Spherical plain bearings, plain bushes, rod ends

INA

Catalogue 238

238

Spherical plain bearings, plain bushes, rod ends

Since the introduction of the spherical plain bearing, ELGES spherical plain bearings and ELGES rod ends have had a decisive influence on the development and technological progress of these precision components. This 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, cylindrical bushes or combinations of radial, angular contact and axial bearings – continue the tradition of this product group and at the same time represent state-of-the-art engineering and economical bearing solutions.

Spherical plain bearings are ready-to-fit, standardised machine elements. The concave outer ring bore and the convex inner ring geometry allow spatial adjustment motion. The bearings can support static loads and are suitable for tilting 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 rod type housing, 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. The ELGOGLIDE® types are maintenance-free – the types requiring maintenance are easily maintained – and extremely reliable in operation and have a long operating life.

Catalogue 238 describes the range of ELGES spherical plain bearings and ELGES rod ends. It has been completely revised from Catalogue 236. Any information in previous editions which does not concur with the data in this edition is therefore invalid. The principal changes relate to the maintenance-free sliding material ELGOGLIDE®.

These are:

■ increased basic load ratings

■ extended sliding travel.

This gives a significant increase in bearing life.

In addition to the catalogue, the INA CD *medias*® *professional* represents a further service. This CD is designed as an advisory system. It contains an information section giving detailed product descriptions, selected application examples with design guidelines, calculation software and a lexicon of terminology relevant to rolling bearing technology. Please contact INA for a copy of this CD.
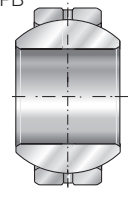
Schaeffler KG
Herzogenaurach (Germany)

Maintenance-free
cylindrical
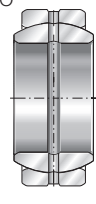plain bushes
ZGB

GE..DW

GE..DW-2RS2
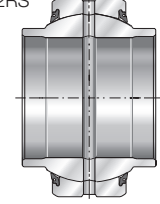
GE..PW
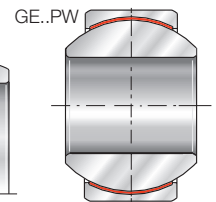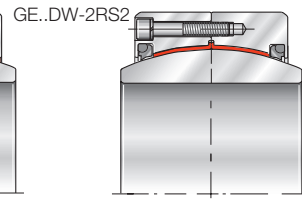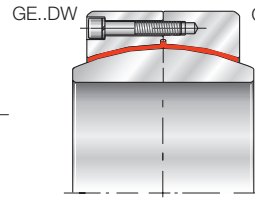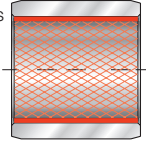
117 198

GE..PB

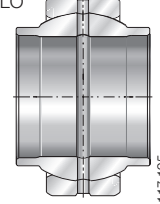GE..ZO

GE..HO-2RS

GE..LO

117 195

GAKFR..PW

GIKFR..PW

117 205

GAKFR..PB

GIKFR..PB

117 201
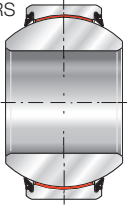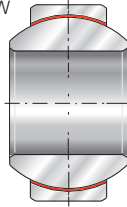
GE..FW-2RS	GE..FW	GE..UK-2RS	GE..UK	**Maintenance-free spherical plain bearings** Radial spherical plain bearings Large radial spherical plain bearings **Maintenance-free cylindrical plain bushes**
		GE..AW	GE..SW	**Maintenance-free spherical plain bearings** Angular contact spherical plain bearings Axial spherical plain bearings
GE..FO-2RS	GE..FO	GE..DO-2RS	GE..DO	**Spherical plain bearings requiring maintenance** Radial spherical plain bearings Large radial spherical plain bearings
		GE..AX	GE..SX	**Spherical plain bearings requiring maintenance** Angular contact spherical plain bearings Axial spherical plain bearings
GAR..UK-2RS	GAR..UK	GIR..UK-2RS	GIR..UK	**Maintenance-free rod ends**
GAR..DO-2RS	GAR..DO	GIR..DO-2RS	GIR..DO	**Rod ends requiring maintenance**
GF..DO	GK..DO	GIHR-K..DO	GIHN-K..LO	**Hydraulic rod ends**
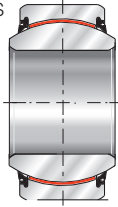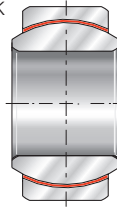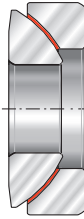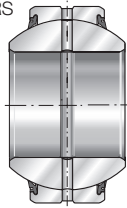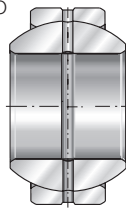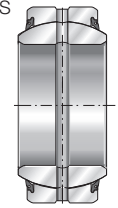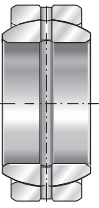
117 199
117 200
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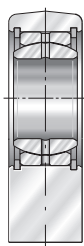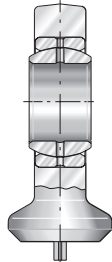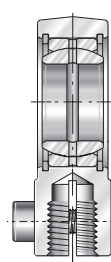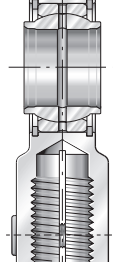
Appendix

Other products

Contents

Contents

Product index

sorted alphanumerically

Product index

Ordering designation

The ordering designation gives an abbreviated description of the product.

It consists of:
- the designation and
- suffixes.

Marking on the product

Do not use the marking on the bearing for ordering. It may be incomplete or not sufficiently specific.

Designation (Figure 1 and 2)

Every product has a designation. This is given in the dimension tables and describes the standard design of the bearing.

The designation consists of several parts.

It indicates:
- the design – the type of product
  (spherical plain bearing, rod end, plain bush)
- the dimensional component – the bore diameter
- the type of sliding contact surface.

Product index, see page 8.

Suffixes (Figure 1 and 2)

The suffixes are placed after the designation.

They supplement the designation and indicate:
- variants on the standard design,
  e.g. lip seals on both sides 2RS
- special designs.

⚠ Special designs are possible only by agreement.

Index of suffixes, see page 13.

Ordering the product (Figure 1 and 2)

Ordering procedure:
- determine the product type required
- take the ordering designation from the dimension table.

⚠ The correct sequence of characters must be observed when ordering.

Further ordering examples are given in the product sections.
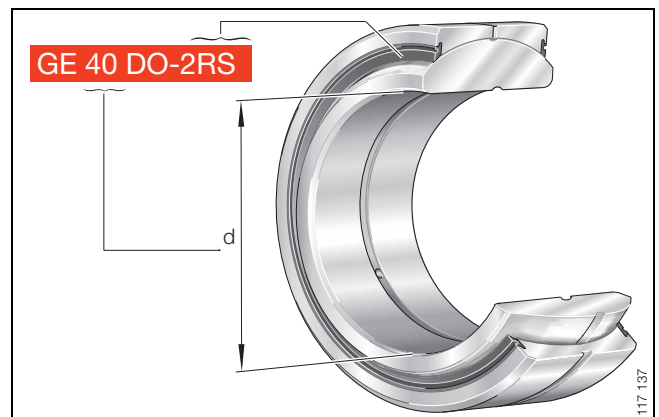
Figure 1 · Radial spherical plain bearing requiring maintenance, lip seals on both sides – designation and suffixes
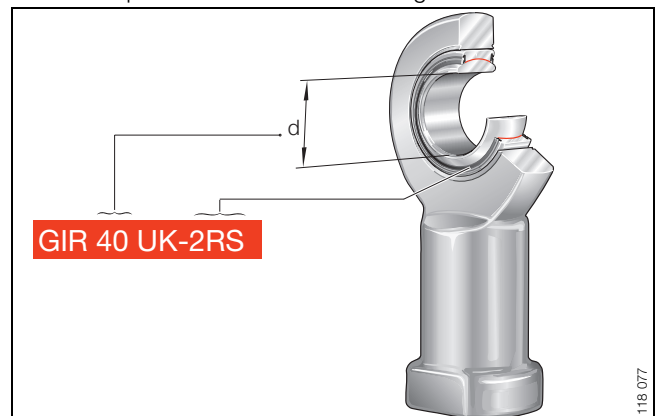
Figure 2 · Maintenance-free rod end, lip seals on both sides – designation and suffixes

Index of suffixes

Suffixes	Description
C2	Radial internal clearance smaller than normal (for spherical plain bearings requiring maintenance)
C3	Radial internal clearance larger than normal (for spherical plain bearings requiring maintenance)
2RS	Lip seals on both sides
2RS1	High performance seals on both sides
2RS2	Increased sealing action on both sides for large radial spherical plain bearings
F10	Angular contact spherical plain bearing GE..SX with lubrication groove system for oil bath lubrication
W3	Maintenance-free radial spherical plain bearing with inner ring made from corrosion-resistant steel
W7	Maintenance-free radial spherical plain bearing, inner ring bore with ELGOGLIDE® lining, giving $d_{New} = d - 1,08$
W8	Inner ring bore with ELGOGLIDE® lining, $d_{New} = d$

Symbols and units

Unless stated otherwise in the text, the values used in this catalogue have the following designations, units and definitions:

a	mm	Expansion of inner ring when using solid shafts – measured on sphere diameter
b	–	Factor for cross-section of inner ring
c	–	Factor for cross-section of outer ring
C_a	N	Basic dynamic load rating, axial
C_{0a}	N	Basic static load rating, axial
C_r	N	Basic dynamic load rating, radial
C_{0r}	N	Basic static load rating, radial
CN	mm	Normal internal clearance
C2	mm	Internal clearance smaller than normal
C3	mm	Internal clearance larger than normal
d	mm	Shaft diameter or bore diameter of inner ring
d_K	mm	Sphere diameter
D_A/D_G	mm	Ratio between diameter of bearing locating bore and outside diameter of housing
e	mm	Contraction of outer ring measured on sphere diameter
f	–	Factor for expansion of housing
f	min⁻¹	Oscillation frequency or speed, frequency of motion
f_b	–	Load factor
f_v	–	Sliding speed factor for ELGOGLIDE®, PTFE composite, PTFE-bronze film
f_H	–	Relubrication factor, dependent on frequency
f_{Hz}	–	Factor for variable load
f_β	–	Relubrication factor, dependent on β
f_1	–	Load direction factor
f_2	–	Temperature factor
f_3	–	Load factor
f_4	–	Bearing design factor
f_5	–	Load type factor (maintenance-free spherical plain bearings and plain bushes)
f_5	–	Material factor (spherical plain bearings requiring maintenance)
f_6	–	Swivel or oscillation angle factor

F_A	N	Axial bearing load
F_R	N	Radial bearing load
F_{max}	N	Maximum bearing load
F_{min}	N	Minimum bearing load
K	N/mm^2	Specific load parameter
l_W	osc.	Maintenance interval between two lubrication operations
l_{hW}	h	Maintenance interval between two lubrication operations
L	osc.	Theoretical life with single initial lubrication (spherical plain bearings requiring maintenance)
L	osc.	Theoretical life under constant load (maintenance-free spherical plain bearings and plain bushes)
L_h	h	Theoretical life under constant load (maintenance-free spherical plain bearings and plain bushes)
L_h	h	Theoretical life taking account of variable conditions
L_h	h	Theoretical life with single initial lubrication (spherical plain bearings requiring maintenance)
L_{hN}	h	Theoretical life with periodic relubrication
L_{hW}	h	Theoretical life under variable load
L_{h1}, L_{h2}	h	Theoretical life for individual time periods
L_N	osc.	Theoretical life with periodic relubrication
L_W	osc.	Theoretical life under variable load
M	Nm	Bearing frictional torque
P	N	Equivalent bearing load
p	N/mm^2	Contact pressure (specific bearing load)
P_{Hz}	Hz	Load frequency
P_{perm}	N	Permissible load on rod end
R_z	μm	Mean roughness depth
s	m	Sliding distance
S	mm	Operating clearance

Symbols and units

t	°C	Operating temperature
t_1, t_2	h or %	Duration of individual operating time period
$\ddot{U}_A$	μm	Effective interference (on outer ring)
$\ddot{U}_I$	μm	Effective interference (on inner ring)
v	mm/s	Mean sliding speed
X	–	Axial load factor for radial and angular contact spherical plain bearings
Y	–	Radial load factor for axial spherical plain bearings
α_1	°	Tilt angle - from centre to left
α_2	°	Tilt angle - from centre to right
β	°	Swivel or oscillation angle (between two extreme points)
β_1	°	Motion angle corresponding to sliding distance
μ	–	Friction factor
Σ_t	h or %	Total operating time ($t_1 + t_2 + t_3 \ .. + t_n$)
ψ	–	Relative internal clearance in fitted condition

Load carrying capacity and life

Spherical plain bearings and rod ends

The size of spherical plain bearing or rod end required depends on the requirements for:

■ load carrying capacity

■ motion

■ rating life

■ operational reliability.

The direction and type of load determine:

■ the bearing type

■ the sliding contact surface.

The load carrying capacity is measured in terms of:

■ the basic dynamic load rating C_r (C_a) (page 20)

■ the basic static load rating C_{0r} (C_{0a}) (page 21).

Cylindrical plain bushes

The principal factors influencing the dimensioning of cylindrical plain bushes and their life calculation include:

■ the magnitude and type of load

■ the motion of the bearing

■ the frequency of motion

■ the load frequency under pulsating or alternating load.

The load carrying capacity is measured in terms of:

■ the basic dynamic load rating C_r (page 20)

■ the basic static load rating C_{0r} (page 21).

Concentric constant load F

Load values can be used directly in the life calculation if they meet the following criteria:

■ they act in a radial direction only on radial spherical plain bearings, angular contact spherical plain bearings and cylindrical plain bushes (Figure 1 and Figure 2)

■ they act in a concentric, axial direction only on axial spherical plain bearings (Figure 3)

■ their magnitude and direction does not change during operation.

In this case, the load value F for life calculation is identical to the calculation value P (F = P).
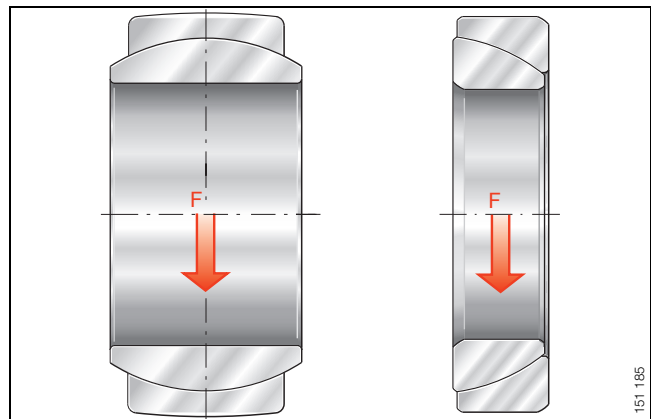
Figure 1 · Concentric, constant radial load F
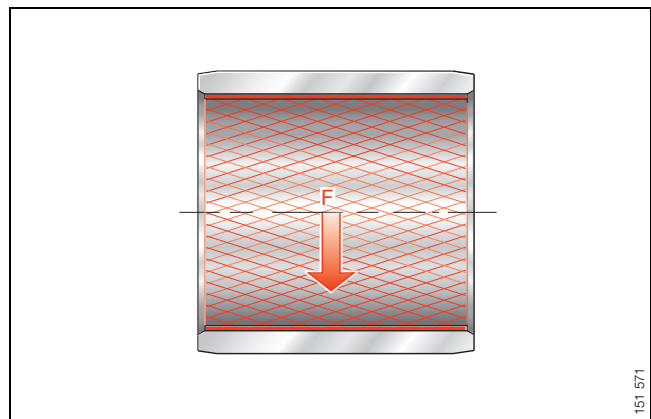
Figure 2 · Concentric, constant radial load F
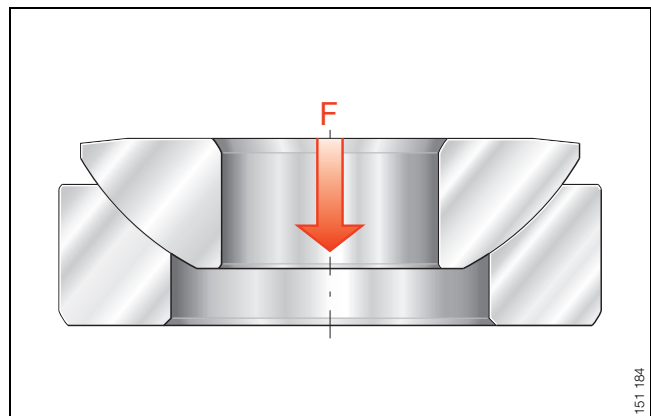
Figure 3 · Concentric, constant axial load F

Combined radial and axial load

If spherical plain bearings are subjected simultaneously to radial and axial loads, the equivalent calculation value P must be used in the life formula.

This value has the same effect on the life as the combined loads themselves.

The value P is determined using the following formulae:
- radial and angular contact spherical plain bearings (Figure 4 and 5):

$$P = X \cdot F_R$$

- axial spherical plain bearings (Figure 6):

$$P = Y \cdot F_A$$

P   N
Equivalent dynamic bearing load

F_R N
Radial bearing load

F_A N
Axial bearing load

X   –
Axial load factor for radial and angular contact spherical plain bearings

Y   –
Radial load factor for axial spherical plain bearings.

$$X = 0{,}978 \cdot 21{,}546^{\frac{F_A}{F_R}}$$
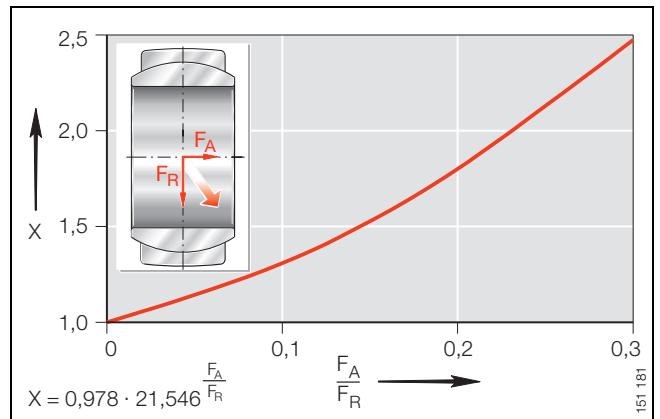
Figure 4 · Radial spherical plain bearings – combined load

$$\frac{F_A}{F_R} = 0 - 2{,}35\text{: } X = 1{,}009 \cdot 1{,}4714^{\frac{F_A}{F_R}}$$

$$\frac{F_A}{F_R} = 2{,}35 - 3{,}0\text{: } X = 0{,}7678 \cdot \frac{F_A}{F_R} + 0{,}6966$$
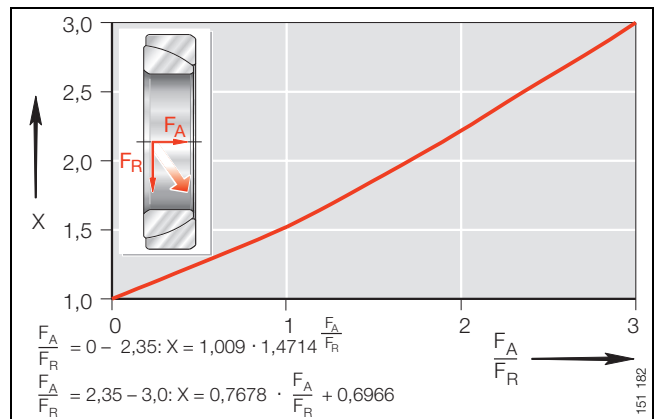
Figure 5 · Angular contact spherical plain bearings – combined load

$$Y = 0{,}998 \cdot 2{,}6254^{\frac{F_R}{F_A}}$$
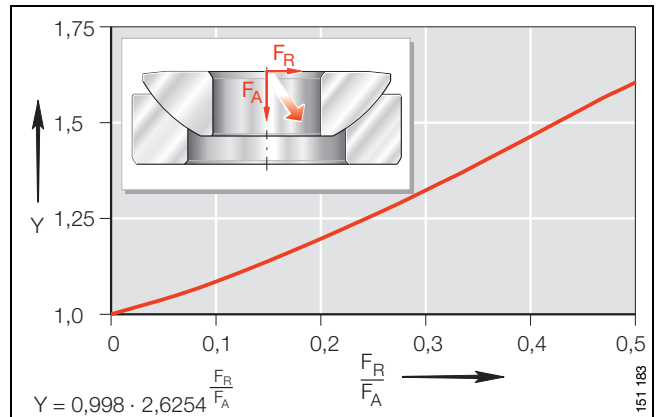
Figure 6 · Axial spherical plain bearings – combined load

Variable bearing load

If the load varies in a linear manner during swivel motion, the equivalent calculation value P must be used (Figure 7 and 8).

This value has the same effect on the life as the variable bearing load itself.

$$P = \sqrt{\frac{F^2_{min} + F^2_{max}}{2}}$$

P   N
Equivalent dynamic bearing load

F_{max} N
Maximum bearing load

F_{min} N
Minimum bearing load.

Calculation of rating life

Where bearings are subjected to differing loads and motions, the life can only be calculated in approximate terms.

The following information must be available (Figure 9):

■ the load

■ the motion

■ the duration of individual operating time periods.

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

L_h h
Theoretical life taking account of variable conditions

t_1, t_2 h or %
Duration of individual operating time period

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

L_{h1}, L_{h2} h
Life for individual time periods.
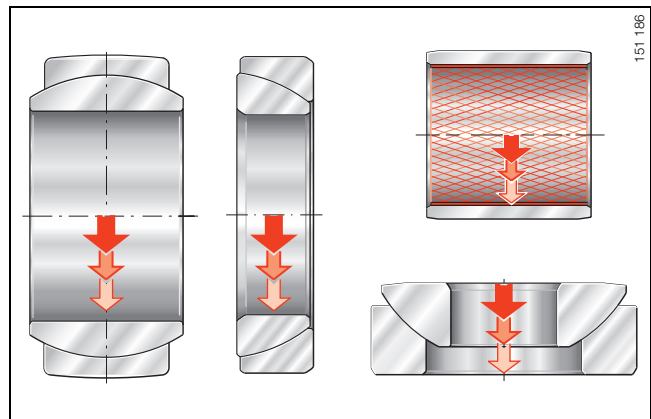
Figure 7 · Bearing load with linear variation
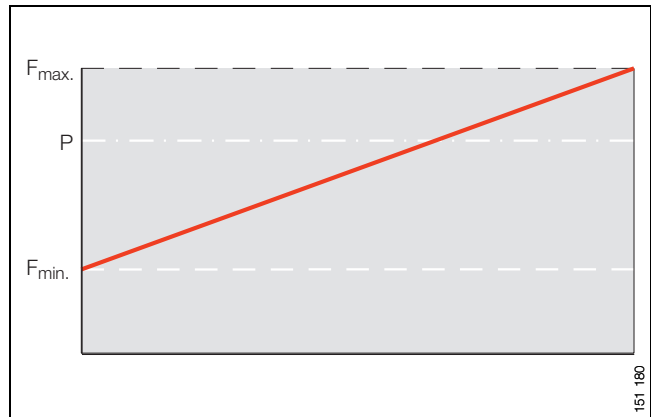
Figure 8 · Maximum and minimum bearing load
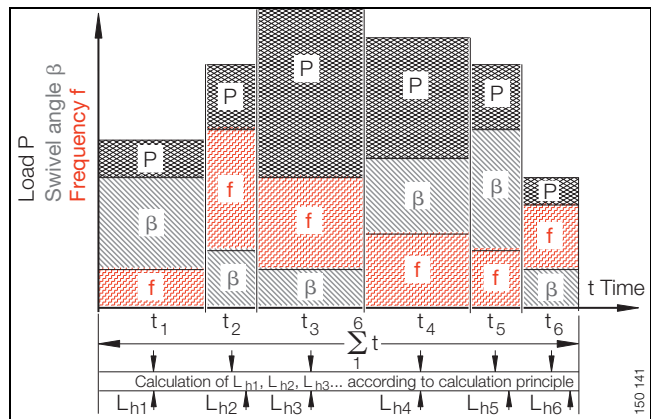
Figure 9 · Life under specified load and motion spectrum

Load carrying capacity and life

Basic load ratings
Contact pressure

The load carrying capacity is measured in terms of the basic static and dynamic load ratings.

Basic load ratings are always defined by the manufacturer of the bearings. They cannot therefore be compared in a simplistic manner with data from other manufacturers.

Basic dynamic load rating

The basic dynamic load rating C_r (C_a) is a parameter for calculating the life of:
- spherical plain bearings, rod ends and plain bushes under dynamic loads.

It is dependent on the sliding contact surface and has a significant influence on the life of spherical plain bearings, rod ends and plain bushes.

Dynamic load

A spherical plain bearing, plain bush or rod end is subject to dynamic load if, under load
- it undergoes swivelling, tilting or rotary motion.

Any relative motion between the sliding surfaces, even if superimposed on the main motion, increases wear and causes material fatigue.

It must always be:
- allocated to the dynamic load case
- taken into consideration in the life calculation.

Calculation of basic dynamic load rating

The contact pressures actually occurring in a spherical plain bearing or a plain bush are dependent on:
- the load
- the sliding contact surface
- the osculation conditions
- the installation situation.

Due to the influence of these factors, it is not possible to determine the pressures precisely. The basic dynamic load ratings (*dimension table*) therefore include (Table 1):
- a load parameter K specific to the material
- the projected load-bearing area.

C = projected load-bearing area · specific load parameter

⚠ The basic load rating C is the maximum permissible dynamic load. The basic load ratings can only be fully utilised if the load:
- acts in a radial direction only on radial and angular contact spherical plain bearings, rod ends and plain bushes
- acts in a concentric, axial direction only on axial spherical plain bearings.

Table 1 · Sliding contact surface and specific load parameter K and K_0

Sliding contact surface	Specific dynamic load parameter K N/mm^2	Specific static load parameter K_0 N/mm^2
Steel/steel	100	500
Steel/bronze	50	125
Hard chromium/PTFE composite	100	250
Steel/PTFE-bronze film	100	250
Hard chromium/ELGOGLIDE®	300	500 (400)[1]

[1] For maintenance-free cylindrical plain bushes ZGB.

Basic static load rating

The basic static load rating C_{0r} (C_{0a}) is used if spherical plain bearings, plain bushes and rod ends

■ are subjected to load while stationary.

It indicates the load that a spherical plain bearing, plain bush or rod end can support at room temperature without damage to the sliding surfaces. This is subject to the precondition that the components adjacent to the bearing must prevent deformation of the bearing.

If the basic static load rating C_{0r} (C_{0a}) is used to the full, the shaft and housing must be made from high-strength materials.

Rod ends

In this case, the basic static load rating C_{0r} indicates the load carrying capacity of the rod end housing under static tensile load. At room temperature, the basic static load rating includes a safety factor of at least 1,2 in relation to the yield point of the housing material.

⚠ The permissible load on rod ends is lower for pulsating or alternating loads.

Calculation of rod ends requiring maintenance using load factors f_b: see Table 1, page 146;
calculation of maintenance-free rod ends using load factors f_b: see Table 1, page 128.

Contact pressure

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

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

Under extreme loading conditions, for example a high axial load acting on radial spherical plain bearings, elastic deformation of the bearing and housing may lead to contact pressure concentrations. Please consult INA for further information.

The contact pressure p of a spherical plain bearing is calculated from:

■ the basic dynamic load rating C_r (C_a)

■ the specific material parameter K

■ the equivalent bearing load P.

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

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

p N/mm^2
Contact pressure

K N/mm^2
Specific load parameter (Table 1)

P   N
Equivalent dynamic bearing load

C_r (C_a)   N
Basic dynamic load rating (*dimension table*).

p · v value

In conjunction with the mean sliding speed, the value p for bearing pressure is used to calculate the frictional energy generated in spherical plain bearings.

The p · v value (N/mm^2 · mm/s) is:

■ the product of the bearing pressure and the sliding speed.

If the basic dynamic load rating C_r (C_a) is used to the full, this often leads to a severe reduction in the operating life of bearings with metallic sliding surfaces. The degree to which the basic load rating is utilised should therefore always be matched to the required operating life.

This is indicated by:

■ the ratio C_r (C_a)/P.

The ratio C_r (C_a)/P must be not less than 1. Depending on the application and bearing type, it is between 1 and 10.

For the purposes of predimensioning, values are stated for the ratio C_r (C_a)/P (Table 2 and Table 3). In conjunction with the diagram, this allows preliminary selection of the appropriate bearing size (Figure 10).

⚠ Predimensioning is not a substitute for more extensive bearing calculation.

Table 2 · Ratio C_r (C_a)/P for maintenance-free spherical plain bearings under dynamic load – guide values

Series	Alternating load C_r (C_a)/P		Unilateral load C_r (C_a)/P
GE..UK GE..UK-2RS	restricted suitability suitable	$\geqq 2$	5 to1
GE..DW	suitable	>2	3 to 1
GE..DW-2RS2	suitable	>2	3 to 1
GE..FW GE..FW-2RS	restricted suitability suitable	$\geqq 2$	5 to 1
GE..PW	restricted suitability	$\geqq 2$	5 to 1
GE..SW GE..AW	suitable	$\geqq 2$	5 to 1

Table 3 · Ratio C_r (C_a)/P for spherical plain bearings requiring maintenance under dynamic load – guide values

Series	Alternating load C_r (C_a)/P	Unilateral load C_r (C_a)/P
GE..DO GE..DO-2RS GE..FO GE..FO-2RS	3 to 1	4 to 1,7
GE..PB	3 to 1	4 to 1
GE..LO GE..HO-2RS GE..ZO	3 to 1	4 to 1,7
GE..SX	3 to 1,5	4 to 2
GE..AX	–	4 to 2

Figure 10 · Bearing size, load and ratio C_r (C_a)/P for predimensioning

Load carrying capacity and life

Bearing motion
Rating life

Spherical plain bearings are principally intended to support high loads under oscillating motion.

The term "bearing motion" describes the dynamic conditions in the bearing.

These are essentially characterised by:
- the magnitude of the motion
- the speed of the motion
- the frequency of the motion.

Motion parameter – swivel angle and tilt angle

Swivel motion is defined as the oscillating motion of the two bearing rings in relation to each other about the axis of the bearing.

Swivel angle

The centring angle described by the two extreme points of the motion is defined as the swivel angle β (Figure 11). This describes the motion between the two extreme points.

Tilt angle

In tilting motion, the inner ring or shaft locating washer moves relative to the outer ring or housing locating washer in a direction transverse to the bearing axis. The axes of the relevant bearing rings intersect at the tilt angle α (Figure 12).

The permissible tilt angle α is given in the dimension tables, based on full utilisation of the basic load ratings.

Combined swivel and tilt motion

The motion angle β_1 corresponding to the sliding distance can be calculated for linear and ellipsoid motion (Figure 13).

Linear motion:

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

Ellipsoid motion:

$$\beta_1 = \frac{\pi \cdot \beta \cdot (\alpha_1 + \alpha_2) + (\beta - \alpha_1 - \alpha_2)^2}{\beta + \alpha_1 + \alpha_2}$$

β_1 °
Motion angle corresponding to sliding distance

α_1 °
Tilt angle – from centre to left

α_2 °
Tilt angle – from centre to right.
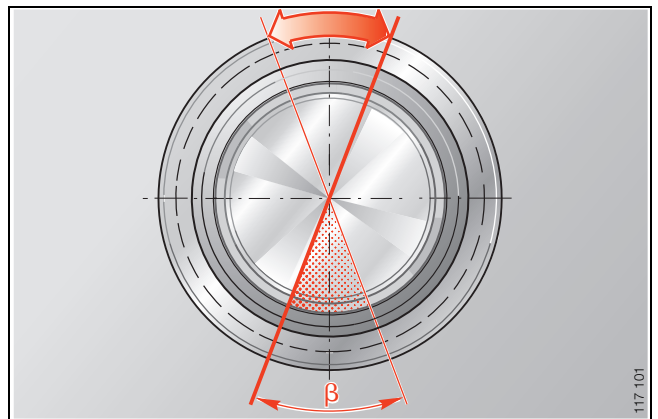
Figure 11 · Swivel motion – swivel angle β
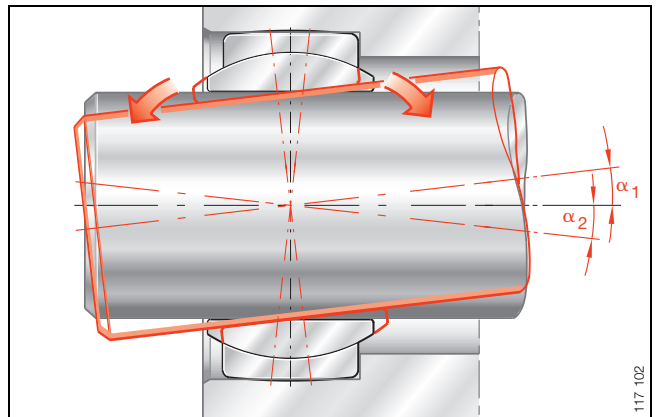
Figure 12 · Tilt motion – tilt angle α
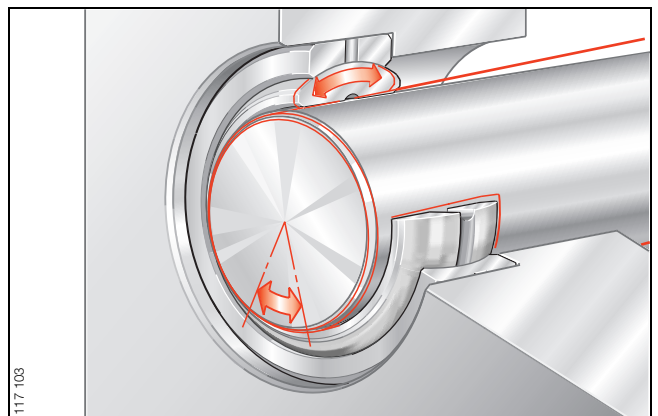
Figure 13 · Swivel and tilt motion – motion angle β_1

Rotary motion

The sliding distance covered in a motion cycle – motion from the start point to the return point and back – corresponds to twice the arc length of the angle β or α. For this reason, an angle β = 180° should be used for rotary motion in life calculation.

Frequency of motion

The number of motions per time period – the frequency – has a significant influence on the life of spherical plain bearings and cylindrical plain bushes.

The frictional energy generated in the bearing is influenced by the frequency of motion as well as the load, coefficient of friction and the magnitude of the motion. It is dependent on the relevant sliding contact surface and must not exceed the permissible p · v values.

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

Intermittent operation

In this case, the mean sliding speed during one motion cycle must be used.

Life

Calculation of the theoretical life is based on a large number of laboratory tests and assumes certain operational data:
- lithium soap multi-purpose greases with solid additives are used in spherical plain bearings with a steel/steel sliding contact surface.

The life is defined as the number of swivel motions or operating hours that can be achieved by a sufficiently large number of spherical plain bearings or cylindrical plain bushes under identical operating conditions before certain failure criteria are met.

The failure criteria are defined by the manufacturer as test limit values related to:
- an amount of wear dependent on the bearing size

  or
- an upper friction limit which is exceeded.

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.

Calculation of the theoretical life gives comparative values for the bearings. They can be used to assess the greater or lesser performance of the bearings selected.

Life calculation:
- *Maintenance-free spherical plain bearings* (page 63 to 71)
- *Maintenance-free cylindrical plain bushes* (page 72, 73)
- *Maintenance-free rod ends* (page 63 to 71 and 128, 129)
- *Spherical plain bearings requiring maintenance* (page 97 to 99)
- *Rod ends requiring maintenance* (page 97 to 99 and 146 to 148).

Operating life

The operating life is the number of motion cycles or operating hours achieved in practice by a spherical plain bearing or a cylindrical plain bush. It may differ from the calculated theoretical life.

The operating life is dependent on factors including:
- the type and magnitude of load
- any shocks occurring
- the sealing arrangement
- corrosion
- contamination
- maintenance.

Calculation service

The influences that must be taken into consideration in calculation are expressed as mathematical functions.
As a result, the calculation principles can be programmed, eliminating the need for time-consuming manual calculation work.

Calculation programs are available which may be used on request.

⚠ The theoretical life calculations are valid for the products described in this catalogue.

  Under no circumstances can they be transferred to other products.

Friction

Friction is principally dependent on:

- the sliding contact surface
- the load
- the sliding speed
- the bearing temperature
- the lubrication condition
- the quality of the sliding surfaces.

Friction behaviour of spherical plain bearings requiring maintenance, maintenance-free spherical plain bearings and maintenance-free cylindrical plain bushes

The friction behaviour changes during the operating life.

The lowest friction values are found with bearings that are well run in. The values are significantly higher during the running-in and failure phases.

⚠ For safety reasons, the maximum values should always be used for calculating the drive power (Table 1).

If the friction value exceeds the maximum value, this may have the following consequences:

- wear may increase
- the bearing temperature may rise
- the function of the bearing may be impaired.

Bearing frictional torque

The bearing frictional torque M (from the formula) is valid for (Figure 1):

- radial and angular contact spherical plain bearings under radial load
- axial spherical plain bearings under axial load.

⚠ If the bearing is subjected to combined load (radial and axial), the bearing frictional torque is calculated by integration of the standard loads.

$$M = P \cdot \mu \cdot d_K \cdot 0,0005$$

0,0005 takes account of $\dfrac{\text{Sphere radius}}{\text{Sphere diameter}} \cdot \dfrac{1 \text{ m}}{1000 \text{ mm}}$

M   Nm
Bearing frictional torque

P   N
Equivalent dynamic bearing load

μ –
Friction factor (Table 1)

d_K mm
Sphere diameter of spherical plain bearing (*dimension table*).
For maintenance-free cylindrical plain bushes,
use d instead of $d_K = d$ (*see dimension table*).
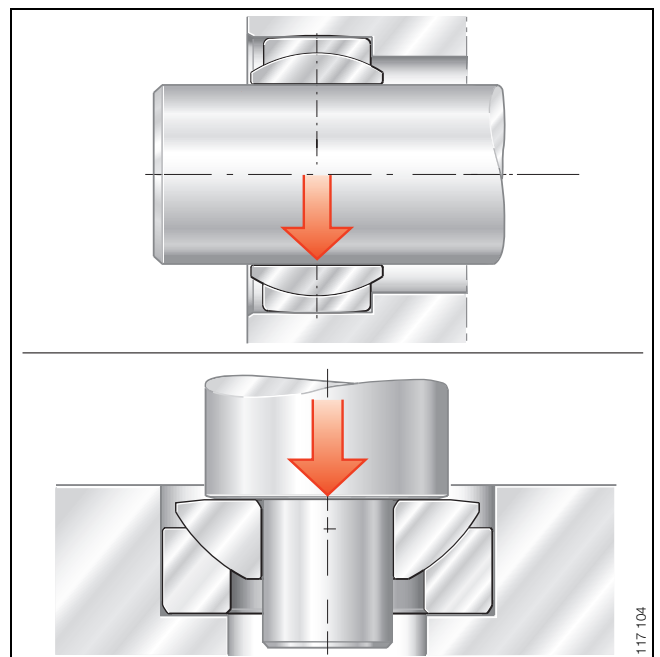
Figure 1 · Load on spherical plain bearing

Table 1 · Friction factor μ
    for spherical plain bearings and plain bushes

Sliding contact surface	Friction factor μ	
	min.	max.
Steel/steel	0,08	0,22
Steel/bronze	0,1	0,25
Hard chromium/PTFE composite	0,05	0,2
Steel/PTFE-bronze film	0,05	0,2
Hard chromium/ELGOGLIDE®	0,02	0,2

Friction behaviour of maintenance-free plain bearing materials based on PTFE

Figure 2 shows the friction factor μ as a function of:

- the sliding speed
- the load
- the temperature.

With new spherical plain bearings, the bearing frictional torque may be significantly higher during the early running-in phase due to:

- plastic transfer of the PTFE material to the surface structure of the opposing running surface
- the incomplete internal bearing tribology and the deposit of PTFE particles on the opposing running surface/ functional surface (PTFE/PTFE friction).

The wear behaviour of maintenance-free spherical plain bearings and plain bushes is shown in Figure 3.
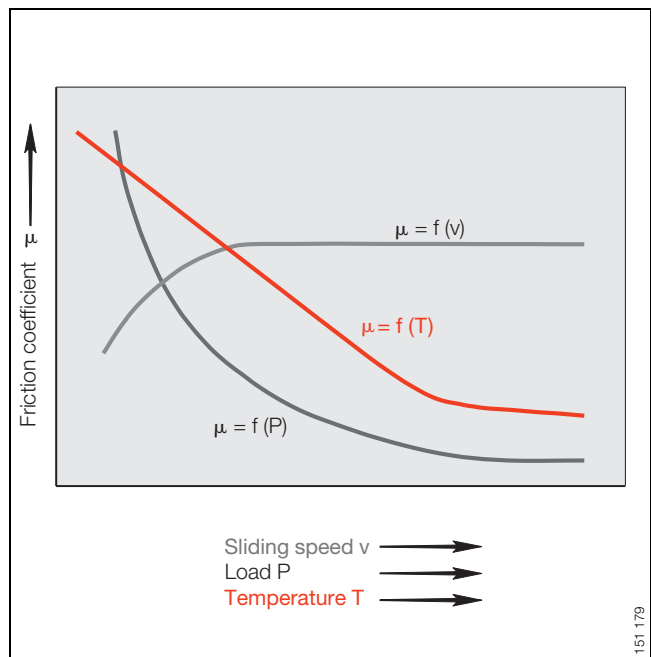
Figure 2 · Friction factor as a function of sliding speed, load, temperature
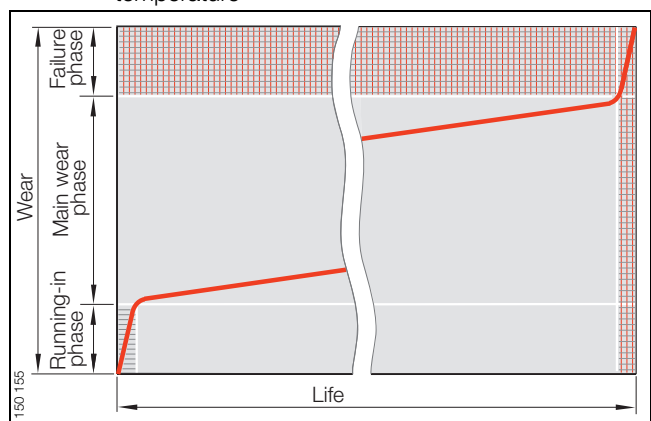
Figure 3 · Wear behaviour of maintenance-free spherical plain bearings and plain bushes

Lubrication

Spherical plain bearings and rod ends with a steel/steel sliding contact surface requiring maintenance are given a special surface treatment and are provided with MoS_2. However, the function and wear of spherical plain bearings and rod ends is heavily influenced by the quality of maintenance.

Functions of the lubricant

The lubricant should (Figure 1):
- reduce friction
- prevent corrosion
- form a lubricant film which is capable of supporting loads between the contact points
- if grease lubrication is used, protect the bearing against contamination and moisture.

Criteria for lubricant selection

The following must be taken into consideration:
- the load
- the load direction
- the swivel angle
- the sliding speed
- the ambient temperature
- the environmental conditions.

⚠ It is more important to use a suitable lubricant than to provide generously defined, short lubrication intervals.

The lubricant must always be chosen in consultation with the lubricant manufacturer.

Grease lubrication

Steel/steel sliding contact surface

The following are suitable for standard applications:
- conventional, corrosion-inhibiting, high-pressure greases with a lithium soap base, EP additives and solid lubricant additives.

Suitable lubricants contain:
- approx. 3% MoS_2 or
- 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

The following are suitable:
- conventional, corrosion-inhibiting, water-repellent lithium soap greases of normal consistency.

⚠ Lubricating greases with MoS_2 additives or other solid lubricants must not be used.
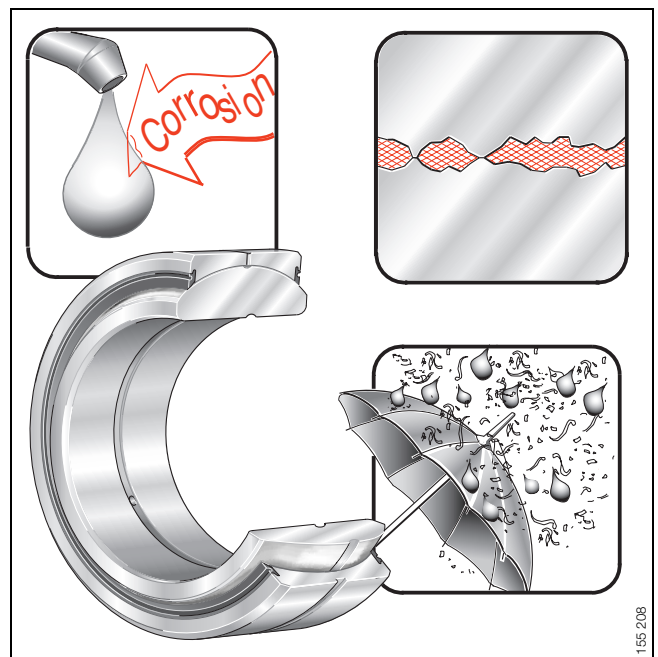
Figure 1 · Functions of the lubricant

Running-in phase

The running-in phase has a significant influence on the later wear behaviour of the bearing. Correct lubrication is of particular importance at this point.

During running-in

■ the surfaces of the contact zones are smoothed

■ the contact zones are elastically bedded in.

This increases the contact area and reduces the load on the material.

Greasing

During the running-in phase, the pressure in the bearing is particularly high. Spherical plain bearings are therefore manganese phosphated and treated with MoS_2.

The wear occurring during the running-in 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 if the bearing:

■ is subjected to about ten swivel motions under load without additional greasing

■ is then provided with an 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 steel/steel sliding contact surfaces must be periodically relubricated.

The relubrication intervals should not be established arbitrarily but determined by calculation or in consultation with the lubricant manufacturer.

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.

Preconditions

■ the grease should be the same as that used for initial greasing
  – if different greases are used, their miscibility and compatibility should be checked

■ relubrication should be carried out
  – with the bearing still warm from operation
  – before the bearing comes to rest if safe to do so
  – before extended breaks in operation.

Maintenance-free spherical plain bearings, plain bushes and rod ends

During the running-in phase, PTFE particles are transferred from the outer ring sliding layer to the opposing running surface of the inner ring. This fills in the areas of slight roughness in the inner ring surface. A long operating life is only achieved with this tribologically smooth surface.

⚠ Maintenance-free spherical plain bearings, plain bushes and rod ends must not be relubricated.
The PTFE particles to be transferred do not adhere to oily surfaces. Lubricant therefore prevents the necessary smoothing of the surface.

If spherical plain bearings, plain bushes and rod ends that have been subjected to dry running-in are subsequently lubricated, this damages the smoothing effect previously achieved.

Maintenance-free spherical plain bearings, plain bushes and rods ends do not have any facilities for relubrication.

Internal clearance and operating clearance

Internal clearance

Radial internal clearance

Radial internal clearance of radial spherical plain bearings requiring maintenance with steel/steel sliding contact surface

The radial internal clearance 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 other (Figure 1).

The radial internal clearance is divided into three groups (Table 1 and Table 2) and is given in the dimension tables. This assumes that the bearing is mounted in a housing bore that, apart from the correction of geometrical inaccuracies, causes no dimensional changes in the bearing.

Normal internal clearance

The normal internal clearance gives an optimum operating clearance under normal operating conditions if the recommended fits (see *Design of bearing arrangements*, Seite 37) are used.

Radial internal clearance larger or smaller than normal

In order to meet the requirements arising from different operating or installation conditions, the bearings are also available with (Table 1 and Table 2):

■ internal clearance larger than normal
  – where tight fits are used or there are large temperature differences between the inner and outer ring
■ internal clearance smaller than normal
  – for bearing arrangements with very small clearance.

Suffixes

Spherical plain bearings with normal internal clearance do not have a suffix.

Bearings with a radial internal clearance C2 and C3 differ from the standard design. They are ordered using a suffix.

Example

Spherical plain bearing GE 60 DO with reduced internal clearance: GE 60 DO-C2.

Axial internal clearance

The axial internal clearance is defined as the amount by which the inner ring can be moved in an axial direction relative to the outer ring from one extreme position to the other (Figure 2).

It is dependent on the bearing geometry and is in a direct relationship to the radial internal clearance. Depending on the bearing type, it may be several times greater than the radial internal clearance.
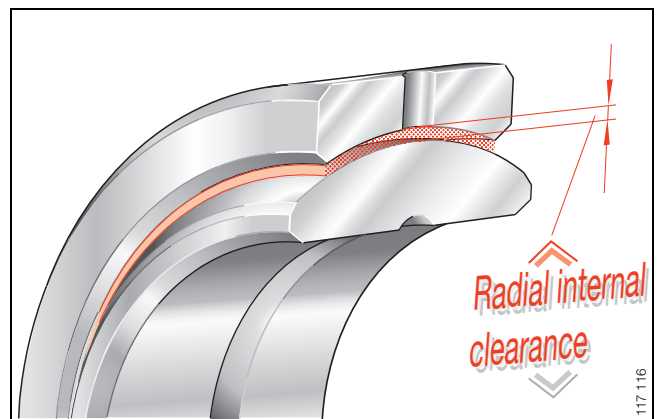
Figure 1 · Radial internal clearance
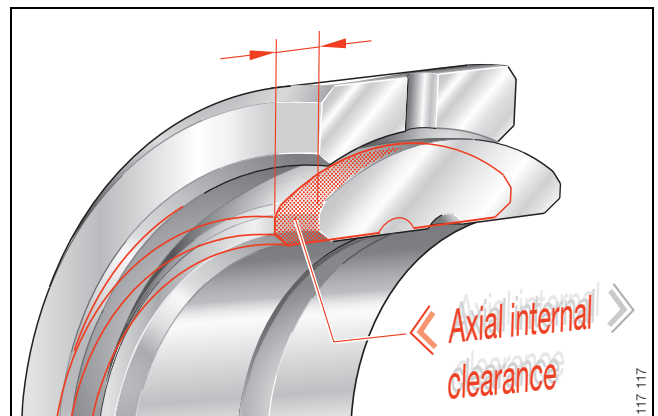
Figure 2 · Axial internal clearance

Table 1 · Radial internal clearance groups

Group		
C2[1]	CN	C3
smaller than normal	normal	larger than normal

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

Table 2 · Radial internal clearance groups

Series		Radial internal clearance in μm					
GE..DO GE..DO-2RS GE..HO-2RS GE..LO Bore d mm	GE..FO GE..FO-2RS Bore d mm	C2		CN		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

(continued)

Series		Radial internal clearance in μm					
GE..DO GE..DO-2RS GE..HO-2RS GE..LO Bore d mm	GE..FO GE..FO-2RS Bore d mm	C2		CN		C3	
		min.	max.	min.	max.	min.	max.
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

For further internal clearance values see *dimension tables*.

Internal clearance of cylindrical plain bushes

Bearings requiring maintenance must have a minimum radial internal clearance for lubrication. Maintenance-free cylindrical plain bushes have an integral solid lubricant supply. They do not therefore require this minimum radial clearance for lubrication purposes.

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 internal clearance ψ (Figure 3 and formula).

For bore diameters d = 30 mm to 200 mm, guide values are given in Table 3.

These ranges can be used:

■ due to the standard tolerances of the plain bushes and

■ if the housing bore and shaft are manufactured to the "average tolerance".

$$S = \psi \cdot d$$

S μm
Operating clearance

ψ ‰
Relative internal clearance in fitted condition

d   mm
Shaft diameter or bore diameter of inner ring.
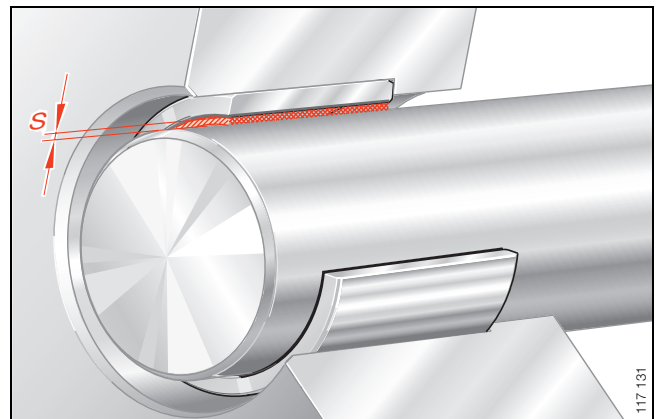
Figure 3 · Internal clearance of cylindrical plain bushes

Table 3 · Bore diameter and relative internal clearance ψ in fitted condition – guide values

Bore diameter mm		
d < 80	d ≧ 80 to 120	d > 120 to 200
$\psi \leqq 1‰$	$\psi \leqq 0,75‰$	$\psi \leqq 0,5‰$

Fits related to practical use for spherical plain bearings

Tables 4 and 5 show the tolerances and clearances which result from the corresponding ISO fits in conjunction with normal bearing tolerances to ISO 12 240-1 to -3 when the actual dimensions correspond to "average tolerance":

- ■ – indicates interference
- ■ + indicates clearance.

Table 4 · Fits for shafts – interference $Ü_I$ in μm[1)2)]

Bearing inner ring/shaft	Nominal deviation range in μm												
	Desig-nation	over incl. 3 6	6 10	10 18	18 30	30 50	50 80	80 120	120 180	180 250	250 315	315 400	400 500
	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)] Example: shaft, diameter 50 m6;
 probable interference 0,023 mm.

[2)] Not applicable to series GE..LO, GE..PB, GE..SX, GE..PW, GE..SW.

Table 5 · Fits for housing bores – interference $Ü_A$ or clearance in μm[1)2)]

Bearing outer ring/housing	Nominal deviation range in μm												
	Desig-nation	over incl. 6 10	10 18	18 30	30 50	50 80	80 120	120 150	150 180	180 250	250 315	315 400	400 500
	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
	J7	+4	+5	+6	+7	+10	+12	+15	+18	+22	+27	+31	+34

[1)] Example: Housing bore, diameter 75 M7;
 probable interference 0,009 mm.

[2)] Not applicable to series GE..SX, GE..SW.

Internal clearance and operating clearance

Operating clearance

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

It is calculated from:
- the radial internal clearance (Table 2, page 31)
- the change in the radial internal clearance due to interference and temperature influences in a fitted bearing.

Influence of interference on the radial internal clearance of radial spherical plain bearings

The radial internal clearance changes due to the fit as a result of:
- expansion of the inner ring
- contraction of the outer ring.

