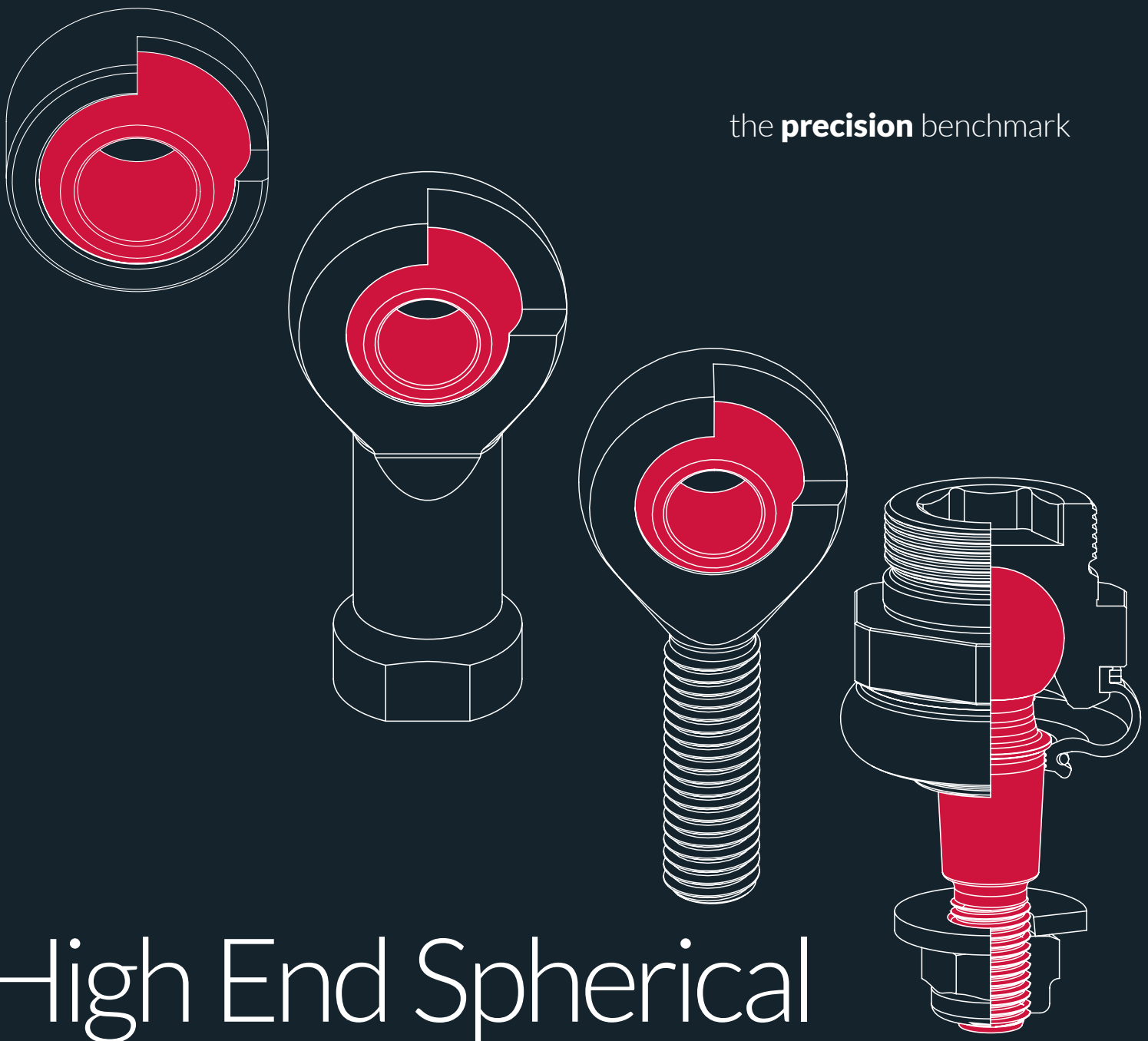
the **precision** benchmark



High End Spherical Bearing Technology

High-performance bearings for the highest demands

CARL HIRSCH MANN

EN 2617

Carl Hirschmann GmbH

Carl Hirschmann – the precision benchmark

We are the leading manufacturer in spherical bearing technology with perfected engineering. Project oriented research and development, testing on our own benches and a high vertical integration - all offered out of one source. Already our standard assortment covers a wide range: maintenance-free bearings, aluminum-titanium lightweight bearings, supporting and sliding ball joints, chassis components, radial and axialbearings. Exactly to your specifications we design and produce individual heavy-duty spherical bearings and rod ends.

A tight cooperation with the customer guarantees perfect results also for complex challenges. We are specialized in lightweight construction even for extreme tensile and compressive loads.

Take benefit of our know-how in automotive and aerospace industry, railed vehicles and other branches. Our spherical bearing technology offers you unbeatable advantages on global market.

Pole position in spherical bearing technology

In light weight construction we are in the pole position since years. Our heavy-duty spherical bearings and rod ends convince with maximum load capacity at minimum weight. With great passion and deep special know-how we develop and produce trend-setting spherical bearing technology for your ambitious requirements. As branch innovator we inspire with high performance competence in solutions and progressive conceptional results.

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Selection

Standard spherical bearings

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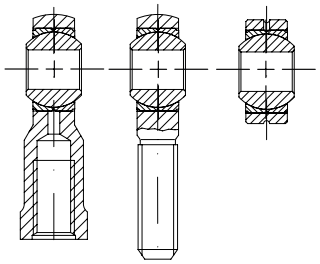
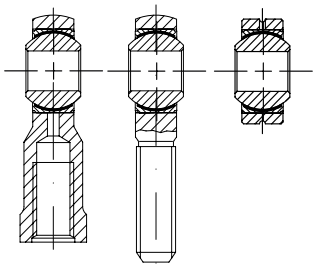
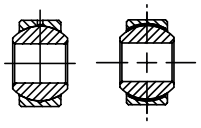
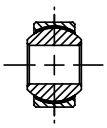
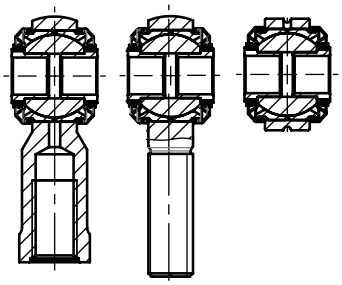
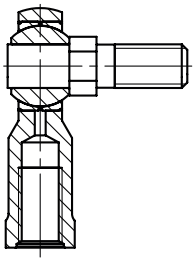
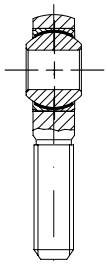
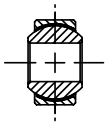
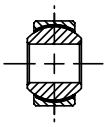
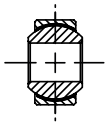
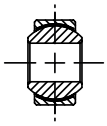
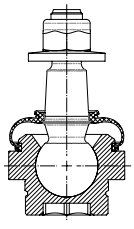
	SFC.. SMC.. SSC..	**Relubricatable Standard rod ends and spherical bearings** Friction pairing: Steel/heavy-duty bronze, with precision-turned bushing having extremely high lining adjustment capability.	Universal application at high alternating and shock loads in radial and axial directions. Suitable for large swings. V_{max} = 60 m/min.	14–15 18
	SFCP.. SMCP.. SSCP..	**Maintenance free standard rod ends and spherical bearings** Friction pairing: Steel/PTFE bronze fabric. The sliding film is affixed inside the bushing. This ensures long service life.	Universal application at high constant loads and low alternating and shock loads in axial and radial directions. For difficult lubrication conditions, high running speeds and large swings. V_{max} = 60 m/min.	16–17 19
	SC.. SCP..	**Relubricatable or maintenance-free high-performance spherical bearings without steel outer ring** Friction pairing: Steel/heavy-duty bronze Steel/PTFE bronze fabric	As for relubricatable or maintenance-free standard rod ends and spherical bearings.	20-21
	SCDZ SCDZ..V	**Maintenance-free high-performance spherical bearings in inch dimensions** Friction pairing: Steel/PTFE-stainl. steel fabric with and without V-groove.	Similar to the maintenance-free high-performance spherical plain bearings.	22
	..2RS	**Sealed rod ends, spherical bearings** Heavy-duty and maintenance-free rod ends and spherical bearings of sizes 8-30 can be supplied with replaceable sealing sleeves.	For use in severe environmental conditions (dirt, dust, splashing water, etc.). Not for automotive.	23
	..W	**Threaded bolts for rod ends and spherical bearings** Heavy-duty and maintenance-free rod ends and spherical bearings of sizes 5–16 and 20 can be supplied ex stock with a down riveted threaded bolt.	Used as angle joints.	24

Selection

Motor sport plain bearings

Construction	Series	Design features	Application features	Page
	SMHP..	**Maintenance-free high-performance rod ends** Slide pairing: Steel/PTFE-stainless steel mesh	For demanding applications, mainly in motorsport. The outer part and the inner ring are made of corrosion resistant material.	28
	SCHP..	**Maintenance-free high-performance spherical plain bearings** Slide pairing: Steel/PTFE-stainless steel mesh	For demanding applications, mainly in motorsport. The outer part and the inner ring are made of corrosion resistant material.	29
	SCHP..V	**Maintenance-free high-performance Spherical plain bearings with V-groove** Slide pairing: Steel/PTFE-stainless steel mesh	Analog series SCHP, but with V-groove for axial securing by rolling in.	29
	SACA..IT	**Maintenance-free high-performance aluminium titanium lightweight bearings** Slide pairing: Titanium/ PTFE-stainless steel mesh	Spherical plain bearings for lightweight applications such as motorsport.	30
	SCHP..IT	**High-performance lightweight bearings** Slide pairing: Titanium/ PTFE-stainless steel mesh	Spherical plain bearings with a unique load-to-weight ratio for highly demanding lightweight applications with high forces to be transmitted.	31

Ball joints

Construction	Series	Design features	Application features	Page
	STCD..	**Performance ball joints** Slide pairing: Steel/PTFE-stainless steel mesh	Ball joints for racing cars, GT road vehicles, special protection vehicles and other demanding applications.	36
	STCD..IX	**High-performance ball joints** High strength ball stud enables increased power transmission in the radial direction.		

Technical notes

Bearing slackness

Bearing slackness or bearing clearance is the dimension by which the inner ring can be moved within the bushings in a radial or axial direction when not installed and unlubricated. Rod ends and spherical bearings are manufactured with differing bearing slackness, as shown in the following charts, depending on the friction pairing and the size of the bearing.

When mounting bearings, please note that the slackness can be reduced to zero if necessary, due to possible differences in tolerance (bearing diameter to housing bore hole).

Recommended **tolerance housing** bore for steel is M7. Other housing materials regarding tolerance on request.

The spherical plain bearing may have to be installed without pre-pressing. Secure with a circlip or adhesive.

The test load is 100 N.

Bearing slackness in lubricated design
(at room temperature)

	Radial slackness in µm					
	C2		Normal		C3	
Size	min	max	min	max	min	max
2– 4	–	–	10	30	–	–
5– 8	5	10	10	30	30	60
10–14	10	20	20	40	40	80
16–20	15	25	30	50	50	100
22–30	20	30	40	60	60	120
35–50	40	60	60	90	90	150

Fig. 1

Bearing slackness in maintenance-free design
(at room temperature)

	Radial slackness in µm Normal		C3	
Size	min	max	min	max
2– 4	2	4	–	–
5–30	5	10	10	20
35–50	10	20	20	40

Fig. 2

The axial slackness is 2 to 3 times the radial slackness under the same test load (measured at room temperature).

Selection of bearing slackness: Lubricated design

If there are no special reasons for a reduced bearing slackness according to C2, the "normal" radial slacckness must be selected as it offers the best lubricating grease distribution with a high bearing contact area.
All rod ends and spherical bearings are supplied with "normal" radial slackness unless otherwise ordered.

Maintenance-free design

These bearings are remarkable for their low bearing slackness and a high contact area ratio. Unless otherwise ordered, the maintenance-free rod ends are supplied with "normal" radial slackness.
If the overall friction movement should be kept low when several rod ends or spherical bearings are used, bearings with a radial slackness in accordance with C3 should be used also.

Consideration of the environment

It is recommendable to apply a stainless or sealed type when using it in a humid environment.
Accordingly to the individual customer's requirements, the bearings are delivered in the following special designs:

- stainless and acid-proof
- high temperature-proof
- low temperature-proof etc.

Lubrication

All relubricatable rod ends and bearings are supplied ungreased. We recommend lubrication with an anticorrosive Lithium-based pressure-resistant grease or a Lithium-complex metal soap (multipurpose antifriction bearing grease) for the temperature range of –20° C to +125° C. For temperatures above 125° C a high temperature grease must be used and for temperatures below –20° C a low temperature grease must be used.

Initial lubrication and relubrication, lubrication intervals

Under severe conditions and at high load, a temperature check is recommended shortly after commissioning. If a temperature rise of 25° C occurs after a running-in time of approx. 1 hour of operation, immediate lubrication is necessary. A periodical relubrication is necessary in any event. Rod ends and spherical bearings under alternate load from both sides require shorter intervals between lubrication than rod ends and spherical bearings under load from one side only. The lubrication intervals depend on the individual circumstances and on the surrounding conditions.

The following guideline values apply for the minimum lubricating periods:

With load from one direction $t = \frac{G_h}{30}$

With load from alternating directions $t = \frac{G_h}{130}$

t = lubricating period in hours of operation

G_h = duration of use in hours of operation
(see page 9)

Lubricating more often does not have any advantages, furthermore it can damage the hydrodynamic balance on the sliding surface.

If the lubricating periods are not observed, the service life can decrease.

The rod ends with female thread are equipped from size 5 upwards with funnel-type lubricating nipples to DIN 3405, those with thread from size 6 upwards. We can supply other lubricating nipples on request.

During the running-in time of the maintenance-free types only a small part of the PTFE is transferred from the sliding foil to the inner ring. Hereby a smoothing effect arises. This reduces the friction and leads to the longer durability. A greasy or oily film prevents this smoothing effect. Thus, we recommend using these elements without lubrication.

Technical notes

Operating temperature

All designs can be used without restriction in a temperature range from –30° C to +120° C. Increasing the operating temperature reduces the bearing power and thus the service life.
Operation at high temperature of relubricatable rod ends and spherical bearings depends to a very great extent on whether the high-temperature lubricating grease used offers sufficient lubricity at high operating temperatures. These designs could be used in the short term under low load and with suitable lubrication at temperatures up to +250° C.

The maintenance-free bearings can be used in a temperature range from –50° C to +150° C (mind the decrease or the increase of bearing slackness).

Sealed rod ends and spherical bearings can be used at temperatures from –20° C to +120° C (sealing sleeves of Perbunan). For higher temperatures up to +250° C sealing sleeves can be specially made from fluorelastomer rubber (FKM).

Moment of friction M

The moment of friction for rod ends and spherical bearings can be calculated using the following equation:

$$M = 5 \cdot 10^{-4} \cdot \mu \cdot P \cdot K$$

M = moment of friction [Nm]
μ = friction coefficient of sliding surface
P = dynamically equivalent bearing load [N]
K = inner ring diameter [mm]

Guideline values for the friction coefficient μ

	Friction coefficient μm	
Bearing type	min	max
lubricated	0,08	0,15
maintenance-free	0,03	0,10

Fig. 3

The low friction coefficients apply for high loads ($p = 80–100\ N/mm^2$) at low running speeds ($v = 5–10\ m/min$). The high friction coefficients are for low loads ($p = 5–10\ N/mm^2$) at high running speeds ($v = 30–60\ m/min$).

p = specific surface pressure [N/mm²]
v = running speed in the lining [m/min]

Bearing capacities

The dynamic bearing capacity C:

The dynamic bearing capacity C is a characteristic value for the calculation of the service life of rod ends and spherical bearings under dynamic load, i.e. having to perform tilting, swinging or pivoting movements under load.

The dynamic bearing capacity C is based on the values given in the table for the specific surface pressure k_c:

Type of bearing	Specific surface pressure k_c [N/mm²]
lubricated	50
maintenance-free	150

Fig. 4

The static bearing capacity C_o

The static bearing capacity C_o represents the maximum permissible load at which no permanent deformation of the lining or the outer part occurs. In the case of the spherical bearing, the surrounding components must be so designed that they prevent any deformation of the bearing.
In the case of rod ends, C_o corresponds to the permissible load based on the weakest cross-section which results from the yield point of the outer material, **with a safety factor of 1,2.**
The ultimate load is at least 1.5 the permissible C_o load.

