



				Zirconia				
	Property	ASTM Method	Units	MSZ (Magnesia Stabilized) MSZ-200	MSZ (Magnesia Stabilized) MSZ-300	YTZP 2000 (Yttria Stabilized)	YTZP 4000 (Yttria Stabilized)	CSZ (Ceria Stabilized)
General	Crystal Size (Average)	Thin Section	Microns	30	30	1	1	3
	Color	--	--	Ivory	Yellow	Ivory	Ivory	Yellow
	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>
	Water Absorption	C 20-97	%	0	0	0	0	0
Mechanical	Density	C 20-97	g/cc	5.72	5.72	6.02	6.07	6.20
	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)
	Hardness	--	R45N	78	78	80	80	78
	Fracture Toughness	Notched Beam	MPam <sup>1/2</sup>	12	12	10	10	12
	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)
	Tensile Strength @ RT°	--	MPa (psi x 10 <sup>3</sup> )	310 (45)	310 (45)	550 (80)	690 (100)	337 (49)
	Compressive Strength @ RT°	--	MPa (psi x 10 <sup>3</sup> )	1862 (270)	1862 (270)	2485 (360)	2485 (360)	2000 (290)
	Elastic Modulus	C848	GPa (psi x 10 <sup>6</sup> )	206 (29.8)	206 (29.8)	210 (30)	210 (30)	200 (29)
	Poisson's Ratio	C848	--	0.28	0.28	0.30	0.30	0.25
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
	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
	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
	Thermal Conductivity @ RT°	C 408	W/m K	3	3	2.2	2.2	3.5
	Max Use Temp (non-loading) (at high strength)	--	Fahrenheit (°F)	2200	2200	932	932	1000
		--	Celsius (°C)	1200	1200	500	500	537
Electrical	Dielectric Strength (.125" Thick)	D 149-97A	V/mil	300	300	240	240	250
	Dielectric Constant @ 1 MHz	D 150-98	--	22.7	22.7	30.0	30.0	30.0
	Dielectric Constant @ Gigahertz	D 2520-95	--	29.2	29.2	--	--	--
				6.2	6.2	--	--	--
	Dielectric Loss @ 1 MHz	D 150-98	--	0.0016	0.0016	0.0010	0.0010	0.0010
	Dielectric Loss @ Gigahertz	D 2520-95	--	0.0018	0.0018	--	--	--
				6.2	6.2	--	--	--
	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>
	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>
	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>
	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>
Volume Resistivity, 1000° C	D 1829	ohms-cm	--	--	--	--	--	

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	Property	ASTM Method	Units	Nitrides		Carbides	Steatite	
				Aluminum Nitride (AlN)	Silicon Nitride (Si <sub>3</sub> N <sub>4</sub> )	Silicon Carbide (SiC) Alpha	L-4	L-5
<b>General</b>	Crystal Size (Average)	Thin Section	Microns	< 6	4	< 7	7	7
	Color	--	--	Gray	Black	Black	Tan	Gray-Green
	Gas Permeability	--	atms-cc/sec	gas tight <10 <sup>-10</sup>	gas tight <10 <sup>-10</sup>	gas tight <10 <sup>-10</sup>	--	--
	Water Absorption	C 20-97	%	0	0	0	0	0
<b>Mechanical</b>	Density	C 20-97	g/cc	3.20	3.25	3.15	2.65	2.75
	Hardness	Vickers 500 gm	GPa (kg/mm <sup>2</sup> )	11.2 (1142)	15 (1529)	26 (2650)	4.9 (500)	4.9 (500)