Expansion of the inner ring

$$a = \ddot{U}_I \cdot b \cdot 0,9$$

a $\quad\quad$ μm
Expansion of inner ring when using solid shafts – measured on sphere diameter

b $\quad\quad$ –
Factor for the cross-section of the inner ring (Table 6, Figure 4)

$\ddot{U}_I$ $\quad\quad$ μm
Effective interference (Table 4, page 33)

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

Contraction of the outer ring

With ring-shaped housings, expansion of the housing must be taken into consideration. The expansion is dependent on the wall thickness and is included in calculation using the factor f.

$$e = \ddot{U}_A \cdot f \cdot 0,9$$

e $\quad\quad$ μm
Contraction of the outer ring – measured on the sphere diameter

c $\quad\quad$ –
Factor for the cross-section of the outer ring (Table 7, Figure 4)

f $\quad\quad$ –
Factor for the expansion of the housing (Figure 5)

$\ddot{U}_A$ $\quad\quad$ μm
Effective interference (Table 5, page 33)

0,9 $\quad\quad$ –
Factor for the roughness, ovality and unevenness of the supporting component surface.
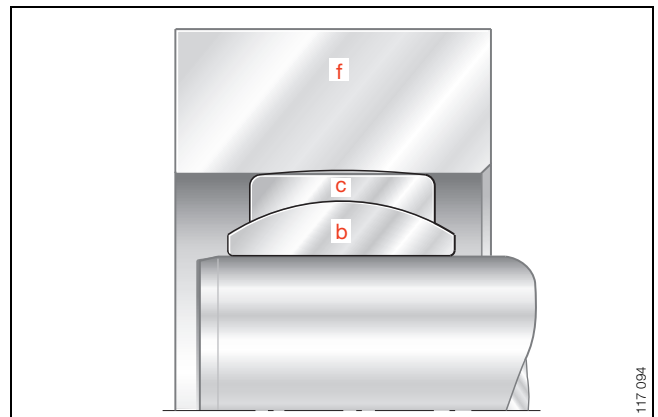
Figure 4 · Factor b and factor c

Table 6 · Factor for the cross-section of the inner ring

Bore		Series	
d mm	d mm	GE..DO/GE..DO-2RS GE..HO-2RS GE..LO[1] GE..UK GE..UK-2RS	GE..FO/GE..FO-2RS GE..FW/GE..FW-2RS GE..PB[1] GE..PW[1]
over	incl.	b	b
6	10	0,65	0,55
12	20	0,72	0,64
25	70	0,79	0,71
80	140	0,80	0,75
160	300	0,84	0,78

[1] Dimension $\ddot{U}_I$ is not listed in Table 4.

Table 7 · Factor c for the cross-section of the outer ring

Bore		Series	
d mm	d mm	GE..DO/GE..DO-2RS GE..HO-2RS GE..LO GE..UK GE..UK-2RS	GE..FO/GE..FO-2RS GE..FW/GE..FW-2RS GE..PB GE..PW
over	incl.	c	c
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	–

Calculation of the factor f for expansion of the housing

The following are taken into consideration (Figure 5 and 6):

■ the cross-section of the bearing ring
■ the ring thickness of the bearing locating housing.

$$\frac{D_A}{D_G} = \frac{\text{bearing locating bore diameter}}{\text{housing outside diameter}}$$
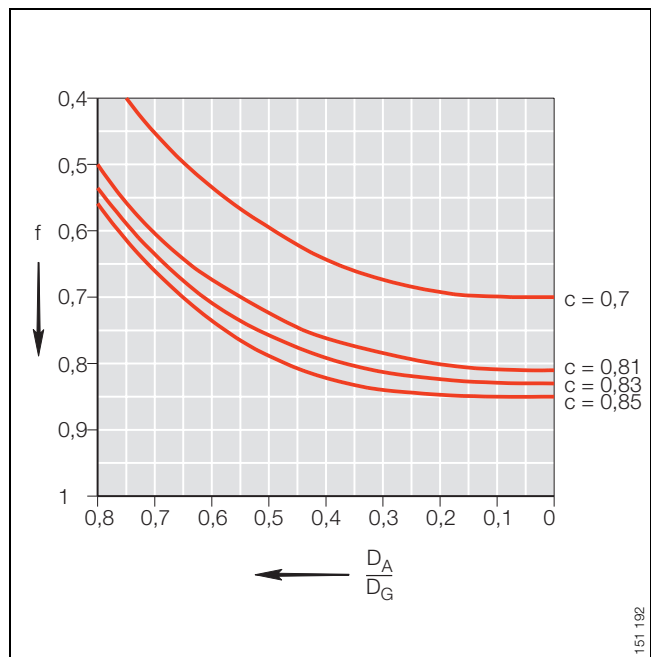
Figure 5 · Factor f for expansion of the housing
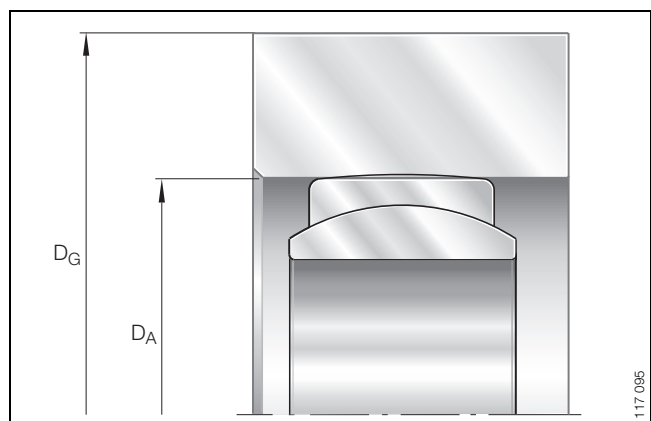
Figure 6 · Housing bore diameter D_A/ housing outside diameter D_G

Calculation example

Given

Radial spherical plain bearing with
steel/steel sliding contact surface GE 50 DO
Fit between locating bore and shaft: M7/m6

Housing outside diameter	$\varnothing$ 120 mm
Solid steel shaft	$\varnothing$ $50_{+0,009}^{+0,025}$
Locating bore	$\varnothing$ $75_{+0,03}^{0}$
Radial internal clearance	60 μm to 120 μm.

Required

Radial internal clearance in fitted condition.

Assumption: production to "average tolerance"

Expansion of the inner ring
(measured on the sphere diameter)

$a = \ddot{U} \cdot b \cdot 0,9$
$\ddot{U}_l = 0,023$ mm   (Table 4, page 33)
$b = 0,79$ (Table 6, page 34)

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

Contraction of the outer ring
(measured on the sphere diameter)

$e = \ddot{U}_A \cdot f \cdot 0,9$
$\ddot{U}_A = 0,009$ mm   (Table 5, page 33)
$c = 0,85$ (Table 7, page 34)
$f^{1)} = f\left(\dfrac{D_A}{D_G}\right) = 0,72$ (Figure 5, page 35)

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

1) f as a function of $\dfrac{D_A}{D_G}$.

Calculate the reduction in the radial internal clearance
by adding a and e.

Δ Ralu $= a + e$
$= 0,016$ mm $+ 0,006$ mm
$= 0,022$ mm.

Maximum possible reduction in radial internal clearance with
"favourable production"

Solid steel shaft:	$\varnothing$ 50,025 mm
	(maximum diameter 50 m6)
Bearing bore:	$\varnothing$ 49,988 mm
	(minimum diameter to DIN 620).

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

Locating bore:	$\varnothing$ 74,97 mm
	(minimum diameter to 75 M7)
Bearing outside diameter:	$\varnothing$ 75 mm
	(maximum diameter 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.

Max. reduction in radial internal clearance in fitted condition:
$a_{max} + e_{max} = 0,026 + 0,019 = 0,045$ mm.

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

	0,060 mm
	–0,045 mm
Minimum internal clearance	0,015 mm.

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

⚠ If the remaining internal clearance of spherical plain
bearings requiring maintenance is $\leqq$ 0, a bearing
of another internal clearance group (in this case C3)
must be selected.

Maintenance-free spherical plain bearings

Maintenance-free spherical plain bearings have a very small
internal clearance. This may lead to preloads in the bearing
once it is fitted.
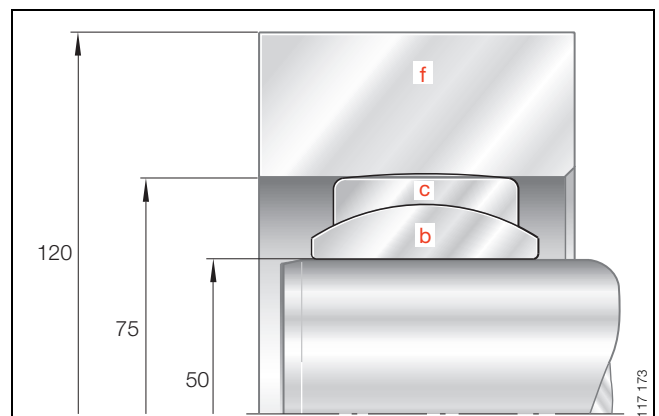
Figure 7 · Factor b and factor c

Design of bearing arrangements

Radial location of spherical plain bearings
and maintenance-free cylindrical plain bushes

In spherical plain bearings, sliding motion should occur between the spherical sliding surfaces of the inner and outer rings – the quality and treatment of the surfaces are matched to this purpose. The internal clearance and osculation of the sliding surfaces must therefore be in a balanced relationship.

Spherical plain bearings requiring maintenance

The operating life of spherical plain bearings requiring maintenance is reduced by:
- preload on the sliding surfaces
- excessively small load-bearing areas on the sliding surfaces due to unacceptably large internal clearance.

The recommended fits are given in Table 1).

⚠ If tighter fits are required, for example due to high impact-type loads, the operating clearance must be checked by calculation (see *Influence of interference on the radial internal clearance*, page 34).

Maintenance-free spherical plain bearings

Looser fits may be used with maintenance-free bearings:
- due to the hard chromium/PTFE sliding contact surface, friction is lower than with steel/steel sliding contact surfaces.

The recommended fits are given in Table 2.

Application as locating bearings

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

When using tight fits, however, it must be noted that:
- 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 bearing (see *Influence of interference on the radial internal clearance*, page 34).

If a tight fit is not possible, the bearing rings must be secured against axial sliding motion on the shaft or in the housing (*Axial location*, page 38).

**Application as non-locating bearings
(between shaft and bearing bore)**

The surface of the shaft must be wear-resistant as follows:
- surface hardness $\geqq$ 56 HRC
- maximum surface roughness R_z10.

Spherical plain bearings requiring maintenance should then only be lubricated via the shaft. Maintenance-free spherical plain bearings can have a lining of sliding material ELGOGLIDE® in the inner ring bore, suffix W7, W8 (page 13).

Table 1 · Shaft and housing fits for spherical plain bearings requiring maintenance

Spherical plain bearings requiring maintenance	Internal clearance Group	Material	
		Housing/shaft Steel/steel	Housing/shaft Light metal/steel
Radial spherical plain bearings	C2	K7/j6[1]	M7/j6[1]
Radial spherical plain bearings	CN (normal)	M7/m6[1][2]	N7/m6[1][2]
Radial spherical plain bearings	C3	M7/m6[1]	N7/m6[1]
Angular contact spherical plain bearings	–	M7/n6	–
Axial spherical plain bearings	–	M7/n6	–

[1] GE..LO: for shaft r6.

[2] GE..PB: housing/shaft K7/m6.

Table 2 · Shaft and housing fits for maintenance-free spherical plain bearings and maintenance-free cylindrical plain bushes

Maintenance-free spherical plain bearings/ maintenance-free cylindrical plain bushes	Bore d mm	Material	
		Housing/shaft Steel/steel	Housing/shaft Light metal/steel
Radial spherical plain bearings	up to 300	K7/j6[1]	M7/j6[1]
Radial spherical plain bearings	over 300	J7/j6	–
Angular contact spherical plain bearings	–	M7/m6	–
Axial spherical plain bearings	–	M7/m6	–
Maintenance-free cylindrical plain bushes	–	H7/f7	–

[1] GE..PW: for shaft m6.

Design of bearing arrangements

Axial location of spherical plain bearings

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

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

Non-locating bearing side

The axial displacement should occur between the shaft and bearing bore because:

■ 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 in general occur in the housing bore.

Location of bearing rings

The following are suitable for location (Figure 1, 2 and 3):

■ retaining rings
  – the bearings can thus be easily fitted and dismantled

■ spacers between the bearing ring and adjacent construction if:
  – the shaft must not be weakened by the use of annular grooves
  – the bearings are to be axially preloaded – this prevents rotary motion between the bearing ring and adjacent construction even with a loose fit.
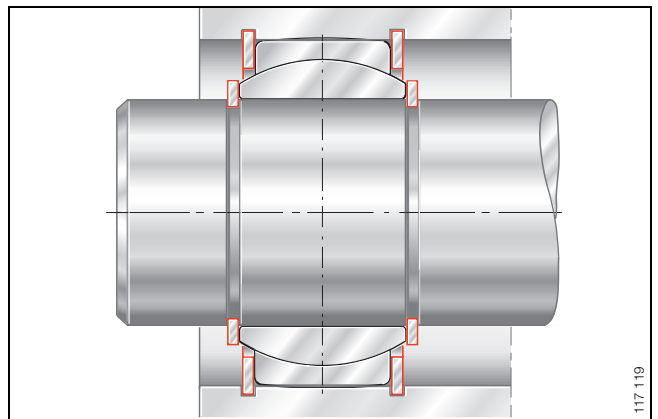
Figure 1 · Location by snap rings
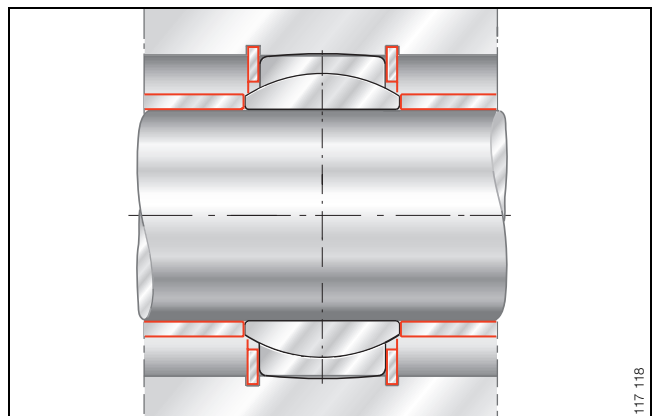
Figure 2 · Location by snap rings and spacers
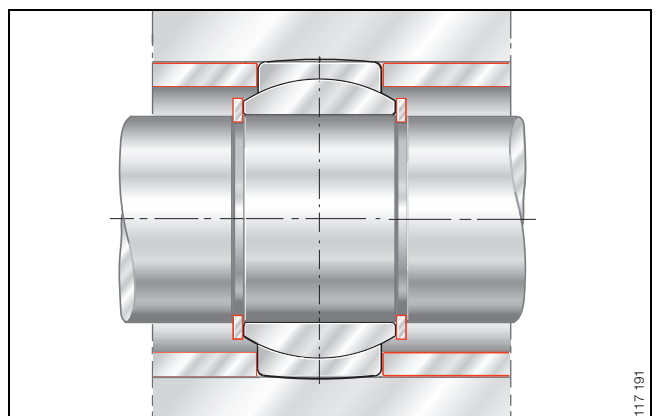
Figure 3 · Location by snap rings and spacers

Chamfer dimensions

Spherical plain bearings have a convex transition between the outside surface and bore to the end faces. This makes fitting of the bearing easier.

The bearing rings must be in contact with the shaft and housing shoulders. The largest radius of the shaft/housing locating face must therefore not be larger than the smallest chamfer dimension r_{1s}/r_{2s} of the spherical plain bearing (Figure 4 and *dimension table*).

Quality of shaft and housing bore

The seating surfaces of the bearing should be such that the loads transmitted through the bearing:

■ do not cause unacceptable geometrical deviations of the shaft and housing

■ do not cause permanent deformation of the spherical plain bearing.

⚠ In the case of highly loaded spherical plain bearings with $p \geqq 80 \text{ N/mm}^2$, the shaft and housing must be checked.

The geometrical accuracy of the seating surfaces should be within the tolerance ranges of the recommended fit.

The recommended surface quality values are given in Table 3 and 4. If larger roughness values are present, please consult INA.
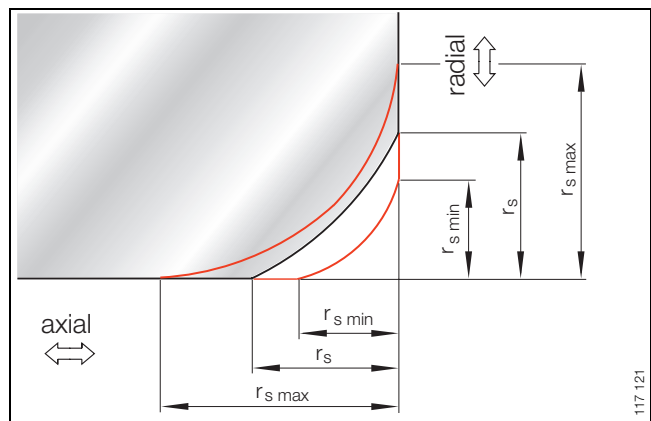
Figure 4 · Chamfer dimensions

Table 3 · Roughness values for the bearing seating surface – spherical plain bearings and rod ends

Roughness μm	Bearing seat
$\leqq R_z16$	Housing bore
$\leqq R_z10$	shaft

Table 4 · Roughness values for the bearing seating surface – maintenance-free cylindrical plain bushes

Roughness μm	Bearing seat
$\leqq R_z10$	Housing bore
R_z1 to R_z4 [1]	shaft

[1] Recommended: $R_z \leqq 1{,}6$.
Note the guidelines on page 62, page 72 and in Figure 13.
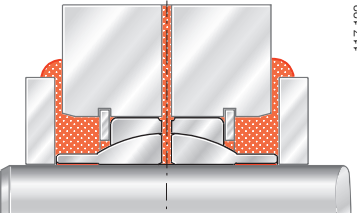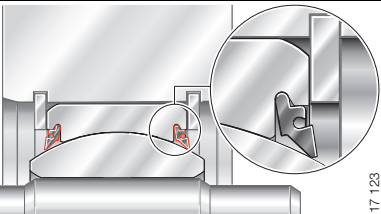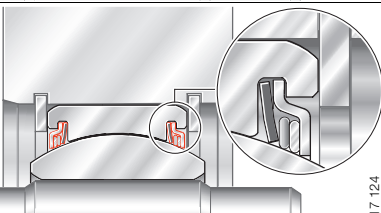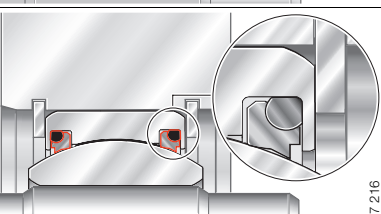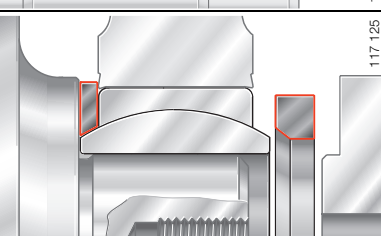
Sealing

In selection (Table 1), account must be taken of:

- the operating and environmental conditions
- the rotary motion of the bearing
- the tilt angle of the bearing
- the available space
- the costs and work required.

Table 1 · Seals

Seal type		Features	Application
Grease collar		■ Simple and effective sealing ■ Due to frequent relubrication, a grease collar is formed on the end faces of the spherical plain bearing	■ Bearings requiring maintenance ■ Proven for aggressive operating conditions in conjunction with daily maintenance ■ Temperature usage according to grease selection
2RS seal		■ Polyurethane lip seal ■ Radially preloaded seal lips	■ Higher demands for sealing action ■ Favourable for indoor applications ■ Operating temperatures from –30 °C to +130 °C
2RS1 seal		■ Lip seal with outer sealing shield ■ Radially preloaded seal lips ■ Special design. Only available by agreement	■ For very high requirements and long maintenance intervals ■ Protection against coarse and very fine contaminants ■ Operating temperatures from –40 °C to +200 °C
2RS2 seal		■ On both sides with increased sealing action ■ Large radial spherical plain bearings	■ For very high requirements and long maintenance intervals ■ Protection against coarse and very fine contaminants ■ Operating temperatures from –40 °C to +120 °C
External seal		■ Simple but very effective seal ■ Partially cellular polyurethane elastomer sealing rings ■ Standard seal from individual sealing ring manufacturers	■ Specially developed for radial spherical plain bearings to ISO 12 240-1, dimensions series E ■ Suitable for integration in adjacent construction as external seal ■ Lower seal friction if sealing rings are worked in oil or flowable grease before assembly ■ Operating temperatures from –40 °C to +100 °C

Maintenance-free cylindrical plain bushes

Suitable seals are shown in Table 1.

During the operating life, the operating clearance may increase – under high alternating loads, this may be by 0,5 mm to 0,8 mm. Furthermore, the plain bushes are not relubricated.

These points must be taken into consideration in the design of the seal and seal environment – the suitability of the seal must be agreed with the seal manufacturer.

Seals (continued)

Seal type		Features	Application
V ring seal	117 126	■ Solid rubber body on shaft ■ Single seal lip, axially preloaded ■ Resistant to grease, oil and ageing	■ Suitable for relatively large tilting motions ■ Particularly user-friendly ■ Operating temperatures from –40 °C to +100 °C
V ring seal	117 127	■ Seal lips on both sides ■ Inside diameter of ring in contact with spherical surface of inner ring	■ Simple sealing ■ Operating temperatures from –40 °C to +100 °C
Two component seal	117 128	■ Seal lip made from PTFE/modified nitrile mixture, preloaded by alloy steel coil spring ■ Seal shoulder with cotton-reinforced nitrile mixture ■ Seal on projecting part of inner ring spherical surface	■ Easy handling ■ Operating temperatures from –40 °C to +120 °C, up to +150 °C for short periods
Rotary shaft seals	117 129	■ Proven standard rotary shaft seal ■ Plastic ring with seal lip and steel reinforcement ■ Seal lip preloaded by coil spring	■ For small tilt angles with grease and oil lubrication ■ Grease lubrication: seal lip facing outwards ■ Oil bath lubrication: seal lip facing inwards ■ Oil bath lubrication: rotary shaft seal with additional dust lip facing outwards ■ Temperature usage dependent on the seal material

Fitting and dismantling

Fitting

Spherical plain bearings, rod ends and cylindrical plain bushes are high precision machine elements. They must be handled very carefully both before and during fitting. Problem-free functioning is substantially dependent on the care taken in fitting.

Bearing failures will lead to:

■ machine downtime

■ expensive repairs.

⚠ If bearings are fitted incorrectly, no liability can be accepted.

Spherical plain bearings, rod ends and cylindrical plain bushes should only be fitted by personnel with sufficient and appropriate training. In case of doubt, please consult INA.

Delivered condition

Spherical plain bearings and cylindrical plain bushes are supplied with the surfaces (except the bore) protected by a preservative. Depending on their design, rod ends are supplied protected by a preservative or with a zinc plating.

⚠ Any change, irrespective of the bearing type, will reduce the operating life of the bearing.

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

Substances containing oil will change the characteristics of the bearing.

Storage

Bearings should only be stored:

■ in the original packaging

■ in dry, clean rooms with the temperature as constant as possible

■ at a relative humidity of max. 65%.

Removal from packaging

Perspiration from handling leads to corrosion. Hands should be kept clean and dry and gloves worn if necessary.

Spherical plain bearings, rod ends and cylindrical plain bushes should only be removed from their original packaging immediately before fitting.

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.

Tools for heat assisted fitting

In order to reduce the forces required for fitting, the spherical plain bearings can be heated:

■ avoid localised overheating. The bearing temperature must be monitored using a thermometer

■ information in the INA catalogue and manufacturer's data on grease and seals must be observed.

Suitable devices for heating include:

■ heating cabinets with a controllable thermostat

■ the induction heater INA*therm*® (Figure 1).
   These have the following advantages:
   – uniform heating
   – no contamination of the components
   – long preheating periods are not required.

Checking the adjacent construction (Figure 2)

■ Quality of bearing seating surfaces
   – shaft and housing bore

■ Dimensional and geometrical accuracy of seating and locating faces

■ Shaft and housing seating

■ Lead chamfer on shaft/housing bore between 10° and 20°

■ Any burrs must be removed

■ If tight fits are used or the fitting conditions present difficulties
   – the surfaces of the shaft and housing bore should be lightly oiled.

⚠ Maintenance-free spherical plain bearings and maintenance-free cylindrical plain bushes should be fitted such that no lubricant or other substances used to aid fitting can reach the sliding surfaces.
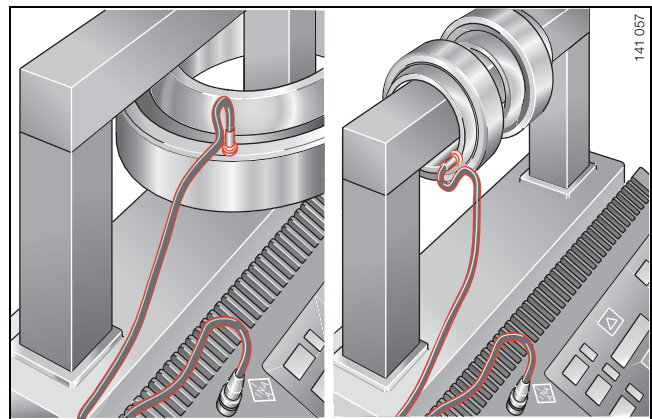
Figure 1 · Heating using an induction heater INA*therm*®
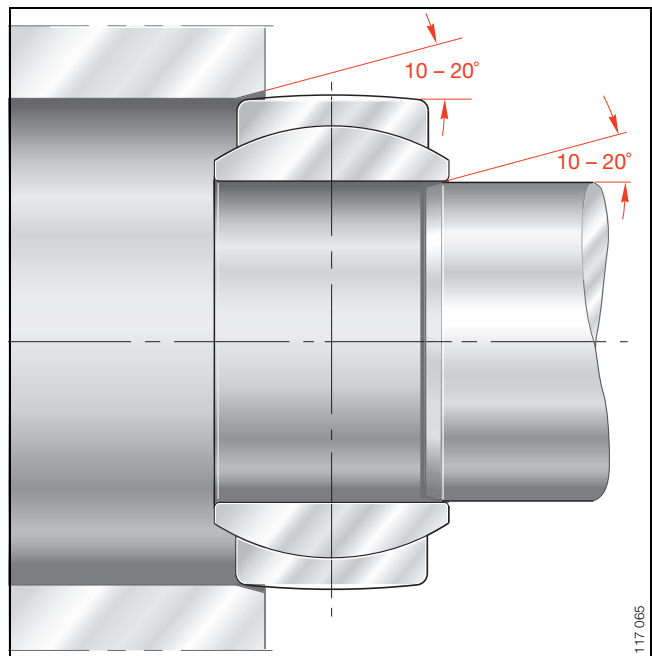
Figure 2 · Lead chamfer

Rules and guidelines

⚠ The information given must be adhered to.
If it is not, there is a direct or indirect hazard to personnel, the product and/or the adjacent construction.

■ The assembly area must be kept clean and free from dust.

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

■ The bearings must always be located concentrically.

Mechanical and thermal assistance

■ Direct blows using a hammer and drift on the end faces of the bearing rings must be avoided
– incorrect handling can damage the bearing and lead to microcracks in the bearing.

■ Fitting forces must always be applied to the inner ring (Figure 3)
– if these forces are directed through the sliding surfaces, the bearings may jam during fitting.

■ If radial spherical plain bearings are fitted on the shaft and in a housing at the same time, fitting tools must be used which act simultaneously on the end faces of the inner and outer ring (Figure 4).

■ Larger bearings must be fitted using special fitting equipment (Figure 5)
– the fitting forces required increase with the diameter. Simple impact type tools are no longer sufficient in these cases.

Thermal assistance

■ Spherical plain bearings must not be heated above +130 °C
– higher temperatures damage the seals

■ Spherical plain bearings must not be heated in an oil bath
– this impairs the tribological system of maintenance-free bearings
– it changes the molybdenum disulphide concentration on the sliding surfaces in bearings with a steel/steel sliding contact surface

■ Bearings must not be heated using a naked flame
– the material undergoes excessive localised heating and its hardness is reduced. Furthermore, stresses are induced in the bearing
– the seals could melt
– maintenance-free sliding surfaces could be damaged.
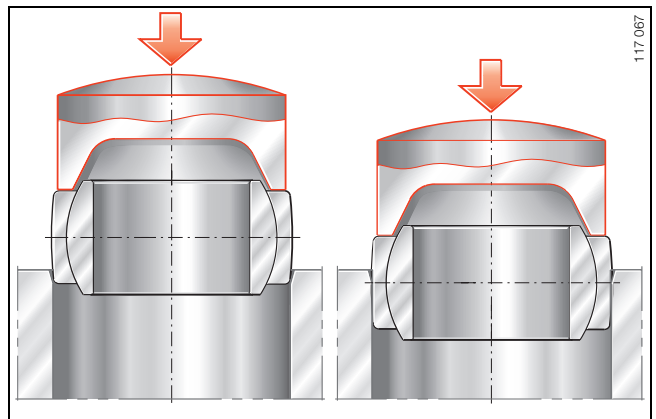
Figure 3 · Fitting forces and bearing ring to be fitted
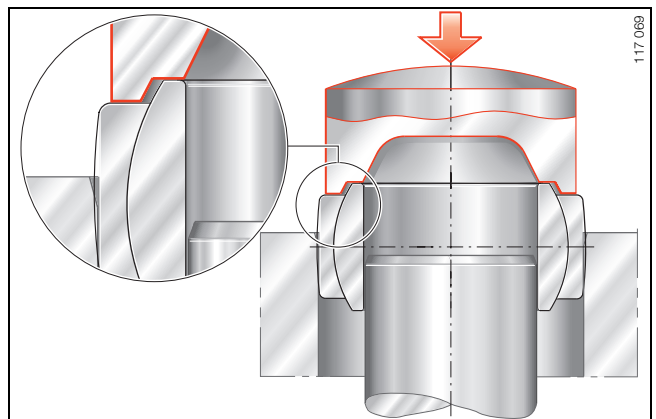
Figure 4 · Simultaneous fitting on shaft and in housing
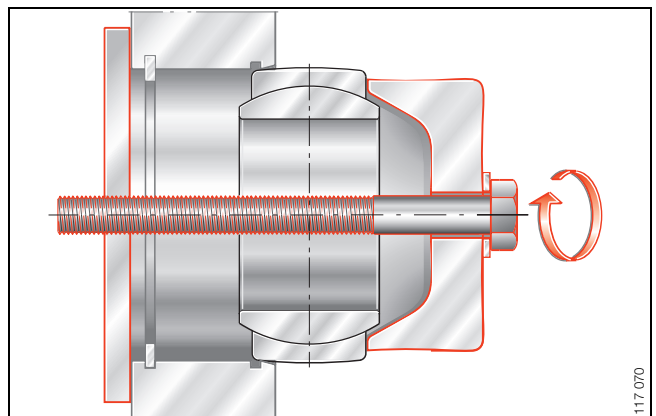
Figure 5 · Special fitting device

Fitting by refrigeration

The inner rings of radial spherical plain bearings with
a steel/steel sliding contact surface undergo structural change
at temperatures below –61 °C. This may cause a volume
increase. Due to the change in the tolerances, the bearing may
then jam

■ if this fitting method is to be used, the bearing rings can
be supplied with appropriate heat treatment. Please consult
INA in this case.

For easier fitting, maintenance-free cylindrical plain bushes can
be cooled in liquid nitrogen (–196 °C) for short periods.
In the case of plain bushes with integral seals (2RS versions),
the correct seating of the seals in the undercut must be
checked after refrigeration.

Adhesive bonding of bearing rings

If the recommended fits are adhered to, it is not necessary to
use adhesive on the bearing rings.

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 checked that the lubricant ducts and lubricant
holes are not blocked by adhesive.

Main load direction

In radial spherical plain bearings with split outer rings, the joints
are offset at 90° from the main load direction (Figure 6)

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

Transporting the bearings (Figure 7)

Large spherical plain bearings must only be transported using
the eye bolts supplied. Radial bearings have threaded holes on
the end faces of the inner and outer rings, large axial spherical
plain bearings have threaded holes on the end faces of the shaft
and housing locating washers.

Welding currents

⚠ 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.
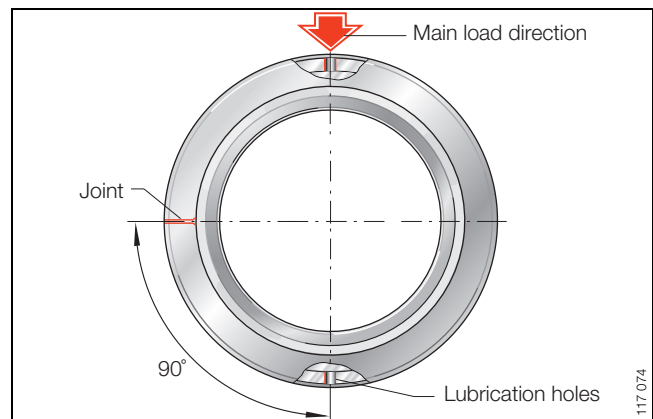
Figure 6 · Joint, main load direction, lubrication holes
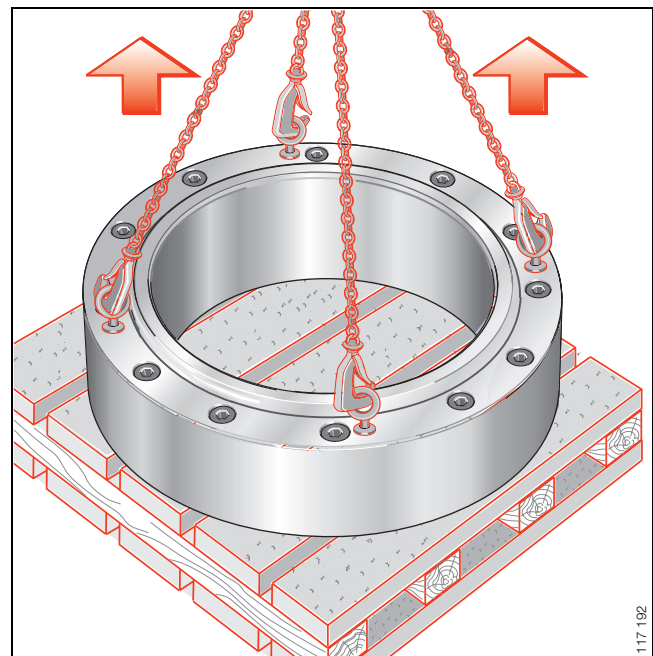
Figure 7 · Transporting large radial spherical plain bearings

Fitting orientation for GE..DW, GE..DW-2RS2

During fitting, 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 dismantling easier.

Even if the load is applied to the ring to be dismantled in accordance with the specification, the frictional contact of the other ring due to the fit presents difficulties in dismantling (Figure 8).

Depending on the level of interference, the inner ring will contract and the outer ring will expand. The extraction forces also increase with increasing interference.

If the following precautions are taken during design, this will make dismantling of the bearings easier:

- a threaded hole for an extraction screw in the shaft (Figure 9)
- threaded holes for extraction screws in the housing (Figure 10)
- milled areas on the stud for the jaws of the extraction device (Figure 10).
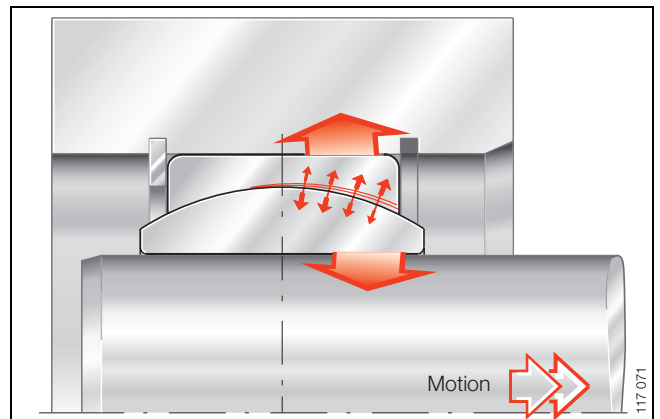
Figure 8 · Contraction of the inner ring and expansion of the outer ring
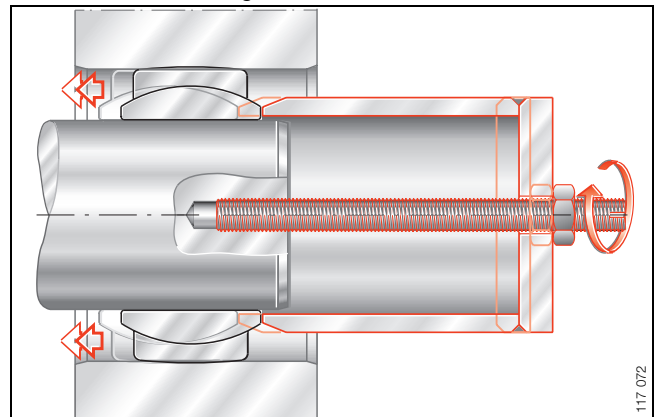
Figure 9 · Threaded holes in the shaft
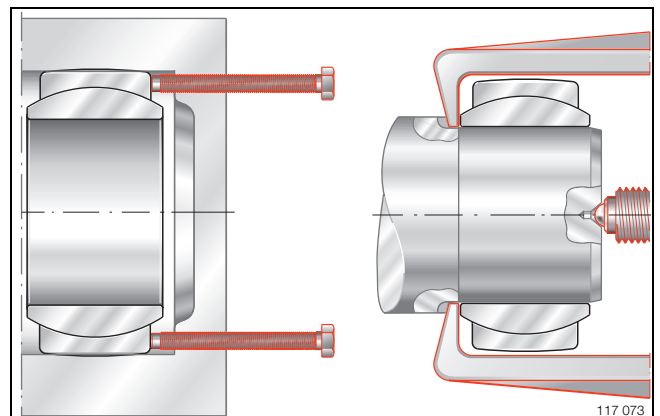
Figure 10 · Threaded holes in the housing and milled areas for extraction device

Operating temperatures

The permissible operating temperature is dependent on:
- the sliding contact surface
- the sealing arrangement.

⚠ If the operating temperature exceeds the values in Table 1, this will reduce:
  - the life of the bearing
  - the efficacy of the sealing arrangement.

If sealed bearings must be used at high temperatures, an unsealed bearing with external heat-resistant seals can be used (Figure 1).

The influence of temperature on life is taken into consideration by means of temperature factors.

Life calculation:
- *Maintenance-free spherical plain bearings* (page 63 to 71)
- *Maintenance-free cylindrical plain bushes* (page 72, 73)
- *Maintenance-free rod ends* (page 63 to 71 and 128, 129)
- *Spherical plain bearings requiring maintenance* (page 97 to 99)
- *Rod ends requiring maintenance* (page 97 to 99 and 146 to 148).

Table 1 · Operating temperatures for spherical plain bearings and maintenance-free cylindrical plain bushes

Spherical plain bearings/ plain bushes	Series	Temperature °C		Reduced life °C
		from	to	from
requiring maintenance	GE..DO	−60	+200	+150
	GE..DO-2RS[1]	−30	+130	−
	GE..FO	−60	+200	+150
	GE..FO-2RS[1]	−30	+130	−
	GE..PB	−60	+250	+150
	GE..LO	−60	+200	+150
	GE..HO-2RS[1]	−30	+130	−
	GE..ZO	−60	+200	+150
	GE..SX	−60	+200	+150
	GE..AX	−60	+200	+150
maintenance-free	GE..UK	−50	+200	+ 95
	GE..UK-2RS[2]	−30	+130	<−20
	GE..DW	−50	+150	<−20
	GE..DW-2RS2[2]	−40	+120	<−20
	GE..FW	−50	+200	+ 95
	GE..FW-2RS[2]	−30	+130	<−20
	GE..PW	−50	+200	+100
	GE..SW	−50	+150	<−20
	GE..AW	−50	+150	<−20
	ZGB	−50	+150	<−20

[1] Without seals: for temperatures from −60 °C to +200 °C.

[2] Without seals: for temperatures from −50 °C to +150 °C.
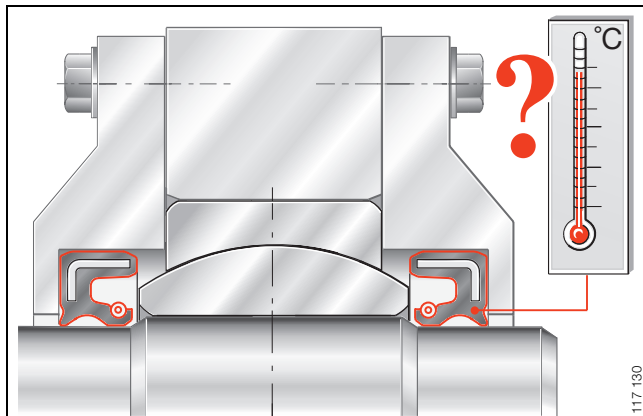
Figure 1 · Unsealed spherical plain bearing with external seals

Materials

Maintenance-free spherical plain bearings

Maintenance-free spherical plain bearings have special sliding layers based on PTFE (polytetrafluoroethylene).

In descending order of performance, these are:
- ELGOGLIDE® – the highest performance sliding layer (Figure 1)
- PTFE-bronze film (Figure 2)
- PTFE composite (Figure 3)

These materials form the slideway of the outer ring. They transmit loads and provide lubrication – the bearings must not be lubricated by any other means.

Features of ELGOGLIDE®

The sliding layer comprises a 0,5 mm thick layer of ELGOGLIDE®, is embedded in resin and fixed to the bush by a high strength bond. The flow behaviour of the sliding layer is, in combination with the bush, almost negligible even under very high load. The bond is resistant to moisture and swelling.

Series GE..UK-2RS, GE..FW-2RS

Inner ring:
- Hardened and ground rolling bearing chromium steel
- Spherical surface finished or polished (from ⌀240 mm) and hard chromium plated.

Outer ring:
- Split at one point in
  – GE..UK-2RS up to shaft diameter d = 140 mm
  – GE..FW-2RS up to shaft diameter d = 120 mm
- In larger bearings, the outer ring is split at two points and held together using heavy-section retaining rings.

Sliding layer (Figure 1):
- ELGOGLIDE® fixed by adhesive in the outer ring spherical surface.

Large radial spherical plain bearings, series GE..DW/GE..DW-2RS2

Inner ring:
- Hardened rolling bearing steel, spherical surface ground, polished and hard chromium plated.

Outer ring:
- 42CrMo4-TQ to EN 10 083-1, radially split and held together by axially arranged screws and dowel pins on one side.

Sliding layer (Figure 1):
- ELGOGLIDE® fixed by adhesive in the outer ring spherical surface.
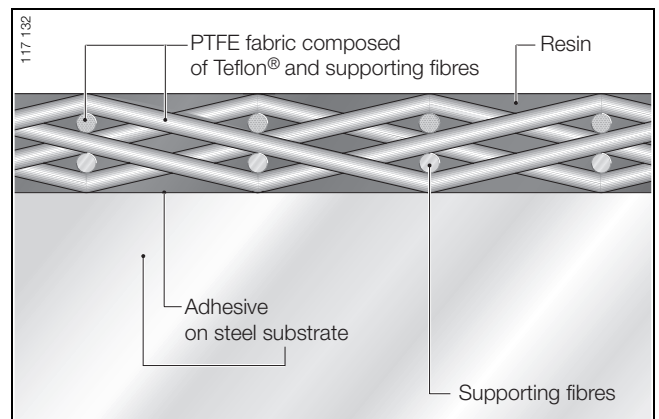
Figure 1 · ELGOGLIDE® – cross-section

Series GE..SW, GE..AW

Inner ring/shaft locating washer:
- Hardened rolling bearing steel, spherical surface ground, polished and hard chromium plated.

Outer ring (in GE..SW)/housing locating washer (in GE..AW):
- Hardened rolling bearing steel, spherical surface ground
  – in ≧GE 160 AW, housing locating washer made from unhardened steel.

Sliding layer (Figure 1):
- ELGOGLIDE® fixed by adhesive in the outer ring spherical surface.

Series GE..PW

Inner ring:
■ Hardened and ground rolling bearing steel, spherical surface finished.

Outer ring:
■ Brass, formed about inner ring, outside surface subsequently precision machined.

Sliding layer (Figure 2):
■ PTFE-bronze film (metal lattice material) fixed in outer ring spherical surface. The metal lattice is made from high strength bronze and acts as a stabiliser for the sintered PTFE compound.

Series GE..UK, GE..FW

Inner ring:
■ Hardened rolling bearing steel, spherical surface finished and hard chromium plated.

Outer ring:
■ Formed around inner ring by special upset process from two bushes pushed into each other, outer steel surface subsequently precision machined.

Sliding layer (Figure 3):
■ PTFE composite sandwiched between inner ring spherical surface and outer steel surface.

Maintenance-free cylindrical plain bushes

Substrate:
■ Steel, outside diameter precision machined.

Sliding layer (Figure 1):
■ ELGOGLIDE® fixed by adhesive in the substrate.
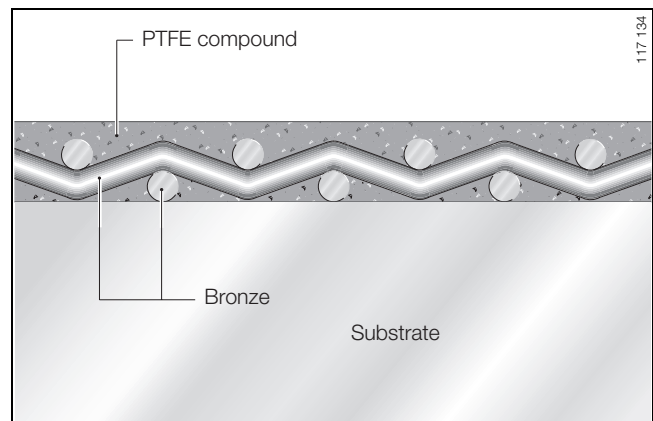
Figure 2 · PTFE-bronze film – cross-section
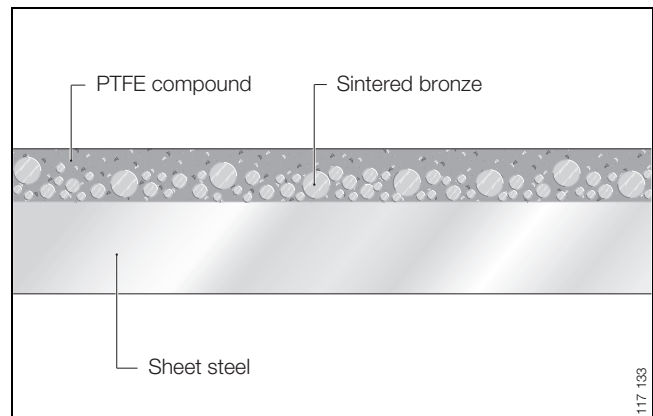
Figure 3 · PTFE composite – cross-section

ELGOGLIDE® is a registered trade name of Schaeffler KG, Herzogenaurach, Germany.

Materials

Spherical plain bearings requiring maintenance

These spherical plain bearings are made from high quality rolling bearing steel. Depending on the bearing size, the raw materials are in the form of tubes, forgings or rolled parts.

The sliding contact surface is:
- steel/steel or steel/bronze.

The steel bearing rings are turned, hardened, ground on all sides and surface treated.

The surface treatment – manganese phosphating with subsequent molybdenum disulphide coating of the sliding surfaces – gives excellent wear resistance. The effective separation of the metallic surfaces gives optimum running-in characteristics.

Series GE..DO, GE..DO-2RS, GE..FO, GE..FO-2RS, GE..LO, GE..HO-2RS, GE..ZO, GE..SX and GE..AX

Inner ring and outer ring, shaft and housing locating washers:
- Martensitic or bainitic hardened structure with low residual austenite content.

Series GE..PB

Inner ring:
- Hardened and ground rolling bearing steel, spherical surface finished.

Outer ring:
- Bronze, formed about inner ring, outside surface subsequently precision machined.

Rod ends

Rod ends of dimension series E and K to ISO 12 240-4
- Drop forged quenched and tempered steel C45-TQ to EN 10 083-2
- Surface zinc plated.

Hydraulic rod ends with internal thread

- $\leqq$ d = 50 mm, drop forged quenched and tempered steel C45-TN to EN 10 083-2
- $>$ d = 50 mm, spheroidal graphite cast iron GJS 400-15 to EN 1 563
- Surfaces preserved.

Hydraulic rod ends with welding faces

Series GK..DO, dimension series E to ISO 12 240-4
- Drop forged construction steel E355J2G3 to EN 10 025
- Surfaces preserved.

Series GF..DO

- Forged or rolled construction steel E355J2G3 to EN 10 025
- Surfaces preserved.

ISO tolerances

Table 1 · ISO tolerances for bores (to ISO 286-2)

Designation	Nominal deviation	Nominal bore diameter in mm															
		over 6 incl. 10	10 18	18 30	30 50	50 80	80 120	120 180	180 250	250 315	315 400	400 500	500 630	630 800	800 1000	1000 1250	1250 1600
		Bore deviation in μm															
G 7	upp.	+20	+24	+28	+34	+40	+47	+54	+61	+69	+75	+83	+92	+104	+116	+133	+155
	low.	+5	+6	+7	+9	+10	+12	+14	+15	+17	+18	+20	+22	+24	+26	+28	+30
H 7	upp.	+15	+18	+21	+25	+30	+35	+40	+46	+52	+57	+63	+70	+80	+90	+105	+125
	low.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H 8	upp.	+22	+27	+33	+39	+46	+54	+63	+72	+81	+89	+97	+110	+125	+140	+165	+195
	low.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H 9	upp.	+36	+43	+52	+62	+74	+87	+100	+115	+130	+140	+155	+175	+200	+230	+260	+310
	low.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
J 6	upp.	+5	+6	+8	+10	+13	+16	+18	+22	+25	+29	+33	+35	+38	+42	+48	+54
	low.	−4	−5	−5	−6	−6	−6	−7	−7	−7	−7	−7	−8	−9	−10	−10	−11
J 7	upp.	+8	+10	+12	+14	+18	+22	+26	+30	+36	+39	+43	+46	+52	+58	+64	+72
	low.	−7	−8	−9	−11	−12	−13	−14	−16	−16	−18	−20	−22	−24	−26	−29	−33
K 7	upp.	+5	+6	+6	+7	+9	+10	+12	+13	+16	+17	+18	0	0	0	0	0
	low.	−10	−12	−15	−18	−21	−25	−28	−33	−36	−40	−45	−70	−80	−90	−105	−125
K 8	upp.	+6	+8	+10	+12	+14	+16	+20	+22	+25	+28	+29	0	0	0	0	0
	low.	−16	−19	−23	−27	−32	−38	−43	−50	−56	−61	−68	−110	−125	−140	−165	−195
M 7	upp.	0	0	0	0	0	0	0	0	0	0	0	−26	−30	−34	−40	−48
	low.	−15	−18	−21	−25	−30	−35	−40	−46	−52	−57	−63	−96	−110	−124	−145	−173
N 7	upp.	−4	−5	−7	−8	−9	−10	−12	−14	−14	−16	−17	−44	−50	−56	−66	−78
	low.	−19	−23	−28	−33	−39	−45	−52	−60	−66	−73	−80	−114	−130	−146	−171	−203

A_o = Upper deviation

A_u = Lower deviation

T_g = Standard tolerance; $T_g = A_o − A_u$

A_g = Fundamental tolerance (minimum distance from zero line)

$A_g = A_u$

Housing

$A_g = A_o$

152 118

..
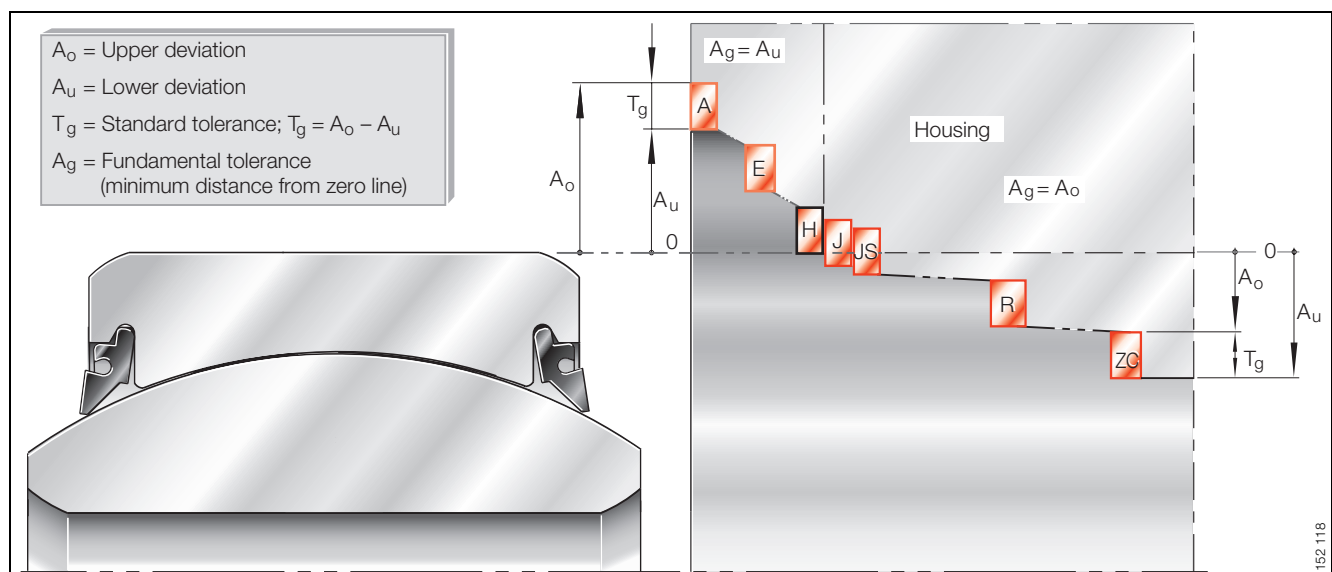
Table 2 · ISO tolerances for shafts (to ISO 286-2)

Designation	Nominal deviation	Nominal shaft diameter in mm															
		over 3 / incl. 6	6 / 10	10 / 18	18 / 30	30 / 40	40 / 50	50 / 65	65 / 80	80 / 100	100 / 120	120 / 140	140 / 160	160 / 180	180 / 200	200 / 225	225 / 250
		Shaft deviations in µm															
e 7	upp.	−20	−25	−32	−40	−50	−50	−60	−60	−72	−72	−85	−85	−85	−100	−100	−100
	low.	−32	−40	−50	−61	−75	−75	−90	−90	−107	−107	−125	−125	−125	−146	−146	−146
f 7	upp.	−10	−13	−16	−20	−25	−25	−30	−30	−36	−36	−43	−43	−43	−50	−50	−50
	low.	−22	−28	−34	−41	−50	−50	−60	−60	−71	−71	−83	−83	−83	−96	−96	−96
g 6	upp.	−4	−5	−6	−7	−9	−9	−10	−10	−12	−12	−14	−14	−14	−15	−15	−15
	low.	−12	−14	−17	−20	−25	−25	−29	−29	−34	−34	−39	−39	−39	−44	−44	−44
h 6	upp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	low.	−8	−9	−11	−13	−16	−16	−19	−19	−22	−22	−25	−25	−25	−29	−29	−29
h 7	upp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	low.	−12	−15	−18	−21	−25	−25	−30	−30	−35	−35	−40	−40	−40	−46	−46	−46
h 8	upp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	low.	−18	−22	−27	−33	−39	−39	−46	−46	−54	−54	−63	−63	−63	−72	−72	−72
j 6	upp.	+6	+7	+8	+9	+11	+11	+12	+12	+13	+13	+14	+14	+14	+16	+16	+16
	low.	−2	−2	−3	−4	−5	−5	−7	−7	−9	−9	−11	−11	−11	−13	−13	−13
j 7	upp.	+8	+10	+12	+13	+15	+15	+18	+18	+20	+20	+22	+22	+22	+25	+25	+25
	low.	−4	−5	−6	−8	−10	−10	−12	−12	−15	−15	−18	−18	−18	−21	−21	−21
k 6	upp.	+9	+10	+12	+15	+18	+18	+21	+21	+25	+25	+28	+28	+28	+33	+33	+33
	low.	+1	+1	+1	+2	+2	+2	+2	+2	+3	+3	+3	+3	+3	+4	+4	+4
m 6	upp.	+12	+15	+18	+21	+25	+25	+30	+30	+35	+35	+40	+40	+40	+46	+46	+46
	low.	+4	+6	+7	+8	+9	+9	+11	+11	+13	+13	+15	+15	+15	+17	+17	+17
n 6	upp.	+16	+19	+23	+28	+33	+33	+39	+39	+45	+45	+52	+52	+52	+60	+60	+60
	low.	+8	+10	+12	+15	+17	+17	+20	+20	+23	+23	+27	+27	+27	+31	+31	+31
p 6	upp.	+20	+24	+29	+35	+42	+42	+51	+51	+59	+59	+68	+68	+68	+79	+79	+79
	low.	+12	+15	+18	+22	+26	+26	+32	+32	+37	+37	+43	+43	+43	+50	+50	+50
r 6	upp.	+23	+28	+34	+41	+50	+50	+60	+62	+73	+76	+88	+90	+93	+106	+109	+113
	low.	+15	+19	+23	+28	+34	+34	+41	+43	+51	+54	+63	+65	+68	+77	+80	+84

250 280	280 315	315 355	355 400	400 450	450 500	500 560	560 630	630 710	710 800	800 900	900 1000	Nominal deviation	Designation
−110	−110	−125	−125	−135	−135	−	−	−	−	−	−	upp.	**e 7**
−162	−162	−182	−182	−198	−198	−	−	−	−	−	−	low.	
−56	−56	−62	−62	−68	−68	−	−	−	−	−	−	upp.	**f 7**
−108	−108	−119	−119	−131	−131	−	−	−	−	−	−	low.	
−17	−17	−18	−18	−20	−20	−22	−22	−24	−24	−26	−26	upp.	**g 6**
−49	−49	−54	−54	−60	−60	−66	−66	−74	−74	−82	−82	low.	
0	0	0	0	0	0	0	0	0	0	0	0	upp.	**h 6**
−32	−32	−36	−36	−40	−40	−44	−44	−50	−50	−56	−56	low.	
0	0	0	0	0	0	0	0	0	0	0	0	upp.	**h 7**
−52	−52	−57	−57	−63	−63	−70	−70	−80	−80	−90	−90	low.	
0	0	0	0	0	0	0	0	0	0	0	0	upp.	**h 8**
−81	−81	−89	−89	−97	−97	−110	−110	−125	−125	−140	−140	low.	
+16	+16	+18	+18	+20	+20	+22	+22	+24	+24	−	−	upp.	**j 6**
−16	−16	−18	−18	−20	−20	−21	−21	−23	−23	−	−	low.	
+26	+26	+29	+29	+31	+31	−	−	−	−	−	−	upp.	**j 7**
−26	−26	−28	−28	−32	−32	−	−	−	−	−	−	low.	
+36	+36	+40	+40	+45	+45	+44	+44	+50	+50	+56	+56	upp.	**k 6**
+4	+4	+4	+4	+5	+5	0	0	0	0	0	0	low.	
+52	+52	+57	+57	+63	+63	+70	+70	+80	+80	+90	+90	upp.	**m 6**
+20	+20	+21	+21	+23	+23	+26	+26	+30	+30	+34	+34	low.	
+66	+66	+73	+73	+80	+80	+88	+88	+100	+100	+112	+112	upp.	**n 6**
+34	+34	+37	+37	+40	+40	+44	+44	+50	+50	+56	+56	low.	
+88	+88	+98	+98	+108	+108	+122	+122	+138	+138	+156	+156	upp.	**p 6**
+56	+56	+62	+62	+68	+68	+78	+78	+88	+88	+100	+100	low.	
+126	+130	+144	+150	+166	+172	+194	+199	+225	+235	+266	+276	upp.	**r 6**
+94	+98	+108	+114	+126	+132	+150	+155	+175	+185	+210	+220	low.	

