



HOYA CORPORATION USA

Color Filter Glass

HOYA CORPORATION USA manufactures and markets color filter glass with wide-range spectral characteristics covering the ultraviolet to infrared region, with world-leading manufacturing technology and under stringent quality control.

These color filter glasses are used for all types of high-technology industries including cameras/optical instruments, physical and chemical appliances, educational materials, electronic instruments, optoelectronic instruments, medical appliances, optical industrial equipment, and many other industrial equipment, where they have earned a reputation for excellence.

This catalog has been compiled to present conventional and newly developed glass types incorporating spectral characteristics and other important properties to provide practical and technical information.

We look forward to your continued patronage.

October, 2020

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1. List of Color Filter Glass Types

Classification	Glass type	Principal characteristic	Application (reference)	Classification	Glass type	Principal characteristic	Application (reference)
Sharp Cut Filters	L37	370 nm	For industrial use	Light Balancing Filters	LA20	Color temperature conversion ability 20	Color temperature conversion
	L38	380 nm			LA40	40	
	L39	390 nm			E-LA80	80	
	L42	420 nm			E-LA100	100	
	Y44	440 nm			E-LA120	120	
	Y48	480 nm			E-LA140	140	
	Y50	500 nm			E-LA200	200	
	Y52	520 nm			LB20	-20	
	O54	540 nm			LB40	-40	
	O56	560 nm			LB80	-80	
Infrared Transmitting Filters	O58	580 nm	Surveillance Camera and Other Purposes	Near-infrared Absorbing Filters (color compensating filters)	LB100	-100	Images/color compensation
	R60	600 nm			LB120	-120	
	R62	620 nm			LB140	-140	
	R64	640 nm			LB200	-200	
	R66	660 nm					
	R70	700 nm					
	R72	720 nm					
	IR76N	760 nm			CM5000 (stock only)		
	IR80N	800 nm			C500S		
	IR83N	830 nm			CM500		
Infrared Band Pass	IR85N	850 nm			E-CM500S (stock only)		
	RM90	900 nm			C5000		
Infrared Band Pass	RM100	1200 nm			CD5000 (stock only)		
	RT830	Wavelength of maximum transmittance 830 nm			CD700		
Sharp Cut Filters (W Series)		$\lambda \tau$ 0.5 (wavelength when τ is 0.5)	For industrial use	Neutral Density Filters	CM700		Industrial use/images
	W-L420	420 nm			ND0	Dimmer Filter High intensity control	
	W-Y435	435 nm			ND006		
	W-Y455	455 nm			ND0.1		
	W-Y475	475 nm			ND0.3		
	W-Y495	495 nm			ND1		
	W-Y515	515 nm			ND3		
	W-O530	530 nm			ND5		
	W-O550	550 nm			ND10		
	W-O570	570 nm			ND13		
	W-O590	590 nm			ND15		
	W-R610	610 nm			ND20		
	W-R630	630 nm			ND25		
	W-R645	645 nm			ND30		
	W-R665	665 nm			ND40		
	W-R695	695 nm			ND50		
	W-R715	715 nm			ND60		
	W-IR760	760 nm			ND70		
	W-IR780	780 nm			ND80		
UV Filters	W-IR800	800 nm		Neutral Density Filter (W-ND Series)	W-ND9	Dimmer Filter High intensity control	Industrial use/images
	W-IR830	830 nm			W-ND3		
	W-IR850	850 nm			W-ND4		
	UV28N	280 nm			W-ND5		
	UV30N	300 nm			W-ND11		
	UV32N	320 nm					
	UV34N	340 nm					
	UV36N	360 nm					
Blue Filters		Wavelength of maximum transmittance		Heat Absorbing Filters	HA5	Heat absorbing	For industrial use
	B370	370 nm			HA15		
	E-B390	390 nm			HA30		
	B410	410 nm			HA50		
	B440	440 nm					
Green Filters	B460	460 nm		Ultraviolet Transmitting, Visible Absorbing Filters	U330	Bandpass	For industrial use
	G530	530 nm			U340		
	G533	533 nm			U360		
	G545	545 nm			UL254S		
	G550	550 nm			UL365S		
Green Filters				Multiband Calibration Filters	V10		For industrial use
					V11		
					HY1		

2. Properties of Color Filter Glass

2.1 Optical Properties

2.1.1 Transmittance

There are 2 kinds of transmittances in this catalog, one is transmittance (T) and the other is internal transmittance (τ). The relationship between these 2 transmittances is shown as follows:

Transmittance ($T(\lambda)$) = $P(\lambda) \tau(\lambda)$

$P(\lambda)$: Reflection coefficient at wavelength is λ

$$P(\lambda) = \frac{2n(\lambda)}{(n(\lambda)^2 + 1)}$$

$n(\lambda)$: Refractive index at wavelength is λ

In this catalog, refractive indexes corresponding to wavelengths ranging between 400 nm and 1000 nm with the 100 nm pitches are shown, and any refractive index in the range can be simply calculated by the least squares method or others.

Internal transmittances are calculated from the refractive indexes.

The internal transmittance is important to estimate the transmittance when the thickness is changed. The internal transmittances for various thicknesses can be calculated by the formula as follows:

$$\tau_2(\lambda) = \tau_1(\lambda)^{\frac{t_2}{t_1}}$$

$\tau_1(\lambda)$: Internal transmittance when filter thickness is t_1 and wavelength is λ

$\tau_2(\lambda)$: Internal transmittance when filter thickness is t_2 and wavelength is λ

The internal transmittance can be simply converted to the transmittance, and therefore, the spectral transmittance characteristics in the case of change in the thickness are also simply available.

- Estimated transmittances by calculation include errors caused by various reasons. To acquire an accurate transmittance in the case of change in the thickness, actual measurement with the thickness changed is necessary.

The standard thickness is described as "Catalog Thickness" in this catalog, and the transmittance characteristics described in this catalog are based on catalog thickness.

If the thickness is changed, the property value changes, too.

The transmittance characteristic values shown in the catalog indicate measures of central tendency of production lots.

- In the catalog, transmittances from 200 nm through 1200 nm and transmittance curves from 200 nm through 5000 nm are shown.
- The transmittance values with 1300 nm or higher are reference values.

2.1.2 Optical Density(OD)

The characteristics of color filter glass may be represented by its optical density. The relationship between the optical density and transmittance is shown as follows:

$$D(\lambda) = \log \left(\frac{1}{T(\lambda)} \right)$$

2.1.3 Chromaticity Coordinates

Chromaticity coordinates are obtained in accordance with JIS Z8701 (1999) and JIS Z8722 (2009).

Standard illuminants A, C, and D65 and auxiliary standard illuminant are used as an illuminant in accordance with JIS Z8720 (2012).

The specifications described above are in conformity with ISO/CIE10526:1991, ISO/CIE10527:1991, CIE15:2004, and CIE63:1984.

The chromaticity diagram shows typical glass types with standard illuminants A and D65 and auxiliary standard illuminant C.

- This catalog shows the chromaticity coordinates when the viewing angle is 2 degrees.

2.1.4 Refractive Index(n)

Refractive indexes corresponding to wavelengths ranging between 400 nm and 1000 nm with the 100 nm pitches are shown to the third decimal place.

- Refractive indexes shown in this catalog are reference values.

2.1.5 Temperature Coefficient of Transmittance ($\Delta\lambda T$)

Refractive indexes corresponding to wavelengths ranging between 400 nm and 1000 nm with the 100 nm pitches are shown to the third decimal place.

- Refractive indexes shown in this catalog are reference values.

Glass type	$\Delta\lambda T$	Glass type	$\Delta\lambda T$
L42/W-L420	0.08	O54/W-O550	0.12
Y44/W-Y435/W-Y455	0.08	O56/W-O570	0.12
Y48/W-Y475/W-Y495	0.10	O58/W-O590	0.13
Y50/W-Y515	0.11	R60/W-R610	0.14
Y52/W-O530	0.13	R62/W-R630	0.14
IR80N/W-IR800	0.20	R64/W-R645	0.15
IR83N/W-IR830	0.22	R66/W-R665	0.16
IR85N/W-IR850	0.23	R70/W-R715	0.17
RM90	0.21	R72	0.19
RM100	0.25	IR76N/W-IR760	0.19

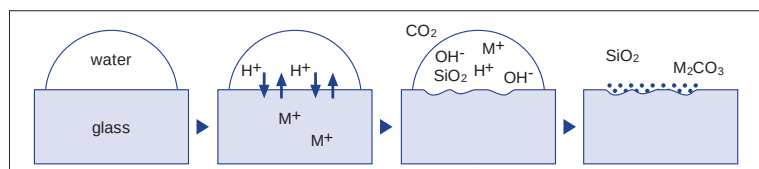
2.2 Chemical properties

Dimming or staining may be observed on the glass surface in the polishing or coating process or during storage.

As the measure indicating the trend of these phenomena, dimming is caused by water durability and staining is caused by acid durability.

• Dimming

Polished glass exposed to high humidity or temperature variation may sweat. Water vapor may condense to form droplets on the glass surface. Some of the glass components that dissolve in the droplets may in turn attack the glass surface and react with gaseous elements in the air such as CO_2 . Reaction products form as white spots or a cloudy film as the glass surface dries. This phenomenon is called dimming.

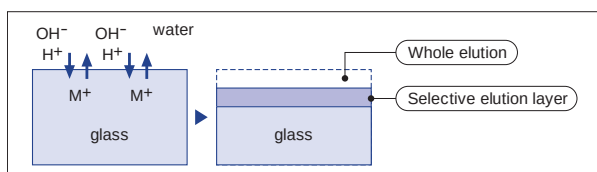


The difficulty degree of dimming generation is evaluated with the water durability by the powdered method (Dw).

- Staining

The surface of a polished optical glass product is damaged by water or acid, and the reflected light of interference colors can sometimes be observed on the surface. This phenomenon is called staining.

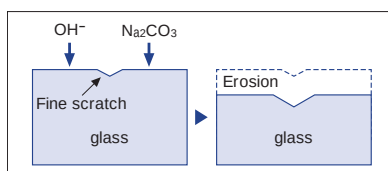
Water or acid contact causes a chemical reaction, which is ion exchange between cations in the glass and hydronium ions in water, resulting in a silica-rich surface layer that causes an interference color at the layer.



The resistance to staining be evaluated with the acid durability by the powdered method (DA) or the staining resistivity by the surface method.

- Latent scratch

Fine scratches created on the glass surfaces during the polishing process may become large and visible after surfaces are eroded by inorganic builders included in cleaning detergents. This phenomenon is called latent scratch.



Erosion in the solution of inorganic builders has 2 types: one is that the builders such as Na_2CO_3 are hydrolyzed and hydroxide ions are generated, which erode the glass, and the other is that hydrolyzed polymerized phosphoric ions such as polymerized phosphate builders erode the glass.

2.2.1 Water Durability (D_w)

The powdered glass (particle size: 425 to 600 μm), weighed by its specific gravity, is placed in a platinum net basket and soaked in 80 ml pure water (pH: 6.5 to 7.5), which is contained in a round-bottom flask made of quartz glass. The glass is then boiled for 60 minutes and classified according to the percentage of weight loss (%).

Class	Reduction in weight (%)
1	<0.05
2	≥ 0.05 to < 0.10
3	≥ 0.10 to < 0.25
4	≥ 0.25 to < 0.60
5	≥ 0.60 to < 1.10
6	≥ 1.10

2.2.2 Acid Durability (DA)

As the same method as the DW measurement, 0.01 mol/liter of nitric acid aqueous solution is put into the flask and classification is performed according to the percentage of weight loss (%) as follows:

Class	Reduction in weight (%)
1	<0.2
2	≥ 0.2 to < 0.35
3	≥ 0.35 to < 0.65
4	≥ 0.65 to < 1.20
5	≥ 1.20 to < 2.20
6	≥ 2.20

2.3 Thermal properties

2.3.1 Transition Temperature (T_g)

The glass transition temperature (T_g) refers to the temperature at which the glass transforms from the "glassy state" (at the lower temperature side) to the "supercooled liquid state" (at the higher temperature side).

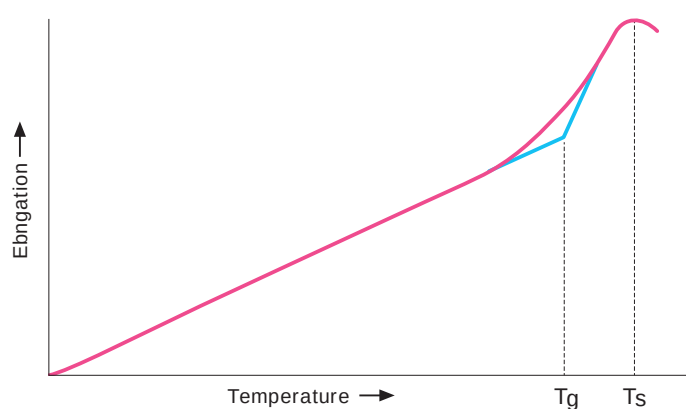
With use of a differential thermal dilatometer whose temperature distribution within its furnace is $\pm 1^\circ\text{C}$, the corresponding temperature is defined as the transition temperature on the thermal expansion curve indicating the relationship between the temperature and expansion, which is acquired when the well-annealed test specimen is heated at a constant rate of $4^\circ\text{C}/\text{minute}$.

For the higher temperature line, we consider the value at which the gradient (differential value) is the highest, and for the lower temperature line, we determine a value 100°C below T_g. The unit for the transition temperature is $^\circ\text{C}$.

This temperature is regarded as the temperature equivalent to the viscosity of approximately 10^{13} to 10^{14} dPa·s, and is a guideline for the retention temperature for annealing.

It can be also used as an indicator for temperature control at coating.

Note: 1 dPa·s = 1 poise



Thermal expansion curve

2.3.2 Sag Temperature (T_s)

The temperature at which expansion stops apparently on the thermal expansion curve is defined as the sag temperature (T_s). This temperature is regarded as the temperature equivalent to the viscosity of approx. 10^{10} to 10^{11} dPa·s.

This phenomenon does not demonstrate the thermal expansion property essential to glass, but results from the deformation caused by the load applied to the glass specimen and the self weight of the glass specimen.

2.3.3 Mean Coefficient of Linear Thermal Expansion (α)

The coefficient of thermal expansion is indicated by α_n for the normal temperature range (-30°C to 70°C) and α_h for the high temperature range (100°C to 300°C), respectively, and expressed by $10^{-7}/\text{K}$.

An interference-dilatometer for the normal temperature range and a differential thermal dilatometer for the high temperature range are used as measurement instruments.

The coefficients of thermal expansion α_n and α_h are obtained by the formulas as follows:

$$\alpha_n = \frac{dL_n}{L \times dT_n}$$

Where, dT_n is a temperature difference between -30 to 70°C (K), L is the initial length of the sample (mm), and dL_n is the amount (mm) of the change in the sample length from -30°C to 70°C .

$$\alpha_h = \frac{dL_h}{L \times dT_h}$$

Where, dT_h is a temperature difference between 100 to 300°C (K), L is the initial length of the sample (mm), and dL_h is the amount (mm) of the change in the sample length from 100°C to 300°C .

2.4 Mechanical Properties

2.4.1 Knoop Hardness (H_K)

The Knoop hardness is calculated by the following formula after applying the load of 0.9807 N to the polished glass surface for 15 seconds with use of a pyramid-shaped diamond indenter with the angle between opposite edges of 172°30' and 130° and measuring the longer diagonal line of the indentation.

$$H_K = 1.451 \times \frac{F}{l^2}$$

Where F is the load (N) and l is the length of the longer diagonal line (mm) of the indentation.

Note 1: Knoop hardness is expressed in MPa or N/mm², which is omitted by custom.

Note 2: The H_K value obtained by the above formula using SI units is equal to the one obtained by the calculation using conventional kgf units.

Note 3: 1N = 1.01972×10⁻⁴kgf

Note 4: Both measured values and classes identified therefrom are shown in the table below.

Class	Knoop hardness
1	<150
2	≥ 150 to < 250
3	≥ 250 to < 350
4	≥ 350 to < 450
5	≥ 450 to < 550
6	≥ 550 to < 650
7	≥ 650

2.4.2 Abrasion Factor (FA)

The glass sample with 9 cm² of area to be measured is placed 80 mm from the center of the cast iron circular plate that is rotated horizontally at 60 r.p.m., and is lapped by applying the load of 9.807 N with uniformly supplying the lapping liquid made by putting 10 g of alumina abrasive grains with average diameter of 20μm in 20 ml of water for 5 minutes. The abrasive weight, m, is acquired by comparing the sample weights between before and after lapping.

Similarly, the abrasive weight, m_0 of the standard specimen (BSC7) specified by the Japan Optical Glass Manufacturers' Association is measured and the abrasion factor (FA) is calculated by the formula as follows:

$$F_A = \frac{m/d}{m_0/d_0} \times 100$$

Where d is the specific gravity of the test specimen and d_0 is the specific gravity of the standard specimen (BSC7).

In other words, the value calculated by the formula above is the speed of sandblast abrasion with respect to BSC7 as 100.

2.5 Other Properties

2.5.1 Specific Gravity (d)

The specific gravity of glass is defined relative to the density of pure water at 4°C.

2.5.2 Fluorescence

Color filter glass in particular may produce fluorescence under ultraviolet irradiation. Especially, sharp cut filters produce fluorescence in the visible range.

2.5.3 Environmental Impact Substances

Color filter glasses partly include hazardous substances specified by RoHS Directive, but those substances are exempt from application according to the Exemption List Annex III.

The information on the specified hazardous substances related to inclusion is shown in the table on the next page. Contact our sales personnel for further information.

The environmental hazardous substance content table of colored glass

Glass Type	As2O3	CdO	PbO	Cr2O3	Glass type	As2O3	CdO	PbO	Cr2O3
L37			○		U350	○		○	
L38			○		U360	○		○	
L39			○		B370	○		○	
L42		○			B440			○	
Y44		○			B460	○		○	
Y46		○			G530	○		○	○(*1)
Y48		○			G533	○		○	○(*1)
R64		○			G545	○		○	○(*1)
R66		○			G550	○		○	○(*1)
R68		○			LA20	○		○	
R70		○			LA40	○		○	
R72		○			LB20	○		○	
IR76N		○			LB40	○		○	
IR80N		○			LB60	○		○	
IR83N		○			LB80	○		○	
IR85N		○			LB100	○		○	
RM90			○	○(*1)	LB120	○			
RM100			○	○(*1)	LB140	○			
RT830		○			LB200	○			
W-L420		○			V10	○			
W-Y435		○							
W-Y455		○							
W-Y475		○							
W-Y495		○							
W-Y515		○							
W-O530		○							
W-O550		○							
W-O570		○							
W-O590		○							
W-R610		○							
W-R630		○							
W-R645		○							
W-R665		○							
W-R695		○							
W-R715		○							
W-IR760		○							
W-IR780		○							
W-IR800		○							
W-IR830		○							
W-IR850		○							

*1 Hexavalent chromium of several ppm - about 100 ppm exists on the manufacture melted at high temperature (analytical value).

3. Quality of Color Filter Glass

We use the method, "Internal Absorption", of glass as opposed to the vapor deposition type to achieve selective transmission and selective absorption. This is the greatest feature of our products.

With the vapor deposition type, the light of unnecessary wavelength is "reflected" which may cause adverse effects in the optical system.

In such a case, our "Internal Absorption" type is best suited for the high-precision optical system. The quality standard is managed and administered in accordance with the global standard, ISO10110.

3.1 Spectral Characteristics

The spectral transmittances in this catalog are the measures of central tendency.

The characteristics for each melting lot vary within the specifications, but variations in a lot are extremely small.

3.2 Optical Constant

The absorption coefficients and refractive indexes in this catalog are reference values, and they are necessary at coating.

3.3 Thickness

The thicknesses in this catalog are standard. Although the thickness can be changed be aware that the optical characteristics will also change.

3.4 Appearance and Internal Quality

Color filter glasses are manufactured with the aim of achieving the same quality as optical glasses. But the quality standards are different between them because of difference in melting methods.

It is hard to eliminate all the small bubbles and striae at glass melting, and some of them may remain at the permissible level.

3.4.1 Polished Products

We provide products appropriate to required quality in accordance with ISO10110-3.

3.4.2 Sliced Products

These are the semi-finished products that were cut from materials.

These products are classified by the total sum of cross sections of foam/foreign substances per 100 ml of a material as follows:

Classes of Bubbles and Inclusions	
Bubble class	Total cross sectional area per 100ml of glass (mm ²)
0	<0.03
1	≥ 0.03 - < 0.10
2	≥ 0.10 - < 0.25
3	≥ 0.25 - < 0.50
4	≥ 0.50

3.5 Polishing Accuracy

The polishing accuracy will be in accordance with requests and applications.

4. *Product Specifications of Color Filter Glass*

4.1 *Polished Products*

These are the products that were formed and polished.

4.2 *Sliced Products*

These are the products that were cut from materials.

4.3 *Coated Products*

We carry coated products.

Antireflective coating has the effect of preventing dimming and staining.

We also offer the vapor deposition type depending on the customer's request.

4.4 *Tempered Glass Products*

There are 2 types of tempering; one is chemical tempering, and the other is thermal tempering.

Support in response to applications and glass composition is available.

Both types of tempering generate a stress in the glass that may affect the transmitted wave surface.

4.5 *Special-Purpose Products*

We may provide other products that are not listed in the catalog, and therefore, please contact our sale personnel.

5. *Preservation and Handling*

Color filter glass may be effected by conditions such as temperature, humidity, and sunlight. Storage for a long time, dimming, staining, or decrease in transmittance by solarization caused by ultraviolet rays may occur.

Before use after storage for months, it is recommended to check the product.

The storage conditions to be recommended are humidity of 50% or less and the temperature of 25 degrees C $\pm$ 5 degrees. Store the product in a dark place as well.

Sudden temperature change, for example inside and outside of a room in winter, may cause condensation on the surface.

Be careful about condensation when the product is integrated into an optical system.

6. *Orders and Inquiries*

When placing an order, please let us know the following:

Dimensions, thickness, tolerance (by drawing as much as possible), quantity, requested date for delivery, etc.
The optical characteristics and data on the catalog are subject to change due to modification without prior notice.

Explanation as to Data Tables

HOYA
HOYA CORPORATION OPTICS SECTION
Transmittance (T) or Internal Transmittance (τ)

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T or τ																				
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T or τ																				
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T or τ																				
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T or τ																				
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T or τ																				

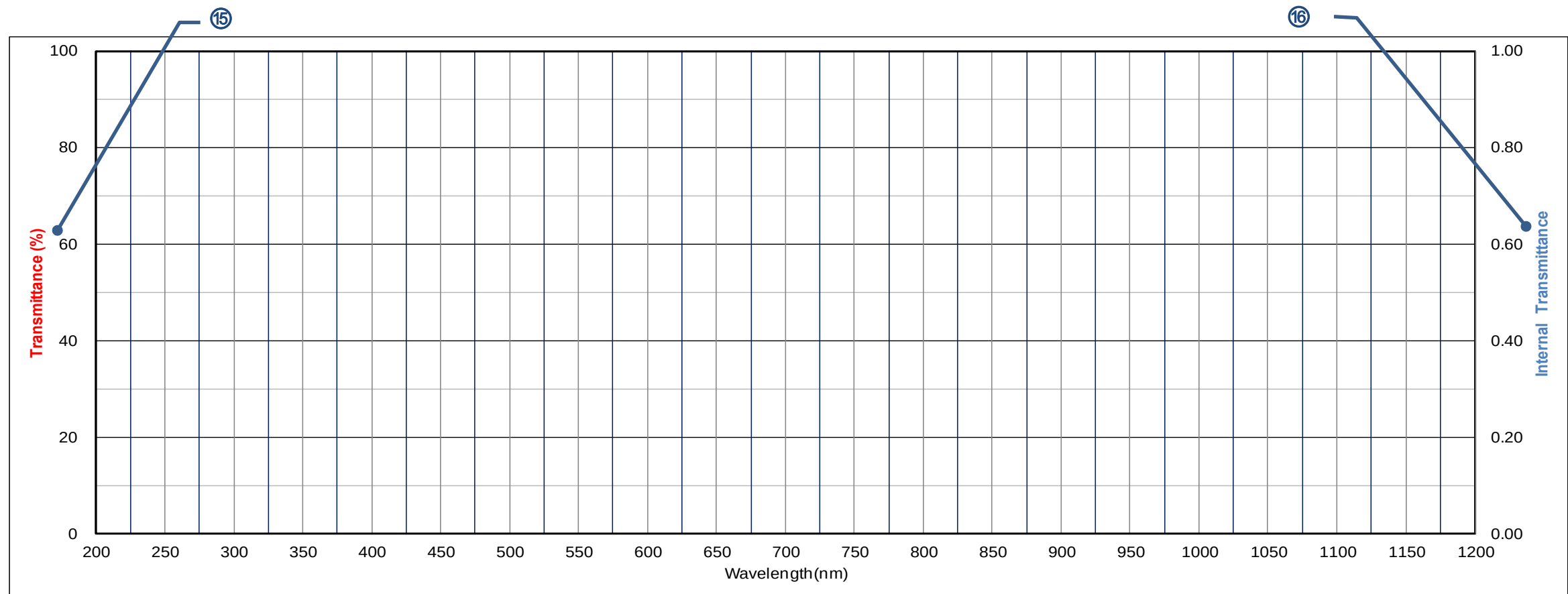
Refractive Index/Absorption coefficient/Reflection coefficient							
λnm	400	500	600	700	800	900	1000
n							
K							
P							

Classes of Bubbles and Inclusions	
	Bubble Class

Color Specification					
	x	y	Y	λ _d	P _e
A					
C					
D65					

Properties							
Chemical		Thermal			Mechanical		Others
D _w	D _A	T _g	T _s	α _{-30/70}	α _{100/300}	H _k	F _A
							d

Tolerance of Transmittance (τ)		



All data is mean values of various melts.

The content of this catalog is accurate as of October 2020

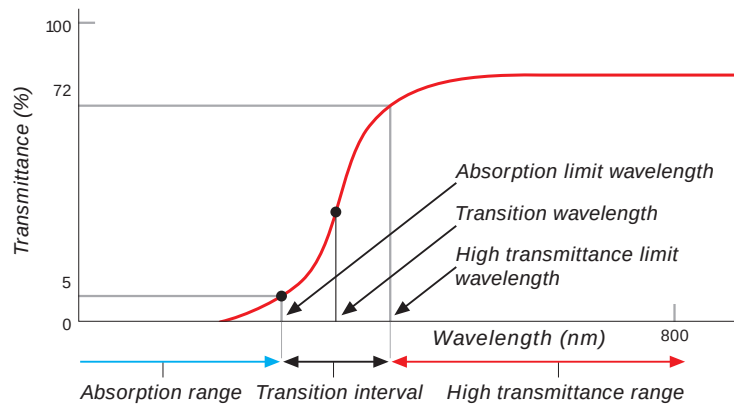
- ① Glass type
- ② Thickness stated in this catalog
- ③ Wavelength(nm)
- ④ Transmittance(%) "T"
Transmittance including reflection loss
or
Internal transmittance (-) "τ"
made correction of surface reflection
(for Sharp-cut filter W-series)
- ⑤ Bubble class
- ⑥ Refractive index for each wavelength
- ⑦ Absorption coefficient for each wavelength
- ⑧ Reflection factor for each wavelength
- ⑨ Color specifications based on standard illuminant "A", "C", and "D65"
x,y : Chromaticity coordinates
Y : Tristimulus value
λ_d : Dominant wavelength
P_e : Excitation purity
- ⑩ Chemical properties
D_w : Water durability
D_a : Acid durability
- ⑪ Thermal properties
T_g : Transformation temperature
T_s : Sag temperature
α : Coefficients of liner thermal expansion
- ⑫ Mechanical properties
H_k : Knoop hardness
F_A : Abrasion factor
- ⑬ Other properties
d : Specific gravity
- ⑭ Tolerances of transmittance specified for each glass type
- ⑮ Transmittance curve including reflection loss
Red line / Left scale
- ⑯ Internal transmittance curve
Blue line / Right scale

Sharp Cut Filters

Sharp cut filters include glass types from L37 through R68 that can cover the visible region from 370 nm through 680 nm. Capital letters of glass types, L, Y, O, and R indicate the color tones of the transmission threshold wavelengths. Those are Colorless, Yellow, Orange, and Red, respectively.

The 2-digit value after the capital letter roughly indicates the transmission threshold wavelength. For example, Y48 indicates that the transmission threshold wavelength is approximately 480 nm and the filter is yellow in color.

Sharp cut filters can be manufactured by aiming other than the transmission threshold wavelengths shown in the catalog.





HOYA CORPORATION OPTICS SECTION

Thickness 2.50 mm

L37

Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	15.8	47.2	68.3	78.6
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	83.5	85.9	87.0	87.7	88.0	88.2	88.4	88.5	88.5	88.6	88.7	88.7	88.7	88.7	88.8	88.8	88.8	88.9	88.9	88.9
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	88.9	88.9	89.0	88.9	89.0	89.0	89.0	89.1	89.1	89.2	89.1	89.2	89.2	89.2	89.2	89.2	89.2	89.3	89.3	89.3
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	89.3	89.1	89.2	89.2	89.3	89.3	89.3	89.3	89.4	89.4	89.5	89.6	89.6	89.6	89.7	89.7	89.8	89.8	89.8	89.9
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	89.8	90.0	90.0	90.0	90.0	90.1	90.0	90.0	90.1	90.0	90.1	90.1	90.2	90.2	90.2	90.2				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.605	1.588	1.580	1.575	1.572	1.570	1.569
P	0.898	0.902	0.904	0.905	0.906	0.906	0.907

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

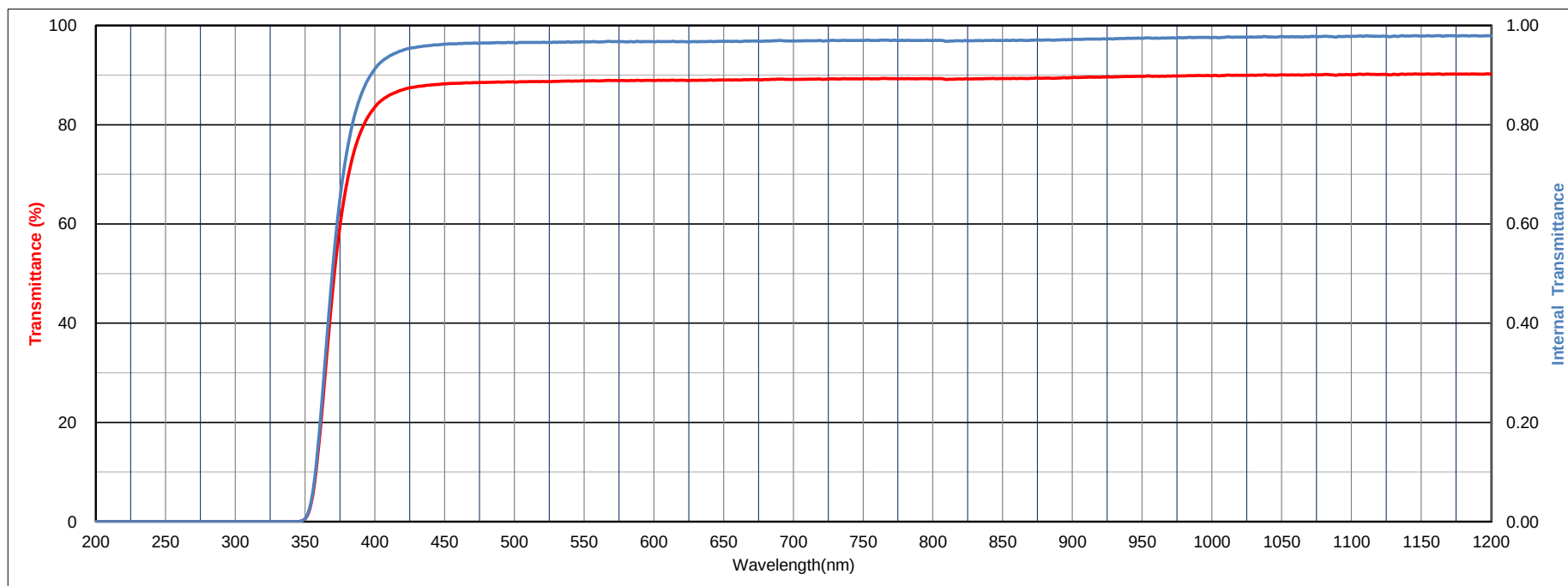
	x	y	Y	λ _u	P _e
A	0.448	0.408	89	583	1
C	0.311	0.317	89	573	0
D65	0.313	0.330	89	572	0

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
2	1	440	490	94	103	460	170	3.26

Tolerance of Transmittance (τ)

λ _T (nm)	Δλ (nm)	TH (%)
370±5	<35	>85



All data is mean values of various melts.

The content of this catalog is accurate as of October ,2020



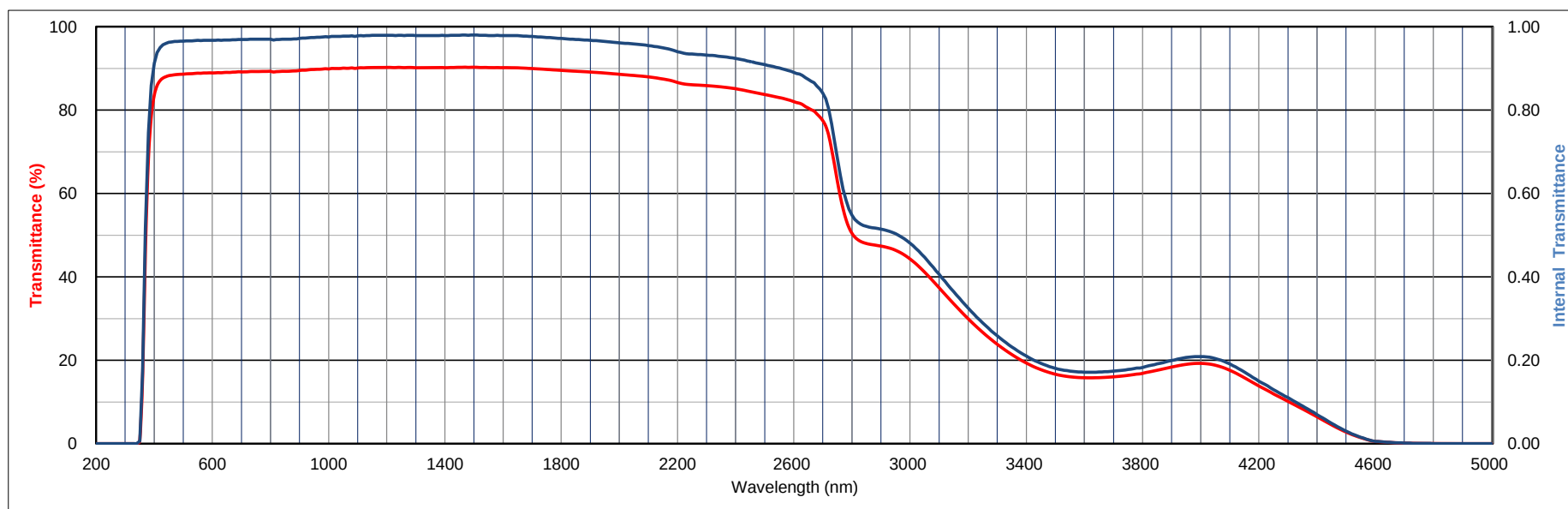
HOYA CORPORATION OPTICS SECTION

Thickness 2.50 mm

L37

Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	15.8	47.2	68.3	78.6
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	83.5	85.9	87.0	87.7	88.0	88.2	88.4	88.5	88.5	88.6	88.6	88.7	88.7	88.7	88.8	88.8	88.8	88.9	88.9	88.9
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	88.9	88.9	89.0	88.9	89.0	89.0	89.0	89.1	89.1	89.2	89.1	89.2	89.2	89.2	89.2	89.2	89.2	89.3	89.3	89.3
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	89.3	89.1	89.2	89.2	89.3	89.3	89.3	89.3	89.4	89.4	89.5	89.6	89.6	89.6	89.7	89.7	89.8	89.8	89.8	89.9
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	89.8	90.0	90.0	90.0	90.0	90.1	90.0	90.0	90.1	90.0	90.1	90.2	90.1	90.2	90.2	90.2	90.2	90.2	90.2	90.2
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	90.2	90.2	90.2	90.2	90.2	90.2	90.2	90.2	90.2	90.2	90.2	90.2	90.2	90.2	90.2	90.2	90.2	90.2	90.2	90.2
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	90.2	90.2	90.2	90.2	90.2	90.3	90.3	90.3	90.2	90.3	90.3	90.3	90.2	90.2	90.2	90.2	90.2	90.2	90.2	90.2
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	90.2	90.2	90.2	90.2	90.1	90.1	90.1	90.1	90.0	90.0	89.9	89.9	89.9	89.8	89.8	89.7	89.7	89.6	89.6	89.6
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	89.5	89.5	89.4	89.4	89.3	89.3	89.3	89.2	89.2	89.2	89.1	89.1	89.0	89.0	88.9	88.9	88.8	88.8	88.7	88.6
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	88.6	88.3	88.0	87.4	86.6	86.1	85.9	85.6	85.1	84.4	83.7	83.0	82.0	80.5	77.5	62.9	50.5	48.0	47.4	46.4
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	44.3	41.1	37.4	33.6	29.9	26.7	23.8	21.4	19.3	17.8	16.6	16.0	15.8	15.8	16.0	16.4	16.9	17.6	18.4	19.0
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	19.2	18.8	17.6	15.8	13.8	11.9	10.1	8.3	6.4	4.5	2.8	1.4	0.5	0.3	0.1	0.1	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



All data is mean values of various melts.

The content of this catalog is accurate as of October ,2020



HOYA CORPORATION OPTICS SECTION

Thickness 2.50 mm

L38

Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	20.8	48.7	66.7
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	76.2	81.1	83.7	85.2	86.0	86.6	86.9	87.2	87.4	87.6	87.7	87.8	87.9	88.0	88.1	88.2	88.2	88.3	88.4	88.4
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	88.4	88.5	88.5	88.5	88.6	88.6	88.6	88.7	88.8	88.8	88.9	88.9	88.9	89.0	89.0	89.0	89.0	89.0	89.0	89.0
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	89.0	88.9	89.0	89.0	89.0	89.0	89.0	89.1	89.1	89.1	89.3	89.3	89.3	89.3	89.5	89.5	89.5	89.5	89.6	89.6
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	89.6	89.6	89.6	89.7	89.7	89.7	89.8	89.7	89.7	89.6	89.8	89.8	89.9	89.8	89.9	89.9				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.576	1.565	1.560	1.557	1.555	1.553	1.552
P	0.905	0.907	0.909	0.910	0.910	0.910	0.911

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

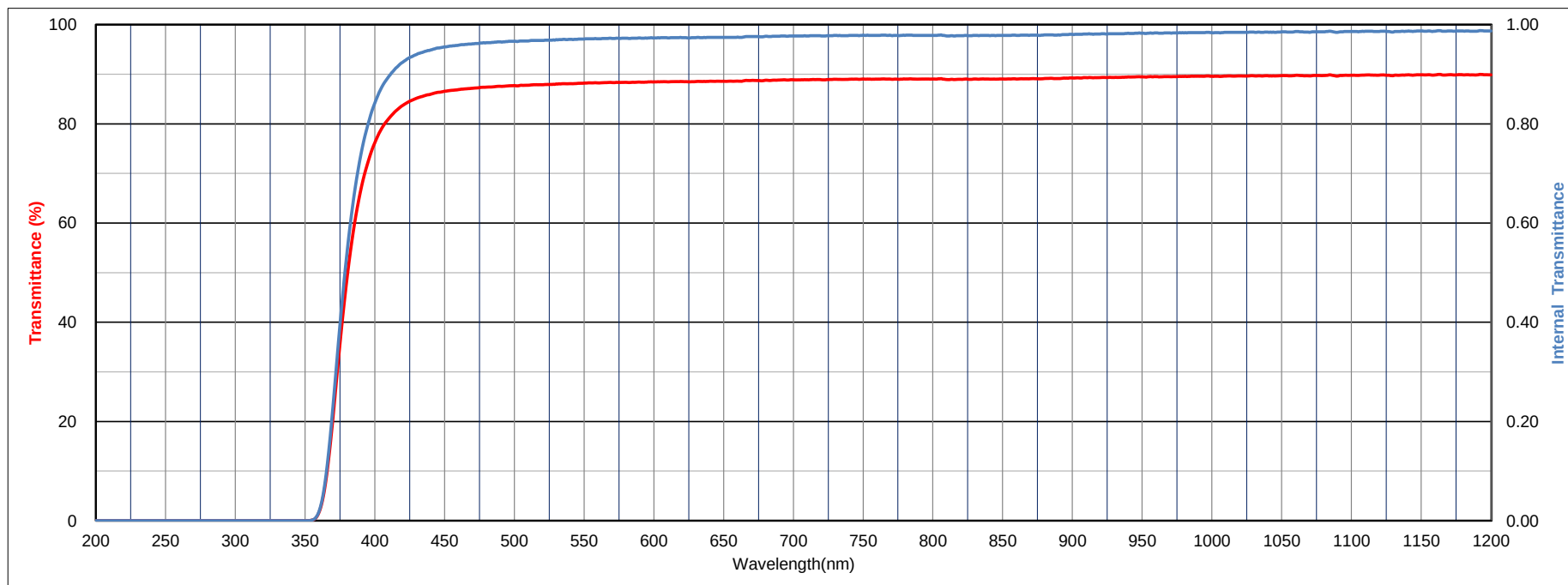
	x	y	Y	λ _u	P _e
A	0.449	0.408	88	583	2
C	0.312	0.319	88	573	1
D65	0.315	0.332	88	572	1

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
2	1	480	535	79	86	490	130	2.96

Tolerance of Transmittance (τ)

λτ (nm)	Δλ (nm)	TH (%)
380±5	<35	>85



All data is mean values of various melts.

The content of this catalog is accurate as of October ,2020



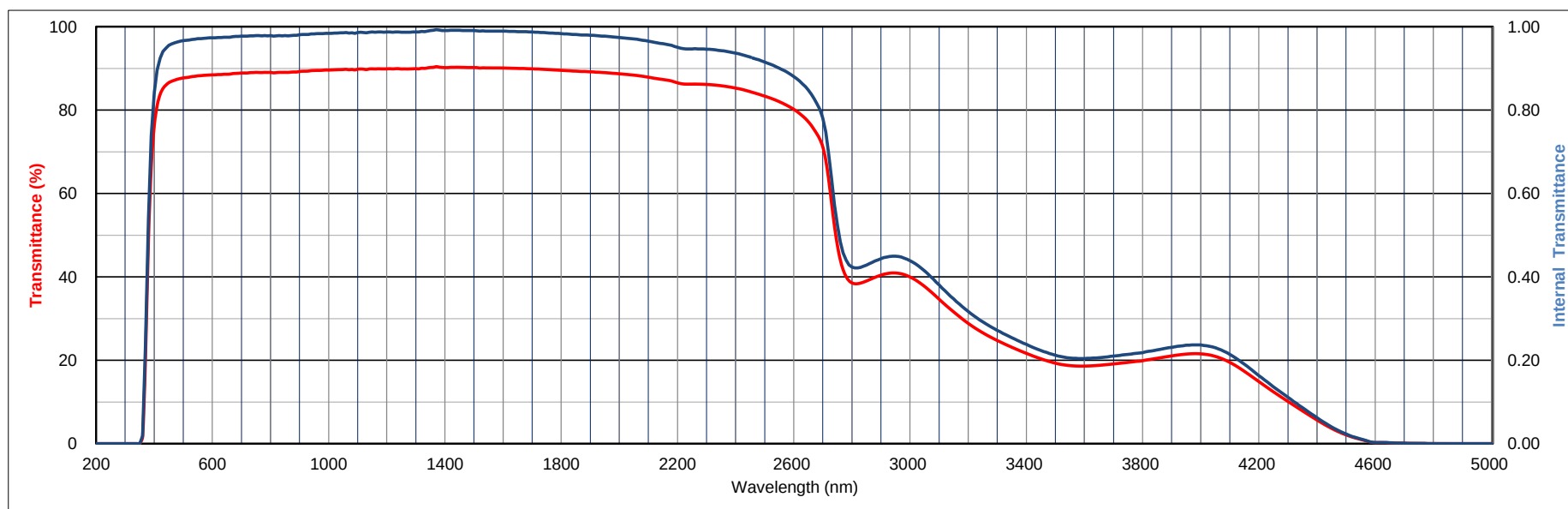
HOYA CORPORATION OPTICS SECTION

Thickness 2.50 mm

L38

Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	20.8	48.7	66.7
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	76.2	81.1	83.7	85.2	86.0	86.6	86.9	87.2	87.4	87.6	87.7	87.8	87.9	88.0	88.1	88.2	88.2	88.3	88.4	88.4
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	88.4	88.5	88.5	88.5	88.6	88.6	88.6	88.7	88.8	88.8	88.9	88.9	88.9	89.0	89.0	89.0	89.0	89.0	89.0	89.0
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	89.0	88.9	89.0	89.0	89.0	89.0	89.0	89.1	89.1	89.1	89.3	89.3	89.3	89.3	89.5	89.5	89.5	89.5	89.6	89.6
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	89.6	89.6	89.6	89.7	89.7	89.7	89.8	89.7	89.7	89.6	89.8	89.8	89.8	89.7	89.9	89.9	89.8	89.9	89.9	89.9
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	89.9	89.9	89.9	89.9	89.9	89.8	89.9	89.8	89.9	89.9	89.9	89.9	90.0	90.0	90.1	90.2	90.2	90.4	90.3	90.2
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	90.2	90.2	90.2	90.2	90.3	90.3	90.2	90.2	90.2	90.2	90.2	90.2	90.1	90.1	90.1	90.1	90.1	90.1	90.1	90.1
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	90.1	90.1	90.0	90.0	90.0	90.0	90.0	90.0	89.9	89.9	89.9	89.8	89.8	89.8	89.8	89.7	89.7	89.6	89.6	89.6
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	89.5	89.5	89.5	89.4	89.4	89.3	89.3	89.3	89.3	89.2	89.2	89.2	89.1	89.1	89.0	89.0	88.9	88.9	88.8	88.8
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	88.7	88.4	87.9	87.3	86.5	86.2	86.1	85.8	85.3	84.4	83.3	82.0	80.2	77.2	71.1	47.6	38.6	39.0	40.4	40.9
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	40.0	37.7	34.6	31.6	28.9	26.6	24.7	23.1	21.7	20.3	19.3	18.7	18.6	18.8	19.1	19.5	19.9	20.5	21.0	21.5
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	21.5	20.9	19.5	17.3	14.9	12.4	10.1	7.9	5.7	3.7	2.1	1.0	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



All data is mean values of various melts.

The content of this catalog is accurate as of October ,2020



HOYA CORPORATION OPTICS SECTION

Thickness 2.50 mm

L39

Transmittance (T)		units: %																	
λ nm		200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370
T		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	4.8	24.6
λ nm		400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570
T		64.3	74.0	79.5	82.5	84.3	85.3	86.0	86.4	86.7	86.9	87.1	87.3	87.4	87.6	87.7	87.9	88.0	88.1
λ nm		600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770
T		88.1	88.2	88.2	88.2	88.3	88.3	88.3	88.4	88.4	88.4	88.5	88.5	88.5	88.6	88.6	88.6	88.6	88.7
λ nm		800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970
T		88.6	88.6	88.6	88.6	88.6	88.7	88.7	88.7	88.8	88.8	88.8	88.9	89.0	89.0	89.2	89.2	89.2	89.3
λ nm		1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200		
T		89.3	89.3	89.4	89.4	89.4	89.4	89.4	89.4	89.4	89.4	89.5	89.5	89.6	89.6	89.6			

Refractive Index/Absorption coefficient/Reflection coefficient

λ nm	400	500	600	700	800	900	1000
n	1.615	1.597	1.588	1.583	1.580	1.578	1.577
P	0.895	0.900	0.902	0.903	0.904	0.904	0.905

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

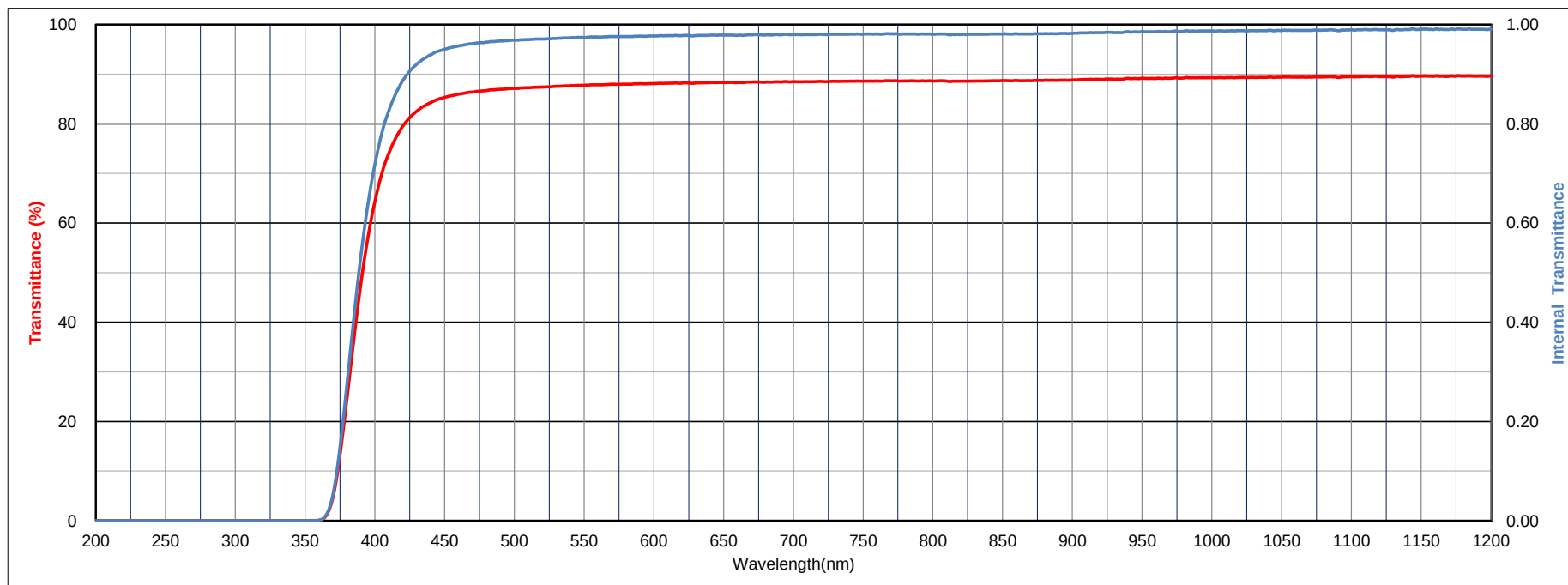
	x	y	Y	λ_u	P _e
A	0.450	0.409	88	582	3
C	0.313	0.321	88	572	2
D65	0.316	0.333	88	571	2

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
2	1	440	490	90	100	460	170	3.29

Tolerance of Transmittance (τ)

$\lambda\tau$ (nm)	$\Delta\lambda$ (nm)	TH (%)
390±5	<40	>85



All data is mean values of various melts.

The content of this catalog is accurate as of October ,2020



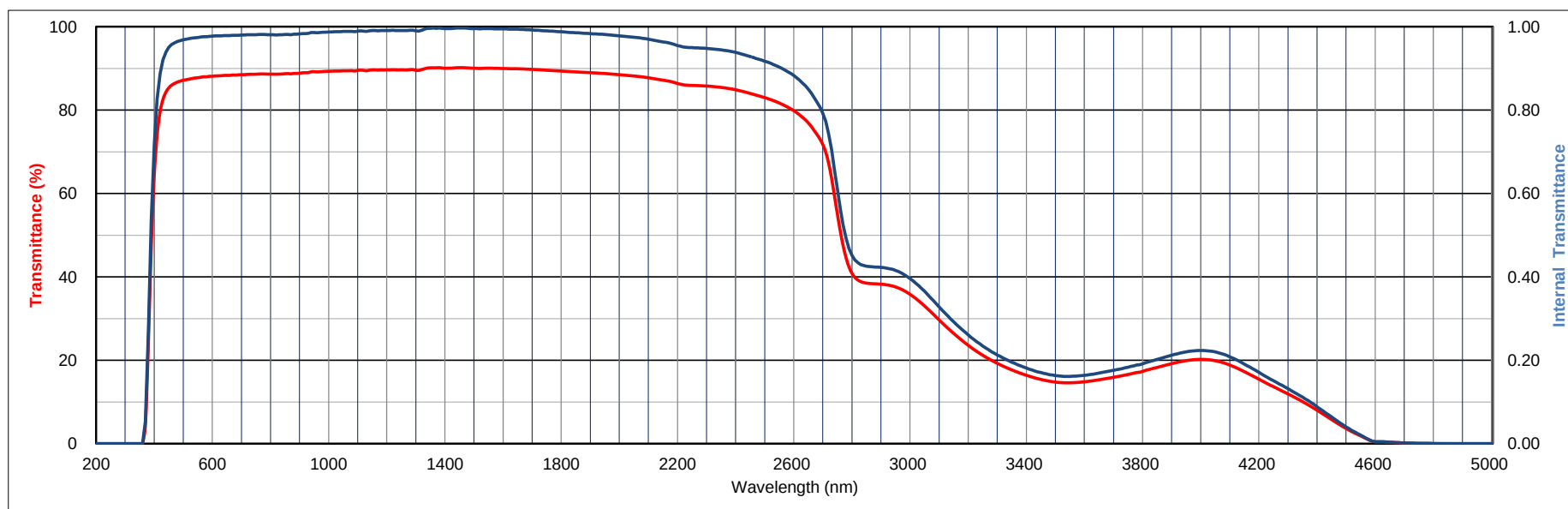
HOYA CORPORATION OPTICS SECTION

Thickness 2.50 mm

L39

Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	4.8	24.6	47.8
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	64.3	74.0	79.5	82.5	84.3	85.3	86.0	86.4	86.7	86.9	87.1	87.3	87.4	87.6	87.7	87.7	87.9	88.0	88.0	88.1
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	88.1	88.2	88.2	88.2	88.3	88.3	88.3	88.4	88.4	88.4	88.5	88.5	88.5	88.6	88.6	88.6	88.6	88.7	88.7	88.6
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	88.6	88.6	88.6	88.6	88.6	88.7	88.7	88.7	88.8	88.8	88.8	88.9	89.0	89.0	89.2	89.2	89.1	89.2	89.2	89.3
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	89.3	89.3	89.4	89.4	89.4	89.4	89.4	89.4	89.4	89.4	89.5	89.6	89.5	89.4	89.6	89.6	89.6	89.6	89.6	89.6
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	89.6	89.6	89.7	89.6	89.6	89.6	89.6	89.6	89.7	89.7	89.5	89.5	89.7	89.9	90.1	90.1	90.1	90.1	90.2	90.1
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	90.0	90.0	90.0	90.1	90.1	90.2	90.2	90.1	90.1	90.1	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	90.0	90.0	89.9	89.9	89.9	89.9	89.9	89.9	89.8	89.8	89.8	89.7	89.7	89.6	89.6	89.5	89.5	89.5	89.4	89.4
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	89.4	89.3	89.3	89.2	89.2	89.1	89.1	89.1	89.0	89.0	89.0	88.9	88.9	88.8	88.8	88.8	88.7	88.7	88.6	88.5
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	88.5	88.2	87.7	87.2	86.4	85.9	85.8	85.4	84.9	84.0	83.0	81.7	79.9	76.9	71.7	55.1	40.9	38.5	38.2	37.6
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	35.8	33.0	29.7	26.4	23.6	21.2	19.3	17.7	16.4	15.4	14.8	14.6	14.8	15.3	15.9	16.6	17.3	18.3	19.2	19.9
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	20.2	19.9	18.8	17.3	15.5	13.7	11.9	10.1	8.0	5.8	3.6	1.9	0.4	0.3	0.2	0.1	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



All data is mean values of various melts.

The content of this catalog is accurate as of October ,2020

Transmittance (T)		units: %																			
λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390	
τ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590	
τ	0.0	5.8	49.8	75.3	82.9	85.6	86.9	87.6	88.1	88.5	88.7	89.0	89.1	89.3	89.4	89.5	89.6	89.7	89.7	89.7	
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790	
τ	89.8	89.8	89.8	89.8	89.8	89.7	89.8	89.9	89.9	90.0	90.0	90.0	90.0	90.1	90.1	90.1	90.1	90.1	90.1	90.0	
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990	
τ	90.0	89.9	89.9	89.9	90.0	90.0	90.0	90.0	90.0	90.0	90.1	90.1	90.1	90.2	90.3	90.3	90.3	90.3	90.3	90.4	
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200					
T	90.4	90.3	90.4	90.5	90.4	90.4	90.4	90.4	90.4	90.4	90.5	90.5	90.5	90.6	90.6	90.6					

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.547	1.537	1.533	1.531	1.529	1.528	1.528
P	0.912	0.914	0.915	0.916	0.916	0.916	0.916

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

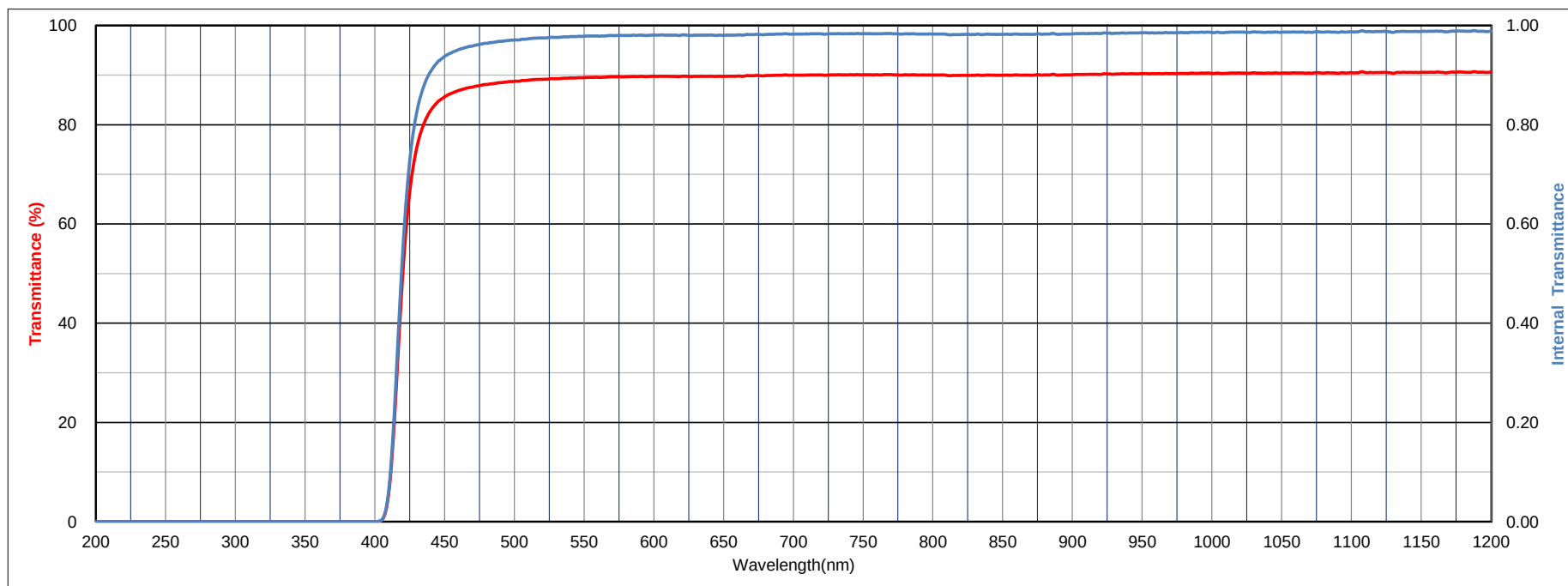
	x	y	Y	λ _u	P _e
A	0.452	0.412	90	580	6
C	0.317	0.329	89	569	5
D65	0.319	0.342	89	569	5

Properties

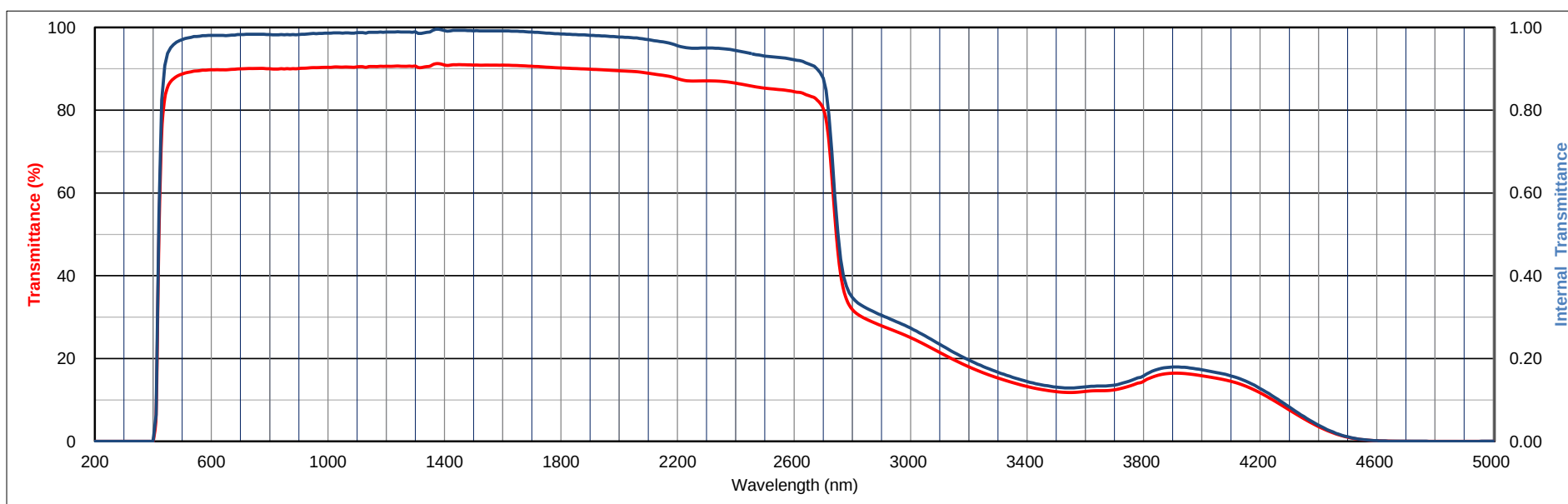
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
2	1	550	600	92	105	540	130	2.59

Tolerance of Transmittance (τ)

λτ (nm)	Δλ (nm)	TH (%)
420±5	<25	>85



Transmittance (T)		units: %																		
λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	0.0	5.8	49.8	75.3	82.9	85.6	86.9	87.6	88.1	88.5	88.7	89.0	89.1	89.3	89.4	89.5	89.6	89.7	89.7	89.7
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	89.8	89.8	89.8	89.8	89.8	89.7	89.8	89.9	89.9	90.0	90.0	90.0	90.0	90.1	90.1	90.1	90.1	90.1	90.1	90.0
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	90.0	89.9	89.9	89.9	90.0	90.0	90.0	90.0	90.0	90.0	90.1	90.1	90.1	90.2	90.3	90.3	90.3	90.3	90.3	90.4
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	90.4	90.3	90.4	90.5	90.4	90.4	90.4	90.4	90.4	90.4	90.5	90.5	90.5	90.4	90.5	90.6	90.6	90.5	90.6	90.6
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	90.6	90.6	90.6	90.6	90.7	90.6	90.6	90.6	90.6	90.6	90.7	90.3	90.3	90.4	90.5	90.6	91.0	91.2	91.2	91.1
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	90.9	90.8	90.9	91.0	91.0	91.0	91.0	91.0	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	90.9	90.9	90.9	90.8	90.8	90.8	90.8	90.7	90.7	90.6	90.6	90.6	90.6	90.5	90.5	90.4	90.4	90.3	90.3	90.2
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	90.2	90.2	90.1	90.1	90.1	90.1	90.0	90.0	90.0	89.9	89.9	89.9	89.8	89.8	89.8	89.7	89.7	89.6	89.6	89.6
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	89.5	89.3	88.9	88.4	87.6	87.0	87.1	87.0	86.5	85.9	85.3	85.0	84.5	83.5	80.4	46.2	31.9	29.5	27.9	26.5
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	25.1	23.3	21.5	19.7	18.0	16.5	15.3	14.2	13.3	12.5	12.0	11.8	12.1	12.2	12.4	13.3	14.5	16.0	16.5	16.3
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	15.8	15.2	14.5	13.3	11.7	9.7	7.6	5.5	3.6	2.1	1.0	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
τ	0.0																			



Transmittance (T)		units: %																			
λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390	
τ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590	
τ	0.0	0.0	0.2	6.9	49.1	76.0	83.7	86.2	87.5	88.4	89.0	89.5	89.9	90.2	90.5	90.7	90.8	90.9	90.9	91.0	
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790	
τ	91.0	91.1	91.1	91.1	91.1	91.1	91.1	91.0	91.1	91.0	91.1	91.1	91.0	91.0	91.0	90.9	90.9	90.9	90.8	90.8	
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990	
τ	90.7	90.6	90.6	90.6	90.6	90.6	90.6	90.5	90.5	90.6	90.6	90.6	90.6	90.7	90.7	90.7	90.7	90.7	90.7	90.7	
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200					
T	90.8	90.7	90.8	90.7	90.7	90.8	90.7	90.7	90.8	90.9	90.8	90.9	90.8	90.8	90.8	90.9					

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.546	1.536	1.531	1.528	1.526	1.525	1.524
P	0.912	0.914	0.916	0.916	0.917	0.917	0.917

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

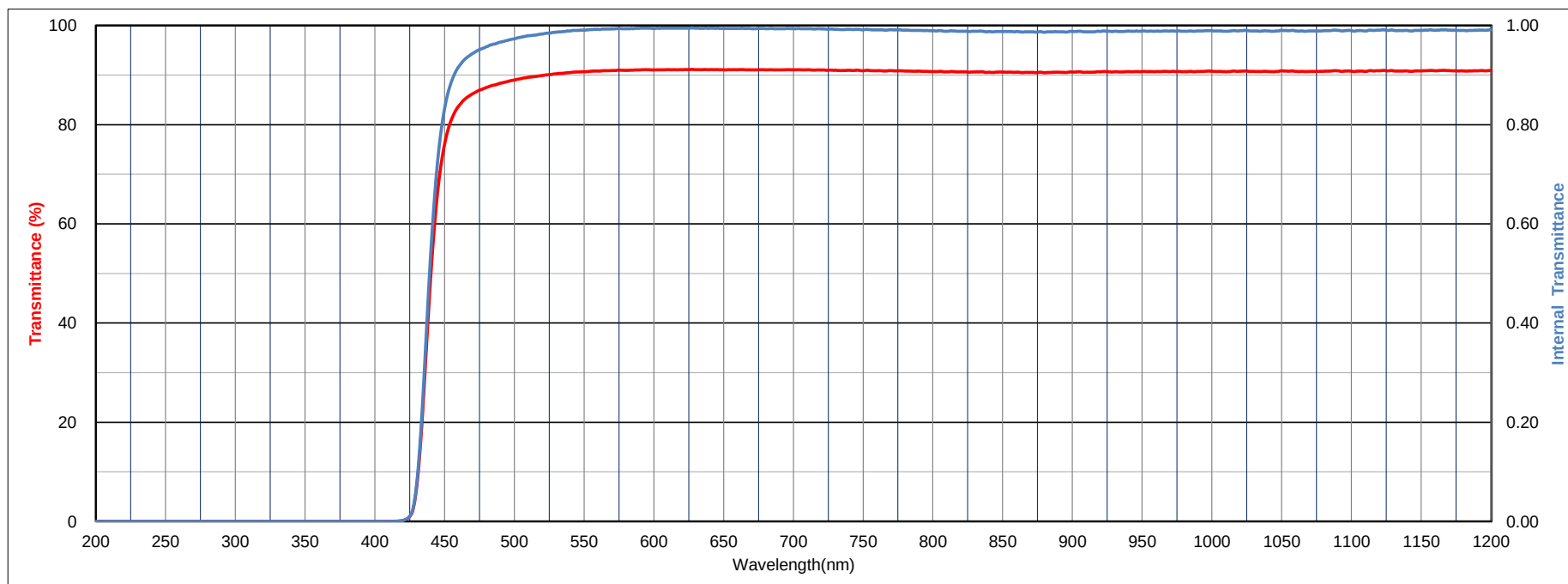
	x	y	Y	λ _u	P _e
A	0.461	0.424	91	580	21
C	0.335	0.366	90	569	20
D65	0.336	0.376	90	568	20

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	2	570	600	99	107	540	130	2.59

Tolerance of Transmittance (τ)

λτ (nm)	Δλ (nm)	TH (%)
440±5	<25	>85





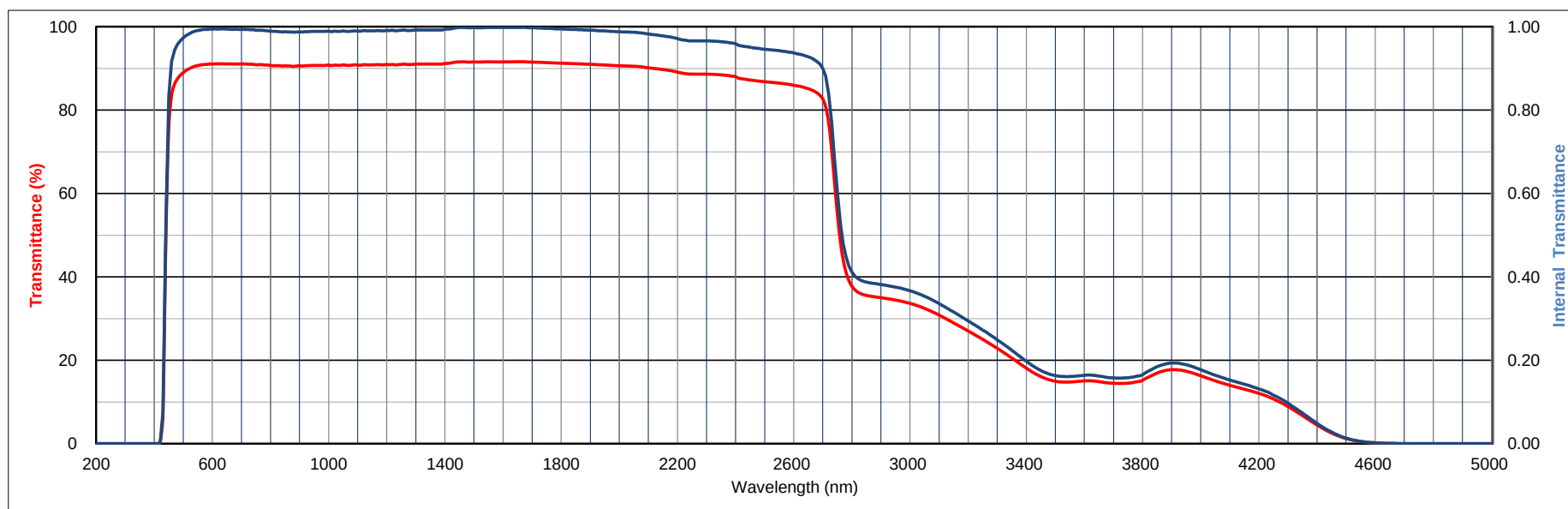
HOYA CORPORATION OPTICS SECTION

Thickness 2.50 mm

Y44

Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.0	0.2	6.9	49.1	76.0	83.7	86.2	87.5	88.4	89.0	89.5	89.9	90.2	90.5	90.7	90.8	90.9	90.9	91.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	91.0	91.1	91.1	91.1	91.1	91.1	91.1	91.0	91.1	91.0	91.1	91.1	91.0	91.0	91.0	90.9	90.9	90.9	90.8	90.8
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	90.7	90.6	90.6	90.6	90.6	90.6	90.6	90.5	90.5	90.6	90.6	90.6	90.6	90.7	90.7	90.7	90.7	90.7	90.7	90.7
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	90.8	90.7	90.8	90.7	90.7	90.8	90.7	90.7	90.8	90.9	90.8	90.7	90.9	90.9	90.8	90.8	90.8	90.9	90.8	90.9
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	90.9	90.9	90.9	90.8	90.9	90.9	91.0	90.9	90.9	90.9	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	91.2	91.2	91.3	91.4	91.5	91.5	91.6	91.6	91.5	91.5	91.5	91.5	91.5	91.5	91.6	91.6	91.6	91.6	91.5	91.5
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	91.6	91.6	91.6	91.6	91.6	91.6	91.6	91.6	91.6	91.5	91.5	91.5	91.5	91.4	91.4	91.4	91.4	91.3	91.3	91.3
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	91.2	91.2	91.2	91.2	91.1	91.1	91.1	91.1	91.0	91.0	91.0	90.9	90.9	90.9	90.8	90.8	90.8	90.7	90.7	90.7
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	90.6	90.5	90.1	89.7	89.1	88.6	88.6	88.4	88.0	87.2	86.8	86.5	86.0	85.1	82.6	55.1	37.8	35.5	35.0	34.4
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	33.6	32.4	30.8	29.0	27.0	25.0	22.9	20.5	18.1	16.1	15.0	14.8	15.0	14.9	14.5	14.5	15.2	16.9	17.7	17.4
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	16.3	15.1	14.0	13.1	12.0	10.7	8.9	6.7	4.5	2.6	1.2	0.5	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



All data is mean values of various melts.

The content of this catalog is accurate as of October ,2020



HOYA CORPORATION OPTICS SECTION

Thickness 2.50 mm

Y48

Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	43.9	79.6	87.1	88.9	89.4	89.7	89.8	89.9	90.0	90.0	90.1	90.1
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	90.1	90.1	90.1	90.1	90.1	90.1	90.1	90.2	90.2	90.3	90.4	90.3	90.3	90.4	90.4	90.4	90.4	90.4	90.3	90.4
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	90.3	90.2	90.2	90.2	90.3	90.3	90.3	90.3	90.3	90.4	90.4	90.4	90.5	90.5	90.6	90.6	90.6	90.7	90.7	90.6
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	90.7	90.8	90.7	90.7	90.7	90.8	90.8	90.7	90.7	90.8	90.8	90.9	90.9	90.9	90.9					

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.538	1.534	1.532	1.531	1.530	1.529	1.529
P	0.914	0.915	0.915	0.916	0.916	0.916	0.916

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

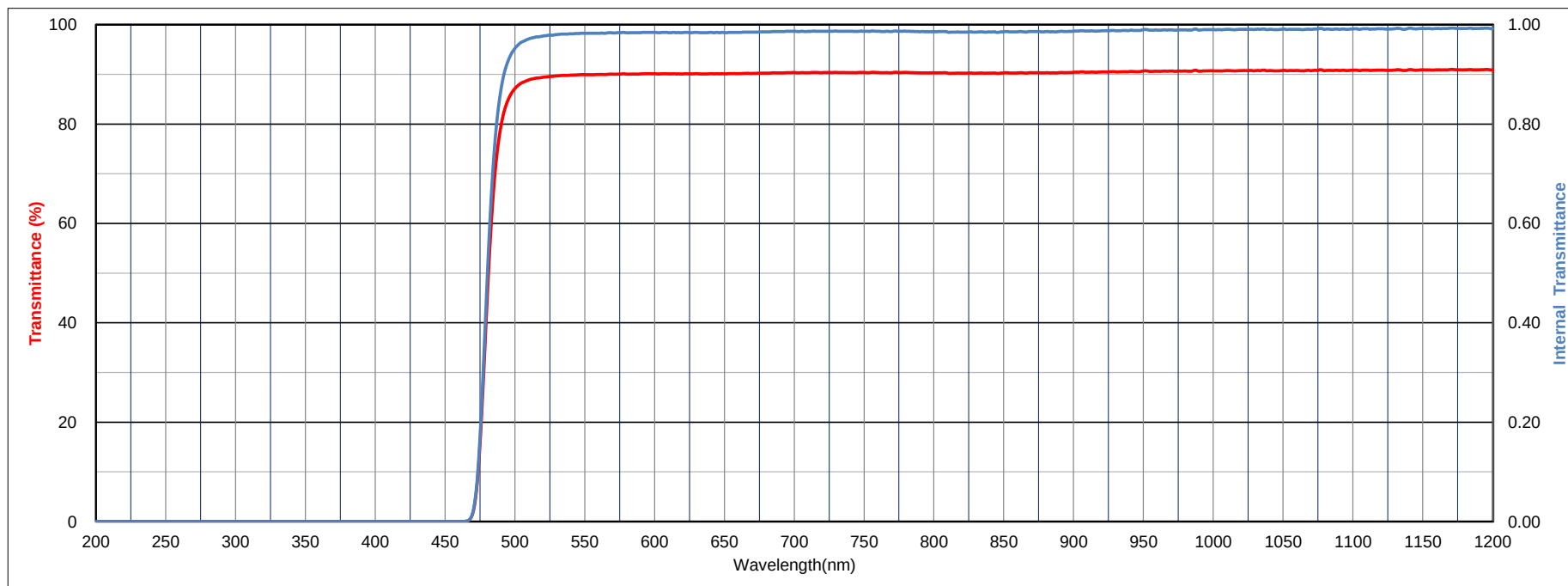
	x	y	Y	λ _u	P _s
A	0.497	0.467	89	580	76
C	0.416	0.504	86	570	79
D65	0.412	0.510	87	569	79

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
3	1	560	625	94	105	540	130	2.67

Tolerance of Transmittance (τ)

λ _T (nm)	Δλ (nm)	TH (%)
480±5	<25	>85



All data is mean values of various melts.

The content of this catalog is accurate as of October ,2020



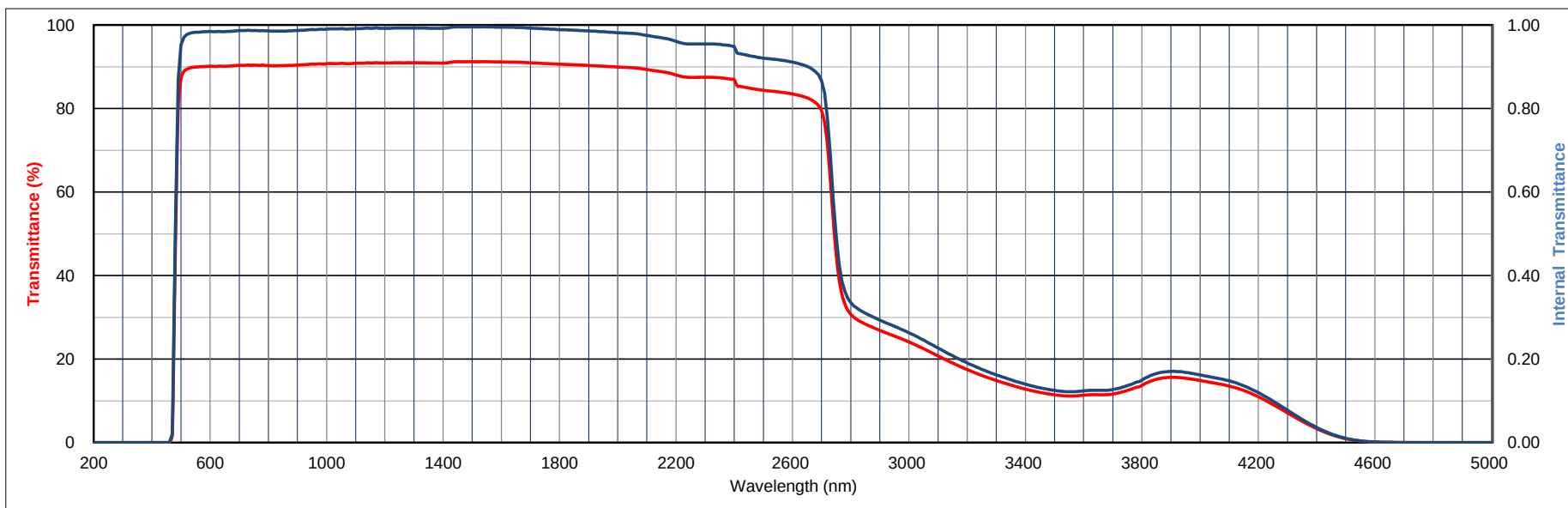
HOYA CORPORATION OPTICS SECTION

Thickness 2.50 mm

Y48

Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	43.9	79.6	87.1	88.9	89.4	89.7	89.8	89.9	90.0	90.0	90.1	90.1
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	90.1	90.1	90.1	90.1	90.1	90.1	90.1	90.2	90.2	90.3	90.4	90.3	90.3	90.4	90.4	90.4	90.4	90.3	90.4	90.3
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	90.3	90.2	90.2	90.2	90.3	90.3	90.3	90.3	90.3	90.4	90.4	90.4	90.5	90.5	90.6	90.6	90.6	90.7	90.7	90.6
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	90.7	90.8	90.7	90.7	90.7	90.8	90.8	90.7	90.7	90.8	90.8	90.8	90.8	90.9	90.9	90.9	90.9	91.0	90.9	90.9
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	90.9	90.9	90.9	91.0	91.0	91.0	90.9	90.9	91.0	91.0	91.0	91.0	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	90.9	90.9	91.0	91.1	91.2	91.2	91.2	91.2	91.2	91.2	91.2	91.2	91.2	91.2	91.2	91.2	91.2	91.2	91.2	91.2
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	91.1	91.1	91.1	91.1	91.1	91.1	91.1	91.1	91.0	91.0	90.9	90.9	90.9	90.9	90.8	90.8	90.7	90.7	90.7	90.6
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	90.6	90.6	90.6	90.5	90.5	90.5	90.4	90.4	90.4	90.3	90.3	90.3	90.2	90.2	90.2	90.1	90.1	90.1	90.0	90.0
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	89.9	89.8	89.3	88.8	88.0	87.4	87.5	87.4	86.9	84.9	84.4	84.0	83.5	82.5	79.4	45.1	30.7	28.4	26.9	25.5
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	24.1	22.5	20.7	19.0	17.5	16.1	14.9	13.8	12.8	12.0	11.4	11.1	11.3	11.5	11.6	12.5	13.7	15.2	15.6	15.4
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	14.9	14.2	13.5	12.5	11.0	9.1	7.1	5.1	3.3	1.9	0.9	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



All data is mean values of various melts.

The content of this catalog is accurate as of October ,2020



HOYA CORPORATION OPTICS SECTION

Thickness 2.50 mm

Y50

Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	8.4	42.5	71.2	83.0	87.2	88.9	89.6	89.8	90.0	90.1	90.1
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	90.1	90.1	90.2	90.2	90.2	90.2	90.2	90.3	90.3	90.3	90.4	90.4	90.4	90.4	90.4	90.5	90.5	90.4	90.5	90.4
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	90.4	90.4	90.4	90.3	90.4	90.4	90.4	90.4	90.4	90.4	90.4	90.5	90.6	90.6	90.6	90.6	90.7	90.7	90.7	90.7
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	90.8	90.8	90.8	90.8	90.9	90.8	90.8	90.8	90.9	90.9	90.9	91.0	91.0	91.0	91.0	91.0				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.552	1.537	1.530	1.526	1.523	1.522	1.520
P	0.911	0.914	0.916	0.917	0.918	0.918	0.918

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

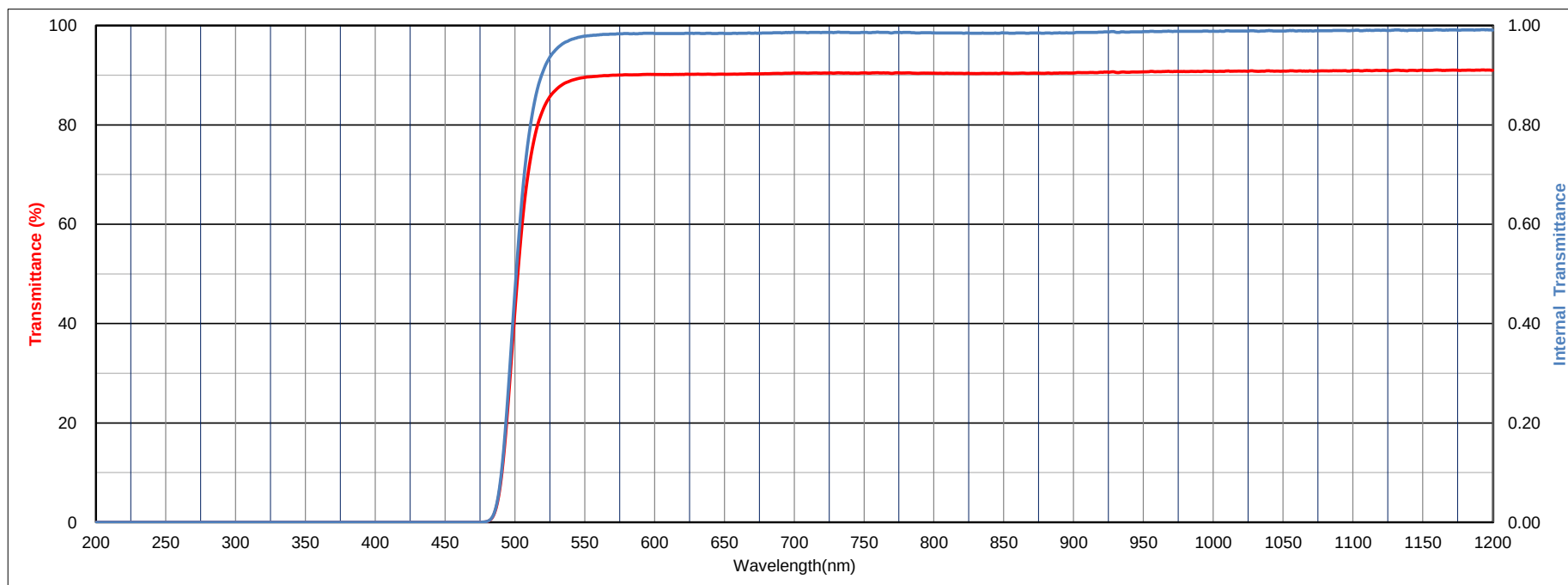
	x	y	Y	λ _u	P _e
A	0.515	0.471	86	582	91
C	0.453	0.521	81	573	93
D65	0.448	0.525	81	572	93

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
2	1	560	620	96	108	540	130	2.68

Tolerance of Transmittance (τ)

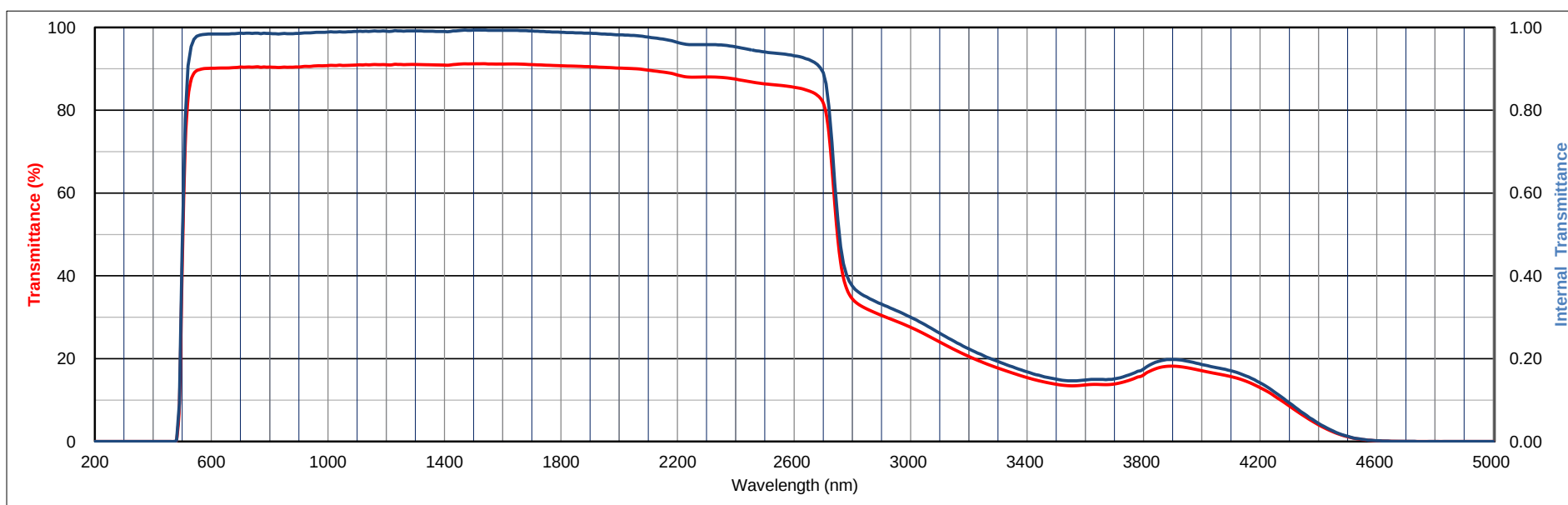
λτ (nm)	Δλ (nm)	TH (%)
500±5	<25	>85



All data is mean values of various melts.

The content of this catalog is accurate as of October ,2020

Transmittance (T)		units: %																		
λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	8.4	42.5	71.2	83.0	87.2	88.9	89.6	89.8	90.0	90.1	90.1
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	90.1	90.1	90.2	90.2	90.2	90.2	90.2	90.3	90.3	90.3	90.4	90.4	90.4	90.4	90.4	90.5	90.5	90.4	90.5	90.4
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	90.4	90.4	90.4	90.3	90.4	90.4	90.4	90.4	90.4	90.4	90.4	90.5	90.6	90.6	90.6	90.7	90.7	90.7	90.7	90.7
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	90.8	90.8	90.8	90.8	90.9	90.8	90.8	90.8	90.9	90.9	90.9	91.0	90.9	91.0	91.0	91.0	91.0	91.0	91.0	91.0
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	91.0	90.9	91.0	91.1	91.1	91.1	91.0	91.0	91.0	91.1	91.0	91.0	91.0	91.0	91.0	91.0	91.0	90.9	90.9	90.9
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	90.9	90.9	90.9	91.0	91.1	91.1	91.2	91.2	91.2	91.2	91.2	91.2	91.2	91.2	91.2	91.2	91.2	91.2	91.1	91.2
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	91.2	91.2	91.2	91.2	91.2	91.2	91.1	91.1	91.1	91.0	91.0	91.0	91.0	90.9	90.9	90.9	90.9	90.8	90.8	90.8
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	90.7	90.7	90.7	90.7	90.7	90.6	90.6	90.6	90.5	90.5	90.5	90.5	90.5	90.4	90.4	90.4	90.3	90.3	90.2	90.2
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	90.2	90.0	89.7	89.2	88.5	88.0	88.0	87.9	87.5	86.9	86.4	86.0	85.5	84.7	81.8	49.1	34.5	32.0	30.5	29.1
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	27.6	25.9	24.0	22.2	20.5	19.0	17.7	16.5	15.4	14.5	13.8	13.4	13.7	13.8	13.9	14.8	16.1	17.8	18.2	17.8
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	17.1	16.4	15.7	14.6	13.0	10.9	8.6	6.2	4.0	2.3	1.1	0.5	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
τ	0.0																			





HOYA CORPORATION OPTICS SECTION

Thickness 2.50 mm

Y52

Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	47.3	79.0	87.1	89.2	89.8	90.1	90.2	90.2
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	90.3	90.2	90.3	90.3	90.3	90.3	90.3	90.3	90.4	90.4	90.5	90.5	90.5	90.5	90.5	90.6	90.5	90.5	90.5	90.5
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	90.5	90.5	90.4	90.4	90.4	90.5	90.5	90.5	90.5	90.6	90.6	90.6	90.7	90.7	90.7	90.8	90.8	90.8	90.9	90.9
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	90.9	91.0	90.9	90.9	90.9	91.0	91.0	91.0	90.9	91.0	91.0	91.0	91.0	91.1	91.1	91.1				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.552	1.539	1.531	1.527	1.524	1.522	1.521
P	0.911	0.914	0.916	0.917	0.917	0.918	0.918

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

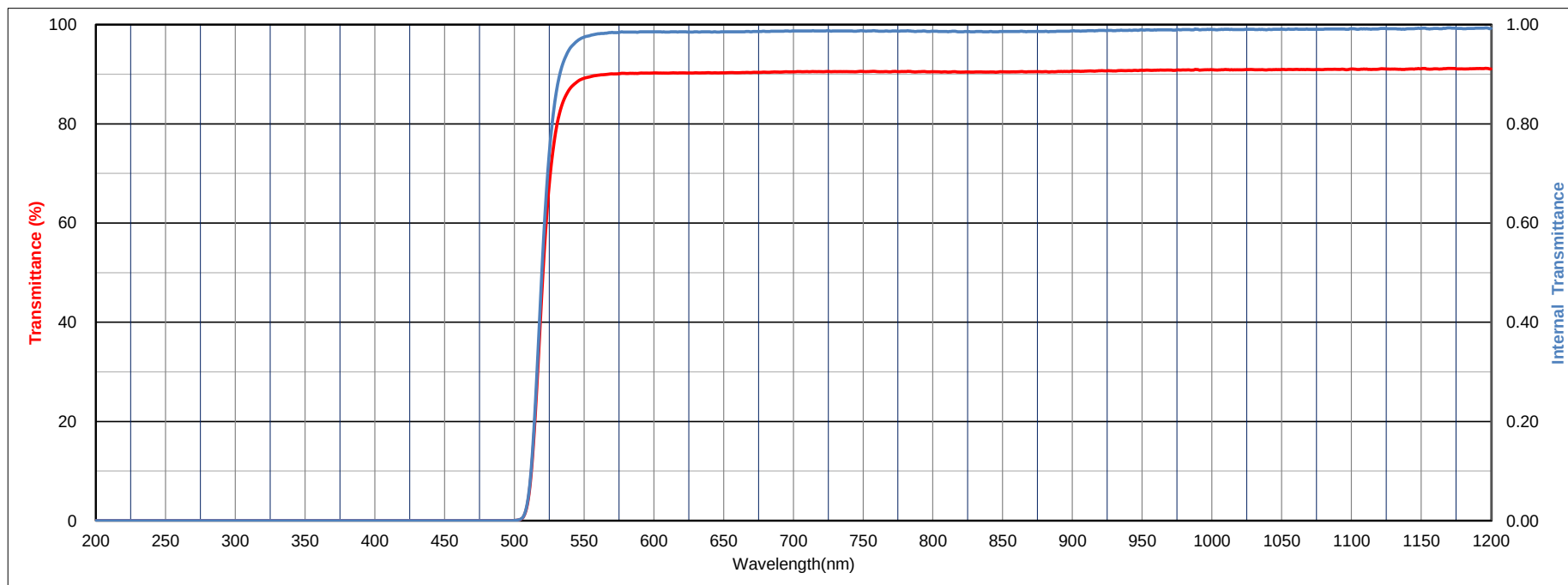
	x	y	Y	λ _u	P _a
A	0.535	0.460	81	584	97
C	0.486	0.507	73	577	98
D65	0.482	0.510	73	576	98

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
2	1	560	620	96	108	540	130	2.68

Tolerance of Transmittance (τ)

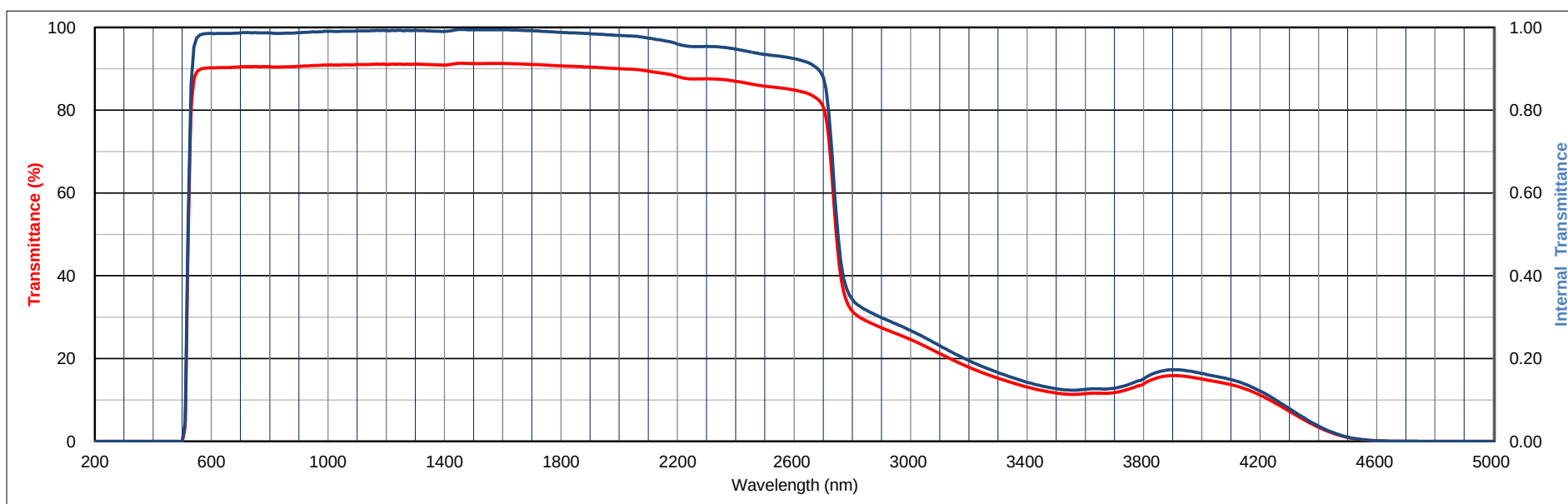
λ _T (nm)	Δλ (nm)	TH (%)
520±5	<25	>85



All data is mean values of various melts.

The content of this catalog is accurate as of October ,2020

Transmittance (T)		units: %																		
λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	47.3	79.0	87.1	89.2	89.8	90.1	90.2	90.2
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	90.3	90.2	90.3	90.3	90.3	90.3	90.3	90.3	90.4	90.4	90.5	90.5	90.5	90.5	90.5	90.6	90.5	90.5	90.5	90.5
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	90.5	90.5	90.4	90.4	90.4	90.5	90.5	90.5	90.5	90.6	90.6	90.6	90.7	90.7	90.7	90.8	90.8	90.8	90.9	90.9
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	90.9	91.0	90.9	90.9	90.9	91.0	91.0	91.0	90.9	91.0	91.0	91.0	91.0	91.0	91.0	91.1	91.1	91.2	91.1	91.1
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	91.1	91.0	91.2	91.1	91.1	91.1	91.0	91.1	91.1	91.1	91.1	91.1	91.1	91.1	91.0	91.0	91.0	91.0	90.9	90.9
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	90.9	90.9	91.0	91.2	91.3	91.3	91.3	91.3	91.3	91.3	91.3	91.2	91.3	91.3	91.3	91.3	91.3	91.3	91.3	91.3
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	91.3	91.3	91.3	91.2	91.2	91.2	91.2	91.1	91.1	91.1	91.1	91.0	91.0	91.0	90.9	90.9	90.8	90.8	90.8	90.7
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	90.7	90.7	90.6	90.6	90.6	90.6	90.5	90.5	90.5	90.5	90.4	90.4	90.4	90.3	90.3	90.2	90.2	90.1	90.1	90.1
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	90.0	89.9	89.4	88.9	88.1	87.6	87.6	87.4	87.0	86.4	85.8	85.4	84.9	84.0	80.8	46.2	31.5	29.0	27.4	26.0
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	24.6	23.0	21.2	19.5	17.9	16.5	15.3	14.1	13.1	12.3	11.7	11.3	11.5	11.6	11.8	12.6	13.9	15.4	15.9	15.6
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	15.0	14.4	13.7	12.6	11.2	9.3	7.3	5.2	3.4	2.0	1.0	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
τ	0.0																			



Transmittance (T)		units: %																			
λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390	
τ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590	
τ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	8.3	42.1	71.4	83.6	87.8	89.3	90.0	
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790	
τ	90.2	90.3	90.4	90.4	90.4	90.4	90.4	90.5	90.5	90.5	90.6	90.5	90.6	90.6	90.6	90.6	90.6	90.6	90.6	90.6	
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990	
τ	90.6	90.5	90.5	90.5	90.5	90.5	90.5	90.5	90.5	90.5	90.6	90.7	90.6	90.7	90.8	90.8	90.8	90.8	90.9	90.8	
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200					
T	90.9	90.9	90.9	90.9	91.0	90.9	91.0	90.9	91.0	90.9	91.0	91.0	91.1	91.1	91.1	91.1					

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.552	1.541	1.532	1.528	1.525	1.524	1.522
P	0.911	0.913	0.915	0.916	0.917	0.917	0.918

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

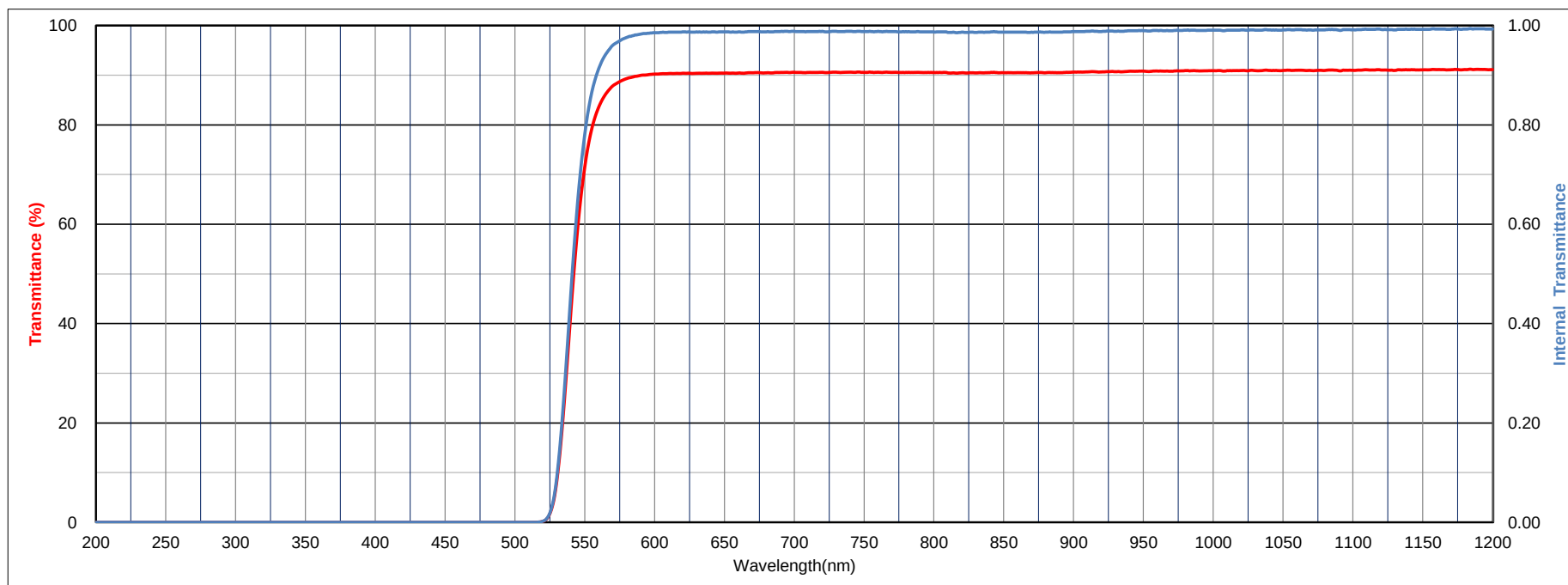
	x	y	Y	λ _u	P _s
A	0.570	0.428	68	589	99
C	0.534	0.464	57	584	100
D65	0.534	0.464	56	583	100

Properties

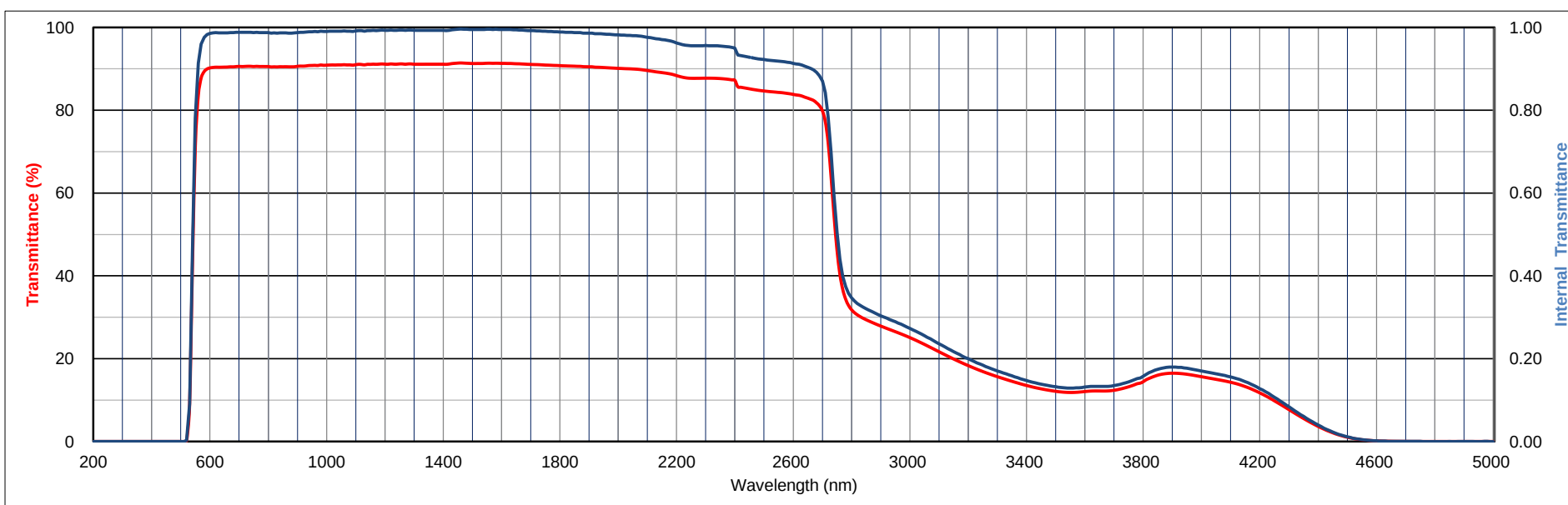
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	1	560	625	99	107	520	140	2.68

Tolerance of Transmittance (τ)

λ _T (nm)	Δλ (nm)	TH (%)
540±5	<25	>85



Transmittance (T)		units: %																		
λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	8.3	42.1	71.4	83.6	87.8	89.3	90.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	90.2	90.3	90.4	90.4	90.4	90.4	90.4	90.5	90.5	90.5	90.6	90.5	90.6	90.6	90.6	90.6	90.6	90.6	90.6	90.6
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	90.6	90.5	90.5	90.5	90.5	90.5	90.5	90.5	90.5	90.5	90.6	90.7	90.6	90.7	90.8	90.8	90.8	90.8	90.9	90.8
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	90.9	90.9	90.9	90.9	91.0	90.9	91.0	90.9	91.0	90.9	91.0	91.1	91.0	91.0	91.1	91.1	91.1	91.1	91.1	91.2
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	91.1	91.1	91.2	91.1	91.1	91.2	91.2	91.1	91.2	91.2	91.1	91.1	91.1	91.1	91.1	91.1	91.1	91.1	91.1	91.1
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	91.1	91.1	91.2	91.3	91.3	91.4	91.4	91.4	91.3	91.3	91.3	91.3	91.3	91.3	91.3	91.3	91.4	91.3	91.3	91.3
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	91.3	91.3	91.3	91.3	91.3	91.2	91.2	91.2	91.1	91.1	91.1	91.0	91.0	91.0	91.0	90.9	90.9	90.9	90.8	90.8
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	90.8	90.7	90.7	90.7	90.7	90.6	90.6	90.6	90.5	90.5	90.5	90.5	90.4	90.4	90.4	90.3	90.3	90.2	90.2	90.2
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	90.1	90.0	89.6	89.1	88.4	87.7	87.7	87.6	87.2	85.2	84.6	84.3	83.8	82.9	79.9	46.4	31.8	29.4	27.9	26.5
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	25.1	23.4	21.7	19.9	18.3	16.9	15.6	14.5	13.5	12.7	12.1	11.8	12.1	12.2	12.4	13.2	14.4	16.0	16.5	16.2
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	15.6	15.0	14.3	13.3	11.7	9.8	7.7	5.6	3.6	2.1	1.0	0.4	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
τ	0.0																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	9.6	41.3	69.9	82.8	87.5	
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	89.2	89.9	90.2	90.3	90.4	90.5	90.4	90.5	90.4	90.6	90.6	90.6	90.6	90.6	90.6	90.6	90.6	90.6	90.5	90.5
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	90.5	90.5	90.4	90.4	90.4	90.5	90.4	90.4	90.4	90.5	90.6	90.6	90.6	90.6	90.7	90.8	90.8	90.7	90.7	90.8
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	90.8	90.8	90.8	90.8	90.9	90.9	90.9	90.9	90.9	90.9	91.0	91.0	91.1	91.1	91.0	91.1				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.549	1.538	1.530	1.525	1.523	1.521	1.520
P	0.911	0.914	0.916	0.917	0.918	0.918	0.918

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

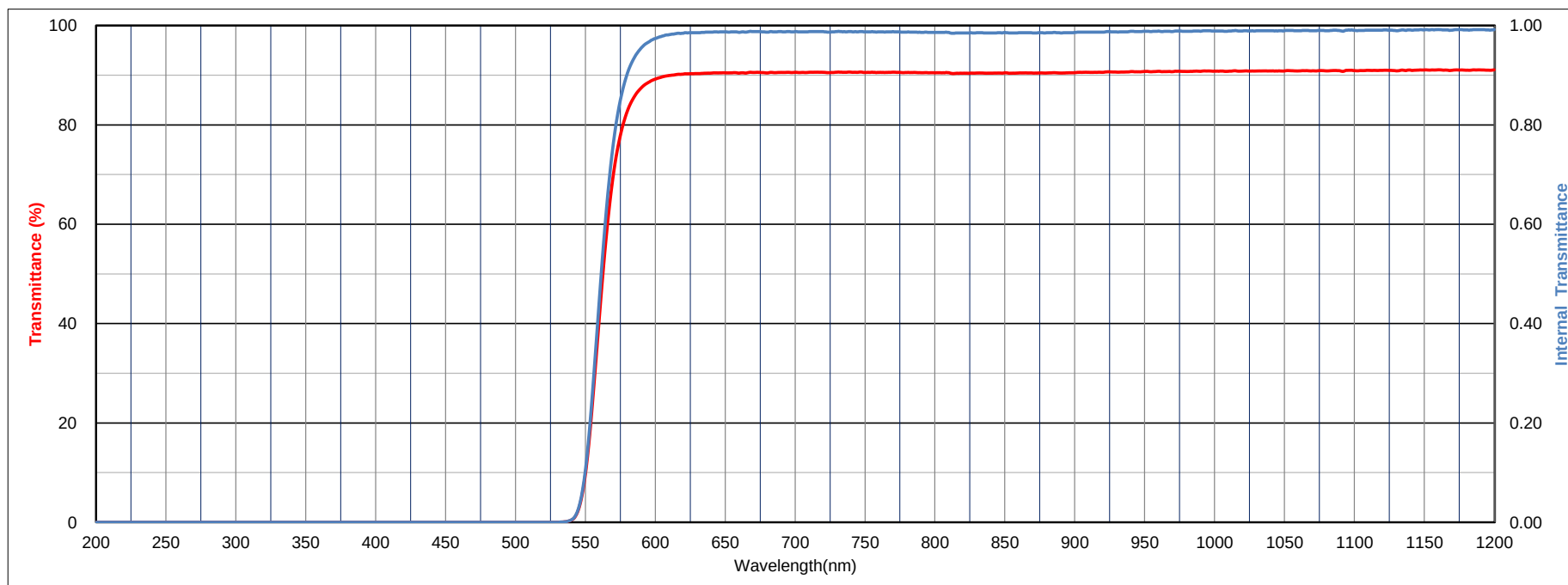
	x	y	Y	λ _u	P _e
A	0.610	0.389	52	597	100
C	0.588	0.412	40	592	100
D65	0.588	0.411	39	592	100

Properties

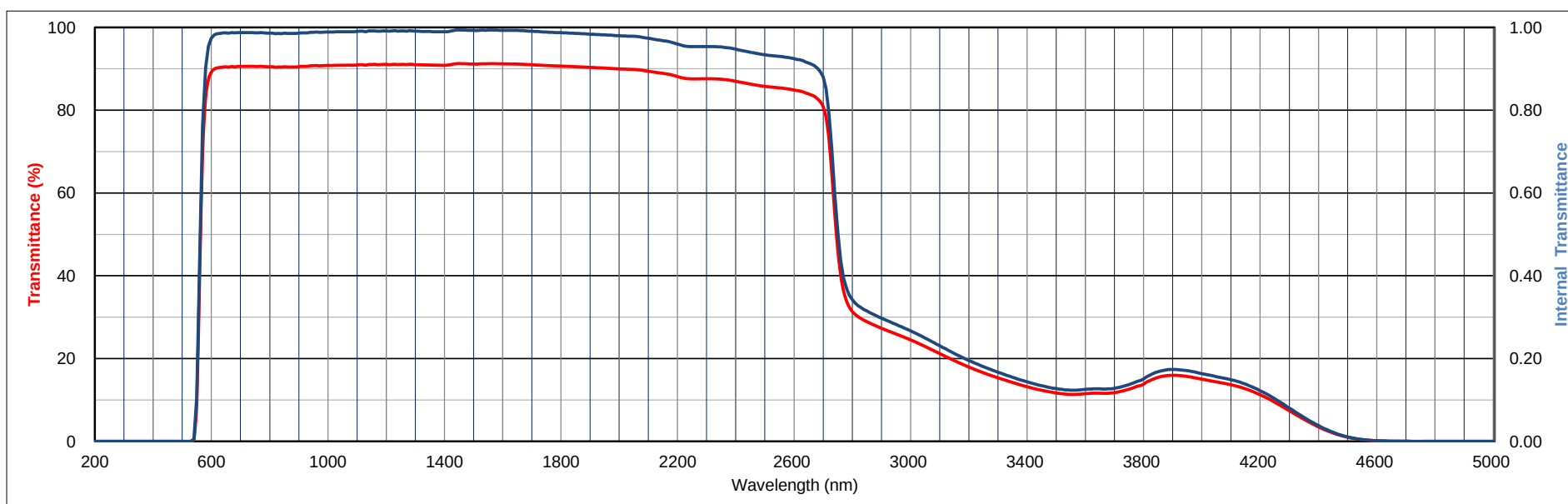
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	1	560	625	93	104	520	140	2.68

Tolerance of Transmittance (τ)

λ _T (nm)	Δλ (nm)	TH (%)
560±5	<25	>85



Transmittance (T)		units: %																		
λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	9.6	41.3	69.9	82.8	87.5
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	89.2	89.9	90.2	90.3	90.4	90.5	90.4	90.5	90.4	90.6	90.6	90.6	90.6	90.6	90.6	90.6	90.6	90.6	90.5	90.5
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	90.5	90.5	90.4	90.4	90.4	90.5	90.4	90.4	90.4	90.4	90.5	90.6	90.6	90.6	90.7	90.8	90.8	90.7	90.7	90.8
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	90.8	90.8	90.8	90.8	90.9	90.9	90.9	90.9	90.9	90.9	90.9	91.0	91.0	90.9	91.0	91.0	91.1	91.0	91.0	91.1
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	91.1	91.0	91.1	91.1	91.0	91.1	91.1	91.0	91.1	91.1	91.0	91.0	91.0	90.9	90.9	90.9	90.9	90.9	90.9	90.8
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	90.8	90.9	91.0	91.1	91.2	91.3	91.2	91.2	91.2	91.1	91.2	91.1	91.2	91.2	91.2	91.2	91.2	91.2	91.2	91.2
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	91.2	91.2	91.2	91.2	91.2	91.1	91.1	91.1	91.0	91.0	91.0	90.9	90.9	90.9	90.8	90.8	90.8	90.7	90.7	90.7
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	90.7	90.6	90.6	90.6	90.5	90.5	90.5	90.4	90.4	90.4	90.3	90.3	90.3	90.2	90.2	90.2	90.1	90.1	90.0	90.0
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	90.0	89.8	89.4	88.9	88.1	87.6	87.6	87.5	87.0	86.3	85.8	85.4	84.9	83.9	80.8	46.4	31.4	28.9	27.3	25.9
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	24.5	22.9	21.2	19.5	18.0	16.6	15.3	14.2	13.2	12.3	11.7	11.3	11.5	11.6	11.8	12.6	13.8	15.5	16.0	15.7
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	15.0	14.4	13.7	12.7	11.2	9.4	7.4	5.3	3.5	2.0	1.0	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
τ	0.0																			



Transmittance (T)		units: %																	
λnm	T	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370
λnm	T	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570
λnm	T	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770
λnm	T	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970
λnm	T	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200		
λnm	T																		

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.550	1.540	1.531	1.526	1.524	1.522	1.520
P	0.911	0.913	0.916	0.917	0.917	0.918	0.918

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

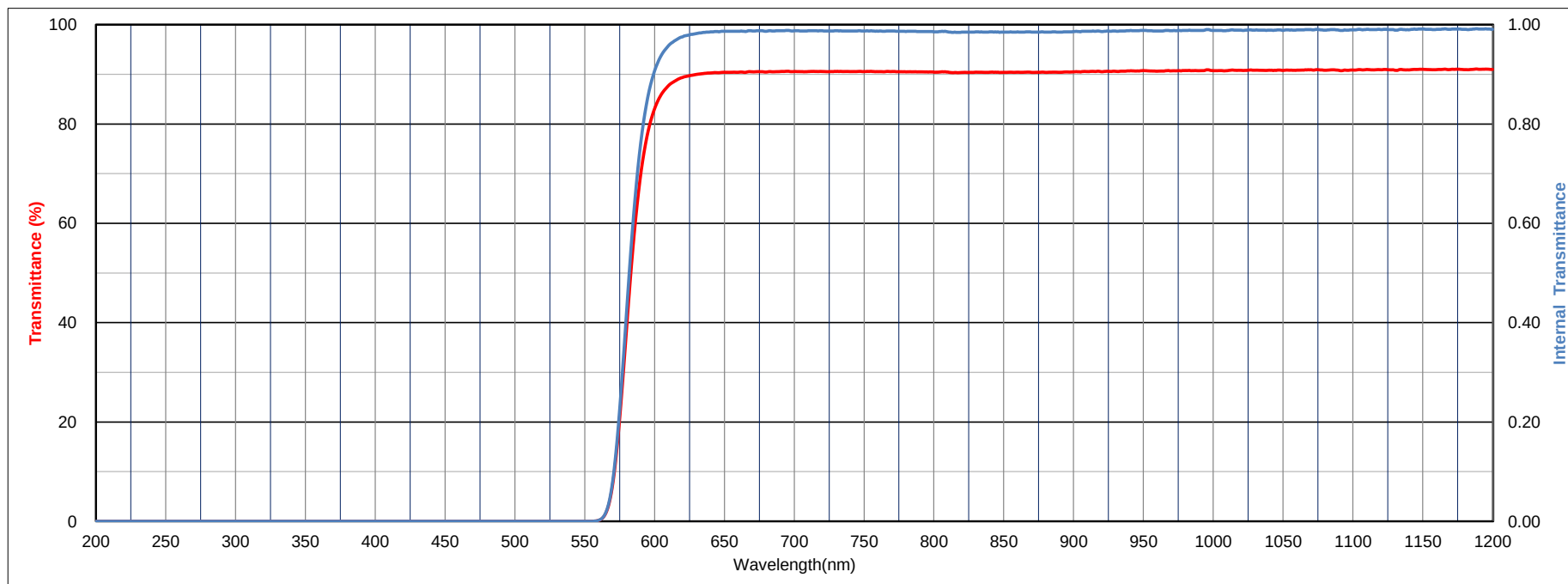
	x	y	Y	λ _u	P _s
A	0.654	0.346	36	606	100
C	0.643	0.356	24	604	100
D65	0.643	0.357	24	604	100

Properties

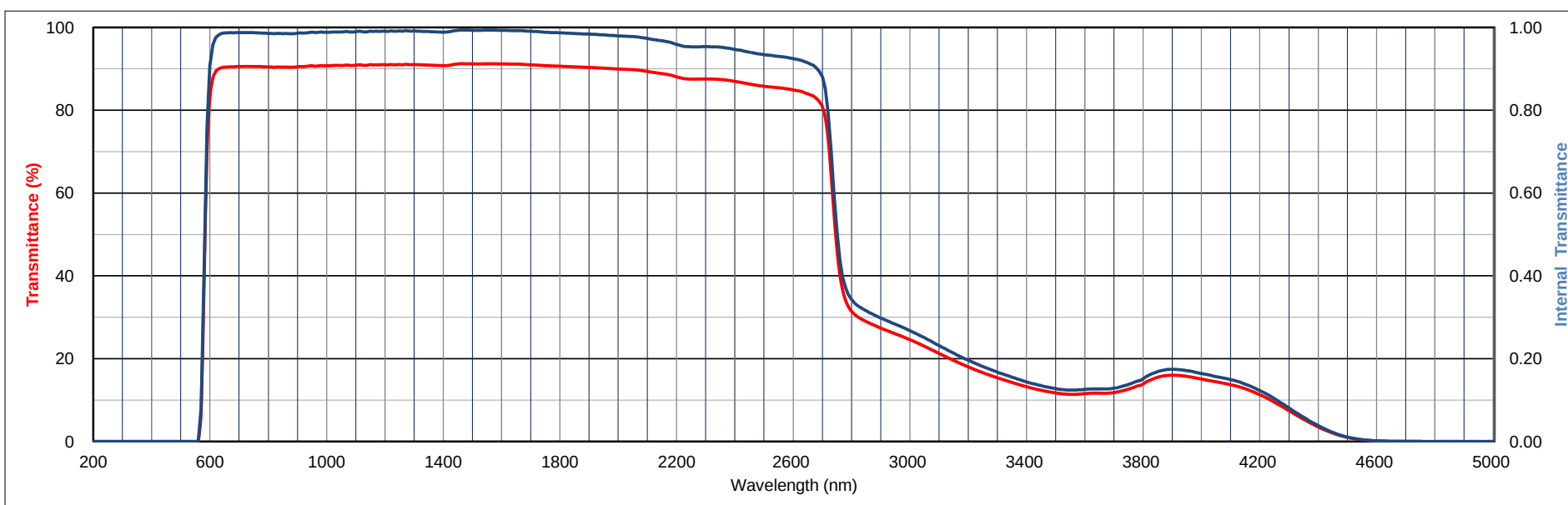
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	1	560	625	93	104	520	140	2.68

Tolerance of Transmittance (τ)

λ _T (nm)	Δλ (nm)	TH (%)
580±5	<25	>85



Transmittance (T)		units: %																		
λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	7.4	38.9	69.7
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	83.0	87.7	89.4	90.0	90.3	90.4	90.4	90.5	90.5	90.6	90.6	90.6	90.6	90.6	90.5	90.6	90.5	90.6	90.5	90.5
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	90.4	90.5	90.4	90.4	90.4	90.4	90.4	90.4	90.4	90.4	90.5	90.6	90.5	90.6	90.7	90.8	90.6	90.7	90.8	90.7
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	90.7	90.7	90.8	90.8	90.8	90.8	90.8	90.9	90.8	90.8	90.9	91.0	90.9	90.8	90.9	91.0	90.9	91.0	90.9	91.0
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.1	91.0	91.0	91.0	91.0	91.0	90.9	90.9	90.9	90.9	90.8	90.8	90.8
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	90.8	90.8	90.8	91.0	91.1	91.2	91.2	91.2	91.2	91.2	91.2	91.2	91.2	91.2	91.2	91.2	91.2	91.2	91.2	91.2
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	91.2	91.2	91.2	91.1	91.1	91.1	91.1	91.1	91.0	91.0	91.0	90.9	90.9	90.8	90.8	90.8	90.7	90.7	90.7	90.7
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	90.6	90.6	90.6	90.5	90.5	90.5	90.4	90.4	90.4	90.4	90.3	90.3	90.3	90.2	90.2	90.2	90.1	90.1	90.0	90.0
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	90.0	89.8	89.4	88.8	88.1	87.5	87.6	87.4	87.0	86.3	85.8	85.4	84.9	84.0	80.8	46.4	31.4	29.0	27.4	26.0
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	24.6	23.0	21.3	19.6	18.0	16.6	15.4	14.3	13.2	12.4	11.7	11.4	11.6	11.7	11.8	12.6	13.9	15.5	16.0	15.7
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	15.1	14.4	13.7	12.7	11.3	9.5	7.4	5.4	3.5	2.0	1.0	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
τ	0.0																			





HOYA CORPORATION OPTICS SECTION

Thickness 2.50 mm

R60

Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	9.6
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	43.5	72.3	84.0	87.9	89.2	89.7	90.0	90.0	90.2	90.3	90.3	90.3	90.3	90.3	90.3	90.3	90.3	90.3	90.3	90.2
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	90.2	90.2	90.3	90.3	90.3	90.4	90.3	90.3	90.4	90.4	90.4	90.4	90.5	90.5	90.5	90.5	90.6	90.6	90.6	90.7
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	90.7	90.8	90.8	90.7	90.7	90.8	90.8	90.7	90.8	90.8	90.8	90.8	90.8	90.9	90.9	91.0				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.550	1.538	1.530	1.526	1.523	1.522	1.520
P	0.911	0.914	0.916	0.917	0.918	0.918	0.918

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

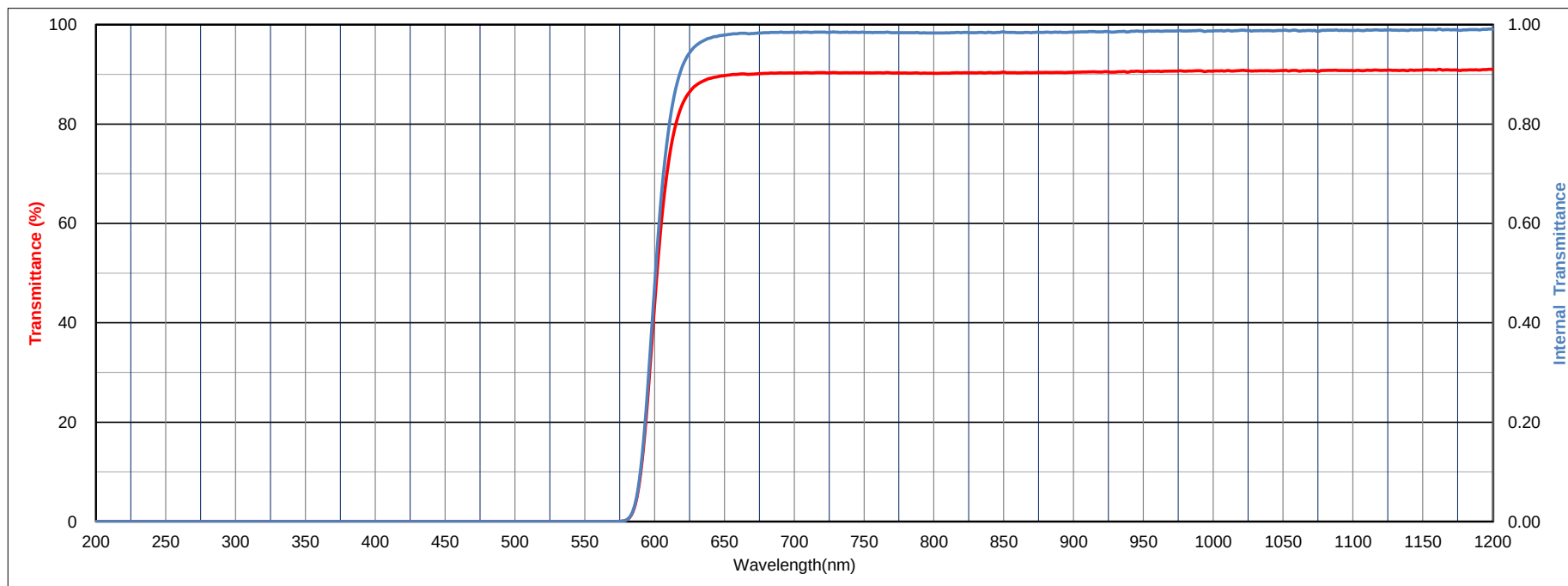
	x	y	Y	λ _u	P _e
A	0.687	0.312	22	618	100
C	0.683	0.316	14	616	100
D65	0.683	0.317	13	616	100

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	2	560	620	93	103	520	140	2.69

Tolerance of Transmittance (τ)

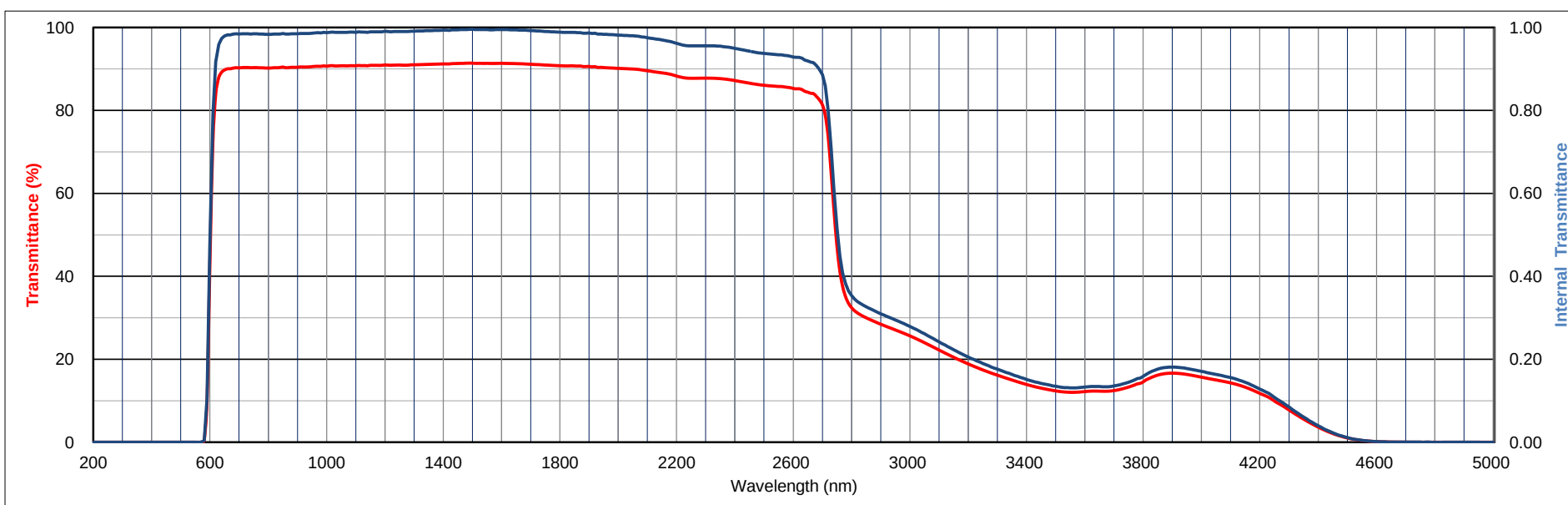
λτ (nm)	Δλ (nm)	TH (%)
600±5	<25	>85



All data is mean values of various melts.

