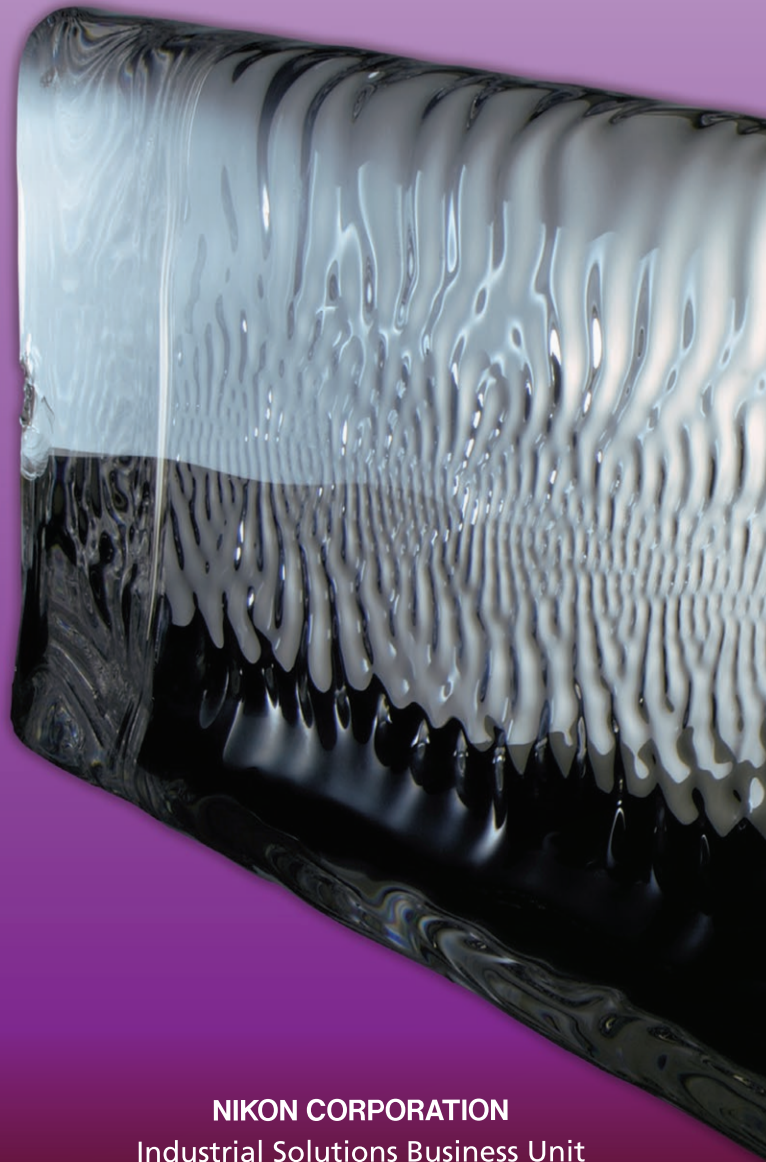




i-line

G l a s s

Two overlapping blue circles, one slightly above and to the right of the other, positioned over the word "G l a s s".

NIKON CORPORATION
Industrial Solutions Business Unit

Nikon i-line Glass Series

i-line Glass ADVANTAGES

Nikon's research and development of high-quality materials has always been related to designs for the company's optical products. Precision is the key factor. Advances in glass technology depend upon precision, and it is here that Nikon excels. Nikon i-line Glass was developed for use with i-line (365 nm) lithography units. It delivers high transmittance and superior homogeneity, even with large diameters.

Glass type	Refractive index n_d	Dispersion ν_d	10 mm internal transmittance (365 nm) τ_i	Refractive index n_i	Variation of n_i within a single lot ($\times 10^{-5}$)	Optical homogeneity (Δn) ($\times 10^{-6}$)		
						$\sim\phi 100$	$\sim\phi 200$	$\sim\phi 280$
4786	1.47410	86.8	99.8%	1.48726	2	1	1	2
5165	1.51183	65.0	99.8%	1.53073	10	—	—	—
5742	1.57653	42.1	99.6%	1.61265	2	1	1	2
5859	1.59042	59.5	99.7%	1.61450	2	1	1	2
7054	1.70623	54.7	99.4%	1.73811	10	—	—	—

10mm internal transmittance:

Indicates a representative value of the light transmittance at i-line (365 nm) with glass of 10 mm thickness, excluding reflection losses.

Refractive index:

Indicates a representative value of the refractive index at i-line (365 nm). Depending on the required quality, longer annealing time is needed and the refractive index value will change. These data are based on Nikon's typical annealing conditions.

