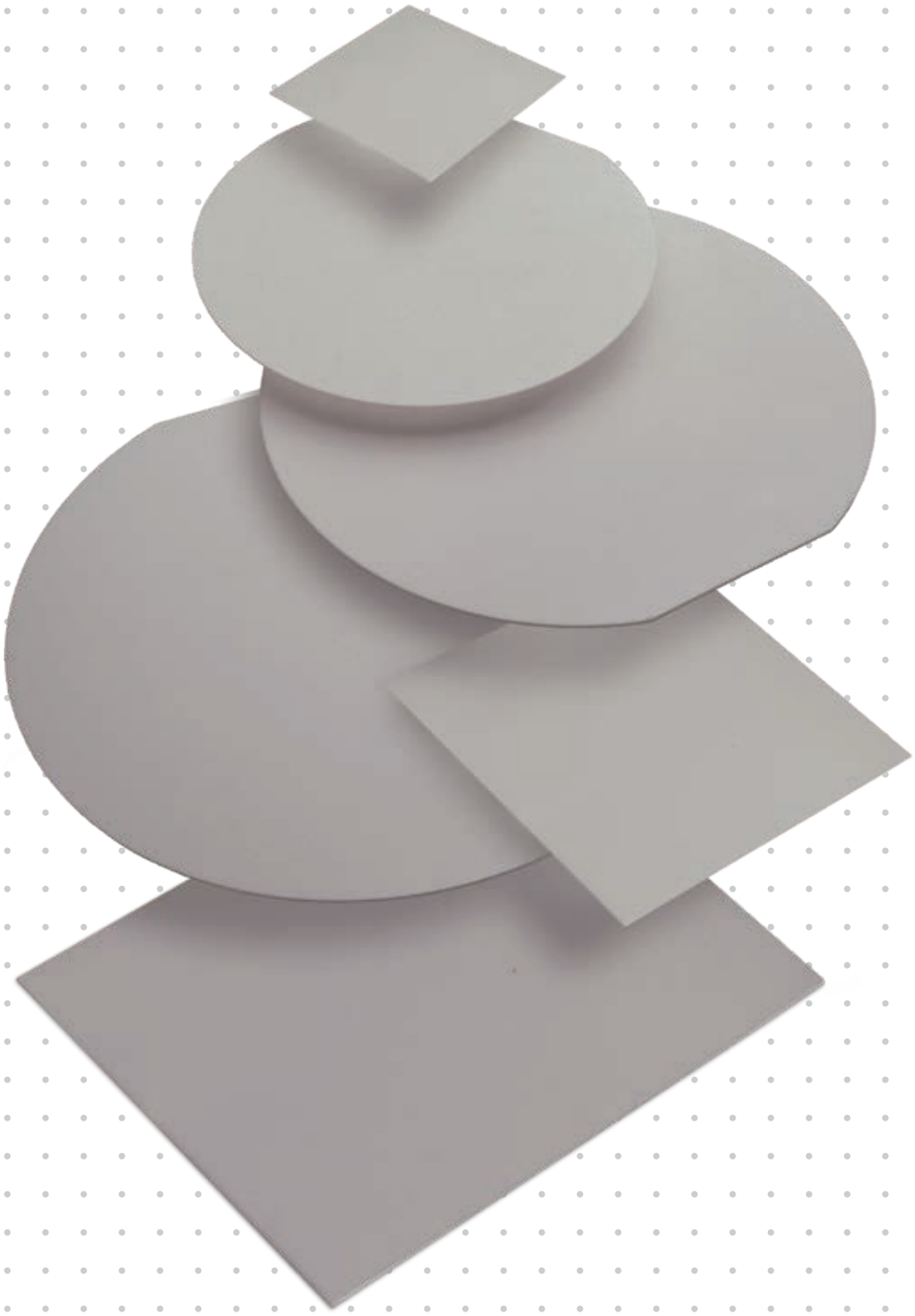
CoorsTek

Aluminum Nitride Substrates

Design Guide



THE WORLD'S LEADING OEMS TRUST COORSTEK FOR SUPERIOR RESULTS.

Why Choose CoorsTek?

We are the largest technical ceramics manufacturer in the world with over 40 state-of-the art facilities on four continents. This means we have the scale, selection of materials, and capabilities to ensure on-time delivery, superior component fit and function, and optimal product life to keep our customers on the road to next-generation technology.

