

## MATERIAL SPECIFICATIONS

Specifications are offered as assistance to Engineers and Purchasing professionals in the design and procurement of thin and thick film circuit substrates. Accumet makes no certification as to the suitability of materials for any application. (Basis for specifications available upon request.)

Properties	Units	High Density 996 Aluminum Oxide	Low Density 96 Aluminum Oxide
<b>Chemical Composition</b>		(Al <sub>2</sub> O <sub>3</sub> )	(Al <sub>2</sub> O <sub>3</sub> )
<b>Purity</b>	%	99.6	96
<b>Color</b>		White	White
<b>Density</b>	g/cm <sup>3</sup>	3.87	3.75
<b>Surface Finish (Polished)</b>	μ-inches	<1.0	<5.0
<b>Surface Finish (Lapped)</b>	μ-inches	10 nominal	20 nominal
<b>Surface Finish (As-Fired)</b>	μ-inches	2-5	15-45
<b>Length &amp; Width Tolerance</b>	Options include: diamond sawcut, laser scribed/cut, &/or diamond ground edges to: +/- 1%, .010", or +/- .001"		
<b>Edge Chips</b>	inches	.025" long x	As required. (call for requirements)
	inches	.010" into face	
<b>Defects (Rej. Criteria) "MIPP"</b>	inches	Any pit >.00125" dia. / FoV	
<b>Defects (Rej. Criteria) "MICROFINE"</b>	inches	Any pit >.00100" dia. / FoV	
<b>Camber</b>	inch/inch	.0003"-.0005"	0.0005"
<b>Thickness</b>	inches	Call for available sizes	Call for available sizes
<b>Sizes (L&amp;W)</b>	inches	Call for available sizes	Call for available sizes
<b>Coefficient of Thermal Expansion (CTE)</b>	10 <sup>-6</sup>	7.0-8.3 (25-1000°C)	6.3-8.0 (25-1000°C)
<b>Thermal Conductivity</b>	Watts/m <sup>0</sup> K	27	26
<b>Dielectric Constant</b>	@1 MHz	9.9	9.5
<b>Dissipation Factor (Loss Tangent)</b>	@1 MHz	0.0001	0.0004
<b>Hardness</b>	Rockwell	87	82
<b>Flexural Strength</b>	K(10 <sup>3</sup> ) lbs/in <sup>2</sup>	90	58
<b>Compressive Strength</b>	M(10 <sup>6</sup> ) lbs/in <sup>2</sup>	54	44
<b>Grain Size</b>	μm (microns)	<1.0	5-7

\*Tighter tolerances are available. Please inquire.

**(FoV)** – Field of View @ 50X

**MIPP** – Minimal Inclusion Polishing Process

**MICROFINE** – Proprietary Microfine Polishing Process

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Properties	Units	Beryllium Oxide	Aluminum Nitride
<b>Chemical Composition</b>		BeO	AlN
<b>Purity</b>	%	99.5	98
<b>Color</b>		White	Tan
<b>Nominal Density</b>	g/cm <sup>3</sup>	2.85	3.28
<b>Surface Finish (Polished)</b>	μ-inches	<4.0	<2.0
<b>Surface Finish (Lapped)</b>	μ-inches	20-60	25 nominal
<b>Surface Finish (As-Fired)</b>	μ-inches	15 max	8-24
<b>Length &amp; Width Tolerance</b>	Options include: diamond sawcut, laser scribed/cut, &/or diamond ground edges to: +/- 1%, .010", or +/- .001"		
<b>Edge Chips</b>		.025" long x	.025" long x
	inches	.010" into face (max)	.010" into face (max)
<b>Defects</b>	inches	<6@.0025" dia. max / FoV	Call for criteria
<b>Camber</b>	inch/inch	.0003"-.0005"*	.0003"-.0005"*
<b>Thickness</b>	inches	Call for available sizes	Call for available sizes
<b>Sizes (L&amp;W)</b>	inches	Call for available sizes	Call for available sizes
<b>Coefficient of Thermal Expansion (CTE)</b>	10 <sup>-6</sup>	25-1000°C 9.0	25-300°C 4.6
<b>Thermal Conductivity</b>	Watts/mK	270	170
<b>Dielectric Constant</b>	@1 MHz	6.5	8.6
<b>Dissipation Factor (Loss Tangent)</b>	@1 MHz	0.0004	0.001
<b>Hardness</b>		45 Rockwell	N/A
<b>Flexural Strength</b>	K(10 <sup>3</sup> ) lbs/in <sup>2</sup>	35 (3 pt. bend)	59 (4 pt. bend)
<b>Young's Modulus</b>	M(10 <sup>6</sup> ) lbs/in <sup>2</sup>	50	47
<b>Grain Size</b>	μm (microns)	9-16	5-7

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Properties	Units	Fused Silica/Quartz	Sapphire (Crystalline)
<b>Chemical Composition</b>		SiO <sub>2</sub>	(Al <sub>2</sub> O <sub>3</sub> )
<b>Purity</b>	%	100	100
<b>Color</b>		Transparent	Transparent
<b>Nominal Density</b>	g/cm <sup>3</sup>	2.2	3.97
<b>Surface Finish (Polished)</b>		60/40 Optical (Scratch/Dig)	<1.0μ-inch CLA
<b>Surface Finish (Lapped)</b>	μ-inches	7 nominal	15-20
<b>Length &amp; Width Tolerance</b>	Options include: diamond sawcut, laser scribed/cut, &/or diamond ground edges to: +/- 1%, .010", or +/- .001"		
<b>Edge Chips</b>	inches	.025" long x	.025" long x
		.010" into face (max)	.010" into face (max)
<b>Defects</b>	inches	Call for criteria	Call for criteria
<b>Camber</b>	inch/inch	.0003"-.0005"*	.0003"-.0005"*
<b>Thickness</b>	inches	.004"-.100"	.003"-.250"
<b>Sizes (L&amp;W)</b>	inches	3.25" Sq Max	Call for available sizes
<b>Coefficient of Thermal Expansion (CTE)</b>	10 <sup>-6</sup>	20-320°C 0.55	A plane @25°C 5.3
<b>Dielectric Constant</b>	@1 MHz	3.826	11.5/9.3 <sup>A</sup>
<b>Dielectric Constant</b>	@24 GHz	3.82	Not available
<b>Dissipation Factor (Loss Tangent)</b>	@1 MHz	0.000015	.00086/.0003 <sup>A</sup>
<b>Dissipation Factor (Loss Tangent)</b>	@24 GHz	0.00033	Not available
<b>Hardness</b>		7 Mohs	1800/2200 <sup>A</sup> Knoop
<b>Flexural Strength</b>	K(10 <sup>3</sup> ) lbs/in <sup>2</sup>	25	60
<b>Compressive Strength</b>	(10 <sup>3</sup> ) lbs/in	161	350
<b>Grain Size</b>		Amorphous	Single crystal

\*Tighter tolerances are available. Please inquire.

<sup>A</sup> – Value varies with orientation ("A" plane / "C" plane)

(FoV) – Field of View @ 50X