

Optics

Lenses & Microscope Components

Coatings

Mirrors, Beamsplitters

Prisms & Polarizers

Filters

Pinholes

Opto-mechanics

Breadboards & Rails

Mounting Hardware

Mirror & Component Mounts

Manual Micro-positioners

Motorized Positioners

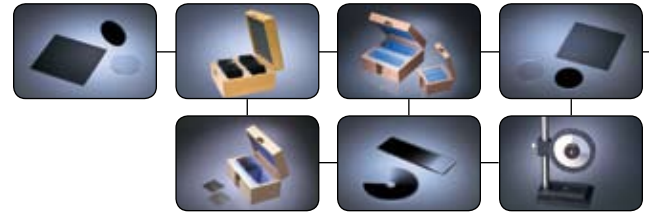
Optical Instruments

Light Sources

Light Measurement

Diode Laser Modules

Optics



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Bandpass Interference Filters

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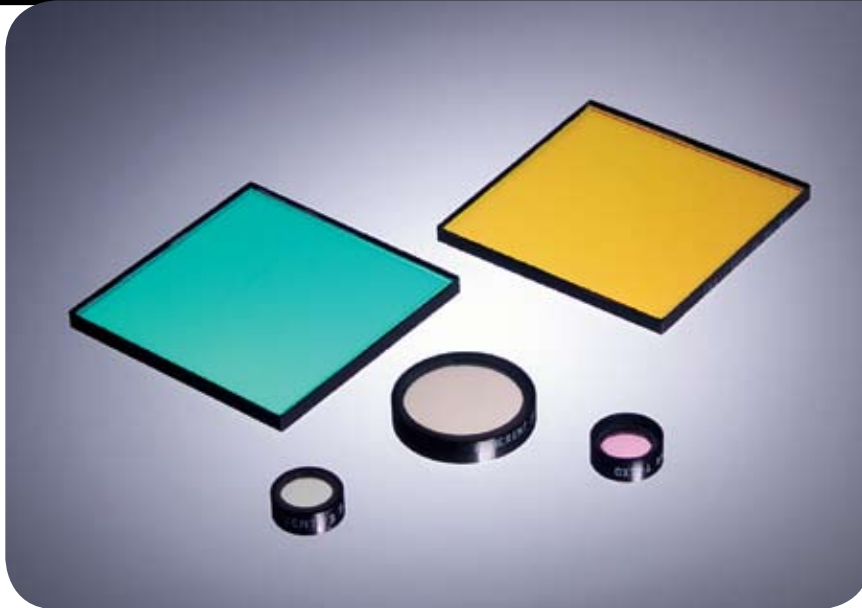
Mirrors, Beamsplitters

Prisms & Polarizers

Filters

Pinholes

- **Precise control of center wavelength and bandpass shape**
- **Wide selection of stock wavelengths from 250 nm-1550 nm**
- **Selection of bandwidths**
- **Available in 1/2" and 1" sizes**
- **High peak transmission values**
- **Excellent blocking from UV to IR**
- **Sealed design provides long term stability**



Opto-mechanics

Breadboards & Rails

Mounting Hardware

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Manual Micro-positioners

Motorized Positioners

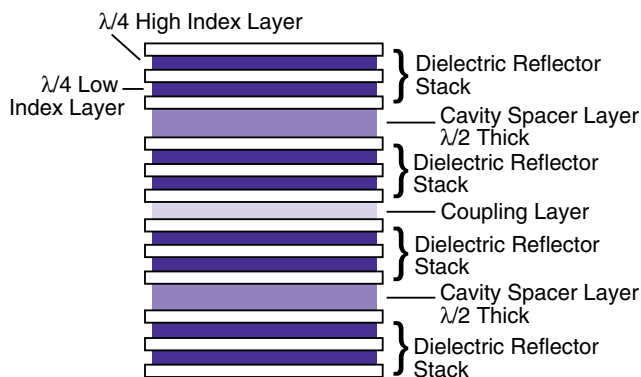
Essentially a stack of Fabry-Perot cavities these filters select the transmitted spectrum by constructive and destructive interference at the boundaries between high and low index dielectric layers. Several cavities may be combined to produce a sharper cut-off and to alter the shape of the passband. Two three and four cavity designs are commonly used in these filters according to the specifications required. Absorbing and reflecting layers are also included in the stack to block the transmission of unwanted wavelengths over a wide spectrum from near UV to far IR. When selecting a filter always be certain to consider the spectral characteristics of the source and detector in use. These should be combined with the filter curve to obtain the resulting spectral response of the system.

Optical Instruments

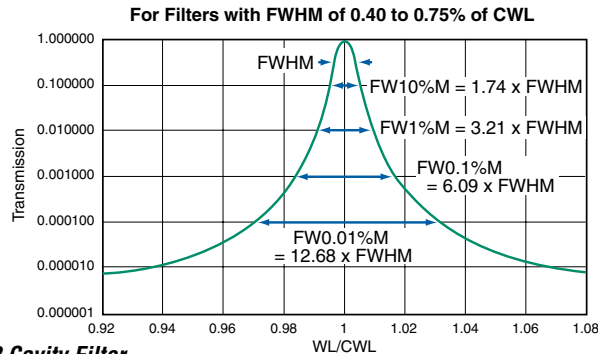
Light Sources

Light Measurement

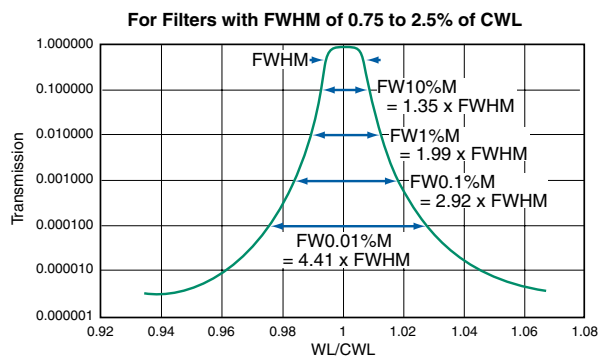
Diode Laser Modules



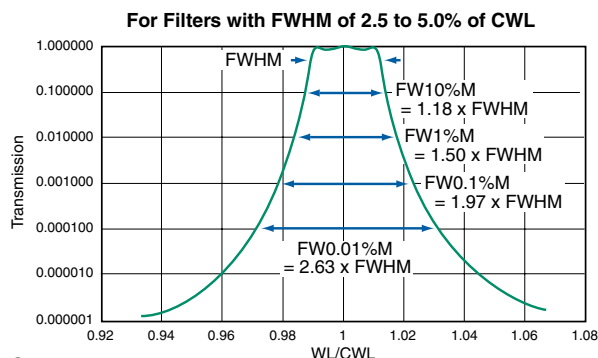
Two Cavity All-Dielectric Filter



2 Cavity Filter



3 Cavity Filter



4 Cavity Filter

Bandpass interference filters are available for a wide range of center wavelengths (CWL) and bandwidths, specified as the “full width at half maximum” (FWHM). Narrower bandwidths naturally cause a lower transmission, but Ealing filters are designed to have the maximum possible peak transmission for a given pass band. These filters are intended for use in approximately collimated light at normal incidence. If tilted or used in a strongly convergent or divergent beam, the peak transmission will be shifted to a shorter wavelength. The amount of this shift is dependent on the “effective index” of the filter (n^*) in accordance with the following formula and table:

$$\lambda_o = \frac{\lambda_o \sqrt{n^{*2} - \sin^2 \theta}}{n^*}$$

where: λ_o = Central wavelength at normal incidence.
 λ_o = Central wavelength at the off-normal angle θ .
 n^* = Effective index of refraction of the total filter.

Keep in mind, while the formula and table can be a reasonable estimate for the wavelength shift, the actual “effective index” varies from filter to filter and should be considered during calculations.

Temperature changes will affect the performance of interference filters due to thermal expansion of the thin film and substrate materials. Filters are designed and specified

for use at 23°C. They work well over a range of -60 to +60 °C, but an approximately linear shift of peak wavelength occurs. In the visible range the expected shift of wavelength is approximately 0.025 nm/°C. Bandwidth and peak transmission vary much more slowly with temperature (0.001 nm/°C and 0.13%/°C respectively) and these second order effects can usually be ignored. Exposure to, or storage at, temperatures outside the operating range could result in a permanent change of the filter’s performance. Thermal shock can cause interference filters to shatter or delaminate.

Ealing offers three series of bandpass filters for UV, VIS and IR ranges. The UV filters use synthetic fused silica substrates, whereas the VIS and IR filters use glass substrates. Specifications are different for each range of products. Each filter is hermetically sealed in a foil envelope with a desiccant capsule for extended shelf life. Measured spectrophotometer traces are supplied with each filter.

We will be pleased to discuss your specific requirements for filters not listed in this catalog, and to quote for your volume OEM requirements.