A_o = Upper deviation
A_u = Lower deviation
T_g = Standard tolerance; $T_g = A_o − A_u$
A_g = Fundamental tolerance (minimum distance from zero line)

152 119

Maintenance-free spherical plain bearings
Maintenance-free cylindrical plain bushes

Criteria for bearing selection

Radial spherical plain bearings

GE..UK   GE..UK-2RS   GE..FW   GE..FW-2RS   GE..PW

Load carrying capacity

C_r

C_{0r}
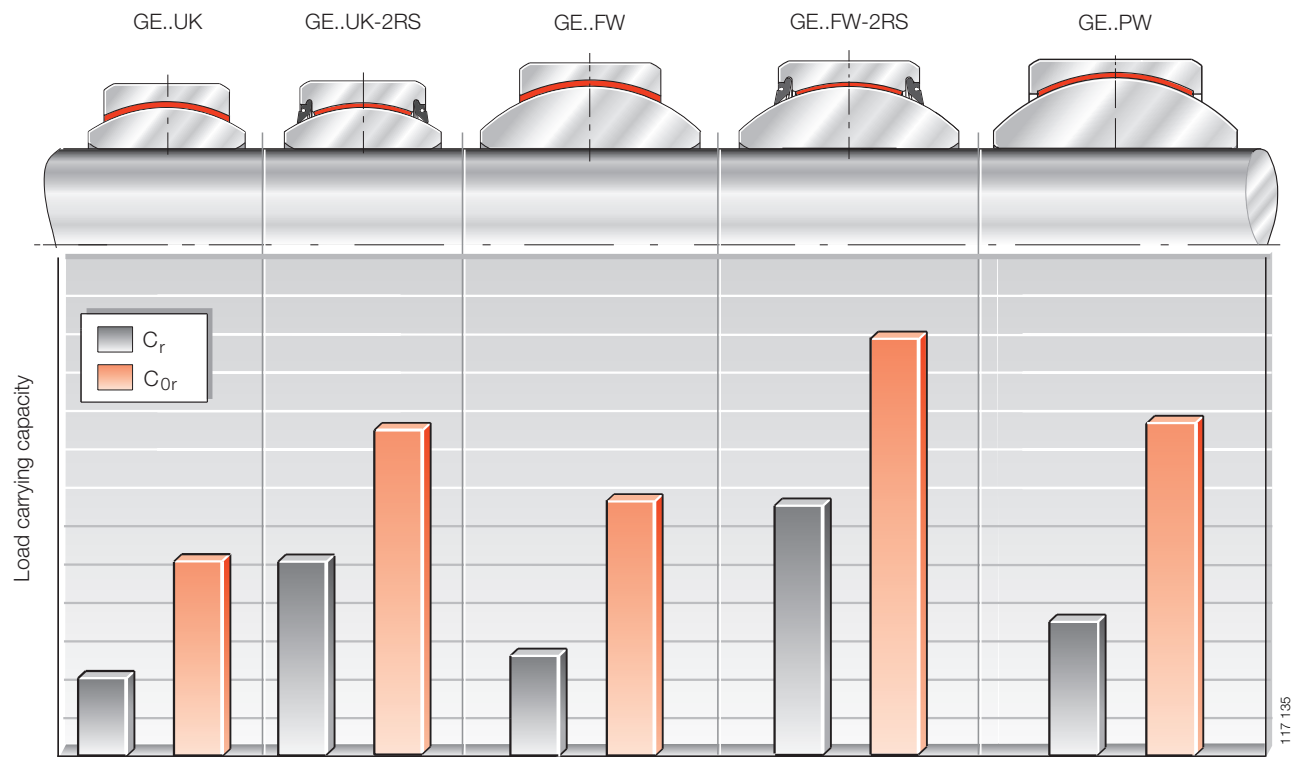
Comparison of load carrying capacity for identical shaft diameter (exception: GE..DW).

Axial spherical plain bearings

GE..AW
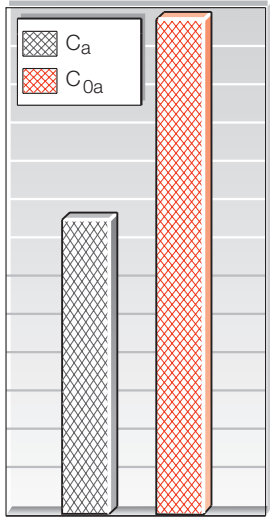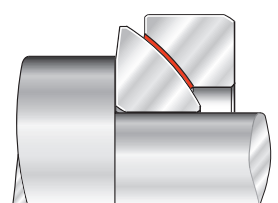
Angular contact spherical plain bearings

GE..SW

Maintenance-free cylindrical plain bushes

ZGB
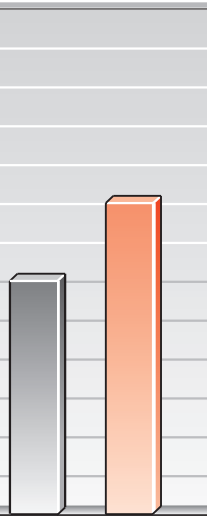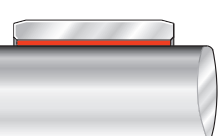
Large radial spherical plain bearings

GE..DW   GE..DW-2RS2

Load carrying capacity

C_a

C_{0a}

C_r

C_{0r}

C_r

C_{0r}

117 136

Maintenance-free spherical plain bearings

Radial spherical plain bearings
Angular contact spherical plain bearings
Axial spherical plain bearings

Maintenance-free cylindrical plain bushes

Features

Radial spherical plain bearings

- are complete units comprising inner rings and outer rings with maintenance-free sliding layers
  - the inner ring has a cylindrical bore and a convex outer slideway
  - the outer ring has a cylindrical outside surface and a concave inner slideway.

    In series GE..UK-2RS with a bore diameter up to 140 mm, the outer ring is split at one point; for a bore diameter $\geqq$160 mm, the outer ring is split at two points and held together by heavy-section retaining washers.

    In series GE..FW-2RS with a bore diameter up to 120 mm, the outer ring is split at one point; for a bore diameter $\geqq$140 mm, the outer ring is split at two points and held together by heavy-section retaining washers.

    In series GE..DW and GE..DW-2RS2, the outer ring is radially split and held together axially by screws and dowel pins
  - sliding layers comprising PTFE composite, PTFE-bronze film or ELGOGLIDE®
- are preferably used to support radial loads
- are completely maintenance-free
  - in bearings with ELGOGLIDE®, lubricant leads to a considerable reduction in bearing life
- are used where:
  - there are particular requirements on bearing life under maintenance-free operation
  - bearings with a metallic sliding contact surface are not suitable for lubrication reasons, e.g. under unilateral load.

Sealed maintenance-free radial spherical plain bearings

- are protected against contaminants and water spray by
  - lip seals.

Radial spherical plain bearings

GE..UK

- to ISO 12 240-1, dimension series E
- hard chromium/PTFE composite sliding contact surface
- for shaft diameters from 6 mm to 30 mm

GE..FW

- to ISO 12 240-1, dimension series G
- hard chromium/PTFE composite sliding contact surface
- larger tilt angle α due to wider inner ring
- for shaft diameters from 6 mm to 25 mm
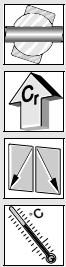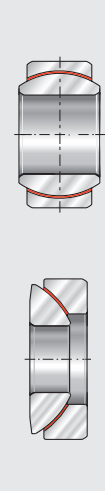
GE..UK-2RS

- to ISO 12 240-1, dimension series E
- hard chromium/ELGOGLIDE® sliding contact surface
- suitable for alternating loads up to p = 100 N/mm²
- lip seals on both sides,
  for operating temperatures from –30 °C to +130 °C
- for shaft diameters from 17 mm to 300 mm

76

117 078
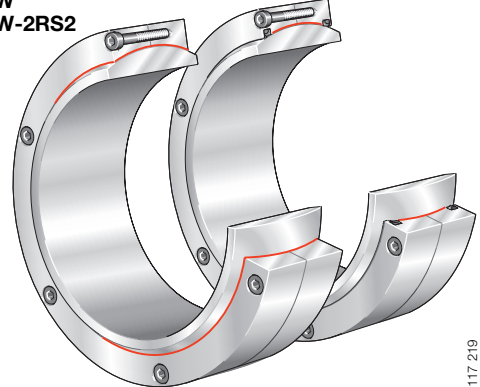
GE..DW
GE..DW-2RS2

- to ISO 12 240-1, dimension series G
- large radial spherical plain bearings
- hard chromium/ELGOGLIDE® sliding contact surface
- suitable for alternating loads up to p = 100 N/mm²
- GE..DW-2RS2 with increased sealing action on both sides
- for shaft diameters from 320 mm to 1 000 mm

78

117 219
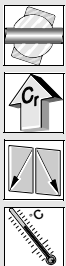
GE..FW-2RS
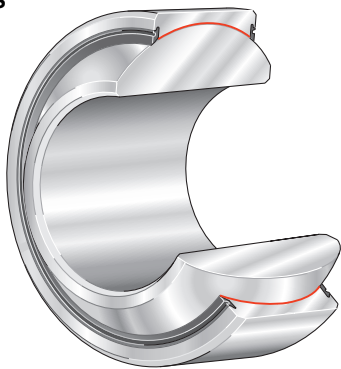
- to ISO 12 240-1, dimension series G
- hard chromium/ELGOGLIDE® sliding contact surface
- suitable for alternating loads up to p = 100 N/mm²
- larger tilt angle a due to wider inner ring
- lip seals on both sides,
  for operating temperatures from –30 °C to +130 °C
- for shaft diameters from 30 mm to 280 mm

80

117 080

GE..PW

- to ISO 12 240-1, dimension series K
- steel/PTFE-bronze film sliding contact surface
- operating temperatures from –50 °C to +200 °C
- for shaft diameters from 5 mm to 30 mm

82

117 081

Maintenance-free spherical plain bearings

Angular contact spherical plain bearings
Axial spherical plain bearings

Features

Angular contact spherical plain bearings

- are complete units comprising an inner ring and outer ring with ELGOGLIDE®
  - the inner ring has a convex outer slideway
  - the outer ring has a concave inner slideway and ELGOGLIDE® secured by adhesive
- can support axial loads as well as radial loads
  - they are thus suitable for alternating dynamic loads
- can be used in paired arrangements as preloaded units
- are used, for example, to support high loads in conjunction with small motions
  - they are a plain bearing alternative to tapered roller bearings
- are maintenance-free throughout their operating life
  - the use of lubricant leads to a considerable reduction in bearing life.

Axial spherical plain bearings

- are complete units comprising shaft and housing locating washers with ELGOGLIDE®
  - the shaft locating washer is supported in the ball socket-shaped sliding zone of the housing locating washer
  - the housing locating washer has ELGOGLIDE® secured by adhesive
- are preferably used to support axial loads
- are suitable for use as support or base bearings
- can be combined with radial spherical plain bearings of dimension series E to ISO 12 240-1
- are maintenance-free throughout their operating life
  - the use of lubricant leads to a considerable reduction in bearing life.

Angular contact spherical plain bearings

GE..SW
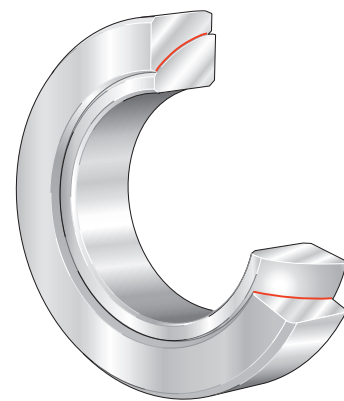
- to ISO 12 240-2
- mounting dimensions as for tapered roller bearings to DIN 720, 320X
- hard chromium/ELGOGLIDE® sliding contact surface
- for shaft diameters from 25 mm to 200 mm

84

Axial spherical plain bearings

GE..AW
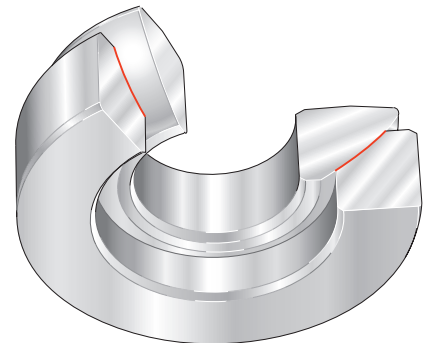
- to ISO 12 240-3
- hard chromium/ELGOGLIDE® sliding contact surface
- for shaft diameters from 10 mm to 360 mm
- from $d \geq 220$ mm, classified as large axial spherical plain bearings

86

Maintenance-free cylindrical plain bushes

Features

Maintenance-free cylindrical plain bushes

- are radial dry plain bearings comprising a cylindrical steel bush and ELGOGLIDE®
  - the steel bush gives protection during handling and fitting
- are maintenance-free throughout their operating life
  - the use of lubricant leads to a considerable reduction in bearing life
- can be used to replace steel, bronze and plastic plain bearings
  - the plain bushes can support higher loads than conventional plain bearings
- can support very high radial loads with unilateral load direction and high static loads
- are used with high alternating loads and swivel motion
- have low friction
- have good damping characteristics
- allow some axial motion
- are easy to fit
  - they are simply pressed into the housing bore
  - no further axial location is required
- can also be combined with separate, additional seals.

Maintenance-free cylindrical plain bush

ZGB
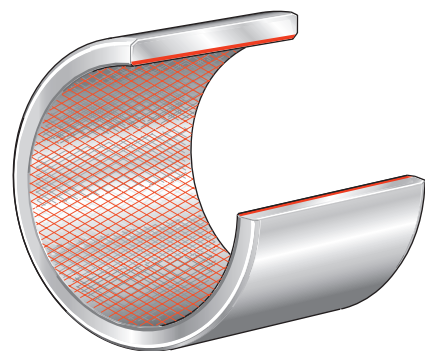
- dimensions to ISO 4 379, diameter series 2 and 3
- operating temperatures from –50 °C to +150 °C
- for shaft diameters from 30 mm to 200 mm

88

Maintenance-free spherical plain bearings

Radial spherical plain bearings
Angular contact spherical plain bearings
Axial spherical plain bearings

Design and safety guidelines

⚠ Note the ratio C_r (C_a)/P (*Predimensioning*, page 22 and Table 1). The permissible ratio is decisively dependent on the operating conditions, lubricant and the required operating life.

Maintenance-free spherical plain bearings are, depending on type, only suitable for alternating dynamic loads in certain cases (Table 1).

The parts of different bearings are not interchangeable with each other.

Table 1 · Ratio C_r (C_a)/P for maintenance-free spherical plain bearings under dynamic load – guide values

Series	Alternating load C_r (C_a)/P		Unilateral load C_r (C_a)/P
GE..UK GE..UK-2RS	restricted suitability suitable	$\geqq 2$	5 to1
GE..DW	suitable	> 2	3 to 1
GE..DW-2RS2	suitable	> 2	3 to 1
GE..FW GE..FW-2RS	restricted suitability suitable	$\geqq 2$	5 to 1
GE..PW	restricted suitability	$\geqq 2$	5 to 1
GE..SW GE..AW	suitable	$\geqq 2$	5 to 1

Angular contact spherical plain bearings

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 (Figure 1).
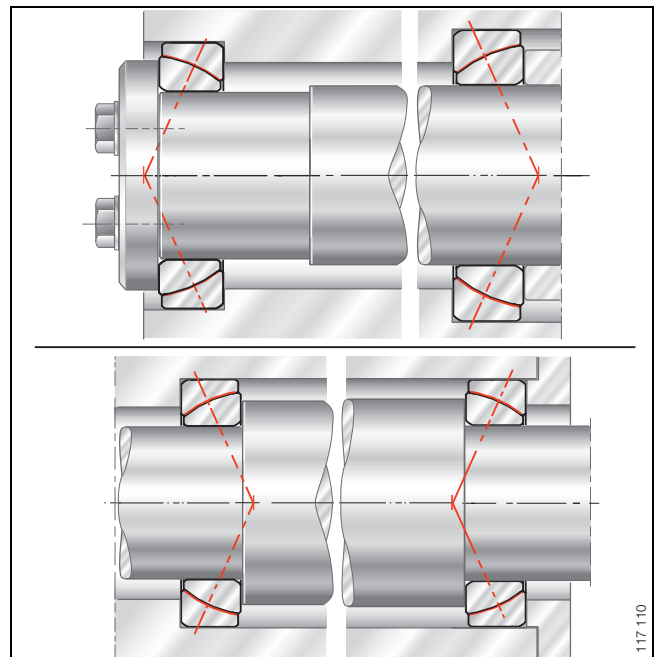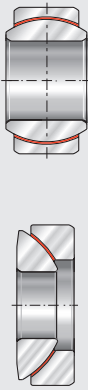
Figure 1 · Bearings in pairs in O and X arrangements

Axial spherical plain bearings

If axial spherical plain bearings are to be combined with radial spherical plain bearings of dimension series E to ISO 12 240-1 in order to support radial loads, the axial and radial load must be distributed over both bearings.

In order to achieve this:

- the pin must have a radial release of approx. 1 mm in the shaft locating washer (Figure 2) or
- the pin must only be in contact with the large end surface of the shaft locating washer (Figure 2).

⚠ From a bore diameter of 160 mm, the bearing must be fitted in a closed housing. The diameter D of the axial bearing corresponds to the inside diameter of the housing.
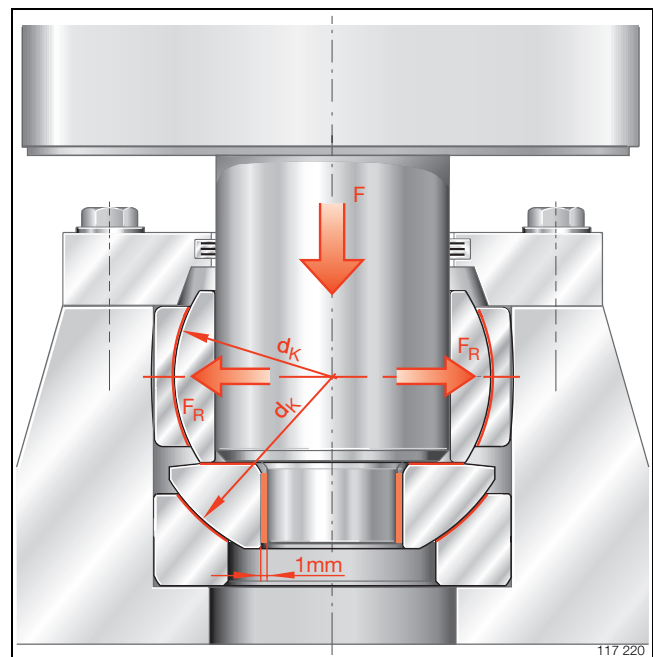
Figure 2 · Combination of axial and radial spherical plain bearing

Maintenance-free cylindrical plain bushes

Maintenance-free cylindrical plain bushes

⚠ Do not lubricate the sliding layer. Lubricant increases wear and considerably reduces the operating life of the bearing.

Plain bushes should not be used for movement involving spatial alignment. Any skewing of the shaft reduces the bearing life.

For applications involving contact with water, plain bushes with a corrosion-resistant steel bush must be used. The "flushing effect" will considerably increase wear of the sliding layer. If movement is infrequent, however, the operating life may nevertheless be sufficient. The design of the plain bush and its suitability should be agreed with INA first.

If plain bushes come into contact with chemical media, special measures will often be required for the bush material or the surface treatment. The design of the plain bush and its suitability should be agreed with INA first.

Design of bearing arrangements

The shaft and housing bore should conform to Figure 3.

■ For optimum conditions, the shaft should be hardened and hard chromium plated or corrosion-resistant steel should be used.

■ The shaft roughness should not exceed R_z1 if possible. Higher roughness values will reduce the operating life of plain bushes. Roughness values $> R_z4$ should be avoided.

If plain bushes are combined with outer seals, it must be taken into consideration when designing the sealing arrangement that:

■ the internal clearance will increase due to wear of the sliding layer

■ the plain bush cannot be relubricated.

Fitting

Plain bushes should be pressed in using a fitting arbor (Figure 5).

The chamfer of the fitting arbor must have rounded corners or ends:

■ $d_D = d – (0{,}3 \text{ mm to } 0{,}5 \text{ mm})$.

⚠ Sharp corners on the entry side of the shaft and arbor will damage the sliding layer and reduce the operating life of the plain bush.
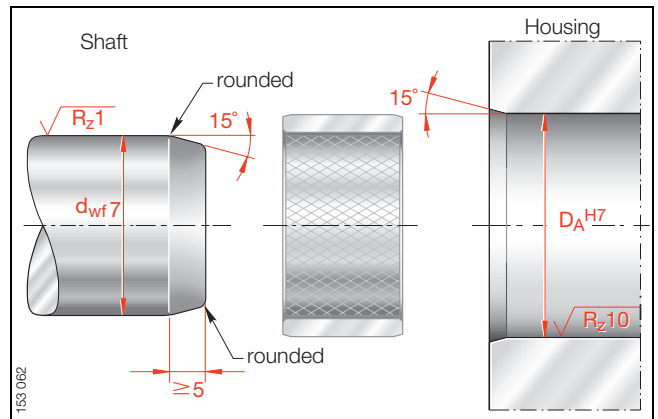
Figure 3 · Design of adjacent components
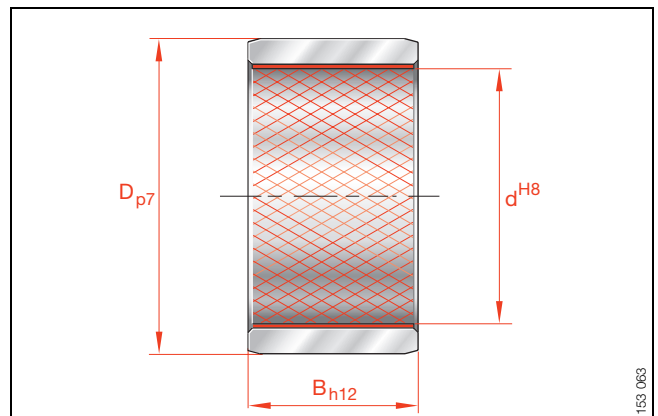
Figure 4 · Tolerances of plain bushes
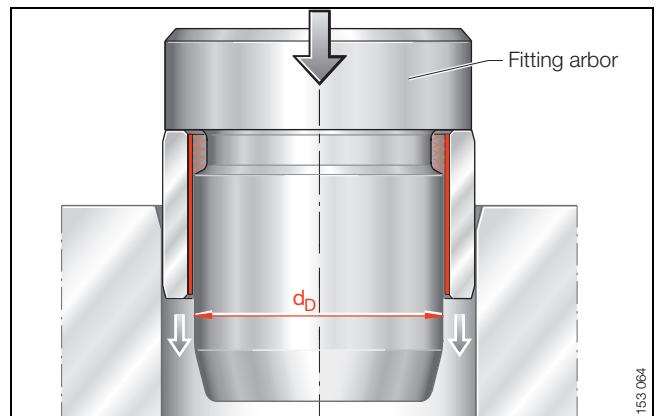
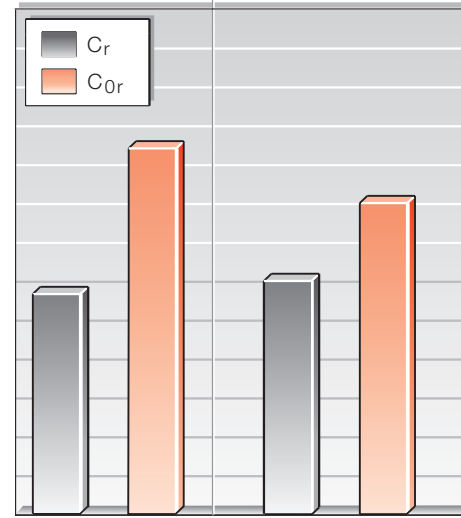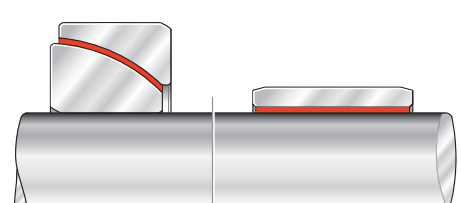Figure 5 · Fitting by means of an arbor

Maintenance-free spherical plain bearings

Radial spherical plain bearings
Angular contact spherical plain bearings
Axial spherical plain bearings

Calculation of rating life

In maintenance-free spherical plain bearings, the sliding surfaces are in direct contact due to the lack of lubricant. This leads to wear. Wear of the sliding surface is therefore the principal failure criterion in life calculation.

Due to wear, the friction increases towards the end of the operating life.

In some cases, low sliding speeds and low bearing loads can result in very high calculated life values. With very long running times, however, parameters that are not taken into consideration in calculation can have a considerable influence on the life; these include:

- vibration
- contamination
- moisture
- corrosion
- ageing.

The actual life may therefore differ considerably from these values.

⚠ The operating life of large spherical plain bearings of series GE..DW and GE..DW-2RS2 cannot be determined using the calculation method presented here – particular attention must be paid to the specific environmental conditions in each application. Please consult INA in this case.

In the case of axial bearings with d ≧ 220 mm, particular attention must be paid to the surrounding constructions and operating conditions. Please consult INA in this case.

Further information

Maintenance-free spherical plain bearings

Radial spherical plain bearings
Angular contact spherical plain bearings
Axial spherical plain bearings

Life calculation for maintenance-free spherical plain bearings – sliding material ELGOGLIDE®

Scope

- Radial spherical plain bearings $\quad$ 17 mm $\leqq$ d $\leqq$ 300 mm
- Angular contact
  spherical plain bearings $\quad$ 25 mm $\leqq$ d $\leqq$ 200 mm
- Axial spherical plain bearings $\quad$ 10 mm $\leqq$ d $\leqq$ 200 mm
- Temperature range $\quad$ –50 °C $\leqq$ t $\leqq$ +150 °C
  (note the restrictions in Table 1, page 47)
- Contact pressure
  – constant load $\quad$ 5 N/mm^2 $\leqq$ p $\leqq$ 300 N/mm^2
  – variable load $\quad$ 5 N/mm^2 $\leqq$ p $\leqq$ 100 N/mm^2
- Sliding speed $\quad$ 1 mm/s $\leqq$ v $\leqq$ 296 mm/s
- Bearing dry, without lubrication
- Angular contact spherical plain bearing
  set axially free from clearance
- Sliding speed factor $f_v \geqq 0{,}2$;
  at $f_v \leqq 0{,}8$, good heat dissipation required.

Failure criteria

Increase in radial internal clearance with:

- unilateral load direction $\quad$ by 0,5 mm
- alternating load direction $\quad$ by 1,0 mm
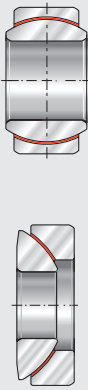
Calculation of rating life

Constant load

$$p = K \cdot \frac{P}{C_r} \quad \text{or} \quad p = K \cdot \frac{P}{C_a}$$

⚠️ If $p \leqq 25$ N/mm² please consult INA.

$$v = 2{,}91 \cdot 10^{-4} \cdot f_4 \cdot d_K \cdot \beta \cdot f$$

$p = 5 - 50$ N/mm²

$$f_v = \frac{1{,}6228}{1{,}004243^{v \cdot p^{0{,}31876}}} \quad \text{(Figure 6)}$$

$p > 50 - 300$ N/mm²

$$f_v = \frac{1{,}6228}{1{,}000295^{v \cdot p}} \quad \text{(Figure 6)}$$

$$f_6 = 0{,}7579 \cdot 1{,}0093^{\beta}$$

$$L = \frac{f_2 \cdot f_v}{f_6} \cdot \frac{s \cdot f}{v} \cdot 14$$

$$L_h = \frac{L}{f \cdot 60}$$

Variable load (pulsating and alternating load)

$$f_{Hz} = \frac{0{,}5442}{1{,}0171^{P_{Hz} \cdot p}} \quad \text{(Figure 7)}$$

$$L_W = L \cdot f_{Hz} \cdot f_5$$

$$L_{hW} = \frac{L_W}{f \cdot 60}$$

Factors K, f_2, f_4, f_5 (Table 3, page 69)
Sliding distance "s"   (Figure 12 and Table 2, page 68).
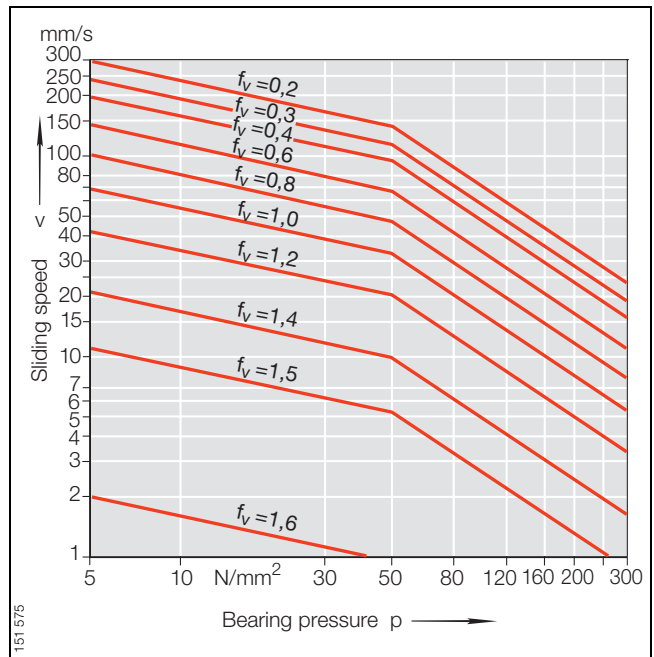
Figure 6 · f_v values for ELGOGLIDE®
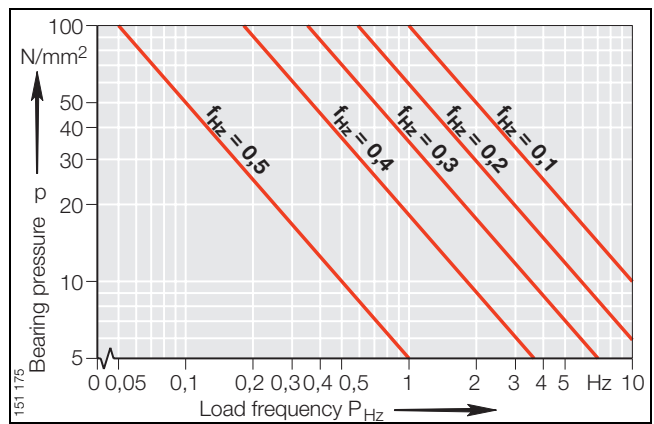
Figure 7 · f_{Hz} values for ELGOGLIDE®

Maintenance-free spherical plain bearings

Radial spherical plain bearings
Angular contact spherical plain bearings
Axial spherical plain bearings

Life calculation for maintenance-free spherical plain bearings – sliding material PTFE composite

Scope

- Radial spherical plain bearings $\qquad$ 6 mm $\leqq$ d $\leqq$ 30 mm
- Temperature range $\qquad$ –50 °C $\leqq$ t $\leqq$ +200 °C
- Unilateral contact pressure, constant load $\qquad$ 5 N/mm^2 $\leqq$ p $\leqq$ 100 N/mm^2
- Variable load $\qquad$ 5 N/mm^2 $\leqq$ p $\leqq$ 60 N/mm^2
- Sliding speed $\qquad$ 1 mm/s $\leqq$ v $\leqq$ 398 mm/s
- Bearing dry, without lubrication
- Sliding speed factor $f_v \geqq 0,4$; at $f_v \leqq 1$, good heat dissipation required.

Failure criteria

Increase in radial internal clearance with:
- unilateral load direction $\qquad$ by 0,15 mm
- alternating load direction $\qquad$ by 0,30 mm

Constant load

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

$$v = 2,91 \cdot 10^{-4} \cdot d_K \cdot \beta \cdot f$$

$$x = \frac{v \cdot 1,0399^p}{236,89} \qquad \text{(Figure 8)}$$

$$f_v = \frac{2,1048}{2,255^x} \qquad \text{(Figure 8)}$$

$$L = f_2 \cdot f_v \cdot \frac{s \cdot f}{v} \cdot 14$$

$$L_h = \frac{L}{f \cdot 60}$$

Variable load (pulsating and alternating load)

$$f_{Hz} = 0,433 - \frac{P_{Hz} \cdot p^{1,25}}{447,15} \qquad \text{(Figure 9)}$$

$$L_W = L \cdot f_{Hz} \cdot f_5$$

$$L_{hW} = \frac{L_W}{f \cdot 60}$$

Factors K, f_2, f_5 $\qquad$ (Table 3, page 69)
Sliding distance "s" $\quad$ (Figure 12 and Table 2, page 68).
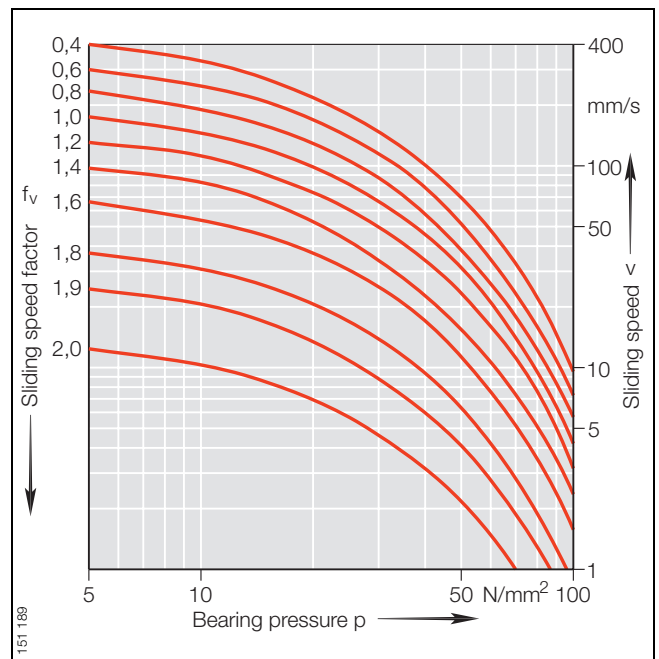
Figure 8 · f_v values for PTFE composite
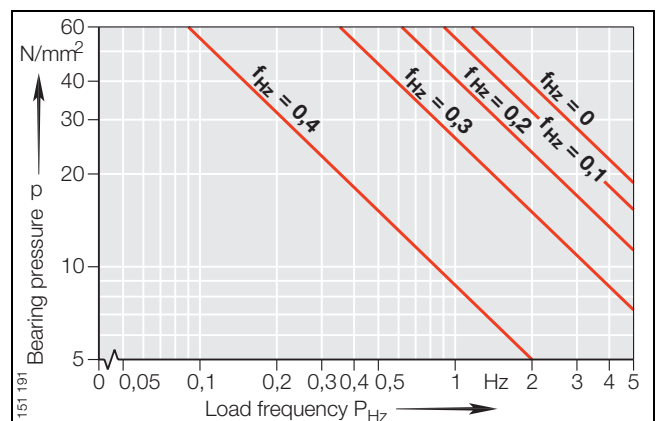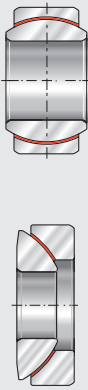
Figure 9 · f_{Hz} values for PTFE composite

Life calculation for maintenance-free spherical plain bearings – sliding material PTFE-bronze film

Scope

- Radial spherical plain bearings   5 mm $\leqq$ d $\leqq$ 30 mm
- Temperature range   –50 °C $\leqq$ t $\leqq$ +200 °C
- Unilateral contact pressure,
  constant load   2 N/mm² $\leqq$ p $\leqq$ 100 N/mm²
- Variable load   5 N/mm² $\leqq$ p $\leqq$ 50 N/mm²
- Sliding speed   1 mm/s $\leqq$ v $\leqq$ 211 mm/s
- Bearing dry, without lubrication
- Sliding speed factor $f_v \geqq 0{,}4$;
  at $f_v \leqq 1$, good heat dissipation required.

Failure criteria

Increase in radial internal clearance with:

- unilateral load direction   by 0,25 mm
- alternating load direction   by 0,50 mm
  – under alternating loads $p > 10$ N/mm²,
    the sliding material can be displaced by approx. 0,1 mm
    without wear (plastic deformation).

Constant load

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

$$v = 2{,}91 \cdot 10^{-4} \cdot d_K \cdot \beta \cdot f$$

$$x = \frac{v \cdot 1{,}0305^p}{109{,}771} \qquad \text{(Figure 10)}$$

$$f_v = \frac{2{,}1048}{2{,}255^x} \qquad \text{(Figure 10)}$$

$$L = f_2 \cdot f_v \cdot \frac{s \cdot f}{v} \cdot 14$$

$$L_h = \frac{L}{f \cdot 60}$$

Variable load (pulsating and alternating load)

$$f_{Hz} = 0{,}433 - \frac{P_{Hz} \cdot p^{1,6}}{790{,}5} \qquad \text{(Figure 11)}$$

$$L_W = L \cdot f_{Hz} \cdot f_5$$

$$L_{hW} = \frac{L_W}{f \cdot 60}$$

Factors K, f_2, f_5 (Table 3, page 69)
Sliding distance "s" (Figure 12 and Table 2, page 68).
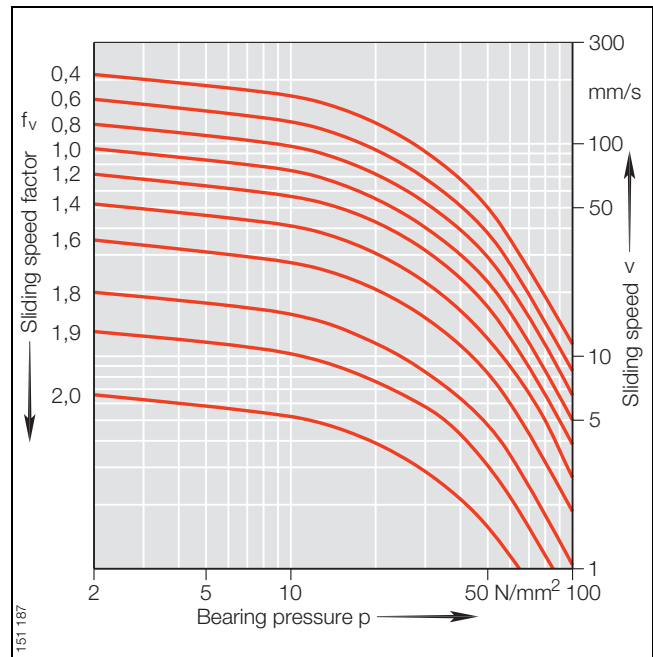
Figure 10 · f_v values for PTFE-bronze film
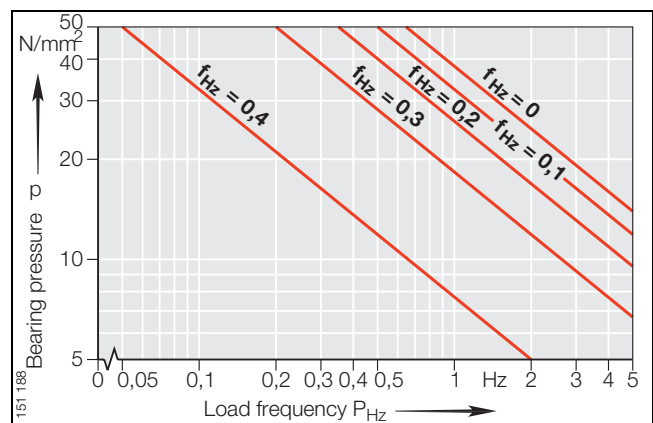
Figure 11 · f_{Hz} values for PTFE-bronze film

Maintenance-free spherical plain bearings

Radial spherical plain bearings
Angular contact spherical plain bearings
Axial spherical plain bearings
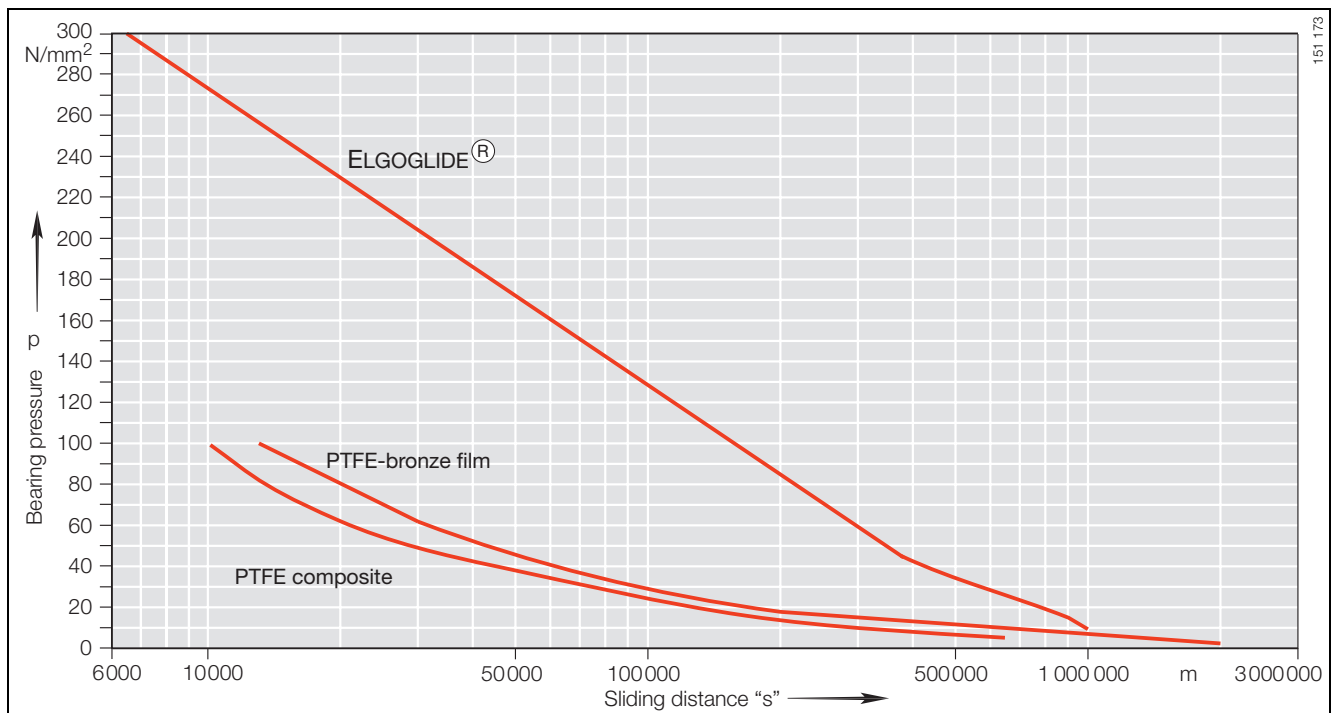
Figure 12 · Sliding distance "s"

Table 2 · Mathematical functions for Figure 12

Contact pressure p N/mm²	Sliding material ELGOGLIDE®	PTFE composite	PTFE-bronze film
> 100 to 300	$s = \dfrac{791\,020}{1{,}01599^{p}}$	–	–
> 65 to 100			$s = \dfrac{42\,052\,415}{p^{1,75829}}$
> 45 to 65		$s = \dfrac{13\,717\,016}{p^{1,568}}$	$s = \dfrac{32\,897\,507}{p^{1,69947}}$
> 25 to 45	$s = \dfrac{1\,408\,185}{1{,}0291^{p}}$		$s = \dfrac{24\,115\,273}{p^{1,61789}}$
> 5 to 25		$s = \dfrac{4\,510\,227}{p^{1,22302}}$	$s = \dfrac{6\,837\,121}{p^{1,2263}}$
> 2 to < 5	–	–	$s = \dfrac{3\,500\,000}{p^{0,81025}}$

Table 3 · Factors for life calculation

Factor	Sliding material	ELGOGLIDE®		PTFE composite		PTFE-bronze film	
Basic load rating factor K	N/mm^2	300		100		100	
Temperature factor f$_2$	Temperature range °C	–20 to +150	<–20 to –50	–50 to +95	>+95 to +200	–50 to +100	>+100 to +200
	f$_2$	1	0,7	1	$163\,341 \cdot t^{-2,64}$	1	$1,5 - 0,005 \cdot t$
Bearing design factor f$_4$	Radial spherical plain bearings	1		–		–	
	Angular contact spherical plain bearings[1]	0,9		–		–	
	Axial spherical plain bearings[1]	0,7		–		–	
Load type factor f$_5$	Alternating load	1		1		1	
	pulsating load	1,4		1,4		1,4	

[1] For predominantly swivel motion. For predominantly elliptical tilting motion, use $f_4 = 1$.

Symbols, units and definitions

p N/mm^2
Specific bearing load, contact pressure

P N
Equivalent dynamic bearing load

C_r (C_a) N
Basic dynamic load rating (*dimension table*, $C_{r\ radial}$, $C_{a\ axial}$)

K N/mm^2
Basic load rating factor (Table 3)

v mm/s
Mean sliding speed

d_K mm
Sphere diameter (*dimension table*)

β °
Swivel or oscillation angle
(from end position to end position, for rotary motion $\beta = 180°$, see page 24 and 25; use $\beta = \beta_1$)

f min^{-1}
Oscillation frequency or speed

P_{Hz} Hz
Load frequency

f_{Hz} –
Factor for variable load   (ELGOGLIDE®, Figure 7, page 65, PTFE composite, Figure 9, page 66, PTFE-bronze film, Figure 11, page 67)

f_2 –
Temperature factor (Table 3)

f_4 –
Bearing design factor (Table 3)

f_5 –
Load type factor (Table 3)

f_6 –
Swivel or oscillation angle factor (formula) (page 65)

f_v –
Sliding speed factor   (ELGOGLIDE®, Figure 6, page 65, PTFE composite, Figure 8, page 66, PTFE-bronze film, Figure 10, page 67)

s m
Sliding distance (Figure 12 and Table 2, page 68)

L oscillations
Theoretical life under constant load

L_h h
Theoretical life under constant load

L_W oscillations
Theoretical life under variable load

L_{hW} h
Theoretical life under variable load

t °C
Operating temperature

α_1 °
Tilt angle from centre to left

α_2 °
Tilt angle from centre to right.

Maintenance-free spherical plain bearings

Radial spherical plain bearings
Angular contact spherical plain bearings
Axial spherical plain bearings

Calculation example for maintenance-free spherical plain bearings – sliding material ELGOGLIDE®

Given

Linkage of an articulated lever, pulsating load in constant direction.

Operating parameters:

Bearing load	$F_{R\ min}$	=	33 kN
	$F_{R\ max}$	=	389 kN
Swivel angle	β	=	48°
Swivel frequency	f	=	7,5 min^{-1}
Load frequency	P_{Hz}	=	0,125 Hz
Operating temperature	t	=	0 °C – 45 °C

Bearing data:

Radial spherical plain bearings		=	GE 120 UK-2RS
■ Basic dynamic load rating	C_r	=	2685 kN
■ Sphere diameter	d_K	=	160 mm
Factors	K	=	300 N/mm^2
(Table 3, page 69)	f_2	=	1
	f_4	=	1
	f_5	=	1,4

Required

Expected life.

Calculation examples for maintenance-free spherical plain bearings – sliding material ELGOGLIDE®

$$P = \sqrt{\frac{F^2_{min} + F^2_{max}}{2}}$$

$$P = \sqrt{\frac{33^2 + 389^2}{2}} = 276,05 \text{ kN}$$

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

$$p = 300 \cdot \frac{276,05}{2685} = 30,8 \text{ N/mm}^2$$

$$v = 2,91 \cdot 10^{-4} \cdot f_4 \cdot d_K \cdot \beta \cdot f$$

$$v = 2,91 \cdot 10^{-4} \cdot 1 \cdot 160 \cdot 48 \cdot 7,5 = 16.76 \text{ mm/s}$$

$$f_v = \frac{1,6228}{1,004243^{v \cdot p^{0,31876}}}$$

$$f_v = \frac{1,6228}{1,004243^{16,76 \cdot 30,8^{0,31876}}} = 1,313$$

$$f_6 = 0,7579 \cdot 1,0093^{\beta}$$

$$f_6 = 0,7579 \cdot 1,0093^{48} = 1,182$$

s (ELGOGLIDE®) for p = 30,8 N/mm^2
from Figure 12, page 68 $\Rightarrow$ 582 000 m,
alternatively calculated using function from Table 2, page 68.

$$s = \frac{1408185}{1,0291^p} = \frac{1408185}{1,0291^{30,8}} = 582058 \text{ m}$$

$$L = \frac{f_2 \cdot f_v}{f_6} \cdot \frac{s \cdot f}{v} \cdot 14$$

$$L = \frac{1 \cdot 1,313}{1,182} \cdot \frac{582058 \cdot 7,5}{16,76} \cdot 14 = 4050688 \text{ osc.}$$

$$f_{Hz} = \frac{0,5442}{1,0171^{P_{Hz} \cdot p}}$$
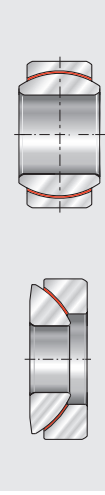
$$f_{Hz} = \frac{0,5442}{1,0171^{0,125 \cdot 30,8}} = 0,5098$$

$$L_W = L \cdot f_{Hz} \cdot f_5$$

$$L_W = 4050688 \cdot 0,5098 \cdot 1,4 = 2891057 \text{ osc.}$$

$$L_{hW} = \frac{L_W}{f \cdot 60}$$

$$L_{hW} = \frac{2891057}{7,5 \cdot 60} = 6424 \text{ h}$$

Calculation example for maintenance-free spherical plain bearings – PTFE composite sliding contact surface

Given

Linkage bearing arrangement of a transfer unit, unilateral combined load.

Operating parameters:

Bearing load	F_R =	16	kN
	F_A =	1,2	kN
Swivel angle	β =	27°	
Swivel frequency	f =	12 min^{-1}	
Operating temperature	t =	+100 °C	

Bearing data:

Radial spherical plain bearings		= GE 25 UK	
■ Basic dynamic load rating	C_r =	51	kN
■ Sphere diameter	d_K =	35,5	mm
Factors (Table 3, page 69)	K =	100 N/mm^2	
	f_2 =	163 341 · $t^{-2,64}$	

Required

Required life approx. 5 000 h.

Calculation

$$P = X \cdot F_R$$

$$\frac{F_A}{F_R} = \frac{1,2}{16} = 0,075$$

X (Figure 4, page 18 $\Rightarrow$ = 1,23
$P = 1,23 \cdot 16 = 19,7$ kN

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

$$p = 100 \cdot \frac{19,7}{51} = 38,63 \text{ N/mm}^2$$

$$v = 2,91 \cdot 10^{-4} \cdot d_K \cdot \beta \cdot f$$

$$v = 2,91 \cdot 10^{-4} \cdot 35,5 \cdot 27 \cdot 12 = 3,35 \text{ mm/s}$$

$$x = \frac{v \cdot 1,0399^p}{236,89}$$

$$x = \frac{3,35 \cdot 1,0399^{38,63}}{236,89} = 0,0641$$

$$f_v = \frac{2,1048}{2,255^x}$$

$$f_v = \frac{2,1048}{2,255^{0,0641}} = 1,998$$

s (PTFE composite) for $p = 38,63$ N/mm^2
from Figure 12, page 68 $\Rightarrow$ 44 000 m,
alternatively calculated using function from Table 2, page 68.

$$s = \frac{13\,717\,016}{p^{1,568}} = \frac{13\,717\,016}{38,63^{1,568}} = 44\,567 \text{ m}$$

$$L = f_2 \cdot f_v \cdot \frac{s \cdot f}{v} \cdot 14$$

$$L = (163\,341 \cdot t^{-2,64}) \cdot f_v \cdot \frac{s \cdot f}{v} \cdot 14$$

$$L = (163\,341 \cdot 100^{-2,64}) \cdot 1,998 \cdot \frac{44\,567 \cdot 12}{3,35} \cdot 14$$

$L = 3\,827\,970$ oscillations

$$L_h = \frac{L}{f \cdot 60}$$

$$L_h = \frac{3\,827\,970}{12 \cdot 60} = 5\,316 \text{ h}$$

$L_h = 5\,316$ h – a safety margin of 1,06.