Variation of n_i within a single lot:

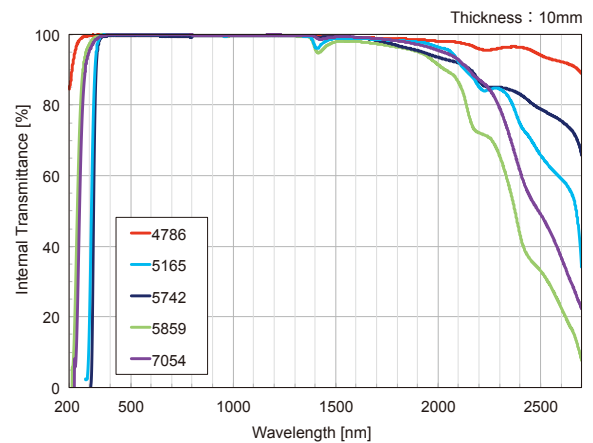
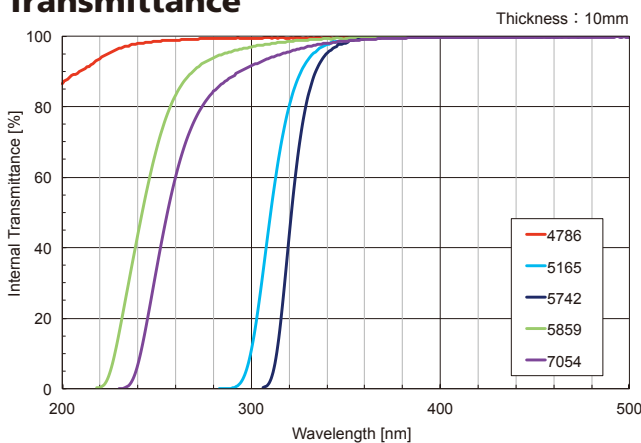
Indicates a guaranteed value of the refractive index variation of a part within a single lot, with the same melt and same annealing run.

Optical homogeneity:

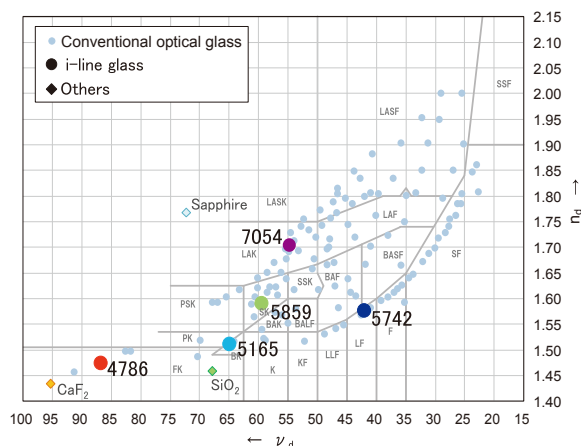
Guaranteed by measurement of in-plane variation on a plane parallel glass plate using He-Ne laser interferometers. The Δn specification is shown for three diameter ranges ($\phi 100$ mm or less, $\phi 200$ mm or less, and $\phi 280$ mm or less) because the Δn will vary with the glass type, size and shape.

Inquiries are welcome about more different sizes of i-line glass available.

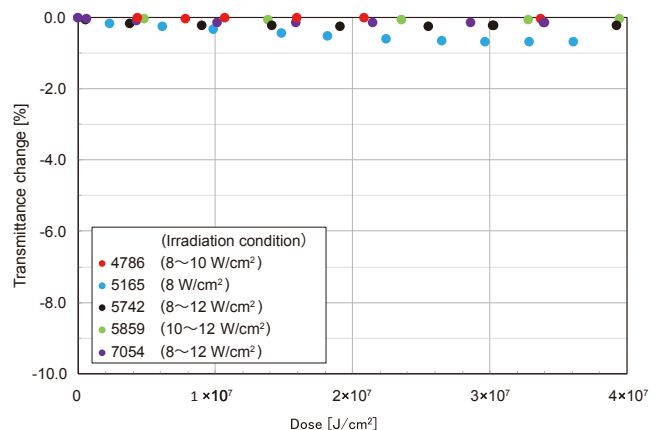
Transmittance



Optical Material n_d - ν_d diagram



Solarization



Properties of 4786

n_d	1.47410	v_d	86.77
n_e	1.47540	v_e	86.36

Optical Properties

Wavelength [μm]	Refractive Index	
-	2.32542	1.457846
-	2.05809	1.460152
-	1.97009	1.460859
-	1.52958	1.464101
-	1.12864	1.466930
-	1.06414	1.467434
t	1.01398	1.467850
s	0.85211	1.469431
A'	0.76819	1.470497
r	0.70652	1.471465
C	0.65627	1.472424
C'	0.64385	1.472691
He-Ne	0.63282	1.472940
D	0.58929	1.474049
d	0.58756	1.474098
e	0.54607	1.475403
F	0.48613	1.477888
F'	0.47999	1.478196
He-Cd	0.44157	1.480426
g	0.43584	1.480812
h	0.40466	1.483215
-	0.38887	1.484670
i	0.36502	1.487260
-	0.33415	1.491549
-	0.32611	1.492893

