

## Materials Property Chart

	Property	ASTM Method	Units	Alumina				High Purity Alumina			Zirconia Toughened Alumina			Zirconia				Nitride		Carbide	Silicates					Units	Property
				AL74 74%	AL95 95%	AL96 96%	AL98 98%	AL995 99.5%	AL9980 99.8%	AL9996 99.96%	ZTA-02 US Patent 8679995	ZTA-14	ZTA-20	MSZ (Magnesia Stabilized)	YTZP 2000 (Yttria Stabilized)	YTZP 4000 (Yttria Stabilized)	CSZ (Ceria Stabilized)	Aluminum Nitride (AlN)	Silicon Nitride (Si <sub>3</sub> N <sub>4</sub> )	Silicon Carbide (SiC) Alpha	Steatite L-4	Steatite L-5	Cordierite	Mullite	Lava Grade A Fired		
General	Crystal Size (Average)	Thin Section	Microns	13	11	8	7	6	6	2	< 2	6	3	30	1	1	3	< 6	4	< 7	7	7	--	7	--	Microns	Crystal Size (Average)
	Color	--	--	White	Ivory	White or Purple	White	Ivory- White	Ivory	Off White/ Blush	Off White	White	White	Ivory or Yellow	Ivory	Ivory	Yellow	Gray	Black	Black	Tan	Gray-Green	Orange-Tan	Gray-Tan	Gray-Tan	--	Color
	Gas Permeability	--	atms-cc/sec	gas tight <10 <sup>-10</sup>	gas tight <10 <sup>-10</sup>	gas tight <10 <sup>-10</sup>	gas tight <10 <sup>-10</sup>	gas tight <10 <sup>-10</sup>	gas tight <10 <sup>-10</sup>	gas tight <10 <sup>-10</sup>	gas tight <10 <sup>-10</sup>	gas tight <10 <sup>-10</sup>	gas tight <10 <sup>-10</sup>	gas tight <10 <sup>-10</sup>	gas tight <10 <sup>-10</sup>	gas tight <10 <sup>-10</sup>	gas tight <10 <sup>-10</sup>	gas tight <10 <sup>-10</sup>	gas tight <10 <sup>-10</sup>	gas tight <10 <sup>-10</sup>	--	--	Porous	--	Porous	atms-cc/sec	Gas Permeability
	Water Absorption	C 20-97	%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	3	%
Mechanical	Density	C 20-97	g/cc	3.03	3.65	3.71	3.78	3.88	3.91	3.93	3.96	4.17	4.30	5.72	6.02	6.07	6.20	3.20	3.25	3.15	2.65	2.75	2.00	3.00	2.30	g/cc	Density
	Hardness	Vickers 500 gm	GPa (kg/mm <sup>2</sup> )	10.5 (1075)	11.5 (1175)	12.7 (1300)	12.7 (1300)	14.3 (1459)	15 (1530)	19.6 (2000)	14 (1440)	14.5 (1478)	14.4 (1470)	11.7 (1200)	12.5 (1250)	12.5 (1250)	11.7 (1200)	11.2 (1142)	15 (1529)	26 (2650)	4.9 (500)	4.9 (500)	5.8 (590)	10 (1000)	4.4 (450)	GPa (kg/mm <sup>2</sup> )	Hardness
	Hardness	--	R45N	78	79	81	81	82	86	90	81	82	82	78	80	80	78	79	83	> 90	57	57	50	78	42	R45N	Hardness
	Fracture Toughness	Notched Beam	MPam <sup>1/2</sup>	2 - 5	3 - 4	4 - 5	4 - 5	4 - 5	3 - 4	5 - 6	5	6	6	12	10	10	12	3	6	4	--	--	--	3	--	MPam <sup>1/2</sup>	Fracture Toughness
	Flexural Strength (MOR) (3 point) @ RT	F417-87	MPa (psi x 10 <sup>3</sup> )	241 (35)	310 (45)	358 (52)	393 (57)	338 (49)	379 (55)	455 (66)	448 (65)	586 (85)	621 (90)	620 (90)	951 (138)	1380 (200)	551 (80)	241 (35)	900 (130)	483 (70)	117 (17)	138 (20)	66 (9.5)	206 (30)	69 (10)	MPa (psi x 10 <sup>3</sup> )	Flexural Strength (MOR) (3 point) @ RT
	Tensile Strength @ RT	--	MPa (psi x 10 <sup>3</sup> )	117 (17)	151 (22)	200 (29)	221 (32)	172 (25)	200 (29)	275 (40)	259 (38)	344 (50)	350 (51)	310 (45)	550 (80)	690 (100)	337 (49)	139 (20)	537 (78)	241 (35)	103 (15)	103 (15)	19 (2.7)	138 (20)	21 (3)	MPa (psi x 10 <sup>3</sup> )	Tensile Strength @ RT
	Compressive Strength @ RT	--	MPa (psi x 10 <sup>3</sup> )	1378 (200)	1827 (265)	2068 (300)	2241 (325)	2137 (310)	2240 (325)	2413 (350)	2413 (350)	2758 (400)	2758 (400)	1862 (270)	2485 (360)	2485 (360)	2000 (290)	2100 (304)	2500 (362)	3306 (480)	551 (80)	586 (85)	165 (24)	1034 (150)	172 (25)	MPa (psi x 10 <sup>3</sup> )	Compressive Strength @ RT
	Elastic Modulus	C848	GPa (psi x 10 <sup>5</sup> )	172 (25)	303 (44)	310 (45)	345 (50)	379 (55)	379 (55)	393 (57)	358 (52)	338 (49)	338 (49)	206 (29.8)	210 (30)	210 (30)	200 (29)	310 (45)	300 (44)	448 (65)	103 (15)	103 (15)	103 (15)	179 (26)	--	GPa (psi x 10 <sup>5</sup> )	Elastic Modulus
Poisson's Ratio	C848	--	0.22	0.22	0.22	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.28	0.30	0.30	0.25	0.24	0.28	0.17	0.24	0.24	0.31	0.24	--	--	Poisson's Ratio	
Thermal	C.T.E. 25 - 100° C	C 372-96	x 10 <sup>-6</sup> /C	5.5	6.1	6.0	6.2	6.3	6.5	6.5	6.7	6.0	6.0	8.9	6.9	6.9	6.9	--	--	3.7	7.3	8.5	2.1	3.6	2.9	x 10 <sup>-6</sup> /C	C.T.E. 25 - 100° C