Maintenance-free cylindrical plain bushes

Life calculation for maintenance-free cylindrical plain bushes – sliding material ELGOGLIDE®

Scope

- Cylindrical plain bush $30\text{ mm} \leq d \leq 200\text{ mm}$
- Temperature range $-50\,°\text{C} \leq t \leq +150\,°\text{C}$
- Contact pressure $5\text{ N/mm}^2 \leq p \leq 300\text{ N/mm}^2$
- Sliding speed $1\text{ mm/s} \leq v \leq 296\text{ mm/s}$
- Bearing dry, without lubrication, no tilting loads.

Shaft requirements:

- Roughness R_z 1 to 4,0 (increased life with $R_z = 1$)
- Hardness ≥ 55 HRC
- Hard chromium surface, carbon steel, corrosion-resistant steel
- No clearance.

Failure criteria

Increase in radial internal clearance with:

- unilateral load direction   by 0,5 mm
- alternating load direction   by 1,0 mm

Constant load

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

⚠ If $p \leqq 25\text{ N/mm}^2$ please consult INA.

$$v = 2,91 \cdot 10^{-4} \cdot d_K \cdot \beta \cdot f$$

$p = 5 - 50\text{ N/mm}^2$

$$f_v = \frac{1,6228}{1,004243^{\,v \cdot p^{0,31876}}} \qquad \text{(Figure 6, page 65)}$$

$p > 50 - 300\text{ N/mm}^2$

$$f_v = \frac{1,6228}{1,000295^{\,v \cdot p}}$$

$$f_R = 1,357 \cdot 0,737^{R_z} \qquad \text{(Figure 13)}$$

$$f_6 = 0,7579 \cdot 1,0093^{\beta}$$

$$L = \frac{f_2 \cdot f_R \cdot f_v}{f_6} \cdot \frac{s \cdot f}{v} \cdot 10$$

$$L_h = \frac{L}{f \cdot 60}$$

Variable load

$$f_{Hz} = \frac{0,5442}{1,0171^{\,P_{Hz} \cdot p}} \qquad \text{(Figure 7, page 65)}$$

$$L_W = L \cdot f_{Hz} \cdot f_5$$

$$L_{hW} = \frac{L_W}{f \cdot 60}$$

Factors K, f_2, f_5 (Table 3, page 69)
Sliding distance "s"   (Figure 12, page 68 and Table 2, page 68).
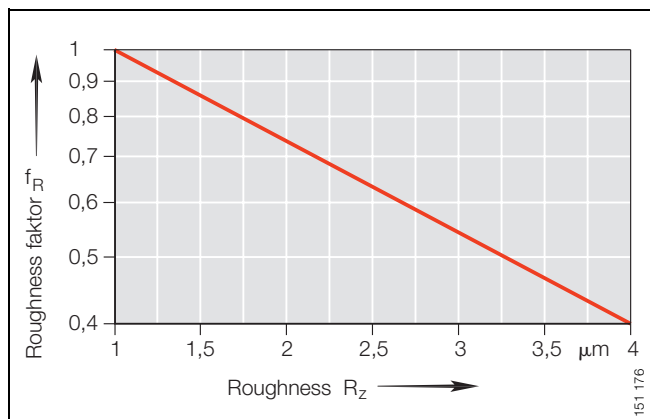
Figure 13 · Roughness factor f_R for shafts

Calculation example for maintenance-free cylindrical plain bushes – sliding material ELGOGLIDE®

Given

Highly loaded pivots on an angled lever.

Operating parameters:

Bearing load	F	$= P = 120$ kN
Load direction		$=$ alternating
Swivel angle	β	$= 30°$
Swivel frequency	f	$= 6$ min^{-1}
Load frequency	P_{Hz}	$= 0,1$ s^{-1}
Temperature range	t	$= 0\,°C$ to $+30\,°C$

Housing bore/shaft:

Locating bore	D_A	$= 70$ H7
Shaft diameter	d_W	$= 60$ f7
Shaft surface		
hard chromium plated, roughness depth		$= R_z 1,6$

Bearing data:

Maintenance-free cylindrical plain bush		$=$ ZGB 60×70×60
Bore diameter	d	$= 60$ H8
Outside diameter	D	$= 70$ p7
Width	B	$= 60$ h12
Basic dynamic load rating	C_r	$= 1080$ kN
Basic load rating factor	K	$= 300$ N/mm^2
(Table 3, page 69)		

Required

Required life 10 000 h.

Calculation

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

$$p = 300 \cdot \frac{120}{1080} = 33,34 \text{ N/mm}^2$$

$$v = 2,91 \cdot 10^{-4} \cdot d_K \cdot \beta \cdot f$$

$$v = 2,91 \cdot 10^{-4} \cdot 60 \cdot 30 \cdot 6 = 3,14 \text{ mm/s}$$

$$f_v = \frac{1,6228}{1,004243^{v \cdot p^{0,31876}}}$$

$$f_v = \frac{1,6228}{1,004243^{3,14 \cdot 33,34^{0,31876}}} = 1,558$$

$$f_R = 1,357 \cdot 0,737^{R_z}$$

$$f_R = 1,357 \cdot 0,737^{1,6} = 0,83$$

$$f_6 = 0,7579 \cdot 1,0093^{\beta}$$

$$f_6 = 0,7579 \cdot 1,0093^{30} = 1$$

$f_2 = 1$ (Table 3, page 69)
s (ELGOGLIDE®) for $p = 33,34$ N/mm^2
from Figure 12, page 68 $\Rightarrow$ 540 000 m,
alternatively calculated using function from Table 2, page 68.

$$s = \frac{1\,408\,185}{1,0291^p} = \frac{1\,408\,185}{1,0291^{33,34}} = 541\,158 \text{ m}$$

$$L = \frac{f_2 \cdot f_R \cdot f_v}{f_6} \cdot \frac{s \cdot f}{v} \cdot 10$$

$$L = \frac{1 \cdot 0,83 \cdot 1,558}{1} \cdot \frac{541\,158 \cdot 6}{3,14} \cdot 10 = 13\,371\,841 \text{ osc.}$$

$$f_{Hz} = \frac{0,5442}{1,0171^{P_{Hz} \cdot p}}$$

$$f_{Hz} = \frac{0,5442}{1,0171^{0,1 \cdot 33,33}} = 0,514$$

$f_5 = 1$ (Table 3, page 69)

$$L_W = L \cdot f_{Hz} \cdot f_5$$

$$L_W = 13\,371\,841 \cdot 0,514 \cdot 1 = 6\,873\,126 \text{ osc.}$$

$$L_{hW} = \frac{L_W}{f \cdot 60}$$

$$L_{hW} = \frac{6\,873\,126}{6 \cdot 60} = 19\,092 \text{ h}$$

$L_{hW} = 19\,092$ operating hours. The plain bush is suitable.

Maintenance-free spherical plain bearings

Radial spherical plain bearings
Angular contact spherical plain bearings
Axial spherical plain bearings
Maintenance-free cylindrical plain bushes

Accuracy

The main dimensions conform to ISO 12 240-1 to -3.

The dimensional and geometrical accuracy of the inside and outside diameters corresponds to ISO 12 240-1 to -3
■ Dimensional and tolerance values are arithmetic means. Dimensional inspection is carried out in accordance with ISO 8 015.

Spherical plain bearings with split outer ring

The outside diameter is within the deviations given in the tables before surface treatment and splitting.

The outer rings become slightly out of round due to splitting. The roundness of the outer ring is restored once it is fitted in a housing bore produced in accordance with the specifications (Figure 14).

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

Maintenance-free cylindrical plain bushes

The main dimensions conform to ISO 4 379.

The dimensional and geometrical accuracies conform to ISO 4 379
■ Dimensional and tolerance values are arithmetic means. Dimensional inspection is carried out in accordance with ISO 8 015.
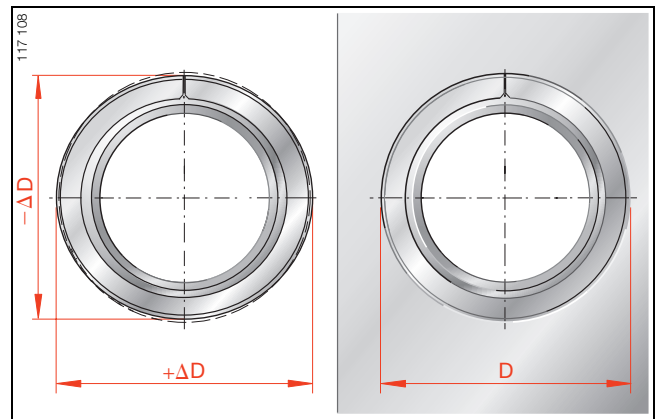
Figure 14 · Out of roundness before fitting and correct roundness after fitting

Special designs

Available by agreement (see also page 13):

■ maintenance-free radial spherical plain bearings with inner ring made from corrosion-resistant steel
   – suffix W3

■ maintenance-free radial spherical plain bearings, inner ring bore with ELGOGLIDE® lining, bore diameter smaller than nominal dimension ($d_{NEW} = d - 1,08$)
   – suffix W7

■ maintenance-free radial spherical plain bearing, inner ring bore with ELGOGLIDE® lining ($d_{NEW} = d$)
   – suffix W8.

Ordering example and ordering designation

Maintenance-free radial spherical plain bearing to ISO 12 240-1-dimension series E, sliding contact surface hard chromium/ELGOGLIDE®, lip seals on both sides, for:
shaft   20 mm.

Ordering designation: **GE 20 UK-2RS** (Figure 15).
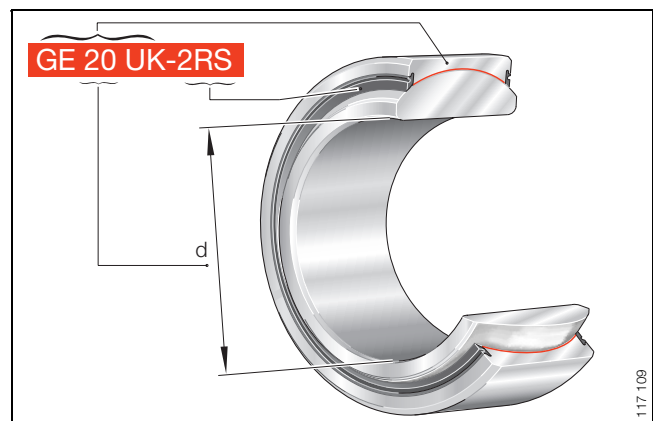
Figure 15 · Ordering example, ordering designation

Maintenance-free cylindrical plain bush to ISO 4 379, for:
shaft   30 mm.

Ordering designation: **ZGB 30×36×30** (Figure 16).
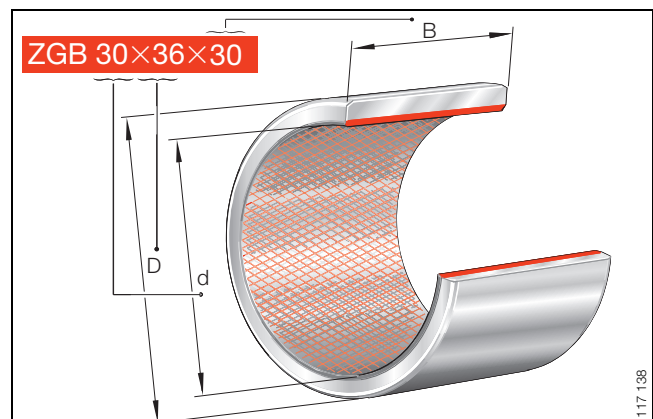
Figure 16 · Ordering example, ordering designation

Radial spherical plain bearings

maintenance-free
ISO 12 240-1, dimension series E
Sliding contact surface: hard chromium/PTFE

Series GE..UK
Sliding material: PTFE composite

GE..UK-2RS
Sliding material: ELGOGLIDE®

GE..UK

Shaft diameter	Designation		Mass	Dimensions					
				d	D	B	C	d_K	α
d	without seals	with seals	≈kg						Degrees
6	GE 6 UK	–	0,004	$6_{-0,008}$	$14_{-0,008}$	$6_{-0,12}$	$4_{-0,24}$	10	13
8	GE 8 UK	–	0,007	$8_{-0,008}$	$16_{-0,008}$	$8_{-0,12}$	$5_{-0,24}$	13	15
10	GE 10 UK	–	0,011	$10_{-0,008}$	$19_{-0,009}$	$9_{-0,12}$	$6_{-0,24}$	16	12
12	GE 12 UK	–	0,016	$12_{-0,008}$	$22_{-0,009}$	$10_{-0,12}$	$7_{-0,24}$	18	11
15	GE 15 UK	–	0,027	$15_{-0,008}$	$26_{-0,009}$	$12_{-0,12}$	$9_{-0,24}$	22	8
17	GE 17 UK	GE 17 UK-2RS	0,037	$17_{-0,008}$	$30_{-0,009}$	$14_{-0,12}$	$10_{-0,24}$	25	10
20	GE 20 UK	GE 20 UK-2RS	0,06	$20_{-0,01}$	$35_{-0,011}$	$16_{-0,12}$	$12_{-0,24}$	29	9
25	GE 25 UK	GE 25 UK-2RS	0,11	$25_{-0,01}$	$42_{-0,011}$	$20_{-0,12}$	$16_{-0,24}$	35,5	7
30	GE 30 UK	GE 30 UK-2RS	0,14	$30_{-0,01}$	$47_{-0,011}$	$22_{-0,12}$	$18_{-0,24}$	40,7	6
35	–	GE 35 UK-2RS	0,22	$35_{-0,012}$	$55_{-0,013}$	$25_{-0,12}$	$20_{-0,3}$	47	6
40	–	GE 40 UK-2RS	0,3	$40_{-0,012}$	$62_{-0,013}$	$28_{-0,12}$	$22_{-0,3}$	53	7
45	–	GE 45 UK-2RS	0,39	$45_{-0,012}$	$68_{-0,013}$	$32_{-0,12}$	$25_{-0,3}$	60	7
50	–	GE 50 UK-2RS	0,53	$50_{-0,012}$	$75_{-0,013}$	$35_{-0,12}$	$28_{-0,3}$	66	6
60	–	GE 60 UK-2RS	0,98	$60_{-0,015}$	$90_{-0,015}$	$44_{-0,15}$	$36_{-0,4}$	80	6
70	–	GE 70 UK-2RS	1,5	$70_{-0,015}$	$105_{-0,015}$	$49_{-0,15}$	$40_{-0,4}$	92	6
80	–	GE 80 UK-2RS	2,2	$80_{-0,015}$	$120_{-0,015}$	$55_{-0,15}$	$45_{-0,4}$	105	6
90	–	GE 90 UK-2RS	2,7	$90_{-0,02}$	$130_{-0,018}$	$60_{-0,2}$	$50_{-0,5}$	115	5
100	–	GE 100 UK-2RS	4,2	$100_{-0,02}$	$150_{-0,018}$	$70_{-0,2}$	$55_{-0,5}$	130	7
110	–	GE 110 UK-2RS	4,7	$110_{-0,02}$	$160_{-0,025}$	$70_{-0,2}$	$55_{-0,5}$	140	6
120	–	GE 120 UK-2RS	8,1	$120_{-0,02}$	$180_{-0,025}$	$85_{-0,2}$	$70_{-0,5}$	160	6
140	–	GE 140 UK-2RS	10,6	$140_{-0,025}$	$210_{-0,03}$	$90_{-0,25}$	$70_{-0,6}$	180	7
160	–	GE 160 UK-2RS	13,8	$160_{-0,025}$	$230_{-0,03}$	$105_{-0,25}$	$80_{-0,6}$	200	8
180	–	GE 180 UK-2RS	17,4	$180_{-0,025}$	$260_{-0,035}$	$105_{-0,25}$	$80_{-0,7}$	225	6
200	–	GE 200 UK-2RS	26	$200_{-0,03}$	$290_{-0,035}$	$130_{-0,3}$	$100_{-0,7}$	250	7
220	–	GE 220 UK-2RS	35,5	$220_{-0,03}$	$320_{-0,04}$	$135_{-0,3}$	$100_{-0,8}$	275	8
240	–	GE 240 UK-2RS	39	$240_{-0,03}$	$340_{-0,04}$	$140_{-0,3}$	$100_{-0,8}$	300	8
260	–	GE 260 UK-2RS	50,8	$260_{-0,035}$	$370_{-0,04}$	$150_{-0,35}$	$110_{-0,8}$	325	7
280	–	GE 280 UK-2RS	64,7	$280_{-0,035}$	$400_{-0,04}$	$155_{-0,35}$	$120_{-0,8}$	350	6
300	–	GE 300 UK-2RS	76,7	$300_{-0,035}$	$430_{-0,045}$	$165_{-0,35}$	$120_{-0,9}$	375	7

Dimension table · Dimensions in mm

[1] Basic load rating for bearing design GE..UK-2RS.
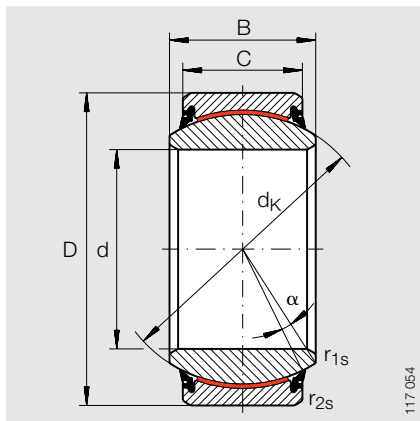
GE..UK-2RS
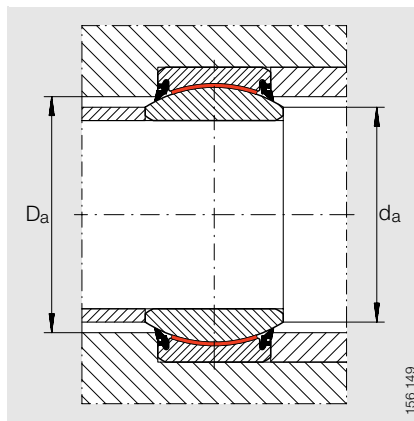
GE..UK-2RS – mounting dimensions
GE..UK – mounting dimensions

Chamfer dimensions		Mounting dimensions		Basic load ratings				Radial internal clearance	Shaft diameter
r_{1s}	r_{2s}	d_a	D_a	dyn. C_r		stat. C_{0r}			
min.	min.	max.	min.	N		N			d
0,3	0,3	8	9,6	3 600	–	9 000	–	0 – 0,032	**6**
0,3	0,3	10,2	12,5	5 850	–	14 600	–	0 – 0,032	**8**
0,3	0,3	13,2	15,5	8 650	–	21 600	–	0 – 0,032	**10**
0,3	0,3	14,9	17,5	11 400	–	28 500	–	0 – 0,032	**12**
0,3	0,3	18,4	21	17 600	–	44 000	–	0 – 0,04	**15**
0,3	0,3	20,7	24	22 400	48 700[1]	56 000	81 200[1]	0 – 0,04	**17**
0,3	0,3	24,1	27,5	31 500	67 500[1]	78 000	112 000[1]	0 – 0,04	**20**
0,6	0,6	29,3	33	51 000	127 000[1]	127 000	212 000[1]	0 – 0,05	**25**
0,6	0,6	34,2	38	65 500	165 000[1]	166 000	275 000[1]	0 – 0,05	**30**
0,6	1	39,7	44,5	–	210 000[1]	–	350 000[1]	0 – 0,05	**35**
0,6	1	45	51	–	277 000[1]	–	462 000[1]	0 – 0,06	**40**
0,6	1	50,7	57	–	360 000[1]	–	600 000[1]	0 – 0,06	**45**
0,6	1	55,9	63	–	442 000[1]	–	737 000[1]	0 – 0,06	**50**
1	1	66,8	75	–	690 000[1]	–	1 150 000[1]	0 – 0,06	**60**
1	1	77,8	87	–	885 000[1]	–	1 475 000[1]	0 – 0,072	**70**
1	1	89,4	99	–	1 125 000[1]	–	1 875 000[1]	0 – 0,072	**80**
1	1	98,1	108	–	1 380 000[1]	–	2 300 000[1]	0 – 0,072	**90**
1	1	109,5	123	–	1 717 000[1]	–	2 862 000[1]	0 – 0,085	**100**
1	1	121,2	134	–	1 845 000[1]	–	3 075 000[1]	0 – 0,085	**110**
1	1	135,5	150	–	2 685 000[1]	–	4 475 000[1]	0 – 0,085	**120**
1	1	155,8	173	–	3 015 000[1]	–	5 025 000[1]	0 – 0,085	**140**
1	1	170,2	191	–	3 840 000[1]	–	6 400 000[1]	0 – 0,1	**160**
1,1	1,1	198,9	219	–	4 320 000[1]	–	7 200 000[1]	0 – 0,1	**180**
1,1	1,1	213,5	239	–	6 000 000[1]	–	10 000 000[1]	0 – 0,1	**200**
1,1	1,1	239,5	267	–	6 600 000[1]	–	11 000 000[1]	0 – 0,1	**220**
1,1	1,1	265,3	295	–	7 200 000[1]	–	12 000 000[1]	0 – 0,1	**240**
1,1	1,1	288,3	319	–	8 550 000[1]	–	14 250 000[1]	0 – 0,11	**260**
1,1	1,1	313,8	342	–	10 050 000[1]	–	16 750 000[1]	0 – 0,11	**280**
1,1	1,1	336,7	370	–	10 800 000[1]	–	18 000 000[1]	0 – 0,11	**300**

Large radial spherical plain bearings

maintenance-free
ISO 12 240-1, dimension series C
Sliding contact surface: Hard chromium/ELGOGLIDE®

Series GE..DW
        GE..DW-2RS2

GE..DW

Dimension table · Dimensions in mm

Shaft diameter	Designation[1]		Mass	Dimensions					
				d	D	B	C	d_K	α
d	without seals	with seals	$\approx$ kg						Degrees
320	GE 320 DW	GE 320 DW-2RS2	76	$320_{-0,04}$	$440_{-0,045}$	$160_{-0,4}$	$135_{-0,9}$	380	4
340	GE 340 DW	GE 340 DW-2RS2	80	$340_{-0,04}$	$460_{-0,045}$	$160_{-0,4}$	$135_{-0,9}$	400	3,8
360	GE 360 DW	GE 360 DW-2RS2	86	$360_{-0,04}$	$480_{-0,045}$	$160_{-0,4}$	$135_{-0,9}$	420	3,6
380	GE 380 DW	GE 380 DW-2RS2	124,5	$380_{-0,04}$	$520_{-0,05}$	$190_{-0,4}$	160_{-1}	450	4,1
400	GE 400 DW	GE 400 DW-2RS2	131	$400_{-0,04}$	$540_{-0,05}$	$190_{-0,4}$	160_{-1}	470	3,9
420	GE 420 DW	GE 420 DW-2RS2	143	$420_{-0,045}$	$560_{-0,05}$	$190_{-0,45}$	160_{-1}	490	3,7
440	GE 440 DW	GE 440 DW-2RS2	194	$440_{-0,045}$	$600_{-0,05}$	$218_{-0,45}$	185_{-1}	520	3,9
460	GE 460 DW	GE 460 DW-2RS2	199	$460_{-0,045}$	$620_{-0,05}$	$218_{-0,45}$	185_{-1}	540	3,7
480	GE 480 DW	GE 480 DW-2RS2	234	$480_{-0,045}$	$650_{-0,075}$	$230_{-0,45}$	$195_{-1,1}$	565	3,8
500	GE 500 DW	GE 500 DW-2RS2	243	$500_{-0,045}$	$670_{-0,075}$	$230_{-0,45}$	$195_{-1,1}$	585	3,6
530	GE 530 DW	GE 530 DW-2RS2	291	$530_{-0,05}$	$710_{-0,075}$	$243_{-0,5}$	$205_{-1,1}$	620	3,7
560	GE 560 DW	GE 560 DW-2RS2	342	$560_{-0,05}$	$750_{-0,075}$	$258_{-0,5}$	$215_{-1,1}$	655	4
600	GE 600 DW	GE 600 DW-2RS2	409	$600_{-0,05}$	$800_{-0,075}$	$272_{-0,5}$	$230_{-1,1}$	700	3,6
630	GE 630 DW	GE 630 DW-2RS2	542	$630_{-0,05}$	$850_{-0,1}$	$300_{-0,5}$	$260_{-1,2}$	740	3,3
670	GE 670 DW	GE 670 DW-2RS2	594	$670_{-0,075}$	$900_{-0,1}$	$308_{-0,75}$	$260_{-1,2}$	785	3,7
710	GE 710 DW	GE 710 DW-2RS2	698	$710_{-0,075}$	$950_{-0,1}$	$325_{-0,75}$	$275_{-1,2}$	830	3,7
750	GE 750 DW	GE 750 DW-2RS2	784	$750_{-0,075}$	$1000_{-0,1}$	$335_{-0,75}$	$280_{-1,2}$	875	3,8
800	GE 800 DW	GE 800 DW-2RS2	920	$800_{-0,075}$	$1060_{-0,125}$	$355_{-0,75}$	$300_{-1,3}$	930	3,6
850	GE 850 DW	GE 850 DW-2RS2	1058	$850_{-0,1}$	$1120_{-0,125}$	365_{-1}	$310_{-1,3}$	985	3,4
900	GE 900 DW	GE 900 DW-2RS2	1192	$900_{-0,1}$	$1180_{-0,125}$	375_{-1}	$320_{-1,3}$	1040	3,2
950	GE 950 DW	GE 950 DW-2RS2	1431	$950_{-0,1}$	$1250_{-0,125}$	400_{-1}	$340_{-1,3}$	1100	3,3
1000	GE 1000 DW	GE 1000 DW-2RS2	1755	$1000_{-0,1}$	$1320_{-0,16}$	438_{-1}	$370_{-1,6}$	1160	3,5

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

[1] Price and delivery on request.

[2] Basic load ratings for bearings without seals.

[3] Basic load ratings for bearings with seals.
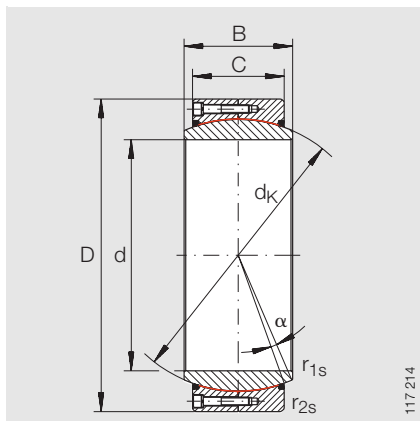
GE..DW-2RS2
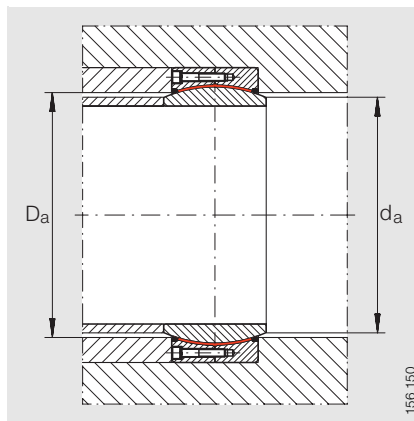
GE..DW-2RS2 – mounting dimensions
GE..DW – mounting dimensions

Detail

Chamfer dimensions		Mounting dimensions		Basic load ratings				Radial internal clearance	Shaft diameter
r_{1s}	r_{2s}	d_a	D_a	dyn.[2] C_r	stat.[2] C_{0r}	dyn.[3] C_r	stat.[3] C_{0r}		
min.	min.	max.	min.	kN	kN	kN	kN		d
1,1	3	344,6	361	15 390	25 650	12 920	21 540	0 – 0,125	*320*
1,1	3	366,6	382	16 200	27 000	13 600	22 680	0 – 0,125	*340*
1,1	3	388,3	403	17 010	28 350	14 280	23 810	0 – 0,135	*360*
1,5	4	407,9	426	21 600	36 000	18 680	31 140	0 – 0,135	*380*
1,5	4	429,8	447	22 560	37 600	19 510	32 520	0 – 0,135	*400*
1,5	4	451,6	469	23 520	39 200	20 340	33 900	0 – 0,135	*420*
1,5	4	472	491	28 860	48 100	24 490	40 820	0 – 0,145	*440*
1,5	4	494	513	29 970	49 950	25 430	42 390	0 – 0,145	*460*
2	5	516	536	33 050	55 080	28 300	47 170	0 – 0,145	*480*
2	5	537,8	557	34 220	57 030	29 300	48 840	0 – 0,145	*500*
2	5	570,3	591	38 130	63 550	32 920	54 870	0 – 0,145	*530*
2	5	602	624	42 240	70 410	36 740	61 240	0 – 0,16	*560*
2	5	644,9	667	48 300	80 500	42 420	70 700	0 – 0,16	*600*
3	6	676,4	698	57 720	96 200	51 500	85 840	0 – 0,16	*630*
3	6	722	746	61 230	102 050	54 630	91 060	0 – 0,16	*670*
3	6	763,7	789	68 470	114 120	60 850	101 420	0 – 0,17	*710*
3	6	808,3	834	73 500	122 500	65 460	109 110	0 – 0,17	*750*
3	6	859,5	886	83 700	139 500	75 160	125 270	0 – 0,17	*800*
3	6	914,8	940	91 600	152 670	82 560	137 600	0 – 0,17	*850*
3	6	970	995	99 840	166 400	90 290	150 480	0 – 0,17	*900*
4	7,5	1024,6	1052	112 200	187 000	102 100	170 170	0 – 0,17	*950*
4	7,5	1074,1	1105	128 760	214 600	118 110	196 850	0 – 0,195	*1000*

Radial spherical plain bearings
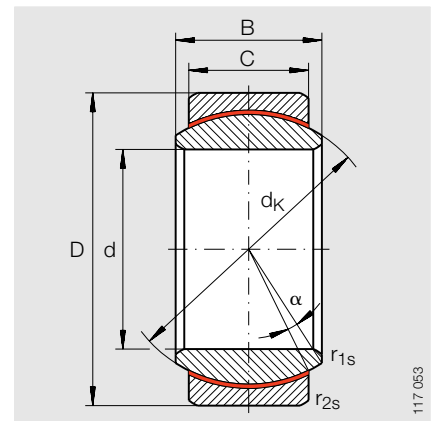
maintenance-free
ISO 12 240-1, dimension series G
Sliding contact surface: hard chromium/PTFE

Series GE..FW
   Sliding material: PTFE composite

   GE..FW-2RS
   Sliding material: ELGOGLIDE®

GE..FW

Shaft diameter	Designation		Mass	Dimensions					
				d	D	B	C	d_K	α
d	without seals	with seals	≈kg						Degrees
6	GE 6 FW[1]	–	0,009	$6_{-0,008}$	$16_{-0,008}$	$9_{-0,12}$	$5_{-0,24}$	13	21
8	GE 8 FW[1]	–	0,014	$8_{-0,008}$	$19_{-0,009}$	$11_{-0,12}$	$6_{-0,24}$	16	21
10	GE 10 FW	–	0,02	$10_{-0,008}$	$22_{-0,009}$	$12_{-0,12}$	$7_{-0,24}$	18	18
12	GE 12 FW	–	0,036	$12_{-0,008}$	$26_{-0,009}$	$15_{-0,12}$	$9_{-0,24}$	22	18
15	GE 15 FW	–	0,049	$15_{-0,008}$	$30_{-0,009}$	$16_{-0,12}$	$10_{-0,24}$	25	16
17	GE 17 FW	–	0,082	$17_{-0,008}$	$35_{-0,011}$	$20_{-0,12}$	$12_{-0,24}$	29	19
20	GE 20 FW	–	0,16	$20_{-0,01}$	$42_{-0,011}$	$25_{-0,12}$	$16_{-0,24}$	35,5	17
25	GE 25 FW	–	0,2	$25_{-0,01}$	$47_{-0,011}$	$28_{-0,12}$	$18_{-0,24}$	40,7	17
30	–	GE 30 FW-2RS	0,28	$30_{-0,01}$	$55_{-0,013}$	$32_{-0,12}$	$20_{-0,3}$	47	17
35	–	GE 35 FW-2RS	0,38	$35_{-0,012}$	$62_{-0,013}$	$35_{-0,12}$	$22_{-0,3}$	53	16
40	–	GE 40 FW-2RS	0,53	$40_{-0,012}$	$68_{-0,013}$	$40_{-0,12}$	$25_{-0,3}$	60	17
45	–	GE 45 FW-2RS	0,67	$45_{-0,012}$	$75_{-0,013}$	$43_{-0,12}$	$28_{-0,3}$	66	15
50	–	GE 50 FW-2RS	1,4	$50_{-0,012}$	$90_{-0,015}$	$56_{-0,15}$	$36_{-0,4}$	80	17
60	–	GE 60 FW-2RS	2,1	$60_{-0,015}$	$105_{-0,015}$	$63_{-0,15}$	$40_{-0,4}$	92	17
70	–	GE 70 FW-2RS	3	$70_{-0,015}$	$120_{-0,015}$	$70_{-0,15}$	$45_{-0,4}$	105	16
80	–	GE 80 FW-2RS	3,6	$80_{-0,015}$	$130_{-0,018}$	$75_{-0,2}$	$50_{-0,5}$	115	14
90	–	GE 90 FW-2RS	5,3	$90_{-0,02}$	$150_{-0,018}$	$85_{-0,2}$	$55_{-0,5}$	130	15
100	–	GE 100 FW-2RS[1]	6	$100_{-0,02}$	$160_{-0,025}$	$85_{-0,2}$	$55_{-0,5}$	140	14
110	–	GE 110 FW-2RS[1]	9,8	$110_{-0,02}$	$180_{-0,025}$	$100_{-0,2}$	$70_{-0,5}$	160	12
120	–	GE 120 FW-2RS[1]	14,6	$120_{-0,02}$	$210_{-0,03}$	$115_{-0,2}$	$70_{-0,6}$	180	16
140	–	GE 140 FW-2RS[1]	18,6	$140_{-0,025}$	$230_{-0,03}$	$130_{-0,25}$	$80_{-0,6}$	200	16
160	–	GE 160 FW-2RS[1]	24,9	$160_{-0,025}$	$260_{-0,035}$	$135_{-0,25}$	$80_{-0,7}$	225	16
180	–	GE 180 FW-2RS[1]	33,6	$180_{-0,025}$	$290_{-0,035}$	$155_{-0,3}$	$100_{-0,7}$	250	14
200	–	GE 200 FW-2RS[1]	44,7	$200_{-0,03}$	$320_{-0,04}$	$165_{-0,3}$	$100_{-0,8}$	275	15
220	–	GE 220 FW-2RS[1]	50,8	$220_{-0,03}$	$340_{-0,04}$	$175_{-0,3}$	$100_{-0,8}$	300	16
240	–	GE 240 FW-2RS[1]	64	$240_{-0,03}$	$370_{-0,04}$	$190_{-0,35}$	$110_{-0,8}$	325	15
260	–	GE 260 FW-2RS[1]	81,8	$260_{-0,035}$	$400_{-0,04}$	$205_{-0,35}$	$120_{-0,8}$	350	15
280	–	GE 280 FW-2RS[1]	96,5	$280_{-0,035}$	$430_{-0,045}$	$210_{-0,35}$	$120_{-0,9}$	375	15

Dimension table · Dimensions in mm

[1] Price and delivery on request.
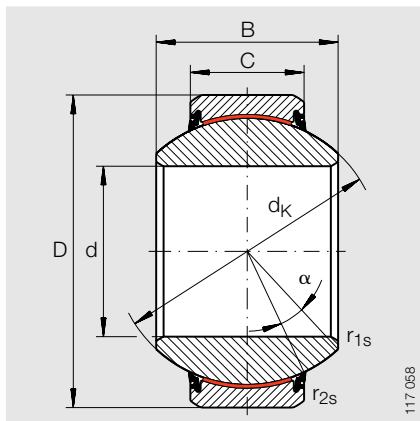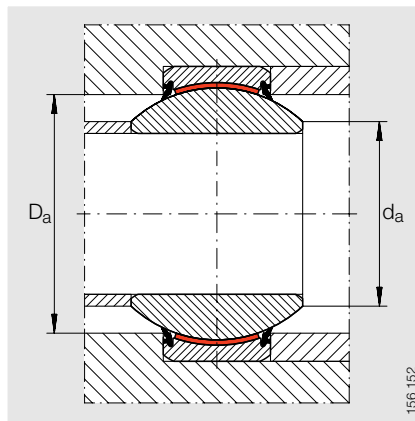
GE..FW-2RS

GE..FW-2RS – mounting dimensions
GE..FW – mounting dimensions

Chamfer dimensions		Mounting dimensions		Basic load ratings		Radial internal clearance	Shaft diameter
r_{1s}	r_{2s}	d_a	D_a	dyn. C_r	stat. C_{0r}		
min.	min.	max.	min.	N	N		d
0,3	0,3	9,3	12,5	5 850	14 600	0 – 0,032	**6**
0,3	0,3	11,6	15,5	8 650	21 600	0 – 0,032	**8**
0,3	0,3	13,4	17,5	11 400	28 500	0 – 0,032	**10**
0,3	0,3	16	21	17 600	44 000	0 – 0,04	**12**
0,3	0,3	19,2	24	22 400	56 000	0 – 0,04	**15**
0,3	0,3	21	27,5	31 500	78 000	0 – 0,04	**17**
0,6	0,6	25,2	33	51 000	127 000	0 – 0,05	**20**
0,6	0,6	29,5	38	65 500	166 000	0 – 0,05	**25**
0,6	1	34,4	44,5	210 000	350 000	0 – 0,05	**30**
0,6	1	39,7	51	277 000	462 000	0 – 0,06	**35**
0,6	1	44,7	57	360 000	600 000	0 – 0,06	**40**
0,6	1	50	63	442 000	737 000	0 – 0,06	**45**
0,6	1	57,1	75	690 000	1 150 000	0 – 0,06	**50**
1	1	67	87	885 000	1 475 000	0 – 0,072	**60**
1	1	78,2	99	1 125 000	1 875 000	0 – 0,072	**70**
1	1	87,1	108	1 380 000	2 300 000	0 – 0,072	**80**
1	1	98,3	123	1 717 000	2 862 000	0 – 0,085	**90**
1	1	111,2	134	1 845 000	3 075 000	0 – 0,085	**100**
1	1	124,8	150	2 685 000	4 475 000	0 – 0,085	**110**
1	1	138,4	173	3 015 000	5 025 000	0 – 0,085	**120**
1	1	151,9	191	3 840 000	6 400 000	0 – 0,1	**140**
1	1,1	180	219	4 320 000	7 200 000	0 – 0,1	**160**
1,1	1,1	196,1	239	6 000 000	10 000 000	0 – 0,1	**180**
1,1	1,1	220	267	6 600 000	11 000 000	0 – 0,1	**200**
1,1	1,1	243,6	295	7 200 000	12 000 000	0 – 0,1	**220**
1,1	1,1	263,6	319	8 550 000	14 250 000	0 – 0,1	**240**
1,1	1,1	283,6	342	10 050 000	16 750 000	0 – 0,11	**260**
1,1	1,1	310,6	370	10 800 000	18 000 000	0 – 0,11	**280**

Radial spherical plain bearings

maintenance-free
ISO 12 240-1, dimension series K
Sliding contact surface: Steel/PTFE-bronze film

Series GE..PW

GE..PW

Dimension table · Dimensions in mm

Shaft diameter	Designation[3]	Mass	Dimensions					
			d[1]	D	B	C	d_K	α
d		≈kg						Degrees
5	GE 5 PW	0,006	$5^{+0,012}$	$13_{-0,008}$	$8_{-0,12}$	$6_{-0,24}$	11,112	13
6	GE 6 PW	0,01	$6^{+0,012}$	$16_{-0,008}$	$9_{-0,12}$	$6,75_{-0,24}$	12,7	13
8	GE 8 PW	0,019	$8^{+0,015}$	$19_{-0,009}$	$12_{-0,12}$	$9_{-0,24}$	15,875	14
10	GE 10 PW	0,027	$10^{+0,015}$	$22_{-0,009}$	$14_{-0,12}$	$10,5_{-0,24}$	19,05	13
12	GE 12 PW	0,043	$12^{+0,018}$	$26_{-0,009}$	$16_{-0,12}$	$12_{-0,24}$	22,225	13
14	GE 14 PW	0,054	$14^{+0,018}$	$28_{-0,009}$[2]	$19_{-0,12}$	$13,5_{-0,24}$	25,4	16
16	GE 16 PW	0,079	$16^{+0,018}$	$32_{-0,011}$	$21_{-0,12}$	$15_{-0,24}$	28,575	15
18	GE 18 PW	0,1	$18^{+0,018}$	$35_{-0,011}$	$23_{-0,12}$	$16,5_{-0,24}$	31,75	15
20	GE 20 PW	0,15	$20^{+0,021}$	$40_{-0,011}$	$25_{-0,12}$	$18_{-0,24}$	34,925	14
22	GE 22 PW	0,18	$22^{+0,021}$	$42_{-0,011}$	$28_{-0,12}$	$20_{-0,24}$	38,1	15
25	GE 25 PW	0,24	$25^{+0,021}$	$47_{-0,011}$	$31_{-0,12}$	$22_{-0,24}$	42,85	15
30	GE 30 PW	0,38	$30^{+0,021}$	$55_{-0,013}$	$37_{-0,12}$	$25_{-0,3}$	50,8	17

[1] Bore tolerance: H7 (arithmetic mean value).

[2] Deviating from ISO 12 240-1, dimension series K.

[3] Price and delivery on request.

GE..PW – mounting dimensions

Chamfer dimensions		Mounting dimensions		Basic load ratings		Radial internal clearance	Shaft diameter
r_{1s}	r_{2s}	d_a	D_a	dyn. C_r	stat. C_{0r}		
min.	min.	max.	min.	N	N		d
0,3	0,3	7,7	9,8	6 000	15 000	0,006 – 0,035	**5**
0,3	0,3	8,9	11,5	7 650	19 300	0,006 – 0,035	**6**
0,3	0,3	10,3	14	12 900	32 000	0,006 – 0,035	**8**
0,3	0,3	12,9	17	18 000	45 000	0,006 – 0,035	**10**
0,3	0,3	15,4	19,5	24 000	60 000	0,006 – 0,035	**12**
0,3	0,3	16,8	22,5	31 000	76 500	0,006 – 0,035	**14**
0,3	0,3	19,3	25,5	39 000	96 500	0,006 – 0,035	**16**
0,3	0,3	21,8	28,5	47 500	118 000	0,006 – 0,035	**18**
0,3	0,6	24,3	31,5	57 000	140 000	0,006 – 0,035	**20**
0,3	0,6	25,8	34	68 000	170 000	0,006 – 0,035	**22**
0,3	0,6	29,5	38,5	85 000	212 000	0,006 – 0,035	**25**
0,3	0,6	34,8	46	114 000	285 000	0,006 – 0,035	**30**

Angular contact spherical plain bearings

maintenance-free
ISO 12 240-2
Sliding contact surface: Hard chromium/ELGOGLIDE®

Series GE..SW
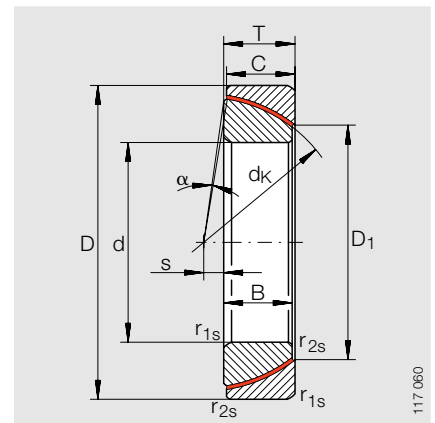
GE..SW

Shaft diameter d	Designation	Mass ≈kg	Dimensions						
			d	D	T	d_K	D_1	B	C
25	GE 25 SW	0,13	$25_{-0,012}$	$47_{-0,014}$	$15\pm0,25$	42,5	31,4	$14_{-0,2}$	$14_{-0,2}$
28	GE 28 SW[1]	0,18	$28_{-0,012}$	$52_{-0,016}$	$16\pm0,25$	47	35,7	$15_{-0,2}$	$15_{-0,2}$
30	GE 30 SW	0,21	$30_{-0,012}$	$55_{-0,016}$	$17\pm0,25$	50	36,1	$16_{-0,2}$	$16_{-0,2}$
35	GE 35 SW	0,27	$35_{-0,012}$	$62_{-0,016}$	$18\pm0,25$	56	42,4	$17_{-0,24}$	$17_{-0,24}$
40	GE 40 SW	0,33	$40_{-0,012}$	$68_{-0,016}$	$19\pm0,25$	60	46,8	$18_{-0,24}$	$18_{-0,24}$
45	GE 45 SW	0,41	$45_{-0,012}$	$75_{-0,016}$	$20\pm0,25$	66	52,9	$19_{-0,24}$	$19_{-0,24}$
50	GE 50 SW	0,45	$50_{-0,012}$	$80_{-0,016}$	$20\pm0,25$	74	59,1	$19_{-0,24}$	$19_{-0,24}$
55	GE 55 SW[1]	0,67	$55_{-0,015}$	$90_{-0,018}$	$23\pm0,25$	80	62	$22_{-0,3}$	$22_{-0,3}$
60	GE 60 SW	0,72	$60_{-0,015}$	$95_{-0,018}$	$23\pm0,25$	86	68,1	$22_{-0,3}$	$22_{-0,3}$
65	GE 65 SW[1]	0,77	$65_{-0,015}$	$100_{-0,018}$	$23\pm0,25$	92	75,6	$22_{-0,3}$	$22_{-0,3}$
70	GE 70 SW	1	$70_{-0,015}$	$110_{-0,018}$	$25\pm0,25$	102	82,2	$24_{-0,3}$	$24_{-0,3}$
80	GE 80 SW	1,5	$80_{-0,015}$	$125_{-0,02}$	$29\pm0,25$	115	90,5	$27_{-0,3}$	$27_{-0,3}$
90	GE 90 SW	2,1	$90_{-0,02}$	$140_{-0,02}$	$32\pm0,25$	130	103,3	$30_{-0,4}$	$30_{-0,4}$
100	GE 100 SW	2,3	$100_{-0,02}$	$150_{-0,02}$	$32\pm0,25$	140	114,3	$30_{-0,4}$	$30_{-0,4}$
110	GE 110 SW[1]	3,7	$110_{-0,02}$	$170_{-0,025}$	$38\pm0,25$	160	125,8	$36_{-0,4}$	$36_{-0,4}$
120	GE 120 SW	3,9	$120_{-0,02}$	$180_{-0,025}$	$38\pm0,25$	170	135,4	$36_{-0,4}$	$36_{-0,4}$
130	GE 130 SW[1]	6,1	$130_{-0,025}$	$200_{-0,03}$	$45\pm0,35$	190	148	$42_{-0,5}$	$42_{-0,5}$
140	GE 140 SW[1]	6,4	$140_{-0,025}$	$210_{-0,03}$	$45\pm0,35$	200	160,6	$42_{-0,5}$	$42_{-0,5}$
150	GE 150 SW[1]	7,8	$150_{-0,025}$	$225_{-0,03}$	$48\pm0,35$	213	170,9	$45_{-0,5}$	$45_{-0,5}$
160	GE 160 SW[1]	9,5	$160_{-0,025}$	$240_{-0,03}$	$51\pm0,35$	225	181,4	$48_{-0,5}$	$48_{-0,5}$
170	GE 170 SW[1]	13	$170_{-0,025}$	$260_{-0,035}$	$57\pm0,35$	250	194,3	$54_{-0,5}$	$54_{-0,5}$
180	GE 180 SW[1]	17,4	$180_{-0,025}$	$280_{-0,035}$	$64\pm0,35$	260	205,5	$61_{-0,5}$	$61_{-0,5}$
190	GE 190 SW[1]	18,2	$190_{-0,03}$	$290_{-0,035}$	$64\pm0,35$	275	211,8	$61_{-0,6}$	$61_{-0,6}$
200	GE 200 SW[1]	23,3	$200_{-0,03}$	$310_{-0,035}$	$70\pm0,35$	290	229,2	$66_{-0,6}$	$66_{-0,6}$

Dimension table · Dimensions in mm

[1] Price and delivery on request.
[2] Basic load ratings in radial direction.

GE..SW – mounting dimensions

Detail

		Chamfer dimensions		Mounting dimensions				Basic load ratings[2)		Shaft diameter
s	α	r_{1s}	r_{2s}	d_a	d_b	D_a	D_b	dyn. C_r	stat. C_{0r}	
	Degrees	min.	min.	max.	max.	min.	min.	N	N	d
1	2,7	0,6	0,2	30,1	39,5	34	43	143 000	239 000	**25**
1	2,4	1	0,3	34,4	42	40	47,5	172 000	287 000	**28**
2	2,3	1	0,3	34,6	45	40,5	50,5	193 000	323 000	**30**
2	2,1	1	0,3	41,1	50	47	57	235 000	392 000	**35**
1,5	1,9	1	0,3	45,5	54	52	61	272 000	453 000	**40**
1,5	1,7	1	0,3	51,7	60	58	67	319 000	532 000	**45**
4	1,6	1	0,3	57,9	67	65	75	354 000	590 000	**50**
4	1,4	1,5	0,6	60,7	71	70	81	447 000	745 000	**55**
5	1,3	1,5	0,6	66,9	77	76	87	481 000	802 000	**60**
5	1,3	1,5	0,6	74,4	83	84	93	520 000	867 000	**65**
7	1,1	1,5	0,6	80,9	92	90	104	626 000	1 040 000	**70**
10	2	1,5	0,6	88	104	99	117	733 000	1 220 000	**80**
11	1,8	2	0,6	100,8	118	112	132	939 000	1 560 000	**90**
12	1,7	2	0,6	112	128	123	142	1 010 000	1 690 000	**100**
15	1,5	2,5	0,6	123,2	146	135	162	1 400 000	2 340 000	**110**
17	1,4	2,5	0,6	132,9	155	145	172	1 490 000	2 490 000	**120**
20	1,9	2,5	0,6	143,9	174	158	192	1 860 000	3 110 000	**130**
20	1,8	2,5	0,6	156,9	184	171	202	1 990 000	3 310 000	**140**
21	1,7	3	1	167,1	194	184	216	2 290 000	3 820 000	**150**
21	1,6	3	1	177,7	206	195	228	2 610 000	4 360 000	**160**
27	1,4	3	1	190,4	228	208	253	3 260 000	5 440 000	**170**
21	1,3	3	1	201,7	240	220	263	3 950 000	6 590 000	**180**
29	1,3	3	1	207,9	252	226	278	4 110 000	6 850 000	**190**
26	1,6	3	1	224,1	268	244	293	4 640 000	7 740 000	**200**

Axial spherical plain bearings

maintenance-free
ISO 12 240-3
Sliding contact surface: Hard chromium/ELGOGLIDE®

Series GE..AW

GE..AW

Dimension table · Dimensions in mm									
Shaft diameter	Designation	Mass	Dimensions						
			d	D	T	d_K	d_2	d_3	D_1
d		$\approx$kg							
10	**GE 10 AW[1]**	0,038	$10_{-0,008}$	$30_{-0,009}$	$9,5_{-0,4}$	32	27,5	21	16,5
12	**GE 12 AW[1]**	0,07	$12_{-0,008}$	$35_{-0,011}$	$13_{-0,4}$	37	32	24	19,5
15	**GE 15 AW[1]**	0,12	$15_{-0,008}$	$42_{-0,011}$	$15_{-0,4}$	45	38,9	29	24
17	**GE 17 AW**	0,16	$17_{-0,008}$	$47_{-0,011}$	$16_{-0,4}$	50	43,4	34	28
20	**GE 20 AW**	0,26	$20_{-0,01}$	$55_{-0,013}$	$20_{-0,4}$	60	50	40	33,5
25	**GE 25 AW**	0,39	$25_{-0,01}$	$62_{-0,013}$	$22,5_{-0,4}$	66	57,5	45	34,5
30	**GE 30 AW**	0,65	$30_{-0,01}$	$75_{-0,013}$	$26_{-0,4}$	80	69	56	44
35	**GE 35 AW**	1	$35_{-0,012}$	$90_{-0,015}$	$28_{-0,4}$	98	84	66	52
40	**GE 40 AW**	1,6	$40_{-0,012}$	$105_{-0,015}$	$32_{-0,4}$	114	98	78	59
45	**GE 45 AW**	2,5	$45_{-0,012}$	$120_{-0,015}$	$36,5_{-0,4}$	130	112	89	68
50	**GE 50 AW**	3,4	$50_{-0,012}$	$130_{-0,018}$	$42,5_{-0,4}$	140	122,5	98	69
60	**GE 60 AW**	4,7	$60_{-0,015}$	$150_{-0,018}$	$45_{-0,4}$	160	140	108	86
70	**GE 70 AW**	5,7	$70_{-0,015}$	$160_{-0,025}$	$50_{-0,4}$	170	149,5	121	95
80	**GE 80 AW**	7,2	$80_{-0,015}$	$180_{-0,025}$	$50_{-0,4}$	194	168	130	108
100	**GE 100 AW**	10,9	$100_{-0,02}$	$210_{-0,03}$	$59_{-0,4}$	220	195,5	155	133
120	**GE 120 AW**	13	$120_{-0,02}$	$230_{-0,03}$	$64_{-0,4}$	245	214	170	154
140	**GE 140 AW[1]**	18,3	$140_{-0,025}$	$260_{-0,035}$	$72_{-0,5}$	272	244	198	176
160	**GE 160 AW[1]**	23,8	$160_{-0,025}$	$290_{-0,035}$	$77_{-0,5}$	310	272	213	199
180	**GE 180 AW[1]**	31,5	$180_{-0,025}$	$320_{-0,04}$	$86_{-0,5}$	335	300	240	224
200	**GE 200 AW[1]**	34,7	$200_{-0,03}$	$340_{-0,04}$	$87_{-0,6}$	358	321	265	246
220	**GE 220 AW[1]**	44,7	$220_{-0,03}$	$370_{-0,04}$	$97_{-0,6}$	388	350	289	265
240	**GE 240 AW[1]**	56,9	$240_{-0,03}$	$400_{-0,04}$	$103_{-0,6}$	420	382	314	294
260	**GE 260 AW[1]**	71,3	$260_{-0,035}$	$430_{-0,045}$	$115_{-0,7}$	449	409	336	317
280	**GE 280 AW[1]**	84	$280_{-0,035}$	$460_{-0,045}$	$110_{-0,7}$	480	445	366	337
300	**GE 300 AW[1]**	88,5	$300_{-0,035}$	$480_{-0,045}$	$110_{-0,7}$	490	460	388	356
320	**GE 320 AW[1]**	111	$320_{-0,04}$	$520_{-0,05}$	$116_{-0,8}$	540	500	405	380
340	**GE 340 AW[1]**	117	$340_{-0,04}$	$540_{-0,05}$	$116_{-0,8}$	550	510	432	380
360	**GE 360 AW[1]**	132	$360_{-0,04}$	$560_{-0,05}$	$125_{-0,8}$	575	535	452	400

[1] Price and delivery on request.

