

# General product information

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## General product information

# Properties

## Spherical plain bearings

Spherical plain bearings are standardized, ready-to-mount, mechanical components that enable multi-directional, self-aligning movements. The inner ring has a spherical convex outside diameter, while the outer ring has a correspondingly concave inside diameter (→ **fig. 1**). The forces acting on the bearing may be static or may occur when the bearing makes oscillating or recurrent tilting and slewing movements at relatively low speeds.

Design advantages inherent to spherical plain bearings include the ability to:

- accommodate misalignment (→ **fig. 2**)
- virtually eliminate edge stresses and excessive stressing of adjacent components (→ **fig. 3**)
- accommodate deformation of surrounding components in operation (→ **fig. 4**)
- accommodate wide manufacturing tolerances and the use of cost-effective, welded assemblies (→ **fig. 5**)

Fig. 1

Spherical plain bearing

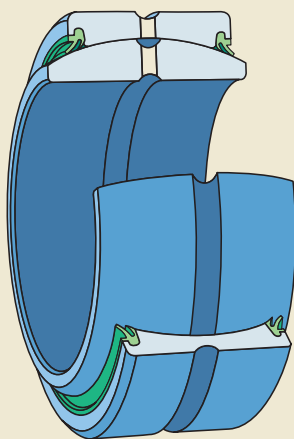


Fig. 2

Spherical plain bearings are designed to accommodate misalignment

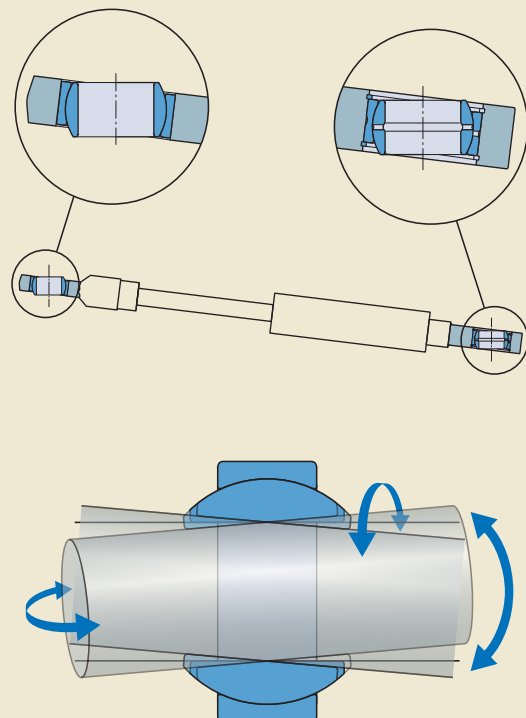


Fig. 3

Compared to bushings, spherical plain bearings provide higher reliability, as the chance of edge stresses and overloading are virtually non-existent

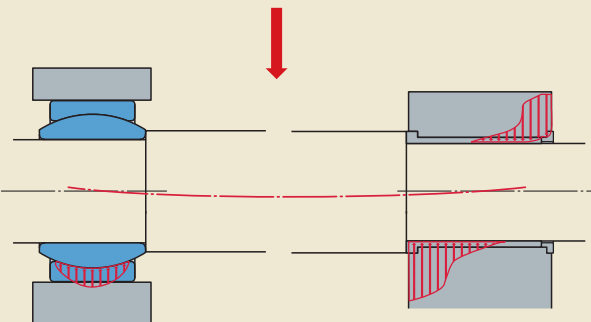


Fig. 4

Shaft deflection does not have a negative influence on bearing service life, the shaft or housing

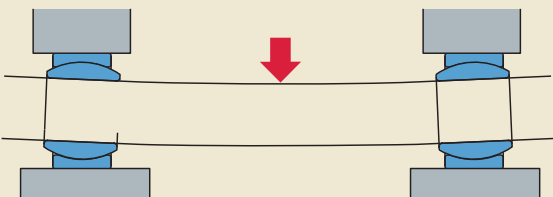


Fig. 5

Spherical plain bearings can accommodate the wide manufacturing tolerances found in cost-effective welded assemblies

