

## Material Characteristics

### Alumina

Type	Alumina 99.99%	Alumina 99.7%	Alumina 96%	ZTA Composite
Material	Al <sub>2</sub> O <sub>3</sub>	Al <sub>2</sub> O <sub>3</sub>	Al <sub>2</sub> O <sub>3</sub>	90%Al <sub>2</sub> O <sub>3</sub> / 10%ZrO <sub>2</sub>

### Chemical

MgO (%)	0,0285 – 0,0315	0.08		0.045
SiO <sub>2</sub> (%)	<0.0025	0.06		0.006
Fe <sub>2</sub> O <sub>3</sub> (%)	<0.0015	0.02		0.002
Na <sub>2</sub> O (%)	<0.0035	0.10	0.1	0.001
K <sub>2</sub> O (%)		-	-	0.001
Y <sub>2</sub> O <sub>3</sub> (%)		-	-	0.520
TiO <sub>2</sub> (%)		-	-	0.010

### Physical

Color	light cream	cream	white	cream
Crystalline structure	Hexagonal	Hexagonal	Hexagonal	Hexa./Tetra.
Grain size (microns)	3			2 – 0,7
Final density (g/cm <sup>3</sup> )	3.92	3.90	3.74 – 3.80	3.90

### Mechanical

Bending strength $\sigma$ (MPa)	600	400	500	650
Hardness Hv500g (GPa)	18.5	17	15	18
Traction resistance (MPa)	200 - 250	320	240	
Compression resistance (MPa)	1900 - 2000	4000	3000	
Shear resistance (MPa)				
Young modulus (GPa)	~380	300	280	
Shear modulus (GPa)				
Poisson ratio (-)	0.25 – 0.30			
Toughness K <sub>1c</sub> (MPa.m <sup>1/2</sup> )		4 - 5	4	

### Thermal

Thermal expansion coef. (./°K)	8.40x 10 <sup>-6</sup>	7.5 x 10 <sup>-6</sup>	7-7.5 x 10 <sup>-6</sup>	
Spécific heat (at 100°C) (J/kg.°K)	930	850-1050	850-1050	
Thermal conductivity (at 20°C) (W/m.°K)	40	20-25	18-23	
Thermal shock resistance (°C)	200			
Max. working temperature		1500°C	1200-1400°C	

### Electrical

Resistivity (at 20°C) (Ohm.cm)		6 x 10 <sup>14</sup>	7,5 x 10 <sup>16</sup>	
Dielectric constant at 20°C and 1 GHz (-)		9,6	9,2	
Tan $\delta$ at 20°C and 100 MHz (-)		3 x 10 <sup>-3</sup>	1 x 10 <sup>-3</sup>	
Dielectric strength à 50 Hz (kV/mm)		17	15	

**Zirconia** (Ceramaret ref.)**0201200A****0201200A HIP****0201900A HIP****0200100A HIP****0200400A HIP****0201500A**

Type	Zirconia A	Zirconia AH	Zirconia BH	Zirconia DH	ATZ Composite H	Mg-PSZ
Material	ZrO <sub>2</sub> (3Y-TZP)	ZrO <sub>2</sub> (3Y-TZP)	ZrO <sub>2</sub> (3Y-TZP)	ZrO <sub>2</sub> (3Y-TZP)	80%ZrO <sub>2</sub> / 20%Al <sub>2</sub> O <sub>3</sub>	ZrO <sub>2</sub> (Mg-PSZ)

**Chemical**

Y <sub>2</sub> O <sub>3</sub> (wt%)	5.25	5.25	4 - 6	5.4	4	-
Al <sub>2</sub> O <sub>3</sub> (wt%)	0.25	0.25	-	0.3	21.1	0.02
HfO <sub>2</sub> (wt%)	< 2	< 2	< 2	< 2	< 2	< 2
SiO <sub>2</sub> (wt%)	0.006	0.006	-	0.15	0.02	0.2
Fe <sub>2</sub> O <sub>3</sub> (wt%)	0.01	0.01	-	0.01	0.01	0.09
Na <sub>2</sub> O (wt%)	0.04	0.04	-	0.05	0.04	-
MgO (wt%)	-	-	-	-	-	3.65
TiO <sub>2</sub> (wt%)	-	-	-	0.15	-	0.01

**Physical**

Color	white	white	black	white	white	yellow
Crystalline structure	Tetragonal	Tetragonal		Tetragonal	Tétrag./Hexag.	Cubic/tetra/ monoclic
Grain size (microns)	0.5	0.5	0.7	0.7		10 - 20
Final density (g/cm <sup>3</sup> )	6.05	6.05	6.00	6.05	5.5	5.67

**Mechanical**

Bending strength $\sigma$ (MPa)	1300	1600	1330		1600	500
Hardness Hv500g (GPa)	14.5	14.5	12.7	14.5	16.0	11.5
Traction resistance (MPa)	200 - 250	200 - 250		200 - 250	-	
Compression resistance (MPa)	2000 - 3000	2000 - 3000		2000 - 3000	-	
Shear resistance (MPa)					-	
Young modulus (GPa)	200	200		210	260	
Shear modulus (GPa)	69	69		69	69	
Poisson ratio (-)	0.3	0.3		0.31	0.3	
Toughness K <sub>1c</sub> (MPa.m <sup>1/2</sup> )	5	5		5	5	

**Thermal**

Thermal expansion coef. (./°K)	10 x 10 <sup>-6</sup>	10 x 10 <sup>-6</sup>		11 x 10 <sup>-6</sup>	9.4 x 10 <sup>-6</sup>	
Spécific heat (at 100°C) (J/kg.°K)	450 - 500	450 - 500		460	450 - 500	
Thermal conductivity (at 20°C) (W/m.°K)	2.5	2.5		3	2.5	
Thermal shock resistance (°C)	470	470		300	470	
Max. working temperature	1000	1000		1000	1000	1000

**Electrical**

Resistivity (at 20°C) (Ohm.cm)	6,7 x 10 <sup>12</sup>	6,7 x 10 <sup>12</sup>		1,2 x 10 <sup>13</sup>		
Dielectric constant at 20°C and 1 GHz (-)	32,5	32,5		31,5		
Tan $\delta$ at 20°C and 100 MHz (-)	1,5 x 10 <sup>-3</sup>	1,5 x 10 <sup>-3</sup>		7,5 x 10 <sup>-3</sup>		
Dielectric strength à 50 Hz (kV/mm)	30 - 40	30 - 40		30 - 40		

Note: **The values quoted are typical. Ceramic property values can vary with the method of manufacture**