	C.T.E. 25 - 300° C	C 372-96	x 10 <sup>-6</sup> /C	5.8	7.0	6.8	6.8	6.9	7.9	7.9	8.1	7.0	7.0	9.7	8.1	8.1	8.1	4.3	--	--	7.4	8.6	2.5	4.1	3.3	x 10 <sup>-6</sup> /C	C.T.E. 25 - 300° C
	C.T.E. 25 - 600° C	C 372-96	x 10 <sup>-6</sup> /C	6.3	7.7	7.5	7.6	7.6	8.1	8.2	8.3	7.1	7.1	10.0	10.5	10.5	10.5	5.0	2.9	4.0	7.5	8.6	3.0	4.8	3.6	x 10 <sup>-6</sup> /C	C.T.E. 25 - 600° C
	Thermal Conductivity @ RT	C 408	W/m K	4	19	23	29	30	30	35	27	24	24	3	2.2	2.2	3.5	160	29	150	3	3	3	4	2	W/m K	Thermal Conductivity @ RT
	Max Use Temp	--	Fahrenheit (°F)	2800	3000	3100	3100	3047	3047	3100	2732	2730	2730	2200	932	932	1000	2912	2552	2912	2350	2350	2350	3100	2000	Fahrenheit (°F)	Max Use Temp
		--	Celcius (°C)	1540	1650	1700	1700	1675	1675	1700	1500	1500	1500	1200	500	500	537	1600	1400	1600	1290	1290	1290	1700	1100	Celcius (°C)	
Electrical	Dielectric Strength (.125" Thick)	D 149-97A	V/mil	225	250	250	260	270	290	422	230	250	250	300	240	240	250	355	300	--	260	270	120	250	100	V/mil	Dielectric Strength (.125" Thick)
	Dielectric Constant @ 1 MHz	D 150-98	--	7.0	9.0	9.1	9.5	9.8	9.8	9.9	10.5	12.5	12.5	22.7	30.0	30.0	30.0	8.6	9.2	10.2	5.6	5.7	5.5	6.7	5.3	--	Dielectric Constant @ 1 MHz
	Dielectric Constant @ Gigahertz	D 2520-95	--	--	9.2	9.1	9.4	9.7	10	--	--	--	12.4	29.2	--	--	--	--	--	--	5.6	5.8	--	6.7	--	--	Dielectric Constant @ Gigahertz
	Dielectric Loss @ 1 MHz	D 150-98	--	0.0012	0.0006	0.0004	0.0006	0.0002	< .0001	< .0001	0.0003	0.0006	0.0006	0.0016	0.0010	0.0010	0.0010	0.0026	--	--	0.003	0.0014	--	0.003	--	--	Dielectric Loss @ 1 MHz
	Dielectric Loss @ Gigahertz	D 2520-95	--	--	0.0009	0.0007	0.0005	< .0001	< .0001	--	--	0.0005	0.0005	0.0018	--	--	--	--	--	--	0.005	0.0017	--	0.003	--	--	Dielectric Loss @ Gigahertz
			--	--	12.5	10.9	9.8	9.8	9.6	--	--	9.4	9.4	6.2	--	--	--	--	--	--	9.2	12.5	--	11.4	--	--	
	Volume Resistivity, 25°C	D 257	ohms-cm	> 1 x 10 <sup>13</sup>	> 1 x 10 <sup>14</sup>	> 1 x 10 <sup>14</sup>	> 1 x 10 <sup>14</sup>	> 1 x 10 <sup>14</sup>	> 1 x 10 <sup>14</sup>	> 1 x 10 <sup>14</sup>	> 1 x 10 <sup>14</sup>	> 1 x 10 <sup>14</sup>	> 1 x 10 <sup>14</sup>	> 1 x 10 <sup>13</sup>	> 1 x 10 <sup>13</sup>	> 1 x 10 <sup>13</sup>	> 1 x 10 <sup>13</sup>	> 1 x 10 <sup>14</sup>	> 1 x 10 <sup>14</sup>	> 1 x 10 <sup>5</sup>	> 1 x 10 <sup>14</sup>	> 1 x 10 <sup>14</sup>	> 1 x 10 <sup>14</sup>	> 1 x 10 <sup>14</sup>	--	ohms-cm	Volume Resistivity, 25°C
	Volume Resistivity, 300° C	D 1829	ohms-cm	4 x 10 <sup>10</sup>	5 x 10 <sup>12</sup>	3 x 10 <sup>12</sup>	8 x 10 <sup>11</sup>	1 x 10 <sup>12</sup>	3 x 10 <sup>12</sup>	1 x 10 <sup>13</sup>	3 x 10 <sup>12</sup>	1 x 10 <sup>10</sup>	1 x 10 <sup>10</sup>	5 x 10 <sup>7</sup>	1 x 10 <sup>10</sup>	1 x 10 <sup>10</sup>	1 x 10 <sup>10</sup>	--	--	1 x 10 <sup>4</sup>	2 x 10 <sup>10</sup>	1 x 10 <sup>11</sup>	--	4 x 10 <sup>10</sup>	--	ohms-cm	Volume Resistivity, 300° C
	Volume Resistivity, 500° C	D 1829	ohms-cm	3 x 10 <sup>7</sup>	3 x 10 <sup>9</sup>	7 x 10 <sup>9</sup>	2 x 10 <sup>9</sup>	5 x 10 <sup>10</sup>	6 x 10 <sup>10</sup>	5 x 10 <sup>12</sup>	6 x 10 <sup>10</sup>	2 x 10 <sup>9</sup>	2 x 10 <sup>9</sup>	1 x 10 <sup>7</sup>	1 x 10 <sup>9</sup>	1 x 10 <sup>9</sup>	1 x 10 <sup>9</sup>	--	--	1 x 10 <sup>3</sup>	1 x 10 <sup>9</sup>	4 x 10 <sup>10</sup>	--	1 x 10 <sup>9</sup>	--	ohms-cm	Volume Resistivity, 500° C
	Volume Resistivity, 700° C	D 1829	ohms-cm	2 x 10 <sup>6</sup>	3 x 10 <sup>6</sup>	4 x 10 <sup>6</sup>	2 x 10 <sup>6</sup>	2 x 10 <sup>9</sup>	6 x 10 <sup>9</sup>	1 x 10 <sup>12</sup>	6 x 10 <sup>9</sup>	2 x 10 <sup>8</sup>	4 x 10 <sup>8</sup>	2 x 10 <sup>6</sup>	5 x 10 <sup>3</sup>	5 x 10 <sup>3</sup>	5 x 10 <sup>3</sup>	--	--	--	2 x 10 <sup>8</sup>	1 x 10 <sup>9</sup>	--	--	--	ohms-cm	Volume Resistivity, 700° C
Volume Resistivity, 1000° C	D 1829	ohms-cm	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	ohms-cm	Volume Resistivity, 1000° C	

