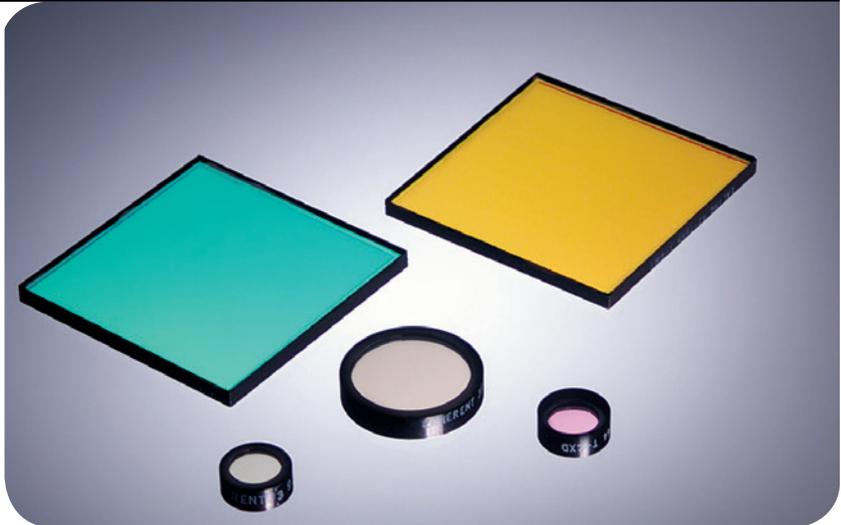


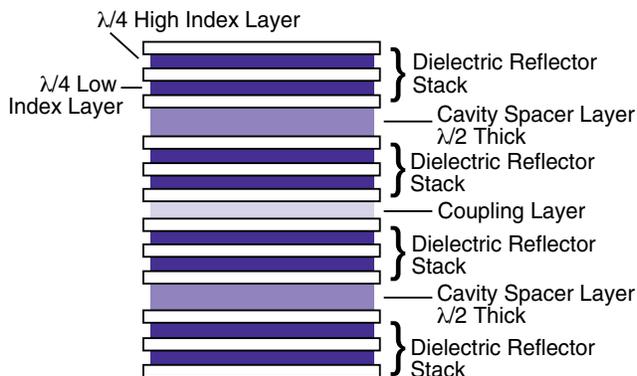
# Bandpass Interference Filters



- **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**

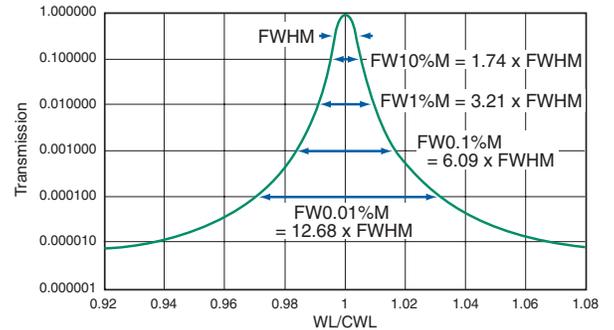
Essentially a stack of Fabry-Perot cavities, these filters select the transmitted spectrum by constructive and destructive interference at the boundaries between high and low index dielectric layers. Several cavities may be combined to produce a sharper cut-off and to alter the shape of the passband. 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.

