General Hints

Installation Position

Principally, the installation positions of the linear axes can be chosen freely.

However, it has to be taken into account that all forces and moments that occur have to be below the maximum values of the respective axes.

Self-Locking

Irrespective of the linear axis, the ball screw feed axes generally are not self-locking.

Especially in the event of the axes being vertically installed, it is necessary to attach motors with a holding brake, a separate holding brake or a suitable counterweight for the linear unit.

Environmental Conditions

All linear units are construed for ambient temperatures up to 60 °C. Temporarily, temperatures up to, at most, 80 °C are permissible. The linear axes are not suitable for temperatures below zero.

Dust, splinters and direct wetness have to be kept away from spindles, bearings, guide rods, as well as from motors and their electronic devices.

When operating in an aggressive environment (acids, bases, abrasives, etc.), it has to be taken care to guide and drive elements being protected. Improper use may lead to increased maintenance rates, susceptibility to failure and failure.

Straightness/Torsion

The deployed aluminium profiles are extruded aluminium profiles that, due to the manufacturing process, show deviations concerning straightness and torsion.

The tolerance of this deviation is defined by DIN EN 12020-2.

At the worst, the deviations of the isel-linear axes come up to these limits, however, they normally are below them.

To achieve the desired accuracy, it is necessary to adjust the linear unit by means of levelling plates and/or to clamp it on a bearing surface that is treated precisely. Thus, tolerances of at least 0.1 mm/1,000 mm are achieved.

Repeatability

„Repeatability" means the ability of a linear drive to reach a once driven to actual position under the same conditions again.

Theoretically Critical Speed

Critical Speed

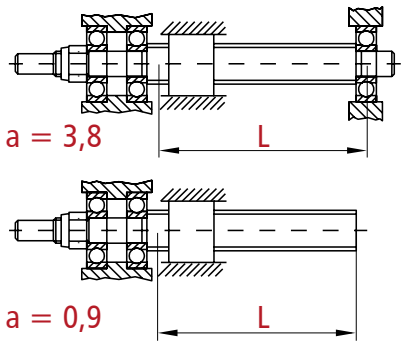
In most application cases, it is necessary to check the threaded spindles with regard to their critical speed.

The critical speed of a threaded spindle is that speed which is caused by the spindle's resonance vibration.

This critical speed depends on the spindle's core diameter, self-supporting length and on the installation mode.

Considering the general safety factor of 0.8, the maximum permissible speed can be calculated as follows:

$$n_{zul} = 392 \frac{a \bullet d_2}{L^2} 10^5$$



Definitions

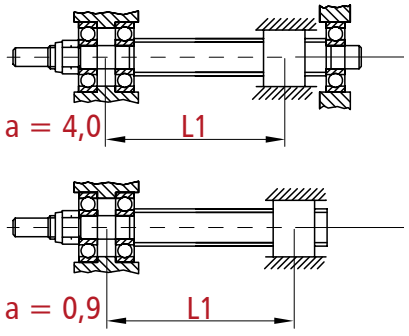
n_{zul} [min-1]	Maximum permissible speed
a	Installation coefficient
d2 [mm]	Core diameter of the spindle
L [mm]	Centre-to-centre distance between the spindle bearings and the nut

Buckling Load

Under load, the ball screw spindle should only be strained subject to tension. In case pressure loads occur, the spindle's bukkling has to be included into the calculation.

Considering a safety factor of 3.0, the following results:

$$F_{zul} = \frac{34000 \bullet b \bullet d_2^4}{L_1^2}$$



Definitions

F_{zul} [N]	Permissible pressure load
d_2 [mm]	Core diameter of the thread
L_1 [mm]	Free effective length, i.e. the maximum distance between bearing's and the nut's centre
b	Installation coefficient

Drive Dimensioning

Drive Torque

The necessary drive torque consists of

- load torque M_{last}
- acceleration torques M_{trans} und M_{rot}
- nominal torque M_{leer}

$$M_A = M_{last} + M_{trans} + M_{rot} + M_{leer}$$

Load Torque

$$M_{last} = \frac{Fx \bullet p}{2 \bullet \pi \bullet 1000}$$

with feed force $Fx = m \bullet g \bullet \mu$

Translator. Acceleration Torque

$$M_{trans} = \frac{F_a \bullet p}{2 \bullet \pi \bullet 1000}$$

with feed force $F_a = m \bullet$

At vertical operation, the gravity g = 9,81m/s² has to be added to the mass acceleration a.

Rotator. Acceleration Torque

$$M_{rot} = \frac{J_{sp} \bullet L \bullet n_{max} \bullet a \bullet 2 \bullet \pi}{v_{max} \bullet 60 \bullet 1000}$$

Rotator. Acceleration Torque

$$P = \frac{M_A \bullet n_{max}}{9550}$$

Definitions

M_A	[Nm]	Necessary drive torque
M_{last}	[Nm]	Moment resulting from the different loads
M_{leer}	[Nm]	Idle torque
M_{rot}	[Nm]	Rotatory acceleration torque
M_{trans}	[Nm]	Translatory acceleration torque
Fx	[N]	Feed force
g	[m/s2]	Gravity
v_{max}	[m/s]	Maximum traverse speed
m	[kg]	The mass to be transported
a	[m/s2]	Acceleration
p	[mm]	Spindle pitch
P	[kW]	Power
L	[mm]	Length
n_{max}	[min-1]	Maximum speed
μ		Coefficient of friction
J_{sp}	[kgm2/m]	The spindle's mass moment of inertia per metre
F_a	[N]	G force