The axial load-bearing capacity

The axial load-bearing capacity of rod ends and spherical bearings is limited by the axial fixing of the bushing (flanged) in the outer part.
In the case of spherical bearings without steel outer ring (types SC.. and SCP..), it must be ensured that the axial bushing support can absorb the forces given in the table (Fig. 5) both statically and dynamically.

The maximum permissible axial load is calculated on the basis of the values given in the table.

Heavy-duty and maintenance-free series	Permissible axial load dynamic $F_{a\,perm.}$ [N]	static $F_{a\,perm.}$ [N]
SFC/SMC/SSC.. SFRC/SMRC/SSRC..	$0,06 \cdot C_o$	$0,3 \cdot C_o$
SFXC/SMXC/SC..	$0,04 \cdot C_o$	$0,2 \cdot C_o$

Fig. 5

Checking bearing size

To check a bearing size with regard to its static and dynamic load-bearing capacity, the bearing must be investigated to the following criteria:

- Constant dynamic load
- Variable dynamic load
- Static load

The equivalent bearing loads are calculated from F_r and F_a.

Dynamic load

The inner ring carries out a swinging or pivoting movement in relation to the bushing.

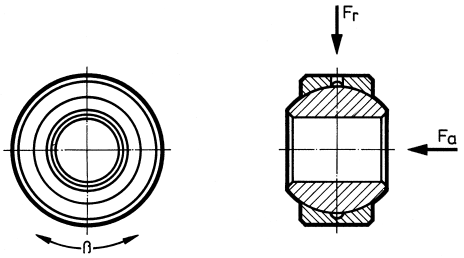


Fig. 6

Constant dynamic load

The dynamically equivalent bearing load P for rod ends and spherical bearings with constant dynamic loads is calculated as follows:

$$P = F_r + Y \cdot F_a \quad [N]$$

It is necessary that: $F_a \leq F_{a,perm}$
$F_{a,perm}$ as per table (Fig.. 5)

The axial factor Y is taken from the following table (Fig. 7). Intermediate values can be interpolated linearly.

Load relation $\frac{F_a}{F_r}$	0,1	0,2	0,3	0,4	0,5	> 0,5
Axial factor Y	0,8	1	1,5	2,5	3	not suitable

Fig. 7

Using the calculated value for P, the load ratio $f_c = \frac{C}{P}$ is formed and compared with the values in the table (Fig. 8). The bearing is overloaded if a value below the limit value is obtained.

P is also required for calculation of the service life.

Type of bearing	$f_c = \frac{C}{P}$ (lower limit)
lubricated	0,5
maintenance-free	1,0

Fig. 8

Variable dynamic load

For rod ends and spherical bearings with variable radial dynamic load, the mean dymanic bearing load F_m from the individual load steps $F_1, F_2 \ldots F_n$ and the corresponding time components $q_1, q_2 \ldots q_n$, for instance for three load steps, are calculated as follows: (Fig. 9)

$$F_m = \sqrt{\frac{F_1^2 \cdot q_1 + F_2^2 \cdot q_2 + F_3^2 \cdot q_3}{Q}} \quad [N]$$

The dynamic bearing load is: $P = F_m$ [N]

If there is also a constant axial load acting, P is calculated as follows:

$$P = F_m + Y \cdot F_a \quad [N]$$

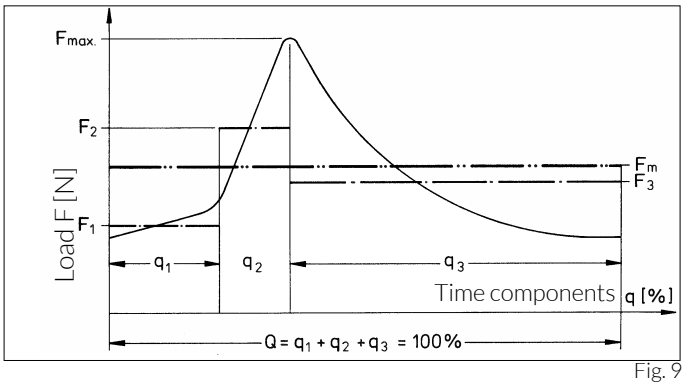


Fig. 9

In addition F_{max} must be checked for static safety.

$$F_{max} \leq P_{perm.} \quad [N]$$

For $P_{perm.}$ see "Permissible load".

Static load

The inner ring is stationary in relation to the bushing.

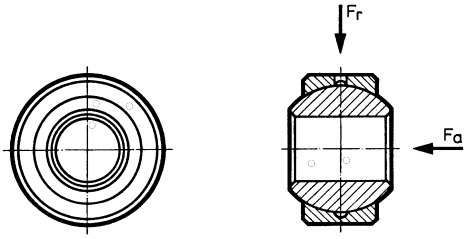


Fig. 10

For rod ends and spherical bearings with static load, the statically equivalent bearing load P_o is calculated as follows:

$$P_o = F_r + Y \cdot F_a \quad [N]$$

$$F_a \leq F_{a\,pem.} \quad [N]$$

It is necessary that:
$F_{a,perm.}$ as per table (Fig. 5)
The axial factor Y is taken from the table (Fig. 7).

P_o must be $\leq P_{perm.}$. See "Permissible load $P_{perm.}$".

Permissible load $P_{perm.}$:

Rod ends:

$$P_{perm.} = C_o \cdot b_2 \cdot b_4$$

Spherical bearings:

$$P_{perm.} = C_o \cdot b_2$$

$P_{perm.}$ = permissible load [N]
C_o = static bearing capacity [N]
b_2 = temperature factor from table (Fig. 12)
b_4 = load factor from table (Fig. 11)

Checking bearing size

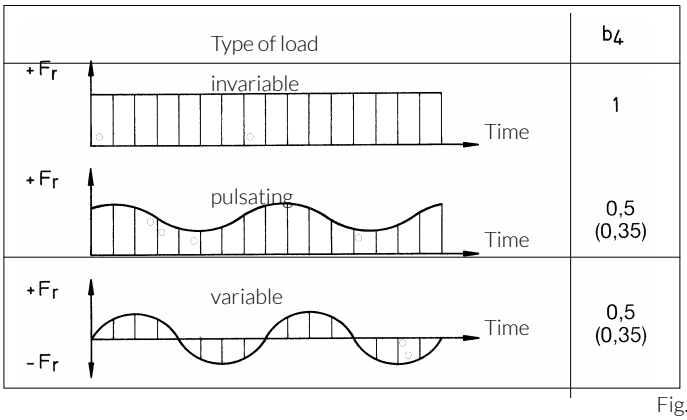


Fig. 11

The values written in brackets are valid for rod ends with male threads and lubricating nipples or lubrication holes.

It is necessary that: $P \leqq P_{perm.}$ $P_o \leqq P_{perm.}$

Attention

The load factors b4 shown in Fig. 11 for determining the permissible load P_{perm} for rod ends are empirical values for common applications.

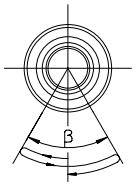
If the outer parts of the rod ends are designed for fatigue strength, please contact us; practical tests may be necessary.

Service life

The service life of a rod end or spherical bearing is a function of several factors, some of which are difficult to determine. A precise calculation is therefore not possible. The calculation method following, which has been proved correct in many test stand trials, gives a relatively accurate result for the service life. Influences as shocks, vibrations, soiling etc. are not taken into consideration. This calculation is based on a total abrasion of the linings of 0.3% of the diameter of the inner ring. The coefficient of the sliding friction of the linings increases of about 0.25.

$$G_h = \frac{b_1 \cdot b_2 \cdot b_3}{k \cdot \beta \cdot f} \cdot 10^7 \cdot \frac{C}{P}$$

G_h = service life [h]
C = dynamic bearing capacity [N]
P = dynamic equivalent bearing load [N]
K = inner ring diameter [mm]
β = swing angle $\geqq 1$ [degrees]
(by pivoting movements $\beta = 180°$)



f = swing frequency [min^{-1}]
b_1 = load direction factor (Fig.12)
b_2 = temperature factor (Fig.12)
b_3 = material factor (Fig.13)

Operating factors	Load direction factor b_1		Temperature factor b_2				
	Load direction		Temperature [° C]				
Bearing type	single direction	alternat. direction	80	100	150	200	250
lubricated	1	2,5	1	1	1	0,8	0,5
maintenance-free	1	0,3	1	1	0,8	0,5	0,3

Fig. 12

Very low loads or running speeds result in a relatively high arithmetic service life. In practice, with a longer service life, environmental influences can acquire importance and lead to an error in the results.

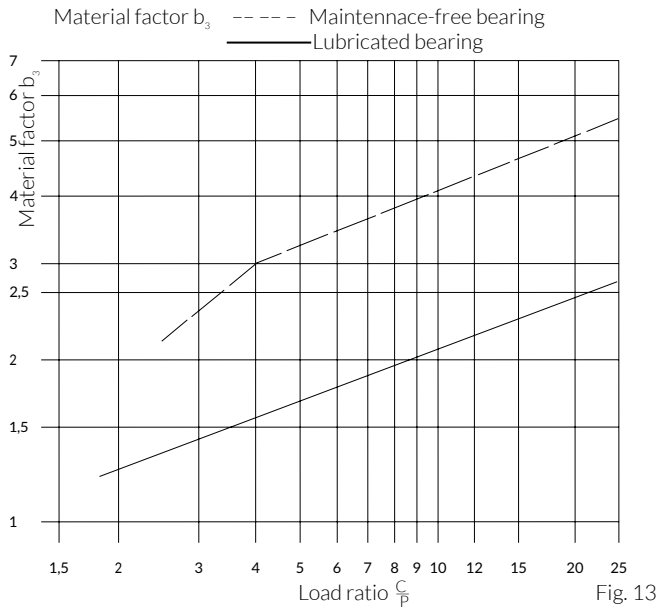


Fig. 13

If the required service life is not obtained, repeat this calculation with next bearing size up.

Checking of linings for overheating
Permissible running speed

The permissible running speed is largely a function of the surface exerted, the friction pairing, the lubrication and cooling if applicable. The heat building up in the bearing is proportional to the product of surface pressure and running speed. When checking the bearing size, therefore the p · v value must be determined and compared with the permissible value (Fig. 14). The bearing running speed must also be checked.

To avoid overheating, the following is necessary:

$p \cdot v \leqq (p \cdot v)_{perm.}$ $\left[\frac{N}{mm^2} \cdot \frac{m}{min.}\right]$

[m/min]

$v \leqq v_{perm.}$

p = surface pressure = $kc \cdot \frac{P}{C}$ [N/mm^2]
kc = specific surface pressure (Fig. 4) [N/mm^2]
v = mean running speed = $1{,}745 \cdot 10^{-5} \cdot K \cdot \beta \cdot f$ [m/min]

Guideline values for the permissible p · v- value

Bearing type	$(p \cdot v)_{perm.}$ $\frac{N}{mm^2} \cdot \frac{m}{min.}$	Perm. running speed $v_{perm.}$ [m/min]	
		swing	pivot
lubricated	30	15	60
maintenance-free	80	60	

Fig.14

Determining bearing size

Lubricated design

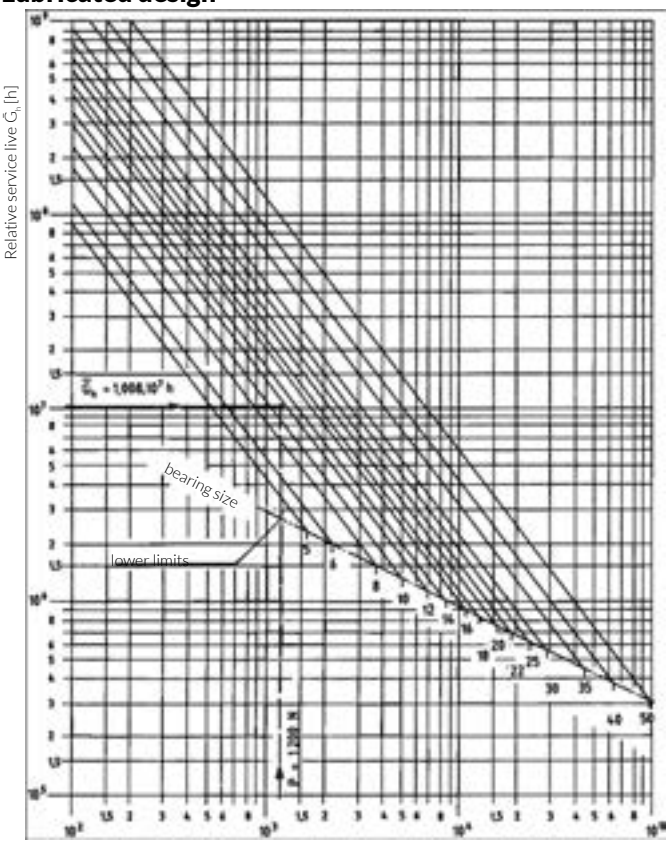


Fig. 15

Maintenance-free design

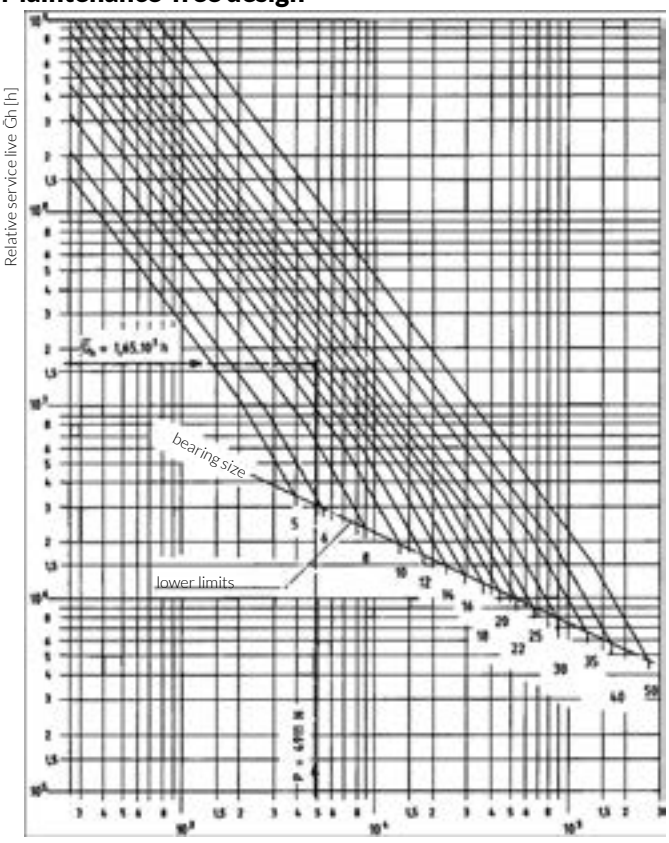


Fig. 16

The insertion of the relative service life $\bar{G}_h$ as auxiliary quantity enables a correlation between the relative service life and the dynamically equivalent bearing load to be represented graphically.

The following equation applies for the relative service life:

$$\bar{G}_h = G_h \cdot \frac{\beta \cdot f}{b_1 \cdot b_2}$$

$\bar{G}_h$ = relative service life	[h]
G_h = required service life	[h]
β = swing angle	[degrees]
f = swing frequency	[min^{-1}]
b_1 = load direction factor (Fig. 12)	
b_2 = temperature factor (Fig. 12)	

Example

A rod end with male thread is required for the following operating conditions:

Alternating dynamic load F_r	1200 N
Swing angle β	30°
Swing frequency f	120 min^{-1}
Operating temperature	50° C
Required service life G_h	7000 h

Since the load is alternating, a lubricated design is recommended, as set forth in the “Selection” section (page 5). Thus, Fig. 12 gives $b_1 = 2.5$ and $b_2 = 1$.

Dynamically equivalent bearing load:

$P = F_r = 1200$ N

Relative service life:

$$\bar{G}_h = G_h \cdot \frac{\beta \cdot f}{b_1 \cdot b_2} = 7000 \cdot \frac{30 \cdot 120}{2{,}5 \cdot 1} = 10{,}08 \cdot 10^6 \text{ h}$$

The intersection in Fig. 15 with P = 1200 N and $\bar{G}_h = 10{,}08 \cdot 10^6$ h results in the bearing size 12. Thus, SMC 12 is chosen.