Note: The information in this data sheet is for design guidance only. STC does not warrant this data as absolute values. Forming methods and specific geometry could affect properties. Slight adjustments can be made to some of the properties to accommodate specific customer requirements. Most of the dense materials in the table are resistant to mechanical erosion and chemical attack. STC has performed ASTM testing qualification for certain compositions, in accordance with ASTM D2442. Please consult our technical staff for appropriate material and specific test results.

Note: In addition to the above compositions, STC offers a wide range of alternative materials. Please contact one of our applications engineers for material requirements that may not be shown above.  
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**STC Delivers...**



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We proudly bring over 120 years of engineering experience to our customers since our humble beginnings in 1898. Our strengths lie in our ability to service all aspects of our customers' demanding engineering needs no matter whether it is a one piece prototype or a high volume mature product. This includes material selection, part design and form, fit and function considerations. Always keeping our customers' cost needs in mind sets us apart from most of our competition both domestic and international.



**TOTAL PROCESS CONTROL**

The quality of all ceramic components begins with the care and control of the starting raw materials. STC prides itself in the fact that we have control of the material portion of the ceramic component equation. Powders are produced with strict process controls to assure that the unique properties of the final components are realized. This same approach is implemented in the forming, green machining, sintering and post fired grinding, coating and assembling of the components built throughout our entire operation. Our AS9100 and ISO:9001 Quality Management System is the foundation for all that we do and how we do it.



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**CONTACT US**

STC looks forward to working closely with you on your quest for a ceramic material solution to any challenging application you may have. We are certain that you will find STC's full service staff an ideal partner to undertake your ceramic component projects.

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