Conditions:

temperature: 22.5 °C

humidity: 50 %

atmospheric pressure: 1013.25 hPa

Dispersion Coefficients *8	
A0	2.1526633E+00
A1	-5.1741938E-03
A2	-2.5238000E-05
A3	7.3883481E-03
A4	8.7091815E-05
A5	-2.3786512E-06
A6	2.5433499E-07
A7	-8.9862525E-09
A8	1.2974356E-10

Fluorescence	[Class] *7	1
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Partial Dispersion	
F - C	0.005464
F' - C'	0.005505
C - t	0.004574
C - A'	0.001927
d - C	0.001674
e - C	0.002979
g - d	0.006714
g - F	0.002924
h - g	0.002403
i - g	0.006448
C' - t	0.004841
e - C'	0.002712
F' - e	0.002793
i - F'	0.009065

Abnormal Dispersion	
$\Delta P_{C,A'}$	-0.0307
$\Delta P_{d,C}$	-0.0099
$\Delta P_{g,d}$	0.0462
$\Delta P_{g,F}$	0.0363
$\Delta P_{i,g}$	0.1729

Relative Partial Dispersions	
C-t / F-C	0.8371
C-A' / F-C	0.3526
d-C / F-C	0.3064
e-C / F-C	0.5452
g-d / F-C	1.2288
g-F / F-C	0.5352
h-g / F-C	0.4398
i-g / F-C	1.1802
C'-t / F'-C'	0.8794
e-C' / F'-C'	0.4926
F'-e / F'-C'	0.5074
i-F' / F'-C'	1.6468

Internal Transmittance	
λ [nm]	τ (10 mm)
240	0.973
250	0.983
260	0.989
270	0.993
280	0.996
290	0.997
300	0.999
310	0.999
320	0.999
330	0.999
340	0.999
350	0.998
360	0.998
365	0.998
370	0.999
380	0.999
390	0.999
400	0.999
420	0.999
440	0.999
460	0.999
480	0.999
500	0.999
550	0.999
600	0.999
650	0.999
700	0.999
800	0.999
900	0.998
1000	0.998
1200	0.999
1400	0.998
1600	0.993
1800	0.988
2000	0.979
2200	0.955
2400	0.961

Color Code	
λ 80	-
λ 5	-

Thermal Properties

Transformation Temp.	[°C]	Tg	472
Yield Point	[°C]	At	495
Expansion Coefficient (-30 ~ +70°C)	[10 ⁻⁶ /°C]	α	12.5
	(+100 ~ +300°C)		[10 ⁻⁶ /°C]
Thermal Conductivity	[W/m·K]	λ	0.75
Specific Heat Capacity	[J/g·K]	c	0.601
Thermal Diffusivity	[10 ⁻⁷ m²/sec]	κ	3.52

Mechanical Properties

Young's Modulus	[GPa]	E	77.7
Poisson's Ratio		μ	0.298
Knoop Hardness	[Class] *1	Hk	358
			4
Abrasion	*2	A	354
Shear Modulus	[GPa]	G	29.9
Stress Optical Coefficient	[10 ⁻¹² /Pa]	β	0.77

Chemical Properties

Climate Resistance	[Class] *3	1
Water Resistance (powder method)	[Class] *4	2
Acid Resistance (powder method)	[Class] *4	3
Acid Resistance (surface method)	[Class] *5	4
Alkaline Detergent Resistance	[Class] *6	4

Pb	[wt%]	0.0
Hg	[wt%]	0.0
Cd	[wt%]	0.0
Cr	[wt%]	0.0
As	[wt%]	0.0

Density	3.55
---------	------

Effect of Temperature on Refractive Index							
°C	$\Delta n / \Delta T$ relative value [10 ⁻⁶ /°C]						
	t	C	d	e	F	g	i
-70 ~ -60	-3.3	-3.2	-3.1	-3.1	-2.9	-2.8	-2.4
-60 ~ -40	-3.8	-3.6	-3.5	-3.5	-3.4	-3.2	-2.8
-40 ~ -20	-4.2	-4.1	-4.0	-3.9	-3.8	-3.7	-3.3
-20 ~ 0	-4.6	-4.4	-4.4	-4.3	-4.2	-4.0	-3.6
0 ~ +20	-4.9	-4.7	-4.7	-4.6	-4.5	-4.3	-3.9
+20 ~ +40	-5.2	-5.0	-4.9	-4.9	-4.7	-4.6	-4.2
+40 ~ +60	-5.5	-5.2	-5.2	-5.1	-4.9	-4.8	-4.4
+60 ~ +80	-5.7	-5.5	-5.4	-5.3	-5.1	-5.0	-4.6
+80 ~ +90	-5.8	-5.6	-5.5	-5.4	-5.3	-5.1	-4.7

※Each property is shown as a typical value.

