The Wamco night vision tool kit

Complete resources to

control NVIS lighting

in your application

Standard Optical Filters

Wamco
Aerospace and automotive lighting

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The Wamco night vision tool kit

Complete resources to control NVIS lighting in your application

Wamco offers all the services and products needed to control your NVIS lighting. We address simple to complex applications, from annunciators to full-color displays to the most demanding color specs. Tough challenges are not a problem.

The following page includes an overview of common NVIS applications and a selection of appropriate Wamco filters. Call us at 714-545-5560, and we can recommend a suitable filter from our many standard products or develop a custom solution.

The Wamco advantage

We were the first company to offer NVIS filtering solutions, more than 20 years ago, and we remain the industry leader, continually developing innovative technologies that increase performance and reduce cost. For example, we developed a new generation of polymeric materials for fast, cost-competitive implementation of day-to-day NVIS filtering requirements.

Count on Wamco tool kit filters for **high performance, short lead time,** and **very competitive pricing**.

We maintain complete control of our design and manufacturing processes, including in-house molding and fabrication, so you receive consistently reliable and cost-effective solutions without delay. Our customers rely on us to:

- Filter all light sources (incandescent, LED, phosphor, fluorescent, EL) and maintain high contrast and sunlight readability.
- Provide all NVIS colors: green, yellow, red, white, full-color displays, and custom specifications.
- Match the optimal substrate to every application from our proprietary series of polymeric, glass, and composite glass materials.
- Apply a variety of coatings and laminations to enhance filter performance for exact bandwidth specifications, ITO, and antireflectivity.
- Provide complete engineering support to evaluate problems and recommend or develop solutions.
- Ship quick-turn samples, prototypes, and production units from our in-house molding and fabrication facilities.
- Provide full QA capabilities, including complete optical testing for NVIS quantification.
- Provide cost-effective, value-added solutions for packaging light sources and filters.
- Wamco designs and manufactures to the following specifications: MIL-L-85762, MIL-STD-3009 and DO-275.

The Wamco night vision tool kit is a collection of standard Wamco NVG filters designed to satisfy common NVIS lighting applications. These filters use the latest in *polymeric* and *glass* technology leading to outstanding performance and compose the largest inventory of NVG filters found anywhere.

What is your application?

We can solve any NVIS lighting challenge. Here are three common application types and a selection of recommended Wamco filters. Detailed specification sheets follow, grouped by glass and composite filters, polymeric filters, lamp assemblies, and ring filters.

Understanding Wamco filter performance data

Source — Filters can be quantified with any reference source. Wamco supplies filter data with the actual source specified by your application. You get the assurance that the filter will meet your specifications.

Chromaticity — Color is controlled in terms of u', v', and r. In the case of incandescent filters, color varies as a function of Kelvin. Wamco filters are designed to provide a minimum color shift as Kelvin varies. For other sources, color is controlled by using the measured spectral energy of the actual application source.

Photopic transmittance (Y%) — Y% is a direct indication of the "brightness" of the filtered display as seen by the unaided eye. Using a photometer, Y% can be calculated by dividing the filtered display luminance by the unfiltered display luminance. The peak transmittance of the filter does not provide the same information.

NVIS performance — The Class-A (rotary wing) NVIS Radiance (**NRa**) and Class-B (fixed wing) NVIS Radiance (**NRb**) values are given at the MIL-L-85762A specified luminance levels. Wamco filters are offered with a much lower NR than the maximum allowable, to provide a "safety factor" for design and measurement. In addition, data for other NVIS performance indices are available.

T2B — The Illuminant B double pass transmittance (T2B) is an indicator of contrast used to determine daylight readability of filtered displays. T2B is defined as the transmittance resulting from a spectral energy distribution simulating sunlight (Illuminant B) that passes through the filter, reflects off a 100% reflectance standard, and transmits back through the filter. T2B should be minimized with respect to Y% for applications that require daylight readability. In general, if two filters have roughly identical Y%, the filter with the lower T2B will have higher contrast.

For more information or help in finding an NVIS lighting solution, please call us at 714-545-5560.

Wamco NV-2GAG-1 NVIS “Intruder” Green A glass filter for incandescent source

New

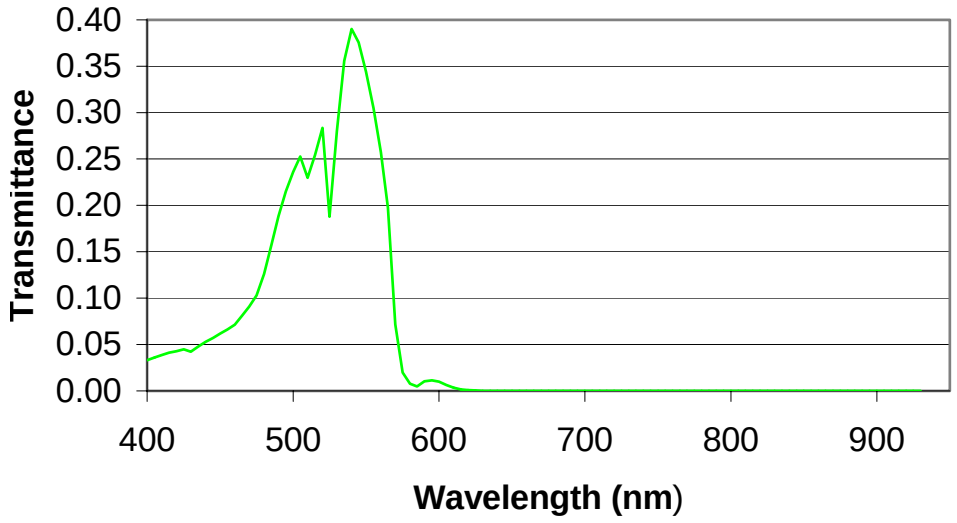
Applications

This cost-effective monolithic glass filter is ideal for high temperature applications.

Size

Cut to customer-specified dimensions in a standard thickness of 0.065-inches.

NV-2GAG-1



Typical performance

Source	Y%	u'	v'	NRa*	NRb*
2100 K	12	0.104	0.565	8E-11	5E-12
1800 K	10	0.108	0.569	9E-11	6E-12
T2B	6				

* Scaled to 0.1 fL.

NV-2GAG-1 rev 1

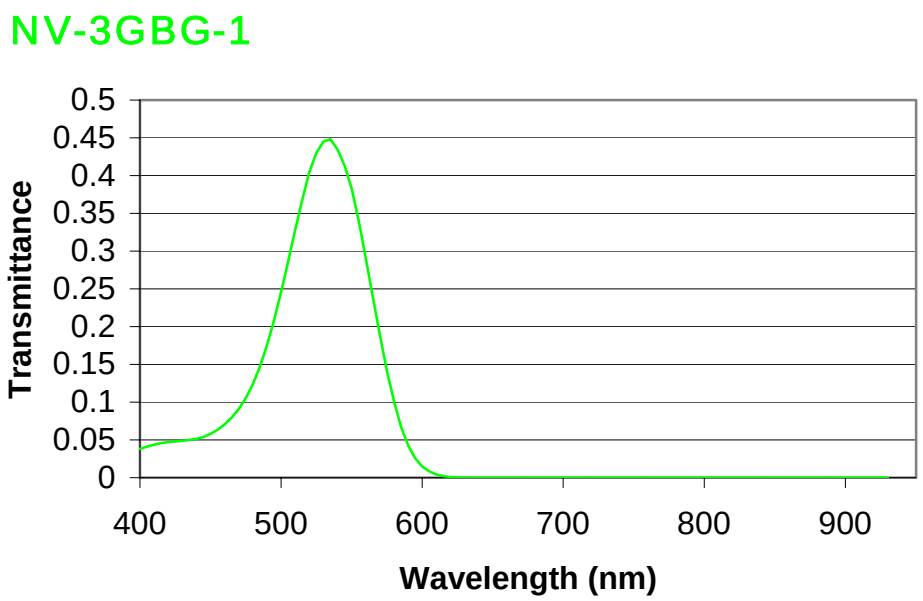
Wamco NV-3GBG-1 NVIS Green B glass filter for incandescent source

Applications

The high transmission and excellent color stability of this monolithic glass filter make it ideal for annunciators and indicator lights with incandescent light sources in NVIS Green B applications.

