SPHERICAL PLAIN BEARINGS AND ROD ENDS FOR HEAVY-DUTY APPLICATIONS

Introduction

According to DIN ISO 12240-1, radial spherical plain bearings are standardized, ready-to-fit machine parts. Spherical plain bearings can perform circular movements, i.e., movements in circumferential direction (pivoting or rotating movements) and/or movements perpendicular to the bearing axis (tilting), all of which can compensate for misalignments and manufacturing inaccuracies as well as settling occurring in foundations.

FLURO® has over 35 years of experience in the development and manufacture of spherical plain bearings and rod ends. To meet increasing customer requirements with sophisticated and high-risk applications under dynamic load conditions, FLURO® has spent years of research developing FLUROGLIDE®.

Figure 1: Performance characteristics

FLUROGLIDE® is used in the series **GE..EW-2RS**, **GE..GW-2RS**, **GE..CW(-2RS)**, **GE..SWE**, **GE..AWE** as well as the cylindrical sliding bushings **GB..x..x..ZW**.

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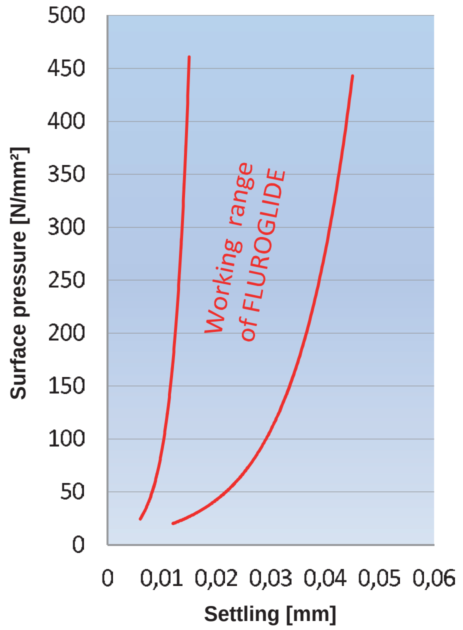
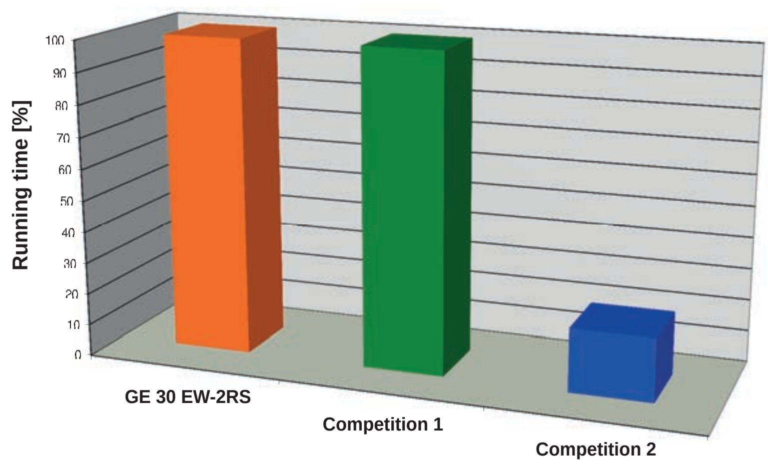
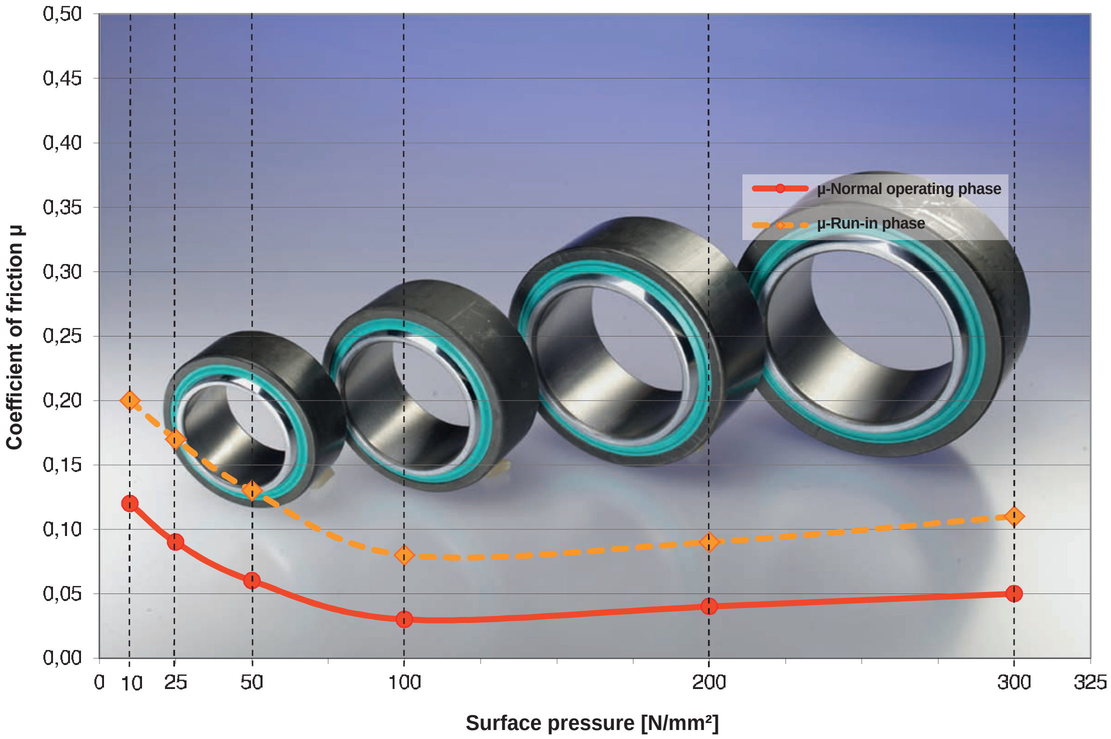
Pressure stability of FLUROGLIDE®



Working life comparison

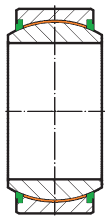
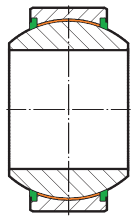
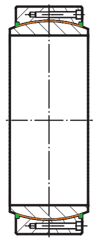


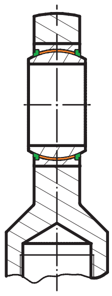
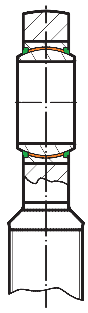
Coefficient of friction of FLUROGLIDE® at different surface pressures

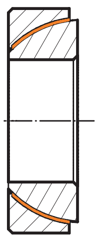
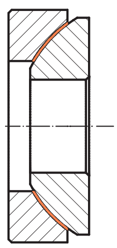
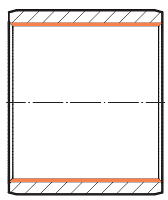


Designs / Series

Product Overview

Spherical Plain Bearings DIN ISO 12240-1 Series E	Spherical Plain Bearings DIN ISO 12240-1 Series G	Spherical Plain Bearings DIN ISO 12240-1 Series C
GE.. EW-2RS Maintenance free 	GE.. GW-2RS Maintenance free 	GE.. CW-2RS Maintenance free 

Rod Ends DIN ISO 12240-4 Series E with Female Thread	Rod Ends DIN ISO 12240-4 Series E with Male Thread
EI.. EW-2RS Maintenance free 	EA.. EW-2RS Maintenance free 

Angular Spherical Plain Bearing DIN ISO 12240-2	Axial Spherical Plain Bearing DIN ISO 12240-3	Cylindrical Sliding Bushing DIN ISO 4379
GE..SWE Maintenance free 	GE..AWE Maintenance free 	GB.x.x.ZW Maintenance free 

The main dimensions and tolerances of the spherical plain bearings GE...EW-2RS and GE...GW-2RS correspond with DIN ISO 12240-1 before splitting the outer ring. Splitting the ring results in minor dimensional and shape deviations, which are eliminated when installing the bearings into the housing bore.

Load Ratings

The load bearing capacity of spherical plain bearings is defined by the bearing manufacturer with the dynamic load rating C and the basic static load rating C_o and is not content of DIN ISO 12240. The load rating comparison of spherical plain bearings from different manufacturers is only viable if the bearing dimensions, the tribological pairing and the calculation method are identical.

Dynamic Load Rating C

– This is a characteristic value for the calculation of the theoretical service life when used under dynamic load conditions.
For maintenance free bearings, each repeat movement is considered movement under dynamic load conditions.
If the main movement is superimposed by relative movements, which also produce friction and wear, these must be added to the main movement and assigned to the dynamic operation.

Only the dynamic load rating C is applied for the theoretical service life calculation of maintenance free bearings!

C is determined by the load/bearing pressure, lubrication conditions, and the installation situation. An exact determination of the bearing pressure is complicated by many factors.
The dynamic load rating C therefore considers a material-specific load factor K (see Table 1: Specific dynamic load factor) and the projected functional area of the bearing.

C = K • projected functional area of the bearing (in N)

Static Load Rating C_o

– Is applied at idle load after, for example, a single adjustment movement, or when dynamically loaded plain bearings are also exposed to additional impact loads.

C_o is the load limit at room temperature for spherical plain bearings at which sliding surface damages may not yet occur. The bearing-surrounding components/materials of the bearing mating structures must be interpreted accordingly in terms of strength when fully utilizing C_o.

C_o determined from the material-specific load factor K_o (see Table 2: Specific static load factor) and the projected functional area of the bearing.

C_o = K_o • projected functional area of the bearing (in N)

Tribological pairing From outer to inner ring	Specific load factor **K** (N/mm²)
FLUROGLIDE®/Hard chrome	300

Table 1: Specific dynamic load factor

Tribological pairing From outer to inner ring	Specific load factor **K_o** (N/mm²)
FLUROGLIDE®/Hard chrome	500

Table 2: Specific static load factor

Internal and operating clearance

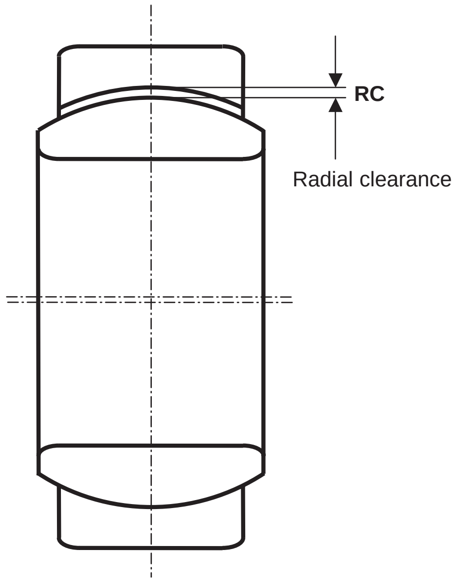
The radial clearance and the operating clearance of a bearing consists of the radial displacement of the inner part (inner ring, shaft, bolt, etc.) in the outer ring (sliding bushing) on the Y-/vertical axis.