2014/6

Nikon i-line Glass Series

Properties of 5165

n_d	1.51183	v_d	64.95
n_e	1.51371	v_e	64.78

Optical Properties

Wavelength [μm]	Refractive Index	
-	2.32542	1.482923
-	2.05809	1.487729
-	1.97009	1.489178
-	1.52958	1.495617
-	1.12864	1.500796
-	1.06414	1.501657
t	1.01398	1.502353
s	0.85211	1.504892
A'	0.76819	1.506528
r	0.70652	1.507979
C	0.65627	1.509393
C'	0.64385	1.509784
He-Ne	0.63282	1.510148
D	0.58929	1.511758
d	0.58756	1.511829
e	0.54607	1.513710
F	0.48613	1.517273
F'	0.47999	1.517714
He-Cd	0.44157	1.520906
g	0.43584	1.521458
h	0.40466	1.524903
-	0.38887	1.526993
i	0.36502	1.530728
-	0.33415	1.536955
-	0.32611	1.538917

Conditions:

temperature: 22.5 °C

humidity: 50 %

atmospheric pressure: 1013.25 hPa

Dispersion Coefficients *8	
A0	2.2576188E+00
A1	-1.0517263E-02
A2	-1.2455953E-04
A3	1.0565994E-02
A4	1.2020898E-04
A5	1.3534118E-06
A6	8.4114850E-08
A7	0.0000000E+00
A8	0.0000000E+00

Fluorescence	[Class] *7	1
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Partial Dispersion	
F - C	0.007881
F' - C'	0.007930
C - t	0.007039
C - A'	0.002865
d - C	0.002436
e - C	0.004317
g - d	0.009629
g - F	0.004185
h - g	0.003445
i - g	0.009270
C' - t	0.007431
e - C'	0.003926
F' - e	0.004004
i - F'	0.013014

Abnormal Dispersion	
$\Delta P_{C,A'}$	0.0085
$\Delta P_{d,C}$	0.0026
$\Delta P_{g,d}$	-0.0070
$\Delta P_{g,F}$	-0.0044
$\Delta P_{i,g}$	-0.0099

Relative Partial Dispersions	
C-t / F-C	0.8932
C-A' / F-C	0.3635
d-C / F-C	0.3091
e-C / F-C	0.5479
g-d / F-C	1.2219
g-F / F-C	0.5310
h-g / F-C	0.4371
i-g / F-C	1.1763
C'-t / F'-C'	0.9370
e-C' / F'-C'	0.4951
F'-e / F'-C'	0.5049
i-F' / F'-C'	1.6412

Internal Transmittance		
λ [nm]	τ (10 mm)	
240	-	
250	-	
260	-	
270	-	
280	-	
290	0.010	
300	0.170	
310	0.570	
320	0.840	
330	0.950	
340	0.984	
350	0.994	
360	0.997	
365	0.998	
370	0.998	
380	0.999	
390	0.999	
400	0.999	
420	0.999	
440	0.999	
460	0.999	
480	0.999	
500	0.999	
550	0.999	
600	0.999	
650	0.999	
700	0.999	
800	0.999	
900	0.999	
1000	0.999	
1200	0.999	
1400	0.976	
1600	0.994	
1800	0.987	
2000	0.969	
2200	0.860	
2400	0.760	

Color Code	
λ_{80}	323
λ_5	297

Thermal Properties

Transformation Temp.	[°C]	Tg	561
Yield Point	[°C]	At	604
Expansion Coefficient (-30 ~ +70°C)	[10 ⁻⁶ /°C]	α	5.8
	(+100 ~ +300°C)		[10 ⁻⁶ /°C]
Thermal Conductivity	[W/m·K]	λ	1.139
Specific Heat Capacity	[J/g·K]	c	0.801
Thermal Diffusivity	[10 ⁻⁷ m ² /sec]	κ	5.83

Mechanical Properties

Young's Modulus	[GPa]	E	78.2
Poisson's Ratio		μ	0.214
Knoop Hardness		Hk	512
	[Class] *1		5
Abrasion	*2	A	71
Shear Modulus	[GPa]	G	32.2
Stress Optical Coefficient	[10 ⁻¹² /Pa]	β	2.90