The content of this catalog is accurate as of October ,2020

Transmittance (T)		units: %																		
λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	9.6
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	43.5	72.3	84.0	87.9	89.2	89.7	90.0	90.0	90.2	90.3	90.3	90.3	90.3	90.3	90.3	90.3	90.3	90.3	90.3	90.2
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	90.2	90.2	90.3	90.3	90.3	90.4	90.3	90.3	90.4	90.4	90.4	90.5	90.5	90.5	90.5	90.6	90.6	90.6	90.6	90.7
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	90.7	90.8	90.8	90.7	90.7	90.8	90.8	90.7	90.8	90.8	90.8	90.8	90.8	90.8	90.8	90.9	90.9	90.9	90.9	90.9
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	91.0	90.9	90.9	90.9	90.9	91.0	90.9	90.9	90.9	91.0	91.0	91.0	91.0	91.1	91.1	91.1	91.1	91.1	91.2	91.2
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	91.2	91.2	91.2	91.3	91.3	91.3	91.3	91.4	91.4	91.4	91.4	91.3	91.4	91.3	91.3	91.4	91.3	91.3	91.3	91.3
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	91.4	91.3	91.3	91.3	91.3	91.3	91.3	91.2	91.2	91.2	91.1	91.1	91.1	91.0	91.0	90.9	90.9	90.9	90.8	90.8
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	90.8	90.7	90.7	90.7	90.8	90.7	90.7	90.7	90.6	90.6	90.6	90.5	90.5	90.4	90.4	90.3	90.3	90.2	90.2	90.2
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	90.1	90.0	89.6	89.1	88.3	87.7	87.8	87.7	87.2	86.6	86.1	85.8	85.3	84.4	81.4	47.3	32.4	30.0	28.5	27.1
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	25.6	24.0	22.2	20.5	18.9	17.4	16.2	15.0	13.9	13.0	12.4	12.0	12.2	12.3	12.4	13.3	14.5	16.2	16.6	16.3
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	15.7	15.0	14.3	13.3	11.8	9.9	7.8	5.6	3.6	2.1	1.0	0.4	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
τ	0.0																			





HOYA CORPORATION OPTICS SECTION

Thickness 2.50 mm

R62

Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.2	8.7	44.9	74.1	85.0	88.4	89.5	89.9	90.1	90.2	90.3	90.3	90.3	90.3	90.3	90.3	90.3	90.3	90.2	90.2
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	90.2	90.3	90.3	90.4	90.3	90.3	90.3	90.4	90.4	90.4	90.5	90.5	90.5	90.5	90.6	90.6	90.6	90.7	90.7	90.6
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	90.6	90.7	90.7	90.7	90.7	90.7	90.8	90.8	90.8	90.8	90.9	90.8	90.8	90.9	90.9	90.9				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.552	1.542	1.533	1.528	1.525	1.523	1.521
P	0.911	0.913	0.915	0.917	0.917	0.918	0.918

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

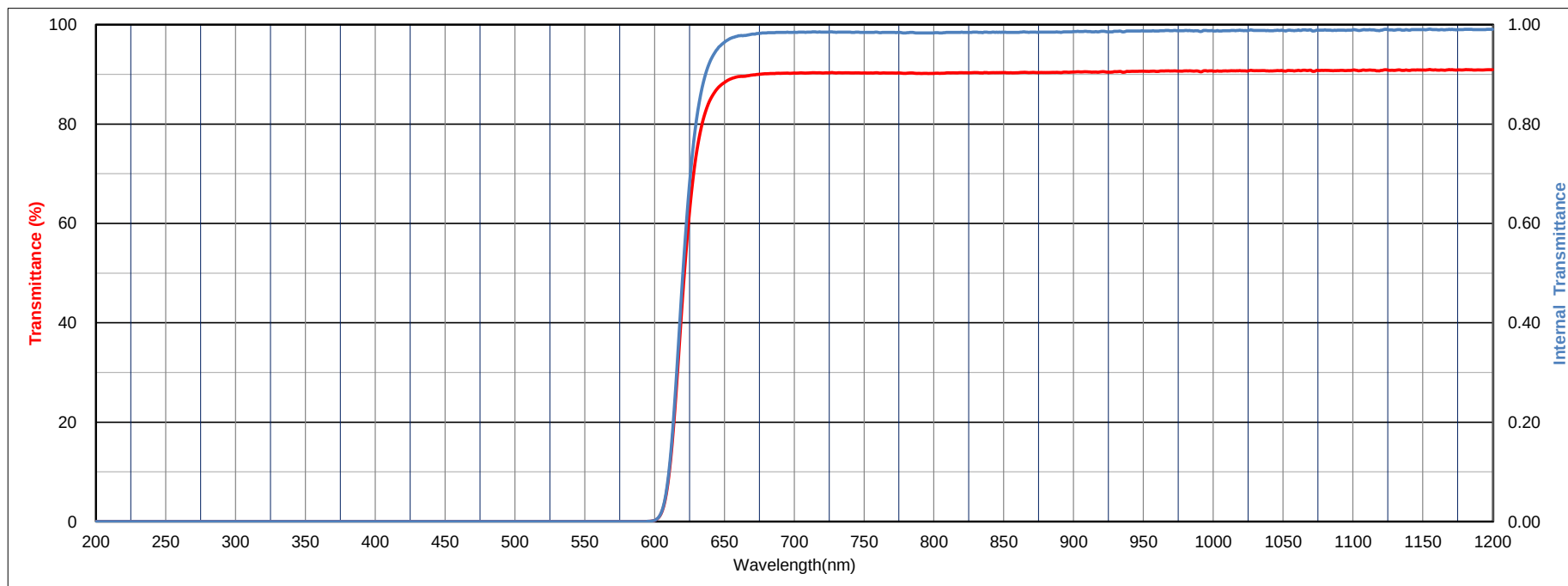
	x	y	Y	λ _u	P _s
A	0.712	0.288	11	633	100
C	0.711	0.289	6	632	100
D65	0.710	0.290	6	632	100

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	1	560	620	95	107	520	140	2.68

Tolerance of Transmittance (τ)

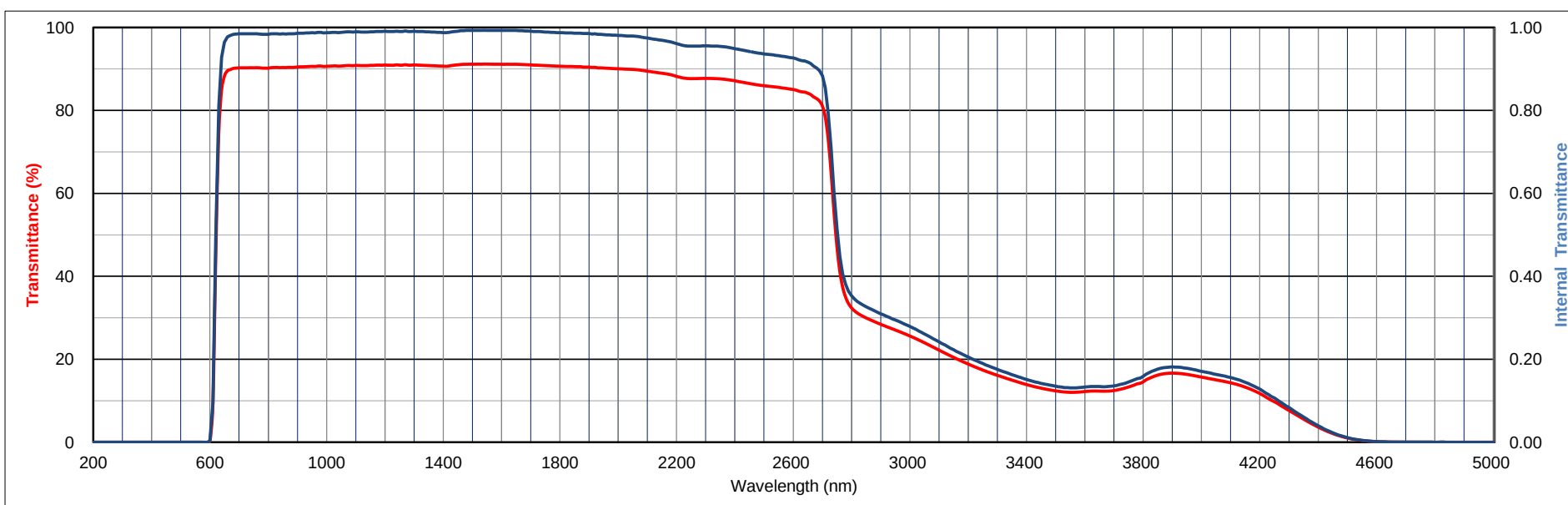
λτ (nm)	Δλ (nm)	TH (%)
620±5	<25	>85



All data is mean values of various melts.

The content of this catalog is accurate as of October ,2020

Transmittance (T)		units: %																		
λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.2	8.7	44.9	74.1	85.0	88.4	89.5	89.9	90.1	90.2	90.3	90.3	90.3	90.3	90.3	90.3	90.3	90.3	90.2	90.2
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	90.2	90.3	90.3	90.4	90.3	90.3	90.3	90.4	90.4	90.4	90.5	90.5	90.5	90.5	90.6	90.6	90.6	90.7	90.7	90.6
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	90.6	90.7	90.7	90.7	90.7	90.7	90.8	90.8	90.8	90.8	90.9	90.8	90.8	90.8	90.8	90.9	90.9	90.9	90.9	90.9
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	90.9	90.9	90.9	90.9	91.0	90.9	90.9	91.0	90.9	90.9	91.0	90.9	90.9	90.9	90.8	90.8	90.8	90.8	90.7	90.7
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	90.7	90.6	90.7	90.8	90.9	91.0	91.1	91.1	91.1	91.1	91.1	91.1	91.2	91.1	91.2	91.2	91.1	91.1	91.1	91.1
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	91.1	91.1	91.1	91.1	91.1	91.1	91.1	91.1	91.0	91.0	91.0	90.9	90.9	90.9	90.8	90.8	90.8	90.7	90.7	90.7
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	90.7	90.6	90.6	90.6	90.6	90.6	90.5	90.5	90.5	90.4	90.4	90.4	90.4	90.3	90.3	90.2	90.2	90.1	90.1	90.1
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	90.0	89.9	89.5	89.0	88.2	87.7	87.7	87.6	87.1	86.5	85.9	85.6	85.0	84.1	81.1	47.2	32.4	30.0	28.4	27.1
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	25.6	24.0	22.2	20.5	18.8	17.4	16.1	15.0	13.9	13.0	12.4	12.0	12.2	12.3	12.5	13.3	14.6	16.2	16.7	16.3
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	15.7	15.0	14.3	13.3	11.8	9.8	7.6	5.6	3.6	2.1	1.0	0.4	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
τ	0.0																			





HOYA CORPORATION OPTICS SECTION

Thickness 2.50 mm

R64

Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.0	0.1	0.9	10.0	39.7	70.3	84.2	88.2	89.7	90.1	90.3	90.3	90.4	90.4	90.4	90.4	90.4	90.4	90.4	90.4
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	90.4	90.4	90.5	90.5	90.5	90.6	90.5	90.6	90.6	90.5	90.6	90.7	90.8	90.8	90.8	90.8	90.8	90.9	90.9	90.9
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	91.0	90.9	91.0	91.0	90.9	91.0	90.9	91.0	91.0	91.0	91.0	90.9	91.0	91.1	91.1	91.1				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.551	1.540	1.532	1.527	1.524	1.522	1.521
P	0.911	0.914	0.915	0.917	0.917	0.918	0.918

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

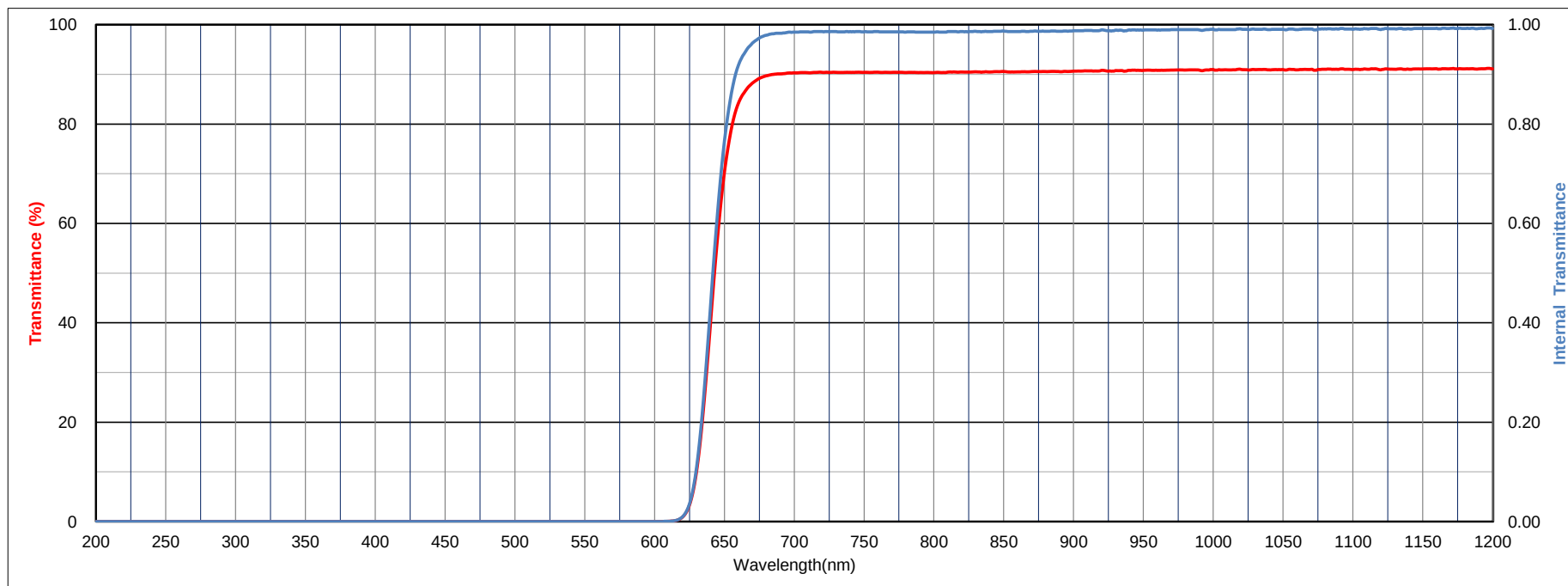
	x	y	Y	λ _u	P _e
A	0.725	0.275	4	648	100
C	0.724	0.276	2	647	100
D65	0.724	0.276	2	647	100

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	1	555	620	94	106	520	140	2.68

Tolerance of Transmittance (τ)

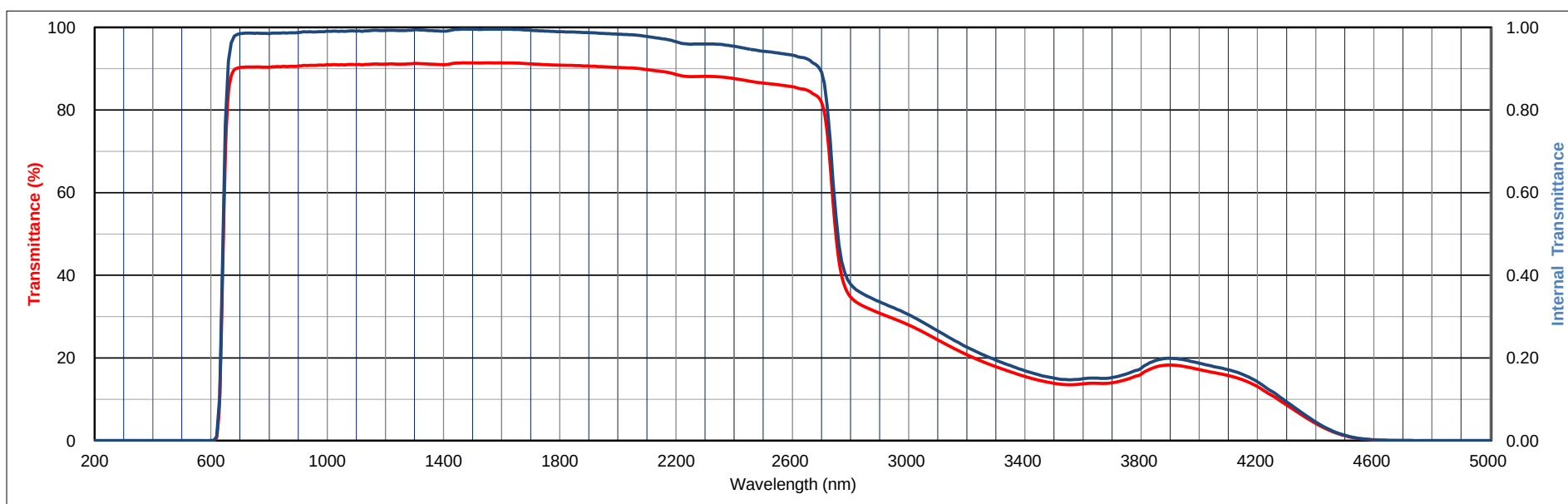
λ _T (nm)	Δλ (nm)	TH (%)
640±5	<35	>85



All data is mean values of various melts.

The content of this catalog is accurate as of October ,2020

Transmittance (T)		units: %																		
λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.0	0.1	0.9	10.0	39.7	70.3	84.2	88.2	89.7	90.1	90.3	90.3	90.4	90.4	90.4	90.4	90.4	90.4	90.4	90.4
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	90.4	90.4	90.5	90.5	90.5	90.6	90.5	90.6	90.6	90.5	90.6	90.7	90.8	90.8	90.8	90.8	90.8	90.9	90.9	90.9
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	91.0	90.9	91.0	91.0	90.9	91.0	90.9	91.0	91.0	91.0	91.0	91.0	90.9	91.0	91.0	91.1	91.1	91.1	91.1	91.1
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	91.1	91.1	91.2	91.1	91.1	91.1	91.1	91.1	91.2	91.2	91.3	91.3	91.2	91.2	91.2	91.1	91.1	91.1	91.0	91.0
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	91.0	91.0	91.1	91.2	91.3	91.4	91.4	91.4	91.4	91.4	91.4	91.4	91.4	91.4	91.4	91.4	91.4	91.4	91.4	91.4
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	91.4	91.4	91.4	91.4	91.4	91.3	91.3	91.3	91.3	91.2	91.2	91.1	91.1	91.1	91.0	91.0	90.9	90.9	90.9	90.9
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	90.9	90.8	90.8	90.8	90.8	90.8	90.7	90.7	90.7	90.7	90.7	90.6	90.6	90.5	90.5	90.5	90.4	90.4	90.4	90.3
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	90.3	90.2	89.8	89.3	88.6	88.1	88.1	88.0	87.6	87.0	86.5	86.1	85.6	84.8	81.9	49.7	34.8	32.3	30.8	29.5
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	28.0	26.3	24.4	22.5	20.8	19.2	17.9	16.7	15.5	14.6	13.9	13.5	13.7	13.9	14.0	14.8	16.1	17.8	18.3	17.9
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	17.2	16.5	15.7	14.7	13.1	10.9	8.6	6.3	4.2	2.4	1.2	0.5	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
τ	0.0																			





HOYA CORPORATION OPTICS SECTION

Thickness 2.50 mm

R66

Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.0	0.0	0.0	0.0	0.6	9.9	42.3	70.9	84.3	88.5	89.8	90.1	90.3	90.3	90.4	90.4	90.4	90.4	90.4	90.4
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	90.4	90.5	90.5	90.5	90.5	90.5	90.5	90.6	90.6	90.6	90.7	90.7	90.7	90.7	90.8	90.8	90.8	90.9	90.9	91.0
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	90.9	90.9	91.0	91.0	90.9	90.9	91.0	91.1	91.0	91.1	91.1	91.0	91.1	91.1	91.2	91.2				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.551	1.542	1.535	1.529	1.526	1.524	1.523
P	0.911	0.913	0.915	0.916	0.917	0.917	0.918

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

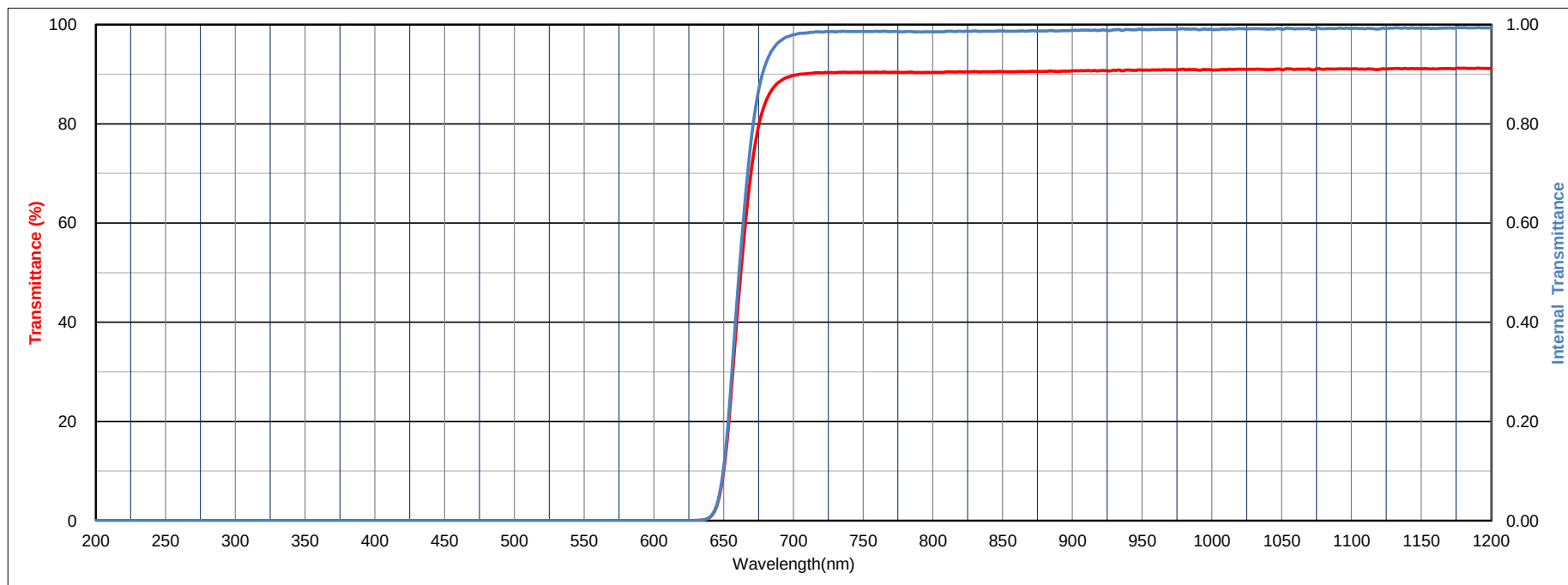
	x	y	Y	λ _d	P _e
A	-	-	-	-	-
C	-	-	-	-	-
D65	-	-	-	-	-

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	3	530	565	98	117	470	160	2.85

Tolerance of Transmittance (τ)

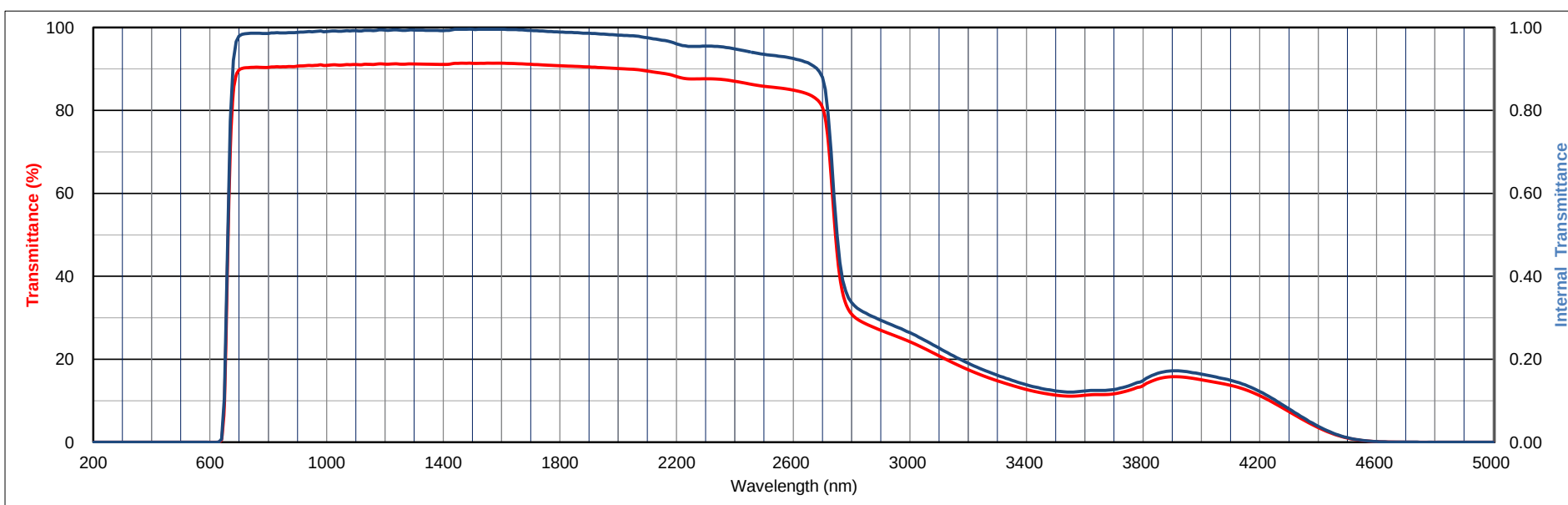
λτ (nm)	Δλ (nm)	TH (%)
660±5	<35	>85



All data is mean values of various melts.

The content of this catalog is accurate as of October ,2020

Transmittance (T)		units: %																		
λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.0	0.0	0.0	0.0	0.6	9.9	42.3	70.9	84.3	88.5	89.8	90.1	90.3	90.3	90.4	90.4	90.4	90.4	90.4	90.4
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	90.4	90.5	90.5	90.5	90.5	90.5	90.5	90.6	90.6	90.6	90.7	90.7	90.7	90.8	90.8	90.8	90.9	90.9	91.0	90.8
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	90.9	90.9	91.0	91.0	90.9	90.9	91.0	91.1	91.0	91.1	91.1	91.0	91.0	91.1	91.1	91.1	91.1	91.1	91.2	91.2
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	91.2	91.1	91.2	91.2	91.2	91.2	91.1	91.1	91.2	91.2	91.2	91.2	91.2	91.2	91.1	91.1	91.1	91.1	91.1	91.1
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	91.1	91.1	91.1	91.3	91.4	91.3	91.4	91.4	91.4	91.4	91.4	91.3	91.3	91.4	91.4	91.4	91.4	91.4	91.4	91.4
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	91.4	91.4	91.3	91.3	91.3	91.3	91.2	91.2	91.2	91.1	91.1	91.1	91.1	91.0	91.0	90.9	90.9	90.9	90.8	90.8
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	90.8	90.7	90.7	90.7	90.7	90.6	90.6	90.6	90.5	90.5	90.5	90.4	90.4	90.3	90.3	90.3	90.3	90.2	90.2	90.1
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	90.1	89.9	89.5	89.0	88.2	87.6	87.6	87.5	87.0	86.4	85.8	85.4	84.9	84.0	80.8	45.9	30.9	28.5	27.0	25.6
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	24.2	22.6	20.8	19.1	17.5	16.0	14.8	13.7	12.7	11.9	11.4	11.1	11.3	11.5	11.7	12.5	13.7	15.3	15.8	15.6
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	15.0	14.4	13.7	12.7	11.2	9.4	7.4	5.4	3.5	2.1	1.0	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
τ	0.0																			



Infrared Transmitting Filters

Infrared Transmitting Filters absorb most of the visible region and transmit in the infrared region.

This type consists of the R and IR series that have relatively sharp transitions from the visible region, the RM series that gradually transitions from the visible region, and the RT series that has band-pass function in the infrared region.

Infrared transmitting filters are used in security systems utilizing infrared rays, night-vision devices and similar applications.



HOYA CORPORATION OPTICS SECTION

Thickness 2.50 mm

R70

Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.5	14.2	44.0	68.9	81.1	86.2	88.2	89.1	89.5	89.7	89.8	89.8
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	89.9	90.0	90.0	90.0	90.0	90.1	90.2	90.1	90.1	90.2	90.2	90.3	90.4	90.4	90.5	90.4	90.4	90.5	90.5	90.6
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	90.6	90.6	90.7	90.6	90.6	90.6	90.6	90.7	90.7	90.7	90.7	90.7	90.8	90.8	90.8	90.8				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.562	1.552	1.546	1.543	1.541	1.540	1.539
P	0.908	0.911	0.912	0.913	0.913	0.914	0.914

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

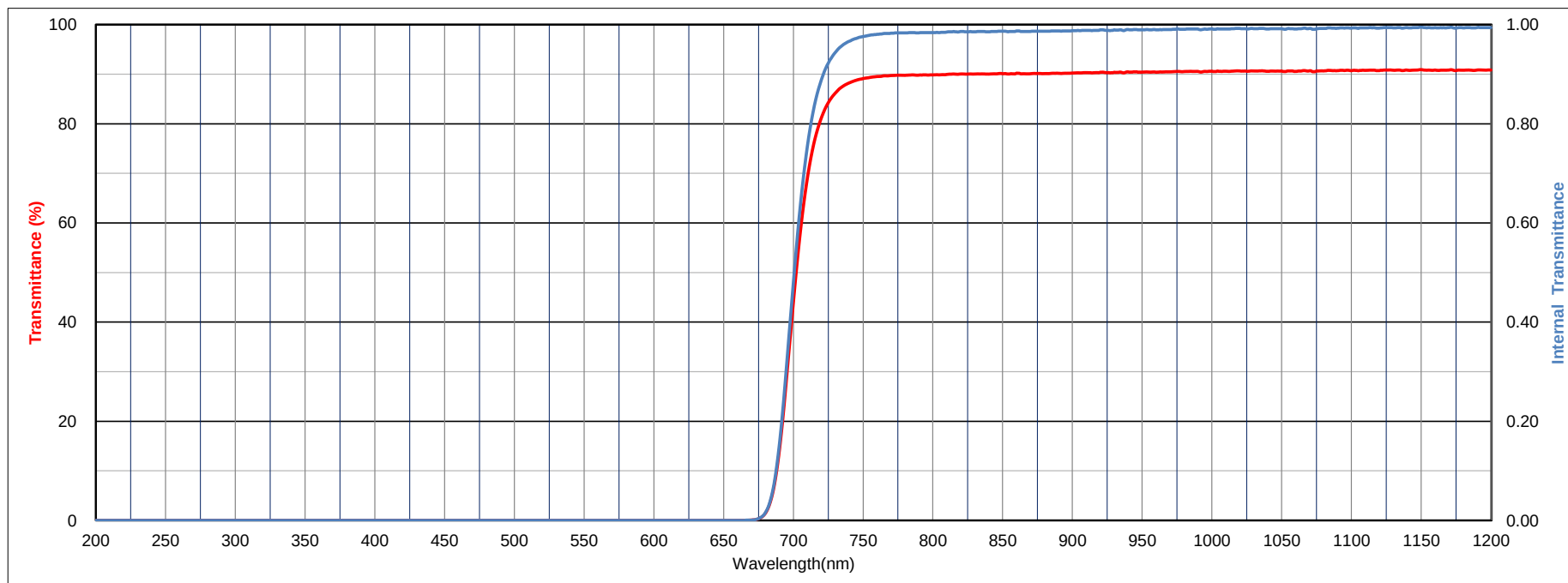
	x	y	Y	λ _d	P _e
A	-	-	-	-	-
C	-	-	-	-	-
D65	-	-	-	-	-

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	3	525	575	98	115	470	160	2.86

Tolerance of Transmittance (τ)

λτ (nm)	Δλ (nm)	TH (%)
700±10	<45	>85



All data is mean values of various melts.

The content of this catalog is accurate as of October ,2020



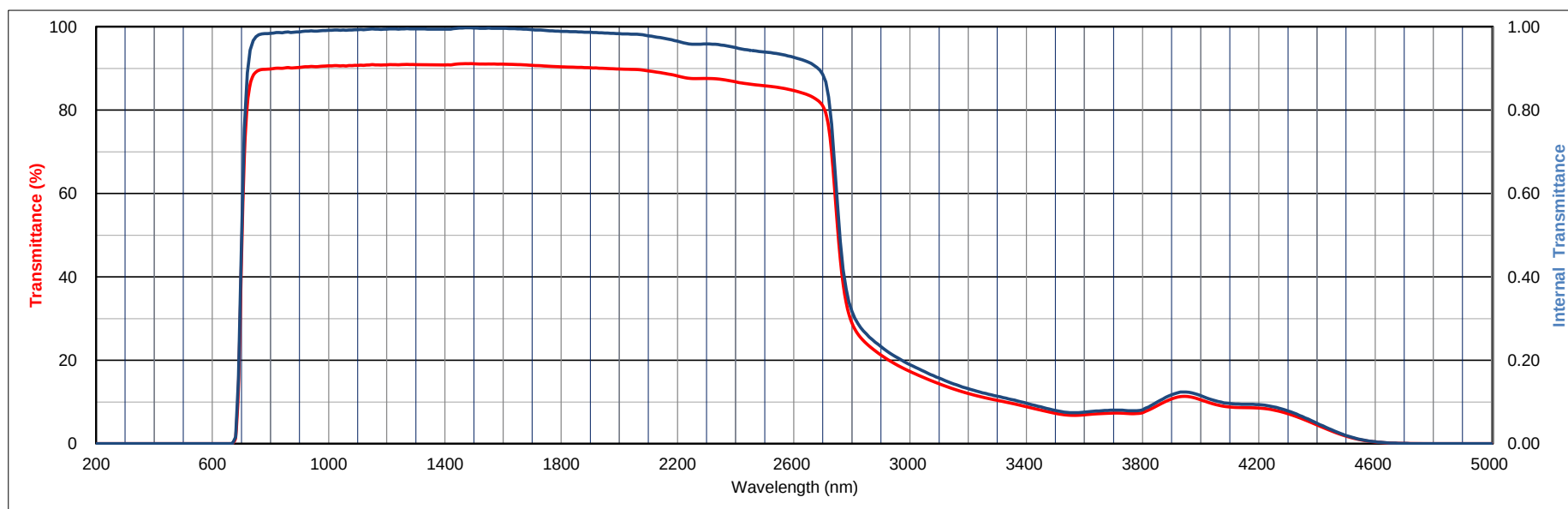
HOYA CORPORATION OPTICS SECTION

Thickness 2.50 mm

R70

Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.5	14.2	44.0	68.9	81.1	86.2	88.2	89.1	89.5	89.7	89.8	89.8
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	89.9	90.0	90.0	90.0	90.0	90.1	90.2	90.1	90.1	90.2	90.2	90.3	90.4	90.4	90.5	90.4	90.4	90.5	90.5	90.6
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	90.6	90.6	90.7	90.6	90.6	90.6	90.6	90.7	90.7	90.7	90.7	90.8	90.7	90.8	90.8	90.9	90.8	90.8	90.8	90.8
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	90.8	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.8	90.8	90.8	90.8
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	90.8	90.9	90.8	90.9	91.0	91.1	91.1	91.1	91.1	91.1	91.1	91.1	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	91.0	91.0	91.0	91.0	90.9	90.9	90.9	90.9	90.8	90.8	90.7	90.7	90.7	90.6	90.6	90.5	90.5	90.5	90.4	90.4
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	90.4	90.3	90.3	90.3	90.3	90.3	90.2	90.2	90.2	90.2	90.1	90.1	90.1	90.0	90.0	90.0	90.0	89.9	89.9	89.9
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	89.8	89.7	89.4	88.9	88.2	87.6	87.6	87.4	86.8	86.2	85.8	85.4	84.7	83.6	81.0	52.4	29.0	24.0	21.2	19.1
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	17.3	15.8	14.4	13.1	12.0	11.1	10.4	9.7	8.9	8.0	7.3	6.8	6.9	7.2	7.3	7.2	7.4	9.1	10.7	11.3
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	10.5	9.4	8.8	8.6	8.5	8.1	7.2	5.9	4.5	3.0	1.8	0.9	0.4	0.2	0.1	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



All data is mean values of various melts.

The content of this catalog is accurate as of October ,2020



HOYA CORPORATION OPTICS SECTION

Thickness 2.50 mm

R72

Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	10.5	45.0	71.2	81.4	84.9	86.1	86.7	87.1	87.3
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	87.4	87.6	87.8	87.9	88.0	88.2	88.2	88.4	88.5	88.6	88.7	88.8	88.9	88.9	89.1	89.1	89.2	89.3	89.3	89.5
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	89.4	89.5	89.5	89.6	89.6	89.6	89.7	89.7	89.8	89.8	89.8	89.8	89.9	90.0	89.9	90.1				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.565	1.554	1.547	1.543	1.540	1.538	1.537
P	0.907	0.910	0.912	0.913	0.914	0.914	0.914

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

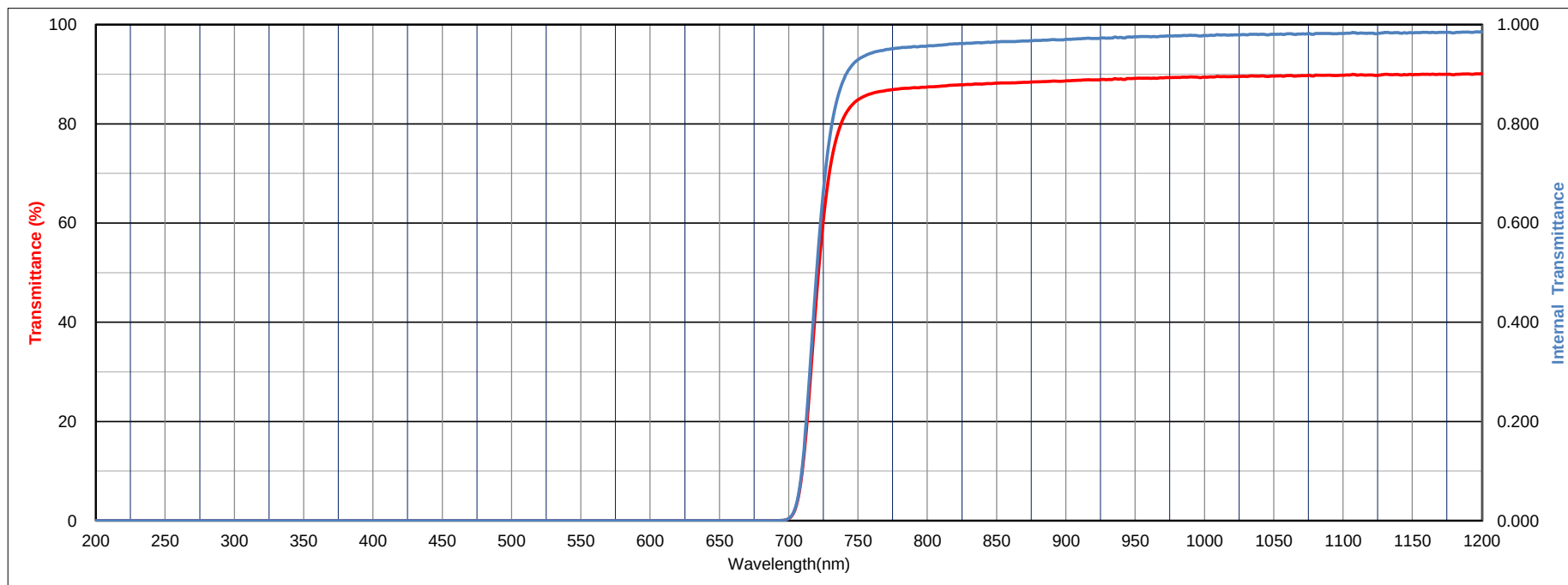
	x	y	Y	λ _d	P _e
A	-	-	-	-	-
C	-	-	-	-	-
D65	-	-	-	-	-

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	3	525	575	100	116	470	160	2.86

Tolerance of Transmittance (τ)

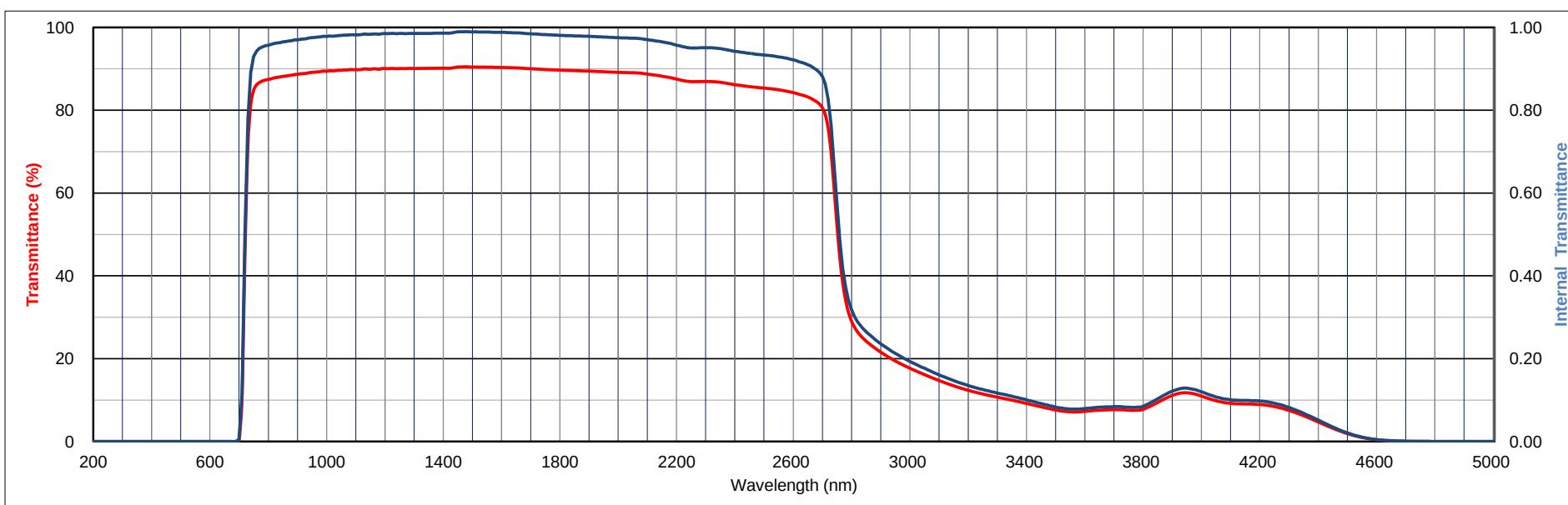
λ _T (nm)	Δλ (nm)	TH (%)
720±10	<45	>85



All data is mean values of various melts.

The content of this catalog is accurate as of October ,2020

Transmittance (T)		units: %																		
λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	10.5	45.0	71.2	81.4	84.9	86.1	86.7	87.1	87.3
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	87.4	87.6	87.8	87.9	88.0	88.2	88.2	88.4	88.5	88.6	88.7	88.8	88.9	88.9	89.1	89.1	89.2	89.3	89.3	89.5
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	89.4	89.5	89.5	89.6	89.6	89.6	89.7	89.7	89.8	89.8	89.8	89.8	89.8	90.0	89.9	89.9	90.0	90.0	89.9	90.1
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	90.1	90.0	90.1	90.1	90.1	90.1	90.1	90.1	90.1	90.1	90.1	90.1	90.1	90.1	90.1	90.1	90.1	90.1	90.1	90.1
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	90.1	90.1	90.1	90.2	90.3	90.4	90.4	90.5	90.5	90.4	90.4	90.4	90.4	90.4	90.4	90.4	90.4	90.4	90.3	90.3
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	90.3	90.3	90.3	90.3	90.2	90.2	90.2	90.2	90.1	90.1	90.0	90.0	89.9	89.9	89.9	89.8	89.8	89.8	89.7	89.7
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	89.7	89.7	89.6	89.6	89.6	89.6	89.5	89.5	89.5	89.5	89.5	89.4	89.4	89.3	89.3	89.3	89.3	89.2	89.2	89.2
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	89.1	89.1	88.7	88.2	87.5	86.9	86.9	86.7	86.2	85.7	85.3	84.9	84.3	83.2	80.6	52.3	29.1	24.2	21.6	19.4
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	17.7	16.1	14.7	13.4	12.4	11.5	10.7	10.0	9.2	8.4	7.6	7.2	7.3	7.6	7.7	7.6	7.7	9.4	11.1	11.8
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	11.0	9.8	9.2	9.1	8.9	8.4	7.5	6.2	4.7	3.2	1.9	1.0	0.4	0.2	0.1	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
τ	0.0																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.8	12.8	38.5	63.7	77.5	83.7
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	86.3	87.3	87.9	88.2	88.3	88.5	88.6	88.7	88.8	88.9	89.0	89.0	89.1	89.2	89.3	89.4	89.3	89.4	89.4	89.5
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	89.5	89.6	89.6	89.6	89.6	89.7	89.7	89.8	89.8	89.8	89.8	89.8	89.9	89.9	89.9	89.9				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.576	1.567	1.561	1.556	1.553	1.551	1.550
P	0.905	0.907	0.908	0.910	0.910	0.911	0.911

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

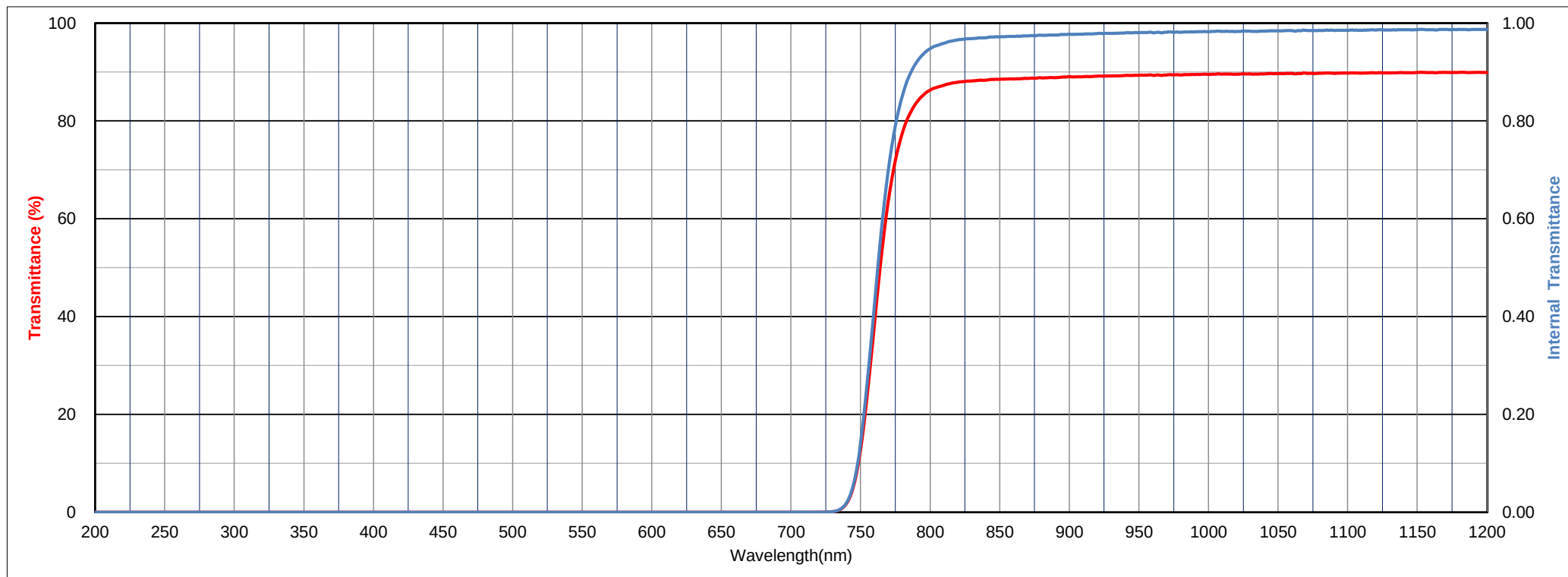
	x	y	Y	λ _d	P _e
A	-	-	-	-	-
C	-	-	-	-	-
D65	-	-	-	-	-

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	2	495	545	89	99	500	160	2.84

Tolerance of Transmittance (T)

λτ (nm)	Δλ (nm)
760±10	<60





HOYA CORPORATION OPTICS SECTION

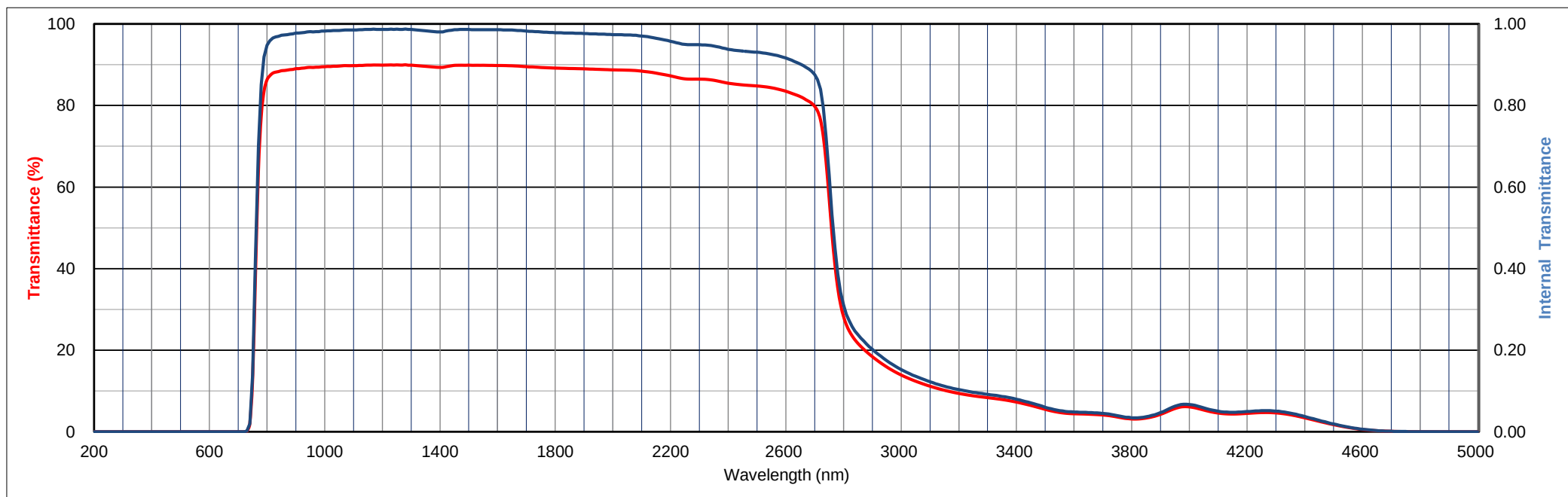
Transmittance (T)

units: %

Thickness 2.50 mm

IR76N

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.8	12.8	38.5	63.7	77.5	83.7
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	86.3	87.3	87.9	88.2	88.3	88.5	88.6	88.7	88.8	88.9	89.0	89.0	89.1	89.2	89.3	89.4	89.3	89.4	89.4	89.5
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	89.5	89.6	89.6	89.6	89.6	89.7	89.7	89.8	89.8	89.8	89.8	89.8	89.8	89.8	89.9	89.9	89.9	89.9	89.9	89.9
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	89.9	89.9	89.9	89.9	89.9	90.0	89.9	89.9	90.0	89.9	89.9	89.8	89.8	89.7	89.7	89.6	89.5	89.5	89.4	89.4
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	89.4	89.4	89.5	89.6	89.7	89.8	89.9	89.9	89.9	89.9	89.9	89.9	89.9	89.9	89.9	89.9	89.8	89.8	89.8	89.8
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	89.8	89.8	89.8	89.8	89.8	89.7	89.7	89.7	89.6	89.6	89.5	89.5	89.5	89.4	89.4	89.3	89.3	89.3	89.2	89.2
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	89.2	89.2	89.1	89.1	89.1	89.1	89.1	89.0	89.0	89.0	89.0	89.0	88.9	88.9	88.9	88.9	88.8	88.8	88.8	88.8
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	88.7	88.7	88.4	87.9	87.3	86.5	86.5	86.2	85.5	85.0	84.8	84.3	83.5	82.2	79.8	57.4	28.3	21.7	18.4	15.9
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	13.9	12.4	11.2	10.2	9.4	8.8	8.4	7.9	7.3	6.4	5.5	4.7	4.4	4.3	4.1	3.6	3.1	3.4	4.3	5.7
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	6.1	5.3	4.6	4.3	4.5	4.7	4.6	4.2	3.4	2.5	1.7	1.1	0.6	0.3	0.1	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.7	3.9	14.8
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	36.9	59.4	74.8	82.3	85.7	87.2	87.8	88.2	88.4	88.6	88.8	88.9	89.0	89.1	89.2	89.2	89.3	89.2	89.4	89.4
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	89.4	89.5	89.5	89.5	89.5	89.6	89.6	89.6	89.7	89.7	89.8	89.8	89.8	89.8	89.9	89.8				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.582	1.570	1.563	1.557	1.554	1.551	1.550
P	0.903	0.906	0.908	0.909	0.910	0.911	0.911

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

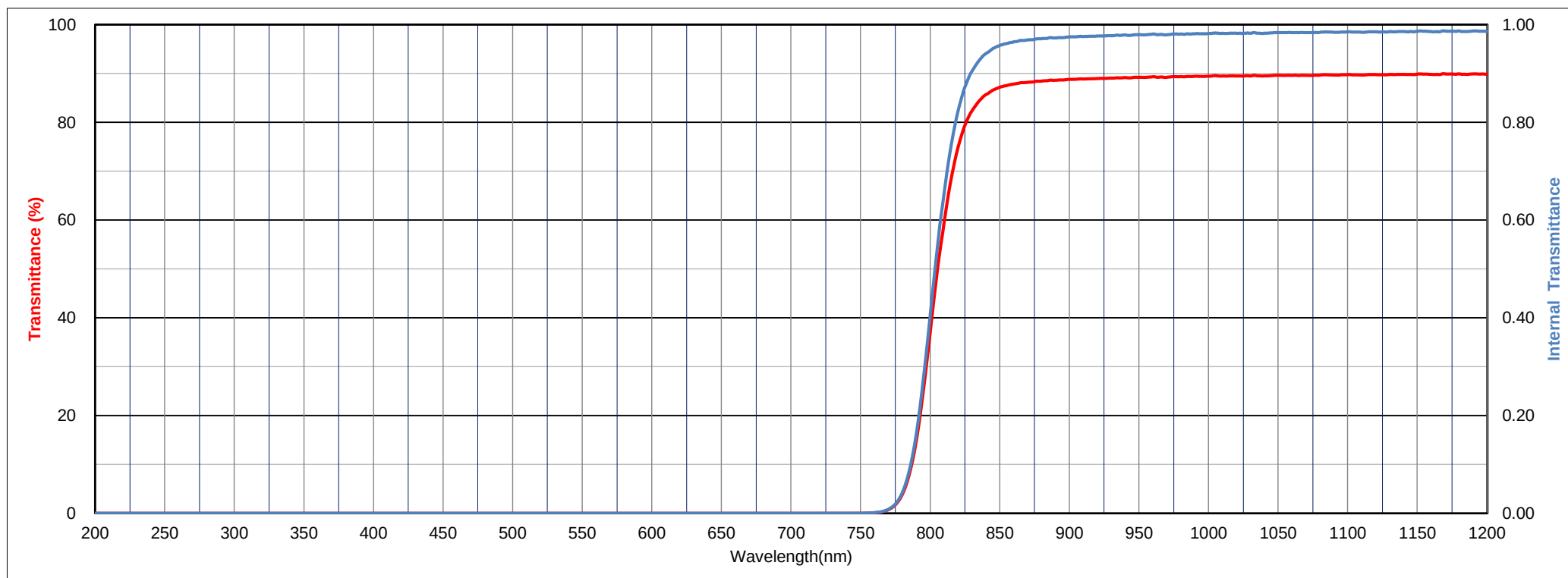
	x	y	Y	λ _d	P _e
A	-	-	-	-	-
C	-	-	-	-	-
D65	-	-	-	-	-

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	3	495	550	87	100	500	160	2.85

Tolerance of Transmittance (T)

λτ (nm)	Δλ (nm)
800±10	<60





HOYA CORPORATION OPTICS SECTION

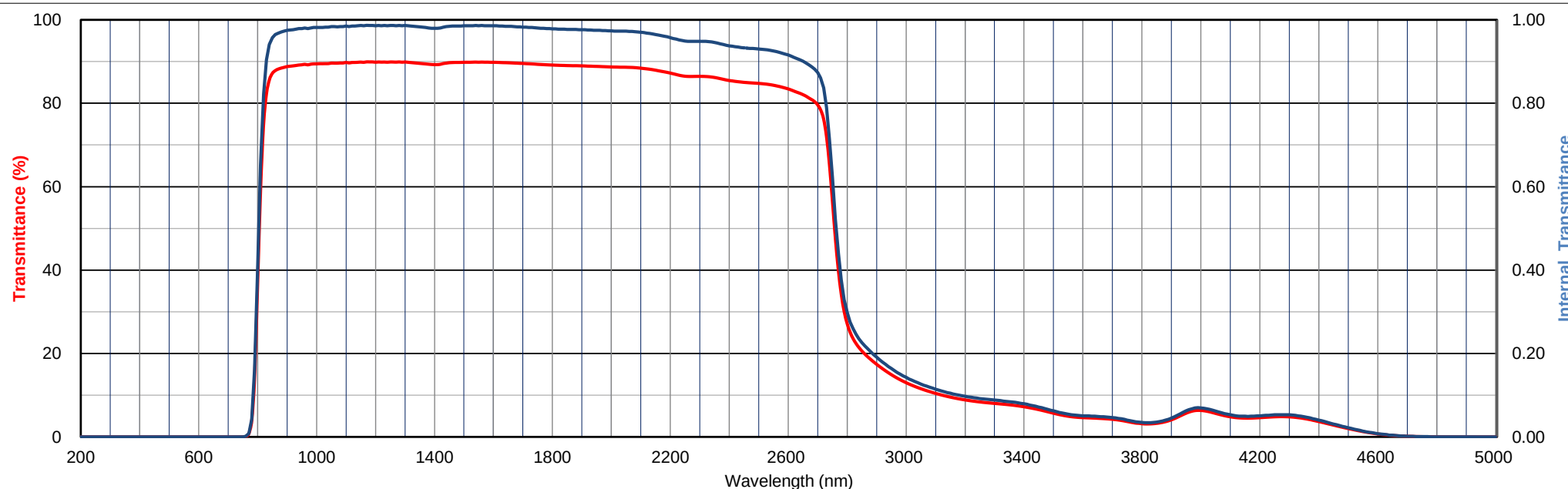
Transmittance (T)

units: %

Thickness 2.50 mm

IR80N

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.7	3.9	14.8
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	36.9	59.4	74.8	82.3	85.7	87.2	87.8	88.2	88.4	88.6	88.8	88.9	89.0	89.1	89.2	89.2	89.3	89.2	89.4	89.4
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	89.4	89.5	89.5	89.5	89.5	89.6	89.6	89.6	89.7	89.7	89.8	89.7	89.8	89.8	89.8	89.9	89.8	89.9	89.9	89.9
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	89.8	89.9	89.9	89.9	89.8	89.9	89.9	89.9	89.9	89.8	89.9	89.8	89.8	89.7	89.6	89.6	89.5	89.4	89.4	89.3
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	89.3	89.3	89.3	89.5	89.6	89.7	89.8	89.8	89.8	89.8	89.8	89.8	89.8	89.9	89.9	89.8	89.9	89.8	89.9	89.8
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	89.8	89.8	89.8	89.7	89.7	89.7	89.7	89.6	89.6	89.6	89.5	89.5	89.5	89.4	89.4	89.3	89.3	89.3	89.2	89.2
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	89.2	89.1	89.1	89.1	89.1	89.0	89.0	89.0	89.0	89.0	89.0	88.9	88.9	88.9	88.9	88.8	88.8	88.8	88.8	88.7
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	88.7	88.6	88.4	87.9	87.2	86.5	86.5	86.2	85.4	85.0	84.8	84.3	83.4	82.1	79.6	56.6	27.2	20.6	17.4	14.9
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	13.0	11.6	10.4	9.5	8.9	8.4	8.0	7.7	7.2	6.5	5.7	5.0	4.6	4.5	4.2	3.7	3.2	3.2	4.1	5.7
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	6.3	5.6	4.8	4.5	4.6	4.8	4.8	4.4	3.7	2.8	2.0	1.3	0.7	0.3	0.2	0.1	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	1.0	4.3	14.7	36.5	59.3	74.9	82.5	85.7	87.0	87.8	88.1	88.4	88.6	88.7	88.8	88.9	89.0	89.0	89.1	89.2
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	89.2	89.3	89.3	89.3	89.3	89.4	89.4	89.4	89.5	89.6	89.6	89.6	89.6	89.7	89.7	89.7				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.588	1.576	1.569	1.563	1.560	1.558	1.556
P	0.902	0.905	0.906	0.908	0.909	0.909	0.910

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

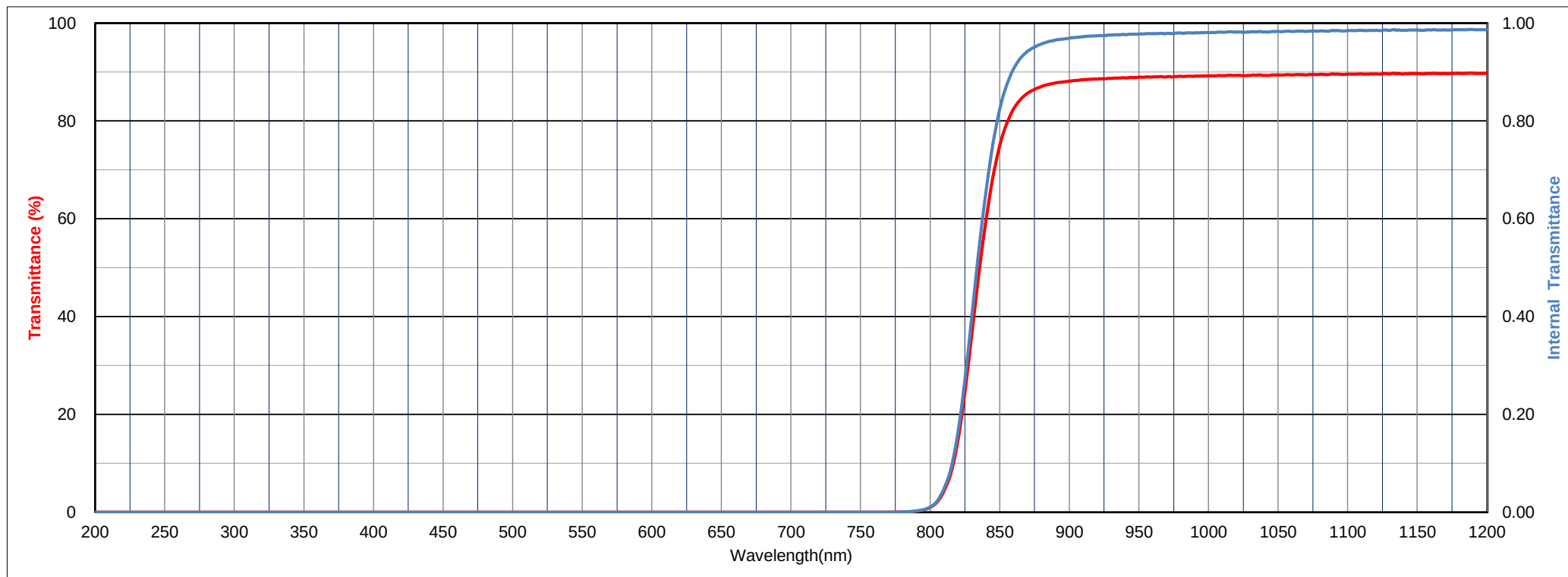
	x	y	Y	λ _d	P _e
A	-	-	-	-	-
C	-	-	-	-	-
D65	-	-	-	-	-

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
2	4	500	555	99	109	500	160	2.99

Tolerance of Transmittance (T)

λτ (nm)	Δλ (nm)
830±10	<60





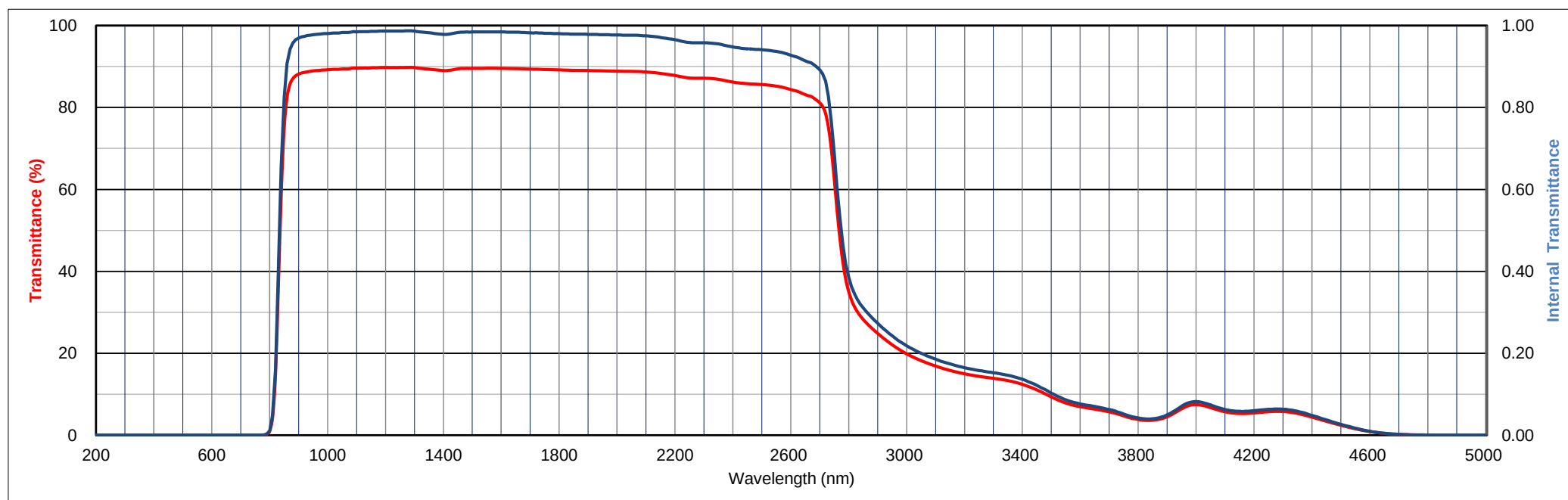
HOYA CORPORATION OPTICS SECTION

Transmittance (T) units: %

Thickness 2.50 mm

IR83N

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	1.0	4.3	14.7	36.5	59.3	74.9	82.5	85.7	87.0	87.8	88.1	88.4	88.6	88.7	88.8	88.9	89.0	89.0	89.1	89.2
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	89.2	89.3	89.3	89.3	89.3	89.4	89.4	89.4	89.5	89.6	89.6	89.6	89.6	89.6	89.6	89.7	89.7	89.7	89.7	89.8
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	89.7	89.8	89.7	89.8	89.7	89.8	89.7	89.8	89.8	89.8	89.7	89.6	89.6	89.5	89.4	89.4	89.3	89.2	89.1	89.1
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	89.0	89.0	89.1	89.2	89.3	89.4	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.6	89.6	89.6	89.6	89.6	89.6
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.4	89.4	89.4	89.4	89.3	89.3	89.3	89.3	89.3	89.3	89.2	89.2	89.2
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	89.2	89.2	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.0	89.0	89.0	89.0	89.0	89.0	88.9	88.9	88.9	88.9	88.9
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	88.9	88.8	88.7	88.3	87.8	87.2	87.1	86.9	86.2	85.8	85.6	85.2	84.4	83.2	81.1	62.7	35.1	28.3	24.9	22.1
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	19.9	18.2	16.9	15.8	15.0	14.4	13.9	13.3	12.4	11.1	9.4	7.9	7.0	6.4	5.7	4.7	3.8	3.7	4.5	6.4
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	7.5	6.7	5.7	5.3	5.4	5.7	5.8	5.3	4.4	3.4	2.4	1.6	0.9	0.4	0.2	0.1	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	0.0	0.1	0.6	3.8	15.9	39.1	60.8	73.7	80.2	83.7	85.5	86.5	87.2	87.6	87.9	88.1	88.4	88.5	88.7	88.8
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	89.0	89.1	89.2	89.3	89.4	89.5	89.6	89.7	89.7	89.8	89.8	90.0	90.1	90.2	90.3	90.3				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.589	1.578	1.572	1.566	1.563	1.560	1.559
P	0.902	0.904	0.906	0.907	0.908	0.909	0.909

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

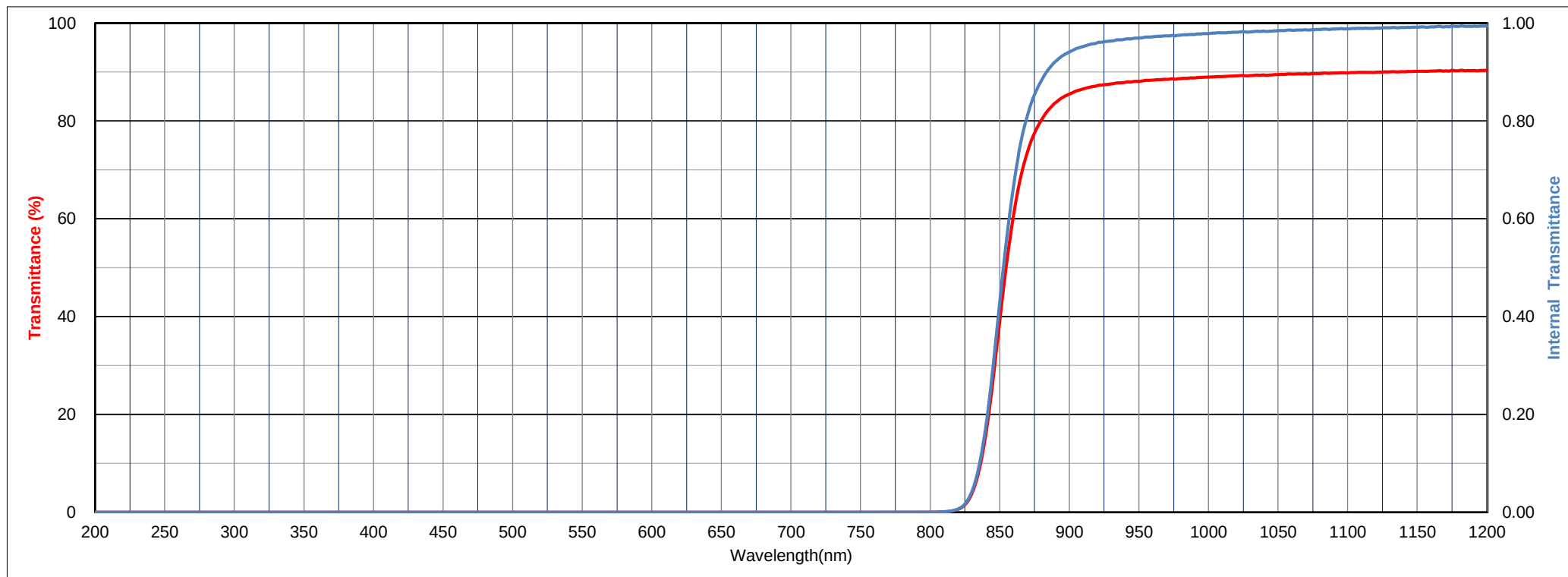
	x	y	Y	λ _d	P _e
A	-	-	-	-	-
C	-	-	-	-	-
D65	-	-	-	-	-

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	4	490	535	92	102	500	150	3.02

Tolerance of Transmittance (T)

λτ (nm)	Δλ (nm)
850±10	<60





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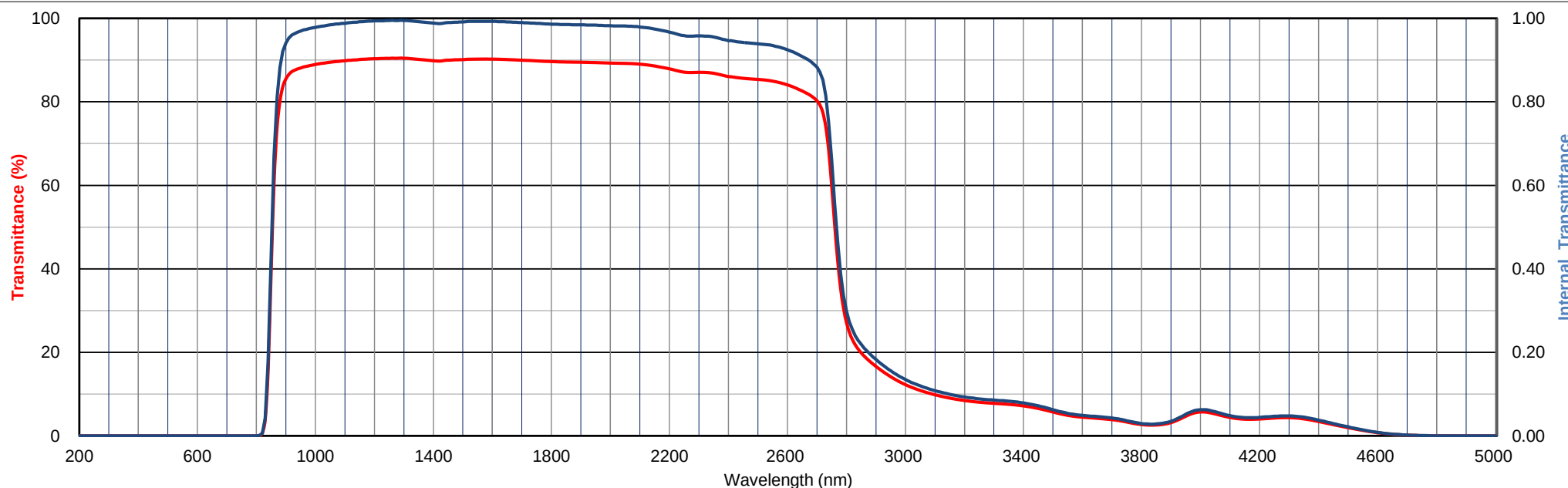
Transmittance (T)

units: %

Thickness 2.50 mm

IR85N

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	0.0	0.1	0.6	3.8	15.9	39.1	60.8	73.7	80.2	83.7	85.5	86.5	87.2	87.6	87.9	88.1	88.4	88.5	88.7	88.8
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	89.0	89.1	89.2	89.3	89.4	89.5	89.6	89.7	89.7	89.8	89.8	89.9	90.0	90.0	90.1	90.2	90.2	90.2	90.3	90.3
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	90.3	90.3	90.4	90.4	90.4	90.4	90.5	90.4	90.4	90.5	90.4	90.4	90.4	90.3	90.2	90.2	90.1	90.0	90.0	89.9
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	89.8	89.8	89.8	89.8	89.9	90.0	90.0	90.1	90.1	90.1	90.1	90.2	90.2	90.2	90.2	90.2	90.2	90.2	90.3	90.2
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	90.2	90.2	90.2	90.2	90.2	90.1	90.1	90.1	90.0	90.0	90.0	89.9	89.9	89.9	89.8	89.8	89.8	89.7	89.7	89.7
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	89.6	89.6	89.6	89.6	89.6	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.4	89.4	89.4	89.4	89.4	89.3	89.3
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	89.3	89.2	89.0	88.6	87.9	87.1	87.1	86.8	86.1	85.6	85.4	85.0	84.1	82.6	80.3	59.9	27.2	19.9	16.6	14.2
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	12.3	10.9	9.8	9.0	8.5	8.1	7.8	7.6	7.2	6.6	5.7	4.9	4.5	4.2	3.9	3.3	2.7	2.6	3.2	4.7
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	5.7	5.2	4.4	4.0	4.0	4.3	4.3	4.1	3.4	2.7	2.0	1.3	0.8	0.4	0.2	0.1	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.4	0.7	1.2	1.8	2.8
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	4.1	5.8	8.0	10.7	13.9	17.8	21.9	26.3	30.8	35.6	40.3	45.0	49.5	53.7	57.6	61.1	64.3	67.3	69.9	72.2
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	74.3	76.2	77.8	79.2	80.4	81.5	82.5	83.3	84.0	84.6	85.3	86.1	86.9	87.4	87.8	88.2				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.573	1.556	1.549	1.544	1.541	1.539	1.537
P	0.905	0.910	0.911	0.913	0.913	0.914	0.914

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

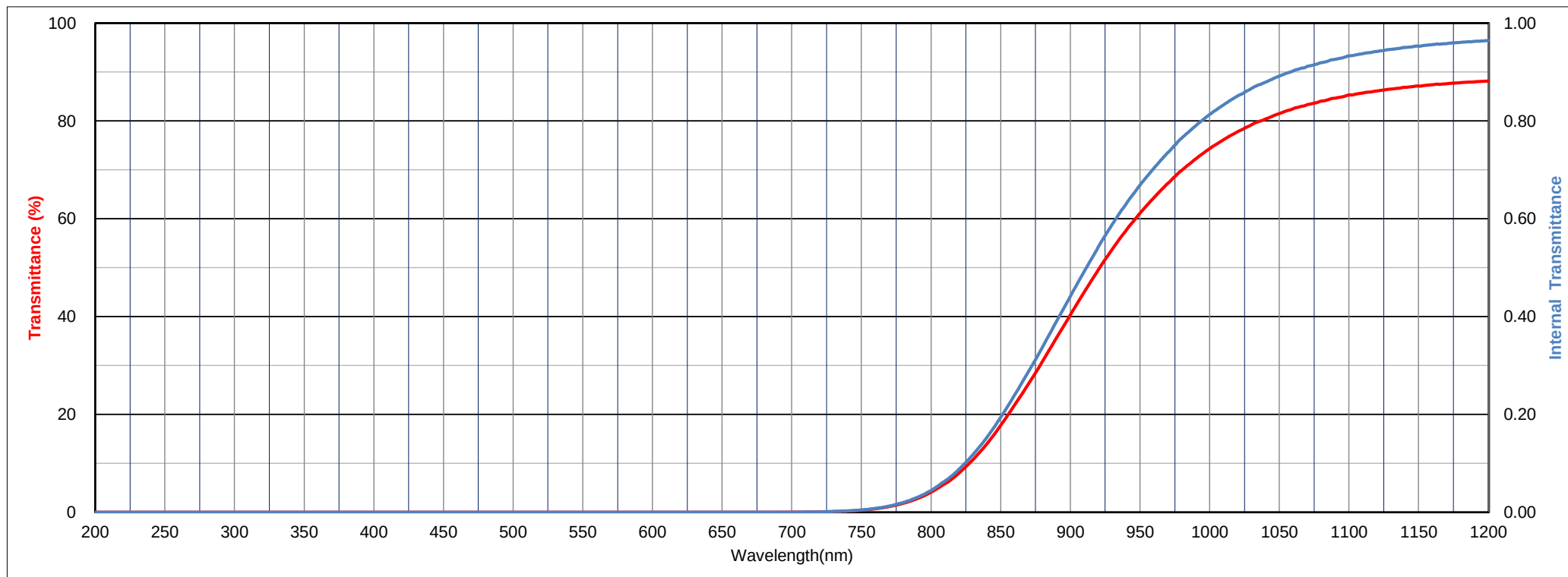
	x	y	Y	λ _d	P _e
A	-	-	-	-	-
C	-	-	-	-	-
D65	-	-	-	-	-

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
3	3	400	490	107	125	450	170	3.15

Tolerance of Transmittance (T)

Wavelength for less than 5% Transmittance	Transmittance at 1200nm
λ5(nm)	λ80(nm)
>770	<1050





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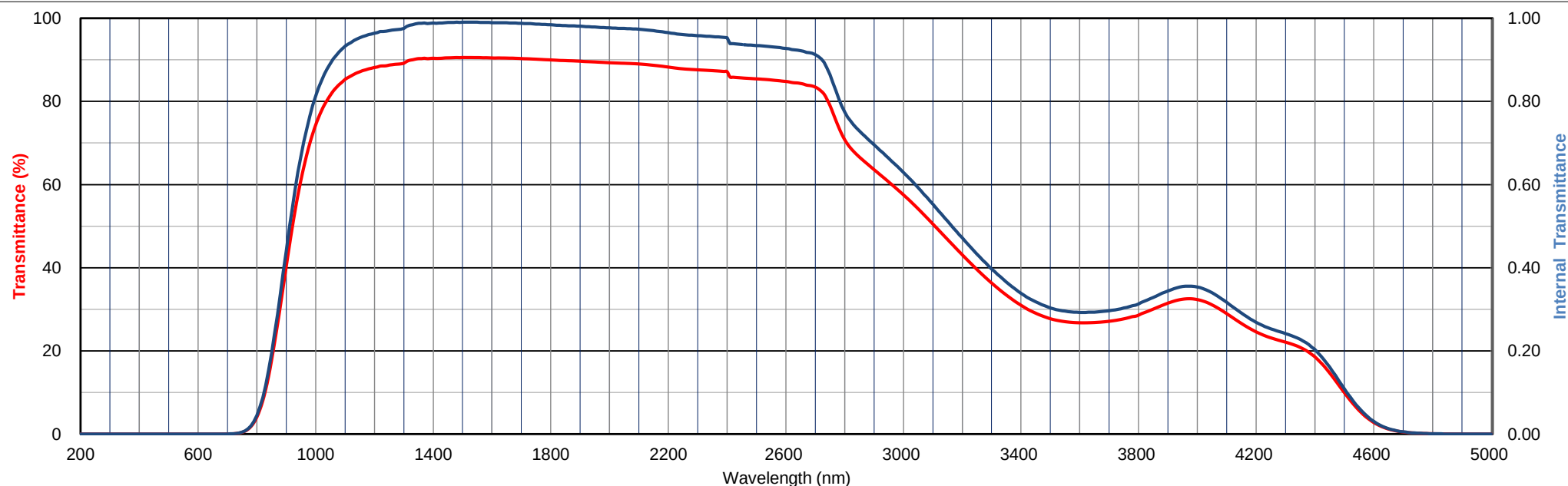
Transmittance (T)

units: %

Thickness 2.50 mm

RM90

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.4	0.7	1.2	1.8	2.8
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	4.1	5.8	8.0	10.7	13.9	17.8	21.9	26.3	30.8	35.6	40.3	45.0	49.5	53.7	57.6	61.1	64.3	67.3	69.9	72.2
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	74.3	76.2	77.8	79.2	80.4	81.5	82.5	83.3	84.0	84.6	85.3	85.7	86.1	86.5	86.9	87.1	87.4	87.6	87.8	88.0
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	88.2	88.3	88.5	88.5	88.6	88.7	88.8	88.9	89.0	89.0	89.2	89.6	89.9	90.0	90.2	90.3	90.3	90.4	90.3	90.3
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	90.4	90.3	90.4	90.4	90.5	90.5	90.5	90.5	90.6	90.5	90.6	90.6	90.6	90.6	90.5	90.5	90.5	90.5	90.5	90.5
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	90.5	90.4	90.5	90.4	90.4	90.4	90.4	90.4	90.4	90.3	90.3	90.3	90.3	90.2	90.2	90.2	90.1	90.1	90.0	90.0
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	90.0	89.9	89.9	89.9	89.8	89.8	89.8	89.8	89.7	89.7	89.7	89.6	89.6	89.6	89.5	89.5	89.5	89.4	89.4	89.3
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	89.3	89.2	89.0	88.7	88.3	87.8	87.6	87.4	87.2	85.6	85.4	85.2	84.8	84.3	83.4	79.0	70.8	66.6	63.6	60.6
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	57.5	54.2	50.5	46.8	43.1	39.6	36.3	33.4	31.0	29.1	27.7	27.0	26.8	26.8	27.1	27.7	28.6	30.1	31.5	32.4
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	32.3	31.1	29.0	26.6	24.6	23.1	22.1	20.8	18.6	14.7	10.0	5.7	2.8	1.2	0.5	0.2	0.1	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	0.2	0.4	0.8	1.3	2.1	3.3	4.9	6.9	9.2	12.1	15.4	19.0	22.9	26.9	31.0	35.0	38.8	42.7	46.4	49.8
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	53.1	56.2	59.0	61.6	63.8	66.0	68.0	69.7	71.2	72.6	73.8	75.9	77.4	78.6	79.4	80.0				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.650	1.630	1.620	1.614	1.610	1.607	1.605
P	0.887	0.892	0.894	0.895	0.896	0.897	0.898

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

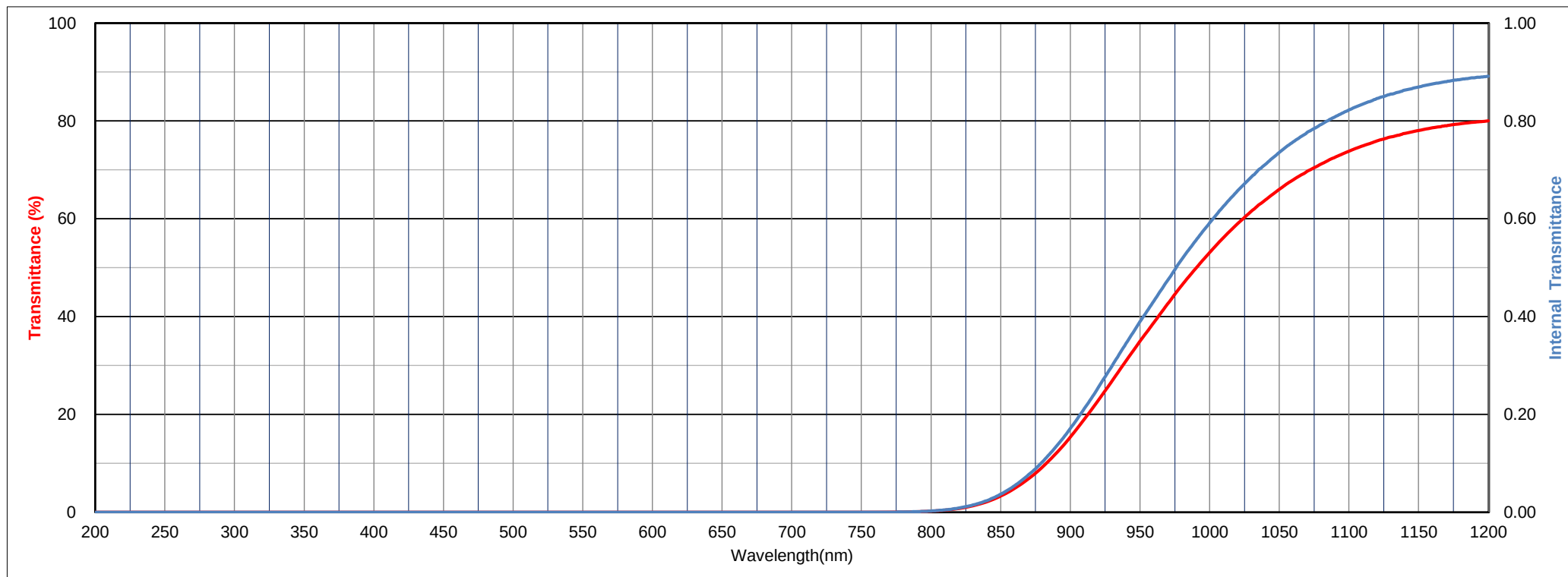
	x	y	Y	λ _d	P _e
A	-	-	-	-	-
C	-	-	-	-	-
D65	-	-	-	-	-

Properties

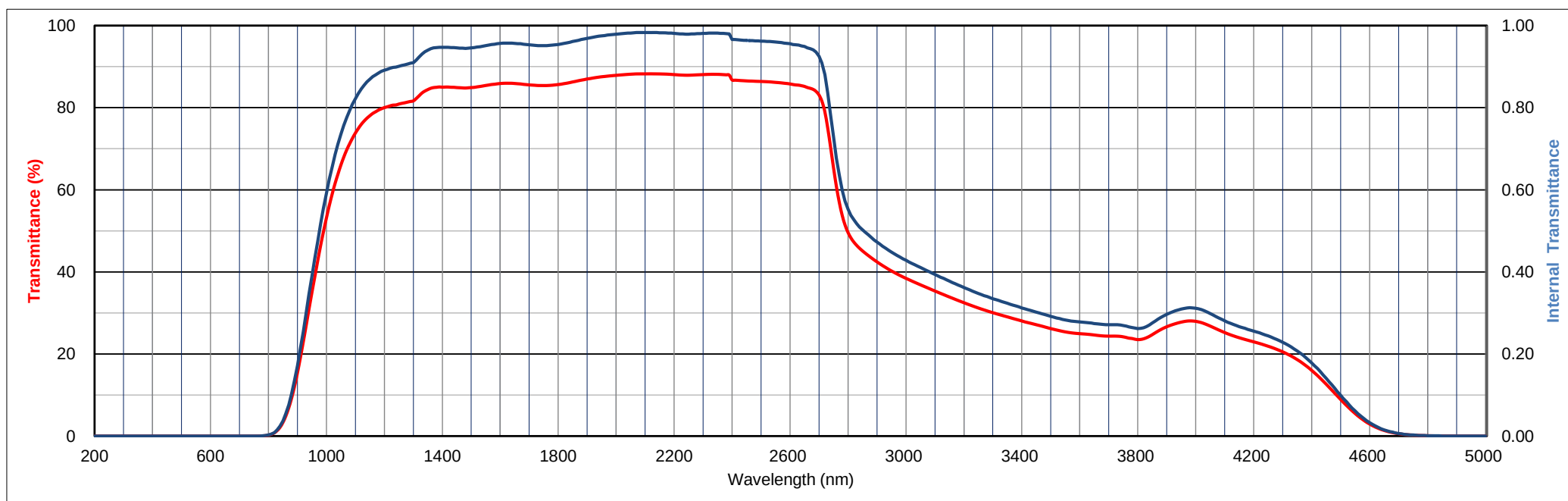
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
3	4	450	490	98	115	460	180	3.23

Tolerance of Transmittance (T)

Wavelength for less than 5% Transmittance	Transmittance at 1200nm
λ5(nm)	T1200(%)
>850	80±5



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	0.2	0.4	0.8	1.3	2.1	3.3	4.9	6.9	9.2	12.1	15.4	19.0	22.9	26.9	31.0	35.0	38.8	42.7	46.4	49.8
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	53.1	56.2	59.0	61.6	63.8	66.0	68.0	69.7	71.2	72.6	73.8	74.9	75.9	76.7	77.4	78.0	78.6	79.0	79.4	79.7
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	80.0	80.2	80.4	80.6	80.7	80.9	81.1	81.2	81.4	81.5	81.6	82.2	82.9	83.6	84.1	84.4	84.7	84.9	85.0	85.1
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	85.0	85.0	85.0	85.0	85.0	84.9	84.9	84.8	84.8	84.9	84.9	85.0	85.1	85.2	85.3	85.4	85.5	85.7	85.7	85.8
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	85.9	85.9	86.0	86.0	86.0	85.9	85.8	85.8	85.7	85.6	85.6	85.5	85.5	85.4	85.4	85.4	85.4	85.4	85.5	85.6
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	85.6	85.7	85.9	86.0	86.1	86.3	86.4	86.6	86.7	86.8	87.0	87.1	87.2	87.3	87.4	87.5	87.6	87.7	87.8	87.8
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	87.9	88.2	88.2	88.2	88.1	87.9	88.1	88.1	86.8	86.5	86.4	86.2	85.8	85.2	83.1	65.4	49.6	45.1	42.4	40.2
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	38.4	36.9	35.3	33.9	32.5	31.2	30.1	29.0	28.0	27.1	26.2	25.4	25.0	24.6	24.3	24.2	23.5	24.7	26.6	27.8
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	28.0	26.8	25.2	24.0	23.0	21.9	20.5	18.6	16.0	12.7	8.9	5.5	2.9	1.4	0.6	0.2	0.1	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	5.0	21.1	43.8	61.4	70.6	75.1	77.0	77.0	77.1
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	79.2	81.5	83.0	83.5	83.4	82.8	82.0	81.0	80.0	78.8	77.6	76.1	74.6	72.8	70.8	68.8	66.5	63.9	60.9	57.8
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	54.3	50.4	46.3	42.0	37.5	32.9	28.3	24.0	20.0	16.3	12.9	7.6	4.1	2.1	1.0	0.5				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.553	1.542	1.536	1.532	1.530	1.529	1.527
P	0.910	0.913	0.915	0.915	0.916	0.916	0.917

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

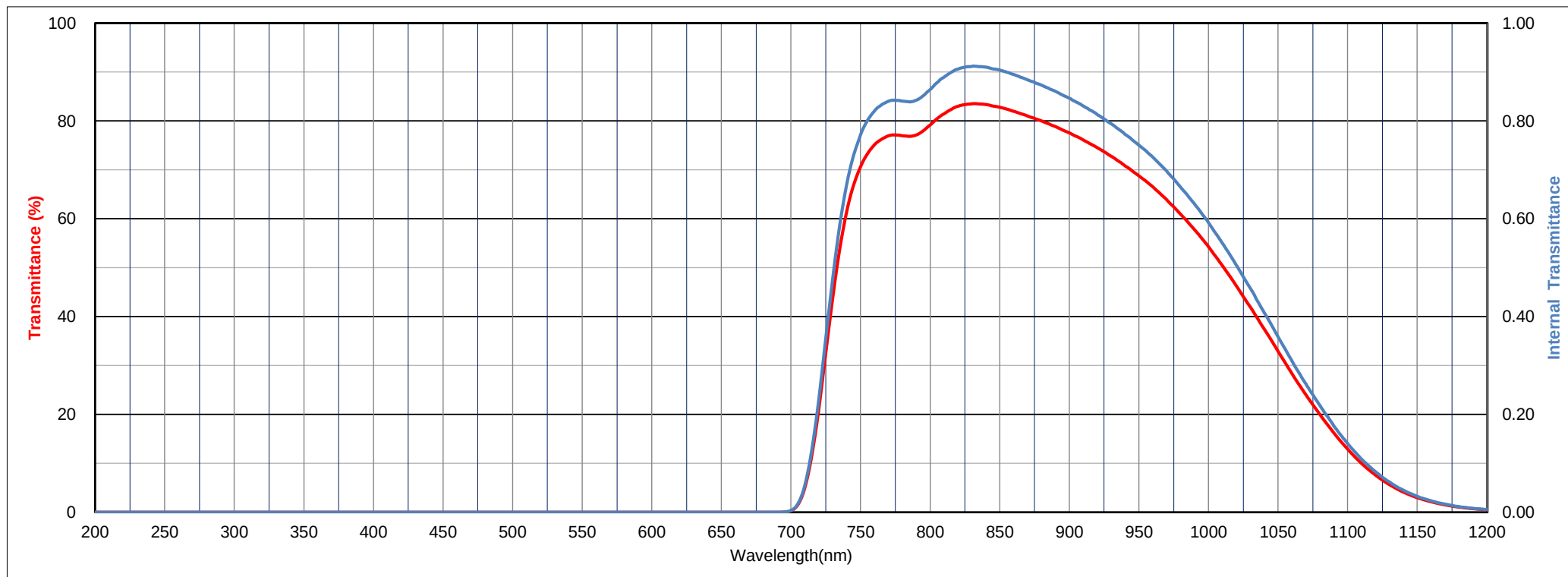
	x	y	Y	λ _d	P _e
A	-	-	-	-	-
C	-	-	-	-	-
D65	-	-	-	-	-

Properties

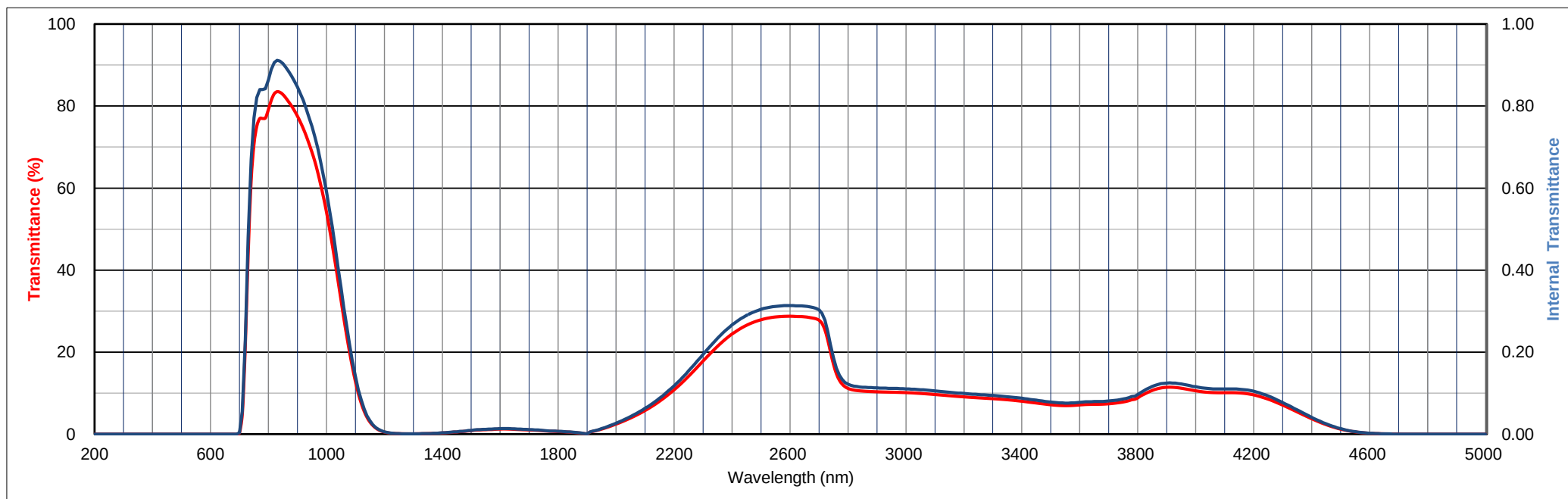
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	1	545	605	-	101	510	140	2.75

Tolerance of Transmittance (T)

Transmittance at 830nm	Transmittance at 700nm	Transmittance at 1200nm
T830(%)	T700(%)	T1200(%)
82±5	<5	<1



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	5.0	21.1	43.8	61.4	70.6	75.1	77.0	77.0	77.1
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	79.2	81.5	83.0	83.5	83.4	82.8	82.0	81.0	80.0	78.8	77.6	76.1	74.6	72.8	70.8	68.8	66.5	63.9	60.9	57.8
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	54.3	50.4	46.3	42.0	37.5	32.9	28.3	24.0	20.0	16.3	12.9	10.0	7.6	5.7	4.1	3.0	2.1	1.5	1.0	0.7
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	0.5	0.4	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.6	0.7	0.8	0.8	0.9	1.0	1.0	1.1	1.1	1.1	1.1	1.2	1.2
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	1.2	1.3	1.3	1.2	1.2	1.2	1.1	1.1	1.1	1.0	1.0	1.0	1.0	0.9	0.9	0.8	0.8	0.7	0.7	0.7
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	0.6	0.6	0.6	0.5	0.5	0.4	0.4	0.3	0.2	0.1	0.1	0.5	0.7	0.8	1.0	1.2	1.5	1.7	1.9	2.2
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	2.5	3.9	5.8	8.0	10.8	14.1	17.8	21.4	24.4	26.5	27.9	28.6	28.8	28.6	27.8	17.0	11.2	10.5	10.3	10.2
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	10.1	9.9	9.7	9.4	9.1	8.9	8.6	8.4	8.0	7.6	7.2	6.9	7.1	7.3	7.4	7.8	8.8	10.7	11.4	11.2
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	10.6	10.2	10.1	10.1	9.6	8.5	7.1	5.4	3.8	2.3	1.2	0.5	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



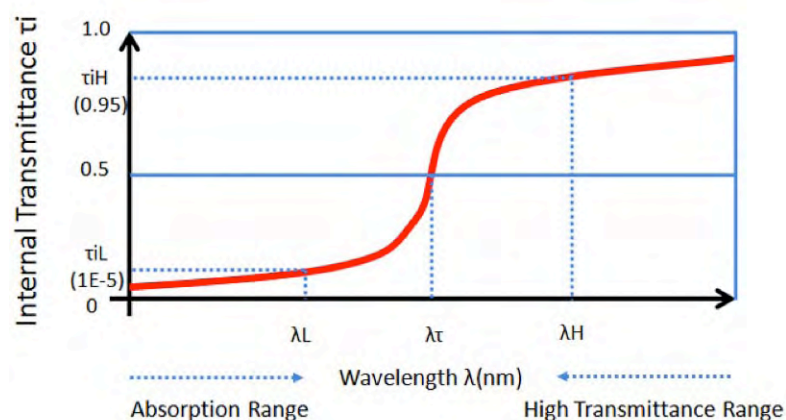
Sharp Cut Filters and Infrared Filters (W series)

Sharp cut filters include our new series (W series) whose transmission threshold wavelength is replaced with $\lambda_{\tau 0.5}$ and that is predicated on the internal transmittance.

The conventional sharp cut filters have been compliant with domestic standards, and the W series is available to meet the needs of the world markets.

Newly specified specification values

Glass type	Specifications on the catalog (thickness: 3 mm)		
	Threshold wavelength	Absorption range	High transmittance range
	$\lambda_{\tau 0.5}$	$\tau < 1 \times 10^{-5}$	Depending on glass type
W-L420	420±5 nm	>360 nm	>0.93 >530 nm
W-Y435	435±5 nm	>370 nm	>0.92 >520 nm
W-Y455	455±5 nm	>390 nm	>0.92 >530 nm
W-Y475	475±5 nm	>410 nm	>0.92 >550 nm
W-Y495	495±5 nm	>430 nm	>0.92 >560 nm
W-Y515	515±5 nm	>440 nm	>0.93 >580 nm
W-O530	530±5 nm	>460 nm	>0.93 >600 nm
W-O550	550±5 nm	>480 nm	>0.93 >620 nm
W-O570	570±5 nm	>500 nm	>0.93 >640 nm
W-O590	590±5 nm	>520 nm	>0.93 >660 nm
W-R610	610±5 nm	>540 nm	>0.94 >690 nm
W-R630	630±5 nm	>550 nm	>0.94 >710 nm
W-R645	645±5 nm	>560 nm	>0.94 >720 nm
W-R665	665±5 nm	>580 nm	>0.96 >750 nm
W-R695	695±5 nm	>610 nm	>0.96 >780 nm
W-R715	715±8 nm	>630 nm	>0.96 >810 nm
W-IR760	760±8 nm	>680 nm	>0.97 >880 nm
W-IR780	780±8 nm	>690 nm	>0.97 >900 nm
W-IR800	800±8 nm	>710 nm	>0.97 >920 nm
W-IR830	830±8 nm	>730 nm	>0.97 >950 nm
W-IR850	850±8 nm	>740 nm	>0.90 >950 nm



Internal Transmittance (τ)

λ nm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	0.036	0.489	0.799	0.895	0.929	0.945	0.953	0.959	0.964	0.967	0.970	0.971	0.973	0.975	0.977	0.977	0.977	0.978	0.978
λ nm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.979	0.979	0.979	0.978	0.979	0.979	0.979	0.980	0.981	0.982	0.982	0.982	0.983	0.983	0.983	0.984	0.983	0.983	0.983	0.983
λ nm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.983	0.982	0.981	0.981	0.981	0.982	0.982	0.982	0.982	0.983	0.984	0.984	0.985	0.986	0.986	0.987	0.987	0.987	0.988	0.988
λ nm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
τ	0.988	0.989	0.989	0.989	0.989	0.989	0.990	0.989	0.990	0.990	0.990	0.990	0.991	0.992	0.992	0.993				

Refractive Index/Absorption coefficient/Reflection coefficient

λ nm	400	500	600	700	800	900	1000
n	1.549	1.536	1.530	1.526	1.524	1.523	1.521
P	0.911	0.914	0.916	0.917	0.917	0.918	0.918

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

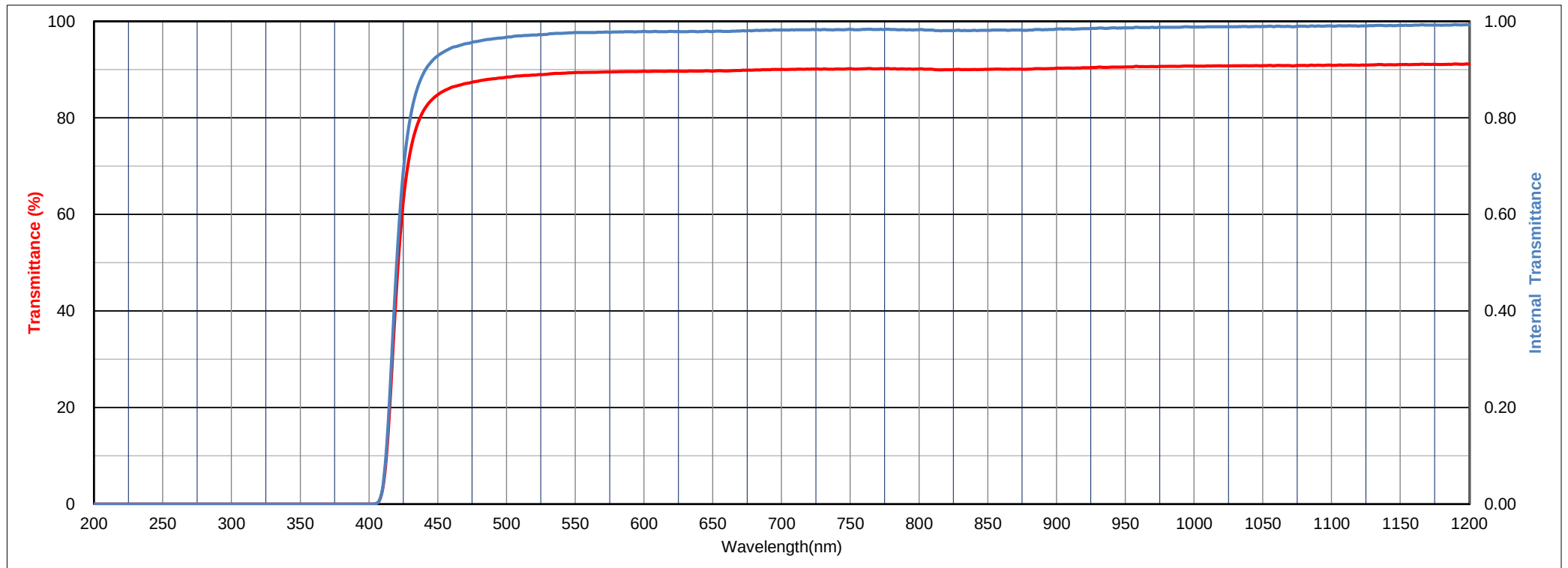
	x	y	Y	λ_d	P _e
A	0.452	0.413	89	580	7
C	0.317	0.330	89	569	6
D65	0.320	0.343	89	569	6

Properties

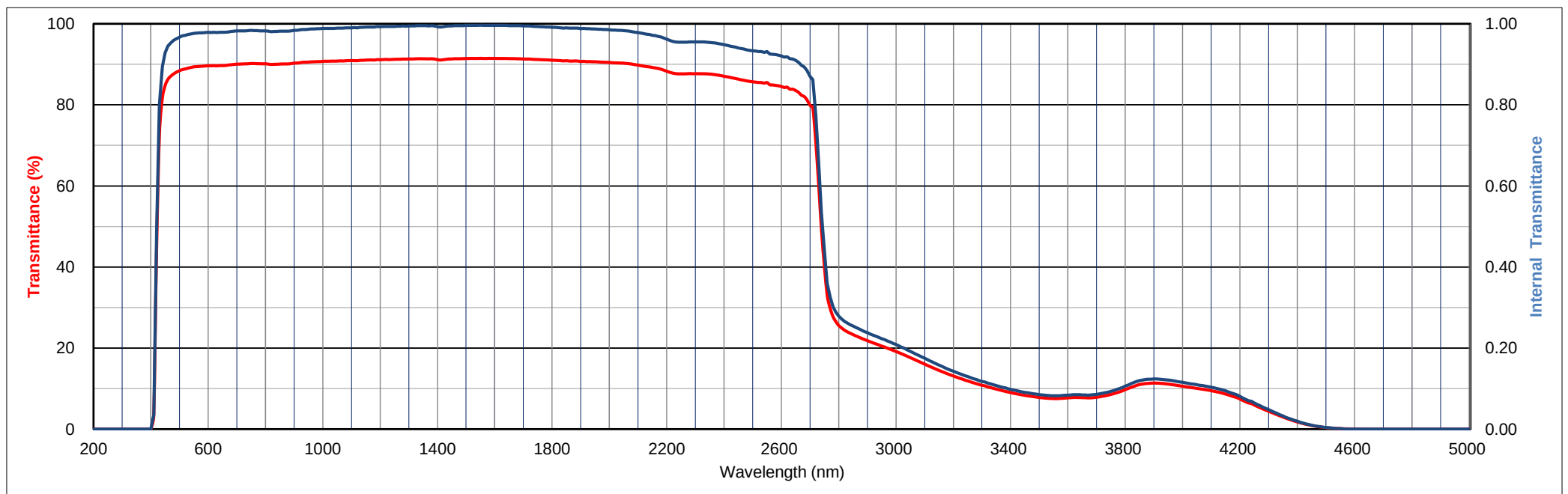
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
2	1	550	600	92	105	540	130	2.59

Tolerance of Transmittance (τ)

$\lambda\tau_{0.5}$ (nm)	ΔL (nm)	ΔH (nm)
420±5	>360	>530



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	0.036	0.489	0.799	0.895	0.929	0.945	0.953	0.959	0.964	0.967	0.970	0.971	0.973	0.975	0.977	0.977	0.977	0.978	0.978
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.979	0.979	0.979	0.978	0.979	0.979	0.979	0.980	0.981	0.982	0.982	0.982	0.983	0.983	0.983	0.984	0.983	0.983	0.983	0.983
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.983	0.982	0.981	0.981	0.981	0.982	0.982	0.982	0.982	0.983	0.984	0.984	0.985	0.986	0.986	0.987	0.987	0.987	0.988	0.988
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	0.988	0.989	0.989	0.989	0.989	0.989	0.990	0.989	0.990	0.990	0.990	0.990	0.990	0.991	0.991	0.992	0.992	0.992	0.992	0.993
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	0.993	0.993	0.994	0.993	0.993	0.994	0.994	0.994	0.995	0.994	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.994
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	0.993	0.992	0.993	0.994	0.995	0.995	0.995	0.995	0.995	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.996
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.995	0.995	0.995	0.994	0.995	0.994	0.993	0.993	0.993	0.993	0.992	0.992
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	0.991	0.991	0.991	0.990	0.989	0.990	0.989	0.989	0.989	0.989	0.988	0.988	0.988	0.988	0.987	0.987	0.987	0.986	0.986	0.986
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	0.985	0.983	0.978	0.972	0.962	0.955	0.955	0.954	0.948	0.940	0.933	0.931	0.921	0.910	0.870	0.440	0.279	0.254	0.238	0.223
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	0.209	0.192	0.175	0.158	0.143	0.130	0.118	0.108	0.098	0.091	0.085	0.082	0.084	0.085	0.086	0.093	0.106	0.120	0.124	0.121
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	0.115	0.109	0.103	0.094	0.081	0.065	0.048	0.033	0.019	0.010	0.004	0.001	0.001	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	5000																			
τ	<1E-05																			



Internal Transmittance (τ)

λ nm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	0.005	0.231	0.678	0.854	0.905	0.925	0.938	0.949	0.957	0.964	0.970	0.974	0.979	0.982	0.984	0.985	0.986	0.987
λ nm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.988	0.988	0.988	0.988	0.989	0.988	0.988	0.988	0.988	0.989	0.988	0.988	0.987	0.988	0.987	0.986	0.986	0.986	0.985	0.984
λ nm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.984	0.983	0.981	0.981	0.981	0.981	0.982	0.980	0.980	0.981	0.981	0.982	0.982	0.983	0.984	0.984	0.984	0.984	0.984	0.984
λ nm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
τ	0.984	0.985	0.985	0.985	0.985	0.985	0.986	0.985	0.985	0.986	0.986	0.986	0.986	0.987	0.987	0.988				

Refractive Index/Absorption coefficient/Reflection coefficient

λ nm	400	500	600	700	800	900	1000
n	1.541	1.534	1.531	1.529	1.527	1.526	1.526
P	0.913	0.915	0.916	0.916	0.917	0.917	0.917

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

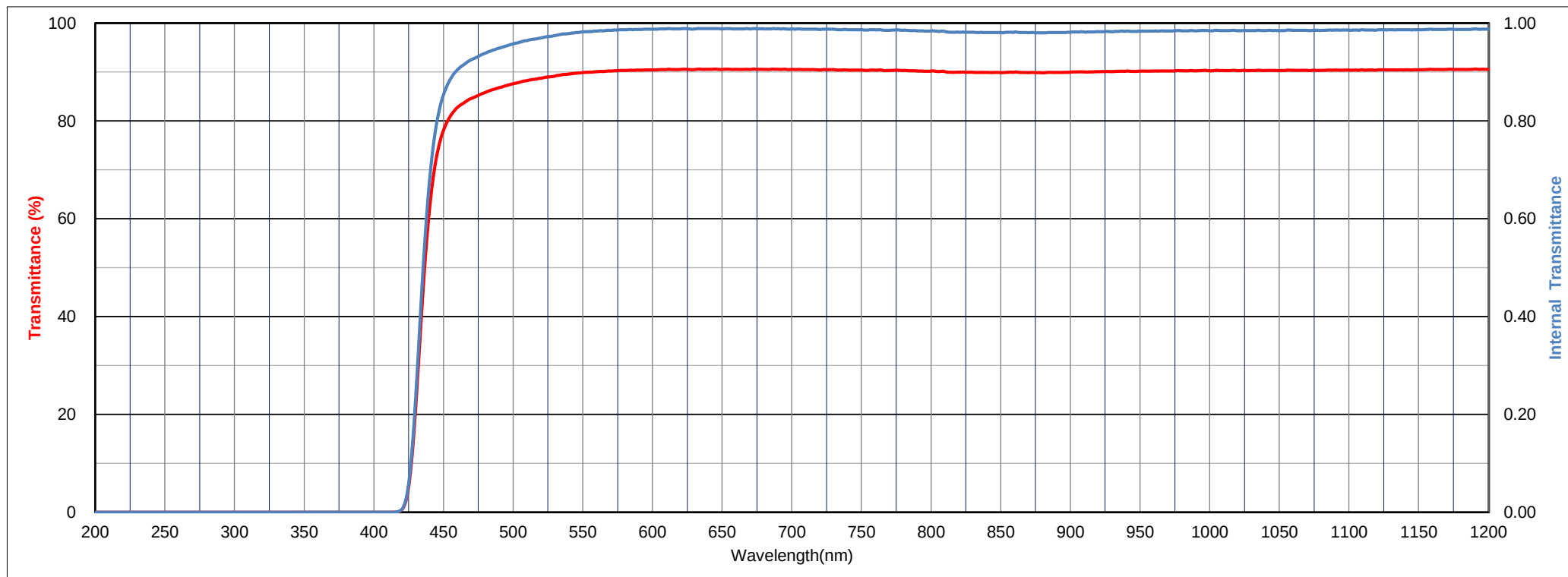
	x	y	Y	λ_d	P _e
A	0.460	0.421	90	580	18
C	0.331	0.357	89	569	17
D65	0.333	0.368	89	569	16

Properties

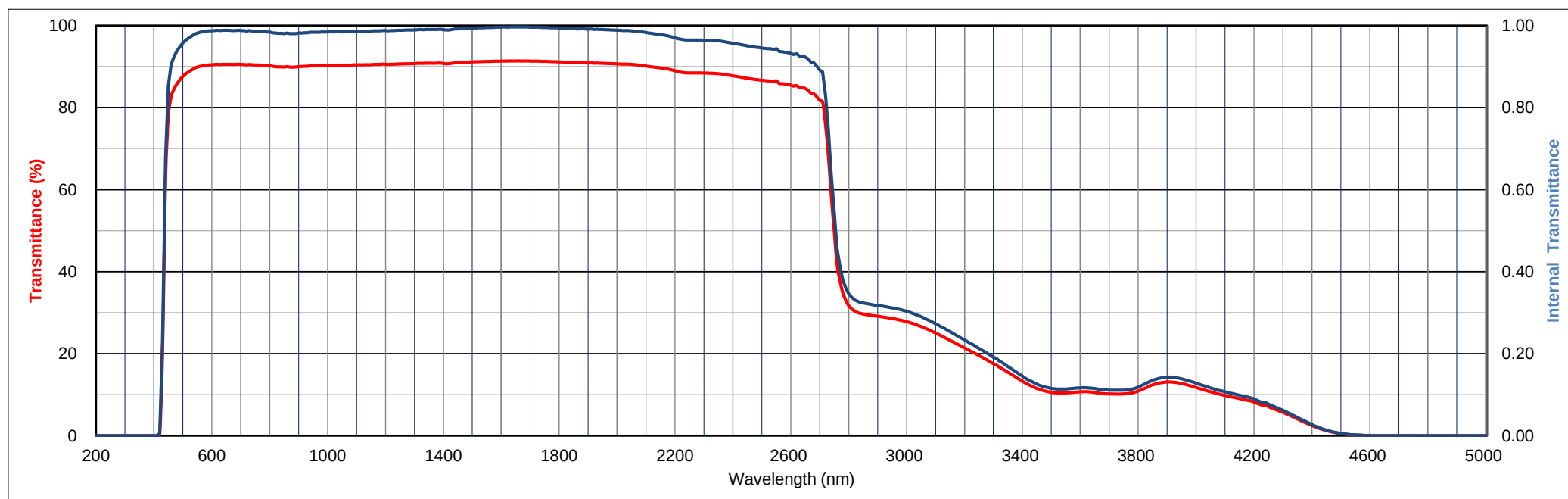
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	2	570	600	99	107	540	130	2.59

Tolerance of Transmittance (τ)

$\lambda\tau_{0.5}$ (nm)	ΔL (nm)	ΔH (nm)
435±5	>370	>520



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	0.005	0.231	0.678	0.854	0.905	0.925	0.938	0.949	0.957	0.964	0.970	0.974	0.979	0.982	0.984	0.985	0.986	0.987
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.988	0.988	0.988	0.988	0.989	0.988	0.988	0.988	0.988	0.989	0.988	0.988	0.987	0.988	0.987	0.986	0.986	0.986	0.985	0.984
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.984	0.983	0.981	0.981	0.981	0.981	0.982	0.980	0.980	0.981	0.981	0.982	0.982	0.983	0.984	0.984	0.984	0.984	0.984	0.984
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	0.984	0.985	0.985	0.985	0.985	0.985	0.986	0.985	0.985	0.986	0.986	0.986	0.986	0.987	0.986	0.987	0.987	0.987	0.987	0.988
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	0.988	0.987	0.988	0.988	0.988	0.989	0.989	0.989	0.989	0.989	0.989	0.990	0.990	0.990	0.991	0.991	0.991	0.991	0.991	0.991
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	0.990	0.989	0.989	0.991	0.992	0.992	0.993	0.993	0.993	0.994	0.994	0.994	0.995	0.995	0.995	0.995	0.995	0.996	0.996	0.996
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	0.996	0.996	0.996	0.997	0.996	0.997	0.997	0.996	0.996	0.997	0.996	0.996	0.996	0.996	0.995	0.995	0.995	0.995	0.995	0.995
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	0.994	0.994	0.993	0.993	0.992	0.993	0.992	0.992	0.993	0.992	0.991	0.992	0.991	0.991	0.991	0.990	0.990	0.990	0.990	0.989
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	0.989	0.987	0.983	0.978	0.970	0.965	0.964	0.963	0.957	0.951	0.945	0.944	0.932	0.923	0.892	0.544	0.346	0.323	0.318	0.312
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	0.303	0.290	0.273	0.254	0.234	0.213	0.191	0.169	0.145	0.126	0.115	0.114	0.117	0.115	0.111	0.111	0.119	0.135	0.143	0.139
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	0.128	0.117	0.107	0.099	0.089	0.077	0.062	0.044	0.027	0.014	0.006	0.002	0.001	0.001	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	5000																			
τ	<1E-05																			



Internal Transmittance (τ)

λ nm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	0.006	0.261	0.708	0.888	0.942	0.960	0.967	0.971	0.974	0.975	0.977	0.978	0.978	0.980	0.981	0.981
λ nm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.982	0.982	0.983	0.983	0.983	0.984	0.985	0.985	0.986	0.984	0.985	0.986	0.986	0.988	0.988	0.987	0.988	0.988	0.989	0.989
λ nm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.988	0.988	0.989	0.989	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.989	0.988	0.989
λ nm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
τ	0.989	0.990	0.990	0.989	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.991	0.991	0.991	0.991	0.993				

Refractive Index/Absorption coefficient/Reflection coefficient

λ nm	400	500	600	700	800	900	1000
n	1.543	1.533	1.528	1.525	1.523	1.522	1.521
P	0.913	0.915	0.916	0.917	0.918	0.918	0.918

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

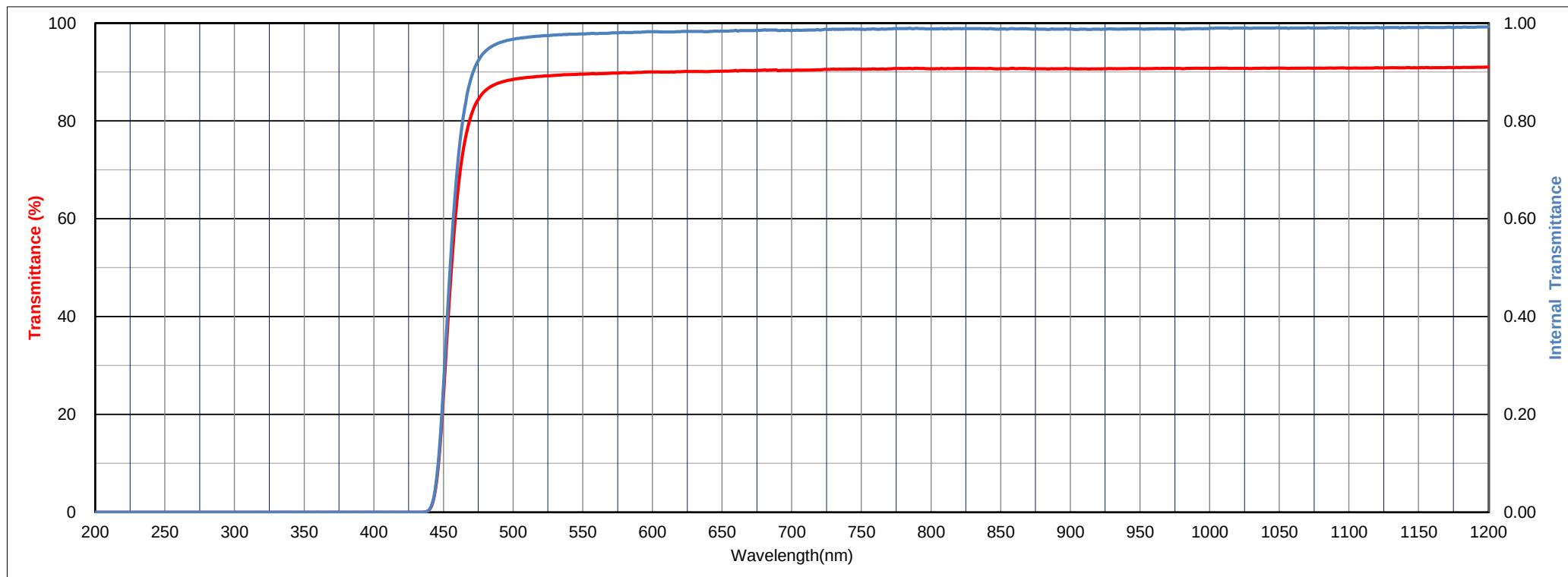
	x	y	Y	λ_d	P _a
A	0.473	0.440	89	580	40
C	0.360	0.416	89	569	40
D65	0.359	0.424	89	568	40

Properties

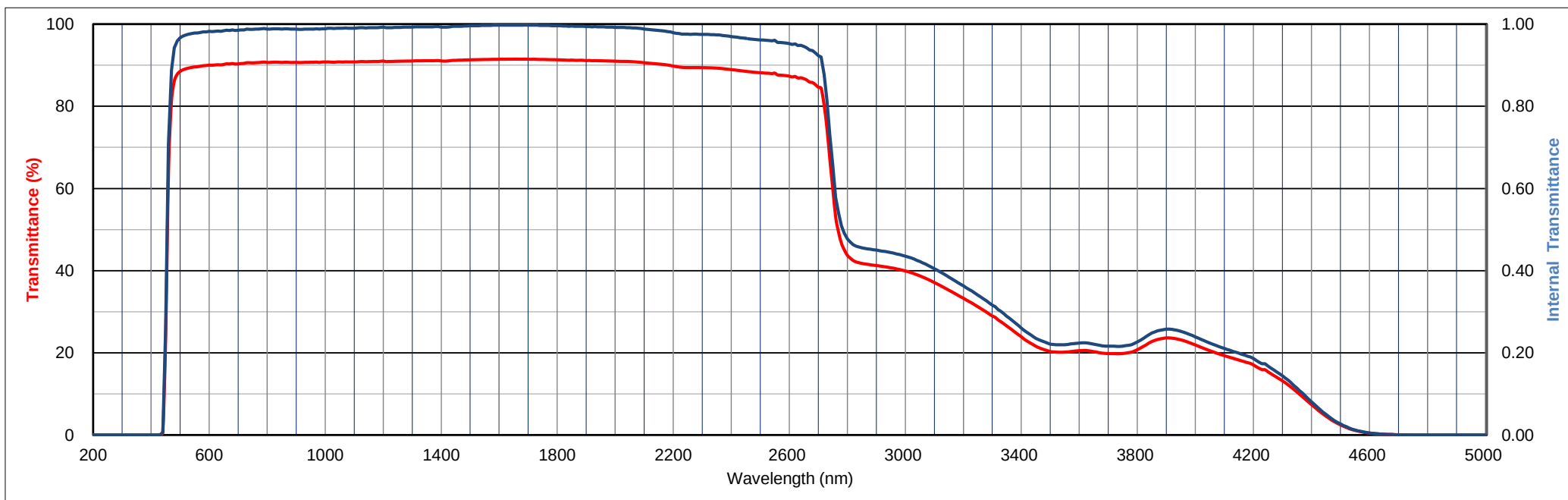
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
3	1	560	625	94	105	540	130	2.67

Tolerance of Transmittance (τ)

$\lambda\tau_{0.5}$ (nm)	ΔL (nm)	ΔH (nm)
455±5	>390	>530



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	0.006	0.261	0.708	0.888	0.942	0.960	0.967	0.971	0.974	0.975	0.977	0.978	0.978	0.980	0.981	0.981
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.982	0.982	0.983	0.983	0.983	0.984	0.985	0.985	0.986	0.984	0.985	0.986	0.986	0.988	0.988	0.987	0.988	0.988	0.989	0.989
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.988	0.988	0.989	0.989	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.988	0.989	0.988	0.989
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	0.989	0.990	0.990	0.989	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.991	0.991	0.991	0.991	0.991	0.992	0.991	0.992
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	0.993	0.991	0.992	0.992	0.992	0.992	0.992	0.992	0.993	0.993	0.993	0.993	0.993	0.993	0.994	0.994	0.994	0.993	0.994	0.994
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	0.993	0.992	0.993	0.993	0.994	0.994	0.995	0.995	0.995	0.996	0.996	0.996	0.996	0.996	0.997	0.997	0.997	0.997	0.997	0.997
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	0.997	0.998	0.997	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.996	0.996	0.996
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	0.996	0.996	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.994	0.994	0.994	0.994	0.994	0.994	0.993	0.993	0.993	0.993	0.993
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	0.992	0.991	0.988	0.985	0.979	0.975	0.975	0.974	0.970	0.965	0.962	0.961	0.952	0.946	0.923	0.655	0.477	0.456	0.450	0.444
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	0.435	0.422	0.405	0.384	0.363	0.341	0.316	0.289	0.261	0.236	0.221	0.220	0.224	0.221	0.216	0.216	0.226	0.248	0.258	0.252
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	0.239	0.224	0.211	0.199	0.186	0.168	0.144	0.114	0.081	0.050	0.027	0.012	0.005	0.002	0.001	0.001	0.001	<1E-05	<1E-05	<1E-05
λnm	5000																			
τ	<1E-05																			



Internal Transmittance (τ)

λ nm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.018	0.281	0.672	0.865	0.934	0.960	0.970	0.975	0.978	0.980	0.980	0.981	0.982	0.982
λ nm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.982	0.982	0.983	0.982	0.982	0.983	0.983	0.984	0.985	0.985	0.986	0.986	0.987	0.987	0.987	0.987	0.987	0.987	0.987	0.986
λ nm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.987	0.985	0.985	0.985	0.985	0.985	0.986	0.985	0.986	0.986	0.988	0.988	0.989	0.990	0.990	0.991	0.991	0.991	0.992	0.993
λ nm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
τ	0.992	0.993	0.993	0.993	0.993	0.993	0.994	0.994	0.994	0.995	0.995	0.995	0.996	0.996	0.996	0.996				

Refractive Index/Absorption coefficient/Reflection coefficient

λ nm	400	500	600	700	800	900	1000
n	1.548	1.536	1.530	1.527	1.525	1.523	1.522
P	0.912	0.915	0.916	0.917	0.917	0.918	0.918

