

Colored Glass Alternative Filters



Newport's Colored-Glass Alternative (CGA) Filters

Newport's patent pending Colored-Glass Alternative (CGA) filters were developed to provide solutions for applications requiring long wave pass filters where the requirements of the application could not be achieved using colored-glass filters. Several product performance and construction attributes have been considered including RoHS compliance, chemical resistance, ultraviolet exposure resistance, autofluorescence, humidity resistance, temperature sensitivity, size & thickness limitations, and availability of cut-on wavelengths. From this list, RoHS compliance and cut-on wavelength availability were most often identified as limitations to be addressed.

Our CGA filters were originally introduced in 2008 as custom materials for OEM applications. The product line quickly gained acclaim from many market leading companies producing analytical instrumentation, and as we began to receive more and more requests for common cut-on wavelengths, it became clear that a standard product offering was needed in the marketplace. This catalog addresses that need, offering a group of thirty-four (34) standard cut-on wavelengths, available in four (4) standard sizes from inventory, in addition to our custom capability. Now, both researchers and OEM consumers can take advantage of this exciting solution, enjoying the rapid availability of standard products for lab and prototype applications as well as our continued custom capability of providing custom sizes of standard wavelengths and non-standard wavelengths as fully-custom solutions.

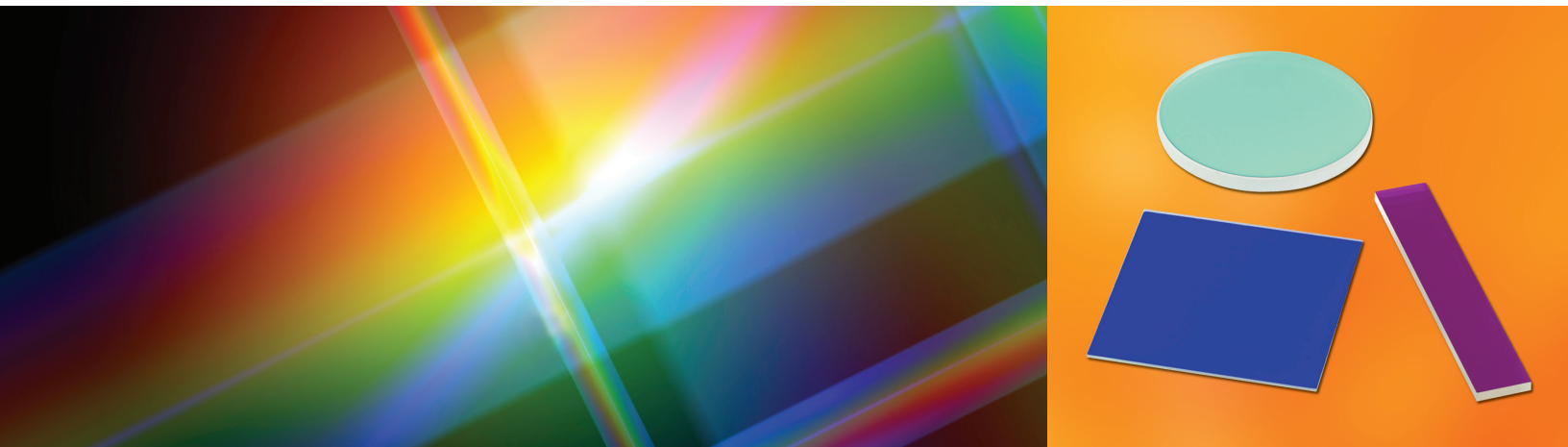


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Introduction

CGA filters are manufactured using our patented Stabilife coating technology which employs only RoHS fully-compliant materials. As such, these filters do not depend on the 4-year temporary exemption granted to allow manufacturers of colored-glass filters to continue to supply filters containing Lead and Cadmium compounds in their formulation. Full compliance to the RoHS directive provides assurance that these products will remain available for sale and will not add potentially harmful substances into our environment.

These filters are manufactured by applying all-dielectric optical thin film coatings to fused silica or borosilicate glass substrates. The coatings are longwave pass interference filter coatings which have been designed to provide very wide spectral bands of reflection and transmission. The designs also provide a very steep transition from reflection to transmission making the filters a good choice for applications where wavelengths of interest are closely spaced with wavelengths that need to be eliminated. Wavelength availability using an optical coating manufacturing process is virtually unlimited. This feature allows us to provide alternatives for currently available colored-glass filters, colored-glass filters that have been discontinued, and filters with cut-on wavelengths where no colored-glass filter is currently or was formerly available.

Chemical resistance, ultraviolet exposure resistance, autofluorescence, humidity resistance, and temperature sensitivity are all performance attributes that benefit from Stabilife optical coatings. Stabilife films exhibit very low sensitivity to thermal variation. They provide excellent resistance to damage due to handling, extreme nuclear and optical radiation, and severe environmental conditions. In the most severe applications, such as autoclave immersed nuclear reactor monitoring, Stabilife filters have demonstrated spectrally stable performance lifetimes exceeding 8,000 hours. Stabilife filters have been qualified for telecommunications applications per the requirements of Telcordia GR-2883. CGA filters have been classified as having stain resistance

of 1.0 (SR Class 1.0) when tested per ISO 8424. Through careful selection of coating and substrate materials, and the use of reflection as the primary means of obtaining optical rejection, autofluorescence has been significantly reduced, particularly when compared to filters that rely primarily upon absorption to provide optical rejection.

Our catalog offering of Colored-Glass Alternative filters is a series of fully-blocked, all-dielectric longwave pass filters at thirty-four (34) different cut-on wavelengths. The group of standard wavelengths of longwave pass filter glasses currently offered by the major manufacturers of colored-glass filters, as well as some wavelengths that have been discontinued by these manufacturers. Four (4) different sizes are available at each wavelength: ½" diameter, 1" diameter, 2" square, and 6½" square. Standard CGA filters are supplied with a thickness of 1.1 mm.

In addition to our standard CGA products, we routinely provide custom products based upon the basic product concept and designs. Custom capabilities are discussed in the section following the pages devoted to our catalog products.

Restrictions on Hazardous Substances (RoHS)

The proliferation of electronics in virtually every part of the average person's life has brought many capabilities and conveniences that were unimaginable only a short time ago. However, as is often the case, along with the many benefits that these technological advances have conferred, some unintended negative consequences have resulted from this proliferation in the form of potential environmental harm from the disposal of waste electronics. In recognition of the present and potential risks to the health of our society as a result of the disposal of waste electronic equipment, the European Union (EU) has developed regulations to reduce the amount of potential pollutants used in manufactured products and to control the disposal of products that can not be manufactured without containing the certain targeted potential pollutants. The principal guiding regulations are the DIRECTIVE 2002/95/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS), and the DIRECTIVE 2002/96/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 27 January 2003 on waste electrical and electronic equipment (WEEE).

The RoHS regulation specifies that Member States of the European Union shall ensure that, from 1 July 2006, new electrical and electronic equipment put on the market does not contain lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE). During the development of these regulations, the council recognized and made provisions for the fact that the complete elimination of these named materials could involve significant scientific development and therefore, established provisions for granting exemptions for a period of four years to allow sufficient time for the scientific development enabling the elimination of the hazardous substances to be completed.

The relevance of these regulations to optical components lies in the fact that many electronics-based instruments employ optical technology as a key enabler. Just as all of the electronic components of these instruments are subject to the RoHS and WEEE regulations, so are all of the other components of the instrument including the optical elements. Many electronic-based instruments have employed colored-glass filters containing Lead and Cadmium compounds. Exemption status was established on 21 October 2005 for Optical and Filter Glasses containing Lead and Cadmium for a period of four (4) years. The regulation requires that four years after an item is added to the list, a review is to be conducted with the aim of considering the removal of the component/s from the list of exempted materials.

Unlike several Yellow, Orange, and Red Colored-Glass filters, Newport's Colored-Glass Alternative filters are fully compliant with RoHS regulations. They do not rely on an exemption and therefore, are not subject to the uncertainty of the review process.

Physical Properties

Manufactured using Newport's patented Stabilife coating technology, our Colored-Glass Alternative (CGA) filters deliver exceptional durability in environments ranging from the most benign conditions found in a typical research laboratory to the most extreme conditions such as those found in nuclear reactors or desert battlefields.

Abrasion Resistance, Adhesion, & Humidity Resistance

CGA filters have been qualified for adhesion using the snap tape test specified in MIL-C-48497, for abrasion resistance using the eraser test specified in MIL-C-675, and for humidity resistance using the aggravated test specified in MIL-STD-810E. These tests are commonly used as benchmarks for determining the robustness of thin film coatings.

Stain Resistance

CGA filters have been evaluated for stain resistance using the Acid Resistance test set forth in ISO 8424. This test is used to determine the surface change that results from exposure to a strong acidic substance. The surface is exposed to a Nitric Acid solution (0.5M/l) having a pH of 0.3 ± 0.05 . Testing is conducted to determine the amount of time needed to etch into the surface to a depth of 0.1 mm. Newport's CGA filters have been confirmed to meet an SR1 rating which corresponds to greater than 100 hours of exposure. Since CGA filters are constructed of very thin layers of vacuum-deposited thin-film coating, an etch depth of 0.1 mm would likely result in a significant change in the spectral performance of the filter. No spectral change was evident after testing indicating an absence of any significant etching after the 100 hour exposure.

Solubility

The extreme hardness of the Stabilife coatings used to manufacture Colored-Glass Alternative filters allows these filters to be subjected to normal and severe weather conditions as well as to the repeated handling and cleaning that is commonplace for filters that are used in a lab environment, without sustaining any surface degradation. Unlike some Colored-Glass Filters that can suffer surface damage from prolonged exposure to rain or submersion in water, CGA filters maintain their clarity and spectral performance under such extreme conditions.

Optical Radiation

Stabilife coatings used to manufacture our CGA filters have been deployed in applications where they are exposed to intense ultraviolet and high energy visible radiation with no change in spectral performance after prolonged exposure. These filters have also been evaluated for Laser Damage Threshold using a frequency-doubled Nd:YAG laser operating at 532 nm with a pulse width of 10 ns and a repetition rate of 20 Hz. Typical damage threshold values exceed 1.0 J/cm^2 .

Extreme Temperature

Colored-Glass Alternative filters are qualified for use at continuous operating temperatures between -100°C and $+400^\circ\text{C}$.

Spectral Properties

Newport's Colored-Glass Alternative filters are constructed using optical thin-film coating technology. Using Newport's patented Stabilife coating technology, many layers of refractory metal oxide film are deposited under vacuum in a precise sequence, defining the spectral signature of the filters. Unlike Colored-Glass filters which rely upon absorption to create the filter's spectral response, CGA filters utilize optical interference phenomena to create wide bands of very-high reflectance to create the blocking region of the filters, and wide bands of very-low reflectance to create the transmission bands of the filters.

Using optical interference coatings to create longwave pass filters provides some distinct advantages over using absorptive colored-glass. Transition slopes between the rejection or blocking band and the transmission band can be made much steeper using interference coatings. On average, CGA filter slopes are 3 times steeper than the transition slopes of corresponding Colored-Glass filters. The spectral response of CGA filters are not dependent upon thickness of the filters. By contrast, the degree of rejection or blocking and the cut-on wavelength of a filter constructed using colored-glass is directly dependent upon its thickness. The relationship between the thickness of the absorbing colored-glass is explained by the Bouguer-Lambert Law (also known as the Lambert Law) which defines the effect on the intensity of light transmitted through an absorbing substance in respect to its thickness. This feature allows Colored-Glass Alternative filters to be manufactured using very thin substrates while maintaining the required depth of blocking, enabling their use in a variety of applications where "small & thin" are desirable features. Filters manufactured using interference coatings also provide an advantage over colored-glass filters in their ability to provide any desired cut-on wavelength without incurring the time and expense of developing custom-formulated glass melts to achieve the desired cut-on wavelength. An equally important advantage of CGA filters is their formulation from 100% environmentally safe materials. This attribute stands in contrast to many colored-glass longwave pass filters that rely upon the use of Lead and Cadmium compounds to achieve their spectral signature.

In addition to the above mentioned benefits of Colored-Glass Alternative filters over colored-glass filters, the cut-on wavelength of CGA filters can be tuned to slightly shorter wavelengths by positioning the filter at off-normal incidence to the source of illumination. This capability is a common phenomena associated with thin-film optical interference coatings.

Angle of Incidence Effects

The cut-on wavelength of Newport's Corion® Stabilife Colored-Glass Alternative filters will slightly shift lower in wavelength with an increase in the angle of incident collimated light. The amount of wavelength shift is dependent upon the incident angle and the effective index (n_e) of the filter. This feature can be very useful in research applications by being able to custom tune a CGA filter to a specific desired wavelength. The following formula may be used to determine the wavelength shift of a filter in random polarized collimated light:

$$\lambda_\theta = \lambda_0 (n_e^2 - \sin^2\theta)^{1/2} (n_e)^{-1}$$

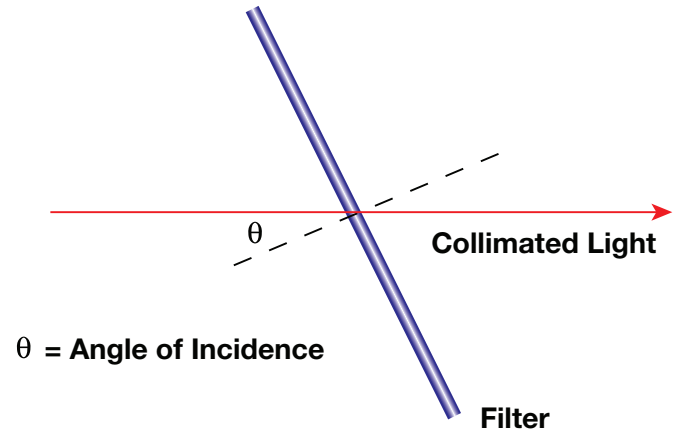
where

λ_θ = Cut-on wavelength at θ° angle of incidence

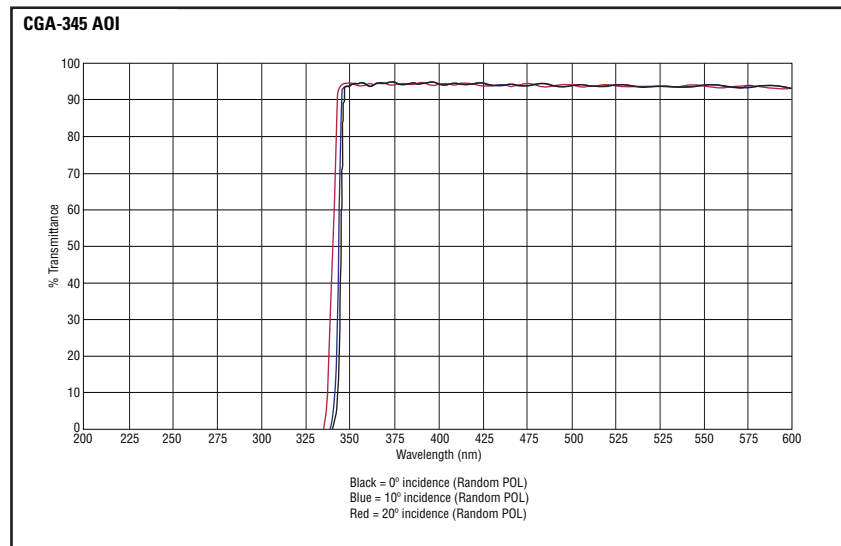
λ_0 = Cut-on wavelength at 0° angle of incidence

θ = Angle of incident light off normal incidence

n_e = Effective index of refraction; specified as a numerical value derived from the indices of the thin film layers of the CGA filter

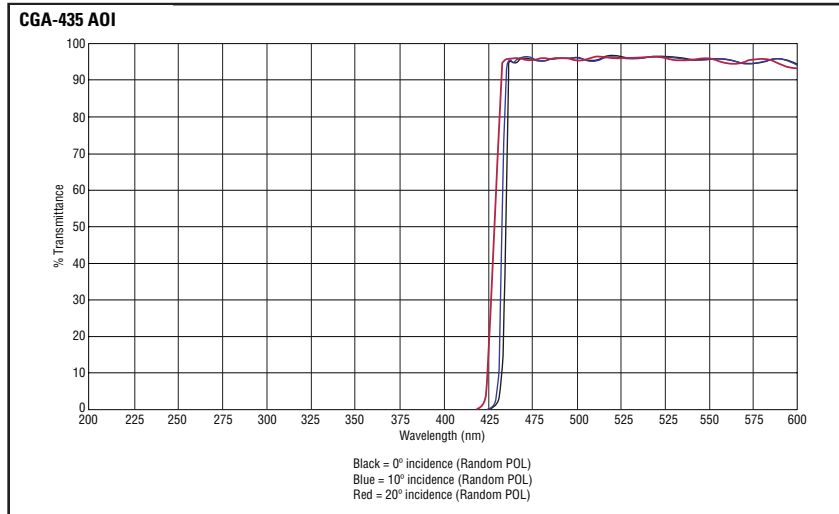


Examples of Angle of Incidence Effects on Selected CGA Filters



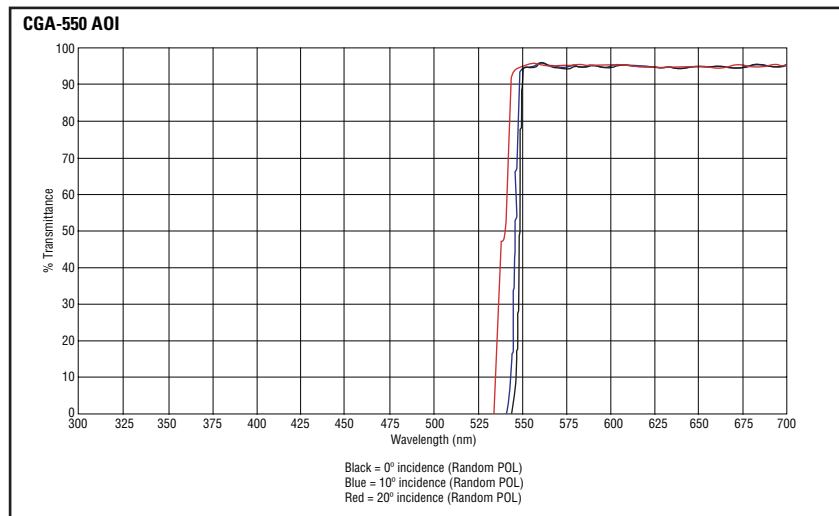
Typical angle of incidence effects for CGA-345 filters with effective index of refraction (n_e) of 2.147

Incident Radiation	Effective Cut-on λ at 50% Transmittance
Collimated @ Normal Incidence	345.0 nm
Collimated @ 10° off-normal (Random POL)	343.9 nm
Collimated @ 10° off-normal (P-POL)	343.4 nm
Collimated @ 10° off-normal (S-POL)	344.2 nm
Collimated @ 20° off-normal (Random POL)	340.3 nm
Collimated @ 20° off-normal (P-POL)	338.8 nm
Collimated @ 20° off-normal (S-POL)	341.8 nm



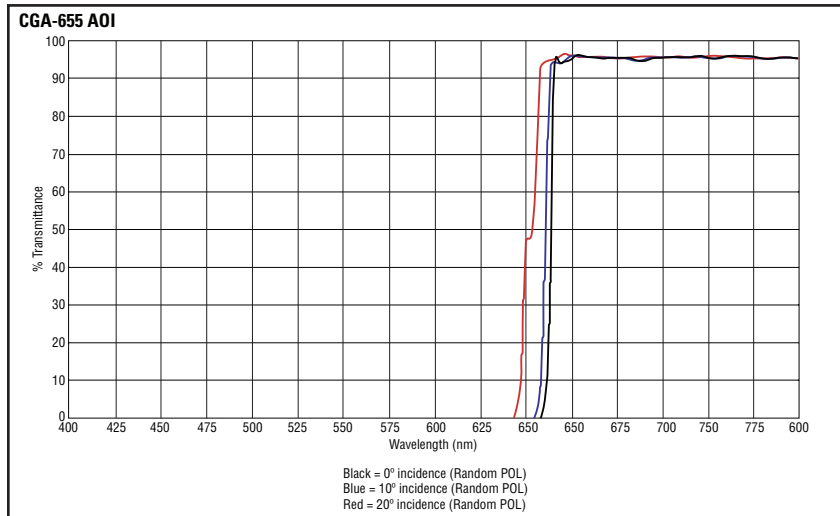
Typical angle of incidence effects for CGA-435 filters with effective index of refraction (n_e) of 1.966

Incident Radiation	Effective Cut-on λ at 50% Transmittance
Collimated @ Normal Incidence	435.0 nm
Collimated @ 10° off-normal (Random POL)	433.3 nm
Collimated @ 10° off-normal (P-POL)	432.8 nm
Collimated @ 10° off-normal (S-POL)	434.0 nm
Collimated @ 20° off-normal (Random POL)	428.7 nm
Collimated @ 20° off-normal (P-POL)	426.7 nm
Collimated @ 20° off-normal (S-POL)	431.2 nm



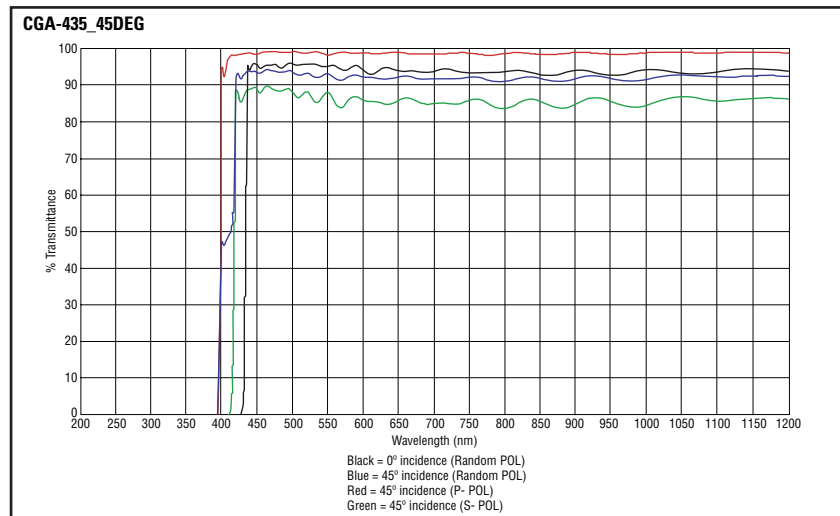
Typical angle of incidence effects for CGA-550 filters with effective index of refraction (n_e) of 1.861

Incident Radiation	Effective Cut-on λ at 50% Transmittance
Collimated @ Normal Incidence	550.0 nm
Collimated @ 10° off-normal (Random POL)	547.6 nm
Collimated @ 10° off-normal (P-POL)	546.9 nm
Collimated @ 10° off-normal (S-POL)	548.4 nm
Collimated @ 20° off-normal (Random POL)	542.3 nm
Collimated @ 20° off-normal (P-POL)	538.0 nm
Collimated @ 20° off-normal (S-POL)	544.01 nm



Typical angle of incidence effects for CGA-665 filters with effective index of refraction (n_e) of 1.831

Incident Radiation	Effective Cut-on λ at 50% Transmittance
Collimated @ Normal Incidence	665.0 nm
Collimated @ 10° off-normal (Random POL)	662.0 nm
Collimated @ 10° off-normal (P-POL)	661.3 nm
Collimated @ 10° off-normal (S-POL)	663.0 nm
Collimated @ 20° off-normal (Random POL)	655.0 nm
Collimated @ 20° off-normal (P-POL)	649.8 nm
Collimated @ 20° off-normal (S-POL)	657.4 nm

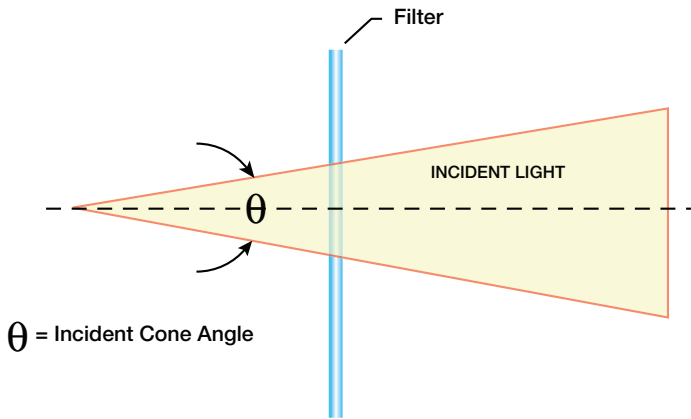


Typical spectral performance of CGA-435 filters at extreme angle of incidence

Incident Radiation	Effective Cut-on λ at 50% Transmittance
Collimated @ Normal Incidence	435.0 nm
Collimated @ 45° off-normal (Random POL)	415.3 nm
Collimated @ 45° off-normal (P-POL)	399.9 nm
Collimated @ 45° off-normal (S-POL)	419.8 nm

Cone-Angle Effects

In the preceding examples, the wavelength changes were modeled under the assumption that the incident light was collimated. In some applications, the incident light is presented at the filter in a convergent or divergent cone. The cone is made up of many light rays at various angles ranging from normal incidence to the extreme angle defining the full cone. The effect of this collection of rays is a weighted average of incident light, producing a wavelength shift toward shorter wavelengths that is smaller than the shift that would be produced if collimated light was presented to the filter at the extreme angle of the full cone.



Examples of Cone-Angle Effects on Specific CGA Filters

The tables that follow illustrate the theoretical blue-shift that would result in the cut-on wavelength of various Colored-Glass Alternative filters when illuminated with incident radiation in a 10° full-cone and a 20° full-cone.

CGA-345

Incident Radiation	Effective Cut-on λ at 50% Transmittance
Collimated @ Normal Incidence	345.0 nm
10° Full-Cone	344.9 nm
20° Full-Cone	344.4 nm

CGA-435

Incident Radiation	Effective Cut-on λ at 50% Transmittance
Collimated @ Normal Incidence	435.0 nm
10° Full-Cone	434.7 nm
20° Full-Cone	434.2 nm

CGA-550

Incident Radiation	Effective Cut-on λ at 50% Transmittance
Collimated @ Normal Incidence	550.0 nm
10° Full-Cone	549.6 nm
20° Full-Cone	548.7 nm

CGA-665

Incident Radiation	Effective Cut-on λ at 50% Transmittance
Collimated @ Normal Incidence	665.0 nm
10° Full-Cone	664.7 nm
20° Full-Cone	663.7 nm

Specifications and Typical Spectral Performance Data

RoHS Status	Fully compliant (without 4-year exemption granted to non-compliant colored-glass filters)
Standard Sizes	0.500" dia. ± 0.005"; 1.000" dia. ± 0.005"; 2.000" sq. ± 0.010"; 6.500" sq. ± 0.010";
Active Area	≥90% of filter size with film to the edge
Thickness	1.1 mm ± 0.1 mm
Surface Quality	F/F (80/50) per MIL-F-48616
Coating Abrasion Resistance, Adhesion, & Hardness	MIL-C-48497
Coating Humidity Resistance	MIL-STD-810, Method 507.3, Procedure III, Modified to 40 cycles
Coating Operating Temperature Range	-100 ° C to 400 ° C
Chemical Resistance	SR Class 1.0 per ISO 8424
Laser Damage Threshold	≥ 1J/cm ² (typical) tested at 532 nm, Pulse width 10 ns, Repetition rate 20Hz
Cleaning	Non-abrasive method, acetone or isopropyl alcohol on lens tissue recommended
Cut-on Wavelength Tolerance	± 5 nm (typical)
Transmittance	≥ 90% typical - Refer to spectral data curves and tables for wavelength-specific typical values
Range of Transmittance	λ of 90% Transmission to 2500 nm
Spectral Blocking	Refer to spectral data curves and tables for wavelength-specific typical values

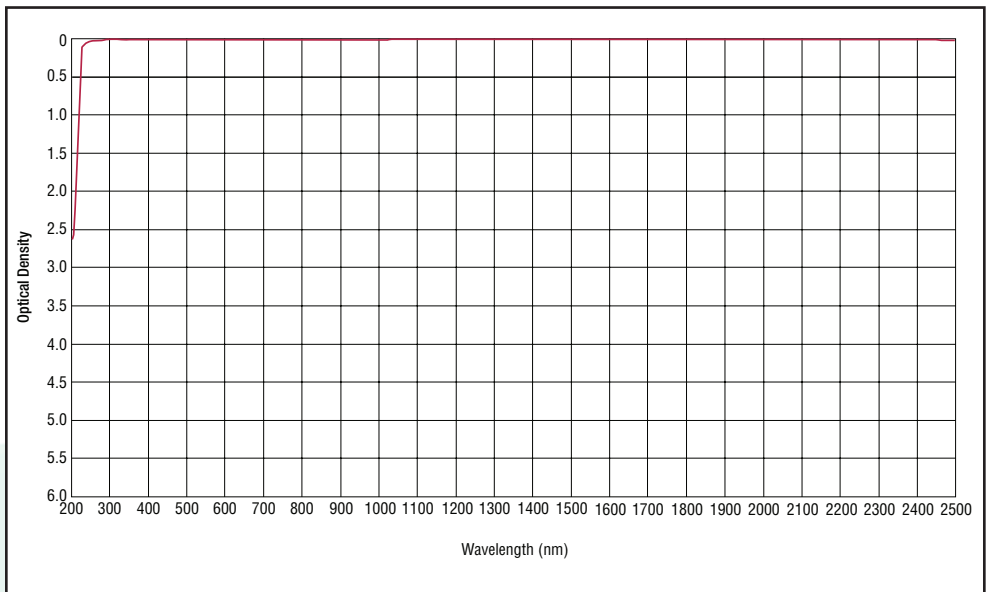
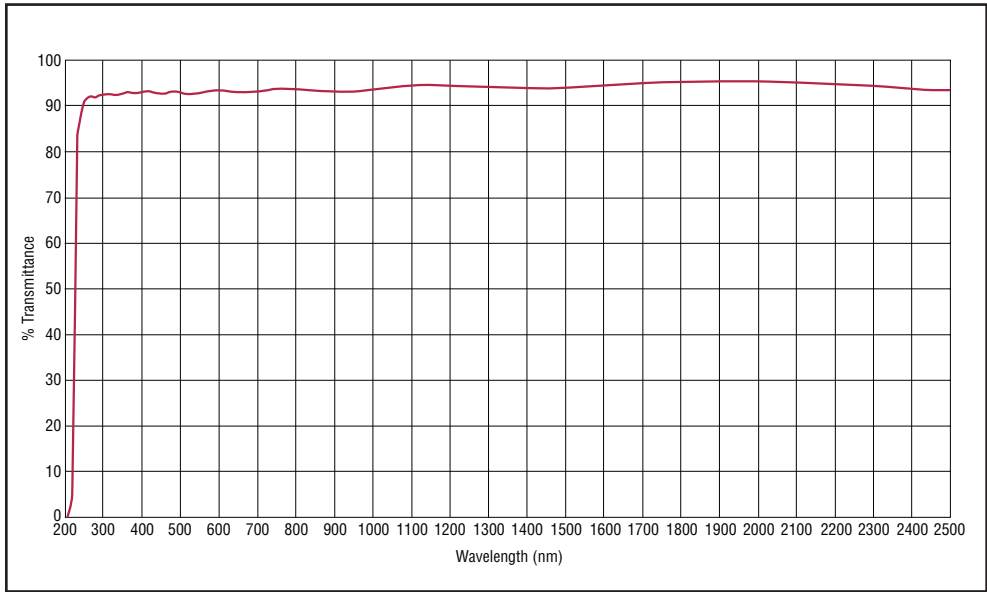
Spectral Specifications

Model 0.5 in. dia.	Model 1 in. dia.	Model 2 in. sq.	Model 6.5 in. sq.	Cut-on/Cut-off Wavelength (nm)	λ @ 90% Transmission	λ @ OD 5	Effective Index of Refraction n_e
5CGA-225	10CGA-225	20CGA-225	65CGA-225	225	≤ 240 nm	N/A	1.76
5CGA-280	10CGA-280	20CGA-280	65CGA-280	280	≤ 295 nm	≥ 250 nm	2.09
5CGA-295	10CGA-295	20CGA-295	65CGA-295	295	≤ 320 nm	≥ 270 nm	3.03
5CGA-305	10CGA-305	20CGA-305	65CGA-305	305	≤ 320 nm	≥ 285 nm	2.35
5CGA-320	10CGA-320	20CGA-320	65CGA-320	320	≤ 335 nm	≥ 300 nm	2.22
5CGA-335	10CGA-335	20CGA-335	65CGA-335	335	≤ 350 nm	≥ 317 nm	2.18
5CGA-345	10CGA-345	20CGA-345	65CGA-345	345	≤ 360 nm	≥ 326 nm	1.98
5CGA-360	10CGA-360	20CGA-360	65CGA-360	360	≤ 375 nm	≥ 338 nm	2.26
5CGA-375	10CGA-375	20CGA-375	65CGA-375	375	≤ 390 nm	≥ 345 nm	1.77
5CGA-385	10CGA-385	20CGA-385	65CGA-385	385	≤ 400 nm	≥ 360 nm	1.75
5CGA-395	10CGA-395	20CGA-395	65CGA-395	395	≤ 415 nm	≥ 370 nm	1.29
5CGA-400	10CGA-400	20CGA-400	65CGA-400	400	≤ 420 nm	≥ 375 nm	1.83
5CGA-420	10CGA-420	20CGA-420	65CGA-420	420	≤ 440 nm	≥ 390 nm	1.86
5CGA-435	10CGA-435	20CGA-435	65CGA-435	435	≤ 455 nm	≥ 400 nm	1.90
5CGA-455	10CGA-455	20CGA-455	65CGA-455	455	≤ 475 nm	≥ 420 nm	1.95
5CGA-475	10CGA-475	20CGA-475	65CGA-475	475	≤ 495 nm	≥ 440 nm	1.41
5CGA-495	10CGA-495	20CGA-495	65CGA-495	495	≤ 515 nm	≥ 455 nm	1.76
5CGA-515	10CGA-515	20CGA-515	65CGA-515	515	≤ 535 nm	≥ 485 nm	1.81
5CGA-530	10CGA-530	20CGA-530	65CGA-530	530	≤ 550 nm	≥ 495 nm	1.84
5CGA-550	10CGA-550	20CGA-550	65CGA-550	550	≤ 570 nm	≥ 515 nm	1.77
5CGA-570	10CGA-570	20CGA-570	65CGA-570	570	≤ 590 nm	≥ 535 nm	1.76
5CGA-590	10CGA-590	20CGA-590	65CGA-590	590	≤ 610 nm	≥ 555 nm	1.75
5CGA-610	10CGA-610	20CGA-610	65CGA-610	610	≤ 630 nm	≥ 575 nm	1.79
5CGA-630	10CGA-630	20CGA-630	65CGA-630	630	≤ 650 nm	≥ 595 nm	1.74
5CGA-645	10CGA-645	20CGA-645	65CGA-645	645	≤ 665 nm	≥ 615 nm	1.78
5CGA-665	10CGA-665	20CGA-665	65CGA-665	665	≤ 685 nm	≥ 630 nm	1.81
5CGA-695	10CGA-695	20CGA-695	65CGA-695	695	≤ 715 nm	≥ 645 nm	1.74
5CGA-715	10CGA-715	20CGA-715	65CGA-715	715	≤ 735 nm	≥ 665 nm	1.70
5CGA-760	10CGA-760	20CGA-760	65CGA-760	760	≤ 780 nm	≥ 705 nm	1.72
5CGA-780	10CGA-780	20CGA-780	65CGA-780	780	≤ 800 nm	≥ 710 nm	1.74
5CGA-800	10CGA-800	20CGA-800	65CGA-800	800	≤ 820 nm	≥ 730 nm	1.73
5CGA-830	10CGA-830	20CGA-830	65CGA-830	830	≤ 850 nm	≥ 755 nm	1.79
5CGA-850	10CGA-850	20CGA-850	65CGA-850	850	≤ 870 nm	≥ 775 nm	1.80
5CGA-1000	10CGA-1000	20CGA-1000	65CGA-1000	1000	≤ 1035 nm	≥ 860 nm	1.76

