BEARING LIFE FOR FANS

Bearing Life
The life of a rolling bearing is defined as the number of operating hours at a given constant speed (or no. of revolutions) which the bearing is capable of enduring before the first sign of fatigue (flaking, spalling) occurs on one of its raceway or rolling elements.

It is, however, evident from both laboratory tests and practical experience that seemingly identical bearings operating under identical conditions have different lives.

A clearer definition of the term ‘life’ is therefore essential for the calculation of bearing size. All information presented here on dynamic load rating is based on the life that 90% of a sufficiently large group of apparently identical bearings can be expected to attain or exceed. This is called the basic rating life, L10 (or nominal life) and agrees with the ISO definition.

Bearing Life Equation
The most simple method of life calculation is to use the ISO equation for basic life rating. For bearings operating at constant speed, it is more convenient to deal with a basic rating life expressed in operating hours as follows :-

\[
L_{10h} = \frac{1000000}{60n} \times \left( \frac{C}{S} \right)^p
\]

where:
- \( n \) = speed of rotation, rpm
- \( C \) = basic dynamic load rating, N
- \( S \) = equivalent dynamic bearing load, N
- \( P \) = life exponent where:
  - \( p=3 \) --------- for ball bearing
  - \( p=10/3 \) ---- for roller bearing

Operating Hours, \( L_{10h} = \frac{1000000}{60n} \times \left( \frac{C}{S} \right)^p \)

\( = \frac{16,667}{n} \times \left( \frac{C}{S} \right)^p \) Hrs

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Life Adjustment Factor
The factor for reliability is used to determine lives other than the basic rating life, L10, i.e. lives which are attained or exceeded with a greater probability than 90%. Please refer to below table for adjustment factor.

<table>
<thead>
<tr>
<th>Life Grade</th>
<th>Reliability %</th>
<th>Adjustment Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>L10</td>
<td>90</td>
<td>1</td>
</tr>
<tr>
<td>L5</td>
<td>95</td>
<td>0.62</td>
</tr>
<tr>
<td>L4</td>
<td>96</td>
<td>0.53</td>
</tr>
<tr>
<td>L3</td>
<td>97</td>
<td>0.44</td>
</tr>
<tr>
<td>L2</td>
<td>98</td>
<td>0.33</td>
</tr>
<tr>
<td>L1</td>
<td>99</td>
<td>0.21</td>
</tr>
</tbody>
</table>

Occasionally, the term “average life” or L50 is used. This is the number of hours that 50% of a group of identical, and identically loaded bearing would survive.

It is calculated by multiplied the L10 life by 4.
For example, a bearing with a L10 of 60,000 hours has an L50 life of 240,000 hours.

DYNAIR recommend to select the right size pulley to have a L10 life of at least 60,000 hours.

Calculation Of Bearing Life
(1) Angular Velocit,
\[ w = \frac{2\pi n}{60} \text{ rad/sec} \]
(2) Max. Torque
\[ C_v = \frac{P}{W} \text{ Nm} \]
(3) Dynamic load of pulley
\[ T = \frac{C_v \times 1000}{(D/2)} \text{ N} \]
(4) Starting Dynamic load of pulley

\[ S = T \times 2N \]

(5) Operation Hours

\[ H = \frac{16.667}{n} \times \left( \frac{C}{S} \right)^P \text{ Hrs} \]

where,
- \( n \) = speed of rotation, rpm
- \( P \) = power installed, W
- \( D \) = diameter of pulley, mm
- \( S \) = maximum load of bearing, N

Example
Given the following specifications below, to determine the bearing life?

Type of Fan = BOX-T 800
Power installed, \( P = 30 \text{ kW} \)
Speed of rotation, \( n = 700 \text{ rpm} \)
Fan pulley dia., \( D = 450 \text{ mm} \)
Type of bearing, = YSA dia.55
Max. load of the bearing, \( C = 52700 \text{ N} \)

(1) Angular velocity (\( w \)) = \( \frac{2\pi n}{60} \)

\[ = \frac{2\pi(700)}{60} = 73.3 \ \text{rad/sec} \]

(2) Max. Torque (\( C_v \)) = \( \frac{P}{w} \)

\[ = \frac{30000}{73.3} = 409.3 \ \text{Nm} \]
(3) Dynamic load of pulley, \( T = \frac{C \times 10^3}{(D / 2)} \)
\[
= \frac{409.3 \times 10^3}{(450 / 2)} = 1819 \text{ N}
\]

(4) Starting dynamic load of pulley,
\[
(S) = Tx2 = 1819 \times 2 = 3638 \text{ N}
\]

(5) Operating hours, \( H = \frac{16,667}{n} \times \left( \frac{C}{S} \right)^3 \)
\[
= \frac{16,667}{700} \times \left( \frac{52700}{3638} \right)^3
\]
\[= 72,378 \text{ Hrs} \]