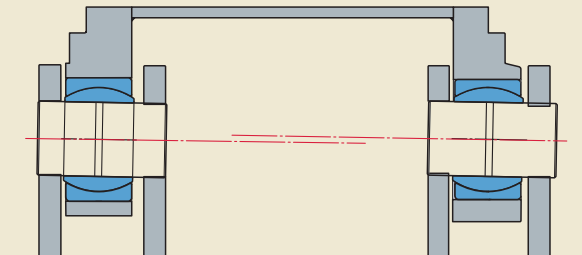
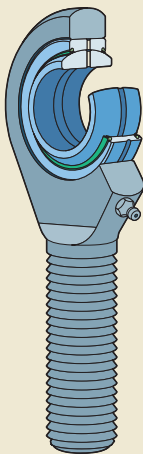


Fig. 6

Rod end with a male thread



## General product information

# Bearing designs and features

SKF spherical plain bearings and rod ends are an excellent choice for applications that require total design economy. These state-of-the-art products are available in a wide assortment of designs, dimension series and sizes to meet the needs of a particular application. **Fig. 7** shows the general bearing and rod end types.

Whether the application calls for a large spherical plain bearing or a small rod end assembly, both are available from SKF and offer:

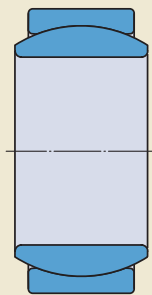
- long service life
- minimal maintenance
- high operational reliability

worldwide, making them readily accessible whenever and wherever they are needed.

Economic considerations and unparalleled design characteristics are not the only reasons that SKF spherical plain bearings and rod ends are the ultimate solution for any plain bearing application. Their designs, materials and manufacturing quality enable long service life and high reliability even in the most demanding applications.

SKF spherical plain bearings and rod ends, produced with standard dimensions, are available

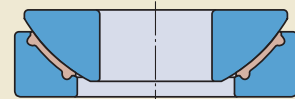
Fig. 7



Radial spherical plain bearing



Angular contact spherical plain bearing



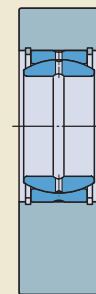
Thrust spherical plain bearing



Rod end with a female thread



Rod end with a male thread



Rod end with a welding shank

## Bearings and rod ends requiring maintenance

Bearings and rod ends requiring maintenance must be greased prior to being put into operation. With the exception of a few applications, they must be relubricated periodically.

SKF steel/steel radial spherical plain bearings are made of bearing steel and are through-hardened. The high-strength sliding contact surfaces are phosphated and treated with a special running-in lubricant. These bearings are used primarily in applications where there are:

- heavy static loads
- heavy alternating loads
- shock loads

They are also relatively insensitive to contaminants and high temperatures.

To facilitate relubrication, lubrication holes and grooves are provided in both the inner and outer rings of all steel/steel radial spherical plain bearings – with the exception of a few small sizes. SKF steel/bronze rod ends also require relubrication. However, requirements are less stringent than for steel/steel rod ends, as the emergency running properties of bronze are more forgiving than steel.

### The multi-groove system

Standard steel/steel radial spherical plain bearings that must accommodate minor alignment movements under very heavy, constant direction loads are prone to lubricant starvation. To maximize the effects of the lubricant under these conditions, SKF has developed the multi-groove system and manufactures all metric steel/steel radial spherical plain bearings with an outside diameter  $D \geq 150$  mm with the multi-groove system on the sliding surface of the outer ring as standard (→ **fig. 8**). Metric steel/steel radial spherical plain bearings with an outside diameter  $D < 150$  mm can be supplied with the multi-groove system on request. These bearings are identified by the designation suffix ESL.

These lubrication grooves provide the following benefits:

- improved lubricant supply to the loaded zone
- enlarged lubricant reservoir in the bearing
- enable relubrication under load
- extended relubrication intervals
- space for wear particles and contaminants
- extended grease life

The main benefit of the multi-groove system is that it improves lubricant distribution in the heavily loaded zone to extend service life and/or maintenance intervals.

Fig. 8

Steel/steel radial spherical plain bearing with the multi-groove system



General product information

Maintenance-free, long-life sliding contact surfaces

“Maintenance-free” is an industry-wide term used to describe plain bearings and rod ends with self-lubricating sliding contact surface combinations. The term maintenance-free does not imply that these bearings should not be inspected as part of a regularly scheduled maintenance program.