The radial clearance in spherical plain bearings are manufacturer-specific and should primarily provide optimum functionality.

The addition of production, form and position tolerances means the radial clearance is specified in the tables for the series E, G and C.

Maintenance free spherical plain bearings require no radial clearance for layers of lubrication film.

At radial clearance = 0, the load share in the bearing amounts to 100%.
Our standard spherical plain bearings of the dimensional series E, C and G are supplied with a very narrow radial clearance range (see Table 3).

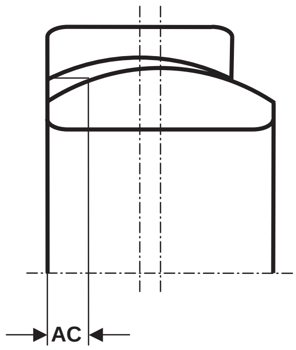


Nominal size to	20	35	60	90	140	240	300	340	400
Radial clearance [1] = (mm) from 0 to	0.04	0.05	0.06	0.072	0.085	0.10	0.11	0.125	0.135

Table 3: Radial clearance

Each radial spherical plain bearing also has axial clearance, which can be about 3 times larger than the radial clearance due to geometric reasons. The axial clearance is not listed in the tables.

The operating clearance is determined on the installed bearing being warm from use.
The radial clearance, its reduction due to interferences, and the temperature effects in the installed state comprise the operating clearance.



[1] The radial clearance is measured and guaranteed with manufacturer-specific test equipment.

Bearing Design

Appropriate measures must be taken to ensure the pivoting, tilting or rotating movements always take place between the functional surfaces of the bearing.

Due to the relatively low friction values of maintenance free bearings, looser fits for housing and shaft/bolt can be used. With regard to load share and load angle in the spherical plain bearing and especially in variable load applications, tighter fits are the better solution.

Fit recommendation:	Bore d (mm)	Housing/shaft Steel/steel	Housing/shaft Light metal/steel
	up to 300 300 and higher	**K7 / j6** **J7 / j6**	**M7 / j6** **-**

Selection as Locating Bearing

Housing and shaft fits must be in accordance with the installation recommendations. If looser fits must be selected due to installation conditions, the outer and inner ring should be subjected to additional friction-lock fixing established through the bearing mating structure.

Selection as Floating Bearing

Spherical plain bearings are always defined as floating bearings by the inner ring bore and the receiving shaft/bolt.

Axial force on the inner ring can lead to expansion of the housing bore. Therefore, the outer rings of the bearing must be firmly fixed in the housing bore.

If thermal or intentional axial displacements occur due to loads, these must take place in the inner ring bore. The inner ring width is the larger supporting surface. The counter mate bolt/shaft should have a surface hardness of HRC > 56 and a maximum roughness of Rz10.

An additional sliding lacquer treatment would be beneficial. The additional lining of the inner ring bore with FLUROGLIDE® acc. to H8 (inner ring bore d in H8) is the more elegant problem solution and is available on request.

Assembly and Disassembly Measures

Spherical plain bearings and sliding bushings are precision machine parts. Trouble-free performance requires careful handling prior to and during installation.

The warranty is voided by installation errors.

When delivered, the bearings are preserved and can be taken directly out of the box and installed where needed. Do not alter the delivery condition and leave the bearings in the packaging until ready to install. The bearings should be stored in clean, dry areas.

For the prevention of corrosion, make sure the bearings are handled dry and clean.
Thermal installation tools with thermostat are permitted if heating/subcooling takes place evenly across the bearing-specific temperature range (-50 to +180 °C[1]).

A visual inspection to check the dimensions and form accuracy of the bearing seats and the presence of centering chamfers in the range of 15 + 5° (see Fig. 2) are part of the installation preparation process.

Slight oiling of the mounting surfaces to aid installation is permitted if oil does not reach the function zone of the bearing as a result. Direct blows to the bearing rings are not permitted. To ensure proper installation, appropriate assembly and installation tools (see Fig. 4 and 5) must be prepared. Direct the installation forces only indirectly onto the inner ring front face for mounting on a shaft/bolt or the outer ring end surface for mounting in a housing using a push-fit cap.

A combination installation tool (see Fig. 5) is needed when the mounting force simultaneously passes through the outer and inner ring faces and the bearing is mounted synchronously on a shaft/bolt and into a housing.

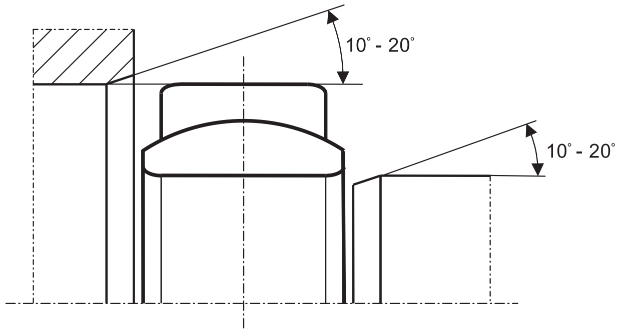


Figure 2: Centering chamfers

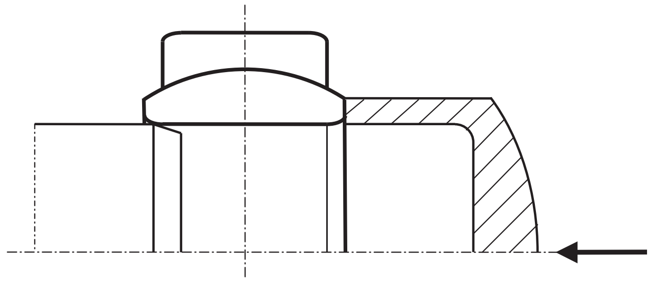


Figure 3: Installation tool

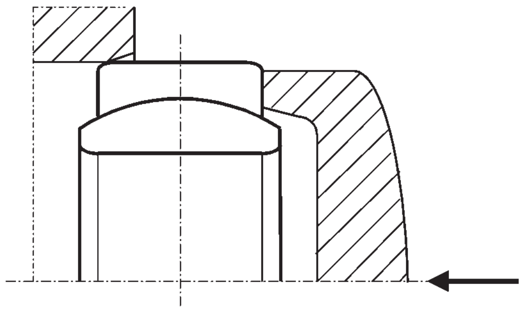


Figure 4: Installation tool

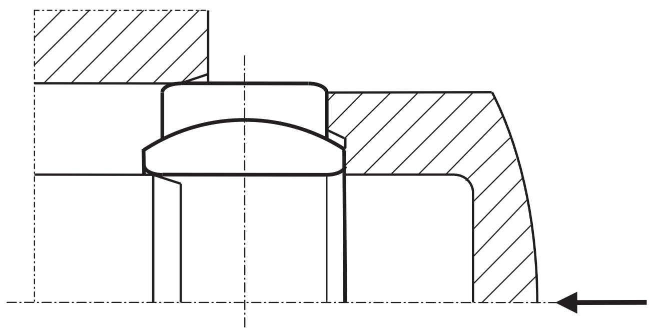


Figure 5: Combination installation tool

[1] To avoid damage to the seals, the seals must be removed from the housing before mounting with thermal installation tools (from 130 °C).

Assembly and Disassembly Measures

The mounting forces increase when the bearing dimensions increase. Appropriate assembly and reassembly options must therefore be provided as early as the design stage.

⚠ **If split outer rings are installed, align the separation point approximately 90° to the direction of the main load.**

The outer ring of the large spherical plain bearings GE...CW is screwed on one side. Having the screw/bolt pattern face the mounting side may facilitate a possible bearing replacement.

The threaded holes for eyebolts according to DIN 580 in the end faces are provided for handling and transport (see Fig. 6).

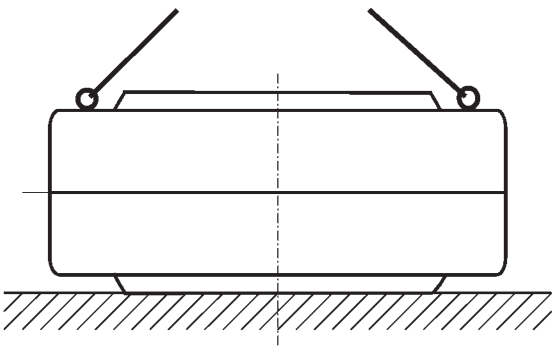


Figure 6: Transporting large spherical plain bearings

Maintenance and Handling of Spherical Plain Bearings

Maintenance free bearings by FLURO® require absolutely no maintenance!

Do not lubricate maintenance free bearings.
The intrinsic tribology of the bearing or its structure is significantly disrupted by lubrication, reducing service/working life radically.

The same applies to the penetration of liquids/contaminants of all types.

High glide/wear distances can only be achieved with dry running and functioning bearings with intrinsic tribology.
Make sure the inner ring is clean and dry after installing. Any residue of grease or oil must be removed with ethanol.

Service Life and Working Life

A variety of test bench and laboratory experiments under different load, motion ratios and conditions are the basis for the service life and the theoretical calculations.
The efforts to make the tests as practical as possible are faced with natural limits, so that theory and application experience must be merged.

Whether the user or FLURO® carries out the calculation, the specifications (page 26) must list the complete technical data.

The calculation of the theoretical service life definitely delivers comparable bearing benchmarks. These can be used to pick the bearing with the best performance among those offered by various providers.

Results may be compared only when provider, product, and theoretical calculation have the same point of origin. The oscillations achieved in practice (pivoting movements) or operating hours comprise the working life of the bearing.

