Linear bearings
made from
Advanced Ceramics

TKL-R Series

TKΦLinear

Your partner in Advanced Ceramics

Advanced Ceramic
materials

In a time of steadily increasing technological requirements and development, traditional materials like metal or plastic are approaching its limits. As a result, there is an incremental focus on advanced ceramics and it´s extraordinary properties, whenever there are cutting edge applications with high demands on materials.

Properties, like chemical or temperature resistance as well as many other characteristics of advanced ceramics enable higher system lifetimes or even make other applications feasible in the first place. In such cases, the probably higher asset costs are mostly more than amortized by reduced downtimes in production (TCO, Total Cost of Ownership).

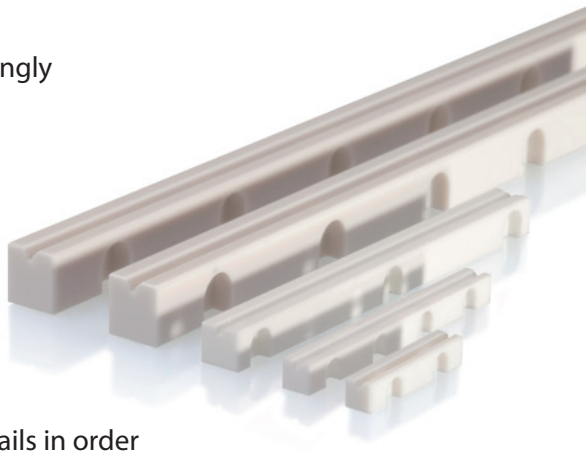
As a consequence one should stay with the common materials at an application, in case these are working out satisfyingly.

In all the other applicational fields, we will be glad to support you for the right solution in your special project – in a best case even in an early stage of progress, in order to have the outstanding abilities of advanced ceramic materials implemented in a most effective way. We will of cause support you also in every stage of development.

Our standard design in the **TKL-R Series** is commonly suitable for substitution in existing systems.

Linear bearings
made from **Advanced Ceramics**

Linear bearings made from ceramic materials have been increasingly proven in many industrial fields. No matter, if in high precision machinery, vacuum technology, cleanroom or magnetic field applications, as well as medical, semiconductor or cryotech: the outstanding material properties combined with high precision manufacturing enable new opportunities.



Ceramic Linear bearings are operating under low lubrication, or even dry running conditions.

The **TKL-R Series** contains rolling elements between the guide rails in order to reduce the friction.

Ceramic linear bearings **TKL-R** contain rolling elements to minimize friction-losses between the different components and guiding elements.

The dimensions are according to standard linear bearings, which results in a compatibility and replacability to the most available metal linear bearings. Especially designed mounting parts, made from titanium enable an easy installation.

Benefits of
Advanced Ceramic materials at a glance

- **Increased lifetime**
- **Higher stiffness**
- **Reduced micro vibrations**
- **Higher lubricants lifetime**
- **Good dry running conditions** (low lubrication or no lubrication)
- **Electric insulation**
- **High chemical corrosional resistance**
- **Non magnetic**
- **Enables operation in ultra high vacuum** (UHV)
- **Temperature resistance** (against high and low temperatures)

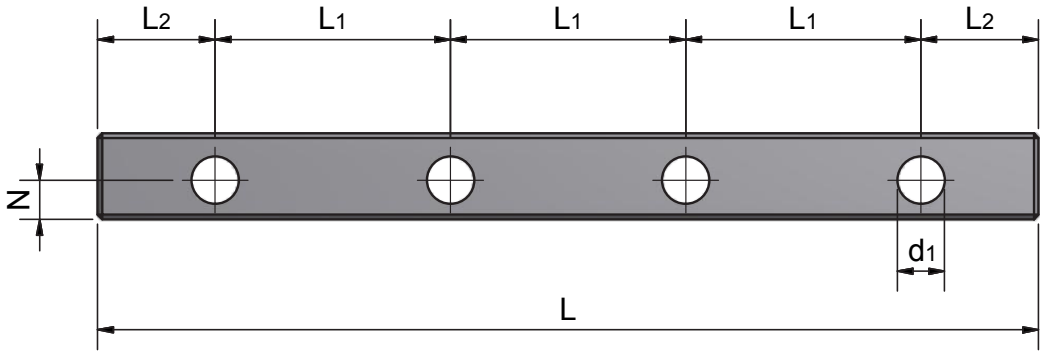
Materials
optional: **ZrO_2** and **Si_3N_4**

