

INTRODUCTION TO
OPTICAL MATERIALS AND OPTICAL DESIGN DATA



General Characteristics Of The Materials

Crystalline materials are often used in optics applications because of their unique optical and physical properties. Their high translucence in the UV and IR spectral regions, wide variety of dispersion properties, etc., permit a considerably wider choice of applications as compared with optical glasses.

CRYSTALLOGRAPHIC

Monocrystalline materials possess an ordered three-dimensional periodic spatial atomic structure. Four useful crystallographic parameters are the *syngony*, the symmetry class, the lattice constants, and the cleavability. *Syngony*, *symmetry class*, and *lattice constants* refer to the type of crystal structure and determine the nature of the basic physical properties. The *cleavability* is the property of the crystal (of forming) cleavage cracks parallel to definite crystallographic faces. For denoting cleavability we indicate the crystallographic symbol of the system of easy cleavage of faces (e.g. 111 or 100). Qualitatively, the cleavability is characterized as "highly perfect", "perfect" or "imperfect". The crystallographic characteristics of polycrystalline materials are given in the same form as those given for monocrystalline, but are applicable to each separate crystal.

OPTICAL

The *refractive index*, n , denotes the ratio between the velocity of electromagnetic radiation in a vacuum and the phase velocity of radiation in a given material. For the optically uniaxial Magnesium Fluoride and Sapphire crystals the refractive index is presented both for the ordinary rays, n_o , as well as for the extraordinary rays, n_e .

The refractive index of an optical material depends on its temperature. The values of the *thermal coefficient of the refractive index* $\beta(t, \lambda) = dn(\lambda)/dt$, deg C^{-1} are presented for the indicated wavelengths within the temperature range from minus 60°C to plus 60°C. For Magnesium Fluoride and Sapphire the relative temperature coefficients of the refractive indices are given for both the ordinary n_o , as well as for the extraordinary n_e rays.

The reflection (Fresnel) loss from one surface may be calculated by the formula:

$$\blacktriangleright \text{ REFLECTION LOSS} = \frac{(n - 1)^2}{(n + 1)^2}$$

The transmittance of crystalline optical materials is characterized by the spectral transmittance $\tau(\lambda)$, spectral internal transmittance $\tau_i(\lambda)$, absorbance coefficient $\mu(\lambda)$

and transmission range. The *spectral transmittance* $\tau(\lambda)$ is the ratio between the flux of monochromatic radiation that has passed through the sample of the material and the incident flux of radiation. The *spectral internal transmittance* coefficient $\tau_i(\lambda)$ is the ratio between the flux of monochromatic radiation that has reached the exit surface of the sample and the flux of radiation that has passed its entry surface. The *absorbance coefficient*, $\mu(\lambda)$, is a magnitude which is inverse to the distance at which the flux of radiation forming a parallel beam is decreased in intensity by a factor of ten. The absorbance coefficient is due to the combined action of absorption and scattering in the material.

The *absorbance coefficient* may be calculated by means of the formula:

$$\blacktriangleright \mu(\lambda) = \frac{-\log_{10} \tau_i(\lambda)}{\text{Thickness}}$$

where $\tau_i(\lambda)$ is the internal transmittance, and Thickness is the thickness of the sample in cm.

The *transmission range* of the material shows the wavelengths of light that can pass through the material. Typical transmittance curves $\tau(\lambda)$ are given for a sample of 10 mm thickness.

THERMAL

Values are given for the thermal linear expansion, thermal conductivity, specific thermal capacity, thermal stability and fusion temperature of melting points.

Thermal linear expansion α_t , deg C^{-1} characterizes the relative change in length of the sample at a change in temperature of one deg C. It is determined by the formula

$$\blacktriangleright \alpha_t = \frac{1}{L} \times \frac{dl}{dt}$$

where L is the length of the sample and t is the temperature.

Average values of the thermal linear expansion coefficient are presented within the given temperature ranges. For optically uniaxial Magnesium Fluoride and Sapphire crystals, thermal linear expansion coefficients are given for directions parallel to and at right angles to the optical axis.

Thermal conductivity, $W/(m \cdot \text{deg C})$, characterizes the capacity of the material to transmit heat and is determined by the amount of thermal energy that has gone through a unit area in a unit time at a unit temperature gradient. For Magnesium Fluoride and Sapphire crystals, thermal conductivity values are given in directions parallel to and at right angles to the optical axis.

Specific heat capacity, J/(kg·deg C), characterizes the energy necessary for heating the material and is determined by the amount of heat needed for warming the material by one degree. Data are presented for specific heat capacity at constant pressure.

Thermal stability, deg C, characterizes the capacity of the material to resist sharp temperature changes without destruction. The measure of thermal stability is the maximum difference in temperature in an abrupt change of the latter, which the sample can withstand without destruction.

Melting points are given in deg C.

MECHANICAL

Density, g/cm³ is determined by the ratio between the mass of the sample and its volume. Reference data are presented for densities at room temperature and at normal pressure.

Moh hardness is a relative scale showing the capacity of a material to resist being scratched by another material. Reference values are presented for hardness according to the conditional Moh scale, in which 10 standard minerals are arranged in the order of increasing hardness (Talc, Moh=1 to Diamond, Moh=10).

Vickers microhardness, Pa, is characterized by the resistance of the surface of the material to impression by the indenter in the form of a four-faced diamond pyramid at indenter load of 1 Newton. Reference microhardness values are presented for optical uniaxial crystals of Magnesium Fluoride and Sapphire in directions parallel to and perpendicular to the optical axis.

Elastic properties are characterized by the **constants of elastic compliance** and by the technical elasticity characteristics: the **Young modulus**, Pa, the **shear modulus**, Pa, and the **Poisson ratio** (coefficient of transversal deformation). The constants of elastic compliance are the proportionality coefficients between the stress and deformation components. The elastic properties depend on the crystallographic directions in which the stress and deformation are applied.

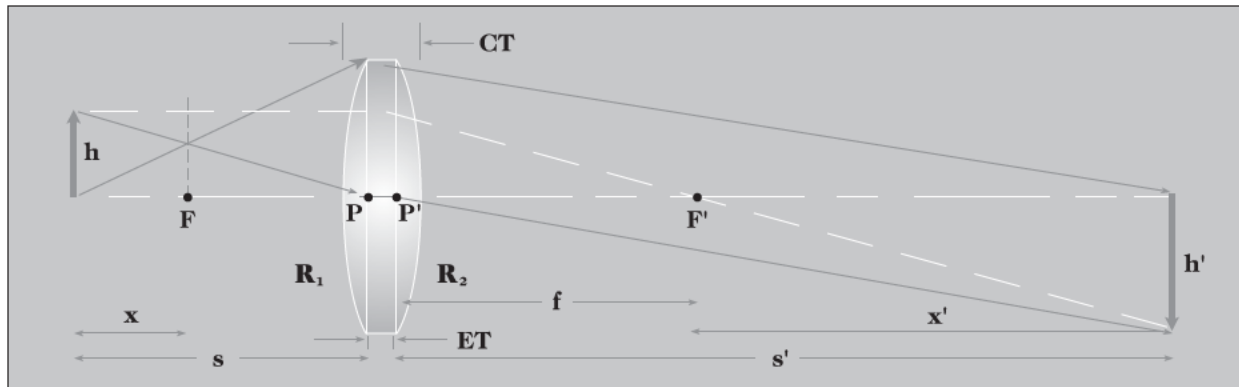
For cubic crystals, constants of elastic compliance S₁₁, S₁₂, S₄₄ are given. This makes it possible to carry out transformation of Young's modulus and of the shear modulus in any arbitrary system of coordinates. It is also possible to obtain maximum and minimum values of the Young modulus and the shear modulus corresponding to the crystallographic directions <100> and <111>, as well as the Poisson Ratio.

For optically uniaxial Magnesium Fluoride and Sapphire crystals, six constants of elastic compliance are given, as well as values of the Young modulus and of the shear modulus for directions and faces parallel to and at right angles to the optical axis. Values of the Poisson Ratio are given for two possible positions. The first is used if the stress is directed parallel to the optical axis, and the deformation of the material under effect of this stress is considered in the direction of the plane perpendicular to the optical axis. The second is used if the stress is directed at right angles to the optical axis (in the case of a magnesium fluoride crystal in the direction at right angles to the face <100>). The deformation of the material under action of this stress, being different, is considered in two planes, positioned parallel and at right angles to the optical axis of the crystal. For polycrystalline materials isotropic Young modulus, shear modulus and Poisson ratio are given without regard to the possible effect of texture formation of the material.

CHEMICAL

The chemical properties of the crystalline materials are characterized by **molecular weight** and **solubility**. The **solubility** of the material is inversely related to its resistivity against the action of aggressive media: water, acids and organic compounds.

Optical Design Data



LENS FORMULAE

This section gives some basic information regarding the primary lens types and their use in image formation and manipulation. The figure above traces rays of light traveling from object h to image h' through a lens.

The axial separation of the principal surface, P , from its corresponding focal point is the effective focal length, f . This is given for a lens with center thickness, CT , by the "Thick Lens Formula":

$$\frac{1}{f} = (n-1) \left(\frac{1}{R_1} - \frac{1}{R_2} + \frac{(n-1)CT}{nR_1R_2} \right)$$

where R_1 and R_2 are the radii of curvature and n is the index of refraction of the lens material. For a thin lens, CT can be assumed to be zero. The effective focal length is then given by:

$$\frac{1}{f} = (n-1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right)$$

The back focal length can be determined by using:

$$BFL = f \left(1 - \frac{(n-1)CT}{nR_1} \right)$$

The Magnification, m , of a finite conjugate system is given by:

$$m = \frac{s'}{s} = -\frac{f}{x}$$

The sagittal height of a lens is given by:

$$Sag = |R| - (R^2 - d^2/4)^{1/2}$$

where R is the radius of curvature.

The F-number of a lens, $F/\#$, is the ratio of the focal length, f , of a lens system to the diameter, d , of its entrance pupil. $F/\#$ is inversely proportional to twice the Numerical Aperture, NA :

$$F/\# = \left(\frac{f}{d} = \frac{1}{2NA} \right)$$

Ignoring the effects of aberrations, the following equations are useful in determining object and image distances and magnification:

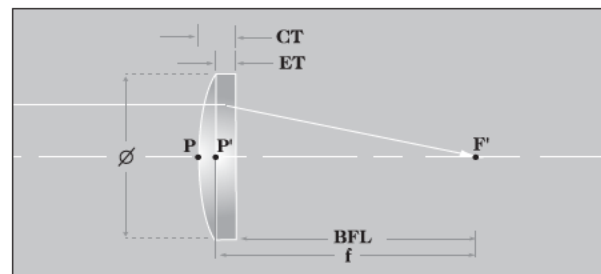
$$\triangleright x = s + f \quad s' = ms$$

$$\triangleright f = \frac{ss'}{s - s'} \quad xx' = -f^2$$

$$\triangleright x' = s' - f$$

LENS TYPES AND SELECTION

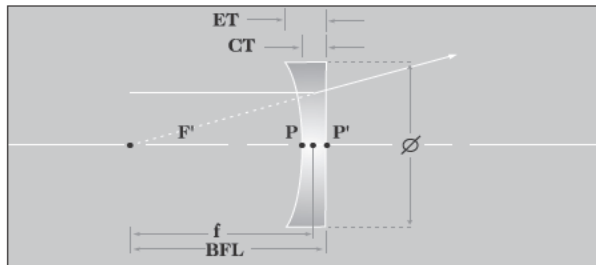
The **plano-convex** lens is the standard focusing optical element. Used with the curved side toward the incident light for focusing, it is useful where optimal spot size is not required. It is most suitable where one conjugate is more than five times the other, such as in sensor applications, or for use with collimated or near collimated light.



The "thick lens formula" from the previous column gives the effective focal length of a **bi-convex** lens:

$$\frac{1}{EFL} = (n-1) \left(\frac{1}{R_1} - \frac{1}{R_2} + \frac{CT(n-1)}{R_1 R_2 n} \right)$$

Plano-concave lenses are most effective where a negative lens is needed and one conjugate is more than five times the other, e.g. to produce divergent light from a collimated input beam. Having the curved surface facing the collimated beam or the longest conjugate distance produces minimal spherical aberration. For plano-convex and plano-concave lenses, R_2 is infinite ($1/R_2 = 0$).

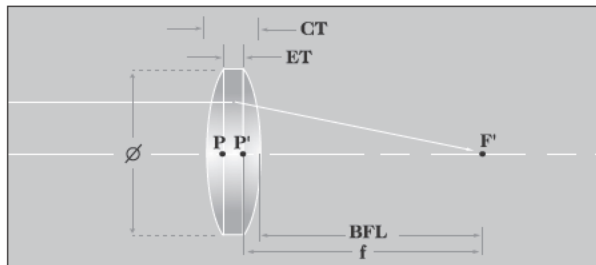


The "thin lens formula" from the previous page as applied to each of these lens types is:

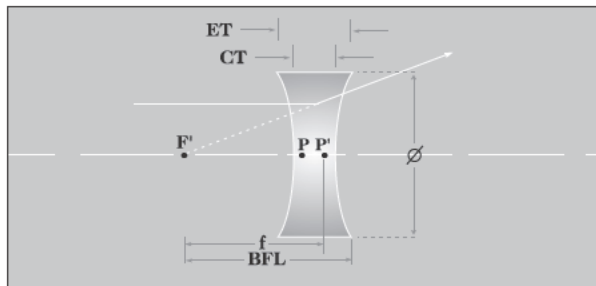
For **plano-convex** and **plano-concave**:

$$\frac{1}{EFL} = \frac{(n-1)}{R_1} \text{ or } R_1 = (n-1)(EFL)$$

The **equi-convex** lens is most suitable where the conjugates are on opposite sides of the lenses and the ratio of the distances is less than 5:1, such as in simple image relay components.



Equi-concave lenses are negative lenses and are best for producing diverging light or a virtual image where the input light is converging. For equi-convex and equi-concave lenses, $R_1 = R_2$.

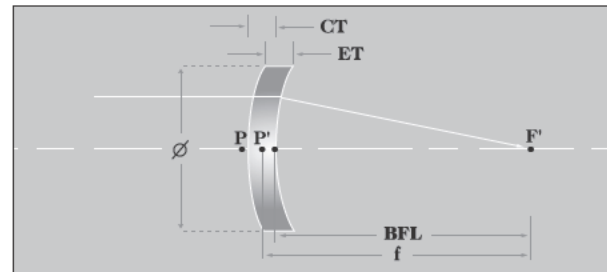


The "thin lens formula" as applied to each of these lens types is:

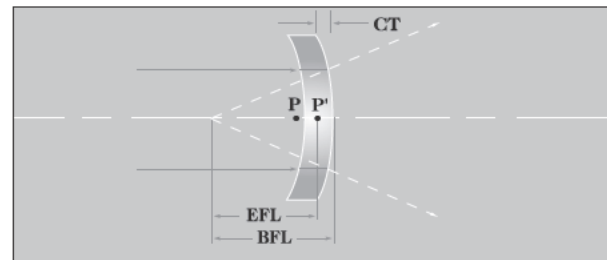
For **equi-convex** and **equi-concave**:

$$\frac{1}{EFL} = \frac{2(n-1)}{R_1} \text{ or } R_1 = 2(n-1)(EFL)$$

Positive meniscus lenses may be used to increase the numerical aperture of a positive lens assembly without an undue increase in the aberrations.



The **negative meniscus** lens is best where one conjugate is relatively far from the lens or where both conjugates are on the same side of the lens.



For meniscus lenses, R_1 and R_2 can vary without changing the value of the EFL, so an additional factor is needed along with the EFL in order to uniquely specify an R_1 and R_2 . This multiplier (M) is typically related to the EFL and R_1 by:

$$R_1 = (M)(EFL)$$

For either positive or negative meniscus lenses, R_2 may then be found from the Thick Lens Formula. Use a positive value for the EFL of a positive meniscus lens and a negative value for the EFL of a negative meniscus lens:

$$R_2 = (n-1)(EFL) \left(\frac{1 - \frac{(CT)(n-1)}{(M)(EFL)(n)}}{\frac{(n-1)}{M} - 1} \right)$$

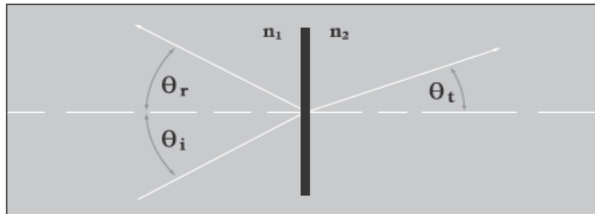
The "thin lens formula" is found by approximating the CT as zero (compared to R_1 and R_2):

$$R_2 = \frac{(EFL)(n-1)}{\frac{n-1}{M} - 1}$$

WINDOWS

A window is used to separate two environments of different pressure, temperature, etc., while allowing light at a specified wavelength to pass between the two. This section briefly discusses the effects of a window on the optical path of light which passes through it. The path taken by each ray through a window is given by Snell's Law:

► $n_i \sin \theta_i = n_t \sin \theta_t$

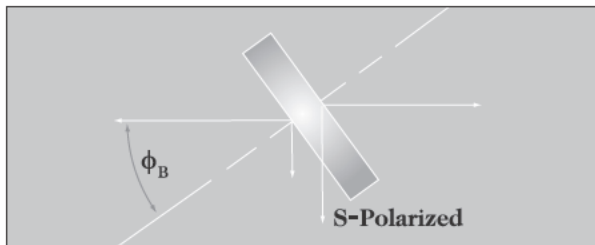


Here n_i is the refractive index of the medium in which the incident light is traveling and n_t is the refractive index of the window material. Usually, there is also a component of light which is reflected from the front surface. The angle the reflected light makes with respect to the normal to the mirror surface is equal to the angle of the incident light with respect to the normal. This is known as the *Law of Reflection* and is stated as:

► $\theta_i = \theta_r$

For a window of any given material, there exists an angle of incidence for which the angle between the reflected and the transmitted light is 90° , as shown below. This is known as the Brewster Angle and is of particular interest because at this angle the reflected light is plane (s-) polarized and the refracted light is partially polarized. A stack of windows placed at the Brewster angle will reduce the s-polarized component of the incident light until it becomes insignificant. The Brewster Angle is given by:

► $\phi_B = \tan^{-1} n_t/n_i$

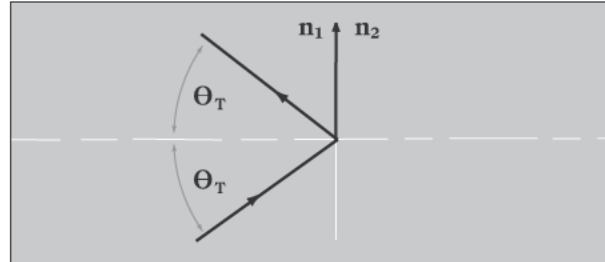


Some of the light traveling within a high refractive index material will reflect off the boundary with a material of lower refractive index. There exists an angle of incidence in this case where all of the light incident on the boundary will be reflected and none is transmitted.

This is known as Total Internal Reflection and the angle at which this occurs is given by:

► $\theta_T = \sin^{-1} n_2/n_1$

where n_2 is the index of refraction of the "outside" material and n_1 is the index of refraction of the window or higher index material.



