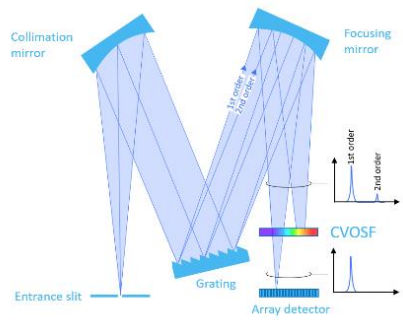
Technical Note

How to request an order sorting filter

The multiple orders from diffraction gratings become problematic in diode array spectrometers when the detected spectrum covers more than one octave. In this situation the orders overlap and it is therefore difficult to interpret the detected spectrum. The solution is to insert an order sorting filter in the spectrometer immediately before the detector. This technical note describes how to specify a Continuously Variable Order Sorting Filters (CVOSF).



Definitions

In order to identify the best CVOSF for your spectrometer, it is important for Delta Optical Thin Film to know a few key parameters of your spectrometer design. Figure 1 shows schematically how the wavelength depends on beam position on the filter for the 1st, 2nd and 3rd order.

It is important to note that the range of wavelengths that potentially could reach and be detected by the detector can be larger than the wavelength range, the spectrometer is designed for. For instance, some detectors might be sensitive down to 180 nm. Even if the spectrometer is designed to detect for example $\lambda_{1st, start}$ = 250 nm to $\lambda_{1st, end}$ = 1050 nm of 1st order light, 2nd and 3rd order ambient light between 180 to 250 nm might also be detected.
The lowest detectable wavelength $\lambda_{ho,start}$ can be limited by several factors like the UV-absorption in a cover glass on the detector or an optical bandpass filter at the entrance to the spectrometer.

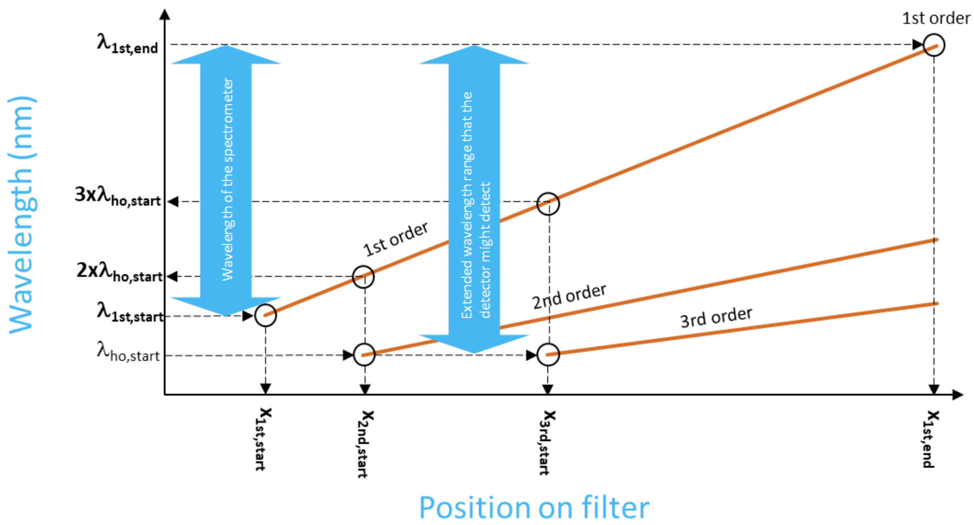


Figure 1: Order location diagram showing how wavelengths vs beam position for 1st, 2nd and 3rd order.