CoorsTek has a highly qualified staff to assist with material selection and product design. Please contact us today at +1 303 277 4701 for more information.

Scope and Intent

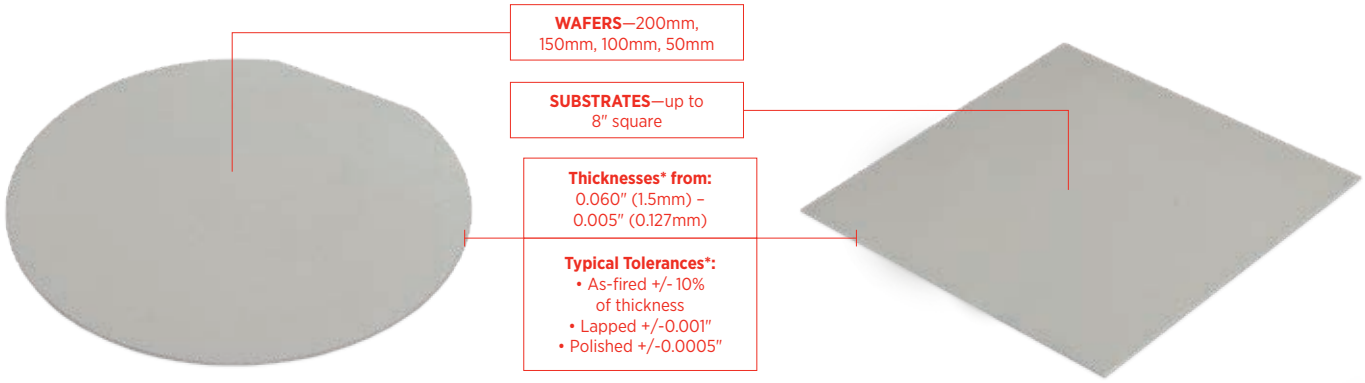
Aluminum nitride, is an ideal material for the rapidly growing LED market and other markets where high-heat dissipation is useful. CoorsTek aluminum nitride ceramic substrates feature a thermal conductivity of 170 W/m K, high dielectric strength, and a thermal expansion coefficient similar to Si, GaN, and GaAs semiconductors.

This technical specification is designed to provide a guide to common sizes, material property information, inspection methods, and quality standards for CoorsTek aluminum nitride substrates.

Design Guidelines

Standard Thickness and Common Sizes

CoorsTek offers a wide range of sizes and thicknesses. The table below represents our standard sizes and common thickness. Our standard length and width tolerance is ±1%, while standard as-fired thickness tolerance is ±10%. If your requirements are outside those listed below, we can customize our products to meet your needs.



* Thickness and tolerance availability are influenced by part length and width or diameter

Camber and Flatness

CoorsTek as-fired and lapped substrates are 100% inspected for camber using two ground, parallel plates spaced at a fixed distance by the following formula.

$$D = T + (C \cdot L)$$

camber distance setting — *substrate mode of thickness* — *camber value* — *substrate length*

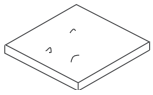
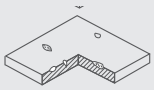
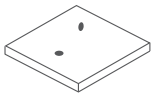
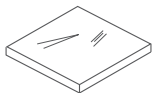
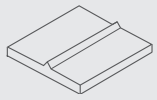
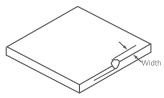
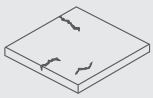
CoorsTek polished substrate flatness is measured in the restrained state.

TABLE I — CAMBER AND FLATNESS TOLERANCES

As-Fired Camber	Lapped Camber	Polished Flatness
Standard: 0.3% (0.003"/") Premium: 0.2% (0.002"/")	0.1% (0.001"/")	0.05% (0.0005"/")

