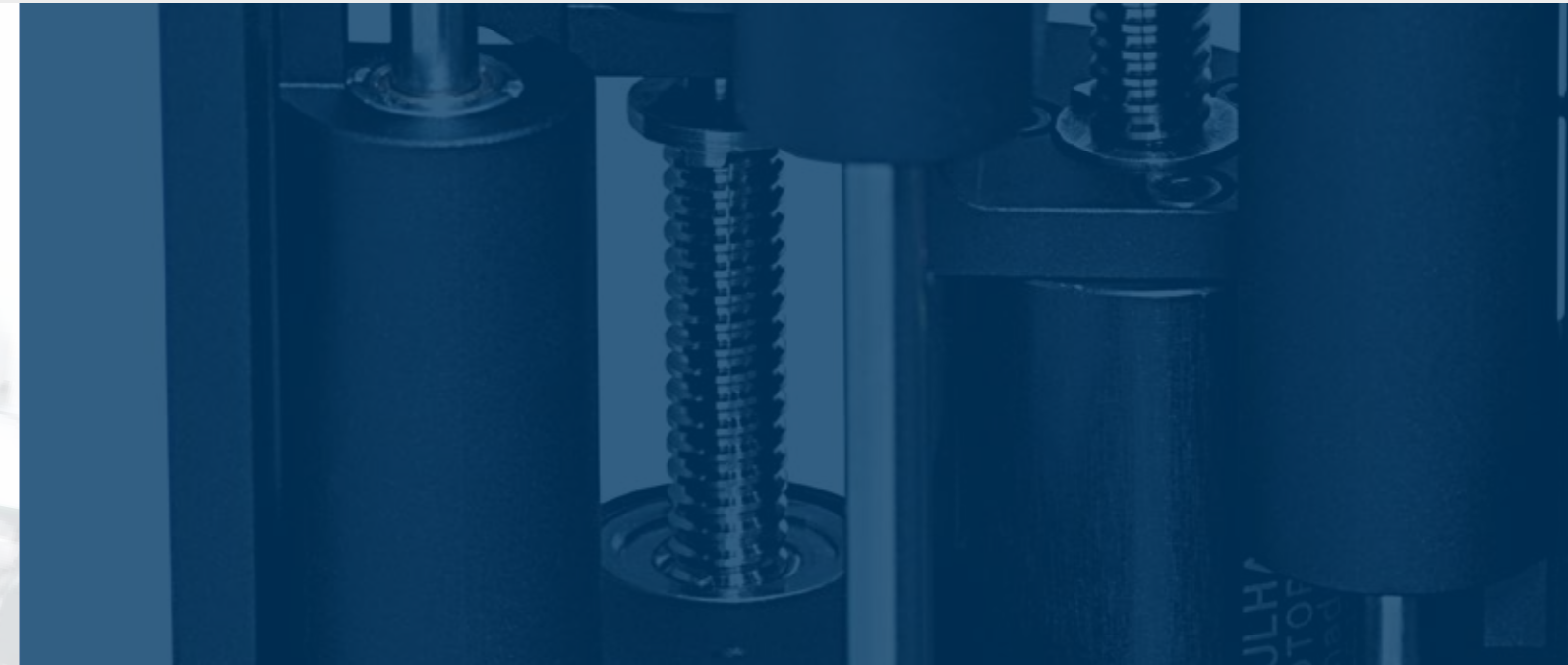


V3 - 09.2018

## Standard and customized components

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## Solutions in microspace

Standard and customized components

High-precision

- Miniature linear ball bearings
- Miniature ball screws
- Miniature balls





## Our company

**„Today we are continuing to take on the toughest challenges by developing complex microsystems of ever smaller dimensions while constantly fulfilling the technical requirements set forth.“**

With more than 80 years of experience in the field of high-precision microsystems, MPS can offer complete customized solutions including innovative technologies.

Thanks to the reliability and quality of MPS ball bearings, the company has been quickly known in ambitious fields of activities such as implantable device in medical applications, active optics or high-end watch products.

Helping to ensure the achievement and success of our customers is our principal motivation. Pushing the limits of microtechnology by continuously improving the manufacturing process is a task that inspires our multidisciplinary professional teams.