	Hardness	--	R45N	79	83	> 90	57	57
	Fracture Toughness	Notched Beam	MPam <sup>1/2</sup>	3	6	4	--	--
	Flexural Strength (MOR) (3 point) @ RT°	F417-87	MPa (psi x 10 <sup>3</sup> )	241 (35)	900 (130)	483 (70)	117 (17)	138 (20)
	Tensile Strength @ RT°	--	MPa (psi x 10 <sup>3</sup> )	139 (20)	537 (78)	241 (35)	103 (15)	103 (15)
	Compressive Strength @ RT°	--	MPa (psi x 10 <sup>3</sup> )	2100 (304)	2500 (362)	3306 (480)	551 (80)	586 (85)
	Elastic Modulus	C848	GPa (psi x 10 <sup>6</sup> )	310 (45)	300 (44)	448 (65)	103 (15)	103 (15)
Poisson's Ratio	C848	--	0.24	0.28	0.17	0.24	0.24	
<b>Thermal</b>	C.T.E. 25 - 100° C	C 372-96	x 10 <sup>-6</sup> /C	--	--	3.7	7.3	8.5
	C.T.E. 25 - 300° C	C 372-96	x 10 <sup>-6</sup> /C	4.3	--	--	7.4	8.6
	C.T.E. 25 - 600° C	C 372-96	x 10 <sup>-6</sup> /C	5.0	2.9	4.0	7.5	8.6
	Thermal Conductivity @ RT°	C 408	W/m K	160	29	150	3	3
	Max Use Temp (non-loading) (at high strength)	--	Fahrenheit (°F)	2912	2552	2912	2350	2350
		--	Celcius (°C)	1600	1400	1600	1290	1290
<b>Electrical</b>	Dielectric Strength (.125" Thick)	D 149-97A	V/mil	355	330	--	260	270
	Dielectric Constant @ 1 MHz	D 150-98	--	8.6	9.2	10.2	5.6	5.7
	Dielectric Constant @ Gigahertz	D 2520-95	--	--	--	--	5.6	5.8
				--	--	--	9.2	12.5
	Dielectric Loss @ 1 MHz	D 150-98	--	0.0026	--	--	0.003	0.0014
	Dielectric Loss @ Gigahertz	D 2520-95	--	--	--	--	0.005	0.0017
				--	--	--	9.2	12.5
	Volume Resistivity, 25° C	D 257	ohms-cm	> 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>
	Volume Resistivity, 300° C	D 1829	ohms-cm	--	--	1 x 10 <sup>4</sup>	2 x 10 <sup>10</sup>	1 x 10 <sup>11</sup>
	Volume Resistivity, 500° C	D 1829	ohms-cm	--	--	1 x 10 <sup>3</sup>	1 x 10 <sup>9</sup>	4 x 10 <sup>10</sup>
	Volume Resistivity, 700° C	D 1829	ohms-cm	--	--	--	2 x 10 <sup>8</sup>	1 x 10 <sup>9</sup>
Volume Resistivity, 1000° C	D 1829	ohms-cm	--	--	--	--	--	

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			Alumina					
	Property	ASTM Method	Units	AL74 74%	AL95 95%	AL96 96%	AL96P 95.5%	AL98 98%
General	Crystal Size (Average)	Thin Section	Microns	13	11	8	9	7
	Color	--	--	White	Ivory	White	Purple	White
	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>
	Water Absorption	C 20-97	%	0	0	0	0	0
Mechanical	Density	C 20-97	g/cc	3.03	3.65	3.71	3.68	3.78
	Hardness	Vickers 500 gm	GPa (kg/mm <sup>2</sup> )	10.5 (1075)	11.5 (1175)	12.7 (1300)	12.7 (1300)	12.7 (1300)
	Hardness	--	R45N	78	79	81	81	81
	Fracture Toughness	Notched Beam	MPam <sup>1/2</sup>	2 - 5	3 - 4	4 - 5	4 - 5	4 - 5
	Flexural Strength (MOR) (3 point) @ RT°	F417-87	MPa (psi x 10 <sup>3</sup> )	241 (35)	310 (45)	358 (52)	331 (48)	393 (57)
	Tensile Strength @ RT°	--	MPa (psi x 10 <sup>3</sup> )	117 (17)	151 (22)	200 (29)	159 (23)	221 (32)
