

Ceramic

Technical ceramics comprise materials developed specifically for demanding industrial applications. At maxon, the focus is on oxide ceramics such as zirconium oxide and aluminum oxide. Zirconium oxide offers exceptional hardness, high wear resistance, and a density comparable to steel—ideal for high-precision gears, shafts, and spindles. Aluminum oxide is used primarily for insulation tasks and is available in various purity grades. The choice of material depends on requirements such as dielectric strength, surface quality, friction, or wear. Technical ceramics enable solutions that perform reliably even under extreme conditions and deliver maximum precision in applications where conventional materials reach their limits.



Ceramic

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Ceramic

High performance industrial ceramic is used primarily for applications where customary materials would fail. maxon ceramic products include: precision screws, axles and shafts, customer-specific components for microtechnology, and scratchresistant housing components.

General material properties of zirconia ZrO_2

Bending strength	$>800 \text{ N/mm}^2$
Elasticity modulus	$2 \times 10^5 \text{ N/mm}^2$
Density	$\geq 6.08 \text{ g/cm}^3$
Hardness	1350 HV
Heat expansion coefficient	$10 \times 10^{-6} \text{ 1/K}$
Thermal conductivity	2 W/mK
Electrical resistance	$10^8 \Omega \text{ cm}$

Polished ceramic surfaces are ideal for sliding movements.

Our ceramic spindles with specially developed cgs surface (ceramic glide surface) work almost completely without slip-stick effect.

The nuts also benefit from the special maxon cgs surface and achieve significantly longer life spans.

- Extremely high wear resistance and hardness
- Excellent sliding characteristics
- High mechanical strength
- Long service life
- High temperature resistance

A unique material

Ceramics are used where all other materials fail.

At the Sexau location in the southwest of Germany, maxon develops and manufactures customer-specific CIM (Ceramic Injection Molding) parts. Our development and engineering department has more than 30 years of experience in powder injection molding, use cutting-edge CAD technology and make use of the finite element calculation method. CIM enables maxon to manufacture highly complex ceramic molds – with unique precision and high quality.

ceramic.maxongroup.com



The benefits of ceramic as material

- Extremely high wear resistance and hardness
- Excellent sliding characteristics
- High mechanical strength
- Long service life
- High temperature resistance
- Excellent insulation properties
- High corrosion resistance and chemical stability
- Biocompatible
- Low specific weight

Our fields of application

Watch technology

Components for mechanical clockwork

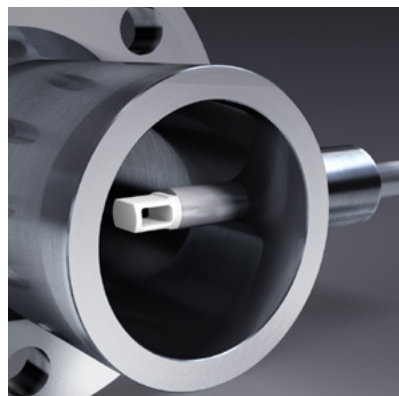
In clockwork, the tiny mechanical parts have to be machined with utmost precision for the clock to run reliably. With ceramic components, the meshing parts maintain precision over life spans never achieved before.

Ceramic components for automatic watches.

- Highest precision
- Unprecedented life spans
- High wear resistance
- Reliable series production
- Absolutely non-magnetic



Precise and long-lasting



Measuring technology

Sensor housing for a flow meter

Ceramic resists harsh conditions. As a sensor housing, ceramic shows resistance against high temperatures, abrasive dust in the mass flow and chemically aggressive condensate. The low heat conductance protects the electronics inside of the sensor. This passive behavior toward electric and magnetic fields makes it possible to use electronic sensors.

- High resistance against external conditions
- Low heat conductance
- Passive behavior toward electric and magnetic fields
- Maintenance and follow-up costs are avoided
- Absolutely non-magnetic



Highly robust and resistant to extreme ambient conditions

Audio technology

Housing for high-tech in-ear headphones

Scratch-resistant ceramic for the headphone housing ensures a long service life and makes it comfortable to wear.



