

# Materials Property Chart

	Property	ASTM Method	Units	Zirconia					Nitrides		Carbides	Zirconia Toughened Alumina			Alumina								Steatite		Cordierite	Mullite	Forsterite	Lava Grade A Fired		
				MSZ (Magnesia Stabilized) MSZ-200	MSZ (Magnesia Stabilized) MSZ-300	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	ZTA-02 US Patent 8679995	ZTA-14	ZTA-20	AL74 74%	AL95 95%	AL96 96%	AL96P 95.5%	AL98 98%	AL995 99.5%	AL998 99.8%	AL999 99.9%	L-4	L-5						
General	Crystal Size (Average)	Thin Section	Microns	30	30	1	1	3	< 6	4	< 7	< 2	6	3	13	11	8	9	7	6	6	6	2	7	7	--	7	7	--	
	Color	--	--	Ivory	Yellow	Ivory	Ivory	Yellow	Gray	Black	Black	Off White	White	White	White	Ivory	White	Purple	White	Ivory-White	Ivory	Ivory	Off White/ Blush	Tan	Gray-Green	Orange-Tan	Gray-Tan	Orange-Tan	Gray-Tan	
	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>	gas tight <10 <sup>-10</sup>	gas tight <10 <sup>-10</sup>	--	--	Porous	--	gas tight <10 <sup>-5</sup>	Porous		
	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	0	0	0	0	10	0	0
Mechanical	Density	C 20-97	g/cc	5.72	5.72	6.02	6.07	6.20	3.20	3.25	3.15	3.96	4.17	4.30	3.03	3.65	3.71	3.68	3.78	3.88	3.91	3.91	3.93	2.65	2.75	2.00	3.00	3.16	2.30	
	Hardness	Vickers 500 gm	GPa (kg/mm <sup>2</sup> )	11.7 (1200)	11.7 (1200)	12.5 (1250)	12.5 (1250)	11.7 (1200)	11.2 (1142)	15 (1529)	26 (2650)	14 (1440)	14.5 (1478)	14.4 (1470)	10.5 (1075)	11.5 (1175)	12.7 (1300)	12.7 (1300)	12.7 (1300)	14.3 (1459)	15 (1530)	15 (1530)	19.6 (2000)	4.9 (500)	4.9 (500)	5.8 (590)	10 (1000)	6 (611)	4.4 (450)	
	Hardness	--	R45N	78	78	80	80	78	79	83	> 90	81	82	82	78	79	81	81	81	82	86	86	90	57	57	50	78	60	42	
	Fracture Toughness	Notched Beam	MPam <sup>1/2</sup>	12	12	10	10	12	3	6	4	5	6	6	2 - 5	3 - 4	4 - 5	4 - 5	4 - 5	4 - 5	3 - 4	3 - 4	5 - 6	--	--	--	3	2	--	
	Flexural Strength (MOR) (3 point) @ RT°	F417-87	MPa (psi x 10 <sup>3</sup> )	620 (90)	586 (85)	951 (138)	1380 (200)	551 (80)	241 (35)	900 (130)	483 (70)	448 (65)	586 (85)	621 (90)	241 (35)	310 (45)	358 (52)	331 (48)	393 (57)	338 (49)	379 (55)	379 (55)	455 (66)	117 (17)	138 (20)	66 (9.5)	206 (30)	103 (15)	69 (10)	
	Tensile Strength @ RT°	--	MPa (psi x 10 <sup>3</sup> )	310 (45)	310 (45)	550 (80)	690 (100)	337 (49)	139 (20)	537 (78)	241 (35)	259 (38)	344 (50)	350 (51)	117 (17)	151 (22)	200 (29)	159 (23)	221 (32)	172 (25)	200 (29)	200 (29)	275 (40)	103 (15)	103 (15)	19 (2.7)	138 (20)	--	21 (3)	
	Compressive Strength @ RT°	--	MPa (psi x 10 <sup>3</sup> )	1862 (270)	1862 (270)	2485 (360)	2485 (360)	2000 (290)	2100 (304)	2500 (362)	3306 (480)	2413 (350)	2758 (400)	2758 (400)	1378 (200)	1827 (265)	2068 (300)	1965 (285)	2241 (325)	2137 (310)	2240 (325)	2240 (325)	2413 (350)	551 (80)	586 (85)	165 (24)	1034 (150)	--	172 (25)	
	Elastic Modulus	C848	GPa (psi x 10 <sup>6</sup> )	206 (29.8)	206 (29.8)	210 (30)	210 (30)	200 (29)	310 (45)	300 (44)	448 (65)	358 (52)	338 (49)	338 (49)	172 (25)	303 (44)	310 (45)	310 (45)	345 (50)	379 (55)	379 (55)	379 (55)	393 (57)	103 (15)	103 (15)	103 (15)	179 (26)	150 (21)	--	
Poisson's Ratio	C848	--	0.28	0.28	0.30	0.30	0.25	0.24	0.28	0.17	0.23	0.23	0.23	0.22	0.22	0.22	0.22	0.23	0.23	0.23	0.23	0.23	0.24	0.24	0.31	0.24	0.24	--		
Thermal	C.T.E. 25 - 100° C	C 372-96	x 10 <sup>-6</sup> /C	8.9	8.9	6.9	6.9	6.9	--	--	3.7	6.7	6.0	6.0	5.5	6.1	6.0	6.3	6.2	6.3	6.5	6.5	6.5	7.3	8.5	2.1	3.6	--	2.9	
	C.T.E. 25 - 300° C	C 372-96	x 10 <sup>-6</sup> /C	9.7	9.7	8.1	8.1	8.1	4.3	--	--	8.1	7.0	7.0	5.8	7.0	6.8	6.9	6.8	6.9	7.9	7.9	7.9	7.4	8.6	2.5	4.1	--	3.3	