Chemical Properties

Climate Resistance	[Class] *3	1
Water Resistance (powder method)	[Class] *4	3
Acid Resistance (powder method)	[Class] *4	3
Acid Resistance (surface method)	[Class] *5	4
Alkaline Detergent Resistance	[Class] *6	1

Pb	[wt%]	0.0
Hg	[wt%]	0.0
Cd	[wt%]	0.0
Cr	[wt%]	0.0
As	[wt%]	0.0

Density	2.44
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Effect of Temperature on Refractive Index							
°C	$\Delta n/\Delta T$ relative value [10 ⁻⁶ /°C]						
	t	C	d	e	F	g	i
-70 ~ -60	3.0	3.2	3.3	3.4	3.6	3.8	4.3
-60 ~ -40	2.8	3.1	3.2	3.3	3.5	3.7	4.2
-40 ~ -20	2.8	3.0	3.1	3.2	3.4	3.7	4.3
-20 ~ 0	2.8	3.0	3.2	3.3	3.5	3.7	4.3
0 ~ +20	2.9	3.1	3.3	3.4	3.6	3.9	4.5
+20 ~ +40	3.0	3.3	3.4	3.5	3.8	4.0	4.7
+40 ~ +60	3.2	3.5	3.6	3.7	4.0	4.3	4.9
+60 ~ +80	3.4	3.7	3.8	4.0	4.2	4.5	5.2
+80 ~ +90	3.5	3.9	4.0	4.1	4.4	4.7	5.4

※Each property is shown as a typical value.
2018/6

Properties of 5742

n_d	1.57653	v_d	42.05
n_e	1.57978	v_e	41.77

Optical Properties

Wavelength [μm]	Refractive Index	
-	2.32542	1.544942
-	2.05809	1.548691
-	1.97009	1.549846
-	1.52958	1.555248
-	1.12864	1.560382
-	1.06414	1.561375
t	1.01398	1.562214
s	0.85211	1.565569
A'	0.76819	1.567954
r	0.70652	1.570191
C	0.65627	1.572458
C'	0.64385	1.573099
He-Ne	0.63282	1.573699
D	0.58929	1.576406
d	0.58756	1.576526
e	0.54607	1.579781
F	0.48613	1.586170
F'	0.47999	1.586978
He-Cd	0.44157	1.592951
g	0.43584	1.594005
h	0.40466	1.600716
-	0.38887	1.604910
i	0.36502	1.612653
-	0.33415	1.626396
-	0.32611	1.630987

Conditions:

temperature: 22.5 °C

humidity: 50 %

atmospheric pressure: 1013.25 hPa

Dispersion Coefficients *8	
A0	2.4305046E+00
A1	-8.2678834E-03
A2	-8.3302283E-05
A3	1.8792549E-02
A4	2.9895386E-04
A5	4.0942941E-05
A6	-2.4258256E-06
A7	1.1962186E-07
A8	5.0283456E-09

Fluorescence	[Class] *7	2
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Partial Dispersion	
F - C	0.013712
F' - C'	0.013879
C - t	0.010244
C - A'	0.004503
d - C	0.004068
e - C	0.007324
g - d	0.017478
g - F	0.007835
h - g	0.006712
i - g	0.018648
C' - t	0.010885
e - C'	0.006683
F' - e	0.007197
i - F'	0.025675

Abnormal Dispersion	
$\Delta P_{C,A'}$	0.0032
$\Delta P_{d,C}$	0.0005
$\Delta P_{g,d}$	-0.0029
$\Delta P_{g,F}$	-0.0024
$\Delta P_{i,g}$	-0.0141

Relative Partial Dispersions	
C-t / F-C	0.7471
C-A' / F-C	0.3284
d-C / F-C	0.2967
e-C / F-C	0.5341
g-d / F-C	1.2747
g-F / F-C	0.5714
h-g / F-C	0.4895
i-g / F-C	1.3600
C'-t / F'-C'	0.7842
e-C' / F'-C'	0.4815
F'-e / F'-C'	0.5185
i-F' / F'-C'	1.8498

Internal Transmittance		
λ [nm]	τ (10 mm)	
240	-	
250	-	
260	-	
270	-	
280	-	
290	-	
300	-	
310	0.070	
320	0.560	
330	0.880	
340	0.971	
350	0.990	
360	0.996	
365	0.996	
370	0.999	
380	0.999	
390	0.999	
400	0.999	
420	0.999	
440	0.999	
460	0.999	
480	0.999	
500	0.999	
550	0.999	
600	0.999	
650	0.999	
700	0.999	
800	0.999	
900	0.999	
1000	0.999	
1200	0.999	
1400	0.997	
1600	0.995	
1800	0.974	
2000	0.943	
2200	0.880	
2400	0.850	

