

The Future Made Clear



VAD-BASED ANHYDROUS SYNTHETIC FUSED SILICA SK-1310



SK-1310 Fused Silica

SK-1310 is the anhydrous synthetic fused silica among the SK-1300 series products of VAD-based synthetic fused silica. In addition to the high reliability of heat resistance, mechanical strength, and chemical resistance maintained by SK-1300, photolytic absorption is not generated to the infrared area of 2.73 μm , because it doesn't contain hydrogenous radicals. SK-1310 products are fully renovated materials with the maximum transmission applicable to the entire ultraviolet, visible and infrared areas. The physical and chemical characteristics are prominent similar to the SK-1300 products in a broad range of applications in advanced technological industries such as semiconductors and optics.

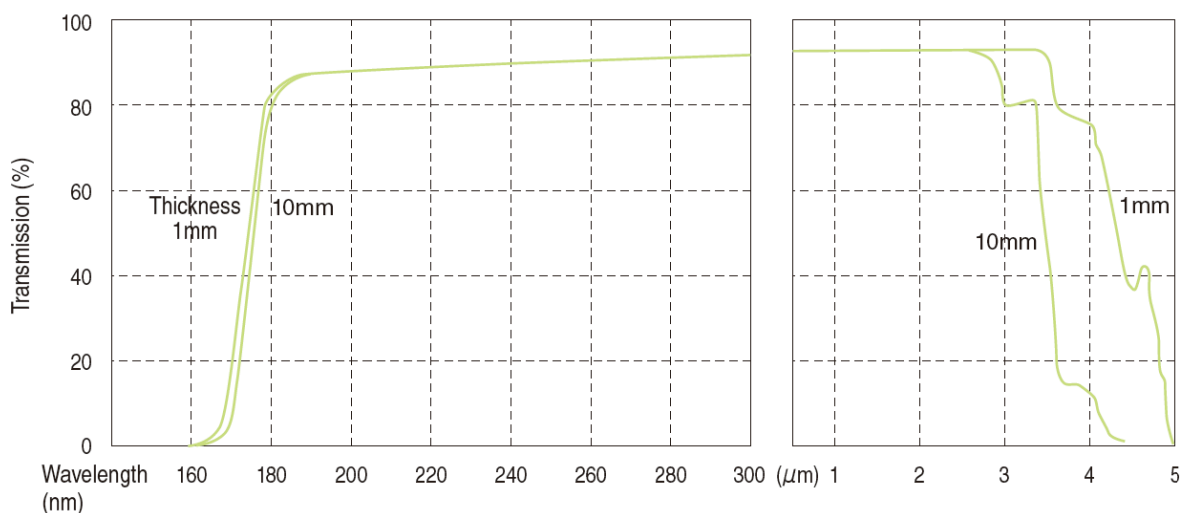
1. Optical fibers
2. Optical elements for ultraviolet and infrared lenses or windows
3. All types of cells for ultraviolet or infrared transmission of entire areas of spectrophotometer
4. Electrical-discharge lamp tubing

		Element	Analytical Value	Element	Analytical Value
Typical Impurity Analysis	ppb	Al	<10	Co	<10
		Fe	<10	Ni	<10
		Ti	<10	P	<10
		Ca	<10	B	<10
		Mg	<10	Na	<10
		Mn	<10	K	<10
		Cr	<10	Li	<10
		Cu	<10	Zr	<10
			ppm	OH	<1

	Solution	Treatment Temperatures (°C)	Hours (H)	Weight Loss (mg/cm ²)
Chemical Resistance	H ₂ O	95	45	0.0001~0.0002
	1/100 N HNO ₃	115	24	0.005~0.01
	5% NaOH	100	10	1.30



Transmission



	Wavelength (nm, in air)	25°C in air	20°C in air	20-5°C in air Wavelength (nm, in air)	1×10 ⁻⁶ /°C dn/dT
Refractive Index	365.015 (i)	1.47475	1.47469	365.015 (i)	11.5
	404.656 (h)	1.46982	1.46977	404.656 (h)	11.0
	435.835 (g)	1.46689	1.46684	435.835 (g)	10.7
	486.133 (F)	1.46333	1.46328	486.133 (F)	10.5
	546.075 (e)	1.46028	1.46023	546.075 (e)	10.2
	587.562 (d)	1.45866	1.45861	587.562 (d)	10.2
	656.273 (C)	1.45657	1.45652	656.273 (C)	10.2
Measuring accuracy		±5×10 ⁻⁶		Measuring accuracy ±0.6×10 ⁻⁶	

Optical Qualities	Item	Grade
	Bubbles	0~0.03mm ² /100cm ³
	Striae	Grade A in one direction (As per Mil-G-174)
	Birefringence (Strain)	20nm/cm and under

Physical Properties	Item	Unit	Value	Item	Unit	Value
	Density	g/cm ³	2.2	Coefficient of thermal expansion	1/K	5.5×10 ⁻⁷
	Young's module	GPa	72.5	Softening point	°C	1600
	Torsional rigidity	GPa	31.4	Annealing point	°C	1160
	Poisson's ratio		0.17	Strain point	°C	1060
	Compression strength	GPa	1.1	Specific heat (25°C)	kJ/kg·K	0.74
	Bending strength	MPa	69	Thermal conductivity ratio (25°C) W/m·K (100°C) W/m·K		1.3
	Tensile strength	MPa	55			1.4
	Vickers hardness	GPa	8.8~10.1			
	Knoop hardness	GPa	6.4~7.0			