These so-called maintenance-free bearings and rod ends offer a number of advantages for OEMs and end users alike. These advantages, which include minimal maintenance and reduced lubricant consumption, quickly compensate for the difference in the initial purchase price when compared to standard steel/steel bearing solutions. And of course, the impact that maintenance-free bearings have on the environment is an added benefit.

To offer maintenance-free solutions for the greatest number of applications, SKF produces spherical plain bearings and rod ends with different sliding contact surface combinations (→ fig 9). These combinations, which in some cases are size dependent, include:

- steel/PTFE (polytetrafluoroethylene) sintered bronze
- steel/PTFE fabric
- steel/PTFE FRP (fibre reinforced polymer)

Maintenance-free bearings can operate without grease, and therefore do not need to be relubricated. Depending on the sliding surfaces, grease

can improve bearing service life or can have a negative effect on it. Therefore, SKF does not recommend the use of lubricants for bearings with steel/PTFE sintered bronze or steel/PTFE fabric sliding contact surface combinations, whereas initial lubrication followed by occasional relubrication of steel/PTFE FRP bearings can extend the service life of the bearing.

Be aware that “maintenance-free” refers to bearing service life only, and does not refer to the service life of an application or general maintenance intervals of other machine parts in the application. For detailed information about the life of spherical plain bearings or rod ends, refer to the section *Basic rating life* starting on **page 39**. The basic rating life as a guideline value for the service life under certain operating conditions can be calculated using the information provided in the section *Basic rating life calculation* starting on **page 51**.

Self-lubricating, dry sliding materials are not as stiff as steel and consequently are subject to greater deformation under load than steel. These sliding materials are also more sensitive than steel to alternating or shock loads. If either of these load conditions exists, contact the SKF application engineering service.

Maintenance-free bearings and rod ends are designed for applications where:

- load direction is constant and may be heavy
- low coefficient of friction is necessary
- relubrication is not possible or difficult



## Optional SKF design features

### A choice of materials

For most applications, SKF spherical plain bearings made of standard bearing steel requiring maintenance are an excellent choice. However, for difficult operating environments, SKF maintenance-free stainless steel spherical plain bearings may be preferred. For other material options, e.g. surface treatments, contact the SKF application engineering service.

### With or without seals

Most popular sizes of SKF spherical plain bearings are available either open (without seals) or sealed on both sides (→ **fig. 10**). Standard sealed bearings can increase the service life of a bearing and save space, while reducing inventory and assembly costs. Maintenance-free bearings without seals have to be protected against contaminants.

Spherical plain bearings fitted on both sides with the SKF RS double lip seal are very effective, under normal operating conditions, at keeping contaminants away from the sliding contact surfaces. These seals also effectively retain the grease and therefore are appropriate for bearings requiring maintenance.

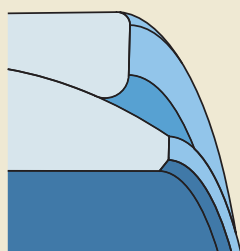
Maintenance-free bearings and all bearings operating in highly contaminated environments should be fitted with the SKF LS triple-lip heavy-duty contact seal (→ **page 79**). They are reinforced with a steel insert and have three seal lips. These very effective seals protect the bearing against contaminants and enhance the operational reliability of the spherical plain bearing.

### Wide operating temperature range

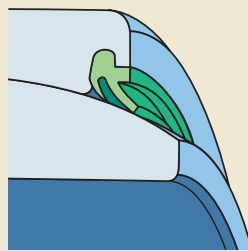
SKF spherical plain bearings and rod ends can operate effectively over a wide temperature range. The operating temperature range of open (without seals) steel/steel radial spherical plain bearings is  $-50$  to  $+200$  °C.

