

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.

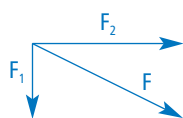
The dimension LL/2 is used as the dimension L (see dimensioned drawings for the relevant guides).

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

The load factor in this case is C0/2.

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

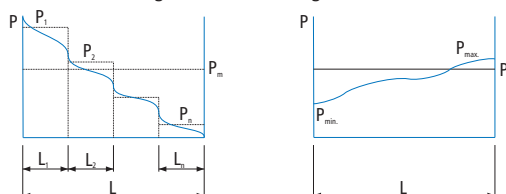
According to DIN, the dynamically equivalent load should not exceed the value $P = 0.5 \cdot C$.

Equivalent load calculation

Operating conditions

Equivalent load

A incremental change B uniform change



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

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

- 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

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

- S₀ static load safety
- C₀ static load factor [N]
- P₀ statically equivalent bearing loading [N]
- M₀ 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.

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

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

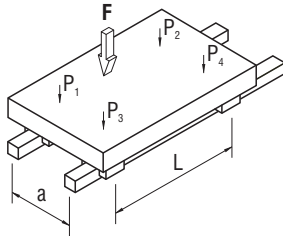
$$L_h = \frac{1666}{V} \cdot \left(\frac{C}{P}\right)^3$$

- 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

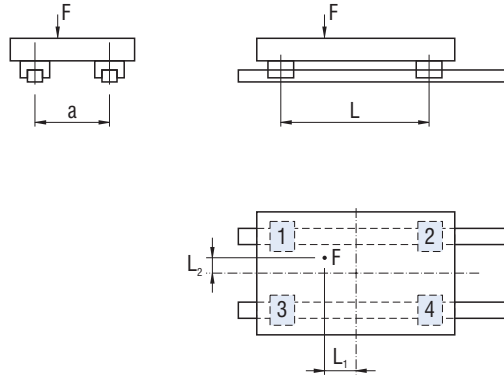
Operating loads calculation

Load vertical on the bench surface

Loading



Dimensioned figure



Load on a trolley

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

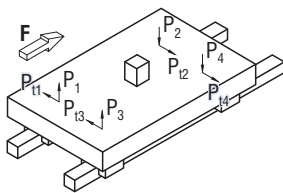
$$P_2 = \frac{F}{4} - \frac{F \cdot L_1}{2L} + \frac{F \cdot L_2}{2a}$$

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

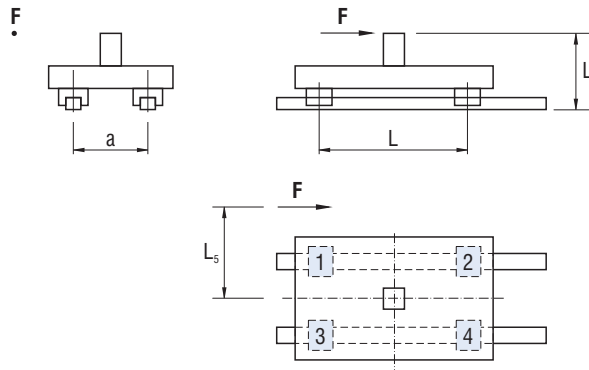
$$P_4 = \frac{F}{4} - \frac{F \cdot L_1}{2L} - \frac{F \cdot L_2}{2a}$$

Load in direction of motion

Loading



Dimensioned figure



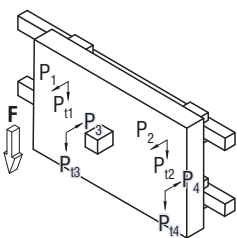
Load on a trolley

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

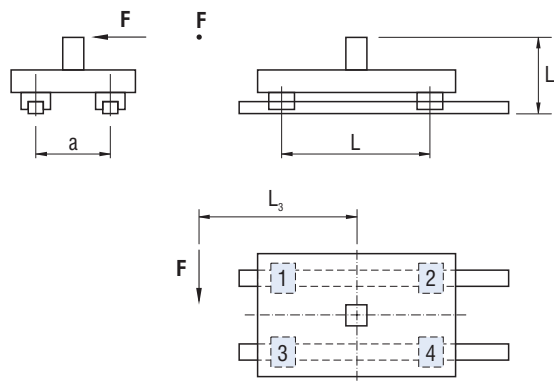
$$P_{11} \dots P_{14} = \frac{F \cdot L_5}{2L}$$

Load at right angles to the direction of motion

Loading



Dimensioned figure



Load on a trolley

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

$$P_{11} = P_{13} = \frac{F}{4} + \frac{F \cdot L_3}{2L}$$

$$P_{12} = P_{14} = \frac{F}{4} - \frac{F \cdot L_3}{2L}$$