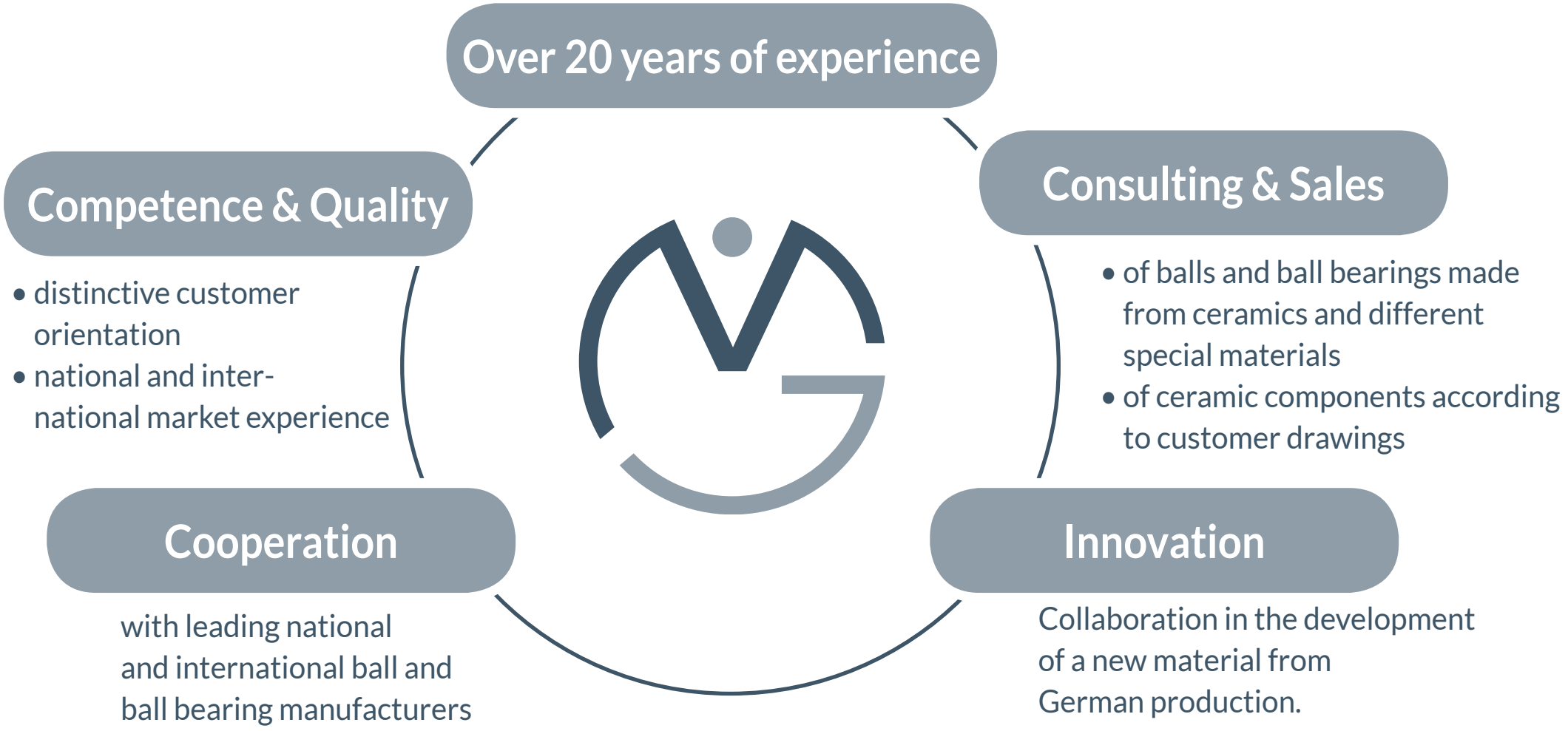
technical ceramics

Your contact person for ceramic balls – if it‘s about precision.

technical ceramics

THE **COMPANY**


Over 20 years of experience
Competence & Quality
• distinctive customer orientation
• national and inter-national market experience
Consulting & Sales
• of balls and ball bearings made from ceramics and different special materials
• of ceramic components according to customer drawings
Cooperation
with leading national and international ball and ball bearing manufacturers
Innovation
Collaboration in the development of a new material from German production.