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

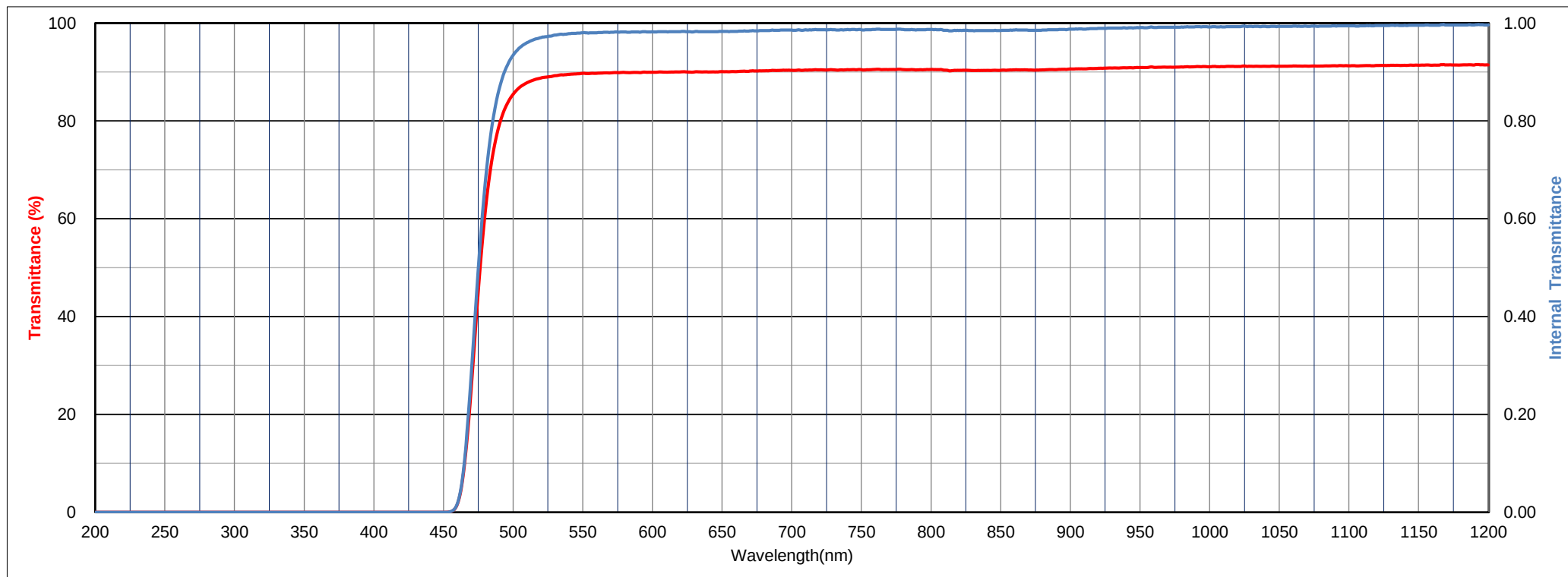
	x	y	Y	λ_d	P_a
A	0.493	0.462	89	580	69
C	0.405	0.487	87	570	71
D65	0.402	0.493	87	569	71

Properties

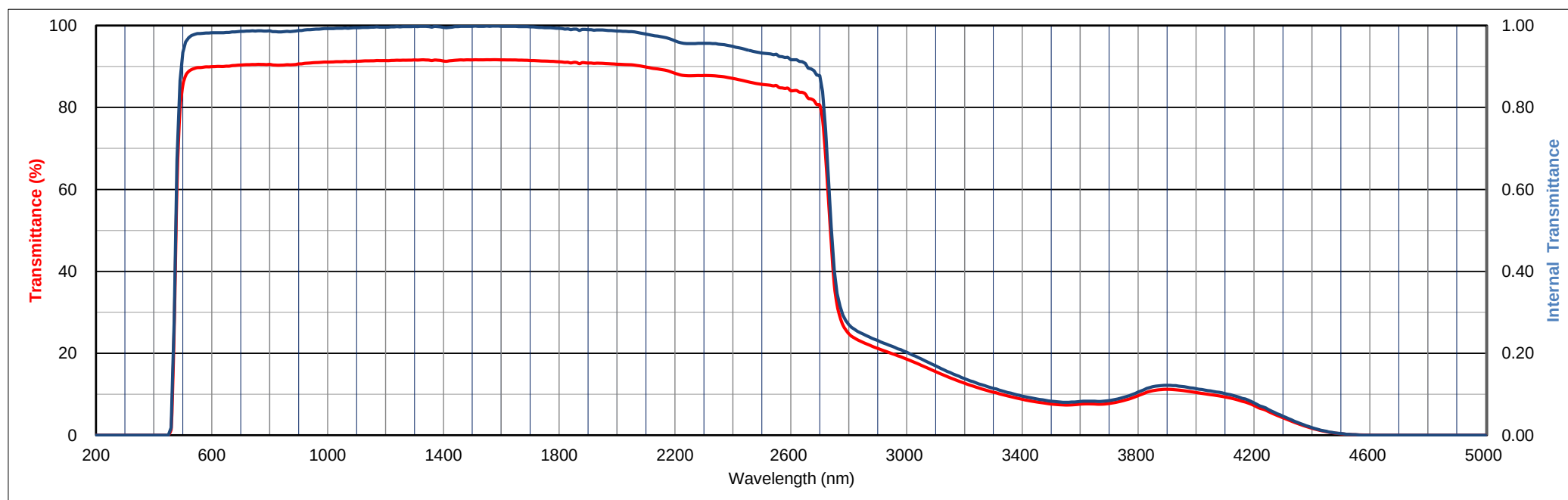
Chemical		Thermal				Mechanical		Others
D_w	D_A	Tg	Ts	α -30/70	α 100/300	H_K	F_A	d
3	1	560	625	94	105	540	130	2.67

Tolerance of Transmittance (τ)

$\lambda\tau_{0.5}$ (nm)	ΔL (nm)	ΔH (nm)
475±5	>410	>550



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.018	0.281	0.672	0.865	0.934	0.960	0.970	0.975	0.978	0.980	0.980	0.981	0.982	0.982
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.982	0.982	0.983	0.982	0.982	0.983	0.983	0.984	0.985	0.985	0.986	0.986	0.987	0.987	0.987	0.987	0.987	0.987	0.987	0.986
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.987	0.985	0.985	0.985	0.985	0.985	0.986	0.985	0.986	0.986	0.988	0.988	0.989	0.990	0.990	0.991	0.991	0.991	0.992	0.993
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	0.992	0.993	0.993	0.993	0.993	0.993	0.994	0.994	0.994	0.995	0.995	0.995	0.995	0.996	0.996	0.996	0.996	0.996	0.996	0.996
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	0.996	0.996	0.997	0.997	0.997	0.997	0.997	0.997	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.996	0.998	0.997	0.997
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	0.995	0.994	0.996	0.996	0.997	0.998	0.998	0.998	0.998	0.998	0.998	0.999	0.998	0.998	0.998	0.999	0.998	0.999	0.999	0.999
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.997	0.997	0.996	0.996	0.996	0.996	0.995	0.995	0.995	0.994	0.994	0.994
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	0.993	0.993	0.992	0.992	0.990	0.992	0.991	0.988	0.991	0.990	0.990	0.990	0.989	0.989	0.989	0.989	0.988	0.988	0.988	0.987
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	0.987	0.985	0.979	0.973	0.962	0.956	0.957	0.955	0.949	0.940	0.933	0.930	0.916	0.908	0.878	0.402	0.270	0.247	0.231	0.217
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	0.202	0.186	0.169	0.153	0.138	0.125	0.114	0.104	0.095	0.088	0.083	0.080	0.083	0.083	0.084	0.092	0.105	0.118	0.122	0.119
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	0.114	0.108	0.102	0.092	0.079	0.063	0.046	0.031	0.018	0.009	0.004	0.001	0.001	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	5000																			
τ	<1E-05																			



Internal Transmittance (τ)

λ nm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.004	0.251	0.720	0.900	0.951	0.968	0.975	0.978	0.980	0.980	0.981	0.981
λ nm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.982	0.981	0.982	0.982	0.982	0.982	0.982	0.983	0.983	0.984	0.985	0.985	0.985	0.986	0.985	0.986	0.985	0.985	0.985	0.985
λ nm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.985	0.984	0.983	0.983	0.983	0.984	0.984	0.984	0.984	0.985	0.986	0.987	0.987	0.988	0.988	0.989	0.990	0.990	0.990	0.991
λ nm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
τ	0.991	0.992	0.991	0.992	0.992	0.992	0.993	0.992	0.992	0.993	0.993	0.993	0.994	0.994	0.994	0.995				

Refractive Index/Absorption coefficient/Reflection coefficient

λ nm	400	500	600	700	800	900	1000
n	1.548	1.537	1.530	1.527	1.525	1.523	1.522
P	0.912	0.914	0.916	0.917	0.917	0.918	0.918

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

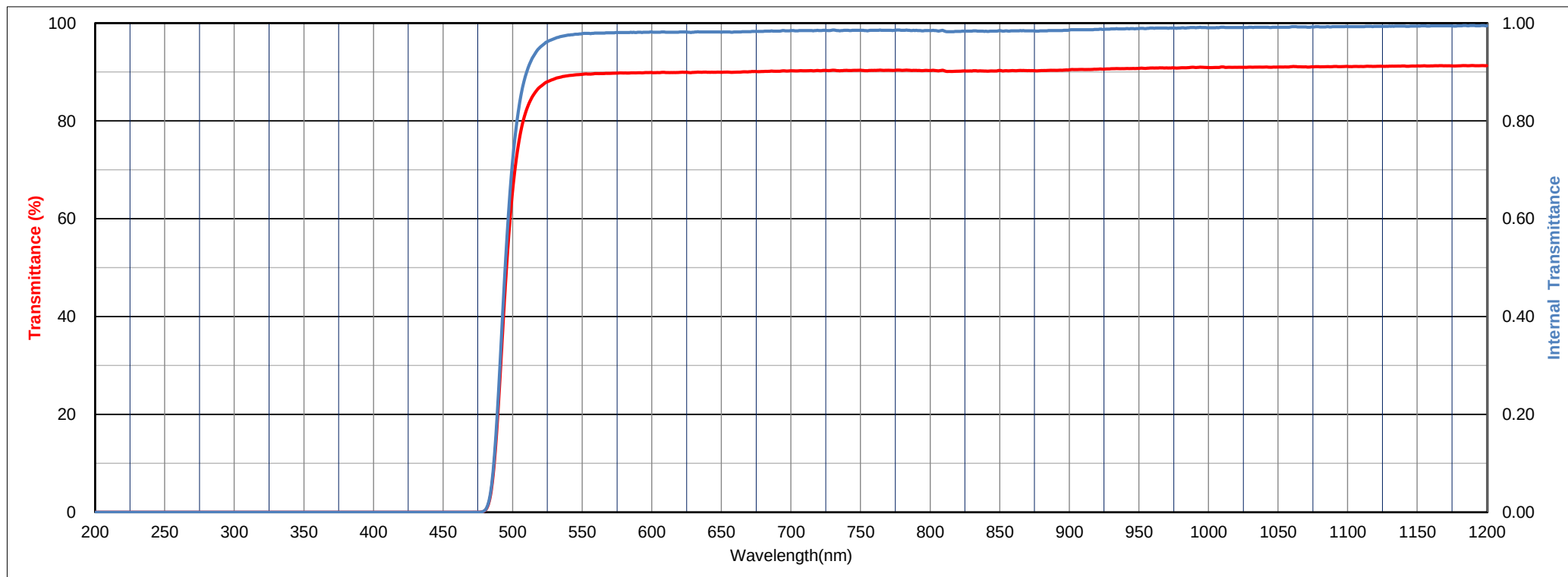
	x	y	Y	λ_d	P_e
A	0.510	0.472	87	581	88
C	0.443	0.521	83	572	91
D65	0.438	0.526	83	571	90

Properties

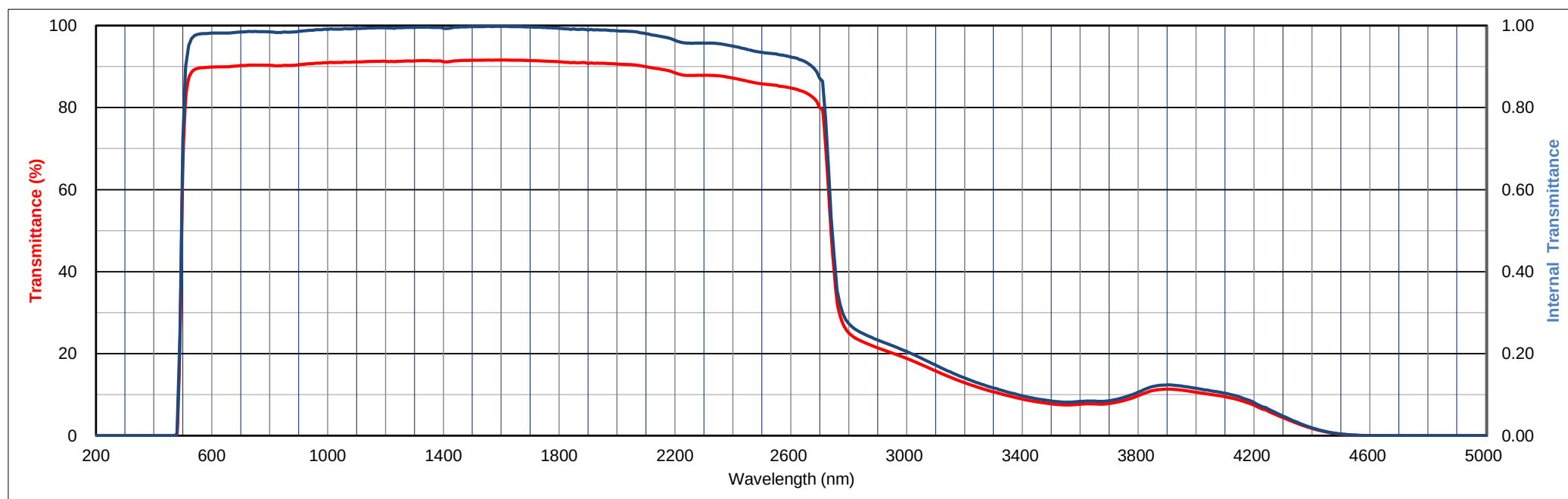
Chemical		Thermal				Mechanical		Others
D_w	D_A	Tg	Ts	α -30/70	α 100/300	H_K	F_A	d
3	1	560	625	94	105	540	130	2.67

Tolerance of Transmittance (τ)

$\lambda\tau_{0.5}$ (nm)	ΔL (nm)	ΔH (nm)
495 $\pm$ 5	>430	>560



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.004	0.251	0.720	0.900	0.951	0.968	0.975	0.978	0.980	0.980	0.981	0.981
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.982	0.981	0.982	0.982	0.982	0.982	0.982	0.983	0.983	0.984	0.985	0.985	0.985	0.986	0.985	0.986	0.985	0.985	0.985	0.985
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.985	0.984	0.983	0.983	0.983	0.984	0.984	0.984	0.984	0.985	0.986	0.987	0.987	0.988	0.988	0.989	0.990	0.990	0.990	0.991
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	0.991	0.992	0.991	0.992	0.992	0.992	0.993	0.992	0.992	0.993	0.993	0.993	0.993	0.994	0.994	0.994	0.994	0.995	0.994	0.995
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	0.995	0.994	0.994	0.994	0.994	0.994	0.995	0.995	0.996	0.995	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.996
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	0.993	0.993	0.994	0.995	0.996	0.996	0.997	0.997	0.997	0.997	0.997	0.998	0.997	0.998	0.998	0.998	0.998	0.998	0.998	0.998
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	0.998	0.998	0.998	0.998	0.997	0.998	0.997	0.997	0.997	0.997	0.996	0.996	0.996	0.996	0.995	0.995	0.995	0.994	0.994	0.994
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	0.993	0.993	0.992	0.992	0.991	0.992	0.991	0.991	0.991	0.991	0.989	0.990	0.989	0.990	0.989	0.989	0.989	0.988	0.988	0.988
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	0.987	0.986	0.980	0.974	0.964	0.957	0.957	0.956	0.950	0.942	0.935	0.931	0.924	0.912	0.871	0.434	0.273	0.249	0.233	0.219
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	0.205	0.189	0.172	0.156	0.141	0.128	0.116	0.106	0.097	0.090	0.084	0.082	0.083	0.084	0.085	0.093	0.106	0.120	0.124	0.121
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	0.115	0.110	0.103	0.094	0.081	0.065	0.048	0.032	0.019	0.010	0.004	0.001	0.001	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	5000																			
τ	<1E-05																			



Internal Transmittance (τ)

λ nm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.004	0.234	0.704	0.894	0.949	0.967	0.973	0.976	0.977	0.978
λ nm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.978	0.978	0.979	0.978	0.979	0.979	0.979	0.980	0.980	0.981	0.981	0.981	0.982	0.982	0.982	0.982	0.982	0.982	0.982	0.982
λ nm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.982	0.981	0.979	0.980	0.980	0.980	0.980	0.981	0.981	0.981	0.982	0.983	0.984	0.985	0.985	0.986	0.987	0.987	0.987	0.988
λ nm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
τ	0.988	0.988	0.988	0.989	0.989	0.989	0.990	0.990	0.990	0.990	0.990	0.991	0.992	0.992	0.992	0.993				

Refractive Index/Absorption coefficient/Reflection coefficient

λ nm	400	500	600	700	800	900	1000
n	1.543	1.534	1.529	1.526	1.524	1.523	1.522
P	0.913	0.915	0.916	0.917	0.917	0.918	0.918

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

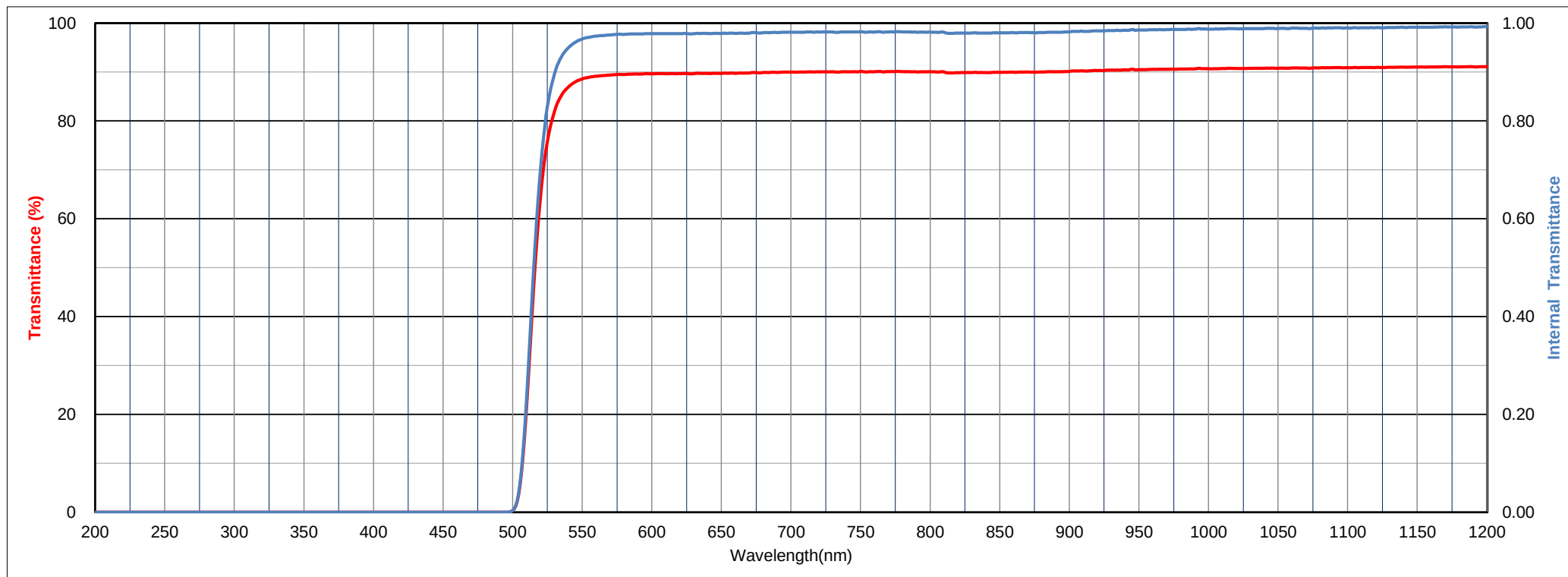
	x	y	Y	λ_d	P _e
A	0.530	0.464	82	583	96
C	0.478	0.512	75	576	98
D65	0.473	0.516	75	575	97

Properties

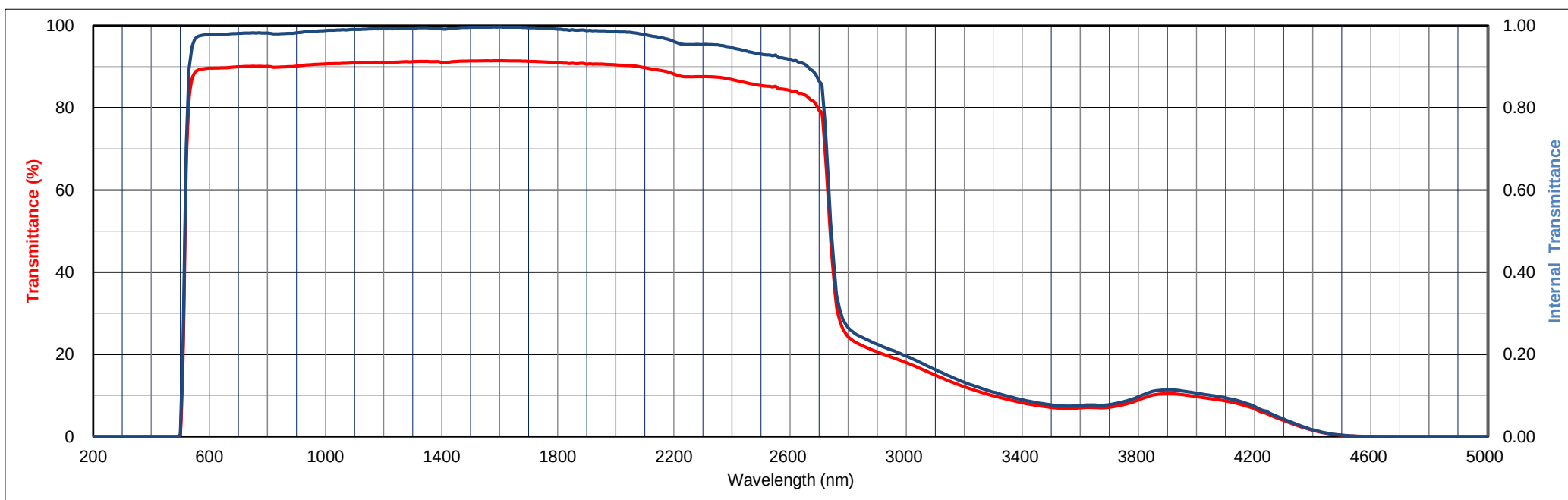
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
2	1	560	620	96	108	540	130	2.68

Tolerance of Transmittance (τ)

$\lambda\tau_{0.5}$ (nm)	ΔL (nm)	ΔH (nm)
515±5	>440	>580



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.004	0.234	0.704	0.894	0.949	0.967	0.973	0.976	0.977	0.978
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.978	0.978	0.979	0.978	0.979	0.979	0.979	0.980	0.980	0.981	0.981	0.981	0.982	0.982	0.982	0.982	0.982	0.982	0.982	0.982
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.982	0.981	0.979	0.980	0.980	0.980	0.980	0.981	0.981	0.981	0.982	0.983	0.984	0.985	0.985	0.986	0.987	0.987	0.987	0.988
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	0.988	0.988	0.988	0.989	0.989	0.989	0.990	0.990	0.990	0.990	0.990	0.991	0.991	0.991	0.992	0.992	0.992	0.993	0.992	0.992
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	0.993	0.992	0.993	0.992	0.993	0.993	0.993	0.994	0.994	0.993	0.994	0.994	0.995	0.995	0.995	0.995	0.994	0.994	0.994	0.994
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	0.992	0.991	0.992	0.993	0.994	0.994	0.995	0.995	0.995	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.997	0.996
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.995	0.995	0.995	0.995	0.995	0.995	0.994	0.994	0.993	0.993	0.993	0.992
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	0.992	0.991	0.990	0.990	0.989	0.990	0.989	0.989	0.990	0.989	0.987	0.988	0.987	0.988	0.987	0.988	0.987	0.987	0.986	0.986
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	0.985	0.984	0.978	0.971	0.961	0.954	0.954	0.953	0.947	0.938	0.931	0.928	0.918	0.906	0.865	0.426	0.265	0.240	0.225	0.210
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	0.196	0.180	0.163	0.147	0.132	0.119	0.108	0.098	0.090	0.082	0.077	0.074	0.076	0.077	0.078	0.085	0.097	0.110	0.114	0.111
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	0.106	0.100	0.094	0.086	0.073	0.058	0.043	0.028	0.017	0.008	0.003	0.001	0.001	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	5000																			
τ	<1E-05																			



Internal Transmittance (τ)

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.007	0.134	0.484	0.772	0.901	0.950	0.968	0.976	0.980
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.981	0.982	0.983	0.983	0.983	0.983	0.984	0.984	0.985	0.985	0.986	0.986	0.986	0.987	0.986	0.986	0.986	0.986	0.986	0.985
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.986	0.986	0.984	0.984	0.984	0.985	0.985	0.985	0.985	0.986	0.987	0.987	0.988	0.989	0.989	0.990	0.990	0.991	0.991	0.992
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
τ	0.992	0.993	0.992	0.993	0.993	0.993	0.993	0.994	0.994	0.995	0.994	0.995	0.995	0.996	0.996	0.996				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.545	1.535	1.529	1.525	1.523	1.522	1.521
P	0.912	0.915	0.916	0.917	0.918	0.918	0.918

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

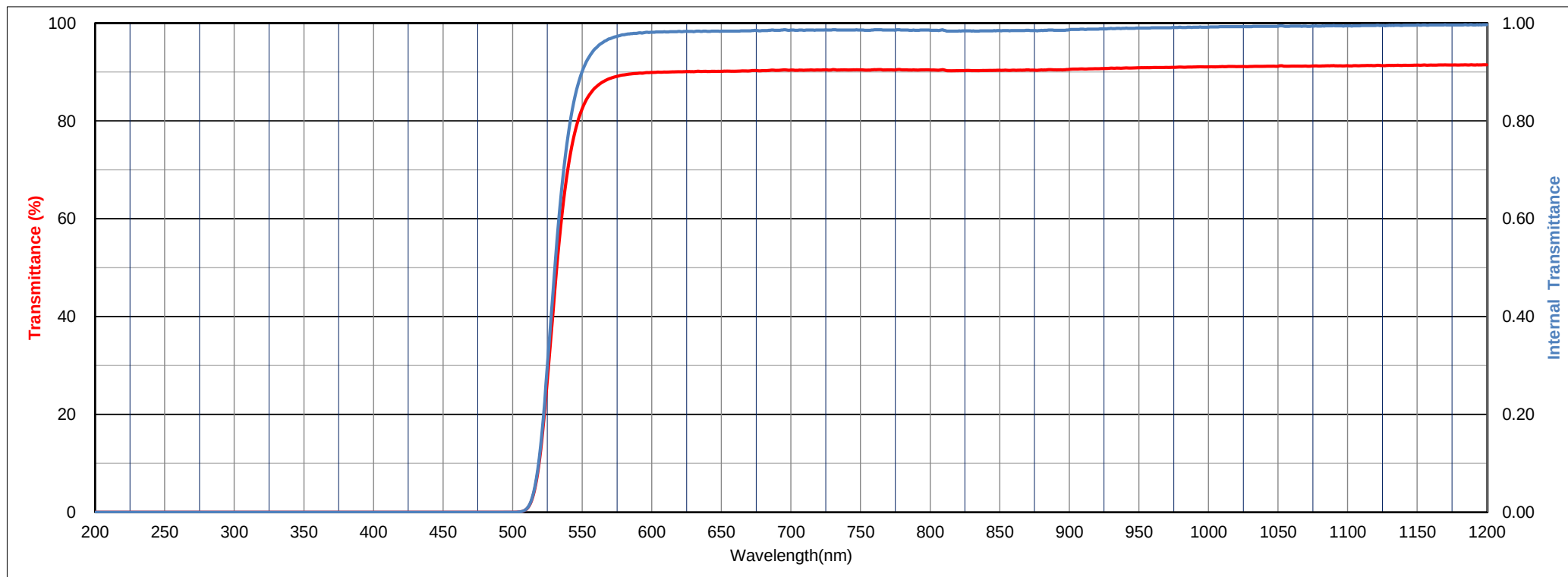
	x	y	Y	λ _d	P _e
A	0.552	0.445	74	586	99
C	0.509	0.487	65	580	99
D65	0.507	0.489	64	579	99

Properties

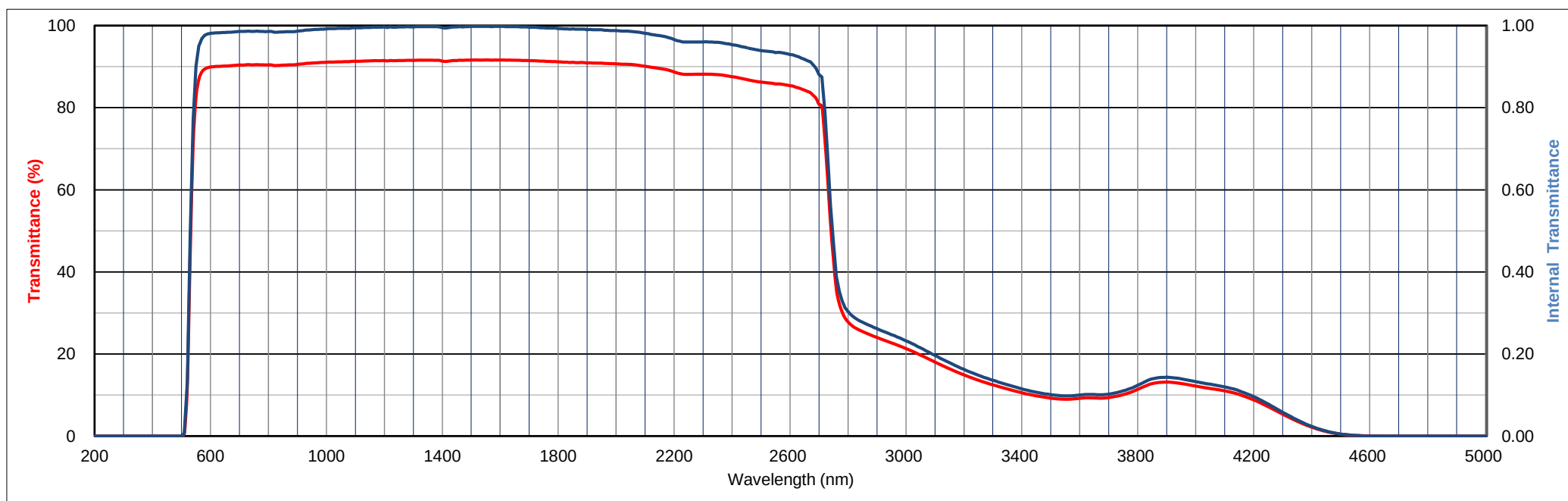
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	1	560	625	99	107	520	140	2.68

Tolerance of Transmittance (τ)

λτ _{0.5} (nm)	ΔL (nm)	ΔH (nm)
530±5	>460	>600



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.007	0.134	0.484	0.772	0.901	0.950	0.968	0.976	0.980
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.981	0.982	0.983	0.983	0.983	0.983	0.984	0.984	0.985	0.985	0.986	0.986	0.986	0.987	0.986	0.986	0.986	0.986	0.986	0.985
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.986	0.986	0.984	0.984	0.984	0.985	0.985	0.985	0.985	0.986	0.987	0.987	0.988	0.989	0.989	0.990	0.990	0.991	0.991	0.992
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	0.992	0.993	0.992	0.993	0.993	0.993	0.993	0.994	0.994	0.995	0.994	0.995	0.995	0.995	0.995	0.996	0.996	0.996	0.996	0.996
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	0.996	0.995	0.997	0.996	0.996	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.998	0.997	0.998	0.997	0.997	0.997	0.997	0.997
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	0.995	0.994	0.995	0.996	0.997	0.997	0.997	0.997	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.998
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	0.998	0.998	0.998	0.998	0.997	0.997	0.997	0.997	0.997	0.997	0.996	0.996	0.996	0.995	0.995	0.995	0.994	0.994	0.994	0.994
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	0.993	0.993	0.992	0.992	0.991	0.992	0.991	0.991	0.991	0.991	0.990	0.990	0.990	0.990	0.990	0.989	0.989	0.988	0.988	0.988
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	0.988	0.986	0.981	0.975	0.966	0.960	0.960	0.959	0.954	0.946	0.939	0.934	0.930	0.918	0.880	0.469	0.303	0.278	0.262	0.247
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	0.232	0.215	0.197	0.179	0.163	0.148	0.136	0.125	0.115	0.107	0.100	0.098	0.100	0.101	0.102	0.110	0.124	0.139	0.143	0.139
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	0.133	0.126	0.120	0.110	0.096	0.078	0.058	0.039	0.024	0.012	0.005	0.002	0.001	0.001	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	5000																			
τ	<1E-05																			



Internal Transmittance (τ)

λ nm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.003	0.111	0.477	0.775	0.903	0.951	0.970
λ nm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.977	0.981	0.982	0.983	0.983	0.984	0.983	0.984	0.985	0.985	0.985	0.986	0.986	0.986	0.986	0.987	0.986	0.986	0.986	0.986
λ nm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.986	0.985	0.984	0.984	0.984	0.984	0.985	0.984	0.984	0.985	0.986	0.987	0.988	0.989	0.989	0.989	0.990	0.990	0.991	0.991
λ nm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
τ	0.992	0.992	0.992	0.993	0.992	0.993	0.993	0.994	0.993	0.994	0.994	0.994	0.995	0.996	0.996	0.996				

Refractive Index/Absorption coefficient/Reflection coefficient

λ nm	400	500	600	700	800	900	1000
n	1.546	1.535	1.528	1.525	1.522	1.521	1.519
P	0.912	0.915	0.916	0.917	0.918	0.918	0.918

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

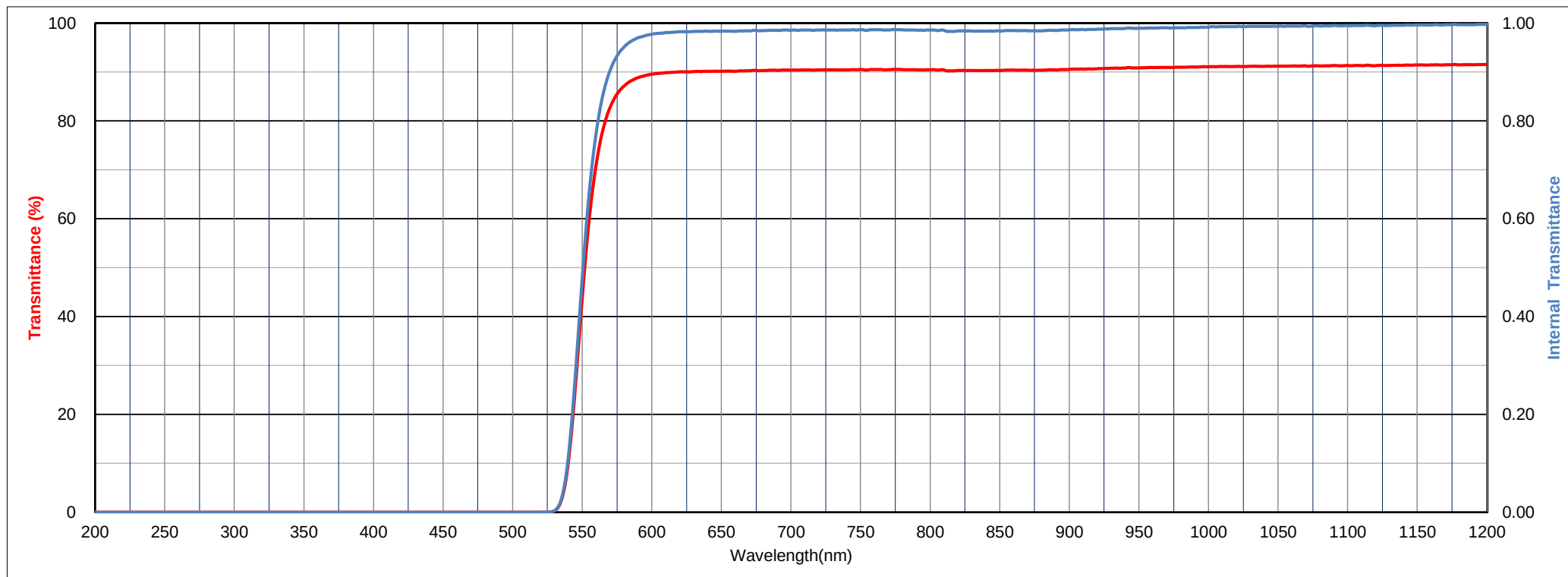
	x	y	Y	λ_d	P_e
A	0.589	0.410	61	592	100
C	0.559	0.440	49	587	100
D65	0.559	0.439	48	587	100

Properties

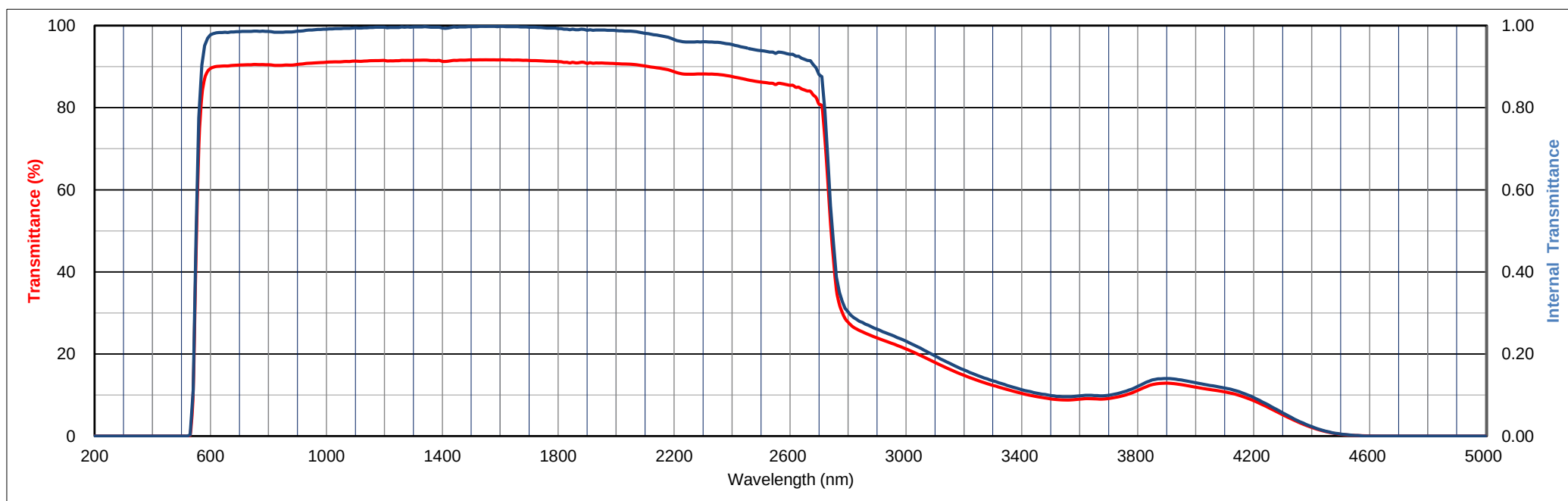
Chemical		Thermal				Mechanical		Others
D_w	D_A	Tg	Ts	α -30/70	α 100/300	H_K	F_A	d
1	1	560	625	93	104	520	140	2.68

Tolerance of Transmittance (τ)

$\lambda\tau_{0.5}$ (nm)	ΔL (nm)	ΔH (nm)
550±5	>480	>620



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.003	0.111	0.477	0.775	0.903	0.951	0.970
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.977	0.981	0.982	0.983	0.983	0.984	0.983	0.984	0.985	0.985	0.985	0.986	0.986	0.986	0.986	0.987	0.986	0.986	0.986	0.986
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.986	0.985	0.984	0.984	0.984	0.984	0.985	0.984	0.984	0.985	0.986	0.987	0.988	0.989	0.989	0.989	0.990	0.990	0.991	0.991
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	0.992	0.992	0.992	0.993	0.992	0.993	0.993	0.994	0.993	0.994	0.994	0.994	0.994	0.995	0.995	0.996	0.996	0.996	0.996	0.996
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	0.996	0.995	0.995	0.995	0.996	0.996	0.996	0.996	0.997	0.996	0.996	0.997	0.997	0.997	0.997	0.997	0.996	0.996	0.996	0.996
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	0.994	0.994	0.994	0.995	0.997	0.996	0.997	0.997	0.997	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.998
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	0.998	0.998	0.998	0.998	0.997	0.997	0.997	0.997	0.997	0.997	0.996	0.996	0.996	0.996	0.995	0.995	0.994	0.994	0.994	0.994
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	0.993	0.993	0.991	0.991	0.990	0.991	0.990	0.990	0.992	0.991	0.988	0.990	0.989	0.990	0.989	0.990	0.989	0.989	0.988	0.988
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	0.988	0.986	0.981	0.976	0.966	0.960	0.960	0.959	0.954	0.946	0.939	0.932	0.930	0.918	0.880	0.468	0.302	0.276	0.261	0.246
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	0.231	0.214	0.195	0.177	0.161	0.147	0.134	0.123	0.113	0.105	0.098	0.096	0.098	0.099	0.100	0.107	0.121	0.136	0.140	0.137
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	0.130	0.123	0.117	0.108	0.094	0.076	0.057	0.038	0.023	0.012	0.005	0.002	0.001	0.001	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	5000																			
τ	<1E-05																			



Internal Transmittance (τ)

λ nm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.003	0.104	0.485	0.794	0.917
λ nm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.958	0.973	0.979	0.981	0.983	0.983	0.983	0.984	0.985	0.985	0.985	0.986	0.985	0.986	0.986	0.986	0.986	0.986	0.986	0.985
λ nm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.985	0.984	0.983	0.983	0.984	0.984	0.985	0.984	0.984	0.985	0.985	0.986	0.987	0.988	0.989	0.989	0.989	0.990	0.990	0.990
λ nm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
τ	0.991	0.991	0.991	0.992	0.992	0.992	0.992	0.992	0.993	0.993	0.993	0.993	0.994	0.994	0.995	0.995				

Refractive Index/Absorption coefficient/Reflection coefficient

λ nm	400	500	600	700	800	900	1000
n	1.545	1.535	1.529	1.525	1.523	1.522	1.521
P	0.912	0.915	0.916	0.917	0.918	0.918	0.918

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

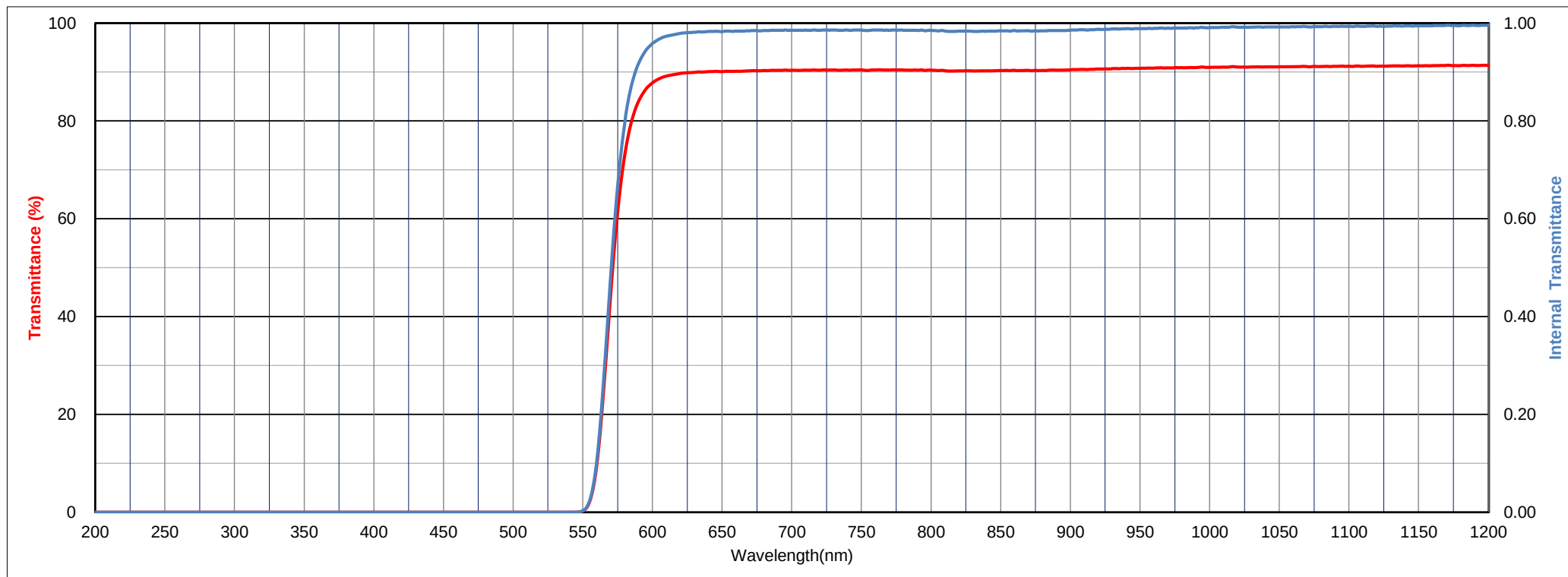
	x	y	Y	λ_d	P_e
A	0.630	0.370	45	601	100
C	0.614	0.386	33	597	100
D65	0.614	0.386	32	597	100

Properties

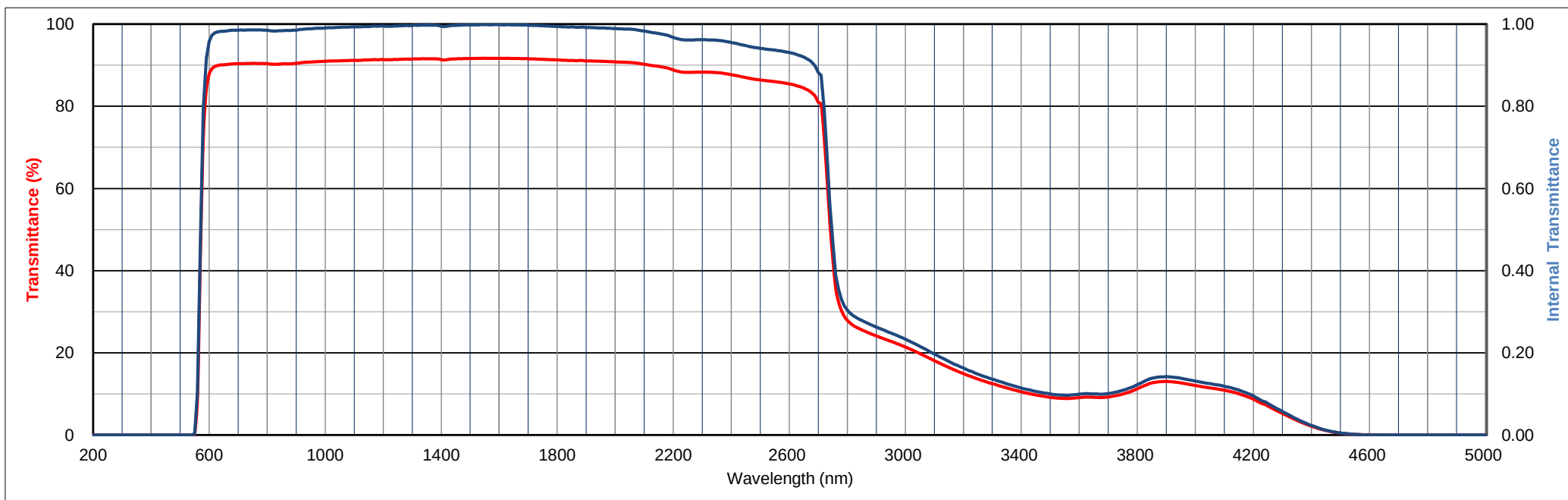
Chemical		Thermal				Mechanical		Others
D_w	D_A	Tg	Ts	α -30/70	α 100/300	H_K	F_A	d
1	1	560	625	93	104	520	140	2.68

Tolerance of Transmittance (τ)

$\lambda\tau_{0.5}$ (nm)	ΔL (nm)	ΔH (nm)
570 $\pm$ 5	>500	>640



λ nm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.003	0.104	0.485	0.794	0.917
λ nm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.958	0.973	0.979	0.981	0.983	0.983	0.983	0.984	0.985	0.985	0.985	0.986	0.985	0.986	0.986	0.986	0.986	0.986	0.986	0.985
λ nm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.985	0.984	0.983	0.983	0.984	0.984	0.985	0.984	0.984	0.985	0.985	0.986	0.987	0.988	0.989	0.989	0.989	0.990	0.990	0.990
λ nm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	0.991	0.991	0.991	0.992	0.992	0.992	0.992	0.992	0.993	0.993	0.993	0.993	0.993	0.994	0.994	0.994	0.994	0.995	0.995	0.995
λ nm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	0.995	0.995	0.995	0.995	0.996	0.995	0.996	0.996	0.997	0.996	0.997	0.997	0.997	0.997	0.998	0.997	0.997	0.997	0.997	0.997
λ nm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	0.995	0.994	0.995	0.996	0.997	0.997	0.998	0.997	0.998	0.998	0.998	0.998	0.998	0.998	0.999	0.999	0.998	0.998	0.999	0.999
λ nm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	0.999	0.998	0.998	0.999	0.998	0.998	0.998	0.998	0.998	0.998	0.997	0.997	0.997	0.996	0.996	0.996	0.996	0.995	0.995	0.995
λ nm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	0.994	0.994	0.993	0.993	0.993	0.993	0.992	0.992	0.993	0.992	0.991	0.992	0.991	0.991	0.991	0.991	0.991	0.990	0.990	0.990
λ nm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	0.989	0.988	0.983	0.977	0.968	0.961	0.962	0.961	0.955	0.948	0.941	0.937	0.931	0.920	0.882	0.469	0.304	0.279	0.263	0.248
λ nm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	0.233	0.216	0.197	0.179	0.163	0.148	0.136	0.125	0.115	0.106	0.100	0.097	0.099	0.100	0.101	0.109	0.123	0.138	0.142	0.138
λ nm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	0.131	0.125	0.119	0.109	0.095	0.077	0.057	0.039	0.023	0.012	0.005	0.002	0.001	0.001	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	5000																			
τ	<1E-05																			



Internal Transmittance (τ)

λ nm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.002	0.100	0.512
λ nm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.822	0.931	0.964	0.975	0.980	0.982	0.983	0.984	0.984	0.985	0.985	0.985	0.986	0.986	0.985	0.985	0.985	0.985	0.984	0.985
λ nm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.984	0.984	0.983	0.983	0.983	0.983	0.984	0.983	0.983	0.984	0.985	0.986	0.986	0.987	0.987	0.988	0.989	0.989	0.989	0.990
λ nm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
τ	0.990	0.991	0.990	0.991	0.991	0.991	0.991	0.992	0.992	0.992	0.993	0.992	0.994	0.994	0.994	0.994				

Refractive Index/Absorption coefficient/Reflection coefficient

λ nm	400	500	600	700	800	900	1000
n	1.546	1.536	1.530	1.526	1.524	1.523	1.521
P	0.912	0.915	0.916	0.917	0.917	0.918	0.918

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

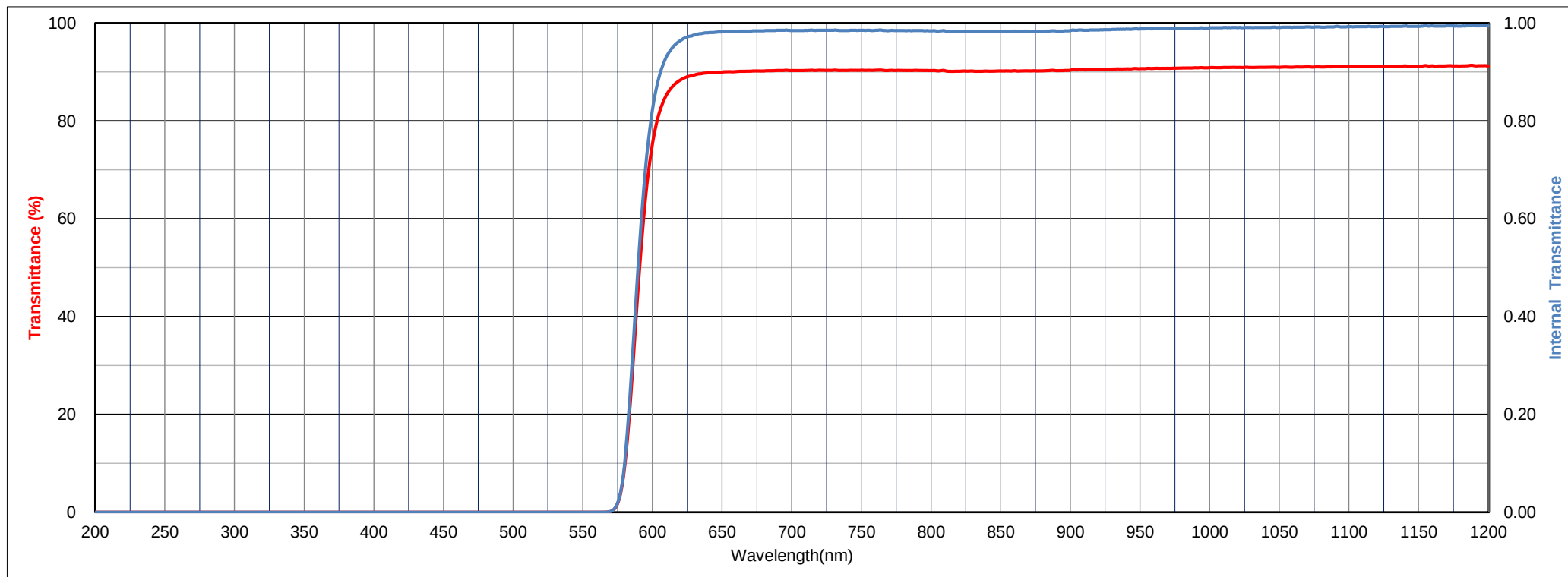
	x	y	Y	λ_d	P_e
A	0.670	0.330	29	611	100
C	0.663	0.337	19	609	100
D65	0.663	0.337	19	609	100

Properties

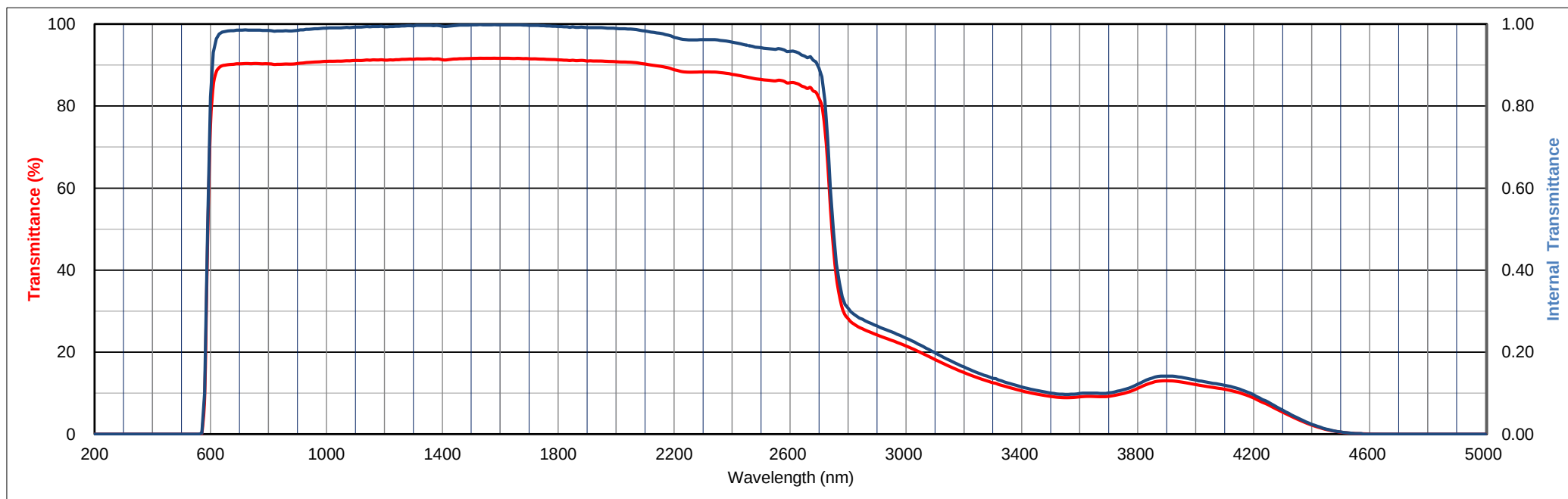
Chemical		Thermal				Mechanical		Others
D_w	D_A	Tg	Ts	α -30/70	α 100/300	H_K	F_A	d
1	1	560	625	93	104	520	140	2.68

Tolerance of Transmittance (τ)

$\lambda\tau_{0.5}$ (nm)	ΔL (nm)	ΔH (nm)
590±5	>520	>660



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.002	0.100	0.512
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.822	0.931	0.964	0.975	0.980	0.982	0.983	0.984	0.984	0.985	0.985	0.985	0.986	0.986	0.985	0.985	0.985	0.985	0.984	0.985
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.984	0.984	0.983	0.983	0.983	0.983	0.984	0.983	0.983	0.984	0.985	0.986	0.986	0.987	0.987	0.988	0.989	0.989	0.989	0.990
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	0.990	0.991	0.990	0.991	0.991	0.991	0.991	0.992	0.992	0.992	0.993	0.992	0.992	0.993	0.994	0.993	0.994	0.994	0.994	0.994
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	0.994	0.993	0.994	0.994	0.995	0.995	0.995	0.996	0.996	0.996	0.996	0.997	0.997	0.996	0.997	0.997	0.997	0.997	0.996	0.996
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	0.994	0.994	0.995	0.996	0.996	0.997	0.997	0.997	0.997	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.999	0.998
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.997	0.998	0.997	0.997	0.997	0.996	0.996	0.996	0.995	0.995	0.995	0.995
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	0.994	0.994	0.993	0.993	0.992	0.993	0.992	0.992	0.993	0.992	0.991	0.992	0.991	0.991	0.991	0.991	0.991	0.990	0.990	0.990
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	0.989	0.988	0.983	0.977	0.968	0.961	0.962	0.961	0.956	0.949	0.942	0.938	0.933	0.922	0.892	0.492	0.307	0.280	0.264	0.249
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	0.234	0.217	0.198	0.180	0.164	0.149	0.136	0.125	0.115	0.107	0.100	0.097	0.099	0.100	0.100	0.108	0.122	0.137	0.142	0.138
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	0.132	0.125	0.119	0.110	0.096	0.078	0.058	0.040	0.024	0.012	0.005	0.002	0.001	0.001	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	5000																			
τ	<1E-05																			



Internal Transmittance (τ)

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.169	0.522	0.806	0.921	0.959	0.971	0.976	0.978	0.979	0.980	0.980	0.981	0.981	0.981	0.981	0.981	0.981	0.981	0.981	0.981
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.981	0.981	0.980	0.980	0.981	0.981	0.980	0.981	0.981	0.982	0.983	0.983	0.984	0.984	0.985	0.986	0.986	0.987	0.987	0.988
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
τ	0.988	0.989	0.986	0.989	0.988	0.989	0.989	0.990	0.990	0.990	0.990	0.991	0.991	0.992	0.992	0.992				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.547	1.536	1.531	1.527	1.525	1.524	1.523
P	0.912	0.914	0.916	0.917	0.917	0.917	0.918

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

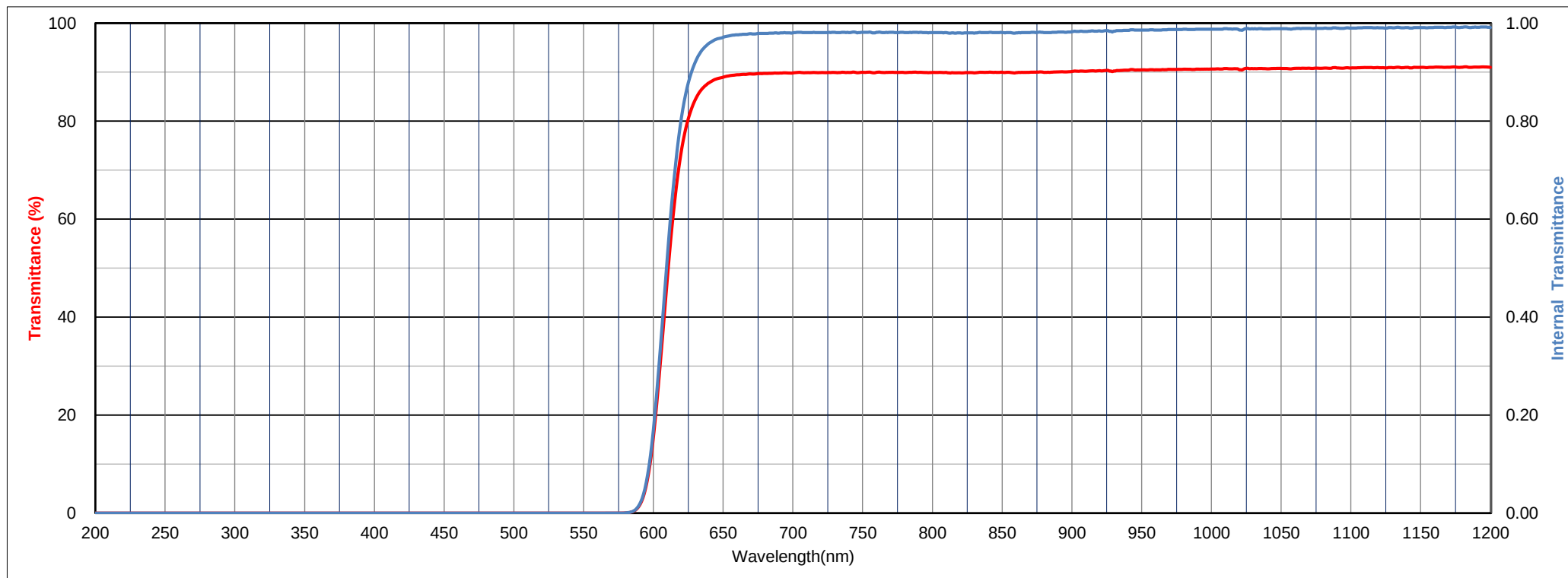
	x	y	Y	λ _d	P _e
A	0.698	0.301	17	624	100
C	0.696	0.304	10	622	100
D65	0.695	0.305	10	622	100

Properties

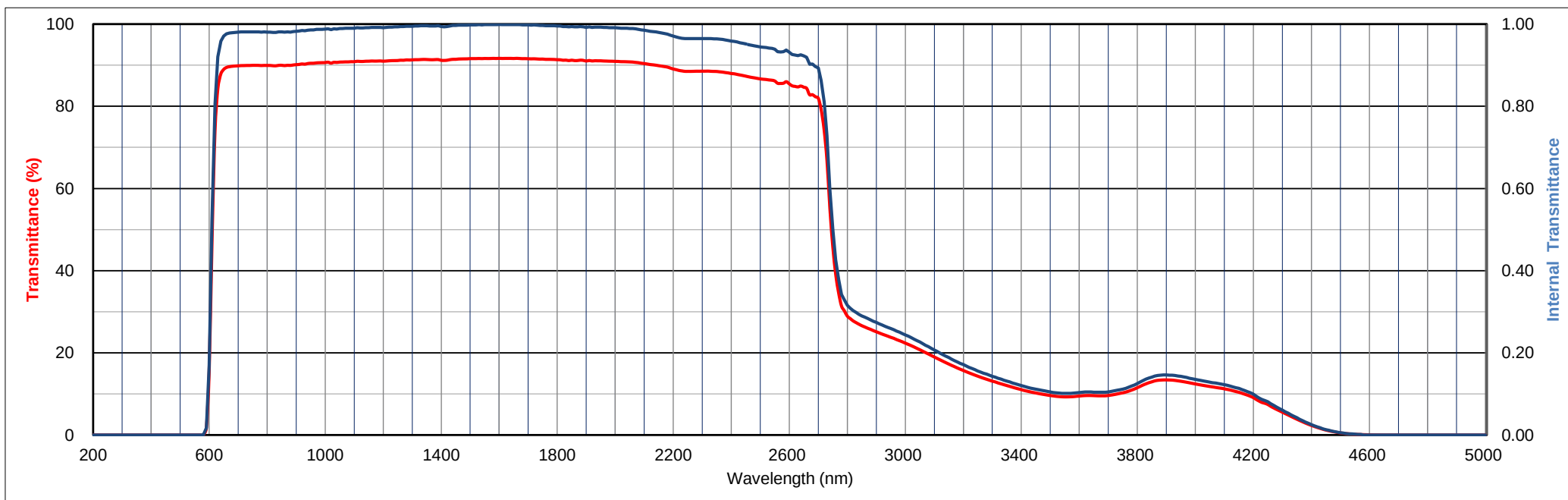
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	2	560	620	93	103	520	140	2.69

Tolerance of Transmittance (τ)

λτ _{0.5} (nm)	ΔL (nm)	ΔH (nm)
610±5	>540	>690



λ nm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.001	0.017
λ nm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.169	0.522	0.806	0.921	0.959	0.971	0.976	0.978	0.979	0.980	0.980	0.981	0.981	0.981	0.981	0.981	0.981	0.981	0.981	0.981
λ nm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.981	0.981	0.980	0.980	0.981	0.981	0.980	0.981	0.981	0.982	0.983	0.983	0.984	0.984	0.985	0.986	0.986	0.987	0.987	0.988
λ nm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	0.988	0.989	0.986	0.989	0.988	0.989	0.989	0.990	0.990	0.990	0.990	0.991	0.991	0.991	0.991	0.991	0.992	0.992	0.992	0.992
λ nm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	0.992	0.992	0.993	0.993	0.993	0.993	0.994	0.994	0.995	0.995	0.995	0.995	0.995	0.996	0.996	0.996	0.995	0.995	0.996	0.996
λ nm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	0.994	0.993	0.994	0.995	0.996	0.996	0.997	0.997	0.998	0.998	0.998	0.998	0.998	0.999	0.998	0.999	0.999	0.999	0.999	0.999
λ nm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.998	0.998	0.998	0.998	0.998	0.997	0.997	0.997	0.996	0.996	0.996	0.996
λ nm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	0.995	0.995	0.994	0.994	0.993	0.994	0.993	0.993	0.994	0.994	0.992	0.993	0.992	0.993	0.992	0.992	0.992	0.992	0.991	0.991
λ nm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	0.991	0.990	0.985	0.980	0.971	0.965	0.965	0.964	0.959	0.952	0.945	0.939	0.931	0.922	0.893	0.500	0.315	0.290	0.274	0.259
λ nm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	0.244	0.226	0.207	0.188	0.171	0.156	0.143	0.131	0.120	0.112	0.105	0.101	0.103	0.104	0.105	0.112	0.125	0.141	0.146	0.143
λ nm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	0.135	0.129	0.122	0.113	0.099	0.081	0.061	0.042	0.025	0.013	0.006	0.002	0.001	0.001	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	5000																			
τ	<1E-05																			



Internal Transmittance (τ)

λ nm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.001	0.013	0.148	0.503	0.802	0.925	0.963	0.974	0.978	0.980	0.981	0.982	0.982	0.981	0.982	0.982	0.982	0.982	0.981	0.982
λ nm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.981	0.980	0.980	0.980	0.981	0.981	0.981	0.982	0.981	0.982	0.983	0.984	0.984	0.984	0.986	0.986	0.986	0.987	0.987	0.988
λ nm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
τ	0.988	0.989	0.986	0.989	0.988	0.989	0.989	0.989	0.990	0.990	0.991	0.990	0.991	0.992	0.992	0.992				

Refractive Index/Absorption coefficient/Reflection coefficient

λ nm	400	500	600	700	800	900	1000
n	1.547	1.536	1.530	1.526	1.524	1.522	1.521
P	0.912	0.914	0.916	0.917	0.917	0.918	0.918

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

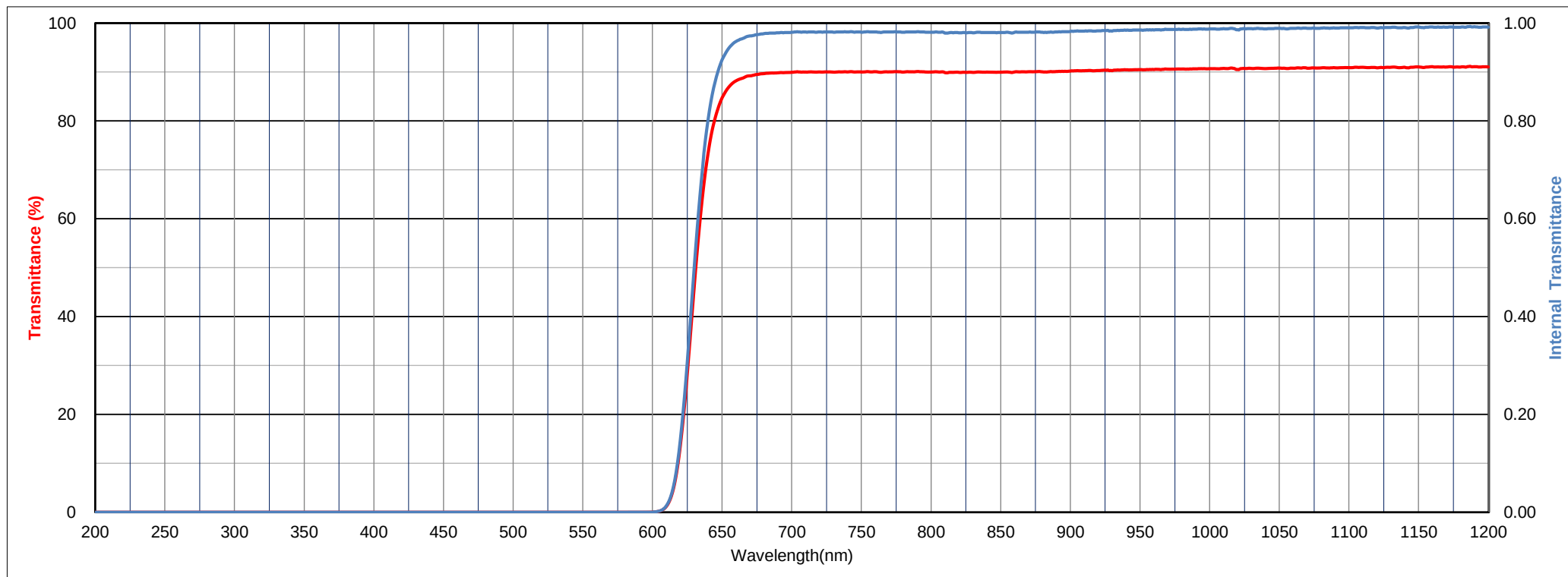
	x	y	Y	λ_d	P_e
A	0.718	0.281	8	639	100
C	0.717	0.283	4	638	100
D65	0.717	0.283	4	638	100

Properties

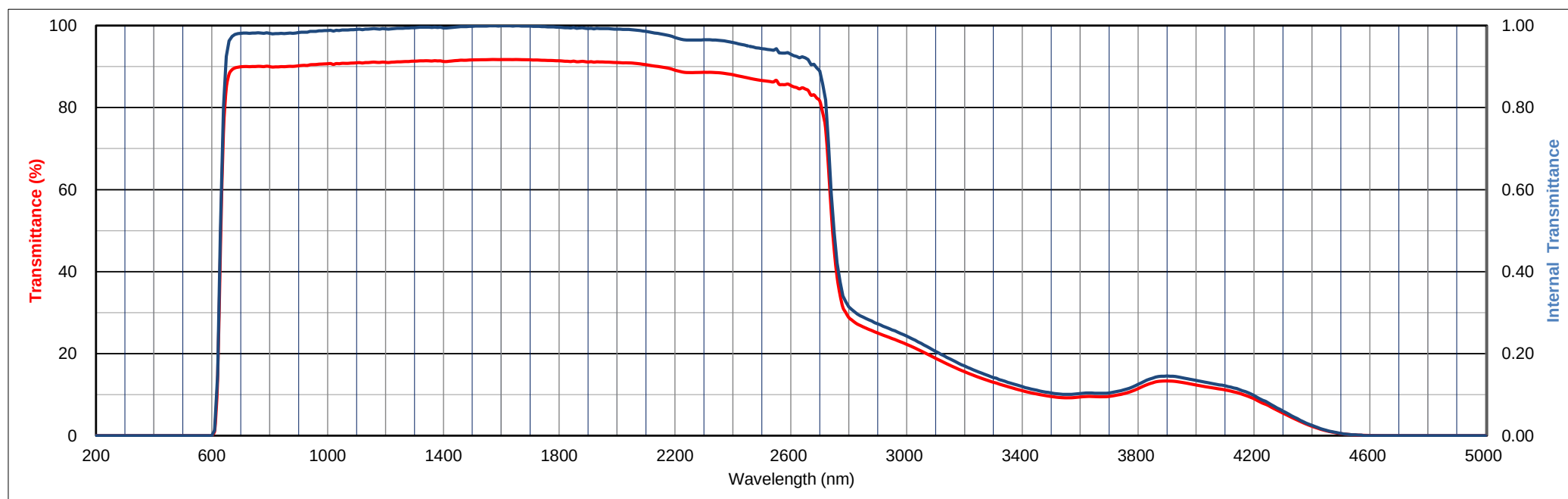
Chemical		Thermal				Mechanical		Others
D_w	D_A	Tg	Ts	α -30/70	α 100/300	H_K	F_A	d
1	1	560	620	95	107	520	140	2.68

Tolerance of Transmittance (τ)

$\lambda\tau_{0.5}$ (nm)	ΔL (nm)	ΔH (nm)
630±5	>550	>710



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.001	0.013	0.148	0.503	0.802	0.925	0.963	0.974	0.978	0.980	0.981	0.982	0.982	0.981	0.982	0.982	0.982	0.982	0.981	0.982
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.981	0.980	0.980	0.980	0.981	0.981	0.981	0.982	0.981	0.982	0.983	0.984	0.984	0.984	0.986	0.986	0.986	0.987	0.987	0.988
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	0.988	0.989	0.986	0.989	0.988	0.989	0.989	0.989	0.990	0.990	0.991	0.991	0.990	0.991	0.991	0.992	0.992	0.992	0.992	0.992
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	0.992	0.991	0.992	0.993	0.993	0.993	0.994	0.994	0.994	0.995	0.995	0.995	0.996	0.996	0.996	0.996	0.995	0.996	0.996	0.996
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	0.994	0.994	0.995	0.995	0.996	0.997	0.998	0.997	0.997	0.998	0.998	0.998	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.998	0.998	0.998	0.997	0.997	0.997	0.997	0.997	0.996
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	0.996	0.995	0.995	0.995	0.994	0.995	0.993	0.994	0.995	0.994	0.993	0.994	0.992	0.993	0.993	0.993	0.992	0.992	0.992	0.991
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	0.991	0.990	0.986	0.980	0.971	0.965	0.965	0.964	0.959	0.951	0.944	0.944	0.930	0.921	0.889	0.493	0.314	0.289	0.273	0.258
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	0.243	0.225	0.206	0.187	0.170	0.155	0.142	0.130	0.119	0.111	0.104	0.101	0.103	0.104	0.104	0.111	0.125	0.140	0.145	0.142
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	0.135	0.128	0.122	0.112	0.098	0.080	0.060	0.041	0.025	0.013	0.005	0.002	0.001	0.001	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	5000																			
τ	<1E-05																			



Internal Transmittance (τ)

λ nm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	<1E-05	<1E-05	0.002	0.047	0.319	0.696	0.890	0.951	0.971	0.978	0.981	0.982	0.983	0.983	0.983	0.983	0.983	0.983	0.983	0.983
λ nm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.983	0.983	0.982	0.982	0.982	0.982	0.983	0.983	0.983	0.983	0.984	0.986	0.986	0.986	0.987	0.988	0.988	0.988	0.989	0.989
λ nm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
τ	0.990	0.990	0.989	0.990	0.990	0.991	0.991	0.992	0.992	0.992	0.993	0.992	0.994	0.994	0.994	0.994				

Refractive Index/Absorption coefficient/Reflection coefficient

λ nm	400	500	600	700	800	900	1000
n	1.547	1.536	1.531	1.527	1.525	1.523	1.522
P	0.912	0.914	0.916	0.917	0.917	0.918	0.918

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

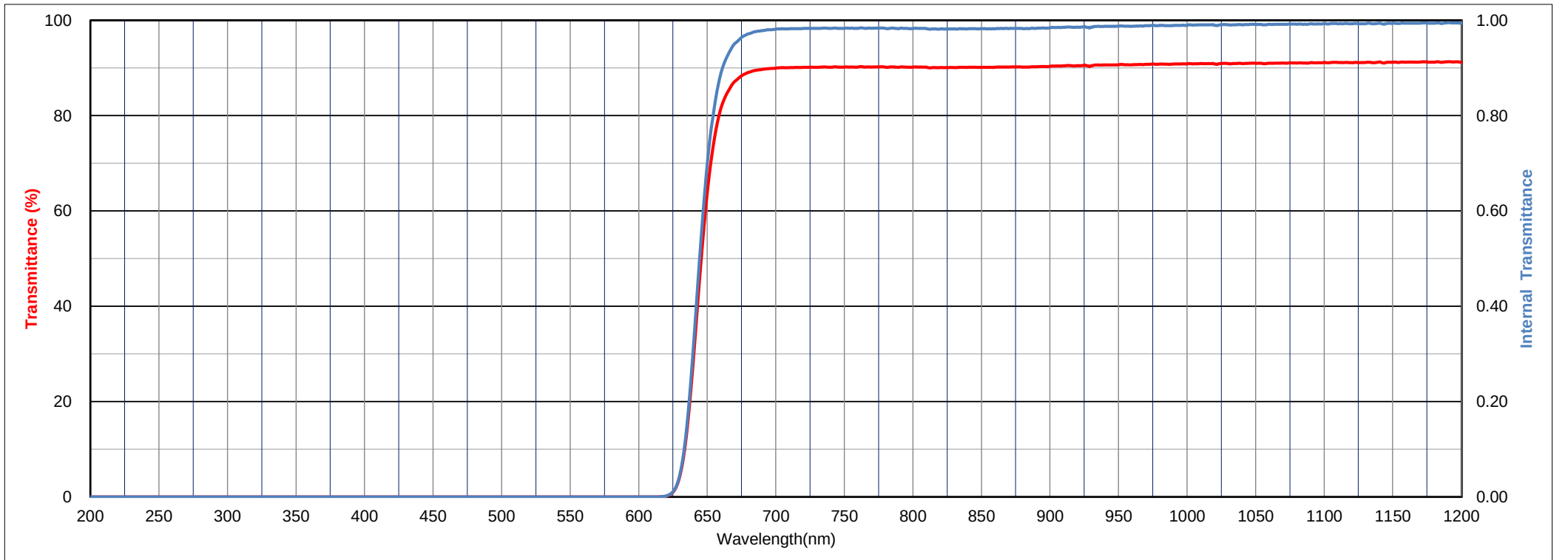
	x	y	Y	λ_d	P _e
A	-	-	-	-	-
C	-	-	-	-	-
D65	-	-	-	-	-

Properties

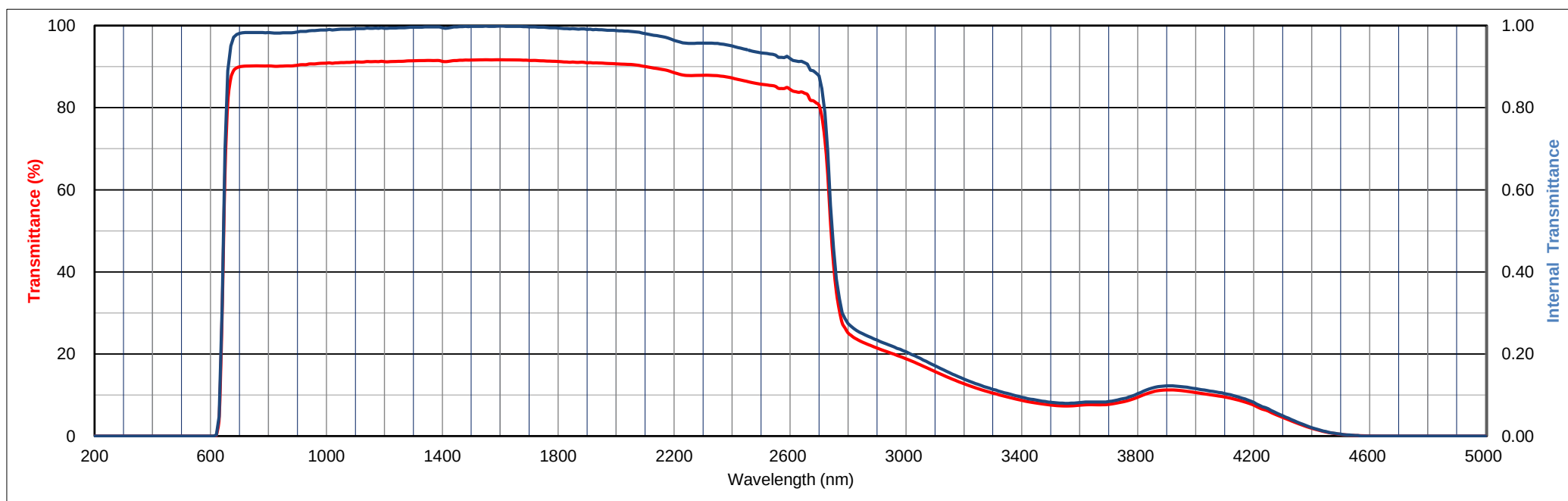
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	$\alpha_{-30/70}$	$\alpha_{100/300}$	H _K	F _A	d
1	1	555	620	94	106	520	140	2.68

Tolerance of Transmittance (τ)

$\lambda\tau_{0.5}$ (nm)	ΔL (nm)	ΔH (nm)
645±5	>560	>720



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	<1E-05	<1E-05	0.002	0.047	0.319	0.696	0.890	0.951	0.971	0.978	0.981	0.982	0.983	0.983	0.983	0.983	0.983	0.983	0.983	0.983
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.983	0.983	0.982	0.982	0.982	0.982	0.983	0.983	0.983	0.983	0.984	0.986	0.986	0.986	0.987	0.988	0.988	0.989	0.989	0.989
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	0.990	0.990	0.989	0.990	0.990	0.991	0.991	0.992	0.992	0.992	0.993	0.993	0.992	0.993	0.994	0.994	0.994	0.994	0.994	0.995
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	0.994	0.993	0.994	0.994	0.994	0.994	0.994	0.995	0.996	0.996	0.996	0.996	0.996	0.996	0.997	0.997	0.997	0.997	0.996	0.996
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	0.994	0.994	0.994	0.995	0.996	0.997	0.997	0.997	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.999	0.998	0.998	0.998	0.999
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	0.999	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.997	0.998	0.997	0.997	0.997	0.996	0.996	0.996	0.995	0.995	0.995	0.994
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	0.994	0.994	0.993	0.993	0.992	0.993	0.992	0.992	0.992	0.992	0.990	0.991	0.990	0.990	0.990	0.990	0.989	0.989	0.989	0.988
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	0.988	0.986	0.981	0.974	0.964	0.957	0.957	0.956	0.950	0.941	0.934	0.928	0.920	0.910	0.878	0.457	0.274	0.249	0.234	0.220
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	0.205	0.189	0.171	0.154	0.139	0.126	0.114	0.104	0.095	0.088	0.082	0.080	0.082	0.083	0.084	0.091	0.103	0.117	0.122	0.121
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	0.115	0.110	0.104	0.095	0.082	0.066	0.050	0.034	0.021	0.011	0.005	0.002	0.001	0.001	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	5000																			
τ	<1E-05																			



Internal Transmittance (τ)

λ nm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.013	0.263	0.663	0.863	0.931	0.955	0.964	0.968	0.970	0.971	0.972	0.973
λ nm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.974	0.973	0.973	0.974	0.974	0.975	0.975	0.976	0.976	0.977	0.978	0.979	0.980	0.980	0.983	0.983	0.983	0.985	0.985	0.986
λ nm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
τ	0.986	0.986	0.985	0.986	0.987	0.987	0.987	0.988	0.988	0.989	0.989	0.990	0.991	0.991	0.991	0.991				

Refractive Index/Absorption coefficient/Reflection coefficient

λ nm	400	500	600	700	800	900	1000
n	1.546	1.535	1.530	1.526	1.523	1.522	1.521
P	0.912	0.915	0.916	0.917	0.918	0.918	0.918

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

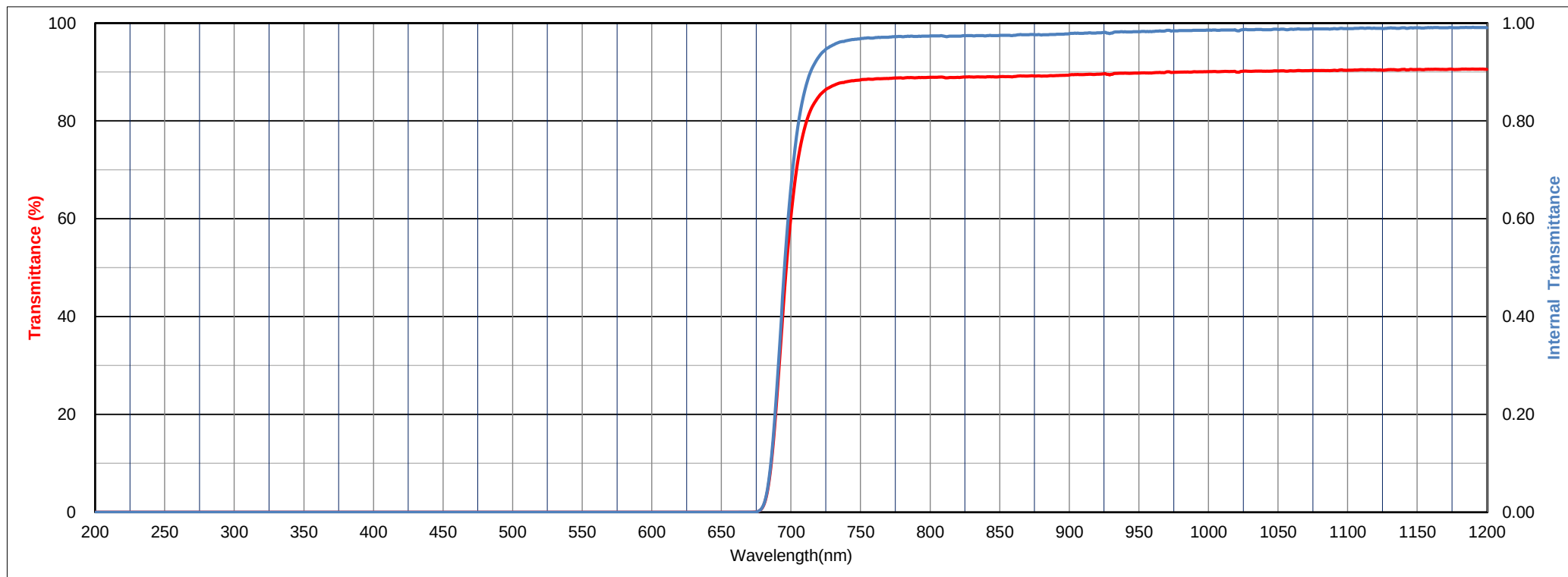
	x	y	Y	λ_d	P_e
A	-	-	-	-	-
C	-	-	-	-	-
D65	-	-	-	-	-

Properties

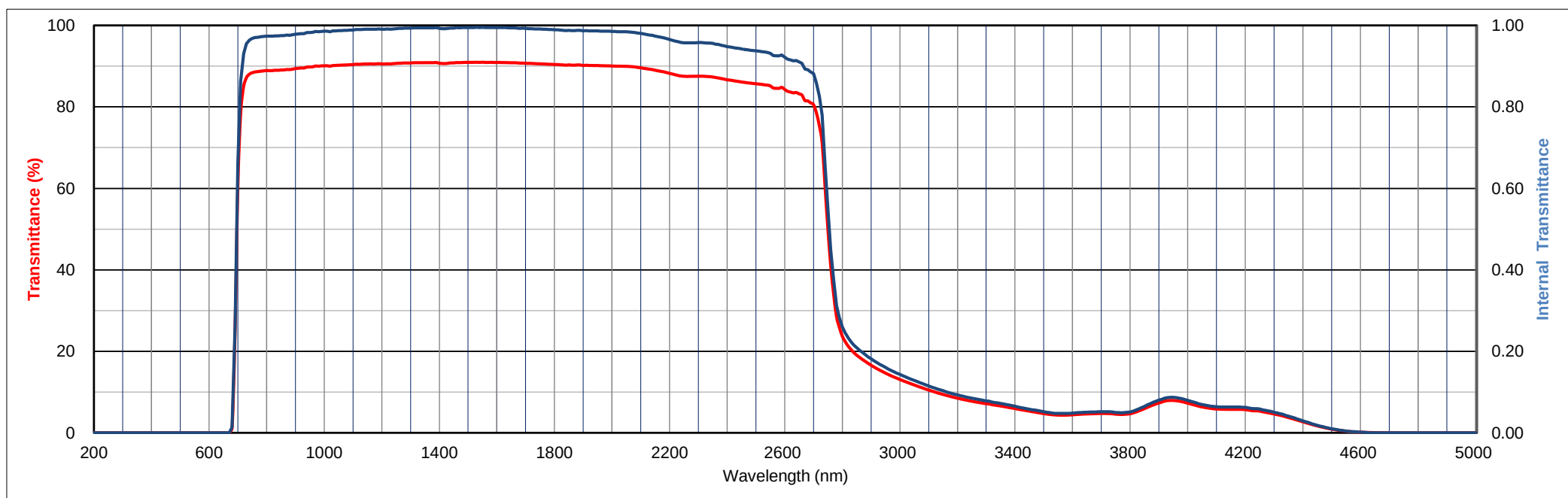
Chemical		Thermal				Mechanical		Others
D_w	D_A	Tg	Ts	α -30/70	α 100/300	H_K	F_A	d
1	1	555	620	94	106	520	140	2.68

Tolerance of Transmittance (τ)

$\lambda_{0.5}$ (nm)	ΔL (nm)	ΔH (nm)
665±5	>580	>750



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.013	0.263	0.663	0.863	0.931	0.955	0.964	0.968	0.970	0.971	0.972	0.973
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.974	0.973	0.973	0.974	0.974	0.975	0.975	0.976	0.976	0.977	0.978	0.979	0.980	0.980	0.983	0.983	0.983	0.985	0.985	0.986
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	0.986	0.986	0.985	0.986	0.987	0.987	0.987	0.988	0.988	0.989	0.989	0.990	0.990	0.990	0.991	0.990	0.991	0.991	0.991	0.991
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	0.991	0.991	0.991	0.991	0.992	0.992	0.993	0.993	0.993	0.993	0.993	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	0.993	0.992	0.992	0.993	0.993	0.994	0.994	0.994	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	0.995	0.995	0.994	0.994	0.994	0.994	0.994	0.994	0.993	0.993	0.992	0.992	0.992	0.992	0.991	0.991	0.991	0.990	0.990	0.990
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	0.989	0.989	0.988	0.988	0.987	0.988	0.987	0.987	0.988	0.988	0.987	0.987	0.987	0.987	0.986	0.986	0.986	0.986	0.986	0.986
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	0.985	0.984	0.980	0.974	0.965	0.958	0.958	0.956	0.948	0.942	0.937	0.932	0.922	0.910	0.882	0.548	0.260	0.209	0.182	0.160
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	0.143	0.129	0.115	0.103	0.093	0.085	0.078	0.072	0.065	0.058	0.052	0.048	0.048	0.051	0.052	0.050	0.051	0.065	0.080	0.087
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	0.080	0.069	0.064	0.063	0.062	0.058	0.051	0.041	0.030	0.019	0.010	0.004	0.002	0.001	0.001	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	5000																			
τ	<1E-05																			



Internal Transmittance (τ)

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.013	0.263	0.663	0.863	0.931	0.955	0.964	0.968	0.970	0.971	0.972	0.973
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.974	0.973	0.973	0.974	0.974	0.975	0.975	0.976	0.976	0.977	0.978	0.979	0.980	0.980	0.983	0.983	0.983	0.985	0.985	0.986
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
τ	0.986	0.986	0.985	0.986	0.987	0.987	0.987	0.988	0.988	0.989	0.989	0.990	0.991	0.991	0.991	0.991				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.562	1.552	1.547	1.543	1.541	1.539	1.538
P	0.908	0.911	0.912	0.913	0.913	0.914	0.914

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

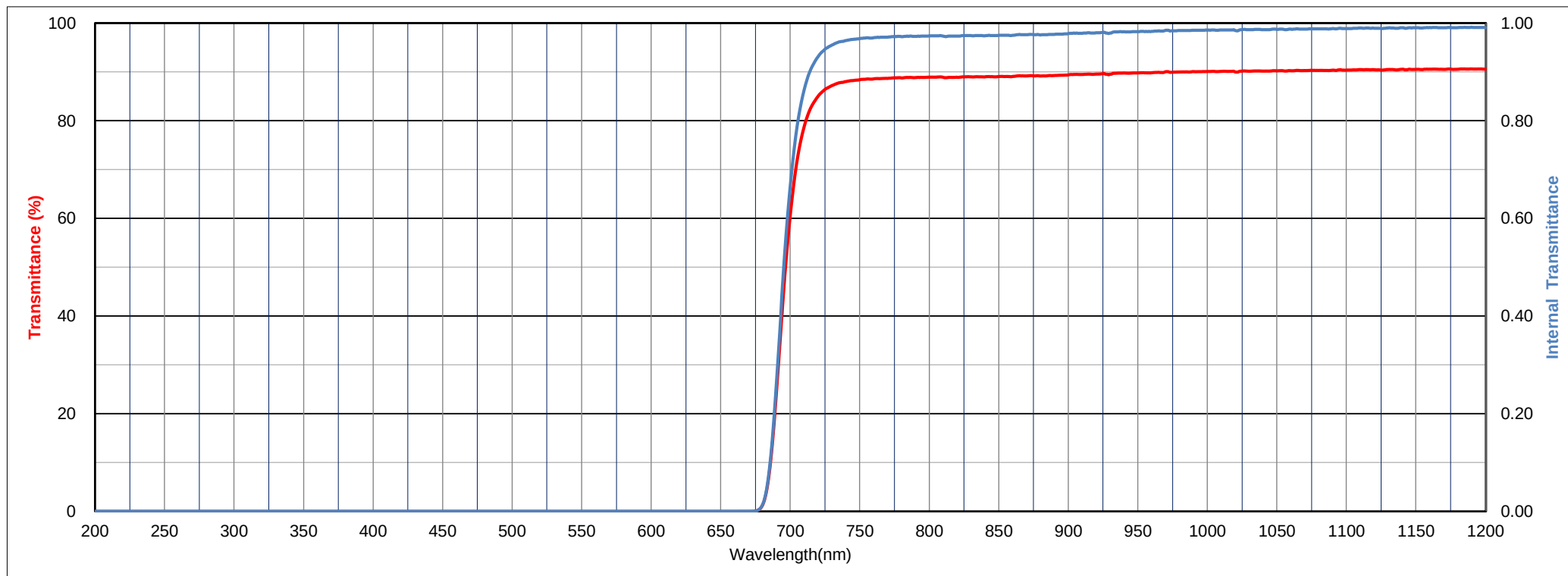
	x	y	Y	λ _d	P _e
A	-	-	-	-	-
C	-	-	-	-	-
D65	-	-	-	-	-

Properties

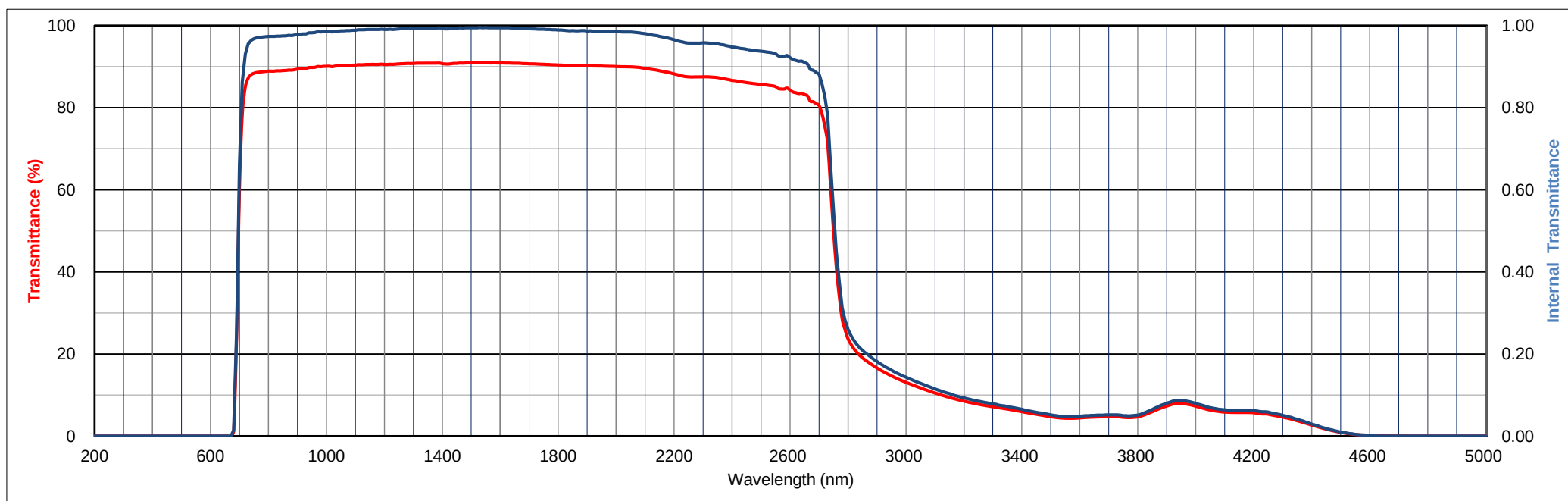
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	3	525	575	98	115	470	160	2.86

Tolerance of Transmittance (τ)

λ _{t0.5} (nm)	ΔL (nm)	ΔH (nm)
695±5	>610	>780



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.013	0.263	0.663	0.863	0.931	0.955	0.964	0.968	0.970	0.971	0.972	0.973
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.974	0.973	0.973	0.974	0.974	0.975	0.975	0.976	0.976	0.977	0.978	0.979	0.980	0.980	0.983	0.983	0.983	0.985	0.985	0.986
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	0.986	0.986	0.985	0.986	0.987	0.987	0.987	0.988	0.988	0.989	0.989	0.990	0.990	0.990	0.991	0.990	0.991	0.991	0.991	0.991
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	0.991	0.991	0.991	0.991	0.992	0.992	0.993	0.993	0.993	0.993	0.993	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	0.993	0.992	0.992	0.993	0.993	0.994	0.994	0.994	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	0.995	0.995	0.994	0.994	0.994	0.994	0.994	0.994	0.993	0.993	0.992	0.992	0.992	0.992	0.991	0.991	0.991	0.990	0.990	0.990
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	0.989	0.989	0.988	0.988	0.987	0.988	0.987	0.987	0.988	0.988	0.987	0.987	0.987	0.987	0.986	0.986	0.986	0.986	0.986	0.986
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	0.985	0.984	0.980	0.974	0.965	0.958	0.958	0.956	0.948	0.942	0.937	0.932	0.922	0.910	0.882	0.548	0.260	0.209	0.182	0.160
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	0.143	0.129	0.115	0.103	0.093	0.085	0.078	0.072	0.065	0.058	0.052	0.048	0.048	0.051	0.052	0.050	0.051	0.065	0.080	0.087
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	0.080	0.069	0.064	0.063	0.062	0.058	0.051	0.041	0.030	0.019	0.010	0.004	0.002	0.001	0.001	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	5000																			
τ	<1E-05																			



Internal Transmittance (τ)

λ nm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.001	0.023	0.301	0.681	0.856	0.914	0.933	0.943	0.946	0.949	0.953
λ nm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.954	0.954	0.957	0.958	0.960	0.962	0.963	0.964	0.965	0.967	0.969	0.970	0.971	0.974	0.974	0.975	0.976	0.978	0.979	0.979
λ nm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
τ	0.980	0.981	0.979	0.982	0.982	0.983	0.983	0.984	0.985	0.985	0.986	0.986	0.987	0.989	0.989	0.988				

Refractive Index/Absorption coefficient/Reflection coefficient

λ nm	400	500	600	700	800	900	1000
n	1.567	1.555	1.549	1.545	1.542	1.541	1.540
P	0.907	0.910	0.911	0.912	0.913	0.913	0.914

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

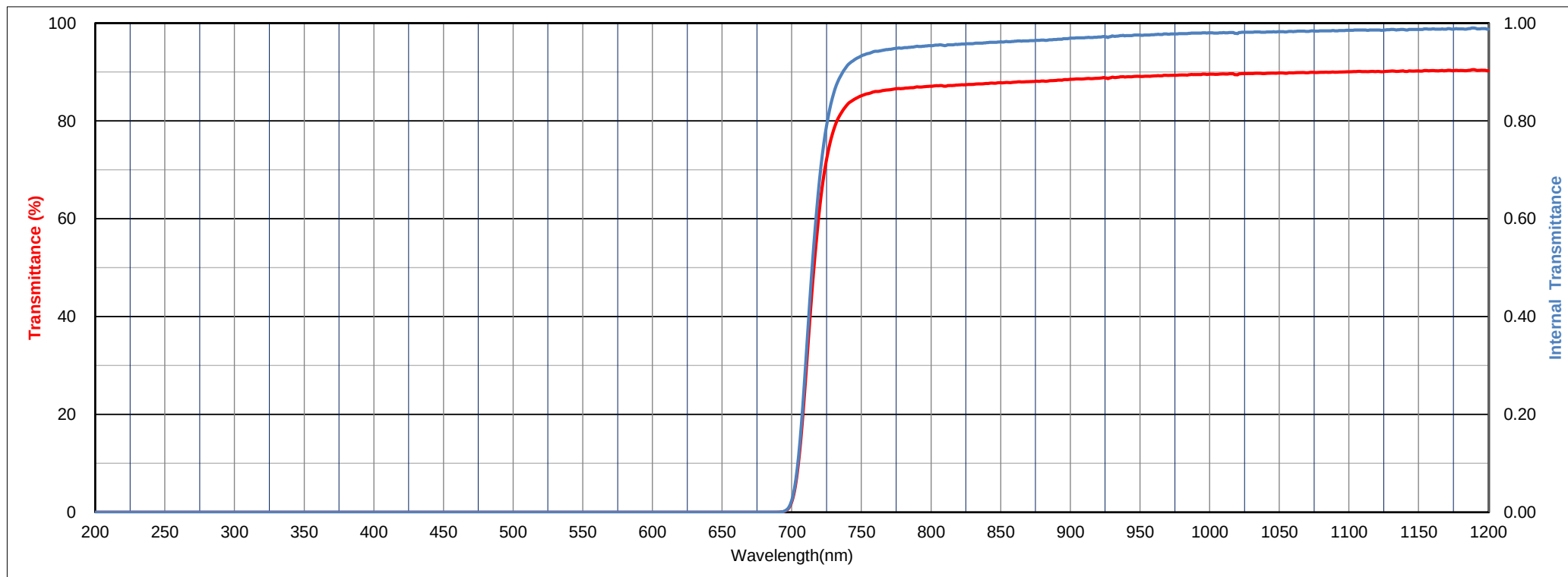
	x	y	Y	λ_d	P _e
A	-	-	-	-	-
C	-	-	-	-	-
D65	-	-	-	-	-

Properties

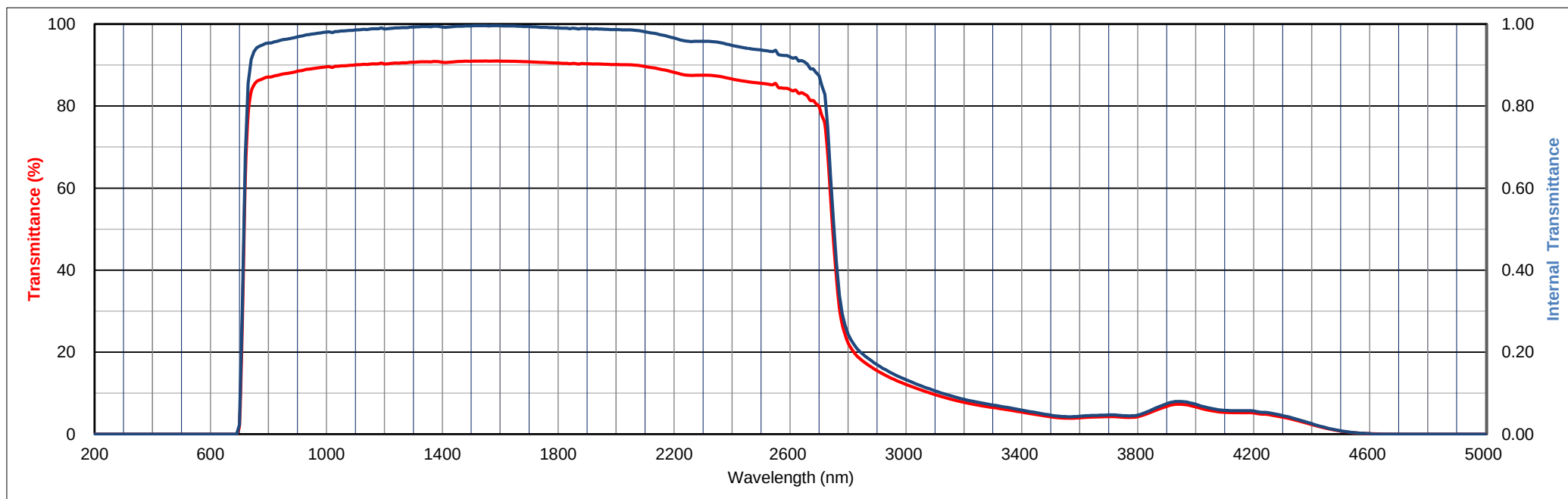
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	3	525	575	100	116	470	160	2.86

Tolerance of Transmittance (τ)

$\lambda_{t0.5}$ (nm)	ΔL (nm)	ΔH (nm)
715±8	>630	>810



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.001	0.023	0.301	0.681	0.856	0.914	0.933	0.943	0.946	0.949	0.953
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.954	0.954	0.957	0.958	0.960	0.962	0.963	0.964	0.965	0.967	0.969	0.970	0.971	0.974	0.974	0.975	0.976	0.978	0.979	0.979
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	0.980	0.981	0.979	0.982	0.982	0.983	0.983	0.984	0.985	0.985	0.986	0.986	0.986	0.987	0.987	0.988	0.989	0.988	0.989	0.991
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	0.988	0.988	0.989	0.990	0.991	0.990	0.991	0.991	0.992	0.993	0.993	0.993	0.994	0.994	0.994	0.994	0.994	0.995	0.995	0.994
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	0.993	0.992	0.993	0.993	0.994	0.995	0.995	0.995	0.996	0.995	0.995	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.996
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	0.996	0.995	0.996	0.995	0.995	0.995	0.995	0.995	0.994	0.994	0.994	0.993	0.993	0.993	0.992	0.992	0.992	0.991	0.991	0.991
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	0.991	0.990	0.990	0.990	0.989	0.990	0.989	0.988	0.989	0.989	0.989	0.989	0.988	0.988	0.988	0.988	0.987	0.987	0.987	0.987
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	0.987	0.986	0.981	0.974	0.966	0.958	0.958	0.956	0.948	0.941	0.937	0.936	0.920	0.908	0.875	0.516	0.244	0.196	0.170	0.149
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	0.133	0.119	0.106	0.094	0.085	0.077	0.071	0.065	0.059	0.052	0.046	0.043	0.044	0.046	0.047	0.045	0.047	0.060	0.074	0.080
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	0.073	0.063	0.058	0.057	0.057	0.052	0.045	0.036	0.026	0.016	0.008	0.003	0.001	0.001	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	5000																			
τ	<1E-05																			



Internal Transmittance (τ)

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.001	0.004	0.046	0.229	0.532	0.765	0.884	0.934
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.956	0.965	0.969	0.971	0.973	0.974	0.975	0.976	0.976	0.977	0.978	0.980	0.980	0.980	0.983	0.983	0.983	0.984	0.985	0.986
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
τ	0.985	0.986	0.984	0.987	0.986	0.987	0.988	0.988	0.988	0.988	0.988	0.989	0.991	0.990	0.991	0.990				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.584	1.572	1.566	1.561	1.559	1.557	1.555
P	0.903	0.906	0.907	0.908	0.909	0.909	0.910

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

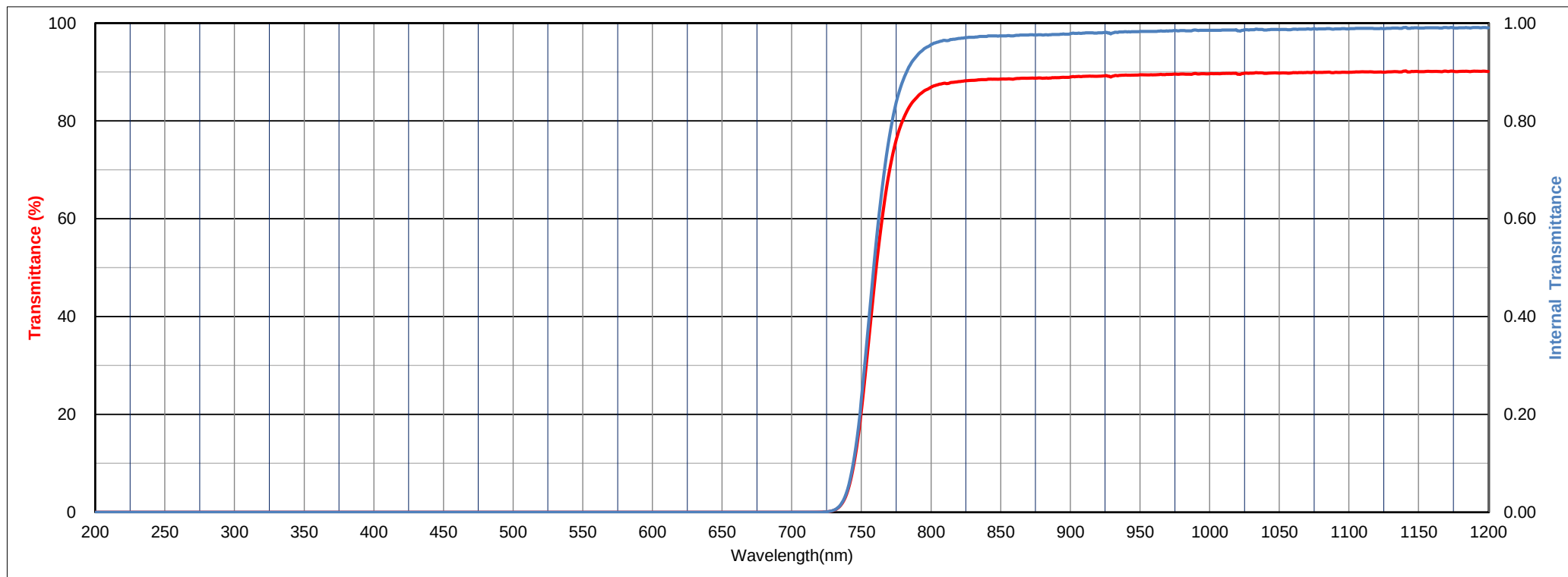
	x	y	Y	λ _d	P _e
A	-	-	-	-	-
C	-	-	-	-	-
D65	-	-	-	-	-

Properties

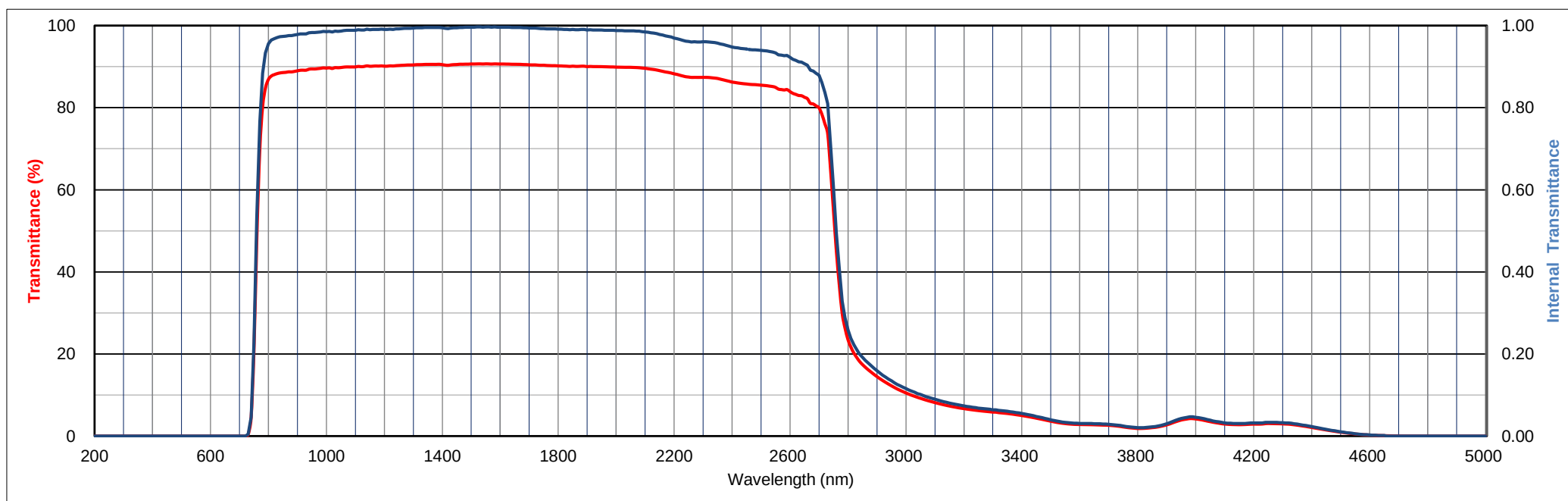
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
4	5	550	605	-	108	415	200	2.97

Tolerance of Transmittance (τ)

λ _{t0.5} (nm)	ΔL (nm)	ΔH (nm)
760±8	>680	>880



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.001	0.004	0.046	0.229	0.532	0.765	0.884
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.956	0.965	0.969	0.971	0.973	0.974	0.975	0.976	0.976	0.977	0.978	0.980	0.980	0.980	0.983	0.983	0.983	0.984	0.985	0.986
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	0.985	0.986	0.984	0.987	0.986	0.987	0.988	0.988	0.988	0.988	0.988	0.990	0.989	0.990	0.991	0.990	0.990	0.991	0.991	0.991
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	0.990	0.990	0.991	0.991	0.992	0.992	0.993	0.993	0.994	0.994	0.994	0.994	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	0.994	0.993	0.993	0.994	0.995	0.995	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.997	0.996	0.996	0.996	0.997	0.996
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	0.996	0.996	0.996	0.996	0.996	0.995	0.995	0.995	0.995	0.995	0.994	0.994	0.994	0.993	0.993	0.993	0.992	0.992	0.992	0.992
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	0.991	0.991	0.991	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.989	0.990	0.989	0.989	0.989	0.989	0.989	0.989	0.988	0.988
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	0.988	0.987	0.985	0.978	0.970	0.961	0.960	0.958	0.948	0.943	0.940	0.934	0.922	0.907	0.879	0.603	0.258	0.192	0.159	0.135
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	0.115	0.101	0.090	0.081	0.074	0.068	0.064	0.061	0.055	0.048	0.040	0.033	0.031	0.030	0.029	0.024	0.020	0.023	0.030	0.043
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	0.046	0.039	0.032	0.031	0.032	0.034	0.033	0.029	0.023	0.016	0.010	0.006	0.003	0.001	0.001	0.001	<1E-05	<1E-05	<1E-05	<1E-05
λnm	5000																			
τ	<1E-05																			



Internal Transmittance (τ)

λ nm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.002	0.031	0.194	0.492	0.736
λ nm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.864	0.916	0.940	0.952	0.957	0.961	0.964	0.965	0.966	0.969	0.971	0.972	0.974	0.975	0.976	0.977	0.978	0.980	0.981	0.982
λ nm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
τ	0.982	0.982	0.984	0.984	0.984	0.984	0.985	0.985	0.986	0.986	0.987	0.987	0.987	0.989	0.990	0.989				

Refractive Index/Absorption coefficient/Reflection coefficient

λ nm	400	500	600	700	800	900	1000
n	1.586	1.573	1.566	1.562	1.559	1.557	1.556
P	0.902	0.905	0.907	0.908	0.909	0.909	0.910

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

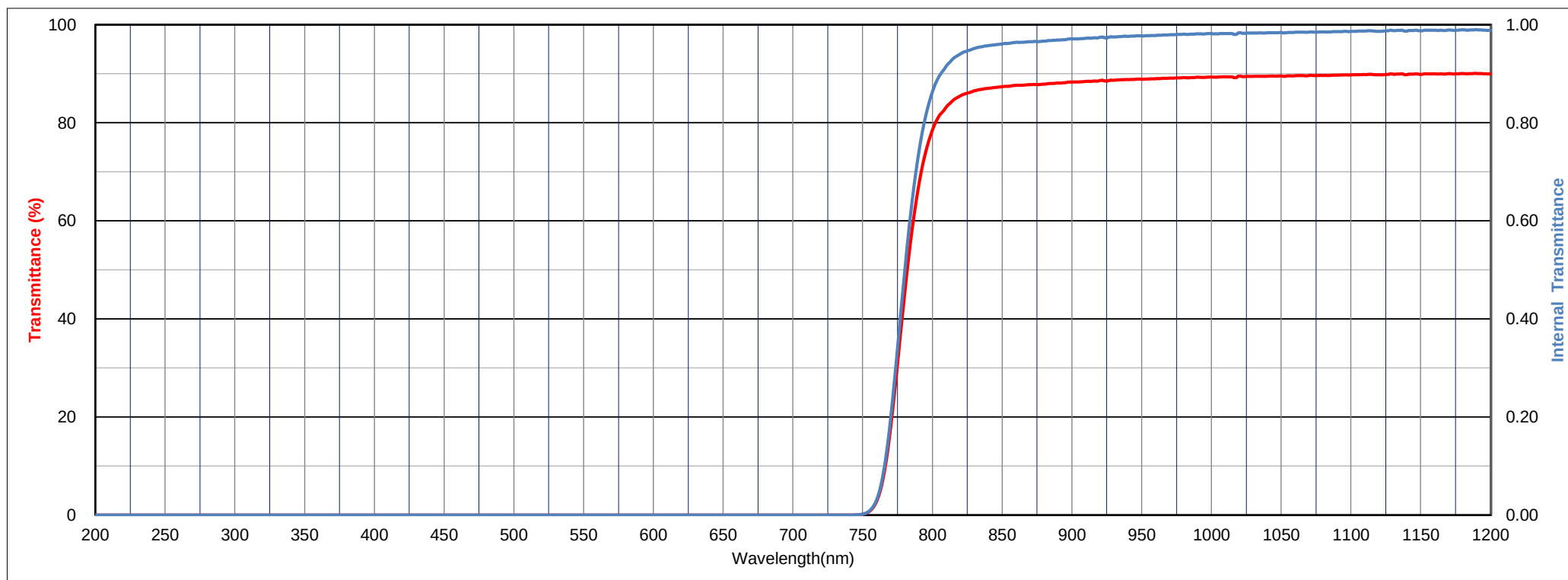
	x	y	Y	λ_d	P_e
A	-	-	-	-	-
C	-	-	-	-	-
D65	-	-	-	-	-

Properties

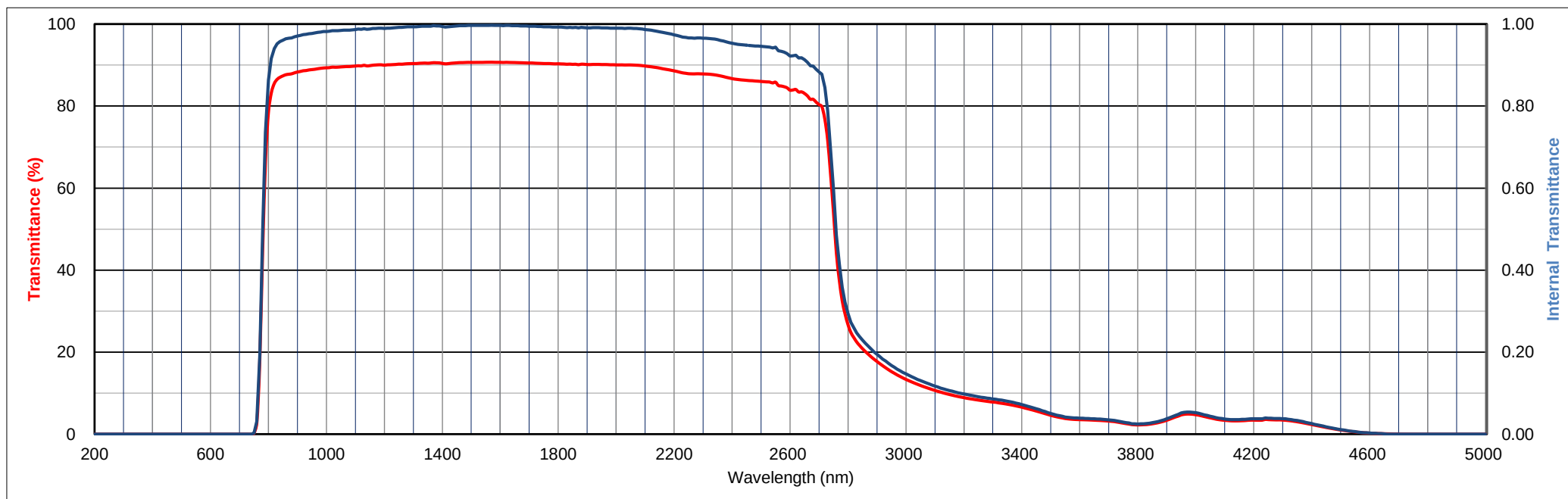
Chemical		Thermal				Mechanical		Others
D_w	D_A	Tg	Ts	α -30/70	α 100/300	H_K	F_A	d
4	5	550	605	-	108	415	200	2.97

Tolerance of Transmittance (τ)

$\lambda\tau_{0.5}$ (nm)	ΔL (nm)	ΔH (nm)
780±8	>690	>900



λ nm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.002	0.031	0.194	0.492	0.736
λ nm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.864	0.916	0.940	0.952	0.957	0.961	0.964	0.965	0.966	0.969	0.971	0.972	0.974	0.975	0.976	0.977	0.978	0.980	0.981	0.982
λ nm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	0.982	0.982	0.984	0.984	0.984	0.984	0.985	0.985	0.986	0.986	0.987	0.988	0.987	0.989	0.987	0.988	0.989	0.990	0.990	0.990
λ nm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	0.989	0.990	0.990	0.991	0.991	0.992	0.992	0.993	0.993	0.993	0.994	0.993	0.994	0.994	0.995	0.994	0.995	0.996	0.996	0.995
λ nm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	0.994	0.993	0.993	0.994	0.995	0.995	0.996	0.996	0.996	0.997	0.996	0.996	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997
λ nm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	0.997	0.996	0.997	0.996	0.996	0.996	0.996	0.996	0.995	0.995	0.995	0.995	0.994	0.994	0.994	0.994	0.993	0.993	0.993	0.993
λ nm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	0.993	0.992	0.992	0.992	0.992	0.991	0.992	0.990	0.992	0.992	0.991	0.991	0.991	0.991	0.991	0.991	0.991	0.991	0.990	0.990
λ nm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	0.990	0.990	0.987	0.981	0.974	0.966	0.966	0.962	0.953	0.948	0.945	0.944	0.922	0.913	0.883	0.595	0.294	0.229	0.195	0.168
λ nm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	0.147	0.131	0.117	0.106	0.098	0.091	0.086	0.080	0.072	0.062	0.050	0.042	0.039	0.037	0.035	0.029	0.025	0.028	0.037	0.052
λ nm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	0.052	0.044	0.037	0.036	0.038	0.039	0.038	0.033	0.026	0.018	0.011	0.006	0.003	0.001	0.001	0.001	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	5000																			
τ	<1E-05																			



Internal Transmittance (τ)

λ nm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.001	0.007	0.047	0.193
λ nm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.460	0.702	0.842	0.911	0.942	0.956	0.962	0.967	0.968	0.970	0.972	0.973	0.975	0.975	0.977	0.978	0.979	0.980	0.981	0.981
λ nm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
τ	0.982	0.983	0.981	0.983	0.983	0.984	0.984	0.985	0.985	0.985	0.986	0.987	0.987	0.988	0.988	0.988				

Refractive Index/Absorption coefficient/Reflection coefficient

λ nm	400	500	600	700	800	900	1000
n	1.590	1.576	1.570	1.565	1.562	1.560	1.559
P	0.901	0.905	0.906	0.907	0.908	0.909	0.909

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

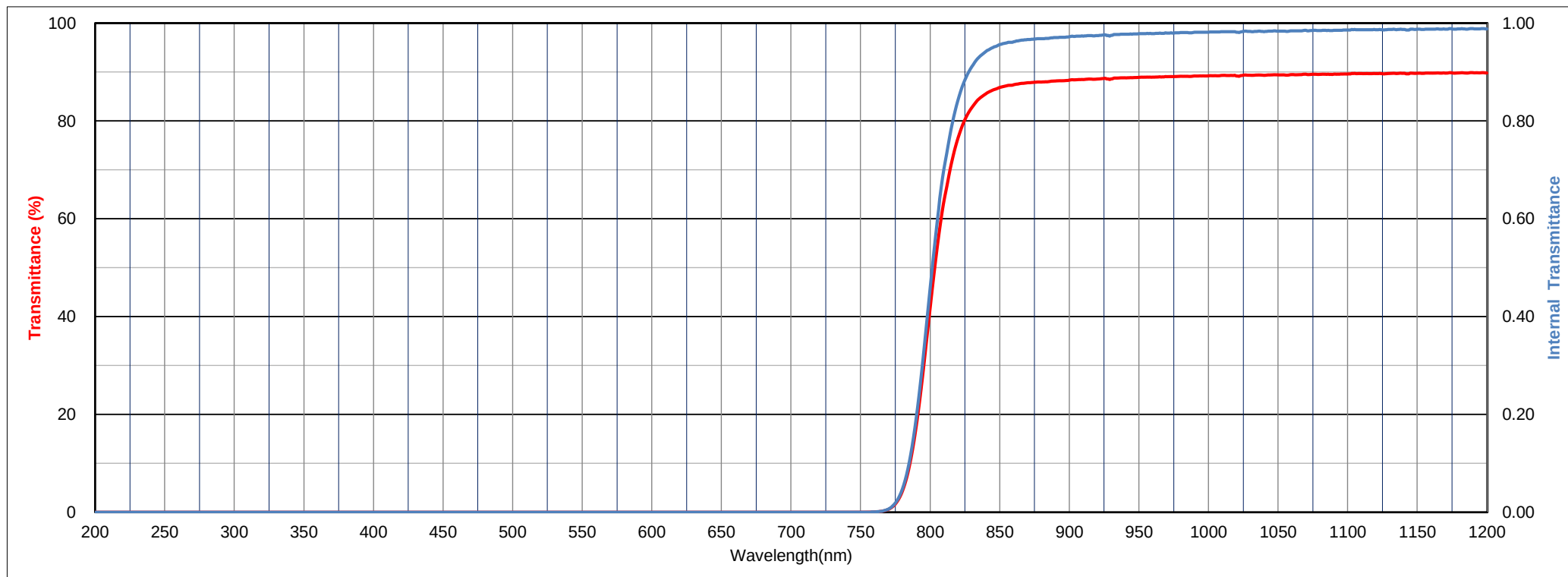
	x	y	Y	λ_d	P_e
A	-	-	-	-	-
C	-	-	-	-	-
D65	-	-	-	-	-

Properties

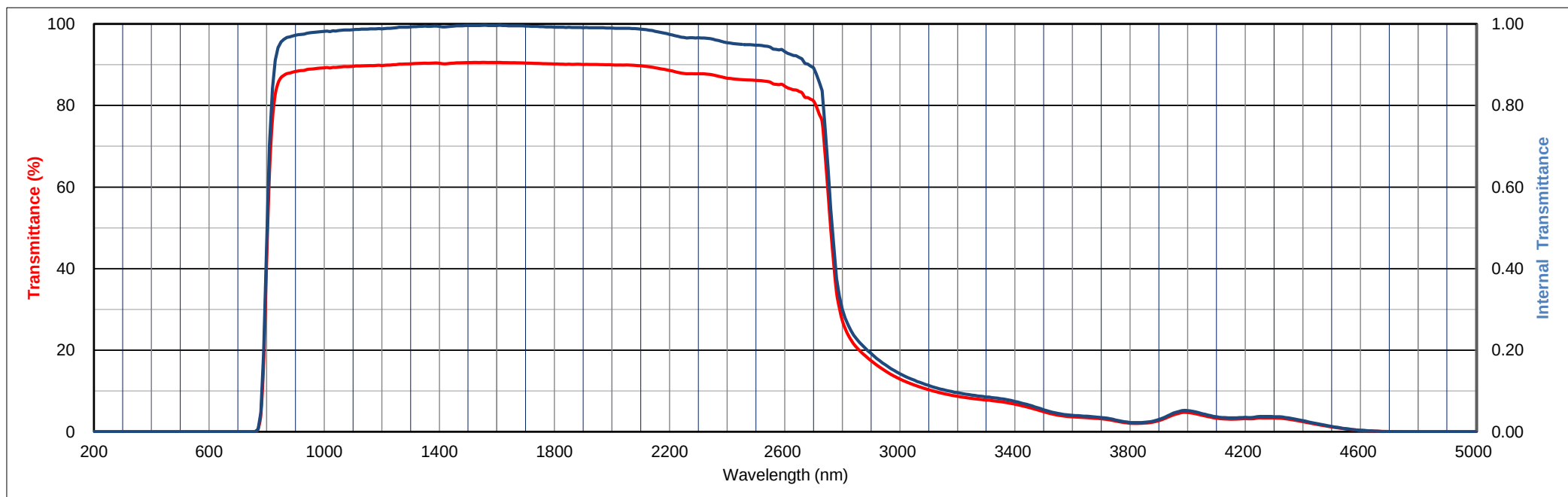
Chemical		Thermal				Mechanical		Others
D_w	D_A	Tg	Ts	α -30/70	α 100/300	H_K	F_A	d
4	5	555	610	-	102	425	190	3.01

Tolerance of Transmittance (τ)

$\lambda\tau_{0.5}$ (nm)	ΔL (nm)	ΔH (nm)
800±8	>710	>920



λ nm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.001	0.007	0.047	0.193
λ nm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.460	0.702	0.842	0.911	0.942	0.956	0.962	0.967	0.968	0.970	0.972	0.973	0.975	0.975	0.977	0.978	0.979	0.980	0.981	0.981
λ nm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	0.982	0.983	0.981	0.983	0.983	0.984	0.984	0.985	0.985	0.985	0.986	0.987	0.987	0.987	0.987	0.988	0.988	0.988	0.988	0.989
λ nm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	0.988	0.989	0.989	0.989	0.990	0.990	0.992	0.992	0.992	0.992	0.993	0.993	0.994	0.994	0.994	0.994	0.994	0.994	0.995	0.995
λ nm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	0.994	0.993	0.993	0.993	0.994	0.994	0.995	0.995	0.996	0.996	0.996	0.996	0.996	0.996	0.997	0.996	0.996	0.996	0.996	0.996
λ nm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.995	0.995	0.995	0.995	0.994	0.994	0.994	0.994	0.994	0.993	0.993	0.993	0.993
λ nm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	0.992	0.992	0.992	0.992	0.991	0.992	0.991	0.991	0.992	0.991	0.991	0.991	0.991	0.991	0.991	0.991	0.990	0.990	0.990	0.990
λ nm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	0.990	0.990	0.987	0.982	0.975	0.967	0.966	0.963	0.954	0.950	0.948	0.943	0.932	0.918	0.893	0.651	0.300	0.227	0.192	0.164
λ nm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	0.142	0.126	0.113	0.103	0.096	0.090	0.085	0.081	0.074	0.065	0.054	0.045	0.040	0.038	0.035	0.029	0.023	0.023	0.030	0.045
λ nm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	0.052	0.044	0.037	0.034	0.035	0.037	0.037	0.034	0.027	0.020	0.013	0.008	0.004	0.002	0.001	0.001	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	5000																			
τ	<1E-05																			



Internal Transmittance (τ)

λ nm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.001	0.001
λ nm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.010	0.057	0.212	0.477	0.708	0.852	0.920	0.951	0.964	0.971	0.976	0.979	0.980	0.980	0.983	0.984	0.984	0.985	0.986	0.986
λ nm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
τ	0.986	0.988	0.986	0.988	0.988	0.989	0.989	0.990	0.990	0.990	0.992	0.991	0.992	0.993	0.993	0.992				

Refractive Index/Absorption coefficient/Reflection coefficient

λ nm	400	500	600	700	800	900	1000
n	1.594	1.579	1.572	1.568	1.565	1.563	1.562
P	0.900	0.904	0.906	0.907	0.907	0.908	0.908

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

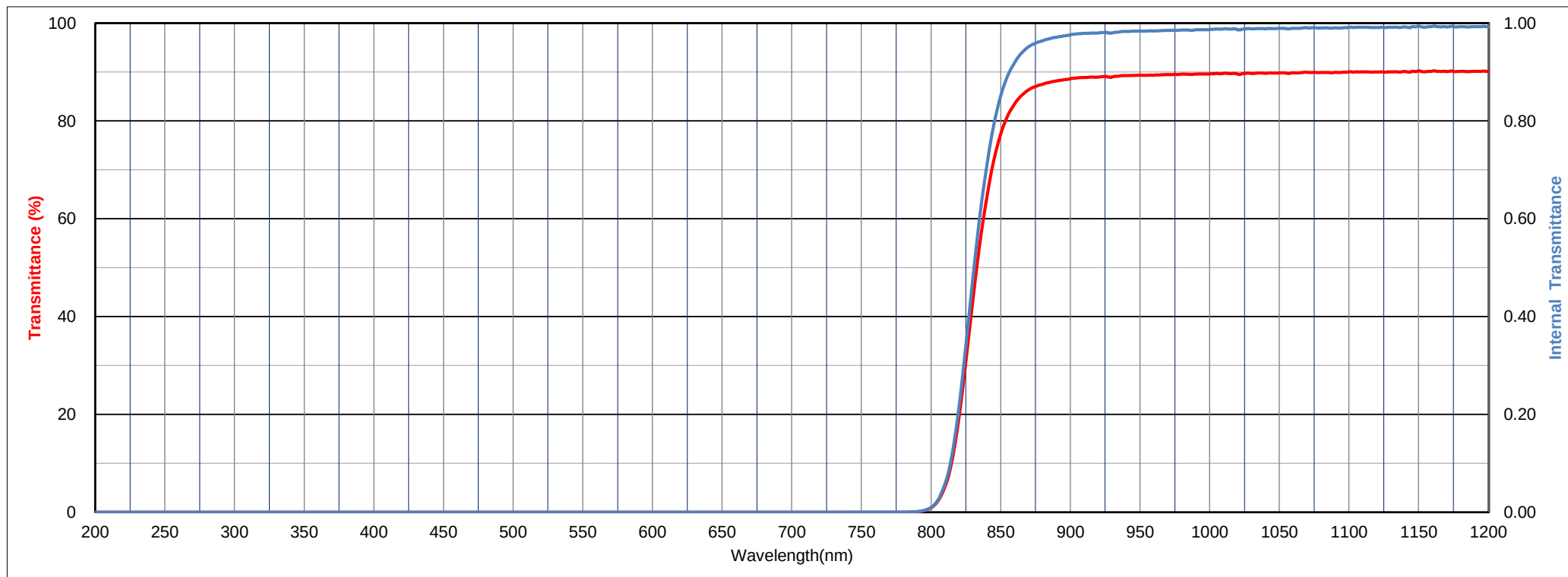
	x	y	Y	λ_d	P_e
A	-	-	-	-	-
C	-	-	-	-	-
D65	-	-	-	-	-

Properties

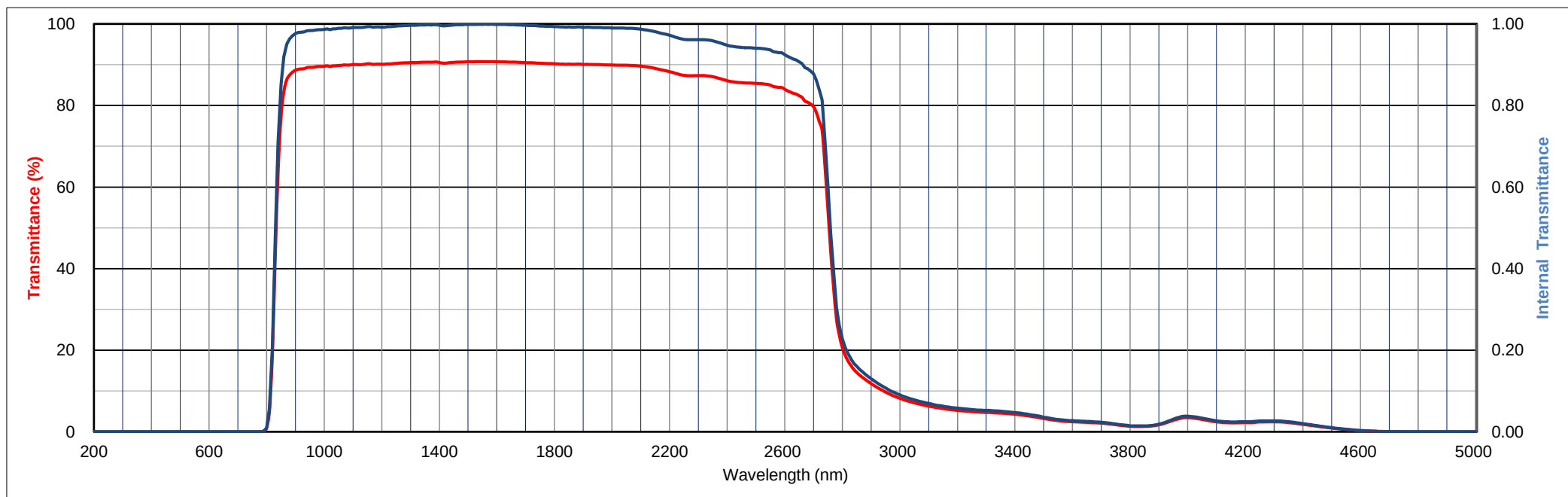
Chemical		Thermal				Mechanical		Others
D_w	D_A	Tg	Ts	α -30/70	α 100/300	H_K	F_A	d
4	5	545	615	-	104	425	190	3.03

Tolerance of Transmittance (τ)

$\lambda\tau_{0.5}$ (nm)	ΔL (nm)	ΔH (nm)
830 $\pm$ 8	>730	>950



λ nm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.010	0.057	0.212	0.477	0.708	0.852	0.920	0.951	0.964	0.971	0.976	0.979	0.980	0.980	0.983	0.984	0.984	0.985	0.986	0.986
λ nm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	0.986	0.988	0.986	0.988	0.988	0.989	0.989	0.990	0.990	0.990	0.992	0.991	0.991	0.991	0.992	0.994	0.993	0.992	0.993	0.993
λ nm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	0.992	0.992	0.993	0.993	0.994	0.994	0.995	0.996	0.996	0.996	0.997	0.997	0.997	0.997	0.998	0.998	0.998	0.998	0.998	0.998
λ nm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	0.997	0.996	0.995	0.996	0.997	0.997	0.998	0.998	0.998	0.998	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999
λ nm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	0.999	0.999	0.999	0.999	0.998	0.998	0.998	0.998	0.997	0.997	0.997	0.996	0.996	0.996	0.995	0.995	0.995	0.994	0.994	0.994
λ nm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	0.993	0.993	0.993	0.993	0.992	0.993	0.992	0.992	0.993	0.993	0.992	0.992	0.992	0.992	0.991	0.991	0.991	0.991	0.991	0.990
λ nm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	0.990	0.990	0.987	0.981	0.972	0.962	0.962	0.959	0.948	0.943	0.941	0.936	0.925	0.907	0.878	0.602	0.228	0.160	0.130	0.107
λ nm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	0.090	0.078	0.069	0.063	0.058	0.054	0.052	0.050	0.047	0.042	0.036	0.030	0.027	0.025	0.023	0.019	0.015	0.015	0.019	0.031
λ nm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	0.038	0.033	0.027	0.024	0.025	0.026	0.027	0.025	0.020	0.015	0.010	0.006	0.003	0.001	0.001	0.001	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	5000																			
τ	<1E-05																			



Internal Transmittance (τ)

λ nm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	<1E-05	0.001	0.010	0.069	0.253	0.530	0.738	0.846	0.897	0.925	0.940	0.948	0.953	0.956	0.961	0.963	0.965	0.967	0.969	0.970
λ nm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
τ	0.971	0.973	0.972	0.975	0.976	0.978	0.978	0.979	0.980	0.981	0.982	0.983	0.984	0.986	0.986	0.987				

Refractive Index/Absorption coefficient/Reflection coefficient

λ nm	400	500	600	700	800	900	1000
n	1.596	1.582	1.575	1.570	1.567	1.565	1.564
P	0.900	0.903	0.905	0.906	0.907	0.907	0.908

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

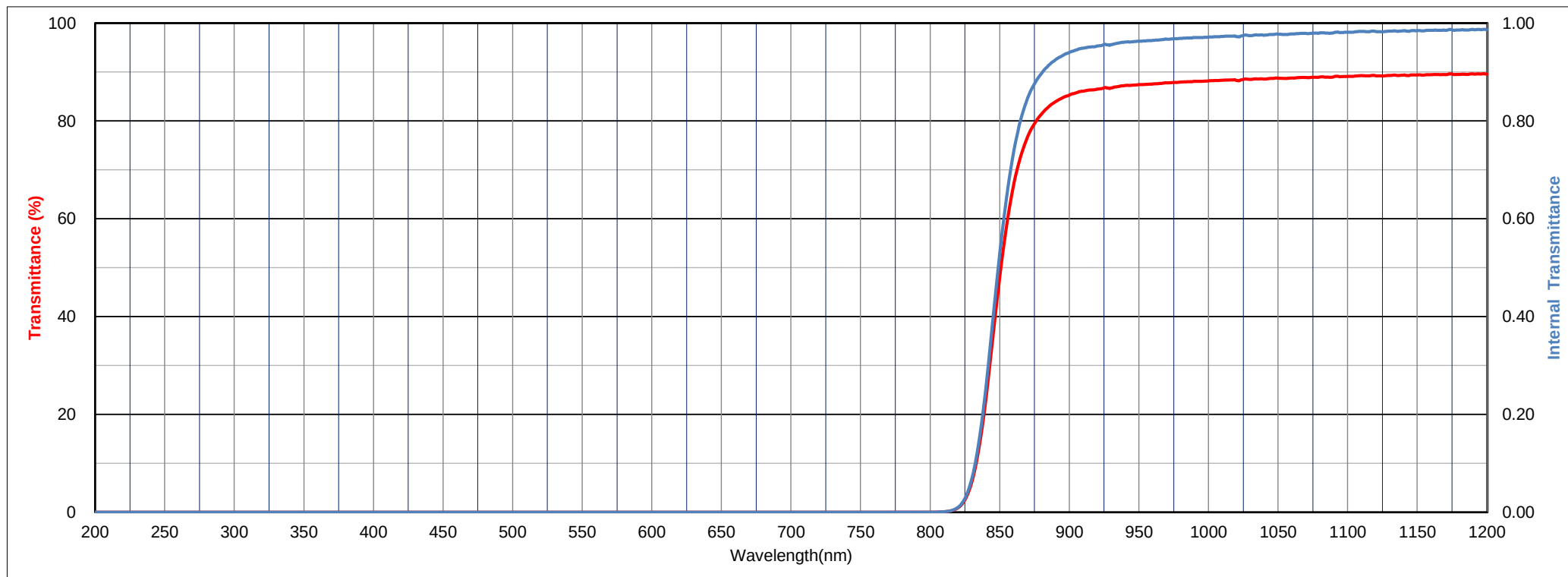
	x	y	Y	λ_d	P_e
A	-	-	-	-	-
C	-	-	-	-	-
D65	-	-	-	-	-

Properties

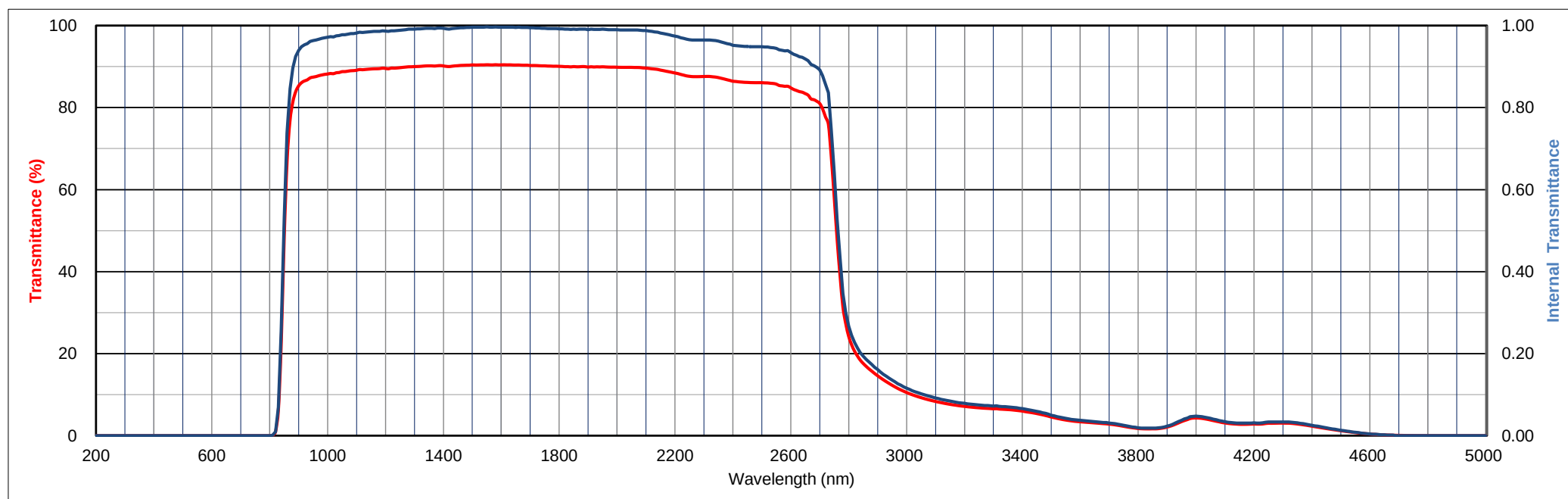
Chemical		Thermal				Mechanical		Others
D_w	D_A	Tg	Ts	α -30/70	α 100/300	H_K	F_A	d
4	5	550	610	-	104	420	190	3.04

Tolerance of Transmittance (τ)

$\lambda\tau_{0.5}$ (nm)	ΔL (nm)	ΔH (nm)
850±8	>740	>950

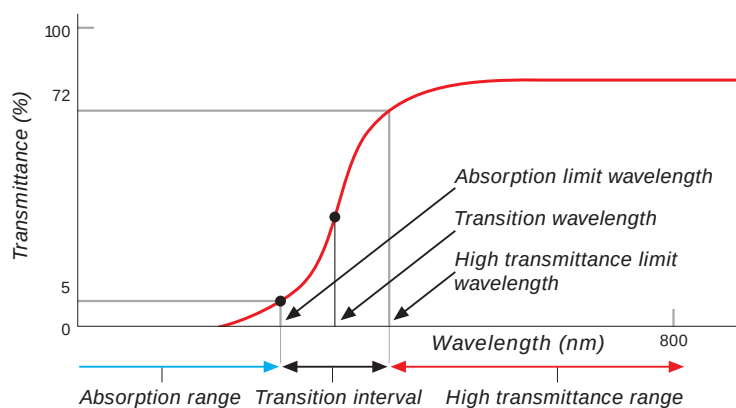


λ nm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	<1E-05	0.001	0.010	0.069	0.253	0.530	0.738	0.846	0.897	0.925	0.940	0.948	0.953	0.956	0.961	0.963	0.965	0.967	0.969	0.970
λ nm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	0.971	0.973	0.972	0.975	0.976	0.978	0.978	0.979	0.980	0.981	0.982	0.984	0.983	0.984	0.984	0.985	0.986	0.986	0.986	0.987
λ nm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	0.987	0.986	0.987	0.987	0.988	0.989	0.989	0.990	0.991	0.991	0.992	0.992	0.992	0.993	0.993	0.994	0.993	0.993	0.994	0.994
λ nm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	0.993	0.992	0.992	0.993	0.993	0.994	0.995	0.995	0.995	0.995	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.997	0.996
λ nm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.995	0.995	0.995	0.994	0.994	0.994	0.994	0.993	0.994	0.993	0.993	0.992	0.993
λ nm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	0.992	0.992	0.991	0.991	0.991	0.992	0.991	0.991	0.992	0.991	0.990	0.991	0.990	0.991	0.991	0.991	0.991	0.990	0.990	0.990
λ nm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	0.990	0.989	0.988	0.982	0.974	0.965	0.965	0.962	0.952	0.949	0.948	0.944	0.934	0.919	0.892	0.642	0.267	0.194	0.161	0.135
λ nm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	0.116	0.102	0.092	0.084	0.079	0.075	0.072	0.070	0.066	0.059	0.050	0.042	0.037	0.034	0.031	0.025	0.019	0.018	0.023	0.038
λ nm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	0.047	0.042	0.034	0.030	0.031	0.033	0.034	0.031	0.025	0.019	0.013	0.008	0.004	0.002	0.001	0.001	0.001	<1E-05	<1E-05	<1E-05
λ nm	5000																			
τ	<1E-05																			



UV Filters (UV Series)

UV28N through UV36N (UV28N, UV30N, UV32N, UV34N, UV36N) are five glass types of ultraviolet filters which absorb the shorter wavelengths of light below a specific wavelength in UV range while transmitting the longer wavelengths of light that are beyond the specific wavelength. The 2-digit value after 'UV' roughly indicates the transmission threshold wavelength. For example, UV28N indicates that the transmission threshold wavelength is approximately 280nm.