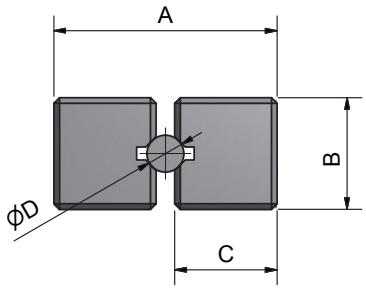
As a standard material, the prism guides and rolling elements(balls and rollers) are delivered in zirconium oxide (ZrO_2) – Order index **WS**

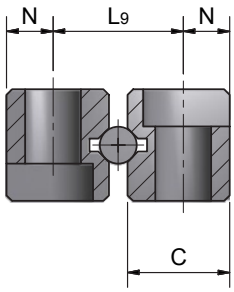
Optional available ist the material combination: prism guides made from zirconium oxide (ZrO_2) and rolling elements made from silicon nitride (Si_3N_4) – Order index **W2**

Different combinations of materials, as well as prism guides made from silicon nitride, upon request.

Dimensions
of the **TKL-R Series**





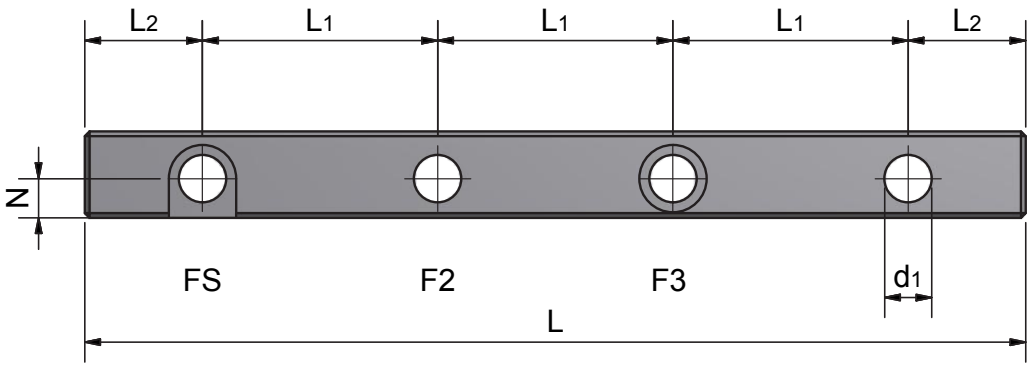


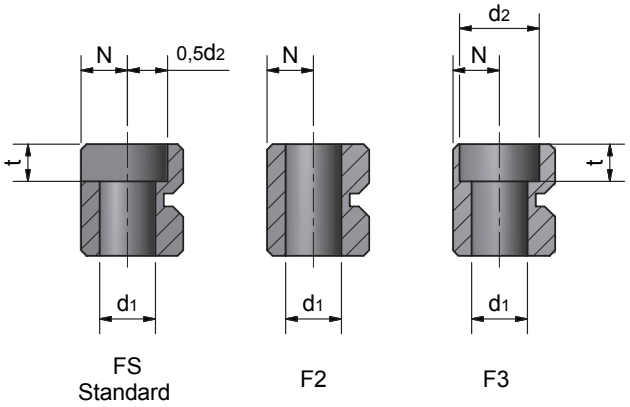
Version	D	A	B	C	N	L1	L2	L9	d1	d2	t	Rolling element	
												ball	roller
TKL-R1	1.5	8.5	4	3.9	1.8	10	5	4.9	1.8	3.0	1.4	X	-
TKL-R2	2	12	6	5.5	2.5	15	7.5	7	3.2	4.8	2	X	-
TKL-R3	3	18	8	8.2	3.5	25	12.5	11	4.2	6.3	3.2	X	X
TKL-R4	4	22	11	10	4.5	40	20	13	5.2	7.5	4.1	X	X
TKL-R6	6	31	15	14	6	50	25	19	6.2	9.5	5.2	X	X
in mm	Other versions upon request, dimensions in mm												