Fig. 10

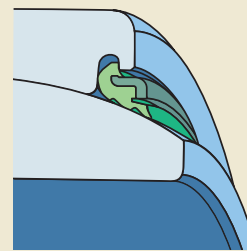
Many sealing problems can be solved economically and in a space-saving manner using sealed bearings



without seal  
(open design)



double-lip seal  
(RS design)



triple-lip heavy-duty seal  
(LS design)



## General product information

# Multi-purpose performance

## Typical applications

Long service life, high reliability and minimal maintenance are some of the features of SKF spherical plain bearings and rod ends. SKF's wide assortment of spherical plain bearings and rod ends is versatile enough to be used in a variety of applications that encompass almost all sectors of industry, including:

- agriculture
- construction
- forklift trucks
- material handling
- metals
- mining
- railways
- trucks
- wind energy

## Application examples

### Suspended roof

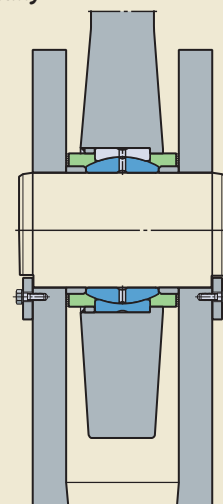
SKF steel/steel radial spherical plain bearings are in service in an unusual and world-renowned application, the roof of the Olympic Stadium in Munich, Germany (→ **fig. 11**). The roof is constructed of a number of pre-stressed steel cables in a network. The nodal points of the network must be torque-free. That is where 225 standard SKF steel/steel radial spherical plain bearings with bore diameters ranging from 160 to 300 mm are located. The nodes are statically loaded but must enable occasional swinging movements of the roof construction.

Although SKF steel/steel radial spherical plain bearings are typically not maintenance-free, these particular bearings have not been relubricated since the construction of the building in 1972.

What better proof could there be for lasting quality and reliability?

Fig. 11

Nodal points of suspended roof construction of the Olympic Stadium in Munich, Germany





### Road roller articulation joint

SKF spherical plain bearings in the articulation joint between the front and rear rollers (→ **fig. 12**) enable a road roller to manoeuvre. This joint must be able to withstand very heavy radial loads and high vibration levels. Due to their location, the bearings should be protected as they are exposed to a variety of contaminants including dust, dirt, water and hot tarmac, which promote premature wear and corrosion.

SKF maintenance-free spherical plain bearings help to eliminate the need for relubrication, and reduce the total cost of ownership.

### Truck twin-axle supports

An SKF spherical plain bearing arrangement on the truck twin-axle support provides even load

distribution between the two axles for trucks driving on rough roads or off-highway conditions (→ **fig. 13**). This bearing arrangement is subjected to heavy loads and, depending on the conditions, heavy shock loads, and frequent alignment movements.

These bearings are located behind the tires in an area that is very difficult to access, making it imperative that sudden bearing damage or failure, requiring immediate roadside repairs, be avoided at all cost. A pair of SKF angular contact spherical plain bearings mounted in a back-to-back arrangement can help prevent these emergencies. These bearings, which can withstand all the rigours of truck duty, are simple to install and easy to maintain.

Fig. 12

Road roller articulation joint

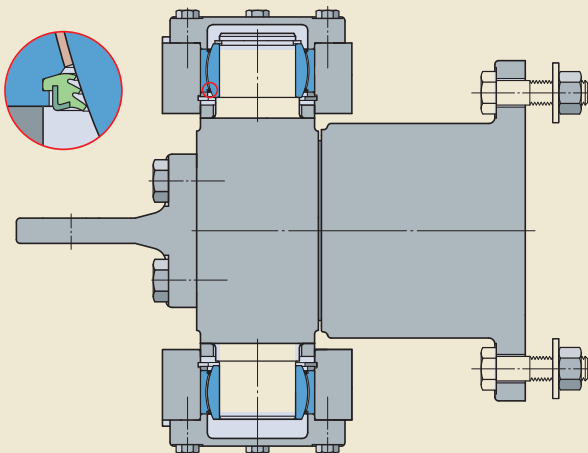
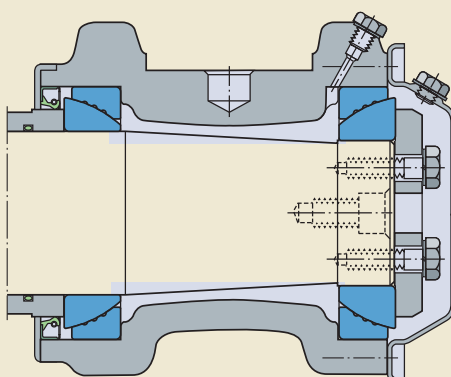


Fig. 13

Truck twin-axle supports



## General product information

### Dam gates

Segment gates for dams and other barrages are home to large-size SKF maintenance-free spherical plain bearings (→ **fig. 14**). The reference list is very long – with over 3 000 applications to date.