Visual Criteria for Surface Imperfections

TABLE II - ALUMINA SURFACE IMPERFECTIONS

Visual Attribute		As-Fired	Lapped	Polished
Burrs Fragments of excess material or foreign particle adhering to the surface		None > 0.001" (0.0254 mm) high None > 0.010" (0.254 mm) diameter	None allowed	None allowed
Pits, Holes, and Pocks A deep depression or void		None > 0.020" (0.50 mm) diameter	None > 0.020" (0.50 mm) diameter	None allowed
Stains, Spots **Contamination**		None allowed	None allowed	None allowed
Blisters Bubbles or gaseous inclusion at the surface which, if broken, could form a pit, pock, or hole		None allowed	None allowed	None allowed
Scratches Relatively long, narrow, shallow groove or cut in the surface		None > 0.0007" (0.018 mm) deep	None > 0.0007" (0.018 mm) deep	None allowed
Bumps, Fins, Ridges		None allowed	None allowed	None allowed
Chips Open - Material broken off along an edge or corner Closed - Material has not broken off or separated		None > 0.030 (0.762 mm) substrate width X unlimited length X unlimited depth	None > 0.030 (0.762 mm) substrate width X unlimited length X unlimited depth	None > 0.030 (0.762 mm) substrate width X unlimited length X unlimited depth
Cracks Line of fracture without complete separation		None allowed	None allowed	None allowed

Note: The criteria in the table does not apply to substrates with surface areas greater than 20 square inches. Please specify acceptance criteria for large area substrates when requesting quotation.

Inspection

CoorsTek uses ANSI standards for our in-process and final inspection. Tables III and IV list our standard requirements. If a customized inspection is required, please submit your requirements when requesting quotation.

TABLE III - VERIFICATION OF SURFACE IMPERFECTIONS

Surface Condition	Surface Imperfection	Verification Method
As-Fired / Lapped	Burrs, Blisters, Fins, and Ridges	0-1" (0-25.4mm) Micrometer
	Pits, Holes, Pocks, Chips, and Scratches	Low angle light, unaided eye
Polished	Burrs, Blisters, Fins, and Ridges. Pits, Holes, Pocks, Chips, and Scratches	Fluorescent lighting, unaided eye
	Stains, Spots, Contamination, Cleanliness	Polarized Microscope

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Quality Assurance

Our quality system is built around operational excellence. The CoorsTek quality system is certified to ISO 9001 which encompasses the design and manufacture of ceramic raw materials and manufacture of advanced technical ceramics.

Certified Environment-Safe Ceramics

DNV Certified ISO-9001

ISO TS16949

TABLE IV: SAMPLING PLAN: ANSI Z1.4 SINGLE SAMPLING PLAN FOR NORMAL INSPECTION

Feature	Inspection Level	Measurement Devices
External Sizes	General Inspection Level 1 AQL 1.0	Calipers, Micrometers
Internal Feature Location and Size	Special Inspection Level S-2 AQL 1.5	Optical Measurement
Dye Check	Special Inspection Level S-2 AQL 1.5	Dye Penetrant
Surface Finish	3 parts per lot	Profilometer
Camber (As-Fired/Lapped), Final Inspection	General Inspection Level 1 AQL 0.65	Camber Bar
Camber (As-Fired/Lapped), In-Process	100%	
Flatness (Polished), Final inspection	General Inspection Level 1 AQL 0.65	Dial Indicator
Flatness (Polished), In-Process	100%	
Visual, Final Inspection	General Inspection Level 1 AQL 1.5	See Table IV
Visual, In-Process	100%	
Density	3 parts per lot	ASTM-C373

MATERIAL PROPERTIES				
PROPERTY		UNITS	TEST METHODS	ALN-170
Thermal Conductivity 25° C		W/(m K)	ASTM E1461	≥ 170
Nominal Density		g/cm^3	ASTM C373	3.31
Surface Finish	As-Fired (Ra) Lapped Polished	µinch (micron)	Profilometer 5.08 µm Radius Stylus 2,540 µm Cutoff ANSI/ASME B46.1	≤ 25 (≤ 0.6) ≤ 25 (≤ 0.6) ≤ 2 (≤ 0.05)
Flexural Strength		MPa	ASTM-F394 (Bi-Axial Method)	> 350
CTE – 25° - 400° C		10^{-6}/ °C	ASTM C372	4.4
Dielectric Strength (60 cycles AC avg. RMS), 0.635mm thick		Kv/mm (room temp)	ASTM-D149	≥ 15
Dielectric Constant (Relative Permittivity), 1 MHz		@ 25° C	ASTM D150	9
Dissipation Factor (Loss Tangent) 1MHz		@ 25° C	ASTM D150	0.002
Loss Index (Loss Factor) 1MHz		@ 25°C	ASTM D150	0.0016
Volume Resistivity, 25° C		ohm-cm	ASTM D257	> 10^{14}

CoorsTek

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