Transmittance (T)		units: %																		
λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.2	2.3	10.2	27.7	50.2	68.3	79.3	84.4	86.7	88.4	88.6	89.3	89.2	89.2	89.5
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	89.6	89.6	89.8	89.8	89.7	89.8	89.7	89.9	90.0	90.0	89.9	89.9	90.0	89.8	90.0	90.0	90.1	90.1	90.0	90.1
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	90.0	90.1	90.0	90.0	90.1	90.1	89.9	90.1	90.2	90.2	90.1	90.1	90.2	90.1	89.9	90.1	90.1	90.5	90.5	90.4
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	90.5	90.5	90.4	90.5	90.6	90.7	90.9	91.1	91.0	91.1	91.2	91.2	91.3	91.3	91.4	91.5	91.5	91.6	91.6	91.7
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	91.6	91.7	91.8	91.7	91.8	91.8	91.9	91.9	91.9	91.9	92.0	92.0	92.1	92.1	92.1	92.2				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.536	1.524	1.518	1.514	1.512	1.510	1.509
P	0.914	0.917	0.919	0.920	0.920	0.921	0.921

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

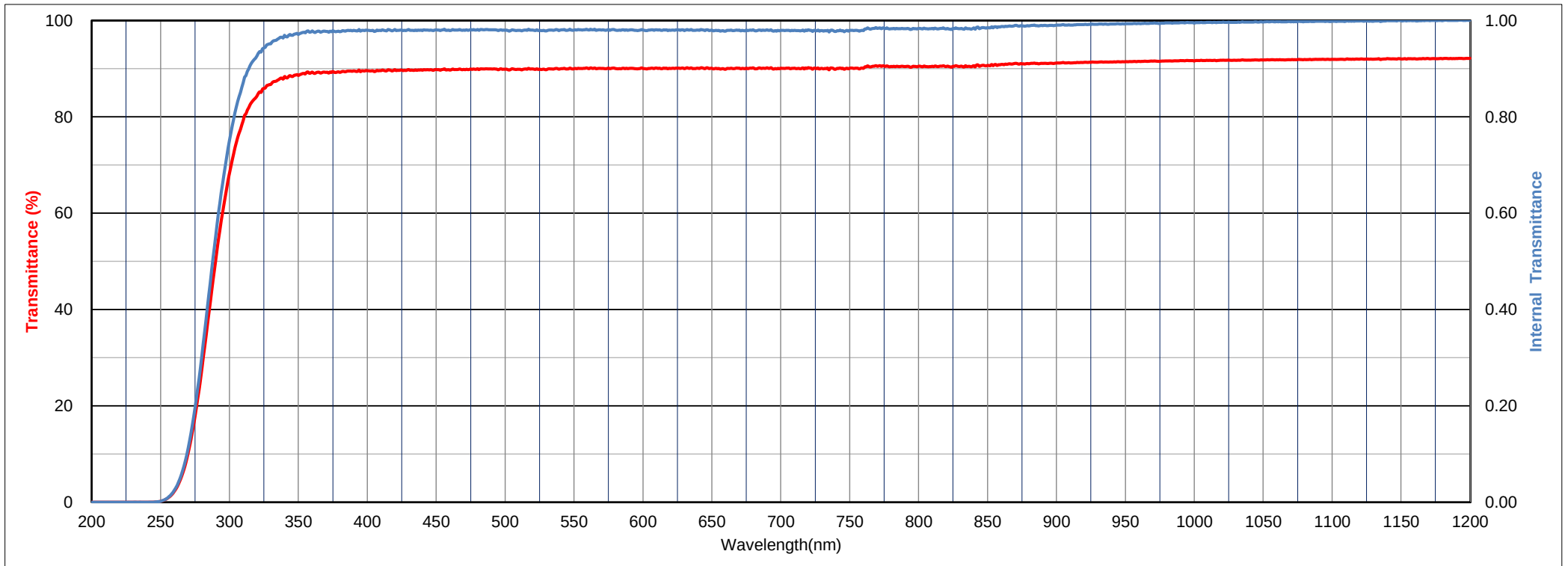
	x	y	Y	λ _d	P _e
A	-	-	-	-	-
C	-	-	-	-	-
D65	-	-	-	-	-

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α _{-30/70}	α _{100/300}	H _K	F _A	d
2	1	572	642	73	87	525	100	2.61

Tolerance of Transmittance (T)

Transition Wavelength	Transition Interval	Average High Transmittance
λ T	Δ λ	Th(%)
280±7 nm	< 45 nm	> 85 %





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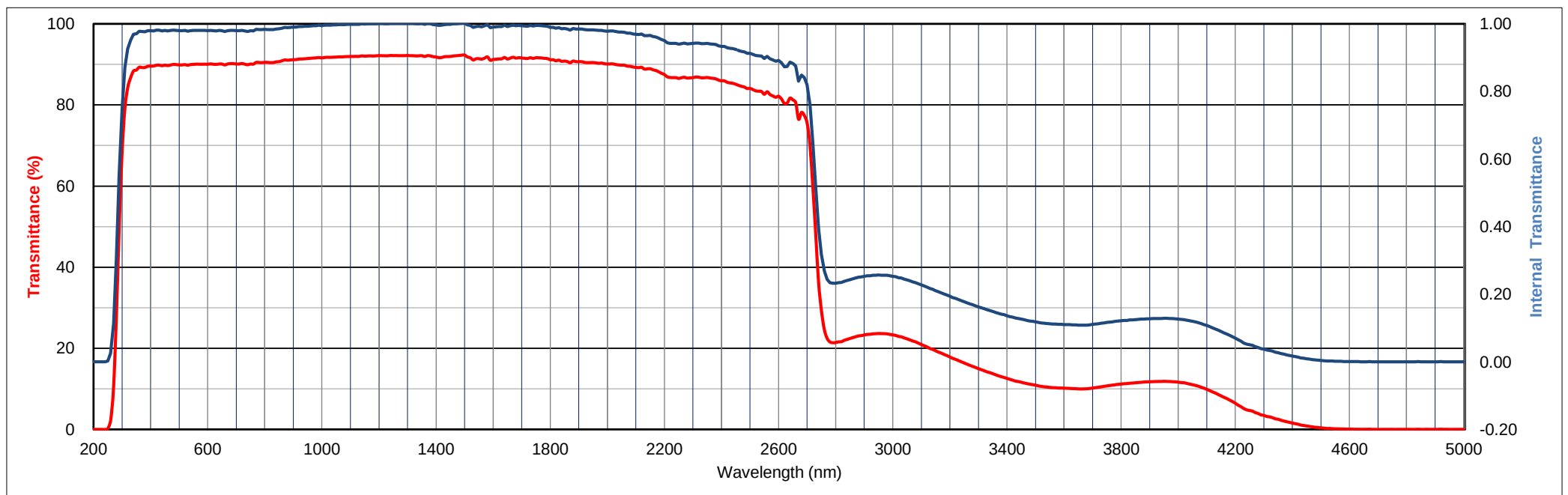
Transmittance (T)

units: %

Thickness 2.50 mm

UV28N

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.2	2.3	10.2	27.7	50.2	68.3	79.3	84.4	86.7	88.4	88.6	89.3	89.2	89.2	89.5
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	89.6	89.6	89.8	89.8	89.7	89.8	89.7	89.9	90.0	90.0	89.9	89.9	90.0	89.8	90.0	90.0	90.1	90.1	90.0	90.1
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	90.0	90.1	90.0	90.0	90.1	90.1	89.9	90.1	90.2	90.2	90.1	90.1	90.2	90.1	89.9	90.1	90.1	90.5	90.5	90.4
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	90.5	90.5	90.4	90.5	90.6	90.7	90.9	91.1	91.0	91.1	91.2	91.2	91.3	91.3	91.4	91.5	91.5	91.6	91.6	91.7
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	91.6	91.7	91.8	91.7	91.8	91.8	91.9	91.9	91.9	91.9	92.0	92.0	92.0	92.0	92.1	92.0	92.1	92.1	92.1	92.1
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	92.2	92.2	92.1	92.1	92.2	92.2	92.2	92.2	92.2	92.2	92.2	92.2	92.2	92.1	92.1	92.2	92.0	92.2	92.1	91.9
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	91.8	91.7	91.7	91.9	91.9	92.0	92.1	92.1	92.2	92.3	92.3	91.8	91.6	91.1	91.4	91.4	91.3	91.6	91.8	91.0
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	91.2	91.3	91.4	91.4	91.7	91.3	91.5	91.8	91.6	91.7	91.6	91.5	91.5	91.6	91.5	91.6	91.6	91.6	91.5	91.4
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	91.2	91.2	90.9	91.0	90.8	90.8	90.7	90.4	90.8	90.7	90.7	90.7	90.5	90.4	90.4	90.5	90.4	90.3	90.3	90.2
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	90.1	89.8	89.3	88.9	87.5	86.5	86.7	86.8	86.0	85.1	84.1	82.6	82.1	81.2	75.5	29.3	21.4	22.4	23.3	23.7
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	23.3	22.3	20.9	19.4	17.9	16.4	15.0	13.8	12.6	11.6	10.9	10.4	10.2	10.0	10.2	10.7	11.2	11.5	11.7	11.9
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	11.7	11.0	9.9	8.3	6.5	4.7	3.5	2.5	1.6	0.8	0.4	0.1	0.1	0.0	-0.0	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	18.5	59.3	79.6	87.0	89.2	90.3	90.5	90.8	91.0	90.9	91.3
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	91.1	91.3	91.4	91.4	91.5	91.3	91.5	91.5	91.6	91.5	91.7	91.7	91.8	91.8	91.8	92.0	91.9	92.0	92.0	92.1
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	92.2	92.2	92.3	92.4	92.4	92.4	92.6	92.6	92.6	92.7	92.8	92.9	92.9	93.1	93.0	93.0	93.2	92.4	92.3	92.3
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	92.3	92.4	92.4	92.5	92.5	92.5	92.8	92.5	92.5	92.5	92.6	92.7	92.7	92.8	92.8	92.8	92.9	93.0	92.9	93.0
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	93.1	93.1	93.1	93.1	93.1	93.2	93.2	93.2	93.2	93.3	93.3	93.3	93.4	93.5	93.4	93.4				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.524	1.509	1.501	1.497	1.494	1.492	1.491
P	0.917	0.921	0.923	0.924	0.925	0.925	0.925

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

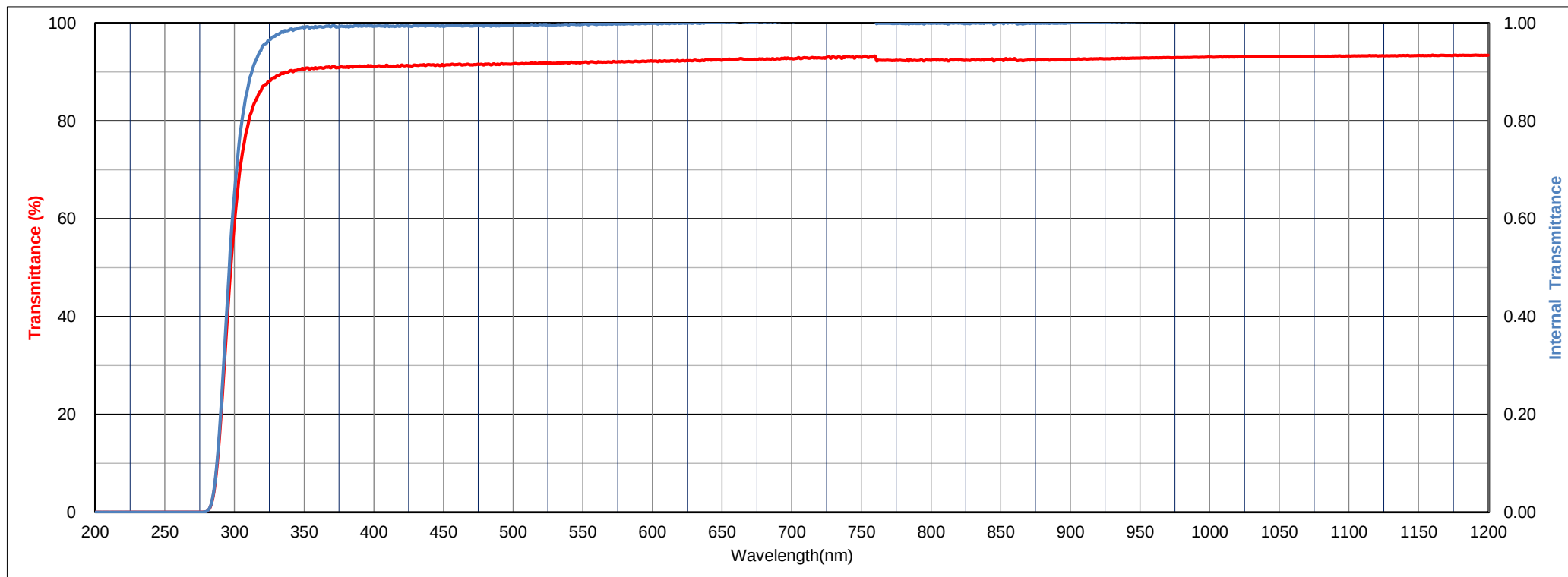
	x	y	Y	λ _d	P _e
A	-	-	-	-	-
C	-	-	-	-	-
D65	-	-	-	-	-

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
2	1	533	622	60	65	515	80	2.50

Tolerance of Transmittance (T)

Transition Wavelength	Transition Interval	Average High Transmittance
λ T	Δ λ	Th(%)
300±7 nm	< 40 nm	> 85 %





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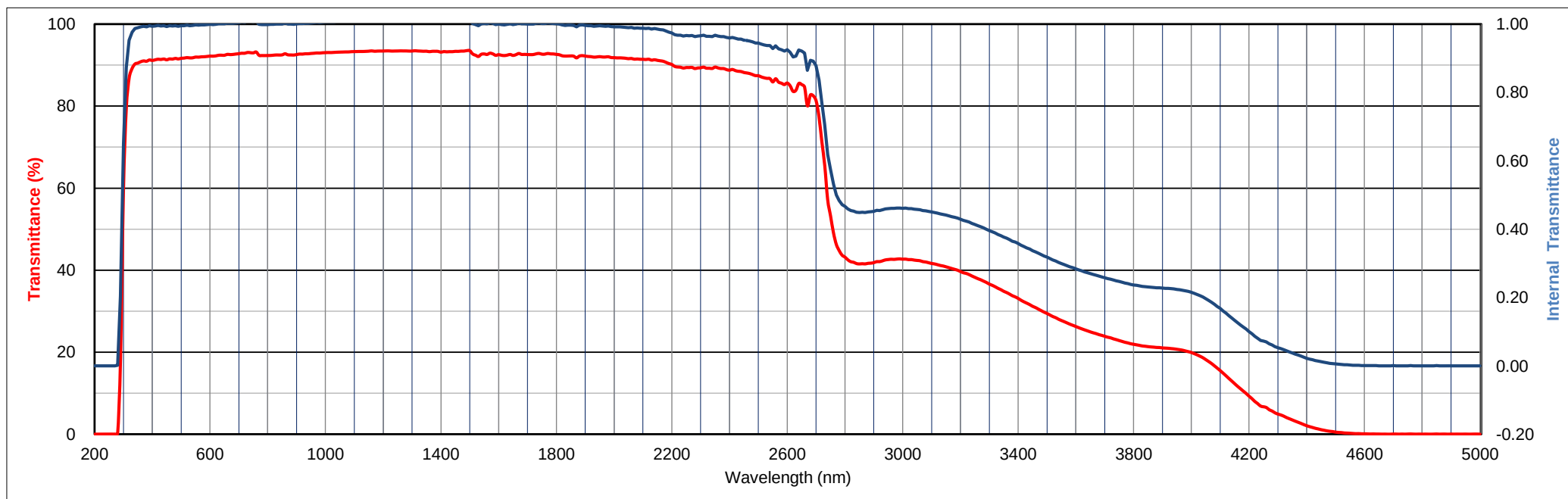
Transmittance (T)

units: %

Thickness 2.50 mm

UV30N

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	18.5	59.3	79.6	87.0	89.2	90.3	90.5	90.8	91.0	90.9	91.3
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	91.1	91.3	91.4	91.4	91.5	91.3	91.5	91.5	91.6	91.5	91.7	91.7	91.8	91.8	91.8	92.0	91.9	92.0	92.0	92.1
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	92.2	92.2	92.3	92.4	92.4	92.4	92.6	92.6	92.6	92.7	92.8	92.9	92.9	93.1	93.0	93.0	93.2	92.4	92.3	92.3
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	92.3	92.4	92.4	92.5	92.5	92.5	92.8	92.5	92.5	92.5	92.6	92.7	92.7	92.8	92.8	92.8	92.9	93.0	92.9	93.0
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	93.1	93.1	93.1	93.1	93.1	93.2	93.2	93.2	93.2	93.3	93.3	93.3	93.3	93.3	93.4	93.4	93.5	93.4	93.4	93.4
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	93.4	93.5	93.5	93.4	93.4	93.5	93.5	93.5	93.5	93.4	93.4	93.5	93.5	93.4	93.4	93.4	93.3	93.4	93.4	93.4
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	93.2	93.3	93.2	93.3	93.3	93.4	93.4	93.4	93.4	93.5	93.5	92.7	92.4	92.1	92.6	92.7	92.6	92.9	92.7	92.4
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	92.6	92.4	92.3	92.4	92.6	92.4	92.6	92.8	92.6	92.6	92.6	92.6	92.6	92.7	92.9	92.7	92.7	92.8	92.7	92.7
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	92.6	92.5	92.3	92.2	92.2	92.2	92.2	91.8	92.2	92.3	92.2	92.1	92.1	92.0	92.0	92.1	92.0	92.0	92.0	91.8
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	91.8	91.6	91.4	91.2	90.2	89.4	89.3	89.5	88.8	88.2	87.4	85.9	85.6	85.3	81.3	53.2	43.2	41.5	41.8	42.6
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	42.7	42.4	41.6	40.8	39.7	38.3	36.6	34.8	33.1	31.2	29.4	27.7	26.3	25.0	23.9	22.8	21.9	21.4	21.0	20.7
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	19.9	18.2	15.5	12.3	9.3	6.7	4.9	3.5	2.1	1.1	0.5	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	6.5	32.5	57.8	72.6	81.0	84.9	87.1	88.1	88.3	89.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	89.2	89.4	89.5	89.6	89.5	89.7	89.7	89.8	89.9	89.9	89.9	90.0	90.1	90.0	90.2	90.3	90.3	90.3	90.3	90.4
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	90.3	90.4	90.4	90.4	90.6	90.5	90.3	90.5	90.5	90.6	90.6	90.6	90.8	90.7	90.6	90.7	90.7	90.7	90.9	90.7
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	90.8	90.7	90.7	90.6	90.8	90.9	90.7	90.7	90.6	90.6	90.8	90.9	91.0	91.0	91.1	91.1	91.1	91.2	91.2	91.3
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	91.2	91.3	91.4	91.4	91.4	91.4	91.5	91.5	91.5	91.6	91.6	91.7	91.7	91.8	91.8	91.8				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.600	1.586	1.579	1.574	1.571	1.570	1.568
P	0.899	0.902	0.904	0.905	0.906	0.906	0.907

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

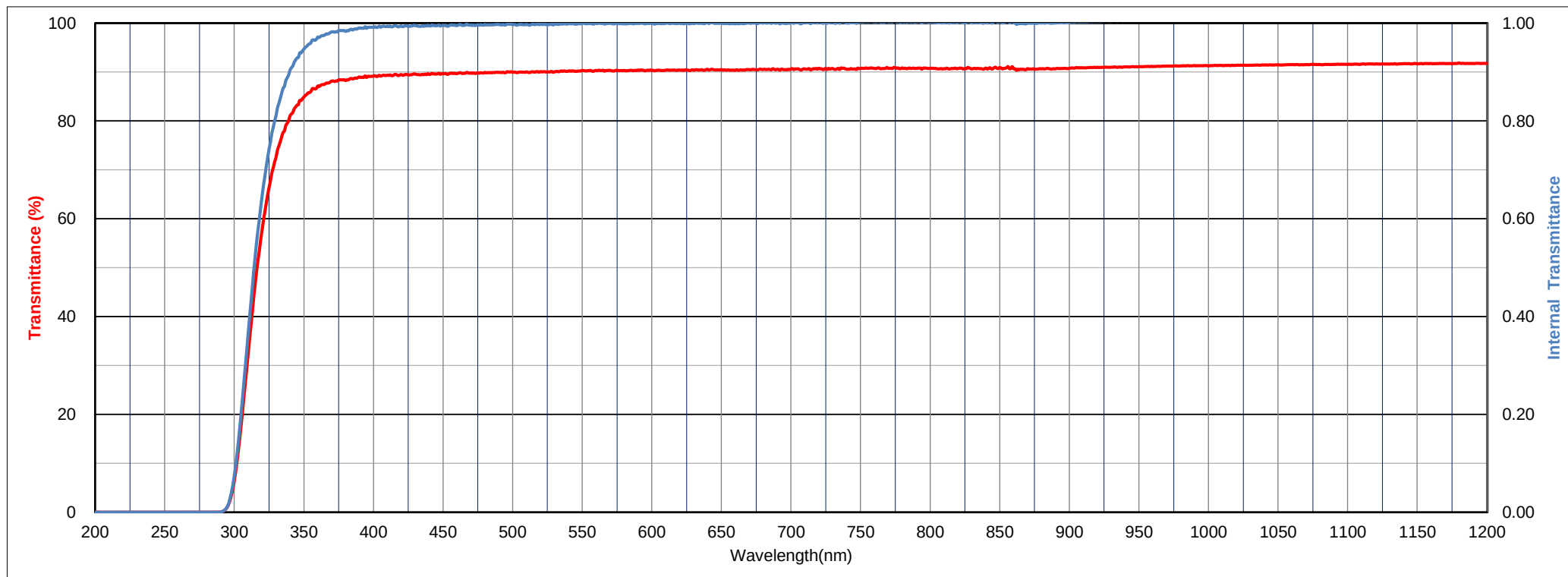
	x	y	Y	λ _d	P _e
A	-	-	-	-	-
C	-	-	-	-	-
D65	-	-	-	-	-

Properties

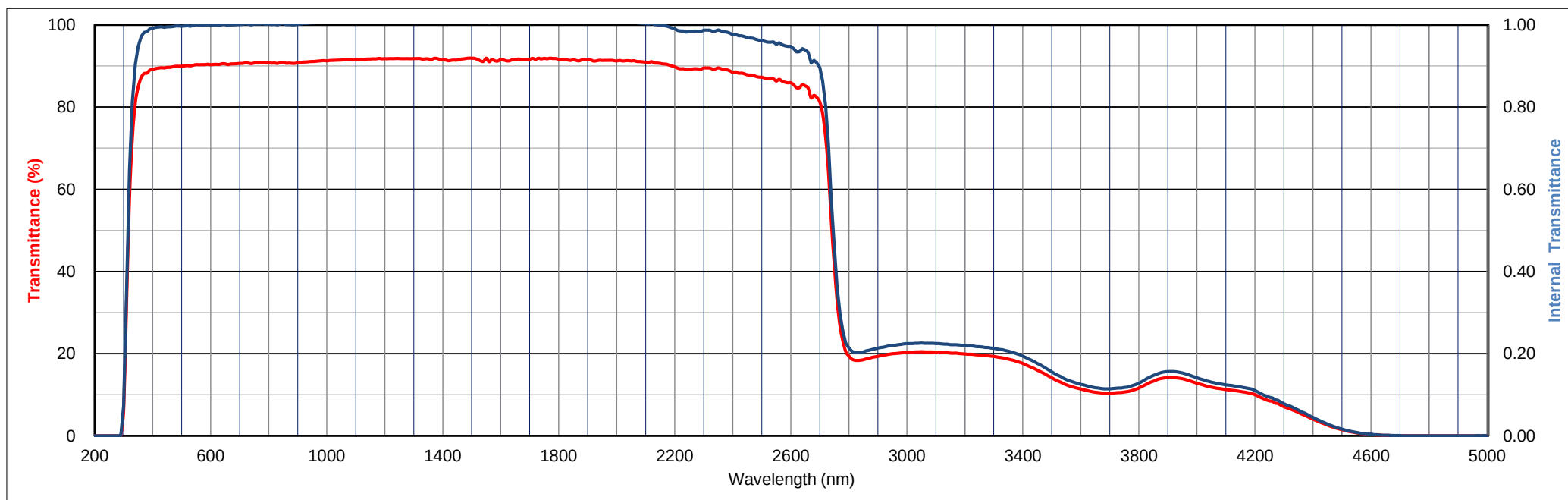
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
2	2	572	630	69	83	495	130	3.23

Tolerance of Transmittance (T)

Transition Wavelength	Transition Interval	Average High Transmittance
λ T	Δ λ	Th(%)
320±7 nm	< 40 nm	> 85 %



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	6.5	32.5	57.8	72.6	81.0	84.9	87.1	88.1	88.3	89.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	89.2	89.4	89.5	89.6	89.5	89.7	89.7	89.8	89.9	89.9	89.9	90.0	90.1	90.0	90.2	90.3	90.3	90.3	90.3	90.4
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	90.3	90.4	90.4	90.4	90.6	90.5	90.3	90.5	90.5	90.6	90.6	90.6	90.8	90.7	90.6	90.7	90.7	90.7	90.9	90.7
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	90.8	90.7	90.7	90.6	90.8	90.9	90.7	90.7	90.6	90.6	90.8	90.9	91.0	91.0	91.1	91.1	91.1	91.2	91.2	91.3
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	91.2	91.3	91.4	91.4	91.4	91.4	91.5	91.5	91.5	91.6	91.6	91.6	91.7	91.6	91.7	91.7	91.8	91.7	91.8	91.8
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	91.8	91.8	91.8	91.8	91.8	91.8	91.8	91.8	91.8	91.8	91.8	91.8	91.8	91.7	91.7	91.7	91.5	91.9	91.8	91.6
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	91.5	91.5	91.3	91.4	91.4	91.4	91.7	91.7	91.8	91.9	91.9	91.9	91.6	91.3	91.1	91.9	91.0	91.6	91.3	91.2
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	91.6	91.5	91.2	91.3	91.6	91.5	91.7	91.6	91.6	91.6	91.7	91.9	91.6	91.9	91.7	91.9	91.8	91.9	91.8	91.8
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	91.6	91.6	91.6	91.5	91.4	91.5	91.4	91.2	91.5	91.5	91.5	91.5	91.2	91.3	91.4	91.3	91.4	91.4	91.4	91.3
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	91.2	91.2	91.0	90.6	89.8	89.2	89.5	89.5	88.4	87.8	87.3	86.3	85.9	85.2	81.2	41.6	19.4	18.5	19.3	20.0
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	20.3	20.5	20.3	20.1	19.9	19.7	19.3	18.7	17.6	16.0	14.1	12.4	11.4	10.6	10.4	10.7	11.6	13.3	14.2	13.9
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	12.8	11.8	11.3	10.8	10.0	8.5	7.1	5.7	4.1	2.6	1.5	0.7	0.4	0.1	0.1	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	14.4	43.4	62.8	73.1	78.8	81.8	83.9
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	85.2	85.8	86.1	86.3	86.4	86.5	86.7	86.7	87.1	87.1	87.3	87.5	87.6	87.6	87.8	87.9	87.9	88.0	87.9	87.8
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	87.9	87.9	87.8	88.0	87.8	87.8	87.9	87.9	88.0	88.1	88.2	88.3	88.3	88.5	88.5	88.6	88.6	88.7	88.6	88.6
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	88.7	88.5	88.6	88.7	88.6	88.6	88.6	88.6	88.6	88.5	88.6	88.8	88.9	88.9	89.0	89.1	89.2	89.2	89.2	89.3
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	89.4	89.4	89.4	89.4	89.5	89.5	89.6	89.6	89.6	89.7	89.6	89.7	89.7	89.8	89.8	89.9				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.704	1.678	1.665	1.657	1.652	1.649	1.647
P	0.873	0.880	0.883	0.885	0.886	0.887	0.887

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

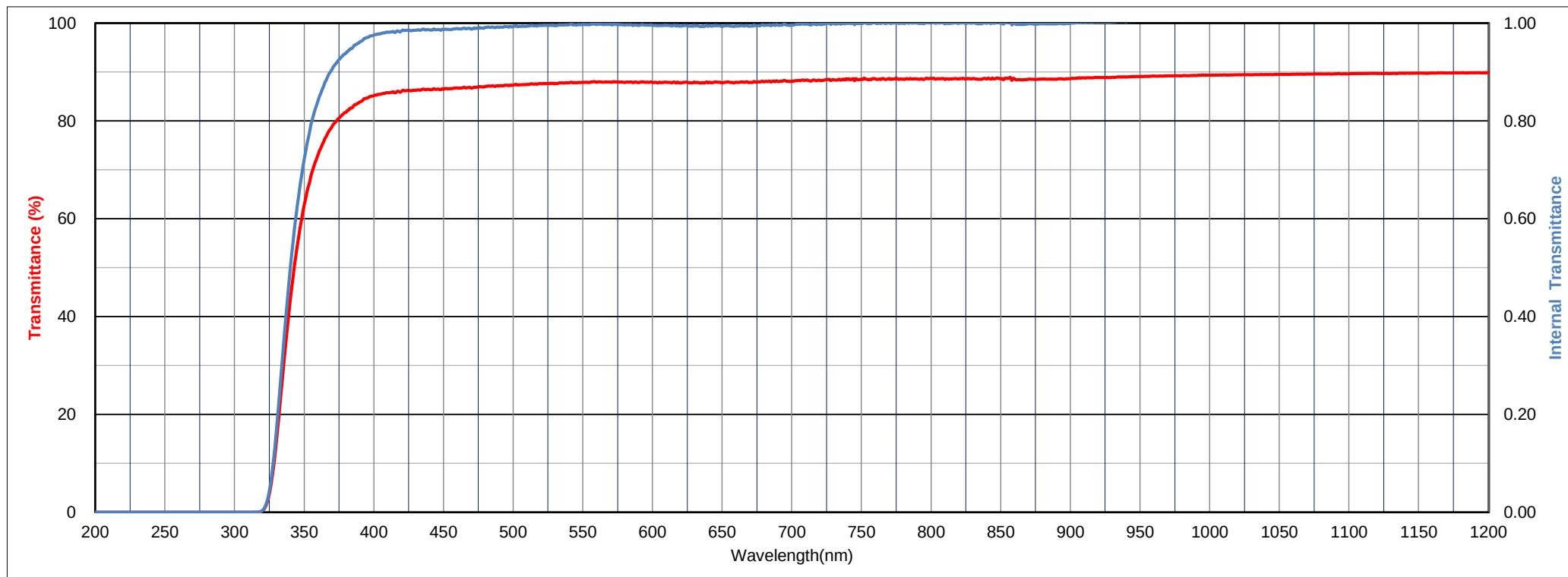
	x	y	Y	λ _d	P _e
A	-	-	-	-	-
C	-	-	-	-	-
D65	-	-	-	-	-

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	3	447	490	79	91	415	150	4.01

Tolerance of Transmittance (T)

Transition Wavelength	Transition Interval	Average High Transmittance
λ T	Δ λ	Th(%)
340±7 nm	< 40 nm	> 85 %





HOYA CORPORATION OPTICS SECTION

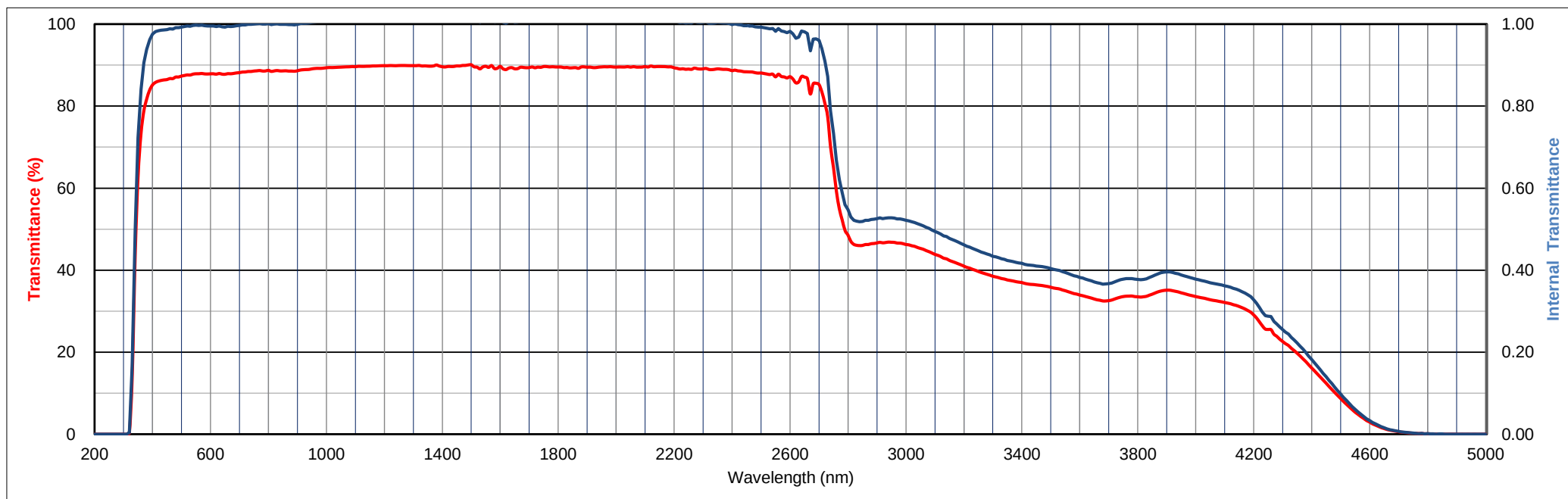
Transmittance (T)

units: %

Thickness 2.50 mm

UV34N

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	14.4	43.4	62.8	73.1	78.8	81.8	83.9
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	85.2	85.8	86.1	86.3	86.4	86.5	86.7	86.7	87.1	87.1	87.3	87.5	87.6	87.6	87.8	87.9	87.9	88.0	87.9	87.8
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	87.9	87.9	87.8	88.0	87.8	87.8	87.9	87.9	88.0	88.1	88.2	88.3	88.3	88.5	88.5	88.6	88.6	88.7	88.6	88.6
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	88.7	88.5	88.6	88.7	88.6	88.6	88.6	88.6	88.6	88.5	88.6	88.8	88.9	88.9	89.0	89.1	89.2	89.2	89.2	89.3
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	89.4	89.4	89.4	89.4	89.5	89.5	89.6	89.6	89.6	89.7	89.6	89.7	89.7	89.7	89.7	89.7	89.8	89.8	89.8	89.9
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	89.9	89.9	89.9	89.9	89.9	89.9	89.9	89.9	89.9	89.9	89.9	89.9	89.9	89.8	89.8	89.8	89.7	89.8	90.0	89.8
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	89.6	89.6	89.7	89.7	89.7	89.8	89.8	89.9	89.9	90.1	90.1	89.6	89.5	89.1	89.6	89.7	89.4	89.9	89.2	89.2
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	89.7	89.1	88.9	89.3	89.4	89.1	89.1	89.5	89.4	89.4	89.4	89.5	89.4	89.5	89.5	89.7	89.7	89.6	89.6	89.6
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	89.5	89.5	89.4	89.4	89.3	89.4	89.4	89.2	89.6	89.6	89.5	89.5	89.4	89.4	89.5	89.6	89.6	89.6	89.6	89.5
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	89.5	89.5	89.6	89.7	89.3	89.0	89.1	89.1	88.7	88.4	88.1	87.1	87.2	87.1	85.3	65.0	48.6	46.0	46.6	46.8
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	46.3	45.3	43.8	42.4	41.0	39.7	38.5	37.6	37.0	36.4	35.8	35.0	33.9	33.0	32.6	33.6	33.5	34.1	35.1	34.5
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	33.6	32.8	32.1	31.1	29.1	25.5	22.6	19.7	16.2	12.4	8.7	5.4	3.0	1.4	0.6	0.2	0.1	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	33.3	68.3	81.6	86.3
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	88.2	89.0	89.5	89.8	90.0	90.1	90.1	90.3	90.3	90.4	90.4	90.5	90.7	90.5	90.7	90.8	90.8	90.9	90.9	90.9
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	90.9	91.0	91.1	91.0	91.2	91.2	91.3	91.4	91.4	91.6	91.6	91.6	91.8	91.7	91.9	92.0	91.9	91.4	91.3	91.4
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	91.5	91.5	91.3	91.4	91.6	91.4	91.5	91.7	91.7	91.7	91.7	91.8	91.9	91.9	92.0	92.1	92.1	92.1	92.2	92.2
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	92.2	92.3	92.3	92.3	92.3	92.4	92.4	92.5	92.5	92.5	92.5	92.6	92.6	92.6	92.6	92.7				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.532	1.521	1.515	1.512	1.510	1.508	1.507
P	0.915	0.918	0.919	0.920	0.921	0.921	0.921

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

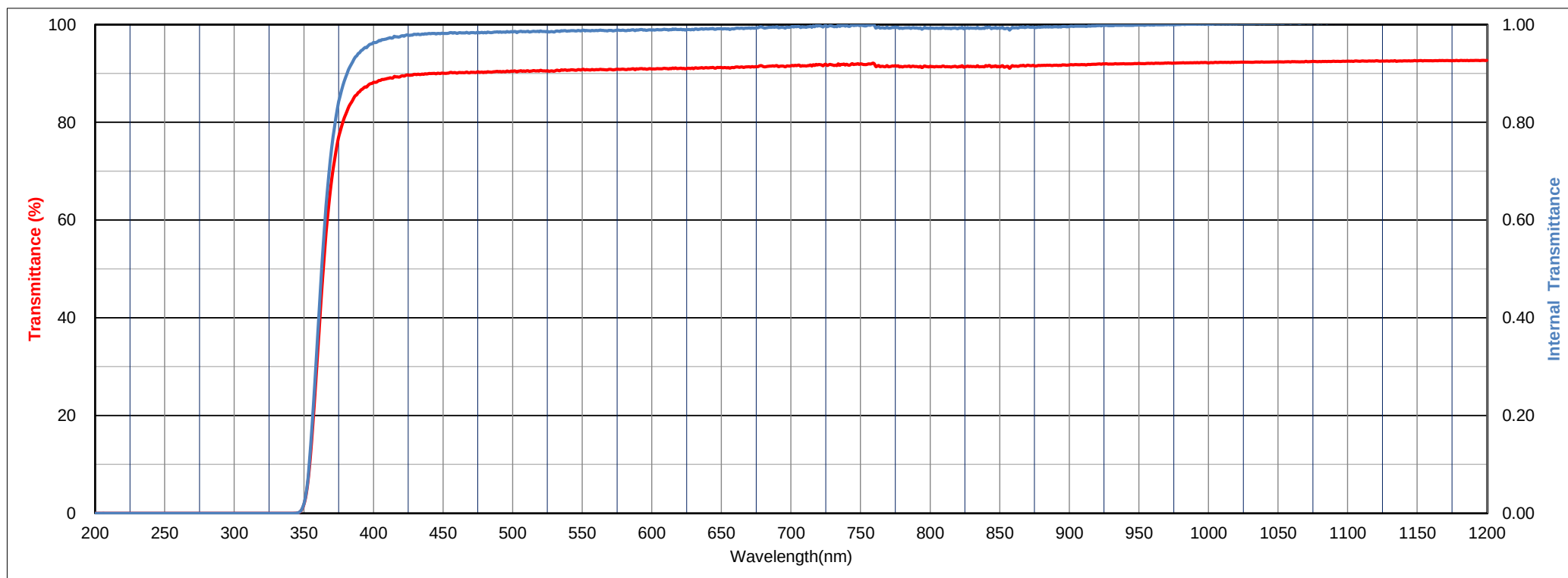
	x	y	Y	λ _d	P _e
A	-	-	-	-	-
C	-	-	-	-	-
D65	-	-	-	-	-

Properties

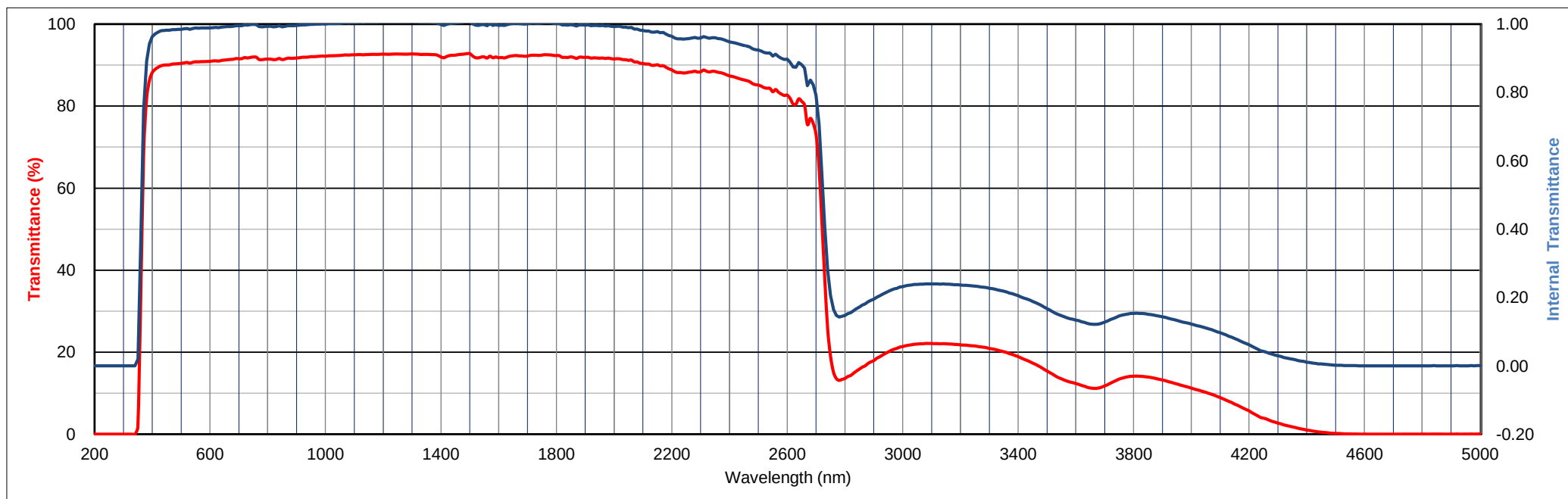
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
2	2	587	646	69	84	600	90	2.52

Tolerance of Transmittance (T)

Transition Wavelength	Transition Interval	Average High Transmittance
λ T	Δ λ	Th(%)
360±7 nm	< 40 nm	> 85 %



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	33.3	68.3	81.6	86.3
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	88.2	89.0	89.5	89.8	90.0	90.1	90.1	90.3	90.3	90.4	90.4	90.5	90.7	90.5	90.7	90.8	90.8	90.9	90.9	90.9
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	90.9	91.0	91.1	91.0	91.2	91.2	91.3	91.4	91.4	91.6	91.6	91.6	91.8	91.7	91.9	92.0	91.9	91.4	91.3	91.4
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	91.5	91.5	91.3	91.4	91.6	91.4	91.5	91.7	91.7	91.7	91.7	91.8	91.9	91.9	92.0	92.1	92.1	92.1	92.2	92.2
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	92.2	92.3	92.3	92.3	92.3	92.4	92.4	92.5	92.5	92.5	92.5	92.6	92.6	92.5	92.6	92.6	92.6	92.6	92.6	92.7
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	92.7	92.7	92.6	92.7	92.7	92.7	92.7	92.7	92.7	92.7	92.7	92.7	92.7	92.6	92.6	92.6	92.6	92.6	92.6	92.4
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	92.0	91.8	92.1	92.3	92.4	92.4	92.6	92.6	92.7	92.8	92.8	92.2	91.8	91.8	92.0	92.0	91.7	92.2	91.8	92.0
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	91.8	91.9	91.8	92.0	92.2	92.3	92.3	92.3	92.2	92.2	92.2	92.4	92.4	92.4	92.4	92.4	92.5	92.5	92.5	92.4
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	92.3	92.3	91.9	91.9	91.9	92.0	91.9	91.6	91.9	91.9	91.9	91.9	91.7	91.8	91.7	91.7	91.7	91.6	91.7	91.6
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	91.5	91.2	90.4	90.1	88.8	88.1	88.4	88.5	87.4	86.4	85.1	83.5	82.7	81.2	73.0	19.0	13.6	15.9	17.9	20.0
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	21.4	22.0	22.1	22.0	21.8	21.5	20.9	20.1	18.9	17.3	15.4	13.5	12.3	11.3	11.8	13.4	14.1	13.9	13.2	12.3
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	11.2	10.2	8.9	7.3	5.7	3.9	2.7	1.8	1.0	0.5	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Blue Filters

Blue filters transmit a relatively narrow band within the blue wavelength region.

The 3-digit value after a capital letter indicates the wavelength of maximum transmittance. For example, E-B390 indicates that the transmittance is maximum when the wavelength is approximately 390 nm.

This filter type features the band-pass function in the vicinity of the ultraviolet region and also has absorption features in other wavelengths.

Transmittance (T)

units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	7.4	26.6	46.9	62.3	71.8	78.0	81.3	81.8	81.2	77.1
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	67.4	56.5	43.5	30.1	18.9	9.3	3.1	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	5.2	25.3	51.8	71.0	81.1	85.4	87.0	87.5	87.3	87.0
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	86.6	86.1	85.5	84.9	84.2	83.4	82.5	81.6	80.6	79.5	78.3	77.0	75.5	73.8	71.9	69.8	67.4	64.6	61.5	58.0
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	54.0	49.9	45.3	40.6	35.9	31.0	26.2	22.0	17.9	14.3	11.1	6.4	3.5	1.8	1.0	0.5				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.541	1.533	1.528	1.526	1.524	1.522	1.521
P	0.913	0.915	0.916	0.917	0.917	0.918	0.918

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

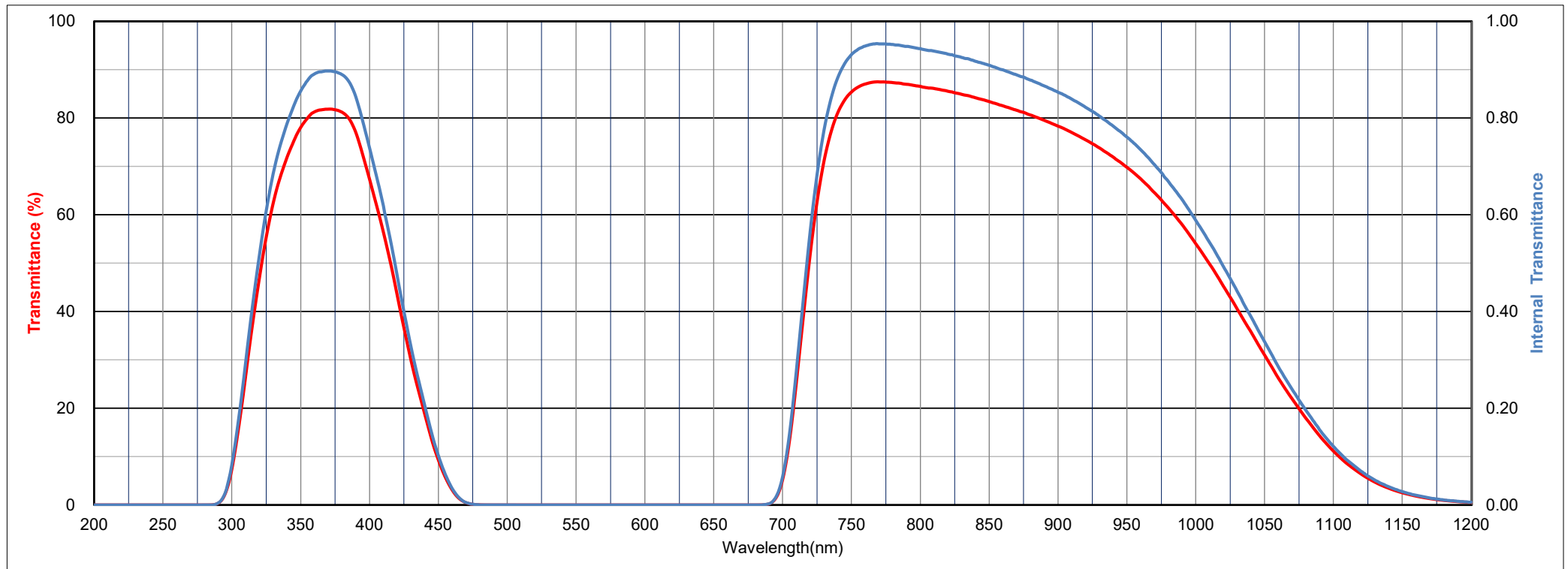
	x	y	Y	λ _d	P _e
A	-	-	-	-	-
C	-	-	-	-	-
D65	-	-	-	-	-

Properties

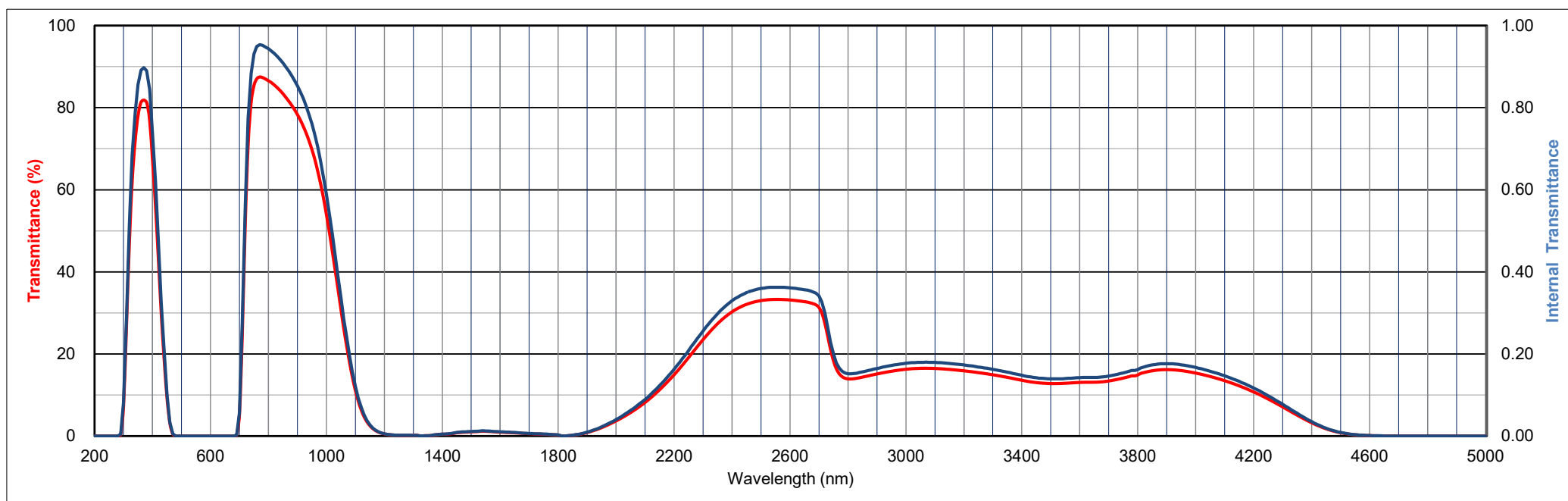
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
2	1	515	565	-	102	540	110	2.62

Tolerance of Transmittance (T)

Maximum Transmittance	Less than 1% Wavelength at Short wave Side	Less than 5% Wavelength at Long wave Side
Tmax(%)	λs1(nm)	λl5(nm)
82±3	>290	<480



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	7.4	26.6	46.9	62.3	71.8	78.0	81.3	81.8	81.2	77.1
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	67.4	56.5	43.5	30.1	18.9	9.3	3.1	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	5.2	25.3	51.8	71.0	81.1	85.4	87.0	87.5	87.3	87.0
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	86.6	86.1	85.5	84.9	84.2	83.4	82.5	81.6	80.6	79.5	78.3	77.0	75.5	73.8	71.9	69.8	67.4	64.6	61.5	58.0
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	54.0	49.9	45.3	40.6	35.9	31.0	26.2	22.0	17.9	14.3	11.1	8.5	6.4	4.7	3.5	2.5	1.8	1.3	1.0	0.7
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	0.5	0.4	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.0	0.1	0.1	0.1	0.2	0.3	0.4
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	0.4	0.5	0.5	0.6	0.7	0.8	0.9	0.9	0.9	1.0	1.0	1.1	1.1	1.1	1.2	1.2	1.1	1.1	1.0	1.0
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	0.9	0.9	0.9	0.9	0.8	0.8	0.7	0.7	0.7	0.6	0.6	0.6	0.5	0.5	0.5	0.4	0.4	0.4	0.3	0.3
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	0.2	0.1	0.0	0.0	0.1	0.2	0.3	0.4	0.5	0.7	0.9	1.1	1.3	1.5	1.8	2.0	2.4	2.7	3.0	3.3
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	3.7	5.7	8.2	11.3	14.9	19.1	23.5	27.4	30.3	32.1	33.0	33.3	33.2	32.7	31.3	18.3	13.9	14.4	15.1	15.8
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	16.3	16.5	16.5	16.2	15.9	15.5	14.9	14.3	13.6	13.0	12.8	12.9	13.1	13.1	13.4	14.1	14.9	15.9	16.2	15.9
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	15.3	14.5	13.5	12.2	10.7	9.0	7.1	5.1	3.2	1.8	0.8	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Transmittance (T)

units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	5.6	21.8	41.6	57.3	67.2	72.8	76.3	78.2
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	77.5	75.4	72.3	67.3	61.4	52.9	41.9	26.2	12.4	4.6	1.7	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.8	2.3	3.5	3.9	3.9	3.8	3.6	3.5	3.4	3.3	3.3
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	3.3	3.4	3.4	3.5	3.6	3.7	3.9	4.1	4.3	4.5	4.8	5.1	5.4	5.8	6.1	6.5	6.9	7.3	7.8	8.2
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	8.6	9.0	9.3	9.7	9.9	10.1	10.3	10.3	10.2	10.1	9.8	9.1	8.0	6.8	5.6	4.6				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.528	1.519	1.514	1.512	1.510	1.509	1.508
P	0.916	0.919	0.920	0.920	0.921	0.921	0.921

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

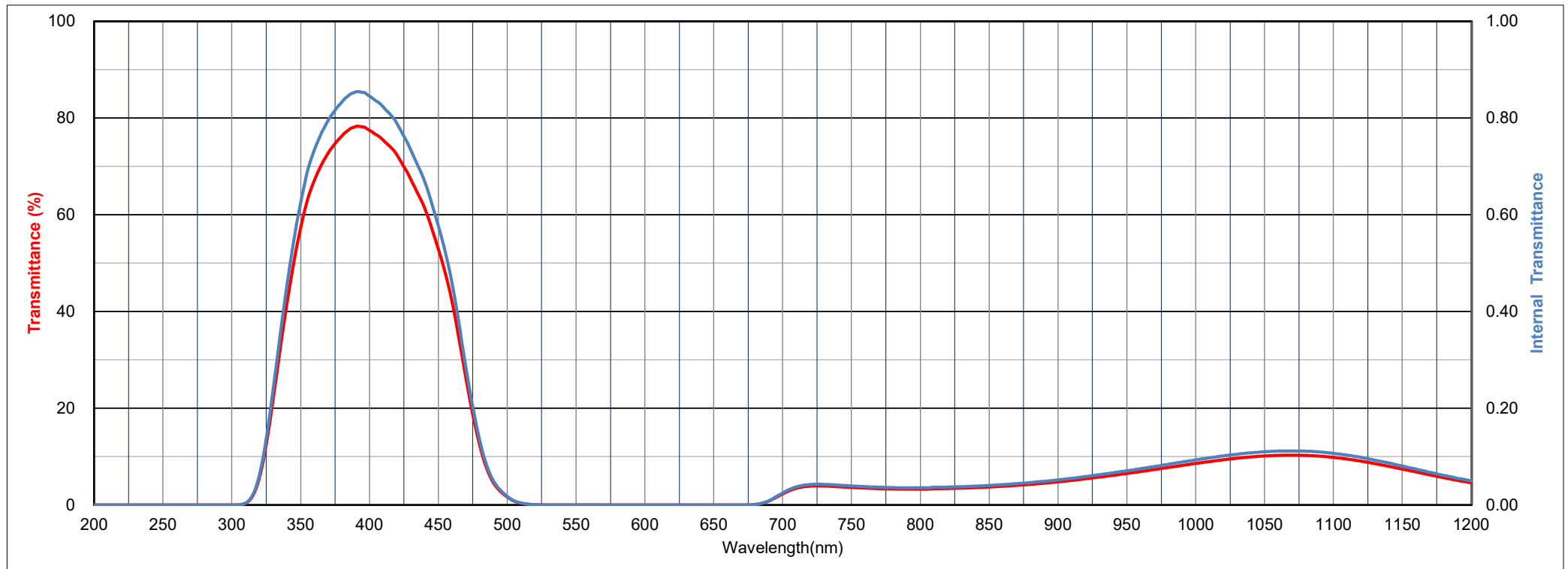
	x	y	Y	λ _d	P _e
A	-	-	-	-	-
C	0.156	0.023	1	452	99
D65	0.155	0.024	1	453	99

Properties

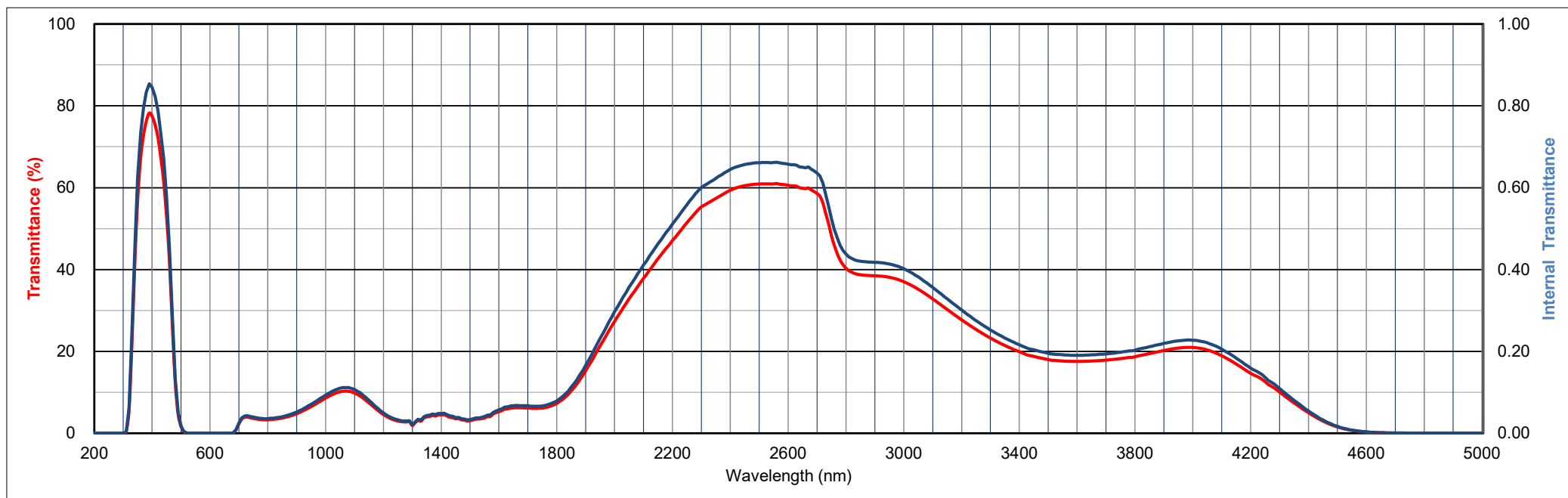
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α	α	H _K	F _A	d
1	1	485	535	-30/70	100/300	510	110	2.57

Tolerance of Transmittance (T)

Maximum Transmittance	Less than 1% Wavelength at Short wave Side	Less than 5% Wavelength at Long wave Side
Tmax(%)	λs1(nm)	λl5(nm)
78±3	>310	<510



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	5.6	21.8	41.6	57.3	67.2	72.8	76.3	78.2
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	77.5	75.4	72.3	67.3	61.4	52.9	41.9	26.2	12.4	4.6	1.7	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.8	2.3	3.5	3.9	3.9	3.8	3.6	3.5	3.4	3.3	3.3
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	3.3	3.4	3.4	3.5	3.6	3.7	3.9	4.1	4.3	4.5	4.8	5.1	5.4	5.8	6.1	6.5	6.9	7.3	7.8	8.2
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	8.6	9.0	9.3	9.7	9.9	10.1	10.3	10.3	10.2	10.1	9.8	9.5	9.1	8.6	8.0	7.4	6.8	6.2	5.6	5.1
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	4.6	4.1	3.8	3.4	3.2	3.0	2.8	2.8	2.8	2.8	1.9	2.6	3.1	3.0	3.7	4.0	4.1	4.3	4.2	4.5
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	4.5	4.5	4.2	3.9	3.8	3.5	3.6	3.3	3.2	3.0	3.1	3.2	3.4	3.5	3.6	3.7	4.1	4.1	4.7	5.0
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	5.3	5.5	5.9	6.0	6.1	6.2	6.2	6.2	6.2	6.2	6.2	6.1	6.1	6.1	6.1	6.1	6.3	6.4	6.7	7.0
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	7.3	7.8	8.3	8.9	9.5	10.4	11.2	12.1	13.2	14.1	15.3	16.5	17.6	18.9	20.2	21.4	22.6	23.8	25.0	26.2
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	27.4	32.9	37.9	42.7	47.1	51.4	55.3	57.4	59.4	60.5	60.9	60.9	60.6	59.9	58.6	48.2	40.4	38.7	38.5	38.1
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	37.0	35.2	32.8	30.3	27.7	25.4	23.3	21.4	19.9	18.8	18.0	17.6	17.6	17.6	17.9	18.2	18.7	19.5	20.2	20.8
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	21.0	20.4	18.9	16.9	14.7	12.6	10.1	7.4	5.0	3.0	1.5	0.7	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	1.3	7.8	17.5	29.3	43.1	57.1	68.7	77.3	83.2	86.9	89.3	90.8	91.5	92.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	91.9	91.8	91.5	90.9	89.7	88.6	87.5	85.3	81.7	76.8	70.7	63.6	55.5	47.0	38.9	29.9	21.5	15.1	10.5	7.1
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	4.1	1.7	1.0	0.9	1.0	0.8	0.4	0.5	0.6	0.7	1.2	4.3	13.8	29.5	50.3	72.4	85.1	89.9	91.3	91.8
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	91.9	91.9	91.9	91.9	91.9	91.8	91.7	91.7	91.6	91.5	91.5	91.4	91.3	91.1	91.0	90.8	90.7	90.5	90.3	90.0
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	89.8	89.5	89.3	89.0	88.6	88.4	88.0	87.5	87.3	86.8	86.3	85.3	84.2	83.1	81.7	80.2				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.486	1.473	1.467	1.463	1.460	1.459	1.457
P	0.926	0.929	0.931	0.932	0.932	0.933	0.933

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

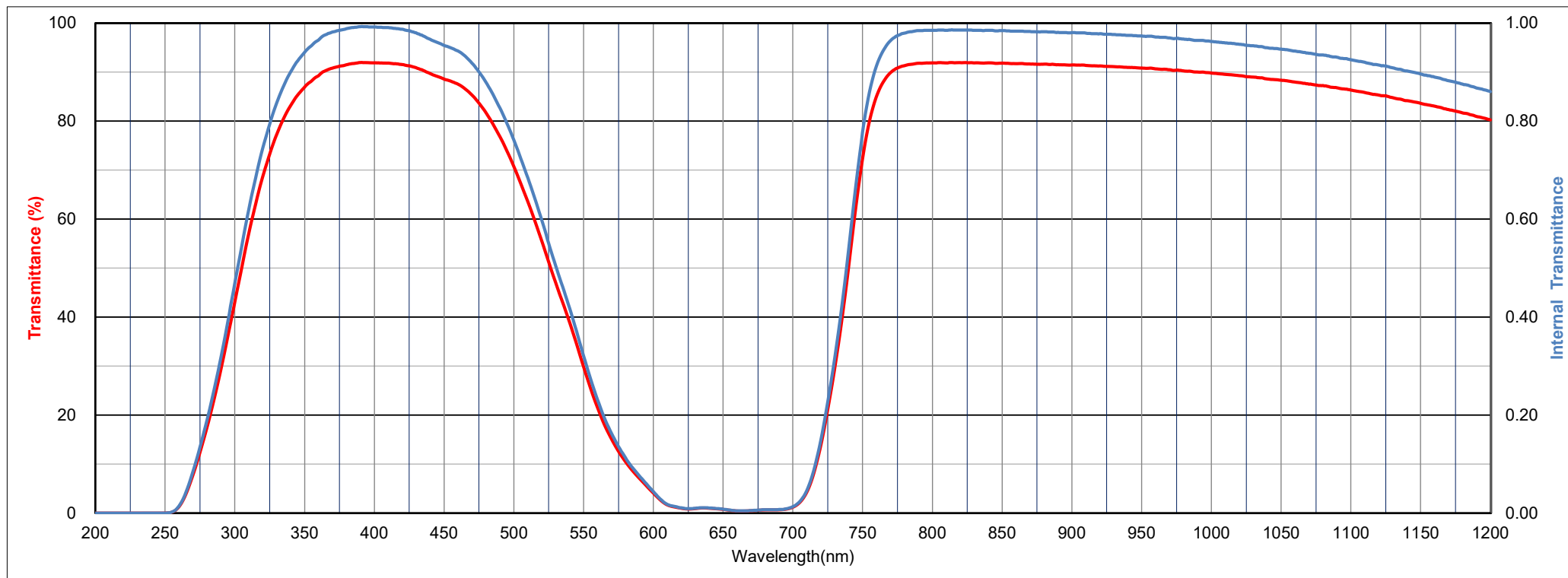
	x	y	Y	λ _d	P _e
A	0.198	0.339	22	490	62
C	0.162	0.190	30	480	68
D65	0.162	0.205	30	481	67

Properties

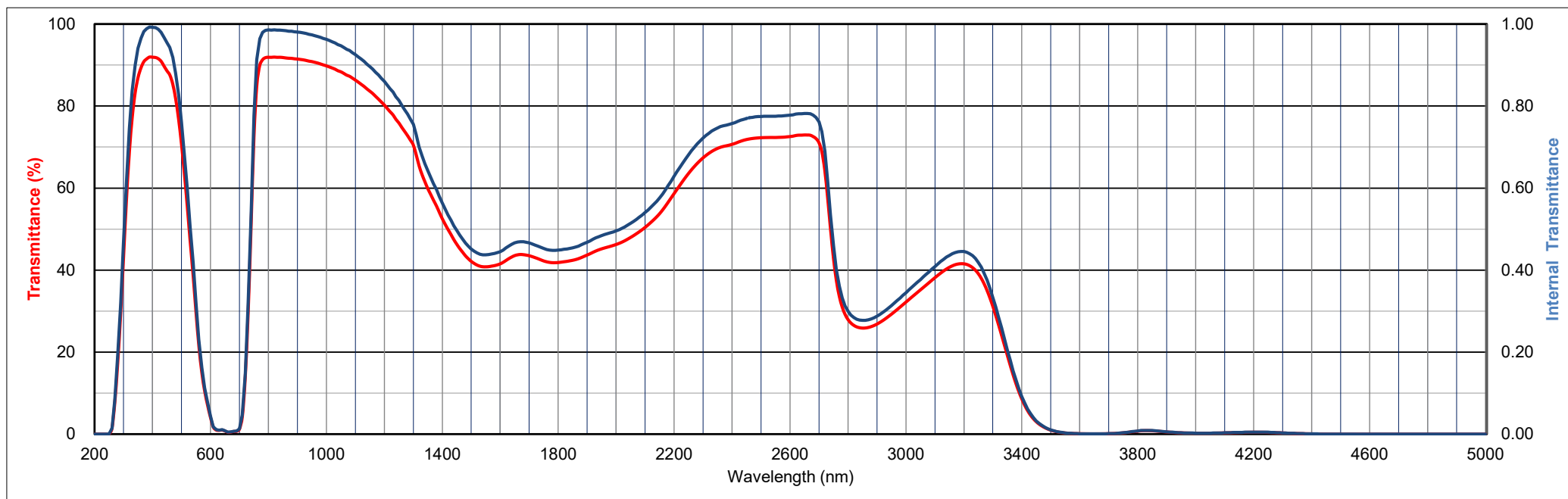
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α	α	H _K	F _A	d
3	4	410	500	-30/70	100/300	420	120	2.27

Tolerance of Transmittance (T)

Maximum Transmittance	Less than 1% Wavelength at Short wave Side	Less than 5% Wavelength at Long wave Side
Tmax(%)	λs1(nm)	λl5(nm)
90±3	>250	<600



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	1.3	7.8	17.5	29.3	43.1	57.1	68.7	77.3	83.2	86.9	89.3	90.8	91.5	92.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	91.9	91.8	91.5	90.9	89.7	88.6	87.5	85.3	81.7	76.8	70.7	63.6	55.5	47.0	38.9	29.9	21.5	15.1	10.5	7.1
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	4.1	1.7	1.0	0.9	1.0	0.8	0.4	0.5	0.6	0.7	1.2	4.3	13.8	29.5	50.3	72.4	85.1	89.9	91.3	91.8
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	91.9	91.9	91.9	91.9	91.9	91.8	91.7	91.7	91.6	91.5	91.5	91.4	91.3	91.1	91.0	90.8	90.7	90.5	90.3	90.0
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	89.8	89.5	89.3	89.0	88.6	88.4	88.0	87.5	87.3	86.8	86.3	85.8	85.3	84.8	84.2	83.6	83.1	82.4	81.7	81.0
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	80.2	79.4	78.6	77.8	76.8	75.9	74.8	73.8	72.8	71.7	70.5	68.1	65.4	63.3	61.6	59.9	58.5	57.0	55.6	54.1
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	52.5	51.2	49.9	48.7	47.4	46.3	45.3	44.4	43.5	42.8	42.1	41.6	41.2	41.0	40.8	40.8	40.8	41.0	41.1	41.3
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	41.5	41.9	42.4	42.8	43.2	43.5	43.7	43.8	43.8	43.7	43.5	43.3	43.0	42.8	42.5	42.2	42.0	41.9	41.8	41.8
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	41.8	41.9	42.0	42.1	42.3	42.4	42.6	42.8	43.1	43.4	43.7	44.0	44.3	44.7	44.9	45.2	45.4	45.6	45.8	46.0
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	46.2	48.0	50.4	53.8	58.7	63.6	67.4	69.7	70.7	71.8	72.3	72.3	72.6	73.0	71.0	42.9	28.0	25.9	26.8	29.2
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	32.2	35.2	38.1	40.7	41.5	39.1	31.1	19.2	8.6	3.0	1.0	0.3	0.1	0.1	0.1	0.3	0.7	0.8	0.5	0.3
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	0.2	0.2	0.3	0.4	0.5	0.4	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Transmittance (T)

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	4.3	12.4	22.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	30.9	38.1	43.4	46.3	47.2	45.2	40.1	30.1	18.7	9.9	5.1	2.1	0.7	0.3	0.2	0.4	0.6	0.2	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.0	1.9	2.5	2.7	2.7	2.6	2.4	2.4	2.3	2.3	2.3
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	2.3	2.3	2.4	2.5	2.5	2.7	2.8	3.0	3.2	3.4	3.6	3.9	4.2	4.5	4.8	5.2	5.6	6.0	6.4	6.8
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	7.2	7.6	8.1	8.5	8.8	9.2	9.5	9.7	9.9	10.0	10.1	10.0	9.7	9.2	8.5	7.9				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.549	1.539	1.534	1.531	1.529	1.528	1.527
P	0.911	0.914	0.915	0.916	0.916	0.916	0.917

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

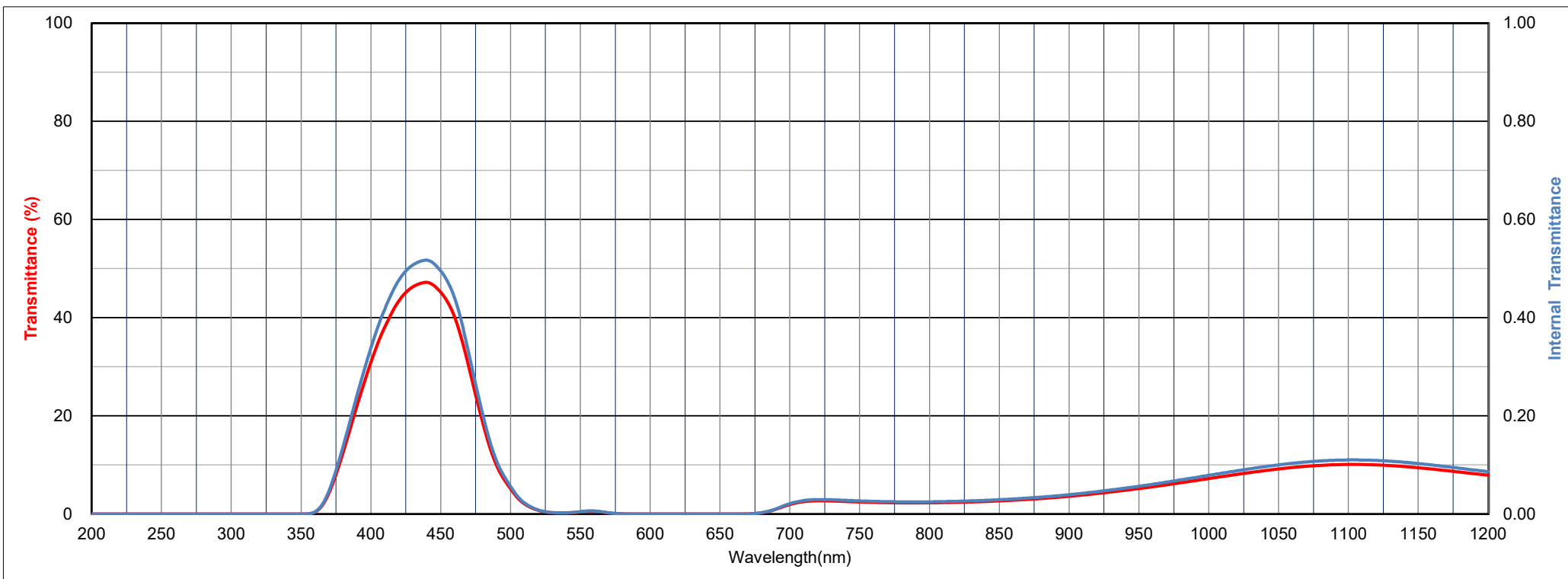
	x	y	Y	λ _d	P _e
A	-	-	-	-	-
C	0.151	0.038	2	459	97
D65	0.150	0.039	2	460	97

Properties

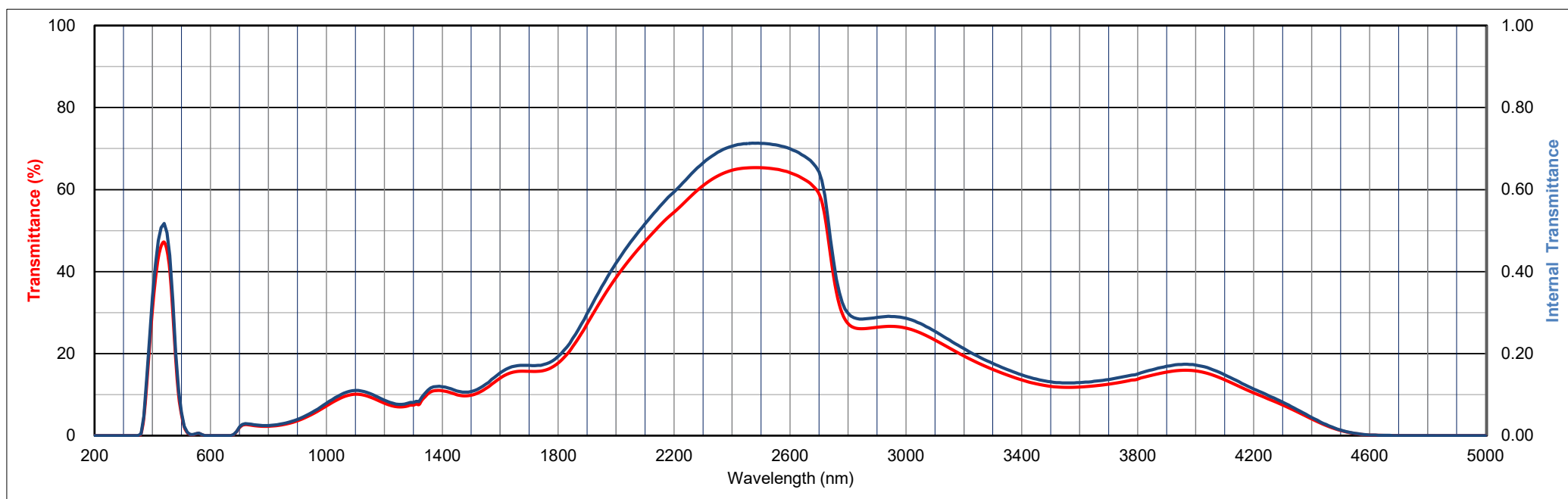
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α	α	H _K	F _A	d
1	1	480	535	-30/70	100/300	530	110	2.70

Tolerance of Transmittance (T)

Maximum Transmittance	Less than 1% Wavelength at Short wave Side	Less than 5% Wavelength at Long wave Side
Tmax(%)	λs1(nm)	λl5(nm)
47±3	>350	<520



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	4.3	12.4	22.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	30.9	38.1	43.4	46.3	47.2	45.2	40.1	30.1	18.7	9.9	5.1	2.1	0.7	0.3	0.2	0.4	0.6	0.2	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.0	1.9	2.5	2.7	2.7	2.6	2.4	2.4	2.3	2.3	2.3
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	2.3	2.3	2.4	2.5	2.5	2.7	2.8	3.0	3.2	3.4	3.6	3.9	4.2	4.5	4.8	5.2	5.6	6.0	6.4	6.8
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	7.2	7.6	8.1	8.5	8.8	9.2	9.5	9.7	9.9	10.0	10.1	10.1	10.0	9.9	9.7	9.4	9.2	8.9	8.5	8.2
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	7.9	7.6	7.4	7.2	7.1	7.0	7.0	7.1	7.2	7.4	7.4	7.7	7.6	8.7	9.4	10.2	10.7	10.9	11.0	11.0
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	10.9	10.8	10.7	10.4	10.2	10.0	9.8	9.7	9.7	9.8	9.9	10.0	10.3	10.6	11.0	11.5	11.9	12.5	13.0	13.5
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	14.0	14.5	14.9	15.2	15.4	15.6	15.7	15.7	15.7	15.7	15.7	15.7	15.7	15.7	15.7	15.9	16.1	16.4	16.7	17.2
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	17.7	18.3	19.0	19.8	20.7	21.7	22.7	23.8	24.9	26.0	27.3	28.5	29.7	30.9	32.0	33.2	34.3	35.4	36.5	37.6
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	38.6	43.2	47.4	51.2	54.5	57.8	61.0	63.3	64.7	65.3	65.3	65.0	64.1	62.4	59.0	39.1	27.3	26.1	26.4	26.6
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	26.2	25.1	23.3	21.4	19.4	17.7	16.1	14.8	13.6	12.6	12.0	11.8	11.9	12.1	12.6	13.1	13.8	14.7	15.5	15.9
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	15.8	15.0	13.6	12.0	10.4	9.0	7.5	5.8	4.1	2.5	1.3	0.5	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	4.4	17.0	34.2	49.6	60.6	67.9	73.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	76.6	79.1	81.1	82.4	83.5	84.2	84.6	84.3	83.6	81.9	79.3	75.3	70.1	63.7	56.7	49.2	41.8	34.7	28.3	22.7
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	18.0	14.1	11.0	8.6	6.7	5.2	4.1	3.4	2.7	2.3	1.9	1.7	1.5	1.3	1.2	1.1	1.1	1.1	1.0	1.0
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	1.0	1.1	1.1	1.1	1.2	1.2	1.3	1.4	1.5	1.7	1.8	2.0	2.2	2.4	2.6	2.8	3.1	3.4	3.8	4.1
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	4.5	4.9	5.3	5.8	6.2	6.7	7.3	7.8	8.4	9.0	9.6	11.0	12.4	13.8	15.4	17.1				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.543	1.533	1.527	1.523	1.521	1.520	1.519
P	0.913	0.915	0.917	0.918	0.918	0.918	0.919

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

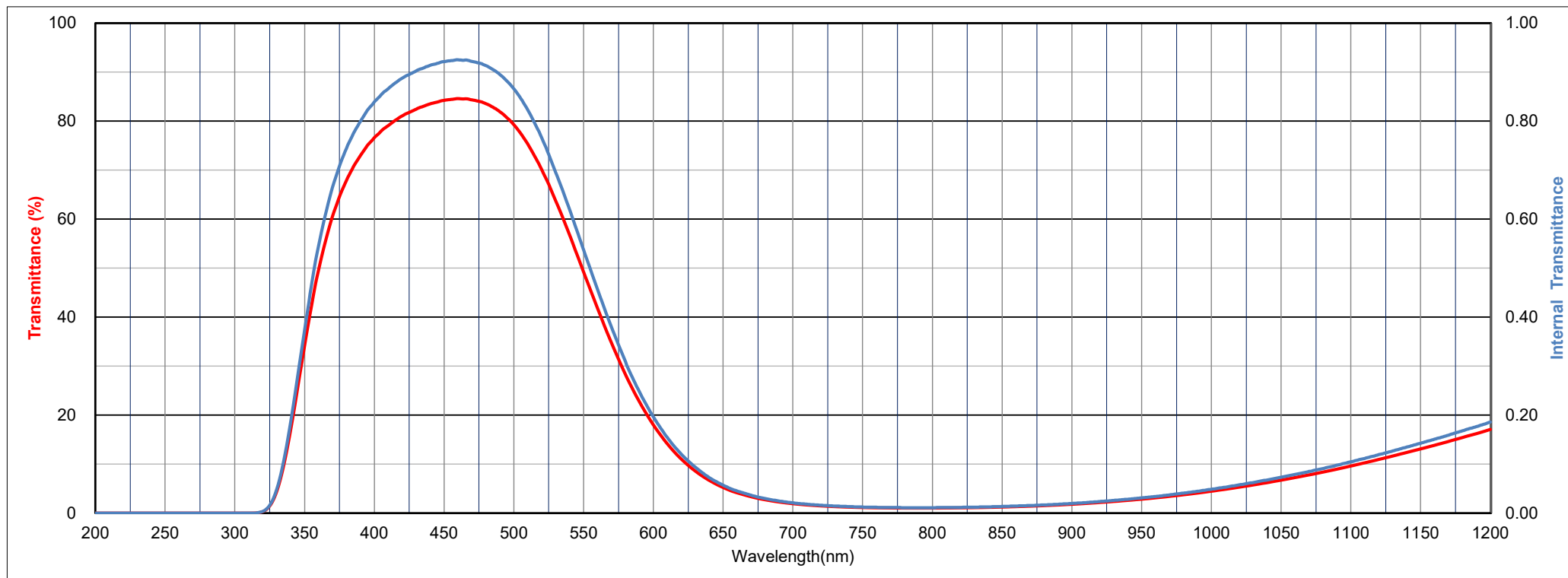
	x	y	Y	λ _d	P _e
A	0.282	0.399	37	494	39
C	0.199	0.251	45	484	47
D65	0.200	0.267	45	485	46

Properties

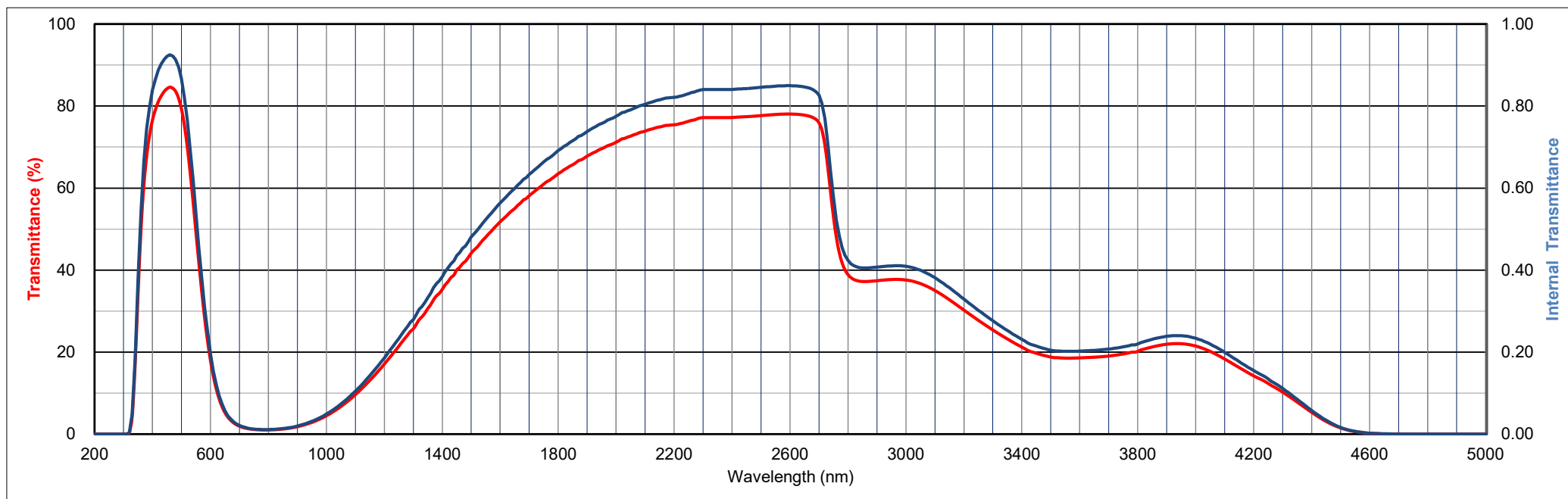
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α	α	H _K	F _A	d
2	1	505	555	-30/70	100/300	540	110	2.60

Tolerance of Transmittance (T)

Maximum Transmittance	Less than 1% Wavelength at Short wave Side	Less than 5% Wavelength at Long wave Side
Tmax(%)	λs1(nm)	λl5(nm)
85±3	>320	<700



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	4.4	17.0	34.2	49.6	60.6	67.9	73.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	76.6	79.1	81.1	82.4	83.5	84.2	84.6	84.3	83.6	81.9	79.3	75.3	70.1	63.7	56.7	49.2	41.8	34.7	28.3	22.7
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	18.0	14.1	11.0	8.6	6.7	5.2	4.1	3.4	2.7	2.3	1.9	1.7	1.5	1.3	1.2	1.1	1.1	1.1	1.0	1.0
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	1.0	1.1	1.1	1.1	1.2	1.2	1.3	1.4	1.5	1.7	1.8	2.0	2.2	2.4	2.6	2.8	3.1	3.4	3.8	4.1
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	4.5	4.9	5.3	5.8	6.2	6.7	7.3	7.8	8.4	9.0	9.6	10.3	11.0	11.7	12.4	13.1	13.8	14.6	15.4	16.2
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	17.1	17.9	18.8	19.7	20.5	21.4	22.4	23.3	24.1	25.0	25.7	26.7	27.9	28.6	29.5	30.6	31.6	32.8	33.7	34.3
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	35.3	36.4	37.2	38.2	38.8	40.0	40.7	41.6	42.2	43.1	44.2	44.9	45.6	46.4	47.3	48.0	48.8	49.5	50.3	51.1
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	51.8	52.4	53.1	53.8	54.5	55.0	55.8	56.4	57.1	57.5	58.1	58.7	59.3	59.9	60.4	61.0	61.5	61.9	62.4	62.9
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	63.5	63.9	64.5	64.9	65.3	65.7	66.1	66.7	66.9	67.3	67.8	68.2	68.6	68.9	69.3	69.6	69.9	70.3	70.6	70.8
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	71.2	72.7	73.9	74.9	75.4	76.3	77.2	77.2	77.2	77.4	77.7	77.9	78.1	77.8	75.9	53.0	38.9	37.2	37.4	37.7
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	37.6	36.7	35.0	32.8	30.3	27.8	25.4	23.2	21.2	19.7	18.8	18.5	18.6	18.8	19.0	19.6	20.2	21.3	21.9	22.0
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	21.5	20.2	18.3	16.2	14.2	12.4	10.2	7.8	5.3	3.1	1.5	0.6	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Green Filters

Green filters transmit relatively narrow bands within the green wavelength region.

The 3-digit value after the capital letter indicates the wavelength of maximum transmittance. For example, G530 indicates that the transmittance is maximum when the wavelength is approximately 530 nm.

Green filters are used as band-pass filters, RGB separation filters and more.

Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5	1.4	3.6	7.5	12.6	17.1	18.9	17.1	12.7	7.9	4.2	1.9	0.8
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.4	0.5	0.7	1.0				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.597	1.581	1.573	1.568	1.565	1.564	1.562
P	0.900	0.904	0.906	0.907	0.907	0.908	0.908

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

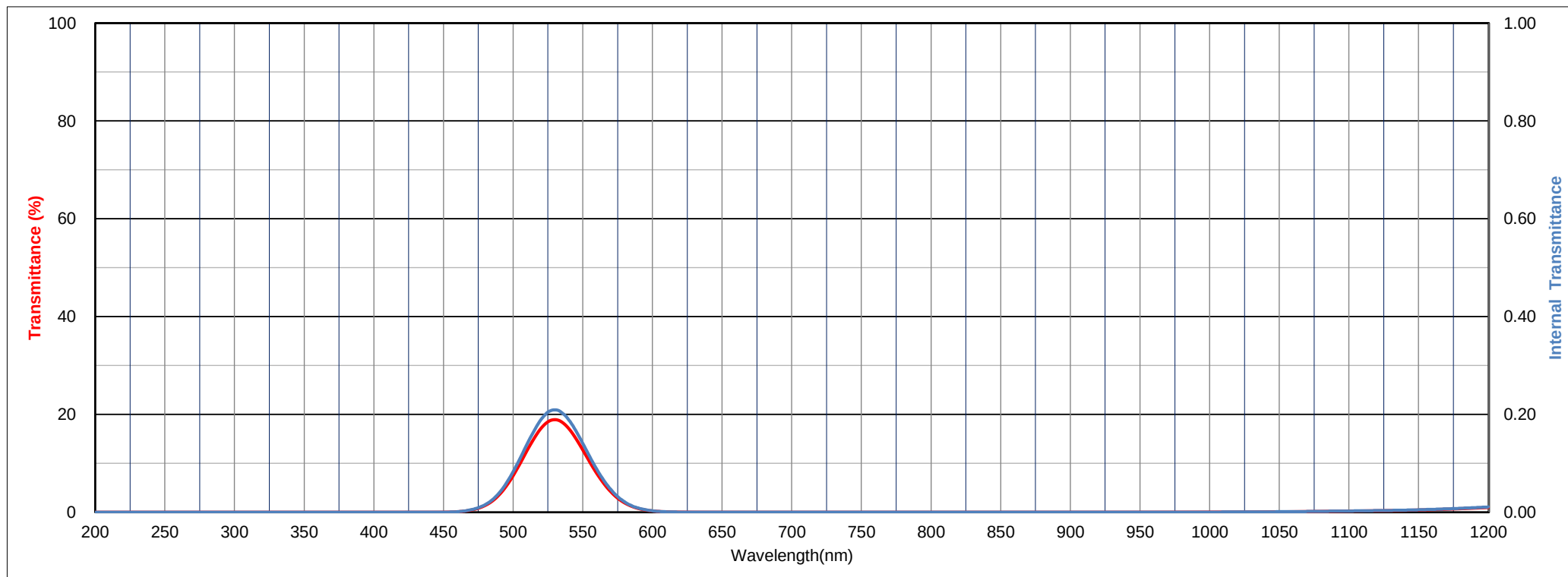
	x	y	Y	λ _d	P _e
A	0.247	0.690	6	532	73
C	0.221	0.686	8	536	80
D65	0.216	0.693	8	535	80

Properties

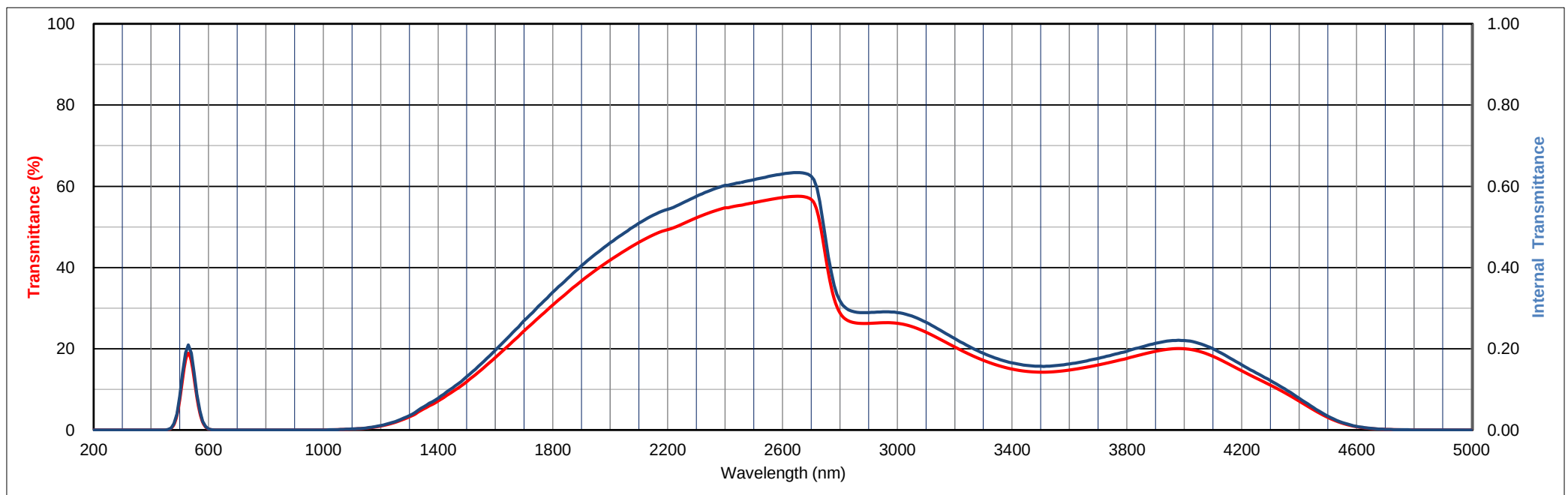
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	1	450	495	94	100	500	130	3.12

Tolerance of Transmittance (T)

Maximum Transmittance	Less than 1% Wavelength at Short wave Side	Less than 5% Wavelength at Long wave Side
Tmax(%)	λs1(nm)	λl5(nm)
18±3	>470	<580



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5	1.4	3.6	7.5	12.6	17.1	18.9	17.1	12.7	7.9	4.2	1.9	0.8
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.5	0.5	0.6	0.7	0.8
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	1.0	1.1	1.3	1.5	1.7	1.9	2.1	2.4	2.6	2.9	3.2	3.5	3.9	4.4	4.8	5.2	5.6	6.0	6.3	6.7
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	7.1	7.6	8.0	8.5	8.9	9.4	9.9	10.3	10.8	11.4	11.9	12.5	13.1	13.6	14.2	14.8	15.4	16.0	16.6	17.2
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	17.9	18.5	19.2	19.8	20.4	21.1	21.8	22.4	23.0	23.8	24.4	25.1	25.7	26.3	27.0	27.6	28.3	28.9	29.5	30.2
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	30.8	31.4	32.0	32.6	33.2	33.8	34.4	35.0	35.6	36.1	36.7	37.3	37.8	38.4	38.9	39.4	39.9	40.4	40.9	41.4
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	41.8	44.1	46.2	48.0	49.3	50.7	52.2	53.6	54.7	55.3	56.0	56.7	57.2	57.5	56.8	42.8	28.9	26.4	26.2	26.4
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	26.3	25.5	24.1	22.3	20.4	18.7	17.2	15.9	15.0	14.4	14.2	14.4	14.8	15.3	16.0	16.8	17.6	18.6	19.4	19.9
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	20.0	19.4	18.1	16.4	14.6	12.8	11.1	9.2	7.1	5.0	3.1	1.7	0.8	0.4	0.2	0.1	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.0	0.0	0.1	0.5	1.7	4.7	9.8	16.8	25.7	35.3	44.1	50.6	53.8	53.3	49.4	43.3	35.9	28.3	21.4
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	15.7	11.4	8.3	6.2	5.0	4.2	3.5	3.3	3.2	2.8	2.8	2.9	3.0	3.2	3.3	3.4	3.5	3.7	3.8	3.9
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	4.0	4.1	4.2	4.4	4.5	4.7	4.9	5.2	5.4	5.7	6.1	6.4	6.9	7.3	7.8	8.2	8.8	9.3	9.9	10.5
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	11.2	11.8	12.5	13.3	14.0	14.8	15.6	16.4	17.2	18.0	18.9	20.7	22.5	24.3	26.1	28.0				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.551	1.541	1.536	1.533	1.531	1.529	1.529
P	0.911	0.913	0.915	0.915	0.916	0.916	0.916

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

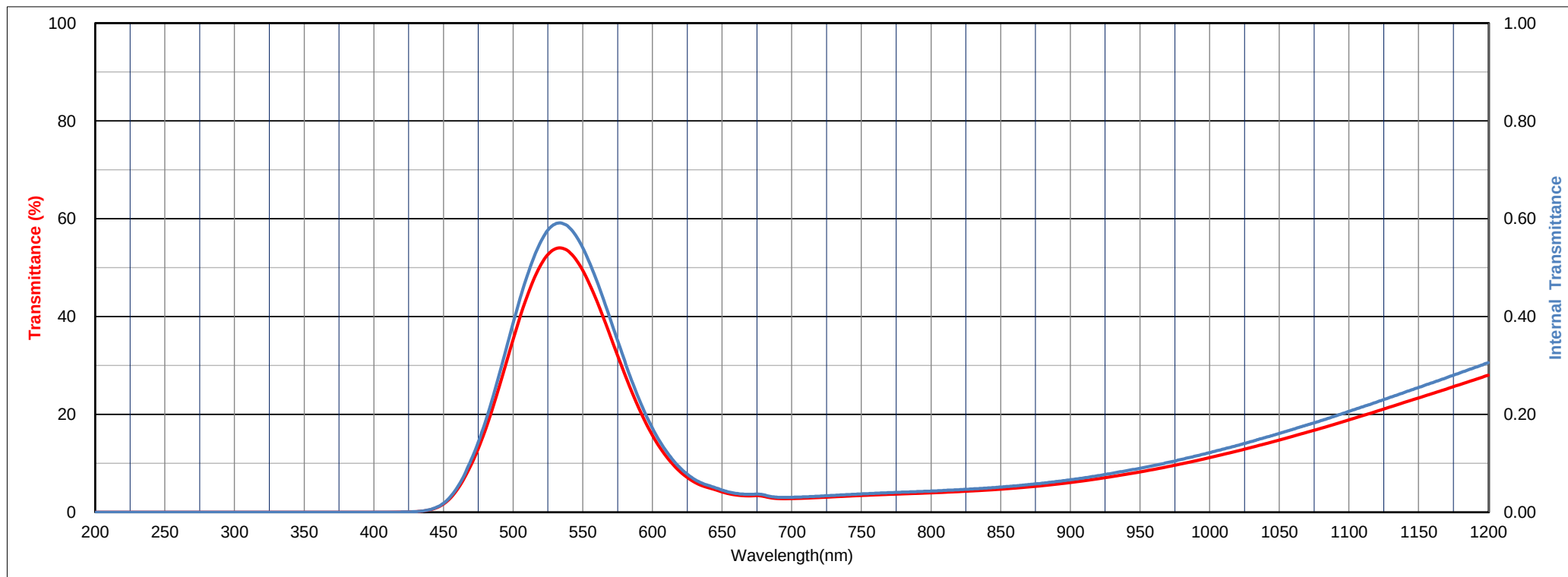
	x	y	Y	λ _d	P _e
A	0.367	0.566	31	551	56
C	0.303	0.564	35	550	65
D65	0.299	0.572	35	549	65

Properties

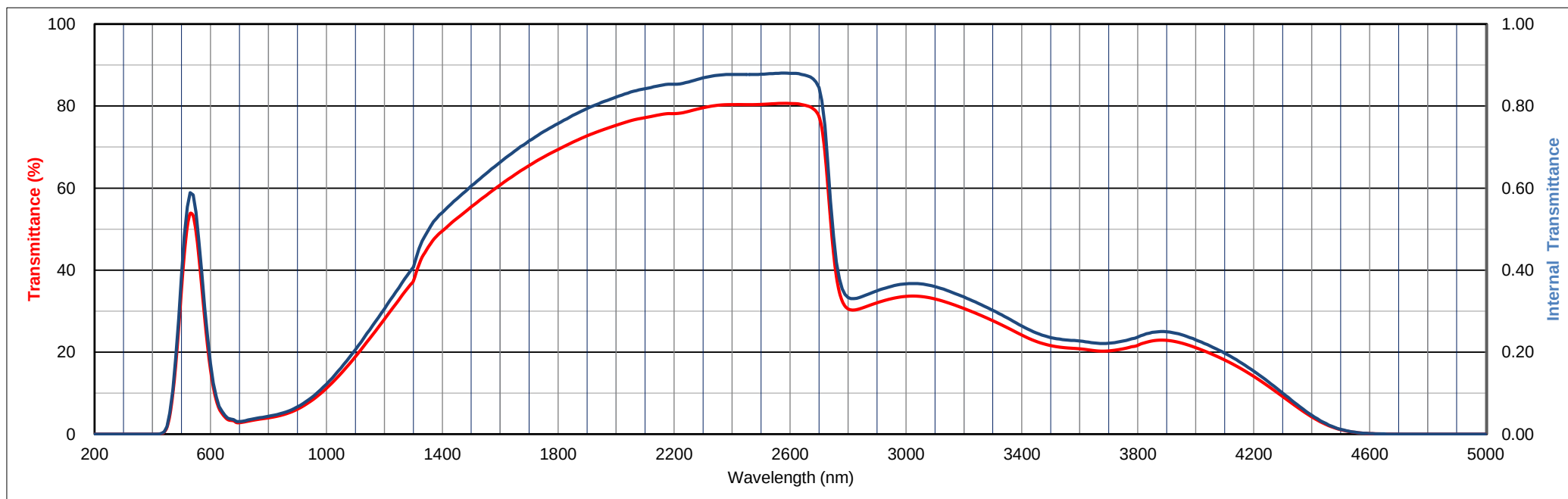
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
3	1	550	600	87	103	580	140	2.60

Tolerance of Transmittance (T)

Maximum Transmittance	Less than 1% Wavelength at Short wave Side	Less than 5% Wavelength at Long wave Side
Tmax(%)	λs1(nm)	λl5(nm)
18±3	>470	<580



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.0	0.0	0.1	0.5	1.7	4.7	9.8	16.8	25.7	35.3	44.1	50.6	53.8	53.3	49.4	43.3	35.9	28.3	21.4
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	15.7	11.4	8.3	6.2	5.0	4.2	3.5	3.3	3.2	2.8	2.8	2.9	3.0	3.2	3.3	3.4	3.5	3.7	3.8	3.9
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	4.0	4.1	4.2	4.4	4.5	4.7	4.9	5.2	5.4	5.7	6.1	6.4	6.9	7.3	7.8	8.2	8.8	9.3	9.9	10.5
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	11.2	11.8	12.5	13.3	14.0	14.8	15.6	16.4	17.2	18.0	18.9	19.8	20.7	21.6	22.5	23.4	24.3	25.2	26.1	27.1
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	28.0	29.0	29.9	30.9	31.8	32.7	33.7	34.7	35.5	36.4	37.3	39.5	41.4	43.1	44.3	45.4	46.5	47.5	48.2	49.0
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	49.5	50.1	50.8	51.4	52.0	52.6	53.1	53.7	54.3	54.8	55.4	56.0	56.5	57.1	57.6	58.1	58.7	59.2	59.7	60.3
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	60.8	61.3	61.8	62.3	62.7	63.2	63.7	64.2	64.6	65.1	65.5	65.9	66.4	66.8	67.2	67.6	68.0	68.4	68.7	69.1
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	69.4	69.8	70.1	70.5	70.8	71.2	71.5	71.8	72.1	72.5	72.8	73.0	73.3	73.6	73.9	74.1	74.4	74.6	74.8	75.1
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	75.3	76.4	77.2	77.9	78.2	78.7	79.6	80.2	80.4	80.4	80.4	80.6	80.6	80.2	77.4	44.3	30.6	30.8	32.0	33.0
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	33.6	33.6	33.0	31.9	30.6	29.2	27.7	26.0	24.2	22.6	21.6	21.1	20.8	20.4	20.3	20.8	21.7	22.7	22.9	22.2
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	21.1	19.7	18.1	16.2	14.1	11.7	9.2	6.6	4.2	2.3	1.1	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.6	2.6	6.5	11.2	14.5	14.6	11.7	7.8	4.4	2.1
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.9	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.5
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.5	1.8	2.0	2.2	2.8	3.5	4.3	5.2	6.1				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.601	1.585	1.576	1.572	1.569	1.567	1.565
P	0.899	0.903	0.905	0.906	0.907	0.907	0.907

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

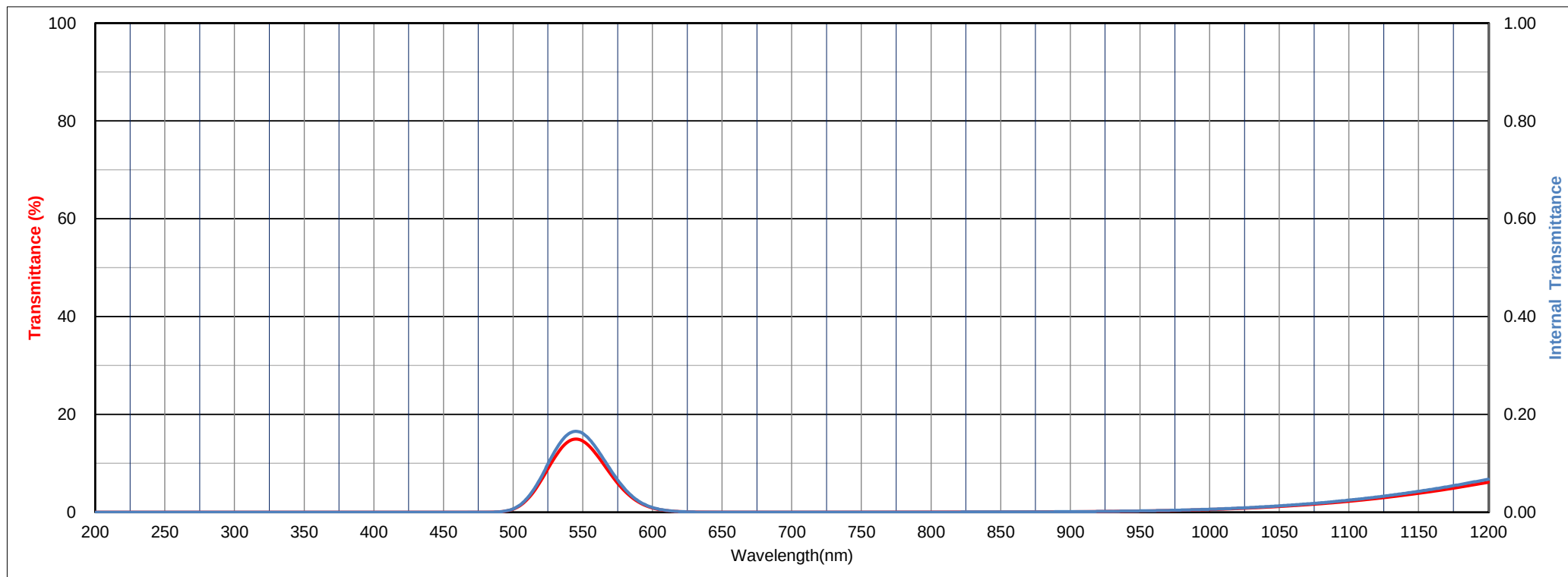
	x	y	Y	λ _d	P _e
A	0.338	0.646	6	554	92
C	0.317	0.663	7	552	96
D65	0.312	0.667	7	551	96

Properties

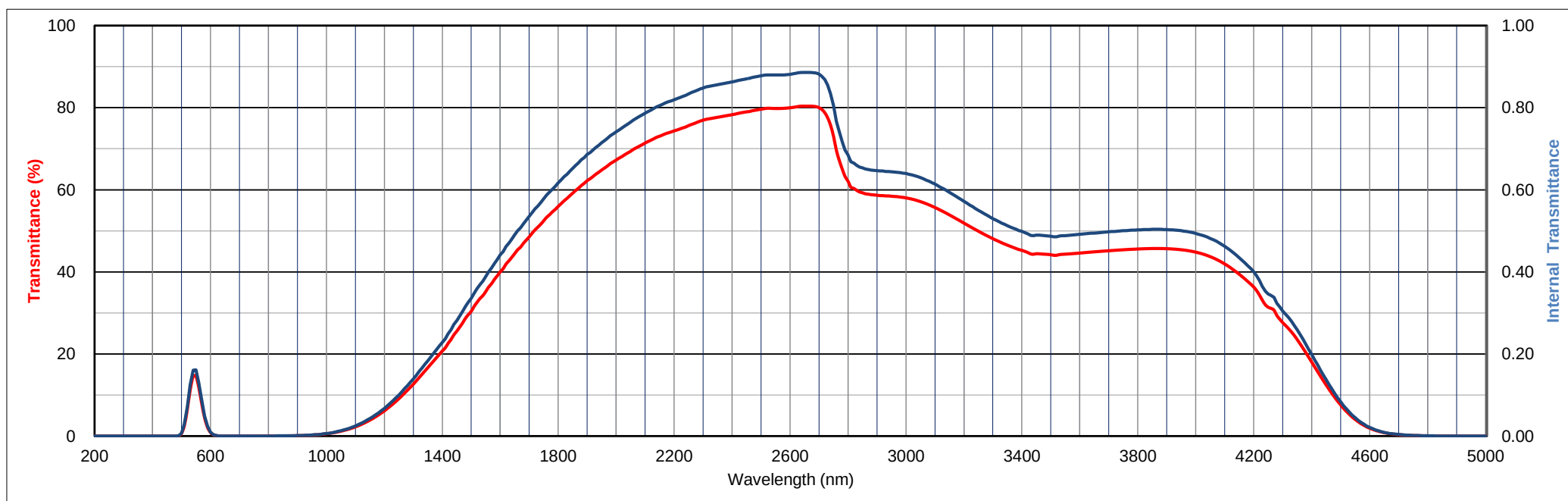
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
4	1	460	510	92	103	500	130	3.10

Tolerance of Transmittance (T)

Maximum Transmittance	Less than 1% Wavelength at Short wave Side	Less than 5% Wavelength at Long wave Side
Tmax(%)	λs1(nm)	λl5(nm)
18±3	>470	<580



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.6	2.6	6.5	11.2	14.5	14.6	11.7	7.8	4.4	2.1
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.9	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.5
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.5	1.8	2.0	2.2	2.5	2.8	3.2	3.5	3.9	4.3	4.7	5.2	5.6
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	6.1	6.7	7.3	7.8	8.5	9.1	9.8	10.5	11.2	11.9	12.6	13.4	14.2	15.0	15.9	16.7	17.5	18.3	19.1	19.9
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	20.7	21.5	22.6	23.5	24.7	25.5	26.5	27.5	28.7	29.6	30.4	31.6	32.6	33.5	34.2	35.2	36.3	37.1	38.2	39.1
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	40.0	40.8	41.9	42.7	43.6	44.5	45.4	46.0	47.0	47.8	48.5	49.4	50.2	50.9	51.6	52.4	53.3	53.9	54.6	55.2
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	56.0	56.6	57.3	57.9	58.5	59.2	59.8	60.4	61.0	61.6	62.2	62.7	63.2	63.8	64.3	64.8	65.3	65.8	66.4	66.8
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	67.3	69.4	71.4	73.1	74.4	75.6	77.0	77.7	78.3	79.0	79.6	79.8	80.0	80.4	80.0	73.1	62.1	59.3	58.7	58.4
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	58.0	57.1	55.7	53.9	51.9	49.9	48.1	46.5	45.3	44.4	44.2	44.3	44.6	44.9	45.1	45.4	45.6	45.7	45.7	45.4
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	44.8	43.7	41.9	39.4	36.3	31.4	27.7	23.5	18.1	12.5	7.6	4.1	1.9	0.8	0.3	0.1	0.1	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.1	0.5	1.6	4.0	8.9	17.0	27.2	37.3	47.6	57.1	65.4	72.0	76.8	79.6	80.7	80.0	77.8	74.5	70.1
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	65.3	60.4	55.9	52.3	50.5	50.2	49.4	51.0	54.8	53.7	56.2	60.0	64.1	68.1	71.8	75.1	78.0	80.4	82.4	83.9
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	85.1	86.0	86.5	87.0	87.3	87.7	87.9	88.1	88.2	88.4	88.5	88.7	88.8	89.0	89.0	89.1	89.2	89.3	89.4	89.4
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	89.5	89.5	89.6	89.7	89.8	89.8	89.8	89.9	89.9	90.0	90.1	90.2	90.2	90.3	90.4	90.4				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.538	1.530	1.525	1.523	1.521	1.520	1.519
P	0.914	0.916	0.917	0.918	0.918	0.918	0.919

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

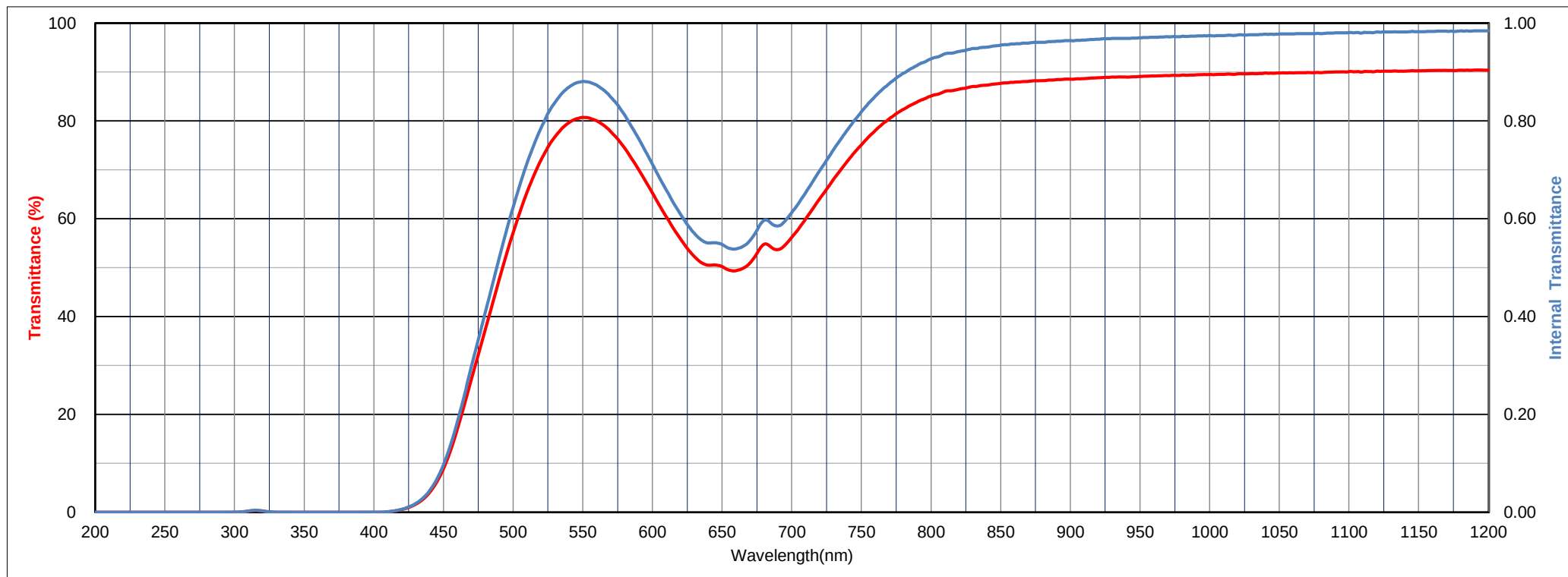
	x	y	Y	λ _d	P _e
A	0.467	0.478	70	575	63
C	0.379	0.481	69	567	63
D65	0.377	0.489	70	566	63

Properties

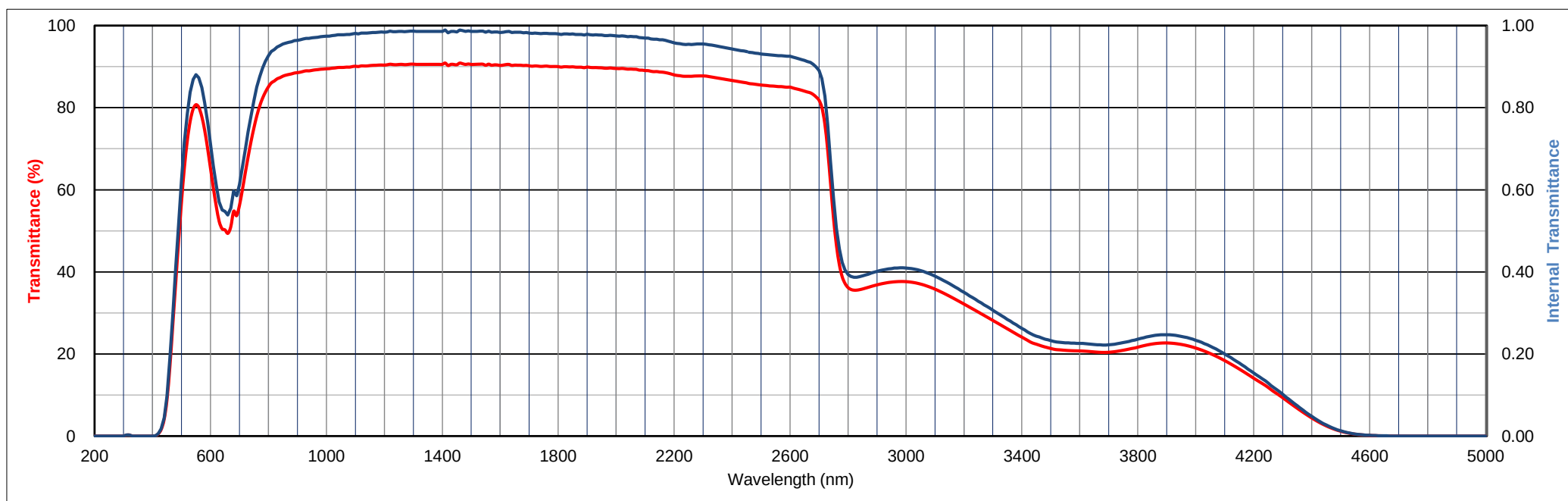
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α	α	H _K	F _A	d
4	1	545	590	-30/70	100/300	560	130	2.58

Tolerance of Transmittance (T)

Maximum Transmittance	Less than 1% Wavelength at Short wave Side	Less than 5% Wavelength at Long wave Side
Tmax(%)	λs1(nm)	λl5(nm)
18±3	>470	<580



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.1	0.5	1.6	4.0	8.9	17.0	27.2	37.3	47.6	57.1	65.4	72.0	76.8	79.6	80.7	80.0	77.8	74.5	70.1
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	65.3	60.4	55.9	52.3	50.5	50.2	49.4	51.0	54.8	53.7	56.2	60.0	64.1	68.1	71.8	75.1	78.0	80.4	82.4	83.9
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	85.1	86.0	86.5	87.0	87.3	87.7	87.9	88.1	88.2	88.4	88.5	88.7	88.8	89.0	89.0	89.1	89.2	89.3	89.4	89.4
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	89.5	89.5	89.6	89.7	89.8	89.8	89.8	89.9	89.9	90.0	90.1	90.0	90.2	90.2	90.2	90.3	90.3	90.3	90.4	90.4
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	90.4	90.5	90.6	90.5	90.5	90.5	90.6	90.5	90.5	90.6	90.6	90.6	90.6	90.6	90.6	90.6	90.6	90.6	90.6	90.6
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	90.6	90.9	90.3	90.6	90.5	90.5	90.9	90.7	90.5	90.7	90.5	90.6	90.6	90.6	90.6	90.3	90.6	90.3	90.4	90.4
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	90.3	90.4	90.5	90.5	90.3	90.4	90.3	90.4	90.3	90.3	90.2	90.1	90.2	90.1	90.1	90.1	90.1	90.0	90.0	90.0
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	90.0	89.9	90.0	90.0	89.9	90.0	89.9	89.9	89.9	89.7	89.9	89.8	89.8	89.8	89.7	89.7	89.6	89.6	89.7	89.6
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	89.6	89.4	89.0	88.7	88.0	87.7	87.7	87.2	86.6	86.1	85.5	85.2	85.0	84.0	81.8	53.1	36.2	35.8	36.8	37.5
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	37.6	37.0	35.8	34.1	32.2	30.2	28.2	26.1	24.1	22.4	21.3	20.9	20.7	20.5	20.4	20.9	21.7	22.4	22.7	22.3
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	21.4	20.1	18.4	16.3	14.1	11.9	9.4	6.8	4.4	2.5	1.2	0.5	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Light Balancing Filters

There is a correlation between the temperature and color of a light-emitting substance and it can be replaced with a numeric value. This temperature is called "Color Temperature".

