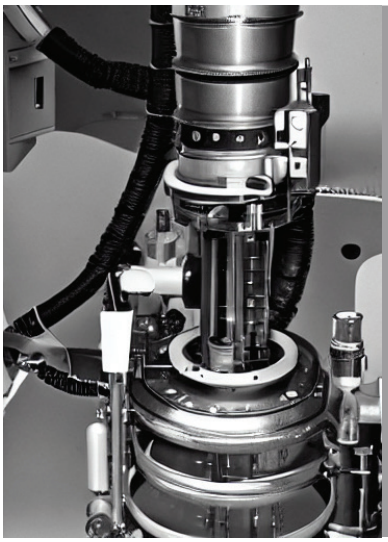
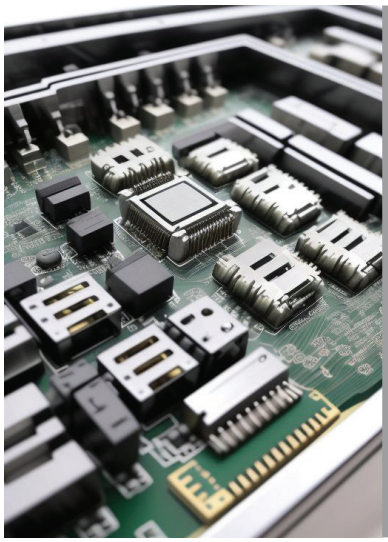
Miniature ball screws (from diameter 5 mm with pitch 0,5 mm) are structural elements, which transmit rotary movement to straight movement with high efficiency (approximately 94 - 97%). They feature high rigidity, accuracy, durability and especially high precision positioning in compact dimensions. Micro ball screws consist of ball shaft, ball nut both with ground thread, and its recirculation system as the standard ball screws.

Characteristics of the Micro Screws:

- **High precision positioning screws**
- **Very high running smoothness**
- **Delivered with required preloading**
- **Longest service life due to corresponding use of materials, custom engineering and the quality promise of a highly sophisticated production**

Miniature ball screws applications:


MICROSCOPES


SEMICONDUCTOR INDUSTRY


AERONAUTICS AND DEFENSE


INSPECTION EQUIPMENT


MEDICINE AND DIAGNOSTICS


LABORATORY EQUIPMENT

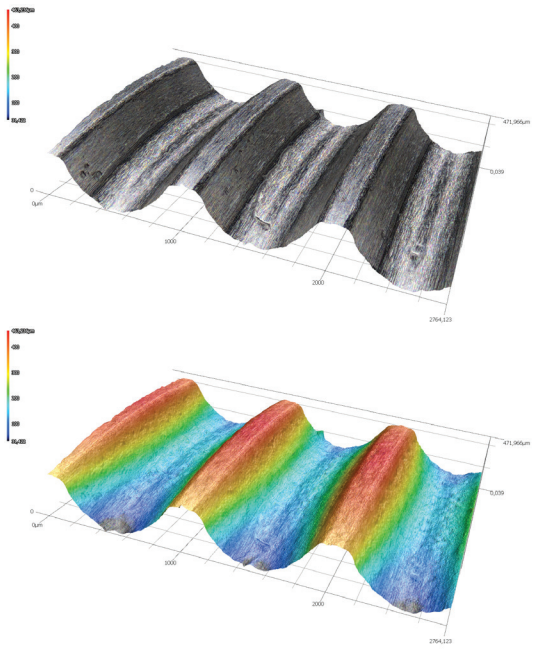
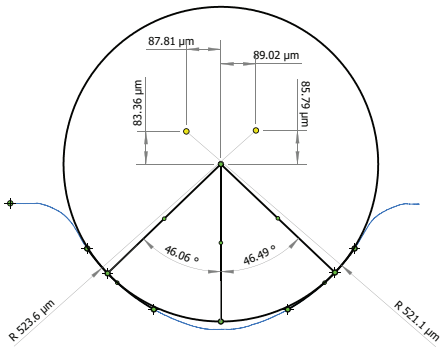
Please contact us with your applications to find all possibilities with our Miniature Ball Screws.

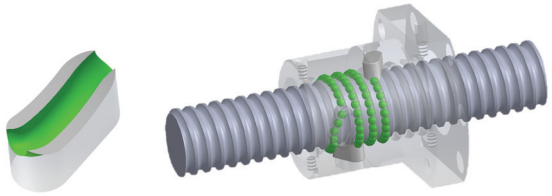
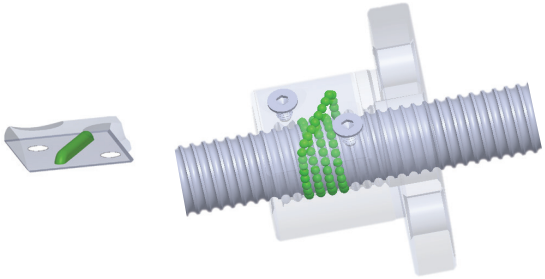
1. Application and use