Checking the rod end SMC 12 with regard to the permissible load P_{perm}. and the service life $\bar{G}_h$, and checking the lining for overheating and determination of the lubricating intervals is conducted as shown in Example 1, page 11.

The example given in Fig. 16 is the result of the 2nd calculation example on page 11.

Calculation examples

Example 1

The conveying lever on a packaging machine is to be moved via a rod end. The designs calls for a size 12 rod end.
Values dictated by design:

Alternating constant dynamic radial load F_r	1200 N
Swing angle ß	30°
Swing frequency f	120 min^{-1}
Operating temperature	50° C

Since the load is alternating and constant, a lubricated design is recommended according to the section "Selection" (page 5), e.g. SMC 12.

Catalogue values:

Dynamic bearing capacity C	13400 N
Static bearing capacity C_o	17000 N
Inner ring Ø K	22,225 mm

Requirements on rod end SMC 12:

1. Radial load F_r must be smaller than the permissible load P_{perm}. to avoid permanent deformation.
2. The service life $G_{h, req.}$ should be at least 6000 operating hours.

Calculation:

Dynamically equivalent bearing load P:

$$P = F_r + Y \cdot F_a \quad \left| \frac{F_a}{F_r} = \frac{0}{1200} = 0 \right| Y = 0$$

$$P = F_r = 1200\ N$$

Permissible rod end load $P_{perm.}$:

$$P_{perm.} = C_o \cdot b_2 \cdot b_4 \quad \left| \begin{array}{l} b_2 = 1 \text{ (acc. to Fig. 12)} \\ b_4 = 0{,}35 \text{ (acc. to Fig. 11)} \end{array} \right.$$

$$P_{perm.} = 17000 \cdot 1 \cdot 0{,}35 = 5950\ N$$

$P = 1200\ N < P_{perm.} = 5950\ N$ **(1st requirement met)**

Determination of service life G_h:

$$G_h = \frac{b_1 \cdot b_2 \cdot b_3}{K \cdot ß \cdot f} \cdot 10^7 \cdot \frac{C}{P}\ [h]$$

$b_1 = 2{,}5$ (Fig. 12)
$b_2 = 1$ (Fig. 12)
$b_3 = 2{,}1$ (Fig. 13) $\left| \frac{C}{P} = \frac{13400}{1200} = 11{,}1 \right.$

$G_h = 7200\ h > G_{h,req.} = 7000\ h$ **(2nd requirement met)**

Checking of lining for overheating:

$$p = k_c \cdot \frac{P}{C}\ [N/mm^2]$$

$k_c = 50\ N/mm^2$ (acc. to Fig. 4)

$$\frac{P}{C} = \frac{1200}{13400} = \frac{1}{11{,}1} = 0{,}089$$

$p = 50 \cdot 0{,}089\ N/mm^2 = 4{,}45\ N/mm^2$
$v = 1{,}745 \cdot 10^{-5} \cdot K \cdot ß \cdot f = 1{,}745 \cdot 10^{-5} \cdot 22{,}225 \cdot 30 \cdot 120\ m/min$
$v = 1{,}4\ m/min < v_{perm.} = 15\ m/min$ (acc. to Fig. 14)
$p \cdot v = 4{,}45 \cdot 1{,}4 = 6{,}23 < (p \cdot v)_{perm.} = 30$ (Fig. 14)

No overheat

Lubrication interval:

$$t = \frac{G_h}{130} = \frac{7200}{130} = 55\ h$$

Example 2

A lever of a filling machine is moved via a double-action pneumatic cylinder. A maintenance-free rod end with mounting dimensions to CETOP is required.
Values dictated by design:

Variable, pulsating, radial, dynamic load

$F_1 = 2000\ N$, $F_2 = 6000\ N$, $F_3 = 3000\ N$, $F_{max} = 8000\ N$
$q_1 = 20\%$, $q_2 = 15\%$, $q_3 = 65\%$

Constant axial load Fa	1000 N
Swing angle ß	25°
Swing frequency f	60 min^{-1}
Operating temperature	max. 80° C

Requirements on rod end:

1. The dynamically equivalent bearing load P and the statically equivalent bearing load P_o must be lower than the permissible load $P_{perm.}$
2. The service life $G_{h, req.}$ must be at least 11000 operating hours.

Calculation:

Mean dynamic bearing load F_m:

$$F_m = \sqrt{\frac{F_1^2 \cdot q_1 + F_2^2 \cdot q_2 + F_3^2 \cdot q_3}{Q}}$$

$$F_m = \sqrt{\frac{2000^2 \cdot 20 + 6000^2 \cdot 15 + 3000^2 \cdot 65}{100}} = 3471\ N$$

Dynamically equivalent bearing load P:

$$P = F_m + Y \cdot F_a \quad \left| \frac{Fa}{Fm} = \frac{1000}{3471} = 0{,}28 \right.$$
Y = 1,44 (interpolated acc. to Fig. 7)

$$P = 3471 + 1{,}44 \cdot 1000 = 4911\ N$$

Determination of relative service life $\bar{G}_h$:

$$\bar{G}_h = G_h \cdot \frac{ß \cdot f}{b1 \cdot b2} \quad \left| ß = 25 \right. \quad \left| \begin{array}{l} b_1 = 1 \text{ (Fig. 12)} \\ b_2 = 1 \text{ (Fig. 12)} \end{array} \right.$$

$$\bar{G}_h = 11000 \cdot \frac{25 \cdot 60}{1 \cdot 1} = 16{,}5 \cdot 10^6\ h$$

On the basis of the chart (Fig. 16) the rod end size calculated is 16. SFCP 16, CETOP is selected (page 17).

Dynamic bearing capacity C	60000 N
Static bearing capacity C_o	28500 N
Inner ring Ø K	28,575 mm

Limit value $f_c = \frac{C}{P} = \frac{60000}{4911} = 12{,}2$ (correct acc. to Fig. 8)

Permissible road end load $P_{perm.}$:

$P_{zul.} = C_o \cdot b_2 \cdot b_4$ | $b_2 = 1$ (Fig. 12) | $b_4 = 0{,}5$ (Fig. 11)
$P_{zul.} = 28\,500 \cdot 1 \cdot 0{,}5 = 14\,250\ N$
$P_o = F_{max} = 8000\ N < P_{perm.}$
$P = 4911\ N < P_{perm.}$ **(1st requirement met)**

Determination of service line G_h:

$$G_h = \frac{b_1 \cdot b_2 \cdot b_3}{K \cdot ß \cdot f} \cdot 10^7 \cdot \frac{C}{P} \quad \left| b_3 = 4{,}2, \text{ for } \frac{C}{P} = 12{,}2 \text{ (Fig. 13)} \right.$$

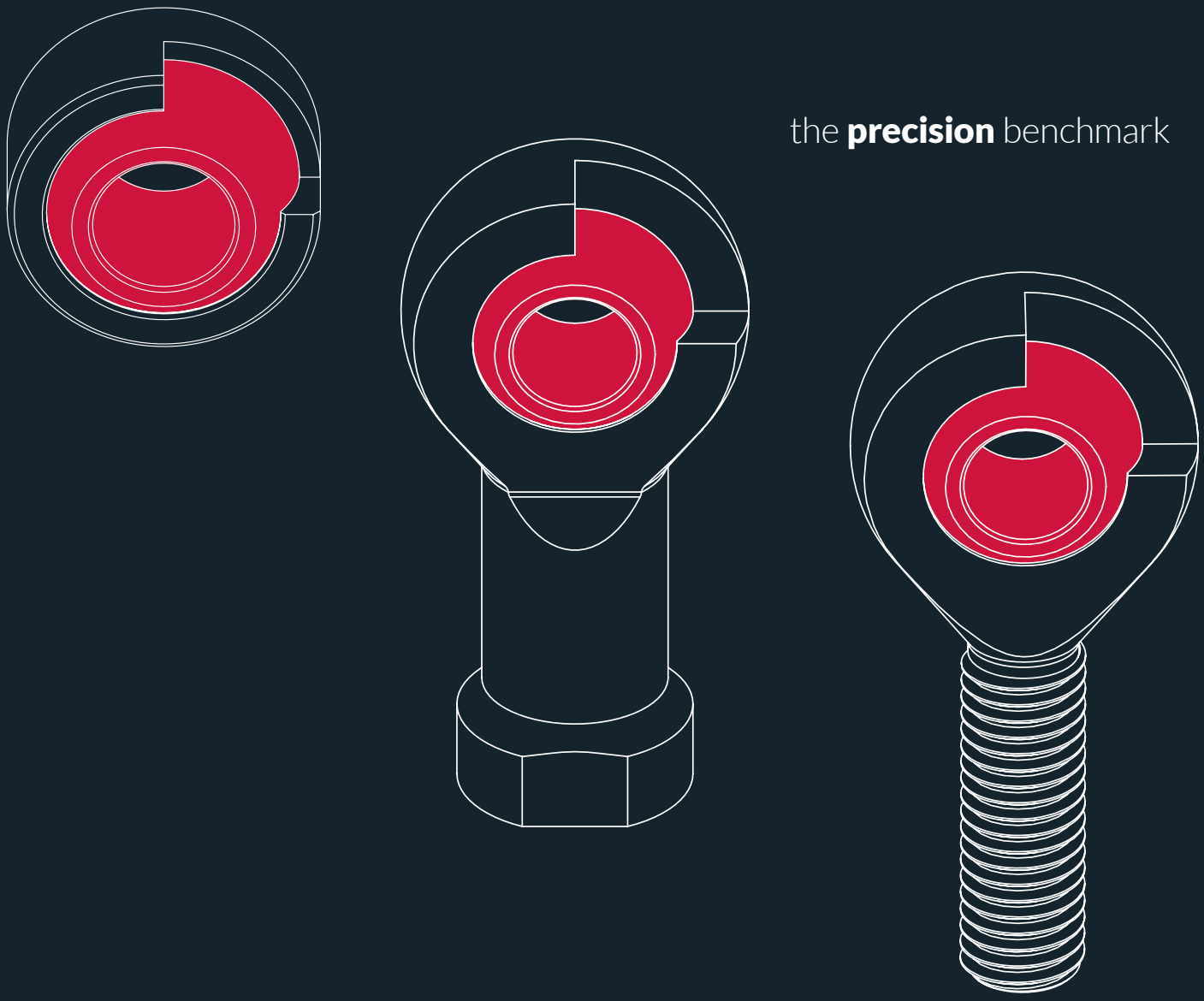
$$G_h = \frac{1 \cdot 1 \cdot 4}{28{,}575 \cdot 25 \cdot 60} \cdot 10^7 \cdot 12{,}2 = 11900\ h$$

$G_{h, req.} = 11000\ h < G_h = 11900\ h$ **(2nd requirement met)**

Overview

Standard solutions

Special solutions



the **precision** benchmark

Standard Rod Ends and Spherical Bearings

DIN ISO 12240-4/12240-1

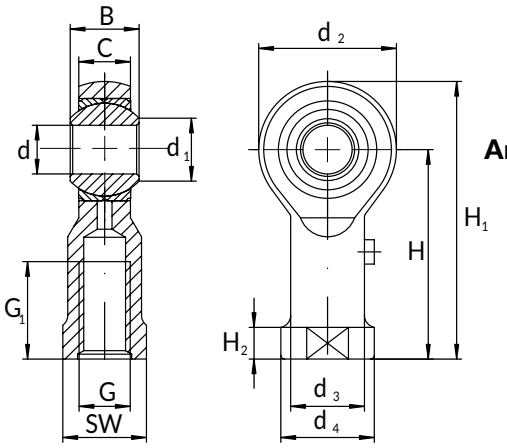
CARL HIRSCH MANN

Relubricatable standard rod ends with female thread

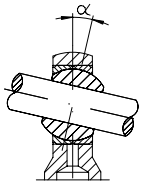
Friction pairing steel on heavy-duty bronze

Series **SFC..**

SFXC.. (high-strength outer part)
SFRC.. (corrosion-resistant outer part)



Angle of misalignment (AOM)



Series	d	B	C	d_1	d_2	d_3	d_4	H	H_1	H_2	G_1	K	G	SW	Bearing capacities dynamic C	Bearing capacities static C_o* SFC/SFRC	Bearing capacities static C_o* SFXC	AOM	Weight each
												Ball ø	Thread						
SFC..	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	N	N	N	α°	≈g
2	2	4,8	3,6	3,6	9	3,8	4,5	16	20,5	2,5	5,5	6,000	M2	4	900	1900	--	16	3
3	3	6	4,5	5,2	12	5	6,5	21	27	3	7	7,937	M3	5,5	1 500	3600/2200	--	15	7
4	4	7	5,25	6,5	14	6,5	8,5	24	31	3,5	9,5	9,520	M4	7	2 260	4500/2700	--	14	11
5	5	8	6	7,7	18	9	11	27	36	4	10	11,112	M5	9	3 250	6 000	15 000	13	19
6	6	9	6,75	9,0	20	10	13	30	40	5	12	12,700	M6	11	4 300	7 000	16 500	13	27
8	8	12	9	10,4	24	12,5	16	36	48	5	16	15,875	M8	14	7 200	12 000	26 000	13	49
10	10	14	10,5	12,9	28	15	19	43	57	6,5	20	19,050	M10	17	10 000	14 500	35 500	13	78
12	12	16	12	15,4	32	17,5	22	50	66	6,5	22	22,225	M12	19	13 400	17 000	43 000	13	120
14	14	19	13,5	16,9	36	20	25	57	75	8	25	25,400	M14	22	17 000	24 000	51 500	15	170
16	16	21	15	19,4	42	22	27	64	85	8	28	28,575	M16	22	21 600	28 500	76 500	15	230
18	18	23	16,5	21,9	46	25	31	71	94	10	32	31,750	M18x1,5	27	26 000	40 000	92 500	15	320
20	20	25	18	24,4	50	27,5	34	77	102	10	33	34,925	M20x1,5	30	31 500	45 000	104 500	15	420
22	22	28	20	25,8	54	30	37	84	111	12	37	38,100	M22x1,5	32	38 000	52 000	125 500	15	540
25	25	31	22	29,6	60	33,5	42	94	124	12	42	42,850	M24x2	36	47 500	60 000	148 000	15	740
30	30	37	25	34,8	70	40	50	110	145	15	51	50,800	M30x2	41	64 000	81 000	193 000	15	1165
35	35	43	30	40,4	80	49	60	125	165	20	56	59,000	M36x2	50	90 000	95 000	210 000	16	1900
40	40	49	35	44,2	90	57	69	142	187	25	60	66,000	M42x2	60	120 000	130 000	293 000	15	2850
50	50	60	45	55,9	116	65	78	160	218	25	65	82,000	M48x2	65	190 000	235 000	554 000	14	4980
Tolerance	H7	0 -0,12	+0,2 -0,2	--	--	--	--	--	--	--	+1,0 0	--	DIN 13 6 H	0 -0,3	--	--	--	--	--

The sizes 2, 3 and 4 are not included in DIN ISO 12240-4.

*Safety factor C_o see page 7.

Material

Series SFC..
Outer part: Up to size 14 free-cutting steel 1.0715+C, from size 16 material 1.0501, galvanized and chromalized to DIN 50961.
Bushings: Cu Sn 8/Cu Zn 40 Al 2 CW713R
Inner ring: Roller bearing steel 1.3505, hardened, ground and polished.

Series SFXC.. (Available from size 5)
Outer part: Material 1.7227 tempered or similar, galvanized and chromalized to DIN 50961.
Bushings: Analogue series SFC..
Inner ring: Analogue series SFC..