CGA-225

Spectral Performance Data - CGA-225

Cut-on Wavelength at 50% Absolute Transmittance	225 ± 5 nm
Cut-on Wavelength at 90% Absolute Transmittance	≤240 nm
Cut-on Wavelength at 10% Absolute Transmittance	221 nm (nominal)
Cut-on Wavelength at OD5	N/A
Effective Index of Refraction	1.76 (nominal)



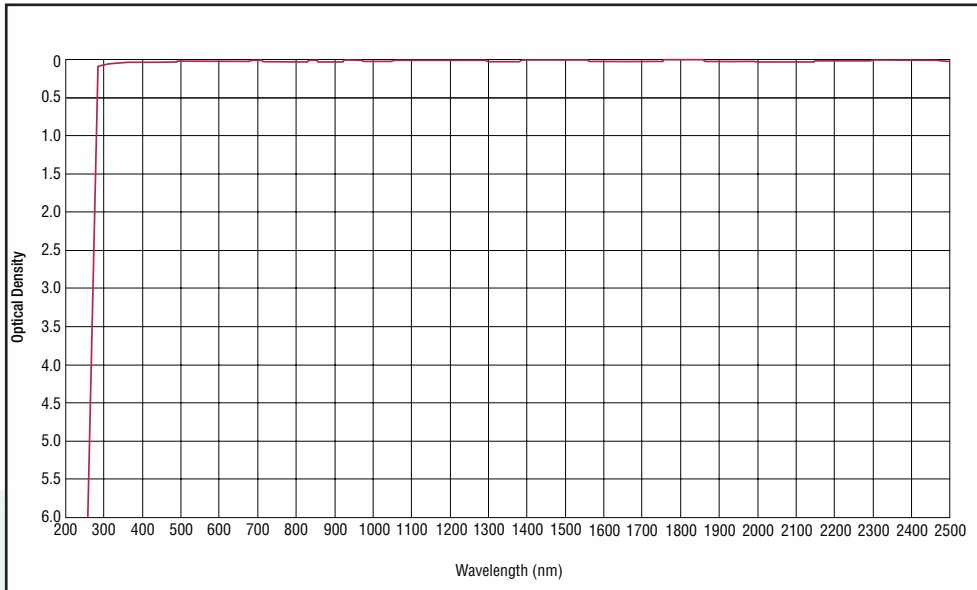
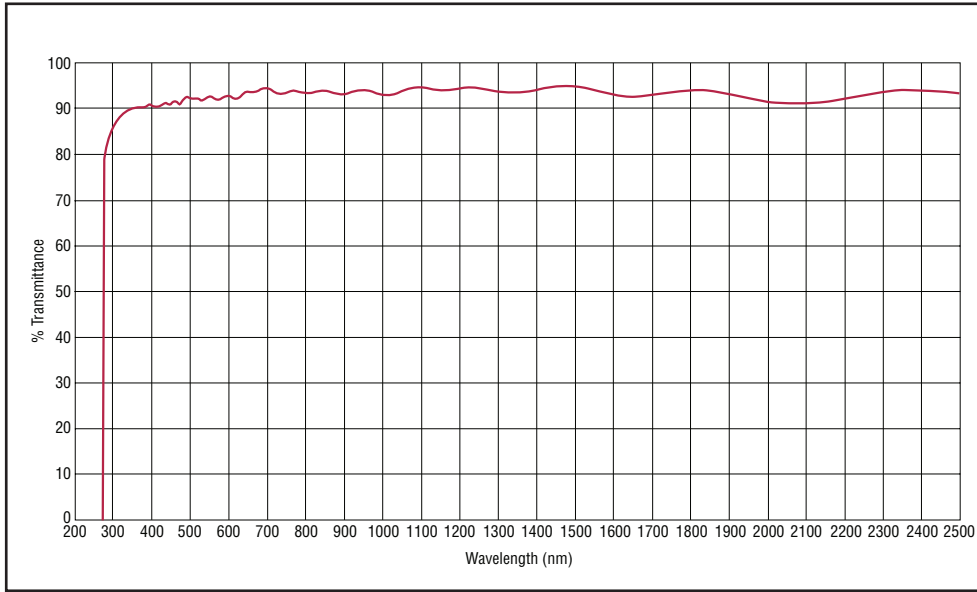
Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)
200	0.2191	238	86.37	600	93.13	980	93.19
201	0.2363	239	86.82	610	93.07	990	93.29
202	0.2551	240	87.19	620	92.96	1000	93.39
203	0.2765	250	90.33	630	92.86	1010	93.51
204	0.3013	260	91.34	640	92.81	1020	93.63
205	0.3309	270	91.24	650	92.77	1030	93.74
206	0.3367	280	91.38	660	92.72	1040	93.85
207	0.4105	290	91.89	670	92.70	1050	93.96
208	0.4648	300	91.86	680	92.73	1060	94.05
209	0.5328	310	92.08	690	92.81	1070	94.14
210	0.6187	320	91.98	700	92.89	1080	94.22
211	0.7283	330	91.61	710	92.99	1090	94.29
212	0.8697	340	91.71	720	93.10	1100	94.35
213	1.05	350	92.23	730	93.22	1110	94.39
214	1.30	360	92.49	740	93.34	1120	94.34
215	1.62	370	92.35	750	93.45	1130	94.46
216	2.06	380	92.22	760	93.53	1140	94.48
217	2.66	390	92.36	770	93.58	1150	94.49
218	3.50	400	92.61	780	93.59	1160	94.49
219	4.68	410	92.70	790	93.57	1170	94.49
220	6.37	420	92.56	800	93.52	1180	94.47
221	8.81	430	92.32	810	93.45	1190	94.46
222	12.38	440	92.16	820	93.36	1200	94.43
223	17.66	450	92.19	830	93.27	1300	94.07
224	25.01	460	92.38	840	93.17	1400	93.82
225	35.32	470	92.59	850	93.07	1500	93.94
226	46.00	480	92.71	860	92.98	1600	94.33
227	55.05	490	92.69	870	92.90	1700	94.81
228	63.22	500	92.57	880	92.84	1800	95.22
229	69.92	510	92.42	890	92.80	1900	95.46
230	75.00	520	92.33	900	92.78	2000	95.49
231	78.62	530	92.32	910	92.78	2100	95.33
232	81.12	540	92.37	920	92.80	2200	95.00
233	82.81	550	92.51	930	92.83	2300	94.55
234	83.97	560	92.70	940	92.87	2400	94.02
235	84.79	570	92.89	950	92.93	2500	93.45
236	85.40	580	93.04	960	93.01		
237	85.91	590	93.13	970	93.09		

Transmittance and Optical Density data are nominal values provided as a reference to indicate typical spectral response.

CGA-280

Spectral Performance Data - CGA-280

Cut-on Wavelength at 50% Absolute Transmittance	280 ± 5 nm
Cut-on Wavelength at 90% Absolute Transmittance	≤295 nm
Cut-on Wavelength at OD5	≥250 nm
Effective Index of Refraction	2.09 (nominal)



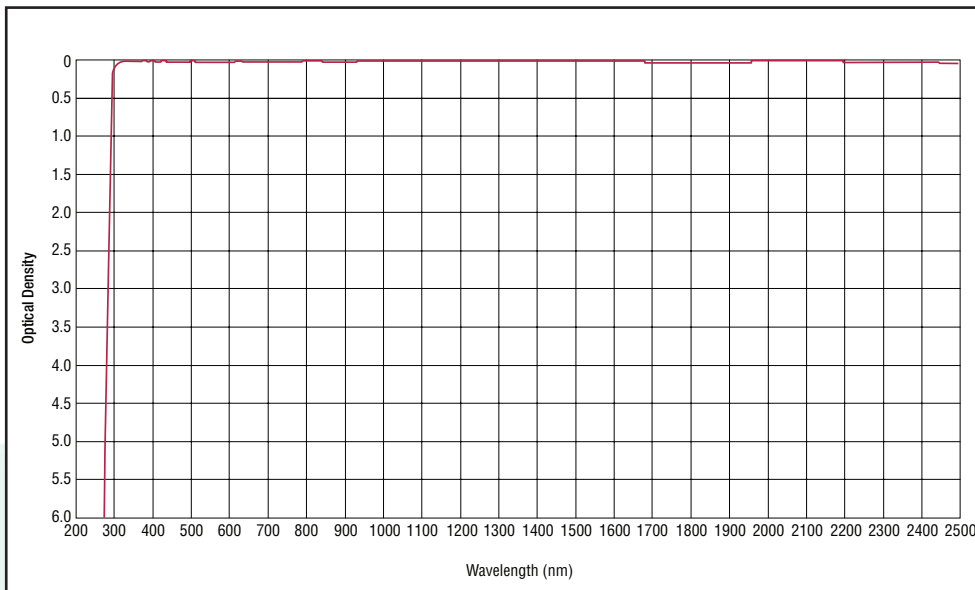
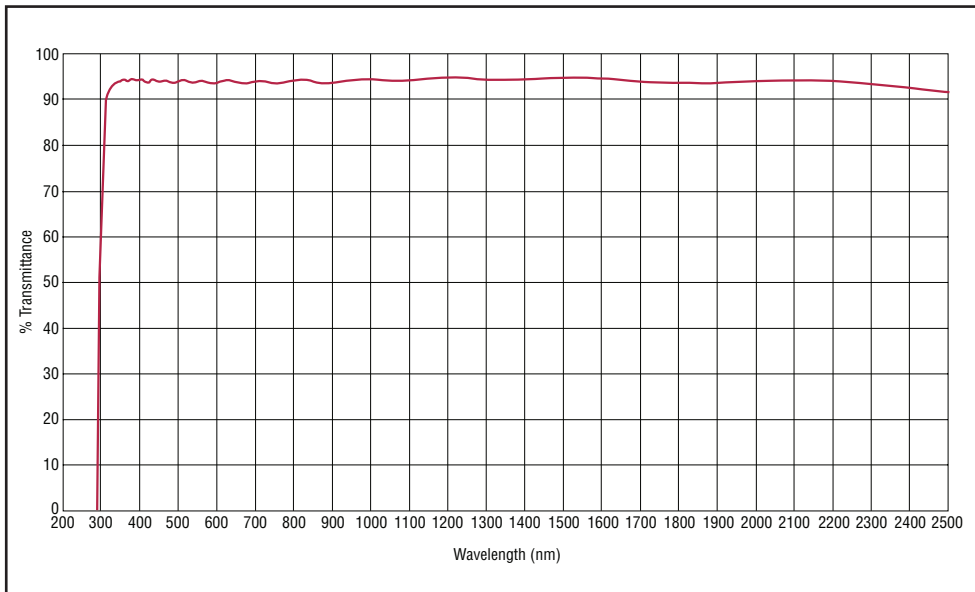
Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)
200	<0.0001	283	78.89	600	92.66	980	93.42
210	<0.0001	284	79.85	610	92.24	990	93.15
220	<0.0001	285	80.50	620	91.99	1000	92.96
230	<0.0001	286	81.00	630	92.43	1010	92.90
240	<0.0001	287	81.50	640	93.17	1020	92.98
250	<0.0001	288	82.02	650	93.50	1030	93.18
251	<0.0001	289	82.51	660	93.33	1040	93.47
252	<0.0001	290	82.93	670	93.39	1050	93.80
253	<0.0001	300	84.54	680	93.84	1060	94.11
254	<0.0001	310	86.74	690	94.28	1070	94.37
255	0.0001 (0D6)	320	87.65	700	94.31	1080	94.54
256	0.0004	330	88.73	710	93.89	1090	94.61
257	0.0006	340	88.84	720	93.31	1100	94.59
258	0.0006	350	89.70	730	92.92	1110	94.51
259	0.0004	360	89.63	740	92.91	1120	94.39
260	0.0004	370	90.11	750	93.22	1130	94.26
261	0.0005	380	90.00	760	93.56	1140	94.14
262	0.0006	390	90.21	770	93.71	1150	94.06
263	0.0010 (0D5)	400	90.64	780	93.62	1160	94.02
264	0.0014	410	90.02	790	93.43	1170	94.03
265	0.0025	420	90.38	800	93.29	1180	94.09
266	0.0051	430	90.54	810	93.32	1190	94.17
267	0.0108	440	90.98	820	93.50	1200	94.27
268	0.0228	450	90.56	830	93.72	1300	93.76
269	0.0429	460	91.46	840	93.86	1400	94.02
270	0.0680	470	91.06	850	93.83	1500	94.96
271	0.0970	480	91.12	860	93.62	1600	93.12
272	0.1407	490	92.13	870	93.33	1700	93.03
273	0.2172	500	92.09	880	93.08	1800	94.05
274	0.3653	510	92.03	890	92.97	1900	93.35
275	0.6792	520	92.15	900	93.05	2000	91.73
276	1.41	530	91.76	910	93.27	2100	91.26
277	3.27	540	91.80	920	93.58	2200	92.28
278	8.46	550	92.38	930	93.86	2300	93.68
279	22.42	560	92.36	940	94.04	2400	94.20
280	48.54	570	91.86	950	94.07	2500	93.42
281	69.82	580	91.94	960	93.95		
282	76.95	590	92.52	970	93.72		

Transmittance and Optical Density data are nominal values provided as a reference to indicate typical spectral response.

CGA-295

Spectral Performance Data - CGA-295

Cut-on Wavelength at 50% Absolute Transmittance	295 ± 5 nm
Cut-on Wavelength at 90% Absolute Transmittance	≤320 nm
Cut-on Wavelength at OD5	≥270 nm
Effective Index of Refraction	3.03 (nominal)



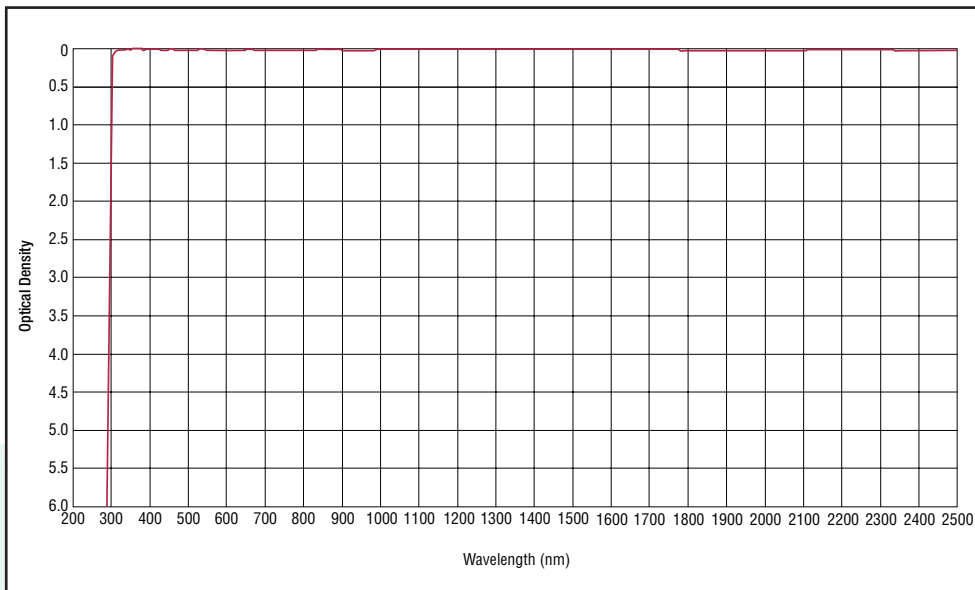
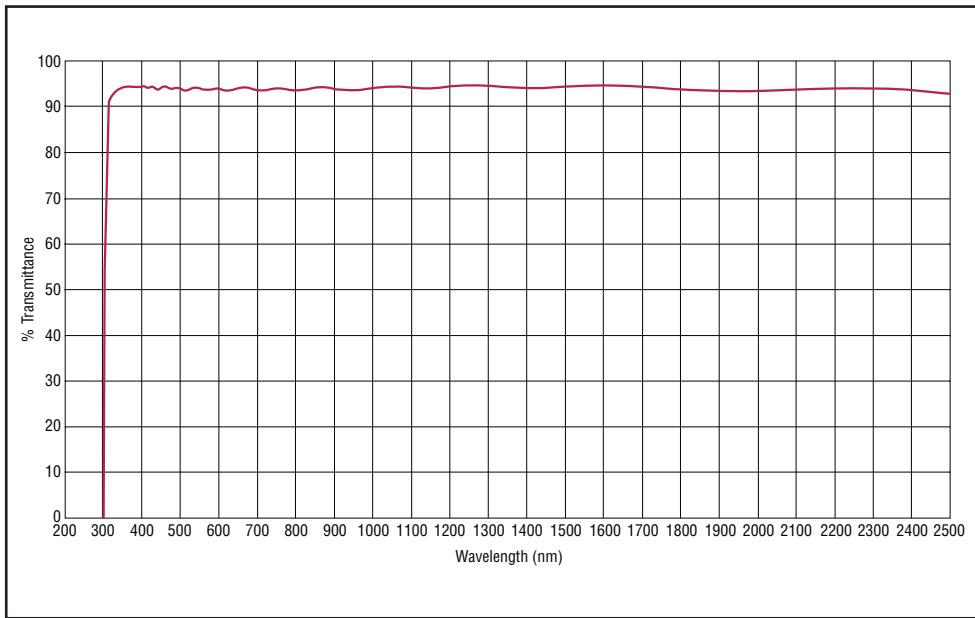
Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)
200	<0.0001	301	73.70	600	93.29	980	94.10
210	<0.0001	302	76.41	610	93.58	990	94.09
220	<0.0001	303	78.80	620	93.77	1000	94.04
230	<0.0001	304	81.20	630	93.74	1010	93.97
240	<0.0001	305	82.76	640	93.55	1020	93.90
250	<0.0001	306	83.62	650	93.32	1030	93.83
260	<0.0001	307	84.23	660	93.20	1040	93.77
270	<0.0001	308	84.58	670	93.22	1050	93.74
271	<0.0001	309	85.27	680	93.37	1060	93.72
272	<0.0001	310	86.29	690	93.54	1070	93.73
273	<0.0001	320	91.46	700	93.65	1080	93.77
274	<0.0001	330	92.75	710	93.65	1090	93.82
275	0.0001 (OD6)	340	93.52	720	93.55	1100	93.90
276	0.0002	350	93.41	730	93.38	1110	93.98
277	0.0003	360	93.82	740	93.21	1120	94.06
278	0.0005	370	93.47	750	93.13	1130	94.15
279	0.0010 (OD5)	380	94.09	760	93.16	1140	94.24
280	0.0016	390	93.60	770	93.30	1150	94.31
281	0.0030	400	93.95	780	93.50	1160	94.38
282	0.0057	410	93.47	790	93.70	1170	94.43
283	0.0111	420	93.40	800	93.87	1180	94.46
284	0.0223	430	93.94	810	93.96	1190	94.48
285	0.0460	440	93.62	820	93.97	1200	94.47
286	0.0982	450	93.36	830	93.89	1300	93.98
287	0.2168	460	93.65	840	93.75	1400	94.18
288	0.4926	470	93.58	850	93.57	1500	94.54
289	1.14	480	93.19	860	93.41	1600	94.25
290	2.63	490	93.25	870	93.28	1700	93.63
291	5.74	500	93.69	880	93.21	1800	93.33
292	11.38	510	93.83	890	93.21	1900	93.49
293	19.66	520	93.53	900	93.27	2000	93.83
294	29.78	530	93.25	910	93.38	2100	93.97
295	40.92	540	93.30	920	93.52	2200	93.71
296	52.74	550	93.52	930	93.67	2300	93.06
297	65.21	560	93.59	940	93.81	2400	92.15
298	67.78	570	93.39	950	93.94	2500	91.17
299	69.18	580	93.14	960	94.03		
300	70.58	590	93.09	970	94.09		

Transmittance and Optical Density data are nominal values provided as a reference to indicate typical spectral response.

CGA-305

Spectral Performance Data - CGA-305

Cut-on Wavelength at 50% Absolute Transmittance	305 ± 5 nm
Cut-on Wavelength at 90% Absolute Transmittance	≤320 nm
Cut-on Wavelength at OD5	≥285 nm
Effective Index of Refraction	2.35 (nominal)



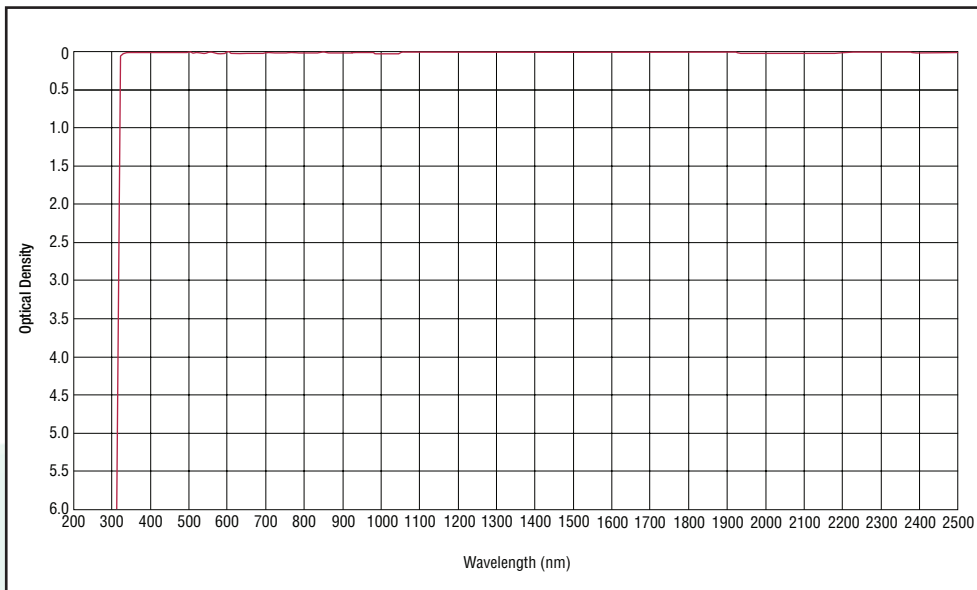
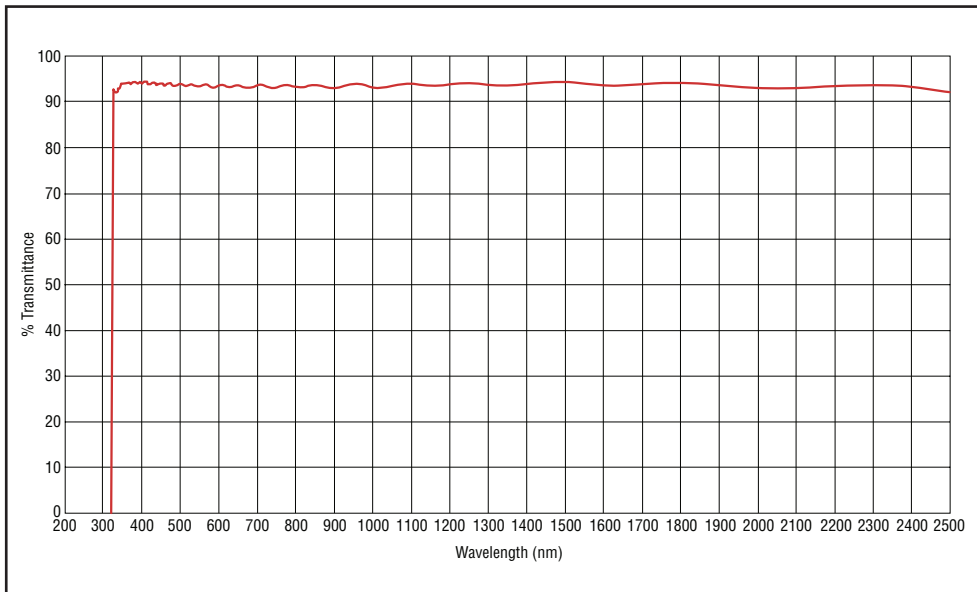
Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)
200	<0.0001	310	84.92	600	93.51	980	93.61
210	<0.0001	311	86.50	610	93.26	990	93.76
220	<0.0001	312	88.07	620	93.12	1000	93.90
230	<0.0001	313	89.42	630	93.19	1010	94.02
240	<0.0001	314	90.46	640	93.45	1020	94.10
250	<0.0001	315	90.59	650	93.71	1030	94.15
260	<0.0001	316	90.83	660	93.83	1040	94.16
270	<0.0001	317	91.25	670	93.75	1050	94.14
280	<0.0001	318	91.77	680	93.54	1060	94.09
281	<0.0001	319	92.23	690	93.34	1070	94.02
282	<0.0001	320	92.53	700	93.21	1080	93.95
283	<0.0001	330	93.17	710	93.22	1090	93.88
284	<0.0001	340	93.60	720	93.35	1100	93.83
285	<0.0001	350	93.48	730	93.52	1110	93.78
286	<0.0001	360	94.11	740	93.67	1120	93.75
287	<0.0001	370	93.86	750	93.70	1130	93.75
288	<0.0001	380	93.99	760	93.63	1140	93.77
289	<0.0001	390	93.69	770	93.48	1150	93.81
290	0.0001 (0D6)	400	94.26	780	93.32	1160	93.86
291	0.0002	410	93.71	790	93.21	1170	93.94
292	0.0003	420	93.97	800	93.19	1180	94.02
293	0.0005	430	93.70	810	93.26	1190	94.11
294	0.0008	440	93.31	820	93.40	1200	94.19
295	0.0010 (0D5)	450	93.85	830	93.60	1300	94.30
296	0.0023	460	93.92	840	93.79	1400	93.89
297	0.0047	470	93.47	850	93.94	1500	94.20
298	0.0073	480	93.53	860	94.03	1600	94.54
299	0.0129	490	93.75	870	94.02	1700	94.21
300	0.0235	500	93.49	880	93.94	1800	93.57
301	0.0881	510	93.17	890	93.81	1900	93.22
302	0.3854	520	93.36	900	93.65	2000	93.33
303	2.03	530	93.78	910	93.49	2100	93.67
304	12.52	540	93.87	920	93.37	2200	93.93
305	48.31	550	93.56	930	93.28	2300	93.84
306	74.03	560	93.26	940	93.25	2400	93.35
307	80.10	570	93.28	950	93.28	2500	92.56
308	81.86	580	93.51	960	93.36		
309	83.22	590	93.63	970	93.47		

Transmittance and Optical Density data are nominal values provided as a reference to indicate typical spectral response.

CGA-320

Spectral Performance Data - CGA-320

Cut-on Wavelength at 50% Absolute Transmittance	320 ± 5 nm
Cut-on Wavelength at 90% Absolute Transmittance	≤335 nm
Cut-on Wavelength at OD5	≥300 nm
Effective Index of Refraction	2.22 (nominal)



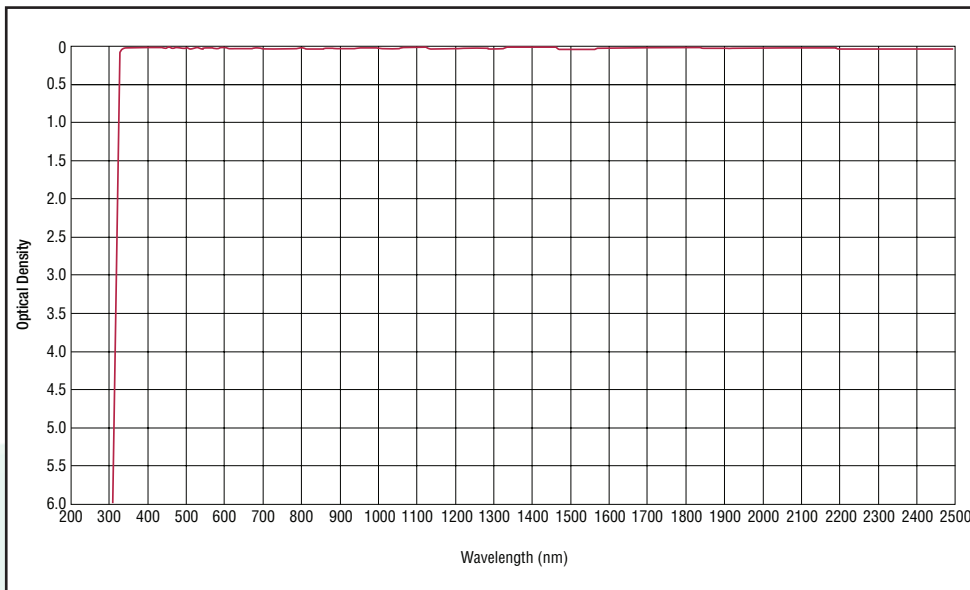
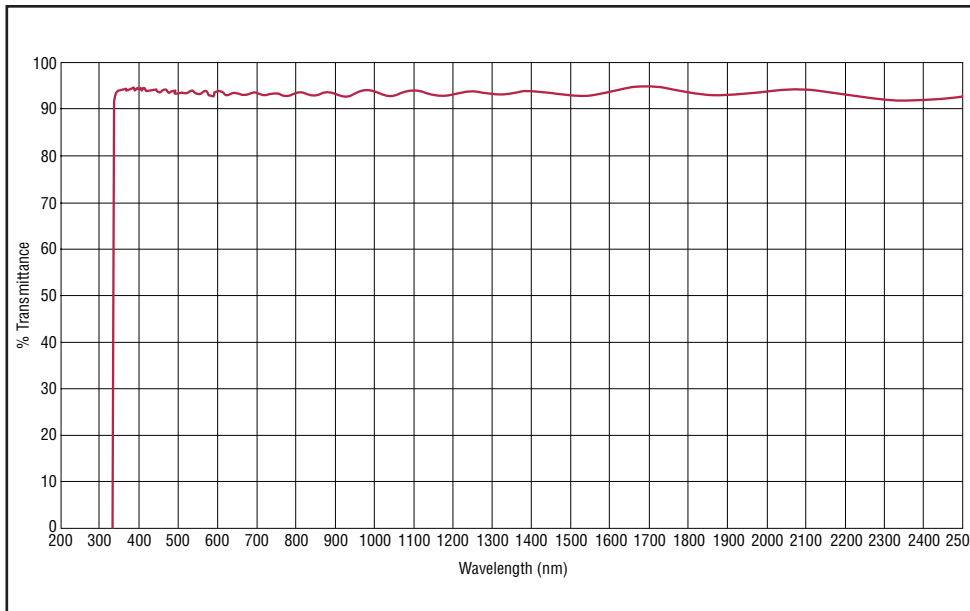
Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)
200	<0.0001	328	91.77	600	93.80	980	93.68
210	<0.0001	329	91.94	610	93.60	990	93.47
220	<0.0001	330	92.28	620	93.32	1000	93.32
230	<0.0001	331	92.29	630	93.41	1010	93.26
240	<0.0001	332	92.09	640	93.65	1020	93.30
250	<0.0001	333	92.11	650	93.62	1030	93.43
260	<0.0001	334	92.35	660	93.31	1040	93.61
270	<0.0001	335	92.74	670	93.12	1050	93.81
280	<0.0001	336	93.08	680	93.30	1060	93.99
290	<0.0001	337	93.23	690	93.66	1070	94.13
300	<0.0001	338	93.17	700	93.86	1080	94.20
301	<0.0001	339	93.04	710	93.73	1090	94.21
302	<0.0001	340	92.98	720	93.38	1100	94.15
303	<0.0001	350	93.69	730	93.10	1110	94.06
304	<0.0001	360	93.87	740	93.11	1120	93.95
305	<0.0001	370	93.83	750	93.38	1130	93.84
306	<0.0001	380	94.37	760	93.68	1140	93.46
307	<0.0001	390	94.28	770	93.80	1150	93.71
308	<0.0001	400	93.87	780	93.71	1160	93.70
309	<0.0001	410	94.24	790	93.50	1170	93.74
310	<0.0001	420	93.88	800	93.35	1180	93.81
311	<0.0001	430	94.11	810	93.34	1190	93.90
312	0.0001 (OD6)	440	93.87	820	93.48	1200	94.01
313	0.0003	450	93.82	830	93.67	1300	93.86
314	0.0010 (OD5)	460	93.67	840	93.81	1400	94.18
315	0.0042	470	94.11	850	93.81	1500	94.48
316	0.0190	480	93.40	860	93.66	1600	93.87
317	0.1020	490	93.77	870	93.44	1700	94.19
318	0.7078	500	93.88	880	93.24	1800	94.47
319	6.92	510	93.46	890	93.15	1900	93.86
320	53.81	520	93.74	900	93.22	2000	93.23
321	88.95	530	93.64	910	93.41	2100	93.32
322	89.45	540	93.28	920	93.67	2200	93.83
323	90.35	550	93.63	930	93.91	2300	94.02
324	91.45	560	93.92	940	94.08	2400	93.47
325	92.53	570	93.47	950	94.13	2500	92.39
326	92.70	580	93.16	960	94.06		
327	92.12	590	93.50	970	93.89		

Transmittance and Optical Density data are nominal values provided as a reference to indicate typical spectral response.