Size

Cut to customer-specified dimensions in a standard thickness of 0.08-inches.



Typical performance

Source	Y%	u'	v'	NRa*	NRb*
2100 K	16	0.119	0.568	9E-11	9E-12
1800 K	14	0.125	0.570	1E-10	2E-11
T2B	8				

* Scaled to 0.1 fL.

NV-3GBG-1 rev B

Wamco NV-3YLG-1 NVIS Yellow Class B glass filter for incandescent source

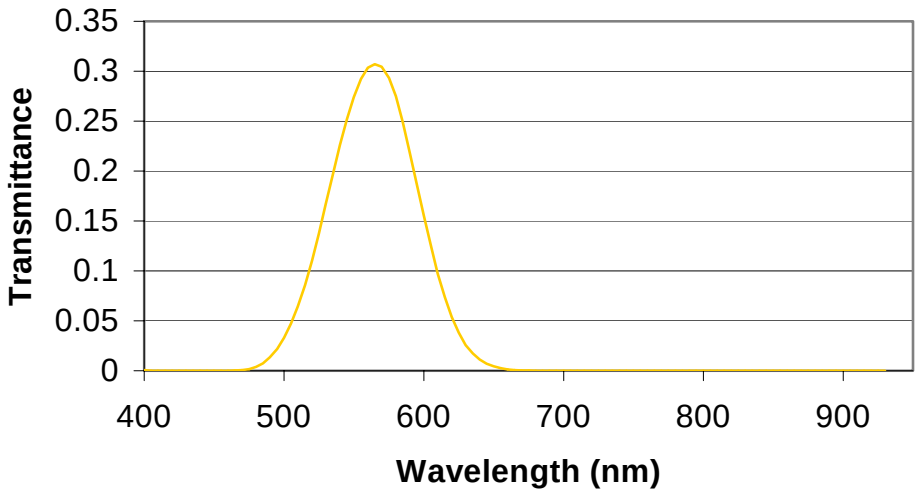
Applications

The high transmission and excellent color stability of this monolithic glass filter make it ideal for annunicators and indicator lights with incandescent light sources in Type I and Type II Class B NVIS Yellow applications.

Size

Cut to customer-specified dimensions in a standard thickness of 0.08-inches.

NV-3YLG-1



Typical performance

Source	Y%	u'	v'	NRa*	NRb*
2100 K	17.5	0.227	0.564	4E-7	6E-8
1800 K	16.8	0.238	0.563	5E-7	7E-8
T2B	4.5				

* Scaled to 15 fL.

NV-3YLG-1 rev C

Wamco NV-5RC-30 NVIS Red Class B composite filter for incandescent source

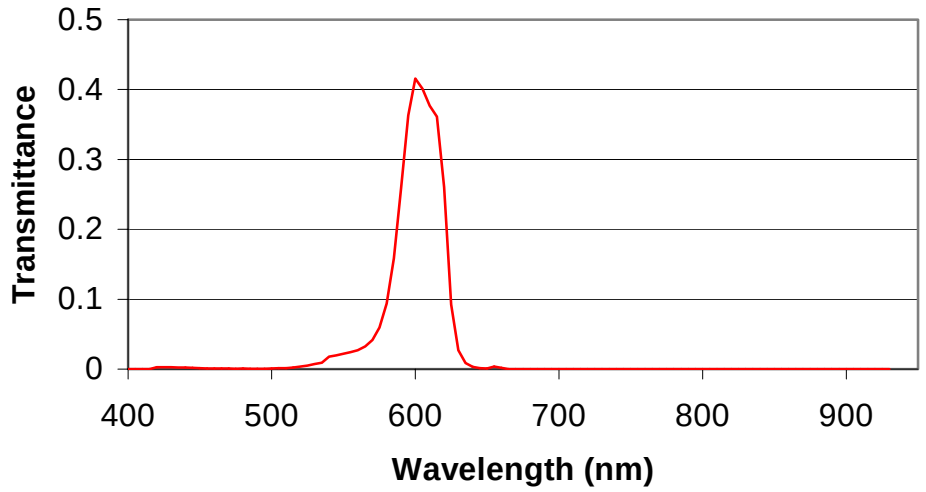
Applications

The high transmission and excellent color stability of this composite glass filter make it ideal for annunciators and indicator lights with incandescent light sources in NVIS Red applications.

Size

Cut to customer-specified dimensions in a standard thickness of 0.12-inches.

NV-5RC-30



Typical performance

Source	Y%	u'	v'	NRa*	NRb*
2100 K	11	0.409	0.538	2.6E-6	9.0E-8
1800 K	12	0.416	0.537	3.0E-6	1.1E-7
T2B	7.6				

* Scaled to 15 fL.

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Wamco NV-4AMG NVIS White glass filter for incandescent source

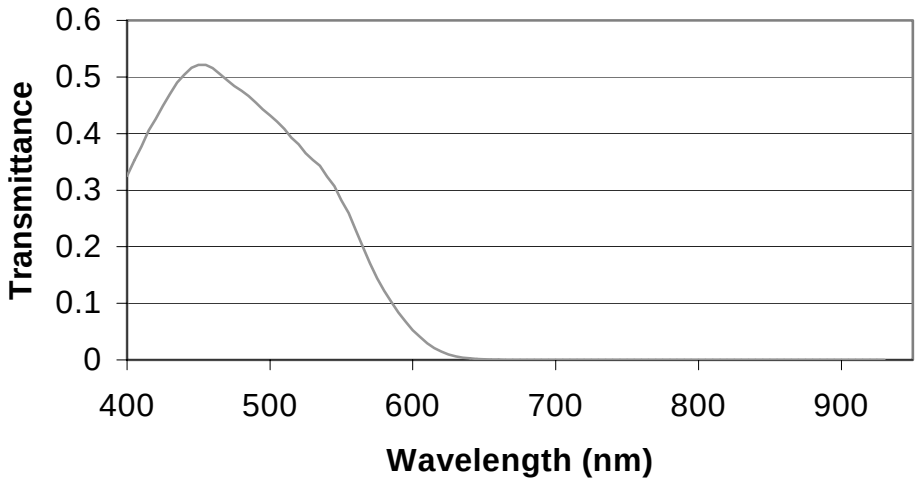
Applications

The high transmission and excellent color stability of this monolithic glass filter make it ideal for flashlights, map lights, annunciators, and indicator lights with incandescent light sources in NVIS White applications.

Size

Cut to customer-specified dimensions in a standard thickness of 0.12-inches.

