Ball Bearings

D. BALL BEARINGS

1.0 INTRODUCTION

Ball bearings are used widely in Instruments and machines in order to minimize friction and power loss.While the concept of the ball bearing dates back at least to Leonardo da Vinci, their design and manufacture has become remarkably sophisticated. In the following we shall review their basic characteristics.

2.0 TYPES OF BALL BEARINGS

Commercially available ball bearings, which are usually made from hardened steel, involve many forms of construction. These have been summarized by A.O. DeHart ("Which Bearing and Why", ASME Paper 59—MD—12, 1959), from which source the following material (including Figures 1 & 2) is hereby reprinted: *

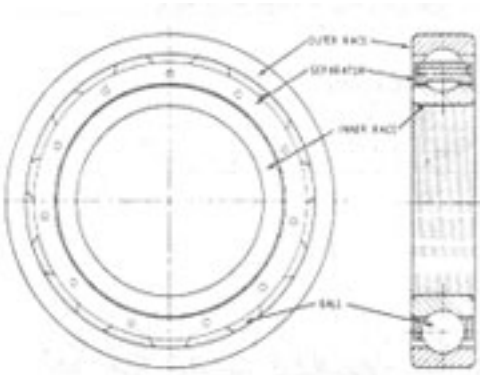

Figure 1 Typical High-Speed Ball Bearing

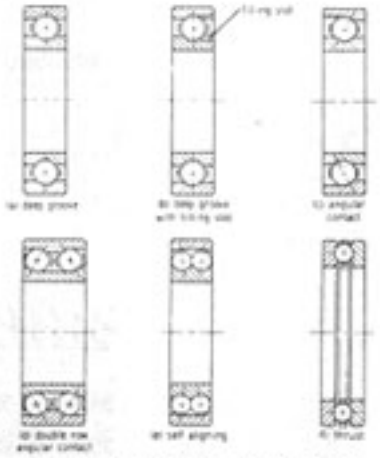

Figure 2 Standard Ball Bearing

"A typical deep-groove bail bearing designed for high-speed operation is shown in Figure 1. in this bearing, the separator serves to keep the bails from rubbing against one another and is piloted on the inner race OD. Alternatively, the separator may be piloted by the rolling elements or by the outer race ID. Where rotative speeds are low, the separator often is omitted. The rolling elements may take many forms—cylinders, bails, tapered rollers, barrels, or very slim rollers known as needles—and the whole bearing name is generally taken from this form.

Ball Bearings

There are several types of ball bearings that fit specific needs. The deep-groove ball bearing, Figure 2(a), is the most versatile. Radial loads and thrust-load capacities may be approximately equal in this

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bearing. When it has the proper separator, it is very good for high-speed operation. At low speeds, no bearing separator is required at intermediate speeds, a ball control separator of steel-ribbon construction is adequate; while the ultimate high-speed performance is obtained with a race controlled (or piloted), fully machined separator.

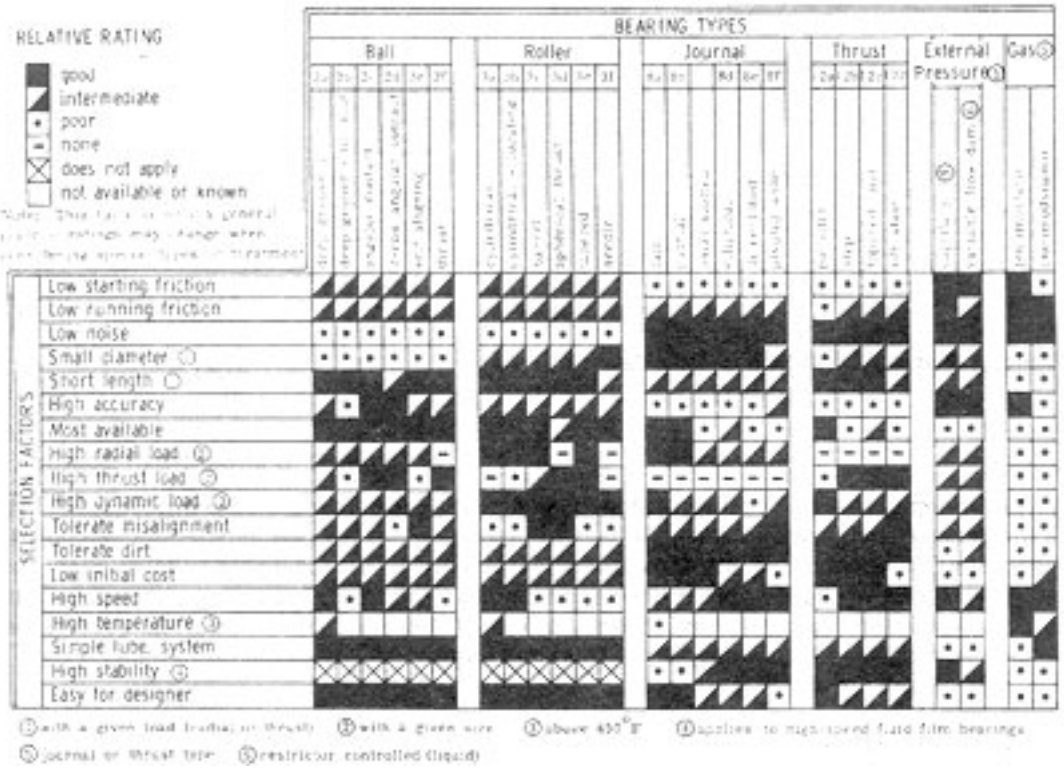
Since balls are assembled into the bearing by eccentric displacement of the races the number of balls in this type of bearing is limited. More balls can be introduced into the bearing if a notch is machined into one of the races, Figure 2(b). Radial load capacity is higher in this bearing than In the standard deep-groove construction, but high-speed performance and thrust-load capacity Is impaired. When large thrust loads in one direction are coupled with radial loads, angular contact ball bearings, Figure 2(c), are usually superior. Most high-speed and precision spindles use axially preloaded pairs of these bearings. Preload is controlled by the length of the spacers, which determine axial location of the races, or by mounting the bearings against one another in a “back-to-back” or “face-to-face” fashion. The double-row, angular-contact bearing, Figure 2(d), is a simpler arrangement from the standpoint of the user. The preload
is built into the bearing at the factory.

In contrast to the previously discussed bearings, in which alignment is a very critical item, the self- aligning ball bearing, Figure 2(e) by virtue of the spherically ground outer race can tolerate considerable misalignment of shaft and housing. On the other hand, load-carrying capacity is. reduced due to the high contact stresses that result from the large difference in curvature between the balls and the outer race.

The thrust bail bearing, Figure 2(f), is adaptable to large thrust loads that have almost no radial component. Very large sizes of this bearing are used in gun turrets and large earth moving machinery.”

Table 1

BEARING SELECTION FACTORS*



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