CGA-335

Spectral Performance Data - CGA-335

Cut-on Wavelength at 50% Absolute Transmittance	335 ± 5 nm
Cut-on Wavelength at 90% Absolute Transmittance	≤350 nm
Cut-on Wavelength at OD5	≥317 nm
Effective Index of Refraction	2.18 (nominal)



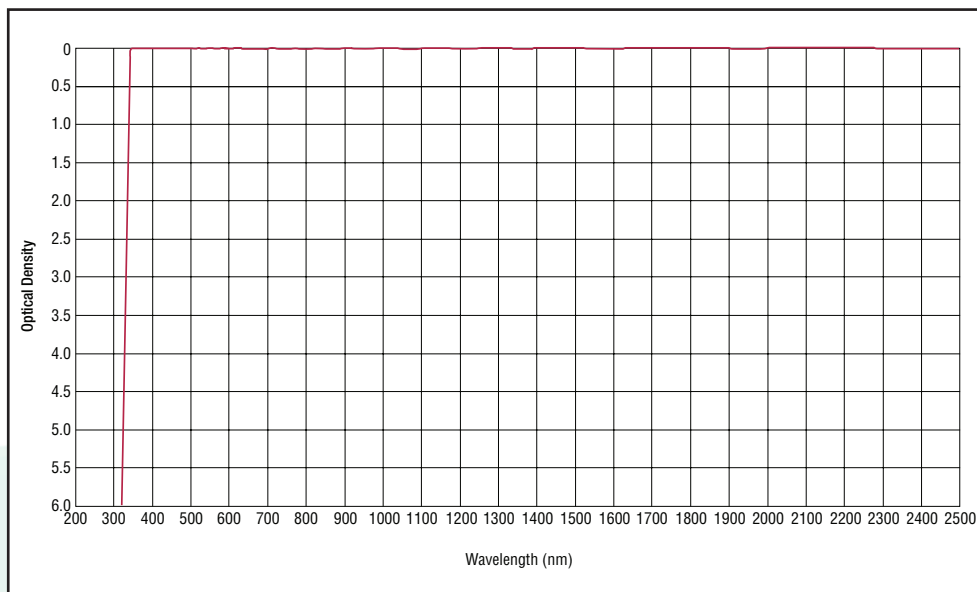
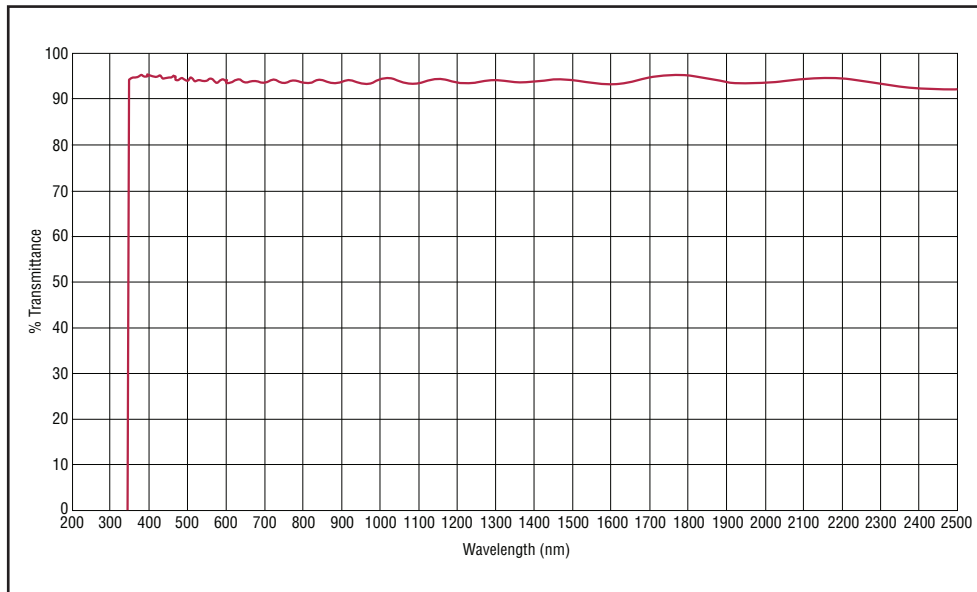
Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)
200	<0.0001	337	91.63	600	94.04	980	94.46
210	<0.0001	338	92.35	610	93.87	990	94.29
220	<0.0001	339	92.20	620	93.23	1000	93.97
230	<0.0001	340	92.89	630	93.27	1010	93.59
240	<0.0001	341	93.52	640	93.68	1020	93.28
250	<0.0001	342	93.69	650	93.62	1030	93.11
260	<0.0001	343	93.66	660	93.26	1040	93.11
270	<0.0001	344	93.78	670	93.27	1050	93.27
280	<0.0001	345	94.08	680	93.68	1060	93.54
290	<0.0001	346	94.35	690	93.94	1070	93.83
300	<0.0001	347	94.35	700	93.74	1080	94.09
310	<0.0001	348	94.06	710	93.36	1090	94.26
311	<0.0001	349	93.69	720	93.25	1100	94.30
312	<0.0001	350	93.48	730	93.46	1110	94.22
313	<0.0001	360	94.51	740	93.69	1120	94.04
314	<0.0001	370	94.08	750	93.62	1130	93.81
315	<0.0001	380	94.33	760	93.33	1140	93.58
316	<0.0001	390	94.05	770	93.13	1150	93.38
317	<0.0001	400	94.35	780	93.23	1160	93.25
318	<0.0001	410	94.75	790	93.56	1170	93.20
319	0.0001 (OD6)	420	93.86	800	93.85	1180	93.24
320	0.0002	430	94.06	810	93.90	1190	93.35
321	0.0003	440	94.36	820	93.68	1200	93.51
322	0.0005	450	93.86	830	93.38	1300	93.67
323	0.0010 (OD5)	460	94.09	840	93.21	1400	94.16
324	0.0015	470	93.79	850	93.28	1500	93.29
325	0.0028	480	93.95	860	93.53	1600	94.21
326	0.0056	490	94.06	870	93.79	1700	95.33
327	0.0122	500	93.56	880	93.88	1800	94.14
328	0.0289	510	93.79	890	93.74	1900	93.60
329	0.0742	520	93.49	900	93.44	2000	94.43
330	0.2064	530	94.03	910	93.15	2100	94.68
331	0.6183	540	93.92	920	93.01	2200	93.70
332	1.98	550	93.26	930	93.08	2300	92.65
333	6.19	560	93.76	940	93.37	2400	92.55
334	18.63	570	93.90	950	93.77	2500	93.31
335	47.08	580	93.15	960	94.17		
336	79.39	590	93.30	970	94.42		

Transmittance and Optical Density data are nominal values provided as a reference to indicate typical spectral response.

CGA-345

Spectral Performance Data - CGA-345

Cut-on Wavelength at 50% Absolute Transmittance	345 ± 5 nm
Cut-on Wavelength at 90% Absolute Transmittance	≤360 nm
Cut-on Wavelength at OD5	≥326 nm
Effective Index of Refraction	1.98 (nominal)



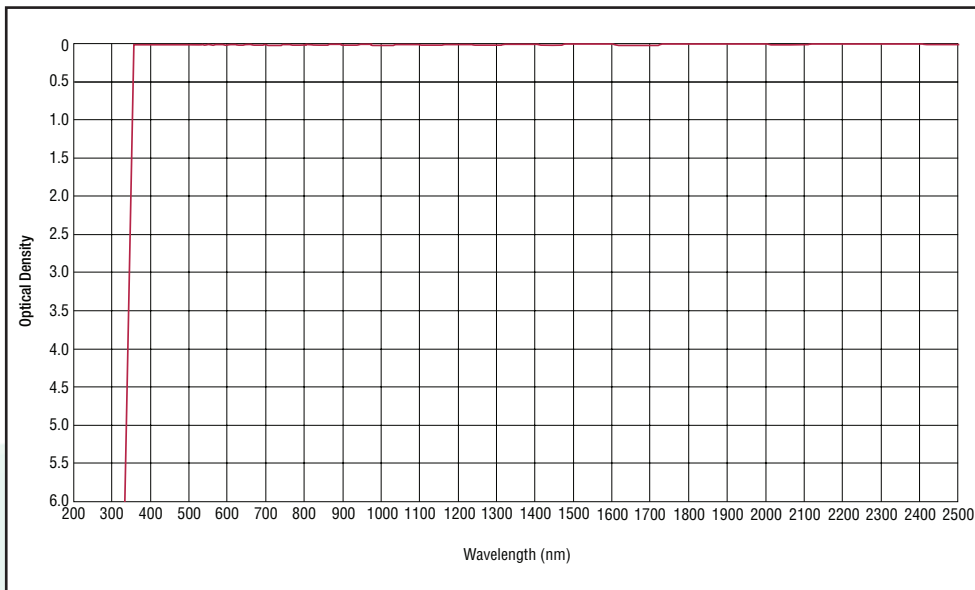
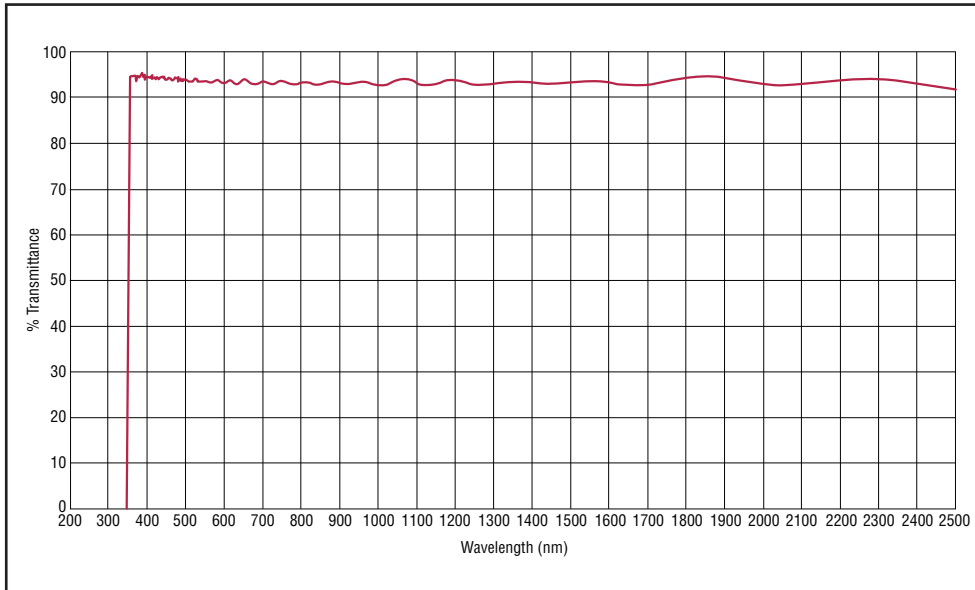
Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)
200	<0.0001	346	81.55	600	93.28	980	93.50
210	<0.0001	347	93.23	610	93.20	990	93.91
220	<0.0001	348	93.97	620	93.93	1000	94.26
230	<0.0001	349	93.44	630	94.04	1010	94.47
240	<0.0001	350	93.69	640	93.41	1020	94.46
250	<0.0001	351	94.25	650	93.17	1030	94.26
260	<0.0001	352	94.55	660	93.55	1040	93.93
270	<0.0001	353	94.51	670	93.74	1050	93.57
280	<0.0001	354	94.42	680	93.45	1060	93.29
290	<0.0001	355	94.47	690	93.22	1070	93.14
300	<0.0001	356	94.66	700	93.42	1080	93.15
310	<0.0001	357	94.81	710	93.83	1090	93.30
320	<0.0001	358	94.74	720	93.92	1100	93.55
321	<0.0001	359	94.46	730	93.60	1110	93.83
322	<0.0001	360	94.09	740	93.26	1120	94.08
323	<0.0001	370	94.47	750	93.27	1130	94.26
324	<0.0001	380	94.09	760	93.54	1140	94.32
325	<0.0001	390	94.35	770	93.72	1150	94.27
326	<0.0001	400	94.57	780	93.61	1160	94.11
327	0.0001 (0D6)	410	94.65	790	93.33	1170	93.90
328	0.0002	420	94.37	800	93.15	1180	93.67
329	0.0003	430	94.15	810	93.25	1190	93.46
330	0.0004	440	94.32	820	93.56	1200	93.30
331	0.0006	450	93.85	830	93.85	1300	94.03
332	0.0010 (0D5)	460	94.61	840	93.92	1400	93.75
333	0.0016	470	93.63	850	93.74	1500	94.00
334	0.0029	480	94.31	860	93.45	1600	93.34
335	0.0053	490	93.63	870	93.26	1700	94.86
336	0.0105	500	94.16	880	93.28	1800	95.10
337	0.0220	510	93.91	890	93.50	1900	93.77
338	0.0494	520	93.64	900	93.75	2000	93.70
339	0.1193	530	93.79	910	93.90	2100	94.58
340	0.3077	540	93.51	920	93.84	2200	93.70
341	0.8442	550	94.05	930	93.60	2300	93.52
342	2.46	560	93.94	940	93.30	2400	92.55
343	7.38		93.28	950	93.07	2500	92.52
344	21.39	580	93.70	960	93.01		
345	50.82	590	93.97	970	93.17		

Transmittance and Optical Density data are nominal values provided as a reference to indicate typical spectral response.

CGA-360

Spectral Performance Data - CGA-360

Cut-on Wavelength at 50% Absolute Transmittance	360 ± 5 nm
Cut-on Wavelength at 90% Absolute Transmittance	≤375 nm
Cut-on Wavelength at OD5	≥338 nm
Effective Index of Refraction	2.26 (nominal)



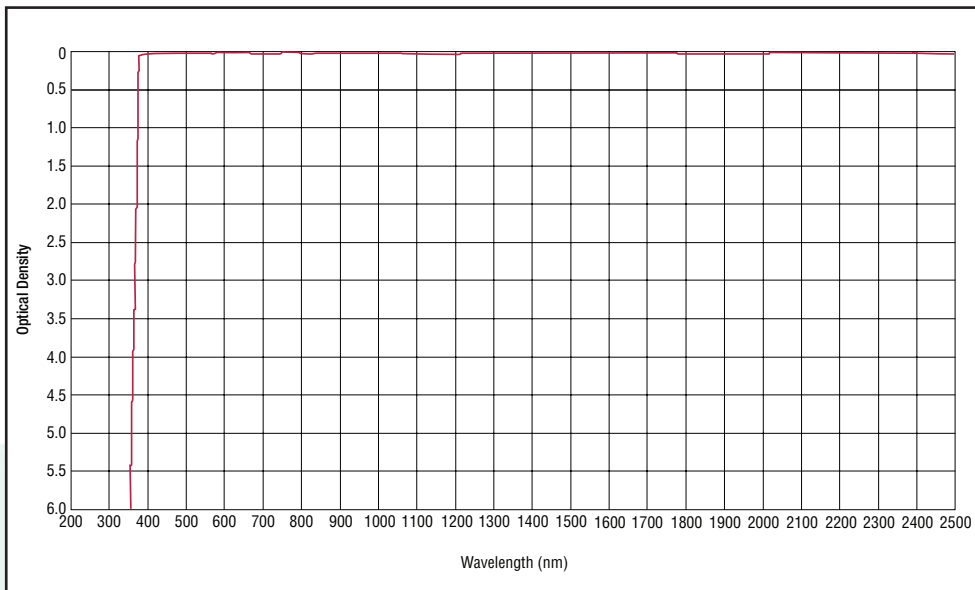
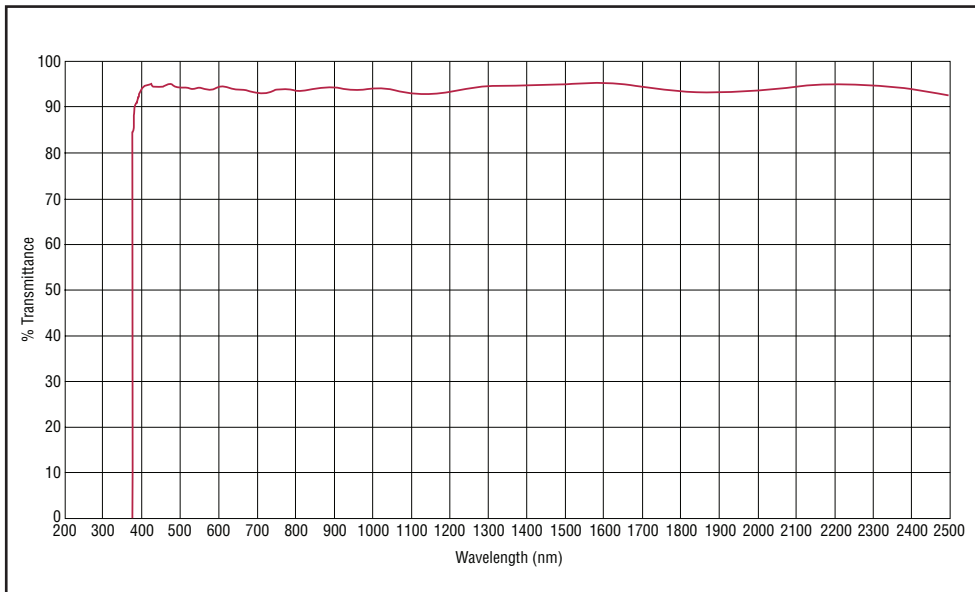
Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)
200	<0.0001	355	0.4814	600	93.31	980	93.66
210	<0.0001	356	1.24	610	93.68	990	93.36
220	<0.0001	357	3.34	620	94.03	1000	93.11
230	<0.0001	358	9.15	630	93.43	1010	93.01
240	<0.0001	359	23.83	640	93.12	1020	93.11
250	<0.0001	360	51.23	650	93.72	1030	93.39
260	<0.0001	361	79.48	660	94.14	1040	93.78
270	<0.0001	362	92.67	670	93.71	1050	94.16
280	<0.0001	363	94.74	680	93.22	1060	94.43
290	<0.0001	364	94.07	690	93.35	1070	94.52
300	<0.0001	365	93.86	700	93.71	1080	94.42
310	<0.0001	366	94.29	710	93.69	1090	94.16
320	<0.0001	367	94.80	720	93.32	1100	93.83
330	<0.0001	368	95.01	730	93.16	1110	93.51
331	<0.0001	369	94.93	740	93.46	1120	93.27
332	<0.0001	370	94.81	750	93.88	1130	93.15
333	<0.0001	380	94.25	760	93.92	1140	93.17
334	<0.0001	390	95.17	770	93.60	1150	93.32
335	<0.0001	400	94.38	780	93.31	1160	93.56
336	<0.0001	410	94.42	790	93.31	1170	93.83
337	<0.0001	420	94.57	800	93.55	1180	94.08
338	<0.0001	430	94.66	810	93.73	1190	94.25
339	0.0001 (OD6)	440	94.32	820	93.68	1200	94.34
340	0.0002	450	94.47	830	93.42	1300	93.47
341	0.0002	460	94.23	840	93.19	1400	93.82
342	0.0003	470	94.00	850	93.19	1500	93.92
343	0.0004	480	94.55	860	94.44	1600	93.84
344	0.0006	490	93.98	870	93.73	1700	93.38
345	0.0010 (OD5)	500	94.03	880	93.95	1800	94.93
346	0.0013	510	94.07	890	93.89	1900	95.10
347	0.0021	520	93.73	900	93.66	2000	93.79
348	0.0035	530	94.32	910	93.41	2100	93.59
349	0.0060	540	93.72	920	93.29	2200	94.44
350	0.0107	550	93.76	930	93.35	2300	94.71
351	0.0204	560	93.73	940	93.56	2400	93.85
352	0.0410	570	93.54	950	93.80	2500	92.74
353	0.0874	580	94.10	960	93.92		
354	0.1986	590	93.93	970	93.87		

Transmittance and Optical Density data are nominal values provided as a reference to indicate typical spectral response.

CGA-375

Spectral Performance Data - CGA-375

Cut-on Wavelength at 50% Absolute Transmittance	375 ± 5 nm
Cut-on Wavelength at 90% Absolute Transmittance	≤390 nm
Cut-on Wavelength at OD5	≥345 nm
Effective Index of Refraction	1.77 (nominal)



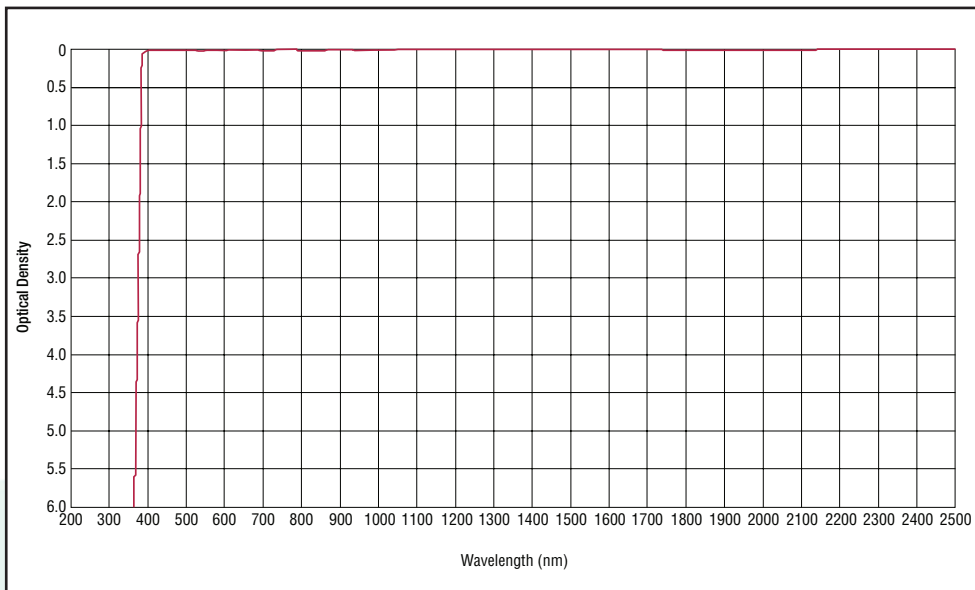
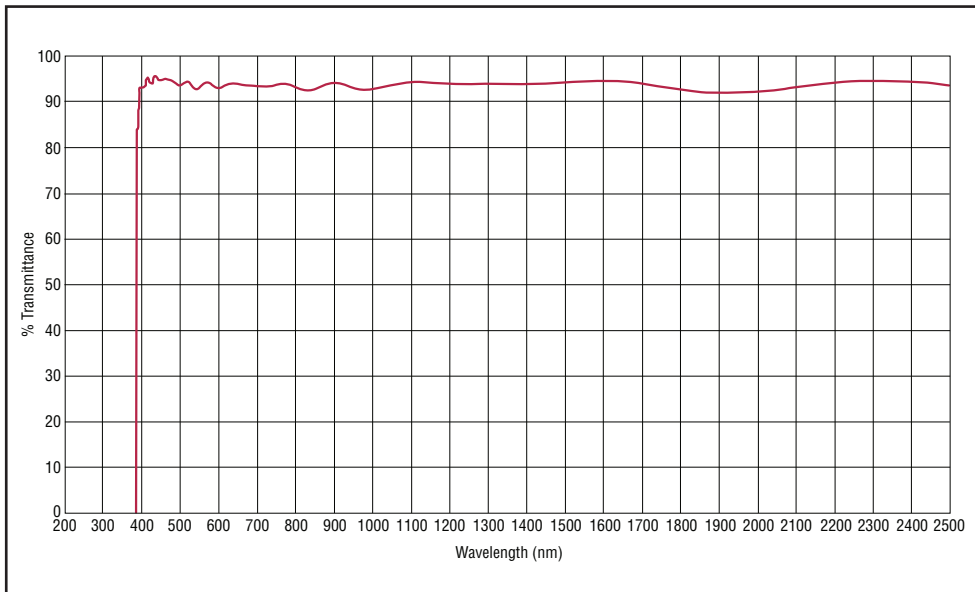
Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)
200	<0.0001	373	8.63	600	94.47	980	94.00a
210	<0.0001	374	20.88	610	94.54	990	94.06
220	<0.0001	375	44.62	620	94.33	1000	94.10
230	<0.0001	376	71.11	630	94.02	1010	94.11
240	<0.0001	377	83.67	640	93.80	1020	94.09
250	<0.0001	378	87.03	650	93.71	1030	94.03
260	<0.0001	379	88.02	660	93.68	1040	93.93
270	<0.0001	380	88.71	670	93.59	1050	93.80
280	<0.0001	381	89.44	680	93.40	1060	93.65
290	<0.0001	382	90.05	690	93.17	1070	93.48
300	<0.0001	383	90.45	700	92.97	1080	93.32
310	<0.0001	384	90.66	710	92.89	1090	93.17
320	<0.0001	385	90.79	720	92.99	1100	93.04
330	<0.0001	386	90.88	730	93.22	1110	92.94
340	<0.0001	387	91.02	740	93.51	1120	92.87
350	<0.0001	388	91.26	750	93.76	1130	92.83
351	<0.0001	389	91.57	760	93.90	1140	92.84
352	<0.0001	390	91.91	770	93.92	1150	92.88
353	<0.0001	400	93.83	780	93.83	1160	92.95
354	<0.0001	410	94.46	790	93.71	1170	93.05
355	<0.0001	420	94.94	800	93.60	1180	93.17
356	0.0001 (0D6)	430	94.53	810	93.55	1190	93.31
357	0.0002	440	94.39	820	93.58	1200	93.46
358	0.0005	450	94.43	830	93.68	1300	94.53
359	0.0010 (0D5)	460	94.65	840	93.82	1400	94.61
360	0.0025	470	95.12	850	93.98	1500	95.08
361	0.0058	480	94.82	860	94.11	1600	95.27
362	0.0090	490	94.33	870	94.20	1700	94.49
363	0.0141	500	94.31	880	94.23	1800	93.46
364	0.0227	510	94.27	890	94.20	1900	93.10
365	0.0373	520	94.00	900	94.13	2000	93.54
366	0.0625	530	93.91	910	94.04	2100	94.32
367	0.1073	540	94.08	920	93.96	2200	94.82
368	0.1894	550	94.15	930	93.90	2300	94.64
369	0.3445	560	93.91	940	93.86	2400	93.70
370	0.7076	570	93.66	950	93.86	2500	92.20
371	1.55	580	93.74	960	93.89		
372	3.57	590	94.11	970	93.94		

Transmittance and Optical Density data are nominal values provided as a reference to indicate typical spectral response.

CGA-385

Spectral Performance Data - CGA-385

Cut-on Wavelength at 50% Absolute Transmittance	385 ± 5 nm
Cut-on Wavelength at 90% Absolute Transmittance	≤400 nm
Cut-on Wavelength at OD5	≥360 nm
Effective Index of Refraction	1.75 (nominal)



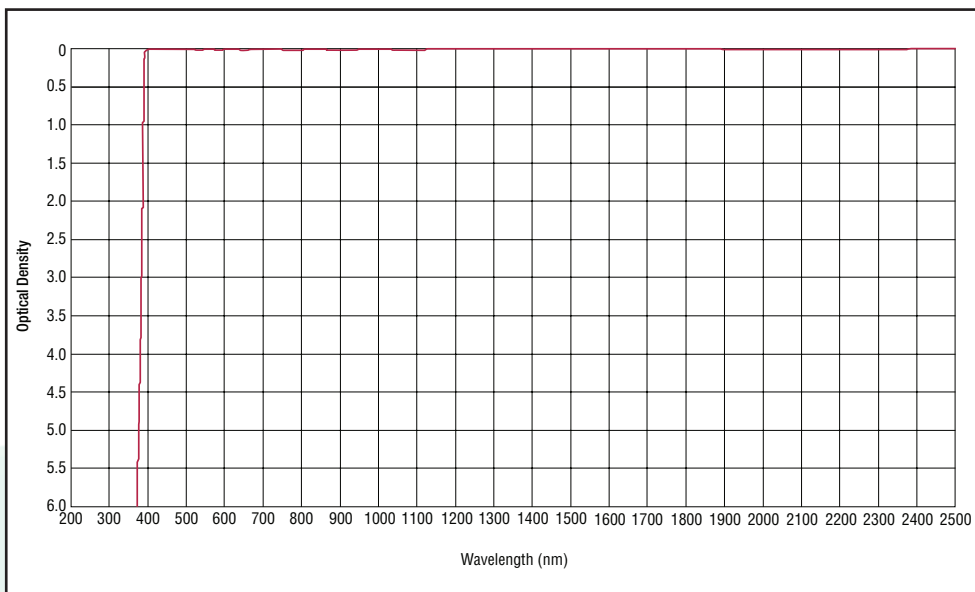
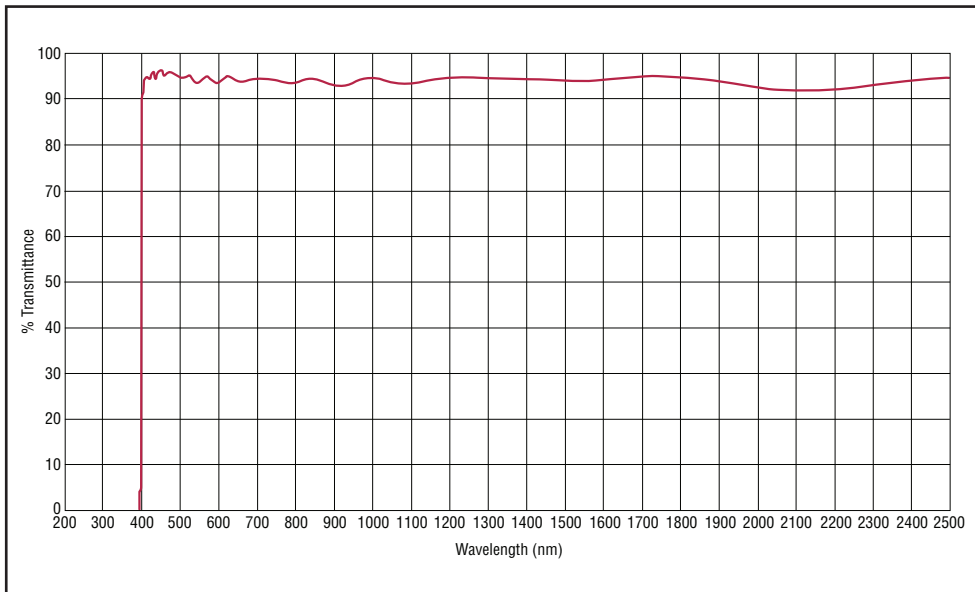
Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)
200	<0.0001	382	4.20	600	93.29	980	92.89
210	<0.0001	383	9.84	610	93.70	990	92.91
220	<0.0001	384	22.84	620	94.13	1000	93.01
230	<0.0001	385	46.39	630	94.30	1010	93.18
240	<0.0001	386	71.25	640	94.20	1020	93.38
250	<0.0001	387	83.10	650	94.01	1030	93.60
260	<0.0001	388	85.79	660	93.87	1040	93.81
270	<0.0001	389	87.25	670	93.80	1050	94.01
280	<0.0001	390	89.05	680	93.74	1060	94.18
290	<0.0001	391	90.80	690	93.65	1070	94.31
300	<0.0001	392	92.11	700	93.55	1080	94.40
310	<0.0001	393	92.90	710	93.48	1090	94.45
320	<0.0001	394	93.10	720	93.50	1100	94.47
330	<0.0001	395	93.26	730	93.64	1110	94.45
340	<0.0001	396	93.42	740	93.87	1120	94.41
350	<0.0001	397	93.59	750	94.11	1130	94.36
360	<0.0001	398	93.71	760	94.23	1140	94.30
361	<0.0001	399	93.76	770	94.17	1150	94.23
362	<0.0001	400	93.75	780	93.94	1160	94.17
363	<0.0001	410	95.13	790	93.59	1170	94.12
364	<0.0001	420	94.49	800	93.22	1180	94.08
365	<0.0001	430	95.72	810	92.92	1190	94.05
366	0.0001 (OD6)	440	95.34	820	92.76	1200	94.03
367	0.0002	450	95.10	830	92.76	1300	94.11
368	0.0003	460	95.26	840	92.93	1400	94.12
369	0.0005	470	95.02	850	93.23	1500	94.55
370	0.0009	480	94.73	860	93.59	1600	94.84
371	0.0010 (OD5)	490	93.94	870	93.94	1700	94.14
372	0.0028	500	93.92	880	94.22	1800	92.93
373	0.0054	510	94.73	890	94.37	1900	92.21
374	0.0104	520	94.62	900	94.40	2000	92.42
375	0.0208	530	93.50	910	94.29	2100	92.28
376	0.0430	540	93.02	920	94.09	2200	94.20
377	0.0932	550	93.70	930	93.83	2300	94.68
378	0.2141	560	94.58	940	93.55	2400	94.48
379	0.4263	570	94.62	950	93.28	2500	93.67
380	0.8712	580	93.94	960	93.08		
381	1.87	590	93.33	970	92.94		

Transmittance and Optical Density data are nominal values provided as a reference to indicate typical spectral response.