As main bearings, they compensate for shaft misalignment, caused by thermal expansion and contraction, elastic deformation of the dam gates as well as changes caused by settling of the foundation. These bearings cope with the heavy radial loads caused by water pressure as well as axial loads that arise from the inclined position of the support arms.

In addition, SKF spherical plain bearings not only serve as heavily loaded bearings under static conditions, they also operate in the frequently used linkage attachments of the lifting and plunger cylinders as well as the flaps.

### Hydraulic and pneumatic cylinders

SKF steel/steel and steel/bronze rod ends are frequently used on hydraulic and pneumatic cylinders (→ **fig. 15**). Acting as the link between the cylinder and its attachments, they are able to transmit heavy mechanical loads.

Hydraulic cylinders (e.g. to ISO 8132) are often fitted with steel/steel rod ends with a female thread that can be secured (compressible) on one end and a steel/steel rod end with a welding shank on the other.

These types of hydraulic cylinders can be found in all types of construction equipment, agricultural machinery, lifting equipment and shutters, recycling depot presses as well as other heavily loaded manoeuvring equipment.

In pneumatic cylinders where working pressures regularly reach 1 MPa, steel/bronze rod ends and maintenance-free rod ends are typically used at the end of the piston rod. At the opposite end, SKF rod ends with a welding shank are used.

### Newspaper conveyor

Speed and flexibility are all-important when producing newspapers, not only in the printing process, but also in distribution. The conveyor system from the printing press to the loading dock is a very important component if the newspapers are to be delivered on time.

The endless conveyor chain is one such system. It consists of a multitude of links, which together provide the speed and flexibility required. **Fig. 16** shows an application where more than 1 000 SKF maintenance-free spherical plain bearings with the sliding contact surface combination steel/PTFE sintered bronze are used. The bearings have been in daily service without maintenance for many years.

Fig. 14

Dam gates

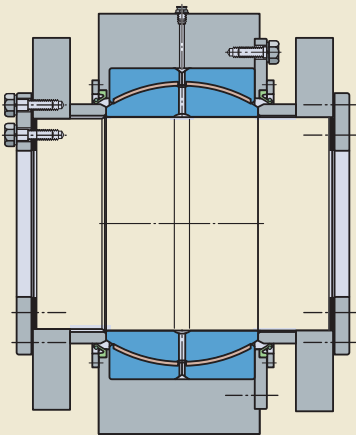
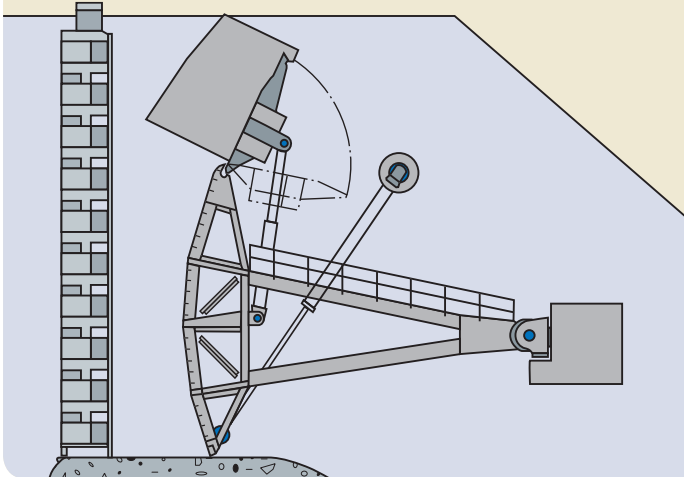


Fig. 15

Hydraulic and pneumatic cylinders

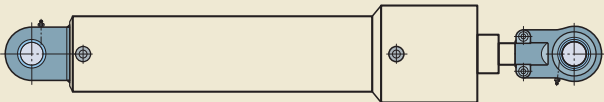


Fig. 16

Newspaper conveyor