Ceramic surfaces feature scratch-resistance and shine. As a result of its low heat conductance, ceramic feels warm and pleasant. The continuous development of our polishing and shaping processes combines aesthetic design and functionality in a very special way. Ceramic housings protect the high-quality technical components inside and give the products a long-lasting high-quality exterior.

- Perfect surface finish
- Scratch resistance for a long service life
- Low heat conductance for pleasant wearing
- Optimal acoustic properties

Audio technology

Bearing for high-end record player

To get the perfect sound experience, there can be no compromises: All factors have to harmonize perfectly. Special challenges such as magnetic fields and precise radial run-out can be mastered easily by using ceramics. The demands in the high-end sector are extremely high: Highest precision and quality have utmost priority in the material selection, processing and surface finishing. Seamless cooperation based on trust is the perfect prerequisite for first-class high-end products.



A ceramic magnetic bearing provides optimal conditions for sampling the record's groove without any interference.

- Absolutely non-magnetic
- Perfect surface finish
- High wear resistance



Industrial automation

Elements for industrial machines

Machine and system availability is of utmost importance in the industry. This is precisely where ceramic shines, featuring hardness, strength, wear resistance, and outstanding sliding characteristics. This is particularly true of maxon ceramic spindles with the ceramic glide surface (cgs). Sleeves, guides, axles, and shafts are other typical applications for ceramic. The chemically resistant, non-magnetic material can be used in applications where other materials reach their limits.

- High wear resistance
- High hardness
- Excellent sliding characteristics
- Extreme strength

Ceramic offers the hardness, strength, wear resistance and sliding characteristics that are sought after in industrial automation.



Medical

Insulation components for endoscopes

Medical technology places exceptionally high requirements on the materials used in the medical devices (e.g. endoscopes): Only excellent, visually perfect and reliable components are accepted. Additionally, the materials have to be biocompatible and resistant against body fluids.

- Perfect surface finish
- Biocompatibility
- Low heat conductance
- Extreme robustness



Ceramic insulation components are highly valued in endoscopic applications: They are biocompatible and robust.



Drive technology

Spindles for extreme conditions

Applications in salt water require robust and corrosion-resistant materials.

In drive technology, customary materials can reach their limits in some applications. For example, customized underwater drives require material that is resistant to salt water. Here our ceramic spindles shine: They are corrosion-resistant, robust, wear resistant and simultaneously offer high efficiency.

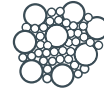
The maxon cgs (ceramic glide surface) ceramic spindles feature:

- Operation almost completely without slip-stick effect
- Smooth-running
- High hardness
- Extraordinary high service life
- High wear resistance
- High efficiency



Procedures and manufacturing process

A range of procedures for manufacturing high-quality ceramic products ensure top results.



CIM process¹	Powder	Feedstock	Injection molding	Solvent debinding	Thermal debinding & sintering
Compression molding procedures	Powder		Compression molding		Sintering
Additive manufacturing	Powder	Suspension	LCM process ²		Thermal debinding & sintering

¹Ceramic injection molding

²Lithography-based ceramic manufacturing

Zirconia ZrO_2

Highly resistant to mechanical stress

Zirconia is a high-performance industrial ceramic. It is used primarily for applications where traditional materials would fail.

Special characteristics of zirconia:

- High wear resistance and hardness
- Excellent sliding characteristics
- High mechanical strength
- High temperature resistance
- Excellent insulation properties
- High corrosion resistance and chemical stability; largely acid and alkali resistant
- Elasticity modulus and heat expansion coefficient similar to steel
- Biocompatible and hypoallergenic
- Low specific weight

General material properties

Bending strength	>800 N/mm ²
Elasticity modulus	2×10^5 N/mm ²
Density	≥ 6.08 g/cm ³
Hardness	1350 HV
Heat expansion coefficient	10×10^{-6} 1/K
Thermal conductivity	2 W/ mK
Electrical resistance	10^{10} Ω cm

Aluminum oxide Al_2O_3

Highly resistant to thermal stress

Aluminum oxide is frequently used as insulation in electrical devices.

