FREEWILL MATERIAL TECHNICAL DATASHEET

Alumina (Al2O3)

Balanced technical ceramic for insulation, wear resistance and cost efficiency.

Best suited for: Electrical insulation, wear components, chemical stability and repeatable high-volume industrial parts.

Engineering Positioning

Alumina is the most widely used technical ceramic because it provides a strong balance of performance, cost and manufacturing availability. It is often the first material to evaluate when an application needs insulation, hardness or chemical resistance without premium material cost.

Typical Material Properties

Property	Typical engineering reference
Common purity grades	95%, 96%, 99%, 99.5%, 99.7%+
Typical service temperature	1500-1700 C, grade and load dependent
Hardness	14-20 GPa typical
Flexural strength	300-450 MPa typical
Thermal conductivity	20-35 W/m-K typical
Key behavior	Electrical insulation, hardness, wear resistance and chemical stability

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

Practical Application Scenarios

- Insulating tubes, bushings, spacers, substrates and high-voltage components.
- Wear plates, liners, plungers and guide parts in general industrial equipment.
- Chemical processing tubes, seats and components exposed to many acids and solvents.
- Cost-sensitive custom ceramic components made in repeatable batches.

Selection Notes for Engineers

- Choose purity based on insulation, temperature, mechanical load, surface finish and cost target.
- Use 95-96% alumina for many industrial parts and higher purity grades for cleaner, hotter or more demanding applications.
- When crack resistance is critical, compare alumina with zirconia or silicon nitride before final selection.

Alumina (Al2O3) - 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	Polymer insulator replaced every 2 months due to heat deformation
Alumina scenario	Alumina insulator replaced once per year under the same duty
Simple model	Polymer part: USD 55 x 6/year; alumina part: USD 120 x 1/year; service labor: USD 90/change
Estimated annual impact	USD 870 to USD 210, about 76% lower maintenance 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.