[2] Basic load ratings in axial direction.
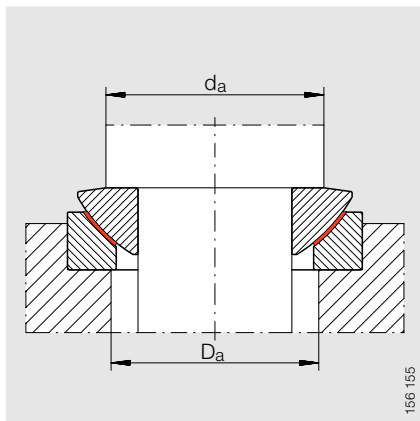
GE..AW – mounting dimensions

Detail

B	C	s	α	Chamfer dimensions		Mounting dimensions		Basic load ratings[2]		Shaft diameter
				r_{1s}	r_{2s}	d_a	D_a	dyn. C_a	stat. C_{0a}	
			Degrees	min.	min.	max.	min.	N	N	d
7,9 −0,24	6 −0,24	7	10	0,6	0,2	21	18,5	73 200	122 000	**10**
9,3 −0,24	9 −0,24	8	9	0,6	0,2	24	21,5	97 200	162 000	**12**
10,7 −0,24	11 −0,24	10	7	0,6	0,2	29	26	156 000	261 000	**15**
11,5 −0,24	11,5 −0,24	11	6	0,6	0,2	34	30,5	177 000	296 000	**17**
14,3 −0,24	13 −0,24	12,5	6	1	0,3	40	38	225 000	375 000	**20**
16 −0,24	17 −0,24	14	7	1	0,3	45	39	387 000	645 000	**25**
18 −0,24	19,5 −0,24	17,5	6	1	0,3	56	49	508 000	848 000	**30**
22 −0,24	20 −0,24	22	6	1	0,3	66	57	777 000	1 290 000	**35**
27 −0,24	22 −0,24	24,5	6	1	0,3	78	64	1 120 000	1 860 000	**40**
31 −0,24	25 −0,24	27,5	6	1	0,3	89	74	1 450 000	2 430 000	**45**
33,5 −0,24	32 −0,24	30	5	1	0,3	98	75	1 950 000	3 250 000	**50**
37 −0,3	33 −0,3	35	7	1	0,3	108	92	2 200 000	3 670 000	**60**
40 −0,3	36 −0,3	35	6	1	0,3	121	102	2 420 000	4 030 000	**70**
42 −0,3	36 −0,3	42,5	6	1	0,3	130	115	3 110 000	5 180 000	**80**
50 −0,4	42 −0,4	45	7	1	0,3	155	141	3 610 000	6 020 000	**100**
52 −0,4	45 −0,4	52,5	8	1	0,3	170	162	3 730 000	6 220 000	**120**
61 −0,5	50 −0,5	52,5	6	1,5	0,6	198	187	4 900 000	8 170 000	**140**
65 −0,5	52 −0,5	65	7	1,5	0,6	213	211	5 670 000	9 460 000	**160**
70 −0,5	60 −0,5	67,5	8	1,5	0,6	240	236	6 380 000	10 630 000	**180**
74 −0,6	60 −0,6	70	8	1,5	0,6	265	259	7 070 000	11 780 000	**200**
82 −0,6	67 −0,6	75	7	1,5	0,6	289	279	8 530 000	14 220 000	**220**
87 −0,6	73 −0,6	77,5	6	1,5	0,6	314	309	10 300 000	17 170 000	**240**
95 −0,7	80 −0,7	82,5	7	1,5	0,6	336	332	10 810 000	18 010 000	**260**
100 −0,7	85 −0,7	80	4	3	1	366	355	17 130 000	28 560 000	**280**
100 −0,7	90 −0,7	80	3,5	3	1	388	375	17 280 000	28 800 000	**300**
105 −0,8	91 −0,8	95	4	4	1,1	405	402	21 110 000	35 180 000	**320**
105 −0,8	91 −0,8	95	4	4	1,1	432	402	23 670 000	39 460 000	**340**
115 −0,8	95 −0,8	95	4	4	1,1	452	422	25 470 000	42 460 000	**360**

Maintenance-free cylindrical plain bushes[1]

to ISO 4 379[2]
ELGOGLIDE® lining

Series ZGB

ZGB

Dimension table · Dimensions in mm

Shaft diameter d	Designation	Mass ≈kg	Dimensions d	D	B	f	Basic load ratings dyn. C_r N	stat. C_{0r} N
30	ZGB 30× 36× 30	0,063	$30^{+0,033}$	$36^{+0,051}_{+0,026}$	$30_{-0,21}$	$1,5 \pm 0,5$	270 000	360 000
35	ZGB 35× 41× 30	0,072	$35^{+0,039}$	$41^{+0,051}_{+0,026}$	$30_{-0,21}$	$1,5 \pm 0,5$	315 000	420 000
40	ZGB 40× 48× 40	0,16	$40^{+0,039}$	$48^{+0,051}_{+0,026}$	$40_{-0,25}$	$2 \pm 0,7$	480 000	640 000
45	ZGB 45× 53× 40	0,17	$45^{+0,039}$	$53^{+0,062}_{+0,032}$	$40_{-0,25}$	$2 \pm 0,7$	540 000	720 000
50	ZGB 50× 58× 50	0,24	$50^{+0,039}$	$58^{+0,062}_{+0,032}$	$50_{-0,25}$	$2 \pm 0,7$	750 000	1 000 000
60	ZGB 60× 70× 60	0,44	$60^{+0,046}$	$70^{+0,062}_{+0,032}$	$60_{-0,3}$	$2 \pm 0,7$	1 080 000	1 440 000
70	ZGB 70× 80× 70	0,59	$70^{+0,046}$	$80^{+0,072}_{+0,037}$	$70_{-0,3}$	3 ± 1	1 470 000	1 960 000
80	ZGB 80× 90× 80	0,75	$80^{+0,046}$	$90^{+0,072}_{+0,037}$	$80_{-0,3}$	3 ± 1	1 920 000	2 560 000
90	ZGB 90×105× 80	1,36	$90^{+0,054}$	$105^{+0,072}_{+0,037}$	$80_{-0,3}$	3 ± 1	2 160 000	2 880 000
100	ZGB 100×115×100	1,9	$100^{+0,054}$	$115^{+0,072}_{+0,037}$	$100_{-0,35}$	3 ± 1	3 000 000	4 000 000
110	ZGB 110×125×100	2	$110^{+0,054}$	$125^{+0,083}_{+0,043}$	$100_{-0,35}$	4 ± 1	3 300 000	4 400 000
120	ZGB 120×135×120	2,6	$120^{+0,054}$	$135^{+0,083}_{+0,043}$	$120_{-0,35}$	4 ± 1	4 320 000	5 760 000
140	ZGB 140×155×150	3,9	$140^{+0,063}$	$155^{+0,083}_{+0,043}$	$150_{-0,4}$	4 ± 1	6 300 000	8 400 000
160	ZGB 160×180×150	6	$160^{+0,063}$	$180^{+0,083}_{+0,043}$	$150_{-0,4}$	4 ± 1	7 200 000	9 600 000
180	ZGB 180×200×180	8	$180^{+0,063}$	$200^{+0,096}_{+0,05}$	$180_{-0,4}$	5 ± 1	9 720 000	12 960 000
200	ZGB 200×220×180	8,8	$200^{+0,072}$	$200^{+0,096}_{+0,05}$	$180_{-0,4}$	5 ± 1	10 800 000	14 400 000

[1] Plain bushes with special dimensions and plain bushes sealed on both sides are available by agreement.

[2] Reference only to nominal value of dimensions d, D, B.
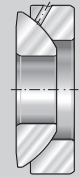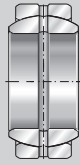
Spherical plain bearings requiring maintenance

Criteria for bearing selection

Radial spherical plain bearings

| GE..DO
GE..DO-2RS | GE..FO
GE..FO-2RS | GE..LO | GE..HO-2RS |

Load carrying capacity

C_r

C_{0r}
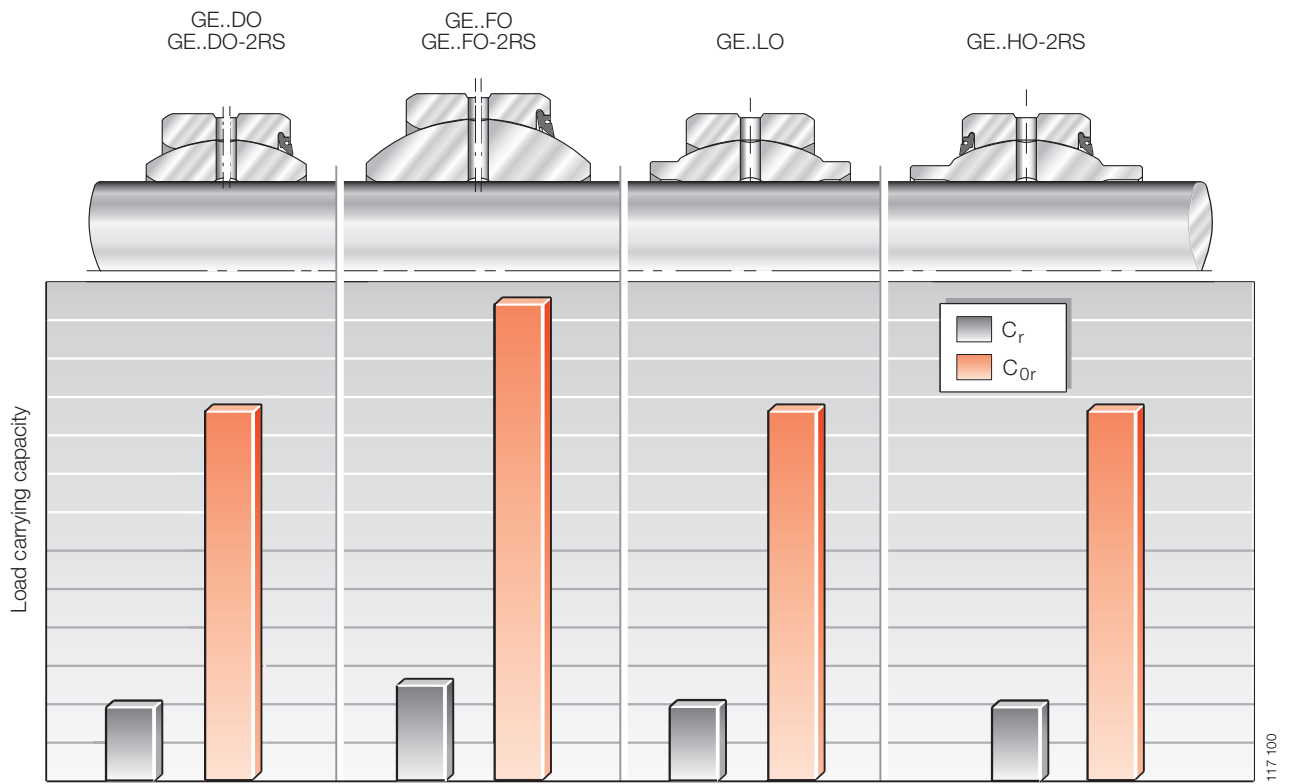
Comparison of load carrying capacity for identical shaft diameter.

117 100

Angular contact
spherical plain bearings

Axial spherical
plain bearings

GE..PB

GE..ZO

GE..SX

Load carrying capacity

C_r
C_{0r}

C_a
C_{0a}

117 120

Spherical plain bearings requiring maintenance

Radial spherical plain bearings
Angular contact spherical plain bearings
Axial spherical plain bearings

Features

Radial spherical plain bearings

- are complete units comprising inner rings and outer rings with a steel/steel or steel/bronze sliding contact surface
  - the inner ring has a cylindrical bore and a convex outer slideway
  - the outer ring has a cylindrical outside surface and concave inner slideway.
    From d = 320 mm, the outer ring is split at two points and held together by retaining rings
  - in series GE..PB, the outer ring is made from bronze
- can support radial loads
- can transmit motion and loads with low moment levels
  - they can thus keep bending stresses away from the adjacent structure
- are particularly suitable for alternating loads with impact type and shock type stresses
- can support axial loads in both directions
- are lubricated via the outer and inner ring
  - with exceptions (*dimensions*)
  - under alternating load, one side is relieved.
    This zone is lubricated as a result of the swivel motion.

Sealed radial spherical plain bearings requiring maintenance

- are protected against contaminants and water spray by
  - lip seals.

Radial spherical plain bearings

GE..DO
GE..DO-2RS

117 161

- to ISO 12 240-1, dimension series E, large radial spherical plain bearings to ISO 12 240-1, dimension series C
- suffix -2RS: lip seals on both sides, for operating temperatures from –30 °C to +130 °C
- GE..DO for shaft diameters from 6 mm to 200 mm; large radial spherical plain bearings for shaft diameters from 320 mm to 1 000 mm
- GE..DO-2RS for shaft diameters from 15 mm to 300 mm

106

GE..HO-2RS

117 087

- inside and outside diameters and outer ring width as GE..DO
- cylindrical extensions on inner ring; As a result, spacers are not required if the bearing is fitted in a clevis
- lip seals on both sides, for operating temperatures from –30 °C to +130 °C
- for shaft diameters from 17 mm to 80 mm

114

GE..FO
GE..FO-2RS
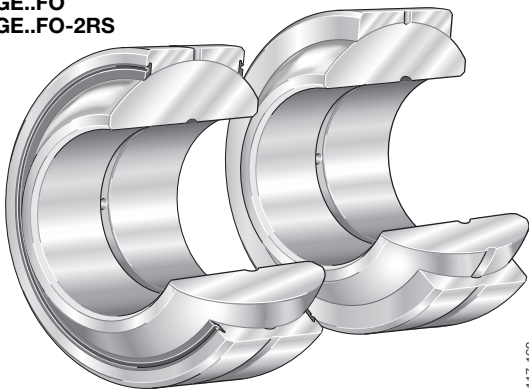
117 162

- to ISO 12 240-1, dimension series G
- larger tilt angle α due to wider inner ring
- suffix -2RS: lip seals on both sides,
  for operating temperatures from –30 °C to +130 °C
- GE..FO for shaft diameters from 6 mm to 12 mm
- GE..FO-2RS for shaft diameters from 15 mm to 280 mm

110

GE..LO

117 086

- to ISO 12 240-1, dimension series W
- bore dimensions to standard sizes,
  dimensions to DIN 24 338 for standard hydraulic cylinders
- for shaft diameters from 12 mm to 320 mm
- bore nominal dimension identical to inner ring width
  nominal dimension
- d = 320,
  classified as large radial spherical plain bearings

112

GE..ZO

117 088

- inch sizes
- for shaft diameters from 0,75 inches (19,05 mm)
  to 3 inches (76,2 mm)

116

GE..PB

117 085

- to ISO 12 240-1, dimension series K
- steel/bronze sliding contact surface
- for shaft diameters from 5 mm to 30 mm

118

Spherical plain bearings requiring maintenance

Angular contact spherical plain bearings
Axial spherical plain bearings

Features

Angular contact spherical plain bearings

■ are complete units comprising an inner ring and an outer ring with a steel/steel sliding contact surface
 – the inner ring has a convex outer slideway
 – the outer ring has a concave inner slideway
■ can support axial loads as well as radial loads
 – they are thus suitable for alternating dynamic loads
■ are used, for example, where loads acting in conjunction with small swivel angles would damage rolling element bearings
 – they are a plain bearing alternative to tapered roller bearings of series 320 X to DIN 720
■ can transmit motion and loads with low moment levels
 – they can thus keep bending stresses away from the adjacent structure
■ are designed as standard for grease lubrication
 – are lubricated via the outer ring.

Axial spherical plain bearings

■ are complete units comprising shaft locating and housing locating washers with a steel/steel sliding contact surface
 – the shaft locating washer is supported in the ball socket-shaped sliding zone of the housing locating washer
■ can support axial loads
■ can transmit support loads into the adjacent construction with low moment levels
■ can be combined with radial spherical plain bearings of dimension series E to ISO 12 240-1
 – in order to support radial loads
■ are lubricated via the housing locating washer.

Angular contact spherical plain bearings

GE..SX

■ to ISO 12 240-2
■ for shaft diameters from 25 mm to 200 mm

120

Axial spherical plain bearings

GE..AX
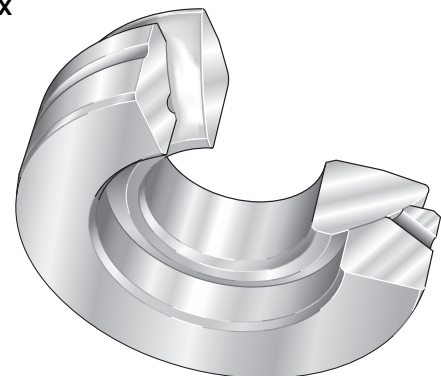
■ to ISO 12 240-3
■ for shaft diameters from 10 mm to 200 mm

122

⚠ Note the ratio C_r (C_a)/P (*Predimensioning*, page 22 and Table 1). The permissible ratio is decisively dependent on the operating conditions, lubricant and the required operating life.

The parts of different bearings are not interchangeable with each other.

The relubrication intervals must be observed.

If oil lubrication is to be used, the bearings must be provided with different lubrication groove systems (suffix F10, page 13).

If fitting is carried out with the aid of refrigeration by means of dry ice or liquid nitrogen, the material may undergo a volume increase that may eliminate the bearing clearance in certain circumstances.

Table 1 · Ratio C_r (C_a)/P for
spherical plain bearings requiring maintenance
under dynamic load – guide values

Series	Alternating load C_r (C_a)/P	Unilateral load C_r (C_a)/P
GE..DO GE..DO-2RS GE..FO GE..FO-2RS	3 to 1	4 to 1,7
GE..PB	3 to 1	4 to 1
GE..LO GE..HO-2RS GE..ZO	3 to 1	4 to 1,7
GE..SX	3 to 1,5	4 to 2
GE..AX	–	4 to 2

Angular contact spherical plain bearings

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 (Figure 1 and Figure 2).

The precondition is: axial clearance (0,1 ± 0,05 mm).

Figure 1 · Bearings in pairs – O arrangement
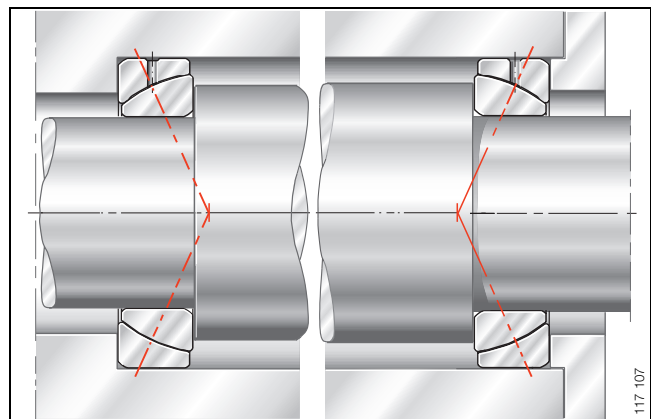
Figure 2 · Bearings in pairs – X arrangement

Spherical plain bearings
requiring maintenance

Radial spherical plain bearings
Angular contact spherical plain bearings
Axial spherical plain bearings

Axial spherical plain bearings

If axial spherical plain bearings are to be combined with radial spherical plain bearings of dimension series E to ISO 12 240-1 in order to support radial loads, the axial and radial load must be distributed over both bearings.

In order to achieve this:

■ the pin must have a radial release of approx. 1 mm in the shaft locating washer (Figure 3) or

■ the pin must only be in contact with the large end surface of the shaft locating washer (Figure 3).

Figure 3 · Combination of axial
and radial spherical plain bearing

Life calculation for radial and angular contact spherical plain bearings with steel/steel sliding contact surface

Scope

- Radial
  spherical plain bearings   6 mm $\leqq$ d $\leqq$ 300 mm
- Angular contact
  spherical plain bearings   25 mm $\leqq$ d $\leqq$ 200 mm
- Temperature range   −60 °C $\leqq$ t $\leqq$ +200 °C
  (note the restrictions in Table 1, page 47)
- Contact pressure   1 N/mm^2 $\leqq$ p $\leqq$ 100 N/mm^2
- Sliding speed   1 mm/s $\leqq$ v $\leqq$ 100 mm/s
- p · v value   1 N/mm^2 · mm/s $\leqq$ p · v $\leqq$ 400 N/mm^2 · mm/s
- Initial lubrication necessary
- Grease lubrication.

Failure criteria

If the load direction is unilateral, failure almost always occurs due to:

- fretting of the sliding surfaces.

If the load direction is alternating, failure can occur due to:
- a significant increase in
  the radial internal clearance   > 0,004 · d
- a substantial increase in friction μ_R > 0,22.

Calculation

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

$$v = 2,91 \cdot 10^{-4} \cdot f_4 \cdot d_K \cdot \beta \cdot f$$

$$L = 1,28 \cdot 10^7 \cdot f_1 \cdot f_2 \cdot \frac{v^{0,5} \cdot \beta^{0,2}}{f_3 \cdot (f_4 \cdot d_K)^{0,64}} \cdot \frac{C_r}{P}$$

$$L_h = \frac{L}{f \cdot 60}$$

With periodic relubrication

$$l_W = l_{hW} \cdot f \cdot 60$$

The precondition is: $l_W \leqq 0,5 \cdot L$

$$L_N = L \cdot f_\beta \cdot f_H$$

$$f_\beta = \beta \cdot 0,21 - 0,66$$

The precondition is: $7° \leqq \beta \leqq 30°$
                   If β is larger/smaller $\Rightarrow$ use 7° or 30°.

$$f_H = \left(\frac{L}{l_W} - 1\right) \cdot 0,121 + 1,28$$

The precondition is: $1 \leqq \left(\frac{L}{l_W} - 1\right) \leqq 35$

                 If$\left(\frac{L}{l_W} - 1\right) > 35 \Rightarrow$ use 35.

$$L_{hN} = \frac{L_N}{f \cdot 60}$$
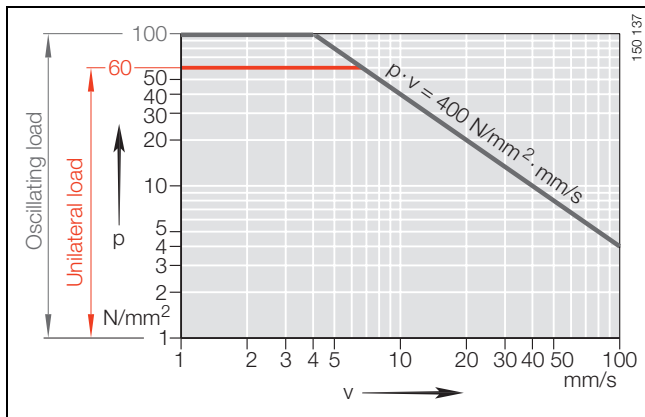
Figure 4 · p · v value – steel/steel sliding contact surface

Spherical plain bearings requiring maintenance

Radial spherical plain bearings
Angular contact spherical plain bearings
Axial spherical plain bearings

Life calculation for steel/bronze sliding contact surface

Scope

- Radial
  spherical plain bearings $5\ mm \leqq d \leqq 30\ mm$
- Temperature range $-60\ °C \leqq t \leqq +250\ °C$
- Contact pressure $1\ N/mm^2 \leqq p \leqq 50\ N/mm^2$
- Sliding speed $1\ mm/s \leqq v \leqq 100\ mm/s$
- $p \cdot v$ value $1\ N/mm^2 \cdot mm/s \leqq p \cdot v \leqq 400\ N/mm^2 \cdot mm/s$
- Initial lubrication necessary
- Grease lubrication.

Failure criteria

If the load direction is unilateral, failure almost always occurs due to:

- fretting of the sliding surfaces.

If the load direction is alternating, failure can occur due to:

- a significant increase in
  the radial internal clearance $> 0,004 \cdot d$
- a substantial increase in friction $\mu_R > 0,25$.

Calculation

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

$$v = 2,91 \cdot 10^{-4} \cdot d_K \cdot \beta \cdot f$$

$$L = 1,4 \cdot 10^8 \cdot \frac{f_1 \cdot f_2 \cdot v^{0,2}}{f_3 \cdot (d_K \cdot \beta)^{0,8}} \cdot \frac{C_r}{P}$$

$$L_h = \frac{L}{f \cdot 60}$$

With periodic relubrication

$$l_W = l_{hW} \cdot f \cdot 60$$

The precondition is: $l_W \leqq 0,5 \cdot L$

$$L_N = L \cdot f_\beta \cdot f_H$$

$$f_\beta = \beta \cdot 0,055 + 0,727$$

The precondition is: $5° \leqq \beta \leqq 60°$
If β is larger/smaller $\Rightarrow$ use 5° or 60°.

$$f_H = \left(\frac{L}{l_W} - 1\right) \cdot 0,14 + 1,26$$

The precondition is: $1 \leqq \left(\frac{L}{l_W} - 1\right) \leqq 20$

$$\text{If}\left(\frac{L}{l_W} - 1\right) > 20 \Rightarrow \text{use } 20.$$

$$L_{hN} = \frac{L_N}{f \cdot 60}$$
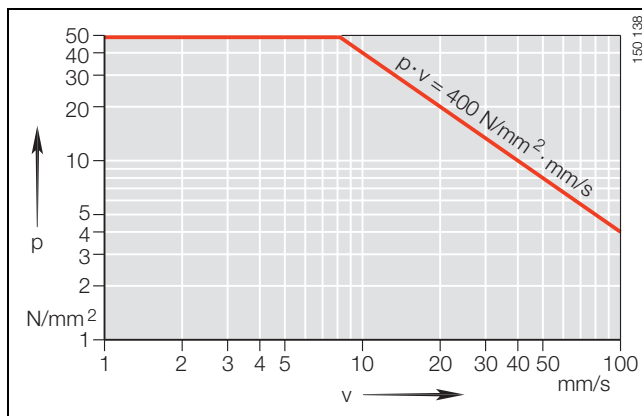
Figure 5 · p · v value – steel/bronze sliding contact surface

Table 2 · Factors for life calculation

Sliding contact surface	Basic load rating factor K	Load direction factor f₁		Temperature factor f₂				Load factor f₃			Bearing design factor f₄	
		Unilateral load	Alternating load	t ≦ 150 °C	t> 150 °C to 180 °C	t> 180 °C to 200 °C	t> 200 °C to 250 °C	p = 1 – 12,5	p => 12,5 – 50	p = > 50 – 100	Radial spherical plain bearings	Angular contact spherical plain bearings
	N/mm²											
Steel/steel	100	1	2	1	0,9	0,7	–	42	$p^{1,48}$	$p^{1,48}$	1	0,9
Steel/bronze	50	1	2	1	0,9	0,8	0,5	4,6	$p^{0,6}$	–	–	–

Symbols, units and definitions

p N/mm²
Specific bearing load, contact pressure

P N
Equivalent bearing load

C_r N
Basic dynamic load rating of bearing (*dimension table*)

K N/mm²
Basic load rating factor (Table 2)

v mm/s
Mean sliding speed

d_K mm
Sphere diameter (*dimension table*)

β °
Swivel or oscillation angle
(from end position to end position, for rotary motion $\beta = 180°$, see page 24 and 25; use $\beta = \beta_1$)

f min⁻¹
Oscillation frequency or speed

f_1 –
Load direction factor (Table 2)

f_2 –
Temperature factor (Table 2)

f_3 –
Load factor (Table 2)

f_4 –
Bearing design factor (Table 2)

L oscillations
Theoretical life with single initial lubrication

L_h h
Theoretical life with single initial lubrication

L_N oscillations
Theoretical life with periodic relubrication

L_{hN} h
Theoretical life with periodic relubrication

l_W oscillations
Maintenance interval between two lubrication operations

l_{hW} h
Maintenance interval between two lubrication operations

f_β –
Relubrication factor, dependent on β

f_H –
Relubrication factor, dependent on frequency.

Spherical plain bearings requiring maintenance

Radial spherical plain bearings
Angular contact spherical plain bearings
Axial spherical plain bearings

Calculation example for steel/steel sliding contact surface

Given

Pivot of a linkage rod.

Operating parameters:

Bearing load	F_R	=	25 kN
	F_A	=	5 kN
Swivel angle	β	=	35°
Swivel frequency	f	=	6 min^{-1}
Maintenance interval	l_{hW}	=	16 h
Ambient temperature		=	−20 °C to +60 °C

Bearing data:

Radial spherical plain bearings		=	GE 50 DO
■ Basic dynamic load rating	C_r	=	156 kN
■ Sphere diameter	d_K	=	66 mm
Basic load rating factor (Table 2)	K	=	100 N/mm^2
Load direction factor (Table 2)	f_1	=	2
■ Alternating load			
Temperature factor (Table 2)	f_2	=	1
Bearing design factor (Table 2)	f_4	=	1
■ for radial spherical plain bearings			

Required

Minimum life of 12 000 h.

Calculation

$$P = X \cdot F_R$$

$$\frac{F_A}{F_R} = \frac{5\ kN}{25\ kN} = 0,2$$

X (Figure 4, page 18) $\Rightarrow$ = 1,807 or
$X = 0,978 \cdot 21,546^{Fa/Fr} = 0,978 \cdot 21,546^{0,2} = 1,807$
$P = 1,807 \cdot 25\ kN = 45,18\ kN$

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

$$p = 100 \cdot \frac{45,18}{156} = 28,96\ N/mm^2$$

$$v = 2,91 \cdot 10^{-4} \cdot f_4 \cdot d_K \cdot \beta \cdot f$$

$v = 2,91 \cdot 10^{-4} \cdot 1 \cdot 66 \cdot 35 \cdot 6 = 4,033\ mm/s$

$$L = 1,28 \cdot 10^7 \cdot f_1 \cdot f_2 \cdot \frac{v^{0,5} \cdot \beta^{0,2}}{f_3 \cdot (f_4 \cdot d_K)^{0,64}} \cdot \frac{C_r}{P}$$

$$L = 1,28 \cdot 10^7 \cdot 2 \cdot 1 \cdot \frac{4,033^{0,5} \cdot 35^{0,2}}{28,96^{1,48} \cdot (1 \cdot 66)^{0,64}} \cdot \frac{156}{45,18}$$

L = 169 920 osc.

$$l_W = l_{hW} \cdot f \cdot 60$$

$l_W = 16 \cdot 6 \cdot 60 = 5\ 760$ osc.
The precondition is: $l_W \leqq 0,5\ L$ is fulfilled

$$f_\beta = \beta \cdot 0,21 - 0,66$$

$\beta > 30° \Rightarrow$ use 30°
$f_\beta = 30 \cdot 0,21 - 0,66 = 5,64$

$$f_H = \left(\frac{L}{l_W} - 1\right) \cdot 0,121 + 1,28$$

$$f_H = \left(\frac{169\ 920}{5\ 760} - 1\right) \cdot 0,121 + 1,28 = 4,728$$

$$L_N = L \cdot f_\beta \cdot f_H$$

$L_N = 169\ 920 \cdot 5,64 \cdot 4,728 = 4\ 527\ 830$ osc.

$$L_{hN} = \frac{L_N}{f \cdot 60}$$

$$L_{hN} = \frac{4\ 527\ 830}{6 \cdot 60} = 12\ 577\ h$$

$L_{hN} = 12\ 577\ h \geqq 12\ 000\ h$ required

Calculation example for steel/bronze sliding contact surface

Given

Indexing plate for indexing station on a packaging line.

Operating parameters:

Bearing load	$F_{R\,min}$	= 16 kN
	$F_{R\,max}$	= 30 kN
Swivel angle	β	= 45°
Time required for indexing operation		= 3 sec
Swivel frequency	f	= 20 min^{-1}

■ required for calculating the mean sliding speed within one motion cycle

| Maintenance interval | l_{hW} | = 40 h |

Bearing data:

Radial spherical plain bearings		= GE 25 PB
Basic dynamic load rating	C_r	= 47,5 kN
Sphere diameter	d_K	= 42,9 mm
Load direction factor for unilateral load (Table 2)	f_1	= 1

Operating duration:

3 s/cycle gives 20 cycles/min with 100% utilisation
300 cycles/h gives 5 cycles/min

$$\text{Operating duration ED} = \frac{5 \text{ cycles/min}}{20 \text{ cycles/min}} = 0,25$$

Required

| Minimum life | L_{hN} | = 4 000 h |

Calculation

$$P = \sqrt{\frac{F^2_{min} + F^2_{max}}{2}}$$

$$P = \sqrt{\frac{16^2 + 30^2}{2}} = 24,04 \text{ kN}$$

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

$$p = 50 \cdot \frac{24,04}{47,5} = 25,31 \text{ N/mm}^2$$

$$v = 2,91 \cdot 10^{-4} \cdot d_K \cdot \beta \cdot f$$

$$v = 2,91 \cdot 10^{-4} \cdot 42,9 \cdot 45 \cdot 20 = 11,24 \text{ mm/s}$$

$p \cdot v = 25,31 \text{ N/mm}^2 \cdot 11,24 \text{ mm/s}$
$p \cdot v = 284,5 \text{ N/mm}^2 \cdot \text{mm/s}$
$p \cdot v \leqq 400 \text{ N/mm}^2$, condition fulfilled

$$L = 1,4 \cdot 10^8 \cdot f_1 \cdot f_2 \cdot \frac{v^{0,2}}{f_3 \cdot (d_K \cdot \beta)^{0,8}} \cdot \frac{C_r}{P}$$

$$L = 1,4 \cdot 10^8 \cdot 1 \cdot 1 \cdot \frac{11,24^{0,2}}{25,31^{0,6} \cdot (42,9 \cdot 45)^{0,8}} \cdot \frac{47,5}{24,04}$$

L = 151 993 oscillations with single initial lubrication

Influence of relubrication

$$l_W = l_{hW} \cdot f \cdot 60 \cdot ED$$

$l_W = 40 \cdot 20 \cdot 60 \cdot 0,25 = 12\,000$ osc.
$l_W \leqq 0,5 \cdot L$, condition fulfilled

$$f_\beta = \beta \cdot 0,055 + 0,727$$

$f_\beta = 45 \cdot 0,055 + 0,727 = 3,2$

$$f_H = \left(\frac{L}{l_W} - 1\right) \cdot 0,14 + 1,26$$

$$f_H = \left(\frac{151\,993}{12\,000} - 1\right) \cdot 0,14 + 1,26 = 11,66 \cdot 0,14 + 1,26$$

$f_H = 2,89$

$$L_N = L \cdot f_\beta \cdot f_H$$

$L_N = 151\,993 \cdot 3,2 \cdot 2,89 = 1\,405\,631$ osc.

$$L_{hN} = \frac{L_N}{f \cdot 60 \cdot ED}$$

$$L_{hN} = \frac{1\,405\,631}{20 \cdot 60 \cdot 0,25} = 4\,685 \text{ h}$$

$L_{hN} = 4\,685 \text{ h} \geqq 4\,000 \text{ h}$ required.
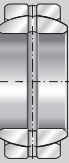
Spherical plain bearings requiring maintenance

Radial spherical plain bearings
Angular contact spherical plain bearings
Axial spherical plain bearings

Calculation example for steel/steel sliding contact surface

Given

Transfer rake for rolled slabs of different cross-sections in a three-shift rolling mill.

Operating parameters:

Bearing load	F_R	=	53 kN
	F_R	=	88 kN
	F_R	=	120 kN
Swivel angle of piston rod	β	=	50°
Swivel angle of cylinder base	β	=	5°
Swivel frequency	f	=	5 min^{-1}
	f	=	3 min^{-1}
	f	=	2 min^{-1}
Maintenance interval	l_{hW}	=	24 h
Ambient temperature		=	up to +180 °C

Bearing data:

Radial spherical plain bearings		=	GE 80 DO
Basic dynamic load rating	C_r	=	400 kN
Sphere diameter	d_K	=	105 mm
Factors (Table 2, page 99)	f_1	=	2
	f_2	=	0,9
	f_4	=	1

Motion and load spectrum of slabs – dependent on cross-section

Slab cross-section mm×mm	% frequency of operating duration ED	Bearing load F_R kN	Swivel frequency f min^{-1}
70× 70	45	53	5
90× 90	30	88	3
105×105	25	120	2

Required

Time interval between bearing replacements.

Calculation

- L_{hN} for load case 1, 2, 3 on piston rod side
- L_{hN} for load case 1, 2, 3 on cylinder base side
- Total life taking into consideration the % frequency according to the formula.

$$L_h = \cfrac{1}{\cfrac{t_1}{\Sigma t \cdot L_{h1}} + \cfrac{t_2}{\Sigma t \cdot L_{h2}} + \cfrac{t_3}{\Sigma t \cdot L_{h3}}}$$

Load case 1: **Piston rod side**

- F_R is constant during motion

$$P = F$$

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

$$P = 100 \cdot \frac{53}{400} = 13,25 \text{ N/mm}^2$$

$$v = 2,91 \cdot 10^{-4} \cdot f_4 \cdot d_K \cdot \beta \cdot f$$

$v = 2,91 \cdot 10^{-4} \cdot 1 \cdot 105 \cdot 50 \cdot 5 = 7,638$ mm/s
$p \cdot v = 13,25 \cdot 7,638 = 101,2$ N/mm$^2 \cdot$ mm/s = permissible

$$L = 1,28 \cdot 10^7 \cdot f_1 \cdot f_2 \cdot \frac{v^{0,5} \cdot \beta^{0,2}}{f_3 \cdot (f_4 \cdot d_K)^{0,64}} \cdot \frac{C_r}{P}$$

$$L = 1,28 \cdot 10^7 \cdot 2 \cdot 0,9 \cdot \frac{7,638^{0,5} \cdot 50^{0,2}}{13,25^{1,48} \cdot (1 \cdot 105)^{0,64}} \cdot \frac{400}{53}$$

$L = 1\,167\,104$ osc.

$$l_W = l_{hW} \cdot f \cdot 60$$

$l_W = 24 \cdot 5 \cdot 60 = 7\,200$ osc.
The precondition is: $l_W \leqq 0,5$ L is fulfilled

$$f_\beta = \beta \cdot 0,21 - 0,66$$

since $\beta > 30° \cdot$ use 30°
$f_\beta = 30 \cdot 0,21 - 0,66 = 5,64$

$$f_H = \left(\frac{L}{l_W} - 1\right) \cdot 0{,}121 + 1{,}28$$

$$\left(\frac{L}{l_W} - 1\right) = \left(\frac{1\,167\,104}{7\,200} - 1\right) = 161$$

$$d_a = \left(\frac{L}{l_W} - 1\right) \Rightarrow \text{use } 35$$

$$f_H = 35 \cdot 0{,}121 + 1{,}28 = 5{,}515$$

$$L_N = L \cdot f_\beta \cdot f_H$$

$$L_N = 1\,167\,104 \cdot 5{,}64 \cdot 5{,}515 = 36\,304\,102 \text{ osc.}$$

$$L_{hN} = \frac{L_N}{f \cdot 60}$$

$$L_{hN} = \frac{36\,304\,102}{5 \cdot 60} = 121\,013 \text{ h}$$

Further results

Load case 2: Piston rod side	$L_{hN} = 44\,427$ h
Load case 3: Piston rod side	$L_{hN} = 24\,543$ h
Load case 1: Cylinder base side	$L_{hN} = 3\,968$ h
Load case 2: Cylinder base side	$L_{hN} = 1\,160$ h
Load case 3: Cylinder base side	$L_{hN} = 653$ h

Total life for piston rod side

$$L_h = \cfrac{1}{\cfrac{45}{100 \cdot 121\,013} + \cfrac{30}{100 \cdot 44\,427} + \cfrac{25}{100 \cdot 24\,543}}$$

$$L_h = 48\,408 \text{ h}$$

Total life for cylinder base side

$$L_h = \cfrac{1}{\cfrac{45}{100 \cdot 3\,968} + \cfrac{30}{100 \cdot 1\,160} + \cfrac{25}{100 \cdot 653}}$$

$$L_h = 1\,324 \text{ h}$$

The life result for the cylinder base linkage reflects the negative influence of small swivel angles and thus low sliding speeds on the life of spherical plain bearings with a steel/steel sliding contact surface.

Longer running times could only be achieved by using a larger bearing.

Spherical plain bearings
requiring maintenance

Radial spherical plain bearings
Angular contact spherical plain bearings
Axial spherical plain bearings

Accuracy

The main dimensions conform to ISO 12 240-1 to -3.

The exceptions are:

■ radial spherical plain bearings GE..HO-2RS

■ spherical plain bearings in inch sizes.

The dimensional and geometrical accuracy of the inside and outside diameters corresponds to ISO 12 240-1 to -3.

Dimensional and tolerance values are arithmetic means. Dimensional inspection is carried out in accordance with ISO 8 015.

The tolerances of spherical plain bearings with a steel/steel sliding contact surface may differ slightly from the stated values due to the surface treatment applied. However, this does not affect the fitting and operating characteristics of the bearings.

Spherical plain bearings with split outer ring

The outside diameter is within the deviations given in the tables before surface treatment and splitting.

The outer rings become slightly out of round due to splitting. The roundness of the outer ring is restored once it is fitted in a housing bore produced in accordance with the specifications (Figure 6).

⚠ Measurements taken of the outside diameter of the unfitted bearing cannot be used as the original actual values for the outside diameter.
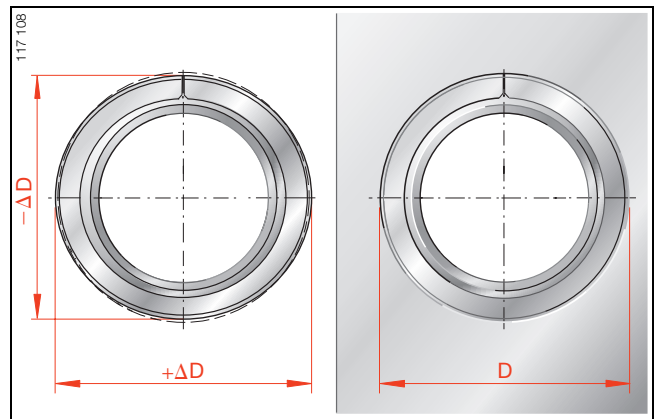
Figure 6 · Out of roundness before fitting and correct roundness after fitting

Special designs

Available by agreement (see also page 13):

- radial internal clearance other than normal, e. g. C3
  – suffix C3 (see Table 2, page 31)

- series GE..SX with lubrication groove system for
  oil bath lubrication
  – suffix F10.
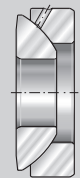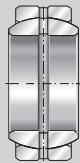
Ordering example and ordering designation

Radial spherical plain bearing requiring maintenance
to ISO 12 240-1, dimension series E,
sliding contact surface steel/steel, lip seals on both sides,
for:
shaft   20 mm.

Ordering designation: **GE 20 DO-2RS** (Figure 7).

GE 20 DO-2RS

d
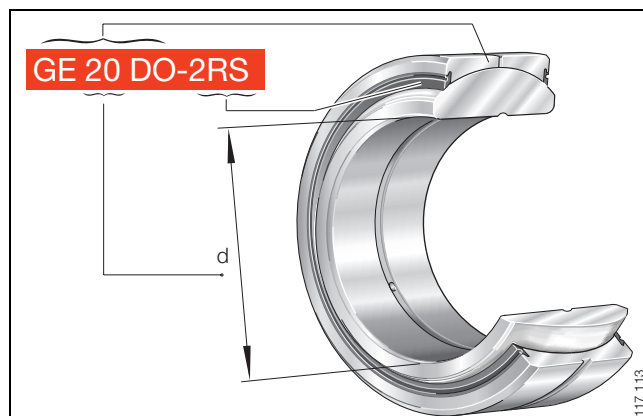
Figure 7 · Ordering example, ordering designation

Radial spherical plain bearings

requiring maintenance
ISO 12 240-1, dimension series E
Sliding contact surface: Steel/steel

Series GE..DO
GE..DO-2RS

GE..DO

Dimension table · Dimensions in mm									
Shaft diameter	Designation		Mass	Dimensions					
				d	D	B	C	d_K	α
d	without seals	with seals	≈kg						Degrees
6	GE 6 DO[1]	–	0,004	$6_{-0,008}$	$14_{-0,008}$	$6_{-0,12}$	$4_{-0,24}$	10[2]	13
8	GE 8 DO[1]	–	0,007	$8_{-0,008}$	$16_{-0,008}$	$8_{-0,12}$	$5_{-0,24}$	13[2]	15
10	GE 10 DO[1]	–	0,012	$10_{-0,008}$	$19_{-0,009}$	$9_{-0,12}$	$6_{-0,24}$	16[2]	12
12	GE 12 DO[1]	–	0,017	$12_{-0,008}$	$22_{-0,009}$	$10_{-0,12}$	$7_{-0,24}$	18[2]	11
15	GE 15 DO	–	0,027	$15_{-0,008}$	$26_{-0,009}$	$12_{-0,12}$	$9_{-0,24}$	22[2]	8
16	GE 16 DO[4]	–	0,044	$16_{-0,008}$	$30_{-0,009}$	$14_{-0,12}$	$10_{-0,24}$	25[2]	10
17	GE 17 DO	GE 17 DO-2RS	0,041	$17_{-0,008}$	$30_{-0,009}$	$14_{-0,12}$	$10_{-0,24}$	25[2]	10
20	GE 20 DO	GE 20 DO-2RS	0,065	$20_{-0,01}$	$35_{-0,011}$	$16_{-0,12}$	$12_{-0,24}$	29[2]	9
25	GE 25 DO	GE 25 DO-2RS	0,12	$25_{-0,01}$	$42_{-0,011}$	$20_{-0,12}$	$16_{-0,24}$	35,5	7
30	GE 30 DO	GE 30 DO-2RS	0,15	$30_{-0,01}$	$47_{-0,011}$	$22_{-0,12}$	$18_{-0,24}$	40,7	6
35	GE 35 DO	GE 35 DO-2RS	0,23	$35_{-0,012}$	$55_{-0,013}$	$25_{-0,12}$	$20_{-0,3}$	47	6
40	GE 40 DO	GE 40 DO-2RS	0,32	$40_{-0,012}$	$62_{-0,013}$	$28_{-0,12}$	$22_{-0,3}$	53	7
45	GE 45 DO	GE 45 DO-2RS	0,41	$45_{-0,012}$	$68_{-0,013}$	$32_{-0,12}$	$25_{-0,3}$	60	7
50	GE 50 DO	GE 50 DO-2RS	0,53	$50_{-0,012}$	$75_{-0,013}$	$35_{-0,12}$	$28_{-0,3}$	66	6
60	GE 60 DO	GE 60 DO-2RS	1	$60_{-0,015}$	$90_{-0,015}$	$44_{-0,15}$	$36_{-0,4}$	80	6
70	GE 70 DO	GE 70 DO-2RS	1,5	$70_{-0,015}$	$105_{-0,015}$	$49_{-0,15}$	$40_{-0,4}$	92	6
80	GE 80 DO	GE 80 DO-2RS	2,2	$80_{-0,015}$	$120_{-0,015}$	$55_{-0,15}$	$45_{-0,4}$	105	6
90	GE 90 DO	GE 90 DO-2RS	2,7	$90_{-0,02}$	$130_{-0,018}$	$60_{-0,2}$	$50_{-0,5}$	115	5
100	GE 100 DO	GE 100 DO-2RS	4,3	$100_{-0,02}$	$150_{-0,018}$	$70_{-0,2}$	$55_{-0,5}$	130	7
110	GE 110 DO	GE 110 DO-2RS	4,7	$110_{-0,02}$	$160_{-0,025}$	$70_{-0,2}$	$55_{-0,5}$	140	6
120	GE 120 DO	GE 120 DO-2RS	8	$120_{-0,02}$	$180_{-0,025}$	$85_{-0,2}$	$70_{-0,5}$	160	6
140	GE 140 DO	GE 140 DO-2RS	11	$140_{-0,025}$	$210_{-0,03}$	$90_{-0,25}$	$70_{-0,6}$	180	7
160	GE 160 DO	GE 160 DO-2RS	14	$160_{-0,025}$	$230_{-0,03}$	$105_{-0,25}$	$80_{-0,6}$	200	8
180	GE 180 DO	GE 180 DO-2RS	18,2	$180_{-0,025}$	$260_{-0,035}$	$105_{-0,25}$	$80_{-0,7}$	225	6
200	GE 200 DO	GE 200 DO-2RS	28,3	$200_{-0,03}$	$290_{-0,035}$	$130_{-0,3}$	$100_{-0,7}$	250	7
220	–	GE 220 DO-2RS	35,4	$220_{-0,03}$	$320_{-0,04}$	$135_{-0,3}$	$100_{-0,8}$	275	8
240	–	GE 240 DO-2RS	39,4	$240_{-0,03}$	$340_{-0,04}$	$140_{-0,3}$	$100_{-0,8}$	300	8
260	–	GE 260 DO-2RS	51,1	$260_{-0,035}$	$370_{-0,04}$	$150_{-0,35}$	$110_{-0,8}$	325	7
280	–	GE 280 DO-2RS	64,6	$280_{-0,035}$	$400_{-0,04}$	$155_{-0,35}$	$120_{-0,8}$	350	6
300	–	GE 300 DO-2RS	77,3	$300_{-0,035}$	$430_{-0,045}$	$165_{-0,35}$	$120_{-0,9}$	375	7

[1] No relubrication facility.

[2] No lubrication groove on inner ring spherical surface.

[3] Also available in groups C2 and C3.

[4] Price and delivery on request.
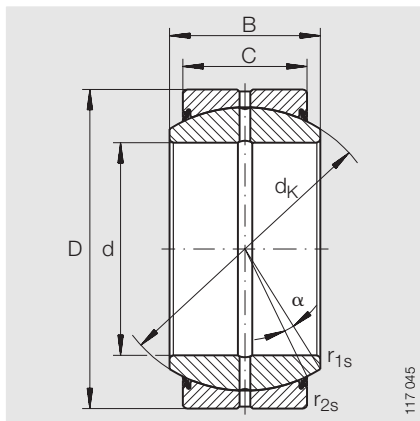
GE..DO-2RS
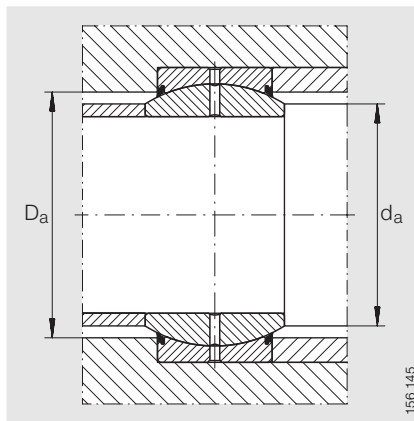
GE..DO-2RS – mounting dimensions
GE..DO – mounting dimensions

Chamfer dimensions		Mounting dimensions		Basic load ratings		Radial internal clearance[3]	Shaft diameter
r_{1s}	r_{2s}	d_a	D_a	dyn. C_r	stat. C_{0r}	CN	
min.	min.	max.	min.	N	N		d
0,3	0,3	8	9,6	3 400	17 000	0,032 – 0,068	**6**
0,3	0,3	10,2	12,5	5 500	27 500	0,032 – 0,068	**8**
0,3	0,3	13,2	15,5	8 150	40 500	0,032 – 0,068	**10**
0,3	0,3	14,9	17,5	10 800	54 000	0,032 – 0,068	**12**
0,3	0,3	18,4	21	17 000	85 000	0,04 – 0,082	**15**
0,3	0,3	20,7	24	21 200	106 000	0,04 – 0,082	**16**
0,3	0,3	20,7	24	21 200	106 000	0,04 – 0,082	**17**
0,3	0,3	24,1	27,5	30 000	146 000	0,04 – 0,082	**20**
0,6	0,6	29,3	33	48 000	240 000	0,05 – 0,1	**25**
0,6	0,6	34,2	38	62 000	310 000	0,05 – 0,1	**30**
0,6	1	39,7	44,5	80 000	400 000	0,05 – 0,1	**35**
0,6	1	45	51	100 000	500 000	0,06 – 0,12	**40**
0,6	1	50,7	57	127 000	640 000	0,06 – 0,12	**45**
0,6	1	55,9	63	156 000	780 000	0,06 – 0,12	**50**
1	1	66,8	75	245 000	1 220 000	0,06 – 0,12	**60**
1	1	77,8	87	315 000	1 560 000	0,072 – 0,142	**70**
1	1	89,4	99	400 000	2 000 000	0,072 – 0,142	**80**
1	1	98,1	108	490 000	2 450 000	0,072 – 0,142	**90**
1	1	109,5	123	610 000	3 050 000	0,085 – 0,165	**100**
1	1	121,2	134	655 000	3 250 000	0,085 – 0,165	**110**
1	1	135,5	150	950 000	4 750 000	0,085 – 0,165	**120**
1	1	155,8	173	1 080 000	5 400 000	0,085 – 0,165	**140**
1	1	170,2	191	1 370 000	6 800 000	0,1 – 0,192	**160**
1,1	1,1	198,9	219	1 530 000	7 650 000	0,1 – 0,192	**180**
1,1	1,1	213,5	239	2 120 000	10 600 000	0,1 – 0,192	**200**
1,1	1,1	239,5	267	2 320 000	11 600 000	0,11 – 0,214	**220**
1,1	1,1	265,3	295	2 550 000	12 700 000	0,11 – 0,214	**240**
1,1	1,1	288,3	319	3 050 000	15 300 000	0,125 – 0,239	**260**
1,1	1,1	313,8	342	3 550 000	18 000 000	0,125 – 0,239	**280**
1,1	1,1	336,7	370	3 800 000	19 000 000	0,125 – 0,239	**300**

Radial spherical plain bearings

requiring maintenance
ISO 12 240-1, dimension series C
Sliding contact surface: Steel/steel

Series GE..DO
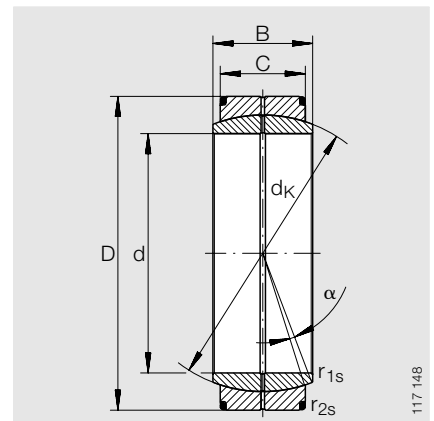
GE..DO

Dimension table · Dimensions in mm								
Shaft diameter	Designation[2]	Mass	Dimensions					
			d	D	B	C	d_K	α
d		$\approx$kg						Degrees
320	**GE 320 DO**	76,4	$320_{-0,04}$	$440_{-0,045}$	$160_{-0,4}$	$135_{-0,9}$	380	4
340	**GE 340 DO**	81,6	$340_{-0,04}$	$460_{-0,045}$	$160_{-0,4}$	$135_{-0,9}$	400	3,8
360	**GE 360 DO**	84,2	$360_{-0,04}$	$480_{-0,045}$	$160_{-0,4}$	$135_{-0,9}$	420	3,6
380	**GE 380 DO**	129	$380_{-0,04}$	$520_{-0,05}$	$190_{-0,4}$	160_{-1}	450	4,1
400	**GE 400 DO**	133	$400_{-0,04}$	$540_{-0,05}$	$190_{-0,4}$	160_{-1}	470	3,9
420	**GE 420 DO**	138	$420_{-0,045}$	$560_{-0,05}$	$190_{-0,45}$	160_{-1}	490	3,7
440	**GE 440 DO**	193	$440_{-0,045}$	$600_{-0,05}$	$218_{-0,45}$	185_{-1}	520	3,9
460	**GE 460 DO**	200	$460_{-0,045}$	$620_{-0,05}$	$218_{-0,45}$	185_{-1}	540	3,7
480	**GE 480 DO**	237	$480_{-0,045}$	$650_{-0,075}$	$230_{-0,45}$	$195_{-1,1}$	565	3,8
500	**GE 500 DO**	244	$500_{-0,045}$	$670_{-0,075}$	$230_{-0,45}$	$195_{-1,1}$	585	3,6
530	**GE 530 DO**	289	$530_{-0,05}$	$710_{-0,075}$	$243_{-0,5}$	$205_{-1,1}$	620	3,7
560	**GE 560 DO**	325	$560_{-0,05}$	$750_{-0,075}$	$258_{-0,5}$	$215_{-1,1}$	655	4
600	**GE 600 DO**	407	$600_{-0,05}$	$800_{-0,075}$	$272_{-0,5}$	$230_{-1,1}$	700	3,6
630	**GE 630 DO**	525	$630_{-0,05}$	$850_{-0,1}$	$300_{-0,5}$	$260_{-1,2}$	740	3,3
670	**GE 670 DO**	594	$670_{-0,075}$	$900_{-0,1}$	$308_{-0,75}$	$260_{-1,2}$	785	3,7
710	**GE 710 DO**	693	$710_{-0,075}$	$950_{-0,1}$	$325_{-0,75}$	$275_{-1,2}$	830	3,7
750	**GE 750 DO**	779	$750_{-0,075}$	$1000_{-0,1}$	$335_{-0,75}$	$280_{-1,2}$	875	3,8
800	**GE 800 DO**	920	$800_{-0,075}$	$1060_{-0,125}$	$355_{-0,75}$	$300_{-1,3}$	930	3,6
850	**GE 850 DO**	1047	$850_{-0,1}$	$1120_{-0,125}$	365_{-1}	$310_{-1,3}$	985	3,4
900	**GE 900 DO**	1184	$900_{-0,1}$	$1180_{-0,125}$	375_{-1}	$320_{-1,3}$	1040	3,2
950	**GE 950 DO**	1420	$950_{-0,1}$	$1250_{-0,125}$	400_{-1}	$340_{-1,3}$	1100	3,3
1000	**GE 1000 DO**	1742	$1000_{-0,1}$	$1320_{-0,16}$	438_{-1}	$370_{-1,6}$	1160	3,5

[1] $\overline{D_{a\,max}} = D_{a\,min} + 20$ mm.