The following four 1st order wavelengths defined on Figure 1 and their positions on the filter are key:

- $\lambda_{1st,\ start}$ The shortest wavelength of 1st order light, that the spectrometer is designed for
- $2x\lambda_{ho,start}$ 2x the shortest wavelength of higher order light that the detector might detect
- $3x\lambda_{ho,\ start}$ 3x the shortest wavelength of higher order light that the detector might detect
- $\lambda_{1st,end}$ The longest wavelength of 1st order light, that the spectrometer is designed for

Order locations, AOI-range and beam spots

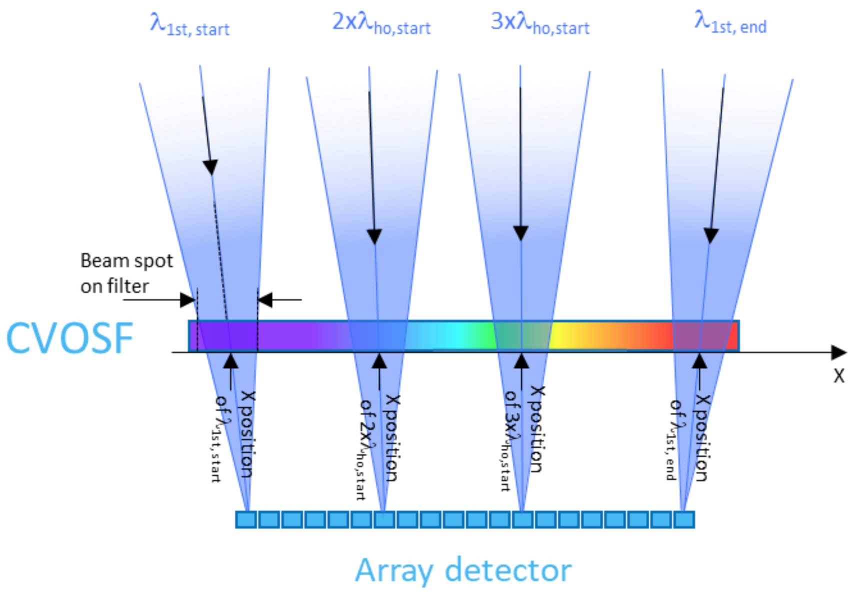


Figure 2: Definition of beam positions, Angle of Incidence (AOI), and beam spot on the CVOSF.

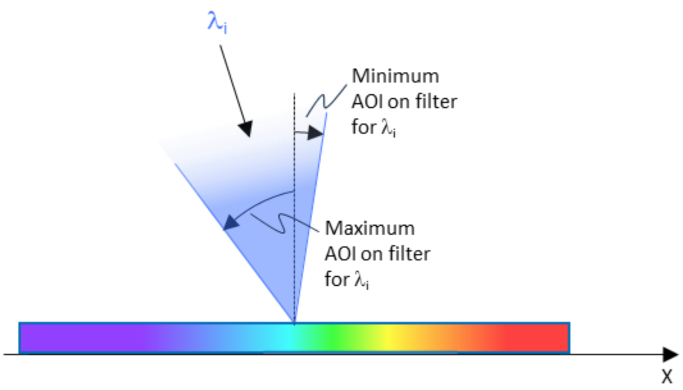


Figure 3: Definition of maximum and minimum AOI on the CVOSF for the wavelength λ_i;. AOI can have both positive and negative values as indicated on the drawing.

In order to choose the best CVOSF design for your spectrometer we kindly ask you to supply the following information (see Figure 1, Figure 2 and Figure 3 for definitions):

- The shortest and longest wavelength (from the grating) that is incident the detector in your spectrometer

- The shortest higher-order wavelength to reject
- The positions along the x-axis on the filter of the chief ray of the following four 1st order wavelengths $\lambda_{1st,\ start}$, $2x\lambda_{ho,start}$, $3x\lambda_{ho,\ start}$ and $\lambda 1_{st,end}$
- The minimum and maximum Angle of Incidence (AOI) of $\lambda_{1st,\ start}$, $2x\lambda_{ho,start}$, $3x\lambda_{ho,\ start}$ and $\lambda 1_{st,end}$. Please, provide the AOIs signed such that angles on opposite sides of the normal have opposite signs.
- The beam spot width on the filter of $\lambda_{1st,\ start}$, $2x\lambda_{ho,start}$, $3x\lambda_{ho,\ start}$ and $\lambda 1_{st,end}$.

