

# VACUUM VIEWPORTS

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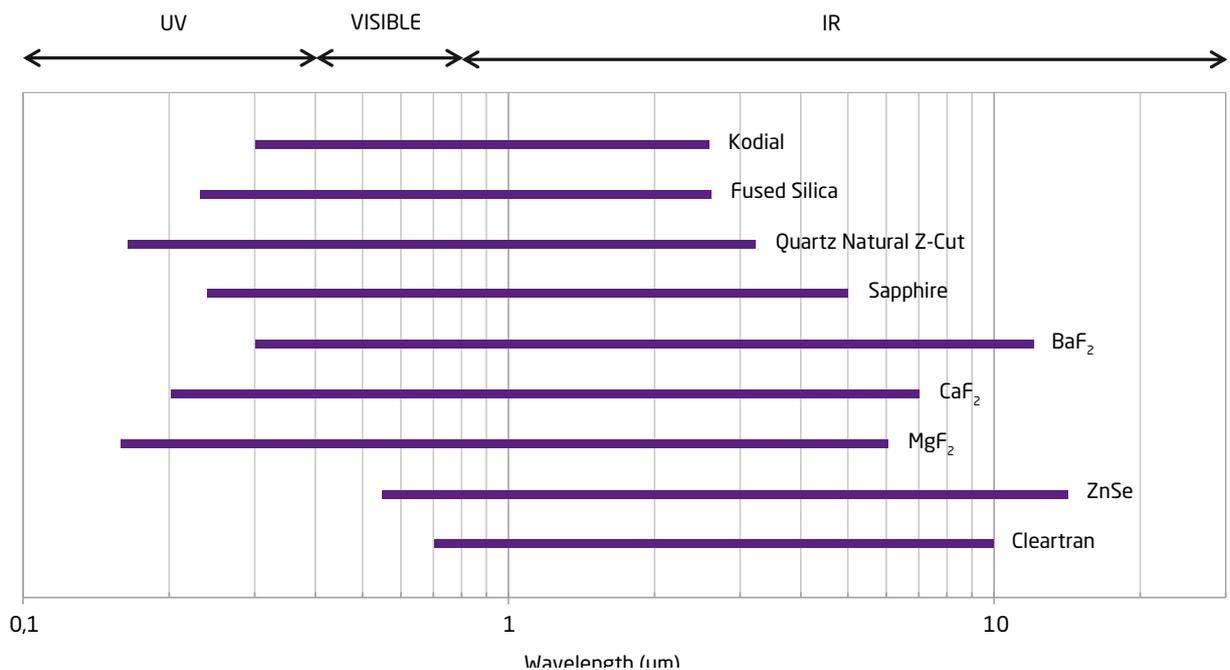
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**Neyco manufactures a range of UHV viewports in CF, ISO or KF flange styles including a variety of coatings to enhance performance.**

Materials include:

- Kodial (borosilicate glass)
- Fused Silica
- Quartz natural
- Sapphire
- Barium Fluoride  $BaF_2$
- Calcium Fluoride  $CaF_2$
- Magnesium Fluoride  $MgF_2$
- Zinc Selenide ZnSe
- Zinc Sulfide Cleartran

Viewports are manufactured in cleanroom conditions and Helium leak tested, cleaned and packed to UHV standards.