CGA-395

Spectral Performance Data - CGA-395

Cut-on Wavelength at 50% Absolute Transmittance	395 ± 5 nm
Cut-on Wavelength at 90% Absolute Transmittance	≤415 nm
Cut-on Wavelength at OD5	≥370 nm
Effective Index of Refraction	1.29 (nominal)



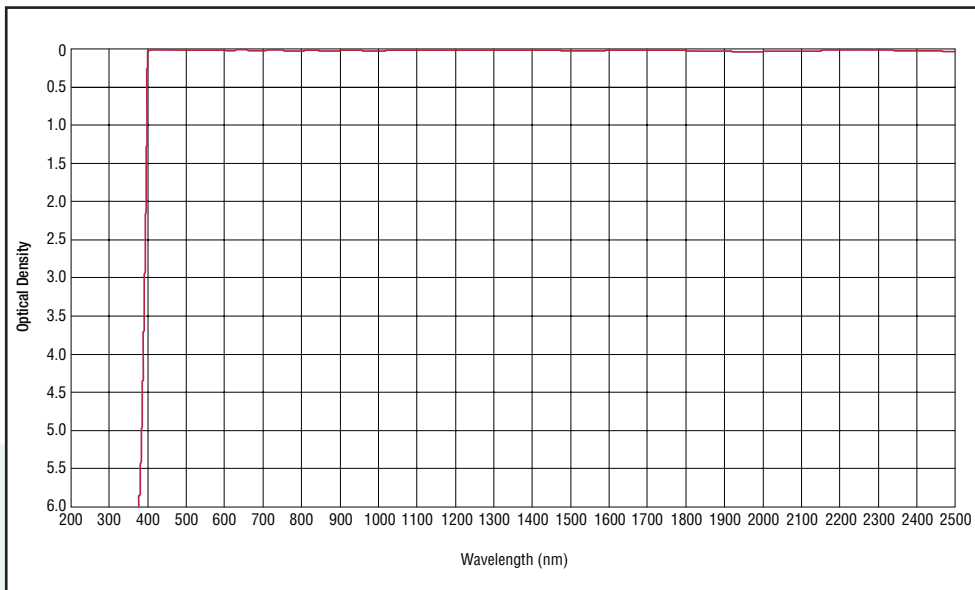
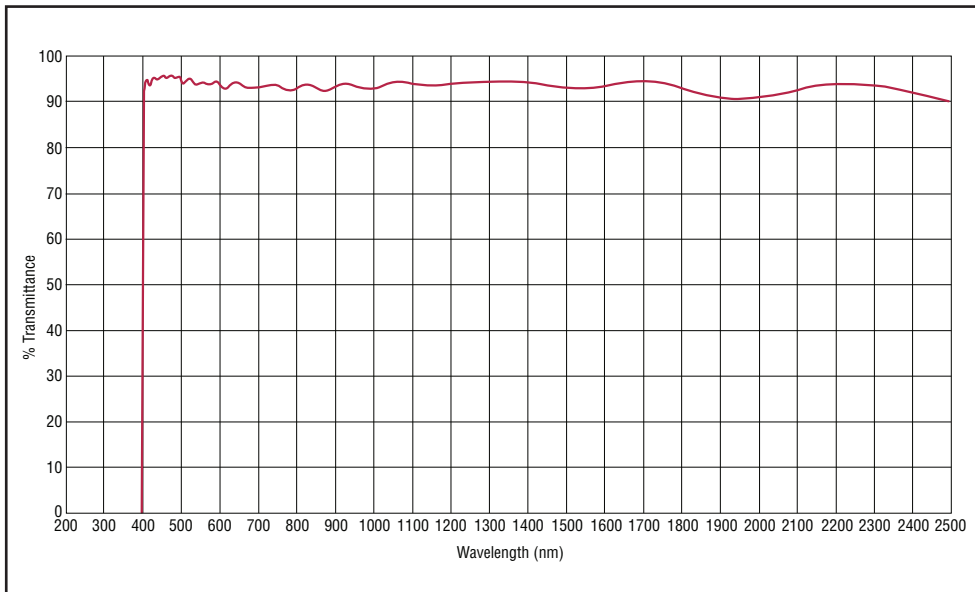
Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)
200	<0.0001	391	1.15	600	93.60	980	94.43
210	<0.0001	392	3.09	610	94.33	990	94.44
220	<0.0001	393	8.81	620	94.56	1000	94.36
230	<0.0001	394	22.48	630	94.24	1010	94.21
240	<0.0001	395	50.48	640	93.78	1020	94.00
250	<0.0001	396	79.62	650	93.54	1030	93.78
260	<0.0001	397	90.12	660	93.59	1040	93.57
270	<0.0001	398	90.66	670	93.77	1050	93.39
280	<0.0001	399	90.52	680	93.92	1060	93.26
290	<0.0001	400	91.40	690	93.99	1070	93.19
300	<0.0001	401	92.71	700	93.99	1080	93.18
310	<0.0001	402	93.74	710	94.00	1090	93.23
320	<0.0001	403	94.26	720	94.04	1100	93.32
330	<0.0001	404	94.45	730	94.05	1110	93.44
340	<0.0001	405	94.48	740	93.96	1120	93.58
350	<0.0001	406	94.50	750	93.75	1130	93.74
360	<0.0001	407	94.54	760	93.47	1140	93.89
370	<0.0001	408	94.59	770	93.23	1150	94.04
371	<0.0001	409	94.60	780	93.13	1160	94.17
372	<0.0001	410	94.55	790	93.21	1170	94.27
373	<0.0001	420	95.46	800	93.44	1180	94.36
374	<0.0001	430	94.35	810	93.77	1190	94.41
375	<0.0001	440	95.92	820	94.09	1200	94.45
376	0.0001 (OD6)	450	95.16	830	94.29	1300	94.31
377	0.0002	460	95.43	840	94.33	1400	94.21
378	0.0004	470	95.49	850	94.19	1500	93.88
379	0.0006	480	95.02	860	93.89	1600	94.12
380	0.0010 (OD5)	490	94.63	870	93.51	1700	94.78
381	0.0016	500	94.27	880	93.15	1800	94.69
382	0.0026	510	94.72	890	92.87	1900	93.57
383	0.0043	520	94.75	900	92.72	2000	92.27
384	0.0073	530	93.69	910	92.74	2100	91.66
385	0.0126	540	93.21	920	92.89	2200	91.96
386	0.0226	550	94.03	930	93.15	2300	92.88
387	0.0448	560	94.81	940	93.47	2400	93.89
388	0.0927	570	94.38	950	93.80	2500	94.53
389	0.2016	580	93.40	960	94.09		
390	0.4648	590	93.07	970	94.31		

Transmittance and Optical Density data are nominal values provided as a reference to indicate typical spectral response.

CGA-400

Spectral Performance Data - CGA-400

Cut-on Wavelength at 50% Absolute Transmittance	400 ± 5 nm
Cut-on Wavelength at 90% Absolute Transmittance	≤420 nm
Cut-on Wavelength at OD5	≥375 nm
Effective Index of Refraction	1.83 (nominal)



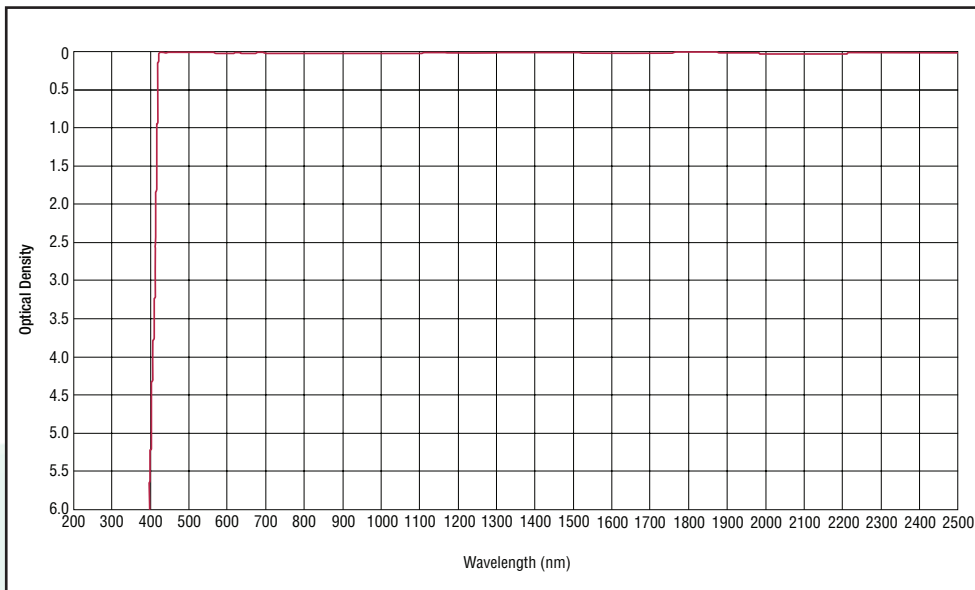
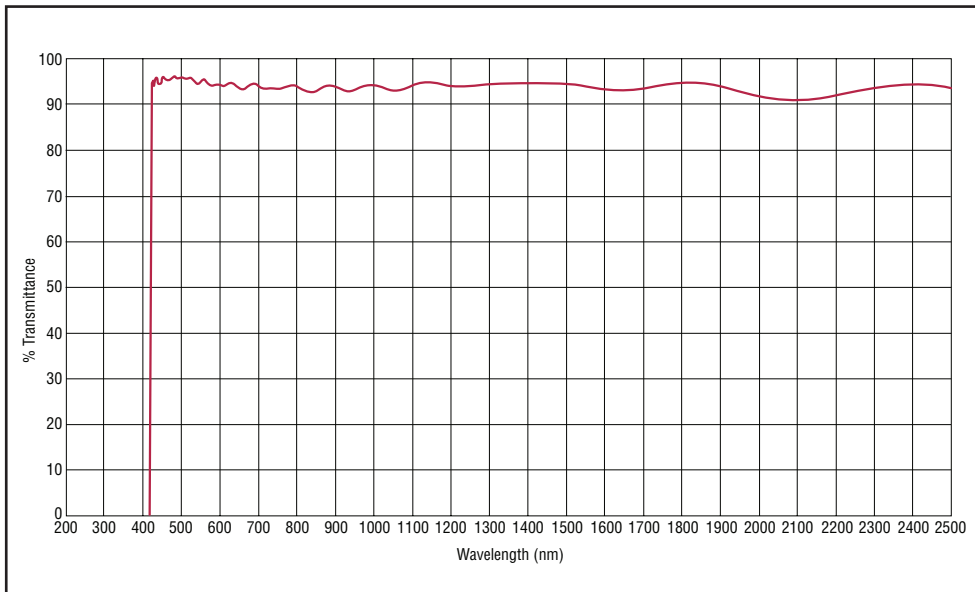
Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)
200	<0.0001	398	4.76	650	94.40	1010	93.48
210	<0.0001	399	12.33	660	93.79	1020	93.83
220	<0.0001	400	31.42	670	93.42	1030	94.18
230	<0.0001	401	64.44	680	93.40	1040	94.48
240	<0.0001	402	88.00	690	93.51	1050	94.70
250	<0.0001	403	92.99	700	93.60	1060	94.81
260	<0.0001	404	92.62	710	93.69	1070	94.81
270	<0.0001	405	92.61	720	93.86	1080	94.72
280	<0.0001	406	93.27	730	94.06	1090	94.57
290	<0.0001	407	94.00	740	94.11	1100	94.39
300	<0.0001	408	94.51	750	93.86	1110	94.21
310	<0.0001	409	94.82	760	93.37	1120	94.06
320	<0.0001	410	95.03	770	92.89	1130	93.95
330	<0.0001	420	94.16	780	92.69	1140	93.89
340	<0.0001	430	95.34	790	92.87	1150	93.89
350	<0.0001	440	95.15	800	93.32	1160	93.92
360	<0.0001	450	95.94	810	93.83	1170	94.00
370	<0.0001	460	95.54	820	94.16	1180	94.09
380	0.0001 (0D6)	470	95.92	830	94.16	1190	94.20
381	0.0002	480	95.61	840	93.85	1200	94.30
382	0.0003	490	95.75	850	93.39	1300	94.68
383	0.0004	500	95.11	860	92.99	1400	94.66
384	0.0006	510	94.51	870	92.81	1500	93.38
385	0.0010 (0D5)	520	95.41	880	92.90	1600	93.83
386	0.0014	530	94.82	890	93.22	1700	94.95
387	0.0024	540	94.01	900	93.66	1800	93.62
388	0.0042	550	94.39	910	94.06	1900	91.52
389	0.0073	560	94.38	920	94.31	2000	91.27
390	0.0133	570	93.99	930	94.34	2100	92.78
391	0.0252	580	94.34	940	94.18	2200	94.22
392	0.0495	590	94.70	950	93.88	2300	94.15
393	0.1005	600	94.04	960	93.54	2400	92.60
394	0.1945	610	93.19	970	93.25	2500	90.61
395	0.3950	620	93.29	980	93.09		
396	0.8479	630	94.14	990	93.07		
397	1.94	640	94.67	1000	93.21		

Transmittance and Optical Density data are nominal values provided as a reference to indicate typical spectral response.

CGA-420

Spectral Performance Data - CGA-420

Cut-on Wavelength at 50% Absolute Transmittance	420 ± 5 nm
Cut-on Wavelength at 90% Absolute Transmittance	≤440 nm
Cut-on Wavelength at OD5	≥390 nm
Effective Index of Refraction	1.86 (nominal)



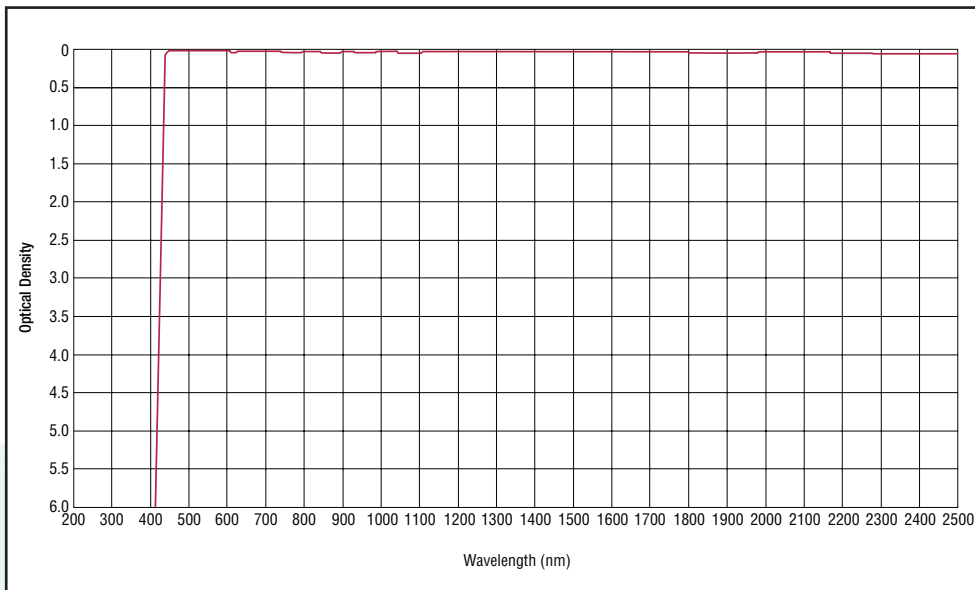
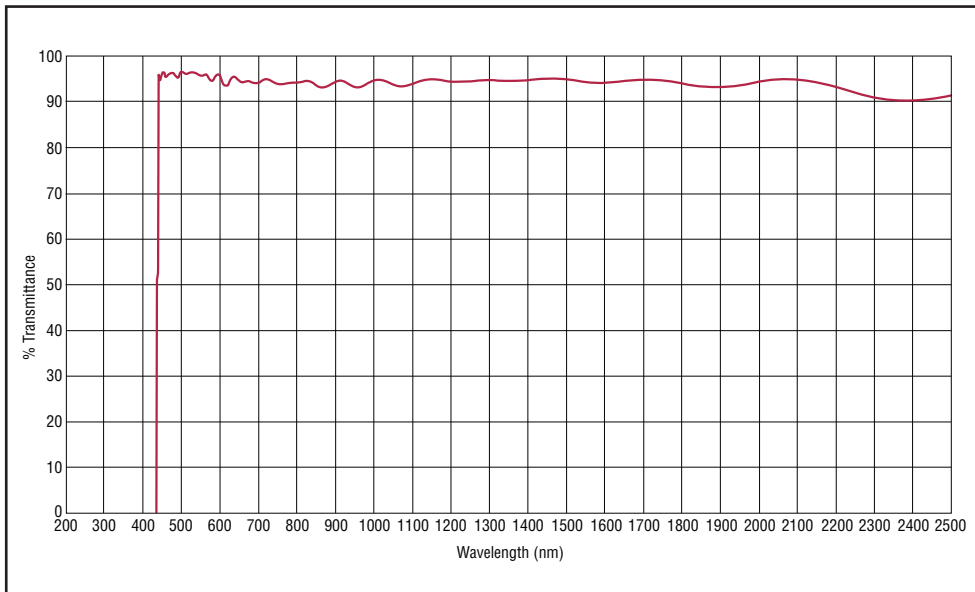
Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)
200	<0.0001	409	0.0222	600	94.17	980	94.33
210	<0.0001	410	0.0375	610	94.03	990	94.40
220	<0.0001	411	0.0643	620	94.52	1000	94.28
230	<0.0001	412	0.1113	630	94.65	1010	94.03
240	<0.0001	413	0.1993	640	93.90	1020	93.71
250	<0.0001	414	0.3703	650	93.16	1030	93.41
260	<0.0001	415	0.7190	660	93.31	1040	93.20
270	<0.0001	416	1.47	670	94.10	1050	93.11
280	<0.0001	417	3.17	680	94.66	1060	93.17
290	<0.0001	418	7.24	690	94.52	1070	93.36
300	<0.0001	419	17.18	700	93.96	1080	93.64
310	<0.0001	420	39.02	710	93.52	1090	93.96
320	<0.0001	421	70.48	720	93.40	1100	94.28
330	<0.0001	422	90.70	730	93.47	1110	94.55
340	<0.0001	423	95.29	740	93.53	1120	94.74
350	<0.0001	424	94.59	750	93.58	1130	94.84
360	<0.0001	425	93.97	760	93.70	1140	94.84
370	<0.0001	426	94.18	770	93.92	1150	94.76
380	<0.0001	427	94.78	780	94.12	1160	94.63
390	<0.0001	428	95.32	790	94.13	1170	94.46
391	<0.0001	429	95.65	800	93.86	1180	94.29
392	<0.0001	430	95.81	810	93.39	1190	94.13
393	<0.0001	440	94.42	820	92.94	1200	94.01
394	<0.0001	450	95.87	830	92.71	1300	94.46
395	<0.0001	460	95.26	840	92.81	1400	94.65
396	0.0001 (OD6)	470	95.48	850	93.20	1500	94.60
397	0.0002	480	96.11	860	93.70	1600	93.34
398	0.0002	490	95.53	870	94.11	1700	93.63
399	0.0003	500	96.01	880	94.24	1800	94.88
400	0.0005	510	95.55	890	94.08	1900	94.04
401	0.0007	520	95.76	900	93.70	2000	91.88
402	0.0010 (OD5)	530	95.16	910	93.28	2100	91.00
403	0.0015	540	94.46	920	92.97	2200	92.02
404	0.0023	550	95.26	930	92.87	2300	93.68
405	0.0034	560	95.15	940	93.00	2400	94.41
406	0.0053	570	94.13	950	93.31	2500	93.61
407	0.0084	580	94.16	960	93.71		
408	0.0135	590	94.50	970	94.08		

Transmittance and Optical Density data are nominal values provided as a reference to indicate typical spectral response.

CGA-435

Spectral Performance Data - CGA-435

Cut-on Wavelength at 50% Absolute Transmittance	435 ± 5 nm
Cut-on Wavelength at 90% Absolute Transmittance	≤455 nm
Cut-on Wavelength at OD5	≥400 nm
Effective Index of Refraction	1.90 (nominal)



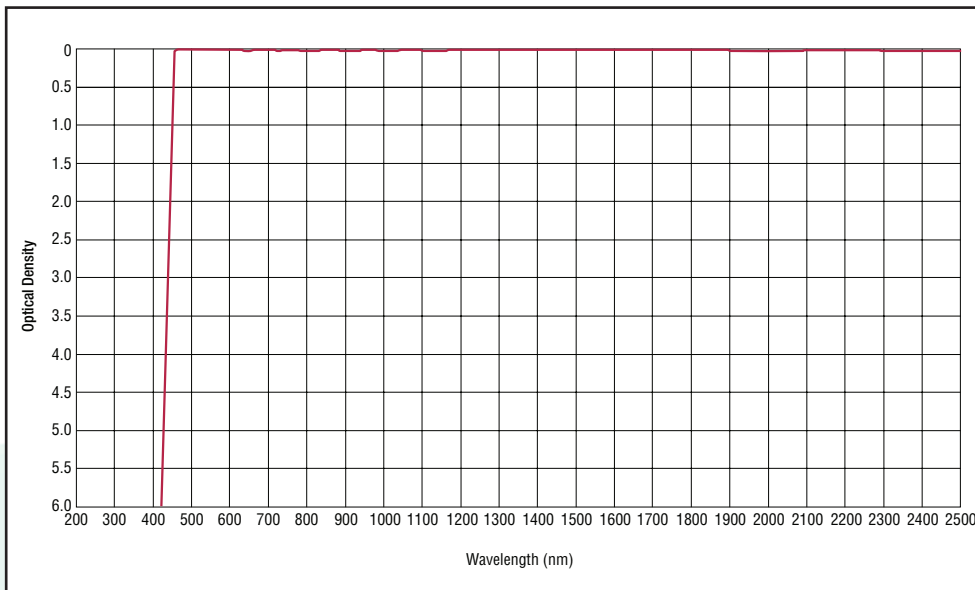
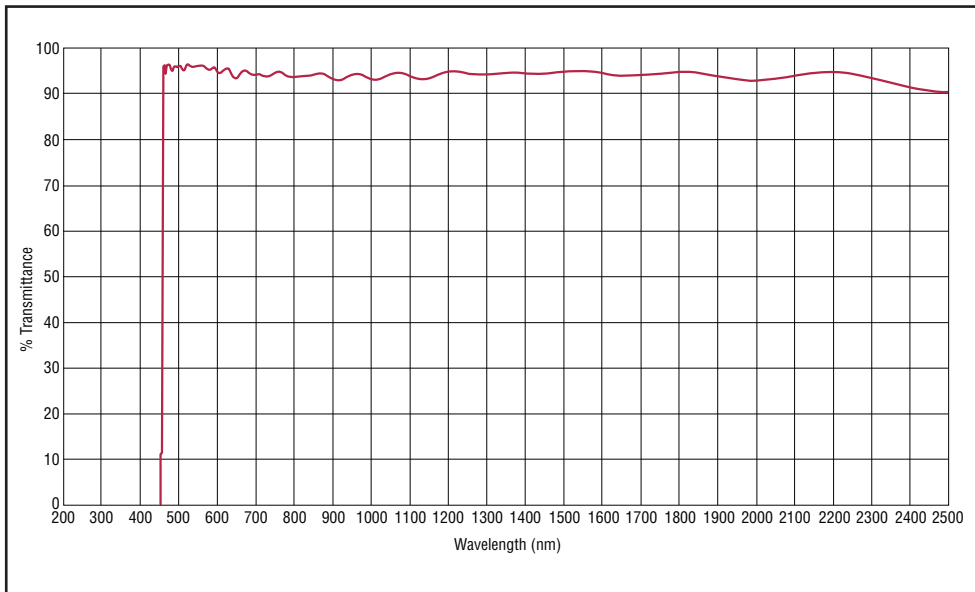
Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)
200	<0.0001	418	0.0038	600	94.23	980	93.64
210	<0.0001	419	0.0057	610	93.00	990	94.09
220	<0.0001	420	0.0085	620	93.90	1000	94.40
230	<0.0001	421	0.0129	630	94.97	1010	94.47
240	<0.0001	422	0.0195	640	94.64	1020	94.30
250	<0.0001	423	0.0301	650	94.01	1030	93.95
260	<0.0001	424	0.0472	660	93.96	1040	93.55
270	<0.0001	425	0.0758	670	93.97	1050	93.19
280	<0.0001	426	0.1248	680	93.70	1060	92.97
290	<0.0001	427	0.2119	690	93.61	1070	92.94
300	<0.0001	428	0.3725	700	94.01	1080	93.08
310	<0.0001	429	0.6815	710	94.50	1090	93.35
320	<0.0001	430	1.31	720	94.51	1100	93.71
330	<0.0001	431	2.63	730	94.02	1110	94.06
340	<0.0001	432	5.60	740	93.53	1120	94.37
350	<0.0001	433	12.03	750	93.38	1130	94.58
360	<0.0001	434	26.06	760	93.49	1140	94.69
370	<0.0001	435	51.35	770	93.61	1150	94.68
380	<0.0001	436	79.32	780	93.63	1160	94.60
390	<0.0001	437	93.52	790	93.68	1170	94.46
400	<0.0001	438	95.73	800	93.84	1180	94.31
401	<0.0001	439	94.76	810	94.08	1190	94.18
402	<0.0001	440	94.19	820	94.19	1200	94.09
403	<0.0001	450	95.87	830	94.00	1300	94.36
404	<0.0001	460	95.36	840	93.54	1400	94.56
405	<0.0001	470	95.51	850	93.03	1500	94.53
406	<0.0001	480	95.27	860	92.73	1600	93.30
407	<0.0001	490	95.54	870	92.82	1700	94.57
408	<0.0001	500	95.99	880	93.24	1800	93.58
409	0.0001 (OD6)	510	95.62	890	93.78	1900	92.89
410	0.0002	520	95.87	900	94.17	2000	94.01
411	0.0003	530	95.94	910	94.23	2100	94.52
412	0.0004	540	95.28	920	93.95	2200	92.91
413	0.0006	550	95.27	930	93.50	2300	90.80
414	0.0008	560	95.44	940	93.06	2400	90.12
415	0.0010 (OD5)	570	94.27	950	92.83	2500	91.18
416	0.0017	580	94.62	960	92.88		
417	0.0026	590	95.54	970	93.19		

Transmittance and Optical Density data are nominal values provided as a reference to indicate typical spectral response.

CGA-455

Spectral Performance Data - CGA-455

Cut-on Wavelength at 50% Absolute Transmittance	455 ± 5 nm
Cut-on Wavelength at 90% Absolute Transmittance	≤475 nm
Cut-on Wavelength at OD5	≥420 nm
Effective Index of Refraction	1.95 (nominal)



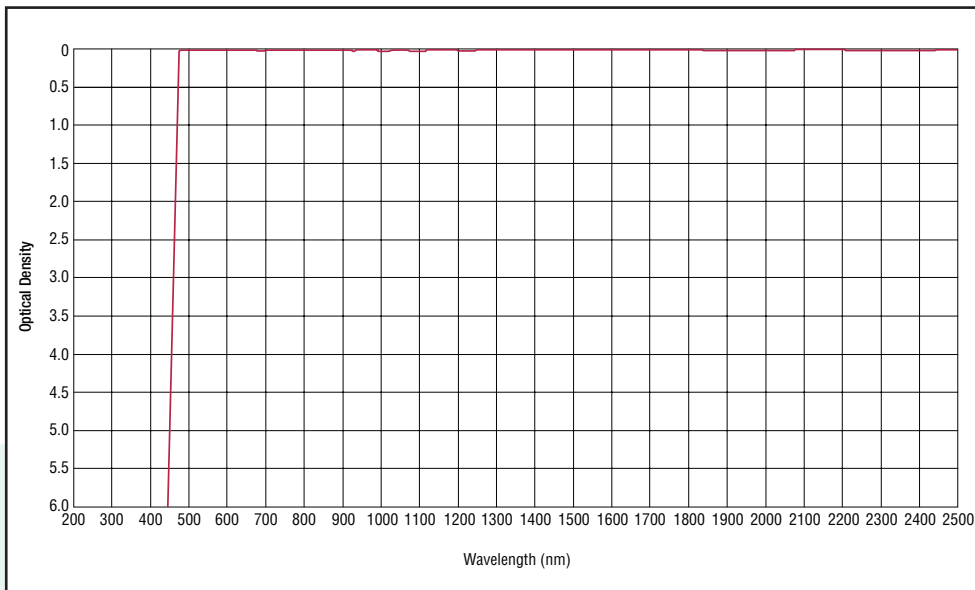
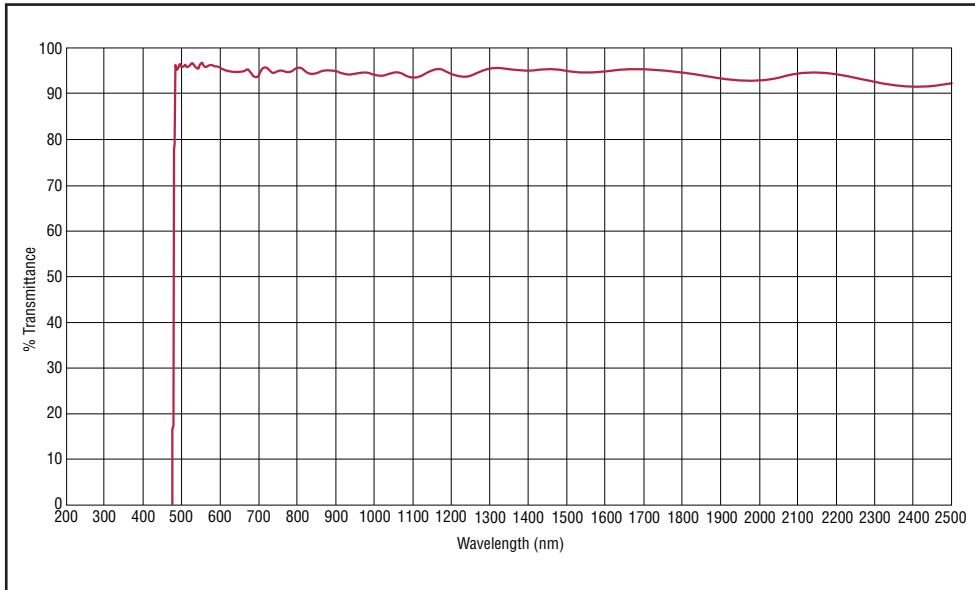
Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)
200	<0.0001	436	0.0033	600	94.38	980	93.69
210	<0.0001	437	0.0046	610	94.41	990	93.24
220	<0.0001	438	0.0066	620	95.50	1000	92.91
230	<0.0001	439	0.0094	630	94.79	1010	92.82
240	<0.0001	440	0.0136	640	93.22	1020	92.99
250	<0.0001	441	0.0198	650	93.34	1030	93.37
260	<0.0001	442	0.0291	660	94.60	1040	93.82
270	<0.0001	443	0.0436	670	94.97	1050	94.23
280	<0.0001	444	0.0662	680	94.35	1060	94.46
290	<0.0001	445	0.1023	690	93.95	1070	94.48
300	<0.0001	446	0.1612	700	94.00	1080	94.30
310	<0.0001	447	0.2608	710	93.92	1090	93.97
320	<0.0001	448	0.4345	720	93.62	1100	93.59
330	<0.0001	449	0.7487	730	93.56	1110	93.25
340	<0.0001	450	1.34	740	93.98	1120	93.03
350	<0.0001	451	2.50	750	94.48	1130	92.96
360	<0.0001	452	4.90	760	94.53	1140	93.06
370	<0.0001	453	10.00	770	94.11	1150	93.28
380	<0.0001	454	20.86	780	93.63	1160	93.59
390	<0.0001	455	41.55	790	93.42	1170	93.94
400	<0.0001	456	69.56	800	93.47	1180	94.26
410	<0.0001	457	89.76	810	93.60	1190	94.51
420	<0.0001	458	95.82	820	93.64	1200	94.66
421	<0.0001	459	95.52	830	93.65	1300	94.09
422	<0.0001	460	94.47	840	93.73	1400	94.24
423	<0.0001	470	96.21	850	93.94	1500	94.70
424	<0.0001	480	94.88	860	94.16	1600	94.37
425	<0.0001	490	95.58	870	94.19	1700	93.88
426	0.0001 (OD6)	500	95.85	880	93.93	1800	94.56
427	0.0002	510	94.84	890	93.46	1900	93.63
428	0.0002	520	96.21	900	93.00	2000	92.81
429	0.0003	530	95.66	910	92.78	2100	93.77
430	0.0004	540	95.75	920	92.89	2200	94.59
431	0.0006	550	95.89	930	93.27	2300	93.48
432	0.0008	560	95.90	940	93.77	2400	91.36
433	0.0010 (OD5)	570	95.21	950	94.15	2500	90.12
434	0.0016	580	95.26	960	94.27		
435	0.0023	590	95.47	970	94.08		

Transmittance and Optical Density data are nominal values provided as a reference to indicate typical spectral response.

CGA-475

Spectral Performance Data - CGA-475

Cut-on Wavelength at 50% Absolute Transmittance	475 ± 5 nm
Cut-on Wavelength at 90% Absolute Transmittance	≤495 nm
Cut-on Wavelength at OD5	≥440 nm
Effective Index of Refraction	1.41 (nominal)



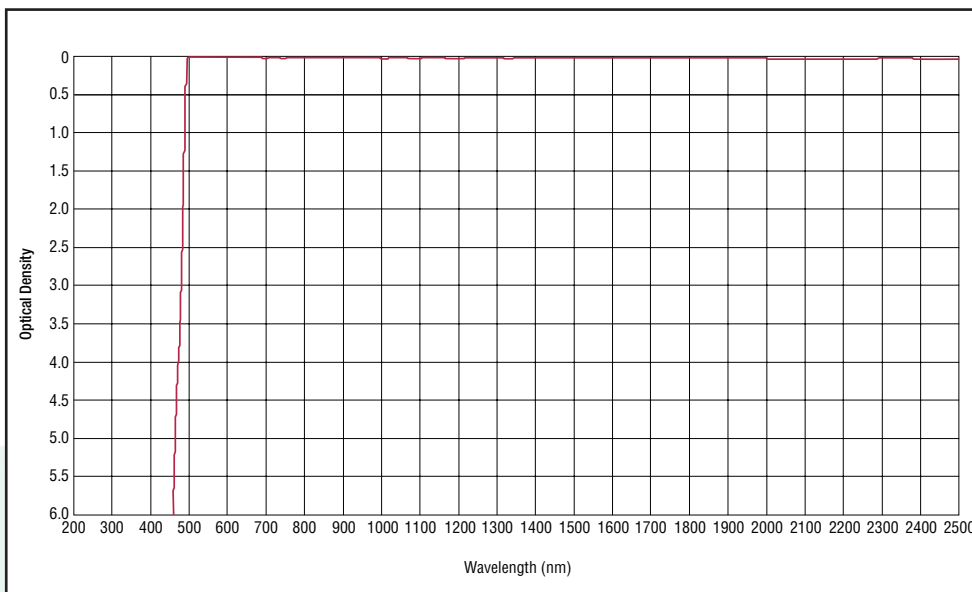
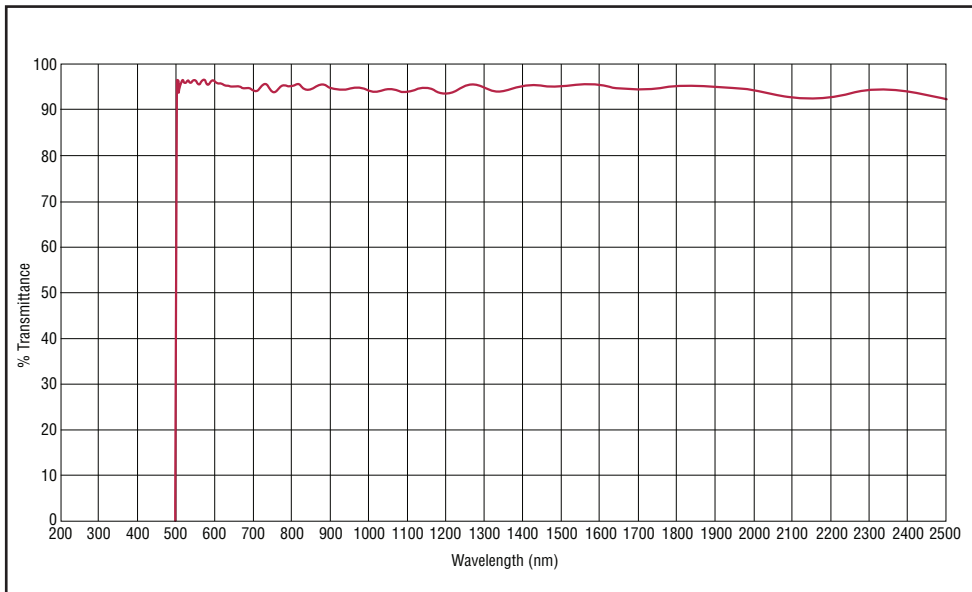
Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)
200	<0.0001	454	0.0049	600	94.81	980	94.01
210	<0.0001	455	0.0068	610	94.60	990	93.75
220	<0.0001	456	0.0090	620	94.35	1000	93.51
230	<0.0001	457	0.0116	630	94.32	1010	93.44
240	<0.0001	458	0.0146	640	94.29	1020	93.57
250	<0.0001	459	0.0183	650	94.19	1030	93.84
260	<0.0001	460	0.0234	660	94.65	1040	94.09
270	<0.0001	461	0.0306	670	94.50	1050	94.21
280	<0.0001	462	0.0412	680	93.36	1060	94.12
290	<0.0001	463	0.0571	690	93.23	1070	93.86
300	<0.0001	464	0.0817	700	94.53	1080	93.53
310	<0.0001	465	0.1212	710	95.33	1090	93.27
320	<0.0001	466	0.1864	720	94.74	1100	93.18
330	<0.0001	467	0.2982	730	94.13	1110	93.32
340	<0.0001	468	0.4975	740	94.34	1120	93.65
350	<0.0001	469	0.8687	750	94.67	1130	94.10
360	<0.0001	470	1.59	760	94.47	1140	94.55
370	<0.0001	471	3.08	770	94.23	1150	94.87
380	<0.0001	472	6.30	780	94.54	1160	94.99
390	<0.0001	473	13.39	790	95.17	1170	94.89
400	<0.0001	474	28.06	800	95.39	1180	94.59
410	<0.0001	475	53.14	810	94.94	1190	94.19
420	<0.0001	476	79.70	820	94.26	1200	93.77
430	<0.0001	477	93.45	830	93.88	1300	95.14
440	<0.0001	478	96.18	840	93.93	1400	94.68
441	<0.0001	479	95.54	850	94.23	1500	94.46
442	<0.0001	480	94.87	860	94.52	1600	94.49
443	<0.0001	490	96.20	870	94.68	1700	94.90
444	<0.0001	500	95.67	880	94.69	1800	94.19
445	0.0001 (OD6)	510	95.39	890	94.56	1900	92.92
446	0.0002	520	96.10	900	94.31	2000	92.64
447	0.0002	530	95.20	910	93.99	2100	93.86
448	0.0003	540	95.80	920	93.73	2200	93.85
449	0.0005	550	95.86	930	93.63	2300	92.13
450	0.0010 (OD5)	560	95.34	940	93.73	2400	91.11
451	0.0014	570	95.77	950	93.94	2500	92.82
452	0.0022	580	95.32	960	94.13		
453	0.0033	590	95.31	970	94.17		

Transmittance and Optical Density data are nominal values provided as a reference to indicate typical spectral response.