## Two Cavity All-Dielectric Filter



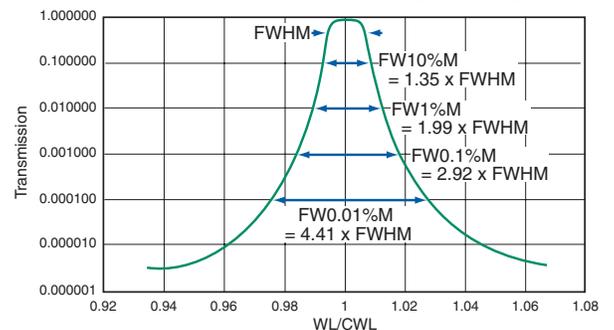
## 2 Cavity Filter

For Filters with FWHM of 0.40 to 0.75% of CWL



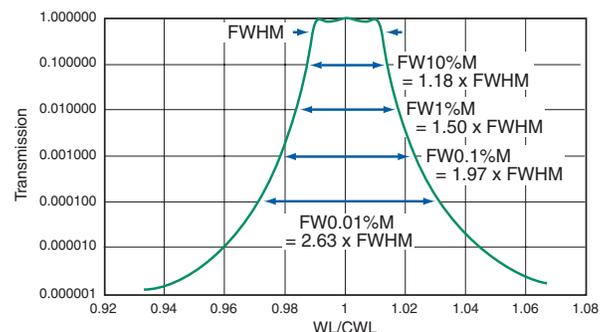
## 3 Cavity Filter

For Filters with FWHM of 0.75 to 2.5% of CWL



## 4 Cavity Filter

For Filters with FWHM of 2.5 to 5.0% of CWL



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:  $\lambda_o$  = Central wavelength at normal incidence.  
 $\lambda_o$  = Central wavelength at the off-normal angle  $\theta$ .  
 $n^*$  = 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. 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 ( $\lambda\theta/\lambda_o$ ) with Tilt Angle ( $\theta$ )

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 +/-0.25 mm diameter
- 1" 25.4 +/-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

- Optics
  - Lenses
  - Mirrors & Beamsplitters
  - Prisms & Polarizers
  - Filters
  - Pinholes
- Opto-mechanics
  - Breadboards & Rails
  - Mounting Hardware
  - Mirror & Component Mounts
  - Manual Micro Positioners
  - Motorized Positioners

**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	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
Mirrors & Beamsplitters	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
Prisms & Polarizers	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
Filters	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
	632.8 + 1.0/ - 0	3 ± 0.5	40%	HeNe	42-4898	\$99.00	42-4940	\$147.00
Pinholes	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
	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

**Opto-mechanics**

**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
Mounting Hardware	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