For example, the standard color temperature of a PC monitor is approximately 6500 K and is visually a little yellow "Color". The surface temperature of the sun is approximately 6000 K and is almost the same temperature.

The unit is the reciprocal of "Color Temperature" multiplied by 10⁶ that is called mired (micro reciprocal degree) and is used to indicate the conversion ability of color temperatures.

When the color temperature of the original light source is K₁ and the color temperature of the filtered light is K₂, the color temperature conversion ability of this filter is calculated as follows:

$$\left(\frac{10^6}{K_2} - \frac{10^6}{K_1} \right) \text{ Mired}$$

This value becomes + with a filter of amber type (red), which decreases the color temperature, and becomes - with a filter of blue type (blue), which increases the color temperature.

Color temperature conversion ability

The definition of "Color Temperature Conversion Ability" is shown as follows:

B-R conversion ability (V)

$$V = 22.1(\log T_r - \log T_b) \text{ Decamired}$$

T_r: Average value (%) of transmittances of the filter at 610 nm, 635 nm, and 655 nm wavelengths

$$T_r = \frac{(T_{610} + T_{635} + T_{655})}{3}$$

T_b: Average value (%) of transmittances of the filter at 405 nm, 435 nm, and 465 nm of wavelengths

$$T_b = \frac{(T_{405} + T_{435} + T_{465})}{3}$$

G-R conversion ability (W)

$$W = 61.6(\log T_r - \log T_g) \text{ Decamired}$$

T_g: Average value (%) of transmittances of the filter at 510 nm, 545 nm, and 565 nm wavelengths

$$T_g = \frac{(T_{510} + T_{545} + T_{565})}{3}$$

Thickness and color temperature conversion ability

The relationship between the color temperature conversion ability and thickness is shown as follows:

$$\frac{v_1}{v_2} = \frac{t_1}{t_2}$$

v₁: Conversion ability at thickness of t₁

v₂: Conversion ability at thickness of t₂

Change in the thickness with use of this relationship allows the given color temperature conversion ability to be acquired.

Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	3.3	16.2	32.0	46.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	56.3	61.9	62.6	63.4	63.3	63.0	62.9	63.0	63.3	63.9	64.4	65.2	66.0	66.7	67.9	69.3	70.6	71.9	72.7	73.4
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	74.3	75.0	75.6	75.9	76.4	77.2	78.4	79.9	81.6	83.3	84.4	85.1	85.7	86.3	86.8	87.2	87.5	87.8	88.0	88.4
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	88.5	88.3	88.2	88.3	88.5	88.7	88.8	88.9	89.1	89.2	89.3	89.5	89.6	89.7	89.8	90.0	90.0	90.1	90.2	90.2
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	90.2	90.3	90.3	90.3	90.3	90.4	90.3	90.3	90.3	90.4	90.4	90.4	90.4	90.4	90.5	90.5				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.569	1.555	1.547	1.543	1.540	1.538	1.537
P	0.907	0.910	0.912	0.913	0.913	0.914	0.914

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

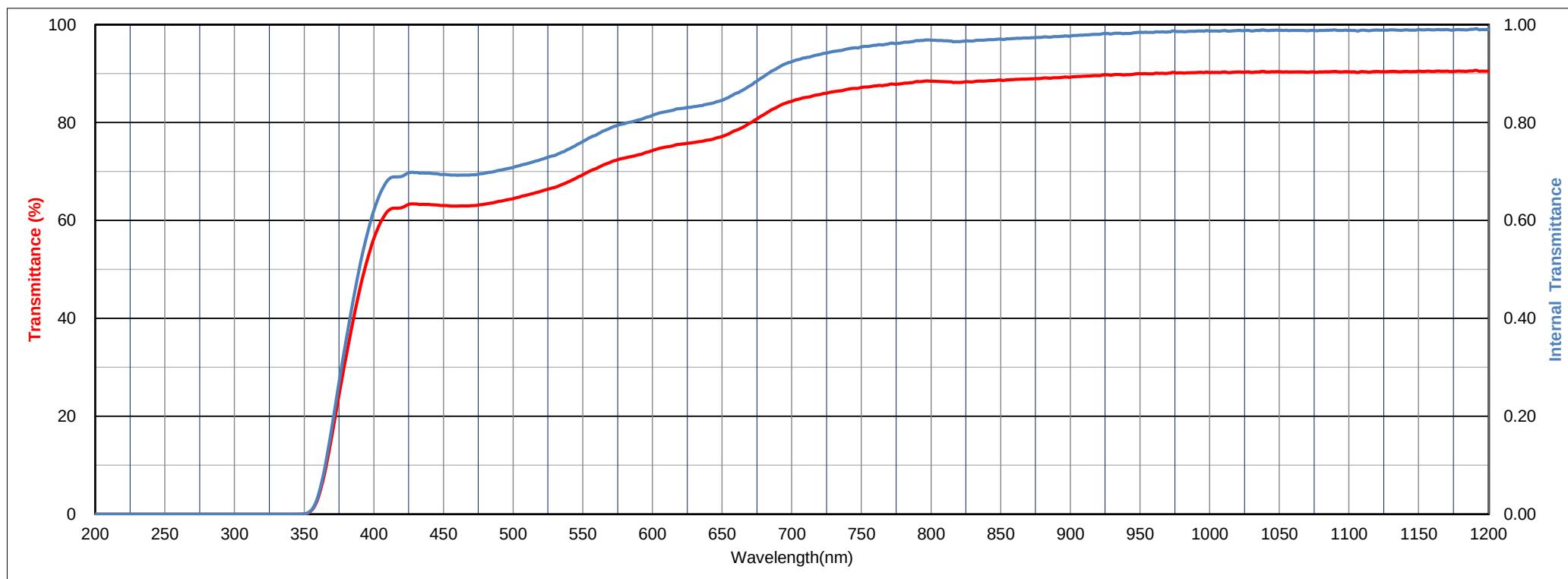
	x	y	Y	λ _d	P _e
A	0.463	0.408	71	591	11
C	0.326	0.326	70	584	7
D65	0.329	0.339	70	584	7

Properties

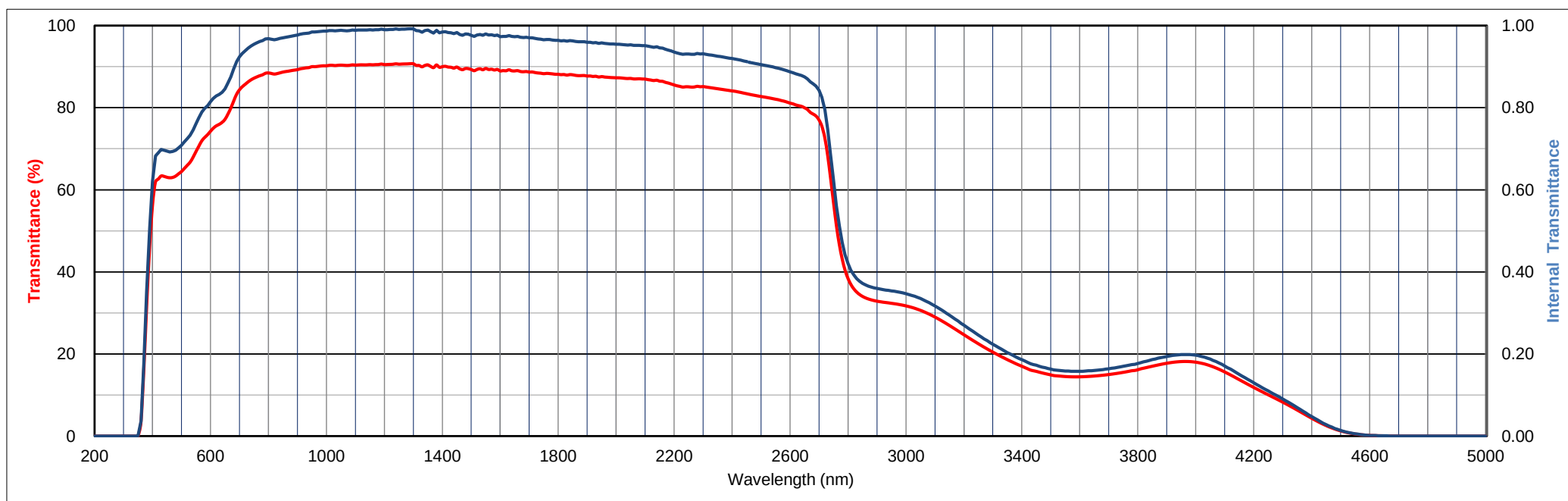
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
2	1	505	545	89	102	520	130	2.73

Tolerances of Transmittance(T)

B-R Conversion Value
V(mired)
20±5



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	3.3	16.2	32.0	46.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	56.3	61.9	62.6	63.4	63.3	63.0	62.9	63.0	63.3	63.9	64.4	65.2	66.0	66.7	67.9	69.3	70.6	71.9	72.7	73.4
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	74.3	75.0	75.6	75.9	76.4	77.2	78.4	79.9	81.6	83.3	84.4	85.1	85.7	86.3	86.8	87.2	87.5	87.8	88.0	88.4
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	88.5	88.3	88.2	88.3	88.5	88.7	88.8	88.9	89.1	89.2	89.3	89.5	89.6	89.7	89.8	90.0	90.0	90.1	90.2	90.2
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	90.2	90.3	90.3	90.3	90.3	90.4	90.3	90.3	90.3	90.4	90.4	90.4	90.4	90.4	90.4	90.5	90.4	90.5	90.5	90.6
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	90.5	90.5	90.6	90.6	90.7	90.6	90.6	90.7	90.7	90.7	90.7	90.3	90.3	90.0	90.3	90.4	90.1	89.8	90.4	89.8
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	90.0	90.1	89.9	89.9	89.6	89.9	89.5	89.3	89.6	89.5	89.3	89.0	89.3	89.5	89.2	89.6	89.3	89.4	89.2	89.3
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	89.0	89.0	89.0	89.2	89.0	89.0	89.0	88.8	88.8	88.8	88.7	88.7	88.6	88.5	88.4	88.3	88.4	88.3	88.2	88.1
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	88.1	88.0	88.1	87.9	88.1	88.0	87.9	87.8	87.8	87.8	87.7	87.7	87.6	87.7	87.5	87.6	87.5	87.4	87.4	87.3
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	87.3	87.1	87.0	86.5	85.5	85.1	85.2	84.6	84.1	83.4	82.7	82.1	81.1	80.0	77.0	56.9	38.4	34.0	32.9	32.3
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	31.7	30.6	29.0	26.9	24.7	22.5	20.5	18.6	17.0	15.8	14.9	14.5	14.4	14.6	15.0	15.5	16.2	17.0	17.7	18.2
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	18.0	17.1	15.6	13.8	11.9	10.1	8.3	6.4	4.4	2.6	1.3	0.5	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	3.2	11.5	23.2
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	35.0	44.1	48.8	53.2	56.1	58.6	60.6	62.2	63.7	65.1	66.4	67.6	68.7	69.9	71.1	72.4	73.7	74.9	75.8	76.4
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	77.2	77.9	78.3	78.6	79.1	79.7	80.7	81.9	83.3	84.5	85.3	86.0	86.4	86.8	87.1	87.4	87.6	87.8	87.9	88.1
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	88.3	88.5	88.6	88.6	88.8	88.9	88.9	89.1	89.1	89.2	89.4	89.5	89.6	89.7	89.7	89.9	89.9	90.0	90.1	90.2
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	90.1	90.2	90.3	90.2	90.2	90.3	90.3	90.2	90.3	90.3	90.3	90.4	90.4	90.5	90.5	90.5				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.576	1.561	1.554	1.549	1.546	1.544	1.543
P	0.905	0.908	0.910	0.911	0.912	0.912	0.913

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

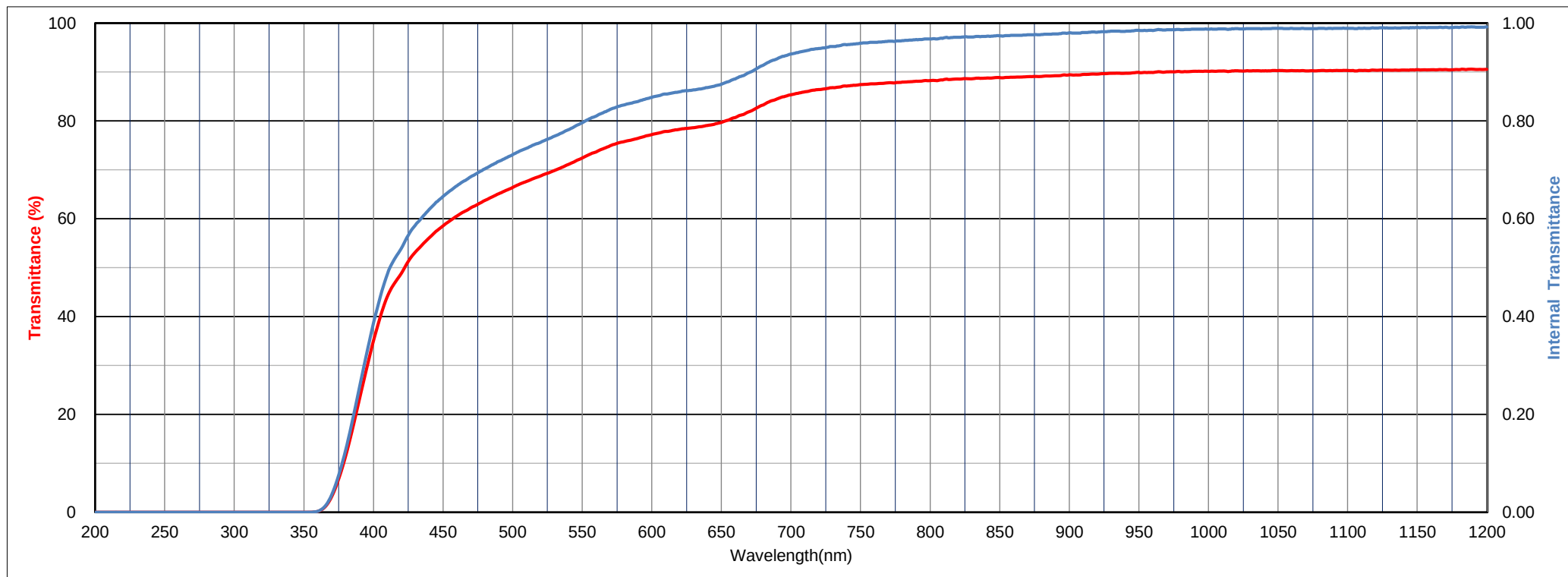
	x	y	Y	λ _d	P _e
A	0.467	0.414	74	586	18
C	0.334	0.341	73	577	13
D65	0.336	0.353	73	576	13

Properties

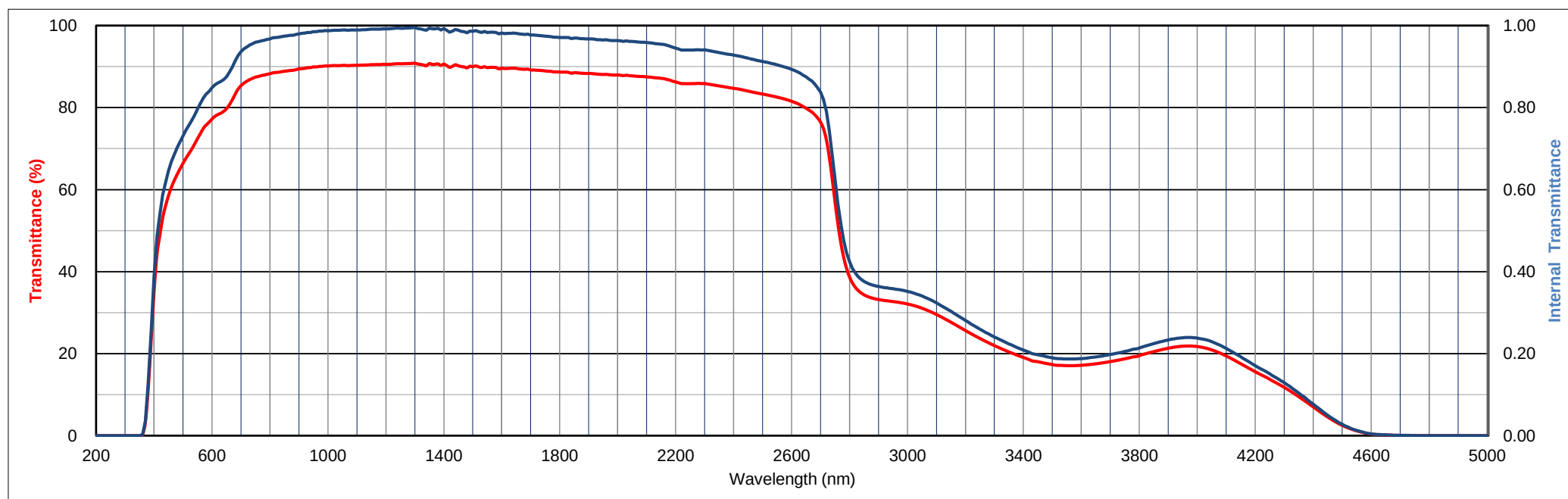
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
2	1	505	550	88	102	520	130	2.76

Tolerances of Transmittance(T)

B-R Conversion Value
V(mired)
40±5



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	3.2	11.5	23.2
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	35.0	44.1	48.8	53.2	56.1	58.6	60.6	62.2	63.7	65.1	66.4	67.6	68.7	69.9	71.1	72.4	73.7	74.9	75.8	76.4
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	77.2	77.9	78.3	78.6	79.1	79.7	80.7	81.9	83.3	84.5	85.3	86.0	86.4	86.8	87.1	87.4	87.6	87.8	87.9	88.1
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	88.3	88.5	88.6	88.6	88.8	88.9	88.9	89.1	89.1	89.2	89.4	89.5	89.6	89.7	89.7	89.9	89.9	90.0	90.1	90.2
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	90.1	90.2	90.3	90.2	90.2	90.3	90.3	90.2	90.3	90.3	90.3	90.3	90.4	90.4	90.4	90.5	90.5	90.5	90.5	90.6
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	90.5	90.5	90.6	90.7	90.7	90.7	90.7	90.7	90.7	90.8	90.8	90.6	90.5	90.4	90.2	90.7	90.5	90.6	90.7	90.3
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	90.6	90.3	89.8	90.1	90.4	90.2	90.0	89.9	89.7	90.1	90.0	90.2	89.9	89.8	90.0	89.7	89.8	89.8	89.8	89.5
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	89.6	89.5	89.5	89.6	89.6	89.6	89.4	89.4	89.3	89.4	89.2	89.2	89.1	89.1	89.0	88.9	88.9	88.8	88.7	88.7
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	88.7	88.7	88.6	88.6	88.4	88.5	88.5	88.4	88.4	88.3	88.3	88.3	88.2	88.2	88.1	88.1	88.1	88.0	88.0	87.9
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	88.0	87.7	87.5	87.1	86.3	85.8	85.9	85.3	84.7	84.0	83.3	82.5	81.5	79.8	76.5	57.0	38.7	34.3	33.2	32.7
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	32.1	31.1	29.5	27.7	25.6	23.7	22.0	20.4	19.1	18.0	17.3	17.1	17.2	17.5	18.1	18.7	19.5	20.5	21.3	21.8
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	21.7	20.9	19.4	17.5	15.6	13.8	11.8	9.5	7.0	4.6	2.5	1.2	0.4	0.2	0.1	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.2	2.9	4.7	5.8	5.9	5.8	6.3	7.8	11.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	16.2	23.1	30.6	37.6	42.9	46.2	48.0	48.9	49.5	50.3	51.6	53.5	56.2	59.5	63.1	66.7	70.2	73.3	76.1	78.5
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	80.4	81.9	83.0	83.9	84.3	84.4	84.2	83.9	83.2	82.3	81.5	80.5	79.6	78.8	78.1	77.7	77.5	77.4	77.6	78.1
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	78.6	79.3	80.0	80.9	81.9	82.9	83.9	84.8	85.6	86.4	87.0	87.7	88.1	88.5	88.9	89.1	89.3	89.5	89.6	89.7
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	89.8	89.9	89.9	90.0	90.1	90.1	90.1	90.2	90.2	90.3	90.3	90.4	90.5	90.5	90.6	90.7				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.540	1.531	1.526	1.523	1.521	1.520	1.519
P	0.913	0.916	0.917	0.918	0.918	0.918	0.919

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

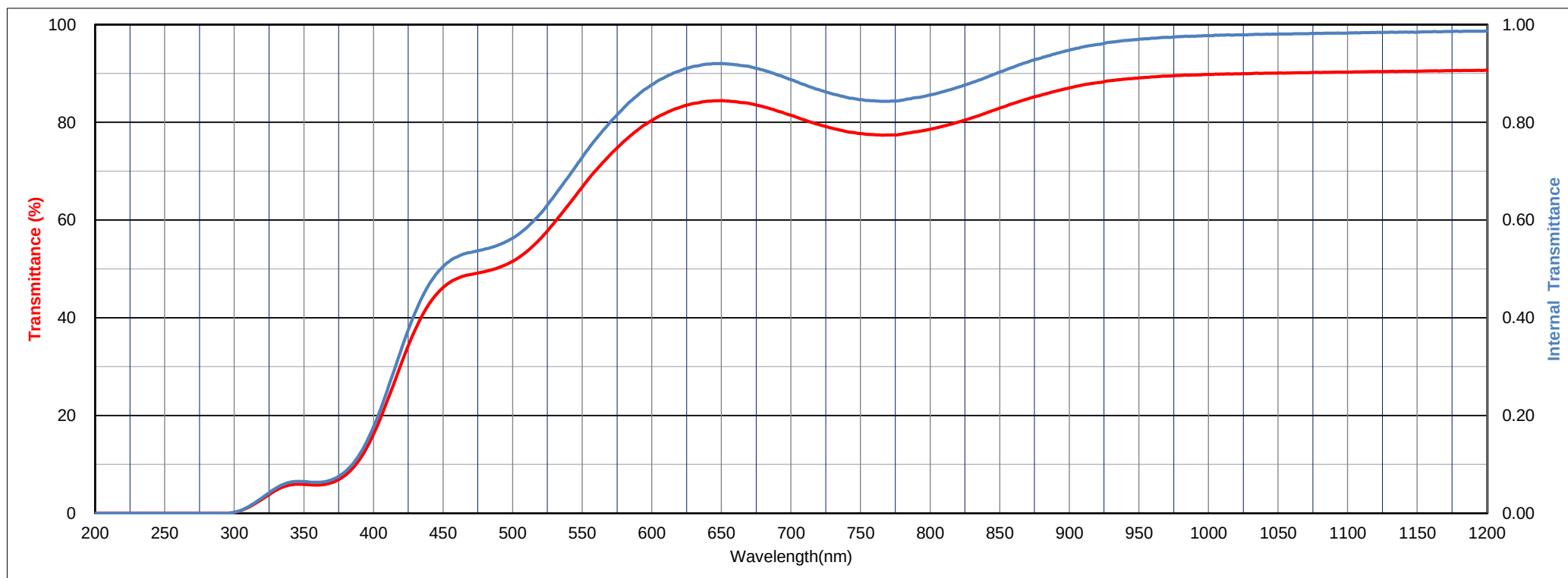
	x	y	Y	λ _d	P _s
A	0.490	0.415	72	589	34
C	0.364	0.358	68	581	26
D65	0.366	0.369	68	581	26

Properties

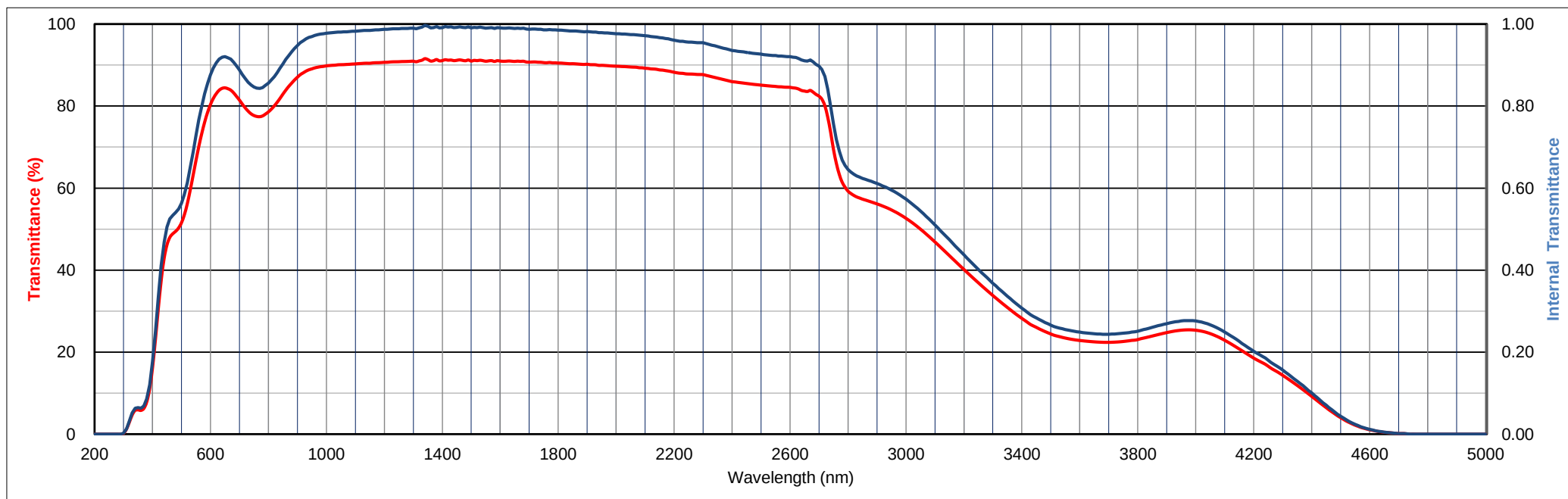
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
3	1	510	560	100	113	530	130	2.67

Tolerances of Transmittance(T)

B-R Conversion Value
V(mired)
80±5



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.2	2.9	4.7	5.8	5.9	5.8	6.3	7.8	11.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	16.2	23.1	30.6	37.6	42.9	46.2	48.0	48.9	49.5	50.3	51.6	53.5	56.2	59.5	63.1	66.7	70.2	73.3	76.1	78.5
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	80.4	81.9	83.0	83.9	84.3	84.4	84.2	83.9	83.2	82.3	81.5	80.5	79.6	78.8	78.1	77.7	77.5	77.4	77.6	78.1
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	78.6	79.3	80.0	80.9	81.9	82.9	83.9	84.8	85.6	86.4	87.0	87.7	88.1	88.5	88.9	89.1	89.3	89.5	89.6	89.7
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	89.8	89.9	89.9	90.0	90.1	90.1	90.1	90.2	90.2	90.3	90.3	90.3	90.4	90.4	90.5	90.4	90.5	90.6	90.6	90.6
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	90.7	90.7	90.8	90.8	90.8	90.8	90.9	90.9	90.9	90.9	90.9	90.8	91.0	91.2	91.6	91.4	91.0	91.1	91.3	91.0
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	91.1	91.3	91.2	91.2	91.1	91.2	91.3	91.1	91.1	91.2	91.0	91.1	91.1	91.2	91.1	90.9	91.0	91.1	90.9	91.1
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	91.0	90.9	90.9	91.0	90.9	90.9	91.0	90.9	90.9	90.7	90.7	90.7	90.8	90.7	90.7	90.6	90.6	90.6	90.5	90.5
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	90.5	90.5	90.4	90.4	90.3	90.3	90.3	90.2	90.2	90.2	90.2	90.1	90.1	90.1	89.9	89.9	89.9	89.9	89.8	89.8
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	89.7	89.5	89.2	88.8	88.2	87.8	87.7	86.8	86.0	85.5	85.1	84.8	84.6	83.7	82.4	69.4	59.3	57.3	56.1	54.7
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	52.6	50.0	46.9	43.5	40.2	36.9	33.8	30.9	28.2	26.0	24.4	23.4	22.8	22.5	22.4	22.6	23.1	23.9	24.8	25.3
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	25.3	24.5	22.9	20.8	18.5	16.6	14.4	11.9	9.2	6.5	4.0	2.2	1.1	0.5	0.1	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.2	2.2	2.8	2.9	2.8	3.1	4.1	6.3
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	10.3	16.1	23.0	29.7	35.1	38.6	40.5	41.4	42.1	43.0	44.3	46.5	49.4	53.1	57.2	61.4	65.5	69.2	72.5	75.3
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	77.6	79.5	80.9	81.9	82.5	82.6	82.4	81.9	81.1	80.0	78.9	77.7	76.6	75.7	74.9	74.4	74.1	74.0	74.2	74.8
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	75.4	76.2	77.2	78.3	79.4	80.7	81.9	83.0	84.0	85.0	85.8	86.6	87.1	87.7	88.1	88.4	88.6	88.8	89.0	89.1
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	89.3	89.4	89.4	89.5	89.6	89.6	89.6	89.7	89.7	89.8	89.9	90.0	90.1	90.2	90.2	90.3				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.530	1.527	1.525	1.524	1.523	1.523	1.523
P	0.916	0.917	0.917	0.917	0.918	0.918	0.918

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

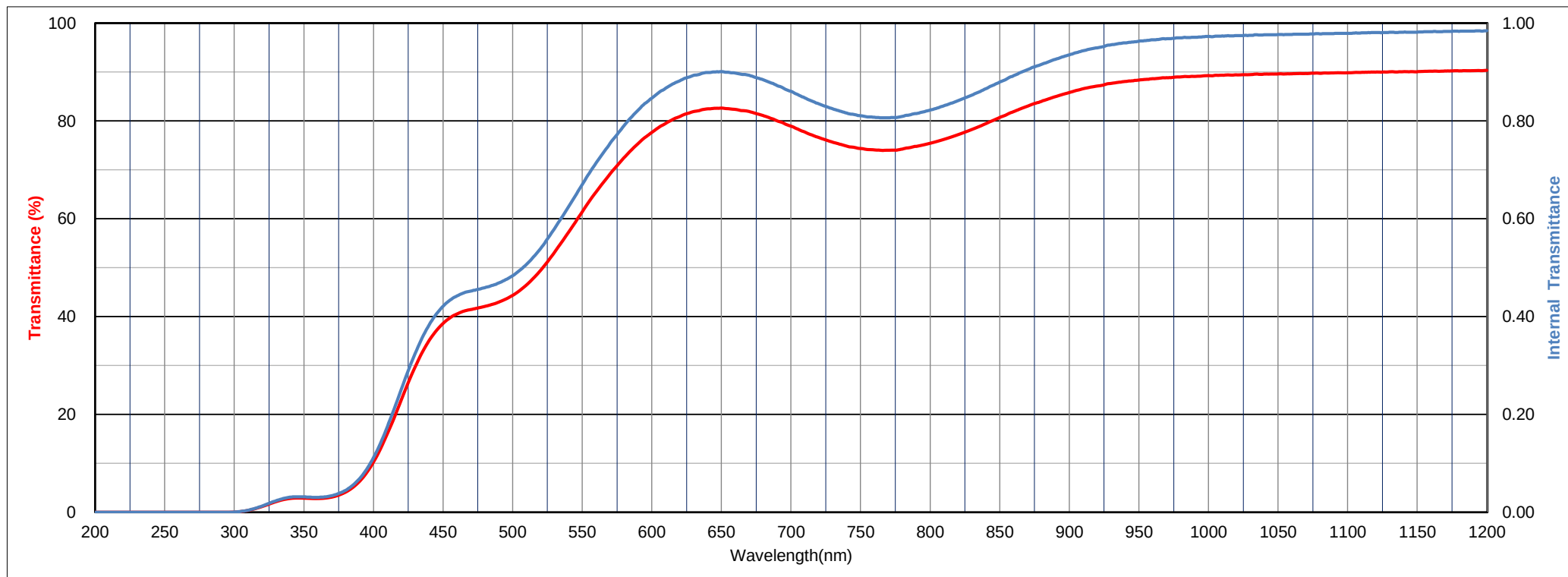
	x	y	Y	λ _d	P _e
A	0.500	0.415	67	590	42
C	0.378	0.367	63	582	32
D65	0.380	0.377	63	581	32

Properties

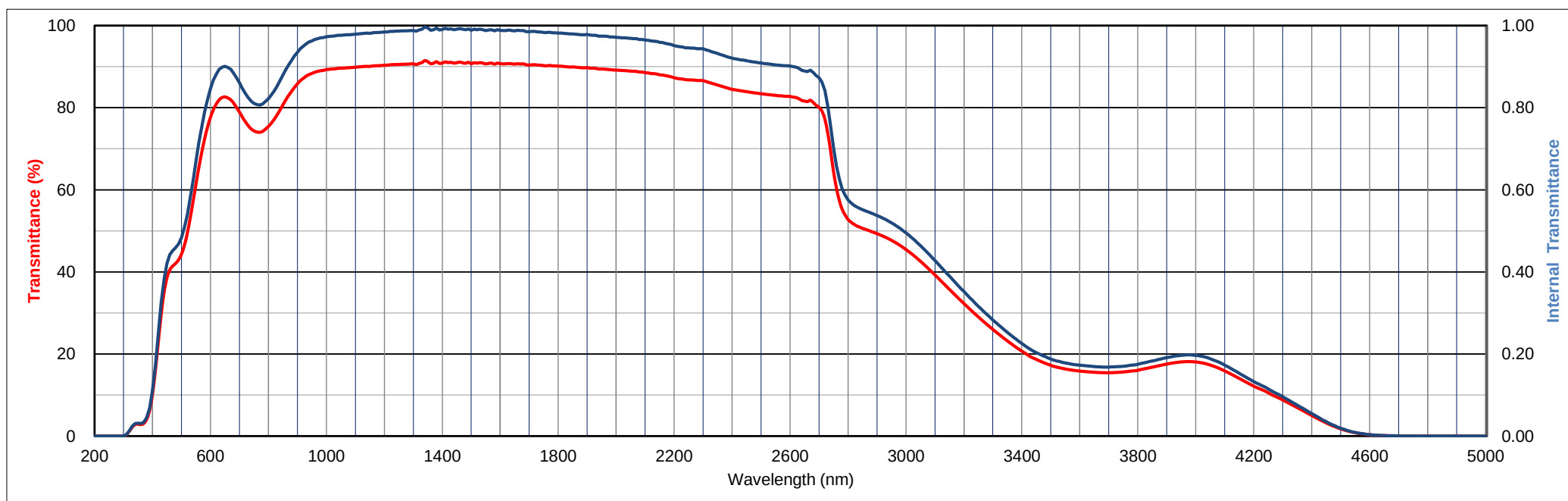
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
3	1	510	560	100	113	530	130	2.67

Tolerances of Transmittance(T)

B-R Conversion Value
V(mired)
100±5



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.2	2.2	2.8	2.9	2.8	3.1	4.1	6.3
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	10.3	16.1	23.0	29.7	35.1	38.6	40.5	41.4	42.1	43.0	44.3	46.5	49.4	53.1	57.2	61.4	65.5	69.2	72.5	75.3
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	77.6	79.5	80.9	81.9	82.5	82.6	82.4	81.9	81.1	80.0	78.9	77.7	76.6	75.7	74.9	74.4	74.1	74.0	74.2	74.8
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	75.4	76.2	77.2	78.3	79.4	80.7	81.9	83.0	84.0	85.0	85.8	86.6	87.1	87.7	88.1	88.4	88.6	88.8	89.0	89.1
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	89.3	89.4	89.4	89.5	89.6	89.6	89.6	89.7	89.7	89.8	89.9	89.9	90.0	90.0	90.1	90.1	90.2	90.2	90.2	90.3
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	90.3	90.4	90.4	90.5	90.5	90.5	90.6	90.6	90.6	90.7	90.7	90.5	90.8	91.0	91.5	91.2	90.7	90.8	91.2	90.8
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	90.9	91.1	91.0	91.1	90.9	91.0	91.1	90.9	90.8	91.1	90.7	90.9	90.9	91.0	90.9	90.7	90.8	90.9	90.6	90.9
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	90.7	90.7	90.7	90.8	90.7	90.6	90.7	90.6	90.7	90.4	90.4	90.4	90.5	90.4	90.4	90.3	90.2	90.3	90.2	90.2
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	90.1	90.1	90.0	90.0	89.9	89.9	89.9	89.8	89.7	89.7	89.8	89.6	89.6	89.6	89.4	89.4	89.4	89.3	89.3	89.2
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	89.2	88.9	88.5	88.0	87.3	86.8	86.6	85.5	84.5	83.9	83.4	83.0	82.7	81.6	80.1	64.5	52.8	50.6	49.3	47.7
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	45.5	42.6	39.3	35.8	32.3	29.0	26.0	23.2	20.7	18.7	17.2	16.4	15.8	15.5	15.4	15.6	16.0	16.8	17.5	18.1
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	18.1	17.3	15.9	14.0	12.2	10.6	8.8	6.9	5.0	3.2	1.8	0.8	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.9	1.3	1.3	1.3	1.4	2.0	3.4
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	6.2	10.8	16.8	23.0	28.3	31.7	33.7	34.6	35.3	36.2	37.6	39.8	43.0	46.9	51.4	56.1	60.7	64.9	68.7	72.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	74.8	77.0	78.6	79.8	80.5	80.7	80.4	79.9	78.9	77.6	76.3	74.9	73.5	72.4	71.5	70.9	70.6	70.5	70.8	71.4
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	72.2	73.1	74.2	75.5	76.9	78.4	79.8	81.2	82.3	83.5	84.5	85.5	86.1	86.8	87.3	87.6	88.0	88.2	88.4	88.5
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	88.7	88.8	88.9	89.0	89.1	89.1	89.2	89.2	89.3	89.4	89.4	89.6	89.7	89.8	89.9	90.0				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.528	1.525	1.524	1.523	1.522	1.522	1.522
P	0.916	0.917	0.917	0.918	0.918	0.918	0.918

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

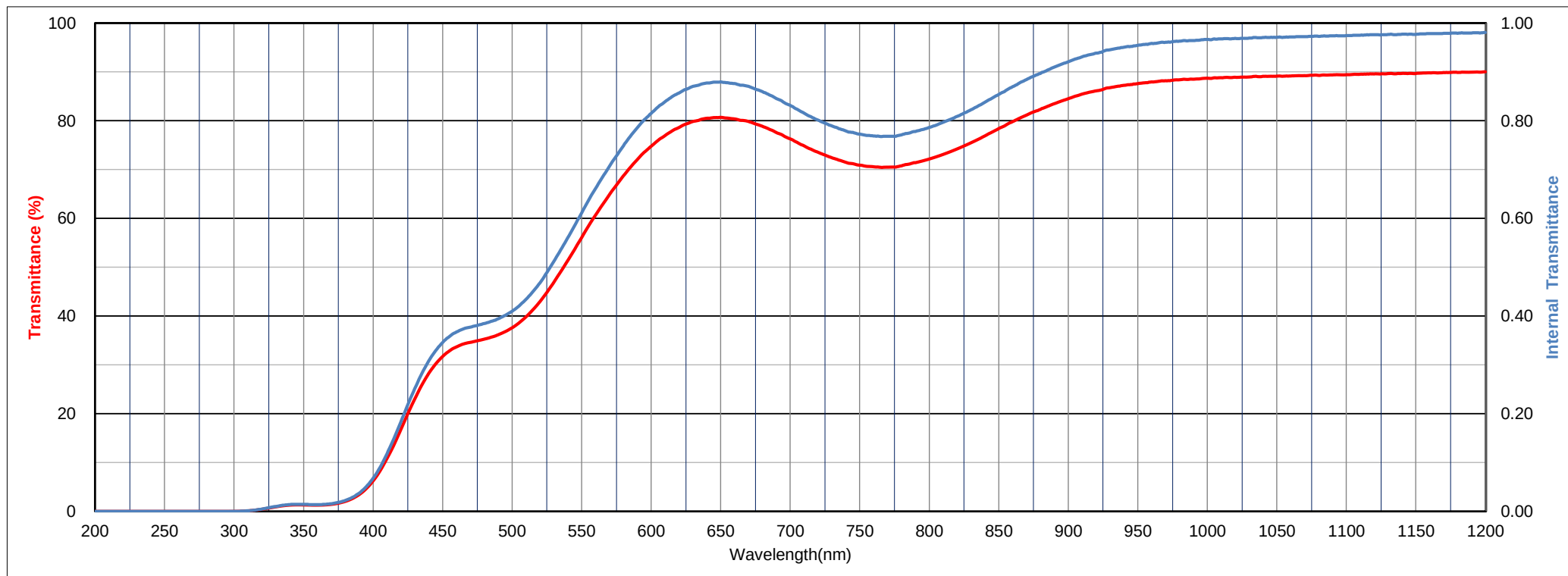
	x	y	Y	λ _d	P _e
A	0.510	0.415	63	590	49
C	0.393	0.375	58	582	38
D65	0.394	0.385	58	582	38

Properties

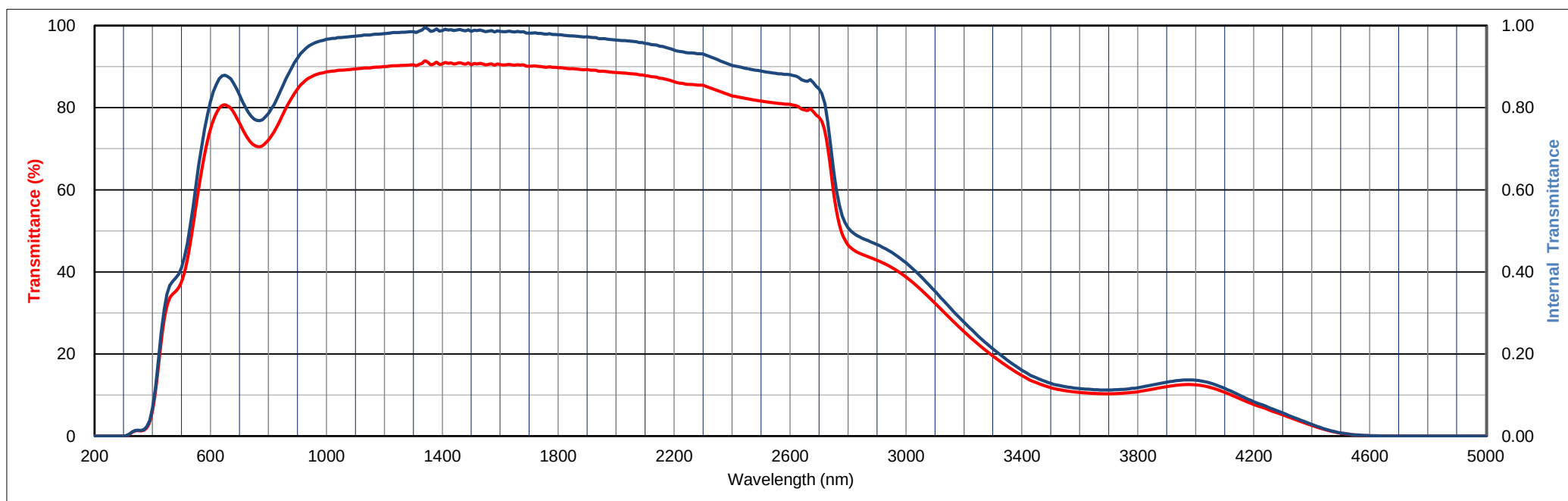
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
3	1	515	565	99	110	530	130	2.68

Tolerances of Transmittance(T)

B-R Conversion Value
V(mired)
120±5



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.9	1.3	1.3	1.3	1.4	2.0	3.4
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	6.2	10.8	16.8	23.0	28.3	31.7	33.7	34.6	35.3	36.2	37.6	39.8	43.0	46.9	51.4	56.1	60.7	64.9	68.7	72.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	74.8	77.0	78.6	79.8	80.5	80.7	80.4	79.9	78.9	77.6	76.3	74.9	73.5	72.4	71.5	70.9	70.6	70.5	70.8	71.4
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	72.2	73.1	74.2	75.5	76.9	78.4	79.8	81.2	82.3	83.5	84.5	85.5	86.1	86.8	87.3	87.6	88.0	88.2	88.4	88.5
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	88.7	88.8	88.9	89.0	89.1	89.1	89.2	89.2	89.3	89.4	89.4	89.5	89.6	89.7	89.7	89.7	89.8	89.9	89.9	89.9
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	90.0	90.0	90.2	90.2	90.2	90.3	90.3	90.3	90.4	90.4	90.4	90.2	90.6	90.8	91.4	91.1	90.5	90.6	91.1	90.6
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	90.7	91.0	90.8	90.9	90.7	90.8	90.9	90.8	90.6	90.9	90.5	90.8	90.7	90.8	90.6	90.4	90.6	90.7	90.4	90.6
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	90.5	90.4	90.4	90.5	90.4	90.4	90.5	90.4	90.4	90.1	90.1	90.1	90.2	90.1	90.0	89.9	89.8	90.0	89.8	89.8
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	89.7	89.7	89.6	89.6	89.5	89.5	89.4	89.4	89.3	89.2	89.3	89.2	89.1	89.1	88.9	88.9	88.9	88.8	88.7	88.6
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	88.6	88.3	87.8	87.2	86.3	85.7	85.5	84.2	82.9	82.2	81.6	81.1	80.8	79.5	77.7	59.5	46.6	44.2	42.8	41.1
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	38.8	35.8	32.4	28.9	25.5	22.4	19.5	17.0	14.8	13.0	11.8	11.1	10.6	10.4	10.3	10.5	10.8	11.4	12.0	12.5
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	12.5	11.9	10.7	9.2	7.7	6.5	5.2	3.9	2.6	1.5	0.7	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.6	0.6	0.6	0.7	1.0	1.9
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	3.8	7.2	12.2	17.8	22.6	26.0	27.9	28.8	29.5	30.3	31.8	34.0	37.2	41.3	46.0	51.1	56.1	60.8	65.1	68.8
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	71.9	74.5	76.4	77.8	78.5	78.8	78.4	77.8	76.6	75.2	73.7	72.0	70.5	69.3	68.2	67.5	67.2	67.1	67.4	68.1
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	69.0	70.0	71.3	72.7	74.4	76.1	77.8	79.3	80.7	82.0	83.2	84.3	85.1	85.9	86.4	86.8	87.2	87.5	87.8	87.9
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	88.1	88.3	88.4	88.4	88.6	88.6	88.7	88.8	88.8	88.9	89.0	89.2	89.3	89.4	89.5	89.7				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.528	1.525	1.524	1.523	1.522	1.522	1.522
P	0.916	0.917	0.917	0.918	0.918	0.918	0.918

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

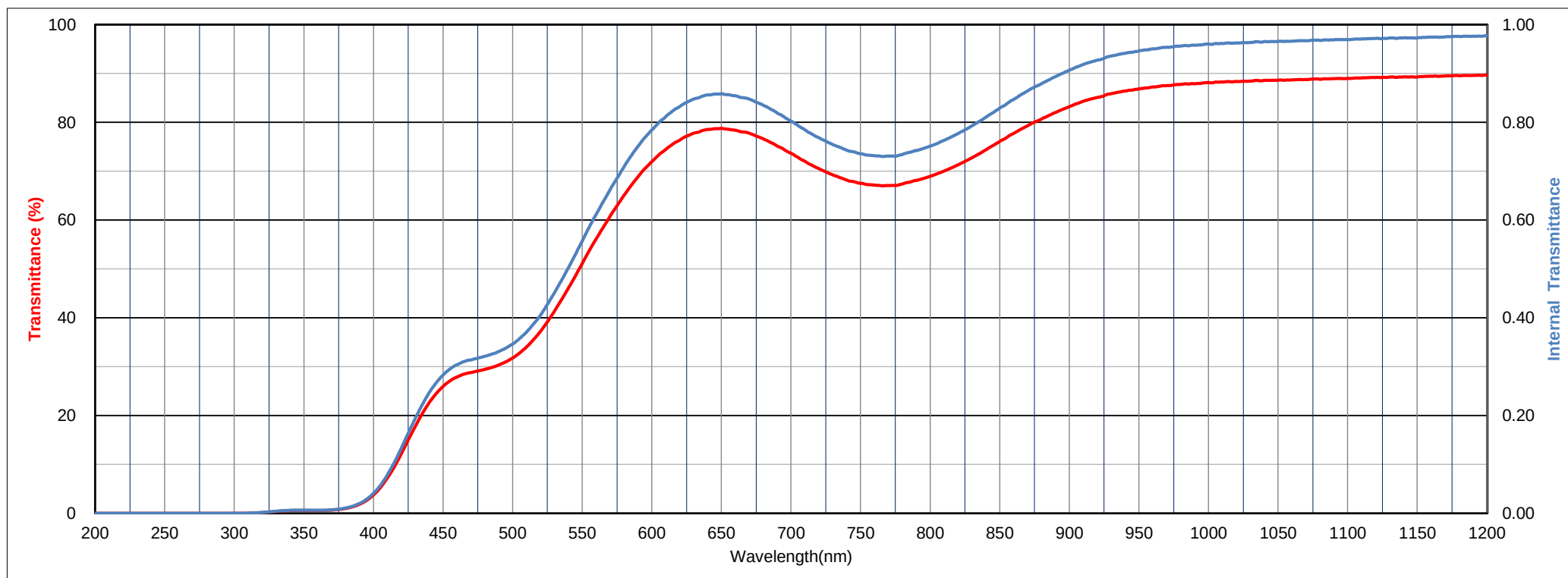
	x	y	Y	λ _d	P _e
A	0.519	0.415	59	591	55
C	0.408	0.383	54	583	44
D65	0.409	0.392	54	583	45

Properties

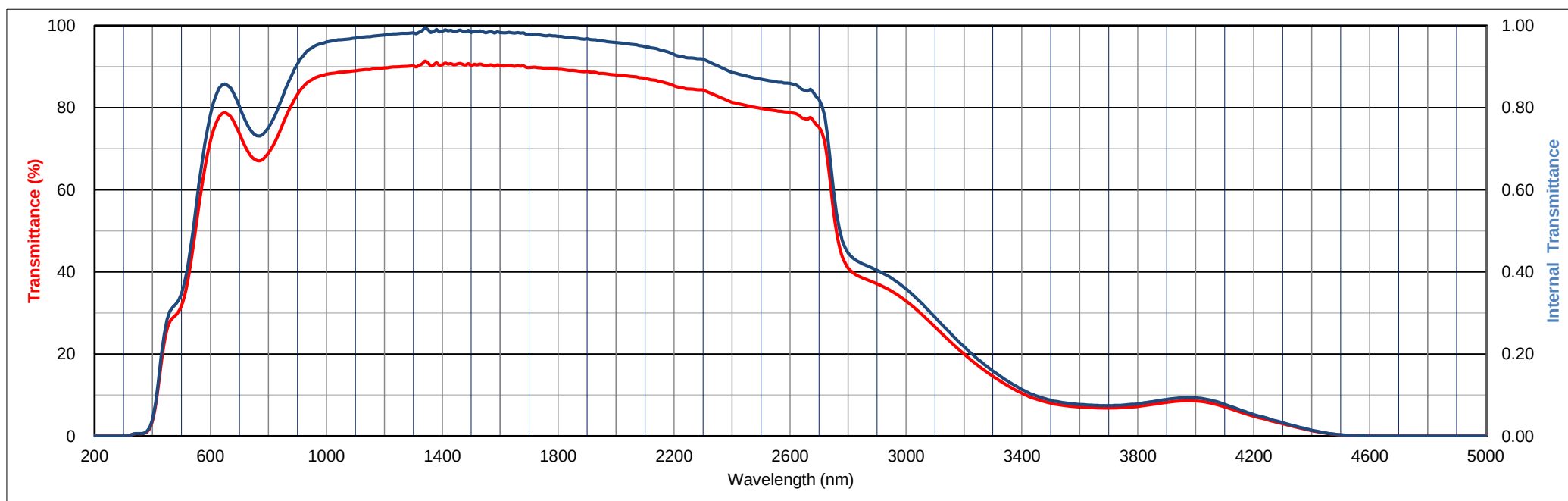
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
3	1	515	565	99	110	530	130	2.68

Tolerances of Transmittance(T)

B-R Conversion Value
V(mired)
140±5



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.6	0.6	0.6	0.7	1.0	1.9
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	3.8	7.2	12.2	17.8	22.6	26.0	27.9	28.8	29.5	30.3	31.8	34.0	37.2	41.3	46.0	51.1	56.1	60.8	65.1	68.8
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	71.9	74.5	76.4	77.8	78.5	78.8	78.4	77.8	76.6	75.2	73.7	72.0	70.5	69.3	68.2	67.5	67.2	67.1	67.4	68.1
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	69.0	70.0	71.3	72.7	74.4	76.1	77.8	79.3	80.7	82.0	83.2	84.3	85.1	85.9	86.4	86.8	87.2	87.5	87.8	87.9
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	88.1	88.3	88.4	88.4	88.6	88.6	88.7	88.8	88.8	88.9	89.0	89.1	89.2	89.3	89.3	89.3	89.4	89.5	89.5	89.6
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	89.7	89.7	89.8	89.9	89.9	90.0	90.0	90.1	90.1	90.2	90.2	89.9	90.3	90.6	91.3	90.9	90.3	90.4	90.9	90.4
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	90.5	90.9	90.6	90.7	90.4	90.6	90.8	90.6	90.4	90.7	90.3	90.6	90.4	90.6	90.4	90.2	90.3	90.4	90.1	90.4
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	90.3	90.2	90.2	90.3	90.2	90.1	90.2	90.1	90.2	89.8	89.8	89.8	89.9	89.7	89.7	89.6	89.5	89.6	89.5	89.5
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	89.4	89.4	89.2	89.2	89.1	89.1	89.0	88.9	88.8	88.8	88.9	88.7	88.7	88.6	88.4	88.4	88.3	88.2	88.1	88.0
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	88.0	87.6	87.1	86.3	85.3	84.6	84.3	82.8	81.3	80.5	79.8	79.3	78.9	77.3	75.2	54.8	41.0	38.5	37.1	35.3
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	32.9	30.0	26.6	23.2	20.0	17.1	14.6	12.3	10.5	9.0	8.0	7.4	7.1	6.9	6.8	6.9	7.2	7.7	8.2	8.6
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	8.6	8.1	7.1	5.9	4.8	3.9	3.0	2.1	1.3	0.7	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.3
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.7	2.0	4.4	7.7	11.1	13.7	15.3	16.0	16.6	17.3	18.6	20.6	23.6	27.6	32.5	38.0	43.8	49.4	54.7	59.6
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	63.7	67.0	69.6	71.6	72.7	73.0	72.4	71.6	70.0	68.0	66.0	63.8	61.8	60.1	58.7	57.9	57.4	57.3	57.6	58.6
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	59.7	61.1	62.8	64.7	66.9	69.3	71.5	73.7	75.6	77.5	79.2	80.8	82.0	83.1	83.9	84.5	85.1	85.5	85.9	86.1
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	86.4	86.6	86.8	86.9	87.1	87.2	87.2	87.4	87.4	87.6	87.7	88.0	88.1	88.4	88.5	88.7				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.536	1.532	1.529	1.528	1.527	1.526	1.526
P	0.915	0.916	0.916	0.916	0.917	0.917	0.917

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

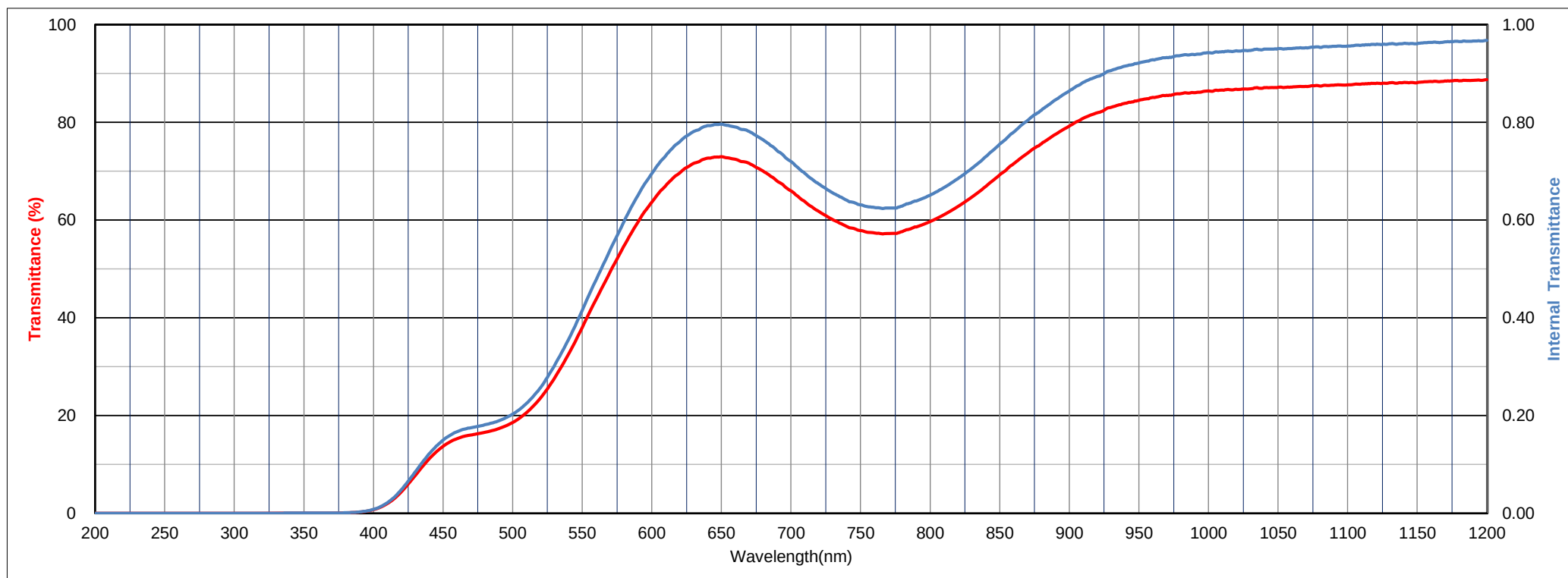
	x	y	Y	λ _d	P _e
A	0.546	0.411	49	592	70
C	0.452	0.401	43	585	61
D65	0.453	0.408	42	585	61

Properties

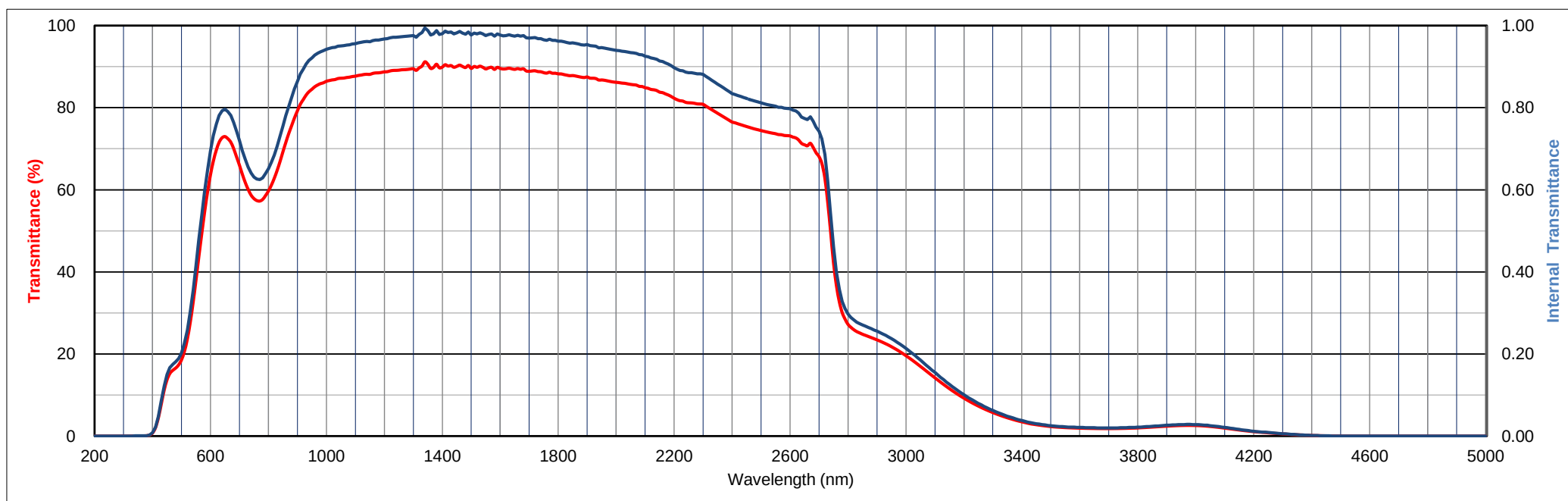
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
3	1	515	565	99	110	530	130	2.68

Tolerances of Transmittance(T)

B-R Conversion Value
V(mired)
200±5



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.3
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.7	2.0	4.4	7.7	11.1	13.7	15.3	16.0	16.6	17.3	18.6	20.6	23.6	27.6	32.5	38.0	43.8	49.4	54.7	59.6
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	63.7	67.0	69.6	71.6	72.7	73.0	72.4	71.6	70.0	68.0	66.0	63.8	61.8	60.1	58.7	57.9	57.4	57.3	57.6	58.6
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	59.7	61.1	62.8	64.7	66.9	69.3	71.5	73.7	75.6	77.5	79.2	80.8	82.0	83.1	83.9	84.5	85.1	85.5	85.9	86.1
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	86.4	86.6	86.8	86.9	87.1	87.2	87.2	87.4	87.4	87.6	87.7	87.9	88.0	88.1	88.1	88.1	88.4	88.5	88.5	88.6
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	88.7	88.8	89.0	89.1	89.1	89.1	89.2	89.3	89.3	89.4	89.5	89.1	89.7	90.1	91.2	90.6	89.6	89.8	90.6	89.7
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	89.9	90.5	90.1	90.3	89.9	90.1	90.4	90.0	89.8	90.3	89.6	90.0	89.8	90.1	89.8	89.5	89.7	89.9	89.3	89.8
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	89.6	89.4	89.5	89.6	89.5	89.3	89.5	89.4	89.5	88.9	88.9	88.9	89.0	88.8	88.8	88.5	88.4	88.6	88.4	88.4
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	88.2	88.2	88.1	87.9	87.8	87.8	87.7	87.6	87.4	87.3	87.5	87.2	87.2	87.1	86.7	86.8	86.7	86.5	86.4	86.3
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	86.2	85.7	84.9	83.8	82.3	81.2	80.8	78.6	76.5	75.4	74.4	73.7	73.1	71.0	68.1	42.3	27.2	24.8	23.4	21.8
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	19.6	17.0	14.2	11.6	9.2	7.3	5.7	4.5	3.5	2.8	2.3	2.1	1.9	1.8	1.8	1.9	2.0	2.2	2.4	2.6
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	2.6	2.3	1.9	1.5	1.1	0.8	0.5	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	4.3	19.7	40.8	58.5	70.2	77.5	82.1	84.5	86.4
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	87.4	87.6	86.5	86.4	86.0	85.7	85.2	84.5	84.0	83.2	82.5	81.5	80.5	79.2	78.4	78.4	78.5	77.8	75.8	73.5
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	72.6	72.1	71.3	70.2	69.0	68.3	68.4	69.0	70.0	70.7	71.0	70.8	70.6	70.3	70.0	69.8	69.7	69.6	69.5	69.5
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	69.6	69.7	69.9	70.1	70.3	70.5	70.8	71.0	71.4	71.7	72.1	72.5	72.8	73.2	73.7	74.1	74.5	74.9	75.3	75.7
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	76.0	76.4	76.8	77.2	77.5	77.8	78.2	78.5	78.8	79.0	79.3	79.8	80.4	80.7	81.2	81.5				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.527	1.524	1.522	1.521	1.520	1.519	1.519
P	0.917	0.917	0.918	0.918	0.918	0.918	0.919

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

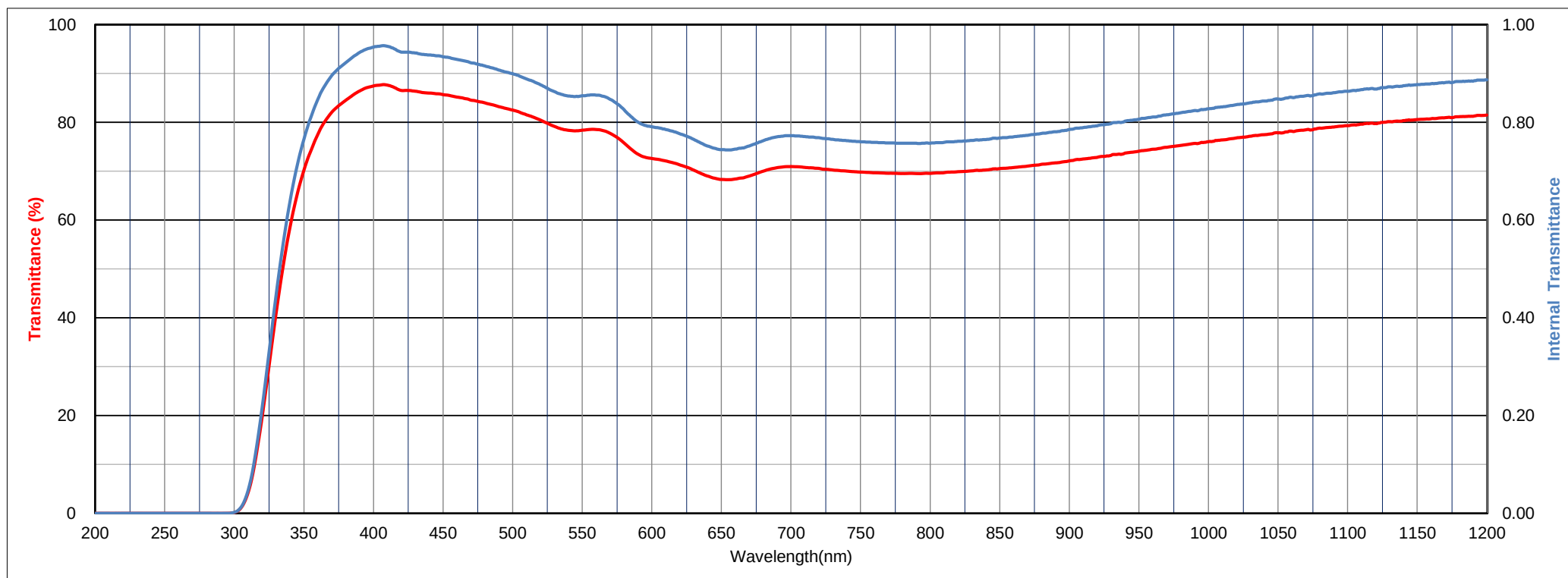
	x	y	Y	λ _d	P _e
A	0.433	0.406	76	493	4
C	0.296	0.306	77	482	6
D65	0.298	0.319	77	483	6

Properties

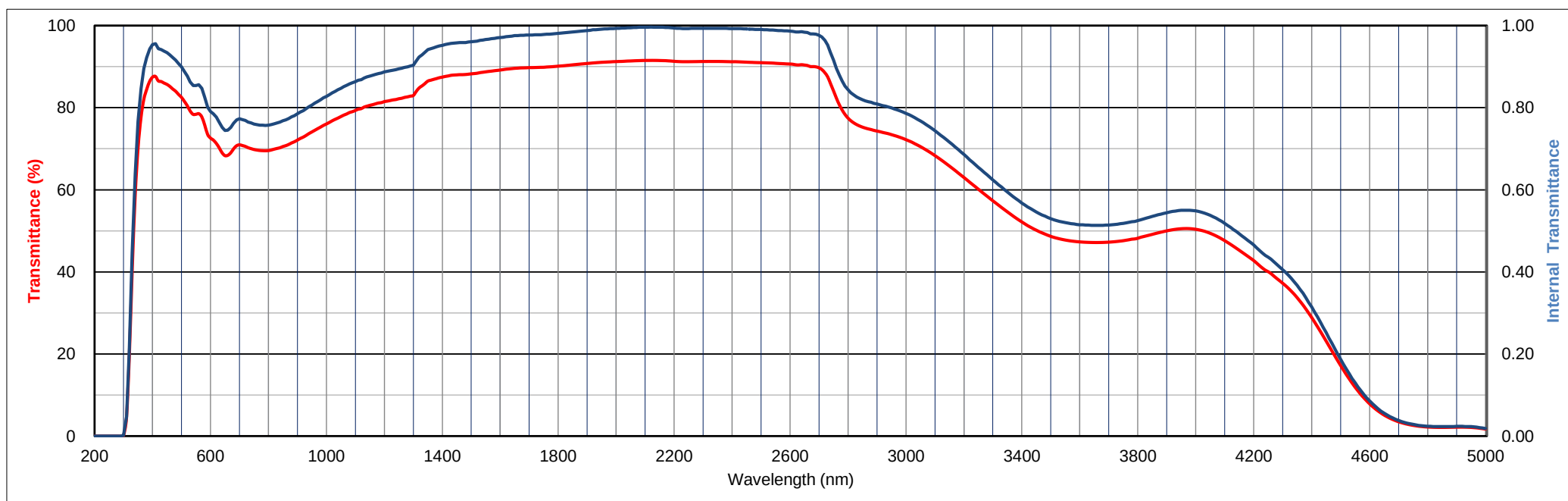
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
3	1	470	515	95	117	490	110	2.81

Tolerances of Transmittance(T)

B-R Conversion Value
V(mired)
-20±5



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	4.3	19.7	40.8	58.5	70.2	77.5	82.1	84.5	86.4
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	87.4	87.6	86.5	86.4	86.0	85.7	85.2	84.5	84.0	83.2	82.5	81.5	80.5	79.2	78.4	78.4	78.5	77.8	75.8	73.5
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	72.6	72.1	71.3	70.2	69.0	68.3	68.4	69.0	70.0	70.7	71.0	70.8	70.6	70.3	70.0	69.8	69.7	69.6	69.5	69.5
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	69.6	69.7	69.9	70.1	70.3	70.5	70.8	71.0	71.4	71.7	72.1	72.5	72.8	73.2	73.7	74.1	74.5	74.9	75.3	75.7
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	76.0	76.4	76.8	77.2	77.5	77.8	78.2	78.5	78.8	79.0	79.3	79.6	79.8	80.1	80.4	80.6	80.7	81.0	81.2	81.2
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	81.5	81.6	81.7	81.9	82.0	82.2	82.3	82.5	82.6	82.8	83.0	84.0	84.8	85.3	85.9	86.5	86.7	86.9	87.1	87.3
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	87.4	87.6	87.7	87.9	88.0	88.0	88.0	88.1	88.1	88.2	88.2	88.3	88.4	88.5	88.6	88.7	88.8	88.9	89.0	89.1
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	89.2	89.3	89.4	89.5	89.5	89.6	89.6	89.7	89.7	89.7	89.8	89.8	89.8	89.8	89.8	89.8	89.9	89.9	90.0	90.1
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	90.1	90.2	90.2	90.3	90.4	90.4	90.5	90.6	90.6	90.7	90.8	90.8	90.9	91.0	91.0	91.1	91.1	91.1	91.2	91.2
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	91.2	91.4	91.5	91.5	91.3	91.2	91.3	91.3	91.2	91.1	91.0	90.8	90.6	90.4	89.7	84.1	77.5	75.3	74.3	73.4
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	72.2	70.5	68.3	65.8	63.0	60.1	57.3	54.6	52.2	50.2	48.7	47.8	47.3	47.2	47.2	47.6	48.2	49.1	50.0	50.5
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	50.4	49.4	47.6	45.3	42.8	40.1	37.2	33.7	28.9	23.2	17.2	11.9	7.9	5.1	3.5	2.6	2.2	2.1	2.2	2.1
λnm	5000																			
T	1.7																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	4.7	19.2	38.8	55.5	67.5	75.5	80.0	83.5
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	85.5	85.7	83.6	83.2	82.4	81.8	80.8	79.7	78.5	77.0	75.7	73.9	71.9	69.7	68.2	68.2	68.5	67.1	63.8	60.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	58.5	57.7	56.5	54.8	52.9	51.8	51.9	52.8	54.4	55.6	55.9	55.6	55.2	54.8	54.4	54.1	53.9	53.7	53.6	53.6
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	53.7	53.9	54.2	54.5	54.7	55.1	55.5	55.9	56.5	56.9	57.5	58.1	58.7	59.2	60.0	60.6	61.2	61.8	62.5	63.1
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	63.7	64.3	64.9	65.5	66.1	66.7	67.1	67.7	68.3	68.7	69.2	70.0	70.9	71.6	72.3	72.9				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.530	1.516	1.509	1.505	1.502	1.500	1.499
P	0.916	0.919	0.921	0.922	0.923	0.923	0.923

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

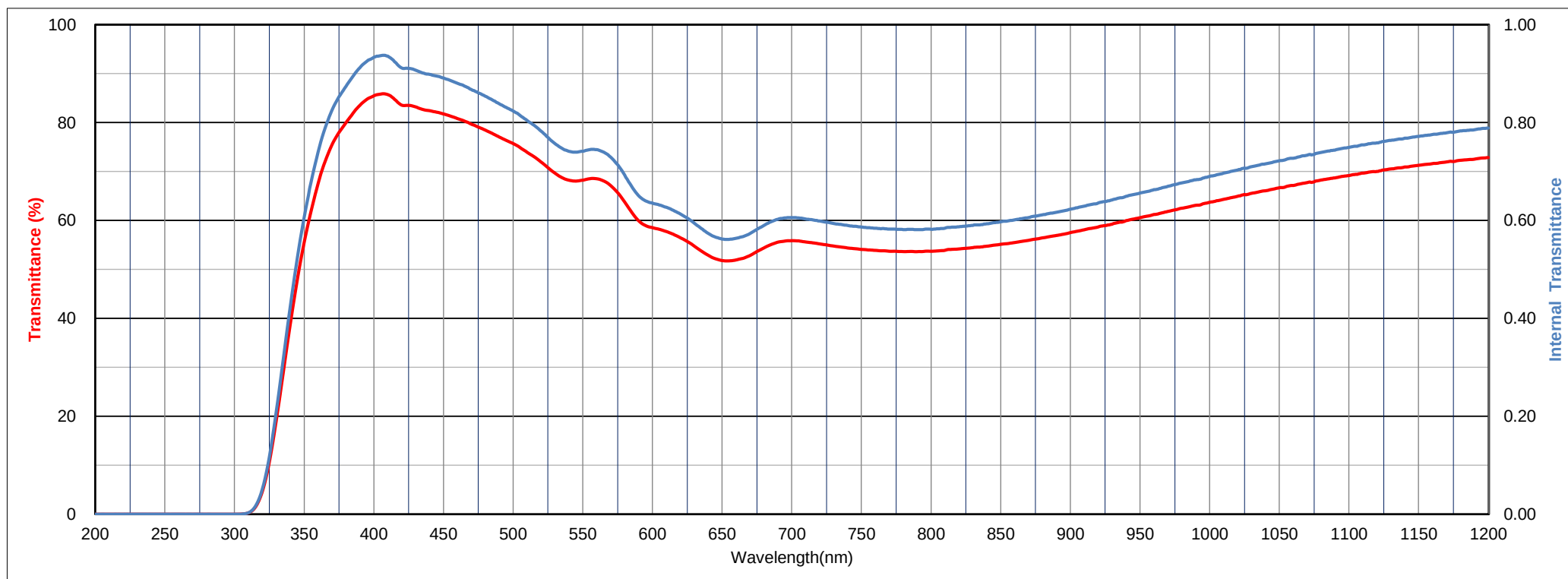
	x	y	Y	λ _d	P _e
A	0.417	0.404	64	493	7
C	0.282	0.295	67	481	13
D65	0.285	0.309	67	482	12

Properties

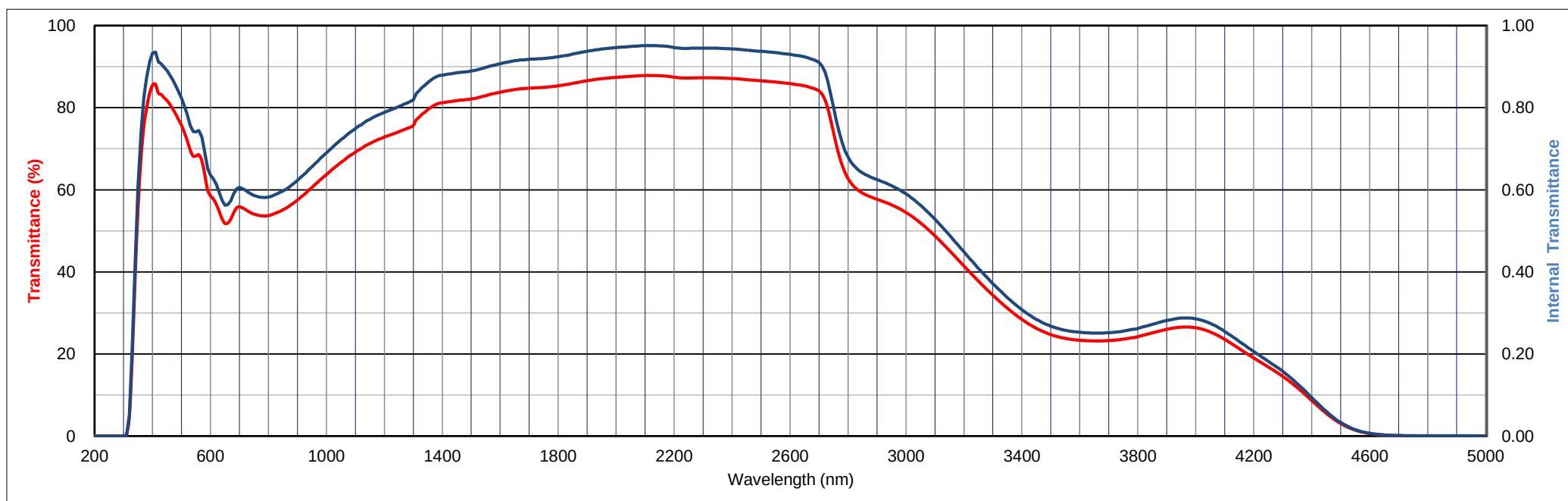
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
2	1	460	515	92	115	490	110	2.81

Tolerances of Transmittance(T)

B-R Conversion Value
V(mired)
-40±5



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	4.7	19.2	38.8	55.5	67.5	75.5	80.0	83.5
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	85.5	85.7	83.6	83.2	82.4	81.8	80.8	79.7	78.5	77.0	75.7	73.9	71.9	69.7	68.2	68.2	68.5	67.1	63.8	60.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	58.5	57.7	56.5	54.8	52.9	51.8	51.9	52.8	54.4	55.6	55.9	55.6	55.2	54.8	54.4	54.1	53.9	53.7	53.6	53.6
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	53.7	53.9	54.2	54.5	54.7	55.1	55.5	55.9	56.5	56.9	57.5	58.1	58.7	59.2	60.0	60.6	61.2	61.8	62.5	63.1
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	63.7	64.3	64.9	65.5	66.1	66.7	67.1	67.7	68.3	68.7	69.2	69.7	70.0	70.5	70.9	71.3	71.6	72.0	72.3	72.5
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	72.9	73.1	73.4	73.6	73.8	74.1	74.4	74.7	75.0	75.3	75.7	77.0	77.7	78.4	78.9	79.5	80.0	80.5	80.8	81.1
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	81.2	81.3	81.4	81.5	81.6	81.7	81.8	81.9	82.0	82.0	82.1	82.2	82.4	82.6	82.7	82.9	83.1	83.3	83.5	83.6
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	83.8	83.9	84.1	84.2	84.3	84.4	84.5	84.6	84.7	84.7	84.8	84.8	84.8	84.9	84.9	84.9	85.0	85.1	85.2	85.2
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	85.3	85.4	85.5	85.7	85.8	85.9	86.1	86.2	86.3	86.5	86.6	86.7	86.8	86.9	87.0	87.1	87.1	87.2	87.3	87.3
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	87.4	87.6	87.8	87.8	87.4	87.2	87.3	87.3	87.1	86.8	86.6	86.3	85.9	85.3	84.1	74.0	62.8	59.2	57.7	56.3
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	54.5	51.9	48.8	45.2	41.5	37.8	34.3	31.2	28.4	26.3	24.7	23.8	23.3	23.2	23.3	23.6	24.2	25.1	26.0	26.5
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	26.4	25.4	23.6	21.3	19.0	16.9	14.6	11.8	8.7	5.6	3.1	1.5	0.6	0.3	0.1	0.1	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	6.6	21.3	39.0	54.5	65.9	73.0	78.7
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	81.9	82.2	78.4	77.3	75.5	73.9	71.9	69.8	67.7	65.6	63.5	61.0	58.2	55.0	52.9	52.5	52.5	50.3	46.0	41.2
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	39.1	37.7	35.8	33.5	31.1	29.6	29.2	29.6	30.5	31.1	31.0	30.4	29.8	29.2	28.7	28.3	28.0	27.8	27.7	27.6
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	27.7	27.9	28.2	28.4	28.8	29.2	29.6	30.2	30.7	31.3	32.0	32.7	33.5	34.3	35.1	35.9	36.7	37.6	38.5	39.4
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	40.3	41.2	42.0	42.9	43.8	44.6	45.5	46.3	47.1	47.9	48.7	50.2	51.8	53.0	54.3	55.4				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.553	1.545	1.541	1.538	1.537	1.535	1.535
P	0.910	0.912	0.913	0.914	0.914	0.915	0.915

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

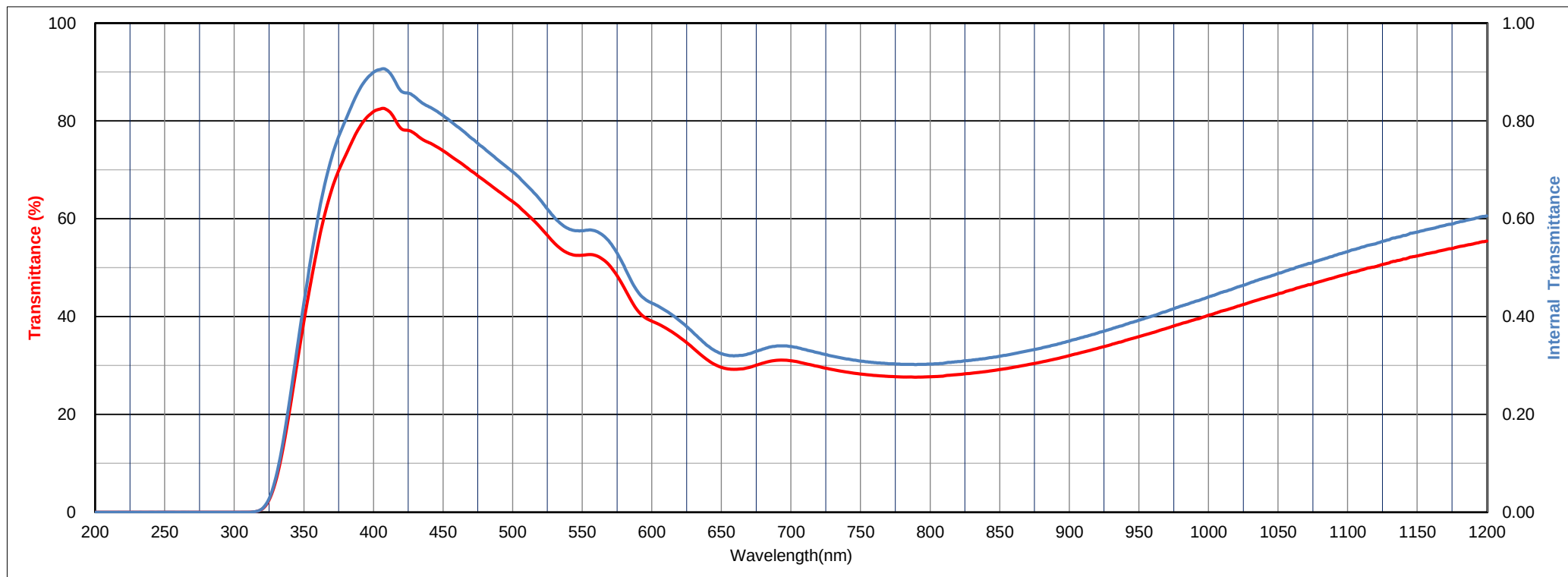
	x	y	Y	λ _d	P _e
A	0.388	0.398	47	492	15
C	0.258	0.275	50	481	23
D65	0.261	0.289	51	482	23

Properties

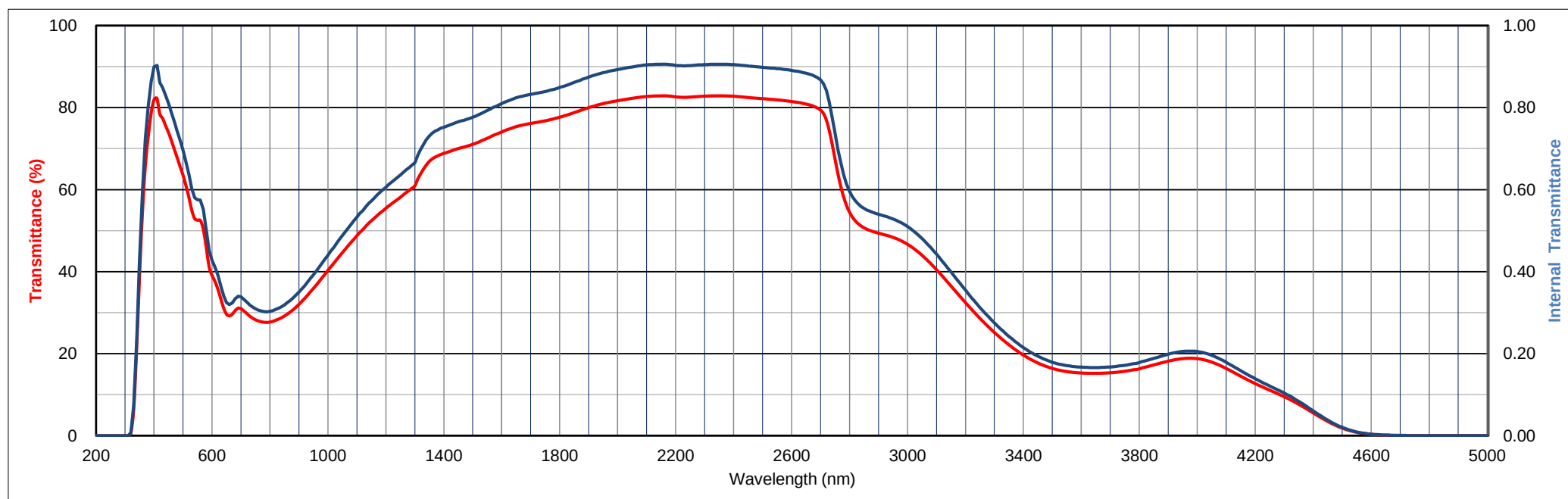
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
2	1	460	510	99	116	490	110	2.83

Tolerances of Transmittance(T)

B-R Conversion Value
V(mired)
-80±5



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	6.6	21.3	39.0	54.5	65.9	73.0	78.7
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	81.9	82.2	78.4	77.3	75.5	73.9	71.9	69.8	67.7	65.6	63.5	61.0	58.2	55.0	52.9	52.5	52.5	50.3	46.0	41.2
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	39.1	37.7	35.8	33.5	31.1	29.6	29.2	29.6	30.5	31.1	31.0	30.4	29.8	29.2	28.7	28.3	28.0	27.8	27.7	27.6
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	27.7	27.9	28.2	28.4	28.8	29.2	29.6	30.2	30.7	31.3	32.0	32.7	33.5	34.3	35.1	35.9	36.7	37.6	38.5	39.4
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	40.3	41.2	42.0	42.9	43.8	44.6	45.5	46.3	47.1	47.9	48.7	49.6	50.2	51.0	51.8	52.4	53.0	53.7	54.3	54.8
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	55.4	56.0	56.5	57.1	57.6	58.1	58.7	59.3	59.8	60.3	60.9	62.5	63.8	65.0	66.0	66.9	67.5	67.9	68.3	68.6
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	68.8	69.1	69.3	69.5	69.8	70.0	70.2	70.4	70.6	70.8	71.1	71.3	71.6	71.9	72.2	72.5	72.8	73.2	73.5	73.8
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	74.1	74.4	74.6	74.9	75.1	75.4	75.5	75.7	75.9	76.0	76.1	76.3	76.4	76.5	76.7	76.8	76.9	77.1	77.3	77.5
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	77.7	77.9	78.1	78.3	78.5	78.8	79.0	79.3	79.5	79.8	80.0	80.2	80.4	80.6	80.8	81.0	81.1	81.3	81.4	81.6
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	81.7	82.3	82.7	82.9	82.6	82.6	82.8	82.9	82.8	82.5	82.2	81.9	81.5	80.9	79.4	67.5	54.5	50.7	49.4	48.3
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	46.7	44.0	40.5	36.5	32.5	28.6	25.2	22.2	19.7	17.7	16.4	15.6	15.3	15.2	15.3	15.7	16.3	17.2	18.2	18.8
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	18.8	17.9	16.4	14.5	12.7	11.1	9.5	7.7	5.6	3.5	1.8	0.8	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	12.6	35.3	55.6	67.5	74.1	77.8	79.2	81.7
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	82.1	79.3	71.3	67.6	63.3	59.3	55.4	52.0	48.9	46.3	44.1	41.6	39.0	36.2	35.0	36.0	37.1	35.7	31.5	27.3
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	26.3	25.8	24.7	23.1	21.4	20.6	21.0	22.2	24.1	25.7	26.3	26.2	25.9	25.6	25.3	25.2	25.1	25.1	25.2	25.3
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	25.6	25.9	26.4	26.8	27.3	27.8	28.4	29.1	29.8	30.5	31.3	32.2	33.0	33.9	34.9	35.8	36.7	37.7	38.7	39.7
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	40.6	41.5	42.5	43.4	44.3	45.2	46.1	47.0	47.8	48.6	49.4	50.8	52.2	53.3	54.4	55.3				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.541	1.537	1.534	1.533	1.532	1.531	1.531
P	0.913	0.914	0.915	0.915	0.915	0.916	0.916

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

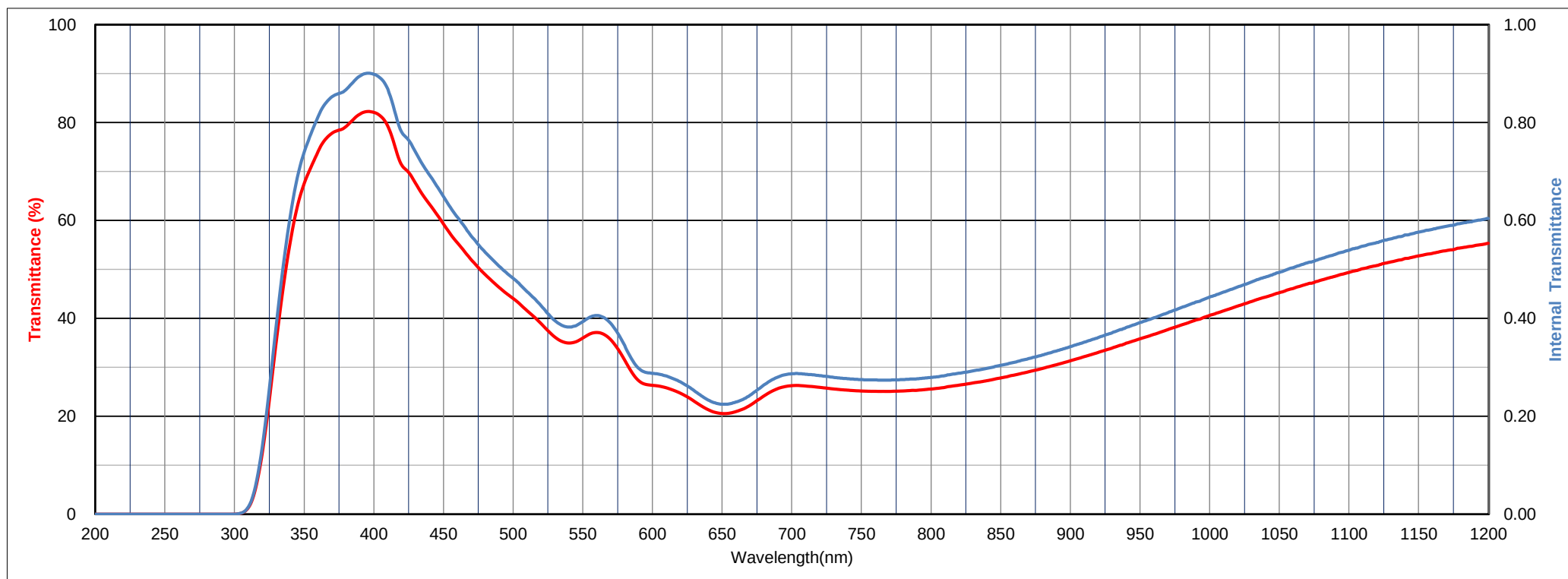
	x	y	Y	λ _d	P _a
A	0.380	0.384	32	489	17
C	0.250	0.252	35	476	29
D65	0.253	0.265	35	477	28

Properties

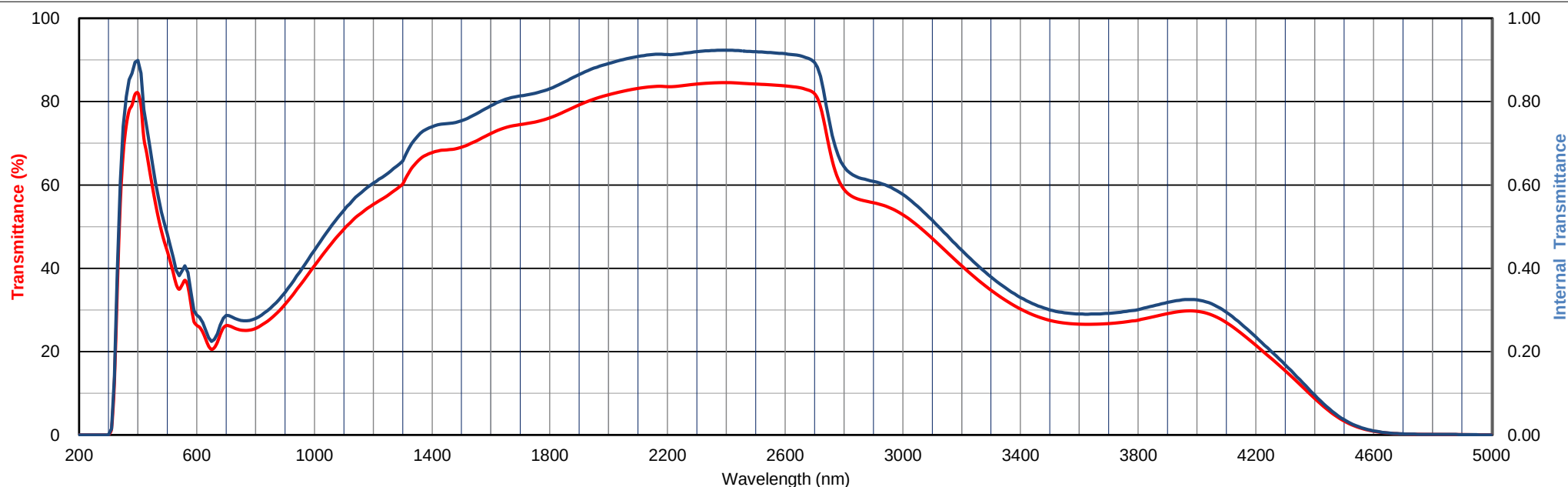
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
2	1	460	505	97	114	490	110	2.81

Tolerances of Transmittance(T)

B-R Conversion Value
V(mired)
-100±5



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	12.6	35.3	55.6	67.5	74.1	77.8	79.2	81.7
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	82.1	79.3	71.3	67.6	63.3	59.3	55.4	52.0	48.9	46.3	44.1	41.6	39.0	36.2	35.0	36.0	37.1	35.7	31.5	27.3
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	26.3	25.8	24.7	23.1	21.4	20.6	21.0	22.2	24.1	25.7	26.3	26.2	25.9	25.6	25.3	25.2	25.1	25.1	25.2	25.3
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	25.6	25.9	26.4	26.8	27.3	27.8	28.4	29.1	29.8	30.5	31.3	32.2	33.0	33.9	34.9	35.8	36.7	37.7	38.7	39.7
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	40.6	41.5	42.5	43.4	44.3	45.2	46.1	47.0	47.8	48.6	49.4	50.2	50.8	51.5	52.2	52.8	53.3	53.9	54.4	54.8
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	55.3	55.8	56.2	56.6	57.0	57.5	58.1	58.6	59.1	59.6	60.2	61.6	62.8	64.0	64.8	65.6	66.3	66.8	67.2	67.5
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	67.8	68.0	68.2	68.3	68.4	68.4	68.5	68.6	68.7	68.9	69.1	69.3	69.6	69.9	70.2	70.5	70.9	71.3	71.6	72.0
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	72.4	72.7	73.0	73.3	73.5	73.8	74.0	74.1	74.3	74.4	74.5	74.6	74.7	74.8	75.0	75.1	75.3	75.5	75.6	75.9
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	76.1	76.4	76.7	77.0	77.3	77.6	77.9	78.2	78.6	78.9	79.2	79.5	79.8	80.1	80.4	80.6	80.8	81.1	81.3	81.5
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	81.7	82.5	83.2	83.6	83.6	83.8	84.2	84.5	84.6	84.4	84.2	84.0	83.8	83.3	81.9	69.0	59.0	56.6	55.7	54.7
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	52.9	50.3	47.2	43.9	40.6	37.5	34.7	32.3	30.2	28.6	27.5	26.9	26.6	26.6	26.7	27.1	27.5	28.3	29.1	29.7
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	29.7	28.8	27.0	24.4	21.5	18.5	15.4	12.1	8.8	5.7	3.3	1.8	0.9	0.4	0.2	0.2	0.1	0.1	0.1	0.0
λnm	5000																			
T	0.0																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	8.3	28.7	50.0	63.5	71.2	75.7	77.3	80.4
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	81.1	78.1	69.4	65.6	61.3	57.2	53.3	49.7	46.5	43.7	41.2	38.5	35.7	32.6	31.3	32.1	33.2	31.5	27.1	22.9
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	21.8	21.2	20.0	18.4	16.8	16.0	16.3	17.3	19.0	20.3	20.7	20.6	20.3	20.0	19.7	19.5	19.4	19.4	19.4	19.5
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	19.7	20.0	20.4	20.8	21.2	21.7	22.3	22.9	23.6	24.3	25.0	25.8	26.7	27.5	28.5	29.3	30.3	31.2	32.2	33.2
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	34.1	35.1	36.1	37.1	38.0	38.9	39.8	40.7	41.6	42.4	43.2	44.8	46.3	47.5	48.7	49.7				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.537	1.524	1.517	1.513	1.510	1.509	1.507
P	0.914	0.917	0.919	0.920	0.921	0.921	0.921

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

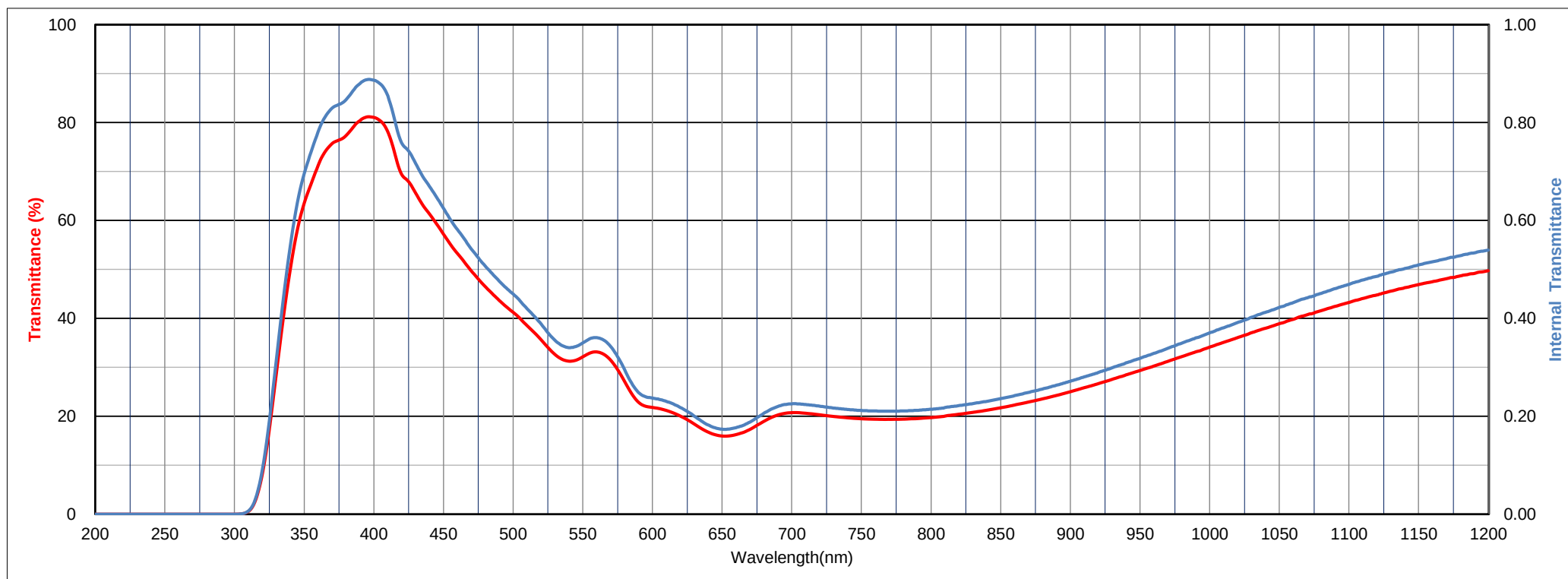
	x	y	Y	λ _d	P _e
A	0.365	0.379	28	489	21
C	0.240	0.242	31	476	34
D65	0.243	0.255	31	477	33

Properties

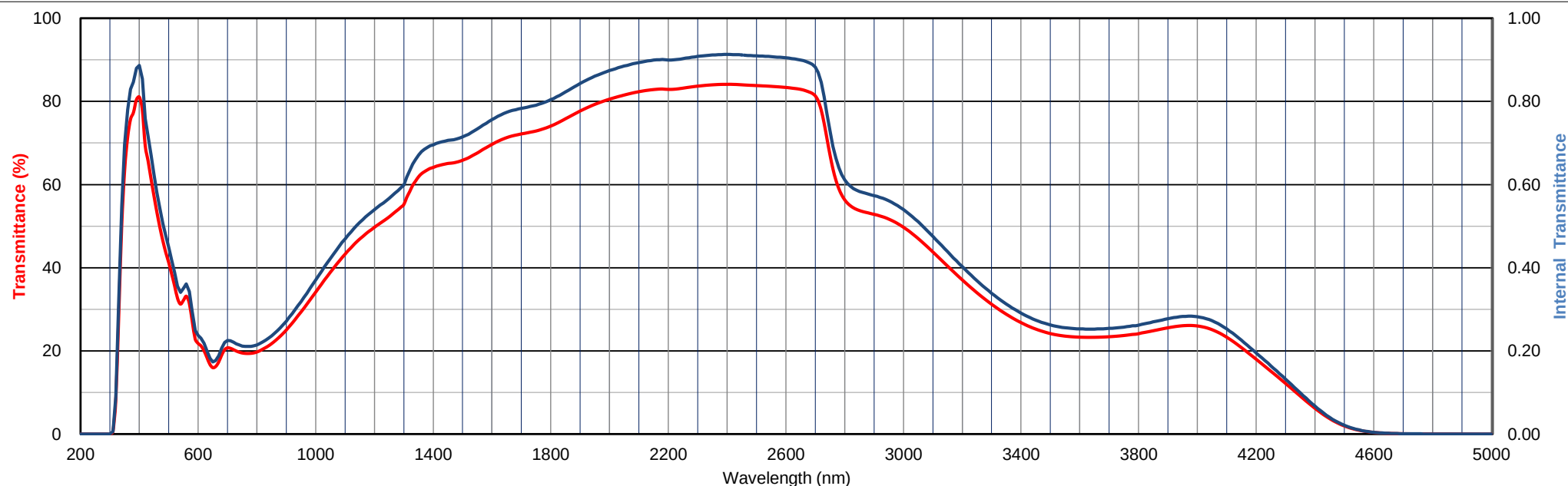
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
2	1	480	535	94	105	520	130	2.57

Tolerances of Transmittance(T)

B-R Conversion Value
V(mired)
-120±5



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	8.3	28.7	50.0	63.5	71.2	75.7	77.3	80.4
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	81.1	78.1	69.4	65.6	61.3	57.2	53.3	49.7	46.5	43.7	41.2	38.5	35.7	32.6	31.3	32.1	33.2	31.5	27.1	22.9
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	21.8	21.2	20.0	18.4	16.8	16.0	16.3	17.3	19.0	20.3	20.7	20.6	20.3	20.0	19.7	19.5	19.4	19.4	19.4	19.5
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	19.7	20.0	20.4	20.8	21.2	21.7	22.3	22.9	23.6	24.3	25.0	25.8	26.7	27.5	28.5	29.3	30.3	31.2	32.2	33.2
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	34.1	35.1	36.1	37.1	38.0	38.9	39.8	40.7	41.6	42.4	43.2	44.1	44.8	45.6	46.3	46.9	47.5	48.1	48.7	49.2
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	49.7	50.2	50.7	51.2	51.7	52.2	52.8	53.4	53.9	54.6	55.2	56.9	58.3	59.8	60.9	61.9	62.6	63.1	63.5	63.9
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	64.1	64.4	64.6	64.8	64.9	65.1	65.1	65.2	65.4	65.6	65.9	66.1	66.4	66.8	67.2	67.6	68.0	68.5	68.9	69.3
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	69.7	70.1	70.4	70.7	71.0	71.3	71.5	71.7	71.9	72.0	72.2	72.3	72.4	72.6	72.7	72.9	73.1	73.3	73.5	73.8
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	74.1	74.4	74.7	75.1	75.4	75.8	76.2	76.6	77.0	77.3	77.7	78.0	78.4	78.7	79.0	79.3	79.6	79.8	80.1	80.3
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	80.5	81.5	82.3	82.9	82.9	83.2	83.7	84.0	84.1	84.0	83.8	83.6	83.4	82.9	81.3	67.2	56.3	53.8	52.8	51.7
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	49.7	47.0	43.8	40.4	37.1	34.0	31.2	28.8	26.8	25.3	24.2	23.6	23.3	23.3	23.4	23.7	24.1	24.8	25.6	26.1
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	26.0	25.1	23.3	20.8	18.0	15.1	12.2	9.1	6.2	3.7	2.0	0.9	0.4	0.2	0.1	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	5.9	24.3	45.8	60.3	68.8	73.7	75.5	79.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	79.7	76.5	66.7	62.6	57.9	53.5	49.3	45.5	42.1	39.2	36.7	33.9	31.1	28.1	26.7	27.6	28.6	26.9	22.7	18.7
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	17.6	17.1	16.0	14.6	13.1	12.4	12.6	13.6	15.0	16.2	16.7	16.6	16.3	16.0	15.7	15.5	15.4	15.4	15.5	15.6
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	15.7	16.0	16.4	16.7	17.1	17.6	18.1	18.7	19.3	19.9	20.7	21.4	22.2	23.0	23.9	24.8	25.7	26.6	27.6	28.5
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	29.5	30.5	31.4	32.4	33.3	34.3	35.2	36.1	37.0	37.9	38.7	40.3	41.8	43.1	44.3	45.4				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.524	1.517	1.513	1.511	1.509	1.508	1.507
P	0.917	0.919	0.920	0.921	0.921	0.921	0.921

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

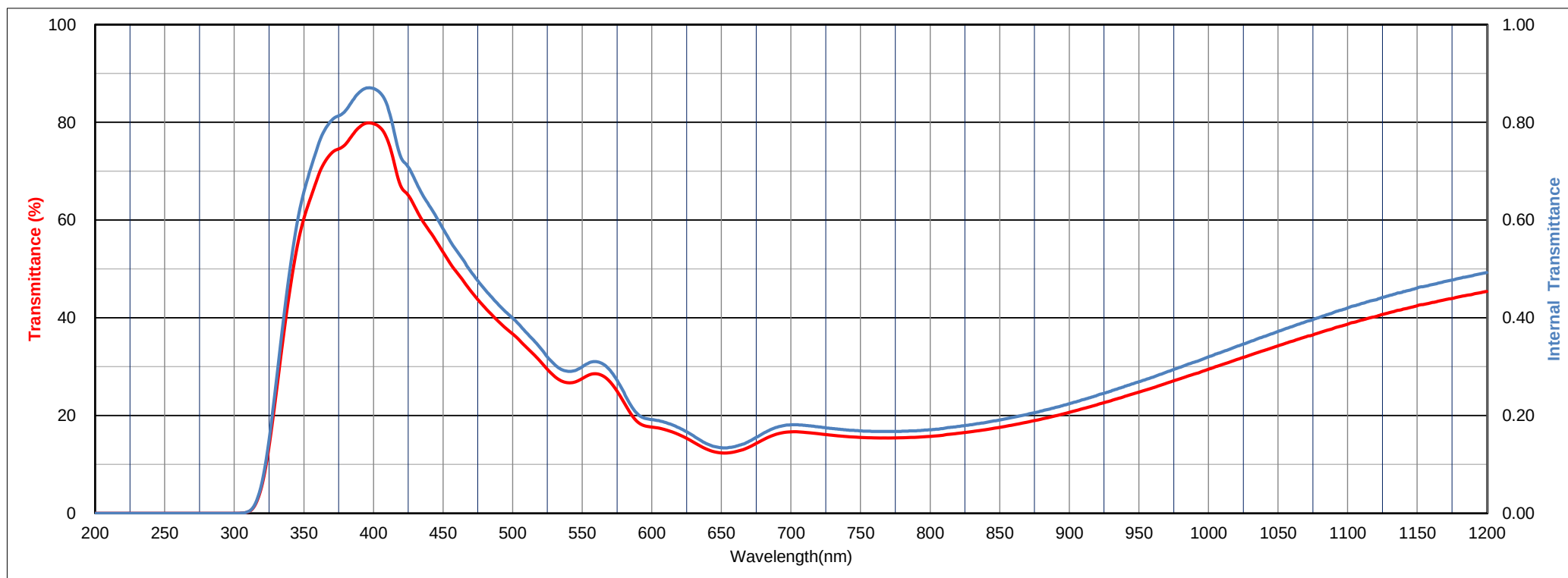
	x	y	Y	λ _d	P _s
A	0.353	0.372	24	488	24
C	0.232	0.230	26	476	38
D65	0.234	0.244	26	477	37

Properties

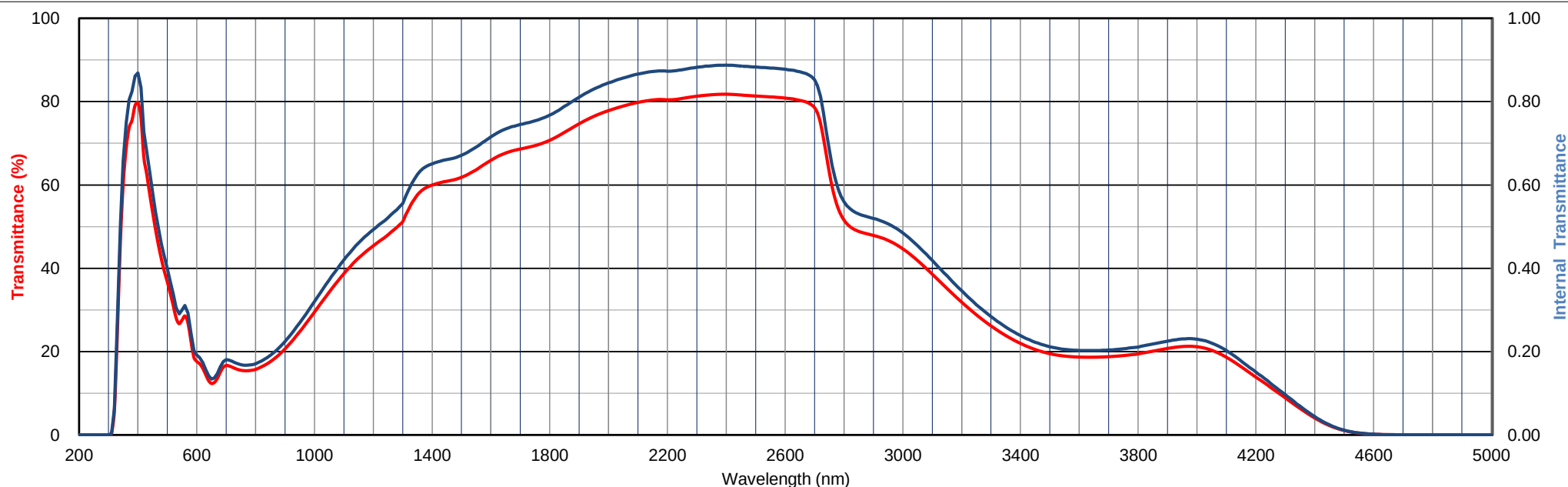
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	1	480	535	95	107	520	130	2.57

Tolerances of Transmittance(T)

B-R Conversion Value
V(mired)
-140±5



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	5.9	24.3	45.8	60.3	68.8	73.7	75.5	79.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	79.7	76.5	66.7	62.6	57.9	53.5	49.3	45.5	42.1	39.2	36.7	33.9	31.1	28.1	26.7	27.6	28.6	26.9	22.7	18.7
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	17.6	17.1	16.0	14.6	13.1	12.4	12.6	13.6	15.0	16.2	16.7	16.6	16.3	16.0	15.7	15.5	15.4	15.4	15.5	15.6
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	15.7	16.0	16.4	16.7	17.1	17.6	18.1	18.7	19.3	19.9	20.7	21.4	22.2	23.0	23.9	24.8	25.7	26.6	27.6	28.5
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	29.5	30.5	31.4	32.4	33.3	34.3	35.2	36.1	37.0	37.9	38.7	39.5	40.3	41.1	41.8	42.5	43.1	43.7	44.3	44.8
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	45.4	45.9	46.5	47.0	47.5	48.0	48.7	49.2	49.8	50.5	51.2	52.8	54.1	55.5	56.6	57.6	58.4	59.0	59.4	59.7
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	60.0	60.2	60.4	60.6	60.8	60.9	61.0	61.2	61.4	61.6	61.8	62.1	62.5	62.9	63.3	63.6	64.1	64.6	65.0	65.5
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	65.9	66.3	66.7	67.1	67.4	67.7	67.9	68.1	68.3	68.5	68.6	68.8	68.9	69.1	69.3	69.4	69.7	69.9	70.1	70.4
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	70.7	71.1	71.4	71.8	72.2	72.6	73.0	73.5	73.9	74.3	74.7	75.1	75.5	75.8	76.2	76.5	76.8	77.1	77.4	77.6
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	77.8	78.9	79.8	80.4	80.4	80.8	81.3	81.7	81.8	81.6	81.3	81.1	80.8	80.3	78.6	63.1	51.6	48.9	47.9	46.7
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	44.7	41.9	38.6	35.2	31.9	28.9	26.2	23.9	22.0	20.5	19.5	18.9	18.7	18.7	18.8	19.1	19.4	20.1	20.8	21.2
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	21.2	20.3	18.6	16.4	13.9	11.4	8.9	6.4	4.1	2.3	1.1	0.4	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	13.1	31.3	46.8	57.1	63.8	67.0	71.5
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	72.6	68.7	56.7	51.1	45.1	39.6	34.8	30.8	27.5	24.9	22.7	20.5	18.2	16.0	15.0	15.6	16.3	15.0	12.0	9.2
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	8.5	8.0	7.3	6.3	5.4	5.0	5.0	5.5	6.2	6.7	6.9	6.7	6.5	6.3	6.1	6.0	5.9	5.9	5.9	6.0
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	6.1	6.2	6.4	6.6	6.8	7.1	7.4	7.7	8.1	8.5	9.0	9.5	10.0	10.6	11.2	11.8	12.4	13.1	13.9	14.6
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	15.4	16.1	16.9	17.7	18.5	19.4	20.2	21.0	21.8	22.6	23.4	25.0	26.5	27.9	29.2	30.4				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.521	1.516	1.514	1.512	1.511	1.511	1.510
P	0.918	0.919	0.920	0.920	0.920	0.921	0.921

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

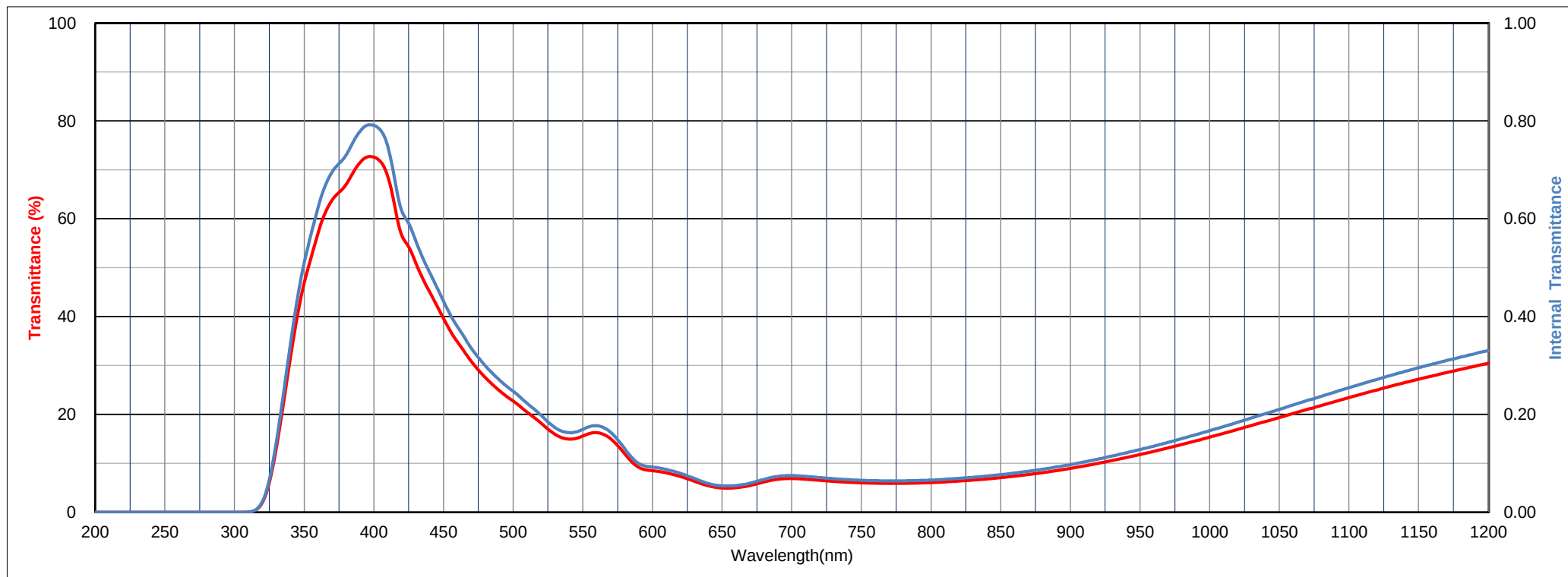
	x	y	Y	λ _d	P _e
A	0.317	0.344	13	486	34
C	0.211	0.194	15	473	51
D65	0.213	0.207	15	474	50

Properties

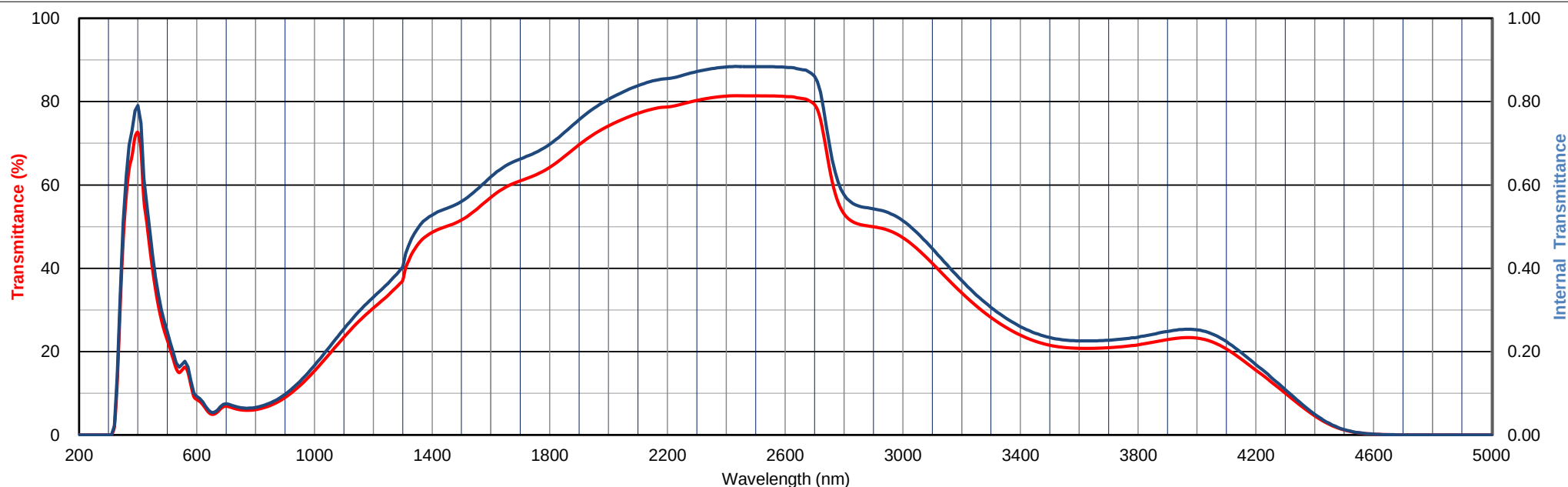
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	1	480	530	92	105	520	130	2.57

Tolerances of Transmittance(T)

B-R Conversion Value
V(mired)
-200±7



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	13.1	31.3	46.8	57.1	63.8	67.0	71.5
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	72.6	68.7	56.7	51.1	45.1	39.6	34.8	30.8	27.5	24.9	22.7	20.5	18.2	16.0	15.0	15.6	16.3	15.0	12.0	9.2
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	8.5	8.0	7.3	6.3	5.4	5.0	5.0	5.5	6.2	6.7	6.9	6.7	6.5	6.3	6.1	6.0	5.9	5.9	5.9	6.0
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	6.1	6.2	6.4	6.6	6.8	7.1	7.4	7.7	8.1	8.5	9.0	9.5	10.0	10.6	11.2	11.8	12.4	13.1	13.9	14.6
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	15.4	16.1	16.9	17.7	18.5	19.4	20.2	21.0	21.8	22.6	23.4	24.2	25.0	25.8	26.5	27.2	27.9	28.6	29.2	29.8
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	30.4	31.0	31.6	32.3	32.9	33.5	34.2	34.9	35.5	36.3	37.1	40.1	41.8	43.4	44.5	45.6	46.5	47.2	47.7	48.2
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	48.6	49.0	49.3	49.6	49.8	50.1	50.3	50.6	50.9	51.2	51.6	52.0	52.5	53.0	53.5	54.1	54.7	55.3	55.9	56.5
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	57.0	57.6	58.1	58.6	59.0	59.5	59.8	60.2	60.5	60.7	61.0	61.2	61.5	61.8	62.1	62.3	62.7	63.0	63.4	63.8
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	64.2	64.7	65.2	65.7	66.3	66.9	67.4	68.0	68.5	69.1	69.7	70.2	70.7	71.2	71.7	72.2	72.6	73.0	73.4	73.8
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	74.2	75.8	77.2	78.2	78.7	79.4	80.3	80.9	81.3	81.4	81.4	81.4	81.2	80.8	79.3	64.3	53.1	50.6	50.0	49.1
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	47.3	44.6	41.2	37.6	34.1	31.0	28.2	25.8	23.9	22.5	21.5	21.0	20.8	20.8	20.9	21.2	21.6	22.3	22.9	23.3
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	23.2	22.4	20.6	18.2	15.6	12.8	10.0	7.2	4.6	2.5	1.2	0.5	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Near-Infrared Absorbing Filters (Color Compensating Filters)

These filters selectively absorb in the red and near-infrared wavelength regions. This filter type is used to correct imaging sensitivity and exposure meter sensitivity.