NV-4AMG



Typical performance

Source	Y%	u'	v'	NRa*	NRb*
2100 K	16	0.142	0.524	7E-10	1E-10
1800 K	14	0.152	0.539	9E-9	1.3E-10

*** Scaled to 0.1 fL.**

NV-4AMG rev B

Wamco FA1 NVIS Green A polymeric filter for incandescent source

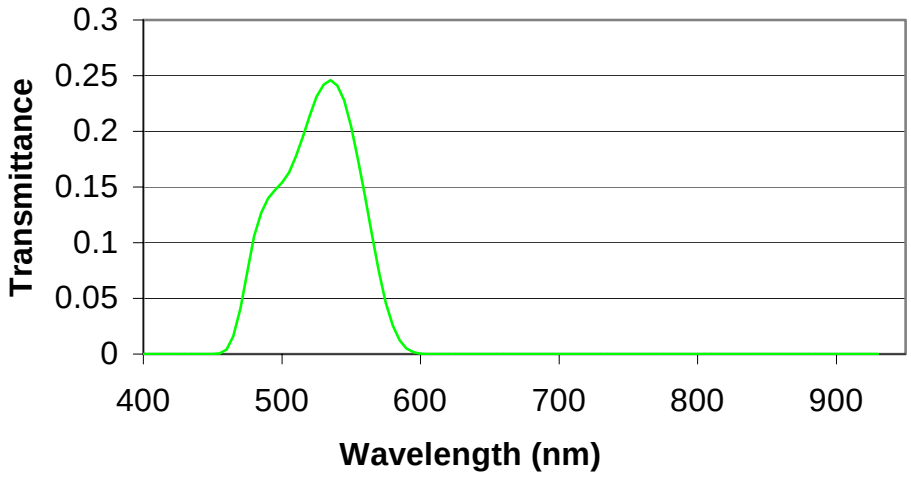
Applications

This polymeric material provides cost-effective NVIS Green A filtering of incandescent light sources in LCD backlights, annunciators, and indicator lights.

Size

Cut to customer-specified dimensions in a standard thickness of 0.043-inches.

FA1



Typical performance

Source	Y%	u'	v'	NRa*	NRb*
2100 K	8.0	0.100	0.571	7E-11	3E-11
1800 K	7.0	0.105	0.573	9E-11	5E-11
T2B	2.2				

* Scaled to 0.1 fL.

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Wamco GA2 NVIS Green A polymeric filter for incandescent source

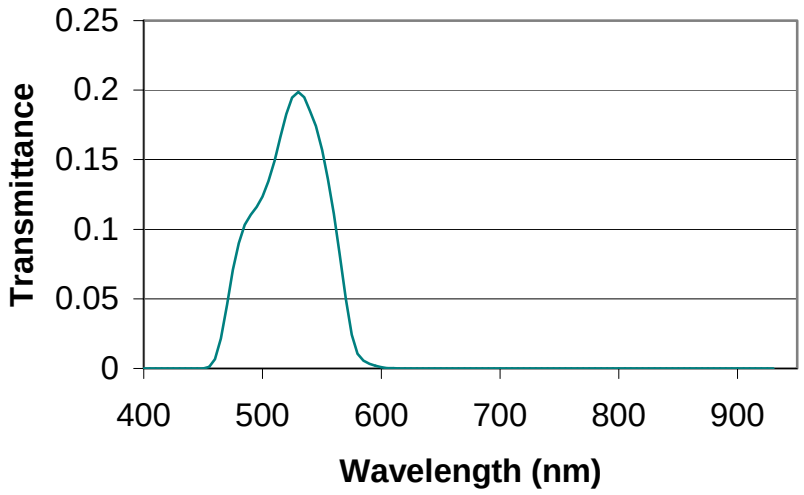
Applications

This polymeric material serves as a cost-effective NVIS Green A filter for high-contrast MS-25041 and MS-25331 press-to-test indicators and other annunciators with incandescent light sources.

Size

Cut to customer-specified dimensions in a standard thickness of 0.088-inches.

GA2



Typical performance

Source	Y%	u'	v'	NRa*	NRb*
2100 K	6	0.095	0.570	6E-11	2E-11
1800 K	5.3	0.100	0.572	8E-11	4E-11
T2B	1.4				

* Scaled to 0.1 fL.

GA2 rev B

Wamco FY1 NVIS Yellow polymeric filter for incandescent source

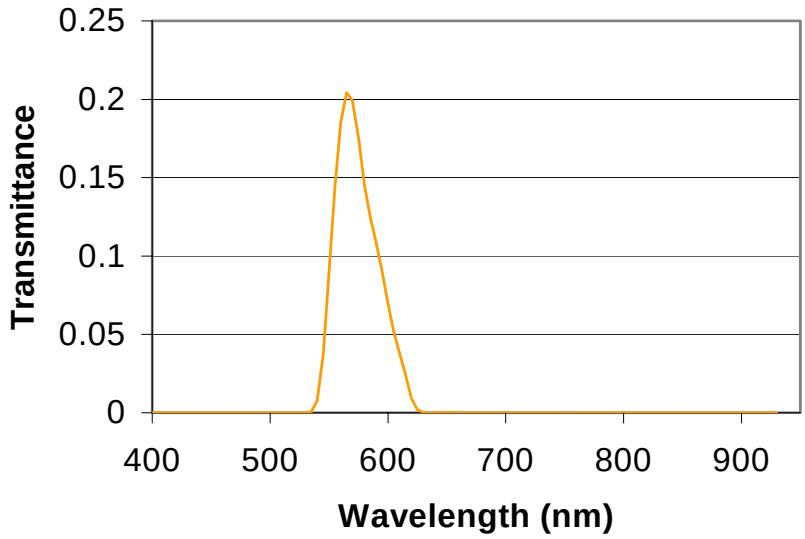
Applications

NVIS Yellow indicators for Type I and Type II Class B and Class A applications.

Size

Cut to customer-specified dimensions in a standard thickness of 0.062-inches.

FY1



Typical performance

Source	Y%	u’	v’	NRa*	NRb*
2100 K	7.5	0.244	0.563	1.0E-7	7.1E-9
1800 K	7.3	0.249	0.562	1.1E-7	8.4E-9

*Scaled to 15.0 fL.

FY1 rev C

Wamco LA1 NVIS Green A polymeric filter for white LEDs

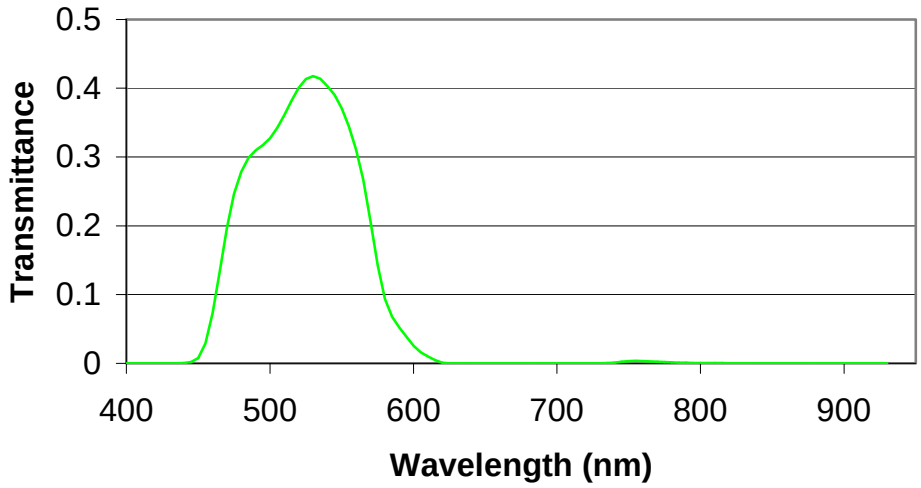
Applications

This polymeric material is optimized for NVIS Green A filtering of white LED light sources such as LCD backlights, annunciators, and indicator lights.

Size

Cut to customer-specified dimensions in a standard thickness of 0.043-inches.

