

## Specialty Glass Materials: Ceramic/Glass

### 1 Ultraviolet Grade Fused Silica:

#### 1.1 JGS1:

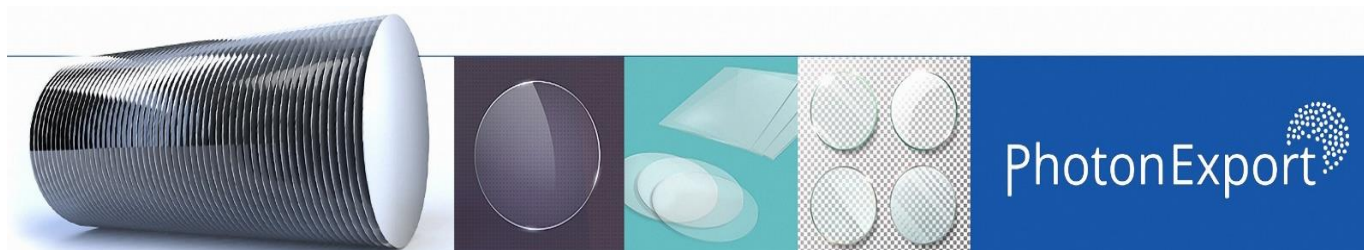
Equivalent to Suprasil 1 and 2 (Heraeus), Spectrosil A and B (Saint-Gobain) and Corning 7940 (Corning), Dynasil 1100 and 4100 (Dynasil). JGS1 is transparent in the ultraviolet and visible regions, and has no absorption bands in 170-250 nm wavelength intervals. It has intensive OH absorption band in the interval of wavelength 2600-2800 nm. JGS1 is used for optics operating in the deep UV and the visible wavelength range (Laser Lenses, Windows, Prisms, Mirrors, etc.). It is practically free of bubbles and inclusions.

#### 1.2 JGS2:

Equivalent to Homosil 1, 2 & 3 (Heraeus), Dynasil 1000 & 4000 and 5000 & 6000 (Dynasil). JGS2 provides good UV and visible transmission. It is close in physical and chemical properties to JGS1. Available in thin & small sheet pieces, JGS2 is virtually bubble-free. Elements built from large pieces will most likely contain bubbles, so application should not be sensitive to these inclusions. Ideal Applications for JGS2: Condenser optics not concerned with scatter or distortion, high temperature and pressure applications, optical flats, microscope slides and sight glasses.

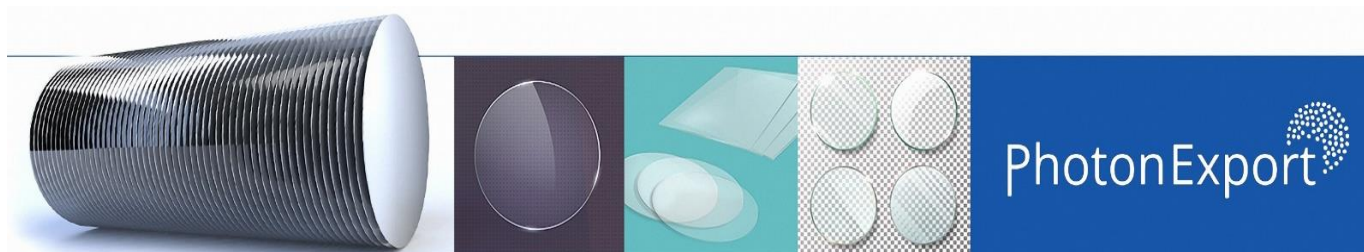
#### 1.3 JGS3:

Equivalent to Suprasil 300 (Heraeus). JGS3 is transparent in the ultraviolet, visible and infrared spectral regions, without considerable absorption bands in the 185-250 nm spectral regions. It has no absorption bands in the visible physical properties with outstanding optical characteristics in the deep UV and the IR wavelength range. It is those requiring very wide wavelength range from DUV to MIR. It is quite a bit more expensive than Silicon and slightly less expensive than Calcium Fluoride or ZnS Multi-spectral grade.

