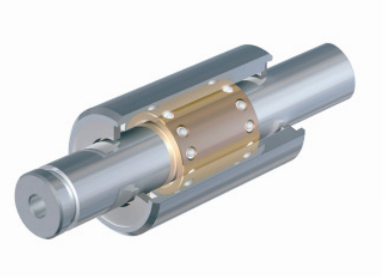
microlinea® - calculations

General formulas – linear bearings

Calculation of the theoretical life expectancy for linear bearings

In Europe we consider a nominal life expectancy of 100'000 meters; this is the reason of the utilization of the factor 10^5 in the following formula (in Japan: 50'000 meters). The load ratings shown in the leaflet were calculated according to DIN 636.



General formulas

The theoretical life expectancy has no practical value unless the following conditions are scrupulously fulfilled:

- Magnitude and direction of constant loads carefully determined
- Constant speed
- Constant temperature not exceeding 100°C.
- Rigorous cleanliness in mounting and during running
- Careful choice and dosage of lubricant

In all cases of complexity or doubt we advise you to contact our technical staff.

In achieved distance

L: Life expectancy in meters [m]
C: Dynamic load rating [N]
P: Equivalent dynamic load [N]

L_h: Life expectancy in hours [h]
f: Number of double strokes per minute [min^{-1}]
s: Length of a double stroke [m]

$$L = \left(\frac{C}{P}\right)^3 \cdot 10^5$$

$$L_h = \left(\frac{C}{P}\right)^3 \cdot \frac{10^5}{f \cdot s \cdot 60}$$

$$L_h = \frac{L}{f \cdot s \cdot 60}$$

Newton / lb conversion

1 Newton = 0.225 lb
1 lb = 4.45 Newtons

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miniature precision bearings – Series L

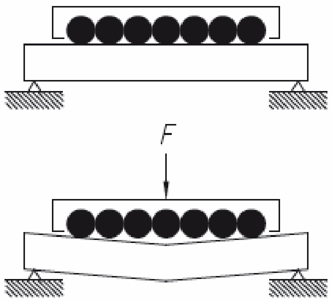
Effective dynamic load capacity C_{eff}

The effective dynamic load capacity is determined by the following coefficients:

- f_1 coefficient related to the angle of load application on the bearing
- f_A coefficient related to the buckling of the shaft
- f_B coefficient related to the displacement length
- f_C coefficient related to the hardness of the shaft
- f_D coefficient related to the temperature (for DBL only)
- f_i coefficient related to the number of bearings per unit

On the basis of the above coefficients, the effective dynamic load capacity is calculated as follows:

$C_{eff} = C \cdot f_1 \cdot f_A \cdot f_B \cdot f_C \cdot f_D \cdot f_i$



Coefficient f_1

If the load is applied directly on one row of balls: $f_1 = 0.7$

In other cases: $f_1 = 1$

Coefficient f_A

As soon as a radial load is applied, the shaft will bend. The bending changes the number of load carrying balls.

≤ 5′	$f_A = 1$
5′ < ≤ 10′	$f_A = 0.8$
10′ < ≤ 15′	$f_A = 0.4$

Coefficient f_B

If the distance of displacement is less than twice the width of the bearing, premature wear caused by running on a small zone must be taken into consideration by including the coefficient f_B.

(stroke/width B) ≤ 2	$f_B = 1$
1 ≤ (stroke/ width B) < 2	$f_B = 0.8$
(stroke/ width B) < 1	$f_B = 0.5$

Coefficient f_C

This factor takes into consideration the hardness of the guiding shaft. If the hardness is less than 58 HRC, the life expectancy will decrease exponentially. It is therefore important to choose materials with hardness near 58 HRC, especially when using stainless steel.

hardness of the shaft ≤ 58	$f_C = 1$
55 ≤ hardness of the shaft < 58	$f_C = 0.7$
50 ≤ hardness of the shaft < 55	$f_C = 0.5$

Coefficient f_D

For service temperatures higher than 25°C the life expectancy of the bearing decreases. It is therefore necessary to define the coefficient f_D.

T < 25 °C	$f_D = 1$
25 °C ≤ T < 40 °C	$f_D = 0.7$
40 °C ≤ T < 60 °C	$f_D = 0.35$

Coefficient f_i

In most applications, linear bearings are not mounted separately. They are more often mounted in blocks forming compact guiding units. Because of differences in tolerances the starting conditions are not the same for each mounted bearing.

Based on several tests a formula taking into account these particular conditions was determined. The coefficient f_i is calculated as follows:

$$f_i = \frac{i^{0.7}}{i}$$

i Number of linear ball bearings in the unit

Nominal life expectancy L_n

The formula which takes into account the effective load capacity (C_{eff}) is as follows:

$$L_n = \left(\frac{C_{eff}}{P}\right)^3 \cdot 10^5$$

- L_n Nominal life expectancy in meters [m]
- C_{eff} Effective dynamic load capacity [N]
- P Equivalent dynamic load [N]

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