The working life is largely determined by the following:
- Proper bearing selection
- Occurring impacts, shocks, knocks, vibrations
- Aggressive corrosion
- Implementation of installation recommendations
- Type and size of the load
- Contaminants, pollution
- Seal functionality

Friction and Wear

Friction in maintenance free bearings depends on the following:
- Tribological pairing (sliding layer in the outer ring/ counter mate inner ring or shaft/bolt)
- Load
- Sliding speed
- Operating temperature

Friction is a function of the load (P). Depending on the sliding layer, the friction decreases with increasing load. The friction increases when the load is reduced. This means friction is a direct function of the sliding speed (v). Friction increases and decreases with increasing or decreasing sliding speed. Friction is also a function of the operating temperature T_B. Reciprocally (inverse function), friction increases and decreases with dropping or rising temperature.

Safety reasons require calculating the bearing friction moment when dimensioning the drive units always with the maximum friction factor for FLUROGLIDE® high-performance sliding liners compared with hard chromium or hardened steels. The maximum coefficient of friction occurs in the run-in phase.

FLUROGLIDE® is characterized in particular by the fact that the coefficient of friction exhibits a low friction level even during the run-in phase.

Depending on the load, well run-in bearings move during the normal operating phase on an almost constant friction level up until the failure phase.

$$M = P \times \mu \times d_k \times 5 \times 10^{-4}$$

M *(Nm)*	=	spherical plain bearing - bearing friction moment
P *(N)*	=	equivalent, dynamic load
μ	=	friction factor (see friction value table on page 4)
d_k *(mm)*	=	spherical plain bearing - ball diameter (from product tables)

Development focused on an optimized run-in phase of the spherical plain bearing value to achieve an extension of the normal operating phase.

Range: p = 1 -300 N/mm²

s = 1500000 / 1.0219^p	to p ≤ 100 N/mm²
s = 800000 / 1.0155^p	from p ≥ 100 – 300 N/mm²

Increased friction values are synonymous with increased wear in the run-in and run-out phases.
A constant coefficient of friction in the normal operating phase reflects the linear wear, which is the result of a trouble-free, properly functioning intrinsic bearing tribology, effected by the continuous replacement of used slide lining particles.
The task of a seal must be to protect the intrinsic tribology from all physical and chemical influences.

If underchallenged in terms of the load and moving at a high friction level, such a bearing installed in a vibration-sensitive design can be the cause of unpleasant noise (slip-stick).

All previous statements relate to the FLUROGLIDE® high-performance liner in the outer ring. The influence of the counter mate inner ring spherical surface, shaft or bolt surface is similar in size and is considered in the service life calculation with the following factors.

Roughness Factor	**$f_6 = 1.357 \times 0.737^{Rz}$**
(Materials: Hard chrome, roller bearing, carbon or hardened stainless steels)	
Hardness Factor	**$f_7 = 1 - (55 - \text{HRC actual value}) \times 0.04$**

The spherical plain bearings form a closed unit, in which roughness $f_6 = 1$ and hardness $f_7 = 1$ are optimally realized. If the spherical plain bearing is used as a floating bearing, the responsibility lies with the user - when the counter mate is a shaft or bolt, the requirements for material, roughness and hardness must be considered.

Loads

In moving bearings, a distinction is made between an unchanging, central load **F** (constant, unidirectional load) and a composite, equivalent load **P**, from simultaneously acting radial (**Fr**) and axial (**Fa**) loads (see Fig. 7), which can also occur unidirectional or alternating. If F is active, **F = P** and is included directly in the calculation of the theoretical service life. If composite loads are active, **P** must be determined first.

P = X x Fr	**$X = 0.97 \times 26.565^{Fa/Fr}$**

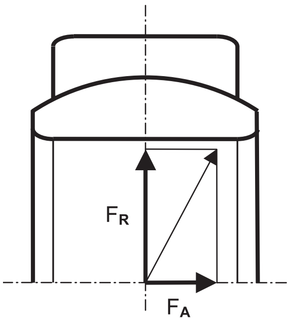


Figure 7: Radial and axial force

⚠ Please note: The ratio of Fa/Fr may not exceed **0.3**.

Service Life and Working Life

Variable Loads

The equivalent load value **P** for a linearly variable load is determined as follows:

$$P = [(F_{min}^2 + F_{max}^2) \times 0.5]^{0.5}$$

If pulsating loads occur, F_{max} represents a calculation on the safe side. With varying load directions (traction/compressive forces), the maximum load P_{max} is always included in the calculation. The theoretical service life, in the order calculated first for an unidirectional load, is corrected using a variable load factor f_5.

Variable Load Factor	$f_5 = 0.5442 / 1.017^{f4 \times p}$
Load Frequency	$f_4 = f / 60$

Load frequency $f_4 = f / 60$ in (Hz) when $f = f_4$. $f \neq f_4$ then used for f_4 the load frequency specified by the customer since movement and load frequencies may differ.

Contact/Bearing Pressure

If the target service lifespan is to become reality, the specific bearing must match the operating conditions. The specific bearing load determines the contact pressure in the bearing and is the criterion for the assessment based on the particular application case.

The contact/bearing pressure p of a radial spherical plain bearing is determined from the following:

- Specific load factor
  K = 300 *(N/mm²)* Table 1 Page 6
- Equivalent dynamic bearing load
  P *(N)* (see above)
- Dynamic load rating
  C *(N)* (from dimensional tables)

Contact/Bearing Pressure	$p = 300 \times P/C$

⚠

- Dynamic constant and pulsating load
  p_{max} **= 300 N/mm²**
- Variable load
  p_{max} **= 150 N/mm²** *(p=150 N/mm² at f_4 = 0,67Hz)*
- Static load
  p_{0max} **= 500N/mm²**

Movements

Spherical plain bearings during dynamic operation transfer high loads, while outer and inner ring are moving relative to one another.

The movements (dynamic conditions) are determined by the following:

- Kinetic momenta
- Movement frequency
- Movement speed

Service Life and Working Life

Kinetic Momenta

The pivoting angle **ß** is one of the kinetic momenta (see Fig. 8). It describes the bearing movement in the circumferential direction from one end position to the other. One pivotal movement comprises 2 ß, i.e., from one end position to another and back.
At a maximum pivoting angle ß = 180°, a pivotal movement amounts to = 2 ß = 360° = 1 revolution.

The tilting angle α also is one of the kinetic momenta. It describes the bearing movement transverse to the bearing axis. A tilting movement comprises 2α. The maximum tilting angle with full utilization of the catalog load ratings is listed in the respective dimension tables. In theory, a radial spherical plain bearing with reduced load rating can be tilted up to the stop of the shaft/bolt in the outer ring. If pivoting and tilting movements occur simultaneously, the spherical plain bearing carries out spherical movements.

The replacement angle β_1 is determined through geometric addition. The movement angles are considered by an angle factor **f_2** in the theoretical calculation of the service life.

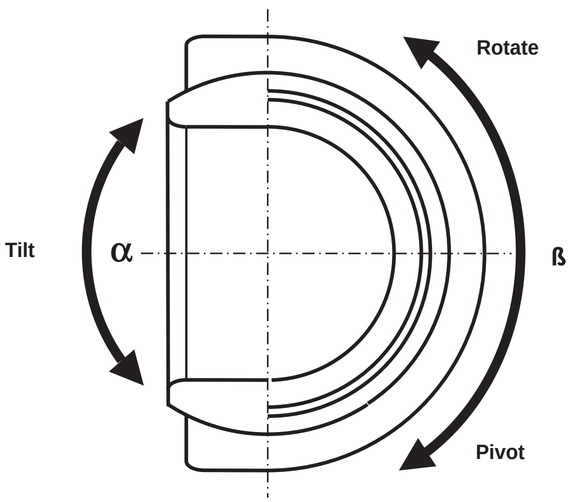


Figure 8: Tilting and pivoting angle

$\beta_1 = (\beta^2 + \alpha^2)^{0.5}$	$f_2 = 0.758 \times 1.00618^{ß \text{ or } \alpha \text{ or } \beta 1}$

Movement Frequency

Movement frequency, also called frequency **f** (min^{-1}), designates the number of movements per time unit. In case of rotary movements, f is replaced by **n**.

The frequency primarily influences the service life of the bearing as well as the friction energy turnover in the spherical plain bearing.

Movement Speed

Movement speed for maintenance free spherical plain bearings is the average sliding speed **v** (mm/s), which prevails in continuous operation, or in operation with recurring downtimes.
The sliding speed is considered during the calculation by a sliding speed factor **f_1**.

$v = 2.91 \times 10^{-4} \times d_k \times ß \times f$	$f_1 = 1.61 - (v \times 1.01^{p}/366.3)$

Operating Temperature T_B

The permissible operating temperatures of the FLURO-GLIDE® high-performance liner amount to -30 to +150°C. In the range of 0 to +150°C, the temperature factor is **f_3** = 1; a service life reduction occurs from 0 to -30°C.

$f_3 = 1 – [-20-(-T_B)] / 100$

Scope of Applicability

⚠ The theoretical service life calculation is valid in the range of d = 17 to 300. To calculate the spherical plain bearings of the series **CW**; **AWE** and **SWE**, please contact our technical staff.

Service Life and Working Life

Calculation Sequence

A preliminary bearing definition and step-by-step theoretical service life determination for the corresponding spherical plain bearing is based on the technical data from the specifications (see calculation example).
This starts with the calculation of unidirectional and pulsating loads; later the result is corrected with the variable factor once traction/pressure is applied to the bearing.

1. Load — **P (kN)**
Unidirectional or alternating load.................................... $F_r = P$
Equivalents, unidirectional, or alternating load.................. $P = 0.97 \times 26.565^{Fa/Fr} \times F_r$
Pulsating load.. $P = [(F_{min}^2 + F_{max}^2) \times 0.5\,]^{0.5}$

Using F_{max} for the theoretical service life calculation represents a calculation that is on the safe side.