Ground miniature ball screws are used where high accuracy and precision are required, e.g. in robotic surgery, medical devices and the aerospace industry – see table of Application and use below:

APPLICATION INDUSTRY	APPLICATION EXAMPLE	PRECISION GRADE		
		P0	P1	P3
MICROSCOPES	Positioning tables	●	●	
	Measuring stages	●		
	Microscope stages		●	●
	Automated Sample Handling	●	●	
SEMICONDUCTOR INDUSTRY	Wafer systems and drives	●		
	Production of printed circuit board (PCB)	●		
	Production of integrated circuits (IC)		●	
	PCB milling machines			●
	Tabletop units for panel production			●
	Device for transporting the glass substrate		●	●
AERONAUTICS AND DEFENSE	Aircraft flap actuators		●	●
	Brake system actuators		●	●
	Motion sensors	●	●	
	Spacecraft control systems	●	●	
INSPECTION EQUIPMENT	Motorized Focus Drives		●	
	Operating Devices		●	●
	Automated Sample Handling			●
MEDICINE AND DIAGNOSTICS	Computed tomography (CT) scanners	●	●	
	Magnetic resonance imaging (MRI)			●
	X-RAY equipment		●	●
	Ultrasound devices		●	●
	Surgical robots	●	●	
LABORATORY EQUIPMENT	Desktop blood analyzers			●
	Automatic analyzers of laboratory samples		●	●
MICROMANIPULATIONS	Miniature robotics		●	●
	Compact actuators	●	●	
	3D printers		●	●
OPTICS	Optics devices		●	●
	Laser surface scanning	●	●	

2. Technical data

CHARACTERISTICS	PICTURE	DESCTIPTION
GROUND BALL SCREW THREAD		Accuracy and quality of the miniature ball screws are largely dependent on the manufacturing technology. Miniature ball screws are produced by grinding technology only.
BALL SCREW PROFILE		To achieve the maximum transmission efficiency, it is necessary to make an ideal profile of the ball screw thread. The profile is not made of one radius but two radii with offset (so called gothic arch, see picture on the left). This profile shape offers an ideal efficiency to load capacity (ratings) ratio of the ball screw.
BALL NUT UNIT TYPE		**A** PRELOADED NUT WITHOUT FLANGE
		**AP** PRELOADED NUT WITH FLANGE

<table>
<tr><th>CHARACTERISTICS</th><th colspan="2">PICTURE</th><th colspan="2">DESCTIPTION</th></tr>
<tr><td rowspan="4">BALL SCREW RECIRCULATION SYSTEM</td><td colspan="2" rowspan="2">  </td><td rowspan="2">Internal ball recirculation with beds</td><td>Version marking:
IN</td></tr>
<tr><td>Maximum speed coefficient:
$n_{max} = \frac{50\,000}{d_0}$</td></tr>
<tr><td colspan="2" rowspan="2">  </td><td rowspan="2">External ball recirculation with shims</td><td>Version marking:
EX</td></tr>
<tr><td>Maximum speed coefficient:
$n_{max} = \frac{70\,000}{d_0}$</td></tr>
<tr><td>GRADE OF RAW MATERIALS</td><td colspan="2">Stainless steel: 1.4112</td><td colspan="2" rowspan="2">Nuts and the shaft are hardened to 50-60 HRC. Minimum shaft strength Rm = 800 MPa.
The final quality is tested by long term durability tests follwed by the analysis of the functional parts of the transmission assembly when the specified wear limits are achieved.</td></tr>
<tr><td>THREAD PITCH ACCURACY CLASS SPECIFICATION</td><td colspan="2">Steel: Cf53</td></tr>
<tr><td rowspan="3">THREAD PITCH ACCURACY CLASS SPECIFICATION</td><td>P0</td><td>3,5</td><td rowspan="3" colspan="2">Pitch tolerance on the thread length of 300 mm
v_{300p} [µm]</td></tr>
<tr><td>P1</td><td>6</td></tr>
<tr><td>P3</td><td>12</td></tr>
</table>

3. Main dimensions

Miniature ball screws are produced from diameter 5 mm, length 60 mm, pitch 0,5 mm up to diameter 16 mm, length 1000 mm and pitch 10 mm. All variants are listed in the table below:

SHAFT DIAMETER [mm]	PITCH [mm]	BALL DIAMETER [mm]	SHAFT MAXIMUM LENGTH [mm]		
d_0	P_H	D_W	P0	P1	P3
5	0,5	0,6	120	160	170
	1	0,8			
	2	0,8			
	3	0,8			
	4	0,8			
6	0,5	0,8	180	240	250
	1	0,8			
	1,25	1			
	1,5	1			
	2	1,5			
	2,5	1,5			
	6	1,5			
	8	1,5			
8	0,5	0,6	250	330	350
	1	0,8			
	1,5	1			
	2	1,5			
	2,5	1,5			
	3	1,5			
	4	1,5			
	5	1,5			
	8	1,5			
10	0,5	0,8	260	320	420
	1	1			
	1,5	1			
	2	1,5			
	2,5	2			
	3	2			
	4	2			
	5	2			
	6	2			
	10	2			
12	1	0,8	320	390	510
	2	1,5			
	2,5	2			
	3	2			
	4	2			
	5	2			
	8	2			
	10	2			
14	1	1	380	460	600
	2	1,5			
	2,5	1,5			
	3	2			
	4	2			
	5	3,175			
	8	3,175			
16	2	1,5	450	540	890
	2,5	1,5875			
	3	2			
	4	3			
	5	3,5			
	6	3,5			
	8	3,5			
	10	3,5			

4. Accuracy Class Specification

Miniature ball screws are produced according to the **ISO 3408 standard**. Below you can find basic permissible deviations and geometric tolerances in accordance with standard tolerance grade P0, P1 and P3.

Table 1: Travel deviations per reference length

LENGTH [mm]		PERMISSIBLE TRAVEL VARIATION v_{pu} [µm]			TOLERANCE ON SPCIFIED TRAVEL e_p [µm]		
>	≤	P0	P1	P3	P0	P1	P3
0	315	3,5	6	12	4	6	12
315	400	3,5	6	12	5	7	13
400	500	4	7	13	6	8	15
500	630	4	7	14	6	9	16
630	800	5	8	16	7	10	18
800	1000	6	9	17	8	11	21

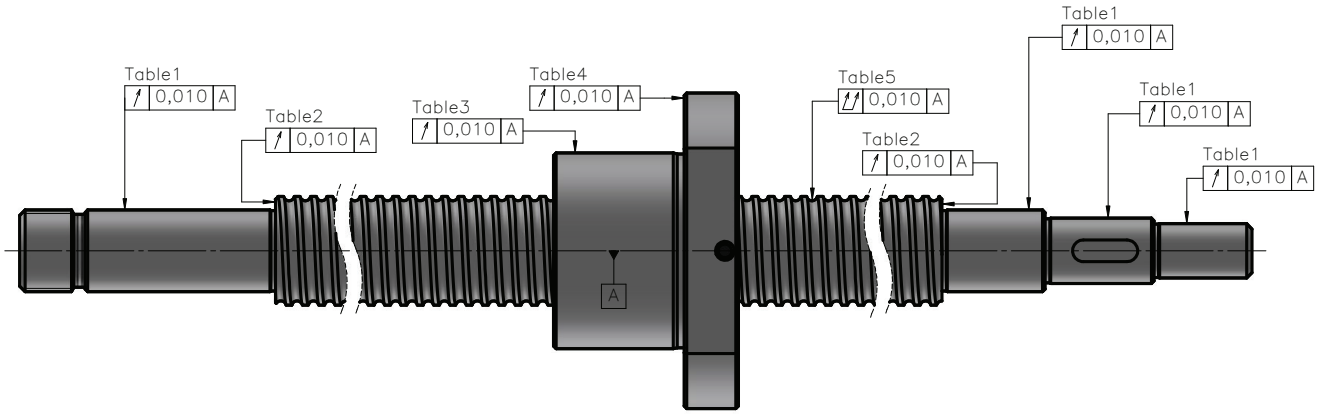


Table 2: Radial run-out bearing seat related to the centerline of screw groove and radial run-out of journal diameter related to the bearing seat.

SHAFT NOMINAL DIAMETER [mm]		PERMESSIBLE DEVIATION OF RADIAL RUN-OUT [µm]		
>	≤	P0	P1	P3
0	8	5	8	10
8	12	5	8	11
12	20	6	9	12

Table 3: Axial run-out of shaft (bearing) face related to the centerline of the bearing seat.

SHAFT NOMINAL DIAMETER [mm]		PERMESSIBLE DEVIATION OF RADIAL RUN-OUT [µm]		
>	≤	P0	P1	P3
0	8	5	8	10
8	12	5	8	11
12	20	6	9	12

Table 4: Axial run-out of ball nut location face related to the centerline of screw shaft.

NUT NOMINAL DIAMETER [mm]		PERMESSIBLE DEVIATION OF RADIAL RUN-OUT [µm]		
>	≤	P0	P1	P3
0	20	6	8	10
20	32	6	8	10
32	50	7	8	11

Table 5: Radial run-out of ball nut location diameter related to the centerline of screw shaft.

NUT NOMINAL DIAMETER [mm]		PERMESSIBLE DEVIATION OF RADIAL RUN-OUT [µm]		
>	≤	P0	P1	P3
0	20	6	9	12
20	32	7	10	12
32	50	8	12	15