CALCULATION OF WINDOW THICKNESS

Minimum thickness of a window required to withstand a pressure difference may be calculated by the following formula:

► $Th = \sqrt{\frac{1.1(P) * (P) * (R)^2 * SF}{MR}}$

Th = thickness, inches

R = unsupported radius, inches

P = pressure difference, psi

MR = modulus of rupture, psi

SF = safety factor

(We use SF=4 in our calculations)

Pressure at 1 atm = 14.7 psi = 101.324 kPa

Modulus of rupture (MR, psi)
of commonly used crystals:

BaF2	3,900
CaF2	5,300
Ge	10,500
LiF	1,600
MgF2	7,200
Sapphire	65,000
Si	18,100
ZnSe	8,000
ZnS	14,900
ZnS Cleartran	8,700

OPTICAL MATERIALS SPECIFICATIONS



AMTIR-1

Custom sizes and
specifications are available

COMPOSITION



OPTICAL

Transmission Range, microns	0.8–13
Absorbance $\mu(\lambda)$, cm^{-1}	
at 2 microns	2.531
at 4 microns	2.515
at 8 microns	2.503

THERMAL

Conductivity	$6 \text{ cal / cm sec}^\circ\text{K} \times 10^{-4}$
Specific Heat	$0.07 \text{ cal / gm}^\circ\text{K}$
Upper Use Temperature	300°C
Resistivity	$2 \times 10^{12} \Omega\text{cm @ } 100 \text{ Hz}$
Glass Transition Temperature	362°C
Annealing Temperature	370°C

MECHANICAL

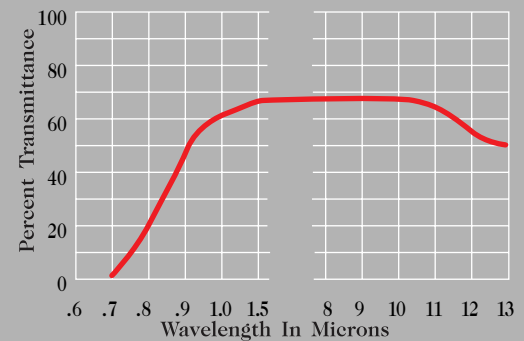
Density, g/cm^3	4.4
Knoop Hardness	170
Rupture Modulus, psi	2700
Young Modules (E), psi	3.2×10.6
Poisson Ratio	0.27

AMTIR-1 is a registered trademark of Amorphous Materials

Refr. Index n vs. Wavelength λ

WAVELENGTH, MICRONS	REFRACTIVE INDEX
1.0	2.605
1.5	2.546
2.0	2.531
2.4	2.525
3.0	2.518
4.0	2.514
5.0	2.511
6.0	2.509
7.0	2.506
8.0	2.503
9.0	2.500
10.0	2.497
11.0	2.494
12.0	2.490
13.0	2.486
14.0	2.482

Transmittance $\tau(\lambda)$ vs. Wavelength λ



AMTIR-2

Custom sizes and
specifications are available

COMPOSITION

As 40% – Se 60%

OPTICAL

Ref Index @ 10 μm 2.7691
Transmittance range, microns 1.0-14
Transmittance at 1 μm T = 0.99999

THERMAL

Resistivity $15 \times 10^9 \text{ ohm-cm}$
Thermal Expansion $22.4 \times 10^{-6} \text{ m/m}^\circ\text{C}$
Glass Trans Temp (T_g) 167°C
Softening Point 188°C
Specific Heat 0.068
Thermal Conductivity $5.3 \times 10^{-4} \text{ cal gm} / ^\circ\text{C sec}$
D N / D T @ 1.5 μm $+ 117 \times 10^{-6} / ^\circ\text{C}$
D N / D T @ 4 μm $+ 31 \times 10^{-6} / ^\circ\text{C}$
D N / D T @ 10 μm $+ 30.7 \times 10^{-6} / ^\circ\text{C}$

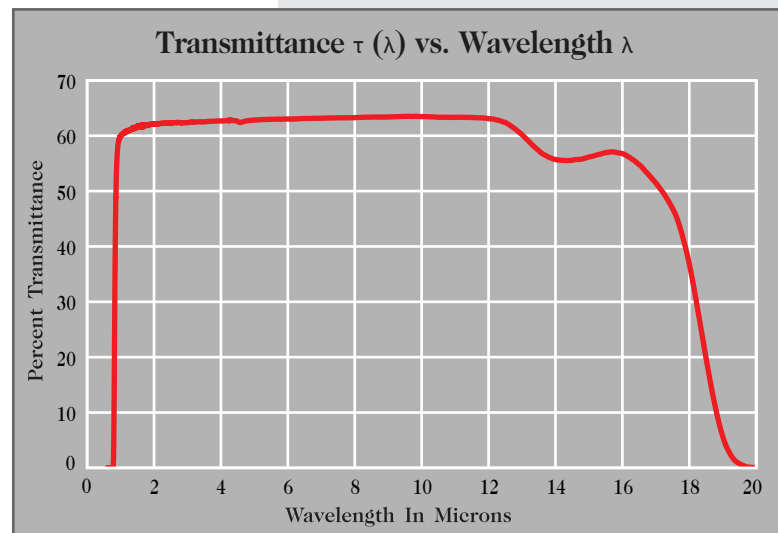
MECHANICAL

Density 4.66 gm/cm^3
Knoop Hardness 110
Rupture Modulus 2500 psi
Young's Modulus E $5.6 \times 10^6 \text{ psi}$
Poisson's Ratio 0.29
Specific gravity 4.4
Shear Modulus G $1.03 \times 10^6 \text{ psi}$
Tensile Strength 1440 psi
Compressive Strength 8800 psi
Dielectric Constant 9.1

AMTIR-2 is a registered trademark of Amorphous Materials.

IR Refractive Index of Amtir-2

μm	Refractive Index	Absorption Coefficient (cm^{-1})
1.0	2.9221	0.056
1.064	2.9023	0.040
1.25	2.8638	0.023
1.5	2.8351	0.016
1.75	2.8186	0.015
2.0	2.8082	0.015
3.0	2.7897	0.01
4.0	2.7830	0.01
5.0	2.7796	0.02
6.0	2.7773	0.01
7.0	2.7753	0.01
8.0	2.7735	0.01
9.0	2.7714	0.01
10.0	2.7691	0.01
11.0	2.7662	0.016
12.0	2.7626	0.031
13.0	2.7577	0.22



Barium Fluoride (BaF₂)

Custom sizes and
specifications are available

CRYSTALLOGRAPHIC

Syngony	Cubic
Symmetry Class	m3m
Lattice Constants, Angstrom	a=6.196
	c=a
Cleavability	(111), perfect

OPTICAL

Refractive Index at n_e	1.4759
Refractive Index $n_F - n_C$	0.0059
Refractive Index at $n_{10.6}$	1.3926
Refractive Index $n_{8.0} - n_{12.5}$	0.0673
Thermal Coefficient of Refractive Index at 3.39 microns for ± 60 deg C	$(-1.27) \dots (-1.51) \times 10^{-5}$
Transmission Range, microns	0.15–12.5
Absorbance $\mu(\lambda)$, cm^{-1}	
at 0.2 microns	0.2
at 0.4 microns	0.08
at 10.6 microns	0.13

THERMAL

Thermal Linear Expansion, deg C^{-1} for ± 60 deg C	$(16.5 \dots 19.2) \times 10^{-6}$
Thermal Conductivity, $\text{W}/(\text{m} \cdot \text{deg C})$ at 38 deg C	7.1
Specific Heat Capacity, $\text{J}/(\text{kg} \cdot \text{deg C})$	0.456×10^3
Thermal Stability, deg C	10 ± 2
Melting Point, deg C	1354

MECHANICAL

Density, g/cm^3 at 20 deg C	4.83
Mohs Hardness	3
Vickers Microhardness, Pa	82×10^7
Constants of Elastic Compliance, Pa^{-1}	$S_{11} = 15.30 \times 10^{-12}$ $S_{12} = -4.69 \times 10^{-12}$ $S_{44} = 39.47 \times 10^{-12}$

Young Modulus (E), Pa	
in $\langle 100 \rangle$ direction	6.54×10^{10}
in $\langle 111 \rangle$ direction	6.63×10^{10}
Shear Modulus (G), Pa	
in $\langle 100 \rangle$ direction	2.51×10^{10}
in $\langle 111 \rangle$ direction	2.53×10^{10}
Poisson Ratio	0.307

CHEMICAL

Molecular Weight	175.3
Solubility	
in water, $\text{gram}/100 \text{ cm}^3$	0.17
in acids	soluble

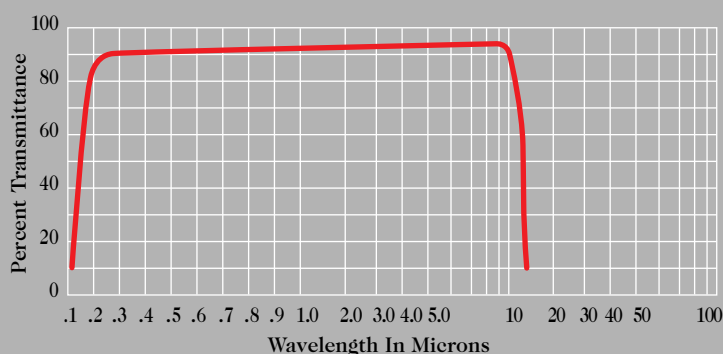
Refr. Index n vs. Wavelength λ

WAVELENGTH, MICRONS	REFRACTIVE INDEX
0.2	1.5573
0.5	1.4779
1.0	1.4686
2.0	1.4647
3.0	1.4612
4.0	1.4558
5.0	1.4511
6.0	1.4441
7.0	1.4357
8.0	1.4258
9.0	1.4144
10.0	1.4014
11.0	1.3865
12.0	1.3696
12.5	1.3585
15.0	1.3050

Internal Transmittance $\tau_i(\lambda)$ vs. Wavelength λ

WAVELENGTH, MICRONS	INTERNAL TRANSMITTANCE
0.2	0.70
0.5	0.96
1.0	0.97
3.0	0.97
5.0	0.97
6.0	0.97
7.0	0.97
8.0	0.97
9.0	0.97
10.0	0.85
12.0	0.42

Transmittance $\tau(\lambda)$ vs. Wavelength λ



Black Diamond 2 (BD2)

Custom sizes and
specifications are available

OPTICAL

Refractive Index at 2.5 μm	2.630
Thermal Coefficient of Refractive Index at 3.39 microns for ± 60 deg C	$91 \times 10^{-6} / ^\circ\text{C}$

THERMAL

Thermal Linear Expansion, deg C^{-1} for ± 60 deg C	$14 \times 10^{-6} / ^\circ\text{C}$
Thermal Conductivity, $\text{W}/(\text{m} \times \text{deg C})$ at 27 deg C	100 W/cm^2 (1064 nm, CW)
Specific Heat Capacity, $\text{J}/(\text{kg} \times \text{deg C})$	0.1 J/cm^2 (1064 nm, 10 ns)
Melting Point, deg C	278
Absorbance $\mu (\lambda)$, cm^{-1} at 10.6 microns	0.027

MECHANICAL

Density, g/cm^3 at 25 deg C	4.67 g/cm^3
Mohs Hardness	3
Young Modulus (E), Pa	22.1 GPa

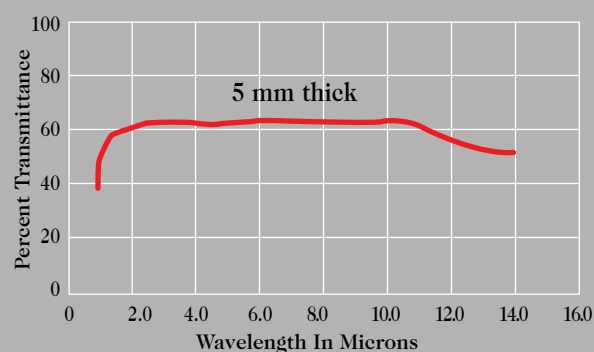
CHEMICAL

Composition	$\text{Ge}_{28}\text{Sb}_{12}\text{Se}_{60}$
Solubility in water, $\text{gram}/100 \text{ cm}^3$	insoluble

Refr. Index n vs. Wavelength λ

WAVELENGTH, MICRONS	REFRACTIVE INDEX
3.0	2.6266
4.0	2.621
5.0	2.6173
6.0	2.6142
7.0	2.6117
8.0	2.6088
9.0	2.6055
10.0	2.6023
11.0	2.5983
12.0	2.5942
13.0	2.5892
14.0	2.5843

Transmittance $\tau (\lambda)$ vs. Wavelength λ



Cadmium Telluride (CdTe)

Custom sizes and
specifications are available

CRYSTALLOGRAPHIC

Syngony	Cubic
Symmetry Class	F43m
Lattice Constant, Angstrom	6.483

OPTICAL

Refractive Index at $n_{10.0}$	2.649
Refractive Index $n_{20.0}$	2.610
Transmission Range, microns	2-25
Absorbance $\mu(\lambda)$, cm^{-1} at 10 microns	0.167

THERMAL

Thermal Linear Expansion, deg C ⁻¹ for 0-30 deg C	4.5×10^{-6}
Thermal Conductivity, W/(m•deg C)	4.10
Specific Heat Capacity, J/(kg•deg C)	0.209
Melting Point, deg C	1092

MECHANICAL

Density, g/cm ³	5.86
Young Modulus (E), Pa	52×10^9
Poisson Ratio	0.41

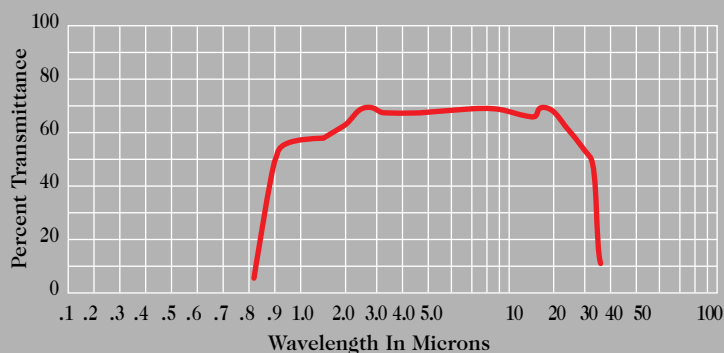
CHEMICAL

Molecular Weight	240.01
Solubility in water, gram/100 cm ³	insoluble

Refr. Index n vs. Wavelength λ

WAVELENGTH, MICRONS	REFRACTIVE INDEX
6.0	2.656
8.0	2.654
10.0	2.649
12.0	2.644
14.0	2.637
16.0	2.629
18.0	2.620
20.0	2.610
22.0	2.598

Transmittance $\tau(\lambda)$ vs. Wavelength λ



Calcium Fluoride (CaF₂)

Custom sizes and
specifications are available

CRYSTALLOGRAPHIC

Syngony	Cubic
Symmetry Class	m3m
Lattice Constants, Angstrom	a=5.462
	c=a
Cleavability	(111), perfect

OPTICAL

Refractive Index at n_e	1.4349
Refractive Index $n_F - n_C$	0.0043
Refractive Index at $n_{10.6}$	1.2996
Thermal Coefficient of Refractive Index at 3.39 microns for ± 60 deg C	$(-0.95) \dots (-1.17) \times 10^{-5}$
Transmission Range, microns	0.15-9.0

THERMAL

Thermal Linear Expansion, deg C ⁻¹ for ± 60 deg C	$(16.5 \dots 19.4) \times 10^{-6}$
Thermal Conductivity, W/(m•deg C) at 36 deg C	9.71
Specific Heat Capacity, J/(kg•deg C)	0.8876×10^3
Thermal Stability, deg C	20 $\pm$ 2
Melting Point, deg C	1418

MECHANICAL

Density, g/cm ³ at 20 deg C	3.18
Mohs Hardness	4
Vickers Microhardness, Pa	165×10^7
Constants of Elastic Compliance, Pa ⁻¹	$S_{11} = 6.83 \times 10^{-12}$ $S_{12} = -1.53 \times 10^{-12}$ $S_{44} = 29.58 \times 10^{-12}$

Young Modulus (E), Pa in <100> direction	14.61×10^{10}
in <111> direction	8.99×10^{10}
Shear Modulus (G), Pa in <100> direction	4.76×10^{10}
in <111> direction	3.38×10^{10}
Poisson Ratio	0.216

CHEMICAL

Molecular Weight	78.08
Solubility in water, gram/100 cm ³	0.0016

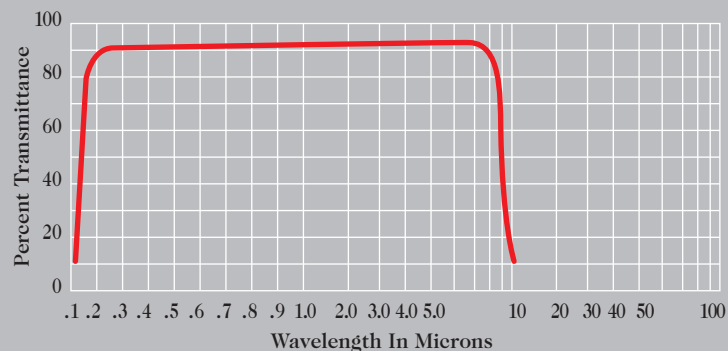
Refr. Index n vs. Wavelength λ

WAVELENGTH, MICRONS	REFRACTIVE INDEX
0.2	1.4951
0.5	1.4365
1.0	1.4289
2.0	1.4239
3.0	1.4179
4.0	1.4096
5.0	1.3990
6.0	1.3856
7.0	1.3693
8.0	1.3498
9.0	1.3268
10.0	1.3002
11.0	1.2676
12.0	1.2299

Internal Transmittance $\tau_i(\lambda)$ vs. Wavelength λ

WAVELENGTH, MICRONS	INTERNAL TRANSMITTANCE
0.2	0.87
0.5	0.97
1.0	0.99
3.0	0.99
5.0	0.99
6.0	0.98
7.0	0.97
8.0	0.88
9.0	0.59
10.0	0.19

Transmittance $\tau(\lambda)$ vs. Wavelength λ



Gallium Arsenide (GaAs)

Custom sizes and
specifications are available

CRYSTALLOGRAPHIC

Syngony	Cubic
Symmetry Class	43m F43m
Lattice Constant, Angstrom	5.653

OPTICAL

Refractive Index at $n_{8.0}$	3.2884
Transmission Range, microns	1-15
Absorbance $\mu(\lambda)$, cm^{-1} at 10.6 microns	0.01

THERMAL

Thermal Linear Expansion, deg C^{-1} for 0-30 deg C	5.39×10^{-6}
Thermal Conductivity, $\text{W}/(\text{m} \cdot \text{deg C})$ at 25 deg C	46.05
Specific Heat Capacity, $\text{J}/(\text{kg} \cdot \text{deg C})$	350
Melting Point, deg C	1238

MECHANICAL

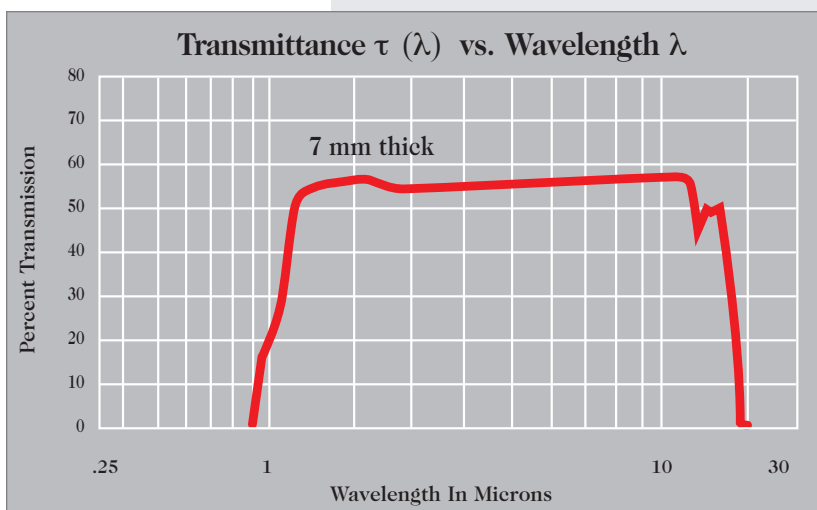
Density, g/cm^3 at 20 deg C	5.316
Mohs Hardness	4.5
Vickers Microhardness, Pa	6.9×10^9
Young Modulus (E), Pa	85×10^9
Poisson Ratio	0.31

CHEMICAL

Molecular Weight	144.64
Solubility in water, $\text{gram}/100 \text{ cm}^3$	insoluble

Refr. Index n vs. Wavelength λ

WAVELENGTH, MICRONS	REFRACTIVE INDEX
7.0	3.2927
8.0	3.2884
9.0	3.2838
10.0	2.2786
11.0	2.2729
12.0	2.2667



GASIR-1

Custom sizes and
specifications are available

COMPOSITION

$\text{Ge}_{22}\text{As}_{20}\text{Se}_{58}$

OPTICAL

Transmittance range, microns 0.8 - 11

THERMAL

Glass temperature 565 K
Upper use temperature 523 K
Specific heat 0.36 J/g*K
Thermal expansion coefficient (300K) $17 \times 10^{-6}/\text{K}$
Thermal conductivity (288 – 307K) 0.28 W/m*K
Heat Capacity 0.36 J/g*K
Dielectric constant $> 20 \text{ M}\Omega$

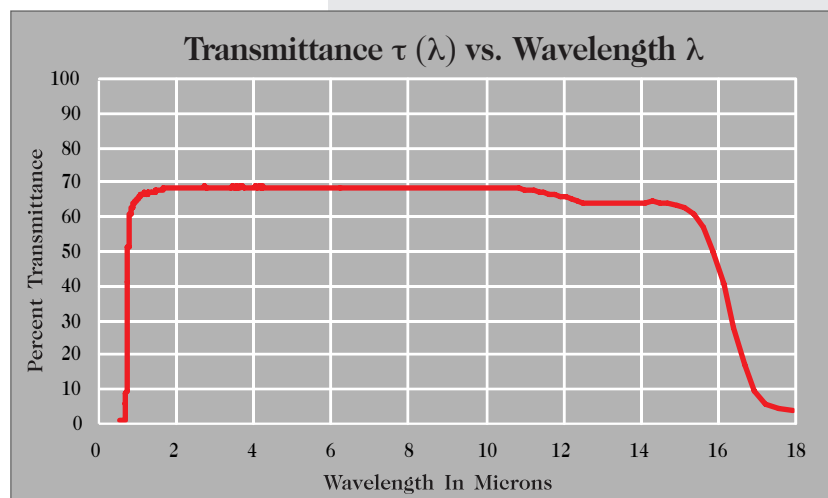
MECHANICAL

Density $4.40(\pm 0.01) \times 10^3 \text{ kg/m}^3$
Young's modulus 17.89 GPa
Torsion modulus 6.98 GPa
Poisson's ratio 0.28
Flexion resistance 17.2 MPa
Compression resistance 161 MPa
Vickers hardness 170 HV

GASIR-1 is a registered trademark of Umicore Electro-Optic Materials.