2. Bearing Pressure — **p (N/mm²)**
Specific bearing load.. $P = 300 \times P/C$ *(C = dynamic load rating from product table)*

3. Glide/Wear Distance — **s (m)**
Up to p ≤ 100 N/mm² $s = 1{,}500{,}000 / 1.0219^p$ .... *From p ≥ 100 – 300 N/mm²* $s = 800{,}000 / 1.0155^p$

4. Sliding Speed — **v (mm/s)**
From 1 – 300 mm/s.. $v = 2.91 \times 10^{-4} \times d_k \times ß \times f$

In case of sliding bushing d instead of d_K from the dimension tables; if pivoting or spherical movements; α or β_1 ($\beta_1 = (\beta^2 + \alpha^2)^{0.5}$) and with rotary movements n instead of f. (f in min^{-1})

5. Slide Speed Factor f_1 — **6. Movement Factor f_2**
$f_1 = 1.61 - [(v \times 1.01^p) / 366.3]$ .... $f_2 = 0.758 \times 1.00618^{\beta}$

7. Temperature Factor f_3
From 0 to +150°C $f_3 = 1$.. *From 0 to -30° C* $f_3 = 1 - [-20 - (T_B)] / 100$

8. Theoretical Service Life
L *In pivoting movements / oscillations* .... L_h *In operating hours*
$L = s \times f \times f_1 \times f_3 \times 10 / v \times f_2$ .... $L_h = L / (f \times 60)$

Theoretical Service Life with Variable Load

Load frequency factor f_4 — **Variable load factor f_5**
$f_4 = f / 60$ .... $f_5 = 0.5442 / 1.017^{f4 \times p}$
L_w *In pivoting movements / oscillations* .... L_{hw} *In operating hours*
$L_w = L \times f_5$ .... $L_{hw} = L_w / (f \times 60)$

Theoretical Service Life Calculation Sliding Bushing

For the calculation of the theoretical service life, the roughness and hardness must be taken into account by means of factors.

Roughness factor f_6 — **Hardness factor f_7**
$f_6 = 1.357 \times 0.737^{Rz}$.. $f_7 = 1 - (55 - \text{HRC actual value}) \times 0.04$
$L = s \times f \times f_1 \times f_3 \times f_6 \times f_7 / v \times f_2$...................................... $L_h = L / (f \times 60)$

If a variable load prevails, the calculation is as follows.
$L_w = L \times f_5$.. $L_{hw} = L_w / (f \times 60)$

Service Life and Working Life

Calculation Example

Customer: .... Crane manufacturer
Installation case/site: .... Jib bearing on double lever jib for grabbing operation
According to DIN 15018 operating class V5
Environmental conditions: .... Temperature: From 5 to 60°C
Atmosphere: Maritime climate
Minimum Bolt/Shaft Diameter .... 200 mm
Loads: .... Radial loads: $F_{r\ max}$ = 1,400 kN; $F_{r\ min}$ = n.n. Axial loads: $F_{a\ max}$ = 70 kN; $F_{a\ min}$ = n.n.
Load Direction: .... Unidirectional / constant
Maximum bearing load (P) - distribution by FEM section IX, load spectrum 2
4 Load cases: >Load case 1 = ED 16.6% (P) ; >Load case 2 = ED 50% (P_1 = P x 0.32);
>Load case 3 = ED 16.7% (P_2 = P x 0.227+P_1) ; >Load case 4 = ED 16.7% (P_3 = P x 0.453 + P_1)
Movements: .... Pivoting β = 32° Time for β = 0.5 min
Movement Frequency: .... Number of pivoting movements f = 1 min^{-1} during 16 hours/day
Customer Request: .... Theoretical service life of L_h 50,000 hours

Radial spherical plain bearings type GE200EW-2RS selected.
Bearing data: Dyn. load rating C= 6,000 kN; ball diameter d_K = 250mm
Factors: Temperature factor f_3 = 1 (temperature from 0 to +150°C)

1. Load ($P = 0.97 \times 26.565^{Fa/Fr} \times F_r$)
Load case 1: P = 0.97 x $26.565^{70/1400}$ x 1400 = 1600 kN ; Load case 2: P_1 = 1600 x 0.32 = 512 kN
Load case 3: P_2 = 1600 x 0.227 + 512 = 875.2 kN ; Load case 4: P_3 = 1600 x 0.453 + 512 = 1236.8 kN

2. Bearing pressure (p = 300 x P / C)
Load case 1: p = 300 x 1600 / 6000 = 80 N/mm² ; Load case 2: p_1 = 300 x 512 / 6000 = 25.6 N/mm²
Load case 3: p_2 = 300 x 875.2 / 6000 = 43.76 N/mm² ; Load case 4: p_3 = 300 x 1236.8 / 6000 = 61.84 N/mm²

3. Glide/wear distance ($s = 1{,}500{,}000 / 1.0219^p$)
Load case 1: s = 1,500,000 / 1.0219^{80} = 265,106 m ; Load case 2: s_1 = 1,500,000 / $1.0219^{25.6}$ = 861,462 m
Load case 3: s = 1,500,000 / $1.0219^{43.76}$ = 581,272 m ; Load case 4: s = 1,500,000 / $1.0219^{61.84}$ = 392,894 m

4. Sliding speed ($v = 2.91 \times 10^{-4} \times d_K \times \beta \times f$)
v = 2.91 x 10^{-4} x 250 x 32 x 1 = 2.328 mm/s

5. Sliding speed factor ($f_1 = 1.61 - [(v \times 1.01^p) / 366.3]$)
Load case 1: f_1 = 1.61 – [(2.328 x 1.01^{80}) / 366.3 = 1.596 ; Load case 2: f_1 = 1.61 – [(2.328 x $1.01^{25.6}$) / 366.3 = 1.602
Load case 3: f_1 = 1.61 – [(2.328 x $1.01^{43.76}$) / 366.3 = 1.60 ; Load case 4: f_1 = 1.61 – [(2.328 x $1.01^{61.84}$) / 366.3 = 1.598

6. Movement factor (f_2 = 0.758 x 1.00618β)
f_2 = 0.758 x 1.00618^{32} = 0.923

7. Theoretical service life ($L = s \times f \times f_1 \times f_3 \times 10 / v \times f_2$; $L_h = L / f \times 60$)
Load case 1: L = 265,106 x 1 x 1.596 x 1 x 10 / (2.328 x 0.923) = 1,969,100 Pivoting movements
Load case 2: L = 861,462 x 1 x 1.602 x 1 x 10 / (2.328 x 0.923) = 6,422,646 Pivoting movements
Load case 3: L = 581,272 x 1 x 1.600 x 1 x 10 / (2.328 x 0.923) = 4,328,274 Pivoting movements
Load case 4: L = 392,894 x 1 x 1.598 x 1 x 10 / (2.328 x 0.923) = 2,921,914 Pivoting movements

$$L_{total} = \frac{100}{\frac{16.6}{1{,}969{,}109} + \frac{50}{6{,}422{,}646} + \frac{16.7}{4{,}328{,}274} + \frac{16.7}{2{,}921{,}914}} = 3{,}877{,}630 \text{ Pivoting movements}$$

$L_h = L_{total} / (f \times 60)$
L_h = 3,877,630 / (1 x 60) = **64,627 hours** **>** 50,000 hours customer request

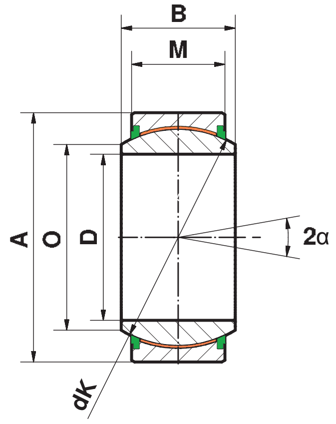
If the calculated service life is not equal to the time requested by the customer, a larger spherical plain bearing must be used for the calculation.

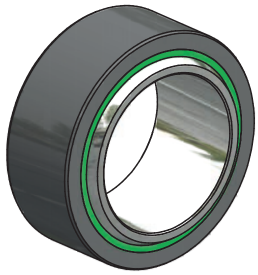
Spherical Plain Bearings Series E

Series GE...EW-2RS

Spherical plain bearings series E, mating surface hard crome/ FLUROGLIDE®, maintenance free

For use with high unidirectionally/variably acting loads





Size (D)	B	M	A	O	dK	Static load ratings C_o kN	Dynamic load ratings C kN	Tilting angle α	Weight g
17 $^{0}_{-0,008}$	14	10	30 $^{0}_{-0,009}$	20,7	25,0	81,2	48,7	10	37
20 $^{0}_{-0,010}$	16	12	35 $^{0}_{-0,011}$	24,1	29,0	112	67,5	9	60
25 $^{0}_{-0,010}$	20	16	42 $^{0}_{-0,011}$	29,3	35,5	212	127	7	110
30 $^{0}_{-0,010}$	22	18	47 $^{0}_{-0,011}$	34,2	40,7	275	165	6	140
35 $^{0}_{-0,012}$	25	20	55 $^{0}_{-0,013}$	39,7	47,0	350	210	6	220
40 $^{0}_{-0,012}$	28	22	62 $^{0}_{-0,013}$	45,0	53,0	462	277	7	300
45 $^{0}_{-0,012}$	32	25	68 $^{0}_{-0,013}$	50,7	60,0	600	360	7	390
50 $^{0}_{-0,012}$	35	28	75 $^{0}_{-0,013}$	55,9	66,0	737	442	6	530
60 $^{0}_{-0,015}$	44	36	90 $^{0}_{-0,015}$	66,8	80,0	1.150	690	6	980
70 $^{0}_{-0,015}$	49	40	105 $^{0}_{-0,015}$	77,8	92,0	1.472	883	6	1.500
80 $^{0}_{-0,015}$	55	45	120 $^{0}_{-0,015}$	89,4	105,0	1.875	1.125	6	2.200
90 $^{0}_{-0,020}$	60	50	130 $^{0}_{-0,018}$	98,1	115,0	2.300	1.380	5	2.700
100 $^{0}_{-0,020}$	70	55	150 $^{0}_{-0,018}$	109,5	130,0	2.860	1.716	7	4.200
110 $^{0}_{-0,020}$	70	55	160 $^{0}_{-0,025}$	121,2	140,0	3.075	1.845	6	4.700
120 $^{0}_{-0,020}$	85	70	180 $^{0}_{-0,025}$	135,5	160,0	4.475	2.685	6	8.100
140 $^{0}_{-0,025}$	90	70	210 $^{0}_{-0,030}$	155,8	180,0	5.025	3.015	7	10.600
160 $^{0}_{-0,025}$	105	80	230 $^{0}_{-0,030}$	170,3	200,0	6.400	3.840	8	13.800
180 $^{0}_{-0,025}$	105	80	260 $^{0}_{-0,035}$	198,9	225,0	7.200	4.320	6	17.400
200 $^{0}_{-0,030}$	130	100	290 $^{0}_{-0,035}$	213,5	250,0	10.000	6.000	7	28.000
220 $^{0}_{-0,030}$	135	100	320 $^{0}_{-0,040}$	239,5	275,0	11.000	6.600	8	35.500
240 $^{0}_{-0,030}$	140	100	340 $^{0}_{-0,040}$	265,3	300,0	12.000	7.200	8	39.000
260 $^{0}_{-0,035}$	150	110	370 $^{0}_{-0,040}$	288,3	325,0	14.250	8.550	7	50.800
280 $^{0}_{-0,035}$	155	120	400 $^{0}_{-0,040}$	313,8	350,0	16.750	10.050	6	64.700
300 $^{0}_{-0,035}$	165	120	430 $^{0}_{-0,045}$	366,7	375,0	18.000	10.800	7	76.600

In spherical plain bearings up to size 120, the hardened shell is split unilaterally due to assembly reasons. Starting with size 140, the spherical plain bearing consists of two hardened shells secured with a clamp and screw.