THE **MATERIALS**

Si_3N_4 & ZrO_2

THE **MATERIALS**

Standards for Si_3N_4 balls

Standardization of the geometrical requirements for a component
- DIN 5401 (balls)
- DIN 54021+3 (cylindrical and needle rollers)

Standardization of ceramic rolling bearing materials
- ASTM F2094 (Si_3N_4 as ball material)
- ASTM F2073 (Si_3N_4 as roll material)

Standardisation Test methods Material characterisation
- Hardness according to Vickers DIN 50133
- Flexural strength, 4-point bending according to DIN EN 843-1, AST 1161
- Fracture toughness according to ASTM C1421

RSK Skew
- DIN EN ISO 4287

Classification of spheres via geometrical parameters
Tolerance in different quality levels
- Diameter tolerance
- Roundness, form deviation
- Surface roughness

Standards
- ISO 3290 (international standard combines national standards)
- DIN 5401 (German standard)
- JIS (Japanese standard)
- AFBMA (American standard)

Additional classification of balls into varieties
- Sorts from G700 to G3 (highest level)
- relevant for the rolling bearing from G10

THE **MATERIALS**

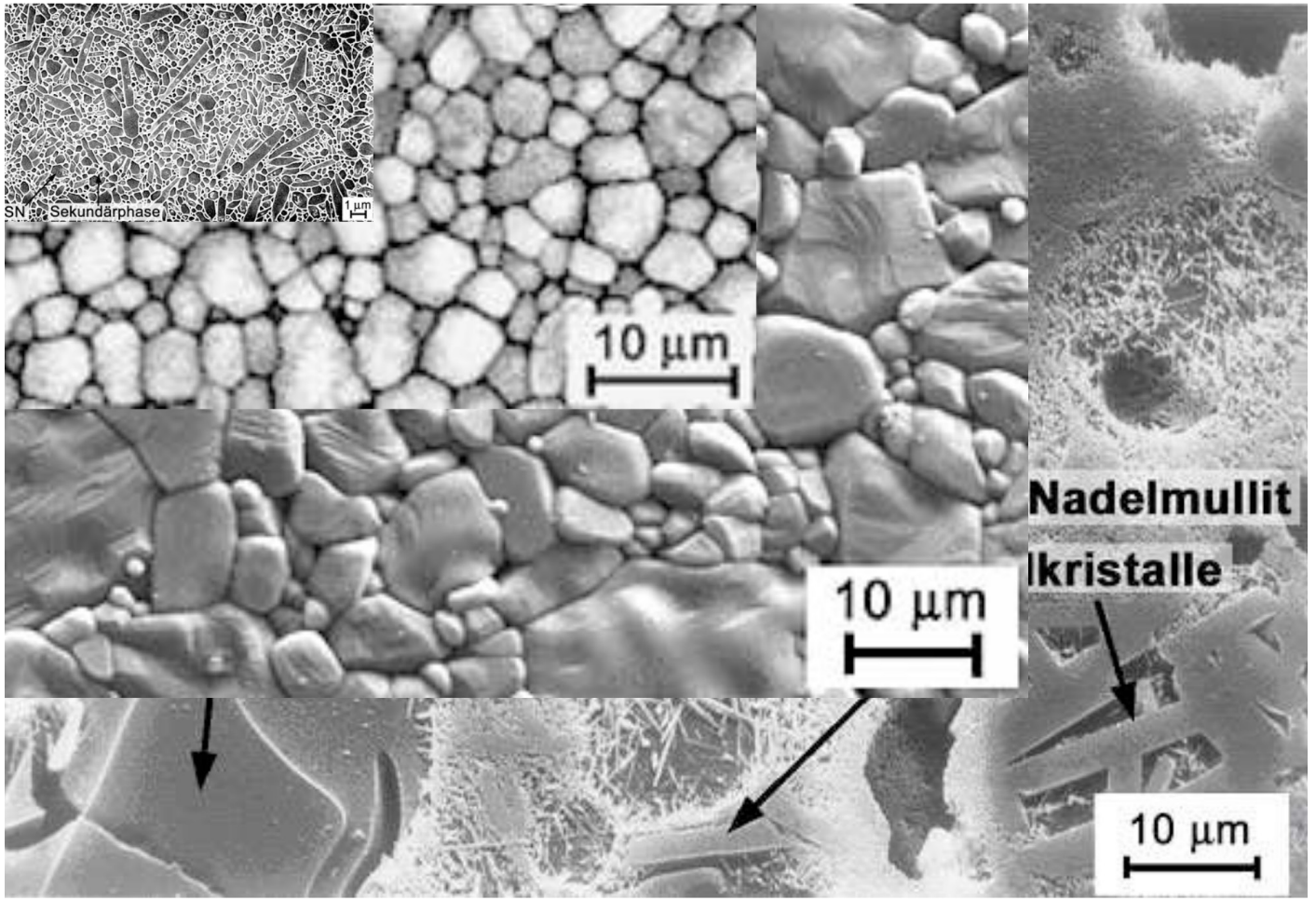
in comparison

Silicon Nitride
(Si_3N_4 HIPSN)

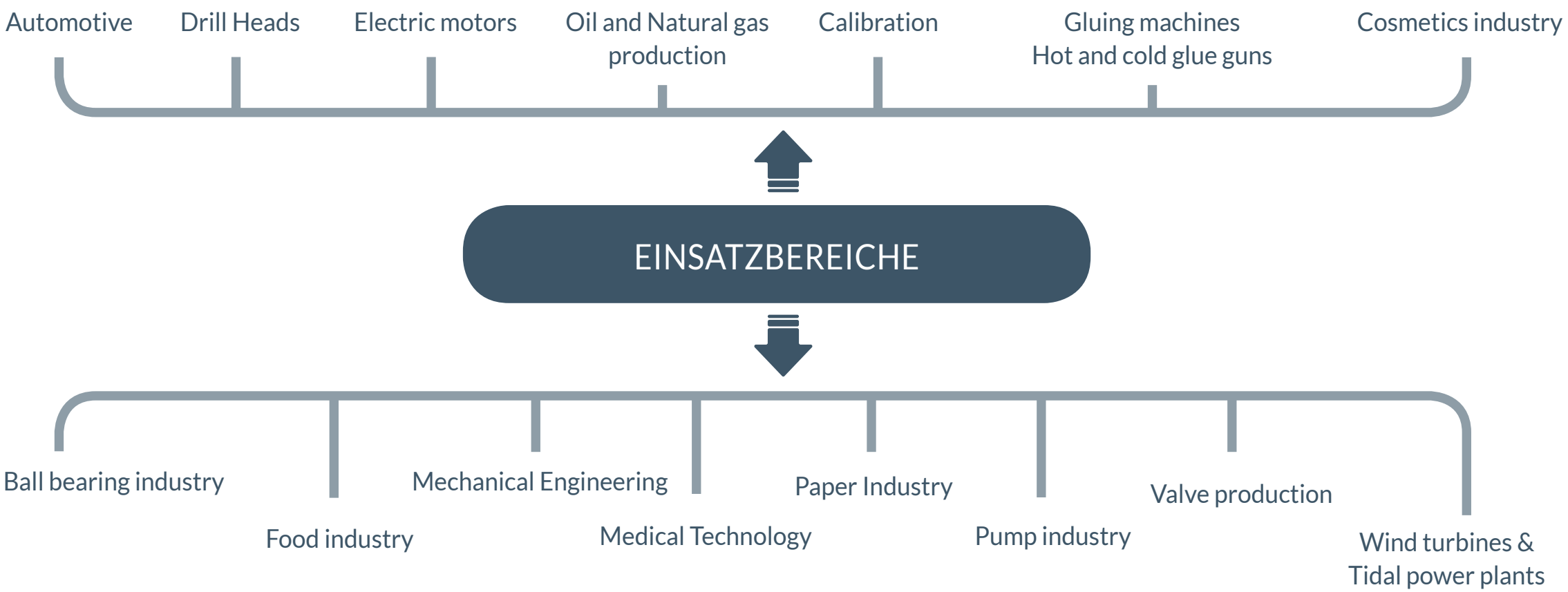
Zirconium oxide
(ZrO_2 PK-TZP)