IR refractive index of Gasir-1

μm	Refractive Index
1.54	2.5424
2	2.5267
3	2.5148
3.5	2.5120
4	2.5100
4.5	2.5085
5	2.5071
6	2.5047
7	2.5024
8	2.4999
9	2.4973
10	2.4944
11	2.4911
12	2.4874
13	2.4834
14	2.4787



Germanium (Ge)

Custom sizes and
specifications are available

CRYSTALLOGRAPHIC

Syngony	Cubic
Symmetry Class	m3m
Lattice Constants, Angstrom	$a=5.657$ $c=a$
Cleavability	(111), non-perfect

OPTICAL

Refractive Index at $n_{10.6}$	4.0034
Refractive Index $n_{8.0} - n_{12.5}$	0.0036
Thermal Coefficient of Refractive Index at 3.39 microns for ± 60 deg C	$35-40 \times 10^{-5}$
Transmission Range, microns	2-17

THERMAL

Thermal Linear Expansion, deg C ⁻¹ for ± 60 deg C	$(5.1...5.8) \times 10^{-6}$
Thermal Conductivity, W/(m•deg C) at 27 deg C	59.8
Specific Heat Capacity, J/(kg•deg C)	0.310
Melting Point, deg C	937
Absorbance $\mu(\lambda)$, cm ⁻¹ at 10.6 microns	0.027

MECHANICAL

Density, g/cm ³ at 25 deg C	5.33
Mohs Hardness	6
Vickers Microhardness, Pa	900×10^7
Constants of Elastic Compliance, Pa ⁻¹	$S_{11}=9.69 \times 10^{-12}$ $S_{12}=-2.65 \times 10^{-12}$ $S_{44}=14.89 \times 10^{-12}$
Young Modulus (E), Pa in <100> direction	10.32×10^{10}
in <111> direction	15.56×10^{10}
Shear Modulus (G), Pa in <100> direction	6.72×10^{10}
in <111> direction	4.67×10^{10}
Poisson Ratio	0.278

CHEMICAL

Molecular Weight	72.61
Solubility in water, gram/100 cm ³	insoluble

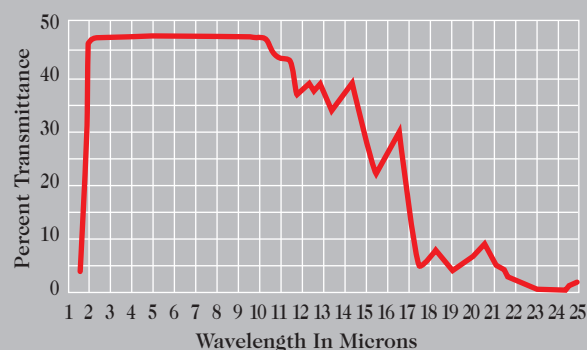
Refr. Index n vs. Wavelength λ

WAVELENGTH, MICRONS	REFRACTIVE INDEX
2.0	4.1079
3.0	4.0446
4.0	4.0242
5.0	4.0153
6.0	4.0106
7.0	4.0076
8.0	4.0053
9.0	4.0047
10.0	4.0040
11.0	4.0031
12.0	4.0029
12.5	4.0024
15.0	4.0017

Internal Transmittance $\tau_i(\lambda)$ vs. Wavelength λ

WAVELENGTH, MICRONS	INTERNAL TRANSMITTANCE
3.0	0.97
5.0	0.97
6.0	0.97
7.0	0.97
8.0	0.97
9.0	0.97
10.0	0.96
12.0	0.70
15.0	0.56

Transmittance $\tau(\lambda)$ vs. Wavelength λ



BK7 Schott Glass (BK7)

Custom sizes and
specifications are available

OPTICAL

Refractive Index at n_e	1.51872
Refractive Index at n_o	1.52283
Thermal Coefficient of Refractive Index at 0.546 microns for 0/+20 deg C	2.8×10^{-6}
Transmission Range, microns	0.35-2.0

THERMAL

Thermal Linear Expansion, deg C ⁻¹ for -30/+70 deg C	7.1×10^{-6}
Thermal Conductivity, W/(m•deg C)	1.114
Specific Heat Capacity, J/(kg•deg C)	0.858×10^3
Melting Point, deg C	559

MECHANICAL

Density, g/cm ³ at 20 deg C	2.51
Young Modulus (E), Pa	8.1×10^{10}
Poisson Ratio	0.206

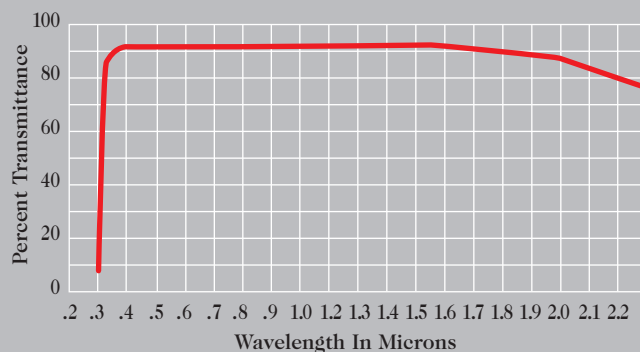
Refr. Index n vs. Wavelength λ

WAVELENGTH, MICRONS	REFRACTIVE INDEX
0.365	1.53626
0.4047	1.53024
0.4358	1.52669
0.4800	1.52283
0.4861	1.52238
0.5461	1.51872
0.5876	1.51680
0.5893	1.51673
0.6328	1.51509
0.6438	1.51472
0.6563	1.51432
0.7065	1.51289
0.8521	1.50981
1.0140	1.50731
1.0600	1.50669
1.5296	1.50094
1.9700	1.49500
2.3254	1.48929

Internal Transmittance $\tau_i(\lambda)$ for 5 mm vs. Wavelength λ

WAVELENGTH, MICRONS	INTERNAL TRANS- MITTANCE FOR 5mm
0.310	0.59
0.320	0.81
0.350	0.986
0.365	0.994
0.370	0.995
0.380	0.996
0.390	0.998
0.400	0.998
0.420	0.998
0.460	0.999
0.500	0.999
0.700	0.999
1.060	0.999
1.530	0.997
1.970	0.968
2.325	0.89

Transmittance $\tau(\lambda)$ vs. Wavelength λ



Infrared Chalcogenide Glass IG2

Custom sizes and specifications are available

COMPOSITION

$\text{Ge}_{22}\text{As}_{12}\text{Se}_{55}$

OPTICAL

Transmission Range, microns	1-12
Absorbance cm^{-1}	
at 2 microns	0.028755 cm^{-1}
at 4 microns	0.024532 cm^{-1}
at 8 microns	0.023686 cm^{-1}

THERMAL

Thermal Expansion	$12.1 \times 10^{-6}/\text{K}$
Specific Heat	0.33 J/gK
Thermal Conductivity	0.24 W/mK
Transition Temperature	368°C
Thermal change dn/dT	$60 \times 10^{-6}/\text{K} (10.6\mu\text{m})$

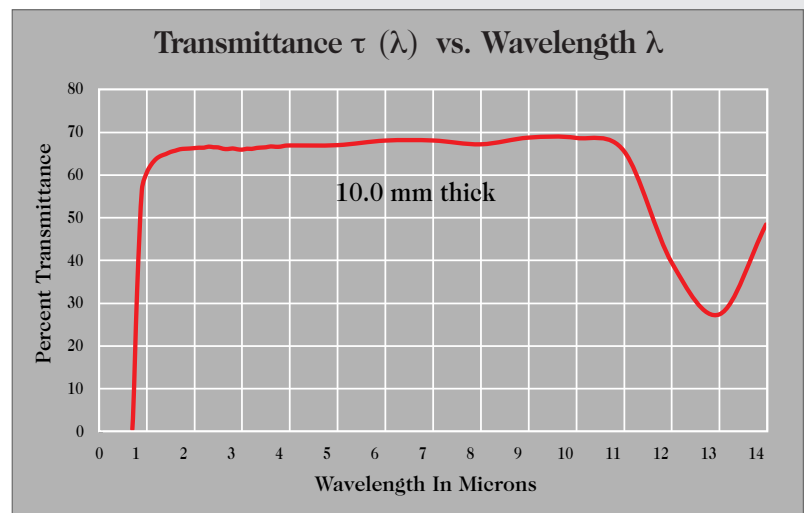
MECHANICAL

Density	4.41 g/cm^3
Hardness (Knoop)	1.41 GPa
Rupture Modulus	19 MPa
Young's Modulus	21.5 GPa
Shear Modulus	8.9 GPa
Dispersion	$108 (10.6\mu\text{m})$

IG-2 is a registered trademark of Vitron.

IR Refractive Index of IG-2

μm	Refractive Index
1.00	2.5969
1.50	2.5462
2.00	2.5298
3.00	2.5180
4.00	2.5133
5.00	2.5104
6.00	2.5078
7.00	2.5054
8.00	2.5026
9.00	2.4999
10.00	2.4968
11.00	2.4931
12.00	2.4891



Infrared Chalcogenide Glasses IG6

Custom sizes and
specifications are available

COMPOSITION $\text{As}_{40}\text{Se}_{60}$

OPTICAL

Transmission Range, microns 1.5-12 μm

MATERIAL PROPERTIES

Density 4.63 g/cm³
 Hardness (Knoop) 1.04 GPa
 Rupture Modulus 17 MPa
 Young's Modulus 18.3 GPa
 Shear Modulus 8.0 GPa
 Dispersion 168 (4 μm)
 161 (10.6 μm)

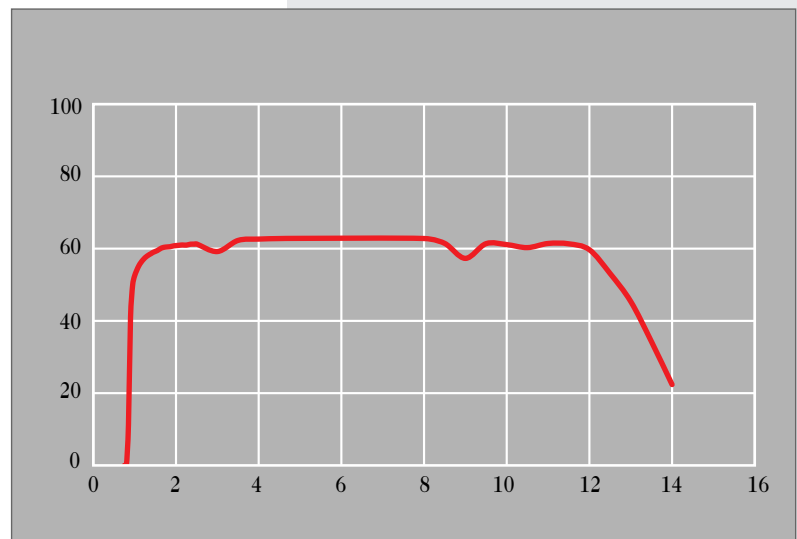
THERMAL

Thermal Expansion $20.7 \times 10^{-6}/\text{K}$
 Specific Heat 0.36 J/gK
 Thermal Conductivity 0.24 W/mK
 Transition Temperature 185°C
 Thermal change dn/dT $35 \times 10^{-6}/\text{K}$ (3.4 μm)
 $41 \times 10^{-6}/\text{K}$ (10.6 μm)

IG-6 is a registered trademark of Vitron

IR Refractive Index of IG-6

μm	Index
1.0	2.9314
1.5	2.8462
2.0	2.8200
3.0	2.8017
4.0	2.7948
5.0	2.7910
6.0	2.7882
7.0	2.7857
8.0	2.7833
9.0	2.7808
10.0	2.7781
11.0	2.7753
12.0	2.7721



Fused Silica UV Grade (SiO₂)

Custom sizes and
specifications are available

OPTICAL

Refractive Index at n_e	1.4601
Refractive Index $n_F - n_C$	0.0068
Refractive Index at n_D	1.4584
Refractive Index $n_F - n_C$	0.0068
Thermal Coefficient of Refractive Index at n_e for +20 deg C	100×10^{-7}
Transmission Range, microns	0.18-3.5

THERMAL

Thermal Linear Expansion, deg C ⁻¹ for 0/+50 deg C	4.0×10^{-6}
Thermal Conductivity, W/(m•deg C) at 20 deg C	1.35
Specific Heat Capacity, J/(kg•deg C)	0.728×10^3
Melting Point, deg C	1900

MECHANICAL

Density, g/cm ³ at 20 deg C	2.21
Young Modulus (E), Pa	7.36×10^{10}
Shear Modulus (G), Pa	3.14×10^{10}
Poisson Ratio	0.17

CHEMICAL

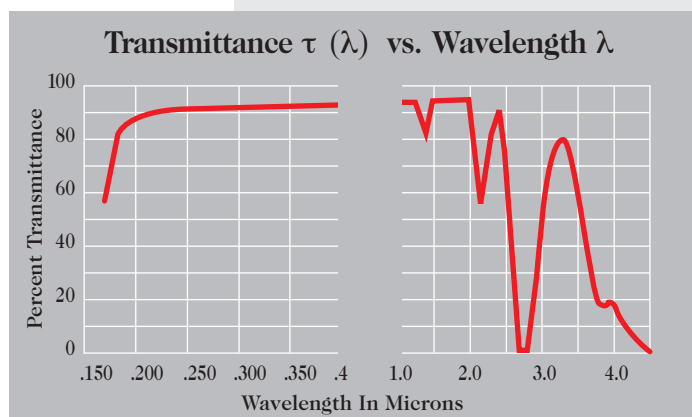
Solubility	
in water, gram/100 cm ³	insoluble
in acids	insoluble

Refr. Index n vs. Wavelength λ

WAVELENGTH, MICRONS	REFRACTIVE INDEX
0.1700	1.615
0.1850	1.575
0.2000	1.550
0.2144	1.5337
0.2803	1.4940
0.3021	1.4872
0.3650	1.4745
0.4046	1.4696
0.4358	1.4666
0.5461	1.4601
0.5876	1.4585
0.5893	1.4584
0.6438	1.4567
0.6563	1.4564
0.8621	1.4525
1.0830	1.4494
1.3950	1.4458
1.7091	1.4421
2.0581	1.4372
3.2439	1.4131

Internal Transmittance $\tau_i(\lambda)$ vs. Wavelength λ

WAVELENGTH, MICRONS	INTERNAL TRANSMITTANCE
0.170	0.63
0.200	0.96
0.400	0.999
0.500	0.999
0.700	0.999
0.900	0.999
1.000	0.999
1.385	0.880
2.000	0.999
2.200	0.580
2.300	0.880
2.380	0.950
2.500	0.790
2.720	0.000
2.800	0.000
2.900	0.295
3.000	0.670



Fused Silica IR Grade (SiO₂)

Custom sizes and
specifications are available

OPTICAL

Refractive Index at ne	1.4601
Refractive Index $n_F - n_C$	0.0068
Refractive Index at nD	1.4584
Refractive Index $n_F - n_C$	0.0068
Thermal Coefficient of Refractive Index at n_C for +20 deg C	100×10^{-7}
Transmission Range, microns	0.18-3.5

THERMAL

Thermal Linear Expansion, deg C-1 for 0/+50 deg C	4.0×10^{-6}
Thermal Conductivity, W/(m•deg C) at 20 deg C	1.35
Specific Heat Capacity, J/(kg•deg C)	0.728×10^3
Melting Point, deg C	1900

MECHANICAL

Density, g/cm ³ at 20 deg C	2.21
Young Modulus (E), Pa	7.36×10^{10}
Shear Modulus (G), Pa	3.14×10^{10}
Poisson Ratio	0.17

CHEMICAL

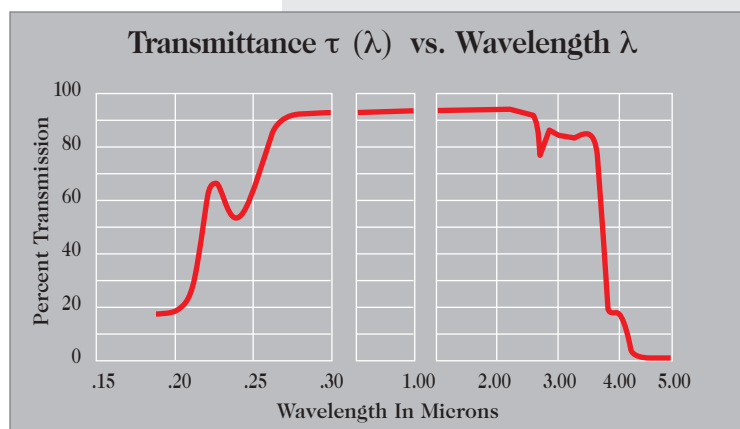
Solubility	
in water, gram/100 cm ³	insoluble
in acids	insoluble

Refr. Index n vs. Wavelength λ

WAVELENGTH, MICRONS	REFRACTIVE INDEX
0.1700	1.615
0.1850	1.575
0.2000	1.550
0.2144	1.5337
0.2803	1.4940
0.3021	1.4872
0.3650	1.4745
0.4046	1.4696
0.4358	1.4666
0.5461	1.4601
0.5876	1.4585
0.5893	1.4584
0.6438	1.4567
0.6563	1.4564
0.8621	1.4525
1.0830	1.4494
1.3950	1.4458
1.7091	1.4421
2.0581	1.4372
3.2439	1.4131

Internal Transmittance $\tau_i(\lambda)$ vs. Wavelength λ

WAVELENGTH, MICRONS	INTERNAL TRANSMITTANCE
0.220	0.220
0.230	0.435
0.240	0.525
0.260	0.800
0.270	0.930
0.280	0.999
0.700	0.999
1.000	0.999
1.500	0.999
2.000	0.999
2.720	0.999
2.800	0.955
2.900	0.900
3.000	0.870
3.750	0.180



Lithium Fluoride Vacuum UV Grade (LiF)

Custom sizes and specifications are available

CRYSTALLOGRAPHIC

Syngony	Cubic
Symmetry Class	m3m
Lattice Constants, Angstrom	a=4.026
	c=a
Cleavability	(100), perfect

OPTICAL

Refractive Index at n_e	1.3931
Refractive Index $n_F - n_C$	0.0040
Thermal Coefficient of Refractive Index at 3.39 microns for +/- 60 deg C	$(-1.25) \dots (-1.51) \times 10^{-5}$
Transmission Range, microns	0.12-6.5

THERMAL

Thermal Linear Expansion, deg C ⁻¹ for +/- 60 deg C	$(28.1 \dots 34.8) \times 10^{-6}$
Thermal Conductivity, W/(m•deg C) at 38 deg C	14.2
Specific Heat Capacity, J/(kg•deg C)	1.5617×10^3
Melting Point, deg C	870

MECHANICAL

Density, g/cm ³ at 20 deg C	2.60
Mohs Hardness	4
Vickers Microhardness, Pa	98×10^7
Constants of Elastic Compliance, Pa ⁻¹	$S_{11} = 11.32 \times 10^{-12}$
	$S_{12} = -3.06 \times 10^{-12}$
	$S_{44} = 15.91 \times 10^{-12}$

