

Bearing basics

Special Notes for iPad Users

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The app offers a download option for offline learning, but please note that:

1. An on-line connection is required to use the links on the “resources” tab
2. If you wish to be able to print your course completion certificate then you need to be on-line when you take the end-of-course test

To continue, you can click the Home icon on the screen to return to the Welcome page of the course.

Welcome

Welcome to the Basic introduction to rolling bearings course. This course will give you an introduction to SKF bearings and consists of three sections: Functions and parts, Applications and bearing types, and Designations.

Module 1: Functions and parts

Why bearings?

Bearings are an essential component of almost all machinery. They transmit loads between, support, guide and locate, machine elements that are required to move relative to each other with a minimum of friction, e.g. a rotating or oscillating shaft, pivot or wheel.

Friction: Page 1

Friction counteracts the movement between two surfaces. It is essential for the success of many operations, such as a car tyre gripping a road. In most machines however, friction is undesirable since it causes power loss, heat generation, wear and noise. SKF bearings help reduce friction.

Friction: Page 2

The earliest bearings were mostly made of wood and consisted of a shaft rotating in a hole in a housing, or a wheel rotating on a stationary shaft. Because the components were sliding over each other, friction was relatively high and wear rather rapid.

This type of bearing is called a plain bearing and, made of modern materials, is still used in some applications today where speeds and loads are relatively low.

Friction: Page 3

The introduction of rolling elements between the shaft and the housing greatly reduces friction.

Friction: Page 4

Today, typical SKF rolling bearings combine maximum load capacity with minimum friction, using hardened steel or ceramic rolling elements, hardened steel inner and outer rings and a cage to guide and separate the rolling elements.

Loads: Page 1

A bearing can be under radial load, perpendicular to the shaft, or under axial load, acting in the direction along the shaft, or a combination of both radial and axial load, a combined load.

Loads: Page 2

Large bearings support heavier loads than small bearings can support, and roller bearings support heavier loads than ball bearings can support.

Raceway contact

The basic difference between ball bearings and roller bearings is in the contacts between the rolling elements and the raceways. Balls have point contact; rollers have linear contact with relatively larger area.

Bearing parts

A typical rolling bearing consists of an inner ring, an outer ring and rolling elements contained by a cage. The most common type of rolling bearing is the deep groove ball bearing. These bearings can, as shown here, be supplied with integral seals to retain the lubricant and resist the ingress of contamination.

Selection factors

There are many factors, which will affect the choice of a bearing. These are: Available space, load, required service life, misalignment, speed, stiffness, axial displacement and clearance.

Selection factors: Space

Space can be an important factor in bearing selection. Where radial space is limited a bearing with small diameter rolling elements, such as a needle roller bearing, may be needed.

Selection factors: Load

When selecting a bearing, it is important to consider the direction of the load, and the amount of load the bearing will have to carry. A bearing can be under radial load, axial load, or a combination of both.

Selection factors: Required service life

The life of a bearing can be expressed in terms of: the number of revolutions before failure, the number of operating hours before failure, or the distance covered (for cars and trucks). A bearing is considered to have failed when it shows the first sign of fatigue in a rolling element or raceway, or damage to other parts such as the cage or the seals. Service life is the real life that an individual bearing achieves in a particular application before it has to be replaced. It depends on a variety of influencing factors, including lubrication, the degree of contamination, misalignment, proper installation, and environmental conditions.

Because service life cannot be calculated or predicted, bearings are selected using calculated rating life. SKF rating life L10m, a reference value calculated according to statistical methods, using modification factors for lubrication conditions and degree of contamination, and applying the same concept of a fatigue load limit as used in ISO 281, to estimate the life, with 90% reliability, that a sufficiently large population of apparently identical bearings might achieve when all are operating in an identical application.

Selection factors: Misalignment

Where a bearing is likely to be subject to angular misalignment, for example the shaft might bend due to operating loads, appropriate bearings need to be selected. Self-aligning bearings can accept a degree of operational misalignment and can also compensate for limited initial alignment errors in mounting.

Selection factors: Speed

The maximum speed that a bearing can be run in an application is limited by the maximum operating temperature for the materials used in its manufacture, or the lubricant. For high-speed applications minimum possible friction is important, so ball bearings are generally used.