Variation of Wavelength Shift (λ_θ/λ_o) with Tilt Angle (θ)

Tilt Angle (Degrees)	Low Effective Index Spacer ($n^* = 1.45$)	High Effective Index Spacer ($n^* = 2.1$)
0.25	0.99999	0.99999
0.5	0.99998	0.99999
1.0	0.99993	0.99996
2.0	0.99971	0.99985
3.0	0.99935	0.99966
4.0	0.99884	0.99939
5.0	0.99819	0.99905
7.5	0.99594	0.99787
10.0	0.99280	0.99622
15.0	0.98394	0.99159
20.0	0.97178	0.98527
25.0	0.95658	0.97742
30.0	0.93867	0.96825
35.0	0.91844	0.95800
40.0	0.89637	0.94695
45.0	0.87303	0.93541

Common UV, VIS and IR Bandpass Filter Specifications

Available sizes:

1/2"	12.7 +0, -0.25 mm diameter
1"	25.4 +0, -0.25 mm diameter

Minimum clear aperture:

1/2"	8.7 mm
1"	21.4 mm

Maximum thickness: 6.4 mm

Edge treatment: Hermetically sealed in black anodized aluminum ring

Humidity resistance: Per Mil-STD-810E

Optimum temp: 23° C

Temperature limits: -50°C to 80°C

Substrate material: Optical quality glass

Surface quality: 80/50 per Mil-O-13830A

Certification: Spectrophotometric print of manufacturing lot sample

Attenuation Specifications

UV Bandpass Filters
 Out-of-Band Attenuation:
 For FWHM ≤ 13 nm: Minimum/ Minimum Average Attenuation OD 3/ OD 4 from 200 nm to 3500 nm

VIS and IR Bandpass Filters
 Out-of-Band Attenuation:
 For FWHM ≤ 10 nm: Minimum/ Minimum Average Attenuation OD 4/ OD 5 from 200 nm to 3500 nm
 For FWHM ≥ 40 nm: Minimum/ Minimum Average Attenuation OD 3/ OD 4 from 200 nm to 1200 nm

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Bandpass Interference Filters

Optics

Narrow Bandpass Filters

	Center Wavelength (nm)	Bandwidth FWHM (nm)	Minimum Peak Transmission	Element or Application	12.7mm(1/2")Diameter		25.4mm(1")Diameter	
					Catalog Number	Price US	Catalog Number	Price US
Lenses & Microscope Components	488.0 + 0.2, - 0	1 ± 0.2	35%	Ar	42-5175	\$147.00	35-8366	\$225.00
	488.0 + 1.0, - 0	3 ± 0.5	35%	Ar	42-5178	\$99.00	35-8389	\$147.00
Coatings	514.5 + 0.2, - 0	1 ± 0.2	35%	Ar	42-5233	\$147.00	35-8424	\$225.00
	514.5 + 1.0, - 0	3 ± 0.5	40%	Ar	42-5236	\$99.00	35-8427	\$147.00
Mirrors, Beamsplitters	532.0 + 0.2, - 0	1 ± 0.2	35%	Nd	42-5266	\$147.00	35-8465	\$225.00
	532.0 + 1.0, - 0	3 ± 0.5	40%	Nd	42-5269	\$99.00	35-8668	\$147.00
	546.1 + 0.2, - 0	1 ± 0.2	35%	Hg	42-5283	\$147.00	35-3667	\$225.00
	546.1 + 1.0, - 0	3 ± 0.5	40%	Hg	42-5286	\$99.00	35-3670	\$147.00
Prisms & Polarizers	577.0 + 1.0, - 0	3 ± 0.5	40%	Hg	42-5333	\$99.00	35-3751	\$147.00
	632.8 + 0.2, - 0	1 ± 0.2	35%	HeNe	42-4895	\$147.00	42-4937	\$225.00
Filters	632.8 + 1.0, - 0	3 ± 0.5	40%	HeNe	42-4898	\$99.00	42-4940	\$147.00
	656.3 + 0.2, - 0	1 ± 0.2	35%	H-Alpha	42-5499	\$147.00	35-3990	\$225.00
	656.3 + 1.0, - 0	3 ± 0.5	40%	H-Alpha	42-5502	\$99.00	35-3993	\$147.00
	694.3 + 0.2, - 0	1 ± 0.2	35%	Ruby	42-5564	\$147.00	35-4103	\$225.00
Pinholes	694.3 + 1.0, - 0	3 ± 0.5	40%	Ruby	42-5567	\$99.00	35-4106	\$147.00
	1064.0 + 1.0, - 0	3 ± 0.5	35%	Nd	42-5921	\$147.00	35-4947	\$195.00

UV Bandpass Filters

	Center Wavelength (nm)	Bandwidth FWHM (nm)	Minimum Peak Transmission	Element or Application	12.7mm(1/2")Diameter		25.4mm(1")Diameter	
					Catalog Number	Price US	Catalog Number	Price US
Breadboards & Rails	334.1 ± 2.0	10 ± 2	25%	Hg, Ti			35-7965	\$228.00
	337.1 ± 2.0	10 ± 2	25%	N			35-7968	\$228.00
	340.0 ± 2.0	10 ± 2	25%	BioMed			35-2989	\$168.00
	365.0 ± 2.0	10 ± 2	25%	Hg			35-3045	\$168.00

Opto-mechanics

Breadboards & Rails

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Mirror & Component Mounts

Manual Micro-positioners

Motorized Positioners

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Visible Bandpass Filters

Center Wavelength (nm)	Bandwidth FWHM (nm)	Minimum Peak Transmission	Element or Application	12.7mm(1/2")Diameter		25.4mm(1")Diameter	
				Catalog Number	Price US	Catalog Number	Price US
390.0 ± 2.0	10 ± 2	30%	Sc	42-5035	\$34.00	35-3089	\$84.00
394.0 ± 2.0	10 ± 2	30%	S	42-5038	\$34.00	35-3092	\$84.00
400.0 ± 2.0	10 ± 2	40%	Dy, Yb	42-5041	\$34.00	35-3201	\$84.00
400.0 ± 8.0	40 ± 8	40%		42-5044	\$34.00	35-3204	\$84.00
404.7 + 3.0, - 1.0	10 ± 2	40%	Hg, BioMed	42-5058	\$34.00	35-3227	\$84.00
410.0 ± 2.0	10 ± 2	40%	Ni, H-Delta	42-5066	\$34.00	35-3243	\$84.00
420.0 ± 2.0	10 ± 2	40%	Eu, Ar	42-5082	\$34.00	35-3284	\$84.00
430.0 ± 2.0	10 ± 2	40%	Ar, Sm, W	42-5090	\$34.00	35-3300	\$84.00
435.8 + 3.0, - 1.0	10 ± 2	40%	Hg, BioMed	42-5108	\$34.00	35-3326	\$84.00
440.0 ± 2.0	10 ± 2	40%		42-5116	\$34.00	35-3342	\$84.00
441.6 + 3.0, - 1.0	10 ± 2	40%	HeCd	42-5119	\$34.00	35-3345	\$84.00
450.0 ± 2.0	10 ± 2	40%	He, Ni, BioM	42-5124	\$34.00	35-3367	\$84.00
450.0 ± 8.0	40 ± 8	60%		42-5132	\$34.00	35-5024	\$84.00
457.9 + 3.0, - 1.0	10 ± 2	40%	Ar	42-5140	\$34.00	35-3383	\$84.00
460.0 ± 2.0	10 ± 2	40%	Eu, Sr	42-5157	\$34.00	35-3409	\$84.00
467.0 ± 2.0	10 ± 2	45%	Xe	42-6965	\$34.00	42-7294	\$84.00
470.0 ± 2.0	10 ± 2	45%	Cd, Br	42-5165	\$34.00	35-3425	\$84.00
476.0 ± 2.0	10 ± 2	45%		42-5168	\$34.00	35-3428	\$84.00
480.0 ± 2.0	10 ± 2	45%	Cd	42-5173	\$34.00	35-3441	\$84.00
486.1 + 3.0, - 1.0	10 ± 2	45%	Zn, H-Beta	42-5177	\$34.00	35-3444	\$84.00
488.0 + 3.0, - 1.0	10 ± 2	45%	Ar	42-5181	\$34.00	35-3466	\$84.00
490.0 ± 2.0	10 ± 2	45%	He, BioMed	42-5199	\$34.00	35-3482	\$84.00
500.0 ± 2.0	10 ± 2	45%		42-5207	\$34.00	35-3508	\$84.00
500.0 ± 8.0	40 ± 8	65%		42-5215	\$34.00	35-5040	\$84.00
500.0 ± 8.0	70 ± 8	65%		42-6999	\$34.00	42-7302	\$84.00
505.0 ± 2.0	10 ± 2	45%		42-7002	\$34.00	35-3537	\$84.00
510.0 ± 2.0	10 ± 2	45%	Cd, Cu	42-5223	\$34.00	35-3540	\$84.00
514.5 + 3.0, - 1.0	10 ± 2	45%	Ar	42-5231	\$34.00	35-3565	\$84.00
520.0 ± 2.0	10 ± 2	45%	Ba, Mg	42-5249	\$34.00	35-3581	\$84.00
530.0 ± 2.0	10 ± 2	45%		42-5256	\$34.00	35-3607	\$84.00
532.0 + 3.0, - 1.0	10 ± 2	45%	Nd	42-5264	\$34.00	35-3623	\$84.00
540.0 ± 2.0	10 ± 2	50%	Ne, BioMed	42-5272	\$34.00	35-3649	\$84.00
543.5 + 3.0, - 1.0	10 ± 2	50%		42-5275	\$34.00	35-3652	\$84.00
546.1 + 3.0, - 1.0	10 ± 2	50%	Hg	42-5280	\$34.00	35-3664	\$84.00
550.0 ± 2.0	10 ± 2	50%		42-5298	\$34.00	35-3680	\$84.00
550.0 ± 8.0	40 ± 8	65%		42-5306	\$34.00	35-5065	\$84.00
550.0 ± 8.0	70 ± 8	75%		42-7039	\$34.00	42-7310	\$84.00
560.0 ± 2.0	10 ± 2	50%		42-5314	\$34.00	35-3706	\$84.00
568.2 ± 2.0	10 ± 2	50%		42-7047	\$34.00	42-7328	\$84.00
570.0 ± 2.0	10 ± 2	50%	Na	42-5322	\$34.00	35-3722	\$84.00
577.0 + 3.0, - 1.0	10 ± 2	50%	Hg	42-5330	\$34.00	35-3748	\$84.00
580.0 ± 2.0	10 ± 2	50%	Hg	42-5348	\$34.00	35-3763	\$84.00
589.3 + 3.0, - 1.0	10 ± 2	50%	Na	42-5355	\$34.00	35-3789	\$84.00
590.0 ± 2.0	10 ± 2	50%	BioMed	42-5363	\$34.00	35-3805	\$84.00
600.0 ± 2.0	10 ± 2	50%	BioMed	42-5371	\$34.00	35-3821	\$84.00
600.0 ± 8.0	40 ± 8	65%		42-5389	\$34.00	35-5081	\$84.00
600.0 ± 8.0	65 ± 8	75%		42-7062	\$34.00	42-7366	\$84.00
610.0 ± 2.0	10 ± 2	50%	Ne	42-5397	\$34.00	35-3847	\$84.00
620.0 ± 2.0	10 ± 2	50%	Ca	42-5405	\$34.00	35-3862	\$84.00
630.0 ± 2.0	10 ± 2	50%	O	42-5413	\$34.00	35-3888	\$84.00
632.8 + 3.0, - 1.0	10 ± 2	50%	HeNe	42-5421	\$34.00	35-3904	\$84.00
632.8 + 3.0, - 1.0	10 ± 2	75%	HeNe	42-5439	\$34.00	35-4126	\$84.00
632.8 ± 8.0	40 ± 8	75%	HeNe	42-5447	\$34.00	42-7344	\$84.00
636.0 ± 2.0	10 ± 2	50%		42-7088	\$34.00	42-7351	\$84.00

