FREEWILL MATERIAL TECHNICAL DATASHEET

Silicon Nitride (Si3N4)

Structural ceramic for impact, load and rapid thermal cycling.

Best suited for: Bearings, rollers, welding fixtures, shafts and high-load components exposed to rapid temperature change.

Engineering Positioning

Silicon Nitride is selected when a ceramic component must survive mechanical load, impact and repeated thermal cycles. It is often the preferred choice when high reliability is more important than the lowest initial part price.

Typical Material Properties

Property	Typical engineering reference
Typical service temperature	1000-1200 C, application dependent
Hardness	14-18 GPa typical
Flexural strength	700-1000 MPa typical
Fracture toughness	5-8 MPa m^0.5 typical
Thermal conductivity	20-35 W/m-K typical
Key behavior	High strength, high toughness, low density and excellent thermal shock resistance

Values are typical reference ranges. Final data depends on grade, forming route, sintering process, geometry and test method.

Practical Application Scenarios

- Ceramic bearings, rollers and guide components for high-speed and high-reliability systems.
- Welding pins, locating pins and fixtures exposed to impact and temperature cycling.
- Shafts, sleeves and structural parts where alumina may be too brittle.
- Thermal cycling fixtures in electronics, automotive and industrial equipment.

Selection Notes for Engineers

- Specify mechanical load, impact risk, temperature cycle speed and mating material.
- Use silicon nitride when fracture risk is the main failure mode and high toughness is required.
- Confirm surface finish and dimensional tolerance for rolling, sliding or positioning functions.

Silicon Nitride (Si3N4) - Cost and Application Review

The lowest unit price is not always the lowest operating cost. For severe-duty ceramic components, cost should be evaluated by service life, downtime, contamination risk, replacement labor and process stability.

Example Lifecycle Cost-Saving Model

Item	Illustrative scenario
Current solution	Alumina locating pins break 18 times/year under impact and heat cycling
Si3N4 scenario	Breakage reduced to 5 times/year after switching material
Simple model	Replacement part and labor: USD 160/event; line interruption: USD 450/event
Estimated annual impact	USD 10,980 to USD 3,050, about 72% lower failure-related cost in this example

This model is illustrative, not a guaranteed saving. Actual savings depend on operating conditions, design, installation, maintenance behavior and process value per hour.

Recommended Information to Share for Quotation

- Drawing, sketch, sample photo or target geometry.
- Working temperature, thermal cycle rate and atmosphere.
- Chemical medium, abrasive particles, pressure, speed and load.
- Current material, failure mode and expected service life.
- Required tolerance, surface finish, purity, quantity and delivery target.

Why Work with Freewill Material

Material selection	Recommendation based on operating conditions, not only material names.
Custom manufacturing	Ceramic and refractory components from drawings, samples or application requirements.
Technical communication	Support for engineers and procurement teams during sample, testing and volume production.
Global customer focus	English technical content, downloadable datasheets and application-oriented inquiry support.

Contact

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Ask for an expert material recommendation and include your working condition details for faster review.