LA1



Typical performance

Source	Y%	u'	v'	NRa*	NRb*
White LED (x=0.33 y=0.33)	23	0.114	0.542	9E-11	2E-11
Green LED (x=0.22 y=0.70)	38	0.065	0.579	3.3E-11	5E-12

* Scaled to 0.1 fL.

Wamco LA2 NVIS Green A polymeric filter for white LEDs

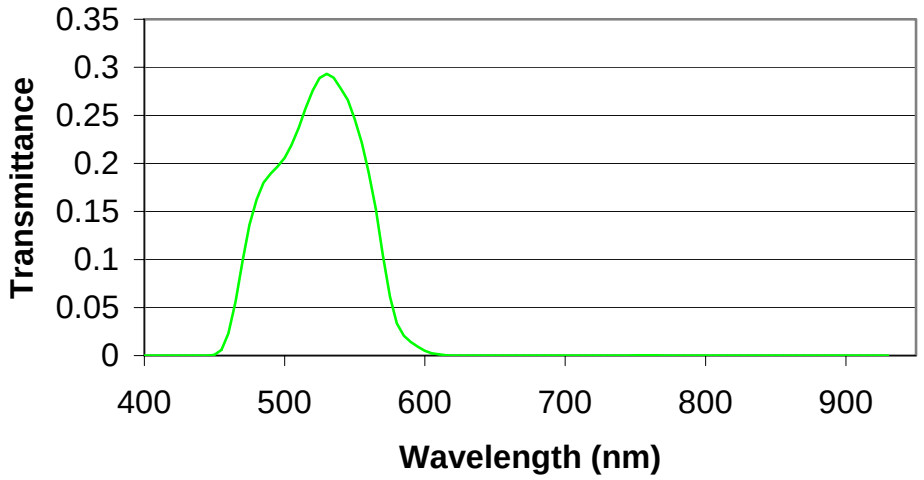
Applications

This polymeric material is optimized for NVIS Green A filtering of white LED light sources such as LCD backlights, annunciators, and indicator lights.

Size

Cut to customer-specified dimensions to a standard thickness of 0.063-inches.

LA2



Typical performance

Source	Y%	u'	v'	NRa*	NRb*
White LED (x=0.33 y=0.33)	14	0.101	0.552	5E-11	6E-12
Green LED (x=0.22 y=0.70)	25	0.062	0.580	3E-11	3E-12

* Scaled to 0.1 fL.

Wamco LB1 NVIS Green B polymeric filter for white LEDs

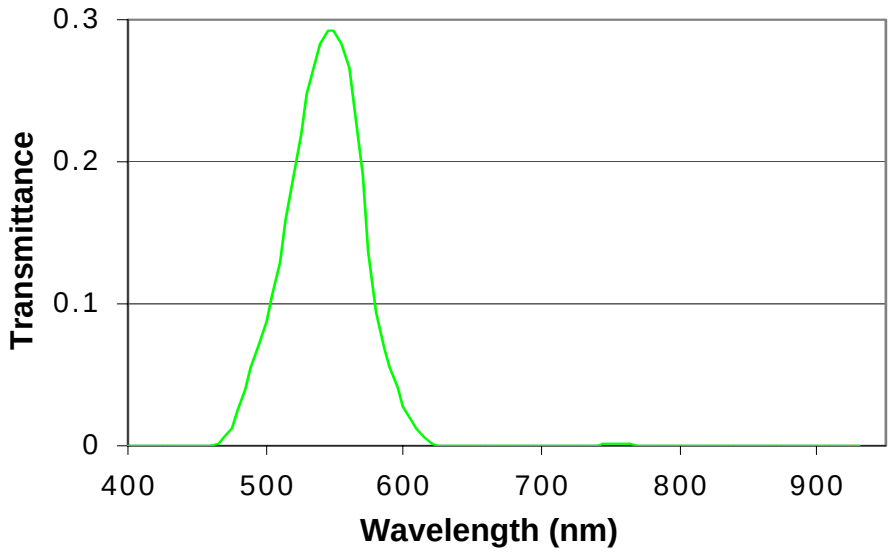
Applications

This polymeric material serves as a cost-effective NVIS Green B filter while providing excellent NVG compatibility with good transmission and contrast. This filter will yield Green B chromaticity regardless of white LED color bin selection.

Size

Cut to customer-specified dimensions in a standard thickness of 0.043-inches.

LB1



Typical performance

Source	Y%	u'	v'	NRa*	NRb*
White LED	15	0.129	0.574	9E-11	1E-11

* Scaled to 0.1 fL.

LB1 rev B

Wamco WY1 NVIS Yellow Class B polymeric filter for white LEDs

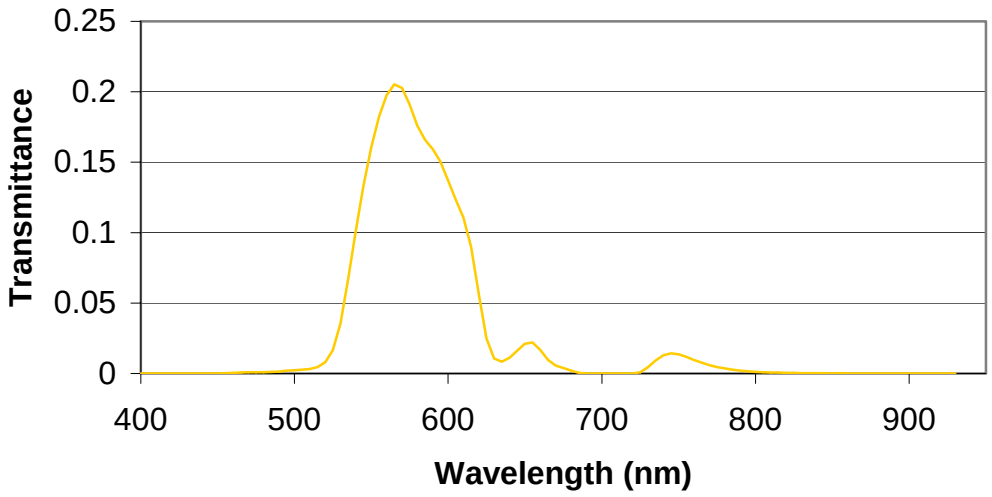
Applications

This filter offers cost-effective NVIS Yellow Class B Type I and Type II compliant filtering of white LED light sources on annunciators and indicator lights, and has a low T2B factor for better daylight readability. For NVIS Yellow Class A Type I and Type II, and Class B Type II, compliant filtering of white LED source light, refer to Wamco WY2 (page 1.13).

Size

Cut to customer-specified dimensions in a standard thickness of 0.063-inches.

WY1



Typical performance

Source	Y%	u'	v'	NRa*	NRb*
White LED	12	0.224	0.565	3E-7	1.1E-7
(x=0.33 y=0.33)					
T2B	1.9				

* Scaled to 15.0 fL.

