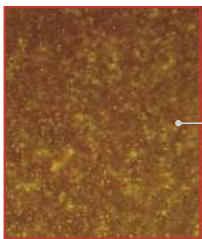
**Bearing forms made-to-order:** Standard forms in special dimensions, thrust washers, half-bearings, sliding plates, customized bearing designs

### APPLICATIONS

**General:** Generally applicable within the limits of the material properties

**Industrial:** Domestic appliances, materials handling equipment, apparatus engineering, slot machines and cash boxes and many more

### MICROSECTION



PPS +  
Solid Lubricant  
+ Fillers

### OPERATING PERFORMANCE

Dry	Very good
Oil lubricated	Good
Grease lubricated	Good
Water lubricated	Very good
Process fluid lubricated	Good after resistance testing

### BEARING PROPERTIES

### UNITS

### VALUE

#### GENERAL

Maximum load, P	Static	N/mm <sup>2</sup>	83
Operating temperature	Min	°C	-40
	Max	°C	240
Coefficient of linear thermal expansion		10 <sup>-6</sup> /K	45

#### DRY

Maximum sliding speed, V		m/s	1,0
Maximum PV factor	for A <sub>H</sub> /A <sub>C</sub> = 5	N/mm <sup>2</sup> x m/s	0,22
	for A <sub>H</sub> /A <sub>C</sub> = 10	N/mm <sup>2</sup> x m/s	0,90
	for A <sub>H</sub> /A <sub>C</sub> = 20	N/mm <sup>2</sup> x m/s	3,59

Coefficient of friction, f			0,11 - 0,2
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#### RECOMMENDATIONS

Shaft surface roughness, Ra		µm	0,2 - 0,8
Shaft surface hardness		HV	> 200

## EP<sup>®</sup>44 Bearing Material



### SELF-LUBRICATING ENGINEERED PLASTIC BEARINGS

#### CHARACTERISTICS

- Good bearing performance in dry working conditions
- Good bearing performance in lubricated or marginally lubricated applications
- Corrosion-resistant in humid/saline environments
- Very good price performance ratio for high temperature applications
- Very good weight performance ratio
- Within injection moulding tool feasibility unlimited dimensions and design features
- Compliant to ELV, WEEE and RoHS specifications

#### AVAILABILITY

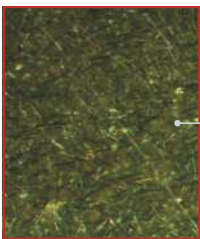
**Bearing forms made-to-order:** Cylindrical bushes, thrust washers, sliding plates, half-bearings, special shapes obtained by stamping, bearings with locating notches, lubricant holes and machined grooves, customized bearing designs

#### APPLICATIONS

**General:** Generally applicable within the limits of the material properties

**Industrial:** Domestic appliances, valve technology, electronics assembly, apparatus engineering and many more

#### MICROSECTION



PPS + Solid Lubricant + Fillers

#### OPERATING PERFORMANCE

Dry	Good
Oil lubricated	Very Good
Grease lubricated	Very Good
Water lubricated	Very Good
Process fluid lubricated	Good after resistance testing

#### BEARING PROPERTIES

#### UNITS

#### VALUE

##### GENERAL

Maximum load, P	Static	N/mm <sup>2</sup>	95
Operating temperature	Min	°C	-40
	Max	°C	240
Coefficient of linear thermal expansion		10 <sup>-6</sup> /K	27

##### DRY

Maximum sliding speed, V		m/s	1,0
Maximum PV factor	for A <sub>H</sub> /A <sub>C</sub> = 5	N/mm <sup>2</sup> x m/s	0,11
	for A <sub>H</sub> /A <sub>C</sub> = 10	N/mm <sup>2</sup> x m/s	0,42
	for A <sub>H</sub> /A <sub>C</sub> = 20	N/mm <sup>2</sup> x m/s	1,69

Coefficient of friction, f			0,16 - 0,26
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##### RECOMMENDATIONS

Shaft surface roughness, Ra		µm	0,2 - 0,8
Shaft surface hardness		HV	> 450

# EP<sup>®</sup>63 Bearing Material



## SELF-LUBRICATING ENGINEERED PLASTIC BEARINGS

### CHARACTERISTICS

- Good bearing performance in dry working conditions
- Good bearing performance in lubricated or marginally lubricated applications
- Corrosion-resistant in humid/saline environments
- Suitable for very high temperature applications
- Very good weight performance ratio
- Within injection moulding tool feasibility unlimited dimensions and design features
- Compliant to ELV, WEEE and RoHS specifications

### AVAILABILITY

#### Bearing forms available in standard dimensions:

- Plain cylindrical bushes
- Plain flanged bushes

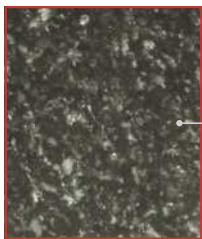
**Bearing forms made-to-order:** Standard forms in special dimensions, thrust washers, half-bearings, sliding plates, customized bearing designs

### APPLICATIONS

**General:** Generally applicable within the limits of the material properties

**Industrial:** Domestic appliances, valve technology, electronics assembly, agricultural machinery and many more

### MICROSECTION



PEEK +  
Solid Lubricant  
+ Fillers

### OPERATING PERFORMANCE

Dry	Good
Oil lubricated	Good
Grease lubricated	Good
Water lubricated	Fair
Process fluid lubricated	Good after resistance testing

### FOR SUPERIOR PERFORMANCE

Water lubricated	EP64
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### BEARING PROPERTIES

### UNITS

### VALUE

#### GENERAL

Maximum load, P	Static	N/mm <sup>2</sup>	90
Operating temperature	Min	°C	-100
	Max	°C	290
Coefficient of linear thermal expansion		10 <sup>-6</sup> /K	50

#### DRY

Maximum sliding speed, V		m/s	1,0
Maximum PV factor	for A <sub>H</sub> /A <sub>C</sub> = 5	N/mm <sup>2</sup> x m/s	0,16
	for A <sub>H</sub> /A <sub>C</sub> = 10	N/mm <sup>2</sup> x m/s	0,66
	for A <sub>H</sub> /A <sub>C</sub> = 20	N/mm <sup>2</sup> x m/s	2,63
Coefficient of friction, f			0,12 - 0,21

#### RECOMMENDATIONS

Shaft surface roughness, Ra		µm	0,1 - 0,5
Shaft surface hardness		HV	> 200

## EP<sup>®</sup>64 Bearing Material



### SELF-LUBRICATING ENGINEERED PLASTIC BEARINGS

#### CHARACTERISTICS

- Good bearing performance in lubricated or marginally lubricated applications
- Excellent flow erosion and cavitation resistance
- Corrosion-resistant in humid/saline environments
- Suitable for very high temperature applications
- Very good weight performance ratio
- Within injection moulding tool feasibility unlimited dimensions and design features
- Compliant to ELV, WEEE and RoHS specifications

#### AVAILABILITY

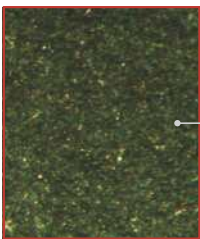
**Bearing forms made-to-order:** Cylindrical bushes, flanged bearings, thrust washers, sliding plates, half-bearings, customized bearing designs

#### APPLICATIONS

**General:** Generally applicable within the limits of the material properties

**Industrial:** Domestic appliances, transportation equipment, apparatus engineering, conveyor equipment and many more

#### MICROSECTION



PEEK + Solid Lubricant + Fillers

#### OPERATING PERFORMANCE

Dry	Good
Oil lubricated	Very good
Grease lubricated	Very good
Water lubricated	Good
Process fluid lubricated	Good after resistance testing

#### BEARING PROPERTIES

##### GENERAL

BEARING PROPERTIES		UNITS	VALUE
Maximum load, P	Static	N/mm <sup>2</sup>	125
Operating temperature	Min	°C	-100
	Max	°C	290
Coefficient of linear thermal expansion		10 <sup>-6</sup> /K	14

##### DRY

Maximum sliding speed, V		m/s	1,0
Maximum PV factor	for A <sub>H</sub> /A <sub>C</sub> = 5	N/mm <sup>2</sup> x m/s	0,09
	for A <sub>H</sub> /A <sub>C</sub> = 10	N/mm <sup>2</sup> x m/s	0,35
	for A <sub>H</sub> /A <sub>C</sub> = 20	N/mm <sup>2</sup> x m/s	1,40
Coefficient of friction, f			0,3 - 0,5

