Plain Bearings
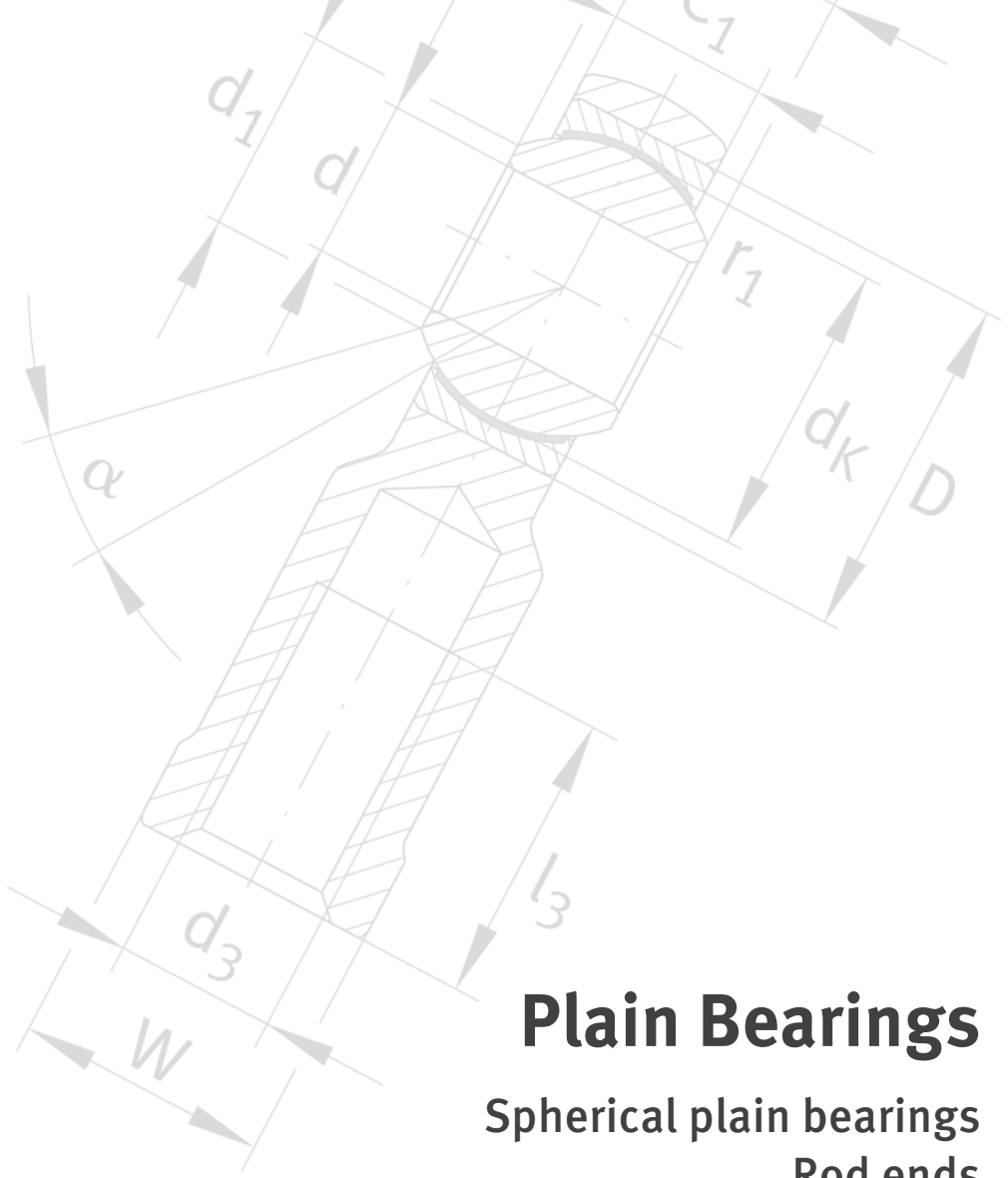
Spherical plain bearings
Rod ends
Plain bushes
Thrust washers, strips

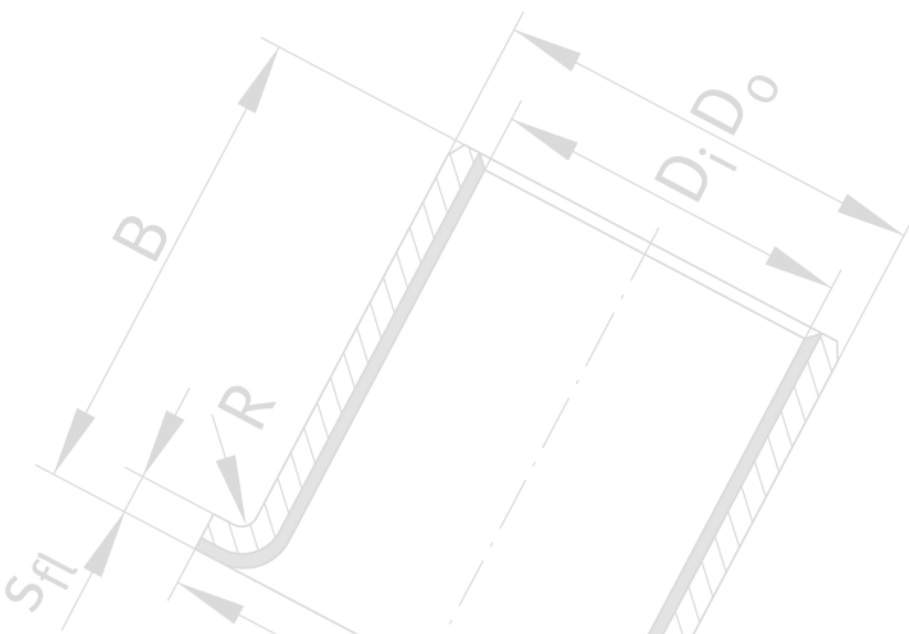**SCHAEFFLER**

Plain Bearings

Spherical plain bearings
Rod ends
Plain bushes
Thrust washers, strips

Foreword

Schaeffler Technologies

Schaeffler Technologies with its brands INA and FAG is a leading worldwide supplier of rolling bearings, spherical plain bearings, plain bearings, linear products, accessories specific to bearings and comprehensive maintenance products and services. Schaeffler has approximately 40 000 catalogue products manufactured as standard, providing an extremely wide portfolio that gives secure coverage of applications from all 60 designated industrial market sectors.

The central factors responsible for this success are our outstanding strength in innovation, our global focus on local customer proximity, highly developed manufacturing methods, extremely high quality standards in all processes and our ability to transform specific customer requirements quickly and accurately into cost-effective solutions. Against this background of expertise, knowledge and experience together with our wide range of catalogue items, we see ourselves as a high performance, customer focussed partner.

Research and development

As a company looking to the future, we are especially active in the field of research and development. The key areas in this respect include not only research into fundamental principles, materials technology, tribology and calculation but also extensive inspection and test methods as well as activities to optimise manufacturing technology. This is oriented towards ensuring the continuous development, improvement and application of our products in the long term.

We carry out research and development on a global basis. Our development centres are linked with each other worldwide and are thus in a position to exchange current information on a very short timescale as well as access and communicate the most recent data. This ensures that a uniform level of knowledge and information is available worldwide.

In addition to continued development of standard products, we work closely in research and development activities with our customers where specific customer solutions are required. They can thus benefit from the best product for their application, with the maximum possible performance capacity at a cost-effective price.

Foreword

**Quality,
manufacturing technology,
environmental protection**

"Zero defects" is our quality objective. We have matched all our processes to this target. In addition, our many years of experience in forming, forging, heat treatment, surface technologies, grinding, honing and assembly ensures that our products fulfil the required quality level.

Ongoing quality inspections are a defined component of the manufacturing process. These are integrated directly as a feedback function in the manufacturing process. This ensures that all products continuously fulfil the same high standard of quality.

The quality of our products and processes is certified; for example, all manufacturing facilities are certified in accordance with DIN EN ISO 9001 and ISO/TS 16949.

With the validation and certification of our manufacturing sites, we are taking a pioneering role in environmental protection. All larger manufacturing sites are certified to ISO 14001 and are also validated in accordance with the more stringent EC Eco-Management and Audit Scheme (EMAS).

Worldwide presence

Through a closely knit network of development and manufacturing sites, sales companies and an international distribution structure, we are represented throughout the world. This global presence ensures effective linkage between the major markets in Europe, India, South East Asia/Pacific Region, East Asia, North and South America.

As a result, we have an on-site presence with service and technical advice in close proximity to the customer.

We take orders from throughout the world and make deliveries worldwide too. Furthermore, we support our customers worldwide in resolving their bearing arrangement requirements, respond to technical queries and develop specific bearing arrangement solutions in local partnership with our customers.

Plain bearings catalogue HG 1

Catalogue HG 1, Plain Bearings, describes the product range of spherical plain bearings, rod ends, plain bushes, thrust washers and strips of the INA brand. It incorporates the complete revision of Catalogue 238 and Catalogue 706 as well as other products such as ELGOTEX plain bearings.

An engineering compendium

Since the introduction of the spherical plain bearing, INA spherical plain bearings and INA rod ends have had a decisive influence on the development and technological progress of these precision components. This has led to extensive product innovations and many pioneering applications only became possible due to the know-how of the company group. Furthermore, the new maintenance-free ELGOGLIDE bearings – as spherical plain bearings or combinations of radial, angular contact and axial bearings – continue in the tradition of this product group for state-of-the-art engineering and economical bearing solutions.

Spherical plain bearings and rod ends

Spherical plain bearings are ready-to-fit precision machine elements. Due to the outer ring with its concave inner slideway and the inner ring with its curved outer slideway, they can perform spatial adjustment motions. The bearings can support static loads and are suitable for tilt and swivel motion. They can compensate for shaft misalignment, are not subject to edge stresses under misalignment and allow substantial manufacturing tolerances in the adjacent construction.

Rod ends are spherical plain bearing units. They comprise a housing and integral shank, into which a spherical plain bearing is integrated, and have an external or internal thread. Rod ends are used as connecting levers and connecting rods and as connecting elements between cylinders and their adjacent parts in hydraulic and pneumatic cylinders.

Spherical plain bearings and rod ends are available in numerous designs, dimension series and versions. They have high operational security and a long operating life. Maintenance-free versions are available with the sliding layers ELGOGLIDE, PTFE composite and PTFE film. Versions requiring maintenance have steel/steel or steel/bronze sliding contact surfaces and can be easily relubricated.

Plain bushes, thrust washers and strips

Plain bushes, thrust washers and strips are used not only for rotary and oscillating motion but also for linear motion with short or long stroke lengths. In the case of maintenance-free bearings with the sliding material E40, lubrication is not necessary at any point during the operating life due to the use of PTFE as a dry lubricant. The low-maintenance bearings with the sliding material E50 receive an initial lubrication at the start of operation. Since the sliding layer has lubrication pockets, this initial lubrication is sufficient in most cases.

All metal/polymer composite plain bearings are free from lead in accordance with the End of Life Vehicles Directive, Directive 2000/53/EC as well as the Directive 2011/65/EU (RoHS-II) for the restriction of hazardous substances. They are thus environmentally safe.

In addition to the polymer composite plain bearings with the sliding materials E40 and E50, there are also plain bushes with ELGOGLIDE and ELGOTEX filament wound bushes.

Current level of technology

The data represent the state of current technology and manufacture as at March 2016. They take account of the progress in bearing technology as well as the experience gained in numerous applications.

Any data in earlier publications that do not correspond to the data in this catalogue are therefore invalid.

Foreword

Definition of the Attention symbol

This catalogue gives descriptions of standard and special bearings. Since these are used in numerous applications, we cannot make a judgement as to whether any malfunctions will cause harm to persons or property.

Follow instructions

It is always and fundamentally the responsibility of the designer and user to ensure that all specifications are observed and that all necessary information is communicated to the end user. This applies in particular to applications in which product failure and malfunction may constitute a hazard to human beings.

If guidelines marked with the Attention symbol are not observed, damage or malfunctions in the product or the adjacent construction may occur.

X-life is the premium brand of Schaeffler. Plain bearings identified as X-life have even higher performance materials, lower coefficients of friction and lower running-in wear than comparable bearings. X-life bearings are described in the sections on product features and are indicated in the dimension tables by the symbol XL.

**Product ranges
for specific market sectors**

Special product ranges are available for specific market sectors. In addition to standard products, these include a large number of special solutions. The range extends from simple, application-specific bearings via complete, ready-to-fit systems to special solutions that can be used to fulfil the most complex bearing technology requirements with high functional security and cost-effectiveness.

Contact our External Sales at the earliest possible stage and benefit from the broad knowledge and considerable experience of these specialists for your project.

***medias*®** *professional*
electronic information system

***medias*®** *professional*, the proven selection and information system, presents the INA and FAG catalogue products in electronic format. As with the printed catalogue, this gives our customers product information on both brands in a single data source. This saves time and gives easier handling.

***medias*®** *professional* is available online and in download form in several languages, is easy to navigate and is particularly clear thanks to the use of numerous images, diagrams and models. There are also highly representative application examples, classified by market sector.

Datasheets on the bearing series can be generated as PDF files. It includes a lubricant database and also the web2CAD link for direct download and integration of 3D models.

***medias*®** *professional* focusses on the individual bearing. The complete shaft can be simulated and any influences arising from its deformation on the bearings can be determined using the calculation program BEARINX. This program can also be made available to direct customers as BEARINX-online via the Internet (for conditions, see the INA/FAG homepage).

In conclusion, ***medias*®** *professional* is a comprehensive, reliable system to help you help yourself answer many questions on rolling and plain bearing technology by electronic means, quickly and at any location.

Foreword

Other technical publications

This catalogue contains radial, angular contact and axial spherical plain bearings, rod ends, metal/polymer composite plain bearings in the form of plain bushes, thrust washers and strips as well as ELGOTEX plain bushes and other plain bearings.

Furthermore, we develop and manufacture many other products and systems that are of significant interest in terms of technical progress and cost-effectiveness for rotary and linear bearing arrangements as well as for the automotive sector. These are covered in separate technical publications that can be obtained upon request.

INA and FAG, when it comes to motion

Catalogue HG 1 stands for pioneering plain bearing technology, application-focussed advice, the highest product and performance density and continuous development.

The benefits to you are:
- selection of products from a vast product range
- the most suitable product in the right place
- worldwide availability of products
- short delivery times
- long term supply capability
- security of planning for the long view
- simplified stockholding
- market-competitive prices
- global service
- comprehensive, application-focussed advice.

Together we move the world

For us, technical progress means never standing still. In partnership with you, we are continually working on new solutions so that your vision and our technical ideas can continue to become a reality, to your benefit.

With our products and our knowledge, we can together continue to fulfil the challenges of your market in relation to bearing arrangements. To this end, this catalogue is an important instrument.

Contents

Product index

Product index

Product index

Product index

0015CE8	**Technical principles**
0001952C	**Spherical plain bearings** ■ Maintenance-free ■ Requiring maintenance
0001952F	**Rod ends** ■ Maintenance-free ■ Requiring maintenance
00019535	**Plain bushes** ■ Metal/polymer composite plain bearings ■ ELGOTEX filament wound bushes ■ ELGOGLIDE plain bushes
00019538	**Thrust washers, strips** ■ Metal/polymer composite plain bearings
00019D43	**Special materials** **Special designs**
00019EEB	**Mounting and maintenance**
00018048	**Addresses**
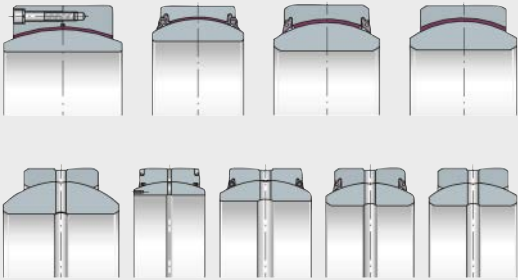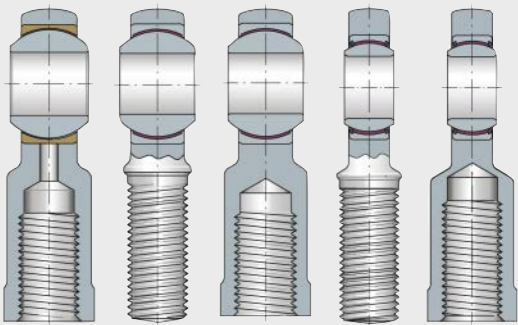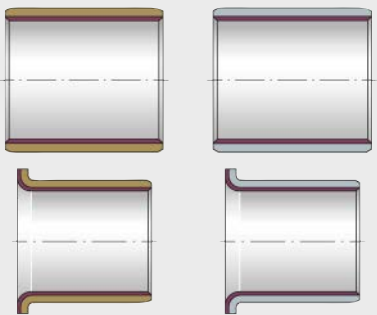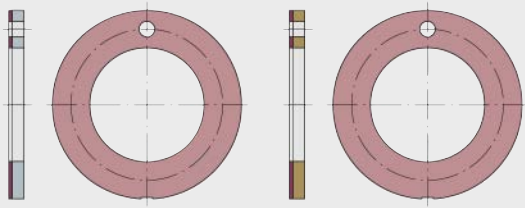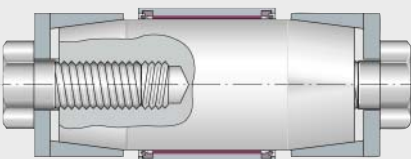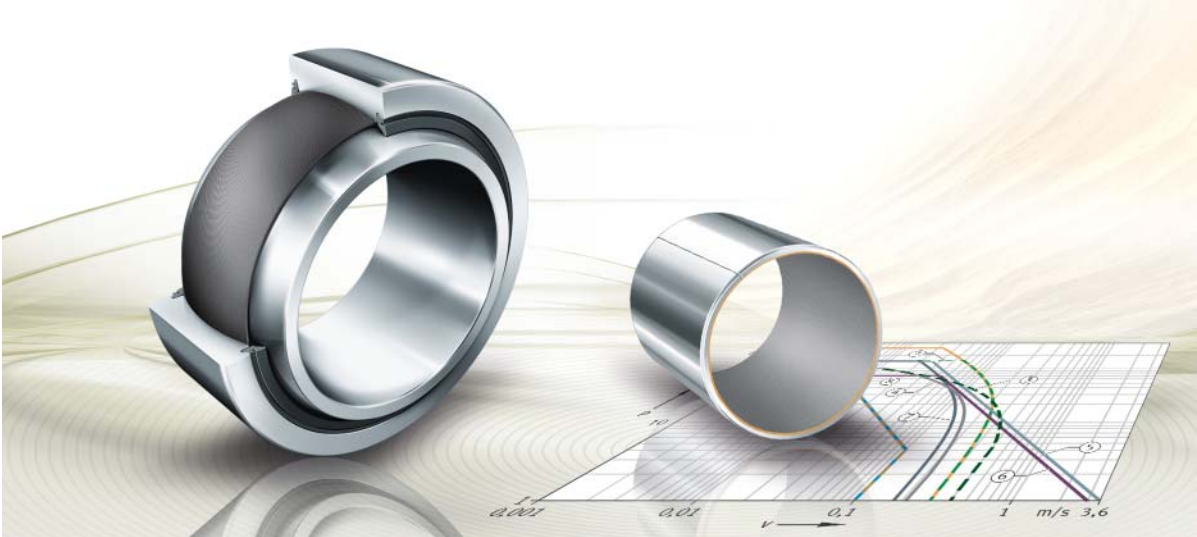
Technical principles

Selection of the correct plain bearing
Load carrying capacity and life
Friction and increases in temperature
Internal clearance and operating clearance
Design of bearing arrangements
Sealing
Mounting and dismounting
ISO tolerances

Technical principles

Technical principles

Selection of the correct plain bearing

Areas of application

Plain bearings from Schaeffler are used under high specific loads and various possible types of motion, from swivel type motion to overlaid motion. They are ideally suited to intermittent operation occurring on a periodic or non-periodic basis.

The plain bearings are bearings for very small radial or axial design envelopes where high load carrying capacity is nevertheless required. They can also be used under vibration coinciding with small amounts of motion. The bearings offer excellent damping characteristics especially under static loading, such as those required under shock loads.

Many of the plain bearings are destined for maintenance-free applications and in cases where long rating values are required.

Requirements of the application

Plain bearings from Schaeffler are available in various bearing types, designs and sizes as well as with different plain bearing materials.

Selection of the suitable bearing is dependent principally on the requirements of the application. These include:
- load conditions
  - type of load
  - direction of load
  - magnitude of load
- motion conditions
  - type of motion
  - direction of motion
  - frequency of motion
- adjacent construction
  - available design envelope
  - shaft, housing
- rating life requirement
- environmental influences
  - temperature
  - influence of media
  - contamination
  - lubrication.
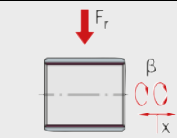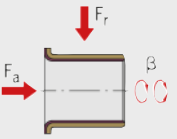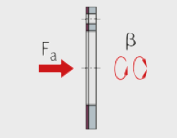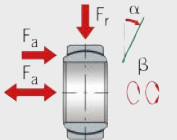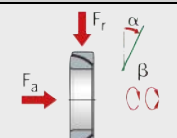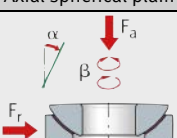
Selection by bearing type

Depending on the type of plain bearing and the typical geometrical structure in the particular case, there are different possibilities for support of load and degrees of freedom of motion. Some bearing types facilitate additional functions such as the compensation of angular misalignment, see table.

Selection of the suitable spherical plain bearing for combined load is dependent on the ratio between the radial and axial force, see page 38.

Support of load and degrees of freedom of motion

Bearing type	Load			Motion			Compensation of angular misalignments	
	F_r	F_a	F_a	β	α	x		
Bush	■	–	–	■	–	■	–	
Flanged bush	■	■	–	■	–	–	–	
Thrust washer	–	■	–	■	–	–	–	
Radial spherical plain bearing, rod end	■	■	■	■	■	–	■	
Angular contact spherical plain bearing	■	■	–	■	■	–	■	
Axial spherical plain bearing	■	■	–	■	■	–	■	

Selection of the correct plain bearing

Sizes of bearing types   The catalogue range of plain bearings from Schaeffler covers a range of shaft diameters from 3 mm to 1 000 mm, see table. The size required is dependent principally on the adjacent construction and the loads to be supported.

For an initial estimate of the size of spherical plain bearing required, predimensioning can be carried out, see page 31.

Shaft diameters in catalogue range

Bearing type	Shaft diameter	
	min. mm	max. mm
Bushes	3	300
Flanged bushes	6	40
Radial spherical plain bearings	6	320
Large radial spherical plain bearings	220	1 000
Rod ends	5	80
Hydraulic rod ends	10	200
Thrust washers	10	62
Angular contact spherical plain bearings	25	200
Axial spherical plain bearings	10	360

Selection by material suitability

The various bearing types are available in different material combinations, see table. The suitable material will depend on the required performance capability and the environmental influences.

Based on the specific material combinations, bearing solutions can be achieved that are maintenance-free, low-maintenance or that require maintenance, see table.

Combinations of bearing type and material

Bearing type	Combination with sliding layer, sliding contact surface[1]							
	PTFE film	PTFE composite	Steel/ bronze	Steel/ steel	ELGOGLIDE	ELGOTEX	E40	E50
Radial spherical plain bearings	■	■	■	■	■	–	–	–
Rod ends	■	■	■	■	■	–	–	–
Angular contact and axial spherical plain bearings	–	–	–	■	■	–	–	–
Thrust washers, strips	–	–	–	–	–	–	■	■
Flanged bushes	–	–	–	–	–	–	■	–
Bushes	–	–	–	–	■	■	■	■

[1] Other combinations are available by agreement.

Type of maintenance of materials

Type of maintenance	Sliding layer Sliding contact surface	Description Page
Maintenance-free	E40 (metal/polymer composite)	292
	ELGOTEX (filament reinforced wound material)	325
	ELGOGLIDE (PTFE fabric)	140
	PTFE composite (metal/polymer composite)	141
	PTFE film (PTFE/metal fabric)	141
Low-maintenance	E50 (metal/polymer composite)	357
Requiring maintenance	Steel/steel	176
	Steel/bronze	176

Selection of the correct plain bearing

Operating limits of plain bearing materials

The suitability of a plain bearing material can be estimated from the particular operating limits of the specific bearing load, *Figure 1*.

Further operating limits are determined from the comparison of sliding velocity, see table, page 29, the pv diagram, *Figure 2*, page 29, the temperature resistance, *Figure 3*, page 29, and the coefficient of friction, table, page 71.

Schaeffler recommends the use of the sliding layer ELGOGLIDE under dynamic bearing loads in the range from 25 N/mm^2 to 300 N/mm^2.

The sliding layer ELGOGLIDE-W11 should be used in preference in the range from 1 N/mm^2 to 100 N/mm^2. If the specific load is outside these ranges, the other ELGOGLIDE sliding layer is recommended.

For static loads of more than 180 N/mm^2, the design of ELGOTEX filament wound bushes must be checked by the Schaeffler engineering service. For loads at or over this range, we alternatively recommend the use of ELGOGLIDE plain bushes.

The actual load carrying capacity of a plain bearing is dependent on the material of the sliding layer and the supporting body as well as on the bearing geometry and the adjacent construction. The data and guidelines in the product chapters must be observed.

p = specific bearing load (this may differ from the specific load parameter K)

p$_{stat.}$ = static load
p$_{dyn.}$ = dynamic load

① ELGOGLIDE
② ELGOGLIDE-W11
③ PTFE composite
④ PTFE film
⑤ E40
⑥ E50
⑦ ELGOTEX
⑧ Steel/steel
⑨ Steel/bronze
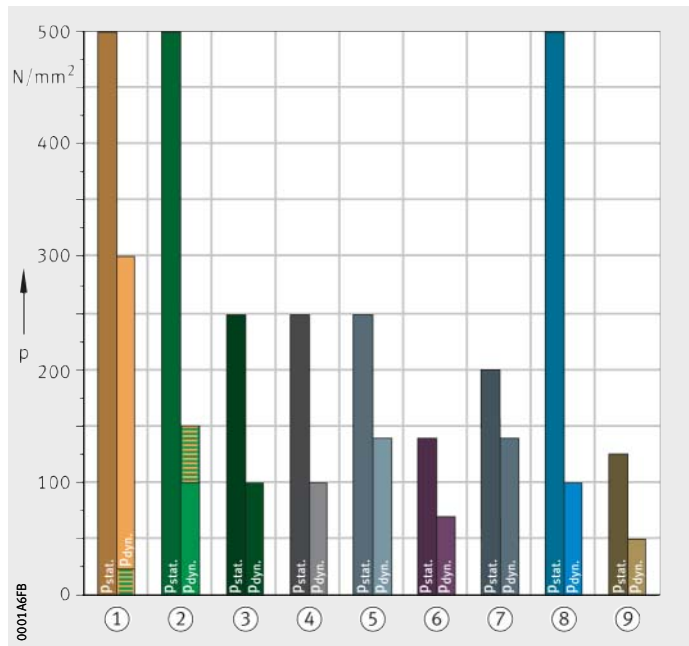
Figure 1
Comparison of specific bearing load

Comparison of sliding velocity

Sliding layer, sliding contact surface	Sliding velocity v m/s
E40	2,5
E50	2,5
ELGOTEX	0,18
ELGOGLIDE-W11	0,3
ELGOGLIDE	
PTFE composite	0,4
PTFE film	0,21
Steel/steel	0,1
Steel/bronze	0,1

p = specific bearing load
v = sliding velocity

① ELGOGLIDE
② ELGOGLIDE-W11
③ PTFE composite
④ PTFE film
⑤ E40
⑥ E50
⑦ ELGOTEX
⑧ Steel/steel
⑨ Steel/bronze

Figure 2
pv diagram
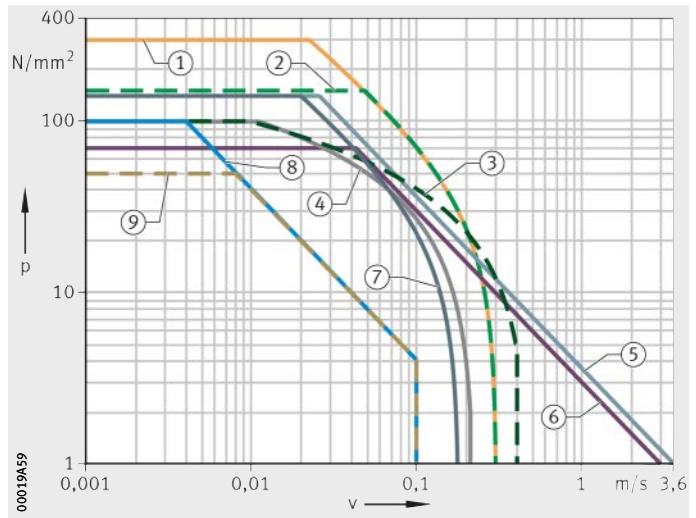
ϑ = temperature

① ELGOGLIDE
② ELGOGLIDE-W11
③ PTFE composite
④ PTFE film
⑤ E40
⑥ E50
⑦ ELGOTEX
⑧ Steel/steel
⑨ Steel/bronze

Figure 3
Comparison
of temperature resistance
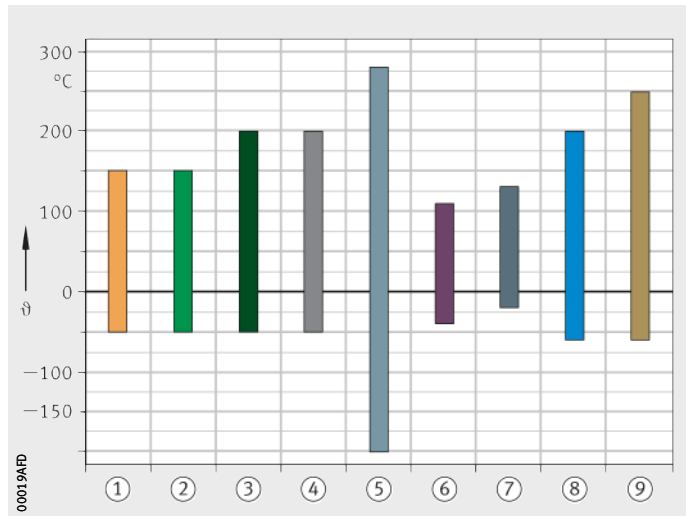
Selection of the correct plain bearing

Estimation of the sliding distance

If the rating life is the decisive selection criterion, a simple estimate of the achievable sliding distance can be made for maintenance-free and low-maintenance plain bearings. The sliding distance is the distance covered by the mating body along the sliding surface.

The failure mechanism of maintenance-free and low-maintenance plain bearing materials is based on wear. The sliding distance s can therefore be determined from a diagram as a function of the specific load p, *Figure 4*.

In the case of plain bearing materials requiring maintenance, the failure mechanism is based on material fatigue. An estimate of the sliding distance cannot therefore be made in the case of steel/steel and steel/bronze sliding contact surfaces.

! The achievable sliding distance applies if all other factors influencing the rating life are assumed to be ideal.

p = specific load
s = sliding distance

① ELGOGLIDE
② ELGOGLIDE-W11
③ PTFE composite
④ PTFE film
⑤ E40
⑥ E50
⑦ ELGOTEX
㉑ ELGOGLIDE is recommended

Figure 4
Sliding distance s
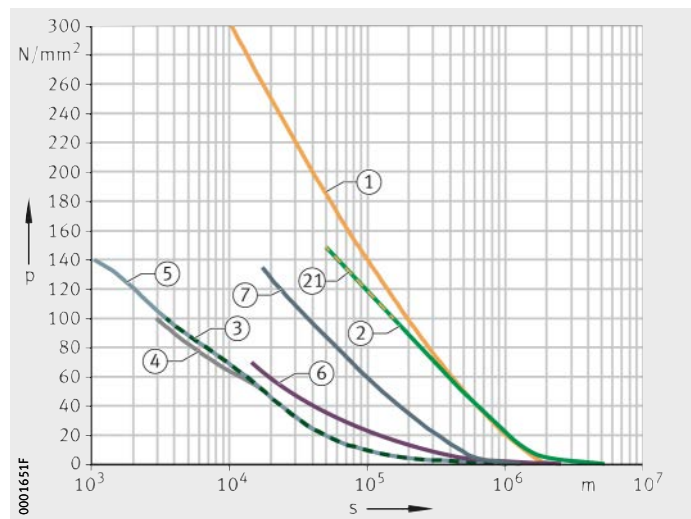
Predimensioning	In the case of spherical plain bearings, predimensioning can be carried out in order to estimate the bearing size.

Predimensioning of the bearing size is carried out on the basis of:
- the ratio C/P
  - basic load rating C, see dimension tables
  - bearing load P, see page 36
- the type of load (alternating or unilateral)
- the magnitude of the load
- the bearing series.

The ratio C_r/P or C_a/P is dependent on the series and must not be < 1.

Predimensioning for spherical plain bearings is not a substitute for more extensive bearing calculation.

For calculation of the rating life L_h in operating hours or oscillations taking account of the operating data applicable to the application, the rating life calculation method is available for almost all products, see page 47.

Maintenance-free spherical plain bearings

Guide values for C_r/P or C_a/P are used in conjunction with the diagram for preselection of the bearing size for maintenance-free spherical plain bearings under dynamic load, see table and *Figure 5*, page 32.

Guide values for the ratio C/P

Series	Dynamic load[1] C/P				
	Alternating		Unilateral		
	Suitability	from	Suitability	from	to
GE..-UK	○	$\geqq 2$	●	5	1
GE..-UK-2RS GE..-UK-2TS	●	$\geqq 2$			
GE..-DW GE..-DW-2RS2	●	> 2	●	3	1
GE..-FW	○	$\geqq 2$	●	5	1
GE..-FW-2RS GE..-FW-2TS	●	$\geqq 2$			
GE..-PW	○	$\geqq 2$	●	5	1
GE..-SW GE..-AW	●	$\geqq 2$	●	5	1

○   Suitable subject to restrictions
●   Suitable

[1] Dynamic load C_r/P for radial consideration, C_a/P for axial consideration.

Selection of the correct plain bearing

C/P = C_r/P or C_a/P
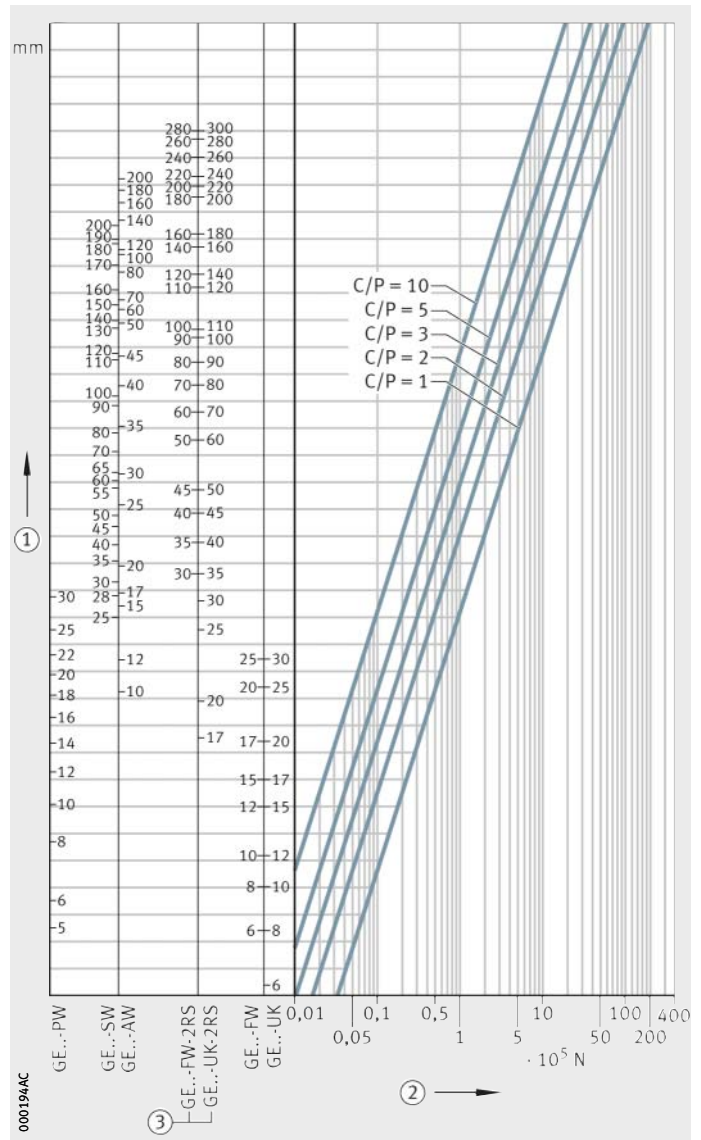
$C/P = C_r/P$ or C_a/P

① Nominal bearing size
② Bearing load
③ Also valid for 2TS designs

Figure 5
Predimensioning
of maintenance-free
spherical plain bearings

Spherical plain bearings requiring maintenance

If the basic dynamic load rating C_r or C_a is utilised to the full, there is often a considerable reduction in the operating life of the bearings. The degree to which the basic load rating is utilised should therefore always be matched to the required operating life.

Guide values for C_r/P or C_a/P are used in conjunction with the diagram for preselection of the bearing size for spherical plain bearings requiring maintenance under dynamic load, see table and *Figure 6*, page 34.

Guide values for the ratio C/P

Series	Dynamic load[1] C/P			
	Alternating		Unilateral	
	from	to	from	to
GE..-DO GE..-DO-2RS GE..-DO-2TS GE..-DO-2RS4 GE..-FO GE..-FO-2RS GE..-FO-2TS	3	1	4	1,7
GE..-PB	3	1	4	1
GE..-LO GE..-HO-2RS GE..-ZO	3	1	4	1,7
GE..-SX	3	1,5	4	2
GE..-AX	–	–	4	2

[1] Dynamic load C_r/P for radial consideration, C_a/P for axial consideration.

Selection of the correct plain bearing

① Nominal bearing size
② Bearing load
③ Also valid in the case of GE..-DO
for seal types 2RS, 2TS and 2RS4
and in the case of GE..-FO
for seal types 2RS and 2TS

$C/P = C_r/P$ or C_a/P

Figure 6
Predimensioning
of spherical plain bearings
requiring maintenance
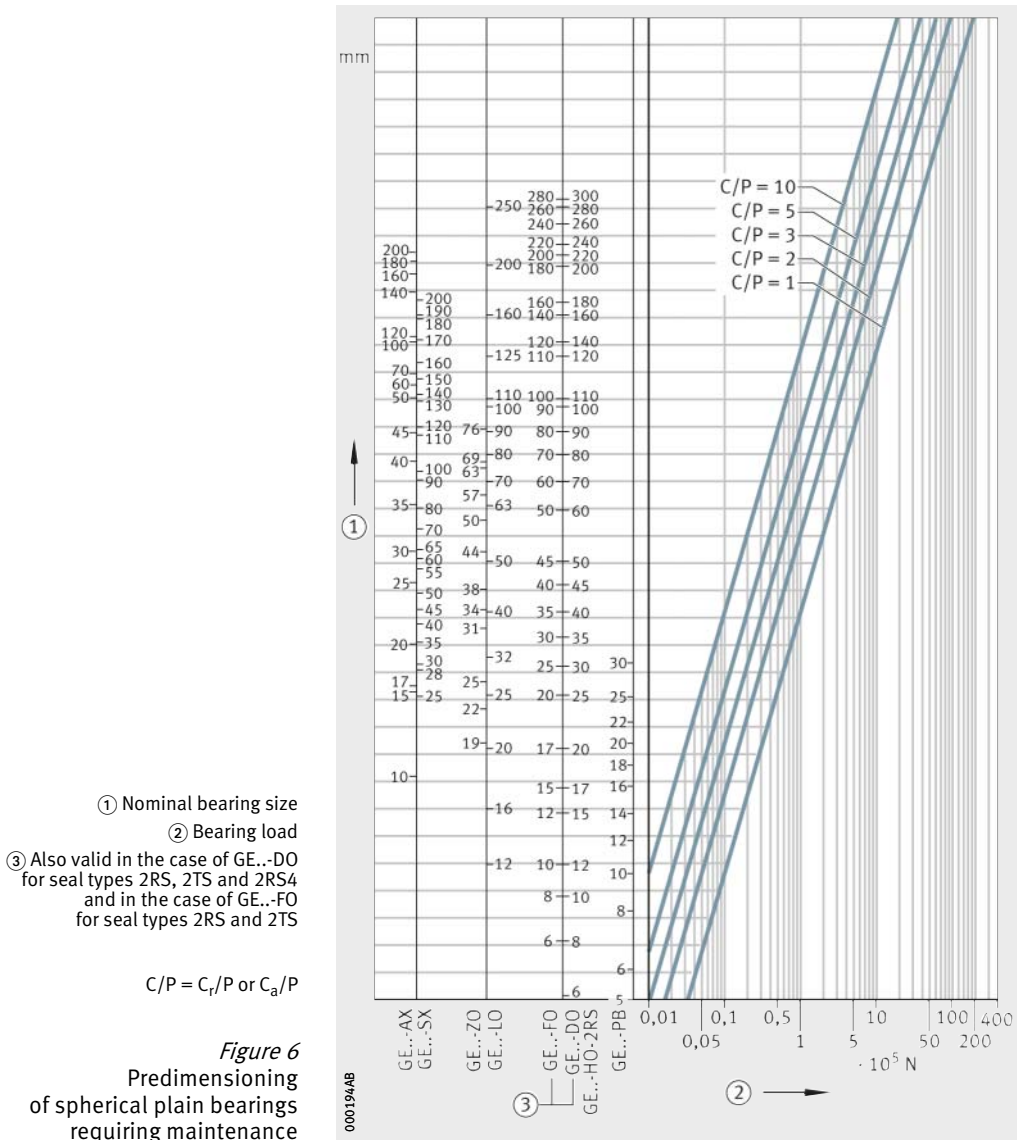
Basic load ratings

Basic load ratings are key data specific to the plain bearings that are not standardised and may differ from manufacturer to manufacturer. They are derived from the material-specific load parameters K and the projected load-bearing area of the bearing in each case.

Basic dynamic load rating

The basic dynamic load rating C_r or C_a is used in cases of dynamic loading. A plain bearing is subjected to dynamic loading if it performs rotary, swivel, tilt or linear motion under load.

The basic dynamic load rating is the maximum permissible dynamic load. In the case of radial spherical plain bearings, it can be utilised to the full only if the load acts purely in a radial direction. In the case of axial spherical plain bearings, it can be utilised to the full only if the load acts purely in a concentric, axial direction.

If the basic dynamic load rating is utilised to the full, there is often a considerable reduction in the operating life of the bearings. The degree to which the basic load rating is utilised should therefore always be matched to the required operating life. The basic load rating depends on the sliding contact surface and influences the rating life of the plain bearings.

Basic static load rating

The basic static load rating C_{0r} or C_{0a} is used if a plain bearing is subjected to load while stationary.

It indicates the load that the plain bearing can support at room temperature without damage to the bearing. This is subject to the precondition that the components adjacent to the bearing must prevent deformation of the bearing.

If the basic load rating C_{0r} or C_{0a} is utilised to the full, the shaft and housing must be made from high strength materials.

Load carrying capacity and life

Bearing load

The bearing load describes the external forces acting on the bearing.

Concentric constant force F

For calculation of the static load safety factor, the specific load and the rating life, load values can be taken directly into consideration under the following preconditions, *Figure 1* and *Figure 2*:

■ Loads act in a radial direction only on radial spherical plain bearings, angular contact spherical plain bearings and cylindrical plain bushes.

■ Loads act in an axial direction only on axial spherical plain bearings.

■ Loads do not vary in their magnitude and direction during operation.

$P = F$
$P_0 = F_0$

① Radial spherical plain bearing
② Angular contact spherical plain bearing
③ Cylindrical plain bush
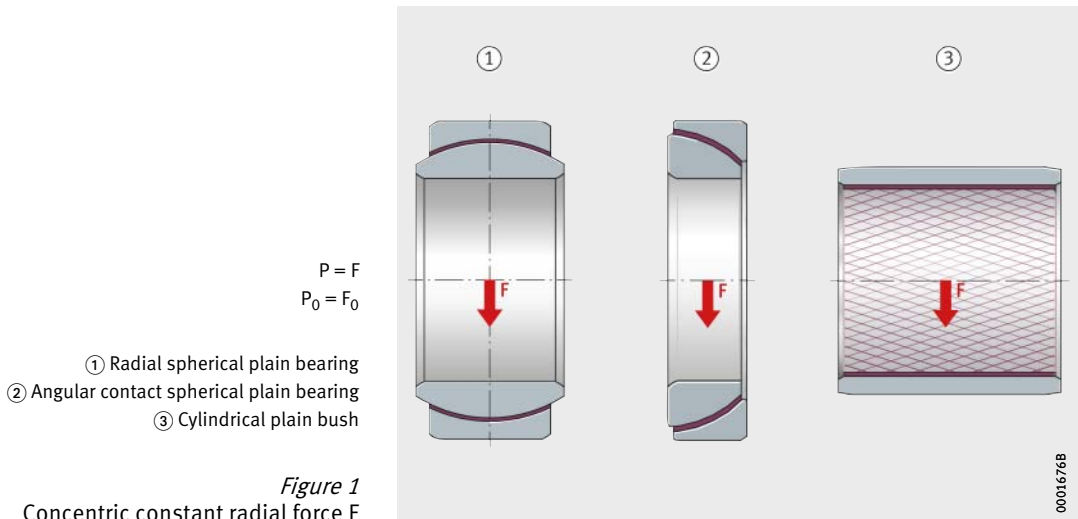
Figure 1
Concentric constant radial force F

$P = F$
$P_0 = F_0$

① Axial spherical plain bearing
② Thrust washer
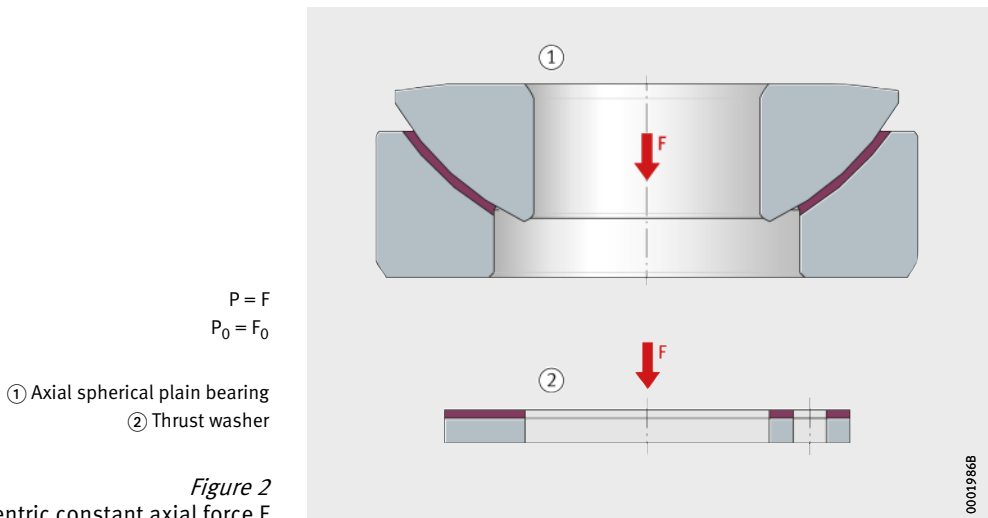
Figure 2
Concentric constant axial force F

Concentric variable force F   If the concentric force varies in magnitude during motion, rating life calculation and checking of the permissible specific load must be carried out on the basis of the maximum force F_{max}, *Figure 3*.

One possible influence on the rating life as a result of pulsating or alternating loads is taken into consideration by means of the correction factor f_{Hz}, see page 66.

$P = F_{max}$

Figure 3
Variable bearing load
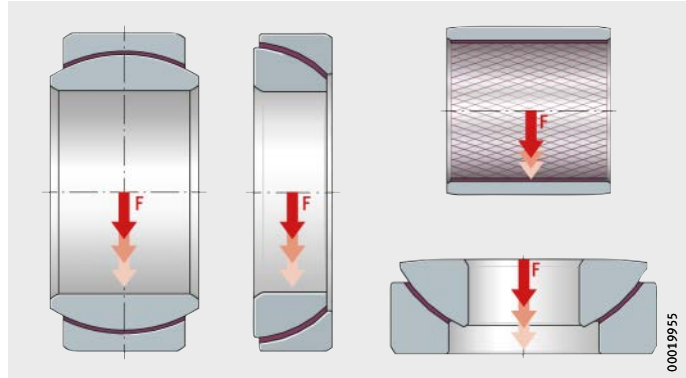
Load carrying capacity and life

Combined loading by radial and axial forces

If spherical plain bearings are subjected simultaneously to radial and axial loads, combined loading is present. The equivalent static bearing load is calculated on a similar basis to the equivalent dynamic bearing load. The permissible ranges for the ratio F_a/F_r are valid for static and for dynamic loading.

In the case of dynamic loading, the equivalent dynamic bearing load P must be used in rating life calculation. This values takes the combined forces into consideration in rating life calculation.

In the case of static loading, the equivalent static bearing load P_0 must be used in calculation of the static load safety factor. This value takes the combined forces into consideration in calculation of the static load safety factor.

Calculation of radial and angular contact spherical plain bearings, *Figure 4* and *Figure 5*, page 39:

$$P = X \cdot F_r$$

$$P_0 = X \cdot F_{r0}$$

Calculation of axial spherical plain bearings, *Figure 6*, page 39:

$$P = Y \cdot F_a$$

$$P_0 = Y \cdot F_{a0}$$

P	N
Equivalent dynamic bearing load	
X	–
Axial load factor for radial and angular contact spherical plain bearings, *Figure 4* and *Figure 5*, page 39	
F_r	N
Radial dynamic bearing load	
P_0	N
Equivalent static bearing load	
F_{r0}	N
Radial static bearing load	
Y	–
Radial load factor for axial spherical plain bearings, *Figure 6*, page 39	
F_a	N
Axial dynamic bearing load	
F_{a0}	N
Axial static bearing load.	

⚠️ The correct spherical plain bearing is selected as follows:
- ▪ The permissible range for the ratio F_a/F_r in the case of radial spherical plain bearings is between 0 and 0,3.
- ▪ If the ratio F_a/F_r exceeds the value 0,3, angular contact spherical plain bearings can be used. Their ratio F_a/F_r extends to a value of 3, since they can support higher axial forces.
- ▪ If the axial forces are more than twice the radial forces, axial spherical plain bearings can be used.

X = axial load factor
for radial spherical plain bearings
F_a = axial bearing load
F_r = radial bearing load

Figure 4
Radial spherical plain bearings,
combined loading
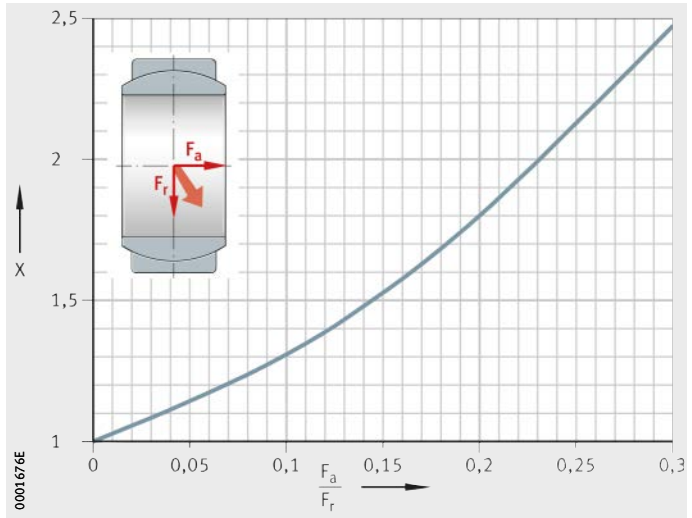
X = axial load factor
for angular contact
spherical plain bearings
F_a = axial bearing load
F_r = radial bearing load

Figure 5
Angular contact
spherical plain bearings,
combined loading
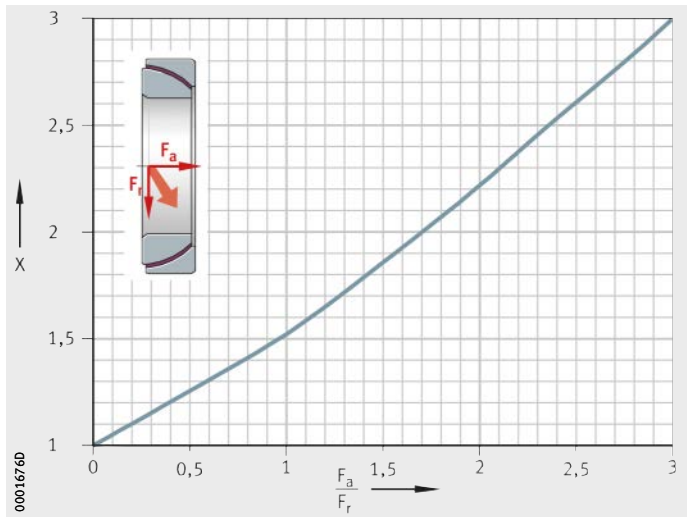
X = axial load factor
for axial spherical plain bearings
F_a = axial bearing load
F_r = radial bearing load

Figure 6
Axial spherical plain bearings,
combined loading
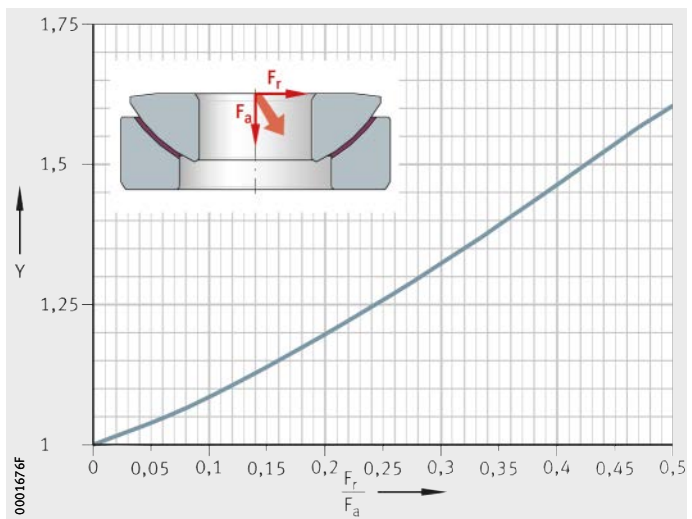
Load carrying capacity and life

Static load safety factor

Before the rating life is calculated, it is advisable to check the static load safety factor.

The static load safety factor S_0 is the ratio between the basic static load rating C_0 and the equivalent static load P_0:

$$S_0 = \frac{C_0}{P_0}$$

S_0	–
Static load safety factor	
C_0	N
Basic static load rating	
P_0	N
Equivalent static bearing load.	

⚠️ The static load safety factor must always be >1. Any instructions relating to specific series must be observed.

Specific bearing load

The specific bearing load describes the contact pressure present in the bearing in the dynamic state. It is the decisive criterion for assessing the suitability of a plain bearing in the particular application.

The specific bearing load occurring in a bearing is dependent on the load, the sliding contact surface, the lubrication conditions and the mounting situation. Due to the influence of these factors, precise calculation is not possible.

If the required operating life is to be achieved, the specific bearing load must be matched to the actual operating conditions.

⚠️ Under extreme loading conditions, such as high axial load in the case of radial spherical plain bearings, elastic deformation of the bearing and housing may lead to contact pressure concentrations. Please contact Schaeffler in this case.

Calculation

The specific bearing load p for a plain bearing is calculated with the aid of the specific load parameter K, see equations.

Radial and angular contact spherical plain bearings:

$$p = K \cdot \frac{P}{C_r}$$

Axial spherical plain bearings:

$$p = K \cdot \frac{P}{C_a}$$

Bushes and radial component of flanged bushes:

$$p = K \cdot \frac{F_r}{C_r}$$

Thrust washers and axial component of flanged bushes:

$$p = K \cdot \frac{F_a}{C_a}$$

p	N/mm^2
Specific bearing load	
K	N/mm^2
Specific dynamic load parameter, see table	
P	N
Equivalent dynamic bearing load, see page 36	
F_r	N
Radial dynamic bearing load	
F_a	N
Axial dynamic bearing load	
C_r, C_a	N
Radial or axial basic dynamic load rating, see dimension tables.	

Specific load parameter

Sliding layer, sliding contact surface	Specific dynamic load parameter K N/mm^2
ELGOGLIDE	300
ELGOGLIDE-W11	300
PTFE composite	100
PTFE film	100
ELGOTEX	140
E40, E40-B	140
E50	70
Steel/steel	100
Steel/bronze	50

Load carrying capacity and life

Alternative calculation method for bushes and thrust washers

Due to the simple geometry of plain bushes EGB, ZWB and ZGB as well as flanged bushes EGF and thrust washers EGW, their specific bearing load can alternatively be determined by means of the following relationships. It is assumed in this case that there is uniform load distribution over the projected area, *Figure 7*.
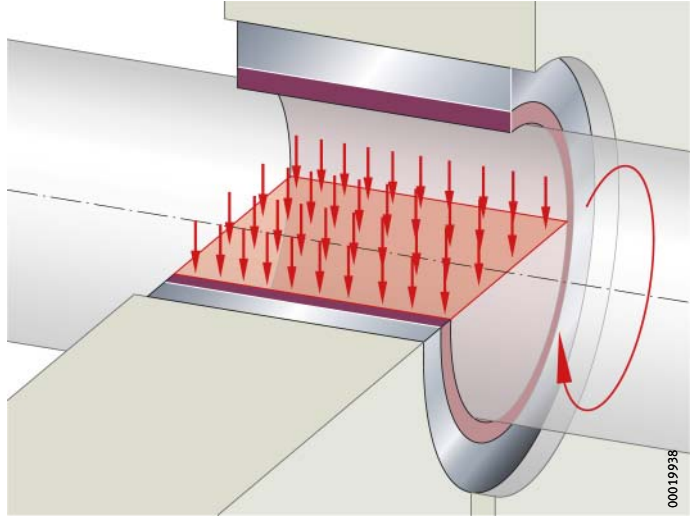
Figure 7
Projected area of a bush

Alternative calculation

Bush:

$$p = \frac{F_r}{D_i \cdot B}$$

Flanged bush, radial force:

$$p = \frac{F_r}{D_i \cdot \left(B - R - s_{fl}\right)}$$

Flanged bush, axial force:

$$p = \frac{4 \cdot F_a}{\left(D_{fl}{}^2 - \left(D_o + 2 \cdot R\right)^2\right) \cdot \pi}$$

Thrust washer:

$$p = \frac{4 \cdot F_a}{\left(D_o^2 - D_i^2\right) \cdot \pi}$$

p	N/mm^2	
Specific bearing load		
F_r	N	
Radial dynamic bearing load		
D_i	mm	
Inside diameter of bush, flanged bush or thrust washer		
B	mm	
Width of bearing		
R	mm	
Radius of flange		
s_{fl}	mm	
Thickness of flange		
F_a	N	
Axial dynamic bearing load		
D_{fl}	mm	
Outside diameter of flange		
D_o	mm	
Outside diameter of bush or thrust washer.		

Load carrying capacity and life

Bearing motion

The bearing motion describes the dynamic conditions in the bearing. These are essentially indicated by the swivel angle and tilt angle, the velocity of motion and the frequency of motion.

Sliding velocity

The sliding velocity is dependent on the plain bearing and its diameter.

Rotary motion:

$$v = \frac{d_x \cdot \pi \cdot n}{60 \cdot 10^3}$$

Swivel motion:

$$v = \frac{d_x \cdot \pi}{60 \cdot 10^3} \cdot \frac{2\beta \cdot f}{360°}$$

v	m/s
Sliding velocity	
d_x	mm
Specific diameter, see table	
n	min^{-1}
Operating speed	
β	°
Swivel angle, *Figure 8*, page 45	
f	min^{-1}
Swivel frequency, *Figure 8*, page 45.	

! For combined swivel and tilt motions in spherical plain bearings, the angle of motion β_1 must be used, see page 46.

Specific diameter

Plain bearing	Specific diameter d_x
Radial spherical plain bearing	d_K
Axial spherical plain bearing	$0{,}7 \cdot d_K$
Angular contact spherical plain bearing	$0{,}9 \cdot d_K$
Bush	D_i
Flanged bush (radial sliding surface)	D_i
Flanged bush (axial sliding surface)	D_{fl}
Thrust washer	D_o

Frequency of motion

The number of motions per time period, the frequency, has a significant influence on the operating life of spherical plain bearings.

In addition to the load, the coefficient of friction and the motion parameter, the frequency influences the frictional energy generated in the bearing. This is dependent on the relevant sliding contact surface and must not exceed the permissible pv values, see table, page 50.

! The frequency can only be used for calculating the sliding velocity in applications with continuous operation or periodic stationary periods.

Swivel angle

Swivel motion is defined as relative motion with reversing direction about the bearing axis. In the case of spherical plain bearings, the two bearing rings move relative to each other, in the case of bushes the shaft and bush move relative to each other.

The centring angle described by the two return points is described as the swivel angle β, *Figure 8*. This describes the motion between the two extreme points.

β = swivel angle
A = start point
B = end point
f = swivel frequency
(number of motions from A to B per minute)
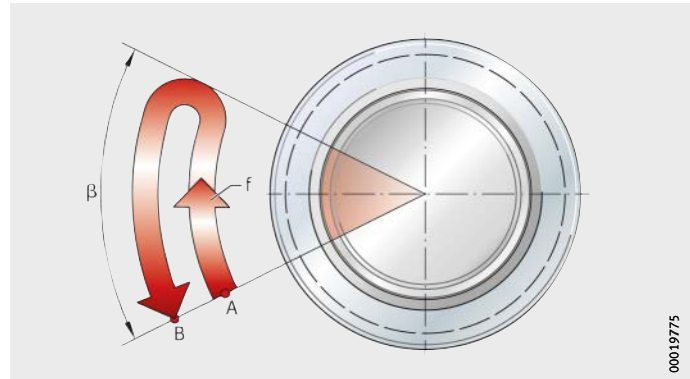
Figure 8
Swivel motion and swivel frequency

Tilt angle

In tilt motion of spherical plain bearings, the inner ring and shaft locating washer move relative to the outer ring and housing locating washer in a direction transverse to the bearing axis. The axes of the relevant bearing rings intersect below the tilt angle α, *Figure 9*.

The maximum permissible tilt angle α must be observed, see dimension tables. Full utilisation of the basic load ratings is only permissible within the stated tilt angle α.

α_1, α_2 = tilt angle
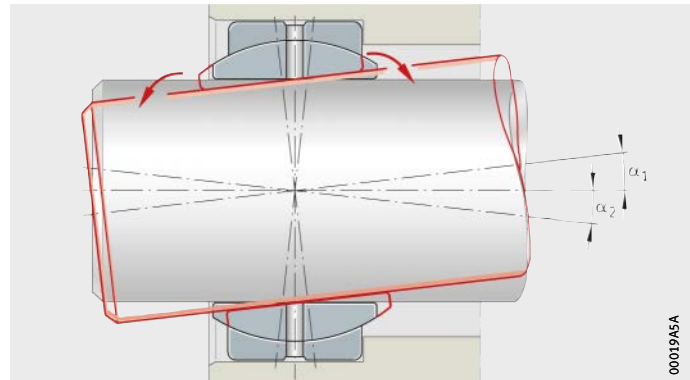
Figure 9
Tilt motion

Load carrying capacity and life

Combined swivel and tilt motion

The motion angle β_1 corresponds to the resultant sliding distance in the case of simultaneous tilt and swivel motion, *Figure 10*.

Combined motions are calculated as follows:

$$\beta_1 = \sqrt{\beta^2 + (\alpha_1 + \alpha_2)^2}$$

β_1 °
Motion angle corresponding to the sliding distance
β °
Swivel angle, see page 45
α_1 °
Tilt angle from centre to left, see page 45
α_2 °
Tilt angle from centre to right, see page 45.
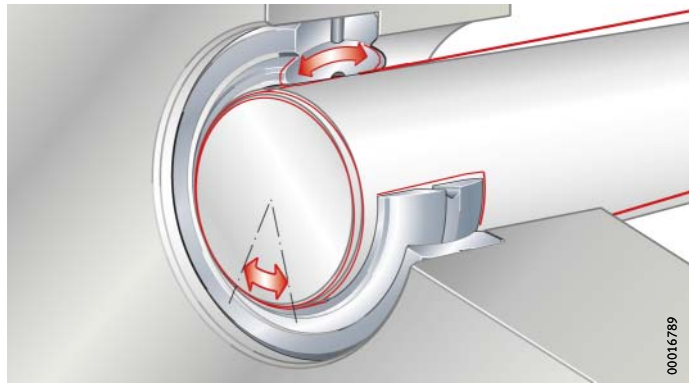
β_1 = motion angle

Figure 10
Swivel and tilt motion

Specific frictional energy pv

The specific bearing load p and the sliding velocity v are in a reciprocal relationship. The product p · v gives the specific frictional energy pv and is an important key value for a plain bearing.

$$pv = p \cdot v$$

pv   N/mm² · m/s
Specific frictional energy
p   N/mm²
Specific bearing load
v   m/s
Sliding velocity.

⚠ In the case of intermittent operation, the sliding velocity during one motion cycle must be used.

Rating life

Calculation of the theoretical rating life is based on a large number of laboratory tests and takes account of certain operational data.

The rating life is defined as the number of motion cycles or operating hours that can be achieved by the majority of a sufficiently large number of plain bearings under identical operating conditions before certain failure criteria are met.

The amount of wear and increase in friction are dependent on the sliding contact surface and the application. Under identical operating conditions, the operating life achieved may therefore differ significantly.

The calculation of the theoretical rating life gives comparative values for the bearings. It gives information about the higher or lower performance of the selected bearings.

Failure criteria

In plain bearings, wear occurs as a result of solid body and mixed friction conditions. The failure criteria are test limit values that are related to a quantity of wear as a function of the bearing size or an upper coefficient of friction that is exceeded, see tables.

Operating clearance as a failure criterion

Load direction	Sliding layer			
	ELGOGLIDE	PTFE composite	PTFE film	ELGOTEX
	Increase in radial operating clearance by mm			
Unilateral or point load	0,5	0,15	0,25	0,5
Alternating or circumferential load	1[1]	0,3	0,5	1

[1] In the case of axial and angular contact spherical plain bearings with the sliding layer ELGOGLIDE, the increase in the operating clearance, irrespective of the operating clearance, is 0,5 mm.

Wear of the load zone as a failure criterion

Failure criterion	Sliding layer	
	E40	E50
	%	
Wear of sliding layer thickness in the load zone by	80	90

Operating clearance and friction as a failure criterion

Load direction, failure criterion	Sliding contact surface	
	Steel/steel	Steel/bronze
	Failure criterion	
Unilateral	Fretting of sliding surfaces	Fretting of sliding surfaces
Alternating		
Increase in radial operating clearance	$> 0{,}004 \cdot d_K$	$> 0{,}004 \cdot d_K$
Increase in friction	$\mu_R > 0{,}22$	$\mu_R > 0{,}25$

Load carrying capacity and life

Influences on the rating life Calculation of the basic rating life applies to plain bearings that perform rotary, swivel or linear motion.

The significant factors for a long rating life are the pv value and the design of the mating surface. In the case of metal/polymer composite plain bearings as well as ELGOGLIDE and ELGOTEX bushes, particular attention must be paid to the material, roughness depth and surface structure of the mating surface. In the case of spherical plain bearings, an optimum mating surface is provided by the inner ring.

The ambient temperature, heat dissipation via the shaft, bearing and housing as well as the operating duration have a fundamental influence on the operating temperature and thus on the rating life.

Extraordinary factors The following parameters are not taken into consideration in rating life calculation and may in certain circumstances have a very considerable influence on the operating life:

- corrosion
- ageing of the lubricant
- contamination
- humidity
- vibrations
- shocks.

Operating life The operating life is the life actually achieved by a plain bearing. It may deviate from the calculated rating life.

| Basic rating life | Due to the large number of influences, the calculated basic rating life is a guide value. In the case of plain bearings, the values may therefore be excessively high at very low bearing loads or very low sliding velocities. |

Due to the large number of influences, the calculated basic rating life is a guide value. In the case of plain bearings, the values may therefore be excessively high at very low bearing loads or very low sliding velocities.

If the sliding layer E50 is used in linear motion, advice should be sought from the Schaeffler engineering service.

! Theoretical rating life calculations are only valid for the products presented in this catalogue when used in accordance with the validity range (load, sliding velocity and operating temperature) and with the recommendations described, see tables, page 50, and section Design of bearing arrangements, page 90. Theoretical rating life calculations can under no circumstances be transferred to other products.

The rating life calculation is not valid for large radial spherical plain bearings GE..-DW, axial spherical plain bearings GE..-AX and strips EGS. For a rating life estimate in the case of these series, the Schaeffler engineering service should be contacted.

In the case of thrust washers EGW, the rating life calculation is only valid if the bearing runs free from clearance at all times and the mating surface is at least as large as the thrust washer.

Dry friction, mixed friction and hydrodynamics

The preconditions for rating life calculation are as follows:
- Maintenance-free plain bearings must undergo dry running.
- Mixed friction must be present in plain bearings that require maintenance or are low-maintenance.
- Where hydrodynamic conditions are applied, the Schaeffler engineering service should be contacted.

Load carrying capacity and life

Range of validity of rating life calculation

Sliding layer, sliding contact surface	pv value[1] N/mm² · m/s		Specific load[2] p N/mm²		
			min.	max.	
	from	to		Constant	Variable
E40	0,01	1,8	0,01	140	140
E50	0,1	3	0,01	70	70
Elgoglide[3]	0,005	6,9	1	300	150
Elgoglide-W11[3]				150	150
Elgotex	0,005	2,8	1	140	140
PTFE composite	0,005	2	1	100	60
PTFE film	0,002	1,2	2	100	50
Steel/steel	0,001	0,4	1	60	100
Steel/bronze	0,001	0,4	1	50	50

[1] The maximum permissible bearing load as function of velocity is determined by means of pv diagrams, *Figure 2*, page 29.

[2] In the case of values lower than 1 N/mm², calculation of the basic rating life must be carried out using the value p = 1 N/mm².

[3] The operating limits of Elgoglide sliding layers must be observed, see page 140.

Range of validity of rating life calculation (continued)

Sliding layer, sliding contact surface	Sliding velocity[1] v m/s	Temperature ϑ °C	
	max.	from	to
E40	2,5	−200	+280
E50	2,5	−40	+110
Elgoglide	0,3	−40	+150
Elgoglide-W11			
Elgotex	0,18	−20	+130
PTFE composite	0,4	−50	+200
PTFE film	0,21	−50	+200
Steel/steel	0,1	−60	+200
Steel/bronze	0,1	−60	+250

[1] In the case of values lower than 0,001 m/s, calculation of the basic rating life must be carried out using the value v = 0,001 m/s.

Calculation service

In the product selection and information system ***medias***®, http://medias.schaeffler.de, it is possible to carry out computer-aided rating life calculation of individual bearings.

In addition, the versatile calculation software BEARINX facilitates the calculation and estimation of rating life of plain bearings in shaft systems. BEARINX is available in a simplified and freely accessible form as an "Easy" module and as a complete, powerful calculation module in various versions; information can be found at www.schaeffler.com ➡ Products & Services ➡ INA/FAG Products ➡ Calculation.

Calculation of the basic rating life	The basic rating life is calculated using the following equations and is dependent on the specific plain bearing factor and any correction factors necessary, see page 52 and tables, page 55.

The procedure for rating life calculation is shown in a diagram, *Figure 11*. Ordering examples are given in the corresponding product descriptions.

! Before calculation of the rating life, it is absolutely essential to check the permissible loads, sliding velocities and temperatures, see tables, page 50.

For flanged bushes, the rating life must be checked for both the radial sliding surface and the axial sliding surface (flange).

Symbols, units and definitions, see page 54

① Checking of the range of validity, see tables, page 50

$$L_h = \frac{1\,000}{p \cdot v} \cdot f_p \cdot f_v \cdot f_{pv} \cdot f_\vartheta \cdot f_R \cdot f_W \cdot f_A$$

Example: EGB..-E40
Selection of correction factors as a function of bearing type

Figure 11
Procedure for rating life calculation
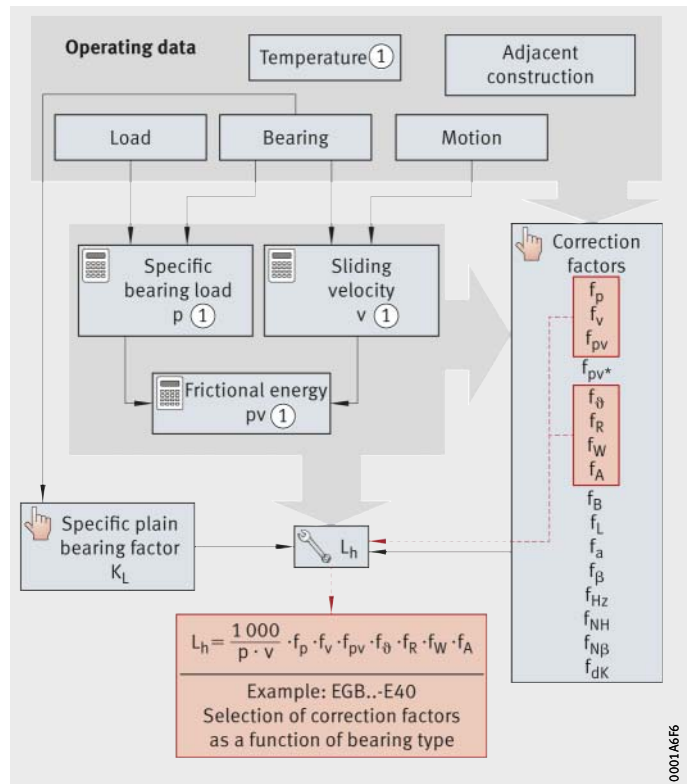
Load carrying capacity and life

Maintenance-free and low-maintenance bearings

Rating life of maintenance-free and low-maintenance bearings:

$$L_h = \frac{K_L}{p \cdot v} \cdot f_p \cdot f_v \cdot f_{pv} \cdot f_{pv\star} \cdot f_\vartheta \cdot f_R \cdot f_W \cdot f_A \cdot f_B \cdot f_L \cdot f_\alpha \cdot f_\beta \cdot f_{Hz}$$

Bearings requiring maintenance

Rating life of bearings requiring maintenance:

$$L_h = \frac{K_L}{v} \cdot \left(\frac{C_r}{P} \right) \cdot f_p \cdot f_v \cdot f_\vartheta \cdot f_A \cdot f_\beta \cdot f_{dK} \cdot f_{Hz}$$

Rating life of bearings requiring maintenance taking account of correction factors for periodic relubrication, see page 68:

$$L_{hN} = L_h \cdot f_{NH} \cdot f_{N\beta}$$

Conversion of rating life value

Conversion of the rating life from operating hours to revolutions:

$$L_{osc} = L_h \cdot f \cdot 60$$

Conversion of the rating life for v < 0,001 m/s

For sliding velocities v < 0,001 m/s, at which the rating life must be calculated using v = 0,001 m/s, the rating life is converted from operating hours to revolutions as follows.

For rotation:

$$L_{osc} = L_h \cdot \frac{3,6 \cdot 10^3}{\pi \cdot d_x}$$

For swivelling:

$$L_{osc} = L_h \cdot \frac{0,648 \cdot 10^6}{\pi \cdot d_x \cdot \beta}$$

d_x mm
Specific diameter, see table, page 44.

Specific plain bearing factor

Sliding layer, sliding contact surface	Specific plain bearing factor K_L
E40, E40-B	1 000
E50	2 500
ELGOGLIDE	25 000
ELGOGLIDE-W11	
ELGOTEX	7 000
PTFE composite	1 000
PTFE film	1 000
Steel/steel	30
Steel/bronze	2,3

Load and motion duty cycle

Where plain bearings are subjected to varying loads and motions, the rating life can be calculated in approximate terms. This requires data for the load, the motion and the corresponding proportional operating times (operating duration), *Figure 12*.

$$L_h = \frac{1}{\dfrac{t_1}{\Sigma t \cdot L_{h1}} + \dfrac{t_2}{\Sigma t \cdot L_{h2}} + \dfrac{t_3}{\Sigma t \cdot L_{h3}} + \dfrac{t_n}{\Sigma t \cdot L_{hn}}}$$

L_h h
Theoretical rating life taking account of variable conditions

$t_1, t_2, ..., t_n$ h or %
Proportional duration of defined corresponding operating period

Σt h or %
Total operating time $(t_1 + t_2 + t_3 ... t_n)$

$L_{h1}, L_{h2}, ..., L_{hn}$ h
Rating life for individual periods.

P = equivalent dynamic bearing load
β = swivel angle
f = frequency
t = time
① Calculation of L_{h1}, L_{h2}, ..., L_{hn} in accordance with calculation principle
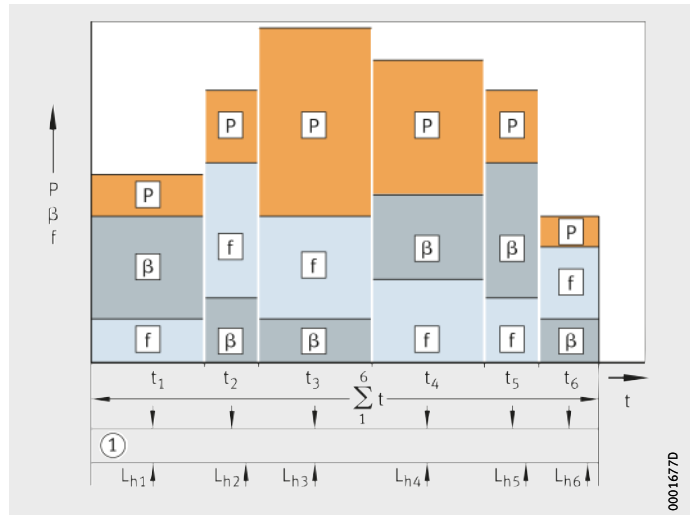
Figure 12
Rating life for specified
load and motion duty cycle

Load carrying capacity and life

Symbols, units and definitions

L_h h
Rating life of plain bearing

L_{osc} revolutions
Rating life in oscillations

L_{hN} h
Rating life with periodic relubrication

K_L –
Specific plain bearing factor, see table, page 52

p N/mm^2
Specific load, for calculation see page 41

v m/s
Sliding velocity, for calculation see page 44

C_r N
Basic radial load rating, see dimension tables

P N
Equivalent bearing load, for calculation see page 38

f min^{-1}
Swivel frequency, *Figure 8*, page 45

f_p –
Correction factor for load, *Figure 13*, page 56

f_v –
Correction factor for sliding velocity, *Figure 16*, page 58

f_{pv} –
Correction factor for frictional energy, *Figure 17*, page 59

f_{pv*} –
Correction factor for frictional energy for ELGOGLIDE and ELGOTEX, *Figure 17*, page 59

f_ϑ –
Correction factor for temperature, *Figure 18*, page 60

f_R –
Correction factor for roughness depth, *Figure 19*, page 61

f_W –
Correction factor for material, see table, page 61

f_A –
Correction factor for condition of rotation, see page 62

f_B –
Correction factor for width ratio, *Figure 21*, page 63

f_L –
Correction factor for linear motion, see page 64

f_α –
Correction factor for tilt angle, *Figure 25*, page 65

f_β –
Correction factor for swivel and oscillation angle, *Figure 26*, page 65

f_{Hz} –
Correction factor for variable load, see page 66

f_{NH} –
Correction factor for relubrication, as a function of frequency, *Figure 31*, page 68

$f_{N\beta}$ –
Correction factor for relubrication, as a function of β, *Figure 32*, page 68

f_{dK} –
Correction factor for sphere diameter, *Figure 22*, page 63.

Correction factors — In calculation of the basic rating life, numerous influences are taken into consideration for the specific bearing by means of correction factors, see page 56.

Preselection of correction factors — The correction factors are selected as a function of the sliding layer or the sliding contact surface and applied in the appropriate rating life equation, see tables.

The lists of the series also include the sealed variant with lip seals 2RS or high performance seals 2TS.

Maintenance-free and low-maintenance bushes, flanged bushes and thrust washers

Series	Sliding layer	Motion	Correction factors												
			f_p	f_v	f_{pv}	$f_{pv}*$	f_ϑ	f_R	f_W	f_A	f_B	f_L	f_α	f_β	f_{Hz}
EGB EGF EGW	E50	Rotary	■	■	■	–	■	■	–	■	–	–	–	–	–
	E40		■	■	■	–	■	■	■	■	–	–	–	–	–
		Linear	■	■	■	–	■	■	■	■	–	■	–	–	–
ZGB	ELGOGLIDE ELGOGLIDE-W11	Rotary	■	–	–	■	■	■	■	■	■	–	–	■	■
		Linear	■	–	–	■	■	■	■	■	–	■	–	–	–
ZWB	ELGOTEX	Rotary	■	–	–	■	■	■	■	■	■	–	–	■	–
		Linear	■	–	–	■	■	■	■	■	–	■	–	–	–

Maintenance-free spherical plain bearings and rod ends

Series		Sliding layer	Correction factors								
Spherical plain bearing	Rod end		f_p	f_v	f_{pv}	$f_{pv}*$	f_ϑ	f_A	f_α	f_β	f_{Hz}
GE..-UK GE..-FW GE..-SW GE..-AW GE..-PW	GIR..-UK GAR..-UK GIKR..-PW GIKPR..-PW GAKR..-PW	ELGOGLIDE ELGOGLIDE-W11	■	–	–	■	■	■	■	■	■
		PTFE composite	■	■	■	–	■	■	–	–	■
		PTFE film	■	■	■	–	■	■	–	–	■

Spherical plain bearings and rod ends requiring maintenance

Series		Sliding contact surface	Correction factors						
Spherical plain bearing	Rod end		f_p	f_v	f_ϑ	f_A	f_{dK}	f_β	f_{Hz}
GE..-DO GE..-HO GE..-FO GE..-ZO GE..-LO GE..-SX	GIR..-DO GIL..-DO GAR..-DO GAL..-DO GIHNRK..-LO GIHRK..-DO GK..-DO GF..-DO	Steel/steel	■	■	■	■	■	■	■
GE..-PB	GIKR..-PB GIKL..-PB GAKR..-PB GAKL..-PB	Steel/bronze	■	■	■	■	■	■	■

Legend

■
The selected correction factor must be applied in the rating life equation.
The value is determined from the diagrams and tables.

Load carrying capacity and life

Load f_p and sliding velocity f_v

The values for the correction factor for load f_p are shown in an overview diagram and two enlarged areas, *Figure 13* to *Figure 15*, page 57. The correction factor for sliding velocity f_v can also be read from a diagram, *Figure 16*, page 58.

f_p = correction factor
p = specific bearing load, see page 40
A = detail, see *Figure 14*, page 57
B = detail, see *Figure 15*, page 57

① ELGOGLIDE
② ELGOGLIDE-W11
③ PTFE composite
④ PTFE film
⑤ E40
⑥ E50
⑦ ELGOTEX
⑧ Steel/steel
⑨ Steel/bronze
⑫ ELGOGLIDE-W11 is recommended
㉑ ELGOGLIDE is recommended
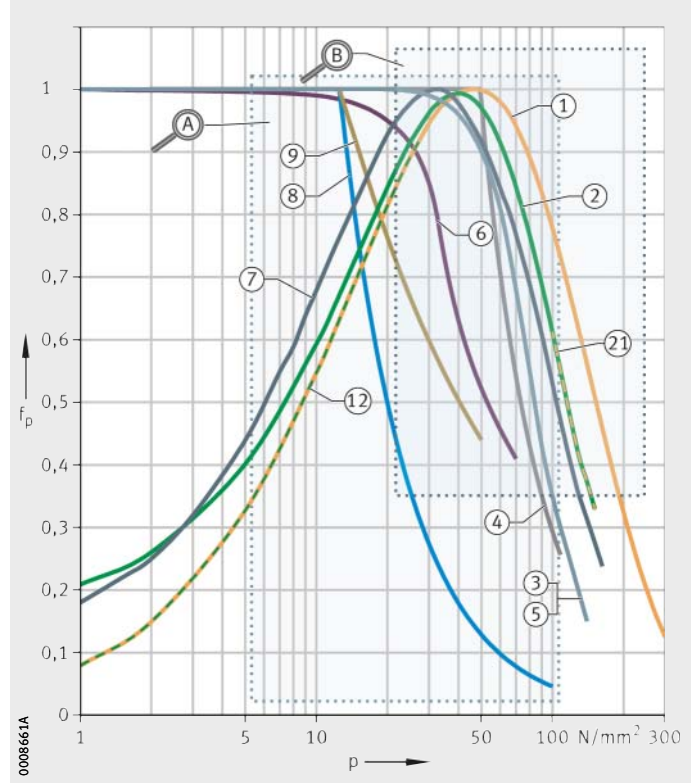
Figure 13
Correction factor for load, overview
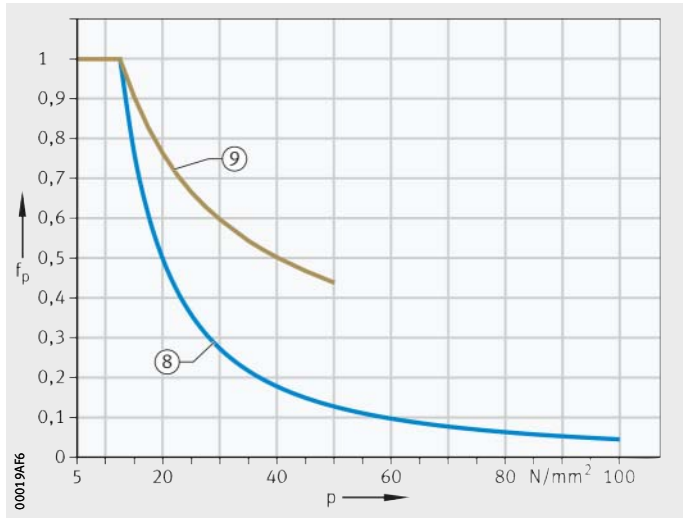
Detail A

⑧ Steel/steel
⑨ Steel/bronze

Figure 14
Correction factor for load,
requiring maintenance
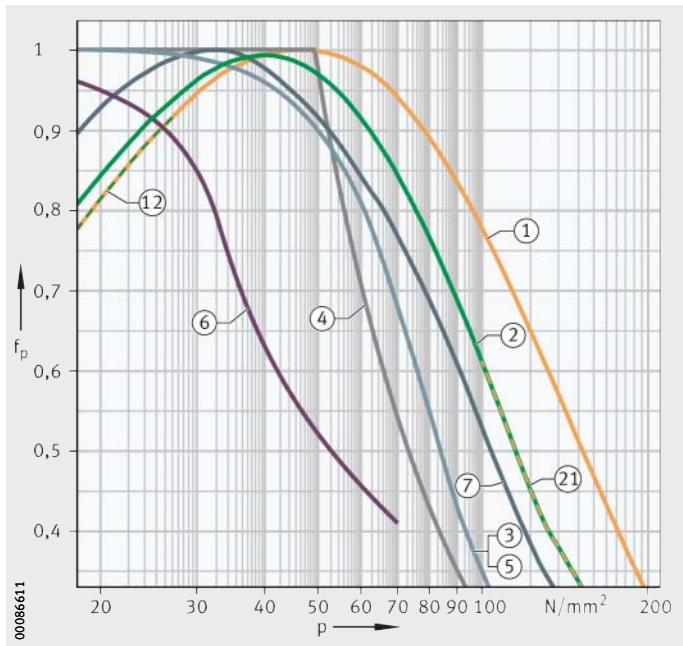
Detail B

① ELGOGLIDE
② ELGOGLIDE-W11
③ PTFE composite
④ PTFE film
⑤ E40
⑥ E50
⑦ ELGOTEX
⑫ ELGOGLIDE-W11 is recommended
㉑ ELGOGLIDE is recommended

Figure 15
Correction factor for load,
maintenance-free and
low-maintenance

Load carrying capacity and life
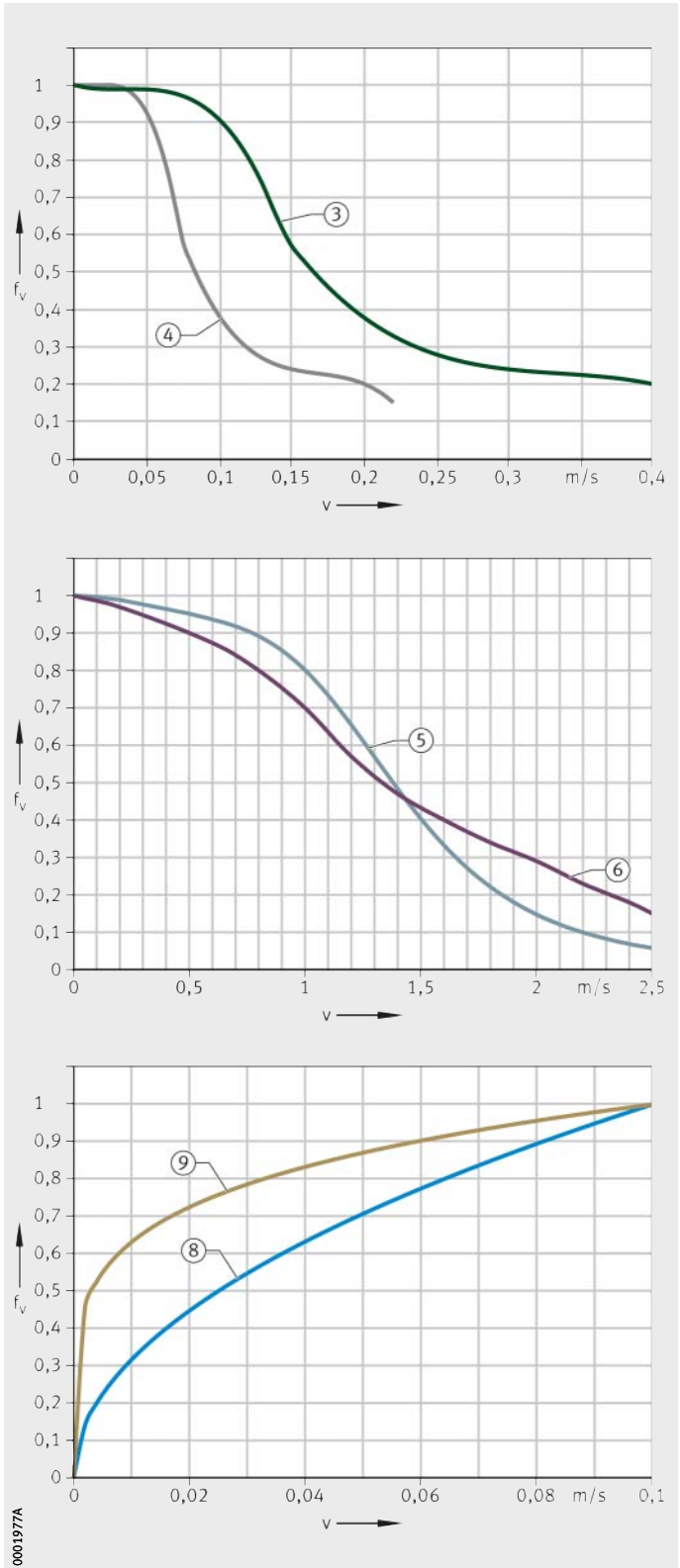
f_v = correction factor
v = sliding velocity, see page 44

③ PTFE composite
④ PTFE film
⑤ E40
⑥ E50
⑧ Steel/steel
⑨ Steel/bronze

Figure 16
Correction factor
for sliding velocity

Frictional energy f_{pv}

The correction factor f_{pv} is derived from the product of the bearing load and the velocity, *Figure 17*. In the case of bearings with ELGOGLIDE or ELGOTEX, the relative specific frictional energy pv* is necessary, see equations.

f_{pv} = correction factor
pv = specific frictional energy,
see page 46

f_{pv*} = correction factor
pv* = relative specific frictional energy,
see equations, page 60

① ELGOGLIDE
② ELGOGLIDE-W11
③ PTFE composite
④ PTFE film
⑤ E40
⑥ E50
⑦ ELGOTEX

Figure 17
Correction factor
for frictional energy
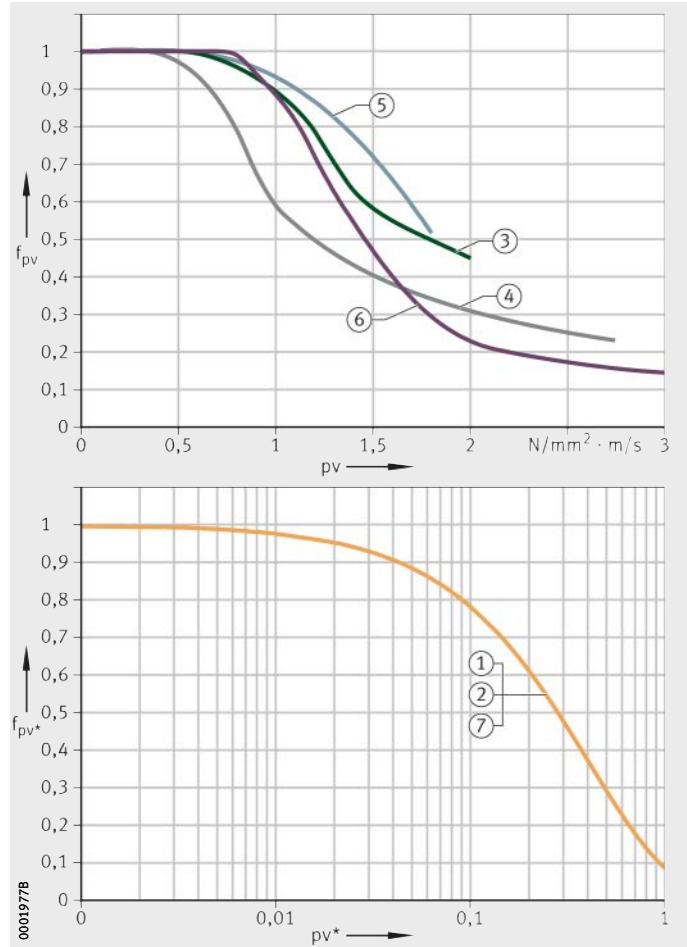
Load carrying capacity and life

Relative specific frictional energy pv*

ELGOGLIDE and ELGOGLIDE-W11:

$$pv^\star = v \cdot \left(100 + p^{1,25}\right) \cdot \frac{1}{30}$$

ELGOTEX:

$$pv^\star = v \cdot \left(60 + p^{1,25}\right) \cdot \frac{1}{10,8}$$

pv*   –
Relative specific frictional energy
p N/mm^2
Specific load, for calculation see page 41
v   m/s
Sliding velocity, for calculation see page 44.

! An increasing pv or pv* value necessitates an increased level of heat dissipation. This must be ensured by means of the adjacent construction.

Temperature f_ϑ

The influence of temperature is taken into consideration in relating life calculation with the aid of the correction factor f_ϑ, *Figure 18* and table.

f_ϑ = correction factor
ϑ = temperature

① ELGOGLIDE
② ELGOGLIDE-W11
③ PTFE composite
④ PTFE film
⑤ E40
⑥ E50
⑦ ELGOTEX

Figure 18
Correction factor
for temperature
for maintenance-free and
low-maintenance bearings
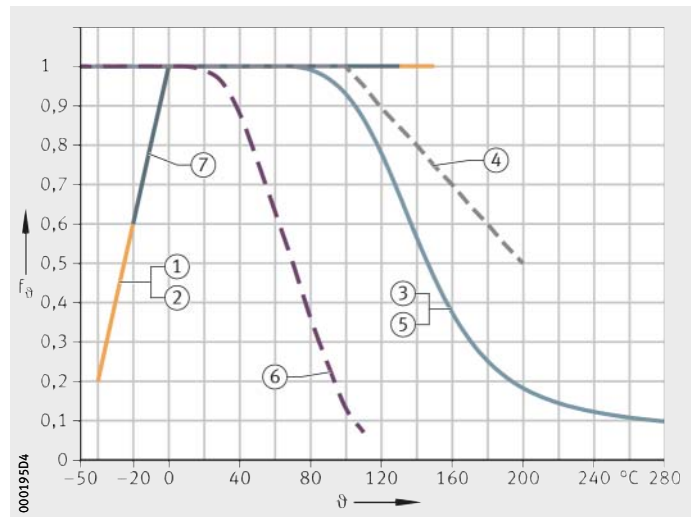
Correction factor f_ϑ for bearings requiring maintenance

Sliding contact surface	Operating temperature ϑ			
	≦ 150 °C	150 °C < ϑ ≦ 180 °C	180 °C < ϑ ≦ 200 °C	200 °C < ϑ ≦ 250 °C
	Correction factor f_ϑ			
Steel/steel	1	0,9	0,7	–
Steel/bronze	1	0,9	0,8	0,5

Roughness depth f_R

In the case of spherical plain bearings and rod ends, a mating surface with the most suitable roughness depth is already provided by the inner ring. For bushes, flanged bushes and thrust washers, the correction factor for roughnesss depth f_R must be taken into consideration, *Figure 19*.

f_R = correction factor
Rz, Ra = roughness depth

① ELGOGLIDE
② ELGOGLIDE-W11
⑤ E40
⑥ E50
⑦ ELGOTEX

Figure 19
Correction factor
for roughness depth
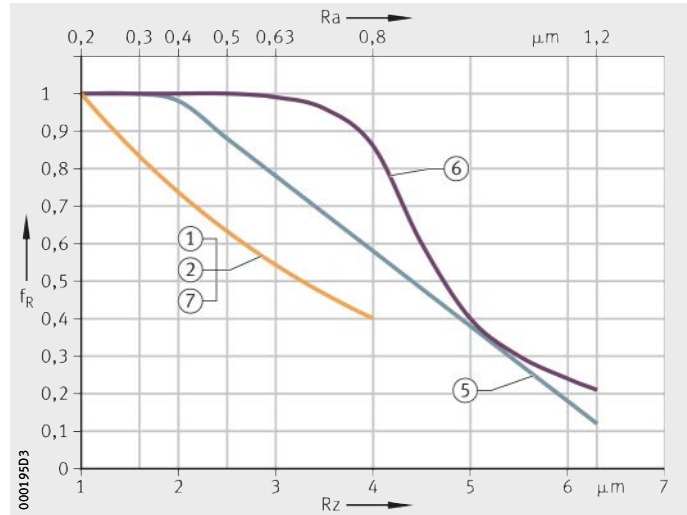
Material f_W

The correction factor f_W is dependent on the material of the mating surface with a roughness depth Rz 2 to Rz 3, see table.

Correction factor f_W

Mating surface material	Layer thickness	Correction factor f_W	
		E40	ELGOGLIDE ELGOGLIDE-W11 ELGOTEX
	mm		
Steel[1]			
Unalloyed	–	0,5	–
Nitrided	–	0,5	1
Corrosion-resistant	–	1	1
Hard chromium coating	$\geqq$ 0,013	1	1
Zinc plated	$\geqq$ 0,013	0,1	–
Phosphated	$\geqq$ 0,013	0,1	–
Flake graphite cast iron Rz 2	–	0,5	–
Anodised aluminium	–	0,2	–
Hard anodised aluminium 450 + 50 HV	0,025	1	–
Copper-based alloys	–	0,2	–
Nickel	–	0,1	–

[1] For increased loads, the steel hardness should correspond to the following values:
- in the case of E40, at least 25 HRC to 50 HRC
- in the case of ELGOGLIDE and ELGOTEX, at least 55 HRC.

Load carrying capacity and life

Condition of rotation f_A

The correction factor f_A is dependent on the type of bearing and the type of load, *Figure 20*:

- plain bushes, thrust washers:
  - point load $f_A = 1$ (rotating shaft, stationary bush)
  - circumferential load $f_A = 2$ (stationary shaft, rotating bush)
  - thrust washer $f_A = 1$
  - linear motion $f_A = 1$
- spherical plain bearings, rod ends:
  - $f_A = 1$.