WY1 rev C

Wamco WY2 NVIS Yellow polymeric filter for white LEDs

New

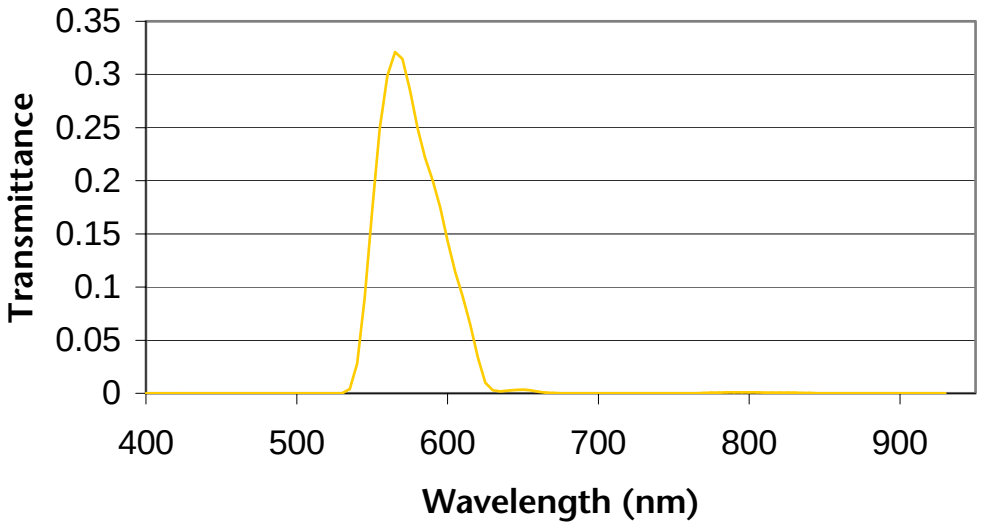
Applications

Optimized for filtering of white LEDs to NVIS Yellow Class A Type I and Type II, and Class B Type II.

Size

Cut to customer-specified dimensions in a standard thickness of 0.043-inches.

WY2



Typical performance

Source	Y%	u'	v'	NRa*	NRb*
White LED	14	0.226	0.566	1E-7	1.1E-8

* Scaled to 15.0 fL.

Wamco FR1 NVIS Red polymeric filter for incandescent and LEDs

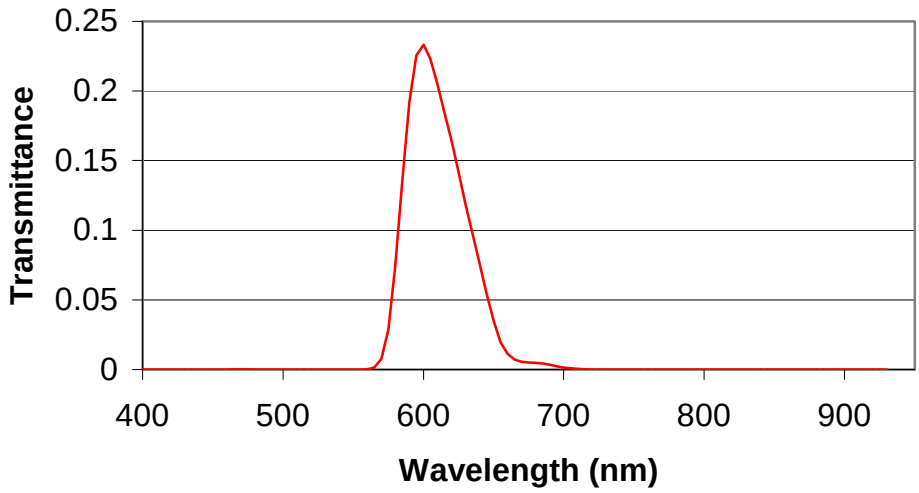
Applications

NVIS Red indicators for “compliant“ Class B and “compatible” Class A applications outperform MIL-L-85762A Class B compliant filters when used in a Class A environment.

Size

Cut to customer-specified dimensions in a standard thickness of 0.043-inches.

FR1



Typical performance

Source	Y%	u'	v'	NRa*	NRb*
2100 K	8	0.424	0.536	4E-6	1E-6
1800 K	8	0.429	0.536	5E-6	2E-6
Red LED**	19	0.436	0.535	5E-8	5E-9

* Scaled to 15.0 fL.

** Recommended 610 nm peak LED

FR1 rev A

Wamco LW1 NVIS White polymeric filter for white LEDs

Preliminary

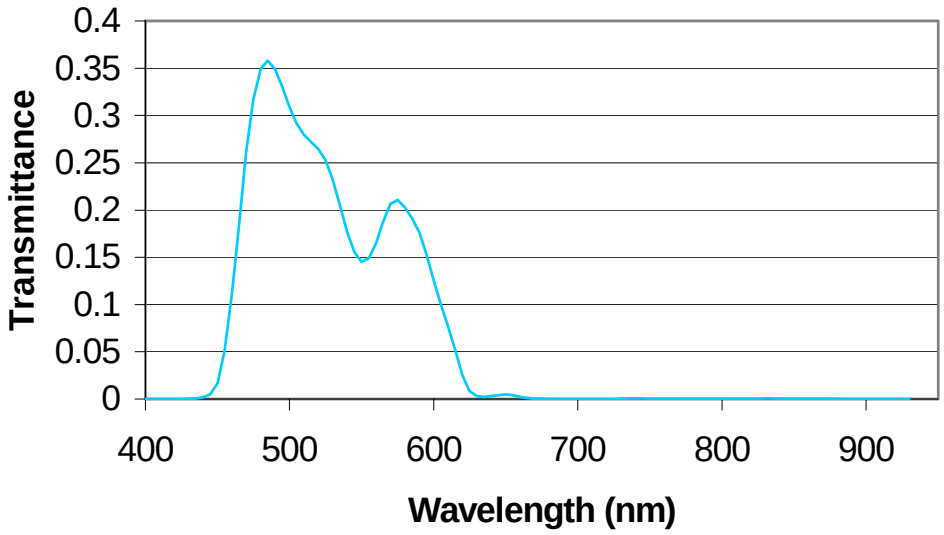
Applications

Filtering of white LED light sources for applications requiring NVG white compliance to MIL-STD-3009 or DO-275.

Size

Cut to customer specified dimensions in a standard thickness of 0.043-inches.

LW1



Typical performance

Source	Y%	u'	v'	NRa*	NRb*
White LED					
(x=0.29 y=0.26)	17	0.160	0.480	6E-10	9E-11
(x=0,31 y=0.28)	17	0.160	0.490	6E-10	9E-11
(x=0.36 y=0.36)	17	0.165	0.515	6E-10	1E-10

*Scaled to 0.1 fL.

LW1 rev 1

Wamco DC1 NVIS polymeric filter for color displays

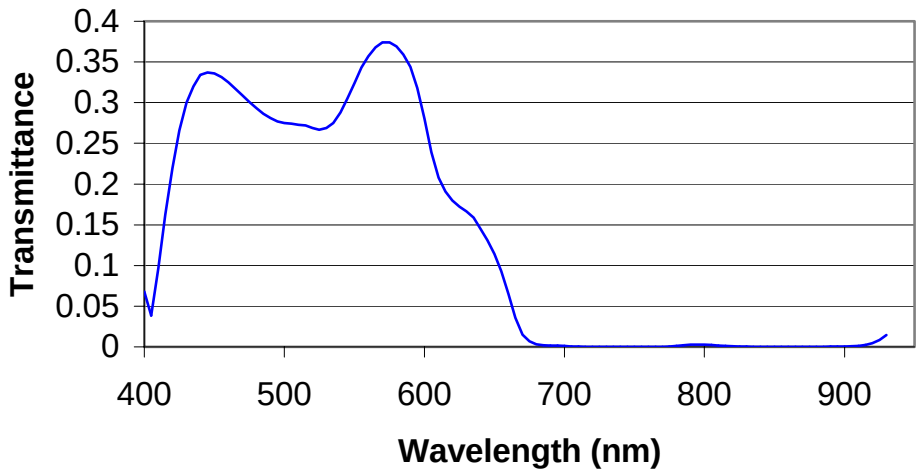
Applications

This polymeric material is optimized for NVIS filtering of color CRT and LCD displays.

Size

Cut to customer-specified dimensions in a standard thickness of 0.100-inches.