	C.T.E. 25 - 600° C	C 372-96	x 10 <sup>-6</sup> /C	10.0	10.0	10.5	10.5	10.5	5.0	2.9	4.0	8.3	7.1	7.1	6.3	7.7	7.5	7.6	7.6	7.6	8.1	8.1	8.2	7.5	8.6	3.0	4.8	10.5	3.6	
	Thermal Conductivity @ RT°	C 408	W/m K	3	3	2.2	2.2	3.5	160	29	150	27	24	24	4	19	23	21	29	30	30	30	35	3	3	3	4	5	2	
	Max Use Temp (non-loading) (at high strength)	--	Fahrenheit (°F)	2200	2200	932	932	1000	2912	2552	2912	2732	2730	2730	2800	3000	3100	3100	3100	3047	3047	3047	3100	2350	2350	2350	3100	1472	2000	
	--	Celsius (°C)	1200	1200	500	500	537	1600	1400	1600	1500	1500	1500	1540	1650	1700	1700	1700	1700	1675	1675	1675	1700	1290	1290	1290	1700	800	1100	
Electrical	Dielectric Strength (.125" Thick)	D 149-97A	V/mil	300	300	240	240	250	355	330	--	230	250	250	225	250	250	250	260	270	290	290	422	260	270	120	250	330	100	
	Dielectric Constant @ 1 MHz	D 150-98	--	22.7	22.7	30.0	30.0	30.0	8.6	9.2	10.2	10.5	12.5	12.5	7.0	9.0	9.1	9.0	9.5	9.8	9.8	9.8	9.9	5.6	5.7	5.5	6.7	6.5	5.3	
	Dielectric Constant @ Gigahertz	D 2520-95	--	29.2	29.2	--	--	--	--	--	--	--	--	12.4	--	9.2	9.1	8.9	9.4	9.7	10	10	--	5.6	5.8	--	6.7	--	--	
	Dielectric Loss @ 1 MHz	D 150-98	--	0.0016	0.0016	0.0010	0.0010	0.0010	0.0026	--	--	0.0003	0.0006	0.0006	0.0012	0.0006	0.0004	0.0006	0.0006	0.0002	< .0001	< .0001	< .0001	0.003	0.0014	--	0.003	0.003	--	
	Dielectric Loss @ Gigahertz	D 2520-95	--	0.0018	0.0018	--	--	--	--	--	--	--	0.0005	0.0005	--	0.0009	0.0007	0.0006	0.0005	< .0001	< .0001	< .0001	--	0.005	0.0017	--	0.003	--	--	
	Volume Resistivity, 25°C	D 257	ohms-cm	> 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>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>13</sup>	> 1 x 10 <sup>14</sup>	> 1 x 10 <sup>14</sup>	> 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>14</sup>	> 1 x 10 <sup>14</sup>	--
	Volume Resistivity, 300° C	D 1829	ohms-cm	5 x 10 <sup>7</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>	3 x 10 <sup>12</sup>	1 x 10 <sup>10</sup>	1 x 10 <sup>10</sup>	4 x 10 <sup>10</sup>	5 x 10 <sup>12</sup>	3 x 10 <sup>12</sup>	1 x 10 <sup>11</sup>	8 x 10 <sup>11</sup>	1 x 10 <sup>12</sup>	3 x 10 <sup>12</sup>	3 x 10 <sup>12</sup>	1 x 10 <sup>13</sup>	2 x 10 <sup>10</sup>	1 x 10 <sup>11</sup>	--	4 x 10 <sup>10</sup>	1 x 10 <sup>9</sup>	--	
	Volume Resistivity, 500° C	D 1829	ohms-cm	1 x 10 <sup>7</sup>	1 x 10 <sup>7</sup>	1 x 10 <sup>6</sup>	1 x 10 <sup>6</sup>	1 x 10 <sup>6</sup>	--	--	1 x 10 <sup>3</sup>	6 x 10 <sup>10</sup>	2 x 10 <sup>9</sup>	2 x 10 <sup>9</sup>	3 x 10 <sup>7</sup>	3 x 10 <sup>9</sup>	7 x 10 <sup>9</sup>	5 x 10 <sup>9</sup>	2 x 10 <sup>9</sup>	5 x 10 <sup>10</sup>	6 x 10 <sup>10</sup>	6 x 10 <sup>10</sup>	5 x 10 <sup>12</sup>	1 x 10 <sup>9</sup>	4 x 10 <sup>10</sup>	--	1 x 10 <sup>9</sup>	--	--	
	Volume Resistivity, 700° C	D 1829	ohms-cm	2 x 10 <sup>6</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>	--	--	--	6 x 10 <sup>9</sup>	2 x 10 <sup>9</sup>	4 x 10 <sup>9</sup>	2 x 10 <sup>9</sup>	3 x 10 <sup>9</sup>	4 x 10 <sup>9</sup>	4 x 10 <sup>9</sup>	2 x 10 <sup>9</sup>	2 x 10 <sup>9</sup>	6 x 10 <sup>9</sup>	6 x 10 <sup>9</sup>	1 x 10 <sup>12</sup>	2 x 10 <sup>9</sup>	1 x 10 <sup>9</sup>	--	--	--	--	
	Volume Resistivity, 1000° C	D 1829	ohms-cm	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

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.

**NSF** STC AL998 is NSF 51 certified as suitable for use in commercial food equipment.

US Patent 8679995 Addition of Magnesium Oxide to Zirconia Toughened Alumina

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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