SKF @ptitude Exchange

Principles of bearing selection and application: Selection of bearing type

SKF General Catalog 6000

Summary
This fourth in our series of articles on how to use the SKF General Catalogue will focus on: principles of bearing selection and application: selection of bearing type.

Contact details and further information:

Email : skfweb@skf.com
Web: www.skf.com/group/index.html

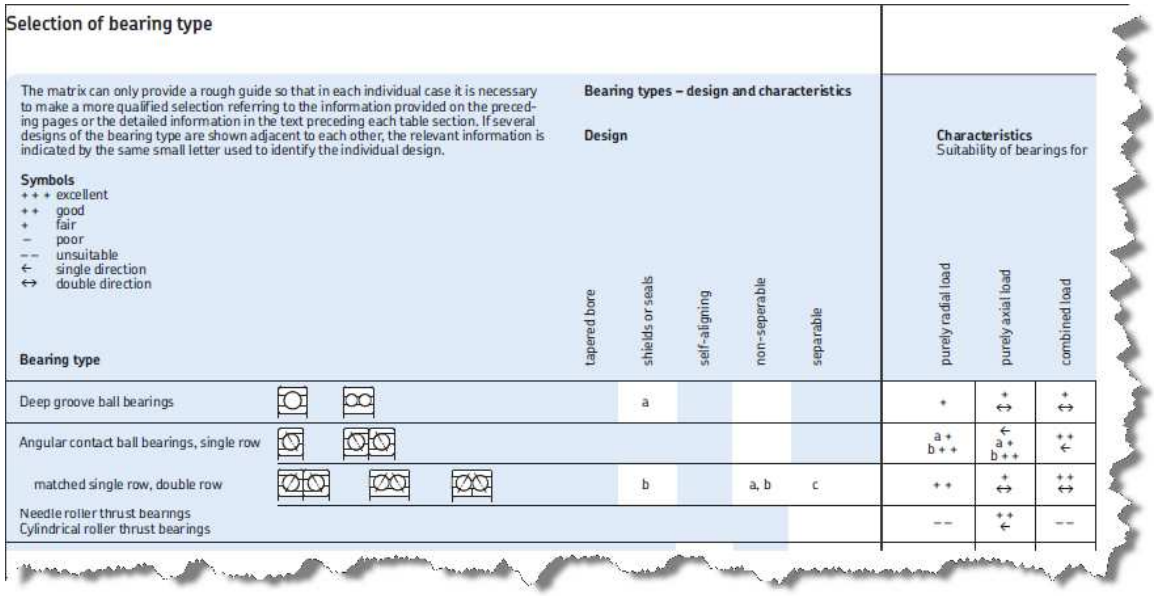
GC6000-2-1
Joe Conyers

5 Pages
Published October, 2009

Introduction

This section of the SKF General Catalogue begins to explain the general concepts of bearing design, which can be grouped into two broad categories. Part 1 of this article will cover bearing Design and Part 2 will discuss Characteristics.

For the person new to rolling element bearings, or new to choosing a specific bearing for an application, this section almost "assumes" the user has a broad knowledge about bearing design and application. However, there is help. Open the SKF General Catalogue to the "*Selection of bearing type*" section. You'll see a table of contents that will lead you through a number of design choices that must be made to select the proper bearing for an application. You're welcome to peruse the entire section later, but for now, let's proceed to the last two pages of this section, just before the "selection of Bearing size." You'll see a matrix (part of which is presented below):



Selection of bearing type

The matrix can only provide a rough guide so that in each individual case it is necessary to make a more qualified selection referring to the information provided on the preceding pages or the detailed information in the text preceding each table section. If several designs of the bearing type are shown adjacent to each other, the relevant information is indicated by the same small letter used to identify the individual design.

Symbols
+ + + excellent
+ + good
+ fair
– poor
– – unsuitable
← single direction
↔ double direction

Bearing types – design and characteristics

Bearing type	Design: tapered bore	shields or seals	self-aligning	non-separable	separable	Characteristics: Suitability of bearings for: purely radial load	purely axial load	combined load
Deep groove ball bearings		a				+	↔	↔
Angular contact ball bearings, single row						a + b + +	← a + b + +	+ + ←
matched single row, double row		b		a, b	c	+ +	↔	+ + ↔
Needle roller thrust bearings Cylindrical roller thrust bearings						– –	+ + ←	– –

Figure 1. Matrix from the SKF general catalogue

As stated in the text of the matrix, "The matrix can only provide a rough guide…" and should be used with the entire catalog in mind as a resource. The matrix is a tool to assist and simplify the design process, but, it's highly recommended to get guidance early and often from the Applications Engineering Service.

Part 1: Design Features

Design features of various bearing types fundamentally limit how the bearing can be used in applications. These design features are:

- Tapered Bore
- Shields or Seals
- Self-aligning
- Non-Separable or Separable

Tapered bore

Most bearings are supplied with a inner ring with a cylindrical bore for mounting on a cylindrical shaft. This is one of the most common methods for mounting rolling element bearings. As an alternative, tapered bore bearings are available for some bearing types with an inner ring bore that is larger on one side than the other. Generally, this is a 1:12 taper, although 1:30 tapered bore are available for some designs. This would mean a bearing with 120mm wide (with a 1:12 taper) would have a bore size 10 mm larger on one side of the inner ring than the other. This tapered bore allows the bearing to be mounted on a tapered shaft, or onto a tapered sleeve that is mated to a cylindrical shaft.