**Comparison of some viewports materials transmission spectra**

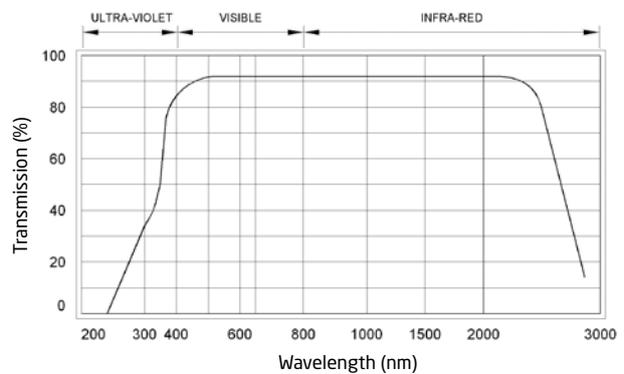
# Introduction

## VIEWPORTS MATERIALS

### KODIAL

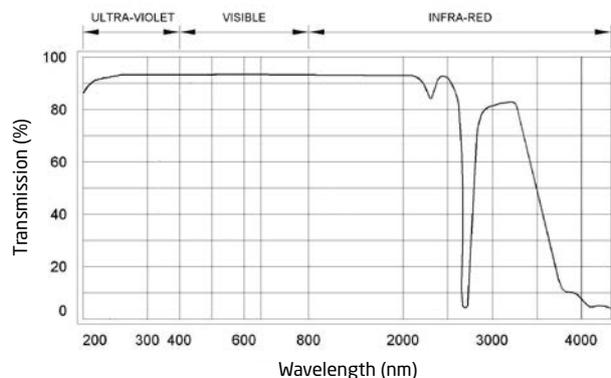
The viewports comprise a Borosilicate glass optic which is sealed to a Kovar weld ring using an induction heater process.

The optic assemblies are TIG welded to flanges. The rugged construction of the Kodial viewports allows repeated bakeout with UHV performance.



### QUARTZ FUSED SILICA

The viewports comprise a high purity laser quality fused silica optic with precise flatness, parallelism, scratch and dig specifications.

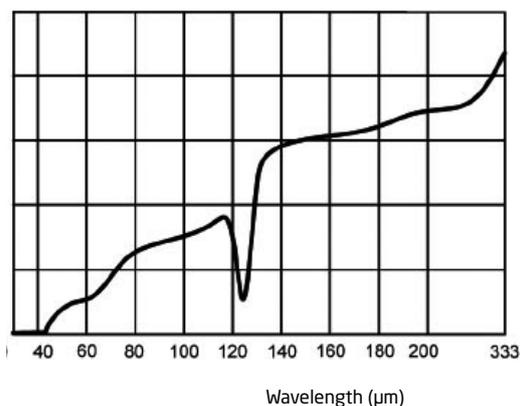
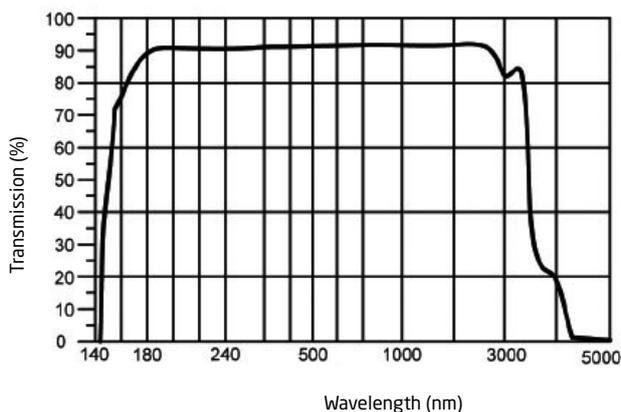


## QUARTZ NATURAL Z-CUT

The viewports comprise a high quality natural quartz optic with precise flatness, parallelism, scratch and dig specifications.

One of the best materials for transmission of wavelengths above 50 μm is z-cut crystal quartz, so z-cut quartz windows are popular as THz\* windows. It is important that z-cut

crystal quartz windows are also transparent in the visible spectrum allowing easy adjustment with a HeNe laser and do not change the state of light polarization. Z-cut quartz also has excellent transparency in the vacuum UV portion of the spectrum and is therefore a popular window material for use in UV spectroscopy and UV lithography.