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Bandpass Interference Filters

Visible Bandpass Filters (continued)

	Center Wavelength (nm)	Bandwidth FWHM (nm)	Minimum Peak Transmission	Element or Application	12.7mm(1/2")Diameter		25.4mm(1")Diameter	
					Catalog Number	Price US	Catalog Number	Price US
Lenses & Microscope Components	640.0 ± 2.0	10 ± 2	50%	Ne	42-5454	\$34.00	35-3920	\$84.00
	647.1 + 3.0, - 1.0	10 ± 2	50%	Kr	42-5462	\$34.00	35-3946	\$84.00
Coatings	650.0 ± 2.0	10 ± 2	50%	Ca, BioMed	42-5470	\$34.00	35-3961	\$84.00
	650.0 ± 8.0	40 ± 8	65%		42-5488	\$34.00	35-5107	\$84.00
Mirrors, Beamsplitters	656.3 + 3.0, - 1.0	10 ± 2	50%	H-Alpha	42-5496	\$34.00	35-3987	\$84.00
	660.0 ± 2.0	10 ± 2	50%		42-5504	\$34.00	35-4001	\$84.00
Prisms & Polarizers	660.0 ± 8.0	40 ± 2	75%		42-7120	\$34.00	42-7377	\$84.00
	670.0 ± 2.0	10 ± 2	50%	Diode	42-5512	\$34.00	35-4027	\$84.00
Filters	670.0 ± 2.0	10 ± 2	75%	Diode	42-5520	\$34.00	42-7385	\$84.00
	670.0 ± 8.0	40 ± 8	75%	Diode	42-5538	\$34.00	42-7393	\$84.00
Pinholes	675.0 ± 2.0	10 ± 2	50%	Diode	42-5541	\$34.00	35-4065	\$84.00
	680.0 ± 2.0	10 ± 2	50%		42-5546	\$34.00	35-4068	\$84.00
	685.0 ± 2.0	10 ± 2	50%		42-5549	\$34.00	35-4071	\$84.00
	690.0 ± 2.0	10 ± 2	50%	Hg, O	42-5553	\$34.00	35-4084	\$84.00
	694.3 + 3.0, - 1.0	10 ± 2	50%	Ruby	42-5561	\$34.00	35-4100	\$84.00
	700.0 ± 2.0	10 ± 2	50%		42-5579	\$34.00	35-4167	\$84.00
	700.0 ± 8.0	40 ± 8	65%		42-5587	\$34.00	35-5123	\$84.00
	710.0 ± 2.0	10 ± 2	50%		42-5595	\$34.00	42-7419	\$84.00
	720.0 ± 2.0	10 ± 2	50%		42-5603	\$34.00	35-4209	\$84.00
	730.0 ± 2.0	10 ± 2	50%	Diode	42-5611	\$34.00	35-4225	\$84.00
Opto-mechanics	730.0 ± 2.0	30 ± 8	75%	Diode	42-5629	\$34.00	35-6345	\$84.00
	740.0 ± 2.0	10 ± 2	50%		42-5637	\$34.00	35-4241	\$84.00
Breadboards & Rails	750.0 ± 2.0	10 ± 2	50%	Alexandrite	42-5645	\$34.00	35-4266	\$84.00
	760.0 ± 2.0	10 ± 2	45%	O	42-5660	\$34.00	35-4282	\$84.00
Mounting Hardware	766.5 + 3.0, - 1.0	10 ± 2	45%	K	42-5663	\$34.00	35-7285	\$84.00
	770.0 ± 2.0	10 ± 2	45%		42-5678	\$34.00	35-4324	\$84.00
Mirror & Component Mounts	780.0 + 3.0, - 1.0	10 ± 2	45%	Rb, Diode	42-5686	\$34.00	35-4340	\$84.00
	780.0 ± 8.0	30 ± 8	75%	Rb, Diode	42-5694	\$34.00	35-5537	\$84.00

IR Bandpass Filters

	Center Wavelength (nm)	Bandwidth FWHM (nm)	Minimum Peak Transmission	Element or Application	12.7mm(1/2")Diameter		25.4mm(1")Diameter	
					Catalog Number	Price US	Catalog Number	Price US
Manual Micro-positioners	640.0 ± 2.0	10 ± 2	50%	Ne	42-5454	\$34.00	35-3920	\$84.00
	790.0 ± 2.0	10 ± 2	45%		42-5702	\$47.00	35-4365	\$110.00
Motorized Positioners	800.0 ± 2.0	10 ± 2	45%	Ar	42-5710	\$47.00	35-4381	\$110.00
	800.0 ± 8.0	65 ± 8	75%	Ar	42-7195	\$47.00	42-7435	\$110.00
Optical Instruments	810.0 ± 2.0	10 ± 2	45%	Diode	42-5728	\$47.00	35-4407	\$110.00
	820.0 ± 2.0	10 ± 2	45%		42-5736	\$47.00	35-4423	\$110.00
Light Sources	830.0 ± 2.0	10 ± 2	45%	Diode	42-5744	\$47.00	35-4449	\$110.00
	830.0 ± 8.0	40 ± 8	75%	Diode	42-5751	\$47.00	35-4452	\$110.00
Light Measurement	840.0 ± 2.0	10 ± 2	45%		42-5769	\$47.00	35-4464	\$110.00
	850.0 ± 2.0	10 ± 2	45%	Hg, Diode	42-5777	\$47.00	35-4480	\$110.00
Diode Laser Modules	850 ± 8.0	70 ± 8	65%		42-7229	\$47.00	42-7443	\$110.00
	855 ± 8.0	40 ± 8	75%		42-5785	\$47.00	35-2583	\$110.00
	870.0 ± 2.0	10 ± 2	45%	Diode	42-5793	\$47.00	35-4522	\$110.00
	880.0 ± 2.0	10 ± 2	45%	Diode	42-5801	\$47.00	35-4548	\$110.00
	880.0 ± 8.0	40 ± 8	65%		42-5819	\$47.00	35-4969	\$110.00
	900.0 ± 2.0	10 ± 2	45%		42-5835	\$47.00	35-4589	\$110.00
	905.0 ± 2.0	10 ± 2	45%	Diode	42-7260	\$47.00	42-7476	\$110.00
	905.0 ± 8.0	50 ± 8	75%	Diode	42-5843	\$47.00	35-4985	\$110.00
	920.0 ± 2.0	10 ± 2	45%		42-5847	\$47.00	35-4988	\$110.00