Series SFRC.. (Available from size 3)
Outer part: Corrosion-resistant steel 1.4305, from size 16, forged.
Bushings: Analogue series SFC..
Inner ring: Analog SFC... but hard chrome-plated, corrosion-resistant on request

Design

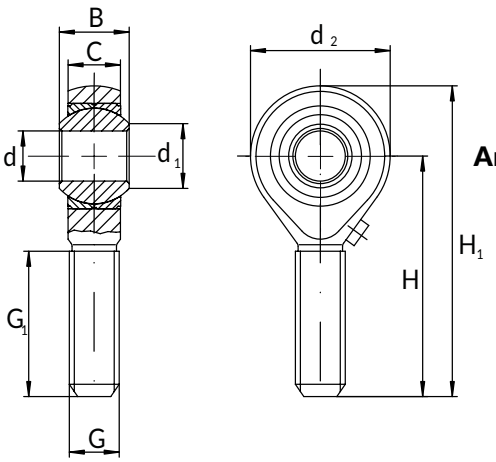
Bearing slackness: Depending on size, between 0.01 and 0.09 mm radially. With reduced or increased slackness see page 6. Designation, for example series SFC 10 **C2.**
Thread: DIN 13 – 6 H, r.h. or l.h. L.h. thread designation, for example series SF**L**C 10. Special threads on request.
Lubricating nipple: Size 5–50 funnel-type DIN 3405, form D.
Corrosion-resistant inner ring: From size 5 with corrosion-resistant inner ring of material 1.4034 possible. Designation, for example series SFRC 10 **IR**.
Hard-chromed inner ring: From size 5 with hard-chromed inner ring (on bearing surface only). Designation example Series SFC 10 **IH**.
Sealed design: Sizes 8–30 can be supplied with replace-able sealing sleeves (see page 23).
Special thread: On request (fine thread, inch, etc.)

Relubricatable standard rod ends with male thread

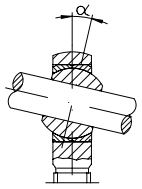
Friction pairing steel on heavy-duty bronze

Series **SMC..**

SMXC.. (high-strength outer part)
SMRC.. (corrosion-resistant outer part)



Angle of misalignment (AOM)



Series	d	B	C	d_1	d_2	H	H_1	G_1	K	G	Bearing capacities dynamic C	Bearing capacities static C_o* SMC/SMRC	Bearing capacities static C_o* SMXC	AOM	Weight each
									Ball ø	Thread					
SMC..	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	N	N	N	α°	≈g
2	2	4,8	3,6	3,6	9	18	22,5	9	6,000	M2	900	400	––	16	2
3	3	6	4,5	5,2	12	27	33	15	7,937	M3	1 500	1200/700	––	15	5
4	4	7	5,25	6,5	14	30	37	18	9,520	M4	2 260	2000/1200	––	14	9
5	5	8	6	7,7	18	33	42	20	11,112	M5	3 250	3 000	7 500	13	15
6	6	9	6,75	9,0	20	36	46	22	12,700	M6	4 300	4 000	10 500	13	21
8	8	12	9	10,4	24	42	54	25	15,875	M8	7 200	8 000	19 500	13	34
10	10	14	10,5	12,9	28	48	62	29	19,050	M10	10 000	13 000	30 500	13	65
12	12	16	12	15,4	32	54	70	33	22,225	M12	13 400	17 000	43 000	13	92
14	14	19	13,5	16,9	36	60	78	36	25,400	M14	17 000	24 000	51 500	15	135
16	16	21	15	19,4	42	66	87	40	28,575	M16	21 600	28 500	76 500	15	215
18	18	23	16,5	21,9	46	72	95	44	31,750	M18x1,5	26 000	38 000	92 500	15	285
20	20	25	18	24,4	50	78	103	47	34,925	M20x1,5	31 500	42 000	104 500	15	375
22	22	28	20	25,8	54	84	111	51	38,100	M22x1,5	38 000	52 000	125 500	15	475
25	25	31	22	29,6	60	94	124	57	42,850	M24x2	47 500	60 000	148 000	15	655
30	30	37	25	34,8	70	110	145	66	50,800	M30x2	64 000	81 000	193 000	15	1075
35	35	43	30	40,4	80	140	180	85	59,000	M36x2	90 000	95 000	210 000	16	1830
40	40	49	35	44,2	90	150	195	90	66,000	M42x2	120 000	130 000	293 000	15	2600
50	50	60	45	55,9	116	185	243	105	82,000	M48x2	190 000	235 000	554 000	14	5000
Tolerance	H7	0 -0,12	+0,2 -0,2	––	––	––	––	+1,0 0	––	DIN 13 6 g	––	–– ––	––	––	

The sizes 2, 3 und 4 are not included in DIN ISO 12240-4.

*Safety factor C_o see page 7.

Material

Series SMC..
Outer part: Up to size 14 free-cutting steel 1.0715+C, from size 16 material 1.0501 galvanized and chromalized to DIN 50961.
Bushings: Cu Sn 8/Cu Zn 40 Al 2 CW713R
Inner ring: Roller bearing steel 1.3505, hardened, ground and polished.

Series SMXC.. (Available from size 5)
Outer part: Material 1.7227 tempered or similar, galvanized and chromalized to DIN 50961.
Bushings: Analogue series SMC..
Inner ring: Analogue series SMC..

Series SMRC.. (Available form size 3)
Outer part: Corrosion-resistant steel 1.4305, from size 16 forged
Bushings: Analogue series SMC..
Inner ring: Hard-chromed

Design

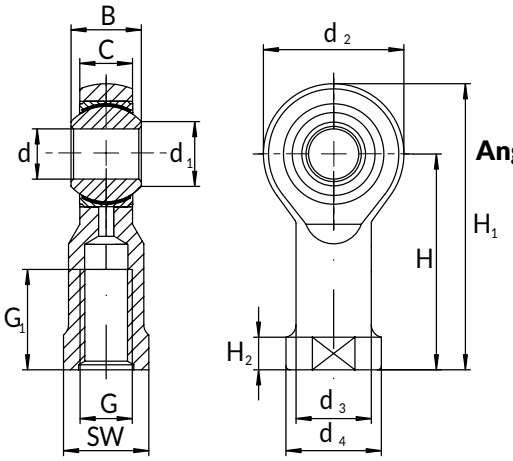
Bearing slackness: Depending on size between 0.01 and 0.09 mm radially. With reduced or increased slackness see page 6. Designation, for example series SMC 10 **C2**.
Thread: DIN 13 – 6 g, r.h. or l.h. L.h. thread designation, for example series SMLC 10. Special threads on request.
Lubricating nipple: Size 6–50 funnel-type DIN 3405, form D.
Corrosion-resistant inner ring: From size 5 with corrosion-resistant steel inner ring of material 1.4034 possible. Designation, for example series SMRC 10 **IR**.
Hard-chromed inner ring: From size 5 available with hard-chromed inner ring (on bearing surface only). Designation, for example series SMC 10 **IH**.
Sealed design: Sizes 8–30 can be supplied with replaceable sealing sleeves (see page 23).

Maintenance-free standard rod ends with female thread

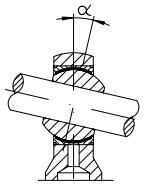
Friction pairing steel on PTFE bronze fabric

Series **SFCP..**

SFXCP.. (high-strength outer part)
SFRCP.. (corrosion-resistant outer part)



Angle of misalignment (AOM)



Series	d	B	C	d_1	d_2	d_3	d_4	H	H_1	H_2	G_1	K	G	SW	Bearing capacities dynamic C	Bearing capacities static C_o* SFCP/SFRCP	Bearing capacities static C_o* SFXCP	AOM	Weight each
												Ball ø	Thread						
SFCP..	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	N	N	N	α°	≈g
3	3	6	4,5	5,2	12	5	6,5	21	27	3	7	7,937	M3	5,5	4 700	2700/1600	––	15	7
4	4	7	5,25	6,5	14	6,5	8,5	24	31	3,5	9,5	9,520	M4	7	6 700	3500/2000	––	14	11
5	5	8	6	7,7	18	9	11	27	36	4	10	11,112	M5	9	7 800	6 000	15 000	13	19
6	6	9	6,75	9,0	20	10	13	30	40	5	12	12,700	M6	11	10 900	7 000	16 500	13	25
8	8	12	9	10,4	24	12,5	16	36	48	5	16	15,875	M8	14	18 000	12 000	26 000	13	43
10	10	14	10,5	12,9	28	15	19	43	57	6,5	20	19,050	M10	17	27 000	14 500	35 500	13	75
12	12	16	12	15,4	32	17,5	22	50	66	6,5	22	22,225	M12	19	36 000	17 000	43 000	13	110
14	14	19	13,5	16,9	36	20	25	57	75	8	25	25,400	M14	22	48 000	24 000	51 500	15	170
16	16	21	15	19,4	42	22	27	64	85	8	28	28,575	M16	22	60 000	28 500	76 500	15	210
18	18	23	16,5	21,9	46	25	31	71	94	10	32	31,750	M18x1,5	27	74 000	40 000	92 500	15	305
20	20	25	18	24,4	50	27,5	34	77	102	10	33	34,925	M20x1,5	30	90 000	45 000	104 500	15	405
22	22	28	20	25,8	54	30	37	84	111	12	37	38,100	M22x1,5	32	110 000	52 000	125 500	15	515
25	25	31	22	29,6	60	33,5	42	94	124	12	42	42,850	M24x2	36	136 000	60 000	148 000	15	730
30	30	37	25	34,8	70	40	50	110	145	15	51	50,800	M30x2	41	186 000	81 000	193 000	15	1160
35	35	43	30	40,4	80	49	60	125	165	20	56	59,000	M36x2	50	264 000	95 000	210 000	16	1890
40	40	49	35	44,2	90	57	69	142	187	25	60	66,000	M42x2	60	348 000	130 000	293 000	15	2800
50	50	60	45	55,9	116	65	78	160	218	25	65	82,000	M48x2	65	550 000	235 000	554 000	14	4960
Tolerance	H7	0 -0,12	+0,2 -0,2	––	––	––	––	––	––	––	+1,0 0	––	DIN 13 6 H	0 -0,3	––	––	––	––	––

The sizes 3 and 4 are not included in DIN ISO 12240-4.

*Safety factor C_o see page 7.

Material

Series SFCP..
Outer part: Up to size 14 free-cutting steel 1.0715+C, from size 16 material 1.0501, galvanized and chromalized to DIN 50961.
Bushings: Cu Sn 8/Cu Zn 40, galvanized, lined with permanently affixed sliding foil, consisting of PTFE with a bronze supporting fabric.
Inner ring: Roller bearing steel 1.3505, hardened, ground and polished.

Series SFXCP.. (Available from size 5)
Outer part: Material 1.7227 tempered or similar, galvanized and chromalized to DIN 50961.
Bushings: Analogue series SFCP..
Inner ring: Analogue series SFCP..

Series SFRCP.. (Available from size 3)
Outer part: Corrosion-resistant steel steel 1.4305, from size 16 forged.
Bushings: Analogue series SFCP..
Inner ring: Analogue series SFCP..

Design

Bearing slackness: Depending on size, between 0.002 and 0.020 mm radially. See page 6 for precise details. Designation, for example series SFCP 10 **C3**.

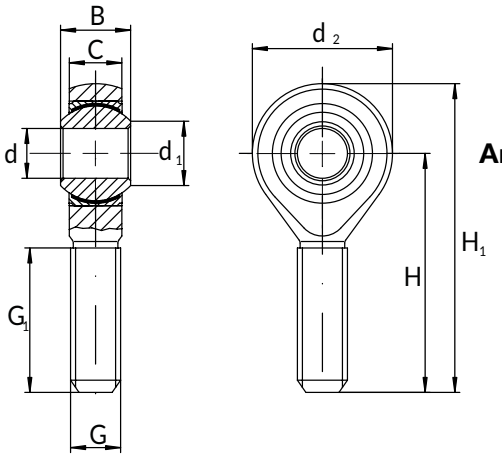
Thread: DIN 13 – 6 H, r.h. or l.h. L.h. thread designation, for example series SF**L**CP 10. Special thread on request.
Corrosion-resistant inner ring: From size 5 with corrosion-resistant inner ring of material 1.4034 possible. Designation, for example series SFRCP 10 **IR**.
Hard-chromed inner ring: From size 5 available with hard-chromed inner ring (on bearing surface only). Designation, for example series SFCP 10 **IH**.
Sealed design: Sizes 8–30 can be supplied with replaceable sealing sleeves (see page 23).

Maintenance-free standard rod ends with male thread

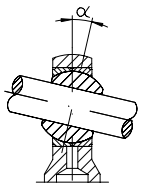
Friction pairing steel on PTFE bronze fabric

Series **SMCP..**

SMXCP.. (high-strength outer part)
SMRCP.. (corrosion-resistant outer part)



Angle of misalignment (AOM)



Series	d	B	C	d_1	d_2	H	H_1	G_1	K	G	Bearing capacities			AOM	Weight
									Ball ø	Thread	dynamic C	static C_o*			each
												SMCP/SMRCP	SMXCP		
SMCP..	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	N	N	N	α°	≈g
3	3	6	4,5	5,2	12	27	33	15	7,937	M3	4 700	900/500	––	15	5
4	4	7	5,25	6,5	14	30	37	18	9,520	M4	6 700	1500/900	––	14	9
5	5	8	6	7,7	18	33	42	20	11,112	M5	7 800	3 000	7 500	13	15
6	6	9	6,75	9,0	20	36	46	22	12,700	M6	10 900	4 000	10 500	13	20
8	8	12	9	10,4	24	42	54	25	15,875	M8	18 000	8 000	19 500	13	40
10	10	14	10,5	12,9	28	48	62	29	19,050	M10	27 000	13 000	30 500	13	65
12	12	16	12	15,4	32	54	70	33	22,225	M12	36 000	17 000	43 000	13	100
14	14	19	13,5	16,9	36	60	78	36	25,400	M14	48 000	24 000	51 500	15	145
16	16	21	15	19,4	42	66	87	40	28,575	M16	60 000	28 500	76 500	15	215
18	18	23	16,5	21,9	46	72	95	44	31,750	M18x1,5	74 000	40 000	92 500	15	285
20	20	25	18	24,4	50	78	103	47	34,925	M20x1,5	90 000	45 000	104 500	15	370
22	22	28	20	25,8	54	84	111	51	38,100	M22x1,5	110 000	52 000	125 500	15	480
25	25	31	22	29,6	60	94	124	57	42,850	M24x2	136 000	60 000	148 000	15	650
30	30	37	25	34,8	70	110	145	66	50,800	M30x2	186 000	81 000	193 000	15	1050
35	35	43	30	40,4	80	140	180	85	59,000	M36x2	264 000	95 000	210 000	16	1825
40	40	49	35	44,2	90	150	195	90	66,000	M42x2	348 000	130 000	293 000	15	2600
50	50	60	45	55,9	116	185	243	105	82,000	M48x2	550 000	235 000	554 000	14	5000
Tolerance	H7	0 -0,12	+0,2 -0,2	––	––	––	––	+1,0 0	––	DIN 13 6g	––	––	––	––	––

The sizes 3 and 4 are not included in DIN ISO 12240-4.

*Safety factor C_o see page 7.

Material

Series SMCP..
Outer part: Up to size 14 free-cutting steel 1.0715+C from size 16 material 1.0501, galvanized and chromalized to DIN 50961.
Bushings: Cu Sn 8/Cu Zn 40 galvanized, lined with permanently affixed sliding foil, consisting of PTFE with a bronze supporting fabric.
Inner ring: Roller bearing steel 1.3505, hardened, ground and polished.

Series SMXCP.. (Available from size 5)
Outer part: Material 1.7227 tempered or similar, galvanized and chromalized to DIN 50961.
Bushings: Analogue series SMCP..
Inner ring: Analogue series SMCP..

Series SMRCP.. (Available from size 3)
Outer part: Corrosion-resistant steel 1.4305, from size 16 forged.
Bushings: Analogue series SMCP..
Inner ring: Analogue series SMCP..

Design

Bearing slackness: Depending on size, between 0.002 and 0.020 mm radially. See page 6 for precise details. Designation, for example series SMCP 10 **C3**.

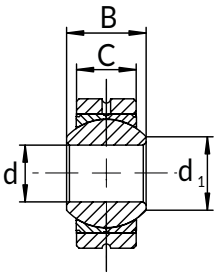
Thread: DIN 13 – 6 g, r.h. or l.h. L.h. designation, for example series SM**L**CP 10. Special thread on request.
Corrosion-resistant inner ring: From size 5 with corrosion-resistantsteel inner ring of material 1.4034 possible. Designation, for example series SMRCP 10 **IR**.
Hard-chromed inner ring: From size 5 available with hard-chromed inner ring (on bearing surface only). Designation, for example series SMCP 10 **IH**.
Sealed design: Sizes 8–30 can be supplied with replaceable sealing sleeves (see page 23).

