



## 1MG.006 Machinable Quarz

### Summary

### Overview

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Final Advanced Materials uses quartz for the manufacture of a wide variety of refractory products. This material, which occurs extremely commonly on Earth, is a type of hard crystalline mineral which, in the natural state, is principally comprised of silicon and oxygen.

Although quartz is employed in numerous industries, it is particularly highly rated in the high-temperature sector for its stability and its thermal resistance. Our products are derived from a highly refined quartz sand. This process permits the achievement of a final product with the highest possible degree of purity.

#### Manufacturing

Quartz sand is melted in a metal crucible, under a neutral atmosphere, by the action of electrical heating resistors. Using this method, the raw material is then moulded into semi-finished elements of electrically fused quartz.

Other production methods exist: flame melting, plasma arc melting or electric arc fusion.

### Applications

- Substrates for laser applications: windows, lenses, prisms, mirrors, etc.
- HT screens for semiconductor applications
- Substrates for IR and UV applications
- Tubes for horizontal and vertical furnaces
- Casings
- Laser-perforated injectors
- Door panels
- Pedestals
- Receptacles for chemical etching and cleaning
- Optical windows
- Combustion tubes for analyzers

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## General Characteristics

### Electrical characteristics:

Quartz is classified as a good electrical insulator, as it maintains a high resistivity, even at high temperatures, together with excellent high-frequency characteristics. Conversely to typical conductors, such as metals, the resistivity of quartz decreases as the temperature rises.

The dielectric constant of quartz has an approximate value of 4, which is substantially lower than that of other glass materials.

### Thermal characteristics:

Quartz has a very low coefficient of expansion, several times lower than that of other common materials. This low expansion permits this material to resist a thermal impact of extreme severity.

### Mechanical characteristics:

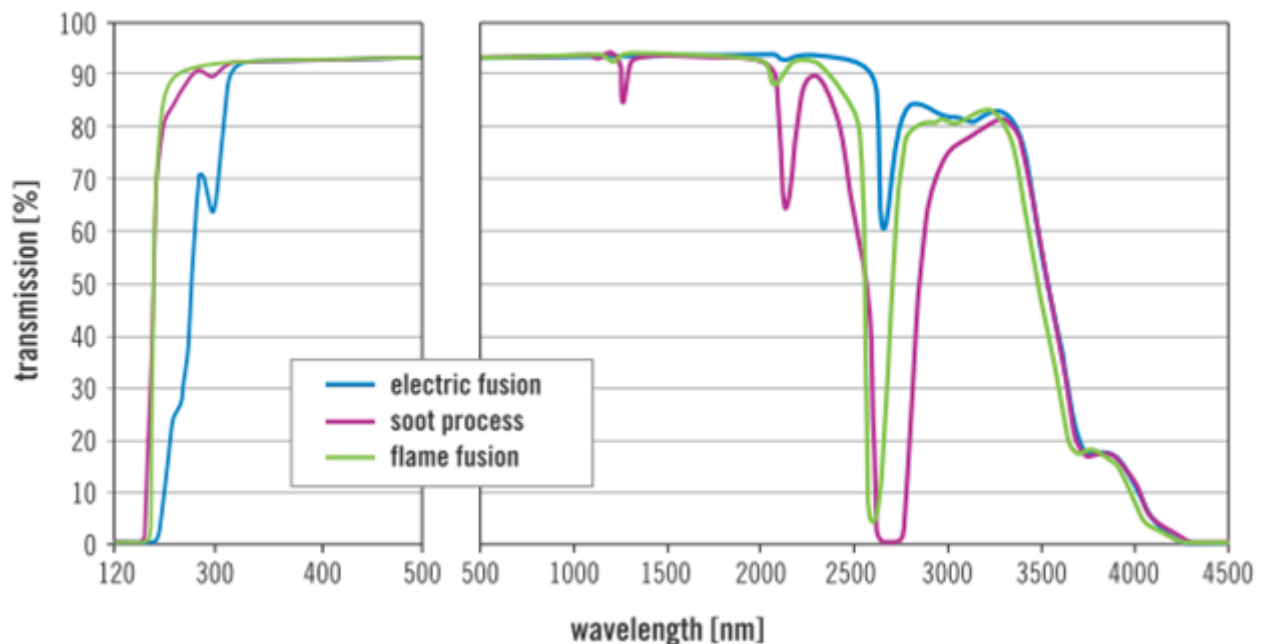
The tensile strength of quartz is dictated by external factors: surface quality, product design and chemical influences from the atmosphere. Surface condition is highly important: defects in this property are the main cause of tensile failure.