Constantly maintaining and developing our unique know-how in assembling microtechnical components, the fruit of pure Swiss watchmaking tradition, is the pride of the specialists who work in our micro-assembly departments. Guaranteeing and certifying a high level of quality by putting in place stringent control procedures illustrates the authority of our quality assurance experts.

The enthusiasm we put in each new project reflects our passion for our work. We look forward to sharing it with you.

**„From standard products to customized solutions: we want to be your privileged partner for microsystems in medical, watch, optics, science, defense and automation.“**

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# L Series - Linear bearings

## Standard product line – microlinea

Miniature high precision linear bearings  
L Series with stainless steel housing and brass retainer.

### Great technology:

- The smallest linear ball bearings in the world
- Exceptional smoothness and extremely low friction
- Extended life
- Ideal for precise positioning without stick-slip effect

### On request

Completely out of stainless steel with reduced bore tolerance.



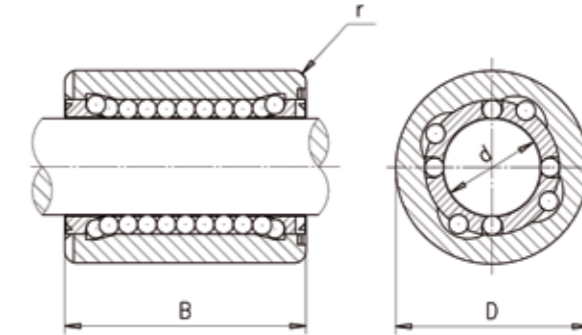
Reference	d (mm)	D (mm)	B (mm)	r min (mm)	Ø balls (mm)	Load ratings to ISO 14728 (N)	
						stat. (C <sub>0</sub> )	dyn. (C <sub>100B</sub> )
L 204X	2	4	5	0.020	0.500	12	11
L 306X	3	6	7	0.130	0.600	31	26
L 307X	3	7	10	0.200	0.794	73	56
L 408X	4	8	10	0.240	0.794	77	53
L 510X	5	10	14	0.240	1.250	131	118
L 612X	6	12	18	0.390	1.588	250	220

## Materials

- Housing:** stainless steel AISI 440C  
**Cage:** brass (on request: stainless steel AISI 303)  
**Balls:** stainless steel AISI 440C  
**Lubrication:** standard: Winsor Lube L245X (other lubricants on request)  
**Temperature:** -40°C to +80°C (or more with the appropriate lubricant)  
**Bearing tolerances:** bore diameter d +8/0 µm  
 outer diameter D 0/-8 µm

Recommended tolerances for shaft: 0/-6 µm  
 Recommended hardness for shaft: 58 HRC  
 Max. press fit between the outer ring and housing: 1 to 3 µm

Data subject to change without notice.



## Linear bearings life calculation

C<sub>100B</sub> is calculated according to ISO 14728.  
 100 stands for a nominal life expectancy of 100km and B for linear ball bearing.  
 Without any precision, a C value may also correspond to C<sub>50B</sub> (C<sub>50B</sub> = 1.26 x C<sub>100B</sub>).

## General formulas

The theoretical life has no practical value unless the following conditions are scrupulously observed:

- Magnitude and direction of constant load carefully determined
- Constant velocity
- Constant temperature not exceeding 100°C
- Rigorous cleanliness in mounting and during running
- Careful choice and dosage of lubricant

## Life in achievable distance

L<sub>m</sub>: Life expectancy in meters [m]  
 C<sub>100B</sub>: Dynamic load rating [N]  
 P: Equivalent dynamic load [N]

$$L_m = \left(\frac{C_{100B}}{P}\right)^3 \cdot 10^5$$

## Life in hours

L<sub>h</sub>: Life expectancy in hours [h]  
 f: Number of double strokes per minute [min<sup>-1</sup>]  
 s: Length of a double stroke [m]

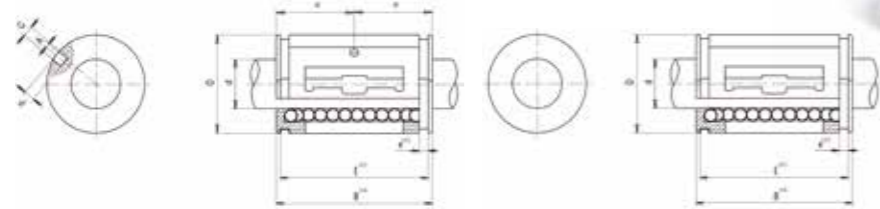
$$L_h = \left(\frac{C_{100B}}{P}\right)^3 \cdot \frac{10^5}{f \cdot s \cdot 60}$$

According to ISO 14728, one shall consider a static safety factor so that the actual load does not exceed half of the C<sub>0</sub> value.