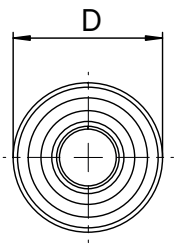
Relubricatable performance spherical bearings

Friction pairing steel on heavy-duty bronze

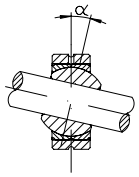
Series **SSC..**

SSRC.. (corrosion-resistant)





Angle of misalignment (AOM)



Series SSC..	d mm	D mm	B mm	C mm	d_1 mm	K Ball ø mm	Bearing capacities dynamic C N	Bearing capacities static Co* N	AOM α°	Weight each ≈g
2	2	9	4,8	3,6	3,6	6,000	900	2 450	16	3
3	3	12	6	4,5	5,2	7,937	1 500	4 200	15	4
4	4	14	7	5,25	6,4	9,520	2 260	5 900	14	6
5	5	16	8	6	7,7	11,112	3 250	19 000	13	9
6	6	18	9	6,75	9,0	12,700	4 300	25 000	13	13
8	8	22	12	9	10,4	15,875	7 200	41 000	13	24
10	10	26	14	10,5	12,9	19,050	10 000	58 000	13	40
12	12	30	16	12	15,4	22,225	13 400	78 000	13	60
14	14	34	19	13,5	16,9	25,400	17 000	100 000	15	85
16	16	38	21	15	19,4	28,575	21 600	125 000	15	120
18	18	42	23	16,5	21,9	31,750	26 000	155 000	15	155
20	20	46	25	18	24,4	34,925	31 500	186 000	15	205
22	22	50	28	20	25,8	38,100	38 000	228 000	15	265
25	25	56	31	22	29,6	42,850	47 500	284 000	15	365
30	30	66	37	25	34,8	50,800	64 000	384 000	15	580
35	35	78	43	30	40,4	59,000	90 000	510 000	16	965
40	40	87	49	35	44,2	66,000	120 000	675 000	15	1370
50	50	108	60	45	55,9	82,000	190 000	1 100 000	14	2705
Tolerance	H7	h6**	0 - 0,12	0 - 0,2	--	--	--	--	--	--

The bearings are not included in DIN ISO 12240-1.
Sizes 2, 3, 4 will be delivered without oil groove.

*Safety factor C_o see page 7.

**Recommended housing bore tolerance for steel is M7.
Other housing materials regarding tolerance on request.

Material

Series SSC..
Outer part: Free-cutting steel 1.0715+C, browned.
Bushings: Cu Sn 8/Cu Zn 40.
Inner ring: Roller bearing steel 1.3505, hardened, ground and polished.

Series SSRC.. (Available from size 5)
Outer part: Corrosion-resistant steel, material 1.4305
Bushings: Analogue series SSC..
Inner ring: Analogue series SSC..

Design

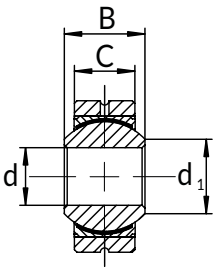
Bearing slackness: Depending on size, between 0.01 and 0.09 mm radially. With reduced or increased slackness see page 6. Designation, for example series SSC 10 **C2**.
Lubrication: Through an annular lubrication groove on the outer ring.
Corrosion-resistant inner ring: From size 5 with corrosion-resistant inner ring of material 1.4034 possible. Designation, for example series SSRC 10 **IR**.
Hard-chromed inner ring: From size 5 available with hard-chromed inner ring.
Designation, for example series SSC 10.

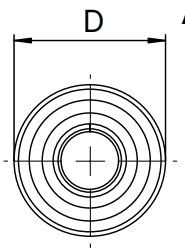
Maintenance-free performance spherical bearings

Friction pairing steel on PTFE bronze fabric

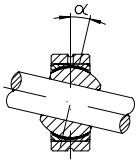
Series **SSCP..**

SSRCP.. (corrosion-resistant)





Angle of misalignment (AOM)



Series SSCP..	d mm	D mm	B mm	C mm	d_1 mm	K Ball ø mm	Bearing capacities dynamic C N	Bearing capacities static Co* N	AOM α°	Weight each ≈g
3	3	12	6	4,5	5,2	7,937	4 700	7 300	15	4
4	4	14	7	5,25	6,4	9,520	6 700	11 000	14	6
5	5	16	8	6	7,7	11,112	7 800	15 000	13	8
6	6	18	9	6,75	9,0	12,700	10 900	21 000	13	12
8	8	22	12	9	10,4	15,875	18 000	36 000	13	23
10	10	26	14	10,5	12,9	19,050	27 000	53 000	13	38
12	12	30	16	12	15,4	22,225	36 000	71 000	13	57
14	14	34	19	13,5	16,9	25,400	48 000	93 000	15	80
16	16	38	21	15	19,4	28,575	60 000	116 000	15	110
18	18	42	23	16,5	21,9	31,750	74 000	143 000	15	150
20	20	46	25	18	24,4	34,925	90 000	173 000	15	195
22	22	50	28	20	25,8	38,100	110 000	212 000	15	260
25	25	56	31	22	29,6	42,850	136 000	263 000	15	360
30	30	66	37	25	34,8	50,800	186 000	358 000	15	570
35	35	78	43	30	40,4	59,000	264 000	500 000	16	960
40	40	87	49	35	44,2	66,000	348 000	660 000	15	1360
50	50	108	60	45	55,9	82,000	550 000	1 000 000	14	2680
Tolerance	H7	h6**	0 -0,12	0 -0,2	--	--	--	--	--	--

The bearings are not included in DIN ISO 12240-1.

*Safety factor C_o see page 7.

**Recommended housing bore tolerance for steel is M7.
Other housing materials regarding tolerance on request.

Material

Series SSCP..
Outer part: Free-cutting steel 1.0715+C, browned.
Bushings: Cu Sn 8/Cu Zn 40 galvanized, lined with permanently affixed sliding foil, consisting of PTFE with a bronze supporting fabric.
Inner ring: Roller bearing steel 1.3505, hardened, ground and polished.

Series SSRCP.. (Available from size 5)
Outer part: Corrosion-resistant steel, material 1.4305
Bushings: Analogue series SSCP..
Inner ring: Analogue series SSCP..

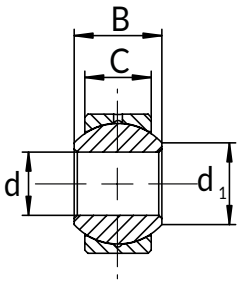
Design

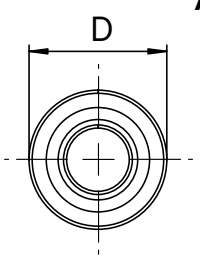
Bearing slackness: Depending on size, between 0.002 and 0.020 mm radially. See page 6 for precise details. Designation, for example series SSCP 10 **C3**.
Corrosion-resistant inner ring: From size 5 with corrosion-resistant inner ring of material 1.4034 possible. Designation, for example series SSCP 10 **IR**.
Sealed design: Sizes 8–30 can be supplied with replaceable sealing sleeves (see page 23).

Relubricatable high-performance spherical bearings

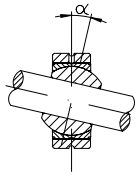
Friction pairing steel on heavy-duty bronze

Series **SC..**





Angle of misalignment (AOM)



Series	d	D_1	B	C	d_1	K	Bearing capacities relubricatable		Angle of misalign.	Weight each
						Ball Ø	dynamic C	static C_o*		
SC..	mm	mm	mm	mm	mm	mm	N	N	α°	≈g
5	5	13	8	6	7,7	11,112	3 250	15 300	13	5
6	6	16	9	6,75	9,0	12,700	4 300	20 000	13	9
8	8	19	12	9	10,4	15,875	7 200	33 000	13	16
10	10	22	14	10,5	12,9	19,050	10 000	46 000	13	25
12	12	26	16	12	15,4	22,225	13 400	63 000	13	41
14	14	29	19	13,5	16,9	25,400	17 000	80 000	15	57
16	16	32	21	15	19,4	28,575	21600	100 000	15	76
18	18	35	23	16,5	21,9	31,750	26 000	124 000	15	99
20	20	40	25	18	24,4	34,925	31 500	150 000	15	143
22	22	42	28	20	25,8	38,100	38 000	182 000	15	170
25	25	47	31	22	29,6	42,850	47 500	227 000	15	234
30	30	55	37	25	34,8	50,800	64 000	307 000	15	369
Tolerance	H7	h6**	0 -0,12	0 -0,2	--	--	--	--	--	--

*Safety factor C_o see Page 7.

**Recommended housing bore tolerance for steel is M7.
Other housing materials regarding tolerance on request.

Material

Series SC..
Outer part/bushing: Cu Sn 8.
Inner ring: Roller bearing steel 1.3505, hardened, ground and polished.

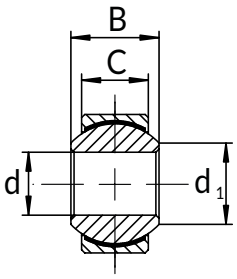
Design

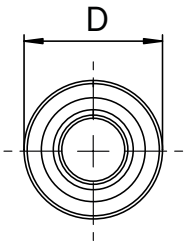
Bearing slackness: Depending on size, radially between 0.01 and 0.09 mm. With restricted or extended clearance, see page 6. Designation e.g. series SC 10 **C2**.
Corrosion-resistant inner ring: Available with corrosion-resistant steel inner ring of material 1.4034. Designation, for example series SC 10 **IR**.

Maintenance-free high-performance spherical bearings

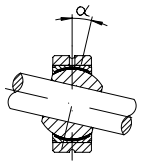
Friction pairing steel on PTFE bronze fabric

Series **SCP..**





Angle of misalignment (AOM)



Series	d	D	B	C	d_1	K	Bearing capacities maintenance-free		Angle of misalign.	Weight each
						Ball ø	dynamic C	static C_o*		
SCP..	mm	mm	mm	mm	mm	mm	N	N	α°	≈g
5	5	13	8	6	7,7	11,112	7 800	12 000	13	5
6	6	16	9	6,75	9,0	12,700	10 900	17 000	13	9
8	8	19	12	9	10,4	15,875	18 000	29 000	13	16
10	10	22	14	10,5	12,9	19,050	27 000	42 000	13	25
12	12	26	16	12	15,4	22,225	36 400	57 000	13	41
14	14	29	19	13,5	16,9	25,400	48 000	75 000	15	57
16	16	32	21	15	19,4	28,575	60 000	93 000	15	76
18	18	35	23	16,5	21,9	31,750	74 000	115 000	15	99
20	20	40	25	18	24,4	34,925	90 000	138 000	15	143
22	22	42	28	20	25,8	38,100	110 000	170 000	15	170
25	25	47	31	22	29,6	42,850	136 000	210 000	15	234
30	30	55	37	25	34,8	50,800	186 000	286 000	15	369
Tolerance	H7	h6**	0 -0,12	0 -0,2	--	--	--	--	--	--

*Safety factor C_o see Page 7.

**Recommended housing bore tolerance for steel is M7.
Other housing materials regarding tolerance on request.

Material

Series SCP..
Outer part/bushing: Corrision-resistent steel material 1.4305. Lined and covered with sliding foil of PTFE with bronze supporting fabric.
Inner ring: Analogue series SC..

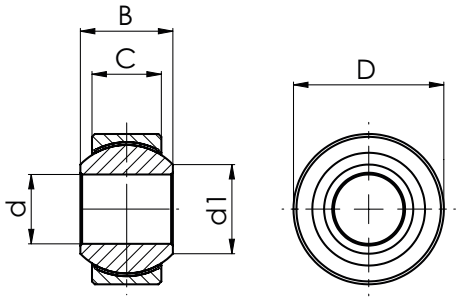
Design

Bearing slackness: Depending on size, between 0.002 and 0.020 mm radially. See page 6 for precise details.
Designation, for example series SCP 10 **C2**.
Corrosion-resistant inner ring: Available with corrosion-resistant steel inner ring of material 1.4034.
Designation, for example series SCP 10 **IR**.

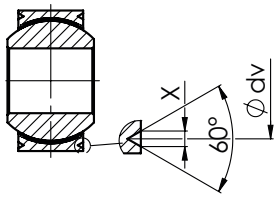
Maintenance-free high-performance spherical bearings in inch dimensions

Friction pairing steel on PTFE stainless steel supporting fabric

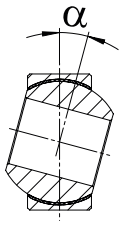
Series **SCDZ..**



Series **SCDZ..V**
(with staking groove)



Angle of misalignment (AOM)



Series	d	D	B	C	d_1	d_V***	X	K	Bearing capacieties maintenance-free		Angle of misalign.	Weight each
								Ball ø	dynamic C	static C_o*		
SCDZ..	mm	mm	mm	mm	mm	mm	mm	mm	N	N	α°	≈g
5	5/16 7,937	17,462	11,100	8,05	10,1	15,9	1,0	15,050	21 000	34 000	14	12
6	3/8 9,525	20,638	12,700	10,3	12,0	18,6	1,0	17,450	33 000	52 500	9	21
7	7/16 11,112	23,812	14,275	11,2	13,7	21,8	1,0	19,850	41 000	66 000	10	31
8	1/2 12,700	25,400	15,880	12,8	15,5	23,4	1,0	22,225	55 000	86 500	9	38
9	9/16 14,287	28,575	17,450	13,6	18,4	26,5	1,0	25,400	67 000	106 000	10	53
10	5/8 15,875	30,162	19,050	14,4	19,1	28,1	1,0	27,000	75 000	117 500	12	60
12	3/4 19,050	34,925	22,225	16,0	22,6	32,9	1,0	31,750	100 000	155 500	13	90
Tolerance	H9	h6**	0 -0,12	+0,1 -0,1	--	--	--	--	--	--	--	--

***Values only apply to V-groove.

**Recommended housing bore tolerance for steel is M7.
Other housing materials regarding tolerance on request.

*Safety factor C_o see Page 7.

Material

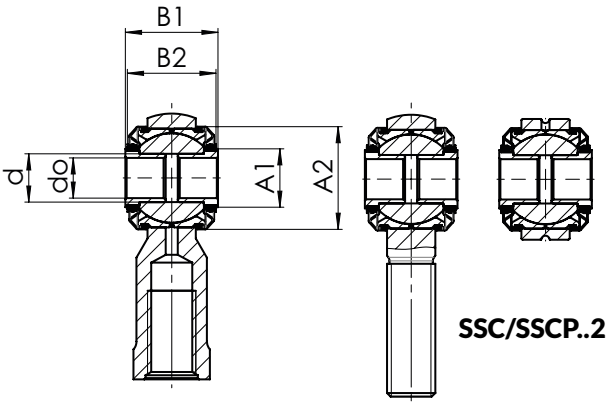
Series SCDZ..
Outer part bearing shell: Corrision-resistent steel 1.4305, lined with firmly bonded sliding film, consisting of PTFE with a corrision-resistent steel support fabric.
Innenring: 1.7227 + GNC

Design

Bearing slackness: Between 0.002 and 0.020 mm radially, depending on size. For exact details see page 6.
Designation e.g. series SCDZ 10 **C3**.