##### RECOMMENDATIONS

Shaft surface roughness, Ra		µm	0,1 - 0,5
Shaft surface hardness		HV	> 450



# KA Glacetal Bearing Material



## ENGINEERED PLASTIC THRUST WASHERS

### CHARACTERISTICS

- Good bearing performance in light duty working conditions
- Good performance in lubricated or marginally lubricated applications
- Corrosion-resistant in humid/saline environments
- Very good price performance ratio
- Very good weight performance ratio



### AVAILABILITY

**Bearing forms available in standard dimensions:**

- Plain thrust washers

**Non standard parts made-to-order**

### APPLICATIONS

**Industrial:** Thrust washers are used as axial bearings in conjunction with all cylindrical bushes according to ISO 3547 to prevent metal-to-metal contact and fretting damage

### MICROSECTION



#### OPERATING PERFORMANCE

Dry	Fair
Oil lubricated	Good
Grease lubricated	Good
Water lubricated	Fair
Process fluid lubricated	Fair

#### FOR SUPERIOR PERFORMANCE

Dry	EP22
Water lubricated	EP22
Process fluid lubricated	EP22

### BEARING PROPERTIES

### UNITS

### VALUE

#### GENERAL

Maximum load, P	Static	N/mm <sup>2</sup>	20
	Dynamic	N/mm <sup>2</sup>	10
Operating temperature	Min	°C	-40
	Max	°C	80

#### GREASED

Maximum sliding speed, V	m/s	1,5
Maximum PV factor	N/mm <sup>2</sup> x m/s	0,35
Coefficient of friction, f		0,08 - 0,12

#### RECOMMENDATIONS

Shaft surface roughness, Ra		µm	≤ 0,4
Shaft surface hardness	Normal	HB	> 200
	For longer service life	HB	> 350

## Multilube Bearing Material



### THERMOPLASTIC PLAIN BEARINGS

#### CHARACTERISTICS

- Good bearing performance in dry working conditions
- Good performance in lubricated or marginally lubricated applications
- Corrosion-resistant in humid/saline environments
- Good price performance ratio
- Very good weight performance ratio
- Within injection moulding tool feasibility unlimited dimensions and design features



#### AVAILABILITY

**Bearing forms made-to-order:** Cylindrical bushes, flanged bearings, thrust washers, sliding plates, half-bearings, customized bearing designs

#### APPLICATIONS

**Industrial:** Linkages, seat suspensions

#### MICROSECTION



POM + Solid Lubricant + Fillers

#### OPERATING PERFORMANCE

Dry	Good
Oil lubricated	Good
Grease lubricated	Good
Water lubricated	Fair
Process fluid lubricated	Fair

#### FOR SUPERIOR PERFORMANCE

Water lubricated	EP22
Process fluid lubricated	EP22

#### BEARING PROPERTIES

#### UNITS

#### VALUE

##### GENERAL

<b>Maximum load, P</b>	Static	N/mm <sup>2</sup>	60
	Dynamic	N/mm <sup>2</sup>	30
<b>Operating temperature</b>	Min	°C	-40
	Max	°C	80
	Momentary	°C	120
<b>Coefficient of linear thermal expansion</b>		10 <sup>-6</sup> /K	101

##### DRY

<b>Maximum sliding speed, V</b>		m/s	1,5
<b>Maximum PV factor</b>		N/mm <sup>2</sup> x m/s	0,6
<b>Coefficient of friction, f</b>			0,1 - 0,2

##### RECOMMENDATIONS

<b>Shaft surface roughness, Ra</b>		µm	0,2 - 0,8
<b>Shaft surface hardness</b>	Normal	HB	> 200
	For longer service life	HB	> 350

## GAR-MAX<sup>®</sup> Bearing Material



### SELF-LUBRICATING FIBERGLASS REINFORCED PLAIN BEARINGS

#### CHARACTERISTICS

- High load capacity
- Excellent shock and misalignment resistance
- Excellent contamination resistance
- Very good friction and wear properties
- Good chemical resistance
- Very good dry wear performance
- GAR-MAX<sup>®</sup> bearing sizes available according to DIN ISO 4379 for the replacement of traditional greased bronze bearings



#### AVAILABILITY

**Bearing forms available in standard dimensions:**

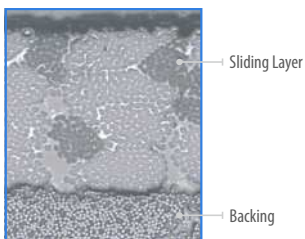
- Plain cylindrical bushes

**Non-standard parts made-to-order:** Cylindrical bushes with non-standard lengths and wall thickness, customized bushing designs

#### APPLICATIONS

**Industrial:** Steering linkages, hydraulic cylinder pivots, king pin bearings, boom lifts, scissor lifts, cranes, hoists, lift gates, backhoes, trenchers, skid steer loaders, front end loaders, etc.

#### MICROSECTION



Sliding Layer

Backing

#### OPERATING PERFORMANCE

Dry	Very good
Oil lubricated	Fair
Grease lubricated	Fair
Water lubricated	Fair
Process fluid lubricated	Poor

#### FOR SUPERIOR PERFORMANCE

Oil lubricated	GAR-FIL
Grease lubricated	DX / DX10
Water lubricated	HPF / HPM
Process fluid lubricated	GAR-FIL

#### BEARING PROPERTIES

#### UNITS

#### VALUE

##### GENERAL

Maximum load, P	Static	N/mm <sup>2</sup>	210
	Dynamic	N/mm <sup>2</sup>	140
Operating temperature	Min	°C	-195
	Max	°C	160

##### DRY

Maximum sliding speed, V	m/s	0,13
Maximum PV factor	N/mm <sup>2</sup> x m/s	1,05
Coefficient of friction, f		0,05 - 0,3*

##### RECOMMENDATIONS

Shaft surface roughness, Ra	µm	0,15 - 0,4	
Shaft surface hardness	Normal	HB	> 350
	For longer service life	HB	> 480

\* Depending on operating conditions

## GAR-FIL Bearing Material



### FIBER REINFORCED COMPOSITE BEARINGS WITH PTFE TAPE LINER

#### CHARACTERISTICS

- Proprietary filled PTFE tape liner
- High load capacity
- Good chemical resistance
- Machinable bearing surface
- High rotational speed capacity
- Very good friction and wear properties
- Excellent contamination resistance



#### AVAILABILITY

**Bearing forms available in standard dimensions:**

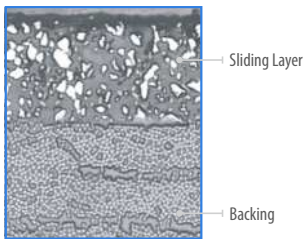
- Plain cylindrical bushes

**Non-standard parts made-to-order:** Cylindrical bushes with non-standard lengths and wall thickness, flanged bearings, hexagonal and square bores, liner on outer diameter, customized bearing designs

#### APPLICATIONS

**Industrial:** Valves, scissor lifts, pulleys, toggle linkages, etc.

#### MICROSECTION



Sliding Layer

Backing

#### OPERATING PERFORMANCE

Dry	Very good
Oil lubricated	Very good
Grease lubricated	Fair
Water lubricated	Fair
Process fluid lubricated	Very good

#### FOR SUPERIOR PERFORMANCE

Grease lubricated	DX / DX10
Water lubricated	HPF / HPM

#### BEARING PROPERTIES

#### UNITS

#### VALUE

##### GENERAL

Maximum load, P	Static	N/mm <sup>2</sup>	140
	Dynamic	N/mm <sup>2</sup>	140
Operating temperature	Min	°C	-195
	Max	°C	205

##### DRY

Maximum sliding speed, V	m/s	2,5
Maximum PV factor	N/mm <sup>2</sup> x m/s	1,23
Coefficient of friction, f		0,02 - 0,12*

##### RECOMMENDATIONS

Shaft surface roughness, Ra	µm	≤ 0,4
Shaft surface hardness	Normal	HB > 200

\* Depending on operating conditions

# HSG Bearing Material



## HIGH-LOAD FIBER REINFORCED COMPOSITE PTFE BEARINGS

### CHARACTERISTICS

- Self-lubricating plain bearing material
- High load capacity (twice as much as standard GAR-MAX® bearings)
- Excellent shock and misalignment resistance
- Excellent contamination resistance
- Very good friction and wear properties
- Good chemical resistance



### AVAILABILITY

**Bearing forms available in standard dimensions:**

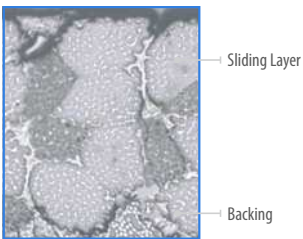
- Plain cylindrical bushes

**Non-standard parts made-to-order:** Cylindrical bushes with non-standard lengths and wall thickness, flanged bearings, hexagonal and square bores, liner on outer diameter, customized bearing designs

### APPLICATIONS

**Industrial:** Steering linkages, hydraulic cylinder pivots, king pin bearings, boom lifts, scissor lifts, cranes, hoists, lift gates, backhoes, trenchers, skid steer loaders, front end loaders, etc.