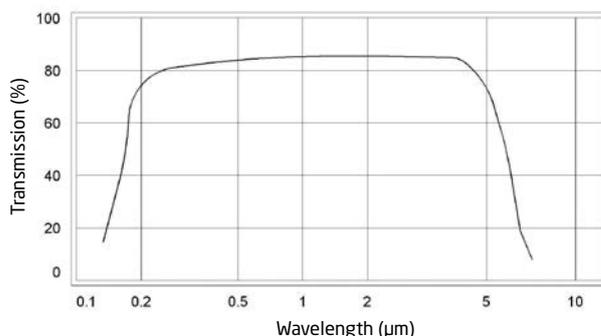


\*THz: Terahertz radiation is located in the spectral region ~ 3 mm - 30 μm (~ 0.1-10 THz)

## SAPPHIRE

The viewports comprise a high quality optic with precise flatness, parallelism, scratch and dig specifications.

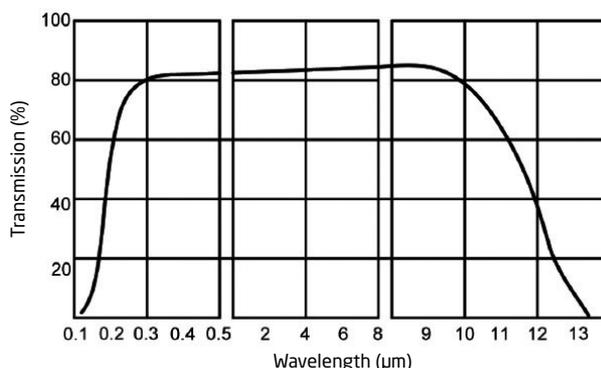
The single crystal sapphire windows have excellent optical, physical and chemical properties. The hardest of the oxide crystals, sapphire retains its high strength at high temperatures. Sapphire has a low coefficient of thermal expansion and low fluorescence, good resistance to thermal shock and scratching making this an excellent material for IR transmitting optics and robust applications. C-cut sapphire is selected to minimise the effects of birefringence.



## BARIUM FLUORIDE BaF<sub>2</sub>

Barium Fluoride is used for windows, lenses and prisms, particularly when transmission into the ultraviolet is desired. Barium Fluoride is suitable for applications in the IR band (8 to 12 μm) and is often used as a IR viewport window for thermography.

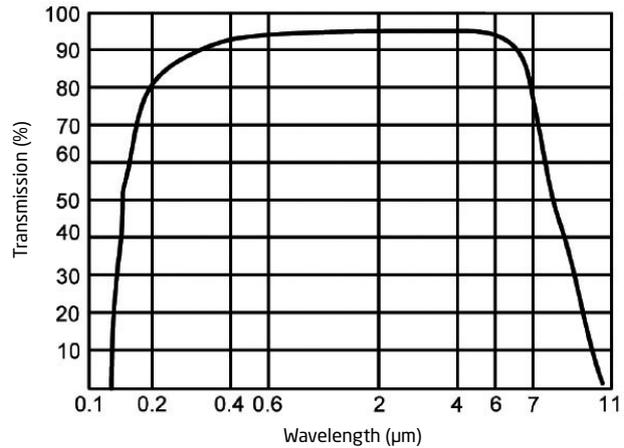
Barium Fluoride is less resistant to attack by water than Calcium Fluoride. Barium Fluoride is the most resistant fluoride to high energy radiation but does not have VUV transmission of other types. The material is relatively hard but is very sensitive to thermal shock.



## CALCIUM FLUORIDE CaF<sub>2</sub>

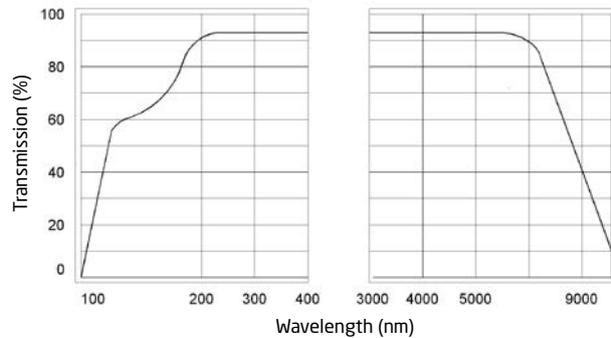
Best transmission by Fluoride crystals in the UV (except very weak LiF). Mechanically only slightly weaker than Zinc Selenide and slightly harder. Single crystal material with cubic symmetry, hence no birefringence. Calcium Fluoride is transparent in the visible (appears similar in color to quartz or glass) and in the UV down to 120 nm, which services all excimer laser applications. Low index of refraction, which means that the windows rarely require antireflective coatings.