CGA-495

Spectral Performance Data - CGA-495

Cut-on Wavelength at 50% Absolute Transmittance	495 ± 5 nm
Cut-on Wavelength at 90% Absolute Transmittance	≤515 nm
Cut-on Wavelength at OD5	≥455 nm
Effective Index of Refraction	1.76 (nominal)



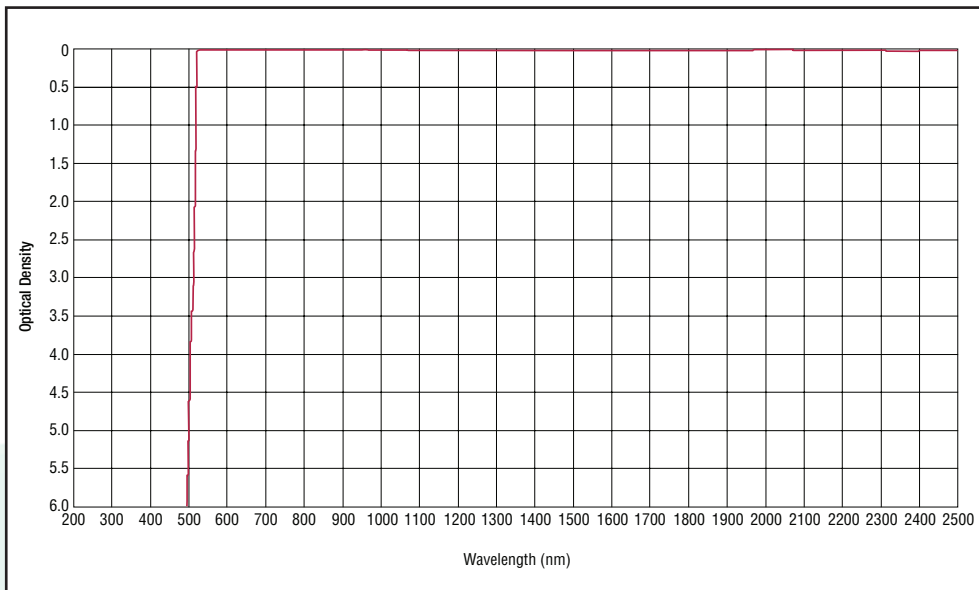
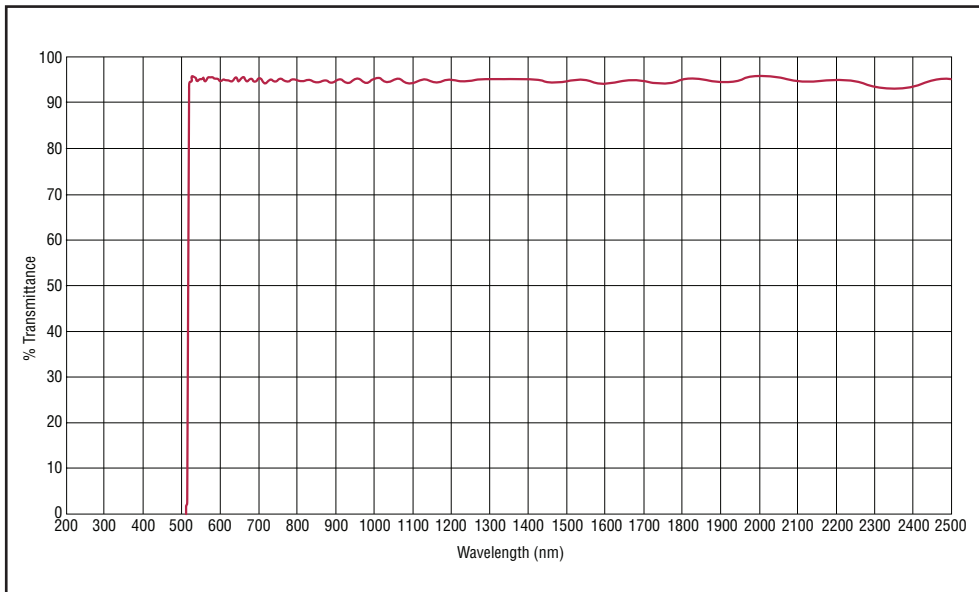
Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)
200	<0.0001	472	0.0019	600	95.44	980	94.22
210	<0.0001	473	0.0028	610	95.43	990	93.92
220	<0.0001	474	0.0038	620	94.89	1000	93.64
230	<0.0001	475	0.0050	630	94.79	1010	93.53
240	<0.0001	476	0.0065	640	94.66	1020	93.63
250	<0.0001	477	0.0082	650	94.58	1030	93.86
260	<0.0001	478	0.0103	660	94.49	1040	94.06
270	<0.0001	479	0.0131	670	94.26	1050	94.12
280	<0.0001	480	0.0170	680	94.35	1060	93.99
290	<0.0001	481	0.0226	690	94.02	1070	93.75
300	<0.0001	482	0.0308	700	93.43	1080	93.51
310	<0.0001	483	0.0432	710	94.04	1090	93.42
320	<0.0001	484	0.0625	720	95.18	1100	93.51
330	<0.0001	485	0.0935	730	94.90	1110	93.77
340	<0.0001	486	0.1448	740	93.66	1120	94.09
350	<0.0001	487	0.2332	750	93.43	1130	94.35
360	<0.0001	488	0.3910	760	94.33	1140	94.45
370	<0.0001	489	0.6860	770	94.92	1150	94.33
380	<0.0001	490	1.25	780	94.78	1160	94.03
390	<0.0001	491	2.59	790	94.68	1170	93.64
400	<0.0001	492	4.81	800	94.99	1180	93.29
410	<0.0001	493	10.23	810	95.14	1190	93.08
420	<0.0001	494	22.29	820	94.70	1200	93.08
430	<0.0001	495	45.69	830	94.06	1300	94.30
440	<0.0001	496	75.40	840	93.89	1400	94.85
450	<0.0001	497	93.03	850	94.33	1500	94.69
460	<0.0001	498	96.25	860	94.94	1600	94.84
461	<0.0001	499	94.89	870	95.22	1700	93.96
462	<0.0001	500	93.77	880	95.04	1800	94.53
463	<0.0001	510	96.21	890	94.62	1900	94.62
464	<0.0001	520	95.73	900	94.22	2000	93.77
465	<0.0001	530	95.49	910	93.98	2100	92.24
466	0.0001 (OD6)	540	96.03	920	93.91	2200	92.40
467	0.0002	550	95.19	930	93.96	2300	93.72
468	0.0003	560	95.93	940	94.11	2400	93.51
469	0.0005	570	95.70	950	94.30	2500	91.85
470	0.0008	580	95.31	960	94.44		
471	0.0010 (OD5)	590	96.03	970	94.42		

Transmittance and Optical Density data are nominal values provided as a reference to indicate typical spectral response.

CGA-515

Spectral Performance Data - CGA-515

Cut-on Wavelength at 50% Absolute Transmittance	515 ± 5 nm
Cut-on Wavelength at 90% Absolute Transmittance	≤535 nm
Cut-on Wavelength at OD5	≥485 nm
Effective Index of Refraction	1.81 (nominal)



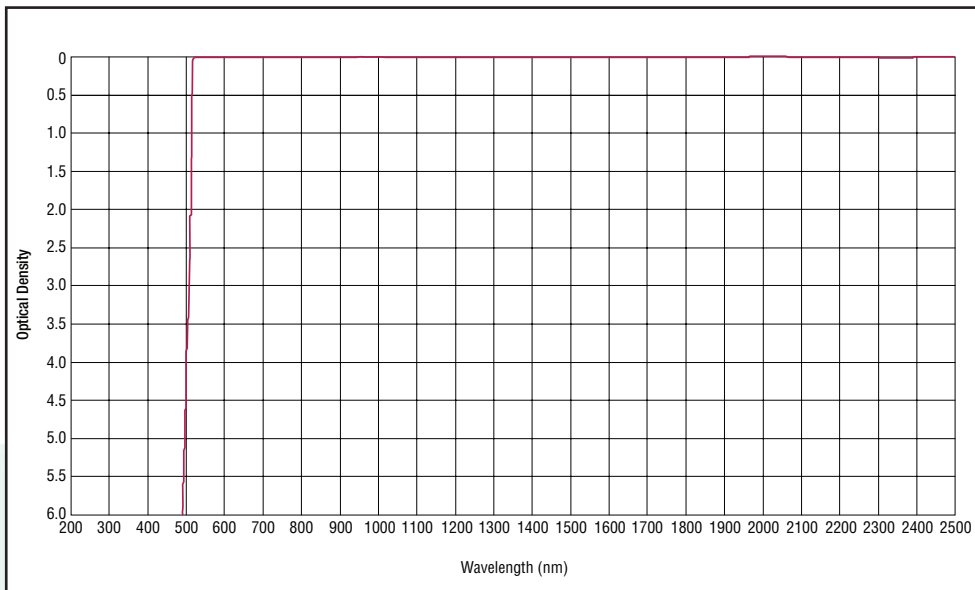
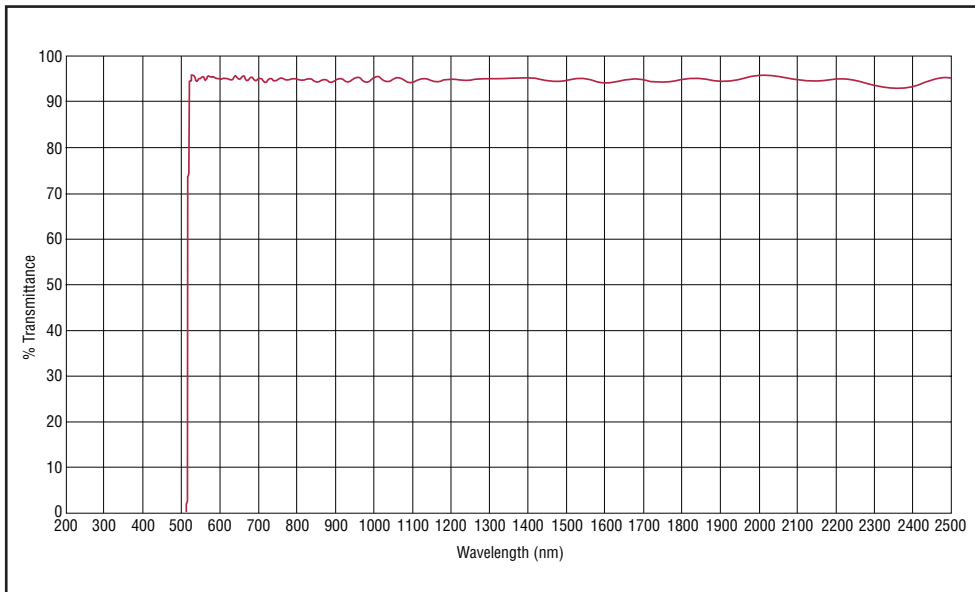
Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)
200	<0.0001	499	0.0081	600	94.73	980	94.32
210	<0.0001	500	0.0119	610	95.05	990	94.82
220	<0.0001	501	0.0154	620	95.00	1000	95.47
230	<0.0001	502	0.0189	630	94.73	1010	95.49
240	<0.0001	503	0.0232	640	95.51	1020	94.91
250	<0.0001	504	0.0297	650	94.87	1030	94.46
260	<0.0001	505	0.0402	660	95.56	1040	94.60
270	<0.0001	506	0.0580	670	94.61	1050	95.09
280	<0.0001	507	0.0896	680	95.35	1060	95.33
290	<0.0001	508	0.1480	690	94.58	1070	95.03
300	<0.0001	509	0.2612	700	95.30	1080	94.50
310	<0.0001	510	0.4991	710	94.43	1090	94.20
320	<0.0001	511	1.04	720	94.55	1100	94.37
330	<0.0001	512	2.40	730	95.10	1110	94.80
340	<0.0001	513	6.13	740	94.52	1120	95.14
350	<0.0001	514	17.05	750	95.03	1130	95.13
360	<0.0001	515	44.59	760	95.11	1140	94.84
370	<0.0001	516	79.45	770	94.71	1150	94.52
380	<0.0001	517	92.39	780	94.98	1160	94.40
390	<0.0001	518	93.56	790	95.10	1170	94.52
400	<0.0001	519	94.05	800	94.84	1180	94.77
410	<0.0001	520	94.64	810	94.72	1190	94.96
420	<0.0001	521	94.66	820	94.92	1200	95.01
430	<0.0001	522	94.36	830	95.04	1300	95.04
440	<0.0001	523	94.33	840	94.63	1400	95.19
450	<0.0001	524	94.80	850	94.30	1500	94.76
460	<0.0001	525	95.52	860	94.65	1600	94.24
470	<0.0001	526	96.11	870	94.90	1700	94.78
480	<0.0001	527	96.31	880	94.51	1800	94.95
490	0.0001 (OD6)	528	96.14	890	94.36	1900	94.58
491	0.0002	529	95.82	900	94.90	2000	95.87
492	0.0002	530	95.55	910	95.18	2100	94.74
493	0.0003	540	94.45	920	94.67	2200	95.02
494	0.0005	550	95.01	930	94.28	2300	93.58
495	0.0010 (OD5)	560	94.63	940	94.75	2400	93.60
496	0.0014	570	95.49	950	95.42	2500	95.18
497	0.0027	580	95.42	960	95.30		
498	0.0048	590	95.04	970	94.61		

Transmittance and Optical Density data are nominal values provided as a reference to indicate typical spectral response.

CGA-530

Spectral Performance Data - CGA-530

Cut-on Wavelength at 50% Absolute Transmittance	530 ± 5 nm
Cut-on Wavelength at 90% Absolute Transmittance	≤550 nm
Cut-on Wavelength at OD5	≥495 nm
Effective Index of Refraction	1.84 (nominal)



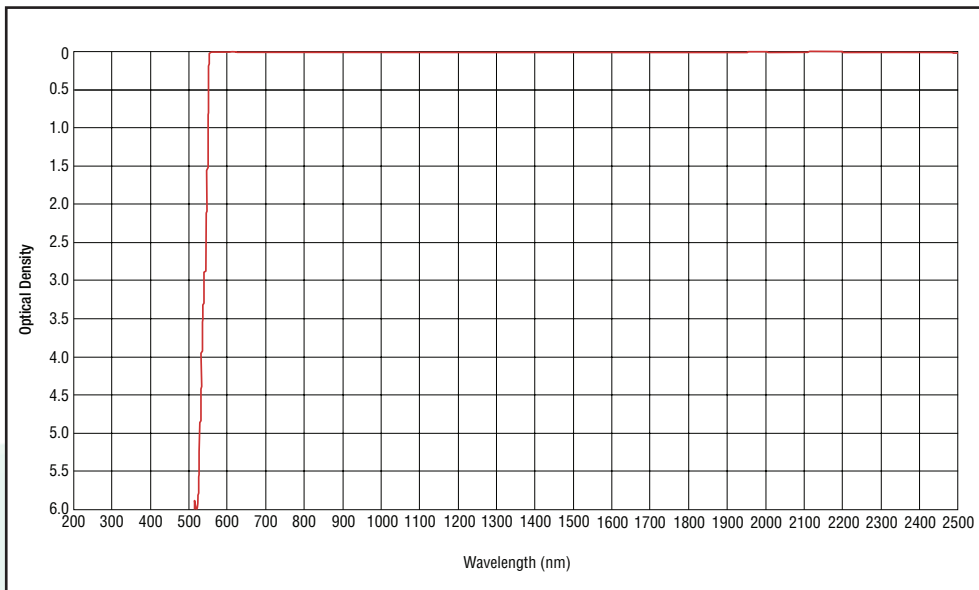
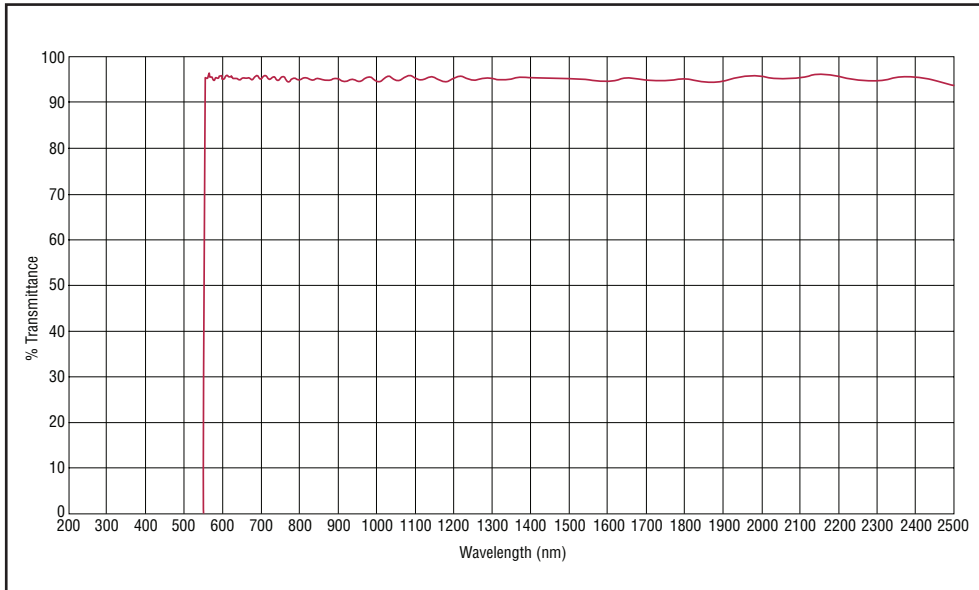
Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)
200	<0.0001	508	0.0005	600	95.26	980	95.37
210	<0.0001	509	0.0010 (OD5)	610	95.04	990	95.39
220	<0.0001	510	0.0014	620	94.82	1000	94.74
230	<0.0001	511	0.0025	630	94.99	1010	94.31
240	<0.0001	512	0.0044	640	94.98	1020	94.66
250	<0.0001	513	0.0076	650	94.74	1030	95.35
260	<0.0001	514	0.0116	660	95.52	1040	95.58
270	<0.0001	515	0.0156	670	94.84	1050	95.14
280	<0.0001	516	0.0192	680	95.63	1060	94.59
290	<0.0001	517	0.0232	690	94.60	1070	94.50
300	<0.0001	518	0.0287	700	95.35	1080	94.90
310	<0.0001	519	0.0371	710	94.63	1090	95.30
320	<0.0001	520	0.0508	720	95.13	1100	95.25
330	<0.0001	521	0.0739	730	94.78	1110	94.79
340	<0.0001	522	0.1146	740	94.24	1120	94.33
350	<0.0001	523	0.1902	750	95.12	1130	94.23
360	<0.0001	524	0.3393	760	94.68	1140	94.52
370	<0.0001	525	0.6549	770	94.76	1150	94.95
380	<0.0001	526	1.38	780	95.25	1160	95.18
390	<0.0001	527	3.21	790	94.84	1170	95.08
400	<0.0001	528	8.16	800	94.80	1180	94.76
410	<0.0001	529	21.53	810	95.11	1190	94.48
420	<0.0001	530	51.24	820	95.01	1200	94.41
430	<0.0001	531	82.68	830	94.76	1300	94.94
440	<0.0001	532	92.56	840	94.77	1400	95.12
450	<0.0001	533	93.03	850	95.01	1500	94.60
460	<0.0001	534	93.42	860	94.97	1600	95.00
470	<0.0001	535	94.22	870	94.50	1700	94.74
480	<0.0001	536	94.55	880	94.37	1800	94.21
490	<0.0001	537	94.37	890	94.78	1900	95.17
500	<0.0001	538	94.20	900	94.87	2000	94.77
501	<0.0001	539	94.41	910	94.46	2100	95.78
502	<0.0001	540	95.01	920	94.43	2200	94.56
503	<0.0001	550	95.42	930	94.97	2300	94.94
504	0.0001 (OD6)	560	95.12	940	95.18	2400	93.15
505	0.0002	570	95.55	950	94.66	2500	94.13
506	0.0002	580	94.99	960	94.28		
507	0.0003	590	95.34	970	94.69		

Transmittance and Optical Density data are nominal values provided as a reference to indicate typical spectral response.

CGA-550

Spectral Performance Data - CGA-550

Cut-on Wavelength at 50% Absolute Transmittance	550 ± 5 nm
Cut-on Wavelength at 90% Absolute Transmittance	≤570 nm
Cut-on Wavelength at OD5	≥515 nm
Effective Index of Refraction	1.77 (nominal)



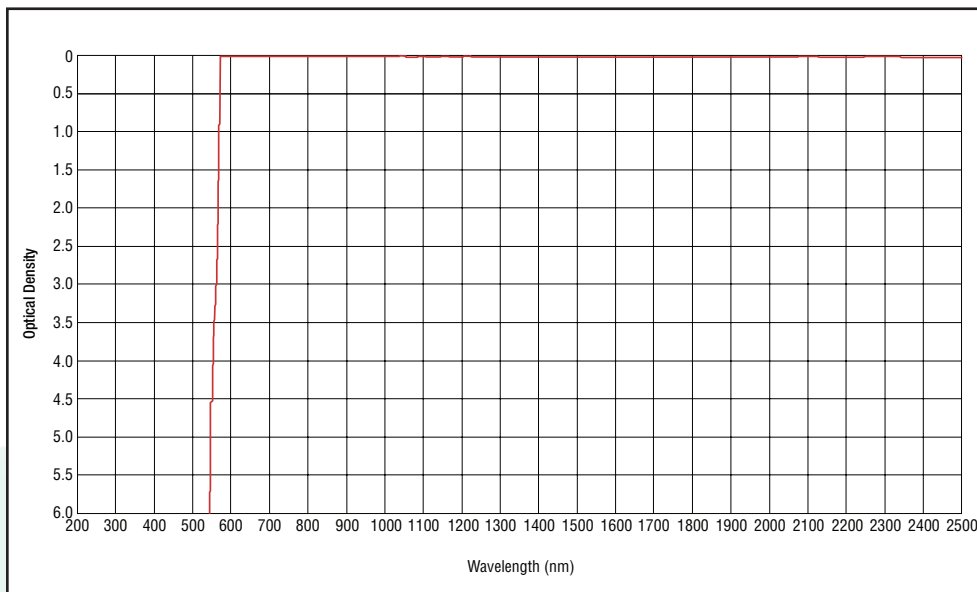
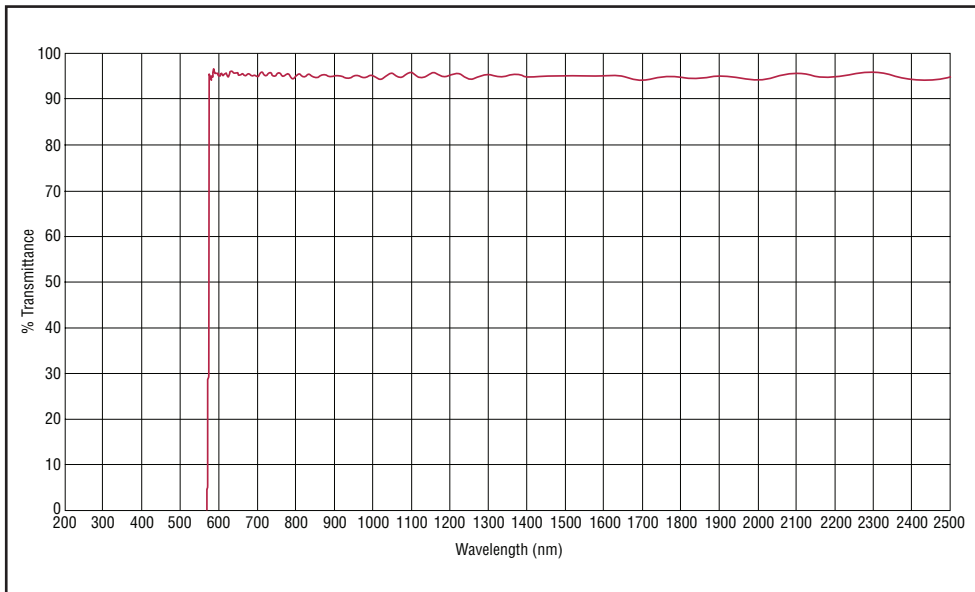
Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)
200	<0.0001	526	0.0004	600	94.69	980	95.32
210	<0.0001	527	0.0007	610	95.54	990	94.77
220	<0.0001	528	0.0010 (OD5)	620	95.44	1000	94.25
230	<0.0001	529	0.0017	630	95.95	1010	94.50
240	<0.0001	530	0.0028	640	94.69	1020	95.20
250	<0.0001	531	0.0049	650	95.10	1030	95.44
260	<0.0001	532	0.0085	660	95.04	1040	94.97
270	<0.0001	533	0.0146	670	94.84	1050	94.47
280	<0.0001	534	0.0230	680	95.17	1060	94.60
290	<0.0001	535	0.0326	690	95.39	1070	95.23
300	<0.0001	536	0.0420	700	95.20	1080	95.68
310	<0.0001	537	0.0517	710	95.53	1090	95.51
320	<0.0001	538	0.0637	720	94.76	1100	94.96
330	<0.0001	539	0.0808	730	95.42	1110	94.63
340	<0.0001	540	0.1073	740	94.64	1120	94.78
350	<0.0001	541	0.1503	750	95.28	1130	95.19
360	<0.0001	542	0.2230	760	94.97	1140	95.40
370	<0.0001	543	0.3516	770	94.27	1150	95.18
380	<0.0001	544	0.5918	780	95.05	1160	94.69
390	<0.0001	545	1.07	790	94.75	1170	94.33
400	<0.0001	546	2.08	800	94.69	1180	94.37
410	<0.0001	547	4.40	810	95.25	1190	94.75
420	<0.0001	548	10.07	820	94.91	1200	95.20
430	<0.0001	549	24.03	830	94.60	1300	94.90
440	<0.0001	550	52.10	840	94.84	1400	95.10
450	<0.0001	551	82.28		94.91	1500	94.91
460	<0.0001	552	94.30	860	94.73	1600	94.34
470	<0.0001	553	95.34	870	94.62	1700	94.61
480	<0.0001	554	94.98		94.77	1800	94.81
490	<0.0001	555	95.12	890	94.99	1900	94.31
500	<0.0001	556	95.31	900	94.80	2000	95.32
510	<0.0001	557	95.23	910	94.36	2100	95.15
520	0.0001 (OD6)	558	95.06	920	94.37	2200	95.34
521	0.0002	559	95.09	930	94.69	2300	94.31
522	0.0002	560	95.40	940	94.65	2400	95.13
523	0.0002	570	95.29	950	94.33	2500	95.15
524	0.0002	580	95.04	960	94.50		
525	0.0003	590	95.23	970	95.12		

Transmittance and Optical Density data are nominal values provided as a reference to indicate typical spectral response.

CGA-570

Spectral Performance Data - CGA-570

Cut-on Wavelength at 50% Absolute Transmittance	570 ± 5 nm
Cut-on Wavelength at 90% Absolute Transmittance	≤590 nm
Cut-on Wavelength at OD5	≥535 nm
Effective Index of Refraction	1.76 (nominal)



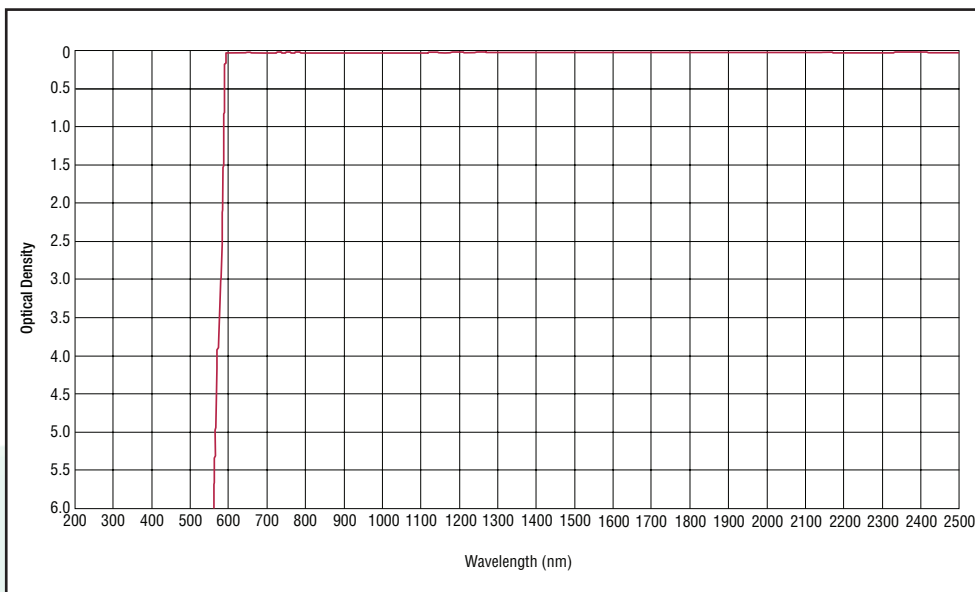
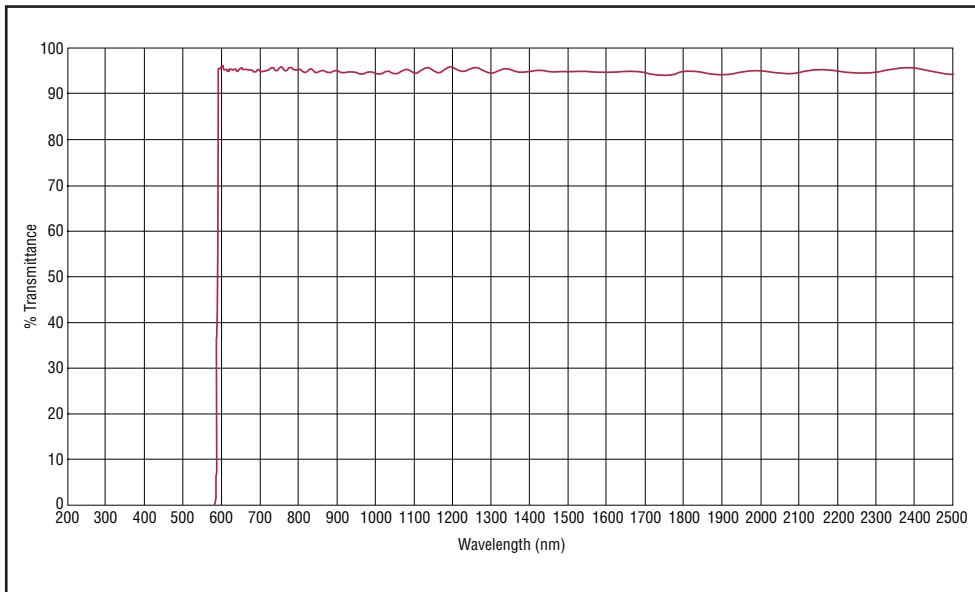
Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)
200	<0.0001	544	0.0002	600	95.18	980	94.68
210	<0.0001	545	0.0002	610	95.15	990	94.98
220	<0.0001	546	0.0003	620	94.65	1000	94.72
230	<0.0001	547	0.0005	630	95.68	1010	94.16
240	<0.0001		0.0008	640	95.42	1020	94.19
250	<0.0001	549	0.0010 (OD5)	650	94.96	1030	94.91
260	<0.0001	550	0.0022	660	94.90	1040	94.45
270	<0.0001	551	0.0038	670	95.17	1050	95.19
280	<0.0001	552	0.0065	680	94.80	1060	94.63
290	<0.0001	553	0.0110	690	94.81	1070	94.57
300	<0.0001	554	0.0169	700	95.17	1080	95.13
310	<0.0001	555	0.0236	710	95.37	1090	95.60
320	<0.0001	556	0.0303	720	95.04	1100	95.42
330	<0.0001	557	0.0377	730	95.57	1110	94.80
340	<0.0001	558	0.0472	740	94.77	1120	94.42
350	<0.0001	559	0.0609	750	95.60	1130	94.64
360	<0.0001	560	0.0823	760	94.87	1140	95.21
370	<0.0001	561	0.1170	770	95.29	1150	95.55
380	<0.0001	562	0.1760	780	94.85	1160	95.38
390	<0.0001	563	0.2812	790	94.29	1170	94.94
400	<0.0001	564	0.4791	800	95.26	1180	94.67
410	<0.0001	565	0.8761	810	94.85	1190	94.82
420	<0.0001	566	1.73	820	94.72	1200	95.21
430	<0.0001	567	3.73	830	95.17	1300	95.10
440	<0.0001	568	8.79	840	94.66	1400	94.74
450	<0.0001	569	22.01	850	94.54	1500	94.99
460	<0.0001	570	51.02	860	95.05	1600	94.94
470	<0.0001	571	83.95	870	95.05	1700	94.06
480	<0.0001	572	95.09	880	94.81	1800	94.62
490	<0.0001	573	94.41	890	94.83	1900	95.03
500	<0.0001	574	93.50	900	94.94	2000	94.09
510	<0.0001	575	93.85	910	94.86	2100	95.47
520	<0.0001	576	94.43	920	92.54	2200	94.79
530	<0.0001	577	94.68	930	94.34	2300	95.76
540	<0.0001	578	94.72	940	94.61	2400	94.20
541	<0.0001	579	94.84	950	94.93	2500	94.75
542	<0.0001	580	95.19	960	94.76		
543	0.0001 (OD6)	590	95.36	970	94.49		

Transmittance and Optical Density data are nominal values provided as a reference to indicate typical spectral response.