Color Code	
λ_{80}	330
λ_5	310

Thermal Properties

Transformation Temp.	[°C]	Tg	422
Yield Point	[°C]	At	461
Expansion Coefficient (-30 ~ +70°C)	[10 ⁻⁶ /°C]	α	8.7
	(+100 ~ +300°C)		[10 ⁻⁶ /°C]
Thermal Conductivity	[W/m·K]	λ	0.945
Specific Heat Capacity	[J/g·K]	c	0.613
Thermal Diffusivity	[10 ⁻⁷ m ² /sec]	κ	4.90

Mechanical Properties

Young's Modulus	[GPa]	E	64.6
Poisson's Ratio		μ	0.221
Knoop Hardness		Hk	415
	[Class] *1		4
Abrasion	*2	A	105
Shear Modulus	[GPa]	G	26.5
Stress Optical Coefficient	[10 ⁻¹² /Pa]	β	2.97

Chemical Properties

Climate Resistance	[Class] *3	1
Water Resistance (powder method)	[Class] *4	1
Acid Resistance (powder method)	[Class] *4	1
Acid Resistance (surface method)	[Class] *5	2
Alkaline Detergent Resistance	[Class] *6	1

Pb	[wt%]	35.0
Hg	[wt%]	0.0
Cd	[wt%]	0.0
Cr	[wt%]	0.0
As	[wt%]	0.0

Density	3.15
---------	------

Effect of Temperature on Refractive Index							
°C	$\Delta n/\Delta T$ relative value [10 ⁻⁶ /°C]						
	t	C	d	e	F	g	i
-70 ~ -60	2.5	3.1	3.4	3.6	4.1	4.7	6.7
-60 ~ -40	2.3	2.9	3.2	3.4	3.9	4.6	6.6
-40 ~ -20	2.1	2.8	3.1	3.3	3.8	4.5	6.6
-20 ~ 0	2.0	2.7	3.0	3.3	3.8	4.6	6.7
0 ~ +20	2.0	2.7	3.0	3.3	3.9	4.6	6.9
+20 ~ +40	2.1	2.8	3.1	3.4	4.0	4.8	7.1
+40 ~ +60	2.1	2.9	3.2	3.5	4.1	4.9	7.4
+60 ~ +80	2.2	3.0	3.4	3.6	4.3	5.1	7.7
+80 ~ +90	2.3	3.1	3.5	3.8	4.4	5.3	7.9

※Each property is shown as a typical value.

2018/6

Nikon i-line Glass Series

Properties of 5859

n_d	1.59042	v_d	59.48
n_e	1.59279	v_e	59.30

Optical Properties

Wavelength [μm]	Refractive Index	
-	2.32542	1.555833
-	2.05809	1.561513
-	1.97009	1.563218
-	1.52958	1.570763
-	1.12864	1.576864
-	1.06414	1.577892
t	1.01398	1.578726
s	0.85211	1.581804
A'	0.76819	1.583814
r	0.70652	1.585610
C	0.65627	1.587371
C'	0.64385	1.587860
He-Ne	0.63282	1.588315
D	0.58929	1.590334
d	0.58756	1.590422
e	0.54607	1.592790
F	0.48613	1.597298
F'	0.47999	1.597857
He-Cd	0.44157	1.601917
g	0.43584	1.602620
h	0.40466	1.607022
-	0.38887	1.609700
i	0.36502	1.614499
-	0.33415	1.622529
-	0.32611	1.625067

Conditions:

temperature: 22.5 °C

humidity: 50 %

atmospheric pressure: 1013.25 hPa

Dispersion Coefficients *8	
A0	2.4915858E+00
A1	-1.2477485E-02
A2	-2.0876118E-04
A3	1.4082534E-02
A4	1.4384470E-04
A5	8.7603745E-06
A6	-3.4480576E-07
A7	1.1644939E-08
A8	0.0000000E+00

Fluorescence	[Class] *7	-
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Partial Dispersion	
F - C	0.009927
F' - C'	0.009997
C - t	0.008644
C - A'	0.003557
d - C	0.003051
e - C	0.005420
g - d	0.012198
g - F	0.005323
h - g	0.004401
i - g	0.011878
C' - t	0.009133
e - C'	0.004931
F' - e	0.005066
i - F'	0.016642

Abnormal Dispersion	
$\Delta P_{C,A'}$	0.0104
$\Delta P_{d,C}$	0.0034
$\Delta P_{g,d}$	-0.0117
$\Delta P_{g,F}$	-0.0084
$\Delta P_{i,g}$	-0.0345

Relative Partial Dispersions	
C-t / F-C	0.8708
C-A' / F-C	0.3583
d-C / F-C	0.3074
e-C / F-C	0.5460
g-d / F-C	1.2288
g-F / F-C	0.5362
h-g / F-C	0.4434
i-g / F-C	1.1966
C'-t / F'-C'	0.9136
e-C' / F'-C'	0.4932
F'-e / F'-C'	0.5068
i-F' / F'-C'	1.6647

