Technical Topics — Bearing Capacity and Life

The capacity of a rotary or linear bearing can be expressed in several ways:

Static Capacity   Is the load that can be applied to a bearing that will cause a small permanent indentation in the race way surface of approximately 0.0001" per 1" of ball or roller diameter

Limiting Load   Used by some manufacturers as an equivalent to static capacity, but it is usually based on testing, and not generally based on an industry standard

Ultimate Capacity   This term is used more in mounted bearings where failure of the actual bearing assembly can be calculated based on strength of materials and defines that point where the product will fail catastrophically

Dynamic Capacity   Is the maximum operating or moving load for the bearing. It is very useful in calculating the predicted life of the bearing and is often manipulated by manufacturers to make their products look superior to their competitors

Capacity Rating Systems

Catalogs usually list one or more of these capacities that are used to determine the suitability and expected life in a given application. The problem is that capacity values can be different for the same product depending on who is doing the calculations. The two major standards organizations are the Anti-Friction Bearings Manufacturing Association (AFBMA) and the International Standards Organization (ISO). Both rating systems use specific and proven rules for their calculations, unfortunately they yield different results / capacities for the same product. For an honest comparison between products you must make sure that the manufacturers are using the same rating system.

Additionally, individual companies often manipulate their bearing capacities, primarily the Dynamic Capacity, based upon what they say are specific results from their own tests. This is where it gets a little sketchy. Clearly a higher capacity bearing will be more desirable, therefore, there is a commercial reason to push these numbers as high as possible.   In some cases their dynamic capacities exceed static capacities, which doesn't make a lot of sense,, ie that the bearing last longer running under load vs just sitting still.

Life Time Calculations

Capacities get a little more complicated when you use them to calculate the application lifetime before failure, or mean time between failure (MTBF) Most dynamic life values are based on a life time value called B10. B10 life is the distance a bearing will travel, expressed in rotations for rotary bearings and in inches or meters for linear bearings, with a 90% chance of surviving, ie 10% will fail. This statistical value has to be multiplied together with the other bearings used in given mechanism to get the expected life of the entire assembly. If you have 4 bearings in a design each designed to their maximum dynamic load capacity, your chances of achieving the expected total lifetime is (0.9x.0.9x0.9x0.9) or about 0.65 or 65%. To increase this percentage requires using bearings with a higher capacity or reduce the bearing loading.