F = load
n = speed

① Point load $f_A = 1$
② Circumferential load $f_A = 2$

Figure 20
Correction factor
for condition of rotation

00016531
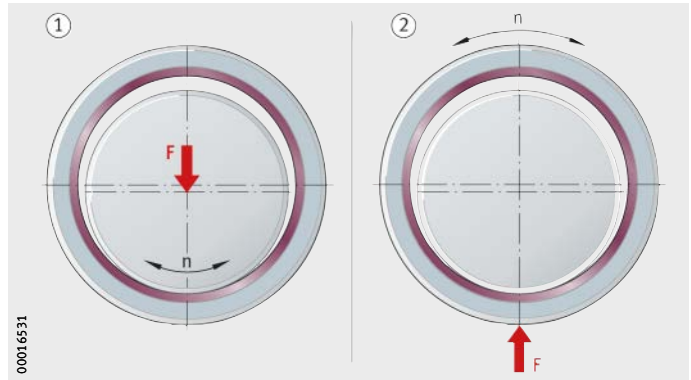
Width ratio f_B and sphere diameter d_K

The factors taken into consideration in rating life calculation are the width ratio in the case of maintenance-free plain bearings and the sphere diameter in the case of plain bearings requiring maintenance, *Figure 21* and *Figure 22*.

f_B = correction factor
B = width of bearing
d = inside diameter of bearing

① ELGOGLIDE
② ELGOGLIDE-W11
⑦ ELGOTEX

Figure 21
Correction factor
for width ratio
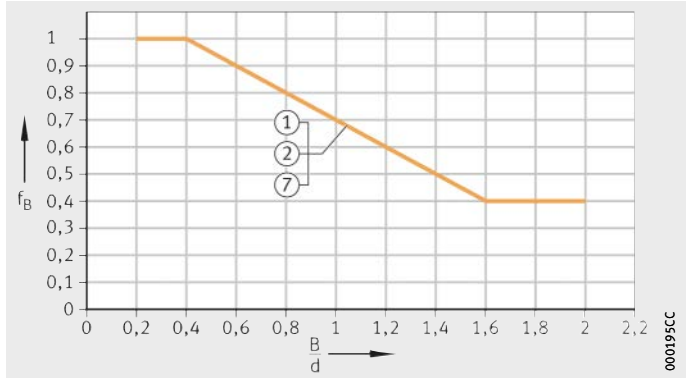
f_{dK} = correction factor
d_K = sphere diameter of bearing

⑧ Steel/steel
⑨ Steel/bronze

Figure 22
Correction factor
for sphere diameter
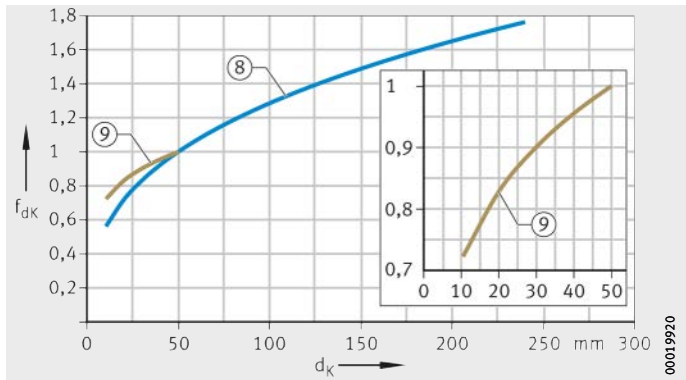
Load carrying capacity and life

Linear motion f_L

The correction factor f_L is necessary in the case of linear motion with bushes with the sliding layer E40, ELGOGLIDE or ELGOTEX, *Figure 23*.

⚠️ In the case of linear motion, the stroke length should not exceed the maximum stroke $H_{max} = 2,5 \cdot B$, *Figure 24*.

① ELGOGLIDE
② ELGOGLIDE-W11
⑤ E40
⑦ ELGOTEX

Figure 23
Correction factor
for linear motion
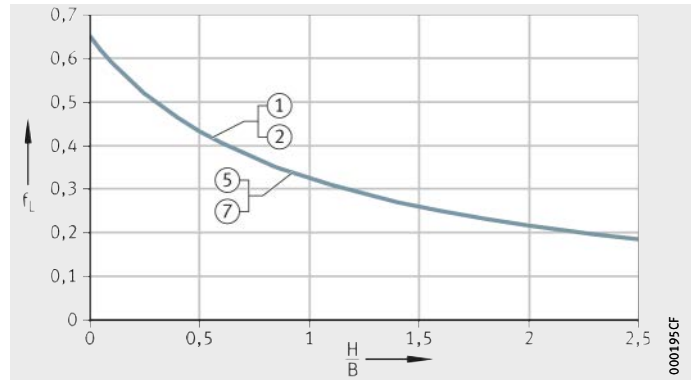
H_{max} = maximum stroke length
B = width of bush

Figure 24
Maximum stroke length
in linear motion
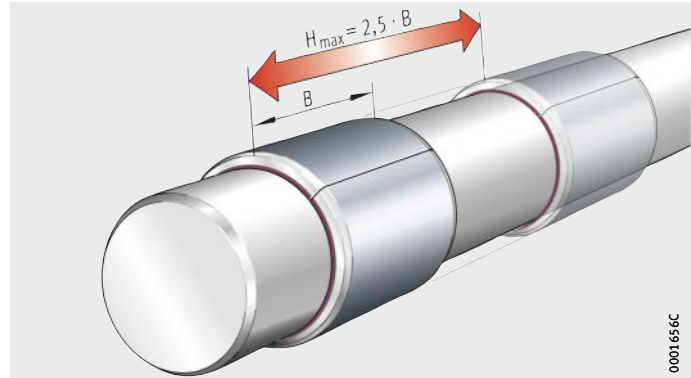
Tilt angle f_α and swivel angle f_β

The tilt motions of spherical plain bearings are taken into consideration by the correction factor f_α, while the swivel motions of spherical plain bearings or bushes are taken into consideration by the correction factor f_β, *Figure 25* and *Figure 26*.

⚠️ In the case of swivel angles of $\geqq 180°$ or rotation, the following applies:

- $f_\beta = 0,15$ for ELGOGLIDE
- $f_\beta = 0,2$ for ELGOTEX.

f_α = correction factor
α_1, α_2 = tilt angle, see page 45

① ELGOGLIDE
② ELGOGLIDE-W11

Figure 25
Correction factor
for tilt angle
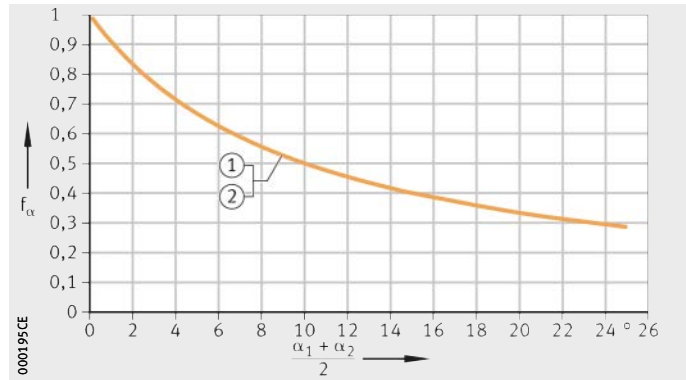
f_β = correction factor
β = swivel angle, see page 45

① ELGOGLIDE
② ELGOGLIDE-W11
⑦ ELGOTEX
⑧ Steel/steel
⑨ Steel/bronze

Figure 26
Correction factor
for swivel and oscillation angle
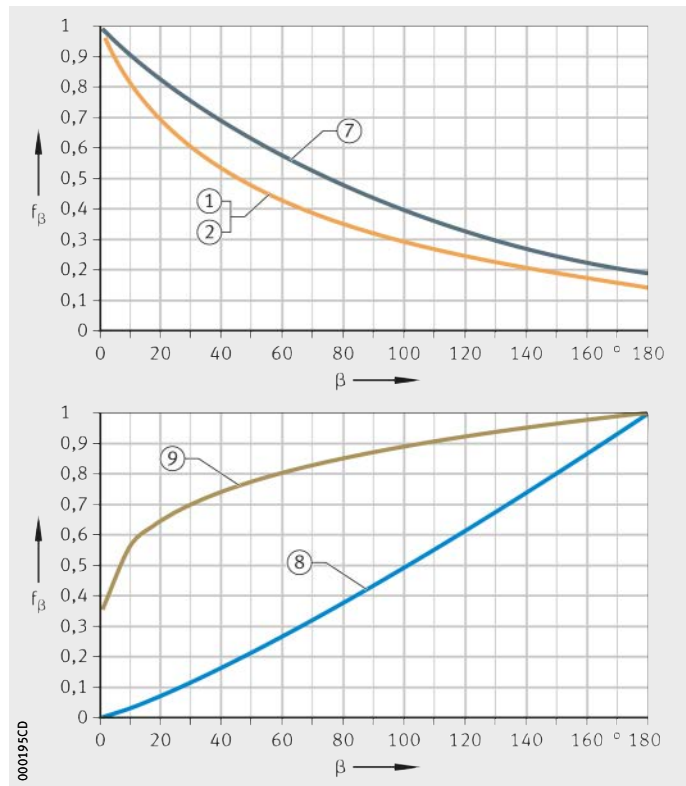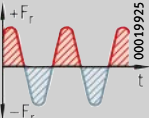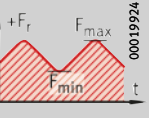
Load carrying capacity and life

Variable load f_{Hz} The correction factor for variable load f_{Hz} takes account of the influence of dynamic pulsating loads and dynamic alternating loads on the rating life. Loads that pass through the zero line in the F_r-t diagram are designated as alternating loads. Loads that are exclusively in the positive or negative region are designated as pulsating loads, see table.

The load frequency P_{Hz} (unit Hz) indicates the number of load cycles or load oscillations per second.

Type of load and correction factor f_{Hz}

Sliding layer, sliding contact surface	Type of load		
	Unilateral constant load	Alternating load	Pulsating load
	Correction factor f_{Hz}		
ELGOGLIDE	1	*Figure 27*	
ELGOGLIDE-W11			
PTFE composite		*Figure 28*, page 67	
PTFE film		*Figure 29*, page 67	
Steel/steel		2	*Figure 30*, page 67
Steel/bronze		2	*Figure 30*, page 67

p = specific bearing load
P_{Hz} = load frequency
f_{Hz} = correction factor

① Pulsating load
② Alternating load

Figure 27
f_{Hz} values for ELGOGLIDE and ELGOGLIDE-W11 under alternating load and pulsating load
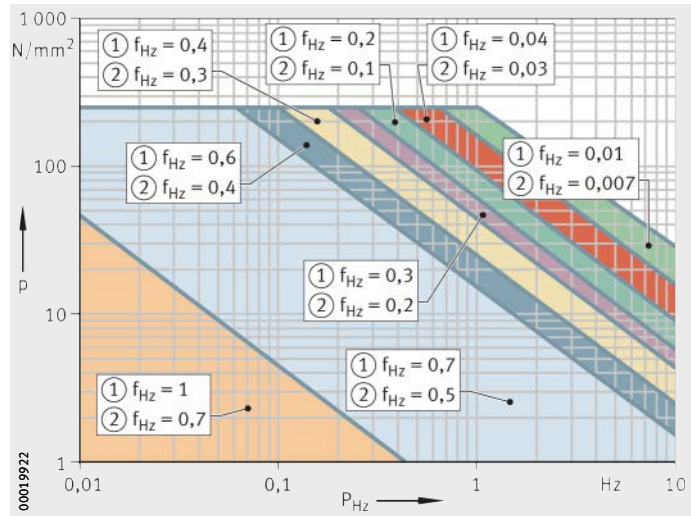
p = specific bearing load
P_{Hz} = load frequency
f_{Hz} = correction factor

① Pulsating load
② Alternating load

Figure 28
f_{Hz} values for PTFE composite
under alternating load and
pulsating load
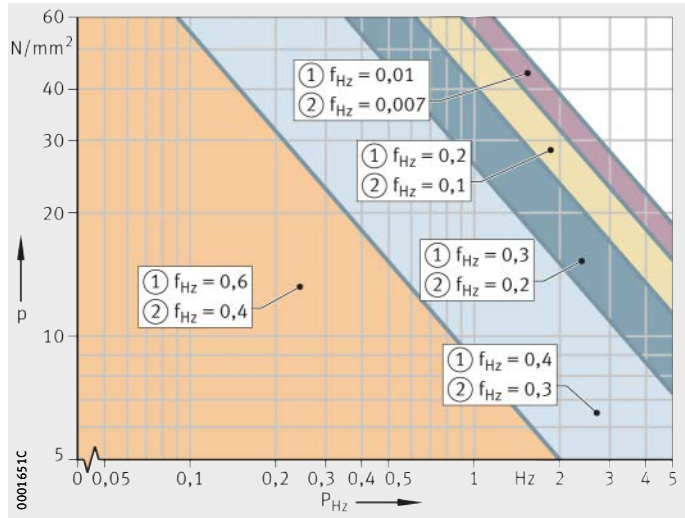
p = specific bearing load
P_{Hz} = load frequency
f_{Hz} = correction factor

① Pulsating load
② Alternating load

Figure 29
f_{Hz} values for PTFE film
under alternating load and
pulsating load
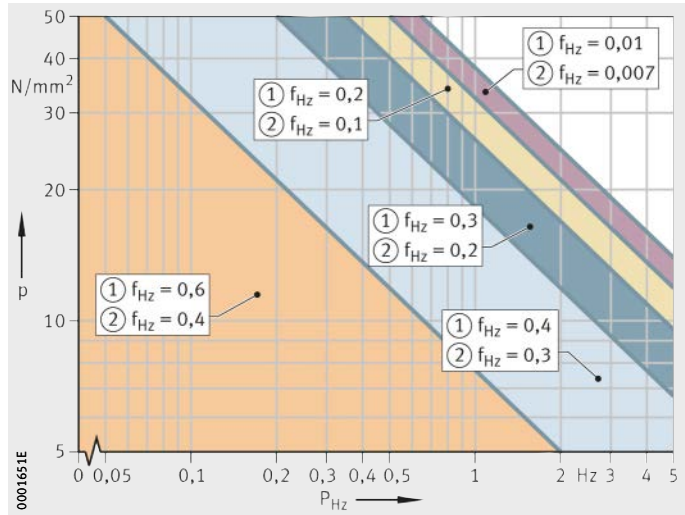
f_{Hz} = correction factor
F_{min}/F_{max} = pulsating load values

⑧ Steel/steel
⑨ Steel/bronze

Figure 30
f_{Hz} values for steel/steel and
steel/bronze under pulsating load
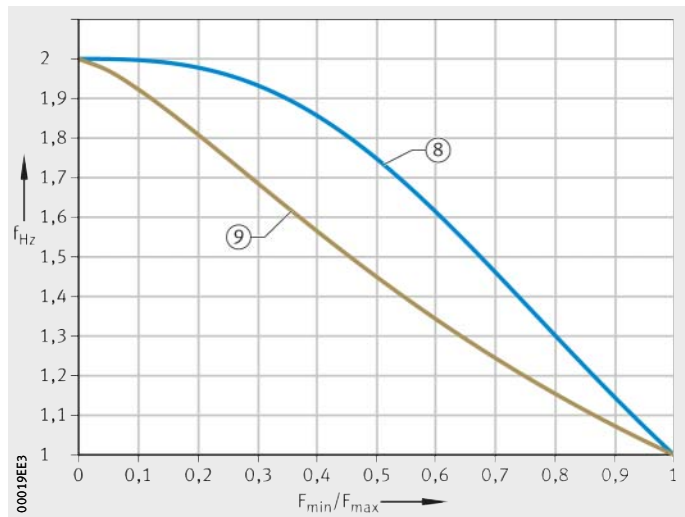
Load carrying capacity and life

Relubrication f_{NH} and $f_{N\beta}$

If periodic relubrication is carried out on spherical plain bearings requiring lubrication, their rating life can be increased. This is taken into consideration by means of a correction factor dependent on the frequency and by a factor dependent on the swivel angle β, *Figure 31* and *Figure 32*.

The relubrication interval for spherical plain bearings requiring lubrication must be no more than half the rating life:

$$l_w \leqq 0,5 \cdot L_h$$

l_w	h
Relubrication interval	
L_h	h
Basic rating life.	

f_{NH} = correction factor
L_h/l_w = frequency of relubrication

⑧ Steel/steel
⑨ Steel/bronze

Figure 31
Correction factor for relubrication,
as a function of frequency
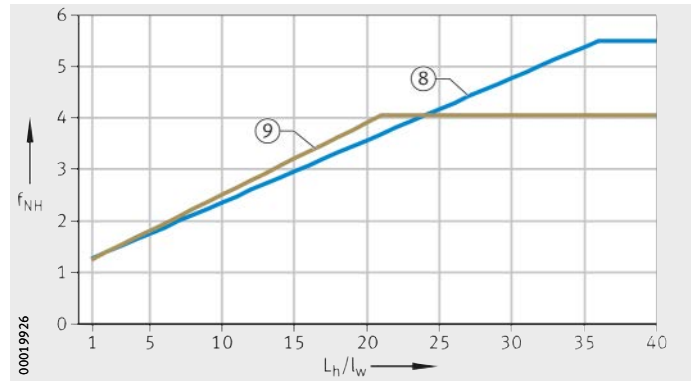
$f_{N\beta}$ = correction factor
β = swivel angle

⑧ Steel/steel
⑨ Steel/bronze

Figure 32
Correction factor for relubrication,
as a function of β
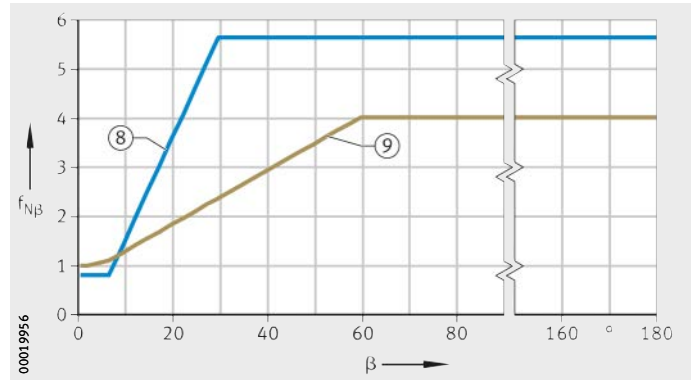
Friction and increases in temperature

Friction and wear

Friction describe the force that acts in opposition to motion. The key value stated is the coefficient of friction μ.

Friction is essentially dependent on the following influencing factors:
- the sliding contact surface
- the load
- the sliding velocity
- the bearing temperature
- the lubrication condition
- the quality of the sliding surfaces.

Fundamental curve of the coefficient of friction

For maintenance-free plain bearings based on PTFE, the fundamental curve of the coefficient of friction μ is shown as a function of sliding velocity, load and temperature, *Figure 1*. The coefficient of friction decreases with an increasing specific bearing load p and a decreasing sliding velocity v.

μ = coefficient of friction
v = sliding velocity
p = specific bearing load
ϑ = temperature
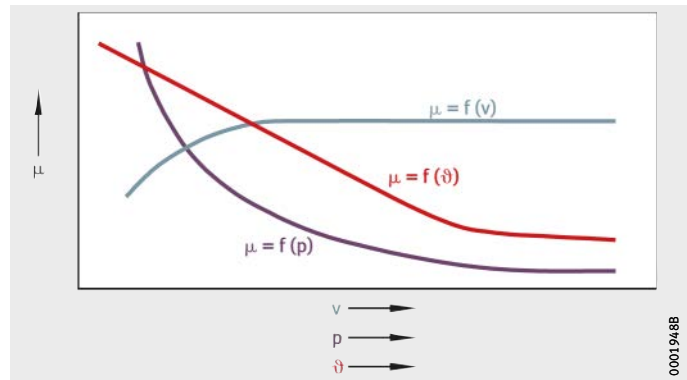
Figure 1
Coefficient of friction,
fundamental curve

Friction and increases in temperature

Friction and wear curve

The wear curve for maintenance-free plain bearings is divided into the running-in phase, main wear phase and failure phase, *Figure 2*. The main wear phase is approximately linear in character.

The friction curve of maintenance-free plain bearings shows a characteristic pattern in the three phases, *Figure 2*.

① Wear
② Friction
③ Rating life
④ Running-in phase
⑤ Main wear phase
⑥ Failure phase
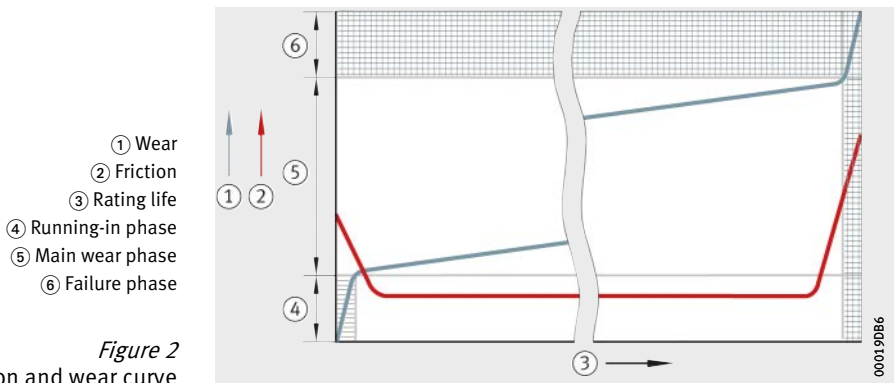
Figure 2
Friction and wear curve

Bearing frictional torque

The bearing frictional torque M is valid under radial load in the case of radial and angular contact spherical plain bearings and in the case of bushes. In the case of axial spherical plain bearings and thrust washers, it is valid under axial load.

In the case of new plain bearings, the bearing frictional torque may be significantly higher during the early running-in phase. This is for the following reasons:

- Plastic transfer of the PTFE material occurs to the surface structure of the mating surface.
- The internal tribology of the bearing is not yet complete and PTFE particles are deposited on the mating surface and functional surface (PTFE/PTFE friction).

⚠ If spherical plain bearings are subjected to combined radial and axial load, the bearing frictional torque is determined by integration of the normal forces. In the case of flanged bushes, the frictional torque must be calculated for both the radial sliding surface and the axial sliding surface on the flange.

Calculation   The bearing frictional torque M is determined as follows:

$$M = F \cdot \mu \cdot \frac{d_x}{2} \cdot \frac{1}{1000}$$

M   Nm
Bearing frictional torque
F   N
Concentric radial or axial load
μ –
Coefficient of friction, see table
d_x mm
Specific diameter, see table.

!   For reasons of safety, the maximum coefficient of friction must always be used when calculating the drive power, see table, page 71. If the coefficient of friction is above the maximum value, this may lead to increased wear, a rise in bearing temperature and impaired functioning of the plain bearing.

Specific diameter

Plain bearing	Specific diameter d_x
Radial spherical plain bearing	d_K
Axial spherical plain bearing	d_K
Angular contact spherical plain bearing	d_K
Bush	D_i
Flanged bush (radial sliding surface)	D_i
Flanged bush (axial sliding surface)	D_{fl}
Thrust washer	D_o

Comparison of coefficients of friction

Sliding layer, sliding contact surface	Mating surface	Coefficient of friction μ	
		min.	max.
E40[1]	Steel	0,03	0,25
E50	Steel	0,02	0,2
ELGOGLIDE	Hard chromium coating	0,02	0,2
ELGOGLIDE-W11	Hard chromium coating	0,02	0,15
ELGOTEX	Steel	0,03	0,2
PTFE composite	Hard chromium coating	0,05	0,2
PTFE film	Steel	0,05	0,2
Steel/steel		0,08	0,22
Steel/bronze		0,1	0,25

[1] For E40, detailed coefficients of friction must be observed, see table, page 295.

Heat dissipation   Friction is converted into heat. Adequate heat dissipation is essential for the function of a plain bearing. This occurs through convection via the housings and shafts to the environment. In some cases, heat is carried away by means of the lubricant.

In plain bearings where high frictional energy pv is converted, increased heat dissipation is required.

Internal clearance and operating clearance

Operating clearance of spherical plain bearings

The operating clearance or preload is determined on a fitted bearing still warm from operation.

It is derived from the radial internal clearance and the change in the radial internal clearance as a result of interference fit and thermal influences in the fitted condition.

Internal clearance of radial spherical plain bearings

The radial and axial internal clearance is determined on the dismounted bearing.

The radial internal clearance of radial spherical plain bearings is defined as the distance by which the inner ring can be moved in a radial direction relative to the outer ring from one extreme position to the precisely opposite extreme position, *Figure 1*.

Maintenance-free spherical plain bearings

Maintenance-free spherical plain bearings have a very small internal clearance, see dimension tables. As a result, preloads may be present once the bearing is fitted.

Spherical plain bearings requiring maintenance

The radial internal clearance is subdivided into three groups in accordance with DIN ISO 12240-1, see table. The precondition is a housing bore that causes no dimensional changes in the bearing with the exception of geometrical inaccuracies.

Group 2 to Group 3 = internal clearance groups

Figure 1
Radial internal clearance
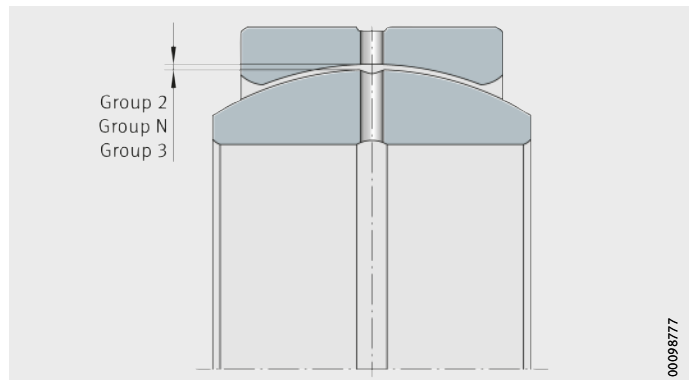
Radial internal clearance groups

Internal clearance group in accordance with ISO 12240-1	Description	Application range
Group N (CN)	Normal internal clearance; CN is not included in bearing designations	Under normal operating conditions and with the recommended fits, this gives optimum operating clearance
Group 2[1)2)] (C2)	Internal clearance < CN (suffix C2)	For bearing arrangements with very small clearance
Group 3 (C3)	Internal clearance > CN (suffix C3)	For bearing rings with press fits or a large temperature differential between the inner and outer ring

[1] Relubrication only possible with tilt angle $\alpha = 0°$.

[2] Example of bearing with restricted internal clearance: GE220-DO-2RS-C2.

Radial internal clearance

Series		Radial internal clearance μm					
GE..-DO GE..-DO-2RS(-2TS) GE..-HO-2RS GE..-LO Bore d mm	GE..-FO GE..-FO-2RS(-2TS)	Group 2 (C2)		Group N (CN)		Group 3 (C3)	
		min.	max.	min.	max.	min.	max.
6	6	8	32	32	68	68	104
8	8	8	32	32	68	68	104
10	10	8	32	32	68	68	104
12	–	8	32	32	68	68	104
–	12	10	40	40	82	82	124
15	15	10	40	40	82	82	124
16	–	10	40	40	82	82	124
17	17	10	40	40	82	82	124
20	–	10	40	40	82	82	124
–	20	12	50	50	100	100	150
25	25	12	50	50	100	100	150
30	30	12	50	50	100	100	150
32	–	12	50	50	100	100	150
35	–	12	50	50	100	100	150
–	35	15	60	60	120	120	150
40	40	15	60	60	120	120	180
45	45	15	60	60	120	120	180
50	50	15	60	60	120	120	180
60	–	15	60	60	120	120	180
–	60	18	72	72	142	142	212
63	–	18	72	72	142	142	212
70	70	18	72	72	142	142	212
80	80	18	72	72	142	142	212
90	–	18	72	72	142	142	212
–	90	18	85	85	165	165	245
100	100	18	85	85	165	165	245
110	110	18	85	85	165	165	245
120	120	18	85	85	165	165	245
140	–	18	85	85	165	165	245
160	140	18	100	100	192	192	284
180	160	18	100	100	192	192	284
200	180	18	100	100	192	192	284
–	200	18	110	110	214	214	318
220	220	18	110	110	214	214	318
240	–	18	110	110	214	214	318
250	240	18	125	125	239	239	353
260	260	18	125	125	239	239	353
280	280	18	125	125	239	239	353
300	–	18	125	125	239	239	353

Axial internal clearance

The axial internal clearance is defined as the distance by which the inner ring can be moved in an axial direction relative to the outer ring from one extreme position to the precisely opposite extreme position, *Figure 2*.

It is dependent on the bearing geometry and is in a direct relationship with the radial internal clearance. Depending on the bearing type, it may be several times greater than the radial internal clearance.

s_a = axial internal clearance

Figure 2
Axial internal clearance
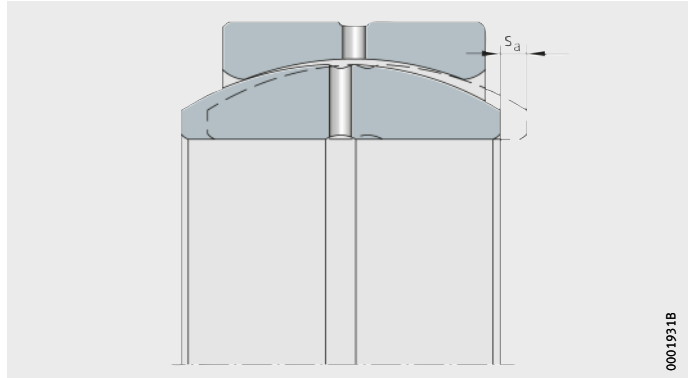
Fit conditions for spherical plain bearings	The interference fits and clearance fits for practical use are determined from the corresponding ISO fit in conjunction with the normal bearing tolerances in accordance with DIN ISO 12240-1 to DIN ISO 12240-3, see tables. The actual dimensions must correspond to the centre tolerance.

Definitions:

- ■ − indicates an interference fit
- ■ + indicates a clearance fit.

Shaft fits

Example:

- ■ A shaft of diameter ∅50 m6 Ⓔ has a probable interference fit of 0,023 mm.

Interference fit Ü$_I$ or clearance fit

Nominal shaft diameter in mm												
over	3	6	10	18	30	50	80	120	180	250	315	400
incl.	6	10	18	30	50	80	120	180	250	315	400	500
Normal tolerance, interference fit or clearance fit in μm[1]												
h6	0	0	+1	+1	+2	+2	+1	0	0	−2	−2	−2
j6	−6	−7	−7	−8	−9	−10	−13	−14	−17	−17	−20	−22
k6	−9	−9	−9	−14	−16	−20	−24	−28	−30	−33	−38	−42
m6	−12	−15	−17	−20	−23	−28	−34	−40	−47	−53	−59	−65
n6	−16	−19	−22	−27	−31	−37	−44	−52	−61	−67	−75	−82

[1] Not applicable to series GE..-LO, GE..-PB, GE..-SX, GE..-PW and GE..-SW.

Housing fits

Example:

- ■ A housing bore of diameter ∅75 M7 Ⓔ has a probable interference fit of 0,009 mm.

Interference fit Ü$_A$ or clearance fit

Nominal housing bore diameter in mm												
over	6	10	18	30	50	80	120	150	180	250	315	400
incl.	10	18	30	50	80	120	150	180	250	315	400	500
Normal tolerance, interference fit or clearance fit in μm[1]												
J7	+4	+5	+6	+7	+10	+12	+15	+18	+22	+27	+31	+34
K7	+1	+1	−1	0	0	−1	+1	+4	+5	+7	+8	+8
M7	−4	−5	−7	−8	−9	−11	−11	−8	−8	−9	−9	−10
N7	−8	−10	−14	−16	−18	−21	−23	−20	−22	−23	−25	−27

[1] Not applicable to series GE..-SX and GE..-SW.

Influence of interference fit

The radial internal clearance of radial spherical plain bearings changes due to the fit as a result of:

■ expansion of the inner ring

■ contraction of the outer ring.

⚠️ If the remaining internal clearance of spherical plain bearings requiring maintenance is $\leqq 0$, a bearing of another internal clearance group with a larger internal clearance must be selected.

Factors for the cross-section:
b = inner ring
c = outer ring
f = factor for expansion of the housing

Figure 3
Factors for expansion or contraction

Expansion of the inner ring

$$a = Ü_I \cdot b \cdot 0{,}9$$
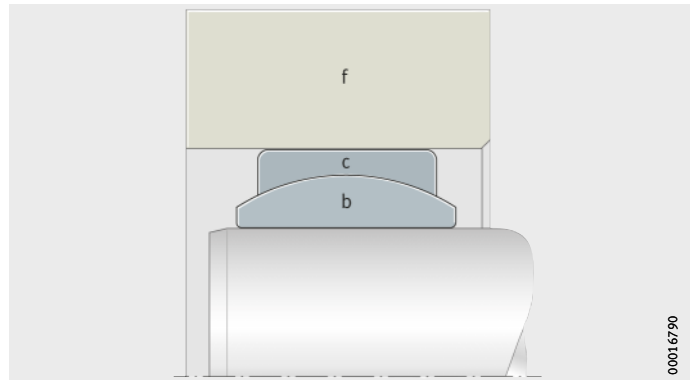
a — μm
Expansion of the inner ring when using solid shafts, measured on the sphere diameter

$Ü_I$ — μm
Effective interference fit, see table, page 75

b — –
Factor for the cross-section of the inner ring, see table, page 77, and *Figure 3*

0,9 — –
Factor for the roughness, ovality and unevenness of the supporting component surface.

Contraction of the outer ring

In the case of ring-shaped housings, expansion of the housing must be taken into consideration. The expansion is dependent on the wall thickness and is taken into consideration in the factor f:

$$e = Ü_A \cdot f \cdot 0{,}9$$

e — μm
Contraction of the outer ring, measured on the raceway diameter

$Ü_A$ — μm
Effective interference fit, see table, page 75

f — –
Factor for expansion of the housing, see page 78

0,9 — –
Factor for the roughness, ovality and unevenness of the supporting component surface.

Factor for the cross-section of the inner ring

Bore d mm		Factor for series b	
from	to	GE..-DO(-2RS), (-2TS) GE..-HO-2RS GE..-LO[1] GE..-UK(-2RS), (-2TS)	GE..-FO(-2RS), (-2TS) GE..-FW(-2RS), (-2TS) GE..-PB[1] GE..-PW[1]
6	10	0,65	0,55
12	20	0,72	0,64
25	70	0,79	0,71
80	140	0,8	0,75
160	300	0,84	0,78

[1] Interference fit $Ü_I$ not listed in the overview, see table, page 75.

Factor for the cross-section of the outer ring

Bore d mm		Factor for series c	
from	to	GE..-DO(-2RS), (-2TS) GE..-HO-2RS GE..-LO GE..-UK(-2RS), (-2TS)	GE..-FO(-2RS), (-2TS) GE..-FW(-2RS), (-2TS) GE..-PB GE..-PW
–	6	0,7	–
6	20	–	0,81
8	25	0,81	–
25	35	–	0,83
30	40	0,83	–
40	280	–	0,85
45	300	0,85	–

Internal clearance and operating clearance

**Calculation of the factor f
for expansion of the housing**

When determining the factor f, the cross-section of the bearing ring
and the ring thickness of the bearing locating housing are taken into
consideration, *Figure 4* and *Figure 5*.

D_A = diameter of housing bore
D_G = outside diameter of housing

Figure 4
Housing ring thickness
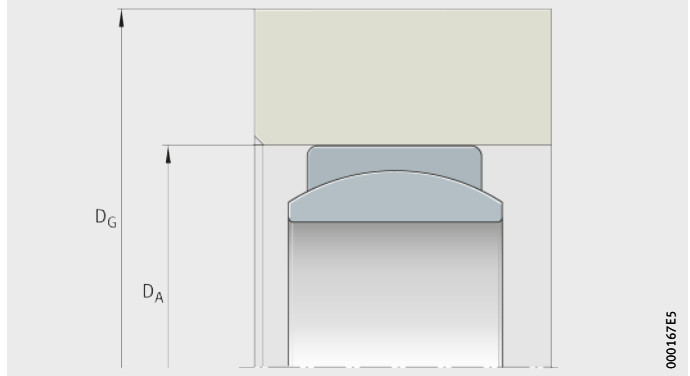
f = factor for expansion of housing
D_A = diameter of housing bore
D_G = outside diameter of housing
c = factor for cross-section of outer ring

Figure 5
Factor f
for expansion of the housing
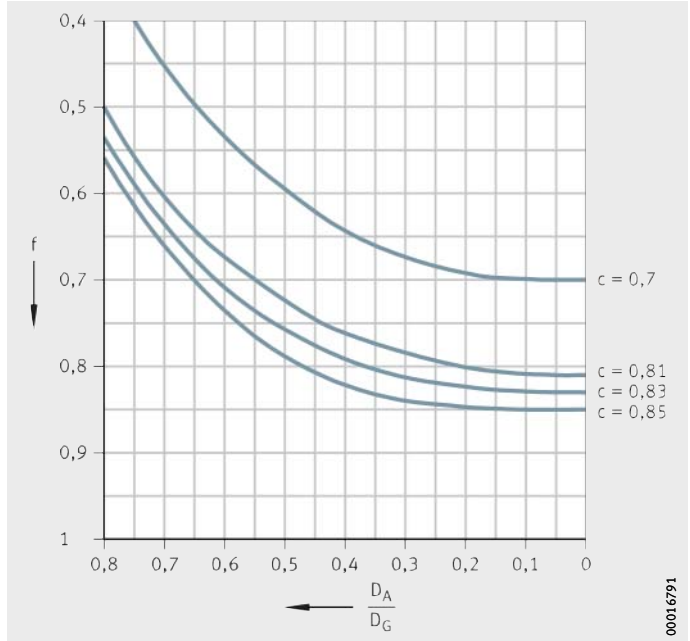
| Calculation example for internal clearance | The internal clearance of a radial spherical plain bearing in the fitted condition is calculated using the influence of the interference fit, see page 76. |

Calculation example for internal clearance

The internal clearance of a radial spherical plain bearing in the fitted condition is calculated using the influence of the interference fit, see page 76.

Given data

Radial spherical plain bearing GE50-DO with steel/steel sliding contact surface:

Fit between locating bore and shaft	M7/m6
Outside diameter of housing	$\varnothing$120 mm
Solid steel shaft	$\varnothing\ 50\,^{+0,025}_{+0,009}$
Locating bore	$\varnothing\ 75\,^{0}_{-0,03}$
Radial internal clearance Group N	60 µm to 120 µm

Required

Radial internal clearance in fitted condition.

Assumption

Production to centre of tolerance.

Expansion of the inner ring

Expansion of the inner ring, measured on the sphere diameter:

$a\ = \ddot{U}_I \cdot b \cdot 0{,}9$
$\ddot{U}_I = 0{,}023$ mm   see table, page 75
$b\ = 0{,}79$ see table, page 77

$a\ = 0{,}023$ mm $\cdot$ 0,79 $\cdot$ 0,9
$a\ = 0{,}016$ mm.

Contraction of the outer ring

Contraction of the outer ring, measured on the raceway diameter:

$e\ = \ddot{U}_A \cdot f \cdot 0{,}9$
$\ddot{U}_A = 0{,}009$ mm   see table, page 75
$c\ = 0{,}85$ see table, page 77
                 Figure 5, page 78

$f\ =\ f\!\left(\dfrac{D_A}{D_G}\right) = 0{,}72$

$e\ = 0{,}009$ mm $\cdot$ 0,72 $\cdot$ 0,9
$e\ = 0{,}006$ mm.

Reduction in radial internal clearance

The reduction in the radial internal clearance is calculated by adding a and e:

$\Delta C = a + e$
    $= 0{,}016$ mm $+ 0{,}006$ mm
    $= 0{,}022$ mm.

Internal clearance and operating clearance

Maximum restriction of internal clearance

Maximum possible restriction of radial internal clearance with production to acceptable values:

Solid steel shaft $\varnothing$ 50,025 mm
(maximum diameter $\varnothing$ 50m6)

Bearing bore $\varnothing$ 49,988 mm
(minimum diameter according to DIN 620)

$\ddot{U}_{I\,max}$ = 0,037 mm
a_{max} = $\ddot{U}_{I\,max} \cdot b \cdot 0{,}9 = 0{,}037$ mm $\cdot 0{,}79 \cdot 0{,}9$
a_{max} = 0,026 mm.

Locating bore $\varnothing$ 74,97 mm
(minimum diameter $\varnothing$ 75M7)

Bearing outside diameter $\varnothing$ 75 mm
(maximum diameter according to DIN 620)

$\ddot{U}_{A\,max}$ = 0,03 mm
e_{max} = $\ddot{U}_{A\,max} \cdot f \cdot 0{,}9 = 0{,}03$ mm $\cdot 0{,}72 \cdot 0{,}9$
e_{max} = 0,019 mm

Maximum reduction in internal clearance

Maximum reduction in the internal clearance in the fitted condition:

■ $\Delta C_{max} = a_{max} + e_{max} = 0{,}026 + 0{,}019 = 0{,}045$ mm.

The radial internal clearance in the fitted condition is 0,06 mm to 0,12 mm. The smallest possible initial clearance is 0,06 mm:

■ minimum internal clearance
= 0,060 mm − 0,045 mm = 0,015 mm.

The internal clearance in the fitted condition in the least favourable case is 0,015 mm.

Theoretical bearing clearance of metal/polymer composite plain bushes

Bushes with the sliding layer E40 and E50 are pressed into the housing. This provides axial and radial location. No additional means of location are required.

If the recommended mounting tolerances are used with rigid housings and shafts, this gives an interference fit or bearing clearance, see table, page 101.

⚠️ Expansion of the housing bore is not taken into account in calculation of the bearing clearance.

Calculation of the interference U is carried out using the tolerances of the housing bore and the deviations for the bush outside diameter D_o, see table, page 101, and table, page 305, or table, page 362.

Calculation of bearing clearance

The theoretical bearing clearance is calculated as follows:

$$\Delta s_{max} = d_{G\,max} - 2 \cdot s_{3\,min} - d_{W\,min}$$

$$\Delta s_{min} = d_{G\,min} - 2 \cdot s_{3\,max} - d_{W\,max}$$

Δs_{max} mm
Maximum bearing clearance, *Figure 6*
Δs_{min} mm
Minimum bearing clearance, *Figure 6*
$d_{G\,max}$ mm
Maximum diameter of housing bore
$d_{G\,min}$ mm
Minimum diameter of housing bore
$d_{W\,max}$ mm
Maximum shaft diameter
$d_{W\,min}$ mm
Minimum shaft diameter
$s_{3\,max}$ mm
Maximum wall thickness, see page 305 or page 362
$s_{3\,min}$ mm
Maximum wall thickness, see page 305 or page 362.

D_o = outside diameter of bush
D_i = inside diameter of bush
d_W = shaft diameter
d_G = diameter of housing bore
s_3 = wall thickness of bush
Δs = bearing clearance

Figure 6
Theoretical bearing clearance
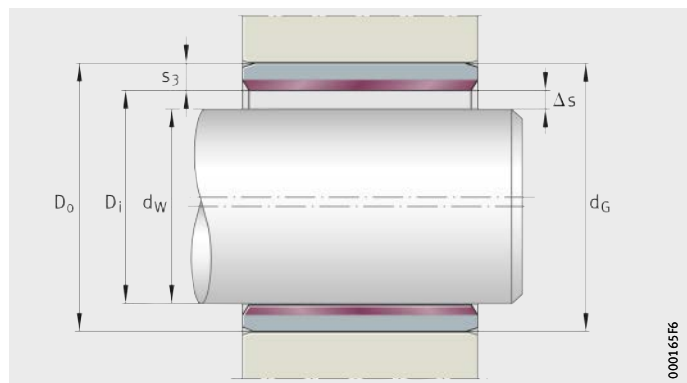
Internal clearance and operating clearance

Theoretical bearing clearance after pressing in

The theoretical bearing clearance after pressing in of bushes or flanged bushes of metric sizes or inch sizes is calculated without considering any possible expansion of the bore, see tables.

Theoretical bearing clearance for metric sizes

Diameter of bush		Bearing clearance Δs			
		E40, E40-B		E50	
D_i mm	D_o mm	Δs_{min} mm	Δs_{max} mm	Δs_{min} mm	Δs_{max} mm
2	3,5	0,000	0,054	–	–
3	4,5	0,000	0,054	–	–
4	5,5	0,000	0,056	–	–
5	7	0,000	0,077	–	–
6	8	0,000	0,077	–	–
7	9	0,003	0,083	–	–
8	10	0,003	0,083	0,040	0,127
10	12	0,003	0,086	0,040	0,130
12	14	0,006	0,092	0,040	0,135
13	15	0,006	0,092	0,040	0,135
14	16	0,006	0,092	0,040	0,135
15	17	0,006	0,092	0,040	0,135
16	18	0,006	0,092	0,040	0,135
18	20	0,006	0,095	0,040	0,138
20	23	0,010	0,112	0,050	0,164
22	25	0,010	0,112	0,050	0,164
24	27	0,010	0,112	0,050	0,164
25	28	0,010	0,112	0,050	0,164
28	32	0,010	0,126	0,060	0,188
30	34	0,010	0,126	0,060	0,188
32	36	0,015	0,135	0,060	0,194
35	39	0,015	0,135	0,060	0,194
40	44	0,015	0,135	0,060	0,194
45	50	0,015	0,155	0,080	0,234
50	55	0,015	0,160	0,080	0,239

**Theoretical bearing clearance
for metric sizes**
(continued)

Diameter of bush		Bearing clearance Δs			
		E40, E40-B		E50	
D_i mm	D_o mm	Δs_{min} mm	Δs_{max} mm	Δs_{min} mm	Δs_{max} mm
55	60	0,020	0,170	0,080	0,246
60	65	0,020	0,170	0,080	0,246
65	70	0,020	0,170	0,080	0,246
70	75	0,020	0,170	0,080	0,246
75	80	0,020	0,170	0,080	0,246
80	85	0,020	0,201	0,080	0,251
85	90	0,020	0,209	0,080	0,251
90	95	0,020	0,209	0,080	0,259
95	100	0,020	0,209	0,080	0,259
100	105	0,020	0,209	0,080	0,259
105	110	0,020	0,209	–	–
110	115	0,020	0,209	–	–
115	120	0,020	0,209	–	–
120	125	0,070	0,264	–	–
125	130	0,070	0,273	–	–
130	135	0,070	0,273	–	–
135	140	0,070	0,273	–	–
140	145	0,070	0,273	–	–
150	155	0,070	0,273	–	–
160	165	0,070	0,273	–	–
180	185	0,070	0,279	–	–
200	205	0,070	0,288	–	–
220	225	0,070	0,288	–	–
250	255	0,070	0,294	–	–
300	305	0,070	0,303	–	–

Theoretical bearing clearance for inch sizes

Designation	Nominal diameter *inch*	Recommended diameter of			
		Shaft *inch*/mm		Housing bore *inch*/mm	
		$d_{W\,min}$	$d_{W\,max}$	$d_{G\,min}$	$d_{G\,max}$
EGBZ03	$3/16$	0,1858	0,1865	0,2497	0,2503
		4,719	4,737	6,342	6,358
EGBZ04	$1/4$	0,2481	0,2490	0,3122	0,3128
		6,302	6,325	7,930	7,945
EGBZ05	$5/16$	0,3106	0,3115	0,3747	0,3753
		7,889	7,912	9,517	9,533
EGBZ06	$3/8$	0,3731	0,3740	0,4684	0,4691
		9,477	9,500	11,897	11,915
EGBZ07	$7/16$	0,4355	0,4365	0,5309	0,5316
		11,062	11,087	13,485	13,503
EGBZ08	$1/2$	0,4980	0,4990	0,5934	0,5941
		12,649	12,675	15,072	15,090
EGBZ09	$9/16$	0,5605	0,5615	0,6559	0,6566
		14,237	14,262	16,660	16,678
EGBZ10	$5/8$	0,6230	0,6240	0,7184	0,7192
		15,824	15,850	18,247	18,268
EGBZ11	$11/16$	0,6855	0,6865	0,7809	0,7817
		17,412	17,437	19,835	19,855
EGBZ12	$3/4$	0,7479	0,7491	0,8747	0,8755
		18,997	19,027	22,217	22,238
EGBZ14	$7/8$	0,8729	0,8741	0,9997	1,0005
		22,172	22,202	25,392	25,413
EGBZ16	1	0,9979	0,9991	1,1246	1,1256
		25,347	25,377	28,565	28,590
EGBZ18	$1 1/8$	1,1226	1,1238	1,2808	1,2818
		28,514	28,545	32,532	32,558
EGBZ20	$1 1/4$	1,2472	1,2488	1,4058	1,4068
		31,679	31,720	35,707	35,733
EGBZ22	$1 3/8$	1,3722	1,3738	1,5308	1,5318
		34,854	34,895	38,882	38,908
EGBZ24	$1 1/2$	1,4972	1,4988	1,6558	1,6568
		38,029	38,070	42,057	42,083
EGBZ26	$1 5/8$	1,6222	1,6238	1,7808	1,7818
		41,204	41,245	45,232	45,258
EGBZ28	$1 3/4$	1,7471	1,7487	1,9371	1,9381
		44,376	44,417	49,202	49,228
EGBZ32	2	1,9969	1,9987	2,1871	2,1883
		50,721	50,767	55,552	55,583

Theoretical bearing clearance for inch sizes (continued)

Designation	Nominal diameter inch/mm		Inside diameter after pressing in inch/mm		Bearing clearance inch/mm	
	D_i	D_o	min.	max.	Δs_{min}	Δs_{max}
EGBZ03	0,1875	0,2500	0,1867	0,1893	0,0002	0,0035
	4,763	6,350	4,742	4,808	0,005	0,089
EGBZ04	0,2500	0,3125	0,2492	0,2518	0,0002	0,0037
	6,350	7,938	6,330	6,396	0,005	0,094
EGBZ05	0,3125	0,3750	0,3117	0,3143	0,0002	0,0037
	7,938	9,525	7,917	7,983	0,005	0,094
EGBZ06	0,3750	0,4688	0,3742	0,3769	0,0002	0,0038
	9,525	11,906	9,505	9,573	0,005	0,096
EGBZ07	0,4375	0,5313	0,4367	0,4394	0,0002	0,0039
	11,113	13,494	11,092	11,161	0,005	0,099
EGBZ08	0,5000	0,5938	0,4992	0,5019	0,0002	0,0039
	12,700	15,082	12,680	12,748	0,005	0,099
EGBZ09	0,5625	0,6563	0,5617	0,5644	0,0002	0,0039
	14,288	16,669	14,267	14,336	0,005	0,099
EGBZ10	0,6250	0,7188	0,6242	0,6270	0,0002	0,0040
	15,875	18,258	15,855	15,926	0,005	0,102
EGBZ11	0,6875	0,7813	0,6867	0,6895	0,0002	0,0040
	17,463	19,844	17,442	17,513	0,005	0,101
EGBZ12	0,7500	0,8750	0,7493	0,7525	0,0002	0,0046
	19,050	22,225	19,032	19,114	0,005	0,116
EGBZ14	0,8750	1,0000	0,8743	0,8775	0,0002	0,0046
	22,225	25,400	22,207	22,289	0,005	0,116
EGBZ16	1,0000	1,1250	0,9992	1,0026	0,0001	0,0047
	25,400	28,575	25,380	25,466	0,003	0,119
EGBZ18	1,1250	1,2813	1,1240	1,1278	0,0002	0,0052
	28,575	32,544	28,550	28,646	0,005	0,132
EGBZ20	1,2500	1,4063	1,2490	1,2528	0,0002	0,0056
	31,750	35,719	31,725	31,821	0,005	0,142
EGBZ22	1,3750	1,5313	1,3740	1,3778	0,0002	0,0056
	34,925	38,894	34,900	34,996	0,005	0,142
EGBZ24	1,5000	1,6563	1,4990	1,5028	0,0002	0,0056
	38,100	42,069	38,075	38,171	0,005	0,142
EGBZ26	1,6250	1,7813	1,6240	1,6278	0,0002	0,0056
	41,275	45,244	41,250	41,346	0,005	0,142
EGBZ28	1,7500	1,9375	1,7489	1,7535	0,0002	0,0064
	44,450	49,213	44,422	44,539	0,005	0,163
EGBZ32	2,0000	2,1875	1,9989	2,0037	0,0002	0,0068
	50,800	55,563	50,772	50,894	0,005	0,173

Interference fit and bearing clearance of metal/polymer composite plain bushes

The table shows measures that can be taken to influence the bearing clearance and interference fit:

- at high ambient temperatures
- depending on housing material
- depending on housing wall thickness.

Reduced clearance tolerances require tighter tolerances for the shaft and the bore.

Consequences and measures due to environmental influences

Consequences and measures for interference fit and bearing clearance in the case of high ambient temperatures, special housing materials or special wall thicknesses, see table.

Environmental influence

Design and environmental influences	Consequences			Measures		
	Bearing clearance		Poor interference fit	Change in diameter		
	Too large	Too small		d_G	d_W	Notes
Light metal or thin-walled housings	■	–	–	●	–	The housing is more highly stressed; the permissible stress on the housing must not be exceeded.
Steel or cast iron housings[1]	–	■	–	–	▼	–
Bronze or copper alloy housings[1]	–	–	■	▲	▲	Reduce d_G and d_W by the same value so that the bearing clearance is maintained.
Aluminium alloy housings[1]	–	–	■	○	○	Reduce d_G and d_W by the same value so that the bearing clearance is maintained. At temperatures below 0 °C, the housing is more highly stressed; the permissible stress on the housing must not be exceeded.
Bushes with thicker anti-corrosion layer	–	■	–	❑	–	The bush and housing will be more highly stressed if appropriate measures are not taken.

■ Applicable
● Reduce
○ Reduce by 0,1% per 100 °C above room temperature
▲ Reduce by 0,05% per 100 °C above room temperature
❑ Increase by 0,03 mm if, for example, the layer thickness = 0,015 mm
▼ Reduce by 0,008 mm per 100 °C above room temperature.

[1] At high ambient temperatures.

Theoretical bearing clearance of ELGOTEX filament wound bushes

The bushes are pressed as standard into a housing with the tolerance H7. This provides radial and axial location.
Due to the contraction of the inside diameter, there is a change in the tolerance of the inside diameter of the bush after pressing in, see table, page 88.

Expansion of the housing bore is not taken into consideration in calculation of the bearing clearance.

Depending on the selected shaft fit, there is a theoretical bearing clearance, see equations:

$$\Delta s_{max} = D_{i\,max} - d_{W\,min}$$

$$\Delta s_{min} = D_{i\,min} - d_{W\,max}$$

Δs_{max} mm
Maximum bearing clearance
Δs_{min} mm
Minimum bearing clearance
$D_{i\,max}$ mm
Maximum inside diameter of bush after pressing in, see table, page 88
$D_{i\,min}$ mm
Minimum inside diameter of bush after pressing in, see table, page 88
$d_{W\,min}$ mm
Minimum shaft diameter
$d_{W\,max}$ mm
Maximum shaft diameter.

Internal clearance and operating clearance

Theoretical bearing clearance after pressing-in

For a housing tolerance H7 and the recommended shaft tolerance h7, the minimum and maximum theoretical clearances for the standard dimensions are stated, see table. The data do not take account of any possible expansion of the housing bore.

Theoretical bearing clearance for metric sizes

Diameter of bush		Inside diameter after pressing-in		Bearing clearance for tolerance H7/h7	
D_i	D_o	$D_{i\,min}$	$D_{i\,max}$	Δs_{min}	Δs_{max}
mm	mm	mm	mm	mm	mm
20	24	20,042	20,18	0,042	0,201
25	30	25,042	25,18	0,042	0,201
28	34	28,028	28,176	0,028	0,197
30	36	30,028	30,176	0,028	0,197
35	41	35,038	35,202	0,038	0,227
40	48	40,038	40,202	0,038	0,227
45	53	45,031	45,207	0,031	0,232
50	58	50,031	50,207	0,031	0,232
55	63	55,041	55,237	0,041	0,267
60	70	60,035	60,231	0,035	0,261
65	75	65,035	65,231	0,035	0,261
70	80	70,045	70,241	0,045	0,271
75	85	75,025	75,234	0,025	0,264
80	90	80,025	80,234	0,025	0,264
85	95	85,045	85,274	0,045	0,309
90	105	90,037	90,266	0,037	0,301
95	110	95,037	95,266	0,037	0,301
100	115	100,037	100,266	0,037	0,301
105	120	105,047	105,276	0,047	0,311
110	125	110,025	110,268	0,025	0,303
120	135	120,025	120,268	0,025	0,303
130	145	130,037	130,3	0,037	0,34
140	155	140,037	140,3	0,037	0,34
150	165	150,039	150,302	0,039	0,342
160	180	160,039	160,302	0,039	0,342
170	190	170,036	170,314	0,036	0,354
180	200	180,036	180,314	0,036	0,354
190	210	190,038	190,341	0,038	0,387
200	220	200,038	200,341	0,038	0,387

**Operating clearance
of ELGOGLIDE plain bushes**

Due to the self-lubricating PTFE fabric, maintenance-free ELGOGLIDE plain bushes do not require a minimum radial clearance determined by lubrication conditions.

Fitting without clearance has particular advantages, especially with alternating load directions. Load distribution is also improved, especially during running-in, due to the larger load-bearing areas.

In order to achieve the largest possible load-bearing angle, the operating clearance s must not exceed defined limits. The clearance can be expressed as a function of the relative bearing clearance ψ, see equation and *Figure 7*.

The guide values for the relative bearing clearance are valid for shaft diameters d = 30 mm to 200 mm, see table.

The ranges for the operating clearance are achievable with the standard tolerances of the plain bushes and where the housing bore and shaft are manufactured to the central tolerance.

**Guide values
for relative bearing clearance
in fitted condition**

Shaft diameter d mm	Relative bearing clearance ψ ‰
< 80	$\leqq 1$
$\geqq$ 80 – 120	$\leqq 0{,}75$
> 120 – 200	$\leqq 0{,}5$

**Calculation
of the operating clearance**

$$s = \psi \cdot d$$

s   μm
Operating clearance, *Figure 7*
ψ ‰
Relative bearing clearance in fitted condition, see table
d   mm
Shaft diameter, bore diameter of inner ring.

s = operating clearance

Figure 7
Operating clearance
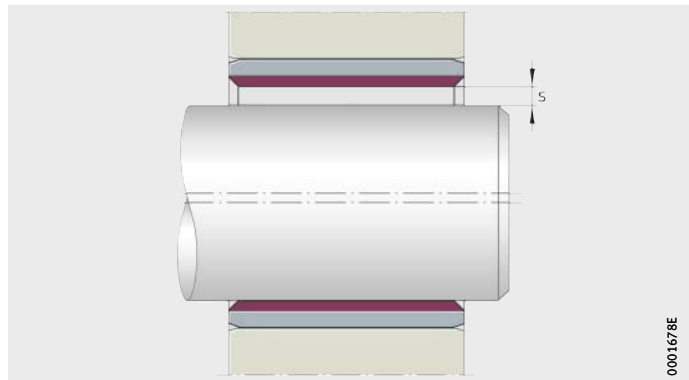
Design of bearing arrangements

**Adjacent construction
of spherical plain bearings**

The chamfers, radii, edge breaks and surface quality required
for the shaft and housing bore are defined as follows.

**Chamfers, radii and
chamfer dimensions**

Spherical plain bearings have a convex transition between
the outside surface and the bore to the end faces. This gives easier
mounting.

The bearing rings must be in contact with the shaft and housing
shoulders. The largest radius of the shaft and housing locating face
must therefore not be larger than the smallest chamfer dimension
r_1, r_2 of the bearing, *Figure 1* and dimension tables.

In the case of spherical plain bearings, the shaft and housing bore
of the adjacent construction should have a lead chamfer of between
10° and 20°, *Figure 2*. Any burrs must be removed.

① Axial
② Radial

Figure 1
Chamfer dimensions
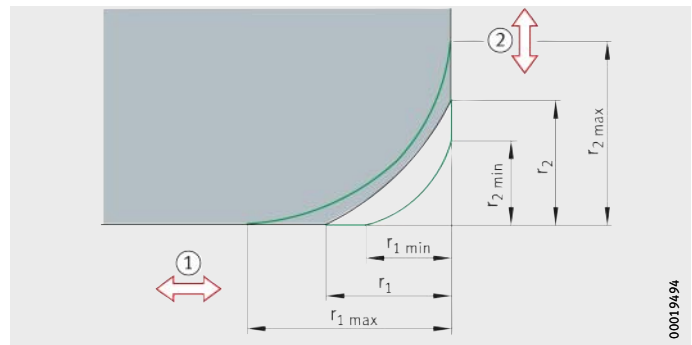
Figure 2
Lead chamfers
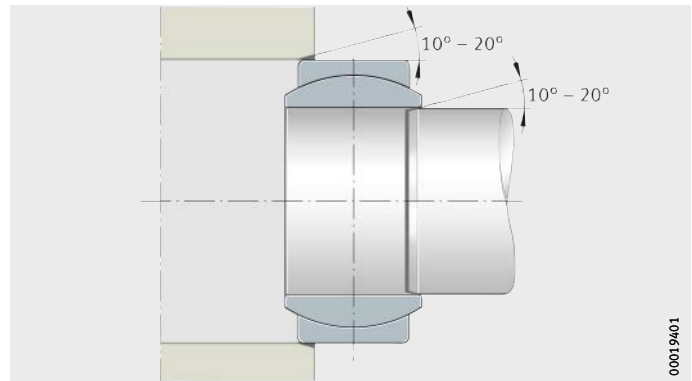
Surface of the shaft and housing bore

The seating surfaces for the bearings must be designed such that the forces introduced via the bearings do not cause impermissible changes to the geometry of the shaft and housing and do not cause permanent deformations of the spherical plain bearing.

Where spherical plain bearings are subjected to high loads of $p \geqq 80$ N/mm^2, the shaft and housing must be checked.

If it is possible that a preload and an associated frictional torque in the bearing is present, this must be taken into consideration in the design of the bearing arrangement. The accuracy of the adjacent construction must therefore be checked with Schaeffler.

Roughness of bearing seats

Recommended values apply to the roughness of the bearing seats, see table.

Roughness values

Bearing seating surface	Roughness µm
Housing bore	$\leqq$ Rz 16
Shaft	$\leqq$ Rz 10

Design of bearing arrangements

Geometrical and positional tolerances of bearing seating surfaces

The geometrical accuracy of seating surfaces is dependent on the application of the spherical plain bearings and the operating conditions. In order to achieve the required fit, the bearing seats on the shaft and housing bore must conform to certain tolerances, *Figure 3* and table.

The tolerances for the bores and shafts correspond to the fundamental tolerances in accordance with ISO 286-2, see section ISO tolerances, page 125.

t_1 = roundness tolerance
t_2 = parallelism tolerance
t_3 = axial runout of abutment shoulders
t_4 = straightness tolerance

Figure 3
Guide values for geometrical and positional tolerances
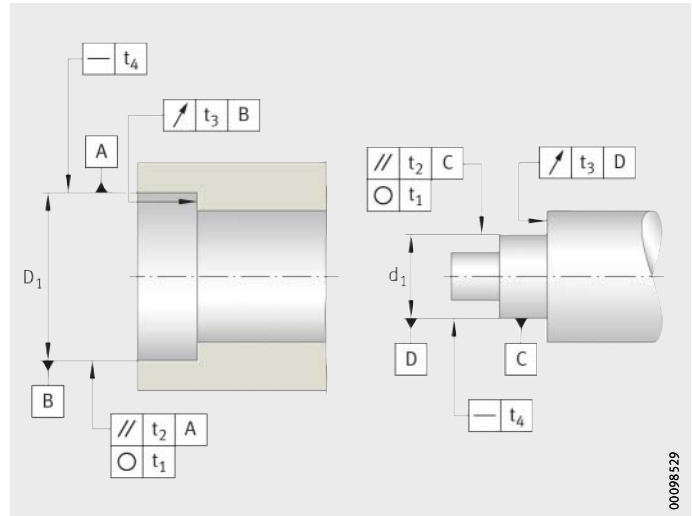
Accuracy of bearing seating surfaces

The degree of accuracy for the bearing seat tolerances on the shaft and in the housing correspond to the fundamental tolerances in accordance with ISO 286-1, see table.

When using the fits in accordance with ISO 286-1, the envelope requirement Ⓔ always applies.

Geometrical and positional tolerances of bearing seating surfaces

Bearing seating surface	Fundamental tolerance grades[1]			
	Roundness tolerance	Parallelism tolerance	Axial runout tolerance of abutment shoulder	Straightness tolerance
	t_1	t_2	t_3	t_4
Shaft	IT6/2	IT6	IT10/2	IT6/2
Housing	IT6/2	IT6	IT10/2	IT6/2

[1] ISO fundamental tolerances (IT grades) in accordance with ISO 286.

Adjacent construction of plain bushes

In the design of the adjacent construction of plain bushes, a distinction is made in relation to the bearing type. The guidelines on ELGOGLIDE plain bushes and ELGOTEX filament wound bushes are similar and have been combined.

ELGOGLIDE plain bushes and ELGOTEX filament wound bushes

The shaft and housing bore should be produced as specified, *Figure 4*. For the shaft, a roughness Rz 1 is recommended. A higher roughness will reduce the operating life of plain bushes. A roughness higher than Rz 4 must be avoided.

d_w, D_A: recommended mounting tolerances, see table, page 101

① Shaft
② Housing bore
③ Rounded

Figure 4
Design of adjacent components
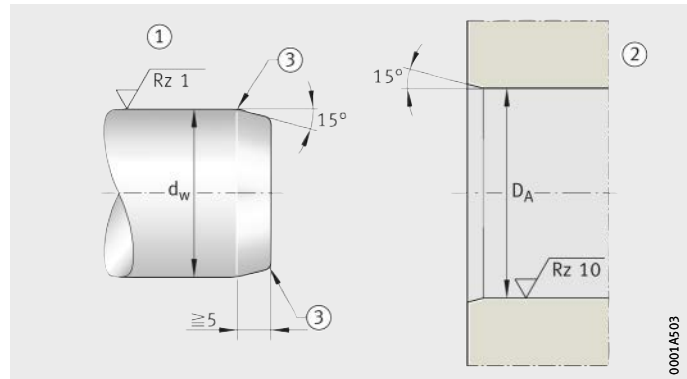
ELGOGLIDE plain bushes

For optimum conditions, the shaft should be hardened and have a hard chromium coating or should be made from corrosion-resistant steel. For increased loads, the hardness of the steel should be at least 55 HRC. Lower hardness values may lead to a reduced rating life.

ELGOTEX filament wound bushes

For optimum conditions, the shaft should be hardened. For increased loads, the hardness of the steel should be at least 55 HRC. Lower hardness values may lead to a reduced rating life.

If the full volume of the sliding layer is to be used, the raceway on the shaft must be hard, smooth and resistant to corrosion.

Design of bearing arrangements

Metal/polymer composite plain bushes

Shafts should be chamfered and all sharp edges rounded, see page 301. For easier pressing in, the chamfer should be produced to $f_G \times 20° \pm 5°$, see table and *Figure 5*.

The recommended mounting tolerances for the shaft and housing bore must be observed, see table, page 101.

For the housing bore, a roughness depth Rz 10 is recommended. The optimum operating life in dry running of the sliding layer E40 is achieved with a roughness depth of the shaft of Rz 2 to Rz 3.

⚠️ Very small roughness depths will not increase the operating life, but larger roughness depths will lead to a significant reduction.

Chamfer width

Bore diameter d_G mm	Chamfer width f_G mm
$d_G \leqq 30$	$0{,}8 \pm 0{,}3$
$30 < d_G \leqq 80$	$1{,}2 \pm 0{,}4$
$80 < d_G \leqq 180$	$1{,}8 \pm 0{,}8$
$180 < d_G$	$2{,}5 \pm 1$

f_G = chamfer width
R = rounded edge

Figure 5
Chamfer on housing bore
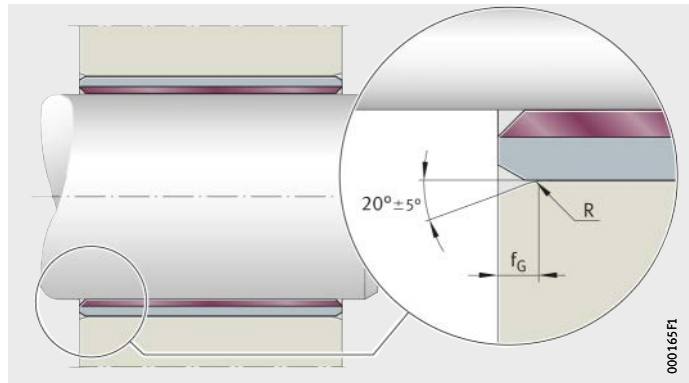
Flanged bushes In flanged bushes, the radius at the transition from the radial to the axial component must be taken into consideration.

The flanged bush must not be in contact in the area of the radius and, where axial loads are present, an adequate level of additional support must be provided for the flange. Chamfer width for the housing bore, see table and *Figure 6*.

Chamfer width

Bore diameter d_G mm	Chamfer width f_G mm
$d_G \leqq 20$	$1,2 \pm 0,2$
$20 < d_G \leqq 28$	$1,7 \pm 0,2$
$28 < d_G \leqq 45$	$2,2 \pm 0,2$
$45 < d_G$	$2,7 \pm 0,2$

f_G = chamfer width
R = rounded edge

Figure 6
Chamfer on housing bore

000165F0
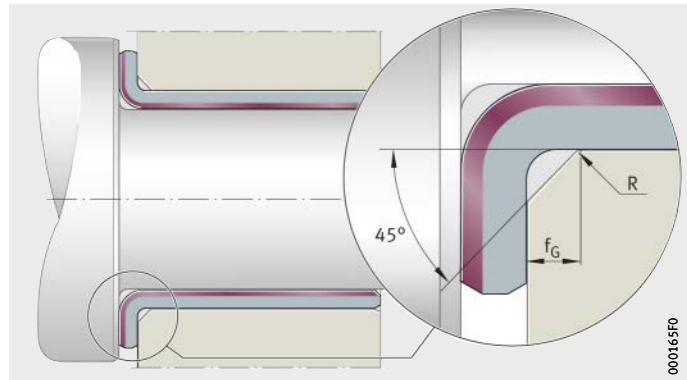
Design of bearing arrangements

Axial location of spherical plain bearings

!

Spherical plain bearings under high loads undergo elastic deformation. This leads to relative micromovements in the fits. As a result, the bearing rings can creep in an axial direction despite a tight fit.

In order to prevent axial displacement, the bearing rings must always be located axially.

Retaining ring or spacer ring

Suitable means of locating the bearing rings are as follows, *Figure 7* and *Figure 8*:

- retaining rings. These allow easy mounting and dismounting of the bearings.
- spacer rings between the bearing ring and adjacent component if weakening of the shaft by annular slots is unacceptable or the bearings are to be preloaded.

Preload prevents rotary motion between the bearing ring and adjacent construction, even with a loose fit.

① Retaining ring

Figure 7
Location by snap rings
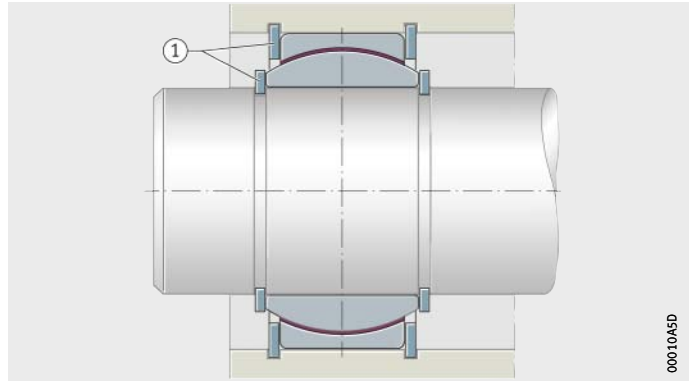
① Retaining ring
② Spacer ring

Figure 8
Location by snap rings and spacer rings
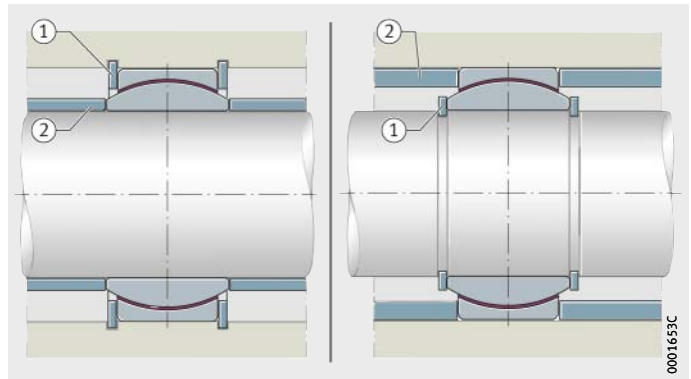
Spacer sleeve, end washer and cover

Spherical plain bearings can also be located with the aid of a spacer sleeve or end washer and a cover, *Figure 9* and *Figure 10*.

① Spacer sleeve
② Cover

Figure 9
Location by means
of spacer sleeves and covers
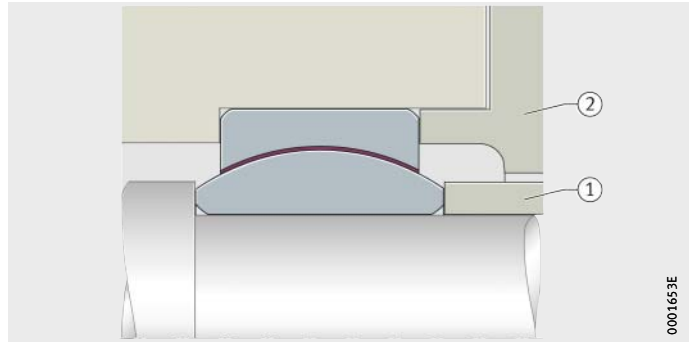
① End washer
② Cover

Figure 10
Location by means
of end washer and cover
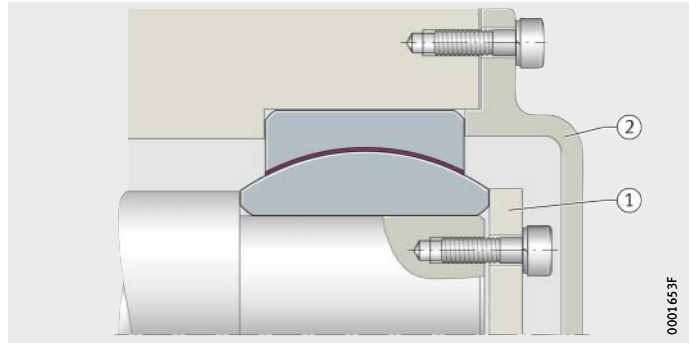
Design of bearing arrangements

**Location
of thrust washers and strips**

Concentric seating of thrust washers is ensured by means of recesses in the housing, *Figure 11*. Diameters and depths of recesses, see dimension tables.

Undesirable rotation of the thrust washers must be prevented by means of a dowel pin or countersunk head screw. The screw head or dowel pin must be recessed relative to the running surface by at least 0,25 mm, *Figure 11* and *Figure 12*. Size and arrangement of the holes, see dimension tables.

If it is not possible to make a recess in the housing, the plain bearings must be secured by means of several dowel pins or screws. It is also possible to use other cost-effective joining techniques such as laser welding, soft soldering or adhesive bonding, see page 377.

It is not always necessary to provide security against rotation. In some cases, the adhesive friction between the backing of the plain bearing and the housing will be sufficient.

Strips can be located in the same way as thrust washers.

R = rounded edge

Figure 11
Prevention of rotation
by dowel pin
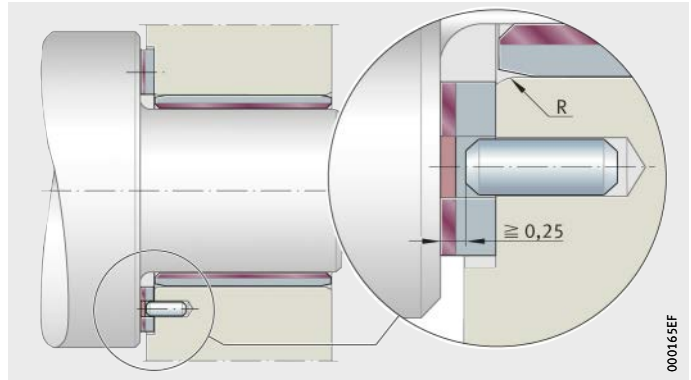
R = rounded edge

Note the guidelines relating to machining
of plain bearings, see page 303.

Figure 12
Prevention of rotation
by countersunk head screw
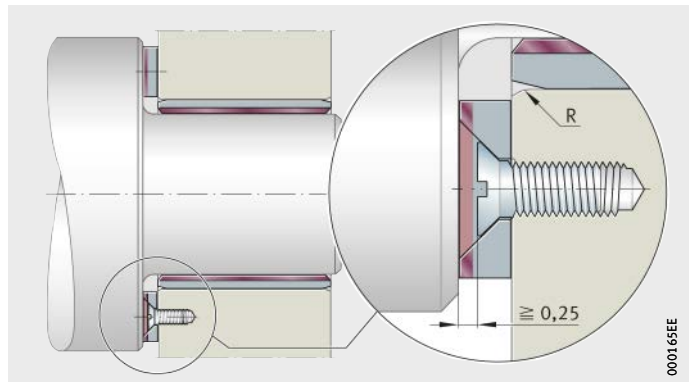
Recommended mounting tolerances for spherical plain bearings	Spherical plain bearings are radially located by means of fits.

Spherical plain bearings are radially located by means of fits.

The recommended values for shaft and housing fits are dependent on the adjacent construction, see tables.

Application as locating bearings

Tight fits prevent damage to the adjacent construction. The shaft and bore fits must therefore be selected such that no sliding motion occurs on the shaft or in the housing bore.

When using tight fits, the following must be noted:
- Interference between the housing and outer ring causes contraction of the outer ring.
- Interference between the shaft and bearing bore causes expansion of the inner ring.

! These elastic deformations of the bearing rings reduce the internal clearance of the spherical plain bearing, see section Internal clearance and operating clearance, page 72. If a tight fit is not possible, the bearing rings must be secured against axial sliding motion on the shaft or in the housing, see page 96.

Application as non-locating bearings

The axial displacement should occur between the shaft and bearing bore:
- The length/diameter ratio of the guidance is more favourable at this point than on the outer ring of the bearing.
- The axially split outer ring expands under axial load and can therefore jam in the bearing location.
- No wear should occur in the housing bore.

! The surface of the shaft must be produced so that it is resistant to wear. The surface hardness must be $\geqq 55$ HRC. Maintenance-free spherical plain bearings can have a lining of ELGOGLIDE in the bearing bore, suffix W7 or W8, see table, page 145.

When used as non-locating bearings, spherical plain bearings requiring maintenance should only be lubricated via the shaft.

In the case of a non-locating bearing arrangement, the shaft fit g6 is recommended.

Design of bearing arrangements

Maintenance-free spherical plain bearings

In comparison with spherical plain bearings requiring maintenance, looser fits may be used with maintenance-free bearings. The bearing friction is lower in this case due to the hard chromium/PTFE sliding contact surface.

! Tighter fits may be necessary for applications with pulsating or alternating loads or where circumferential loads are present. Since maintenance-free spherical plain bearings have only a very small internal clearance, preload may occur in the bearing once in the fitted condition.

Shaft and housing fits for maintenance-free spherical plain bearings

Type	Bore d mm	Material of adjacent construction	
		Housing/shaft[1] Steel/steel	Housing/shaft[1] Light metal/steel
Radial spherical plain bearings[2]	$\leqq$ 300	K7/j6[3]	M7/j6[3]
	> 300	J7/j6	–
Angular contact spherical plain bearings	–	M7/m6	–
Axial spherical plain bearings	–	M7/m6	–

[1] The envelope condition Ⓔ applies here.

[2] In the case of alternating load, M7/m6 is recommended.

[3] GE..-PW: for shaft m6.

Spherical plain bearings requiring maintenance

The operating life of spherical plain bearings requiring maintenance is reduced by preloading of the sliding surfaces and excessively small load-bearing areas of the sliding surfaces as a result of an impermissibly high internal clearance. The recommended values for shaft and housing fits are dependent on the adjacent construction, see table.

! If tighter fits are necessary, for example where high, impact type loads occur, the operating clearance must be checked by means of calculation, see chapter page 72.

If it is possible that a preload and an associated frictional torque in the bearing is present, this must be taken into consideration in the design of the bearing arrangement. The accuracy of the adjacent construction must therefore be checked with Schaeffler.

Shaft and housing fits for spherical plain bearings requiring maintenance

Type	Radial internal clearance	Material of adjacent construction	
		Housing/shaft[1] Steel/steel	Housing/shaft[1] Light metal/steel
Radial spherical plain bearings[2]	Group 2 (C2)	K7/j6	M7/j6
	Group N (CN)	M7/m6[3]	N7/m6[3]
	Group 3 (C3)	M7/m6	N7/m6
Angular contact spherical plain bearings	–	M7/n6	–
Axial spherical plain bearings	–	M7/n6	–

[1] The envelope condition Ⓔ applies here.

[2] GE..-LO: for shaft r6.

[3] GE..-PB: for housing/shaft K7/m6.

Recommended mounting tolerances for plain bushes

The plain bearing bushes are pressed into the housing. This provides axial and radial location. No additional means of location are required.

Recommended mounting tolerances, see tables.

⚠️ If shafts with the tolerance class h Ⓔ are used, the bearing clearance must be checked in accordance with the equations for Δs_{max} and Δs_{min}, see page 81.

For aluminium housings, mounting tolerances to M7 Ⓔ are recommended.

Mounting tolerances for metal/polymer composite plain bushes

Diameter range	Sliding layer[1]		
mm	E40	E40-B	E50
Shaft			
$d_W <$ 5	h6	–	–
5 $\leqq d_W <$ 80	f7	f7	h8
80 $\leqq d_W$	h8	h8	h8
Housing bore			
$d_G \leqq$ 5,5	H6	–	–
5,5 $< d_G$	H7	H7	H7

[1] The envelope condition Ⓔ applies here.

Mounting tolerances for plain bushes with ELGOGLIDE or ELGOTEX

Adjacent component	Sliding layer[1]	
	ELGOGLIDE	ELGOTEX
Shaft	f7	h7
Housing bore	H7	H7

[1] The envelope condition Ⓔ applies here.

Design of bearing arrangements

Misalignment of plain bushes

Precise alignment is important for plain bushes. This is particularly valid for maintenance-free plain bushes, in which load cannot be distributed by means of a lubricant film.

The misalignment across the entire bush width should be $\leqq 0,02$ mm, *Figure 13*. This also applies across the entire width of bushes arranged in pairs as well as to thrust washers.

Plain bushes should not be used for movement involving spatial motion. Any skewing of the shaft will reduce the operating life.
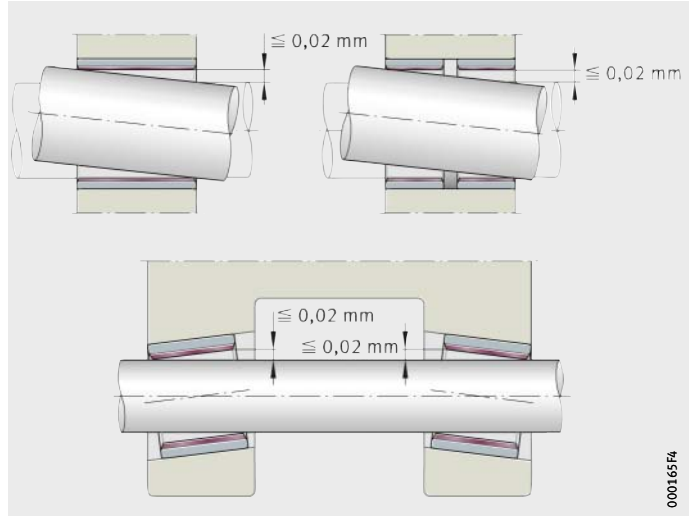
Figure 13
Permissible misalignment of bushes

Edge loading of metal/polymer composite plain bushes

In the case of metal/polymer composite plain bushes, the high edge loads should be reduced by means of chamfers, larger bore diameters in the vicinity of the edge or wide bushes that protrude beyond the edge of the bore, *Figure 14*.

Where bushes are arranged in series, they should be of the same width and the butt joints should be in alignment.
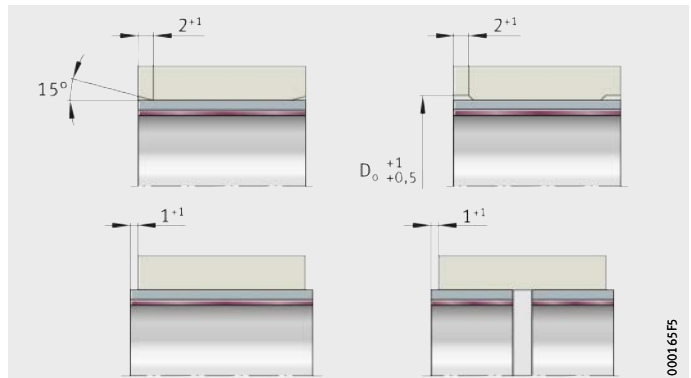
Figure 14
Reduction of peak stresses at edges

Angular contact spherical plain bearings in O or X arrangement

If angular contact spherical plain bearings are to transmit axial and radial loads, the bearings can be installed in pairs in an O or X arrangement under preload, *Figure 15* and *Figure 16*.

The precondition for angular contact spherical plain bearings requiring maintenance is:

■ axial clearance per bearing of $0,1_{\pm0,05}$ mm.

Figure 15
Angular contact
spherical plain bearings
in O arrangement
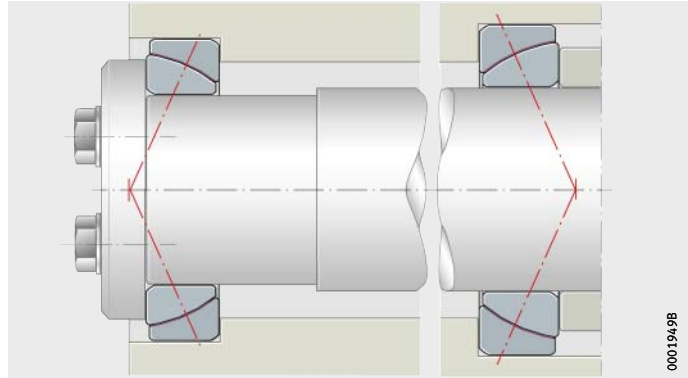
Figure 16
Angular contact
spherical plain bearings
in X arrangement
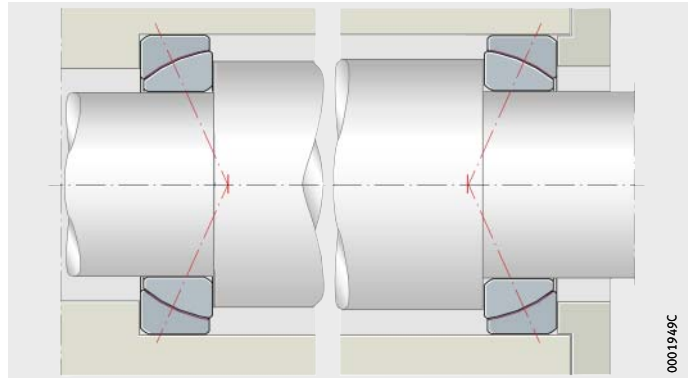
Design of bearing arrangements

Combination of axial and radial spherical plain bearings

If axial spherical plain bearings are combined with radial spherical plain bearings of dimension series E to DIN ISO 12240-1 in order to support radial forces, the axial and radial load must be distributed over both bearings. The pin in the shaft locating washer must have a radial release of approx. 1 mm or the pin must only be in contact with the large end face of the shaft locating washer, *Figure 17*.

For a bore diameter of d $\geqq$ 160 mm or larger in the case of maintenance-free radial spherical plain bearings, the bearing must be fitted in a closed housing. The diameter D of the axial bearing corresponds to the inside diameter of the housing.

F_r = radial load
d_K = sphere diameter
1 mm = pin with radial release

Figure 17
Combination of axial and radial spherical plain bearings
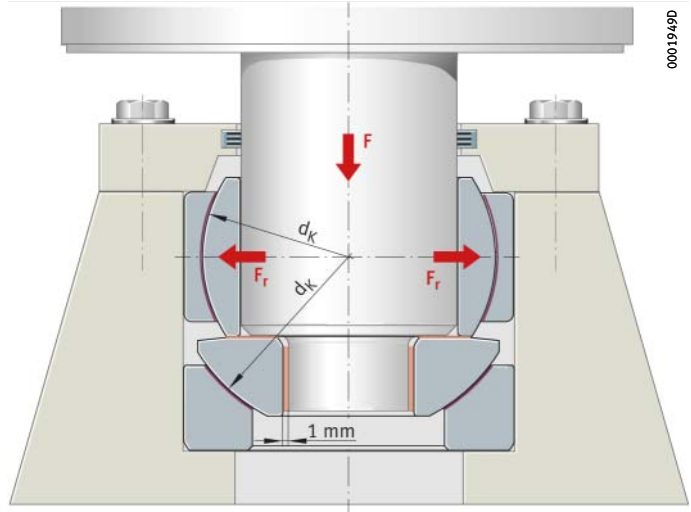
Sealing

Functions   The sealing arrangement has a considerable influence on the operating life of a bearing arrangement. It is intended to retain the lubricant in the bearing and prevent the ingress of contaminants into the bearing.

In the selection of seals, attention must be paid to:
- the operating and environmental conditions
- the degree of radial mobility of the bearing
- the tilt angle of the bearing
- the design envelope
- the costs and work required.
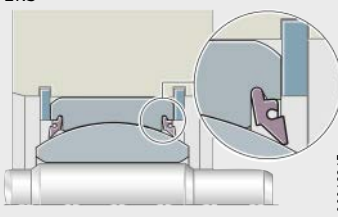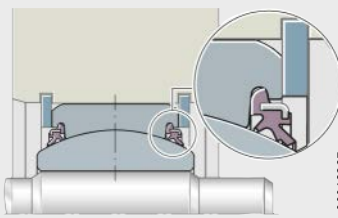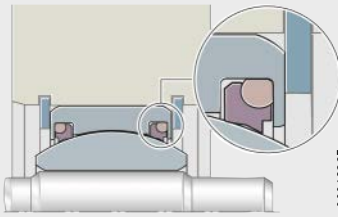
⚠️   For expanded temperature ranges, sealing must be agreed in consultation with Schaeffler.

Overview of seal types   For the sealing of bearings various seals and seal types are available, which are described in detail, see tables and page 108.
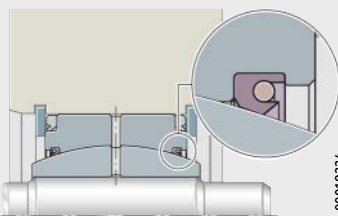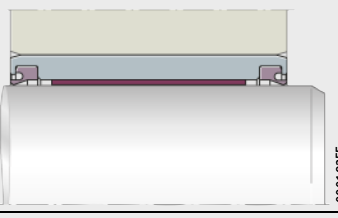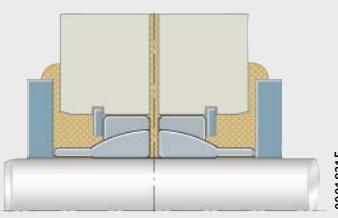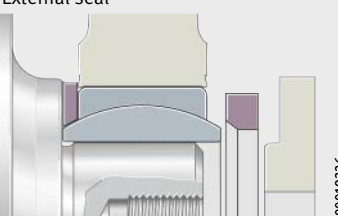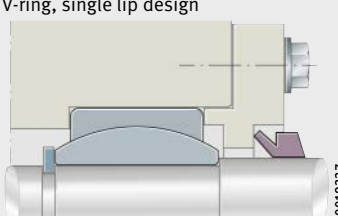
Seal types

Seal					Guidelines
Design	Internal	External	for		Page
2RS	■	–	■	–	108
0001931F					
2TS	■	–	■	–	108
00019327					
2RS2	■	–	■	–	109
0001932F					

Sealing

Seal					Guidelines
Design	Internal	External	for		Page
2RS4	■	–	■	–	109
Seal RS or 2RS for plain bushes with ELGOGLIDE or ELGOTEX	■	–	–	■	110
Grease collar	–	■	■	–	111
External seal	–	■	■	–	111
V-ring, single lip design	–	■	■	–	112
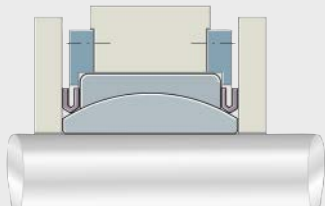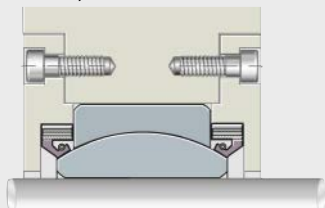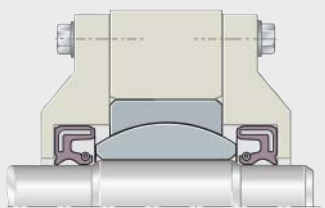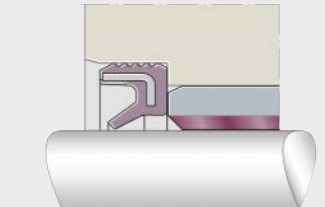
Seal types
(continued)

Seal Design	Internal	External	for ⊔	for ▭	Guidelines Page
Seal types (continued)					
V-shaped sealing ring, double lip design	–	■	■		112
00019338					
Two component seal	–	■	■		113
000193FA					
Rotary shaft seal, preloaded	–	■	■	■	113
000193FC					
Rotary shaft seal with lip seal	–	■	–	■	114
00019F46					
Modified adjacent construction, gap seal	–	■	–	■	114
00019F63					

Sealing

Seals in the bearing Various possibilities are available for the sealing of bearings. These should be selected as a function of the application.

Seal 2RS Where higher requirements for sealing action are present, lip seals made from thermoplastic polyurethane TPU are used. The seal lips are radially preloaded against the bearing, *Figure 1*.

Seals 2RS for maintenance-free spherical plain bearings and spherical plain bearings requiring maintenance are designed for indoor applications and are suitable for operating temperatures from −30 °C to +130 °C.

① Seal 2RS

Figure 1
Seal 2RS
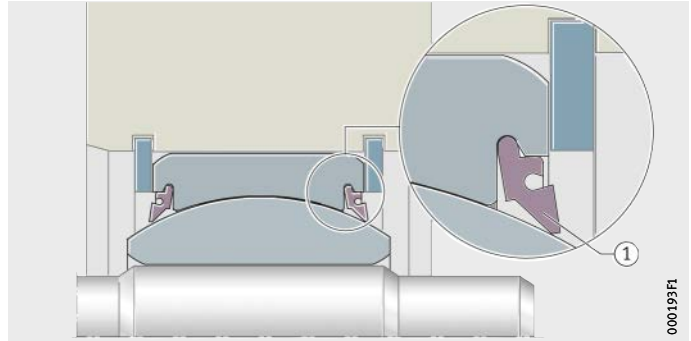
Seal 2TS Where very high requirements for sealing action are present, triple lip seals made from NBR with steel supporting elements are used, *Figure 2*. They give excellent protection of the bearing against water, dust and contamination and are suitable for indoor and outdoor applications.

Seals 2TS for maintenance-free spherical plain bearings and spherical plain bearings requiring maintenance are suitable for operating temperatures from −30 °C to +100 °C. For short periods, temperatures up to a maximum of +130 °C are permissible. Seals for expanded temperature ranges are available by agreement.

① Seal 2TS

Figure 2
Seal 2TS
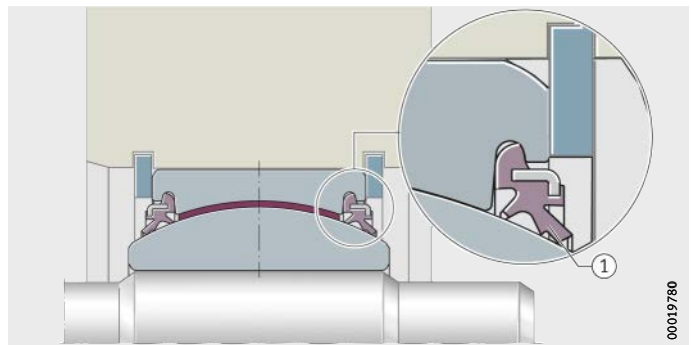
Seal 2RS2 Lip seals on both sides with increased sealing action for very high requirements and long maintenance intervals, *Figure 3*. They give protection against coarse and very fine contaminants.

Seals 2RS2 are suitable for maintenance-free large radial spherical plain bearings and operating temperatures from −40 °C to +120 °C.

① Seal 2RS2

Figure 3
Seal 2RS2
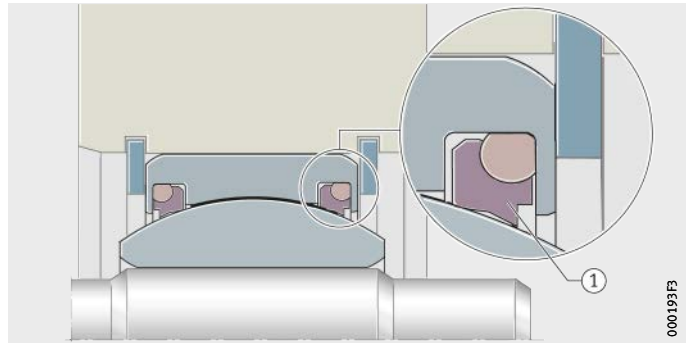
Seal 2RS4 Lip seals on both sides with increased sealing action for very high requirements and long maintenance intervals, *Figure 4*. They give protection against coarse and very fine contaminants.

Seals 2RS4 are suitable for large radial spherical plain bearings requiring maintenance and operating temperatures from −40 °C to +120 °C.

① Seal 2RS4

Figure 4
Seal 2RS4
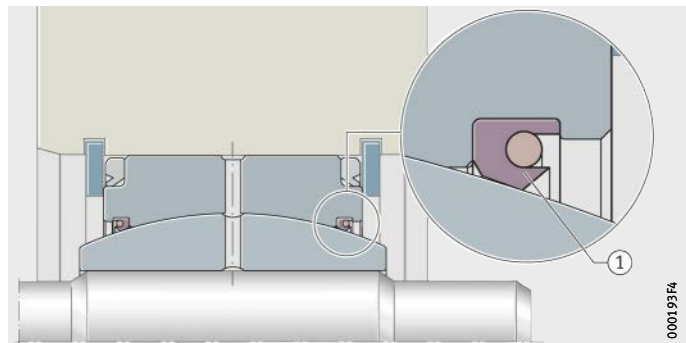
Sealing

Seal RS or 2RS for plain bushes with ELGOGLIDE or ELGOTEX

ELGOGLIDE plain bushes and ELGOTEX filament wound bushes are available by agreement on one side with lip seals RS or on both sides with lip seals 2RS, *Figure 5*. The sealing rings used are made from NBR and are designed for temperature ranges of −30 °C to +100 °C. For short periods, temperatures up to a maximum of +130 °C are permissible.

① Seal 2RS

Figure 5
Seal for plain bushes with ELGOGLIDE or ELGOTEX
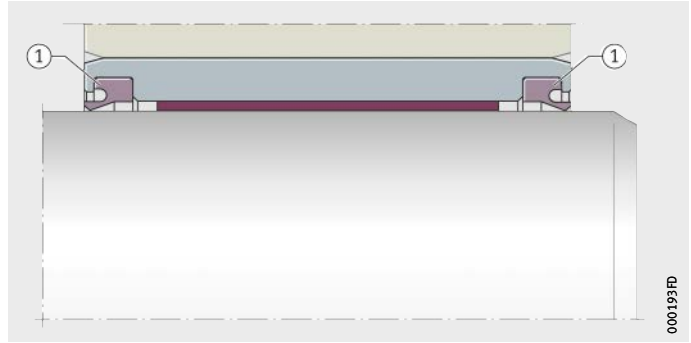
Seals in the adjacent construction

Open and sealed plain bearings can be additionally sealed by means of external seals.

Grease collar

The grease collar is a simple and effective type of seal, *Figure 6*. By means of frequent relubrication, a grease collar is formed on the end faces of the spherical plain bearing that protects the bearing against contaminants.

The grease collar is suitable for spherical plain bearings requiring lubrication and has proved particularly effective, in conjunction with daily maintenance, in aggressive operating conditions.

The temperature range is dependent on the grease selection. For suitable lubricants, see page 180.