### MICROSECTION



Sliding Layer

Backing

### OPERATING PERFORMANCE

Dry	Very good
Oil lubricated	Fair
Grease lubricated	Fair
Water lubricated	Fair
Process fluid lubricated	Fair

### FOR SUPERIOR PERFORMANCE

Oil lubricated	GAR-FIL
Grease lubricated	DX / DX10
Water lubricated	HPF / HPM
Process fluid lubricated	GAR-FIL

### BEARING PROPERTIES

### UNITS

### VALUE

#### GENERAL

Maximum load, P	Static	N/mm <sup>2</sup>	415
	Dynamic	N/mm <sup>2</sup>	140
Operating temperature	Min	°C	-195
	Max	°C	160

#### DRY

Maximum sliding speed, V		m/s	0,13
Maximum PV factor		N/mm <sup>2</sup> x m/s	1,05
Coefficient of friction, f			0,05 - 0,3*

#### RECOMMENDATIONS

Shaft surface roughness, Ra		µm	0,15 - 0,4
Shaft surface hardness	Normal	HB	> 350
	For longer service life	HB	> 480

\* Depending on operating conditions

## MLG Bearing Material



### SELF-LUBRICATING FIBER REINFORCED COMPOSITE BEARINGS

#### CHARACTERISTICS

- Value engineered filament-wound bearing for lighter duty applications
- High load capacity
- Good misalignment resistance
- Excellent shock resistance
- Good friction and wear properties
- Good chemical resistance

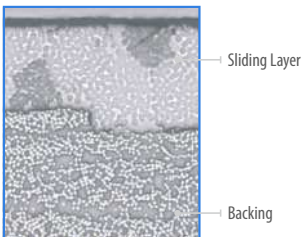
#### AVAILABILITY

**Bearing forms made-to-order:** Cylindrical bushes with non-standard lengths and wall thickness, flanged bearings, hexagonal and square bores, liner on outer diameter, customized bearing designs

#### APPLICATIONS

**Industrial:** Construction and earth moving equipment, conveyors, cranes, hoists, hydraulic cylinder pivots, etc.

#### MICROSECTION



Sliding Layer

Backing

#### OPERATING PERFORMANCE

Dry	Very good
Oil lubricated	Good
Grease lubricated	Poor
Water lubricated	Fair
Process fluid lubricated	Fair

#### FOR SUPERIOR PERFORMANCE

Grease lubricated	DX / DX10
Water lubricated	HPF / HPM
Process fluid lubricated	GAR-FIL

#### BEARING PROPERTIES

#### UNITS

#### VALUE

##### GENERAL

Maximum load, P	Static	N/mm <sup>2</sup>	210
	Dynamic	N/mm <sup>2</sup>	140
Operating temperature	Min	°C	-195
	Max	°C	160

##### DRY

Maximum sliding speed, V	m/s	0,13
Maximum PV factor	N/mm <sup>2</sup> x m/s	1,05
Coefficient of friction, f		0,05 - 0,3*

##### RECOMMENDATIONS

Shaft surface roughness, Ra	µm	0,15 - 0,4
Shaft surface hardness	HB	> 350

\* Depending on operating conditions

# HPM Bearing Material



## FIBER REINFORCED COMPOSITE HYDRO BEARINGS

### CHARACTERISTICS

- Designed for hydropower applications
- High load capacity
- Excellent shock and edge loading capacity
- Low-friction, superior wear rate and bearing life
- Excellent corrosion-resistance
- Dimensionally stable - very low water absorption, low swelling
- Environmentally friendly

### AVAILABILITY

#### Bearing forms available in standard dimensions:

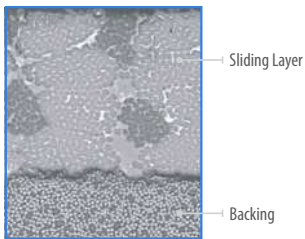
- Plain cylindrical bushes

**Non-standard parts made-to-order:** Cylindrical bushes with non-standard dimensions, customized bearing designs

### APPLICATIONS

**Industrial:** Servo-motor bearings, operating ring sliding segments, linkage bearings, wicket gate bearings, guide vane bearings, intake gate sliding segments, intake gate roller bearings, spillway gate bearings, trash rate bearings, fish screen bearings, trunnion bearings, blade bearings, injector bearings, deflector bearings, ball and butterfly trunnion bearings, etc.

### MICROSECTION



### OPERATING PERFORMANCE

Dry	Very good
Oil lubricated	Fair
Grease lubricated	Poor
Water lubricated	Very good
Process fluid lubricated	Poor

### FOR SUPERIOR PERFORMANCE

Oil lubricated	GAR-FIL / HPF
Grease lubricated	DX / DX10
Process fluid lubricated	GAR-FIL / HPF

### BEARING PROPERTIES

### UNITS

### VALUE

#### GENERAL

Maximum load, P	Static	N/mm <sup>2</sup>	210
	Dynamic	N/mm <sup>2</sup>	140
Operating temperature	Min	°C	-195
	Max	°C	160

#### DRY

Maximum sliding speed, V	m/s	0,13
Maximum PV factor	N/mm <sup>2</sup> x m/s	1,23
Coefficient of friction, f		0,03 - 0,12*

#### RECOMMENDATIONS

Shaft surface roughness, Ra	µm	0,2 - 0,8	
Shaft surface hardness	Normal	HB	> 180
	For longer service life	HB	> 480

\* Depending on operating conditions

## HPMB® Bearing Material



### HIGH PRECISION FIBER REINFORCED COMPOSITE BEARINGS

#### CHARACTERISTICS

- Machinable inner and outer diameters for superior application precision, circularity and cylindricity tolerances
- Pre-machined high precision HPMB bearings available for immediate installation
- High precision through easy single point machining of the bearing liner, on-site prior to installation
- Superior precision achieved with post-installation (inner diameter tolerance IT7 attainable) single point machining of the bearing liner
- High load capacity
- Excellent shock and edge loading capacity
- Low-friction with negligible stick-slip
- Low wear rate for extended bearing life
- Excellent corrosion-resistance

#### AVAILABILITY

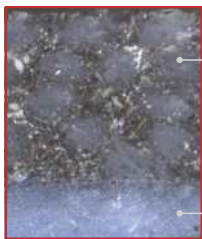
**Bearing forms made-to-order:** Finished cylindrical bushings, pre-machined cylindrical bushings, flanged cylindrical bushings (subject to design review)

#### APPLICATIONS

**Industrial:** Railroad stabilization system, railroad brake linkages, injection molding machines – guide bushings, hydraulic cylinder pivots, water turbines – wicket gates, servomotors, links, water gates, valves

- Dimensionally stable - very low water absorption, low swelling
- Environmentally friendly grease-free operation

#### MICROSECTION



Sliding Layer

Backing

#### OPERATING PERFORMANCE

Dry	Very good
Oil lubricated	Fair
Grease lubricated	Not recommended
Water lubricated	Very good
Process fluid lubricated	To be tested by final user

#### FOR SUPERIOR PERFORMANCE

Oil lubricated	GAR-FIL / HPF
Grease lubricated	DX / DX10
Process fluid lubricated	GAR-FIL / HPF

#### BEARING PROPERTIES

#### UNITS

#### VALUE

##### GENERAL

Maximum load, P	Static	N/mm <sup>2</sup>	210
	Dynamic	N/mm <sup>2</sup>	140
Operating temperature	Min	°C	-196
	Max	°C	163
Coefficient of linear thermal expansion		10 <sup>-6</sup> /K	12,6