[2] Price and delivery on request.

GE..DO – mounting dimensions

Chamfer dimensions		Mounting dimensions		Basic load ratings		Radial internal clearance	Shaft diameter
r_{1s}	r_{2s}	d_a	D_a[1]	dyn. C_r	stat. C_{0r}	CN	
min.	min.	max.	min.	kN	kN		d
1,1	3	344,6	361	4 400	22 000	0,125 – 0,239	**320**
1,1	3	366,6	382	4 650	23 200	0,125 – 0,239	**340**
1,1	3	388,3	403	4 800	24 000	0,135 – 0,261	**360**
1,5	4	407,9	426	6 300	31 500	0,135 – 0,261	**380**
1,5	4	429,8	447	6 550	32 500	0,135 – 0,261	**400**
1,5	4	451,6	469	6 800	34 500	0,135 – 0,261	**420**
1,5	4	472	491	8 650	42 300	0,145 – 0,285	**440**
1,5	4	494	513	9 000	45 000	0,145 – 0,285	**460**
2	5	516	536	9 800	49 000	0,145 – 0,285	**480**
2	5	537,8	557	10 200	51 000	0,145 – 0,285	**500**
2	5	570,3	591	11 400	57 000	0,145 – 0,285	**530**
2	5	602	624	12 700	64 000	0,16 – 0,32	**560**
2	5	644,9	667	14 600	73 500	0,16 – 0,32	**600**
3	6	676,4	698	17 600	88 000	0,16 – 0,32	**630**
3	6	722	746	19 000	95 000	0,16 – 0,32	**670**
3	6	763,7	789	21 200	106 000	0,17 – 0,35	**710**
3	6	808,3	834	22 800	114 000	0,17 – 0,35	**750**
3	6	859,5	886	26 000	129 000	0,17 – 0,35	**800**
3	6	914,8	940	28 500	143 000	0,17 – 0,35	**850**
3	6	970	995	31 000	156 000	0,195 – 0,405	**900**
4	7,5	1024,6	1052	35 500	176 000	0,195 – 0,405	**950**
4	7,5	1074,1	1105	40 500	204 000	0,195 – 0,405	**1000**

Radial spherical plain bearings

requiring maintenance
ISO 12 240-1, dimension series G
Sliding contact surface: Steel/steel

Series GE..FO
   GE..FO-2RS

GE..FO

Dimension table · Dimensions in mm									
Shaft diameter	Designation		Mass	Dimensions					
				d	D	B	C	d_K	α
d	without seals	with seals	≈kg						Degrees
6	GE 6 FO[1)][5)]	–	0,008	$6_{-0,008}$	$16_{-0,008}$	$9_{-0,12}$	$5_{-0,24}$	$13^{3)}$	21
8	GE 8 FO[1)][5)]	–	0,014	$8_{-0,008}$	$19_{-0,009}$	$11_{-0,12}$	$6_{-0,24}$	$16^{3)}$	21
10	GE 10 FO[1)][5)]	–	0,02	$10_{-0,008}$	$22_{-0,009}$	$12_{-0,12}$	$7_{-0,24}$	$18^{3)}$	18
12	GE 12 FO[2)][5)]	–	0,034	$12_{-0,008}$	$26_{-0,009}$	$15_{-0,12}$	$9_{-0,24}$	$22^{3)}$	18
15	–	GE 15 FO-2RS[5)]	0,046	$15_{-0,008}$	$30_{-0,009}$	$16_{-0,12}$	$10_{-0,24}$	$25^{3)}$	16
17	–	GE 17 FO-2RS[5)]	0,077	$17_{-0,008}$	$35_{-0,011}$	$20_{-0,12}$	$12_{-0,24}$	$29^{3)}$	19
20	–	GE 20 FO-2RS	0,15	$20_{-0,01}$	$42_{-0,011}$	$25_{-0,12}$	$16_{-0,24}$	35,5	17
25	–	GE 25 FO-2RS	0,19	$25_{-0,01}$	$47_{-0,011}$	$28_{-0,12}$	$18_{-0,24}$	40,7	17
30	–	GE 30 FO-2RS	0,29	$30_{-0,01}$	$55_{-0,013}$	$32_{-0,12}$	$20_{-0,3}$	47	17
35	–	GE 35 FO-2RS	0,38	$35_{-0,012}$	$62_{-0,013}$	$35_{-0,12}$	$22_{-0,3}$	53	16
40	–	GE 40 FO-2RS	0,54	$40_{-0,012}$	$68_{-0,013}$	$40_{-0,12}$	$25_{-0,3}$	60	17
45	–	GE 45 FO-2RS	0,68	$45_{-0,012}$	$75_{-0,013}$	$43_{-0,12}$	$28_{-0,3}$	66	15
50	–	GE 50 FO-2RS	1,4	$50_{-0,012}$	$90_{-0,015}$	$56_{-0,15}$	$36_{-0,4}$	80	17
60	–	GE 60 FO-2RS	2	$60_{-0,015}$	$105_{-0,015}$	$63_{-0,15}$	$40_{-0,4}$	92	17
70	–	GE 70 FO-2RS	2,9	$70_{-0,015}$	$120_{-0,015}$	$70_{-0,15}$	$45_{-0,4}$	105	16
80	–	GE 80 FO-2RS	3,5	$80_{-0,015}$	$130_{-0,018}$	$75_{-0,2}$	$50_{-0,5}$	115	14
90	–	GE 90 FO-2RS	5,4	$90_{-0,02}$	$150_{-0,018}$	$85_{-0,2}$	$55_{-0,5}$	130	15
100	–	GE 100 FO-2RS	5,9	$100_{-0,02}$	$160_{-0,025}$	$85_{-0,2}$	$55_{-0,5}$	140	14
110	–	GE 110 FO-2RS	9,6	$110_{-0,02}$	$180_{-0,025}$	$100_{-0,2}$	$70_{-0,5}$	160	12
120	–	GE 120 FO-2RS[5)]	15,1	$120_{-0,02}$	$210_{-0,03}$	$115_{-0,25}$	$70_{-0,6}$	180	16
140	–	GE 140 FO-2RS[5)]	18,8	$140_{-0,025}$	$230_{-0,03}$	$130_{-0,25}$	$80_{-0,6}$	200	16
160	–	GE 160 FO-2RS[5)]	24,7	$160_{-0,025}$	$260_{-0,035}$	$135_{-0,25}$	$80_{-0,7}$	225	16
180	–	GE 180 FO-2RS[5)]	35,4	$180_{-0,025}$	$290_{-0,035}$	$155_{-0,3}$	$100_{-0,7}$	250	14
200	–	GE 200 FO-2RS[5)]	44,8	$200_{-0,03}$	$320_{-0,04}$	$165_{-0,3}$	$100_{-0,8}$	275	15
220	–	GE 220 FO-2RS[5)]	50,9	$220_{-0,03}$	$340_{-0,04}$	$175_{-0,3}$	$100_{-0,8}$	300	16
240	–	GE 240 FO-2RS[5)]	64,9	$240_{-0,03}$	$370_{-0,04}$	$190_{-0,35}$	$110_{-0,8}$	325	15
260	–	GE 260 FO-2RS[5)]	81,7	$260_{-0,035}$	$400_{-0,04}$	$205_{-0,35}$	$120_{-0,8}$	350	15
280	–	GE 280 FO-2RS[5)]	96,5	$280_{-0,035}$	$430_{-0,045}$	$210_{-0,35}$	$120_{-0,9}$	375	15

[1)] No relubrication facility.

[2)] Can only be relubricated via the outer ring.

[3)] No lubrication groove on inner ring spherical surface.

[4)] Also available in groups C2 and C3.

[5)] Price and delivery on request.
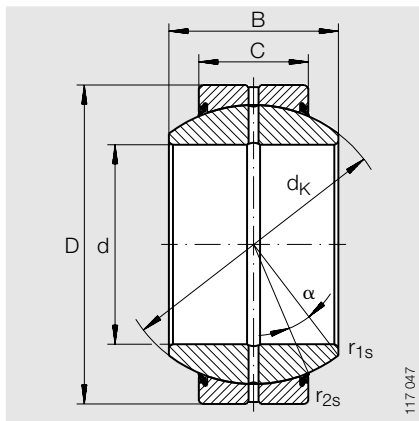
GE..FO-2RS
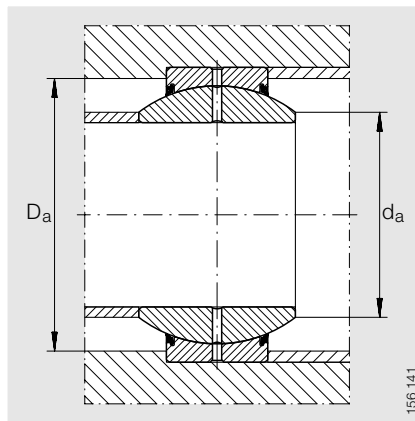
GE..FO-2RS – mounting dimensions
GE..FO – mounting dimensions

| Chamfer dimensions		Mounting dimensions		Basic load ratings		Radial internal clearance[4]	Shaft diameter
r_{1s}	r_{2s}	d_a	D_a	dyn. C_r	stat. C_{0r}	CN	
min.	min.	max.	min.	N	N		d
0,3	0,3	9,3	12,5	5 500	27 500	0,032 – 0,068	**6**
0,3	0,3	11,6	15,5	8 150	40 500	0,032 – 0,068	**8**
0,3	0,3	13,4	17,5	10 800	54 000	0,032 – 0,068	**10**
0,3	0,3	16	21	17 000	85 000	0,04 – 0,082	**12**
0,3	0,3	19,2	24	21 200	106 000	0,04 – 0,082	**15**
0,3	0,3	21	27,5	30 000	146 000	0,04 – 0,082	**17**
0,3	0,6	25,2	33	48 000	240 000	0,05 – 0,1	**20**
0,6	0,6	29,5	38	62 000	310 000	0,05 – 0,1	**25**
0,6	1	34,4	44,5	80 000	400 000	0,05 – 0,1	**30**
0,6	1	39,7	51	100 000	500 000	0,06 – 0,12	**35**
0,6	1	44,7	57	127 000	640 000	0,06 – 0,12	**40**
0,6	1	50	63	156 000	780 000	0,06 – 0,12	**45**
0,6	1	57,1	75	245 000	1 220 000	0,06 – 0,12	**50**
1	1	67	87	315 000	1 560 000	0,072 – 0,142	**60**
1	1	78,2	99	400 000	2 000 000	0,072 – 0,142	**70**
1	1	87,1	108	490 000	2 450 000	0,072 – 0,142	**80**
1	1	98,3	123	610 000	3 050 000	0,085 – 0,165	**90**
1	1	111,2	134	655 000	3 250 000	0,085 – 0,165	**100**
1	1	124,8	150	950 000	4 750 000	0,085 – 0,165	**110**
1	1	138,4	173	1 080 000	5 400 000	0,085 – 0,165	**120**
1	1	151,9	191	1 370 000	6 800 000	0,1 – 0,192	**140**
1	1,1	180	219	1 530 000	7 650 000	0,1 – 0,192	**160**
1,1	1,1	196,1	239	2 120 000	10 600 000	0,1 – 0,192	**180**
1,1	1,1	220	267	2 320 000	11 600 000	0,11 – 0,214	**200**
1,1	1,1	243,6	295	2 550 000	12 700 000	0,11 – 0,214	**220**
1,1	1,1	263,6	319	3 050 000	15 300 000	0,125 – 0,239	**240**
1,1	1,1	283,6	342	3 550 000	18 000 000	0,125 – 0,239	**260**
1,1	1,1	310,6	370	3 800 000	19 000 000	0,125 – 0,239	**280**

Radial spherical plain bearings

requiring maintenance
ISO 12 240-1, dimension series W
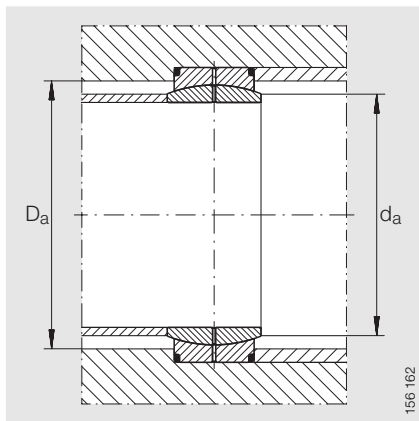Sliding contact surface: Steel/steel

Series GE..LO
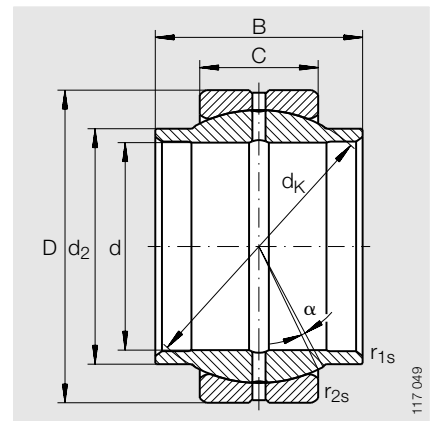
GE..LO

Dimension table · Dimensions in mm							
Shaft diameter	Designation	Mass	Dimensions				
			d	D	B	C	d_K
d		≈kg					
12	**GE 12 LO**[2)4)]	0,017	$12^{+0,018}$	$22_{-0,009}$	$12_{-0,18}$	$7_{-0,24}$	18
16	**GE 16 LO**[4)5)]	0,035	$16^{+0,018}$	$28_{-0,009}$	$16_{-0,18}$	$9_{-0,24}$	23
20	**GE 20 LO**[5)]	0,067	$20^{+0,021}$	$35_{-0,011}$	$20_{-0,21}$	$12_{-0,24}$	29
25	**GE 25 LO**	0,12	$25^{+0,021}$	$42_{-0,011}$	$25_{-0,21}$	$16_{-0,24}$	35,5
32	**GE 32 LO**	0,21	$32^{+0,025}$	$52_{-0,013}$	$32_{-0,25}$	$18_{-0,3}$	44
40	**GE 40 LO**	0,33	$40^{+0,025}$	$62_{-0,013}$	$40_{-0,25}$	$22_{-0,3}$	53
50	**GE 50 LO**	0,59	$50^{+0,025}$	$75_{-0,013}$	$50_{-0,25}$	$28_{-0,3}$	66
63	**GE 63 LO**	1,3	$63^{+0,03}$	$95_{-0,015}$	$63_{-0,3}$	$36_{-0,4}$	83
70	**GE 70 LO**[3)6)]	1,6	$70^{+0,03}$	$105_{-0,015}$	$70_{-0,3}$	$40_{-0,4}$	92
80	**GE 80 LO**	2,6	$80^{+0,03}$	$120_{-0,015}$	$80_{-0,3}$	$45_{-0,4}$	105
90	**GE 90 LO**[3)6)]	3	$90^{+0,035}$	$130_{-0,018}$	$90_{-0,35}$	$50_{-0,5}$	115
100	**GE 100 LO**	4,7	$100^{+0,035}$	$150_{-0,018}$	$100_{-0,35}$	$55_{-0,5}$	130
110	**GE 110 LO**[3)]	5,5	$110^{+0,035}$	$160_{-0,025}$	$110_{-0,35}$	$55_{-0,5}$	140
125	**GE 125 LO**	8,1	$125^{+0,04}$	$180_{-0,025}$	$125_{-0,4}$	$70_{-0,5}$	160
160	**GE 160 LO**[6)]	15,8	$160^{+0,04}$	$230_{-0,03}$	$160_{-0,4}$	$80_{-0,6}$	200
200	**GE 200 LO**[6)]	32,5	$200^{+0,046}$	$290_{-0,035}$	$200_{-0,46}$	$100_{-0,7}$	250
250	**GE 250 LO**[6)]	102	$250^{+0,046}$	$400_{-0,04}$	$250_{-0,46}$	$120_{-0,8}$	350
320	**GE 320 LO**[6)]	224	$320^{+0,057}$	$520_{-0,05}$	$320_{-0,57}$	160_{-1}	450

[1)] Bore tolerance: H7 (arithmetic mean value).

[2)] No relubrication facility.

[3)] Not included in ISO 12 240-1, dimension series W.

[4)] Cylindrical throughout.

[5)] No lubrication groove on inner ring spherical surface.

[6)] Price and delivery on request.

[7)] Also available in groups C2 and C3.

GE..LO – mounting dimensions

$d_2 = d_{a\,max}$	α	Chamfer dimensions		Mounting dimensions	Basic load ratings		Radial internal clearance[7]	Shaft diameter
		r_{1s}	r_{2s}	D_a	dyn. C_r	stat. C_{0r}	CN	
	Degrees	min.	min.	min.	N	N		d
15,5	4	0,3	0,3	17,5	10 800	54 000	0,032 – 0,068	**12**
20	4	0,3	0,3	23	17 600	88 000	0,04 – 0,082	**16**
25	4	0,3	0,3	27,5	30 000	146 000	0,04 – 0,082	**20**
30	4	0,6	0,6	33	48 000	240 000	0,05 – 0,1	**25**
38	4	0,6	1	42	67 000	335 000	0,05 – 0,1	**32**
46	4	0,6	1	51	100 000	500 000	0,06 – 0,12	**40**
57	4	0,6	1	63	156 000	780 000	0,06 – 0,12	**50**
71,5	4	1	1	78	255 000	1 270 000	0,072 – 0,142	**63**
79	4	1	1	87	315 000	1 560 000	0,072 – 0,142	**70**
91	4	1	1	99	400 000	2 000 000	0,072 – 0,142	**80**
99	4	1	1	108	490 000	2 450 000	0,072 – 0,142	**90**
113	4	1	1	123	610 000	3 050 000	0,085 – 0,165	**100**
124	4	1	1	134	655 000	3 250 000	0,085 – 0,165	**110**
138	4	1	1	150	950 000	4 750 000	0,085 – 0,165	**125**
177	4	1	1	191	1 370 000	6 800 000	0,1 – 0,192	**160**
221	4	1,1	1,1	239	2 120 000	10 600 000	0,1 – 0,192	**200**
317	4	2,5	1,1	342	3 550 000	18 000 000	0,125 – 0,239	**250**
405	4	2,5	4	438	6 100 000	30 500 000	0,135 – 0,261	**320**

Radial spherical plain bearings

requiring maintenance
Sliding contact surface: Steel/steel

Series GE..HO-2RS
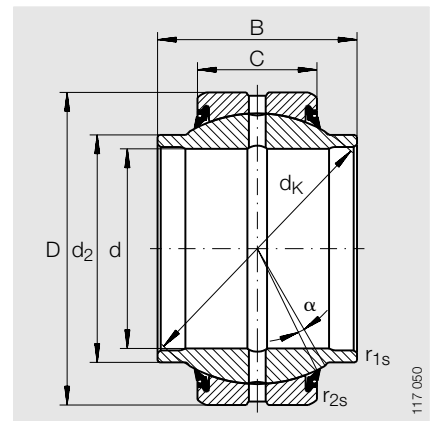
GE..HO-2RS

Shaft diameter d	Designation	Mass ≈kg	Dimensions				
			d	D	B	C	d_K
20	**GE 20 HO-2RS**	0,069	$20_{-0,01}$	$35_{-0,011}$	$24_{\pm0,2}$	$12_{-0,24}$	29[1]
25	**GE 25 HO-2RS**	0,12	$25_{-0,01}$	$42_{-0,011}$	$29_{\pm0,3}$	$16_{-0,24}$	35,5
30	**GE 30 HO-2RS**	0,15	$30_{-0,01}$	$47_{-0,011}$	$30_{\pm0,3}$	$18_{-0,24}$	40,7
35	**GE 35 HO-2RS**	0,26	$35_{-0,012}$	$55_{-0,013}$	$35_{\pm0,3}$	$20_{-0,3}$	47
40	**GE 40 HO-2RS**	0,32	$40_{-0,012}$	$62_{-0,013}$	$38_{\pm0,3}$	$22_{-0,3}$	53
45	**GE 45 HO-2RS**	0,43	$45_{-0,012}$	$68_{-0,013}$	$40_{\pm0,3}$	$25_{-0,3}$	60
50	**GE 50 HO-2RS**	0,55	$50_{-0,012}$	$75_{-0,013}$	$43_{\pm0,3}$	$28_{-0,3}$	66
60	**GE 60 HO-2RS**	1,1	$60_{-0,015}$	$90_{-0,015}$	$54_{\pm0,3}$	$36_{-0,4}$	80
70	**GE 70 HO-2RS**	1,6	$70_{-0,015}$	$105_{-0,015}$	$65_{\pm0,3}$	$40_{-0,4}$	92
80	**GE 80 HO-2RS**	2,5	$80_{-0,015}$	$120_{-0,015}$	$74_{\pm0,3}$	$45_{-0,4}$	105

Dimension table · Dimensions in mm

[1] No lubrication groove on inner ring spherical surface.

[2] Also available in groups C2 and C3.

GE..HO-2RS – mounting dimensions

| $d_2 = d_{a\,max}$ | α | Chamfer dimensions | | Mounting dimensions | Basic load ratings | | Radial internal clearance[2] | Shaft diameter |
		r_{1s}	r_{2s}	D_a	dyn. C_r	stat. C_{0r}	CN	
	Degrees	min.	min.	min.	N	N		d
24	3	0,2	0,3	27,5	30 000	146 000	0,04 – 0,082	**20**
29	3	0,2	0,6	33	48 000	240 000	0,05 – 0,1	**25**
34,2	3	0,2	0,6	38	62 000	310 000	0,05 – 0,1	**30**
40	3	0,3	1	44,5	80 000	400 000	0,05 – 0,1	**35**
45	3	0,3	1	51	100 000	500 000	0,06 – 0,12	**40**
51,5	3	0,3	1	57	127 000	640 000	0,06 – 0,12	**45**
56,5	3	0,3	1	63	156 000	780 000	0,06 – 0,12	**50**
67,7	3	0,3	1	75	245 000	1 220 000	0,06 – 0,12	**60**
78	3	0,3	1	87	315 000	1 560 000	0,072 – 0,142	**70**
90	3	0,3	1	99	400 000	2 000 000	0,072 – 0,142	**80**

Radial spherical plain bearings

requiring maintenance
inch sizes
Sliding contact surface: Steel/steel

Series GE..ZO
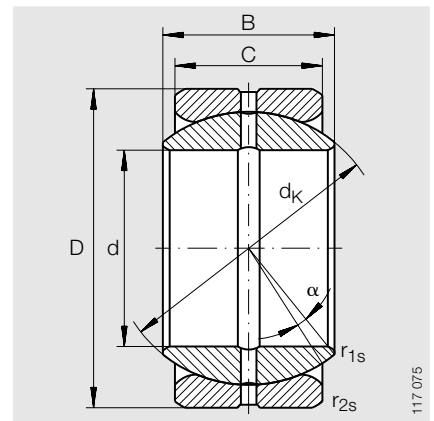
GE..ZO

Dimension table · Dimensions in *inch*/mm								
Shaft diameter	Designation[1]	Mass	Dimensions					
			d	D	B	C	d_K	α
d		≈kg						Degrees
0,750	**GE 19 ZO**	0,051	*0,750*	*1,2500*	*0,659*	*0,562*	27,5	6
19,050			$19,050_{-0,01}$	$31,7500_{-0,011}$	$16,662_{-0,12}$	$14,275_{-0,24}$		
0,875	**GE 22 ZO**	0,084	*0,875*	*1,4375*	*0,765*	*0,656*	32	6
22,225			$22,225_{-0,01}$	$36,5130_{-0,011}$	$19,431_{-0,12}$	$16,662_{-0,24}$		
1,000	**GE 25 ZO**	0,12	*1,000*	*1,6250*	*0,875*	*0,750*	35,5	6
25,400			$25,400_{-0,01}$	$41,2750_{-0,011}$	$22,225_{-0,12}$	$19,050_{-0,24}$		
1,250	**GE 31 ZO**	0,22	*1,250*	*2,0000*	*1,093*	*0,937*	45,5	6
31,750			$31,750_{-0,012}$	$50,8000_{-0,013}$	$27,762_{-0,12}$	$23,800_{-0,3}$		
1,375	**GE 34 ZO**	0,29	*1,375*	*2,1875*	*1,187*	*1,031*	49	6
34,925			$34,925_{-0,012}$	$55,5630_{-0,013}$	$30,150_{-0,12}$	$26,187_{-0,3}$		
1,500	**GE 38 ZO**	0,4	*1,500*	*2,4375*	*1,321*	*1,125*	53	6
38,100			$38,100_{-0,012}$	$61,9130_{-0,013}$	$33,325_{-0,12}$	$28,575_{-0,3}$		
1,750	**GE 44 ZO**	0,62	*1,750*	*2,8125*	*1,531*	*1,312*	63,9	6
44,450			$44,450_{-0,012}$	$71,4380_{-0,013}$	$38,887_{-0,12}$	$33,325_{-0,3}$		
2,000	**GE 50 ZO**	0,92	*2,000*	*3,1875*	*1,750*	*1,500*	73	6
50,800			$50,800_{-0,015}$	$80,9630_{-0,015}$	$44,450_{-0,15}$	$38,100_{-0,4}$		
2,250	**GE 57 ZO**	1,6	*2,250*	*3,5625*	*1,969*	*1,687*	82	6
57,150			$57,150_{-0,015}$	$90,4880_{-0,015}$	$50,013_{-0,15}$	$42,850_{-0,4}$		
2,500	**GE 63 ZO**	1,7	*2,500*	*3,9375*	*2,187*	*1,875*	92	6
63,500			$63,500_{-0,015}$	$100,0130_{-0,015}$	$55,550_{-0,15}$	$47,625_{-0,4}$		
2,750	**GE 69 ZO**	2,3	*2,750*	*4,3750*	*2,406*	*2,062*	100	6
69,850			$69,850_{-0,015}$	$111,1250_{-0,015}$	$61,112_{-0,15}$	$52,375_{-0,4}$		
3,000	**GE 76 ZO**	3	*3,000*	*4,7500*	*2,625*	*2,250*	109,5	6
76,200			$76,200_{-0,015}$	$120,6500_{-0,018}$	$66,675_{-0,15}$	$57,150_{-0,5}$		

[1] Price and delivery on request.

GE..ZO – mounting dimensions

Chamfer dimensions		Mounting dimensions		Basic load ratings		Radial internal clearance	Shaft diameter
r_{1s}	r_{2s}	d_a	D_a	dyn. C_r	stat. C_{0r}		
min.	min.	max.	min.	N	N		d
0,3	0,6	21,8	24,5	31 400	94 200	0,08 − 0,18	**0,750**
							19,050
0,3	0,6	25,4	28,5	42 600	127 000	0,08 − 0,18	**0,875**
							22,225
0,3	0,6	27,6	31,5	54 100	162 000	0,08 − 0,18	**1,000**
							25,400
0,6	0,6	36	40,5	86 600	259 000	0,08 − 0,18	**1,250**
							31,750
0,6	1	38,6	43,5	102 000	307 000	0,08 − 0,18	**1,375**
							34,925
0,6	1	41,2	46,5	121 000	363 000	0,08 − 0,18	**1,500**
							38,100
0,6	1	50,7	57	170 000	511 000	0,08 − 0,18	**1,750**
							44,450
0,6	1	57,9	65	222 000	667 000	0,08 − 0,18	**2,000**
							50,800
0,6	1	64,9	73	281 000	843 000	0,1 − 0,2	**2,250**
							57,150
1	1	73,3	82	350 000	1 050 000	0,1 − 0,2	**2,500**
							63,500
1	1	79,1	89	419 000	1 250 000	0,1 − 0,2	**2,750**
							69,850
1	1	86,8	98	500 000	1 500 000	0,1 − 0,2	**3,000**
							76,200

Radial spherical plain bearings

requiring maintenance
ISO 12 240-1, dimension series K
Sliding contact surface: Steel/bronze

Series GE..PB

GE..PB

Dimension table · Dimensions in mm								
Shaft diameter	Designation[4]	Mass	Dimensions					
			$d^{1)}$	D	B	C	d_K	α
d		$\approx$kg						Degrees
5	**GE 5 PB[2]**	0,006	$5^{+0,012}$	$13_{-0,008}$	$8_{-0,12}$	$6_{\ -0,24}$	11,112	13
6	**GE 6 PB**	0,01	$6^{+0,012}$	$16_{-0,008}$	$9_{-0,12}$	$6,75_{-0,24}$	12,7	13
8	**GE 8 PB**	0,018	$8^{+0,015}$	$19_{-0,009}$	$12_{-0,12}$	$9_{\ -0,24}$	15,875	14
10	**GE 10 PB**	0,027	$10^{+0,015}$	$22_{-0,009}$	$14_{-0,12}$	$10,5_{\ -0,24}$	19,05	13
12	**GE 12 PB**	0,043	$12^{+0,018}$	$26_{-0,009}$	$16_{-0,12}$	$12_{\ -0,24}$	22,225	13
14	**GE 14 PB**	0,055	$14^{+0,018}$	$28_{-0,009}{}^{3)}$	$19_{-0,12}$	$13,5_{\ -0,24}$	25,4	16
16	**GE 16 PB**	0,08	$16^{+0,018}$	$32_{-0,011}$	$21_{-0,12}$	$15_{\ -0,24}$	28,575	15
18	**GE 18 PB**	0,1	$18^{+0,018}$	$35_{-0,011}$	$23_{-0,12}$	$16,5_{\ -0,24}$	31,75	15
20	**GE 20 PB**	0,15	$20^{+0,021}$	$40_{-0,011}$	$25_{-0,12}$	$18_{\ -0,24}$	34,925	14
22	**GE 22 PB**	0,18	$22^{+0,021}$	$42_{-0,011}$	$28_{-0,12}$	$20_{\ -0,24}$	38,1	15
25	**GE 25 PB**	0,24	$25^{+0,021}$	$47_{-0,011}$	$31_{-0,12}$	$22_{\ -0,24}$	42,85	15
30	**GE 30 PB**	0,38	$30^{+0,021}$	$55_{-0,013}$	$37_{-0,12}$	$25_{\ -0,3}$	50,8	17

[1] Bore tolerance: H7 (arithmetic mean value).

[2] No relubrication facility.

[3] Deviating from ISO 12 240-1, dimension series K.

[4] Price and delivery on request.

GE..PB – mounting dimensions

Chamfer dimensions		Mounting dimensions		Basic load ratings		Radial internal clearance[3]	Shaft diameter
r_{1s}	r_{2s}	d_a	D_a	dyn. C_r	stat. C_{0r}		
min.	min.	max.	min.	N	N		d
0,3	0,3	7,7	9,8	3 250	8 500	0,006 – 0,035	**5**
0,3	0,3	8,9	11,5	4 300	10 800	0,006 – 0,035	**6**
0,3	0,3	10,3	14	7 200	18 000	0,006 – 0,035	**8**
0,3	0,3	12,9	17	10 000	25 000	0,006 – 0,035	**10**
0,3	0,3	15,4	19,5	13 400	33 500	0,006 – 0,035	**12**
0,3	0,3	16,8	22,5	17 000	43 000	0,006 – 0,035	**14**
0,3	0,3	19,3	25,5	21 600	54 000	0,006 – 0,035	**16**
0,3	0,3	21,8	28,5	26 000	66 500	0,006 – 0,035	**18**
0,3	0,6	24,3	31,5	31 500	80 000	0,006 – 0,035	**20**
0,3	0,6	25,8	34	38 000	96 500	0,006 – 0,035	**22**
0,3	0,6	29,5	38,5	47 500	118 000	0,006 – 0,035	**25**
0,3	0,6	34,8	46	64 000	160 000	0,006 – 0,035	**30**

Angular contact spherical plain bearings

requiring maintenance,
ISO 12 240-2
Sliding contact surface: Steel/steel

Series GE..SX

GE..SX

Shaft diameter	Designation[1]	Mass	Dimensions						
			d	D	T	d_K	D_1	B	C
d		≈kg							
25	GE 25 SX	0,14	$25_{-0,012}$	$47_{-0,014}$	$15_{\pm0,25}$	42,5	31,4	$14_{-0,2}$	$14_{-0,2}$
28	GE 28 SX	0,18	$28_{-0,012}$	$52_{-0,016}$	$16_{\pm0,25}$	47	35,7	$15_{-0,2}$	$15_{-0,2}$
30	GE 30 SX	0,21	$30_{-0,012}$	$55_{-0,016}$	$17_{\pm0,25}$	50	36,1	$16_{-0,2}$	$16_{-0,2}$
35	GE 35 SX	0,27	$35_{-0,012}$	$62_{-0,016}$	$18_{\pm0,25}$	56	42,4	$17_{-0,24}$	$17_{-0,24}$
40	GE 40 SX	0,33	$40_{-0,012}$	$68_{-0,016}$	$19_{\pm0,25}$	60	46,8	$18_{-0,24}$	$18_{-0,24}$
45	GE 45 SX	0,42	$45_{-0,012}$	$75_{-0,016}$	$20_{\pm0,25}$	66	52,9	$19_{-0,24}$	$19_{-0,24}$
50	GE 50 SX	0,46	$50_{-0,012}$	$80_{-0,016}$	$20_{\pm0,25}$	74	59,1	$19_{-0,24}$	$19_{-0,24}$
55	GE 55 SX	0,68	$55_{-0,015}$	$90_{-0,018}$	$23_{\pm0,25}$	80	62	$22_{-0,3}$	$22_{-0,3}$
60	GE 60 SX	0,73	$60_{-0,015}$	$95_{-0,018}$	$23_{\pm0,25}$	86	68,1	$22_{-0,3}$	$22_{-0,3}$
65	GE 65 SX	0,77	$65_{-0,015}$	$100_{-0,018}$	$23_{\pm0,25}$	92	75,6	$22_{-0,3}$	$22_{-0,3}$
70	GE 70 SX	1,1	$70_{-0,015}$	$110_{-0,018}$	$25_{\pm0,25}$	102	82,2	$24_{-0,3}$	$24_{-0,3}$
80	GE 80 SX	1,5	$80_{-0,015}$	$125_{-0,02}$	$29_{\pm0,25}$	115	90,5	$27_{-0,3}$	$27_{-0,3}$
90	GE 90 SX	2,1	$90_{-0,02}$	$140_{-0,02}$	$32_{\pm0,25}$	130	103,3	$30_{-0,4}$	$30_{-0,4}$
100	GE 100 SX	2,3	$100_{-0,02}$	$150_{-0,02}$	$32_{\pm0,25}$	140	114,3	$30_{-0,4}$	$30_{-0,4}$
110	GE 110 SX	3,9	$110_{-0,02}$	$170_{-0,025}$	$38_{\pm0,25}$	160	125,8	$36_{-0,4}$	$36_{-0,4}$
120	GE 120 SX	4	$120_{-0,02}$	$180_{-0,025}$	$38_{\pm0,25}$	170	135,4	$36_{-0,4}$	$36_{-0,4}$
130	GE 130 SX	6,1	$130_{-0,025}$	$200_{-0,03}$	$45_{\pm0,35}$	190	148	$42_{-0,5}$	$42_{-0,5}$
140	GE 140 SX	6,5	$140_{-0,025}$	$210_{-0,03}$	$45_{\pm0,35}$	200	160,6	$42_{-0,5}$	$42_{-0,5}$
150	GE 150 SX	7,9	$150_{-0,025}$	$225_{-0,03}$	$48_{\pm0,35}$	213	170,9	$45_{-0,5}$	$45_{-0,5}$
160	GE 160 SX	9,4	$160_{-0,025}$	$240_{-0,03}$	$51_{\pm0,35}$	225	181,4	$48_{-0,5}$	$48_{-0,5}$
170	GE 170 SX	13	$170_{-0,025}$	$260_{-0,035}$	$57_{\pm0,35}$	250	194,3	$54_{-0,5}$	$54_{-0,5}$
180	GE 180 SX	17,5	$180_{-0,025}$	$280_{-0,035}$	$64_{\pm0,35}$	260	205,5	$61_{-0,5}$	$61_{-0,5}$
190	GE 190 SX	18,3	$190_{-0,03}$	$290_{-0,035}$	$64_{\pm0,35}$	275	211,8	$61_{-0,6}$	$61_{-0,6}$
200	GE 200 SX	23,3	$200_{-0,03}$	$310_{-0,035}$	$70_{\pm0,35}$	290	229,2	$66_{-0,6}$	$66_{-0,6}$

[1] Price and delivery on request.
[2] Basic load ratings in radial direction.

GE..SX – mounting dimensions

			Chamfer dimensions		Mounting dimensions				Basic load ratings[2]		Shaft diameter
s	A	α	r_{1s}	r_{2s}	d_a	d_b	D_a	D_b	dyn. C_r	stat. C_{0r}	
		Degrees	min.	min.	max.	max.	min.	min.	N	N	d
1	7,5	2,7	0,6	0,2	30,1	39,5	34	43	47 800	239 000	**25**
1	8	2,4	1	0,3	34,4	42	40	47,5	57 500	287 000	**28**
2	8,5	2,3	1	0,3	34,6	45	40,5	50,5	64 600	323 000	**30**
2	9	2,1	1	0,3	41,1	50	47	57	78 500	392 000	**35**
1,5	9,5	1,9	1	0,3	45,5	54	52	61	90 600	453 000	**40**
1,5	10	1,7	1	0,3	51,7	60	58	67	106 000	532 000	**45**
4	10	1,6	1	0,3	57,9	67	65	75	118 000	590 000	**50**
4	11,5	1,4	1,5	0,6	60,7	71	70	81	149 000	745 000	**55**
5	11,5	1,3	1,5	0,6	66,9	77	76	87	160 000	802 000	**60**
5	11,5	1,3	1,5	0,6	74,4	83	84	93	173 000	867 000	**65**
7	12,5	1,1	1,5	0,6	80,9	92	90	104	208 000	1 040 000	**70**
10	14,5	2	1,5	0,6	88	104	99	117	244 000	1 220 000	**80**
11	16	1,8	2	0,6	100,8	118	112	132	313 000	1 560 000	**90**
12	16	1,7	2	0,6	112	128	123	142	339 000	1 690 000	**100**
15	19	1,5	2,5	0,6	123,2	146	135	162	469 000	2 340 000	**110**
17	19	1,4	2,5	0,6	132,9	155	145	172	498 000	2 490 000	**120**
20	22,5	1,9	2,5	0,6	143,9	174	158	192	622 000	3 110 000	**130**
20	22,5	1,8	2,5	0,6	156,9	184	171	202	663 000	3 310 000	**140**
21	24	1,7	3	1	167,1	194	184	216	764 000	3 820 000	**150**
21	25,5	1,6	3	1	177,7	206	195	228	872 000	4 360 000	**160**
27	28,5	1,4	3	1	190,4	228	208	253	1 080 000	5 440 000	**170**
21	32	1,3	3	1	201,7	240	220	263	1 310 000	6 590 000	**180**
29	32	1,3	3	1	207,9	252	226	278	1 370 000	6 850 000	**190**
26	35	1,6	3	1	224,1	268	244	293	1 540 000	7 740 000	**200**

Axial spherical plain bearings

requiring maintenance
ISO 12 240-3
Sliding contact surface: Steel/steel

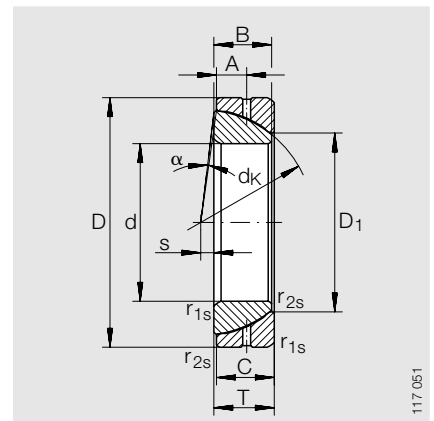Series GE..AX
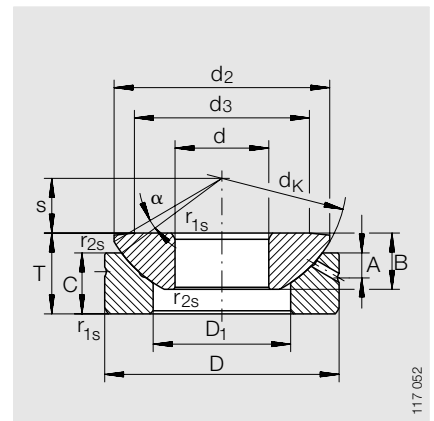
GE..AX

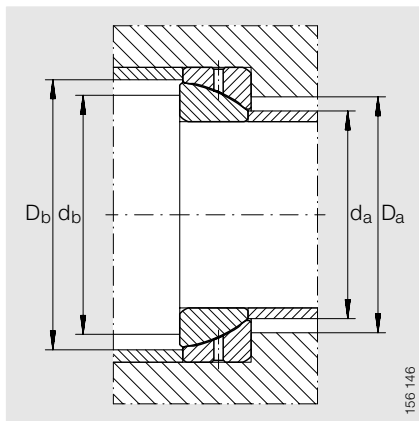| Dimension table · Dimensions in mm											
Shaft diameter	Designation	Mass	Dimensions								
			d	D	T	d_K	d_2	d_3	D_1	B	
d		$\approx$kg									
10	GE 10 AX	0,039	$10_{-0,008}$	$30_{-0,009}$	$9,5_{-0,4}$	32	27,5	21	16,5	$7,9_{-0,24}$	
12	GE 12 AX	0,071	$12_{-0,008}$	$35_{-0,011}$	$13_{-0,4}$	37	32	24	19,5	$9,3_{-0,24}$	
15	GE 15 AX	0,12	$15_{-0,008}$	$42_{-0,011}$	$15_{-0,4}$	45	38,9	29	24	$10,7_{-0,24}$	
17	GE 17 AX	0,16	$17_{-0,008}$	$47_{-0,011}$	$16_{-0,4}$	50	43,4	34	28	$11,5_{-0,24}$	
20	GE 20 AX	0,26	$20_{-0,01}$	$55_{-0,013}$	$20_{-0,4}$	60	50	40	33,5	$14,3_{-0,24}$	
25	GE 25 AX	0,39	$25_{-0,01}$	$62_{-0,013}$	$22,5_{-0,4}$	66	57,5	45	34,5	$16_{-0,24}$	
30	GE 30 AX	0,65	$30_{-0,01}$	$75_{-0,013}$	$26_{-0,4}$	80	69	56	44	$18_{-0,24}$	
35	GE 35 AX	1	$35_{-0,012}$	$90_{-0,015}$	$28_{-0,4}$	98	84	66	52	$22_{-0,24}$	
40	GE 40 AX	1,7	$40_{-0,012}$	$105_{-0,015}$	$32_{-0,4}$	114	98	78	59	$27_{-0,24}$	
45	GE 45 AX	2,5	$45_{-0,012}$	$120_{-0,015}$	$36,5_{-0,4}$	130	112	89	68	$31_{-0,24}$	
50	GE 50 AX[1]	3,4	$50_{-0,012}$	$130_{-0,018}$	$42,5_{-0,4}$	140	122,5	98	69	$33,5_{-0,24}$	
60	GE 60 AX[1]	4,7	$60_{-0,015}$	$150_{-0,018}$	$45_{-0,4}$	160	140	108	86	$37_{-0,3}$	
70	GE 70 AX[1]	5,7	$70_{-0,015}$	$160_{-0,025}$	$50_{-0,4}$	170	149,5	121	95	$40_{-0,3}$	
80	GE 80 AX[1]	7,2	$80_{-0,015}$	$180_{-0,025}$	$50_{-0,4}$	194	168	130	108	$42_{-0,3}$	
100	GE 100 AX[1]	10,9	$100_{-0,02}$	$210_{-0,03}$	$59_{-0,4}$	220	195,5	155	133	$50_{-0,4}$	
120	GE 120 AX[1]	13	$120_{-0,02}$	$230_{-0,03}$	$64_{-0,4}$	245	214	170	154	$52_{-0,4}$	
140	GE 140 AX[1]	18,6	$140_{-0,025}$	$260_{-0,035}$	$72_{-0,5}$	272	244	198	176	$61_{-0,5}$	
160	GE 160 AX[1]	23,9	$160_{-0,025}$	$290_{-0,035}$	$77_{-0,5}$	310	272	213	199	$65_{-0,5}$	
180	GE 180 AX[1]	31,6	$180_{-0,025}$	$320_{-0,040}$	$86_{-0,5}$	335	300	240	224	$70_{-0,5}$	
200	GE 200 AX[1]	35	$200_{-0,03}$	$340_{-0,040}$	$87_{-0,5}$	358	321	265	246	$74_{-0,6}$	

[1] Price and delivery on request.

[2] Basic load ratings in axial direction.

GE..AX – mounting dimensions

156 147

C		s	A	α	Chamfer dimensions		Mounting dimensions		Basic load ratings[2]		Shaft diameter
					r_{1s}	r_{2s}	d_a	D_a	dyn. C_a	stat. C_{0a}	
				Degrees	min.	min.	max.	min.	N	N	d
6	−0,24	7	3	10	0,6	0,2	21	18,5	24 400	122 000	**10**
9	−0,24	8	4	9	0,6	0,2	24	21,5	32 400	162 000	**12**
11	−0,24	10	5	7	0,6	0,2	29	26	52 200	261 000	**15**
11,5	−0,24	11	5	6	0,6	0,2	34	30,5	59 200	296 000	**17**
13	−0,24	12,5	6	6	1	0,3	40	38	75 100	375 000	**20**
17	−0,24	14	6	7	1	0,3	45	39	129 000	645 000	**25**
19,5	−0,24	17,5	8	6	1	0,3	56	49	169 000	848 000	**30**
20	−0,24	22	8	6	1	0,3	66	57	259 000	1 290 000	**35**
22	−0,24	24,5	9	6	1	0,3	78	64	373 000	1 860 000	**40**
25	−0,24	27,5	11	6	1	0,3	89	74	486 000	2 430 000	**45**
32	−0,24	30	10	5	1	0,3	98	75	650 000	3 250 000	**50**
33	−0,3	35	12,5	7	1	0,3	108	92	735 000	3 670 000	**60**
36	−0,3	35	13,5	6	1	0,3	121	102	806 000	4 030 000	**70**
36	−0,3	42,5	14,5	6	1	0,3	130	115	1 030 000	5 180 000	**80**
42	−0,4	45	15	7	1	0,3	155	141	1 200 000	6 020 000	**100**
45	−0,4	52,5	16,5	8	1	0,3	170	162	1 240 000	6 220 000	**120**
50	−0,5	52,5	23	6	1,5	0,6	198	187	1 630 000	8 170 000	**140**
52	−0,5	65	23	7	1,5	0,6	213	211	1 890 000	9 460 000	**160**
60	−0,5	67,5	26	8	1,5	0,6	240	236	2 120 000	10 630 000	**180**
60	−0,6	70	27	8	1,5	0,6	265	259	2 350 000	11 780 000	**200**
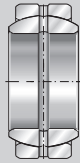
Maintenance-free rod ends

Criteria for bearing selection

Maintenance-free rod ends

GIR..UK   GIR..UK-2RS   GAR..UK   GAR..UK-2RS

Load carrying capacity

C_r Bearing
C_{0r} Housing
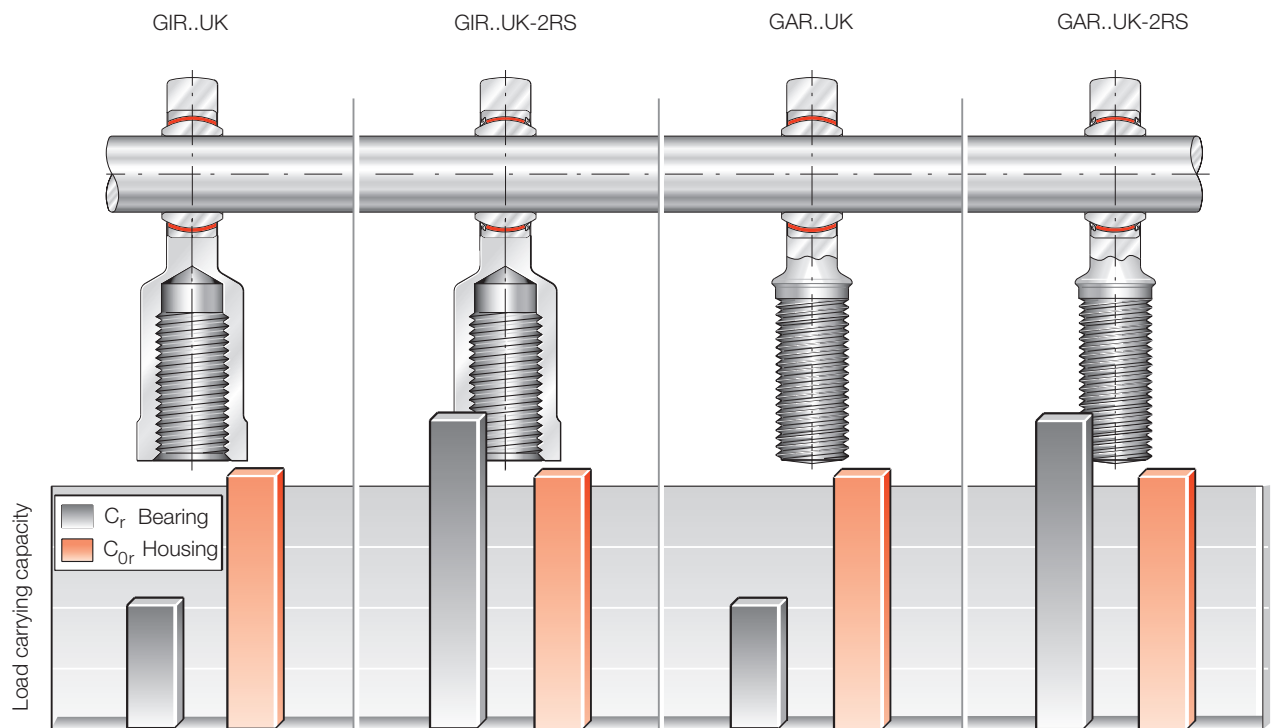
Comparison of load carrying capacity for identical shaft diameter.

Maintenance-free rod ends
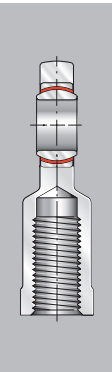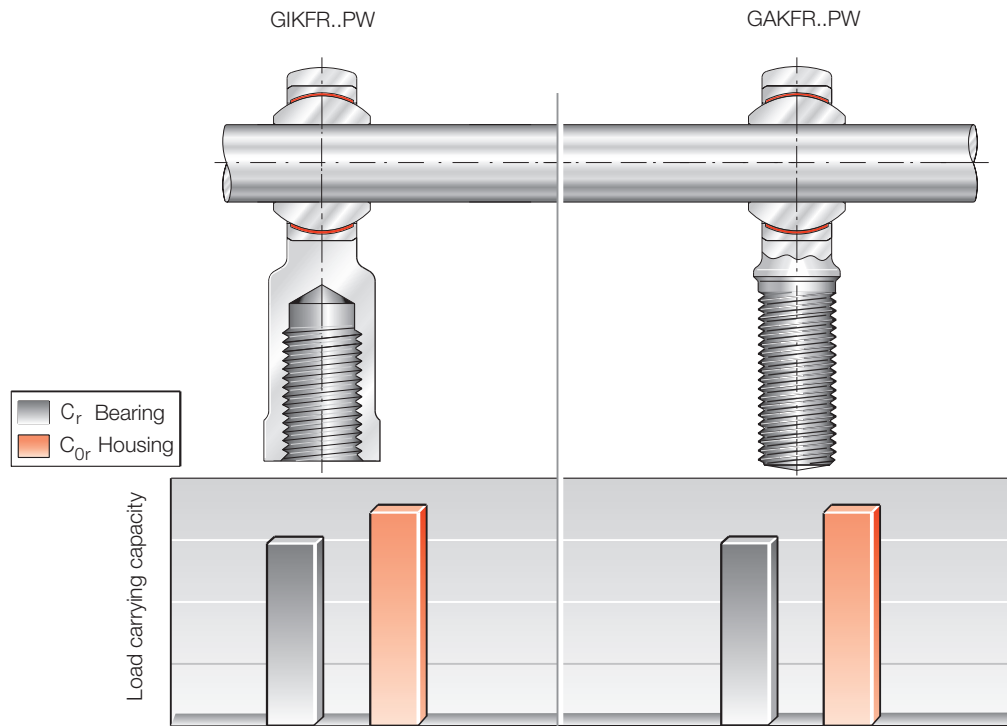
GIKFR..PW   GAKFR..PW

C_r Bearing
C_{0r} Housing

Load carrying capacity

Maintenance-free rod ends

Features

Maintenance-free rod ends

are complete units comprising a housing with an integral shank and a maintenance-free spherical plain bearing
  – the integral shank has an external or internal thread
  – the spherical plain bearing is firmly seated and located in the housing
■ can support radial loads in a tensile or compressive direction
■ can transmit slow movements with small or moderate swivel angles
■ are suitable for unilateral loads
  – they are suitable for supporting alternating loads in certain cases
  – they are suitable for alternating loads in combination with bearings GE..UK-2RS
■ are protected against corrosion by a zinc plating
■ are maintenance-free
  – in bearings with ELGOGLIDE®, lubricant leads to a considerable reduction in bearing life.

Sealed maintenance-free rod ends

■ are protected against contaminants and water spray by
  – lip seals.