	Compressive Strength @ RT°	--	MPa (psi x 10 <sup>3</sup> )	1378 (200)	1827 (265)	2068 (300)	1965 (285)	2241 (325)
	Elastic Modulus	C848	GPa (psi x 10 <sup>6</sup> )	172 (25)	303 (44)	310 (45)	310 (45)	345 (50)
Poisson's Ratio	C848	--	0.22	0.22	0.22	0.22	0.23	
Thermal	C.T.E. 25 - 100° C	C 372-96	x 10 <sup>-6</sup> /C	5.5	6.1	6.0	6.3	6.2
	C.T.E. 25 - 300° C	C 372-96	x 10 <sup>-6</sup> /C	5.8	7.0	6.8	6.9	6.8
	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
	Thermal Conductivity @ RT°	C 408	W/m K	4	19	23	21	29
	Max Use Temp (non-loading) (at high strength)	--	Fahrenheit (°F)	2800	3000	3100	3100	3100
--		Celcius (°C)	1540	1650	1700	1700	1700	
Electrical	Dielectric Strength (.125" Thick)	D 149-97A	V/mil	225	250	250	250	260
	Dielectric Constant @ 1 MHz	D 150-98	--	7.0	9.0	9.1	9.0	9.5
	Dielectric Constant @ Gigahertz	D 2520-95	--	--	9.2	9.1	8.9	9.4
				--	11.0	10.9	10.8	9.8
	Dielectric Loss @ 1 MHz	D 150-98	--	0.0012	0.0006	0.0004	0.0006	0.0006
	Dielectric Loss @ Gigahertz	D 2520-95	--	--	0.0009	0.0007	0.0006	0.0005
				--	12.5	10.9	10.8	9.8
	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>13</sup>	> 1 x 10 <sup>14</sup>
	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>	1 x 10 <sup>11</sup>	8 x 10 <sup>11</sup>
	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>	5 x 10 <sup>9</sup>	2 x 10 <sup>9</sup>
Volume Resistivity, 700° C	D 1829	ohms-cm	2 x 10 <sup>6</sup>	3 x 10 <sup>8</sup>	4 x 10 <sup>8</sup>	4 x 10 <sup>8</sup>	2 x 10 <sup>8</sup>	
Volume Resistivity, 1000° C	D 1829	ohms-cm	--	--	--	--	--	

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			Alumina				
Property	ASTM Method	Units	AL995 99.5%	AL998 NSF51 Certified 99.8%	AL9980 99.8%	AL999 99.9%	
<b>General</b>	Crystal Size (Average)	Thin Section	Microns	6	6	6	2
	Color	--	--	Ivory-White	Ivory	Ivory	Off White/ Blush
	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>
	Water Absorption	C 20-97	%	0	0	0	0
<b>Mechanical</b>	Density	C 20-97	g/cc	3.88	3.91	3.91	3.93
	Hardness	Vickers 500 gm	GPa (kg/mm <sup>2</sup> )	14.3 (1459)	15 (1530)	15 (1530)	19.6 (2000)
	Hardness	--	R45N	82	86	86	90
	Fracture Toughness	Notched Beam	MPam <sup>1/2</sup>	4 - 5	3 - 4	3 - 4	5 - 6
	Flexural Strength (MOR) (3 point) @ RT°	F417-87	MPa (psi x 10 <sup>3</sup> )	338 (49)	379 (55)	379 (55)	455 (66)
	Tensile Strength @ RT°	--	MPa (psi x 10 <sup>3</sup> )	172 (25)	200 (29)	200 (29)	275 (40)
	Compressive Strength @ RT°	--	MPa (psi x 10 <sup>3</sup> )	2137 (310)	2240 (325)	2240 (325)	2413 (350)
	Elastic Modulus	C848	GPa (psi x 10 <sup>9</sup> )	379 (55)	379 (55)	379 (55)	393 (57)
Poisson's Ratio	C848	--	0.23	0.23	0.23	0.23	
<b>Thermal</b>	C.T.E. 25 - 100° C	C 372-96	x 10 <sup>-6</sup> /C	6.3	6.5	6.5	6.5
	C.T.E. 25 - 300° C	C 372-96	x 10 <sup>-6</sup> /C	6.9	7.9	7.9	7.9