IR Bandpass Filters (continued)

Center Wavelength (nm)	Bandwidth FWHM (nm)	Minimum Peak Transmission	Element or Application	12.7mm(1/2")Diameter		25.4mm(1")Diameter	
				Catalog Number	Price US	Catalog Number	Price US
920.0 ± 2.0	10 ± 2	45%		42-5847	\$47.00	35-4988	\$110.00
940.0 ± 2.0	10 ± 2	45%	Diode	42-5868	\$47.00	35-4688	\$110.00
950.0 ± 2.0	10 ± 2	45%	Diode	42-5884	\$47.00	35-4704	\$110.00
950 ± 8.0	70 ± 8	65%		42-7278	\$47.00	42-7484	\$110.00
970.0 ± 2.0	10 ± 2	45%		42-7281	\$47.00	42-7487	\$110.00
1000.0 ± 2.0	10 ± 2	45%		42-5892	\$47.00	42-7492	\$110.00
1050.0 ± 2.0	10 ± 2	45%		42-5900	\$47.00	42-7500	\$110.00
1064.0 + 3.0, - 0	10 ± 2	40%	Nd	42-5918	\$47.00	35-4944	\$110.00
1100.0 ± 2.0	10 ± 2	40%		42-5934	\$47.00	42-6254	\$110.00
1150.0 ± 2.0	10 ± 2	40%		42-5937	\$47.00	42-6257	\$110.00
1200.0 ± 2.0	10 ± 2	40%		42-5983	\$47.00	42-6304	\$110.00
1250.0 ± 2.0	10 ± 2	40%		42-5986	\$47.00	42-6307	\$110.00
1300.0 ± 2.0	12 ± 2	35%	Diode	42-6031	\$47.00	42-6353	\$110.00
1350.0 ± 2.0	12 ± 2	35%	Diode	42-6034	\$47.00	42-6356	\$110.00
1400.0 ± 2.0	12 ± 2	35%	Diode	42-6080	\$47.00	42-6403	\$110.00
1450.0 ± 2.0	12 ± 2	35%		42-6083	\$47.00	42-6406	\$110.00
1500.0 ± 2.0	12 ± 2	35%	Diode	42-6130	\$47.00	42-6452	\$110.00
1550.0 ± 2.0	12 ± 2	35%	Diode	42-6133	\$47.00	42-6455	\$110.00

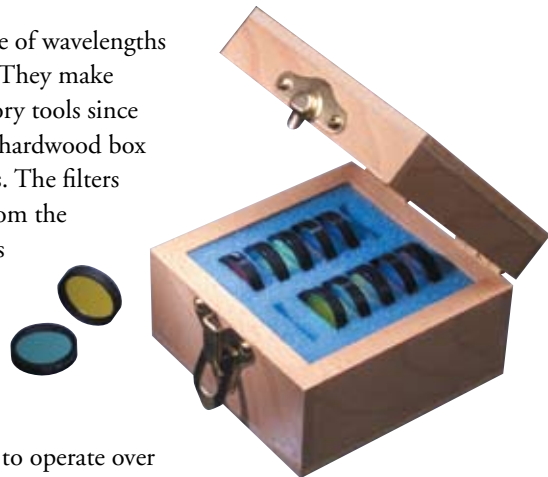
- Optics
- Lenses & Microscope Components
- Coatings
- Mirrors, Beamsplitters
- Prisms & Polarizers
- Filters
- Pinholes

Bandpass Filter Sets

- **Convenient sets of commonly used filters**
- **Wavelengths from 400-700 nm**
- **Bandwidths of 10 and 40 nm**
- **Supplied in foam lined, hardwood storage box**

These filter sets include a range of wavelengths covering the visible spectrum. They make convenient and useful laboratory tools since the filters can be stored in the hardwood box provided and used many times. The filters included have been selected from the range of visible bandpass filters previously described. Please look at the prior pages for detailed specifications (bandwidths stated below are approximate).

These filters may be tilt tuned to operate over a broad spectral range enabling the user to select an almost continuous range of wavelengths. Spectrophotometer traces showing the transmission of each filter are included with the sets.



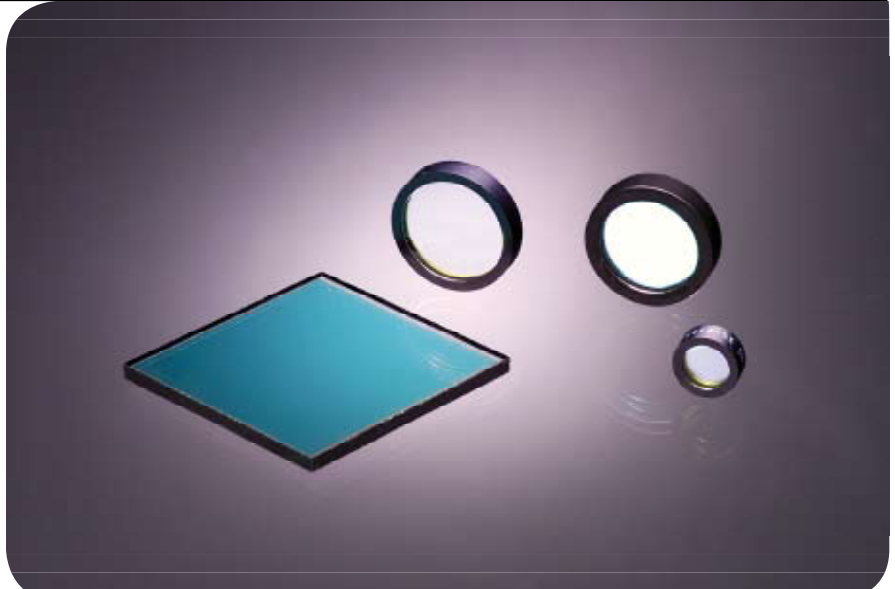
- Opto-mechanics
- Breadboards & Rails
- Mounting Hardware
- Mirror & Component Mounts
- Manual Micro-positioners
- Motorized Positioners

Bandpass Filter Sets

Catalog Number	Bandpass (nm)	Size (mm)	Number in Set	Center Wavelength (nm)												Price US
				400	450	488	500	530	550	589.6	600	632.8	650	656.3	700	
35-1999	10	25.4 dia	12	•	•	•	•	•	•	•	•	•	•	•	•	\$893.00
35-2526	40	25.4 dia	6		•		•			•		•		•		\$491.00

- Optical Instruments
- Light Sources
- Light Measurement
- Diode Laser Modules

Edgepass Interference Filters



- **Short-pass and long-pass for a wide range of wavelengths**
- **Very sharp cut-on and cut-off**
- **Attenuation >99% average within specified range**
- **May be combined to form custom bandpass filters**
- **Supplied with spectrophotometer traces**

Edgepass filters are called short-pass or long-pass according to whether they transmit below or above their transition wavelength. Our Short-wave and Long-wave Pass Filters exhibit a sharp transition from a spectral region of attenuation to one of transmission. Because they attenuate by reflection, these filters can be used in either the transmissive or the reflective mode.

Transition wavelength, or cut-on/off wavelength (COWL) is the wavelength at which the transmission is 50% of its peak value. The sharpness of an edge pass filter is defined by a slope factor which is expressed as a percentage:

The value of edge filters is in rejecting unwanted wavelengths. For this reason

they must be effectively blocked over a wide spectral range (see tables for specifications). Ealing edgepass filters attenuate >99% average within the specified range.

$$<6\% \text{ slope} = \frac{\lambda_{80} - \lambda_5}{\lambda_5} \times 100, \text{ where } \lambda_{80} \text{ and } \lambda_5 \text{ are the wavelength at 80\% and 5\% of peak transmission}$$

A common use for edgepass filters is to combine them with a filter or detector response in order to define a wavelength range. They may be used to separate spectral orders, and in pairs as variable bandpass filters. They may also be used as heat or

UV filters. Please see the later section on infrared and ultraviolet rejection filters. Measured spectrophotometer lot sample traces are supplied with each filter. Choose a combination of filters to make your own customized filter sets with one of our foam lined hardwood protective storage boxes. Measured spectrophotometer traces are supplied with each filter.

We will be pleased to discuss your specific requirements for filters not listed in this catalog and to quote for your volume OEM requirements.

Modular Filter Wheels are also available.



Filter Storage Boxes are also available.