Near-infrared absorbing filters feature near-infrared absorbing function, high transmittance in the visible region and high resistivity to weathering at the same time.

Transmittance (T)

units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	0.00	2.35E-03	0.16	4.32	21.34	43.97	61.55	72.11	77.85	81.02
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	83.00	84.36	85.37	86.17	86.95	87.46	87.90	88.22	88.52	88.61	88.57	88.43	87.85	86.72	84.82	82.06	78.02	72.79	66.42	58.94
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	50.88	42.59	34.60	27.31	20.92	15.61	11.32	8.18	5.78	4.05	2.83	2.00	1.42	1.03	0.76	0.58	0.45	0.37	0.30	0.26
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	0.23	0.21	0.20	0.20	0.20	0.20	0.21	0.23	0.25	0.27	0.30	0.34	0.39	0.44	0.51	0.58	0.66	0.76	0.87	0.99
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	1.14	1.32	1.50	1.72	1.96	2.23	2.53	2.87	3.22	3.62	4.06	5.08	6.27	7.61	9.17	10.88				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.506	1.499	1.495	1.492	1.491	1.490	1.490
P	0.922	0.923	0.924	0.925	0.925	0.925	0.926

Classes of Bubbles and Inclusions

Bubble Class
0

Color Specification

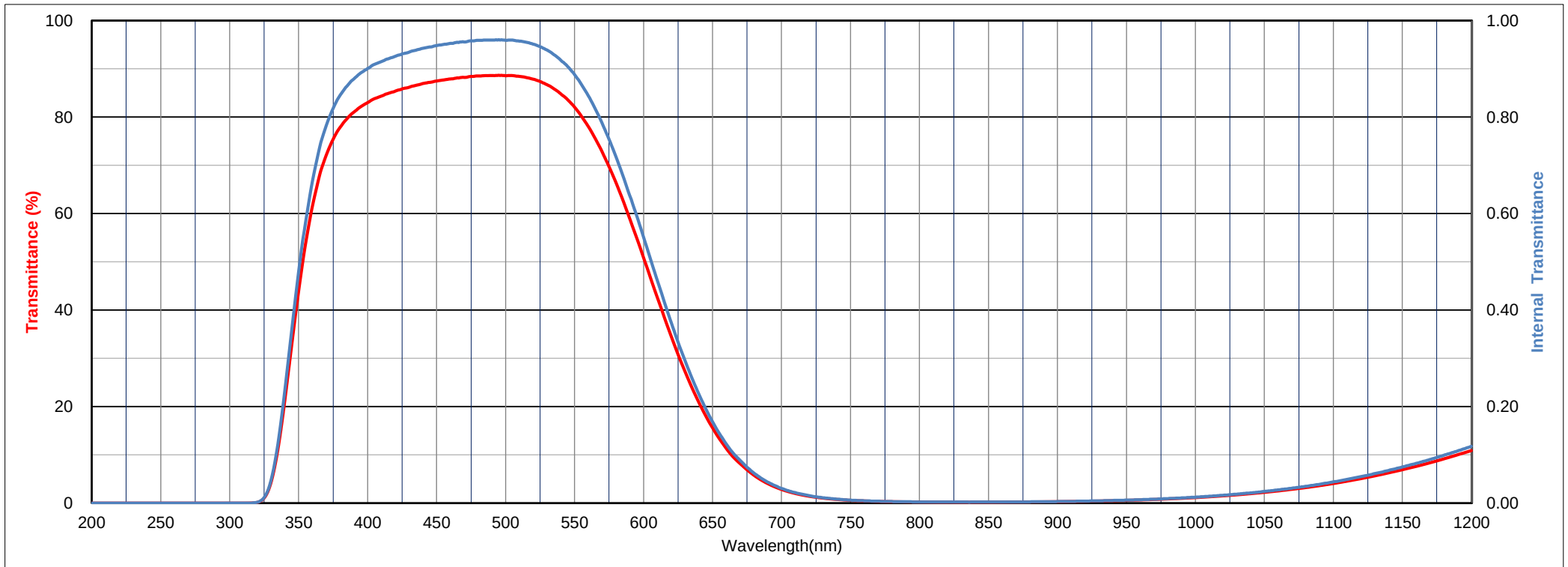
	x	y	Y	λ _d	P _e
A	0.364	0.430	65	500	19
C	0.253	0.306	72	489	22
D65	0.255	0.321	72	490	22

Properties

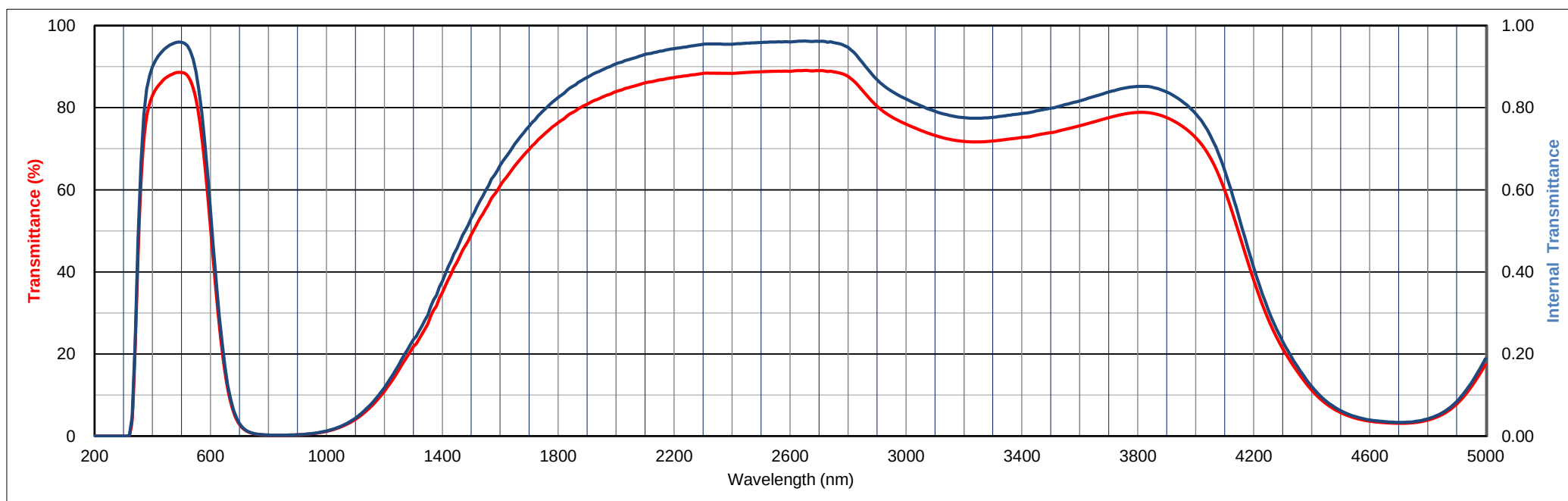
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α _{-30/70}	α _{100/300}	H _k	F _A	d
1	3	330	370	139	183	390	640	3.31

Tolerance of Transmittance (T)

Transmittance at 400nm	Transmittance at 500nm	Transmittance at 600nm
T400(%)	T500(%)	T600(%)
≥ 76	≥ 85	≥ 43



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	0.00	2.35E-03	0.16	4.32	21.34	43.97	61.55	72.11	77.85	81.02
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	83.00	84.36	85.37	86.17	86.95	87.46	87.90	88.22	88.52	88.61	88.57	88.43	87.85	86.72	84.82	82.06	78.02	72.79	66.42	58.94
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	50.88	42.59	34.60	27.31	20.92	15.61	11.32	8.18	5.78	4.05	2.83	2.00	1.42	1.03	0.76	0.58	0.45	0.37	0.30	0.26
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	0.23	0.21	0.20	0.20	0.20	0.20	0.21	0.23	0.25	0.27	0.30	0.34	0.39	0.44	0.51	0.58	0.66	0.76	0.87	0.99
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	1.14	1.32	1.50	1.72	1.96	2.23	2.53	2.87	3.22	3.62	4.06	4.55	5.08	5.65	6.27	6.92	7.61	8.36	9.17	10.01
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	10.88	11.88	12.86	13.89	14.98	16.11	17.33	18.40	19.50	20.63	21.78	22.49	23.67	24.87	26.09	27.34	29.21	30.66	31.76	33.62
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	34.95	36.53	38.07	39.45	41.05	42.30	43.73	45.24	46.42	47.62	49.10	50.37	51.74	53.04	54.11	55.36	56.53	57.96	58.87	59.84
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	61.02	62.09	62.92	63.88	64.85	65.81	66.68	67.51	68.34	69.14	69.85	70.71	71.32	72.15	72.78	73.42	74.06	74.67	75.31	75.80
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	76.36	76.87	77.31	77.94	78.47	78.85	79.24	79.78	80.14	80.54	80.83	81.24	81.62	81.90	82.17	82.51	82.81	83.10	83.29	83.67
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	83.93	85.04	86.07	86.78	87.35	87.86	88.35	88.40	88.36	88.59	88.75	88.87	88.85	89.08	89.00	88.75	87.63	84.21	80.38	77.80
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	76.01	74.50	73.26	72.31	71.79	71.68	71.88	72.30	72.77	73.30	73.93	74.73	75.60	76.57	77.57	78.41	78.85	78.65	77.60	75.65
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	72.69	67.85	59.89	49.22	38.04	28.54	21.34	15.81	11.21	7.89	5.74	4.39	3.64	3.27	3.11	3.24	3.88	5.23	7.74	11.90
λnm	5000																			
T	17.42																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.31	4.34	17.77	37.01	54.21	66.33	73.84	78.32	81.00
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	82.72	84.03	84.85	85.63	86.19	86.77	87.25	87.67	88.00	88.29	88.44	88.39	88.10	87.44	86.28	84.40	81.70	77.98	73.29	67.71
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	61.39	54.59	47.65	40.97	34.66	28.83	23.60	19.34	15.55	12.44	9.93	7.91	6.34	5.12	4.16	3.43	2.86	2.42	2.08	1.81
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	1.61	1.44	1.33	1.22	1.15	1.09	1.04	1.00	0.99	0.97	0.98	0.99	1.01	1.04	1.09	1.14	1.19	1.28	1.37	1.47
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	1.59	1.73	1.88	2.05	2.24	2.45	2.68	2.92	3.19	3.47	3.79	4.48	5.27	6.13	7.09	8.14				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.528	1.519	1.514	1.511	1.509	1.508	1.507
P	0.916	0.919	0.920	0.920	0.921	0.921	0.921

Classes of Bubbles and Inclusions

Bubble Class
0

Color Specification

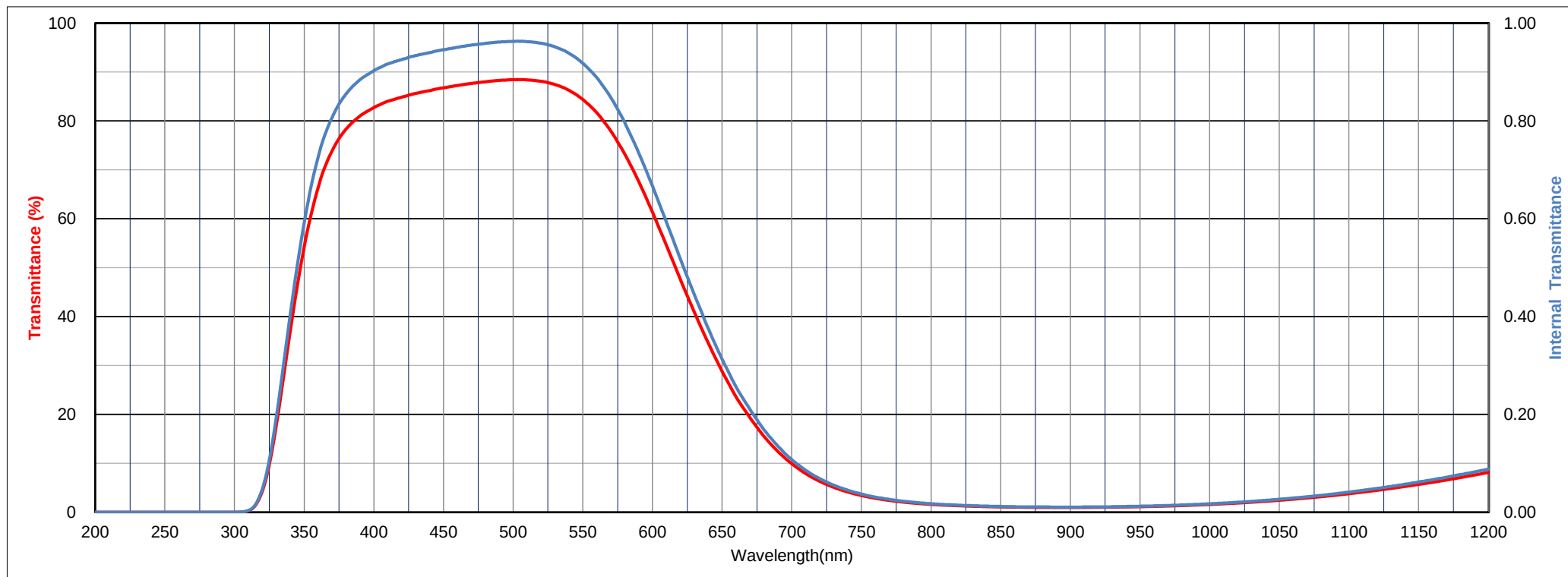
	x	y	Y	λ _d	P _e
A	0.389	0.426	71	500	13
C	0.269	0.312	76	490	16
D65	0.271	0.326	77	491	15

Properties

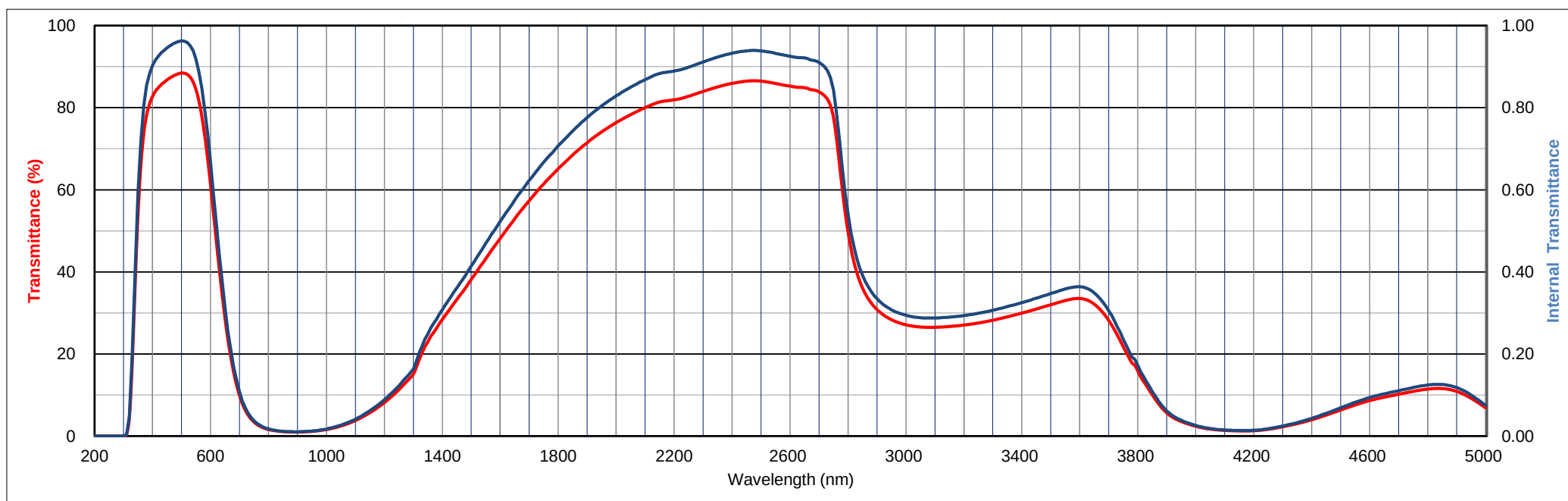
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	1	615	675	54	70	485	120	2.54

Tolerance of Transmittance (T)

Transmittance at 400nm	Transmittance at 500nm	Transmittance at 600nm
T400(%)	T500(%)	T600(%)
≥80	≥88	≥58



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	0.00	0.00	0.31	4.34	17.77	37.01	54.21	66.33	73.84	78.32	81.00
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	82.72	84.03	84.85	85.63	86.19	86.77	87.25	87.67	88.00	88.29	88.44	88.39	88.10	87.44	86.28	84.40	81.70	77.98	73.29	67.71
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	61.39	54.59	47.65	40.97	34.66	28.83	23.60	19.34	15.55	12.44	9.93	7.91	6.34	5.12	4.16	3.43	2.86	2.42	2.08	1.81
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	1.61	1.44	1.33	1.22	1.15	1.09	1.04	1.00	0.99	0.97	0.98	0.99	1.01	1.04	1.09	1.14	1.19	1.28	1.37	1.47
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	1.59	1.73	1.88	2.05	2.24	2.45	2.68	2.92	3.19	3.47	3.79	4.13	4.48	4.86	5.27	5.69	6.13	6.59	7.09	7.61
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	8.14	8.73	9.33	9.95	10.60	11.28	12.02	12.76	13.48	14.25	15.05	16.65	18.59	20.19	21.77	22.93	24.27	25.23	26.26	27.41
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	28.40	29.38	30.34	31.32	32.32	33.25	34.23	35.10	36.08	37.13	38.18	39.17	40.17	41.25	42.18	43.20	44.23	45.29	46.24	47.19
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	48.16	49.15	50.11	51.08	51.96	52.96	53.92	54.78	55.65	56.50	57.37	58.20	59.04	59.88	60.70	61.43	62.24	62.95	63.67	64.39
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	65.13	65.82	66.46	67.14	67.83	68.49	69.14	69.72	70.36	70.91	71.45	72.08	72.60	73.13	73.62	74.11	74.59	75.05	75.50	75.93
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	76.37	78.30	80.02	81.39	81.92	82.79	83.96	85.06	85.94	86.47	86.47	85.91	85.27	84.86	83.87	77.63	49.85	36.10	30.83	28.35
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	27.10	26.57	26.50	26.70	27.05	27.55	28.23	29.05	29.96	30.95	32.00	33.02	33.52	32.13	28.15	21.76	15.91	10.06	5.65	3.55
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	2.39	1.70	1.38	1.25	1.30	1.65	2.26	3.02	3.96	5.10	6.34	7.56	8.64	9.47	10.18	10.88	11.44	11.57	10.90	9.23
λnm	5000																			
T	6.90																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	0.00	0.00	0.03	1.68	14.93	38.69	57.39	68.21	73.95	77.47	79.88
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	81.76	83.23	84.45	85.49	86.40	87.04	87.69	88.16	88.56	88.77	88.92	88.84	88.35	87.35	85.56	82.84	78.65	73.07	66.05	57.61
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	48.42	38.98	29.97	22.03	15.39	10.22	6.39	3.90	2.24	1.23	0.65	0.34	0.17	0.08	0.04	0.02	0.01	0.01	3.57E-03	2.14E-03
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	1.38E-03	9.33E-04	6.75E-04	5.13E-04	4.19E-04	3.42E-04	2.92E-04	#####	2.73E-04	3.02E-04	3.01E-04	3.35E-04	3.74E-04	4.55E-04	5.35E-04	6.36E-04	7.82E-04	9.44E-04	1.19E-03	1.49E-03
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	1.90E-03	2.42E-03	3.12E-03	4.00E-03	5.15E-03	6.62E-03	8.50E-03	#####	1.37E-02	1.75E-02	2.21E-02	3.54E-02	5.61E-02	8.61E-02	1.23E-01	1.89E-01				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.554	1.544	1.539	1.536	1.534	1.533	1.532
P	0.910	0.913	0.914	0.915	0.915	0.915	0.915

Classes of Bubbles and Inclusions

Bubble Class
0

Color Specification

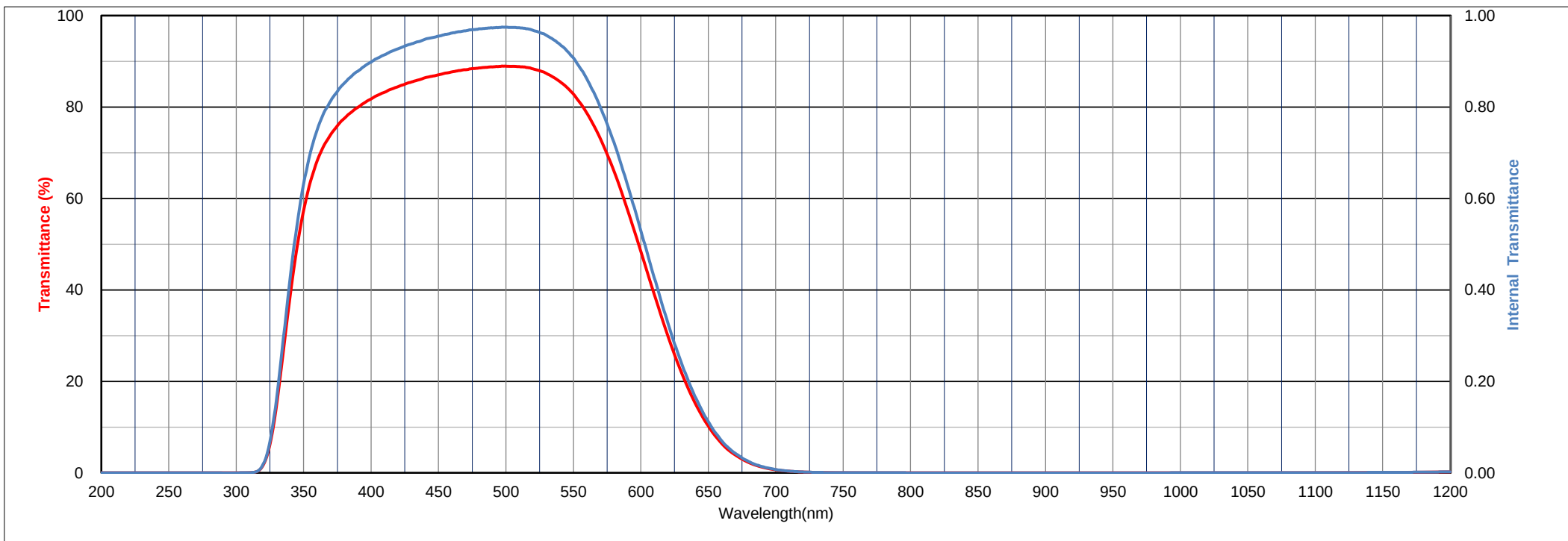
	x	y	Y	λ _d	P _e
A	0.355	0.435	64	500	21
C	0.248	0.308	71	489	24
D65	0.250	0.323	72	490	23

Properties

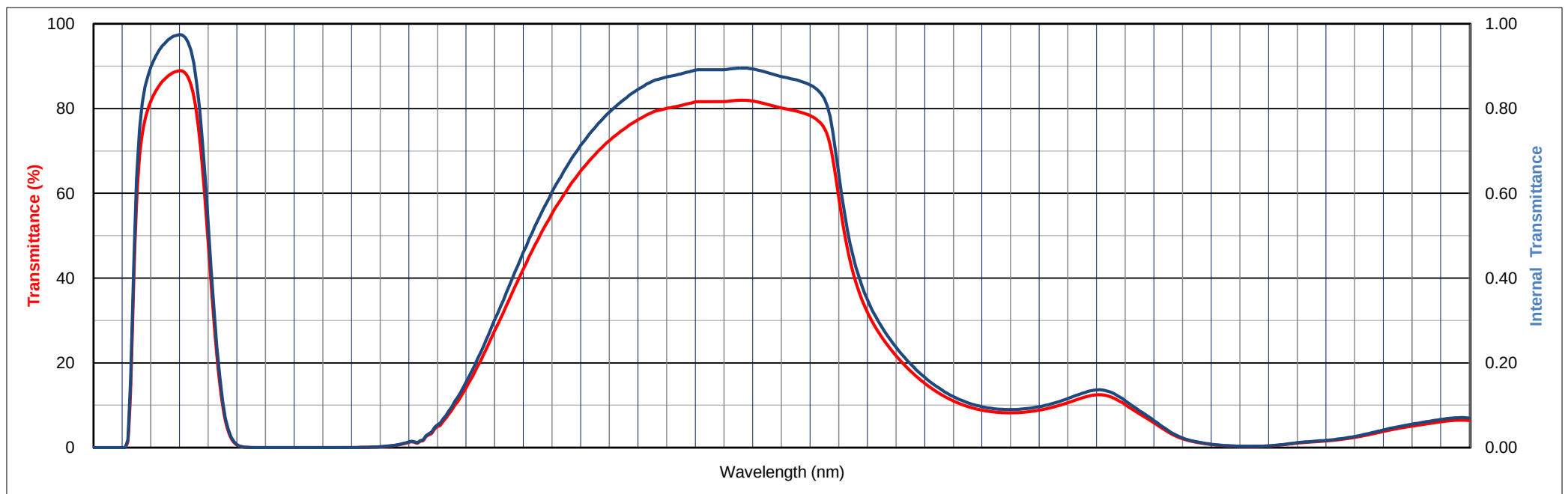
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _k	F _A	d
4	4	390	430	124	-	500	180	2.60

Tolerance of Transmittance (T)

Transmittance at 400nm	Transmittance at 500nm	Transmittance at 600nm
T400(%)	T500(%)	T600(%)
≥80	≥88	≤50



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	0.00	0.00	0.03	1.68	14.93	38.69	57.39	68.21	73.95	77.47	79.88
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	81.76	83.23	84.45	85.49	86.40	87.04	87.69	88.16	88.56	88.77	88.92	88.84	88.35	87.35	85.56	82.84	78.65	73.07	66.05	57.61
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	48.42	38.98	29.97	22.03	15.39	10.22	6.39	3.90	2.24	1.23	0.65	0.34	0.17	0.08	0.04	0.02	0.01	0.01	3.6E-03	2.1E-03
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	1.4E-03	9.3E-04	6.7E-04	5.1E-04	4.2E-04	3.4E-04	2.9E-04	2.7E-04	2.7E-04	3.0E-04	3.0E-04	3.4E-04	3.7E-04	4.5E-04	5.3E-04	6.4E-04	7.8E-04	9.4E-04	1.2E-03	1.5E-03
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	1.9E-03	2.4E-03	3.1E-03	4.0E-03	5.2E-03	6.6E-03	8.5E-03	1.1E-02	1.4E-02	1.8E-02	2.2E-02	2.8E-02	3.5E-02	4.5E-02	5.6E-02	7.0E-02	8.6E-02	1.0E-01	1.2E-01	1.5E-01
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	1.9E-01	0.23	0.29	0.35	0.42	0.51	0.62	0.75	0.89	1.05	1.24	1.37	1.26	1.05	1.50	1.67	2.60	3.01	3.38	4.37
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	4.96	5.29	6.21	7.00	7.95	8.83	9.94	10.78	11.84	12.98	14.10	15.38	16.51	17.82	19.20	20.39	21.81	23.22	24.68	26.17
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	27.65	28.99	30.43	31.88	33.42	34.85	36.40	37.88	39.30	40.74	42.19	43.53	45.09	46.36	47.79	48.97	50.36	51.63	52.83	53.95
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	55.22	56.43	57.46	58.45	59.57	60.56	61.63	62.62	63.44	64.37	65.29	66.09	66.86	67.69	68.43	69.12	69.91	70.54	71.22	71.89
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	72.42	75.11	77.37	79.12	80.06	80.73	81.58	81.63	81.64	81.95	81.78	81.01	80.14	79.44	78.35	75.34	59.18	41.37	31.99	26.11
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	21.70	18.11	15.19	12.84	11.02	9.70	8.83	8.36	8.21	8.37	8.84	9.59	10.60	11.74	12.46	11.95	10.14	7.95	5.86	3.67
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	2.09	1.24	0.73	0.44	0.32	0.30	0.39	0.67	1.06	1.33	1.57	1.91	2.41	3.05	3.80	4.49	5.06	5.58	6.08	6.43
λnm	5000																			
T	6.39																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	0.00	0.00	0.13	4.41	23.09	46.92	62.93	71.74	76.62	79.55	81.56
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	83.08	84.38	85.35	86.23	86.95	87.51	87.98	88.44	88.73	88.97	89.04	88.89	88.44	87.53	85.95	83.50	79.91	75.16	69.09	61.88
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	53.77	45.35	36.96	29.21	22.30	16.47	11.69	8.22	5.54	3.65	2.35	1.50	0.95	0.60	0.39	0.25	0.16	0.11	0.08	0.05
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	0.04	0.03	0.03	0.02	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.05
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	0.06	0.08	0.09	0.11	0.13	0.15	0.18	0.21	0.25	0.30	0.35	0.48	0.66	0.88	1.17	1.54				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.550	1.541	1.536	1.533	1.531	1.530	1.529
P	0.911	0.913	0.915	0.915	0.916	0.916	0.916

Classes of Bubbles and Inclusions

Bubble Class
0

Color Specification

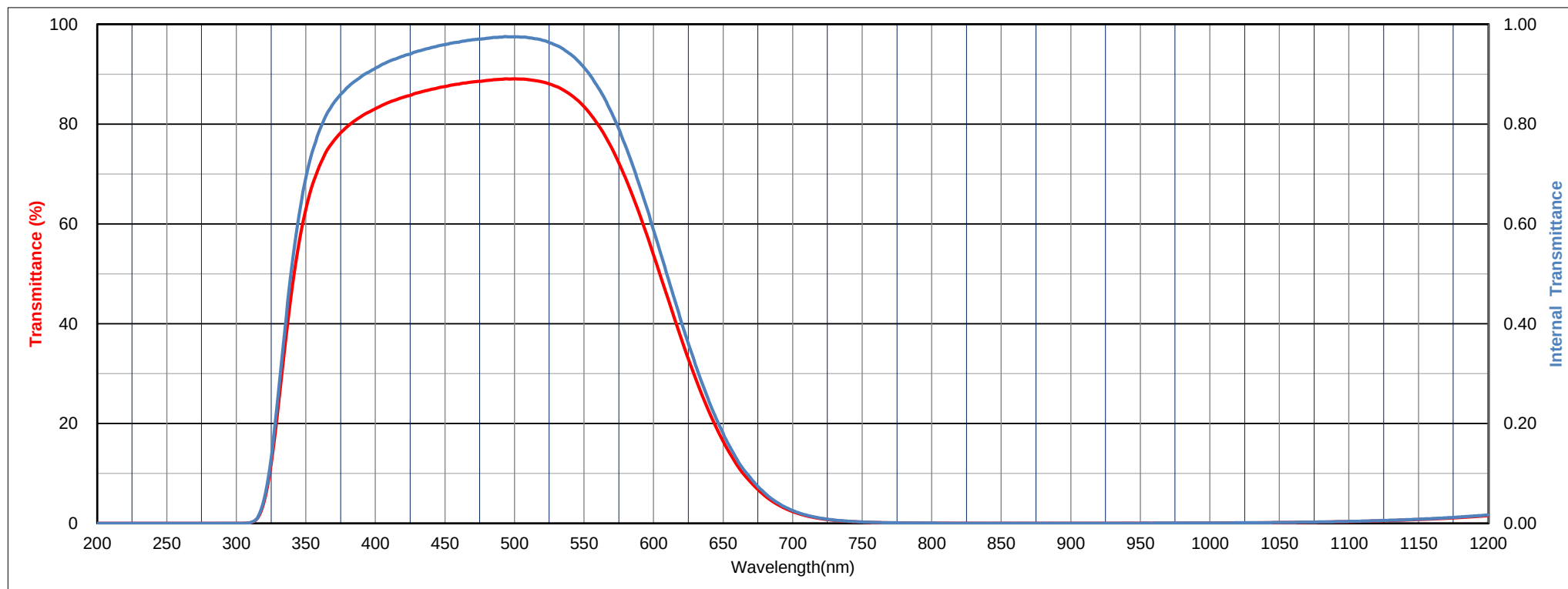
	x	y	Y	λ _d	P _e
A	0.369	0.431	67	500	18
C	0.256	0.309	73	489	21
D65	0.258	0.323	74	490	20

Properties

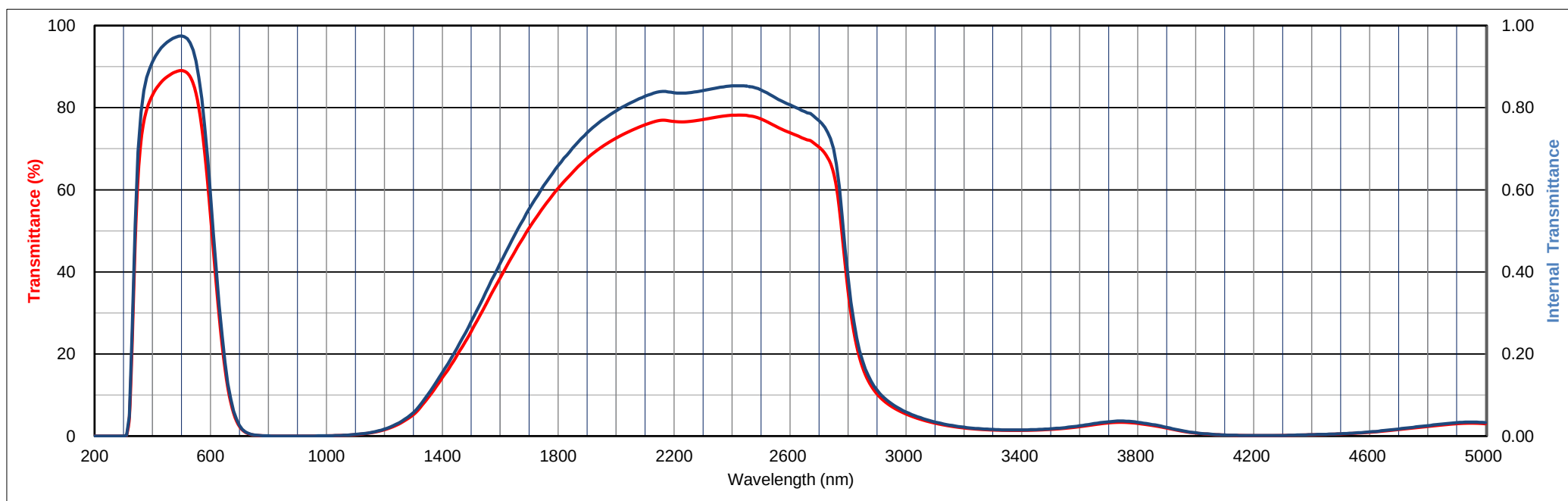
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	2	425	470	83	110	420	150	2.59

Tolerance of Transmittance (T)

Transmittance at 400nm	Transmittance at 500nm	Transmittance at 600nm
T400(%)	T500(%)	T600(%)
≥80	≥88	≤55



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	0.00	0.00	0.13	4.41	23.09	46.92	62.93	71.74	76.62	79.55	81.56
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	83.08	84.38	85.35	86.23	86.95	87.51	87.98	88.44	88.73	88.97	89.04	88.89	88.44	87.53	85.95	83.50	79.91	75.16	69.09	61.88
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	53.77	45.35	36.96	29.21	22.30	16.47	11.69	8.22	5.54	3.65	2.35	1.50	0.95	0.60	0.39	0.25	0.16	0.11	0.08	0.05
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	0.04	0.03	0.03	0.02	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.05
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	0.06	0.08	0.09	0.11	0.13	0.15	0.18	0.21	0.25	0.30	0.35	0.41	0.48	0.56	0.66	0.76	0.88	1.01	1.17	1.34
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	1.54	1.76	2.01	2.28	2.59	2.93	3.32	3.76	4.19	4.68	5.21	5.84	6.62	7.51	8.36	9.26	10.18	11.12	12.16	13.15
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	14.23	15.22	16.17	17.31	18.37	19.57	20.77	21.86	23.07	24.22	25.52	26.86	28.09	29.39	30.68	32.02	33.37	34.74	36.01	37.28
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	38.55	39.84	41.13	42.42	43.64	44.85	46.13	47.27	48.40	49.62	50.73	51.81	52.84	53.83	54.88	55.85	56.81	57.70	58.63	59.54
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	60.38	61.20	62.01	62.76	63.49	64.26	65.02	65.75	66.38	67.04	67.68	68.31	68.87	69.41	69.92	70.42	70.90	71.34	71.78	72.20
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	72.59	74.37	75.85	76.89	76.65	76.63	77.12	77.75	78.17	78.14	77.25	75.51	73.91	72.42	70.41	64.17	35.50	16.82	10.28	7.23
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	5.38	4.09	3.15	2.46	1.98	1.66	1.47	1.39	1.38	1.46	1.63	1.90	2.29	2.78	3.21	3.35	3.09	2.59	1.95	1.23
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	0.73	0.43	0.25	0.15	0.11	0.11	0.14	0.23	0.32	0.41	0.52	0.68	0.92	1.23	1.59	1.96	2.33	2.69	3.01	3.14
λnm	5000																			
T	2.99																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	0.00	0.00	0.01	0.20	5.37	25.50	50.41	67.52	76.89	81.67	84.09	85.48
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	86.39	87.09	87.63	88.09	88.48	88.82	89.16	89.36	89.56	89.65	89.67	89.54	89.13	88.42	87.21	85.35	82.67	79.14	74.61	69.19
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	62.93	56.14	49.00	42.01	35.27	29.06	23.45	18.92	14.92	11.74	9.19	7.21	5.70	4.56	3.68	3.02	2.53	2.16	1.88	1.68
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	1.54	1.44	1.38	1.34	1.33	1.34	1.38	1.43	1.50	1.60	1.71	1.85	2.01	2.19	2.39	2.61	2.86	3.13	3.44	3.76
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	4.13	4.52	4.95	5.41	5.90	6.43	6.99	7.60	8.22	8.89	9.62	11.18	12.92	14.77	16.81	18.98				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.525	1.518	1.514	1.511	1.509	1.509	1.508
P	0.917	0.919	0.920	0.920	0.921	0.921	0.921

Classes of Bubbles and Inclusions

Bubble Class
0

Color Specification

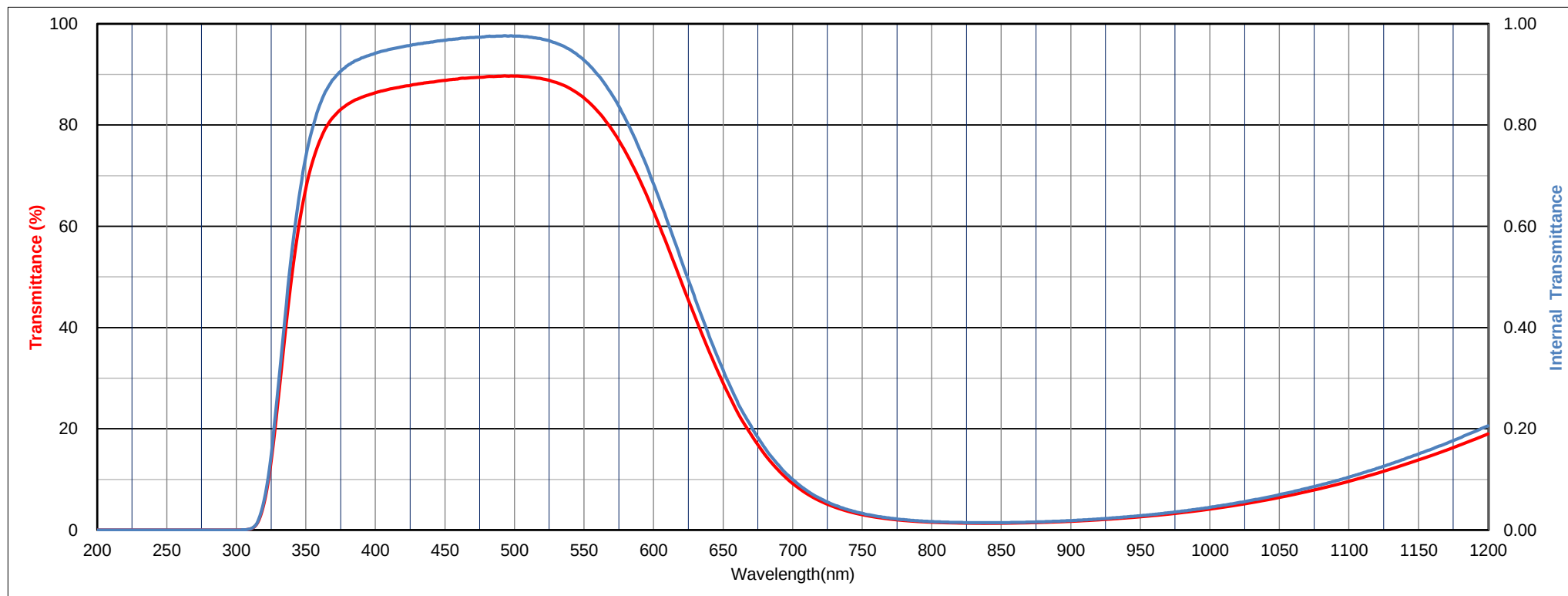
	x	y	Y	λ _d	P _e
A	0.390	0.425	72	500	13
C	0.269	0.310	77	489	16
D65	0.272	0.325	78	490	15

Properties

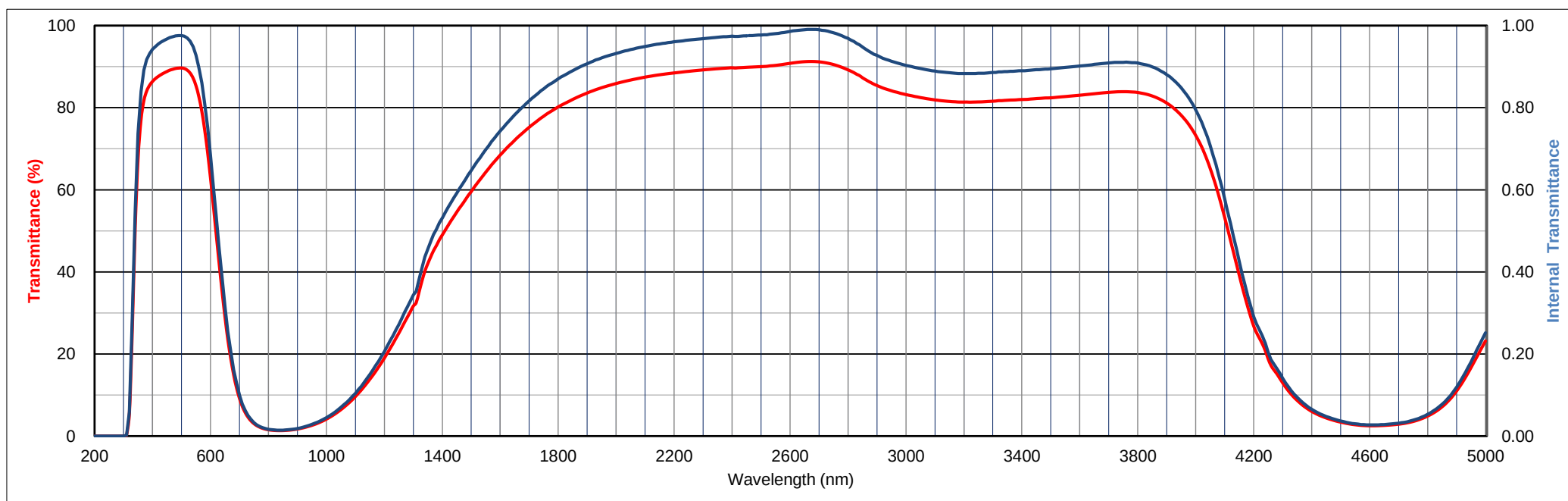
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
2	4	370	405	127	158	380	520	3.40

Tolerance of Transmittance (T)

Transmittance at 400nm	Transmittance at 500nm	Transmittance at 600nm
T400(%)	T500(%)	T600(%)
≥86	≥89	≥60



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	0.00	0.00	0.01	0.20	5.37	25.50	50.41	67.52	76.89	81.67	84.09	85.48
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	86.39	87.09	87.63	88.09	88.48	88.82	89.16	89.36	89.56	89.65	89.67	89.54	89.13	88.42	87.21	85.35	82.67	79.14	74.61	69.19
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	62.93	56.14	49.00	42.01	35.27	29.06	23.45	18.92	14.92	11.74	9.19	7.21	5.70	4.56	3.68	3.02	2.53	2.16	1.88	1.68
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	1.54	1.44	1.38	1.34	1.33	1.34	1.38	1.43	1.50	1.60	1.71	1.85	2.01	2.19	2.39	2.61	2.86	3.13	3.44	3.76
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	4.13	4.52	4.95	5.41	5.90	6.43	6.99	7.60	8.22	8.89	9.62	10.40	11.18	12.04	12.92	13.84	14.77	15.76	16.81	17.87
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	18.98	20.16	21.34	22.55	23.83	25.07	26.40	27.75	29.04	30.35	31.68	32.51	35.16	37.83	40.20	42.02	43.67	45.20	46.46	47.84
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	48.99	50.16	51.29	52.44	53.49	54.58	55.62	56.57	57.62	58.67	59.57	60.61	61.55	62.47	63.38	64.29	65.17	66.07	66.88	67.68
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	68.47	69.22	69.99	70.73	71.37	72.08	72.78	73.40	74.02	74.65	75.23	75.82	76.35	76.91	77.45	77.93	78.45	78.89	79.32	79.76
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	80.20	80.59	80.95	81.30	81.66	82.02	82.36	82.68	83.00	83.29	83.58	83.88	84.13	84.40	84.64	84.88	85.09	85.31	85.51	85.70
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	85.89	86.74	87.46	88.02	88.47	88.86	89.21	89.50	89.74	89.84	90.00	90.31	90.81	91.21	91.17	90.51	89.22	87.30	85.40	84.13
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	83.19	82.47	81.90	81.53	81.37	81.40	81.58	81.82	82.00	82.23	82.41	82.72	83.04	83.40	83.74	83.90	83.71	82.85	81.13	78.14
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	73.25	65.20	53.24	39.27	26.82	18.81	12.98	8.70	6.01	4.42	3.40	2.76	2.50	2.59	2.89	3.55	4.86	7.12	10.94	16.66
λnm	5000																			
T	23.17																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	0.00	0.00	1.03E-01	3.79	21.83	47.89	67.86	79.49	85.31	88.07	89.44
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	90.04	90.44	90.61	90.81	90.94	91.02	91.13	91.19	91.16	91.13	90.99	90.75	90.13	89.11	87.62	85.36	82.19	78.07	73.03	66.99
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	60.25	53.11	45.70	38.60	31.89	25.77	20.42	16.23	12.59	9.73	7.52	5.82	4.56	3.60	2.89	2.37	1.98	1.69	1.48	1.33
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	1.23	1.16	1.12	1.10	1.11	1.14	1.18	1.25	1.32	1.42	1.54	1.68	1.84	2.02	2.22	2.45	2.69	2.97	3.28	3.61
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	3.98	4.38	4.82	5.29	5.80	6.35	6.95	7.57	8.22	8.95	9.70	11.38	13.23	15.21	17.42	19.78				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.535	1.526	1.521	1.518	1.517	1.516	1.515
P	0.915	0.917	0.918	0.919	0.919	0.919	0.919

Classes of Bubbles and Inclusions

Bubble Class
0

Color Specification

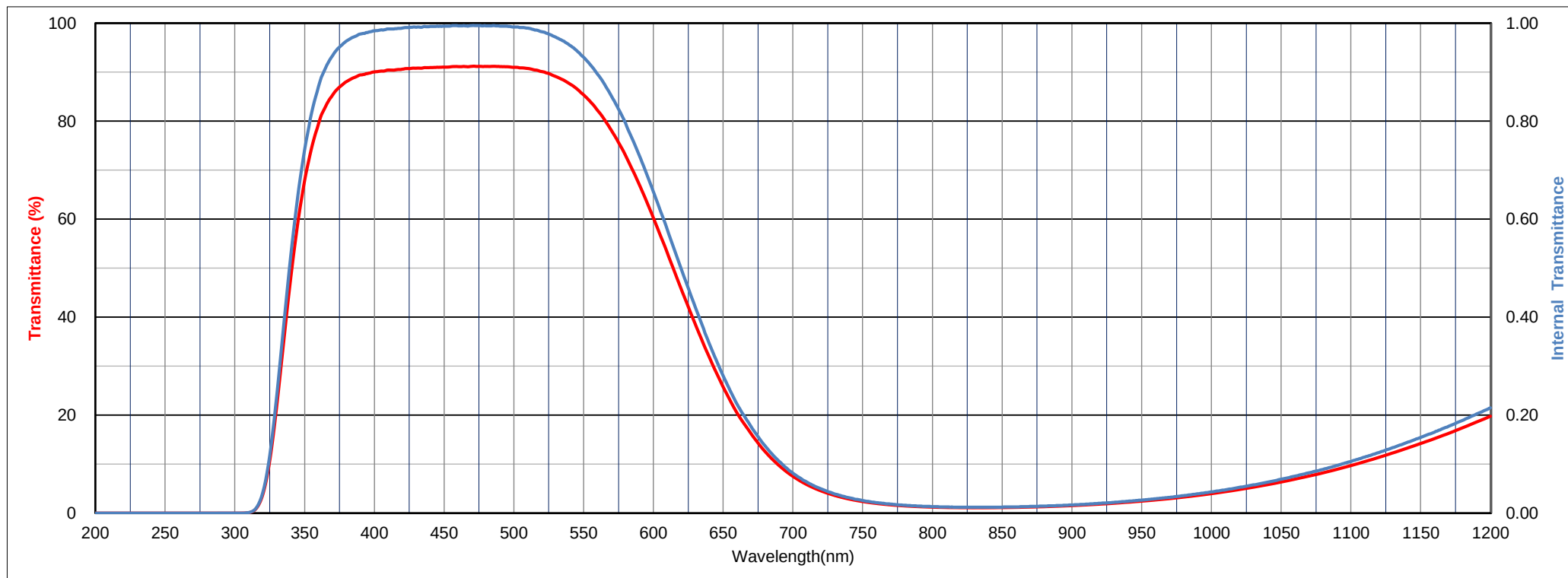
	x	y	Y	λ _d	P _e
A	0.382	0.425	71	499	15
C	0.264	0.307	77	489	18
D65	0.266	0.321	77	490	18

Properties

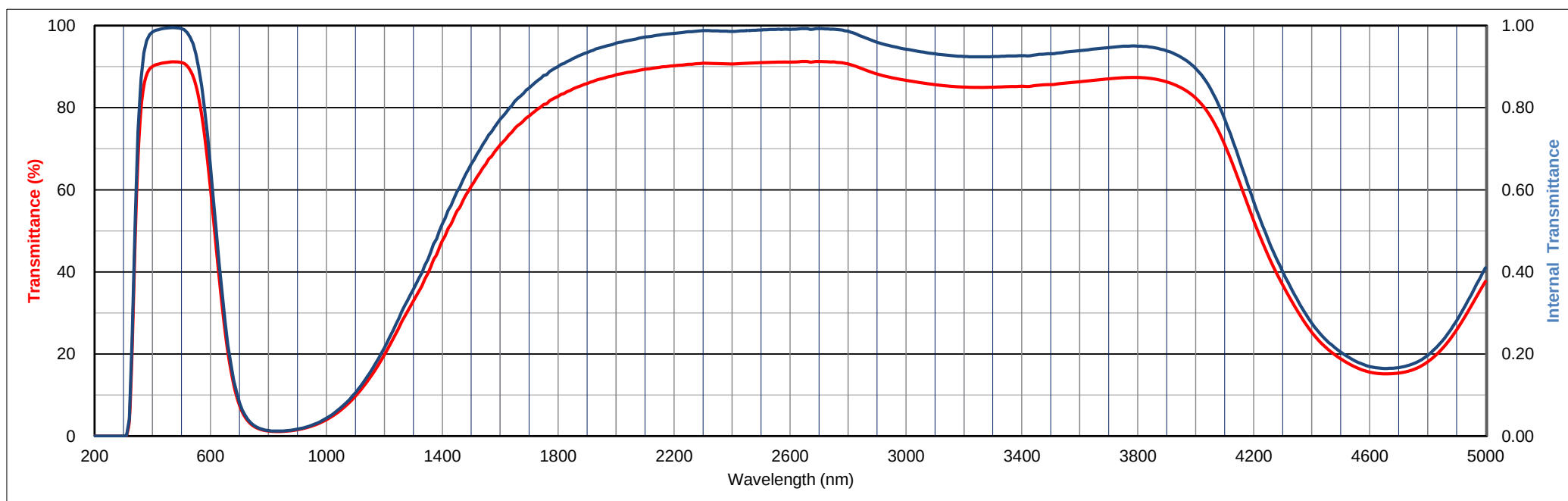
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	4	330	365	128	170	440	440	3.27

Tolerance of Transmittance (T)

Transmittance at 400nm	Transmittance at 500nm	Transmittance at 600nm
T400(%)	T500(%)	T600(%)
≥85	≥89	≥59



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	0.00	0.00	1.0E-01	3.79	21.83	47.89	67.86	79.49	85.31	88.07	89.44
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	90.04	90.44	90.61	90.81	90.94	91.02	91.13	91.19	91.16	91.13	90.99	90.75	90.13	89.11	87.62	85.36	82.19	78.07	73.03	66.99
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	60.25	53.11	45.70	38.60	31.89	25.77	20.42	16.23	12.59	9.73	7.52	5.82	4.56	3.60	2.89	2.37	1.98	1.69	1.48	1.33
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	1.23	1.16	1.12	1.10	1.11	1.14	1.18	1.25	1.32	1.42	1.54	1.68	1.84	2.02	2.22	2.45	2.69	2.97	3.28	3.61
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	3.98	4.38	4.82	5.29	5.80	6.35	6.95	7.57	8.22	8.95	9.70	10.53	11.38	12.29	13.23	14.21	15.21	16.28	17.42	18.59
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	19.78	21.03	22.33	23.67	25.00	26.37	27.87	29.12	30.38	31.63	32.88	34.13	35.39	36.64	38.29	39.59	41.18	43.00	44.15	45.93
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	47.57	48.82	50.54	51.62	53.17	54.73	55.68	57.15	58.56	59.67	60.89	61.95	63.14	64.18	65.35	66.24	67.47	68.14	69.19	70.07
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	70.94	71.70	72.45	73.38	74.03	74.93	75.63	76.13	76.78	77.51	77.97	78.60	79.14	79.72	80.17	80.77	80.97	81.66	82.08	82.44
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	82.78	83.24	83.45	83.89	84.15	84.54	84.86	85.12	85.37	85.70	85.88	86.19	86.40	86.68	86.90	87.06	87.24	87.47	87.61	87.78
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	88.03	88.68	89.39	89.84	90.22	90.58	90.84	90.75	90.65	90.83	90.98	91.09	91.10	91.27	91.25	91.17	90.68	89.47	88.22	87.33
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	86.67	86.10	85.62	85.24	85.02	84.95	84.99	85.12	85.23	85.42	85.63	85.99	86.33	86.68	87.04	87.31	87.36	87.07	86.29	84.84
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	82.34	77.95	71.00	62.04	52.50	44.01	36.85	30.62	25.33	21.54	18.84	16.85	15.58	15.16	15.35	16.17	18.06	21.25	25.83	31.60
λnm	5000																			
T	37.69																			



Transmittance (T)		units: %																		
λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	2E-06	5E-05	2E-03	6E-02	1.97	15.29	39.20	59.72	71.92	78.24	81.45	83.27
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	84.42	85.31	85.95	86.53	87.11	87.56	87.96	88.24	88.49	88.67	88.75	88.58	88.13	87.26	85.86	83.75	80.78	76.87	72.03	66.29
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	59.82	52.96	45.83	38.92	32.32	26.27	20.92	16.66	12.90	9.92	7.61	5.84	4.50	3.49	2.74	2.18	1.78	1.47	1.24	1.08
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	0.96	0.87	0.83	0.79	0.77	0.76	0.79	0.80	0.85	0.88	0.96	1.02	1.12	1.20	1.35	1.45	1.61	1.78	1.95	2.16
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	2.38	2.63	2.89	3.19	3.50	3.85	4.22	4.62	5.03	5.49	5.98	7.06	8.30	9.65	11.20	12.90				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.554	1.544	1.539	1.535	1.533	1.532	1.532
P	0.910	0.913	0.914	0.915	0.915	0.915	0.916

Classes of Bubbles and Inclusions

Bubble Class
0

Color Specification

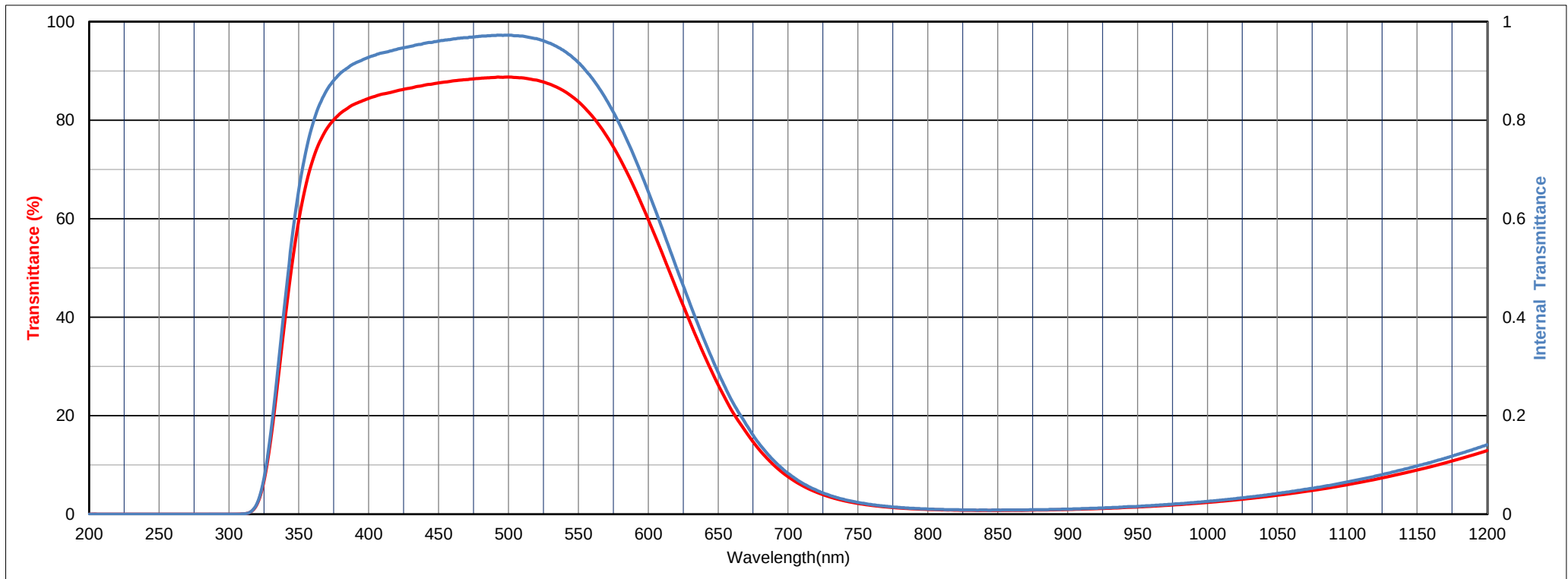
	x	y	Y	λ _d	P _e
A	0.385	0.426	70	500	14
C	0.266	0.310	76	489	17
D65	0.268	0.324	76	490	17

Properties

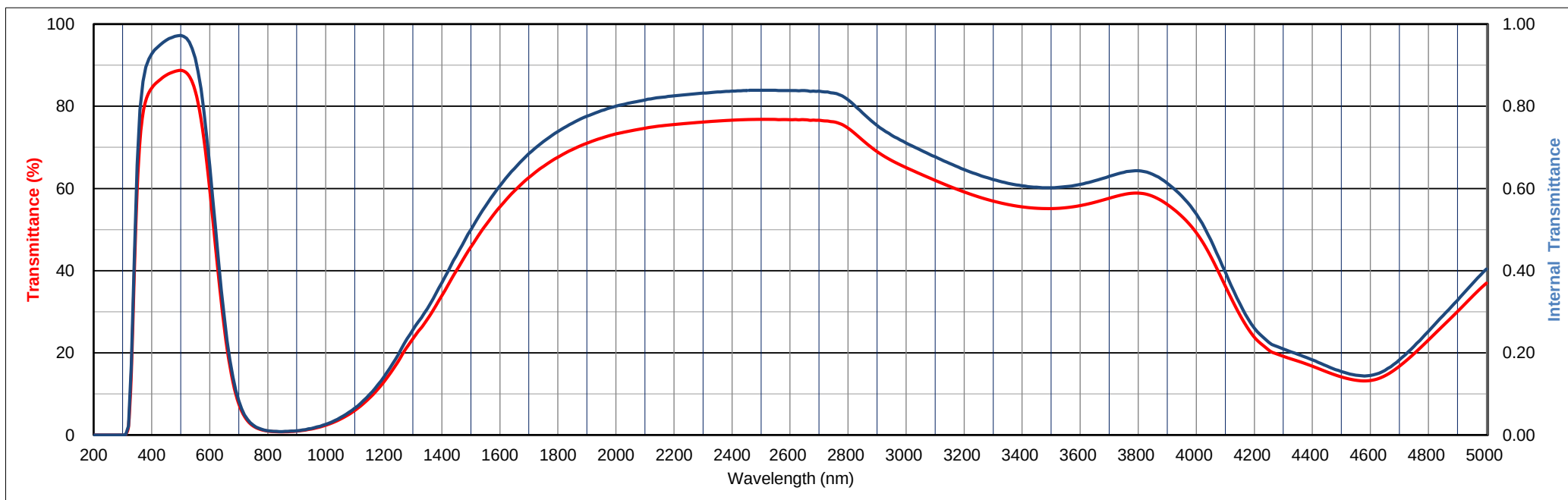
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α _{-30/70}	α _{100/300}	H _K	F _A	d
1	4	425	471	117	141	370	490	3.08

Tolerance of Transmittance (T)

Transmittance at 400nm	Transmittance at 500nm	Transmittance at 600nm
T400(%)	T500(%)	T600(%)
≥83	≥87	≥57



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	2E-06	5E-05	2E-03	6E-02	1.97	15.29	39.20	59.72	71.92	78.24	81.45	83.27
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	84.42	85.31	85.95	86.53	87.11	87.56	87.96	88.24	88.49	88.67	88.75	88.58	88.13	87.26	85.86	83.75	80.78	76.87	72.03	66.29
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	59.82	52.96	45.83	38.92	32.32	26.27	20.92	16.66	12.90	9.92	7.61	5.84	4.50	3.49	2.74	2.18	1.78	1.47	1.24	1.08
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	0.96	0.87	0.83	0.79	0.77	0.76	0.79	0.80	0.85	0.88	0.96	1.02	1.12	1.20	1.35	1.45	1.61	1.78	1.95	2.16
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	2.38	2.63	2.89	3.19	3.50	3.85	4.22	4.62	5.03	5.49	5.98	6.51	7.06	7.66	8.30	8.96	9.65	10.40	11.20	12.02
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	12.90	13.84	14.80	15.82	16.87	17.94	19.15	20.36	21.39	22.40	23.40	24.39	25.36	26.16	27.14	28.17	29.21	30.36	31.53	32.75
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	33.91	35.08	36.33	37.58	38.82	39.99	41.13	42.34	43.52	44.67	45.75	46.80	47.90	48.96	50.00	50.96	51.89	52.85	53.78	54.68
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	55.51	56.31	57.13	57.93	58.70	59.39	60.08	60.77	61.44	62.08	62.66	63.22	63.81	64.36	64.89	65.35	65.85	66.32	66.78	67.23
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	67.60	68.01	68.41	68.79	69.16	69.48	69.81	70.14	70.45	70.75	71.01	71.28	71.55	71.80	72.04	72.25	72.48	72.70	72.91	73.10
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	73.28	74.01	74.66	75.20	75.56	75.88	76.17	76.41	76.62	76.76	76.82	76.81	76.74	76.74	76.61	76.22	74.68	71.76	68.97	66.81
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	65.08	63.51	61.97	60.51	59.16	57.95	56.93	56.11	55.52	55.19	55.10	55.32	55.83	56.63	57.62	58.53	58.87	58.10	56.11	53.23
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	49.24	43.45	36.26	29.26	23.80	20.66	19.15	17.99	16.75	15.36	14.14	13.33	13.26	14.41	16.74	19.75	23.12	26.57	30.03	33.61
λnm	5000																			
T	36.96																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	0.00	3.43E-03	0.79	10.68	34.15	56.71	70.74	77.85	81.44	83.47
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	84.75	85.46	86.16	86.65	87.33	87.73	88.10	88.21	88.58	88.71	88.70	88.35	87.57	86.28	84.25	81.19	77.10	71.83	65.55	58.33
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	50.55	42.72	34.99	27.93	21.64	16.33	11.98	8.78	6.21	4.35	3.06	2.14	1.52	1.08	0.78	0.58	0.44	0.35	0.28	0.24
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	0.20	0.18	0.17	0.16	0.15	0.15	0.16	0.16	0.18	0.19	0.21	0.23	0.26	0.30	0.33	0.38	0.43	0.49	0.56	0.64
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	0.73	0.83	0.94	1.07	1.22	1.38	1.56	1.76	1.97	2.21	2.49	3.11	3.84	4.70	5.73	6.93				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.554	1.544	1.539	1.536	1.534	1.533	1.532
P	0.910	0.913	0.914	0.915	0.915	0.915	0.915

Classes of Bubbles and Inclusions

Bubble Class
0

Color Specification

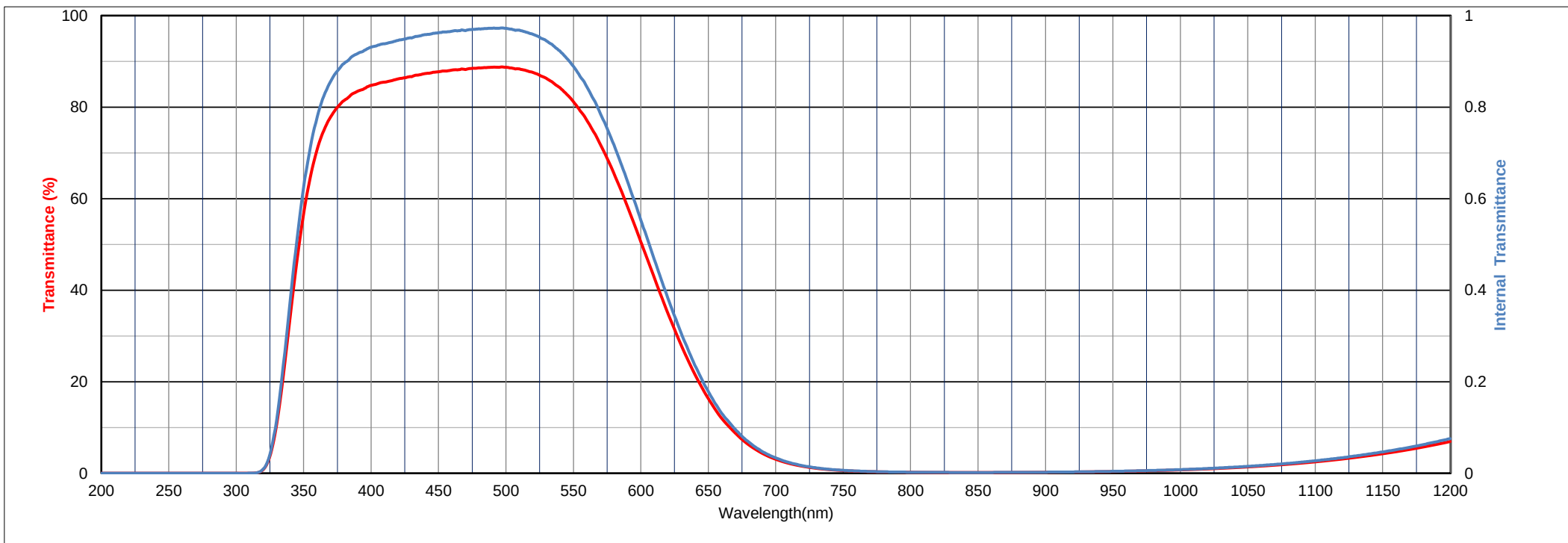
	x	y	Y	λ _d	P _e
A	0.364	0.429	65	499	19
C	0.252	0.305	71	489	22
D65	0.254	0.320	72	490	22

Properties

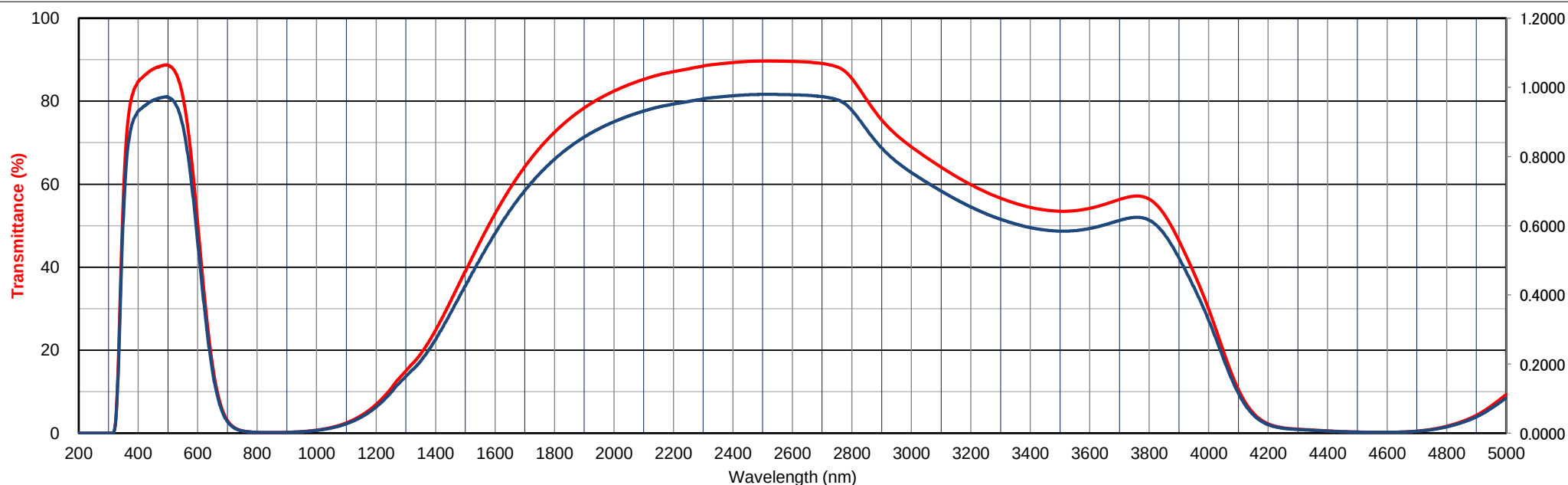
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α _{-30/70}	α _{100/300}	H _k	F _A	d
1	4	429	474	118	141	375	490	3.07

Tolerance of Transmittance (T)

Transmittance at 400nm	Transmittance at 500nm	Transmittance at 700nm
T400(%)	T500(%)	T700(%)
≥82	≥86	≤6



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	0.00	3.4E-03	0.79	10.68	34.15	56.71	70.74	77.85	81.44	83.47
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	84.75	85.46	86.16	86.65	87.33	87.73	88.10	88.21	88.58	88.71	88.70	88.35	87.57	86.28	84.25	81.19	77.10	71.83	65.55	58.33
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	50.55	42.72	34.99	27.93	21.64	16.33	11.98	8.78	6.21	4.35	3.06	2.14	1.52	1.08	0.78	0.58	0.44	0.35	0.28	0.24
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	0.20	0.18	0.17	0.16	0.15	0.15	0.16	0.16	0.18	0.19	0.21	0.23	0.26	0.30	0.33	0.38	0.43	0.49	0.56	0.64
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	0.73	0.83	0.94	1.07	1.22	1.38	1.56	1.76	1.97	2.21	2.49	2.78	3.11	3.46	3.84	4.26	4.70	5.19	5.73	6.30
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	6.93	7.59	8.31	9.08	9.87	10.73	11.70	12.65	13.41	14.19	15.00	15.82	16.57	17.34	18.20	19.06	20.09	21.20	22.36	23.61
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	24.76	26.09	27.49	28.91	30.35	31.67	33.16	34.66	36.16	37.67	38.94	40.35	41.85	43.32	44.79	46.16	47.52	48.90	50.30	51.62
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	52.89	54.12	55.38	56.61	57.83	58.93	60.02	61.12	62.21	63.25	64.21	65.14	66.09	67.01	67.90	68.68	69.52	70.31	71.09	71.82
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	72.48	73.18	73.87	74.53	75.15	75.70	76.29	76.85	77.40	77.93	78.37	78.87	79.33	79.79	80.21	80.58	81.01	81.37	81.77	82.08
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	82.45	83.98	85.27	86.32	87.12	87.80	88.45	88.97	89.32	89.57	89.68	89.66	89.58	89.44	89.10	88.29	85.47	80.34	75.51	71.87
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	68.99	66.49	64.11	61.89	59.90	58.12	56.62	55.39	54.41	53.78	53.48	53.61	54.18	55.15	56.32	57.12	56.39	52.78	46.39	38.68
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	29.88	19.68	10.52	4.86	2.26	1.29	0.96	0.75	0.55	0.39	0.28	0.22	0.21	0.29	0.50	0.92	1.66	2.76	4.31	6.55
λnm	5000																			
T	9.30																			



Neutral Density Filters

Neutral density filters feature almost even spectral transmittance in the visible region, and are classified by the average transmittance within the wavelengths from 400 nm through 700 nm. For example, ND50 indicates that the average transmittance is 50%.

Neutral density filters can be used for various purposes including adjustment of light amount because the light intensity can be controlled without selectively absorbing light with a specific wavelength.

The relationships between general name in the product market/what we call and darkening performance are shown as follows:

Amount of	Transmittance	OD value	Our filter name	General name
1/2	50.0	0.3	ND50	ND2
1/4	25.0	0.6	ND25	ND4
1/8	12.5	0.9	ND13	ND8
1/16	6.3	1.2	Made-to-order products	ND16
1/32	3.1	1.5	ND3	ND32
1/64	1.6	1.8	Made-to-order products	ND64
1/100	1.0	2.0	ND1	ND100
(1/128)	0.8	2.1		
1/200	0.5	2.3	ND0.3	ND200
(1/256)	0.4	2.4		
1/500	0.3	2.6		ND500
(1/512)	0.2	2.7		
1/1000	0.1	2.9	ND0.1	ND1000
(1/1024)	0.1	3.0		

Note: In the product market, 1/2 may be called ND2 according to the darkening characteristics of the light amount. We call our product with 50% of transmittance level ND50.

This product can achieve high transmittance by changing the thickness if the transmittance characteristics are regarded as important.

Internal Transmittance (τ)

λ nm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	0.001	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05				

Refractive Index/Absorption coefficient/Reflection coefficient

λ nm	400	500	600	700	800	900	1000
n	1.592	1.568	1.555	1.548	1.544	1.541	1.539
P	0.901	0.907	0.910	0.912	0.913	0.913	0.914

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

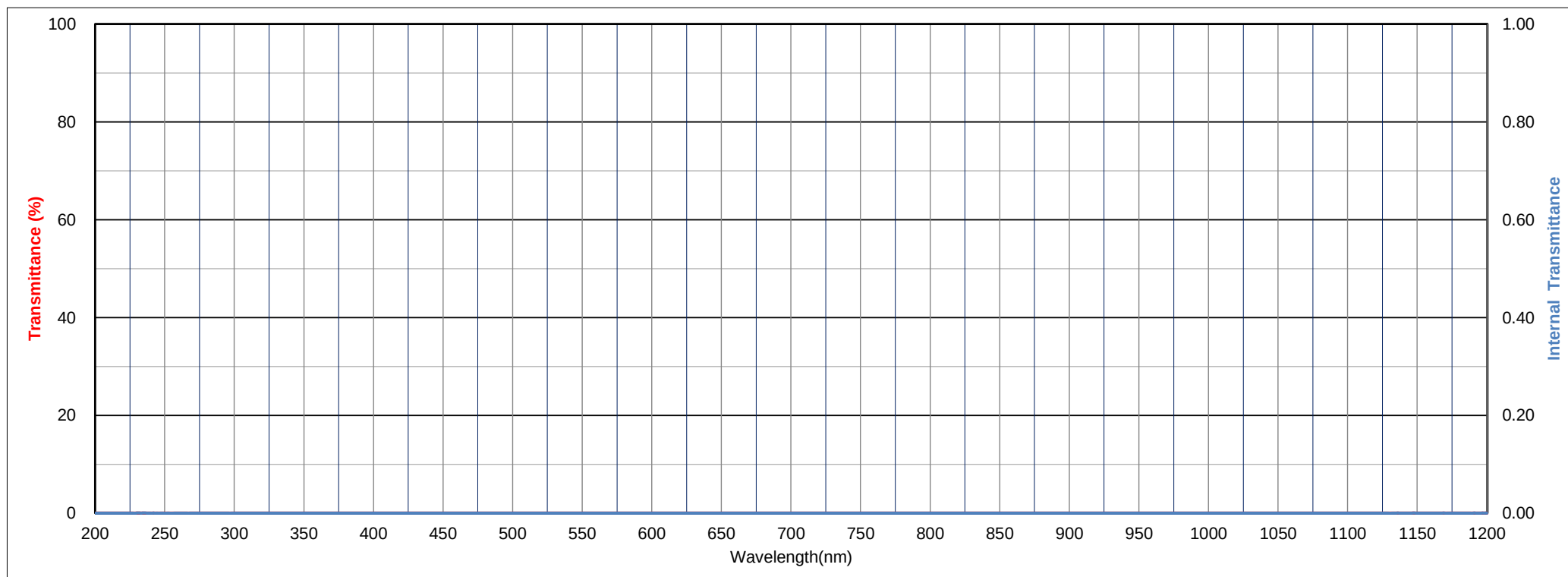
	x	y	Y	λ_d	P _s
A	-	-	-	-	-
C	-	-	-	-	-
D65	-	-	-	-	-

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
2	1	542	622	-	76	-	-	2.47

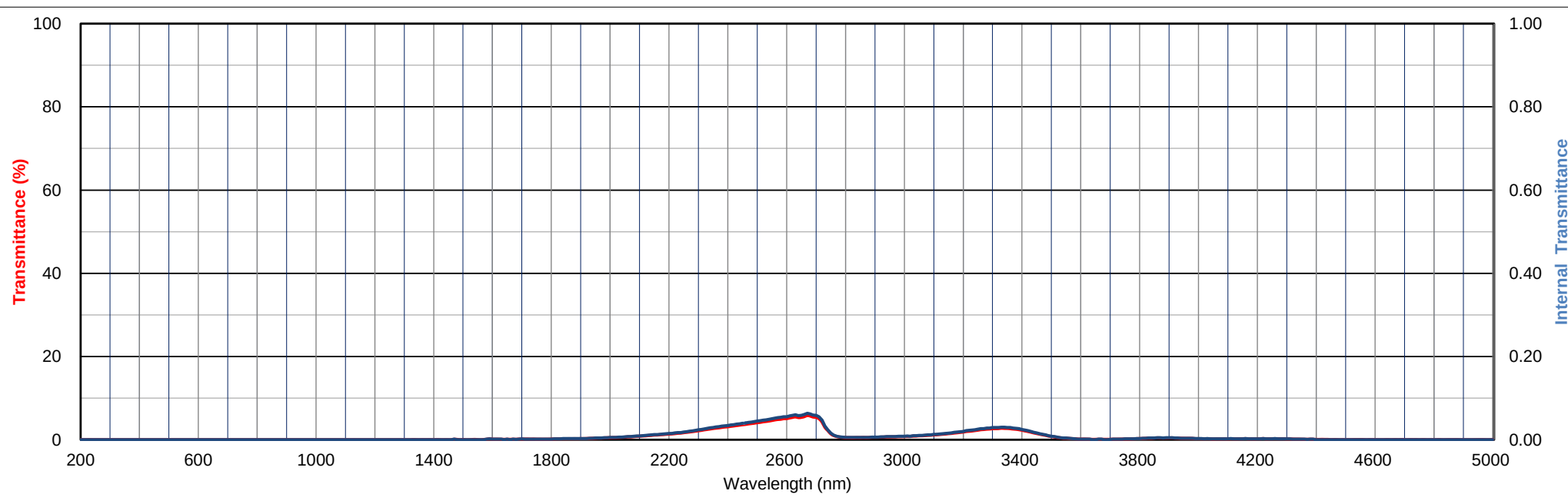
Tolerance of Transmittance (T)

Average Transmittance at 400nm-700nm	
Tav(%)	OD
<0.01	>4



Internal Transmittance (τ)

λ nm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	0.001	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λ nm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.001	0.001	<1E-05	0.001	0.001	0.001
λ nm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	<1E-05	0.001	0.001	<1E-05	0.001	<1E-05	<1E-05	0.001	0.001	<1E-05	0.001	<1E-05	0.001	0.001	0.001	0.001	<1E-05	0.001	0.001	0.002
λ nm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.001
λ nm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.004	0.004	0.004	0.004	0.005	0.005
λ nm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	0.005	0.007	0.009	0.012	0.015	0.019	0.024	0.029	0.034	0.039	0.045	0.051	0.055	0.059	0.059	0.016	0.005	0.005	0.006	0.007
λ nm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	0.008	0.010	0.013	0.016	0.020	0.025	0.029	0.030	0.025	0.016	0.008	0.004	0.002	0.001	0.001	0.002	0.003	0.004	0.005	0.004
λ nm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.001	0.001	0.001	<1E-05	0.001	0.001	0.001	0.001	<1E-05	<1E-05	0.001	<1E-05	0.001
λ nm	5000																			
τ	0.001																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.14	0.23	1.00
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	1.99	2.37	2.56	2.90	3.00	3.45	4.08	4.33	4.29	4.21	4.19	4.22	4.25	4.32	4.53	4.85	5.16	5.22	5.00	4.71
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	4.72	4.97	5.31	5.56	5.73	5.91	6.24	6.76	7.68	8.84	10.01	10.96	11.61	11.97	12.14	12.19	12.14	12.05	11.93	11.79
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	11.67	11.56	11.44	11.34	11.26	11.17	11.08	11.01	10.91	10.81	10.71	10.61	10.49	10.36	10.23	10.10	9.96	9.83	9.69	9.56
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	9.43	9.30	9.18	9.07	8.96	8.86	8.77	8.69	8.61	8.54	8.49	8.41	8.37	8.38	8.45	8.58				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.558	1.540	1.531	1.526	1.522	1.520	1.518
P	0.909	0.913	0.916	0.917	0.918	0.918	0.919

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

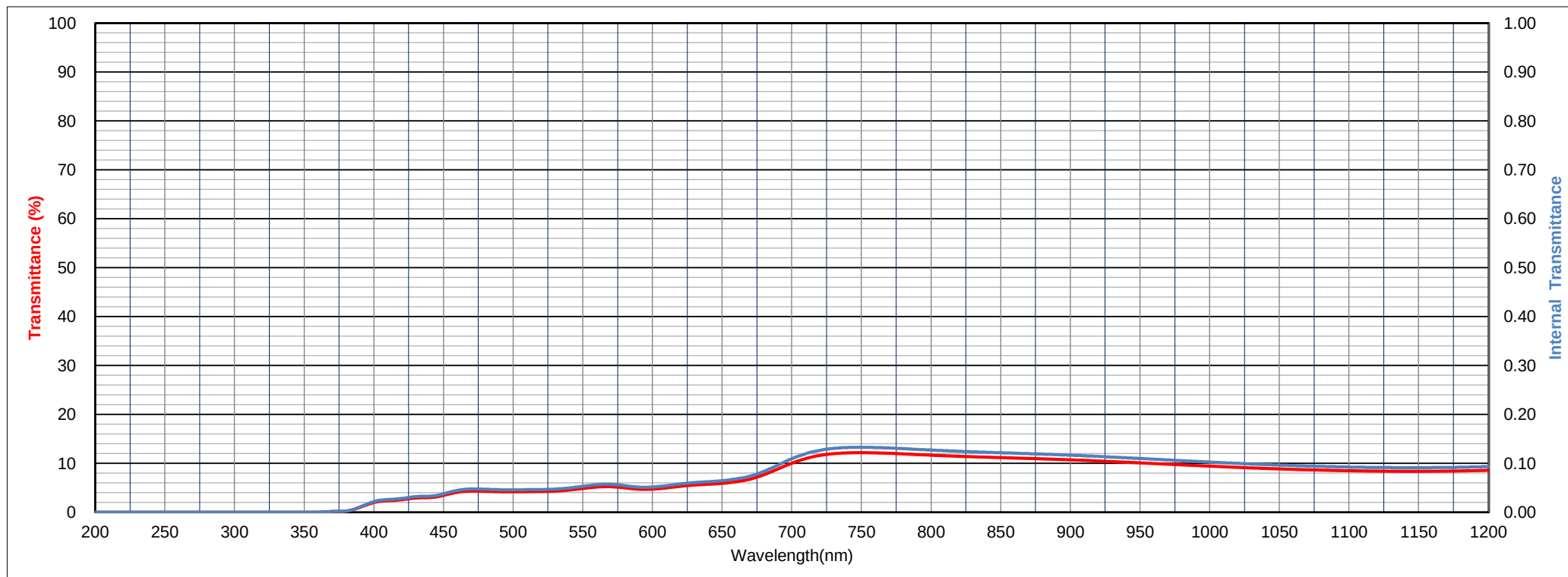
	x	y	Y	λ _d	P _e
A	0.474	0.414	5	588	23
C	0.342	0.348	5	578	17
D65	0.344	0.359	5	577	17

Properties

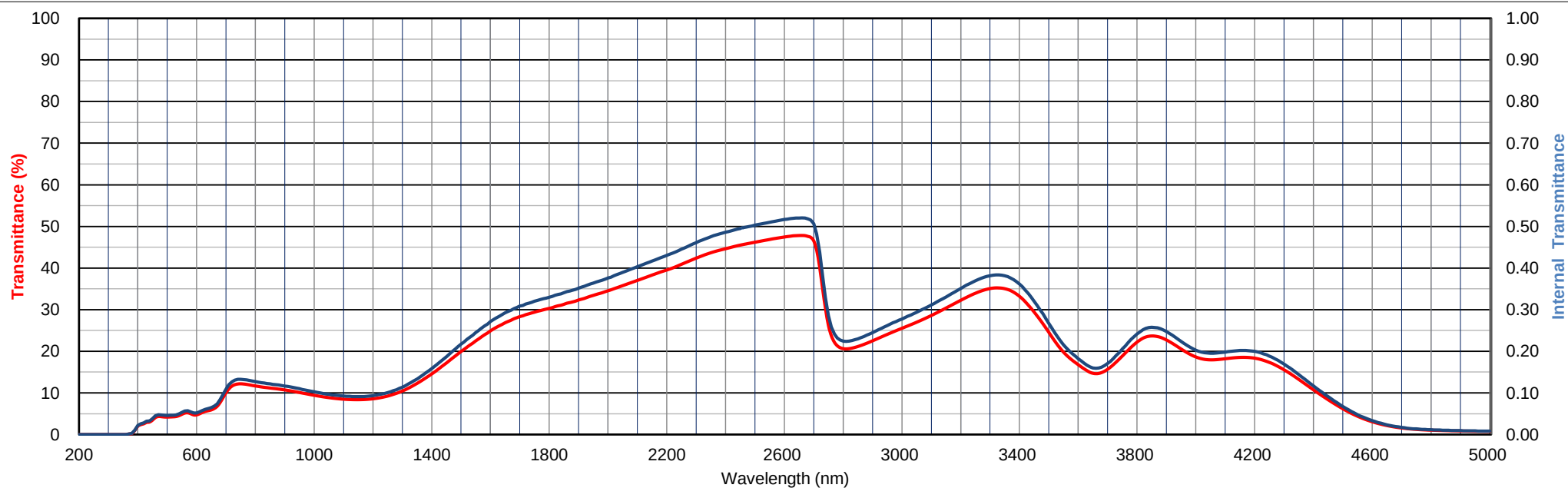
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
2	1	542	622	-	76	-	-	2.47

Tolerance of Transmittance (T)

Average Transmittance at 400nm-700nm	
Tav(%)	OD
4.9±2	1.3±0.2



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	1.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	2.0	2.4	2.6	2.9	3.0	3.4	4.1	4.3	4.3	4.2	4.2	4.2	4.3	4.3	4.5	4.9	5.2	5.2	5.0	4.7
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	4.7	5.0	5.3	5.6	5.7	5.9	6.2	6.8	7.7	8.8	10.0	11.0	11.6	12.0	12.1	12.2	12.1	12.1	11.9	11.8
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	11.7	11.6	11.4	11.3	11.3	11.2	11.1	11.0	10.9	10.8	10.7	10.6	10.5	10.4	10.2	10.1	10.0	9.8	9.7	9.6
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	9.4	9.3	9.2	9.1	9.0	8.9	8.8	8.7	8.6	8.5	8.5	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.5	8.5
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	8.6	8.7	8.8	8.9	9.1	9.2	9.4	9.7	9.9	10.2	10.4	10.8	11.1	11.5	11.9	12.3	12.7	13.1	13.6	14.1
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	14.5	15.0	15.6	16.1	16.7	17.2	17.7	18.3	18.9	19.4	20.0	20.4	21.0	21.5	22.0	22.5	23.0	23.5	24.0	24.4
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	24.9	25.4	25.7	26.1	26.5	26.9	27.2	27.5	27.8	28.1	28.3	28.5	28.8	29.0	29.2	29.4	29.6	29.8	30.0	30.1
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	30.3	30.5	30.7	30.9	31.1	31.3	31.5	31.7	31.9	32.1	32.3	32.5	32.7	33.0	33.2	33.4	33.7	33.9	34.1	34.3
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	34.5	35.8	37.0	38.3	39.5	40.9	42.4	43.7	44.6	45.5	46.2	46.9	47.5	47.8	46.5	26.2	20.6	21.1	22.5	24.1
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	25.5	27.0	28.6	30.4	32.2	33.9	35.1	35.0	33.2	29.4	24.5	19.8	16.8	14.7	15.7	18.9	22.2	23.7	22.7	20.6
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	18.6	17.9	18.2	18.5	18.4	17.3	15.6	13.3	10.8	8.4	6.2	4.4	3.1	2.2	1.6	1.2	1.0	0.9	0.9	0.8
λnm	5000																			
τ	0.8																			



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	0.001	<1E-05	0.001	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.003	0.004	0.006	0.009	0.011	0.012	0.014	0.015	0.017	0.018	0.019	0.020
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.021	0.021	0.022	0.022	0.022	0.023	0.023	0.023	0.024	0.022	0.023	0.024	0.022	0.023	0.022	0.022	0.021	0.021	0.020	0.021
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
τ	0.020	0.020	0.020	0.019	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.021	0.022	0.023	0.024	0.026				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.534	1.520	1.513	1.509	1.506	1.504	1.503
P	0.915	0.918	0.920	0.921	0.922	0.922	0.922

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

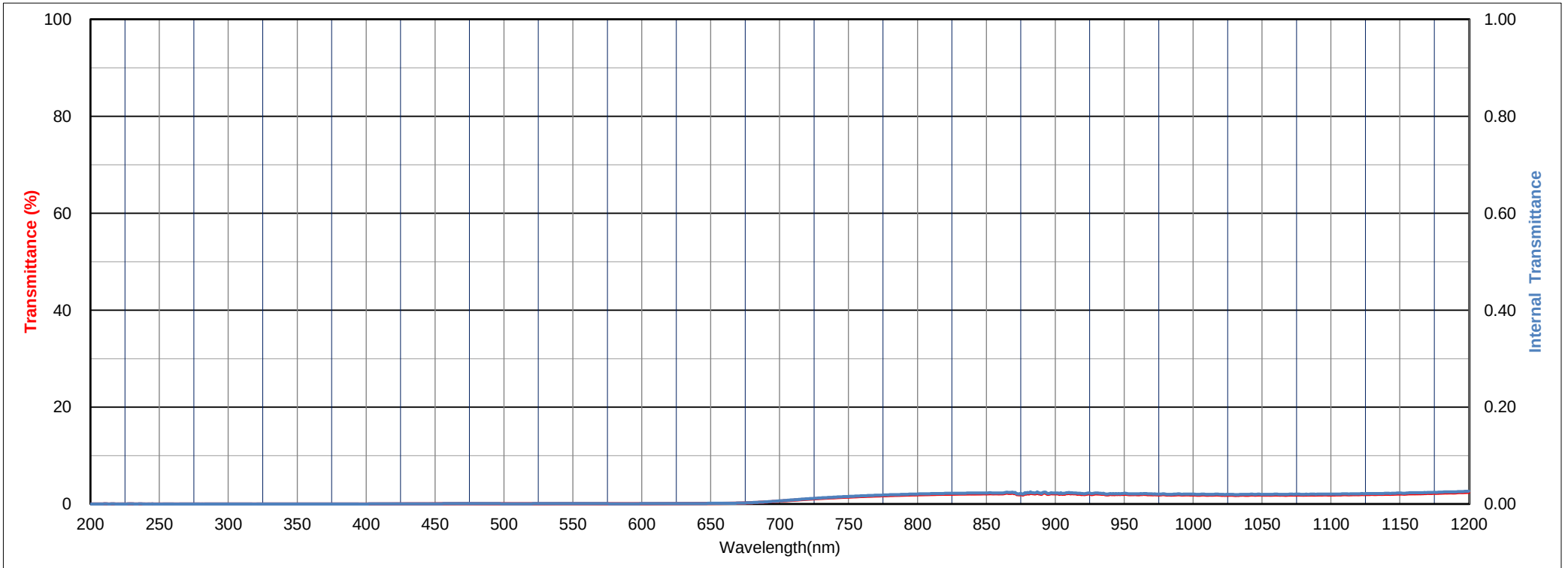
	x	y	Y	λ _d	P _s
A	-	-	-	-	-
C	-	-	-	-	-
D65	-	-	-	-	-

Properties

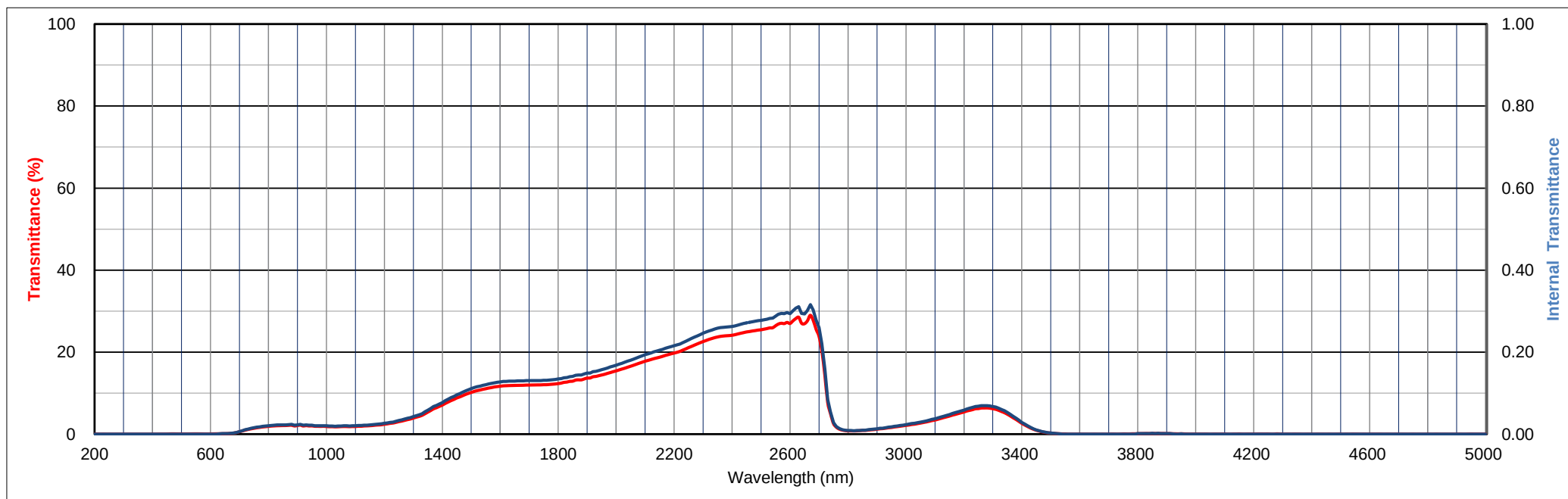
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	3	490	565	-	65	530	100	2.41

Tolerance of Transmittance (T)

Average Transmittance at 400nm-700nm	
Tav(%)	OD
0.1±0.05	3 ±0.3



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	0.001	<1E-05	0.001	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	<1E-05	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.003	0.004	0.006	0.009	0.011	0.012	0.014	0.015	0.017	0.018	0.019	0.020
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.021	0.021	0.022	0.022	0.022	0.023	0.023	0.023	0.024	0.022	0.023	0.024	0.022	0.023	0.022	0.022	0.021	0.021	0.020	0.021
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	0.020	0.020	0.020	0.019	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.021	0.021	0.022	0.022	0.022	0.023	0.024	0.024	0.025
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	0.026	0.027	0.029	0.030	0.031	0.033	0.035	0.037	0.039	0.040	0.043	0.045	0.047	0.050	0.054	0.058	0.063	0.067	0.070	0.074
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	0.077	0.081	0.085	0.089	0.092	0.096	0.099	0.102	0.105	0.108	0.111	0.113	0.116	0.117	0.119	0.121	0.122	0.124	0.125	0.126
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	0.127	0.128	0.129	0.129	0.129	0.129	0.130	0.130	0.130	0.130	0.130	0.131	0.131	0.131	0.131	0.131	0.131	0.132	0.133	0.133
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	0.134	0.136	0.138	0.138	0.140	0.141	0.144	0.144	0.144	0.147	0.149	0.149	0.152	0.153	0.155	0.157	0.159	0.161	0.164	0.166
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	0.168	0.180	0.194	0.204	0.215	0.230	0.246	0.258	0.263	0.272	0.277	0.288	0.294	0.293	0.260	0.028	0.009	0.010	0.013	0.018
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	0.023	0.029	0.037	0.048	0.059	0.068	0.067	0.053	0.029	0.010	0.003	0.001	0.001	0.001	<1E-05	0.001	0.001	0.002	0.001	0.001
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	0.001	<1E-05	0.001	0.001	0.001	0.001	0.001	0.001	<1E-05	<1E-05	0.001	0.001	<1E-05	<1E-05	<1E-05	0.001	0.001	<1E-05	<1E-05	0.001
λnm	5000																			
τ	0.001																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.05	0.08	0.11	0.14	0.14	0.19	0.25	0.26	0.24	0.21	0.20	0.20	0.20	0.22	0.23	0.24	0.23	0.20	0.18	0.18
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.19	0.22	0.25	0.27	0.29	0.32	0.37	0.46	0.64	0.94	1.30	1.69	2.04	2.33	2.57	2.77	2.94	3.09	3.21	3.31
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	3.40	3.48	3.54	3.58	3.61	3.62	3.62	3.60	3.58	3.54	3.50	3.46	3.41	3.35	3.31	3.26	3.21	3.17	3.13	3.09
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	3.06	3.02	3.00	2.98	2.96	2.95	2.94	2.95	2.95	2.96	2.98	3.03	3.12	3.24	3.40	3.60				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.531	1.520	1.514	1.511	1.508	1.507	1.506
P	0.916	0.918	0.920	0.921	0.921	0.921	0.922

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

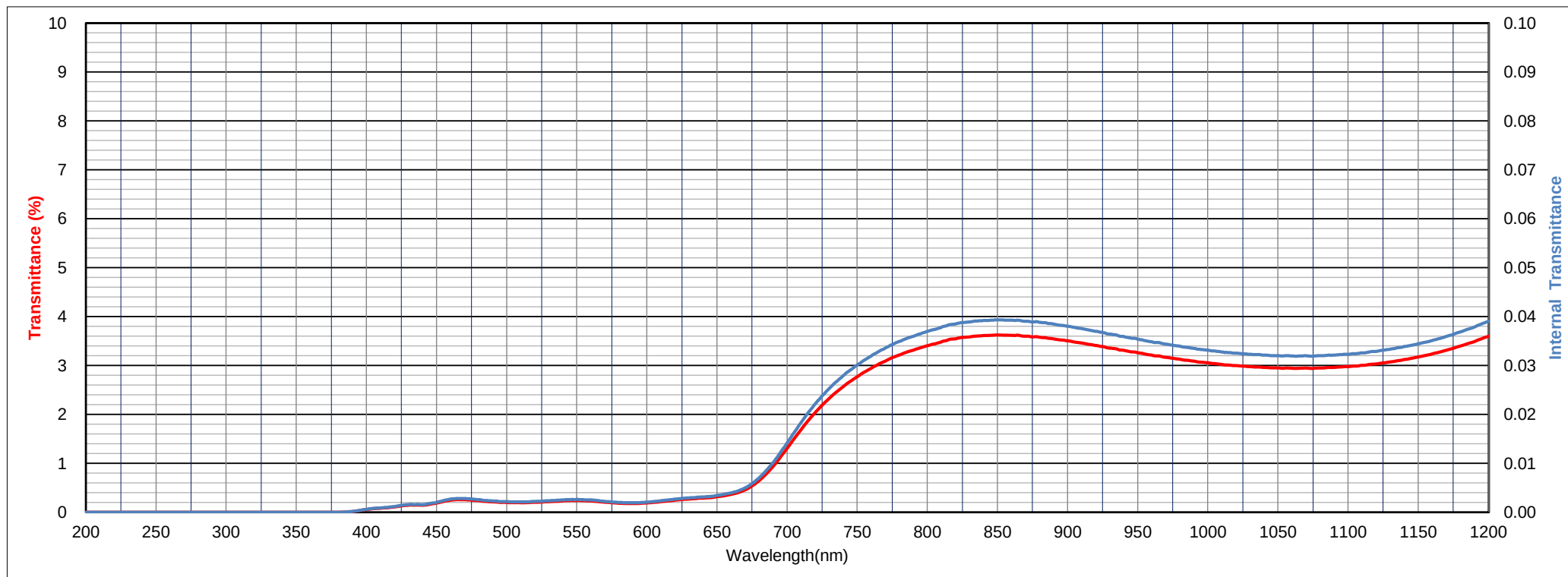
	x	y	Y	λ _d	P _e
A	-	-	-	-	-
C	-	-	-	-	-
D65	-	-	-	-	-

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	3	490	565	-	65	530	100	2.41

Tolerance of Transmittance (T)

Average Transmittance at 400nm-700nm	
Tav(%)	OD
0.3±0.05	2.5±0.1





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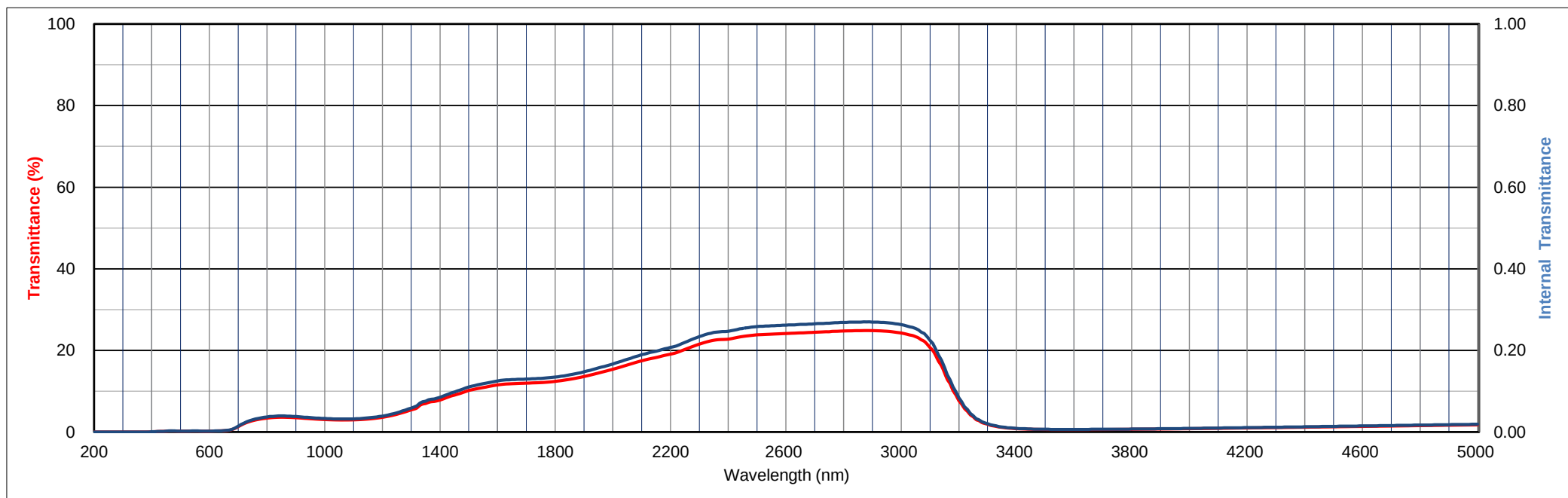
Transmittance (T)

units: %

Thickness (2.85) mm

ND0.3

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.5	0.6	0.9	1.3	1.7	2.0	2.3	2.6	2.8	2.9	3.1	3.2	3.3
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	3.4	3.5	3.5	3.6	3.6	3.6	3.6	3.6	3.5	3.5	3.5	3.5	3.4	3.4	3.3	3.3	3.2	3.2	3.1	3.1
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	3.1	3.0	3.0	3.0	3.0	3.0	2.9	2.9	3.0	3.0	3.0	3.0	3.0	3.1	3.1	3.2	3.2	3.3	3.4	3.5
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	3.6	3.7	3.9	4.0	4.2	4.3	4.5	4.7	4.9	5.2	5.4	5.6	5.9	6.5	6.9	7.0	7.3	7.4	7.5	7.6
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	7.8	8.1	8.3	8.6	8.9	9.0	9.3	9.5	9.7	9.9	10.2	10.3	10.5	10.6	10.8	10.9	11.0	11.2	11.3	11.4
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	11.5	11.6	11.7	11.8	11.8	11.8	11.9	11.9	11.9	11.9	12.0	12.0	12.0	12.1	12.1	12.1	12.2	12.2	12.3	12.3
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	12.4	12.5	12.6	12.7	12.8	12.9	13.0	13.2	13.3	13.4	13.6	13.8	13.9	14.1	14.3	14.5	14.6	14.8	15.0	15.2
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	15.4	16.4	17.5	18.3	19.1	20.2	21.5	22.5	22.8	23.4	23.8	24.0	24.1	24.3	24.4	24.6	24.8	24.8	24.9	24.7
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	24.3	23.4	20.7	14.6	7.7	3.7	1.9	1.1	0.8	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.8
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	0.8	0.9	0.9	0.9	1.0	1.0	1.1	1.1	1.2	1.2	1.3	1.3	1.4	1.4	1.5	1.5	1.6	1.6	1.7	1.7
λnm	5000																			
τ	1.8																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.3	0.4	0.5	0.6	0.6	0.7	0.9	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.8	0.7	0.7
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.7	0.8	0.9	1.0	1.0	1.1	1.2	1.5	1.9	2.6	3.3	4.1	4.7	5.2	5.7	6.0	6.3	6.5	6.7	6.9
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	7.1	7.2	7.3	7.3	7.4	7.4	7.4	7.4	7.3	7.3	7.2	7.1	7.1	7.0	6.9	6.8	6.7	6.7	6.6	6.5
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	6.5	6.4	6.4	6.4	6.3	6.3	6.3	6.3	6.3	6.3	6.4	6.4	6.6	6.8	7.0	7.4				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.532	1.520	1.514	1.510	1.508	1.506	1.505
P	0.915	0.918	0.920	0.921	0.921	0.922	0.922

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

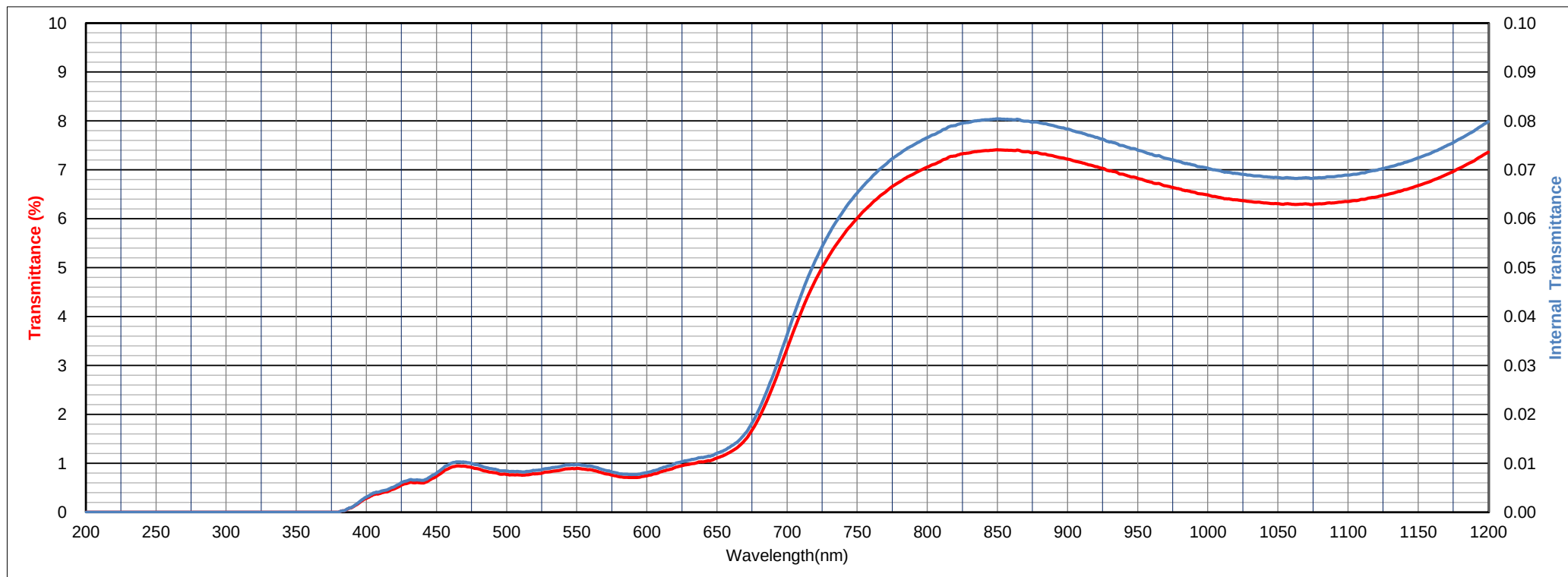
	x	y	Y	λ _d	P _e
A	-	-	-	-	-
C	-	-	-	-	-
D65	-	-	-	-	-

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	3	490	565	-	65	530	100	2.41

Tolerance of Transmittance (T)

Average Transmittance at 400nm-700nm	
Tav(%)	OD
1±0.5	2 ±0.3





HOYA CORPORATION OPTICS SECTION

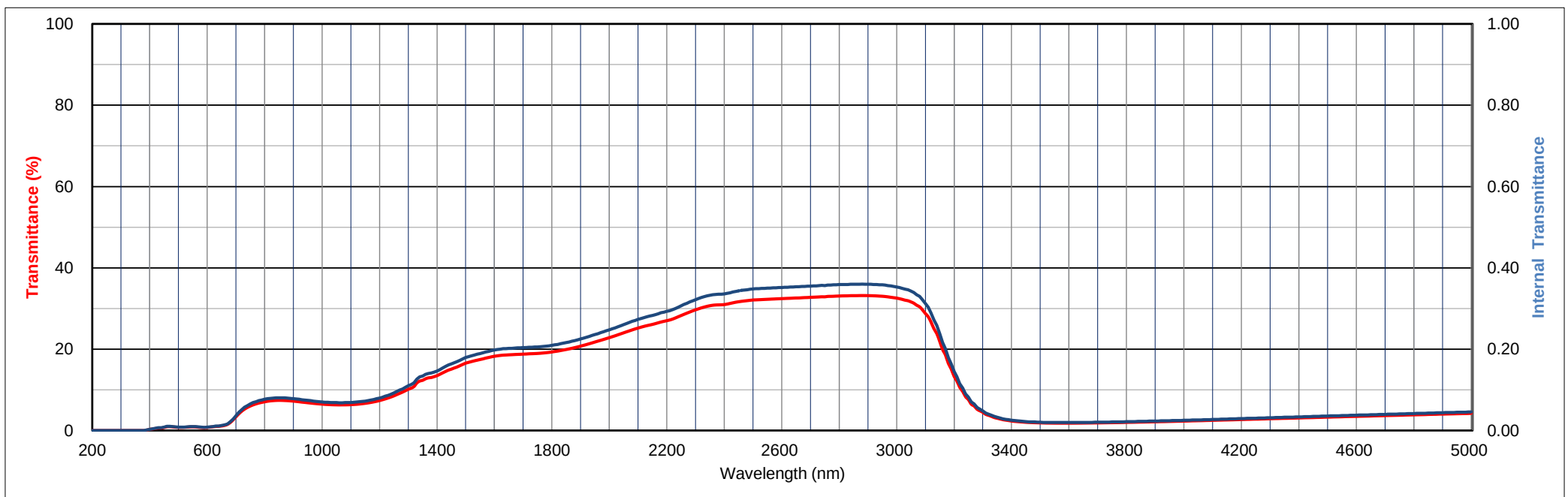
Transmittance (T)

units: %

Thickness (2.22) mm

ND1

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	0.3	0.4	0.5	0.6	0.6	0.7	0.9	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.8	0.7	0.7
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.7	0.8	0.9	1.0	1.0	1.1	1.2	1.5	1.9	2.6	3.3	4.1	4.7	5.2	5.7	6.0	6.3	6.5	6.7	6.9
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	7.1	7.2	7.3	7.3	7.4	7.4	7.4	7.4	7.3	7.3	7.2	7.1	7.1	7.0	6.9	6.8	6.7	6.7	6.6	6.5
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	6.5	6.4	6.4	6.4	6.3	6.3	6.3	6.3	6.3	6.3	6.4	6.4	6.4	6.5	6.6	6.7	6.8	6.9	7.0	7.2
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	7.4	7.6	7.8	8.0	8.2	8.5	8.8	9.1	9.4	9.8	10.1	10.4	10.8	11.7	12.2	12.3	12.7	12.9	13.0	13.2
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	13.5	13.8	14.2	14.5	14.9	15.1	15.4	15.6	15.9	16.3	16.6	16.8	16.9	17.1	17.3	17.5	17.6	17.8	18.0	18.1
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	18.3	18.4	18.5	18.5	18.6	18.6	18.6	18.7	18.7	18.7	18.8	18.8	18.9	18.9	18.9	19.0	19.0	19.1	19.1	19.2
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	19.3	19.4	19.5	19.7	19.8	19.9	20.1	20.2	20.4	20.6	20.7	20.9	21.1	21.3	21.5	21.8	22.0	22.2	22.4	22.6
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	22.8	24.0	25.2	26.1	27.0	28.3	29.7	30.7	31.0	31.7	32.1	32.3	32.4	32.6	32.8	32.9	33.1	33.2	33.2	33.0
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	32.6	31.6	28.8	21.9	13.3	7.6	4.5	3.0	2.3	2.0	1.9	1.8	1.8	1.8	1.9	1.9	2.0	2.1	2.1	2.2
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.7	3.8	3.9	4.0	4.1
λnm	5000																			
τ	4.2																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	1.2	1.6	1.8	2.2	2.2	2.5	3.0	3.0	2.9	2.7	2.6	2.6	2.7	2.8	2.9	2.9	2.9	2.7	2.5	2.5
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	2.6	2.8	3.0	3.1	3.3	3.4	3.7	4.3	5.2	6.5	7.8	9.1	10.1	10.9	11.6	12.1	12.5	12.9	13.2	13.4
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	13.6	13.8	14.0	14.1	14.1	14.2	14.1	14.1	14.1	14.0	13.9	13.8	13.7	13.5	13.4	13.3	13.2	13.1	13.0	12.9
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	12.8	12.7	12.7	12.6	12.6	12.5	12.5	12.5	12.5	12.6	12.6	12.7	13.0	13.2	13.6	14.1				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.533	1.522	1.516	1.513	1.511	1.509	1.508
P	0.915	0.918	0.919	0.920	0.921	0.921	0.921

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

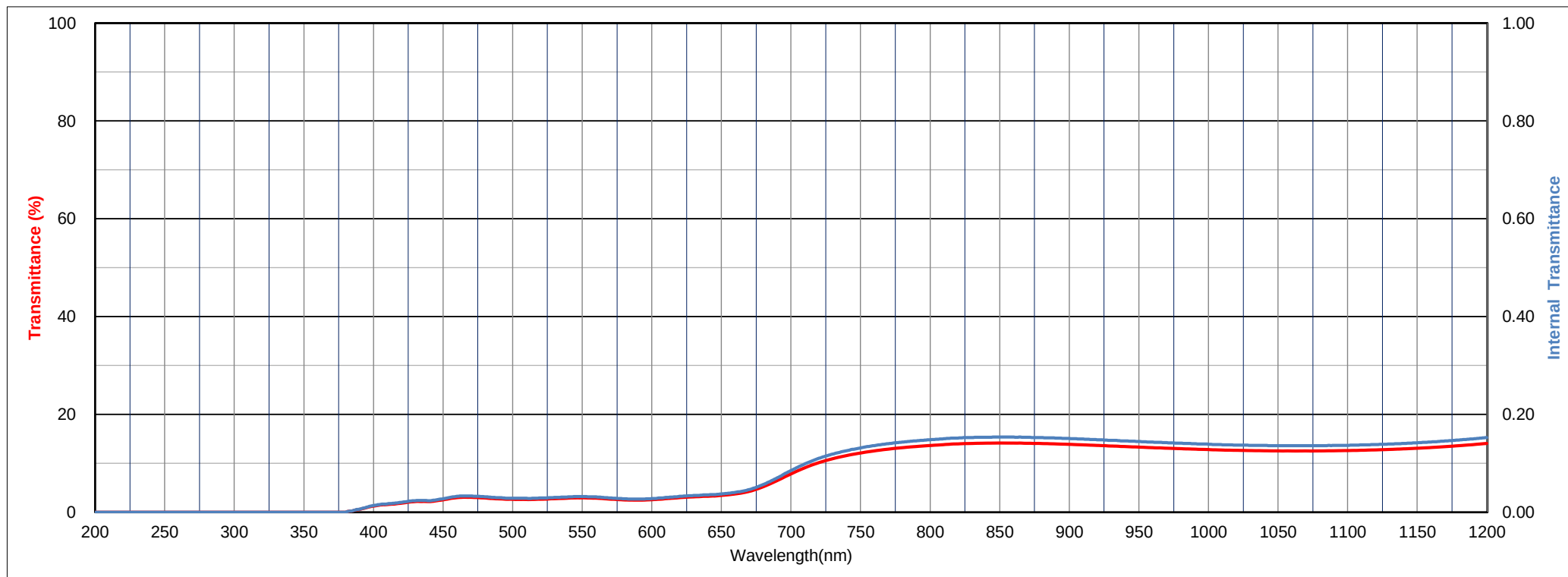
	x	y	Y	λ _d	P _e
A	0.460	0.405	3	600	7
C	0.319	0.325	3	578	5
D65	0.322	0.337	3	577	5

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	3	490	565	-	65	530	100	2.41

Tolerance of Transmittance (T)

Average Transmittance at 400nm-700nm	
Tav(%)	OD
3±0.5	1.5 ±0.1





HOYA CORPORATION OPTICS SECTION

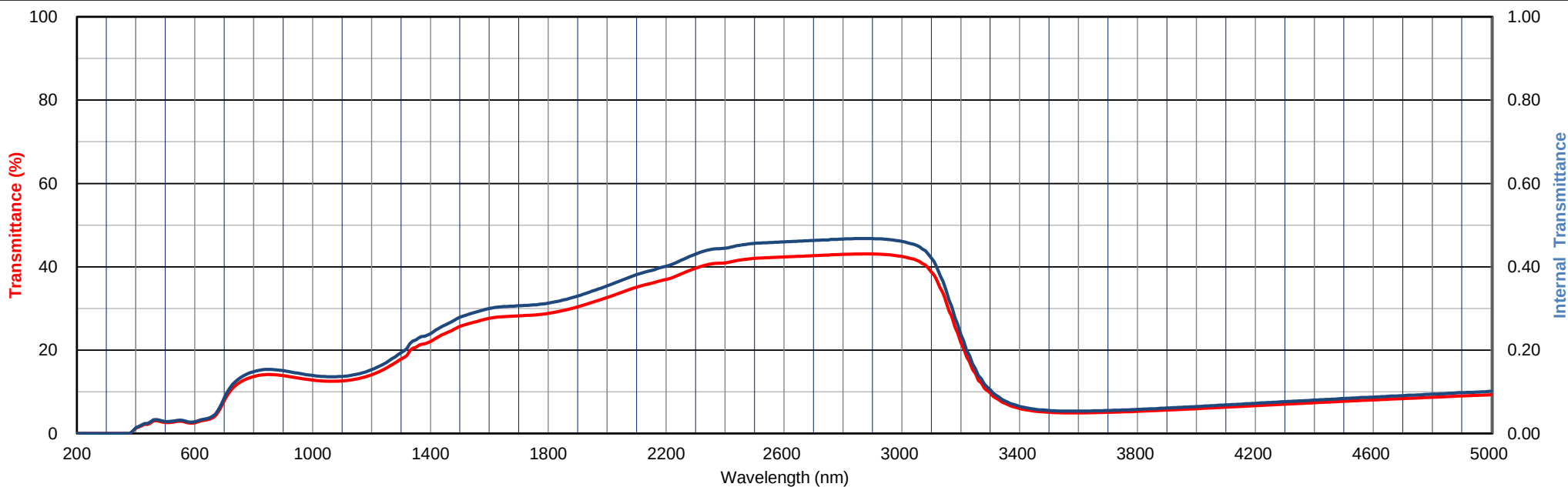
Transmittance (T)

units: %

Thickness (1.65) mm

ND3

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	1.2	1.6	1.8	2.2	2.2	2.5	3.0	3.0	2.9	2.7	2.6	2.6	2.7	2.8	2.9	2.9	2.9	2.7	2.5	2.5
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	2.6	2.8	3.0	3.1	3.3	3.4	3.7	4.3	5.2	6.5	7.8	9.1	10.1	10.9	11.6	12.1	12.5	12.9	13.2	13.4
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	13.6	13.8	14.0	14.1	14.1	14.2	14.1	14.1	14.1	14.0	13.9	13.8	13.7	13.5	13.4	13.3	13.2	13.1	13.0	12.9
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	12.8	12.7	12.7	12.6	12.6	12.5	12.5	12.5	12.5	12.6	12.6	12.7	12.7	12.8	13.0	13.1	13.2	13.4	13.6	13.8
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	14.1	14.3	14.6	15.0	15.3	15.7	16.1	16.5	16.9	17.4	17.8	18.2	18.7	19.8	20.4	20.7	21.1	21.4	21.5	21.8
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	22.1	22.5	22.9	23.3	23.7	24.0	24.3	24.6	25.0	25.4	25.7	25.9	26.2	26.4	26.5	26.7	26.9	27.1	27.3	27.5
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	27.6	27.8	27.9	27.9	28.0	28.0	28.1	28.1	28.2	28.2	28.2	28.3	28.3	28.3	28.4	28.4	28.5	28.5	28.6	28.7
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	28.8	28.9	29.1	29.2	29.3	29.5	29.7	29.8	30.0	30.2	30.4	30.6	30.8	31.0	31.3	31.5	31.7	31.9	32.2	32.4
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	32.6	33.9	35.1	36.0	37.0	38.3	39.7	40.7	40.9	41.6	42.0	42.2	42.4	42.5	42.7	42.8	43.0	43.1	43.1	42.9
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	42.5	41.6	38.8	31.7	21.9	14.4	9.7	7.2	6.0	5.4	5.1	4.9	4.9	5.0	5.1	5.2	5.3	5.5	5.6	5.8
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	5.9	6.1	6.3	6.5	6.7	6.8	7.0	7.2	7.4	7.5	7.7	7.9	8.0	8.2	8.4	8.5	8.7	8.9	9.0	9.1
λnm	5000																			
T	9.3																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	2.3	2.8	3.3	3.8	3.8	4.3	4.9	5.0	4.8	4.6	4.4	4.4	4.5	4.6	4.8	4.9	4.8	4.5	4.3	4.2
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	4.3	4.6	4.9	5.1	5.3	5.6	6.0	6.7	7.9	9.5	11.2	12.7	14.0	14.9	15.7	16.3	16.8	17.2	17.5	17.8
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	18.0	18.2	18.4	18.5	18.6	18.6	18.6	18.5	18.5	18.4	18.3	18.2	18.0	17.9	17.8	17.6	17.5	17.4	17.3	17.2
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	17.1	17.0	16.9	16.8	16.8	16.8	16.7	16.8	16.8	16.8	16.8	17.0	17.2	17.5	18.0	18.5				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.538	1.524	1.516	1.512	1.509	1.507	1.506
P	0.914	0.917	0.919	0.920	0.921	0.921	0.922

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

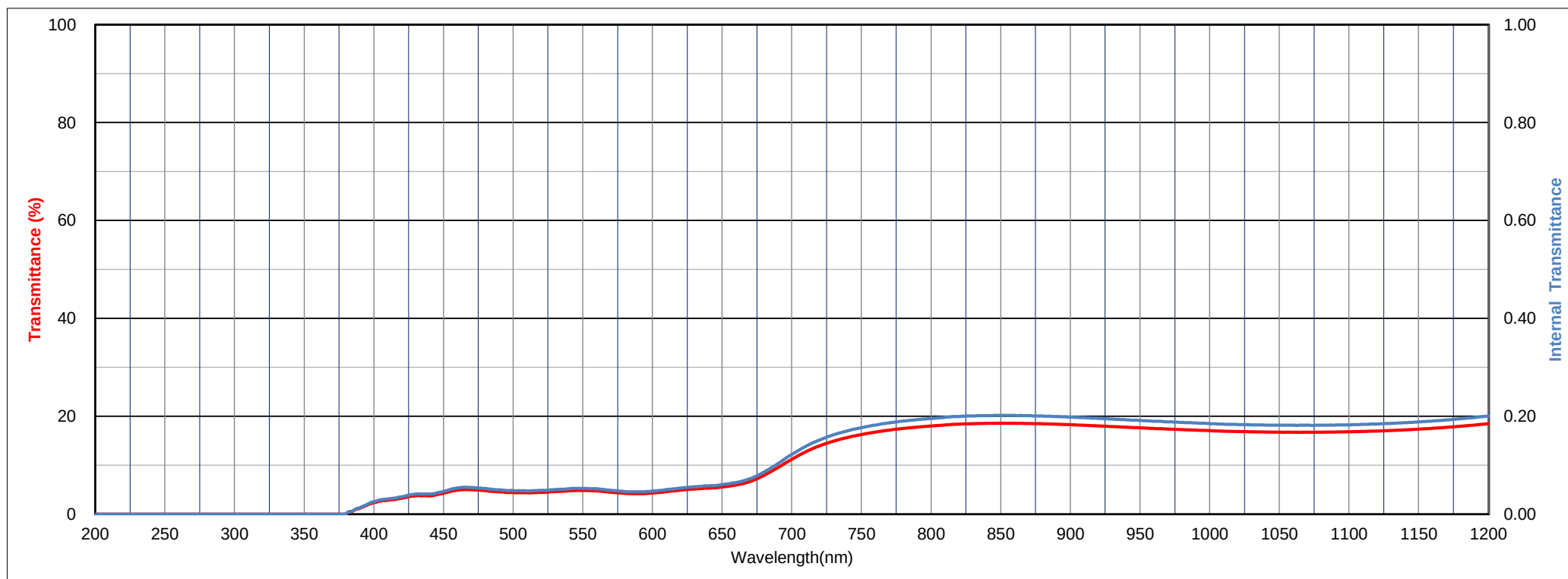
	x	y	Y	λ _d	P _e
A	0.458	0.406	5	599	6
C	0.318	0.324	5	577	4
D65	0.320	0.337	5	577	4

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	3	490	565	-	65	530	100	2.41

Tolerance of Transmittance (T)