Young Modulus (E), Pa in <100> direction	8.84×10^{10}
in <111> direction	14.22×10^{10}
Shear Modulus (G), Pa in <100> direction	4.09×10^{10}
in <111> direction	6.29×10^{10}
Poisson Ratio	0.270

CHEMICAL

Molecular Weight	25.94
Solubility	
in water, gram/100 cm ³	0.27
in acids	soluble

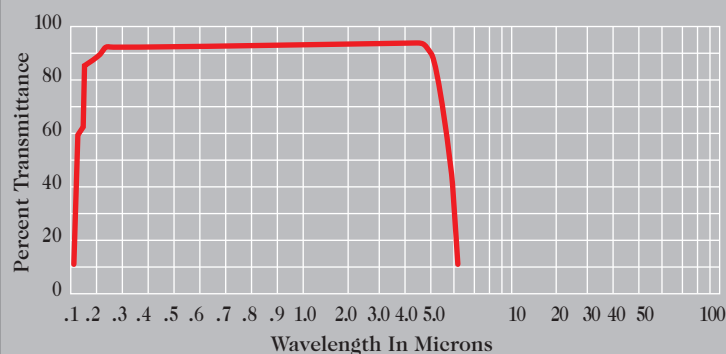
Refr. Index n vs. Wavelength λ

WAVELENGTH, MICRONS	REFRACTIVE INDEX
0.2	1.439
0.5	1.3943
1.0	1.3871
2.0	1.3788
3.0	1.3666
4.0	1.3494
5.0	1.3266
6.0	1.2975
7.0	1.262
8.0	1.218
9.0	1.165
10.0	1.101

Internal Transmittance $\tau_i(\lambda)$ vs. Wavelength λ

WAVELENGTH, MICRONS	INTERNAL TRANSMITTANCE
0.2	0.90
0.5	0.98
1.0	0.97
3.0	0.97
5.0	0.88
6.0	0.65
7.0	0.14

Transmittance $\tau(\lambda)$ vs. Wavelength λ



Magnesium Fluoride (MgF₂)

Custom sizes and
specifications are available

CRYSTALLOGRAPHIC

Syngony	Tetragonal
Symmetry Class	4/mmm
Lattice Constants, Angstrom	a=4.64 c=3.06
Cleavability	(100),(110), imperfect

OPTICAL

Refractive Index at n_e for "o"-ray	1.3786
Refractive Index n_e for "e"-ray	1.3904
Refractive Index at n_{F-C} for "o"-ray	0.0034
Refractive Index n_{F-C} for "e"-ray	0.0110
Thermal Coefficient of Refractive Index at 3.39 microns for +/-60 deg C	$\beta_o = (0.15...0.10) \times 10^{-5}$ $\beta_e = (0.10...0.04) \times 10^{-5}$
Transmission Range, microns	0.13-7.0

THERMAL

Thermal Linear Expansion, deg C ⁻¹ for +/-60 deg C	
⊥ to c-axis	$(6.23...9.25) \times 10^{-6}$
to c-axis	$(10.86...14.54) \times 10^{-6}$
Specific Heat Capacity, J/(kg•deg C)	0.9200×10^3
Melting Point, deg C	1255

MECHANICAL

Density, g/cm ³ at 20 deg C	3.18
Mohs Hardness	6
Vickers Microhardness, Pa	
⊥ to c-axis	441×10^7
to c-axis	289×10^7
Constants of Elastic Compliance, Pa ⁻¹	$S_{11} = 12.45 \times 10^{-12}$ $S_{12} = -7.16 \times 10^{-12}$ $S_{13} = -1.66 \times 10^{-12}$ $S_{33} = 5.94 \times 10^{-12}$ $S_{44} = 17.54 \times 10^{-12}$ $S_{66} = 10.53 \times 10^{-12}$

Young Modulus (E), Pa	
⊥ to c-axis	16.91×10^{10}
to c-axis	7.97×10^{10}
Shear Modulus (G), Pa	
⊥ to c-axis	5.71×10^{10}
to c-axis	9.52×10^{10}
Poisson Ratio	
to c-axis	0.577

CHEMICAL

Molecular Weight	62.32
Solubility	
in water, gram/100 cm ³	0.0076
in acids	soluble

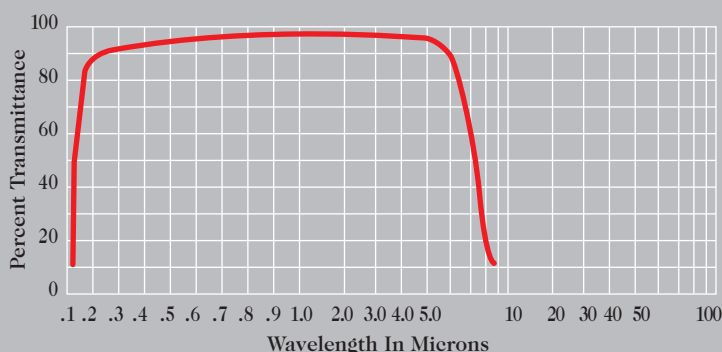
Refr. Index n vs. Wavelength λ

WAVELENGTH, MICRONS	REFRACTIVE INDEX n_o	n_e
0.2	1.4231	1.4367
0.5	1.3797	1.3916
1.0	1.3736	1.3852
2.0	1.3686	1.3797
3.0	1.3618	1.3724
4.0	1.3525	1.3622
5.0	1.3400	1.3487
6.0	1.3242	1.3315
7.0	1.3044	1.3101

Internal Transmittance $\tau_i(\lambda)$ vs. Wavelength λ

WAVELENGTH, MICRONS	INTERNAL TRANSMITTANCE
0.2	0.95
0.5	0.97
1.0	0.97
3.0	0.97
5.0	0.97
6.0	0.91
7.0	0.54
8.0	0.12

Transmittance $\tau(\lambda)$ vs. Wavelength λ



Potassium Bromide (KBr)

Custom sizes and
specifications are available

CRYSTALLOGRAPHIC

Syngony	Cubic
Symmetry Class	m3m
Lattice Constants, Angstrom	a=6.598
	c=a
Cleavability	(100), perfect

OPTICAL

Refractive Index at n_e	1.5639
Refractive Index $n_F - n_C$	0.0617
Refractive Index at $n_{10.6}$	1.5251
Refractive Index $n_{8.0} - n_{12.5}$	0.0099
Thermal Coefficient of Refractive Index at 3.39 microns for ± 60 deg C	$(-3.95...-4.29) \times 10^{-5}$
Transmission Range, microns	0.21-28

THERMAL

Thermal Linear Expansion, deg C ⁻¹ for ± 60 deg C	$(36.6...39.6) \times 10^{-6}$
Thermal Conductivity, W/(m•deg C) at 46 deg C	4.81
Specific Heat Capacity, J/(kg•deg C)	0.4522×10^3
Melting Point, deg C	728

MECHANICAL

Density, g/cm ³ at 20 deg C	2.75
Mohs Hardness	1.5
Vickers Microhardness, Pa	10×10^7
Constants of Elastic Compliance, Pa ⁻¹	$S_{11}=30.29 \times 10^{-12}$ $S_{12}=-4.18 \times 10^{-12}$ $S_{44}=194.92 \times 10^{-12}$

Young Modulus (E), Pa	
in <100> direction	3.30×10^{10}
in <110> direction	1.38×10^{10}
Shear Modulus (G), Pa	
in <100> direction	0.90×10^{10}
in <110 direction	0.51×10^{10}
Poisson Ratio	0.138

CHEMICAL

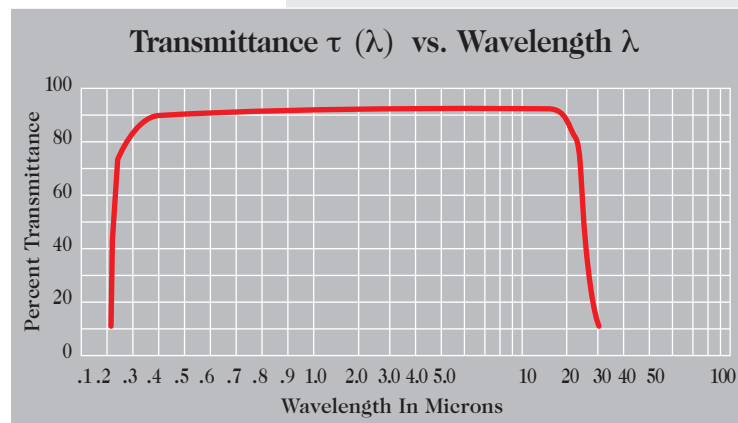
Molecular Weight	119.01
Solubility in water, gram/100 cm ³	53.48

Refr. Index n vs. Wavelength λ

WAVELENGTH, MICRONS	REFRACTIVE INDEX
0.2	2.0995
0.5	1.5700
1.0	1.5444
2.0	1.5383
3.0	1.5357
4.0	1.5346
5.0	1.5334
6.0	1.5319
7.0	1.5303
8.0	1.5285
9.0	1.5265
10.0	1.5242
11.0	1.5217
12.0	1.5204
15.0	1.5127
20.0	1.4924
30.0	1.4253

Internal Transmittance $\tau_i(\lambda)$ vs. Wavelength λ

WAVELENGTH, MICRONS	INTERNAL TRANSMITTANCE
0.2	0.48
0.5	0.98
1.0	0.98
3.0	0.98
5.0	0.98
6.0	0.98
7.0	0.98
8.0	0.98
9.0	0.98
10.0	0.98
12.0	0.98
15.0	0.98
20.0	0.92
30.0	0.26



Sapphire (Al_2O_3)

Custom sizes and
specifications are available

CRYSTALLOGRAPHIC

Syngony	Tetragon
Symmetry Class	3m
Lattice Constants, Angstrom	$a=4.758$ $c=12.991$
Cleavability	(1011),(1120), imperfect

OPTICAL

Refractive Index at n_e	1.7771
Refractive Index $n_F - n_C$	0.0107
Thermal Coefficient of Refractive Index at 3.39 microns for ± 60 deg C	$\beta_o = (0.88...1.28) \times 10^{-5}$ $\beta_e = (0.99...1.39) \times 10^{-5}$
Transmission Range, microns	0.17-5.0

THERMAL

Thermal Linear Expansion, deg^{-1} for ± 60 deg C	
$\perp$ to c-axis	$(3.24...5.66) \times 10^{-6}$
Thermal Conductivity, $\text{W}/(\text{m} \cdot \text{deg C})$ at 46 deg C	
$\perp$ to c-axis	25.2
$\parallel$ to c-axis	23.1
Specific Heat Capacity, $\text{J}/(\text{kg} \cdot \text{deg C})$	0.7610×10^3
Thermal Stability, deg C	162 $\pm$ 8
Melting Point, deg C	2030

MECHANICAL

Density, g/cm^3 at 20 deg C	3.98
Mohs Hardness	9
Vickers Microhardness, Pa	
$\perp$ to c-axis	2200
$\parallel$ to c-axis	1940
Constants of Elastic Compliance, Pa^{-1}	$S_{11}=2.3 \times 10^{-12}$ $S_{12}=-0.7 \times 10^{-12}$ $S_{13}=-0.4 \times 10^{-12}$ $S_{33}=2.2 \times 10^{-12}$ $S_{44}=6.8 \times 10^{-12}$ $S_{14}=0.5 \times 10^{-12}$

Young Modulus (E), Pa	
$\perp$ to c-axis	46.26×10^{10}
$\parallel$ to c-axis	42.64×10^{10}
Shear Modulus (G), Pa	
$\perp$ to c-axis	14.43×10^{10}
$\parallel$ to c-axis	16.29×10^{10}
Poisson Ratio $\parallel$ to c-axis	0.309

CHEMICAL

Molecular Weight	101.96
Solubility in water, $\text{gram}/100 \text{ cm}^3$	$98 \cdot 10^{-6}$

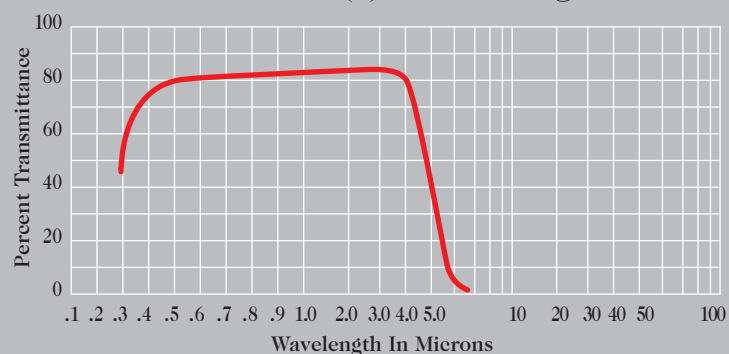
Refr. Index n vs. Wavelength λ

WAVELENGTH, MICRONS	REFRACTIVE INDEX n_o	n_e
1.0	1.7545	1.7460
2.0	1.7374	1.7299
3.0	1.7015	1.6920
4.0	1.6748	1.6679

Internal Transmittance $\tau_i(\lambda)$ vs. Wavelength λ

WAVELENGTH, MICRONS	INTERNAL TRANSMITTANCE
0.2	0.79
0.5	0.97
1.0	0.97
3.0	0.97
5.0	0.45

Transmittance $\tau(\lambda)$ vs. Wavelength λ



Silicon (Si)

Custom sizes and
specifications are available

CRYSTALLOGRAPHIC

Syngony	Cubic
Symmetry Class	m3m Fd3m
Lattice Constants, Angstrom	a=5.43089

OPTICAL

Refractive Index at $n_{3.0}$	3.436
Refractive Index at $n_{5.0}$	3.426
Thermal Coefficient of Refractive Index at 25 deg C	1.50×10^{-4}
Transmission Range, microns	1.2-10, 50-100

THERMAL

Thermal Linear Expansion, deg C ⁻¹ for 25 deg C	2.55×10^{-6}
Thermal Conductivity, W/(m•deg C) at 27 deg C	159
Specific Heat Capacity (solid), J/(kg•deg C)	0.712×10^3
Melting Point, deg C	1412

MECHANICAL

Density, g/cm ³ at 20 deg C	2.329
Mohs Hardness	7
Young Modulus (E), Pa	1.89×10^{10}
Shear Modulus (G), Pa	7.99×10^{10}
Poisson Ratio	0.266

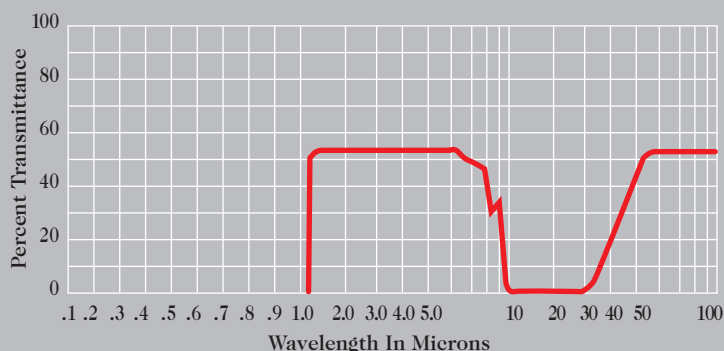
CHEMICAL

Molecular Weight	28.09
Solubility in water, gram/100 cm ³	insoluble

Refr. Index n vs. Wavelength λ

WAVELENGTH, MICRONS	REFRACTIVE INDEX
1.5	3.484
2.0	3.456
3.0	3.436
4.0	3.429
5.0	3.426
6.0	3.424
7.0	3.423
8.0	3.422
9.0	3.422

Transmittance τ (λ) vs. Wavelength λ



High Resistivity Silicon (Si)

Custom sizes and
specifications are available

RESISTIVITY

> 10,000 ohm cm

CRYSTALLOGRAPHIC

Syngony Cubic
Symmetry Class m3m
Lattice Constants, Angstro $a=5.43089$

OPTICAL

Refractive Index at $n_{3.0}$ 3.430
Refractive Index at $n_{5.0}$ 3.420
Thermal Coefficient of Refractive Index
at 25 deg C 1.50×10^{-4}
Transmission Range, microns 1.2-10, 50-100

THERMAL

Thermal Linear Expansion, deg C⁻¹
for 25 deg C 2.55×10^{-6}
Thermal Conductivity, W/(m•deg C)
at 27 deg C 159
Specific Heat Capacity (solid), J/(kg•deg C) 0.712×10^3
Melting Point, deg C 1412

MECHANICAL

Density, g/cm³ at 20 deg C 2.329
Mohs Hardness 7
Young Modulus (E), Pa 1.89×10^{10}
Shear Modulus (G), Pa 7.99×10^{10}
Poisson Ratio 0.266

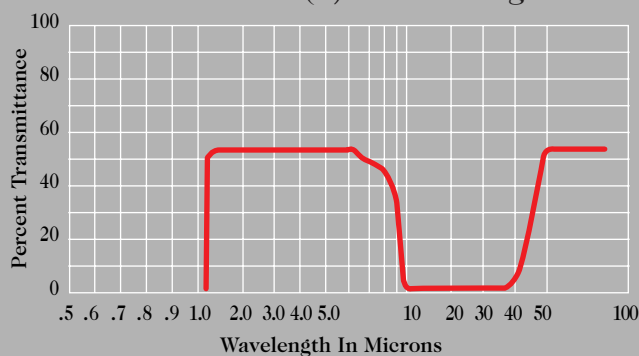
CHEMICAL

Molecular Weight 28.09
Solubility
in water, gram/100 cm³ insoluble

Refr. Index n vs. Wavelength λ

WAVELENGTH, MICRONS	REFRACTIVE INDEX
3.00	3.430
3.25	3.428
3.50	3.427
3.75	3.425
4.00	3.423
4.25	3.422
4.50	3.421
4.75	3.421
5.00	3.420

Transmittance τ (λ) vs. Wavelength λ



Sodium Chloride (NaCl)

Custom sizes and
specifications are available

CRYSTALLOGRAPHIC

Syngony	Cubic
Symmetry Class	m3m
Lattice Constants, Angstrom	a=5.640
	c=a
Cleavability	(100), perfect

OPTICAL

Refractive Index at n_e	1.5467
Refractive Index at $n_F - n_C$	0.0132
Refractive Index at $n_{10.6}$	1.4906
Refractive Index at $n_{8.0} - n_{12.5}$	0.0308

Thermal Coefficient of Refractive Index at 3.39 microns for +/- 60 deg C	$(-3.31) \dots (-3.73) \times 10^{-5}$
Transmission Range, microns	0.2-20

THERMAL

Thermal Linear Expansion, deg C ⁻¹ for +/- 60 deg C	$(36.4 \dots 40.8) \times 10^{-6}$
Thermal Conductivity, W/(m•deg C) at 35 deg C	6.15
Specific Heat Capacity, J/(kg•deg C)	0.871×10^3
Melting Point, deg C	801

MECHANICAL

Density, g/cm ³ at 20 degC	2.17
Mohs Hardness	3
Vickers Microhardness, Pa	20×10^7
Constants of Elastic Compliance, Pa ⁻¹	$S_{11} = 22.85 \times 10^{-12}$
	$S_{12} = -4.69 \times 10^{-12}$
	$S_{44} = 78.34 \times 10^{-12}$

Young Modulus (E), Pa	
in <100> direction	4.37×10^{10}
in <111> direction	3.27×10^{10}
Shear Modulus (G), Pa	
in <100> direction	1.59×10^{10}
in <111> direction	1.28×10^{10}
Poisson Ratio	0.203

CHEMICAL

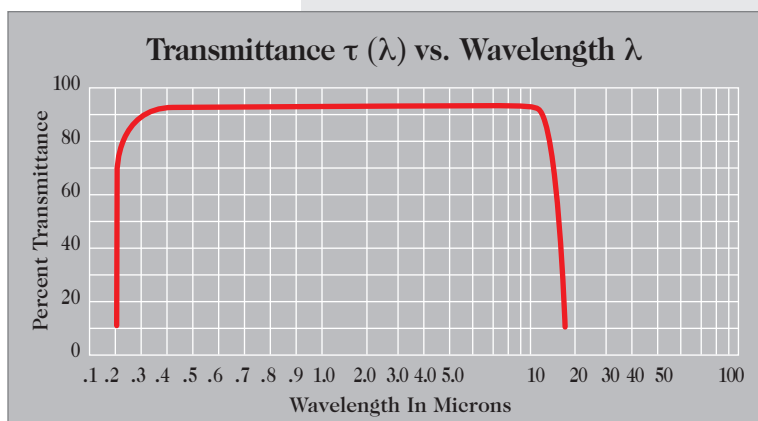
Molecular Weight	58.45
Solubility	
in water, gram/100 cm ³	35.7
in acids	soluble