Optics

Lenses & Microscope Components

Coatings

Mirrors, Beamsplitters

Prisms & Polarizers

Filters

Pinholes

Opto-mechanics

Breadboards & Rails

Mounting Hardware

Mirror & Component Mounts

Manual Micro-positioners

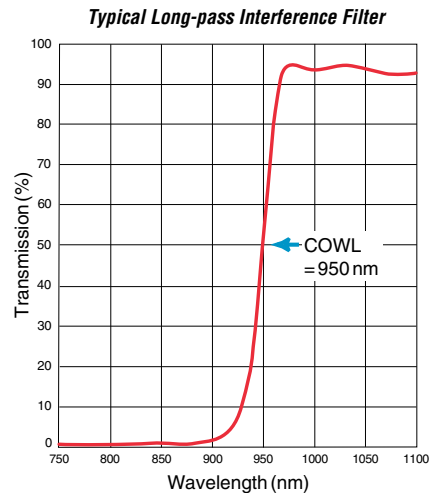
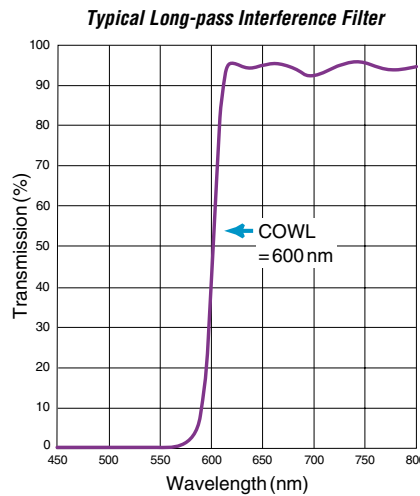
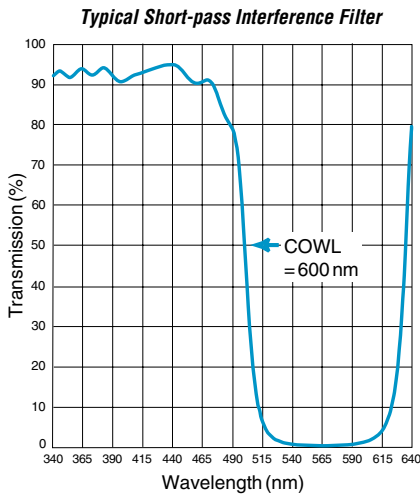
Motorized Positioners

Optical Instruments

Light Sources

Light Measurement

Diode Laser Modules



- Optics
- Lenses & Microscope Components
- Coatings
- Mirrors, Beamsplitters
- Prisms & Polarizers
- Filters
- Pinholes

Short-pass Interference Filters

Catalog Number	CWOL (nm)	Transmission Range (nm)	Wavelength at 50% T (nm)	Attenuation Range (nm)	Price US
40-0001	450	305-425	450 ±10	475-530	\$95.00
40-0006	500	340-475	500 ±10	525-600	\$95.00
40-0011	550	375-520	550 ±10	575-650	\$95.00
40-0016	600	400-565	600 ±10	630-750	\$95.00
40-0021	650	400-615	650 ±10	685-815	\$95.00
40-0026	700	400-660	700 ±10	735-875	\$95.00
40-0031	750	400-710	750 ±10	790-935	\$95.00
40-0036	800	400-755	800 ±10	840-1000	\$95.00
40-0041	850	400-805	850 ±10	895-1060	\$95.00
40-0047	900	400-850	900 ±10	945-1125	\$95.00
40-0052	950	400-900	950 ±10	1000-1188	\$95.00
40-0057	1000	400-945	1000 ±10	1050-1250	\$95.00

Specifications

- Diameter:** 25.0 +0, -.025 mm diameter
- Thickness:** 1.5 ± 0.5 mm
- Min. clear aperture:** 21.0 mm
- Transmission:** >80% average within specified range
- Attenuation:** >99% average within specified range
- Slope:** <6%, where slope = $(\lambda_{80\%Tpk} - \lambda_{5\%Tabs}) / \lambda_{5\%Tabs}$
- Angle of incidence:** 0° ± 5°
- Substrate material:** Fused silica
- Coating material:** Refractory oxide
- Surface quality:** 80/50 per Mil-O-13830B
- Coating quality:** 40/20 per Mil-O-13830B
- Wedge:** <3 arc minutes
- Wavefront distortion:** ≤1 wave per inch
- Humidity resistance:** Per Mil-C-675A
- Abrasion resistance:** Per Mil-C-675A
- Optimum temp:** 23°C
- Temperature limits:** -50°C to 100°C
- Certification:** Spectrophotometer print of lot sample
- Cleaning:** Non-abrasive method, isopropyl alcohol on lens tissue recommended
- Laser Damage Threshold:**
 - CW: 1 W/cm²
 - Pulsed: 1 J/cm²

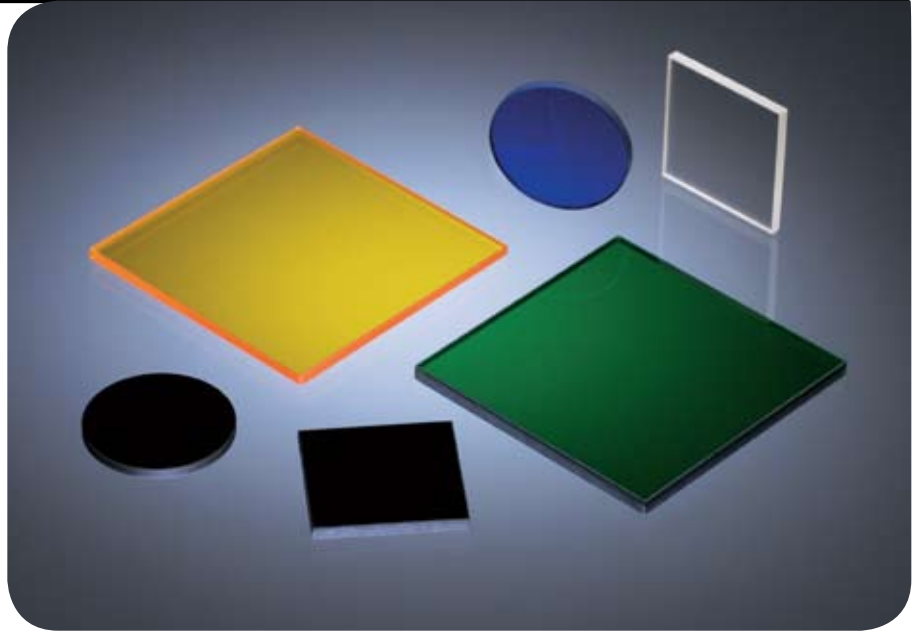
Long-pass Interference Filters

Catalog Number	CWOL (nm)	Attenuation Range (nm)	Wavelength at 50% T (nm)	Transmission Range (nm)	Price US
40-0062	400	320-380	400 ±10	440-1320	\$95.00
40-0067	450	360-425	450 ±10	495-1485	\$95.00
40-0072	500	400-475	500 ±10	550-1650	\$95.00
40-0077	550	440-520	550 ±10	605-1815	\$95.00
40-0082	600	480-565	600 ±10	660-1980	\$95.00
40-0087	650	520-615	650 ±10	715-2145	\$95.00
40-0092	700	560-660	700 ±10	770-2200	\$95.00
40-0097	750	600-710	750 ±10	825-2200	\$95.00
40-0103	800	640-755	800 ±10	880-2200	\$95.00
40-0108	850	680-805	850 ±10	935-2200	\$95.00
40-0113	900	720-850	900 ±10	990-2200	\$95.00
40-0118	950	760-900	950 ±10	1045-2200	\$95.00
40-0123	1000	800-945	1000 ±10	1100-2200	\$95.00

- Opto-mechanics
- Breadboards & Rails
- Mounting Hardware
- Mirror & Component Mounts
- Manual Micro-positioners
- Motorized Positioners

- Optical Instruments
- Light Sources
- Light Measurement
- Diode Laser Modules

Color Glass Filters



- **Wide variety of applications**
- **Standard Schott glasses for repeatability**
- **2" square or 1" round sizes**
- **Filter mounts also available**

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Diode Laser Modules

Absorbing glass filters are the simplest form of color filter. The transmittance curves for each type of glass are well known and repeatable. Thickness of the filter defines the actual transmission. These filters are ground to a specified thickness and polished to produce a given spectral transmission which is found by applying the correction factor in the table to the diagrams which follow. For filters of different thickness it is necessary to recompute the transmission using the following formula:

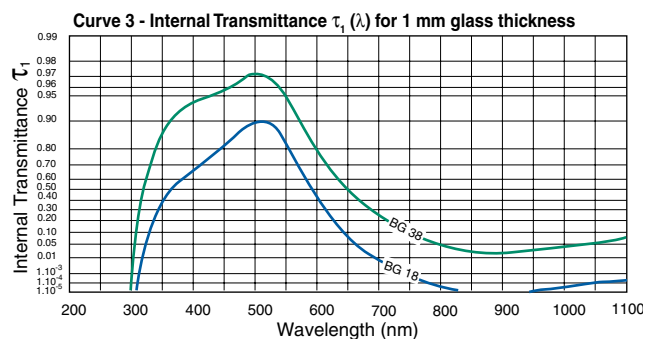
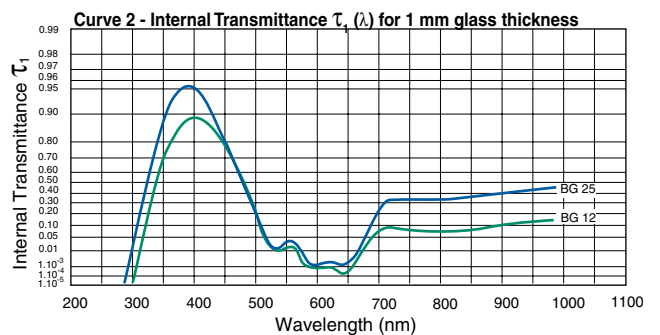
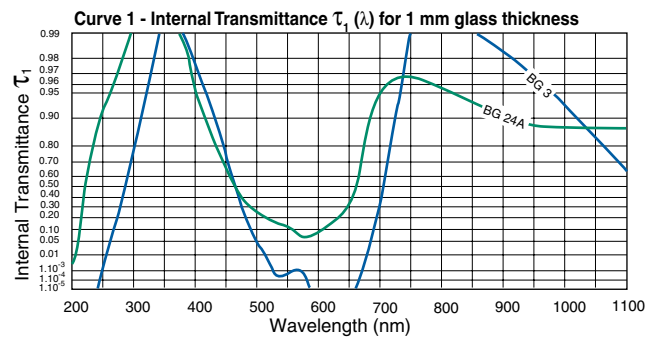
$$T = P(\tau_1(\lambda))^{d/d_0}$$

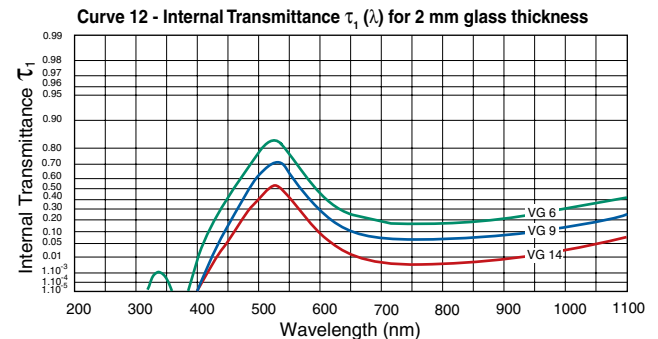
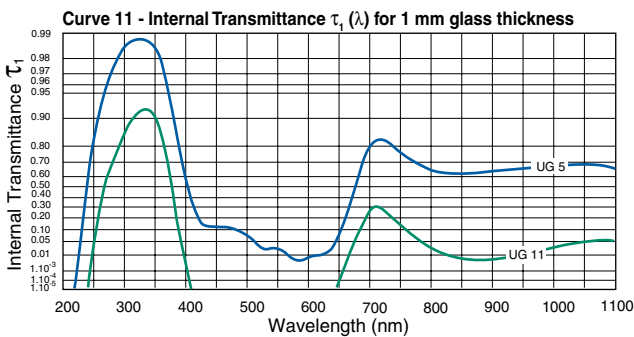
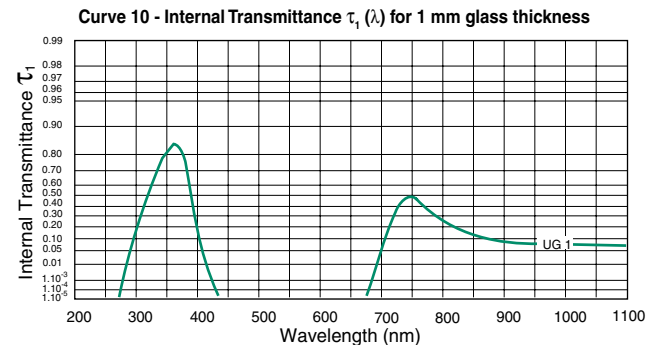
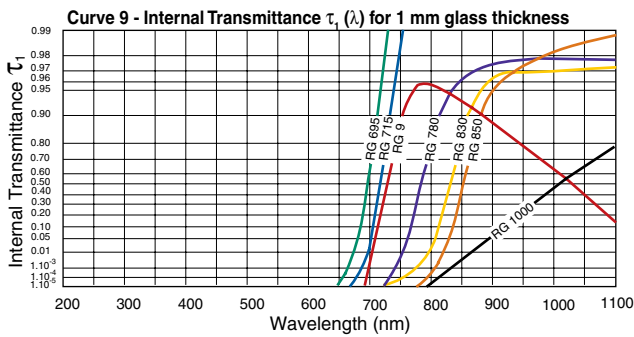
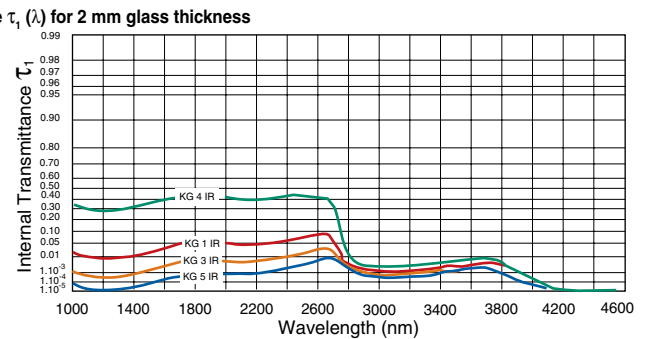
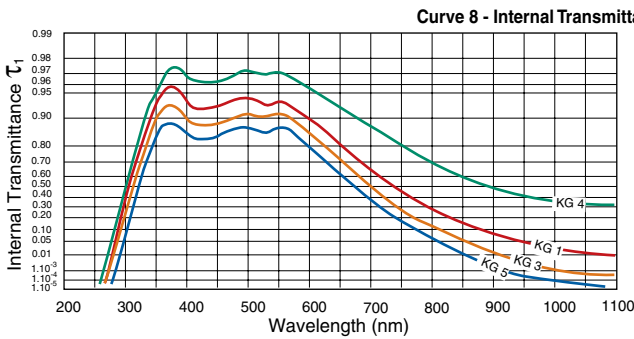
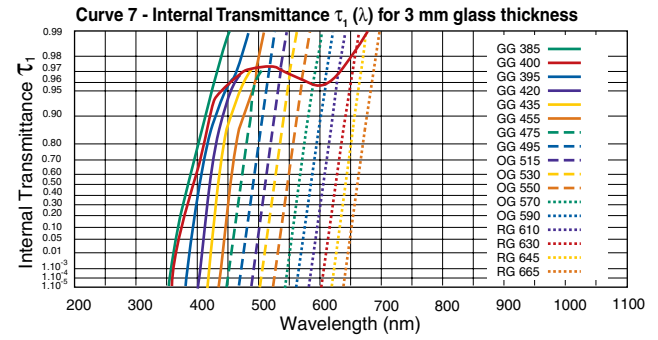
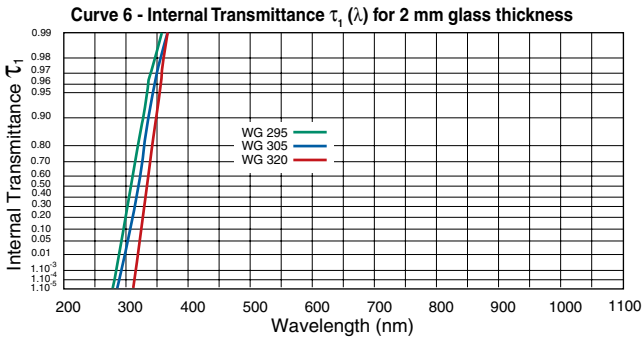
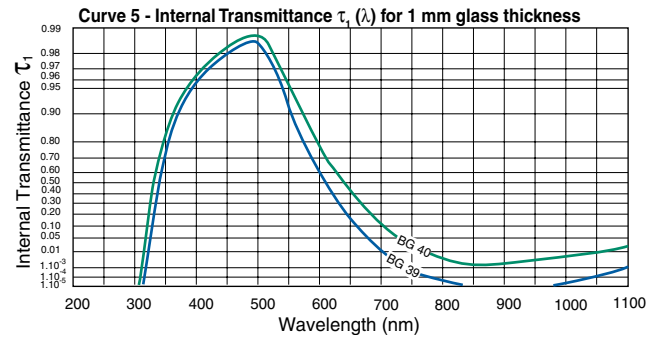
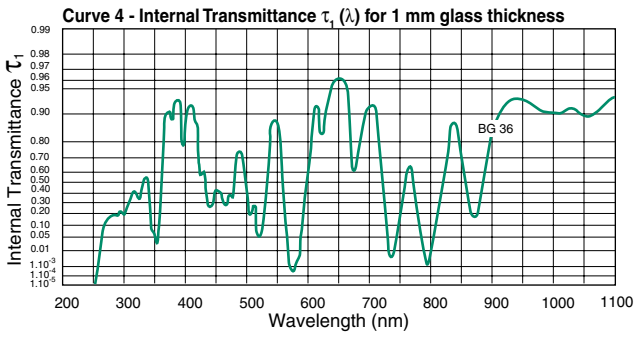
T = Total filter transmittance
 P = Correction factor
 $\tau_1(\lambda)$ = Transmittance at wavelength λ (see curves)
 d = Thickness in millimeters of the Ealing filter required.
 d_0 = Thickness in millimeters indicated above the curve for the material.

