General Technical Data and Calculations

Definition of dynamic load capacity

The radial loading of constant magnitude and direction which a linear rolling bearing can theoretically endure for a nominal life of 10^5 meters distance traveled (as per DIN 636 Part 2).

Definition of static load capacity

The static loading in the direction of load which corresponds to a calculated stress of 4200 M_{Pa} at the center of the most heavily loaded rolling-element/raceway (rail) contact with a ball conformity of $f_r \leq 0.52$, and 4600 M_{Pa} with a ball conformity of $f_r \geq 0.6$.

Note:
With this contact stress, a permanent overall deformation of the rolling element and the raceway will occur at the contact point corresponding to approx. 0.0001 times the rolling element diameter (as per DIN 636 Part 2).

Definition and calculation of the nominal life

The calculated service life which an individual linear rolling bearing, or a group of apparently identical rolling element bearings operating under the same conditions, can attain with a 90% probability, with contemporary, commonly used materials and manufacturing quality under conventional operating conditions (to DIN 636 Part 2).

Calculate the nominal life L or L_h according to formula (1), (2) or (3):

Nominal life at constant speed

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

(2) $$L_h = \frac{L}{2 \cdot s \cdot n_s \cdot 60}$$

Nominal life at variable speed

(3) $$L_h = \frac{L}{3600 \cdot v_m}$$

(4) $$v_m = \frac{q_{t1} \cdot |v_1| + q_{t2} \cdot |v_2| + ... + q_{tn} \cdot v_n}{100\%}$$

C	=	dynamic load capacity	(N)
F_m	=	equivalent dynamic load	(N)
L	=	nominal life	(m)
L_h	=	nominal life	(h)
n_s	=	stroke repetition rate (full cycles)	(min^{-1})
$q_{t1}, q_{t2}...q_{tn}$	=	discrete time steps for $v_1, v_2...v_n$	(%)
s	=	length of stroke	(m)
$v_1, v_2...v_n$	=	travel speeds	(m/s)
v_m	=	average speed	(m/s)

Equivalent dynamic load on bearing for calculation of service life

If the bearing is subject to variable loads, the equivalent dynamic load F_m must be calculated according to formula (5):

F_m = equivalent dynamic load (N)
$F_{eff1}, F_{eff2} ... F_{effn}$ = discrete load steps (N)
$q_{s1}, q_{s2} ... q_{sn}$ = discrete travel steps for $F_{eff1}, F_{eff2} ... F_{effn}$ (%)

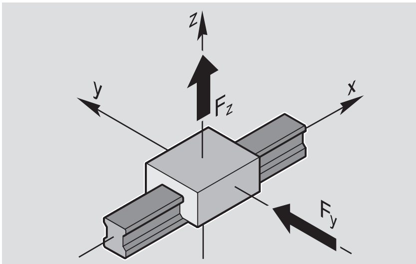
For variable load on bearing

$$(5)\quad F_m = \sqrt[3]{|F_{eff1}|^3 \cdot \frac{q_{s1}}{100\%} + |F_{eff2}|^3 \cdot \frac{q_{s2}}{100\%} + ... + |F_{effn}|^3 \cdot \frac{q_{sn}}{100\%}}$$

For combined load on bearing
The combined equivalent load on bearing F_{comb} resulting from combined vertical and horizontal external loads is calculated according to formula (6):

Note:
The structure of the Ball Rail System permits this simplified calculation.

$$(6)\quad F_{comb} = |F_y| + |F_z|$$

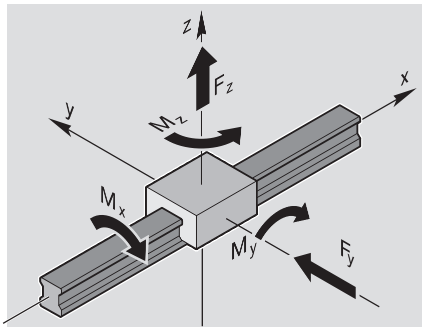


C = dynamic load capacity [2] (N)
F_{comb} = combined equivalent load on bearing (N)
F_y, F_z = dyn. external loads [1] (N)
M_L = dyn. longitudinal moment load capacity [2] (Nm)
M_t = dyn. torsional moment load capacity [2] (Nm)
M_x = dyn. torsional moment about the x-axis (Nm)
M_y = dyn. longitudinal moment load about the y-axis (Nm)
M_z = dyn. longitudinal moment load about the z-axis (Nm)

For combined load on the bearing in conjunction with a torsional moment
The combined equivalent load on bearing F_{comb} resulting from combined vertical and horizontal external loads in conjunction with a torsional moment is calculated according to formula (7):

Formula (7) applies only when using a single guide rail.

$$(7)\quad F_{comb} = |F_y| + |F_z| + C \cdot \frac{|M_x|}{M_t} + C \cdot \frac{|M_y|}{M_L} + C \cdot \frac{|M_z|}{M_L}$$

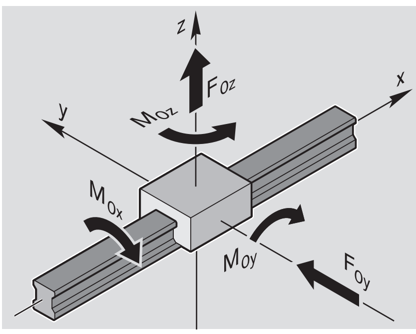


Equivalent static load on bearing

For combined static external loads – vertical and horizontal – in conjunction with a static torsional moment load, calculate the combined equivalent static load on the bearing F_{0comb} using formula (8).
The combined equivalent static load on the bearing F_{0comb} must not exceed the static load capacity C_0.

Formula (8) applies only when using a single guide rail.

$$(8)\quad F_{0comb} = |F_{0y}| + |F_{0z}| + C_0 \cdot \frac{|M_{0x}|}{M_{t0}} + C_0 \cdot \frac{|M_{0y}|}{M_{L0}} + C_0 \cdot \frac{|M_{0z}|}{M_{L0}}$$



C_0 = static load capacity [2] (N)
F_{0comb} = combined equivalent load on bearing (N)
F_{0y}, F_{0z} = stat. external load [1] (N)
M_{0x} = stat. torsional moment load about the x-axis (Nm)
M_{0y} = stat. longitudinal moment load about the y-axis (Nm)
M_{0z} = stat. longitudinal moment load about the z-axis (Nm)
M_{t0} = stat. torsional moment load [2] (Nm)
M_{L0} = stat. longitudinal moment load [2] (Nm)

1) An external load acting at an angle on the runner block is to be broken down into its F_y and F_z components, and these values are then are then to be used in formula.
2) See tables