##### DRY

Maximum sliding speed, V		m/s	0,13
Maximum PV factor		N/mm <sup>2</sup> x m/s	1,23
Coefficient of friction, f			0,03 - 0,12*

##### RECOMMENDATIONS

Shaft surface roughness, Ra		µm	0,2 - 0,8
Shaft surface hardness	Normal	HB	> 180
	For longer service life	HB	> 480

\* Depending on operating conditions



# HPF Bearing Material



## FIBER REINFORCED COMPOSITE BEARINGS WITH PTFE TAPE LINER

### CHARACTERISTICS

- Proprietary filled PTFE tape machinable liner
- Designed for hydropower applications
- Machinable bearing surface
- High load capacity
- Excellent shock and edge loading capacity
- Low-friction, superior wear rate and bearing life
- Excellent corrosion-resistance
- Dimensionally stable - very low water absorption, low swelling
- Environmentally friendly



### AVAILABILITY

**Bearing forms available in standard dimensions:**

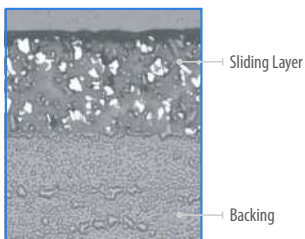
- Plain cylindrical bushes
- Sliding plates

**Non-standard parts made-to-order:** Cylindrical bushes with non-standard dimensions, customized bearing designs

### APPLICATIONS

**Industrial:** Servo-motor bearings, operating ring sliding segments, linkage bearings, wicket gate bearings, guide vane bearings, intake gate sliding segments, intake gate roller bearings, spillway gate bearings, trash rate bearings, fish screen bearings, trunnion bearings, blade bearings, injector bearings, deflector bearings, ball and butterfly trunnion bearings, etc.

### MICROSECTION



### OPERATING PERFORMANCE

Dry	Very good
Oil lubricated	Very good
Grease lubricated	Poor
Water lubricated	Very good
Process fluid lubricated	Good

### FOR SUPERIOR PERFORMANCE

Grease lubricated	DX / DX10
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### BEARING PROPERTIES

### UNITS

### VALUE

#### GENERAL

Maximum load, P	Static	N/mm <sup>2</sup>	140
	Dynamic	N/mm <sup>2</sup>	140
Operating temperature	Min	°C	-195
	Max	°C	140

#### DRY

Maximum sliding speed, V	m/s	2,5
Maximum PV factor	N/mm <sup>2</sup> x m/s	1,23
Coefficient of friction, f		0,02 - 0,1*

#### GREASE LUBRICATED

Coefficient of friction, f		0,02 - 0,08*
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#### RECOMMENDATIONS

Shaft surface roughness, Ra	µm	0,2 - 0,8	
Shaft surface hardness	Normal	HB	> 180
	For longer service life	HB	> 480

\* Depending on operating conditions

## GGB-MEGALIFE® XT



### FIBER REINFORCED COMPOSITE PTFE THRUST WASHERS

#### CHARACTERISTICS

- Proprietary filled PTFE tape liner on both surfaces
- Excellent shock resistance
- High load capacity
- Excellent misalignment resistance
- Excellent contamination resistance
- Good surface speed capability
- Very good friction and wear properties
- Good chemical resistance

#### AVAILABILITY

**Bearing forms available in standard dimensions:**

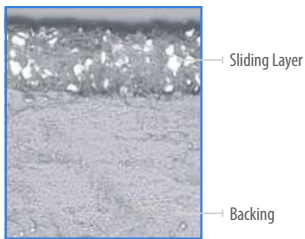
- Plain thrust washers

**Bearing forms made-to-order:** Thrust washers with non-standard dimensions

#### APPLICATIONS

**Industrial:** Pulley spacers, gear spacers, aerial lifts, fork lift masts, king pins, steering links, lift gates, cranes, backhoes, valve actuator linkages, etc.

#### MICROSECTION



#### OPERATING PERFORMANCE

Dry	Very good
Oil lubricated	Fair
Grease lubricated	Poor
Water lubricated	Very good
Process fluid lubricated	Fair

#### FOR SUPERIOR PERFORMANCE

Oil lubricated	HPF
Grease lubricated	DX
Process fluid lubricated	HPF

#### BEARING PROPERTIES

#### UNITS

#### VALUE

##### GENERAL

Maximum load, P	Static	N/mm <sup>2</sup>	140
	Dynamic	N/mm <sup>2</sup>	140
Operating temperature	Min	°C	-195
	Max	°C	175

##### DRY

Maximum sliding speed, V	m/s	0,5
Maximum PV factor	N/mm <sup>2</sup> x m/s	1,23
Coefficient of friction, f		0,02 - 0,12*

##### RECOMMENDATIONS

Shaft surface roughness, Ra	µm	≤ 0,4
Shaft surface hardness	Normal HB	> 200

\* Depending on operating conditions

# Multifil Bearing Material



## PROPRIETARY FILLED PTFE SLIDING BEARING TAPE

### CHARACTERISTICS

- Superior sliding bearing material which can be easily bonded to any clean, rigid substrate
- Reduces vibration

### AVAILABILITY

Bearing forms available in standard dimensions:

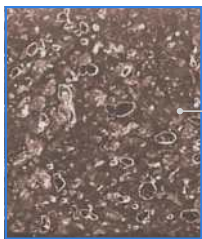
- Bearing tape

**Tape with 0,015" to 0,125" (0,38 to 3,2 mm) thickness and 12" (305 mm) width or 24" (610 mm) width**

### APPLICATIONS

**Industrial:** Machine tool ways, gibs and other sliding applications

### MICROSECTION



PTFE tape with proprietary fillers

### OPERATING PERFORMANCE

Dry	Very good
Oil lubricated	Very good
Grease lubricated	Very good
Water lubricated	Good
Process fluid lubricated	Good

BEARING PROPERTIES		UNITS	VALUE
<b>GENERAL</b>			
Maximum load, P	Static	N/mm <sup>2</sup>	70
	Dynamic	N/mm <sup>2</sup>	35
Operating temperature	Min	°C	-200
	Max	°C	280
<b>DRY</b>			
Maximum sliding speed, V		m/s	2,5
Maximum PV factor		N/mm <sup>2</sup> x m/s	0,32
Coefficient of friction, f			0,07
<b>GREASE / OIL LUBRICATED</b>			
Maximum pU factor		N/mm <sup>2</sup> x m/s	1,25
Coefficient of friction, f			0,05
<b>RECOMMENDATIONS</b>			
Shaft surface roughness, Ra		µm	0,2 - 0,4
Shaft surface hardness		HB	> 200

## SBC with GAR-MAX<sup>®</sup> Bearing Material



### SEALED FIBER REINFORCED COMPOSITE BEARINGS

#### CHARACTERISTICS

- Self-lubricating bearings
- High static load capacity
- Excellent resistance to shock loading and misalignment
- Very good friction and wear properties
- Good chemical resistance
- Sealed to exclude contaminants to offer extended service life
- Environmentally friendly and eliminates need for automated grease system and grease



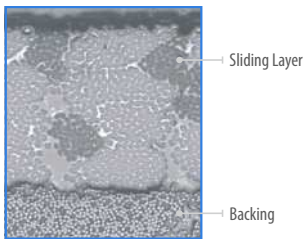
#### AVAILABILITY

**Bearing forms made-to-order:** GGB SBC with GAR-MAX<sup>®</sup> sealed assemblies with or without steel outer shell, customized bearing designs

#### APPLICATIONS

**Industrial:** Steering linkages, hydraulic cylinder pivots, king pin bearings, boom lifts, scissor lifts, cranes, hoists, lift gates, backhoes, trenchers, skid steer loaders, front end loaders, etc.

