CoorsTek

Cerbec® Silicon Nitride

Genuine Cerbec Ceramic Balls

Ceramic Balls for High-Performance and Severe-Duty Applications

Cerbec® silicon nitride balls outperform traditional all-steel bearing balls. With tailored material properties and finishing that maximize the benefits of using ceramics, Cerbec balls outperform in applications where steel balls degrade rapidly or where electrical insulation is required.

Smoother Surface, Better Geometry, & Inert Material

- Decreased lube degradation
- No cold welding/adhesive wear
- Less friction
- Lower operating temperature
- Less wear
- Eliminates vibration-induced false brinelling

Lower Total Operating Cost

- Less wear equals longer bearing life
- Increased reliability reduces downtime and maintenance
- Reduced energy consumption

Harder & Stiffer

Cerbec balls are manufactured from a specially formulated CoorsTek silicon nitride. This unique material is 121% harder and 68% stiffer than traditional steel alloys, providing:

- Reduced ball/race contact area
- Less friction
- Resistance to hard particle contamination
- Higher rigidity
- Increased machine accuracy

Lighter Weight

Manufactured from high-quality silicon nitride, Cerbec balls are 58% lighter than steel alloys—lowering centrifugal force, reducing gyroscopic movement, and minimizing ball skidding. The lighter weight also causes less friction and lower raceway stress.

Lower Thermal Expansion

- Reduced contact angle change
- Stable running pre-load
- Minimal ball deformation

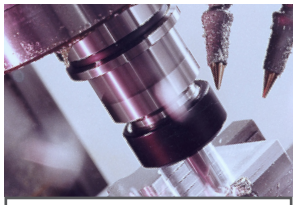
Corrosion & Electrical Resistance

- No electrical arcing through balls
- Increased durability in harsh environments
- Decreased raceway pitting

Additional Benefits

- Minimal lubrication required
- Reduced startup and running torque
- Lower noise and vibration
- Expanded design possibilities available to solve technical challenges
- Higher operating speeds possible

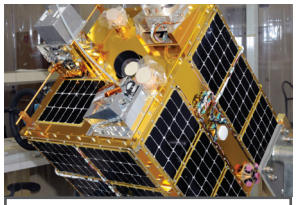
HIGH SPEED



Machine tool spindles

Dental handpieces

EXTREME TEMPERATURES



Space satellites

ELECTRICAL RESISTANCE

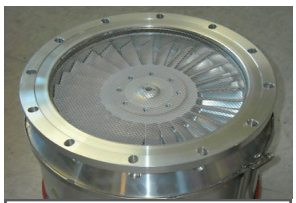
Electric motors and generators

LOW FRICTION

Bicycles, in-line skates

Bearings for low friction and electrical resistance

EXTREMELY LOW LUBE



Turbomolecular pumps

LIGHTWEIGHT

Jet engines and wing flap ballscrew actuator

ASTM F2094 Si_3N_4 BALL SPECIFICATION					
Grade	Allowable Ball Diameter Variation	Allowable Deviation from Spherical Form	Maximum Surface Roughness Ra	Allowable Lot Diameter Variation	Basic Diameter Tolerance
3C	0.08 (3)	0.08 (3)	0.004 (0.15)	0.13 (5)	+/- 0.51 (+/- 20)
5C	0.13 (5)	0.13 (5)	0.005 (0.20)	0.25 (10)	+/- 0.76 (+/- 30)
5 Steel For Comparison	0.13 (5)	0.13 (5)	0.02 (0.8)	0.25 (10)	+/- 1.0 (+/- 40)

Units of measure = micron (micro-inch)

Cerbec Ball Processing

Cerbec bearing balls are produced utilizing high-purity raw silicon nitride materials with highly controlled milling preparation to guarantee consistent chemistry and particle size. Additionally, the Cerbec manufacturing processes include:

- Spray drying for flowability and packing density
- Forming to uniform compaction
- Pre-firing to remove binders
- Hot Isostatic Press (HIP) densification for proper microstructural development — resulting in greater hardness, toughness, and less rolling contact fatigue
- Lapping for consistent geometry, surface finish, and surface quality
- Quality control – Cerbec balls undergo an intensive final inspection to ensure incomparable quality

CoorsTek engineers precision Cerbec balls in sizes ranging from large application bearings in wind turbines to micro-bearings in dental drills, with a diameter range from 50 mm (2 in) to 0.5 mm (0.02 in).

WHY CERBEC CERAMIC BALLS?			
Property	Typical Steel	Cerbec Typical Properties	Cerbec Difference
Density [g/cm^3]	7.6	3.2	58% Lighter
Hardness [Vickers]	700	1550	121% Harder
Elastic Modulus [GPa]	190	320	68% Stiffer
Thermal Expansion Coefficient, 1 X 10^{-6} / °C [RT to 1000°C]	12.3	3.7	70% Less
Max Use Temp [°C]	320	1000	680°C Hotter
Surface Finish, Grade 5 [micron]	0.02	0.005	75% Smoother

	CERAMIC SILICON NITRIDE TYPICAL PROPERTIES					
	Properties	Units	NBD-200*	SN-101C**	SN-102	SN-103
MECHANICAL	Density	g/cm^3	3.16	3.21	3.23	3.23
	Crystal Size (Average)	µm	< 1	2.5	< 1	< 1
	Water Absorption	%	0	0	0	0
	Gas Permeability		0	0	0	0
	Flexural Strength (MOR)(20 °C)	MPa	900	1000	1000	1000
	Elastic Modulus (20 °C)	GPa	320	310	290	290
	Poisson's Ratio (20 °C)		0.26	0.27	0.27	0.27
	Compressive Strength (20 °C)	MPa	2500	3800	3500	3400
	Hardness	HV10	1550	1550	1490	1490
	Fracture Toughness (ASTM F2094 IFR)	MPa-m$^{1/2}$	5.5	6.5	6	6
THERMAL	Thermal Conductivity (20 °C)	W/m-K	29	34	18	14
	Coefficient of Thermal Expansion (25-1000 °C)	1 X 10$^{-6/°C}$	2.9	3.7	3.5	3.6
	Specific Heat (100 °C)	J/kg-K	-	740	740	650
	Thermal Shock Resistance (Δ T)	°C	-	760	760	675
	Maximum Use Temperature	°C	1400	1400	1000	1000
ELECTRICAL	Dielectric Strength (6.35 mm)	ac-kV/mm	-	-	8.6	12
	Dielectric Constant (1 MHz, 25 °C)		8	8	8.15	8.02
	Dielectric Loss (tan δ) (1 MHz, 25 °C)		-	-	0.0017	< 0.0004
	Volume Resistivity (25 °C)	Ω-cm	> 10^{14}	> 10^{14}	> 10^{14}	> 10^{14}

*NBD-200 typical for balls 3.175 mm (0.125") diameter or smaller

**SN-101C typical for balls greater than 3.175 mm (0.125") diameter

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