

S-NPH 4

Code(d) 893204
Code(e) 903202

Refractive Index n_d	1.892 86 1.892 860	Abbe Number ν_d	20.36	Dispersion $n_F - n_C$	0.043 851
Refractive Index n_e	1.903 144	Abbe Number ν_e	20.20	Dispersion $n_{F'} - n_{C'}$	0.044 721

Refractive Indices		
λ (μm)		
n_{2325}	2.325 42	1.818 64
n_{1970}	1.970 09	1.826 94
n_{1530}	1.529 58	1.836 81
n_{1129}	1.128 64	1.847 77
n_t	1.013 98	1.852 18
n_s	0.852 11	1.860 88
$n_{A'}$	0.768 19	1.867 45
n_F	0.706 52	1.873 83
n_C	0.656 27	1.880 48
$n_{C'}$	0.643 85	1.882 40
n_{He-Ne}	0.632 8	1.884 20
n_D	0.589 29	1.892 49
n_d	0.587 56	1.892 86
n_e	0.546 07	1.903 14
n_F	0.486 13	1.924 33
$n_{F'}$	0.479 99	1.927 12
n_{He-Cd}	0.441 57	1.948 46
n_g	0.435 835	1.952 37
n_h	0.404 656	1.978 53
n_i	0.365 015	

Constants of Dispersion Formula	
A_1	1.935 639 31E+00
A_2	4.495 964 78E-01
A_3	2.718 285 73E+00
B_1	1.525 852 89E-02
B_2	6.968 157 78E-02
B_3	1.703 271 49E+02

Chemical Properties	
Water Resistance(Powder) Group RW(P)	1
Acid Resistance(Powder) Group RA(P)	1
Weathering Resistance(Surface) Group W(S)	1
Acid Resistance(Surface) Group SR	1.0
Phosphate Resistance PR	1.0

Mechanical Properties	
Young's Modulus E (GPa)	94.5
Rigidity Modulus G (GPa)	37.7
Poisson's Ratio σ	0.254
Knoop Hardness Hk[Class]	450 5
Abrasion Aa	268

Partial Dispersions	
$n_C - n_t$	0.028 304
$n_C - n_{A'}$	0.013 036
$n_d - n_C$	0.012 376
$n_e - n_C$	0.022 660
$n_g - n_d$	0.059 511
$n_g - n_F$	0.028 036
$n_h - n_g$	0.026 158
$n_i - n_g$	
$n_{C'} - n_t$	0.030 217
$n_e - n_{C'}$	0.020 747
$n_{F'} - n_e$	0.023 974
$n_i - n_{F'}$	

Relative Partial Dispersions	
$\theta_{C,t}$	0.645 5
$\theta_{C,A'}$	0.297 3
$\theta_{d,C}$	0.282 2
$\theta_{e,C}$	0.516 7
$\theta_{g,d}$	1.357 1
$\theta_{g,F}$	0.639 3
$\theta_{h,g}$	0.596 5
$\theta_{i,g}$	
$\theta'_{C,t}$	0.675 7
$\theta'_{e,C'}$	0.463 9
$\theta'_{F,e}$	0.536 1
$\theta'_{i,F'}$	

Anomalous dispersion	
$\Delta\theta_{C,t}$	0.003 3
$\Delta\theta_{C,A'}$	-0.003 2
$\Delta\theta_{g,d}$	0.034 7
$\Delta\theta_{g,F}$	0.030 8
$\Delta\theta_{i,g}$	

Coloring			
λ_{80}		λ_5	380
λ_{70}	410		
Internal transmission			
$\lambda_{0.80}$	409	$\lambda_{0.05}$	380
CCI			
B	G	R	
0.00	4.93	5.17	

Internal Transmittance	
λ (nm)	τ_i (10 mm)
280	
290	
300	
310	
320	
330	
340	
350	
360	
370	
380	0.06
390	0.39
400	0.71
420	0.915
440	0.951
460	0.966
480	0.975
500	0.982
550	0.993
600	0.997
650	0.997
700	0.998
800	0.999
900	0.999
1 000	0.999
1 200	0.999
1 400	0.999
1 600	0.995
1 800	0.984
2 000	0.971
2 200	0.948
2 400	0.915