CGA-590

Spectral Performance Data - CGA-590

Cut-on Wavelength at 50% Absolute Transmittance	590 ± 5 nm
Cut-on Wavelength at 90% Absolute Transmittance	≤610 nm
Cut-on Wavelength at OD5	≥555 nm
Effective Index of Refraction	1.75 (nominal)



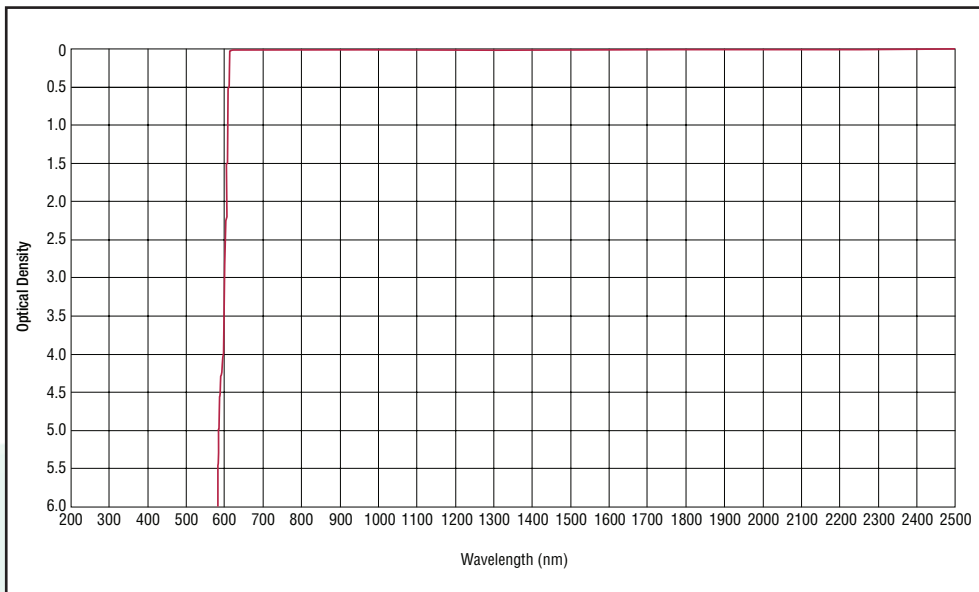
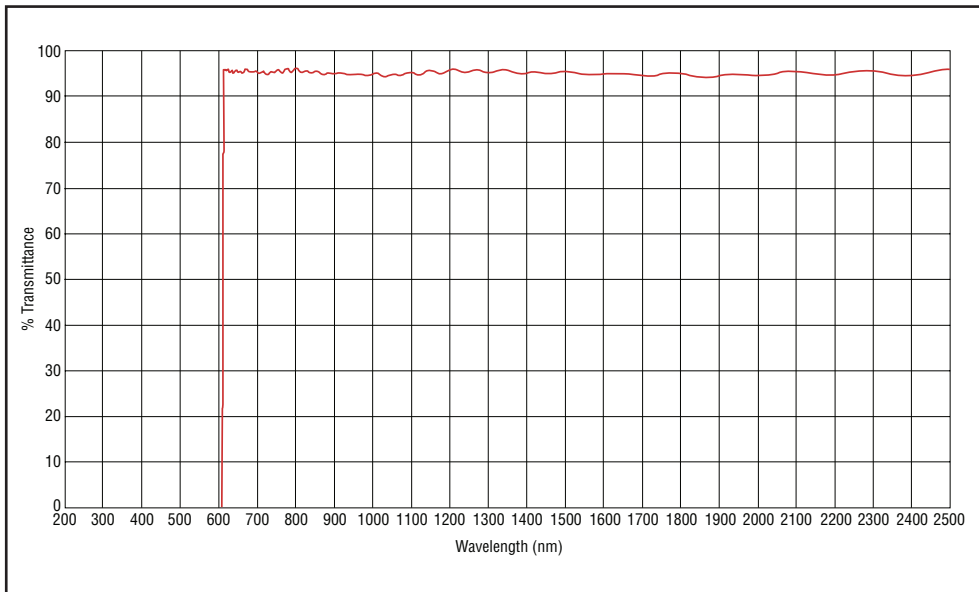
Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)
200	<0.0001	562	0.0002	600	95.65	980	94.72
210	<0.0001	563	0.0003	610	95.34	990	94.76
220	<0.0001	564	0.0004	620	95.19	1000	94.40
230	<0.0001	565	0.0006	630	95.08	1010	94.27
240	<0.0001	566	0.0010 (OD5)	640	94.77	1020	94.60
250	<0.0001	567	0.0016	650	95.75	1030	94.84
260	<0.0001	568	0.0026	660	95.21	1040	94.59
270	<0.0001	569	0.0042	670	95.00	1050	94.29
280	<0.0001	570	0.0064	680	94.91	1060	94.54
290	<0.0001	571	0.0090	690	95.04	1070	95.15
300	<0.0001	572	0.0117	700	94.87	1080	95.38
310	<0.0001	573	0.0144	710	94.91	1090	94.98
320	<0.0001	574	0.0174	720	94.98	1100	94.54
330	<0.0001	575	0.0213	730	95.71	1110	94.66
340	<0.0001	576	0.0265	740	95.03	1120	95.29
350	<0.0001	577	0.0342	750	95.69	1130	95.78
360	<0.0001	578	0.0458	760	95.35	1140	95.62
370	<0.0001	579	0.0639	770	95.22	1150	95.03
380	<0.0001	580	0.0933	780	95.71	1160	94.63
390	<0.0001	581	0.1428	790	94.97	1170	94.81
400	<0.0001	582	0.2296	800	95.35	1180	95.37
410	<0.0001	583	0.3894	810	94.80	1190	95.80
420	<0.0001	584	0.7000	820	94.73	1200	95.74
430	<0.0001	585	1.34	830	95.33	1300	94.54
440	<0.0001	586	2.76	840	94.76	1400	94.95
450	<0.0001	587	6.09	850	94.71	1500	94.89
460	<0.0001	588	14.28	860	95.07	1600	94.69
470	<0.0001	589	33.25	870	94.69	1700	94.62
480	<0.0001	590	64.42	880	94.64	1800	94.74
490	<0.0001	591	88.54	890	95.01	1900	94.10
500	<0.0001	592	95.28	900	94.92	2000	95.05
510	<0.0001	593	95.42	910	94.66	2100	94.72
520	<0.0001	594	95.20	920	94.67	2200	95.03
530	<0.0001	595	95.37	930	94.77	2300	94.78
540	<0.0001	596	95.50	940	94.74	2400	95.56
550	<0.0001	597	95.44	950	94.50	2500	94.15
560	<0.0001	598	95.36	960	94.25		
561	0.0001 (OD6)	599	95.42	970	94.36		

Transmittance and Optical Density data are nominal values provided as a reference to indicate typical spectral response.

CGA-610

Spectral Performance Data - CGA-610

Cut-on Wavelength at 50% Absolute Transmittance	610 ± 6 nm
Cut-on Wavelength at 90% Absolute Transmittance	≤630 nm
Cut-on Wavelength at OD5	≥575 nm
Effective Index of Refraction	1.79 (nominal)



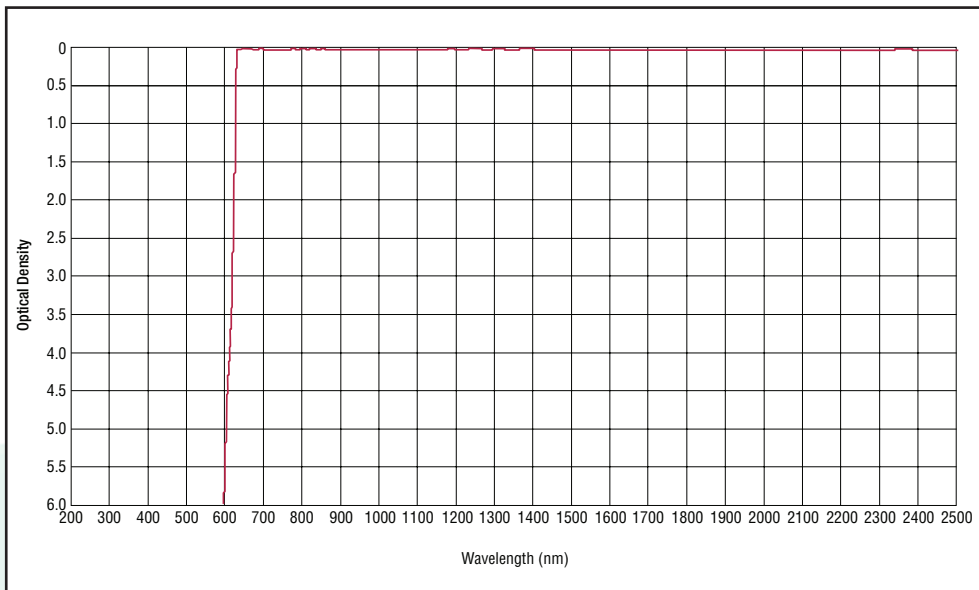
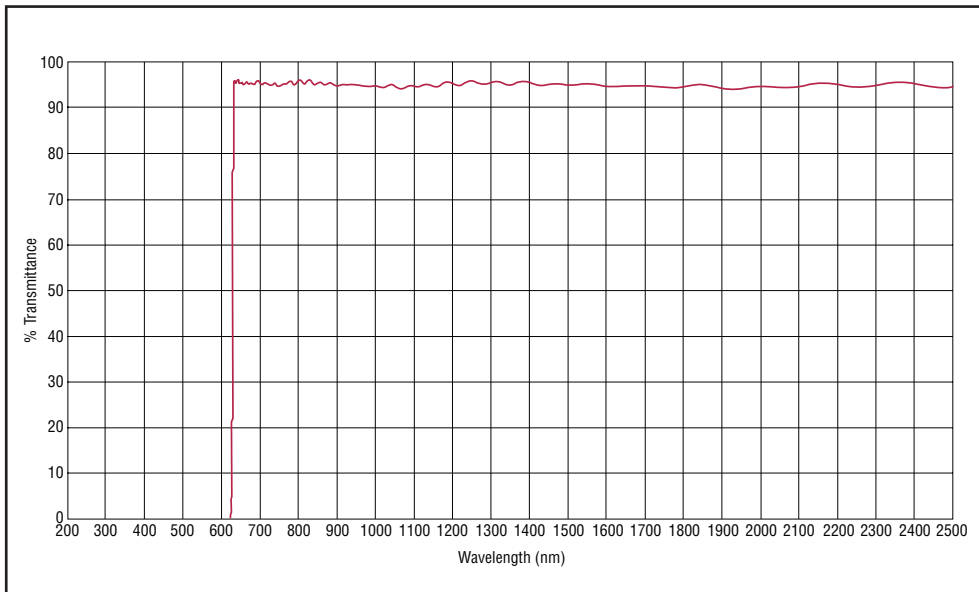
Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)
200	<0.0001	580	<0.0001	618	95.28	980	94.34
210	<0.0001	581	0.0001 (OD6)	619	95.37	990	94.45
220	<0.0001	582	0.0002	620	95.58	1000	94.80
230	<0.0001	583	0.0003	630	95.41	1010	94.71
240	<0.0001	584	0.0004	640	95.22	1020	94.20
250	<0.0001	585	0.0006	650	94.95	1030	94.03
260	<0.0001	586	0.0010 (OD5)	660	94.79	1040	94.39
270	<0.0001	587	0.0014	670	95.89	1050	94.67
280	<0.0001	588	0.0020	680	95.07	1060	94.55
290	<0.0001	589	0.0028	690	95.18	1070	94.47
300	<0.0001	590	0.0038	700	94.92	1080	94.76
310	<0.0001	591	0.0049	710	95.14	1090	95.08
320	<0.0001	592	0.0061	720	94.65	1100	94.96
330	<0.0001	593	0.0076	730	94.88	1110	94.58
340	<0.0001	594	0.0096	740	95.01	1120	94.50
350	<0.0001	595	0.0122	750	95.70	1130	94.92
360	<0.0001	596	0.0160	760	94.97	1140	95.41
370	<0.0001	597	0.0216	770	95.67	1150	95.45
380	<0.0001	598	0.0301	780	95.58	1160	95.06
390	<0.0001	599	0.0437	790	95.26	1170	94.75
400	<0.0001	600	0.0660	800	96.00	1180	94.91
410	<0.0001	601	0.1038	810	94.97	1190	95.42
420	<0.0001	602	0.1709	820	95.32	1200	95.81
430	<0.0001	603	0.2955	830	95.22	1300	94.95
440	<0.0001	604	0.5385	840	94.93	1400	95.03
450	<0.0001	605	1.04	850	95.35	1500	95.20
460	<0.0001	606	2.13	860	94.87	1600	94.76
470	<0.0001	607	4.66	870	94.59	1700	94.33
480	<0.0001	608	10.86	880	94.85	1800	94.84
490	<0.0001	609	25.62	890	94.80	1900	94.32
500	<0.0001	610	53.31	900	94.84	2000	94.33
510	<0.0001	611	81.65	910	94.94	2100	95.26
520	<0.0001	612	93.82	920	94.81	2200	94.51
530	<0.0001	613	95.74	930	94.66	2300	95.34
540	<0.0001	614	95.57	940	94.59	2400	94.42
550	<0.0001	615	95.45	950	94.61	2500	95.73
560	<0.0001	616	95.40	960	94.70		
570	<0.0001	617	95.32	970	94.59		

Transmittance and Optical Density data are nominal values provided as a reference to indicate typical spectral response.

CGA-630

Spectral Performance Data - CGA-630

Cut-on Wavelength at 50% Absolute Transmittance	630 ± 6 nm
Cut-on Wavelength at 90% Absolute Transmittance	≤650 nm
Cut-on Wavelength at OD5	≥595 nm
Effective Index of Refraction	1.74 (nominal)



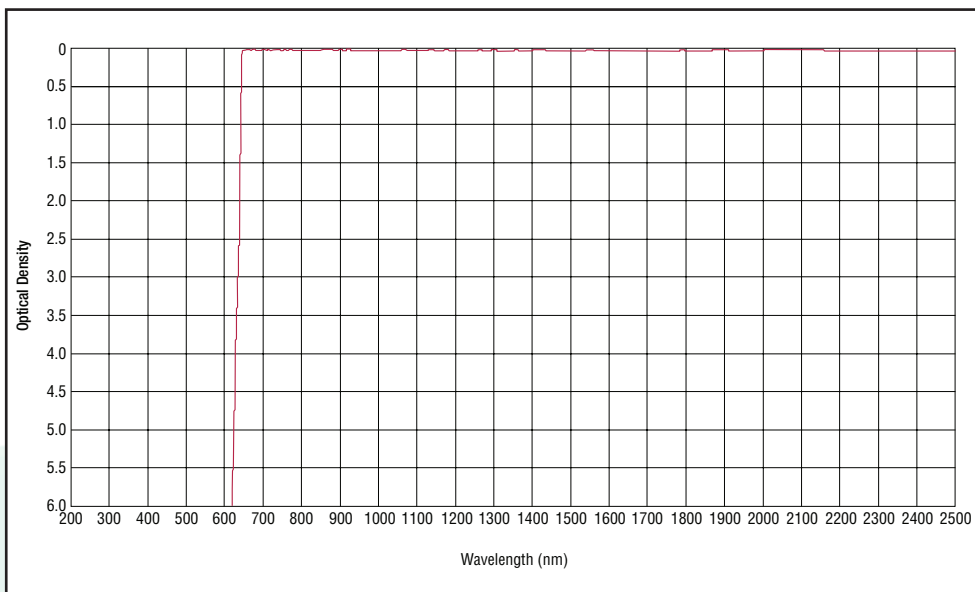
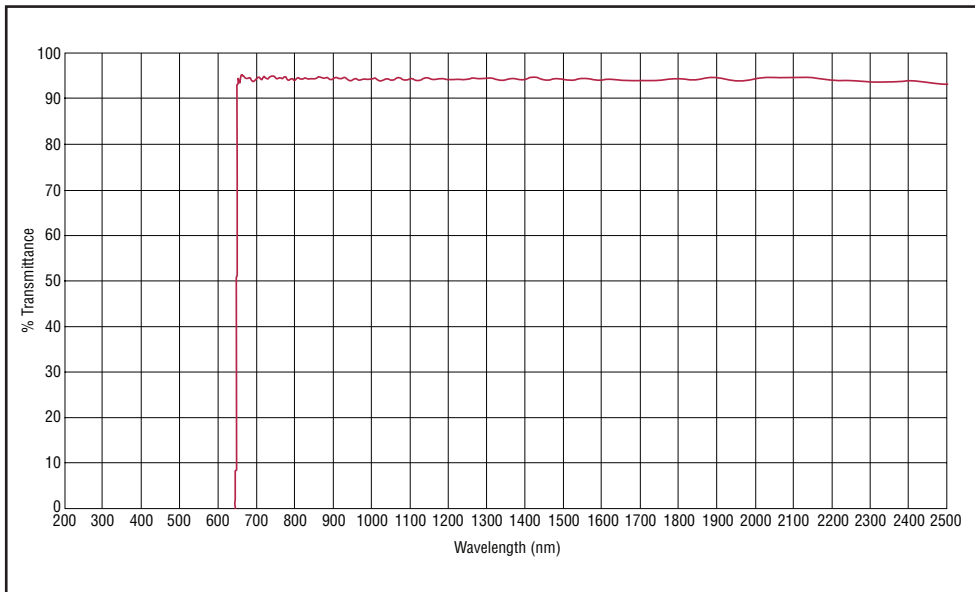
Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)
200	<0.0001	580	<0.0001	636	95.27	980	94.58
210	<0.0001	590	<0.0001	637	95.28	990	94.68
220	<0.0001	600	0.0001 (OD6)	638	95.26	1000	94.69
230	<0.0001	601	0.0002	639	95.31	1010	94.44
240	<0.0001	602	0.0003	640	95.49	1020	94.35
250	<0.0001	603	0.0004	650	95.32	1030	94.67
260	<0.0001	604	0.0006	660	95.02	1040	94.86
270	<0.0001	605	0.0010 (OD5)	670	95.03	1050	94.51
280	<0.0001	606	0.0014	680	95.03	1060	94.07
290	<0.0001	607	0.0020	690	95.78	1070	94.16
300	<0.0001	608	0.0029	700	95.14	1080	94.55
310	<0.0001	609	0.0038	710	95.18	1090	94.68
320	<0.0001	610	0.0050	720	95.11	1100	94.52
330	<0.0001	611	0.0062	730	94.81	1110	94.53
340	<0.0001	612	0.0077	740	95.14	1120	94.86
350	<0.0001	613	0.0095	750	94.47	1130	95.11
360	<0.0001	614	0.0119	760	95.11	1140	94.92
370	<0.0001	615	0.0153	770	95.23	1150	94.55
380	<0.0001	616	0.0201	780	95.63	1160	94.51
390	<0.0001	617	0.0272	790	94.91	1170	94.93
400	<0.0001	618	0.0382	800	96.03	1180	95.41
410	<0.0001	619	0.0554	810	95.19	1190	95.46
420	<0.0001	620	0.0835	820	95.60	1200	95.10
430	<0.0001	621	0.1310	830	95.81	1300	95.52
440	<0.0001	622	0.2147	840	94.91	1400	95.32
450	<0.0001	623	0.3686	850	95.41	1500	94.77
460	<0.0001	624	0.6661	860	95.14	1600	94.66
470	<0.0001	625	1.27	870	94.99	1700	94.74
480	<0.0001	626	2.59	880	95.37	1800	94.52
490	<0.0001	627	5.63	890	94.86	1900	94.14
500	<0.0001	628	12.90	900	94.61	2000	94.61
510	<0.0001	629	29.54	910	94.87	2100	94.54
520	<0.0001	630	58.38	920	94.83	2200	94.95
530	<0.0001	631	84.68	930	94.83	2300	94.79
540	<0.0001	632	94.54	940	94.95	2400	95.06
550	<0.0001	633	95.60	950	94.84	2500	94.59
560	<0.0001	634	95.25	960	94.69		
570	<0.0001	635	95.27	970	94.61		

Transmittance and Optical Density data are nominal values provided as a reference to indicate typical spectral response.

CGA-645

Spectral Performance Data - CGA-645

Cut-on Wavelength at 50% Absolute Transmittance	645 ± 6 nm
Cut-on Wavelength at 90% Absolute Transmittance	≤665 nm
Cut-on Wavelength at OD5	≥615 nm
Effective Index of Refraction	1.78 (nominal)



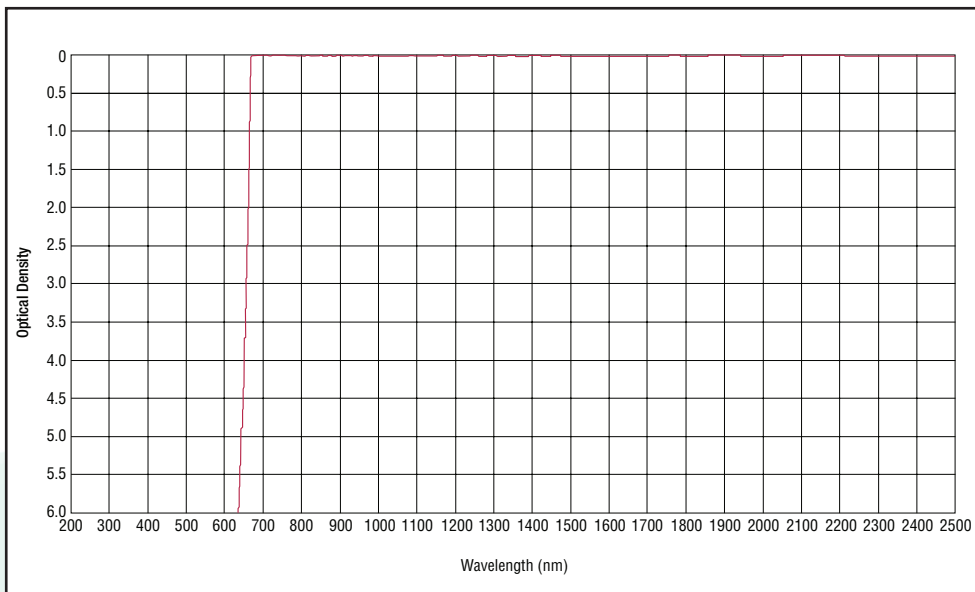
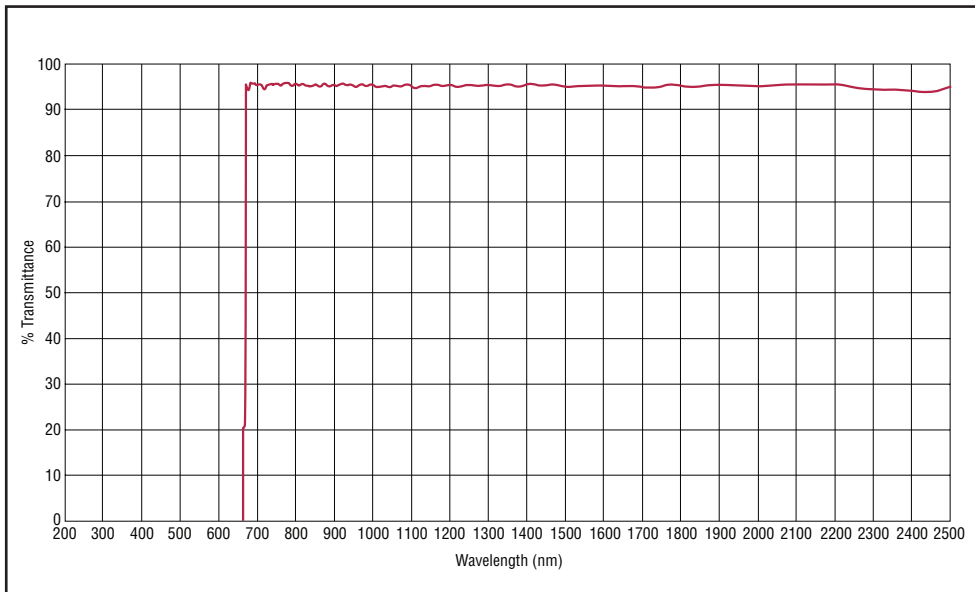
Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)
200	<0.0001	560	<0.0001	650	94.69	1010	94.97
210	<0.0001	570	<0.0001	660	95.79	1020	94.72
220	<0.0001	580	<0.0001	670	95.29	1030	95.11
230	<0.0001	590	<0.0001	680	95.25	1040	95.07
240	<0.0001	600	<0.0001	690	94.79	1050	94.99
250	<0.0001	610	<0.0001	700	95.73	1060	95.39
260	<0.0001	620	0.0001 (0D6)	710	95.30	1070	95.33
270	<0.0001	621	0.0002	720	95.20	1080	94.99
280	<0.0001	622	0.0002	730	95.89	1090	95.17
290	<0.0001	623	0.0002	740	95.65	1100	95.27
300	<0.0001	624	0.0003	750	95.28	1110	94.87
310	<0.0001	625	0.0005	760	95.17	1120	94.83
320	<0.0001	626	0.0010 (0D5)	770	95.63	1130	95.33
330	<0.0001	627	0.0012	780	94.93	1140	95.48
340	<0.0001	628	0.0019	790	94.91	1150	95.13
350	<0.0001	629	0.0033	800	95.28	1160	95.05
360	<0.0001	630	0.0057	810	95.03	1170	95.29
370	<0.0001	631	0.0098	820	95.45	1180	95.30
380	<0.0001	632	0.0165	830	95.07	1190	95.05
390	<0.0001	633	0.0269	840	95.25	1200	94.99
400	<0.0001	634	0.0427	850	95.20	1300	95.40
410	<0.0001	635	0.0674	860	95.67	1400	95.24
420	<0.0001	636	0.1069	870	95.31	1500	94.98
430	<0.0001	637	0.1745	880	95.39	1600	95.01
440	<0.0001	638	0.2988	890	95.01	1700	94.96
450	<0.0001	639	0.5444	900	95.51	1800	95.25
460	<0.0001	640	1.07	910	95.15	1900	95.44
470	<0.0001	641	2.28	920	95.48	2000	95.29
480	<0.0001	642	5.35	930	95.17	2100	95.58
490	<0.0001	643	13.60	940	94.78	2200	94.90
500	<0.0001	644	34.54	950	95.26	2300	94.54
510	<0.0001	645	69.03	960	94.94	2400	94.71
520	<0.0001	646	91.05	970	95.03	2500	93.96
530	<0.0001	647	95.11	980	95.14		
540	<0.0001	648	94.90	990	95.04		
550	<0.0001	649	94.78	1000	95.29		

Transmittance and Optical Density data are nominal values provided as a reference to indicate typical spectral response.

CGA-665

Spectral Performance Data - CGA-665

Cut-on Wavelength at 50% Absolute Transmittance	665 ± 6 nm
Cut-on Wavelength at 90% Absolute Transmittance	≤685 nm
Cut-on Wavelength at OD5	≥630 nm
Effective Index of Refraction	1.81 (nominal)



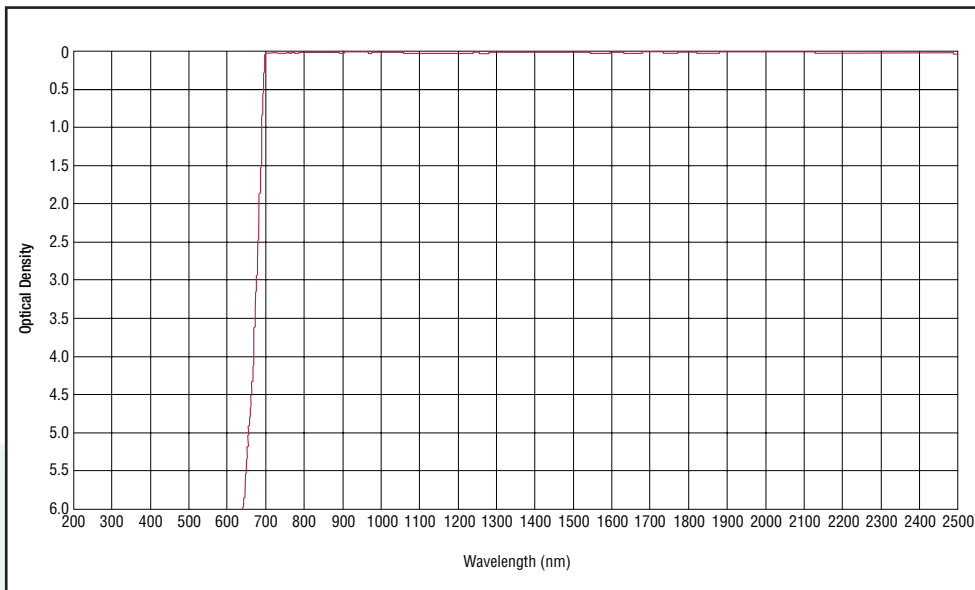
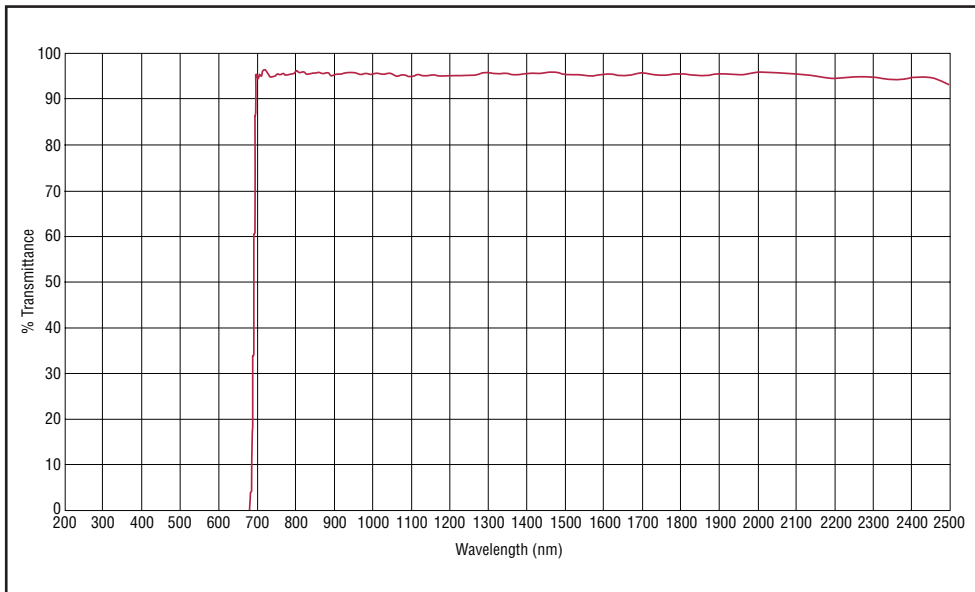
Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)
200	<0.0001	580	<0.0001	663	8.45	980	95.20
210	<0.0001	590	<0.0001	664	17.73	990	95.44
220	<0.0001	600	<0.0001	665	36.66	1000	95.07
230	<0.0001	610	<0.0001	666	65.36	1010	94.90
240	<0.0001	620	<0.0001	667	88.35	1020	95.22
250	<0.0001	630	<0.0001	668	95.51	1030	95.08
260	<0.0001	631	<0.0001	669	95.15	1040	95.01
270	<0.0001	632	<0.0001	670	94.12	1050	95.24
280	<0.0001	633	<0.0001	680	96.12	1060	95.10
290	<0.0001	634	<0.0001	690	95.59	1070	95.05
300	<0.0001	635	0.0001 (OD6)	700	95.56	1080	95.39
310	<0.0001	636	0.0002	710	95.03	1090	95.31
320	<0.0001	637	0.0002	720	94.99	1100	94.85
330	<0.0001	638	0.0002	730	95.52	1110	94.87
340	<0.0001	639	0.0003	740	95.32	1120	95.21
350	<0.0001	640	0.0005	750	95.70	1130	95.24
360	<0.0001	641	0.0006	760	95.53	1140	95.15
370	<0.0001	642	0.0008	770	95.77	1150	95.29
380	<0.0001	643	0.0010 (OD5)	780	95.42	1160	95.39
390	<0.0001	644	0.0014	790	95.23	1170	95.25
400	<0.0001	645	0.0018	800	95.30	1180	95.19
410	<0.0001	646	0.0025	810	95.52	1190	95.35
420	<0.0001	647	0.0034	820	95.07	1200	95.35
430	<0.0001	648	0.0047	830	95.09	1300	95.44
440	<0.0001	649	0.0068	840	95.03	1400	95.49
450	<0.0001	650	0.0100	850	95.48	1500	94.90
460	<0.0001	651	0.0149	860	95.03	1600	95.28
470	<0.0001	652	0.0228	870	95.68	1700	94.86
480	<0.0001	653	0.0356	880	95.08	1800	95.10
490	<0.0001	654	0.0563	890	95.41	1900	95.45
500	<0.0001	655	0.0903	900	95.23	2000	95.02
510	<0.0001	656	0.1465	910	95.59	2100	95.61
520	<0.0001	657	0.2408	920	95.58	2200	95.38
530	<0.0001	658	0.4020	930	95.28	2300	94.25
540	<0.0001	659	0.6855	940	95.40	2400	93.92
550	<0.0001	660	1.20	950	95.06	2500	94.92
560	<0.0001	661	2.19	960	95.35		
570	<0.0001	662	4.19	970	95.35		

Transmittance and Optical Density data are nominal values provided as a reference to indicate typical spectral response.