Refr. Index n vs. Wavelength λ

WAVELENGTH, MICRONS	REFRACTIVE INDEX
0.2	1.7899
0.5	1.5516
1.0	1.5320
2.0	1.5254
3.0	1.5242
4.0	1.5217
5.0	1.5185
6.0	1.5153
7.0	1.5112
8.0	1.5066
9.0	1.5009
10.0	1.4947
11.0	1.4878
12.0	1.4800
12.5	1.4758
15.0	1.4403
20.0	1.3822
30.0	1.0912

Internal Transmittance $\tau_i(\lambda)$ vs. Wavelength λ

WAVELENGTH, MICRONS	INTERNAL TRANSMITTANCE
0.2	0.16
0.5	0.97
1.0	0.97
3.0	0.98
5.0	0.98
6.0	0.98
7.0	0.98
8.0	0.98
9.0	0.98
10.0	0.98
12.0	0.98
15.0	0.87
20.0	0.05



Quartz (SiO₂)

Custom sizes and
specifications are available

CRYSTALLOGRAPHIC

Syngony	Hexagonal
Symmetry Class	P ₃ 21
Lattice Constants, Angstrom	a=4.9138
	c=5.4052

OPTICAL

Refractive Index n_o at $n_{0.436}$	1.5538
Refractive Index n_e at $n_{0.436}$	1.5632
Thermal Coefficient of Refractive Index in air at 340 nm for +20/+100 deg C	
n_o	-5.01×10^{-6}
n_e	-3.93×10^{-6}
Transmission Range, microns	0.15-3.3

THERMAL

Thermal Linear Expansion, deg C ⁻¹ for 0/+20 deg C	13.24 x 10 ⁻⁶
Thermal Conductivity, W/(m•deg C) at 25 deg C	
n_o	6.82
n_e	11.43
Specific Heat Capacity, J/(kg•deg C)	0.741 x 103
Melting Point, deg C	1470

MECHANICAL

Density, g/cm ³ at 20 deg C	2.649
Mohs Hardness	7
Vickers Microhardness, Pa	981 x 10 ⁷
Young Modulus (E), Pa	
n_o	8.7 x 10 ¹⁰
n_e	10.5 x 10 ¹⁰

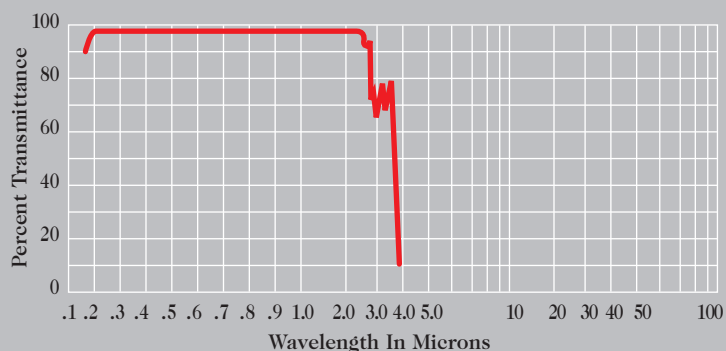
CHEMICAL

Molecular Weight	60.06
Solubility in water, gram/100 cm ³	insoluble

Refr. Index n vs. Wavelength λ

WAVELENGTH, MICRONS	REFRACTIVE INDEX	
	n_o	n_e
0.2001	1.6493	1.6623
0.2503	1.6003	1.6114
0.3034	1.5770	1.5872
0.4047	1.5572	1.5667
0.5086	1.5482	1.5575
0.6438	1.5423	1.5513
1.0000	1.5350	1.5438
1.2000	1.5323	1.5410
1.4000	1.5297	1.5383
1.6000	1.5270	1.5355
1.8000	1.5241	1.5324
2.5000	1.5116	1.5195
3.0000	1.4996	1.5070

Transmittance τ (λ) vs. Wavelength λ



Thallium Bromoiodide KRS-5 (TlBr-TlI)

Custom sizes and
specifications are available

CRYSTALLOGRAPHIC

Syngony	Cubic
Symmetry Class	m3m Pm3m
Lattice Constants, Angstrom	a=0.4125

OPTICAL

Refractive Index at $n_{10.0}$	2.37
Transmission Range, microns	0.6-40

THERMAL

Thermal Linear Expansion, deg C ⁻¹ for 0/+20 deg C	6×10^{-6}
Thermal Conductivity, W/(m•deg C) at 25 deg C	0.54
Specific Heat Capacity, J/(kg•deg C)	0.151×10^3
Melting Point, deg C	414.5

MECHANICAL

Density, g/cm ³ at 20 deg C	7.371
Vickers Microhardness, Pa	35×10^7
Young Modulus (E), Pa	3.1×10^{10}
Shear Modulus (G), Pa	1.2×10^{10}
Poisson Ratio	0.37

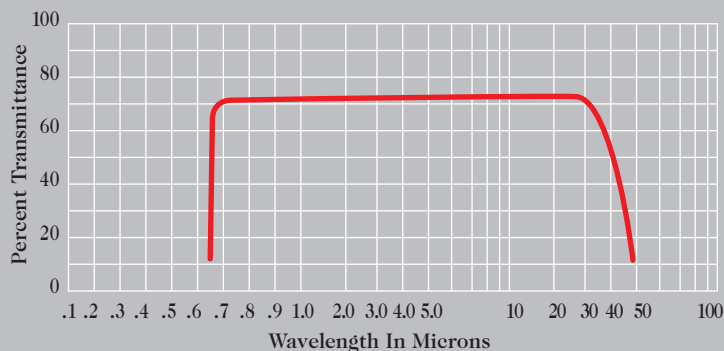
CHEMICAL

Molecular Weight	42 mole% TlBr / 58 mole% TlI
Solubility	
in water, gram/100 cm ³	0.05
in acids	soluble

Refr. Index n vs. Wavelength λ

WAVELENGTH, MICRONS	REFRACTIVE INDEX
0.6	2.60
1.0	2.45
2.0	2.40
4.0	2.38
6.0	2.38
8.0	2.37
10.0	2.37
20.0	2.34
30.0	2.29
40.0	2.21

Transmittance τ (λ) vs. Wavelength λ



Zero Expansion Glass - ZERODUR®

Custom sizes and
specifications are available

OPTICAL

Refractive Index at n_e	1.5447
Refractive Index $n_F - n_C$	0.00975
Thermal Coefficient of Refractive Index (relative) at 0.5461 microns for 0/+20 deg C	14.3×10^{-6}
Transmission Range, microns	0.5-2.5

THERMAL

Thermal Linear Expansion, deg C ₋₁ for +20/+ 300 deg C	0.05×10^{-6}
Thermal Conductivity, W/(m•deg C) for +80/+100 deg C	1.64
Specific Heat Capacity, J/(kg•deg C)	0.821×10^3

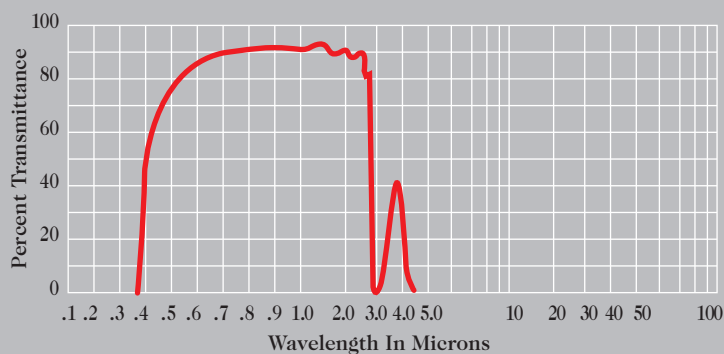
MECHANICAL

Density, g/cm ³	2.53
Young Modulus (E), Pa	9.1×10^{10}
Poisson Ratio	0.24

Refr. Index n vs. Wavelength λ

WAVELENGTH, MICRONS	REFRACTIVE INDEX
0.4358	1.5544
0.4800	1.5497
0.4861	1.5491
0.5461	1.5447
0.5876	1.5424
0.6438	1.5399
0.6563	1.5394

Transmittance τ (λ) vs. Wavelength λ



Zerodur® is a registered trademark
of Schott Glass Technologies

Zinc Selenide Laser Grade (ZnSe CVD)

Custom sizes and
specifications are available

CRYSTALLOGRAPHIC

Syngony	Cubic
Symmetry Class	43m

OPTICAL

Refractive Index at $n_{10.6}$	2.4028
Thermal Coefficient of Refractive Index at 10.6 microns	6.1×10^{-5}
Transmission Range, microns	0.55-20

THERMAL

Thermal Linear Expansion, deg C^{-1} at 27 deg C	7.57×10^{-6}
Thermal Conductivity, $\text{W}/(\text{m} \cdot \text{deg C})$ at 20 deg C	16
Specific Heat Capacity, $\text{J}/(\text{kg} \cdot \text{deg C})$	0.339×10^3

MECHANICAL

Density, g/cm^3 at 20 deg C	5.27
Mohs Hardness	4
Young Modulus (E), Pa	7.03×10^{10}
Poisson Ratio	0.28

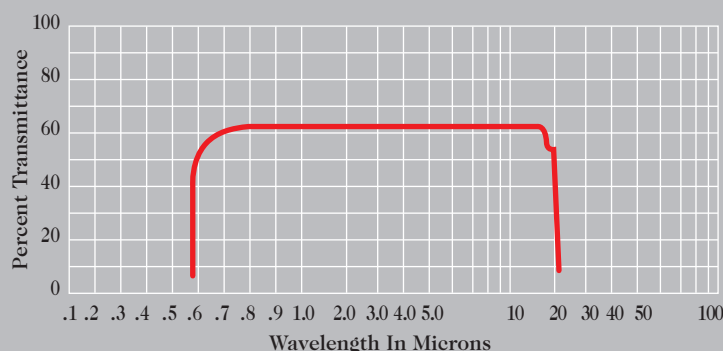
CHEMICAL

Molecular Weight	144.33
Solubility	
in water, $\text{gram}/100 \text{ cm}^3$	insoluble
in acids	soluble

Refr. Index n vs. Wavelength λ

WAVELENGTH, MICRONS	REFRACTIVE INDEX
0.58	2.6754
1.0	2.4892
3.0	2.4376
5.0	2.4295
7.0	2.4218
9.0	2.4122
10.6	2.4028
11.0	2.4001
13.0	2.3850
15.0	2.3623
17.0	2.3448

Transmittance $\tau (\lambda)$ vs. Wavelength λ



Zinc Sulfide Clear Grade (ZnS)

Custom sizes and
specifications are available

CRYSTALLOGRAPHIC

Syngony Cubic

OPTICAL

Refractive Index at $n_{0.4678}$ 2.44915
 Refractive Index at $n_{10.0}$ 2.20084
 Thermal Coefficient of Refractive Index
 at 0.6328 microns 5.43×10^{-5}
 Spectral Range, microns 0.37-14

THERMAL

Thermal Linear Expansion, deg C⁻¹ 6.5×10^{-6}
 Thermal Conductivity, W/(m•deg C) 27.2
 Specific Heat Capacity, J/(kg•deg C) 0.515×10^3

MECHANICAL

Density, g/cm³ at 20 deg C 4.09
 Young Modulus (E), Pa 7.45×10^{10}
 Vickers Microhardness , Pa 1.47×10^7
 Poisson Ratio 0.28

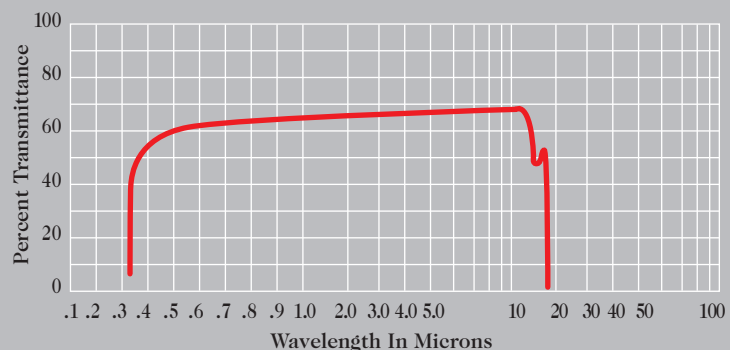
CHEMICAL

Molecular Weight 97.43
 Solubility
 in water, gram/100 cm³ 65×10^{-6}
 in acids soluble

Refr. Index n vs. Wavelength λ

WAVELENGTH, MICRONS	REFRACTIVE INDEX
0.4047	2.54515
0.4358	2.48918
0.4800	2.43691
0.5461	2.38838
0.6678	2.34033
0.7800	2.31669
0.8943	2.30183
1.0140	2.29165
2.0581	2.26442
3.000	2.25772
4.000	2.25231
5.000	2.24661
8.000	2.22334
9.000	2.21290
10.000	2.20084
12.000	2.17101
13.000	2.15252

Transmittance τ (λ) vs. Wavelength λ



WINDOWS



AMTIR-1

Dia tolerance +0,-0.005" (+0,-0.13mm)
Th tolerance ±0.005" (±0.13mm)
Clear Aperture 85%
Parallelism 3 arc min
Flatness 1/10 wave at 10.6 um
Surface Finish 40/20

CAT #	DIA, in	DIA, mm	TH, in	TH, mm
AM-W-25-1	1.0	25.4	0.039	1.0
AM-W-25-3	1.0	25.4	0.118	3.0

Custom sizes and specifications are available

AMTIR-1 is a registered trademark of Amorphous Materials

Barium Fluoride (BaF₂)

Dia tolerance +0,-0.005" (+0,-0.13mm)

Th tolerance ±0.005" (±0.13mm)

Clear Aperture 85%

Parallelism 3 arc min

Flatness 2 waves at 633 nm

Surface Finish 40/20

CAT #	DIA, in	DIA, mm	TH, in	TH, mm
BF-W-12-1	0.5	12.7	0.039	1.0
BF-W-12-2	0.5	12.7	0.079	2.0
BF-W-25-1	1.0	25.4	0.039	1.0
BF-W-25-2	1.0	25.4	0.079	2.0
BF-W-25-3	1.0	25.4	0.118	3.0
BF-W-25-4	1.0	25.4	0.157	4.0
BF-W-25-5	1.0	25.4	0.197	5.0
BF-W-25-6	1.0	25.4	0.236	6.0
BF-W-38-1	1.5	38.1	0.039	1.0
BF-W-38-2	1.5	38.1	0.079	2.0
BF-W-38-3	1.5	38.1	0.118	3.0
BF-W-38-4	1.5	38.1	0.157	4.0
BF-W-38-5	1.5	38.1	0.197	5.0
BF-W-38-6	1.5	38.1	0.236	6.0
BF-W-50-1	2.0	50.8	0.039	1.0
BF-W-50-2	2.0	50.8	0.079	2.0
BF-W-50-3	2.0	50.8	0.118	3.0
BF-W-50-4	2.0	50.8	0.157	4.0
BF-W-50-5	2.0	50.8	0.197	5.0
BF-W-50-6	2.0	50.8	0.236	6.0
BF-W-63-6	2.5	63.5	0.236	6.0
BF-W-63-8	2.5	63.5	0.315	8.0

Custom sizes and specifications are available

Cadmium Telluride (CdTe)

Dia tolerance	+0,-0.005" (+0,-0.13mm)
Th tolerance	±0.005" (±0.13mm)
Clear Aperture	85%
Parallelism	3 arc min
Flatness	2 waves at 633 nm
Surface Finish	60/40

CAT #	DIA, in	DIA, mm	TH, in	TH, mm
CD-W-12-1	0.5	12.7	0.039	1.0
CD-W-25-2	1.0	25.4	0.079	2.0
CD-W-25-3	1.0	25.4	0.118	3.0
CD-W-25-6	1.0	25.4	0.236	6.0
CD-W-38-2	1.5	38.1	0.079	2.0
CD-W-50-3	2.0	50.8	0.118	3.0

Custom sizes and specifications are available

Calcium Fluoride (CaF₂)

Dia tolerance +0,-0.005" (+0,-0.13mm)
Th tolerance ±0.005" (±0.13mm)
Clear Aperture 85%
Parallelism 3 arc min
Flatness 2 waves at 633 nm
Surface Finish 40/20

CAT#	DIA, in	DIA, mm	TH, in	TH, mm
CF-W-12-1	0.5	12.7	0.039	1.0
CF-W-12-2	0.5	12.7	0.079	2.0
CF-W-25-1	1.0	25.4	0.039	1.0
CF-W-25-2	1.0	25.4	0.079	2.0
CF-W-25-3	1.0	25.4	0.118	3.0
CF-W-25-4	1.0	25.4	0.157	4.0
CF-W-25-5	1.0	25.4	0.197	5.0
CF-W-25-6	1.0	25.4	0.236	6.0
CF-W-38-1	1.5	38.1	0.039	1.0
CF-W-38-2	1.5	38.1	0.079	2.0
CF-W-38-3	1.5	38.1	0.118	3.0
CF-W-38-4	1.5	38.1	0.157	4.0
CF-W-38-5	1.5	38.1	0.197	5.0
CF-W-38-6	1.5	38.1	0.236	6.0
CF-W-50-1	2.0	50.8	0.039	1.0
CF-W-50-2	2.0	50.8	0.079	2.0
CF-W-50-3	2.0	50.8	0.118	3.0
CF-W-50-4	2.0	50.8	0.157	4.0
CF-W-50-5	2.0	50.8	0.197	5.0
CF-W-50-6	2.0	50.8	0.236	6.0
CF-W-76-6	3.0	76.2	0.236	6.0
CF-W-76-8	3.0	76.2	0.315	8.0
CF-W-76-12	3.0	76.2	0.500	12.7
CF-W-101-8	4.0	101.6	0.315	8.0
CF-W-101-10	4.0	101.6	0.394	10.0
CF-W-101-12	4.0	101.6	0.500	12.7

Custom sizes and specifications are available

Fused Silica IR Grade, Water Free (SiO₂)

Dia tolerance	+0,-0.005" (+0,-0.13mm)
Th tolerance	±0.005" (±0.13mm)
Clear Aperture	85%
Parallelism	3 arc min
Flatness	1 wave per inch at 633 nm
Surface Finish	40/20

CAT #	DIA, in	DIA, mm	TH, in	TH, mm
QI-W-12-1	0.5	12.7	0.039	1.0
QI-W-12-2	0.5	12.7	0.079	2.0
QI-W-25-1	1.0	25.4	0.039	1.0
QI-W-25-2	1.0	25.4	0.079	2.0
QI-W-25-3	1.0	25.4	0.118	3.0
QI-W-38-3	1.5	38.1	0.118	3.0
QI-W-50-3	2.0	50.8	0.118	3.0
QI-W-50-5	2.0	50.8	0.197	5.0
QI-W-63-6	2.5	63.5	0.236	6.0
QI-W-63-8	2.5	63.5	0.315	8.0
QI-W-76-6	3.0	76.2	0.236	6.0
QI-W-76-8	3.0	76.2	0.315	8.0

Custom sizes and specifications are available

Fused Silica UV Grade (SiO₂)

Dia tolerance	+0,-0.005" (+0,-0.13mm)
Th tolerance	±0.005" (±0.13mm)
Clear Aperture	85%
Parallelism	3 arc min
Flatness	1 wave per inch at 633 nm
Surface Finish	40/20

CAT #	DIA, in	DIA, mm	TH, in	TH, mm
QU-W-12-1	0.5	12.7	0.039	1.0
QU-W-25-1	1.0	25.4	0.039	1.0
QU-W-25-2	1.0	25.4	0.079	2.0
QU-W-25-3	1.0	25.4	0.118	3.0
QU-W-38-2	1.5	38.1	0.079	2.0
QU-W-38-3	1.5	38.1	0.118	3.0
QU-W-50-3	2.0	50.8	0.118	3.0
QU-W-50-5	2.0	50.8	0.197	5.0
QU-W-63-6	2.5	63.5	0.236	6.0
QU-W-63-8	2.5	63.5	0.315	8.0
QU-W-76-6	3.0	76.2	0.236	6.0

Custom sizes and specifications are available

Gallium Arsenide (GaAs)

Dia tolerance +0,-0.005" (+0,-0.13mm)
Th tolerance ±0.005" (±0.13mm)
Clear Aperture 85%
Parallelism 3 arc min
Flatness 1/10 wave at 10.6 microns
Surface Finish 60/40

