

# Clear Fused Quartz

## N, NP, OZ Grades

These grades are Oxygen/Hydrogen fused clear quartz glass from quartz powder and used for semiconductor manufacturing apparatus and optical application. N and NP grades have excellent feature with low impurity and bubble.

### Impurity (Typical Data)

	Al	Ca	Cu	Fe	Na	K	Li	Mg	Uni OH
N	9	0.6	0.01	0.1	0.6	0.1	0.01	0.04	200
NP	8	0.5	0.01	0.05	0.1	0.02	0.01	0.02	200
OZ	34	1.6	0.06	0.4	4.0	0.9	0.3	0.2	180

### Bubble

Bubble Size		> 0.5mm	0.3 - 0.5	0.2 - 0.3	0.1 - 0.2	< 0.1mm
Number	N	0	0	5	40	700
pcs / ft <sup>3</sup>	NP	0	0	5	40	700

Bubble Size		1.27mm < $\phi$	0.1 < $\phi$ $\leq$ 1.27mm	$\phi$ $\leq$ 0.1mm	
Number	OZ	N/A	N/A	N/A	
pcs/ft <sup>3</sup>					

### Available Size

	(mm)					
Square slab	450	575	675	750	850	1200
Round slab	360	400				1200



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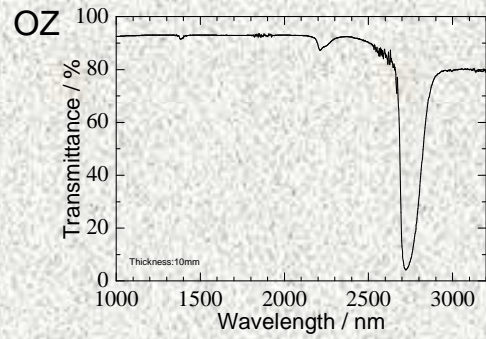
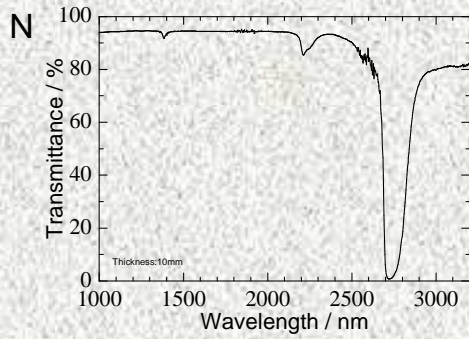
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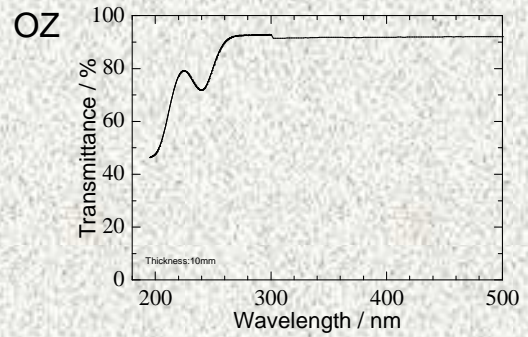
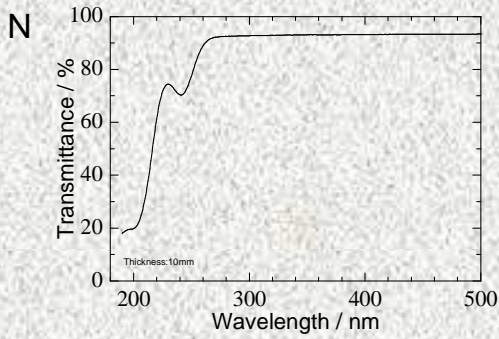


## Spectra

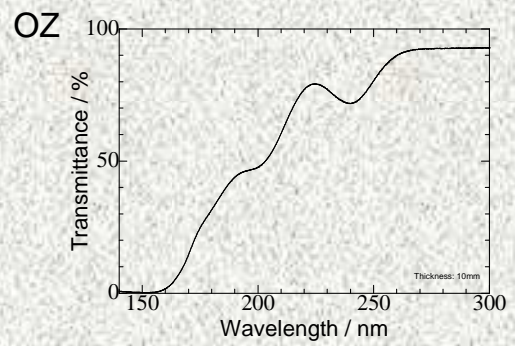
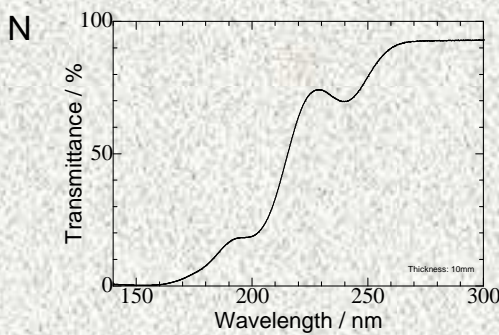
### IR transmittance