Average Transmittance at 400nm-700nm	
Tav(%)	OD
5±1	1.3±0.1





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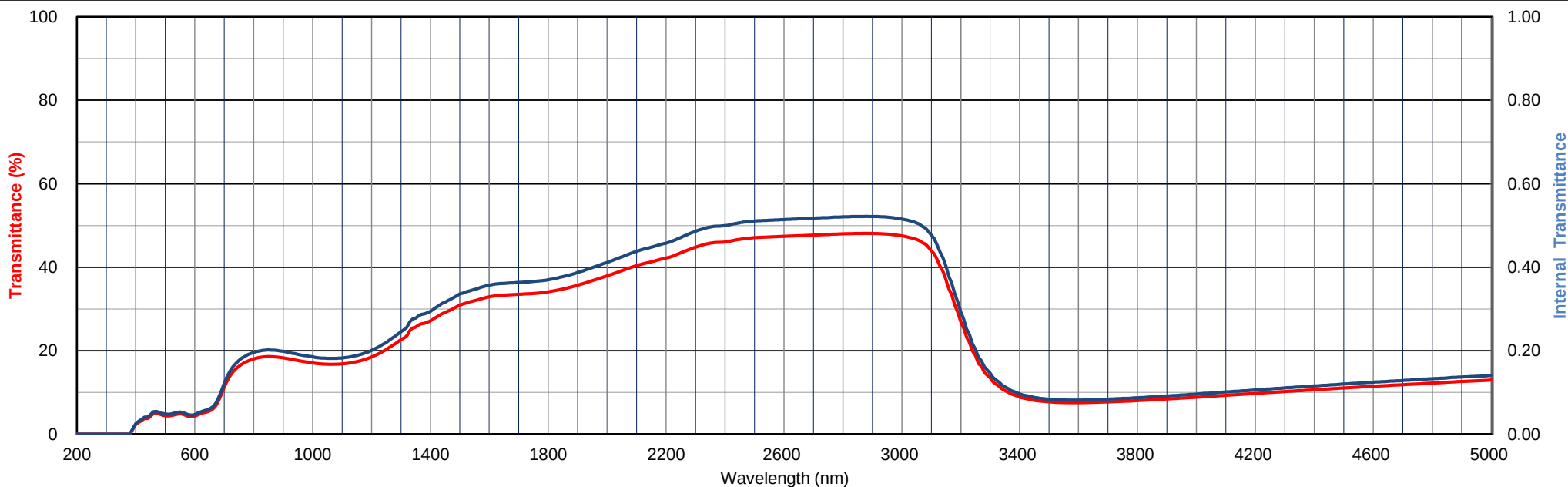
Transmittance (T)

units: %

Thickness (1.41) mm

ND5

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	2.3	2.8	3.3	3.8	3.8	4.3	4.9	5.0	4.8	4.6	4.4	4.4	4.5	4.6	4.8	4.9	4.8	4.5	4.3	4.2
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	4.3	4.6	4.9	5.1	5.3	5.6	6.0	6.7	7.9	9.5	11.2	12.7	14.0	14.9	15.7	16.3	16.8	17.2	17.5	17.8
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	18.0	18.2	18.4	18.5	18.6	18.6	18.6	18.5	18.5	18.4	18.3	18.2	18.0	17.9	17.8	17.6	17.5	17.4	17.3	17.2
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	17.1	17.0	16.9	16.8	16.8	16.8	16.7	16.8	16.8	16.8	16.8	16.9	17.0	17.1	17.2	17.4	17.5	17.7	18.0	18.2
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	18.5	18.8	19.1	19.5	19.9	20.3	20.7	21.2	21.6	22.1	22.6	23.0	23.6	24.8	25.4	25.7	26.1	26.5	26.6	26.8
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	27.2	27.6	28.0	28.5	28.9	29.2	29.5	29.8	30.2	30.6	30.9	31.2	31.4	31.6	31.8	32.0	32.2	32.4	32.6	32.8
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	32.9	33.0	33.1	33.2	33.3	33.3	33.4	33.4	33.4	33.5	33.5	33.5	33.6	33.6	33.7	33.7	33.8	33.8	33.9	34.0
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	34.1	34.2	34.3	34.5	34.6	34.8	35.0	35.1	35.3	35.5	35.7	35.9	36.1	36.3	36.6	36.8	37.0	37.2	37.5	37.7
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	37.9	39.2	40.4	41.3	42.2	43.5	44.8	45.8	46.0	46.7	47.1	47.3	47.4	47.6	47.7	47.8	48.0	48.1	48.1	47.9
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	47.5	46.6	43.9	37.0	27.0	18.8	13.5	10.5	8.9	8.1	7.7	7.6	7.6	7.6	7.7	7.9	8.0	8.2	8.4	8.6
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	8.9	9.1	9.3	9.5	9.8	10.0	10.2	10.4	10.6	10.8	11.1	11.3	11.5	11.7	11.8	12.0	12.2	12.4	12.6	12.8
λnm	5000																			
T	13.0																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.7	0.7	3.6
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	6.4	6.5	6.7	7.6	7.5	8.8	10.4	10.7	10.4	10.1	10.0	10.1	10.3	10.6	11.1	11.4	11.6	11.2	10.4	9.7
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	9.5	9.8	10.1	10.2	10.0	9.8	9.9	10.3	11.3	12.6	13.7	14.4	14.6	14.4	14.0	13.5	12.9	12.3	11.7	11.2
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	10.7	10.2	9.9	9.5	9.1	8.8	8.5	8.3	8.0	7.8	7.5	7.3	7.1	6.9	6.7	6.5	6.3	6.2	6.0	5.9
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	5.7	5.6	5.5	5.4	5.3	5.2	5.1	5.0	5.0	4.9	4.9	4.8	4.8	4.8	4.9	5.0				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.529	1.520	1.516	1.513	1.512	1.511	1.510
P	0.916	0.918	0.919	0.920	0.920	0.921	0.921

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

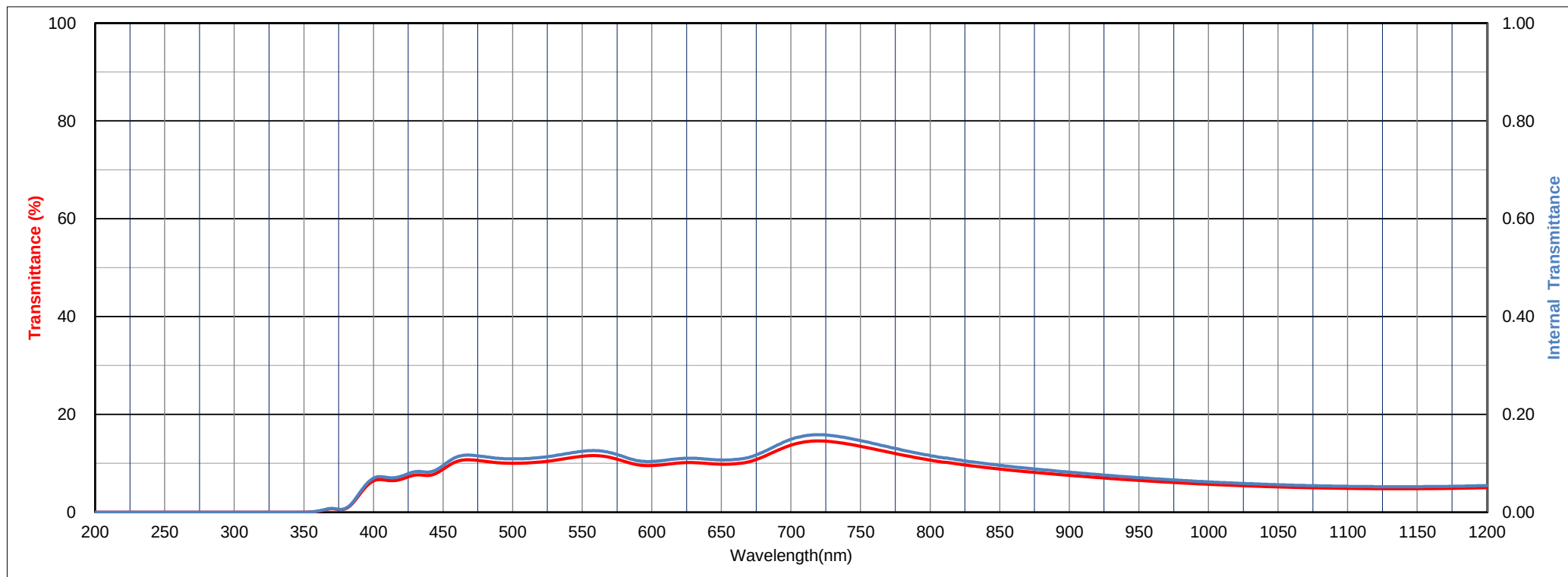
	x	y	Y	λ _d	P _e
A	0.447	0.420	11	569	8
C	0.316	0.340	11	562	8
D65	0.318	0.352	11	561	8

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	3	490	565	-	65	530	100	2.41

Tolerance of Transmittance (T)

Average Transmittance at 400nm-700nm	
Tav(%)	OD
10±2	1±0.1





HOYA CORPORATION OPTICS SECTION

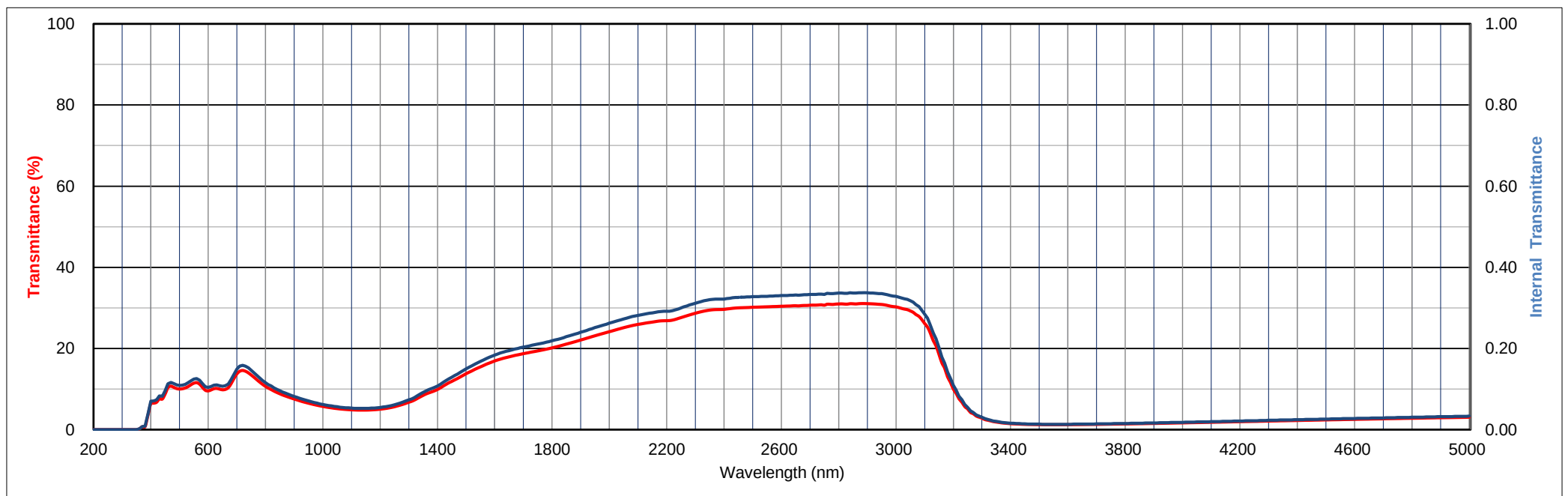
Transmittance (T)

units: %

Thickness (2.75) mm

ND10

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.7	0.7	3.6
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	6.4	6.5	6.7	7.6	7.5	8.8	10.4	10.7	10.4	10.1	10.0	10.1	10.3	10.6	11.1	11.4	11.6	11.2	10.4	9.7
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	9.5	9.8	10.1	10.2	10.0	9.8	9.9	10.3	11.3	12.6	13.7	14.4	14.6	14.4	14.0	13.5	12.9	12.3	11.7	11.2
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	10.7	10.2	9.9	9.5	9.1	8.8	8.5	8.3	8.0	7.8	7.5	7.3	7.1	6.9	6.7	6.5	6.3	6.2	6.0	5.9
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	5.7	5.6	5.5	5.4	5.3	5.2	5.1	5.0	5.0	4.9	4.9	4.8	4.8	4.8	4.8	4.8	4.8	4.9	4.9	5.0
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	5.0	5.1	5.2	5.3	5.5	5.6	5.8	6.0	6.2	6.5	6.7	7.0	7.3	7.7	8.1	8.4	8.8	9.1	9.3	9.6
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	9.9	10.3	10.7	11.1	11.6	11.9	12.3	12.6	13.0	13.4	13.8	14.1	14.5	14.8	15.2	15.5	15.8	16.1	16.4	16.7
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	16.9	17.2	17.4	17.6	17.8	17.9	18.1	18.3	18.4	18.6	18.7	18.9	19.0	19.1	19.3	19.4	19.5	19.7	19.8	20.0
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	20.1	20.3	20.5	20.7	20.9	21.1	21.3	21.5	21.7	21.9	22.1	22.3	22.5	22.7	22.9	23.1	23.3	23.5	23.7	23.9
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	24.1	25.1	25.9	26.5	26.8	27.6	28.7	29.5	29.6	30.0	30.2	30.3	30.4	30.5	30.7	30.7	31.0	31.0	31.0	30.8
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	30.2	29.2	26.2	18.6	10.0	5.1	2.8	1.9	1.5	1.3	1.2	1.2	1.2	1.3	1.3	1.3	1.4	1.5	1.5	1.6
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	1.7	1.7	1.8	1.9	2.0	2.0	2.1	2.2	2.3	2.3	2.4	2.5	2.5	2.6	2.7	2.7	2.8	2.9	2.9	3.0
λnm	5000																			
T	3.1																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.3	1.3	5.3
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	8.8	8.9	9.2	10.2	10.2	11.6	13.5	13.9	13.5	13.2	13.1	13.1	13.4	13.7	14.3	14.7	14.8	14.4	13.5	12.7
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	12.5	12.8	13.1	13.2	13.0	12.8	13.0	13.4	14.6	16.0	17.2	18.0	18.2	18.0	17.6	17.0	16.3	15.7	15.0	14.4
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	13.8	13.3	12.9	12.5	12.1	11.7	11.4	11.1	10.8	10.5	10.2	9.9	9.7	9.4	9.2	8.9	8.7	8.5	8.3	8.2
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	8.0	7.8	7.7	7.6	7.4	7.3	7.2	7.1	7.1	7.0	6.9	6.9	6.9	6.9	7.0	7.1				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.539	1.523	1.516	1.512	1.509	1.508	1.507
P	0.914	0.918	0.919	0.920	0.921	0.921	0.922

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

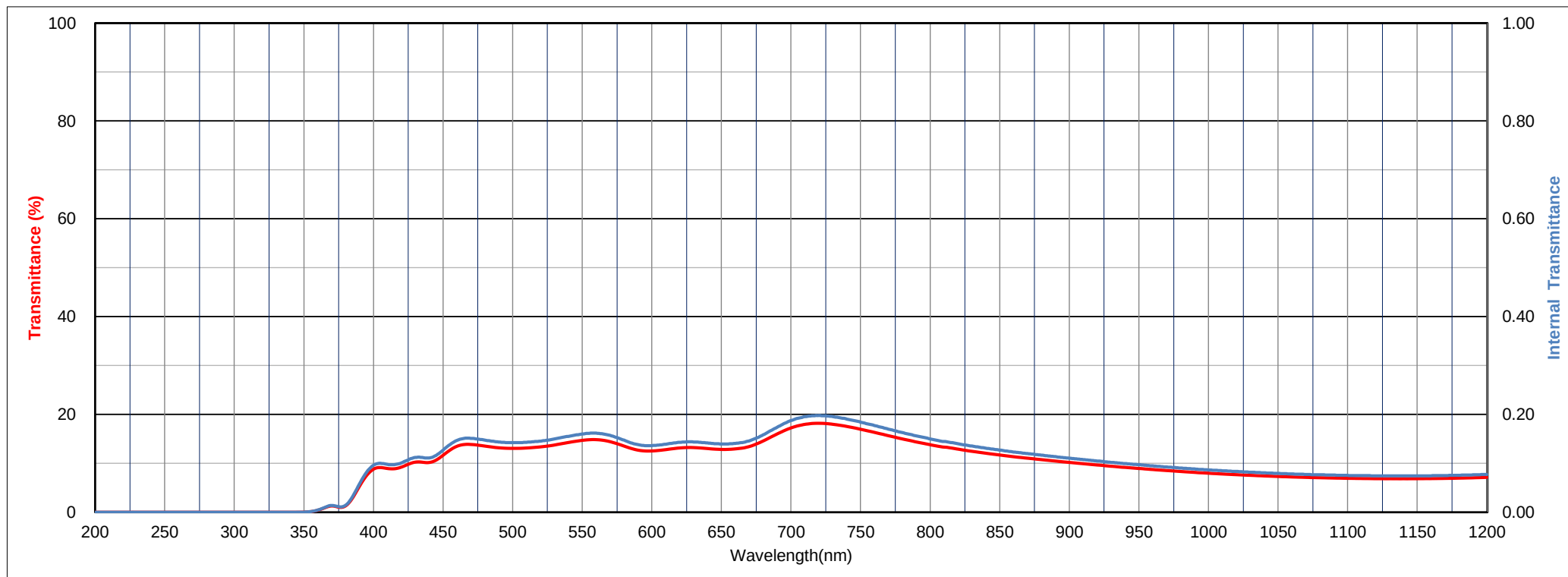
	x	y	Y	λ _d	P _e
A	0.447	0.419	14	569	7
C	0.315	0.337	14	562	7
D65	0.318	0.350	14	561	7

Properties

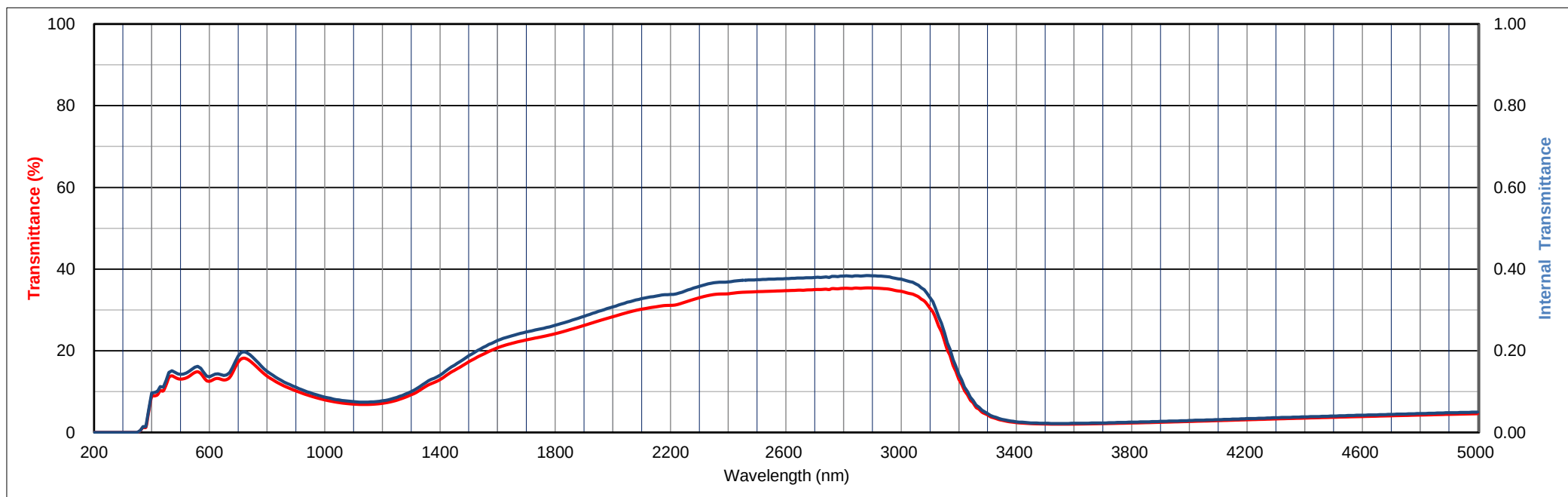
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α _{-30/70}	α _{100/300}	H _K	F _A	d
1	1	535	595	58	68	530	100	2.43

Tolerance of Transmittance (T)

Average Transmittance at 400nm-700nm	
Tav(%)	OD
12.5±2	0.90±0.1



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.3	1.3	5.3
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	8.8	8.9	9.2	10.2	10.2	11.6	13.5	13.9	13.5	13.2	13.1	13.1	13.4	13.7	14.3	14.7	14.8	14.4	13.5	12.7
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	12.5	12.8	13.1	13.2	13.0	12.8	13.0	13.4	14.6	16.0	17.2	18.0	18.2	18.0	17.6	17.0	16.3	15.7	15.0	14.4
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	13.8	13.3	12.9	12.5	12.1	11.7	11.4	11.1	10.8	10.5	10.2	9.9	9.7	9.4	9.2	8.9	8.7	8.5	8.3	8.2
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	8.0	7.8	7.7	7.6	7.4	7.3	7.2	7.1	7.1	7.0	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	7.0	7.0
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	7.1	7.2	7.4	7.5	7.7	7.9	8.1	8.4	8.6	8.9	9.2	9.5	9.9	10.3	10.8	11.2	11.6	12.0	12.2	12.6
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	12.9	13.4	13.9	14.4	14.8	15.2	15.6	16.0	16.4	16.9	17.3	17.7	18.1	18.5	18.8	19.1	19.5	19.8	20.1	20.4
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	20.7	21.0	21.2	21.4	21.6	21.8	22.0	22.2	22.3	22.5	22.7	22.8	23.0	23.1	23.2	23.4	23.5	23.7	23.8	24.0
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	24.2	24.4	24.5	24.7	24.9	25.2	25.4	25.6	25.8	26.0	26.2	26.4	26.6	26.9	27.1	27.3	27.5	27.7	27.9	28.1
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	28.3	29.4	30.2	30.8	31.1	31.9	33.0	33.8	33.9	34.3	34.5	34.6	34.7	34.8	35.0	35.0	35.3	35.3	35.4	35.2
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	34.6	33.6	30.4	22.5	13.1	7.2	4.3	3.0	2.4	2.2	2.1	2.0	2.1	2.1	2.2	2.2	2.3	2.4	2.5	2.6
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.3	4.4	4.5
λnm	5000																			
T	4.6																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.8	1.8	6.6
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	10.5	10.6	10.9	12.0	12.0	13.6	15.5	15.9	15.6	15.2	15.1	15.2	15.4	15.8	16.4	16.8	17.0	16.6	15.6	14.7
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	14.5	14.8	15.2	15.3	15.1	14.9	15.0	15.5	16.7	18.2	19.5	20.3	20.5	20.3	19.8	19.2	18.6	17.8	17.1	16.5
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	15.9	15.4	14.9	14.4	14.0	13.6	13.3	12.9	12.6	12.3	12.0	11.7	11.4	11.1	10.9	10.6	10.4	10.2	10.0	9.8
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	9.6	9.4	9.2	9.1	8.9	8.8	8.7	8.6	8.5	8.5	8.4	8.3	8.3	8.3	8.4	8.6				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.538	1.527	1.521	1.518	1.515	1.514	1.513
P	0.914	0.917	0.918	0.919	0.919	0.920	0.920

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

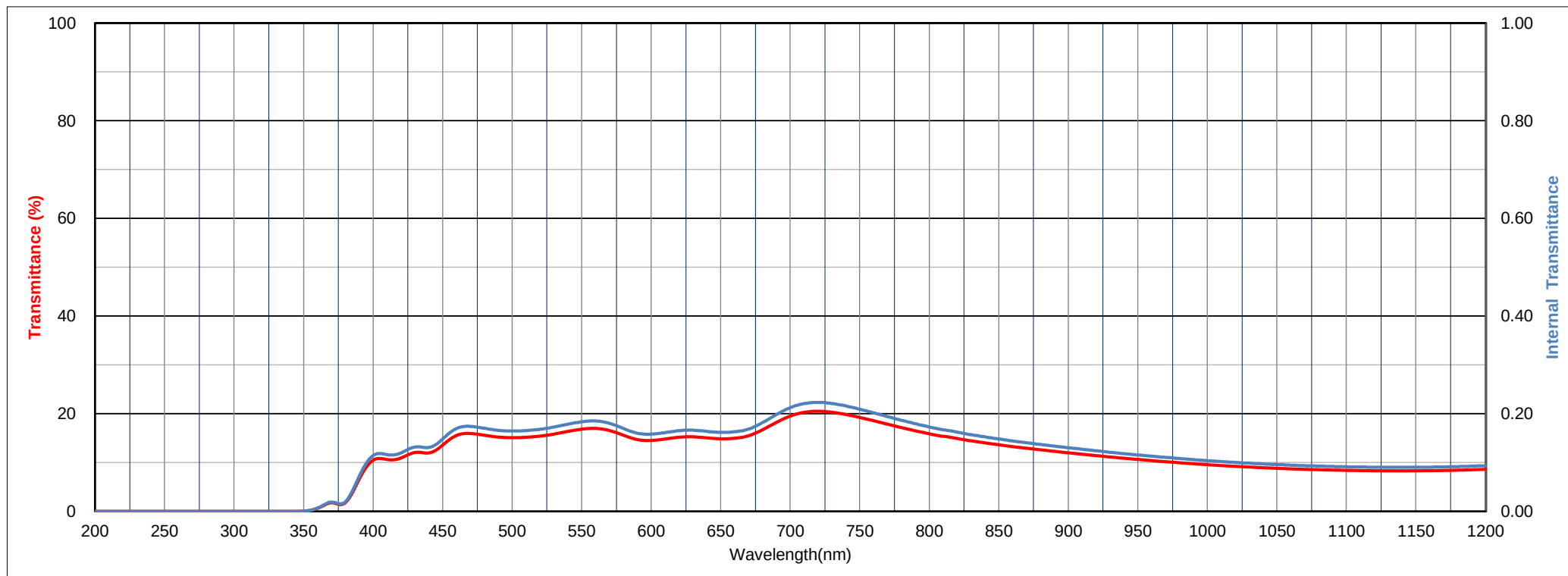
	x	y	Y	λ _d	P _e
A	0.447	0.418	16	569	7
C	0.315	0.336	16	562	7
D65	0.317	0.348	16	561	7

Properties

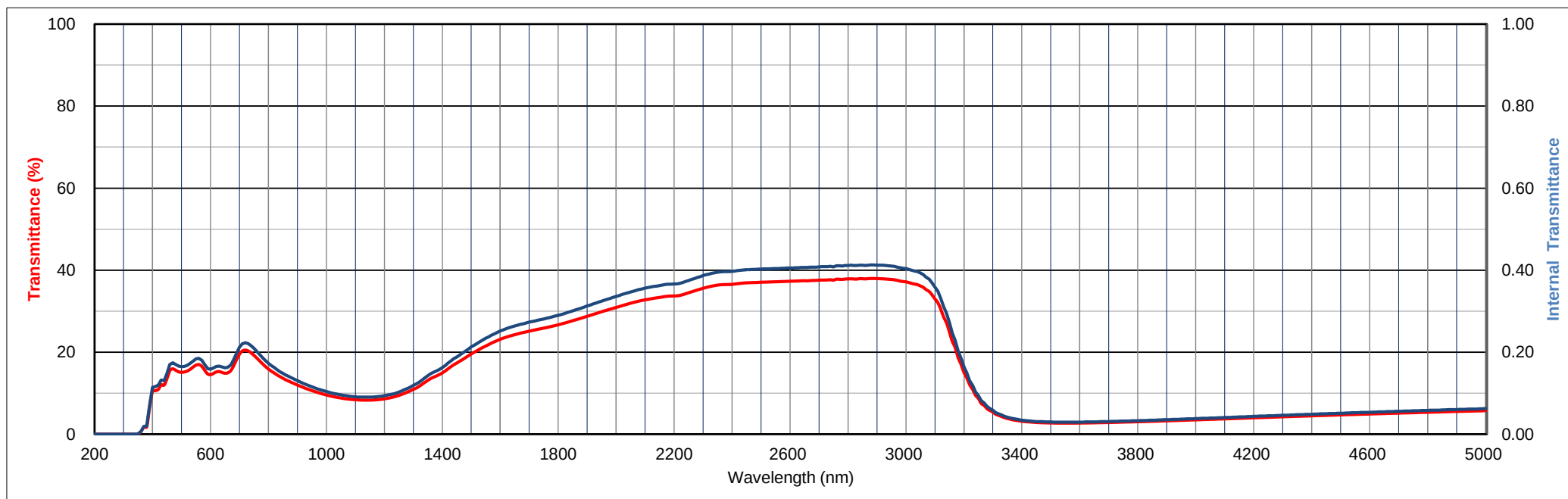
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α _{-30/70}	α _{100/300}	H _K	F _A	d
1	1	535	595	58	68	530	100	2.43

Tolerance of Transmittance (T)

Average Transmittance at 400nm-700nm	
Tav(%)	OD
15±2	0.82±0.1



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.8	1.8	6.6
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	10.5	10.6	10.9	12.0	12.0	13.6	15.5	15.9	15.6	15.2	15.1	15.2	15.4	15.8	16.4	16.8	17.0	16.6	15.6	14.7
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	14.5	14.8	15.2	15.3	15.1	14.9	15.0	15.5	16.7	18.2	19.5	20.3	20.5	20.3	19.8	19.2	18.6	17.8	17.1	16.5
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	15.9	15.4	14.9	14.4	14.0	13.6	13.3	12.9	12.6	12.3	12.0	11.7	11.4	11.1	10.9	10.6	10.4	10.2	10.0	9.8
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	9.6	9.4	9.2	9.1	8.9	8.8	8.7	8.6	8.5	8.5	8.4	8.4	8.3	8.3	8.3	8.3	8.3	8.4	8.4	8.5
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	8.6	8.7	8.9	9.0	9.2	9.5	9.7	10.0	10.3	10.6	10.9	11.2	11.7	12.2	12.7	13.1	13.6	13.9	14.2	14.5
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	14.9	15.4	16.0	16.5	17.0	17.3	17.8	18.2	18.7	19.1	19.6	20.0	20.4	20.8	21.2	21.5	21.8	22.2	22.5	22.8
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	23.1	23.4	23.6	23.9	24.1	24.3	24.5	24.6	24.8	25.0	25.1	25.3	25.4	25.6	25.7	25.9	26.0	26.2	26.3	26.5
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	26.7	26.9	27.1	27.3	27.5	27.7	27.9	28.1	28.3	28.5	28.8	29.0	29.2	29.4	29.6	29.9	30.1	30.3	30.5	30.7
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	30.9	31.9	32.8	33.4	33.7	34.5	35.6	36.4	36.5	36.9	37.1	37.2	37.3	37.4	37.6	37.6	37.9	37.9	37.9	37.7
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	37.1	36.1	33.0	24.9	15.1	8.7	5.4	3.8	3.1	2.9	2.7	2.7	2.7	2.8	2.8	2.9	3.0	3.1	3.3	3.4
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	3.5	3.6	3.7	3.9	4.0	4.1	4.2	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.3	5.4	5.5	5.6
λnm	5000																			
T	5.7																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.9	2.6	2.3	9.3
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	14.8	14.7	14.9	16.4	16.3	18.5	21.3	21.9	21.6	21.2	21.1	21.3	21.5	21.9	22.4	23.0	23.2	22.7	21.4	20.2
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	19.8	19.9	20.1	20.0	19.5	19.0	18.9	19.2	20.2	21.3	22.0	22.2	21.8	21.1	20.1	19.0	17.9	16.9	15.9	15.0
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	14.2	13.6	13.0	12.4	11.9	11.5	11.0	10.6	10.3	10.0	9.6	9.4	9.0	8.8	8.5	8.3	8.1	7.9	7.7	7.5
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	7.3	7.1	7.0	6.9	6.8	6.6	6.5	6.5	6.4	6.3	6.3	6.2	6.2	6.2	6.3	6.4				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.533	1.520	1.513	1.509	1.506	1.504	1.503
P	0.915	0.918	0.920	0.921	0.922	0.922	0.922

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

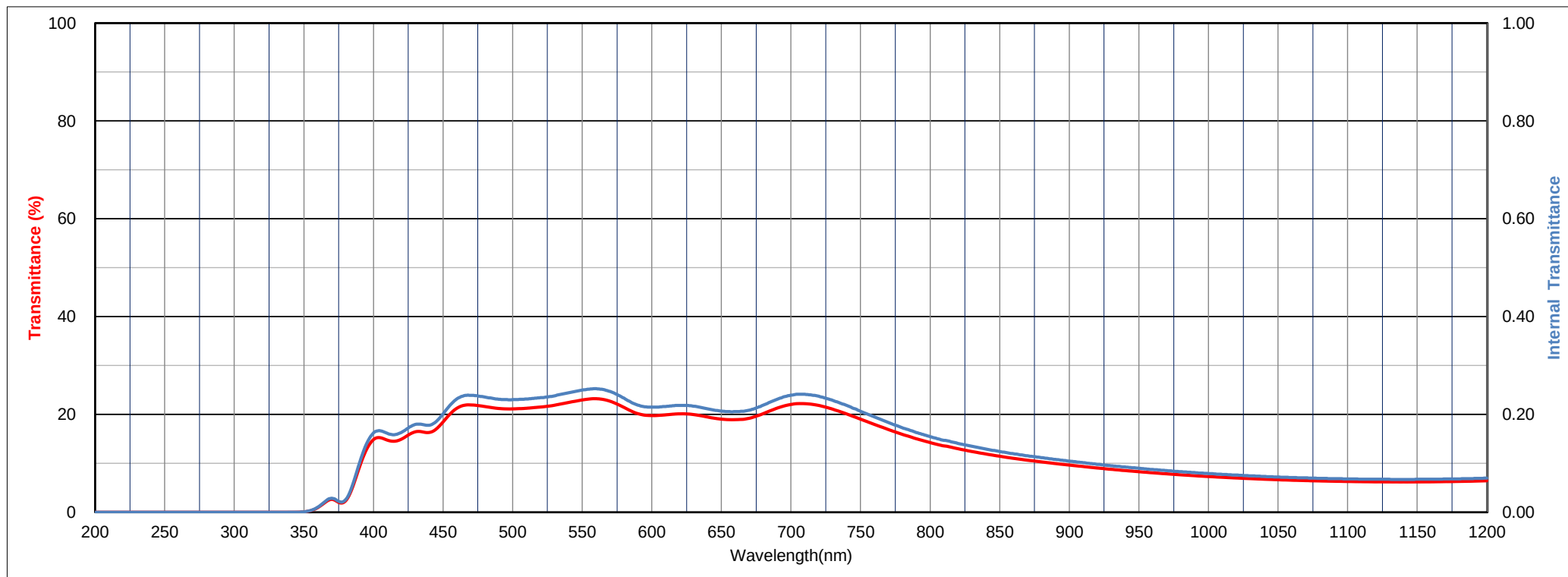
	x	y	Y	λ _d	P _e
A	0.443	0.420	21	559	6
C	0.312	0.337	22	556	6
D65	0.314	0.349	22	555	6

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α _{-30/70}	α _{100/300}	H _K	F _A	d
1	1	535	595	58	68	530	100	2.43

Tolerance of Transmittance (T)

Average Transmittance at 400nm-700nm	
Tav(%)	OD
20±2	0.70±0.05





HOYA CORPORATION OPTICS SECTION

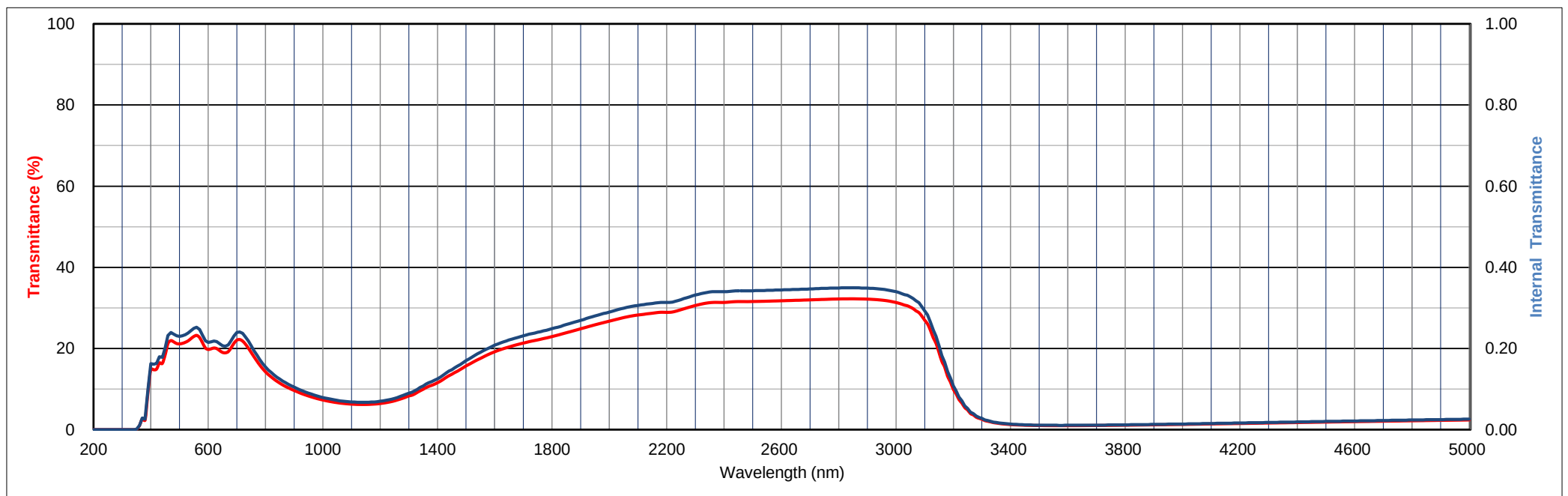
Transmittance (T)

units: %

Thickness (3.06) mm

ND20

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.9	2.6	2.3	9.3
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	14.8	14.7	14.9	16.4	16.3	18.5	21.3	21.9	21.6	21.2	21.1	21.3	21.5	21.9	22.4	23.0	23.2	22.7	21.4	20.2
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	19.8	19.9	20.1	20.0	19.5	19.0	18.9	19.2	20.2	21.3	22.0	22.2	21.8	21.1	20.1	19.0	17.9	16.9	15.9	15.0
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	14.2	13.6	13.0	12.4	11.9	11.5	11.0	10.6	10.3	10.0	9.6	9.4	9.0	8.8	8.5	8.3	8.1	7.9	7.7	7.5
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	7.3	7.1	7.0	6.9	6.8	6.6	6.5	6.5	6.4	6.3	6.3	6.2	6.2	6.2	6.2	6.2	6.2	6.3	6.3	6.4
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	6.4	6.5	6.6	6.8	6.9	7.1	7.3	7.5	7.8	8.0	8.3	8.5	8.8	9.2	9.6	9.9	10.3	10.7	10.9	11.2
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	11.6	11.9	12.4	12.8	13.3	13.6	14.1	14.4	14.8	15.3	15.7	16.1	16.5	16.9	17.2	17.6	17.9	18.3	18.6	18.9
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	19.2	19.5	19.7	20.0	20.2	20.4	20.6	20.8	21.0	21.2	21.3	21.5	21.7	21.8	22.0	22.1	22.3	22.4	22.6	22.8
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	22.9	23.1	23.3	23.5	23.7	23.9	24.1	24.3	24.5	24.7	24.9	25.1	25.2	25.5	25.6	25.8	26.0	26.2	26.4	26.6
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	26.7	27.6	28.3	28.7	28.9	29.6	30.6	31.3	31.3	31.6	31.6	31.7	31.8	31.9	32.0	32.1	32.2	32.2	32.2	31.9
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	31.3	30.2	27.0	19.0	9.9	4.8	2.6	1.6	1.2	1.1	1.0	1.0	1.0	1.0	1.0	1.1	1.1	1.1	1.2	1.2
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	1.3	1.3	1.4	1.5	1.5	1.6	1.6	1.7	1.7	1.8	1.9	1.9	2.0	2.0	2.1	2.1	2.2	2.2	2.3	2.3
λnm	5000																			
T	2.4																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.9	4.4	4.0	13.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	19.4	19.3	19.5	21.2	21.0	23.4	26.4	27.1	26.7	26.3	26.2	26.4	26.6	27.0	27.6	28.2	28.4	27.9	26.6	25.2
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	24.8	24.9	25.2	25.0	24.5	24.0	23.9	24.2	25.2	26.4	27.2	27.4	27.0	26.2	25.1	24.0	22.8	21.7	20.6	19.6
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	18.7	18.0	17.3	16.7	16.1	15.6	15.1	14.6	14.2	13.8	13.4	13.1	12.7	12.4	12.1	11.8	11.5	11.3	11.0	10.8
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	10.6	10.4	10.2	10.1	9.9	9.8	9.7	9.6	9.5	9.4	9.3	9.2	9.2	9.2	9.3	9.5				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.536	1.523	1.516	1.512	1.510	1.508	1.507
P	0.915	0.918	0.919	0.920	0.921	0.921	0.921

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

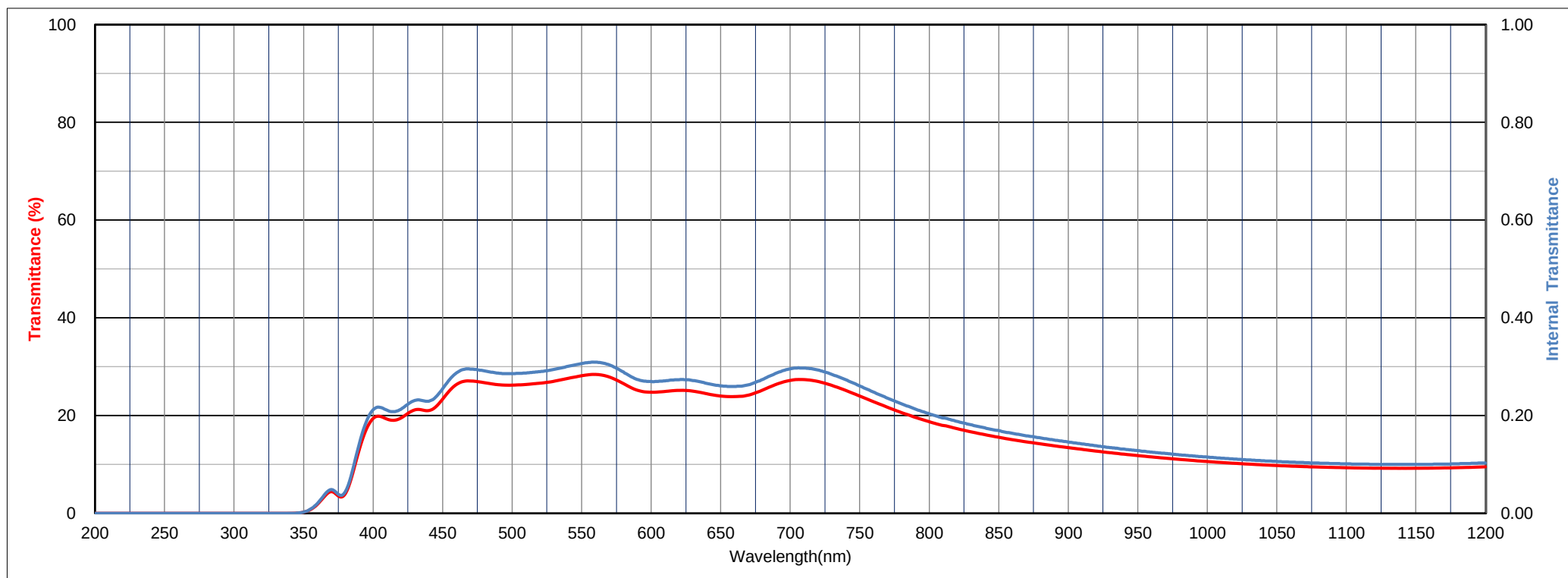
	x	y	Y	λ _d	P _e
A	0.444	0.418	26	559	5
C	0.312	0.334	27	556	5
D65	0.314	0.346	27	555	5

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	2	535	600	62	66	550	100	2.42

Tolerance of Transmittance (T)

Average Transmittance at 400nm-700nm	
Tav(%)	OD
25±2.5	0.60±0.05





HOYA CORPORATION OPTICS SECTION

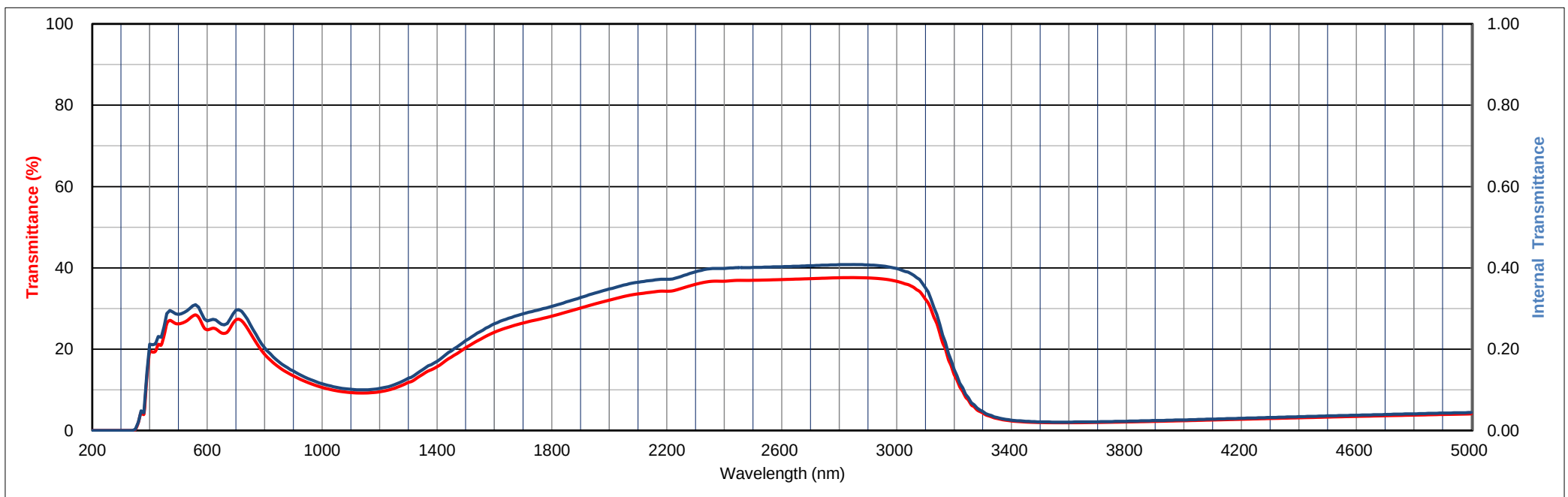
Transmittance (T)

units: %

Thickness (2.61) mm

ND25

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.9	4.4	4.0	13.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	19.4	19.3	19.5	21.2	21.0	23.4	26.4	27.1	26.7	26.3	26.2	26.4	26.6	27.0	27.6	28.2	28.4	27.9	26.6	25.2
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	24.8	24.9	25.2	25.0	24.5	24.0	23.9	24.2	25.2	26.4	27.2	27.4	27.0	26.2	25.1	24.0	22.8	21.7	20.6	19.6
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	18.7	18.0	17.3	16.7	16.1	15.6	15.1	14.6	14.2	13.8	13.4	13.1	12.7	12.4	12.1	11.8	11.5	11.3	11.0	10.8
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	10.6	10.4	10.2	10.1	9.9	9.8	9.7	9.6	9.5	9.4	9.3	9.3	9.2	9.2	9.2	9.2	9.2	9.3	9.3	9.4
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	9.5	9.6	9.8	9.9	10.1	10.3	10.6	10.9	11.2	11.5	11.8	12.0	12.4	12.9	13.4	13.8	14.2	14.6	14.9	15.3
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	15.7	16.1	16.6	17.2	17.6	18.1	18.5	18.9	19.4	19.9	20.4	20.8	21.2	21.6	22.0	22.4	22.8	23.2	23.5	23.9
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	24.2	24.5	24.7	25.0	25.2	25.4	25.6	25.9	26.1	26.3	26.4	26.6	26.8	27.0	27.1	27.3	27.4	27.6	27.8	27.9
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	28.1	28.3	28.5	28.7	28.9	29.1	29.3	29.5	29.7	29.9	30.1	30.3	30.5	30.7	30.9	31.1	31.3	31.5	31.7	31.9
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	32.1	33.0	33.6	34.0	34.3	34.9	36.0	36.7	36.7	36.9	36.9	37.0	37.1	37.2	37.3	37.5	37.6	37.6	37.5	37.3
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	36.7	35.5	32.3	24.0	13.8	7.5	4.3	2.9	2.3	2.1	2.0	1.9	1.9	1.9	2.0	2.0	2.1	2.2	2.2	2.3
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	2.4	2.5	2.6	2.7	2.8	2.9	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.5	3.6	3.7	3.8	3.9	3.9	4.0
λnm	5000																			
T	4.1																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	3.2	6.8	6.2	17.1
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	24.2	24.0	24.3	26.0	25.9	28.4	31.5	32.2	31.8	31.4	31.3	31.5	31.7	32.1	32.7	33.3	33.6	33.0	31.7	30.3
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	29.8	30.0	30.2	30.1	29.5	29.0	28.9	29.2	30.3	31.5	32.3	32.5	32.1	31.3	30.2	29.0	27.8	26.6	25.5	24.4
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	23.5	22.7	22.0	21.2	20.6	20.0	19.5	19.0	18.5	18.1	17.7	17.3	16.8	16.5	16.1	15.8	15.5	15.2	14.9	14.6
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	14.4	14.2	14.0	13.8	13.6	13.4	13.3	13.2	13.1	13.0	12.9	12.8	12.8	12.8	12.9	13.1				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.538	1.524	1.517	1.513	1.510	1.508	1.507
P	0.914	0.917	0.919	0.920	0.921	0.921	0.921

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

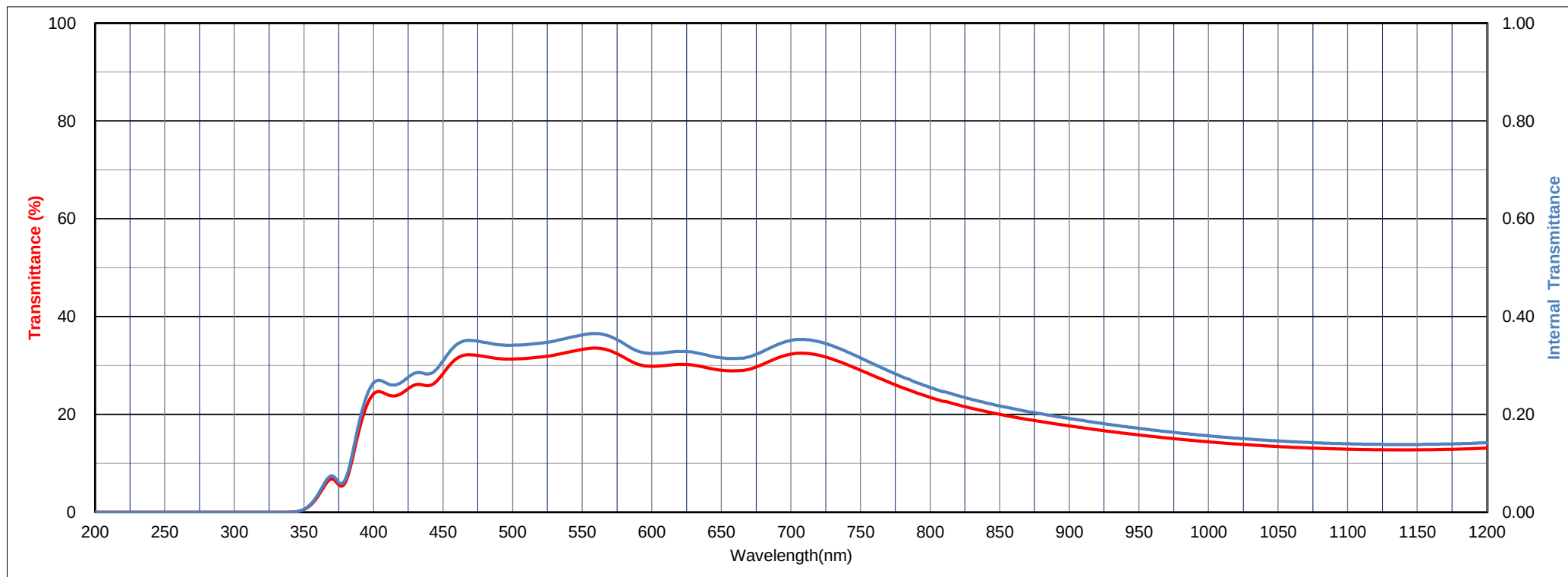
	x	y	Y	λ _d	P _e
A	0.444	0.417	32	560	4
C	0.312	0.332	32	556	5
D65	0.314	0.344	32	556	5

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	2	535	600	62	66	550	100	2.42

Tolerance of Transmittance (T)

Average Transmittance at 400nm-700nm	
Tav(%)	OD
30±3	0.52±0.05





HOYA CORPORATION OPTICS SECTION

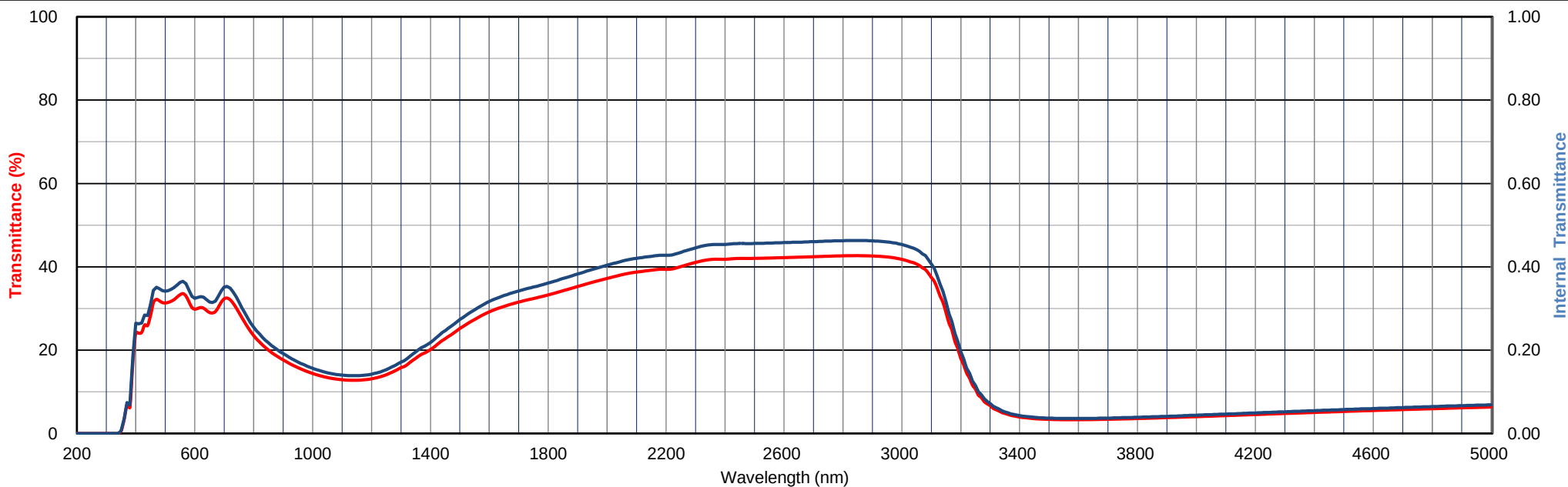
Transmittance (T)

units: %

Thickness (2.24) mm

ND30

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	3.2	6.8	6.2	17.1
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	24.2	24.0	24.3	26.0	25.9	28.4	31.5	32.2	31.8	31.4	31.3	31.5	31.7	32.1	32.7	33.3	33.6	33.0	31.7	30.3
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	29.8	30.0	30.2	30.1	29.5	29.0	28.9	29.2	30.3	31.5	32.3	32.5	32.1	31.3	30.2	29.0	27.8	26.6	25.5	24.4
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	23.5	22.7	22.0	21.2	20.6	20.0	19.5	19.0	18.5	18.1	17.7	17.3	16.8	16.5	16.1	15.8	15.5	15.2	14.9	14.6
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	14.4	14.2	14.0	13.8	13.6	13.4	13.3	13.2	13.1	13.0	12.9	12.8	12.8	12.8	12.8	12.8	12.8	12.9	12.9	13.0
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	13.1	13.3	13.4	13.6	13.8	14.1	14.4	14.7	15.0	15.4	15.8	16.0	16.5	17.0	17.6	18.0	18.6	19.0	19.3	19.7
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	20.1	20.6	21.2	21.8	22.3	22.7	23.2	23.7	24.2	24.7	25.2	25.6	26.1	26.5	27.0	27.3	27.8	28.2	28.5	28.9
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	29.2	29.5	29.8	30.0	30.3	30.5	30.7	31.0	31.1	31.4	31.5	31.7	31.9	32.1	32.2	32.4	32.5	32.7	32.9	33.1
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	33.3	33.4	33.6	33.8	34.1	34.3	34.5	34.7	34.9	35.1	35.3	35.5	35.7	35.9	36.1	36.3	36.5	36.7	36.8	37.0
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	37.2	38.1	38.7	39.2	39.4	40.0	41.1	41.7	41.8	42.0	42.0	42.1	42.2	42.3	42.4	42.5	42.6	42.7	42.6	42.4
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	41.8	40.7	37.5	29.0	18.0	10.6	6.7	4.8	3.9	3.6	3.4	3.3	3.3	3.3	3.4	3.5	3.6	3.7	3.8	3.9
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	4.0	4.2	4.3	4.4	4.5	4.7	4.8	4.9	5.0	5.2	5.3	5.4	5.5	5.6	5.7	5.8	5.9	6.1	6.1	6.2
λnm	5000																			
T	6.4																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	2.1	8.4	14.0	13.0	27.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	34.0	33.4	33.7	35.4	34.9	37.4	40.4	40.9	40.5	40.1	40.1	40.3	40.7	41.1	41.5	41.7	41.6	41.1	40.3	39.8
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	39.7	40.0	40.3	40.3	40.0	39.8	39.9	40.3	41.3	42.5	43.3	43.6	43.5	43.1	42.4	41.7	40.8	39.9	39.0	38.0
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	37.1	36.4	35.7	34.9	34.2	33.5	32.8	32.1	31.5	30.9	30.4	29.8	29.2	28.7	28.2	27.7	27.3	26.8	26.4	26.1
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	25.7	25.4	25.1	24.9	24.6	24.4	24.2	24.1	24.0	23.9	23.9	23.8	24.0	24.2	24.5	25.0				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.509	1.507	1.506	1.506	1.505	1.505	1.505
P	0.921	0.921	0.922	0.922	0.922	0.922	0.922

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

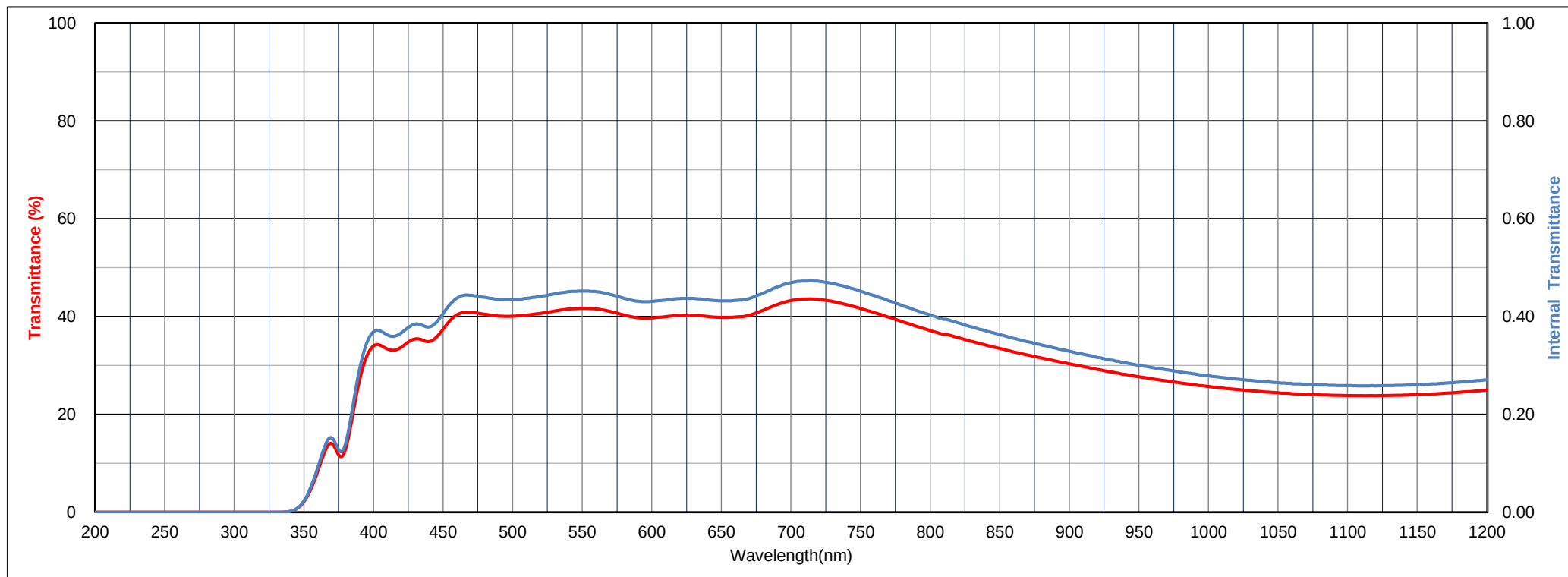
	x	y	Y	λ _d	P _e
A	0.448	0.413	41	573	4
C	0.313	0.327	41	564	4
D65	0.316	0.339	41	563	4

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α _{-30/70}	α _{100/300}	H _K	F _A	d
2	3	525	570	61	65	550	100	2.42

Tolerance of Transmittance (T)

Average Transmittance at 400nm-700nm	
Tav(%)	OD
40±4	0.40±0.05





HOYA CORPORATION OPTICS SECTION

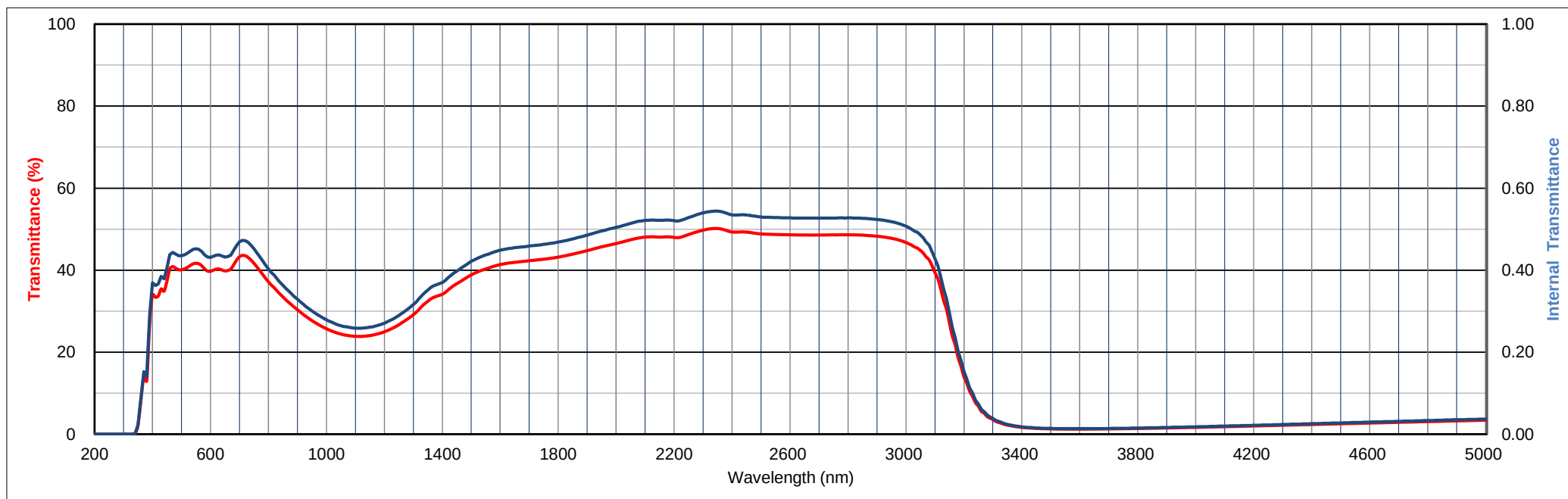
Transmittance (T)

units: %

Thickness (2.73) mm

ND40

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	2.1	8.4	14.0	13.0	27.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	34.0	33.4	33.7	35.4	34.9	37.4	40.4	40.9	40.5	40.1	40.1	40.3	40.7	41.1	41.5	41.7	41.6	41.1	40.3	39.8
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	39.7	40.0	40.3	40.3	40.0	39.8	39.9	40.3	41.3	42.5	43.3	43.6	43.5	43.1	42.4	41.7	40.8	39.9	39.0	38.0
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	37.1	36.4	35.7	34.9	34.2	33.5	32.8	32.1	31.5	30.9	30.4	29.8	29.2	28.7	28.2	27.7	27.3	26.8	26.4	26.1
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	25.7	25.4	25.1	24.9	24.6	24.4	24.2	24.1	24.0	23.9	23.9	23.8	23.8	23.9	24.0	24.1	24.2	24.3	24.5	24.7
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	25.0	25.3	25.6	25.9	26.3	26.7	27.2	27.6	28.1	28.6	29.1	29.7	30.4	31.2	31.9	32.4	33.0	33.4	33.6	33.8
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	34.1	34.6	35.2	35.7	36.3	36.7	37.1	37.6	38.0	38.5	38.8	39.2	39.5	39.8	40.1	40.3	40.5	40.8	41.0	41.2
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	41.4	41.5	41.6	41.7	41.8	41.9	42.0	42.1	42.1	42.2	42.3	42.4	42.4	42.5	42.6	42.7	42.8	42.9	43.0	43.1
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	43.2	43.3	43.5	43.6	43.8	43.9	44.1	44.2	44.4	44.6	44.8	44.9	45.1	45.3	45.5	45.7	45.9	46.0	46.2	46.3
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	46.5	47.4	48.1	48.1	48.0	48.7	49.8	50.2	49.3	49.3	48.8	48.7	48.6	48.6	48.6	48.6	48.6	48.5	48.3	47.8
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	46.7	44.8	39.4	27.2	14.0	6.8	3.6	2.2	1.7	1.4	1.3	1.2	1.2	1.3	1.3	1.3	1.4	1.5	1.5	1.6
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	1.7	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.2	3.3
λnm	5000																			
T	3.4																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	5.4	15.6	22.7	20.7	37.5
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	44.9	43.9	44.2	45.9	45.3	48.0	51.0	51.5	51.1	50.7	50.7	50.9	51.3	51.8	52.1	52.3	52.2	51.7	50.9	50.2
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	50.2	50.4	50.6	50.6	50.3	50.0	50.0	50.4	51.3	52.4	53.1	53.3	53.2	52.7	52.0	51.2	50.3	49.4	48.4	47.5
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	46.6	45.8	45.0	44.2	43.5	42.7	42.0	41.3	40.7	40.1	39.5	38.9	38.3	37.8	37.2	36.7	36.2	35.8	35.3	34.9
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	34.6	34.2	33.9	33.6	33.3	33.1	32.9	32.8	32.6	32.5	32.5	32.4	32.5	32.7	33.0	33.5				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.515	1.508	1.505	1.503	1.502	1.501	1.500
P	0.919	0.921	0.922	0.922	0.923	0.923	0.923

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

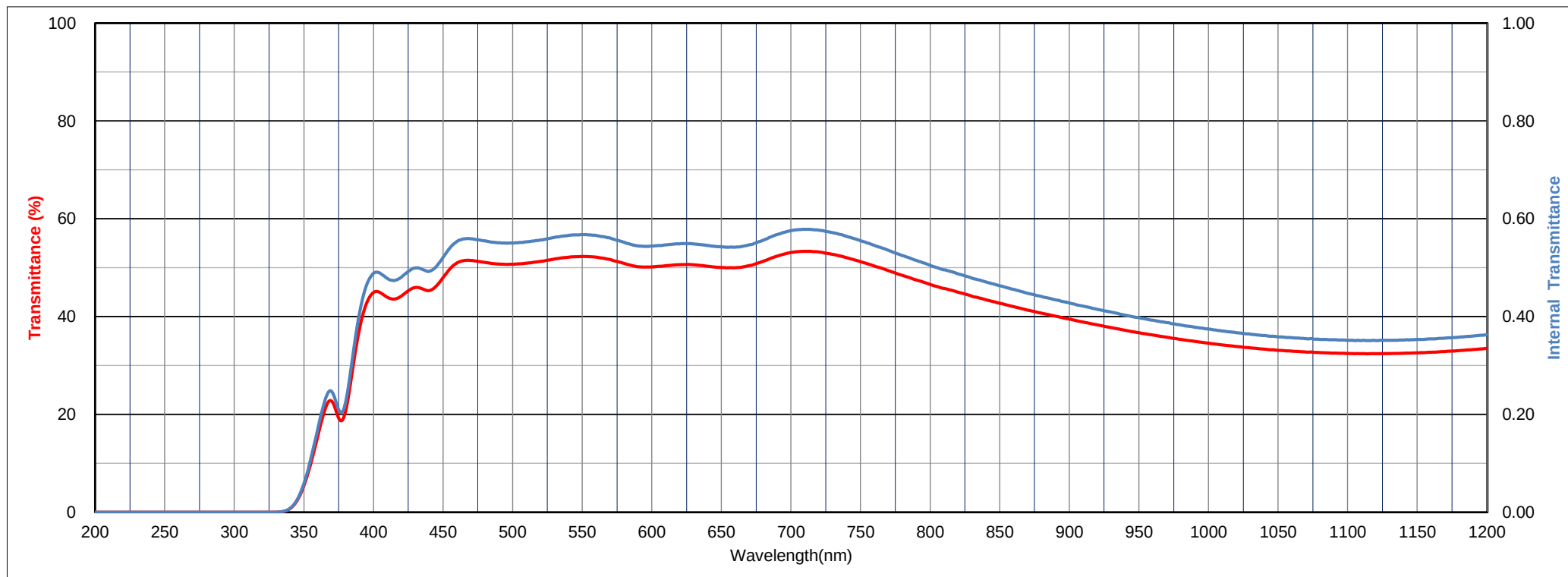
	x	y	Y	λ _d	P _e
A	0.448	0.412	51	571	3
C	0.312	0.325	51	562	3
D65	0.315	0.337	51	562	3

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α _{-30/70}	α _{100/300}	H _K	F _A	d
2	4	495	555	62	66	550	90	2.42

Tolerance of Transmittance (T)

Average Transmittance at 400nm-700nm	
Tav(%)	OD
50±5	0.30±0.05





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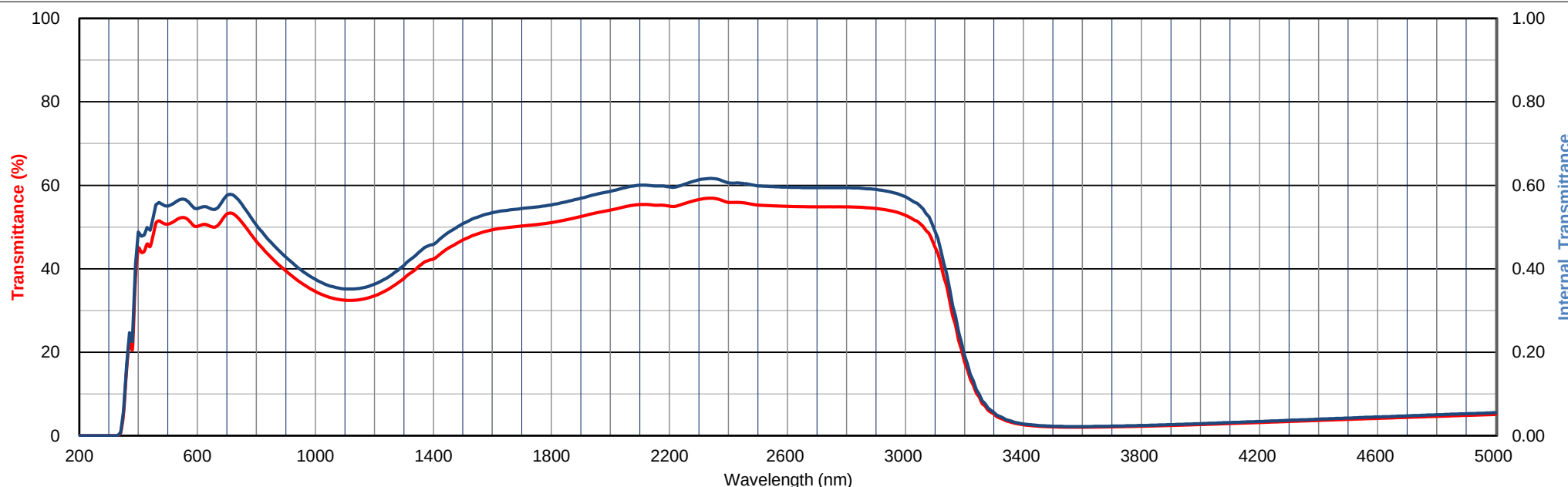
Transmittance (T)

units: %

Thickness (2.5) mm

ND50

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	5.4	15.6	22.7	20.7	37.5
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	44.9	43.9	44.2	45.9	45.3	48.0	51.0	51.5	51.1	50.7	50.7	50.9	51.3	51.8	52.1	52.3	52.2	51.7	50.9	50.2
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	50.2	50.4	50.6	50.6	50.3	50.0	50.0	50.4	51.3	52.4	53.1	53.3	53.2	52.7	52.0	51.2	50.3	49.4	48.4	47.5
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	46.6	45.8	45.0	44.2	43.5	42.7	42.0	41.3	40.7	40.1	39.5	38.9	38.3	37.8	37.2	36.7	36.2	35.8	35.3	34.9
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	34.6	34.2	33.9	33.6	33.3	33.1	32.9	32.8	32.6	32.5	32.5	32.4	32.4	32.5	32.5	32.6	32.7	32.9	33.0	33.3
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	33.5	33.8	34.1	34.4	34.8	35.2	35.7	36.1	36.6	37.1	37.7	38.3	38.8	39.3	39.9	40.5	41.1	41.6	41.9	42.2
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	42.3	42.8	43.4	43.9	44.4	44.9	45.3	45.7	46.1	46.5	46.9	47.2	47.5	47.9	48.1	48.4	48.6	48.8	49.0	49.2
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	49.3	49.5	49.6	49.7	49.8	49.9	49.9	50.0	50.1	50.2	50.3	50.3	50.4	50.5	50.5	50.6	50.7	50.8	50.8	51.0
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	51.1	51.2	51.3	51.4	51.6	51.7	51.9	52.0	52.2	52.4	52.5	52.7	52.9	53.1	53.2	53.4	53.5	53.7	53.8	53.9
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	54.1	54.9	55.4	55.2	55.0	55.6	56.6	56.9	55.9	55.8	55.2	55.1	55.0	54.9	54.8	54.8	54.8	54.7	54.4	53.9
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	52.8	50.8	45.2	32.2	17.7	9.2	5.2	3.4	2.6	2.3	2.1	2.0	2.0	2.1	2.1	2.2	2.3	2.4	2.4	2.6
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	2.7	2.8	2.9	3.0	3.2	3.3	3.4	3.5	3.7	3.8	3.9	4.0	4.1	4.3	4.4	4.5	4.6	4.8	4.9	5.0
λnm	5000																			
T	5.1																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	3.1	12.7	26.5	34.5	32.4	49.1
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	55.7	54.8	55.1	56.6	56.1	58.3	60.9	61.3	61.0	60.7	60.6	60.8	61.1	61.6	61.9	62.0	61.9	61.5	60.8	60.2
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	60.2	60.4	60.6	60.6	60.3	60.1	60.1	60.4	61.2	62.1	62.7	62.9	62.8	62.4	61.8	61.1	60.4	59.6	58.8	58.0
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	57.2	56.5	55.8	55.1	54.5	53.8	53.2	52.6	52.0	51.5	50.9	50.4	49.9	49.4	48.9	48.4	48.0	47.6	47.1	46.8
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	46.4	46.1	45.8	45.5	45.3	45.0	44.9	44.7	44.6	44.5	44.4	44.4	44.5	44.7	45.0	45.4				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.515	1.511	1.509	1.508	1.508	1.507	1.507
P	0.920	0.920	0.921	0.921	0.921	0.921	0.921

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

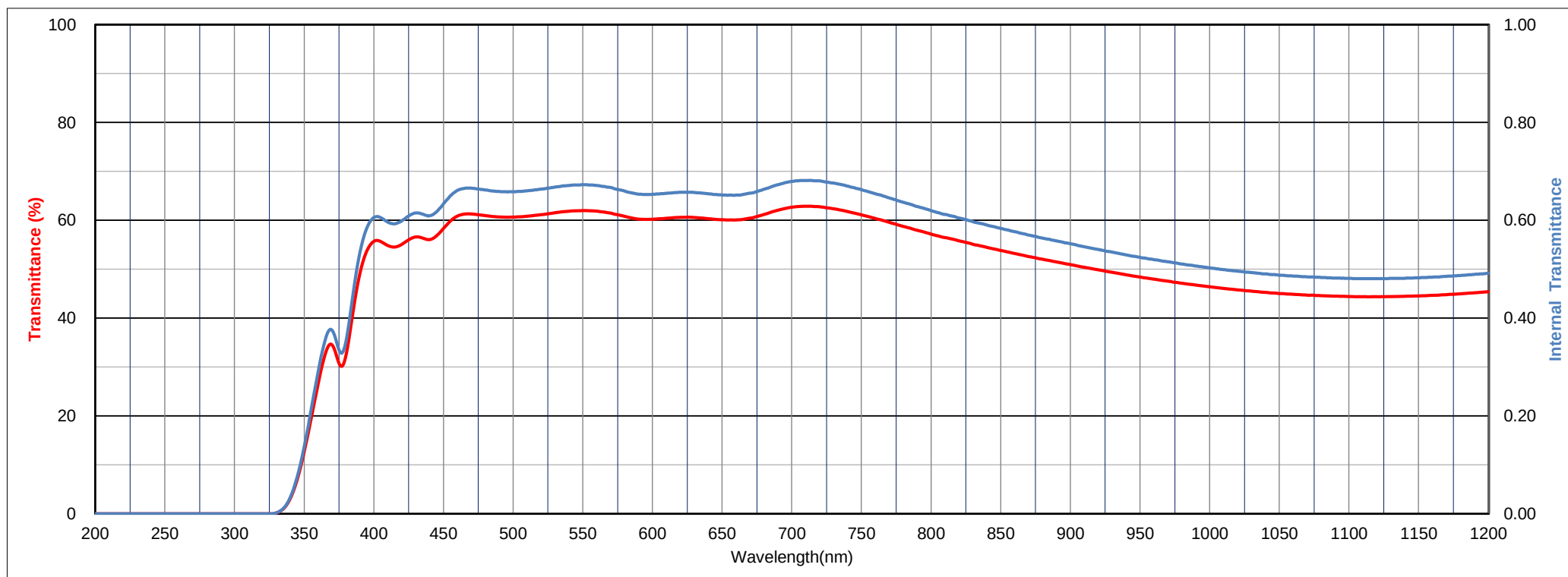
	x	y	Y	λ _d	P _e
A	0.448	0.411	61	571	2
C	0.312	0.322	61	562	2
D65	0.314	0.335	61	562	2

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α _{-30/70}	α _{100/300}	H _K	F _A	d
2	4	495	555	62	66	550	90	2.42

Tolerance of Transmittance (T)

Average Transmittance at 400nm-700nm	
Tav(%)	OD
60±5	0.22±0.04





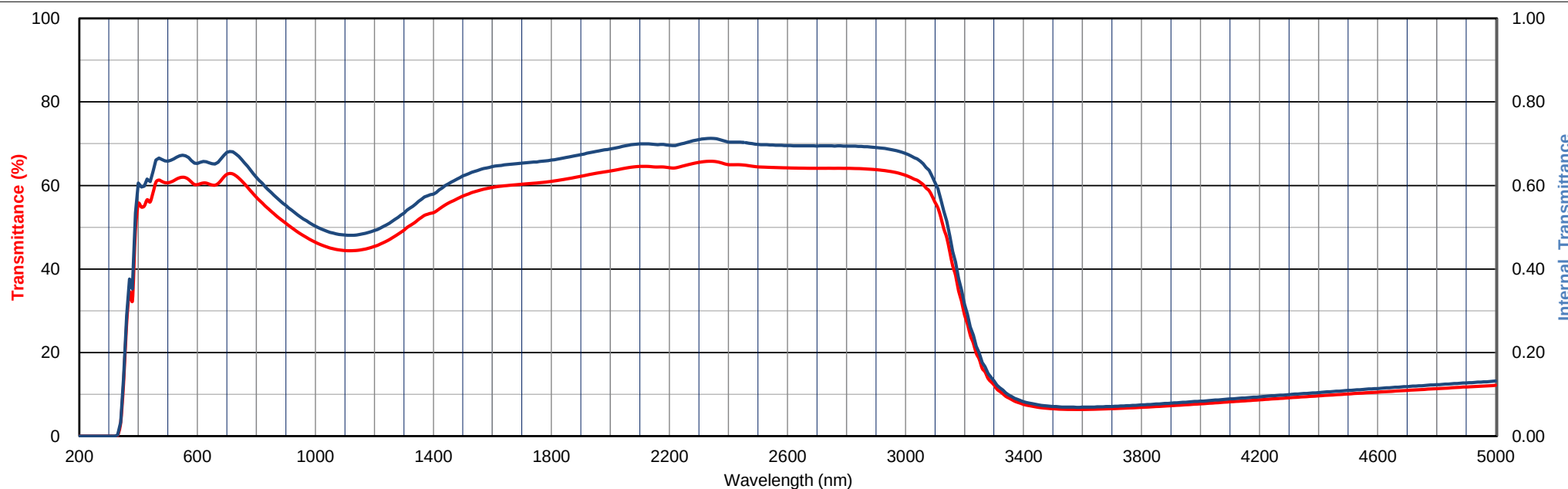
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Transmittance (T) units: %

Thickness (1.75) mm

ND60

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	3.1	12.7	26.5	34.5	32.4	49.1
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	55.7	54.8	55.1	56.6	56.1	58.3	60.9	61.3	61.0	60.7	60.6	60.8	61.1	61.6	61.9	62.0	61.9	61.5	60.8	60.2
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	60.2	60.4	60.6	60.6	60.3	60.1	60.1	60.4	61.2	62.1	62.7	62.9	62.8	62.4	61.8	61.1	60.4	59.6	58.8	58.0
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	57.2	56.5	55.8	55.1	54.5	53.8	53.2	52.6	52.0	51.5	50.9	50.4	49.9	49.4	48.9	48.4	48.0	47.6	47.1	46.8
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	46.4	46.1	45.8	45.5	45.3	45.0	44.9	44.7	44.6	44.5	44.4	44.4	44.4	44.4	44.5	44.5	44.7	44.8	45.0	45.2
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	45.4	45.6	46.0	46.3	46.6	47.0	47.4	47.9	48.3	48.8	49.3	49.9	50.4	50.8	51.3	51.9	52.4	52.9	53.1	53.3
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	53.5	53.9	54.4	54.9	55.3	55.7	56.1	56.4	56.8	57.1	57.5	57.7	58.0	58.3	58.5	58.7	58.9	59.1	59.3	59.4
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	59.5	59.7	59.8	59.8	59.9	60.0	60.1	60.1	60.2	60.2	60.3	60.4	60.4	60.5	60.5	60.6	60.7	60.7	60.8	60.9
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	61.0	61.1	61.2	61.3	61.4	61.5	61.7	61.8	61.9	62.1	62.2	62.3	62.5	62.6	62.8	62.9	63.0	63.1	63.2	63.4
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	63.5	64.1	64.6	64.4	64.3	64.7	65.5	65.8	65.0	64.9	64.4	64.3	64.2	64.1	64.1	64.1	64.1	64.0	63.8	63.3
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	62.4	60.8	56.0	44.2	29.1	18.4	12.3	9.1	7.6	6.9	6.5	6.4	6.4	6.5	6.6	6.7	6.9	7.1	7.3	7.5
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	7.7	8.0	8.2	8.4	8.7	8.9	9.2	9.4	9.6	9.8	10.1	10.3	10.5	10.7	10.9	11.1	11.4	11.6	11.8	11.9
λnm	5000																			
T	12.2																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	4.6	17.7	34.8	42.9	38.7	58.4
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	65.4	63.8	63.8	65.4	64.8	67.4	70.3	71.0	70.9	71.0	71.2	71.5	71.9	72.1	72.2	72.2	72.2	72.0	71.5	71.1
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	70.9	70.8	70.7	70.5	70.1	69.7	69.4	69.2	69.1	69.0	68.8	68.3	67.6	66.7	65.8	64.8	63.7	62.6	61.6	60.5
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	59.6	58.7	57.9	57.1	56.3	55.6	54.9	54.2	53.7	53.1	52.5	51.9	51.4	50.9	50.4	49.9	49.5	49.0	48.6	48.3
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	47.9	47.6	47.3	47.0	46.8	46.6	46.4	46.3	46.1	46.1	46.0	46.0	46.1	46.4	46.7	47.2				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.520	1.510	1.504	1.501	1.499	1.497	1.496
P	0.918	0.921	0.922	0.923	0.923	0.924	0.924

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

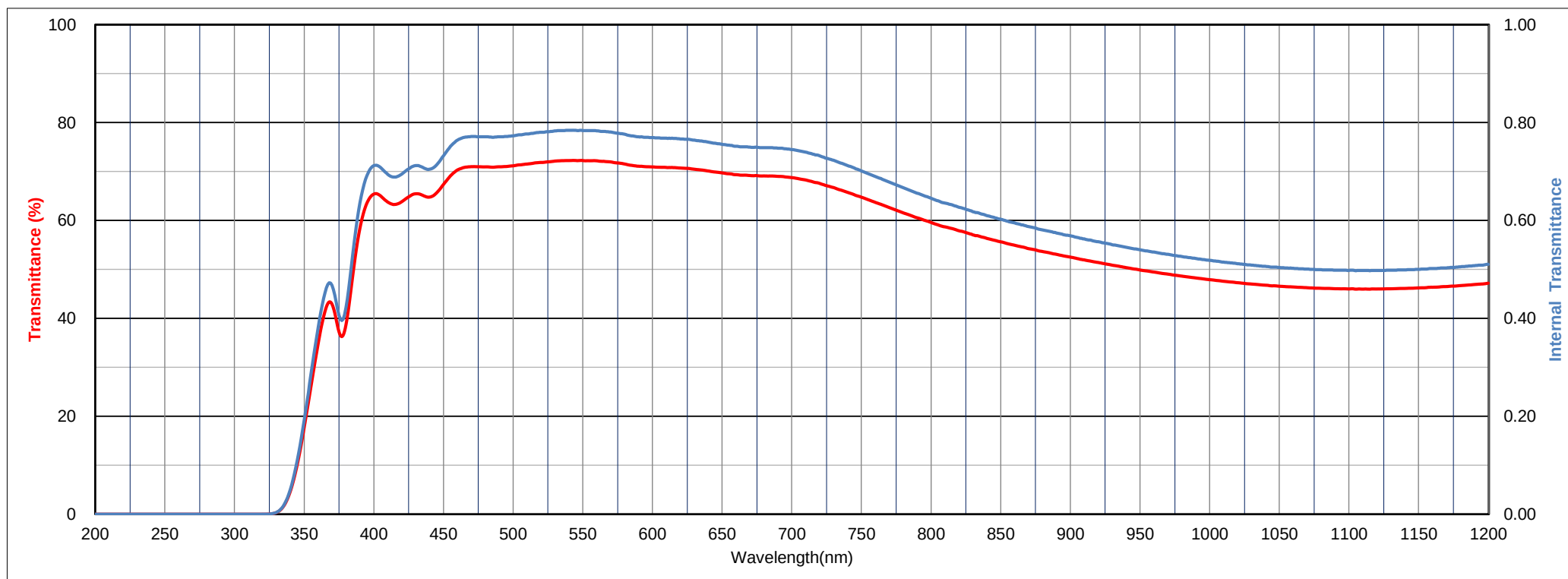
	x	y	Y	λ _d	P _e
A	0.448	0.411	71	572	3
C	0.312	0.324	72	564	3
D65	0.315	0.336	72	563	3

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α _{-30/70}	α _{100/300}	H _K	F _A	d
4	5	470	540	66	72	510	100	2.39

Tolerance of Transmittance (T)

Average Transmittance at 400nm-700nm	
Tav(%)	OD
70±5	0.15±0.04





HOYA CORPORATION OPTICS SECTION

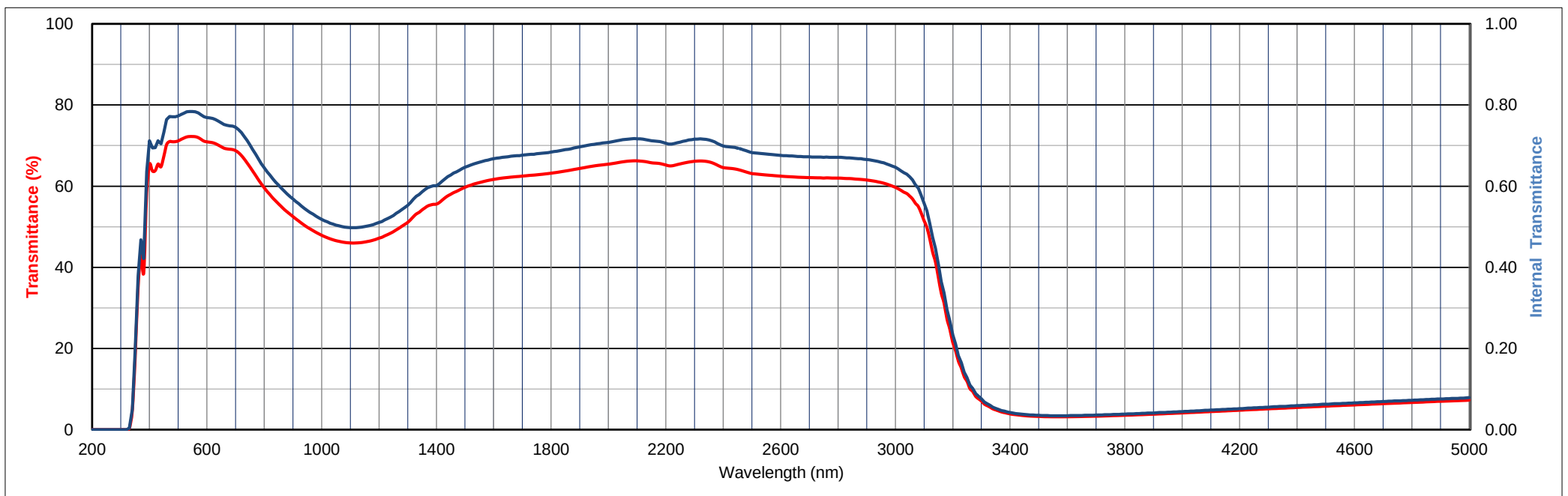
Transmittance (T)

units: %

Thickness (2.9) mm

ND70

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	4.6	17.7	34.8	42.9	38.7	58.4
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	65.4	63.8	63.8	65.4	64.8	67.4	70.3	71.0	70.9	71.0	71.2	71.5	71.9	72.1	72.2	72.2	72.2	72.0	71.5	71.1
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	70.9	70.8	70.7	70.5	70.1	69.7	69.4	69.2	69.1	69.0	68.8	68.3	67.6	66.7	65.8	64.8	63.7	62.6	61.6	60.5
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	59.6	58.7	57.9	57.1	56.3	55.6	54.9	54.2	53.7	53.1	52.5	51.9	51.4	50.9	50.4	49.9	49.5	49.0	48.6	48.3
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	47.9	47.6	47.3	47.0	46.8	46.6	46.4	46.3	46.1	46.1	46.0	46.0	46.0	46.0	46.1	46.2	46.4	46.5	46.7	46.9
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	47.2	47.4	47.8	48.1	48.4	48.8	49.2	49.7	50.1	50.6	51.1	51.7	52.5	53.1	53.5	54.1	54.6	55.1	55.4	55.5
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	55.6	55.9	56.5	57.1	57.6	58.0	58.4	58.7	59.1	59.4	59.7	60.0	60.2	60.5	60.7	60.9	61.1	61.2	61.4	61.5
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	61.7	61.8	61.9	62.0	62.1	62.2	62.2	62.3	62.4	62.4	62.5	62.5	62.6	62.7	62.7	62.8	62.9	62.9	63.0	63.1
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	63.2	63.3	63.4	63.5	63.6	63.7	63.9	64.0	64.1	64.2	64.4	64.5	64.6	64.8	64.9	65.0	65.1	65.2	65.3	65.3
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	65.4	66.0	66.2	65.8	65.2	65.5	66.1	66.0	64.6	64.1	63.1	62.8	62.5	62.3	62.1	62.0	62.0	61.8	61.5	60.9
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	59.7	57.6	51.5	37.5	21.5	11.9	7.1	4.9	3.9	3.4	3.2	3.2	3.2	3.2	3.3	3.4	3.5	3.7	3.8	4.0
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	4.1	4.3	4.5	4.6	4.8	5.0	5.1	5.3	5.5	5.6	5.8	5.9	6.1	6.2	6.4	6.5	6.7	6.8	7.0	7.1
λnm	5000																			
T	7.3																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	4.9	19.6	39.2	55.5	61.9	58.7	72.6
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	77.0	76.0	76.1	77.1	76.7	78.3	80.1	80.5	80.4	80.5	80.6	80.8	81.0	81.2	81.2	81.2	81.2	81.1	80.9	80.6
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	80.5	80.5	80.4	80.3	80.0	79.8	79.6	79.5	79.5	79.4	79.3	79.0	78.6	78.0	77.5	76.8	76.2	75.5	74.9	74.2
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	73.6	73.1	72.5	72.0	71.5	71.1	70.6	70.1	69.7	69.4	69.0	68.6	68.2	67.9	67.5	67.2	66.9	66.6	66.3	66.0
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	65.8	65.3	65.1	64.9	64.8	64.6	64.5	64.4	64.3	64.2	64.2	64.2	64.3	64.5	64.7	65.1				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.525	1.516	1.512	1.509	1.507	1.506	1.505
P	0.917	0.919	0.920	0.921	0.921	0.922	0.922

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

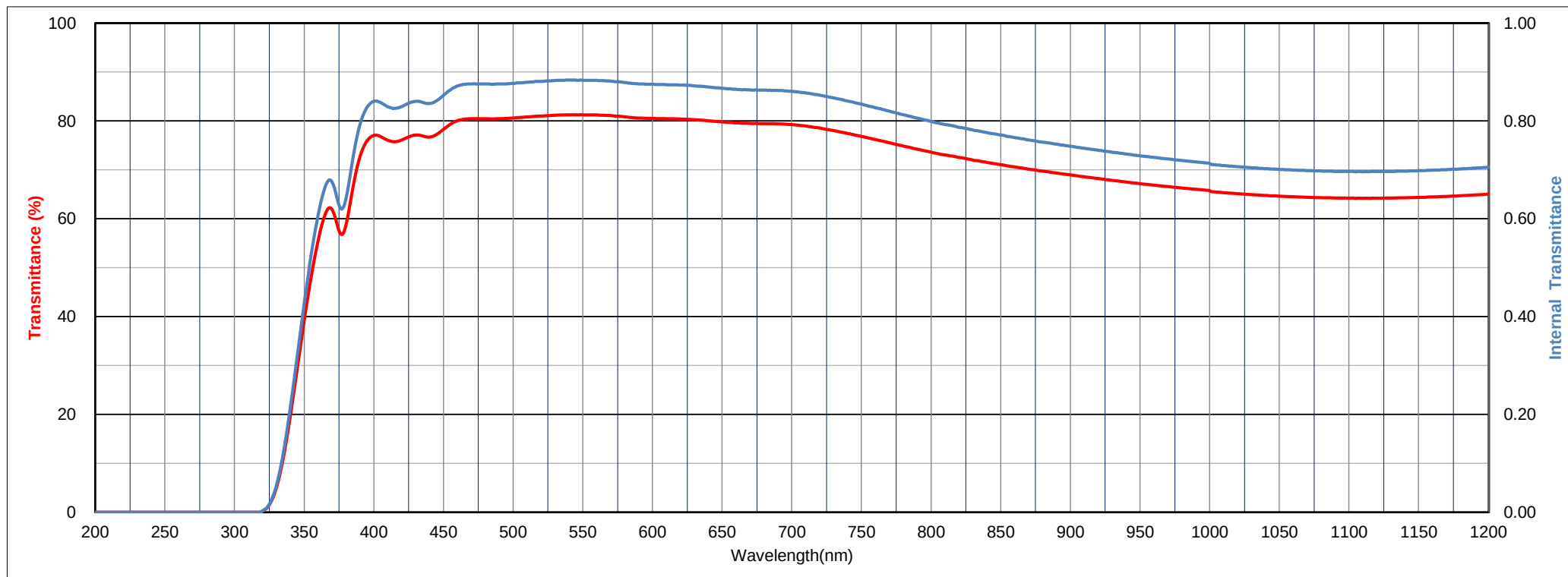
	x	y	Y	λ _d	P _e
A	0.448	0.409	81	573	2
C	0.311	0.320	81	564	1
D65	0.314	0.333	81	564	1

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α _{-30/70}	α _{100/300}	H _K	F _A	d
4	5	470	540	66	72	510	100	2.39

Tolerance of Transmittance (T)

Average Transmittance at 400nm-700nm	
T _{av} (%)	OD
80±5	0.1±0.03





HOYA CORPORATION OPTICS SECTION

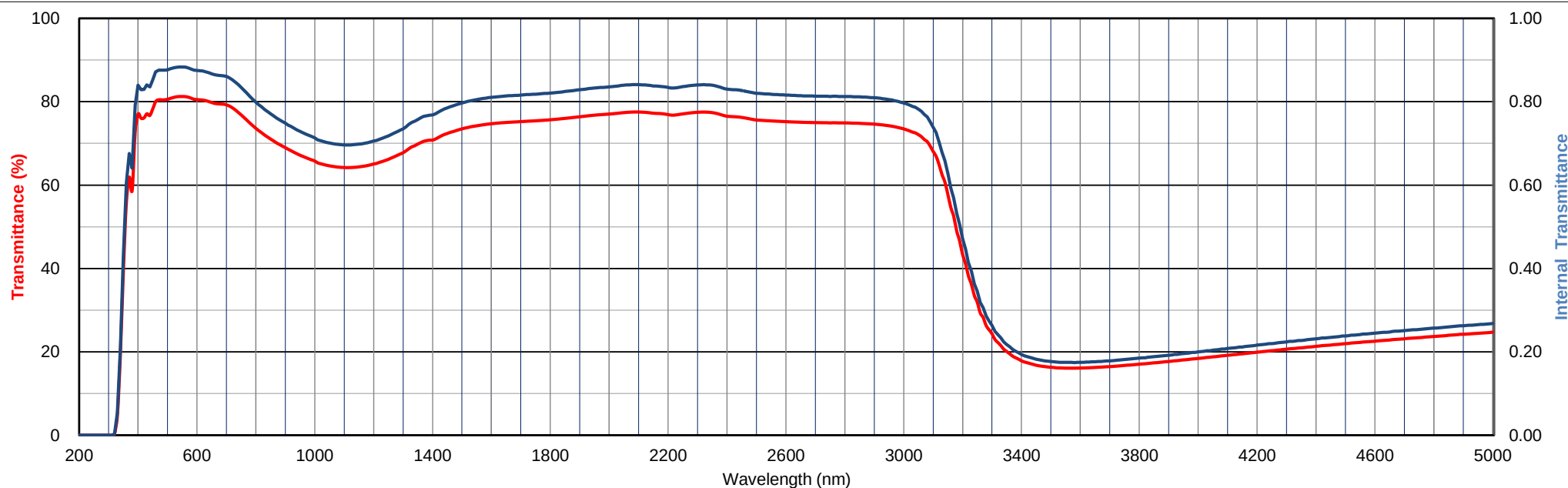
Transmittance (T)

units: %

Thickness (1.5) mm

ND80

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	4.9	19.6	39.2	55.5	61.9	58.7	72.6
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	77.0	76.0	76.1	77.1	76.7	78.3	80.1	80.5	80.4	80.5	80.6	80.8	81.0	81.2	81.2	81.2	81.2	81.1	80.9	80.6
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	80.5	80.5	80.4	80.3	80.0	79.8	79.6	79.5	79.5	79.4	79.3	79.0	78.6	78.0	77.5	76.8	76.2	75.5	74.9	74.2
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	73.6	73.1	72.5	72.0	71.5	71.1	70.6	70.1	69.7	69.4	69.0	68.6	68.2	67.9	67.5	67.2	66.9	66.6	66.3	66.0
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	65.8	65.3	65.1	64.9	64.8	64.6	64.5	64.4	64.3	64.2	64.2	64.2	64.2	64.2	64.3	64.4	64.5	64.6	64.7	64.9
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	65.1	65.2	65.5	65.7	65.9	66.2	66.5	66.8	67.1	67.4	67.8	68.2	68.7	69.2	69.5	69.9	70.2	70.5	70.7	70.8
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	70.8	71.0	71.4	71.8	72.1	72.4	72.6	72.8	73.1	73.3	73.5	73.7	73.8	74.0	74.1	74.2	74.3	74.5	74.6	74.6
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	74.7	74.8	74.9	74.9	75.0	75.0	75.1	75.1	75.1	75.2	75.2	75.3	75.3	75.4	75.4	75.4	75.5	75.5	75.6	75.6
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	75.7	75.7	75.8	75.9	75.9	76.0	76.1	76.2	76.2	76.3	76.4	76.5	76.5	76.6	76.7	76.8	76.8	76.9	76.9	77.0
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	77.0	77.4	77.5	77.2	76.9	77.1	77.5	77.4	76.5	76.2	75.6	75.4	75.2	75.1	75.0	74.9	74.9	74.8	74.6	74.2
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	73.5	72.1	68.1	57.8	43.4	31.9	24.3	20.1	17.8	16.8	16.3	16.1	16.1	16.3	16.4	16.7	17.0	17.4	17.7	18.1
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	18.4	18.8	19.2	19.5	19.9	20.3	20.6	21.0	21.3	21.6	22.0	22.3	22.5	22.8	23.1	23.4	23.7	24.0	24.2	24.4
λnm	5000																			
T	24.7																			



Neutral Density Filters (W-ND series)

World standard Neutral density filters (W-ND filters) with top quality and excellent optical performance. W-ND series is designed to match the world standard and different from current line of neutral density glass types in terms of thickness and transmittance.

Neutral density filters can be used for various purposes including adjustment of light amount as the light intensity can be controlled without selectively absorbing light with a specific wavelength (405nm, 546nm and 694nm).

Neutral Density Product Portfolio:

	HOYA W-ND series	HOYA ND series
Standard Thickness	t1.0mm*	t2.5mm*
Transmittance	Specified at 405nm, 546nm, 694nm	Average 400-700nm
	Internal Transmittance	External Transmittance

*Optical characteristics of W-ND/ND series filters are always made by adjusting thickness of the glass.

“W-ND” Series Specification:

W-ND Series of absorption type Neutral Density Filters are widely available with specific OD or transmittance values. They are able to achieve the expansive offering by adjusting thickness based on the characteristics of the mother glass. Neutral Density Filter types make it possible to provide particularly high density filters. The table below reflects the W-ND filter series options by OD value and typical thickness.

Transmission (%) @546nm	Optical Density @546nm	Standard Thickness (mm) *reference	Mother Glass
50	0.3	2.3	W-ND11
25	0.6	2.3	W-ND5
10	1.0	1.7	W-ND4
5	1.3	2.3	W-ND4
1	2.0	2.0	W-ND3
0.1	3.0	2.1	W-ND9
0.01	4.0	2.8	W-ND9
0.001	5.0	3.5	W-ND9

*All data is mean values of various melts.

*Optical characteristics of W-ND/ND series filters are always made by adjusting thickness of the glass.

Internal Transmittance (τ)

λ nm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.001	0.001	0.004	0.006	0.014
λ nm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	0.021	0.025	0.028	0.031	0.032	0.035	0.039	0.039	0.038	0.037	0.036	0.036	0.036	0.037	0.038	0.038	0.037	0.037	0.036	0.037
λ nm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.038	0.040	0.041	0.043	0.045	0.048	0.051	0.056	0.063	0.071	0.078	0.084	0.089	0.093	0.097	0.100	0.102	0.104	0.106	0.108
λ nm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.109	0.108	0.110	0.110	0.110	0.110	0.109	0.109	0.107	0.106	0.104	0.104	0.103	0.102	0.101	0.100	0.100	0.099	0.099	0.099
λ nm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
τ	0.099	0.099	0.100	0.100	0.101	0.102	0.103	0.104	0.105	0.106	0.108	0.111	0.116	0.121	0.127	0.133				

Refractive Index/Absorption coefficient/Reflection coefficient

λ nm	400	500	600	700	800	900	1000
n	1.539	1.527	1.521	1.517	1.514	1.513	1.512
P	0.914	0.917	0.918	0.919	0.920	0.920	0.920

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

	x	y	Y	λ_d	P _e
A	0.463	0.404	4	602	8
C	0.323	0.324	3	585	6
D65	0.326	0.336	3	585	6

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
3	2	490	545	-	78	415	109	2.46

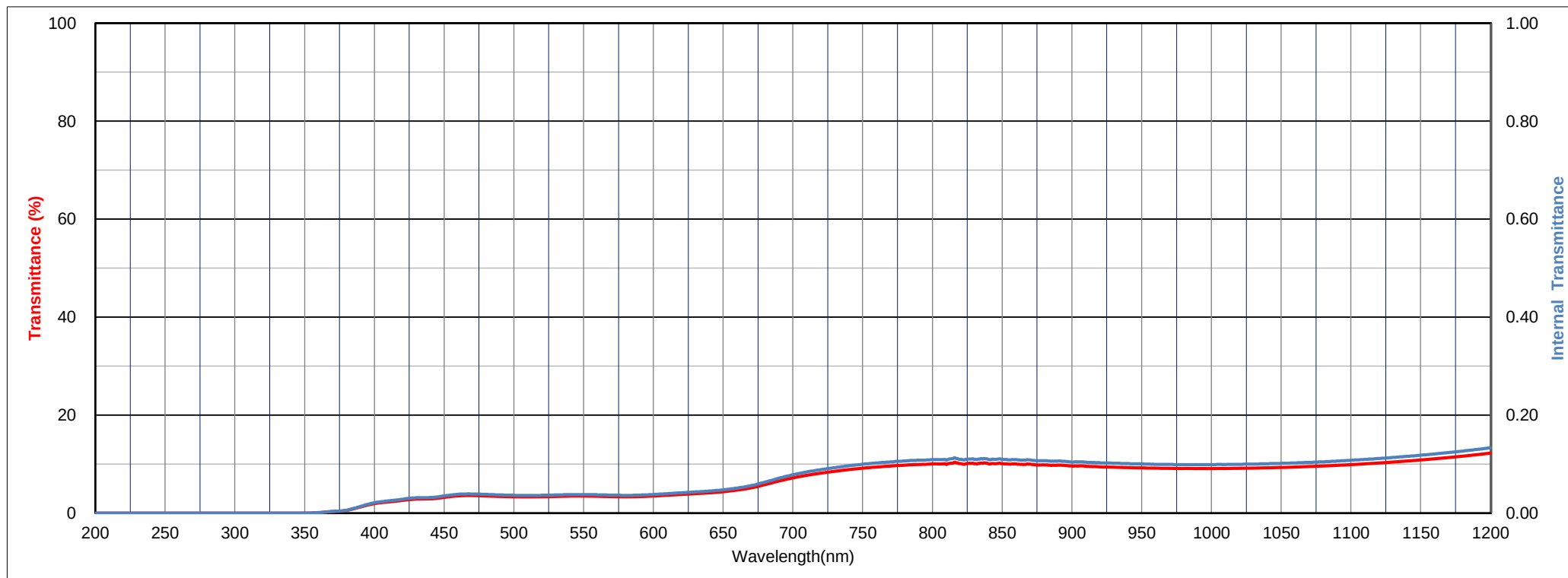
Tolerance of Transmittance (τ)

τ 405 (1)	τ 546 (2)	τ 694 (3)
0.025±0.01	0.04±0.02	0.08±0.02

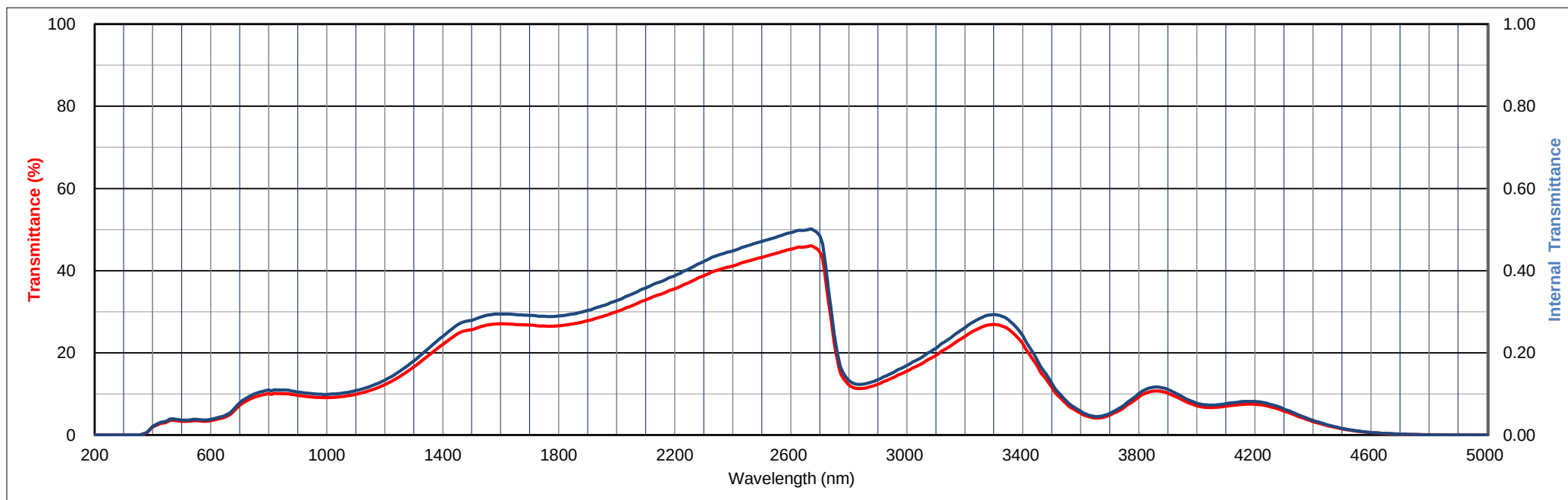
(1)Internal transmittance at 405nm

(2)Internal transmittance at 546nm

(3)Internal transmittance at 694nm



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.001	0.001	0.004	0.006	0.014
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	0.021	0.025	0.028	0.031	0.032	0.035	0.039	0.039	0.038	0.037	0.036	0.036	0.036	0.037	0.038	0.038	0.037	0.037	0.036	0.037
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.038	0.040	0.041	0.043	0.045	0.048	0.051	0.056	0.063	0.071	0.078	0.084	0.089	0.093	0.097	0.100	0.102	0.104	0.106	0.108
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.109	0.108	0.110	0.110	0.110	0.110	0.109	0.109	0.107	0.106	0.104	0.104	0.103	0.102	0.101	0.100	0.100	0.099	0.099	0.099
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	0.099	0.099	0.100	0.100	0.101	0.102	0.103	0.104	0.105	0.106	0.108	0.110	0.111	0.114	0.116	0.118	0.121	0.124	0.127	0.130
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	0.133	0.137	0.141	0.145	0.150	0.154	0.159	0.164	0.169	0.175	0.180	0.186	0.192	0.198	0.204	0.210	0.216	0.222	0.228	0.234
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	0.240	0.246	0.251	0.257	0.262	0.268	0.272	0.275	0.277	0.278	0.279	0.281	0.284	0.287	0.289	0.291	0.292	0.293	0.294	0.295
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	0.295	0.295	0.295	0.294	0.294	0.293	0.292	0.292	0.292	0.292	0.291	0.291	0.290	0.289	0.289	0.289	0.288	0.288	0.289	0.289
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	0.290	0.290	0.291	0.292	0.294	0.295	0.296	0.298	0.299	0.301	0.303	0.305	0.307	0.310	0.312	0.314	0.316	0.319	0.322	0.325
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	0.327	0.342	0.358	0.373	0.388	0.404	0.422	0.438	0.448	0.460	0.471	0.482	0.492	0.499	0.485	0.243	0.133	0.124	0.134	0.151
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	0.169	0.188	0.211	0.236	0.261	0.283	0.293	0.281	0.242	0.183	0.127	0.083	0.058	0.045	0.053	0.073	0.100	0.116	0.111	0.093
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	0.077	0.073	0.076	0.081	0.081	0.075	0.063	0.049	0.035	0.025	0.016	0.010	0.006	0.004	0.002	0.001	0.001	0.001	0.001	0.001
λnm	5000																			
τ	<1E-05																			



Internal Transmittance (τ)

λ nm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.001	0.002	0.008	0.019	0.027	0.050
λ nm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	0.068	0.075	0.081	0.087	0.087	0.093	0.100	0.100	0.097	0.094	0.093	0.092	0.092	0.094	0.096	0.096	0.094	0.092	0.090	0.091
λ nm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.093	0.096	0.099	0.102	0.104	0.108	0.114	0.122	0.135	0.149	0.160	0.168	0.175	0.179	0.184	0.187	0.189	0.191	0.192	0.192
λ nm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.193	0.191	0.193	0.191	0.190	0.187	0.185	0.182	0.180	0.178	0.176	0.174	0.171	0.169	0.167	0.166	0.164	0.163	0.162	0.162
λ nm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
τ	0.161	0.161	0.161	0.161	0.161	0.162	0.162	0.163	0.164	0.166	0.167	0.171	0.175	0.181	0.187	0.195				

Refractive Index/Absorption coefficient/Reflection coefficient

λ nm	400	500	600	700	800	900	1000
n	1.537	1.523	1.516	1.512	1.509	1.507	1.506
P	0.914	0.918	0.919	0.920	0.921	0.921	0.922

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

	x	y	Y	λ_d	P _e
A	0.454	0.404	9	638	3
C	0.315	0.318	9	593	2
D65	0.317	0.330	9	593	2

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
3	2	485	545	-	75	416	114	2.44

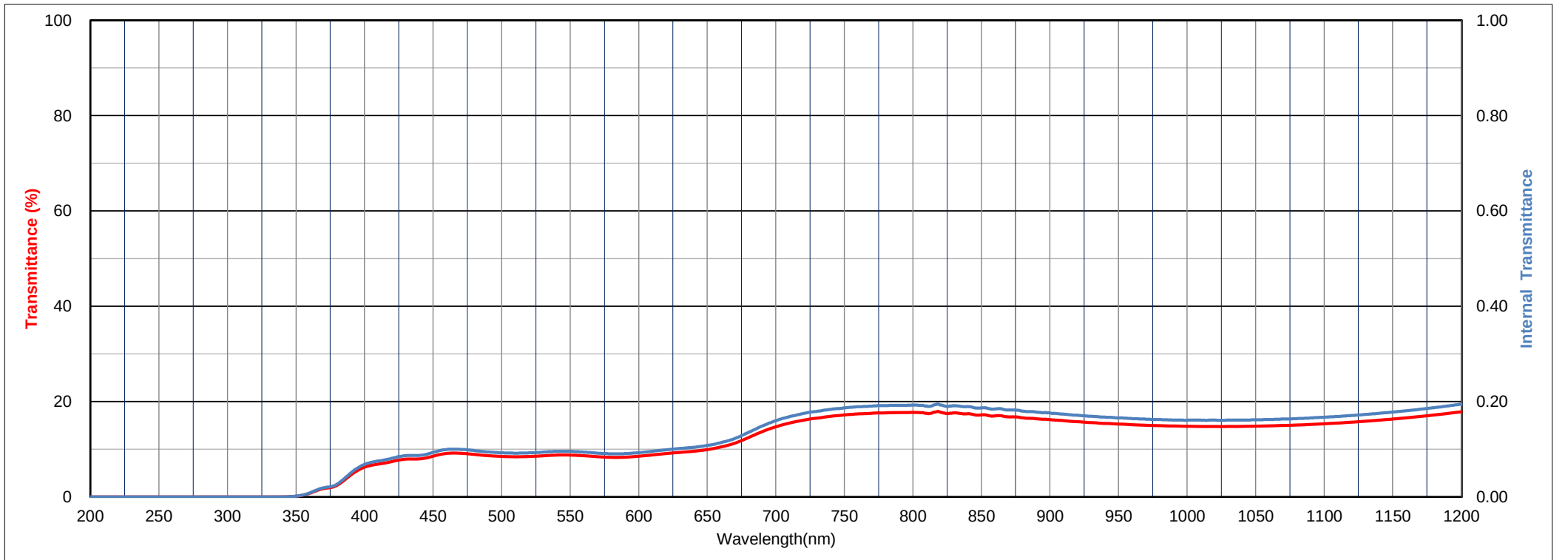
Tolerance of Transmittance (τ)

τ 405 (1)	τ 546 (2)	τ 694 (3)
0.06±0.02	0.10±0.02	0.17±0.03

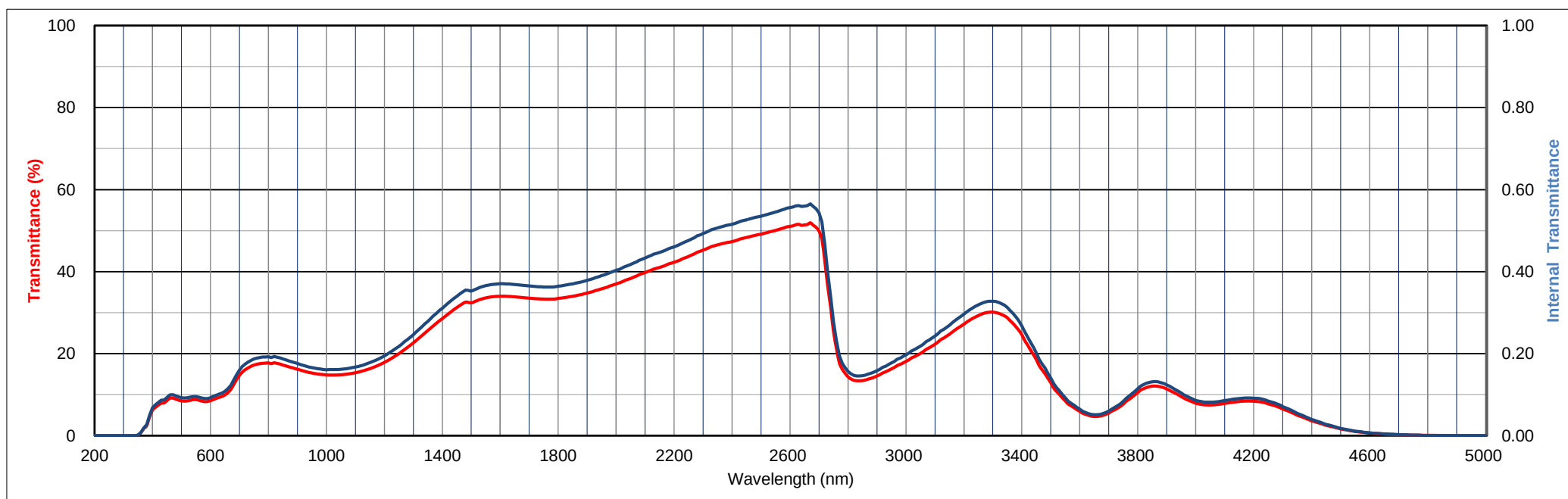
(1) Internal transmittance at 405nm

(2) Internal transmittance at 546nm

(3) Internal transmittance at 694nm



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.001	0.002	0.008	0.019	0.027	0.050
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	0.068	0.075	0.081	0.087	0.087	0.093	0.100	0.100	0.097	0.094	0.093	0.092	0.092	0.094	0.096	0.096	0.094	0.092	0.090	0.091
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.093	0.096	0.099	0.102	0.104	0.108	0.114	0.122	0.135	0.149	0.160	0.168	0.175	0.179	0.184	0.187	0.189	0.191	0.192	0.192
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.193	0.191	0.193	0.191	0.190	0.187	0.185	0.182	0.180	0.178	0.176	0.174	0.171	0.169	0.167	0.166	0.164	0.163	0.162	0.162
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	0.161	0.161	0.161	0.161	0.161	0.162	0.162	0.163	0.164	0.166	0.167	0.169	0.171	0.173	0.175	0.178	0.181	0.184	0.187	0.191
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	0.195	0.199	0.203	0.208	0.213	0.218	0.223	0.229	0.234	0.240	0.246	0.253	0.259	0.266	0.273	0.279	0.286	0.292	0.299	0.305
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	0.311	0.317	0.323	0.329	0.335	0.340	0.345	0.350	0.355	0.354	0.353	0.356	0.359	0.362	0.364	0.366	0.367	0.369	0.370	0.370
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	0.370	0.370	0.370	0.370	0.369	0.369	0.368	0.367	0.367	0.366	0.365	0.365	0.364	0.363	0.363	0.363	0.363	0.363	0.363	0.363
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	0.365	0.365	0.367	0.368	0.369	0.370	0.372	0.373	0.375	0.377	0.379	0.381	0.383	0.386	0.388	0.390	0.392	0.395	0.398	0.400
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	0.403	0.418	0.433	0.447	0.461	0.476	0.493	0.507	0.515	0.526	0.535	0.545	0.556	0.560	0.543	0.277	0.156	0.146	0.159	0.177
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	0.197	0.218	0.243	0.269	0.296	0.319	0.328	0.313	0.268	0.202	0.141	0.092	0.065	0.051	0.060	0.084	0.115	0.132	0.124	0.104
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	0.086	0.081	0.086	0.091	0.091	0.084	0.071	0.054	0.039	0.027	0.018	0.011	0.007	0.004	0.002	0.001	0.001	0.001	0.001	0.001
λnm	5000																			
τ	<1E-05																			



Internal Transmittance (τ)

λ nm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.001	0.008	0.038	0.093	0.139	0.157	0.228
λ nm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	0.267	0.275	0.282	0.291	0.290	0.300	0.310	0.307	0.300	0.293	0.287	0.285	0.287	0.291	0.295	0.294	0.289	0.282	0.275	0.274
λ nm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.276	0.281	0.284	0.287	0.288	0.291	0.300	0.312	0.334	0.356	0.371	0.381	0.386	0.388	0.389	0.388	0.385	0.382	0.378	0.373
λ nm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.369	0.364	0.359	0.354	0.349	0.343	0.337	0.333	0.327	0.322	0.316	0.311	0.306	0.302	0.298	0.294	0.290	0.287	0.284	0.282
λ nm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
τ	0.279	0.279	0.277	0.276	0.275	0.275	0.274	0.274	0.274	0.275	0.276	0.278	0.282	0.287	0.293	0.301				

Refractive Index/Absorption coefficient/Reflection coefficient

λ nm	400	500	600	700	800	900	1000
n	1.529	1.515	1.508	1.504	1.501	1.499	1.498
P	0.916	0.919	0.921	0.922	0.923	0.923	0.924

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

	x	y	Y	λ_d	P _s
A	0.445	0.405	26	483	1
C	0.306	0.312	26	479	2
D65	0.308	0.325	26	480	2

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
3	2	490	555	-	70	417	111	2.42

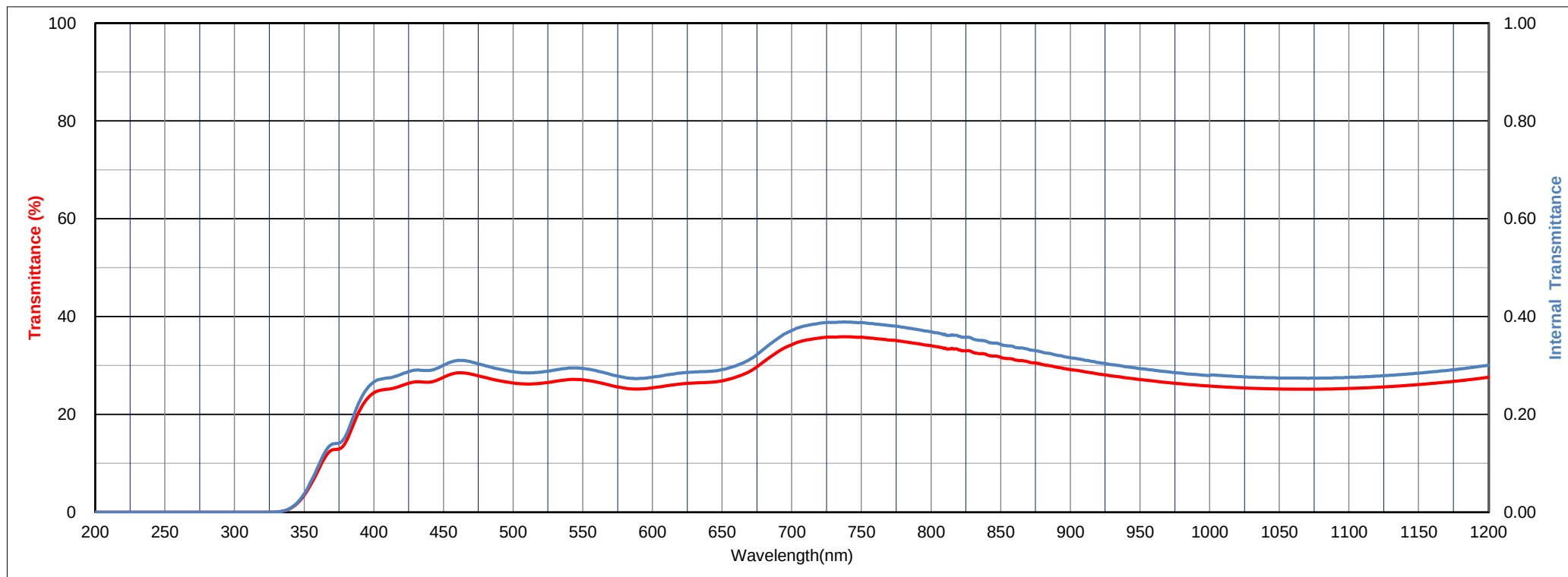
Tolerance of Transmittance (τ)

τ 405 (1)	τ 546 (2)	τ 694 (3)
0.27±0.03	0.31±0.03	0.39±0.04

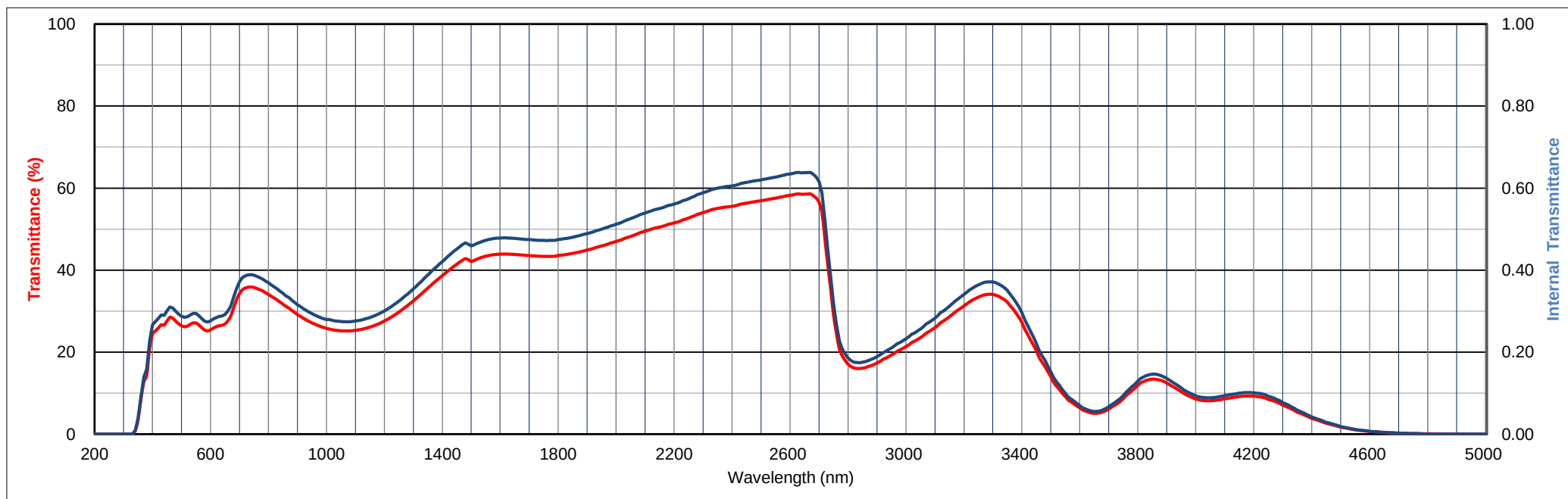
(1)Internal transmittance at 405nm

(2)Internal transmittance at 546nm

(3)Internal transmittance at 694nm



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.001	0.008	0.038	0.093	0.139	0.157	0.228
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	0.267	0.275	0.282	0.291	0.290	0.300	0.310	0.307	0.300	0.293	0.287	0.285	0.287	0.291	0.295	0.294	0.289	0.282	0.275	0.274
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.276	0.281	0.284	0.287	0.288	0.291	0.300	0.312	0.334	0.356	0.371	0.381	0.386	0.388	0.389	0.388	0.385	0.382	0.378	0.373
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.369	0.364	0.359	0.354	0.349	0.343	0.337	0.333	0.327	0.322	0.316	0.311	0.306	0.302	0.298	0.294	0.290	0.287	0.284	0.282
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	0.279	0.279	0.277	0.276	0.275	0.275	0.274	0.274	0.274	0.275	0.276	0.277	0.278	0.280	0.282	0.284	0.287	0.290	0.293	0.297
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	0.301	0.305	0.309	0.314	0.319	0.324	0.330	0.336	0.342	0.348	0.354	0.361	0.368	0.374	0.381	0.388	0.395	0.402	0.408	0.415
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	0.421	0.427	0.434	0.440	0.446	0.452	0.457	0.462	0.466	0.463	0.459	0.461	0.465	0.468	0.471	0.473	0.475	0.476	0.477	0.478
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	0.478	0.478	0.478	0.478	0.478	0.477	0.477	0.476	0.476	0.475	0.474	0.474	0.473	0.473	0.473	0.472	0.472	0.472	0.472	0.473
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	0.475	0.475	0.476	0.478	0.479	0.480	0.482	0.483	0.485	0.487	0.489	0.491	0.493	0.496	0.498	0.500	0.502	0.505	0.507	0.510
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	0.512	0.525	0.539	0.550	0.561	0.574	0.589	0.600	0.605	0.614	0.620	0.627	0.635	0.638	0.616	0.317	0.186	0.175	0.189	0.210
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	0.233	0.256	0.283	0.312	0.341	0.364	0.371	0.351	0.297	0.222	0.153	0.100	0.070	0.055	0.066	0.094	0.129	0.146	0.136	0.113
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	0.093	0.089	0.094	0.100	0.101	0.093	0.077	0.059	0.042	0.029	0.019	0.011	0.007	0.004	0.002	0.001	0.001	0.001	0.001	0.001
λnm	5000																			
τ	<1E-05																			



Internal Transmittance (τ)

λ nm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.001	0.015	0.080	0.200	0.330	0.395	0.404	0.514
λ nm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	0.558	0.558	0.562	0.571	0.569	0.582	0.595	0.594	0.588	0.582	0.579	0.577	0.580	0.584	0.588	0.587	0.583	0.575	0.568	0.567
λ nm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.568	0.571	0.573	0.574	0.574	0.575	0.580	0.591	0.607	0.623	0.634	0.640	0.640	0.639	0.637	0.632	0.627	0.621	0.615	0.609
λ nm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.604	0.597	0.591	0.583	0.575	0.569	0.563	0.556	0.550	0.544	0.538	0.531	0.525	0.520	0.515	0.511	0.506	0.502	0.499	0.495
λ nm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
τ	0.492	0.493	0.491	0.489	0.487	0.486	0.485	0.484	0.484	0.484	0.484	0.486	0.489	0.493	0.498	0.505				

Refractive Index/Absorption coefficient/Reflection coefficient

λ nm	400	500	600	700	800	900	1000
n	1.527	1.513	1.506	1.502	1.499	1.497	1.495
P	0.917	0.920	0.922	0.923	0.923	0.924	0.924

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

	x	y	Y	λ_d	P _s
A	0.446	0.408	53	500	0
C	0.309	0.317	53	494	0
D65	0.311	0.329	53	495	0

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
3	2	490	560	-	68	416	124	2.42

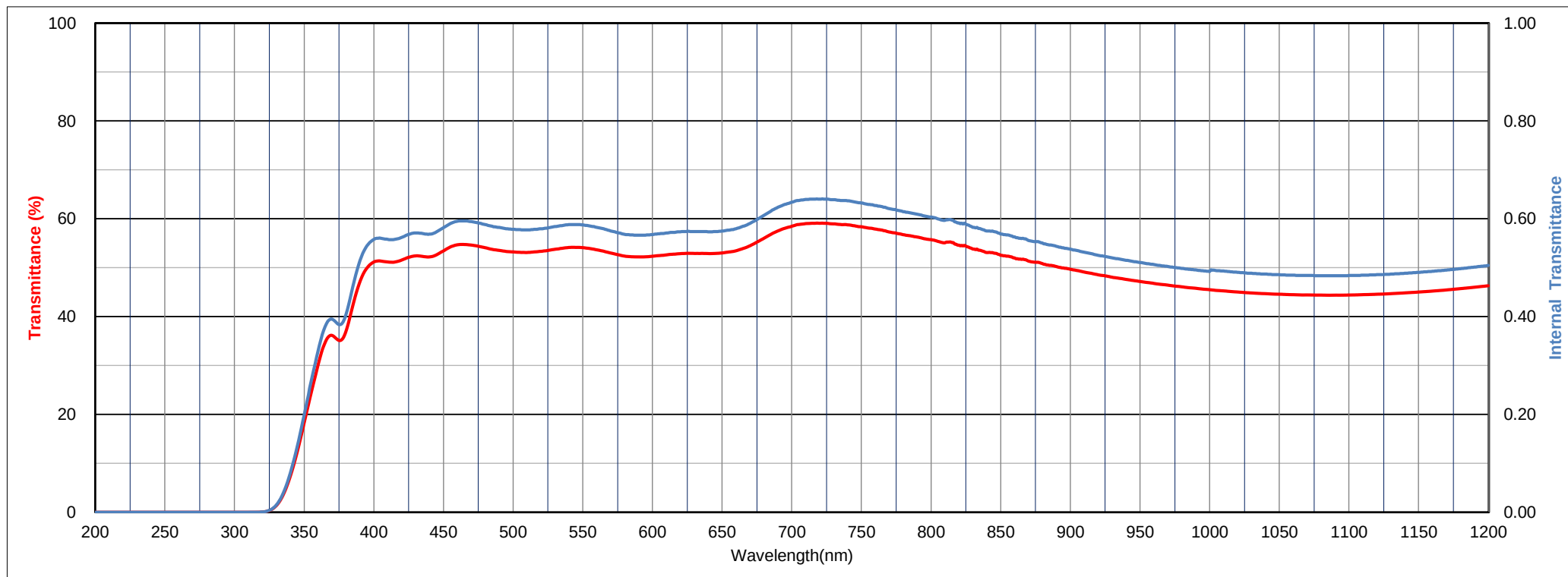
Tolerance of Transmittance (τ)

τ 405 (1)	τ 546 (2)	τ 694 (3)
0.56±0.03	0.57±0.03	0.62±0.03

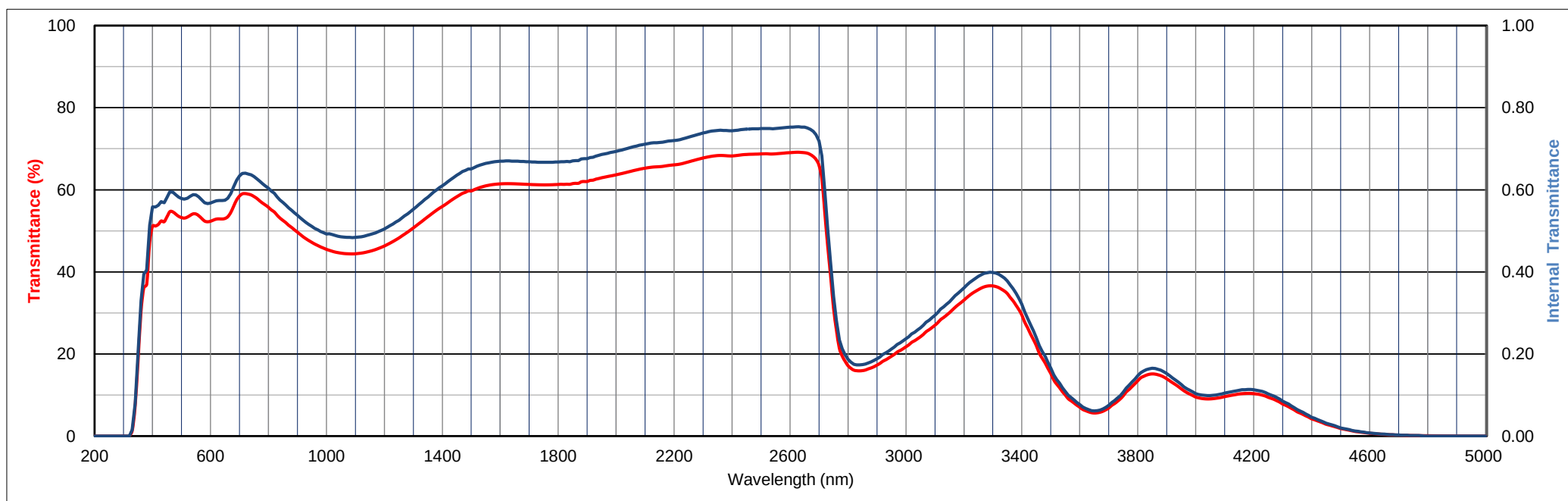
(1)Internal transmittance at 405nm

(2)Internal transmittance at 546nm

(3)Internal transmittance at 694nm



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.001	0.015	0.080	0.200	0.330	0.395	0.404	0.514
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	0.558	0.558	0.562	0.571	0.569	0.582	0.595	0.594	0.588	0.582	0.579	0.577	0.580	0.584	0.588	0.587	0.583	0.575	0.568	0.567
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.568	0.571	0.573	0.574	0.574	0.575	0.580	0.591	0.607	0.623	0.634	0.640	0.640	0.639	0.637	0.632	0.627	0.621	0.615	0.609
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.604	0.597	0.591	0.583	0.575	0.569	0.563	0.556	0.550	0.544	0.538	0.531	0.525	0.520	0.515	0.511	0.506	0.502	0.499	0.495
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	0.492	0.493	0.491	0.489	0.487	0.486	0.485	0.484	0.484	0.484	0.484	0.485	0.486	0.487	0.489	0.491	0.493	0.495	0.498	0.501
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	0.505	0.508	0.512	0.517	0.521	0.526	0.531	0.536	0.541	0.547	0.553	0.559	0.564	0.570	0.576	0.582	0.588	0.594	0.600	0.605
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	0.610	0.615	0.620	0.625	0.631	0.635	0.640	0.645	0.647	0.651	0.651	0.654	0.657	0.660	0.662	0.664	0.666	0.667	0.668	0.669
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	0.670	0.670	0.670	0.670	0.670	0.670	0.669	0.669	0.669	0.668	0.668	0.668	0.667	0.667	0.667	0.667	0.667	0.667	0.667	0.668
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	0.668	0.669	0.668	0.669	0.668	0.670	0.671	0.671	0.675	0.676	0.676	0.679	0.679	0.682	0.684	0.686	0.687	0.689	0.691	0.692
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	0.694	0.703	0.711	0.715	0.720	0.728	0.738	0.745	0.744	0.748	0.749	0.749	0.752	0.752	0.719	0.341	0.187	0.174	0.188	0.212
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	0.237	0.264	0.294	0.327	0.361	0.389	0.399	0.378	0.321	0.240	0.166	0.109	0.077	0.061	0.075	0.107	0.147	0.165	0.152	0.126
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	0.104	0.099	0.105	0.112	0.113	0.103	0.085	0.064	0.046	0.031	0.020	0.012	0.008	0.004	0.003	0.001	0.001	0.001	0.001	0.001
λnm	5000																			
τ	<1E-05																			



Internal Transmittance (τ)

λ nm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.001	0.010	0.085	0.246	0.431	0.565	0.624	0.608	0.713
λ nm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	0.750	0.744	0.746	0.755	0.751	0.763	0.773	0.771	0.766	0.760	0.757	0.755	0.756	0.759	0.761	0.761	0.759	0.752	0.745	0.741
λ nm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.740	0.743	0.747	0.747	0.744	0.744	0.746	0.752	0.763	0.775	0.784	0.791	0.796	0.799	0.795	0.792	0.786	0.778	0.772	0.765
λ nm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.758	0.750	0.742	0.735	0.726	0.720	0.711	0.707	0.703	0.693	0.688	0.681	0.674	0.666	0.662	0.657	0.650	0.647	0.641	0.637
λ nm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
τ	0.634	0.634	0.631	0.628	0.626	0.624	0.621	0.619	0.618	0.617	0.617	0.616	0.618	0.620	0.623	0.627				

Refractive Index/Absorption coefficient/Reflection coefficient

λ nm	400	500	600	700	800	900	1000
n	1.524	1.511	1.504	1.500	1.498	1.496	1.495
P	0.917	0.920	0.922	0.923	0.924	0.924	0.924

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

	x	y	Y	λ_d	P _e
A	0.446	0.408	69	496	0
C	0.308	0.316	69	487	1
D65	0.311	0.329	69	488	1

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
3	2	485	565	-	66	423	110	2.40

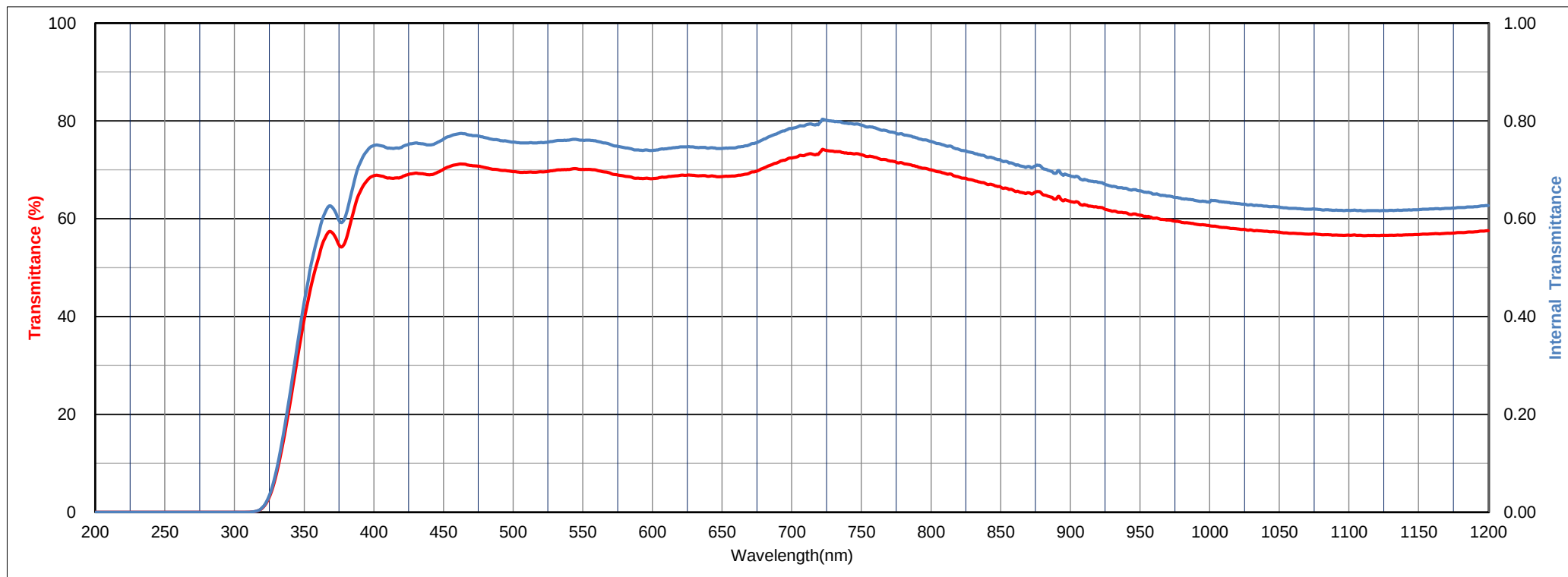
Tolerance of Transmittance (τ)

τ 405 (1)	τ 546 (2)	τ 694 (3)
0.76±0.02	0.77±0.02	0.79±0.02

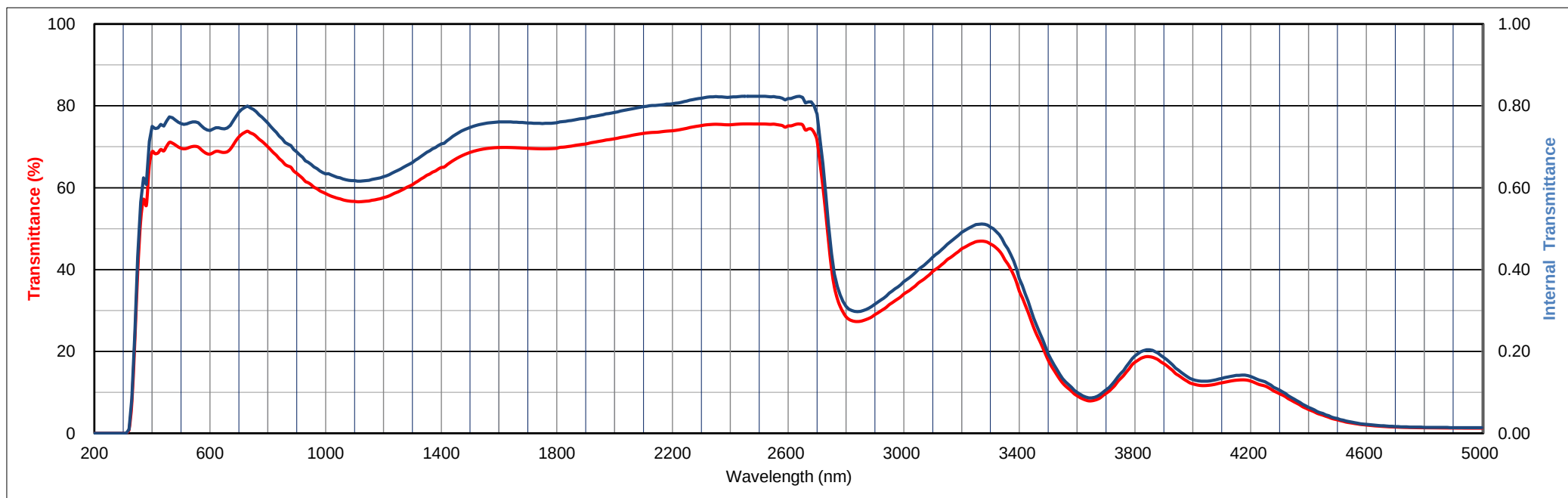
(1)Internal transmittance at 405nm

(2)Internal transmittance at 546nm

(3)Internal transmittance at 694nm



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
τ	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	<1E-05	0.001	0.010	0.085	0.246	0.431	0.565	0.624	0.608	0.713
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
τ	0.750	0.744	0.746	0.755	0.751	0.763	0.773	0.771	0.766	0.760	0.757	0.755	0.756	0.759	0.761	0.761	0.759	0.752	0.745	0.741
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
τ	0.740	0.743	0.747	0.747	0.744	0.744	0.746	0.752	0.763	0.775	0.784	0.791	0.796	0.799	0.795	0.792	0.786	0.778	0.772	0.765
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
τ	0.758	0.750	0.742	0.735	0.726	0.720	0.711	0.707	0.703	0.693	0.688	0.681	0.674	0.666	0.662	0.657	0.650	0.647	0.641	0.637
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
τ	0.634	0.634	0.631	0.628	0.626	0.624	0.621	0.619	0.618	0.617	0.617	0.616	0.616	0.617	0.618	0.618	0.620	0.621	0.623	0.624
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
τ	0.627	0.629	0.632	0.636	0.639	0.642	0.646	0.650	0.654	0.658	0.662	0.667	0.671	0.677	0.681	0.687	0.690	0.695	0.698	0.703
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
τ	0.707	0.709	0.715	0.720	0.725	0.730	0.734	0.738	0.742	0.745	0.748	0.750	0.752	0.754	0.756	0.757	0.758	0.759	0.760	0.760
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
τ	0.761	0.761	0.761	0.761	0.761	0.760	0.760	0.760	0.759	0.759	0.758	0.758	0.758	0.757	0.757	0.757	0.757	0.757	0.758	0.758
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
τ	0.759	0.761	0.761	0.762	0.763	0.764	0.766	0.767	0.768	0.769	0.770	0.772	0.774	0.775	0.776	0.777	0.779	0.780	0.781	0.783
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
τ	0.784	0.791	0.798	0.801	0.805	0.812	0.819	0.822	0.821	0.823	0.823	0.823	0.818	0.821	0.780	0.439	0.310	0.298	0.316	0.342
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
τ	0.370	0.400	0.431	0.462	0.491	0.510	0.504	0.461	0.378	0.281	0.194	0.133	0.100	0.086	0.106	0.145	0.189	0.204	0.185	0.154
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
τ	0.132	0.127	0.134	0.141	0.139	0.126	0.105	0.084	0.063	0.048	0.036	0.027	0.022	0.019	0.017	0.015	0.015	0.014	0.014	0.014
λnm	5000																			
τ	0.0																			



Heat Absorbing Filters

These slightly bluish glass filters feature high transmittance in the visible region and good absorption of heat rays (infrared rays), and include HA-5 and HA-15, which are made of silicate glass, and HA-30 and HA-50, which consist of phosphate glass. The latter efficiently absorb thermal radiations emitted from a light source, and so are highly effective when employed for slide projectors and a variety of illumination equipment.