Rod ends to ISO 12 240-4, dimension series E

■ are fitted with radial spherical plain bearings GE..UK or GE..UK-2RS
■ have hard chromium/PTFE composite or hard chromium/ELGOGLIDE® sliding contact surfaces
■ have a right hand or left hand internal or external thread
■ the thin walled design of the eye housing allows compact adjacent constructions.

Rod ends to ISO 12 240-4, dimension series K

■ incorporate a radial spherical plain bearing GE..PW
■ have a steel/PTFE-bronze film sliding contact surface
■ have a right hand or left hand internal or external thread.

Maintenance-free rod ends

GIR..UK
(right hand thread)
GIR..UK-2RS
(right hand thread)
GIL..UK
(left hand thread)
GIL..UK-2RS
(left hand thread)
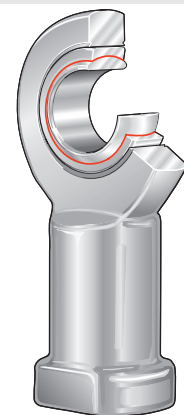
118 056

■ to ISO 12 240-4, dimension series E, type F
■ shank with internal thread
■ suffix -2RS: lip seals on both sides, for operating temperatures from –30 °C to +130 °C
■ GIR..UK and GIL..UK
  for shaft diameters from 6 mm to 30 mm
■ GIR..UK-2RS and GIL..UK-2RS
  for shaft diameters from 35 mm to 80 mm

132

GIKFR..PW
(right hand thread)
GIPFR..PW
(right hand thread)
GIKFL..PW
(left hand thread)
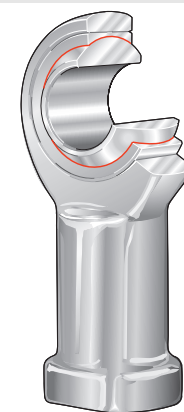
118 057

■ to ISO 12 240-4, dimension series K, type F
■ shank with internal thread
■ GIPFR..PW has a fine pitch thread shank for standard pneumatic cylinders to DIN 24 335
■ GIKFR..PW and GIKFL..PW
  for shaft diameters from 5 mm to 30 mm
■ GIPFR..PW
  for shaft diameters from 5 mm to 30 mm

136
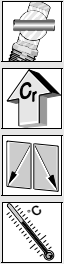
GAR..UK
(right hand thread)
GAR..UK-2RS
(right hand thread)
GAL..UK
(left hand thread)
GAL..UK-2RS
(left hand thread)
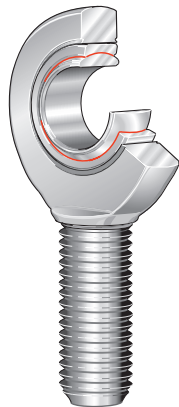
118 063

- to ISO 12 240-4, dimension series E, type M
- shank with external thread
- suffix -2RS: lip seals on both sides,
  for operating temperatures from –30 °C to +130 °C
- GAR..UK and GAL..UK
  for shaft diameters from 6 mm to 30 mm
- GAR..UK-2RS and GAL..UK-2RS
  for shaft diameters from 35 mm to 80 mm

134

GAKFR..PW
(right hand thread)
GAKFL..PW
(left hand thread)
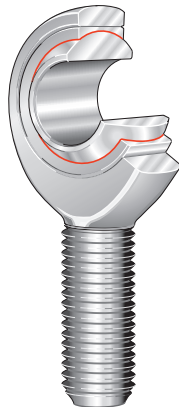
118 059

- to ISO 12 240-4, dimension series K, type M
- shank with external thread
- for shaft diameters from 5 mm to 30 mm

138

Maintenance-free rod ends

 Design and safety guidelines

Basic dynamic load rating

The basic dynamic load rating C_r (*dimension table*) refers to the spherical plain bearing when fitted. It represents a factor used for calculating the bearing life.

The equivalent bearing load and additional bending stresses in the shank area are 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.

Basic static load rating

The basic static load rating C_{0r} (*dimension table*) of the rod end refers only to the load carrying capacity of the rod end housing.

It indicates:

- the maximum constant tensile load when utilising 83% of the material yield strength in the most highly stressed cross-section.

Permissible loading of rod ends

The permissible loading of rod ends depends on the type of load.

Pulsating or alternating loads subject the material to greater stress than constant loads. The reduction factors f_b must therefore be used for these operating conditions in calculation (Table 1).

⚠ In rod ends with the sliding material ELGOGLIDE®, the basic static load rating C_{0r} of the housing is less than the basic dynamic load rating C_r of the bearing.

Table 1 · Load factors f_b

Load type		Series	Load factor f_b
Unilateral load	151 540	All series	1
Pulsating load	151 541	GIR..UK[1] GAR..UK[1] GIKFR..PW GAKFR..PW	2,25 3 2,25 3
Alternating load	151 542		

P_{perm} = permissible rod end load N C_{0r} = basic static radial load rating of rod end N f_b = load factor	$P_{perm} = \dfrac{C_{0r}}{f_b}$

[1] f_b values are also valid for sealed designs (-2RS).

Calculation of rating life

Two calculations must always be carried out:

■ the permissible load on the rod end

■ the life of the spherical plain bearing.

⚠ The equivalent bearing load P must not exceed the permissible load on the rod end P_{perm}.

$$P_{perm} = \frac{C_{0r}}{f_b}$$

P_{perm} N
Permissible load on rod end

f_b –
Load factor (Table 1)

C_{0r} N
Basic static load rating (radial) of rod end.

Maintenance-free rod ends

Calculation example

Given

Swivel arm pivot of the feed device of a continuous furnace.

Operating parameters:

Load	$F_{R\,max}$ =	75 kN
Load direction	=	unilateral
Load type	=	pulsating load
Load factor	f_b =	2,25
Bearing load	$F_{R\,min}$ =	22 kN
	$F_{R\,max}$ =	75 kN
Swivel angle	β =	47°
Swivel frequency	f =	5,4 min^{-1}
Load frequency	P_{Hz} =	0,09 Hz
Operating temperature	t =	110 °C

Bearing data:

Maintenance-free rod end		= GIR..UK-2RS
Factors for maintenance-free	K	= 300 N/mm^2
spherical plain bearings	f_2	= 1
(Table 3, page 69)	f_4	= 1
	f_5	= 1,4

Required

Rod end size with a bearing which allows a life of min. 13 000 h.

Calculation of rod end size

$$P_{perm} = \frac{C_{0r}}{f_b}$$

$$C_{0r\,min} = F_{R\,max} \cdot f_b$$

$C_{0r\,min}$ = 75 · 2,25 = 168,75 kN.

The rod end GIR 40 UK-2RS with a rod end basic load rating C_{0r} = 194 kN is suitable for the application.

Calculation of rating life (see page 65)

Radial spherical plain bearing GE 40 UK-2RS
C_r = 277 kN
d_K = 53 mm

$$P = \sqrt{\frac{F^2_{min} + F^2_{max}}{2}}$$

$$P = \sqrt{\frac{22^2 + 75^2}{2}} = 55,27 \text{ kN}$$

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

$$p = 300 \cdot \frac{55,27}{277} = 59,86 \text{ N/mm}^2$$

$$v = 2,91 \cdot 10^{-4} \cdot f_4 \cdot d_K \cdot \beta \cdot f$$

$$v = 2,91 \cdot 10^{-4} \cdot 1 \cdot 53 \cdot 47 \cdot 5,4 = 3,91 \text{ mm/s}$$

$$f_v = \frac{1,6228}{1,000295^{v \cdot p}}$$

$$f_v = \frac{1,6228}{1,000295^{3,91 \cdot 59,86}} = 1,515$$

$$f_6 = 0,7579 \cdot 1,0093^{\beta}$$

f_6 = 0,7579 · 1,009347 = 1,171

s (ELGOGLIDE®) for p = 59,86 N/mm^2
from Figure 12, page 68 $\Rightarrow$ 306 000 m,
alternatively calculated using function from Table 2, page 68.

$$s = \frac{791\,020}{1,01599^p} = \frac{791\,020}{1,01599^{59,86}} = 306\,045$$

$$L = \frac{f_2 \cdot f_v}{f_6} \cdot \frac{s \cdot f}{v} \cdot 14$$

$$L = \frac{1 \cdot 1,515}{1,171} \cdot \frac{306\,045 \cdot 5,4}{3,91} \cdot 14 = 7\,655\,720 \text{ osc.}$$

$$f_{Hz} = \frac{0,5442}{1,0171^{P_{Hz} \cdot p}}$$

$$f_{Hz} = \frac{0,5442}{1,0171^{0,09 \cdot 59,75}} = 0,497$$

$$L_W = L \cdot f_{Hz} \cdot f_5$$

L_W = 7 655 720 · 0,497 · 1,4 = 5 326 850 osc.

$$L_{hW} = \frac{L_W}{f \cdot 60}$$

$$L_{hW} = \frac{5\,326\,850}{5,4 \cdot 60} = 16\,440 \text{ h}$$

Accuracy

The main dimensions of these rod ends conform
to ISO 12 240-4.

All connecting threads have metric dimensions to DIN 13,
central tolerance class, 6H, 6g.

The stated thread length is the minimum usable length,
based on normal chamfering practice for the thread of
the mating component.

Special designs

Available by agreement:
- rod ends with special threads
- rod ends with different anti-corrosion protection.

Ordering example and ordering designation

Maintenance-free rod end to ISO 12 240-4, dimension series E,
type F
for:
shaft   15 mm.

Ordering designation: **GIR 15 UK** (Figure 1).

GIR 15 UK

d
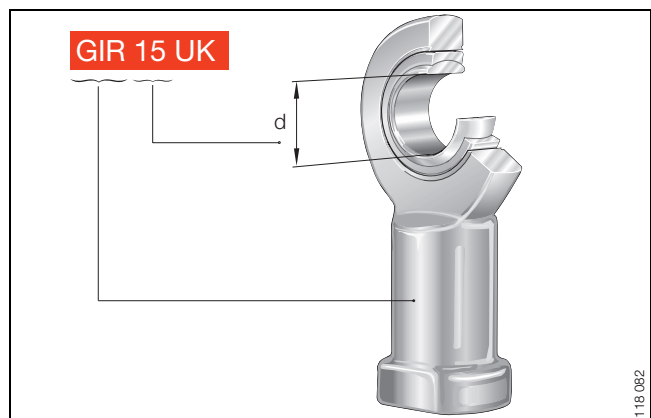
Figure 1 · Ordering example, ordering designation
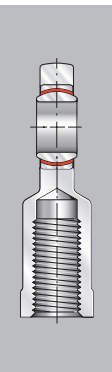
Rod ends

maintenance-free
ISO 12 240-4, dimension series E, type F
Sliding contact surface: hard chromium/PTFE

Series GIR..UK
　　　Sliding material: PTFE composite

　　　GIR..UK-2RS
　　　Sliding material: ELGOGLIDE®
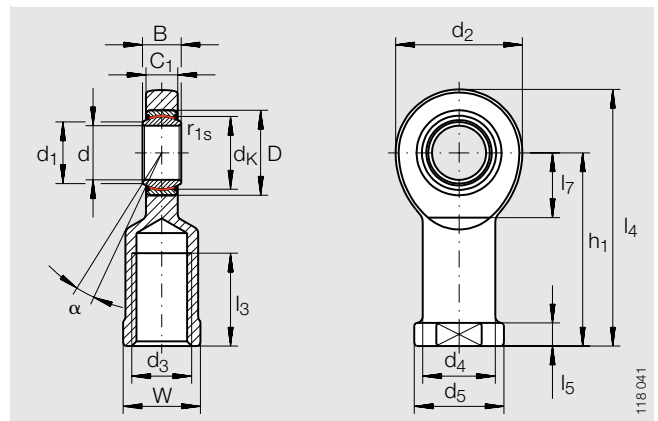
GIR..UK, GIR..UK-2RS

Dimension table · Dimensions in mm												
Shaft diameter	Designation[1]		Mass	Dimensions								
				d	D	B	d_K	d_1	d_2	d_3	d_4	h_1
d	without seals	with seals	≈kg									
6	GIR 6 UK	–	0,021	$6_{-0,008}$	14	$6_{-0,12}$	10	8	21	M 6	10	30
8	GIR 8 UK	–	0,039	$8_{-0,008}$	16	$8_{-0,12}$	13	10,2	24	M 8	12,5	36
10	GIR 10 UK	–	0,061	$10_{-0,008}$	19	$9_{-0,12}$	16	13,2	29	M10	15	43
12	GIR 12 UK	–	0,096	$12_{-0,008}$	22	$10_{-0,12}$	18	14,9	34	M12	17,5	50
15	GIR 15 UK	–	0,18	$15_{-0,008}$	26	$12_{-0,12}$	22	18,4	40	M14	21	61
17	GIR 17 UK	–	0,22	$17_{-0,008}$	30	$14_{-0,12}$	25	20,7	46	M16	24	67
20	GIR 20 UK	–	0,35	$20_{-0,01}$	35	$16_{-0,12}$	29	24,1	53	M20×1,5	27,5	77
25	GIR 25 UK	–	0,64	$25_{-0,01}$	42	$20_{-0,12}$	35,5	29,3	64	M24×2	33,5	94
30	GIR 30 UK	–	0,93	$30_{-0,01}$	47	$22_{-0,12}$	40,7	34,2	73	M30×2	40	110
35	–	GIR 35 UK-2RS	1,3	$35_{-0,012}$	55	$25_{-0,12}$	47	39,7	82	M36×3	47	125
40	–	GIR 40 UK-2RS	2	$40_{-0,012}$	62	$28_{-0,12}$	53	45	92	M39×3[2]	52	142
45	–	GIR 45 UK-2RS	2,5	$45_{-0,012}$	68	$32_{-0,12}$	60	50,7	102	M42×3[2]	58	145
50	–	GIR 50 UK-2RS	3,5	$50_{-0,012}$	75	$35_{-0,12}$	66	55,9	112	M45×3[2]	62	160
60	–	GIR 60 UK-2RS	5,5	$60_{-0,015}$	90	$44_{-0,15}$	80	66,8	135	M52×3[2]	70	175
70	–	GIR 70 UK-2RS	8,6	$70_{-0,015}$	105	$49_{-0,15}$	92	77,8	160	M56×4[2]	80	200
80	–	GIR 80 UK-2RS	12	$80_{-0,015}$	120	$55_{-0,15}$	105	89,4	180	M64×4[2]	95	230

[1] For a left hand thread, the R is replaced by an L (example: GIL..).

[2] Thread runout or thread groove at manufacturer's discretion.
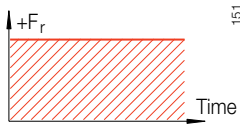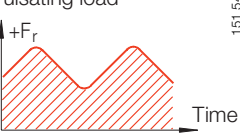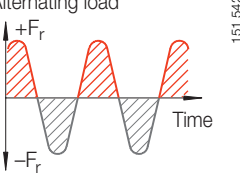
[3] Basic load rating of housing.
⚠ In rod ends with the sliding material ELGOGLIDE®,
the basic static load rating C_{0r} of the housing is less than the basic dynamic load rating C_r of the bearing.

C_1	α Degrees	l_3	l_4	l_5	l_7	d_5	W	Chamfer dimension r_{1s} min.	Basic load ratings dyn. C_r N	stat. C_{0r}[3] N	Radial internal clearance	Shaft diameter d
4,4	13	11	40,5	5	12	13	11	0,3	3 600	10 200	0 – 0,032	**6**
6	15	15	48	5	14	16	14	0,3	5 850	16 000	0 – 0,032	**8**
7	12	20	57,5	6,5	15	19	17	0,3	8 650	22 000	0 – 0,032	**10**
8	11	23	67	6,5	18	22	19	0,3	11 400	30 400	0 – 0,032	**12**
10	8	30	81	8	20	26	22	0,3	17 600	44 800	0 – 0,04	**15**
11	10	34	90	10	23	30	27	0,3	22 400	56 500	0 – 0,04	**17**
13	9	40	103,5	10	27	35	32	0,3	31 500	75 600	0 – 0,04	**20**
17	7	48	126	12	32	42	36	0,6	51 000	104 000	0 – 0,05	**25**
19	6	56	146,5	15	37	50	41	0,6	65 500	138 000	0 – 0,05	**30**
21	6	60	166	15	42	58	50	0,6	210 000	159 000	0 – 0,05	**35**
23	7	65	188	18	48	65	55	0,6	277 000	194 000	0 – 0,06	**40**
27	7	65	196	20	52	70	60	0,6	360 000	259 000	0 – 0,06	**45**
30	6	68	216	20	60	75	65	0,6	442 000	313 000	0 – 0,06	**50**
38	6	70	242,5	20	75	88	75	1	690 000	485 000	0 – 0,06	**60**
42	6	80	280	20	87	98	85	1	885 000	564 000	0 – 0,072	**70**
47	6	85	320	25	100	110	100	1	1 125 000	689 000	0 – 0,072	**80**

Rod ends

maintenance-free
ISO 12 240-4, dimension series E, type M
Sliding contact surface: hard chromium/PTFE

Series GAR..UK
Sliding material: PTFE composite

GAR..UK-2RS
Sliding material: ELGOGLIDE®

GAR..UK, GAR..UK-2RS

Dimension table · Dimensions in mm										
Shaft diameter	Designation[1]		Mass	Dimensions						
				d	D	B	d_K	d_1	d_2	d_3
d	without seals	with seals	$\approx$kg							
6	GAR 6 UK	–	0,017	$6_{-0,008}$	14	$6_{-0,12}$	10	8	21	M 6
8	GAR 8 UK	–	0,029	$8_{-0,008}$	16	$8_{-0,12}$	13	10,2	24	M 8
10	GAR 10 UK	–	0,051	$10_{-0,008}$	19	$9_{-0,12}$	16	13,2	29	M10
12	GAR 12 UK	–	0,086	$12_{-0,008}$	22	$10_{-0,12}$	18	14,9	34	M12
15	GAR 15 UK	–	0,14	$15_{-0,008}$	26	$12_{-0,12}$	22	18,4	40	M14
17	GAR 17 UK	–	0,19	$17_{-0,008}$	30	$14_{-0,12}$	25	20,7	46	M16
20	GAR 20 UK	–	0,31	$20_{-0,01}$	35	$16_{-0,12}$	29	24,1	53	M20×1,5
25	GAR 25 UK	–	0,56	$25_{-0,01}$	42	$20_{-0,12}$	35,5	29,3	64	M24×2
30	GAR 30 UK	–	0,89	$30_{-0,01}$	47	$22_{-0,12}$	40,7	34,2	73	M30×2
35	–	GAR 35 UK-2RS	1,4	$35_{-0,012}$	55	$25_{-0,12}$	47	39,7	82	M36×3
40	–	GAR 40 UK-2RS	1,8	$40_{-0,012}$	62	$28_{-0,12}$	53	45	92	M39×3
45	–	GAR 45 UK-2RS	2,6	$45_{-0,012}$	68	$32_{-0,12}$	60	50,7	102	M42×3
50	–	GAR 50 UK-2RS	3,4	$50_{-0,012}$	75	$35_{-0,12}$	66	55,9	112	M45×3
60	–	GAR 60 UK-2RS	5,9	$60_{-0,015}$	90	$44_{-0,15}$	80	66,8	135	M52×3
70	–	GAR 70 UK-2RS	8,2	$70_{-0,015}$	105	$49_{-0,15}$	92	77,8	160	M56×4
80	–	GAR 80 UK-2RS	12	$80_{-0,015}$	120	$55_{-0,15}$	105	89,4	180	M64×4

[1] For a left hand thread, the R is replaced by an L (example: GAL..).

[2] Basic load rating of housing.
⚠ In rod ends with the sliding material ELGOGLIDE®, the basic static load rating C_{0r} of the housing is less than the basic dynamic load rating C_r of the bearing.

h	C_1	α	l_1	l_2	l_7	Chamfer dimension r_{1s}	Basic load ratings		Radial internal clearance	Shaft diameter
		Degrees				min.	dyn. C_r N	stat. C_{0r}[2] N		d
36	4,4	13	18	46,5	12	0,3	3 600	6 920	0 – 0,032	**6**
42	6	15	22	54	14	0,3	5 850	12 900	0 – 0,032	**8**
48	7	12	26	62,5	15	0,3	8 650	20 600	0 – 0,032	**10**
54	8	11	28	71	18	0,3	11 400	30 100	0 – 0,032	**12**
63	10	8	34	83	20	0,3	17 600	41 500	0 – 0,04	**15**
69	11	10	36	92	23	0,3	22 400	56 500	0 – 0,04	**17**
78	13	9	43	104,5	27	0,3	31 500	75 600	0 – 0,04	**20**
94	17	7	53	126	32	0,6	51 000	104 000	0 – 0,05	**25**
110	19	6	65	146,5	37	0,6	65 500	138 000	0 – 0,05	**30**
140	21	6	82	181	42	0,6	210 000	159 000	0 – 0,05	**35**
150	23	7	86	196	48	0,6	277 000	194 000	0 – 0,06	**40**
163	27	7	94	214	52	0,6	360 000	259 000	0 – 0,06	**45**
185	30	6	107	241	60	0,6	442 000	313 000	0 – 0,06	**50**
210	38	6	115	277,5	75	1	690 000	485 000	0 – 0,06	**60**
235	42	6	125	315	87	1	885 000	564 000	0 – 0,072	**70**
270	47	6	140	360	100	1	1 125 000	689 000	0 – 0,072	**80**

Rod ends

maintenance-free
ISO 12 240-4, dimension series K, type F
Sliding contact surface: Steel/PTFE-bronze film

Series GIKFR..PW
GIPFR..PW
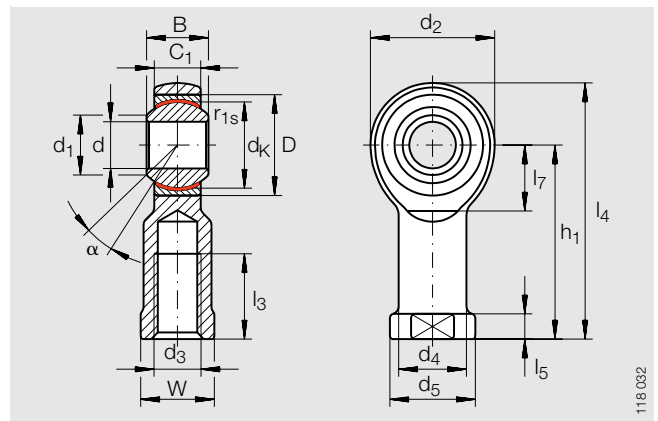
GIKFR..PW, GIPFR..PW

118 032

Dimension table · Dimensions in mm												
Shaft diameter	Designation [1][2]		Mass	Dimensions								
				d [3]	D	B	d_K	d_1	d_2	d_3	d_4	
d			$\approx$ kg									
5	**GIKFR 5 PW**	–	0,016	$5^{+0,012}$	13	$8_{-0,12}$	11,112	7,7	18	M 5	8,5	
	–	**GIPFR 5 PW[4]**	0,016	$5^{+0,012}$	13	$8_{-0,12}$	11,112	7,7	18	M 4	8,5	
6	**GIKFR 6 PW[4]**	–	0,022	$6^{+0,012}$	16	$9_{-0,12}$	12,7	8,9	20	M 6	10	
8	**GIKFR 8 PW[4]**	–	0,047	$8^{+0,015}$	19	$12_{-0,12}$	15,875	10,3	24	M 8	12,5	
10	**GIKFR 10 PW**	–	0,077	$10^{+0,015}$	22	$14_{-0,12}$	19,05	12,9	28	M10	15	
	–	**GIPFR 10 PW[4]**	0,077	$10^{+0,015}$	22	$14_{-0,12}$	19,05	12,9	28	M10×1,25	15	
12	**GIKFR 12 PW**	–	0,1	$12^{+0,018}$	26	$16_{-0,12}$	22,225	15,4	32	M12	17,5	
	–	**GIPFR 12 PW[4]**	0,1	$12^{+0,018}$	26	$16_{-0,12}$	22,225	15,4	32	M12×1,25	17,5	
14	**GIKFR 14 PW**	–	0,16	$14^{+0,018}$	28 [5]	$19_{-0,12}$	25,4	16,8	36	M14	21	
16	**GIKFR 16 PW**	–	0,22	$16^{+0,018}$	32	$21_{-0,12}$	28,575	19,3	42	M16	22	
	–	**GIPFR 16 PW[4]**	0,22	$16^{+0,018}$	32	$21_{-0,12}$	28,575	19,3	42	M16×1,5	22	
18	**GIKFR 18 PW**	–	0,32	$18^{+0,018}$	35	$23_{-0,12}$	31,75	21,8	46	M18×1,5	25	
20	**GIKFR 20 PW[4]**	–	0,42	$20^{+0,021}$	40	$25_{-0,12}$	34,925	24,3	50	M20×1,5	27,5	
22	**GIKFR 22 PW**	–	0,54	$22^{+0,021}$	42	$28_{-0,12}$	38,1	25,8	54	M22×1,5	30	
25	**GIKFR 25 PW[4]**	–	0,73	$25^{+0,021}$	47	$31_{-0,12}$	42,85	29,5	60	M24×2	33,5	
30	**GIKFR 30 PW**	–	1,1	$30^{+0,021}$	55	$37_{-0,12}$	50,8	34,8	70	M30×2	40	
	–	**GIPFR 30 PW[4]**	1,1	$30^{+0,021}$	55	$37_{-0,12}$	50,8	34,8	70	M27×2	40	

[1] For a left hand thread, the R is replaced by an L (example: GIKFL..).

[2] Series GIPFR..PW has a fine pitch thread to fit standard pneumatic cylinders to DIN 24 335 (right hand thread only).

[3] Bore tolerance: H7 (arithmetic mean value).

[4] Also in accordance with ISO 8139.

[5] Deviating from ISO 12 240-4, dimension series K.

[6] Basic load rating of housing.

| h_1	C_1	α	l_3	l_4	l_5	l_7	d_5	W	Chamfer dimension	Basic load ratings		Radial internal clearance	Shaft diameter
		Degrees							r_{1s}	dyn. C_r	stat. C_{0r}[6]		
									min.	N	N		d
27	6	13	10	36	4	10	11	9	0,3	6 000	9 180	0 – 0,035	**5**
27	6	13	10	36	4	10	11	9	0,3	6 000	9 180	0 – 0,035	
30	6,75	13	12	40	5	11	13	11	0,3	7 650	8 000	0 – 0,035	**6**
36	9	14	16	48	5	13	16	14	0,3	12 900	13 100	0 – 0,035	**8**
43	10,5	13	20	57	6,5	15	19	17	0,3	18 000	18 500	0 – 0,035	**10**
43	10,5	13	20	57	6,5	15	19	17	0,3	18 000	18 500	0 – 0,035	
50	12	13	22	66	6,5	17	22	19	0,3	24 000	20 800	0 – 0,035	**12**
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	**14**
64	15	15	28	85	8	23	28	22	0,3	39 000	45 200	0 – 0,035	**16**
64	15	15	28	85	8	23	28	22	0,3	39 000	45 200	0 – 0,035	
71	16,5	15	32	94	10	25	31	27	0,3	47 500	46 900	0 – 0,035	**18**
77	18	14	33	102	10	26	35	30	0,3	57 000	45 600	0 – 0,035	**20**
84	20	15	37	111	12	29	38	32	0,3	68 000	61 100	0 – 0,035	**22**
94	22	15	42	124	12	32	42	36	0,3	85 000	72 800	0 – 0,035	**25**
110	25	17	51	145	15	37	50	41	0,3	114 000	95 900	0 – 0,035	**30**
110	25	17	51	145	15	37	50	41	0,3	114 000	95 900	0 – 0,035	

Rod ends

maintenance-free
ISO 12 240-4, dimension series K, type M
Sliding contact surface: Steel/PTFE-bronze film

Series GAKFR..PW

GAKFR..PW

Dimension table · Dimensions in mm

Shaft diameter	Designation[1]	Mass	Dimensions								
			d[2]	D	B	d_K	d_1	d_2	d_3	h
d		$\approx$kg								
5	**GAKFR 5 PW**	0,013	$5^{+0,012}$	13	$8_{-0,12}$	11,112	7,7	18	M 5	33
6	**GAKFR 6 PW**	0,02	$6^{+0,012}$	16	$9_{-0,12}$	12,7	8,9	20	M 6	36
8	**GAKFR 8 PW**	0,038	$8^{+0,015}$	19	$12_{-0,12}$	15,875	10,3	24	M 8	42
10	**GAKFR 10 PW**	0,055	$10^{+0,015}$	22	$14_{-0,12}$	19,05	12,9	28	M10	48
12	**GAKFR 12 PW**	0,085	$12^{+0,018}$	26	$16_{-0,12}$	22,225	15,4	32	M12	54
14	**GAKFR 14 PW**	0,14	$14^{+0,018}$	28[3]	$19_{-0,12}$	25,4	16,8	36	M14	60
16	**GAKFR 16 PW**	0,21	$16^{+0,018}$	32	$21_{-0,12}$	28,575	19,3	42	M16	66
18	**GAKFR 18 PW**	0,28	$18^{+0,018}$	35	$23_{-0,12}$	31,75	21,8	46	M18×1,5	72
20	**GAKFR 20 PW**	0,38	$20^{+0,021}$	40	$25_{-0,12}$	34,925	24,3	50	M20×1,5	78
22	**GAKFR 22 PW**	0,48	$22^{+0,021}$	42	$28_{-0,12}$	38,1	25,8	54	M22×1,5	84
25	**GAKFR 25 PW**	0,64	$25^{+0,021}$	47	$31_{-0,12}$	42,85	29,5	60	M24×2	94
30	**GAKFR 30 PW**	1,1	$30^{+0,021}$	55	$37_{-0,12}$	50,8	34,8	70	M30×2	110

[1] For a left hand thread, the R is replaced by an L (example: GAKFL..).

[2] Bore tolerance: H7 (arithmetic mean value).

[3] Deviating from ISO 12 240-4, dimension series K.

[4] Basic load rating of housing.

C_1	α Degrees	l_1	l_2	l_7	Chamfer dimension r_{1s} min.	Basic load ratings dyn. C_r N	stat. $C^{4)}$ N	Radial internal clearance	Shaft diameter d
6	13	19	42	–	0,3	6 000	4 890	0 – 0,035	**5**
6,75	13	21	46	–	0,3	7 650	6 920	0 – 0,035	**6**
9	14	25	54	–	0,3	12 900	12 900	0 – 0,035	**8**
10,5	13	28	62	–	0,3	18 000	18 500	0 – 0,035	**10**
12	13	32	70	–	0,3	24 000	20 800	0 – 0,035	**12**
13,5	16	36	78	18	0,3	31 000	32 000	0 – 0,035	**14**
15	15	37	87	23	0,3	39 000	45 200	0 – 0,035	**16**
16,5	15	41	95	25	0,3	47 500	46 900	0 – 0,035	**18**
18	14	45	103	26	0,3	57 000	45 600	0 – 0,035	**20**
20	15	48	111	29	0,3	68 000	61 100	0 – 0,035	**22**
22	15	55	124	32	0,3	85 000	72 800	0 – 0,035	**25**
25	17	66	145	37	0,3	114 000	95 900	0 – 0,035	**30**

Rod ends requiring maintenance
Hydraulic rod ends

Criteria for bearing selection

Rod ends requiring maintenance

| GIR..DO | GAR..DO | GIKFR..PB | GAKFR..PB |
| GIR..DO-2RS | GAR..DO-2RS | | |

Load carrying capacity

C_r Bearing
C_{0r} Housing

Comparison of load carrying capacity for identical shaft diameter.
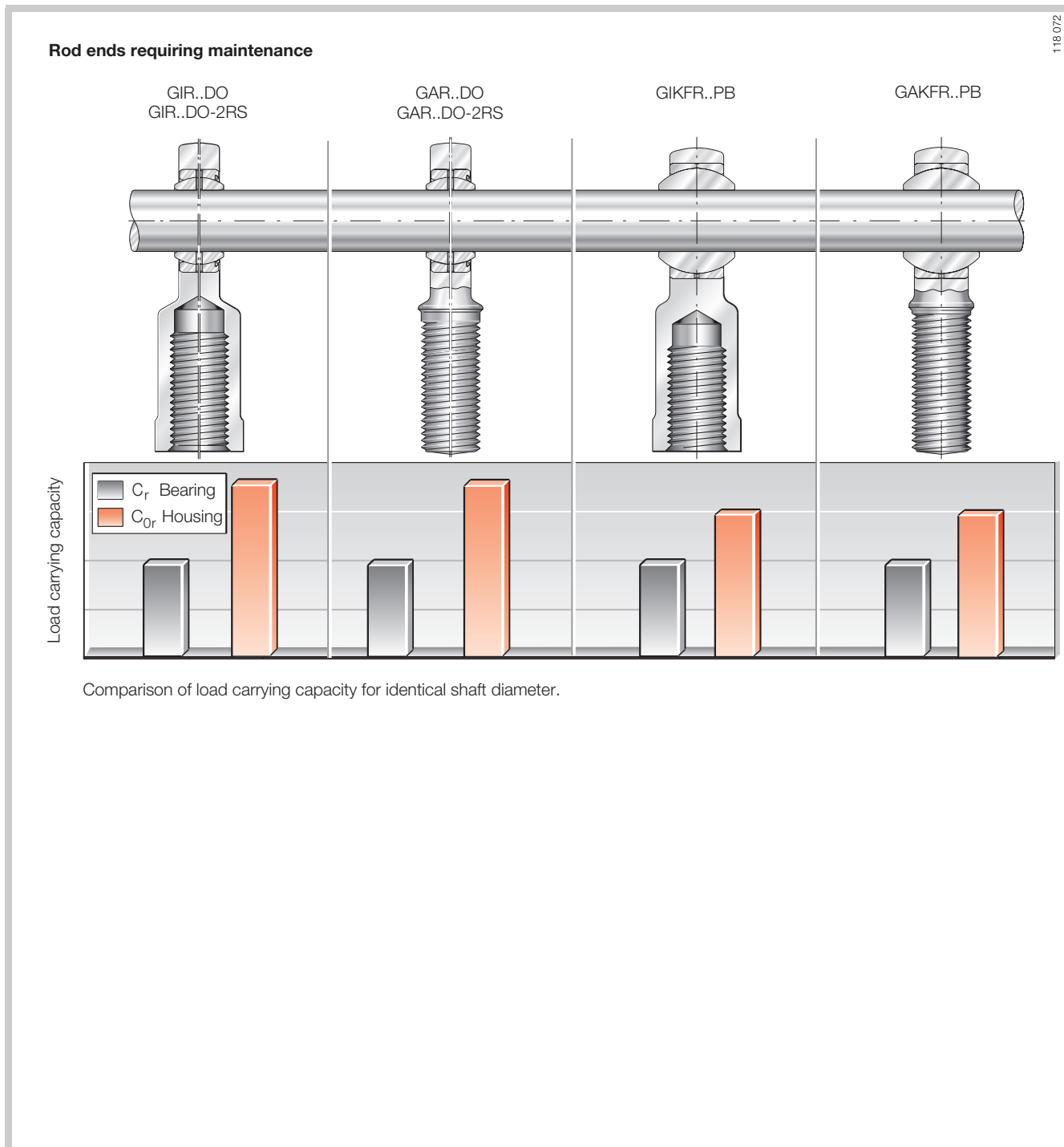
Hydraulic rod ends

GIHN-K..LO   GIHR-K..DO   GK..DO   GF..DO

Load carrying capacity

C_r Bearing
C_{0r} Housing
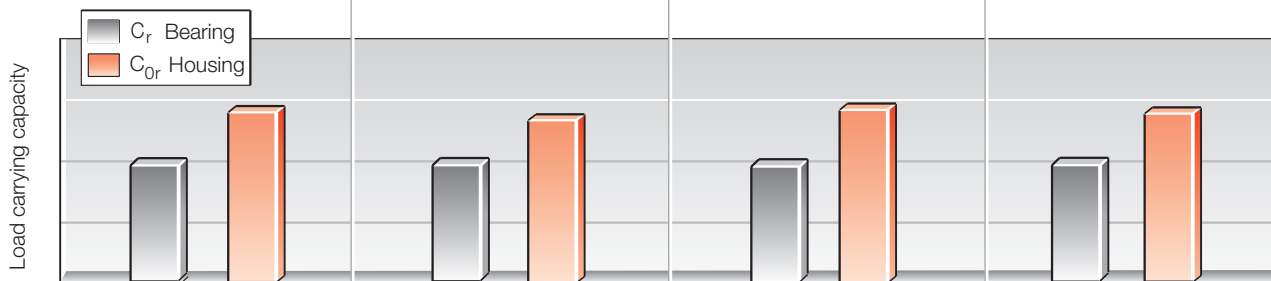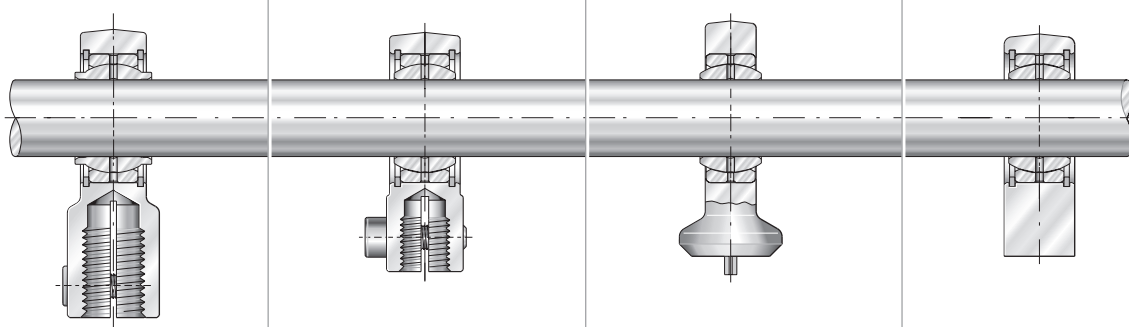
118 073

Rod ends
requiring maintenance
Hydraulic rod ends

Features

Rod ends requiring maintenance

■ are complete units comprising a housing with an integral shank and a spherical plain bearing requiring maintenance
– the integral shank has an external or internal thread
– the spherical plain bearing is firmly seated and located in the housing
■ can support radial loads in a tensile or compressive direction
■ can transmit motion and loads with low moment levels
■ are suitable for alternating loads
– they are suitable for supporting unilateral load in certain cases
■ are protected against corrosion by a zinc plating
■ the thin walled design of the eye housing allows compact adjacent constructions.

Sealed rod ends requiring maintenance

■ are protected against contaminants and water spray by
– lip seals.

Rod ends to ISO 12 240-4, dimension series E

■ are fitted with a radial spherical plain bearing GE..DO or GE..DO-2RS with a steel/steel sliding contact surface
■ have a right hand or left hand internal or external thread
■ have taper type lubrication nipples to DIN 71 412
■ can be relubricated via the lubrication nipples or the housing bore.

Rod ends to ISO 12 240-4, dimension series K

■ are fitted with a radial spherical plain bearing GE..PB with a steel/bronze sliding contact surface
■ have a right hand or left hand internal or external thread
■ have funnel type lubrication nipples to DIN 3405 on the eye housing.

Rod ends requiring maintenance

GIR..DO
(right hand thread)
GIR..DO-2RS
(right hand thread)
GIL.DO
(left hand thread)
GIL..DO-2RS
(left hand thread)
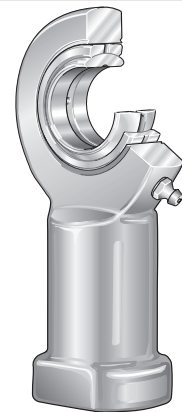
118 046

■ to ISO 12 240-4, dimension series E, type F
■ steel/steel sliding contact surface
■ shank with internal thread
■ suffix -2RS: lip seals on both sides, for operating temperatures from –30 °C to +130 °C
■ GIR..DO and GIL..DO for shaft diameters from 6 mm to 30 mm
■ GIR..DO-2RS and GIL..DO-2RS for shaft diameters from 35 mm to 80 mm

152

GIKFR..PB
(right hand thread)
GIKFL..PB
(left hand thread)

118 047

■ to ISO 12 240-4, dimension series K, type F
■ steel/bronze sliding contact surface
■ shank with internal thread
■ for shaft diameters from 5 mm to 30 mm

156

GAR..DO
(right hand thread)
GAR..DO-2RS
(right hand thread)
GAL.DO
(left hand thread)
GAL..DO-2RS
(left hand thread)
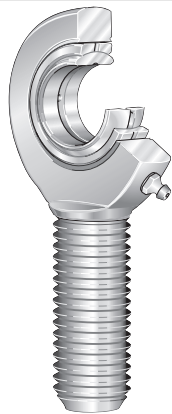
118 048

- to ISO 12 240-4, dimension series E, type M
- steel/steel sliding contact surface
- shank with external thread
- suffix -2RS: lip seals on both sides,
  for operating temperatures from –30 °C to +130 °C
- GAR..DO and GAL..DO
  for shaft diameters from 6 mm to 30 mm
- GAR..DO-2RS and GAL..DO-2RS
  for shaft diameters from 35 mm to 80 mm

154

GAKFR..PB
(right hand thread)
GAKFL..PB
(left hand thread)
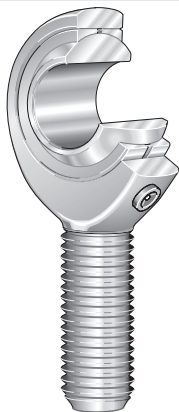
118 049

- to ISO 12 240-4, dimension series K, type M
- steel/bronze sliding contact surface
- shank with external thread
- for shaft diameters from 5 mm to 30 mm

158

Hydraulic rod ends

Features

Hydraulic rod ends

- are fitted with radial spherical plain bearings GE..LO or GE..DO
  - rod ends GIHR-K..DO are also available with maintenance-free spherical plain bearings GE..UK-2RS, UK, FW-2RS, FW
- have a steel/steel sliding contact surface
- can support radial loads in a tensile or compressive direction
- can transmit motion and loads with low moment levels
- are suitable for alternating loads
- can be screw mounted using the thread in the shank
- can be welded in place by means of round or square welding faces
  - rod ends with a circular welding face have a 45° welding chamfer and a centring option by means of a concentric locating pin
  - rod ends with a circular welding face are particularly suitable for piston rods
  - rod ends with a square welding face are particularly suitable for cylinder bases
- are slotted on both sides up to d ≦ 50 mm and on one side from d > 50 mm
- can be relubricated via taper type lubrication nipples to DIN 71 412.

Hydraulic rod ends

GIHN-K..LO
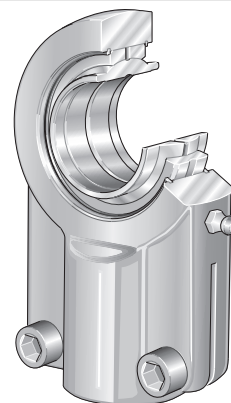
- to DIN 24 338, ISO 6982
- for standard hydraulic cylinders to Cetop recommendation RP 58 H; DIN 24 333; DIN 24 336; ISO/DIS 6020 I; ISO/DIS 6022
- spherical plain bearing located in the housing by retaining rings
- thread clamping by means of two hexagonal socket screws to EN ISO 4 762
- for shaft diameters from 12 mm to 200 mm

160

GK..DO
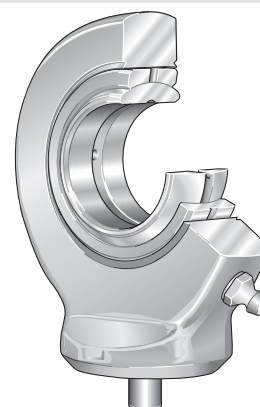
- to ISO 12 240-4, dimension series E, type S – circular welding face
- concentric locating pin on shank base and 45° welding chamfer
- spherical plain bearing located in housing by staking on both sides
- for piston rod ends and cylinder bases
- for shaft diameters from 10 mm to 80 mm

164

GIHR-K..DO
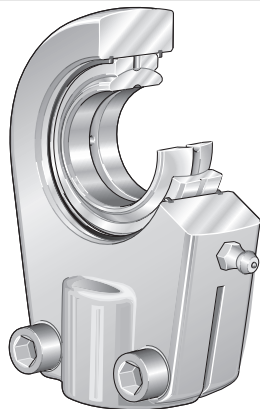
- especially for hydraulic cylinders
- very small linkage distances with maximum stroke utilisation
- thread clamping by means of two hexagonal socket screws to EN ISO 4 762
- spherical plain bearing located in the housing by retaining rings
- also available with maintenance-free spherical plain bearings GE..UK-2RS, GE..FW-2RS, GE..UK and GE..FW
- for shaft diameters from 20 mm to 120 mm

162

118 052

GF..DO
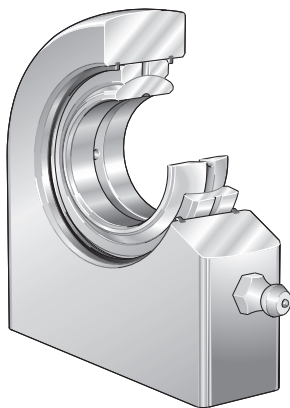
- heavy-duty design with square welding face
- spherical plain bearing located in the housing by retaining rings, can be dismantled
- for hydraulic cylinder bases
- for shaft diameters from 20 mm to 120 mm

166

118 055

Rod ends requiring maintenance
Hydraulic rod ends

Design and safety guidelines

Basic dynamic load rating

The basic dynamic load ratings C_r (*dimension table*) refer to the spherical plain bearing when fitted. They represent a factor used for calculating the bearing life.

The equivalent bearing load and additional bending stresses in the shank area are 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.

Basic static load rating

The basic static load ratings C_{0r} (*dimension table*) of rod ends refer only to the load carrying capacity of the rod end housing.

They are based on tensile/compressive loads acting across or in the direction of the rod end shank.

Permissible loading of rod ends

The permissible loading of rod ends depends on the type of load.

Pulsating or alternating loads subject the material to greater stress than constant loads. The reduction factors f_b must therefore be used for these operating conditions in calculation (Table 1).

Maintenance

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 ISO 12 240-4, dimension series E – bore diameter d = 15 mm to 20 mm – are relubricated via a hole in the rod end eye housing (Figure 1). For reasons of housing strength, these rod ends do not have lubrication nipples.

Tightening torques for fixing screws in hydraulic rod ends

⚠ The fixing screws must be tightened according to the scheme (Table 2, Figures 2 and 3, page 147). The tightening torques must be adhered to.

Table 1 · Load factors f_b

Load type		Series	Load factor f_b
Unilateral load	151 540	All series	1
Pulsating load	151 541	GIHN-K..LO GIHR-K..DO GK..DO GF..DO GIR..DO[1] GAR..DO[1] GIKFR..PB GAKFR..PB	2 2,75 2,75 2,75 3 3 3 3
Alternating load	151 542		

P_{perm} = permissible rod end load N C_{0r} = basic static load rating of rod end N f_b = load factor	$P_{perm} = \dfrac{C_{0r}}{f_b}$

[1] f_b values are also valid for sealed designs (-2RS).
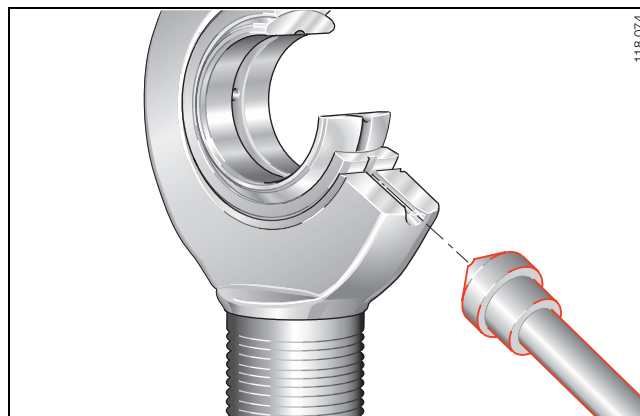
Figure 1 · Relubrication via holes

Table 2 · Tightening torques for fixing screws – hydraulic rod ends

Designation		Fixing screw		Tightening torque	Steps 1 to 4 (tightening torques in Nm)				
		Dimensions	Grade		Figure 2				Figure 3
					1	2	3	4	1, 2, 3, 4
				Nm	A + B	A	B	A	C, D, C, D
GIHN-K 12	–	M 5	10.9	8	0,16	2,6	8	8	–
GIHN-K 16	–	M 6	10.9	13	0,26	4,3	13	13	–
GIHN-K 20	GIHR-K 20	M 8	10.9	32	0,64	11	32	32	–
GIHN-K 25	GIHR-K 25	M 8	10.9	32	0,64	11	32	32	–
–	GIHR-K 30	M 8	10.9	32	0,64	11	32	32	–
GIHN-K 32	–	M10	10.9	64	1,2	21	64	64	–
–	GIHR-K 35	M10	10.9	64	1,2	21	64	64	–
GIHN-K 40	GIHR-K 40	M10	10.9	64	1,2	21	64	64	–
GIHN-K 50	GIHR-K 50	M12	10.9	110	2,2	36	110	110	–
–	GIHR-K 60	M10	10.9	46	–	–	–	–	46
GIHN-K 63	–	M12	10.9	80	–	–	–	–	80
GIHN-K 70	–	M16	10.9	194	–	–	–	–	195
–	GIHR-K 70	M12	10.9	80	–	–	–	–	80
GIHN-K 80	GIHR-K 80	M16	10.9	195	–	–	–	–	195
GIHN-K 90	GIHR-K 90	M16	10.9	195	–	–	–	–	195
GIHN-K 100	GIHR-K 100	M20	10.9	385	–	–	–	–	385
GIHN-K 110	GIHR-K 110	M20	10.9	385	–	–	–	–	385
–	GIHR-K 120	M24	10.9	660	–	–	–	–	660
GIHN-K 125	–	M20	10.9	385	–	–	–	–	385
GIHN-K 160	–	M24	10.9	660	–	–	–	–	660
GIHN-K 200	–	M30	10.9	1350	–	–	–	–	1350
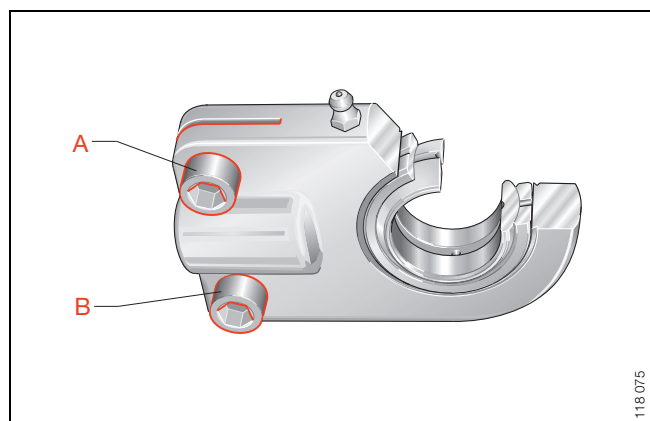
Figure 2 · Slots on both sides
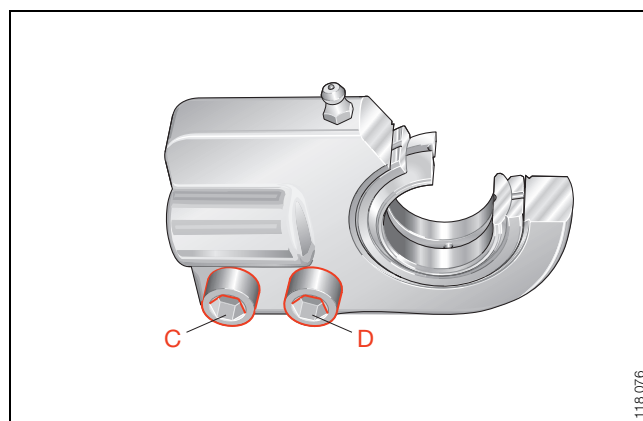
Figure 3 · Slot on one side

Rod ends requiring maintenance

Hydraulic rod ends

Calculation of rating life

Two calculations must always be carried out:

- the permissible load on the rod end
- the life of the spherical plain bearing.

⚠ The maximum equivalent bearing load P must not exceed the permissible load on the rod end P_{perm} (formula).

$$P_{perm} = \frac{C_{0r}}{f_b}$$

P_{perm} N
Permissible load on rod end

f_b –
Load factor (Table 1, page 146)

C_{0r} N
Basic static load rating (radial) of rod end.

Calculation example

Given

Linkage bearing arrangement in a conveyor system, alternating load varying over the swivel angle.

Operating parameters:

Load	P_{max}	=	160 kN
Load direction		=	alternating
Load factor	f_b	=	2,75
Bearing load	$F_{r\,min}$	=	20 kN
	$F_{r\,max}$	=	160 kN
Swivel angle	β	=	25°
Swivel frequency	f	=	6 min^{-1}
Maintenance interval	l_{hW}	=	8 h

Bearing data:

Hydraulic rod end	=	GIHR-K 70 DO
	C_{0r}	= 440 kN
Spherical plain bearing	=	GE 70 DO
Basic dynamic load rating	C_r	= 315 kN
Sphere diameter	d_K	= 92 mm
Factors for spherical plain bearings requiring maintenance	K	= 100 N/mm^2
(Table 2, page 147)	f_1	= 2
	f_2	= 1
	f_4	= 1

Required

Suitability of rod end size.
Calculation of bearing life.

Calculation of rod end size

$$P_{max\,perm} = \frac{C_{0r}}{f_b}$$

$$C_{0r\,min} = P_{max} \cdot f_b$$

$C_{0r\,min} = 160 \cdot 2,75 = 440$ kN $\leqq C_{0r} = 440$ kN.

The rod end GIHR-K 70 DO with a rod end basic load rating $C_{0r} = 440$ kN is suitable for the application.

Calculation (see page 97)

P = F_{max} = 160 kN (under alternating load)

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

$$p = 100 \cdot \frac{160}{315} = 50,79 \text{ N/mm}^2$$

$$v = 2,91 \cdot 10^{-4} \cdot f_4 \cdot d_K \cdot \beta \cdot f$$

$v = 2,91 \cdot 10^{-4} \cdot 1 \cdot 92 \cdot 25 \cdot 6 = 4,02$ mm/s

$p \cdot v = 50,79 \cdot 4,02 = 204,19$ N/mm$^2 \cdot$ mm/s; condition fulfilled

$$L = 1,28 \cdot 10^7 \cdot f_1 \cdot f_2 \cdot \frac{v^{0,5} \cdot \beta^{0,2}}{f_3 \cdot (f_4 \cdot d_K)^{0,64}} \cdot \frac{C_r}{P}$$

$$L = 1,28 \cdot 10^7 \cdot 2 \cdot 1 \cdot \frac{4,02^{0,5} \cdot 25^{0,2}}{50,79^{1,48} \cdot (1 \cdot 92)^{0,64}} \cdot \frac{315}{160}$$

L = 31 824 osc.

$$l_W = l_{hW} \cdot f \cdot 60$$

$l_W = 8 \cdot 6 \cdot 60 = 2\,880$ osc.

The precondition is: $l_W \leqq 0,5 \cdot L$ is fulfilled

$$f_\beta = \beta \cdot 0,21 - 0,66$$

$f_\beta = 25 \cdot 0,21 - 0,66 = 4,59$

$$f_H = \left(\frac{L}{l_W} - 1\right) \cdot 0,121 + 1,28$$

$$f_H = \left(\frac{31\,824}{2\,880} - 1\right) \cdot 0,121 + 1,28 = 2,496$$

$$L_N = L \cdot f_\beta \cdot f_H$$

$L_N = 31\,824 \cdot 4,59 \cdot 2,496 = 364\,596$ osc.

$$L_{hN} = \frac{L_N}{f \cdot 60}$$

$$L_{hN} = \frac{364\,596}{6 \cdot 60} = 1013 \text{ h}$$

Rod ends requiring maintenance
Hydraulic rod ends

Accuracy

The main dimensions of these rod ends conform
to ISO 12 240-4.