Sealed rod ends and spherical bearings*

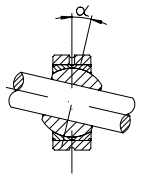
Series **..2RS**



SSC/SSCP..2 RS

SFC/SFCP..2 RS **SMC/SMCP..2 RS**

Angle of misalignment (AOM)



Series ..2 RS	d mm	d_o mm	A_1 mm	A_2 mm	B_1 mm	B_2 mm	Angle of misalignment α°
8	8	6	10,5	18,5	19	18	10
10	10	8	12,5	21,5	21	20	10
12	12	10	14,5	25,5	23	22	10
14	14	12	16,5	29,5	26	25	12
16	16	14	19	32,5	28	27	12
18	18	16	21	35,5	30	29	12
20	20	18	23	39	32	31	12
22	22	20	25,5	42,5	35	34	12
25	25	22	29	46,5	38	37	12
30	30	25	33,5	55	44	43	12
Tolerance	--	H7	--	--	0 - 0,3	--	--

Material

Series 2RS..
Sealing sleeve: Fluorelastomer rubber (FKM).
Oil and ozone resistant, temperature resistant from –25° C to +250° C.
Slip ring: Brass
Bore bushing: Corrision-resistent steel, material 1.4305

Design

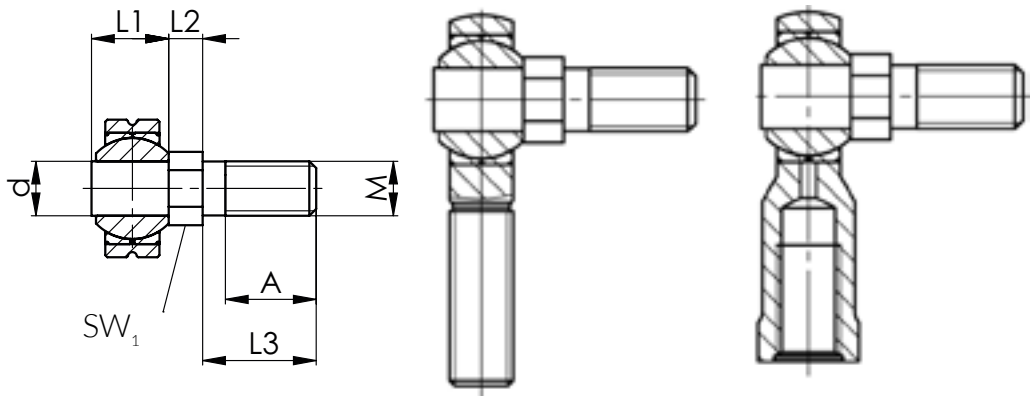
The relubricatable and maintenance-free rod ends and spherical bearings of sizes 8 to 30 can be provided with replaceable sealing sleeves to protect the bearing from dirt, dust and splashing water.
The elastic sealing sleeve is pulled on the outside over the specially extended and grooved bushing, and on the inside over a slip ring.
Designation, for example series SFC 10.2**RS**.

* This type of seal is not suitable for automotive applications. Advice from the sales department is required for this series.

Threaded bolts for rod ends and spherical bearings

– for spherical plain bearings and rod ends

Series **..W**



Series	d	L_1	L_2	L_3	A	M	SW_1	Weight each (only bolts)
..W	mm	mm	mm	mm	mm	mm	mm	≈g
5	5	9	5	11	8	M 5	7	4
6	6	10	5,5	13	10	M 6	7	7
8	8	13	6,5	17	13	M 8	11	17
10	10	15	7	21	17	M 10	11	26
12	12	17	7,5	25	20	M 12	14	45
14	14	20	8,5	29	22	M 14	14	70
16	16	22	9,5	33	24	M 16	17	105
20	20	26	12	45	35	M 20	22	210
Tolerance		––	+0,1 -0,1	+0,3 -0,3	0 -1,0	DIN13 6g		––

Material

Series ..W
Threaded bold: Corrosion-resistent steel, material 1.4305, hexagon blank.
Other materials such as 1.7227 browned.

Design

All series of rod ends and spherical bearings, except the sealed series ..2RS design, can be fitted with threaded bolts and used as angle joints. The bolt is pressed and riveted into the inner ring.
Designation, for example series SFC 10 **W**.
Special dimensions: On request.

Standard for the special:

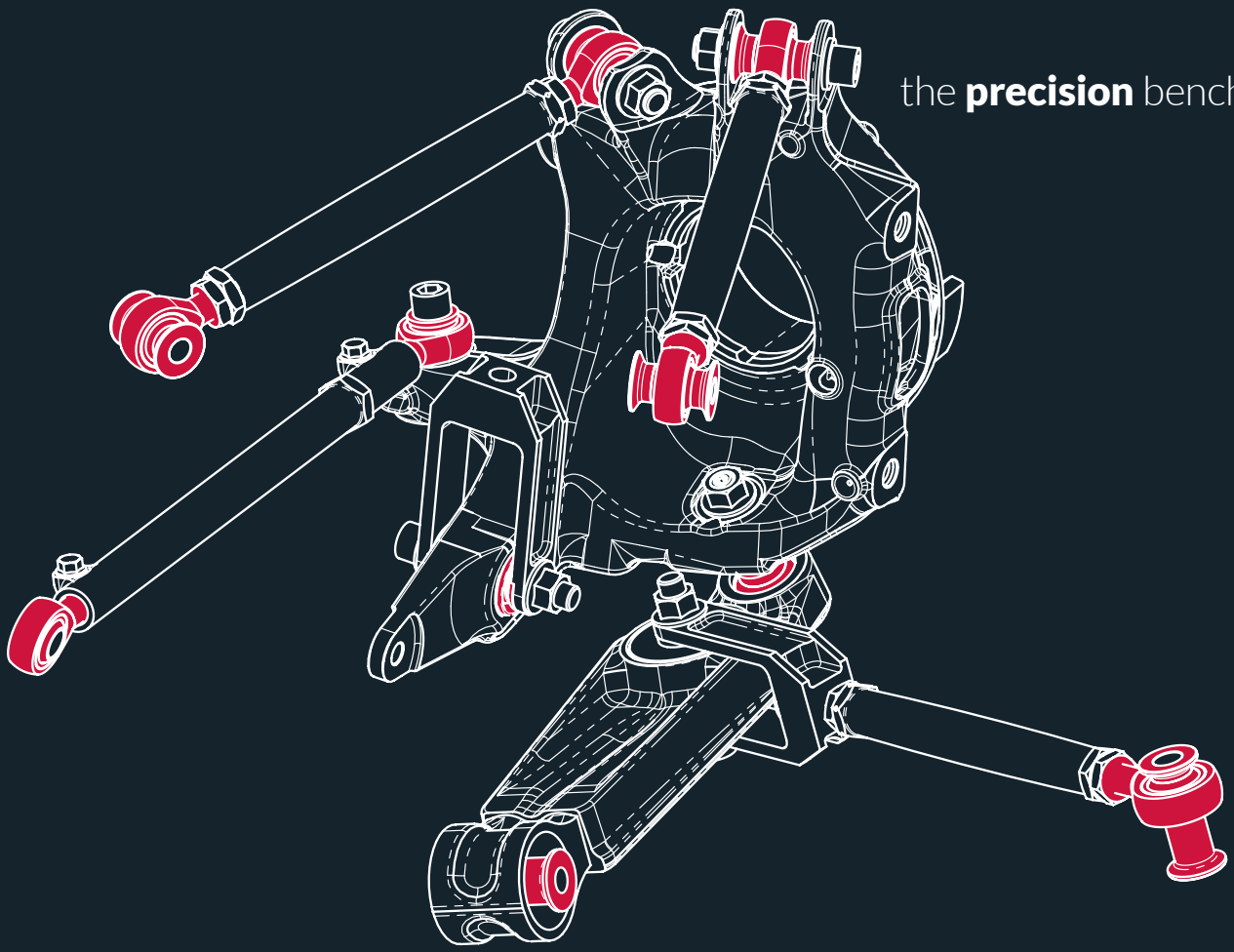
IVECO pilot Jochen Hahn at the Truck Grand Prix in Misano. The Hahn-Racing team is relying on our **standard bearing technology** already for 20 years.

Picture: Hahn-Racing

Handlebars and spherical bearing technology

Chassis technology

the **precision** benchmark



Spherical Bearings for Motor Sports

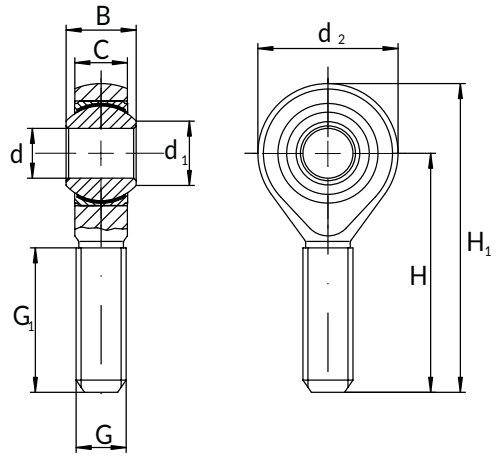
High-Performance Series

CARL HIRSCH MANN

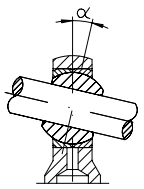
Maintenance-free High-Performance rod ends with male thread

Sliding combination of steel on PTFE stainless steel fabric

Series **SM(L)HP..**



Angle of misalignment (AOM)



Type	d	B	C	d_1	d_2	H	H_1	G_1	K Ball Ø	G Thread	Bearing capacities dynamic C	Bearing capacities static C_o*	Torque	AOM	Weight each
SM(L)HP..	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	N	N	Nm	α°	≈g
6	6	9	6,75	9,0	20	36	46	22	12,700	M6	15 000	10 000	0,05 - 0,5	13	21
8	8	12	9	10,4	24	42	54	25	15,875	M8	25 000	18 000	0,2 - 1,0	13	38
10	10	14	10,5	12,9	28	48	62	29	19,050	M10x1,5	37 500	29 000	0,5 - 1,5	13	62
12	12	16	12	15,4	32	54	70	33	22,225	M12x1,5	50 000	40 000	1,0 - 2,0	13	93
14	14	19	13,5	16,9	36	60	78	36	25,400	M14x1,5	67 000	48 000	1,5 - 3,0	15	130
16	16	21	15	19,4	42	66	87	40	28,575	M16x1,5	84 000	71 000	1,5 - 3,5	15	200
18	18	23	16,5	21,9	46	72	95	44	31,750	M18x1,5	103 000	86 000	2,0 - 5,0	15	275
20	20	25	18	24,4	50	78	103	47	34,925	M20x1,5	126 000	98 000	3,0 - 6,0	15	360
Tolerance	H9	0 -0,12	+0,2 -0,2	--	--	--	--	+1,0 -1,0	--	DIN 13 6g	--	--	--	--	

Further thread pitches on request.

*Safety factor C_o see page 7.

Material

Series SM(L)HP..
Outer part: 1.4057 (high-strength and corrosion-resistant), 100% crack-tested.
Inner ring: 1.7227 + GNC
Bearing shells: CW713R

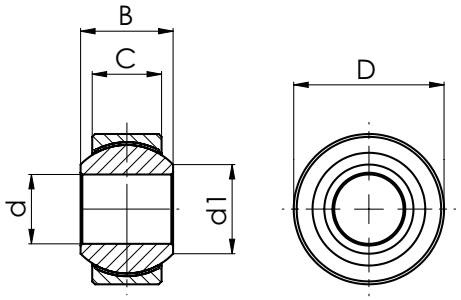
Design

Thread: DIN 13 – 6 g, r.h. or l.h. L.h. thread designation, for example series SM**L**HP 10.
Sliding pairing: PTFE stainless steel mesh.
Roll-in service on request.

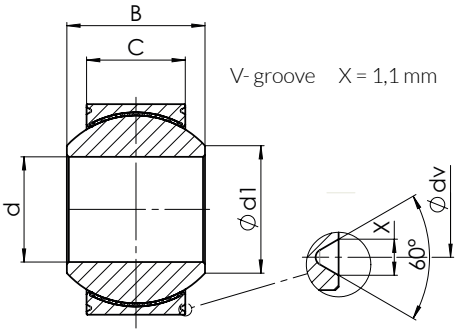
Maintenance-free high-performance spherical plain bearings

Sliding combination of steel on PTFE stainless steel fabric

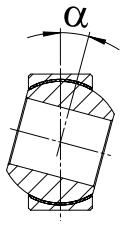
Series **SCHP..**



Series **SCHP..V**
(with V-goove)



Angle of misalignment (AOM)



Type	d	D	B	C	d_1	d_v***	K	Bearing capacities		Tilting moment	AOM	Weight each
							Ball Ø	dynamic C	static C_o*			
SCHP..	mm	mm	mm	mm	mm	mm	mm	N	N	Nm	α°	≈g
6	6	16	9	6,75	9,0	14	12,700	15 000	23 000	0,025 - 0,16	13	10
8	8	19	12	9	10,4	17	15,875	25 000	40 000	0,1 - 0,33	13	17
10	10	22	14	10,5	12,9	20	19,050	37 500	58 000	0,25 - 0,5	13	25
12	12	26	16	12	15,4	24	22,225	50 000	79 000	0,5 - 0,66	13	41
14	14	29	19	13,5	16,9	27	25,400	67 000	105 000	0,75 - 1,0	15	57
16	16	32	21	15	19,4	30	28,575	84 000	130 000	0,75 - 1,2	15	76
18	18	35	23	16,5	21,9	33	31,750	103 000	161 000	1,0 - 1,66	15	100
20	20	40	25	18	24,4	38	34,925	126 000	193 000	1,5 - 2,0	15	140
Tolerance	H9	h6**	0 -0,12	0 -0,2	--	--	--	--	--	--	--	

*Safety factor C_o see page 7.

**Recommended housing bore tolerance for steel is M7.
Other housing materials regarding tolerance on request.

*** Values only apply to V-groove.

Material

Series SCHP..
Outer part: 1.4305 (corrosion-resistant)
Inner ring: 1.7227 + GNC

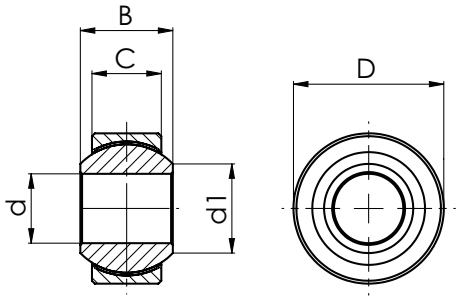
Design

Series SCHP-V (with V-groove)
Sliding pairing: Friction pairing steel on PTFE corrosion-resistant steel fabric
Roll-in service on request.

Maintenance-free high-performance spherical plain bearings

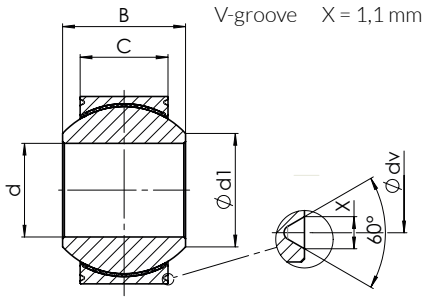
Titanium on PTFE stainless steel fabric sliding pairing

Series **SACA..IT**

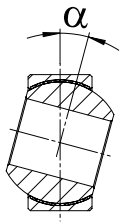


Series **SACA..ITV**

(with V-Nut)



Angle of misalignment (AOM)



Type	d	d_1	d_v***	B	C	D	K	Bearing capacities		Torque	AOM	Weight
							Ball Ø	dynamisch C	statisch C_o*			-each
SACA..IT	mm	mm	mm	mm	mm	mm	mm	N	N	Nm	α°	≈g
8	8	10,4	17	12	9	19,0	15,875	25 000	20 000	0,1 - 0,33	13	11
10	10	12,9	20	14	10,5	22,0	19,050	37 500	29 000	0,25 - 0,5	13	13
12	12	15,4	24	16	12	26,0	22,225	50 000	40 000	0,5 - 0,66	13	20
14	14	16,9	27	19	13,5	29,0	25,400	67 000	52 500	0,75 - 1,0	15	29
16	16	19,4	30	21	15	32,0	28,575	84 000	65 000	0,75 - 1,2	15	39
18	18	21,9	33	23	16,5	35,0	31,750	103 000	80 000	1,0 - 1,66	15	50
Tolerance	H7	--	--	0 -0,12	0 -0,2	h6**	--	--	--	--	--	--

*Safety factor C_o see page 7.

**Recommended housing bore tolerance for steel is M7.
Other housing materials regarding tolerance on request.

*** Values only apply to V-groove.

Material

Series SACA..IT
Outer part: high-tensile aluminium EN-AW 6082-T6
Inner ring: Titanium Ti-Al6-V4
Roll-in service on request.

Design

Series SACA..ITV (with V-groove)
Friction pairing: Titanium on PTFE corrosion-resistant steel fabric.
Roll-in service on request.

