MECH 3652 MARCH 18, 2020

BEARINGS - a machine element that is intended to support a load (forces and Moments) while allowing for some predefined relative motion (1 or more degrees of freedom) between 2 parts

Types of bearings include:

1 Sliding Contact Bearings
   a) Linear Motion
   b) Rotational Motion
2 Rolling Contact Bearings (Anti friction)
   a) Linear Motion
   b) Rotational Motion
3 Flexural Bearings (Hinges - one piece)
4 Flexural Rolling Bearings
5 Hydrodynamic
6 Hydrostatic or Aerostatic
7 Magnetic

1 Sliding Contact Bearings are often used for low to medium speed applications. Typical materials include various polymers (nylon, etc.), brass, and ceramics. A wide assortment of modular sliding contact bearings can be found in many catalogs.

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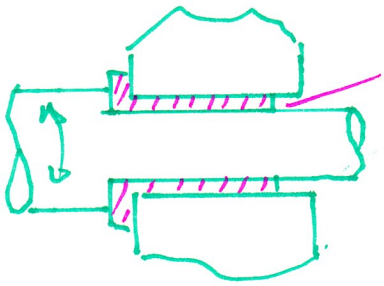
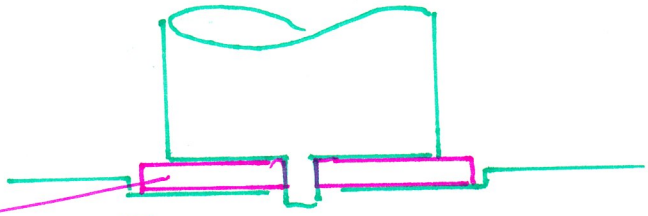
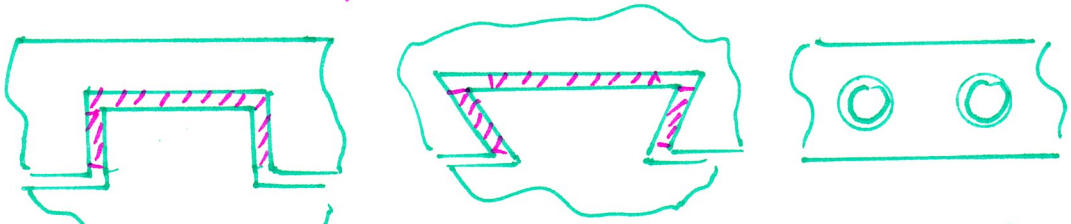
Possible configurations include:



Cylindrical Sliding Contact Bearing (Sometimes called a Bushing Insert)



Washer configuration to support thrust forces



Boxway Dovetail Twin Rail

In most cases, an intermediate material is used, although not necessary, which adds the following functionality

- Friction can be minimized
- Eliminate Wear of Expensive parts
- Helps deal with tolerance issues
- Insolate parts both thermally and electrically
- Isolate and/or dampen mechanical vibrations