Standard versions include balls as rolling elements

Version	Length L										
TKL-R1	030	040	050	060	070	080	090	100	120	140	
TKL-R2	045	060	075	090	105	120	135	150	165	180	
TKL-R3	075	100	125	150	175	200	225	250	275	300	350
TKL-R4	120	160	200	240	280						
TKL-R6	150	200	250	300							
in mm	Other versions upon request, dimensions in mm										

Realization of the **mounting holes**





Mounting holes:

FS Standard version including screw pockets (fitting for screws DIN912)

F2 Simple hole version (most favourable price)

F3 Only available upon expressed customer´s request. Not a version commonly used in ceramic

Example for composing an **order number**

Standard version:

Order number **TKL-R2090-FS-WS**

TKL	Manufacturer:	TK Linear GmbH
R	Ceramic linear bearing:	Version R
2	Ball-rolling element size:	Diameter 2 mm
090	Lenght of the guide:	90 mm
FS	Type of mounting hole:	Version FS
WS	Material of rolling elements:	Zirconium oxide (ZrO_2)

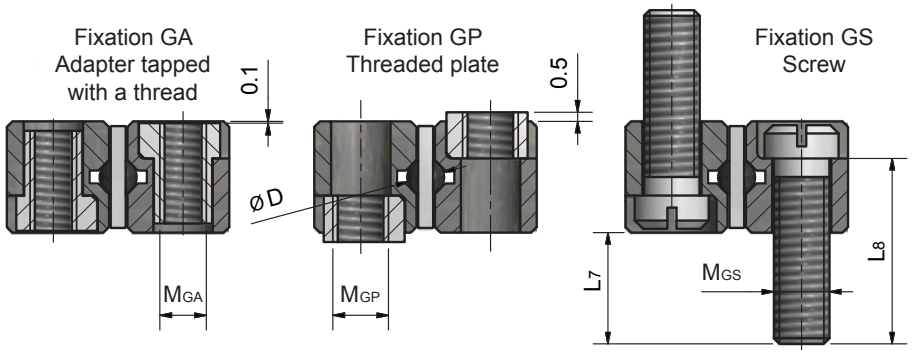
At variance from standard version:

Order number **TKL-R3125-F2-W2-Roll**

TKL	Manufacturer:	TK Linear
R	Ceramic linear bearing:	Version R
3	Ball-rolling element size:	Diameter 3 mm
125	Lenght of the guide:	125 mm
F2	Type of mounting hole:	Version F2
W2	Material of rolling elements:	Silicon Nitride (Si_3N_4)
Roll	Type of rolling elements:	Roller

Please mention the requested mounting elements seperately in case of order or RFQ.

