Operating loads calculation

Effective loading calculation

Various factors affect the calculation of the loading of isel guides. This includes the position of the C of G of the load, tensile and compressive forces, torques, load and acceleration forces.

For a linear bench on 4 bearings, the bearing forces are calculated according to the force application point for various load directions.

The calculation can also be applied to a slide configuration with 2 slides.

The dimension LL/2 is used as the dimension L (see dimensioned drawings for the relevant guides).

The load factor in this case is CO/2.

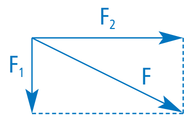
Combined load

If the load alignment of an element does not coincide with one of the main load directions, then the equivalent load is calculated:

$$P = |F_1| + |F_2|$$

If a force F and a torque M load an element simultaneously, then the dynamically equivalent load is:

$$P = |F| + |M| \cdot \frac{C_0}{M_{0(XYZ)}}$$



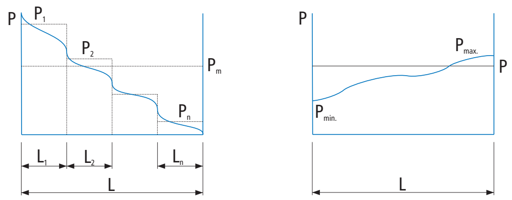
P [N]	dynamically equivalent load
F [N]	opposing force $= \sqrt{F_1^2 + F_2^2}$
F1 [N]	vertical component see sketch (4)
F2 [N]	horizontal component see sketch (4)
C0 [N]	static load factor
M [Nm]	opposing torque
M0(XYZ) [Nm]	static torque in the direction of the opposing torque

According to DIN, the dynamically equivalent load should not exceed the value P = 0.5 · C.

Equivalent load calculation

Operating conditions

A incremental change B uniform change



Equivalent load

$$P = \sqrt[3]{\frac{1}{L} \cdot (P_1^3 \cdot L_1 + P_2^3 \cdot L_2 + P_3^3 \cdot L_3 ..... + P_n^3 \cdot L_n)}$$

$$P = \frac{1}{3} \cdot (P_{min} + 2 \cdot P_{max})$$

P	dynamically equivalent load [N]
$P_{1...n}$	Individual load [N]
L	Total travel [m]
$L_{1...n}$	Individual travel [m]
P_{min}	smallest load [N]
P_{max}	largest load [N]

Static safety

Operating conditions	S_0
Normal motion	1.0 - 3.0
High speed	2.0 - 4.0
With impacts and vibration	3.0 - 5.0

$$S_0 = \frac{C_0}{P_0} = \frac{M_0}{M}$$

S_0	static load safety
C_0	static load factor [N]
P_0	statically equivalent bearing loading [N]
M_0	static loading torque [Nm]
M	equivalent static torque [Nm]

Nominal working life

The nominal working life is achieved or exceeded by 90% of an adequately large quantity of identical bearings, before the first signs of material fatigue become apparent.

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

$$L_h = \frac{833}{H \bullet n_{OSZ}} \bullet \left(\frac{C}{P}\right)^3$$

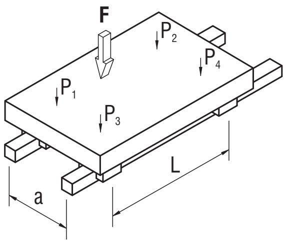
$$L_h = \frac{1666}{V} \bullet \left(\frac{C}{P}\right)^3$$

L [m]	nominal working life in units of 100,000 m
L_h [h]	nominal working life in hours run
C [N]	dynamic load factor
P [N]	dynamically equivalent load
H [m]	single stroke of the oscillating motion
n_{OSZ} [min]	Number of double strokes per minute
v [m/min]	average speed of movement

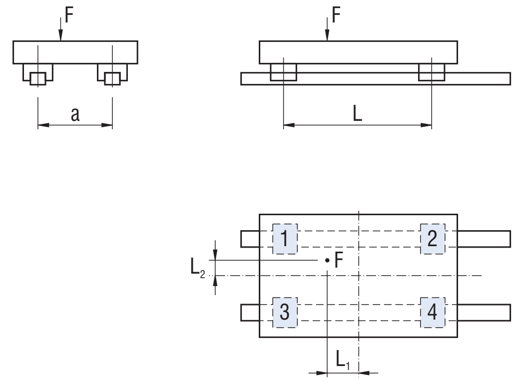
Operating loads calculation

Load vertical on the **bench surface**

Loading



Dimensioned figure



Load on a trolley

$$P_1 = \frac{F}{4} + \frac{F \cdot L_1}{2L} + \frac{F \cdot L_2}{2a}$$

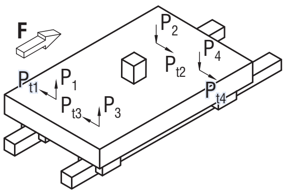
$$P_2 = \frac{F}{4} - \frac{F \cdot L_1}{2L} + \frac{F \cdot L_2}{2a}$$

$$P_3 = \frac{F}{4} + \frac{F \cdot L_1}{2L} - \frac{F \cdot L_2}{2a}$$

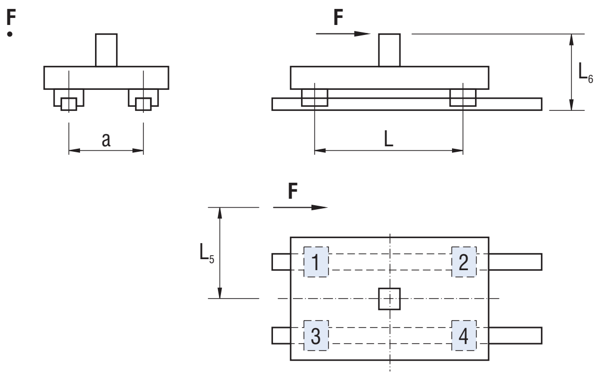
$$P_4 = \frac{F}{4} - \frac{F \cdot L_1}{2L} - \frac{F \cdot L_2}{2a}$$

Load in **direction of motion**

Loading



Dimensioned figure



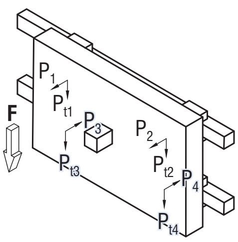
Load on a trolley

$$P_1 \dots P_4 = \frac{F \cdot L_6}{2L}$$

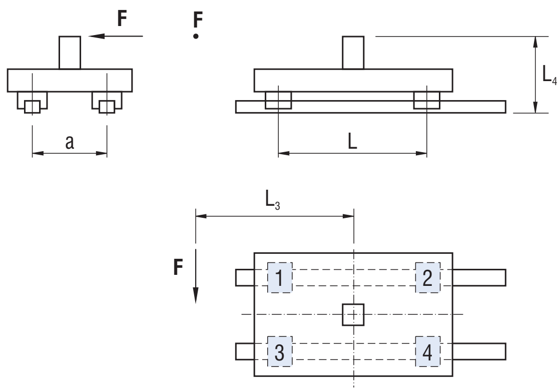
$$P_{t1} \dots P_{t4} = \frac{F \cdot L_5}{2L}$$

Load at right angles to the **direction of motion**

Loading



Dimensioned figure



Load on a trolley

$$P_1 \dots P_4 = \frac{F \cdot L_4}{2a}$$

$$P_{t1} = P_{t3} = \frac{F}{4} + \frac{F \cdot L_3}{2L}$$

$$P_{t2} = P_{t4} = \frac{F}{4} - \frac{F \cdot L_3}{2L}$$