OMEGA OPTICAL

Custom Filters from Prototype to Production

TECHNICAL DATA SHEET

Filter Specifications + Cost Drivers

Overview

We design and produce filters for many different applications. Each application has specific, often complex and demanding requirements. The level of performance attained in an optical system depends upon the integration of the filter design with the performance of other system components. This section addresses the most important system characteristics as related to filter performance.

Optical Specifications

- Transmission & Optical Density- the steeper the edge between transmission and reflection, the thicker the film and the higher the cost. Omega defines measures edge steepness from the 50% transmission wavelength to the OD5 wavelength. This transition is often measured in wavenumbers (cm-1). Most of our edge steepnesses are within 1-5% of the 50% transmission wavelength (200-1000 cm-1 at 500 nm).
- Out-of-band blocking/ Signal-to-Noise Ratio- Blocking of wavelengths over a very large range (i.e. all visible wavelengths) can increase costs. For an LED or laser-cleanup filter where the wavelengths to be filtered are close to the peak wavelength, a large blocking wavelength range is not usually necessary. Deep blocking (>OD 6) in a narrow wavelength range (< 20 nm), as in a rejection (notch) filter, can also increase costs.
- Full-Width at Half-max (FWHM)- FWHM is directly proportional to the center wavelength- narrower filters are more difficult to achieve at longer wavelengths. We often specify FWHM as a percentage of the center wavelength.
- Angle of Incidence (AOI) & Polarization – When a filter or dichroic is used at an angle, the two polarizations are affected differently. This difference can be minimized or enhanced during the design process.
- F# or numerical aperture (NA)- A filter can be designed to work at a range of incoming angles (around the AOI), but the larger the range, the more expensive the filter will be. It is easiest to design and manufacture filters that work in a narrow range of angles (typically +5 degrees)
- Image Quality (total transmitted/ reflected wavefront distortion) and parallelism- thin substrates are often warped by the coating process or by mounting if they are large. We can help you determine what thickness is appropriate for the filter size you are using.
- Surface Quality- tight scratch/dig tolerances (like E/E) reduces yield, requires extra inspection time and increases cost. Our standard surface quality specifications are F/F (MIL C-48497A)

Environmental Specifications

- Temperature Effects- Thermal expansion and contraction affect the properties of the thin-film and substrate. The operating temperature of the filter should be noted before the design phase. This is especially important for satellite and space applications.
- Humidity Effects- many materials are affected by high humidity or submersion. This should be noted before the design phase. Omega designs its filters to adhere to the 10-day MIL810E environmental test.
- Incident Power – very high powered lasers can damage optical filters. An application such as this may require a non-standard approach

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Physical Specifications

- Physical Dimensions- large filters (over 3 inches) and very small (less than 5mm) are more expensive to manufacture because of material and handling costs. If the dimensions are not already part of Omega's standard size offerings, additional costs may be incurred. Standard Dimension Tolerances +0/-0.2mm
- Shape- circles are cut out one at a time, while squares and rectangles can be cut out in a grid-pattern, which reduces cost. Special shapes such as rounded corners also increase cost.
- Edge treatments- edge painting, chamfers, bevels, rings, etc. all increase handling time and cost
- Special Substrates- Alternative (non-glass) substrates such as ZnSe, Si, Ge, Infrasil, etc. are intrinsically more expensive. Omega often deposits on customer-supplied substrates, including lenses, fiber tips, and prisms.
- Thickness- tightly-toleranced thickness and thin parts can limit the design options, depending on the other specifications. For instance, for large amounts of blocking, a lower-cost filter may have more than one component laminated together which results in a thicker final product.

Other Considerations

- Coating type- some materials are intrinsically more expensive than others (gold), PARMS deposited hard-oxide coatings and IR coatings take longer to manufacture
- Quantity- economies of scale play into producing large quantities- especially in the PARMS chambers
- Lead time- Extra fees are assessed for a short lead-time
- Patterned filters- filters that require special patterning or edge coating require the development of custom masks and holders which increase cost
- Specialized testing- angle dependence or temperature dependenace of spectral performance, TWD testing, per-part vs. batch spectral performance, environmental testing, etc. increase cost. Typical testing at Omega consists of a room temperature batch spectrum of %T, OD or %R at 0 deg AOI.
- Packaging- cleanroom, non-contact packaging and the like increases cost

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