All connecting threads have metric dimensions to DIN 13,
central tolerance class, 6H, 6g.

The stated thread length is the minimum usable length,
based on normal chamfering practice for the thread of
the mating component.

Special designs

Available by agreement:
- rod ends requiring maintenance with internal clearance
  larger or smaller than normal
  – suffix C2 or C3
- 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
- rod ends with special threads
- rod ends with different anti-corrosion protection.

Ordering example and ordering designation

Rod end requiring maintenance to ISO 12 240-4,
dimension series E,
for:
shaft   15 mm.

Ordering designation: **GIR 15 DO** or **GAR 15 DO** (Figure 4).
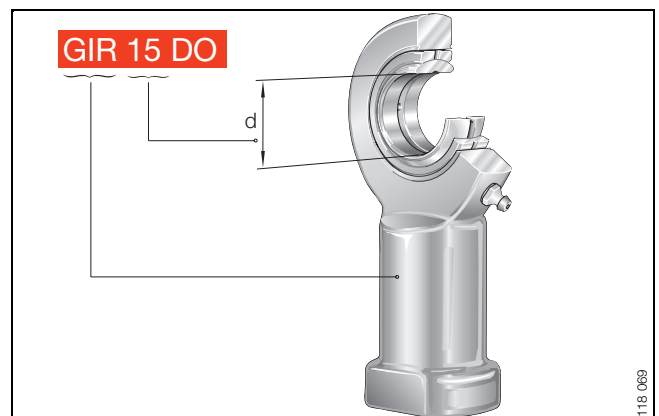
Figure 4 · Ordering example, ordering designation

Rod ends

requiring maintenance
ISO 12 240-4, dimension series E, type F
Sliding contact surface: Steel/steel

Series GIR..DO
       GIR..DO-2RS

GIR..DO, GIR..DO-2RS

Dimension table · Dimensions in mm

Shaft diameter	Designation[1]		Mass	Dimensions								
				d	D	B	d_K	d_1	d_2	d_3	d_4	h_1
d	without seals	with seals	≈kg									
6	GIR 6 DO[2]	–	0,022	$6_{-0,008}$	14	$6_{-0,12}$	10	8	21	M 6	10	30
8	GIR 8 DO[2]	–	0,039	$8_{-0,008}$	16	$8_{-0,12}$	13	10,2	24	M 8	12,5	36
10	GIR 10 DO[2]	–	0,065	$10_{-0,008}$	19	$9_{-0,12}$	16	13,2	29	M10	15	43
12	GIR 12 DO[2]	–	0,098	$12_{-0,008}$	22	$10_{-0,12}$	18	14,9	34	M12	17,5	50
15	GIR 15 DO[3]	–	0,17	$15_{-0,008}$	26	$12_{-0,12}$	22	18,4	40	M14	21	61
17	GIR 17 DO[3]	–	0,25	$17_{-0,008}$	30	$14_{-0,12}$	25	20,7	46	M16	24	67
20	GIR 20 DO[3]	–	0,35	$20_{-0,01}$	35	$16_{-0,12}$	29	24,1	53	M20×1,5	27,5	77
25	GIR 25 DO	–	0,65	$25_{-0,01}$	42	$20_{-0,12}$	35,5	29,3	64	M24×2	33,5	94
30	GIR 30 DO	–	0,96	$30_{-0,01}$	47	$22_{-0,12}$	40,7	34,2	73	M30×2	40	110
35	–	GIR 35 DO-2RS	1,3	$35_{-0,012}$	55	$25_{-0,12}$	47	39,7	82	M36×3	47	125
40	–	GIR 40 DO-2RS	2	$40_{-0,012}$	62	$28_{-0,12}$	53	45	92	M39×3[4]	52	142
45	–	GIR 45 DO-2RS	2,5	$45_{-0,012}$	68	$32_{-0,12}$	60	50,7	102	M42×3[4]	58	145
50	–	GIR 50 DO-2RS	3,5	$50_{-0,012}$	75	$35_{-0,12}$	66	55,9	112	M45×3[4]	62	160
60	–	GIR 60 DO-2RS	5,5	$60_{-0,015}$	90	$44_{-0,15}$	80	66,8	135	M52×3[4]	70	175
70	–	GIR 70 DO-2RS	8,6	$70_{-0,015}$	105	$49_{-0,15}$	92	77,8	160	M56×4[4]	80	200
80	–	GIR 80 DO-2RS	12	$80_{-0,015}$	120	$55_{-0,15}$	105	89,4	180	M64×4[4]	95	230

[1] For a left hand thread, the R is replaced by an L (example: GIL..).

[2] No relubrication facility.

[3] Relubrication via lubrication hole in housing.

[4] Thread runout or thread groove at manufacturer's discretion.

[5] Basic load rating of housing.

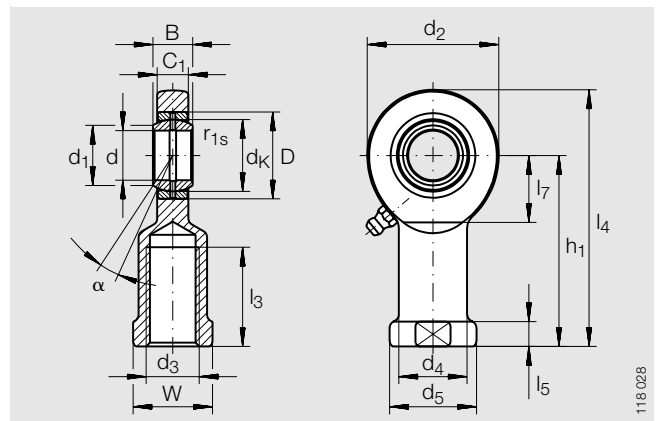| C_1	α	l_3	l_4	l_5	l_7	d_5	W	Chamfer dimension r_{1s}	Basic load ratings dyn. C_r	stat. C_{0r}[5]	Radial internal clearance CN	Shaft diameter
	Degrees							min.	N	N		d
4,4	13	11	40,5	5	12	13	11	0,3	3 400	10 200	0,023 – 0,068	**6**
6	15	15	48	5	14	16	14	0,3	5 500	16 000	0,023 – 0,068	**8**
7	12	20	57,5	6,5	15	19	17	0,3	8 150	22 000	0,023 – 0,068	**10**
8	11	23	67	6,5	18	22	19	0,3	10 800	30 400	0,023 – 0,068	**12**
10	8	30	81	8	20	26	22	0,3	17 000	44 800	0,030 – 0,082	**15**
11	10	34	90	10	23	30	27	0,3	21 200	56 500	0,030 – 0,082	**17**
13	9	40	103,5	10	27	35	32	0,3	30 000	75 600	0,030 – 0,082	**20**
17	7	48	126	12	32	42	36	0,6	48 000	88 200	0,037 – 0,1	**25**
19	6	56	146,5	15	37	50	41	0,6	62 000	119 000	0,037 – 0,1	**30**
21	6	60	166	15	42	58	50	0,6	80 000	159 000	0,037 – 0,1	**35**
23	7	65	188	18	48	65	55	0,6	100 000	194 000	0,043 – 0,12	**40**
27	7	65	196	20	52	70	60	0,6	127 000	259 000	0,043 – 0,12	**45**
30	6	68	216	20	60	75	65	0,6	156 000	313 000	0,043 – 0,12	**50**
38	6	70	242,5	20	75	88	75	1	245 000	485 000	0,043 – 0,12	**60**
42	6	80	280	20	87	98	85	1	315 000	564 000	0,055 – 0,142	**70**
47	6	85	320	25	100	110	100	1	400 000	689 000	0,055 – 0,142	**80**

Rod ends

requiring maintenance
ISO 12 240-4, dimension series E, type M
Sliding contact surface: Steel/steel

Series GAR..DO
       GAR..DO-2RS

GAR..DO, GAR..DO-2RS

118 034

Dimension table · Dimensions in mm

Shaft diameter	Designation[1]		Mass	Dimensions						
				d	D	B	d_K	d_1	d_2	d_3
d	without seals	with seals	≈kg							
6	**GAR 6 DO[2]**	–	0,018	$6_{-0,008}$	14	$6_{-0,12}$	10	8	21	M 6
8	**GAR 8 DO[2]**	–	0,032	$8_{-0,008}$	16	$8_{-0,12}$	13	10,2	24	M 8
10	**GAR 10 DO[2]**	–	0,054	$10_{-0,008}$	19	$9_{-0,12}$	16	13,2	29	M10
12	**GAR 12 DO[2]**	–	0,086	$12_{-0,008}$	22	$10_{-0,12}$	18	14,9	34	M12
15	**GAR 15 DO[3]**	–	0,14	$15_{-0,008}$	26	$12_{-0,12}$	22	18,4	40	M14
17	**GAR 17 DO[3]**	–	0,2	$17_{-0,008}$	30	$14_{-0,12}$	25	20,7	46	M16
20	**GAR 20 DO[3]**	–	0,31	$20_{-0,01}$	35	$16_{-0,12}$	29	24,1	53	M20×1,5
25	**GAR 25 DO**	–	0,56	$25_{-0,01}$	42	$20_{-0,12}$	35,5	29,3	64	M24×2
30	**GAR 30 DO**	–	0,89	$30_{-0,01}$	47	$22_{-0,12}$	40,7	34,2	73	M30×2
35	–	**GAR 35 DO-2RS**	1,4	$35_{-0,012}$	55	$25_{-0,12}$	47	39,7	82	M36×3
40	–	**GAR 40 DO-2RS**	1,8	$40_{-0,012}$	62	$28_{-0,12}$	53	45	92	M39×3
45	–	**GAR 45 DO-2RS**	2,6	$45_{-0,012}$	68	$32_{-0,12}$	60	50,7	102	M42×3
50	–	**GAR 50 DO-2RS**	3,4	$50_{-0,012}$	75	$35_{-0,12}$	66	55,9	112	M45×3
60	–	**GAR 60 DO-2RS**	5,9	$60_{-0,015}$	90	$44_{-0,15}$	80	66,8	135	M52×3
70	–	**GAR 70 DO-2RS**	8,2	$70_{-0,015}$	105	$49_{-0,15}$	92	77,8	160	M56×4
80	–	**GAR 80 DO-2RS**	12	$80_{-0,015}$	120	$55_{-0,15}$	105	89,4	180	M64×4

[1] For a left hand thread, the R is replaced by an L (example: GAL..).

[2] No relubrication facility.

[3] Relubrication via lubrication hole in housing.

[4] Basic load rating of housing.

h	C_1	α Degrees	l_1	l_2	l_7	Chamfer dimension r_{1s} min.	Basic load ratings dyn. C_r N	stat. C_{0r}[4] N	Radial internal clearance CN	Shaft diameter d
36	4,4	13	18	46,5	12	0,3	3 400	6 920	0,023 – 0,068	**6**
42	6	15	22	54	14	0,3	5 500	12 900	0,023 – 0,068	**8**
48	7	12	26	62,5	15	0,3	8 150	20 600	0,023 – 0,068	**10**
54	8	11	28	71	18	0,3	10 800	30 100	0,023 – 0,068	**12**
63	10	8	34	83	20	0,3	17 000	41 500	0,030 – 0,082	**15**
69	11	10	36	92	23	0,3	21 200	56 500	0,030 – 0,082	**17**
78	13	9	43	104,5	27	0,3	30 000	75 600	0,030 – 0,082	**20**
94	17	7	53	126	32	0,6	48 000	88 200	0,037 – 0,1	**25**
110	19	6	65	146,5	37	0,6	62 000	119 000	0,037 – 0,1	**30**
140	21	6	82	181	42	0,6	80 000	159 000	0,037 – 0,1	**35**
150	23	7	86	196	48	0,6	100 000	194 000	0,043 – 0,12	**40**
163	27	7	94	214	52	0,6	127 000	259 000	0,043 – 0,12	**45**
185	30	6	107	241	60	0,6	156 000	313 000	0,043 – 0,12	**50**
210	38	6	115	277,5	75	1	245 000	485 000	0,043 – 0,12	**60**
235	42	6	125	315	87	1	315 000	564 000	0,055 – 0,142	**70**
270	47	6	140	360	100	1	400 000	689 000	0,055 – 0,142	**80**

Rod ends

requiring maintenance
ISO 12 240-4, dimension series K, type F
Sliding contact surface: Steel/bronze

Series GIKFR..PB

GIKFR..PB

Dimension table · Dimensions in mm

Shaft diameter	Designation[1]	Mass	Dimensions									
			d[2]	D	B	d_K	d_1	d_2	d_3	d_4	h_1	C_1
d		$\approx$kg										
5	**GIKFR 5 PB**[4]	0,016	$5^{+0,012}$	13	$8_{-0,12}$	11,112	7,7	18	M 5	8,5	27	6
6	**GIKFR 6 PB**	0,022	$6^{+0,012}$	16	$9_{-0,12}$	12,7	8,9	20	M 6	10	30	6,75
8	**GIKFR 8 PB**	0,047	$8^{+0,015}$	19	$12_{-0,12}$	15,875	10,3	24	M 8	12,5	36	9
10	**GIKFR 10 PB**	0,077	$10^{+0,015}$	22	$14_{-0,12}$	19,05	12,9	28	M10	15	43	10,5
12	**GIKFR 12 PB**	0,1	$12^{+0,018}$	26	$16_{-0,12}$	22,225	15,4	32	M12	17,5	50	12
14	**GIKFR 14 PB**	0,16	$14^{+0,018}$	28[3]	$19_{-0,12}$	25,4	16,8	36	M14	21	57	13,5
16	**GIKFR 16 PB**	0,22	$16^{+0,018}$	32	$21_{-0,12}$	28,575	19,3	42	M16	22	64	15
18	**GIKFR 18 PB**	0,32	$18^{+0,018}$	35	$23_{-0,12}$	31,75	21,8	46	M18×1,5	25	71	16,5
20	**GIKFR 20 PB**	0,42	$20^{+0,021}$	40	$25_{-0,12}$	34,925	24,3	50	M20×1,5	27,5	77	18
22	**GIKFR 22 PB**	0,54	$22^{+0,021}$	42	$28_{-0,12}$	38,1	25,8	54	M22×1,5	30	84	20
25	**GIKFR 25 PB**	0,73	$25^{+0,021}$	47	$31_{-0,12}$	42,85	29,5	60	M24×2	33,5	94	22
30	**GIKFR 30 PB**	1,1	$30^{+0,021}$	55	$37_{-0,12}$	50,8	34,8	70	M30×2	40	110	25

[1] For a left hand thread, the R is replaced by an L (example: GIKFL..).

[2] Bore tolerance: H7 (arithmetic mean value).

[3] Deviating from ISO 12 240-4, dimension series K.

[4] No relubrication facility.

[5] Basic load rating of housing.

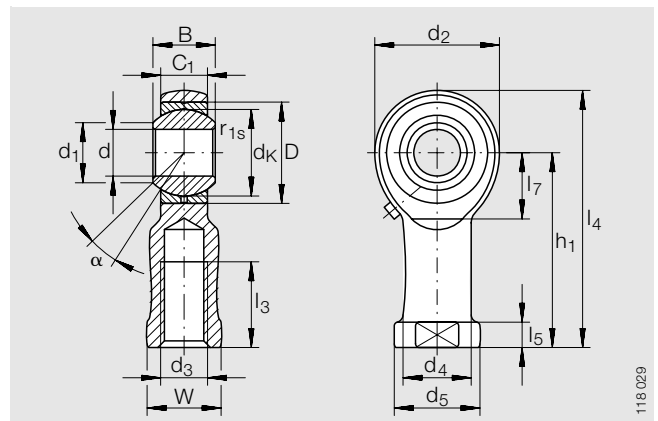|							Chamfer dimension	Basic load ratings		Radial internal clearance[3]	Shaft diameter
α	l_3	l_4	l_5	l_7	d_5	W	r_{1s}	dyn. C_r	stat. C_{0r}[5]		
Degrees							min.	N	N		d
13	10	36	4	10	11	9	0,3	3 250	9 180	0 – 0,035	**5**
13	12	40	5	11	13	11	0,3	4 300	8 000	0 – 0,035	**6**
14	16	48	5	13	16	14	0,3	7 200	13 100	0 – 0,035	**8**
13	20	57	6,6	15	19	17	0,3	10 000	18 500	0 – 0,035	**10**
13	22	66	6,5	17	22	19	0,3	13 400	20 800	0 – 0,035	**12**
16	25	75	8	18	26	22	0,3	17 000	32 000	0 – 0,035	**14**
15	28	85	8	23	28	22	0,3	21 600	45 200	0 – 0,035	**16**
15	32	94	10	25	31	27	0,3	26 000	46 900	0 – 0,035	**18**
14	33	102	10	26	35	30	0,3	31 500	45 600	0 – 0,035	**20**
15	37	111	12	29	38	32	0,3	38 000	61 100	0 – 0,035	**22**
15	42	124	12	32	42	36	0,3	77 500	72 800	0 – 0,035	**25**
17	51	145	15	37	50	41	0,3	64 000	95 900	0 – 0,035	**30**

Rod ends

requiring maintenance
ISO 12 240-4, dimension series K, type M
Sliding contact surface: Steel/bronze

Series GAKFR..PB

GAKFR..PB

Dimension table · Dimensions in mm

Shaft diameter	Designation[1]	Mass	Dimensions						
			d[2]	D	B	d_K	d_1	d_2	d_3
d		$\approx$kg							
5	**GAKFR 5 PB**[4]	0,013	$5^{+0,012}$	13	$8_{-0,12}$	11,112	7,7	18	M 5
6	**GAKFR 6 PB**	0,02	$6^{+0,012}$	16	$9_{-0,12}$	12,7	8,9	20	M 6
8	**GAKFR 8 PB**	0,038	$8^{+0,015}$	19	$12_{-0,12}$	15,875	10,3	24	M 8
10	**GAKFR 10 PB**	0,055	$10^{+0,015}$	22	$14_{-0,12}$	19,05	12,9	28	M10
12	**GAKFR 12 PB**	0,085	$12^{+0,018}$	26	$16_{-0,12}$	22,225	15,4	32	M12
14	**GAKFR 14 PB**	0,14	$14^{+0,018}$	28[3]	$19_{-0,12}$	25,4	16,8	36	M14
16	**GAKFR 16 PB**	0,21	$16^{+0,018}$	32	$21_{-0,12}$	28,575	19,3	42	M16
18	**GAKFR 18 PB**	0,28	$18^{+0,018}$	35	$23_{-0,12}$	31,75	21,8	46	M18×1,5
20	**GAKFR 20 PB**	0,38	$20^{+0,021}$	40	$25_{-0,12}$	34,925	24,3	50	M20×1,5
22	**GAKFR 22 PB**	0,48	$22^{+0,021}$	42	$28_{-0,12}$	38,1	25,8	54	M22×1,5
25	**GAKFR 25 PB**	0,64	$25^{+0,021}$	47	$31_{-0,12}$	42,85	29,5	60	M24×2
30	**GAKFR 30 PB**	1,1	$30^{+0,021}$	55	$37_{-0,12}$	50,8	34,8	70	M30×2

[1] For a left hand thread, the R is replaced by an L (example: GAKFL..).

[2] Bore tolerance: H7 (arithmetic mean value).

[3] Deviating from ISO 12 240-4, dimension series K.

[4] No relubrication facility.

[5] Basic load rating of housing.

| h	C_1	α	l_1	l_2	l_7	Chamfer dimension	Basic load ratings		Radial internal clearance[3]	Shaft diameter
						r_{1s}	dyn. C_r	stat. C_{0r}[5]		
		Degrees				min.	N	N		d
33	6	13	19	42	–	0,3	3 250	4 890	0 – 0,035	**5**
36	6,75	13	21	46	–	0,3	4 300	6 920	0 – 0,035	**6**
42	9	14	25	54	–	0,3	7 200	12 900	0 – 0,035	**8**
48	10,5	13	28	62	–	0,3	10 000	18 500	0 – 0,035	**10**
54	12	13	32	70	–	0,3	13 400	20 800	0 – 0,035	**12**
60	13,5	16	36	78	18	0,3	17 000	32 000	0 – 0,035	**14**
66	15	15	37	87	23	0,3	21 600	45 200	0 – 0,035	**16**
72	16,5	15	41	95	25	0,3	26 000	46 900	0 – 0,035	**18**
78	18	14	45	103	26	0,3	31 500	45 600	0 – 0,035	**20**
84	20	15	48	111	29	0,3	38 000	61 100	0 – 0,035	**22**
94	22	15	55	124	32	0,3	47 500	72 800	0 – 0,035	**25**
110	25	17	66	145	37	0,3	64 000	95 900	0 – 0,035	**30**

Hydraulic rod ends

requiring maintenance
DIN 24338, ISO 6982
Sliding contact surface:
Steel/steel

Series GIHN-K..LO
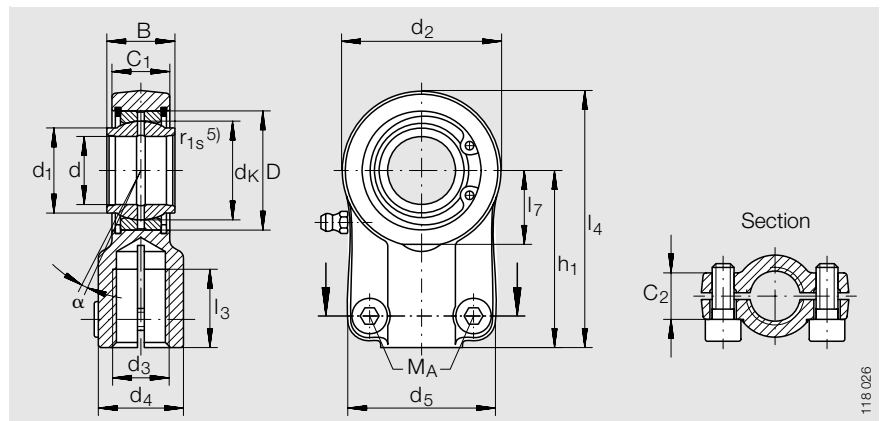
GIHN-K..LO (d ≦ 50 mm)

Dimension table · Dimensions in mm													
Shaft diameter	Designation[1]	Mass	Dimensions										
			d[2]	D	B	d_K	d_1	d_2	d_3	d_4	h_1	C_1	
d		$\approx$kg											
12	**GIHN-K 12 LO**[2)4)]	0,1	$12^{+0,018}$	22	$12_{-0,18}$	18	15,5	32	M 12×1,25	16,5	38	10,6	
16	**GIHN-K 16 LO**[4]	0,2	$16^{+0,018}$	28	$16_{-0,18}$	23	20	40	M 14×1,5	21	44	13	
20	**GIHN-K 20 LO**	0,4	$20^{+0,021}$	35	$20_{-0,21}$	29	25	47	M 16×1,5	25	52	17	
25	**GIHN-K 25 LO**	0,66	$25^{+0,021}$	42	$25_{-0,21}$	35,5	30,5	58	M 20×1,5	30	65	21	
32	**GIHN-K 32 LO**	1,2	$32^{+0,025}$	52	$32_{-0,25}$	44	38	70	M 27×2	38	80	27	
40	**GIHN-K 40 LO**[6]	2,1	$40^{+0,025}$	62	$40_{-0,25}$	53	46	89	M 33×2	47	97	32	
50	**GIHN-K 50 LO**[6]	4,4	$50^{+0,025}$	75	$50_{-0,25}$	66	57	108	M 42×2	58	120	40	
63	**GIHN-K 63 LO**[6]	7,6	$63^{+0,03}$	95	$63_{-0,3}$	83	71,5	132	M 48×2	70	140	52	
70	**GIHN-K 70 LO**[3)6)7)]	9,5	$70^{+0,03}$	105	$70_{-0,3}$	92	79	155	M 56×2	80	160	57	
80	**GIHN-K 80 LO**[6]	14,5	$80^{+0,03}$	120	$80_{-0,3}$	105	91	168	M 64×3	90	180	66	
90	**GIHN-K 90 LO**[3)6)]	17	$90^{+0,035}$	130	$90_{-0,35}$	115	99	185	M 72×3	100	195	72	
100	**GIHN-K 100 LO**	28	$100^{+0,035}$	150	$100_{-0,35}$	130	113	210	M 80×3	110	210	84	
110	**GIHN-K 110 LO**[3]	32	$110^{+0,035}$	160	$110_{-0,35}$	140	124	235	M 90×3	125	235	88	
125	**GIHN-K 125 LO**	43	$125^{+0,04}$	180	$125_{-0,4}$	160	138	262	M100×3	135	260	102	
160	**GIHN-K 160 LO**[7]	80	$160^{+0,04}$	230	$160_{-0,4}$	200	177	326	M125×4	165	310	130	
200	**GIHN-K 200 LO**[7]	165	$200^{+0,046}$	290	$200_{-0,46}$	250	221	418	M160×4	215	390	162	

[1] Bore tolerance: H7 (arithmetic mean value).

[2] No relubrication facility.
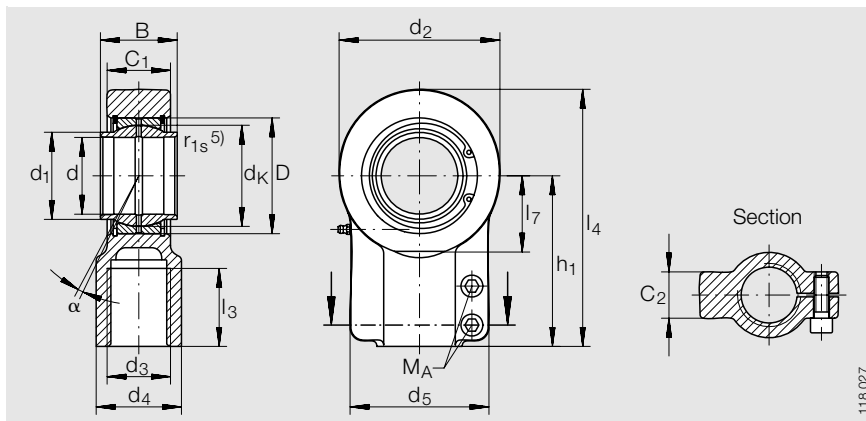
[3] Not included in DIN 24338.

[4] Cylindrical throughout.

[5] Values in dimension table, page 113.

[6] Thread runout or thread groove at manufacturer's discretion.

[7] Price and delivery on request.

[8] Basic load rating of housing.

GIHN-K..LO (d ≧ 63 mm)

α	l_3	l_4	l_7	d_5	C_2	Basic load ratings		Radial internal clearance	Nominal cylinder force	Fixing screws EN ISO 4762	Tightening torque M_A	Shaft diameter
						dyn. C_r	stat. C_{0r}[8)]					
Degrees						N	N		kN		Nm	d
4	17	54	14	32	10,6	10 800	24 000	0,023 – 0,068	8	M 5× 12	8	**12**
4	19	64	18	40	13	17 600	35 300	0,030 – 0,082	12,5	M 6× 16	13	**16**
4	23	75,2	22	47	17	30 000	41 400	0,030 – 0,082	20	M 8× 20	32	**20**
4	29	94	27	54	17	48 000	69 900	0,037 – 0,1	32	M 8× 20	32	**25**
4	37	115	32	66	22	67 000	98 800	0,037 – 0,1	50	M10× 25	64	**32**
4	46	141,5	41	80	26	100 000	175 000	0,043 – 0,12	80	M10× 25	64	**40**
4	57	174	50	96	32	156 000	268 000	0,043 – 0,12	125	M12× 30	110	**50**
4	64	211	62	114	38	255 000	320 000	0,055 – 0,142	200	M12× 35	80	**63**
4	76	245	70	135	42	315 000	475 000	0,055 – 0,142	250	M16× 40	195	**70**
4	86	270	78	148	48	400 000	527 000	0,055 – 0,142	320	M16× 45	195	**80**
4	91	296	85	160	52	490 000	660 000	0,055 – 0,142	400	M16× 50	195	**90**
4	96	322	98	178	62	610 000	840 000	0,065 – 0,165	500	M20× 60	385	**100**
4	106	364	105	190	62	655 000	1 100 000	0,065 – 0,165	635	M20× 60	385	**110**
4	113	405	120	200	72	950 000	1 393 000	0,065 – 0,165	800	M20× 70	385	**125**
4	126	488	150	250	82	1 370 000	2 080 000	0,065 – 0,192	1250	M24× 80	660	**160**
4	161	620	195	320	102	2 120 000	3 456 000	0,065 – 0,192	2000	M30×100	1350	**200**

Hydraulic rod ends

requiring maintenance
Sliding contact surface:
Steel/steel

Series GIHR-K..DO
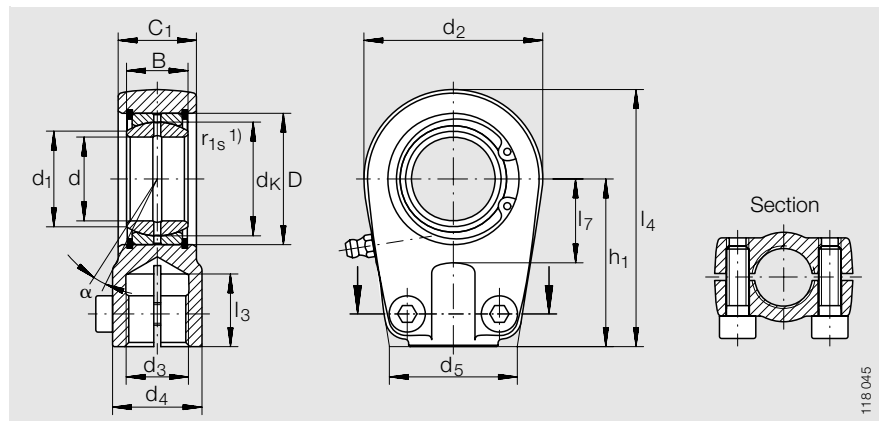
GIHR-K..DO (d $\leqq$ 50 mm)

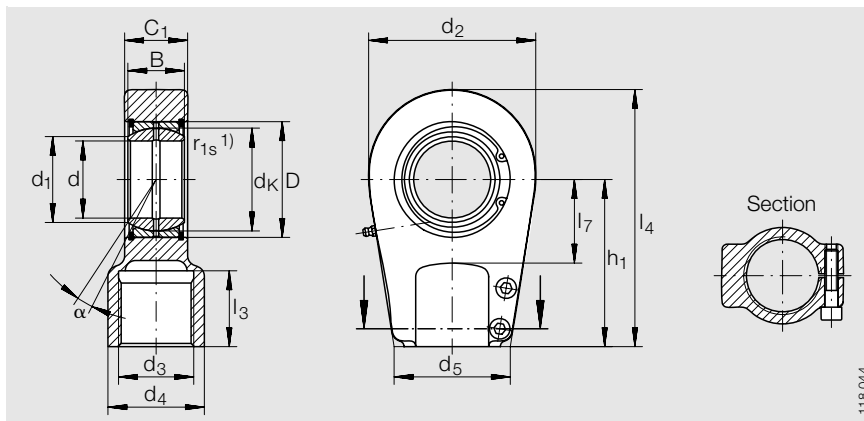| **Dimension table** · Dimensions in mm										
Shaft diameter	Designation[3]	Mass	Dimensions							
			d	D	B	d_K	d_1	d_2	d_3	d_4
d		$\approx$kg								
20	**GIHR-K 20 DO**	0,43	$20_{-0,01}$	35	$16_{-0,12}$	29	24,1	56	M 16×1,5	25
25	**GIHR-K 25 DO**	0,48	$25_{-0,01}$	42	$20_{-0,12}$	35,5	29,3	56	M 16×1,5	25
30	**GIHR-K 30 DO**	0,74	$30_{-0,01}$	47	$22_{-0,12}$	40,7	34,2	64	M 22×1,5	32
35	**GIHR-K 35 DO**	1,2	$35_{-0,012}$	55	$25_{-0,12}$	47	39,7	78	M 28×1,5	40
40	**GIHR-K 40 DO**	2	$40_{-0,012}$	62	$28_{-0,12}$	53	45	94	M 35×1,5	49
50	**GIHR-K 50 DO**	3,8	$50_{-0,012}$	75	$35_{-0,12}$	66	55,9	116	M 45×1,5	61
60	**GIHR-K 60 DO**	5,4	$60_{-0,015}$	90	$44_{-0,15}$	80	66,8	130	M 58×1,5	75
70	**GIHR-K 70 DO**	8,5	$70_{-0,015}$	105	$49_{-0,15}$	92	77,8	154	M 65×1,5	86
80	**GIHR-K 80 DO**	12	$80_{-0,015}$	120	$55_{-0,15}$	105	89,4	176	M 80×2	102
90	**GIHR-K 90 DO**	21,5	$90_{-0,02}$	130	$60_{-0,2}$	115	98,1	206	M100×2	124
100	**GIHR-K 100 DO**	27,5	$100_{-0,02}$	150	$70_{-0,2}$	130	109,5	230	M110×2	138
110	**GIHR-K 110 DO**	40,5	$110_{-0,02}$	160	$70_{-0,2}$	140	121,2	265	M120×3	152
120	**GIHR-K 120 DO**	76	$120_{-0,02}$	180	$85_{-0,2}$	160	135,5	340	M130×3	172

For rod ends of sizes 20 mm, 25 mm and 30 mm, thread runout to DIN 76.

[1] Values in dimension table, page 107.

[2] Basic load rating of housing.

[3] These hydraulic rod ends are also available with
maintenance-free spherical plain bearings GE..UK, GE..UK-2RS, GE..FW, GE..FW-2RS.

⚠ In this case, the basic dynamic load ratings C_r then correspond to the values on page 77 and 81.

GIHR-K..DO (d ≧ 60 mm)

| h_1 | α | l_3 | l_4 | l_7 | d_5 | C_1 | Basic load ratings | | Radial internal clearance | Fixing screws | Tightening torque | Shaft diameter |
| | | | | | | | dyn. C_r | stat. C_{0r}[2] | CN | EN ISO 4762 | M_A | |
	Degrees						N	N			Nm	d
50	9	17	78	25	41	19	30 000	81 100	0,030 – 0,082	M 8×20	32	**20**
50	7	17	78	25	41	23	48 000	65 400	0,037 – 0,1	M 8×25	32	**25**
60	6	23	92	30	46	28	62 000	96 700	0,037 – 0,1	M 8×25	32	**30**
70	6	29	109	38	58	30	80 000	140 000	0,037 – 0,1	M10×30	64	**35**
85	7	36	132	45	66	35	100 000	227 000	0,043 – 0,12	M10×35	64	**40**
105	6	46	163	55	88	40	156 000	333 000	0,043 – 0,12	M12×35	110	**50**
130	6	59	200	65	90	50	245 000	326 000	0,043 – 0,12	M10×45	46	**60**
150	6	66	232	75	100	55	315 000	440 000	0,055 – 0,142	M12×50	80	**70**
170	6	81	265	80	125	60	400 000	550 000	0,055 – 0,142	M16×50	195	**80**
210	5	101	323	90	146	65	490 000	810 000	0,055 – 0,142	M16×60	195	**90**
235	7	111	360	105	166	70	610 000	920 000	0,065 – 0,165	M20×60	385	**100**
265	6	125	407,5	115	190	80	655 000	1382 000	0,065 – 0,165	M20×70	385	**110**
310	6	135	490	140	217	90	950 000	2373 000	0,065 – 0,165	M24×80	660	**120**

Hydraulic rod ends

requiring maintenance
ISO 12 240-4, dimension series E, type S
Sliding contact surface: Steel/steel

Series GK..DO
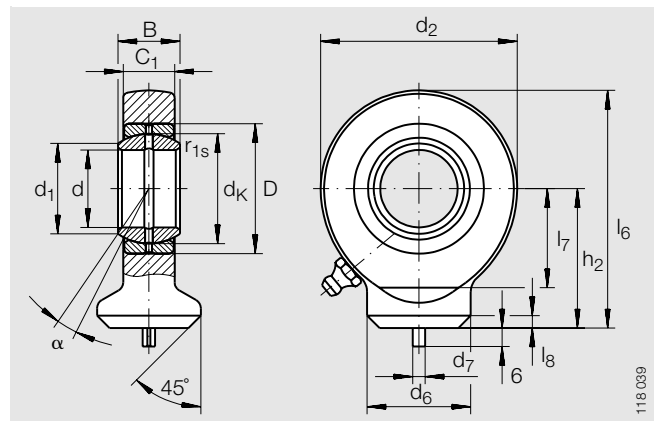
GK..DO

Dimension table · Dimensions in mm										
Shaft diameter	Designation	Mass	Dimensions							
			d	D	B	d_K	d_1	d_2	d_6	h_2
d		≈kg								
10	**GK 10 DO**[1)4)]	0,041	$10_{-0,008}$	19	$9_{-0,12}$	16	13,2	29	15	24
12	**GK 12 DO**[1)4)]	0,066	$12_{-0,008}$	22	$10_{-0,12}$	18	14,9	34	17,5	27
15	**GK 15 DO**[2)4)]	0,12	$15_{-0,008}$	26	$12_{-0,12}$	22	18,4	40	21	31
17	**GK 17 DO**[2)]	0,19	$17_{-0,008}$	30	$14_{-0,12}$	25	20,7	46	24	35
20	**GK 20 DO**[2)]	0,23	$20_{-0,01}$	35	$16_{-0,12}$	29	24,1	53	27,5	38
25	**GK 25 DO**	0,43	$25_{-0,01}$	42	$20_{-0,12}$	35,5	29,3	64	33,5	45
30	**GK 30 DO**	0,64	$30_{-0,01}$	47	$22_{-0,12}$	40,7	34,2	73	40	51
35	**GK 35 DO**	0,96	$35_{-0,012}$	55	$25_{-0,12}$	47	39,7	82	47	61
40	**GK 40 DO**	1,3	$40_{-0,012}$	62	$28_{-0,12}$	53	45	92	52	69
45	**GK 45 DO**	1,8	$45_{-0,012}$	68	$32_{-0,12}$	60	50,7	102	58	77
50	**GK 50 DO**	2,5	$50_{-0,012}$	75	$35_{-0,12}$	66	55,9	112	62	88
60	**GK 60 DO**	3,9	$60_{-0,015}$	90	$44_{-0,15}$	80	66,8	135	70	100
70	**GK 70 DO**	6,6	$70_{-0,015}$	105	$49_{-0,15}$	92	77,8	160	80	115
80	**GK 80 DO**	8,7	$80_{-0,015}$	120	$55_{-0,15}$	105	89,4	180	95	141

[1)] No relubrication facility.

[2)] Relubrication via lubrication hole in housing.

[3)] Basic load rating of housing.

[4)] Price and delivery on request.

[5)] Deviating from ISO 12 240-4.

C_1	α	l_6	l_7	l_8	d_7	r_{1s}	Basic load ratings		Radial internal clearance[5]	Shaft diameter
							dyn. C_r	stat. C_{0r}[3]	CN	
	Degrees					min.	N	N		d
7	12	38,5	15	2	3	0,3	8 150	15 600	0,023 – 0,068	**10**
8	11	44	18	2	3	0,3	10 800	21 500	0,023 – 0,068	**12**
10	8	51	20	2,5	4	0,3	17 000	31 800	0,030 – 0,082	**15**
11	10	58	23	3	4	0,3	21 200	40 100	0,030 – 0,082	**17**
13	9	64,5	27	3	4	0,3	30 000	52 400	0,030 – 0,082	**20**
17	7	77	32	4	4	0,6	48 000	70 800	0,037 – 0,1	**25**
19	6	87,5	37	4	4	0,6	62 000	95 600	0,037 – 0,1	**30**
21	6	102	42	4	4	0,6	80 000	127 000	0,037 – 0,1	**35**
23	7	115	48	5	4	0,6	100 000	155 000	0,043 – 0,12	**40**
27	7	128	52	5	6	0,6	127 000	208 000	0,043 – 0,12	**45**
30	6	144	60	6	6	0,6	156 000	251 000	0,043 – 0,12	**50**
38	6	167,5	75	8	6	1	245 000	389 000	0,043 – 0,12	**60**
42	6	195	87	10	6	1	315 000	510 000	0,055 – 0,142	**70**
47	6	231	100	10	6	1	400 000	624 000	0,055 – 0,142	**80**

Hydraulic rod ends

requiring maintenance
Sliding contact surface: Steel/steel

Series GF..DO
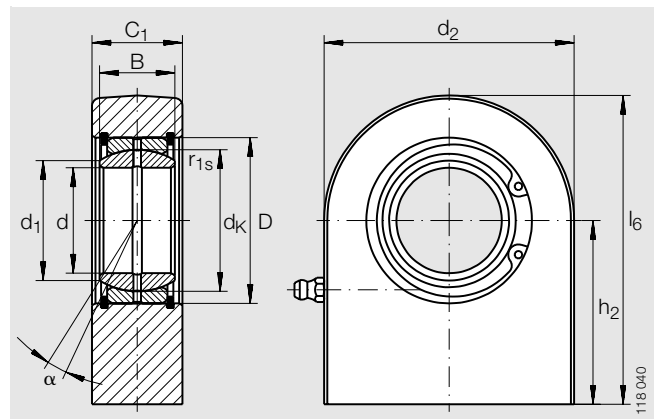
GF..DO

Dimension table · Dimensions in mm

Shaft diameter	Designation	Mass	Dimensions						
			d	D	B	d_K	d_1	d_2	h_2
d		$\approx$kg							
20	**GF 20 DO**	0,35	$20_{-0,01}$	35	$16_{-0,12}$	29	24,1	50	38
25	**GF 25 DO**	0,53	$25_{-0,01}$	42	$20_{-0,12}$	35,5	29,3	55	45
30	**GF 30 DO**	0,87	$30_{-0,01}$	47	$22_{-0,12}$	40,7	34,2	65	51
35	**GF 35 DO**	1,5	$35_{-0,012}$	55	$25_{-0,12}$	47	39,7	83	61
40	**GF 40 DO**	2,4	$40_{-0,012}$	62	$28_{-0,12}$	53	45	100	69
45	**GF 45 DO**	3,4	$45_{-0,012}$	68	$32_{-0,12}$	60	50,7	110	77
50	**GF 50 DO**	4,4	$50_{-0,012}$	75	$35_{-0,12}$	66	55,9	123	88
60	**GF 60 DO**	7,1	$60_{-0,015}$	90	$44_{-0,15}$	80	66,8	140	100
70	**GF 70 DO**	10,5	$70_{-0,015}$	105	$49_{-0,15}$	92	77,8	164	115
80	**GF 80 DO**	15	$80_{-0,015}$	120	$55_{-0,15}$	105	89,4	180	141
90	**GF 90 DO**[2]	23,5	$90_{-0,02}$	130	$60_{-0,2}$	115	98,1	226	150
100	**GF 100 DO**[2]	31,5	$100_{-0,02}$	150	$70_{-0,2}$	130	109,5	250	170
110	**GF 110 DO**[2]	48	$110_{-0,02}$	160	$70_{-0,2}$	140	121,2	295	185
120	**GF 120 DO**[2]	79	$120_{-0,02}$	180	$85_{-0,2}$	160	135,5	360	210

[1] Basic load rating of housing.

[2] Price and delivery on request.

C_1	C_1	a	l_6	Chamfer dimension	Basic load ratings		Radial internal clearance	Shaft diameter
				r_{1s}	dyn. C_r	stat. C_{0r}[1]	CN	
nominal	max.	Degrees		min.	N	N		d
19	20	9	63	0,3	30 000	65 500	0,030 – 0,082	**20**
23	24	7	72,5	0,6	48 000	68 700	0,037 – 0,1	**25**
28	29	6	83,5	0,6	62 000	115 000	0,037 – 0,1	**30**
30	31	6	102,5	0,6	80 000	193 000	0,037 – 0,1	**35**
35	36,5	7	119	0,6	100 000	305 000	0,043 – 0,12	**40**
40	41,5	7	132	0,6	127 000	386 000	0,043 – 0,12	**45**
40	41,5	6	149,5	0,6	156 000	441 000	0,043 – 0,12	**50**
50	52,5	6	170	1	245 000	558 000	0,043 – 0,12	**60**
55	58	6	197	1	315 000	724 000	0,055 – 0,142	**70**
60	63	6	231	1	400 000	804 000	0,055 – 0,142	**80**
65	69	5	263	1	490 000	1 352 000	0,055 – 0,142	**90**
70	74	7	295	1	610 000	1 516 000	0,065 – 0,165	**100**
80	85	6	332,5	1	655 000	2 340 000	0,065 – 0,165	**110**
90	95	6	390	1	950 000	3 510 000	0,065 – 0,165	**120**

Other products

Other products in the range:

- are special products which differ from the catalogue range in type and design
- are products for special bearing arrangement problems
- are produced exclusively for specific customers or orders.

In order to achieve the most favourable solution in technical and economic terms using products from this range, the development should be discussed and agreed as early as possible in the project with the manufacturer's engineering service.

Special rod ends

- comprise a rod end and spherical plain bearing whose inner ring is in the form of a mounting lug
- can be combined with a hydraulic rod end, for example for fitting on the piston side to a hydraulic cylinder
- are made from high strength forged materials
- are easy to fit and service – the lug is fixed to the moving part by cap head screws
- can be quickly and easily fitted and are more easily dismantled than conventional pin arrangements due to the screw connection
- require no precision fixtures, shafts or anti-rotation devices on the customer's part (leading to cost savings).
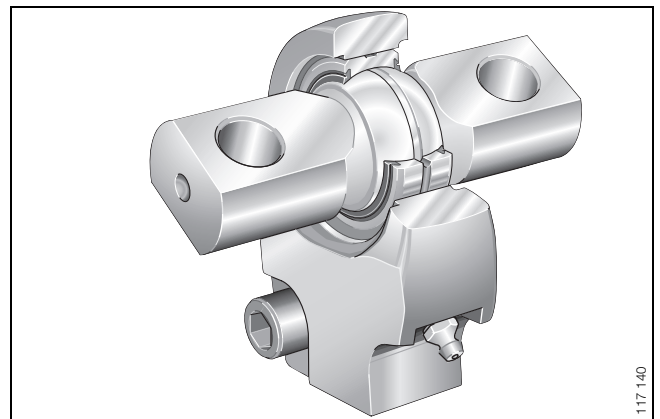
Figure 1 · Special rod end

Locating bearings for articulated frame steering

- are used as locating bearings in frame steering systems for construction machinery
- can support high radial and axial loads
- have sliding zones of a special geometrical design. This prevents edge stresses in the part of the bearing under axial load
- are supplied preadjusted. There is therefore no need for clearance adjustment by the customer.
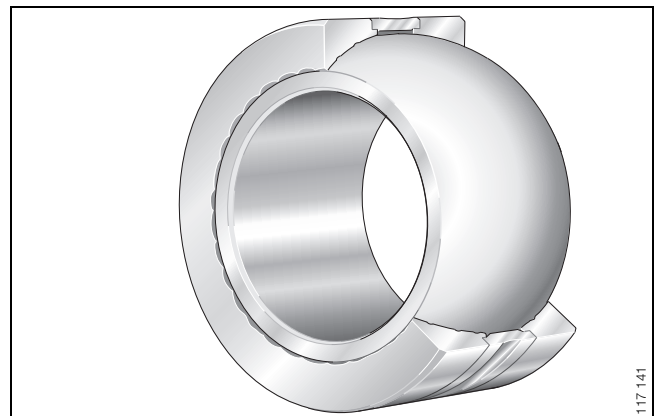
Figure 2 · Locating bearings for articulated frame steering

Prop shaft centring bearings

■ are movable cardanic centring elements

■ are used to damp vibrations in rear and four wheel drive vehicles in the centre of the coupling between the gearbox and prop shaft

■ support the prop shaft mass on the coupling, preventing eccentricity of the elastically coupled shafts.
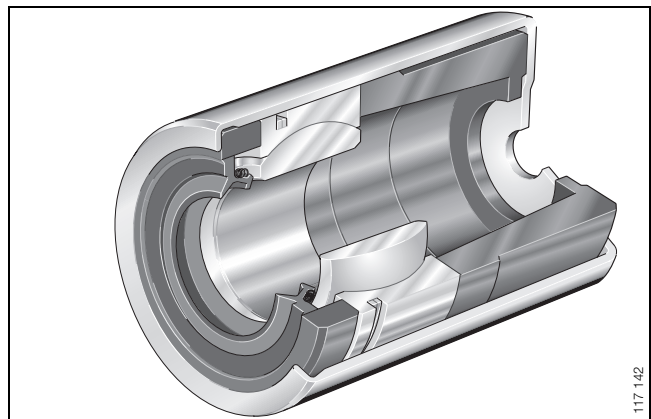
Figure 3 · Prop shaft centring bearings

Flanged spherical plain bearings

■ are used in clutch actuation systems

■ are maintenance-free.
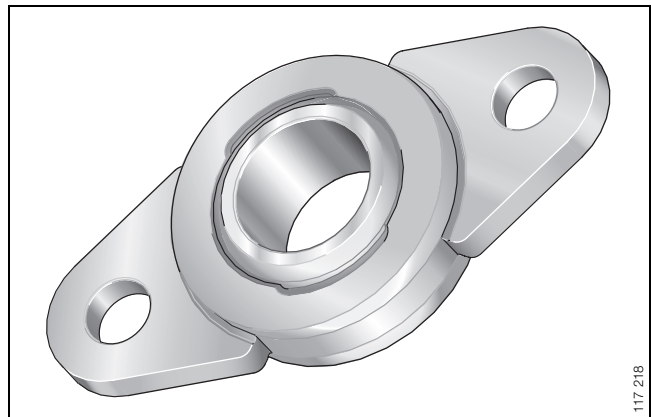
Figure 4 · Flanged spherical plain bearings

Joint connecting rods

■ are used in brake actuation systems

■ contain maintenance-free spherical plain bearings.
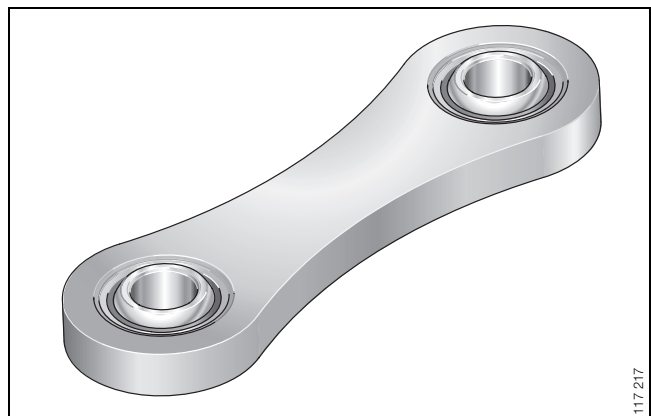
Figure 5 · Joint connecting rod

Spherical plain bearings for clearance-free bearing arrangements

- are used in clearance-free bearing arrangements for control elements such as gear levers
- have a plastic/steel sliding contact surface
- compensate wear up to 0,4 mm due to the use of preloaded rubber elements
- have preload values comparable to a new bearing even after a long operating life
- are maintenance-free throughout their operating life after initial greasing.
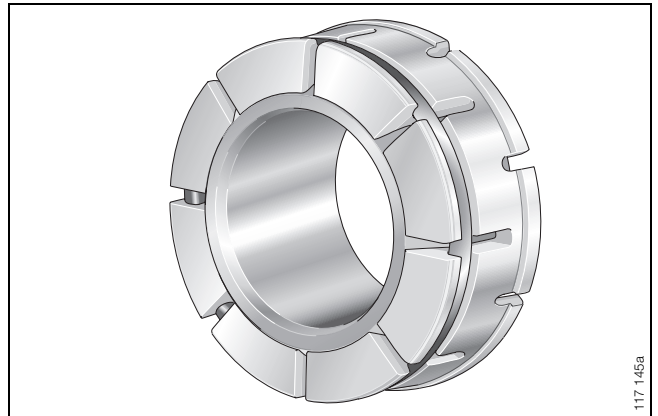
Figure 6 · Spherical plain bearings for clearance-free bearing arrangements

Gear lever bearing arrangements

- are developed to meet the specific requirements of the vehicle manufacturer
- give continuous compensation of the operating clearance
- have a constant tilting moment
- are maintenance-free for the life of the vehicle
- can be combined with noise and vibration damping measures.
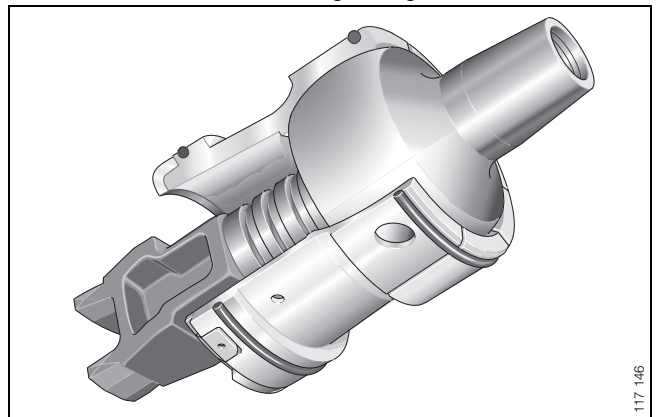
Figure 7 · Gear lever bearing arrangement

Brake pedal linkages

- are spherical plain bearing units
- connect the brake pedal to the brake servo unit
- give positive transmission of the brake pedal stroke and pedal force moment-free by means of a coupling on both sides
- have a rod end at one end fixed to the aluminium linkage rod to prevent rotation
- have a rod end on the other end with a thread for adjusting the rod length. The set position is then fixed using a locknut. A sheet metal safety lug is formed about the pressure pipe and spot welded.
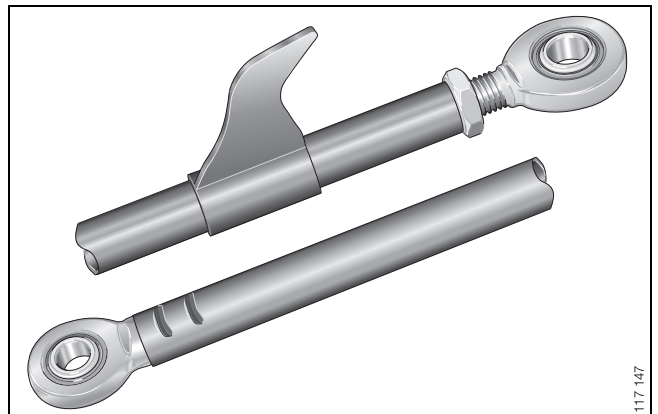
Figure 8 · Brake pedal linkage

medias® professional

Each section in Catalogue 238 begins with a description of the product series and their features.

The essential characteristics of the spherical plain bearings, maintenance-free plain bushes and rod ends are indicated by means of pictograms.

The advantages of this type of presentation include:
■ less reading is required
■ the required information can be accessed more quickly
■ a direct comparison between alternative bearings is possible.

Definition of pictograms

Pictogram	Description
	The spherical plain bearings can perform spatial oscillating motion even under load
	The rod ends can perform spatial oscillating motion even under load
	The bearings can support radial forces
	The bearings can support axial forces in one direction
	The bearings are greased
	The bearings can be relubricated
	The bearings are sealed on both sides
	The permissible operating temperature differs from the standard values
	This pictogram indicates the dimension table
	If this information is not adhered to, there is a direct or indirect risk to the product and/or the adjacent construction

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Catalogue 238   Spherical plain bearings · Plain bushes · Rod ends