ABOUT BANDPASS FILTERS

The use of bandpass filters is one of the simplest and most economical way to transmit a well-defined band of light and to reject all other unwanted radiation. Their design is essentially a thin film Fabry-Perot interferometer formed by vacuum deposition, and consists of two reflecting stacks separated by an even-order spacer layer.

Because the Fabry-Perot filter is essentially Lorentzian in shape, the cut-on and cut-off slopes are shallow and the rate of attenuation in the out-of-band blocking range is slow. To improve the slopes and increase the attenuation in the blocking band, we introduce more cavities into the construction of our standard dielectric bandpass filters.

Minimizing Wavelength Shift

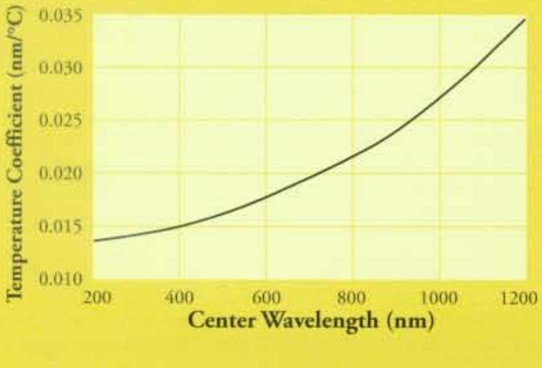
Ambient temperature and optical path geometry are important factors to consider in selecting or specifying bandpass filters.

AMBIENT TEMPERATURE

The center wavelength of a bandpass filter shifts linearly with changes in ambient temperature—up with a positive change and down with a negative change. The temperature coefficient chart below gives a good approximation of the shift in wavelength for a given temperature change.

To counter these effects, Andover has developed temperature controllers that help to maintain ambient temperature of passband filters. *(For more information, see page 23.)*

TEMPERATURE WAVELENGTH SHIFT COEFFICIENT



ANGLE OF INCIDENCE

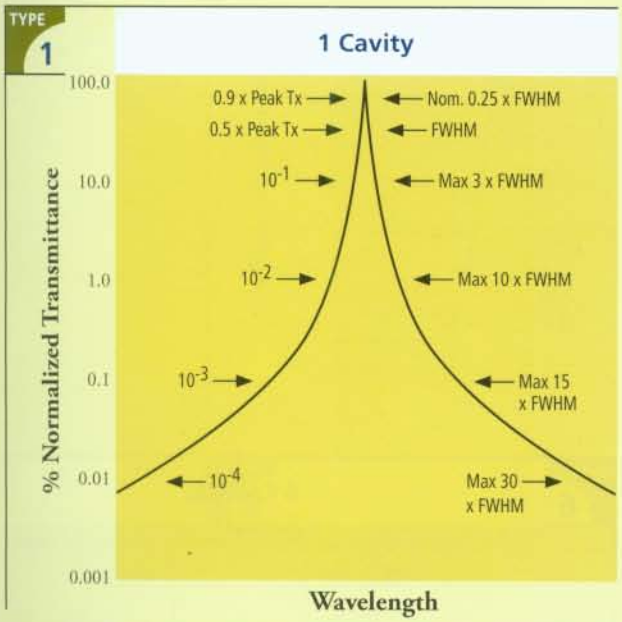
The central wavelength of the all-dielectric Fabry-Perot filter shifts lower with an increase in the incident angle. The amount of shift depends upon the incident angle and the filter's effective index (N*). This feature can be very useful in tuning a filter to the desired central wavelength. Use the formula below to determine the wavelength shift of a filter in collimated light with incident angles up to 15°.