Aluminiumodix
(Al_2O_3, „as fired“)

Aluminium oxide porcelain
(china ware)



APPLICATION AREAS



APPLICATION AREAS

PRODUCT COMPARISON

ceramic vs. steel balls

- 70 % less thermal expansion
- 60 % lower density
- 50 % higher e-module
- reduced centrifugal force
- higher power-plant mounting rigidity
- less friction
- corrosion resistance
- thermal-shock resistance
- higher hardness and resistance
- resistant to strong pressure
- electrically isolating
- unmagnetic
- considerably longer durability

PRODUCT COMPARISON

Full ceramic bearing vs. steel ball bearing

- heat-resistant (up to 1,000 Grad °C)
- resistant to acids, water, bases, gas
- non-corroding, non-magnetic, electrically isolating
- non-lubricant applicable
- up to 40% lighter than hybrid or steel bearings
- multifunctional

PRODUCT COMPARISON

Comparison of mechanical and thermal properties:

PROPERTIES	Si_3N_4	Tungsten carbide	100Cr6
DENSITY	3.23 g/cm³	14.95 g/cm³	7.8 g/cm³
HARDNESS	~ 76 HRc	~ 76 HRc	~ 60-67 HRc
FLEXURAL STRENGTH (3 pt. 20°C)	1000 MPa	2600 MPa	2000 MPa (Zug)
COMPRESSIVE STRENGHT	> 4000 MPa	6200 MPa	1400 MPa
ELASTICITY	310 GPa	650 GPa	205 GPa
POISSON'S RATIO	0.27	0.22	0.29
BREAKING STRENGTH	7 MPa-√m	12 MPa-√m	70 MPa-√m
THERMAL EXPANSION	3.0 x 10-6/°C	5 x 10-6/°C	12.5 x 10-6/°C
THERMAL CONDUCTIVITY	22 W/m-°C	100 W/m-°C	37 W/m-°C
SPECIFIC HEAT	0.68 J/g-°C	0.34 J/g-°C	0.50 J/g-°C
MAX. OPERATING TEMPERATURE	1000 °C	450 °C	180 °C

The table shows the typical material properties and serves as a comparison. These are not absolute engineering data for which we assume legal responsibility.

SPECIFICATIONS

Dimensional and geometrical accuracy according to DIN 5401:2002-08

Class (Grades)	DW Nominal dimensions in mm		Vdws in µm	Ra in µm	Vdwl in µm	Vdwa in µm	Border-dimensions in µm	Variety range and classification in µm			IG/ST in µm
	at	to	max.	max.	max.	max.					
G3	--	12,7	0,08	0,01	0,13	--	± 5,32	-5 bis -0,5	0	+0,5 bis +5	0,5
G5	--	12,7	0,13	0,014	0,25	--	± 5,63	-5 bis -1	0	+1 bis +5	1
G10	--	25,4	0,25	0,02	0,5	--	± 9,75	-9 bis -1	0	+1 bis +9	1
G16	--	25,4	0,4	0,025	0,8	--	± 11,40	-10 bis -2	0	+2 bis +10	2
G20	--	38,1	0,5	0,032	1,0	--	± 11,50	-10 bis -2	0	+2 bis +10	2
G28	--	50,8	0,7	0,05	1,4	--	± 13,70	-12 bis -2	0	+2 bis +12	2
G40	--	100	1	0,06	2,0	--	± 19,00	-16 bis -4	0	+4 bis +16	4
G80	--	100	2	0,1	--	4,0	± 14,00	-12 bis -4	0	+4 bis +12	4
G100	--	150	2,5	0,1	5,0	--	± 47,50	-40 bis -10	0	+10 bis +40	10
G200	--	150	5	0,15	10,0	--	± 72,50	-60 bis -10	0	+10 bis +60	10

Dw = nominal diameter of the ball
The diameter value used for the general designation of a ball size.

