Important Bearing Terminology:

Bearing Life Basic Static Load Rating Dynamic Load Rating

Bearing Life:

The amount of time a bearing will perform in a specified operation before failure. Generally, vendors and engineers talk about the **L-10 life. L-10 life** is the life that 90% of all the bearings exposed to the exact same loading and environmental conditions will reach before failing in fatigue. Another way to think about L-10 life is that represents a reliability of 90%.

Factors affecting bearing life are:

Temperature Lubrication Improperly mounting the bearings

> Misalignment Deformation Contamination

Basic Static Load Rating:

The load that will produce a total permanent deformation in the raceway and rolling element at any contact point of 0.0001 times the diameter of the rolling element is the <u>Basic Static Load Rating</u>.

Basic Dynamic Load Rating:

The load that will give a life of 1E6 revolutions of the inner race.

$$C_{10}(L_R n_r 60)^{1/a} = F_d(L_d n_d 60)^{1/a}$$

 L_R = rating life in hours n_R = rating speed, r/min C_{10} = Catalog rating

 L_D = desired life in hours N_D = desired speed, r/min F_D = desired load

a = 3 for ball bearings, 10/3 for roller bearings

Example:

A bearing vendor rates its bearings for 1E6 revolutions, so that $(L_R n_r 60) = 1E6 \ revs$

If you are the designer and you need a bearing life of 5000 hours at 1725 r/min with a load of 400 lbf and a reliability of 90%, what catalog rating would you look for in the vendor's catalog?

$$C_{10} = F_D \left(\frac{L_D n_D 60}{L_r n_r 60}\right)^{1/a} = 400 \left(\frac{5000*1725*60}{1E6}\right)^{1/3} = 3211 lb = 14.3 kN$$

How to Handle combined loading (Thrust + Radial Loads)

In order to specify bearings that can handle radial and thrust loads, we must be able to express the actual loading on the bearing in terms that the vendor will understand. An equivalent radial load will be computed that considers the effects of both radial and thrust loads.

 $F_e = X_i V F_r + Y_i F_a$

Fe is the equivalent radial load

V is the ring rotation factor (1 when the inner ring rotates, 1.2 when the outer ring rotates) Fa is the axial load

X and Y are geometry factors and depend on the number of balls and the ball diameter

For cylindrical roller bearings, Y is 0.0, since they cannot take an axial load.

To determine the values of Xi and Yi, we need to examine the ratios:

$$\frac{F_a}{VF_r} \le e \ X_i = 1, \ Y_i = 0$$
$$\frac{F_a}{VF_r} > e \ X_i = .56, Y_i \ \text{var} \ ies \ with \ e$$

e is a function of the applied axial load, Fa, and Basic Static Load Rating, Co (Fa/Co).

Example:

A certain manufacturer's angular contact bearing has an axial load of 400 lb applied, a radial load of 500 lb applied and the outer ring is stationary. The basic static load rating, Co, is 4450 lb and the dynamic load rating is 7900 lb. Estimate the L10 life at a speed of 720 r/min.