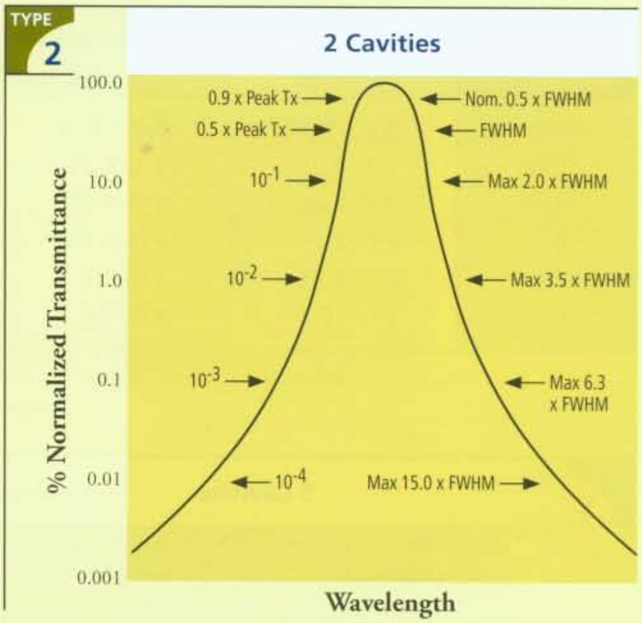
$$\lambda_\theta = \lambda_0 \left[1-\left(\tfrac{Ne}{N^*}\right)^2 \sin^2\theta \right]^{\frac{1}{2}}$$

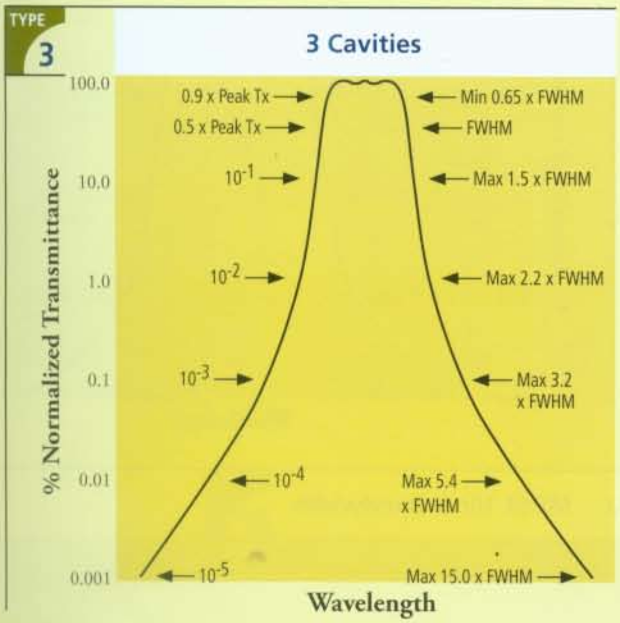
Where: λ_θ = Wavelength at angle of incidence
λ_0 = Wavelength at normal incidence
Ne = Refractive index of external medium
N* = Effective refractive index of the filter
θ = Angle of incidence

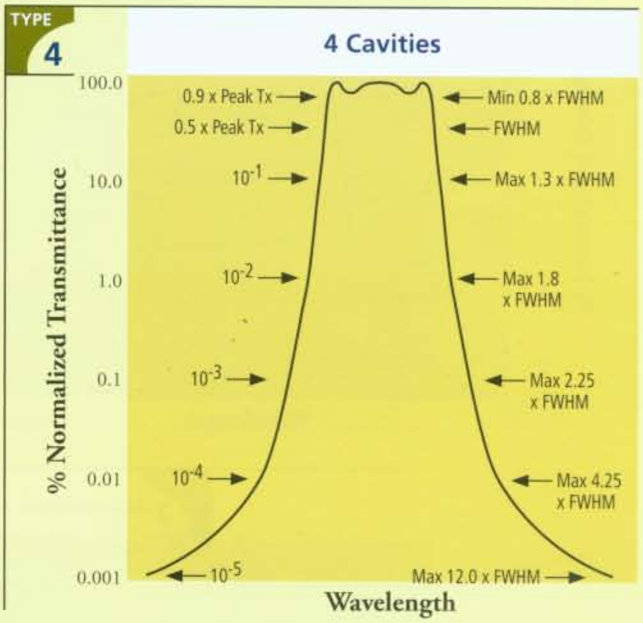
When using a filter with non-collimated light, the wavelength shift will appear somewhat less than that of collimated light at the same angle. In a cone of light, only the central ray is normal to the surface while all others are increasingly off-angle. To approximate this shift, use this same formula and divide the results by two. (This approach works in systems where the full cone angle is up to 20°.)