DC1



Typical performance

Source	Y%	u'	v'	NRa*	NRb*
Color LCD (Fluorescent Backlight)					
Blue	30	0.126	0.334	1.6E-9	3.8E-10
Green	31	0.135	0.566	1.9E-9	2.6E-10
Red	24	0.371	0.534	6.5E-8	8.5E-9
White	29	0.186	0.515	1.6E-8	2.2E-9
T2B	10				

* Scaled to 0.5 fL.

DC1 rev B

Wamco NV-1GLG-1 NVIS glass filter for green LED displays

New

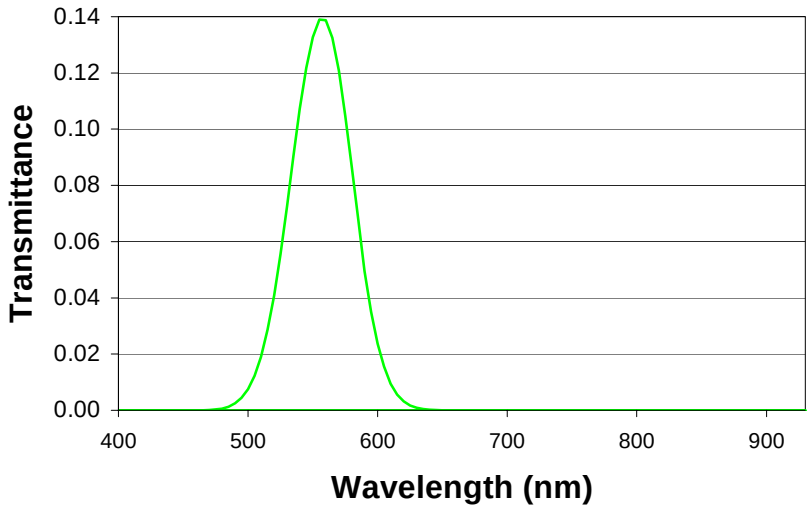
Applications

Monolithic glass filter specially designed to provide NVG compatibility and sunlight readability of high efficiency green alpha numeric LED displays.

Size

Cut to customer-specified dimensions in a standard thickness of 0.054-inches.

NV-1GLG-1



Typical performance

Source	Y%	u'	v'	NRa*	NRb*
LED					
568 nm Peak	11.0	0.203	0.569	1.40E-10	7.5E-12
565 nm Peak	11.5	0.181	0.572	9.76E-11	6.5E-12
T2B	0.95				

* Scaled to 0.1 fL.

NV-1GLG-1 rev A

Wamco DM3 NVIS polymeric filter for monochrome displays

New

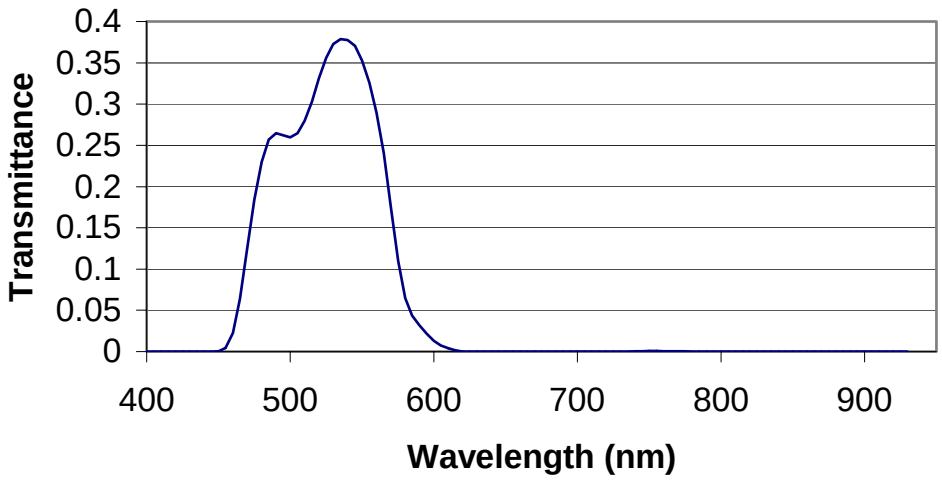
Applications

Cost-effective filtering of most types of displays. LED dot matrix and most CRT are filtered to full NVG compatibility. Call for performance data for your specific display type.

Size

Cut to customer-specified dimensions in a standard thickness of 0.088-inches.

DM3



Typical performance

Source	Y%	u'	v'	NRa*	NRb*
LED (dot matrix)	16	0.179	0.585	7E-11	5E-12
P43 CRT	30	0.098	0.572	4E-11	3.3E-12
P1 CRT	29	0.082	0.571	4E-11	3.3E-12

* Scaled to 0.1 fL.

Wamco GA1 NVIS Green A polymeric filter for incandescent source

New

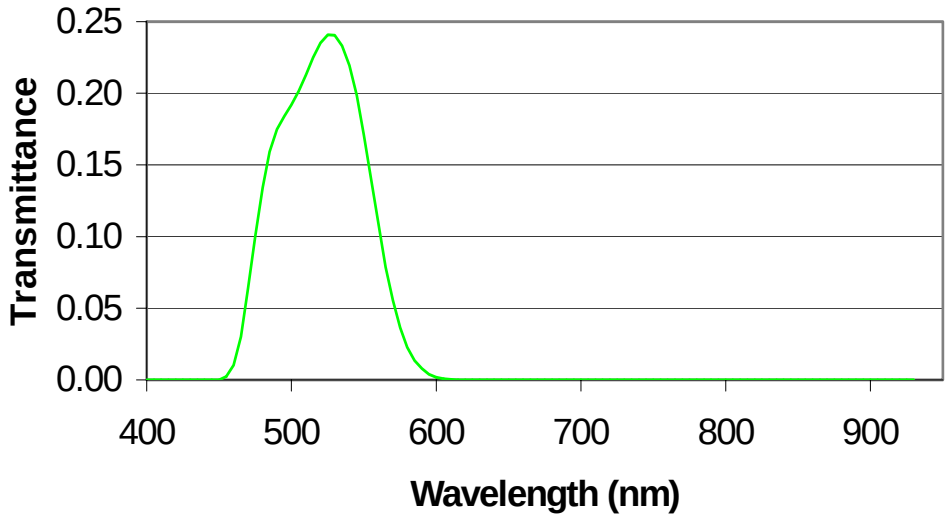
Applications

Cost-effective NVIS Green A filter for filtering incandescent light sources in edge-lit panels and keyboards. Color shifting as a function of the source temperature (Kelvin) is minimized yielding excellent color stability.

Size

Ring and bathtub filters with 0.028-inch standard wall thickness. Please refer to the Wamco FP-series RING (page 3.8) and BATHTUB (page 3.9) filter dimensional sheets.

GA1



Typical performance

Source	Y%	u'	v'	NRa*	NRb*
2100 K	7.2	0.094	0.567	4E-11	3E-12
1800 K	6.1	0.100	0.569	5E-11	4E-12
T2B	2.1				

* Scaled to 0.1 fL.