The rugged, bonded construction of the CaF<sub>2</sub> viewports allows bake-out to a maximum of 120°C with UHV performance.



## MAGNESIUM FLUORIDE MgF<sub>2</sub>

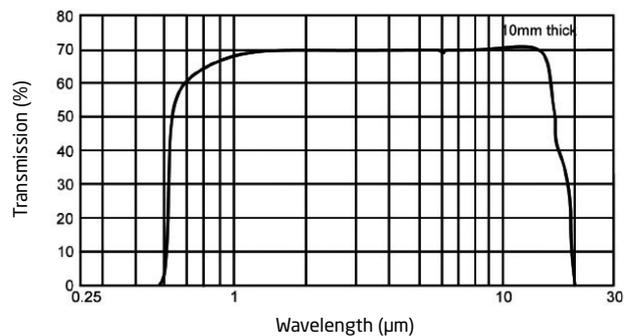
Next best transmission of fluorides compared to CaF<sub>2</sub> and similar in all other characteristics with the following exceptions. MgF<sub>2</sub> is stronger and harder and is naturally, strongly birefringent



## ZINC SELENIDE ZnSe

The viewports comprise a laser quality Zinc Selenide optic with precise flatness, parallelism, scratch and dig specifications.

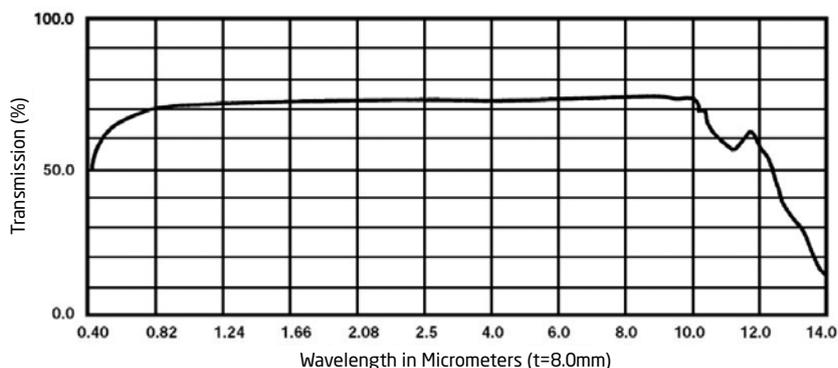
Best transmission available at 10.6 μm (CO<sub>2</sub> laser fundamental line) and in the visible. It has some absorption in the blue-green causing it to appear yellow. The index of refraction is high and thus requires anti-reflection coatings on both sides for optimum performance. This polycrystalline, CVD grown material is strong, though relatively soft compared to other crystalline, optical materials. It is non-hygroscopic. ZnSe sublimates at 300°C and reacts violently with strong mineral acids.



## ZINC SULFIDE CLEARTRAN

Comparable to ZnSe in most respects, only slightly more absorbing at 10.6 μm. Advantage is the transmission in the visible is better, no absorption to only slight absorption in the bluegreen thus appearing clear (i.e. not yellow). It is much harder than ZnSe and thus resists scratching much better.

Cleartran is a form of CVD Zinc Sulfide that is modified by a post-deposition hot isostatic process. This process removes Zinc hydrides from the crystal lattice, normalizes crystal structure and purifies the material, all contributing to single crystal-like transmittance in the visible through far infrared ranges (0.35-14 μm).



Please note that the optical transmission curves are approximations and should be used for reference only.

## FLANGE AND WELD RING MATERIALS

The UHV CF versions are offered using high grade Stainless Steel 304L or 316LN flanges.

Flanges in Stainless Steel 316L are used for the high vacuum KF and ISO viewports.