CAT#	DIA, in	DIA, mm	TH, in	TH, mm
GA-W-12-1	0.5	12.7	0.039	1.0
GA-W-12-2	0.5	12.7	0.079	2.0
GA-W-25-1	1.0	25.4	0.039	1.0
GA-W-25-2	1.0	25.4	0.079	2.0
GA-W-25-3	1.0	25.4	0.157	4.0
GA-W-25-5	1.0	25.4	0.197	5.0

Custom sizes and specifications are available

Germanium (Ge)

Dia tolerance	+0,-0.005" (+0,-0.13mm)
Th tolerance	±0.005" (±0.13mm)
Clear Aperture	85%
Parallelism	3 arc min
Flatness	1/10 wave at 10.6 microns
Surface Finish	40/20

CAT#	DIA, in	DIA, mm	TH, in	TH, mm
GE-W-12-1	0.5	12.7	0.039	1.0
GE-W-12-2	0.5	12.7	0.079	2.0
GE-W-25-1	1.0	25.4	0.039	1.0
GE-W-25-2	1.0	25.4	0.079	2.0
GE-W-25-3	1.0	25.4	0.118	3.0
GE-W-25-4	1.0	25.4	0.157	4.0
GE-W-25-5	1.0	25.4	0.197	5.0
GE-W-25-6	1.0	25.4	0.236	6.0
GE-W-38-1	1.5	38.1	0.039	1.0
GE-W-38-2	1.5	38.1	0.079	2.0
GE-W-38-3	1.5	38.1	0.118	3.0
GE-W-50-1	2.0	50.8	0.039	1.0
GE-W-50-2	2.0	50.8	0.079	2.0
GE-W-50-3	2.0	50.8	0.118	3.0
GE-W-50-4	2.0	50.8	0.157	4.0
GE-W-50-5	2.0	50.8	0.197	5.0
GE-W-76-3	3.0	76.2	0.118	3.0
GE-W-76-6	3.0	76.2	0.236	6.0

Custom sizes and specifications are available

Germanium (Ge)

coated AR 8-12 microns both sides

Dia tolerance	+0,-0.005" (+0,-0.13mm)
Th tolerance	±0.005" (±0.13mm)
Clear Aperture	85%
Parallelism	3 arc min
Flatness	1/10 wave at 10.6 microns
Surface Finish	40/20
Coating Part Number	BBAR-GE-8-12

CAT #	DIA, in	DIA, mm	TH, in	TH, mm
AR812-GE-W-12-1	0.5	12.7	0.034	1.0
AR812-GE-W-12-2	0.5	12.7	0.074	2.0
AR812-GE-W-25-1	1.0	25.4	0.034	1.0
AR812-GE-W-25-2	1.0	25.4	0.079	2.0
AR812-GE-W-25-3	1.0	25.4	0.118	3.0
AR812-GE-W-38-3	1.5	38.1	0.118	3.0
AR812-GE-W-50-3	2.0	50.8	0.118	3.0
AR812-GE-W-50-5	2.0	50.8	0.197	5.0
AR812-GE-W-76-6	3.0	76.2	0.236	6.0

Custom sizes and specifications are available

Germanium (Ge)

Dia tolerance +0,-0.005" (+0,-0.13mm)
Th tolerance ±0.005" (±0.13mm)
Clear Aperture 85%
Parallelism 3 arc min
Flatness 1/10 wave at 10.6 microns
Surface Finish 40/20

CAT#	DIA, in	DIA, mm	TH, in	TH, mm
DLC812-GE-W-25-3	1.0	25.4	0.118	3.0
DLC812-GE-W-38-3	1.5	38.1	0.118	3.0
DLC812-GE-W-50-3	2.0	50.8	0.118	3.0
DLC812-GE-W-76-3	3.0	76.2	0.118	3.0

Custom sizes and specifications are available

Germanium (Ge)

Dia tolerance +0,-0.005" (+0,-0.13mm)
Th tolerance ±0.005" (±0.13mm)
Clear Aperture 85%
Parallelism 3 arc min
Flatness 1/10 wave at 10.6 microns
Surface Finish 40/20

CAT#	DIA, in	DIA, mm	TH, in	TH, mm
DLC812-GE-W-25-3	1.0	25.4	0.118	3.0
DLC812-GE-W-38-3	1.5	38.1	0.118	3.0
DLC812-GE-W-50-3	2.0	50.8	0.118	3.0
DLC812-GE-W-76-3	3.0	76.2	0.118	3.0

Custom sizes and specifications are available

Lithium Fluoride (LiF)

Dia tolerance +0,-0.005" (+0,-0.13mm)
Th tolerance ±0.005" (±0.13mm)
Clear Aperture 85%
Parallelism 3 arc min
Flatness 2 waves at 633 nm
Surface Finish 40/20

CAT#	DIA, in	DIA, mm	TH, in	TH, mm
LF-W-12-1	0.5	12.7	0.039	1.0
LF-W-25-1	1.0	25.4	0.039	1.0
LF-W-25-2	1.0	25.4	0.079	2.0
LF-W-25-3	1.0	25.4	0.118	3.0
LF-W-25-4	1.0	25.4	0.157	4.0
LF-W-25-5	1.0	25.4	0.197	5.0
LF-W-38-3	1.5	38.1	0.118	3.0
LF-W-38-4	1.5	38.1	0.157	4.0
LF-W-38-5	1.5	38.1	0.197	5.0

Custom sizes and specifications are available

Magnesium Fluoride (MgF₂)

Dia tolerance +0,-0.005" (+0,-0.13mm)
Th tolerance ±0.005" (±0.13mm)
Clear Aperture 85%
Parallelism 3 arc min
Flatness 2 waves at 633 nm
Surface Finish 40/20

CAT #	DIA, in	DIA, mm	TH, in	TH, mm
MF-W-12-1	0.5	12.7	0.039	1.0
MF-W-12-2	0.5	12.7	0.079	2.0
MF-W-25-1	1.0	25.4	0.039	1.0
MF-W-25-2	1.0	25.4	0.079	2.0
MF-W-25-3	1.0	25.4	0.118	3.0
MF-W-25-4	1.0	25.4	0.157	4.0
MF-W-38-3	1.5	38.1	0.118	3.0
MF-W-50-3	2.0	50.8	0.118	3.0
MF-W-50-4	2.0	50.8	0.157	4.0
MF-W-50-5	2.0	50.8	0.197	5.0
MF-W-50-6	2.0	50.8	0.236	6.0

Custom sizes and specifications are available

Potassium Bromide (KBr)

Dia tolerance +0,-0.005" (+0,-0.13mm)
Th tolerance ±0.005" (±0.13mm)
Clear Aperture 85%
Parallelism 3 arc min
Flatness 1/10 wave at 10.6 microns
Surface Finish 60/40

CAT #	DIA, in	DIA, mm	TH, in	TH, mm
KB-W-12-2	0.5	12.7	0.079	2.0
KB-W-12-3	0.5	12.7	0.118	3.0
KB-W-25-3	1.0	25.4	0.118	3.0
KB-W-25-4	1.0	25.4	0.157	4.0
KB-W-25-5	1.0	25.4	0.197	5.0
KB-W-38-4	1.5	38.1	0.157	4.0
KB-W-38-6	1.5	38.1	0.236	6.0
KB-W-50-6	2.0	50.8	0.236	6.0
KB-W-50-8	2.0	50.8	0.315	8.0

Custom sizes and specifications are available

Quartz, Crystalline (SiO₂)

C-axis parallel to optical axis

Dia tolerance +0,-0.005" (+0,-0.13mm)
Th tolerance ±0.005" (±0.13mm)
Clear Aperture 85%
Parallelism 3 arc min
Flatness 1 wave per inch at 633 nm
Surface Finish 40/20

CAT#	DIA, in	DIA, mm	TH, in	TH, mm
Q-W-12-1	0.5	12.7	0.039	1.0
Q-W-12-2	0.5	12.7	0.079	2.0
Q-W-25-1	1.0	25.4	0.039	1.0
Q-W-25-2	1.0	25.4	0.079	2.0
Q-W-25-3	1.0	25.4	0.118	3.0
Q-W-38-2	1.5	38.1	0.079	2.0
Q-W-38-3	1.5	38.1	0.118	3.0
Q-W-50-5	2.0	50.8	0.197	5.0

Custom sizes and specifications are available

Sapphire (Al₂O₃)

Dia tolerance	+0,-0.005" (+0,-0.13mm)
Th tolerance	±0.005" (±0.13mm)
Clear Aperture	85%
Parallelism	3 arc min
Flatness	2 wave per inch at 633 nm
Surface Finish	60/40

CAT#	DIA, in	DIA, mm	TH, in	TH, mm
AL-W-12-1	0.5	12.7	0.039	1.0
AL-W-25-1	1.0	25.4	0.039	1.0
AL-W-25-2	1.0	25.4	0.079	2.0
AL-W-25-3	1.0	25.4	0.118	3.0
AL-W-38-2	1.5	38.1	0.079	2.0
AL-W-38-3	1.5	38.1	0.118	3.0
AL-W-50-3	2.0	50.8	0.118	3.0
AL-W-50-5	2.0	50.8	0.197	5.0
AL-W-63-3	2.5	63.5	0.118	3.0
AL-W-63-5	2.5	63.5	0.197	5.0
AL-W-76-3	3.0	76.2	0.118	3.0

Custom sizes and specifications are available

Silicon (Si)

Dia tolerance +0,-0.005" (+0,-0.13mm)
Th tolerance ±0.005" (±0.13mm)
Clear Aperture 85%
Parallelism 3 arc min
Flatness 2 waves at 633 nm
Surface Finish 40/20

CAT #	DIA, in	DIA, mm	TH, in	TH, mm
SI-W-12-2	0.5	12.7	0.079	2.0
SI-W-25-1	1.0	25.4	0.039	1.0
SI-W-25-2	1.0	25.4	0.079	2.0
SI-W-25-3	1.0	25.4	0.118	3.0
SI-W-25-4	1.0	25.4	0.157	4.0
SI-W-25-5	1.0	25.4	0.197	5.0
SI-W-25-6	1.0	25.4	0.236	6.0
SI-W-38-1	1.5	38.1	0.039	1.0
SI-W-38-2	1.5	38.1	0.079	2.0
SI-W-50-1	2.0	50.8	0.039	1.0
SI-W-50-2	2.0	50.8	0.079	2.0
SI-W-50-3	2.0	50.8	0.118	3.0

Custom sizes and specifications are available

Silicon (Si) Coated HDAR 3-5 microns both sides

Dia tolerance	+0,-0.005" (+0,-0.13mm)
Th tolerance	±0.005" (±0.13mm)
Clear Aperture	85%
Parallelism	3 arc min
Flatness	2 waves at 633 nm
Surface Finish	40/20
Coating	HD-SI-3-5

CAT #	DIA, in	DIA, mm	TH, in	TH, mm
HDAR35-SI-W-12-1	0.5	12.7	0.039	1.0
HDAR35-SI-W-12-2	0.5	12.7	0.079	2.0
HDAR35-SI-W-25-1	1.0	25.4	0.039	1.0
HDAR35-SI-W-25-2	1.0	25.4	0.079	2.0
HDAR35-SI-W-25-3	1.0	25.4	0.118	3.0
HDAR35-SI-W-25-5	1.0	25.4	0.197	5.0
HDAR35-SI-W-50-4	2.0	50.8	0.157	4.0
HDAR35-SI-W-50-5	2.0	50.8	0.197	5.0
HDAR35-SI-W-50-6	2.0	50.8	0.236	6.0
HDAR35-SI-W-63-3	2.5	63.5	0.118	3.0
HDAR35-SI-W-76-3	3.0	76.2	0.118	3.0
HDAR35-SI-W-76-6	3.0	76.2	0.236	6.0

Custom sizes and specifications are available

Silicon (Si)

Dia tolerance	+0,-0.005" (+0,-0.13mm)
Th tolerance	±0.005" (±0.13mm)
Clear Aperture	85%
Parallelism	3 arc min
Flatness	1/10 wave at 10.6 microns
Surface Finish	40/20

CAT#	DIA, in	DIA, mm	TH, in	TH, mm
DLC35-SI-W-25-2	1.0	25.4	0.79	2.0
DLC35-SI-W-38-2	1.5	38.1	0.079	2.0
DLC35-SI-W-50-3	2.0	50.8	0.118	3.0
DLC35-SI-W-76-3	3.0	76.2	0.118	3.0

Custom sizes and specifications are available

Thallium-Bromiodide (KRS-5)

Dia tolerance	+0,-0.005" (+0,-0.13mm)
Th tolerance	±0.005" (±0.13mm)
Clear Aperture	85%
Parallelism	3 arc min
Flatness	1/10 wave at 10.6 microns
Surface Finish	60/40

CAT #	DIA, in	DIA, mm	TH, in	TH, mm
K5-W-12-1	0.5	12.7	0.039	1.0
K5-W-12-2	0.5	12.7	0.079	2.0
K5-W-25-2	1.0	25.4	0.079	2.0
K5-W-25-3	1.0	25.4	0.118	3.0
K5-W-25-4	1.0	25.4	0.157	4.0
K5-W-25-5	1.0	25.4	0.197	5.0
K5-W-25-6	1.0	25.4	0.236	6.0
K5-W-38-2	1.5	38.1	0.079	2.0
K5-W-38-3	1.5	38.1	0.118	3.0
K5-W-38-4	1.5	38.1	0.157	4.0
K5-W-38-5	1.5	38.1	0.197	5.0
K5-W-38-6	1.5	38.1	0.236	6.0
K5-W-50-2	2.0	50.8	0.079	2.0
K5-W-50-3	2.0	50.8	0.118	3.0
K5-W-50-4	2.0	50.8	0.157	4.0
K5-W-50-5	2.0	50.8	0.197	5.0
K5-W-50-6	2.0	50.8	0.236	6.0

Custom sizes and specifications are available

Zinc Selenide (ZnSe CVD)

Dia tolerance +0,-0.005" (+0,-0.13mm)
Th tolerance ±0.005" (±0.13mm)
Clear Aperture 85%
Parallelism 3 arc min
Flatness 1/20 wave at 10.6 microns
Surface Finish 60/40

CAT#	DIA, in	DIA, mm	TH, in	TH, mm
ZC-W-12-1	0.5	12.7	0.039	1.0
ZC-W-12-2	0.5	12.7	0.079	2.0
ZC-W-25-1	1.0	25.4	0.039	1.0
ZC-W-25-2	1.0	25.4	0.079	2.0
ZC-W-25-3	1.0	25.4	0.118	3.0
ZC-W-25-4	1.0	25.4	0.157	4.0
ZC-W-25-5	1.0	25.4	0.197	5.0
ZC-W-25-6	1.0	25.4	0.236	6.0
ZC-W-38-3	1.5	38.1	0.118	3.0
ZC-W-38-4	1.5	38.1	0.157	4.0
ZC-W-38-5	1.5	38.1	0.197	5.0
ZC-W-50-1	2.0	50.8	0.039	1.0
ZC-W-50-2	2.0	50.8	0.079	2.0
ZC-W-50-3	2.0	50.8	0.118	3.0
ZC-W-50-4	2.0	50.8	0.157	4.0
ZC-W-50-5	2.0	50.8	0.197	5.0
ZC-W-50-6	2.0	50.8	0.236	6.0
ZC-W-76-6	3.0	76.2	0.236	6.0
ZC-W-76-8	3.0	76.2	0.315	8.0

Custom sizes and specifications are available

Zinc Selenide (ZnSe CVD) coated AR 2-13 microns both sides

Dia tolerance	+0,-0.005" (+0,-0.13mm)
Th tolerance	±0.005" (±0.13mm)
Clear Aperture	85%
Parallelism	3 arc min
Flatness	1/20 wave at 10.6 microns
Surface Finish	60/40
Coating Part Number	BBAR-ZNSE-2-13

CAT#	DIA, in	DIA, mm	TH, in	TH, mm	
AR213-ZC-W-12-1		0.5	12.7	0.039	1.0
AR213-ZC-W-12-2		0.5	12.7	0.079	2.0
AR213-ZS-W-25-1		1.0	25.4	0.039	1.0
AR213-ZC-W-25-2		1.0	25.4	0.079	2.0
AR213-ZC-W-25-3		1.0	25.4	0.118	3.0
AR213-ZC-W-25-4		1.0	25.4	0.157	4.0
AR213-ZC-W-25-5		1.0	25.4	0.197	5.0
AR213-ZC-W-38-3		1.5	38.1	0.118	3.0
AR213-ZC-W-50-1		2.0	50.8	0.039	1.0
AR213-ZC-W-50-2		2.0	50.8	0.079	2.0
AR213-ZC-W-50-3		2.0	50.8	0.118	3.0
AR213-ZC-W-50-5		2.0	50.8	0.197	5.0
AR213-ZC-W-76-6		3.0	76.2	0.236	6.0

Custom sizes and specifications are available

*) Flatness: 4 waves at 633 nm per inch

Zinc Selenide (ZnSe CVD)

Coated AR 3-12 microns both sides

Dia tolerance	+0,-0.005" (+0,-0.13mm)
Th tolerance	±0.005" (±0.13mm)
Clear Aperture	85%
Parallelism	3 arc min
Flatness	1/20 wave at 10.6 microns
Surface Finish	60/40
Coating Part Number	BBAR-ZNSE-3-12

CAT #	DIA, in	DIA, mm	TH, in	TH, mm
AR312-ZC-W-25-3	1.0	25.4	0.118	3.0
AR312-ZC-W-50-3	2.0	50.8	0.118	3.0

Custom sizes and specifications are available

Zinc Selenide (ZnSe CVD)

Coated AR 8-12 microns both sides

Dia tolerance	+0,-0.005" (+0,-0.13mm)
Th tolerance	±0.005" (±0.13mm)
Clear Aperture	85%
Parallelism	3 arc min
Flatness	1/20 wave at 10.6 microns
Surface Finish	60/40
Coating Part Number	BBAR-ZNSE-8-12

CAT #	DIA, in	DIA, mm	TH, in	TH, mm
AR812-ZC-W-25-2	1.0	25.4	0.079	2.0
AR812-ZC-W-25-3	1.0	25.4	0.118	3.0
AR812-ZC-W-38-3	1.5	38.1	0.118	3.0
AR812-ZC-W-50-1	2.0	50.8	0.039	1.0
AR812-ZC-W-50-3	2.0	50.8	0.118	3.0
AR812-ZC-W-50-5	2.0	50.8	0.197	5.0

Custom sizes and specifications are available

Zinc Sulfide Clear Grade (ZnS)

Dia tolerance	+0,-0.005" (+0,-0.13 mm)
Th tolerance	+/-0.005" (+/-0.13 mm)
Clear Aperture	85%
Parallelism	3 arc min
Flatness	1/20 wave at 10.6 microns
Surface Finish	60/40

CAT #	DIA, in	DIA, mm	TH, in	TH, mm
ZL-W-12-1	0.5	12.7	0.039	1.0
ZL-W-12-2	0.5	12.7	0.079	2.0
ZL-W-25-1	1.0	25.4	0.039	1.0
ZL-W-25-2	1.0	25.4	0.079	2.0
ZL-W-25-3	1.0	25.4	0.118	3.0
ZL-W-25-4	1.0	25.4	0.157	4.0
ZL-W-25-5	1.0	25.4	0.197	5.0
ZL-W-25-6	1.0	25.4	0.236	6.0
ZL-W-38-3	1.5	38.1	0.118	3.0
ZL-W-38-4	1.5	38.1	0.157	4.0
ZL-W-38-5	1.5	38.1	0.197	5.0
ZL-W-38-6	1.5	38.1	0.236	6.0
ZL-W-50-3	2.0	50.8	0.118	3.0
ZL-W-50-4	2.0	50.8	0.157	4.0
ZL-W-50-5	2.0	50.8	0.197	5.0
ZL-W-50-6	2.0	50.8	0.236	6.0
ZL-W-63-6	2.5	63.5	0.236	6.0
ZL-W-63-8	2.5	63.5	0.315	8.0
ZL-W-76-6	3.0	76.2	0.236	6.0
ZL-W-76-8	3.0	76.2	0.315	8.0

Custom sizes and specifications are available

BREWSTER WINDOWS



Germanium (Ge)

Dimensional tolerance	$\pm 0.005''$ ($\pm 0.13\text{mm}$)
Clear Aperture	80% elliptical
Parallelism	3 min
Flatness	1/40 wave per inch at 10.6 microns
Surface Quality	40/20

CAT#	LENGTH		WIDTH		THICKNESS	
	in	mm	in	mm	in	mm
GE-BW-84	3.307	84.00	0.799	20.30	0.118	3.0

Custom sizes and specifications are available

Zinc Selenide CVD Grade (ZnSe)