CGA-695

Spectral Performance Data - CGA-695

Cut-on Wavelength at 50% Absolute Transmittance	695 ± 6 nm
Cut-on Wavelength at 90% Absolute Transmittance	≤715 nm
Cut-on Wavelength at OD5	≥645 nm
Effective Index of Refraction	1.74 (nominal)



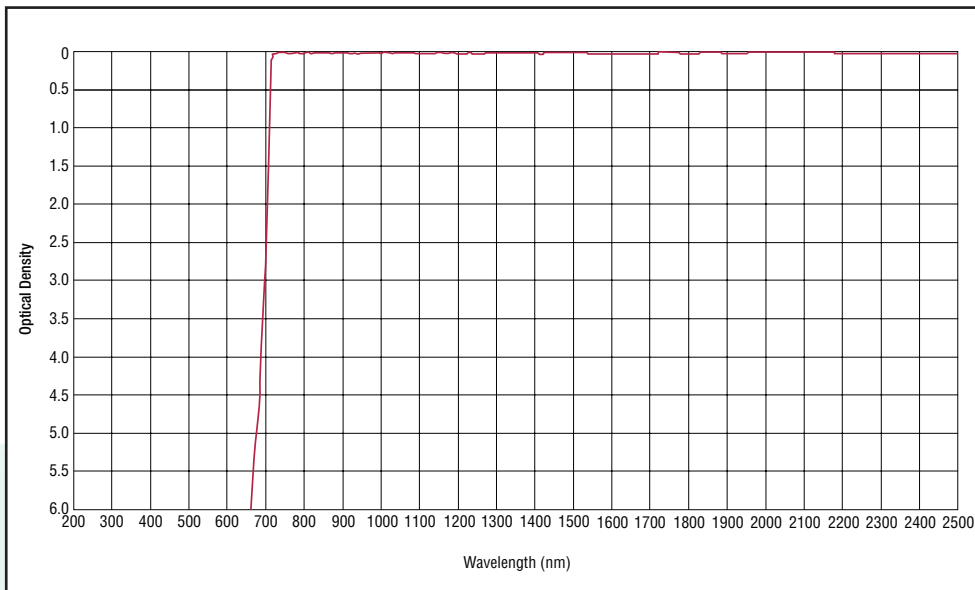
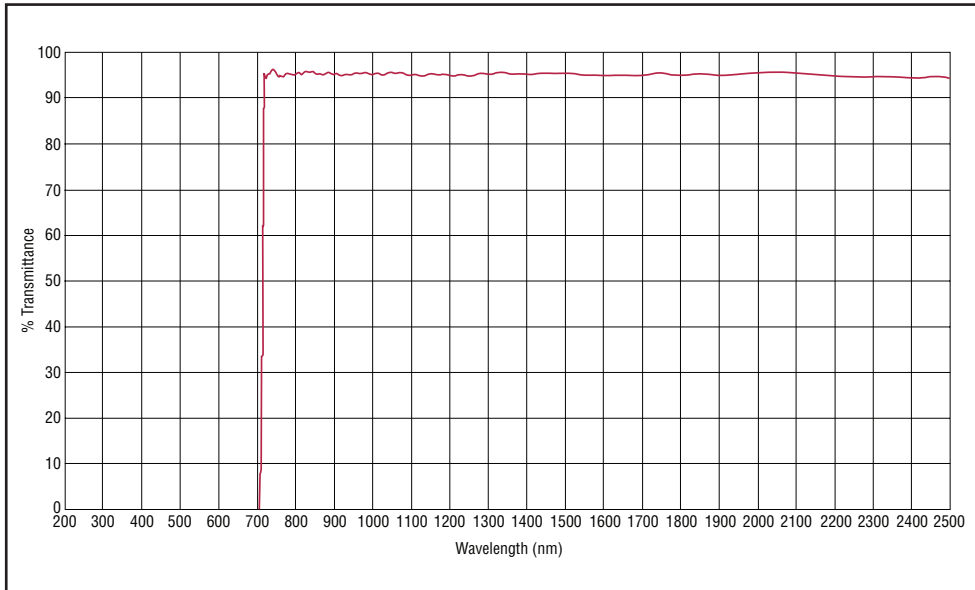
Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)
200	<0.0001	580	<0.0001	690	8.39	980	95.45
210	<0.0001	590	<0.0001	691	12.24	990	95.44
220	<0.0001	600	<0.0001	692	17.65	1000	95.33
230	<0.0001	610	<0.0001	693	25.09	1010	95.61
240	<0.0001	620	<0.0001	694	35.03	1020	95.52
250	<0.0001	630	<0.0001	695	47.60	1030	95.31
260	<0.0001	640	<0.0001	696	61.92	1040	95.57
270	<0.0001	641	<0.0001	697	75.83	1050	95.51
280	<0.0001	642	<0.0001	698	86.65	1060	95.02
290	<0.0001	643	0.0001 (OD6)	699	92.99	1070	94.97
300	<0.0001	644	0.0002	700	95.46	1080	95.17
310	<0.0001	645	0.0002	710	95.15	1090	94.99
320	<0.0001	646	0.0002	720	96.39	1100	94.82
330	<0.0001	647	0.0002	730	95.37	1110	95.09
340	<0.0001	648	0.0002	740	94.77	1120	95.29
350	<0.0001	649	0.0002	750	94.88	1130	95.11
360	<0.0001	650	0.0003	760	95.27	1140	95.00
370	<0.0001	651	0.0004	770	95.48	1150	95.18
380	<0.0001	652	0.0005	780	95.03	1160	95.26
390	<0.0001	653	0.0006	790	95.36	1170	95.05
400	<0.0001	654	0.0007	800	95.73	1180	94.89
410	<0.0001	655	0.0008	810	95.83	1190	94.97
420	<0.0001	656	0.0010 (OD5)	820	95.90	1200	95.07
430	<0.0001	657	0.0011	830	95.37	1300	95.75
440	<0.0001	658	0.0013	840	95.55	1400	95.62
450	<0.0001	659	0.0015	850	95.42	1500	95.40
460	<0.0001	660	0.0017	860	95.72	1600	95.38
470	<0.0001	670	0.0152	870	95.43	1700	95.60
480	<0.0001	680	0.2208	880	95.61	1800	95.49
490	<0.0001	681	0.2966	890	95.29	1900	95.47
500	<0.0001	682	0.4058	900	95.04	2000	95.79
510	<0.0001	683	0.5666	910	95.37	2100	95.44
520	<0.0001	684	0.8066	920	95.31	2200	94.52
530	<0.0001	685	1.17	930	95.61	2300	94.75
540	<0.0001	686	1.72	940	95.55	2400	94.61
550	<0.0001	687	2.56	950	95.62	2500	92.99
560	<0.0001	688	3.82	960	95.58		
570	<0.0001	689	5.68	970	95.28		

Transmittance and Optical Density data are nominal values provided as a reference to indicate typical spectral response.

CGA-715

Spectral Performance Data - CGA-715

Cut-on Wavelength at 50% Absolute Transmittance	715 ± 7 nm
Cut-on Wavelength at 90% Absolute Transmittance	≤735 nm
Cut-on Wavelength at OD5	≥665 nm
Effective Index of Refraction	1.70 (nominal)



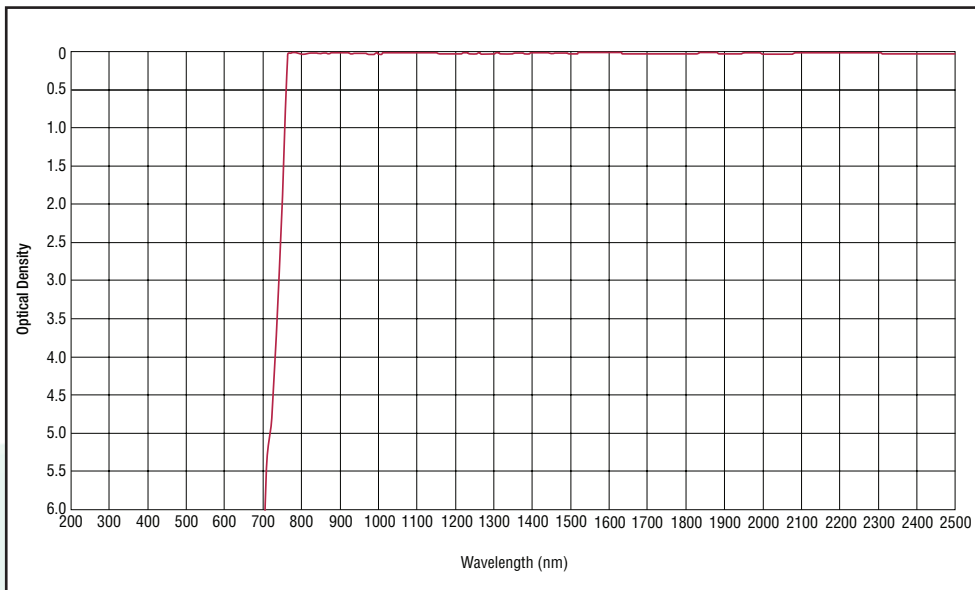
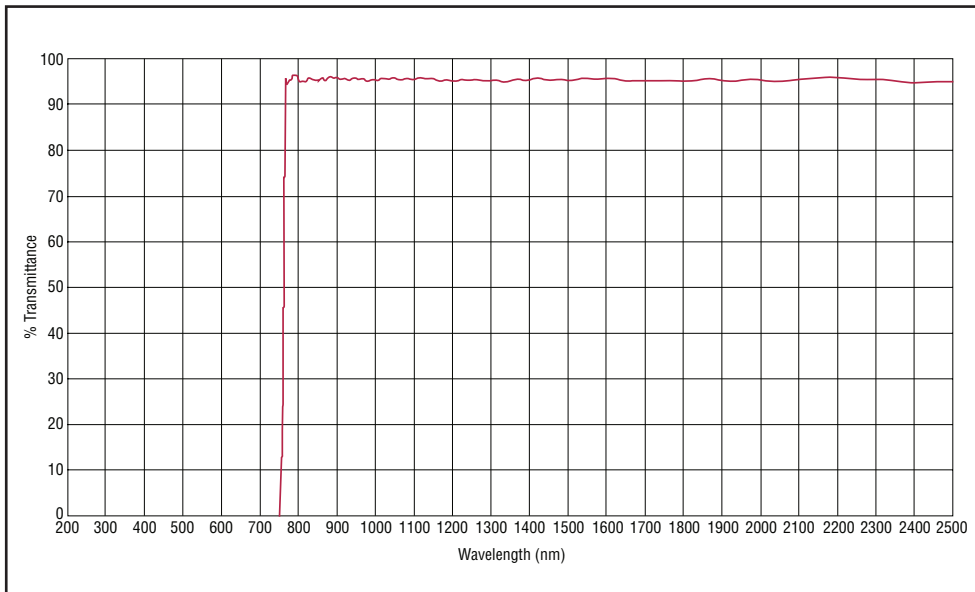
Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)
200	<0.0001	580	<0.0001	708	4.32	980	95.74
210	<0.0001	590	<0.0001	709	6.21	990	95.41
220	<0.0001	600	<0.0001	710	8.90	1000	95.34
230	<0.0001	610	<0.0001	711	12.78	1010	95.65
240	<0.0001	620	<0.0001	712	18.39	1020	95.37
250	<0.0001	630	<0.0001	713	26.39	1030	95.31
260	<0.0001	640	<0.0001	714	37.37	1040	95.72
270	<0.0001	650	<0.0001	715	51.43	1050	95.66
280	<0.0001	660	<0.0001	716	67.00	1060	95.50
290	<0.0001	661	<0.0001	717	80.90	1070	95.61
300	<0.0001	662	<0.0001	718	90.26	1080	95.41
310	<0.0001	663	0.0001 (OD6)	719	94.66	1090	95.07
320	<0.0001	664	0.0002	720	95.75	1100	95.17
330	<0.0001	665	0.0002	730	95.40	1110	95.29
340	<0.0001	666	0.0003	740	96.38	1120	95.07
350	<0.0001	667	0.0003	750	95.43	1130	94.97
360	<0.0001	668	0.0004	760	95.04	1140	95.24
370	<0.0001	669	0.0005	770	94.99	1150	95.40
380	<0.0001	670	0.0006	780	95.56	1160	95.27
390	<0.0001	671	0.0006	790	96.25	1170	95.21
400	<0.0001	672	0.0007	800	95.31	1180	95.31
410	<0.0001	673	0.0007	810	95.46	1190	95.25
420	<0.0001	674	0.0008	820	95.55	1200	95.04
430	<0.0001	675	0.0008	830	95.87	1300	95.31
440	<0.0001	676	0.0009	840	95.87	1400	95.38
450	<0.0001	677	0.0010 (OD5)	850	95.44	1500	95.65
460	<0.0001	678	0.0013	860	95.50	1600	95.15
470	<0.0001	679	0.0015	870	95.15	1700	95.04
480	<0.0001	680	0.0018	880	95.67	1800	95.05
490	<0.0001	690	0.0232	890	95.60	1900	95.12
500	<0.0001	700	0.2354	900	95.39	2000	95.68
510	<0.0001	701	0.3269	910	95.31	2100	95.55
520	<0.0001	702	0.4623	920	95.03	2200	95.12
530	<0.0001	703	0.6636	930	95.36	2300	94.84
540	<0.0001	704	0.9629	940	95.21	2400	94.46
550	<0.0001	705	1.41	950	95.55	2500	94.31
560	<0.0001	706	2.05	960	95.58		
570	<0.0001	707	2.99	970	95.46		

Transmittance and Optical Density data are nominal values provided as a reference to indicate typical spectral response.

CGA-760

Spectral Performance Data - CGA-760

Cut-on Wavelength at 50% Absolute Transmittance	760 ± 7 nm
Cut-on Wavelength at 90% Absolute Transmittance	≤780 nm
Cut-on Wavelength at OD5	≥705 nm
Effective Index of Refraction	1.72 (nominal)



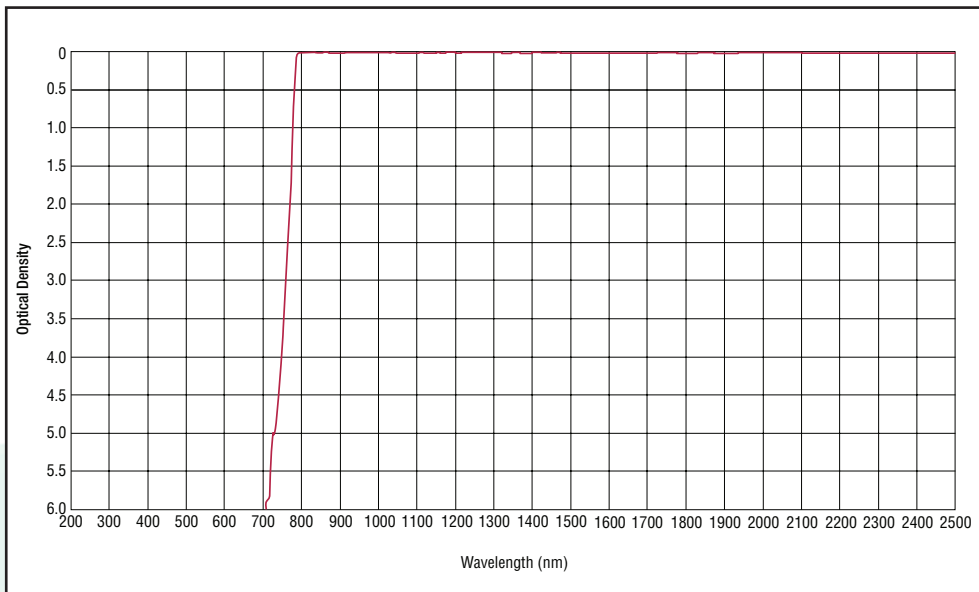
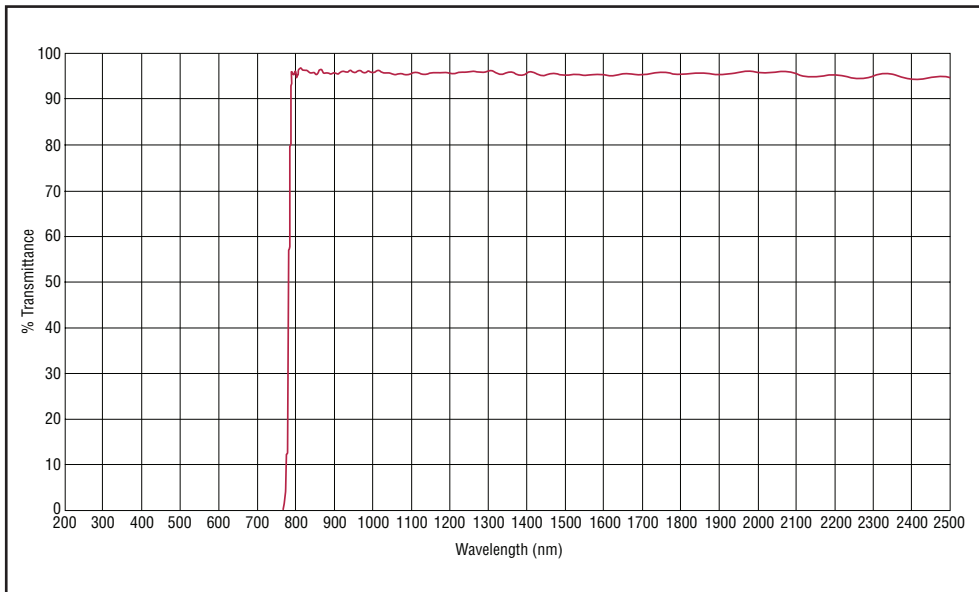
Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)
200	<0.0001	580	<0.0001	753	5.83	980	95.07
210	<0.0001	590	<0.0001	754	8.19	990	95.35
220	<0.0001	600	<0.0001	755	11.46	1000	95.20
230	<0.0001	610	<0.0001	756	16.03	1010	95.51
240	<0.0001	620	<0.0001	757	22.42	1020	95.64
250	<0.0001	630	<0.0001	758	31.23	1030	95.44
260	<0.0001	640	<0.0001	759	42.86	1040	95.71
270	<0.0001	650	<0.0001	760	56.89	1050	95.59
280	<0.0001	660	<0.0001	761	71.40	1060	95.29
290	<0.0001	670	<0.0001	762	83.60	1070	95.58
300	<0.0001	680	<0.0001	763	91.44	1080	95.60
310	<0.0001	690	<0.0001	764	94.98	1090	95.28
320	<0.0001	700	<0.0001	765	95.72	1100	95.49
330	<0.0001	701	<0.0001	766	95.25	1110	95.78
340	<0.0001	702	0.0001 (0D6)	767	94.64	1120	95.62
350	<0.0001	703	0.0002	768	94.28	1130	95.53
360	<0.0001	704	0.0002	769	94.28	1140	95.63
370	<0.0001	705	0.0002	770	94.51	1150	95.40
380	<0.0001	706	0.0002	780	95.69	1160	95.09
390	<0.0001	707	0.0003	790	96.27	1170	95.16
400	<0.0001	708	0.0004	800	94.99	1180	95.31
410	<0.0001	709	0.0004	810	95.10	1190	95.13
420	<0.0001	710	0.0005	820	95.24	1200	94.96
430	<0.0001	711	0.0006	830	95.54	1300	95.26
440	<0.0001	712	0.0007	840	95.28	1400	95.43
450	<0.0001	713	0.0007	850	95.29	1500	95.21
460	<0.0001	714	0.0008	860	95.58	1600	95.62
470	<0.0001	715	0.0008	870	95.40	1700	95.13
480	<0.0001	716	0.0009	880	95.97	1800	94.97
490	<0.0001	717	0.0010 (0D5)	890	95.84	1900	95.09
500	<0.0001	718	0.0011	900	95.69	2000	95.26
510	<0.0001	719	0.0012	910	95.43	2100	95.45
520	<0.0001	720	0.0014	920	95.40	2200	95.82
530	<0.0001	730	0.0129	930	95.26	2300	95.31
540	<0.0001	740	0.0962	940	95.86	2400	94.65
550	<0.0001	750	2.04	950	95.42	2500	94.82
560	<0.0001	751	2.91	960	95.45		
570	<0.0001	752	4.13	970	95.21		

Transmittance and Optical Density data are nominal values provided as a reference to indicate typical spectral response.

CGA-780

Spectral Performance Data - CGA-780

Cut-on Wavelength at 50% Absolute Transmittance	780 ± 7 nm
Cut-on Wavelength at 90% Absolute Transmittance	≤800 nm
Cut-on Wavelength at OD5	≥710 nm
Effective Index of Refraction	1.74 (nominal)



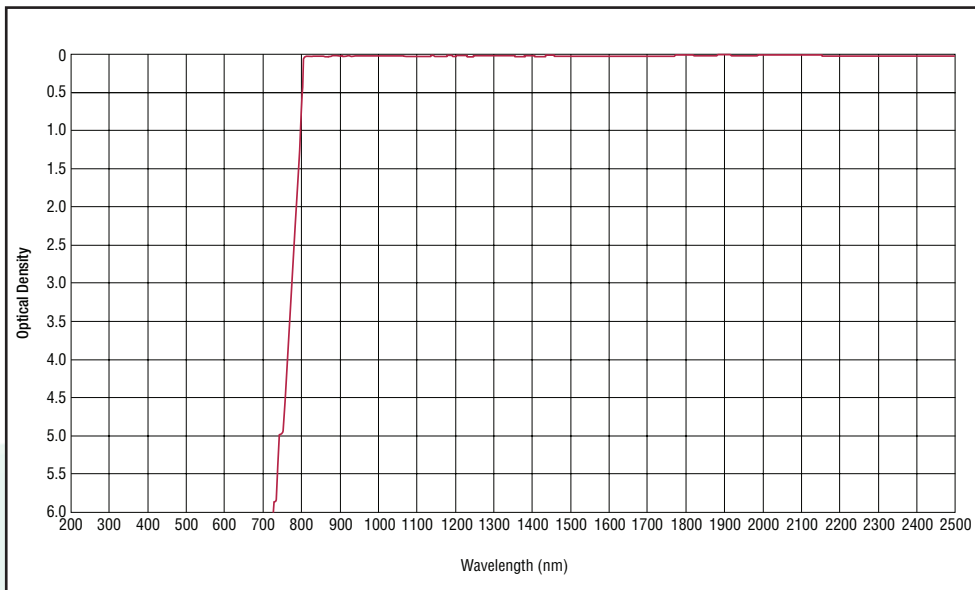
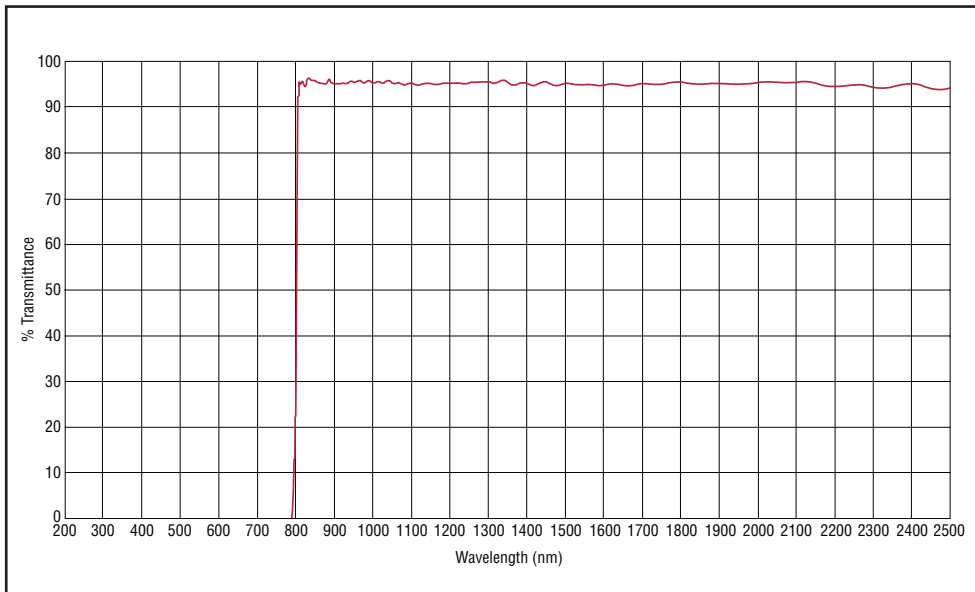
Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)
200	<0.0001	580	<0.0001	771	3.49	980	95.55
210	<0.0001	590	<0.0001	772	4.78	990	95.51
220	<0.0001	600	<0.0001	773	6.55	1000	95.43
230	<0.0001	610	<0.0001	774	8.91	1010	95.87
240	<0.0001	620	<0.0001	775	12.02	1020	95.43
250	<0.0001	630	<0.0001	776	16.02	1030	95.34
260	<0.0001	640	<0.0001	777	21.12	1040	95.30
270	<0.0001	650	<0.0001	778	27.57	1050	94.93
280	<0.0001	660	<0.0001	779	35.63	1060	95.12
290	<0.0001	670	<0.0001	780	45.43	1070	95.21
300	<0.0001	680	<0.0001	781	56.70	1080	94.92
310	<0.0001	690	<0.0001	782	68.51	1090	94.95
320	<0.0001	700	0.0001 (OD6)	783	79.35	1100	95.24
330	<0.0001	710	0.0002	784	87.66	1110	95.36
340	<0.0001	720	0.0005	785	92.78	1120	95.17
350	<0.0001	721	0.0006	786	95.09	1130	94.98
360	<0.0001	722	0.0007	787	95.61	1140	95.13
370	<0.0001	723	0.0009	788	95.36	1150	95.33
380	<0.0001	724	0.0010 (OD5)	789	95.00	1160	95.29
390	<0.0001	725	0.0011	790	94.85	1170	95.31
400	<0.0001	726	0.0011	800	94.49	1180	95.49
410	<0.0001	727	0.0011	810	96.37	1190	95.46
420	<0.0001	728	0.0011	820	95.84	1200	95.24
430	<0.0001	729	0.0011	830	95.53	1300	95.86
440	<0.0001	730	0.0012	840	95.27	1400	95.52
450	<0.0001	740	0.0054	850	95.02	1500	94.87
460	<0.0001	750	0.0290	860	96.04	1600	94.96
470	<0.0001	760	0.2558	870	95.24	1700	94.99
480	<0.0001	761	0.3063	880	95.29	1800	95.14
490	<0.0001	762	0.3673	890	95.01	1900	95.01
500	<0.0001	763	0.4434	900	95.31	2000	95.50
510	<0.0001	764	0.5416	910	95.27	2100	95.20
520	<0.0001	765	0.6716	920	95.65	2200	95.03
530	<0.0001	766	0.8475	930	95.54	2300	94.86
540	<0.0001	767	1.09	940	95.88	2400	93.96
550	<0.0001	768	1.43	950	95.32	2500	94.18
560	<0.0001	769	1.90	960	95.90		
570	<0.0001	770	2.56	970	95.39		

Transmittance and Optical Density data are nominal values provided as a reference to indicate typical spectral response.

CGA-800

Spectral Performance Data - CGA-800

Cut-on Wavelength at 50% Absolute Transmittance	800 ± 8 nm
Cut-on Wavelength at 90% Absolute Transmittance	≤820 nm
Cut-on Wavelength at OD5	≥730 nm
Effective Index of Refraction	1.73 (nominal)



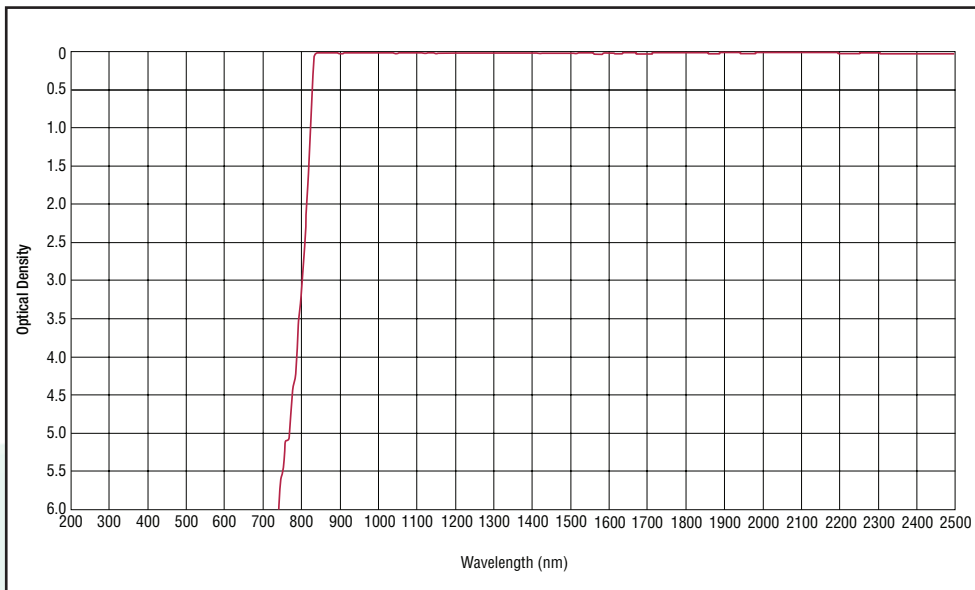
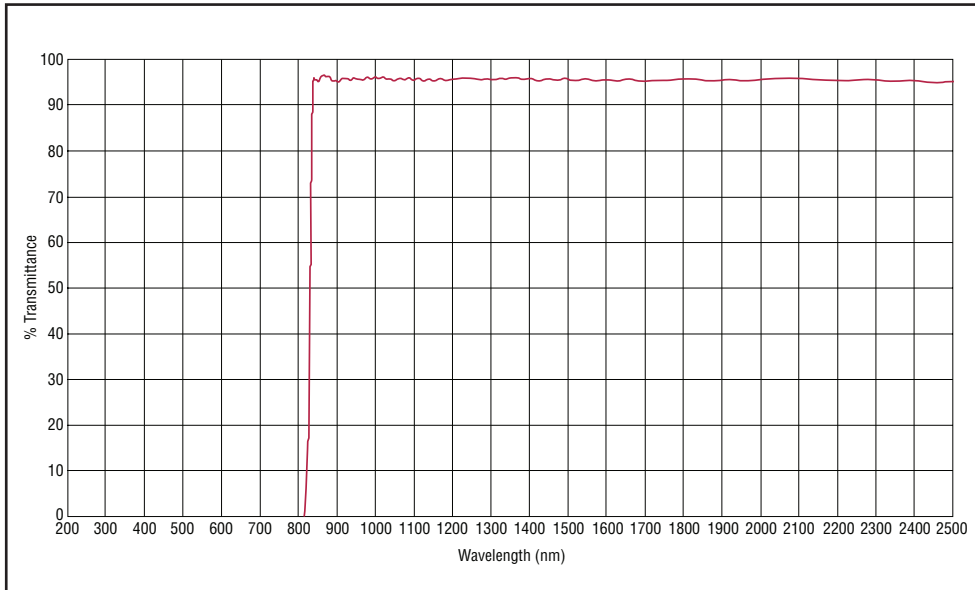
Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)
200	<0.0001	580	<0.0001	789	2.28	980	95.64
210	<0.0001	590	<0.0001	790	3.08	990	95.74
220	<0.0001	600	<0.0001	791	4.17	1000	95.32
230	<0.0001	610	<0.0001	792	5.68	1010	95.68
240	<0.0001	620	<0.0001	793	7.69	1020	95.36
250	<0.0001	630	<0.0001	794	10.35	1030	95.67
260	<0.0001	640	<0.0001	795	13.78	1040	95.79
270	<0.0001	650	<0.0001	796	18.15	1050	95.31
280	<0.0001	660	<0.0001	797	23.66	1060	95.40
290	<0.0001	670	<0.0001	798	30.54	1070	95.18
300	<0.0001	680	<0.0001	799	39.00	1080	94.93
310	<0.0001	690	<0.0001	800	49.04	1090	95.21
320	<0.0001	700	<0.0001	801	60.25	1100	95.16
330	<0.0001	710	<0.0001	802	71.59	1110	94.89
340	<0.0001	720	0.0001 (OD6)	803	81.58	1120	94.99
350	<0.0001	730	0.0002	804	88.97	1130	95.27
360	<0.0001	740	0.0007	805	93.34	1140	95.36
370	<0.0001	741	0.0008	806	95.22	1150	95.16
380	<0.0001	742	0.0010 (OD5)	807	95.57	1160	94.98
390	<0.0001	743	0.0011	808	95.28	1170	95.14
400	<0.0001	744	0.0011	809	94.92	1180	95.34
410	<0.0001	745	0.0011	810	94.78	1190	95.29
420	<0.0001	746	0.0011	820	94.55	1200	95.30
430	<0.0001	747	0.0011	830	96.41	1300	95.57
440	<0.0001	748	0.0012	840	95.82	1400	95.21
450	<0.0001	749	0.0012	850	95.62	1500	95.30
460	<0.0001	750	0.0013	860	95.24	1600	94.86
470	<0.0001	760	0.0071	870	95.10	1700	95.23
480	<0.0001	770	0.0368	880	95.83	1800	95.51
490	<0.0001	780	0.2994	890	95.48	1900	95.37
500	<0.0001	781	0.3571	900	95.29	2000	95.59
510	<0.0001	782	0.4293	910	94.99	2100	95.60
520	<0.0001	783	0.5188	920	95.37	2200	94.56
530	<0.0001	784	0.6370	930	95.11	2300	94.35
540	<0.0001	785	0.7498	940	95.71	2400	95.19
550	<0.0001	786	1.01	950	95.40	2500	94.33
560	<0.0001	787	1.30	960	95.94		
570	<0.0001	788	1.71	970	95.44		

Transmittance and Optical Density data are nominal values provided as a reference to indicate typical spectral response.