Thermal Properties	
Strain Point StP (°C)	-
Annealing Point AP (°C)	-
Transformation Temperature Tg (°C)	650
Yield Point At (°C)	685
Softening Point SP (°C)	711
Expansion Coefficients (-30 °C ~ 70 °C)	74
α_i (10 ⁻⁷ K ⁻¹) (100 °C ~ 300 °C)	89
Thermal Conductivity λ (W/(m·K))	0.925

Linear coefficient of thermal expansion	
Temperature range (°C)	α_i (10 ⁻⁷ K ⁻¹)
-100 ~ -90	59
-90 ~ -80	61
-80 ~ -70	62
-70 ~ -60	63
-60 ~ -50	65
-50 ~ -40	66
-40 ~ -30	67
-30 ~ -20	68
-20 ~ -10	70
-10 ~ 0	71
0 ~ 10	72
10 ~ 20	73
20 ~ 30	74
30 ~ 40	75
40 ~ 50	76
50 ~ 60	77
60 ~ 70	78
70 ~ 80	79
80 ~ 90	80
90 ~ 100	81
100 ~ 110	82
110 ~ 120	83
120 ~ 130	84
130 ~ 140	84
140 ~ 150	85
150 ~ 160	86
160 ~ 170	87
170 ~ 180	87
180 ~ 190	88
190 ~ 200	89
200 ~ 210	89
210 ~ 220	90
220 ~ 230	90
230 ~ 240	91
240 ~ 250	91
250 ~ 260	92
260 ~ 270	92
270 ~ 280	93
280 ~ 290	93
290 ~ 300	94

Other Properties	
Photoelastic Constant β nm/(cm ³ ·105Pa)	3.39
Specific Gravity d	3.61
Remarks	

Temperature Coefficients of Refractive Index												
Range of Temperature (°C)	$\Delta n_{rel} / \Delta T$ (10 ⁻⁶ K ⁻¹)											
	1550	t	r	C	C'	d	e	F	F'	g	h	i
-80 ~ -60	-2.5	-2.2	-1.6	-1.4	-1.2	-0.8	-0.3	1.0	1.2	3.2	6.1	-
-60 ~ -40	-2.5	-2.2	-1.5	-1.3	-1.2	-0.7	-0.1	1.2	1.4	3.6	6.7	-
-40 ~ -20	-2.4	-2.1	-1.4	-1.0	-0.9	-0.4	0.1	1.5	1.7	4.1	7.4	-
-20 ~ 0	-2.3	-2.0	-1.1	-0.8	-0.7	-0.2	0.4	1.9	2.3	4.7	8.1	-
0 ~ 20	-2.1	-1.8	-0.8	-0.5	-0.4	0.2	0.8	2.4	2.6	5.3	9.0	-
20 ~ 40	-1.9	-1.5	-0.6	-0.3	-0.2	0.4	1.2	2.9	3.1	5.8	9.8	-
40 ~ 60	-1.7	-1.3	-0.4	0.0	0.2	0.8	1.6	3.3	3.6	6.5	10.6	-
60 ~ 80	-1.6	-1.1	-0.1	0.3	0.4	1.1	1.9	3.7	4.0	7.0	11.4	-
80 ~ 100	-1.4	-1.0	0.1	0.5	0.6	1.4	2.2	4.2	4.5	7.6	12.1	-
100 ~ 120	-1.3	-0.8	0.3	0.7	0.9	1.6	2.4	4.5	4.9	8.2	12.9	-
120 ~ 140	-1.2	-0.7	0.5	0.9	1.1	1.8	2.7	4.9	5.3	8.7	13.6	-
140 ~ 160	-1.1	-0.6	0.6	1.1	1.2	2.0	3.0	5.3	5.6	9.2	14.2	-
160 ~ 180	-1.0	-0.6	0.8	1.3	1.4	2.3	3.2	5.5	5.9	9.6	14.8	-

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