Selection factors: Stiffness

Elastic deformation occurs under load. Usually this deformation is very small and can be ignored. However, in some applications, stiffness is an important factor. Roller bearings have higher stiffness than ball bearings due to the larger area of the line contact.

Selection factors: Axial displacement

Some applications require bearings that allow the shaft to move axially relative to the bearing. This is called axial displacement. Most often, a shaft is supported by a locating bearing and a non-locating bearing. The locating bearing does not allow axial displacement and keeps the shaft in position. The non-locating bearing supports the shaft and allows displacement to prevent the bearings from being stressed. Cylindrical and CARB toroidal

roller bearings can accommodate a limited degree of axial internal displacement.

Selection factors: Clearance

The amount of initial internal radial clearance required in a bearing depends mainly on the fits and temperature gradient between the inner and outer rings of the bearing in the particular application. Operational internal radial clearance is almost always less than initial internal clearance. SKF manufactures bearings with the following ranges of radial internal clearances:

- C1 radial internal clearance less than C2
- C2 radial internal clearance less than Normal
- -- Normal radial internal clearance
- C3 radial internal clearance greater than Normal
- C4 radial internal clearance greater than C3

Summary

In this lesson, you have learnt about the functions of a bearing. These are: reducing friction, transmitting loads, locating and guiding moving parts. You have also been introduced to the different parts of a bearing: outer and inner rings, rolling elements, cage, and seals and their respective functionalities.

Finally, you have also explored the different selection factors, which will affect your choice of bearing: available space, load, required service life, misalignment, speed, stiffness, axial displacement and clearance.

Module 2: Applications

Introduction

In this section you will be introduced to the most common bearing types offered by SKF.

Motor: Page 1

Electrical motors can be found almost anywhere there is mechanical movement.

Motor: Page 2

In this drawing you can see that the shaft is supported by two different bearings.

Motor: Page 3

Cylindrical roller bearings are simply bearings with cylindrical rollers. They can usually accommodate heavy radial loads and can operate at relatively high speeds.

Motor: Page 4

It is now time to choose the right side bearing.

Motor: Page 5

Deep groove ball bearings have deep uninterrupted raceways and close osculation between balls and raceways. This enables them to take axial loads in both directions.

Pump: Page 1

A pump is a device for lifting, transferring or moving fluids by suction or pressure from one position to another. This picture shows a medium-duty process pump, which is often used in refineries.

Pump: Page 2

In this drawing you can see that the shaft, which is running the impeller, is supported by one deep groove ball bearing to the right, and another bearing or bearings to the left.

Pump: Page 3

Single row angular contact ball bearings are widely used in medium and heavy-duty centrifugal pumps. They have raceways arranged at an angle to the bearing axis.

Pump: Page 4

Single row angular contact ball bearings can only take axial load in one direction. Therefore they are nearly always mounted as pairs in back to back or face to face arrangement at either end of a shaft, or as shown here, universally matchable bearings mounted immediately adjacent to each other.

Fan: Page 1

This is an industrial fan, in which SKF bearings are commonly used. Industrial fans can either be designed for light loads and high speeds, or for heavy loads and moderate speeds.

Fan: Page 2

A fan is designed with two bearings along its shaft, placed between the fan and the motor. Both bearings carry radial loads and the bearing closest to the fan (on the left hand side here) also needs to be a locating bearing, keeping the shaft and the fan in a fixed position.

Fan: Page 3

Spherical roller bearings have two rows of rollers with a common raceway in the outer ring. The two inner ring raceways are inclined at an angle to the bearing axis.

Fan: Page 4

Returning to the fan application again, you now know which bearing is suitable as the locating bearing and here you have to make a guess concerning the non-locating bearing.

Fan: Page 5

CARB [ka:b] is a single row toroidal roller bearing with long, slightly crowned, rollers and concave raceways in both the inner and outer rings.

Fan: Page 6

The complete application looks like this with one spherical roller bearing and one CARB toroidal roller bearing.

Separator: Page 1

Alfa Laval, a Swedish company, has developed a range of machines specifically designed for rigorous oil processing duties. An example of this would be separators.

