Working life calculation

The nominal theoretical working life of a ball screw is calculated by a method similar to that for calculating the working life of a ball bearing. It should be noted that vibration and shock loads adversely affect the working life of the ball screw. Radial loadings are not permitted.

Average speed:

$$n_m = \frac{n_1 \cdot q_1 + n_2 \cdot q_2 + \ldots + n_i \cdot q_i}{100}$$

n_m ... Average speed in [rpm]

n_1, n_2 … Speeds in [rpm] during the interval q_1, q_2, ...

q_1, q_2 … Proportions of the duration of loaded operation in one direction of loading in [%]

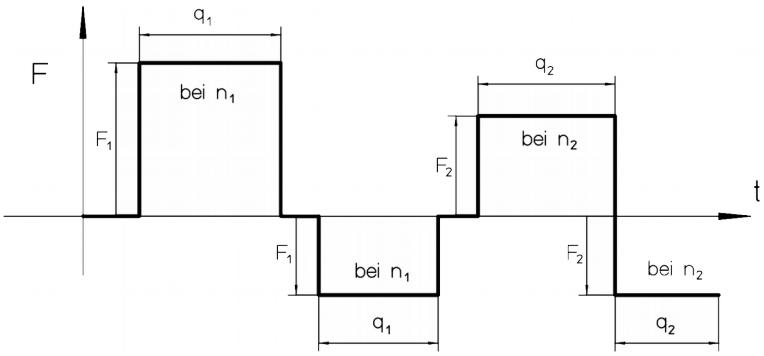
Dynamic equivalent axial load:

$$F_m = \sqrt[3]{F_1^3 \cdot \frac{n_1 \cdot q_1}{n_m \cdot 100} + F_2^3 \cdot \frac{n_2 \cdot q_2}{n_m \cdot 100} + \ldots + F_i^3 \cdot \frac{n_i \cdot q_i}{n_m \cdot 100}}$$

F_1, F_2 … Axial loads in [N] in one direction of loading during the interval q_1, q_2, ...

F_m ... Dynamic equivalent axial load

Since a ball screw can be loaded in either of two directions, F_m is first determined for each of the two directions of loading. The larger value is then used in the calculation of L.
In general it is useful to create the following structure:



It should be remembered that a pre-load represents an ever-present additional load.

Theoretical working life:

$$L_{10} = \left(\frac{C}{F_m}\right)^3 \cdot 10^6$$

C ... Dynamic load rating
Centrally applied load in [N], of unchangeable value and direction, for which a sufficiently large number of identical ball screws each achieves a nominal working life of 10^6 revolutions.

L_{10} ... Working life of the ball screw. Expressed as the number of overrollings which are reached or exceeded by 90 % of a sufficiently large number of apparently identical ball screws before the first signs of material fatigue appear.

(Working life in metres: L_{10} multiplied by the pitch, divided by 1000)