Highest performance lightweight bearings

– for highly demanding lightweight applications

Series **SCHP..IT**

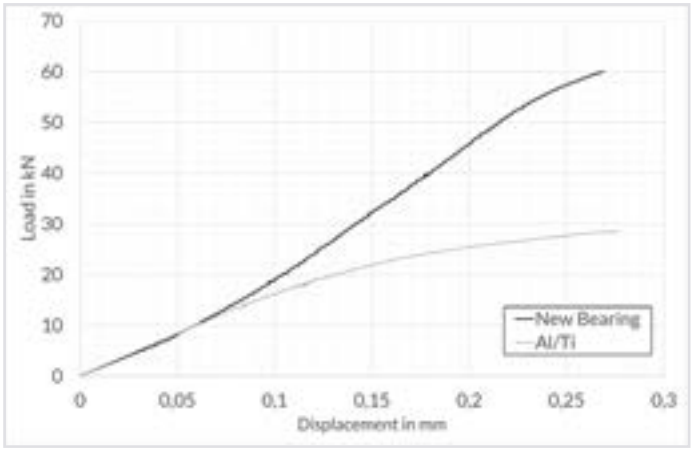
The bearings, tried and tested in racing series, consist of a coated titanium inner ring combined with a high-strength stainless steel as bushing material.

This provides a unique strength-to-weight ratio.

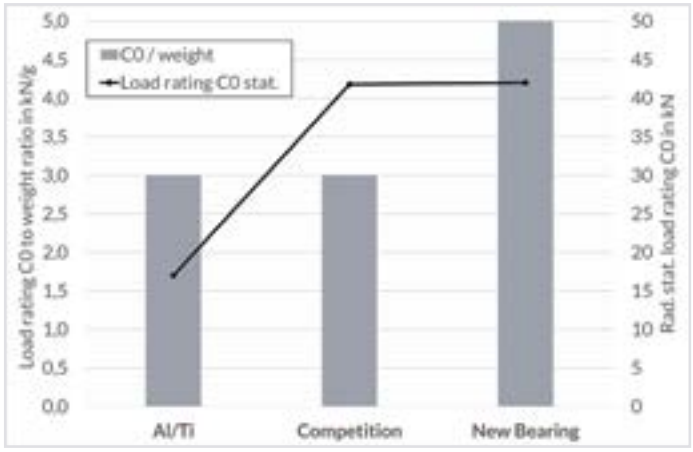
	Competition	Al-Ti Lightweight Bearing	Highest Performance Lightweight Bearing New!
Weight	16,0 g	6,0 g	8,5 g
Load rating C_0	41,8 kN	17,0 kN	42,0 kN

Data refer to bearing size 5 in inch dimensions

Load test spherical plain bearing size 5 in inches



Products compared

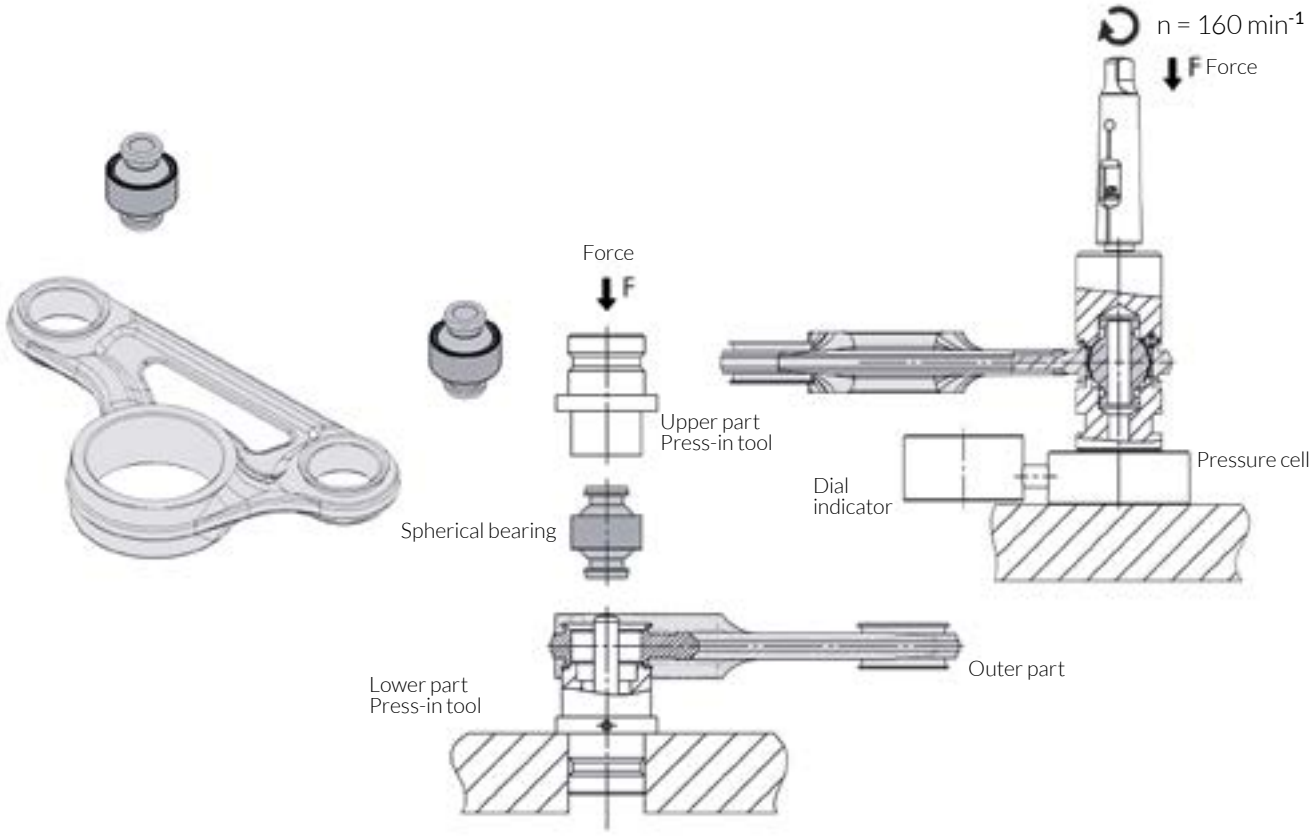


Highest performance at a glance:

Features	Advantages
High Strength	Tensile strength of selected materials ~ 900 MPa
Weight reduction inner ring	Titanium alloy inner ring* achieves approx. 40% weight reduction compared to steel. *Variants of bearing also available with other inner ring materials on request.
Resistance to corrosion	Bushing material made of corrosion-resistant steel with high content of Cr (superior toughness and corrosion resistance compared to 13 % chromium steel)
Excellent anti-friction properties	The combination of a DLC coated inner ring and a special anti-friction foil ensures excellent anti-friction properties and a minimum breakaway torque.

SCHP..IT series bearings on request.

Roll-in tool for bearings with V-groove



1. Part with bearing positions

- Outer part with defined bearing bores
- Spherical bearing with V-groove

2. Press-in tool

- Place the outer part on the lower part of the press-in tool
- Insert spherical plain bearings
- Press-in the spherical plain bearing through the upper part using a press

3. Roll-in tool

- Insert rolling head into drill chuck
- Place outer part with press-fitted bearing in fixture
- Roll-in/roll-up first side
- Turn part
- Roll-in/roll-up second side

Advantages

Low force effect, protecting the bearings
No hydraulic press required
Simple, as one box coumn drill is sufficient
We can roll-in bearings on request

A training as well as further details are available on request. Please do not hesitate to contact us.

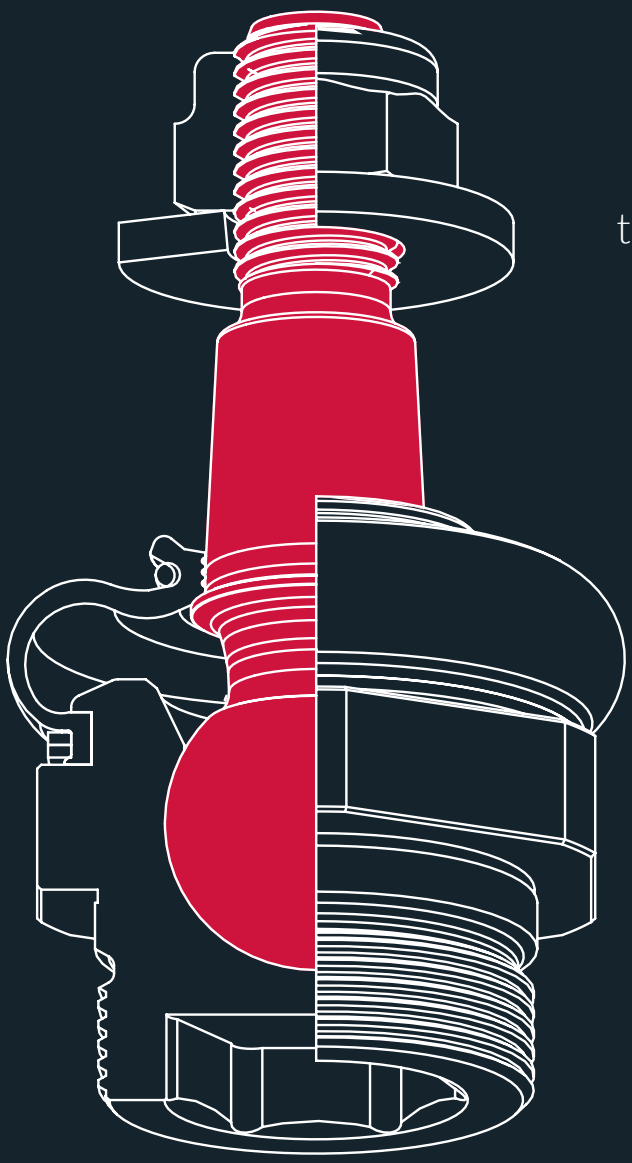
Insights into 1,000 square meters of efficient production:

We produce under the most modern conditions automotive chassis parts such as wishbones, track rods and trailing arms with integrated Carl Hirschmann plain bearing technology.

Industry solutions

Support and sliding ball joints for automotive applications

Customized solutions



the **precision** benchmark

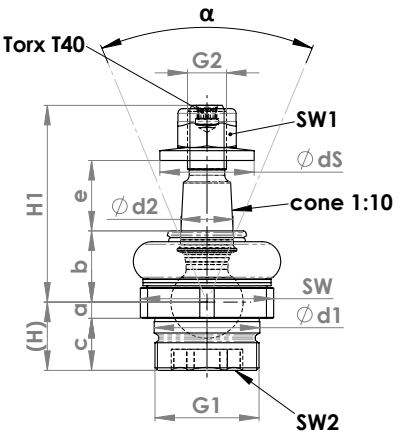
Ball Joints

High performance chassis

CARL HIRSCH MANN

Ball Joints

Series **STCD..** (Performance)
STCD..IX (High-Performance)



Type			Size 12		Size 14		Size 16		Size 18	
STCD.. STCD..IX			Performance	**High-Performance**	Performance	**High-Performance**	Performance	**High-Performance**	Performance	**High-Performance**
a		mm	5		5		5		7	
b		mm	21		25,5		26		27	
c		mm	16		16		18		18	
e		mm	17,0-23,5		17,7-23,1		20,5-29,5		23,5-31,0	
Ød1	-0,02 -0,03	mm	32,5		36,5		42,5		42,5	
Ød2		mm	16,1		19,1		20,1		22,15	
ØdA	min.	mm	26		31		33		35	
ØdS		mm	29		35		35		39	
G1	Thread		M32x1,5		M36x1,5		M42x1,5		M42x1,5	
G2	Thread		M12x1,5		M14x1,5		M14x1,5		M16x1,5	
H		mm	21		21		23		25	
H1		mm	61		68		75		80	
SW	With across flats hexagon head ball joints	mm	41		46		50		55	
SW1	Hexagon head nut	mm	19		22		22		24	
SW2	Internal hexagon ball joint	mm	19		19		24		24	
α°		°	45		45		40		40	
Max. static bearing capacity	Radial Co,rad	kN	11,2	**20,7**	13,5	**24,7**	17	**31,5**	24,5	**45,5**
	Tension Co,ax	kN	9,5		17,5		23,5		30	
	Pressure Co,ax	kN	73,5		92		113		154	
Recommended tightening torque SW	Hexagon head ball joint	Nm	110		200		300		330	
Recommended tightening torque SW1	Journal with nut	Nm	42		80		105		125	

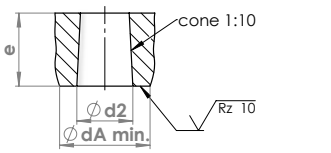
Performance

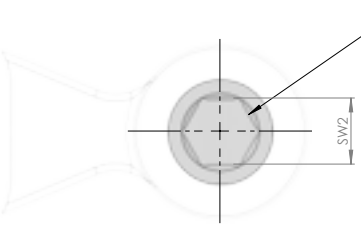
Series STCD..
Outer part: High-strength aluminum EN AW-6082-T6
Ball stud: 1.7227+GNC
Sealing sleeve: Chloroprene rubber
Lock nut: According to ISO 10513, strength class 10 Zinc flake coated
Clamping disk: 1.1211; ISO 10670; Zinc flake coated
Clamping rings: According to EN-10270-1-SM; phosphated and lacquered

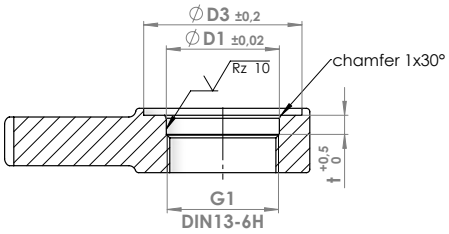
High-Performance

Series STCD..IX
Outer part: High-strength aluminum EN AW-6082-T6
Ball stud: Precipitation-hardenable, corrosion-resistant steel
Sealing sleeve: Chloroprene rubber
Lock nut: According to ISO 10513, strength class 10 Zinc flake coated
Clamping disk: 1.1211;ISO 10670; Zinc flake coated
Clamping rings: According to EN-10270-1-SM; phosphated and lacquered

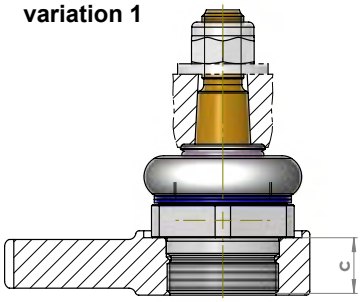
Installation Variations



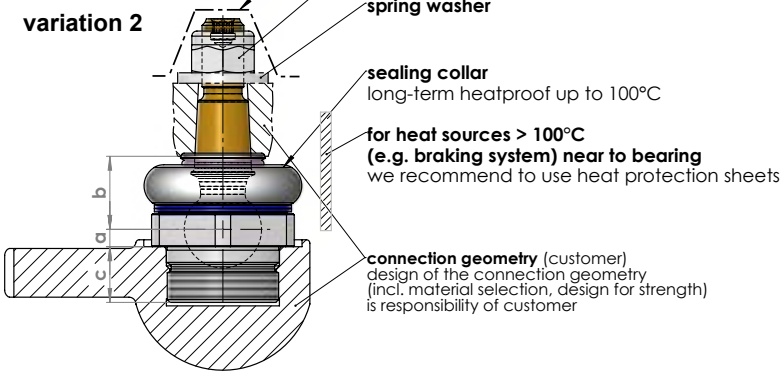




variation 1



variation 2



Recomendation:
for the best possible corrosion protection Nut, overlaying thread and connected parts should be completely covered with protection wax

self-locking nut

spring washer

sealing collar
long-term heatproof up to 100°C

for heat sources > 100°C
(e.g. braking system) near to bearing
we recommend to use heat protection sheets

connection geometry (customer)
design of the connection geometry (incl. material selection, design for strength) is responsibility of customer

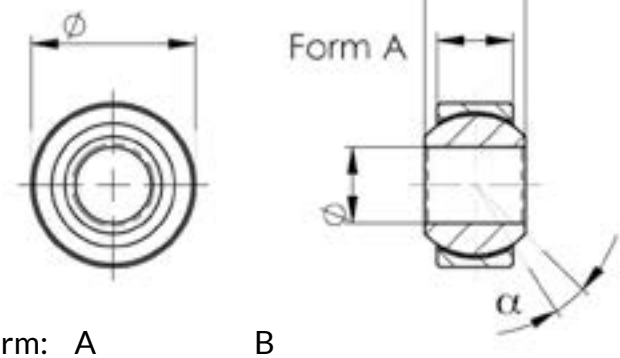
Type STCD.. STCD..IX			Size 12	Size 14	Size 16	Size 18
a		mm	5	5	5	7
b		mm	21	25,5	26	27
c		mm	16	16	18	18
t		mm	5,5	5,5	6,5	6,5
Ød2	±0,02	mm	32,5	36,5	42,5	42,5
Ød3	±0,2	mm	45,5	50,5	55,5	59,5
Ød2		mm	16,1	19,1	20,1	22,15
min. ØdA contact surface R_z10		mm	26	31	33	35
G1	Thread		M32x1,5	M36x1,5	M42x1,5	M42x1,5
SW1		mm	19	19	24	24

Contact form

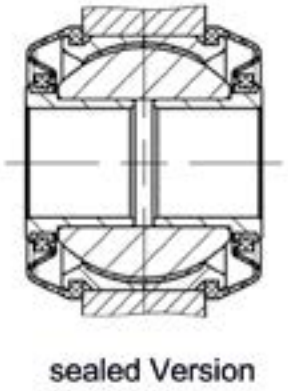
- Rod Ends / Spherical Bearings

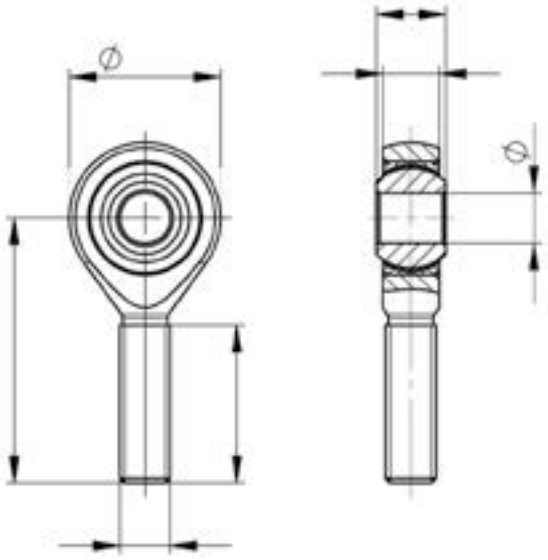
Please give us on this paper all information like dimensions, required design and quantities, and send this to our E-Mail: **gleitlager@carlhirschmann.de**. You will get a quotation timely.