Dimensional tolerance	±0.005" (±0.13mm)
Clear Aperture	80% elliptical
Parallelism	3 min
Flatness	1/40 wave per inch at 10.6 microns
Surface Quality	40/20

CAT #	LENGTH		WIDTH		THICKNESS	
	in	mm	in	mm	in	mm
ZC-BW-65	2.563	65.10	1.000	25.40	0.118	3.0

Custom sizes and specifications are available

30 MIN WEDGES



Barium Fluoride (BaF₂)

Dia tolerance	+0,-0.005" (+0,-0.13mm)
Th tolerance	±0.005" (±0.13mm)
Clear Aperture	85%
Angle	30 ± 15 min
Flatness	2 waves at 633 nm
Surface Finish	60/40

CAT #	DIAMETER		CENTER THICKNESS	
	in	mm	in	mm
BF-WW-12-2	0.5	12.7	0.079	2.0
BF-WW-25-4	1.0	25.4	0.157	4.0
BF-WW-38-5	1.5	38.1	0.197	5.0
BF-WW-50-6	2.0	50.8	0.236	6.0

Custom sizes and specifications are available

Calcium Fluoride (CaF₂)

Dia tolerance	+0,-0.005" (+0,-0.13mm)
Th tolerance	±0.005" (±0.13mm)
Clear Aperture	85%
Angle	30 ±15 min
Flatness	2 waves at 633 nm
Surface Finish	60/40

CAT #	DIAMETER		CENTER THICKNESS	
	in	mm	in	mm
CF-WW-12-2	0.5	12.7	0.079	2.0
CF-WW-25-4	1.0	25.4	0.157	4.0
CF-WW-50-6	2.0	50.8	0.236	6.0

Custom sizes and specifications are available

Germanium (Ge)

Dia tolerance	+0,-0.005" (+0,-0.13mm)
Th tolerance	±0.005" (±0.13mm)
Clear Aperture	85%
Angle	30 ±15 min
Flatness	2 waves at 633 nm
Surface Finish	60/40

CAT #	DIAMETER		CENTER THICKNESS	
	in	mm	in	mm
GE-WW-25-4	1.0	25.4	0.157	4.0
GE-WW-38-5	1.5	38.1	0.197	5.0
GE-WW-50-6	2.0	50.8	0.236	6.0

Custom sizes and specifications are available

Zinc Selenide CVD Grade (ZnSe)

Dia tolerance	+0,-0.005" (+0,-0.13mm)
Th tolerance	±0.005" (±0.13mm)
Clear Aperture	85%
Angle	30 ±15 min
Flatness	2 waves at 633 nm
Surface Finish	60/40

CAT #	DIAMETER		CENTER THICKNESS	
	in	mm	in	mm
ZC-WW-25-4	1.0	25.4	0.157	4.0
ZC-WW-38-5	1.5	38.1	0.197	5.0
ZC-WW-50-6	2.0	50.8	0.236	6.0

Custom sizes and specifications are available

3 DEGREE WEDGES



Calcium Fluoride (CaF₂)

Dia tolerance	+0,-0.005" (+0,-0.13mm)
Th tolerance	±0.005" (±0.13mm)
Clear Aperture	85%
Angle	3 deg ±30 min
Flatness	2 waves at 633 nm
Surface Finish	60/40

CAT #	DIAMETER		CENTER THICKNESS	
	in	mm	in	mm
CF-WW3-12-2	0.5	12.7	0.079	2.0
CF-WW3-25-3	1.0	25.4	0.118	3.0
CF-WW3-38-3	1.5	38.1	0.118	3.0
CF-WW3-50-5	2.0	50.8	0.197	5.0

Custom sizes and specifications are available

Zinc Selenide CVD Grade (ZnSe)

Dia tolerance	+0,-0.005" (+0,-0.13mm)
Th tolerance	±0.005" (±0.13mm)
Clear Aperture	85%
Angle	3 deg±30 min
Flatness	2 waves at 633 nm
Surface Finish	60/40

CAT #	DIAMETER		CENTER THICKNESS	
	in	mm	in	mm
ZC-WW3-12-2	0.5	12.7	0.079	2.0
ZC-WW3-25-3	1.0	25.4	0.118	3.0
ZC-WW3-38-3	1.5	38.1	0.118	3.0
ZC-WW3-50-5	2.0	50.8	0.197	5.0

Custom sizes and specifications are available

ASPHERIC LENSES



Silicone (Si) Aspheric Lenses

Diameter tolerance	+0,-0.005" (+0,-0.13 mm)
Center Thickness tolerance	+/-0.008" (+/-0.2 mm)
Design Wavelength	4 microns
Focal Length Tolerance	+/-2%
Surface Quality	60/40
Clear Aperture	90% Central Diameter
Wedge Angle	<3 arc min

CAT#	DIA, in	DIA, mm	FOC, mm	CT, mm	ET, mm	F #
ASPH-SI-25-12	1.0	25.4	12.7	4.0	1.10	0.5
ASPH-SI-25-25	1.0	25.4	25.4	3.0	1.47	1.0
ASPH-SI-25-50	1.0	25.4	50.8	3.0	2.26	2.0

Custom sizes and specifications are available

Silicon (Si) Aspheric Lenses Coated HDAR 3-5 microns both sides

Diameter tolerance	+0,-0.005" (+0,-0.13 mm)
Center Thickness tolerance	+/-0.008" (+/-0.2 mm)
Design Wavelength	4 microns
Focal Length Tolerance	+/-2%
Surface Quality	60/40
Clear Aperture	90% Central Diameter
Wedge Angle	<3 arc min
Coating Part Number	HD-SI-3-5

CAT#	DIA, in	DIA, mm	FOC, mm	CT, mm	ET, mm	F #
HDAR35-ASPH-SI-25-12	1.0	25.4	12.7	4.0	1.10	0.5
HDAR35-ASPH-SI-25-25	1.0	25.4	25.4	3.0	1.47	1.0
HDAR35-ASPH-SI-25-50	1.0	25.4	50.8	3.0	2.26	2.0

Custom sizes and specifications are available

Xtra-Wide Wavelength Lens

Diameter Tolerance	+0, -0.005" (+0, -0.13 mm)
Center Thickness Tolerance	+/-0.008" (+/-0.2 mm)
Focal Length Tolerance	+/-2%
Surface Quality	60/40
Clear Aperature	90% Central Diameter
Wedge Angle	<3 arc min
Coating Part Number	BBAR-ZNSE-1-12

CAT #	DIA, in	DIA, mm	FOC, mm	CT, mm	ET, mm	F#
AR112-ZC-XWL-25-12	1.0	25.4	12.7	7.2	1.3	0.5
AR112-ZC-XWL-25-25	1.0	25.4	25.4	3.5	0.9	1.0
AR112-ZC-XWL-25-38	1.0	25.4	38.1	3.5	1.8	1.5
AR112-ZC-XWL-25-50	1.0	25.4	50.8	3.5	2.3	2.0
AR112-ZC-XWL-25-63	1.0	25.4	63.5	3.5	2.5	2.5
AR112-ZC-XWL-25-76	1.0	25.4	76.2	3.5	2.7	3.0
AR112-ZC-XWL-25-88	1.0	25.4	88.9	3.5	2.8	3.5
AR112-ZC-XWL-25-100	1.0	25.4	101.6	3.5	2.9	4.0
AR112-ZC-XWL-25-127	1.0	25.4	127.0	3.5	3.0	5.0
AR112-ZC-XWL-25-150	1.0	25.4	152.4	3.5	3.1	6.0
AR112-ZC-XWL-25-177	1.0	25.4	177.8	3.5	3.2	7.0
AR112-ZC-XWL-25-203	1.0	25.4	203.2	3.5	3.2	8.0
AR112-ZC-XWL-25-254	1.0	25.4	254.0	3.5	3.3	10.0
AR112-ZC-XWL-25-304	1.0	25.4	304.8	3.5	3.3	12.0

Custom sizes and specifications are available

Zinc Selenide CVD (ZnSe) Aspheric Lenses

Diameter tolerance	+0,-0.005" (+0,-0.13 mm)
Center Thickness tolerance	+/-0.008" (+/-0.2 mm)
Design Wavelength	10.6 microns
Focal Length Tolerance	+/-2%
Surface Quality	60/40
Clear Aperture	90% Central Diameter
Wedge Angle	<3 arc min

CAT#	DIA, in	DIA, mm	FOC, mm	CT, mm	ET, mm	F #
ASPH-ZC-25-12	1.0	25.4	12.7	7.0	1.5	0.5
ASPH-ZC-25-20	1.0	25.4	20.0	4.0	1.0	0.8
ASPH-ZC-25-25	1.0	25.4	25.4	4.3	1.8	1.0
ASPH-ZC-25-50	1.0	25.4	50.8	3.0	1.7	2.0
ASPH-ZC-50-25	2.0	50.8	25.4	11.2	2.8	0.5
ASPH-ZC-50-50	2.0	50.8	50.8	8.3	3.1	1.0

Custom sizes and specifications are available

Zinc Selenide CVD (ZnSe) Aspheric Lenses

Coated AR 8-12 microns both sides

Diameter tolerance	+0,-0.005" (+0,-0.13 mm)
Center Thickness tolerance	+/-0.008" (+/-0.2 mm)
Design Wavelength	10.6 microns
Focal Length Tolerance	+/-2%
Surface Quality	60/40
Clear Aperture	90% Central Diameter
Wedge Angle	<3 arc min
Coating Part Number	BBAR-ZNSE-8-12

CAT#	DIA, in	DIA, mm	FOC, mm	CT, mm	ET, mm	F #
AR812-ASPH-ZC-25-12	1.0	25.4	12.7	7.0	1.5	0.5
AR812-ASPH-ZC-25-20	1.0	25.4	20.0	4.0	1.0	0.8
AR812-ASPH-ZC-25-25	1.0	25.4	25.4	4.3	1.8	1.0
AR812-ASPH-ZC-25-50	1.0	25.4	50.8	3.0	1.7	2.0
AR812-ASPH-ZC-50-25	2.0	50.8	25.4	11.2	2.8	0.5
AR812-ASPH-ZC-50-50	2.0	50.8	50.8	8.3	3.1	1.0

Custom sizes and specifications are available

PLANO-CONVEX LENSES



Barium Fluoride (BaF₂)

Diameter tolerance	+0,-0.005" (+0,-0.13 mm)
Center Thickness tolerance	±0.008" (±0.2 mm)
Design Wavelength	5.0 microns
Focal Length tolerance	±2%
Surface Quality	60/40
Clear Aperture	90% Central Diameter
Wedge Angle	< 3 arc min
Surface Irregularity	1 wave at 633 nm

CAT #	DIA, in	DIA, mm	FOC, mm	CT, mm	R, mm	ET, mm
BF-PX-12-25	0.5	12.7	25	4.0	11.296	2.0
BF-PX-12-50	0.5	12.7	50	3.0	22.619	2.0
BF-PX-12-75	0.5	12.7	75	2.6	33.870	2.0
BF-PX-25-50	1.0	25.4	50	5.9	22.619	2.0
BF-PX-25-63	1.0	25.4	63	5.0	28.380	2.0
BF-PX-25-75	1.0	25.4	75	4.5	33.870	2.0
BF-PX-25-100	1.0	25.4	100	3.9	45.080	2.0
BF-PX-25-150	1.0	25.4	150	3.2	67.570	2.0
BF-PX-25-200	1.0	25.4	200	2.9	90.200	2.0
BF-PX-25-250	1.0	25.4	250	2.7	112.720	2.0
BF-PX-25-500	1.0	25.4	500	2.6	224.900	2.0
BF-PX-25-1000	1.0	25.4	1000	2.2	449.500	2.0
BF-PX-25-2000	1.0	25.4	2000	2.1	899.500	2.0
BF-PX-50-75	2.0	50.8	75	14.0	33.870	2.5
BF-PX-50-100	2.0	50.8	100	10.5	45.080	2.5
BF-PX-50-150	2.0	50.8	150	7.4	67.570	2.5
BF-PX-50-200	2.0	50.8	200	6.1	90.200	2.5
BF-PX-50-250	2.0	50.8	250	5.4	112.720	2.5
BF-PX-50-500	2.0	50.8	500	3.9	224.900	2.5
BF-PX-50-1000	2.0	50.8	1000	3.2	449.500	2.5
BF-PX-50-2000	2.0	50.8	2000	2.8	899.500	2.5

Custom sizes and specifications are available

Calcium Fluoride (CaF₂)

Diameter tolerance	+0,-0.005" (+0,-0.13 mm)
Center Thickness tolerance	±0.008" (±0.2 mm)
Design Wavelength	5.0 microns
Focal Length Tolerance	±2%
Surface Quality	60/40
Clear Aperture	90% Central Diameter
Wedge Angle	< 3 arc min
Surface Irregularity	1 wave at 633 nm

CAT#	DIA, in	DIA, mm	FOC, mm	CT, mm	R, mm	ET, mm
CF-PX-12-25	0.5	12.7	25	4.3	10.000	2.0
CF-PX-12-50	0.5	12.7	50	3.0	20.000	2.0
CF-PX-12-75	0.5	12.7	75	2.7	29.99	2.0
CF-PX-25-50	1.0	25.4	50	6.4	20.000	2.0
CF-PX-25-63	1.0	25.4	63	5.4	25.100	2.0
CF-PX-25-75	1.0	25.4	75	4.8	29.990	2.0
CF-PX-25-100	1.0	25.4	100	4.1	39.990	2.0
CF-PX-25-150	1.0	25.4	150	3.4	59.980	2.0
CF-PX-25-200	1.0	25.4	200	3.0	79.980	2.0
CF-PX-25-250	1.0	25.4	250	2.8	100.000	2.0
CF-PX-25-500	1.0	25.4	500	2.4	199.990	2.0
CF-PX-25-1000	1.0	25.4	1000	2.2	399.900	2.0
CF-PX-25-2000	1.0	25.4	2000	2.1	799.800	2.0
CF-PX-38-50	1.5	38.1	50	16.0	20.000	2.0
CF-PX-38-63	1.5	38.1	63	10.7	25.100	2.0
CF-PX-38-75	1.5	38.1	75	8.9	29.990	2.0
CF-PX-38-100	1.5	38.1	100	6.8	39.990	2.0
CF-PX-38-150	1.5	38.1	150	5.0	59.980	2.0
CF-PX-38-200	1.5	38.1	200	4.3	79.980	2.0
CF-PX-38-250	1.5	38.1	250	3.8	100.000	2.0
CF-PX-38-1000	1.5	38.1	1000	2.5	399.900	2.0
CF-PX-38-2000	1.5	38.1	2000	2.2	799.800	2.0
CF-PX-50-75	2.0	50.8	75	16.5	29.990	2.5
CF-PX-50-100	2.0	50.8	100	11.6	39.990	2.5
CF-PX-50-150	2.0	50.8	150	8.1	59.980	2.5
CF-PX-50-200	2.0	50.8	200	6.6	79.980	2.5
CF-PX-50-250	2.0	50.8	250	5.8	100.000	2.5
CF-PX-50-500	2.0	50.8	500	4.1	199.990	2.5
CF-PX-50-1000	2.0	50.8	1000	3.3	399.900	2.5
CF-PX-50-2000	2.0	50.8	2000	2.9	799.800	2.5
CF-PX-76-150	3.0	76.2	150	16.6	59.980	3.0
CF-PX-76-200	3.0	76.2	200	12.7	79.980	3.0

Custom sizes and specifications are available

Germanium (Ge)

Diameter tolerance	0,-0.005" (+0,-0.13 mm)
Center Thickness tolerance	+/-0.008" (+/-0.2 mm)
Design Wavelength	10.6 microns
Focal Length Tolerance	+/-0.02
Surface Quality	60/40
Clear Aperture	90% Central Diameter
Wedge Angle	<3 arc min
Surface Irregularity	1/20 wave at 10.6 microns

CAT #	DIA, in	DIA, mm	FOC, mm	CT, mm	R, mm	ET, mm
GE-PX-12-25	0.5	12.7	25.4	2.3	76.05	2.0
GE-PX-12-50	0.5	12.7	50.8	2.1	151.01	2.0
GE-PX-25-50	1.0	25.4	50.8	2.5	151.01	2.0
GE-PX-25-63	1.0	25.4	63.5	2.4	188.80	2.0
GE-PX-25-76	1.0	25.4	75.0	2.4	229.10	2.0
GE-PX-25-100	1.0	25.4	100	2.3	299.90	2.0
GE-PX-25-127	1.0	25.4	127	2.2	376.70	2.0
GE-PX-25-150	1.0	25.4	150	2.2	452.90	2.0
GE-PX-25-200	1.0	25.4	200	2.2	597.16	2.0
GE-PX-25-254	1.0	25.4	254	2.1	748.20	2.0
GE-PX-25-500	1.0	25.4	500	2.0	1500.0	2.0
GE-PX-38-50	1.5	38.1	50.8	3.2	151.01	2.0
GE-PX-38-63	1.5	38.1	63.5	3.0	188.80	2.0
GE-PX-38-76	1.5	38.1	75.0	2.8	229.10	2.0
GE-PX-38-100	1.5	38.1	100	2.6	299.90	2.0
GE-PX-38-127	1.5	38.1	127	2.5	376.70	2.0
GE-PX-38-150	1.5	38.1	150	2.4	452.90	2.0
GE-PX-38-254	1.5	38.1	254	2.2	748.20	2.0
GE-PX-38-1000	1.5	38.1	1000	2.0	2965.0	2.0
GE-PX-50-76	2.0	50.8	75.0	4.0	229.10	2.6
GE-PX-50-100	2.0	50.8	100	3.6	299.90	2.5
GE-PX-50-127	2.0	50.8	127	3.3	376.70	2.5
GE-PX-50-200	2.0	50.8	200	3.0	597.16	2.5
GE-PX-50-300	2.0	50.8	300	2.9	855.10	2.5
GE-PX-50-500	2.0	50.8	500	2.7	1500.0	2.5
GE-PX-76-150	3.0	76.2	150	4.7	452.90	3.1
GE-PX-76-500	3.0	76.2	500	3.5	1500.0	3.0

Custom sizes and specifications are available

Germanium (Ge) Coated AR 3-12 microns both sides

Diameter tolerance	0,-0.005" (+0,-0.13 mm)
Center Thickness tolerance	+/-0.008" (+/-0.2 mm)
Design Wavelength	10.6 microns
Focal Length Tolerance	+/-0.02
Surface Quality	60/40
Clear Aperture	90% Central Diameter
Wedge Angle	<3 arc min
Surface Irregularity	1/20 wave at 10.6 microns
AR Coating	BBAR-GE-3-12

CAT #	DIA, in	DIA, mm	FOC, mm	CT, mm	R, mm	ET, mm
AR312-GE-PX-12-25	0.5	12.7	25.4	2.3	76.05	2.0
AR312-GE-PX-12-50	0.5	12.7	50.8	2.1	151.01	2.0
AR312-GE-PX-25-50	1.0	25.4	50.8	2.5	151.01	2.0
AR312-GE-PX-25-63	1.0	25.4	63.5	2.4	188.80	2.0
AR312-GE-PX-25-76	1.0	25.4	75.0	2.4	229.10	2.0
AR312-GE-PX-25-100	1.0	25.4	100	2.3	299.90	2.0
AR312-GE-PX-25-127	1.0	25.4	127	2.2	376.70	2.0
AR312-GE-PX-25-150	1.0	25.4	150	2.2	452.90	2.0
AR312-GE-PX-25-200	1.0	25.4	200	2.2	597.16	2.0
AR312-GE-PX-25-254	1.0	25.4	254	2.1	748.20	2.0
AR312-GE-PX-25-500	1.0	25.4	500	2.0	1500.0	2.0
AR312-GE-PX-50-100	2.0	50.8	100	3.6	299.90	2.5

Custom sizes and specifications are available

Silicon (Si) Coated

HDAR 3-5 microns both sides

Diameter tolerance	+0,-0.005" (+0,-0.13 mm)
Center Thickness tolerance	±0.008" (±0.2 mm)
Design Wavelength	4.0 microns
Focal Length Tolerance	±2%
Surface Irregularity	1 wave at 633 nm
Surface Quality	80/50
Clear Aperture	90% Central Diameter
Wedge Angle	< 3 arc min
Coating Part Number	HD-SI-3-5