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	\$42.00	35-3089	\$92.00
394.0 ± 2.0	10 ± 2	30%	S	42-5038	\$42.00	35-3092	\$92.00
400.0 ± 2.0	10 ± 2	40%	Dy, Yb	42-5041	\$42.00	35-3201	\$92.00
400.0 ± 8.0	40 ± 8	40%		42-5044	\$42.00	35-3204	\$92.00
404.7 + 3.0/ - 1.0	10 ± 2	40%	Hg, BioMed	42-5058	\$42.00	35-3227	\$92.00
410.0 ± 2.0	10 ± 2	40%	Ni, H-Delta	42-5066	\$42.00	35-3243	\$92.00
420.0 ± 2.0	10 ± 2	40%	Eu, Ar	42-5082	\$42.00	35-3284	\$92.00
430.0 ± 2.0	10 ± 2	40%	Ar, Sm, W	42-5090	\$42.00	35-3300	\$92.00
435.8 + 3.0/ - 1.0	10 ± 2	40%	Hg, BioMed	42-5108	\$42.00	35-3326	\$92.00
440.0 ± 2.0	10 ± 2	40%		42-5116	\$42.00	35-3342	\$92.00
441.6 + 3.0/ - 1.0	10 ± 2	40%	HeCd	42-5119	\$42.00	35-3345	\$92.00
450.0 ± 2.0	10 ± 2	40%	He, Ni, BioM	42-5124	\$42.00	35-3367	\$92.00
450.0 ± 8.0	40 ± 8	60%		42-5132	\$42.00	35-5024	\$92.00
457.9 + 3.0/ - 1.0	10 ± 2	40%	Ar	42-5140	\$42.00	35-3383	\$92.00
460.0 ± 2.0	10 ± 2	40%	Eu, Sr	42-5157	\$42.00	35-3409	\$92.00
467.0 ± 2.0	10 ± 2	45%	Xe	42-6965	\$42.00	42-7294	\$92.00
470.0 ± 2.0	10 ± 2	45%	Cd, Br	42-5165	\$42.00	35-3425	\$92.00
476.0 ± 2.0	10 ± 2	45%		42-5168	\$42.00	35-3428	\$92.00
480.0 ± 2.0	10 ± 2	45%	Cd	42-5173	\$42.00	35-3441	\$92.00
486.1 + 3.0/ - 1.0	10 ± 2	45%	Zn, H-Beta	42-5177	\$42.00	35-3444	\$92.00
488.0 + 3.0/ - 1.0	10 ± 2	45%	Ar	42-5181	\$42.00	35-3466	\$92.00
490.0 ± 2.0	10 ± 2	45%	He, BioMed	42-5199	\$42.00	35-3482	\$92.00
500.0 ± 2.0	10 ± 2	45%		42-5207	\$42.00	35-3508	\$92.00
500.0 ± 8.0	40 ± 8	65%		42-5215	\$42.00	35-5040	\$92.00
500.0 ± 8.0	70 ± 8	65%		42-6999	\$42.00	42-7302	\$92.00
505.0 ± 2.0	10 ± 2	45%		42-7002	\$42.00	35-3537	\$92.00
510.0 ± 2.0	10 ± 2	45%	Cd, Cu	42-5223	\$42.00	35-3540	\$92.00
514.5 + 3.0/ - 1.0	10 ± 2	45%	Ar	42-5231	\$42.00	35-3565	\$92.00
520.0 ± 2.0	10 ± 2	45%	Ba, Mg	42-5249	\$42.00	35-3581	\$92.00
530.0 ± 2.0	10 ± 2	45%		42-5256	\$42.00	35-3607	\$92.00
532.0 + 3.0/ - 1.0	10 ± 2	45%	Nd	42-5264	\$42.00	35-3623	\$92.00
540.0 ± 2.0	10 ± 2	50%	Ne, BioMed	42-5272	\$42.00	35-3649	\$92.00
543.5 + 3.0/ - 1.0	10 ± 2	50%		42-5275	\$42.00	35-3652	\$92.00
546.1 + 3.0, - 1.0	10 ± 2	50%	Hg	42-5280	\$42.00	35-3664	\$92.00
550.0 ± 2.0	10 ± 2	50%		42-5298	\$42.00	35-3680	\$92.00
550.0 ± 8.0	40 ± 8	65%		42-5306	\$42.00	35-5065	\$92.00
550.0 ± 8.0	70 ± 8	75%		42-7039	\$42.00	42-7310	\$92.00
560.0 ± 2.0	10 ± 2	50%		42-5314	\$42.00	35-3706	\$92.00
568.2 ± 2.0	10 ± 2	50%		42-7047	\$42.00	42-7328	\$92.00
570.0 ± 2.0	10 ± 2	50%	Na	42-5322	\$42.00	35-3722	\$92.00
577.0 + 3.0/ - 1.0	10 ± 2	50%	Hg	42-5330	\$42.00	35-3748	\$92.00
580.0 ± 2.0	10 ± 2	50%	Hg	42-5348	\$42.00	35-3763	\$92.00
589.3 + 3.0/ - 1.0	10 ± 2	50%	Na	42-5355	\$42.00	35-3789	\$92.00
590.0 ± 2.0	10 ± 2	50%	BioMed	42-5363	\$42.00	35-3805	\$92.00
600.0 ± 2.0	10 ± 2	50%	BioMed	42-5371	\$42.00	35-3821	\$92.00
600.0 ± 8.0	40 ± 8	65%		42-5389	\$42.00	35-5081	\$92.00
600.0 ± 8.0	65 ± 8	75%		42-7062	\$42.00	42-7366	\$92.00
610.0 ± 2.0	10 ± 2	50%	Ne	42-5397	\$42.00	35-3847	\$92.00
620.0 ± 2.0	10 ± 2	50%	Ca	42-5405	\$42.00	35-3862	\$92.00
630.0 ± 2.0	10 ± 2	50%	O	42-5413	\$42.00	35-3888	\$92.00
632.8 + 3.0/ - 1.0	10 ± 2	50%	HeNe	42-5421	\$42.00	35-3904	\$92.00
632.8 + 3.0/ - 1.0	10 ± 2	75%	HeNe	42-5439	\$42.00	35-4126	\$92.00
632.8 ± 8.0	40 ± 8	75%	HeNe	42-5447	\$42.00	42-7344	\$92.00
636.0 ± 2.0	10 ± 2	50%		42-7088	\$42.00	42-7351	\$92.00