#### MICROSECTION



#### OPERATING PERFORMANCE

Dry	Very good
Oil lubricated	Fair
Grease lubricated	Fair
Water lubricated	Fair
Process fluid lubricated	Fair

#### BEARING PROPERTIES

##### GENERAL

		UNITS	VALUE
Maximum load, P	Static	N/mm <sup>2</sup>	210
	Dynamic	N/mm <sup>2</sup>	140
Operating temperature	Min	°C	93
	Max	°C	104

##### DRY

Maximum sliding speed, V	m/s	0,13
Maximum PV factor	N/mm <sup>2</sup> x m/s	1,05

##### RECOMMENDATIONS

Shaft surface roughness, Ra	μm	0,15 - 0,4	
Shaft surface hardness	Normal	HB	> 350
	For longer service life	HB	> 480

# SBC with HSG Bearing Material



## SEALED FIBER REINFORCED COMPOSITE BEARINGS

### CHARACTERISTICS

- Self-lubricating bearings
- High static load capacity
- Excellent resistance to shock loading and misalignment
- Very good friction and wear properties
- Good chemical resistance
- Sealed to exclude contaminants to offer extended service life
- Environmentally friendly and eliminates need for automated grease system and grease



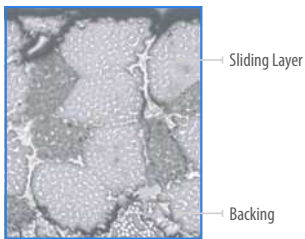
### AVAILABILITY

**Bearing forms made-to-order:** GGB SBC with HSG sealed assemblies with or without steel outer shell, customized bearing designs

### APPLICATIONS

**Industrial:** Steering linkages, hydraulic cylinder pivots, king pin bearings, boom lifts, scissor lifts, cranes, hoists, lift gates, backhoes, trenchers, skid steer loaders, front end loaders, etc.

### MICROSECTION



Sliding Layer

Backing

### OPERATING PERFORMANCE

Dry	Very good
Oil lubricated	Fair
Grease lubricated	Fair
Water lubricated	Fair
Process fluid lubricated	Fair

### BEARING PROPERTIES

### UNITS

### VALUE

#### GENERAL

Maximum load, P	Static	N/mm <sup>2</sup>	415
	Dynamic	N/mm <sup>2</sup>	140
Operating temperature	Min	°C	93
	Max	°C	104

#### DRY

Maximum sliding speed, V	m/s	0,13
Maximum PV factor	N/mm <sup>2</sup> x m/s	1,05

#### RECOMMENDATIONS

Shaft surface roughness, Ra	µm	0,15 - 0,4	
Shaft surface hardness	Normal	HB	> 350
	For longer service life	HB	> 480

## GGB-CSM® Bearing Material



### THICK WALLED MONOMENTAL BEARINGS

#### CHARACTERISTICS

- Self-lubricating metal bearings produced by metallurgic powder
- Maintenance-free bearings with homogeneously distributed solid lubricant (graphite, MoS<sub>2</sub>) in the metallic matrix
- High load capacity and temperature ranges up to 600°C possible depending on the alloy
- Corrosion-resistant alloys are available
- Lead-free alloys are available

#### MICROSECTION

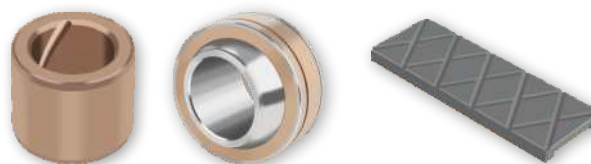


Solid Lubricant:  
Graphite, MoS<sub>2</sub>

Metallic Matrix:  
Bronze, Nickel,  
or Iron-based

#### OPERATING PERFORMANCE

Dry	Good
Oil lubricated	Good
Grease lubricated	Good
Water lubricated	Depending on alloy
Process fluid lubricated	Depending on fluid or alloy



#### AVAILABILITY

**Bearing forms made-to-order:** Cylindrical bushes, flanged bushes, thrust washers, sliding plates, half-bearings, axial and radial segment rings, self-aligning spherical bearings, special shapes, customized bearing designs

#### APPLICATIONS

**Industrial:** General mechanical engineering, applications with elevated temperatures and corrosion risk, exhaust or smoke flaps, valves, turbines, iron foundry, steel and aluminum industry, furnaces, blower, steel works and civil engineering, turbines (water, steam and gas), pumps and compressors, sewage purification plants, thermal treatment furnaces, hot rolling mills, food and beverage industry, packaging equipment, agriculture and construction machines, handling equipment, tire molds, etc.

BEARING PROPERTIES		UNITS	VALUE
<b>GENERAL</b>			
Maximum load, P	Static	N/mm <sup>2</sup>	100 - 260
	Dynamic	N/mm <sup>2</sup>	55 - 130
Operating temperature	Min	°C	-200
	Max	°C	600
Coefficient of linear thermal expansion		10 <sup>-6</sup> /K	13 - 18
<b>DRY</b>			
Maximum sliding speed, V		m/s	0,2 - 0,5
Maximum PV factor		N/mm <sup>2</sup> x m/s	0,8 - 1,5
Coefficient of friction, f			0,11 - 0,5
<b>WATER LUBRICATED</b>			
Coefficient of friction, f			0,08 - 0,18
<b>RECOMMENDATIONS</b>			
Shaft surface roughness, Ra		µm	0,2 - 0,8
Shaft surface hardness		HB	> 180
		HRC	> 45

Bearing properties and recommendations depending on GGB-CSM material grade

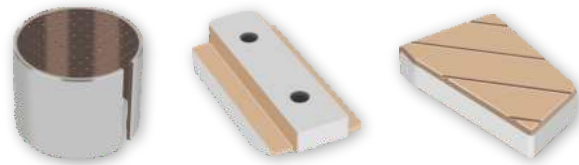
# GGB-CBM<sup>®</sup> Bearing Material



## THIN WALLED BIMETAL BEARINGS MADE BY METALLURGIC POWDER

### CHARACTERISTICS

- Self-lubricating and maintenance-free with homogeneously distributed solid lubricant (graphite) in the sliding layer
- High load capacity and suited to temperatures from -150°C up to 280°C
- Different metallic backings are available: stainless steel, carbon steel or bronze
- Lead-free alloys are available



### AVAILABILITY

**Bearing forms made-to-order:** Cylindrical bushes, flanged bushes, thrust washers, axial washers, sliding plates, half shells, axial and radial segment rings, spherical bushings, customized bearing designs

### APPLICATIONS

**Industrial:** General mechanical engineering, applications at high loads, iron foundry, steel and aluminum industry, furnaces, blower, steel works, food and beverage industry, packaging equipment, agriculture and construction machines, handling equipment, tire molds, etc.

### MICROSECTION



- Solid Lubricant: Graphite
- Metallic Matrix: Bronze-based
- Backing: Stainless Steel, Carbon Steel or Bronze

### OPERATING PERFORMANCE

Dry	Good
Oil lubricated	Good
Grease lubricated	Good
Water lubricated	Good
Process fluid lubricated	Depending on fluid

### BEARING PROPERTIES

### UNITS

### VALUE

#### GENERAL

Maximum load, P	Static	N/mm <sup>2</sup>	260 - 280
	Dynamic	N/mm <sup>2</sup>	80 - 150
Operating temperature	Min	°C	-150
	Max	°C	280
Coefficient of linear thermal expansion		10 <sup>-6</sup> /K	12 - 16

#### DRY

Maximum sliding speed, V		m/s	0,3 - 0,5
Maximum PV factor		N/mm <sup>2</sup> x m/s	0,5 - 1,0
Coefficient of friction, f			0,10 - 0,2

#### WATER LUBRICATED

Coefficient of friction, f			0,10 - 0,15
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#### RECOMMENDATIONS

Shaft surface roughness, Ra		µm	0,2 - 0,8
Shaft surface hardness		HB	> 180 - > 250

Bearing properties and recommendations depending on GGB-CBM material grade

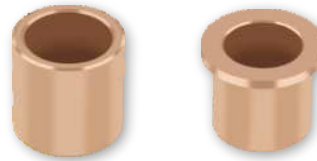
## GGB-BP25 Bearing Material



### METAFRAM OIL IMPREGNATED SINTERED BRONZE BEARINGS

#### CHARACTERISTICS

- Similar to SINT A 50, impregnation group 1
- Maintenance-free bearing for general engineering applications
- Optimum performance under relatively light loads and high speeds
- Produced by powder metallurgy process and therefore suitable for complex shapes



#### AVAILABILITY

##### Bearing forms available in standard dimensions:

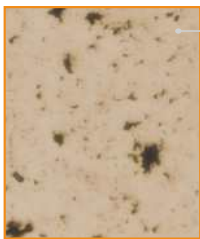
- Plain cylindrical bushes
- Plain flanged bushes

