CoorsTek
*Amazing Solutions.*

# Ceramic Properties Standard

OXIDES — NON-OXIDES

| | Properties* | | Units | Test | Porcelain | Steatite | Cordierite | Mullite | Alumina: AD-85 | AD-90 | AD-94 | AD-96 | FG-995 | AD-995 | AD-998 | PlasmaPure-UC™ Alumina | ESD Alumina | Zirconia: ZTA 10% | DURA-Z™ (TTZ) | YTZP (Sintered) | YTZP (HIPed) | Carbides: SC-RB (SC-2) | UltraSiC™ (SC-30) | PureSiC® | RBB4C | HPB4C | WC | Nitrides: HP AlN | SN 101C | NBD-200 | NT 154 | Kersit 303 | Steel |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Nom. 85% $Al_2O_3$ | Nom. 90% $Al_2O_3$ | Nom. 94% $Al_2O_3$ | Nom. 96% $Al_2O_3$ | Nom. 98.5% $Al_2O_3$ | Nom. 99.5% $Al_2O_3$ | Min. 99.8% $Al_2O_3$ | Min. 99.9% $Al_2O_3$ | | Zirconia-Toughened Alumina | MgO Partially Stabilized Zirconia | $Y_2O_3$ Partially Stabilized Zirconia | $Y_2O_3$ Partially Stabilized Zirconia | Reaction Bonded Silicon Carbide | Direct Sintered Silicon Carbide | CVD Silicon Carbide > 99.9995% | Reaction Bonded Boron Carbide | Hot Pressed Boron Carbide | Tungsten Carbide | Hot Pressed Aluminum Nitride | Silicon Nitride (Glass HIPed) | Silicon Nitride (Glass HIPed) | High Temp Silicon Nitride (Glass HIPed) | Silicon Nitride (GPS) | |
| MECHANICAL | Density | | gm/cc | ASTM-C20 | 2.40 | 2.78 | 2.05 | 2.80 | 3.42 | 3.60 | 3.70 | 3.72 | 3.80 | 3.90 | 3.92 | 3.92 | 3.85 | 4.01 | 5.72 | 6.02 | 6.07 | 3.10 | 3.15 | 3.21 | 2.65 | 2.5 | 14.90 | 3.26 | 3.21 | 3.16 | 3.22 | 3.20 | 7.5-8.0 |
| | Crystal Size | Average | MICRONS | THIN-SECTION | – | – | – | 10 | 6 | 4 | 12 | 6 | 6 | 6 | 6 | 3 | 6 | 2 | 35 | 1 | 1 | 12 | 3 - 10 | 3 - 10 | – | 15 | 2 | 3 | – | – | – | – | – |
| | Water Absorption | | % | ASTM-373 | 0 | 0 | 9.50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Gas Permeability | | – | – | 0 | 0 | – | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Color | | – | – | WHITE | BEIGE | YELLOW | TAN | WHITE | WHITE | WHITE | WHITE | WHITE | IVORY | IVORY | IVORY | BLACK | WHITE | IVORY | IVORY | GRAY | BLACK | BLACK | BLACK | – | BLACK | GRAY | GRAY | GRAY | GRAY | GRAY | GRAY | GRAY |
| | Flexural Strength (MOR) | 20° C | MPa (psi x $10^3$) | ASTM-F417 | 130 (19) | 140 | 55 | 170 (25) | 296 (43) | 338 (49) | 352 (51) | 358 (52) | 375 (54) | 379 (55) | 375 (54) | 400 (58) | 300 | 450 (65) | 900 (130) | 1240 (180) | 1720 (250) | 462 (67) | 480 (70) | 470-520 | 250 (36) | 410 | 1550 (225) | 340 ❹ | 1000 | 900 | 900 ❹ | 900 | – |
| | Elastic Modulus | 20° C | GPa (psi x $10^6$) | ASTM-C848 | 104 (15) | 110 | 40 | 150 (22) | 221 (32) | 276 (40) | 303 (44) | 303 (44) | 350 (51) | 370 (54) | 370 (54) | 386(56) | 370 | 360 (52) | 200 (29) | 210 (30) | 210 (30) | 393 (57) | 410 (59) | 435-460 | 379 (55) | 460 | 627 (91) | 330 | 310 | 320 | 310 | 315 | 210-235 (30-34) |
| | Poisson's Ratio | 20° C | – | ASTM-C848 | – | – | – | – | 0.22 | 0.22 | 0.21 | 0.21 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.23 | 0.30 | 0.23 | 0.23 | 0.20 | 0.21 | 0.21 | 0.18 | 0.17 | – | 0.25 | 0.27 | 0.26 | 0.27 | – | 0.29 |