### Chemical characteristics:

Quartz is highly sensitive to alkaline and earth alkaline compounds, which accelerate its devitrification (recrystallization) at high temperatures. Consequently, it is recommended that this material should be handled using gloves.

Typical Transmission Spectrum (including Fresnel reflection losses)

Sample thickness: 10 mm





## Benefits

- Excellent thermal insulation
- High tensile strength
- No binders or lubricants required
- Good thermal stability
- Low thermal accumulation
- Excellent chemical stability and resistance to the majority of corrosive agents.
- Exceptional flexibility and resilience
- Insensitivity to thermal impacts
- Non-carcinogenic, according to note Q of Directive n° 97/69 EC

## Deployment

- Hot working (e.g. for the closure of a tube, or the formation of an elbow bend in a component)
- Digitally-controlled machining
- Laser cutting
- Water jet cutting
- Control rooms with 3D metrology facilities

## Products

Property		Unit	Quarz	
Item N°			055-0040	
Composition	Main component	ppm	SiO <sub>2</sub> : 99.98	
	Impurities		Al :15	Li :0.6
			Ca :0.5	Mg :0.05
			Cu < 0.05	Mn < 0.05
			Cr < 0.05	Na :0.3
			Fe :0.1	Ti :1.1
			K :0.4	Zr :0.7
<b>Mechanical Characteristics at 20 °C</b>				
Density		g/cm <sup>3</sup>	2.2	
Hardness		Mohs	5.5 - 6.5	
		Knoop (MPa)	5,800 - 6,100	
Elasticity Modulus at 20 °C		MPa	7.25 x 10 <sup>4</sup>	
Torsion Modulus		MPa	3 x 10 <sup>4</sup>	
Poisson Coefficient			0.17	
Compressive Strength		MPa	1,150	
Tensile Strength		MPa	50	
Flexural Strength		MPa	67	
Torsion Strength		MPa	30	
Sound Speed		m/s	5,720	

**Machinable Quarz**

Thermal Characteristics			
Softening Temperature		°C	1,710
Annealing Temperature		°C	1,125
Max. Operating Temperature		°C	1,160
Max. Peak Temperature		°C	1,300
Specific Warmth	0 – 100 °C	Jkg <sup>-1</sup> K <sup>-1</sup>	772
	0 – 500 °C		964
	0 – 900 °C		1,052
Thermal Conductivity	at 20 °C	W.m <sup>-1</sup> .K <sup>-1</sup>	1.38
	at 100°C		1.47
	at 200 °C		1.55
	at 400 °C		1.84
	at 950 °C		2.68
Thermal Expansion Coeff.	0-100 °C	10 <sup>-6</sup> K <sup>-1</sup>	0.51
	0-600 °C		0.54
	0-900 °C		0.48
	-50-0 °C		0.27
Electrical Characteristics			
Electrical Resistivity	at 20 °C	Ω.m	10 <sup>16</sup>
	at 400 °C		10 <sup>8</sup>
	at 800 °C		6.3x10 <sup>4</sup>
	at 1 200 °C		1.3x10 <sup>3</sup>
Dielectric Strength	at 20 °C	kV/mm	25-40
	at 50 °C		4-5
Loss Tangent	at 1 kHz	tg δ	5x10 <sup>-4</sup>
	at 1 MHz		1x10 <sup>-4</sup>
	at 3 x 1 010 Hz		4x10 <sup>-4</sup>
Dielectric Constant	0 – 106 Hz	ε	3.7
	9 x 108 Hz		3.77
	3 x 1 010 Hz		3.81

**Dimensions**

Measure	Unit	Plate	Disc	Tube
Dimension	mm	Up to 500x500	Ø up to 500	-
Thickness	mm	from 1 to 10	from 1 to 10	1 to 10
Max. Size	mm	1,000x800x100	Ø 1,000x100	-
Outer Diameter	mm	-	-	from 5 to 300
Wall Thickness	mm	-	-	from 0.6 to 6
Max. Curve	‰	-	-	3

Physical variables included in this documentation are provided by way of indication only and do not, under any circumstances, constitute a contractual undertaking. Please contact our technical service if you require any additional information.