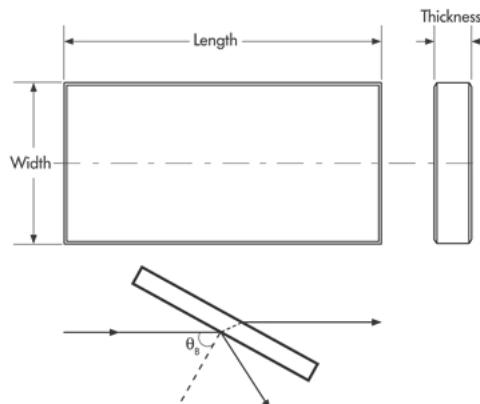


## ZnSe BREWSTER WINDOWS (UNCOATED)



Brewster angle ZnSe:  $\theta = 67.4^\circ$

### FEATURES / CHARACTERISTICS

ZnSe Brewster windows are used in polarization separation. Upon assembly at the Brewster angle (67.4° for ZnSe at 10.6 μm) p-pol. light is transmitted completely and s-pol. light is reflected by app. 50%. The Fresnel reflection over the angle of incidence for ZnSe can be found in the simulation on page 2.

Due to the steep angle of incidence, Brewster windows are generally exclusively offered as rectangular components. Standard ZnSe Brewster windows are available from 3 mm to 200 mm in length and with a thickness of 1 mm to 10 mm. To present a square profile to the incident beam, they are about 2.5 times longer than their width. The length / thickness ratio should be smaller than 30:1 because a larger thickness ensures a better surface figure. Usually, Brewster windows are used in pairs.

### APPLICATIONS

#### **Polarizers/Analyzers, Isolators, Attenuators for Polarized Light**

ZnSe Brewster windows may be used within a laser resonator so as to force the laser to emit linearly polarized radiation.

Outside a laser cavity, plates may be used singly or in stacks to perform the role of polarizers or analyzers.

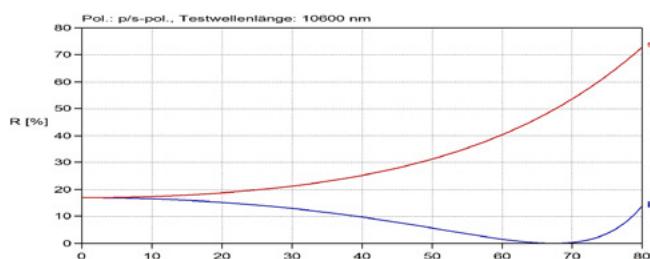
A particularly useful function of Brewster plates occurs in the laser-processing of highly reflective metals, where Brewster-based 'isolator' assemblies and phase-retarder units may be used to prevent back-reflected radiation from re-entering the laser resonator.

A Brewster window can also be used as an attenuator, if the plane of incidence is rotated.

## SPECIFICATIONS

Dimensions tolerance [mm]	+0/-0.2
Thickness tolerance [mm]	± 0.25
Wedge [arc min]	<3, or on request 2.0 ±1.0
Surface figure [ $\mu\text{m}$ ]	typ. $\lambda/20$ at 10.6 (depends on diameter thickness ratio)
Surface quality	40 - 20
Clear aperture [%]	>85
Transmission [%]	>99 p-pol (depends on thickness)
Reflection value [%]	R(s)-50 per surface, R(p)-0

## SIMULATIONS



Fresnel reflection per surface for ZnSe at 10.6  $\mu\text{m}$

## GOOD TO KNOW

If the level of parallelism of the Brewster window is high, then multiple interference between beams reflected from the two surfaces can affect the intended function of the plate. If this effect is critical for your application, please contact us. We then can manufacture plates with a wedge between 1 and 3 arc minutes to overcome this effect.

Additionally, please see data sheet ZnSe Enhanced Brewster Windows.

Customer designs are available upon request.

## ORDERING CODE

Length [mm]	Width [mm]	Thickness [mm]	
<b>WBZ</b>	<b>X</b>	<b>X</b>	<b>X</b>

Example: WBZ-33-15-3.0 (Brewster window, ZnSe, 33 x 15 mm, 3.0 mm thick)

## ZNSE ENHANCED BREWSTER WINDOWS (COATED)



### FEATURES / CHARACTERISTICS

Enhanced ZnSe Brewster windows are rectangular in form, and used at a specific angle of incidence (the Brewster angle) to the laser beam. Light that is polarized parallel to the plane of incidence/reflection is fully transmitted at Brewster angle. This radiation is termed 'P-polarized'. Radiation with an electric field at 90 degrees to this plane is called 'S-polarized'.

Enhanced Brewster windows are treated with a complex coating stack on one surface which has the effect of enhancing the 'natural' polarizing effect to the extent that almost all of the S-polarized radiation is reflected. No anti-reflection coating is needed at the second surface since the uncoated surface will anyway transmit nearly 100 % of the P-polarized incident radiation.

### APPLICATIONS

#### **Polarizers/Analyzers**

Outside a laser cavity, uncoated plates may be used singly or in stacks to perform the role of polarizers or analyzers. An enhanced plate can often be used where otherwise a multiple stack of uncoated plates would be needed. This can have beneficial effects in elimination of multiple reflections from the use of many uncoated surfaces.

#### **Test equipment**

Enhanced Brewster plates are particularly useful in specialized laser test equipment, where it is necessary to use beams of CO<sub>2</sub> laser radiation of strictly linear polarization. A typical example occurs in equipment used for checking mirrors and phase retarders for phase change on reflection at 45 degrees.

#### **Isolators**

Enhanced Brewster plates are used in isolator devices to stop unwanted back reflected laser energy from reaching the laser.

## Wedge angle

Multiple reflections are not a problem when enhanced Brewster plates are used. The reason for the nominal 3 arcminute wedge in the standard range of enhanced plates is due to their selection from batches of standard (uncoated) windows. Custom-made plates can be specified to higher levels of parallelism if required.

## SPECIFICATIONS

Dimensions tolerance [mm]	+0/-0.2
Thickness tolerance [mm]	±0.25
Wedge [arc min]	<3, higher levels of parallelism possible on request
Surface figure [ $\mu\text{m}$ ]	typ. $\lambda/20$ at 10.6 (depends on diameter thickness ratio)
Clear aperture [%]	>85
Reflection value [%]	S-pol : >98
Transmission [%]	P-pol : >99
Laser damage threshold [W/mm]	typ. 200 CW CO <sub>2</sub> laser
Max. power density [W/cm <sup>2</sup> ]	<500 recommended (to minimize thermal-lensing)

## GOOD TO KNOW

Custom-made Brewster plates may be made in sizes up to 200 mm length as long as the specified thickness is appropriate to the size. Standard sizes are length 42.0 – 98.0 mm, width 16.5 – 36.0 mm, thickness 3.0 or 4.0 mm.

The Brewster angle for an enhanced ZnSe plate is 67.4°. The special enhancing coatings are sensitive to changes of wavelength, and so this product type cannot be used in broad-band applications. The coating stack is sensitive to errors in mounting angle. When specifying Brewster windows to have some known value for optical clear aperture, it is necessary to make appropriate allowances (on the width and length of the plate) for the mechanical mounting arrangement.

Customer designs are available upon request.

## ORDERING CODE

Length [mm]	Width [mm]	Thickness [mm]
<b>EWBZ</b>	<b>X</b>	<b>X</b>

Example: EWBZ-66-25.4-3.0 (Enhanced brewster window, dim. 66 x 25.4 x 3 mm)