# DBL Series - Linear bearings

## Standard product line – microlinea

Miniature high precision linear bearings DBL series with plastic body (POM), with stainless steel balls and needles.



Reference	d (mm)	D (mm)	B (mm)	e (mm)	E (mm)	Ø balls (mm)	A (mm)	P (mm)	G (mm)	Load ratings to ISO 14728 (N)		
										stat. (C <sub>0</sub> )	dyn. (C <sub>100B</sub> )	no. of ball rows
DBL 307X	3	7	10	-	-	1.0	0.0	0.75	1.0	27	26	3
DBL 408X	4	8	12	-	-	1.0	0.0	0.9	1.0	50	44	4
DBL 510X	5	10	15	-	-	1.2	0.1	1.0	1.2	84	72	4
DBL 612X	6	12	19	-	-	1.0	0.0	1.0	1.0	132	114	4
DBL 815X	8	15	24	1.1	23	1.5	0.85	1.0	1.5	204	167	5
DBL 1017X	10	17	26	1.1	25	1.5	0.85	1.2	1.5	234	186	5
DBL 1219X	12	19	28	1.3	26.4	1.5	1.25	1.2	1.5	257	202	6
Bearings have wipers on both sides												
DBL 1222X-JR	12	22	32	1.3	22.60	2.0	-	-	-	352	310	6
DBL 1626X-JR	16	26	36	1.3	24.60	2.0	-	-	-	440	372	7
DBL 2032X-JR	20	32	45	1.6	31.20	2.5	-	-	-	689	591	7
DBL 2540X-JR	25	40	58	1.85	43.70	3.5	-	-	-	1332	1162	7

### Materials

**Housing:** polyoxymethylen (POM)  
**Balls and needles:** stainless steel  
**Lubrication:** standard: Winsor Lube L245X (other lubricants on request)  
**Temperature:** -40°C to +60°C

### Example of part number definition

**DBL 307X** precision linear bearing DBL-type  
**DBL 307X** bore diameter = 3 mm  
**DBL 307X** outer diameter = 7 mm  
**DBL 307X** stainless steel balls and needles

Data subject to change without notice.

DBL	Recommended tolerances				Radial clearance with the proposed tolerances for the housing and shaft		
	Housing		Shaft		Nominal value	H5/h5 [µm]	H6/h6 [µm]
307	H5 [µm]	H6 [µm]	h5 [µm]	h6 [µm]	0-6	0-16	0-21
408	0/+6	0/+9	0/-5	0/-8	0-6	0-17	0-23
510	0/+6	0/+9	0/-5	0/-8	0-6	0-17	0-23
612	0/+8	0/+11	0/-5	0/-8	0-6	0-19	0-25
815	0/+8	0/+11	0/-6	0/-9	0-6	0-20	0-26
1017	0/+8	0/+11	0/-6	0/-9	0-6	0-20	0-26
1219	0/+9	0/+13	0/-8	0/-11	0-6	0-23	0-30
1222	0/+9	0/+13	0/-8	0/-11	0-6	0-23	0-30
1626	0/+9	0/+13	0/-8	0/-11	0-6	0-23	0-30
2032	0/+11	0/+16	0/-9	0/-13	0-6	0-26	0-35
2540	0/+11	0/+16	0/-9	0/-13	0-7	0-27	0-36

### Calculation of the theoretical life expectancy for linear bearings

C<sub>100B</sub> is calculated according to ISO 14728. 100 stands for a nominal life expectancy of 100km and B for linear ball bearing. Without any precision, a C value may also correspond to C<sub>50B</sub> (C<sub>50B</sub> = 1.26 x C<sub>100B</sub>).