Ra = Surface roughness
For the purposes of this standard, deviations from a geometrically perfect surface, whereby form deviation and waviness are not taken into account.
Note: The limits given in the table refer to the arithmetic mean of the deviation of the roughness profile from the mean line (Ra).

Vdwa = Variation of the ball diameter in a variety
Difference between largest and smallest average ball diameter Dwm in one grade.
Note: The parameter applies only to balls of classes G300 to G700 and G80.

Dwm = average diameter of a sphere
Arithmetic mean of largest and smallest single diameter Dws of a sphere.

Dws = single diameter of a sphere
Distance between two parallel planes that Touch ball surface.

SPECIFICATIONS

Test results based on the example of a 3 mm ball made of shifted Si_3N_4

ITEM	METHOD		SPECIFICATION	RESULT
Chemical analysis	Atomic Absorption-spectrometer	n=1/M.L.	Aluminium (Al) 3.2~ 4.2 Yttrium (Y) 3.0~ 4.0 Titanium (Ti) 0.5~ 1.0 Oxygen (O) 3.5~ 5.5 Carbon (C) 0~ 0.3 Magnesium (Mg) 0~ 0.1 Calcium (Ca) 0~ 0.05 Iron (Fe) 0~ 0.05	Al 3.3 Y 3.40 Ti 0.76 O 4.20 C 0.100 Mg 0.006 Ca 0.011 Fe 0.007
Rupture strength	3-point bending test Sample size width 4 mm thickness 3 mm length 35 mm span 30 mm	n=20/M.L.	Minimum strength ? 730 Mpa Room temperature The Weibull no. (m) ? 12	1148 1157 1161 1198 1204 1208 1214 1223 1228 1246 1258 1259 1264 1270 1274 1283 1286 1289 1289 1305 Average = 1238 Minimum = 1148 m = 31.3
Density	Archimedes method	n=10/D.L.	3.22~ 3.26 g/cm^3	3.24 3.24 3.24 3.24 3.24 3.24 3.24 3.24 3.24 3.24

SPECIFICATIONS

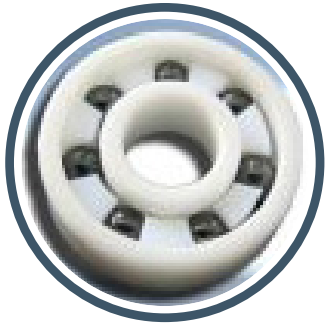
Test results based on the example of a 3 mm ball made of shifted Si_3N_4

ITEM	METHOD		SPECIFICATION	RESULT
Vickers-Hardness (HV20)	Load = 196N (20 kgf) Hold Time = 30 sec.	n=5/D.L.	HV20 = 1460~1600	1539 1531 1540 1529 1546
Fracture Toughness	Indentation Fracture-Methode (NIIHARA's Methode)	n=5/D.L.	K_{IC} = 6.0~ 8.0 MPa $m^{1/2}$	7.8 7.7 7.8 7.3 7.8
Microstructur	Microscope 100x (~5000x) (at the section)	n=3/D.L.	Porosity (<10 µm) none Volume Rating 0.02 % max. Inclusion. ceramic 2nd phase (<25 µm) none metallic phases (<10 µm) none SEM image Metallurgical microscope image	none < 0.02 % none page 3/3 page 3/3 page 3/3
Surface defects	Dye penetration		no crack	no crack
Dimension	Micrometer	n=20/D.L.	Supply sepc. TSB/4g	page 3/3