Separator: Page 2

The separation process creates imbalance due to the mud, which is distributed unevenly inside the separator and this makes the spindle bend.

Separator: Page 3

Self-aligning ball bearings have two rows of balls and a common concave sphered raceway in the outer ring. This makes the bearing insensitive to angular misalignments of the shaft relative to the housing. Self-aligning ball bearings accommodate high speeds due to the point contact between balls and raceways.

Refiner: Page 1

SKF bearings can be used in refiners in the production of mechanical pulp and other high-yield pulps.

Refiner: Page 2

In the process wood chips are ground at high mechanical pressure between a stationary disc and a rotating disc, which is powered by an electrical motor. The shaft between the motor and the grinding discs is supported by three bearings.

Refiner: Page 3

The high production capacity of the refiners is directly related to the demands on the bearing arrangement. The bearings have to provide high stability, operate at high speed, carry high thrust loads and handle deflections of the shaft.

Refiner: Page 4

The spherical roller thrust bearing incorporates a large number of asymmetrical, spherical rollers and has specially designed raceways. The load is transmitted from one raceway to the other at an angle to the bearing axis and the bearing can carry heavy axial load in one direction and some simultaneously applied radial load as well.

Refiner: Page 5

This is how the spherical roller thrust bearings are situated in the refiner application.

Screw conveyor: Page 1

Machines used in the agricultural industry often require bearings that can easily be changed and that can handle misalignments.

Screw conveyor: Page 2

This is a drawing of a screw conveyor attached to an agricultural machine. The bearings are the only contact between the screw conveyor and the machine.

Screw conveyor: Page 3

A Y-bearing unit consists of two parts: a housing and a bearing. The bearing is based on the deep groove ball bearing and can carry light radial and axial loads. It has a convex-sphered outside diameter, which allows the bearing to take up misalignment between the shaft and housing at the assembly stage. They are available with a wide range of highly effective,

integral seals and a range of different methods for easy mounting to the shaft.

Screw conveyor: Page 4

This is what the Y-bearing unit looks like in the screw conveyor.

Front wheel: Page 1

SKF bearings are used in front wheels of commercial vehicles. These applications require bearings that can handle very heavy loads.

Front wheel: Page 2

This drawing shows how a truck front wheel arrangement is designed and where its bearings are situated. The bearings must carry a large part of the weight of the vehicle and the induced forces when driving, which means that they have to handle heavy loads in both radial and axial directions.

Front wheel: Page 3

Tapered roller bearings have tapered rollers running in tapered inner and outer ring raceways. This design makes them suitable for handling heavy combined loads.

A tapered roller bearing can only carry axial loads in one direction and, for this reason, they are generally fitted in pairs.

Front wheel: Page 4

See how the tapered roller bearings are mounted in the front wheel of a commercial vehicle.

Summary

In this lesson, you have studied the most common SKF bearing types. Now click on each bearing picture to repeat the most important characteristics of each type. If you want to read more about SKF bearings, enter the SKF Interactive Engineering Catalogue on line at www.skf.com.

Module 3: Designations

Introduction

SKF bearing designations describe a bearing's or component's type, design, and variants. The designation can be found both on the box and on the bearing itself.

Basic designations: Page 1

A bearing designation for metric size bearings can either consist of a basic designation alone or a basic designation plus one or more supplementary designations, called prefixes and suffixes.

The basic designation identifies the product type and size, while the supplementary designations identify design, special variants and bearing components.

Basic designations: Page 2

Each SKF bearing of standard metric design is given a basic designation, which normally consists of three, four or five figures.

Basic designations: Page 3

For example, the basic designation 22206 denotes a spherical roller bearing with the width series 2, diameter series 2 and a bore diameter of 30 mm.

Supplementary designations: Page 1

The supplementary designations consist of both prefixes and suffixes.

Supplementary designations: Page 2

Prefixes are used to identify component parts of a bearing and are usually followed by the designation of the complete bearing.

Supplementary designations: Page 3

Suffixes are used to identify designs, which differ in some way from the original design. The suffixes are divided into four main groups: Internal design, external design, cage design and variants, all of which are added to the basic designation in this order.

End of course test

Now it's time to see what you learned.

If you pass the test on-line then you'll be able to print your course completion certificate.