① Grease collar
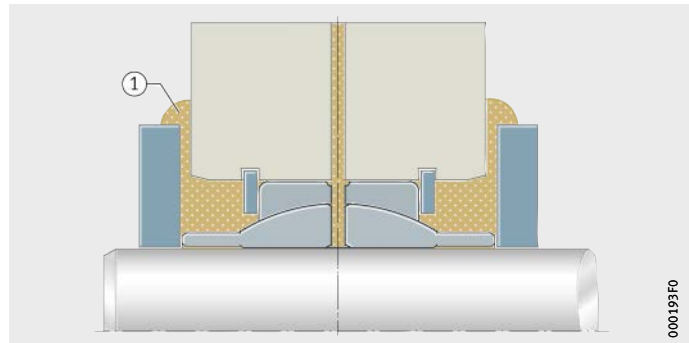
Figure 6
Sealing by means of grease collar

External seal

Simple but highly effective sealing can be achieved by means of sealing rings made from thermoplastic polyurethane TPU. This is specially developed for radial spherical plain bearings in accordance with DIN ISO 12240-1, dimension series E and can be integrated in the adjacent construction as an external seal, *Figure 7*.

Particularly low seal friction is achieved if the sealing rings for spherical plain bearings are worked in oil or flowable grease before fitting. In the case of maintenance-free spherical plain bearings, please consult Schaeffler.

External seals are suitable for operating temperatures from −30 °C to +130 °C.

① External seal
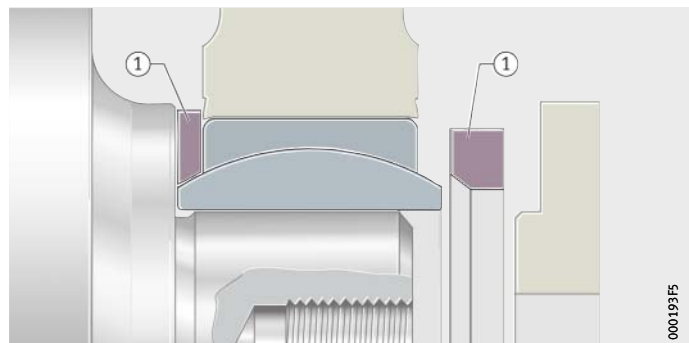
Figure 7
External seal

Sealing

V-ring, single lip design

The V-ring, *Figure 8* is a lip seal with axial sealing action. During fitting, this single piece rubber ring is pushed under tension along the shaft until its lip is in axial contact with the housing wall. The seal lip acts simultaneously as a flinger shield.

The single lip V-ring is suitable for relatively large tilt motions and for operating temperatures from −40 °C to +100 °C.

It is particularly easy to fit and is resistant to grease, oil and ageing.

① V-ring
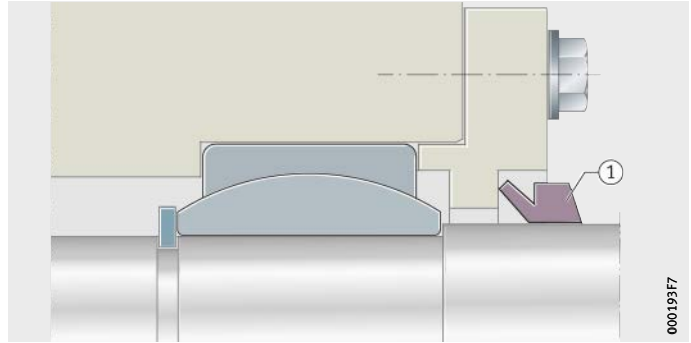
Figure 8
V-ring, single lip design

V-shaped sealing ring, double lip design

The V-shaped sealing ring is a simple seal with lip seals on both sides. The inside diameter of the sealing ring is in contact with the spherical surface of the inner ring, *Figure 9*.

V-shaped sealing rings are suitable for operating temperatures from −40 °C to +100 °C.

① V-shaped sealing ring
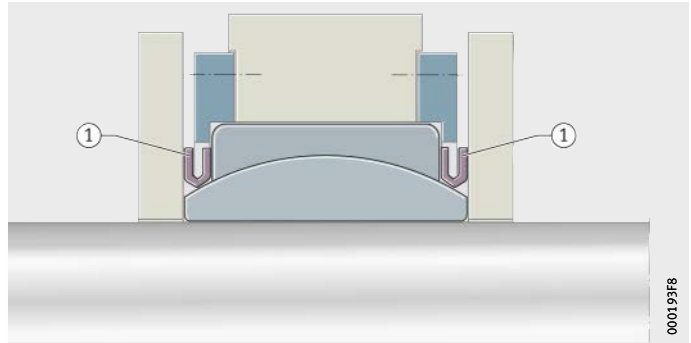
Figure 9
V-shaped sealing ring

Two component seal

The two component seal is a seal lip made from a nitrile mixture modified with PTFE and is preloaded by means of a high-grade steel coil spring. The seal shoulder is made from a nitrile mixture reinforced with cotton, *Figure 10*.

The bearing is sealed on the protruding part of the inner ring spherical surface.

The two component seal is easy to use and is suitable for operating temperatures from −40 °C to +120 °C, with operation for short periods at up to +150 °C.
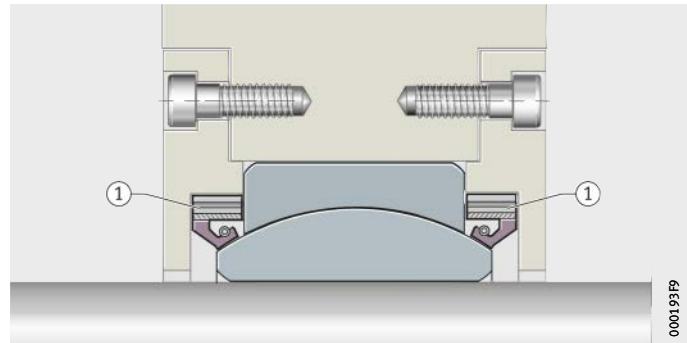
① Two component seal

Figure 10
Two component seal

Rotary shaft seal

The rotary shaft seal is a steel-reinforced plastic ring with a seal lip. The seal collar with one lip is pressed against the shaft running surface by a coil spring, *Figure 11*.

Rotary shaft seals are suitable for small tilt angles with grease and oil lubrication. They prevent the egress of lubricant. A sealing ring with an additional protective lip also prevents the ingress of contamination.

The temperature range is dependent on the seal material.

If grease lubrication is used:
- the seal lip should be positioned facing outwards.

If oil bath lubrication is used:
- the seal lip should be positioned facing inwards
- an additional dust lip facing outwards should be used.
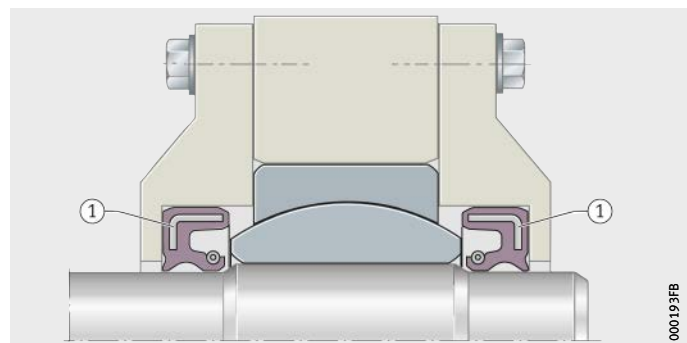
① Rotary shaft seal

Figure 11
Rotary shaft seal

Sealing

Seals for plain bushes

Possibilities for sealing the bearing position in the adjacent construction are as follows, *Figure 12*:

- ■ a modified adjacent construction
- ■ gap seals
- ■ rotary shaft seals.

The suitability of the sealing arrangement must be agreed in consultation with the seal manufacturer.

! If the seal is designed with additional outer seals, it must be borne in mind that the bearing clearance will increase due to the wear of the sliding layer. Plain bushes with ELGOGLIDE, ELGOTEX or E40 are not lubricated. Grease must be prevented from leaving a seal and coming into contact with these sliding layers.

① Protection by adjacent construction
② Gap seal
③ Shaft seal

Figure 12
Seals for protection
of the bearing position
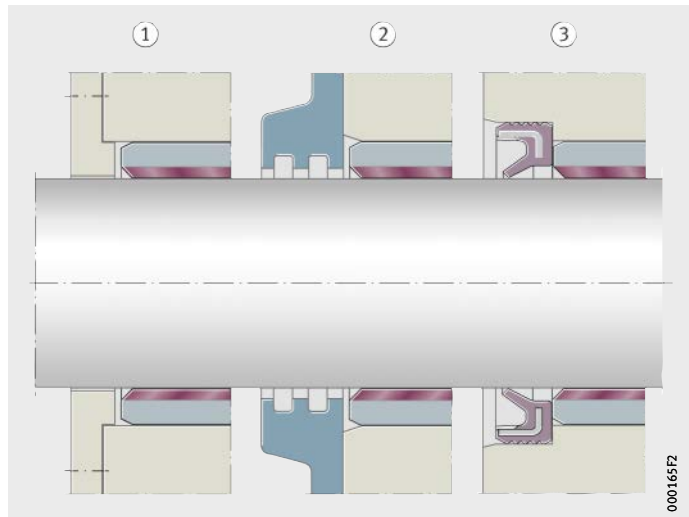
Mounting and dismounting

General guidelines
In the interests of the user, the applicable legal regulations and other directives relating to environmental protection and occupational safety must be observed.

[!] Plain bearings must be handled with care before and during mounting. Problem-free functioning of the sliding surfaces is substantially dependent on the care taken in mounting. The sliding surfaces must not be damaged. It must be ensured that mounting is carried out in clean conditions.

The bearings will only achieve their maximum operating life and functional capability if they are mounted correctly. Where a mounting position is specified, this must be observed in all cases.

Further information
■ Schaeffler offers products and services for the mounting and dismounting of plain bearings, see section Mounting and maintenance, page 415.

Delivered condition
The plain bearings are supplied with preservative in a box, or in a bag held in a box or in a crate. Depending on their design, rod ends are supplied protected by a preservative or with a zinc coating.

[!] Any change, irrespective of the bearing type, will reduce their operating life.

Bearings must not be treated or cleaned using trichloroethylene, perchloroethylene, petroleum spirit or other solvents.

Substances containing oil will change the characteristics of the bearings.

Storage of bearings
Plain bearings should be stored:
■ in the original packaging
■ in clean, dry areas
■ at as constant a temperature as possible
■ at a relative humidity of max. 65%.

Unpacking of bearings
Plain bearings should only be removed from their packaging immediately before mounting:
■ Hands should be kept clean and dry and protective gloves worn if necessary (perspiration leads to corrosion).
■ If the original packaging is damaged, the products must be checked.
■ If the products are contaminated, they must be wiped with a clean cloth only.

Mounting and dismounting

Guidelines for mounting

The guidelines for mounting must be followed precisely and the operating specifications must be observed:

■ If not, there is a direct or indirect hazard to personnel, the product or the adjacent construction.

■ The bearings must be protected against moisture and aggressive media.

■ The bearings must always be located concentrically.

■ Mounting may only be carried out by qualified personnel. If errors are made in mounting, no claims may be made under warranty. Schaeffler assumes no liability for damage caused by defective mounting, incorrect maintenance, incorrect communication of the content of this chapter to third parties or a failure to communicate the content.

Maintenance-free plain bearings

Plain bearings with maintenance-free sliding layers must not be lubricated. The use of lubricant will lead to a considerable reduction in the operating life.

Maintenance-free spherical plain bearings and maintenance-free plain bushes should be mounted such that no lubricant or other substances used to aid mounting can reach the sliding surfaces.

Transport of large radial spherical plain bearings

Large spherical plain bearings must only be transported using the eye bolts supplied. For this purpose, the radial bearings have threaded holes on the end faces of the inner and outer rings, *Figure 1*.
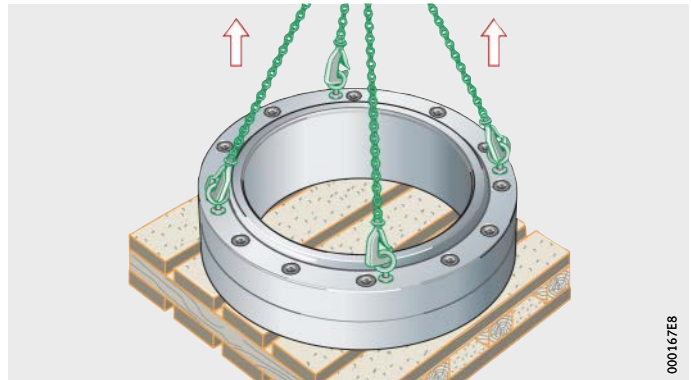
Figure 1
Transport by means of eye bolts

Orientation for mounting of large radial spherical plain bearings

For the mounting of large radial spherical plain bearings GE..-DW and GE..-DW-2RS2, it must be ensured that the screw connection on one side of the outer ring halves is facing towards the open side of the bearing. This makes subsequent dismounting easier.

Checking the adjacent construction

Before mounting of spherical plain bearings, rod ends and plain bushes, the adjacent construction must be checked as follows:

- ■ the quality of the bearing seating surface on the shaft and housing bore
- ■ the dimensional and geometrical accuracy of seating and locating faces
- ■ the shaft and housing seats
- ■ any chamfers, radii and edge breaks required on the shaft and housing bore, see section Design of bearing arrangements, page 90.

Any burrs present must be removed.

If tight fits are present or mounting conditions present difficulties, the surface of the shaft and housing bore should be lightly oiled.

⚠ If welding work is carried out on the adjacent construction, welding currents must not be allowed to pass through the spherical plain bearing, since this will immediately damage the sliding surfaces.

Positioning of the joint

In radial spherical plain bearings with outer rings split at one and two points, the joints must be positioned at 90° to the main load direction, *Figure 2*.

The lubrication holes in bearings requiring maintenance are thus positioned directly in the load zone. This allows good lubricant distribution in the load zone area.

① Joint
② Main load direction
③ Lubrication hole

Figure 2
Position of joint in main load direction
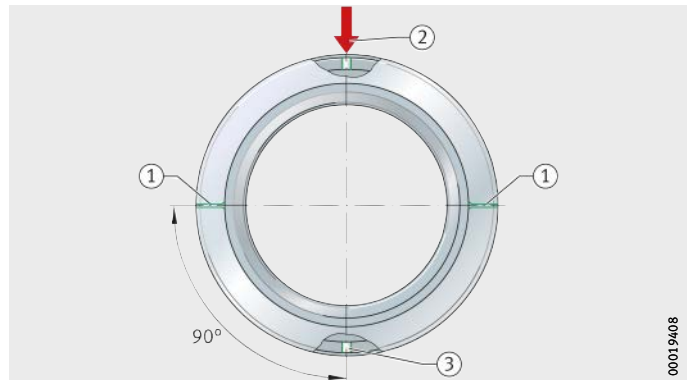
Adhesive bonding of bearing rings

If the recommended fits are observed, adhesive bonding of the bearing rings is not generally necessary.

Adhesives may only be used on spherical plain bearings with steel/steel sliding contact surfaces under the following conditions:

- ■ The surfaces to be bonded must be clean and free from grease.
- ■ The raceways must be cleaned using a cleaning agent and well lubricated using a paste with a high MoS_2 content.
- ■ It must be ensured that the lubricant ducts and lubricant holes are not blocked by adhesive.

Mounting and dismounting

Pressing in of spherical plain bearings

Always apply mounting forces to the bearing ring to be mounted, *Figure 3*. If these forces are directed through the sliding surfaces, this could lead to jamming of the bearings during mounting.

When mounting the bearings on a shaft and in a housing, the mounting tools used must act simultaneously on the end faces of the inner and outer ring, *Figure 3*.

Larger bearings must be mounted using special mounting equipment, *Figure 4*. As the bearing diameter increases, so do the mounting forces required and simple impact type tools are no longer adequate in these cases.

Further information on the mounting and maintenance of plain bearings is available from the industrial service function of Schaeffler, see section Mounting and maintenance, page 415.

! Avoid direct blows with a hammer and drift on the end faces of the bearing rings, since this can lead to microcracks in the bearing.

① Mounting in housing
② Simultaneous mounting on shaft and in housing

Figure 3
Mounting forces and bearing ring to be mounted
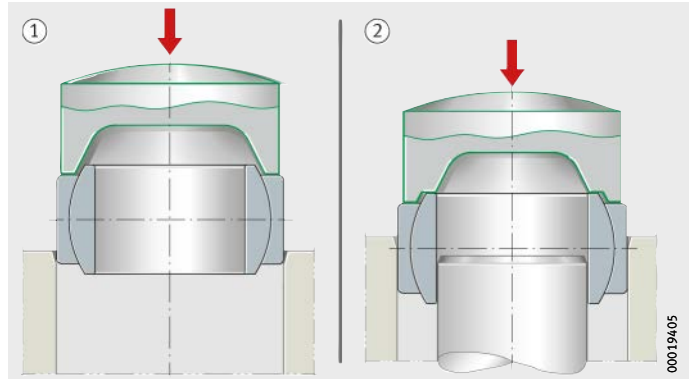
① Mounting device

Figure 4
Special mounting equipment for larger bearings
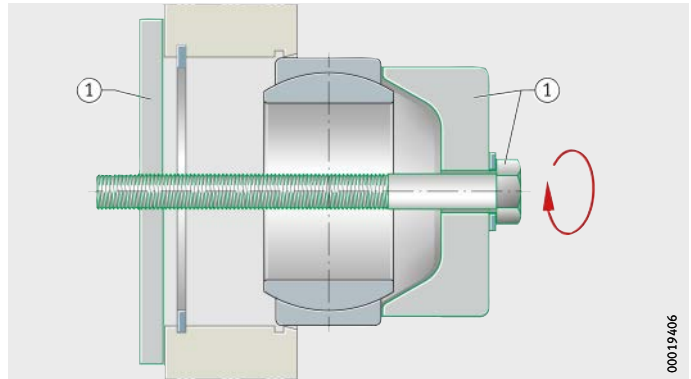
Hydraulic assistance

For special spherical plain bearings with a conical bore, hydraulic nuts are used in conjunction with hydraulic pumps, see page 426.

Pressing in of bushes

The bushes can be easily pressed into the housing bore. The bushes can be pressed in more easily if the bush backing or housing bore is lightly oiled.

Bushes can be pressed in flush or into a counterbore using a press-in mandrel, *Figure 5* and *Figure 6*. In the case of metal/polymer composite plain bushes, an auxiliary ring should additionally be used due to the butt joint for a diameter equal to or greater than $\geqq 55$ mm, *Figure 7*, page 120.

The chamfer on the mandrel must have rounded transitions or rounding of the end.

! Sharp transitions on the entry side of the shaft and mandrel will damage the sliding layer during mounting and reduce the operating life of the plain bearings.

Diameter of press-in mandrel

Series	Diameter of press-in mandrel d_D
Metal/polymer composite plain bushes	$D_i \ {}^{-0,1}_{-0,2}$
ELGOTEX filament wound bushes	$D_i \ {}^{-0,3}_{-0,5}$
ELGOGLIDE plain bushes	

D_i, D_o = inside or outside diameter
d_D = outside diameter of press-in mandrel
F = pressing in force

① Bush
② Press-in mandrel
③ Housing

Figure 5
Pressing bush in flush
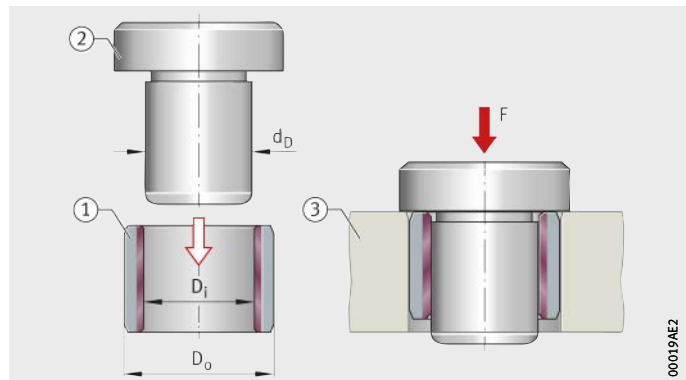
D_i, D_o = inside or outside diameter
d_D = outside diameter of press-in mandrel
F = pressing in force

① Bush
② Press-in mandrel
③ Housing
④ Shoulder diameter

Figure 6
Pressing bush into a counterbore
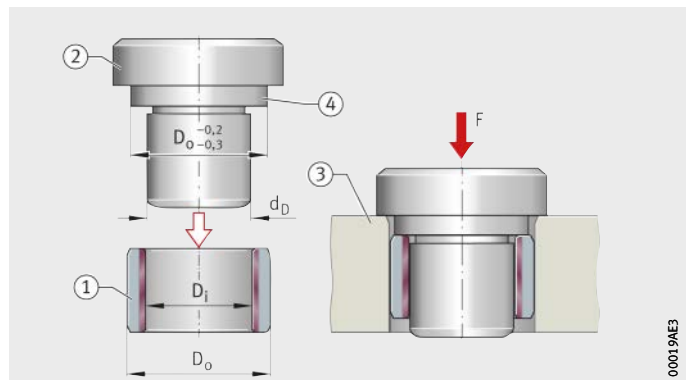
Mounting and dismounting

Auxiliary ring for metal/polymer composite plain bushes with $D_o \geqq 55$ mm

Outside diameter of bush D_o mm	Inside diameter of auxiliary ring d_H mm
$55 \leqq D_o \leqq 100$	$D_{o\,+0,25}^{\;+0,28}$
$100 < D_o \leqq 200$	$D_{o\,+0,36}^{\;+0,4}$
$200 < D_o \leqq 305$	$D_{o\,+0,46}^{\;+0,5}$

$D_o \geqq 55$ mm
D_o = outside diameter of bush
D_i = inside diameter of bush
d_H = inside diameter of auxiliary ring

① Bush
② Auxiliary ring
③ Press-in mandrel
④ Housing
⑤ Shoulder diameter
⑥ O-ring
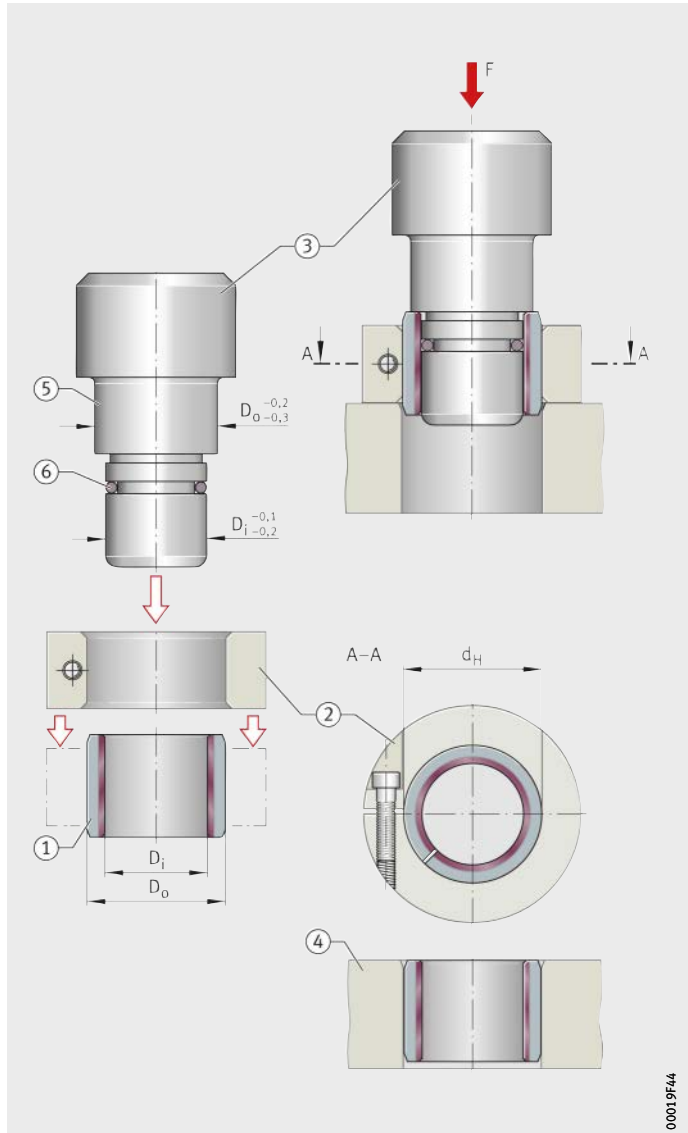
Figure 7
Pressing bush in using auxiliary ring

Thermal assistance

In order to reduce the mounting forces, spherical plain bearings can be heated.

⚠️ Do not heat bearings to more than +130 °C, since higher temperatures will damage the seals in sealed bearings.

Spherical plain bearings must not be heated in an oil bath:

- ◻ In the case of maintenance-free spherical plain bearings, this affects the tribological system.
- ◻ In the case of spherical plain bearings requiring maintenance with a steel/steel sliding contact surface, this will change the concentration of molybdenum disulphide on the sliding surfaces.

Bearings must not be heated using a naked flame:

- ◻ The material undergoes excessive localised heating, reducing its hardness.
- ◻ Furthermore, stresses are induced in the bearing.
- ◻ The seals could melt.
- ◻ Maintenance-free sliding layers could be damaged.

Mounting by means of refrigeration

The structure of the rings of radial spherical plain bearings with a steel/steel sliding contact surface will change at temperatures below −61 °C. Due to the structural change, their volume may increase; the change to the tolerances may lead to jamming of the bearing.

If this mounting method is to be used, the bearing rings can be supplied with appropriate heat treatment. Please consult the Schaeffler engineering service.

For easier fitting, maintenance-free ELGOGLIDE plain bushes can be cooled for a short time in liquid nitrogen at −196 °C.

⚠️ In the case of plain bushes with integrated seals 2RS, the correct seating of the seals in the undercut must be checked after refrigeration.

Mounting and dismounting

Heating can be carried out using heating cabinets with a controllable thermostat, induction heating devices, *Figure 8*, or medium frequency technology. The advantages include uniform heating, no contamination of components and the absence of long pre-heating times.

Further information is available from the industrial service function of Schaeffler, see page 423.

Localised heating must be avoided. The bearing temperature must be monitored using a thermometer.

Information in the catalogue and manufacturer's data on grease and seals must be observed.

Figure 8
Heating by means
of an induction heating device

Dismounting of spherical plain bearings

Even if the force is applied to the ring to be dismounted in accordance with the specification in the case of spherical plain bearings, the frictional contact of the other ring due to the fit presents difficulties in dismounting.

Depending on the joint pressure, contraction of the inner ring and expansion of the outer ring will occur, *Figure 9*. The extraction forces also increase with increasing joint pressure.

① Motion

Figure 9
Contraction of the inner ring and expansion of the outer ring
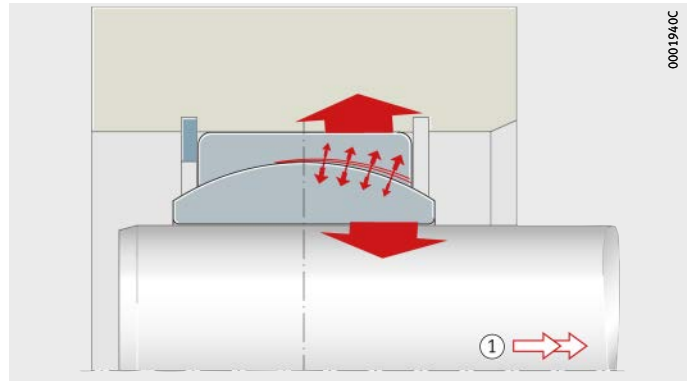
Mounting and dismounting

Precautions for dismounting

Dismounting of spherical plain bearings can be facilitated if the following design precautions are taken:

- ☐ a threaded hole for an extraction screw in the shaft, *Figure 10*
- ☐ threaded holes for extraction screws in the housing, *Figure 11*
- ☐ milled areas on the stud for the jaws of the extraction device, *Figure 11*.

① Threaded hole

Figure 10
Threaded hole in the shaft
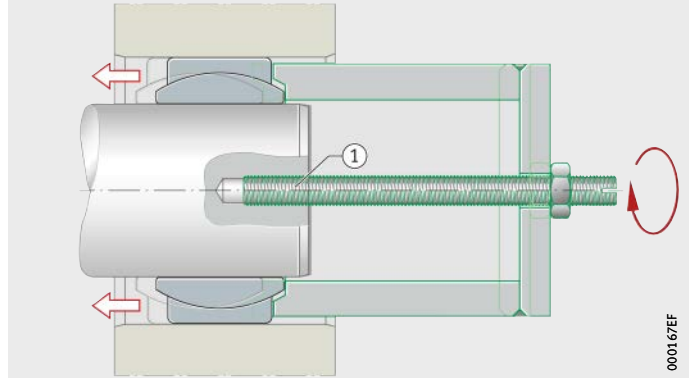
① Threaded hole
② Milled areas

Figure 11
Threaded hole in the housing and
milled areas for extractors
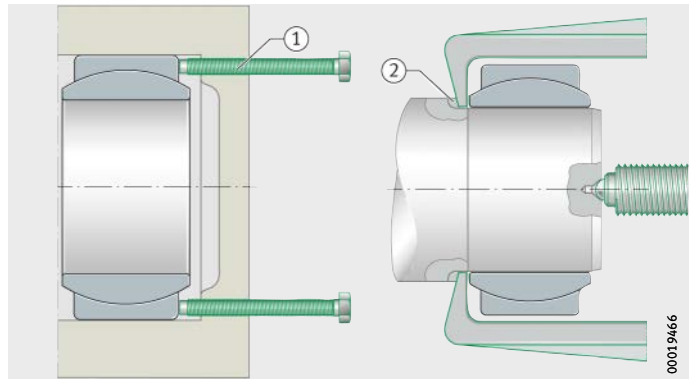
ISO tolerances

ISO tolerances for bores

The fit, *Figure 1* and tables, is determined by the ISO tolerances for housings in accordance with ISO 286-2 in conjunction with the tolerances for the outside diameter of the bearings.

ES = upper deviation
EI = lower deviation
IT = fundamental tolerance
H = fundamental deviation;
smallest distance from the zero line

① Housing

Figure 1
ISO tolerances for bores
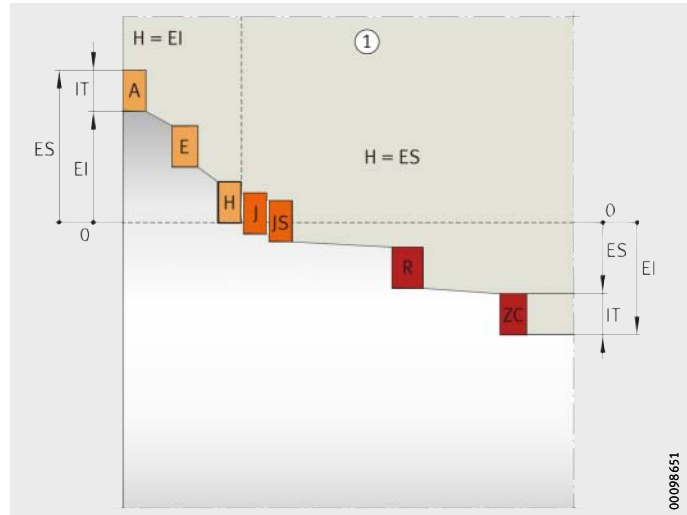
Limit deviations for bores

Nominal housing bore diameter in mm										
over incl.	− 3	3 6	6 10	10 18	18 30	30 50	50 80	80 120	120 180	180 250
Housing deviation in μm										
G7	+12 +2	+16 +4	+20 +5	+24 +6	+28 +7	+34 +9	+40 +10	+47 +12	+54 +14	+61 +15
H6	+6 0	+8 0	+9 0	+11 0	+13 0	+16 0	+19 0	+22 0	+25 0	+29 0
H7	+10 0	+12 0	+15 0	+18 0	+21 0	+25 0	+30 0	+35 0	+40 0	+46 0
H8	+14 0	+18 0	+22 0	+27 0	+33 0	+39 0	+46 0	+54 0	+63 0	+72 0
H9	+25 0	+30 0	+36 0	+43 0	+52 0	+62 0	+74 0	+87 0	+100 0	+115 0
J6	+2 −4	+5 −3	+5 −4	+6 −5	+8 −5	+10 −6	+13 −6	+16 −6	+18 −7	+22 −7
J7	+4 −6	+6 −6	+8 −7	+10 −8	+12 −9	+14 −11	+18 −12	+22 −13	+26 −14	+30 −16
K7	0 −10	+3 −9	+5 −10	+6 −12	+6 −15	+7 −18	+9 −21	+10 −25	+12 −28	+13 −33
K8	0 −14	+5 −13	+6 −16	+8 −19	+10 −23	+12 −27	+14 −32	+16 −38	+20 −43	+22 −50
M7	−2 −12	0 −12	0 −15	0 −18	0 −21	0 −25	0 −30	0 −35	0 −40	0 −46
N7	−4 −14	−4 −16	−4 −19	−5 −23	−7 −28	−8 −33	−9 −39	−10 −45	−12 −52	−14 −60

ISO tolerances

Limit deviations for bores
(continued)

Nominal bore diameter in mm								
over incl.	250 315	315 400	400 500	500 630	630 800	800 1000	1000 1250	1250 1600
Bore deviation in μm								
G7	+69 +17	+75 +18	+83 +20	+92 +22	+104 +24	+116 +26	+133 +28	+155 +30
H6	+32 0	+36 0	+40 0	+44 0	+50 0	+56 0	+66 0	+78 0
H7	+52 0	+57 0	+63 0	+70 0	+80 0	+90 0	+105 0	+125 0
H8	+81 0	+89 0	+97 0	+110 0	+125 0	+140 0	+165 0	+195 0
H9	+130 0	+140 0	+155 0	+175 0	+200 0	+230 0	+260 0	+310 0
J6	+25 −7	+29 −7	+33 −7	−	−	−	−	−
J7	+36 −16	+39 −18	+43 −20	−	−	−	−	−
K7	+16 −36	+17 −40	+18 −45	0 −70	0 −80	0 −90	0 −105	0 −125
K8	+25 −56	+28 −61	+29 −68	0 −110	0 −125	0 −140	0 −165	0 −195
M7	0 −52	0 −57	0 −63	−26 −96	−30 −110	−34 −124	−40 −145	−48 −173
N7	−14 −66	−16 −73	−17 −80	−44 −114	−50 −130	−56 −146	−66 −171	−78 −203

ISO tolerances for shafts

The fit, *Figure 2* and tables, is determined by the ISO tolerances for the shaft in accordance with ISO 286-2 in conjunction with the tolerances for the bore diameter of the bearings.

es = upper deviation
ei = lower deviation
IT = fundamental tolerance
h = fundamental deviation; smallest distance from the zero line

① Shaft

Figure 2
ISO tolerances for shafts

Limit deviations for shafts

Nominal bore diameter in mm											
over incl.	– 3	3 6	6 10	10 18	18 30	30 40	40 50	50 65	65 80	80 100	100 120
Shaft deviation in μm											
e7	−14 −24	−20 −32	−25 −40	−32 −50	−40 −61	−50 −75		−60 −90		−72 −107	
f7	−6 −16	−10 −22	−13 −28	−16 −34	−20 −41	−25 −50		−30 −60		−36 −71	
g6	−2 −8	−4 −12	−5 −14	−6 −17	−7 −20	−9 −25		−10 −29		−12 −34	
h6	0 −6	0 −8	0 −9	0 −11	0 −13	0 −16		0 −19		0 −22	
h7	0 −10	0 −12	0 −15	0 −18	0 −21	0 −25		0 −30		0 −35	
h8	0 −14	0 −18	0 −22	0 −27	0 −33	0 −39		0 −46		0 −54	
j6	+4 −2	+6 −2	+7 −2	+8 −3	+9 −4	+11 −5		+12 −7		+13 −9	
j7	+6 −4	+8 −4	+10 −5	+12 −6	+13 −8	+15 −10		+18 −12		+20 −15	
k6	+6 0	+9 +1	+10 +1	+12 +1	+15 +2	+18 +2		+21 +2		+25 +3	
m6	+8 +2	+12 +4	+15 +6	+18 +7	+21 +8	+25 +9		+30 +11		+35 +13	
n6	+10 +4	+16 +8	+19 +10	+23 +12	+28 +15	+33 +17		+39 +20		+45 +23	
p6	+12 +6	+20 +12	+24 +15	+29 +18	+35 +22	+42 +26		+51 +32		+59 +37	
r6	+16 +10	+23 +15	+28 +19	+34 +23	+41 +28	+50 +34		+60 +41	+62 +43	+73 +51	+76 +54

ISO tolerances

Limit deviations for shafts (continued)

Nominal bore diameter in mm									
over incl.	120 140	140 160	160 180	180 200	200 225	225 250	250 280	280 315	315 355	355 400
Shaft deviation in µm										
e7	−85 −125			−100 −146			−110 −162		−125 −182	
f7	−43 −83			−50 −96			−56 −108		−62 −119	
g6	−14 −39			−15 −44			−17 −49		−18 −54	
h6	0 −25			0 −29			0 −32		0 −36	
h7	0 −40			0 −46			0 −52		0 −57	
h8	0 −63			0 −72			0 −81		0 −89	
j6	+14 −11			+16 −13			+16 −16		+18 −18	
j7	+22 −18			+25 −21			+26 −26		+29 −28	
k6	+28 +3			+33 +4			+36 +4		+40 +4	
m6	+40 +15			+46 +17			+52 +20		+57 +21	
n6	+52 +27			+60 +31			+66 +34		+73 +37	
p6	+68 +43			+79 +50			+88 +56		+98 +62	
r6	+88 +63	+90 +65	+93 +68	+106 +77	+109 +80	+113 +84	+126 +94	+130 +98	+144 +108	+150 +114

Limit deviations for shafts
(continued)

Nominal bore diameter in mm								
over incl.	400 450	450 500	500 560	560 630	630 710	710 800	800 900	900 1 000
Shaft deviation in μm								
e7	−135 −198		−145 −215		−160 −240		−170 −260	
f7	−68 −131		−76 −146		−80 −160		−86 −176	
g6	−20 −60		−22 −66		−24 −74		−26 −82	
h6	0 −40		0 −44		0 −50		0 −56	
h7	0 −63		0 −70		0 −80		0 −90	
h8	0 −97		0 −110		0 −125		0 −140	
j6	+20 −20		–		–		–	
j7	+31 −32		–		–		–	
k6	+45 +5		+44 0		+50 0		+56 0	
m6	+63 +23		+70 +26		+80 +30		+90 +34	
n6	+80 +40		+88 +44		+100 +50		+112 +56	
p6	+108 +68		+122 +78		+138 +88		+156 +100	
r6	+166 +126	+172 +132	+194 +150	+199 +155	+225 +175	+235 +185	+266 +210	+276 +220

Spherical plain bearings

Maintenance-free
Requiring maintenance

Spherical plain bearings

Spherical plain bearings, maintenance-free

Spherical plain bearings are ready-to-fit, standardised machine elements. Due to the outer ring with its concave inner slideway and the inner ring with its curved outer slideway, they can perform spatial adjustment motions.

The bearings are available as radial and axial spherical plain bearings. They can support static loads, are suitable for tilt and swivel motion, compensate for shaft misalignment, are not subject to edge stresses under misalignment and allow substantial manufacturing tolerances in the adjacent construction.

These spherical plain bearings are completely maintenance-free. They are used where particular requirements for operating life apply in conjunction with maintenance-free operation or where, for reasons of lubrication, bearings with metallic sliding contact surfaces are not suitable, for example under unilateral load.

The standard sliding layer used is ELGOGLIDE.

Spherical plain bearings, requiring maintenance

These bearings correspond in their construction to the maintenance-free designs but are lubricated via the outer and inner ring.

They transmit movements and forces with low moment levels, thus keeping bending stresses away from the construction elements and are particularly suitable for alternating loads with impact and shock type stresses.

The sliding contact surface is the metallic combination steel/steel or steel/bronze.

GE..-DW GE..-UK-2TS GE..-UK-2RS GE..-UK

GE..-DW-2RS2 GE..-FW-2TS GE..-FW-2RS GE..-FW

GE..-AW GE..-SW GE..-PW

0001953A

GE..-FO GE..-DO-2RS4 GE..-DO-2TS GE..-DO-2RS GE..-DO

GE..-FO-2TS GE..-FO-2RS GE..-HO-2RS GE..-LO

GE..-AX GE..-SX GE..-PB GE..-ZO

0008CE19

Spherical plain bearings, maintenance-free

Radial spherical plain bearings
Large radial spherical plain bearings
Angular contact spherical plain bearings
Axial spherical plain bearings

Spherical plain bearings, maintenance-free

Product overview	Spherical plain bearings, maintenance-free

Radial spherical plain bearings

Sliding contact surface hard chromium/PTFE composite
Open design

GE..-UK

000164C6

GE..-FW

000164C9
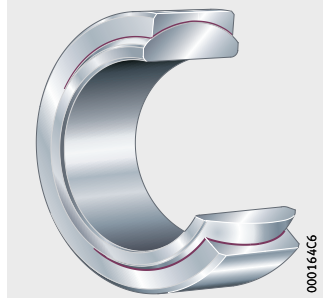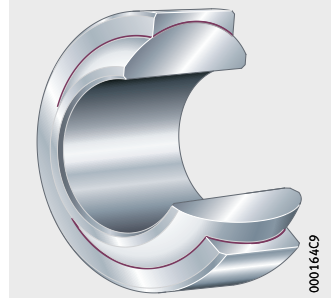
Sliding contact surface hard chromium/ELGOGLIDE
With lip seals or high performance seals

GE..-UK-2RS, GE..-UK-2TS

00016693

GE..-FW-2RS, GE..-FW-2TS

00016694
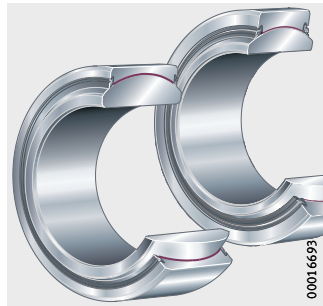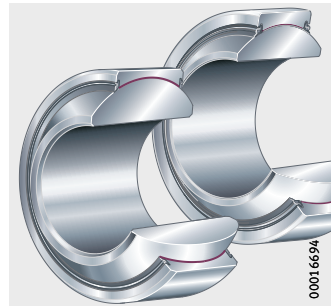
Sliding contact surface steel/PTFE film
Open design

GE..-PW
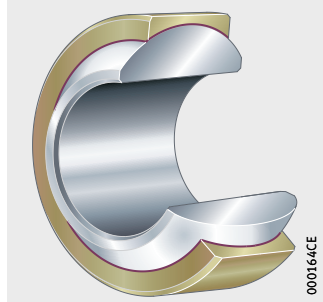
000164CE

X-life Large radial spherical plain bearings

Sliding contact surface hard chromium/ ELGOGLIDE
With or without lip seals

GE..-DW

00019C97

GE..-DW-2RS2

00019CB1

Angular contact spherical plain bearings

Sliding contact surface hard chromium/ELGOGLIDE

Open design

GE..-SW

000164BA

X-life Axial spherical plain bearings

Sliding contact surface hard chromium/ELGOGLIDE

Open design

GE..-AW

00019CB2

Spherical plain bearings, maintenance-free

Features

Spherical plain bearings allow spatial adjustment movements and, depending on the bearing type, can support radial, combined or axial loads.

Radial spherical plain bearings

Maintenance-free radial spherical plain bearings comprise inner rings, outer rings and maintenance-free sliding layers. The inner rings have a cylindrical bore with a curved outer slideway.

The outer rings have a cylindrical outside surface and a concave inner slideway.

Between the inner and outer ring is an ELGOGLIDE sliding surface. The sliding surface in the series GE..-UK and GE..-FW is PTFE composite, while the sliding surface in series GE..-PW is PTFE film.
For a description of the sliding surfaces, see page 140.

The bearings are available in open and sealed designs.

Area of application

Radial spherical plain bearings are preferably used to support radial forces. GE..-UK-2RS(-2TS), GE..-FW-2RS(-2TS), GE..-DW and GE..-DW-2RS2 are also suitable for alternating loads up to a contact pressure of $p = 150 \ N/mm^2$. The bearings are used where particular requirements for operating life apply in conjunction with maintenance-free operation or where, for reasons of lubrication, bearings with metallic sliding contact surfaces are not suitable, for example under unilateral load.

X-life

Large radial spherical plain bearings GE..-DW and GE..-DW-2RS2 of $d \geqq 320$ mm are X-life bearings and are indicated as such in the dimension tables.

These bearings have even higher performance materials, lower coefficients of friction and lower running-in wear than comparable bearings.

Split outer ring

In series GE..-UK-2RS(-2TS) up to a diameter $d \leqq 140$ mm, the outer ring is axially split at one point, while for diameters $d \geqq 160$ mm it is axially split at two points and held together by means of heavy-section retaining washers.

In the case of bearings GE..-FW-2RS(-2TS) up to a diameter $d \leqq 120$ mm, the outer ring is axially split at one point, while for diameters $d \geqq 140$ mm it is axially split at two points and held together by means of heavy-section retaining washers. In the case of GE..-DW and GE..-DW-2RS2, the outer ring is radially split. It is held together by means of screws and dowel pins.

Extended inner rings

GE..-FW-2RS(-2TS) and GE..-FW have extended inner rings. As a result, larger tilt angles are possible.

	Radial spherical plain bearings are designed according to their specific series with different sliding layers, see table and section Sliding layers, page 140.

Series, sliding layer, standard — Radial spherical plain bearings are designed according to their specific series with different sliding layers, see table and section Sliding layers, page 140.

Series and design

Series	Sliding layer	DIN ISO	Dimension series	Shaft d mm	
				over	incl.
GE..-UK-2RS	ELGOGLIDE	12240-1	E	17	300
GE..-UK-2TS	ELGOGLIDE	12240-1	E	30	300
GE..-FW-2RS	ELGOGLIDE	12240-1	G	25	280
GE..-FW-2TS	ELGOGLIDE	12240-1	G	25	280
GE..-DW	ELGOGLIDE (X-life)	12240-1	C	320	1000
GE..-DW-2RS2	ELGOGLIDE (X-life)	12240-1	C	320	1000
GE..-UK	PTFE composite	12240-1	E	6	30
GE..-FW	PTFE composite	12240-1	G	6	25
GE..-PW	PTFE film	12240-1	K	6	30

Angular contact spherical plain bearings

Angular contact spherical plain bearings GE..-SW correspond to DIN ISO 12240-2. They have inner rings with a curved outer slideway and outer rings with a concave inner slideway to which the sliding layer ELGOGLIDE is attached by adhesive.

The bearings are available for shaft diameters from 25 mm to 200 mm. Other sizes are available by agreement.

Area of application

The bearings can support radial and axial loads and are suitable for alternating dynamic loads. They can be used in paired arrangements as preloaded units.

Angular contact spherical plain bearings are used to support high loads occurring in conjunction with small motions. They are a good plain bearing alternative to tapered roller bearings 320..-X in accordance with ISO 355 and DIN 720, since they have the same mounting dimensions.

Axial spherical plain bearings

Axial spherical plain bearings GE..-AW correspond to DIN ISO 12240-3. In these units, the shaft locating washer is supported in the ball socket-shaped sliding zone of the housing locating washer.

The sliding material in the housing locating washer is ELGOGLIDE or, in the case of a nominal diameter $d \geqq 220$ mm, ELGOGLIDE in X-life.

The bearings are available for shaft diameters from 10 mm to 360 mm. Other sizes are available by agreement.

Area of application

The bearings are preferably used to support axial forces. They are suitable as support or base bearings and can also be combined with radial spherical plain bearings of dimension series E in accordance with DIN ISO 12240-1.

X-life

Axial spherical plain bearings GE..-AW of $d \geqq 220$ mm are X-life bearings and are indicated as such in the dimension tables.

These bearings have even higher performance materials, lower coefficients of friction and lower running-in wear than comparable bearings.

Spherical plain bearings, maintenance-free

Sliding layers

Maintenance-free spherical plain bearings have special sliding layers based on polytetrafluorethylene PTFE in the outer ring.

In descending order of performance capability, these are:

- ELGOGLIDE, the highest performance sliding layer
- ELGOGLIDE-W11, the sliding layer for low friction
- PTFE film
- PTFE composite.

These materials form the slideway, transmit the forces occurring and perform the lubrication function.

! Maintenance-free bearings must not be lubricated.

ELGOGLIDE

The sliding layer comprises a 0,5 mm thick layer of ELGOGLIDE, is embedded in synthetic resin and attached by a high strength bond to the support body, *Figure 1*.

The flow behaviour of the sliding layer is, in conjunction with the supporting body, almost negligible even under very high load. The adhesive bond is resistant to moisture and swelling.

ELGOGLIDE is a registered trademark and product of Schaeffler.

① PTFE fabric,
comprising PTFE and support fibres
② Resin matrix
③ Support fibres
④ Steel supporting body
⑤ Adhesive bond

Figure 1
ELGOGLIDE,
maintenance-free
plain bearing material

00019EB7
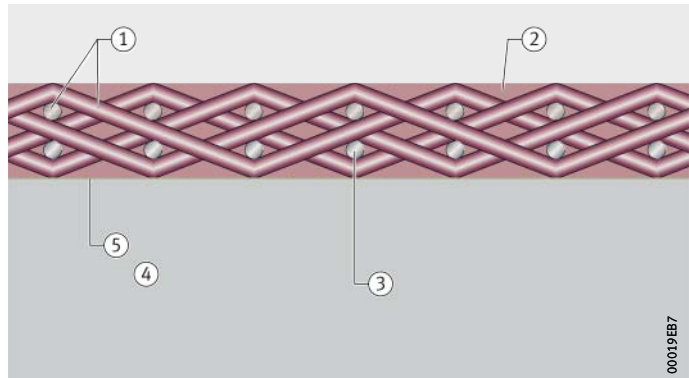
ELGOGLIDE designs

For differing requirements, the following are available:

- ELGOGLIDE
  the standard material for very high dynamic contact pressures from 25 N/mm^2 to 300 N/mm^2 and a long operating life

- ELGOGLIDE-W11
  the material for dynamic contact pressures from 1 N/mm^2 to 100 N/mm^2 and with low coefficients of friction even at low contact pressures.

PTFE film   The PTFE film (metal fabric material) is fixed to the outer ring curved surface, *Figure 2*.

The metal fabric is made from high strength bronze and acts as a stabiliser for the sintered PTFE composite.

① Plastic composite comprising PTFE
② Supporting body
③ Bronze

Figure 2
PTFE film, cross-section
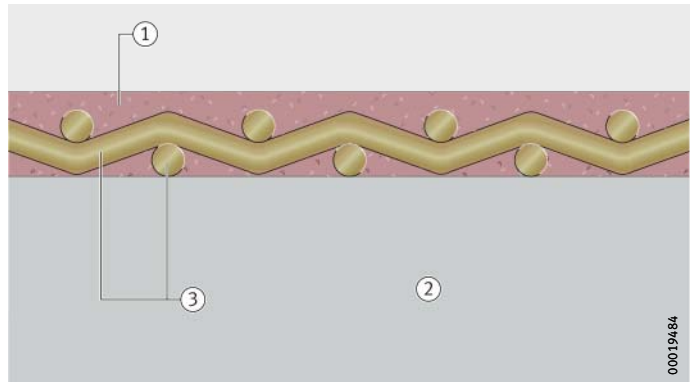
PTFE composite   PTFE composite comprises sheet steel with bronze attached by sintering and an embedded plastic composite made from PTFE, *Figure 3*.

The composite is embedded with form fit between the inner ring curved surface and the outer steel surface.

① Plastic composite comprising PTFE
② Sintered bronze
③ Sheet steel

Figure 3
PTFE composite, cross-section
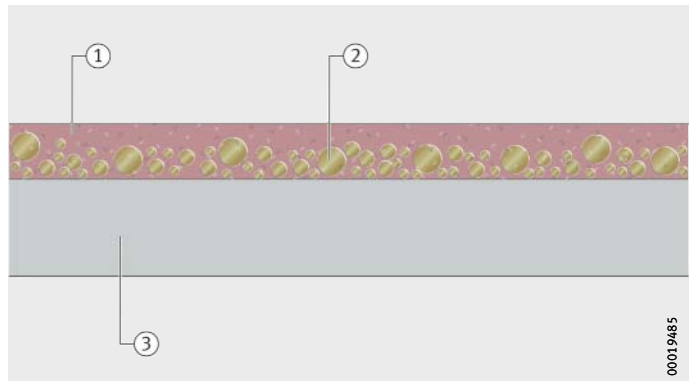
Spherical plain bearings, maintenance-free

Bearing materials

Maintenance-free spherical plain bearings fulfil all the requirements in terms of fatigue and wear resistance, hardness, toughness and structural stability as well as maintenance-free operation.

The materials used for the inner and outer rings and the shaft and housing locating washers are generally hardened and ground rolling bearing steel, see table.

Materials and design

Series	Material	
	Inner ring or shaft locating washer	Outer ring or housing locating washer
GE..-UK-2RS GE..-UK-2TS GE..-FW-2RS GE..-FW-2TS	Hardened and ground rolling bearing steel, curved surface finished or polished (d $\geqq$ 240 mm) and hard chromium coated.	Axially split at one point in GE..-UK-2RS(-2TS) to d $\leqq$ 140 mm and in GE..-FW-2RS(-2TS) to d $\leqq$ 120 mm. In larger sizes, axially split at two points and held together by means of heavy-section retaining washers. ELGOGLIDE fixed by adhesive in the outer ring curved surface.
GE..-DW GE..-DW-2RS2	Hardened rolling bearing steel, curved surface ground, polished and hard chromium coated.	42CrMo4-TQ in accordance with DIN EN 10083-1, radially split and held together by means of screws and dowel pins arranged axially on one side. ELGOGLIDE fixed by adhesive in the outer ring curved surface.
GE..-UK GE..-FW	Hardened rolling bearing steel, curved surface finished and hard chromium coated.	Formed around inner ring by special upset process from two bushes pushed into each other, outer steel surface subsequently precision machined. PTFE composite embedded with form contact between the inner ring curved surface and the outer steel surface.
GE..-PW	Hardened and ground rolling bearing steel, curved surface finished.	Brass, formed about inner ring, outside surface subsequently precision machined. PTFE film fixed by adhesive in the outer ring curved surface.
GE..-SW GE..-AW	Hardened rolling bearing steel, curved surface ground, polished and hard chromium coated.	Outer ring in GE..-SW and housing locating washer in GE..-AW made from hardened rolling bearing steel. Curved surface ground, in the case of GE..-AW $\geqq$ 160 mm, housing locating washer made from unhardened steel. ELGOGLIDE fixed by adhesive in the outer ring or housing locating washer curved surface.

Sealing Sealed radial spherical plain bearings have the suffix 2RS, 2RS2 or 2TS. They are protected by lip seals on both sides against contaminants and water spray.

Large radial spherical plain bearings GE..-DW-2RS2 have seals with increased sealing action for very high requirements.

Radial spherical plain bearings GE..-UK-2TS and GE..-FW-2TS are sealed on both sides by integrated, triple lip high performance seals.

Angular contact and axial spherical plain bearings are not sealed but can be protected by means of an external seal, page 105.

Lubrication Maintenance-free spherical plain bearings do not have relubrication facilities and must not be lubricated.

⚠ Maintenance-free spherical plain bearings must be subjected to dry running-in. Any lubricant will impair the smoothing effect necessary and will considerably reduce the operating life of the bearings.

Spherical plain bearings, maintenance-free

Operating temperature

The permissible operating temperature is dependent on the sliding contact surface and the sealing arrangement, see table.

⚠️ If the temperature exceeds the stated values, there will be a reduction in the operating life and the effect of the sealing arrangement.

Operating temperature

Series	Temperature °C	
	over	incl.
GE..-UK	−50	+200
GE..-UK-2RS[1]	−30	+130
GE..-UK-2TS[1]	−30	+100
GE..-DW	−50	+150
GE..-DW-2RS2[1]	−40	+120
GE..-FW	−50	+200
GE..-FW-2RS[1]	−30	+130
GE..-FW-2TS[1]	−30	+100
GE..-PW	−50	+200
GE..-SW	−50	+150
GE..-AW	−50	+150

[1] Due to the different sliding layers in the series, these bearings are suitable, if they are used without seals, for temperatures from −50 °C to +150 °C, see table, page 139.

Temperature-resistant seals

If sealed bearings must be used at higher temperatures, an unsealed bearing with external, temperature-resistant seals can be used, *Figure 4*.

① Seal

Figure 4
Open spherical plain bearing with external seals
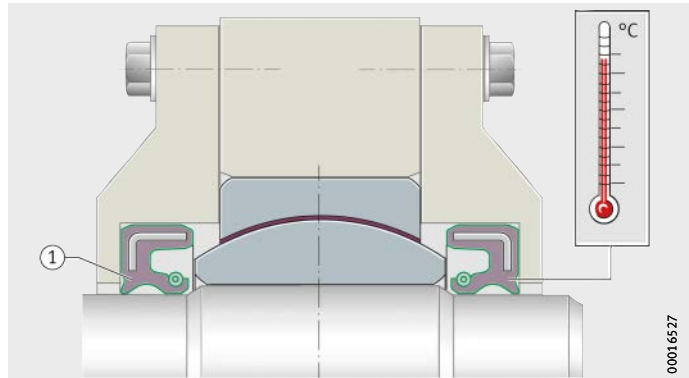
Suffixes Suffixes for available designs: see table.

Available designs

Suffix	Description	Design
2RS	Standard lip seals on both sides	Standard
2RS2	Lip seals with increased sealing action on both sides	
2TS	Triple lip high performance seals on both sides	
W1	Inner and outer ring made from corrosion-resistant steel	Special design, available by agreement only
W3	Inner ring made from corrosion-resistant steel	
W7	Inner ring bore with ELGOGLIDE lining; inside diameter d reduced by 1,08 mm ($d_{NEW} = d - 1{,}08$)	
W8	Inner ring bore with ELGOGLIDE lining; inside diameter d remains in accordance with nominal diameter ($d_{NEW} = d$)	
W11	For low contact pressures (starting as low as 1 N/mm^2) and minimal friction	
G8	Outer ring with Corrotect ZN coating, curved and end surfaces of inner ring with hard chromium coating	

Spherical plain bearings, maintenance-free

Design and safety guidelines

The chapter Technical principles brings together the essential guidelines on the subjects of operating clearance, the adjacent construction and mounting and dismounting, see section Technical principles, page 20.

Friction

The friction behaviour is dependent on the sliding contact surface and changes during the operating life. Calculation of the bearing frictional torque and the typical wear characteristics are given in the chapter Technical principles, see section Friction and increases in temperature, page 69.

Running-in phase

During the running-in phase, PTFE particles are transferred from the sliding layer to the opposing running surface. As a result, the small roughness features of the inner ring surface are filled in. It is only once this tribologically smooth surface is produced in conjunction with the detached PTFE particles that the bearings can achieve a long operating life.

⚠️ Maintenance-free spherical plain bearings do not have relubrication facilities and must not be lubricated.

Any lubrication of maintenance-free spherical plain bearings after dry running-in will impair the smoothing effect necessary and will considerably reduce the operating life of the bearings.

Design of bearing arrangements

In the design of the adjacent construction, the guidelines in the chapter Technical principles must be observed, see section Design of bearing arrangements, page 90.

Predimensioning

In the case of maintenance-free spherical plain bearings, predimensioning can be carried out, see page 31.

Dimensioning and rating life

The dimensioning of maintenance-free spherical plain bearings is brought together in the chapter Technical principles, see section Technical principles, page 20.

Depending on whether the bearing is subjected to dynamic or static load, the following must be checked:
- static load safety factor S_0
- maximum permissible specific bearing load p
- maximum permissible sliding velocity v
- maximum specific frictional energy pv.

⚠️ The rating life can be calculated if the range of validity is observed, see tables, page 50.

Interchangeability of bearing parts

In the case of maintenance-free spherical plain bearings, the inner ring and outer ring or respectively the shaft locating washer and housing locating washer of each bearing are matched to each other by means of the manufacturing technology used. As a result, these bearings must not be interchanged with each other.

Calculation example for radial spherical plain bearing GE50-UK-2TS

The rating life of the radial spherical plain bearing is calculated on the basis of the sliding layer ELGOGLIDE, see section Load carrying capacity and life, page 35.

Given data

The given data for calculation of the rating life are as follows:
- ▪ pivot of a tiller steering axis
- ▪ axial and radial loads in the pulsating range.

Operating parameters

Bearing load	$F_{r\,min}$	= 10 000 N
	$F_{r\,max}$	= 70 000 N
	F_a	= 20 000 N
Swivel angle	β	= 12°
Tilt angle	$\alpha_1,$	= 1,2°
	α_2	
Swivel frequency	f	= 30 min^{-1}
Load frequency	P_{Hz}	= 0,20 Hz
Operating temperature	ϑ_{min}	= −20 °C
	ϑ_{max}	= +50 °C

Bearing data

Radial spherical plain bearing		= GE50-UK-2TS
Basic dynamic load rating	C_r	= 444 000 N
Sphere diameter	d_K	= 66 mm
Sliding material	ELGOGLIDE	

Required

Bearing with the required rating life $L_h \geqq 8\,500$ h.

Spherical plain bearings, maintenance-free

Checking of permissible loads

⚠️ The validity of the permissible loads and sliding velocities must be checked, since useful rating life calculation is only possible within this range, see tables, page 50.

Combined load

For calculation of the combined load, the factor X must be determined from the diagram for radial spherical plain bearings using the ratio $F_a/F_r = 20\,000\,N / 70\,000\,N = 0,29$, *Figure 4*, page 39:

$$P = X \cdot F_r$$

$$P = 2,4 \cdot 70\,000 = 168\,000\,N$$

Specific bearing load

The specific bearing load must be calculated with the aid of the specific load parameter K and checked for validity, see table, page 41, and table, page 50:

$$p = K \cdot \frac{P}{C_r}$$

$$p = 300 \cdot \frac{168\,000}{444\,000} = 113,51\,N/mm^2$$

Combined swivel and tilt motion

The motion angle for combined motion must be calculated and checked for validity, see page 46:

$$\beta_1 = \sqrt{\beta^2 + (\alpha_1 + \alpha_2)^2}$$

$$\beta_1 = \sqrt{12^2 + (1,2 + 1,2)^2} = 12,24°$$

Sliding velocity in swivel motion

The sliding velocity must be calculated with the aid of the sphere diameter d_K and the motion angle β_1 for combined loads and checked for validity, see table, page 44, and table, page 50:

$$v = \frac{d_K \cdot \pi}{60 \cdot 10^3} \cdot \frac{2 \cdot \beta_1 \cdot f}{360°}$$

$$v = \frac{66 \cdot \pi \cdot 2 \cdot 12,24 \cdot 30}{60 \cdot 10^3 \cdot 360} = 7,05 \cdot 10^{-3}\,m/s$$

Specific frictional energy pv

The specific frictional energy pv must be checked for validity, see table, page 50:

$$pv = 113,51 \cdot 7,05 \cdot 10^{-3} = 0,8\,N/mm^2 \cdot m/s$$

Determining the rating life equation	For calculation of the rating life, the valid rating life equation must be selected and then subjected to correction.
Selection of the valid rating life equation	For maintenance-free plain bearings, the following applies, see page 52:

$$L_h = \frac{K_L}{p \cdot v} \cdot f_p \cdot f_v \cdot f_{pv} \cdot f_{pv^\star} \cdot f_\vartheta \cdot f_R \cdot f_W \cdot f_A \cdot f_B \cdot f_L \cdot f_\alpha \cdot f_\beta \cdot f_{Hz}$$

The correction factors necessary for the plain bearing material ELGOGLIDE must be selected from the matrix and used to correct the rating life equation appropriately, see table, page 55, and equation.

Correction factors, as a function of bearing type

Series		Sliding layer	Correction factors								
Spherical plain bearing	Rod end		f_p	f_v	f_{pv}	$f_{pv^\star}$	f_ϑ	f_A	f_α	f_β	f_{Hz}
GE..-UK	–	ELGOGLIDE	■	–	–	■	■	■	■	■	■

Rating life equation following correction

$$L_h = \frac{K_L}{pv} \cdot f_p \cdot f_{pv^\star} \cdot f_\vartheta \cdot f_A \cdot f_\alpha \cdot f_\beta \cdot f_{Hz}$$

Calculation of rating life

The values for the correction factors in the corrected rating life equation must be taken from the diagrams, see page 56 and table. The specific plain bearing factor $K_L = 25\,000$, see table, page 52.

Correction factors

Correction factor	Source	Value
Load f_p	*Figure 13*, page 56	0,7
Frictional energy $f_{pv^\star}$ $$pv^\star = v \cdot \left(100 + p^{1,25}\right) \cdot \frac{1}{30}$$ $$pv^\star = 7,05 \cdot 10^{-3} \cdot \left(100 + 113,51^{1,25}\right) \cdot \frac{1}{30} = 0,11$$	Page 59	0,78
Temperature f_ϑ	*Figure 18*, page 60	0,6
Condition of rotation f_A	Page 62	1
Tilt angle f_α	*Figure 25*, page 65	0,91
Swivel angle, oscillation angle f_β	*Figure 26*, page 65	0,78
Variable load f_{Hz}	*Figure 27*, page 66	0,6

Rating life L_h

The rating life is calculated as follows:

$$L_h = \frac{25\,000}{0,8} \cdot 0,7 \cdot 0,78 \cdot 0,6 \cdot 1 \cdot 0,91 \cdot 0,78 \cdot 0,6 = 4\,359\,h$$

Result

The ratio F_a/F_r for radial spherical plain bearings is in the valid range $\leqq 0,3$, but calculation of the rating life does not fulfil the required rating life $L_h \geqq 8\,500\,h$. For this reason, an angular contact spherical plain bearing GE50-SW is selected and calculated, see page 150.

Spherical plain bearings, maintenance-free

Calculation example for angular contact spherical plain bearing GE50-SW	The rating life of the angular contact spherical plain bearing is calculated on the basis of the sliding layer ELGOGLIDE, see section Load carrying capacity and life, page 35.
Given data	For calculation of the rating life, the application and the operating parameters in the preceding calculation example are used, page 147.
Bearing data	Angular contact spherical plain bearing $\quad$ = GE50-SW

Basic dynamic load rating $\qquad C_r$ = 355 000 N
Sphere diameter $\qquad d_K$ = 74 mm
Sliding material $\qquad$ ELGOGLIDE

Required $\qquad$ Bearing with the required rating life $L_h \gtrsim 8\,500$ h.

Checking of permissible loads

> [!] The validity of the permissible loads and sliding velocities must be checked, since useful rating life calculation is only possible within this range, see tables, page 50.

Combined load $\qquad$ For calculation of the combined load, the factor X must be determined from the diagram for angular contact spherical plain bearings using the ratio $F_a/F_r = 20\,000$ N / $70\,000$ N = 0,29, *Figure 5*, page 39:

$$P = X \cdot F_r$$

$$P = 1{,}13 \cdot 70\,000 = 79\,100 \, N$$

Specific bearing load $\qquad$ The specific bearing load must be calculated with the aid of the specific load parameter K and checked for validity, see table, page 41, and table, page 50:

$$p = K \cdot \frac{P}{C_r}$$

$$p = 300 \cdot \frac{79\,100}{355\,000} = 66{,}85 \, N/mm^2$$

Combined swivel and tilt motion

The motion angle for combined motion must be calculated and checked for validity, see page 46:

$$\beta_1 = \sqrt{\beta^2 + \left(\alpha_1 + \alpha_2\right)^2}$$

$$\beta_1 = \sqrt{12^2 + \left(1,2 + 1,2\right)^2} = 12,24°$$

Sliding velocity in swivel motion

The sliding velocity must be calculated with the aid of the sphere diameter $0,9 \cdot d_K$ and the motion angle β_1 for combined loads and checked for validity, see table, page 44, and table, page 50:

$$v = \frac{0,9 \cdot d_K \cdot \pi}{60 \cdot 10^3} \cdot \frac{2 \cdot \beta_1 \cdot f}{360°}$$

$$v = \frac{0,9 \cdot 74 \cdot \pi \cdot 2 \cdot 12,24 \cdot 30}{60 \cdot 10^3 \cdot 360} = 7,1 \cdot 10^{-3} \, \text{m/s}$$

Specific frictional energy pv

The specific frictional energy pv must be checked for validity, see table, page 50:

$$pv = 66,85 \cdot 7,1 \cdot 10^{-3} = 0,47 \, \text{N/mm}^2 \cdot \text{m/s}$$

Spherical plain bearings, maintenance-free

Determining the rating life equation

For calculation of the rating life, the valid rating life equation must be selected and then subjected to correction.

Selection of the valid rating life equation

For maintenance-free plain bearings, the following applies, see page 52:

$$L_h = \frac{K_L}{p \cdot v} \cdot f_p \cdot f_v \cdot f_{pv} \cdot f_{pv\star} \cdot f_\vartheta \cdot f_R \cdot f_W \cdot f_A \cdot f_B \cdot f_L \cdot f_\alpha \cdot f_\beta \cdot f_{Hz}$$

The correction factors necessary for the plain bearing material ELGOGLIDE must be selected from the matrix and used to correct the rating life equation appropriately, see table, page 55, table and equation.

Correction factors, as a function of bearing type

Series		Sliding layer	Correction factors								
Spherical plain bearing	Rod end		f_p	f_v	f_{pv}	$f_{pv\star}$	f_ϑ	f_A	f_α	f_β	f_{Hz}
GE..-SW	–	ELGOGLIDE	■	–	–	■	■	■	■	■	■

Rating life equation following correction

$$L_h = \frac{K_L}{pv} \cdot f_p \cdot f_{pv\star} \cdot f_\vartheta \cdot f_A \cdot f_\alpha \cdot f_\beta \cdot f_{Hz}$$

Calculation of rating life

The values for the correction factors in the corrected rating life equation must be taken from the diagrams, see page 56 and table. The specific plain bearing factor $K_L = 25\,000$, see table, page 52.

Correction factors

Correction factor	Source	Value
Load f_p	*Figure 13*, page 56	0,94
Frictional energy $f_{pv\star}$ $$pv^\star = v \cdot \left(100 + p^{1,25}\right) \cdot \frac{1}{30}$$ $$pv^\star = 7{,}1 \cdot 10^{-3} \cdot \left(100 + 66{,}85^{1,25}\right) \cdot \frac{1}{30} = 0{,}069$$	Page 59	0,84
Temperature f_ϑ	*Figure 18*, page 60	0,6
Condition of rotation f_A	Page 62	1
Tilt angle f_α	*Figure 25*, page 65	0,91
Swivel angle, oscillation angle f_β	*Figure 26*, page 65	0,78
Variable load f_{Hz}	*Figure 27*, page 66	0,7

Rating life L_h

The rating life is calculated as follows:

$$L_h = \frac{25\,000}{0{,}47} \cdot 0{,}94 \cdot 0{,}84 \cdot 0{,}6 \cdot 1 \cdot 0{,}91 \cdot 0{,}78 \cdot 0{,}7 = 12\,520\ h$$

Result

The selected angular contact spherical plain bearing GE50-SW fulfils the requirement for a rating life $L_h \geqq 8\,500$ h. Since angular contact spherical plain bearings are only supplied in an open design, external seals must be selected for sealing, see section Sealing, page 105.

Accuracy

The main dimensions as well as the dimensional and geometrical accuracy of the inside and outside diameter are in accordance with DIN ISO 12240-1 to DIN ISO 12240-3.

The dimensional and tolerance values are arithmetic mean values and dimensional checking is carried out in accordance with ISO 8015.

Spherical plain bearings with axially split or radially split outer ring

Before surface treatment and axial splitting, the outside diameters are within the deviations given in the tables.

As a result of axial and radial splitting, the outer rings become slightly out of round. The roundness of the outer ring is restored once it is mounted in a locating bore produced in accordance with the specifications, see page 92 and *Figure 5*.

Measurements taken of the outside diameter of the unmounted bearing cannot be used as the original actual values for the outside diameter.

ΔD = deviation of outside diameter
D = outside diameter of spherical plain bearing
t = tolerance zone

① Deviation within tolerance zone before mounting
② Bearing after mounting in locating bore
③ Reference circle
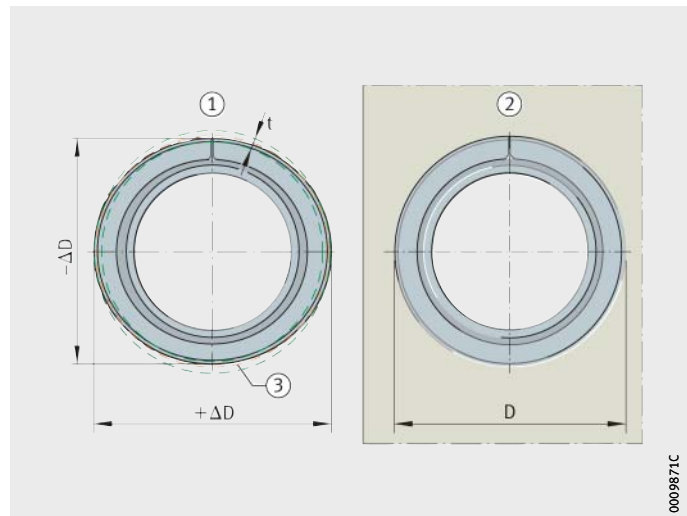
Figure 5
Deviation in roundness before mounting

Radial spherical plain bearings

Maintenance-free
DIN ISO 12240-1, dimension series E
Inner ring curved surface with hard chromium coating
Open design

GE..-UK
PTFE composite

Dimension table · Dimensions in mm							
Designation	Mass	Dimensions					
	m	d	D	B	C	d_K	α[1]
	$\approx$kg						°
GE6-UK	0,004	$6_{-0,008}$	$14_{-0,008}$	$6_{-0,12}$	$4_{-0,24}$	10	13
GE8-UK	0,007	$8_{-0,008}$	$16_{-0,008}$	$8_{-0,12}$	$5_{-0,24}$	13	15
GE10-UK	0,011	$10_{-0,008}$	$19_{-0,009}$	$9_{-0,12}$	$6_{-0,24}$	16	12
GE12-UK	0,016	$12_{-0,008}$	$22_{-0,009}$	$10_{-0,12}$	$7_{-0,24}$	18	11
GE15-UK	0,027	$15_{-0,008}$	$26_{-0,009}$	$12_{-0,12}$	$9_{-0,24}$	22	8
GE17-UK	0,042	$17_{-0,008}$	$30_{-0,009}$	$14_{-0,12}$	$10_{-0,24}$	25	10
GE20-UK	0,067	$20_{-0,01}$	$35_{-0,011}$	$16_{-0,12}$	$12_{-0,24}$	29	9
GE25-UK	0,12	$25_{-0,01}$	$42_{-0,011}$	$20_{-0,12}$	$16_{-0,24}$	35,5	7
GE30-UK	0,15	$30_{-0,01}$	$47_{-0,011}$	$22_{-0,12}$	$18_{-0,24}$	40,7	6

[1] The values for the tilt angle α are subject to tolerances.

[2] This differs from DIN ISO 12240-1, dimension series E.

Mounting dimensions

Chamfer dimensions		Mounting dimensions		Basic load ratings		Radial internal clearance[2]
r_1	r_2	d_a	D_a	dyn. C_r	stat. C_{0r}	
min.	min.	max.	min.	N	N	
0,3	0,3	8	9,6	3 600	9 000	0 – 0,032
0,3	0,3	10,2	12,5	5 850	14 600	0 – 0,032
0,3	0,3	13,2	15,5	8 640	21 600	0 – 0,032
0,3	0,3	14,9	17,5	11 300	28 400	0 – 0,032
0,3	0,3	18,4	21	17 800	44 600	0 – 0,04
0,3	0,3	20,7	24	22 500	56 300	0 – 0,04
0,3	0,3	24,2	27,5	31 300	78 300	0 – 0,04
0,6	0,6	29,3	33	51 100	128 000	0 – 0,05
0,6	0,6	34,2	38	65 900	165 000	0 – 0,05

Radial spherical plain bearings

Maintenance-free
DIN ISO 12240-1, dimension series E
Inner ring curved surface with hard chromium coating
Sealed

GE..-UK-2RS
ELGOGLIDE

Dimension table · Dimensions in mm								
Designation		Mass	Dimensions					
		m	d	D	B	C	d_K	$\alpha^{2)}$
		$\approx$ kg						°
GE17-UK-2RS	–	0,038	$17_{-0,008}$	$30_{-0,009}$	$14_{-0,12}$	$10_{-0,24}$	25	10
GE20-UK-2RS	–	0,061	$20_{-0,01}$	$35_{-0,011}$	$16_{-0,12}$	$12_{-0,24}$	29	9
GE25-UK-2RS	–	0,11	$25_{-0,01}$	$42_{-0,011}$	$20_{-0,12}$	$16_{-0,24}$	35,5	7
GE30-UK-2RS	GE30-UK-2TS	0,14	$30_{-0,01}$	$47_{-0,011}$	$22_{-0,12}$	$18_{-0,24}$	40,7	6
GE35-UK-2RS	GE35-UK-2TS	0,22	$35_{-0,012}$	$55_{-0,013}$	$25_{-0,12}$	$20_{-0,3}$	47	6
GE40-UK-2RS	GE40-UK-2TS	0,31	$40_{-0,012}$	$62_{-0,013}$	$28_{-0,12}$	$22_{-0,3}$	53	7
GE45-UK-2RS	GE45-UK-2TS	0,41	$45_{-0,012}$	$68_{-0,013}$	$32_{-0,12}$	$25_{-0,3}$	60	7
GE50-UK-2RS	GE50-UK-2TS	0,55	$50_{-0,012}$	$75_{-0,013}$	$35_{-0,12}$	$28_{-0,3}$	66	6
GE60-UK-2RS	GE60-UK-2TS	1	$60_{-0,015}$	$90_{-0,015}$	$44_{-0,15}$	$36_{-0,4}$	80	6
GE70-UK-2RS	GE70-UK-2TS	1,53	$70_{-0,015}$	$105_{-0,015}$	$49_{-0,15}$	$40_{-0,4}$	92	6
GE80-UK-2RS	GE80-UK-2TS	2,25	$80_{-0,015}$	$120_{-0,015}$	$55_{-0,15}$	$45_{-0,4}$	105	6
GE90-UK-2RS	GE90-UK-2TS	2,73	$90_{-0,02}$	$130_{-0,018}$	$60_{-0,2}$	$50_{-0,5}$	115	5
GE100-UK-2RS	GE100-UK-2TS	4,34	$100_{-0,02}$	$150_{-0,018}$	$70_{-0,2}$	$55_{-0,5}$	130	7
GE110-UK-2RS	GE110-UK-2TS	4,71	$110_{-0,02}$	$160_{-0,025}$	$70_{-0,2}$	$55_{-0,5}$	140	6
GE120-UK-2RS	GE120-UK-2TS	7,98	$120_{-0,02}$	$180_{-0,025}$	$85_{-0,2}$	$70_{-0,5}$	160	6
GE140-UK-2RS	GE140-UK-2TS	11,1	$140_{-0,025}$	$210_{-0,03}$	$90_{-0,25}$	$70_{-0,6}$	180	7
GE160-UK-2RS	GE160-UK-2TS	14	$160_{-0,025}$	$230_{-0,03}$	$105_{-0,25}$	$80_{-0,6}$	200	8
GE180-UK-2RS	GE180-UK-2TS[1)]	18,4	$180_{-0,025}$	$260_{-0,035}$	$105_{-0,25}$	$80_{-0,7}$	225	6
GE200-UK-2RS	GE200-UK-2TS[1)]	28,2	$200_{-0,03}$	$290_{-0,035}$	$130_{-0,3}$	$100_{-0,7}$	250	7
GE220-UK-2RS	GE220-UK-2TS[1)]	35,4	$220_{-0,03}$	$320_{-0,04}$	$135_{-0,3}$	$100_{-0,8}$	275	8
GE240-UK-2RS	GE240-UK-2TS[1)]	39,4	$240_{-0,03}$	$340_{-0,04}$	$140_{-0,3}$	$100_{-0,8}$	300	8
GE260-UK-2RS	GE260-UK-2TS[1)]	51,1	$260_{-0,035}$	$370_{-0,04}$	$150_{-0,35}$	$110_{-0,8}$	325	7
GE280-UK-2RS	GE280-UK-2TS[1)]	64,6	$280_{-0,035}$	$400_{-0,04}$	$155_{-0,35}$	$120_{-0,8}$	350	6
GE300-UK-2RS	GE300-UK-2TS[1)]	77,3	$300_{-0,035}$	$430_{-0,045}$	$165_{-0,35}$	$120_{-0,9}$	375	7

[1)] Price and delivery by agreement.

[2)] The values for the tilt angle α are subject to tolerances.

[3)] This differs from DIN ISO 12240-1, dimension series E.

GE..-UK-2TS
ELGOGLIDE

Mounting dimensions

Chamfer dimensions		Mounting dimensions		Basic load ratings		Radial internal clearance[3]
r_1	r_2	d_a	D_a	dyn. C_r	stat. C_{0r}	
min.	min.	max.	min.	N	N	
0,3	0,3	20,7	24	48 800	81 300	0 – 0,04
0,3	0,3	24,2	27,5	67 900	113 000	0 – 0,04
0,6	0,6	29,3	33	128 000	213 000	0 – 0,05
0,6	0,6	34,2	38	165 000	275 000	0 – 0,05
0,6	1	39,8	44,5	212 000	353 000	0 – 0,05
0,6	1	45	51	280 000	466 000	0 – 0,06
0,6	1	50,8	57	360 000	600 000	0 – 0,06
0,6	1	56	63	444 000	739 000	0 – 0,06
1	1	66,8	75	691 000	1 150 000	0 – 0,06
1	1	77,9	87	883 000	1 470 000	0 – 0,072
1	1	89,4	99	1 130 000	1 890 000	0 – 0,072
1	1	98,1	108	1 380 000	2 300 000	0 – 0,072
1	1	109,5	123	1 720 000	2 860 000	0 – 0,085
1	1	121,2	134	1 850 000	3 080 000	0 – 0,085
1	1	135,6	150	2 690 000	4 480 000	0 – 0,085
1	1	155,9	173	3 020 000	5 040 000	0 – 0,085
1	1	170,2	191	3 840 000	6 400 000	0 – 0,1
1,1	1,1	199	219	4 320 000	7 200 000	0 – 0,1
1,1	1,1	213,5	239	6 000 000	10 000 000	0 – 0,1
1,1	1,1	239,6	267	6 600 000	11 000 000	0 – 0,11
1,1	1,1	265,3	295	7 200 000	12 000 000	0 – 0,11
1,1	1,1	288,3	319	8 580 000	14 300 000	0 – 0,125
1,1	1,1	313,8	342	10 100 000	16 800 000	0 – 0,125
1,1	1,1	336,7	370	10 800 000	18 000 000	0 – 0,125

Large radial spherical plain bearings

Maintenance-free
DIN ISO 12240-1, dimension series C
Inner ring curved surface with hard chromium coating
Open or sealed
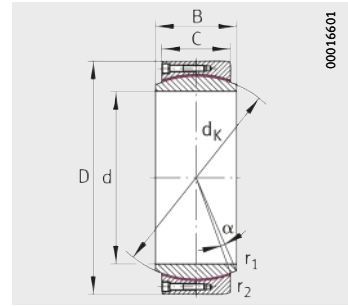
X-life

GE..-DW
ELGOGLIDE

Dimension table · Dimensions in mm										
Designation[1]				Mass m		Dimensions				
Open	X-life	Sealed	X-life	Open	Sealed	d	D	B	C	
				$\approx$ kg	$\approx$ kg					
GE320-DW	XL	**GE320-DW-2RS2**	XL	77,5	76,6	$320_{-0,04}$	$440_{-0,045}$	$160_{-0,4}$	$135_{-0,9}$	
GE340-DW	XL	**GE340-DW-2RS2**	XL	82	81,1	$340_{-0,04}$	$460_{-0,045}$	$160_{-0,4}$	$135_{-0,9}$	
GE360-DW	XL	**GE360-DW-2RS2**	XL	86,4	85,4	$360_{-0,04}$	$480_{-0,045}$	$160_{-0,4}$	$135_{-0,9}$	
GE380-DW	XL	**GE380-DW-2RS2**	XL	127	126	$380_{-0,04}$	$520_{-0,05}$	$190_{-0,4}$	160_{-1}	
GE400-DW	XL	**GE400-DW-2RS2**	XL	134	132	$400_{-0,04}$	$540_{-0,05}$	$190_{-0,4}$	160_{-1}	
GE420-DW	XL	**GE420-DW-2RS2**	XL	140	139	$420_{-0,045}$	$560_{-0,05}$	$190_{-0,45}$	160_{-1}	
GE440-DW	XL	**GE440-DW-2RS2**	XL	195	192	$440_{-0,045}$	$600_{-0,05}$	$218_{-0,45}$	185_{-1}	
GE460-DW	XL	**GE460-DW-2RS2**	XL	203	200	$460_{-0,045}$	$620_{-0,05}$	$218_{-0,45}$	185_{-1}	
GE480-DW	XL	**GE480-DW-2RS2**	XL	237	235	$480_{-0,045}$	$650_{-0,075}$	$230_{-0,45}$	$195_{-1,1}$	
GE500-DW	XL	**GE500-DW-2RS2**	XL	247	244	$500_{-0,045}$	$670_{-0,075}$	$230_{-0,45}$	$195_{-1,1}$	
GE530-DW	XL	**GE530-DW-2RS2**	XL	292	289	$530_{-0,05}$	$710_{-0,075}$	$243_{-0,5}$	$205_{-1,1}$	
GE560-DW	XL	**GE560-DW-2RS2**	XL	342	340	$560_{-0,05}$	$750_{-0,075}$	$258_{-0,5}$	$215_{-1,1}$	
GE600-DW	XL	**GE600-DW-2RS2**	XL	410	407	$600_{-0,05}$	$800_{-0,075}$	$272_{-0,5}$	$230_{-1,1}$	
GE630-DW	XL	**GE630-DW-2RS2**	XL	533	530	$630_{-0,05}$	$850_{-0,1}$	$300_{-0,5}$	$260_{-1,2}$	
GE670-DW	XL	**GE670-DW-2RS2**	XL	599	595	$670_{-0,075}$	$900_{-0,1}$	$308_{-0,75}$	$260_{-1,2}$	
GE710-DW	XL	**GE710-DW-2RS2**	XL	698	694	$710_{-0,075}$	$950_{-0,1}$	$325_{-0,75}$	$275_{-1,2}$	
GE750-DW	XL	**GE750-DW-2RS2**	XL	786	782	$750_{-0,075}$	$1\,000_{-0,1}$	$335_{-0,75}$	$280_{-1,2}$	
GE800-DW	XL	**GE800-DW-2RS2**	XL	927	923	$800_{-0,075}$	$1\,060_{-0,125}$	$355_{-0,75}$	$300_{-1,3}$	
GE850-DW	XL	**GE850-DW-2RS2**	XL	1\,055	1\,056	$850_{-0,1}$	$1\,120_{-0,125}$	365_{-1}	$310_{-1,3}$	
GE900-DW	XL	**GE900-DW-2RS2**	XL	1\,191	1\,186	$900_{-0,1}$	$1\,180_{-0,125}$	375_{-1}	$320_{-1,3}$	
GE950-DW	XL	**GE950-DW-2RS2**	XL	1\,436	1\,430	$950_{-0,1}$	$1\,250_{-0,125}$	400_{-1}	$340_{-1,3}$	
GE1000-DW	XL	**GE1000-DW-2RS2**	XL	1\,758	1\,751	$1\,000_{-0,1}$	$1\,320_{-0,16}$	438_{-1}	$370_{-1,6}$	

Attention!
The screw design is only valid for the basic load rating C_r.
If the load is greater, the outer ring halves must be supported by lateral clamping covers.

[1] Price and delivery by agreement.

[2] The values for the tilt angle α are subject to tolerances.

[3] This differs from DIN ISO 12240-1, dimension series C.

GE..-DW-2RS2
ELGOGLIDE

Mounting dimensions

Detail

d_K	α[2]	Chamfer dimensions		Mounting dimensions		Basic load ratings				Radial internal clearance[3]
						Open		Sealed		
		r_1	r_2	d_a	D_a	dyn. C_r	stat. C_{0r}	dyn. C_r	stat. C_{0r}	
	°	min.	min.	max.	min.	N	N	N	N	
380	4	1,1	3	344,7	361	15 400 000	25 700 000	12 900 000	21 500 000	0 − 0,125
400	3,8	1,1	3	366,6	382	16 200 000	27 000 000	13 600 000	22 700 000	0 − 0,125
420	3,6	1,1	3	388,3	403	17 000 000	28 400 000	14 300 000	23 800 000	0 − 0,135
450	4,1	1,5	4	407,9	426	21 600 000	36 000 000	18 700 000	31 100 000	0 − 0,135
470	3,9	1,5	4	429,9	447	22 600 000	37 600 000	19 500 000	32 500 000	0 − 0,135
490	3,7	1,5	4	451,7	469	23 500 000	39 200 000	20 300 000	33 900 000	0 − 0,135
520	3,9	1,5	4	472,1	491	28 900 000	48 100 000	24 500 000	40 800 000	0 − 0,145
540	3,7	1,5	4	494	513	30 000 000	50 000 000	25 400 000	42 400 000	0 − 0,145
565	3,8	2	5	516,1	536	33 100 000	55 100 000	28 300 000	47 200 000	0 − 0,145
585	3,6	2	5	537,9	557	34 200 000	57 000 000	29 300 000	48 800 000	0 − 0,145
620	3,7	2	5	570,4	591	38 100 000	63 600 000	32 900 000	54 900 000	0 − 0,145
655	4	2	5	602	624	42 200 000	70 400 000	36 700 000	61 200 000	0 − 0,16
700	3,6	2	5	645	667	48 300 000	80 500 000	42 400 000	70 700 000	0 − 0,16
740	3,3	3	6	676,5	698	57 700 000	96 200 000	51 500 000	85 800 000	0 − 0,16
785	3,7	3	6	722,1	746	61 200 000	102 000 000	54 600 000	91 100 000	0 − 0,16
830	3,7	3	6	763,7	789	68 500 000	114 000 000	60 900 000	101 000 000	0 − 0,17
875	3,8	3	6	808,3	834	73 500 000	123 000 000	65 500 000	109 000 000	0 − 0,17
930	3,6	3	6	859,6	886	83 700 000	140 000 000	75 200 000	125 000 000	0 − 0,17
985	3,4	3	6	914,9	940	91 600 000	153 000 000	82 600 000	138 000 000	0 − 0,17
1 040	3,2	3	6	970	995	99 800 000	166 000 000	90 300 000	150 000 000	0 − 0,195
1 100	3,3	4	7,5	1 024,7	1 052	112 000 000	187 000 000	102 000 000	170 000 000	0 − 0,195
1 160	3,5	4	7,5	1 074,1	1 105	129 000 000	215 000 000	118 000 000	197 000 000	0 − 0,195

Radial spherical plain bearings

Maintenance-free
DIN ISO 12240-1, dimension series G
Inner ring curved surface with hard chromium coating
Open design
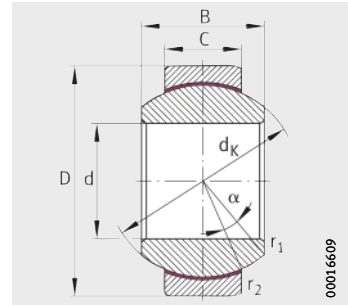
GE..-FW
PTFE composite

Dimension table · Dimensions in mm								
Designation	Mass	Dimensions						
	m	d	D	B	C	d_K	α[1]	
	$\approx$kg						°	
GE6-FW	0,009	$6_{-0,008}$	$16_{-0,008}$	$9_{-0,12}$	$5_{-0,24}$	13	21	
GE8-FW	0,015	$8_{-0,008}$	$19_{-0,009}$	$11_{-0,12}$	$6_{-0,24}$	16	21	
GE10-FW	0,021	$10_{-0,008}$	$22_{-0,009}$	$12_{-0,12}$	$7_{-0,24}$	18	18	
GE12-FW	0,037	$12_{-0,008}$	$26_{-0,009}$	$15_{-0,12}$	$9_{-0,24}$	22	18	
GE15-FW	0,05	$15_{-0,008}$	$30_{-0,009}$	$16_{-0,12}$	$10_{-0,24}$	25	16	
GE17-FW	0,083	$17_{-0,008}$	$35_{-0,011}$	$20_{-0,12}$	$12_{-0,24}$	29	19	
GE20-FW	0,16	$20_{-0,01}$	$42_{-0,011}$	$25_{-0,12}$	$16_{-0,24}$	35,5	17	
GE25-FW	0,21	$25_{-0,01}$	$47_{-0,011}$	$28_{-0,12}$	$18_{-0,24}$	40,7	17	

[1] The values for the tilt angle α are subject to tolerances.

[2] This differs from DIN ISO 12240-1, dimension series G.

Mounting dimensions

Chamfer dimensions		Mounting dimensions		Basic load ratings		Radial internal clearance[2]
r_1	r_2	d_a	D_a	dyn. C_r	stat. C_{0r}	
min.	min.	max.	min.	N	N	
0,3	0,3	9,4	12,5	5 850	14 600	0 – 0,032
0,3	0,3	11,6	15,5	8 640	21 600	0 – 0,032
0,3	0,3	13,4	17,5	11 300	28 400	0 – 0,032
0,3	0,3	16,1	21	17 800	44 600	0 – 0,04
0,3	0,3	19,2	24	22 500	56 300	0 – 0,04
0,3	0,3	21	27,5	31 300	78 300	0 – 0,04
0,3	0,6	25,2	33	51 100	128 000	0 – 0,05
0,6	0,6	29,5	38	65 900	165 000	0 – 0,05

Radial spherical plain bearings

Maintenance-free
DIN ISO 12240-1, dimension series G
Inner ring curved surface with hard chromium coating
Sealed

GE..-FW-2RS
ELGOGLIDE

Dimension table · Dimensions in mm								
Designation		Mass	Dimensions					
		m	d	D	B	C	d_K	α[1]
		$\approx$kg						°
GE25-FW-2RS	GE25-FW-2TS	0,2	$25_{-0,01}$	$47_{-0,011}$	$28_{-0,12}$	$18_{-0,24}$	40,7	17
GE30-FW-2RS	GE30-FW-2TS	0,29	$30_{-0,01}$	$55_{-0,013}$	$32_{-0,12}$	$20_{-0,3}$	47	17
GE35-FW-2RS	GE35-FW-2TS	0,4	$35_{-0,012}$	$62_{-0,013}$	$35_{-0,12}$	$22_{-0,3}$	53	16
GE40-FW-2RS	GE40-FW-2TS	0,53	$40_{-0,012}$	$68_{-0,013}$	$40_{-0,12}$	$25_{-0,3}$	60	17
GE45-FW-2RS	GE45-FW-2TS	0,69	$45_{-0,012}$	$75_{-0,013}$	$43_{-0,12}$	$28_{-0,3}$	66	15
GE50-FW-2RS	GE50-FW-2TS	1,4	$50_{-0,012}$	$90_{-0,015}$	$56_{-0,12}$	$36_{-0,4}$	80	17
GE60-FW-2RS	GE60-FW-2TS	2,1	$60_{-0,015}$	$105_{-0,015}$	$63_{-0,15}$	$40_{-0,4}$	92	17
GE70-FW-2RS	GE70-FW-2TS	3	$70_{-0,015}$	$120_{-0,015}$	$70_{-0,15}$	$45_{-0,4}$	105	16
GE80-FW-2RS	GE80-FW-2TS	3,6	$80_{-0,015}$	$130_{-0,018}$	$75_{-0,15}$	$50_{-0,5}$	115	14
GE90-FW-2RS	GE90-FW-2TS	5,34	$90_{-0,02}$	$150_{-0,018}$	$85_{-0,2}$	$55_{-0,5}$	130	15
GE100-FW-2RS	GE100-FW-2TS	6	$100_{-0,02}$	$160_{-0,025}$	$85_{-0,2}$	$55_{-0,5}$	140	14
GE110-FW-2RS	GE110-FW-2TS	9,7	$110_{-0,02}$	$180_{-0,025}$	$100_{-0,2}$	$70_{-0,5}$	160	12
GE120-FW-2RS	GE120-FW-2TS	15,1	$120_{-0,02}$	$210_{-0,03}$	$115_{-0,2}$	$70_{-0,6}$	180	16
GE140-FW-2RS	GE140-FW-2TS	18,9	$140_{-0,025}$	$230_{-0,03}$	$130_{-0,25}$	$80_{-0,6}$	200	16
GE160-FW-2RS	GE160-FW-2TS[3]	24,7	$160_{-0,025}$	$260_{-0,035}$	$135_{-0,25}$	$80_{-0,7}$	225	16
GE180-FW-2RS	GE180-FW-2TS[3]	35,8	$180_{-0,025}$	$290_{-0,035}$	$155_{-0,25}$	$100_{-0,7}$	250	14
GE200-FW-2RS[3]	GE200-FW-2TS[3]	44,9	$200_{-0,03}$	$320_{-0,04}$	$165_{-0,3}$	$100_{-0,8}$	275	15
GE220-FW-2RS[3]	GE220-FW-2TS[3]	50,9	$220_{-0,03}$	$340_{-0,04}$	$175_{-0,3}$	$100_{-0,8}$	300	16
GE240-FW-2RS[3]	GE240-FW-2TS[3]	65	$240_{-0,03}$	$370_{-0,04}$	$190_{-0,3}$	$110_{-0,8}$	325	15
GE260-FW-2RS[3]	GE260-FW-2TS[3]	81,8	$260_{-0,035}$	$400_{-0,04}$	$205_{-0,35}$	$120_{-0,8}$	350	15
GE280-FW-2RS[3]	GE280-FW-2TS[3]	96,6	$280_{-0,035}$	$430_{-0,045}$	$210_{-0,35}$	$120_{-0,9}$	375	15

[1] The values for the tilt angle α are subject to tolerances.

[2] This differs from DIN ISO 12240-1, dimension series G.

[3] Price and delivery by agreement.

GE..-FW-2TS
ELGOGLIDE

Mounting dimensions

Chamfer dimensions		Mounting dimensions		Basic load ratings		Radial internal clearance[2]
r_1	r_2	d_a	D_a	dyn. C_r	stat. C_{0r}	
min.	min.	max.	min.	N	N	
0,6	0,6	29,5	38	165 000	275 000	0 – 0,05
0,6	1	34,4	44,5	212 000	353 000	0 – 0,05
0,6	1	39,8	51	280 000	466 000	0 – 0,06
0,6	1	44,7	57	360 000	600 000	0 – 0,06
0,6	1	50,1	63	444 000	739 000	0 – 0,06
0,6	1	57,1	75	691 000	1 150 000	0 – 0,06
1	1	67	87	883 000	1 470 000	0 – 0,072
1	1	78,3	99	1 130 000	1 890 000	0 – 0,072
1	1	87,2	108	1 380 000	2 300 000	0 – 0,072
1	1	98,4	123	1 720 000	2 860 000	0 – 0,085
1	1	111,2	134	1 850 000	3 080 000	0 – 0,085
1	1	124,9	150	2 690 000	4 480 000	0 – 0,085
1	1	138,5	173	3 020 000	5 040 000	0 – 0,085
1	1	152	191	3 840 000	6 400 000	0 – 0,1
1	1,1	180	219	4 320 000	7 200 000	0 – 0,1
1,1	1,1	196,2	239	6 000 000	10 000 000	0 – 0,1
1,1	1,1	220	267	6 600 000	11 000 000	0 – 0,11
1,1	1,1	243,7	295	7 200 000	12 000 000	0 – 0,11
1,1	1,1	263,7	319	8 580 000	14 300 000	0 – 0,125
1,1	1,1	283,7	342	10 100 000	16 800 000	0 – 0,125
1,1	1,1	310,7	370	10 800 000	18 000 000	0 – 0,125

Radial spherical plain bearings

Maintenance-free
DIN ISO 12240-1, dimension series K
Brass outer ring
Open design
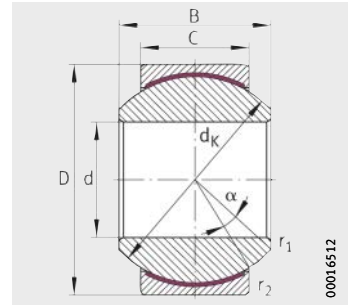
GE..-PW
PTFE film

Dimension table · Dimensions in mm							
Designation[1]	Mass m ≈kg	Dimensions					
		d H7	D	B	C	d_K	α[2] °
GE6-PW	0,01	$6^{+0,012}$	$16_{-0,008}$	$9_{-0,12}$	$6,75_{-0,24}$	12,7	13
GE8-PW	0,018	$8^{+0,015}$	$19_{-0,009}$	$12_{-0,12}$	$9_{-0,24}$	15,875	14
GE10-PW	0,027	$10^{+0,015}$	$22_{-0,009}$	$14_{-0,12}$	$10,5_{-0,24}$	19,05	13
GE12-PW	0,043	$12^{+0,018}$	$26_{-0,009}$	$16_{-0,12}$	$12_{-0,24}$	22,225	13
GE14-PW	0,055	$14^{+0,018}$	$28_{-0,009}$[3]	$19_{-0,12}$	$13,5_{-0,24}$	25,4	16
GE16-PW	0,079	$16^{+0,018}$	$32_{-0,011}$	$21_{-0,12}$	$15_{-0,24}$	28,575	15
GE18-PW	0,11	$18^{+0,018}$	$35_{-0,011}$	$23_{-0,12}$	$16,5_{-0,24}$	31,75	15
GE20-PW	0,15	$20^{+0,021}$	$40_{-0,011}$	$25_{-0,12}$	$18_{-0,24}$	34,925	14
GE22-PW	0,18	$22^{+0,021}$	$42_{-0,011}$	$28_{-0,12}$	$20_{-0,24}$	38,1	15
GE25-PW	0,25	$25^{+0,021}$	$47_{-0,011}$	$31_{-0,12}$	$22_{-0,24}$	42,85	15
GE30-PW	0,38	$30^{+0,021}$	$55_{-0,013}$	$37_{-0,12}$	$25_{-0,3}$	50,8	17

[1] Price and delivery by agreement.