Materials:

Outer ring: Bearing steel 100Cr6, hardened and phosphated, with FLUROGLIDE® bonded to the inner surface

Inner ring: Bearing steel 100Cr6, hardened, ground, polished, hard chrome plated

On request available in stainless steel

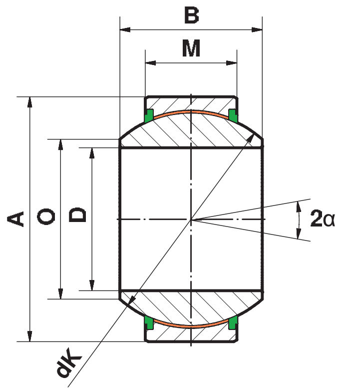
Please note that the numbers pointed off on the pages 17 to 23 and 25 in the data sheets, signalise a thousands place. And the numbers with thousands separators (comma) signalise a decimal point.

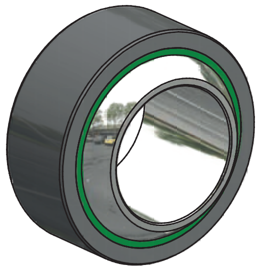
Spherical Plain Bearings Series G

Series GE...GW-2RS

Spherical plain bearings series G
DIN ISO 12240-1,
mating surface, hard chrome/FLUROGLIDE®,
maintenance free

Larger tilting angle due to wider inner ring





Size (D)	B	M	A	O	dK	Static load ratings C_o kN	Dynamic load ratings C kN	Tilting angle α	Weight g
20 $^{0}_{-0,010}$	25	16	42 $^{0}_{-0,011}$	25,2	35,5	182	110	17	153
25 $^{0}_{-0,010}$	28	18	47 $^{0}_{-0,011}$	29,5	40,7	272	162	17	203
30 $^{0}_{-0,010}$	32	20	55 $^{0}_{-0,013}$	34,4	47	350	210	17	280
35 $^{0}_{-0,012}$	35	22	62 $^{0}_{-0,013}$	39,7	53	462	277	16	380
40 $^{0}_{-0,012}$	40	25	68 $^{0}_{-0,013}$	44,7	60	600	360	17	530
45 $^{0}_{-0,012}$	43	28	75 $^{0}_{-0,013}$	50,0	66	737	442	15	670
50 $^{0}_{-0,012}$	56	36	90 $^{0}_{-0,015}$	57,1	80	1.150	690	17	1.400
60 $^{0}_{-0,015}$	63	40	105 $^{0}_{-0,015}$	67,0	92	1.472	883	17	2.100
70 $^{0}_{-0,015}$	70	45	120 $^{0}_{-0,015}$	78,2	105	1.875	1.125	16	3.000
80 $^{0}_{-0,015}$	75	50	130 $^{0}_{-0,018}$	87,1	115	2.300	1.380	14	3.600
90 $^{0}_{-0,020}$	85	55	150 $^{0}_{-0,018}$	98,3	130	2.860	1.716	15	5.300
100 $^{0}_{-0,020}$	85	55	160 $^{0}_{-0,025}$	111,2	140	3.075	1.845	14	6.000
110 $^{0}_{-0,020}$	100	70	180 $^{0}_{-0,025}$	124,8	160	4.475	2.685	12	9.800
120 $^{0}_{-0,020}$	115	70	210 $^{0}_{-0,030}$	138,4	180	5.025	3.015	16	14.600
140 $^{0}_{-0,025}$	130	80	230 $^{0}_{-0,030}$	151,9	200	6.400	3.840	16	18.600
160 $^{0}_{-0,025}$	135	80	260 $^{0}_{-0,035}$	180,0	225	7.200	4.320	16	24.900
180 $^{0}_{-0,025}$	155	100	290 $^{0}_{-0,035}$	196,1	250	10.000	6.000	14	33.600
200 $^{0}_{-0,030}$	165	100	320 $^{0}_{-0,040}$	220,0	275	11.000	6.600	15	44.700
220 $^{0}_{-0,030}$	175	100	340 $^{0}_{-0,040}$	243,6	300	12.000	7.200	16	50.800
240 $^{0}_{-0,030}$	190	110	370 $^{0}_{-0,040}$	263,6	325	14.250	8.550	15	64.000
260 $^{0}_{-0,035}$	205	120	400 $^{0}_{-0,040}$	283,6	350	16.750	10.050	15	81.800
280 $^{0}_{-0,035}$	210	120	430 $^{0}_{-0,045}$	310,6	375	18.000	10.800	15	96.500

In spherical plain bearings up to size 110, the hardened shell is split unilaterally due to assembly reasons. Starting with size 120, the spherical plain bearing consists of two hardened shells secured with a clamp and screw.

Materials:

Outer ring: Bearing steel 100Cr6, hardened and phosphated, with FLUROGLIDE® bonded to the inner surface

Inner ring: Bearing steel 100Cr6, hardened, ground, polished, hard chrome plated

On request available in stainless steel

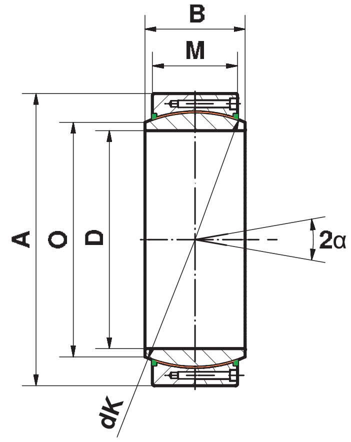
Please note that the numbers pointed off on the pages 17 to 23 and 25 in the data sheets, signalise a thousands place. And the numbers with thousands separators (comma) signalise a decimal point.

Spherical Plain Bearings Series C

Series GE...CW
GE...CW-2RS

Spherical plain bearings series C.
DIN ISO 12240-1, mating surface hard chrome/FLUROGLIDE®, maintenance free

For use with high unidirectionally/variably acting loads



Series GE...CW	Size (D)	B	M	A	O	dK	Static load ratings C_o kN	Dynamic load ratings C kN	Tilting angle α	Weight kg
	320 $^{0}_{-0,040}$	160	135 $^{0}_{-0,90}$	440 $^{0}_{-0,045}$	344,6	380	25.480	15.290	4,0	76,0
	340 $^{0}_{-0,040}$	160	135 $^{0}_{-0,90}$	460 $^{0}_{-0,045}$	366,6	400	26.830	16.095	3,8	80,0
	360 $^{0}_{-0,040}$	160	135 $^{0}_{-0,90}$	480 $^{0}_{-0,045}$	388,3	420	28.170	16.900	3,6	86,0
	380 $^{0}_{-0,040}$	190	160 $^{0}_{-1,0}$	520 $^{0}_{-0,050}$	407,9	450	35.795	21.475	4,1	124,5
	400 $^{0}_{-0,040}$	190	160 $^{0}_{-1,0}$	540 $^{0}_{-0,050}$	429,8	470	37.385	22.430	3,9	131,0

Series GE...CW-2RS	Size (D)	B	M	A	O	dK	Static load ratings C_o kN	Dynamic load ratings C kN	Tilting angle α	Weight kg
	320 $^{0}_{-0,040}$	160	135 $^{0}_{-0,90}$	440 $^{0}_{-0,045}$	344,6	380	21.420	12.850	4,0	76,0
	340 $^{0}_{-0,040}$	160	135 $^{0}_{-0,90}$	460 $^{0}_{-0,045}$	366,6	400	22.550	13.530	3,8	80,0
	360 $^{0}_{-0,040}$	160	135 $^{0}_{-0,90}$	480 $^{0}_{-0,045}$	388,3	420	23.675	14.205	3,6	86,0
	380 $^{0}_{-0,040}$	190	160 $^{0}_{-1,0}$	520 $^{0}_{-0,050}$	407,9	450	30.980	18.590	4,1	124,5
	400 $^{0}_{-0,040}$	190	160 $^{0}_{-1,0}$	540 $^{0}_{-0,050}$	429,8	470	32.370	19.415	3,9	131,0

⚠ Please note: The screw design is dimensioned only for the dynamic load rating C!
In case of higher loads, the outer ring halves must be secured by constructional measures (e.g. clamshell cover).

Materials:

Outer ring: Quenched and tempered steel, with FLUROGLIDE® bonded to the inner surface

Inner ring: Bearing steel 100CrMn6, hardened, ground, polished, hard chrome plated

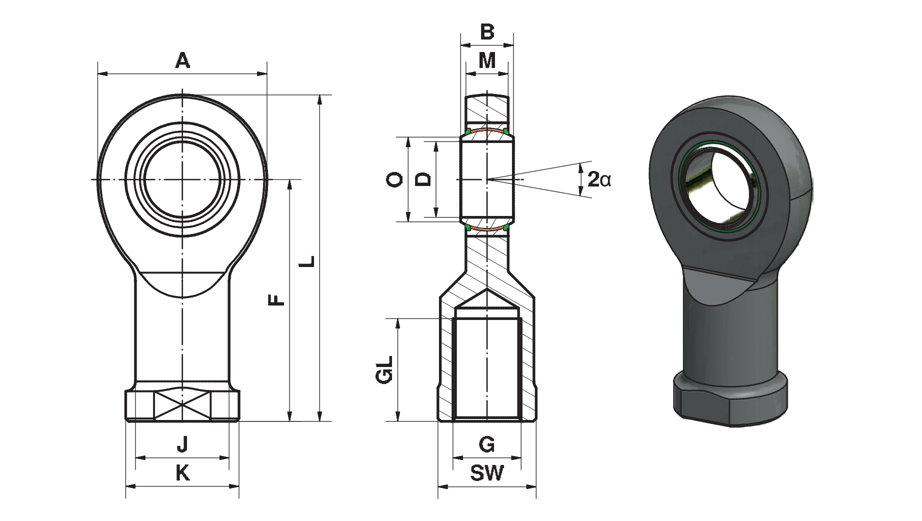
Please note that the numbers pointed off on the pages 17 to 23 and 25 in the data sheets, signalise a thousands place. And the numbers with thousands separators (comma) signalise a decimal point.