	C.T.E. 25 - 600° C	C 372-96	x 10 <sup>-6</sup> /C	7.6	8.1	8.1	8.2
	Thermal Conductivity @ RT°	C 408	W/m K	30	30	30	35
	Max Use Temp (non-loading) (at high strength)	--	Fahrenheit (°F)	3047	3047	3047	3100
	--	Celcius (°C)	1675	1675	1675	1700	
<b>Electrical</b>	Dielectric Strength (.125" Thick)	D 149-97A	V/mil	270	290	290	422
	Dielectric Constant @ 1 MHz	D 150-98	--	9.8	9.8	9.8	9.9
	Dielectric Constant @ Gigahertz	D 2520-95	--	9.7	10	10	--
	Dielectric Loss @ 1 MHz	D 150-98	--	0.0002	< .0001	< .0001	< .0001
	Dielectric Loss @ Gigahertz	D 2520-95	--	< .0001	< .0001	< .0001	--
	Volume Resistivity, 25°C	D 257	ohms-cm	> 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	1 x 10 <sup>12</sup>	3 x 10 <sup>12</sup>	3 x 10 <sup>12</sup>	1 x 10 <sup>13</sup>
	Volume Resistivity, 500° C	D 1829	ohms-cm	5 x 10 <sup>10</sup>	6 x 10 <sup>10</sup>	6 x 10 <sup>10</sup>	5 x 10 <sup>12</sup>
	Volume Resistivity, 700° C	D 1829	ohms-cm	2 x 10 <sup>9</sup>	6 x 10 <sup>9</sup>	6 x 10 <sup>9</sup>	1 x 10 <sup>12</sup>
	Volume Resistivity, 1000° C	D 1829	ohms-cm	--	--	--	--

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				Zirconia Toughened Alumina			
		Property	ASTM Method	Units	ZTA-02 US Patent 8679995	ZTA-14	ZTA-20
General	Crystal Size (Average)	Thin Section	Microns	< 2	6	3	
	Color	--	--	Off White	White	White	
	Gas Permeability	--	atms-cc/sec	gas tight <10 <sup>-10</sup>	gas tight <10 <sup>-10</sup>	gas tight <10 <sup>-10</sup>	
	Water Absorption	C 20-97	%	0	0	0	
Mechanical	Density	C 20-97	g/cc	3.96	4.17	4.30	
	Hardness	Vickers 500 gm	GPa (kg/mm <sup>2</sup> )	14 (1440)	14.5 (1478)	14.4 (1470)	
	Hardness	--	R45N	81	82	82	
	Fracture Toughness	Notched Beam	MPam <sup>1/2</sup>	5	6	6	
	Flexural Strength (MOR) (3 point) @ RT°	F417-87	MPa (psi x 10 <sup>3</sup> )	448 (65)	586 (85)	621 (90)	
	Tensile Strength @ RT°	--	MPa (psi x 10 <sup>3</sup> )	259 (38)	344 (50)	350 (51)	
	Compressive Strength @ RT°	--	MPa (psi x 10 <sup>3</sup> )	2413 (350)	2758 (400)	2758 (400)	
	Elastic Modulus	C848	GPa (psi x 10 <sup>6</sup> )	358 (52)	338 (49)	338 (49)	
	Poisson's Ratio	C848	--	0.23	0.23	0.23	
Thermal	C.T.E. 25 - 100° C	C 372-96	x 10 <sup>-6</sup> /C	6.7	6.0	6.0	
	C.T.E. 25 - 300° C	C 372-96	x 10 <sup>-6</sup> /C	8.1	7.0	7.0	
	C.T.E. 25 - 600° C	C 372-96	x 10 <sup>-6</sup> /C	8.3	7.1	7.1	
	Thermal Conductivity @ RT°	C 408	W/m K	27	24	24	
	Max Use Temp (non-loading) (at high strength)	--	Fahrenheit (°F)	2732	2730	2730	
		--	Celcius (°C)	1500	1500	1500	
Electrical	Dielectric Strength (.125" Thick)	D 149-97A	V/mil	230	250	250	
	Dielectric Constant @ 1 MHz	D 150-98	--	10.5	12.5	12.5	
	Dielectric Constant @ Gigahertz	D 2520-95	--	--	--	12.4	
				--	--	9.4	