**Non-standard parts made-to-order:** Cylindrical bushes and flanged bushes with non-standard dimensions, spherical bearings, tubes and rod blanks, customized bearing designs

#### APPLICATIONS

**Industrial:** FHP motor bearings, domestic appliances and hand tools

#### MICROSECTION



BP25 with composition  
Sn 8 - 10,5 %  
Other < 2 %  
Cu Rest  
Impregnation group 1 (up to 80°C)

#### OPERATING PERFORMANCE

Dry	Good (PTFE / MoS <sub>2</sub> )
Oil lubricated	Good
Grease lubricated	Fair
Water lubricated	Not recommended
Process fluid lubricated	Not recommended

#### BEARING PROPERTIES

#### UNITS

#### VALUE

##### GENERAL

Maximum load, P	Static	N/mm <sup>2</sup>	20
	Dynamic	N/mm <sup>2</sup>	10
Operating temperature	Min	°C	-180 / 0*
	Max	°C	90 / 300*
Minimum density		g/cm <sup>3</sup>	6,2
Minimum apparent porosity		%	23

##### OIL IMPREGNATED

Maximum sliding speed, V		m/s	0,1 - 6,0*
Maximum PV factor		N/mm <sup>2</sup> x m/s	0,1 - 1,8*
Coefficient of friction, f			0,05 - 0,25*

##### RECOMMENDATIONS

Shaft surface roughness, Ra		µm	≤ 0,3 - ≤ 0,6*
Shaft surface hardness		HB	> 240 - > 355*

Bearing properties depending on oil or solid lubricants



# GGB-FP20 Bearing Material



## METAFRAM OIL IMPREGNATED SINTERED IRON BEARINGS

### CHARACTERISTICS

- Similar to SINT A 50, impregnation group 1
- Maintenance-free bearing for general engineering applications
- Optimum performance under relatively light loads and high speeds
- Produced by powder metallurgy process and therefore suitable for complex shapes



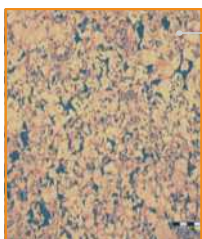
### AVAILABILITY

**Non-standard parts made-to-order:** plain cylindrical bushes, plain flanged bushes, non standard parts

### APPLICATIONS

**Industrial:** FHP motor bearings, domestic appliances and hand tools

### MICROSECTION



Cu 1 - 4 %  
C < 0,25 %  
Other < 2%  
Rest Fe  
Impregnation group 1 (up to 80°C)

### OPERATING PERFORMANCE

<b>Dry</b>	Good (PTFE / MoS <sub>2</sub> )
<b>Oil lubricated</b>	Good (Oil impregnated)
<b>Grease lubricated</b>	Not recommended
<b>Water lubricated</b>	Not recommended
<b>Process fluid lubricated</b>	Not recommended

### BEARING PROPERTIES

#### GENERAL

		UNITS	VALUE
<b>Maximum load, P</b>	Static	N/mm <sup>2</sup>	45
	Dynamic	N/mm <sup>2</sup>	8,0 - 22,5
<b>Operating temperature</b>	Min	°C	-180 / -5*
	Max	°C	90 / 300*
<b>Minimum density</b>		g/cm <sup>3</sup>	5,6
<b>Minimum apparent porosity</b>		%	20

#### OIL IMPREGNATED

<b>Maximum sliding speed, V</b>		m/s	0,1 - 4,0*
<b>Maximum pU factor</b>		N/mm <sup>2</sup> x m/s	0,1 - 1,8*
<b>Coefficient of friction, f</b>			0,05 - 0,25*

#### RECOMMENDATIONS

<b>Shaft surface roughness, Ra</b>		µm	≤ 0,2 - ≤ 0,3*
<b>Shaft surface hardness</b>		HB	> 240 - > 355*

Bearing properties depending on oil or solid lubricants

## GGB-S016 Bearing Material



### METAFRAM OIL IMPREGNATED SINTERED IRON BEARINGS

#### CHARACTERISTICS

- Maintenance-free bearing for general engineering applications
- Superior performance compared to GGB-FP20 under high loads and low speeds
- Produced by powder metallurgy process and therefore suitable for complex shapes



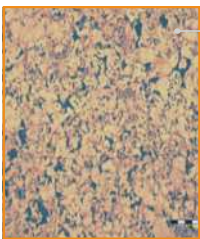
#### AVAILABILITY

Blanks are made-to-order

#### APPLICATIONS

**Industrial:** FHP motor bearings, domestic appliances and hand tools, heavy duty applications: construction equipment, railway equipment, military equipment

#### MICROSECTION



Cu 20 %  
C 0,3 - 0,6 %  
Other < 2%  
Rest Fe

#### OPERATING PERFORMANCE

<b>Dry</b>	Not applicable
<b>Oil lubricated</b>	Good (Oil impregnated)
<b>Grease lubricated</b>	Not recommended
<b>Water lubricated</b>	Not recommended
<b>Process fluid lubricated</b>	Not recommended

#### BEARING PROPERTIES

#### UNITS

#### VALUE

##### GENERAL

<b>Maximum load, P</b>	Static	N/mm <sup>2</sup>	120
	Dynamic	N/mm <sup>2</sup>	60
<b>Operating temperature</b>	Min	°C	0
	Max	°C	105
<b>Minimum density</b>		g/cm <sup>3</sup>	6
<b>Minimum apparent porosity</b>		%	16

##### OIL IMPREGNATED

<b>Maximum sliding speed, V</b>		m/s	0,3
<b>Maximum PV factor</b>		N/mm <sup>2</sup> x m/s	0,9
<b>Coefficient of friction, f</b>			0,05 - 0,15*

##### RECOMMENDATIONS

<b>Shaft surface roughness, Ra</b>		µm	≤ 0,2*
<b>Shaft surface hardness</b>		HB	> 355

Bearing properties depending on oil or solid lubricants

# GGB-SHB® Bearing Material



## CASE HARDENED STEEL BEARINGS

### CHARACTERISTICS

- For lubricated applications
- With plain or grooved sliding layer
- Suitable for grease lubrication
- Low rotation speed with high specific pressure



### AVAILABILITY

**Bearing forms available in standard dimensions:**

- Plain cylindrical bushes

**Non-standard parts made-to-order:** bearings with various lubrication grooves, non-standard parts

### APPLICATIONS

**Industrial:** Earth moving machinery, excavators and loaders, farming machinery, power harrows, ploughs and harvesters, grabs, buckets and grippers, hydraulic cylinders for the protection against wear of bottoms and eyelets, industrial washing machines, sliding guides for industrial presses, suction pumps, sliding seats, machine tools

### MICROSECTION



Steel E410, E470 (20MnV6, AISI A381) acc. to EN 10305

### OPERATING PERFORMANCE

Dry	Poor
Oil lubricated	Good
Grease lubricated	Very good
Water lubricated	Not recommended
Process fluid lubricated	Depending on fluid

### BEARING PROPERTIES

#### GENERAL

		UNITS	VALUE
Maximum load, P	Static	N/mm <sup>2</sup>	300
	Dynamic	N/mm <sup>2</sup>	150
Tensile strength		N/mm <sup>2</sup>	550
Operating temperature	Min	°C	150
Density			7,8
Coefficient of linear thermal expansion		%	12

#### GREASE LUBRICATED

Maximum sliding speed, V		m/s	0,1
Maximum PV factor		N/mm <sup>2</sup> x m/s	1,5
Coefficient of friction, f			0,2

#### RECOMMENDATIONS

Shaft surface roughness, Ra		µm	≤ 0,8
Shaft surface hardness		HRC	58 - 62

Bearing properties depending on oil or solid lubricants

## AuGlide® Bearing Material



### BIMETAL LEAD-FREE PLAIN BEARINGS

#### CHARACTERISTICS

- Lead-free
- Machinable
- Design freedom – customizable to meet specific indentation and shape needs
- Capable of supporting high specific loads and high temperatures
- Excellent fatigue strength under dynamic and shock load conditions
- Excellent wear resistance
- Suitable for hydrodynamic operation
- Suitable for oil and grease lubrication
- Superior performance under oscillating movement

#### MICROSECTION



#### OPERATING PERFORMANCE

Dry	Poor
Oil lubricated	Good
Grease lubricated	Very good
Water lubricated	Poor
Process fluid lubricated	Poor



#### AVAILABILITY

**Bearing forms made-to-order:** Cylindrical bushes and sliding plates with non-standard dimensions, RoHS customized bearing designs

#### APPLICATIONS

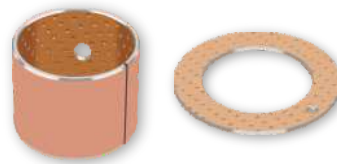
**Automotive:** Transmissions, king pin, truck brake caliper

**Industrial:** Agricultural machinery, earth-movers, textile machinery, pneumatic equipment, mechanical handling and lifting equipment, hydraulic cylinders, offhighway equipment, and many more.