[2] The values for the tilt angle α are subject to tolerances.

[3] This differs from DIN ISO 12240-1, dimension series K.

Mounting dimensions

Chamfer dimensions		Mounting dimensions		Basic load ratings		Radial internal clearance[3]
r_1	r_2	d_a	D_a	dyn. C_r	stat. C_{0r}	
min.	min.	max.	min.	N	N	
0,3	0,3	9	11,5	7 750	19 400	0,006 – 0,035
0,3	0,3	10,4	14	12 900	32 100	0,006 – 0,035
0,3	0,3	12,9	17	18 100	45 200	0,006 – 0,035
0,3	0,3	15,4	19,5	24 000	60 000	0,006 – 0,035
0,3	0,3	16,9	22,5	31 000	77 500	0,006 – 0,035
0,3	0,3	19,4	25,5	38 600	96 400	0,006 – 0,035
0,3	0,3	21,9	28,5	47 300	118 000	0,006 – 0,035
0,3	0,6	24,4	31,5	56 600	141 000	0,006 – 0,035
0,3	0,6	25,8	34	68 600	171 000	0,006 – 0,035
0,3	0,6	29,6	38,5	84 800	212 000	0,006 – 0,035
0,3	0,6	34,8	46	114 000	286 000	0,006 – 0,035

Angular contact spherical plain bearings

Maintenance-free
DIN ISO 12240-2
Inner ring curved surface with hard chromium coating
Open design

GE..-SW
ELGOGLIDE

Dimension table · Dimensions in mm								
Designation[1]	Mass	Dimensions						
	m ≈kg	d	D	T	d_K	D_1	B	C
GE25-SW	0,14	**$25_{-0,012}$**	$47_{-0,014}$	$15\pm0,25$	42,5	31,4	$14_{-0,2}$[4]	$14_{-0,2}$[4]
GE28-SW	0,18	**$28_{-0,012}$**	$52_{-0,016}$	$16\pm0,25$	47	35,7	$15_{-0,2}$[4]	$15_{-0,2}$[4]
GE30-SW	0,21	**$30_{-0,012}$**	$55_{-0,016}$	$17\pm0,25$	50	36,1	$16_{-0,2}$[4]	$16_{-0,2}$[4]
GE35-SW	0,28	**$35_{-0,012}$**	$62_{-0,016}$	$18\pm0,25$	56	42,4	$17_{-0,24}$	$17_{-0,24}$
GE40-SW	0,34	**$40_{-0,012}$**	$68_{-0,016}$	$19\pm0,25$	60	46,8	$18_{-0,24}$	$18_{-0,24}$
GE45-SW	0,42	**$45_{-0,012}$**	$75_{-0,016}$	$20\pm0,25$	66	52,9	$19_{-0,24}$	$19_{-0,24}$
GE50-SW	0,46	**$50_{-0,012}$**	$80_{-0,016}$	$20\pm0,25$	74	59,1	$19_{-0,24}$	$19_{-0,24}$
GE55-SW	0,68	**$55_{-0,015}$**	$90_{-0,018}$	$23\pm0,25$	80	62	$22_{-0,3}$	$22_{-0,3}$
GE60-SW	0,73	**$60_{-0,015}$**	$95_{-0,018}$	$23\pm0,25$	86	68,1	$22_{-0,3}$	$22_{-0,3}$
GE65-SW	0,78	**$65_{-0,015}$**	$100_{-0,018}$	$23\pm0,25$	92	75,6	$22_{-0,3}$	$22_{-0,3}$
GE70-SW	1,1	**$70_{-0,015}$**	$110_{-0,018}$	$25\pm0,25$	102	82,2	$24_{-0,3}$	$24_{-0,3}$
GE80-SW	1,56	**$80_{-0,015}$**	$125_{-0,02}$	$29\pm0,25$	115	90,5	$27_{-0,3}$	$27_{-0,3}$
GE90-SW	2,15	**$90_{-0,02}$**	$140_{-0,02}$	$32\pm0,25$	130	103,3	$30_{-0,4}$	$30_{-0,4}$
GE100-SW	2,33	**$100_{-0,02}$**	$150_{-0,02}$	$32\pm0,25$	140	114,3	$30_{-0,4}$	$30_{-0,4}$
GE110-SW	3,76	**$110_{-0,02}$**	$170_{-0,025}$	$38\pm0,25$	160	125,8	$36_{-0,4}$	$36_{-0,4}$
GE120-SW	4,1	**$120_{-0,02}$**	$180_{-0,025}$	$38\pm0,25$	170	135,4	$36_{-0,4}$	$36_{-0,4}$
GE130-SW[5]	6,1	**$130_{-0,025}$**	$200_{-0,03}$	$45\pm0,35$	190	148	$42_{-0,5}$	$42_{-0,5}$
GE140-SW[5]	6,46	**$140_{-0,025}$**	$210_{-0,03}$	$45\pm0,35$	200	160,6	$42_{-0,5}$	$42_{-0,5}$
GE150-SW[5]	7,92	**$150_{-0,025}$**	$225_{-0,03}$	$48\pm0,35$	213	170,9	$45_{-0,5}$	$45_{-0,5}$
GE160-SW[5]	9,6	**$160_{-0,025}$**	$240_{-0,03}$	$51\pm0,35$	225	181,4	$48_{-0,5}$	$48_{-0,5}$
GE170-SW[5]	13,1	**$170_{-0,025}$**	$260_{-0,035}$	$57\pm0,35$	250	194,3	$54_{-0,5}$	$54_{-0,5}$
GE180-SW[5]	17,5	**$180_{-0,025}$**	$280_{-0,035}$	$64\pm0,35$	260	205,5	$61_{-0,5}$	$61_{-0,5}$
GE190-SW[5]	18,4	**$190_{-0,03}$**	$290_{-0,035}$	$64\pm0,35$	275	211,8	$61_{-0,6}$	$61_{-0,6}$
GE200-SW[5]	23,3	**$200_{-0,03}$**	$310_{-0,035}$	$70\pm0,35$	290	229,2	$66_{-0,6}$	$66_{-0,6}$

[1] Other sizes available by agreement.

[2] The values for the tilt angle α are subject to tolerances.

[3] Basic load ratings in radial direction.

[4] Tolerance deviates from DIN ISO 12240-2.

[5] Price and delivery by agreement.
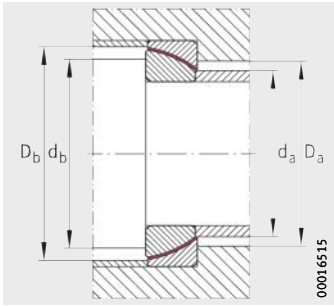
Mounting dimensions
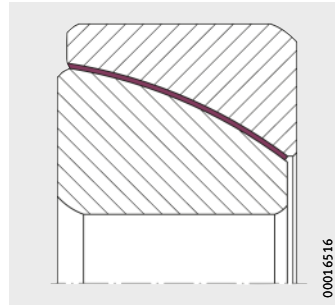
Detail

		Chamfer dimensions		Mounting dimensions				Basic load ratings[3)]	
s	α[2)]	r_1	r_2	d_a	d_b	D_a	D_b	dyn. C_r	stat. C_{0r}
	°	min.	min.	max.	max.	min.	min.	N	N
1	2,7	0,6	0,3	30,1	39,5	34	43	143 000	239 000
1	2,4	1	0,3	34,4	42	40	47,5	173 000	288 000
2	2,3	1	0,3	34,7	45	40,5	50,5	194 000	323 000
2	2,1	1	0,3	41,1	50	47	57	236 000	393 000
1,5	1,9	1	0,3	45,6	54	52	61	272 000	454 000
1,5	1,7	1	0,3	51,7	60	58	67	319 000	532 000
4	1,6	1	0,3	58	67	65	75	355 000	592 000
4	1,4	1,5	0,6	60,8	71	70	81	448 000	746 000
5	1,3	1,5	0,6	66,9	77	76	87	483 000	805 000
5	1,3	1,5	0,6	74,5	83	84	93	520 000	867 000
7	1,1	1,5	0,6	81	92	90	104	627 000	1 040 000
10	2	1,5	0,6	88	104	99	117	734 000	1 220 000
11	1,8	2	0,6	100,9	118	112	132	941 000	1 570 000
12	1,7	2	0,6	112	128	123	142	1 020 000	1 700 000
15	1,5	2,5	0,6	123,3	146	135	162	1 410 000	2 340 000
17	1,4	2,5	0,6	132,9	155	145	172	1 500 000	2 490 000
20	1,9	2,5	0,6	144	174	158	192	1 870 000	3 110 000
20	1,8	2,5	0,6	156,9	184	171	202	1 990 000	3 320 000
21	1,7	3	1	167,2	194	184	216	2 300 000	3 830 000
21	1,6	3	1	177,7	206	195	228	2 620 000	4 370 000
27	1,4	3	1	190,4	228	208	253	3 270 000	5 450 000
21	1,3	3	1	201,8	240	220	263	3 960 000	6 590 000
29	1,3	3	1	207,9	252	226	278	4 110 000	6 850 000
26	1,6	3	1	224,2	268	244	293	4 640 000	7 740 000

Axial spherical plain bearings

Maintenance-free
DIN ISO 12240-3
Shaft locating washer curved surface
with hard chromium coating
Open design
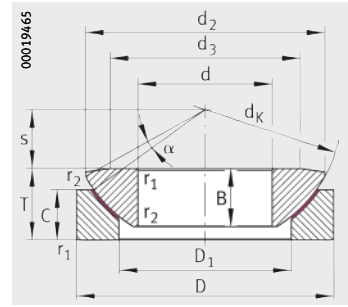
X-life

GE..-AW
ELGOGLIDE

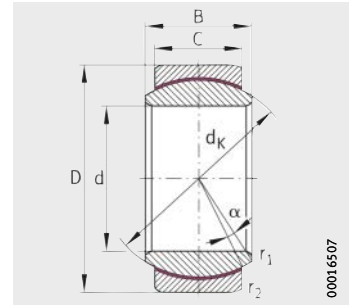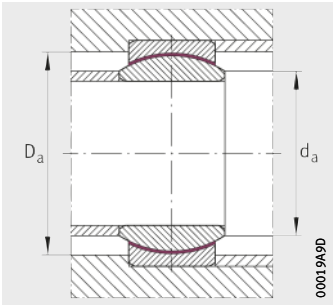| Dimension table · Dimensions in mm										
Designation		Mass	Dimensions							
	X-life	m ≈kg	d	D	T	d_K	d_2	d_3	D_1	
GE10-AW	–	0,039	$10_{-0,008}$	$30_{-0,009}$	$9,5_{-0,4}$	32	27,5	21	16,5	
GE12-AW	–	0,071	$12_{-0,008}$	$35_{-0,011}$	$13_{-0,4}$	37	32	24	19,5	
GE15-AW	–	0,12	$15_{-0,008}$	$42_{-0,011}$	$15_{-0,4}$	45	38,9	29	24	
GE17-AW	–	0,16	$17_{-0,008}$	$47_{-0,011}$	$16_{-0,4}$	50	43,4	34	28	
GE20-AW	–	0,27	$20_{-0,01}$	$55_{-0,013}$	$20_{-0,4}$	60	50	40	33,5	
GE25-AW	–	0,39	$25_{-0,01}$	$62_{-0,013}$	$22,5_{-0,4}$	66	57,5	45	34,5	
GE30-AW	–	0,65	$30_{-0,01}$	$75_{-0,013}$	$26_{-0,4}$	80	69	56	44	
GE35-AW	–	1,04	$35_{-0,012}$	$90_{-0,015}$	$28_{-0,4}$	98	84	66	52	
GE40-AW	–	1,65	$40_{-0,012}$	$105_{-0,015}$	$32_{-0,4}$	114	98	78	59	
GE45-AW	–	2,48	$45_{-0,012}$	$120_{-0,015}$	$36,5_{-0,4}$	130	112	89	68	
GE50-AW	–	3,43	$50_{-0,012}$	$130_{-0,018}$	$42,5_{-0,4}$	140	122,5	98	69	
GE60-AW	–	4,65	$60_{-0,015}$	$150_{-0,018}$	$45_{-0,4}$	160	139,5	109	86	
GE70-AW	–	5,65	$70_{-0,015}$	$160_{-0,025}$	$50_{-0,4}$	170	149,5	121	95	
GE80-AW	–	7,16	$80_{-0,015}$	$180_{-0,025}$	$50_{-0,4}$	194	168	130	108	
GE100-AW	–	10,7	$100_{-0,02}$	$210_{-0,03}$	$59_{-0,4}$	220	195,5	155	133	
GE120-AW	–	13,1	$120_{-0,02}$	$230_{-0,03}$	$64_{-0,4}$	245	214	170	154	
GE140-AW	–	18,6	$140_{-0,025}$	$260_{-0,035}$	$72_{-0,5}$	272	244	198	176	
GE160-AW[2]	–	24	$160_{-0,025}$	$290_{-0,035}$	$77_{-0,5}$	310	272	213	199	
GE180-AW[2]	–	31,5	$180_{-0,025}$	$320_{-0,04}$	$86_{-0,5}$	335	300	240	224	
GE200-AW[2]	–	35	$200_{-0,03}$	$340_{-0,04}$	$87_{-0,6}$	358	321	265	246	
GE220-AW[2][3]	XL	45,7	$220_{-0,03}$	$370_{-0,04}$	$97_{-0,6}$	388	350	289	265	
GE240-AW[2][3]	XL	57	$240_{-0,03}$	$400_{-0,04}$	$103_{-0,6}$	420	382	314	294	
GE260-AW[2][3]	XL	71,3	$260_{-0,035}$	$430_{-0,045}$	$115_{-0,7}$	449	409	336	317	
GE280-AW[2][3]	XL	84,1	$280_{-0,035}$	$460_{-0,045}$	$110_{-0,7}$	480	445	366	337	
GE300-AW[2][3]	XL	88,6	$300_{-0,035}$	$480_{-0,045}$	$110_{-0,7}$	490	460	388	356	
GE320-AW[2][3]	XL	112	$320_{-0,04}$	$520_{-0,05}$	$116_{-0,8}$	540	500	405	380	
GE340-AW[2][3]	XL	117	$340_{-0,04}$	$540_{-0,05}$	$116_{-0,8}$	550	510	432	380	
GE360-AW[2][3]	XL	133	$360_{-0,04}$	$560_{-0,05}$	$125_{-0,8}$	575	535	452	400	

[1] The values for the tilt angle α are subject to tolerances.

[2] Price and delivery by agreement.

[3] Not included in DIN ISO 12240-3.
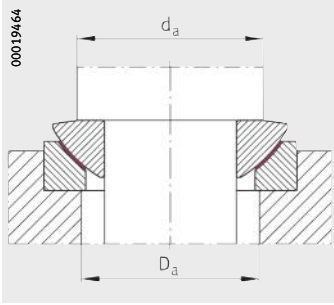
Mounting dimensions
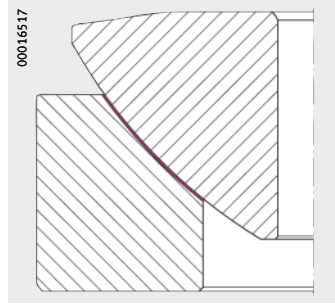
Detail

B	C	s	$\alpha^{1)}$	Chamfer dimensions		Mounting dimensions		Basic axial load ratings	
				r_1	r_2	d_a	D_a	dyn. C_a	stat. C_{0a}
			°	min.	min.	max.	min.	N	N
$7,9_{-0,24}$	$6_{-0,24}$	7	10	0,6	0,2	21	18,5	73 200	122 000
$9,3_{-0,24}$	$9_{-0,24}$	8	9	0,6	0,2	24	21,5	97 300	162 000
$10,7_{-0,24}$	$11_{-0,24}$	10	7	0,6	0,2	29	26	157 000	261 000
$11,5_{-0,24}$	$11,5_{-0,24}$	11	6	0,6	0,2	34	30,5	178 000	296 000
$14,3_{-0,24}$	$13_{-0,24}$	12,5	6	1	0,3	40	38	225 000	376 000
$16_{-0,24}$	$17_{-0,24}$	14	7	1	0,3	45	39	388 000	646 000
$18_{-0,24}$	$19,5_{-0,24}$	17,5	6	1	0,3	56	49	509 000	848 000
$22_{-0,24}$	$20_{-0,24}$	22	6	1	0,3	66	57	778 000	1 300 000
$27_{-0,24}$	$22_{-0,24}$	24,5	6	1	0,3	78	64	1 120 000	1 870 000
$31_{-0,24}$	$25_{-0,24}$	27,5	6	1	0,3	89	74	1 460 000	2 430 000
$33,5_{-0,24}$	$32_{-0,24}$	30	5	1	0,3	98	75	1 950 000	3 250 000
$37_{-0,3}$	$33_{-0,3}$	35	7	1	0,3	108	92	2 210 000	3 680 000
$40_{-0,3}$	$36_{-0,3}$	35	6	1	0,3	121	102	2 420 000	4 030 000
$42_{-0,3}$	$36_{-0,3}$	42,5	6	1	0,3	130	115	3 110 000	5 180 000
$50_{-0,4}$	$42_{-0,4}$	45	7	1	0,3	155	141	3 610 000	6 020 000
$52_{-0,4}$	$45_{-0,4}$	52,5	6,5	1	0,3	170	162	3 740 000	6 230 000
$61_{-0,5}$	$50_{-0,5}$	52,5	6	1,5	0,6	198	187	4 900 000	8 170 000
$65_{-0,5}$	$52_{-0,5}$	65	7	1,5	0,6	213	211	5 680 000	9 460 000
$70_{-0,5}$	$60_{-0,5}$	67,5	8	1,5	0,6	240	236	6 380 000	10 600 000
$74_{-0,6}$	$60_{-0,6}$	70	6,5	1,5	0,6	265	259	7 070 000	11 800 000
$82_{-0,6}$	$67_{-0,6}$	75	7	1,5	0,6	289	279	8 530 000	14 200 000
$87_{-0,6}$	$73_{-0,6}$	77,5	6	1,5	0,6	314	309	10 300 000	17 200 000
$95_{-0,7}$	$80_{-0,7}$	82,5	7	1,5	0,6	336	332	10 800 000	18 000 000
$100_{-0,7}$	$85_{-0,7}$	80	4	3	1	366	355	17 100 000	28 600 000
$100_{-0,7}$	$90_{-0,7}$	80	3,5	3	1	388	375	17 300 000	28 800 000
$105_{-0,8}$	$91_{-0,8}$	95	4	4	1,1	405	402	21 100 000	35 200 000
$105_{-0,8}$	$91_{-0,8}$	95	4	4	1,1	432	402	23 700 000	39 500 000
$115_{-0,8}$	$95_{-0,8}$	95	4	4	1,1	452	422	25 500 000	42 500 000

Spherical plain bearings, requiring maintenance

Radial spherical plain bearings
Large radial spherical plain bearings
Angular contact spherical plain bearings
Axial spherical plain bearings

Spherical plain bearings, requiring maintenance

Product overview

Spherical plain bearings, requiring maintenance

Radial spherical plain bearings

Sliding contact surface steel/steel
Metric or inch sizes
Open design

GE..-DO, GE..-ZO
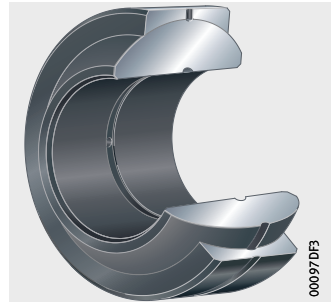
00097DCC

GE..-FO

00097DF3

Cylindrical extensions on inner ring
Open design

GE..-LO

00097E3B
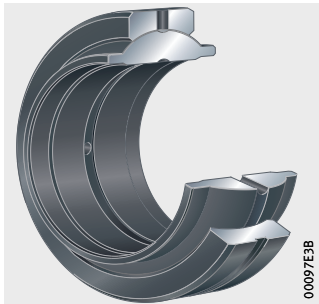
Sliding contact surface
steel/bronze
Open design

GE..-PB

00016528
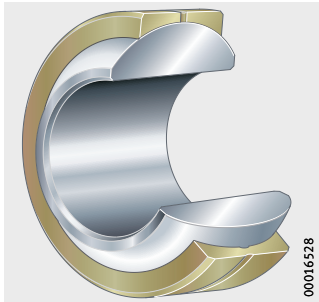
Sliding contact surface steel/steel
With lip seals or
high performance seals

GE..-DO-2RS, GE..-DO-2TS

00097E44

GE..-FO-2RS, GE..-FO-2TS

00097E4D
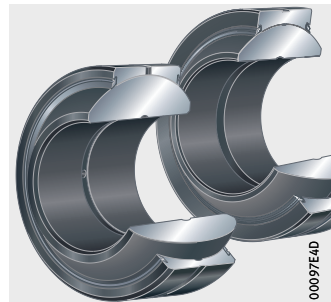
Radial
spherical plain bearings
Sliding contact surface steel/steel
Cylindrical extensions on inner ring
With lip seals

GE..-HO-2RS
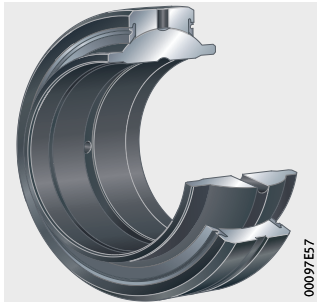
00097E57

Large radial
spherical plain bearings
Sliding contact surface steel/steel
With lip seals

GE..-DO-2RS4

00097E61

Angular contact
spherical plain bearings
Sliding contact surface steel/steel
Open design

GE..-SX

00097E6A

Axial
spherical plain bearings
Sliding contact surface steel/steel
Open design

GE..-AX

00097E73

Spherical plain bearings, requiring maintenance

Features	Spherical plain bearings allow spatial adjustment movements and, depending on the bearing type, can support radial, combined or axial loads.
Radial spherical plain bearings	Radial spherical plain bearings requiring maintenance comprise inner rings and outer rings with a steel/steel or steel/bronze sliding contact surface. The inner rings have a cylindrical bore with a curved outer slideway. The outer rings have a cylindrical outside surface and a concave inner slideway.
	As a sliding contact surface, the series GE..-DO, GE..-HO, GE..-FO, GE..-LO and GE..-ZO have inner and outer rings made from steel. Series GE..-PB has a steel inner ring and a bronze outer ring.
	Bearings of series GE-ZO are available in inch sizes.
	The bearings are available in open designs and in designs sealed on both sides, see dimension tables.
	Spherical plain bearings GE..-LO have bore dimensions to standard sizes and dimensions in accordance with DIN 24338 for standard hydraulic cylinders.
Area of application	Radial spherical plain bearings can support radial forces, transmit motion and loads with low moment levels, thus keeping bending stresses away from the construction elements. The bearings are particularly suitable for alternating loads with impact and shock type stresses and support axial loads in both directions.
Outer ring	In bearings of diameter $d \geqq 320$ mm, the outer ring is axially split at two points and held together by means of heavy-section retaining washers.
Inner ring	GE..-FO and GE..-FO-2RS(-2TS) have extended inner rings. As a result, larger tilt angles are possible.
	GE..-HO-2RS has cylindrical extensions on the inner ring. As a result, spacer rings are not required if the bearing is mounted in a clevis.
Sealing	Sealed bearings have the suffix 2RS, 2TS or 2RS4. They are protected by lip seals on both sides against contaminants and water spray.
	Radial spherical plain bearings GE..-DO-2TS and GE..-FO-2TS are sealed on both sides by integrated, triple lip high performance seals.
	Large radial spherical plain bearings GE..-DO-2RS4 have seals with increased sealing action for very high requirements.
Lubrication	Radial spherical plain bearings are lubricated via the outer and inner ring. For exceptions, see dimension table. Under alternating load, one side is relieved of load and this zone is lubricated by the swivel motion of the bearing.

| | Series, sliding contact surface, standard | Radial spherical plain bearings requiring maintenance are designed according to their specific series with different sliding contact surfaces, see table. |

Series, sliding contact surface, standard

Radial spherical plain bearings requiring maintenance are designed according to their specific series with different sliding contact surfaces, see table.

Series and design

Series[1]	Sliding contact surface	DIN ISO	Dimension series	Shaft d mm	
				over	incl.
GE..-DO	Steel/steel	12240-1	E	6	300
			C	320	1000
GE..-DO-2RS			E	17	300
GE..-DO-2TS			E	30	140
GE..-DO-2RS4			C	320	1000
GE..-HO		–	–	20	120
GE..-HO-2RS		–	–	20	120
GE..-FO		12240-1	G	6	280
GE..-FO-2RS			G	15	280
GE..-FO-2TS			G	25	120
GE..-LO			W	12	320
GE..-PB	Steel/bronze		K	6	30

[1] Radial spherical plain bearings GE..-ZO are available in inch sizes and with a shaft diameter from 0,75 inch to 5 inch.

Angular contact spherical plain bearings

Angular contact spherical plain bearings GE..-SX correspond to DIN ISO 12240-2. They have inner rings with a curved outer slideway and outer rings with a concave inner slideway, where a steel/steel sliding contact surface is present.

The bearings are available for shaft diameters from 25 mm to 200 mm. Other sizes are available by agreement.

Area of application

Angular contact spherical plain bearings can support axial forces as well as radial forces. As a result, they are suitable for alternating dynamic loads.

The bearings are used where loads acting in conjunction with small swivel angles would damage rolling element bearings. They are a good plain bearing alternative to tapered roller bearings 320..-X in accordance with ISO 355 and DIN 720, since they have the same mounting dimensions.

Since motion and loads are transmitted with low moment levels, bending stresses are kept away from the construction elements.

Sealing

Angular contact spherical plain bearings are not sealed.

Lubrication

The bearings are intended as standard for grease lubrication and are lubricated via the outer ring.

Spherical plain bearings, requiring maintenance

Axial spherical plain bearings	Axial spherical plain bearings GE..-AX correspond to DIN ISO 12240-3. In these units, the shaft locating washer is supported in the ball socket-shaped sliding zone of the housing locating washer, where a steel/steel sliding contact surface is present.
	The bearings are available for shaft diameters from 10 mm to 200 mm. Other sizes are available by agreement.
Area of application	The bearings can support axial forces and transmit support forces with low moment levels into the adjacent construction. In order to support radial forces, they can be combined with radial spherical plain bearings of dimension series E in accordance with DIN ISO 12240-1.
Sealing	Axial spherical plain bearings are not sealed.
Lubrication	The bearings are lubricated via the housing locating washer.
Bearing materials	Radial spherical plain bearings requiring maintenance are made from high grade rolling bearing steel and have a steel/steel or steel/bronze sliding contact surface.
	The steel bearing rings are hardened, ground and surface treated. Manganese phosphating with subsequent molybdenum disulphide coating has proved effective as a surface treatment. As a result, the bearings can fulfil high requirements for wear resistance and the effective separation of the metallic surfaces gives optimum running-in characteristics.
Steel/steel sliding contact surface	The inner and outer rings and the shaft and housing locating washers are made from a martensitic or bainitic hardened structure with a low residual austenite content.
Steel/bronze sliding contact surface	The inner ring is made from hardened and ground rolling bearing steel and the curved surface is finished.
	The outer ring is made from bronze which is formed around the inner ring. The outside surface is subsequently precision machined.

Operating temperature   The permissible operating temperature is dependent on the sliding contact surface and the sealing arrangement, see table.

!   If the temperature exceeds the stated values, there will be a reduction in the operating life and the effect of the sealing arrangement.

Operating temperature

Series	Temperature °C	
	over	incl.
GE..-DO	−60	+200
GE..-DO-2RS(-2RS4)[1]	−30	+130
GE..-DO-2TS[1]	−30	+100
GE..-FO	−60	+200
GE..-FO-2RS(-2RS4)[1]	−30	+130
GE..-FO-2TS[1]	−30	+100
GE..-PB	−60	+250
GE..-LO	−60	+200
GE..-HO	−60	+200
GE..-HO-2RS[1]	−30	+130
GE..-ZO	−60	+200
GE..-SX	−60	+200
GE..-AX	−60	+200

[1] Suitable without seals for temperatures from −60 °C to +200 °C.

Temperature-resistant seals   If sealed bearings must be used at higher temperatures, unsealed bearings with external, temperature-resistant seals can be used, *Figure 1*.

① Seal

Figure 1
Open spherical plain bearing with external seals

00016541
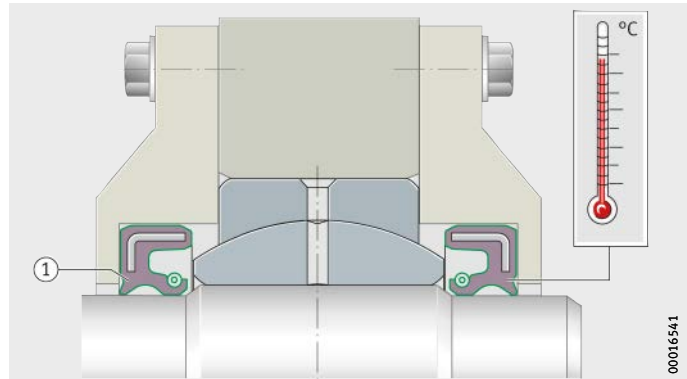
Spherical plain bearings, requiring maintenance

Suffixes for available designs: see table.

Available designs

Suffix	Description	Design
2RS	Lip seals on both sides	Standard
2RS4	Lip seals with increased sealing action on both sides	
2TS	Integrated triple lip high performance seals on both sides	
C2	Radial internal clearance Group 2, smaller than normal	Special design, available by agreement only
C3	Radial internal clearance Group 3, larger than normal	
F7	Lubrication groove system for grease lubrication in the case of smaller angles	
F10	Lubrication groove system for oil bath lubrication for angular contact spherical plain bearings GE..-SX	

Design and safety guidelines

The chapter Technical principles brings together the essential guidelines on the subjects of operating clearance, the adjacent construction and mounting and dismounting, see section Technical principles, page 20.

Friction

The friction behaviour is dependent on the sliding contact surface and changes during the operating life. Calculation of the bearing frictional torque and the typical coefficients of friction are given in the chapter Technical principles, see section Friction and increases in temperature, page 69.

Principles of lubrication

Spherical plain bearings with a steel/steel sliding contact surface requiring maintenance are given a special surface treatment and are provided with MoS_2. Nevertheless, the quality of maintenance has a considerable influence on the function and wear of spherical plain bearings.

Functions of the lubricant

The functions of the lubricant are as follows, *Figure 2*:

- ◾ A lubricant film is formed on the contact surfaces that is sufficiently capable of supporting loads and thus preventing wear and premature fatigue ①.
- ◾ When grease lubrication is used, the bearing is additionally sealed against the entry of both solid and fluid contaminants ②.
- ◾ It gives protection against corrosion ③.

⚠ It is more important to use a suitable lubricant than to provide generously defined, short lubrication intervals. The lubricant must always be selected in consultation with the lubricant manufacturers.

① Formation of a lubricant film capable of supporting loads
② Sealing of the bearing against external contaminants in the case of grease lubrication
③ Protection against corrosion

Figure 2
Functions of the lubricant
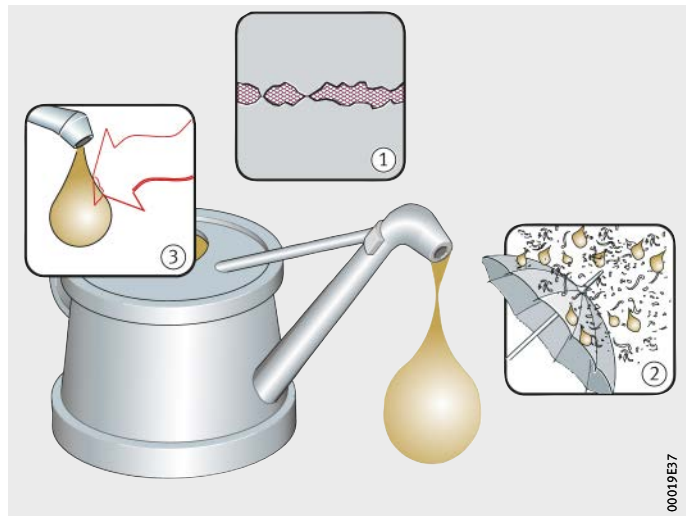
00019E37

Spherical plain bearings, requiring maintenance

Selection of lubricant

The lubricant is selected as a function of the sliding contact surface in the bearing.

The following criteria must be considered:
- the load
- the load direction
- the swivel angle
- the sliding velocity
- the ambient temperature
- the environmental conditions.

Steel/steel sliding contact surface

For standard applications, conventional, corrosion-inhibiting, high-pressure greases with a lithium soap base, EP additives and solid lubricant additives are suitable.

The composition of suitable lubricants is as follows:
- a proportion of approx. 3% MoS_2
- solid additives based on calcium and zinc phosphate compounds. Even under high contact pressure, these additives separate the sliding surfaces from each other.

Steel/bronze sliding contact surface

Conventional, corrosion-inhibiting, water-repellent lithium soap greases of normal consistency are suitable.

⚠ Lubricants with MoS_2 additives or other solid lubricants must not be used.

Running-in phase

The running-in phase has a significant influence on the later wear behaviour of the bearing. Correct lubrication is therefore of particular importance at this point.

During running-in, the surfaces of the contact zones undergo smoothing and elastic moulding. This gives additional load-bearing areas and reduces the strain on the material.

Guidelines on greasing

During the running-in phase, the pressure in the bearing is particularly high. The spherical plain bearings are therefore manganese phosphated and treated with MoS_2. The running-in wear phase proceeds all the more favourably the more MoS_2 is embedded in the porous-crystalline manganese phosphate.

This process is at its most effective with the following sequence:
- The bearing is subjected to about ten swivel motions under load without additional greasing.
- The bearing is then given its initial greasing.

If this is not possible, the initial greasing must be metered carefully in order to avoid flushing an excessive quantity of MoS_2 out of the bearing.

| Relubrication | During relubrication, old grease is replaced by fresh grease. At the same time, the grease flushes wear debris and contaminants out of the bearing. |

Bearings with a steel/steel sliding contact surface must be periodically relubricated. The relubrication intervals should not be established arbitrarily but determined by calculation as part of the rating life calculation (correction factor f_{NH}). Alternatively, this should be determined in consultation with the lubricant manufacturer.

The bearings should also be relubricated before long periods without operation.

If relubrication is carried out too frequently, the operating life of the bearing may be reduced, since the friction of spherical plain bearings always increases for a short time after relubrication.

Relubrication conditions

The grease used for relubrication must be the same as that used in initial greasing.

If other greases are used, the miscibility and compatibility of the greases must be checked.

The following conditions should be used for relubrication:
- The bearing should still be warm from operation.
- It should always be carried out before the bearing comes to rest.
- Relubrication should continue until a fresh collar of grease appears at the seal gaps. Old grease must be allowed to leave the bearing unhindered.

Design of bearing arrangements

In the design of the adjacent construction, the guidelines in the chapter Technical principles must be observed, see section Design of bearing arrangements, page 90.

Spherical plain bearings,
requiring maintenance

Predimensioning

In the case of spherical plain bearings requiring maintenance, predimensioning can be carried out, see page 33.

Dimensioning and rating life

The dimensioning of spherical plain bearings requiring maintenance is brought together in the chapter Technical principles, see section Technical principles, page 20.

Depending on whether the bearing is subjected to dynamic or static load, the following must be checked:
- static load safety factor S_0
- maximum permissible specific bearing load p
- maximum permissible sliding velocity v
- maximum specific frictional energy pv.

The rating life can be calculated if the range of validity is observed, see tables, page 50.

Calculation example for radial spherical plain bearing GE50-DO

The rating life of the radial spherical plain bearing is calculated on the basis of the steel/steel sliding contact surface, see section Load carrying capacity and life, page 35.

Given data

The given data for calculation of the rating life are as follows:
- pivot of a linkage rod
- axial and radial alternating load.

Operating parameters

Bearing load		
	F_r	= 25 000 N
	F_a	= 5 000 N
Swivel angle	β	= 35°
Swivel frequency	f	= 6 min^{-1}
Relubrication interval	l_W	= 16 h
Operating temperature	ϑ_{min}	= −20 °C
	ϑ_{max}	= +60 °C

Bearing data

Radial spherical plain bearing		= GE50-DO
Basic dynamic load rating	C_r	= 157 000 N
Sphere diameter	d_K	= 66 mm
Sliding contact surface		Steel/steel

Required

Bearing with the required rating life $L_h \geqq 10\,000$ h.

Checking of permissible loads

⚠ The validity of the permissible loads and sliding velocities must be checked, since useful rating life calculation is only possible within this range, see tables, page 50.

Combined load
For calculation of the combined load, the factor X must be determined from the diagram for radial spherical plain bearings using the ratio $F_a/F_r = 5\,000\ N\ /\ 25\,000\ N = 0,2$, *Figure 4*, page 39:

$$P = X \cdot F_r$$

$$P = 1,8 \cdot 25\,000 = 45\,000\ N$$

Specific bearing load
The specific bearing load must be calculated with the aid of the specific load parameter K and checked for validity, see table, page 41, and table, page 50:

$$p = K \cdot \frac{P}{C_r}$$

$$p = 100 \cdot \left(\frac{45\,000}{157\,000} \right) = 28,66\ N/mm^2$$

Sliding velocity in swivel motion
The sliding velocity must be calculated with the aid of the sphere diameter d_K and the swivel angle β and checked for validity, see table, page 44, and table, page 50:

$$v = \frac{d_K \cdot \pi}{60 \cdot 10^3} \cdot \frac{2 \cdot \beta \cdot f}{360°}$$

$$v = \frac{66 \cdot \pi \cdot 2 \cdot 35 \cdot 6}{60 \cdot 10^3 \cdot 360} = 4,0 \cdot 10^{-3}\ m/s$$

Specific frictional energy pv
The specific frictional energy pv must be checked for validity, see table, page 50:

$$pv = 28,66 \cdot 4,0 \cdot 10^{-3} = 0,11\ N/mm^2 \cdot m/s$$

Spherical plain bearings, requiring maintenance

Determining the rating life equation

For calculation of the rating life, the valid rating life equation must be selected and then subjected to correction.

Selection of the valid rating life equation

For plain bearings requiring maintenance, the following applies, see page 52:

$$L_h = \frac{K_L}{v} \cdot \left(\frac{C_r}{P} \right) \cdot f_p \cdot f_v \cdot f_\vartheta \cdot f_A \cdot f_\beta \cdot f_{dK} \cdot f_{Hz}$$

The correction factors necessary for the steel/steel sliding contact surface must be selected from the matrix and used to correct the rating life equation appropriately, see table, page 55 and equation.

Correction factors, as a function of bearing type

Series		Sliding contact surface	Correction factors						
Spherical plain bearing	Rod end		f_p	f_v	f_ϑ	f_A	f_{dK}	f_β	f_{Hz}
GE..-DO	–	Steel/steel	■	■	■	■	■	■	■

Rating life equation following correction

$$L_h = \frac{K_L}{v} \cdot \left(\frac{C_r}{P} \right) \cdot f_p \cdot f_v \cdot f_\vartheta \cdot f_A \cdot f_\beta \cdot f_{dK} \cdot f_{Hz}$$

Calculation of rating life

The values for the correction factors in the corrected rating life equation must be taken from the diagrams, see page 56 and table. The specific plain bearing factor $K_L = 30$, see table, page 52.

Correction factors

Correction factor	Source	Value
Load f_p	*Figure 13*, page 56	0,29
Sliding velocity f_v	*Figure 16*, page 58	0,2
Temperature f_ϑ	*Figure 18*, page 60	1
Condition of rotation f_A	Page 62	1
Sphere diameter f_{dK}	*Figure 22*, page 63	1,1
Swivel angle, oscillation angle f_β	*Figure 26*, page 65	0,14
Variable load f_{Hz}	*Figure 27*, page 66	2

Rating life L_h

The rating life is calculated as follows:

$$L_h = \frac{30}{4,0 \cdot 10^{-3}} \cdot \left(\frac{157\,000}{45\,000} \right) \cdot 0,29 \cdot 0,2 \cdot 1 \cdot 1 \cdot 1,1 \cdot 0,14 \cdot 2 = 467 \text{ h}$$

Rating life L_{hN} with periodic relubrication

The rating life can be increased by means of periodic relubrication as a function of the relubrication interval, see page 52.

The necessary relubrication interval and preferred relubrication interval must be calculated and checked for validity, see page 68 and page 182:

$$l_W \leqq 0,5 \cdot L_h$$

$$l_W \leq 0,5 \cdot 467$$
$$32\,h < 233\,h$$

Based on a relubrication frequency $L_h/l_W = 467\,h/16\,h = 29,19$, a correction factor $f_{NH} = 4,7$ is determined, *Figure 31*, page 68. Based on a swivel angle $\beta = 35°$, the correction factor $f_{N\beta} = 5,6$, *Figure 32*, page 68.

$$L_{hN} = L_h \cdot f_{NH} \cdot f_{N\beta}$$

$$L_{hN} = 467 \cdot 4,7 \cdot 5,6 = 12\,291\,h$$

Result

The selected radial spherical plain bearing GE50-DO fulfils the requirement for a rating life $L_h \geqq 10\,000\,h$.

Spherical plain bearings, requiring maintenance

Accuracy

The main dimensions as well as the dimensional and geometrical accuracy of the inside and outside diameter are in accordance with DIN ISO 12240-1 to DIN ISO 12240-3. The exceptions are radial spherical plain bearings of series GE..-HO-2RS and spherical plain bearings GE..-ZO in inch sizes.

The dimensional and tolerance values are arithmetic mean values and dimensional checking is carried out in accordance with ISO 8015.

As a result of the surface treatment, the tolerances of spherical plain bearings with a steel/steel sliding contact surface may differ slightly from the stated values. However, this does not affect the mounting and operating characteristics.

Spherical plain bearings with axially split or radially split outer ring

Before surface treatment and axial splitting, the outside diameters are within the deviations given in the tables. As a result of axial and radial splitting, the outer rings become slightly out of round. The roundness of the outer ring is restored once it is fitted in a locating bore produced in accordance with the specifications, see page 92 and *Figure 3*.

⚠ Measurements taken of the outside diameter of the unmounted bearing cannot be used as the original actual values for the outside diameter.

ΔD = deviation of outside diameter
D = outside diameter
of spherical plain bearing
t = tolerance zone

① Deviation within tolerance zone before mounting
② Bearing after mounting in locating bore
③ Reference circle

Figure 3
Deviation in roundness
before mounting
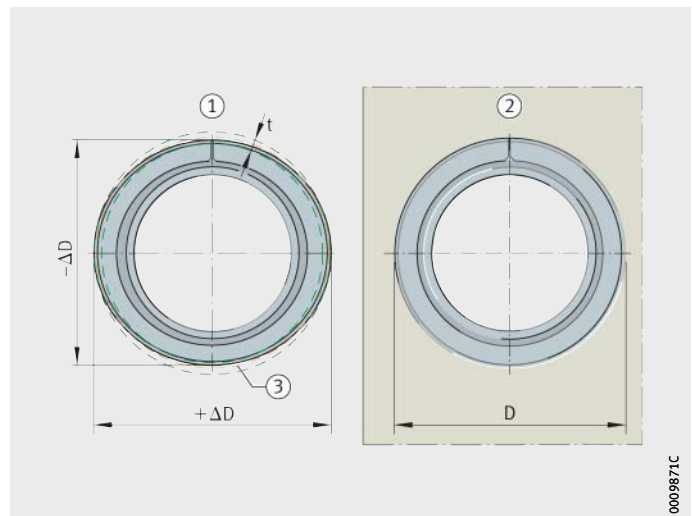
Radial spherical plain bearings

Requiring maintenance
DIN ISO 12240-1, dimension series E
Open or sealed

GE..-DO
Steel/steel

Dimension table · Dimensions in mm									
Designation			Mass	Dimensions					
Open	Sealed		m $\approx$ kg	d	D	B	C	d_K	α[1] $\circ$
GE6-DO[2]	–	–	0,005	**$6_{-0,008}$**	$14_{-0,008}$	$6_{-0,12}$	$4_{-0,24}$	10[3]	13
GE8-DO[2]	–	–	0,007	**$8_{-0,008}$**	$16_{-0,008}$	$8_{-0,12}$	$5_{-0,24}$	13[3]	15
GE10-DO[2]	–	–	0,012	**$10_{-0,008}$**	$19_{-0,009}$	$9_{-0,12}$	$6_{-0,24}$	16[3]	12
GE12-DO[2]	–	–	0,017	**$12_{-0,008}$**	$22_{-0,009}$	$10_{-0,12}$	$7_{-0,24}$	18[3]	11
GE15-DO	–	–	0,027	**$15_{-0,008}$**	$26_{-0,009}$	$12_{-0,12}$	$9_{-0,24}$	22[3]	8
GE16-DO[4]	–	–	0,044	**$16_{-0,008}$**	$30_{-0,009}$	$14_{-0,12}$	$10_{-0,24}$	25[3]	10
GE17-DO	**GE17-DO-2RS**	–	0,041	**$17_{-0,008}$**	$30_{-0,009}$	$14_{-0,12}$	$10_{-0,24}$	25[3]	10
GE20-DO	**GE20-DO-2RS**	–	0,065	**$20_{-0,01}$**	$35_{-0,011}$	$16_{-0,12}$	$12_{-0,24}$	29[3]	9
GE25-DO	**GE25-DO-2RS**	–	0,12	**$25_{-0,01}$**	$42_{-0,011}$	$20_{-0,12}$	$16_{-0,24}$	35,5	7
GE30-DO	**GE30-DO-2RS**	**GE30-UK-2TS**	0,15	**$30_{-0,01}$**	$47_{-0,011}$	$22_{-0,12}$	$18_{-0,24}$	40,7	6
GE35-DO	**GE35-DO-2RS**	**GE35-DO-2TS**	0,23	**$35_{-0,012}$**	$55_{-0,013}$	$25_{-0,12}$	$20_{-0,3}$	47	6
GE40-DO	**GE40-DO-2RS**	**GE40-DO-2TS**	0,32	**$40_{-0,012}$**	$62_{-0,013}$	$28_{-0,12}$	$22_{-0,3}$	53	7
GE45-DO	**GE45-DO-2RS**	**GE45-DO-2TS**	0,42	**$45_{-0,012}$**	$68_{-0,013}$	$32_{-0,12}$	$25_{-0,3}$	60	7
GE50-DO	**GE50-DO-2RS**	**GE50-DO-2TS**	0,56	**$50_{-0,012}$**	$75_{-0,013}$	$35_{-0,12}$	$28_{-0,3}$	66	6
GE60-DO	**GE60-DO-2RS**	**GE60-DO-2TS**	1,03	**$60_{-0,015}$**	$90_{-0,015}$	$44_{-0,15}$	$36_{-0,4}$	80	6
GE70-DO	**GE70-DO-2RS**	**GE70-DO-2TS**	1,56	**$70_{-0,015}$**	$105_{-0,015}$	$49_{-0,15}$	$40_{-0,4}$	92	6
GE80-DO	**GE80-DO-2RS**	**GE80-DO-2TS**	2,29	**$80_{-0,015}$**	$120_{-0,015}$	$55_{-0,15}$	$45_{-0,4}$	105	6
GE90-DO	**GE90-DO-2RS**	**GE90-DO-2TS**	2,76	**$90_{-0,02}$**	$130_{-0,018}$	$60_{-0,2}$	$50_{-0,5}$	115	5
GE100-DO	**GE100-DO-2RS**	**GE100-DO-2TS**	4,42	**$100_{-0,02}$**	$150_{-0,018}$	$70_{-0,2}$	$55_{-0,5}$	130	7
GE110-DO	**GE110-DO-2RS**	**GE110-DO-2TS**	4,8	**$110_{-0,02}$**	$160_{-0,025}$	$70_{-0,2}$	$55_{-0,5}$	140	6
GE120-DO	**GE120-DO-2RS**	**GE120-DO-2TS**	8,06	**$120_{-0,02}$**	$180_{-0,025}$	$85_{-0,2}$	$70_{-0,5}$	160	6
GE140-DO	**GE140-DO-2RS**	**GE140-DO-2TS**	11,2	**$140_{-0,025}$**	$210_{-0,03}$	$90_{-0,25}$	$70_{-0,6}$	180	7
GE160-DO	**GE160-DO-2RS**	–	14,2	**$160_{-0,025}$**	$230_{-0,03}$	$105_{-0,25}$	$80_{-0,6}$	200	8
GE180-DO	**GE180-DO-2RS**	–	18,6	**$180_{-0,025}$**	$260_{-0,035}$	$105_{-0,25}$	$80_{-0,7}$	225	6
GE200-DO	**GE200-DO-2RS**	–	28,5	**$200_{-0,03}$**	$290_{-0,035}$	$130_{-0,3}$	$100_{-0,7}$	250	7
GE220-DO[4]	**GE220-DO-2RS**	–	35,5	**$220_{-0,03}$**	$320_{-0,04}$	$135_{-0,3}$	$100_{-0,8}$	275	8
GE240-DO[4]	**GE240-DO-2RS**	–	39,5	**$240_{-0,03}$**	$340_{-0,04}$	$140_{-0,3}$	$100_{-0,8}$	300	8
GE260-DO[4]	**GE260-DO-2RS**	–	51,2	**$260_{-0,035}$**	$370_{-0,04}$	$150_{-0,35}$	$110_{-0,8}$	325	7
GE280-DO[4]	**GE280-DO-2RS**	–	64,8	**$280_{-0,035}$**	$400_{-0,04}$	$155_{-0,35}$	$120_{-0,8}$	350	6
GE300-DO[4]	**GE300-DO-2RS**	–	77,5	**$300_{-0,035}$**	$430_{-0,045}$	$165_{-0,35}$	$120_{-0,9}$	375	7

[1] The values for the tilt angle α are subject to tolerances.

[2] No relubrication facility.

[3] No lubrication groove on inner ring curved surface.

[4] Price and delivery by agreement.
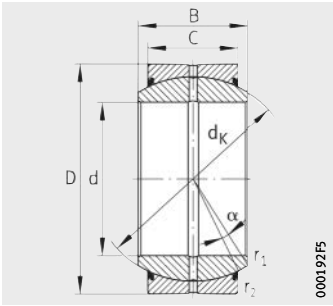
GE..-DO-2RS
Steel/steel

GE..-DO-2TS
Steel/steel

Mounting dimensions

Chamfer dimensions		Mounting dimensions		Basic load ratings		Radial internal clearance		
r_1	r_2	d_a	D_a	dyn. C_r	stat. C_{0r}	Group 2 (C2)	Group N (CN)	Group 3 (C3)
min.	min.	max.	min.	N	N			
0,3	0,3	8	9,6	3 400	17 000	0,008 − 0,032	0,032 − 0,068	0,068 − 0,104
0,3	0,3	10,2	12,5	5 590	28 000	0,008 − 0,032	0,032 − 0,068	0,068 − 0,104
0,3	0,3	13,2	15,5	8 160	40 800	0,008 − 0,032	0,032 − 0,068	0,068 − 0,104
0,3	0,3	14,9	17,5	10 800	54 000	0,008 − 0,032	0,032 − 0,068	0,068 − 0,104
0,3	0,3	18,4	21	16 900	84 700	0,01 − 0,04	0,04 − 0,082	0,082 − 0,124
0,3	0,3	20,7	24	21 300	106 000	0,01 − 0,04	0,04 − 0,082	0,082 − 0,124
0,3	0,3	20,7	24	21 300	106 000	0,01 − 0,04	0,04 − 0,082	0,082 − 0,124
0,3	0,3	24,2	27,5	29 600	148 000	0,01 − 0,04	0,04 − 0,082	0,082 − 0,124
0,6	0,6	29,3	33	48 300	241 000	0,012 − 0,05	0,05 − 0,1	0,1 − 0,15
0,6	0,6	34,2	38	62 300	311 000	0,012 − 0,05	0,05 − 0,1	0,1 − 0,15
0,6	1	39,8	44,5	79 900	400 000	0,012 − 0,05	0,05 − 0,1	0,1 − 0,15
0,6	1	45	51	99 100	496 000	0,015 − 0,06	0,06 − 0,12	0,12 − 0,18
0,6	1	50,8	57	128 000	639 000	0,015 − 0,06	0,06 − 0,12	0,12 − 0,18
0,6	1	56	63	157 000	785 000	0,015 − 0,06	0,06 − 0,12	0,12 − 0,18
1	1	66,8	75	245 000	1 220 000	0,015 − 0,06	0,06 − 0,12	0,12 − 0,18
1	1	77,9	87	313 000	1 560 000	0,018 − 0,072	0,072 − 0,142	0,142 − 0,212
1	1	89,4	99	402 000	2 010 000	0,018 − 0,072	0,072 − 0,142	0,142 − 0,212
1	1	98,1	108	489 000	2 440 000	0,018 − 0,072	0,072 − 0,142	0,142 − 0,212
1	1	109,5	123	608 000	3 040 000	0,018 − 0,085	0,085 − 0,165	0,165 − 0,245
1	1	121,2	134	655 000	3 280 000	0,018 − 0,085	0,085 − 0,165	0,165 − 0,245
1	1	135,6	150	952 000	4 760 000	0,018 − 0,085	0,085 − 0,165	0,165 − 0,245
1	1	155,9	173	1 070 000	5 360 000	0,018 − 0,085	0,085 − 0,165	0,165 − 0,245
1	1	170,2	191	1 360 000	6 800 000	0,018 − 0,1	0,1 − 0,192	0,192 − 0,284
1,1	1,1	199	219	1 530 000	7 650 000	0,018 − 0,1	0,1 − 0,192	0,192 − 0,284
1,1	1,1	213,5	239	2 130 000	10 600 000	0,018 − 0,1	0,1 − 0,192	0,192 − 0,284
1,1	1,1	239,6	267	2 340 000	11 700 000	0,018 − 0,11	0,11 − 0,214	0,214 − 0,318
1,1	1,1	265,3	295	2 550 000	12 800 000	0,018 − 0,11	0,11 − 0,214	0,214 − 0,318
1,1	1,1	288,3	319	3 040 000	15 200 000	0,018 − 0,125	0,125 − 0,239	0,239 − 0,353
1,1	1,1	313,8	342	3 570 000	17 900 000	0,018 − 0,125	0,125 − 0,239	0,239 − 0,353
1,1	1,1	336,7	370	3 830 000	19 100 000	0,018 − 0,125	0,125 − 0,239	0,239 − 0,353

Large radial spherical plain bearings

Requiring maintenance
DIN ISO 12240-1, dimension series C
Open or sealed
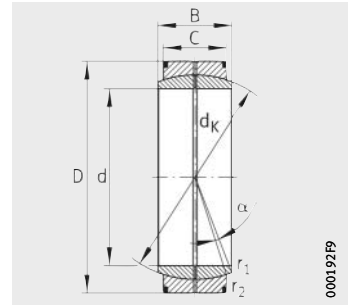
GE..-DO
Steel/steel

Dimension table · Dimensions in mm								
Designation[1]		Mass	Dimensions					
Open	Sealed	m	d	D	B	C	d_K	α[2]
		$\approx$kg						°
GE320-DO	GE320-DO-2RS4	77,2	$320_{-0,04}$	$440_{-0,045}$	$160_{-0,4}$	$135_{-0,9}$	380	4
GE340-DO	GE340-DO-2RS4	81,5	$340_{-0,04}$	$460_{-0,045}$	$160_{-0,4}$	$135_{-0,9}$	400	3,8
GE360-DO	GE360-DO-2RS4	85,8	$360_{-0,04}$	$480_{-0,045}$	$160_{-0,4}$	$135_{-0,9}$	420	3,6
GE380-DO	GE380-DO-2RS4	127	$380_{-0,04}$	$520_{-0,05}$	$190_{-0,4}$	160_{-1}	450	4,1
GE400-DO	GE400-DO-2RS4	133	$400_{-0,04}$	$540_{-0,05}$	$190_{-0,4}$	160_{-1}	470	3,9
GE420-DO	GE420-DO-2RS4	139	$420_{-0,045}$	$560_{-0,05}$	$190_{-0,45}$	160_{-1}	490	3,7
GE440-DO	GE440-DO-2RS4	193	$440_{-0,045}$	$600_{-0,05}$	$218_{-0,45}$	185_{-1}	520	3,9
GE460-DO	GE460-DO-2RS4	201	$460_{-0,045}$	$620_{-0,05}$	$218_{-0,45}$	185_{-1}	540	3,7
GE480-DO	GE480-DO-2RS4	236	$480_{-0,045}$	$650_{-0,075}$	$230_{-0,45}$	$195_{-1,1}$	565	3,8
GE500-DO	GE500-DO-2RS4	245	$500_{-0,045}$	$670_{-0,075}$	$230_{-0,45}$	$195_{-1,1}$	585	3,6
GE530-DO	GE530-DO-2RS4	290	$530_{-0,05}$	$710_{-0,075}$	$243_{-0,5}$	$205_{-1,1}$	620	3,7
GE560-DO	GE560-DO-2RS4	340	$560_{-0,05}$	$750_{-0,075}$	$258_{-0,5}$	$215_{-1,1}$	655	4
GE600-DO	GE600-DO-2RS4	408	$600_{-0,05}$	$800_{-0,075}$	$272_{-0,5}$	$230_{-1,1}$	700	3,6
GE630-DO	GE630-DO-2RS4	531	$630_{-0,05}$	$850_{-0,1}$	$300_{-0,5}$	$260_{-1,2}$	740	3,3
GE670-DO	GE670-DO-2RS4	595	$670_{-0,075}$	$900_{-0,1}$	$308_{-0,75}$	$260_{-1,2}$	785	3,7
GE710-DO	GE710-DO-2RS4	693	$710_{-0,075}$	$950_{-0,1}$	$325_{-0,75}$	$275_{-1,2}$	830	3,7
GE750-DO	GE750-DO-2RS4	780	$750_{-0,075}$	$1\,000_{-0,1}$	$335_{-0,75}$	$280_{-1,2}$	875	3,8
GE800-DO	GE800-DO-2RS4	920	$800_{-0,075}$	$1\,060_{-0,125}$	$355_{-0,75}$	$300_{-1,3}$	930	3,6
GE850-DO	GE850-DO-2RS4	1 047	$850_{-0,1}$	$1\,120_{-0,125}$	365_{-1}	$310_{-1,3}$	985	3,4
GE900-DO	GE900-DO-2RS4	1 185	$900_{-0,1}$	$1\,180_{-0,125}$	375_{-1}	$320_{-1,3}$	1 040	3,2
GE950-DO	GE950-DO-2RS4	1 422	$950_{-0,1}$	$1\,250_{-0,125}$	400_{-1}	$340_{-1,3}$	1 100	3,3
GE1 000-DO	GE1 000-DO-2RS4	1 744	$1\,000_{-0,1}$	$1\,320_{-0,16}$	438_{-1}	$370_{-1,6}$	1 160	3,5

[1] Price and delivery by agreement.

[2] The values for the tilt angle α are subject to tolerances.

[3] $D_{a\,max} = D_{a\,min} + 20$ mm.

[4] Internal clearance groups Group 2 and Group 3 available by agreement.
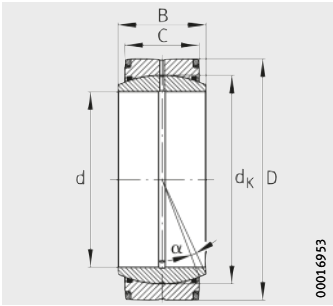
GE..-DO-2RS4
Steel/steel
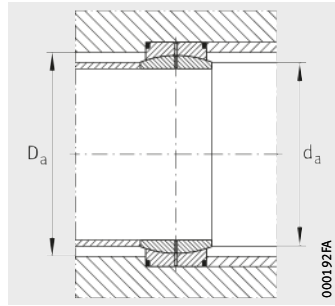
Mounting dimensions

Chamfer dimensions		Mounting dimensions		Basic load ratings					Radial internal clearance[4]
r_1	r_2	d_a	D_a[3]	Open		Sealed			Group N (CN)
				dyn. C_r	stat. C_{0r}	dyn. C_r	stat. C_{0r}		
min.	min.	max.	min.	N	N	N	N		
1,1	3	344,7	361	4 370 000	21 900 000	3 910 000	19 550 000		0,125 – 0,239
1,1	3	366,6	382	4 600 000	23 000 000	4 100 000	20 500 000		0,125 – 0,239
1,1	3	388,3	403	4 830 000	24 200 000	4 350 000	21 750 000		0,135 – 0,261
1,5	4	407,9	426	6 300 000	31 500 000	5 760 000	28 800 000		0,135 – 0,261
1,5	4	429,9	447	6 580 000	32 900 000	6 000 000	30 000 000		0,135 – 0,261
1,5	4	451,7	469	6 860 000	34 300 000	6 300 000	31 500 000		0,135 – 0,261
1,5	4	472,1	491	8 580 000	42 900 000	7 980 000	39 900 000		0,145 – 0,285
1,5	4	494	513	8 910 000	44 600 000	8 100 000	40 500 000		0,145 – 0,285
2	5	516,1	536	9 890 000	49 400 000	8 800 000	44 000 000		0,145 – 0,285
2	5	537,9	557	10 200 000	51 200 000	9 200 000	46 000 000		0,145 – 0,285
2	5	570,4	591	11 500 000	57 400 000	10 300 000	51 500 000		0,145 – 0,285
2	5	602	624	12 800 000	63 900 000	11 400 000	57 000 000		0,16 – 0,32
2	5	645	667	14 700 000	73 500 000	13 100 000	65 500 000		0,16 – 0,32
3	6	676,5	698	17 800 000	88 800 000	15 800 000	79 000 000		0,16 – 0,32
3	6	722,1	746	18 800 000	94 200 000	17 100 000	85 500 000		0,16 – 0,32
3	6	763,7	789	21 200 000	106 000 000	19 100 000	95 500 000		0,17 – 0,35
3	6	808,3	834	22 800 000	114 000 000	20 500 000	102 500 000		0,17 – 0,35
3	6	859,6	886	26 000 000	130 000 000	23 400 000	117 000 000		0,17 – 0,35
3	6	914,9	940	28 600 000	143 000 000	25 700 000	128 500 000		0,17 – 0,35
3	6	970	995	31 200 000	156 000 000	27 900 000	139 500 000		0,195 – 0,405
4	7,5	1 024,7	1 052	35 200 000	176 000 000	32 000 000	160 000 000		0,195 – 0,405
4	7,5	1 074,1	1 105	40 600 000	203 000 000	36 500 000	182 500 000		0,195 – 0,405

Radial spherical plain bearings

Requiring maintenance
DIN ISO 12240-1, dimension series G
Open or sealed

GE..-FO
Steel/steel

Dimension table · Dimensions in mm									
Designation			Mass	Dimensions					
Open	Sealed		m ≈kg	d	D	B	C	d_K	α[4] °
GE6-FO[1]	–	–	0,009	**6$_{-0,008}$**	16$_{-0,008}$	9$_{-0,12}$	5$_{-0,24}$	13[3]	21
GE8-FO[1]	–	–	0,015	**8$_{-0,008}$**	19$_{-0,009}$	11$_{-0,12}$	6$_{-0,24}$	16[3]	21
GE10-FO[1]	–	–	0,021	**10$_{-0,008}$**	22$_{-0,009}$	12$_{-0,12}$	7$_{-0,24}$	18[3]	18
GE12-FO[2]	–	–	0,037	**12$_{-0,008}$**	26$_{-0,009}$	15$_{-0,12}$	9$_{-0,24}$	22[3]	18
GE15-FO[5]	**GE15-FO-2RS**	–	0,047	**15$_{-0,008}$**	30$_{-0,009}$	16$_{-0,12}$	10$_{-0,24}$	25[3]	16
GE17-FO[5]	**GE17-FO-2RS**	–	0,079	**17$_{-0,008}$**	35$_{-0,011}$	20$_{-0,12}$	12$_{-0,24}$	29[3]	19
GE20-FO[5]	**GE20-FO-2RS**	–	0,15	**20$_{-0,01}$**	42$_{-0,011}$	25$_{-0,12}$	16$_{-0,24}$	35,5	17
GE25-FO[5]	**GE25-FO-2RS**	**GE25-FO-2TS**	0,2	**25$_{-0,01}$**	47$_{-0,011}$	28$_{-0,12}$	18$_{-0,24}$	40,7	17
GE30-FO	**GE30-FO-2RS**	**GE30-FO-2TS**	0,3	**30$_{-0,01}$**	55$_{-0,013}$	32$_{-0,12}$	20$_{-0,3}$	47	17
GE35-FO[5]	**GE35-FO-2RS**	**GE35-FO-2TS**	0,4	**35$_{-0,012}$**	62$_{-0,013}$	35$_{-0,12}$	22$_{-0,3}$	53	16
GE40-FO[5]	**GE40-FO-2RS**	**GE40-FO-2TS**	0,53	**40$_{-0,012}$**	68$_{-0,013}$	40$_{-0,12}$	25$_{-0,3}$	60	17
GE45-FO[5]	**GE45-FO-2RS**	**GE45-FO-2TS**	0,69	**45$_{-0,012}$**	75$_{-0,013}$	43$_{-0,12}$	28$_{-0,3}$	66	15
GE50-FO[5]	**GE50-FO-2RS**	**GE50-FO-2TS**	1,41	**50$_{-0,012}$**	90$_{-0,015}$	56$_{-0,12}$	36$_{-0,4}$	80	17
GE60-FO[5]	**GE60-FO-2RS**	**GE60-FO-2TS**	2,1	**60$_{-0,015}$**	105$_{-0,015}$	63$_{-0,15}$	40$_{-0,4}$	92	17
GE70-FO[5]	**GE70-FO-2RS**	**GE70-FO-2TS**	3	**70$_{-0,015}$**	120$_{-0,015}$	70$_{-0,15}$	45$_{-0,4}$	105	16
GE80-FO[5]	**GE80-FO-2RS**	**GE80-FO-2TS**	3,6	**80$_{-0,015}$**	130$_{-0,018}$	75$_{-0,15}$	50$_{-0,5}$	115	14
GE90-FO[5]	**GE90-FO-2RS**	**GE90-FO-2TS**	5,5	**90$_{-0,02}$**	150$_{-0,018}$	85$_{-0,2}$	55$_{-0,5}$	130	15
GE100-FO[5]	**GE100-FO-2RS**	**GE100-FO-2TS**	6	**100$_{-0,02}$**	160$_{-0,025}$	85$_{-0,2}$	55$_{-0,5}$	140	14
GE110-FO[5]	**GE110-FO-2RS**	**GE110-FO-2TS**	9,7	**110$_{-0,02}$**	180$_{-0,025}$	100$_{-0,2}$	70$_{-0,5}$	160	12
GE120-FO[5]	**GE120-FO-2RS**	**GE120-FO-2TS**	15,1	**120$_{-0,02}$**	210$_{-0,03}$	115$_{-0,2}$	70$_{-0,6}$	180	16
GE140-FO[5]	**GE140-FO-2RS**	–	18,9	**140$_{-0,025}$**	230$_{-0,03}$	130$_{-0,25}$	80$_{-0,6}$	200	16
GE160-FO[5]	**GE160-FO-2RS**	–	24,8	**160$_{-0,025}$**	260$_{-0,035}$	135$_{-0,25}$	80$_{-0,7}$	225	16
GE180-FO[5]	**GE180-FO-2RS**	–	35,9	**180$_{-0,025}$**	290$_{-0,035}$	155$_{-0,25}$	100$_{-0,7}$	250	14
GE200-FO[5]	**GE200-FO-2RS**	–	44,9	**200$_{-0,03}$**	320$_{-0,04}$	165$_{-0,3}$	100$_{-0,8}$	275	15
GE220-FO[5]	**GE220-FO-2RS**[5]	–	51	**220$_{-0,03}$**	340$_{-0,04}$	175$_{-0,3}$	100$_{-0,8}$	300	16
GE240-FO[5]	**GE240-FO-2RS**[5]	–	65,2	**240$_{-0,03}$**	370$_{-0,04}$	190$_{-0,3}$	110$_{-0,8}$	325	15
GE260-FO[5]	**GE260-FO-2RS**[5]	–	82	**260$_{-0,035}$**	400$_{-0,04}$	205$_{-0,35}$	120$_{-0,8}$	350	15
GE280-FO[5]	**GE280-FO-2RS**[5]	–	96,7	**280$_{-0,035}$**	430$_{-0,045}$	210$_{-0,35}$	120$_{-0,9}$	375	15

[1] No relubrication facility.

[2] Relubrication only possible via the outer ring.

[3] No lubrication groove on inner ring curved surface.

[4] The values for the tilt angle α are subject to tolerances.

[5] Price and delivery by agreement.
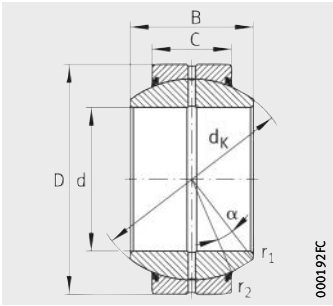
GE..-FO-2RS
Steel/steel

GE..-FO-2TS
Steel/steel

Mounting dimensions

Chamfer dimensions		Mounting dimensions		Basic load ratings		Radial internal clearance		
r_1	r_2	d_a	D_a	dyn. C_r	stat. C_{0r}	Group 2 (C2)	Group N (CN)	Group 3 (C3)
min.	min.	max.	min.	N	N			
0,3	0,3	9,4	12,5	5 590	28 000	0,008 – 0,032	0,032 – 0,068	0,068 – 0,104
0,3	0,3	11,6	15,5	8 160	40 800	0,008 – 0,032	0,032 – 0,068	0,068 – 0,104
0,3	0,3	13,4	17,5	10 800	54 000	0,008 – 0,032	0,032 – 0,068	0,068 – 0,104
0,3	0,3	16,1	21	16 900	84 700	0,01 – 0,04	0,04 – 0,082	0,082 – 0,124
0,3	0,3	19,2	24	21 300	106 000	0,01 – 0,04	0,04 – 0,082	0,082 – 0,124
0,3	0,3	21	27,5	29 600	148 000	0,01 – 0,04	0,04 – 0,082	0,082 – 0,124
0,3	0,6	25,2	33	48 300	241 000	0,012 – 0,05	0,05 – 0,1	0,1 – 0,15
0,6	0,6	29,5	38	62 300	311 000	0,012 – 0,05	0,05 – 0,1	0,1 – 0,15
0,6	1	34,4	44,5	79 900	400 000	0,012 – 0,05	0,05 – 0,1	0,1 – 0,15
0,6	1	39,8	51	99 100	496 000	0,015 – 0,06	0,06 – 0,12	0,12 – 0,18
0,6	1	44,7	57	128 000	639 000	0,015 – 0,06	0,06 – 0,12	0,12 – 0,18
0,6	1	50,1	63	157 000	785 000	0,015 – 0,06	0,06 – 0,12	0,12 – 0,18
0,6	1	57,1	75	245 000	1 220 000	0,015 – 0,06	0,06 – 0,12	0,12 – 0,18
1	1	67	87	313 000	1 560 000	0,018 – 0,072	0,072 – 0,142	0,142 – 0,212
1	1	78,3	99	402 000	2 010 000	0,018 – 0,072	0,072 – 0,142	0,142 – 0,212
1	1	87,2	108	489 000	2 440 000	0,018 – 0,072	0,072 – 0,142	0,142 – 0,212
1	1	98,4	123	608 000	3 040 000	0,018 – 0,085	0,085 – 0,165	0,165 – 0,245
1	1	111,2	134	655 000	3 280 000	0,018 – 0,085	0,085 – 0,165	0,165 – 0,245
1	1	124,9	150	952 000	4 760 000	0,018 – 0,085	0,085 – 0,165	0,165 – 0,245
1	1	138,5	173	1 070 000	5 360 000	0,018 – 0,085	0,085 – 0,165	0,165 – 0,245
1	1	152	191	1 360 000	6 800 000	0,018 – 0,1	0,1 – 0,192	0,192 – 0,284
1	1,1	180	219	1 530 000	7 650 000	0,018 – 0,1	0,1 – 0,192	0,192 – 0,284
1,1	1,1	196,2	239	2 130 000	10 600 000	0,018 – 0,1	0,1 – 0,192	0,192 – 0,284
1,1	1,1	220	267	2 340 000	11 700 000	0,018 – 0,11	0,11 – 0,214	0,214 – 0,318
1,1	1,1	243,7	295	2 550 000	12 800 000	0,018 – 0,11	0,11 – 0,214	0,214 – 0,318
1,1	1,1	263,7	319	3 040 000	15 200 000	0,018 – 0,125	0,125 – 0,239	0,239 – 0,353
1,1	1,1	283,7	342	3 570 000	17 900 000	0,018 – 0,125	0,125 – 0,239	0,239 – 0,353
1,1	1,1	310,7	370	3 830 000	19 100 000	0,018 – 0,125	0,125 – 0,239	0,239 – 0,353

Radial spherical plain bearings

Requiring maintenance
DIN ISO 12240-1, dimension series W
Cylindrical extensions on inner ring
Open design

GE..-LO
Steel/steel

Dimension table · Dimensions in mm								
Designation[1]	Mass	Dimensions						
	m	d	D	B	C	d_K	d_2	α[2]
	$\approx$kg	H7						°
GE12-LO[3][4]	0,018	**12$^{+0,018}$**	22$_{-0,009}$	12$_{-0,18}$	7$_{-0,24}$	18	15,5	4
GE16-LO[4][5]	0,035	**16$^{+0,018}$**	28$_{-0,009}$	16$_{-0,18}$	9$_{-0,24}$	23	20	4
GE20-LO[5]	0,07	**20$^{+0,021}$**	35$_{-0,011}$	20$_{-0,21}$	12$_{-0,24}$	29	25	4
GE25-LO	0,13	**25$^{+0,021}$**	42$_{-0,011}$	25$_{-0,21}$	16$_{-0,24}$	35,5	30	4
GE32-LO	0,22	**32$^{+0,025}$**	52$_{-0,013}$	32$_{-0,25}$	18$_{-0,3}$	44	38	4
GE40-LO	0,35	**40$^{+0,025}$**	62$_{-0,013}$	40$_{-0,25}$	22$_{-0,3}$	53	46	4
GE50-LO	0,62	**50$^{+0,025}$**	75$_{-0,013}$	50$_{-0,25}$	28$_{-0,3}$	66	57	4
GE63-LO	1,28	**63$^{+0,03}$**	95$_{-0,015}$	63$_{-0,3}$	36$_{-0,4}$	83	71,5	4
GE70-LO[6]	1,71	**70$^{+0,03}$**	105$_{-0,015}$	70$_{-0,3}$	40$_{-0,4}$	92	79	4
GE80-LO	2,56	**80$^{+0,03}$**	120$_{-0,015}$	80$_{-0,3}$	45$_{-0,4}$	105	91	4
GE90-LO[6]	3,05	**90$^{+0,035}$**	130$_{-0,018}$	90$_{-0,35}$	50$_{-0,5}$	115	99	4
GE100-LO	4,9	**100$^{+0,035}$**	150$_{-0,018}$	100$_{-0,35}$	55$_{-0,5}$	130	113	4
GE110-LO[6]	5,57	**110$^{+0,035}$**	160$_{-0,025}$	110$_{-0,35}$	55$_{-0,5}$	140	124	4
GE125-LO	8,2	**125$^{+0,04}$**	180$_{-0,025}$	125$_{-0,4}$	70$_{-0,5}$	160	138	4
GE160-LO[7]	16,1	**160$^{+0,04}$**	230$_{-0,03}$	160$_{-0,4}$	80$_{-0,6}$	200	177	4
GE200-LO[7]	32,2	**200$^{+0,046}$**	290$_{-0,035}$	200$_{-0,46}$	100$_{-0,7}$	250	221	4
GE250-LO[7]	103	**250$^{+0,046}$**	400$_{-0,04}$	250$_{-0,46}$	120$_{-0,8}$	350	317	4
GE320-LO[7]	225	**320$^{+0,057}$**	520$_{-0,05}$	320$_{-0,57}$	160$_{-1}$	450	405	4

[1] Sealed design available by agreement.

[2] The values for the tilt angle α are subject to tolerances.

[3] No relubrication facility.

[4] Bore cylindrical throughout.

[5] No lubrication groove on inner ring curved surface.

[6] Not included in DIN ISO 12240-1, dimension series W.

[7] Price and delivery by agreement.

Mounting dimensions

Chamfer dimensions		Mounting dimensions		Basic load ratings		Radial internal clearance		
r_1	r_2	d_a	D_a	dyn. C_r	stat. C_{0r}	Group 2 (C2)	Group N (CN)	Group 3 (C3)
min.	min.	max.	min.	N	N			
0,3	0,3	15,5	17,5	10 800	54 000	0,008 – 0,032	0,032 – 0,068	0,068 – 0,104
0,3	0,3	20	23	17 700	88 600	0,01 – 0,04	0,04 – 0,082	0,082 – 0,124
0,3	0,3	25	27,5	29 600	148 000	0,01 – 0,04	0,04 – 0,082	0,082 – 0,124
0,6	0,6	30	33	48 300	241 000	0,012 – 0,05	0,05 – 0,1	0,1 – 0,15
0,6	1	38	42	67 300	337 000	0,012 – 0,05	0,05 – 0,1	0,1 – 0,15
0,6	1	46	51	99 100	496 000	0,015 – 0,06	0,06 – 0,12	0,12 – 0,18
0,6	1	57	63	157 000	785 000	0,015 – 0,06	0,06 – 0,12	0,12 – 0,18
1	1	71,5	78	254 000	1 270 000	0,018 – 0,072	0,072 – 0,142	0,142 – 0,212
1	1	79	87	313 000	1 560 000	0,018 – 0,072	0,072 – 0,142	0,142 – 0,212
1	1	91	99	402 000	2 010 000	0,018 – 0,072	0,072 – 0,142	0,142 – 0,212
1	1	99	108	489 000	2 440 000	0,018 – 0,072	0,072 – 0,142	0,142 – 0,212
1	1	113	123	608 000	3 040 000	0,018 – 0,085	0,085 – 0,165	0,165 – 0,245
1	1	124	134	655 000	3 280 000	0,018 – 0,085	0,085 – 0,165	0,165 – 0,245
1	1	138	150	952 000	4 760 000	0,018 – 0,085	0,085 – 0,165	0,165 – 0,245
1	1	177	191	1 360 000	6 800 000	0,018 – 0,1	0,1 – 0,192	0,192 – 0,284
1,1	1,1	221	239	2 130 000	10 600 000	0,018 – 0,1	0,1 – 0,192	0,192 – 0,284
2,5	1,1	317	342	3 570 000	17 900 000	0,018 – 0,125	0,125 – 0,239	0,239 – 0,353
2,5	4	405	438	6 300 000	31 500 000	0,018 – 0,135	0,135 – 0,261	0,261 – 0,387

Radial spherical plain bearings

Requiring maintenance
Cylindrical extensions
on inner ring
Open or sealed
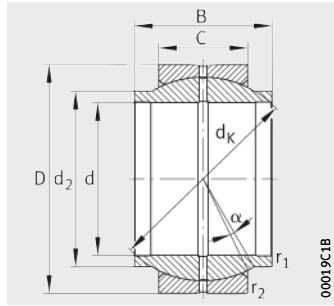
GE..-HO
Steel/steel
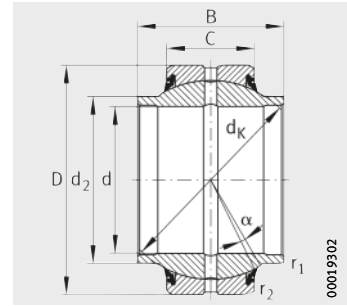
GE..-HO-2RS
Steel/steel

Dimension table · Dimensions in mm										
Designation		Mass	Dimensions							
Open	Sealed	m ≈kg	d	D	B	C	d_K	d_2	α[1] °	
GE20-HO[2]	**GE20-HO-2RS**	0,07	**20**$_{-0,01}$	$35_{-0,011}$	$24{\pm}0,2$	$12_{-0,24}$	29[3]	24	3	
GE25-HO[2]	**GE25-HO-2RS**	0,13	**25**$_{-0,01}$	$42_{-0,011}$	$29{\pm}0,3$	$16_{-0,24}$	35,5	29	3	
GE30-HO[2]	**GE30-HO-2RS**	0,16	**30**$_{-0,01}$	$47_{-0,011}$	$30{\pm}0,3$	$18_{-0,24}$	40,7	34,2	3	
GE35-HO[2]	**GE35-HO-2RS**	0,25	**35**$_{-0,012}$	$55_{-0,013}$	$35{\pm}0,3$	$20_{-0,3}$	47	40	3	
GE40-HO[2]	**GE40-HO-2RS**	0,33	**40**$_{-0,012}$	$62_{-0,013}$	$38{\pm}0,3$	$22_{-0,3}$	53	45	3	
GE45-HO[2]	**GE45-HO-2RS**	0,44	**45**$_{-0,012}$	$68_{-0,013}$	$40{\pm}0,3$	$25_{-0,3}$	60	51,5	3	
GE50-HO[2]	**GE50-HO-2RS**	0,58	**50**$_{-0,012}$	$75_{-0,013}$	$43{\pm}0,3$	$28_{-0,3}$	66	56,5	3	
GE60-HO[2]	**GE60-HO-2RS**	1,06	**60**$_{-0,015}$	$90_{-0,015}$	$54{\pm}0,3$	$36_{-0,4}$	80	67,7	3	
GE70-HO[2]	**GE70-HO-2RS**	1,64	**70**$_{-0,015}$	$105_{-0,015}$	$65{\pm}0,3$	$40_{-0,4}$	92	78	3	
GE80-HO[2]	**GE80-HO-2RS**	2,44	**80**$_{-0,015}$	$120_{-0,015}$	$74{\pm}0,3$	$45_{-0,4}$	105	90	3	
GE90-HO[2]	**GE90-HO-2RS**[2]	2,9	**90**$_{-0,02}$	$130_{-0,018}$	$80{\pm}0,3$	$50_{-0,5}$	115	99	3	
GE100-HO[2]	**GE100-HO-2RS**[2]	4,6	**100**$_{-0,02}$	$150_{-0,018}$	$90{\pm}0,3$	$55_{-0,5}$	130	113	3	
GE110-HO[2]	**GE110-HO-2RS**[2]	5,18	**110**$_{-0,02}$	$160_{-0,025}$	$90{\pm}0,3$	$55_{-0,5}$	140	124	3	
GE120-HO[2]	**GE120-HO-2RS**[2]	8,7	**120**$_{-0,02}$	$180_{-0,025}$	$108{\pm}0,3$	$70_{-0,5}$	160	138	3	

[1] The values for the tilt angle α are subject to tolerances.

[2] Price and delivery by agreement.

[3] No lubrication groove on inner ring curved surface.

Mounting dimensions

Chamfer dimensions		Mounting dimensions		Basic load ratings		Radial internal clearance		
r_1	r_2	d_a	D_a	dyn. C_r	stat. C_{0r}	Group 2 (C2)	Group N (CN)	Group 3 (C3)
min.	min.	max.	min.	N	N			
0,2	0,3	24	27,5	29 600	148 000	0,01 – 0,04	0,04 – 0,082	0,082 – 0,124
0,2	0,6	29	33	48 300	241 000	0,012 – 0,05	0,05 – 0,1	0,1 – 0,15
0,2	0,6	34,2	38	62 300	311 000	0,012 – 0,05	0,05 – 0,1	0,1 – 0,15
0,3	1	40	44,5	79 900	400 000	0,012 – 0,05	0,05 – 0,1	0,1 – 0,15
0,3	1	45	51	99 100	496 000	0,015 – 0,06	0,06 – 0,12	0,12 – 0,18
0,3	1	51,5	57	128 000	639 000	0,015 – 0,06	0,06 – 0,12	0,12 – 0,18
0,3	1	56,5	63	157 000	785 000	0,015 – 0,06	0,06 – 0,12	0,12 – 0,18
0,3	1	67,7	75	245 000	1 220 000	0,015 – 0,06	0,06 – 0,12	0,12 – 0,18
0,3	1	78	87	313 000	1 560 000	0,018 – 0,072	0,072 – 0,142	0,142 – 0,212
0,3	1	90	99	402 000	2 010 000	0,018 – 0,072	0,072 – 0,142	0,142 – 0,212
0,6	1	99	108	489 000	2 440 000	0,018 – 0,072	0,072 – 0,142	0,142 – 0,212
0,6	1	113	123	608 000	3 040 000	0,018 – 0,085	0,085 – 0,165	0,165 – 0,245
0,6	1	124	134	655 000	3 280 000	0,018 – 0,085	0,085 – 0,165	0,165 – 0,245
0,6	1	138	150	952 000	4 760 000	0,018 – 0,085	0,085 – 0,165	0,165 – 0,245

Radial spherical plain bearings

Requiring maintenance
Inch sizes
Open design

GE..-ZO
Steel/steel

Dimension table · Dimensions in mm and *inch*

Designation[1][2]	Mass m ≈kg	Dimensions[3] d	D	B	C	d_K	α[4] °
GE19-ZO	0,052	*0,750* $19,050_{-0,01}$	*1,250* $31,750_{-0,011}$	*0,659* $16,662_{-0,12}$	*0,562* $14,275_{-0,24}$	27,5	6
GE22-ZO	0,085	*0,875* $22,225_{-0,01}$	*1,4375* $36,513_{-0,011}$	*0,765* $19,431_{-0,12}$	*0,656* $16,662_{-0,24}$	32	6
GE25-ZO	0,13	*1,000* $25,400_{-0,01}$	*1,625* $41,275_{-0,011}$	*0,875* $22,225_{-0,12}$	*0,750* $19,050_{-0,24}$	35,5	6
GE31-ZO	0,23	*1,250* $31,750_{-0,012}$	*2,000* $50,800_{-0,013}$	*1,093* $27,762_{-0,12}$	*0,937* $23,800_{-0,3}$	45,5	6
GE34-ZO	0,3	*1,375* $34,925_{-0,012}$	*2,1875* $55,563_{-0,013}$	*1,187* $30,150_{-0,12}$	*1,031* $26,187_{-0,3}$	49	6
GE38-ZO	0,41	*1,500* $38,100_{-0,012}$	*2,4375* $61,913_{-0,013}$	*1,321* $33,325_{-0,12}$	*1,125* $28,575_{-0,3}$	53	6
GE44-ZO	0,64	*1,750* $44,450_{-0,012}$	*2,8125* $71,438_{-0,013}$	*1,531* $38,887_{-0,12}$	*1,312* $33,325_{-0,3}$	63,9	6
GE50-ZO	0,94	*2,000* $50,800_{-0,015}$	*3,1875* $80,963_{-0,015}$	*1,750* $44,450_{-0,15}$	*1,500* $38,100_{-0,4}$	73	6
GE57-ZO	1,6	*2,250* $57,150_{-0,015}$	*3,5625* $90,488_{-0,015}$	*1,969* $50,013_{-0,15}$	*1,687* $42,850_{-0,4}$	82	6
GE63-ZO	1,78	*2,500* $63,500_{-0,015}$	*3,9375* $100,013_{-0,015}$	*2,187* $55,550_{-0,15}$	*1,875* $47,625_{-0,4}$	92	6
GE69-ZO	2,41	*2,750* $69,850_{-0,015}$	*4,375* $111,125_{-0,015}$	*2,406* $61,112_{-0,15}$	*2,062* $52,375_{-0,4}$	100	6

[1] Price and delivery by agreement.

[2] Sealed design available by agreement.

[3] Other sizes available by agreement.

[4] The values for the tilt angle α are subject to tolerances.

Mounting dimensions

Chamfer dimensions		Mounting dimensions		Basic load ratings		Radial internal clearance
r_1	r_2	d_a	D_a	dyn. C_r	stat. C_{0r}	
min.	min.	max.	min.	N	N	
0,3	0,6	21,9	24,5	31 400	94 100	0,08 – 0,18
0,3	0,6	25,4	28,5	42 600	128 000	0,08 – 0,18
0,3	0,6	27,7	31,5	54 000	162 000	0,08 – 0,18
0,6	0,6	36	40,5	86 500	259 000	0,08 – 0,18
0,6	1	38,6	43,5	102 000	307 000	0,08 – 0,18
0,6	1	41,2	46,5	121 000	364 000	0,08 – 0,18
0,6	1	50,9	57	171 000	512 000	0,08 – 0,18
0,6	1	57,9	65	223 000	668 000	0,08 – 0,18
0,6	1	65	73	281 000	844 000	0,1 – 0,2
1	1	73,3	82	351 000	1 050 000	0,1 – 0,2
1	1	79,2	89	419 000	1 260 000	0,1 – 0,2

Radial spherical plain bearings

Requiring maintenance
Inch sizes
Open design

GE..-ZO
Steel/steel

Dimension table (continued) · Dimensions in mm and *inch*							
Designation[1] [2]	Mass m ≈kg	Dimensions[3]					
		d	D	B	C	d_K	α[4] °
GE76-ZO	3,1	*3,000*	*4,750*	*2,625*	*2,250*	109,5	6
		76,200$_{-0,015}$	120,650$_{-0,018}$	66,675$_{-0,15}$	57,150$_{-0,5}$		
GE82-ZO	3,8	*3,250*	*5,125*	*2,844*	*2,437*	119	6
		82,550$_{-0,02}$	130,175$_{-0,018}$	72,238$_{-0,2}$	61,900$_{-0,5}$		
GE88-ZO	4,83	*3,500*	*5,500*	*3,062*	*2,625*	128	6
		88,900$_{-0,02}$	139,700$_{-0,018}$	77,775$_{-0,2}$	66,675$_{-0,5}$		
GE95-ZO	5,87	*3,750*	*5,875*	*3,281*	*2,812*	137	6
		95,250$_{-0,02}$	149,225$_{-0,018}$	83,337$_{-0,2}$	71,425$_{-0,5}$		
GE101-ZO	7,06	*4,000*	*6,250*	*3,500*	*3,000*	146	6
		101,600$_{-0,02}$	158,750$_{-0,025}$	88,900$_{-0,2}$	76,200$_{-0,5}$		
GE107-ZO	8,42	*4,250*	*6,625*	*3,719*	*3,187*	155	6
		107,950$_{-0,02}$	168,275$_{-0,025}$	94,463$_{-0,2}$	80,950$_{-0,5}$		
GE114-ZO	9,95	*4,500*	*7,000*	*3,937*	*3,375*	164,5	6
		114,300$_{-0,02}$	177,800$_{-0,025}$	100,000$_{-0,2}$	85,725$_{-0,5}$		
GE127-ZO	13,5	*5,000*	*7,750*	*4,375*	*3,750*	183	6
		127,000$_{-0,025}$	196,850$_{-0,03}$	111,125$_{-0,25}$	95,250$_{-0,6}$		

[1] Price and delivery by agreement.

[2] Sealed design available by agreement.

[3] Other sizes available by agreement.

[4] The values for the tilt angle α are subject to tolerances.
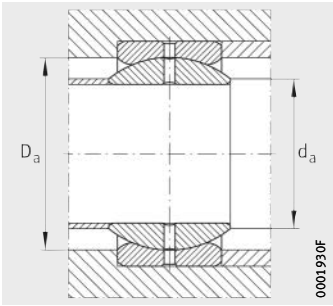
Mounting dimensions

Chamfer dimensions		Mounting dimensions		Basic load ratings		Radial internal clearance
r_1	r_2	d_a	D_a	dyn. C_r	stat. C_{0r}	
min.	min.	max.	min.	N	N	
1	1	86,9	98	500 000	1 500 000	0,1 – 0,2
1	1	94,5	106	589 000	1 770 000	0,13 – 0,23
1	1	101,6	114	683 000	2 050 000	0,13 – 0,23
1	1	108,7	122	783 000	2 350 000	0,13 – 0,23
1	1	115,8	130	890 000	2 670 000	0,13 – 0,23
1	1	122,8	138	1 000 000	3 010 000	0,13 – 0,23
1	1	130,6	147	1 130 000	3 380 000	0,13 – 0,23
1	1	145,3	163	1 390 000	4 180 000	0,13 – 0,23

Radial spherical plain bearings

Requiring maintenance
DIN ISO 12240-1, dimension series K
Open design
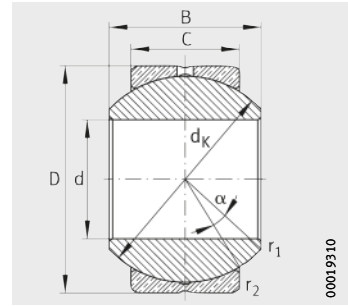
GE..-PB
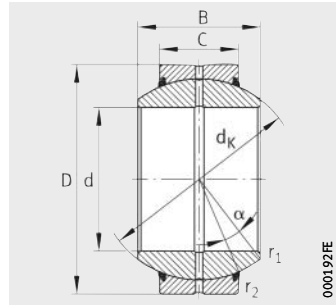Steel/bronze

Dimension table · Dimensions in mm

Designation[1]	Mass m ≈kg	Dimensions d H7	D	B	C	d_K	α[3] °
GE6-PB	0,011	$6^{+0,012}$	$16_{-0,008}$	$9_{-0,12}$	$6,75_{-0,24}$	12,7	13
GE8-PB	0,019	$8^{+0,015}$	$19_{-0,009}$	$12_{-0,12}$	$9_{-0,24}$	15,875	14
GE10-PB	0,028	$10^{+0,015}$	$22_{-0,009}$	$14_{-0,12}$	$10,5_{-0,24}$	19,05	13
GE12-PB	0,045	$12^{+0,018}$	$26_{-0,009}$	$16_{-0,12}$	$12_{-0,24}$	22,225	13
GE14-PB	0,057	$14^{+0,018}$	$28_{-0,009}$[2]	$19_{-0,12}$	$13,5_{-0,24}$	25,4	16
GE16-PB	0,082	$16^{+0,018}$	$32_{-0,011}$	$21_{-0,12}$	$15_{-0,24}$	28,575	15
GE18-PB	0,11	$18^{+0,018}$	$35_{-0,011}$	$23_{-0,12}$	$16,5_{-0,24}$	31,75	15
GE20-PB	0,15	$20^{+0,021}$	$40_{-0,011}$	$25_{-0,12}$	$18_{-0,24}$	34,925	14
GE22-PB	0,18	$22^{+0,021}$	$42_{-0,011}$	$28_{-0,12}$	$20_{-0,24}$	38,1	15
GE25-PB	0,24	$25^{+0,021}$	$47_{-0,011}$	$31_{-0,12}$	$22_{-0,24}$	42,85	15
GE30-PB	0,39	$30^{+0,021}$	$55_{-0,013}$	$37_{-0,12}$	$25_{-0,3}$	50,8	17

[1] Price and delivery by agreement.

[2] This differs from DIN ISO 12240-1, dimension series K.

[3] The values for the tilt angle α are subject to tolerances.

Mounting dimensions

Chamfer dimensions		Mounting dimensions		Basic load ratings		Radial internal clearance[2]
r_1	r_2	d_a	D_a	dyn. C_r	stat. C_{0r}	
min.	min.	max.	min.	N	N	
0,3	0,3	9	11,5	4 320	10 800	0,006 – 0,035
0,3	0,3	10,4	14	7 140	17 900	0,006 – 0,035
0,3	0,3	12,9	17	10 000	25 000	0,006 – 0,035
0,3	0,3	15,4	19,5	13 300	33 300	0,006 – 0,035
0,3	0,3	16,9	22,5	17 100	42 900	0,006 – 0,035
0,3	0,3	19,4	25,5	21 400	53 600	0,006 – 0,035
0,3	0,3	21,9	28,5	26 200	65 600	0,006 – 0,035
0,3	0,6	24,4	31,5	31 400	78 600	0,006 – 0,035
0,3	0,6	25,8	34	38 100	95 300	0,006 – 0,035
0,3	0,6	29,6	38,5	47 100	118 000	0,006 – 0,035
0,3	0,6	34,8	46	63 500	159 000	0,006 – 0,035

Angular contact spherical plain bearings

Requiring maintenance
DIN ISO 12240-2
Open design
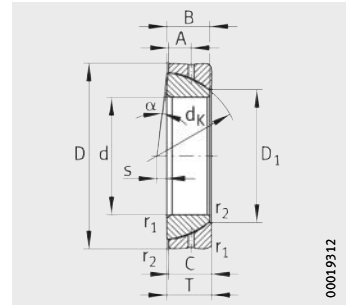
GE..-SX
Steel/steel

Dimension table · Dimensions in mm								
Designation	Mass	Dimensions[1]						
	m ≈kg	d	D	T	d_K	D_1	B	C
GE25-SX	0,14	$25_{-0,012}$	$47_{-0,014}$	$15\pm0,25$	42,5	31,4	$14_{-0,2}$[3]	$14_{-0,2}$[3]
GE28-SX	0,18	$28_{-0,012}$	$52_{-0,016}$	$16\pm0,25$	47	35,7	$15_{-0,2}$[3]	$15_{-0,2}$[3]
GE30-SX	0,22	$30_{-0,012}$	$55_{-0,016}$	$17\pm0,25$	50	36,1	$16_{-0,2}$[3]	$16_{-0,2}$[3]
GE35-SX	0,28	$35_{-0,012}$	$62_{-0,016}$	$18\pm0,25$	56	42,4	$17_{-0,24}$	$17_{-0,24}$
GE40-SX	0,35	$40_{-0,012}$	$68_{-0,016}$	$19\pm0,25$	60	46,8	$18_{-0,24}$	$18_{-0,24}$
GE45-SX	0,43	$45_{-0,012}$	$75_{-0,016}$	$20\pm0,25$	66	52,9	$19_{-0,24}$	$19_{-0,24}$
GE50-SX	0,47	$50_{-0,012}$	$80_{-0,016}$	$20\pm0,25$	74	59,1	$19_{-0,24}$	$19_{-0,24}$
GE55-SX	0,68	$55_{-0,015}$	$90_{-0,018}$	$23\pm0,25$	80	62	$22_{-0,3}$	$22_{-0,3}$
GE60-SX	0,74	$60_{-0,015}$	$95_{-0,018}$	$23\pm0,25$	86	68,1	$22_{-0,3}$	$22_{-0,3}$
GE65-SX	0,79	$65_{-0,015}$	$100_{-0,018}$	$23\pm0,25$	92	75,6	$22_{-0,3}$	$22_{-0,3}$
GE70-SX	1,08	$70_{-0,015}$	$110_{-0,018}$	$25\pm0,25$	102	82,2	$24_{-0,3}$	$24_{-0,3}$
GE80-SX	1,55	$80_{-0,015}$	$125_{-0,02}$	$29\pm0,25$	115	90,5	$27_{-0,3}$	$27_{-0,3}$
GE90-SX	2,1	$90_{-0,02}$	$140_{-0,02}$	$32\pm0,25$	130	103,3	$30_{-0,4}$	$30_{-0,4}$
GE100-SX	2,36	$100_{-0,02}$	$150_{-0,02}$	$32\pm0,25$	140	114,3	$30_{-0,4}$	$30_{-0,4}$
GE110-SX[4]	3,78	$110_{-0,02}$	$170_{-0,025}$	$38\pm0,25$	160	125,8	$36_{-0,4}$	$36_{-0,4}$
GE120-SX	4,05	$120_{-0,02}$	$180_{-0,025}$	$38\pm0,25$	170	135,4	$36_{-0,4}$	$36_{-0,4}$
GE130-SX[4]	6,1	$130_{-0,025}$	$200_{-0,03}$	$45\pm0,35$	190	148	$42_{-0,5}$	$42_{-0,5}$
GE140-SX[4]	6,5	$140_{-0,025}$	$210_{-0,03}$	$45\pm0,35$	200	160,6	$42_{-0,5}$	$42_{-0,5}$
GE150-SX[4]	7,9	$150_{-0,025}$	$225_{-0,03}$	$48\pm0,35$	213	170,9	$45_{-0,5}$	$45_{-0,5}$
GE160-SX[4]	9,4	$160_{-0,025}$	$240_{-0,03}$	$51\pm0,35$	225	181,4	$48_{-0,5}$	$48_{-0,5}$
GE170-SX[4]	13,2	$170_{-0,025}$	$260_{-0,035}$	$57\pm0,35$	250	194,3	$54_{-0,5}$	$54_{-0,5}$
GE180-SX[4]	17,6	$180_{-0,025}$	$280_{-0,035}$	$64\pm0,35$	260	205,5	$61_{-0,5}$	$61_{-0,5}$
GE190-SX[4]	18,3	$190_{-0,03}$	$290_{-0,035}$	$64\pm0,35$	275	211,8	$61_{-0,6}$	$61_{-0,6}$
GE200-SX[4]	23,3	$200_{-0,03}$	$310_{-0,035}$	$70\pm0,35$	290	229,2	$66_{-0,6}$	$66_{-0,6}$

[1] Other sizes available by agreement.