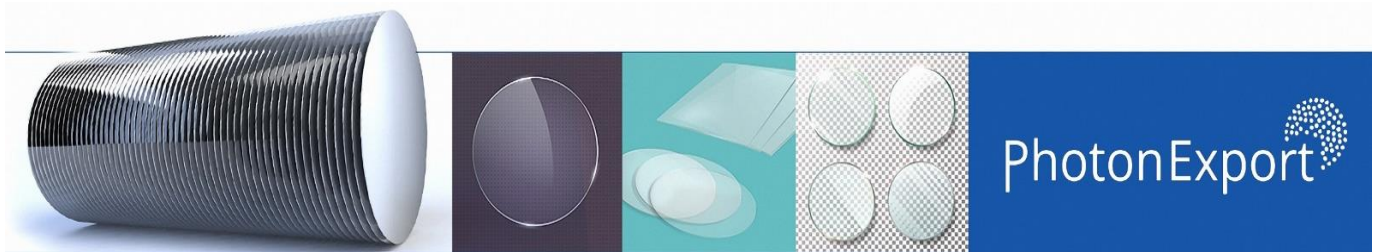


## 1.4 Mechanical, Chemical, thermal specifications:

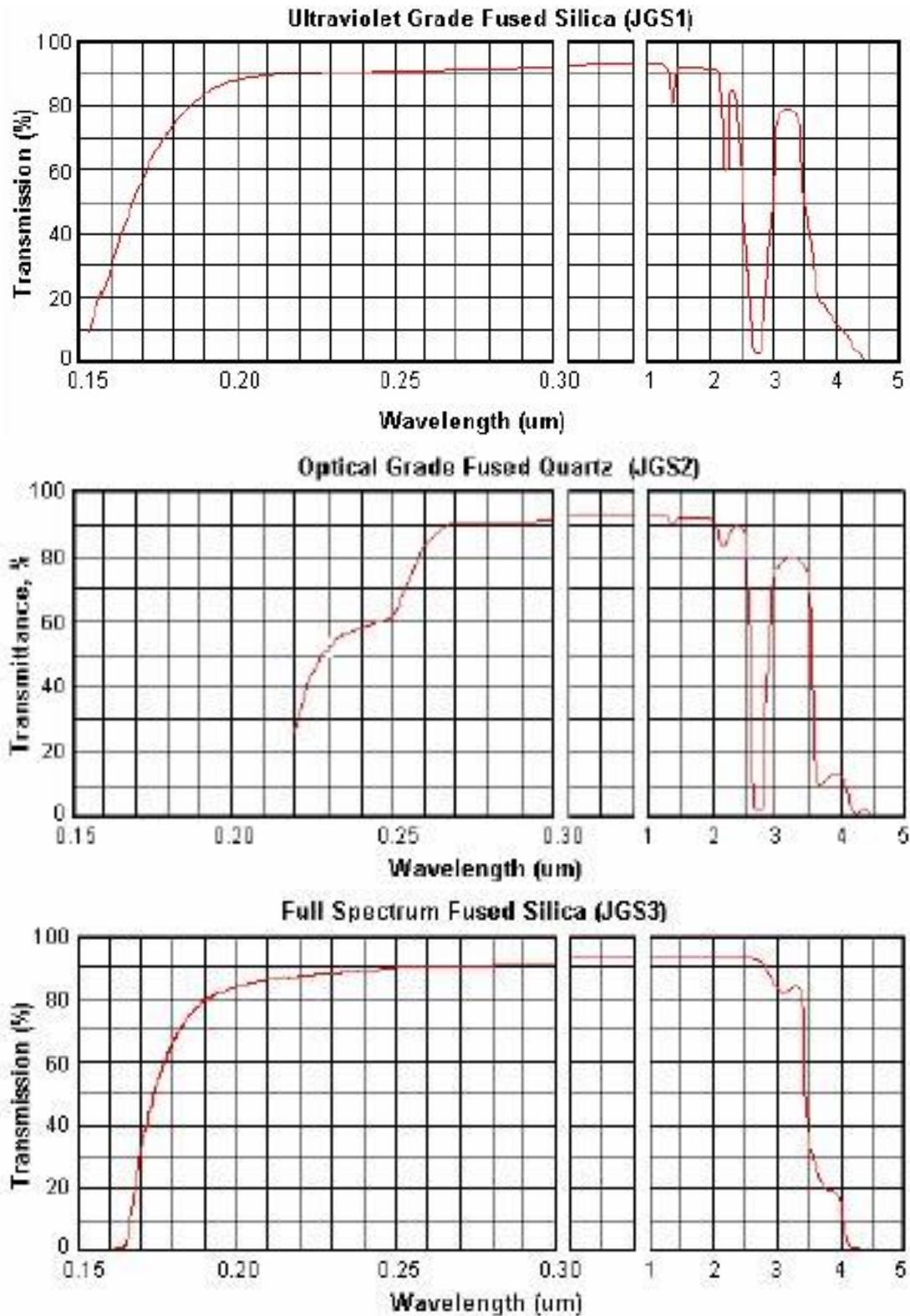
| Parameter Value                               | UV grade Fused Silica                                 |
|-----------------------------------------------|-------------------------------------------------------|
| Density                                       | 2.20g/cm <sup>3</sup>                                 |
| Maximum Size                                  | <Φ200mm                                               |
| Transmission Range(Medium transmission ratio) | 0.17~2.10um(Tavg>90%)                                 |
| OH- Content                                   | 1200 ppm                                              |
| Fluorescence (ex 254nm)                       | Virtually Free                                        |
| Impurity Content                              | 5 ppm                                                 |
| Birefringence Constant                        | 2-4 nm/cm                                             |
| Melting Method                                | Synthetic CVD                                         |
| Applications                                  | Laser substrate: Window, lens, prism, mirror...       |
| Hardness                                      | 5.5 - 6.5 Mohs' Scale 570 KHN 100                     |
| Design Tensile Strength                       | 4.8x10 <sup>7</sup> Pa (N/mm <sup>2</sup> )(7000 psi) |
| Design Compressive Strength                   | Greater than 1.1x10 <sup>9</sup> Pa (160,000 psi)     |
| Bulk Modulus                                  | 3.7x10 <sup>10</sup> Pa (5.3x10 <sup>6</sup> psi)     |
| Rigidity Modulus                              | 3.1x10 <sup>10</sup> Pa (4.5x10 <sup>6</sup> psi)     |
| Young's Modulus                               | 7.2x10 <sup>10</sup> Pa (10.5x10 <sup>6</sup> psi)    |
| Poisson's Ratio                               | 0.17                                                  |
| Coefficient of Thermal Expansion              | 5.5x10 <sup>-7</sup> cm/cm.°C (20°C-320°C)            |
| Thermal Conductivity                          | 1.4 W/m.°C                                            |
| Specific Heat                                 | 670 J/kg.°C                                           |
| Softening Point                               | 1683°C                                                |
| Annealing Point                               | 1215°C                                                |
| Strain Point                                  | 1120°C                                                |
| Electrical Receptivity                        | 7x10 <sup>7</sup> ohm.cm (350°C)                      |