GA1 rev 1

Wamco GA3 NVIS Green A polymeric filter for incandescent and white LEDs

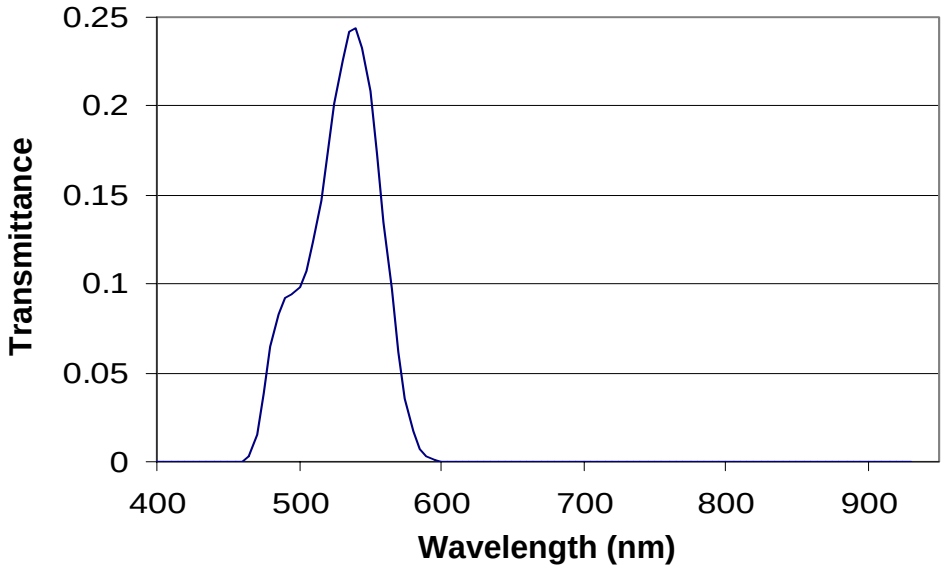
Applications

This low cost filter is designed to provide excellent NVG compatibility, “upper right quadrant”, and NVIS Green A, and is ideal for DO-275 application.

Size

Ring and bathtub filters with 0.028-inch standard wall thickness. Please refer to the Wamco FP- series RING (page 3.8) and BATHTUB (page 3.9) filter dimensional sheets.

GA3



Typical performance

Source	Y%	u'	v'	NRa*	NRb*
White LED	14	0.100	0.560	4E-11	4E-12
2100 K	10	0.109	0.572	7E-11	8E-12

* Scaled to 0.1 fL.

GA3 rev D

Wamco GB1 NVIS Green B polymeric filter for incandescent and white LEDs

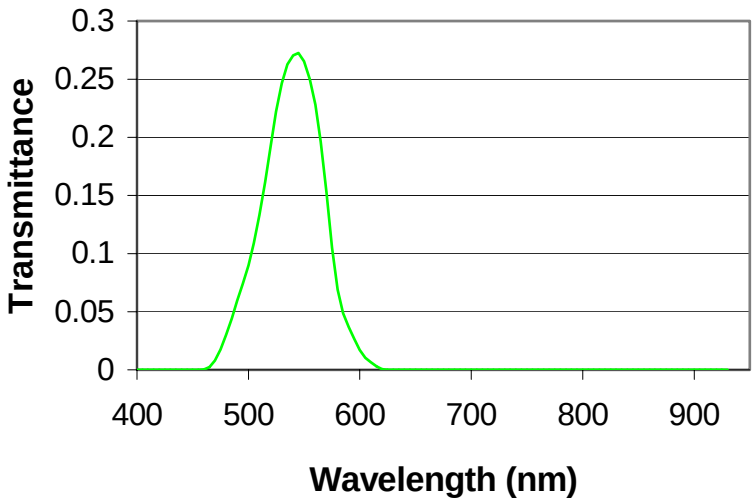
Applications

This low cost filter is designed to provide NVG compatibility and NVIS Green B with both incandescent and white LED sources, and is ideal for DO-275 application.

Size

Ring and bathtub filters with 0.028-inch standard wall thickness. Please refer to the Wamco FP- series RING (page 3.8) and BATHTUB (page 3.9) filter dimensional sheets.

GB1



Typical performance

Source	Y%	u'	v'	NRa*	NRb*
White LED	14	0.128	0.575	9E-11	4E-12
2100 K	12	0.138	0.575	1E-10	5E-12

* Scaled to 0.1 fL.

GB1 rev B

Wamco WA1 NVIS Green A polymeric filter for white LEDs

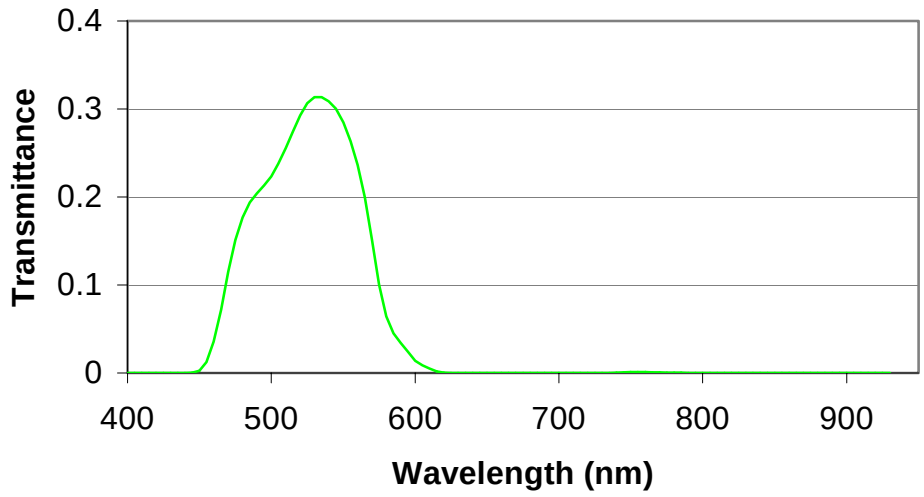
Applications

This polymeric material is optimized for NVIS Green A filtering of white LED light sources in edge-lit panels, LCD backlights, annunciators, and indicator lights.

Size

Ring and bathtub filters with 0.028-inch standard wall thickness. Please refer to Wamco FP- series RING (page 3.8) and BATHTUB (page 3.9) filter dimensional sheets.

WA1



Typical performance

Source	Y%	u'	v'	NRa*	NRb*
White LED (x=0.33 y=0.33)	20	0.116	0.547	8E-11	6E-12

* Scaled to 0.1 fL.

WA1 rev C

Wamco WB1 NVIS Green B polymeric filter for white LEDs

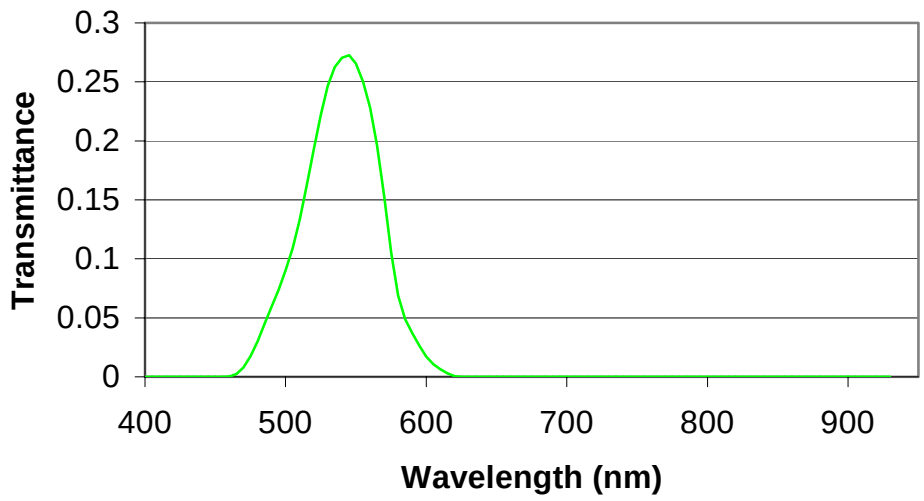
Applications

This polymeric material is optimized for NVIS Green B filtering of white LED light sources in edge-lit panels, LCD backlights, annunciators, and indicator lights.