Note: "Strengthened glass", produced by tempering processes, may also be supplied to minimize the cracking of filter glass due to thermal shock.

Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	1.34E-04	0.02	0.60	5.16	18.49	37.74	54.04	66.07	75.02	78.72	79.91	77.95
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	74.02	71.98	70.18	71.15	72.72	73.07	71.88	73.23	74.44	75.53	75.33	74.76	73.41	72.83	73.58	75.34	75.52	74.69	73.21	70.88
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	67.89	64.16	59.72	54.82	49.64	44.26	38.85	34.00	28.78	23.77	19.20	15.17	11.83	9.04	6.75	4.91	3.47	2.39	1.60	1.06
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	0.68	0.45	0.28	0.17	0.10	0.06	0.03	0.02	0.01	0.01	3.39E-03	1.87E-03	1.02E-03	5.68E-04	3.14E-04	1.78E-04	1.04E-04	6.01E-05	3.50E-05	2.10E-05
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	1.29E-05	8.01E-06	5.13E-06	3.37E-06	2.28E-06	1.58E-06	1.12E-06	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.539	1.529	1.525	1.522	1.520	1.519	1.518
P	0.914	0.916	0.917	0.918	0.918	0.919	0.919

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

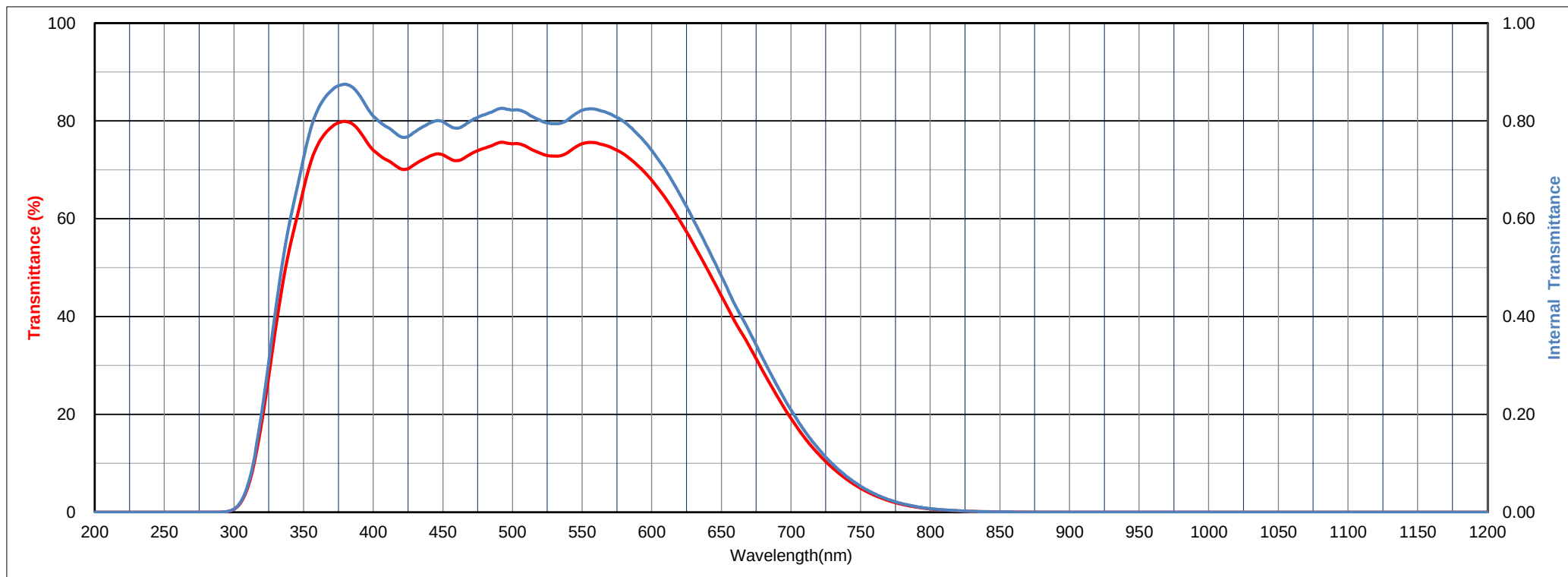
	x	y	Y	λ _d	P _s
A	0.424	0.419	69	504	5
C	0.295	0.320	71	494	5
D65	0.298	0.333	71	495	5

Properties

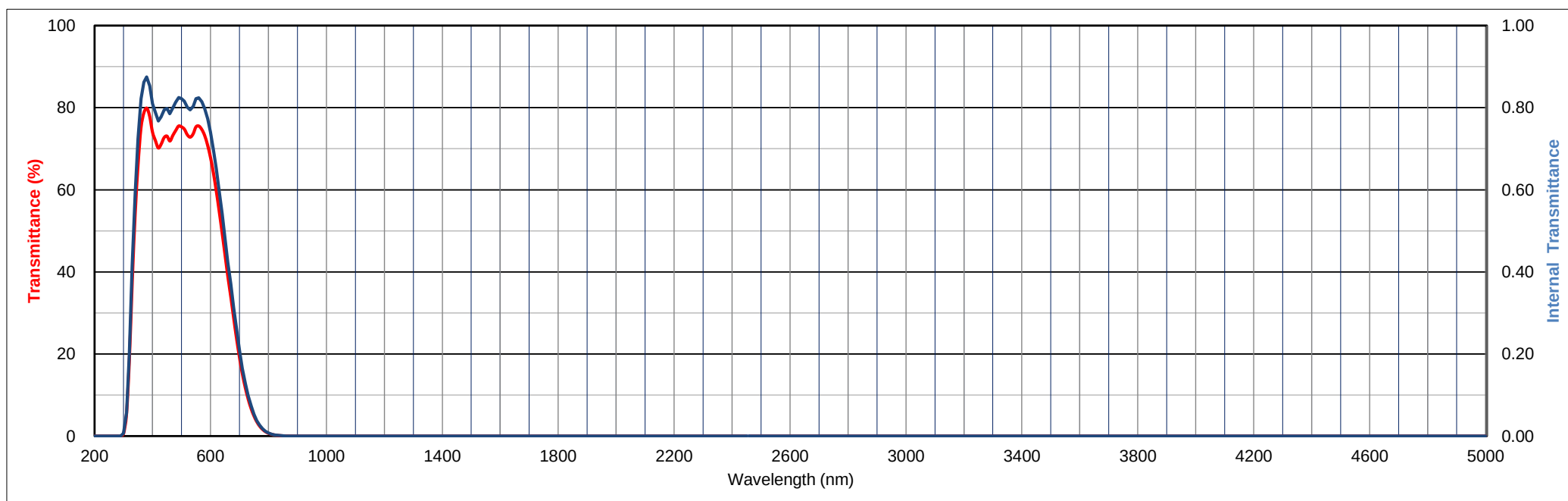
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	-	595	-	-	64	517	-	2.63

Tolerance of Transmittance (T)

Transmittance at 750nm	Transmittance at 1000nm	Average Transmittance at 400nm-700nm
T750(%)	T1000(%)	Tav(%)
<6	<1	63±5



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	1.3E-04	0.02	0.60	5.16	18.49	37.74	54.04	66.07	75.02	78.72	79.91	77.95
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	74.02	71.98	70.18	71.15	72.72	73.07	71.88	73.23	74.44	75.53	75.33	74.76	73.41	72.83	73.58	75.34	75.52	74.69	73.21	70.88
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	67.89	64.16	59.72	54.82	49.64	44.26	38.85	34.00	28.78	23.77	19.20	15.17	11.83	9.04	6.75	4.91	3.47	2.39	1.60	1.06
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	0.68	0.45	0.28	0.17	0.10	0.06	0.03	0.02	0.01	0.01	3.4E-03	1.9E-03	1.0E-03	5.7E-04	3.1E-04	1.8E-04	1.0E-04	6.0E-05	3.5E-05	2.1E-05
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	1.3E-05	8.0E-06	5.1E-06	3.4E-06	2.3E-06	1.6E-06	1.1E-06	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	<1E-6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
λnm	5000																			
T	0.00																			



Transmittance (T)		units: %																		
λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	4.32E-05	0.01	0.20	2.31	11.86	30.59	50.81	65.17	74.39	80.53	83.05	83.78	82.40
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	79.69	78.02	77.11	78.05	79.31	79.59	78.63	79.44	80.26	80.90	80.59	80.02	78.93	78.35	78.78	79.84	79.86	79.15	78.00	76.35
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	74.23	71.61	68.36	64.65	60.65	56.38	51.81	47.56	42.67	37.73	32.88	28.20	24.00	20.16	16.70	13.62	10.89	8.57	6.63	5.07
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	3.80	2.84	2.12	1.52	1.08	0.76	0.53	0.37	0.26	0.18	0.12	0.08	0.06	0.04	0.03	0.02	0.01	0.01	0.01	4.51E-03
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	3.28E-03	2.46E-03	1.86E-03	1.43E-03	1.12E-03	8.91E-04	7.22E-04	5.96E-04	5.05E-04	4.33E-04	3.75E-04	2.99E-04	2.53E-04	2.26E-04	2.12E-04	2.06E-04				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.538	1.529	1.524	1.521	1.519	1.518	1.517
P	0.914	0.916	0.917	0.918	0.919	0.919	0.919

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

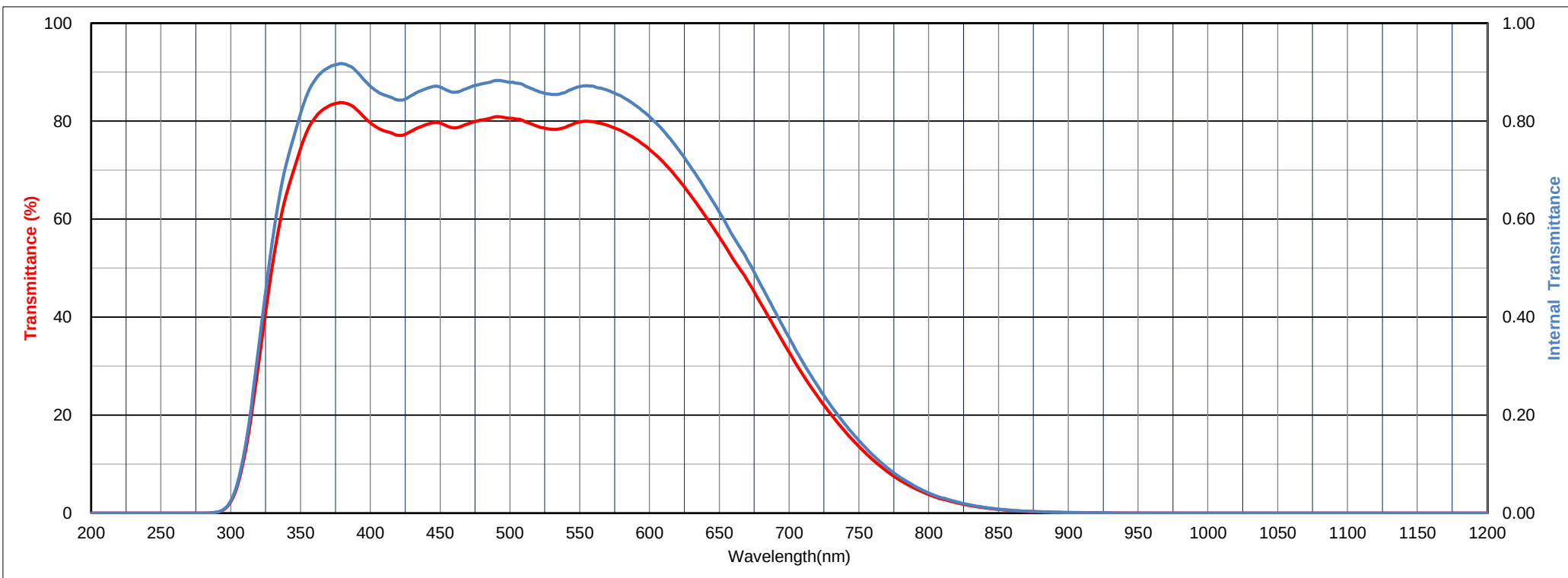
	x	y	Y	λ _d	P _s
A	0.431	0.414	75	502	4
C	0.298	0.317	77	492	4
D65	0.301	0.330	77	492	4

Properties

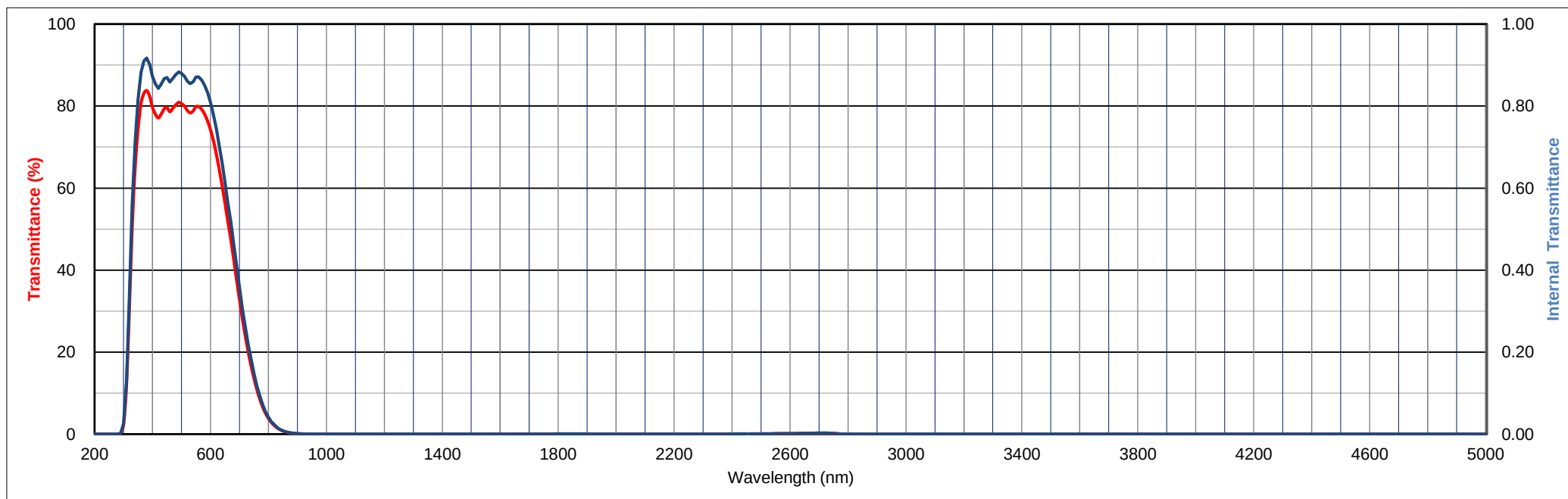
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	-	597	-	-	65	502	-	2.64

Tolerance of Transmittance (T)

Wavelength for Max Transmittance	Transmittance at 750nm	Average Transmittance at 400nm-700nm
λTmax(nm)	T750(%)	Tav(%)
380±5	<15	70±5



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	4.3E-05	0.01	0.20	2.31	11.86	30.59	50.81	65.17	74.39	80.53	83.05	83.78	82.40
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	79.69	78.02	77.11	78.05	79.31	79.59	78.63	79.44	80.26	80.90	80.59	80.02	78.93	78.35	78.78	79.84	79.86	79.15	78.00	76.35
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	74.23	71.61	68.36	64.65	60.65	56.38	51.81	47.56	42.67	37.73	32.88	28.20	24.00	20.16	16.70	13.62	10.89	8.57	6.63	5.07
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	3.80	2.84	2.12	1.52	1.08	0.76	0.53	0.37	0.26	0.18	0.12	0.08	0.06	0.04	0.03	0.02	0.01	0.01	0.01	0.00
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	3.3E-03	2.5E-03	1.9E-03	1.4E-03	1.1E-03	8.9E-04	7.2E-04	6.0E-04	5.0E-04	4.3E-04	3.8E-04	3.3E-04	3.0E-04	2.7E-04	2.5E-04	2.4E-04	2.3E-04	2.2E-04	2.1E-04	2.1E-04
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	2.1E-04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.04	0.05	0.08	0.10	0.14	0.19	0.24	0.18	0.01	0.00	0.00	0.00
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
λnm	5000																			
T	0.00																			



Transmittance (T)		units: %																		
λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	3.35E-04	0.05	1.30	9.24	28.21	50.81	67.65	77.92	83.91	86.23	87.11	86.49
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	84.91	83.92	83.41	84.01	84.78	84.97	84.47	85.03	85.55	86.00	85.83	85.57	84.98	84.71	85.01	85.65	85.77	85.46	84.81	83.87
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	82.57	80.92	78.88	76.44	73.73	70.68	67.28	64.04	60.11	55.98	51.68	47.26	43.02	38.84	34.77	30.83	27.01	23.44	20.14	17.18
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	14.48	12.20	10.26	8.45	6.93	5.60	4.50	3.64	2.93	2.33	1.86	1.48	1.18	0.94	0.75	0.61	0.49	0.40	0.33	0.27
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	0.23	0.19	0.16	0.14	0.12	0.10	0.09	0.09	0.08	0.08	0.07	0.06	0.05	0.05	0.05	0.05				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.533	1.524	1.519	1.516	1.514	1.513	1.512
P	0.915	0.917	0.919	0.919	0.920	0.920	0.920

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

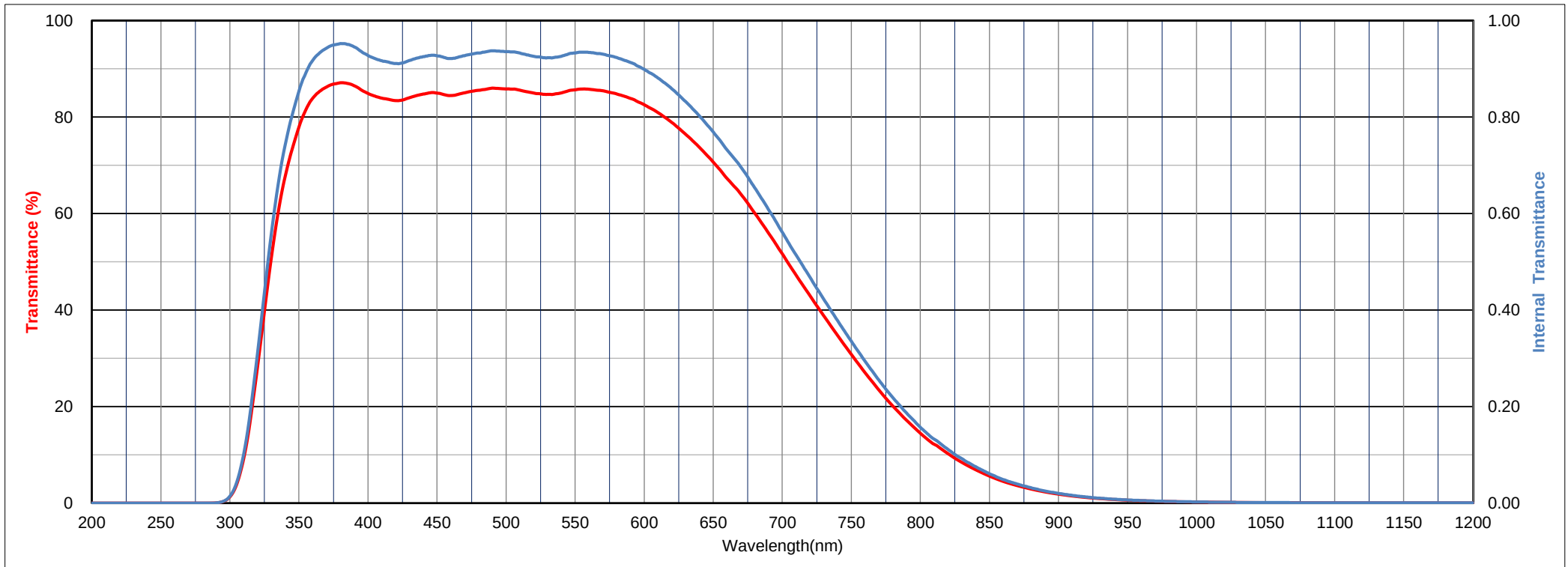
	x	y	Y	λ _d	P _a
A	0.438	0.412	83	503	2
C	0.304	0.317	84	493	2
D65	0.307	0.330	84	494	2

Properties

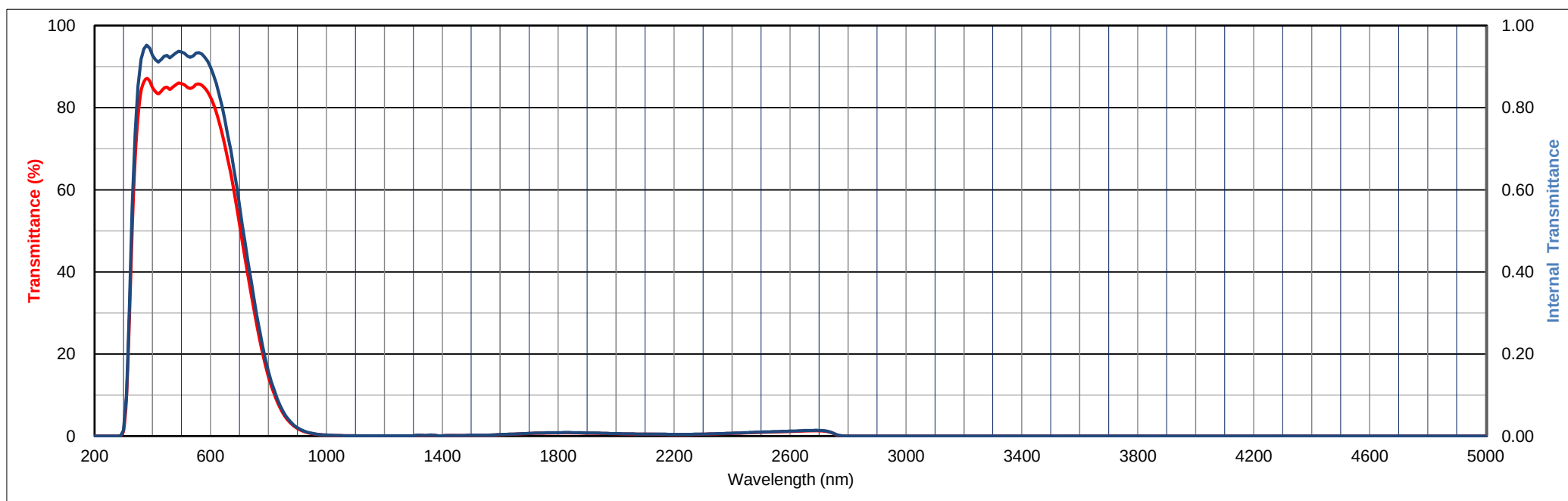
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _k	F _A	d
1	-	565	620	-	66	-	-	2.61

Tolerance of Transmittance (T)

Transmittance at 750nm	Transmittance at 1000nm	Average Transmittance at 400nm-700nm
T750(%)	T1000(%)	Tav(%)
<35	<1	80±5



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	3.4E-04	0.05	1.30	9.24	28.21	50.81	67.65	77.92	83.91	86.23	87.11	86.49
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	84.91	83.92	83.41	84.01	84.78	84.97	84.47	85.03	85.55	86.00	85.83	85.57	84.98	84.71	85.01	85.65	85.77	85.46	84.81	83.87
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	82.57	80.92	78.88	76.44	73.73	70.68	67.28	64.04	60.11	55.98	51.68	47.26	43.02	38.84	34.77	30.83	27.01	23.44	20.14	17.18
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	14.48	12.20	10.26	8.45	6.93	5.60	4.50	3.64	2.93	2.33	1.86	1.48	1.18	0.94	0.75	0.61	0.49	0.40	0.33	0.27
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	0.23	0.19	0.16	0.14	0.12	0.10	0.09	0.09	0.08	0.08	0.07	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.18	0.22	0.17	0.13	0.17	0.23	0.17	0.12	0.01
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	0.06	0.11	0.13	0.16	0.16	0.13	0.13	0.14	0.16	0.19	0.19	0.21	0.20	0.18	0.18	0.20	0.21	0.25	0.29	0.32
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	0.36	0.39	0.41	0.43	0.45	0.47	0.51	0.53	0.57	0.59	0.63	0.66	0.68	0.69	0.71	0.71	0.73	0.73	0.76	0.76
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	0.78	0.79	0.79	0.79	0.79	0.78	0.77	0.76	0.74	0.72	0.71	0.70	0.69	0.67	0.66	0.65	0.64	0.62	0.60	0.59
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	0.57	0.49	0.46	0.44	0.39	0.40	0.46	0.55	0.66	0.78	0.91	1.01	1.12	1.24	1.28	0.64	0.00	0.00	0.01	0.00
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.01	0.00
λnm	5000																			
T	0.00																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	3.09E-03	0.32	2.91	11.77	29.03	49.56	66.40	77.11	82.72	85.84	87.94	88.59	88.69	87.92
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	86.60	85.85	85.19	85.46	85.98	86.05	85.66	86.11	86.55	86.82	86.70	86.45	85.95	85.63	85.82	86.24	86.21	85.90	85.33	84.52
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	83.49	82.17	80.49	78.56	76.40	73.95	71.17	68.49	65.19	61.70	57.97	54.11	50.29	46.48	42.71	38.90	35.16	31.52	28.05	24.83
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	21.79	19.12	16.78	14.43	12.43	10.60	8.97	7.61	6.47	5.46	4.59	3.86	3.26	2.75	2.32	1.98	1.70	1.45	1.26	1.09
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	0.95	0.83	0.74	0.66	0.59	0.53	0.49	0.45	0.42	0.39	0.37	0.33	0.31	0.29	0.28	0.28				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.528	1.519	1.515	1.512	1.510	1.509	1.508
P	0.916	0.919	0.920	0.920	0.921	0.921	0.921

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

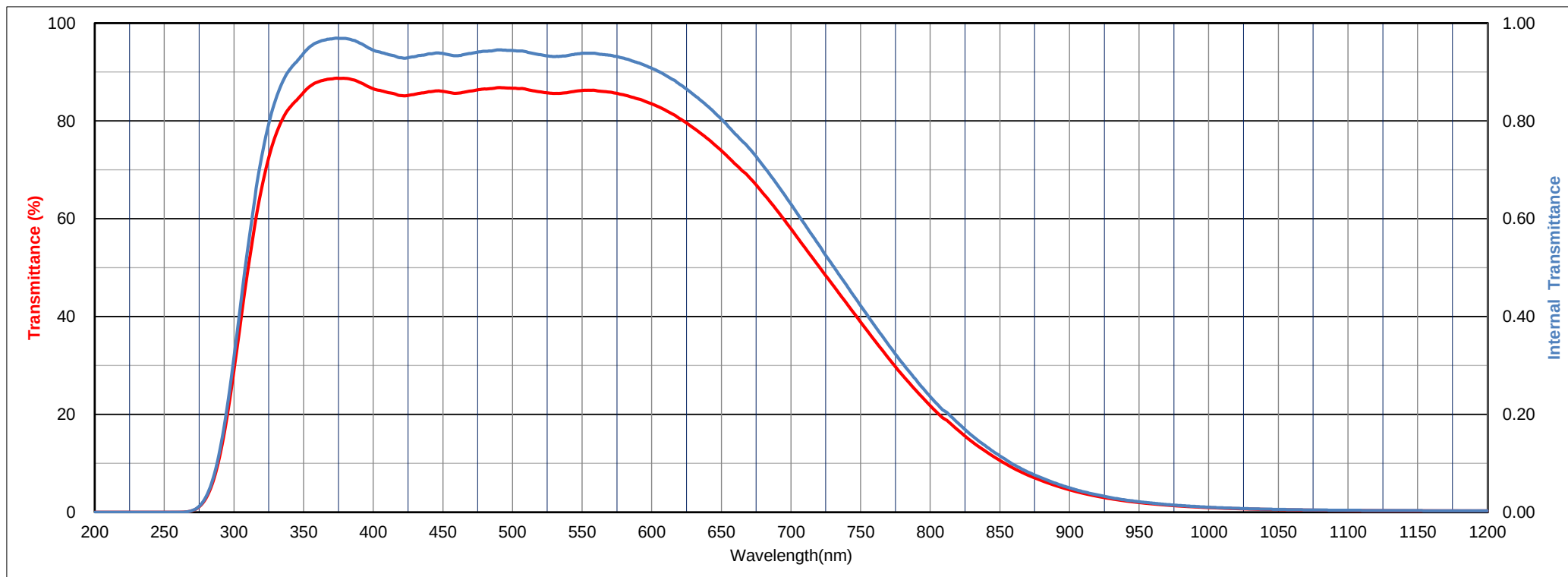
	x	y	Y	λ _d	P _s
A	0.440	0.411	84	502	2
C	0.305	0.316	85	491	2
D65	0.307	0.329	85	493	2

Properties

Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	-	560	615	-	66	-	-	2.60

Tolerance of Transmittance (T)

Transmittance at 750nm	Transmittance at 1000nm	Average Transmittance at 400nm-700nm
T750(%)	T1000(%)	Tav(%)
<55	<3	80±5





HOYA CORPORATION OPTICS SECTION

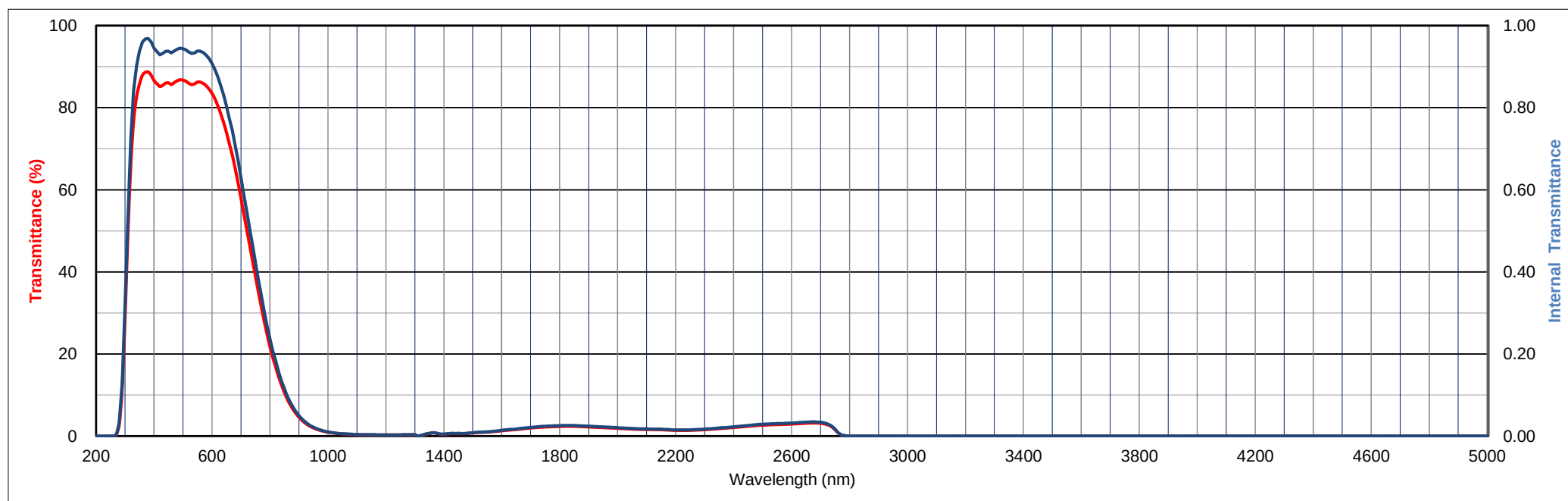
Transmittance (T)

units: %

Thickness 3.00 mm

HA50

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	<1E-6	0.00	0.32	2.91	11.77	29.03	49.56	66.40	77.11	82.72	85.84	87.94	88.59	88.69	87.92
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	86.60	85.85	85.19	85.46	85.98	86.05	85.66	86.11	86.55	86.82	86.70	86.45	85.95	85.63	85.82	86.24	86.21	85.90	85.33	84.52
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	83.49	82.17	80.49	78.56	76.40	73.95	71.17	68.49	65.19	61.70	57.97	54.11	50.29	46.48	42.71	38.90	35.16	31.52	28.05	24.83
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	21.79	19.12	16.78	14.43	12.43	10.60	8.97	7.61	6.47	5.46	4.59	3.86	3.26	2.75	2.32	1.98	1.70	1.45	1.26	1.09
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	0.95	0.83	0.74	0.66	0.59	0.53	0.49	0.45	0.42	0.39	0.37	0.35	0.33	0.32	0.31	0.30	0.29	0.29	0.28	0.28
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	0.28	0.28	0.28	0.28	0.28	0.29	0.29	0.30	0.30	0.31	0.31	0.00	0.13	0.31	0.49	0.62	0.75	0.75	0.60	0.44
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	0.45	0.50	0.56	0.60	0.58	0.60	0.57	0.58	0.64	0.71	0.77	0.82	0.87	0.90	0.94	0.96	1.00	1.09	1.14	1.22
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	1.29	1.36	1.42	1.49	1.54	1.60	1.68	1.75	1.84	1.90	1.97	2.04	2.09	2.14	2.18	2.21	2.24	2.27	2.30	2.33
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	2.35	2.37	2.39	2.39	2.38	2.37	2.35	2.32	2.29	2.25	2.22	2.19	2.16	2.12	2.09	2.06	2.03	1.99	1.96	1.93
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	1.88	1.71	1.60	1.54	1.40	1.40	1.56	1.81	2.09	2.39	2.65	2.80	2.93	3.13	3.11	1.54	0.01	0.00	0.00	0.00
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	0.01	0.01	0.00	0.01	0.01	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00
λnm	5000																			
T	0.00																			



Ultraviolet Transmitting, Visible Absorbing Filters

These are dark glass filters, nearly black, which transmit the ultraviolet region but absorb the visible region. They transmit slightly in the near-infrared region.

The glass type figure represents the wavelength that provides the maximum transmittance. These filters are chiefly used for single extraction of the ultraviolet rays, and are often utilized for selectively transmitting the 253.7nm and 365nm wavelengths, which are the representative line spectra of mercury lamps.

Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.4	17.6	52.1	72.4	80.2	84.9	87.0	87.7	87.9	88.1	87.9	87.5	86.9	85.2	79.8	65.4	38.4
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	12.8	3.1	0.9	0.4	0.3	0.4	0.5	0.5	0.4	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.0	0.0	0.0	0.0	0.0	0.1	1.1	5.4	15.5	30.2	42.0	48.0	49.6	47.5	43.7	39.5	35.6	32.2	29.3	27.1
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	25.4	24.2	23.4	22.8	22.5	22.3	22.4	22.5	22.8	23.2	23.7	24.3	25.0	25.8	26.7	27.6	28.6	29.5	30.4	31.3
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	32.1	32.7	33.2	33.5	33.6	33.4	33.1	32.5	31.7	30.7	29.5	26.8	23.7	20.8	17.9	15.4				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.567	1.557	1.552	1.549	1.547	1.545	1.544
P	0.907	0.909	0.911	0.911	0.912	0.912	0.912

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

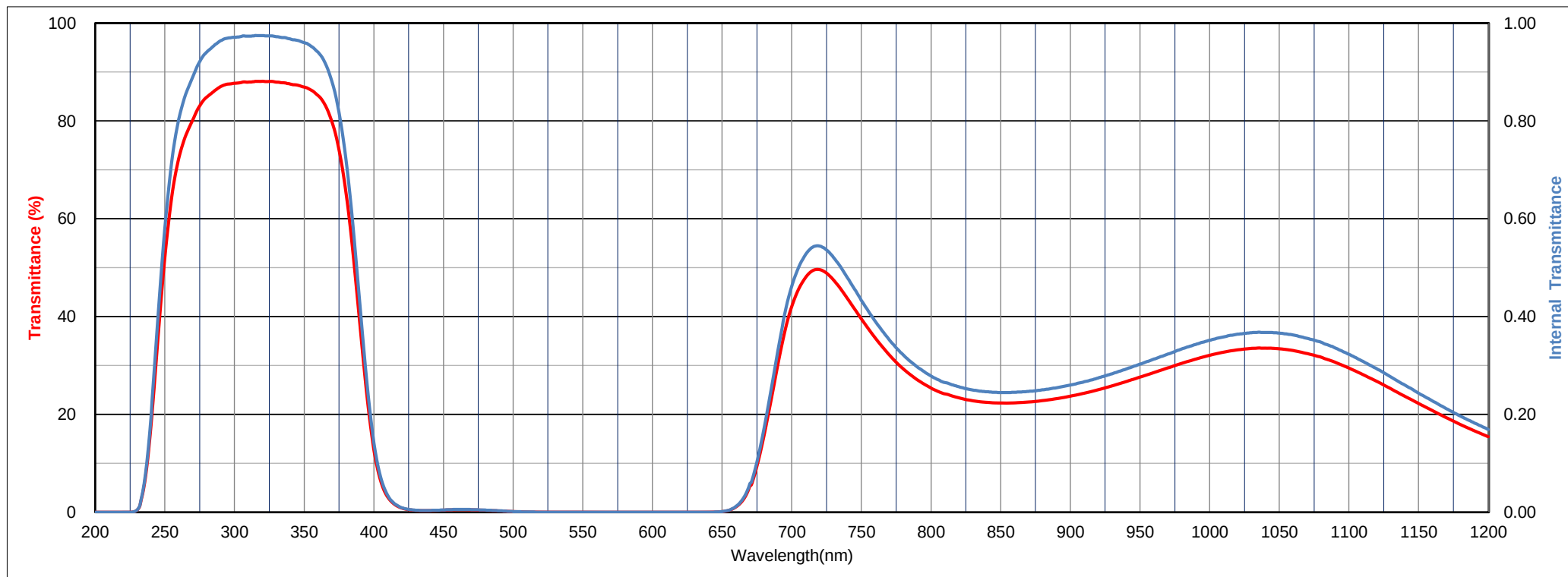
	x	y	Y	λ _d	P _e
A	-	-	-	-	-
C	-	-	-	-	-
D65	-	-	-	-	-

Properties

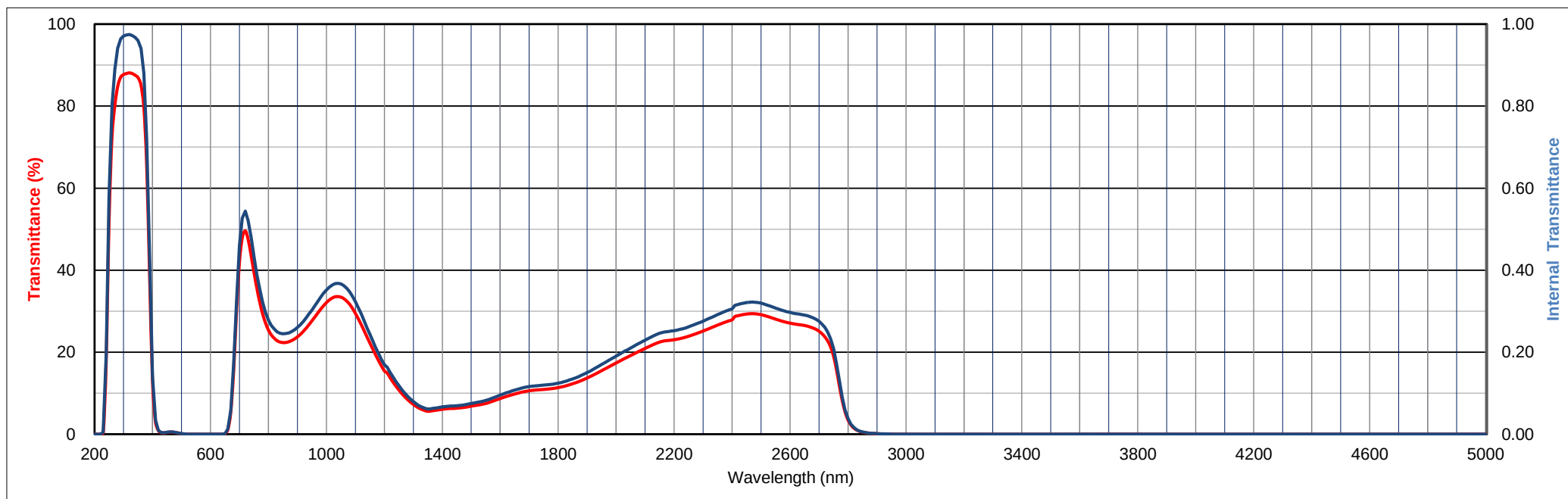
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
4	5	470	505	82	93	420	230	2.78

Tolerance of Transmittance (T)

Maximum Transmittance	Transmittance at 254nm	Transmittance at 405nm
Tmax(%)	T254(%)	T405(%)
85±5	>40	<15



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.4	17.6	52.1	72.4	80.2	84.9	87.0	87.7	87.9	88.1	87.9	87.5	86.9	85.2	79.8	65.4	38.4
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	12.8	3.1	0.9	0.4	0.3	0.4	0.5	0.5	0.4	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.0	0.0	0.0	0.0	0.0	0.1	1.1	5.4	15.5	30.2	42.0	48.0	49.6	47.5	43.7	39.5	35.6	32.2	29.3	27.1
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	25.4	24.2	23.4	22.8	22.5	22.3	22.4	22.5	22.8	23.2	23.7	24.3	25.0	25.8	26.7	27.6	28.6	29.5	30.4	31.3
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	32.1	32.7	33.2	33.5	33.6	33.4	33.1	32.5	31.7	30.7	29.5	28.1	26.8	25.3	23.7	22.2	20.8	19.3	17.9	16.6
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	15.4	14.9	13.8	12.7	11.7	10.8	9.9	9.2	8.5	7.8	7.3	6.8	6.4	6.0	5.8	5.6	5.6	5.8	5.9	6.0
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	6.1	6.2	6.2	6.3	6.3	6.3	6.4	6.5	6.6	6.7	6.8	7.0	7.1	7.2	7.3	7.5	7.7	8.0	8.2	8.4
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	8.7	8.9	9.2	9.4	9.6	9.8	10.0	10.2	10.3	10.5	10.6	10.7	10.8	10.8	10.9	10.9	11.0	11.1	11.1	11.2
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	11.4	11.5	11.7	11.9	12.1	12.3	12.5	12.8	13.1	13.4	13.7	14.0	14.4	14.7	15.1	15.5	15.9	16.2	16.6	17.0
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	17.4	19.2	20.9	22.5	23.0	23.9	25.2	26.6	27.9	29.3	29.1	28.1	27.1	26.5	25.1	19.1	3.5	0.5	0.1	0.0
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.2	7.8	30.7	54.3	67.5	73.4	75.9	76.7	75.9	72.3	63.0	39.7	9.4	0.2
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.9	1.6	2.1	2.1	1.4	0.7	0.3	0.1	0.1	0.0	0.0
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.587	1.576	1.571	1.568	1.565	1.563	1.562
P	0.902	0.905	0.906	0.907	0.907	0.908	0.908

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

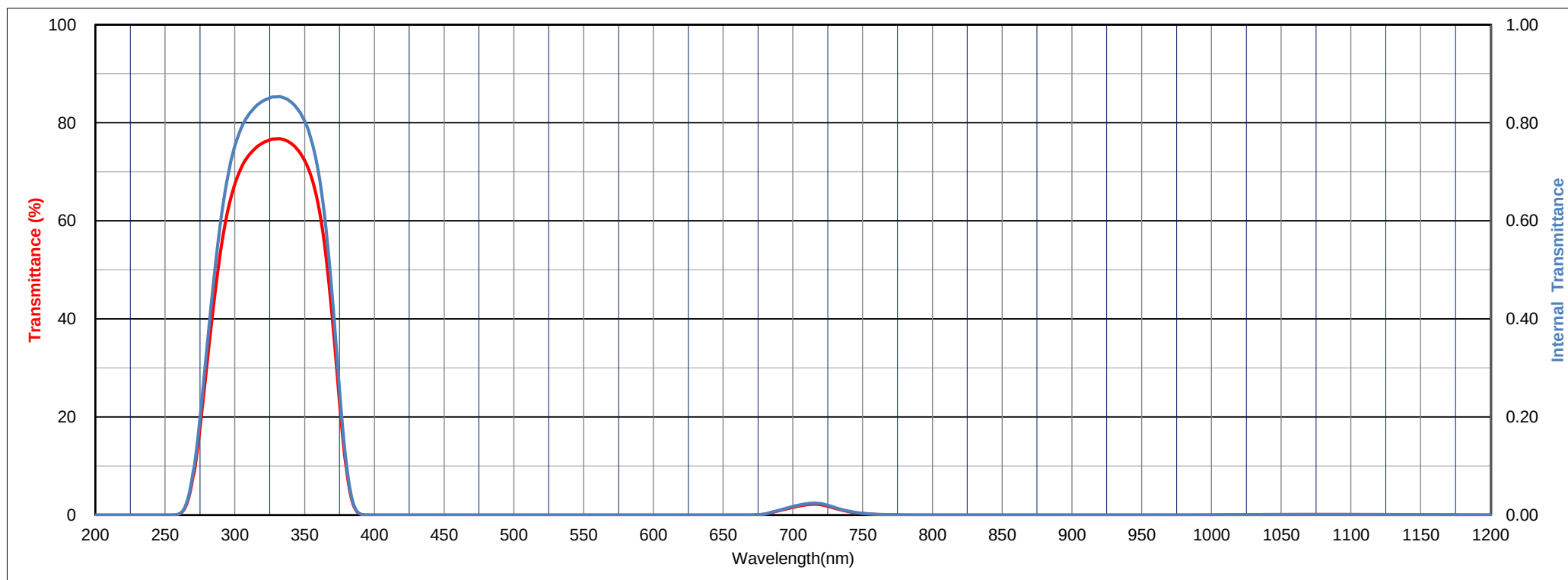
	x	y	Y	λ _d	P _e
A	-	-	-	-	-
C	-	-	-	-	-
D65	-	-	-	-	-

Properties

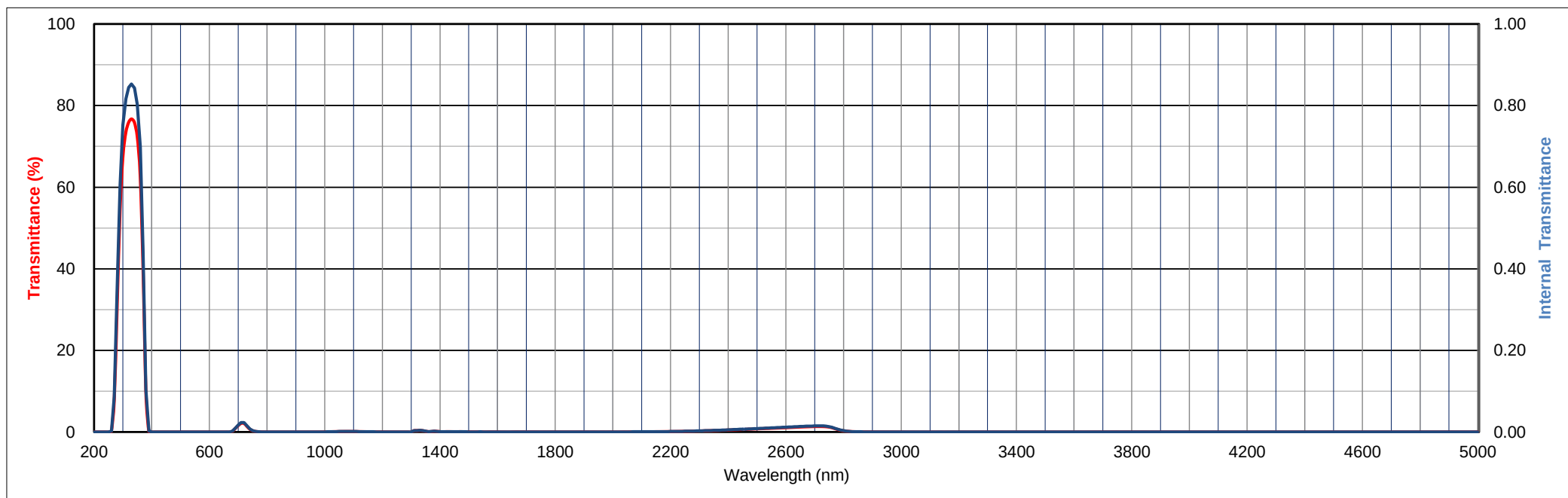
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
4	4	530	565	85	96	430	250	2.92

Tolerance of Transmittance (T)

Maximum Transmittance	Transmittance at 254nm	Transmittance at 405nm
Tmax(%)	T254(%)	T405(%)
75±5	<1	<0.1



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.2	7.8	30.7	54.3	67.5	73.4	75.9	76.7	75.9	72.3	63.0	39.7	9.4	0.2
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.9	1.6	2.1	2.1	1.4	0.7	0.3	0.1	0.1	0.0	0.0
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.4	0.3	0.2	0.1	0.1	0.2	0.1
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	0.0	0.0	0.0	0.1	0.1	0.2	0.3	0.4	0.5	0.6	0.8	0.9	1.1	1.2	1.3	1.2	0.3	0.1	0.0	0.0
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	24.9	47.9	62.2	69.2	72.1	71.0	62.3	38.0	8.2
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	2.2	5.5	7.7	9.6	9.1	6.7	4.0	2.6	1.9
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	1.3	0.9	0.6	0.5	0.4	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.552	1.542	1.537	1.534	1.532	1.531	1.531
P	0.911	0.913	0.914	0.915	0.915	0.916	0.916

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

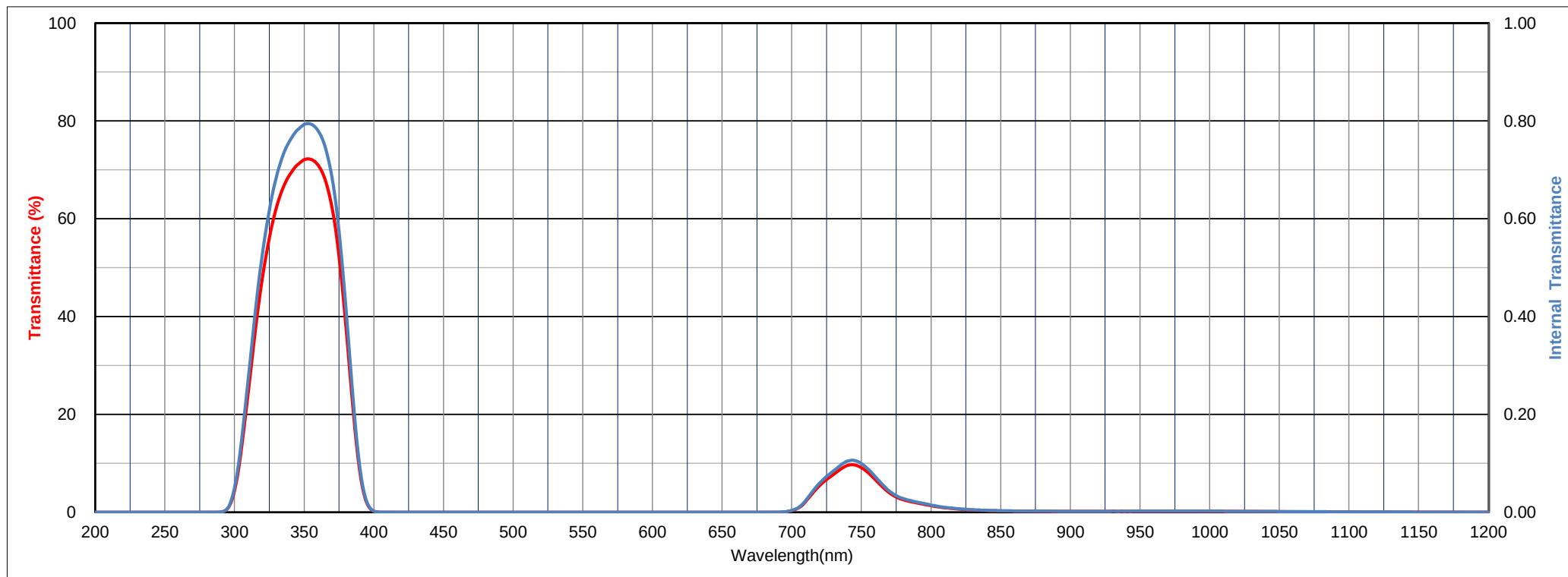
	x	y	Y	λ _d	P _e
A	-	-	-	-	-
C	-	-	-	-	-
D65	-	-	-	-	-

Properties

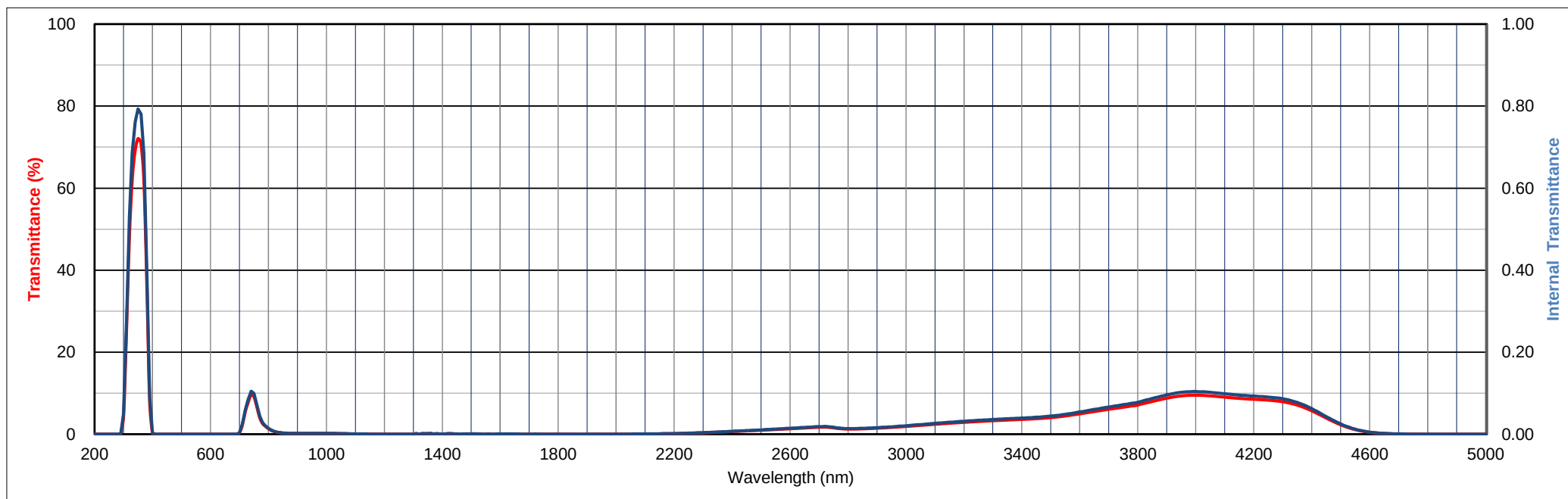
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
3	2	520	560	100	111	560	140	2.74

Tolerance of Transmittance (T)

Maximum Transmittance	Transmittance at 254nm	Transmittance at 405nm
Tmax(%)	T254(%)	T405(%)
70±5	<0.01	<1



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	24.9	47.9	62.2	69.2	72.1	71.0	62.3	38.0	8.2
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	2.2	5.5	7.7	9.6	9.1	6.7	4.0	2.6	1.9
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	1.3	0.9	0.6	0.5	0.4	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.2	0.1	0.1	0.2	0.0	0.1	0.1
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	0.0	0.0	0.1	0.1	0.1	0.2	0.3	0.5	0.6	0.8	1.0	1.1	1.3	1.5	1.7	1.5	1.3	1.3	1.5	1.7
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	1.9	2.2	2.4	2.7	2.9	3.1	3.3	3.5	3.6	3.8	4.0	4.4	5.0	5.5	6.1	6.6	7.1	8.0	8.8	9.3
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	9.5	9.3	9.0	8.7	8.5	8.3	7.9	7.1	5.7	4.0	2.3	1.1	0.5	0.2	0.1	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	4.0	34.4	65.1	78.2	82.7	86.2	88.0	88.6	88.8	88.9	88.7	88.4	88.0	87.0	84.1	75.4	56.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	30.3	12.5	5.4	2.9	2.3	2.1	1.8	1.2	0.7	0.4	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.0	0.0	0.0	0.0	0.0	0.1	0.9	5.1	17.5	35.2	50.1	58.5	61.7	61.2	58.7	55.5	52.2	49.2	46.4	44.2
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	42.3	40.7	39.5	38.6	37.9	37.4	37.0	36.8	36.6	36.6	36.7	36.8	37.1	37.4	37.8	38.2	38.7	39.1	39.6	40.1
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	40.4	40.7	40.8	40.8	40.6	40.2	39.6	38.8	37.8	36.7	35.3	32.3	29.0	25.7	22.5	19.6				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.566	1.556	1.551	1.548	1.546	1.544	1.543
K	1.4E-05	9.9E-05	2.2E-04	9.5E-06	1.5E-05	2.0E-05	1.9E-05
P	0.907	0.910	0.911	0.912	0.912	0.912	0.913

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

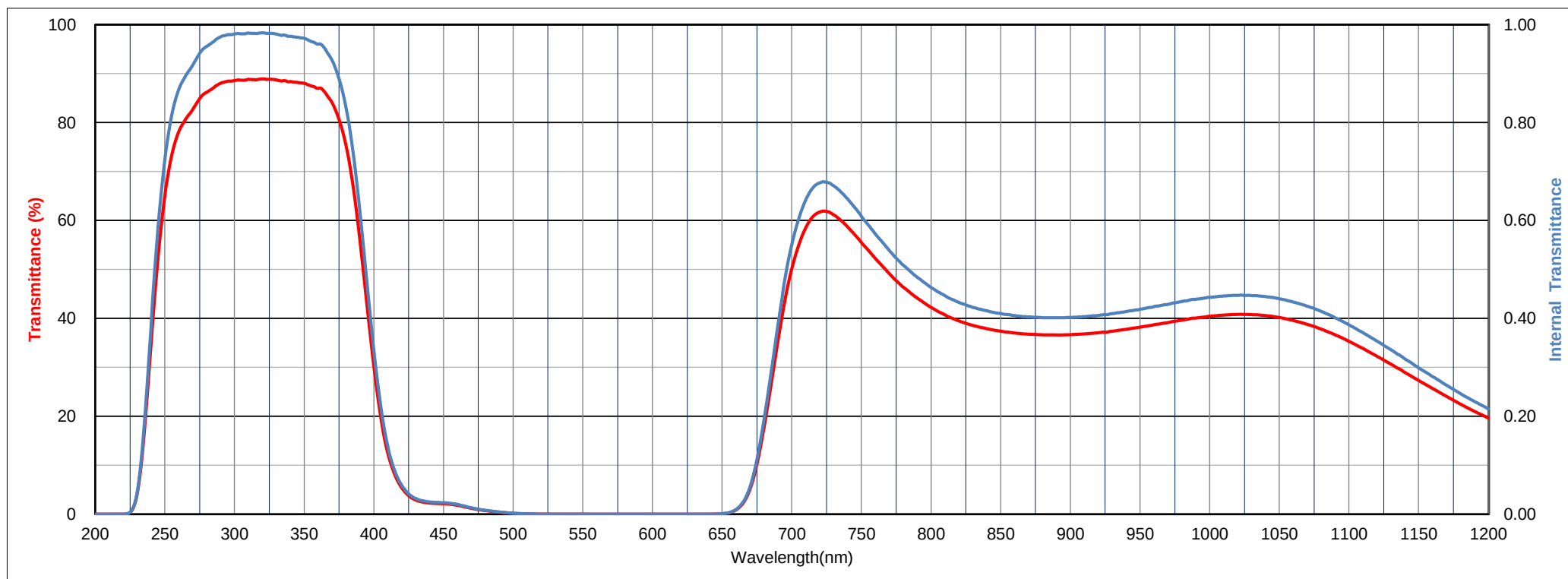
	x	y	Y	λ _d	P _e
A	-	-	-	-	-
C	-	-	-	-	-
D65	-	-	-	-	-

Properties

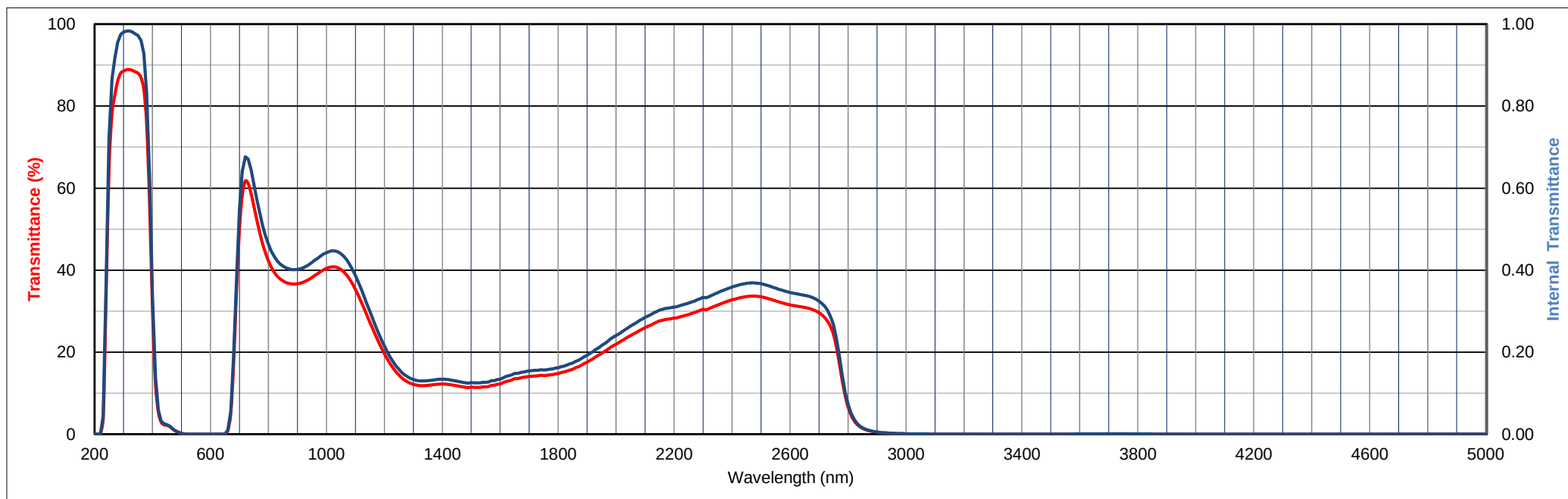
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
4	3	450	500	93	65	380	220	2.89

Tolerance of Transmittance (T)

Transmittance at 254nm	Transmittance at 310nm	Transmittance at 365nm
T254(%)	T310(%)	T365(%)
≥70	≥85	≥83



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	4.0	34.4	65.1	78.2	82.7	86.2	88.0	88.6	88.8	88.9	88.7	88.4	88.0	87.0	84.1	75.4	56.0
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	30.3	12.5	5.4	2.9	2.3	2.1	1.8	1.2	0.7	0.4	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.0	0.0	0.0	0.0	0.0	0.1	0.9	5.1	17.5	35.2	50.1	58.5	61.7	61.2	58.7	55.5	52.2	49.2	46.4	44.2
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	42.3	40.7	39.5	38.6	37.9	37.4	37.0	36.8	36.6	36.6	36.7	36.8	37.1	37.4	37.8	38.2	38.7	39.1	39.6	40.1
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	40.4	40.7	40.8	40.8	40.6	40.2	39.6	38.8	37.8	36.7	35.3	33.9	32.3	30.7	29.0	27.3	25.7	24.1	22.5	21.0
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	19.6	18.3	17.2	16.1	15.2	14.5	13.7	13.2	12.8	12.4	12.2	12.0	11.9	11.8	11.9	11.9	12.0	12.1	12.2	12.2
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	12.2	12.2	12.1	12.0	11.9	11.8	11.7	11.6	11.4	11.3	11.5	11.4	11.4	11.4	11.5	11.5	11.6	11.9	11.9	12.2
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	12.2	12.6	12.8	13.0	13.2	13.5	13.6	13.7	13.9	14.0	14.1	14.1	14.2	14.2	14.4	14.3	14.3	14.5	14.5	14.7
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	14.8	15.0	15.2	15.4	15.6	15.8	16.2	16.5	16.8	17.2	17.6	18.0	18.4	18.9	19.3	19.7	20.2	20.6	21.1	21.6
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	21.9	24.1	26.0	27.6	28.3	29.2	30.5	31.5	32.8	33.6	33.5	32.5	31.5	30.9	29.6	24.3	6.7	1.4	0.5	0.2
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	2.8	16.1	37.3	56.6	69.6	76.8	80.1	78.6	68.3	41.2
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	10.4	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	2.5	10.7	21.3	31.1	39.9	40.8	33.6	26.1	24.3	23.5
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	20.9	17.8	15.1	12.9	11.2	9.9	9.0	8.3	7.8	7.4	7.1	6.8	6.6	6.4	6.2	6.0	5.8	5.6	5.3	5.0
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	4.7	4.3	3.9	3.5	3.2	2.8	2.5	2.2	1.9	1.7	1.5	1.2	1.0	0.9	0.7	0.7				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.550	1.539	1.532	1.529	1.526	1.525	1.524
P	0.911	0.914	0.915	0.916	0.917	0.917	0.917

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

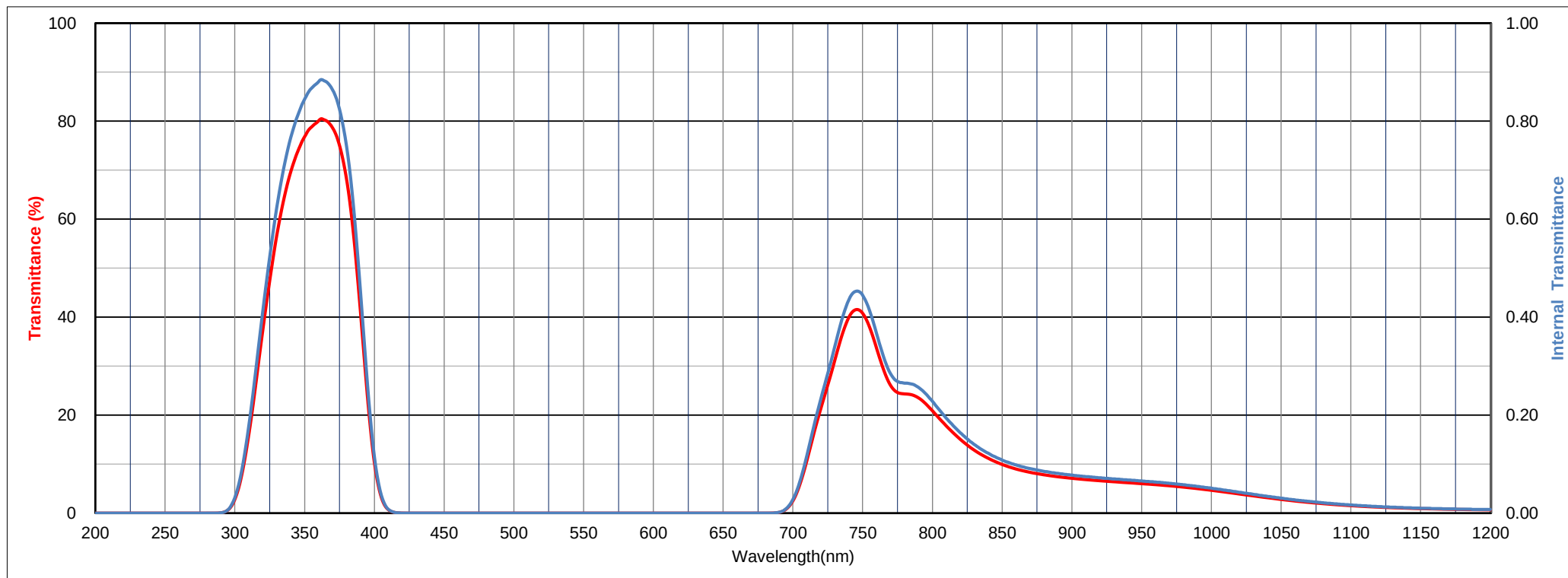
	x	y	Y	λ _d	P _e
A	-	-	-	-	-
C	-	-	-	-	-
D65	-	-	-	-	-

Properties

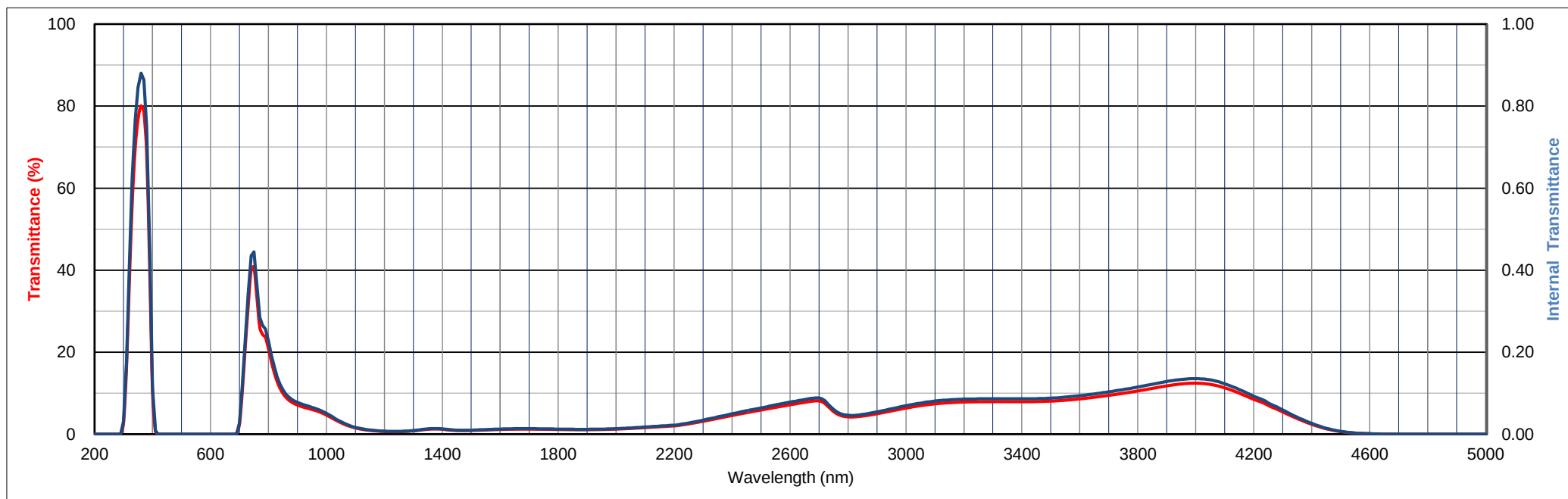
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	1	527	687	88	-	490	100	2.61

Tolerance of Transmittance (T)

Maximum Transmittance	Transmittance at 254nm	Transmittance at 405nm
T _{max} (%)	T ₂₅₄ (%)	T ₄₀₅ (%)
≥ 73%	≤ 7%	≤ 3%



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	2.8	16.1	37.3	56.6	69.6	76.8	80.1	78.6	68.3	41.2
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	10.4	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	2.5	10.7	21.3	31.1	39.9	40.8	33.6	26.1	24.3	23.5
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	20.9	17.8	15.1	12.9	11.2	9.9	9.0	8.3	7.8	7.4	7.1	6.8	6.6	6.4	6.2	6.0	5.8	5.6	5.3	5.0
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	4.7	4.3	3.9	3.5	3.2	2.8	2.5	2.2	1.9	1.7	1.5	1.4	1.2	1.1	1.0	0.9	0.9	0.8	0.7	0.7
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.8	0.8	0.9	1.0	1.0	1.1	1.2	1.2	1.3	1.3	1.2
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	1.2	1.1	1.0	1.0	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.1	1.1	1.1	1.1
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.2	1.2	1.2	1.2
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	1.2	1.4	1.6	1.8	2.0	2.5	3.1	3.8	4.6	5.2	5.9	6.5	7.2	7.8	8.1	5.5	4.2	4.4	5.0	5.7
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	6.4	7.0	7.4	7.7	7.8	7.9	7.9	7.9	7.9	8.0	8.1	8.3	8.6	9.0	9.5	10.0	10.5	11.2	11.8	12.3
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	12.4	12.1	11.3	10.0	8.5	7.0	5.4	3.8	2.4	1.3	0.6	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Multiband Calibration Filters

V10 and V11 contain neodymium and HY1 contains holmium, all of which can remarkably absorb specific wavelengths.

Multiband calibration filters are used as a wavelength calibration and dual-color-type filter.

Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	6.5	62.3	75.9	82.5
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	85.9	87.3	86.1	63.2	47.5	56.2	59.5	49.4	44.1	75.3	74.2	51.8	52.2	24.4	65.9	84.5	81.3	5.2	3.0	1.5
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	24.2	56.7	86.8	84.6	88.7	89.6	89.5	84.7	77.3	77.7	88.0	89.3	86.5	67.3	5.6	8.7	43.6	69.5	67.8	32.2
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	9.0	3.5	38.8	67.2	83.7	85.7	71.0	49.1	30.5	57.8	74.3	83.7	86.9	89.8	90.4	90.3	90.0	89.8	89.6	88.9
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	88.9	89.2	89.7	90.2	90.5	90.8	91.1	91.2	91.3	91.3	91.4	91.5	91.5	91.6	91.5	91.5				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.551	1.538	1.530	1.526	1.523	1.522	1.520
P	0.911	0.914	0.916	0.917	0.918	0.918	0.918

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

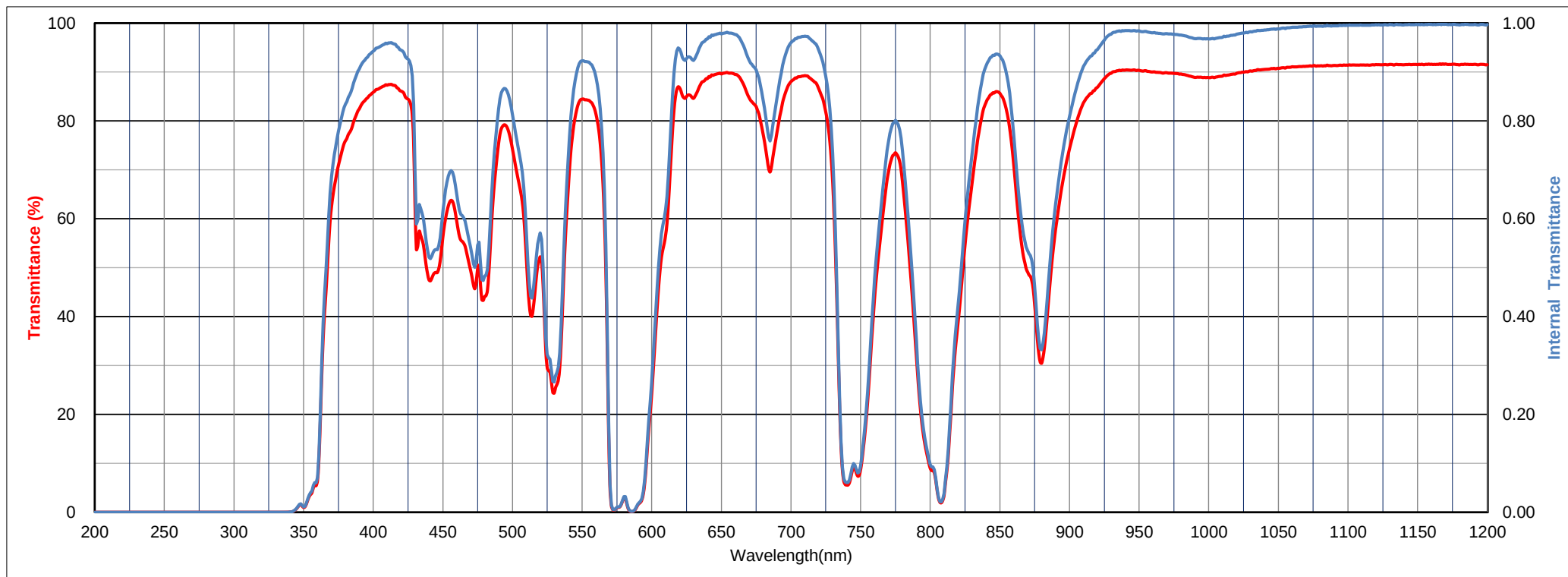
	x	y	Y	λ _d	P _a
A	0.453	0.383	48	-565	10
C	0.295	0.292	49	467	9
D65	0.297	0.304	49	466	9

Properties

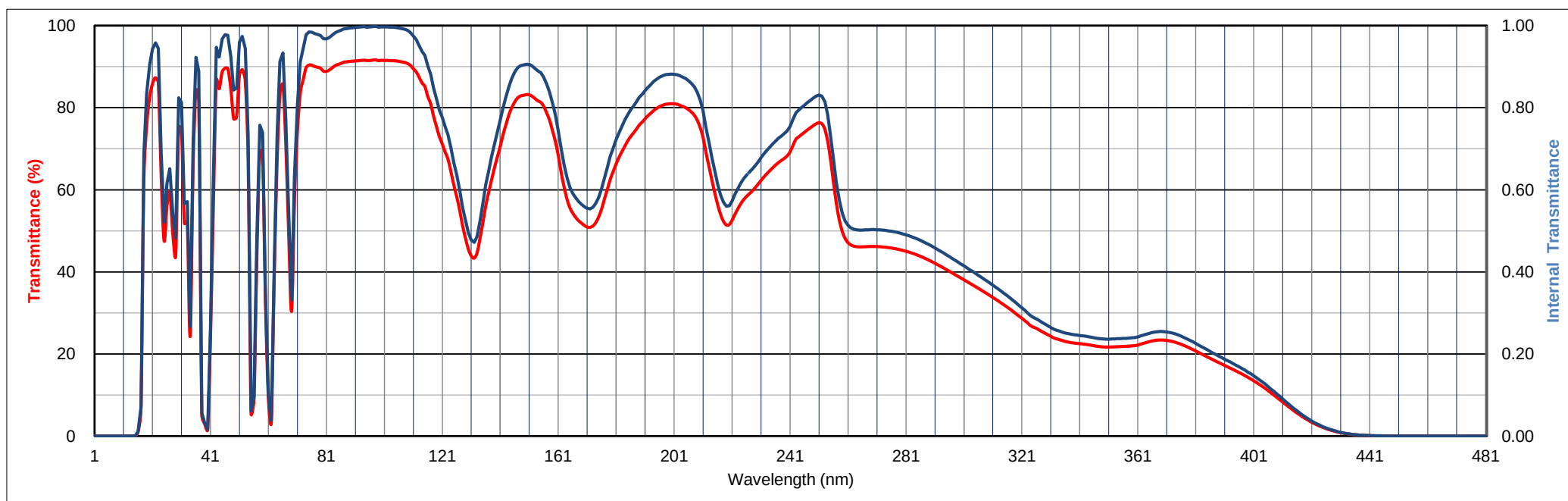
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
4	1	500	545	103	117	520	130	2.87

Tolerance of Transmittance (T)

Transmittance at 550nm	Wavelength for Min. Transmittance
T550(%)	λ Tmin(nm)
>80	586±1



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	6.5	62.3	75.9	82.5
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	85.9	87.3	86.1	63.2	47.5	56.2	59.5	49.4	44.1	75.3	74.2	51.8	52.2	24.4	65.9	84.5	81.3	5.2	3.0	1.5
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	24.2	56.7	86.8	84.6	88.7	89.6	89.5	84.7	77.3	77.7	88.0	89.3	86.5	67.3	5.6	8.7	43.6	69.5	67.8	32.2
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	9.0	3.5	38.8	67.2	83.7	85.7	71.0	49.1	30.5	57.8	74.3	83.7	86.9	89.8	90.4	90.3	90.0	89.8	89.6	88.9
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	88.9	89.2	89.7	90.2	90.5	90.8	91.1	91.2	91.3	91.3	91.4	91.4	91.5	91.6	91.5	91.5	91.6	91.7	91.5	91.5
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	91.5	91.5	91.5	91.5	91.4	91.3	91.2	91.0	90.8	90.3	89.5	88.7	87.4	86.0	85.1	82.7	80.9	77.9	75.4	72.9
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	71.2	69.1	67.4	64.3	61.1	58.2	55.0	51.3	48.2	45.5	43.9	43.4	44.6	48.1	52.0	56.1	59.3	62.4	65.3	68.0
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	70.6	73.5	75.9	78.3	80.0	81.4	82.4	82.9	83.0	83.2	83.2	82.8	82.2	81.7	81.3	80.3	78.7	77.0	74.5	71.8
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	68.5	64.3	60.8	57.8	55.7	54.3	53.3	52.5	51.9	51.3	50.9	50.9	51.2	52.1	53.5	55.4	57.9	60.2	62.6	64.5
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	66.3	73.0	77.3	80.3	80.9	79.5	72.7	56.5	52.6	58.4	62.3	66.0	69.2	74.0	76.3	61.8	47.1	46.1	46.2	45.8
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	45.0	43.8	42.1	40.1	38.1	36.0	33.8	31.4	28.7	26.3	24.3	23.1	22.5	22.0	21.7	21.8	22.2	23.2	23.3	22.3
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	20.7	18.9	17.2	15.5	13.5	11.1	8.3	5.6	3.4	1.8	0.8	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



Transmittance (T)

units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.1	2.0	10.8	24.8	33.9	37.5	42.4	44.9	64.7	17.1	21.0	89.2	89.4	90.3
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	90.4	90.4	88.9	66.7	88.8	87.7	79.8	75.1	76.7	87.5	77.8	54.4	54.8	28.2	70.8	86.3	83.4	4.1	3.6	2.6
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	29.9	59.3	88.4	86.8	90.0	90.8	90.6	86.2	79.2	80.5	89.2	90.2	87.5	63.3	9.9	13.9	48.3	72.5	70.4	35.4
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	13.4	7.3	43.9	70.3	85.4	86.5	72.6	56.2	36.9	60.4	75.9	84.7	88.0	90.7	91.6	91.8	91.8	91.9	91.9	91.9
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	92.0	92.0	92.0	92.1	92.1	92.1	92.1	92.1	92.1	92.2	92.1	92.2	92.2	92.3	92.3	92.3				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.559	1.547	1.541	1.537	1.534	1.533	1.532
P	0.909	0.912	0.913	0.914	0.915	0.915	0.916

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

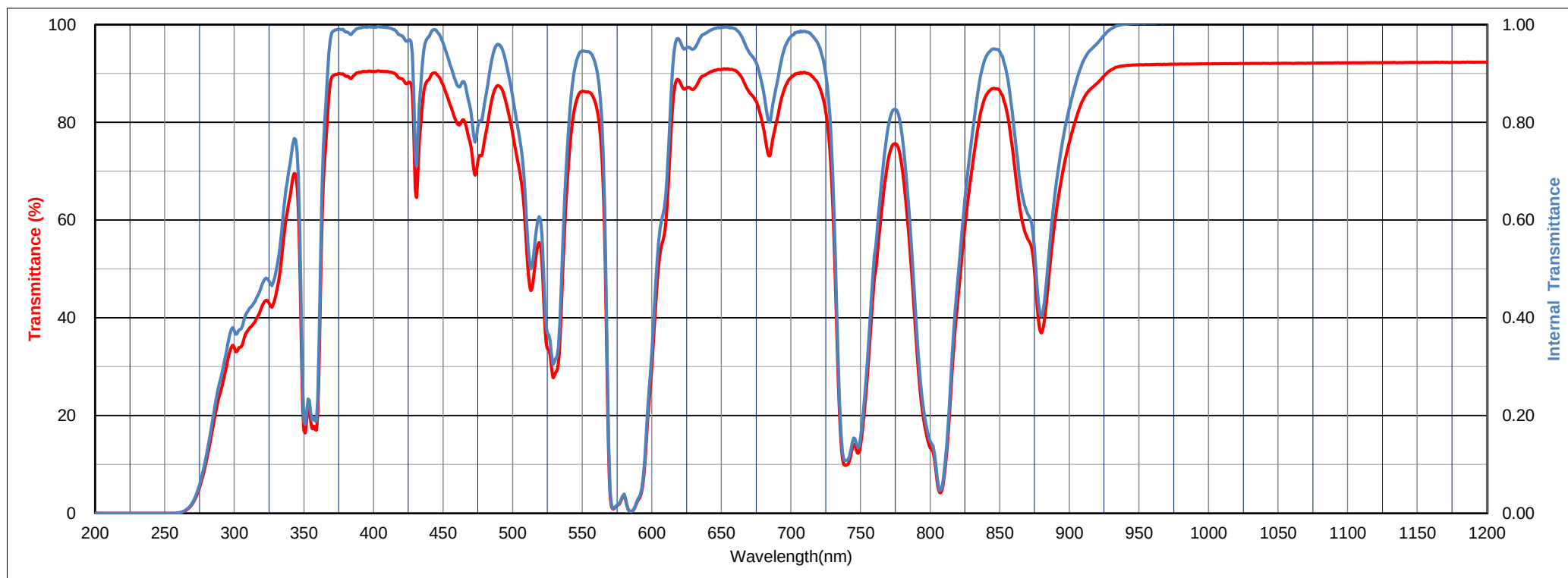
	x	y	Y	λ _d	P _e
A	-	-	-	-	-
C	-	-	-	-	-
D65	-	-	-	-	-

Properties

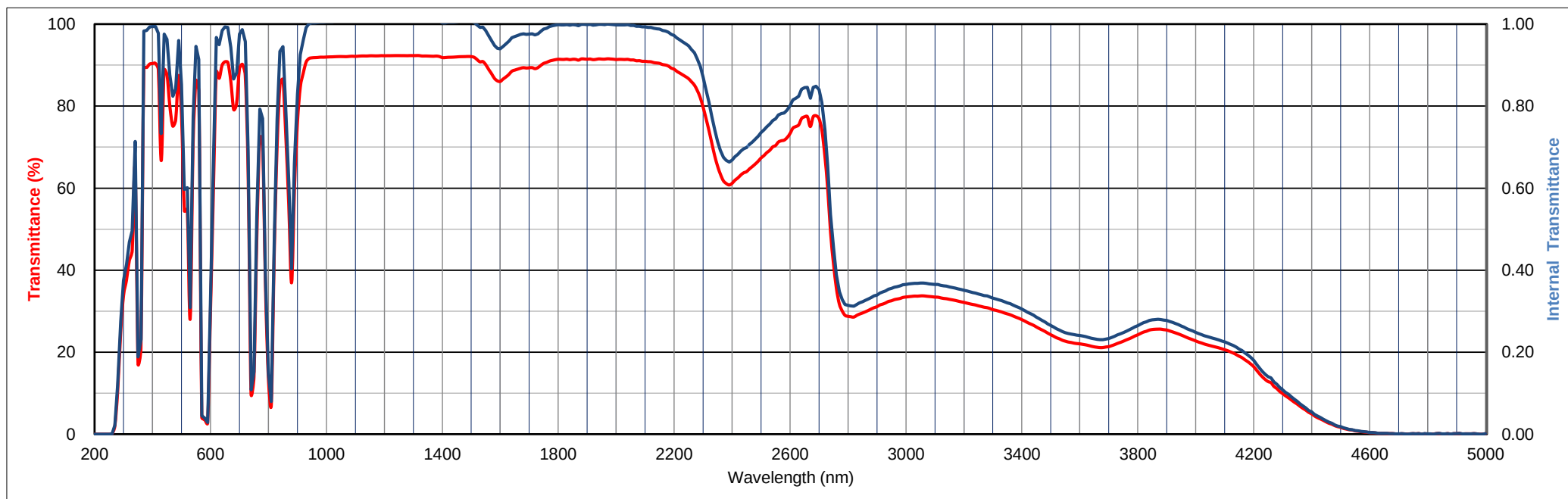
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
1	1	596	657	-	88	555	110	2.83

Tolerance of Transmittance (T)

Transmittance at 586nm
T586(%)
< 1%



λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	0.1	2.0	10.8	24.8	33.9	37.5	42.4	44.9	64.7	17.1	21.0	89.2	89.4	90.3
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	90.4	90.4	88.9	66.7	88.8	87.7	79.8	75.1	76.7	87.5	77.8	54.4	54.8	28.2	70.8	86.3	83.4	4.1	3.6	2.6
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	29.9	59.3	88.4	86.8	90.0	90.8	90.6	86.2	79.2	80.5	89.2	90.2	87.5	63.3	9.9	13.9	48.3	72.5	70.4	35.4
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	13.4	7.3	43.9	70.3	85.4	86.5	72.6	56.2	36.9	60.4	75.9	84.7	88.0	90.7	91.6	91.8	91.8	91.9	91.9	91.9
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	92.0	92.0	92.0	92.1	92.1	92.1	92.1	92.1	92.1	92.2	92.1	92.2	92.2	92.2	92.2	92.3	92.3	92.3	92.3	92.3
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	92.3	92.3	92.3	92.3	92.3	92.3	92.3	92.3	92.3	92.3	92.3	92.3	92.3	92.2	92.2	92.2	92.2	92.2	92.2	92.1
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	91.8	91.8	91.9	91.9	92.0	92.0	92.1	92.1	92.1	92.1	92.1	91.9	91.4	90.8	90.9	90.1	89.0	87.9	86.8	86.2
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	86.0	86.6	87.1	87.7	88.5	88.8	89.0	89.2	89.4	89.3	89.3	89.4	89.1	89.4	89.9	90.4	90.7	91.0	91.2	91.3
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	91.4	91.4	91.4	91.5	91.3	91.4	91.4	91.2	91.5	91.5	91.4	91.5	91.3	91.4	91.5	91.5	91.5	91.5	91.5	91.5
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	91.4	91.3	90.9	90.4	89.0	86.7	79.8	65.4	61.2	64.0	67.4	70.4	73.3	77.4	77.0	41.6	28.7	29.5	31.1	32.5
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	33.5	33.7	33.4	32.9	32.1	31.3	30.4	29.3	27.9	26.2	24.3	22.7	22.0	21.3	21.4	22.7	24.2	25.5	25.4	24.2
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	22.7	21.6	20.6	19.0	16.5	12.8	9.9	7.4	5.0	3.0	1.7	0.8	0.4	0.2	0.0	0.1	0.1	0.0	0.1	0.1
λnm	5000																			
T	0.1																			



Transmittance (T) units: %

λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	1.7	11.5	23.9	44.8	71.2	81.0	85.5	86.1	84.7	84.6	36.3	83.2	87.6	87.6
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	89.2	88.0	71.4	87.5	78.2	38.1	17.1	81.7	85.8	81.8	89.4	89.2	89.2	85.0	68.9	83.6	89.5	89.7	89.7	89.5
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	89.5	89.5	89.0	85.5	75.1	78.4	83.8	88.7	89.5	89.8	89.8	89.8	89.7	89.7	89.6	89.7	89.6	89.5	89.5	89.6
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	89.7	89.7	89.8	90.0	89.8	89.9	89.7	89.7	89.0	89.3	89.7	89.5	89.6	90.2	90.2	90.3	90.4	90.4	90.4	90.5
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1120	1140	1160	1180	1200				
T	90.5	90.5	90.5	90.6	90.6	90.5	90.6	90.6	90.6	90.5	90.4	88.9	86.2	88.1	87.8	87.5				

Refractive Index/Absorption coefficient/Reflection coefficient

λnm	400	500	600	700	800	900	1000
n	1.517	1.511	1.509	1.508	1.508	1.507	1.507
P	0.919	0.920	0.921	0.921	0.921	0.921	0.921

Classes of Bubbles and Inclusions

Bubble Class
3

Color Specification

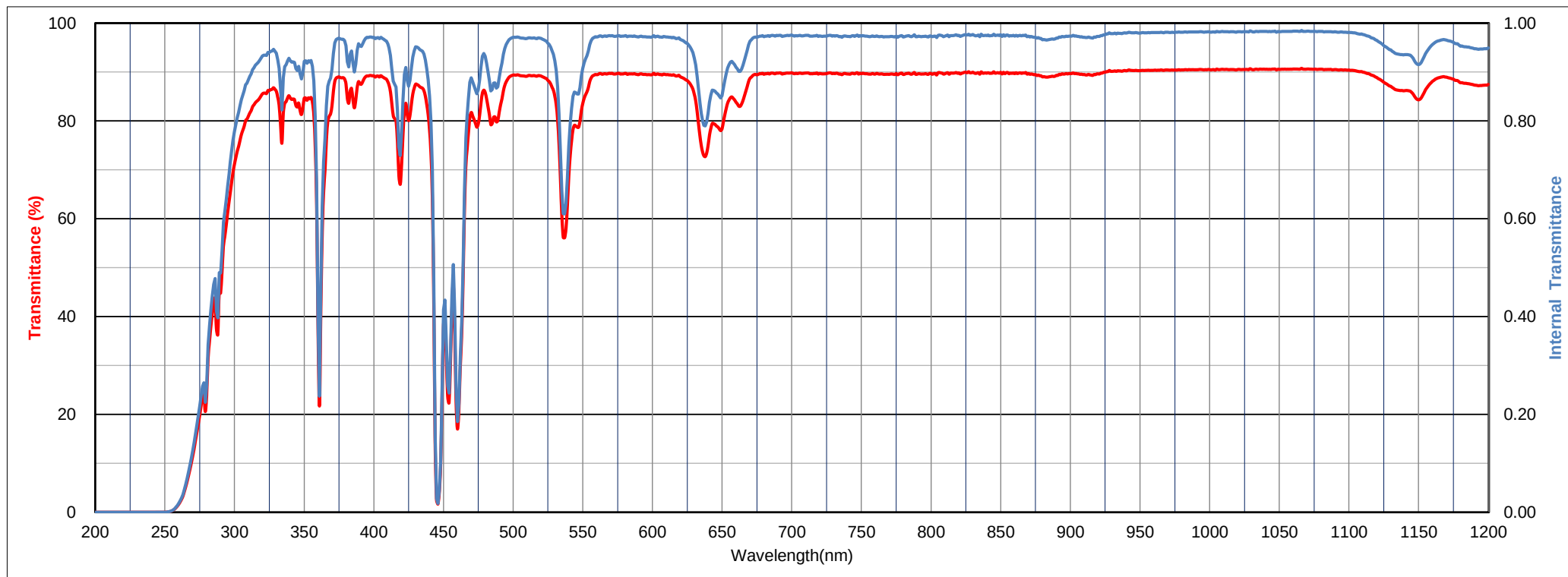
	x	y	Y	λ _d	P _s
A	0.465	0.425	86	581	24
C	0.337	0.360	85	572	19
D65	0.340	0.373	85	571	20

Properties

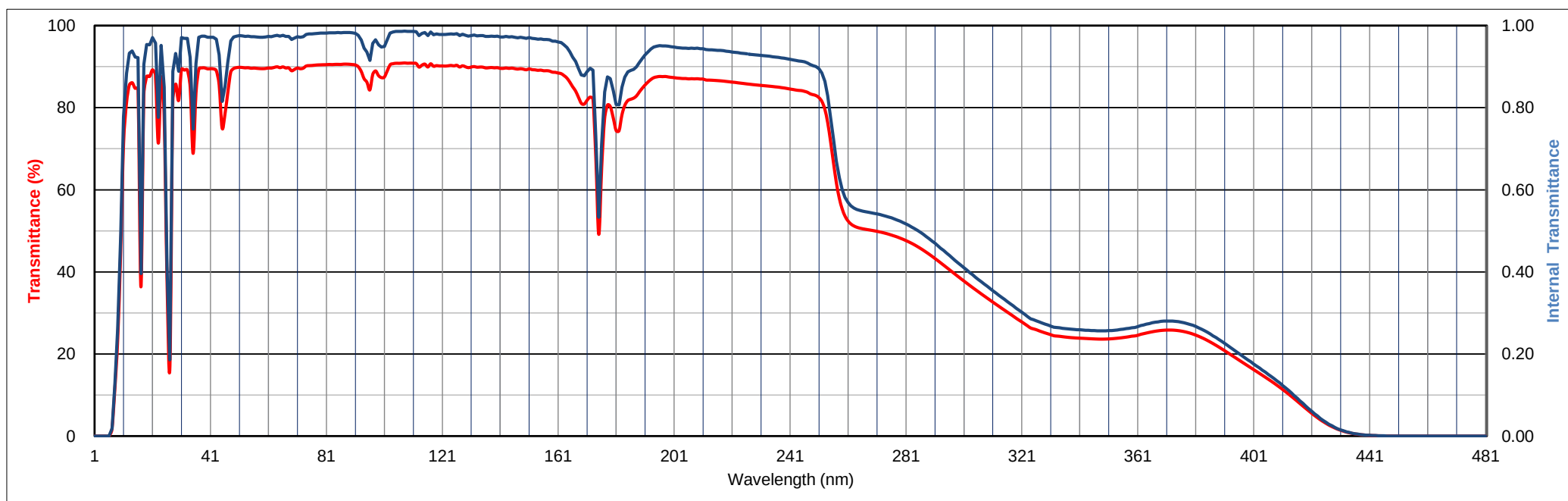
Chemical		Thermal				Mechanical		Others
D _w	D _A	T _g	T _s	α -30/70	α 100/300	H _K	F _A	d
4	1	590	640	102	116	520	130	3.19

Tolerance of Transmittance (T)

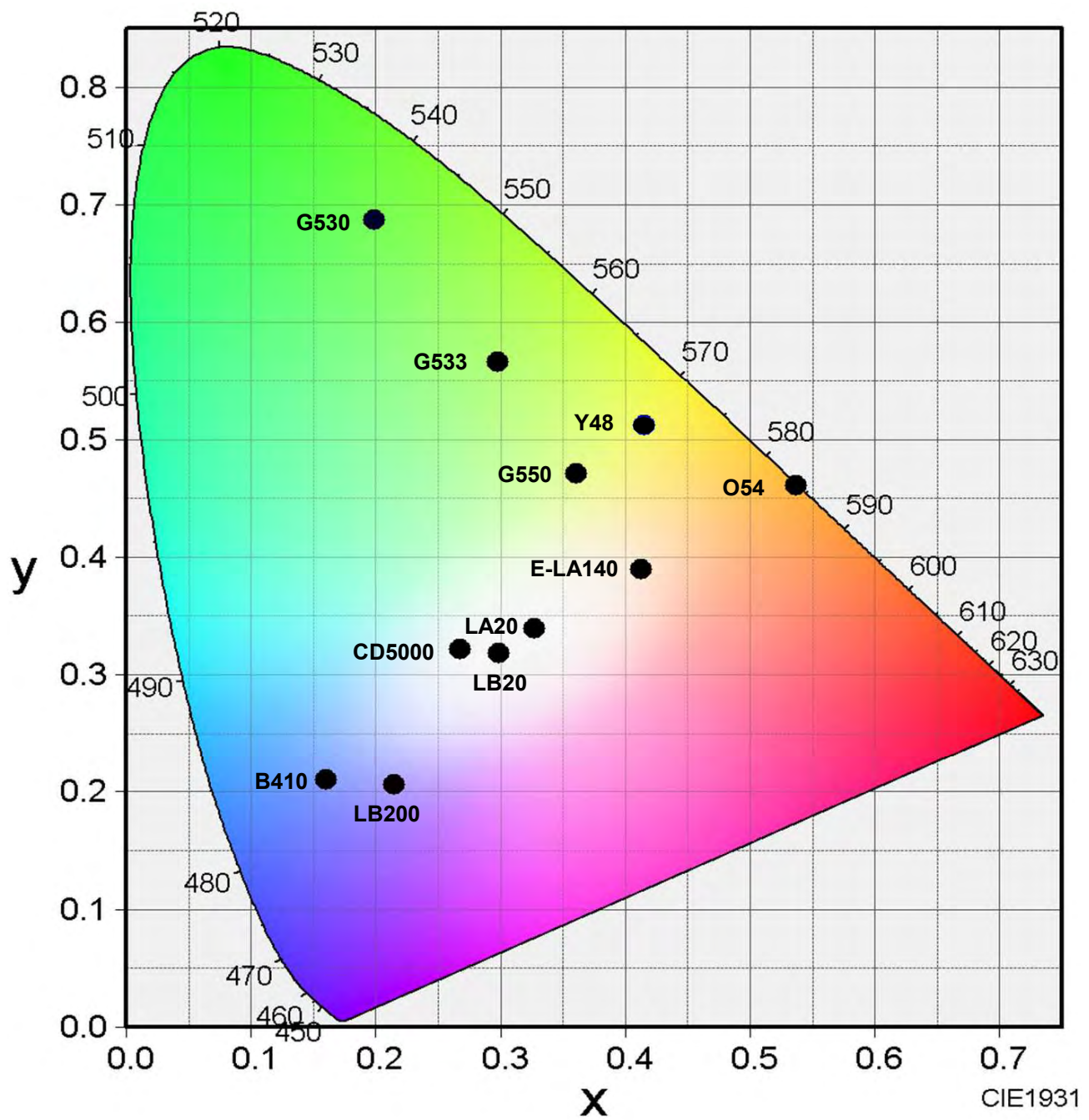
Transmittance at 435nm	Wavelength for Min. Transmittance
T435(%)	λ Tmin(nm)
>80	454±1



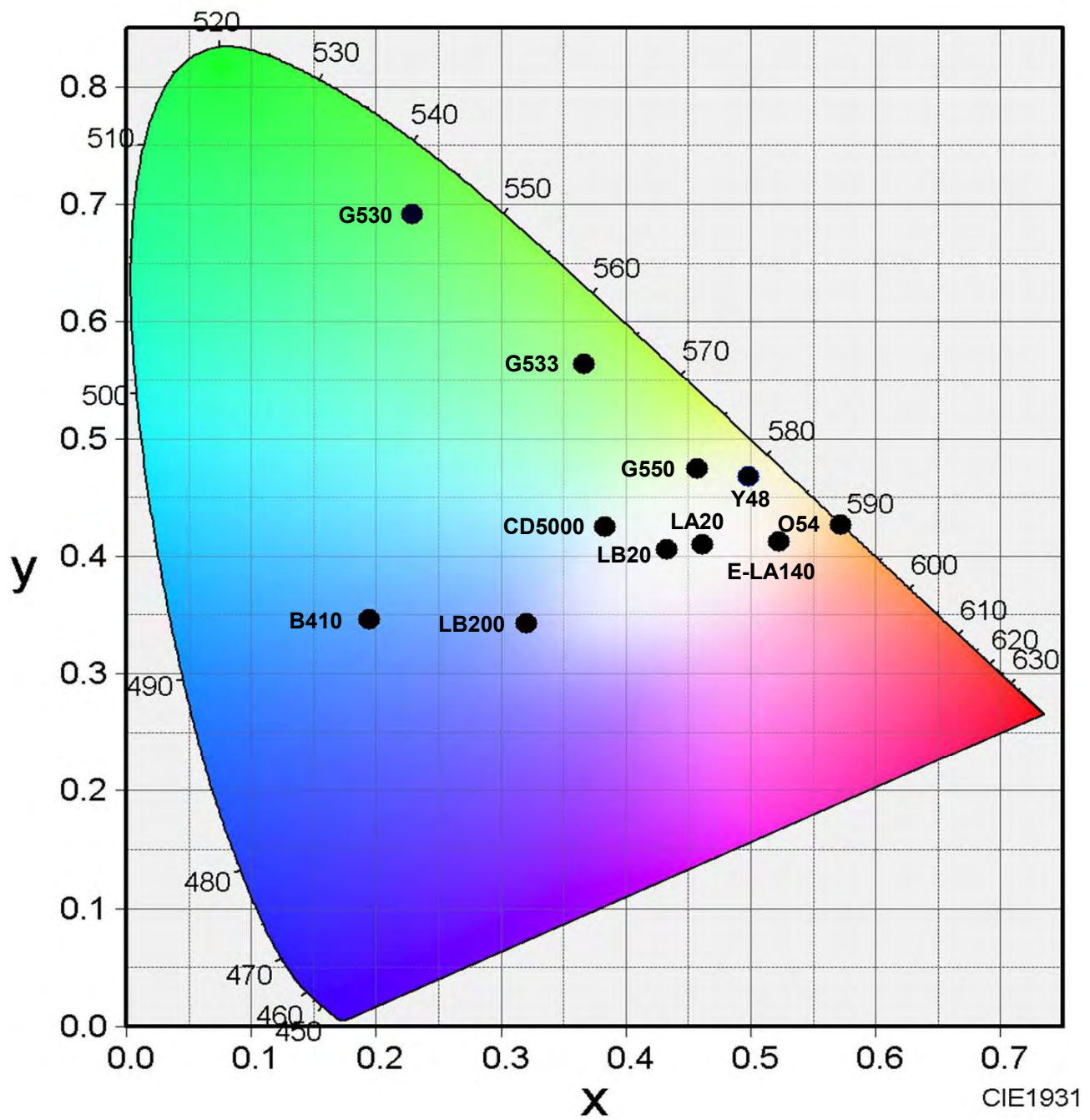
λnm	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
T	0.0	0.0	0.0	0.0	0.0	0.0	1.7	11.5	23.9	44.8	71.2	81.0	85.5	86.1	84.7	84.6	36.3	83.2	87.6	87.6
λnm	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590
T	89.2	88.0	71.4	87.5	78.2	38.1	17.1	81.7	85.8	81.8	89.4	89.2	89.2	85.0	68.9	83.6	89.5	89.7	89.7	89.5
λnm	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790
T	89.5	89.5	89.0	85.5	75.1	78.4	83.8	88.7	89.5	89.8	89.8	89.8	89.7	89.7	89.6	89.7	89.6	89.5	89.5	89.6
λnm	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990
T	89.7	89.7	89.8	90.0	89.8	89.9	89.7	89.7	89.0	89.3	89.7	89.5	89.6	90.2	90.2	90.3	90.4	90.4	90.4	90.5
λnm	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190
T	90.5	90.5	90.5	90.6	90.6	90.5	90.6	90.6	90.6	90.5	90.4	90.0	88.9	87.1	86.2	84.3	88.1	89.0	87.8	87.3
λnm	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390
T	87.5	89.0	90.5	90.7	90.8	90.8	90.8	90.9	90.8	90.9	90.8	90.8	89.9	90.4	90.6	89.9	90.7	90.1	90.3	90.2
λnm	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550	1560	1570	1580	1590
T	90.2	90.1	90.2	90.3	90.2	90.3	89.9	90.2	90.0	89.8	89.9	90.0	89.9	89.9	89.9	89.7	89.7	89.8	89.7	89.8
λnm	1600	1610	1620	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790
T	89.6	89.6	89.7	89.6	89.7	89.5	89.4	89.5	89.4	89.2	89.5	89.3	89.2	89.1	89.2	89.0	89.0	88.9	88.7	88.6
λnm	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990
T	88.4	88.3	87.8	87.2	86.2	85.1	84.1	82.5	81.0	80.9	81.8	82.6	82.2	67.4	49.1	65.4	77.3	80.6	80.2	77.5
λnm	2000	2050	2100	2150	2200	2250	2300	2350	2400	2450	2500	2550	2600	2650	2700	2750	2800	2850	2900	2950
T	74.4	82.1	85.6	87.6	87.3	87.0	87.0	86.6	86.2	85.8	85.4	85.1	84.5	84.0	82.4	66.6	52.4	50.5	49.9	49.0
λnm	3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600	3650	3700	3750	3800	3850	3900	3950
T	47.6	45.7	43.3	40.5	37.8	35.2	32.6	30.2	27.8	25.9	24.7	24.1	23.9	23.7	23.7	24.0	24.6	25.4	25.8	25.6
λnm	4000	4050	4100	4150	4200	4250	4300	4350	4400	4450	4500	4550	4600	4650	4700	4750	4800	4850	4900	4950
T	24.6	22.9	20.8	18.5	16.2	13.9	11.4	8.5	5.6	3.1	1.4	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
λnm	5000																			
T	0.0																			



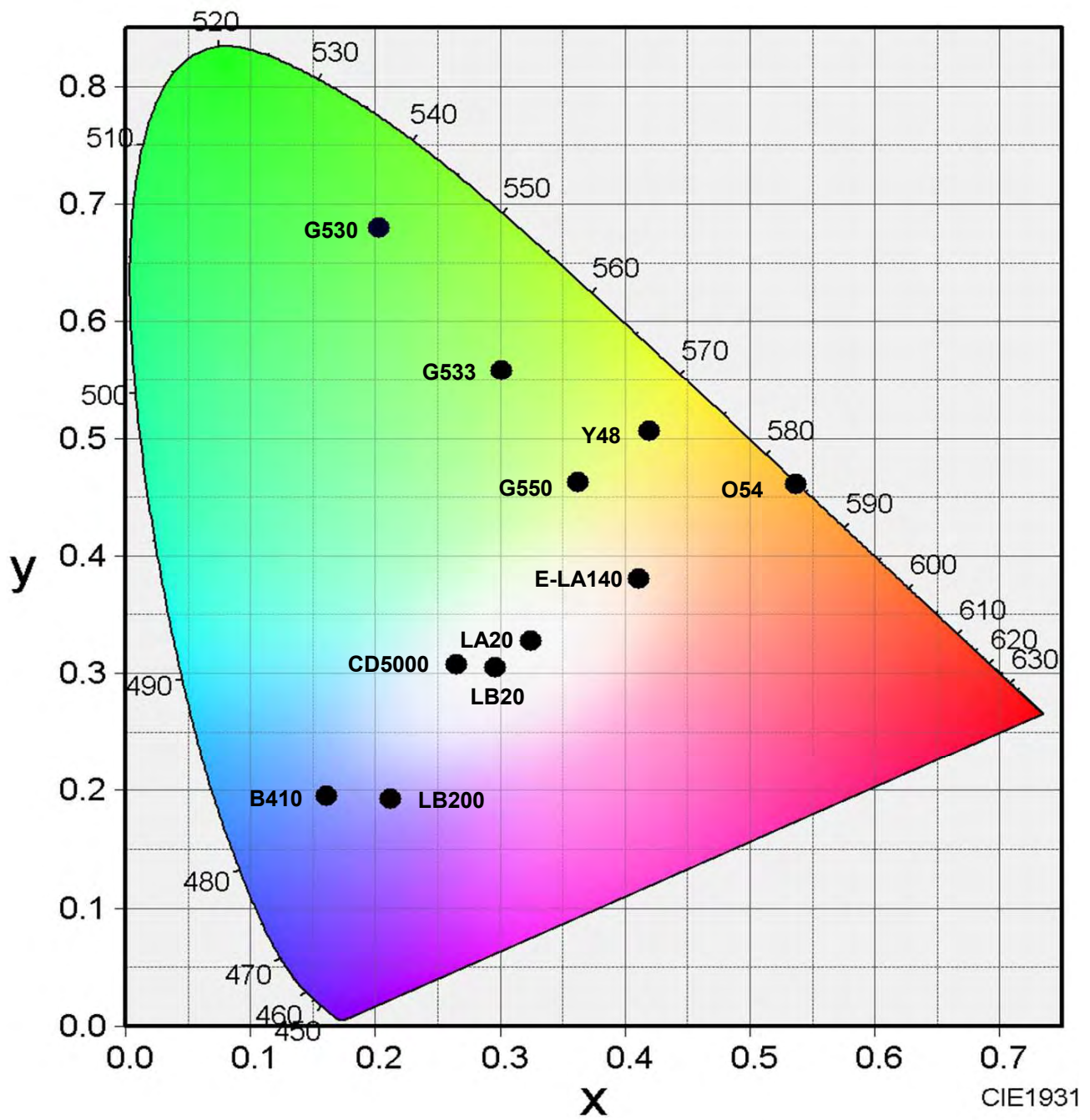
Standard Illuminant D65



Standard Illuminant A



Auxiliary Standard Illuminant C



Revision

April, 2014	First edition issued
July, 2015	Revision Issued List changes here (G530, G533 and HY1 data sheet updated)
December, 2017	Neutral Density Filters (W-ND) is added
April, 2019	U325B and V30 are removed. CD700 and CM700 are added.
October, 2020	UV filters are added. UL254S is added for U325C. V11 is added.

Specifications subject to change without notice.