Rod Ends Series E

Series EI...EW-2RS

Rod end series E with female thread made of heat-treated steel, galvanized, with EW spherical plain bearing

For use with high, unidirectionally/variably acting loads and low installation width



Size (D)	B	M	A	F	L	K	J	O	SW	G	GL	Static load ratings C_o kN	Dynamic load ratings C kN	Tilting angle α	Weight g
17	14	11	46	67	90,0	30	24,0	20,7	27	M16	33	54,5	48,7	10	220
20	16	13	53	77	103,5	35	27,5	24,2	32	M20x1,5	40	62,5	67,5	9	350
25	20	17	64	94	126,0	42	33,5	29,3	36	M24x2	48	92,0	127,0	7	640
30	22	19	73	110	146,5	50	40,0	34,2	41	M30x2	56	124,0	165,0	6	930
35	25	21	82	125	166,0	58	47,0	39,8	50	M36x3	60	144,0	210,0	6	1.300
40	28	23	92	142	188,0	65	52,0	45,0	55	M39x3	65	178,0	277,0	7	2.000
45	32	27	102	145	196,0	70	58,0	50,8	60	M42x3	65	263,0	360,0	7	2.500
50	35	30	112	160	216,0	75	62,0	56,0	65	M45x3	68	320,0	442,0	6	3.500
60	44	38	135	175	242,5	88	70,0	66,8	75	M52x3	70	497,0	690,0	6	5.550
70	49	42	160	200	280,0	98	80,0	77,9	85	M56x4	80	606,0	885,0	6	8.600
80	55	47	180	230	320,0	110	95,0	89,4	100	M64x4	85	752,0	1.125,0	6	12.000

⚠ Please note: For rod ends with FLUROGLIDE®, the dynamic load rating of the bearing is higher than the static load capacity C_o of the rod end!

Materials:

Housing: Heat-treated steel to C45, forged, galvanized

Bearing: Maintenance free spherical plain bearing with sealing GE...EW-2RS (see page 17)

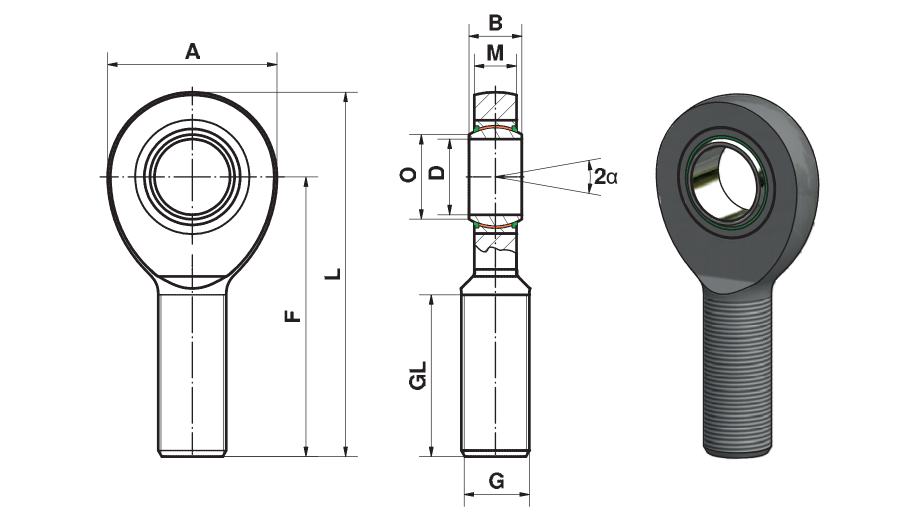
Please note that the numbers pointed off on the pages 17 to 23 and 25 in the data sheets, signalise a thousands place. And the numbers with thousands separators (comma) signalise a decimal point.

Rod Ends Series E

Series EA...EW-2RS

Rod end series E with male thread made of heat-treated steel, galvanized, with EW spherical plain bearing

For use with high, unidirectionally/variably acting loads and low installation width



Size (D)	B	M	A	F	L	O	G	GL	Static load ratings C_o kN	Dynamic load ratings C kN	Tilting angle α	Weight g
17	14	11	46	69	92,0	20,7	M16	36	54,0	48,7	10	190
20	16	13	53	78	104,5	24,1	M20x1,5	43	62,5	67,5	9	320
25	20	17	64	94	126,0	29,3	M24x2	53	92,0	127,0	7	560
30	22	19	73	110	146,5	34,2	M30x2	65	124,0	165,0	6	890
35	25	21	82	140	181,0	39,7	M36x3	82	144,0	210,0	6	1.400
40	28	23	92	150	196,0	45,0	M39x3	86	178,0	277,0	7	1.800
45	32	27	102	163	214,0	50,7	M42x3	94	263,0	360,0	7	2.610
50	35	30	112	185	241,0	55,9	M45x3	107	320,0	442,0	6	3.450
60	44	38	135	210	277,5	66,8	M52x3	115	497,0	690,0	6	5.900
70	49	42	160	235	315,0	77,8	M56x4	125	566,0	885,0	6	8.200
80	55	47	180	270	360,0	89,4	M64x4	140	752,0	1.125,0	6	12.000

⚠ Please note: For rod ends with FLUROGLIDE®, the dynamic load rating of the bearing is higher than the static load capacity C_o of the rod end!

Materials:

Housing: Heat-treated steel to C45, forged, galvanized

Bearing: Maintenance free spherical plain bearing with sealing GE...EW -2RS (see page 17)

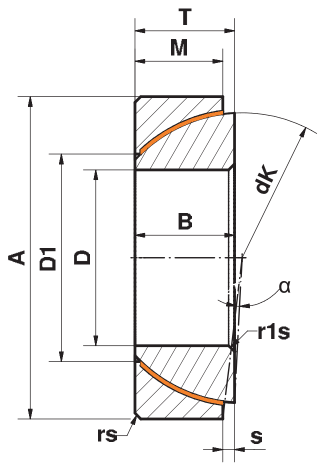
Please note that the numbers pointed off on the pages 17 to 23 and 25 in the data sheets, signalise a thousands place. And the numbers with thousands separators (comma) signalise a decimal point.

Angular Spherical Plain Bearing

Series GE...SWE

Angular spherical plain bearing, mating surface hard chrome/ FLUROGLIDE®, maintenance free

For use with high radial load in combination with axial load



Size (D)	D1	B	M	A	T	S	r_s, r_{1s} min	d_K	Radial load rating kN		Tilting angle $\alpha \approx$	Weight g
									Static C_o	Dynamic C		
25 $^{0}_{-0,012}$	31,8	15	14,0	47 $^{0}_{-0,014}$	15 $^{+0,25}_{-0,40}$	0,6	1,0	42,0	235	141	2,5	148
28 $^{0}_{-0,012}$	35,8	15	15,0	52 $^{0}_{-0,016}$	16 $^{+0,25}_{-0,40}$	1,0	1,0	47,0	287	171	2,0	186
30 $^{0}_{-0,012}$	36,8	17	15,0	55 $^{0}_{-0,016}$	17 $^{+0,25}_{-0,40}$	1,3	1,0	49,5	298	179	4,5	208
35 $^{0}_{-0,012}$	42,7	18	16,0	62 $^{0}_{-0,016}$	18 $^{+0,25}_{-0,40}$	2,1	1,0	55,5	345	207	4,0	268
40 $^{0}_{-0,012}$	47,7	19	17,0	68 $^{0}_{-0,016}$	19 $^{+0,25}_{-0,40}$	2,8	1,0	62,0	424	254	3,5	327
45 $^{0}_{-0,012}$	53,7	20	18,0	75 $^{0}_{-0,016}$	20 $^{+0,25}_{-0,40}$	3,5	1,0	68,5	494	296	3,0	416
50 $^{0}_{-0,012}$	59,7	20	19,0	80 $^{0}_{-0,016}$	20 $^{+0,25}_{-0,40}$	4,3	1,0	74,0	567	340	1,5	455
55 $^{0}_{-0,015}$	62,7	23	20,0	90 $^{0}_{-0,018}$	23 $^{+0,25}_{-0,50}$	5,0	1,0	82,0	681	408	4,0	645
60 $^{0}_{-0,015}$	70,0	23	21,0	95 $^{0}_{-0,018}$	23 $^{+0,25}_{-0,50}$	5,7	1,1	88,5	784	470	2,5	714
65 $^{0}_{-0,015}$	76,6	23	22,0	100 $^{0}_{-0,018}$	23 $^{+0,25}_{-0,50}$	6,5	1,1	93,5	836	502	1,0	759
70 $^{0}_{-0,015}$	82,6	25	23,0	110 $^{0}_{-0,018}$	25 $^{+0,25}_{-0,50}$	7,2	1,1	102,0	972	583	2,0	1.040
80 $^{0}_{-0,015}$	91,6	29	25,5	125 $^{0}_{-0,020}$	29 $^{+0,25}_{-0,50}$	8,6	1,1	115,0	1.184	711	3,5	1.540
90 $^{0}_{-0,020}$	100,9	32	28,0	140 $^{0}_{-0,020}$	32 $^{+0,25}_{-0,60}$	10,1	1,5	128,5	1.490	894	3,5	2.090
100 $^{0}_{-0,020}$	114,6	32	31,0	150 $^{0}_{-0,020}$	32 $^{+0,25}_{-0,60}$	11,6	1,5	141,0	1.848	1.109	0,5	2.340
110 $^{0}_{-0,020}$	126,5	38	34,0	170 $^{0}_{-0,020}$	38 $^{+0,25}_{-0,60}$	13,0	2,0	155,0	1.967	1.180	3,0	3.680
120 $^{0}_{-0,020}$	136,5	38	37,0	180 $^{0}_{-0,025}$	38 $^{+0,25}_{-0,60}$	14,5	2,0	168,0	2.585	1.551	0,5	3.970
130 $^{0}_{-0,020}$	144,0	45	43,0	200 $^{0}_{-0,025}$	45 $^{+0,35}_{-0,70}$	18,0	2,5	188,0	3.412	2.047	1,0	5.920
140 $^{0}_{-0,020}$	161,5	45	43,0	210 $^{0}_{-0,025}$	45 $^{+0,35}_{-0,70}$	19,0	2,5	198,0	3.286	1.972	1,0	6.330
150 $^{0}_{-0,025}$	171,4	48	46,0	225 $^{0}_{-0,030}$	48 $^{+0,35}_{-0,70}$	20,0	3,0	211,0	3.814	2.288	1,0	8.010
160 $^{0}_{-0,025}$	182,4	51	49,0	240 $^{0}_{-0,030}$	51 $^{+0,35}_{-0,70}$	20,0	3,0	225,0	4.524	2.714	1,0	9.790
170 $^{0}_{-0,025}$	194,4	57	55,0	260 $^{0}_{-0,035}$	57 $^{+0,35}_{-0,70}$	21,0	3,0	246,0	5.872	3.523	1,0	12.300
180 $^{0}_{-0,025}$	206,4	64	61,0	280 $^{0}_{-0,035}$	64 $^{+0,35}_{-0,70}$	21,0	3,0	260,0	6.536	3.922	1,0	17.400
190 $^{0}_{-0,030}$	212,5	64	62,0	290 $^{0}_{-0,035}$	64 $^{+0,35}_{-0,80}$	26,0	3,0	275,0	7.352	4.410	0,5	18.200
200 $^{0}_{-0,030}$	229,4	70	66,0	310 $^{0}_{-0,035}$	70 $^{+0,35}_{-0,80}$	26,0	3,0	290,0	7.725	4.635	1,5	23.800