Some industries have already standardized on either cylindrical bore or tapered bore bearing designs. For example, most electric motor and pump applications use a cylindrical bore bearing mated to a cylindrical shaft. On the other hand, industrial fans, paper machines, and some precision bearing applications tend to favor tapered bore bearings.

Shields or seals

As will be discussed in future articles, seals and shields provide a dramatic increase in the service life of bearings in contaminated applications. Choosing a bearing without this feature may require external seals to provide contaminant control. SKF Sealing Solutions can be accessed through the SKF Applications Engineering Service for assistance with you sealing needs.

Self-aligning

SKF patented the first self-aligning ball bearing design in 1906 and has extended the self-aligning concept to several other bearing types, including spherical roller bearings, spherical roller thrust bearings, and the CARB™ toroidal roller bearings. These bearings are often chosen for applications with high dynamic misalignment. An example of dynamic misalignment would be a vibrating screen with rotating imbalance and therefore rotating deflection of the shaft.

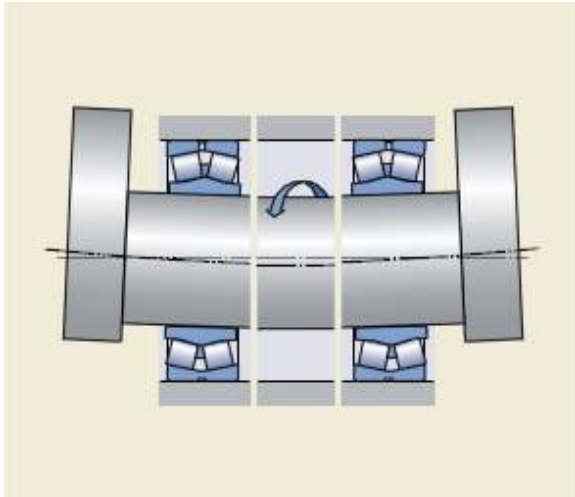


Figure 2. Two spherical roller bearings supporting an eccentric mass on the shaft ends.

Several bearing types also accommodate static misalignment from errors of form or mounting. For example, two y-bearings in a sphered housing cast iron housing can accommodate static misalignment in a light duty fan:

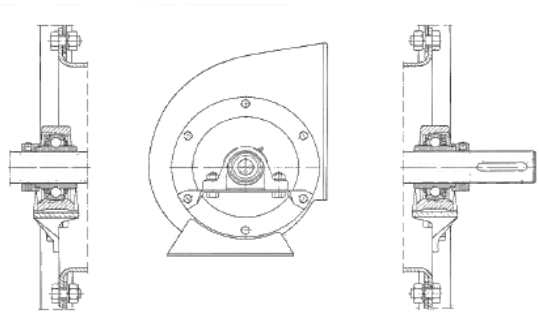


Figure 3. Fan bearing arrangement

Non-separable or separable

A compelling advantage of a separable bearing over a non-separable bearing would be ease of mounting. The rings of a separable bearing can be mounted and dismounted separately, making assembly and disassembly much easier for some applications.

Characteristics

The "Selection of bearing type" matrix in the lists fourteen additional characteristics that are important to consider in the bearing selection and design process. These include loads, speeds, stiffness, and so on. Details of each of the characteristics can be found in the preceding pages of the Catalogue section. The accompanying legend ("Symbols") on the matrix indicates the suitability of the bearing for a particular characteristic.

Let's try a "simple" example. You have an industrial hand drill to design. You need a main shaft bearing that can accept both axial and radial loads (also called a "combined" load.) Looking over the matrix, there are several bearings suitable (+, ++ or +++) for combined loads. Deep groove ball bearings, Angular contact ball bearings, several types of Cylindrical roller bearings, one type of Needle roller bearing, Taper roller bearings, Spherical roller bearings and Spherical roller thrust bearings *may* be suitable. However, the shaft size required to support the loads you have estimated with this drill is under 20 mm. Although not apparent from the matrix, a quick look at the "Product tables" doesn't list any spherical roller bearings smaller than 25mm bore diameter, or any spherical roller thrust bearings less than 60mm bore diameter. That still leaves several choices. A single bearing that has a "double-arrow" <-> might be a good choice, since a bearing that can carry axial (thrust) load in both directions (double direction) means extra space isn't required for two bearings. You have begun to narrow down the options. The lesson learned might be that there are no "simple" applications. The matrix is a good guide to begin looking in the right direction. Read all the notes, and use with caution.

Other processes can be used to narrow down choices, such as rank-ordering the most desirable characteristics and eliminating the least likely candidates.

Another process would be to dive in and make a "best guess" selection. Then consult your local SKF Applications Engineering Service for advice. There are some excellent reasons to call for help:

1. Prevent costly re-engineering
2. Reduce field failures from unexpected or unfamiliar operating conditions
3. Some bearings use more energy to operate
4. Some bearing type are more "maintenance friendly"
5. Some bearing types have extremely limited production rates
6. Many features are not available for all bearing types
7. Technologies may be available that are not yet published

Finally, the SKF General Catalogue doesn't consider at least two practical factors: Cost and availability. Your local SKF Applications Engineering Service can assist with every aspect of the bearing selection process from a design, maintenance and operational standpoint. Your local Authorized SKF Distributor and SKF sales team can complete the commercial part of the selection process with advice on cost and availability.

Next in our series will be the SKF General Catalogue: Principles of Bearing selection and Application: Selection of Bearing Size: System Approach to Bearing Reliability.