### General formulas

The theoretical life has no practical value unless the following conditions are scrupulously observed:

- Magnitude and direction of constant load carefully determined
- Constant velocity
- Constant temperature not exceeding 60°C
- Rigorous cleanliness in mounting and during running
- Careful choice and dosage of lubricant

### Life in achievable distance

L<sub>m</sub>: Life expectancy in meters [m]  
 C<sub>100B</sub>: Dynamic load rating [N]  
 P: Equivalent dynamic load [N]

$$L_m = \left(\frac{C_{100B}}{P}\right)^3 \cdot 10^5$$

### Life in hours

L<sub>h</sub>: Life expectancy in hours [h]  
 f: Number of double strokes per minute [min<sup>-1</sup>]  
 s: Length of a double stroke [m]

$$L_h = \left(\frac{C_{100B}}{P}\right)^3 \cdot \frac{10^5}{f \cdot s \cdot 60}$$

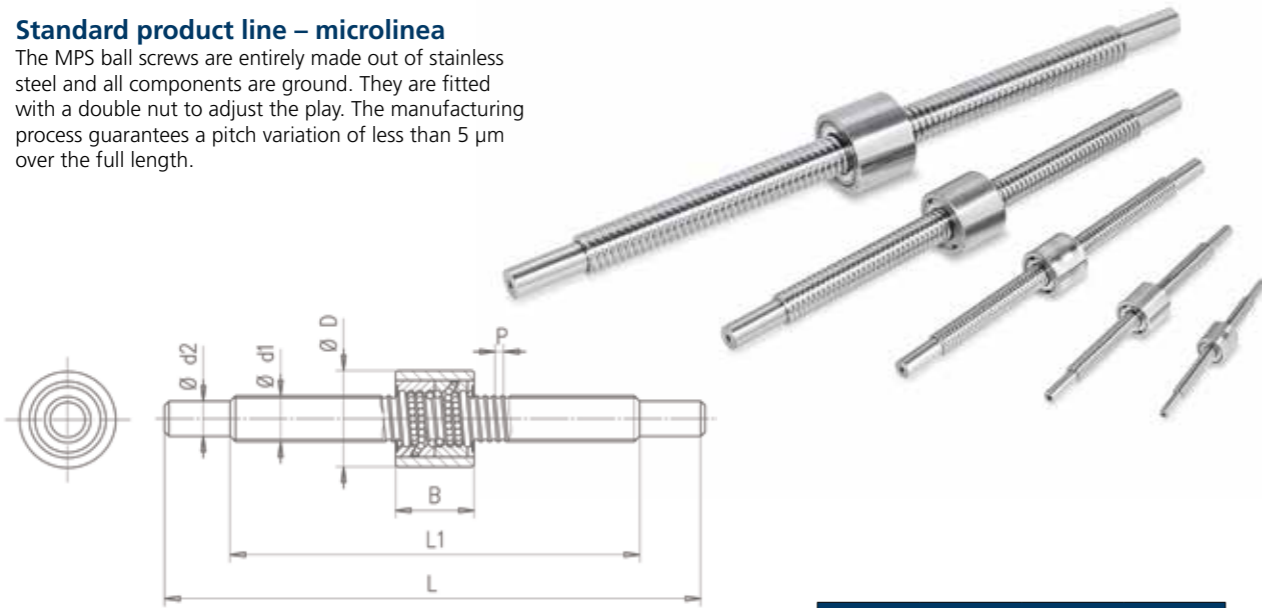
According to ISO 14728, one shall consider a static safety factor so that the actual load does not exceed half of the C<sub>0</sub> value.

Data subject to change without notice.

# Ball screws

## Standard product line – microlinea

The MPS ball screws are entirely made out of stainless steel and all components are ground. They are fitted with a double nut to adjust the play. The manufacturing process guarantees a pitch variation of less than 5 µm over the full length.



Reference	Nut		Screw						Axial load rating ISO3408-5 (N)			
	D (mm)	B (mm)	Ø balls (mm)	d1 (mm)	P (mm)	d <sub>2</sub> (mm)	L (mm)	L <sub>1</sub> (mm)	Standard profile		High load profile	
									dyn. (Cam)	stat. (Coa)	dyn. (Cam)	stat. (Coa)
ED 410X / V404X	10	10	0.794	4.25	1.0	3	70	50	229	179	426	422
ED 513X / V501X	13	12	1.000	5.8	1.25	4	100	75	356	302	660	709
ED 616X / V601X	16	14	1.191	7.4	1.5	6	140	110	519	475	958	1114
ED 822X / V801X	22	18	1.588	10.5	2.0	8	190	150	890	887	1646	2085