[2] The values for the tilt angle α are subject to tolerances.

[3] Tolerance deviates from DIN ISO 12240-2.

[4] Price and delivery by agreement.

Mounting dimensions

		Chamfer dimensions		Mounting dimensions				Basic load ratings	
s	A	α[2]	r_1	r_2	d_a	d_b	D_a	D_b	dyn. C_r	stat. C_{0r}
		°	min.	min.	max.	max.	min.	min.	N	N
1	7,5	2,7	0,6	0,3	30,1	39,5	34	43	47 800	239 000
1	8	2,4	1	0,3	34,4	42	40	47,5	57 700	288 000
2	8,5	2,3	1	0,3	34,7	45	40,5	50,5	64 600	323 000
2	9	2,1	1	0,3	41,1	50	47	57	78 600	393 000
1,5	9,5	1,9	1	0,3	45,6	54	52	61	90 800	454 000
1,5	10	1,7	1	0,3	51,7	60	58	67	106 000	532 000
4	10	1,6	1	0,3	58	67	65	75	118 000	592 000
4	11,5	1,4	1,5	0,6	60,8	71	70	81	149 000	746 000
5	11,5	1,3	1,5	0,6	66,9	77	76	87	161 000	805 000
5	11,5	1,3	1,5	0,6	74,5	83	84	93	173 000	867 000
7	12,5	1,1	1,5	0,6	81	92	90	104	209 000	1 040 000
10	14,5	2	1,5	0,6	88	104	99	117	245 000	1 220 000
11	16	1,8	2	0,6	100,9	118	112	132	314 000	1 570 000
12	16	1,7	2	0,6	112	128	123	142	339 000	1 700 000
15	19	1,5	2,5	0,6	123,3	146	135	162	469 000	2 340 000
17	19	1,4	2,5	0,6	132,9	155	145	172	499 000	2 490 000
20	22,5	1,9	2,5	0,6	144	174	158	192	623 000	3 110 000
20	22,5	1,8	2,5	0,6	156,9	184	171	202	664 000	3 320 000
21	24	1,7	3	1	167,2	194	184	216	765 000	3 830 000
21	25,5	1,6	3	1	177,7	206	195	228	874 000	4 370 000
27	28,5	1,4	3	1	190,4	228	208	253	1 090 000	5 450 000
21	32	1,3	3	1	201,8	240	220	263	1 320 000	6 590 000
29	32	1,3	3	1	207,9	252	226	278	1 370 000	6 850 000
26	35	1,6	3	1	224,2	268	244	293	1 550 000	7 740 000

Axial spherical plain bearings

Requiring maintenance
DIN ISO 12240-3
Open design
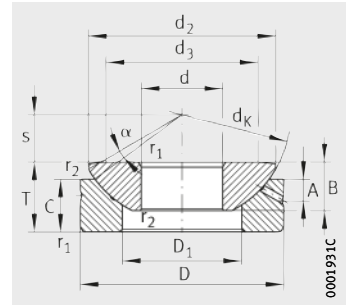
GE..-AX
Steel/steel

Dimension table · Dimensions in mm								
Designation	Mass	Dimensions[1]						
	m	d	D	T	d_K	d_2	d_3	D_1
	$\approx$kg							
GE10-AX	0,039	**10**$_{-0,008}$	30$_{-0,009}$	9,5$_{-0,4}$	32	27,5	21	16,5
GE12-AX	0,072	**12**$_{-0,008}$	35$_{-0,011}$	13$_{-0,4}$	37	32	24	19,5
GE15-AX	0,12	**15**$_{-0,008}$	42$_{-0,011}$	15$_{-0,4}$	45	38,9	29	24
GE17-AX	0,16	**17**$_{-0,008}$	47$_{-0,011}$	16$_{-0,4}$	50	43,4	34	28
GE20-AX	0,27	**20**$_{-0,01}$	55$_{-0,013}$	20$_{-0,4}$	60	50	40	33,5
GE25-AX	0,4	**25**$_{-0,01}$	62$_{-0,013}$	22,5$_{-0,4}$	66	57,5	45	34,5
GE30-AX	0,65	**30**$_{-0,01}$	75$_{-0,013}$	26$_{-0,4}$	80	69	56	44
GE35-AX	1,05	**35**$_{-0,012}$	90$_{-0,015}$	28$_{-0,4}$	98	84	66	52
GE40-AX	1,65	**40**$_{-0,012}$	105$_{-0,015}$	32$_{-0,4}$	114	98	78	59
GE45-AX	2,49	**45**$_{-0,012}$	120$_{-0,015}$	36,5$_{-0,4}$	130	112	89	68
GE50-AX[3]	3,44	**50**$_{-0,012}$	130$_{-0,018}$	42,5$_{-0,4}$	140	122,5	98	69
GE60-AX[3]	4,66	**60**$_{-0,015}$	150$_{-0,018}$	45$_{-0,4}$	160	139,5	109	86
GE70-AX[3]	5,68	**70**$_{-0,015}$	160$_{-0,025}$	50$_{-0,4}$	170	149,5	121	95
GE80-AX[3]	7,2	**80**$_{-0,015}$	180$_{-0,025}$	50$_{-0,4}$	194	168	130	108
GE100-AX[3]	10,7	**100**$_{-0,02}$	210$_{-0,03}$	59$_{-0,4}$	220	195,5	155	133
GE120-AX[3]	13,1	**120**$_{-0,02}$	230$_{-0,03}$	64$_{-0,4}$	245	214	170	154
GE140-AX[3]	18,7	**140**$_{-0,025}$	260$_{-0,035}$	72$_{-0,5}$	272	244	198	176
GE160-AX[3]	23,9	**160**$_{-0,025}$	290$_{-0,035}$	77$_{-0,5}$	310	272	213	199
GE180-AX[3]	31,1	**180**$_{-0,025}$	320$_{-0,04}$	86$_{-0,5}$	335	300	240	224
GE200-AX[3]	35	**200**$_{-0,03}$	340$_{-0,04}$	87$_{-0,6}$	358	321	265	246

[1] Other sizes available by agreement.

[2] The values for the tilt angle α are subject to tolerances.

[3] Price and delivery by agreement.

Mounting dimensions

					Chamfer dimensions		Mounting dimensions		Basic load ratings	
B	C	s	A	α[2]	r_1	r_2	d_a	D_a	dyn. C_a	stat. C_{0a}
				°	min.	min.	max.	min.	N	N
$7{,}9_{-0{,}24}$	$6_{-0{,}24}$	7	3	10	0,6	0,2	21	18,5	24 400	122 000
$9{,}3_{-0{,}24}$	$9_{-0{,}24}$	8	4	9	0,6	0,2	24	21,5	32 400	162 000
$10{,}7_{-0{,}24}$	$11_{-0{,}24}$	10	5	7	0,6	0,2	29	26	52 200	261 000
$11{,}5_{-0{,}24}$	$11{,}5_{-0{,}24}$	11	5	6	0,6	0,2	34	30,5	59 300	296 000
$14{,}3_{-0{,}24}$	$13_{-0{,}24}$	12,5	6	6	1	0,3	40	38	75 100	376 000
$16_{-0{,}24}$	$17_{-0{,}24}$	14	6	7	1	0,3	45	39	129 000	646 000
$18_{-0{,}24}$	$19{,}5_{-0{,}24}$	17,5	8	6	1	0,3	56	49	170 000	848 000
$22_{-0{,}24}$	$20_{-0{,}24}$	22	8	6	1	0,3	66	57	259 000	1 300 000
$27_{-0{,}24}$	$22_{-0{,}24}$	24,5	9	6	1	0,3	78	64	373 000	1 870 000
$31_{-0{,}24}$	$25_{-0{,}24}$	27,5	11	6	1	0,3	89	74	486 000	2 430 000
$33{,}5_{-0{,}24}$	$32_{-0{,}24}$	30	10	5	1	0,3	98	75	650 000	3 250 000
$37_{-0{,}3}$	$33_{-0{,}3}$	35	12,5	7	1	0,3	109	92	736 000	3 680 000
$40_{-0{,}3}$	$36_{-0{,}3}$	35	13,5	6	1	0,3	121	102	807 000	4 030 000
$42_{-0{,}3}$	$36_{-0{,}3}$	42,5	14,5	6	1	0,3	130	115	1 040 000	5 180 000
$50_{-0{,}4}$	$42_{-0{,}4}$	45	15	7	1	0,3	155	141	1 200 000	6 020 000
$52_{-0{,}4}$	$45_{-0{,}4}$	52,5	16,5	6,5	1	0,3	170	162	1 250 000	6 230 000
$61_{-0{,}5}$	$50_{-0{,}5}$	52,5	23	6	1,5	0,6	198	187	1 630 000	8 170 000
$65_{-0{,}5}$	$52_{-0{,}5}$	65	23	7	1,5	0,6	213	211	1 890 000	9 460 000
$70_{-0{,}5}$	$60_{-0{,}5}$	67,5	26	8	1,5	0,6	240	236	2 130 000	10 600 000
$74_{-0{,}6}$	$60_{-0{,}6}$	70	27	6,5	1,5	0,6	265	259	2 360 000	11 800 000

Rod ends

Maintenance-free
Requiring maintenance

Rod ends

**Rod ends,
maintenance-free**

Maintenance-free rod ends comprise a housing with integral shank and a maintenance-free spherical plain bearing. The integral shank has an internal or external thread. The spherical plain bearing is firmly seated and located in the housing. The housings and shanks are protected against corrosion by a zinc coating.

The rod ends can support radial loads in a tensile or compressive direction. They are suitable for slow movements with small to moderate swivel angles, for unilateral load and under certain conditions for alternating loads (also suitable for alternating loads with GE..-UK-2RS). Sealed rod ends have lip seals on both sides and are thus protected against contamination and water spray.

**Corrosion-resistant rod ends,
maintenance-free**

Corrosion-resistant rod ends made from high-grade steel correspond in their construction to the maintenance-free rod ends but are of a corrosion-resistant design.

The preferred areas of application include machinery for the food and drink industry, butchery machines, the chemical industry and medical equipment. The products have also proven effective in aircraft and ship building as well as for applications in buses and rail vehicles.

Rod ends with CETOP mounting dimensions are often used in control and automation engineering.

**Rod ends and
hydraulic rod ends,
requiring maintenance**

Rod ends requiring maintenance comprise a housing with integral shank and a spherical plain bearing requiring maintenance. In other respects, the construction corresponds to that of maintenance-free rod ends.

Hydraulic rod ends requiring maintenance incorporate radial spherical plain bearings with a steel/steel sliding contact surface. The rod ends can be screw mounted using a thread in the shank or welded in place by means of circular or rectangular welding faces. In the case of rod ends with a thread clamping facility, the spherical plain bearings are axially located in the housing by means of retaining rings.
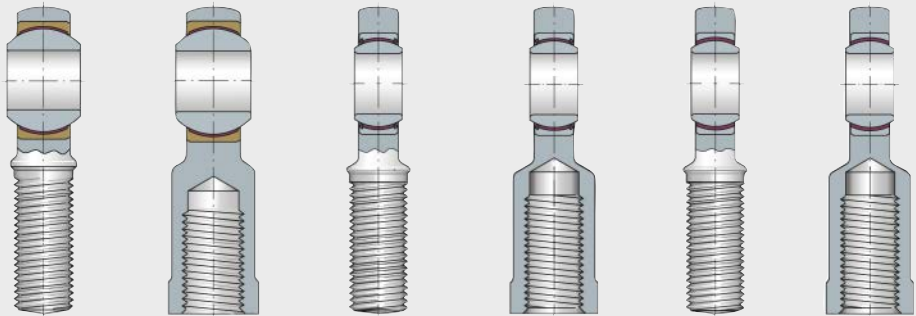
GAKR..-PW

GIKR..-PW
GIKPR..-PW

GAR..-UK-2RS
GAR..-UK-2TS

GIR..-UK-2RS
GIR..-UK-2TS

GAR..-UK

GIR..-UK
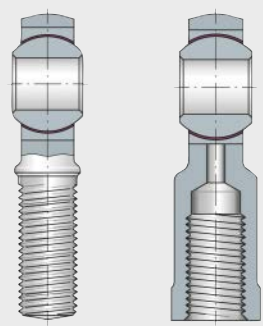
GAKSR..-PS

GIKSR..-PS
GIKPSR..-PS
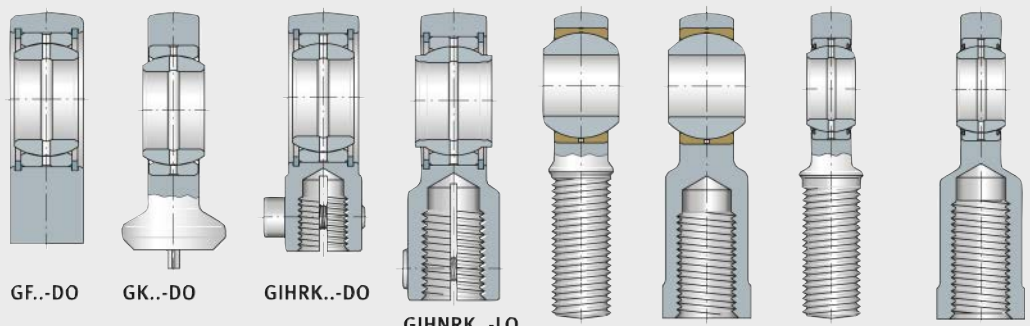
GF..-DO

GK..-DO

GIHRK..-DO

GIHNRK..-LO

GAKR..-PB

GIKR..-PB

GAR..-DO
GAR..-DO-2RS
GAR..-DO-2TS

GIR..-DO
GIR..-DO-2RS
GIR..-DO-2TS
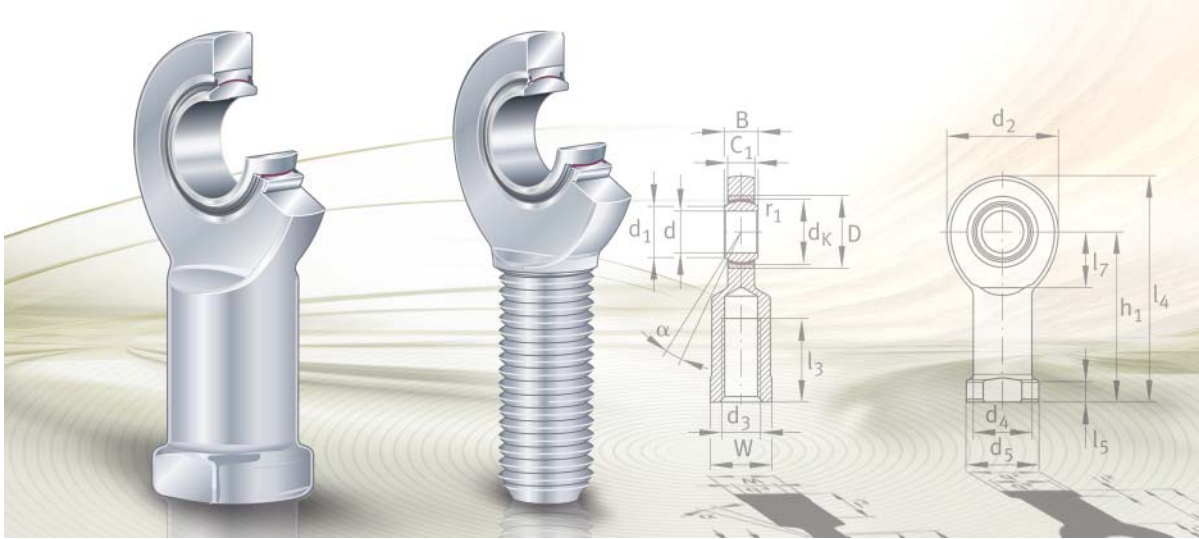
Rod ends, maintenance-free

Rod ends, maintenance-free

Product overview   Rod ends, maintenance-free

Dimension series E

**Sliding contact surface
hard chromium/PTFE composite**

Right or left hand thread

Open design
With internal thread

GIR..-UK, GIL..-UK

000166BF
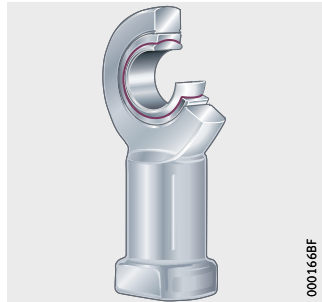
With external thread

GAR..-UK, GAL..-UK

000166CA
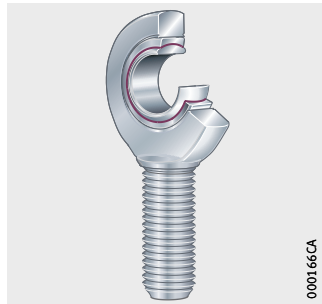
**Sliding contact surface
hard chromium/**Elgoglide

Right or left hand thread

**With lip seals or
high performance seals**
With internal thread

GIR..-UK-2RS, GIL..-UK-2RS

00016762

GIR..-UK-2TS, GIL..-UK-2TS

00016763
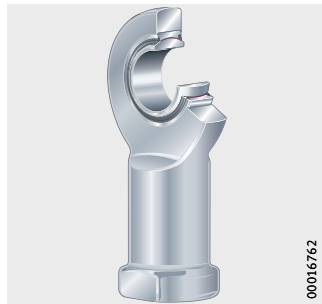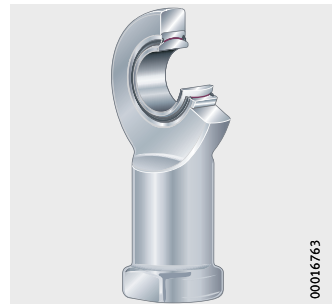
With external thread

GAR..-UK-2RS, GAL..-UK-2RS

00016764

GAR..-UK-2TS, GAL..-UK-2TS

00016766
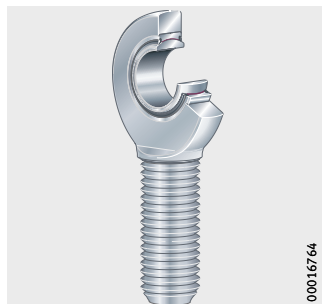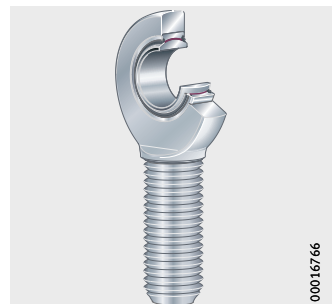
Dimension series K

Sliding contact surface
steel/PTFE film

Right or left hand thread

Open design
With internal or external thread

**GIKR..-PW, GIKPR..-PW,
GIKL..-PW**
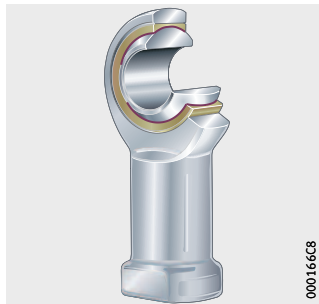
00016C8

GAKR..-PW, GAKL..-PW
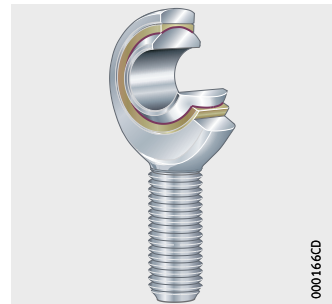
00016CD

Corrosion-resistant rod ends

Sliding contact surface
corrosion-resistant steel/PTFE film

Right or left hand thread

Open design
With internal thread

**GIKSR..-PS, GIKPSR..-PS,
GIKSL..-PS**
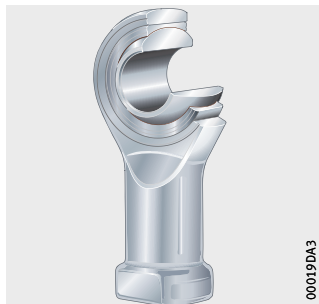
00019DA3

With external thread

GAKSR..-PS, GAKSL..-PS
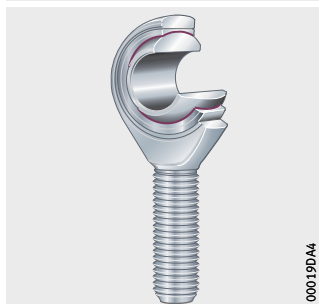
00019DA4

Rod ends, maintenance-free

Features Maintenance-free rod ends and maintenance-free corrosion-resistant rod ends comprise a housing with integral shank and a maintenance-free spherical plain bearing. The shank has an internal or external thread, the spherical plain bearing is firmly seated and located in the housing.

The rod ends are available in open designs and in designs sealed on both sides. The housings and shanks are protected against corrosion by a zinc coating.

The sliding layer between the inner ring and outer ring is PTFE composite, ELGOGLIDE or PTFE film, see page 140.

Area of application Maintenance-free rod ends can support radial loads in a tensile or compressive direction. They are particularly suitable for slow movements with small to moderate swivel angles and unilateral loads. For alternating loads, rod ends with bearings of series GE..-UK-2RS(-2TS) and GE..-FW-2RS(-2TS) can be used.

Dimension series E Rod ends to DIN ISO 12240-4, dimension series E incorporate radial spherical plain bearings GE..-UK or GE..-UK-2RS(-2TS) and have a right or left internal or external thread, *Figure 1*. The sliding contact surfaces are hard chromium/PTFE composite or hard chromium/ELGOGLIDE. The thin walled design of the eye housing allows compact adjacent constructions. These rod ends are also available by agreement with radial spherical plain bearings GE..-FW or GE..-FW-2RS(-2TS) of dimension series G.

① With internal thread
② With external thread

Figure 1
Rod ends,
dimension series E

Dimension series K

Rod ends to DIN ISO 12240-4, dimension series K incorporate radial spherical plain bearings GE..-PW and have a right hand or left hand internal or external thread, *Figure 2*. The sliding contact surface is steel/PTFE film.

① With internal thread
② With external thread

Figure 2
Rod ends,
dimension series K
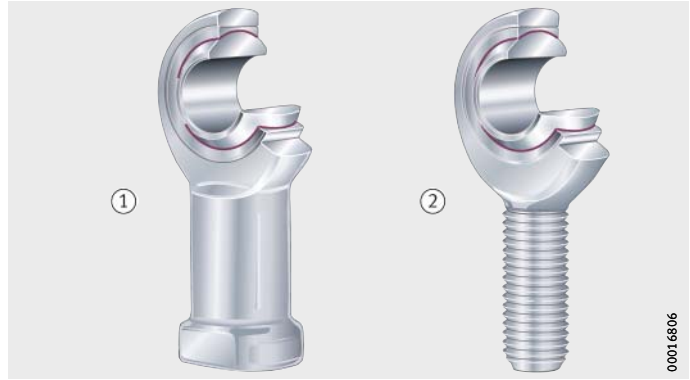
Corrosion-resistant rod ends

Corrosion-resistant rod ends to DIN ISO 12240-4, dimension series K incorporate radial spherical plain bearings GE..-PS and have a right hand or left hand internal or external thread, *Figure 3*. The sliding contact surface comprises corrosion-resistant steel and corrosion-resistant PTFE film attached to the curved outer ring surface.

The housing and shank has a thread to DIN 13 and the diameter range extends from 5 mm to 30 mm. The bore tolerance of the spherical plain bearings is H7 ⓔ.

Corrosion-resistant rod ends with an internal thread are also available with CETOP mounting dimensions to ISO 8139 for pneumatic cylinders. These are used in preference in control and automation engineering.

① With internal thread
② With external thread

Figure 3
Corrosion-resistant rod ends,
corrosion-resistant,
dimension series K

Rod ends, maintenance-free

Series, sliding layer, standard	Maintenance-free rod ends are designed according to their specific series with different sliding layers, see tables and page 140.

Series and design for sliding layer ELGOGLIDE or PTFE composite

Series	Thread	DIN ISO	Dimension series	Shaft d mm	
				over	incl.
GIR..-UK	Internal, right hand	12240-4	E, type F	6	30
GIR..-UK-2RS				17	80
GIR..-UK-2TS				30	80
GIL..-UK	Internal, left hand			6	30
GIL..-UK-2RS				17	80
GIL..-UK-2TS				30	80
GAR..-UK	External, right hand	12240-4	E, type M	6	30
GAR..-UK-2RS				17	80
GAR..-UK-2TS				30	80
GAL..-UK	External, left hand			6	30
GAL..-UK-2RS				17	80
GAL..-UK-2TS				30	80

Series and design for sliding layer PTFE film

Series	Thread	DIN ISO	Dimension series	Shaft d mm	
				over	incl.
GIKR..-PW	Internal, right hand	12240-4	K, type F	5	30
GIKSR..-PS					
GIKPR..-PW	Internal, right hand, fine pitch thread for standard pneumatic cylinders to DIN ISO 15552				
GIKPSR..-PS					
GIKL..-PW	Internal, left hand				
GIKSL..-PS					
GAKR..-PW	External, right hand	12240-4	K, type M	5	30
GAKSR..-PS					
GAKL..-PW	External, left hand				
GAKSL..-PS					

Materials   Maintenance-free rod ends fulfil all the requirements in terms of fatigue and wear resistance, hardness, toughness and structural stability as well as maintenance-free operation.

Maintenance-free rod ends are manufactured from drop forged quenched and tempered steel C45 QT in accordance with DIN EN 10083-2 and have a zinc coated surface.

Corrosion-resistant rod ends have an inner ring made from a corrosion-resistant steel such as X105CrMo17. The outer ring and the housing are made from X8CrNiS18-9. Alternative materials are permissible.

Sealing   Sealed rod ends of dimension series E have the suffix 2RS or 2TS. They are protected by lip seals on both sides against contaminants and water spray. Rod ends GIR..-UK-2TS, GIL..-UK-2TS, GAR..-UK-2TS and GAL..-UK-2TS are sealed on both sides by integrated, triple lip high performance seals.

Rod ends of dimension series K are not sealed.

Lubrication   During the running-in phase, PTFE particles are transferred from the sliding layer to the opposing running surface. As a result, the small roughness features of the inner ring surface are filled in. It is only once this tribologically smooth surface is produced in conjunction with the detached PTFE particles that the bearings can achieve a long operating life.

⚠️   Maintenance-free rod ends do not have relubrication facilities and must not be lubricated.

Any lubrication of maintenance-free rod ends after dry running-in will impair the smoothing effect necessary and will considerably reduce the operating life of the bearings.

Rod ends, maintenance-free

Operating temperature   The permissible operating temperature is dependent on the sliding contact surface and the sealing arrangement, see table.

⚠️ If the temperature exceeds the stated values, there will be a reduction in the operating life and the effect of the sealing arrangement.

At temperatures below 0 ºC, a reduction in the load carrying capacity of the rod ends must be taken into consideration.

Operating temperature

Series	Temperature ºC		Reduced load carrying capacity ºC
	over	incl.	from
GIR..-UK GIL..-UK GAR..-UK GAL..-UK	−50	+200	+100
GIR..-UK-2RS GIL..-UK-2RS GAR..-UK-2RS GAL..-UK-2RS	−30	+130	
GIR..-UK-2TS GIL..-UK-2TS GAR..-UK-2TS GAL..-UK-2TS	−30	+100	
GAKR..-PW, GAKL..-PW	−50	+200	
GIKSR..-PS, GIKPSR..-PS, GAKSR..-PS	−10	+80	+80

Special designs   The following are available by agreement:
- rod ends with special threads
- rod ends with different anti-corrosion protection.

Suffixes   Suffixes for available designs: see table.

Available designs

Suffix	Description	Design
2RS	Standard lip seals on both sides	Standard
2TS	Triple lip high performance seals on both sides	
−	With special thread	Special design, available by agreement only
−	With different anti-corrosion protection	

| **Design and safety guidelines** | The chapter Technical principles brings together the essential guidelines on the subjects of friction, rating life and the adjacent construction, see section Technical principles, page 20. |

Dimensioning

In the case of rod ends, the permissible static load of the housing and shank must always be checked. In calculation of the rating life of the rod end, the decisive factor is the rating life of the spherical plain bearing fitted in the housing, see page 47.

The direction of load and the type of load determine the design of the rod end and the sliding contact surface of the spherical plain bearing.

Permissible loading of rod ends

The permissible load depends on the type of load.

Pulsating or alternating loads subject the material of the rod ends to greater stress than constant loads. For calculation, these operating conditions must be taken into consideration by means of the load factor f_b, see table, page 222.

The maximum equivalent bearing load P must not exceed the permissible load on the rod end P_{per}, see equation.

In the case of rod ends with the sliding material ELGOGLIDE, the basic static load rating C_{0r} of the rod end is lower than the basic dynamic load rating C_r of the bearing.

Loading of rod end

The following applies:

$$P_{per} \geqq P$$
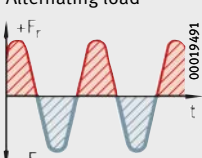
The permissible load on the rod end P_{per} is calculated as follows:

$$P_{per} = \frac{C_{0r}}{f_b}$$

P   N
Maximum equivalent bearing load
P_{per} N
Permissible load on the rod end
C_{0r} N
Basic static load rating of the rod end
f_b –
Load factor, see table, page 222.

Rod ends, maintenance-free

Load factors

Type of load	Series	Load factor f_b
Unilateral load	All series	1
Pulsating load Alternating load	GIR..-UK(-2RS, -2TS) GAR..-UK(-2RS, -2TS) GIKR..-PW GAKR..-PW GIKSR..-PS GIKPSR..-PS GAKSR..-PS	2,25 3 2,25 3 2,25 2,25 3

Basic static load rating

In this case, the basic static load rating C_{0r} indicates the load carrying capacity of the housing and shank under static tensile load, see dimension table. At room temperature, it includes a safety factor of at least 1,2 in relation to the yield strength of the material used for the housing and shank. The basic load rating describes the maximum permissible static tensile load when utilising 83% of the material yield strength at the most highly stressed cross-section.

⚠ The basic static load rating C_{0r} of the rod end refers only to the load carrying capacity of the rod end housing, see dimension table. It is based on tensile and compressive loads acting across or in the direction of the rod end shank.

If the basic static load rating C_{0r} is used to the full, the shaft and housing must be made from high-strength materials.

Basic dynamic load rating

The basic dynamic load rating C_r refers to the spherical plain bearing fitted and is a parameter for calculating the bearing rating life, see dimension table. It is dependent on the sliding contact surface and has a significant influence on the rating life of the rod ends.

⚠ The equivalent bearing load and additional bending stresses in the shank area must be taken into consideration if, in addition to radial load in a tensile or compressive direction, other transverse forces act in an axial direction to the shank.

Calculation example for radial rod end GAR25-UK

The rating life of the radial rod end is calculated on the basis of the sliding layer PTFE composite, see section Load carrying capacity and life, page 35.

Given data

The given data for calculation of the rating life are as follows:
- linkage bearing arrangement of a transfer unit
- unilateral combined load.

Operating parameters

Bearing load	F_r	= 16 000 N
	F_a	= 1 200 N
Swivel angle	β	= 27°
Swivel frequency	f	= 12 min^{-1}
Operating temperature	ϑ	= +100 °C

Bearing data

Radial rod end		= GAR25-UK
Basic dynamic load rating	C_r	= 51 100 N
Basic static load rating of housing	C_{0r}	= 105 000 N
Sphere diameter	d_K	= 35,5 mm
Sliding material		PTFE composite

Required

Bearing with the required rating life $L_h \geqq 6\,000$ h.

Rod ends, maintenance-free

Checking of permissible loads

!

The validity of the permissible loads and sliding velocities must be checked, since useful rating life calculation is only possible within this range, see tables, page 50.

Combined load

For calculation of the combined load, the factor X must be determined from the diagram for radial spherical plain bearings using the ratio $F_a/F_r = 1\,200\,N / 16\,000\,N = 0,075$, *Figure 4*, page 39:

$$P = X \cdot F_r$$

$$P = 1,23 \cdot 16\,000 = 19\,680\,N$$

Specific bearing load

The specific bearing load must be calculated with the aid of the specific load parameter K and checked for validity, see table, page 41, and table, page 50:

$$p = K \cdot \frac{P}{C_r}$$

$$p = 100 \cdot \frac{19\,680}{51\,100} = 38,51\,N/mm^2$$

Sliding velocity in swivel motion

The sliding velocity must be calculated with the aid of the sphere diameter d_K and the swivel angle β and checked for validity, see table, page 44, and table, page 50:

$$v = \frac{d_K \cdot \pi}{60 \cdot 10^3} \cdot \frac{2 \cdot \beta \cdot f}{360°}$$

$$v = \frac{35,5 \cdot \pi \cdot 2 \cdot 27° \cdot 12}{60 \cdot 10^3 \cdot 360°} = 3,35 \cdot 10^{-3}\,m/s$$

Specific frictional energy pv

The specific frictional energy pv must be checked for validity, see table, page 50:

$$pv = 38,51 \cdot 3,35 \cdot 10^{-3} = 0,13\,N/mm^2 \cdot m/s$$

Permissible load on the rod end

The load carrying capacity of the rod end must be considered separately from that of the spherical plain bearing. Calculation of the load carrying capacity required should be carried out using the load factor f_b, see table, page 222.

$$P_{per} = \frac{C_{0r}}{f_b}$$

$$C_{0r\,min} = F_{r\,max} \cdot f_b$$

$$C_{0r\,min} = 19\,680 \cdot 1 = 19\,680\,N$$

The rod end GAR25-UK with a housing having a basic load rating $C_{0r} = 105\,000\,N$ is suitable.

<table>
<tr><td>Determining
the rating life equation</td><td>For calculation of the rating life, the valid rating life equation must be selected and then subjected to correction.</td></tr>
</table>

Determining the rating life equation

For calculation of the rating life, the valid rating life equation must be selected and then subjected to correction.

Selection of the valid rating life equation

For maintenance-free plain bearings, the following applies, see page 52:

$$L_h = \frac{K_L}{p \cdot v} \cdot f_p \cdot f_v \cdot f_{pv} \cdot f_{pv\star} \cdot f_\vartheta \cdot f_R \cdot f_W \cdot f_A \cdot f_B \cdot f_L \cdot f_\alpha \cdot f_\beta \cdot f_{Hz}$$

The correction factors necessary for the plain bearing material PTFE composite must be selected from the matrix and used to correct the rating life equation appropriately, see table, page 55, and equation.

Correction factors, as a function of bearing type

Series		Sliding layer	Correction factors								
Spherical plain bearing	Rod end		f_p	f_v	f_{pv}	$f_{pv\star}$	f_ϑ	f_A	f_α	f_β	f_{Hz}
GE..-UK	GAR..-UK	PTFE composite	■	■	■	–	■	■	–	–	■

Rating life equation following correction

$$L_h = \frac{K_L}{pv} \cdot f_p \cdot f_v \cdot f_{pv} \cdot f_\vartheta \cdot f_A \cdot f_{Hz}$$

Calculation of rating life

The values for the correction factors in the corrected rating life equation must be taken from the diagrams, see page 56 and table. The specific plain bearing factor $K_L = 1000$, see table, page 52.

Correction factors

Correction factor	Source	Value
Load f_p	*Figure 13*, page 56	0,96
Sliding velocity fv	*Figure 16*, page 58	0,99
Frictional energy f_{pv}	*Figure 17*, page 59	1
Temperature f_ϑ	*Figure 18*, page 60	0,92
Condition of rotation f_A	Page 62	1
Variable load f_{Hz}	*Figure 27*, page 66	1

Rating life L_h

The rating life is calculated as follows:

$$L_h = \frac{1000}{0,13} \cdot 0,96 \cdot 0,99 \cdot 1 \cdot 0,92 \cdot 1 \cdot 1 = 6725\,h$$

Result

The selected rod end GAR25-UK fulfils the requirement for a rating life $L_h \cong 6000\,h$.

Rod ends, maintenance-free

Accuracy The main dimensions of the rod ends conform to DIN ISO 12240-4.

All connecting threads have metric dimensions to DIN 13, tolerance class central, 6H ⒠, 6g ⒠.

The stated thread length is the minimum usable length, based on normal chamfering practice for the thread of the mating component.

Rod ends

With internal thread, maintenance-free
DIN ISO 12240-4, dimension series E, type F
Inner ring curved surface
with hard chromium coating
Open design

GIR..-UK
PTFE composite

Dimension table · Dimensions in mm													
Designation[1]	Mass	Dimensions											
	m $\approx$kg	d	D	B	d_K	d_1	d_2	d_3	d_4	h_1	C_1		
GIR6-UK	0,023	$6_{-0,008}$	14	$6_{-0,12}$	10	8	21	M6	10	30	4,4		
GIR8-UK	0,039	$8_{-0,008}$	16	$8_{-0,12}$	13	10,2	24	M8	12,5	36	6		
GIR10-UK	0,066	$10_{-0,008}$	19	$9_{-0,12}$	16	13,2	29	M10	15	43	7		
GIR12-UK	0,1	$12_{-0,008}$	22	$10_{-0,12}$	18	14,9	34	M12	17,5	50	8		
GIR15-UK	0,18	$15_{-0,008}$	26	$12_{-0,12}$	22	18,4	40	M14	21	61	10		
GIR17-UK	0,25	$17_{-0,008}$	30	$14_{-0,12}$	25	20,7	46	M16	24	67	11		
GIR20-UK	0,36	$20_{-0,01}$	35	$16_{-0,12}$	29	24,2	53	M20×1,5	27,5	77	13		
GIR25-UK	0,6	$25_{-0,01}$	42	$20_{-0,12}$	35,5	29,3	64	M24×2	33,5	94	17		
GIR30-UK	0,98	$30_{-0,01}$	47	$22_{-0,12}$	40,7	34,2	73	M30×2	40	110	19		

[1] For a left hand thread, the R in the designation is replaced by an L, for example GIL6-UK.

[2] The values for the tilt angle α are subject to tolerances.

[3] Basic load rating of housing.

[4] This differs from DIN ISO 12240-4, dimension series E.

$\alpha^{2)}$	l_3	l_4	l_5	l_7	d_5	W	Chamfer dimension r_1	Basic load ratings dyn. C_r	stat. $C_{0r}^{3)}$	Radial internal clearance[4]
°							min.	N	N	
13	11	40,5	5	12	13	11	0,3	3 600	10 300	0 – 0,032
15	15	48	5	14	16	14	0,3	5 850	16 000	0 – 0,032
12	20	57,5	6,5	15	19	17	0,3	8 640	22 000	0 – 0,032
11	23	67	6,5	18	22	19	0,3	11 300	30 400	0 – 0,032
8	30	81	8	20	26	22	0,3	17 800	44 800	0 – 0,04
10	34	90	10	23	30	27	0,3	22 500	56 500	0 – 0,04
9	40	103,5	10	27	35	32	0,3	31 300	75 600	0 – 0,04
7	48	126	12	32	42	36	0,6	51 100	105 000	0 – 0,05
6	56	146,5	15	37	50	41	0,6	65 900	139 000	0 – 0,05

Rod ends

With internal thread, maintenance-free
DIN ISO 12240-4, dimension series E, type F
Inner ring curved surface
with hard chromium coating
Sealed
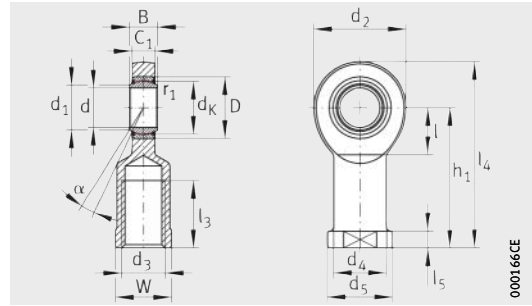
GIR..-UK-2RS, GIR..-UK-2TS
ELGOGLIDE

Dimension table · Dimensions in mm												
Designation[1]		Mass	Dimensions									
		m $\approx$kg	d	D	B	d_K	d_1	d_2	d_3	d_4	h_1
GIR17-UK-2RS	–	0,25	$17_{-0,008}$	30	$14_{-0,12}$	25	20,7	46	M16	24	67
GIR20-UK-2RS	–	0,36	$20_{-0,01}$	35	$16_{-0,12}$	29	24,2	53	M20×1,5	27,5	77
GIR25-UK-2RS	–	0,65	$25_{-0,01}$	42	$20_{-0,12}$	35,5	29,3	64	M24×2	33,5	94
GIR30-UK-2RS	GIR30-UK-2TS	0,97	$30_{-0,01}$	47	$22_{-0,12}$	40,7	34,2	73	M30×2	40	110
GIR35-UK-2RS	GIR35-UK-2TS	1,43	$35_{-0,012}$	55	$25_{-0,12}$	47	39,8	82	M36×3	47	125
GIR40-UK-2RS	GIR40-UK-2TS	2,1	$40_{-0,012}$	62	$28_{-0,12}$	53	45	92	M39×3[5]	52	142
GIR45-UK-2RS	GIR45-UK-2TS	2,7	$45_{-0,012}$	68	$32_{-0,12}$	60	50,8	102	M42×3[5]	58	145
GIR50-UK-2RS	GIR50-UK-2TS	3,54	$50_{-0,012}$	75	$35_{-0,12}$	66	56	112	M45×3[5]	62	160
GIR60-UK-2RS	GIR60-UK-2TS	5,6	$60_{-0,015}$	90	$44_{-0,15}$	80	66,8	135	M52×3[5]	70	175
GIR70-UK-2RS	GIR70-UK-2TS	8,61	$70_{-0,015}$	105	$49_{-0,15}$	92	77,9	160	M56×4[5]	80	200
GIR80-UK-2RS	GIR80-UK-2TS	13,2	$80_{-0,015}$	120	$55_{-0,15}$	105	89,4	180	M64×4[5]	95	230

[1] For a left hand thread, the R in the designation is replaced by an L, for example GIL17-UK-2RS.

[2] The values for the tilt angle α are subject to tolerances.

[3] Basic load rating of housing.
Attention!
In the case of rod ends with $d \geqq 25$ mm and the sliding material ELGOGLIDE,
the basic static load rating C_{0r} of the rod end is lower than the basic dynamic load rating C_r of the bearing.

[4] This differs from DIN ISO 12240-4, dimension series E.

[5] Thread runout or thread groove at manufacturer's discretion.

C_1	α [2] °	l_3	l_4	l_5	l_7	d_5	W	Chamfer dimension r_1 min.	Basic load ratings dyn. C_r N	stat. C_{0r} [3] N	Radial internal clearance [4]
11	10	34	90	10	23	30	27	0,3	48 800	56 500	0 – 0,04
13	9	40	103,5	10	27	35	32	0,3	67 900	75 600	0 – 0,04
17	7	48	126	12	32	42	36	0,6	128 000	105 000	0 – 0,05
19	6	56	146,5	15	37	50	41	0,6	165 000	139 000	0 – 0,05
21	6	60	166	15	42	58	50	0,6	212 000	159 000	0 – 0,05
23	7	65	188	18	48	65	55	0,6	280 000	194 000	0 – 0,06
27	7	65	196	20	52	70	60	0,6	360 000	259 000	0 – 0,06
30	6	68	216	20	60	75	65	0,6	444 000	314 000	0 – 0,06
38	6	70	242,5	20	75	88	75	1	691 000	485 000	0 – 0,06
42	6	80	280	20	87	98	85	1	883 000	564 000	0 – 0,072
47	6	85	320	25	100	110	100	1	1 130 000	690 000	0 – 0,072

Rod ends

With external thread, maintenance-free
DIN ISO 12240-4, dimension series E, type M
Inner ring curved surface
with hard chromium coating
Open design
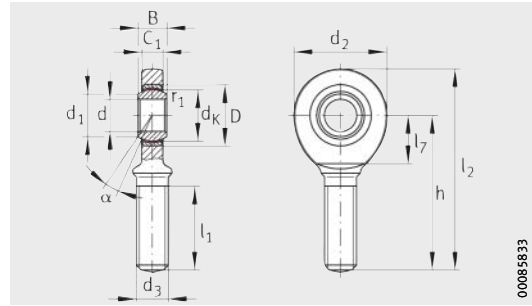
GAR..-UK
PTFE composite

Dimension table · Dimensions in mm											
Designation[1]	Mass	Dimensions									
	m $\approx$kg	d	D	B	d_K	d_1	d_2	d_3	h	C_1	
GAR6-UK	0,018	$6_{-0,008}$	14	$6_{-0,12}$	10	8	21	M6	36	4,4	
GAR8-UK	0,033	$8_{-0,008}$	16	$8_{-0,12}$	13	10,2	24	M8	42	6	
GAR10-UK	0,056	$10_{-0,008}$	19	$9_{-0,12}$	16	13,2	29	M10	48	7	
GAR12-UK	0,086	$12_{-0,008}$	22	$10_{-0,12}$	18	14,9	34	M12	54	8	
GAR15-UK	0,15	$15_{-0,008}$	26	$12_{-0,12}$	22	18,4	40	M14	63	10	
GAR17-UK	0,21	$17_{-0,008}$	30	$14_{-0,12}$	25	20,7	46	M16	69	11	
GAR20-UK	0,33	$20_{-0,01}$	35	$16_{-0,12}$	29	24,2	53	M20×1,5	78	13	
GAR25-UK	0,6	$25_{-0,01}$	42	$20_{-0,12}$	35,5	29,3	64	M24×2	94	17	
GAR30-UK	0,95	$30_{-0,01}$	47	$22_{-0,12}$	40,7	34,2	73	M30×2	110	19	

[1] For a left hand thread, the R in the designation is replaced by an L, for example GAL6-UK.

[2] The values for the tilt angle α are subject to tolerances.

[3] Basic load rating of housing.

[4] This differs from DIN ISO 12240-4, dimension series E.

$\alpha^{2)}$ °	l_1	l_2	l_7	Chamfer dimension r_1 min.	Basic load ratings dyn. C_r N	stat. $C_{0r}{}^{3)}$ N	Radial internal clearance[4]
13	18	46,5	12	0,3	3 600	6 930	0 – 0,032
15	22	54	14	0,3	5 850	12 900	0 – 0,032
12	26	62,5	15	0,3	8 640	20 600	0 – 0,032
11	28	71	18	0,3	11 300	30 200	0 – 0,032
8	34	83	20	0,3	17 800	41 600	0 – 0,04
10	36	92	23	0,3	22 500	56 500	0 – 0,04
9	43	104,5	27	0,3	31 300	75 600	0 – 0,04
7	53	126	32	0,6	51 100	105 000	0 – 0,05
6	65	146,5	37	0,6	65 900	139 000	0 – 0,05

Rod ends

With external thread, maintenance-free
DIN ISO 12240-4, dimension series E, type M
Inner ring curved surface
with hard chromium coating
Sealed
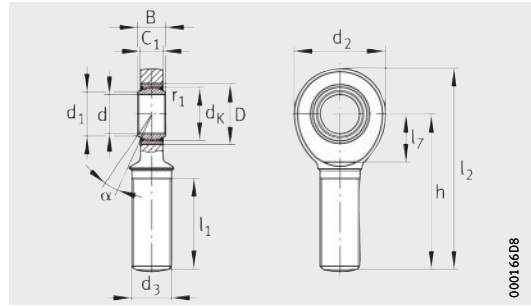
GAR..-UK-2RS, GAR..-UK-2TS
ELGOGLIDE

Dimension table · Dimensions in mm											
Designation[1]		Mass	Dimensions								
		m $\approx$kg	d	D	B	d_K	d_1	d_2	d_3	h	
GAR17-UK-2RS	–	0,2	$17_{-0,008}$	30	$14_{-0,12}$	25	20,7	46	M16	69	
GAR20-UK-2RS	–	0,33	$20_{-0,01}$	35	$16_{-0,12}$	29	24,2	53	M20×1,5	78	
GAR25-UK-2RS	–	0,59	$25_{-0,01}$	42	$20_{-0,12}$	35,5	29,3	64	M24×2	94	
GAR30-UK-2RS	GAR30-UK-2TS	0,93	$30_{-0,01}$	47	$22_{-0,12}$	40,7	34,2	73	M30×2	110	
GAR35-UK-2RS	GAR35-UK-2TS	1,53	$35_{-0,012}$	55	$25_{-0,12}$	47	39,8	82	M36×3	140	
GAR40-UK-2RS	GAR40-UK-2TS	1,97	$40_{-0,012}$	62	$28_{-0,12}$	53	45	92	M39×3	150	
GAR45-UK-2RS	GAR45-UK-2TS	2,65	$45_{-0,012}$	68	$32_{-0,12}$	60	50,8	102	M42×3	163	
GAR50-UK-2RS	GAR50-UK-2TS	3,53	$50_{-0,012}$	75	$35_{-0,12}$	66	56	112	M45×3	185	
GAR60-UK-2RS	GAR60-UK-2TS	5,91	$60_{-0,015}$	90	$44_{-0,15}$	80	66,8	135	M52×3	210	
GAR70-UK-2RS	GAR70-UK-2TS	8,51	$70_{-0,015}$	105	$49_{-0,15}$	92	77,9	160	M56×4	235	
GAR80-UK-2RS	GAR80-UK-2TS	12,5	$80_{-0,015}$	120	$55_{-0,15}$	105	89,4	180	M64×4	270	

[1] For a left hand thread, the R in the designation is replaced by an L, for example GAL17-UK-2RS.

[2] The values for the tilt angle α are subject to tolerances.

[3] Basic load rating of housing.
   Attention!
   In the case of rod ends with d $\geqq$ 25 mm and the sliding material ELGOGLIDE,
   the basic static load rating C_{0r} of the rod end is lower than the basic dynamic load rating C_r of the bearing.

[4] This differs from DIN ISO 12240-4, dimension series E.

| C_1 | $\alpha^{2)}$ | l_1 | l_2 | l_7 | Chamfer dimension r_1 | Basic load ratings | | Radial internal clearance[4] |
| | | | | | | dyn. C_r | stat. $C_{0r}^{3)}$ | |
	°				min.	N	N	
11	10	36	92	23	0,3	48 800	56 500	0 – 0,04
13	9	43	104,5	27	0,3	67 900	75 600	0 – 0,04
17	7	53	126	32	0,6	128 000	105 000	0 – 0,05
19	6	65	146,5	37	0,6	165 000	139 000	0 – 0,05
21	6	82	181	42	0,6	212 000	159 000	0 – 0,05
23	7	86	196	48	0,6	280 000	194 000	0 – 0,06
27	7	94	214	52	0,6	360 000	259 000	0 – 0,06
30	6	107	241	60	0,6	444 000	314 000	0 – 0,06
38	6	115	277,5	75	1	691 000	485 000	0 – 0,06
42	6	125	315	87	1	883 000	564 000	0 – 0,072
47	6	140	360	100	1	1 130 000	690 000	0 – 0,072

Rod ends

With internal thread, maintenance-free
DIN ISO 12240-4, dimension series K, type F
Brass outer ring
Open design
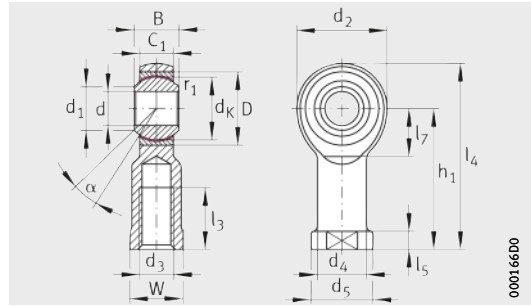
GIKR..-PW, GIKPR..-PW
PTFE film

Dimension table · Dimensions in mm									
Designation[1] [2]	Mass	Dimensions							
	m	d	D	B	d_K	d_1	d_2	d_3	d_4
	$\approx$kg	H7							
GIKR6-PW[6]	0,028	$6^{+0,012}$	16	$9_{-0,12}$	12,7	9	20	M6	10
GIKR8-PW[6]	0,05	$8^{+0,015}$	19	$12_{-0,12}$	15,875	10,4	24	M8	12,5
GIKR10-PW	0,08	$10^{+0,015}$	22	$14_{-0,12}$	19,05	12,9	28	M10	15
GIKPR10-PW[6]								M10×1,25	
GIKR12-PW	0,12	$12^{+0,018}$	26	$16_{-0,12}$	22,225	15,4	32	M12	17,5
GIKPR12-PW[6]								M12×1,25	
GIKR14-PW	0,18	$14^{+0,018}$	28[5]	$19_{-0,12}$	25,4	16,9	36	M14	21
GIKR16-PW	0,24	$16^{+0,018}$	32	$21_{-0,12}$	28,575	19,4	42	M16	22
GIKPR16-PW[6]								M16×1,5	
GIKR20-PW[6]	0,43	$20^{+0,021}$	40	$25_{-0,12}$	34,925	24,4	50	M20×1,5	27,5
GIKR25-PW[6]	0,73	$25^{+0,021}$	47	$31_{-0,12}$	42,85	29,6	60	M24×2	33,5
GIKR30-PW	1,17	$30^{+0,021}$	55	$37_{-0,12}$	50,8	34,8	70	M30×2	40
GIKPR30-PW[6]								M27×2	

Other dimensions by agreement.

[1] For a left hand thread, the R in the designation is replaced by an L, for example GIKL6-PW.

[2] Series GIKPR..-PW has a fine pitch thread connector for standard pneumatic cylinders to DIN ISO 15552 (right hand thread only).

[3] The values for the tilt angle α are subject to tolerances.

[4] Basic load rating of housing.

[5] This differs from DIN ISO 12240-4, dimension series K.

[6] In accordance with ISO 8139.

| h_1 | C_1 | $\alpha^{3)}$ | l_3 | l_4 | l_5 | l_7 | d_5 | W | Chamfer dimension | Basic load ratings | | Radial internal clearance[5] |
| | | ° | | | | | | | r_1 | dyn. C_r | stat. $C_{0r}^{4)}$ | |
									min.	N	N	
30	6,75	13	12	40	5	11	13	11	0,3	7 750	7 990	0 – 0,035
36	9	14	16	48	5	13	16	14	0,3	12 900	13 100	0 – 0,035
43	10,5	13	20	57	6,5	15	19	17	0,3	18 100	18 500	0 – 0,035
50	12	13	22	66	6,5	17	22	19	0,3	24 000	20 800	0 – 0,035
57	13,5	16	25	75	8	18	26	22	0,3	31 000	32 000	0 – 0,035
64	15	15	28	85	8	23	28	22	0,3	38 600	45 300	0 – 0,035
77	18	14	33	102	10	26	35	30	0,3	56 600	45 600	0 – 0,035
94	22	15	42	124	12	32	42	36	0,3	84 800	72 900	0 – 0,035
110	25	17	51	145	15	37	50	41	0,3	114 000	95 900	0 – 0,035

Rod ends

With external thread, maintenance-free
DIN ISO 12240-4, dimension series K, type M
Brass outer ring
Open design
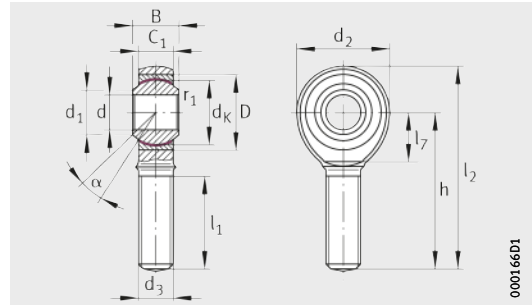
GAKR..-PW
PTFE film

Dimension table · Dimensions in mm								
Designation[1]	Mass	Dimensions						
	m	d	D	B	d_K	d_1	d_2	d_3
	$\approx$kg	H7						
GAKR6-PW	0,022	**$6^{+0,012}$**	16	$9_{-0,12}$	12,7	9	20	M6
GAKR8-PW	0,042	**$8^{+0,015}$**	19	$12_{-0,12}$	15,875	10,4	24	M8
GAKR10-PW	0,069	**$10^{+0,015}$**	22	$14_{-0,12}$	19,05	12,9	28	M10
GAKR12-PW	0,11	**$12^{+0,018}$**	26	$16_{-0,12}$	22,225	15,4	32	M12
GAKR14-PW	0,16	**$14^{+0,018}$**	28[4]	$19_{-0,12}$	25,4	16,9	36	M14
GAKR16-PW	0,23	**$16^{+0,018}$**	32	$21_{-0,12}$	28,575	19,4	42	M16
GAKR20-PW	0,39	**$20^{+0,021}$**	40	$25_{-0,12}$	34,925	24,4	50	M20×1,5
GAKR25-PW	0,67	**$25^{+0,021}$**	47	$31_{-0,12}$	42,85	29,6	60	M24×2
GAKR30-PW	1,1	**$30^{+0,021}$**	55	$37_{-0,12}$	50,8	34,8	70	M30×2

Other dimensions by agreement.

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[1] For a left hand thread, the R in the designation is replaced by an L, for example GAKL6-PW.

[2] The values for the tilt angle α are subject to tolerances.

[3] Basic load rating of housing.

[4] This differs from DIN ISO 12240-4, dimension series K.

h	C_1	$\alpha^{2)}$ °	l_1	l_2	l_7	Chamfer dimension r_1 min.	Basic load ratings dyn. C_r N	stat. $C_{0r}{}^{3)}$ N	Radial internal clearance[4]
36	6,75	13	21	46	–	0,3	7 750	6 930	0 – 0,035
42	9	14	25	54	–	0,3	12 900	12 900	0 – 0,035
48	10,5	13	28	62	–	0,3	18 100	18 500	0 – 0,035
54	12	13	32	70	–	0,3	24 000	20 800	0 – 0,035
60	13,5	16	36	78	18	0,3	31 000	32 000	0 – 0,035
66	15	15	37	87	23	0,3	38 600	45 300	0 – 0,035
78	18	14	45	103	26	0,3	56 600	45 600	0 – 0,035
94	22	15	55	124	32	0,3	84 800	72 900	0 – 0,035
110	25	17	66	145	37	0,3	114 000	95 900	0 – 0,035

Corrosion-resistant rod ends

With internal thread, maintenance-free
DIN ISO 12240-4, dimension series K, type F
Corrosion-resistant
Open design
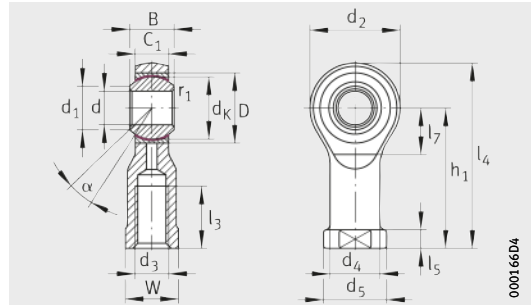
GIKSR..-PS, GIKPSR..-PS
PTFE film

Dimension table · Dimensions in mm

Designation[1][2]	Mass	Dimensions								
	m	d	D	B	d_K	d_1	d_2	d_3	d_4	h_1
	$\approx$kg	H7					max.			
GIKSR5-PS	0,017	**5+0,012**	13	$8_{-0,12}$	11,1	7,7	19	M5	9	27
GIKPSR5-PS								M4		
GIKSR6-PS	0,025	**6+0,012**	16	$9_{-0,12}$	12,7	9	21	M6	10	30
GIKSR8-PS	0,043	**8+0,015**	19	$12_{-0,12}$	15,8	10,4	25	M8	12,5	36
GIKSR10-PS	0,072	**10+0,015**	22	$14_{-0,12}$	19	12,9	29	M10	15	43
GIKPSR10-PS								M10×1,25		
GIKSR12-PS	0,11	**12+0,018**	26	$16_{-0,12}$	22,2	15,4	33	M12	17,5	50
GIKPSR12-PS								M12×1,25		
GIKSR14-PS	0,16	**14+0,018**	28[5]	$19_{-0,12}$	25,4	16,8	37	M14	20	57
GIKSR16-PS	0,21	**16+0,018**	32	$21_{-0,12}$	28,5	19,4	43	M16	22	64
GIKPSR16-PS								M16×1,5		
GIKSR18-PS	0,3	**18+0,018**	35	$23_{-0,12}$	31,7	21,9	47	M18×1,5	25	71
GIKSR20-PS	0,38	**20+0,021**	40	$25_{-0,12}$	34,9	24,4	51	M20×1,5	27,5	77
GIKSR22-PS	0,49	**22+0,021**	42	$28_{-0,12}$	38,1	25,8	55	M22×1,5	30	84
GIKSR25-PS	0,65	**25+0,021**	47	$31_{-0,12}$	42,8	29,6	61	M24×2	33,5	94
GIKSR30-PS	1,15	**30+0,021**	55	$37_{-0,12}$	50,8	34,8	71	M30×2	40	110
GIKPSR30-PS								M27×2		

[1] For a left hand thread, the R in the designation is replaced by an L, for example GIKSL5-PS.

[2] Series GIKPSR..-PS has a fine pitch thread connector
for standard pneumatic cylinders to DIN ISO 15552 (right hand thread only).

[3] The values for the tilt angle α are subject to tolerances.

[4] Basic load rating of housing.

[5] This differs from DIN ISO 12240-4, dimension series K.

								Chamfer dimension	Basic load ratings		Radial internal clearance[5]
C_1	α[3]	l_3	l_4	l_5	l_7	d_5	W	r_1	dyn. C_r	stat. C_{0r}[4]	
	°	min.		≈	min.			min.	N	N	
6	13	8	36,5	4	9	11	9	0,3	6 000	3 800	0,003 − 0,035
6,75	13	9	40,5	5	10	13	11	0,3	7 650	3 400	0,003 − 0,035
9	13	12	48,5	5	12	16	14	0,3	12 900	5 700	0,005 − 0,040
10,5	13	15	57,5	6,5	14	19	17	0,3	18 000	8 000	0,005 − 0,040
12	13	18	66,5	6,5	16	22	19	0,3	24 000	9 100	0,005 − 0,045
13,5	15	21	75,5	8	18	25	22	0,3	31 000	13 700	0,005 − 0,045
15	15	24	85,5	8	21	27	22	0,3	39 000	19 000	0,005 − 0,045
16,5	15	27	94,5	10	23	31	27	0,3	47 500	23 000	0,005 − 0,045
18	15	30	102,5	10	25	34	30	0,3	57 000	22 800	0,010 − 0,055
20	15	33	111,5	12	27	37	32	0,3	68 000	30 400	0,010 − 0,055
22	15	36	124,5	12	30	42	36	0,3	85 000	36 200	0,010 − 0,055
25	15	45	145,5	15	35	50	41	0,3	114 000	47 500	0,010 − 0,055

Corrosion-resistant rod ends

With external thread, maintenance-free
DIN ISO 12240-4, dimension series K, type M
Corrosion-resistant
Open design
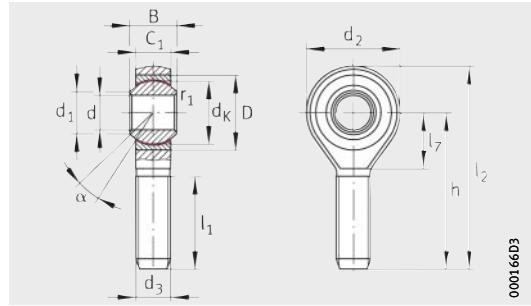
GAKSR..-PS
PTFE film

Dimension table · Dimensions in mm

Designation[1]	Mass	Dimensions							
	m	d	D	B	d_K	d_1	d_2	d_3	h
	$\approx$kg	H7					max.		
GAKSR5-PS	0,01	**$5^{+0,012}$**	13	$8_{-0,12}$	11,1	7,7	19	M5	33
GAKSR6-PS	0,02	**$6^{+0,012}$**	16	$9_{-0,12}$	12,7	9	21	M6	36
GAKSR8-PS	0,03	**$8^{+0,015}$**	19	$12_{-0,12}$	15,8	10,4	25	M8	42
GAKSR10-PS	0,05	**$10^{+0,015}$**	22	$14_{-0,12}$	19	12,9	29	M10	48
GAKSR12-PS	0,09	**$12^{+0,018}$**	26	$16_{-0,12}$	22,2	15,4	33	M12	54
GAKSR14-PS	0,13	**$14^{+0,018}$**	28[4]	$19_{-0,12}$	25,4	16,9	37	M14	60
GAKSR16-PS	0,19	**$16^{+0,018}$**	32	$21_{-0,12}$	28,5	19,4	43	M16	66
GAKSR18-PS	0,26	**$18^{+0,018}$**	35	$23_{-0,12}$	31,7	21,9	47	M18×1,5	72
GAKSR20-PS	0,34	**$20^{+0,021}$**	40	$25_{-0,12}$	34,9	24,4	51	M20×1,5	78
GAKSR22-PS	0,44	**$22^{+0,021}$**	42	$28_{-0,12}$	38,1	25,8	55	M22×1,5	84
GAKSR25-PS	0,59	**$25^{+0,021}$**	47	$31_{-0,12}$	42,8	29,6	61	M24×2	94
GAKSR30-PS	1,06	**$30^{+0,021}$**	55	$37_{-0,12}$	50,8	34,8	71	M30×2	110

[1] For a left hand thread, the R in the designation is replaced by an L, for example GAKSL5-PS.

[2] The values for the tilt angle α are subject to tolerances.

[3] Basic load rating of housing.

[4] This differs from DIN ISO 12240-4, dimension series K.

					Chamfer dimension	Basic load ratings		Radial internal clearance[4]
C_1	$\alpha^{2)}$ °	l_1	l_2	l_7	r_1 min.	dyn. C_r N	stat. $C_{0r}^{3)}$ N	
6	13	19	42,5	9	0,3	6 000	1 800	0,003 − 0,035
6,75	13	21	46,5	10	0,3	7 650	2 500	0,003 − 0,035
9	13	25	54,5	12	0,3	12 900	4 600	0,005 − 0,040
10,5	13	28	62,5	14	0,3	18 000	7 300	0,005 − 0,040
12	13	32	70,5	16	0,3	24 000	9 100	0,005 − 0,045
13,5	15	36	78,5	18	0,3	31 000	13 700	0,005 − 0,045
15	15	37	87,5	21	0,3	39 000	19 000	0,005 − 0,045
16,5	15	41	95,5	23	0,3	47 500	23 000	0,005 − 0,045
18	15	45	104	25	0,3	57 000	22 800	0,010 − 0,055
20	15	48	112	27	0,3	68 000	30 400	0,010 − 0,055
22	15	55	125	30	0,3	85 000	36 200	0,010 − 0,055
25	15	66	146	35	0,3	114 000	47 500	0,010 − 0,055

Rod ends and hydraulic rod ends, requiring maintenance

Rod ends and hydraulic rod ends, requiring maintenance

Product overview	**Rod ends and hydraulic rod ends, requiring maintenance**

Dimension series E

Sliding contact surface
steel/steel

Right or left hand thread

Open design

With internal thread

GIR..-DO, GIL..-DO

00097FFA
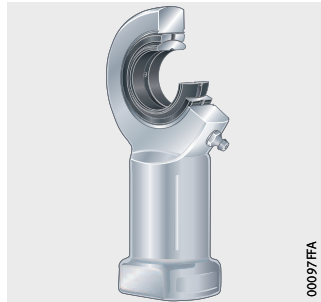
With external thread

GAR..-DO, GAL..-DO

00098003
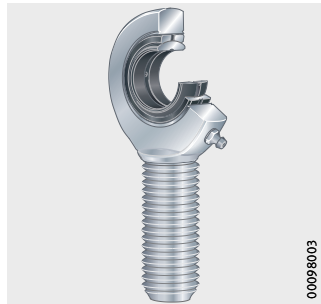
**With lip seals or
high performance seals**
With internal thread

GIR..-DO-2RS, GIL..-DO-2RS

0009800E

GIR..-DO-2TS, GIL..-DO-2TS

0009806B
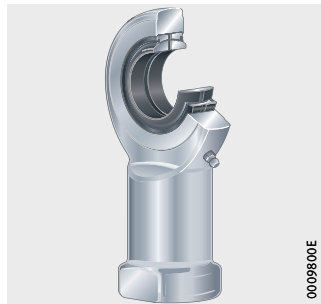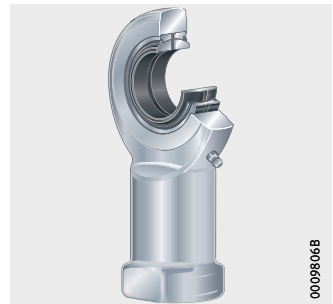
With external thread

GAR..-DO-2RS, GAL..-DO-2RS

00098074

GAR..-DO-2TS, GAL..-DO-2TS

0009807D
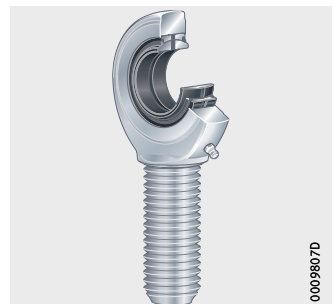
Dimension series K

Sliding contact surface
steel/bronze
Right or left hand thread
Open design
With internal thread

GIKR..-PB, GIKL..-PB

00016690
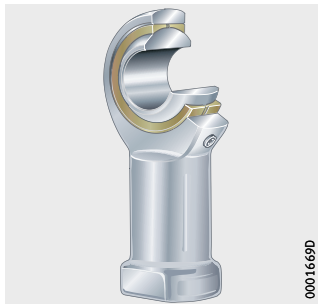
With external thread

GAKR..-PB, GAKL..-PB

00016732
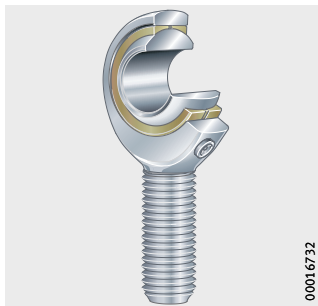
Hydraulic rod ends

Sliding contact surface
steel/steel
With thread clamping device
Open design

GIHNRK..-LO

00098086

GIHRK..-DO

0009808F
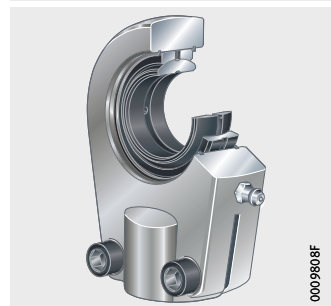
With welding faces
Open design

GK..-DO

00098099

GF..-DO

000980A3

Rod ends and hydraulic rod ends, requiring maintenance

Features

Rod ends requiring maintenance and hydraulic rod ends incorporate spherical plain bearings with a steel/steel sliding contact surface. Schaeffler can also supply spherical plain bearings with a steel/bronze sliding contact surface.

Rod ends requiring maintenance

Rod ends requiring maintenance comprise a housing with integral shank and a spherical plain bearing requiring maintenance. The shank has an internal or external thread, the spherical plain bearing is firmly seated and located in the housing.

The rod ends are available in open designs and in designs sealed on both sides. The housings and shanks are protected against corrosion by a zinc coating.

Area of application

Rod ends requiring maintenance can support radial forces in a tensile or compressive direction and can transmit motions and forces with low moment levels. They are particularly suitable for alternating radial loads and, in certain circumstances, for unilateral loads. The thin walled design of the eye housing allows compact adjacent constructions.

Dimension series E

Rod ends to DIN ISO 12240-4, dimension series E incorporate radial spherical plain bearings GE..-DO or GE..-DO-2RS(-2TS) and have a right or left hand internal or external thread. The sliding contact surface is formed by steel inner and outer rings, *Figure 1*.

① With internal thread
② With external thread

Figure 1
Rod ends requiring maintenance, dimension series E, steel/steel sliding contact surface
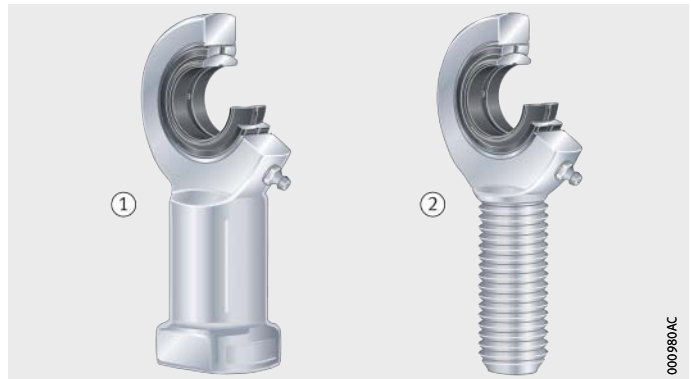
000980AC

Dimension series K

Rod ends to DIN ISO 12240-4, dimension series K incorporate radial spherical plain bearings GE..-PB and have a right or left hand internal or external thread. The sliding contact surface is formed by steel inner rings and bronze outer rings, *Figure 2*.

① With internal thread
② With external thread
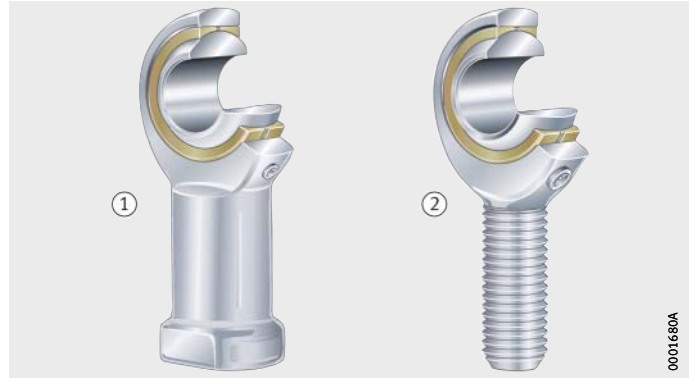
Figure 2
Rod ends requiring maintenance,
dimension series K,
steel/bronze sliding contact surface

Sealing

Sealed rod ends have the suffix 2RS or 2TS. They are protected by lip seals on both sides against contaminants and water spray. Rod ends GIR..-DO-2TS, GIL..-DO-2TS, GAR..-DO-2TS and GAL..-DO-2TS are sealed on both sides by integrated, triple lip high performance seals.

Rod ends of dimension series K are not sealed.

Lubrication

The relubrication options for rod ends of dimension series E or dimension series K are of differing design depending on the rod end size, see tables.

Dimension series E, relubrication facility

Shaft d mm		Relubrication
over	incl.	
–	12	–
15	20	Lubrication hole in housing
25	–	Taper type lubrication nipple to DIN 71412 on rod end eye housing

Dimension series K, relubrication facility

Shaft d mm	Relubrication
5	–
>5	Taper type lubrication nipple to DIN 3405 on rod end eye housing

Rod ends and hydraulic rod ends, requiring maintenance

Series, sliding contact surface, standard

Rod ends requiring maintenance are designed according to their specific series with different sliding contact surfaces, see table.

Series and design

Series	Sliding contact surface	Thread	DIN ISO	Dimension series	Shaft d mm	
					over	incl.
GIR..-DO	Steel/steel	Internal, right hand	12240-4	E, type F	6	30
GIR..-DO-2RS					17	80
GIR..-DO-2TS					30	80
GIL..-DO		Internal, left hand			6	30
GIL..-DO-2RS					17	80
GIL..-DO-2TS					30	80
GAR..-DO		External, right hand		E, type M	6	30
GAR..-DO-2RS					17	80
GAR..-DO-2TS					30	80
GAL..-DO		External, left hand			6	30
GAL..-DO-2RS					17	80
GAL..-DO-2RS					30	80
GIKR..-PB	Steel/bronze	Internal, right hand	12240-4	K, type F	6	30
GIKL..-PB		Internal, left hand				
GAKR..-PB		External, right hand		K, type M		
GAKL..-PB		External, left hand				

Hydraulic rod ends

Hydraulic rod ends incorporate radial spherical plain bearings GE..-LO or GE..-DO. The sliding contact surface is formed by steel inner and outer rings. The rod ends can be screw mounted using a thread in the shank or welded in place by means of circular or rectangular welding faces.

Rod ends GIHRK..-DO and GF..-DO are also available with maintenance-free spherical plain bearings of series GE..-UK, GE..-UK-2RS(-2TS), GE..-FW or GE..-FW-2RS(-2TS).

Rod ends GIHRK and GIHNRK are slotted on both sides up to diameter $d \leqq 50$ mm. Rod ends GIHRK are slotted on one side from $d \geqq 60$ mm and rod ends GIHNRK are slotted on one side from $d \geqq 63$ mm.

Area of application

Hydraulic rod ends can support radial forces in a tensile or compressive direction and can transmit motions and forces with low moment levels. They are also suitable for alternating radial loads.

Hydraulic rod ends with thread clamping device

The spherical plain bearings used are located in the rod end by means of retaining rings. A thread clamping facility comprising two hexagonal socket screws to DIN EN ISO 4762 is present on the threaded shank, *Figure 3*.

Rod ends GIHNRK..-LO conform to DIN 24338 and ISO 6982. They are used in standard hydraulic cylinders to CETOP recommendation RP 58 H and to the standards DIN 24333, DIN 24336, DIN ISO 6020-1 and DIN ISO 6022.

Rod ends GIHRK..-DO are particularly suitable for hydraulic cylinders. They have very small linkage distances with maximum stroke utilisation.

① GIHNRK..-LO
② GIHRK..-DO

Figure 3
Hydraulic rod ends
with thread clamping device

Rod ends and hydraulic rod ends, requiring maintenance

Hydraulic rod ends with welding face

Rod ends of series GK..-DO conform to DIN ISO 12240-4. They have a circular welding face, a locating pin on the shank base and a 45° welding chamfer, *Figure 4*. These rod ends are suitable for fixing to piston rod ends and cylinder bases. The spherical plain bearings are located in the rod end by staking on both sides.

Rod ends of series GF..-DO are available in a heavy-duty design with a rectangular welding face. They are suitable for fixing to hydraulic cylinder bases. The spherical plain bearings are located in the rod end by retaining rings and can be dismounted.

① GK..-DO,
with circular welding face,
locating pin on shank base
and 45° welding chamfer
② GF..-DO,
with rectangular welding face

Figure 4
Hydraulic rod ends
with welding face

| | Sealing | Rod ends with integrated spherical plain bearings GE..-DO-2RS or GE..-FO-2RS are protected by lip seals on both sides against contaminants and water spray. |

Sealing

Rod ends with integrated spherical plain bearings GE..-DO-2RS or GE..-FO-2RS are protected by lip seals on both sides against contaminants and water spray.

Rod ends with integrated spherical plain bearings GE..-DO-2TS or GE..-FO-2TS are sealed on both sides by integrated, triple lip high performance seals.

Lubrication

The relubrication options for hydraulic rod ends are of differing design depending on the rod end size, see tables. Hydraulic rod ends GIHRK..-DO and GF..-DO are relubricated by means of taper type lubrication nipples to DIN 71412 on the rod end eye housing.

Hydraulic rod end GK..-DO, relubrication facility

Shaft d mm		Relubrication
over	incl.	
–	12	–
15	20	Lubrication hole in housing
25	–	Taper type lubrication nipple to DIN 71412 on rod end eye housing

Hydraulic rod end GIHNRK..-LO, relubrication facility

Shaft d mm	Relubrication
12	–
>16	Taper type lubrication nipple to DIN 71412 on rod end eye housing

Series, sliding contact surface, standard

Hydraulic rod ends requiring maintenance have a steel/steel sliding contact surface, see table.

Series and design

Series	Sliding contact surface	Standard	Shaft d mm	
			from	to
GIHNRK..-LO	Steel/steel	DIN 24338, ISO 6982	12	250
GIHRK..-DO			20	120
GK..-DO		DIN ISO 12240-4, dimension series E, type S	10	80
GF..-DO		–	20	120

Rod ends and hydraulic rod ends, requiring maintenance

Materials   Materials and material variants for rod ends requiring maintenance and hydraulic rod ends differ according to their specific series, see table.

Materials

Series	Material
GIR..-DO, GIL..-DO GIR..-DO-2RS, GIL..-DO-2RS GIR..-DO-2TS, GIL..-DO-2TS GIKR..-PB, GIKL..-PB GAR..-DO, GAL..-DO GAR..-DO-2RS, GAL..-DO-2RS GAR..-DO-2TS, GAL..-DO-2TS GAKR..-PB, GAKL..-PB	Drop forged quenched and tempered steel C45+QT to DIN EN 10083-2, surface with zinc coating
GIHNRK..-LO GIHRK..-DO	$d \leqq 50$ mm: ▫ drop forged quenched and tempered steel C45+N to DIN EN 10083-2 ▫ surface with preservative
	$d > 50$ mm: ▫ spheroidal graphite cast iron GJS 400-15 to DIN EN 1563 ▫ surface with preservative
GK..-DO	Drop forged structural steel S355J2G3 to DIN EN 10025, surface with preservative
GF..-DO	Forged or rolled structural steel S355J2G3 to DIN EN 10025, surface with preservative

Operating temperature

The permissible operating temperature is dependent on the sliding contact surface and the sealing arrangement, see table.

If the temperature exceeds the stated values, there will be a reduction in the operating life and the effect of the sealing arrangement.

At temperatures below 0 °C, a reduction in the load carrying capacity of the rod ends must be taken into consideration.

Operating temperature

Series	Temperature °C		Reduced load carrying capacity °C
	from	to	from
GIR..-DO GIL..-DO GAR..-DO GAL..-DO	−60	+200	+100
GIR..-DO-2RS GIL..-DO-2RS GAR..-DO-2RS GAL..-DO-2RS	−30	+130	
GIR..-DO-2TS GIL..-DO-2TS GAR..-DO-2TS GAL..-DO-2TS	−30	+100	
GIKR..-PB GIKL..-PB GAKR..-PB GAKL..-PB	−60	+250	
GIHNRK..-LO GIHRK..-DO GK..-DO GF..-DO	−60	+200	

Rod ends and hydraulic rod ends, requiring maintenance

Special designs In addition to the special designs with suffixes, Schaeffler can also supply further designs by agreement:

- hydraulic rod ends requiring maintenance with other types of lubrication nipple or threaded connector for central lubrication
- hydraulic rod ends with maintenance-free spherical plain bearings GE..-UK, GE..-UK-2RS(2TS), GE..-FW, GE..-FW-2RS(2TS)
- rod ends with special threads
- rod ends with different anti-corrosion protection.

Suffixes Suffixes for available designs: see table.

Available designs

Suffix	Description	Design
2RS	Standard lip seals on both sides	Standard
2TS	Triple lip high performance seals on both sides	
C2	Radial internal clearance Group 2, smaller than normal	Special design, available by agreement only
C3	Radial internal clearance Group 3, larger than normal	
–	With other types of lubrication nipple or threaded connector for central lubrication	
–	Hydraulic rod ends with maintenance-free spherical plain bearings GE..-UK, GE..-UK-2RS (2TS),GE..-FW, GE..-FW-2RS (2TS)	
–	With special thread	
–	With different anti-corrosion protection	

Design and safety guidelines

The chapter Technical principles brings together the essential guidelines on the subjects of friction, rating life and the adjacent construction, see section Technical principles, page 20.

Principles of lubrication

The lubrication of spherical plain bearings requiring maintenance is covered in detail in the corresponding chapter for spherical plain bearings, see page 179.

Relubrication

Rod ends requiring maintenance must be lubricated.

They have relubrication facilities, except for smaller rod ends of some series that do not have lubrication grooves and lubrication holes. These rod ends are indicated in the dimension tables.

Rod ends to DIN ISO 12240-4, dimension series E with bore diameter $d = 15$ mm to 20 mm are relubricated via a hole in the rod end eye housing, *Figure 5*. For reasons of housing strength, these rod ends do not have lubrication nipples.

① Grease gun with tapered nozzle

Figure 5
Relubrication via hole

Rod ends and hydraulic rod ends, requiring maintenance

Dimensioning

In the case of rod ends, the permissible static load of the housing and shank must always be checked. In calculation of the rating life of the rod end, the decisive factor is the rating life of the spherical plain bearing fitted in the housing, see page 47.

The direction of load and the type of load determine the design of the rod end and the sliding contact surface of the spherical plain bearing.

Permissible loading of rod ends

The permissible load depends on the type of load.

Pulsating or alternating loads subject the material of the rod ends to greater stress than constant loads. For calculation, these operating conditions must be taken into consideration by means of the load factor f_b, see table.

The maximum equivalent bearing load P must not exceed the permissible load on the rod end P_{per}, see equation.

Loading of rod end

The following applies:

$$P_{per} \geqq P$$

The permissible load on the rod end P is calculated as follows:

$$P_{per} = \frac{C_{0r}}{f_b}$$

P	N
Maximum equivalent bearing load	
P_{per}	N
Permissible load on the rod end	
C_{0r}	N
Basic static load rating of the rod end	
f_b	–
Load factor, see table.	

Load factors

Type of load	Series	Load factor f_b
Unilateral load 	All series	1
Pulsating load Alternating load 	GIHNRK..-LO GIHRK..-DO GK..-DO GF..-DO GIR..-DO(-2RS, -2TS) GAR..-DO(-2RS, -2TS) GIKR..-PB GAKR..-PB	2 2,75 2,75 2,75 3 3 3 3

Basic static load rating

In this case, the basic static load rating C_{0r} indicates the load carrying capacity of the housing and shank under static tensile load, see dimension table. At room temperature, it includes a safety factor of at least 1,2 in relation to the yield strength of the material used for the housing and shank. The basic load rating describes the maximum permissible static tensile load when utilising 83% of the material yield strength at the most highly stressed cross-section.

The basic static load rating C_{0r} of the rod end refers only to the load carrying capacity of the rod end housing, see dimension table. It is based on tensile and compressive loads acting across or in the direction of the rod end shank.

Basic dynamic load rating

The basic dynamic load rating C_r refers to the spherical plain bearing fitted and is a parameter for calculating the bearing rating life, see dimension table. It is dependent on the sliding contact surface and has a significant influence on the rating life of the rod ends.

The equivalent bearing load and additional bending stresses in the shank area must be taken into consideration if, in addition to radial load in a tensile or compressive direction, other transverse forces act in an axial direction to the shank.

Calculation example for radial rod end GIKR25-PB

The rating life of the radial spherical plain bearing is calculated on the basis of the steel/bronze sliding contact surface, see section Load carrying capacity and life, page 35.

Given data

The given data for calculation of the rating life are as follows:
- machine on a packaging line
- pulsating load.

Operating parameters

Bearing load	$F_{r\,min}$	= 10 000 N
	$F_{r\,max}$	= 20 000 N
Swivel angle	ß	= 45°
Swivel frequency	f	= 20 min^{-1}
Time required for indexing operation (cycle)		= 3 s
Number of indexing operations		= 300 cycles/h
Relubrication interval	I_W	= 40 h
Operating temperature	ϑ	= 21 °C

Bearing data

Radial rod end		= GIKR25-PB
Basic dynamic load rating	C_r	= 47 100 N
Basic static load rating	C_{0r}	= 72 900 N
Sphere diameter	d_K	= 42,85 mm

Required Bearing with the required rating life $L_{hN}(ED) \geqq 5\,000$ h.

Rod ends and hydraulic rod ends, requiring maintenance

Calculation of rod end size

The permissible static load on the rod end is calculated using the load factor $f_b = 3$, see table, page 258.

$$P_{per} = \frac{C_{0r}}{f_b}$$

$$C_{0r\,min} = F_{r\,max} \cdot f_b$$

$$C_{0r\,min} = 20\,000 \cdot 3 = 60\,000 \text{ N}$$

The rod end GIKR25-PB with the basic load rating $C_{0r} = 72\,900$ N is suitable.

Checking of permissible loads

The validity of the permissible loads and sliding velocities must be checked, since useful rating life calculation is only possible within this range, see tables, page 50.

Specific bearing load

The specific bearing load must be calculated with the aid of the specific load parameter K and checked for validity, see table, page 41 and table, page 50. In the case of a concentrically acting, variable force F, $P = F_{max} = 20\,000$ N:

$$p = K \cdot \frac{P}{C_r}$$

$$p = 50 \cdot \frac{20\,000}{47\,100} = 21,23 \text{ N/mm}^2$$

Sliding velocity in swivel motion

The sliding velocity must be calculated with the aid of the sphere diameter d_K and the swivel angle β and checked for validity, see table, page 44 and table, page 50:

$$v = \frac{d_K \cdot \pi}{60 \cdot 10^3} \cdot \frac{2 \cdot \beta \cdot f}{360°}$$

$$v = \frac{42,85 \cdot \pi \cdot 2 \cdot 45 \cdot 20}{60 \cdot 10^3 \cdot 360} = 1,1 \cdot 10^{-2} \text{ m/s}$$

Specific frictional energy pv

The specific frictional energy pv must be checked for validity, see table, page 50:

$$pv = 21,23 \cdot 1,1 \cdot 10^{-2} = 0,23 \text{ N/mm}^2 \cdot \text{m/s}$$

| Determining the rating life equation | For calculation of the rating life, the valid rating life equation must be selected and then subjected to correction. |

| Selection of the valid rating life equation | For plain bearings requiring maintenance, the following applies, see page 52: |

$$L_h = \frac{K_L}{v} \cdot \left(\frac{C_r}{P} \right) \cdot f_p \cdot f_v \cdot f_\vartheta \cdot f_A \cdot f_\beta \cdot f_{dK} \cdot f_{Hz}$$

The correction factors necessary for the steel/bronze sliding contact surface must be selected from the matrix and used to correct the rating life equation appropriately, see table, page 55 and table.

Correction factors, as a function of bearing type

Series		Sliding contact surface	Correction factors						
Spherical plain bearing	Rod end		f_p	f_v	f_ϑ	f_A	f_{dK}	f_β	f_{Hz}
–	GIKR..-PB	Steel/bronze	■	■	■	■	■	■	■

| Rating life equation following correction | |

$$L_h = \frac{K_L}{v} \cdot \left(\frac{C_r}{P} \right) \cdot f_p \cdot f_v \cdot f_\vartheta \cdot f_A \cdot f_\beta \cdot f_{dK} \cdot f_{Hz}$$

| Calculation of rating life | The values for the correction factors in the corrected rating life equation must be taken from the diagrams, see page 56 and table. The specific plain bearing factor $K_L = 2{,}3$, see table, page 52. |

Correction factors

Correction factor	Source	Value
Load f_p	*Figure 13*, page 56	0,75
Sliding velocity f_v	*Figure 16*, page 58	0,71
Temperature f_ϑ	*Figure 18*, page 60	1
Condition of rotation f_A	Page 62	1
Swivel angle, oscillation angle f_β	*Figure 26*, page 65	0,76
Sphere diameter f_{dK}	*Figure 22*, page 63	0,97
Variable load f_{Hz}	*Figure 30*, page 67	1,45

| Rating life L_h | The rating life is calculated as follows: |

$$L_h = \frac{2{,}3}{1{,}1 \cdot 10^{-2}} \cdot \left(\frac{47\,100}{20\,000} \right) \cdot 0{,}75 \cdot 0{,}71 \cdot 1 \cdot 1 \cdot 0{,}76 \cdot 0{,}97 \cdot 1{,}45$$

$$L_h = 280\ h$$

Rod ends and hydraulic rod ends, requiring maintenance

Rating life L_{hN} with periodic relubrication

The rating life can be increased by means of periodic relubrication as a function of the relubrication interval, see page 68.

The necessary relubrication interval and preferred relubrication interval must be calculated and checked for validity, see page 68:

$$l_w \leqq 0,5 \cdot L_h$$

$$l_w \leq 0,5 \cdot 280$$
$$40\,h < 140\,h$$

Based on a relubrication frequency $L_h/l_W = 280\,h/40\,h = 7$, a correction factor $f_{NH} = 2,1$ is determined, *Figure 31*, page 68. Based on a swivel angle $\beta = 45°$, the correction factor $f_{N\beta} = 3,2$, *Figure 32*, page 68.

$$L_{hN} = L_h \cdot f_{NH} \cdot f_{N\beta}$$

$$L_{hN} = 280 \cdot 2,1 \cdot 3,2 = 1\,881\,h$$

Taking account of the operating duration

3 s/cycle gives 20 cycles/min at a utilisation of 100%. The number of indexing operations of 300 cycles/h gives 5 cycles/min

The operating duration ED is calculated as follows:

$$ED = \frac{5}{20} = 0,25$$

Rating life L_{hN} taking account of the operating duration ED:

$$L_{hN}(ED) = \frac{L_{hN}}{ED}$$

$$L_{hN}(ED) = \frac{1\,881\,h}{0,25} = 7\,524\,h$$

Result

The selected radial rod end GIKR25-PB fulfils the requirement for a rating life $L_{hN}(ED) \geqq 5\,000\,h$.

**Welding
of hydraulic rod ends**

The thermal distortion occurring during welding must be kept
as small as possible.

Recommendation

The following procedure has proved effective in the welding of rod
ends:

- ◼ The thickness of the weld seam should be as small as possible.
  This should be based on the load.
- ◼ If thicker weld seams are necessary, these should be welded
  in several layers.
- ◼ Electrodes with low heat generation should be used, such as
  Kb electrodes.
- ◼ The current strength selected for welding should be towards
  the lower limit.

⚠ Welding current must not pass through the rod end, otherwise
macroscopic protrusions may occurr on the curved inner or outer
rings.

Rod ends and hydraulic rod ends, requiring maintenance

Tightening torques for fixing screws in hydraulic rod ends

The fixing screws in hydraulic rod ends must be tightened according to a defined scheme, *Figure 6* and table.

① Slotted on both sides
② Slotted on one side
A, B, C, D = hexagonal socket screw
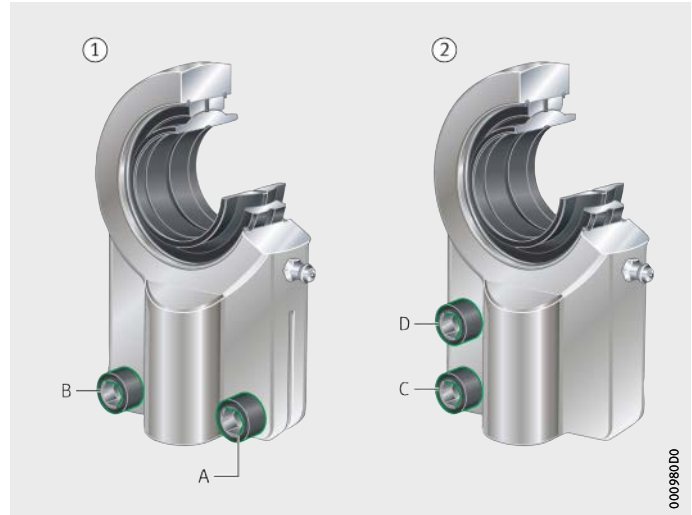
Figure 6
Hydraulic rod ends

Tightening torques

Designation		Fixing screw	Tightening torque M_A Step, screw				
			1	2	3	4	1, 2, 3, 4
			A	B	A	B	C, D, C, D
			Nm				
GIHNRK12	–	M5	0,16	2,6	8	8	–
GIHNRK16	–	M6	0,26	4,3	13	13	–
GIHNRK20	GIHRK20	M8	0,64	11	32	32	–
GIHNRK25	GIHRK25	M8	0,64	11	32	32	–
–	GIHRK30	M8	0,64	11	32	32	–
GIHNRK32	–	M10	1,2	21	64	64	–
–	GIHRK35	M10	1,2	21	64	64	–
GIHNRK40	GIHRK40	M10	1,2	21	64	64	–
GIHNRK50	GIHRK50	M12	2,2	36	110	110	–
–	GIHRK60	M10	–	–	–	–	46
GIHNRK63	–	M12	–	–	–	–	80
GIHNRK70	–	M16	–	–	–	–	195
–	GIHRK70	M12	–	–	–	–	80
GIHNRK80	GIHRK80	M16	–	–	–	–	195
GIHNRK90	GIHRK90	M16	–	–	–	–	195
GIHNRK100	GIHRK100	M20	–	–	–	–	385
GIHNRK110	GIHRK110	M20	–	–	–	–	385
–	GIHRK120	M24	–	–	–	–	660
GIHNRK125	–	M20	–	–	–	–	385
GIHNRK160	–	M24	–	–	–	–	660
GIHNRK200	–	M30	–	–	–	–	1350

Accuracy The main dimensions of the rod ends conform to DIN ISO 12240-4.

All connecting threads have metric dimensions to DIN 13, tolerance class central, 6H ⓔ, 6g ⓔ.

The stated thread length is the minimum usable length, based on normal chamfering practice for the thread of the mating component.

Rod ends

With internal thread, requiring maintenance
DIN ISO 12240-4, dimension series E, type F
Open or sealed

GIR..-DO
Steel/steel

Dimension table · Dimensions in mm											
Designation[1]			Mass	Dimensions							
Open	Sealed		m ≈kg	d	D	B	d_K	d_1	d_2	d_3	
GIR6-DO[5]	–	–	0,023	**6**$_{-0,008}$	14	6$_{-0,12}$	10	8	21	M6	
GIR8-DO[5]	–	–	0,039	**8**$_{-0,008}$	16	8$_{-0,12}$	13	10,2	24	M8	
GIR10-DO[5]	–	–	0,066	**10**$_{-0,008}$	19	9$_{-0,12}$	16	13,2	29	M10	
GIR12-DO[5]	–	–	0,1	**12**$_{-0,008}$	22	10$_{-0,12}$	18	14,9	34	M12	
GIR15-DO[6]	–	–	0,18	**15**$_{-0,008}$	26	12$_{-0,12}$	22	18,4	40	M14	
GIR17-DO[6]	**GIR17-DO-2RS**[6]	–	0,25	**17**$_{-0,008}$	30	14$_{-0,12}$	25	20,7	46	M16	
GIR20-DO[6]	**GIR20-DO-2RS**[6]	–	0,36	**20**$_{-0,01}$	35	16$_{-0,12}$	29	24,2	53	M20×1,5	
GIR25-DO	**GIR25-DO-2RS**	–	0,66	**25**$_{-0,01}$	42	20$_{-0,12}$	35,5	29,3	64	M24×2	
GIR30-DO	**GIR30-DO-2RS**	**GIR30-DO-2TS**	0,98	**30**$_{-0,01}$	47	22$_{-0,12}$	40,7	34,2	73	M30×2	
–	**GIR35-DO-2RS**	**GIR35-DO-2TS**	1,43	**35**$_{-0,012}$	55	25$_{-0,12}$	47	39,8	82	M36×3	
–	**GIR40-DO-2RS**	**GIR40-DO-2TS**	2,1	**40**$_{-0,012}$	62	28$_{-0,12}$	53	45	92	M39×3[7]	
–	**GIR45-DO-2RS**	**GIR45-DO-2TS**	2,7	**45**$_{-0,012}$	68	32$_{-0,12}$	60	50,8	102	M42×3[7]	
–	**GIR50-DO-2RS**	**GIR50-DO-2TS**	3,54	**50**$_{-0,012}$	75	35$_{-0,12}$	66	56	112	M45×3[7]	
–	**GIR60-DO-2RS**	**GIR60-DO-2TS**	5,6	**60**$_{-0,015}$	90	44$_{-0,15}$	80	66,8	135	M52×3[7]	
–	**GIR70-DO-2RS**	**GIR70-DO-2TS**	8,62	**70**$_{-0,015}$	105	49$_{-0,15}$	92	77,9	160	M56×4[7]	
–	**GIR80-DO-2RS**	**GIR80-DO-2TS**	13,2	**80**$_{-0,015}$	120	55$_{-0,15}$	105	89,4	180	M64×4[7]	

[1] For a left hand thread, the R in the designation is replaced by an L, for example GIL6-DO.