- Optics
- Lenses
- Mirrors & Beamsplitters
- Prisms & Polarizers
- Filters
- Pinholes
- Opto-mechanics
- Breadboards & Rails
- Mounting Hardware
- Mirror & Component Mounts
- Manual Micro Positioners
- Motorized Positioners

**Optics**

**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	640.0 ± 2.0	10 ± 2	50%	Ne	42-5454	\$42.00	35-3920	\$92.00
	647.1 + 3.0/ - 1.0	10 ± 2	50%	Kr	42-5462	\$42.00	35-3946	\$92.00
Mirrors & Beamsplitters	650.0 ± 2.0	10 ± 2	50%	Ca, BioMed	42-5470	\$42.00	35-3961	\$92.00
	650.0 ± 8.0	40 ± 8	65%		42-5488	\$42.00	35-5107	\$92.00
Prisms & Polarizers	656.3 + 3.0/ - 1.0	10 ± 2	50%	H-Alpha	42-5496	\$42.00	35-3987	\$92.00
	660.0 ± 2.0	10 ± 2	50%		42-5504	\$42.00	35-4001	\$92.00
	660.0 ± 8.0	40 ± 2	75%		42-7120	\$42.00	42-7377	\$92.00
Filters	670.0 ± 2.0	10 ± 2	50%	Diode	42-5512	\$42.00	35-4027	\$92.00
	670.0 ± 2.0	10 ± 2	75%	Diode	42-5520	\$42.00	42-7385	\$92.00
	670.0 ± 8.0	40 ± 8	75%	Diode	42-5538	\$42.00	42-7393	\$92.00
Pinholes	675.0 ± 2.0	10 ± 2	50%	Diode	42-5541	\$42.00	35-4065	\$92.00
	680.0 ± 2.0	10 ± 2	50%		42-5546	\$42.00	35-4068	\$92.00
	685.0 ± 2.0	10 ± 2	50%		42-5549	\$42.00	35-4071	\$92.00
	690.0 ± 2.0	10 ± 2	50%	Hg, O	42-5553	\$42.00	35-4084	\$92.00
	694.3 + 3.0/ - 1.0	10 ± 2	50%	Ruby	42-5561	\$42.00	35-4100	\$92.00
	700.0 ± 2.0	10 ± 2	50%		42-5579	\$42.00	35-4167	\$92.00
	700.0 ± 8.0	40 ± 8	65%		42-5587	\$42.00	35-5123	\$92.00
Opto-mechanics	710.0 ± 2.0	10 ± 2	50%		42-5595	\$42.00	42-7419	\$92.00
	720.0 ± 2.0	10 ± 2	50%		42-5603	\$42.00	35-4209	\$92.00
	730.0 ± 2.0	10 ± 2	50%	Diode	42-5611	\$42.00	35-4225	\$92.00
Breadboards & Rails	730.0 ± 2.0	30 ± 8	75%	Diode	42-5629	\$42.00	35-6345	\$92.00
	740.0 ± 2.0	10 ± 2	50%		42-5637	\$42.00	35-4241	\$92.00
	750.0 ± 2.0	10 ± 2	50%	Alexandrite	42-5645	\$42.00	35-4266	\$92.00
Mounting Hardware	760.0 ± 2.0	10 ± 2	45%	O	42-5660	\$42.00	35-4282	\$92.00
	766.5 + 3.0/ - 1.0	10 ± 2	45%	K	42-5663	\$42.00	35-7285	\$92.00
	770.0 ± 2.0	10 ± 2	45%		42-5678	\$42.00	35-4324	\$92.00
Mirror & Component Mounts	780.0 + 3.0/ - 1.0	10 ± 2	45%	Rb, Diode	42-5686	\$42.00	35-4340	\$92.00
	780.0 ± 8.0	30 ± 8	75%	Rb, Diode	42-5694	\$42.00	35-5537	\$92.00