- Thin-wall construction permits compact bearing assembly
- Indents in the bearing surface provide a reservoir for grease and thus allow extended re-greasing

BEARING PROPERTIES		UNITS	VALUE
<b>GENERAL</b>			
<b>Maximum load, P</b>	Static	N/mm <sup>2</sup>	300
	Dynamic	N/mm <sup>2</sup>	140
<b>Operating temperature</b>	Min	°C	- 40
	Max greased	°C	150
	Max oil lubricated	°C	250
<b>OIL LUBRICATED</b>			
<b>Maximum sliding speed, V</b>		m/s	2,5
<b>Maximum PV factor</b>		N/mm <sup>2</sup> x m/s	2,8
<b>Coefficient of friction, f</b>	Greased		0,05 - 0,12
	Oil		0,04 - 0,12
<b>RECOMMENDATIONS</b>			
<b>Shaft surface roughness, Ra</b>	Normal	µm	≤ 0,8
<b>Shaft surface hardness</b>	Normal		> 200 HB
	For longer service life		> 350 HB

# SY Bearing Material



## BIMETAL PLAIN BEARINGS TO STANDARD SAE 792

### CHARACTERISTICS

- Bimetal bearing with steel backing and bronze overlay
- Particularly suitable for high specific loads with oscillating motion and low frequency
- Applicable in rough operation conditions
- High load capacity, very good resistance to fatigue strength at higher temperatures

### AVAILABILITY

**Bearing forms available in standard dimensions:**

- Cylindrical bushes
- Thrust washers

**Bearing forms made-to-order:** Cylindrical bushes and thrust washers with non-standard dimensions, sliding plates, customized bearing designs

### APPLICATIONS

**Industrial:** Mechanical handling and lifting equipment, hydraulic cylinders, agricultural equipment, off highway equipment etc.

### MICROSECTION



Sliding Layer with Lubrication Indents  
CuPb10Sn10 consists of Approx. Cu 80 % Pb 10 % Sn 10 %  
Steel Backing

### OPERATING PERFORMANCE

Dry	Poor
Oil lubricated	Good
Grease lubricated	Very good
Water lubricated	Poor
Process fluid lubricated	Poor

### BEARING PROPERTIES

### UNITS

### VALUE

#### GENERAL

Maximum load, P	Static	N/mm <sup>2</sup>	300
	Dynamic	N/mm <sup>2</sup>	140
Operating temperature	Min	°C	-40
	Max greased	°C	150
	Max oil lubricated	°C	250

#### OIL IMPREGNATED

Maximum sliding speed, V		m/s	2,5
Maximum PV factor		N/mm <sup>2</sup> x m/s	2,8
Coefficient of friction, f	Greased		0,05 - 0,12
	Oil lubricated		0,04 - 0,12

#### RECOMMENDATIONS

Shaft surface roughness, Ra		µm	≤ 0,8
Shaft surface hardness	Normal	HB	> 200
	For longer service life	HB	> 350

Bearing properties depending on oil or solid lubricants

## SP Bearing Material



### BIMETAL PLAIN BEARINGS TO STANDARD SAE 794

#### CHARACTERISTICS

- Bimetal bearing with steel backing and leaded bronze overlay
- For lubricated applications with plain sliding layer
- Suitable for oil and grease lubrication

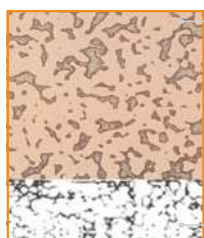
#### AVAILABILITY

**Bearing forms made-to-order:** Cylindrical bushes, thrust washers, sliding plates, customized bearing designs

#### APPLICATIONS

**Industrial:** Mechanical handling and lifting equipment, machine slides, hydraulic cylinders, hydraulic motors, pneumatic equipment, medical equipment, textile machinery, agricultural equipment, etc.

#### MICROSECTION



Sliding Layer

CuPb26Sn2 consists of Approx.  
Cu 72 %  
Pb 26 %  
Sn 2 %

Steel Backing

#### OPERATING PERFORMANCE

Dry	Poor
Oil lubricated	Good
Grease lubricated	Good
Water lubricated	Poor
Process fluid lubricated	Poor

#### BEARING PROPERTIES

#### UNITS

#### VALUE

##### GENERAL

Maximum load, P	Static	N/mm <sup>2</sup>	250
	Dynamic	N/mm <sup>2</sup>	120
Operating temperature	Min	°C	-40
	Max greased	°C	150
	Max oil lubricated	°C	250

##### GREASED / OIL LUBRICATED

Maximum sliding speed, V		m/s	2,5
Maximum PV factor		N/mm <sup>2</sup> x m/s	2,8
Coefficient of friction, f	Greased		0,05 - 0,12
	Oil lubricated		0,04 - 0,12

##### RECOMMENDATIONS

Shaft surface roughness, Ra		µm	≤ 0,4
Shaft surface hardness	Normal	HB	> 200
	For longer service life	HB	> 350

Bearing properties depending on oil or solid lubricants

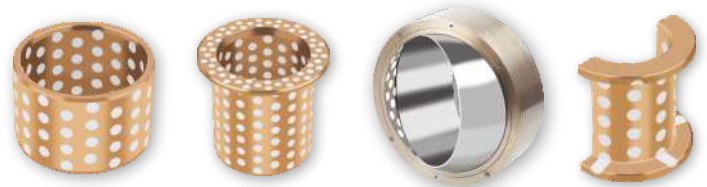
# GGB-DB<sup>®</sup> Bearing Material



## CAST BRONZE BEARINGS WITH SOLID LUBRICANT INSERTS

### CHARACTERISTICS

- Maintenance-free bearing material for heavy duty applications
- Excellent performance under high loads and intermittent operation
- Also available with graphite inserts for temperatures above 250°C



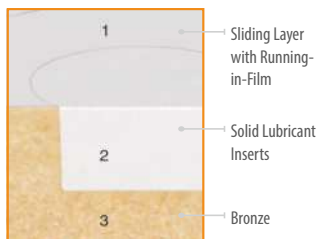
### AVAILABILITY

**Bearing forms made-to-order:** Cylindrical bushes, flanged bushes, thrust washers, sliding plates, pintle bearings, half-bearings, axial and radial segment rings, self-aligning spherical bearings, customized bearing designs

### APPLICATIONS

**Industrial:** Offshore industry, underwater equipment, bridges and civil engineering, iron and steel industry equipment, cranes and conveyors, deep and open cast mining equipment, construction and earthmoving equipment, etc.