1st order

Wavelength [nm]			Pos. on filter [mm]	Min. AOI on filter [degrees]	Max. AOI on filter [degrees]	Beam width on filter [μm]
λ1st,start		-->				
2x λho,start	0	-->				
3x λho,start	0	-->				
λ1st,end		-->				

Higher-order range to be rejected

Wavelength [nm]	
λho,start	

Dimensions and substrate material

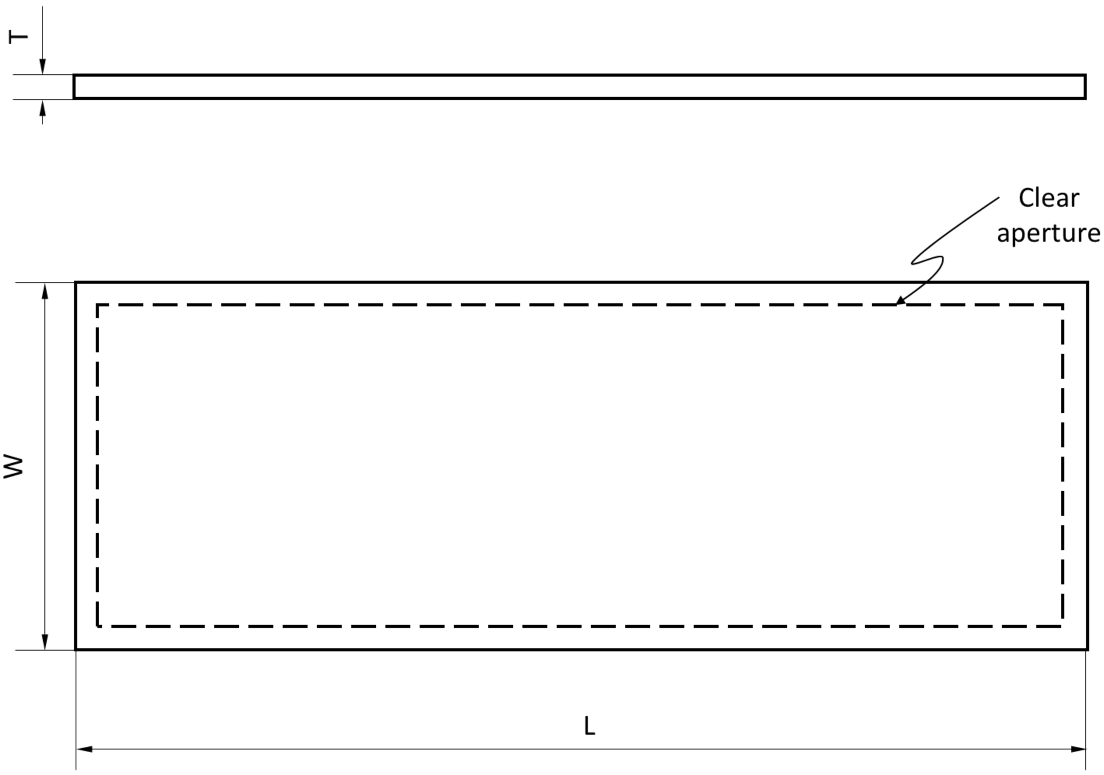


Figure 4: Definition of dimensional parameters for filter

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With reference to Figure 4 please, specify the following parameters for the filter. Typically, tolerances are +/- 0.1 mm. The standard substrate material is UV-grade fused silica. Please contact us if you require a non-standard substrate material.

Length of substrate (L) [mm]	
Width of substrate (W) [mm]	
Thickness of substrate (T) [mm]	
Clear aperture length (LA) [mm]	
Clear aperture width (WA) [mm]	
If clear aperture is not centered on the substrate please specifiy	

Our filters are inspected for visual defects according to ISO 10110-7 and we generally fulfill the following specification: 5x0.1;Lx0.06;E0.25 (5 grade 0.1 defects; long scratches maximum 0.06 mm width; Edge chips maximum 0.25mm from edge).

For applications where 1st order wavelengths shorter than 320 nm must be detected, we leave a part of the CVOSF uncoated. The tolerance on the length of the uncoated area is typically +/- 1 mm. The width of the transition step from coated to un-coated zone is less than 0.5 mm. Note that the part of the diode array beneath the transition step will 'see' artefacts from the step, such as refracted and diffracted light.

Read out white paper "Optimum order sorting filters for spectrometers" to learn more.