| | Compressive Strength | 20° C | MPa (psi x $10^3$) | ASTM-C773 | 590 (86) | – | – | 550 (80) | 1930 (280) | 2482 (360) | 2103 (305) | 2068 (300) | 2500 (363) | 2600 (377) | 2500 (363) | 2700 (392) | 1975 (287) | 2900 (421) | 1750 (254) | 2500 (363) | 2500 (363) | 2700 (363) | 3500 (507) | – | 1721 (250) | – | 5000 (725) | – | 2500 | 2500 | – | 2500 | 1000-2000 (145-290) |
| | Hardness | | GPa (kg/mm²) | KNOOP 1000 gm | 5.9 (600) | – | – | 7.4 (750) | 9.4 (960) | 10.4 (1058) | 11.5 (1175) | 11.5 (1175) | 13.7 (1400) | 14.1 (1440) | 14.1 (1440) | 14.5 (1480) | – | 14.4 (1475) | 11.8 (1200) | 12.7 (1300) | 12.7 (1300) | 26 (2500) ❸ | 26 (2800) ❸ | 27 (2750) ❸ | 25.5 (2600) ❸ | (3200) ❸ | 16 (1630) | 11 | 16 | 15 | 16 | 16 | 6.4-8.8 (650-900) |
| | | | R45N | ROCKWELL 45 N | 60 | 57 | – | 70 | 73 | 75 | 78 | 78 | 82 | 83 | 83 | 86 | 78 | 85 | 77 | 81 | 81 | – | – | – | – | – | – | – | – | – | – | 55-80 |
| | Tensile Strength | 25° C | MPa (psi x $10^3$) | ACMA TEST #4 | – | – | – | – | 155 (22) | 221 (32) | 193 (28) | 221 (32) | 248 (36) | 262 (38) | 248 (36) | 283 (41) | – | 290 (42) | 483 (70) | – | – | 307 (44.5) | – | – | – | – | – | – | – | 630 | – | 1110 (103) |
| | Fracture Toughness | K(I c) | Mpa $m^{1/2}$ | NOTCHED BEAM | 2 | – | – | 2 | 3 - 4 | 3 - 4 | 4 - 5 | 4 - 5 | 4 - 5 | 4 - 5 | 4 - 5 | 4 - 5 | 3 - 4 | 5 - 6 | 11 | 13 | 13 | 4 | 4 | 3.5 | 3-4 | 2.5 | > 6 | 3 | 6.5 | 5.5 | 6.0 | 7.5 | 50-80 |
| THERMAL | Thermal Conductivity | 20° C | W/m K | ASTM-C408 | 5.0 | 2.5 | 1.6 | 3.5 | 16.0 | 16.7 | 22.4 | 24.7 | 27.5 | 30.0 | 30.0 | 35.0 | 25 | 27.0 | 2.2 | 2.2 | 2.2 | 125.0 | 150.0 | 115.0 | 50.0 | 90 | 100.0 | 80.0 | 34 | 29 | 38 | 19 | 35-55 |
| | Coefficient of Thermal Expansion | 25-1000° C | 1X $10^{-6}$/°C | ASTM-C372 | 4.9 | 9 | 3.4 | 5.3 | 7.2 | 8.1 | 8.2 | 8.2 | 8.2 | 8.2 | 8.2 | 8.1 | 8 | 8.3 | 10.2 | 10.3 | 10.3 | 4.3 | 4.4 | 4.6 | 4.5 | 5.6 | 5.1 | 5.0 | 3.7 | 2.9 | 3.1 | 3.1 | 12 |
| | Specific Heat | 100° C | J/kg*K | ASTM-E1269 | – | – | – | 950 | 920 | 920 | 880 | 880 | 880 | 880 | 880 | 870 | – | 885 | 400 | 400 | 400 | 800 | 800 | 665 | – | – | – | 740 | – | – | 724 | 800 | 475 |
| | Thermal Shock Resistance | ΔTc | °C | ❶ | – | 100 | 350 | 300 | 300 | 250 | 250 | 250 | 200 | 200 | 200 | 200 | – | 300 | 350 | 350 | 350 | 400 | 300 | – | – | – | – | – | – | – | – | – | – |
| | Maximum Use Temperature | | °C | NO-LOAD COND. | 1400 | 1200 | 1200 | 1700 | 1400 | 1500 | 1700 | 1700 | 1700 | 1750 | 1750 | 1750 | 800 | 1500 | 500 | 1500 | 1500 | 1000 | 1600 | 1600 | 1000 | 2000 | 1000 | 800 | 1400 | 1400 | 1400 | 1400 | 800 |
| ELECTRICAL | Dielectric Strength | 6.35mm | ac-kV/mm (ac V/mil) | ASTM-D116 | – | – | – | 9.8 (248) | 9.4 (240) | 8.3 (210) | 8.3 (210) | 8.3 (210) | 8.7 (220) | 8.7 (220) | 8.7 (220) | 8.7 (220) | – | 9.0 (228) | 9.4 (240) | 9.0 (228) | 9.0 (228) | – | – | – | – | – | – | 17 | – | – | – | 15 | – |