Spectral Profiles for Andover's 10 Basic Filter Types



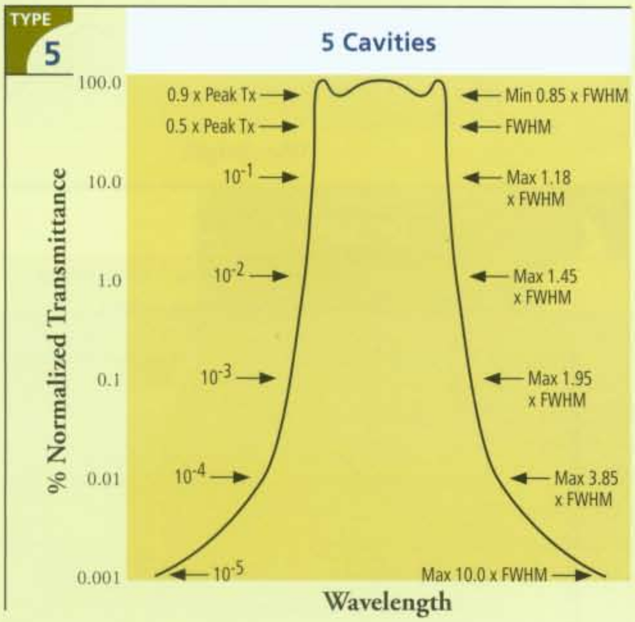




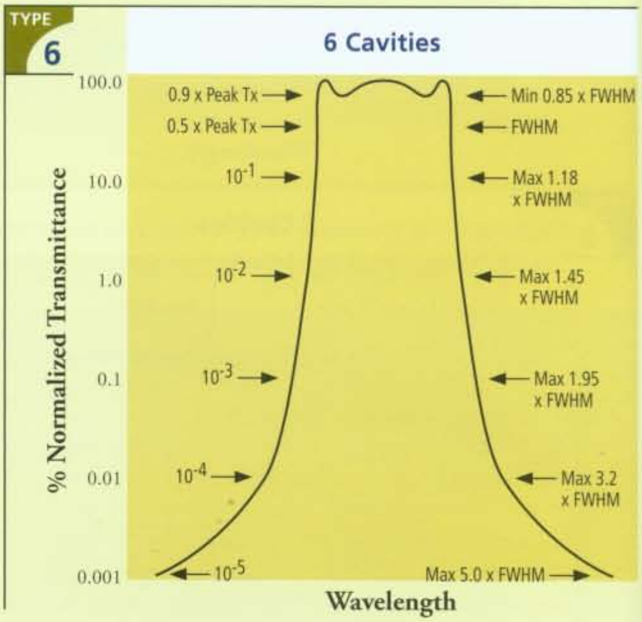


Normalized Transmittance of Peak (%)	Full Bandwidth Multiplier (FWHM)			
	1 Cavity	2 Cavities	3 Cavities	4 Cavities
90.0	0.25 nom.	0.5 nom.	0.65–0.70	0.8–0.9
10.0	2.5–3.0	1.6–2.0	1.2–1.5	1.1–1.3
1.0	8.0–10.0	2.8–3.5	1.9–2.2	1.5–1.8
0.1	15.0–20.0	5.5–6.3	2.9–3.2	2.0–2.25
0.01	undefined	10.0–15.0	4.9–5.4	3.5–4.25
0.001	undefined	undefined	10.0–15.0	9.0–12.0