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SK-1310

Glass Data Sheet

Code(d) **459678**

Code(e) **460677**

Refractive Index n_d	1.45866 1.458663	Abbe Number v_d	67.8 67.85	Dispersion n_F-n_C	0.00676 0.006760
Refractive Index n_e	1.460277	Abbe Number v_e	67.71	Dispersion $n_F-n_{C'}$	0.006798

Refractive Indices(at 25°C,Air,1013hPa)		
$\lambda(\mu\text{m})$		
n_{2325}	2.32542	1.43320
n_{1970}	1.97009	1.43876
n_{1530}	1.52958	1.44449
n_{1129}	1.12864	1.44908
n_t	1.01398	1.45045
n_s	0.85211	1.45267
$n_{A'}$	0.76819	1.45409
n_r	0.70652	1.45535
n_C	0.65627	1.45657
$n_{C'}$	0.64385	1.45690
n_{He-Ne}	0.63280	1.45722
n_D	0.58929	1.45860
n_d	0.58756	1.45866
n_e	0.54607	1.46028
n_F	0.48613	1.46333
$n_{F'}$	0.47999	1.46370
n_{He-Cd}	0.44157	1.46642
n_g	0.435835	1.46689
n_h	0.404656	1.46982
n_i	0.365015	1.47475
n_{KrF^*}	0.248500	1.50849
n_{ArF^*}	0.193300	1.56051

Partial Dispersions	
n_C-n_t	0.006118
$n_C-n_{A'}$	0.002476
n_d-n_C	0.002097
n_e-n_C	0.003711
n_g-n_d	0.008230
n_g-n_F	0.003567
n_h-n_g	0.002927
n_i-n_g	0.007853
n_C-n_t	0.006456
$n_e-n_{C'}$	0.003373
$n_{F'-n_e}$	0.003425
$n_i-n_{F'}$	0.011044

Relative Partial Dispersions	
$\theta_{C,t}$	0.905
$\theta_{C,A'}$	0.3663
$\theta_{d,C}$	0.3102
$\theta_{e,C}$	0.549
$\theta_{g,d}$	1.2175
$\theta_{g,F}$	0.5277
$\theta_{h,g}$	0.433
$\theta_{i,g}$	1.1617
$\theta'_{C,t}$	0.9497
$\theta'_{e,C'}$	0.4962
$\theta'_{F',e}$	0.5038
$\theta'_{i,F}$	1.6246

Thermal Properties	
Strain Point StP (°C)	1060
Annealing Point AP (°C)	1160
Softening Point SP (°C)	1600
Expansion Coefficients (+0~+200°C)	5.5
α (10 ⁻⁷ /°C) (+100~+300°C)	-
Thermal Conductivity k (W/m·K)	1.3
Specific heat capacity c (J/kg·K)	736
Thermal diffusivity (10 ⁻⁷ m ² /s)	8.04

Coloring			
λ_{80}	~180	λ_5	~180
λ_{70}	~180		

~180:Less than 180nm

Internal Transmittance	
$\lambda(\text{nm})$	$\tau_{10\text{mm}}$
172*	0.662
193*	0.991
248*	0.999~
250	0.999~
260	0.999~
270	0.999~
280	0.999~
290	0.999~
300	0.999~
320	0.999~
340	0.999~
360	0.999~
365*	0.999~
380	0.999~
400	0.999~
450	0.999~
500	0.999~
550	0.999~
587*	0.999~
600	0.999~
650	0.999~
700	0.999~
800	0.999~
900	0.999~
1000	0.999~
1129*	0.999~
1200	0.999~
1400	0.999~
1530*	0.999~
1600	0.999~
1800	0.999~
1970*	0.999~
2000	0.999~
2326*	0.998
2400	0.995
2500	0.992

Deviation of Relative Dispersions $\Delta\theta$ from "Normal"	
$\Delta\theta_{C,t}$	0.0400
$\Delta\theta_{C,A'}$	0.0082
$\Delta\theta_{g,d}$	-0.0063
$\Delta\theta_{g,F}$	-0.0040
$\Delta\theta_{i,g}$	0.0048

Mechanical Properties	
Young's Modulus E (10 ⁸ N/m ²)	725
Rigiditv Modulus G (10 ⁸ N/m ²)	310
Poisson's Ratio σ	0.17
Knoop Hardness Hk[Class]	660 7
Abrasion Aa	-
Photoelastic Constant β (nm/cm/10 ⁵ Pa)	3.5

Constants of Dispersion Formula	
A_1	7.50110530E-01
A_2	3.54568578E-01
A_3	9.18389018E-01
B_1	4.97286260E-03
B_2	1.42109021E-02
B_3	1.00468940E+02

Chemical Properties	
Water Resistance(Powder) Group RW(P)	1
Acid Resistance(Powder) Group RA(P)	1
Weathering Resistance(Surface) Group W(S)	-
Acid Resistance(Surface) Group SR	1
Phosphate Resistance PR	-

Other Properties	
Bubble Quality Group	1
Specific Gravity	2.20
Remarks	

Electrical Properties	
Dielectric constant ϵ	4.0
Dielectric tangent $\tan\delta$	0.0004
Volume resistivity($\Omega\cdot\text{cm}$)	>1E+16

Impurities	
OH content (ppm)	<1
Cl content (ppm)	<2000

Temperature Coefficients of Refractive Index							
Range of Temperature (°C)	dn/dt relative (10 ⁻⁶ /°C)						
	t	C'	He-Ne	D	e	F'	g
-40~0	-	-	-	-	-	-	-
0~20	-	-	-	-	-	-	-
20~25	9.7	10.1	10.0	10.1	10.2	10.5	10.7
20~40	-	-	-	-	-	-	-
40~60	-	-	-	-	-	-	-

0.999~:better than 0.999

*Precision Measurements

Rev.F DATE 2018/10/24