Mounting elements made from **Titanium**



Version	D	MGA	MGP	MGS x L8	L7 (mm)
TKL-R1	1.5	-	-	M1.6 x 6	3.4
TKL-R2	2	2.5	3	M3 x 10	6
TKL-R3	3	3	4	M4 x 12	7.2
TKL-R4	4	4	5	M5 x 16	9.1
TKL-R6	6	5	6	M6 x 20	10.2

Material properties of **Advanced Ceramic materials,** used in linear bearings

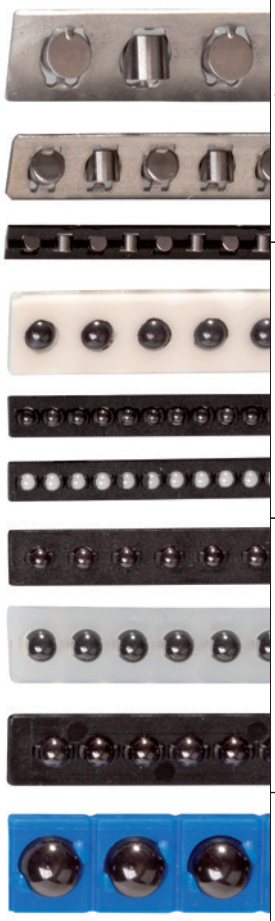
	Units	Zirconium oxide		Silicon nitride
Material		**TTZ**	**Y-TZP**	**GPSN**
		MgO – partially stabilized	Y_2O_3 – partially stabilized	
Colour		Ivory	Ivory	Dark grey to black
Mechanical Properties				
Density	g/cm^3	5.72	6.02	3.20
Water absorption	%	0	0	0
Flexural strength (at 20 °C)	MPa	620	900	> 760
Compressive strength	MPa	1750	2500	3000
Fracture toughness K_{IC}	MPa $m^{1/2}$	11	13	6
Young´s modulus	GPa	200	210	320
Poisson´s ratio		0.30	0.23	0.26
Thermal properties				
Thermal conductivity (at 20 °C)	W/mK	2.2	2.2	30
Linear thermal expansion coefficient (20 – 400 °C)	$10^{-6}K^{-1}$	10.1	10.3	3.2
Specific heat capacity cP (at 20 °C)	kJ/kgK	0.4	0.4	0.8
Maximum temperature of usage, no load	°C	650	900	1200
Thermal shock resistance	°C	350	350	650
Electrical properties				
Electric resistivity (at 20 °C)	Ω cm	> $1x10^{13}$	> $1x10^{13}$	> $1x10^{14}$
Dielectric strength	kV/mm	9.4	9.0	-
Permittivity (1 MHz)		29.0	29.0	8
Dielectric loss index		0.0010	0.0010	0.040

The mentioned values has been evaluated on test samples and are considered being standard values. The Values has been evaluated based on DIN/DIN-VDE-Standards and, if not available, upon manufacturer´s specifications and standards. This values cannot be transferred to any random geometries, parts or components, which comprise deviating surface qualities or structures. The values are no guaranty or warranty for material properties.

Materials used for the
rolling element retainers

Retainers as guiding elements for balls or rollers are available in a number of different materials and will be chosen on customer`s demands, if required. As a standard material, we use PEEK.

We also supply retainers made from stainless steel (AISI 420 / AISI 304), aluminium or advanced ceramic (Al_2O_3).



Tolerances for
Advanced Ceramic materials

The precision during operation as well as the precision of positioning is not only depending on the linear bearings, but also on the quality of the surrounding construction.

Tightening and
pretension torques

The tightening torque used when mounting with screws, as well as the pretension torque for the rolling elements can be provide on request.

Tolerances in parallelism at
TKL-R Series

The standard series is available in this quality:

Different quality upon request.

L (mm)	Quality (µm)
0 – 20	2
21 – 60	3
61 – 100	4
101 – 160	5
161 – 220	6
221 – 300	7
301 – 600	8
601 – 900	9
901 – 1000	10

Special version:
Full ceramic bearings

In accordance with our **TKL-R Series,** the linear bearings are as well available comprising a full ceramic ball retainer with controlled balls.
Linear bearings and balls made from ZrO_2,
retainer made from Al_2O_3,
balls made from ZrO_2,
available from Size 3.

Ideal for a usage at temperatures exceeding 250 °C.

Cutting edge technology –
even in **miniature size**

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