

Rolling Element Bearing Basics

Since everything in industry turns on bearings, it is necessary for those persons responsible for keeping equipment running to fully understand bearings. There are two types of bearings; namely, sliding bearings and rolling bearings. The majority of bearings used are rolling bearings and the subject of this article will concentrate only on rolling bearings.

Rolling bearings were developed in order to eliminate sliding friction. Sliding friction is the resistance that takes place when one object slides against another, as shown in **Figure 1**. In some applications, sliding friction is almost eliminated with smooth machined or cast metal bearing elements that slide against equally smooth surfaces separated by a thin film of lubricant.

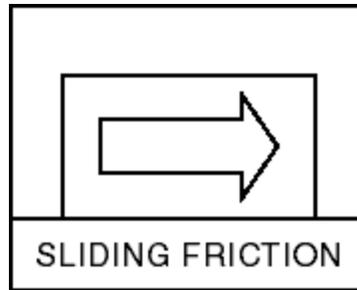


Figure 1

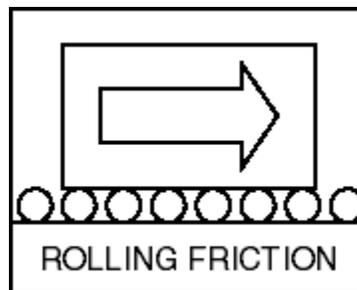


Figure 2

A better way to eliminate sliding friction in many applications is the introduction of rolling elements. Placing rolling elements namely balls or rollers, between the moving surfaces, as illustrated in **Figure 2**, replaces sliding friction with rolling motion. This principle is the basis of all anti-friction bearings.

Practically all rolling bearings consist of four basic parts; namely: inner ring, outer ring, rolling elements, and cage or separator, as shown in **Figure 3**. Three of these parts the inner ring, outer ring, and rolling elements - support the bearing load. The fourth part - the cage or separator - provides positive separation of adjacent rolling elements.

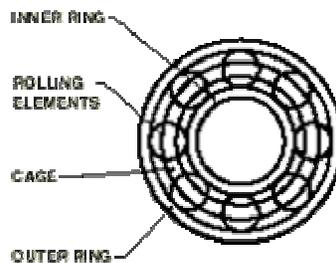


Figure 3

Depending on the internal design, rolling bearings may be classified as radial bearings or thrust bearings. A radial bearing is designed primarily for carrying a radial load. Radial load is a pressing force at right angles to the shaft (**Figure 4**). Thrust load is a pushing force against the bearing parallel to the shaft (**Figure 5**).

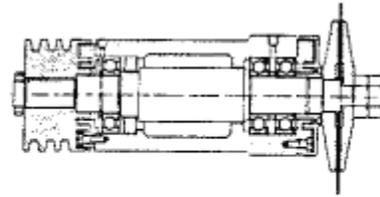


Figure 4

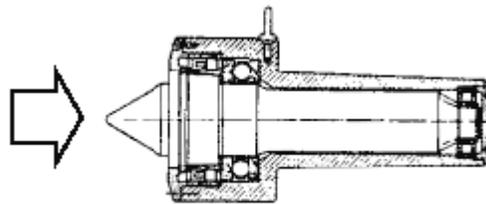


Figure 5

There are two basic bearing families, namely ball and roller. Each family includes a variety of bearing designs, depending on the following requirements:

- 1) Available space
- 2) Loads
 - a) Magnitude of load
 - b) Direction of load
 - (1) Radial load
 - (2) Axial load
 - (3) Combined load
- 3) Misalignment
- 4) Speed
- 5) Precision
- 6) Quiet running
- 7) Stiffness
- 8) Axial displacement

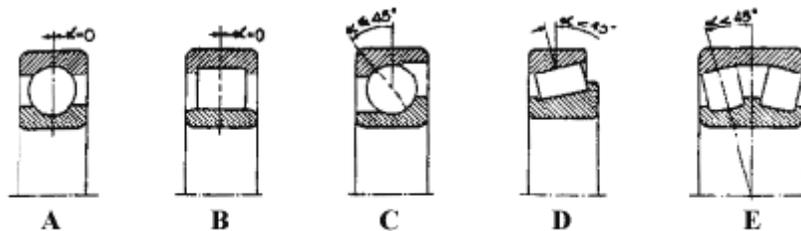


Figure 6

Since most types of radial bearings can carry some thrust, there is no sharp distinction between them; however, bearings having a contact angle $\alpha = 45$ or smaller ($\alpha < 45$ degrees) are considered radial bearings and their ratings are given as radial load. Some of these bearings are shown in **Figure 6** and are identified as shown below:

- A. Ball bearing
- B. Cylindrical roller bearing
- C. Angular contact ball bearing
- D. Tapered roller bearing
- E. Spherical roller bearing

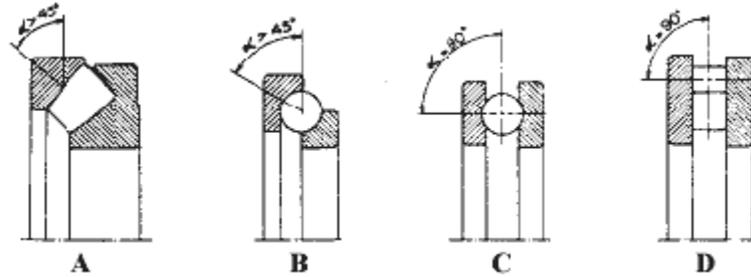


Figure 7

Bearings with a contact angle a greater than 45 ($\alpha > 45$ degrees) are considered thrust bearings and are rated axially. Some of these bearings are shown in **Figure 7** and are identified as shown below:

- A. Spherical roller thrust bearing
- B. Ball thrust bearing
- C. Ball thrust bearing
- D. Cylindrical roller thrust bearing

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