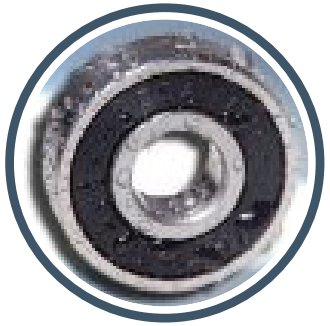
OTHER **PRODUCTS** Synthetic ball bearings

preferable option
to steel with regard to heat, cold, moisture, alkalis, acids, etc.

high dimensional stability and long life
by a metal-cutting manufacturing process



high standard
with almost unlimited possible applications



Ball bearings
also available completely from Peek

Material of the outer and inner rings
POM | PE | PPH | PETP | PTFE | PA | PEEK
PVDF | PSU

Material of the balls
Soda-lime glass | Duran glass | stainless steel 1.4401
Stainless steel 1.4571 | POM | PP | PVC | PEEK
Ceramics | PVDF

OTHER **PRODUCTS** Solid ceramics ball bearings

Material of the bearing

100 % ceramic material

Material of the balls

Silicon Nitride (SI_3N_4)

Bearing

- open on both sides
- easy and quick cleaning
- also available with a Teflon gasket for intense dirt applications, or a rubber gasket for fine-grained dirt applications

ball bearing cage

- made of highly frictionless Teflon
- ball bearings which are high-temperature-resistant are also available without cage

Material of the inner and outer ring

zirconium oxide (ZrO_2)

OTHER **PRODUCTS** Grinding media

Material

- Si_3N_4, Al_2O_3, ZrO_2 (TZP, PSZ), Cordierite, Steatite
- balls or cylinders

Diameter

from 2 mm

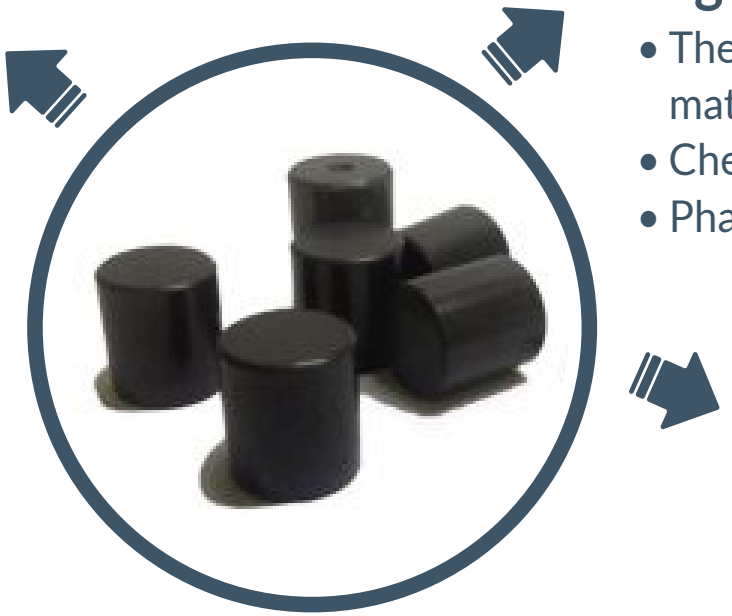
Minimum order quantity

- 10 kgs
- in Si_3N_4 we are also able to quote for customer specific raw material (Minimum order quantity: 50 kgs)

OTHER **PRODUCTS** Ceramic Rollers made of Si_3N_4

Main properties

- Usage at high rotational speeds (> 1 mio. mm/min)
- High precision (< 2 micron)
- Reduced friction
- Low specific weight of the rolling elements
- High wear resistance
- Usage with low/no lubrication
- Prolonged lifetime of lubrication and bearing
- Chemical resistance
- High temperature resistance
- Dry running ability



High Temperature

- Thermal engineering and base material industry
- Chemical engineering
- Pharmaceutical and food industry

Field of application

High speed and high precision for applications like

- Machinery
- Spindles
- Automation
- Automotive Industries
- Aerospace and Military Industries

CONTACT

technical ceramics

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CERTIFICATES

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