### Materials

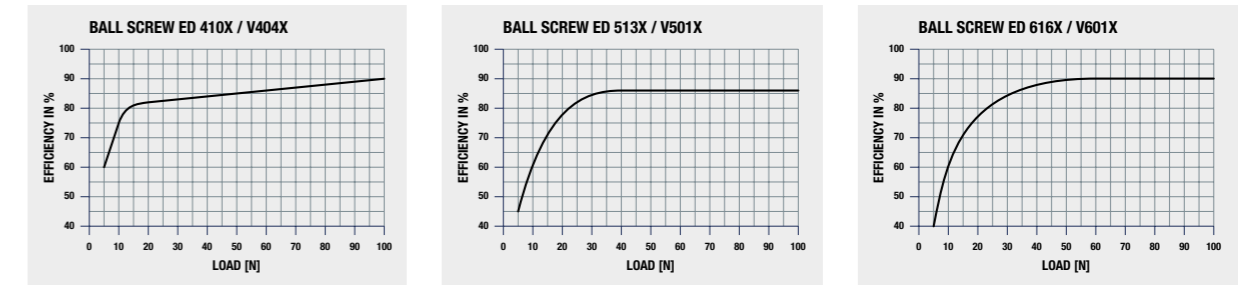
- Housing:** stainless steel AISI 440C
- Ball nuts ED/ES:** stainless steel AISI 440C
- Shields:** stainless steel AISI 302 or AISI 303
- Balls:** stainless steel AISI 440C
- Lubrication:** standard: Winsor Lube L245X

### Example of part number definition

- ED 513X/V501X double nut
- EDD 513X/V501X two double nuts
- ED 513X/V501X 4 x lead of nut thread
- ED 513X/V501X outer diameter of nut
- ED 513X/V501X nut in stainless steel
- ED 513X/V501X ground precision screw
- ED 513X/V501X 4 x lead of screw thread
- ED 513X/V501X screw drawing number
- ED 513X/V501X screw in stainless steel

Data subject to change without notice.

## Starting efficiency (Useful information for dimensioning the system)



Technical Data		ED 410X / V404X	ED 513X / V501X	ED 616X / V601X	ED 822X / V801X
Tolerance of nut outer diameter	D [µm]	0/-6	0/-6	0/-6	0/-9
Tolerance of screw end diameters	d <sub>2</sub> [µm]	0/-8	0/-8	0/-8	0/-8
Max. pitch variation over total leadscrew length*	[µm]	5	5	5	5
Max. eccentricity nut/screw	[µm]	10	10	12	14
Average efficiency	[ % ]	80-85	80-87	80-89	81-91
Standard axial play	[µm]	0-5	0-5	0-5	0-5
Zero backlash		on request			

\*Standard specification. The precision can be increased on request. Note: do not remove the nut from the shaft.

### Ball screw calculations – general formulas

The theoretical life expectancy is generally expressed by the total number of revolutions. The life expectancy can also be expressed in hours or in total travel distance. The fatigue life is calculated as follows:

- L<sub>m</sub>: Life expectancy in number of millions of revolutions [rev]
  - L<sub>hm</sub>: Life expectancy in hours [h]
  - C<sub>am</sub>: Equivalent axial dynamic load rating [N]
  - F<sub>m</sub>: Equivalent axial load [N], to ISO 3408-5
  - n<sub>m</sub>: Equivalent rotating speed [min<sup>-1</sup>], to ISO 3408-5
- $$L_m = \left(\frac{C_{am}}{F_m}\right)^3 \cdot 10^6$$
- $$L_{hm} = \frac{L_m}{n_m \cdot 60}$$

Data subject to change without notice.

## Customized ball screws

MPS offers a comprehensive range of miniature high precision ball screws with a positioning accuracy  $< 5 \mu\text{m}$ .

The ball screw technology that was developed by MPS leads to outstanding performances such as high efficiencies, smoothness and long-life reliability.

Most applications require specific mechanical interfaces, or special characteristics.

Throughout a long-time experience with countless cases in various application fields MPS has acquired an exceptional level of expertise in the design and manufacture of customized ball screws, thus always gathering two essential features: precision and compactness.



### On request

- Lubricants: grease, oil, or dry lubrication
- Machined ends
- Higher static and dynamic load capacity
- Multiple nuts
- Left-hand thread
- Customized length and diameter
- Reduced axial play (down to zero backlash)
- Special surface treatments
- Customized nut outer sleeve with flange, pins, etc.