Materials:

Housing disk: Bearing steel 100Cr6, hardened and phosphated, with FLUROGLIDE® bonded to the inner surface

Inner disk: Bearing steel 100Cr6, hardened, ground, polished, hard chrome plated

On request available in stainless steel

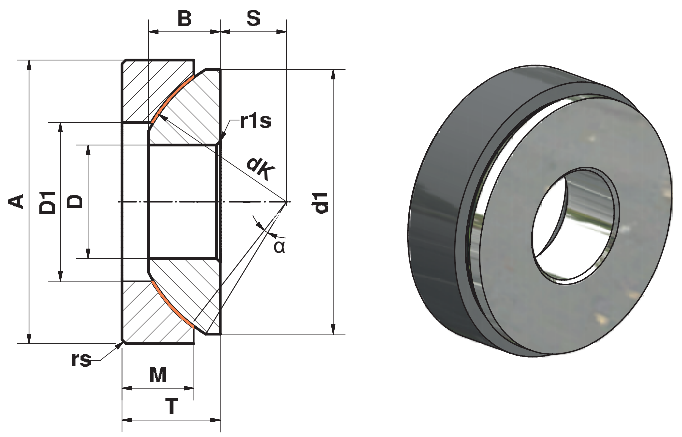
Please note that the numbers pointed off on the pages 17 to 23 and 25 in the data sheets, signalise a thousands place. And the numbers with thousands separators (comma) signalise a decimal point.

Axial Spherical Plain Bearing

Series GE…AWE

Axial spherical plain bearing, mating surface hard chrome/ FLUROGLIDE®, maintenance free

For use with high axial loads



Size (D)	B	M	A	T	S	r_s, r_{1s} min	d_1 min	D1	d_k	Axial load rating kN		Tilting angle α ≈	Weight g
										Static C_o	Dynamic C		
10 $^{0}_{-0,008}$	7,5	7,0	30 $^{0}_{-0,009}$	9,5 $^{+0,25}_{-0,40}$	7,0	0,6	27,5	17,0	32	146	88	5,0	36
12 $^{0}_{-0,008}$	9,5	9,3	35 $^{0}_{-0,011}$	13,0 $^{+0,25}_{-0,40}$	8,0	0,6	32,0	20,0	38	195	117	5,0	72
15 $^{0}_{-0,008}$	11	10,8	42 $^{0}_{-0,011}$	15,0 $^{+0,25}_{-0,40}$	10,0	0,6	39,0	24,5	46	278	167	6,0	108
17 $^{0}_{-0,008}$	11,8	11,2	47 $^{0}_{-0,011}$	16,0 $^{+0,25}_{-0,40}$	11,0	0,6	43,5	28,5	52	350	210	4,0	137
20 $^{0}_{-0,010}$	14,5	13,8	55 $^{0}_{-0,013}$	20,0 $^{+0,25}_{-0,40}$	12,5	1,0	50,0	34,0	60	410	246	5,0	246
25 $^{0}_{-0,010}$	16,5	16,7	62 $^{0}_{-0,013}$	22,5 $^{+0,25}_{-0,40}$	14,0	1,0	58,5	35,0	68	718	431	5,0	415
30 $^{0}_{-0,010}$	19,0	19,0	75 $^{0}_{-0,013}$	26,0 $^{+0,25}_{-0,40}$	17,5	1,0	70,0	44,5	82	920	552	5,0	614
35 $^{0}_{-0,012}$	22,0	20,7	90 $^{0}_{-0,015}$	28,0 $^{+0,25}_{-0,40}$	22,0	1,0	84,0	52,5	98	1.340	804	5,0	973
40 $^{0}_{-0,012}$	27,0	21,5	105 $^{0}_{-0,015}$	32,0 $^{+0,25}_{-0,40}$	24,5	1,0	97,0	59,5	114	1.789	1.073	6,0	1.590
45 $^{0}_{-0,012}$	31,0	25,5	120 $^{0}_{-0,015}$	36,5 $^{+0,25}_{-0,40}$	27,5	1,0	110,0	68,5	128	2.263	1.357	6,0	2.240
50 $^{0}_{-0,012}$	33,0	30,5	130 $^{0}_{-0,018}$	42,5 $^{+0,25}_{-0,40}$	30,0	1,0	120,0	71,0	139	2.836	1.702	6,0	3.140
60 $^{0}_{-0,015}$	37,0	34,0	150 $^{0}_{-0,018}$	45,0 $^{+0,25}_{-0,50}$	35,0	1,0	140,0	86,5	160	3.790	2.274	6,0	4.630
70 $^{0}_{-0,015}$	42,0	36,5	160 $^{0}_{-0,025}$	50,0 $^{+0,25}_{-0,50}$	35,0	1,0	153,0	95,5	176	4.887	2.932	3,0	5.370
80 $^{0}_{-0,015}$	43,5	38,0	180 $^{0}_{-0,025}$	50,0 $^{+0,25}_{-0,50}$	42,5	1,0	172,0	109,0	197	5.908	3.545	4,0	6.910
100 $^{0}_{-0,020}$	51,0	46,0	210 $^{0}_{-0,030}$	59,0 $^{+0,25}_{-0,60}$	45,0	1,1	198,0	134,0	222	7.018	4.210	4,0	11.000
120 $^{0}_{-0,020}$	53,5	50	230 $^{0}_{-0,030}$	64,0 $^{+0,25}_{-0,60}$	52,5	1,1	220,0	155,0	250	8.162	4.897	3,0	14.000
140 $^{0}_{-0,025}$	61,0	54,0	260 $^{0}_{-0,035}$	72,0 $^{+0,35}_{-0,70}$	52,5	1,5	243,0	177,0	274	9.372	5.623	3,0	19.100
160 $^{0}_{-0,025}$	66,0	58,0	290 $^{0}_{-0,035}$	77,0 $^{+0,35}_{-0,70}$	65,0	1,5	271,0	200,0	313	11.680	7.008	2,0	25.000
180 $^{0}_{-0,025}$	74,0	62,0	320 $^{0}_{-0,040}$	86,0 $^{+0,35}_{-0,70}$	67,5	1,5	299,0	225,0	340	12.364	7.418	4,0	32.800
200 $^{0}_{-0,030}$	80,0	66,0	340 $^{0}_{-0,040}$	87,0 $^{+0,35}_{-0,80}$	70,0	1,5	320,0	247,0	365	15.350	9.210	1,0	35.400
220 $^{0}_{-0,030}$	82,0	67,0	370 $^{0}_{-0,040}$	97,0 $^{+0,35}_{-0,80}$	75,0	1,5	350,0	265,5	388	14.119	8.471	7,0	44.700
240 $^{0}_{-0,030}$	87,0	73,0	400 $^{0}_{-0,040}$	103,0 $^{+0,35}_{-0,80}$	77,5	1,5	382,0	294,0	420	17.176	10.305	6,0	56.900
260 $^{0}_{-0,035}$	95,0	80,0	430 $^{0}_{-0,045}$	115,0 $^{+0,35}_{-0,80}$	82,5	1,5	409,0	317,0	449	18.019	10.811	7,0	71.300
280 $^{0}_{-0,035}$	100,0	85,0	460 $^{0}_{-0,045}$	110,0 $^{+0,35}_{-0,80}$	80,0	3,0	445,0	337,0	480	28.561	17.136	4,0	84.700
300 $^{0}_{-0,035}$	100,0	90,0	480 $^{0}_{-0,045}$	110,0 $^{+0,35}_{-0,80}$	80,0	3,0	460,0	356,0	490	28.809	17.285	3,5	88.900

Materials:

Housing disk: Bearing steel 100Cr6, hardened and phosphated, with FLUROGLIDE® bonded to the inner surface

Inner disk: Bearing steel 100Cr6, hardened, ground, polished, hard chrome plated

On request available in stainless steel

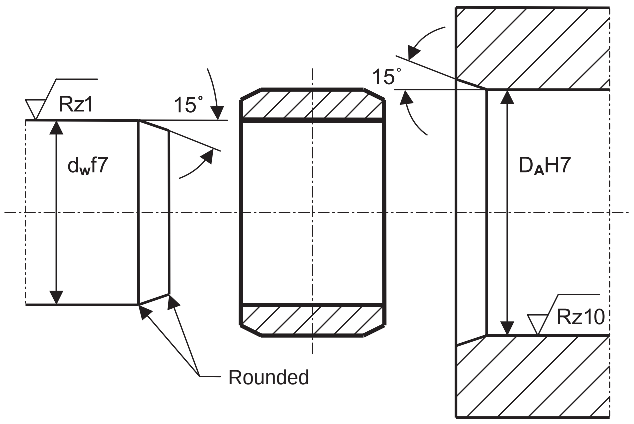
Please note that the numbers pointed off on the pages 17 to 23 and 25 in the data sheets, signalise a thousands place. And the numbers with thousands separators (comma) signalise a decimal point.