[2] The values for the tilt angle α are subject to tolerances.

[3] Basic load rating of housing.

[4] This differs from DIN ISO 12240-4, dimension series E.

[5] No relubrication facility.

[6] No taper type lubrication nipple.
Relubrication via lubrication hole in housing.

[7] Thread runout or thread groove at manufacturer's discretion.
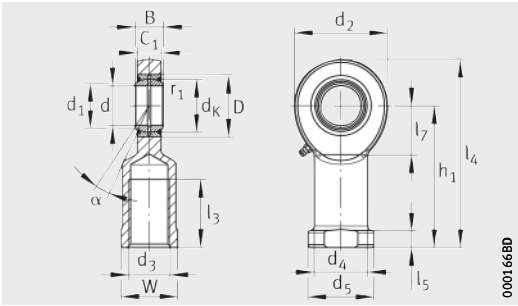
GIR..-DO-2RS, GIR..-DO-2TS
Steel/steel

d_4	h_1	C_1	α[2] °	l_3	l_4	l_5	l_7	d_5	W	Chamfer dimension r_1 min.	Basic load ratings dyn. C_r N	stat. C_{0r}[3] N	Radial internal clearance[4] Group N (CN)
10	30	4,4	13	11	40,5	5	12	13	11	0,3	3 400	10 300	0,023 – 0,068
12,5	36	6	15	15	48	5	14	16	14	0,3	5 590	16 000	0,023 – 0,068
15	43	7	12	20	57,5	6,5	15	19	17	0,3	8 160	22 000	0,023 – 0,068
17,5	50	8	11	23	67	6,5	18	22	19	0,3	10 800	30 400	0,023 – 0,068
21	61	10	8	30	81	8	20	26	22	0,3	16 900	44 800	0,030 – 0,082
24	67	11	10	34	90	10	23	30	27	0,3	21 300	56 500	0,030 – 0,082
27,5	77	13	9	40	103,5	10	27	35	32	0,3	29 600	75 600	0,030 – 0,082
33,5	94	17	7	48	126	12	32	42	36	0,6	48 300	88 300	0,037 – 0,1
40	110	19	6	56	146,5	15	37	50	41	0,6	62 300	119 000	0,037 – 0,1
47	125	21	6	60	166	15	42	58	50	0,6	79 900	159 000	0,037 – 0,1
52	142	23	7	65	188	18	48	65	55	0,6	99 100	194 000	0,043 – 0,12
58	145	27	7	65	196	20	52	70	60	0,6	128 000	259 000	0,043 – 0,12
62	160	30	6	68	216	20	60	75	65	0,6	157 000	314 000	0,043 – 0,12
70	175	38	6	70	242,5	20	75	88	75	1	245 000	485 000	0,043 – 0,12
80	200	42	6	80	280	20	87	98	85	1	313 000	564 000	0,055 – 0,142
95	230	47	6	85	320	25	100	110	100	1	402 000	690 000	0,055 – 0,142

Rod ends

With external thread, requiring maintenance
DIN ISO 12240-4, dimension series E, type M
Open or sealed

GAR..-DO
Steel/steel

Dimension table · Dimensions in mm									
Designation[1]			Mass	Dimensions					
Open	Sealed		m $\approx$ kg	d	D	B	d_K	d_1	d_2
GAR6-DO[5]	–	–	0,018	**$6_{-0,008}$**	14	$6_{-0,12}$	10	8	21
GAR8-DO[5]	–	–	0,033	**$8_{-0,008}$**	16	$8_{-0,12}$	13	10,2	24
GAR10-DO[5]	–	–	0,056	**$10_{-0,008}$**	19	$9_{-0,12}$	16	13,2	29
GAR12-DO[5]	–	–	0,086	**$12_{-0,008}$**	22	$10_{-0,12}$	18	14,9	34
GAR15-DO[6]	–	–	0,15	**$15_{-0,008}$**	26	$12_{-0,12}$	22	18,4	40
GAR17-DO[6]	**GAR17-DO-2RS**[6]	–	0,21	**$17_{-0,008}$**	30	$14_{-0,12}$	25	20,7	46
GAR20-DO[6]	**GAR20-DO-2RS**[6]	–	0,33	**$20_{-0,01}$**	35	$16_{-0,12}$	29	24,2	53
GAR25-DO	**GAR25-DO-2RS**	–	0,6	**$25_{-0,01}$**	42	$20_{-0,12}$	35,5	29,3	64
GAR30-DO	**GAR30-DO-2RS**	**GAR30-DO-2TS**	0,95	**$30_{-0,01}$**	47	$22_{-0,12}$	40,7	34,2	73
–	**GAR35-DO-2RS**	**GAR35-DO-2TS**	1,53	**$35_{-0,012}$**	55	$25_{-0,12}$	47	39,8	82
–	**GAR40-DO-2RS**	**GAR40-DO-2TS**	1,97	**$40_{-0,012}$**	62	$28_{-0,12}$	53	45	92
–	**GAR45-DO-2RS**	**GAR45-DO-2TS**	2,66	**$45_{-0,012}$**	68	$32_{-0,12}$	60	50,8	102
–	**GAR50-DO-2RS**	**GAR50-DO-2TS**	3,53	**$50_{-0,012}$**	75	$35_{-0,12}$	66	56	112
–	**GAR60-DO-2RS**	**GAR60-DO-2TS**	5,92	**$60_{-0,015}$**	90	$44_{-0,15}$	80	66,8	135
–	**GAR70-DO-2RS**	**GAR70-DO-2TS**	8,51	**$70_{-0,015}$**	105	$49_{-0,15}$	92	77,9	160
–	**GAR80-DO-2RS**	**GAR80-DO-2TS**	12,5	**$80_{-0,015}$**	120	$55_{-0,15}$	105	89,4	180

[1] For a left hand thread, the R in the designation is replaced by an L, for example GAL6-DO.

[2] The values for the tilt angle α are subject to tolerances.

[3] Basic load rating of housing.

[4] This differs from DIN ISO 12240-4, dimension series E.

[5] No relubrication facility.

[6] No taper type lubrication nipple.
Relubrication via lubrication hole in housing.
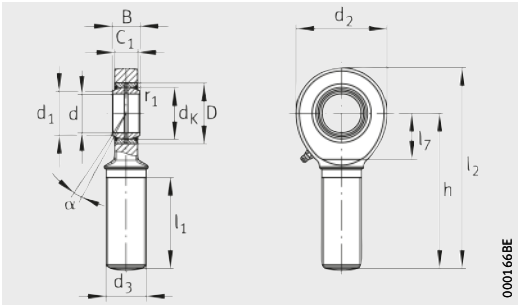
GAR..-DO-2RS, GAR..-DO-2TS
Steel/steel

d$_3$	h	C$_1$	$\alpha^{2)}$ °	l$_1$	l$_2$	l$_7$	Chamfer dimension r$_1$ min.	Basic load ratings dyn. C$_r$ N	stat. C$_{0r}^{3)}$ N	Radial internal clearance$^{4)}$ Group N (CN)
M6	36	4,4	13	18	46,5	12	0,3	3 400	6 930	0,023 − 0,068
M8	42	6	15	22	54	14	0,3	5 590	12 900	0,023 − 0,068
M10	48	7	12	26	62,5	15	0,3	8 160	20 600	0,023 − 0,068
M12	54	8	11	28	71	18	0,3	10 800	30 200	0,023 − 0,068
M14	63	10	8	34	83	20	0,3	16 900	41 600	0,030 − 0,082
M16	69	11	10	36	92	23	0,3	21 300	56 500	0,030 − 0,082
M20×1,5	78	13	9	43	104,5	27	0,3	29 600	75 600	0,030 − 0,082
M24×2	94	17	7	53	126	32	0,6	48 300	88 300	0,037 − 0,1
M30×2	110	19	6	65	146,5	37	0,6	62 300	119 000	0,037 − 0,11
M36×3	140	21	6	82	181	42	0,6	79 900	159 000	0,037 − 0,1
M39×3	150	23	7	86	196	48	0,6	99 100	194 000	0,043 − 0,12
M42×3	163	27	7	94	214	52	0,6	128 000	259 000	0,043 − 0,12
M45×3	185	30	6	107	241	60	0,6	157 000	314 000	0,043 − 0,12
M52×3	210	38	6	115	277,5	75	1	245 000	485 000	0,043 − 0,12
M56×4	235	42	6	125	315	87	1	313 000	564 000	0,055 − 0,142
M64×4	270	47	6	140	360	100	1	402 000	690 000	0,055 − 0,142

Rod ends

With internal thread, requiring maintenance
DIN ISO 12240-4, dimension series K, type F
Open design
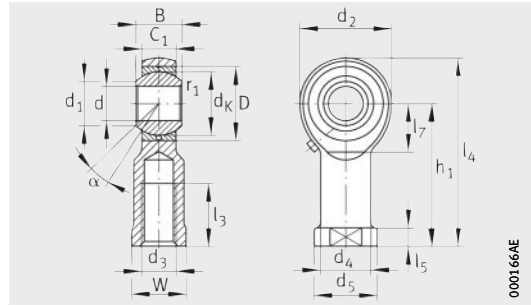
GIKR..-PB
Steel/bronze

Dimension table · Dimensions in mm											
Designation[1]	Mass	Dimensions									
	m	d	D	B	d_K	d_1	d_2	d_3	d_4	h_1	
	$\approx$kg	H7									
GIKR6-PB	0,029	$6^{+0,012}$	16	$9_{-0,12}$	12,7	9	20	M6	10	30	
GIKR8-PB	0,05	$8^{+0,015}$	19	$12_{-0,12}$	15,875	10,4	24	M8	12,5	36	
GIKR10-PB	0,081	$10^{+0,015}$	22	$14_{-0,12}$	19,05	12,9	28	M10	15	43	
GIKR12-PB	0,13	$12^{+0,018}$	26	$16_{-0,12}$	22,225	15,4	32	M12	17,5	50	
GIKR14-PB	0,19	$14^{+0,018}$	28[4]	$19_{-0,12}$	25,4	16,9	36	M14	21	57	
GIKR16-PB	0,25	$16^{+0,018}$	32	$21_{-0,12}$	28,575	19,4	42	M16	22	64	
GIKR20-PB	0,43	$20^{+0,021}$	40	$25_{-0,12}$	34,925	24,4	50	M20×1,5	27,5	77	
GIKR25-PB	0,76	$25^{+0,021}$	47	$31_{-0,12}$	42,85	29,6	60	M24×2	33,5	94	
GIKR30-PB	1,18	$30^{+0,021}$	55	$37_{-0,12}$	50,8	34,8	70	M30×2	40	110	

Other dimensions by agreement.

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[1] For a left hand thread, the R in the designation is replaced by an L, for example GIKL6-PB.

[2] The values for the tilt angle α are subject to tolerances.

[3] Basic load rating of housing.

[4] This differs from DIN ISO 12240-4, dimension series K.

C_1	$\alpha^{2)}$ $^\circ$	l_3	l_4	l_5	l_7	d_5	W	Chamfer dimension r_1 min.	Basic load ratings dyn. C_r N	stat. $C_{0r}^{3)}$ N	Radial internal clearance[4]
6,75	13	12	40	5	11	13	11	0,3	4 320	7 990	0 – 0,035
9	14	16	48	5	13	16	14	0,3	7 140	13 100	0 – 0,035
10,5	13	20	57	6,6	15	19	17	0,3	10 000	18 500	0 – 0,035
12	13	22	66	6,5	17	22	19	0,3	13 300	20 800	0 – 0,035
13,5	16	25	75	8	18	26	22	0,3	17 100	32 000	0 – 0,035
15	15	28	85	8	23	28	22	0,3	21 400	45 300	0 – 0,035
18	14	33	102	10	26	35	30	0,3	31 400	45 600	0 – 0,035
22	15	42	124	12	32	42	36	0,3	47 100	72 900	0 – 0,035
25	17	51	145	15	37	50	41	0,3	63 500	95 900	0 – 0,035

Rod ends

With external thread, requiring maintenance
DIN ISO 12240-4, dimension series K, type M
Open design
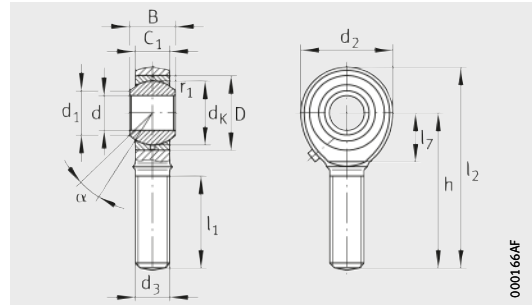
GAKR..-PB
Steel/bronze

Dimension table · Dimensions in mm										
Designation[1]	Mass	Dimensions								
	m ≈kg	d H7	D	B	d_K	d_1	d_2	d_3	h	
GAKR6-PB	0,023	**6$^{+0,012}$**	16	9$_{-0,12}$	12,7	9	20	M6	36	
GAKR8-PB	0,044	**8$^{+0,015}$**	19	12$_{-0,12}$	15,875	10,4	24	M8	42	
GAKR10-PB	0,07	**10$^{+0,015}$**	22	14$_{-0,12}$	19,05	12,9	28	M10	48	
GAKR12-PB	0,11	**12$^{+0,018}$**	26	16$_{-0,12}$	22,225	15,4	32	M12	54	
GAKR14-PB	0,16	**14$^{+0,018}$**	28[4]	19$_{-0,12}$	25,4	16,9	36	M14	60	
GAKR16-PB	0,23	**16$^{+0,018}$**	32	21$_{-0,12}$	28,575	19,4	42	M16	66	
GAKR20-PB	0,39	**20$^{+0,021}$**	40	25$_{-0,12}$	34,925	24,4	50	M20×1,5	78	
GAKR25-PB	0,67	**25$^{+0,021}$**	47	31$_{-0,12}$	42,85	29,6	60	M24×2	94	
GAKR30-PB	1,1	**30$^{+0,021}$**	55	37$_{-0,12}$	50,8	34,8	70	M30×2	110	

Other dimensions by agreement.

[1] For a left hand thread, the R in the designation is replaced by an L, for example GAKL6-PB.

[2] The values for the tilt angle α are subject to tolerances.

[3] Basic load rating of housing.

[4] This differs from DIN ISO 12240-4, dimension series K.

C_1	$\alpha^{2)}$	l_1	l_2	l_7	Chamfer dimension r_1	Basic load ratings dyn. C_r	stat. $C_{0r}^{3)}$	Radial internal clearance[4]
	°				min.	N	N	
6,75	13	21	46	–	0,3	4 320	6 930	0 – 0,035
9	14	25	54	–	0,3	7 140	12 900	0 – 0,035
10,5	13	28	62	–	0,3	10 000	18 500	0 – 0,035
12	13	32	70	–	0,3	13 300	20 800	0 – 0,035
13,5	16	36	78	18	0,3	17 100	32 000	0 – 0,035
15	15	37	87	23	0,3	21 400	45 300	0 – 0,035
18	14	45	103	26	0,3	31 400	45 600	0 – 0,035
22	15	55	124	32	0,3	47 100	72 900	0 – 0,035
25	17	66	145	37	0,3	63 500	95 900	0 – 0,035

Hydraulic rod ends

With thread clamping device
Requiring maintenance
DIN 24338, ISO 6982
Open design
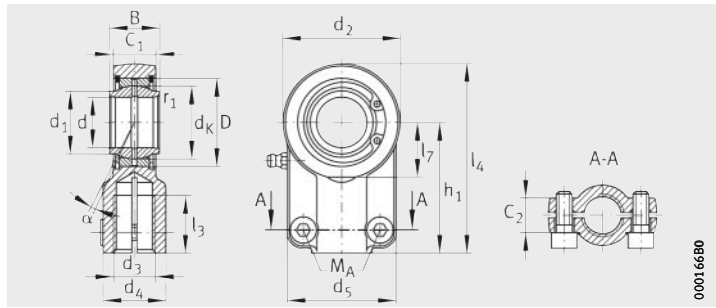
GIHNRK..-LO (d $\leqq$ 50 mm)
Steel/steel

Dimension table · Dimensions in mm												
Designation[1]	Mass	Dimensions										
	m	d	D	B	d_K	d_1	d_2	d_3	d_4	h_1	C_1	α[2]
	$\approx$kg	H7										o
GIHNRK12-LO[4][5]	0,11	$12^{+0,018}$	22	$12_{-0,18}$	18	15,5	32	M12×1,25	16,5	38	10,6	4
GIHNRK16-LO[5]	0,2	$16^{+0,018}$	28	$16_{-0,18}$	23	20	40	M14×1,5	21	44	13	4
GIHNRK20-LO	0,36	$20^{+0,021}$	35	$20_{-0,21}$	29	25	47	M16×1,5	25	52	17	4
GIHNRK25-LO	0,59	$25^{+0,021}$	42	$25_{-0,21}$	35,5	30	58	M20×1,5	30	65	21,5	4
GIHNRK32-LO	1,06	$32^{+0,025}$	52	$32_{-0,25}$	44	38	70	M27×2	38	80	27	4
GIHNRK40-LO	1,93	$40^{+0,025}$	62	$40_{-0,25}$	53	46	89	M33×2[6]	47	97	32	4
GIHNRK50-LO	3,49	$50^{+0,025}$	75	$50_{-0,25}$	66	57	108	M42×2[6]	58	120	40	4
GIHNRK63-LO	6,29	$63^{+0,03}$	95	$63_{-0,3}$	83	71,5	132	M48×2[6]	70	140	52	4
GIHNRK70-LO[7][8]	9,75	$70^{+0,03}$	105	$70_{-0,3}$	92	79	155	M56×2[6]	80	160	57	4
GIHNRK80-LO	13	$80^{+0,03}$	120	$80_{-0,3}$	105	91	168	M64×3[6]	90	180	66	4
GIHNRK90-LO[7]	17	$90^{+0,035}$	130	$90_{-0,35}$	115	99	185	M72×3[6]	100	195	72	4
GIHNRK100-LO	23,8	$100^{+0,035}$	150	$100_{-0,35}$	130	113	210	M80×3	110	210	84	4
GIHNRK110-LO[7]	31,9	$110^{+0,035}$	160	$110_{-0,35}$	140	124	235	M90×3	125	235	88	4
GIHNRK125-LO	44	$125^{+0,04}$	180	$125_{-0,4}$	160	138	262	M100×3	135	260	102	4
GIHNRK160-LO	80,3	$160^{+0,04}$	230	$160_{-0,4}$	200	177	326	M125×4	165	310	130	4
GIHNRK200-LO	167	$200^{+0,046}$	290	$200_{-0,46}$	250	221	418	M160×4	215	390	162	4
GIHNRK250-LO[7][8]	395	$250^{+0,046}$	400	$250_{-0,46}$	350	317	570	M200×4	300	530	192	4

[1] Design with left hand thread available by agreement.
For a left hand thread, the R in the designation is replaced by an L, for example GIHNLK12-LO

[2] The values for the tilt angle α are subject to tolerances.

[3] Basic load rating of housing.

[4] No relubrication facility.

[5] Bore cylindrical throughout.

[6] Thread runout or thread groove at manufacturer's discretion.

[7] Not included in DIN ISO 24338.

[8] Price and delivery by agreement.
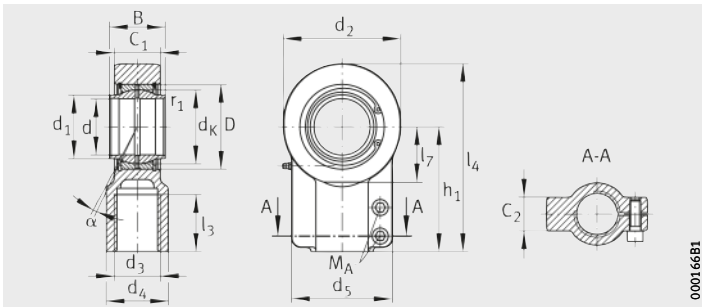
GIHNRK..-LO (d ≧ 63 mm)
Steel/steel

l_3	l_4	l_7	d_5	C_2	Chamfer dimension r_1 min.	Basic load ratings dyn. C_r N	stat. C_{0r}[3] N	Radial internal clearance	Nominal cylinder force N	Socket head screw to DIN EN ISO 4762	Tightening torque M_A Nm
17	54	14	32	10,6	0,3	10 800	24 000	0,023 − 0,068	8 000	M5×12	8
19	64	18	40	13	0,3	17 700	35 400	0,030 − 0,082	12 500	M6×16	13
23	75,5	22	47	17	0,3	29 600	41 500	0,030 − 0,082	20 000	M8×20	32
29	94	27	54	17	0,6	48 300	69 900	0,037 − 0,1	32 000	M8×20	32
37	115	32	66	22	0,6	67 300	98 800	0,037 − 0,1	50 000	M10×25	64
46	141,5	41	80	26	0,6	99 100	176 000	0,043 − 0,12	80 000	M10×25	64
57	174	50	96	32	0,6	157 000	268 000	0,043 − 0,12	125 000	M12×30	110
64	211	62	114	38	1	254 000	321 000	0,055 − 0,142	200 000	M12×35	80
76	245	70	135	42	1	313 000	475 000	0,055 − 0,142	250 000	M16×40	195
86	270	78	148	48	1	402 000	528 000	0,055 − 0,142	320 000	M16×45	195
91	296	85	160	52	1	489 000	660 000	0,055 − 0,142	400 000	M16×50	195
96	322	98	178	62	1	608 000	840 000	0,065 − 0,165	500 000	M20×60	385
106	364	105	190	62	1	655 000	1 100 000	0,065 − 0,165	635 000	M20×60	385
113	405	120	200	72	1	952 000	1 390 000	0,065 − 0,165	800 000	M20×70	385
126	488	150	250	82	1	1 360 000	2 080 000	0,065 − 0,192	1 250 000	M24×80	660
161	620	195	320	102	1,1	2 130 000	3 460 000	0,065 − 0,192	2 000 000	M30×100	1 350
205	815	265	420	142	2,5	3 570 000	5 440 000	0,065 − 0,239	3 200 000	M36×140	2 280

Hydraulic rod ends

With thread clamping device
Requiring maintenance
Open design
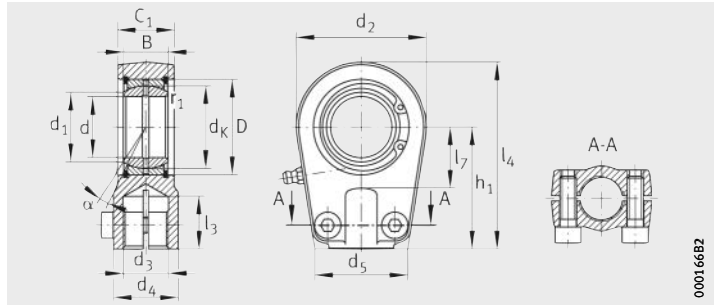
GIHRK..-DO (d ≦ 50 mm)
Steel/steel

Dimension table · Dimensions in mm												
Designation[1] [2]	Mass	Dimensions										
	m $\approx$ kg	d	D	B	d_K	d_1	d_2	d_3	d_4	h_1	$\alpha^{3)}$ °	
GIHRK20-DO	0,44	$20_{-0,01}$	35	$16_{-0,12}$	29	24,2	56	M16×1,5	25	50	9	
GIHRK25-DO	0,48	$25_{-0,01}$	42	$20_{-0,12}$	35,5	29,3	56	M16×1,5	25	50	7	
GIHRK30-DO	0,74	$30_{-0,01}$	47	$22_{-0,12}$	40,7	34,2	64	M22×1,5	32	60	6	
GIHRK35-DO	1,21	$35_{-0,012}$	55	$25_{-0,12}$	47	39,8	78	M28×1,5	40	70	6	
GIHRK40-DO	2,05	$40_{-0,012}$	62	$28_{-0,12}$	53	45	94	M35×1,5	49	85	7	
GIHRK50-DO	3,7	$50_{-0,012}$	75	$35_{-0,12}$	66	56	116	M45×1,5	61	105	6	
GIHRK60-DO	5,76	$60_{-0,015}$	90	$44_{-0,15}$	80	66,8	130	M58×1,5	75	130	6	
GIHRK70-DO	8,81	$70_{-0,015}$	105	$49_{-0,15}$	92	77,9	154	M65×1,5	86	150	6	
GIHRK80-DO	13,7	$80_{-0,015}$	120	$55_{-0,15}$	105	89,4	176	M80×2	102	170	6	
GIHRK90-DO	20,6	$90_{-0,02}$	130	$60_{-0,2}$	115	98,1	206	M100×2	124	210	5	
GIHRK100-DO	28	$100_{-0,02}$	150	$70_{-0,2}$	130	109,5	230	M110×2	138	235	7	
GIHRK110-DO	41,7	$110_{-0,02}$	160	$70_{-0,2}$	140	121,2	265	M120×3	152	265	6	
GIHRK120-DO	75,9	$120_{-0,02}$	180	$85_{-0,2}$	160	135,6	340	M130×3	172	310	6	

For rod ends of sizes 20 mm, 25 mm and 30 mm, thread runout to DIN 76.

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[1] Design with left hand thread available by agreement.
For a left hand thread, the R in the designation is replaced by an L, for example GIHLK20-DO.

[2] These hydraulic rod ends are also available by agreement with maintenance-free spherical plain
bearings GE..-UK, GE..-UK-2RS, GE..-UK-2TS, GE..-FW, GE..-FW-2RS and GE..-FW-2TS.
Attention!
In this case, the basic dynamic load ratings C_r correspond to the values for maintenance-free spherical plain bearings,
see pages starting page 154 and starting page 160.

[3] The values for the tilt angle α are subject to tolerances.

[4] Basic load rating of housing.
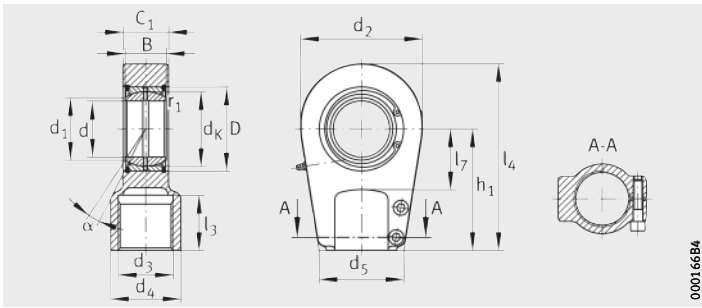
GIHRK..-DO (d $\geqq$ 60 mm)
Steel/steel

l_3	l_4	l_7	d_5	C_1	Chamfer dimension r_1 min.	Basic load ratings dyn. C_r N	stat. C_{0r}[4) N	Radial internal clearance	Socket head screw to DIN EN ISO 4762	Tightening torque M_A Nm
17	78	25	41	19	0,3	29 600	81 100	0,030 – 0,082	M8×20	32
17	78	25	41	23	0,6	48 300	65 500	0,037 – 0,1	M8×25	32
23	92	30	46	28	0,6	62 300	96 800	0,037 – 0,1	M8×25	32
29	109	38	58	30	0,6	79 900	140 000	0,037 – 0,1	M10×30	64
36	132	45	66	35	0,6	99 100	228 000	0,043 – 0,12	M10×35	64
46	163	55	88	40	0,6	157 000	333 000	0,043 – 0,12	M12×35	110
59	200	65	90	50	1	245 000	327 000	0,043 – 0,12	M10×45	46
66	232	75	100	55	1	313 000	441 000	0,055 – 0,142	M12×50	80
81	265	80	125	60	1	402 000	551 000	0,055 – 0,142	M16×50	195
101	323	90	146	65	1	489 000	811 000	0,055 – 0,142	M16×60	195
111	360	105	166	70	1	608 000	920 000	0,065 – 0,165	M20×60	385
125	407,5	115	190	80	1	655 000	1 380 000	0,065 – 0,165	M20×70	385
135	490	140	217	90	1	952 000	2 370 000	0,065 – 0,165	M24×80	660

Hydraulic rod ends

With circular welding face
Requiring maintenance
DIN ISO 12240-4, dimension series E, type S
Open design

GK..-DO
Steel/steel

Dimension table · Dimensions in mm										
Designation[1]	Mass	Dimensions								
	m	d	D	B	d_K	d_1	d_2	d_6	h_2	
	$\approx$ kg									
GK10-DO[5][6]	0,046	$10_{-0,008}$	19	$9_{-0,12}$	16	13,2	29	15	24	
GK12-DO[5][6]	0,069	$12_{-0,008}$	22	$10_{-0,12}$	18	14,9	34	17,5	27	
GK15-DO[5][6]	0,12	$15_{-0,008}$	26	$12_{-0,12}$	22	18,4	40	21	31	
GK17-DO[7]	0,17	$17_{-0,008}$	30	$14_{-0,12}$	25	20,7	46	24	35	
GK20-DO[7]	0,25	$20_{-0,01}$	35	$16_{-0,12}$	29	24,2	53	27,5	38	
GK25-DO	0,45	$25_{-0,01}$	42	$20_{-0,12}$	35,5	29,3	64	33,5	45	
GK30-DO	0,65	$30_{-0,01}$	47	$22_{-0,12}$	40,7	34,2	73	40	51	
GK35-DO	0,98	$35_{-0,012}$	55	$25_{-0,12}$	47	39,8	82	47	61	
GK40-DO	1,32	$40_{-0,012}$	62	$28_{-0,12}$	53	45	92	52	69	
GK45-DO	1,89	$45_{-0,012}$	68	$32_{-0,12}$	60	50,8	102	58	77	
GK50-DO	2,55	$50_{-0,012}$	75	$35_{-0,12}$	66	56	112	62	88	
GK60-DO	4,3	$60_{-0,015}$	90	$44_{-0,15}$	80	66,8	135	70	100	
GK70-DO	6,53	$70_{-0,015}$	105	$49_{-0,15}$	92	77,9	160	80	115	
GK80-DO	10,1	$80_{-0,015}$	120	$55_{-0,15}$	105	89,4	180	95	141	

[1] These hydraulic rod ends are also available by agreement with maintenance-free spherical plain
bearings GE..-UK, GE..-UK-2RS, GE..-UK-2TS, GE..-FW, GE..-FW-2RS and GE..-FW-2TS.
Attention!
In this case, the basic dynamic load ratings C_r correspond to the values for maintenance-free spherical plain bearings,
see pages starting page 154 and starting page 160.

[2] The values for the tilt angle α are subject to tolerances.

[3] Basic load rating of housing.

[4] This deviates from DIN ISO 12240-4.

[5] No relubrication facility.

[6] Price and delivery by agreement.

[7] No taper type lubrication nipple. Relubrication via lubrication hole in housing.

C_1	$\alpha^{2)}$	l_6	l_7	l_8	d_7	Chamfer dimension r_1	Basic load ratings dyn. C_r	stat. $C_{0r}^{3)}$	Radial internal clearance[4] Group N (CN)
	°					min.	N	N	
7	12	38,5	15	2	3	0,3	8 160	15 600	0,023 – 0,068
8	11	44	18	2	3	0,3	10 800	21 600	0,023 – 0,068
10	8	51	20	2,5	4	0,3	16 900	31 800	0,030 – 0,082
11	10	58	23	3	4	0,3	21 300	40 100	0,030 – 0,082
13	9	64,5	27	3	4	0,3	29 600	53 700	0,030 – 0,082
17	7	77	32	4	4	0,6	48 300	70 800	0,037 – 0,1
19	6	87,5	37	4	4	0,6	62 300	95 700	0,037 – 0,1
21	6	102	42	4	4	0,6	79 900	128 000	0,037 – 0,1
23	7	115	48	5	4	0,6	99 100	156 000	0,043 – 0,12
27	7	128	52	5	6	0,6	128 000	208 000	0,043 – 0,12
30	6	144	60	6	6	0,6	157 000	252 000	0,043 – 0,12
3	6	167,5	75	8	6	1	245 000	389 000	0,043 – 0,12
42	6	195	87	10	6	1	313 000	511 000	0,055 – 0,142
47	6	231	100	10	6	1	402 000	624 000	0,055 – 0,142

Hydraulic rod ends

With rectangular welding face
Requiring maintenance
Open design
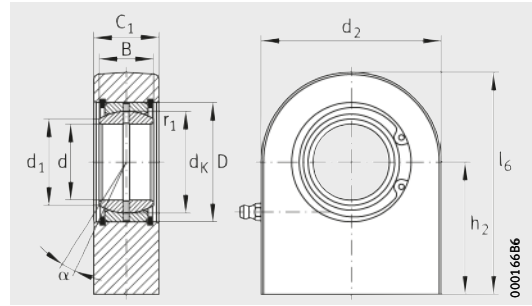
GF..-DO
Steel/steel

Dimension table · Dimensions in mm								
Designation[1]	Mass	Dimensions						
	m	d	D	B	d_K	d_1	d_2	h_2
	$\approx$ kg							
GF20-DO	0,35	$20_{-0,01}$	35	$16_{-0,12}$	29	24,2	50	38
GF25-DO	0,53	$25_{-0,01}$	42	$20_{-0,12}$	35,5	29,3	55	45
GF30-DO	0,87	$30_{-0,01}$	47	$22_{-0,12}$	40,7	34,2	65	51
GF35-DO	1,5	$35_{-0,012}$	55	$25_{-0,12}$	47	39,8	83	61
GF40-DO	2,4	$40_{-0,012}$	62	$28_{-0,12}$	53	45	100	69
GF45-DO	3,4	$45_{-0,012}$	68	$32_{-0,12}$	60	50,8	110	77
GF50-DO	4,4	$50_{-0,012}$	75	$35_{-0,12}$	66	56	123	88
GF60-DO	7,1	$60_{-0,015}$	90	$44_{-0,15}$	80	66,8	140	100
GF70-DO	10,5	$70_{-0,015}$	105	$49_{-0,15}$	92	77,9	164	115
GF80-DO	15	$80_{-0,015}$	120	$55_{-0,15}$	105	89,4	180	141
GF90-DO[4]	23,5	$90_{-0,02}$	130	$60_{-0,2}$	115	98,1	226	150
GF100-DO[4]	31,5	$100_{-0,02}$	150	$70_{-0,2}$	130	109,5	250	170
GF110-DO[4]	48	$110_{-0,02}$	160	$70_{-0,2}$	140	121,2	295	185
GF120-DO[4]	79	$120_{-0,02}$	180	$85_{-0,2}$	160	135,6	360	210

[1] These hydraulic rod ends are also available by agreement with maintenance-free spherical plain
bearings GE..-UK, GE..-UK-2RS, GE..-UK-2TS, GE..-FW, GE..-FW-2RS and GE..-FW-2TS.
Attention!
In this case, the basic dynamic load ratings C_r correspond to the values for maintenance-free spherical plain bearings,
see pages starting page 154 and starting page 160.

[2] The values for the tilt angle α are subject to tolerances.

[3] Basic load rating of housing.

[4] Price and delivery by agreement.

C_1 nom.	C_1 max.	α [2] °	l_6	Chamfer dimension r_1 min.	Basic load ratings dyn. C_r N	stat. C_{0r} [3] N	Radial internal clearance
19	20	9	63	0,3	29 600	65 600	0,030 − 0,082
23	24	7	72,5	0,6	48 300	68 800	0,037 − 0,1
28	29	6	83,5	0,6	62 300	116 000	0,037 − 0,1
30	31	6	102,5	0,6	79 900	193 000	0,037 − 0,1
35	36,5	7	119	0,6	99 100	306 000	0,043 − 0,12
40	41,5	7	132	0,6	128 000	386 000	0,043 − 0,12
40	41,5	6	149,5	0,6	157 000	442 000	0,043 − 0,12
50	52,5	6	170	1	245 000	558 000	0,043 − 0,12
55	58	6	197	1	313 000	725 000	0,055 − 0,142
60	63	6	231	1	402 000	804 000	0,055 − 0,142
65	69	5	263	1	489 000	1 350 000	0,055 − 0,142
70	74	7	295	1	608 000	1 520 000	0,065 − 0,165
80	85	6	332,5	1	655 000	2 340 000	0,065 − 0,165
90	95	6	390	1	952 000	3 400 000	0,065 − 0,165
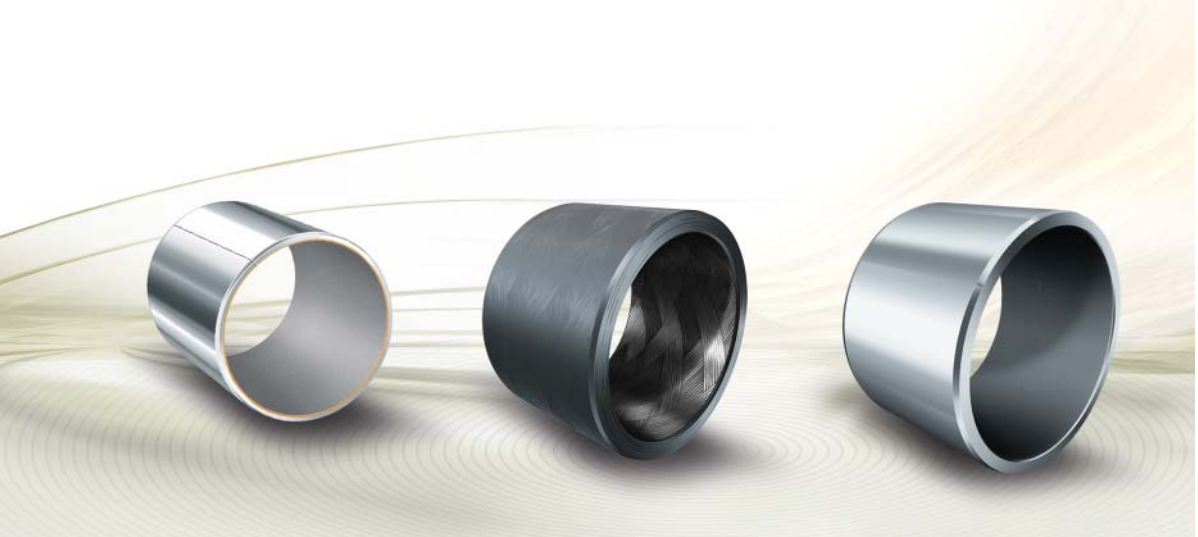
Plain bushes

Metal/polymer composite plain bushes
Elgotex filament wound bushes
Elgoglide plain bushes

Plain bushes

The maintenance-free plain bearing material E40 is, due to PTFE, intended for dry running. These bearings are particularly suitable where the bearing position must be maintenance-free, there is a risk of lubricant starvation or where lubricant is unacceptable or undesirable. E40 can be used for rotary and oscillating motion as well as for short stroke linear motion.

The bearings are rolled from a cut section of strip and have a butt joint over the entire width of the bearing.

The maintenance-free wound bushes made from filament composite are non-metallic and thus resistant to numerous media. They have low mass, are resistant to shocks and vibration and have a low coefficient of friction. Lubrication of the bearings is not necessary. The performance capability of the bearings is higher than the metal/polymer composite plain bearings and lower than ELGOGLIDE plain bushes.

For use in water, Schaeffler has developed the sliding material ELGOTEX-WA. The performance capability in salt water has been certified in accordance with specification MCM-0112 from Germanischer Lloyd. This approval is valid for application as rudder carrier bearings, shaft bearings, pintle bearings and bearings for stabilisers.

The maintenance-free, solid section plain bushes offer very high load carrying capacity in the same design envelope. The sliding layer ELGOGLIDE gives very long life and is particularly suitable for high alternating loads and swivel motions.

ELGOGLIDE plain bushes can support very high radial forces as well as high static loads with a unilateral load direction. They have a very low coefficient of friction.

The low-maintenance plain bearing material E50 with a sliding layer made from POM has low wear, good damping characteristics and long relubrication intervals. E50 can be used for rotary and oscillating motion and is recommended for long stroke linear motion.

The bearings are rolled from a cut section of strip and have a butt joint over the entire width of the bearing.
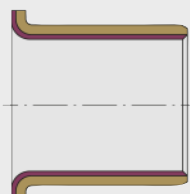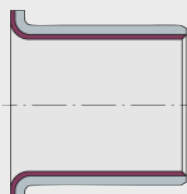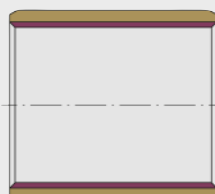
EGF..-E40-B EGF..-E40 EGB..-E40-B EGB..-E40
EGBZ..-E40

0008E9B9
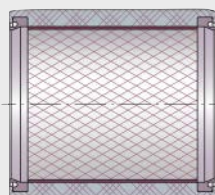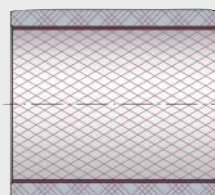
ZWB..-2RS ZWB
ZWB..-2RS-WA ZWB..-WA
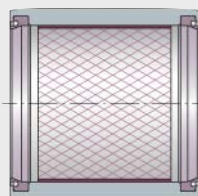
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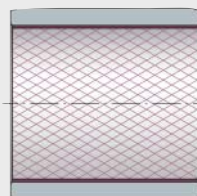
ZGB..-2RS ZGB
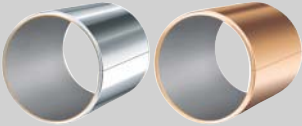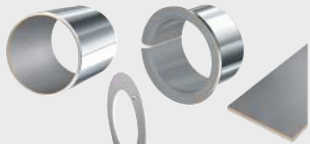
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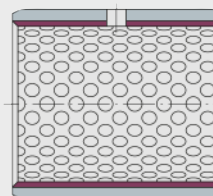
EGB..-E50
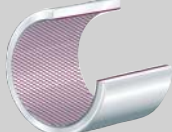
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Overview of available plain bushes

Plain bearings		Metal/polymer composite plain bearings E40, E40-B
Type of maintenance		Maintenance-free
Permissible specific bearing load	Static	250 N/mm^2
	Dynamic	140 N/mm^2
Permissible sliding velocity		2,5 m/s
Maximum permissible pv value in continuous operation		1,8 N/mm$^2 \cdot$ m/s
Permissible operating temperature[4]		−200 °C to +280 °C
Coefficient of friction		0,03 to 0,25
Dry running		✔
Grease and oil lubrication		−
Hydrodynamic operation		✔
Media lubrication		✔
Increased corrosion resistance		E40-B ■ E40 ❑
Use in water		E40-B ❑
Integrated sealing possible		−
Standard designs		EGB, EGF, EGW, EGS

✔ Possible
■ Standard design
❑ Optional

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[1] For static loads of more than 180 N/mm^2, the design of ELGOTEX filament wound bushes must be checked by the Schaeffler engineering service.

[2] Standard bushes have a static load carrying capacity of 300 N/mm^2. If a material of higher strength is used for the steel support body, this value can be increased to 500 N/mm^2.

[3] Certified specific bearing load p_{max} = 15 N/mm^2 for use in rudder carrier bearings in accordance with MCM-0112 (Germanischer Lloyd).

[4] Valid for open design (without seals).

Metal/polymer composite plain bearings E50	ELGOTEX	ELGOTEX-WA	ELGOGLIDE
Low-maintenance	Maintenance-free	Water-resistant	Maintenance-free
140 N/mm²	200 N/mm² [1]	150 N/mm²	500 N/mm² [2]
70 N/mm²	140 N/mm²	50 N/mm² [3]	300 N/mm²
2,5 m/s	0,18 m/s	0,024 m/s	0,3 m/s
3 N/mm² · m/s	2,8 N/mm² · m/s	1,2 N/mm² · m/s	7 N/mm² · m/s
−40 °C to +110 °C	−20 °C to +130 °C		−50 °C to +150 °C
0,02 to 0,2	0,03 to 0,2	0,05 to 0,15	0,02 to 0,2
–	✔	✔	✔
✔	✔	✔	–
–	–	–	–
–	✔	✔	–
❑	■	■	❑
–	❑	■	–
–	❑	❑	❑
EGB, EGW, EGS	ZWB, ZWB..-WA		ZGB

Schaeffler supplies plain bushes and metal/polymer composite plain bearings for diverse requirements, *Figure 1* and table.

Figure 1
Product spectrum
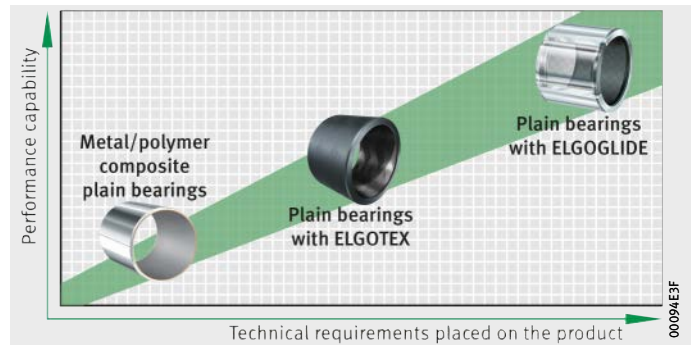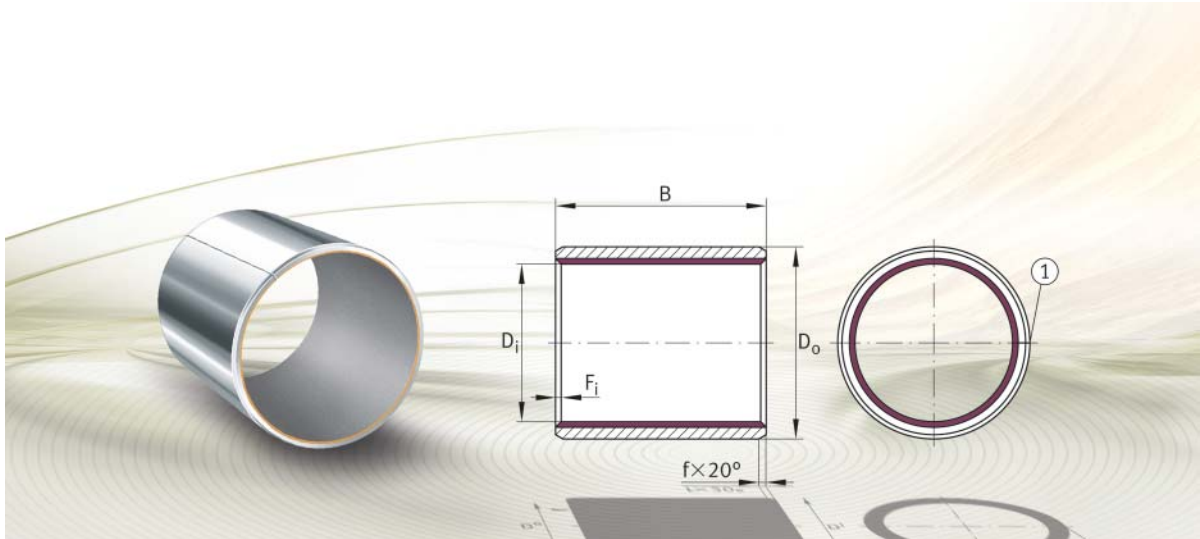
Metal/polymer composite plain bushes, maintenance-free

Bushes
Flanged bushes

Metal/polymer composite plain bushes, maintenance-free

Product overview   Metal/polymer composite plain bushes, maintenance-free

Bushes

With steel backing or
with bronze backing
Metric or inch sizes

EGB..-E40, EGBZ..-E40

00017297

EGB..-E40-B

00017298
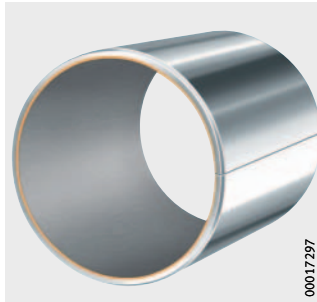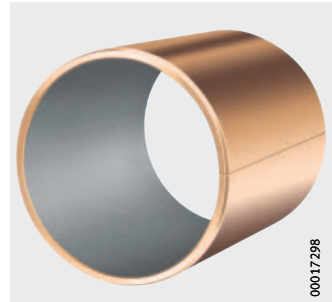
Flanged bushes

With steel backing or
with bronze backing

EGF..-E40
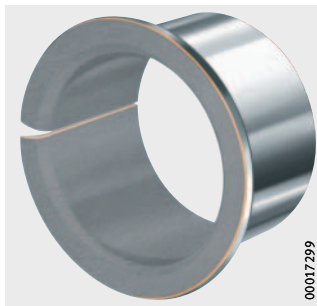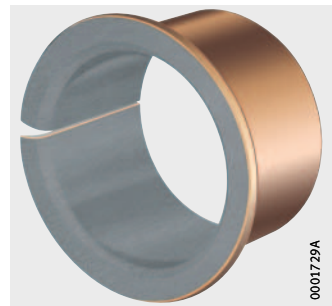
00017299

EGF..-E40-B

0001729A

Metal/polymer composite plain bushes, maintenance-free

Features
Maintenance-free plain bushes are used for rotary, oscillating and linear motion. These plain bearings are bearings for very small radial or axial design envelopes. These products are available as bushes and flanged bushes. The bushes are available in metric sizes and in inch sizes. They are rolled from a cut section of strip and have a butt joint over the entire width of the bearing.

The plain bushes are supplied with either steel backing or bronze backing. Bearings with a bronze backing have high corrosion resistance and very good thermal conductivity and are antimagnetic.

If the plain bushes are to be used in the aerospace sector or in the food or pharmaceuticals industry, please contact the Schaeffler engineering service.

Metal/polymer composite plain bushes, maintenance-free

Maintenance-free plain bearing material

For maintenance-free metal/polymer composite plain bearings from Schaeffler, the sliding material E40 and E40-B is used. The basis of the dry lubricant is polytetrafluoroethylene PTFE with embedded chemically non-reactive additives.

In the three-layered material, the steel or bronze backing has a sintered porous tin/bronze sliding layer whose pores are filled with the superimposed running-in layer, see table, *Figure 1* and *Figure 2*. The running-in layer is a plastic composite comprising PTFE and additives.

Sliding and running-in layer E40, E40-B

Chemical element	Proportion of mass w %		Layer thickness mm	
	Sliding layer	Running-in layer	Sliding layer	Running-in layer
Molybdenum disulphide MoS_2	–	max. 8	$0{,}2 - 0{,}4$	$0{,}01 - 0{,}05$
Polytetrafluoroethylene PTFE	–	$80 - 86$		
Fillers	max. 5,5	max. 19		
Tin Sn	$7 - 12$	–		
Copper Cu	Balance	–		

① Running-in layer
② Sliding layer
③ Steel backing
④ Tin layer as surface protection

Figure 1
Maintenance-free
plain bearing material E40

① Running-in layer
② Sliding layer
③ Bronze backing

Figure 2
Maintenance-free
plain bearing material E40-B

**Resistance
of the plain bearing material**

The resistance of the material E40 depends on the chemical characteristics of the individual layers:

◻ The material E40 is resistant to water, alcohols, glycols and numerous mineral and synthetic oils.

◻ The tin-plated steel surface gives adequate protection against corrosion in most cases.

◻ In the case of the material E40-B, the bronze backing is additionally resistant to water vapour and seawater.

⚠ The material E40 is not resistant to acidic media (pH < 5) and alkaline media (pH > 9). The bronze backing of E40-B is not resistant to oxidising acids and gases such as free halides, ammonia or hydrogen sulphide, especially if these gases have a high moisture content.

Technical data for E40

The sliding layer E40 is maintenance-free. It can be used for rotary and oscillating motion as well as for short stroke linear motion.

The low-wear material has good sliding characteristics (no stick-slip), a low coefficient of friction and high resistance to chemicals. It does not absorb water (it is highly resistant to swelling), does not tend to weld to metal and is also suitable for hydrodynamic operation.

Maintenance-free plain bushes are available in the variants E40 and E40-B with the following mechanical and physical characteristics, see table.

Characteristics of E40 and E40-B

Characteristic	Loading		
Maximum pv value for dry running	Continuous operation	pv	$1,8 \text{ N/mm}^2 \cdot \text{m/s}$
	For short periods		$3,6 \text{ N/mm}^2 \cdot \text{m/s}$
Permissible specific bearing load	Static	p_{max}	250 N/mm^2
	Rotary, oscillating		140 N/mm^2
Permissible sliding velocity	Dry running	v_{max}	$2,5 \text{ m/s}$
	Hydrodynamic operation		$>2,5 \text{ m/s}$
Permissible operating temperature		ϑ	$-200 \text{ °C to } +280 \text{ °C}$
Coefficient of thermal expansion	Steel backing	α_{St}	$11 \cdot 10^{-6} \text{ K}^{-1}$
	Bronze backing	α_{Bz}	$17 \cdot 10^{-6} \text{ K}^{-1}$
Coefficient of thermal conductivity	Steel backing	λ_{St}	$>42 \text{ Wm}^{-1}\text{K}^{-1}$
	Bronze backing	λ_{Bz}	$>70 \text{ Wm}^{-1}\text{K}^{-1}$
Relative electrical resistance after running-in		$R_{rel\,min}$	$>1 \ \Omega \cdot \text{cm}^2$

Metal/polymer composite plain bushes, maintenance-free

Sealing
The plain bearings are not sealed, but can be protected against the ingress of contamination and moisture by the use of external seals, see page 114.

Lubrication
Plain bearings with the sliding layer E40 contain dry lubricants and do not therefore require lubrication.

Lubrication can be used to protect the mating surface against corrosion or simply to provide sealing against contamination. It should be checked in advance, however, whether it is more advantageous in such cases to use a corrosion-resistant material for the mating surface or a different means of sealing the bearing position.

In certain applications, the sliding layer E40 can be used in fluid media. In this case, the improved heat dissipation may considerably increase the operating life.

The compatibility of the media with the sliding layer E40 must be checked. Further advice should therefore be sought from the Schaeffler engineering service.

Lubricants
Oil and grease lubrication, even in very small quantities, impairs the transfer of material during the running-in phase.

Over time, grease and small quantities of oil mix with wear debris to form a paste that promotes wear. Solid lubricants such as zinc sulphide, molybdenum disulphide or similar grease additives are not permitted, since they promote this paste formation to an increased extent.

Relubrication
If it is not possible in exceptional cases to avoid the use of grease lubrication, the bearings must be relubricated periodically. During relubrication, old grease is replaced by fresh grease. At the same time, the grease flushes wear debris and contaminants out of the bearing.

If periodic relubrication is carried out, the formation of paste comprising debris and contaminants must be avoided.

Operating temperature
The permissible operating temperature for maintenance-free metal/polymer composite plain bearings is between −200 °C and +280 °C.

The running-in layer and sliding layer may undergo swelling in the presence of some mineral oils at temperatures above +100 °C. This could lead to jamming of the bearing.

This can be remedied by increasing the bearing clearance, since other characteristics of the sliding layer E40 are unaffected.

Suffixes
Suffixes for available designs: see table.

Available designs

Suffix	Description	Design
E40	Maintenance-free sliding layer, with steel backing	Standard
E40-B	Maintenance-free sliding layer, with bronze backing	

Design and safety guidelines

In addition to the design and safety guidelines described here, the following guidelines in the Technical principles must also be observed:

- theoretical bearing clearance of metal/polymer composite plain bushes, see page 81
- design of bearing arrangements, see page 90
- recommended mounting tolerances, see page 101
- misalignment of plain bushes, see page 102, and edge loading of metal/polymer composite plain bushes, see page 102
- pressing in of bushes, see page 119.

! Plain bushes should not be used for movement involving spatial motion. Any skewing of the shaft will reduce the operating life.

Friction

Sliding motion is free from stick-slip.

The friction in a plain bearing is influenced by:

- the roughness depth of the mating surface
- the mating surface material
- the specific bearing load
- the sliding velocity
- the operating temperature
  - Up to approx. +100 °C, the coefficient of friction is slightly lower than the value at room temperature.
  - Above +100 °C, the coefficient of friction may be up to 50% above the value at room temperature.

Friction behaviour

The coefficient of friction is lower under high specific bearing load and low sliding velocity. The coefficients of friction stated are valid for the condition after running-in, see table.

Coefficient of friction for sliding layer E40

Specific bearing load p N/mm^2	Sliding velocity v m/s	Coefficient of friction μ
250 to 140	≦ 0,001	0,03
140 to 60	0,001 to 0,005	0,04 to 0,07
60 to 10	0,005 to 0,05	0,07 to 0,1
10 to 1	0,05 to 0,5	0,1 to 0,15
≦ 1	0,5 to 2	0,15 to 0,25

Bearing frictional torque

Calculation of the bearing frictional torque and the typical wear characteristics are given in the chapter Technical principles, see section Friction and increases in temperature, page 69.

Metal/polymer composite plain bushes, maintenance-free

Running-in process

During the running-in process, part of the running-in layer is transferred to the mating surface, *Figure 3*:

- ■ This compensates uneven areas.
- ■ A mating surface with a low coefficient of friction is formed, which acts favourably on the operating behaviour.
- ■ After running in, some of the porous bronze layer is visible on the sliding layer as individual areas of differing sizes, *Figure 4*. This shows that the bearing is running correctly.

① Before running-in
② After running-in
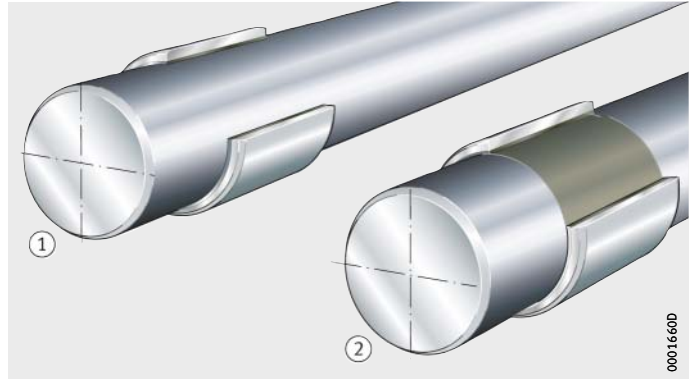
Figure 3
Material transfer during running-in

① Before running-in
② After running-in
③ After long operating life
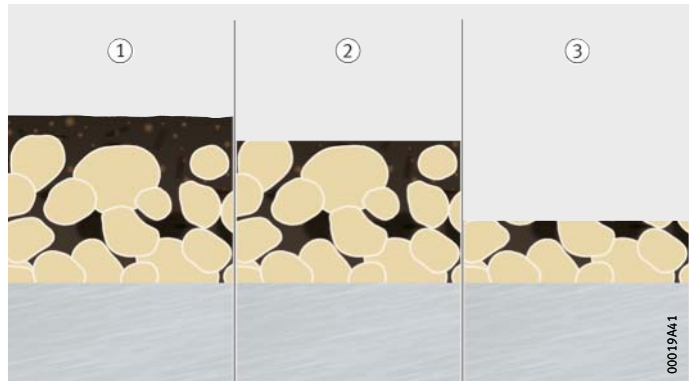
Figure 4
Typical wear pattern
of sliding layer E40

Operating behaviour   After running-in, the wear of maintenance-free plain bearings proceeds in a linear manner, *Figure 5*.

s_{Mat} = material removal
t = time

① Wear during operation
② Material transfer during running-in

Figure 5
Typical operating behaviour
during operating life
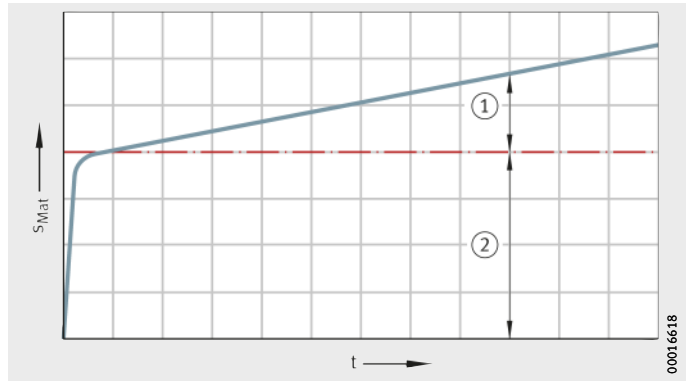
Metal/polymer composite plain bushes, maintenance-free

Dimensioning and rating life

The dimensioning of plain bushes is summarised in the chapter Technical principles, see section Technical principles, page 20.

Depending on whether the bearing is subjected to dynamic or static load, the following must be checked:
- static load safety factor S_0
- maximum permissible specific bearing load p
- maximum permissible sliding velocity v
- maximum specific frictional energy pv.

⚠️ The rating life can be calculated if the range of validity is observed, see tables, page 50.

Calculation example for flanged bush EGF30260-E40

The rating life of the flanged bush is calculated on the basis of the sliding layer E40, see section Load carrying capacity and life, page 35. For flanged bushes, the rating life must be checked for both the radial sliding surface and the axial sliding surface (flange).

Given data

The given data for calculation of the rating life are as follows:
- bearing arrangement for an extruder shaft
- shaft and axial running surface ground (unalloyed steel, roughness depth Rz 2)
- point load (rotating shaft, stationary bush).

Operating parameters

Bearing load	F_r	= 14 000 N
	F_a	= 3 000 N
Operating speed	n	= 25 min^{-1}
Operating temperature	ϑ	= +35 °C

Bearing data

Flanged bush		= EGF30260-E40
Basic dynamic load rating	C_r	= 92 400 N
	C_a	= 35 200 N
Inside diameter	D_i	= 30 mm
Outside diameter of flange	D_{fl}	= 42 mm
Sliding material	E40	

Required

Bearing with the required rating life $L_h \geqq 500$ h.

Checking of permissible loads

For flanged bushes, the rating life must be checked for both the radial sliding surface and the axial sliding surface (flange).

⚠️ The validity of the permissible loads and sliding velocities must be checked, since useful rating life calculation is only possible within this range, see tables, page 50.

| Specific bearing load | The specific bearing load must be calculated with the aid of the specific load parameter K and checked for validity, see table, page 41, and table, page 50. |

Radial component of flanged bushes:

$$p = K \cdot \frac{F_r}{C_r}$$

$$p = 140 \cdot \frac{14\,000}{92\,400} = 21,21\,\text{N}/\text{mm}^2$$

Axial component of flanged bushes:

$$p = K \cdot \frac{F_a}{C_a}$$

$$p = 140 \cdot \frac{3\,000}{35\,200} = 11,93\,\text{N}/\text{mm}^2$$

| Sliding velocity in rotary motion | The sliding velocity must be calculated with the aid of the inside diameter D_i or the flange diameter D_{fl} and checked for validity, see table, page 44, and tables, page 50. |

Radial sliding surface:

$$v = \frac{D_i \cdot \pi \cdot n}{60 \cdot 10^3}$$

$$v = \frac{30 \cdot \pi \cdot 25}{60 \cdot 10^3} = 3,9 \cdot 10^{-2}\,\text{m}/\text{s}$$

Axial sliding surface:

$$v = \frac{D_{fl} \cdot \pi \cdot n}{60 \cdot 10^3}$$

$$v = \frac{42 \cdot \pi \cdot 25}{60 \cdot 10^3} = 5,5 \cdot 10^{-2}\,\text{m}/\text{s}$$

| Specific frictional energy pv | The specific frictional energy pv must be checked for validity, see table, page 50. |

Radial component of flanged bushes:

$$pv = 21,21 \cdot 3,9 \cdot 10^{-2} = 0,83\,\text{N}/\text{mm}^2 \cdot \text{m}/\text{s}$$

Axial component of flanged bushes:

$$pv = 11,93 \cdot 5,5 \cdot 10^{-2} = 0,66\,\text{N}/\text{mm}^2 \cdot \text{m}/\text{s}$$

Metal/polymer composite plain bushes, maintenance-free

Determining the rating life equation	For calculation of the rating life, the valid rating life equation must be selected and then subjected to correction.
Selection of the valid rating life equation	For maintenance-free plain bearings, the following applies, see page 52:

$$L_h = \frac{K_L}{p \cdot v} \cdot f_p \cdot f_v \cdot f_{pv} \cdot f_{pv\star} \cdot f_\vartheta \cdot f_R \cdot f_W \cdot f_A \cdot f_B \cdot f_L \cdot f_\alpha \cdot f_\beta \cdot f_{Hz}$$

The correction factors necessary for the plain bearing material E40 must be selected from the matrix and used to correct the rating life equation appropriately, see table, page 55, and equation.

Correction factors, as a function of bearing type

Series	Sliding layer	Motion	Correction factors												
			f_p	f_v	f_{pv}	$f_{pv\star}$	f_ϑ	f_R	f_W	f_A	f_B	f_L	f_α	f_β	f_{Hz}
EGF	E40	Rotary	■	■	■	–	■	■	■	■	–	–	–	–	–

Rating life equation following correction

$$L_h = \frac{K_L}{pv} \cdot f_p \cdot f_v \cdot f_{pv} \cdot f_\vartheta \cdot f_R \cdot f_W \cdot f_A$$

Calculation of rating life

The values for the correction factors in the corrected rating life equation must be taken from the diagrams, see page 56 and table. The specific plain bearing factor $K_L = 1000$, see table, page 52.

Correction factors

Correction factor	Source	Value Sliding surface	
		Radial	Axial
Load f_p	*Figure 13*, page 56	1	1
Sliding velocity f_v	*Figure 16*, page 58	1	1
Frictional energy f_{pv}	*Figure 17*, page 59	0,96	0,98
Temperature f_ϑ	*Figure 18*, page 60	1	1
Roughness depth f_R	*Figure 19*, page 61	0,97	0,97
Material f_W	Table, page 61	0,5	0,5
Condition of rotation f_A	Page 62	1	1

Rating life L_h

The rating life for the radial sliding surface is calculated as follows:

$$L_h = \frac{1000}{0,83} \cdot 1 \cdot 1 \cdot 0,96 \cdot 1 \cdot 0,97 \cdot 0,5 \cdot 1 = 560 \text{ h}$$

The rating life for the axial sliding surface is calculated as follows:

$$L_h = \frac{1000}{0,66} \cdot 1 \cdot 1 \cdot 0,98 \cdot 1 \cdot 0,97 \cdot 0,5 \cdot 1 = 720 \text{ h}$$

Result

The basic rating life is determined by the radial sliding surface. The total rating life is therefore 560 h. The selected flanged bush fulfils the required rating life $L_h \geqq 500$ h.

Hydrodynamic operation	Metal/polymer composite plain bearings with the sliding layer E40 can be operated under hydrodynamic conditions. Higher circumferential speeds are permissible than with dry running.

Once the transition speed is reached, pure fluid friction is present. This allows wear-free operation.

At speeds below the transition speed, mixed friction is present and the self-lubricating effect of the sliding layer is utilised.

! For hydrodynamic operation with the sliding layer E40, the roughness Rz of the mating surface should be less than the smallest lubricant film thickness in fluid friction.

Schaeffler offers the calculation of hydrodynamic conditions for plain bearings as a service.

Calculation For the calculation of hydrodynamic conditions, the following data are necessary:
- load
- speed
- diameter of the housing bore d_G with tolerance
- diameter of the shaft d_W with tolerance
- bush width B
- viscosity of the fluid at operating temperature.

Shaft design The shafts should be chamfered and all sharp edges should be rounded. This allows easier mounting and prevents damage to the sliding layer of the bush.

Mating surface The mating surface should always be wider than the bearing to prevent the formation of steps in the sliding layer.

The optimum operating life in dry running of the sliding layer E40 is achieved with a roughness depth of the mating surface of Rz 2 to Rz 3.

! Very small roughness values do not have a beneficial effect on the operating life, but larger roughness values reduce it considerably.

Metal/polymer composite plain bushes, maintenance-free

Surface quality

Ground or drawn surfaces are preferable as a mating surface. Surfaces that have been precision turned or rolled by precision turning, even with Rz 2 to Rz 3, can cause greater wear since helical manufacturing grooves are created by precision turning.

Spheroidal graphite cast iron GGG has an open surface structure and should therefore be ground to Rz 2 or better.

The direction of rotation of cast shafts in the application should be the same as that of the grinding wheel during machining, since increased wear should be anticipated if rotation is in the opposing direction, *Figure 6*.

① Direction of shaft rotation
in the application
② Direction of grinding wheel rotation
③ Direction of shaft rotation
during grinding
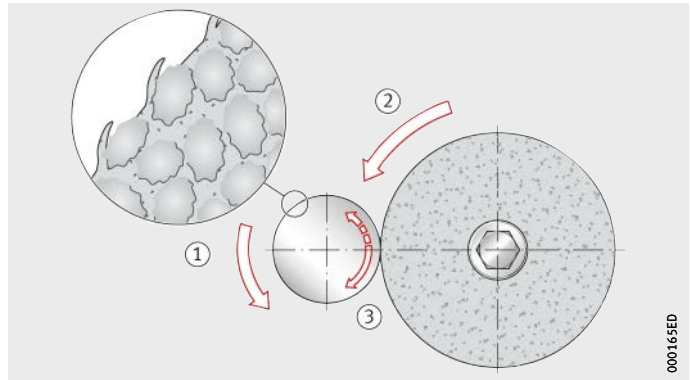
Figure 6
Grinding of a cast shaft

Heat dissipation

Correct and sufficient heat dissipation must be ensured:
- ☐ If hydrodynamic operation is present, the heat is dissipated predominantly via the fluid lubricant.
- ☐ In the case of maintenance-free plain bearings, the heat is dissipated via the housing and shaft.

Protection against corrosion

Corrosion of the mating surface in the case of the sliding layer E40 is prevented by sealing or the use of corrosion-resistant steel. Alternatively, suitable surface treatments may be carried out.

Fretting corrosion

Due to the tin coating applied as standard, fretting corrosion between the steel backing of E40 and the housing occurs only rarely. In such cases, electroplated protective coatings can be used to achieve a delaying effect.

Electrochemical contact corrosion

In unfavourable conditions, electrical cells (local elements) can be formed that reduce the operating life through corrosion of the steel. This should be checked at the design stage and clarified by means of tests. In case of doubt, please consult the Schaeffler engineering service.

Machining of plain bearings

Metal/polymer composite plain bearings can be machined by either cutting or non-cutting methods, such as shortening or drilling.

The procedure is as follows:

- Cut the plain bearings starting from the PTFE side, since the burr formed in cutting will impair the running surface.
- Clean the bearing elements thoroughly.
- Protect any bright steel surfaces such as cut edges against corrosion by means of oil or electroplated protective coatings.

⚠️ In electroplating with high current densities or or long coating times, the sliding layers should be masked to prevent deposits.

The machining temperature must not exceed +280 °C in the case of the sliding layer E40, otherwise there may be a health risk.

Alternative joining methods

If the press fit of the bush is not sufficient, the bush can be secured by additional adhesive bonding.

⚠️ The running-in or sliding surface must always be kept free of adhesive.

If adhesive is used, the adhesive manufacturer must always be consulted, particularly on the selection of adhesives, preparation of the surface, hardening, strength, temperature range and elongation behaviour.

Electrical conductivity

The electrical conductivity of new bearings may be lower because the running-in layer is still present. The bronze layer is partially exposed after the running-in process, thus improving the electrical conductivity, *Figure 4*, page 296.

The electrical resistance is dependent on the size of the contact surface.

Metal/polymer composite plain bushes, maintenance-free

Setting the bearing clearance

Metal/polymer composite plain bearings are supplied ready for mounting. In order to set the tolerance of the bearing clearance, measures should be selected at the predimensioning stage that will not shorten the life of the bearings, such as closer tolerances of the housing bore or the shaft.

In a further possibility for setting the bearing clearance, the bushes are sized, *Figure 7* and table. This should only be carried out if there is no other way to achieve a reduced tolerance of the bearing clearance.

Sizing leads to a significant reduction in the rating life L_h of metal/polymer composite plain bearings with the sliding layer E40, see table. Precise values for the reduction in rating life can only be determined by means of tests.

Guide values for diameter of the sizing arbor and reduction in the rating life

Required inside diameter of bush after pressing in	Diameter of sizing arbor[1] d_K	Rating life[2] L_h %
D_{iE}	–	100
D_{iE}+0,02	D_{iE}+0,06	80
D_{iE}+0,03	D_{iE}+0,08	60
D_{iE}+0,04	D_{iE}+0,10	30

[1] Guide value, related to steel housing.

[2] Guide value for dry running.

① Sizing arbor, case hardening depth CHD > 0,6, HRC 56 to 64
② Plain bearing bush EGB..-E40
③ Housing

B = bush width
D_{iE} = inside diameter of bush after pressing in
d_K = diameter of sizing arbor
r = rounded edge
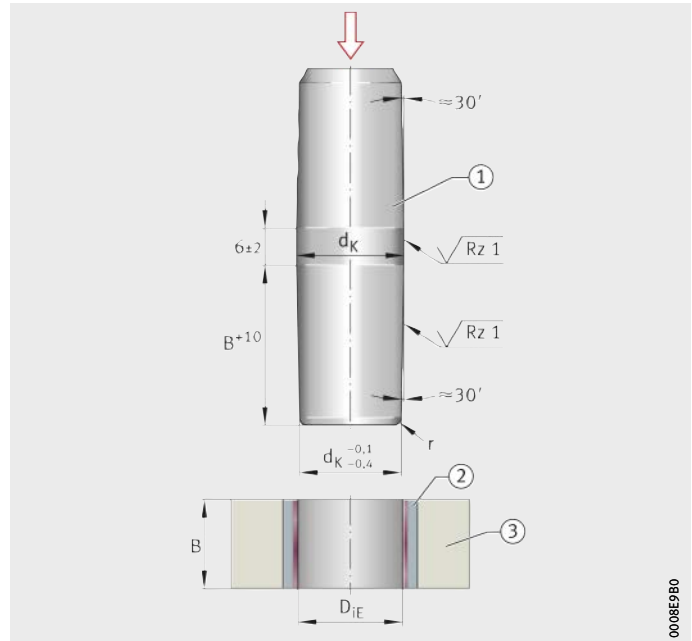
Figure 7
Sizing of plain bearing bush

Tables of deviations and wall thicknesses

The deviations for the bushes are defined in ISO 3547.

Deviations of outside diameter

The deviations for the outside diameter D_o conform to ISO 3547-1, Table 7, see table.

Deviations Tolerances in mm

D_o		E40		E40-B	
		Deviation			
mm		upper	lower	upper	lower
$D_o \leqq \ 10$		+0,055	+0,025	+0,075	+0,045
$10 < D_o \leqq \ 18$		+0,065	+0,030	+0,080	+0,050
$18 < D_o \leqq \ 30$		+0,075	+0,035	+0,095	+0,055
$30 < D_o \leqq \ 50$		+0,085	+0,045	+0,110	+0,065
$50 < D_o \leqq \ 80$		+0,100	+0,055	+0,125	+0,075
$80 < D_o \leqq 120$		+0,120	+0,070	+0,140	+0,090
$120 < D_o \leqq 180$		+0,170	+0,100	+0,190	+0,120
$180 < D_o \leqq 305$		+0,255	+0,125	+0,245	+0,145

Wall thickness for sliding layer E40

The nominal dimensions and limiting deviations for the wall thickness s_3 of bushes and flanged bushes with the sliding layer E40 conform to ISO 3547-1, Table 5, Series B, see table.

Wall thickness Tolerances in mm

D_i	s_3	E40		E40-B	
		Deviation			
mm	mm	upper	lower	upper	lower
$D_i < \ 5$	0,75	0,000	−0,020	−	−
	1	−	−	+0,005	−0,020
$5 \leqq D_i < \ 20$	1	+0,005	−0,020	+0,005	−0,020
$20 \leqq D_i < \ 28$	1,5	+0,005	−0,025	+0,005	−0,025
$28 \leqq D_i < \ 45$	2	+0,005	−0,030	+0,005	−0,030
$45 \leqq D_i < \ 80$	2,5	+0,005	−0,040	+0,005	−0,040
$80 \leqq D_i < 120$	2,5	−0,010	−0,060	−0,010	−0,060
$120 \leqq D_i$	2,5	−0,035	−0,085	−0,035	−0,085

Metal/polymer composite plain bushes, maintenance-free

Chamfers and chamfer tolerances

The tolerances and dimensions of the outer chamfer f and the inner edge break F_i for bushes of metric sizes conform to ISO 3547-1, *Figure 8* and dimension tables. For plain bushes of inch sizes, corresponding values apply, see dimension tables.

Chamfer deformation due to round bending is permissible.

① $\cong$ 0,3 mm (0,012 inch)

F_i = inner edge break
f = outer chamfer
s_3 = wall thickness

Figure 8
Outer chamfer and inner edge break

Bushes

Maintenance-free
ISO 3547
With steel backing

EGB
① Butt joint

Dimension table · Dimensions in mm										
Designation	Mass	Dimensions							Basic load ratings	
	m	D_i	D_o	B	f	F_i			dyn. C_r	stat. C_{0r}
	≈g			±0,25		min.	max.		N	N
EGB0303-E40	0,1	**3**	4,5	3	0,5±0,3	0,1	0,4		1 260	2 250
EGB0304-E40	0,2	**3**	4,5	4	0,5±0,3	0,1	0,4		1 680	3 000
EGB0305-E40	0,3	**3**	4,5	5	0,5±0,3	0,1	0,4		2 100	3 750
EGB0306-E40	0,3	**3**	4,5	6	0,5±0,3	0,1	0,4		2 520	4 500
EGB0403-E40	0,2	**4**	5,5	3	0,5±0,3	0,1	0,4		1 680	3 000
EGB0404-E40	0,3	**4**	5,5	4	0,5±0,3	0,1	0,4		2 240	4 000
EGB0406-E40	0,4	**4**	5,5	6	0,5±0,3	0,1	0,4		3 360	6 000
EGB0410-E40	0,7	**4**	5,5	10	0,5±0,3	0,1	0,4		5 600	10 000
EGB0505-E40	0,6	**5**	7	5	0,6±0,4	0,1	0,6		3 500	6 250
EGB0508-E40	1,0	**5**	7	8	0,6±0,4	0,1	0,6		5 600	10 000
EGB0510-E40	1,3	**5**	7	10	0,6±0,4	0,1	0,6		7 000	12 500
EGB0606-E40	0,9	**6**	8	6	0,6±0,4	0,1	0,6		5 040	9 000
EGB0608-E40	1,2	**6**	8	8	0,6±0,4	0,1	0,6		6 720	12 000
EGB0610-E40	1,5	**6**	8	10	0,6±0,4	0,1	0,6		8 400	15 000
EGB0710-E40	1,7	**7**	9	10	0,6±0,4	0,1	0,6		9 800	17 500
EGB0806-E40	1,1	**8**	10	6	0,6±0,4	0,1	0,6		6 720	12 000
EGB0808-E40	1,5	**8**	10	8	0,6±0,4	0,1	0,6		8 960	16 000
EGB0810-E40	2,0	**8**	10	10	0,6±0,4	0,1	0,6		11 200	20 000
EGB0812-E40	2,4	**8**	10	12	0,6±0,4	0,1	0,6		13 400	24 000
EGB1008-E40	1,9	**10**	12	8	0,6±0,4	0,1	0,6		11 200	20 000
EGB1010-E40	2,4	**10**	12	10	0,6±0,4	0,1	0,6		14 000	25 000
EGB1012-E40	2,9	**10**	12	12	0,6±0,4	0,1	0,6		16 800	30 000
EGB1015-E40	3,6	**10**	12	15	0,6±0,4	0,1	0,6		21 000	37 500
EGB1020-E40	4,9	**10**	12	20	0,6±0,4	0,1	0,6		28 000	50 000
EGB1208-E40	2,3	**12**	14	8	0,6±0,4	0,1	0,6		13 400	24 000
EGB1210-E40	2,8	**12**	14	10	0,6±0,4	0,1	0,6		16 800	30 000
EGB1212-E40	3,4	**12**	14	12	0,6±0,4	0,1	0,6		20 200	36 000
EGB1215-E40	4,3	**12**	14	15	0,6±0,4	0,1	0,6		25 200	45 000
EGB1220-E40	5,8	**12**	14	20	0,6±0,4	0,1	0,6		33 600	60 000
EGB1225-E40	7,3	**12**	14	25	0,6±0,4	0,1	0,6		42 000	75 000
EGB1310-E40	3,1	**13**	15	10	0,6±0,4	0,1	0,6		18 200	32 500

Recommended mounting tolerances, see page 101.

Bushes

Maintenance-free
ISO 3547
With steel backing

EGB
① Butt joint

Dimension table (continued) · Dimensions in mm										
Designation	Mass	Dimensions							Basic load ratings	
	m	D_i	D_o	B	f	F_i			dyn. C_r	stat. C_{0r}
	$\approx$g			$\pm0,25$		min.	max.		N	N
EGB1410-E40	3,3	14	16	10	0,6±0,4	0,1	0,6		19 600	35 000
EGB1412-E40	4	14	16	12	0,6±0,4	0,1	0,6		23 500	42 000
EGB1415-E40	5	14	16	15	0,6±0,4	0,1	0,6		29 400	52 500
EGB1420-E40	6,7	14	16	20	0,6±0,4	0,1	0,6		39 200	70 000
EGB1425-E40	8,4	14	16	25	0,6±0,4	0,1	0,6		49 000	87 500
EGB1510-E40	3,5	15	17	10	0,6±0,4	0,1	0,6		21 000	37 500
EGB1512-E40	4,2	15	17	12	0,6±0,4	0,1	0,6		25 200	45 000
EGB1515-E40	5,3	15	17	15	0,6±0,4	0,1	0,6		31 500	56 300
EGB1520-E40	7,1	15	17	20	0,6±0,4	0,1	0,6		42 000	75 000
EGB1525-E40	8,9	15	17	25	0,6±0,4	0,1	0,6		52 500	93 800
EGB1610-E40	3,7	16	18	10	0,6±0,4	0,1	0,6		22 400	40 000
EGB1612-E40	4,5	16	18	12	0,6±0,4	0,1	0,6		26 900	48 000
EGB1615-E40	5,7	16	18	15	0,6±0,4	0,1	0,6		33 600	60 000
EGB1620-E40	7,6	16	18	20	0,6±0,4	0,1	0,6		44 800	80 000
EGB1625-E40	9,5	16	18	25	0,6±0,4	0,1	0,6		56 000	100 000
EGB1810-E40	4,2	18	20	10	0,6±0,4	0,1	0,6		25 200	45 000
EGB1815-E40	6,3	18	20	15	0,6±0,4	0,1	0,6		37 800	67 500
EGB1820-E40	8,5	18	20	20	0,6±0,4	0,1	0,6		50 400	90 000
EGB1825-E40	10,6	18	20	25	0,6±0,4	0,1	0,6		63 000	113 000
EGB2010-E40	7,4	20	23	10	0,6±0,4	0,1	0,7		28 000	50 000
EGB2015-E40	11,1	20	23	15	0,6±0,4	0,1	0,7		42 000	75 000
EGB2020-E40	14,9	20	23	20	0,6±0,4	0,1	0,7		56 000	100 000
EGB2025-E40	18,6	20	23	25	0,6±0,4	0,1	0,7		70 000	125 000
EGB2030-E40	22,4	20	23	30	0,6±0,4	0,1	0,7		84 000	150 000
EGB2215-E40	12,2	22	25	15	0,6±0,4	0,1	0,7		46 200	82 500
EGB2220-E40	16,3	22	25	20	0,6±0,4	0,1	0,7		61 600	110 000
EGB2225-E40	20,4	22	25	25	0,6±0,4	0,1	0,7		77 000	138 000
EGB2230-E40	24,5	22	25	30	0,6±0,4	0,1	0,7		92 400	165 000
EGB2415-E40	13,2	24	27	15	0,6±0,4	0,1	0,7		50 400	90 000
EGB2420-E40	17,7	24	27	20	0,6±0,4	0,1	0,7		67 200	120 000
EGB2425-E40	22,1	24	27	25	0,6±0,4	0,1	0,7		84 000	150 000
EGB2430-E40	26,5	24	27	30	0,6±0,4	0,1	0,7		101 000	180 000

Recommended mounting tolerances, see page 101.

Bushes

Maintenance-free
ISO 3547
With steel backing

EGB
① Butt joint

Dimension table (continued) · Dimensions in mm										
Designation	Mass	Dimensions							Basic load ratings	
	m	D_i	D_o	B	f	F_i			dyn. C_r	stat. C_{0r}
						min.	max.			
	≈g			±0,25					N	N
EGB2510-E40	9,1	**25**	28	10	0,6±0,4	0,1	0,7		35 000	62 500
EGB2515-E40	13,7	**25**	28	15	0,6±0,4	0,1	0,7		52 500	93 800
EGB2520-E40	18,3	**25**	28	20	0,6±0,4	0,1	0,7		70 000	125 000
EGB2525-E40	23	**25**	28	25	0,6±0,4	0,1	0,7		87 500	156 000
EGB2530-E40	27,6	**25**	28	30	0,6±0,4	0,1	0,7		105 000	188 000
EGB2540-E40	36,8	**25**	28	40	0,6±0,4	0,1	0,7		140 000	250 000
EGB2550-E40	46,1	**25**	28	50	0,6±0,4	0,1	0,7		175 000	313 000
EGB2820-E40	27,8	**28**	32	20	1,2±0,4	0,1	0,7		78 400	140 000
EGB2830-E40	42	**28**	32	30	1,2±0,4	0,1	0,7		118 000	210 000
EGB3015-E40	22,2	**30**	34	15	1,2±0,4	0,1	0,7		63 000	113 000
EGB3020-E40	29,7	**30**	34	20	1,2±0,4	0,1	0,7		84 000	150 000
EGB3025-E40	37,4	**30**	34	25	1,2±0,4	0,1	0,7		105 000	188 000
EGB3030-E40	44,8	**30**	34	30	1,2±0,4	0,1	0,7		126 000	225 000
EGB3040-E40	59,9	**30**	34	40	1,2±0,4	0,1	0,7		168 000	300 000
EGB3230-E40	47,6	**32**	36	30	1,2±0,4	0,1	0,7		134 000	240 000
EGB3240-E40	63,6	**32**	36	40	1,2±0,4	0,1	0,7		179 000	320 000
EGB3520-E40	34,4	**35**	39	20	1,2±0,4	0,1	0,7		98 000	175 000
EGB3530-E40	51,8	**35**	39	30	1,2±0,4	0,1	0,7		147 000	263 000
EGB3540-E40	69,2	**35**	39	40	1,2±0,4	0,1	0,7		196 000	350 000
EGB3550-E40	86,7	**35**	39	50	1,2±0,4	0,1	0,7		245 000	438 000
EGB4020-E40	39	**40**	44	20	1,2±0,4	0,1	0,7		112 000	200 000
EGB4030-E40	58,8	**40**	44	30	1,2±0,4	0,1	0,7		168 000	300 000
EGB4040-E40	78,6	**40**	44	40	1,2±0,4	0,1	0,7		224 000	400 000
EGB4050-E40	98,4	**40**	44	50	1,2±0,4	0,1	0,7		280 000	500 000
EGB4530-E40	83,2	**45**	50	30	1,8±0,6	0,2	1		189 000	338 000
EGB4540-E40	111	**45**	50	40	1,8±0,6	0,2	1		252 000	450 000
EGB4550-E40	140	**45**	50	50	1,8±0,6	0,2	1		315 000	563 000
EGB5020-E40	60,8	**50**	55	20	1,8±0,6	0,2	1		140 000	250 000
EGB5030-E40	92	**50**	55	30	1,8±0,6	0,2	1		210 000	375 000
EGB5040-E40	123	**50**	55	40	1,8±0,6	0,2	1		280 000	500 000
EGB5060-E40	186	**50**	55	60	1,8±0,6	0,2	1		420 000	750 000

Recommended mounting tolerances, see page 101.

Bushes

Maintenance-free
ISO 3547
With steel backing

EGB
① Butt joint

Dimension table (continued) · Dimensions in mm										
Designation	Mass	Dimensions							Basic load ratings	
	m	D_i	D_o	B	f	F_i			dyn. C_r	stat. C_{0r}
	$\approx$g			$\pm0,25$		min.	max.		N	N
EGB5540-E40	135	**55**	60	40	1,8±0,6	0,2	1	308 000	550 000
EGB5560-E40	203	**55**	60	60	1,8±0,6	0,2	1	462 000	825 000
EGB6030-E40	110	**60**	65	30	1,8±0,6	0,2	1	252 000	450 000
EGB6040-E40	147	**60**	65	40	1,8±0,6	0,2	1	336 000	600 000
EGB6060-E40	221	**60**	65	60	1,8±0,6	0,2	1	504 000	900 000
EGB6070-E40	259	**60**	65	70	1,8±0,6	0,2	1	588 000	1 050 000
EGB6530-E40	119	**65**	70	30	1,8±0,6	0,2	1	273 000	488 000
EGB6540-E40	158	**65**	70	40	1,8±0,6	0,2	1	364 000	650 000
EGB6550-E40	200	**65**	70	50	1,8±0,6	0,2	1	455 000	813 000
EGB6560-E40	240	**65**	70	60	1,8±0,6	0,2	1	546 000	975 000
EGB6570-E40	279	**65**	70	70	1,8±0,6	0,2	1	637 000	1 140 000
EGB7040-E40	170	**70**	75	40	1,8±0,6	0,2	1	392 000	700 000
EGB7050-E40	214	**70**	75	50	1,8±0,6	0,2	1	490 000	875 000
EGB7070-E40	301	**70**	75	70	1,8±0,6	0,2	1	686 000	1 230 000
EGB7540-E40	182	**75**	80	40	1,8±0,6	0,2	1	420 000	750 000
EGB7550-E40	229	**75**	80	50	1,8±0,6	0,2	1	525 000	938 000
EGB7560-E40	278	**75**	80	60	1,8±0,6	0,2	1	630 000	1 130 000
EGB7580-E40	367	**75**	80	80	1,8±0,6	0,2	1	840 000	1 500 000
EGB8040-E40	194	**80**	85	40	1,8±0,6	0,2	1	448 000	800 000
EGB8060-E40	292	**80**	85	60	1,8±0,6	0,2	1	672 000	1 200 000
EGB8080-E40	390	**80**	85	80	1,8±0,6	0,2	1	896 000	1 600 000
EGB80100-E40	488	**80**	85	100	1,8±0,6	0,2	1	1 120 000	2 000 000
EGB8560-E40	311	**85**	90	60	1,8±0,6	0,2	1	714 000	1 280 000
EGB85100-E40	519	**85**	90	100	1,8±0,6	0,2	1	1 190 000	2 130 000
EGB9050-E40	272	**90**	95	50	1,8±0,6	0,2	1	630 000	1 130 000
EGB9060-E40	327	**90**	95	60	1,8±0,6	0,2	1	756 000	1 350 000
EGB90100-E40	547	**90**	95	100	1,8±0,6	0,2	1	1 260 000	2 250 000
EGB9560-E40	345	**95**	100	60	1,8±0,6	0,2	1	798 000	1 430 000
EGB95100-E40	578	**95**	100	100	1,8±0,6	0,2	1	1 330 000	2 380 000
EGB10050-E40	301	**100**	105	50	1,8±0,6	0,2	1	700 000	1 250 000
EGB10060-E40	362	**100**	105	60	1,8±0,6	0,2	1	840 000	1 500 000
EGB100115-E40	697	**100**	105	115	1,8±0,6	0,2	1	1 610 000	2 880 000

Recommended mounting tolerances, see page 101.

Bushes

Maintenance-free
ISO 3547
With steel backing

EGB
① Butt joint

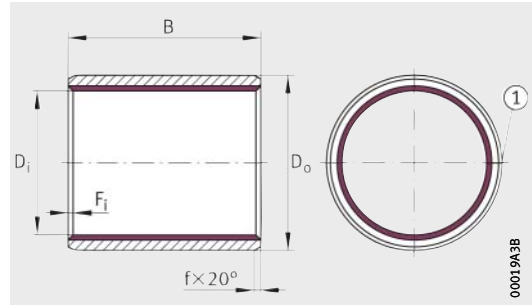**Dimension table** (continued) · Dimensions in mm

Designation	Mass	Dimensions							Basic load ratings	
	m	D_i	D_o	B	f	F_i			dyn. C_r	stat. C_{0r}
						min.	max.			
	≈g			±0,25					N	N
EGB10560-E40	382	**105**	110	60	1,8±0,6	0,2	1		882 000	1 580 000
EGB105115-E40	733	**105**	110	115	1,8±0,6	0,2	1		1 690 000	3 020 000
EGB11060-E40	398	**110**	115	60	1,8±0,6	0,2	1		924 000	1 650 000
EGB110115-E40	767	**110**	115	115	1,8±0,6	0,2	1		1 770 000	3 160 000
EGB11550-E40	347	**115**	120	50	1,8±0,6	0,2	1		805 000	1 440 000
EGB11560-E40	417	**115**	120	60	1,8±0,6	0,2	1		966 000	1 730 000
EGB11570-E40	487	**115**	120	70	1,8±0,6	0,2	1		1 130 000	2 010 000
EGB12060-E40	433	**120**	125	60	1,8±0,6	0,2	1		1 010 000	1 800 000
EGB120100-E40	724	**120**	125	100	1,8±0,6	0,2	1		1 680 000	3 000 000
EGB125100-E40	754	**125**	130	100	1,8±0,6	0,2	1		1 750 000	3 130 000
EGB13060-E40	468	**130**	135	60	1,8±0,6	0,2	1		1 090 000	1 950 000
EGB130100-E40	785	**130**	135	100	1,8±0,6	0,2	1		1 820 000	3 250 000
EGB13560-E40	486	**135**	140	60	1,8±0,6	0,2	1		1 130 000	2 030 000
EGB13580-E40	649	**135**	140	80	1,8±0,6	0,2	1		1 510 000	2 700 000
EGB14060-E40	504	**140**	145	60	1,8±0,6	0,2	1		1 180 000	2 100 000
EGB140100-E40	842	**140**	145	100	1,8±0,6	0,2	1		1 960 000	3 500 000
EGB15060-E40	539	**150**	155	60	1,8±0,6	0,2	1		1 260 000	2 250 000
EGB15080-E40	720	**150**	155	80	1,8±0,6	0,2	1		1 680 000	3 000 000
EGB150100-E40	901	**150**	155	100	1,8±0,6	0,2	1		2 100 000	3 750 000
EGB16080-E40	768	**160**	165	80	1,8±0,6	0,2	1		1 790 000	3 200 000
EGB160100-E40	961	**160**	165	100	1,8±0,6	0,2	1		2 240 000	4 000 000
EGB180100-E40	1 078	**180**	185	100	1,8±0,6	0,2	1		2 520 000	4 500 000
EGB200100-E40	1 197	**200**	205	100	1,8±0,6	0,2	1		2 800 000	5 000 000
EGB220100-E40	1 315	**220**	225	100	1,8±0,6	0,2	1		3 080 000	5 500 000
EGB250100-E40	1 492	**250**	255	100	1,8±0,6	0,2	1		3 500 000	6 250 000
EGB300100-E40	1 790	**300**	305	100	1,8±0,6	0,2	1		4 200 000	7 500 000

Bushes

Maintenance-free
With steel backing
Inch sizes

EGBZ
① Butt joint

Dimension table · Dimensions in mm and *inch*										
Designation	Mass m	Dimensions							Basic load ratings	
		D_i	D_o	B	f	F_i			dyn. C_r	stat. C_{0r}
	$\approx$g						min.	max.	N	N
EGBZ0303-E40	0,5	$^3/_{16}$	$^1/_4$	$^3/_{16}$	$0,5\pm0,3$	0,1	0,4	3 170	5 670
		4,763	6,35	4,76$\pm$0,25					
EGBZ0304-E40	0,7	$^3/_{16}$	$^1/_4$	$^1/_4$	$0,5\pm0,3$	0,1	0,4	4 230	7 560
		4,763	6,35	6,35$\pm$0,25					
EGBZ0306-E40	1	$^3/_{16}$	$^1/_4$	$^3/_8$	$0,5\pm0,3$	0,1	0,4	6 350	11 300
		4,763	6,35	9,53$\pm$0,25					
EGBZ0404-E40	0,9	$^1/_4$	$^5/_{16}$	$^1/_4$	$0,5\pm0,3$	0,1	0,4	5 650	10 100
		6,35	7,938	6,35$\pm$0,25					
EGBZ0406-E40	1,3	$^1/_4$	$^5/_{16}$	$^3/_8$	$0,5\pm0,3$	0,1	0,4	8 470	15 100
		6,35	7,938	9,53$\pm$0,25					
EGBZ0408-E40	1,7	$^1/_4$	$^5/_{16}$	$^1/_2$	$0,5\pm0,3$	0,1	0,4	11 300	20 200
		6,35	7,938	12,70$\pm$0,25					
EGBZ0504-E40	1,1	$^5/_{16}$	$^3/_8$	$^1/_4$	$0,5\pm0,3$	0,1	0,4	7 060	12 600
		7,938	9,525	6,35$\pm$0,25					
EGBZ0506-E40	1,6	$^5/_{16}$	$^3/_8$	$^3/_8$	$0,5\pm0,3$	0,1	0,4	10 600	18 900
		7,938	9,525	9,53$\pm$0,25					
EGBZ0603-E40	1,5	$^3/_8$	$^{15}/_{32}$	$^3/_{16}$	$0,6\pm0,4$	0,1	0,6	6 350	11 300
		9,525	11,906	4,76$\pm$0,25					
EGBZ0604-E40	2	$^3/_8$	$^{15}/_{32}$	$^1/_4$	$0,6\pm0,4$	0,1	0,6	8 470	15 100
		9,525	11,906	6,35$\pm$0,25					
EGBZ0606-E40	3	$^3/_8$	$^{15}/_{32}$	$^3/_8$	$0,6\pm0,4$	0,1	0,6	12 700	22 700
		9,525	11,906	9,53$\pm$0,25					
EGBZ0608-E40	3,9	$^3/_8$	$^{15}/_{32}$	$^1/_2$	$0,6\pm0,4$	0,1	0,6	16 900	30 200
		9,525	11,906	12,7$\pm$0,25					
EGBZ0610-E40	4,9	$^3/_8$	$^{15}/_{32}$	$^5/_8$	$0,6\pm0,4$	0,1	0,6	21 200	37 800
		9,525	11,906	15,88$\pm$0,25					
EGBZ0612-E40	6	$^3/_8$	$^{15}/_{32}$	$^3/_4$	$0,6\pm0,4$	0,1	0,6	25 400	45 400
		9,525	11,906	19,05$\pm$0,25					
EGBZ0706-E40	3,4	$^7/_{16}$	$^{17}/_{32}$	$^3/_8$	$0,6\pm0,4$	0,1	0,6	14 800	26 500
		11,113	13,494	9,53$\pm$0,25					
EGBZ0708-E40	4,5	$^7/_{16}$	$^{17}/_{32}$	$^1/_2$	$0,6\pm0,4$	0,1	0,6	19 800	35 300
		11,113	13,494	12,70$\pm$0,25					

Recommended mounting tolerances, see page 84.