MPS ball screws are primarily intended for demanding applications which require very accurate movements with positioning accuracies in the micron range.

To obtain an accurate adjustment, the dimensional and geometric tolerances of each component interfacing with the ball screw must be properly determined.

To optimize the function and achieve the longevity of the ball screws, it is strongly recommended to take utmost care of the cleanliness during their installation in the final application, for instance by wearing appropriate gloves, and avoid any shock or mechanical stress.

The MPS team of experts is at your disposal to answer all your questions and to support you in finding solutions as needed.



# Balls

The sphere is a symbol of perfection that guides MPS in the ball manufacturing process.

### Steel in revolution

It takes several days of machining, starting from an extruded steel wire, to achieve the perfect sphere. The thermal treatment lends the stainless steel outstanding physical characteristics and a hardness of minimum 58 HRC. The final polishing stage leaves a mirror-finish on the surface of the ball and a precision beyond imagination.

### Sub-millimetric dimensions

MPS specializes in the manufacturing of balls measuring less than a millimeter in diameter. The smallest sphere manufactured by MPS has a diameter of 0.150 mm.

### Sub-micron tolerances

MPS manufactures "Grade 3" balls, the highest quality defined by the ISO 3290/DIN 5401 norm.

	Grade 3 (ISO 3290/DIN 5401)
Material	Stainless steel: AISI 440C
Spherical variation	0.08 µm
Diameter variation within a batch	0.13 µm
Density	7.7 g/cm <sup>3</sup>
Hardness	min. 58 HRC
E-module	21'400 Mpa
Linear coefficient of thermal expansion	10.4 x 10 <sup>-6</sup> K <sup>-1</sup>
Bending strength	1930 Mpa

Designation
0.200X/G3
0.250X/G3
0.300X/G3
0.397X/G3
0.500X/G3
0.600X/G3
0.794X/G3
1.000X/G3
1.150X/G3
1.250X/G3
1.450X/G3
1.500X/G3
1.588X/G3

### EXAMPLE OF PART NUMBER DEFINITION

**0.200X/G3** Nominal ball diameter in [mm]  
**0.200X/G3** AISI 440C stainless steel  
**0.200X/G3** Grade 3 quality to ISO 3290/DIN 5401

### SPECIFIC CALIBERS

MPS balls can also be purchased in specific calibres, i.e. in increments of 1 µm.

### EXAMPLES OF SPECIFIC CALIBERS

**1.250X/G3-M2** "M" stands for "Minus"; 2 µm from nominal (1.248 mm)  
**1.250X/G3-NO** "N" stands for "Nominal"; 0 µm (1.250 mm)  
**1.250X/G3-P3** "P" stands for "Plus"; 3 µm from nominal (1.253 mm)

Larger diameters up to Ø 2.778 mm available until stocks are exhausted.

Data subject to change without notice.

MPS Microsystems develops and manufactures high-precision, high-performance and low-friction electro-mechanical microsystems.

Managing the miniaturization and integration of functions in small volumes, MPS Microsystems provides solutions that meet specific customer requirements.

Here are few examples:



**Precision & Compactness**

Application:  
New generation of pick-and-place heads.

- Technical characteristics:
- Preloaded linear bearing
  - Extremely low friction
  - High lifetime



**Precision & Controlled play**

Application:  
Precision actuator for guiding system.

- Technical characteristics:
- Ball screws shaft and 4 contact-points ball bearing incorporated into the motor
  - Very high linear accuracy
  - High axial load
  - Lubricant free
  - Adhesive free



**High load capacity & Lifetime**

Application:  
Linear ball bearing for measuring system.

- Technical characteristics:
- Low friction anti-rotation pin
  - Controlled radial play
  - Lubricant free



**Integration & Combination**

Application:  
Lens actuator in a guidance system.

- Technical characteristics:
- Linear positioning precision
  - Ensured perpendicularity during movement
  - Microlinea customized ball screws and linear bearings



**High-end Technology**

Application:  
Miniature, high precision hexapod for spinal surgery.

- Technical characteristics:
- Six Faulhaber 5mm smooth gearmotors
  - LVDT sensor (resolution 1µm)
  - High motion control accuracy
  - Compactness
  - M 2.5 x 0.35 mm leadscrew < 5µm backlash