FLANGE TYPE	GLASS TYPE	WELD RING MATERIAL	
		MAGNETIC	NON MAGNETIC
CF 304L KF 316L ISO 316L	Kodial Quartz Sapphire ZnSe	Kovar	-
	CaF <sub>2</sub> BaF <sub>2</sub> MgF <sub>2</sub>	316L	-
CF 316LN	Kodial Quartz Sapphire ZnSe	Kovar	Tantalum
	CaF <sub>2</sub> BaF <sub>2</sub> MgF <sub>2</sub>	-	316L

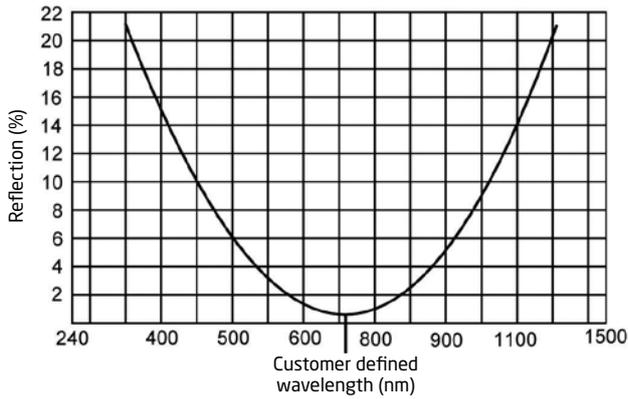
## TECHNICAL SPECIFICATIONS

	KODIAL	FUSED SILICA	SAPPHIRE	QUARTZ NATURAL Z-CUT	ZnSe	BaF <sub>2</sub>	CaF <sub>2</sub>	MgF <sub>2</sub>
Seal type	Braze Bond Mechanically sealed	Braze Mechanically sealed		Braze Bond Mechanically sealed	Bond Mechanically sealed			
Maximum temperature	120°C <sup>(1)</sup> 130°C <sup>(2)</sup> 150°C (KF & ISO) <sup>(3)</sup> 350°C (CF) <sup>(3)</sup>	150°C (KF & ISO) 200°C (CF)	150°C (KF & ISO) 200°C (CF)	120°C <sup>(2)</sup> 150°C (KF & ISO) <sup>(3)</sup> 200°C (CF) <sup>(3)</sup>	120°C <sup>(2)</sup> 130°C <sup>(1)</sup>			
Minimum temperature	-20°C							
Maximum rate of temperature change	3°C / min							
Leak rate	< 1.10 <sup>-10</sup> mbar.l.sec <sup>-1</sup> (He)							
Pressure range	1 bar to 1.10 <sup>-11</sup> mbar <sup>(4)</sup>							
Surface quality (scratch / dig)	20/10	20/10	60/40	20/10	60/40			
Parallelism	-	< 3 arc minutes			-	-	-	-
Flatness	λ/4 <sup>(1)(2)</sup> , < 8λ <sup>(3)</sup>	< 8λ	< 8λ	λ/4 <sup>(2)</sup> , < 8λ <sup>(3)</sup>	< 2λ	λ/4		

- (1) For mechanically sealed viewport
- (2) For bonded viewport
- (3) For brazed viewport
- (4) 1.10<sup>-8</sup> mbar for mechanically sealed viewport

## ANTI-REFLECTIVE COATINGS

A range of anti-reflective coatings can be processed and optimised to customer specified wavelengths. Theoretical reflectance curves can be supplied on request for particular window material and wavelength combinations. The coatings are processed on eBeam system in cleanroom conditions and tested on a state of the art UV-Vis spectrophotometer.