### UV Transmittance



### DUV Transmittance



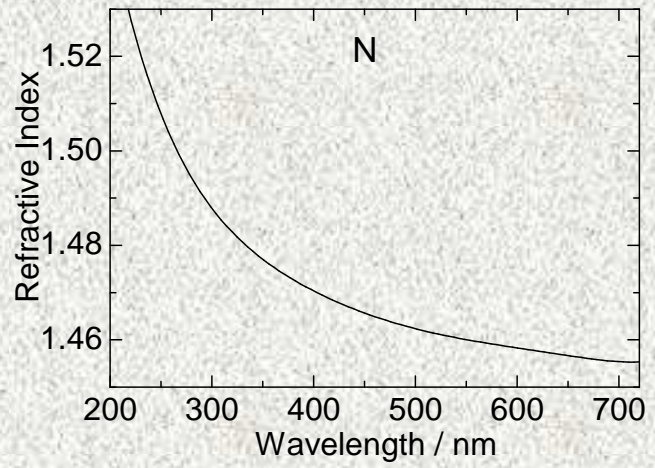
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Dependence of Refractive Index on Wave Length



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## Mechanical properties

		Fused Quartz							
		N	NP	HR	HRP	OZ	OP-1	OP-3	OP-3HD
Vickers hardness	GPa	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9
Young's modulus	GPa	74	74	74	74	74	71	71	71
Shea modulus	GPa	31	31	31	31	31	30	30	30
Poisson's Ratio		0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Bending Strength	MPa	94	94	94	94	94	60	60	67
Compressive Strength	GPa	1.1	1.1	1.1	1.1	1.1	1.0	1.0	1.0
Tensile Strength	MPa	49	49	49	49	49	48	48	48
Torsion Strength	MPa	30	30	30	30	30	29	29	29

## Electrical properties

		Fused Quartz							
		N	NP	HR	HRP	OZ	OP-1	OP-3	OP-3HD
Dielectric Constant	1MHz	3.88	3.88	3.88	3.88	3.88	3.72	3.72	3.80
Dielectric Loss Factor( $\tan \delta$ )	1MHz	0.005	0.005	0.004	0.004	0.005	0.005	0.005	0.005
Resistivity	100°C $\Omega$ cm	$10^{16}$	$10^{16}$	$10^{16}$	$10^{16}$	$10^{16}$	$10^{15}$	$10^{15}$	$10^{15}$
	500°C $\Omega$ cm	$10^9$	$10^9$	$10^9$	$10^9$	$10^9$	$10^8$	$10^8$	$10^8$
	1000°C $\Omega$ cm	$10^6$	$10^6$	$10^6$	$10^6$	$10^6$	$10^5$	$10^5$	$10^5$
Dielectric Breakdown Voltage	20°C kV/m m	32	32	32	32	32	26	26	26
	500°C kV/m m	11	11	11	11	11	8	8	8



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## Thermal properties

		Fused Quartz							
		N	NP	HR	HRP	OZ	OP-1	OP-3	OP-3HD
Strain point	°C	1,070	1,070	1,120	1,120	1,070	1,050	1,050	1,050
Annealing point	°C	1,180	1,180	1,220	1,220	1,180	1,170	1,170	1,170
Softening point	°C	1,720	1,720	1,720	1,720	1,720	1,720	1,720	1,720
Coefficient of Thermal Expansion	$\times 10^{-7} \text{ } ^\circ\text{C}^{-1}$	5.9	5.9	5.9	5.9	5.9	6.9	6.9	6.9
Specific Heat	20°C	$\text{J kg}^{-1} \text{ K}^{-1}$	749	749	749	749	749	749	749
	500°C	$\text{J kg}^{-1} \text{ K}^{-1}$	1,122	1,122	1,122	1,122	1,122	1,122	1,122
	700°C	$\text{J kg}^{-1} \text{ K}^{-1}$	1,201	1,201	1,201	1,201	1,201	1,188	1,201
	900°C	$\text{J kg}^{-1} \text{ K}^{-1}$	1,243	1,243	1,243	1,243	1,243	1,212	1,243
Thermal Diffusivity	19°C	$\times 10^{-7} \text{ m}^2 \text{ s}^{-1}$	8.3	8.3	8.3	8.3	8.3	8.4	8.5
	500°C	$\times 10^{-7} \text{ m}^2 \text{ s}^{-1}$	7.3	7.3	7.3	7.3	7.3	7.5	7.6
	700°C	$\times 10^{-7} \text{ m}^2 \text{ s}^{-1}$	7.6	7.6	7.6	7.6	7.6	7.7	8.2
	1000°C	$\times 10^{-7} \text{ m}^2 \text{ s}^{-1}$	9.5	9.5	9.5	9.5	9.5	9.4	10.0
Thermal Conductivity	19°C	$\text{W m}^{-1} \text{ K}^{-1}$	1.38	1.38	1.38	1.38	1.38	1.24	1.33
	500°C	$\text{W m}^{-1} \text{ K}^{-1}$	1.71	1.71	1.71	1.71	1.71	1.65	1.77
	700°C	$\text{W m}^{-1} \text{ K}^{-1}$	2.01	2.01	2.01	2.01	2.01	1.80	2.07
	1000°C	$\text{W m}^{-1} \text{ K}^{-1}$	2.55	2.55	2.55	2.55	2.55	2.23	2.75
Viscosity ( $\log \eta$ , 1200°C)	Pa s	11.72	11.72	12.18	12.18	12.10	11.72	11.72	11.72



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