Internal Transmittance	
λ [nm]	τ (10 mm)
240	0.516
250	0.725
260	0.851
270	0.912
280	0.943
290	0.961
300	0.973
310	0.980
320	0.986
330	0.991
340	0.994
350	0.995
360	0.996
365	0.997
370	0.998
380	0.998
390	0.999
400	0.999
420	0.999
440	0.999
460	0.999
480	0.999
500	0.999
550	0.999
600	0.999
650	0.999
700	0.999
800	0.999
900	0.999
1000	0.998
1200	0.999
1400	0.966
1600	0.982
1800	0.966
2000	0.915
2200	0.720
2400	0.440

Color Code	
λ_{80}	264
λ_5	222

Thermal Properties

Transformation Temp.	[°C]	Tg	607
Yield Point	[°C]	At	631
Expansion Coefficient (-30 ~ +70°C)	[10 ⁻⁶ /°C]	α	4.3
	(+100 ~ +300°C)		[10 ⁻⁶ /°C]
Thermal Conductivity	[W/m·K]	λ	0.884
Specific Heat Capacity	[J/g·K]	c	0.693
Thermal Diffusivity	[10 ⁻⁷ m ² /sec]	κ	4.45

Mechanical Properties

Young's Modulus	[GPa]	E	79.9
Poisson's Ratio		μ	0.289
Knoop Hardness		Hk	497
	[Class] *1		5
Abrasion	*2	A	75
Shear Modulus	[GPa]	G	31.0
Stress Optical Coefficient	[10 ⁻¹² /Pa]	β	3.43

Chemical Properties

Climate Resistance	[Class] *3	3
Water Resistance (powder method)	[Class] *4	4
Acid Resistance (powder method)	[Class] *4	5
Acid Resistance (surface method)	[Class] *5	7
Alkaline Detergent Resistance	[Class] *6	4

Pb	[wt%]	0.0
Hg	[wt%]	0.0
Cd	[wt%]	0.0
Cr	[wt%]	0.0
As	[wt%]	0.2

Density	2.87
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Effect of Temperature on Refractive Index							
°C	$\Delta n/\Delta T$ relative value [10 ⁻⁶ /°C]						
	t	C	d	e	F	g	i
-70 ~ -60	4.9	5.3	5.4	5.5	5.7	5.9	6.4
-60 ~ -40	4.8	5.1	5.2	5.3	5.5	5.8	6.3
-40 ~ -20	4.6	5.0	5.1	5.2	5.4	5.7	6.3
-20 ~ 0	4.5	4.9	5.1	5.2	5.4	5.7	6.5
0 ~ +20	4.6	4.9	5.1	5.2	5.5	5.8	6.7
+20 ~ +40	4.6	5.0	5.2	5.3	5.6	6.0	6.9
+40 ~ +60	4.7	5.1	5.3	5.5	5.8	6.2	7.2
+60 ~ +80	4.8	5.3	5.5	5.6	6.0	6.4	7.5
+80 ~ +90	4.9	5.4	5.6	5.8	6.1	6.6	7.7

※Each property is shown as a typical value.
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Properties of 7054

n_d	1.70623	v_d	54.69
n_e	1.70931	v_e	54.46

Optical Properties

Wavelength [μm]	Refractive Index	
-	2.32542	1.668299
-	2.05809	1.673845
-	1.97009	1.675525
-	1.52958	1.683106
-	1.12864	1.689607
-	1.06414	1.690763
t	1.01398	1.691717
s	0.85211	1.695356
A'	0.76819	1.697821
r	0.70652	1.700070
C	0.65627	1.702304
C'	0.64385	1.702929
He-Ne	0.63282	1.703512
D	0.58929	1.706115
d	0.58756	1.706229
e	0.54607	1.709308
F	0.48613	1.715217
F'	0.47999	1.715954
He-Cd	0.44157	1.721321
g	0.43584	1.722255
h	0.40466	1.728109
-	0.38887	1.731685
i	0.36502	1.738114
-	0.33415	1.748933
-	0.32611	1.752369

Conditions:
 temperature: 22.5 °C
 humidity: 50 %
 atmospheric pressure: 1013.25 hPa

Dispersion Coefficients *8	
A0	2.8562273E+00
A1	-1.3186004E-02
A2	-1.8310363E-04
A3	1.9696625E-02
A4	2.8111719E-04
A5	5.9507421E-06
A6	1.2191426E-07
A7	0.0000000E+00
A8	0.0000000E+00

