

Ball screw spindles

Technical Information

Efficiency and self-limitation:

As the result of low roll friction, ball screw spindles achieve a mechanical efficiency of up to 95% and so have no self-limitation. The duty cycle can be as high as 100%. A braking mechanism must be provided when self-limitation is required in the application (reduction gear or motor brake). This is especially necessary by vertical constructions.

Speeds:

The maximum permissible speed is 3000 rpm, and may be used only under optimal operating conditions. The speed in m/min results from the rpm multiplied by the pitch. The ability to achieve the maximum speed depends on the bearings at the spindle ends, the diameter and the drive speed.

Operating temperature:

Ball screw spindles can be used under normal loads within a temperature range of -20 °C to +80 °C. Briefly to +110 °C is also permissible. Correct lubrication is always a prerequisite.

Lubrication:

Only by correct lubrication can the calculated expected life of the ball screw be achieved, excessive heating prevented and smooth and quiet operation made possible. The lubricants used for ball screw spindles are identical to those employed for ball bearings. In normal operation, re-lubrication usually takes place after 200 to 300 operating hours. The spindle nut should be directly lubricated on a regular basis. These lubrication intervals must be observed. When using grease as the lubricant, the amount must be sufficient to half fill the spindle nut cavities. The design must ensure that used and excess grease can escape. By oil mist lubrication, care must be taken to ensure that only ball screw nuts without wipers are used. The amount of oil supplied must replace volume loss. Ball screw spindles must always be protected against dirt.

Installation information:

Installing ball screw spindles requires technical knowledge and suitable measuring instruments. The ball screw nut must not be removed from the spindle, otherwise the balls will fall out. To prevent damage to the ball screw, overtravel must be prevented. Limit switches and end-of-travel dampers must be provided on the machine.

Note:

Ball screw drives consist of a ball screw spindle, a ball screw nut with integrated balls and the ball recirculation. They are used to convert a rotary motion into a linear motion and the reverse. They are characterized by high accuracy and high efficiency.

Manufacturing technology:

Miniature ball screw spindles are manufactured by a precision grinding process. Both spindle and nut have a pointed arch profile. The load angle is 45°. Similar to precision screw drives, the tracks in the spindle nut are ground. This guarantees quiet operation and a long service life.

Gradient deviations:

Thread length		Precision class			
over	under	C 3 (µm)	C 5 (µm)	C 7 (µm)	C 10 (µm)
0	315	8	18	±50 / 300 mm	±210 / 300 mm
315	500	10	20		
500	630	12	23		
630	800	13	25		
800	1000	15	27		
1000	1250	16	30		
1250	1600	18	35		
1600	2000	21	40		
2000	2500	24	46		
2500	3150	29	54		
3150	4000	35	65		
4000	5000	41	77		

Axial play and pretensioning:

A distinction is made between a ball screw with restricted backlash (axial backlash > 0) and a ball screw with zero backlash or pretension (axial backlash < 0). By pretensioned nuts considerably less elastic deformation occurs than by nuts without pretension. Pretensioned nuts are only recommended when high positioning accuracy under load is required.

Spindle Ø	Axial play P0 (mm)	Play free P1 (mm)	Light pre-tension P2 break-free force single nut N
16x5	0.08	0	1 - 3
20x5			1 - 3
25x5			2 - 5
32x5			2 - 5
32x10			3 - 6

Assessment of the lifespan:

The lifespan can be calculated from the ratio of dynamic load rating and average load.

$$L = \left(\frac{C \text{ dyn}}{F_m} \right) \cdot 10^6$$

- L = Service life in revolutions
- C dyn = dynamic load rating (N)
- Fm = Mean load (N)