Bushes

Maintenance-free
With steel backing
Inch sizes

EGBZ
① Butt joint

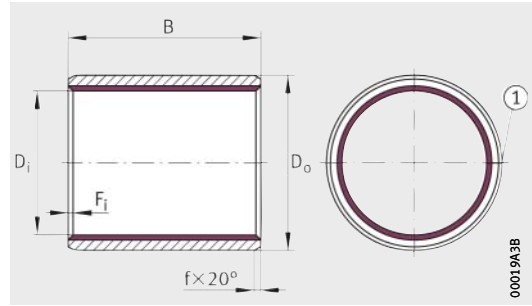| Dimension table (continued) · Dimensions in mm and *inch*										
Designation	Mass	Dimensions							Basic load ratings	
	m	D_i	D_o	B	f	F_i			dyn. C_r	stat. C_{0r}
							min.	max.		
	≈g								N	N
EGBZ0712-E40	7	$7/16$	$17/32$	$3/4$	$0,6 \pm 0,4$	0,1	0,6	29 600	52 900
		11,113	13,494	$19,05 \pm 0,25$					
EGBZ0804-E40	2,6	$1/2$	$19/32$	$1/4$	$0,6 \pm 0,4$	0,1	0,6	11 300	20 200
		12,7	15,082	$6,35 \pm 0,25$					
EGBZ0806-E40	3,8	$1/2$	$19/32$	$3/8$	$0,6 \pm 0,4$	0,1	0,6	16 900	30 200
		12,7	15,082	$9,53 \pm 0,25$					
EGBZ0808-E40	6	$1/2$	$19/32$	$1/2$	$0,6 \pm 0,4$	0,1	0,6	22 600	40 300
		12,7	15,082	$12,70 \pm 0,25$					
EGBZ0810-E40	7	$1/2$	$19/32$	$5/8$	$0,6 \pm 0,4$	0,1	0,6	28 200	50 400
		12,7	15,082	$15,88 \pm 0,25$					
EGBZ0812-E40	8	$1/2$	$19/32$	$3/4$	$0,6 \pm 0,4$	0,1	0,6	33 900	60 500
		12,7	15,082	$19,05 \pm 0,25$					
EGBZ0814-E40	9	$1/2$	$19/32$	$7/8$	$0,6 \pm 0,4$	0,1	0,6	39 500	70 600
		12,7	15,082	$22,23 \pm 0,25$					
EGBZ0906-E40	4,3	$9/16$	$21/32$	$3/8$	$0,6 \pm 0,4$	0,1	0,6	19 100	34 000
		14,288	16,669	$9,53 \pm 0,25$					
EGBZ0908-E40	6	$9/16$	$21/32$	$1/2$	$0,6 \pm 0,4$	0,1	0,6	25 400	45 400
		14,288	16,669	$12,70 \pm 0,25$					
EGBZ0912-E40	9	$9/16$	$21/32$	$3/4$	$0,6 \pm 0,4$	0,1	0,6	38 100	68 000
		14,288	16,669	$19,05 \pm 0,25$					
EGBZ1004-E40	3,1	$5/8$	$23/32$	$1/4$	$0,6 \pm 0,4$	0,1	0,6	14 100	25 200
		15,875	18,258	$6,35 \pm 0,25$					
EGBZ1008-E40	7	$5/8$	$23/32$	$1/2$	$0,6 \pm 0,4$	0,1	0,6	28 200	50 400
		15,875	18,258	$12,70 \pm 0,25$					
EGBZ1010-E40	8	$5/8$	$23/32$	$5/8$	$0,6 \pm 0,4$	0,1	0,6	35 300	63 000
		15,875	18,258	$15,88 \pm 0,25$					
EGBZ1012-E40	10	$5/8$	$23/32$	$3/4$	$0,6 \pm 0,4$	0,1	0,6	42 300	75 600
		15,875	18,258	$19,05 \pm 0,25$					
EGBZ1014-E40	11	$5/8$	$23/32$	$7/8$	$0,6 \pm 0,4$	0,1	0,6	49 400	88 200
		15,875	18,258	$22,23 \pm 0,25$					
EGBZ1112-E40	11	$11/16$	$25/32$	$3/4$	$0,6 \pm 0,4$	0,1	0,6	46 600	83 200
		17,463	19,844	$19,05 \pm 0,25$					

Recommended mounting tolerances, see page 84.

Bushes

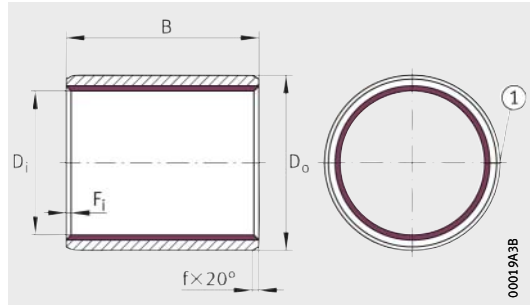Maintenance-free
With steel backing
Inch sizes

EGBZ
① Butt joint

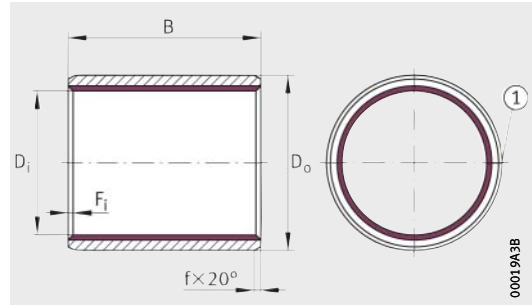| Dimension table (continued) · Dimensions in mm and *inch*										
Designation	Mass	Dimensions							Basic load ratings	
	m	D_i	D_o	B	f	F_i			dyn. C_r	stat. C_{0r}
							min.	max.		
	$\approx$ g								N	N
EGBZ1204-E40	6	*3/4*	*7/8*	*1/4*	0,6±0,4	0,1	0,7		16 900	30 200
		19,05	**22,225**	**6,35±0,25**						
EGBZ1206-E40	8	*3/4*	*7/8*	*3/8*	0,6±0,4	0,1	0,7		25 400	45 400
		19,05	**22,225**	**9,53±0,25**						
EGBZ1208-E40	11	*3/4*	*7/8*	*1/2*	0,6±0,4	0,1	0,7		33 900	60 500
		19,05	**22,225**	**12,70±0,25**						
EGBZ1210-E40	13	*3/4*	*7/8*	*5/8*	0,6±0,4	0,1	0,7		42 300	75 600
		19,05	**22,225**	**15,88±0,25**						
EGBZ1212-E40	16	*3/4*	*7/8*	*3/4*	0,6±0,4	0,1	0,7		50 800	90 700
		19,05	**22,225**	**19,05±0,25**						
EGBZ1216-E40	21	*3/4*	*7/8*	*1*	0,6±0,4	0,1	0,7		67 700	121 000
		19,05	**22,225**	**25,40±0,25**						
EGBZ1412-E40	18	*7/8*	*1*	*3/4*	0,6±0,4	0,1	0,7		59 300	105 800
		22,225	**25,4**	**19,05±0,25**						
EGBZ1416-E40	24	*7/8*	*1*	*1*	0,6±0,4	0,1	0,7		79 000	141 100
		22,225	**25,4**	**25,40±0,25**						
EGBZ1606-E40	10	*1*	*1 1/8*	*3/8*	0,6±0,4	0,1	0,7		33 900	60 500
		25,4	**28,575**	**9,53±0,25**						
EGBZ1608-E40	14	*1*	*1 1/8*	*1/2*	0,6±0,4	0,1	0,7		45 200	80 600
		25,4	**28,575**	**12,70±0,25**						
EGBZ1610-E40	17	*1*	*1 1/8*	*1/2*	0,6±0,4	0,1	0,7		56 250	101 000
		25,4	**28,575**	**15,788±0,25**						
EGBZ1612-E40	20	*1*	*1 1/8*	*3/4*	0,6±0,4	0,1	0,7		67 700	121 000
		25,4	**28,575**	**19,05±0,25**						
EGBZ1614-E40	23	*1*	*1 1/8*	*7/8*	0,6±0,4	0,1	0,7		79 000	141 200
		25,4	**28,575**	**22,23±0,25**						
EGBZ1616-E40	27	*1*	*1 1/8*	*1*	0,6±0,4	0,1	0,7		90 300	161 300
		25,4	**28,575**	**25,40±0,25**						
EGBZ1620-E40	33	*1*	*1 1/8*	*1 1/4*	0,6±0,4	0,1	0,7		113 000	202 000
		25,4	**28,575**	**31,75±0,25**						
EGBZ1624-E40	40	*1*	*1 1/8*	*1 1/2*	0,6±0,4	0,1	0,7		135 000	242 000
		25,4	**28,575**	**38,10±0,25**						

Recommended mounting tolerances, see page 84.

Schaeffler Technologies

Bushes

Maintenance-free
With steel backing
Inch sizes
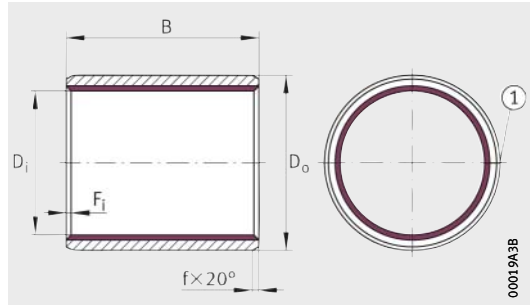
EGBZ
(1) Butt joint

Dimension table (continued) · Dimensions in mm and *inch*

Designation	Mass m ≈g	Dimensions D_i	D_o	B	f	F_i min.	max.	Basic load ratings dyn. C_r N	stat. C_{0r} N
EGBZ1808-E40	19	*1¹/₈*	*1⁹/₃₂*	*¹/₂*	1,2±0,4	0,1	0,7	50 800	90 700
		28,575	32,544	12,70±0,25					
EGBZ1812-E40	28	*1¹/₈*	*1⁹/₃₂*	*³/₄*	1,2±0,4	0,1	0,7	76 200	136 100
		28,575	32,544	19,05±0,25					
EGBZ1816-E40	38	*1¹/₈*	*1⁹/₃₂*	*1*	1,2±0,4	0,1	0,7	102 000	183 000
		28,575	32,544	25,40±0,25					
EGBZ2006-E40	16	*1¹/₄*	*1¹³/₃₂*	*³/₈*	1,2±0,4	0,1	0,7	42 400	75 600
		31,75	35,719	9,53±0,25					
EGBZ2012-E40	31	*1¹/₄*	*1¹³/₃₂*	*³/₄*	1,2±0,4	0,1	0,7	84 700	151 200
		31,75	35,719	19,05±0,25					
EGBZ2016-E40	42	*1¹/₄*	*1¹³/₃₂*	*1*	1,2±0,4	0,1	0,7	113 000	202 000
		31,75	35,719	25,40±0,25					
EGBZ2020-E40	52	*1¹/₄*	*1¹³/₃₂*	*1¹/₄*	1,2±0,4	0,1	0,7	141 000	252 000
		31,75	35,719	31,75±0,25					
EGBZ2206-E40	17	*1³/₈*	*1¹⁷/₃₂*	*³/₈*	1,2±0,4	0,1	0,7	46 600	83 200
		34,925	38,894	9,53±0,25					
EGBZ2208-E40	23	*1³/₈*	*1¹⁷/₃₂*	*¹/₂*	1,2±0,4	0,1	0,7	62 100	110 900
		34,925	38,894	12,70±0,25					
EGBZ2210-E40	29	*1³/₈*	*1¹⁷/₃₂*	*⁵/₈*	1,2±0,4	0,1	0,7	77 600	138 700
		34,925	38,894	15,88±0,25					
EGBZ2212-E40	34	*1³/₈*	*1¹⁷/₃₂*	*³/₄*	1,2±0,4	0,1	0,7	93 100	166 300
		34,925	38,894	19,05±0,25					
EGBZ2216-E40	46	*1³/₈*	*1¹⁷/₃₂*	*1*	1,2±0,4	0,1	0,7	124 000	222 000
		34,925	38,894	25,40±0,25					
EGBZ2224-E40	68	*1³/₈*	*1¹⁷/₃₂*	*1¹/₂*	1,2±0,4	0,1	0,7	186 000	333 000
		34,925	38,894	38,10±0,25					
EGBZ2228-E40	79	*1³/₈*	*1¹⁷/₃₂*	*1³/₄*	1,2±0,4	0,1	0,7	217 000	388 000
		34,925	38,894	44,45±0,25					

Recommended mounting tolerances, see page 84.

Bushes

Maintenance-free
With steel backing
Inch sizes

EGBZ
① Butt joint

f×20°

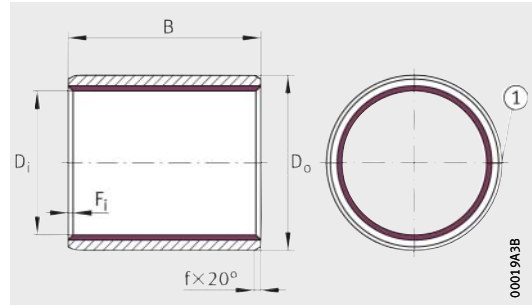| Dimension table (continued) · Dimensions in mm and *inch*										
Designation	Mass	Dimensions								Basic load ratings
	m	D_i	D_o	B	f	F_i			dyn. C_r	stat. C_{0r}
	$\approx$g						min.	max.	N	N
EGBZ2408-E40	25	$1^1/_2$	$1^{21}/_{32}$	$^1/_2$	$1,2\pm0,4$	0,1	0,7		67 700	121 000
		38,1	42,069	12,70$\pm$0,25						
EGBZ2416-E40	49	$1^1/_2$	$1^{21}/_{32}$	1	$1,2\pm0,4$	0,1	0,7		135 000	242 000
		38,1	42,069	25,40$\pm$0,25						
EGBZ2420-E40	62	$1^1/_2$	$1^{21}/_{32}$	$1^1/_4$	$1,2\pm0,4$	0,1	0,7		169 000	302 000
		38,1	42,069	31,75$\pm$0,25						
EGBZ2424-E40	74	$1^1/_2$	$1^{21}/_{32}$	$1^1/_2$	$1,2\pm0,4$	0,1	0,7		203 000	363 000
		38,1	42,069	38,10$\pm$0,25						
EGBZ2432-E40	98	$1^1/_2$	$1^{21}/_{32}$	2	$1,2\pm0,4$	0,1	0,7		271 000	484 000
		38,1	42,069	50,80$\pm$0,25						
EGBZ2616-E40	53	$1^5/_8$	$1^{25}/_{32}$	1	$1,2\pm0,4$	0,1	0,7		147 000	262 000
		41,275	45,244	25,40$\pm$0,25						
EGBZ2624-E40	80	$1^5/_8$	$1^{25}/_{32}$	$1^1/_2$	$1,2\pm0,4$	0,1	0,7		220 000	393 000
		41,275	45,244	38,10$\pm$0,25						
EGBZ2816-E40	69	$1^3/_4$	$1^{15}/_{16}$	1	$1,8\pm0,4$	0,2	1		158 000	282 000
		44,45	49,213	25,40$\pm$0,25						
EGBZ2824-E40	104	$1^3/_4$	$1^{15}/_{16}$	$1^1/_2$	$1,8\pm0,4$	0,2	1		237 000	423 000
		44,45	49,213	38,10$\pm$0,25						
EGBZ2832-E40	138	$1^3/_4$	$1^{15}/_{16}$	2	$1,8\pm0,4$	0,2	1		316 000	565 000
		44,45	49,213	50,80$\pm$0,25						
EGBZ3216-E40	79	2	$2^3/_{16}$	1	$1,8\pm0,4$	0,2	1		181 000	323 000
		50,8	55,563	25,4$\pm$0,25						
EGBZ3224-E40	118	2	$2^3/_{16}$	$1^1/_2$	$1,8\pm0,4$	0,2	1		271 000	484 000
		50,8	55,563	38,1$\pm$0,25						
EGBZ3232-E40	157	2	$2^3/_{16}$	2	$1,8\pm0,4$	0,2	1		361 000	645 000
		50,8	55,563	50,8$\pm$0,25						
EGBZ3240-E40	196	2	$2^3/_{16}$	$2^1/_2$	$1,8\pm0,4$	0,2	1		452 000	806 000
		50,8	55,563	63,5$\pm$0,25						

Recommended mounting tolerances, see page 84.

Bushes

Maintenance-free
ISO 3547
With bronze backing
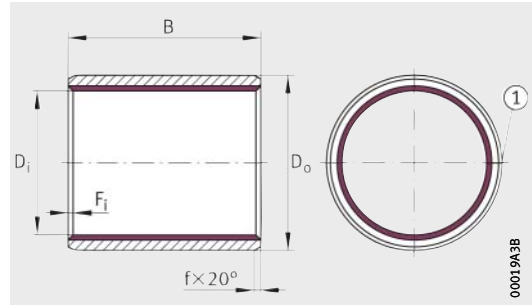
EGB
① Butt joint

Dimension table · Dimensions in mm										
Designation	Mass	Dimensions							Basic load ratings	
	m	D_i	D_o	B	f	F_i			dyn. C_r	stat. C_{0r}
							min.	max.		
	$\approx$ g			$\pm 0,25$					N	N
EGB0406-E40-B-6	0,7	**4**	6	6	0,6±0,4	0,1	0,6		3 360	6 000
EGB0505-E40-B	0,7	**5**	7	5	0,6±0,4	0,1	0,6		3 500	6 250
EGB0606-E40-B	1	**6**	8	6	0,6±0,4	0,1	0,6		5 040	9 000
EGB0610-E40-B	1,6	**6**	8	10	0,6±0,4	0,1	0,6		8 400	15 000
EGB0808-E40-B	1,7	**8**	10	8	0,6±0,4	0,1	0,6		8 960	16 000
EGB0810-E40-B	2,1	**8**	10	10	0,6±0,4	0,1	0,6		11 200	20 000
EGB0812-E40-B	2,6	**8**	10	12	0,6±0,4	0,1	0,6		13 400	24 000
EGB1005-E40-B	1,3	**10**	12	5	0,6±0,4	0,1	0,6		7 000	12 500
EGB1010-E40-B	2,6	**10**	12	10	0,6±0,4	0,1	0,6		14 000	25 000
EGB1015-E40-B	4	**10**	12	15	0,6±0,4	0,1	0,6		21 000	37 500
EGB1020-E40-B	5,3	**10**	12	20	0,6±0,4	0,1	0,6		28 000	50 000
EGB1210-E40-B	3,1	**12**	14	10	0,6±0,4	0,1	0,6		16 800	30 000
EGB1212-E40-B	3,7	**12**	14	12	0,6±0,4	0,1	0,6		20 200	36 000
EGB1215-E40-B	4,7	**12**	14	15	0,6±0,4	0,1	0,6		25 200	45 000
EGB1220-E40-B	6,3	**12**	14	20	0,6±0,4	0,1	0,6		33 600	60 000
EGB1225-E40-B	7,9	**12**	14	25	0,6±0,4	0,1	0,6		42 000	75 000
EGB1415-E40-B	5,4	**14**	16	15	0,6±0,4	0,1	0,6		29 400	52 500
EGB1515-E40-B	5,8	**15**	17	15	0,6±0,4	0,1	0,6		31 500	56 300
EGB1525-E40-B	9,7	**15**	17	25	0,6±0,4	0,1	0,6		52 500	93 800
EGB1615-E40-B	6,2	**16**	18	15	0,6±0,4	0,1	0,6		33 600	60 000
EGB1625-E40-B	10,3	**16**	18	25	0,6±0,4	0,1	0,6		56 000	100 000
EGB1815-E40-B	6,9	**18**	20	15	0,6±0,4	0,1	0,6		37 800	67 500
EGB1825-E40-B	11,6	**18**	20	25	0,6±0,4	0,1	0,6		63 000	113 000
EGB2015-E40-B	12,2	**20**	23	15	0,6±0,4	0,1	0,7		42 000	75 000
EGB2020-E40-B	16,3	**20**	23	20	0,6±0,4	0,1	0,7		56 000	100 000
EGB2025-E40-B	20,4	**20**	23	25	0,6±0,4	0,1	0,7		70 000	125 000
EGB2030-E40-B	24,5	**20**	23	30	0,6±0,4	0,1	0,7		84 000	150 000
EGB2215-E40-B	13,3	**22**	25	15	0,6±0,4	0,1	0,7		46 200	82 500
EGB2220-E40-B	17,8	**22**	25	20	0,6±0,4	0,1	0,7		61 600	110 000
EGB2225-E40-B	22,3	**22**	25	25	0,6±0,4	0,1	0,7		77 000	138 000

Recommended mounting tolerances, see page 101.

Bushes

Maintenance-free
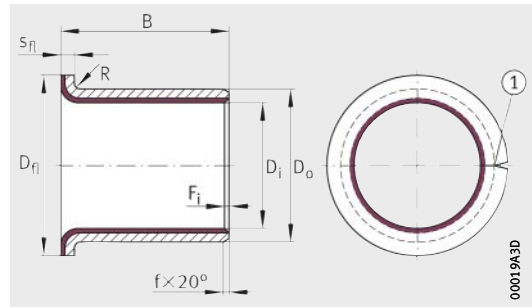ISO 3547
With bronze backing

EGB
① Butt joint

Dimension table (continued) · Dimensions in mm										
Designation	Mass	Dimensions							Basic load ratings	
	m	D_i	D_o	B	f	F_i			dyn. C_r	stat. C_{0r}
						min.	max.			
	≈g			±0,25					N	N
EGB2430-E40-B	29,1	**24**	27	30	0,6±0,4	0,1	0,7		101 000	180 000
EGB2525-E40-B	25,2	**25**	28	25	0,6±0,4	0,1	0,7		87 500	156 000
EGB2530-E40-B	30,2	**25**	28	30	0,6±0,4	0,1	0,7		105 000	188 000
EGB2830-E40-B	46,1	**28**	32	30	1,2±0,4	0,1	0,7		118 000	210 000
EGB3020-E40-B	32,6	**30**	34	20	1,2±0,4	0,1	0,7		84 000	150 000
EGB3030-E40-B	49,2	**30**	34	30	1,2±0,4	0,1	0,7		126 000	225 000
EGB3040-E40-B	65,8	**30**	34	40	1,2±0,4	0,1	0,7		168 000	300 000
EGB3520-E40-B	37,7	**35**	39	20	1,2±0,4	0,1	0,7		98 000	175 000
EGB3530-E40-B	56,9	**35**	39	30	1,2±0,4	0,1	0,7		147 000	263 000
EGB4050-E40-B	108	**40**	44	50	1,2±0,4	0,1	0,7		280 000	500 000
EGB4550-E40-B	154	**45**	50	50	1,8±0,6	0,2	1		315 000	563 000
EGB5030-E40-B	101	**50**	55	30	1,8±0,6	0,2	1		210 000	375 000
EGB5040-E40-B	136	**50**	55	40	1,8±0,6	0,2	1		280 000	500 000
EGB5060-E40-B	204	**50**	55	60	1,8±0,6	0,2	1		420 000	750 000
EGB5540-E40-B	149	**55**	60	40	1,8±0,6	0,2	1		308 000	550 000
EGB6040-E40-B	161	**60**	65	40	1,8±0,6	0,2	1		336 000	600 000
EGB6050-E40-B	202	**60**	65	50	1,8±0,6	0,2	1		420 000	750 000
EGB6060-E40-B	243	**60**	65	60	1,8±0,6	0,2	1		504 000	900 000
EGB6070-E40-B	284	**60**	65	70	1,8±0,6	0,2	1		588 000	1 050 000
EGB7050-E40-B	235	**70**	75	50	1,8±0,6	0,2	1		490 000	875 000
EGB7070-E40-B	329	**70**	75	70	1,8±0,6	0,2	1		686 000	1 230 000
EGB8060-E40-B	321	**80**	85	60	1,8±0,6	0,2	1		672 000	1 200 000
EGB80100-E40-B	537	**80**	85	100	1,8±0,6	0,2	1		1 120 000	2 000 000
EGB9060-E40-B	360	**90**	95	60	1,8±0,6	0,2	1		756 000	1 350 000
EGB90100-E40-B	602	**90**	95	100	1,8±0,6	0,2	1		1 260 000	2 250 000
EGB9560-E40-B	379	**95**	100	60	1,8±0,6	0,2	1		798 000	1 430 000
EGB10060-E40-B	399	**100**	105	60	1,8±0,6	0,2	1		840 000	1 500 000
EGB100115-E40-B	767	**100**	105	115	1,8±0,6	0,2	1		1 610 000	2 880 000

Recommended mounting tolerances, see page 101.

Flanged bushes

Maintenance-free
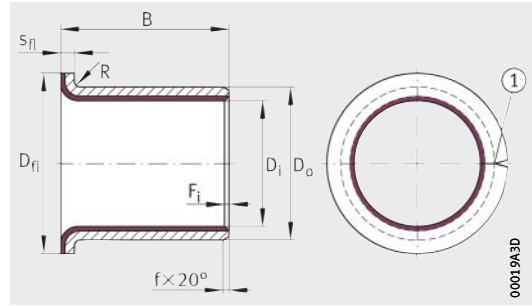ISO 3547
With steel backing

EGF
① Butt joint

Dimension table · Dimensions in mm													
Designation	Mass	Dimensions								Basic load ratings			
										radial		axial	
	m	D_i	D_o	D_{fl}	B	s_{fl}	R	f	F_i		dyn. C_r	stat. C_{0r}	dyn. C_a	stat. C_{0a}
									min.	max.				
	$\approx$ g			±0,5	±0,25	+0,05 −0,2	max.				N	N	N	N
EGF06040-E40	0,9	**6**	8	12	4	1	1	0,6±0,4	0,1	0,6	1 680	3 000	4 840	8 640
EGF06070-E40	1,4	**6**	8	12	7	1	1	0,6±0,4	0,1	0,6	4 200	7 500	4 840	8 640
EGF06080-E40	1,6	**6**	8	12	8	1	1	0,6±0,4	0,1	0,6	5 040	9 000	4 840	8 640
EGF08055-E40	1,6	**8**	10	15	5,5	1	1	0,6±0,4	0,1	0,6	3 920	7 000	8 910	15 900
EGF08075-E40	2	**8**	10	15	7,5	1	1	0,6±0,4	0,1	0,6	6 160	11 000	8 910	15 900
EGF08095-E40	2,4	**8**	10	15	9,5	1	1	0,6±0,4	0,1	0,6	8 400	15 000	8 910	15 900
EGF10070-E40	2,5	**10**	12	18	7	1	1	0,6±0,4	0,1	0,6	7 000	12 500	14 100	25 100
EGF10090-E40	3	**10**	12	18	9	1	1	0,6±0,4	0,1	0,6	9 800	17 500	14 100	25 100
EGF10120-E40	3,8	**10**	12	18	12	1	1	0,6±0,4	0,1	0,6	14 000	25 000	14 100	25 100
EGF10170-E40	5	**10**	12	18	17	1	1	0,6±0,4	0,1	0,6	21 000	37 500	14 100	25 100
EGF12070-E40	2,9	**12**	14	20	7	1	1	0,6±0,4	0,1	0,6	8 400	15 000	15 800	28 300
EGF12090-E40	3,5	**12**	14	20	9	1	1	0,6±0,4	0,1	0,6	11 800	21 000	15 800	28 300
EGF12120-E40	4,4	**12**	14	20	12	1	1	0,6±0,4	0,1	0,6	16 800	30 000	15 800	28 300
EGF12170-E40	5,9	**12**	14	20	17	1	1	0,6±0,4	0,1	0,6	25 200	45 000	15 800	28 300
EGF14120-E40	5,1	**14**	16	22	12	1	1	0,6±0,4	0,1	0,6	19 600	35 000	17 600	31 400
EGF14170-E40	6,8	**14**	16	22	17	1	1	0,6±0,4	0,1	0,6	29 400	52 500	17 600	31 400
EGF15090-E40	4,3	**15**	17	23	9	1	1	0,6±0,4	0,1	0,6	14 700	26 300	18 500	33 000
EGF15120-E40	5,4	**15**	17	23	12	1	1	0,6±0,4	0,1	0,6	21 000	37 500	18 500	33 000
EGF15170-E40	7,2	**15**	17	23	17	1	1	0,6±0,4	0,1	0,6	31 500	56 300	18 500	33 000
EGF16120-E40	5,7	**16**	18	24	12	1	1	0,6±0,4	0,1	0,6	22 400	40 000	19 400	34 600
EGF16170-E40	7,5	**16**	18	24	17	1	1	0,6±0,4	0,1	0,6	33 600	60 000	19 400	34 600
EGF18120-E40	6,4	**18**	20	26	12	1	1	0,6±0,4	0,1	0,6	25 200	45 000	21 100	37 700
EGF18170-E40	8,5	**18**	20	26	17	1	1	0,6±0,4	0,1	0,6	37 800	67 500	21 100	37 700
EGF18220-E40	10,7	**18**	20	26	22	1	1	0,6±0,4	0,1	0,6	50 400	90 000	21 100	37 700

Recommended mounting tolerances, see page 101.

Flanged bushes

Maintenance-free
ISO 3547
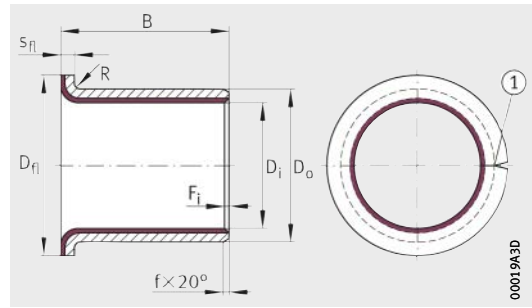With steel backing

EGF
① Butt joint

Dimension table (continued) · Dimensions in mm															
Designation	Mass	Dimensions									Basic load ratings			
											radial		axial	
	m	D_i	D_o	D_{fl}	B	s_{fl}	R	f	F_i		dyn. C_r	stat. C_{0r}	dyn. C_a	stat. C_{0a}
	$\approx$g			±0,5	±0,25	+0,05 −0,2	max.		min.	max.	N	N	N	N
EGF20115-E40	11,1	**20**	23	30	11,5	1,5	1,5	0,6±0,4	0,1	0,7	23 800	42 500	24 600	44 000
EGF20165-E40	14,8	**20**	23	30	16,5	1,5	1,5	0,6±0,4	0,1	0,7	37 800	67 500	24 600	44 000
EGF20215-E40	18,6	**20**	23	30	21,5	1,5	1,5	0,6±0,4	0,1	0,7	51 800	92 500	24 600	44 000
EGF25115-E40	13,5	**25**	28	35	11,5	1,5	1,5	0,6±0,4	0,1	0,7	29 800	53 100	29 000	51 800
EGF25165-E40	18,1	**25**	28	35	16,5	1,5	1,5	0,6±0,4	0,1	0,7	47 300	84 400	29 000	51 800
EGF25215-E40	22,7	**25**	28	35	21,5	1,5	1,5	0,6±0,4	0,1	0,7	64 800	115 600	29 000	51 800
EGF30160-E40	29,2	**30**	34	42	16	2	2	1,2±0,4	0,1	0,7	50 400	90 000	35 200	62 800
EGF30260-E40	44,2	**30**	34	42	26	2	2	1,2±0,4	0,1	0,7	92 400	165 000	35 200	62 800
EGF35160-E40	33,5	**35**	39	47	16	2	2	1,2±0,4	0,1	0,7	58 800	105 000	39 600	70 700
EGF35260-E40	51	**35**	39	47	26	2	2	1,2±0,4	0,1	0,7	108 000	193 000	39 600	70 700
EGF40260-E40	58,9	**40**	44	53	26	2	2	1,2±0,4	0,1	0,7	123 000	220 000	55 500	99 200

Flanged bushes

Maintenance-free
ISO 3547
With bronze backing

EGF
① Butt joint

Dimension table · Dimensions in mm															
Designation	Mass	Dimensions								Basic load ratings					
										radial		axial			
	m	D_i	D_o	D_{fl}	B	s_{fl}	R	f	F_i		dyn. C_r	stat. C_{0r}	dyn. C_a	stat. C_{0a}	
	$\approx$g			±0,5	±0,25	+0,05 −0,2	max.		min.	max.	N	N	N	N	
EGF06080-E40-B	1,7	**6**	8	12	8	1	1	0,6±0,4	0,1	0,6	5 040	9 000	4 840	8 640
EGF08055-E40-B	1,8	**8**	10	15	5,5	1	1	0,6±0,4	0,1	0,6	3 920	7 000	8 910	15 900
EGF08095-E40-B	2,7	**8**	10	15	9,5	1	1	0,6±0,4	0,1	0,6	8 400	15 000	8 910	15 900
EGF10070-E40-B	2,8	**10**	12	18	7	1	1	0,6±0,4	0,1	0,6	7 000	12 500	14 100	25 100
EGF10120-E40-B	4,1	**10**	12	18	12	1	1	0,6±0,4	0,1	0,6	14 000	25 000	14 100	25 100
EGF10170-E40-B	5,5	**10**	12	18	17	1	1	0,6±0,4	0,1	0,6	21 000	37 500	14 100	25 100
EGF12070-E40-B	3,2	**12**	14	20	7	1	1	0,6±0,4	0,1	0,6	8 400	15 000	15 800	28 300
EGF12090-E40-B	3,9	**12**	14	20	9	1	1	0,6±0,4	0,1	0,6	11 800	21 000	15 800	28 300
EGF12120-E40-B	4,8	**12**	14	20	12	1	1	0,6±0,4	0,1	0,6	16 800	30 000	15 800	28 300
EGF15120-E40-B	5,9	**15**	17	23	12	1	1	0,6±0,4	0,1	0,6	21 000	37 500	18 500	33 000
EGF15170-E40-B	7,8	**15**	17	23	17	1	1	0,6±0,4	0,1	0,6	31 500	56 300	18 500	33 000
EGF16120-E40-B	6,2	**16**	18	24	12	1	1	0,6±0,4	0,1	0,6	22 400	40 000	19 400	34 600
EGF18100-E40-B	6	**18**	20	26	10	1	1	0,6±0,4	0,1	0,6	20 200	36 000	21 100	37 700
EGF18220-E40-B	11,6	**18**	20	26	22	1	1	0,6±0,4	0,1	0,6	50 400	90 000	21 100	37 700
EGF20115-E40-B	12,1	**20**	23	30	11,5	1,5	1,5	0,6±0,4	0,1	0,7	23 800	42 500	24 600	44 000
EGF20165-E40-B	16,2	**20**	23	30	16,5	1,5	1,5	0,6±0,4	0,1	0,7	37 800	67 500	24 600	44 000
EGF25215-E40-B	24,9	**25**	28	35	21,5	1,5	1,5	0,6±0,4	0,1	0,7	64 800	115 600	29 000	51 800
EGF30160-E40-B	32	**30**	34	42	16	2	2	1,2±0,4	0,1	0,7	50 400	90 000	35 200	62 800
EGF30260-E40-B	48,6	**30**	34	42	26	2	2	1,2±0,4	0,1	0,7	92 400	165 000	35 200	62 800
EGF35260-E40-B	56	**35**	39	47	26	2	2	1,2±0,4	0,1	0,7	108 000	193 000	39 600	70 700
EGF40260-E40-B	64,8	**40**	44	53	26	2	2	1,2±0,4	0,1	0,7	123 000	220 000	55 500	99 200

Recommended mounting tolerances, see page 101.
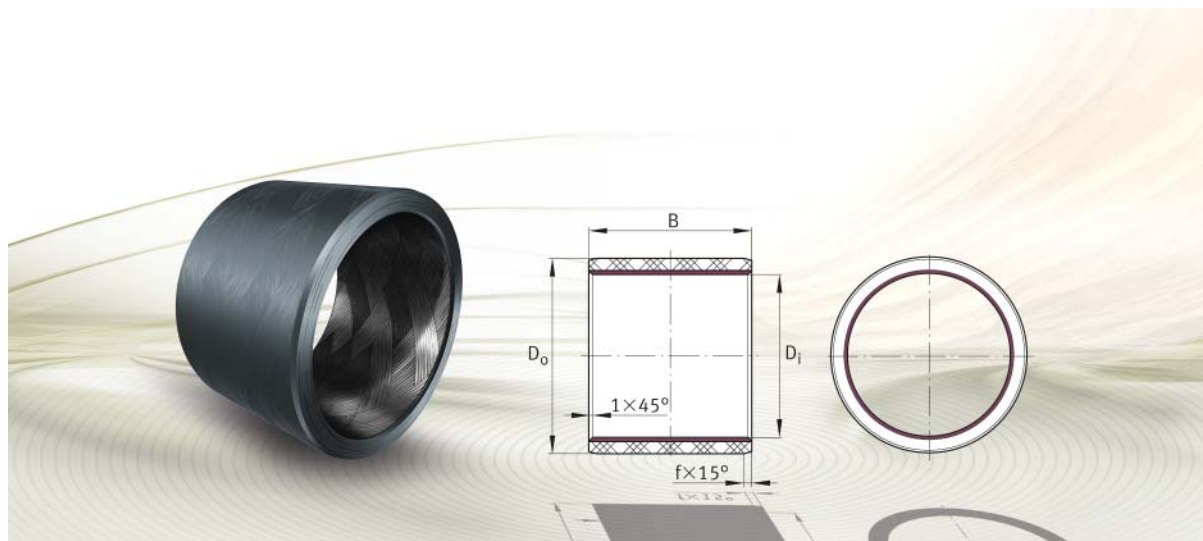
ELGOTEX filament wound bushes, maintenance-free

ELGOTEX filament wound bushes, maintenance-free

Product overview

ELGOTEX filament wound bushes, maintenance-free

Bushes

Open design

ZWB

00019A3F

With lip seals

Available by agreement

ZWB..-2RS

00019AF4

ELGOTEX filament wound bushes, maintenance-free

Features

ELGOTEX filament wound bushes are maintenance-free, free from corrosion and have low wear and friction. Further advantages of the filament composite are low mass together with high load carrying capacity and resistance to shocks as well as suitability for applications involving vibrations.

ELGOTEX filament wound bushes are particularly suitable as an environmentally-friendly and maintenance-free bearing type for replacing steel or bronze bearings.

Maintenance-free plain bearing material

The radial dry plain bearings have a sliding layer made from ELGOTEX and a twin layer structure, *Figure 1*:

- ◻ The outer layer (the backing) ensures the strength of the bush. It comprises continuous glass fibres that are additionally stabilised by means of a specific winding angle, giving an increase in strength. The fibres are bound in epoxy resin.
- ◻ The inner layer (sliding layer) contains a polymer/PTFE yarn that is embedded together with fillers and solid lubricants in a resin matrix.

Due to the combination of filaments and resin matrix, the bushes are suited in preference for dry-running applications, see table, page 326.

① Backing
② Sliding layer

Figure 1
Microsection
of a ELGOTEX filament wound bush
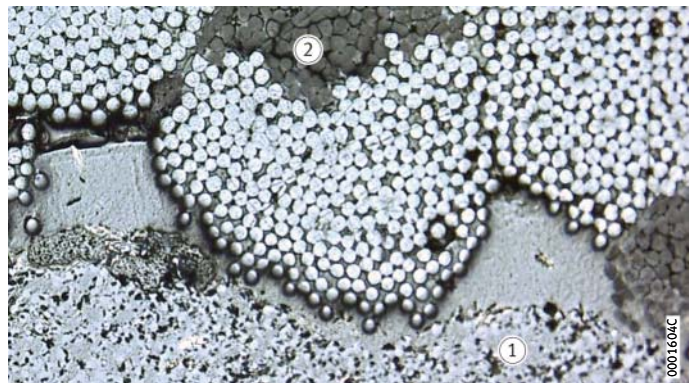
Resistance of the plain bearing material

The filament wound bushes are non-metallic and thus substantially resistant to media. For special environmental conditions, please consult the Schaeffler engineering service.

ELGOTEX filament wound bushes, maintenance-free

Technical data for ELGOTEX

Maintenance-free ELGOTEX filament wound bushes have the following mechanical and physical characteristics, see table.

ELGOTEX filament wound bushes are intended for dry running. They achieve their maximum operating life under these conditions.

Slight settling of the material occurs during running-in.

⚠️ In underwater use, there is a considerable reduction in operating life. In this case, the coefficient of friction may increase significantly.

In the production of ELGOTEX filament wound bushes, defects (pores) and fraying may occur in the PTFE due to the production process. These cannot be prevented by technological measures and do not represent any impairment of the function.

Characteristics of ELGOTEX

Characteristic	Load		
Maximum pv value[1]		pv	$2,8 \text{ N/mm}^2 \cdot \text{m/s}$
Permissible specific bearing load[2]	Static	p_{max}	200 N/mm^2
	Rotary, oscillating		140 N/mm^2
Permissible sliding velocity		v	0,18 m/s
Permissible operating temperature		ϑ	−20 °C to +130 °C
Coefficient of friction		μ	0,03 − 0,2
Operating life behaviour with			
dry running			+++
grease and oil lubrication			+
media lubrication, water lubrication			+

Definition of the symbols:
+++ very good
+ adequate.

[1] The maximum permissible bearing load as a function of velocity is determined by means of pv diagrams, *Figure 2*, page 29.

[2] For static loads of more than 180 N/mm², the design of ELGOTEX filament wound bushes must be checked by the Schaeffler engineering service.
For loads at or over this range, we alternatively recommend the use of ELGOGLIDE plain bushes, see page 344.

Sealing	Standard plain bushes without a suffix are not sealed. These can, however, be combined with separate external seals in order to prevent the ingress of contamination and moisture, see section Sealing, page 105.
	Plain bushes ZWB are available by agreement with integrated seals 2RS on both sides or integrated seals RS on one side.
⚠	In the design of the sealing arrangement, it must be borne in mind that the bearing clearance will increase due to wear of the sliding layer, see page 87.
Lubrication	During the running-in phase, PTFE particles are transferred from the sliding layer to the mating surface. As a result, the small roughness features of the shaft surface are filled in. It is only once this tribologically smooth surface is produced in conjunction with the detached PTFE particles that the bearings can achieve a long operating life.
⚠	Maintenance-free ELGOTEX filament wound bushes do not have relubrication facilities and must not be lubricated.
	Any lubrication of maintenance-free ELGOTEX filament wound bushes after dry running-in will impair the smoothing effect necessary and will considerably reduce the operating life of the bearings.
Operating temperature	The permissible operating temperature for maintenance-free ELGOTEX filament wound bushes is between −20 °C and +130 °C.
Suffixes	Suffixes for available designs: see table.

Available designs

Suffix	Description	Design
RS	Standard lip seals on one side	Special design, available by agreement only
2RS	Standard lip seals on both sides	

ELGOTEX filament wound bushes, maintenance-free

Design and safety guidelines

In addition to the design and safety guidelines described here, the following guidelines in the Technical principles must also be observed:

- theoretical bearing clearance of ELGOTEX filament wound bushes, see page 87
- design of bearing arrangements, see page 90
- recommended mounting tolerances, see page 101
- misalignment of plain bushes, see page 102
- pressing in of bushes, see page 119.

⚠ Plain bushes should not be used for movement involving spatial motion. Any skewing of the shaft will reduce the operating life.

Friction

The characteristic coefficients of friction, calculation of the bearing frictional torque and the typical wear characteristics are given in the chapter Technical principles, see section Friction and increases in temperature, page 69.

Dimensioning and rating life

The dimensioning of plain bushes is summarised in the chapter Technical principles, see section Technical principles, page 20.

Depending on whether the bearing is subjected to dynamic or static load, the following must be checked:

- static load safety factor S_0
- maximum permissible specific bearing load p
- maximum permissible sliding velocity v
- maximum specific frictional energy pv.

⚠ The rating life can be calculated if the range of validity is observed, see tables, page 50.

Calculation example for bush ZWB607060

The rating life of the bush is calculated on the basis of the sliding layer Elgotex, see section Load carrying capacity and life, page 35.

Given data

The given data for calculation of the rating life are as follows:
- highly loaded pivots on an angled lever
- steel shaft (hard chromium coating, roughness depth Rz 1,6)
- point load (rotating shaft, stationary bush).

Operating parameters

Bearing load	F_r	= 120 000 N
Swivel angle	β	= 30°
Swivel frequency	f	= 6 min^{-1}
Operating temperature	ϑ_{min}	= 0 °C
	ϑ_{max}	= +30 °C

Bearing data

Elgotex bush		= ZWB607060
Basic dynamic load rating	C_r	= 504 000 N
Inside diameter	D_i	= 60 mm
Width of bush	B	= 60 mm
Sliding material	Elgotex	

Required

Bearing with the required rating life $L_h \geqq 15\,000$ h.

Checking of permissible loads

! The validity of the permissible loads and sliding velocities must be checked, since useful rating life calculation is only possible within this range, see tables, page 50.

Specific bearing load

The specific bearing load must be calculated with the aid of the specific load parameter K and checked for validity, see table, page 41, and table, page 50:

$$p = K \cdot \frac{F_r}{C_r}$$

$$p = 140 \cdot \frac{120\,000}{504\,000} = 33,33\,\text{N/mm}^2$$

Sliding velocity in swivel motion

The sliding velocity must be calculated with the aid of the inside diameter D_i and the swivel angle β and checked for validity, see table, page 44, and table, page 50:

$$v = \frac{D_i \cdot \pi}{60 \cdot 10^3} \cdot \frac{2 \cdot \beta \cdot f}{360°}$$

$$v = \frac{60 \cdot \pi \cdot 2 \cdot 30° \cdot 6}{60 \cdot 10^3 \cdot 360°} = 3,1 \cdot 10^{-3}\,\text{m/s}$$

Specific frictional energy pv

The specific frictional energy pv must be checked for validity, see table, page 50.

$$pv = 33,33 \cdot 3,1 \cdot 10^{-3} = 0,10\,\text{N/mm}^2 \cdot \text{m/s}$$

ELGOTEX filament wound bushes, maintenance-free

Determining the rating life equation

For calculation of the rating life, the valid rating life equation must be selected and then subjected to correction.

Selection of the valid rating life equation

For maintenance-free plain bearings, the following applies, see page 52:

$$L_h = \frac{K_L}{p \cdot v} \cdot f_p \cdot f_v \cdot f_{pv} \cdot f_{pv\star} \cdot f_\vartheta \cdot f_R \cdot f_W \cdot f_A \cdot f_B \cdot f_L \cdot f_\alpha \cdot f_\beta \cdot f_{Hz}$$

The correction factors necessary for the plain bearing material ELGOTEX must be selected from the matrix and used to correct the rating life equation appropriately, see table, page 55, and equation.

Correction factors, as a function of bearing type

Series	Sliding layer	Motion	Correction factors												
			f_p	f_v	f_{pv}	$f_{pv\star}$	f_ϑ	f_R	f_W	f_A	f_B	f_L	f_α	f_β	f_{Hz}
ZWB	ELGOTEX	Rotary	■	–	–	■	■	■	■	■	■	–	–	■	–

Rating life equation following correction

$$L_h = \frac{K_L}{pv} \cdot f_p \cdot f_{pv\star} \cdot f_\vartheta \cdot f_R \cdot f_W \cdot f_A \cdot f_B \cdot f_\beta$$

Calculation of rating life

The values for the correction factors in the corrected rating life equation must be taken from the diagrams, see page 56 and table. The specific plain bearing factor $K_L = 7\,000$, see table, page 52.

Correction factors

Correction factor	Source	Value
Load f_p	*Figure 13*, page 56	0,99
Frictional energy $f_{pv\star}$ $$pv^\star = v \cdot \left(60 + p^{1,25}\right) \cdot \frac{1}{10,8}$$ $$pv^\star = 3,1 \cdot 10^{-3} \cdot \left(60 + 33,33^{1,25}\right) \cdot \frac{1}{10,8} = 0,040$$	Page 59	0,9
Temperature f_ϑ	*Figure 18*, page 60	1
Roughness depth f_R	*Figure 19*, page 61	0,82
Material f_W	Table, page 61	1
Condition of rotation f_A	Page 62	1
Width ratio f_B $B/d = 1$	*Figure 21*, page 63	0,7
Swivel angle f_β	*Figure 26*, page 65	0,75

Rating life L_h

The rating life is calculated as follows:

$$L_h = \frac{7\,000}{0,10} \cdot 0,99 \cdot 0,9 \cdot 1 \cdot 0,82 \cdot 1 \cdot 1 \cdot 0,7 \cdot 0,75 = 26\,850\ \text{h}$$

Result

The selected ELGOTEX plain bush ZWB607060 fulfils the required rating life $L_h \geqq 15\,000$ h.

ELGOTEX filament wound bushes

Maintenance-free
DIN ISO 4379[1]

ZWB

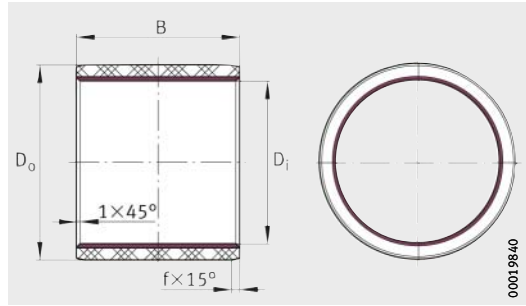| Dimension table · Dimensions in mm								
Designation	Mass	Dimensions					Basic load ratings	
	m	D_i	D_o	B	f		dyn. C_r	stat. C_{0r}[2]
	$\approx$ g	C10	s8	h13			N	N
ZWB202415	4	**20**$^{+0,194}_{+0,11}$	24$^{+0,068}_{+0,035}$	15$_{-0,27}$	1,5$\pm$0,5		42 000	60 000
ZWB202420	5	**20**$^{+0,194}_{+0,11}$	24$^{+0,068}_{+0,035}$	20$_{-0,33}$	1,5$\pm$0,5		56 000	80 000
ZWB202430	7	**20**$^{+0,194}_{+0,11}$	24$^{+0,068}_{+0,035}$	30$_{-0,33}$	1,5$\pm$0,5		84 000	120 000
ZWB253020	8	**25**$^{+0,194}_{+0,11}$	30$^{+0,068}_{+0,035}$	20$_{-0,33}$	1,5$\pm$0,5		70 000	100 000
ZWB253030	12	**25**$^{+0,194}_{+0,11}$	30$^{+0,068}_{+0,035}$	30$_{-0,33}$	1,5$\pm$0,5		105 000	150 000
ZWB253040	16	**25**$^{+0,194}_{+0,11}$	30$^{+0,068}_{+0,035}$	40$_{-0,39}$	1,5$\pm$0,5		140 000	200 000
ZWB283420	11	**28**$^{+0,194}_{+0,11}$	34$^{+0,082}_{+0,043}$	20$_{-0,33}$	1,5$\pm$0,5		78 400	112 000
ZWB283430	16	**28**$^{+0,194}_{+0,11}$	34$^{+0,082}_{+0,043}$	30$_{-0,33}$	1,5$\pm$0,5		118 000	168 000
ZWB283440	21	**28**$^{+0,194}_{+0,11}$	34$^{+0,082}_{+0,043}$	40$_{-0,39}$	1,5$\pm$0,5		157 000	224 000
ZWB303620	11	**30**$^{+0,194}_{+0,11}$	36$^{+0,082}_{+0,043}$	20$_{-0,33}$	1,5$\pm$0,5		84 000	120 000
ZWB303630	17	**30**$^{+0,194}_{+0,11}$	36$^{+0,082}_{+0,043}$	30$_{-0,33}$	1,5$\pm$0,5		126 000	180 000
ZWB303640	22	**30**$^{+0,194}_{+0,11}$	36$^{+0,082}_{+0,043}$	40$_{-0,39}$	1,5$\pm$0,5		168 000	240 000
ZWB354130	19	**35**$^{+0,22}_{+0,12}$	41$^{+0,082}_{+0,043}$	30$_{-0,33}$	1,5$\pm$0,5		147 000	210 000
ZWB354140	26	**35**$^{+0,22}_{+0,12}$	41$^{+0,082}_{+0,043}$	40$_{-0,39}$	1,5$\pm$0,5		196 000	280 000
ZWB354150	32	**35**$^{+0,22}_{+0,12}$	41$^{+0,082}_{+0,043}$	50$_{-0,39}$	1,5$\pm$0,5		245 000	350 000
ZWB404830	30	**40**$^{+0,22}_{+0,12}$	48$^{+0,082}_{+0,043}$	30$_{-0,33}$	2 $\pm$0,7		168 000	240 000
ZWB404840	40	**40**$^{+0,22}_{+0,12}$	48$^{+0,082}_{+0,043}$	40$_{-0,39}$	2 $\pm$0,7		224 000	320 000
ZWB404860	60	**40**$^{+0,22}_{+0,12}$	48$^{+0,082}_{+0,043}$	60$_{-0,46}$	2 $\pm$0,7		336 000	480 000
ZWB455330	33	**45**$^{+0,23}_{+0,13}$	53$^{+0,099}_{+0,053}$	30$_{-0,33}$	2 $\pm$0,7		189 000	270 000
ZWB455340	44	**45**$^{+0,23}_{+0,13}$	53$^{+0,099}_{+0,053}$	40$_{-0,39}$	2 $\pm$0,7		252 000	360 000
ZWB455360	66	**45**$^{+0,23}_{+0,13}$	53$^{+0,099}_{+0,053}$	60$_{-0,46}$	2 $\pm$0,7		378 000	540 000
ZWB505840	49	**50**$^{+0,23}_{+0,13}$	58$^{+0,099}_{+0,053}$	40$_{-0,39}$	2 $\pm$0,7		280 000	400 000
ZWB505850	61	**50**$^{+0,23}_{+0,13}$	58$^{+0,099}_{+0,053}$	50$_{-0,39}$	2 $\pm$0,7		350 000	500 000
ZWB505860	73	**50**$^{+0,23}_{+0,13}$	58$^{+0,099}_{+0,053}$	60$_{-0,46}$	2 $\pm$0,7		420 000	600 000

Recommended mounting tolerances, see page 101.

Filament wound bushes with special dimensions up to an outside diameter of 1 200 mm,
special tolerances and seals are available by agreement.

[1] Reference only to the nominal value of dimensions D_i, D_o and B.

[2] For static loads of more than 180 N/mm², the design of ELGOTEX filament wound bushes
must be checked by the Schaeffler engineering service.
For loads at or over this value, we alternatively recommend the use of ELGOGLIDE plain bushes,
see page 352.

ELGOTEX filament wound bushes

Maintenance-free
DIN ISO 4379[1]

ZWB

Designation	Mass	Dimensions				Basic load ratings	
	m	D_i	D_o	B	f	dyn. C_r	stat. C_{0r}[2]
	≈g	C10	s8	h13		N	N
ZWB556340	53	$55^{+0,26}_{+0,14}$	$63^{+0,099}_{+0,053}$	$40_{-0,39}$	$2\pm0,7$	308 000	440 000
ZWB556350	67	$55^{+0,26}_{+0,14}$	$63^{+0,099}_{+0,053}$	$50_{-0,39}$	$2\pm0,7$	385 000	550 000
ZWB556370	93	$55^{+0,26}_{+0,14}$	$63^{+0,099}_{+0,053}$	$70_{-0,46}$	$2\pm0,7$	539 000	770 000
ZWB607040	74	$60^{+0,26}_{+0,14}$	$70^{+0,105}_{+0,059}$	$40_{-0,39}$	$2\pm0,7$	336 000	480 000
ZWB607060	110	$60^{+0,26}_{+0,14}$	$70^{+0,105}_{+0,059}$	$60_{-0,46}$	$2\pm0,7$	504 000	720 000
ZWB607080	147	$60^{+0,26}_{+0,14}$	$70^{+0,105}_{+0,059}$	$80_{-0,46}$	$2\pm0,7$	672 000	960 000
ZWB657550	99	$65^{+0,26}_{+0,14}$	$75^{+0,105}_{+0,059}$	$50_{-0,39}$	$2\pm0,7$	455 000	650 000
ZWB657560	119	$65^{+0,26}_{+0,14}$	$75^{+0,105}_{+0,059}$	$60_{-0,46}$	$2\pm0,7$	546 000	780 000
ZWB657580	158	$65^{+0,26}_{+0,14}$	$75^{+0,105}_{+0,059}$	$80_{-0,46}$	$2\pm0,7$	728 000	1 040 000
ZWB708050	106	$70^{+0,27}_{+0,15}$	$80^{+0,105}_{+0,059}$	$50_{-0,39}$	3 ± 1	490 000	700 000
ZWB708070	148	$70^{+0,27}_{+0,15}$	$80^{+0,105}_{+0,059}$	$70_{-0,46}$	3 ± 1	686 000	980 000
ZWB708090	191	$70^{+0,27}_{+0,15}$	$80^{+0,105}_{+0,059}$	$90_{-0,54}$	3 ± 1	882 000	1 260 000
ZWB758550	113	$75^{+0,27}_{+0,15}$	$85^{+0,125}_{+0,071}$	$50_{-0,39}$	3 ± 1	525 000	750 000
ZWB758570	158	$75^{+0,27}_{+0,15}$	$85^{+0,125}_{+0,071}$	$70_{-0,46}$	3 ± 1	735 000	1 050 000
ZWB758590	204	$75^{+0,27}_{+0,15}$	$85^{+0,125}_{+0,071}$	$90_{-0,54}$	3 ± 1	945 000	1 350 000
ZWB809060	144	$80^{+0,27}_{+0,15}$	$90^{+0,125}_{+0,071}$	$60_{-0,46}$	3 ± 1	672 000	960 000
ZWB809080	192	$80^{+0,27}_{+0,15}$	$90^{+0,125}_{+0,071}$	$80_{-0,46}$	3 ± 1	896 000	1 280 000
ZWB8090100	240	$80^{+0,27}_{+0,15}$	$90^{+0,125}_{+0,071}$	$100_{-0,54}$	3 ± 1	1 120 000	1 600 000
ZWB859560	153	$85^{+0,31}_{+0,17}$	$95^{+0,125}_{+0,071}$	$60_{-0,46}$	3 ± 1	714 000	1 020 000
ZWB859580	204	$85^{+0,31}_{+0,17}$	$95^{+0,125}_{+0,071}$	$80_{-0,46}$	3 ± 1	952 000	1 360 000
ZWB8595100	254	$85^{+0,31}_{+0,17}$	$95^{+0,125}_{+0,071}$	$100_{-0,54}$	3 ± 1	1 190 000	1 700 000

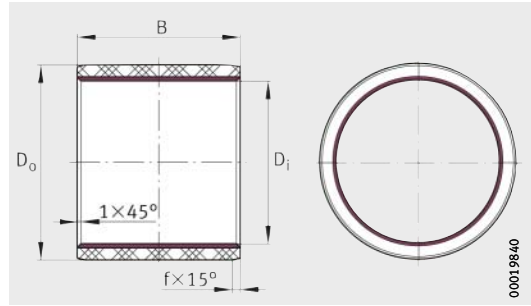Recommended mounting tolerances, see page 101.

Filament wound bushes with special dimensions up to an outside diameter of 1 200 mm,
special tolerances and seals are available by agreement.

[1] Reference only to the nominal value of dimensions D_i, D_o and B.

[2] For static loads of more than 180 N/mm², the design of ELGOTEX filament wound bushes
must be checked by the Schaeffler engineering service.
For loads at or over this value, we alternatively recommend the use of ELGOGLIDE plain bushes,
see page 352.

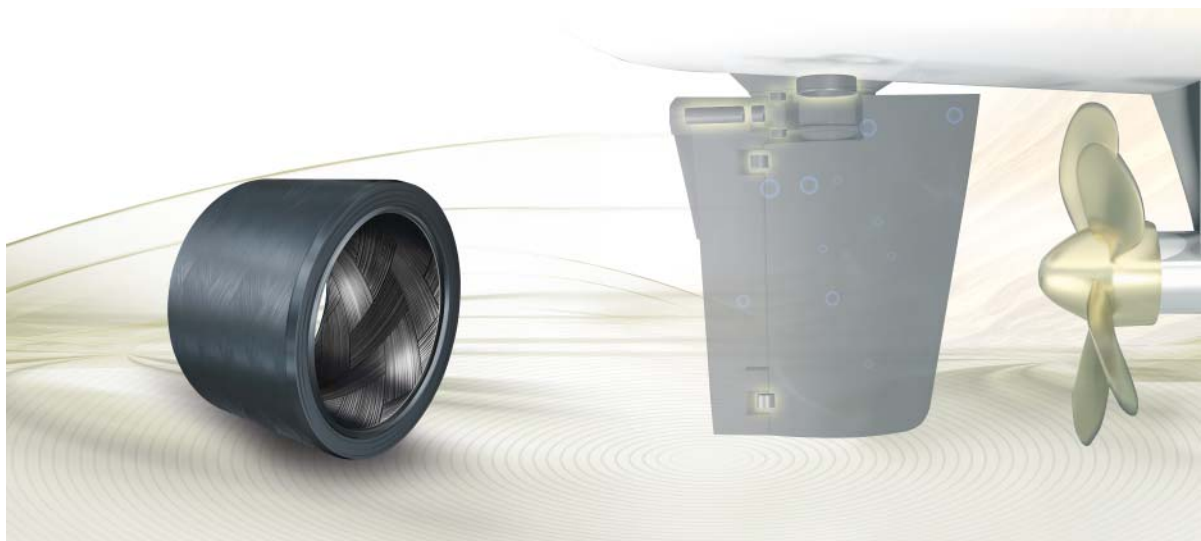# ELGOTEX filament wound bushes

Maintenance-free
DIN ISO 4379[1]

ZWB

Dimension table (continued) · Dimensions in mm								
Designation	Mass	Dimensions					Basic load ratings	
	m	D_i	D_o	B	f		dyn. C_r	stat. C_{0r}[2]
	$\approx$ g	C10	s8	h13			N	N
ZWB9010560	248	$90^{+0,31}_{+0,17}$	$105^{+0,133}_{+0,079}$	$60_{-0,46}$	3 ± 1		756 000	1 080 000
ZWB9010580	331	$90^{+0,31}_{+0,17}$	$105^{+0,133}_{+0,079}$	$80_{-0,46}$	3 ± 1		1 010 000	1 440 000
ZWB90105120	496	$90^{+0,31}_{+0,17}$	$105^{+0,133}_{+0,079}$	$120_{-0,54}$	3 ± 1		1 510 000	2 160 000
ZWB9511060	261	$95^{+0,31}_{+0,17}$	$110^{+0,133}_{+0,079}$	$60_{-0,46}$	3 ± 1		798 000	1 140 000
ZWB95110100	435	$95^{+0,31}_{+0,17}$	$110^{+0,133}_{+0,079}$	$100_{-0,54}$	3 ± 1		1 330 000	1 900 000
ZWB95110120	522	$95^{+0,31}_{+0,17}$	$110^{+0,133}_{+0,079}$	$120_{-0,54}$	3 ± 1		1 600 000	2 280 000
ZWB10011580	365	$100^{+0,31}_{+0,17}$	$115^{+0,133}_{+0,079}$	$80_{-0,46}$	3 ± 1		1 120 000	1 600 000
ZWB100115100	456	$100^{+0,31}_{+0,17}$	$115^{+0,133}_{+0,079}$	$100_{-0,54}$	3 ± 1		1 400 000	2 000 000
ZWB100115120	547	$100^{+0,31}_{+0,17}$	$115^{+0,133}_{+0,079}$	$120_{-0,54}$	3 ± 1		1 680 000	2 400 000
ZWB10512080	382	$105^{+0,32}_{+0,18}$	$120^{+0,133}_{+0,079}$	$80_{-0,46}$	4 ± 1		1 180 000	1 680 000
ZWB105120100	477	$105^{+0,32}_{+0,18}$	$120^{+0,133}_{+0,079}$	$100_{-0,54}$	4 ± 1		1 470 000	2 100 000
ZWB105120120	573	$105^{+0,32}_{+0,18}$	$120^{+0,133}_{+0,079}$	$120_{-0,54}$	4 ± 1		1 760 000	2 520 000
ZWB11012580	399	$110^{+0,32}_{+0,18}$	$125^{+0,155}_{+0,092}$	$80_{-0,46}$	4 ± 1		1 230 000	1 760 000
ZWB110125100	498	$110^{+0,32}_{+0,18}$	$125^{+0,155}_{+0,092}$	$100_{-0,54}$	4 ± 1		1 540 000	2 200 000
ZWB110125120	598	$110^{+0,32}_{+0,18}$	$125^{+0,155}_{+0,092}$	$120_{-0,54}$	4 ± 1		1 850 000	2 640 000
ZWB120135100	541	$120^{+0,32}_{+0,18}$	$135^{+0,155}_{+0,092}$	$100_{-0,54}$	4 ± 1		1 680 000	2 400 000
ZWB120135120	649	$120^{+0,32}_{+0,18}$	$135^{+0,155}_{+0,092}$	$120_{-0,54}$	4 ± 1		2 020 000	2 880 000
ZWB120135150	811	$120^{+0,32}_{+0,18}$	$135^{+0,155}_{+0,092}$	$150_{-0,63}$	4 ± 1		2 520 000	3 600 000
ZWB130145100	583	$130^{+0,36}_{+0,2}$	$145^{+0,163}_{+0,1}$	$100_{-0,54}$	4 ± 1		1 820 000	2 600 000
ZWB130145120	700	$130^{+0,36}_{+0,2}$	$145^{+0,163}_{+0,1}$	$120_{-0,54}$	4 ± 1		2 180 000	3 120 000
ZWB130145150	875	$130^{+0,36}_{+0,2}$	$145^{+0,163}_{+0,1}$	$150_{-0,63}$	4 ± 1		2 730 000	3 900 000

Recommended mounting tolerances, see page 101.

Filament wound bushes with special dimensions up to an outside diameter of 1 200 mm, special tolerances and seals are available by agreement.

[1] Reference only to the nominal value of dimensions D_i, D_o and B.

[2] For static loads of more than 180 N/mm^2, the design of ELGOTEX filament wound bushes must be checked by the Schaeffler engineering service.
For loads at or over this value, we alternatively recommend the use of ELGOGLIDE plain bushes, see page 352.

ELGOTEX filament wound bushes

Maintenance-free
DIN ISO 4379[1]

ZWB

ZWB diagram labels: B, D_o, D_i, $1\times45°$, $f\times15°$, 00019840

Dimension table (continued) · Dimensions in mm								
Designation	Mass	Dimensions					Basic load ratings	
	m	D_i	D_o	B	f		dyn. C_r	stat. C_{0r}[2]
	≈g	C10	s8	h13			N	N
ZWB140155100	626	$140^{+0,36}_{+0,2}$	$155^{+0,163}_{+0,1}$	$100_{-0,54}$	4±1		1 960 000	2 800 000
ZWB140155150	938	$140^{+0,36}_{+0,2}$	$155^{+0,163}_{+0,1}$	$150_{-0,63}$	4±1		2 940 000	4 200 000
ZWB140155180	1 126	$140^{+0,36}_{+0,2}$	$155^{+0,163}_{+0,1}$	$180_{-0,63}$	4±1		3 530 000	5 040 000
ZWB150165120	802	$150^{+0,37}_{+0,21}$	$165^{+0,171}_{+0,108}$	$120_{-0,54}$	4±1		2 520 000	3 600 000
ZWB150165150	1 002	$150^{+0,37}_{+0,21}$	$165^{+0,171}_{+0,108}$	$150_{-0,63}$	4±1		3 150 000	4 500 000
ZWB150165180	1 202	$150^{+0,37}_{+0,21}$	$165^{+0,171}_{+0,108}$	$180_{-0,63}$	4±1		3 780 000	5 400 000
ZWB160180120	1 154	$160^{+0,37}_{+0,21}$	$180^{+0,171}_{+0,108}$	$120_{-0,54}$	4±1		2 690 000	3 840 000
ZWB160180150	1 442	$160^{+0,37}_{+0,21}$	$180^{+0,171}_{+0,108}$	$150_{-0,63}$	4±1		3 360 000	4 800 000
ZWB160180180	1 730	$160^{+0,37}_{+0,21}$	$180^{+0,171}_{+0,108}$	$180_{-0,63}$	4±1		4 030 000	5 760 000
ZWB170190120	1 221	$170^{+0,39}_{+0,23}$	$190^{+0,194}_{+0,122}$	$120_{-0,54}$	5±1		2 860 000	4 080 000
ZWB170190180	1 832	$170^{+0,39}_{+0,23}$	$190^{+0,194}_{+0,122}$	$180_{-0,63}$	5±1		4 280 000	6 120 000
ZWB170190200	2 036	$170^{+0,39}_{+0,23}$	$190^{+0,194}_{+0,122}$	$200_{-0,72}$	5±1		4 760 000	6 800 000
ZWB180200150	1 612	$180^{+0,39}_{+0,23}$	$200^{+0,194}_{+0,122}$	$150_{-0,63}$	5±1		3 780 000	5 400 000
ZWB180200180	1 934	$180^{+0,39}_{+0,23}$	$200^{+0,194}_{+0,122}$	$180_{-0,63}$	5±1		4 540 000	6 480 000
ZWB180200250	2 686	$180^{+0,39}_{+0,23}$	$200^{+0,194}_{+0,122}$	$250_{-0,72}$	5±1		6 300 000	9 000 000
ZWB190210150	1 696	$190^{+0,425}_{+0,24}$	$210^{+0,202}_{+0,13}$	$150_{-0,63}$	5±1		3 990 000	5 700 000
ZWB190210180	2 036	$190^{+0,425}_{+0,24}$	$210^{+0,202}_{+0,13}$	$180_{-0,63}$	5±1		4 790 000	6 840 000
ZWB190210250	2 827	$190^{+0,425}_{+0,24}$	$210^{+0,202}_{+0,13}$	$250_{-0,72}$	5±1		6 650 000	9 500 000
ZWB200220180	2 137	$200^{+0,425}_{+0,24}$	$220^{+0,202}_{+0,13}$	$180_{-0,63}$	5±1		5 040 000	7 200 000
ZWB200220200	2 375	$200^{+0,425}_{+0,24}$	$220^{+0,202}_{+0,13}$	$200_{-0,72}$	5±1		5 600 000	8 000 000
ZWB200220250	2 969	$200^{+0,425}_{+0,24}$	$220^{+0,202}_{+0,13}$	$250_{-0,72}$	5±1		7 000 000	10 000 000

Recommended mounting tolerances, see page 101.

Filament wound bushes with special dimensions up to an outside diameter of 1 200 mm,
special tolerances and seals are available by agreement.

[1] Reference only to the nominal value of dimensions D_i, D_o and B.

[2] For static loads of more than 180 N/mm², the design of ELGOTEX filament wound bushes
must be checked by the Schaeffler engineering service.
For loads at or over this value, we alternatively recommend the use of ELGOGLIDE plain bushes,
see page 352.

Schaeffler Technologies

ELGOTEX-WA filament wound bushes, water-resistant

ELGOTEX-WA filament wound bushes, water-resistant

Product overview   **ELGOTEX-WA filament wound bushes, water-resistant**

Bushes
Open design

ZWB..-WA

0001AD07

With lip seals

Available by agreement

ZWB..-2RS-WA

0008F269

ELGOTEX-WA filament wound bushes, water-resistant

Features
In contrast to the standard design of ELGOTEX, ELGOTEX-WA is specially developed for use in water as well as salt water and sea water. Shipbuilding is an important area of application. Furthermore, ELGOTEX-WA is also highly suitable for use in marine engineering, hydromechanical steel structures and water power generation as well as in pumps and turbines.

The specific characteristic of ELGOTEX-WA lies in the specific matching of fibre and matrix to the particular operating conditions. The inner sliding layer contains a polymer/PTFE sliding filament that is embedded together with fillers and solid lubricants in a resin matrix. This is hydrophobic and dimensionally stable. The backing, which is reinforced by means of glass fibre, ensures the necessary strength of the bush. The thickness of the sliding layer and backing layer is specifically designed in accordance with the requirements of the application and thus of the wear limit.

① Sliding filament
② Resin matrix
③ Fillers

Figure 1
Microsection of the sliding layer of an ELGOTEX-WA filament wound bush

Availability
ELGOTEX-WA filament wound bushes have the suffix WA.

ELGOTEX filament wound bushes with special dimensions up to an outside diameter $D_0 = 1\,200$ mm, special tolerance classes or in the form of segment bearings are possible and may be available by agreement from Schaeffler.

ELGOTEX-WA filament wound bushes, water-resistant

Technical data for ELGOTEX-WA

Maintenance-free ELGOTEX filament wound bushes have the following mechanical and physical characteristics, see table.

Slight settling of the material occurs during running-in.

⚠️ In the production of ELGOTEX-WA filament wound bushes, defects (pores) and fraying may occur in the PTFE due to the production process. These cannot be prevented by technological measures and do not represent any impairment of the function.

For information on the rating life, please consult the Schaeffler engineering service.

Characteristics of ELGOTEX-WA

Characteristic			
Maximum pv value[1]		pv	$1,2 \text{ N/mm}^2 \cdot \text{m/s}$
Permissible specific bearing load	Static	p_{max}	150 N/mm^2
	Rotary, oscillating		50 N/mm^2
Certified specific bearing load in accordance with MCM-0112			15 N/mm^2
Permissible sliding velocity		v	$0,024 \text{ m/s}$
Permissible operating temperature		ϑ	$-20\ °C$ to $+130\ °C$
Coefficient of friction		μ	$0,05$ to $0,15$
Operating life behaviour with:			
Dry running			+++
Grease and oil lubrication			+
Media lubrication, water lubrication			+++

Definition of the symbols:
+++ Very good
+   Adequate

[1] The maximum permissible bearing load as a function of velocity is determined by means of pv diagrams, *Figure 2*.

p = specific bearing load
v = sliding velocity

Performance capability:
① Certified by GL in accordance with MCM-0112
② Proven in accordance with the requirements for certification to MCM-0112
③ Achievable performance capability

Figure 2
pv diagram
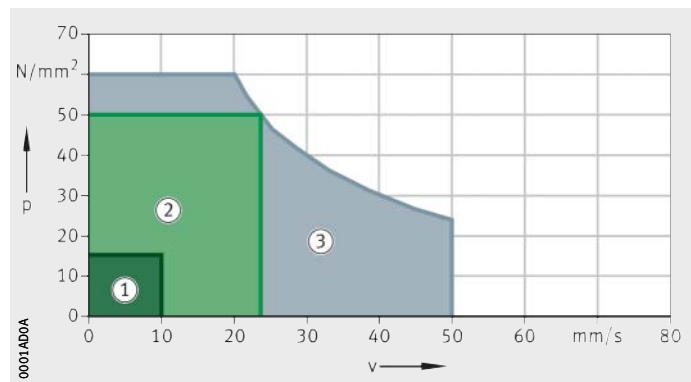
Certification The rudder bearing is a safety-relevant component and must therefore be monitored by classification companies such as Lloyd, Lloyds Register, DNV or Germanischer Lloyd. For this reason, the bearing positions, the bearing itself and its design must be certified before mounting.

On the basis of a specification issued by Germanischer Lloyd, Schaeffler has completed a comprehensive programme of testing in this direction. This has fully demonstrated the functional capability of the plain bearings. For INA plain bearings with ELGOTEX-WA, the performance capability in salt water has been certified in accordance with MCM-0112 from Germanischer Lloyd, *Figure 3* and *Figure 4*.

This approval is valid for:
- rudder carrier bearings
- shaft bearings
- pintle bearings
- bearings for stabilisers.

Schaeffler is the first manufacturer to receive approval from this classification company for a maximum specific bearing load on the plain bearing of 15 N/mm^2.

Figure 3
Application for rudder bearing

Figure 4
ELGOTEX filament wound bush

ELGOTEX-WA filament wound bushes, water-resistant

Ordering designation

Water-resistant ELGOTEX-WA filament wound bushes are matched to the specific application. For available sizes, please place an enquiry with Schaeffler on the basis of the following ordering designation, *Figure 5*.

① Cylindrical filament wound bush
② Inside diameter
③ Outside diameter
④ Width of bush
⑤ Standard lip seal:
RS (on one side)
2RS (on both sides)
⑥ Design using ELGOTEX-WA

Figure 5
Structure of the designation
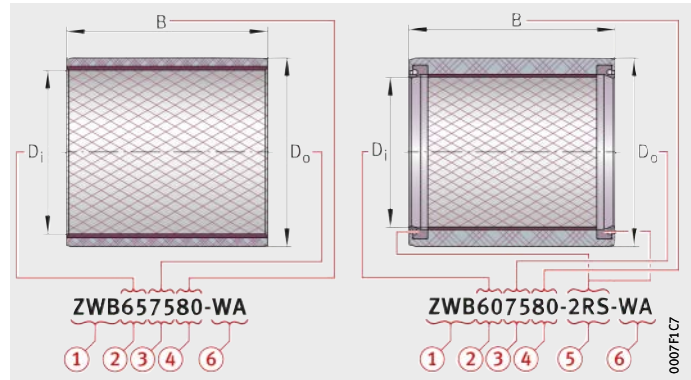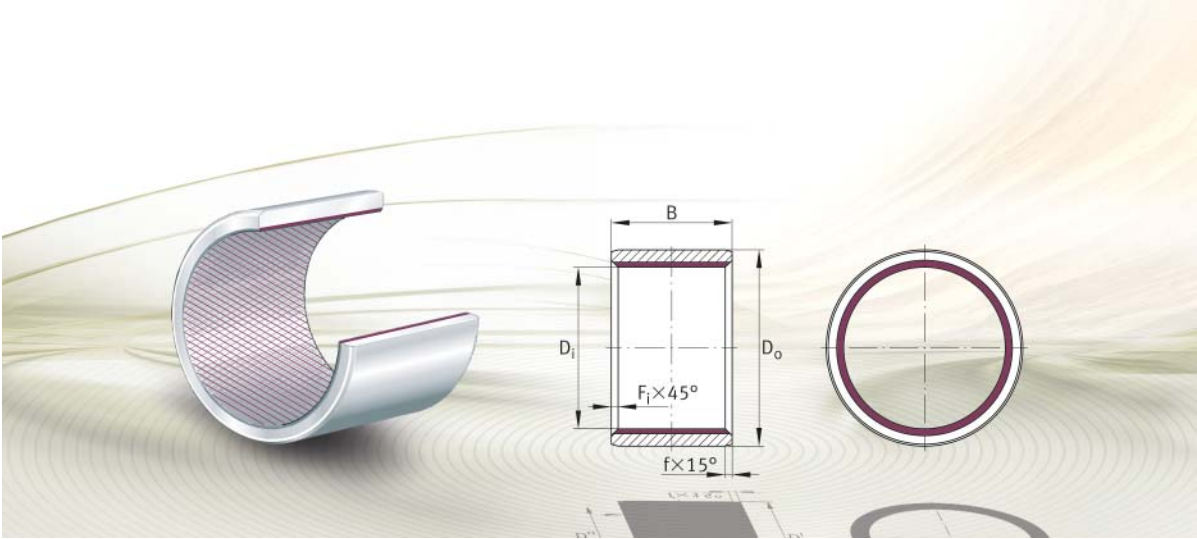
ELGOGLIDE plain bushes, maintenance-free

ELGOGLIDE plain bushes, maintenance-free

Product overview ELGOGLIDE plain bushes, maintenance-free

Bushes
With steel backing
Sliding layer ELGOGLIDE
Open design
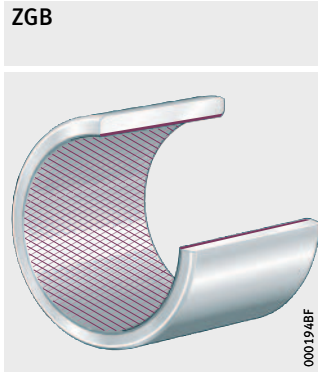
ZGB

000194BF

With lip seals

ZGB..-2RS

00019A53

ELGOGLIDE plain bushes, maintenance-free

Features

Maintenance-free ELGOGLIDE plain bushes ZGB are radial dry plain bearings and comprise a cylindrical steel backing with a sliding layer made from ELGOGLIDE. The steel backing protects the plain bush against damage during handling and mounting.

The plain bushes are available for shaft diameters from 30 mm to 200 mm. They have low friction and good damping behaviour. The dimensions conform to DIN ISO 4379, diameter series 2 and 3.

The plain bushes are very easy to mount. They are pressed into the housing bore and require no further axial location.

Area of application

ELGOGLIDE plain bushes can support higher forces than conventional plain bushes and can therefore be used to replace steel, bronze and plastic bearings.

Since they can support very high radial forces with a uniform load direction as well as high static loads, they are particularly suitable for high alternating loads and swivel motion. They allow some axial motion.

ELGOGLIDE plain bushes, maintenance-free

Maintenance-free plain bearing material

The material for the support body is steel and the outside diameter is precision machined.

The sliding layer comprises a 0,5 mm thick layer of ELGOGLIDE, is embedded in synthetic resin and attached by a high strength bond to the support body, *Figure 1*.

The flow behaviour of the sliding layer is, in conjunction with the support body, almost negligible even under very high load. The adhesive bond is resistant to moisture and swelling.

① PTFE fabric, comprising PTFE and support fibres
② Resin matrix
③ Support fibres
④ Steel supporting body
⑤ Adhesive bond

Figure 1
ELGOGLIDE, maintenance-free plain bearing material
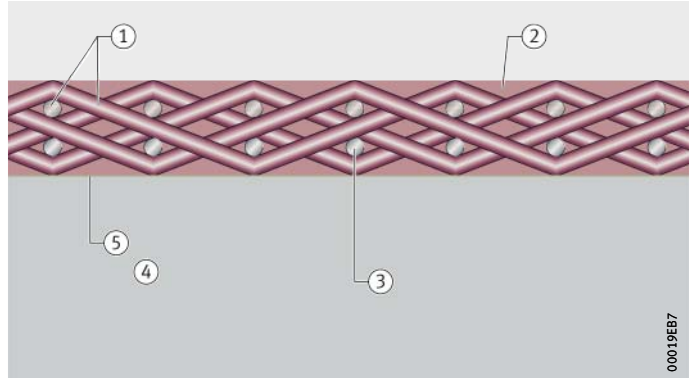
ELGOGLIDE designs

For differing requirements, the following are available:

- ELGOGLIDE
  the standard material for very high dynamic contact pressures from 25 N/mm^2 to 300 N/mm^2 and a long operating life.

- ELGOGLIDE-W11
  the material for dynamic contact pressures from 1 N/mm^2 to 100 N/mm^2 and with low coefficients of friction even at low contact pressures.

Resistance of the plain bearing material

The maintenance-free plain bearing material ELGOGLIDE is intended for dry running.

Application in damp environments

For applications involving contact with water, plain bushes with a corrosion-resistant steel support body must be used, suffix W1. Wear of the sliding layer is considerably increased by the flushing effect. The operating life is sufficient in applications with low frequency of motion.

⚠ The design of the plain bush and its suitability should be agreed in consultation with Schaeffler.

| Technical data for ELGOGLIDE | Maintenance-free ELGOGLIDE plain bushes have the following mechanical and physical characteristics, see table. |

Characteristic	Load		
Maximum pv value		pv	7 N/mm^2 · m/s
Permissible specific bearing load	Static[1]	p$_{max}$	300 N/mm^2
	Rotary, oscillating		300 N/mm^2
Permissible sliding velocity		v	0,3 m/s
Permissible operating temperature		ϑ	−50 °C to +150 °C
Coefficient of friction		μ	0,02 to 0,2

Characteristics of ELGOGLIDE plain bushes

[1] The static load carrying capacity of ELGOGLIDE plain bushes is determined by the steel support body. Plain bushes with a static load carrying capacity of up to 500 N/mm^2 can be achieved by agreement through the use of a higher strength material for the steel support body.

Sealing

Standard plain bushes without a suffix are not sealed. These can, however, be combined with separate external seals in order to prevent the ingress of contamination and moisture, see page 105.

Plain bushes ZGB are available by agreement with integrated seals 2RS on both sides or integrated seals RS on one side.

In the design of the sealing arrangement, it must be borne in mind that the bearing clearance will increase due to wear of the sliding layer, see page 89.

Lubrication

During the running-in phase, PTFE particles are transferred from the sliding layer to the mating surface. As a result, the small roughness features of the shaft surface are filled in. It is only once this tribologically smooth surface is produced in conjunction with the detached PTFE particles that the bearings can achieve a long operating life.

Maintenance-free ELGOGLIDE plain bushes do not have relubrication facilities and must not be lubricated.

Any lubrication of maintenance-free ELGOGLIDE plain bushes after dry running-in will impair the smoothing effect necessary and will considerably reduce the operating life of the bearings.

ELGOGLIDE plain bushes, maintenance-free

Operating temperature

Maintenance-free ELGOGLIDE plain bushes ZGB are suitable for temperatures from −50 °C to +150 °C.

The sealed plain bushes ZGB..-2RS have a restricted temperature range from −30 °C to +100 °C.

⚠️ If the temperature exceeds the stated values, there will be a considerable reduction in the operating life.

Suffixes

Suffixes for available designs: see table.

Available designs

Suffix	Description	Design
W1	Support body made from corrosion-resistant steel	Special design, available by agreement only
W11	For low contact pressures (starting as low as 1 N/mm^2) and minimal friction	
2RS	Standard lip seals on both sides	
RS	Standard lip seals on one side	

Design and safety guidelines

In addition to the design and safety guidelines described here, the following guidelines in the Technical principles must also be observed:

- operating clearance of ELGOGLIDE plain bushes, see page 81
- design of bearing arrangements, see page 90
- recommended mounting tolerances, see page 101
- misalignment of plain bushes, see page 102
- pressing in of bushes, see page 119.

! Plain bushes should not be used for movement involving spatial motion. Any skewing of the shaft will reduce the operating life.

Friction

The friction behaviour changes during the operating life. Bearings that have been well run in give the lowest coefficients of friction. During the running-in and failure phases, the values are in some cases significantly higher than those of bearings after running-in.

The characteristic coefficients of friction, calculation of the bearing frictional torque and the typical wear characteristics are given in the chapter Technical principles, see section Friction and increases in temperature, page 69.

Dimensioning and rating life

The dimensioning of plain bushes is summarised in the chapter Technical principles, see section Technical principles, page 20.

Depending on whether the bearing is subjected to dynamic or static load, the following must be checked:

- static load safety factor S_0
- maximum permissible specific bearing load p
- maximum permissible sliding velocity v
- maximum specific frictional energy pv.

! The rating life can be calculated if the range of validity is observed, see tables, page 50.

ELGOGLIDE plain bushes

Maintenance-free
DIN ISO 4379[1]

ZGB

00019A3C

Dimension table · Dimensions in mm								
Designation	Mass	Dimensions						Basic load ratings	
	m	D_i	D_o	B	f	F_i	dyn. C_r	stat. C_{0r}
	≈kg	H8	p7	h12			N	N
ZGB30X36X30	0,063	**30**$^{+0,033}$	36$^{+0,051}_{+0,026}$	30$_{-0,21}$	1,5±0,5	0,4±0,2	270 000	270 000
ZGB35X41X30	0,072	**35**$^{+0,039}$	41$^{+0,051}_{+0,026}$	30$_{-0,21}$	1,5±0,5	0,4±0,2	315 000	315 000
ZGB40X48X40	0,16	**40**$^{+0,039}$	48$^{+0,051}_{+0,026}$	40$_{-0,25}$	2±0,7	0,6±0,3	480 000	480 000
ZGB45X53X40	0,17	**45**$^{+0,039}$	53$^{+0,062}_{+0,032}$	40$_{-0,25}$	2±0,7	0,6±0,3	540 000	540 000
ZGB50X58X50	0,24	**50**$^{+0,039}$	58$^{+0,062}_{+0,032}$	50$_{-0,25}$	2±0,7	0,6±0,3	750 000	750 000
ZGB60X70X60	0,44	**60**$^{+0,046}$	70$^{+0,062}_{+0,032}$	60$_{-0,3}$	2±0,7	0,6±0,3	1 080 000	1 080 000
ZGB70X80X70	0,59	**70**$^{+0,046}$	80$^{+0,072}_{+0,037}$	70$_{-0,3}$	3±1	0,8±0,4	1 470 000	1 470 000
ZGB80X90X80	0,75	**80**$^{+0,046}$	90$^{+0,072}_{+0,037}$	80$_{-0,3}$	3±1	0,8±0,4	1 920 000	1 920 000
ZGB90X105X80	1,36	**90**$^{+0,054}$	105$^{+0,072}_{+0,037}$	80$_{-0,3}$	3±1	0,8±0,4	2 160 000	2 160 000
ZGB100X115X100	1,9	**100**$^{+0,054}$	115$^{+0,072}_{+0,037}$	100$_{-0,35}$	3±1	0,8±0,4	3 000 000	3 000 000
ZGB110X125X100	2	**110**$^{+0,054}$	125$^{+0,083}_{+0,043}$	100$_{-0,35}$	4±1,3	0,8±0,4	3 300 000	3 300 000
ZGB120X135X120	2,6	**120**$^{+0,054}$	135$^{+0,083}_{+0,043}$	120$_{-0,35}$	4±1,3	0,8±0,4	4 320 000	4 320 000
ZGB140X155X150	3,9	**140**$^{+0,063}$	155$^{+0,083}_{+0,043}$	150$_{-0,4}$	4±1,3	0,8±0,4	6 300 000	6 300 000
ZGB160X180X150	6	**160**$^{+0,063}$	180$^{+0,083}_{+0,043}$	150$_{-0,4}$	4±1,3	0,8±0,4	7 200 000	7 200 000
ZGB180X200X180	8	**180**$^{+0,063}$	200$^{+0,096}_{+0,05}$	180$_{-0,4}$	5±1,6	1,5±0,7	9 720 000	9 720 000
ZGB200X220X180	8,8	**200**$^{+0,072}$	220$^{+0,096}_{+0,05}$	180$_{-0,4}$	5±1,6	1,5±0,7	10 800 000	10 800 000

Recommended mounting tolerances, see page 101.

Plain bushes with special dimensions, special tolerances and seals are available by agreement.

[1] Reference only to the nominal value of dimensions D_i, D_o and B.
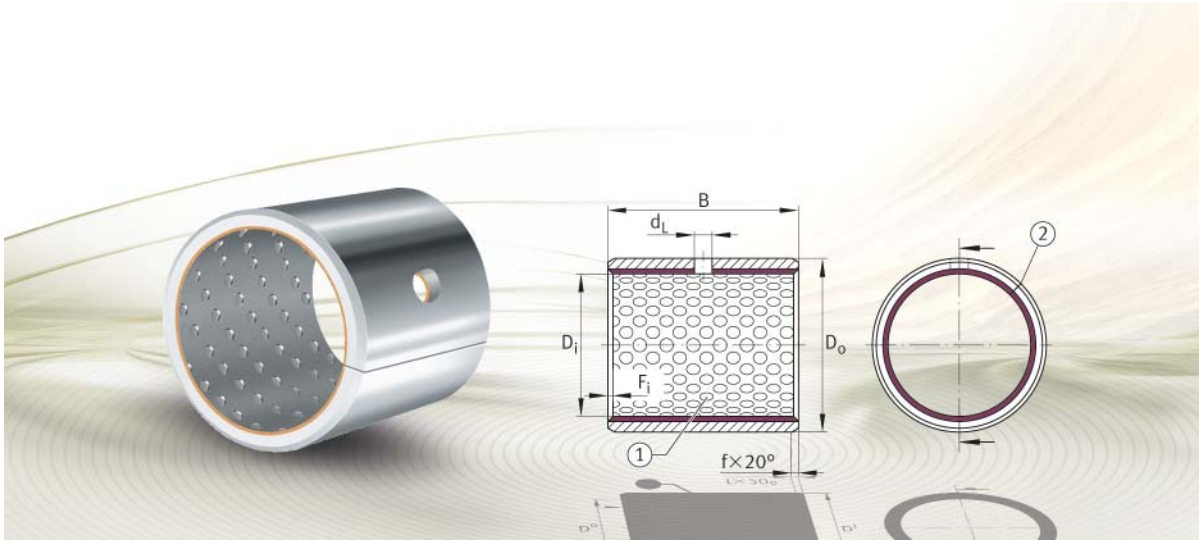
Metal/polymer composite plain bushes, low-maintenance

Bushes

Metal/polymer composite plain bushes, low-maintenance

Product overview   Metal/polymer composite plain bushes, low-maintenance

Bushes
With steel backing

EGB..-E50
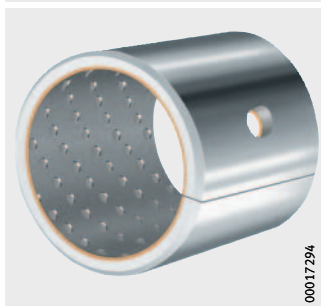
00017294

Metal/polymer composite plain bushes, low-maintenance

Features

Low-maintenance plain bushes are used for rotary, oscillating and linear motion. These plain bearings are bearings for very small radial or axial design envelopes. They are rolled from a cut section of strip and have a butt joint over the entire width of the bearing.

If the plain bushes are to be used in the aerospace sector or in the food or pharmaceuticals industry, please contact the Schaeffler engineering service.

Low-maintenance plain bearing material

For low-maintenance metal/polymer composite plain bearings from Schaeffler, the sliding material E50 is used. The basis of the sliding layer is polyoxymethylene POM.

In the three-layered material, the steel backing has a sintered porous tin/bronze intermediate layer whose pores are filled with the superimposed sliding layer, see table and *Figure 1*.

Sliding and intermediate layer E50

Chemical element	Proportion of mass w %		Layer thickness mm	
	Intermediate layer	Sliding layer	Intermediate layer	Sliding layer
Polyoxymethylene POM	–	99,6 – 99,8	0,15 – 0,5	0,2 – 0,5
Fillers	max. 0,95	max. 0,4		
Tin Sn	10 – 12	–		
Copper Cu	Balance	–		

① Sliding layer
② Intermediate layer
③ Steel backing
④ Tin layer as surface protection
⑤ Lubrication pocket
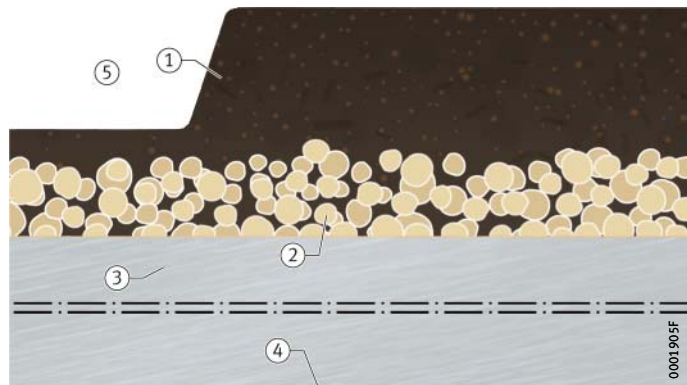
Figure 1
Low-maintenance
plain bearing material E50

Resistance of the plain bearing material

The resistance of the material E50 depends on the chemical characteristics of the individual layers:

- The material E50 is resistant to many greases.
- The tin-plated steel surface gives adequate protection against corrosion in most cases.

The material E50 is not resistant to acidic media (pH $<$ 5) and alkaline media (pH $>$ 9).

Metal/polymer composite plain bushes, low-maintenance

Technical data for E50

The sliding layer E50 is a low-maintenance, low-wear material with good damping characteristics and long relubrication intervals. It can be used for rotary and oscillating motion and for long stroke linear motion, is only slightly sensitive to edge loads and is insensitive to shocks.

Low-maintenance plain bushes are available in the variant E50 with the following mechanical and physical characteristics, see table.

Characteristics of E50

Characteristics	Load		
Maximum pv value		pv	$3 \ N/mm^2 \cdot m/s$
Permissible specific bearing load	Static	p_{max}	$140 \ N/mm^2$
	Rotary, oscillating		$70 \ N/mm^2$
Permissible sliding velocity		v_{max}	$2,5 \ m/s$
Permissible operating temperature		ϑ	$-40 \ °C$ to $+110 \ °C$
Coefficient of thermal expansion	Steel backing	α_{St}	$11 \cdot 10^{-6} \ K^{-1}$
Coefficient of thermal conductivity	Steel backing	λ_{St}	$<4 \ Wm^{-1}K^{-1}$
Coefficient of friction		μ	$0,02$ to $0,2$

Sealing

The plain bearings are not sealed, but can be protected against the ingress of contamination and moisture by the use of external seals, see page 114.

Lubrication

Low-maintenance plain bearing bushes made from E50 have a lubrication hole and lubrication pockets. The lubrication pockets retain the lubricant, which means that an initial lubrication is sufficient in most cases.

The operating life increases if relubrication is carried out regularly.

Greases

Low-maintenance plain bushes made from E50 must be lubricated using suitable grease or oil.

Lithium soap greases with a mineral oil base are highly suitable.

Grease additives such as molybdenum disulphide, zinc sulphide or other solid lubricants are unfavourable since they increase wear. Greases may contain max. 5% MoS_2.

Operating temperature

The permissible operating temperature for low-maintenance plain bearings is between $-40 \ °C$ and $+110 \ °C$.

Suffixes

Suffixes for available designs: see table.

Available designs

Suffix	Description	Design
E50	Low-maintenance sliding layer, with lubrication pockets, ready-to-fit	Standard

| **Design and safety guidelines** | In addition to the design and safety guidelines described here, the following guidelines in the Technical principles must also be observed: |

- theoretical bearing clearance of metal/polymer composite plain bushes, see page 81
- design of bearing arrangements, see page 90
- recommended mounting tolerances, see page 101
- misalignment of plain bushes, see page 102, and edge loading of metal/polymer composite plain bushes, see page 102
- pressing in of bushes, see page 119.

! Plain bushes should not be used for movement involving spatial motion. Any skewing of the shaft will reduce the operating life.

Friction The characteristic coefficients of friction, calculation of the bearing frictional torque and the typical wear characteristics are given in the chapter Technical principles, see section Friction and increases in temperature, page 69.

Dimensioning and rating life The dimensioning of plain bushes is summarised in the chapter Technical principles, see section Technical principles, page 20.

Depending on whether the bearing is subjected to dynamic or static load, the following must be checked:

- static load safety factor S_0
- maximum permissible specific bearing load p
- maximum permissible sliding velocity v
- maximum specific frictional energy pv.

! The rating life can be calculated if the range of validity is observed, see tables, page 50.

Shaft design The shaft and mating surface of the bearing arrangement must be produced in accordance with the following specifications.

Shafts should be chamfered and all sharp edges rounded. This allows easier mounting and prevents damage to the sliding layer of the bush.

Mating surface The mating surface should always be wider than the bearing to prevent the formation of steps in the sliding layer.

The optimum operating life of the sliding layer E50 is achieved with a roughness depth of the mating surface of Rz 2 to Rz 3.

! Very small roughness values do not have a beneficial effect on the operating life, but larger roughness values reduce it considerably.

Metal/polymer composite plain bushes, low-maintenance

Surface quality

Ground or drawn surfaces are preferable as a mating surface. Surfaces that have been precision turned or rolled by precision turning, even with Rz 2 to Rz 3, can cause greater wear since helical manufacturing grooves are created by precision turning.

Spheroidal graphite cast iron GGG has an open surface structure and should therefore be ground to Rz 2 or better.

The direction of rotation of cast shafts in the application should be the same as that of the grinding wheel during machining, since increased wear should be anticipated if rotation is in the opposing direction, *Figure 2*.

① Direction of shaft rotation in the application
② Direction of grinding wheel rotation
③ Direction of shaft rotation during grinding
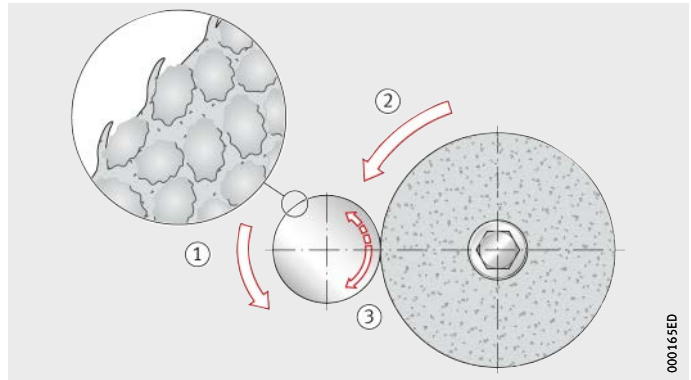
Figure 2
Grinding of a cast shaft

Heat dissipation

Correct and sufficient heat dissipation must be ensured:
- ▪ If media-lubricated operation is present, the heat is dissipated predominantly via the fluid lubricant.
- ▪ In the case of low-maintenance plain bearings, the heat is dissipated via the housing and shaft.

Protection against corrosion

Corrosion of the mating surface is prevented by sealing or the use of corrosion-resistant steel. Alternatively, suitable surface treatments may be carried out. In the case of the sliding layer E50, the lubricant gives additional protection against corrosion.

Fretting corrosion

Due to the tin coating applied as standard, fretting corrosion between the steel backing of E50 and the housing occurs only rarely. In such cases, electroplated protective coatings can be used to achieve a delaying effect.

Electrochemical contact corrosion

In unfavourable conditions, electrical cells (local elements) can be formed that reduce the operating life through corrosion of the steel. This should be checked at the design stage and clarified by means of tests. In case of doubt, please consult the Schaeffler engineering service.

Machining of plain bearings

Metal/polymer composite plain bearings can be machined by either cutting or non-cutting methods, such as shortening or drilling.

The procedure is as follows:

■ Cut the plain bearings starting from the POM side, since the burr formed in cutting will impair the running surface.

■ Clean the bearing elements thoroughly.

■ Protect any bright steel surfaces such as cut edges against corrosion by means of oil or electroplated protective coatings.

⚠ In electroplating with high current densities or or long coating times, the sliding layers should be masked to prevent deposits.

The machining temperature must not exceed +110 °C in the case of the sliding layer E50.

Alternative joining methods

If the interference fit of the bush is inadequate or if it is uneconomical to use dowel pins or screws, there are economical alternative methods for location:

■ laser welding

■ soft soldering

■ adhesive bonding.

⚠ The temperature of the sliding layer must not exceed +110 °C in the case of E50.

The running-in or sliding surface must always be kept free of adhesive.

If adhesive is used, the adhesive manufacturer must always be consulted, particularly on the selection of adhesives, preparation of the surface, hardening, strength, temperature range and elongation behaviour.

Metal/polymer composite plain bushes, low-maintenance

Tables of deviations and wall thicknesses

The deviations for the bushes are defined in ISO 3547.

Deviations of outside diameter

The deviations for the outside diameter D_o conform to ISO 3547-1, Table 7, see table.