In colored glass filters the only effect of tilt is an increase in path length through the filter. For angles of incidence (θ) less than the Brewster angle (appx 57°), the new thickness can be calculated as follows:

$$t_0 = \frac{1}{\sqrt{1 - \sin^2 \theta}} t_0$$

Temperature change is of little concern in the application of colored glass filters. However, there is a small shift which could affect the performance of sharp cut filters in some circumstances. Normal operating temperature is 23°C .





- Optics
- Lenses & Microscope Components
- Coatings
- Mirrors, Beamsplitters
- Prisms & Polarizers
- Filters
- Pinholes

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- Motorized Positioners

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- Light Sources
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Optics

Lenses & Microscope Components

Coatings

Mirrors, Beam Splitters

Prisms & Polarizers

Filters

Pinholes

Specifications

Material: Schott Color Glass as in table

Dimensions Tolerance: ±0.3 mm

Thickness: 2-3 mm, typical

Thickness Tolerance: ±0.1 mm

Surface Quality: 60-40

Parallelism: <3 arcmin

Color Glass Filters

Glass Type	Schott Number	Curve Number	Factor P	25.4 mm (1") Diameter		50.8 mm (2") Square	
				Catalog Number	Price US	Catalog Number	Price US
Blue-green multi band glasses	BG-3	1	0.921	36-9207	\$22.00	26-5611	\$46.00
	BG-18	4	0.915	36-9231	\$22.00	26-5678	\$54.00
	BG-25	2	0.92	36-9264	\$22.00	26-5728	\$46.00
	BG-36	6	0.877	36-9306	\$54.00	26-5850	\$69.00
	BG-38	4	0.915	36-9314	\$22.00	26-2998	\$46.00
	BG-39	7	0.915	36-9322	\$22.00	26-6668	\$46.00
	BG-40	7	0.915	36-9330	\$22.00	26-6676	\$54.00
Yellow glasses	GG-395	11	0.894	36-9371	\$22.00	26-4739	\$46.00
	GG-400	11	0.913	36-9389	\$22.00	26-4242	\$46.00
	GG-420	11	0.913	36-9397	\$22.00	26-4267	\$46.00
	GG-435	11	0.912	36-9405	\$22.00	26-4275	\$46.00
	GG-455	11	0.913	36-9413	\$22.00	26-4283	\$46.00
	GG-475	11	0.914	36-9421	\$22.00	26-4291	\$46.00
	GG-495	11	0.914	36-9439	\$22.00	26-4317	\$46.00
IR absorbing glasses (virtually colorless)	KG-1	12	0.92	36-9447	\$23.10	26-3665	\$39.00
	KG-3	12	0.919	36-9454	\$23.10	26-3681	\$39.00
	KG-5	12	0.92	36-9470	\$23.10	26-6684	\$39.00
Orange glasses	OG-515	11	0.914	36-9561	\$22.00	26-4333	\$46.00
	OG-530	11	0.914	36-9579	\$22.00	26-4358	\$46.00
	OG-550	11	0.914	36-9587	\$22.00	26-4366	\$46.00
	OG-570	11	0.914	36-9595	\$22.00	26-4374	\$46.00
	OG-590	11	0.914	36-9603	\$22.00	26-4382	\$46.00
Red and black glasses with IR transmission	RG-9	13	0.914	36-9611	\$22.00	26-4499	\$54.00
	RG-610	11	0.916	36-9629	\$22.00	26-4390	\$46.00
	RG-630	11	0.917	36-9637	\$22.00	26-4416	\$46.00
	RG-645	11	0.914	36-9645	\$22.00	26-4424	\$46.00
	RG-665	11	0.913	36-9652	\$22.00	26-4432	\$46.00
	RG-695	13	0.914	36-9660	\$22.00	26-4440	\$46.00
	RG-715	13	0.914	36-9678	\$22.00	26-4457	\$54.00
	RG-780	13	0.915	36-9686	\$22.00	26-4465	\$54.00
	RG-830	13	0.911	36-9694	\$22.00	26-9571	\$54.00
	RG-850	13	0.91	36-9702	\$22.00	26-9589	\$54.00
Black and with UV transmission	UG-1	14	0.914	36-9728	\$23.10	26-5512	\$46.00
	UG-5	15	0.917	36-9736	\$54.00	26-5553	\$68.00
	UG-11	15	0.909	36-9744	\$48.00	26-5579	\$78.00
Green	VG-9	16	0.911	36-9769	\$22.00	26-3269	\$46.00
UV long-pass	WG-295	10	0.919	36-9785	\$22.00	26-4622	\$46.00
	WG-305	10	0.918	36-9793	\$22.00	26-4630	\$46.00
	WG-320	10	0.903	36-9801	\$22.00	26-4648	\$46.00

Opto-mechanics

Breadboards & Rails

Mounting Hardware

Mirror & Component Mounts

Manual Micro-positioners

Motorized Positioners

Optical Instruments

Light Sources

Light Measurement

Diode Laser Modules

Color Glass Filter Sets

- 11 standard color glass filters
- Supplied in foam lined, hardwood storage box

Ealing offers a convenient set of 12 color glass filters supplied in a foam lined hardwood box. These sets include the following filters: BG-25, BG-39, GG-420, GG-475, KG-3, OG-550, RG-610, RG-850, UG-11, VG-9, and WG-320.



Color Glass Filter Set

Catalog Number	Description	Price US
26-2238	1 inch diameter set	\$296.00
26-2254	2 inch square set	\$580.00

Optics

- Lenses & Microscope Components
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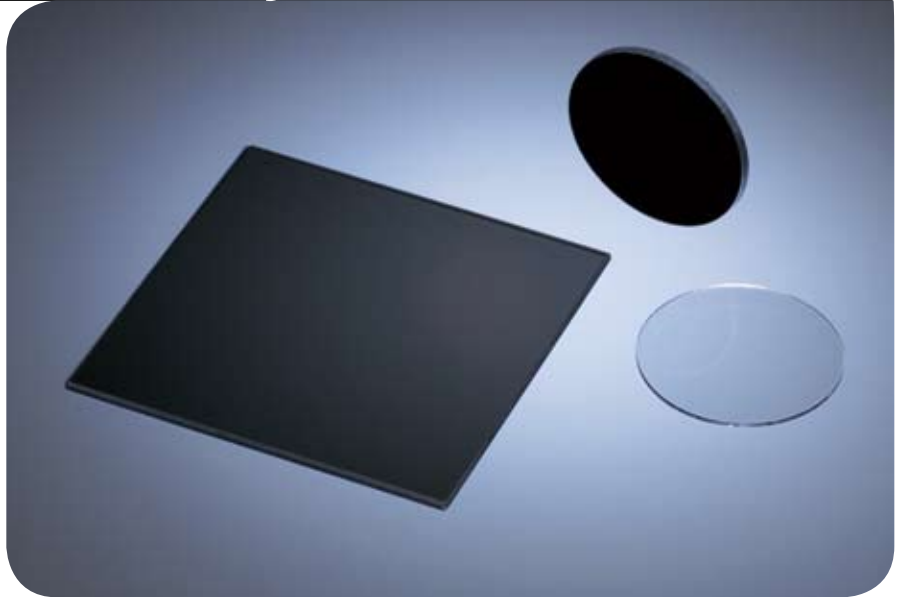
Opto-mechanics

- Breadboards & Rails
- Mounting Hardware
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- Motorized Positioners

Optical Instruments

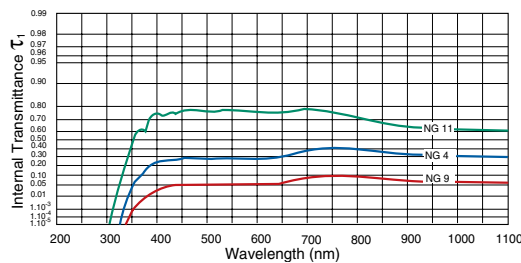
- Light Sources
- Light Measurement
- Diode Laser Modules

Absorptive Neutral Density Filters



- **Good general purpose attenuators**
- **Optical density values to 4**
- **Stackable without concern for multiple reflections**

Spectral Response of Neutral Density Filters (1 mm thick samples)



Specifications

Material: Schott Optical Glass
Dimensions Tolerance: +0/ -0.508 mm
Surface Quality: 60-40
Spectral Range: 400-1100 nm