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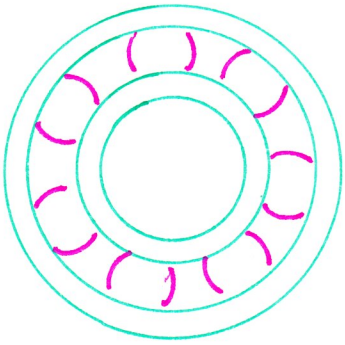
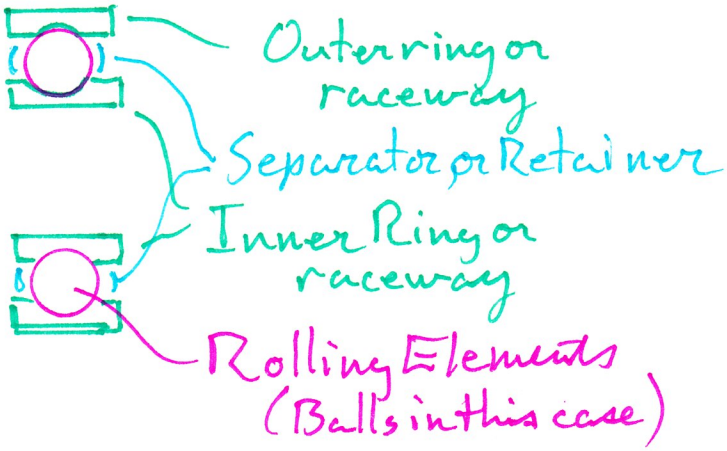
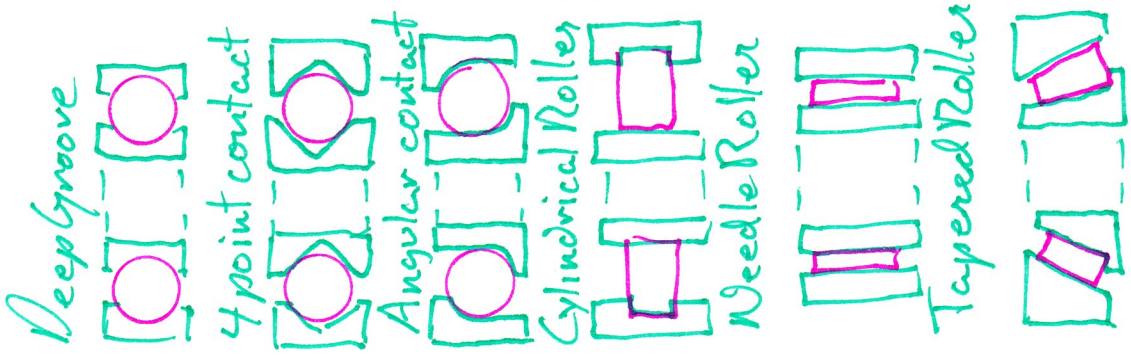
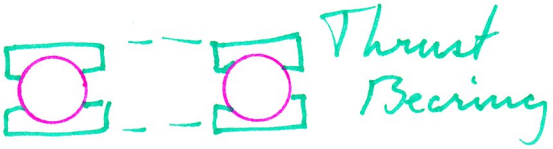
2 Rolling Contact Bearings or often called Antifriction Bearings use Balls or Rollers between parts to reduce friction

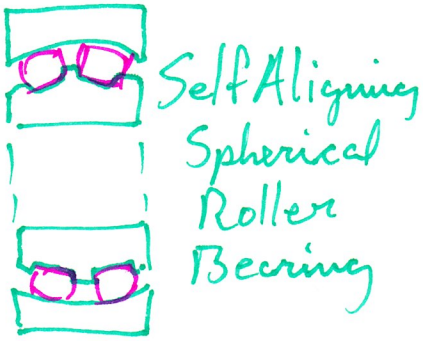




Bearing speed is limited by thermal and centrifugal effects along with the desired load support







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The life of a bearing is determined @ a certain load and counting the number or revolutions until first evidence of failure or the number of hours at a standard speed until first evidence of failure

The following expression gives reasonable results

$$F\,L^{\frac{1}{a}} = \text{constant}$$

F: Force, L: Life

$a = 3$ ball bearings
$= 3.33$ roller bearings

$$\text{Life, } L = 60 \cdot (\text{Life in hours}) \cdot (\text{revs/minute})$$

Normally, the rated life is 1 million revs

Catalogue load rating is represented by $F_{rated} = C_{10}$ or C_0

C_{10}: rated load where 10% of bearings fail

C_0: rated load where 0% of bearings fail

We source a bearing given a desired force $F_{desired}$ and for a desired life, using

$$C_{10} = F_{rated} = F_{desired} \cdot \left(\frac{L_{desired}}{L_{rated}}\right)^{\frac{1}{a}}$$

When both radial and axial loads are applied, we can determine an effective force

$$F_e = XVF_r + YF_a$$

where V is the rotation factor

$$V = \begin{cases} 1 & \text{inner ring rotates} \\ 1.2 & \text{outer ring rotates} \end{cases}$$

and X and Y are look-up parameters based on the ratio of F_a/C_0

where C_0 is the basic static load rating Table 11-1

Nt C_0 is typically around 40-60% of C_{10} depending on the size of the bearing

Table 11-4 Gives recommended bearing lifes for various applications