Fluorescence	[Class] *7	2
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Partial Dispersion	
F - C	0.012913
F' - C'	0.013025
C - t	0.010588
C - A'	0.004483
d - C	0.003925
e - C	0.007003
g - d	0.016025
g - F	0.007038
h - g	0.005854
i - g	0.015859
C' - t	0.011213
e - C'	0.006378
F' - e	0.006646
i - F'	0.022160

Abnormal Dispersion	
$\Delta P_{c,A'}$	0.0055
$\Delta P_{d,C}$	0.0021
$\Delta P_{g,d}$	-0.0097
$\Delta P_{g,F}$	-0.0076
$\Delta P_{i,g}$	-0.0422

Relative Partial Dispersions	
C - t / F - C	0.8199
C - A' / F - C	0.3472
d - C / F - C	0.3040
e - C / F - C	0.5424
g - d / F - C	1.2410
g - F / F - C	0.5450
h - g / F - C	0.4533
i - g / F - C	1.2281
C' - t / F' - C'	0.8609
e - C' / F' - C'	0.4897
F' - e / F' - C'	0.5103
i - F' / F' - C'	1.7014

Internal Transmittance	
λ [nm]	τ (10 mm)
240	0.213
250	0.492
260	0.717
270	0.842
280	0.903
290	0.935
300	0.953
310	0.965
320	0.975
330	0.983
340	0.988
350	0.990
360	0.992
365	0.994
370	0.996
380	0.997
390	0.998
400	0.998
420	0.998
440	0.998
460	0.998
480	0.999
500	0.999
550	0.998
600	0.999
650	0.998
700	0.999
800	0.999
900	0.998
1000	0.999
1200	0.999
1400	0.993
1600	0.993
1800	0.981
2000	0.951
2200	0.860
2400	0.600

Color Code	
λ_{80}	282
λ_5	237

Thermal Properties

Transformation Temp.	[°C]	Tg	641
Yield Point	[°C]	At	661
Expansion Coefficient (-30 ~ +70°C)	[10 ⁻⁶ /°C]	α	5.7
	(+100 ~ +300°C)		[10 ⁻⁶ /°C]
Thermal Conductivity	[W/m·K]	λ	0.852
Specific Heat Capacity	[J/g·K]	c	0.558
Thermal Diffusivity	[10 ⁻⁷ m²/sec]	κ	3.91

Mechanical Properties

Young's Modulus	[GPa]	E	108.0
Poisson's Ratio		μ	0.293
Knoop Hardness	[Class] *1	Hk	605
			6
Abrasion	*2	A	75
Shear Modulus	[GPa]	G	41.7
Stress Optical Coefficient	[10 ⁻¹² /Pa]	β	2.07

Chemical Properties

Climate Resistance	[Class] *3	1
Water Resistance (powder method)	[Class] *4	1
Acid Resistance (powder method)	[Class] *4	4
Acid Resistance (surface method)	[Class] *5	5
Alkaline Detergent Resistance	[Class] *6	4

Pb	[wt%]	0.0
Hg	[wt%]	0.0
Cd	[wt%]	0.0
Cr	[wt%]	0.0
As	[wt%]	0.2

Density	3.91
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Effect of Temperature on Refractive Index							
°C	$\Delta n / \Delta T$ relative value [10 ⁻⁶ /°C]						
	t	C	d	e	F	g	i
-70 ~ -60	3.8	4.2	4.4	4.5	4.8	5.2	6.2
-60 ~ -40	3.6	4.0	4.2	4.3	4.7	5.1	6.0
-40 ~ -20	3.4	3.8	4.0	4.2	4.5	5.0	6.0
-20 ~ 0	3.4	3.8	4.0	4.2	4.5	5.0	6.0
0 ~ +20	3.4	3.8	4.0	4.2	4.6	5.0	6.1
+20 ~ +40	3.4	3.9	4.1	4.3	4.7	5.1	6.3
+40 ~ +60	3.5	4.0	4.2	4.4	4.8	5.3	6.5
+60 ~ +80	3.6	4.1	4.4	4.6	5.0	5.5	6.7
+80 ~ +90	3.7	4.2	4.5	4.7	5.1	5.6	6.9

※Each property is shown as a typical value.
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Note

1	JOGIS 09-1975
2	JOGIS 10-1994
3	JOGIS 07-2006
4	JOGIS 06-2009
5	ISO 8424-1996
6	ISO 9689-1990
7	JOGIS 03-2005
8	$n^2=A_0 + A_1 \lambda^2 + A_2 \lambda^4 + A_3 \lambda^{-2} + A_4 \lambda^{-4} + A_5 \lambda^{-6} + A_6 \lambda^{-8} + A_7 \lambda^{-10} + A_8 \lambda^{-12}$

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*Products: Hardware and its technical information (including software)



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