CGA-830

Spectral Performance Data - CGA-830

Cut-on Wavelength at 50% Absolute Transmittance	830 ± 8 nm
Cut-on Wavelength at 90% Absolute Transmittance	≤850 nm
Cut-on Wavelength at OD5	≥755 nm
Effective Index of Refraction	1.79 (nominal)



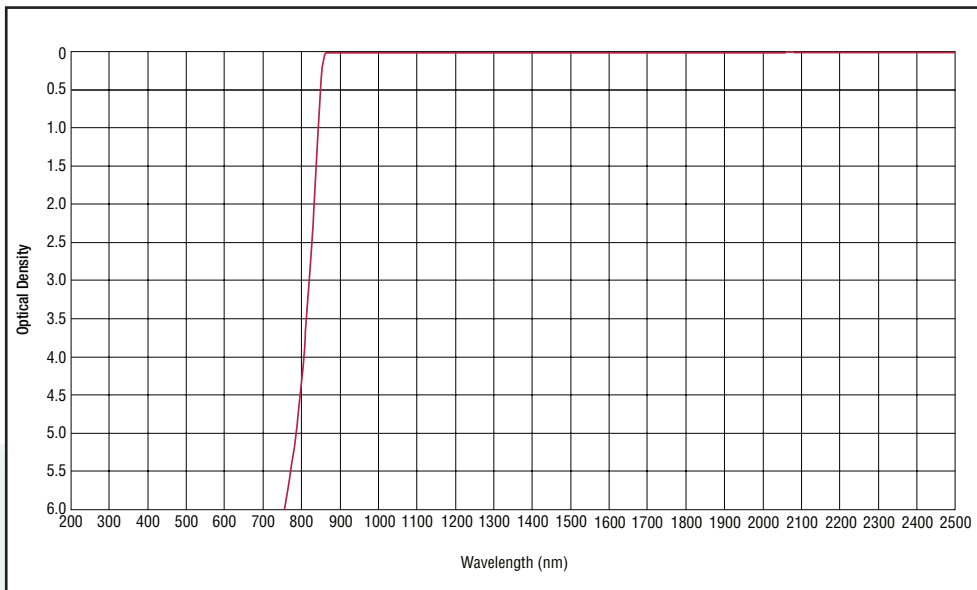
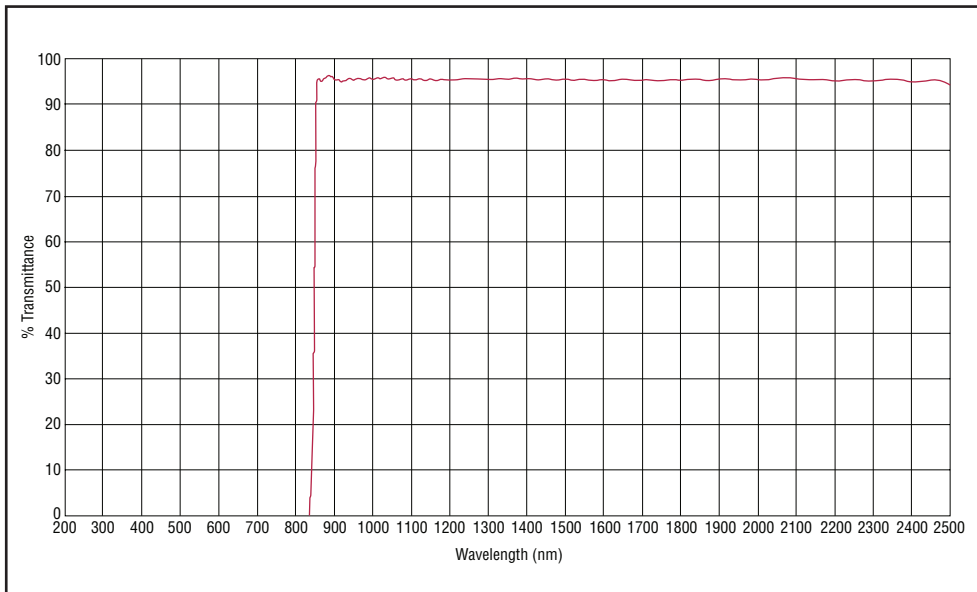
Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)
200	<0.0001	580	<0.0001	816	1.52	980	95.79
210	<0.0001	590	<0.0001	817	1.90	990	95.79
220	<0.0001	600	<0.0001	818	2.44	1000	95.89
230	<0.0001	610	<0.0001	819	3.19	1010	95.90
240	<0.0001	620	<0.0001	820	4.26	1020	95.87
250	<0.0001	630	<0.0001	821	5.77	1030	95.55
260	<0.0001	640	<0.0001	822	7.86	1040	95.43
270	<0.0001	650	<0.0001	823	10.66	1050	95.30
280	<0.0001	660	<0.0001	824	14.26	1060	95.80
290	<0.0001	670	<0.0001	825	18.64	1070	95.44
300	<0.0001	680	<0.0001	826	23.71	1080	95.79
310	<0.0001	690	<0.0001	827	29.41	1090	95.55
320	<0.0001	700	<0.0001	828	35.78	1100	95.49
330	<0.0001	710	<0.0001	829	42.96	1110	95.75
340	<0.0001	720	<0.0001	830	51.06	1120	95.87
350	<0.0001	730	<0.0001	831	60.01	1130	95.55
360	<0.0001	740	0.0001 (OD6)	832	69.38	1140	95.43
370	<0.0001	750	0.0003	833	78.24	1150	95.30
380	<0.0001	760	0.0007	834	85.90	1160	95.80
390	<0.0001	770	0.0010 (OD5)	835	91.33	1170	95.44
400	<0.0001	780	0.0044	836	94.51	1180	95.31
410	<0.0001	790	0.0174	837	95.89	1190	95.55
420	<0.0001	800	0.0675	838	96.15	1200	95.67
430	<0.0001	801	0.0784	839	95.92	1300	95.49
440	<0.0001	802	0.0932	840	95.62	1400	95.59
450	<0.0001	803	0.1134	850	95.06	1500	95.57
460	<0.0001	804	0.1406	860	96.35	1600	95.52
470	<0.0001	805	0.1768	870	96.06	1700	95.08
480	<0.0001	806	0.2238	880	96.00	1800	95.56
490	<0.0001	807	0.2829	890	95.21	1900	95.47
500	<0.0001	808	0.3542	900	94.81	2000	95.53
510	<0.0001	809	0.4363	910	95.65	2100	95.79
520	<0.0001	810	0.5276	920	95.66	2200	95.27
530	<0.0001	811	0.6278	930	95.41	2300	95.34
540	<0.0001	812	0.7498	940	95.74	2400	95.18
550	<0.0001	813	0.7400	950	95.56	2500	94.99
560	<0.0001	814	1.03	960	95.56		
570	<0.0001	815	1.24	970	95.61		

Transmittance and Optical Density data are nominal values provided as a reference to indicate typical spectral response.

CGA-850

Spectral Performance Data - CGA-850

Cut-on Wavelength at 50% Absolute Transmittance	850 ± 8 nm
Cut-on Wavelength at 90% Absolute Transmittance	≤870 nm
Cut-on Wavelength at OD5	≥775 nm
Effective Index of Refraction	1.80 (nominal)



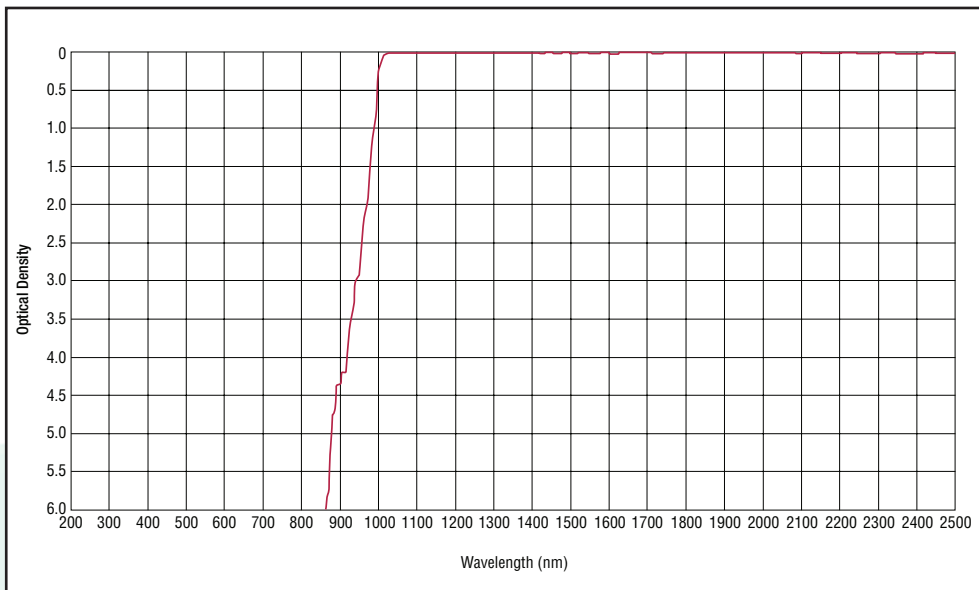
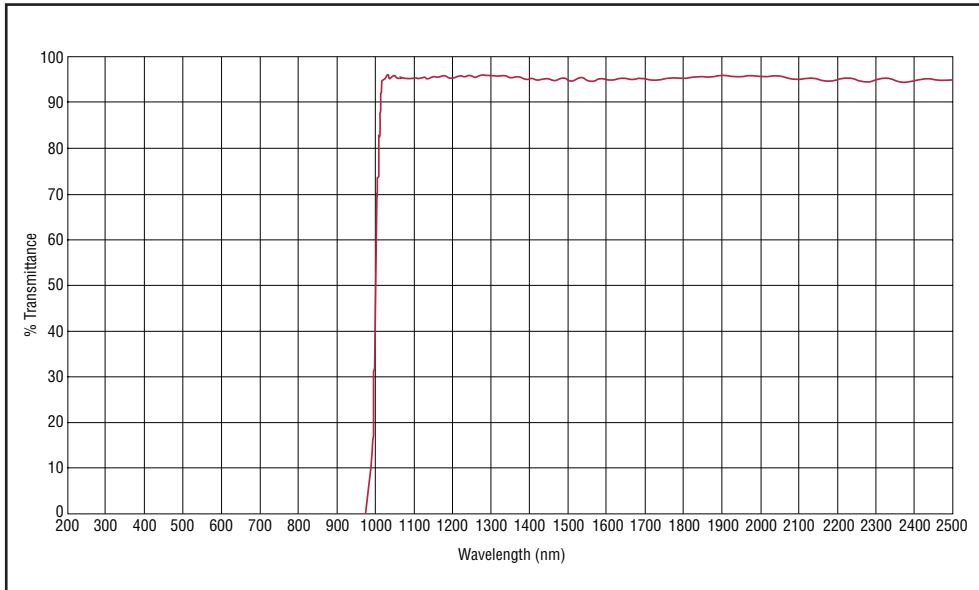
Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)
200	<0.0001	580	<0.0001	834	1.36	980	95.55
210	<0.0001	590	<0.0001	835	1.76	990	95.86
220	<0.0001	600	<0.0001	836	2.30	1000	95.54
230	<0.0001	610	<0.0001	837	3.02	1010	95.91
240	<0.0001	620	<0.0001	838	3.97	1020	95.80
250	<0.0001	630	<0.0001	839	5.17	1030	96.09
260	<0.0001	640	<0.0001	840	6.60	1040	95.74
270	<0.0001	650	<0.0001	841	8.24	1050	95.90
280	<0.0001	660	<0.0001	842	10.10	1060	95.53
290	<0.0001	670	<0.0001	843	12.21	1070	95.54
300	<0.0001	680	<0.0001	844	14.71	1080	95.61
310	<0.0001	690	<0.0001	845	17.79	1090	95.50
320	<0.0001	700	<0.0001	846	21.73	1100	95.77
330	<0.0001	710	<0.0001	847	26.87	1110	95.49
340	<0.0001	720	<0.0001	848	33.55	1120	95.72
350	<0.0001	730	<0.0001	849	42.05	1130	95.53
360	<0.0001	740	<0.0001	850	52.29	1140	95.45
370	<0.0001	750	0.0001 (OD6)	851	63.56	1150	95.75
380	<0.0001	760	0.0002	852	74.50	1160	95.37
390	<0.0001	770	0.0003	853	83.57	1170	95.42
400	<0.0001	780	0.0010 (OD5)	854	89.83	1180	95.68
410	<0.0001	790	0.0019	855	93.41	1190	95.48
420	<0.0001	800	0.0057	856	95.06	1200	95.53
430	<0.0001	810	0.0235	857	95.64	1300	95.75
440	<0.0001	820	0.0943	858	95.78	1400	95.64
450	<0.0001	821	0.1174	859	95.79	1500	95.70
460	<0.0001	822	0.1463	860	95.80	1600	95.55
470	<0.0001	823	0.1813	870	95.37	1700	95.37
480	<0.0001	824	0.2218	880	96.06	1800	95.37
490	<0.0001	825	0.2670	890	96.21	1900	95.56
500	<0.0001	826	0.3163	900	95.75	2000	95.52
510	<0.0001	827	0.3705	910	95.53	2100	95.62
520	<0.0001	828	0.4316	920	95.10	2200	95.18
530	<0.0001	829	0.5041	930	95.33	2300	95.12
540	<0.0001	830	0.5941	940	95.84	2400	94.94
550	<0.0001	831	0.7104	950	95.39	2500	94.25
560	<0.0001	832	0.8651	960	95.81		
570	<0.0001	833	1.07	970	95.68		

Transmittance and Optical Density data are nominal values provided as a reference to indicate typical spectral response.

CGA-1000

Spectral Performance Data - CGA-1000

Cut-on Wavelength at 50% Absolute Transmittance	1000 ± 9 nm
Cut-on Wavelength at 90% Absolute Transmittance	≤1035 nm
Cut-on Wavelength at OD5	≥860 nm
Effective Index of Refraction	1.76 (nominal)



Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)	Wavelength (nm)	Transmission (%)
200	<0.0001	580	<0.0001	960	0.5250	1025	95.41
210	<0.0001	590	<0.0001	970	1.06	1026	95.61
220	<0.0001	600	<0.0001	980	4.95	1027	95.82
230	<0.0001	610	<0.0001	990	11.87	1028	96.02
240	<0.0001	620	<0.0001	991	13.18	1029	96.17
250	<0.0001	630	<0.0001	992	14.88	1030	96.24
260	<0.0001	640	<0.0001	993	17.08	1040	95.50
270	<0.0001	650	<0.0001	994	19.90	1050	96.09
280	<0.0001	660	<0.0001	995	23.45	1060	95.53
290	<0.0001	670	<0.0001	996	27.84	1070	95.60
300	<0.0001	680	<0.0001	997	33.10	1080	95.59
310	<0.0001	690	<0.0001	998	39.12	1090	95.45
320	<0.0001	700	<0.0001	999	45.59	1100	95.72
330	<0.0001	710	<0.0001	1000	52.03	1110	95.43
340	<0.0001	720	<0.0001	1001	57.89	1120	95.82
350	<0.0001	730	<0.0001	1002	62.75	1130	95.51
360	<0.0001	740	<0.0001	1003	66.47	1140	95.59
370	<0.0001	750	<0.0001	1004	69.21	1150	95.95
380	<0.0001	760	<0.0001	1005	71.31	1160	95.71
390	<0.0001	770	<0.0001	1006	73.12	1170	95.05
400	<0.0001	780	<0.0001	1007	74.93	1180	96.08
410	<0.0001	790	<0.0001	1008	76.92	1190	95.73
420	<0.0001	800	<0.0001	1009	79.16	1200	95.56
430	<0.0001	810	<0.0001	1010	81.63	1300	96.13
440	<0.0001	820	<0.0001	1011	84.24	1400	95.50
450	<0.0001	830	<0.0001	1012	86.85	1500	95.17
460	<0.0001	840	<0.0001	1013	89.29	1600	95.27
470	<0.0001	850	<0.0001	1014	91.41	1700	95.41
480	<0.0001	860	0.0001 (OD6)	1015	93.10	1800	95.53
490	<0.0001	870	0.0010 (OD5)	1016	94.30	1900	96.17
500	<0.0001	880	0.0019	1017	95.05	2000	95.92
510	<0.0001	890	0.0035	1018	95.42	2100	95.31
520	<0.0001	900	0.0046	1019	95.51	2200	95.25
530	<0.0001	910	0.0063	1020	95.44	2300	95.18
540	<0.0001	920	0.0116	1021	95.32	2400	95.01
550	<0.0001	930	0.0377	1022	95.23	2500	95.26
560	<0.0001	940	0.0956	1023	95.20		
570	<0.0001	950	0.1351	1024	95.27		

Transmittance and Optical Density data are nominal values provided as a reference to indicate typical spectral response.

Custom Capability

As was noted in the introduction to this catalog, Newport’s Colored-Glass Alternative filters were originally developed for custom and OEM applications either as alternatives to a Colored-Glass filter that utilized non-RoHS compliant material in its formulation, as replacements of a Colored-Glass filter that had been discontinued by one of the major Colored-Glass filter manufacturers, or as a new product to fill a gap in the wavelength offering of the major Colored-Glass filter manufacturers. The versatility of our coating processes

and equipment support our ability to offer unlimited combinations of wavelength, size, shape, thickness, optical figure, surface quality, etc..In the table that follows, we have listed some of the principle capability specifications for CGA filters. Please provide your detailed requirements to our technical sales team and allow us to engineer the exact solution to meet your application.

Capability Specifications

RoHS Status	Fully compliant (without 4-year exemption granted to non-compliant colored-glass filters)
Passband Transmittance	≥90% average (typical)
Cut-on Wavelength Availability	300 - 1000 nm
Spectral Blocking	≥ 5 OD
Surface Quality	F/F (80/50) per MIL-F-48616 (typical)
Coating Hardness	MIL-C-48497
Coating Abrasion Resistance	MIL-C-48497
Coating Adhesion	MIL-C-48497
Coating Humidity Resistance	MIL-STD-810, Method 507.3, Procedure III, Modified to 40 cycles
Coating Operating Temperature Range	-100 ° C to 400 ° C
Chemical Resistance	SR Class 1.0 per ISO 8424
Filter Size Range	1.0 mm sq. to 380 mm dia.
Filter Thickness	1.1 mm (typical)

Stabilife Coating Technology

Newport's Colored-Glass Alternative filters are manufactured using our patented Stabilife coating technology. Some of the key features and benefits of this technology are provided in the paragraphs that follow.



Newport's Stabilife Reactive Ion Plating Deposition System

Stabilife optical filters and coatings are manufactured using two patented processes for the deposition of metal oxide thin film optical coatings; Reactive Ion Plating (RIP) and Hybrid Plasma Enhanced Deposition (HPED). Both processes yield highly dense, thin film coatings with extraordinary hardness, abrasion resistance, and adhesion to the substrate. Our Stabilife processes have been in full-scale production at our Corion coating facility in Franklin, Massachusetts since the early 1990's.

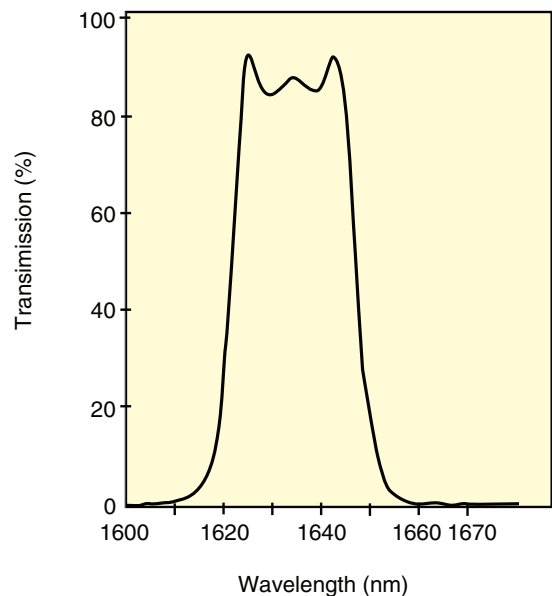
Spectral Stability

Optical components which directly affect the spectral performance of an optical system must be able to deliver repeatable and accurate wavelength vs transmission response, regardless of the operating conditions. In some applications, un-stabilized metal oxide optical coatings or laminated soft-film coatings are adequate to meet the required performance parameters. However, for some of the more demanding applications such as fluorescence detection, wavelength stability is absolutely critical to insure dependable results. Stabilife optical filters and coatings provide the solution for these high accuracy applications.

Film Density & Spectral Stability

Film density is a critical factor affecting the spectral stability of an optical coating. Un-stabilized metal oxide thin film coatings typically exhibit a significantly lower packing density than Stabilife coatings. This occurs as a result of the intrinsic growth properties of the coating materials when deposited using methods which do not enhance film densification. The film structure of un-stabilized metal oxide film tends to be columnar with a significant number of voids. The presence of these voids contributes to the occurrence of environmentally induced spectral shift in un-stabilized external coatings. Changes in wavelength, which are influenced by the presence of voids, tend to be elastic in nature and depend upon the ambient relative humidity in which the coating is being used. The permeability of the film will determine the degree to which this phenomenon will occur. Spectral shifts in the range of 2-5% of wavelength are typical of un-stabilized metal oxide coatings. Stabilife coatings have a higher packing density and lower void ratio than un-stabilized metal oxide coatings and are therefore less affected by water absorption. They typically exhibit total wet-to-dry shifts of less than 0.02% of wavelength.

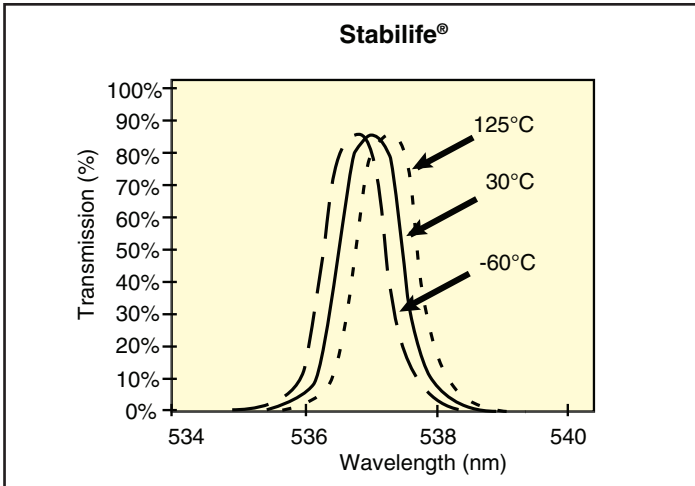
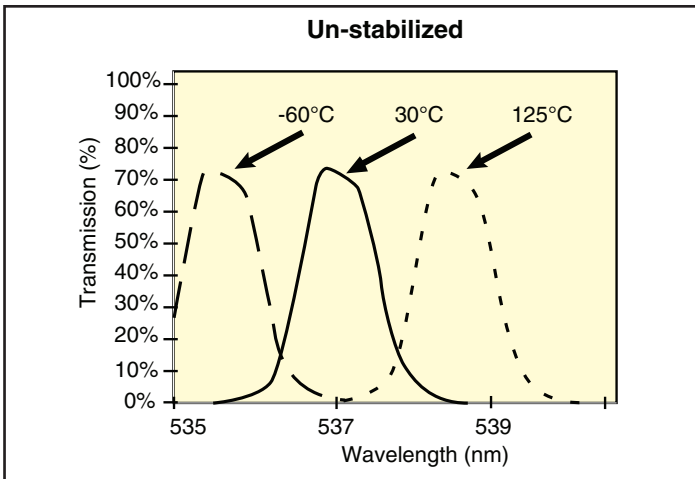
Humidity Stability of Stabilife Filters



Measured transmittance scans of a Stabilife filter at 0% and 100% relative humidity. Scans are exactly overlaid as no shift is discernable at the standard scan speed for a 30nm bandwidth filter.

Thermal Properties & Spectral Stability

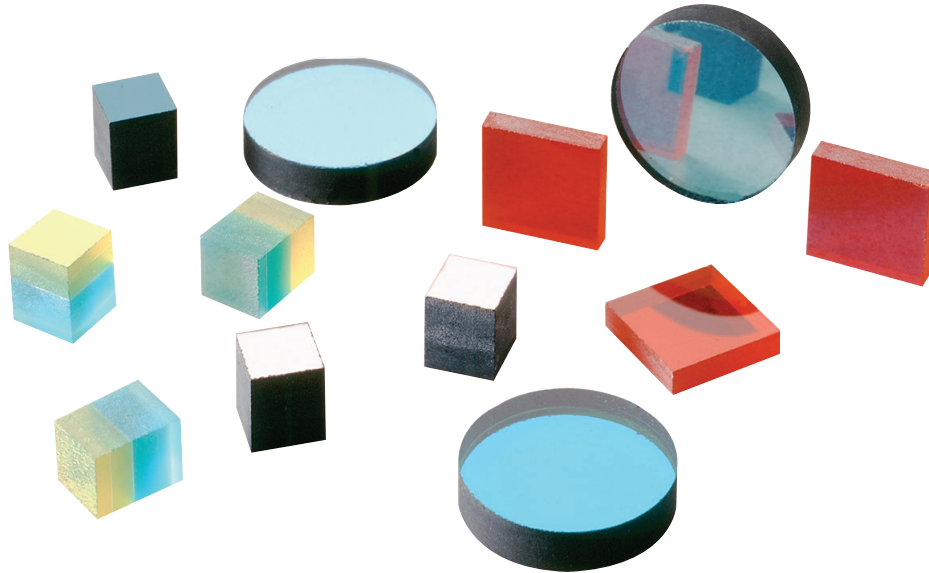
Stabilife films are typically 5 to 10 times less sensitive to thermal variation than un-stabilized metal oxide films as a result of film densification. Temperature change functions as a catalyst for moisture migration in thin films having a significant volume of voids. When un-stabilized films are exposed to high temperatures, moisture migrates out of film voids contributing to the wavelength change discussed earlier. The high film density and reduced permeability resulting from the Stabilife processes reduces this effect providing the maximum spectral stability available for all types of precision coatings including bandpass, dichroic, edge, notch and polarizer coatings.



Measured temperature-induced wavelength shift of an un-stabilized metal oxide ultra-narrow bandpass filter compared to a Stabilife ultra-narrow bandpass filter.

Physical Durability

Stabilife thin-film optical coatings have demonstrated excellent resistance to damage due to handling, extreme nuclear and optical radiation, and severe environmental conditions. In the most severe applications, such as autoclave immersed nuclear reactor monitoring, Stabilife filters have demonstrated spectrally stable performance lifetimes exceeding 8,000 hours. Stabilife filters have been qualified for telecommunications applications per the requirements of Telcordia GR-2883. While most applications are much less demanding than these, the same robust coatings as are required for extreme applications are routinely supplied for all Stabilife products. In the course of normal production, Stabilife films are tested for adhesion using the snap tape test specified in MIL-C-48497, for abrasion resistance using the eraser test specified in MIL-C-675, and for humidity resistance using the aggravated test specified in MIL-STD-810E. Stabilife thin-film optical coatings require no additional protection such as hermetic sealing using lamination or other processes, to achieve their exceptional durability.



Typical Stabilife General Specifications

Spectral Range	200 nm to 3.0 μm
Surface Quality	F/F (80/50) per MIL-F-48616 (typical); D/C (40/20) or C/B (20/10) achievable
Coating Hardness	MIL-C-48497
Coating Abrasion Resistance	MIL-C-48497
Coating Adhesion	MIL-C-48497
Coating Humidity Resistance	MIL-STD-810, Method 507.3, Procedure III, Modified to 40 cycles**
Coating Operating Temperature Range	-100 ° C to 300 ° C**
Filter Size Range	1 mm to 300 mm
Filter Thickness Range	0.5 mm to 20 mm

**The specifications for humidity resistance and coating operating temperature range listed above apply to exposed coatings only. Humidity resistance and operating temperature range of filters manufactured using Stabilife coatings and assembled using epoxy systems revert to the humidity resistance and operating temperature range of the epoxy system.

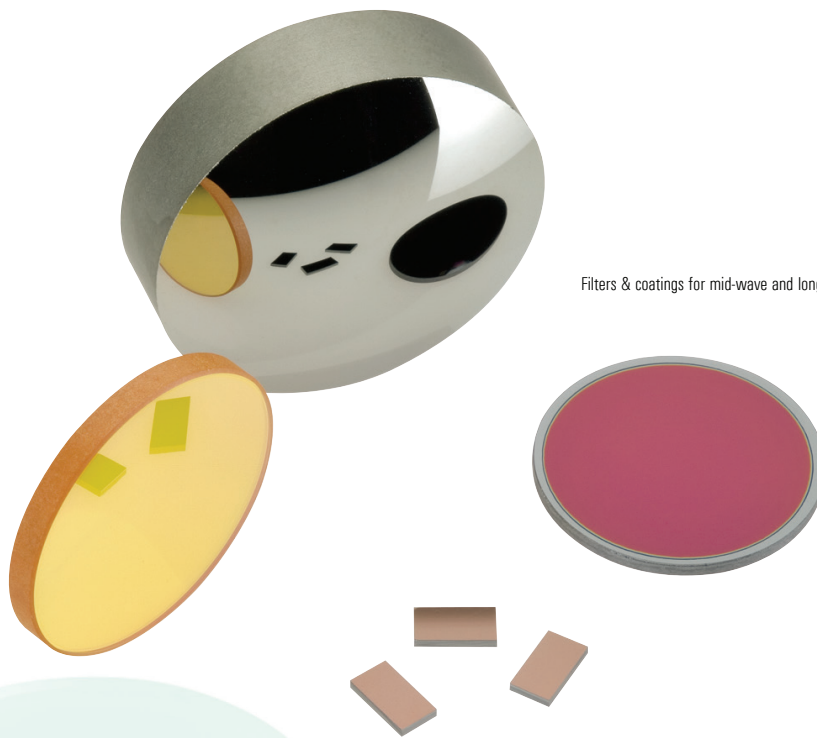
Newport's Optical Filters & Coatings History

Established in 1967, Newport's Franklin facility has been supplying Corion brand optical filters and coatings for more than 35 years. With the acquisition of Spectra-Physics® Lasers and Photonics, which included the Franklin coating facility, Newport significantly expanded its thin-film coating capability. In addition to the Irvine coating operations, we manufacture optical coatings in our, Rochester, NY, Santa Clara, CA, and Franklin, MA facilities. A significant portion of this coating capacity is devoted to vertically integrated manufacturing such as our inter-cavity laser optics coating facility, supporting our laser manufacturing operations, and our Rochester coating facility which supports diffraction grating manufacturing. Newport's Franklin facility is focused upon manufacturing optical filters and coatings for direct sale as components to OEMs and end-users.

Products

We manufacture a wide variety of products based upon thin-film coating technology. Our products span the spectrum from 150 nm to 16 μm . Our major product families include:

- Anti-reflection
- Bandpass
- Beamsplitter
- Conformal
- Dichroic
- Fluorescence
- Long/Short wave pass
- Metallic reflector
- Neutral density
- Notch



Filters & coatings for mid-wave and long-wave infrared applications

Applications

Our custom filters are the enabling optical technology in instruments ranging from DNA Analyzers to Desktop Printers. We collaborate with OEM instrument design engineers to define filters & coatings that will deliver optimum performance in their application. Below are just a few of the many applications where Newport filters and coatings are the preferred choice:

- Clinical Chemistry Systems
- DNA Analysis Systems
- Rangefinders
- Laser Safety Eyewear
- Paint Color Matching Systems
- Thermal Imaging Systems
- Confocal Microscopy Systems
- Flow Cytometers
- Environmental Monitoring Systems
- Endoscopes
- Moisture Measurement Systems

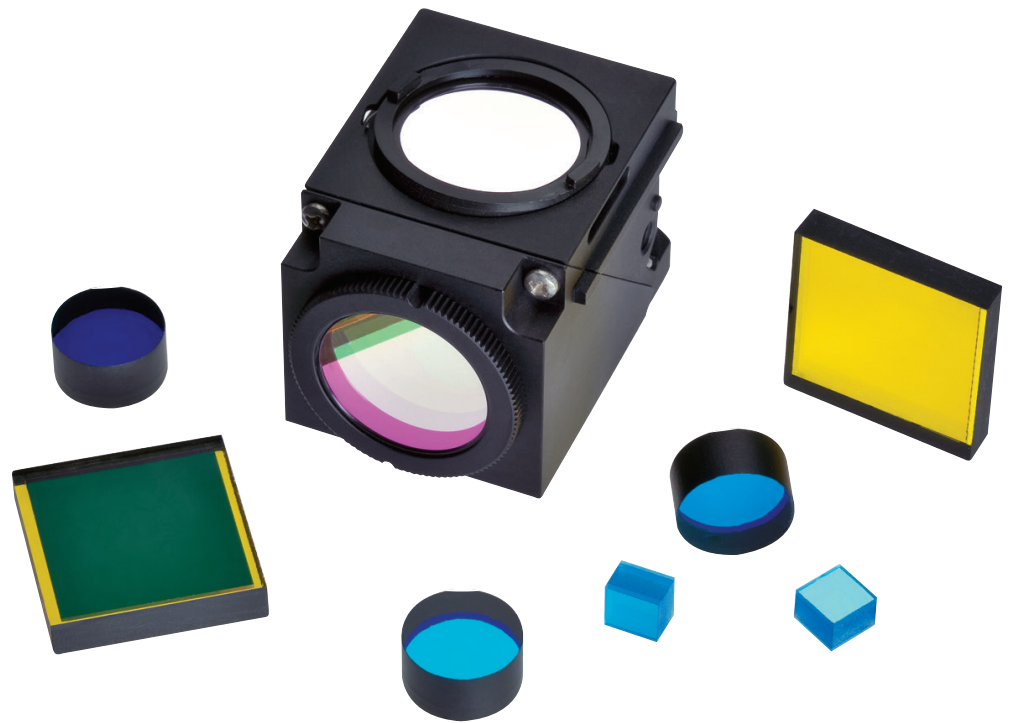


Filter wheels for clinical chemistry analyzers



Manufacturing / Inspection

We process orders for quantities as large as one million and as small as one and we maintain one of the highest customer satisfaction ratings in the process. We have coating chambers that coat 1 – 6” square plate at a time and chambers that coat 16 – 6” squares at a time. We coat a wide variety of substrates including optical glasses, semiconductors, and crystals in a full range of shapes containing plano, spherical, and aspherical surfaces. To insure that our products perform to the high standards required by today’s sophisticated technologies, we maintain inspection capabilities that allow us to perform high precision spectral measurements from 150 nm to 30 μm , as well as measurements of physical, optical and environmental parameters ranging from humidity resistance to transmitted wavefront error.



Filters for fluorescence detection

Precision Optics

Newport's precision optics manufacturing operation, located in Irvine, CA, provides a comprehensive fabrication capability for plano, spherical and aspherical optics in a wide variety of transmissive materials ranging from Fused silica for Ultraviolet optics to II-IV materials for infrared optics, as well as metals for reflective optics. Our fabrication processes include traditional grinding and polishing, diamond machining, and Magnetorheological Finishing. To support our optics fabrication, we maintain a large array of optical metrology equipment which allows us to test for wavefront distortion, focal length, MTF, wedge, and surface roughness. We fabricate optics ranging from 10 mm to 250 mm in size, from 80/50 to 10/5 in surface quality, and from commercial flatness to $\lambda/40$. In addition to providing a wide variety of optics for our catalog product offering, high precision laser optics for our laser manufacturing, and large volume OEM optics, Newport's precision optics operation is the principal provider of spherical and aspherical optics for the Franklin coating operation.

Germanium and Zinc Selenide optics





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Optical Filters & Coating Technical Sales 800-598-6783 - filters.sales@newport.com