Special characteristics of aluminum oxide:

- High temperature resistance
- Good thermal conductivity
- Average mechanical strength
- Low coefficient of thermal expansion
- High corrosion resistance and chemical stability; largely acid and alkali resistant
- Good hardness
- Low specific weight

General material properties

Bending strength	>350 N/mm ²
Elasticity modulus	3.5×10^5 N/mm ²
Density	≥ 3.98 g/cm ³
Hardness	2000 HV
Heat expansion coefficient	$\geq 5 \times 10^{-6}$ 1/K
Thermal conductivity	25 W/ mK
Electrical resistance	10^{15} Ω cm



System-specific nuts

The right nut for each application

In combination with ceramic screws, nuts are available in steel, brass, bronze or plastic. For applications with very high demands to the life span, we use CVD-coated steel nuts. The nuts benefit from the special maxon cgs surface of the screws, this results in significantly longer life spans than those offered by metal screws.

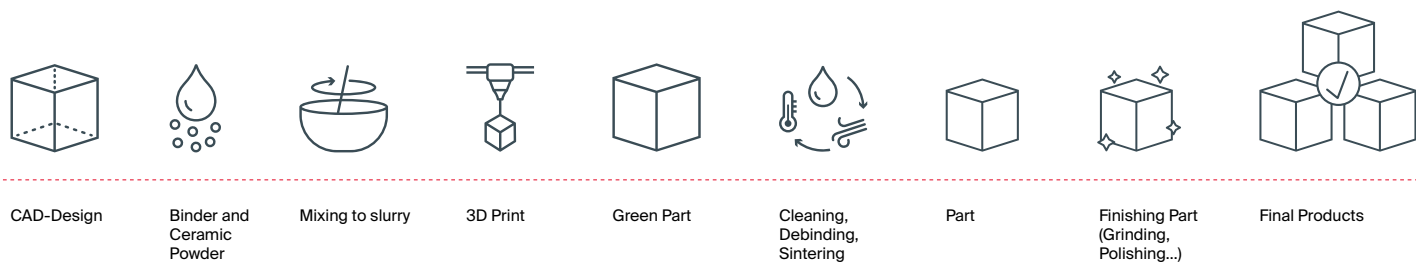
For backlash-free applications, we offer preloaded nuts. For applications with strong magnetic or electric fields, plastic nuts are preferred. In applications involving movements with little load, the nuts may be operated without the lubricant.

Individual solutions

In addition to our standard program, we also offer screws and nuts tailored to your application needs. We provide screws with fine thread, special leads, as well as double-thread screws. A customer-specific integration with your bearing system is also possible. Please contact us if you are interested in learning more.

Additive Manufacturing of Ceramic Components

Process Flow



Technical data

Tank capacity	mm ³	300 x 300 x 100
Lateral resolution	µm	70
Vertical resolution	µm	25
Manufacturing tolerances		ISO 2768mk
Minimum bore diameter	mm	0.5
Minimum/maximum wall thickness	mm	0.3 - max. 4

Materials

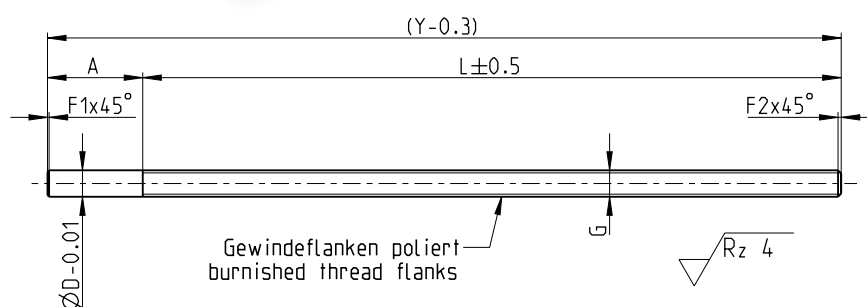
Currently available materials	ZrO ₂ , Al ₂ O ₃
Other materials possible after consultation and technical clarification	Zr8Y, Silicium Nitride, ATZ, ZTA, Cordierite, Hydroxyapatite (HAP), Tricalcium phosphate (TCP)