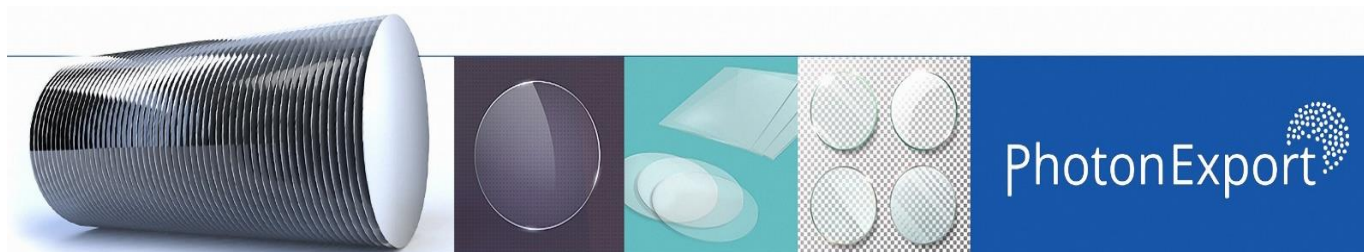
|                                                                          |                                           |
|--------------------------------------------------------------------------|-------------------------------------------|
| <b>Dielectric Properties (20°C and 1 MHz)</b>                            |                                           |
| Constant                                                                 | <b>3.75</b>                               |
| Strength                                                                 | <b>5x10<sup>7</sup> V/m</b>               |
| Loss Factor                                                              | <b>Less than 4x10<sup>-4</sup></b>        |
| Dissipation Factor                                                       | <b>Less than 1x10<sup>-4</sup></b>        |
| Velocity of Sound-Shear Wave                                             | <b>3.75x10<sup>3</sup> m/s</b>            |
| Velocity of Sound/Compression Wave                                       | <b>5.90x10<sup>3</sup> m/s</b>            |
| Sonic Attenuation                                                        | <b>Less than 11 dB/m MHz</b>              |
| Permeability Constants (cm <sup>3</sup> mm/cm <sup>2</sup> sec cm of Hg) | <b>(700°C)</b>                            |
| Helium                                                                   | <b>210x10<sup>-10</sup></b>               |
| Hydrogen                                                                 | <b>21x10<sup>-10</sup></b>                |
| Deuterium                                                                | <b>17x10<sup>-10</sup></b>                |
| Neon                                                                     | <b>9.5x10<sup>-17</sup></b>               |
| Chemical Stability (except hydrofluoric)                                 | <b>High resistance to water and acids</b> |



## 1.5 Internal Transmittance:







## 1.6 Optical Properties

| Abbe Constant                  |                      | 67.6            |                      |
|--------------------------------|----------------------|-----------------|----------------------|
| Refractive Index (nd) at 588nm |                      | 1.4586          |                      |
| Wavelength (um)                | Refractive Index (n) | Wavelength (um) | Refractive Index (n) |
| 0.200                          | 1.55051              | 1.000           | 1.45042              |
| 0.220                          | 1.52845              | 1.064           | 1.44962              |
| 0.250                          | 1.50745              | 1.100           | 1.44920              |
| 0.300                          | 1.48779              | 1.200           | 1.44805              |
| 0.320                          | 1.48274              | 1.300           | 1.44692              |
| 0.360                          | 1.47529              | 1.500           | 1.44462              |
| 0.400                          | 1.47012              | 1.600           | 1.44342              |
| 0.450                          | 1.46557              | 1.700           | 1.44217              |
| 0.488                          | 1.46302              | 1.800           | 1.44087              |
| 0.500                          | 1.46233              | 1.900           | 1.43951              |
| 0.550                          | 1.46008              | 2.000           | 1.43809              |
| 0.588                          | 1.45860              | 2.200           | 1.43501              |
| 0.600                          | 1.45804              | 2.400           | 1.43163              |
| 0.633                          | 1.45702              | 2.600           | 1.42789              |
| 0.650                          | 1.45653              | 2.800           | 1.42377              |
| 0.700                          | 1.45529              | 3.000           | 1.41925              |
| 0.750                          | 1.45424              | 3.200           | 1.41427              |
| 0.800                          | 1.45332              | 3.370           | 1.40990              |
| 0.850                          | 1.45250              | 3.507           | 1.40566              |
| 0.900                          | 1.45175              | 3.707           | 1.39936              |