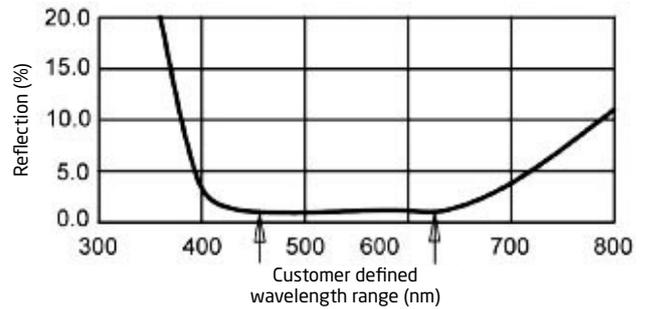
**Reflectance curve with BBAR anti-reflective coating**

Viewports are offered with :

- a **single QWOT\*** MgF<sub>2</sub> layer anti-reflective (AR) coating on both sides of the window optimised to a customer specified wavelength range (standard wavelengths between 190 nm and 1550 nm).
- a **two-layer VAR** or a **four-layer broadband BBAR** anti-reflective coating on both sides of the window optimised to a customer specified wavelength. In many cases, the coating reduces reflection to below 0.5% per face or 1% total at the wavelength specified (standard wavelengths between 240 nm and 1550 nm).

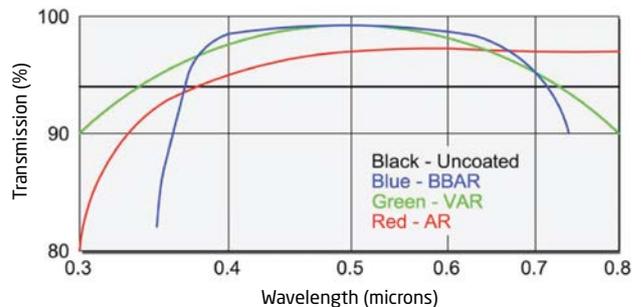
Coatings for other wavelengths can be quoted also on request.

\*QWOT = Quarterwave optical thickness



**Reflectance curve with VAR anti-reflective coating**

The graph below shows typical before and after transmission effect of AR, VAR, and BBAR anti-reflective coatings on Kodial viewports.



Please note that the optical transmission curves are approximations and should be used for reference only.

## THIN FILM COATINGS

Neyco also coats viewports with transparent conductive coatings such as ITO (Indium Tin Oxide) on the vacuum side of the window to provide surface conductivity either to eliminate electrostatic charge build up or to improve EMC/RFI screening.

# Differentially Pumped Viewports

## APPLICATIONS

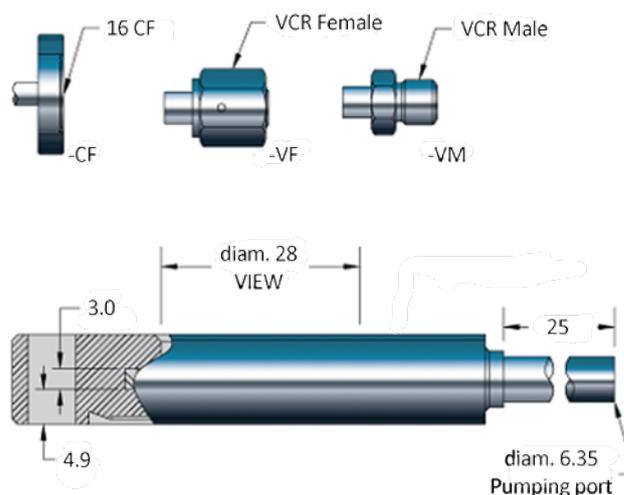
A few of the many applications in which these differentially pumped viewports are commonly used are:

- Geochronology
- Geology
- Argon Dating



## SPECIFICATIONS

- Flange material : Stainless Steel 304
- Window material : Zinc Selenide or Cleartran
- With anti-reflective coating
- Transmission range : 10.6  $\mu\text{m}$  optimized
- Temperature range :  $-8^{\circ}\text{C}$  to  $204^{\circ}\text{C}$
- Leak rate  $< 1.10^{-10}$  mbar.l/s (He)
- Installation: 40 CF or 63 CF flange
- View diameter: 28 mm
- Terminal option : tube, male VCR, female VCR, 16 CF
- Different optics are available upon request (Silicon, Germanium, Zinc Sulfide...)
- Specialized coatings are also available





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