

Crystal Quartz

Since approximately 1970 most crystal quartz components have been produced from man-made cultured quartz, which has the same physical, optical and electronic properties as natural quartz. Cultured quartz stones exhibit all the faceting of natural quartz except that the longest dimension is usually Y, whereas natural quartz is usually longest in Z.

Material characteristics

Physical Properties	
Molecular weight	60.06
Density	2.65 g/cm ³
Crystal class	Hexagonal
Moh's hardness	7
Q	Approximately 2 million
Melting temperature	1610 °C
Curie point	573 °C
Thermal expansion	7.97 x 10 ⁻⁶ /°C parallel to Z-axis in a temp. range from 0°C to 80°C. 14.45 x 10 ⁻⁶ /°C perpendicular to Z-axis in a temp. range from 0°C to 80°C
Thermal conductivity @ 50 °C	0.0215 cal/(cm/sec/°C) parallel to Z-axis. 0.0133 cal/(cm/sec/°C) perpendicular to Z-axis.
Optical Properties	
Refractive index (L in μm)	$n_o^2 = 3.4269 + 1.0654 \times 10^{-2} / (L^2 - 0.010627)$ $+ 111.49 / (L^2 - 100.77)$ $n_e^2 = 3.5612557 + 0.00844614 / (L^2 - 0.0127493)$ $+ 0.00276113 / (L^2 - 0.000974)$ $+ 127.2 / (L^2 - 108)$
Rotary Power	201.9 °/mm @ 2265.03 Angstroms 95.02 °/mm @ 3034.12 Angstroms

	21.724 °/mm @ 5892.9 Angstroms
	11.589 °/mm @ 7947.63 Angstroms
	0.972 °/mm @ 25000 Angstroms
Fresnel loss	8.2% @ 2 μm
Transmission range	0.4 μm - 4.5 μm 50 - 200 μm

Piezoelectric & Dielectric Properties

$d_{11} = -2.30 \times 10^{-12} \text{ C/N}$	$e_{11} = 0.171 \text{ C/m}^2$
$d_{14} = 0.67$	$e_{14} = 0.0403$
$g_{11} = -5.80 \times 10^{-2} \text{ m}^2/\text{C}$	$h_{11} = 4.36 \times 10^9 \text{ N/C}$
$g_{14} = 1.82 \times 10^{-2}$	$h_{14} = 1.03$
$\epsilon_{11}^s/\epsilon_0 = 4.42$	$e_{11}^T/e_0 = 4.52$
$\epsilon_{33}^s/\epsilon_0 = 4.63$	$e_{33}^T/\epsilon_0 = 4.70$

Elastic Constants

Young's Modulus	14.9 PSI parallel to Z-axis 11.3 PSI perpendicular to Z-axis
Modulus of Rigidity	6.65 PSI parallel to Z-axis 5.05 PSI perpendicular to Z-axis
$S_{11}^E = 12.77 \times 10^{-12} \text{ m}^2/\text{N}$	$C_{11}^E = 86.74 \times 10^9 \text{ N/m}^2$
$S_{12}^E = -1.79$	$C_{12}^E = 6.99$
$S_{13}^E = -1.22$	$C_{13}^E = 11.91$
$S_{14}^E = 4.50$	$C_{14}^E = -17.91$
$S_{33}^E = 9.60$	$C_{33}^E = 107.2$
$S_{44}^E = 20.04$	$C_{44}^E = 57.94$
$S_{66}^E = 29.12$	$C_{66}^E = 39.88$
$S_{11}^D = 12.79$	$C_{11}^D = 87.49$
$S_{12}^D = -1.54$	$C_{12}^D = 6.87$
$S_{13}^D = -1.10$	$C_{13}^D = 11.91$
$S_{14}^D = -4.46$	$C_{14}^D = -18.09$

$S_{33}^D = 9.56$	$C_{33}^D = 107.2$
$S_{44}^D = 19.78$	$C_{44}^D = 57.98$
$S_{66}^D = 28.66$	$C_{66}^D = 40.63$

Direction Dependent Properties

Orientation	X	Y	AT	AC	BC	ST
Wave type	Comp.	Shear	Shear	Shear	Shear	Surface
Wave speed (m/s)	5700	3850	3320	3300	5000	3158
Coupling factor	.10	-.14	-0.88	-.10	-.04	-.0011
d (pC/N)	2.3	-4.6	-3.4	-3.7	-0.9	---

Questions? [Contact us](#) to discuss your particular application.