Contact: **Company:** **Phone.:**

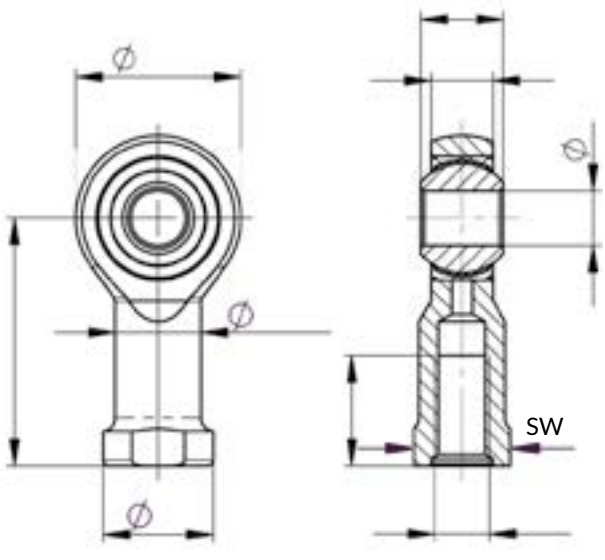


Form: A B
Material Inner ring:
Material Outer ring:
Maintenance free: relubricatable:
Sealed:
Angle of misalignment α:
Quantity:





Form: A B
Material Inner ring:
Material Outer part:
Maintenance free: relubricatable:
Sealed:
Angle of misalignment α:
Quantity:



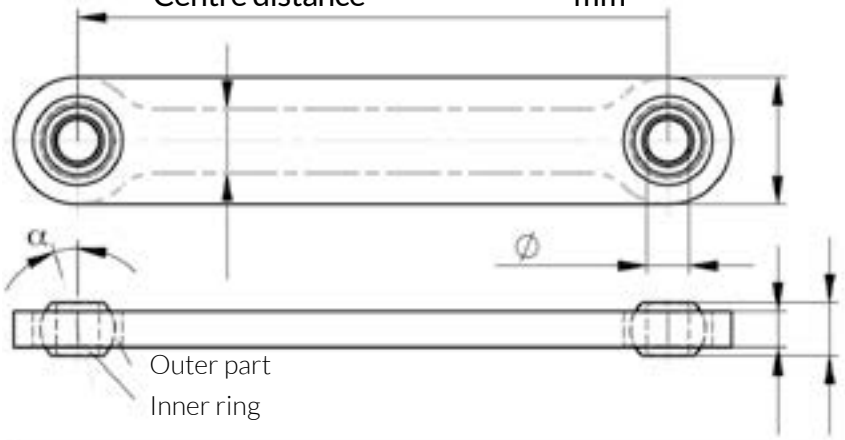
Form: A B
Material Inner ring:
Material Outer part:
Maintenance free: relubricatable:
Sealed:
Angle of misalignment α:
Quantity:

Contact form

- Double spherical bearing

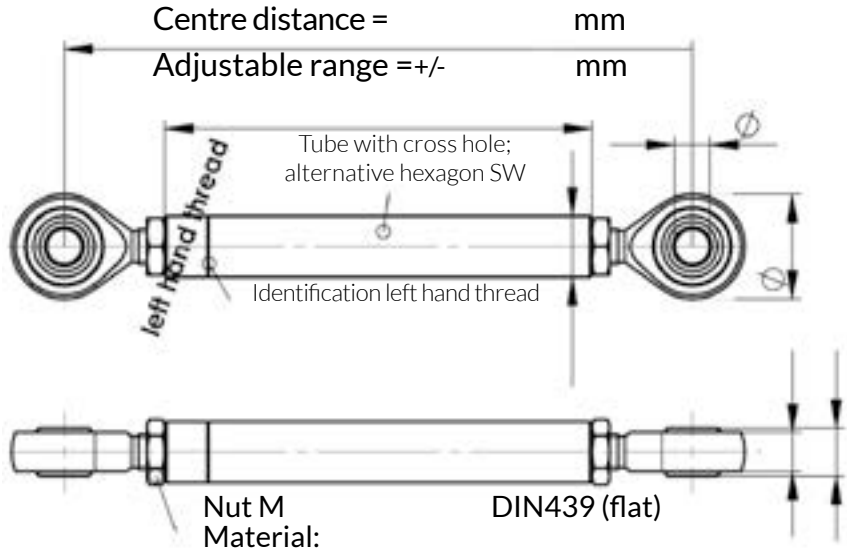
Please give us on this paper all information like dimensions, required design and quantities, and send this to our E-Mail: **gleitlager@carlhirschmann.de**. You will get a quotation timely.

Contact: **Company:** **Phone:**



Material outer part:
Form A:
Form B:
Material inner ring:
Maintenance free: relubricatable:
Angle of misalignment α:

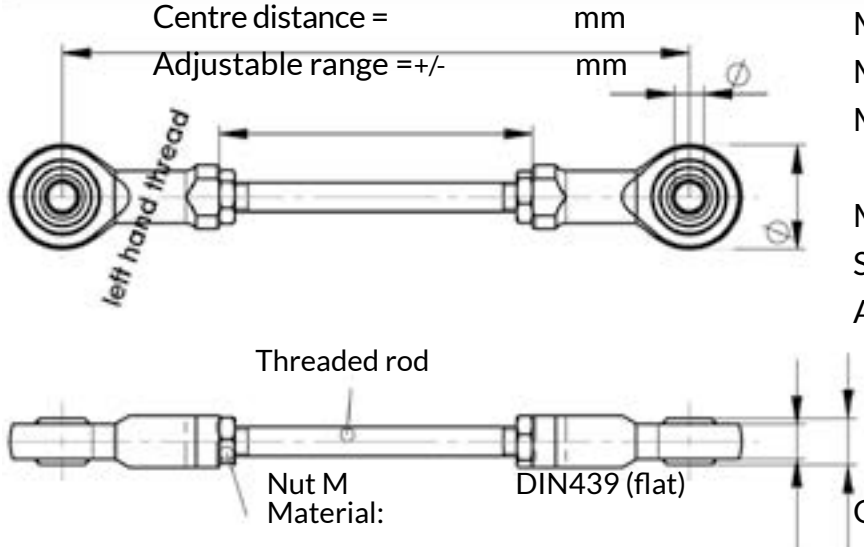
Quantity:



Material connecting rod:
Tube: Ø
Hexagon: SW
Material inner Ring:
Material rod end outer part:

Maintenance free: relubricatable:
Sealed:
Angle of misalignment α:

Quantity:



Material threaded rod:
Material inner ring:
Material rod end outer part:

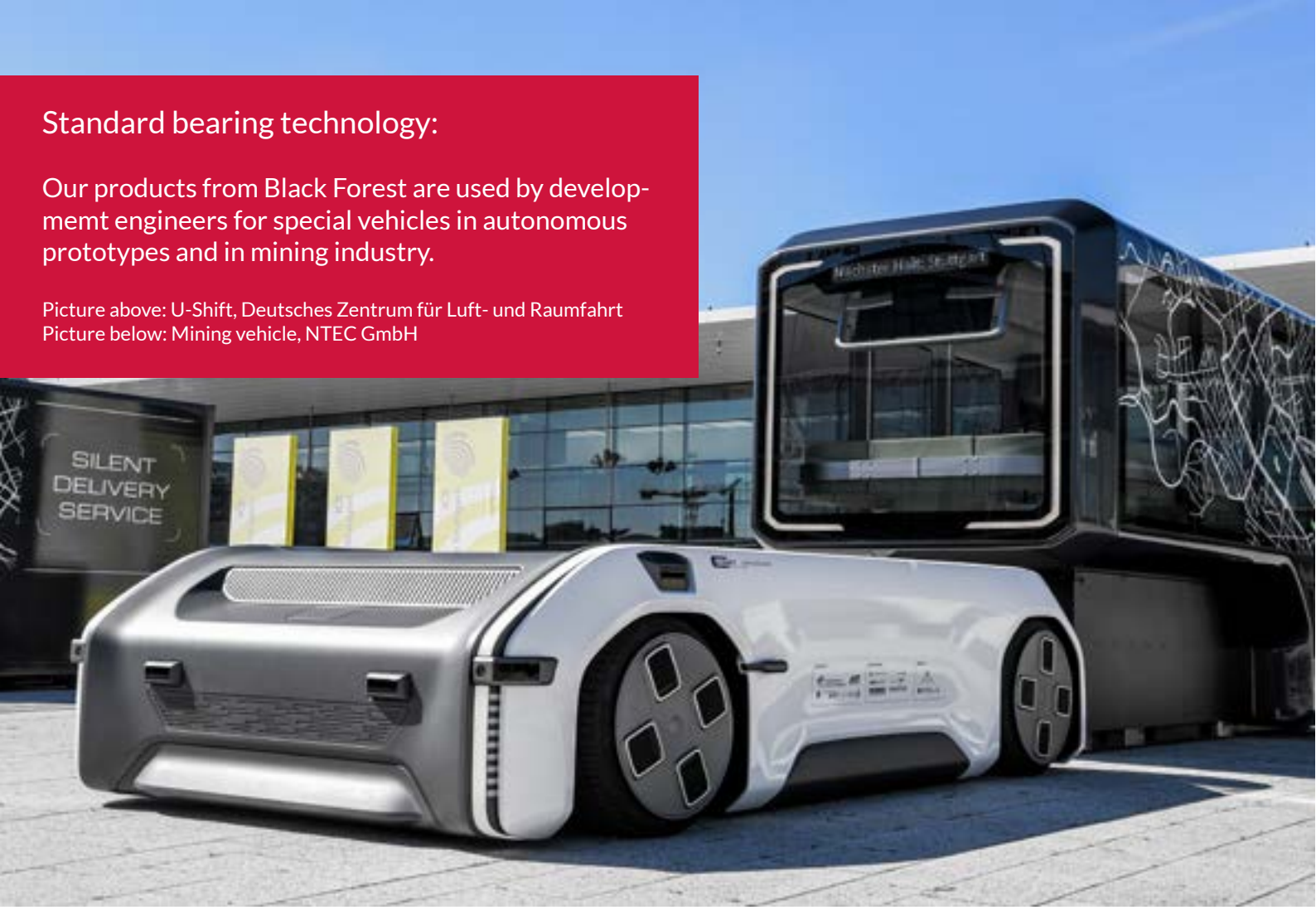
Maintenance free: relubricatable:
Sealed:
Angle of misalignment α:

Quantity:

Standard bearing technology:

Our products from Black Forest are used by develop-memt engineers for special vehicles in autonomous prototypes and in mining industry.

Picture above: U-Shift, Deutsches Zentrum für Luft- und Raumfahrt
Picture below: Mining vehicle, NTEC GmbH



Applications

Bakery machines
Bottle-washing machines
Brick-making machines
Cardboard-making machines
Cigarette making machines
Construction machines
Conveying systems
Engine building
Engraving machines
Filling machines
Gas producers
Gliders
Handling machines
Hydraulic cylinders
Knitting machines
Labelling machines
Leather-working machines
Lifts
Machine tools
Mining machines
Mixing machines
Motor vehicles
Packaging machines
Pneumatic cylinders
Power engineering
Preforming machines
Printing machines
Road-building machinery
Scales
Separating equipment
Sewing machines
Signaling equipment
Snow-clearing machines
Spinning machine
Textile machinery
Vehicles
Water turbines
Welders
Wine-bottling machines
Woodworking machines
and many more

General information

Standard products
Details of the possible variations can be found in the text below the tables.

Special parts
We also manufacture according to customer requirements or drawings.

Warranty
All catalog information is based on many years of experience in the development, manufacture and use of rod ends and spherical plain bearings.

Our guarantee refers to the quality and reliability of our products, but we would like to point out that the operating conditions and parameters may vary in each individual case. General statements about the performance of our products are not always accurate, as practical tests are necessary to verify suitability for specific applications. Therefore, we cannot guarantee the accuracy of any recommendations made regarding the use of our products.

We therefore recommend that you test the products under the intended conditions to obtain the best results. If you have any questions or require further information, please do not hesitate to contact us!

Certificates
ISO 9001 / EN 9100 / ISO 14001 / TISAX

Consulting and sales
Our employees, representatives and authorized dealers in Germany and abroad are at your disposal.

Warranty rights
Please refer to our "General Terms and Conditions of Delivery and Payment".

Technical changes
We reserve the right to make technical changes.

Sales and Advice Carl Hirschmann GmbH

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T: +49 32 222 007 000
E: info@eriks.de

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E: info@mat-antriebstechnik.de

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01730 Vantaa, Finland
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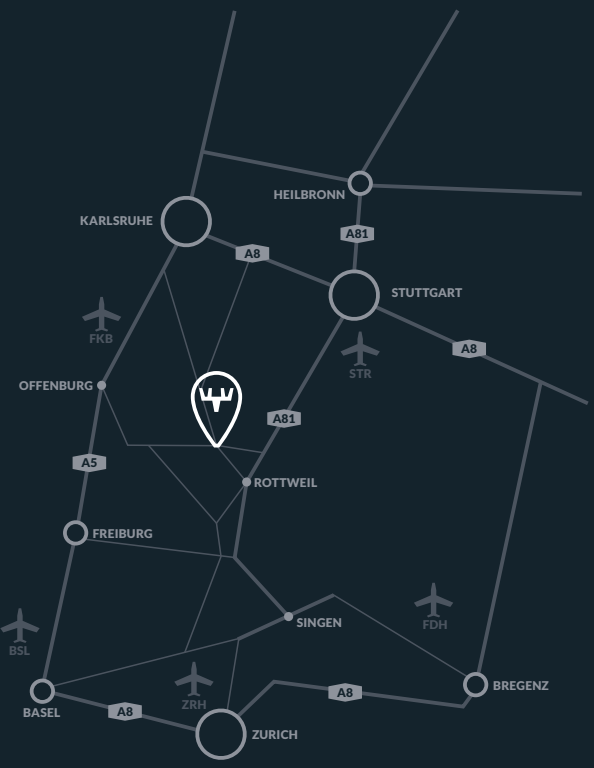

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