Manual Micro Positioners

Motorized Positioners

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
640.0 ± 2.0	10 ± 2	50%	Ne	42-5454	\$42.00	35-3920	\$92.00
790.0 ± 2.0	10 ± 2	45%		42-5702	\$50.00	35-4365	\$121.00
800.0 ± 2.0	10 ± 2	45%	Ar	42-5710	\$50.00	35-4381	\$121.00
800.0 ± 8.0	65 ± 8	75%	Ar	42-7195	\$50.00	42-7435	\$121.00
810.0 ± 2.0	10 ± 2	45%	Diode	42-5728	\$50.00	35-4407	\$121.00
820.0 ± 2.0	10 ± 2	45%		42-5736	\$50.00	35-4423	\$121.00
830.0 ± 2.0	10 ± 2	45%	Diode	42-5744	\$50.00	35-4449	\$121.00
830.0 ± 8.0	40 ± 8	75%	Diode	42-5751	\$50.00	35-4452	\$121.00
840.0 ± 2.0	10 ± 2	45%		42-5769	\$50.00	35-4464	\$121.00
850.0 ± 2.0	10 ± 2	45%	Hg, Diode	42-5777	\$50.00	35-4480	\$121.00
850 ± 8.0	70 ± 8	65%		42-7229	\$50.00	42-7443	\$121.00
855 ± 8.0	40 ± 8	75%		42-5785	\$50.00	35-2583	\$121.00
870.0 ± 2.0	10 ± 2	45%	Diode	42-5793	\$50.00	35-4522	\$121.00
880.0 ± 2.0	10 ± 2	45%	Diode	42-5801	\$50.00	35-4548	\$121.00
880.0 ± 8.0	40 ± 8	65%		42-5819	\$50.00	35-4969	\$121.00
900.0 ± 2.0	10 ± 2	45%		42-5835	\$50.00	35-4589	\$121.00
905.0 ± 2.0	10 ± 2	45%	Diode	42-7260	\$50.00	42-7476	\$121.00
905.0 ± 8.0	50 ± 8	75%	Diode	42-5843	\$50.00	35-4985	\$121.00
920.0 ± 2.0	10 ± 2	45%		42-5847	\$50.00	35-4988	\$121.00
920.0 ± 2.0	10 ± 2	45%		42-5847	\$60.00	35-4988	\$121.00
940.0 ± 2.0	10 ± 2	45%	Diode	42-5868	\$60.00	35-4688	\$121.00
950.0 ± 2.0	10 ± 2	45%	Diode	42-5884	\$60.00	35-4704	\$121.00
950 ± 8.0	70 ± 8	65%		42-7278	\$60.00	42-7484	\$121.00
970.0 ± 2.0	10 ± 2	45%		42-7281	\$60.00	42-7487	\$121.00
1000.0 ± 2.0	10 ± 2	45%		42-5892	\$60.00	42-7492	\$121.00
1050.0 ± 2.0	10 ± 2	45%		42-5900	\$60.00	42-7500	\$121.00
1064.0 + 3.0/ - 0	10 ± 2	40%	Nd	42-5918	\$60.00	35-4944	\$121.00
1100.0 ± 2.0	10 ± 2	40%		42-5934	\$60.00	42-6254	\$121.00
1150.0 ± 2.0	10 ± 2	40%		42-5937	\$60.00	42-6257	\$121.00
1200.0 ± 2.0	10 ± 2	40%		42-5983	\$60.00	42-6304	\$121.00
1250.0 ± 2.0	10 ± 2	40%		42-5986	\$60.00	42-6307	\$121.00
1300.0 ± 2.0	12 ± 2	35%	Diode	42-6031	\$60.00	42-6353	\$121.00
1350.0 ± 2.0	12 ± 2	35%	Diode	42-6034	\$60.00	42-6356	\$121.00
1400.0 ± 2.0	12 ± 2	35%	Diode	42-6080	\$60.00	42-6403	\$121.00
1450.0 ± 2.0	12 ± 2	35%		42-6083	\$60.00	42-6406	\$121.00
1500.0 ± 2.0	12 ± 2	35%	Diode	42-6130	\$60.00	42-6452	\$121.00
1550.0 ± 2.0	12 ± 2	35%	Diode	42-6133	\$60.00	42-6455	\$121.00

- Optics
  - Lenses
  - Mirrors & Beamsplitters
  - Prisms & Polarizers
  - Filters
  - Pinholes
- Opto-mechanics
  - Breadboards & Rails
  - Mounting Hardware
  - Mirror & Component Mounts
  - Manual Micro Positioners
  - Motorized Positioners