SAPPHIRE PROPERTIES DATA SHEET

GENERAL

Chemical Formula	$A1_20_3$ (aluminum oxide)
Names	Corundum, Sapphire, Alpha-alumina
Crystal System	Trigonal
Class	Hexagonal-scalenohedral

THERMAL

Melting Point	2053°C (3727°F)
Maximum Useful Temperature	≈2000°C
Specific Heat	0.181 cal/ gm°K (25°C) 0.300 cal/ gm°K (1000°C)
Thermal Conductivity	0.4 watts/ cm°K (25°C) 0.1 watts/ cm°K (1000°C) Sapphire is a notable example of variable thermal conductivity based on orientation and temperature, with 35W/(m▪K) along the C-axis and 32 W/(m▪K) along the A-axis
Thermal Expansion Coefficient	(25 - 1000°C) 8.8×10^{-6} parallel to C-axis 7.9×10^{-6} perpendicular to C-axis

PHYSICAL/MECHANICAL

Density:	3.97 gm/ cm^3 (0.143 lb/in^3) (25°C)
Young's Modulus	435 GPa (63 x 10^6 psi) parallel to C-axis (25°C) 386 GPa (56 x 10^6 psi) parallel to C-axis (1000°C)
Modulus of Rigidity (Shear Modulus)	175 GPa (26 x 10^6 psi)
Poisson's Ratio:	0.27 - 0.30 orientation dependent
Flexural Strength	1035 Mpa (150 kpsi) parallel to C-axis (25°) 760 Mpa (110 kpsi) perpendicular to C-axis (25°)
Compressive Strength	≈2 Gpa (300,000 psi) 25°C)
Hardness	9 Moh's scale 1900 Knoop parallel to C-axis 2200 Knoop perpendicular to C-axis

OPTICAL

Uniaxial Negative	
Refractive Index	Ordinary ray (C-axis) $N_o = 1.768$ Extrodinary ray $N_e = 1.760$ Birefringence: 0.008
Temperature Coefficient of Refractive Index	13 x 10^{-6}°C^{-1} (visible range)
Spectral Emittance	0.1 (1600°C)
Spectral Absorption Coefficient	0.1 - 0.2 cm^{-1} (0.66 µm, 1600° C)

ELECTRICAL

Volume Resistivity	10^{16} ohm-cm (25°C) 10^{11} ohm-cm (500°C) 10^6 ohm-cm (1000°C)
Dielectric Strength	480,000 volts/cm (1,200 volts/mil)
Dielectric Constant	11.5 (10^3 - 10^9Hz, 25°C) parallel to C-axis 9.3 (10^3 - 10^9Hz, 25°C) perpendicular to C-axis
Loss Tangent	8.6×10^{-5} (@10^{10} Hz, 25°C) parallel to C-axis 3.0×10^{-5} (@10^{10} Hz, 25°C) perpendicular to C-axis
Magnetic Susceptibility	-0.21×10^{-6} parallel to C-axis -0.25×10^{-6} perpendicular to C-axis

CHEMICAL

Acid Resistance	Insoluble in inorganic acids at room temperature. Attacked by boiling hydrofluoric acid. Slowly attacked or dissolved by molten salts and oxides at high temperatures (>1000°C)
Weathering Resistance	Unaffected by atmospheric exposure
Sea Water Resistance	Unaffected by marine exposure
Biological Resistance	Unaffected by *in-vivo* exposure Non-thrombogenic Non-reactive with body fluids