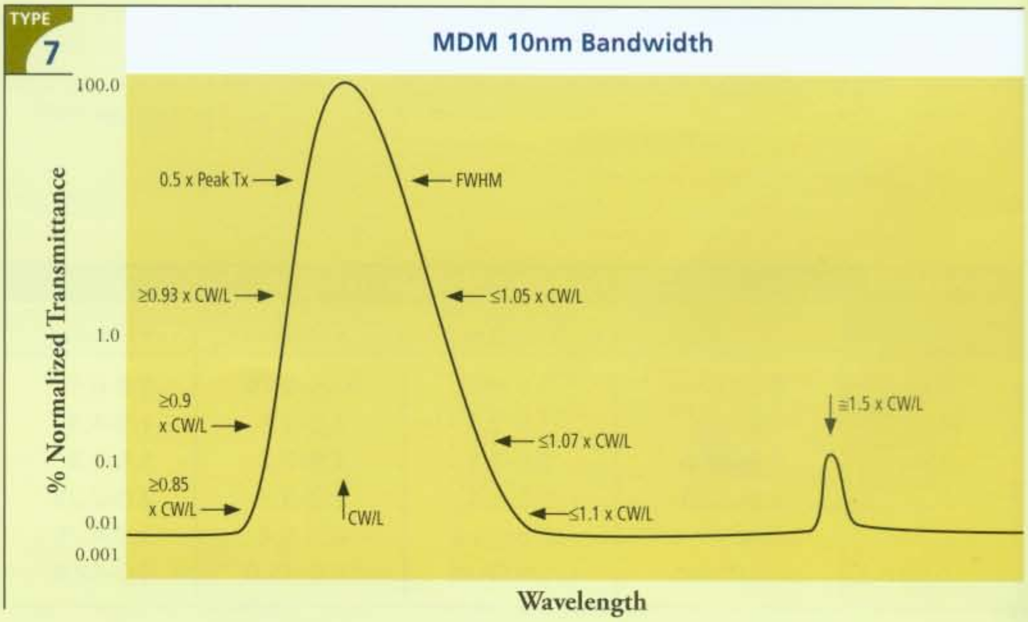
Normalized Transmittance of Peak (%)	Full Bandwidth Multiplier (FWHM)	
	5 Cavity	6 Cavities
90.0	0.85–0.90	0.85–0.90
10.0	1.1–1.25	1.1–1.25
1.0	1.5–1.65	1.5–1.65
0.1	2.0–2.25	2.0–2.25
0.01	3.1–3.85	2.9–3.2
0.001	8.0–10.0	4.0–5.0


TYPE 5

5 Cavities


TYPE 6

6 Cavities


TYPE 7

MDM 10nm Bandwidth

MDM= Metal-Dielectric-Metal

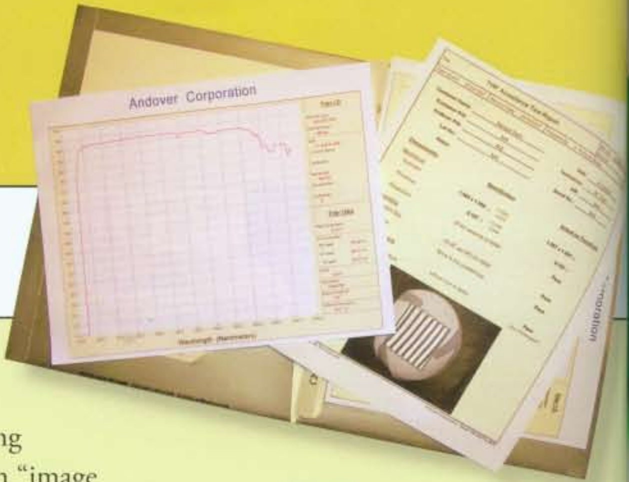


Image Quality Filters

Astronomical observations, video monitoring systems, high-resolution photography, and other imaging applications require components of the highest optical quality. To meet these demanding requirements, Andover Corporation has developed a line of custom "image quality" filters using high-grade optical material that is both striation- and-inclusion-free. The surfaces are ground and polished to a transmitted wavefront of λ/4 per inch and parallel to 30 arc seconds or better. The internal coating positions are optimized and the exterior surfaces antireflection coated to eliminate multiple images and fringe patterns. For very high-resolution applications, we can also provide image quality filters with a transmitted wavefront of λ/10 and parallelism of 10 arc seconds.

All filters come with test documentation

For quality custom products, please call 1.888.893.9992 (US) or +00.1.603.893.6888 (Outside US)

Image quality filters are ideal for applications that require high resolution, such as astronomical observations. To make these products, we fabricate high-quality optical glass to ensure the substrate is extremely flat and parallel, and then apply antireflective coatings on the external surfaces to reduce ghost images and maximize energy throughput. Commercial quality filters can have the same spectral characteristics as image quality filters, but they are designed for use in instruments rather than imaging applications.

Antireflective Coatings

Thin-film coatings are an effective way to limit reflections while also improving optimal system performance. Andover Corporation manufactures a variety of antireflective coatings designed for high efficiency, mechanical durability, and environmental stability.

BROADBAND VISIBLE ANTIREFLECTION