### MICROSECTION



### OPERATING PERFORMANCE

Dry	Good
Oil lubricated	Good
Grease lubricated	Good
Water lubricated	Good
Process fluid lubricated	Fair

### BEARING PROPERTIES

### UNITS

### VALUE

#### GENERAL

Maximum load, P	Static	N/mm <sup>2</sup>	200
	Dynamic	N/mm <sup>2</sup>	100
Operating temperature	Min	°C	-50
	Max greased	°C	350

#### DRY

Maximum sliding speed, V	m/s	0,5
Maximum PV factor	N/mm <sup>2</sup> x m/s	1,5
Coefficient of friction, f		0,05 - 0,18

#### RECOMMENDATIONS

Shaft surface roughness, Ra	µm	0,2 - 0,8
Shaft surface hardness	Normal	HB > 200

## UNI Self-Aligning Bearing Housing



### SELF-ALIGNING PILLOW BLOCK BEARING HOUSING

#### CHARACTERISTICS

- Adjusting bearing for misalignment equalisation
- All-purpose as flange or pedestal bearing, suitable for high loads
- Self-aligning spheric avoids edge load to the bearing
- Adjustable up to  $\pm 5^\circ$
- Spheric is secured against distortion
- Depending on choice of housing, spherics and bearings, simple to most demanding bearing solutions are possible
- For optimum design solutions, various bearings from the GGB product program are applicable



Housing Material: **GGG40**  
 Spherical Material: **16MnCr5**  
**Corrosion-resistant material possible**

#### AVAILABILITY

**Made-to-order**

#### APPLICATIONS

**Industrial:** Wind energy plants, car washes, cleaning machines, drum systems, bevelling equipment, handling systems, conveyor belts (pulleys), printing machines, heating and ventilation equipment, hoists, cranes, textile machinery, special machine engineering, bakery equipment, marine equipment

#### LOAD LIMIT VALUES FOR RADIAL FORCES

SIZE	BUSH ID	MAX RADIAL LOAD [N] (HOUSING)	MAX RADIAL LOAD [N] (BOLT)	MAX SHEAR OFF LOAD [N] (BOLT)
1	10 - 25	20 000	10 000	1 000
2	28 - 40	30 000	15 000	1 500
3	45 - 60	50 000	25 000	2 500
4	65 - 80	90 000	45 000	4 500
5	85 - 100	125 000	62 500	6 000

The given data for UNI bearing housings are valid for 12.9 screws (DIN EN 20898, part 1), since the housing stability exceeds the permissible load of the fixing screws.



# MINI Self-Aligning Bearing Housing



## SELF-ALIGNING PILLOW BLOCK BEARING HOUSING

### CHARACTERISTICS

- Adjusting bearing for misalignment equalisation
- All-purpose as flange or pedestal bearing, suitable for high loads
- Self-aligning spheric avoids edge load to the bearing
- Adjustable up to  $\pm 5^\circ$
- Spheric is secured against distortion
- Depending on choice of housing, spherics and bearings, simple to most demanding bearing solutions are possible
- For optimum design solutions, various bearings from the GGB product program are applicable



Housing Material: **AlMgSi12**  
 Spherical Material: **9SMn28K**  
**Stainless steel and other materials available**

### AVAILABILITY

**Made-to-order**

### APPLICATIONS

**Industrial:** Wind energy plants, car washes, cleaning machines, drum systems, bevelling equipment, handling systems, conveyor belts (pulleys), printing machines, heating and ventilation equipment, hoists, cranes, textile machinery, special machine engineering, bakery equipment, marine equipment

### LOAD LIMIT VALUES FOR RADIAL FORCES

SIZE	BUSH ID	MAX RADIAL LOAD [N] (HOUSING)	MAX RADIAL LOAD [N] (BOLT)	MAX SHEAR OFF LOAD [N] (BOLT)
0	8 - 15	10 000	5 000	500

The permissible loads for MINI bearings housings are defined by the housing stability or the strength of the fixing screws (6mm diameter), depending on the load direction.

## EXALIGN® Self-Aligning Bearing Housing



### SELF-ALIGNING PEDESTAL AND FLANGE BEARING HOUSING

#### CHARACTERISTICS

- Adjusting bearing for misalignment equalisation
- All-purpose as flange (EXALIGN® DF and FL) or pedestal bearing (EXALIGN® PB), suitable for high loads
- Self-aligning spheric avoids edge load to the bearing
- Adjustable up to  $\pm 5^\circ$
- Spheric is secured against distortion
- Depending on choice of housing, spherics and bearings, simple to most demanding bearing solutions are possible
- For optimum design solutions, various bearings from the GGB product program are applicable



Housing Material: **Cast Iron**

Spherical Material: **Cast Iron**

**Corrosion-free and corrosion-resistant models possible**

#### AVAILABILITY

**Made-to-order**

#### APPLICATIONS

**Industrial:** Wind energy plants, car washes, cleaning machines, drum systems, bevelling equipment, handling systems, conveyor belts (pulleys), printing machines, heating and ventilation equipment, hoists, cranes, textile machinery, special machine engineering, bakery equipment, marine equipment

LOAD LIMIT VALUES FOR RADIAL FORCES		TYPE PB 2-HOLE PEDESTAL BEARING	TYPE FL/DF 4-HOLE / 2-HOLE FLANGE BEARING
SIZE	BUSH ID	MAX RADIAL LOAD [N]	MAX RADIAL LOAD [N]
1	10 - 15	4 250	3 750
2	20 - 25	7 700	5 900
3	30	9 500	8 000
4	35 - 40	17 000	11 000
5	45	23 000	12 000
6	50	25 000	14 500
7	55 - 60	30 000	16 000
8	70 - 75	38 000	17 000
9	80 - 85	45 500	27 000
10	90 - 100	74 500	30 500

# 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	$S_s$	

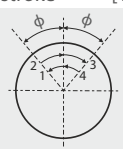
### LOAD

- 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]	
Frequency of stroke	[1/min]	
Oscillating cycle	$\phi$ [°]	



Osc. frequency	$N_{osz}$ [1/min]	
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### MATING SURFACE

Material		
Hardness	HB/HRC	
Surface finish	Ra [μm]	

### CUSTOMER INFORMATION

Company \_\_\_\_\_  
 Street \_\_\_\_\_  
 City / State / Province / Post Code \_\_\_\_\_  
 Telephone \_\_\_\_\_ Fax \_\_\_\_\_  
 Name \_\_\_\_\_  
 Email Address \_\_\_\_\_ Date \_\_\_\_\_

### 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

### LUBRICATION

- Dry  
 Continuous lubrication  
 Process fluid lubrication  
 Initial lubrication only  
 Hydrodynamic conditions

Process fluid		
Lubricant		
Dynamic viscosity	$\eta$ [mPas]	

### SERVICE HOURS PER DAY

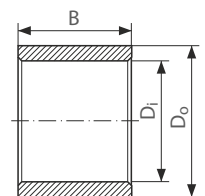
Continuous operation		
Intermittent operation		
Operating time		
Days per year		

### SERVICE LIFE

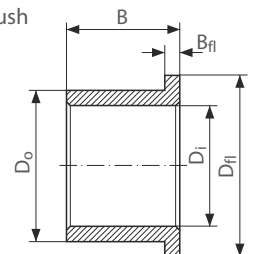
Required service life	$L_H$ [h]	
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### BEARING TYPE

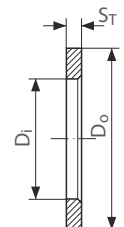
- Cylindrical bush



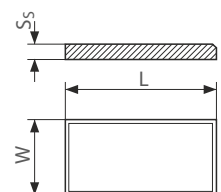
- Flanged bush



- Thrust washer



- Slideplate



- Special parts (sketch)

# Product Information

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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: <https://www.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 2025. 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: <https://www.ggbearings.com/en/company/certificates>.

A detailed explanation of our commitment to REACH and RoHS directives can be found at <https://www.ggbearings.com/en/company/quality-and-environment>.

## POLYMER FUMES

At temperatures up to 250°C the polytetrafluoroethylene (PTFE) present in the lining material is completely inert so that even on the rare occasions in which DP4, DP4-B, DP10 or DP11 bushes are drilled or sized after assembly there is no danger in boring or burnishing.

At higher temperatures however, small quantities of toxic fumes can be produced and the direct inhalation of these can cause an influenza type of illness which may not appear for some hours but which subsides without after-effects in 24-48 hours.

Such fumes can arise from PTFE particles picked up on the end of a cigarette. Therefore smoking should be prohibited where DP4, DP4-B, DP10 or DP11 are being machined.

## TRADEMARKS

GGB®, TriboShield®, TriboMate®, DP4, DP4-B, DU®, DU-B, DP10, DP11, DP31, DX®, DX®10, HI-EX®, DTS10®, DS, EP®, EP®12, EP®15, EP®22, EP®30, EP®43, EP®44, EP®63, EP®64, EP®73, EP®79, FLASH-CLICK®, KA Glacetal, Multilube, GAR-MAX®, GAR-FIL®, HSG, MLG, HPM, HPMB®, HPF®, GGB-MEGALIFE® XT, Multifil, SBC with GAR-MAX®, SBC with HSG, GGB-CSM®, GGB-CBM®, GGB-BP25, GGB-FP20, GGB-SHB, GGB-SO16, AuGlide®, SY, SP, GGB-DB®, UNI, MINI and EXALIGN® are registered trademarks or trademarks, as the case may be, of GGB and its affiliates. TIMKEN® is a registered trademark of The Timken Company.

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# Stronger. Together.



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