Size

Ring and bathtub filters with 0.028-inch standard wall thickness. Please refer to the Wamco FP- series RING (page 3.8) and BATHTUB (page 3.9) filter dimensional sheets.

WB1



Typical performance

Source	Y%	u'	v'	NRa*	NRb*
White LED (x=0.33 y=0.33)	14	0.120	0.574	7E-11	5E-12

* Scaled to 0.1 fL.

Wamco BW1 polymeric “blue-white” filter for white LEDs

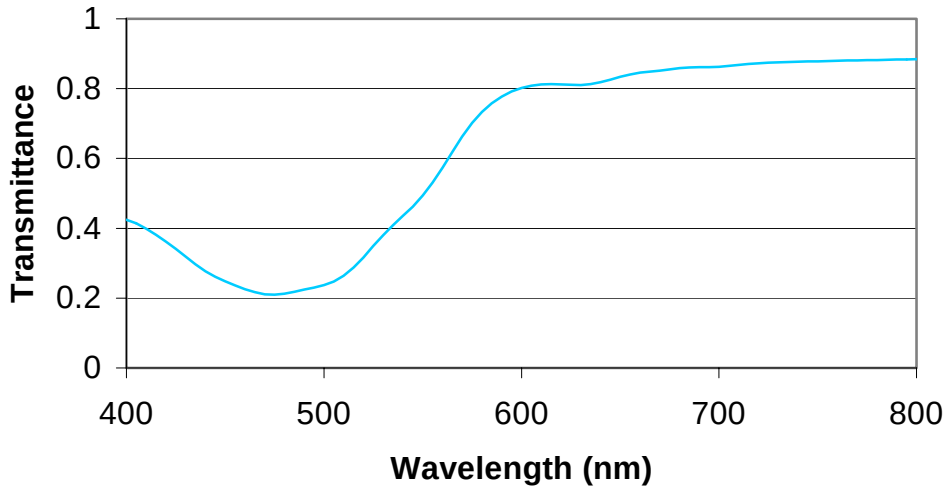
Applications

This polymeric material is optimized for “blue-white” filtering of white LED light sources in edge-lit panels, keyboards, annunciators, and indicator lights.

Size

Ring and bathtub filters with 0.028-inch standard wall thickness. Please refer to the Wamco FP- series RING (page 3.8) and BATHTUB (page 3.9) filter dimensional sheets.

BW1



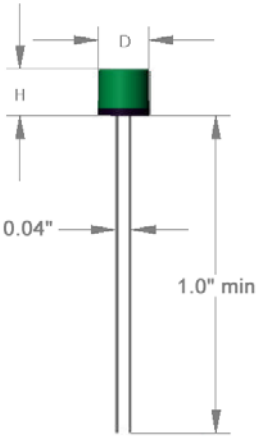
Typical performance

Source	Y%	x	y
White LED			
(x=0.29 y=0.26)	57	0.405	0.340
(x=0.21 y=0.44)	57	0.420	0.360
(x=0.36 y=0.36)	57	0.460	0.410

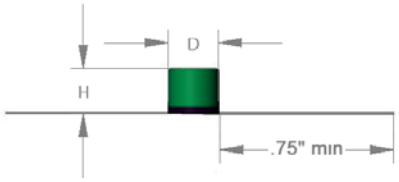
BW1 rev C

Wamco NVIS polymeric incandescent lamp assemblies

Lead type S



Lead type O



New

Ordering information

Part number: FP-XXXXD-YYY-ZZZZ-X

(Sizes) (Materials) (Lamp types) (Lead type S or O)

Sizes

XXXX	D	H
1816	0.185" ± .005"	0.187" max
2015	0.200" ± .005"	0.180" max

Materials **YYY**

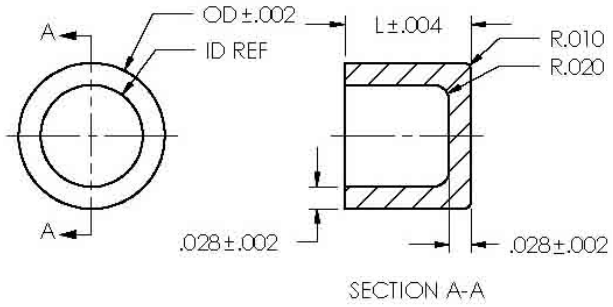
GA1 (Green A)

GB1 (Green B)

Lamp types

ZZZZ	Voltage (V)	Current (mA)	MSCd (cd)
7132	5	75	0.09
7152	5	115	0.15
8552	28	20	0.15
30702	5	60	0.15

Wamco FP-series NVG polymeric ring filters for incandescent and LEDs



Ordering information

Part number: F P - X X X X D - Y Y Y
(Table 1) (Filter)

Table 1

XXXX	O.D.	I.D.	L
2412	0.242	0.186	0.12
2015	0.200	0.144	0.15
1816	0.185	0.128	0.16

Custom sizes available

Filter* WA1 (white LED to Green A)

WB1 (white LED to Green B)

GA1 (incandescent to Green A)

GA3 (white LED to Green A) ***/*** (incandescent to Green A)

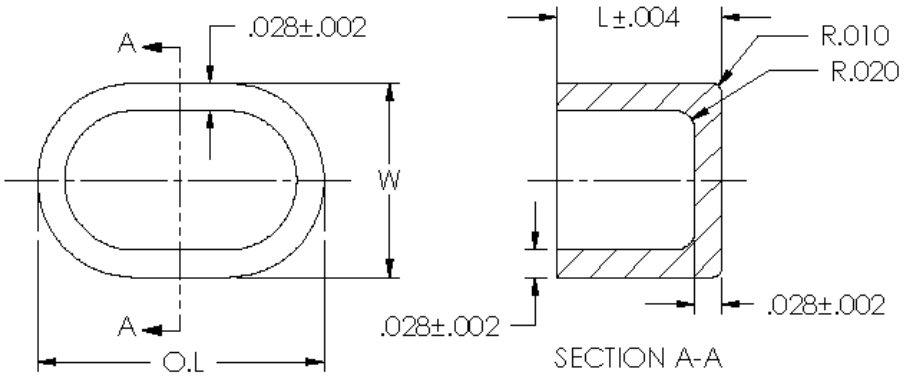
GB1 (white LED to Green B) ***/*** (incandescent to Green B)

GC1 (green LED to Comanche Green)

In-stock and available for immediate delivery:
FP-2412D-WA1, -WB1, GA3, -GB1
FP-2015D-WA1, -WB1, -GA1, -GB1, -GC1
FP-1816D-WB1, -GA1, -GA3

*Refer to individual -YYY data sheets for filter characteristics and other filters available.

Wamco FP-series NVG polymeric “bathtub” filters for incandescent and LEDs



Ordering information

Part number: FP-XXXXBD-YYY
(Table 1) (Filter)

Table 1

XXXX	O.L.	W	L
2616	0.255	0.200	0.159
3017	0.295	0.200	0.170

Custom sizes available

Filter* WA1 (white LED to Green A)
WB1 (white LED to Green B)
GA1 (incandescent to Green A)
GA3 (white LED to Green A) ***/*** (incandescent to Green A)
GB1 (white LED to Green B) ***/*** (incandescent to Green B)

In-stock and available for immediate delivery:
FP-2616BD-WA1, -WB1
FP-3017BD-WA1, -WB1

* Refer to individual -YYY data sheets for filter characteristics and other filters available.

DISCLAIMER

All Wamco filter and other product specifications and performance data are provided for reference only and are subject to change without notice. Data illustrate the typical magnitude or range of product properties, but Wamco does not guarantee their accuracy or applicability to any specific situation. Customers are responsible for verifying product performance in their specific applications and conditions of use.