| | Dielectric Constant | 1 MHz | 25° C | ASTM-D150 | 5.9 | – | – | 6.0 | 8.2 | 8.8 | 9.1 | 9 | 9.6 | 9.7 | 9.8 | 9.8 | – | 10.6 | 28.0 | 29.0 | 29.0 | – | – | – | – | – | – | 9 | 8 | 8 | – | – | – |
| | Dielectric Loss (tan delta) | 1 MHz | 25° C | ASTM-D150 | 0.0024 | – | – | 0.002 | 0.0009 | 0.0004 | 0.0004 | 0.0002 | 0.0002 | 0.0001 | < 0.0001 | <0.0001 | – | 0.0005 | 0.001 | 0.001 | 0.001 | – | – | – | – | – | – | < 0.001 | – | – | – | – | – |
| | Volume Resistivity | 25° C | ohm-cm | ASTM-D1829 | – | $10^{13}$ | $10^{12}$ | > $10^{14}$ | > $10^{14}$ | > $10^{14}$ | > $10^{14}$ | > $10^{14}$ | > $10^{14}$ | > $10^{14}$ | > $10^{14}$ | > $10^{15}$ | $10^8$ - $10^{10}$ | > $10^{14}$ | > $10^{13}$ | > $10^{13}$ | > $10^{13}$ | < $10^3$ | < $10^5$ | < 0.10 - > $10^6$ | < $10^3$ | $10^2$ | < $10^3$ | > $10^{13}$ | $10^{14}$ | $10^{14}$ | – | $10^{10}$ | $10^{-5}$ |
| | | 500° C | ohm-cm | ASTM-D1829 | – | $10^8$ | $10^6$ | 5 x $10^{12}$ | 4 x $10^8$ | 4 x $10^8$ | 4 x $10^9$ | 4 x $10^9$ | 2 x $10^{10}$ | 2 x $10^{10}$ | 2 x $10^{10}$ | 1 x $10^{12}$ | – | 2 x $10^9$ | 2 x $10^5$ | 2 x $10^4$ | 2 x $10^4$ | < $10^3$ | < $10^3$ | – | < $10^3$ | – | < $10^3$ | > $10^5$ | – | – | – | – | – |
| | | 1000° C | ohm-cm | ASTM-D1829 | – | – | – | 3 x $10^5$ | – | 5 x $10^5$ | 5 x $10^5$ | 1 x $10^6$ | 2 x $10^6$ | 2 x $10^6$ | 2 x $10^7$ | 1 x $10^7$ | – | 3 x $10^6$ | < $10^3$ | < $10^3$ | < $10^3$ | < $10^3$ | < $10^3$ | – | < $10^3$ | – | < $10^3$ | > $10^3$ | – | – | – | – | – |
| WEAR | Impingement | | – | ❷ | – | – | – | – | 1.00 | 0.45 | 0.52 | 0.50 | 0.48 | 0.47 | 0.47 | 0.47 | – | 0.41 | 0.63 | 0.20 | 0.20 | 0.14 | 0.12 | 0.03 | – | – | 0.12 | – | – | – | – | – | – |
| | Rubbing | | – | ❷ | – | – | – | – | 1.00 | 0.36 | – | 0.60 | – | – | – | – | – | 0.49 | 0.57 | 0.20 | 0.20 | – | – | – | – | – | – | – | – | – | – | – | – |



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Notes:
❶ Thermal Shock Resistance – Tests are run by quenching samples into water from various elevated temperatures.
The change in temperature where a sharp decrease in flexural strength is observed is listed as DTc.
❷ Wear Resistance – Impingement tests are run using a dry fused alumina abrasive. Rubbing tests are run using a dry 240 grit fused alumina abrasive. The indices in the chart are calculated by dividing the material volume loss by the volume loss of an AD-85 alumina control. The lower in the index, the better the wear resistance.

❸ 100 gm load
❹ Four point bend modulus of rupture

*Ceramic property values vary somewhat with method of manufacture, size, and shape of part.
Close control of values of most properties can be maintained if specified.

The chart is intended to illustrate typical properties. Property values vary with method of manufacture, size, and shape of part. Data contained herein is not to be construed as absolute and does not constitute a representation or warranty for which CoorsTek assumes legal responsibility.

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