Cylindrical Sliding Bushings

According to DIN ISO 4379[1] cylindrical sliding bushings are standardized, ready-to-fit machine parts. They consist of a backing with cylindrical outer and inner surface to support the sliding layer.

They can absorb higher forces than conventional steel, bronze, or plastic slide bearings and are ideal for pivoting movements and high, unidirectional and variable loads.
Used as **axial** guide bearings, they are also superior to the already mentioned slide bearings.

⚠ Please note: The linear stroke of the shaft in the sliding bushing may not exceed **2.5 x dimensions B** or the service life will be significantly reduced.



Series

Sliding bushings are manufactured as GB... X... X... ZW in the range d = 30–200. The unhardened steel backing/outer ring is mechanically machined accordingly and the sliding layer is applied to the bore. The counter mate (shaft/bolt) is missing and is usually provided by the customer.

The counter mate should have a surface hardness of $HR_c \geq 55$ and a roughness of $R_z \leq 1$.

Precision

The main dimensions acc. to DIN ISO 286-2 are toleranced as follows:

Bore diameter d = H8,
Outside diameter D = p7,
Width W = h12.
The shape and position tolerances are within the specifications listed above.

If the sliding bushings GB... x... x... ZW are installed in a housing bore H7 and the shaft/the bolt is manufactured in f7, the resulting operating clearance is in the following ranges (see Table 4):

	d > 30 – 80	d > 80 – 120	d > 120 – 200
Operating clearance =	**0.030 – 0.080**	**0.060 – 0.090**	**0.060 – 0.100**

Table 4: Sliding bushing operating clearance

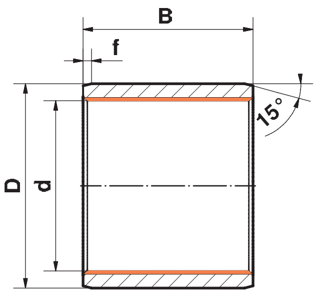
[1] Applies to dimensions d, D and B

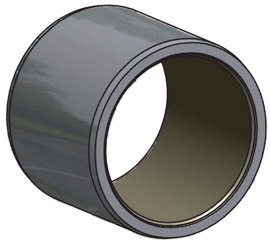
Cylindrical Sliding Bushings

Series GB..x..x..ZW

Cylindrical sliding bushings, DIN ISO 4379

Lined with FLUROGLIDE®





Nominal diameter (d)	Code	Weight g	D (p7)	B	f	Static / Dynamic Load rating kN
30 +0,033/0	GB 30 x 36 x 30 ZW	63	36 +0,051/+0,026	30 0/-0,21	1,5 ±0,5	270
35 +0,039/0	GB 35 x 41 x 30 ZW	72	41 +0,051/+0,026	30 0/-0,21	1,5 ±0,5	315
40 +0,039/0	GB 40 x 48 x 40 ZW	160	48 +0,051/+0,026	40 0/-0,25	2,0 ±0,7	480
45 +0,039/0	GB 45 x 53 x 40 ZW	170	53 +0,062/+0,032	40 0/-0,25	2,0 ±0,7	540
50 +0,039/0	GB 50 x 58 x 50 ZW	240	58 +0,062/+0,032	50 0/-0,25	2,0 ±0,7	750
60 +0,046/0	GB 60 x 70 x 60 ZW	440	70 +0,062/+0,032	60 0/-0,30	2,0 ±0,7	1.080
70 +0,046/0	GB 70 x 80 x 70 ZW	590	80 +0,072/+0,037	70 0/-0,30	3,0 ±1,0	1.470
80 +0,046/0	GB 80 x 90 x 80 ZW	750	90 +0,072/+0,037	80 0/-0,30	3,0 ±1,0	1.920
90 +0,054/0	GB 90 x 105 x 80 ZW	1.360	105 +0,072/+0,037	80 0/-0,30	3,0 ±1,0	2.160
100 +0,054/0	GB 100 x 115 x 100 ZW	1.900	115 +0,072/+0,037	100 0/-0,35	3,0 ±1,0	3.000
110 +0,054/0	GB 110 x 125 x 100 ZW	2.000	125 +0,083/+0,043	100 0/-0,35	4,0 ±1,0	3.300
120 +0,054/0	GB 120 x 135 x 120 ZW	2.600	135 +0,083/+0,043	120 0/-0,35	4,0 ±1,0	4.320
140 +0,063/0	GB 140 x 155 x 150 ZW	3.900	155 +0,083/+0,043	150 0/-0,40	4,0 ±1,0	6.300
160 +0,063/0	GB 160 x 180 x 150 ZW	6.000	180 +0,083/+0,043	150 0/-0,40	4,0 ±1,0	7.200
180 +0,063/0	GB 180 x 200 x 180 ZW	8.000	200 +0,096/+0,050	180 0/-0,40	5,0 ±1,0	9.720
200 +0,072/0	GB 200 x 220 x 180 ZW	8.800	220 +0,096/+0,050	180 0/-0,40	5,0 ±1,0	10.820

Materials:

Bushing: Bearing steel 100Cr6 with FLUROGLIDE® bonded to the inner surface

Bushings sealed on both sides are available upon request

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Specifications Service Life Calculation

Fax +49 (0) 74 28 / 93 85-25

Please fill in

Company: ____________________

Contact: ____________________

Phone: ____________________

Installation site: ____________________

Environmental conditions

Temperature:	Humidity:	Special conditions:

Load

Radial load	Axial load
$F_{r\,max}$	$F_{a\,max}$
$F_{r\,min}$	$F_{a\,min}$
F_r static	

Load direction ☐ unidirectional ☐ pulsating ☐ variable Load frequency ____________ (if known)

Movements

	Pivoting	Tilting	Pivoting + Tilting	Rotating
Angle (°)	β =	α =	β_1 =	β =
Time (min)	tβ =	tα =	$t\beta_1$=	tβ =

Definition: *A pivoting-, tilting-, combination-, or rotating movement comprises* ***2β*** *or* ***2α*** *or* ***2 x 180° = 360***

Movement Frequency

Number "f" of the pivoting-, tilting, or rotating movement per second s^{-1}*, minute* min^{-1} *or hour* h^{-1}
Please also indicate in the field the duration of the frequency of the respective angles in ***h/day, days/weeks*** *and week*

	Pivoting	Tilting	Pivoting + Tilting	Rotating
Frequency	f =	f =	f =	n =
On:				

Are loading and movement collectives to be expected, please also indicate the duty cycle (DC) as a percentage in DC %.

Requirements for the spherical plain bearing service life

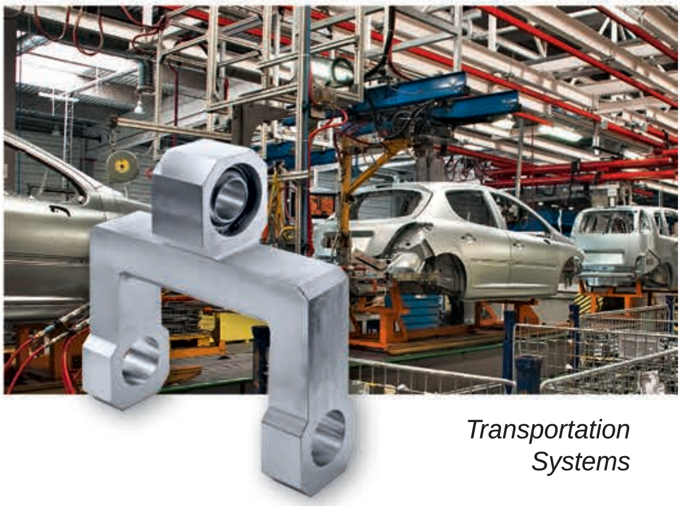
Oscillations/Pivoting Movements	Hours	Days	Years
L_f =	L_h =	L_T =	L_j =

Please add all other available information to the filled in specifications as best as possible.

Additional comments:

Special Applications

Railway vehicles



Transportation Systems

Loading Cranes

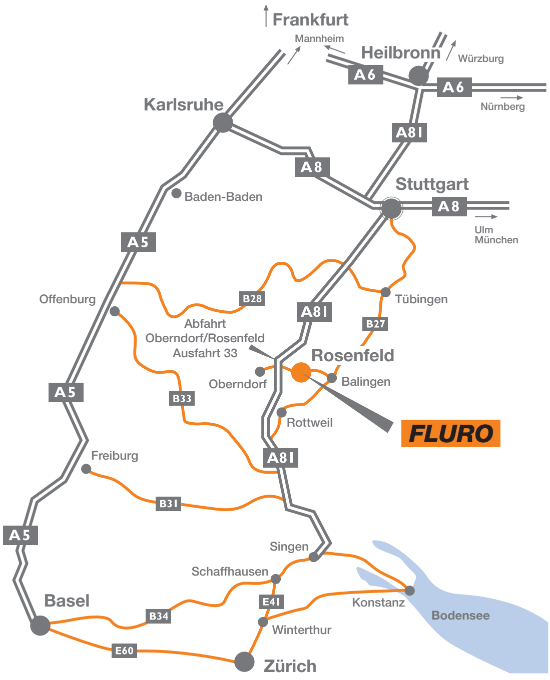
Construction machines

Shear lifting table

Ship building

Rosenfeld is situated between the city of Stuttgart and the lake Bodensee, in southern Germany. You can get to us easily from the international airport of Stuttgart by car. Drive Highway A81 south (towards Singen), exit at Oberndorf and follow the road to Rosenfeld. Our company's plant is situated in the midst of an industrial area on the right hand side behind the town's entrance. We invite you to pay a visit at our manufacturing plant to see our capability.

This is how you can get to us:



FLURO - Gelenklager GmbH
Siemensstrasse 13
D-72348 Rosenfeld
Phone +49 (0) 74 28 93 85-0
Fax +49 (0) 74 28 93 85-25
Internet: www.fluro.de
E-Mail: info@fluro.de

TÜV SÜD ISO 9001