Machining Tolerances and Design Rules

Achievable tolerances, surface finish and design guidelines for Si3N4 parts

What tolerances silicon nitride can actually hold. Si3N4 is dry-pressed or CIP-formed, green-machined if needed, sintered (15-20% shrinkage), then diamond-ground and lapped. Tolerance only the features that touch, seal or set a fit - tighten everything else to general tolerance to control cost.

Feature	As-sintered	Ground (standard)	Ground + lapped (precision)
Linear dimension	+/-1-2% of nominal	+/-0.05 mm	+/-0.005 mm (+/-0.002 mm small features)
Flatness	Not controlled	0.01 mm over 50 mm	<0.5 um over 50 mm
Parallelism	-	0.02 mm	0.005 mm
Roundness (balls)	-	G10 (0.25 um)	G5 (0.13 um)
Surface roughness Ra	1.0 - 2.0 um	0.2 - 0.4 um	0.05 - 0.1 um (polished <0.02 um)
Typical cost impact	Baseline	1.5 - 3x	4 - 10x

Design rules that save money

- **Tolerance only functional faces.** A +/-0.005 mm callout on a non-functional OD adds cost without adding value.
- **Minimum wall thickness about 1 mm**, preferably 2 mm - thin walls warp in sintering and chip in handling.
- **Chamfer every edge.** Sharp edges are the number-one chipping and strength-loss point.
- **Avoid internal threads.** Use through-holes with metal inserts, clamps or shrink fits instead.
- **Keep tight tolerances in one grinding setup.** Features needing a second setup cost disproportionately more.
- **Tighter than +/-0.005 mm?** On small features (under ~25 mm, single setup) +/-0.002 mm is achievable by lapping.
- **Surface finish drives price.** As-sintered to ground adds 1.5-3x; lapped/polished adds 4-10x - specify per functional face, not blanket notes.
- **Mind grind direction.** Grinding marks perpendicular to the principal tensile stress preserve strength.

What to send with your RFQ

1. Grade and sintering route (GPS / GPS+HIP / HP) with acceptance density. 2. Fully dimensioned drawing with a single primary datum and only functional tolerances tightened. 3. Surface finish per functional face. 4. Working environment (load, speed, temperature, media). 5. Quantity and target unit price.

Send drawings to dolphintec@aliyun.com - our engineers reply with a manufacturability review, grade recommendation and quote. Free feasibility check, samples available for qualified projects.