	Dielectric Loss @ 1 MHz	D 150-98	--	0.0003	0.0006	0.0006	
	Dielectric Loss @ Gigahertz	D 2520-95	--	--	0.0005	0.0005	
				--	9.4	9.4	
	Volume Resistivity, 25°C	D 257	ohms-cm	> 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	3 x 10 <sup>12</sup>	1 x 10 <sup>10</sup>	1 x 10 <sup>10</sup>	
	Volume Resistivity, 500° C	D 1829	ohms-cm	6 x 10 <sup>10</sup>	2 x 10 <sup>9</sup>	2 x 10 <sup>9</sup>	
	Volume Resistivity, 700° C	D 1829	ohms-cm	6 x 10 <sup>9</sup>	2 x 10 <sup>8</sup>	4 x 10 <sup>8</sup>	
Volume Resistivity, 1000° C	D 1829	ohms-cm	--	--	--		

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	Property	ASTM Method	Units	Cordierite	Mullite	Forsterite	Lava Grade A Fired
<b>General</b>	Crystal Size (Average)	Thin Section	Microns	--	7	7	--
	Color	--	--	Orange-Tan	Gray-Tan	Orange-Tan	Gray-Tan
	Gas Permeability	--	atms-cc/sec	Porous	--	gas tight <10 <sup>-5</sup>	Porous
	Water Absorption	C 20-97	%	10	0	0	3
<b>Mechanical</b>	Density	C 20-97	g/cc	2.00	3.00	3.16	2.30
	Hardness	Vickers 500 gm	GPa (kg/mm <sup>2</sup> )	5.8 (590)	10 (1000)	6 (611)	4.4 (450)
	Hardness	--	R45N	50	78	60	42
	Fracture Toughness	Notched Beam	MPam <sup>1/2</sup>	--	3	2	--
	Flexural Strength (MOR) (3 point) @ RT°	F417-87	MPa (psi x 10 <sup>3</sup> )	66 (9.5)	206 (30)	103 (15)	69 (10)
	Tensile Strength @ RT°	--	MPa (psi x 10 <sup>3</sup> )	19 (2.7)	138 (20)	--	21 (3)
	Compressive Strength @ RT°	--	MPa (psi x 10 <sup>3</sup> )	165 (24)	1034 (150)	--	172 (25)
	Elastic Modulus	C848	GPa (psi x 10 <sup>6</sup> )	103 (15)	179 (26)	150 (21)	--
Poisson's Ratio	C848	--	0.31	0.24	0.24	--	
<b>Thermal</b>	C.T.E. 25 - 100° C	C 372-96	x 10 <sup>-6</sup> /C	2.1	3.6	--	2.9
	C.T.E. 25 - 300° C	C 372-96	x 10 <sup>-6</sup> /C	2.5	4.1	--	3.3
	C.T.E. 25 - 600° C	C 372-96	x 10 <sup>-6</sup> /C	3.0	4.8	10.5	3.6
	Thermal Conductivity @ RT°	C 408	W/m K	3	4	5	2
	Max Use Temp (non-loading) (at high strength)	--	Fahrenheit (°F)	2350	3100	1472	2000
		--	Celcius (°C)	1290	1700	800	1100
<b>Electrical</b>	Dielectric Strength (.125" Thick)	D 149-97A	V/mil	120	250	330	100
	Dielectric Constant @ 1 MHz	D 150-98	--	5.5	6.7	6.5	5.3
	Dielectric Constant @ Gigahertz	D 2520-95	--	--	6.7	--	--
				--	11.4	--	--
	Dielectric Loss @ 1 MHz	D 150-98	--	--	0.003	0.003	--
	Dielectric Loss @ Gigahertz	D 2520-95	--	--	0.003	--	--
				--	11.4	--	--
	Volume Resistivity, 25°C	D 257	ohms-cm	> 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	--	4 x 10 <sup>10</sup>	1 x 10 <sup>9</sup>	--
	Volume Resistivity, 500° C	D 1829	ohms-cm	--	1 x 10 <sup>9</sup>	--	--
	Volume Resistivity, 700° C	D 1829	ohms-cm	--	--	--	--
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.

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.

**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