Deviations Tolerances in mm

D_o	E50	
	Deviation	
mm	upper	lower
$D_o \leqq 10$	+0,055	+0,025
$10 < D_o \leqq 18$	+0,065	+0,030
$18 < D_o \leqq 30$	+0,075	+0,035
$30 < D_o \leqq 50$	+0,085	+0,045
$50 < D_o \leqq 80$	+0,100	+0,055
$80 < D_o \leqq 120$	+0,120	+0,070
$120 < D_o \leqq 180$	+0,170	+0,100
$180 < D_o \leqq 305$	+0,255	+0,125

Wall thickness for sliding layer E50

The nominal dimensions and limit deviations for the wall thickness s_3 of bushes with the sliding layer E50 for inside diameter D_i conform to ISO 3547-1, Table 5, Series D, see table.

Wall thickness Tolerances in mm

D_i	s_3	E50	
		Deviation	
mm	mm	upper	lower
$8 \leqq D_i < 20$	1	−0,020	−0,045
$20 \leqq D_i < 28$	1,5	−0,025	−0,055
$28 \leqq D_i < 45$	2	−0,030	−0,065
$45 \leqq D_i$	2,5	−0,040	−0,085

Chamfers and chamfer tolerances

The tolerances and dimensions of the outer chamfer f and the inner edge break F_i for bushes of metric sizes conform to ISO 3547-1, see dimension tables and *Figure 3*.

Chamfer deformation due to round bending is permissible.

① $\geqq 0,3$ mm

F_i = inner edge break
f = outer chamfer
s_3 = wall thickness

Figure 3
Outer chamfer and inner edge break

Bushes

Low-maintenance
ISO 3547
With steel backing

EGB
① Lubrication pockets, ② Butt joint

Dimension table · Dimensions in mm											
Designation	Mass	Dimensions								Basic load ratings	
	m	D_i	D_o	B	d_L	f	F_i			dyn. C_r	stat. C_{0r}
							min.	max.			
	≈g			±0,25				min.	max.	N	N
EGB0808-E50	1,2	**8**	10	8	[1]	0,6±0,4	0,1	0,6		4 480	8 960
EGB0810-E50	1,5	**8**	10	10	[1]	0,6±0,4	0,1	0,6		5 600	11 200
EGB0812-E50	1,8	**8**	10	12	[1]	0,6±0,4	0,1	0,6		6 720	13 400
EGB1008-E50	1,6	**10**	12	8	[1]	0,6±0,4	0,1	0,6		5 600	11 200
EGB1010-E50	1,9	**10**	12	10	3	0,6±0,4	0,1	0,6		7 000	14 000
EGB1015-E50	2,7	**10**	12	15	3	0,6±0,4	0,1	0,6		10 500	21 000
EGB1210-E50	2,1	**12**	14	10	3	0,6±0,4	0,1	0,6		8 400	16 800
EGB1212-E50	2,5	**12**	14	12	3	0,6±0,4	0,1	0,6		10 100	20 200
EGB1215-E50	3,3	**12**	14	15	3	0,6±0,4	0,1	0,6		12 600	25 200
EGB1220-E50	4,4	**12**	14	20	3	0,6±0,4	0,1	0,6		16 800	33 600
EGB1420-E50	4,9	**14**	16	20	3	0,6±0,4	0,1	0,6		19 600	39 200
EGB1510-E50	2,7	**15**	17	10	3	0,6±0,4	0,1	0,6		10 500	21 000
EGB1515-E50	4	**15**	17	15	3	0,6±0,4	0,1	0,6		15 800	31 500
EGB1525-E50	6,8	**15**	17	25	3	0,6±0,4	0,1	0,6		26 300	52 500
EGB1612-E50	3,3	**16**	18	12	3	0,6±0,4	0,1	0,6		13 400	26 900
EGB1615-E50	4,3	**16**	18	15	3	0,6±0,4	0,1	0,6		16 800	33 600
EGB1620-E50	5,8	**16**	18	20	3	0,6±0,4	0,1	0,6		22 400	44 800
EGB1815-E50	4,7	**18**	20	15	3	0,6±0,4	0,1	0,6		18 900	37 800
EGB1820-E50	6,4	**18**	20	20	3	0,6±0,4	0,1	0,6		25 200	50 400
EGB2015-E50	8,4	**20**	23	15	3	0,6±0,4	0,1	0,7		21 000	42 000
EGB2020-E50	11,2	**20**	23	20	3	0,6±0,4	0,1	0,7		28 000	56 000
EGB2025-E50	14	**20**	23	25	3	0,6±0,4	0,1	0,7		35 000	70 000
EGB2030-E50	16,9	**20**	23	30	3	0,6±0,4	0,1	0,7		42 000	84 000
EGB2220-E50	12,2	**22**	25	20	3	0,6±0,4	0,1	0,7		30 800	61 600
EGB2515-E50	10,3	**25**	28	15	4	0,6±0,4	0,1	0,7		26 300	52 500
EGB2520-E50	13,8	**25**	28	20	4	0,6±0,4	0,1	0,7		35 000	70 000
EGB2525-E50	17,3	**25**	28	25	4	0,6±0,4	0,1	0,7		43 800	87 500
EGB2530-E50	20,8	**25**	28	30	4	0,6±0,4	0,1	0,7		52 500	105 000
EGB2830-E50	34,3	**28**	32	30	4	1,2±0,4	0,1	0,7		58 800	117 600

Recommended mounting tolerances, see page 101.

[1] No lubrication hole.

Bushes

Low-maintenance
ISO 3547
With steel backing

EGB
① Lubrication pockets, ② Butt joint

Dimension table (continued) · Dimensions in mm										
Designation	Mass	Dimensions							Basic load ratings	
	m	D_i	D_o	B	d_L	f	F_i		dyn. C_r	stat. C_{0r}
							min.	max.		
	≈g			±0,25					N	N
EGB3020-E50	24,2	**30**	34	20	4	1,2±0,4	0,1	0,7	42 000	84 000
EGB3025-E50	30,4	**30**	34	25	4	1,2±0,4	0,1	0,7	52 500	105 000
EGB3030-E50	36,6	**30**	34	30	4	1,2±0,4	0,1	0,7	63 000	126 000
EGB3040-E50	48,9	**30**	34	40	4	1,2±0,4	0,1	0,7	84 000	168 000
EGB3230-E50	38,9	**32**	36	30	4	1,2±0,4	0,1	0,7	67 200	134 400
EGB3520-E50	28	**35**	39	20	4	1,2±0,4	0,1	0,7	49 000	98 000
EGB3530-E50	42,3	**35**	39	30	4	1,2±0,4	0,1	0,7	73 500	147 000
EGB3550-E50	70,9	**35**	39	50	4	1,2±0,4	0,1	0,7	123 000	245 000
EGB4020-E50	31,8	**40**	44	20	4	1,2±0,4	0,1	0,7	56 000	112 000
EGB4030-E50	48,1	**40**	44	30	4	1,2±0,4	0,1	0,7	84 000	168 000
EGB4040-E50	64,3	**40**	44	40	4	1,2±0,4	0,1	0,7	112 000	224 000
EGB4050-E50	80,5	**40**	44	50	4	1,2±0,4	0,1	0,7	140 000	280 000
EGB4540-E50	95,2	**45**	50	40	5	1,8±0,6	0,2	1	126 000	252 000
EGB4550-E50	119	**45**	50	50	5	1,8±0,6	0,2	1	158 000	315 000
EGB5025-E50	65,2	**50**	55	25	5	1,8±0,6	0,2	1	87 500	175 000
EGB5040-E50	105	**50**	55	40	5	1,8±0,6	0,2	1	140 000	280 000
EGB5060-E50	159	**50**	55	60	5	1,8±0,6	0,2	1	210 000	420 000
EGB5540-E50	115	**55**	60	40	6	1,8±0,6	0,2	1	154 000	308 000
EGB6030-E50	93,4	**60**	65	30	6	1,8±0,6	0,2	1	126 000	252 000
EGB6040-E50	125	**60**	65	40	6	1,8±0,6	0,2	1	168 000	336 000
EGB6060-E50	189	**60**	65	60	6	1,8±0,6	0,2	1	252 000	504 000
EGB7040-E50	145	**70**	75	40	6	1,8±0,6	0,2	1	196 000	392 000
EGB7050-E50	182	**70**	75	50	6	1,8±0,6	0,2	1	245 000	490 000
EGB7070-E50	256	**70**	75	70	6	1,8±0,6	0,2	1	343 000	686 000
EGB7540-E50	155	**75**	80	40	6	1,8±0,6	0,2	1	210 000	420 000
EGB7580-E50	313	**75**	80	80	6	1,8±0,6	0,2	1	420 000	840 000
EGB8040-E50	166	**80**	85	40	6	1,8±0,6	0,2	1	224 000	448 000
EGB8055-E50	229	**80**	85	55	6	1,8±0,6	0,2	1	308 000	616 000
EGB8060-E50	250	**80**	85	60	6	1,8±0,6	0,2	1	336 000	672 000
EGB8080-E50	334	**80**	85	80	6	1,8±0,6	0,2	1	448 000	896 000
EGB9060-E50	280	**90**	95	60	6	1,8±0,6	0,2	1	378 000	756 000
EGB10050-E50	258	**100**	105	50	6	1,8±0,6	0,2	1	350 000	700 000
EGB10060-E50	310	**100**	105	60	6	1,8±0,6	0,2	1	420 000	840 000

Recommended mounting tolerances, see page 101.
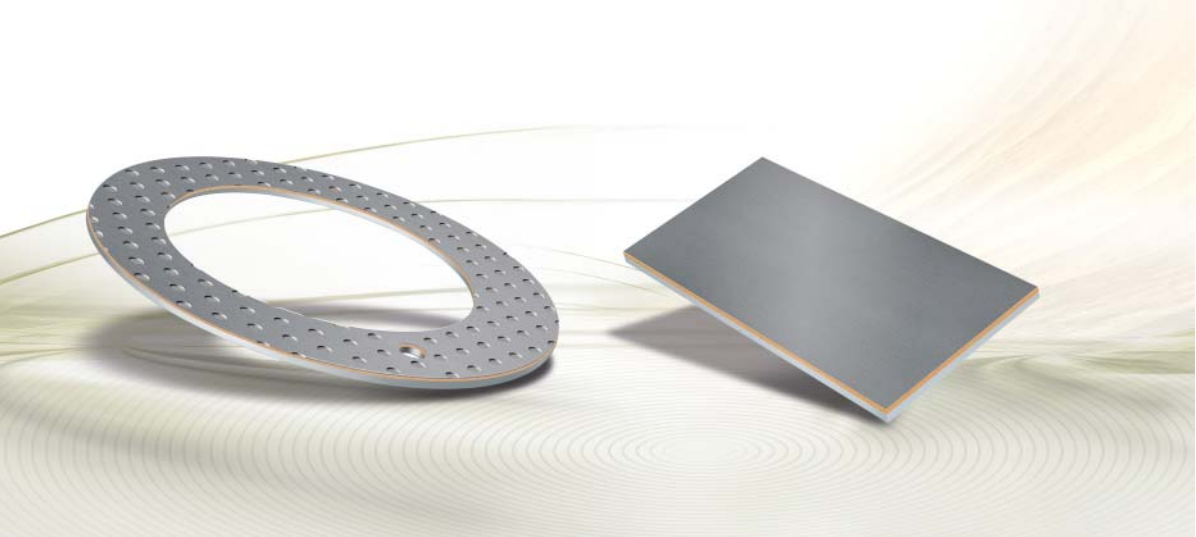
Thrust washers, strips

Metal/polymer composite plain bearings

Thrust washers, strips

Metal/polymer composite plain bearings, maintenance-free

.... **368**

Maintenance-free thrust washers are used to support forces in an axial direction. Strips are used to facilitate linear motion. Strips are also used as the basic material for individual special designs produced in accordance with drawings.

The maintenance-free plain bearing material E40 is, due to the dry lubricant polytetrafluorethylene PTFE, intended for dry running. These bearings are thus particularly suitable where the bearing position must be maintenance-free, there is a risk of lubricant starvation or where lubricant is unacceptable or undesirable.

Typical areas of application include automatic assembly machines, door hinges, damping elements, electrotechnical installations and solar energy plant.

Metal/polymer composite plain bearings, low-maintenance

.... **382**

Low-maintenance thrust washers and strips support axial forces and facilitate rotary or linear motion as in the case of the maintenance-free variants. Due to the presence of lubrication pockets, however, they can be lubricated with oil or grease.

The low-maintenance plain bearing material E50 is a low-wear material with good damping characteristics and long relubrication intervals. The bearings have a sliding layer made from polyoxymethylene POM.

It is only slightly sensitive to edge loads and is insensitive to shocks.

Application examples can be found in particular in the area of production machinery, construction and agricultural equipment as well as commercial vehicles.

EGS..-E40-B   EGS..-E40   EGW..-E40-B   EGW..-E40

00019543

EGS..-E50   EGW..-E50

00019544

Thrust washers, strips, maintenance-free

Metal/polymer composite plain bearings

Thrust washers, strips, maintenance-free

Product overview

Thrust washers, strips, maintenance-free

Thrust washers

Metal/polymer composite
plain bearings

With steel backing or
with bronze backing

EGW..-E40	EGW..-E40-B

00017298B

00017359

Strips

Metal/polymer composite
plain bearings

With steel backing

EGS..-E40

0001729C

With bronze backing

Available by agreement

EGS..-E40-B
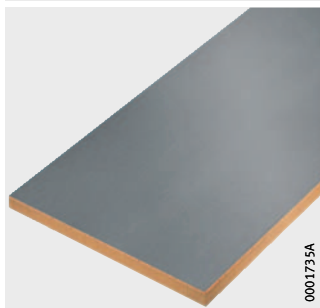
0001735A

Thrust washers, strips, maintenance-free

Features   Maintenance-free thrust washers are used for rotary and oscillating motion. Strips are used predominantly for linear motion or as the basic material for other designs, such as half-cups or special geometries.

These plain bearings are bearings for very small design envelopes.

The plain bearings are supplied with either steel backing or bronze backing. Bearings with a bronze backing have high corrosion resistance and very good thermal conductivity and are antimagnetic.

!   If the plain bushes are to be used in the aerospace sector or in the food or pharmaceuticals industry, please contact the Schaeffler engineering service.

Thrust washers, strips, maintenance-free

Maintenance-free plain bearing material

For maintenance-free metal/polymer composite plain bearings from Schaeffler, the sliding material E40 and E40-B is used. The basis of the dry lubricant is polytetrafluoroethylene PTFE with embedded chemically non-reactive additives.

In the three-layered material, the steel or bronze backing has a sintered porous tin/bronze sliding layer whose pores are filled with the superimposed running-in layer, see table, *Figure 1* and *Figure 2*. The running-in layer is a plastic composite comprising PTFE and additives.

Sliding and running-in layer E40, E40-B

Chemical element	Proportion of mass w %		Layer thickness mm	
	Sliding layer	Running-in layer	Sliding layer	Running-in layer
Molybdenum disulphide MoS_2	–	max. 8	$0,2 - 0,4$	$0,01 - 0,05$
Polytetrafluoroethylene PTFE	–	$80 - 86$		
Fillers	max. 5,5	max. 19		
Tin Sn	$7 - 12$	–		
Copper Cu	Balance	–		

① Running-in layer
② Sliding layer
③ Steel backing
④ Tin layer as surface protection

Figure 1
Maintenance-free
plain bearing material E40

① Running-in layer
② Sliding layer
③ Bronze backing

Figure 2
Maintenance-free
plain bearing material E40-B

**Resistance
of the plain bearing material**

The resistance of the material E40 depends on the chemical characteristics of the individual layers:

- The material E40 is resistant to water, alcohols, glycols and numerous mineral and synthetic oils.
- The tin-plated steel surface gives adequate protection against corrosion in most cases.
- In the case of the material E40-B, the bronze backing is additionally resistant to water vapour and seawater.

! The material E40 is not resistant to acidic media (pH $<$ 5) and alkaline media (pH $>$ 9). The bronze backing of E40-B is not resistant to oxidising acids and gases such as free halides, ammonia or hydrogen sulphide, especially if these gases have a high moisture content.

Technical data for E40

The sliding layer E40 is maintenance-free. It can be used for rotary and oscillating motion as well as for short stroke linear motion.

The low-wear material has good sliding characteristics (no stick-slip), a low coefficient of friction and high resistance to chemicals. It does not absorb water (it is highly resistant to swelling), does not tend to weld to metal and is also suitable for hydrodynamic operation.

Maintenance-free thrust washers and strips are available in the variants E40 and E40-B with the following mechanical and physical characteristics, see table.

Characteristics of E40 and E40-B

Characteristic	Loading		
Maximum pv value for dry running	Continuous operation	pv	$1,8\ \text{N/mm}^2 \cdot \text{m/s}$
	For short periods		$3,6\ \text{N/mm}^2 \cdot \text{m/s}$
Permissible specific bearing load	Static	p_{max}	$250\ \text{N/mm}^2$
	Rotary, oscillating		$140\ \text{N/mm}^2$
Permissible sliding velocity	Dry running	v_{max}	$2,5\ \text{m/s}$
	Hydrodynamic operation		$>2,5\ \text{m/s}$
Permissible operating temperature		ϑ	$-200\ ^\circ\text{C}$ to $+280\ ^\circ\text{C}$
Coefficient of thermal expansion	Steel backing	α_{St}	$11 \cdot 10^{-6}\ \text{K}^{-1}$
	Bronze backing	α_{Bz}	$17 \cdot 10^{-6}\ \text{K}^{-1}$
Coefficient of thermal conductivity	Steel backing	λ_{St}	$>42\ \text{Wm}^{-1}\text{K}^{-1}$
	Bronze backing	λ_{Bz}	$>70\ \text{Wm}^{-1}\text{K}^{-1}$
Relative electrical resistance after running-in		$R_{rel\ min}$	$>1\ \Omega \cdot \text{cm}^2$

Thrust washers, strips, maintenance-free

Lubrication

Plain bearings with the sliding layer E40 contain dry lubricants and do not therefore require lubrication.

Lubrication can be used to protect the mating surface against corrosion or simply to provide sealing against contamination. It should be checked in advance, however, whether it is more advantageous in such cases to use a corrosion-resistant material for the mating surface or a different means of sealing the bearing position.

In certain applications, the sliding layer E40 can be used in fluid media. In this case, the improved heat dissipation may considerably increase the operating life.

! The compatibility of the media with the sliding layer E40 must be checked. Further advice should therefore be sought from the Schaeffler engineering service.

Lubricants

Oil and grease lubrication, even in very small quantities, impairs the transfer of material during the running-in phase.

Over time, grease and small quantities of oil mix with wear debris to form a paste that promotes wear. Solid lubricants such as zinc sulphide, molybdenum disulphide or similar grease additives are not permitted, since they promote this paste formation to an increased extent.

Relubrication

If it is not possible in exceptional cases to avoid the use of grease lubrication, the bearings must be relubricated periodically. During relubrication, old grease is replaced by fresh grease. At the same time, the grease flushes wear debris and contaminants out of the bearing.

! If periodic relubrication is carried out, the formation of paste comprising debris and contaminants must be avoided.

Operating temperature

The permissible operating temperature for maintenance-free metal/polymer composite plain bearings is between −200 °C and +280 °C.

! The running-in layer and sliding layer may undergo swelling in the presence of some mineral oils at temperatures above +100 °C. This could lead to jamming of the bearing.

This can be remedied by increasing the bearing clearance, since other characteristics of the sliding layer E40 are unaffected.

Suffixes

Suffixes for available designs: see table.

Available designs

Suffix	Description	Design
E40	Maintenance-free sliding layer, with steel backing	Standard
E40-B	Maintenance-free sliding layer, with bronze backing	

Design and safety guidelines

The guidelines on the design of bearing arrangements and on mounting and dismounting must be observed, see section Design of bearing arrangements, page 90.

Friction

At high specific bearing load and low sliding velocity, the coefficient of friction is more favourable, see section Friction and increases in temperature, page 69.

Running-in process

During the running-in process, part of the running-in layer is transferred to the mating surface:

- This compensates uneven areas.

- A mating surface with a low coefficient of friction is formed, which acts favourably on the operating behaviour.

- After running-in, some of the porous bronze layer is visible on the sliding layer as individual areas of differing sizes, *Figure 3*. This shows that the bearing is running correctly.

① Before running-in
② After running-in
③ After long operating life
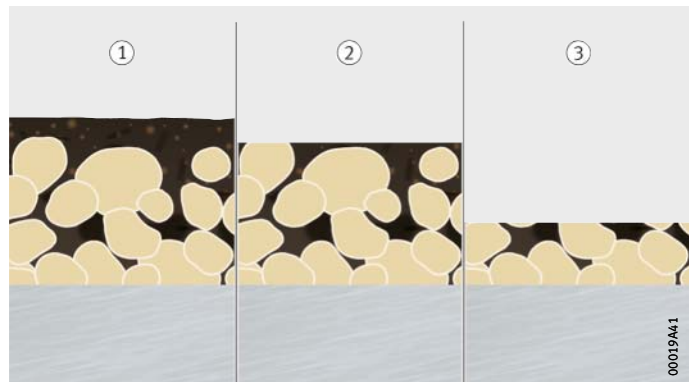
Figure 3
Typical wear pattern
of sliding layer E40

Operating behaviour

After running-in, the wear of maintenance-free plain bearings proceeds in a linear manner, *Figure 4*.

s_{Mat} = material removal
t = time

① Wear during operation
② Material transfer during running-in
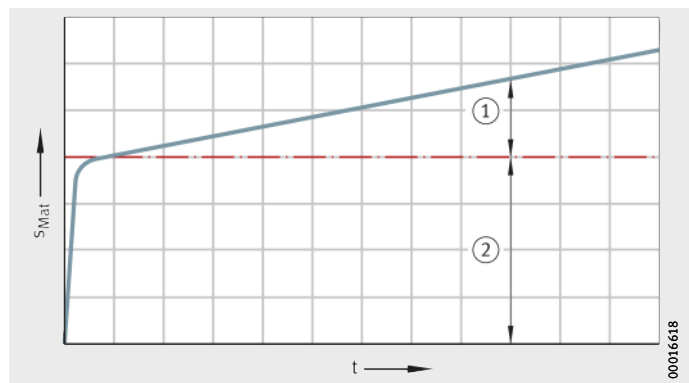
Figure 4
Typical operating behaviour during
operating life

Thrust washers, strips, maintenance-free

Dimensioning and rating life

The dimensioning of thrust washers and strips is summarised in the chapter Technical principles, see section Technical principles, page 20.

Depending on whether the bearing is subjected to dynamic or static load, the following must be checked:

- static load safety factor S_0
- maximum permissible specific bearing load p
- maximum permissible sliding velocity v
- maximum specific frictional energy pv.

[!] The rating life of thrust washers can be calculated if the range of validity is observed, see tables, page 50.

For a rating life estimate in the case of strips EGS, the Schaeffler engineering service should be contacted.

Design of the adjacent construction

The adjacent construction should be chamfered and all sharp edges should be rounded. This allows easier mounting and prevents damage to the sliding layer.

Mating surface

The mating surface should always be wider than the bearing to prevent the formation of steps in the sliding layer.

The optimum operating life in dry running of the sliding layer E40 is achieved with a roughness depth of the mating surface of Rz 2 to Rz 3.

[!] Very small roughness values do not have a beneficial effect on the operating life, but larger roughness values reduce it considerably.

Surface quality

Ground or drawn surfaces are preferable as a mating surface. Surfaces that have been precision turned or rolled by precision turning, even with Rz 2 to Rz 3, can cause greater wear since helical manufacturing grooves are created by precision turning.

Spheroidal graphite cast iron GGG has an open surface structure and should therefore be ground to Rz 2 or better, *Figure 6*, page 302.

Heat dissipation

Correct and sufficient heat dissipation must be ensured:

- If hydrodynamic operation is present,
  the heat is dissipated predominantly via the fluid lubricant.
- In the case of maintenance-free plain bearings,
  the heat is dissipated via the housing and shaft.

Protection against corrosion	Corrosion of the mating surface in the case of the sliding layer E40 is prevented by sealing or the use of corrosion-resistant steel. Alternatively, suitable surface treatments may be carried out.

Fretting corrosion Due to the tin coating applied as standard, fretting corrosion between the steel backing of E40 and the housing occurs only rarely. In such cases, electroplated protective coatings can be used to achieve a delaying effect.

Electrochemical contact corrosion In unfavourable conditions, electrical cells (local elements) can be formed that reduce the operating life through corrosion of the steel. This should be checked at the design stage and clarified by means of tests. In case of doubt, please consult the Schaeffler engineering service.

Machining of plain bearings Metal/polymer composite plain bearings can be machined by either cutting or non-cutting methods, such as turning, shearing, drilling or bending.

The procedure is as follows:
- Cut the sliding layer starting from the PTFE side, since the burr formed in cutting will impair the running surface.
- Clean the bearing elements thoroughly.
- Protect any bright steel surfaces such as cut edges against corrosion by means of oil or electroplated protective coatings.

⚠ In electroplating with high current densities or long coating times, the sliding layers should be masked to prevent deposits.

The machining temperature must not exceed +280 °C in the case of the sliding layer E40, otherwise there may be a health risk.

Alternative joining methods If it is uneconomical to use dowel pins or screws, there are economical alternative methods for location:
- laser welding
- soft soldering
- adhesive bonding.

⚠ The temperature of the running-in layer or sliding layer must not exceed +280 °C in the case of E40.

The running-in or sliding layer must always be kept free of adhesive.

If adhesive is used, the adhesive manufacturer must always be consulted, particularly on the selection of adhesives, preparation of the surface, hardening, strength, temperature range and elongation behaviour.

Electrical conductivity The electrical conductivity of new bearings may be lower because the running-in layer is still present. The bronze layer is partially exposed after the running-in process, thus improving the electrical conductivity, *Figure 3*, page 375.

The electrical resistance is dependent on the size of the contact surface.

Thrust washers

Maintenance-free
Material in accordance
with ISO 3547-4
With steel backing

EGW
① Cutout[1]

Mounting
dimensions

Dimension table · Dimensions in mm

Designation	Mass	Dimensions					Mounting dimensions		Basic load ratings	
	m	D_i	D_o	s_3	J	d_1	t_a	d_{6a}	dyn. C_a	stat. C_{0a}
	$\approx$g	+0,25	−0,25	−0,05	±0,12	+0,4 +0,1	±0,2	+0,12	N	N
EGW10-E40[2]	2,6	**10**	20	1,5	–	–	1	20	33 000	58 900
EGW12-E40	3,7	**12**	24	1,5	18	1,5	1	24	47 500	84 800
EGW14-E40	4,1	**14**	26	1,5	20	2	1	26	52 800	94 200
EGW16-E40	5,6	**16**	30	1,5	22	2	1	30	70 800	126 000
EGW18-E40	6,1	**18**	32	1,5	25	2	1	32	77 000	137 000
EGW20-E40	7,7	**20**	36	1,5	28	3	1	36	98 500	176 000
EGW22-E40	8,3	**22**	38	1,5	30	3	1	38	106 000	188 000
EGW26-E40	10,9	**26**	44	1,5	35	3	1	44	139 000	247 000
EGW28-E40	13,1	**28**	48	1,5	38	4	1	48	167 000	298 000
EGW32-E40	16,4	**32**	54	1,5	43	4	1	54	208 000	371 000
EGW38-E40	20,9	**38**	62	1,5	50	4	1	62	264 000	471 000
EGW42-E40	22,5	**42**	66	1,5	54	4	1	66	285 000	509 000
EGW48-E40	37,3	**48**	74	2	61	4	1,5	74	349 000	623 000
EGW52-E40	39,8	**52**	78	2	65	4	1,5	78	372 000	664 000
EGW62-E40	50,2	**62**	90	2	76	4	1,5	90	468 000	836 000

Thrust washers in special sizes available by agreement.

[1] Cutouts permissible on the inside or outside diameter in any quantity and position.

[2] No fixing hole.

Thrust washers

Maintenance-free
Material in accordance
with ISO 3547-4
With bronze backing

EGW
① Cutout[1]

Mounting
dimensions

Dimension table · Dimensions in mm										
Designation	Mass	Dimensions					Mounting dimensions		Basic load ratings	
	m	D_i	D_o	s_3	J	d_1	t_a	d_{6a}	dyn. C_a	stat. C_{0a}
	≈g	+0,25	−0,25	−0,05	±0,12	+0,4 +0,1	±0,2	+0,12	N	N
EGW10-E40-B[2]	2,8	**10**	20	1,5	–	–	1	20	33 000	58 900
EGW12-E40-B	4,1	**12**	24	1,5	18	1,5	1	24	47 500	84 800
EGW14-E40-B	4,5	**14**	26	1,5	20	2	1	26	52 800	94 200
EGW16-E40-B	6,1	**16**	30	1,5	22	2	1	30	70 800	126 000
EGW18-E40-B	6,6	**18**	32	1,5	25	2	1	32	77 000	137 000
EGW20-E40-B	8,4	**20**	36	1,5	28	3	1	36	98 500	176 000
EGW22-E40-B	9,1	**22**	38	1,5	30	3	1	38	106 000	188 000
EGW26-E40-B	11,9	**26**	44	1,5	35	3	1	44	139 000	247 000
EGW28-E40-B	14,4	**28**	48	1,5	38	4	1	48	167 000	298 000
EGW32-E40-B	17,9	**32**	54	1,5	43	4	1	54	208 000	371 000
EGW38-E40-B	22,8	**38**	62	1,5	50	4	1	62	264 000	471 000
EGW42-E40-B	24,7	**42**	66	1,5	54	4	1	66	285 000	509 000
EGW48-E40-B	41	**48**	74	2	61	4	1,5	74	349 000	623 000
EGW52-E40-B	43,7	**52**	78	2	65	4	1,5	78	372 000	664 000
EGW62-E40-B	55,1	**62**	90	2	76	4	1,5	90	468 000	836 000

Thrust washers in special sizes available by agreement.

[1] Cutouts permissible on the inside or outside diameter in any quantity and position.

[2] No fixing hole.
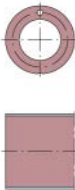
Strips

Maintenance-free
Material in accordance with ISO 3547-4
With steel backing
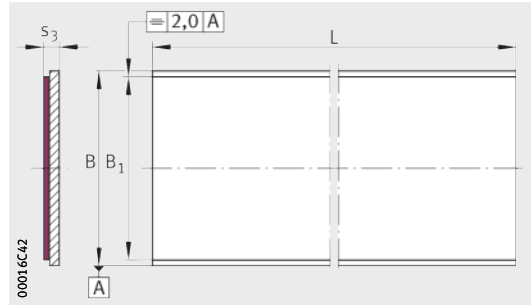
EGS..-E40-S3E

Dimension table · Dimensions in mm

Designation	Mass	Dimensions			
	m	s_3	B	B_1	L
	≈g		±2		+3
EGS15260-E40-S3E	1 456	1,505	260	243	500
EGS20260-E40-S3E	1 966	2,005	260	243	500
EGS25260-E40-S3E	2 476	2,505	260	243	500
EGS30260-E40-S3E	3 048	3,065	260	243	500

B = total width
B_1 = minimum usable width

Strips with a smaller wall thickness s_3 and in special sizes are available by agreement.

Thrust washers, strips, low-maintenance

Metal/polymer composite plain bearings

Thrust washers, strips, low-maintenance

Product overview   Thrust washers, strips, low-maintenance

Thrust washers

Metal/polymer composite plain bearings

With steel backing

EGW..-E50

00017295

Strips

Metal/polymer composite plain bearings

With steel backing

EGS..-E50

00017296

Thrust washers, strips, low-maintenance

Features

Low-maintenance thrust washers are used for rotary and oscillating motion. Strips are used predominantly for linear motion or as the basic material for other designs, such as half-cups or special geometries.

These plain bearings are bearings for very small design envelopes.

⚠️ If the plain bearings are to be used in the aerospace sector or in the food or pharmaceuticals industry, please contact the Schaeffler engineering service.

Low-maintenance plain bearing material

For low-maintenance metal/polymer composite plain bearings from Schaeffler, the sliding material E50 is used. The basis of the sliding layer is polyoxymethylene POM.

In the three-layered material, the steel backing has a sintered porous tin/bronze intermediate layer whose pores are filled with the superimposed sliding layer, see table and *Figure 1*.

Sliding and intermediate layer E50

Chemical element	Proportion of mass w %		Layer thickness mm	
	Inter-mediate layer	Sliding layer	Inter-mediate layer	Sliding layer
Polyoxymethylene POM	–	99,6 – 99,8	0,15 – 0,5	0,2 – 0,5
Fillers	max. 0,95	max. 0,4		
Tin Sn	10 – 12	–		
Copper Cu	Balance	–		

① Sliding layer
② Intermediate layer
③ Steel backing
④ On thrust washers: tin layer
On strips: without tin layer
⑤ Lubrication pocket
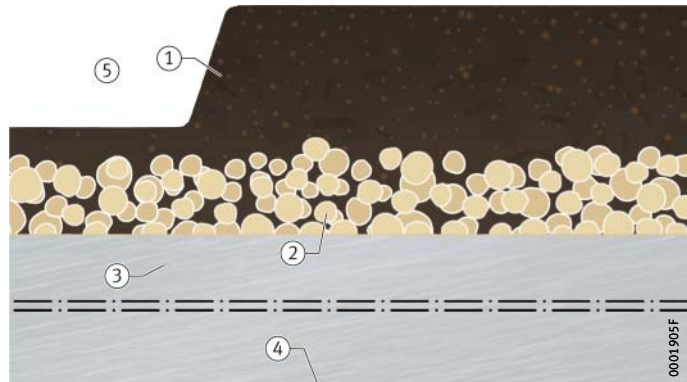
Figure 1
Low-maintenance
plain bearing material E50

Strips with steel backing

Strips EGS..-E50 do not have a tin layer and have a copper layer as a backing.
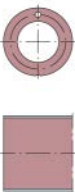
Thrust washers, strips, low-maintenance

Resistance of the plain bearing material

The resistance of the material E50 depends on the chemical characteristics of the individual layers:

- The material E50 is resistant to many greases.
- The tin-plated steel surface of thrust washers is adequate protection against corrosion in most cases.

⚠️ The material E50 is not resistant to acidic media (pH < 5) and alkaline media (pH > 9).

Technical data for E50

The sliding layer E50 is a low-maintenance, low-wear material with good damping characteristics and long relubrication intervals. It can be used for rotary and oscillating motion and for long stroke linear motion, is only slightly sensitive to edge loads and is insensitive to shocks.

Low-maintenance thrust washers and strips are available in the variant E50 with the following mechanical and physical characteristics, see table.

Characteristics of E50

Characteristics	Load		
Maximum pv value		pv	$3 \text{ N/mm}^2 \cdot \text{m/s}$
Permissible specific bearing load	Static	p_{max}	140 N/mm^2
	Rotary, oscillating		70 N/mm^2
Permissible sliding velocity		v_{max}	$2,5 \text{ m/s}$
Permissible operating temperature		ϑ	$-40\ ^\circ\text{C}$ to $+110\ ^\circ\text{C}$
Coefficient of thermal expansion	Steel backing	α_{St}	$11 \cdot 10^{-6} \text{ K}^{-1}$
Coefficient of thermal conductivity	Steel backing	λ_{St}	$<4 \text{ Wm}^{-1}\text{K}^{-1}$
Coefficient of friction		μ	$0,02$ to $0,2$

Lubrication	Low-maintenance thrust washers and strips made from E50 have lubrication pockets. The lubrication pockets retain the lubricant, which means that an initial lubrication is sufficient in most cases.
	The operating life increases if relubrication is carried out regularly.
Greases	Low-maintenance plain bearings made from E50 must be lubricated using suitable grease or oil.
	Lithium soap greases with a mineral oil base are highly suitable.
	Grease additives such as molybdenum disulphide, zinc sulphide or other solid lubricants are unfavourable since they increase wear. Greases may contain max. 5% MoS_2.
Operating temperature	The permissible operating temperature for low-maintenance plain bearings is between −40 °C and +110 °C.
Suffixes	Suffixes for available designs: see table.

Available designs

Suffix	Description	Design
E50	Low-maintenance sliding layer, with lubrication pockets, ready-to-fit	Standard

Thrust washers, strips, low-maintenance

Design and safety guidelines

The guidelines on the design of bearing arrangements and on mounting and dismounting must be observed, see section Technical principles.

Friction

The characteristic coefficients of friction and the calculation of the bearing frictional torque are given in the chapter Technical principles, see section Friction and increases in temperature, page 69.

Dimensioning and rating life

The dimensioning of thrust washers and strips is summarised in the chapter Technical principles, see section Technical principles, page 20.

Depending on whether the bearing is subjected to dynamic or static load, the following must be checked:

- static load safety factor S_0
- maximum permissible specific bearing load p
- maximum permissible sliding velocity v
- maximum specific frictional energy pv.

⚠️ The rating life of thrust washers can be calculated if the range of validity is observed, see tables, page 50.

For a rating life estimate in the case of strips EGS, the Schaeffler engineering service should be contacted.

Design of the adjacent construction

The adjacent construction should be chamfered and all sharp edges should be rounded. This allows easier mounting and prevents damage to the sliding layer.

Mating surface

The mating surface should always be wider than the bearing to prevent the formation of steps in the sliding layer.

The optimum operating life of the sliding layer E50 is achieved with a roughness depth of the mating surface of Rz 2 to Rz 3.

⚠️ Very small roughness values do not have a beneficial effect on the operating life, but larger roughness values reduce it considerably.

Surface quality

Ground or drawn surfaces are preferable as a mating surface. Surfaces that have been precision turned or rolled by precision turning, even with Rz 2 to Rz 3, can cause greater wear since helical manufacturing grooves are created by precision turning.

Spheroidal graphite cast iron GGG has an open surface structure and should therefore be ground to Rz 2 or better, *Figure 6*, page 302.

Heat dissipation	Correct and sufficient heat dissipation must be ensured:
	▪ If media-lubricated operation is present, the heat is dissipated predominantly via the fluid lubricant.
	▪ In the case of low-maintenance plain bearings, the heat is dissipated via the housing and shaft.

Heat dissipation

Correct and sufficient heat dissipation must be ensured:

▪ If media-lubricated operation is present,
the heat is dissipated predominantly via the fluid lubricant.

▪ In the case of low-maintenance plain bearings,
the heat is dissipated via the housing and shaft.

Protection against corrosion

Corrosion of the mating surface is prevented by sealing or the use of corrosion-resistant steel. Alternatively, suitable surface treatments may be carried out. In the case of the sliding layer E50, the lubricant gives additional protection against corrosion.

Fretting corrosion

Due to the tin coating on thrust washers, fretting corrosion between the steel backing of the sliding layer E50 and the housing occurs only rarely. In such cases, electroplated protective coatings can be used to achieve a delaying effect.

Electrochemical contact corrosion

In unfavourable conditions, electrical cells (local elements) can be formed that reduce the operating life through corrosion of the steel. This should be checked at the design stage and clarified by means of tests. In case of doubt, please consult the Schaeffler engineering service.

Machining of plain bearings

Metal/polymer composite plain bearings can be machined by either cutting or non-cutting methods, such as shortening, drilling or bending.

The procedure is as follows:

▪ Cut the sliding layer starting from the POM side, since the burr formed in cutting will impair the running surface.

▪ Clean the bearing elements thoroughly.

▪ Protect any bright steel surfaces such as cut edges against corrosion by means of oil or electroplated protective coatings.

⚠ In electroplating with high current densities or long coating times, the sliding layers should be masked to prevent deposits.

The machining temperature must not exceed +110 °C in the case of the sliding layer E50.
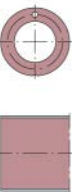
Thrust washers

Low-maintenance
Material in accordance
with ISO 3547-4
With steel backing
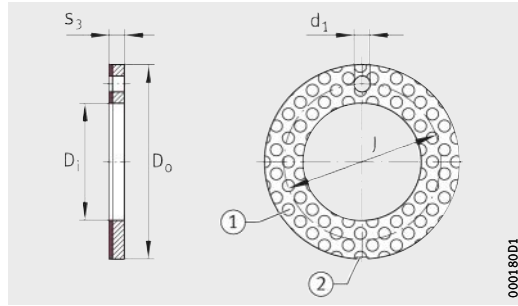
EGW
① Lubrication pockets, ② Cutout[1]

Mounting
dimensions

Dimension table · Dimensions in mm										
Designation	Mass	Dimensions					Mounting dimensions		Basic load ratings	
	m	D_i	D_o	s_3	J	d_1	t_a	d_{6a}	dyn. C_a	stat. C_{0a}
	$\approx$g	+0,25	−0,25	−0,05	±0,12	+0,4 +0,1	±0,2	+0,12	N	N
EGW12-E50	2,8	**12**	24	1,5	18	1,5	1	24	23 800	47 500
EGW14-E50	3,1	**14**	26	1,5	20	2	1	26	26 400	52 800
EGW18-E50	4,6	**18**	32	1,5	25	2	1	32	38 500	77 000
EGW20-E50	5,8	**20**	36	1,5	28	3	1	36	49 300	98 500
EGW22-E50	6,3	**22**	38	1,5	30	3	1	38	52 800	106 000
EGW26-E50	8,3	**26**	44	1,5	35	3	1	44	69 300	139 000
EGW28-E50	9,9	**28**	48	1,5	38	4	1	48	83 600	167 000
EGW32-E50	12,4	**32**	54	1,5	43	4	1	54	104 000	208 000
EGW38-E50	15,8	**38**	62	1,5	50	4	1	62	132 000	264 000
EGW42-E50	17	**42**	66	1,5	54	4	1	66	143 000	285 000
EGW48-E50	30,6	**48**	74	2	61	4	1,5	74	174 000	349 000
EGW52-E50	32,6	**52**	78	2	65	4	1,5	78	186 000	372 000

Thrust washers in special sizes available by agreement.

[1] Cutouts permissible on the inside or outside diameter in any quantity and position.

Strips

Low-maintenance
Material in accordance with ISO 3547-4
With steel backing
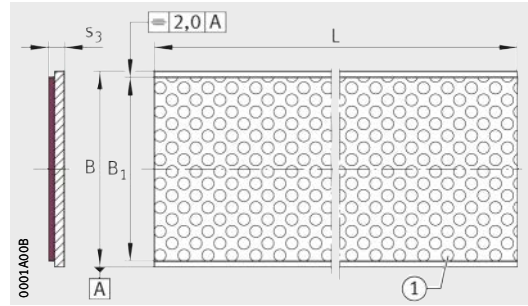
EGS..-E50
① Lubrication pockets

Dimension table · Dimensions in mm					
Designation	Mass	Dimensions			
	m	s_3	B	B_1	L
	≈g	−0,04	±2		+3
EGS10080-E50	238	0,99	80	70	500
EGS15200-E50	829	1,48	200	190	500
EGS20200-E50	1 213	1,97	200	190	500
EGS25200-E50	1 598	2,46	200	190	500

B = total width
B_1 = minimum usable width

Strips in special sizes are available by agreement.
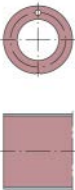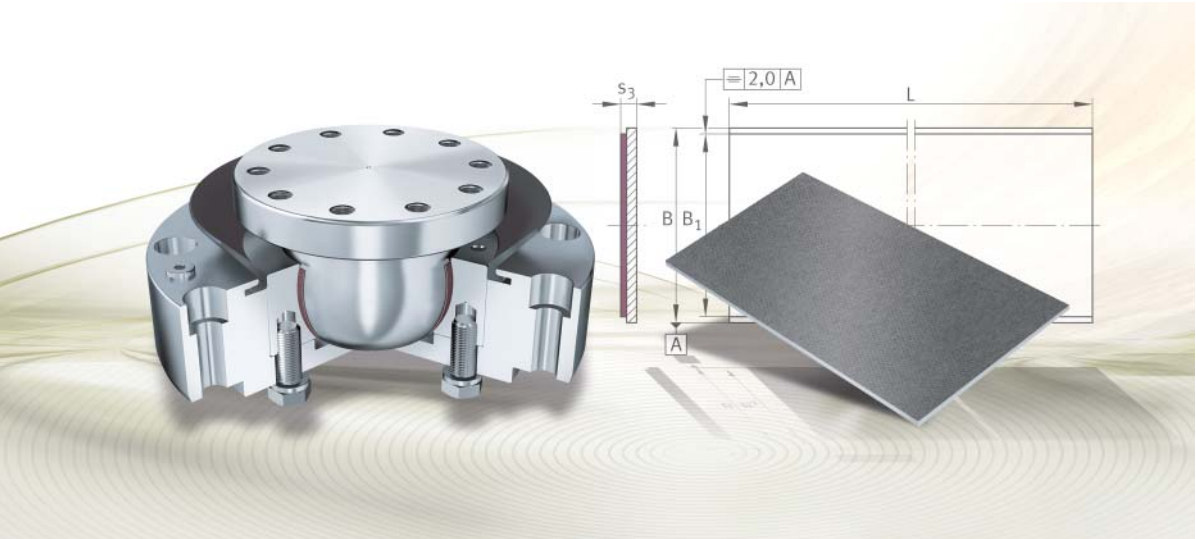
Special materials
Special designs

Special materials, special designs

Special materials

Features

By agreement, Schaeffler can supply plain bearings in materials other than those stated in the product descriptions. These have differing characteristics and areas of application.

In the case of spherical plain bearings, Schaeffler offers a glass fibre reinforced plastic as a sliding material, in the case of metal/polymer composite plain bearings the maintenance-free special material E421 or the plain bearing material E60 for film bearings.

These maintenance-free special materials conform to the regulations for lead-free plain bearings as stated in the Technical Principles.

Maintenance-free material E421

E421 is a two-layered metal/polymer composite comprising a steel supporting body with a plastic composite layer made from PTFE. The particularly thin-walled material facilitates very small design envelopes. Possible products include bushes, flanged bushes, thrust washers, strips and special designs in accordance with customer requirements.

Structure

The material comprises a steel backing and a sliding layer, *Figure 1*. As standard, the steel backing is protected against corrosion by a zinc coating.

① Sliding layer
② Steel backing
③ Zinc coating as surface protection
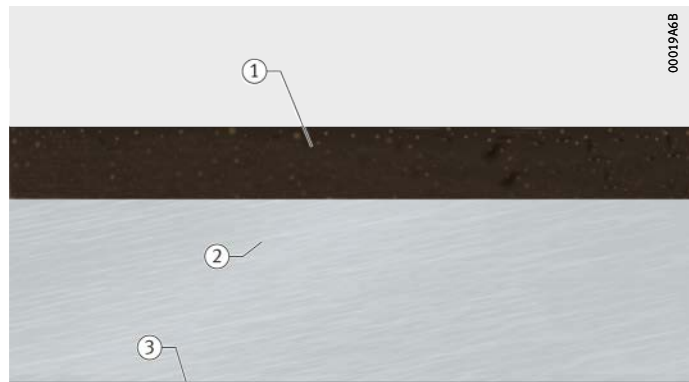
Figure 1
Maintenance-free
plain bearing material E421

Layer thickness

The sliding material is available with a layer thickness of 0,5 mm.

Technical data for E421

For the important mechanical and physical characteristics of the maintenance-free plain bearing material E421, see table.

Data

Characteristics	Loads		
Maximum pv value for dry running		pv	$1,8 \, N/mm^2 \cdot m/s$
Permissible specific bearing load	Static	p_{max}	$200 \, N/mm^2$
	Dynamic		$150 \, N/mm^2$
Permissible sliding velocity		v_{max}	$1,5 \, m/s$
Permissible operating temperature		ϑ	$-200 \, ^\circ C$ to $+180 \, ^\circ C$

Special materials

Plain bearing material E60 for film bearings

E60 is the new plain bearing material from Schaeffler for maintenance-free film bearings. The metal/polymer composite comprises a bronze rib mesh that is filled with a dry lubricant made from polytetrafluorethylene PTFE. This dry lubricant contains embedded chemically non-reactive additives.

Structure

The material comprises a rib mesh and a sliding layer, *Figure 2*.

A sliding layer made from PTFE is rolled and sintered into the rib mesh. The mesh thus functions as both a carrier and a sliding layer.
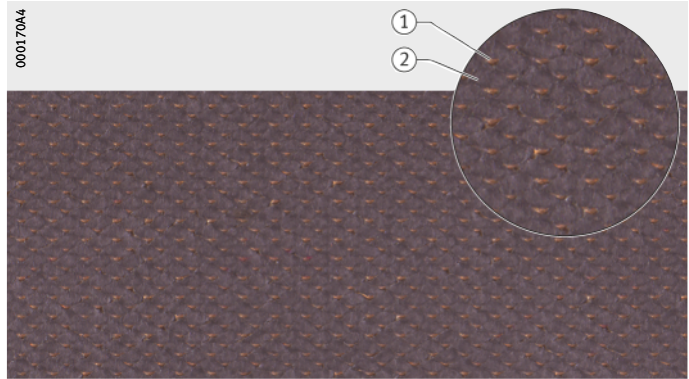
① Rib mesh
② Sliding layer

Figure 2
Maintenance-free
plain bearing material E60

Rib mesh and sliding layer

Chemical element	Proportion of mass w %	
	Rib mesh	Sliding layer
Tin Sn	6	–
Copper Cu	94	–
Polytetrafluoroethylene PTFE	–	86
Fillers	–	14

Film thickness

The plain bearing material is available in a film thickness of 0,5 mm.

Technical data for E60

For the important mechanical and physical characteristics of the maintenance-free plain bearing material E60, see table.

Data

Characteristics	Loads		
Permissible specific bearing load	Static	p	100 N/mm^2
	Dynamic	p	80 N/mm^2
Permissible sliding velocity		v_{max}	1 m/s
Permissible operating temperature		ϑ	−200 °C to +260 °C

Glass fibre reinforced plastic

A glass fibre reinforced plastic plate GFRP with additives of PTFE offers a sliding layer with a very long operating life, for example for the large spherical plain bearing GE..-DF, *Figure 3* and dimension table.

Due to the larger sliding layer thickness, this bearing offers a longer wear life compared to bearings with other sliding materials.

The sliding material can be lubricated and is suitable for low as well as high sliding velocities. The operating life can be increased even further by initial lubrication and occasional relubrication.

Examples of applications include ladle turrets or mills, since greater clearance is permissible here and loads tend to act in one direction only.

Axial spherical plain bearings are also available by agreement with a glass fibre reinforced plastic plate, *Figure 4*, page 398.

① Sliding layer comprising GFRP and PTFE

Figure 3
Large spherical
plain bearing GE..-DF
with hard chromium/
GFRP sliding contact surface

00019C06

Special materials
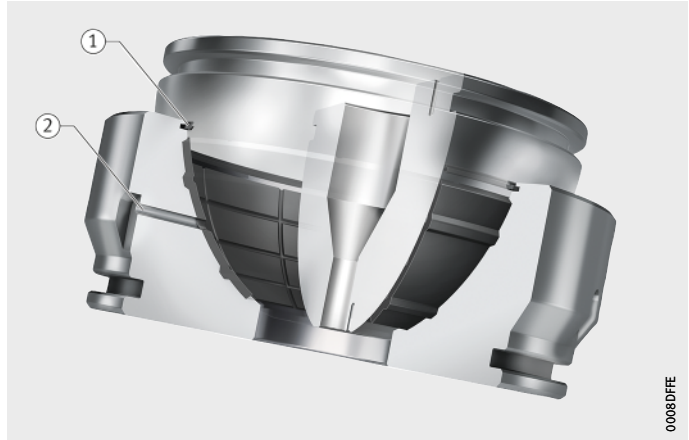
① Seal
② Lubrication hole

Figure 4
Axial spherical plain bearing
with hard chromium/
GFRP sliding contact surface

Technical data for GFRP For the important mechanical and physical characteristics
of the plain bearing material GFRP, see table.

Data

Characteristics	Loads		
Maximum pv value for dry running		pv	$1,2 \text{ N/mm}^2 \cdot \text{m/s}$
Permissible specific bearing load	Static	p_{max}	120 N/mm^2
	Dynamic		80 N/mm^2
Permissible sliding velocity		v_{max}	$0,075 \text{ m/s}$
Permissible operating temperature Reduced load carrying capacity from		ϑ	$-20 \text{ °C to } +75 \text{ °C}$ $+50 \text{ °C}$

Large radial spherical plain bearings

Maintenance-free
DIN ISO 12240-1, dimension series C
Inner ring curved surface and outer ring outside surface
with hard chromium coating
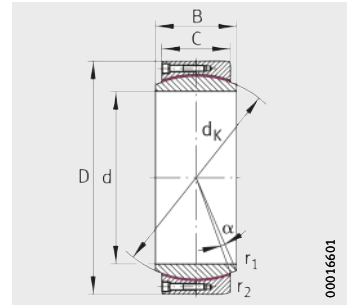
GE..-DF
GFRP-PTFE composite

Dimension table · Dimensions in mm

Designation[1]	Mass m ≈ kg	Dimensions d H7	D	B −0,4	C −0,4	d_K	α °
GE320-DF-G9	70,2	$320^{+0,057}$	$440_{-0,06}$	160	135	380	4
GE340-DF-G9	74,1	$340^{+0,057}$	$460_{-0,06}$	160	135	400	3,8
GE360-DF-G9[2]	78	$360^{+0,057}$	$480_{-0,06}$	160	135	420	3,6
GE380-DF-G9	115	$380^{+0,057}$	$520_{-0,06}$	190	160	450	4,1
GE400-DF-G9	120	$400^{+0,057}$	$540_{-0,06}$	190	160	470	3,9
GE420-DF-G9	125,4	$420^{+0,063}$	$560_{-0,06}$	190	160	490	3,7
GE440-DF-G9	177,6	$440^{+0,063}$	$600_{-0,06}$	218	185	520	3,9
GE460-DF-G9[2]	184	$460^{+0,063}$	$620_{-0,06}$	218	185	540	3,7
GE480-DF-G9[2]	217	$480^{+0,063}$	$650_{-0,07}$	230	195	565	3,8
GE500-DF-G9	225	$500^{+0,063}$	$670_{-0,07}$	230	195	585	3,6
GE530-DF-G9[2]	269	$530^{+0,07}$	$710_{-0,07}$	243	205	620	3,7
GE560-DF-G9	317	$560^{+0,07}$	$750_{-0,07}$	258	215	655	4
GE600-DF-G9[2]	380	$600^{+0,07}$	$800_{-0,07}$	272	230	700	3,6
GE630-DF-G9[2]	500	$630^{+0,07}$	$850_{-0,08}$	300	260	740	3,3
GE670-DF-G9[2]	556	$670^{+0,08}$	$900_{-0,08}$	308	260	785	3,7

[1] Suffix G9: Outer ring outside surface with hard chromium coating,
bore tolerance H7, dimensions to DIN ISO 12240-1, dimension series C, excluding tolerances,
chamfer dimension r_2 and radial internal clearance.

[2] Available by agreement.
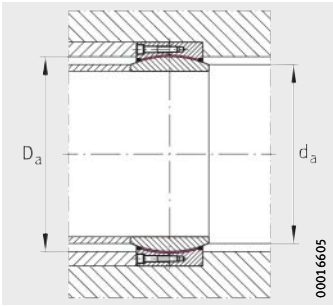
Mounting dimensions

Chamfer dimensions		Mounting dimensions		Basic load ratings		Radial internal clearance
r_1	r_2	d_a	D_a	dyn. C_r	stat. C_{0r}	
min.	min.	max.	min.	N	N	
1,1	1	344,7	361	3 040 000	4 560 000	0,125 − 0,34
1,1	1	366,6	382	3 200 000	4 800 000	0,125 − 0,34
1,1	1	388,3	403	3 360 000	5 040 000	0,135 − 0,36
1,5	1	407,9	426	4 320 000	6 480 000	0,135 − 0,36
1,5	1	429,9	447	4 510 000	6 770 000	0,135 − 0,36
1,5	1	451,7	469	4 700 000	7 060 000	0,135 − 0,36
1,5	1	472,1	491	5 760 000	8 640 000	0,145 − 0,39
1,5	1	494	513	5 980 000	8 970 000	0,145 − 0,39
2	1	516,1	536	6 620 000	9 930 000	0,145 − 0,39
2	1	537,9	557	6 850 000	10 300 000	0,145 − 0,39
2	1	570,4	591	7 660 000	11 500 000	0,145 − 0,39
2	1	602	624	8 500 000	12 750 000	0,165 − 0,42
2	1	645	667	9 630 000	14 400 000	0,165 − 0,42
3	1,5	676,5	698	11 600 000	17 400 000	0,165 − 0,42
3	1,5	722,1	746	12 300 000	18 500 000	0,165 − 0,42

Product overview   Special designs

Plain bushes

Swivel motion or rotation
Bushes with slot
Pivoting cradle bearings

00019EBF

00019C42

Ball cups,
maintenance-free or
low-maintenance

00019C44

00019C46

Bush/pin system

00019C4B

	PAB..-PP-AS	PAGBAO..-PP-AS
Linear motion Linear plain bearing units	00019C53	00019C58
Linear bush with external coating	00019C5E	
Spherical plain bearings Locating bearings for articulated frame steering systems Prop shaft centring bearings	00019C61	00019C62
Flanged spherical plain bearings Joint connecting rods	00019C63	00019C64
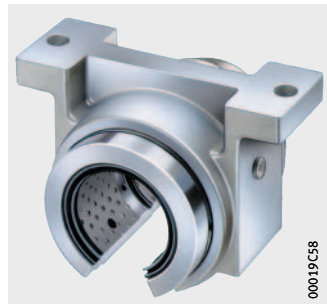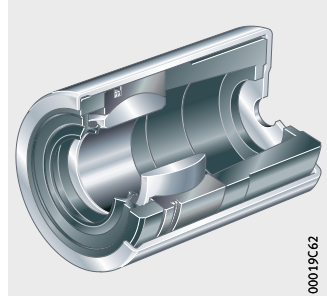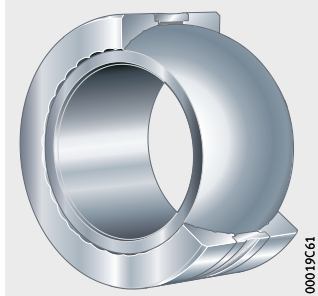
Spherical plain bearings
for clearance-free bearing
arrangements
Gear lever bearing arrangements

00019C65

00019C66

Spherical plain bearings
with bellows

00019C67

Central joint bearings

00019C69

Special designs

Features By agreement, Schaeffler manufactures plain bearings as special designs in accordance with customer requirements.

For such special designs, please consult the Schaeffler engineering service.

⚠️ The feasibility of special designs should be checked as early as possible. This applies to the geometry and also to the costs.

Plain bushes In addition to the catalogue range of metal/polymer composite plain bearings, there are numerous special designs which are run in either a predominantly rotary direction or a predominantly linear direction. A small selection of special designs already produced is shown below, *Figure 1*, page 406 to *Figure 6*, page 408.

The following special designs are possible:
- made from any plain bearing material
- with different dimensions from the catalogue products
- as combined components
  - pressed into rings
  - with plastic moulded parts
- in different shapes
  - bushes with windows and holes
  - bushes with stamped oil grooves
  - blanked components
  - ball cups
  - bearing shells
- with the sliding layer on the outside
- with different butt joint geometries.

Special designs

Swivel motion and rotation

Special designs for rotary or oscillating swivel motion are developed in accordance with customer requirements, *Figure 1* and *Figure 2*.

① Pivoting cradle bearing
② Plain bush
with lubrication groove and recess

Figure 1
Plain bearings
for swivel motion or rotation
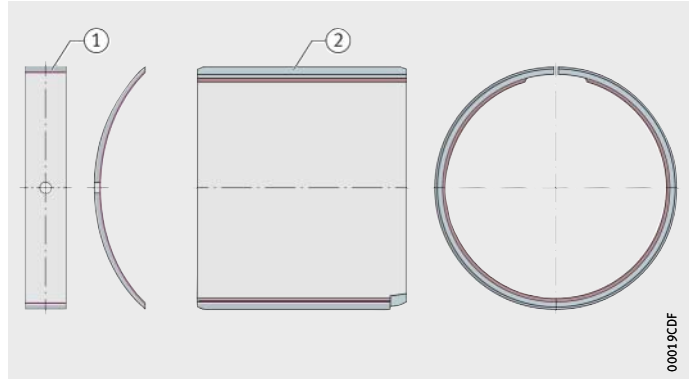
① Maintenance-free
② Low-maintenance

Figure 2
Ball cups
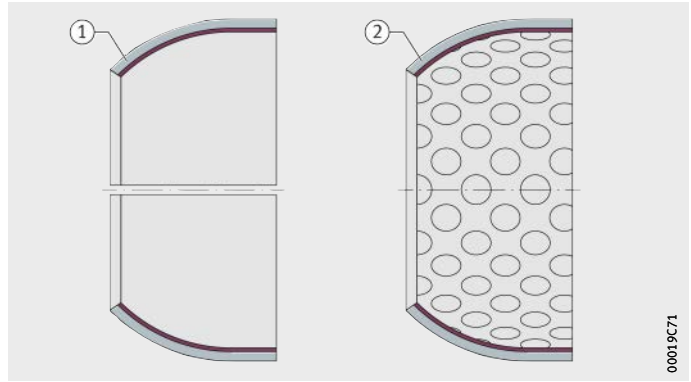
Bush/pin system
with ELGOGLIDE plain bushes

In the case of ready-to-fit bush/pin systems with a clamping device, the raceway of the pin is already integrated, *Figure 3*. The raceway and the sliding material are matched to each other to form a unit that fulfils the required specifications.

The system with the integrated ELGOGLIDE plain bushes can replace steel or bronze bushes with a relubrication facility.

These units are pressed into housings and frames and require no additional means of axial location.

Due to the very high compressive strength of the ELGOGLIDE sliding material, it can easily withstand shock loads as well as static and dynamic alternating loads. Application possibilities include articulated loaders.
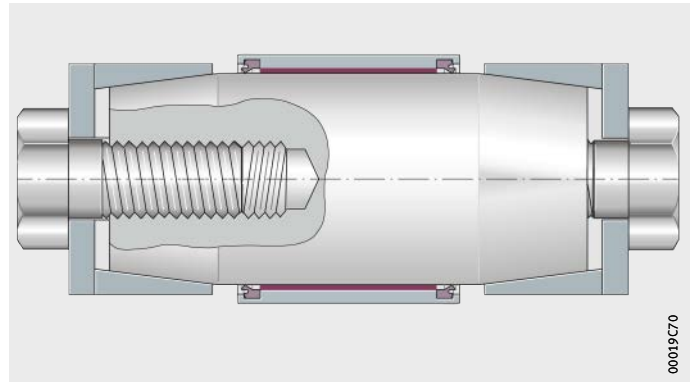
Figure 3
Ready-to-fit system
with ELGOGLIDE plain bushes

Special designs

For linear motion, there are special designs in accordance
with customer requirements, *Figure 4*, and the catalogue range
of linear plain bearing units, see Catalogue WF1, Shaft Guidance
Systems, *Figure 5* and *Figure 6*.

Linear plain bearings ▪ Linear plain bearings PAB comprise an outer ring
with pressed-in plain bearing bushes EGB..-E50.
The design PABO has a segment cut out for supported shafts.

▪ Linear plain bearing units PAGH and PAGBA comprise a housing
and a pressed-in linear plain bearing PAB or PABO.

Figure 4
Plain bearing with external coating
for linear motion
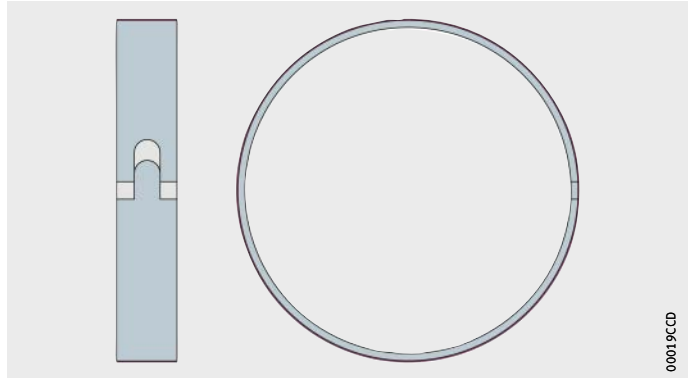
PAB..-PP-AS

Figure 5
Linear plain bearing
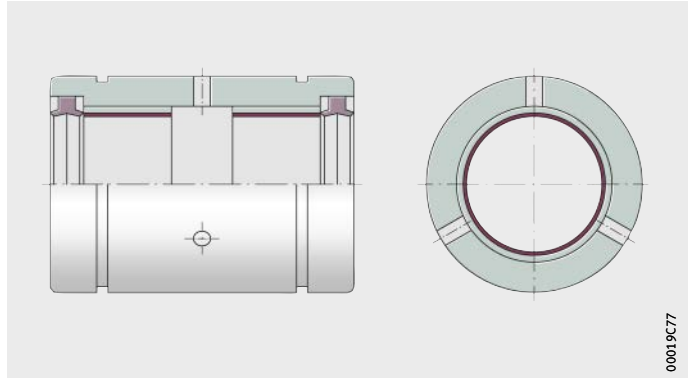
PAGBAO..-PP-AS

Figure 6
Linear plain bearing unit
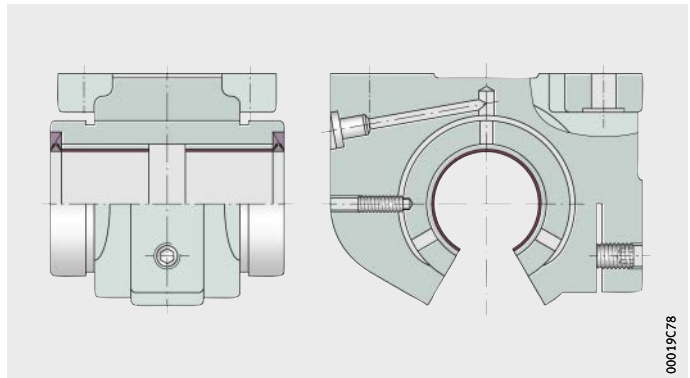
Spherical plain bearings

Special designs of spherical plain bearings are products for specific bearing arrangement problems and are manufactured exclusively for specific customers or orders. The products presented here are examples taken from a large number of such developments.

Locating bearings for articulated frame steering systems

These bearings are used as locating bearings in articulated frame steering systems for construction machinery and have a high radial and axial load carrying capacity. They have sliding zones of a special geometrical design, *Figure 7*.

This prevents edge stresses in the part of the bearing under axial load. Since the bearings are supplied preadjusted and ready for mounting, there is no need for clearance setting by the customer.
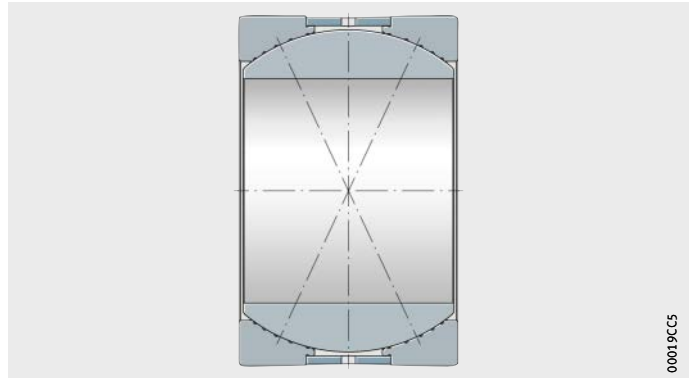
Figure 7
Locating bearing for articulated frame steering system

Prop shaft centring bearings

These bearings are centring elements capable of cardanic type motion and are used for the damping of vibrations in rear and four wheel drive vehicles in the centre of the coupling between the gearbox and prop shaft, *Figure 8*. They support the prop shaft mass on the coupling, thus preventing eccentricity of the elastically coupled shafts. A lamellar ring made from spring steel sets the internal clearance of the bearing automatically to zero, so the unit is permanently free from clearance.
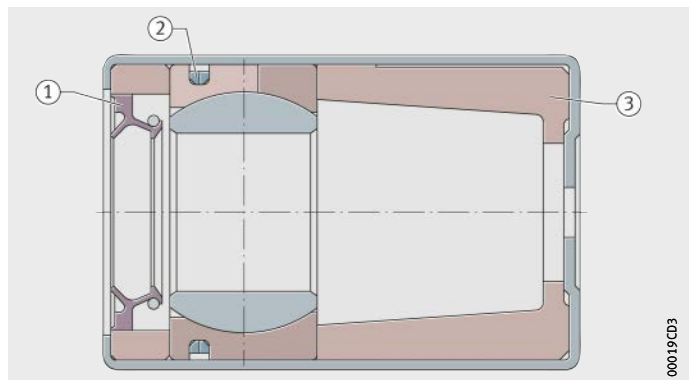
① Lip seal
② Lamellar ring
③ Centring element

Figure 8
Prop shaft centring bearing

Special designs

Flanged spherical plain bearings   The maintenance-free flanged spherical plain bearings are used in clutch actuation systems, *Figure 9*.
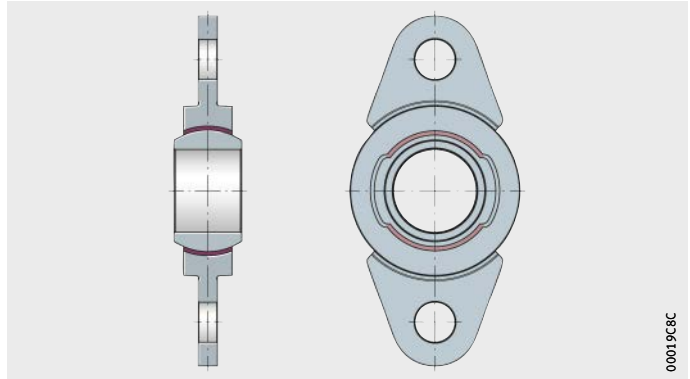

Figure 9
Flanged spherical plain bearing

Joint connecting rods   Joint connecting rods with maintenance-free spherical plain bearings are used in brake actuation systems, *Figure 10*.
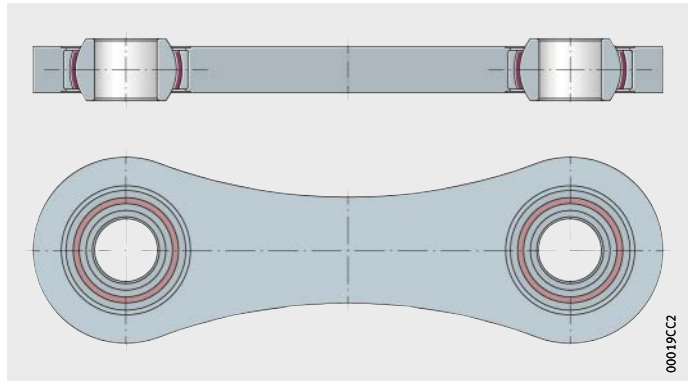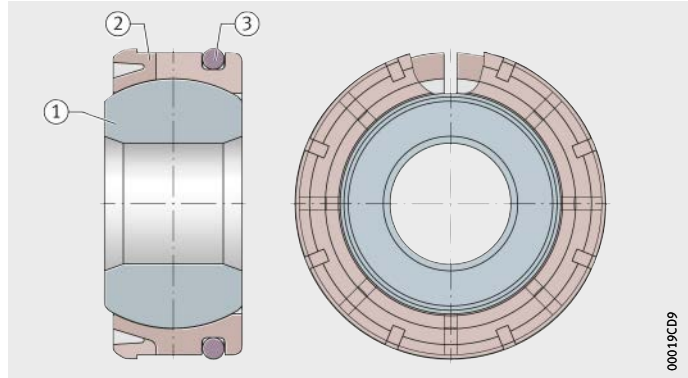

Figure 10
Joint connecting rod

Spherical plain bearings for clearance-free bearing arrangements

This design has a steel/plastic sliding contact surface and is used in clearance-free bearing arrangements such as gear levers, *Figure 11*.

The preloaded rubber elements allow compensation of the effects of wear up to 0,4 mm. As a result, the bearings can exhibit preload values comparable to those of a new bearing even after a long operating life. After initial greasing, they are maintenance-free for the entire operating life.

① Steel inner ring
② Plastic outer ring with preloaded rubber elements
③ O-ring

Figure 11
Spherical plain bearing for clearance-free bearing arrangement

Gear lever bearing arrangements

Gear lever bearing arrangements are developed to meet the specific requirements of the vehicle manufacturer, *Figure 12*:

- continuous compensation of operating clearance
- constant tilting moment
- maintenance-free throughout the life of the vehicle
- suitable for combination with noise and vibration damping measures.

① O-ring

Figure 12
Gear lever bearing arrangement
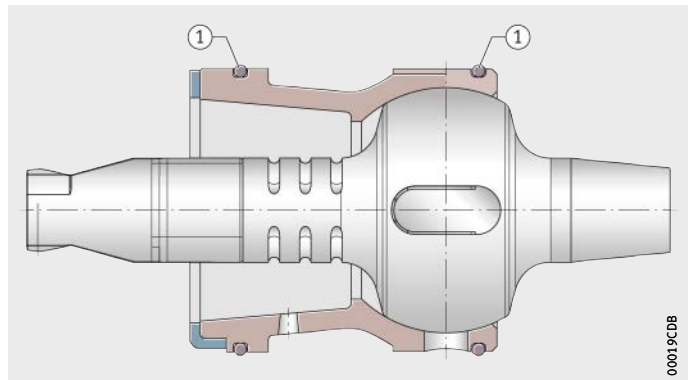
Special designs

Spherical plain bearings with bellows

The special spherical plain bearing has a particularly large motion angle, with a swivel angle of $\beta = \pm 20°$ and a tilt angle of $\alpha = \pm 19°$. In addition, the bearing is sealed by means of bellows, *Figure 13*.

In comprehensive tests, reliability in terms of rating life, maximum swivel and tilt angle, seal integrity and resistance to media was successfully demonstrated.

The bearing is located in the adjacent construction by means of snap rings and spacer sleeves and contributes to cost reduction due to its ease of mounting and dismounting.

① Bellows

Figure 13
Spherical plain bearing
with bellows
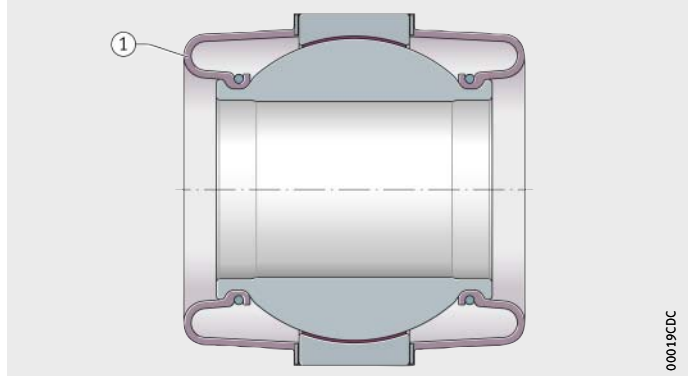
Central joint bearings   The central joint bearing is used to connect two carriage bodies of rail vehicles and must support not only static but also dynamic loads occurring in operation, *Figure 14*. It facilitates all necessary turning, tilting and pitching motions that occur when travelling on curved tracks, across valleys or where these are caused by the nature of the track.

The central joint bearing is based on a radial spherical plain bearing that was developed with an integral anti-lift system. The bearing is easy to mount and is screw mounted to the upper and lower housings. Due to its compact, low-section design, it can be used in low-floor vehicles as well as in other types of rail vehicle.

The bearing system is protected effectively against contamination by means of integrated seals. The inner and outer ring have special coatings in order to give very good protection against corrosion.

① Lip seal

Figure 14
Central joint bearing
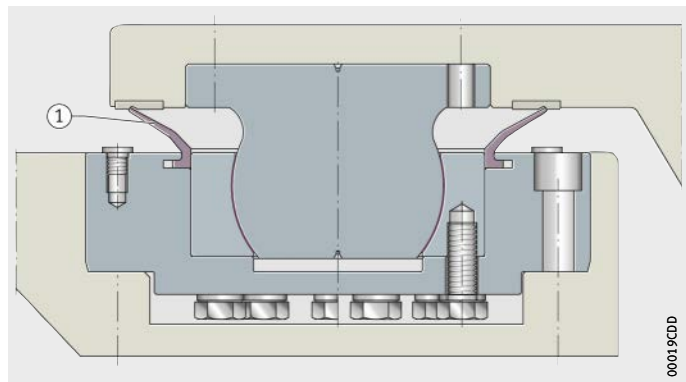
Special designs

Rod ends   For the tip/tilt cylinder pivot on fork lift trucks, special rod ends are necessary that can support high loads despite their small design envelope, *Figure 15*.

In order to support the loads, the special rod ends are forged from high strength material. They are easy to mount and maintain.
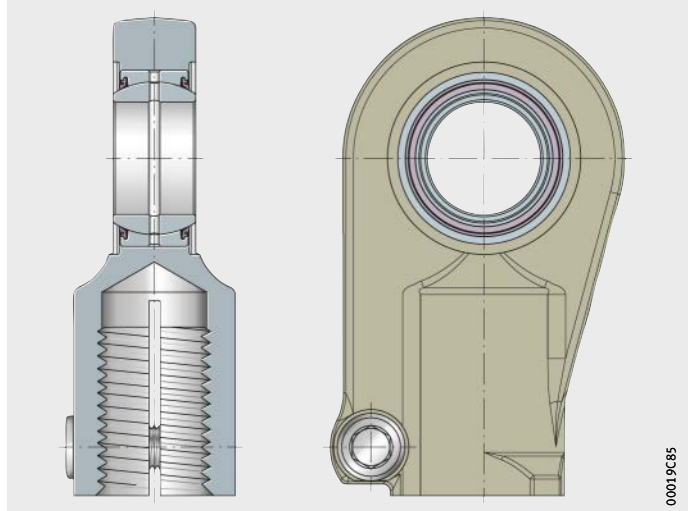The moving part is fixed to the rod end by means of cap head screws.

Figure 15
Special rod end for fork lift trucks

Mounting and maintenance

Mounting and maintenance

Products and services

Features   Within its industrial service concept, Schaeffler offers high quality products, services and training, *Figure 1*.

Portfolio   This chapter gives an overview of the portfolio:
- Mounting
- Lubrication
- Condition monitoring
- Reconditioning.

The employees of Schaeffler worldwide will be pleased to help you select the ideal products, services and training courses, *Figure 1*.

Figure 1
Portfolio

Products and services

Industrial Aftermarket

Schaeffler Industrial Aftermarket (IAM) is responsible for replacement parts and service business for end customers and sales partners in all significant industrial sectors. On the basis of innovative solutions, products and services relating to rolling and plain bearings, the service function of Schaeffler Industrial Aftermarket offers a comprehensive portfolio that covers all phases in the lifecycle of the bearing and takes account of the total costs (TCO).

The aim is to help customers save on maintenance costs, optimise plant availability and avoid unforeseen machine downtime. Schaeffler Industrial Aftermarket offers each customer an individual concept solution.

Schaeffler has centres of competence all around the world. This means we can provide customers worldwide with products, services and training quickly and professionally. All service employees worldwide undergo a comprehensive training programme and are audited regularly by officially certified specialists. This ensures that services throughout the world conform to a uniformly high standard of quality.

Mounting Toolbox – mounting made easy

The Schaeffler Mounting Toolbox, *Figure 2*, brings together valuable knowledge relating to mounting and dismounting. In individual video sequences, the service experts present step by step the points that must be paid close attention for correct mounting, lubrication and alignment.

http://mounting-toolbox.schaeffler.de
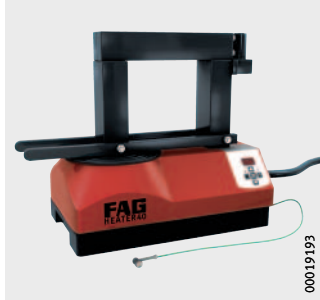
Figure 2
Mounting Toolbox
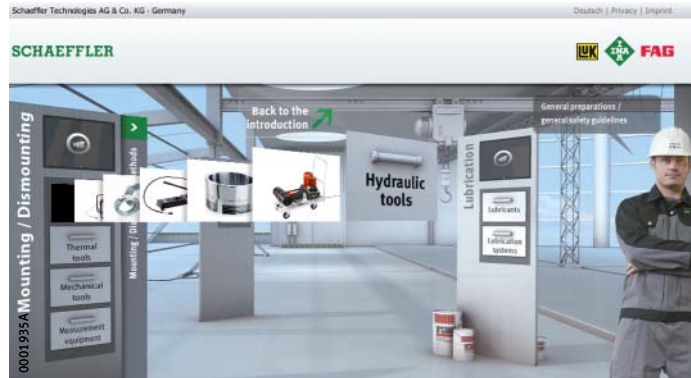
Product overview   Mounting

Thermal tools
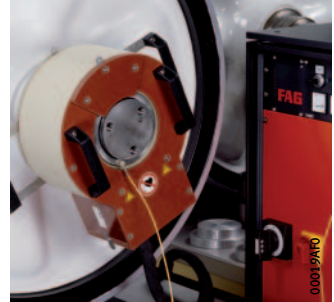
Induction heating devices

HEATER

00019193

Induction units
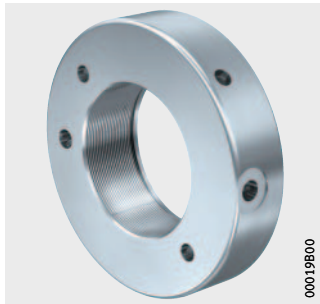with medium frequency technology

HEAT-GENERATOR,
HEAT-INDUCTOR

00019AEE

HEAT-GENERATOR,
HEAT-INDUCTOR

00019AF0

Hydraulic tools

Hydraulic nuts

HYDNUT

00019B00

Hand pumps for drive-up distance

PUMP1000-4L-CONTROL

000179C2

Mounting

Features The Schaeffler industrial service experts offer mounting services for plain bearings that are applicable across industrial sectors. They have detailed knowledge and extensive experience in all industrial sectors.

The mounting personnel in the Industrial Service function are trained and skilled personnel who can provide reliable, rapid and competent assistance. The services are provided either at the customer's location or in the Schaeffler workshop facilities.

Mounting services The mounting services, *Figure 1*, include:
- mounting and dismounting of plain bearings of all types
- approval inspection of adjacent parts (shafts and housings)
- measurement and production inspection of tapered shaft seats, together with provision of the necessary measuring equipment
- maintenance and inspection of bearing arrangements
- support in achieving optimum mounting operations
- the use of modern mounting tools, such as heating by means of the versatile medium frequency technique
- the design and manufacture of special tools.

Figure 1
Mounting services

Advantages The mounting services give the following advantages:
- extended bearing life
- considerable cost reductions
- less unplanned downtime
- increased plant availability
- correct use of plain bearings.

Further information - Enquiries: tel. +49 9721 91-3142, fax +49 9721 91-3639.

Mounting

Equipment rental   Customers who require special mounting and measuring equipment only infrequently, for example in order to carry out repairs, can rent these from Schaeffler on a weekly basis for a fee.

Schaeffler offers rental of the following equipment:
- hydraulic nuts
- hand pump sets
- heating devices.

The devices are checked after each use by the Schaeffler experts and, where necessary, returned to full working condition.

Further information
- Enquiries: tel. +49 9721 91-1133, fax +49 9721 91-3809
- Service Hotline: tel. +49 2407 9149-99.

Mechanical tools   Mechanical tools are designed for the mounting and dismounting of bearings. The mounting forces are transmitted by the form fit effect.

Further information
- Detailed information on mechanical tools can be found in Catalogue IS 1, Mounting and Maintenance of Rolling Bearings.

Thermal tools

Induction heating devices HEATER with mains frequency technology are used to heat plain bearings and other components with a cylindrical bore where a tight fit on the shaft or in the housing is intended.

Adequate expansion of the bearings is achieved in most cases at +80 °C to +100 °C. During the heating operation, the maximum heating temperature must be observed. In the case of plain bearings, the temperature may not normally exceed +130 °C, in order to avoid damage to the seals. In all devices for heating, the temperature can be steplessly controlled.

⚠ Wear protective gloves during mounting and dismounting of heated parts.

Induction heating devices HEATER

The induction heating devices HEATER for spherical plain bearings up to a mass of 1 200 kg have been improved further in terms of their performance capability and safety compared with their predecessors. They can also be used to heat sealed and greased spherical plain bearings. In addition to the tabletop devices HEATER10 to HEATER300, the range also includes the standalone devices HEATER600 and HEATER1200 for larger bearings. HEATER300 can also be converted to a mobile unit by means of accessories.

The scope of delivery of the induction heating devices HEATER covers a basic setup for the initial applications, *Figure 2*.

The spherical plain bearing to be heated is either placed horizontally on the support rails or is suspended on the ledge.

① Heating device
② Ledges
③ Temperature sensor
④ Remote control
⑤ Mounting grease
⑥ Protective gloves
⑦ Cover
⑧ User manual

Figure 2
Scope of delivery:
Induction heating device HEATER

Mounting

Advantages of heating devices

The advantages of induction heating devices are as follows:
- very safe operation
- high reliability
  (certified in accordance with the German inspection and certification body TÜV)
- effective, energy-efficient heating (high efficiency level)
- uniform, controlled heating
- automatic demagnetisation
- simple operation
- high cost-effectiveness through selection of the device size most suitable for the particular application.

The heating devices have various functions, see table.

Functions

Function	HEATER						
	10	20	40	150	300	600	1200
Demagnetisation	●	●	●	●	●	●	●
Program shutdown	●	●	●	●	●	●	●
Display of actual temperature value	●	●	●	●	●	●	●
Temperature display in °C or °F	●	●	●	●	●	●	●
Display of actual temperature value and time	−	−	●	●	●	●	●

● present

Operating modes

The induction heating devices can be operated in the following modes:
- temperature control
- time control
- ramp control (size HEATER40 and above).

Induction units with medium frequency technology

The heating device with medium frequency technology gives rapid, simple and effective heating of medium-sized to large spherical plain bearings and similar steel parts for mounting and dismounting. The device always comprises two parts: an inductor and a generator.

The inductor can be of a flexible or rigid design. The rigid design is particularly suitable for batch applications. The flexible design of inductor can be wound around the components.

Each device is designed for the specific application and is fitted, depending on the workpiece, with flexible or rigid inductors.

Due to its compact construction, the device can also be used for mobile operation. The device can therefore be moved to the location of the workpiece. It can therefore be used, for example, at construction sites for wind turbines or for other large components that are difficult to transport.

Advantages

The advantages of the heating device with medium frequency technology are as follows:

- suitable for mounting
- suitable for dismounting
- operating frequency from 10 kHz to 25 kHz
- efficiency of the generator higher than 90%
- low energy requirements
- short heating times
- control of heating according to time and temperature
- automatic demagnetisation
- flexible and fixed inductors available
- suitable for use either inside or outside component
- lower mains connection power than heating devices with mains frequency
- almost silent
- air-cooled system.

Mounting

Hydraulic tools

Hydraulic tools can be used to apply large forces. These tools are therefore particularly suitable for the mounting and dismounting of large bearings or parts with a tapered bore.

Hydraulic nuts are used as a mounting tool. Pressure can be generated using oil injectors, hand pumps or hydraulic units.

Hydraulic nuts

Hydraulic nuts HYDNUT, see table, are used to press components with a tapered bore onto their tapered seat. Presses are mainly used if the drive-up forces required cannot be applied using other accessories, e.g. shaft nuts or pressure screws.

The main area of application is:

■ the mounting and dismounting of spherical plain bearings with a tapered bore.

Spherical plain bearings are available by agreement with a tapered bore. The bearings can be seated directly on a tapered shaft, an adapter sleeve or a withdrawal sleeve. The hydraulic nut can also be used for the dismounting of adapter or withdrawal sleeves.

Available hydraulic nuts

Designation	Design	Application
HYDNUT50 to **HYDNUT200**	With metric fine pitch thread to DIN 13	Standardised adapter and withdrawal sleeves
HYDNUT205 to **HYDNUT1180**	With trapezoidal thread to DIN 103	With metric dimensions
HYDNUT90-INCH to **HYDNUT530-INCH**	With inch size thread to ABMA "Standards for Mounting Accessories, Section 8, Locknut Series N-0"	Sleeves with inch dimensions
HYDNUT100-HEAVY to **HYDNUT900-HEAVY**	Increased capacity design with smooth bore	For high mounting forces, for example in shipbuilding

Further information

■ For detailed information, see TPI 196, FAG Hydraulic Nuts.

■ Enquiries: industrial-services@schaeffler.com, +49 2407 9149-66.

Pump for drive-up distance

The hand pump PUMP1000-4L-CONTROL is particularly suitable as a pressure generation device where special spherical plain bearings are to be driven onto their tapered seat using a hydraulic nut, *Figure 3*.

First, the bearing is driven smoothly onto the tapered seat as far as the initial position. A suitable hydraulic nut is then screwed onto the shaft and the hand pump is connected. The hand pump is then operated until the pressure to reach the start position is achieved. The pump is then operated further to drive the bearing by the required drive-up distance and thus achieve the final position.

The user manual for the pump PUMP1000-4L-CONTROL contains a table that shows the number of strokes necessary to achieve the required drive-up distance of the bearing. The required drive-up distance is calculated using the software Mounting Manager.

① Hand pump
② Hydraulic nut
③ Spherical plain bearing
④ Tapered seat
⑤ Initial position
⑥ Start position
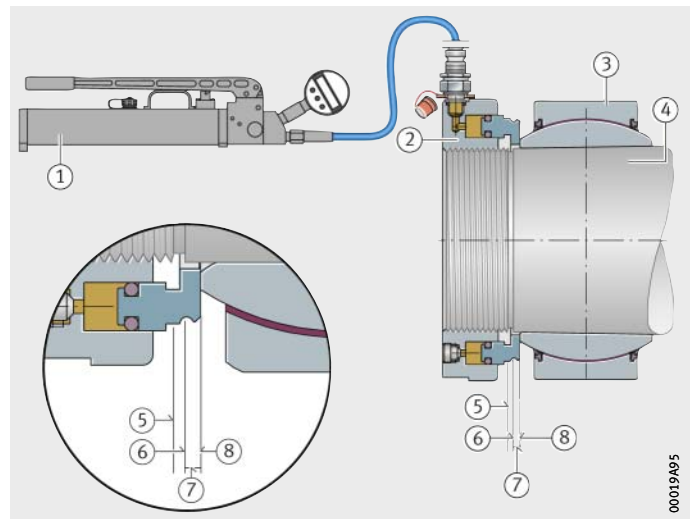⑦ Drive-up distance
⑧ Final position

Figure 3
Mounting of a spherical plain bearing using PUMP1000-4L-CONTROL

Scope of delivery

Hand pump with digital manometer
High pressure hose with coupling sleeve
Spacer ring (HYDNUT50 to HYDNUT150)
Plug-in coupling nipple
User manual
Metal case

Ordering designation **PUMP1000-4L-CONTROL**

Product overview   Lubrication

Arcanol greases

ARCANOL

00019AEA

Lubrication

Features In more than half of all cases, inadequate lubrication is the cause of unplanned machine downtime. The life of machine elements undergoing swivel, rotary or linear motion can be significantly extended by the use of greases appropriate to the different operating and environmental conditions as well as the definition of and adherence to lubrication intervals and quantities.

Services Services relating to lubrication include:
- the selection of lubricants and lubrication systems
- the preparation of lubrication and maintenance plans
- lubrication point management
- consultancy on lubricants
- lubricant investigations and tests.

Advantages The Schaeffler lubrication service helps to:
- prevent failures involving components undergoing swivel, rotary or linear motion
- achieve increases in productivity
- reduce lubrication costs.

Lubricants An extensive selection of high quality Arcanol rolling bearing greases is available. In case of doubt, please consult the Schaeffler engineering service.

Lubrication devices Lubricators and lubrication systems automatically provide bearings with the correct quantity of lubricant. For manual relubrication, grease guns are suitable.

Lever grease gun The lever grease gun, see table, can be used to manually relubricate rod ends requiring maintenance via lubrication nipples.

The container on the lever grease gun can be filled with 500 g loose grease or by means of a 400 g cartridge. The cartridge must correspond to DIN 1284 (diameter 53,5 mm, length 235 mm).

The lever grease gun is connected to the lubrication nipple via a reinforced hose. The reinforced hose must be ordered separately, see table.

Available lever grease guns

Designation	Maximum delivery pressure bar	Delivery quantity per stroke cm^3
ARCA-GREASE-GUN	800	2

Available reinforced hoses

Designation	Length mm	Connector
ARCA-GREASE-GUN.HOOK-ON-HOSE	300	Cylindrical lubrication nipple with head 16 mm to DIN 3404
ARCA-GREASE-GUN.HOSE	300	Taper type lubrication nipple to DIN 71412

Further information
- For information on products for the supply of lubricant, see Catalogue IS 1, Mounting and Maintenance of Rolling Bearings.

Product overview   Condition Monitoring

Continuous or regular monitoring

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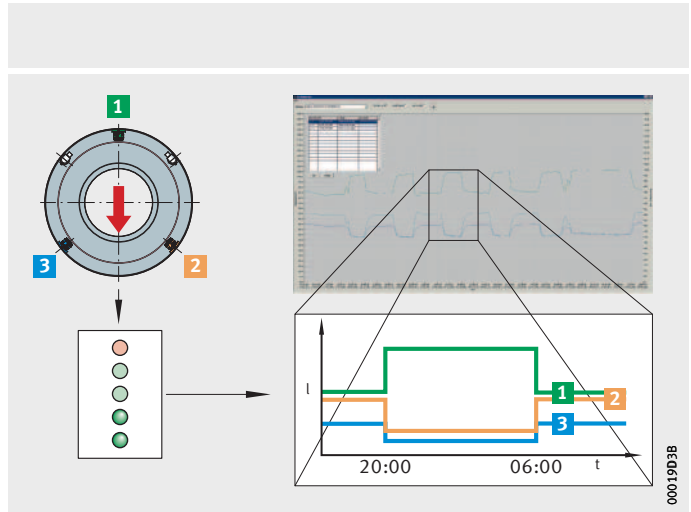
Wear measurement system for spherical plain bearings

00019A96

Condition Monitoring

Features

The malfunction-free and optimised operation of complex machinery and plant can only be achieved by means of condition-based maintenance. Schaeffler uses vibration diagnosis as a preferred method here.

This method makes it possible to detect damage in machinery at a very early stage. This means that, for example, damaged components can be replaced as part of planned downtime. Unscheduled downtime is avoided.

Depending on the type of machine and its importance for the production process, condition monitoring can be carried out by means of either continuous (online) monitoring or regular (offline) monitoring.

Continuous monitoring

For production-critical machinery, continuous monitoring, *Figure 1*, by means of vibration diagnosis is indispensable in many cases.

In addition to giving advice on selecting the right system, Schaeffler also implements monitoring of the machine. This includes not only hardware selection but also system configuration and, where necessary, its integration into existing systems.

The customer can decide whether to carry out plant monitoring himself or to enlist the services of Schaeffler for online monitoring. Due to the communication options of the monitoring systems, remote analysis can be carried out by the Schaeffler experts.

Figure 1
Continuous monitoring

Condition Monitoring

Regular monitoring

The failure of so-called "B" or "C" category plant items not does lead directly to downtime and does not therefore lead to expensive secondary damage. In the case of such machine parts, regular monitoring is generally recommended as a more economical option.

In this type of monitoring, machinery is examined and assessed by vibration analysis at regular intervals, for example every four weeks. This regularity gives more in-depth knowledge of the normal condition of the machine. Deviations can thus be detected. For the monitoring concept, the selection of measurement points and monitoring accessories as well as the measurement interval play a decisive role. If deviations occur during measurement or if trends are to be investigated, the data can be sent to the Schaeffler Diagnosis Centre. Vibration experts will then analyse the data and prepare a diagnosis report. Through working with the Schaeffler experts, customers can build up their own know-how in analysis.

If no personnel are available for data logging, Schaeffler can also offer support in data logging. The Company's experts can carry out regular measurements on site.

Troubleshooting

Where malfunctions occur on a machine, defects must be detected and rectified very quickly. Based on many years of experience with different sectors and applications, the Schaeffler diagnosis experts are well versed in such troubleshooting tasks.

Problems or malfunctions in machine operation often become apparent through changes in vibration behaviour, unusual temperature patterns or similar phenomena. The investigation is closed-out by a handover discussion between the diagnosis experts and all relevant employees on site. In addition to the results of the investigation, the recommended countermeasures are discussed in particular.

Further information

■ Enquiries: industrial-services@schaeffler.com, +49 2407 9149-66.

Wear measurement system In order to facilitate condition monitoring for plain bearings as well, Schaeffler has developed a special measurement method.

Several sensors distributed around the circumference allow continuous monitoring of the wear state and the temperature in the bearing, *Figure 2*.

In order to measure the depth of wear on a sliding layer in a maintenance-free spherical plain bearing, inductive sensors can be used. The data can be used, for example, to assist in calculating when the sliding layer will come to the end of its life. As a result, service intervals can be planned for reconditioning of the bearing.

The wear measurement system is available by agreement for large spherical plain bearings. These special bearings must be matched and calibrated specifically to the relevant application. In this case, please consult the Schaeffler engineering service.
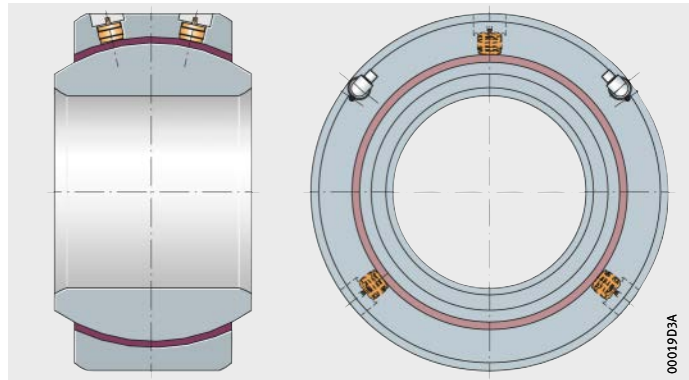

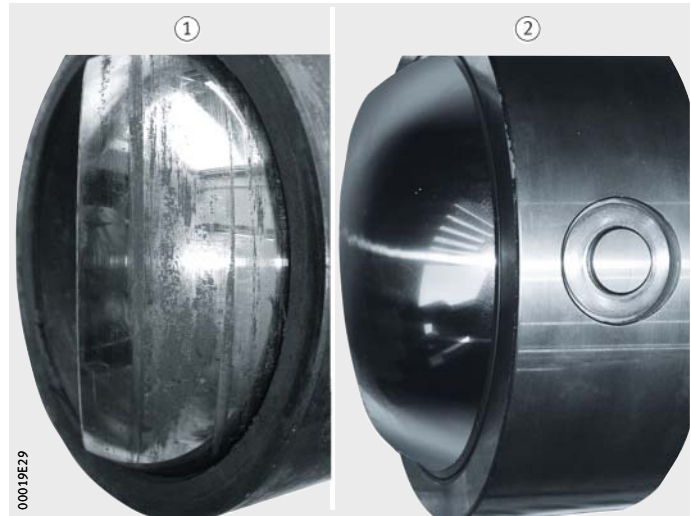*Figure 2*
Spherical plain bearing
with wear measurement system

**Reconditioning
of plain bearings**

Reconditioning

Features

Many bearings are replaced completely in the course of maintenance work although they could be restored to almost as-new condition by means of reconditioning. In the case of maintenance-free spherical plain bearings with ELGOGLIDE, this may represent an economically attractive alternative, *Figure 1*.

① Before reconditioning
② After reconditioning

Figure 1
Spherical plain bearing
before and after reconditioning

Advantages

The advantages for the customer are as follows:
- longer useful life due to high quality maintenance work
- short downtime periods due to swift implementation of the maintenance process
- little mounting work, since the bearings are returned in a condition ready for mounting
- reduced maintenance costs due to preventive maintenance.

Reconditioning level

Before reconditioning, the bearing is dismounted, cleaned and examined. The processing steps required are established and a proposal is prepared. The scope of reconditioning of plain bearings is subdivided into levels, see table.

Level I to Level II

Processing steps	Level	
	I	II
Removal of fretting corrosion	■	■

Reconditioning of outer ring:
  remove worn ELGOGLIDE sliding layer
  bond and cure new ELGOGLIDE sliding layer
	■	■

Reconditioning of inner ring:
  remove chromium layer
  apply new chromium layer
	–	■

Assembly	■	■
Preservation	■	■

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