Necessary data for technical clarification

Drawings and STEP, STL, Solid Works or ProEngineer PRT

Ceramic standard components

Spindles



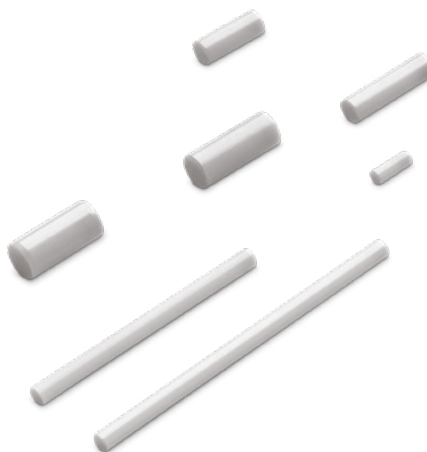
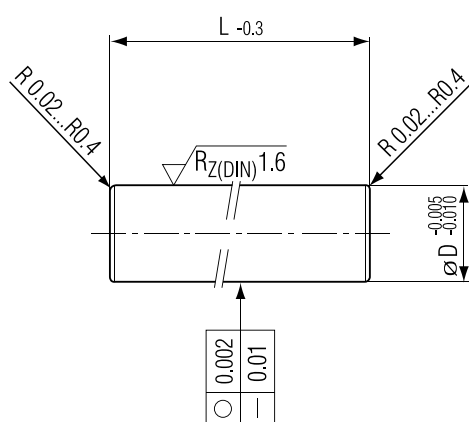
G	Color	Part No.	D	A max.	L max.	F1	F2	Pitch	(Y) max.
M2	white	426634	2.0	18	102	0.3	0.3	0.4	120
M2.5	white	426707	2.5	18	132	0.3	0.3	0.45	150
M3	white	426715	3.0	18	132	0.4	0.4	0.5	150
M4	white	426717	4.0	18	132	0.5	0.5	0.7	150
M5	white	426730	5.0	18	132	0.6	0.6	0.8	150
M6	white	426740	6.0	18	232	0.7	0.7	1.0	250
M8	white	426763	8.0	18	232	0.8	0.8	1.25	250

Larger diameters and lengths upon request.

Various spindle geometries/thread profiles are possible (trapezoidal screws, fine thread, buttress thread). The possible colors are white and gray.

Ceramic standard components

Axes



Ø D	L = 6.4	L = 7.4	L = 10.6	L = 13.8	L = 15	L = 35	L = 40	L = 60	L = 70
0.8	255900	255901	255902	255903	255904	255905	348501	348502	348503
1.0	255892	255893	255894	255895	255896	255898	348498	348499	348500
1.5	255884	255885	255886	255887	255888	255889	255890	255792	255793
2.0	255873	348693	255875	255876	255877	255879	255880	255881	255882
2.5	143825	255866	255867	255868	255869	255870	255871	346621	348288
3.0	255857	255858	255859	255860	255861	255862	255863	346619	346620
4.0	255846	166875	857744	255849	255850	255851	255853	255854	255791
5.0	255834	255835	255836	255837	255838	255839	255840	255841	255842
5.5	255819	255820	255786	857764	255825	255826	255827	255828	255830
6.0	255807	255808	255809	255810	255811	255812	255813	255814	255815

Min. 0.5 mm diameter, max. 12 mm diameter. Other diameters and lengths can be produced individually.

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