Absorptive Neutral Density Filters

Optical Density	Schott Glass Type	Transmission (%)	25.4 mm (1") Diameter		50.8 mm (2") Square	
			Catalog Number	Price US	Catalog Number	Price US
0.1	NG11	79.4	36-5304	\$40.00	36-4430	\$79.20
0.2	NG11	63.1	36-5326	\$40.00	36-4448	\$79.20
0.3	NG11	50.1	36-5338	\$40.00	36-4679	\$79.20
0.4	NG4	39.8	36-5346	\$40.00	36-4455	\$79.20
0.5	NG4	31.6	36-5353	\$40.00	36-4463	\$79.20
0.6	NG4	25.1	36-5361	\$40.00	36-4687	\$79.20
1.0	NG4	10.0	36-5403	\$40.00	36-4695	\$79.20
2.0	NG9	1.0	36-5437	\$40.00	36-4729	\$79.20
3.0	NG9	0.1	36-5460	\$40.00	36-4752	\$79.20
4.0	NG9	0.01	36-5494	\$40.00	36-4786	\$79.20

Neutral density filters are used to control the intensity level without affecting the spectral response of the system. They are normally specified in terms of their optical density which is defined as the logarithm of the ratio of intensities in the incident and transmitted beams as follows:

This series of absorbing glass neutral

$$D = \log_{10} \frac{I_0}{I_t}$$

density filters is offered in small increments from $D=0.1$ up to $D=4$. The thickness of the filters is controlled to produce a calibrated optical density at

546 nm. The response is approximately neutral so they can be used as broad band devices. However, if used at other wavelengths the optical densities will not be exactly as stated for 546 nm. Since these filters rely on absorption as the attenuation mechanism they may be combined in stacks without concern for multiple reflection effects. Optical densities may be combined additively when stacking these filters.

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Coatings

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Optical Instruments

Light Sources

Light Measurement

Diode Laser Modules

Absorptive Neutral Density Filter Sets

- **Convenient set of 10 filters**
- **Complete range of optical densities**
- **Supplied with wooden storage box**



These sets consist of 10 absorptive neutral density filters. This provides a full range of optical densities. The sets are supplied in a foam lined hardwood storage box. Detailed specifications for these filters are as listed on the previous page.

Absorptive Neutral Density Filter Sets

Catalog Number	Description	Price US
36-4840	Absorptive Neutral Density Filter Set, 25.4 mm (1") diameter	\$400.00
36-4832	Absorptive Neutral Density Filter Set, 50.8 mm (2") square	\$792.00

Filter Storage Boxes

- **Excellent for storing 1" or 2" filters**
- **High quality hardwood construction**



A range of attractive hardwood boxes is available to provide safe and convenient storage of filters when not in use. The boxes are foam lined with molded recesses to secure each individual filter.

Filter Storage Boxes

Catalog Number	Description	Price
31-4948	Storage Box for 6 x 25.4 mm Diameter Filters	\$28.00
31-4955	Storage Box for 12 x 25.4 mm Diameter Filters	\$32.00
31-4906	Storage Box for 24 x 25.4 mm Diameter Filters	\$36.00
31-4963	Storage Box for 6 x 50.8 mm Square Filters	\$30.00
31-4914	Storage Box for 12 x 50.8 mm Square Filters	\$36.00
31-4971	Storage Box for 24 x 50.8 mm Square Filters	\$56.00

Optics

Lenses & Microscope Components

Coatings

Mirrors, Beamsplitters

Prisms & Polarizers

Filters

Pinholes

Opto-mechanics

Breadboards & Rails

Mounting Hardware

Mirror & Component Mounts

Manual Micro-positioners

Motorized Positioners

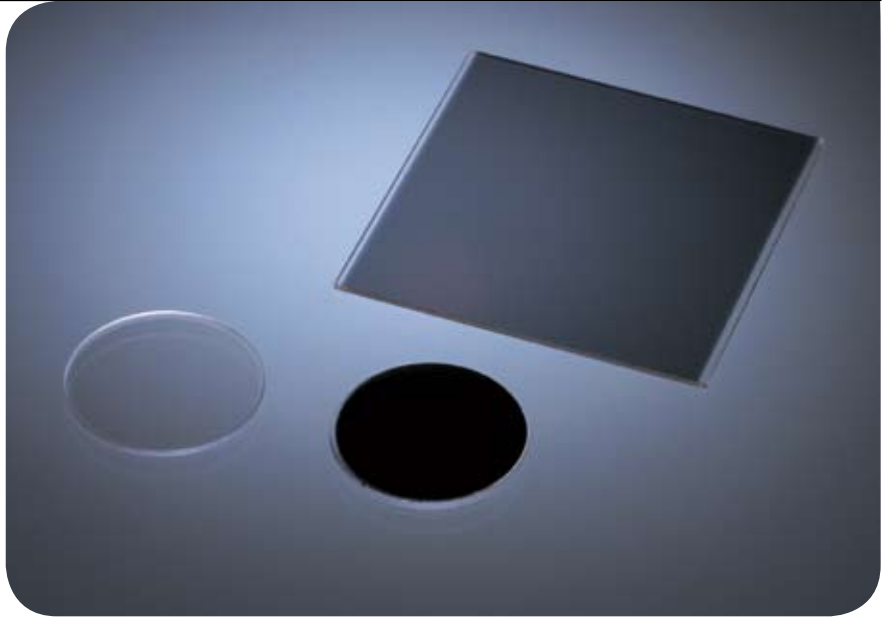
Optical Instruments

Light Sources

Light Measurement

Diode Laser Modules

Reflective Neutral Density Filters



- **Optical densities from 0.1 to 4**
- **Wavelength insensitive transmission**
- **Useable over 280-2000 nm**

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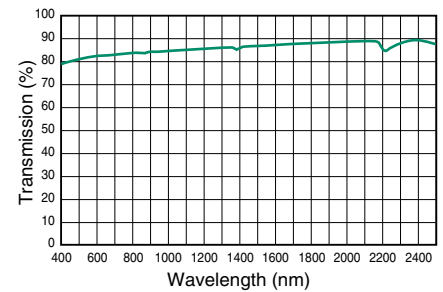
Diode Laser Modules

There are two ways to achieve neutral attenuation: reflection or absorption of the unwanted light. These Ealing reflective filters use a layer of inconel on a flat polished substrate. Inconel has the property that it is neutral over a large wavelength range. It also adheres well and can be controllably deposited to assure precise reflectance and transmittance values. These filters are supplied on fused silica substrates. The fused silica substrates will cover

a wavelength range from 280 nm-2 μ m. Since the attenuation mechanism is reflection these may also be used as effective beamsplitters.

Neutral density filters are normally specified in terms of their optical density which is defined as the logarithm of the ratio of intensities in the incident and transmitted beams as follows:

$$D = \log_{10} \frac{I_o}{I_t}$$



Typical Spectral Response of Inconel on Fused Silica

Specifications

Substrate: UV Fused Silica

Coating: Inconel

Dimensions Tolerance:

+0, -0.508 mm for 25.4 mm

+0, -0.813 mm for 50.8 mm

Clear Aperture: 80% of central diameter

Surface Quality: 80-50

Spectral Range: 280-2000 nm

Optical Density Tolerance:

\pm 10% of density at 546.1 nm

Reflective Neutral Density Filters

Optical Density	Transmission (%)	25.4 mm (1") Diameter		50.8 mm (2") Square	
		Catalog Number	Price US	Catalog Number	Price US
0.1	79.4	35-6048	\$90.00	35-6055	\$130.00
0.2	63.1	35-6063	\$90.00	35-6071	\$130.00
0.3	50.1	35-6089	\$90.00	35-6097	\$130.00
0.4	39.8	35-6105	\$90.00	35-6113	\$130.00
0.5	31.6	35-6121	\$90.00	35-6139	\$130.00
0.6	25.0	35-6147	\$90.00	35-6154	\$130.00
0.7	20.0	35-6162	\$90.00	35-6170	\$130.00
0.8	15.9	35-6188	\$90.00	35-6196	\$130.00
0.9	12.6	35-6204	\$90.00	35-6212	\$130.00
1.0	10.0	35-6220	\$90.00	35-6238	\$130.00
1.5	3.2	35-6246	\$110.00	35-6253	\$145.00
2.0	1.0	35-6261	\$110.00	35-6279	\$145.00
3.0	0.1	35-6287	\$110.00	35-6295	\$145.00
4.0	0.01	35-6303	\$110.00	35-6311	\$145.00

Reflective Neutral Density Filter Sets



These filter sets include one each of the ten reflective neutral density filters up to an optical density of 1. They are useful as experimental attenuator and beamsplitter sets. Quartz substrates are used in these sets so they cover the

entire wavelength spectrum from UV to IR. The set is supplied in a foam lined hardwood storage box. Detailed specifications for these filters are listed individually.

Reflective Neutral Density Filter Sets

Description	25.4 mm (1") Diameter		50.8 mm (2") Square	
	Catalog Number	Price US	Catalog Number	Price US
Reflective Neutral Density Filter Set	35-7723	\$605.00	35-7731	\$1060.00

Modular Filter Wheels are also available.



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