CAT#	DIA, in	DIA, mm	FOC, mm	CT, mm	R, mm	ET, mm
HDAR35-SI-PX-12-25	0.5	12.7	25.4	2.3	61.66	2.0
HDAR35-SI-PX-12-50	0.5	12.7	50.8	2.1	123.59	2.0
HDAR35-SI-PX-12-76	0.5	12.7	76.2	2.1	184.50	2.0
HDAR35-SI-PX-25-50	1.0	25.4	50.8	2.6	123.59	2.0
HDAR35-SI-PX-25-63	1.0	25.4	63.5	2.5	154.17	2.0
HDAR35-SI-PX-25-76	1.0	25.4	76.2	2.4	184.50	2.0
HDAR35-SI-PX-25-100	1.0	25.4	100	2.3	242.42	2.0
HDAR35-SI-PX-25-150	1.0	25.4	150	2.2	363.54	2.0
HDAR35-SI-PX-25-200	1.0	25.4	200	2.1	483.10	2.0
HDAR35-SI-PX-25-250	1.0	25.4	250	2.1	608.10	2.0
HDAR35-SI-PX-25-500	1.0	25.4	500	2.0	1213.90	2.0

Custom sizes and specifications are available

Zinc Selenide (ZnSe CVD)

Diameter tolerance	0,-0.005" (+0,-0.13 mm)
Center Thickness tolerance	+/-0.008" (+/-0.2 mm)
Design Wavelength	10.6 microns
Focal Length Tolerance	+/-2%
Surface Quality	60/40
Clear Aperture	90% Central Diameter
Wedge Angle	<3 arc min
Surface Irregularity	1/20 wave at 10.6 microns

CAT #	DIA, in	DIA, mm	FOC, mm	CT, mm	R, mm	ET, mm
ZC-PX-12-25	0.5	12.7	25.4	2.6	35.97	2.0
ZC-PX-12-50	0.5	12.7	50.8	2.3	71.46	2.0
ZC-PX-25-50	1.0	25.4	50.8	3.1	71.46	2.0
ZC-PX-25-63	1.0	25.4	63.5	2.9	89.14	2.0
ZC-PX-25-76	1.0	25.4	75.0	2.8	106.15	2.0
ZC-PX-25-100	1.0	25.4	100	2.6	139.96	2.0
ZC-PX-25-127	1.0	25.4	127	2.5	180.32	2.0
ZC-PX-25-150	1.0	25.4	150	2.4	209.91	2.0
ZC-PX-25-200	1.0	25.4	200	2.3	281.20	2.0
ZC-PX-25-254	1.0	25.4	254	2.2	356.51	2.0
ZC-PX-25-500	1.0	25.4	500	2.1	698.17	2.0
ZC-PX-38-50	1.5	38.1	50.8	4.6	71.46	2.0
ZC-PX-38-63	1.5	38.1	63.5	4.1	89.14	2.0
ZC-PX-38-76	1.5	38.1	76.2	3.7	106.15	2.0
ZC-PX-38-100	1.5	38.1	100	3.3	139.96	2.0
ZC-PX-38-127	1.5	38.1	127	3.0	180.32	2.0
ZC-PX-38-150	1.5	38.1	150	2.9	209.91	2.0
ZC-PX-38-200	1.5	38.1	200	2.6	281.20	2.0
ZC-PX-38-254	1.5	38.1	254	2.5	356.51	2.0
ZC-PX-38-500	1.5	38.1	500	2.3	698.17	2.0
ZC-PX-38-1000	1.5	38.1	1000	2.1	1404.0	2.0
ZC-PX-38-2000	1.5	38.1	2000	2.1	2808.0	2.0
ZC-PX-50-76	2.0	50.8	75.0	5.6	106.15	2.5
ZC-PX-50-100	2.0	50.8	100	4.8	139.96	2.5
ZC-PX-50-127	2.0	50.8	127	4.3	180.32	2.5
ZC-PX-50-150	2.0	50.8	150	4.0	209.91	2.5
ZC-PX-50-200	2.0	50.8	200	3.7	281.20	2.5
ZC-PX-50-254	2.0	50.8	254	3.4	356.51	2.5
ZC-PX-50-300	2.0	50.8	300	3.3	424.67	2.5
ZC-PX-50-500	2.0	50.8	500	3.0	698.17	2.5
ZC-PX-50-1000	2.0	50.8	1000	2.7	1404.00	2.5

Custom sizes and specifications are available

Zinc Selenide (ZnSe CVD)

Coated AR 8-12 microns both sides

Diameter tolerance	0,-0.005" (+0,-0.13 mm)
Center Thickness tolerance	+/-0.008" (+/-0.2 mm)
Design Wavelength	10.6 microns
Focal Length Tolerance	+/-2%
Surface Quality	60/40
Clear Aperture	90% Central Diameter
Wedge Angle	<3 arc min
Surface Irregularity	1/20 wave at 10.6 microns
Coating Part Number	BBAR-ZNSE-8-12

CAT #	DIA, in	DIA, mm	FOC, mm	CT, mm	R, mm	ET, mm
AR812-ZC-PX-12-25	0.5	12.7	25.4	2.6	35.97	2.0
AR812-ZC-PX-12-50	0.5	12.7	50.8	2.3	71.46	2.0
AR812-ZC-PX-25-50	1.0	25.4	50.8	3.1	71.46	2.0
AR812-ZC-PX-25-63	1.0	25.4	63.5	2.9	89.14	2.0
AR812-ZC-PX-25-76	1.0	25.4	75.0	2.8	106.15	2.0
AR812-ZC-PX-25-100	1.0	25.4	100	2.6	139.96	2.0
AR812-ZC-PX-25-127	1.0	25.4	127	2.5	180.32	2.0
AR812-ZC-PX-25-150	1.0	25.4	150	2.4	209.91	2.0
AR812-ZC-PX-25-200	1.0	25.4	200	2.3	281.20	2.0
AR812-ZC-PX-25-254	1.0	25.4	254	2.2	356.51	2.0
AR812-ZC-PX-25-500	1.0	25.4	500	2.1	698.17	2.0
AR812-ZC-PX-38-50	1.5	38.1	50.8	4.6	71.46	2.0
AR812-ZC-PX-38-63	1.5	38.1	63.5	4.1	89.14	2.0
AR812-ZC-PX-38-76	1.5	38.1	76.2	3.7	106.15	2.0
AR812-ZC-PX-38-100	1.5	38.1	100	3.3	139.96	2.0
AR812-ZC-PX-38-127	1.5	38.1	127	3.0	180.32	2.0
AR812-ZC-PX-38-150	1.5	38.1	150	2.9	209.91	2.0
AR812-ZC-PX-38-200	1.5	38.1	200	2.6	281.20	2.0
AR812-ZC-PX-38-254	1.5	38.1	254	2.5	356.51	2.0
AR812-ZC-PX-38-500	1.5	38.1	500	2.3	698.17	2.0
AR812-ZC-PX-38-1000	1.5	38.1	1000	2.1	1404.0	2.0
AR812-ZC-PX-38-2000	1.5	38.1	2000	2.1	2808.0	2.0
AR812-ZC-PX-50-76	2.0	50.8	75.0	5.6	106.15	2.5
AR812-ZC-PX-50-100	2.0	50.8	100	4.8	139.96	2.5
AR812-ZC-PX-50-127	2.0	50.8	127	4.3	180.32	2.5
AR812-ZC-PX-50-150	2.0	50.8	150	4.0	209.91	2.5
AR812-ZC-PX-50-200	2.0	50.8	200	3.7	281.20	2.5
AR812-ZC-PX-50-254	2.0	50.8	254	3.4	356.51	2.5
AR812-ZC-PX-50-300	2.0	50.8	300	3.3	424.67	2.5
AR812-ZC-PX-50-500	2.0	50.8	500	3.0	698.17	2.5
AR812-ZC-PX-50-1000	2.0	50.8	1000	2.7	1404.00	2.5
AR812-ZC-PX-50-2000	2.0	50.8	2000	2.6	2808.00	2.5

PLANO-CONVEX MICRO LENSES



Fused Silica UV Grade (SiO₂)

Diameter tolerance	+0,-0.002" (+0,-0.05 mm)
Center Thickness tolerance	±0.004" (±0.1 mm)
Design Wavelength	546 nm
Focal Length Tolerance	±3%
Surface Quality	60/40
Clear Aperture	90% Central Diameter
Wedge Angle	< 6 arc min

CAT#	DIA, in	DIA, mm	FOC, mm	CT, mm	ET, mm	R, mm
QU-PXM-2-3.0	0.08	2.0	3.0	0.9	0.47	1.393
QU-PXM-4-6.0	0.16	4.0	6.0	1.4	0.54	2.754

Custom sizes and specifications are available

Germanium (Ge)

Diameter tolerance	+ 0,-0.002" (+0,-0.05 mm)
Center Thickness tolerance	±0.004" (±0.1 mm)
Design Wavelength	10.6 microns
Focal Length Tolerance	±3%
Surface Quality	60/40
Clear Aperture	90% Central Diameter
Wedge Angle	< 6 arc min

CAT #	DIA, in	DIA, mm	FOC, mm	CT, mm	ET, mm	R, mm
GE-PXM-4-4.0	0.16	4.0	4.0	0.7	0.53	12.203

Custom sizes and specifications are available

PLANO-CONCAVE LENSES



Calcium Fluoride (CaF₂)

Diameter tolerance	+0,-0.005" (+0,-0.13 mm)
Center Thickness tolerance	±0.008" (±0.2 mm)
Design Wavelength	5 microns
Focal Length Tolerance	±2%
Surface Quality	60/40
Clear Aperture	90% Central Diameter
Wedge Angle	< 3 arc min
Surface Irregularity	1/2 wave at 633 nm

CAT #	DIA, in	DIA, mm	FOC, mm	CT, mm	R, mm	ET, mm
CF-PC-12-25	0.5	12.7	-25.4	1.5	10.209	3.7
CF-PC-12-50	0.5	12.7	-50.8	1.5	20.460	2.5
CF-PC-12-76	0.5	12.7	-76.2	1.5	30.690	2.2
CF-PC-25-50	1	25.4	-50.8	2.0	20.460	6.4
CF-PC-25-63	1	25.4	-63.5	2.0	25.590	5.4
CF-PC-25-76	1	25.4	-76.2	2.0	30.698	4.8
CF-PC-25-100	1	25.4	-100	2.0	40.350	4.0
CF-PC-38-63	1.5	38.1	-63.5	2.5	25.590	11.0
CF-PC-38-76	1.5	38.1	-76.2	2.5	30.698	9.1
CF-PC-38-100	1.5	38.1	-100	2.5	40.350	7.1
CF-PC-50-76	2	50.8	-76.2	3.0	30.698	13.0
CF-PC-50-100	2	50.8	-100	3.0	40.350	12.0
CF-PC-50-200	2	50.8	-200	3.0	80.540	7.1
CF-PC-50-500	2	50.8	-500	3.0	200.42	4.6

Custom sizes and specifications are available

BI-CONVEX LENSES



Barium Fluoride (BaF₂)

Diameter tolerance	+0,-0.005" (+0,-0.13 mm)
Center Thickness tolerance	±0.008" (±0.2 mm)
Design Wavelength	5.0 microns
Focal Length Tolerance	±2%
Surface Quality	60/40
Clear Aperture	90% Central Diameter
Wedge Angle	< 3 arc min
Surface Irregularity	1 wave at 633 nm

CAT #	DIA, in	DIA, mm	FOC, mm	CT, mm	R, mm	ET, mm
BF-BX-12-12	0.5	12.7	12.7	5.8	10.471	1.5
BF-BX-12-25	0.5	12.7	25.4	3.3	22.340	1.5
BF-BX-12-50	0.5	12.7	50.8	2.4	45.430	1.5
BF-BX-12-76	0.5	12.7	76.2	2.1	68.390	1.5
BF-BX-25-25	1.0	25.4	25.4	10.5	21.230	2.1
BF-BX-25-50	1.0	25.4	50.8	5.7	44.870	2.0
BF-BX-25-63	1.0	25.4	63.5	4.9	56.490	2.0
BF-BX-25-150	1.0	25.4	150.0	3.2	134.90	2.0
BF-BX-38-38	1.5	38.1	38.1	15.2	31.840	2.5
BF-BX-38-63	1.5	38.1	63.5	9.2	55.850	2.5

Custom sizes and specifications are available

Calcium Fluoride (CaF₂)

Diameter tolerance	+0,-0.005" (+0,-0.13 mm)
Center Thickness tolerance	±0.008" (±0.2 mm)
Design Wavelength	5.0 microns
Focal Length Tolerance	±2%
Surface Quality	60/40
Clear Aperture	90% Central Diameter
Wedge Angle	< 3 arc min
Surface Irregularity	1 wave at 633 nm

CAT #	DIA, in	DIA, mm	FOC, mm	CT, mm	R, mm	ET, mm
CF-BX-12-12	0.5	12.7	12.7	6.7	9.078	1.5
CF-BX-12-25	0.5	12.7	25.4	3.6	19.770	1.5
CF-BX-12-50	0.5	12.7	50.8	2.5	40.090	1.5
CF-BX-12-76	0.5	12.7	76.2	2.2	60.530	1.5
CF-BX-25-25	1.0	25.4	25.4	12.2	18.365	2.0
CF-BX-25-50	1.0	25.4	50.8	6.2	39.610	2.0
CF-BX-25-63	1.0	25.4	63.5	5.3	49.890	2.0
CF-BX-25-76	1.0	25.4	76.2	4.7	60.120	2.0
CF-BX-25-100	1.0	25.4	100.0	4.1	79.070	2.0
CF-BX-25-150	1.0	25.4	150.0	3.4	119.12	2.0
CF-BX-38-38	1.5	38.1	38.1	17.7	27.610	2.5
CF-BX-38-50	1.5	38.1	50.8	12.5	38.640	2.5
CF-BX-38-63	1.5	38.1	63.5	10.2	49.090	2.5
CF-BX-38-150	1.5	38.1	150	5.6	118.85	2.5
CF-BX-50-50	2.0	50.8	50.8	23.3	36.900	3.0
CF-BX-50-76	2.0	50.8	76.2	14.6	58.730	3.0
CF-BX-50-100	2.0	50.8	100	11.5	78.125	3.0
CF-BX-50-150	2.0	50.8	150	8.5	118.58	3.0
CF-BX-50-200	2.0	50.8	200	7.1	158.49	3.0
CF-BX-50-250	2.0	50.8	250	6.3	199.07	3.0
CF-BX-76-200	3.0	76.2	200	12.3	157.76	3.0
CF-BX-76-250	3.0	76.2	250	10.4	197.70	3.0
CF-BX-76-500	3.0	76.2	500	6.7	398.10	3.0

Custom sizes and specifications are available

BI-CONVEX MICRO LENSES



Zinc Selenide CVD Grade (ZnSe)

Diameter tolerance	+0,-0.002" (+0,-0.05 mm)
Center Thickness tolerance	±0.004" (±0.1 mm)
Design Wavelength	10.6 microns
Focal Length Tolerance	±3%
Surface Quality	60/40
Clear Aperture	90% Central Diameter
Wedge Angle	< 6 arc min

CAT#	DIA, in	DIA, mm	FOC, mm	CT, mm	ET, mm	R, mm
ZC-BXM-4-4.0	0.16	4.0	4.0	0.9	0.53	11.050
ZC-BXM-4-6.0	0.16	4.0	6.0	0.7	0.45	16.672
ZC-BXM-4-8.0	0.16	4.0	8.0	0.7	0.52	22.280

Custom sizes and specifications are available

POSITIVE MENISCUS LENSES



Germanium (Ge)

Diameter tolerance	+0,-0.005" (+0,-0.13 mm)
Center Thickness tolerance	+/-0.008" (+/-0.2 mm)
Design Wavelength	10.6 microns
Focal Length Tolerance	+/-2%
Surface Quality	60/40
Clear Aperture	90% Central Diameter
Wedge Angle	<3 arc min
Surface Irregularity	1/20 wave at 10.6 microns

CAT#	DIA, in	DIA, mm	FOC, mm	CT, mm	T, mm	Sag1, mm	Sag2, mm	R1cc, mm	R2ex, mm
GE-PM-12-12	0.5	12.7	13.0	2.5	2.1	1.1	1.5	22.96	15.59
GE-PM-12-25	0.5	12.7	25.0	2.0	1.8	0.5	0.8	40.27	27.13
GE-PM-12-50	0.5	12.7	50.0	2.0	1.9	0.3	0.4	79.43	52.84
GE-PM-25-25	1.0	25.4	25.0	3.0	2.0	2.4	3.4	37.15	26.30
GE-PM-25-38	1.0	25.4	38.0	2.7	2.0	1.5	2.2	53.95	38.04
GE-PM-25-50	1.0	25.4	50.0	3.0	2.5	1.1	1.6	74.47	51.45
GE-PM-25-63	1.0	25.4	63.5	3.0	2.6	0.9	1.3	93.11	63.68
GE-PM-25-76	1.0	25.4	75.0	2.8	2.4	0.8	1.1	104.23	72.78
GE-PM-25-100	1.0	25.4	100	3.0	2.7	0.5	0.8	161.06	106.15
GE-PM-25-127	1.0	25.4	127	2.9	2.7	0.4	0.6	187.07	127.35
GE-PM-38-38	1.5	38.1	38.0	4.5	2.9	3.5	5.0	52.36	38.04
GE-PM-38-50	1.5	38.1	50.0	4.5	3.4	2.4	3.3	77.62	53.33
GE-PM-38-63	1.5	38.1	63.5	3.9	3.0	2.1	3.0	87.30	61.94
GE-PM-38-76	1.5	38.1	75.0	4.5	3.7	1.7	2.4	109.65	76.03
GE-PM-38-100	1.5	38.1	100	4.3	3.7	1.2	1.8	151.05	102.33
GE-PM-38-127	1.5	38.1	127	4.5	4.0	1.0	1.4	187.07	127.35
GE-PM-38-150	1.5	38.1	150	4.4	4.0	0.8	1.2	223.40	151.36
GE-PM-38-200	1.5	38.1	200	4.5	4.2	0.6	1.8	290.40	199.07
GE-PM-50-50	2.0	50.8	50.0	5.2	3.1	4.7	6.8	65.77	48.53
GE-PM-50-63	2.0	50.8	63.0	5.1	3.5	3.8	5.4	86.70	61.94
GE-PM-50-76	2.0	50.8	75.0	5.4	4.0	3.0	4.4	106.17	74.64
GE-PM-50-100	2.0	50.8	100	5.8	4.8	2.3	3.3	139.64	98.40
GE-PM-50-127	2.0	50.8	127	5.2	4.3	1.8	2.6	187.07	127.35
GE-PM-50-150	2.0	50.8	150	5.3	4.6	1.6	2.3	200.40	141.25
GE-PM-50-200	2.0	50.8	200	5.2	4.7	1.1	1.6	290.40	199.07

Custom sizes and specifications are available

Zinc Selenide CVD (ZnSe CVD)

Diameter tolerance	+0,-0.005" (+0,-0.13 mm)
Center Thickness tolerance	+/-0.008" (+/-0.2 mm)
Design Wavelength	10.6 microns
Focal Length Tolerance	+/-2%
Surface Quality	60/40
Clear Aperture	90% Central Diameter
Wedge Angle	<3 arc min
Surface Irregularity	1/20 wave at 10.6 microns

CAT#	DIA, in	DIA, mm	FOC, mm	CT, mm	ET, mm	Sag1, mm	Sag2, mm	R1cc, mm	R2cx, mm
ZC-PM-12-12	0.5	12.7	13.0	2.70	1.50	0.80	2.00	22.96	10.79
ZC-PM-12-25	0.5	12.7	25.4	2.10	1.50	???	???	64.27	23.66
ZC-PM-12-50	0.5	12.7	50.8	1.80	1.50	???	???	107.65	42.85
ZC-PM-25-25	1.0	25.4	25.4	4.40	2.00	1.50	3.90	58.34	22.91
ZC-PM-25-38	1.0	25.4	38.1	3.60	2.00	1.00	2.50	122.73	38.04
ZC-PM-25-50	1.0	25.4	50.8	3.20	2.00	0.70	1.90	107.65	43.95
ZC-PM-25-63	1.0	25.4	63.5	2.90	2.00	0.50	1.40	161.08	58.49
ZC-PM-25-76	1.0	25.4	76.2	2.80	2.00	0.40	1.10	179.47	68.23
ZC-PM-25-100	1.0	25.4	101	2.60	2.00	0.30	0.90	250.00	90.78
ZC-PM-25-127	1.0	25.4	127	2.50	2.00	0.30	0.70	449.80	127.35
ZC-PM-25-150	1.0	25.4	150	2.40	2.00	0.20	0.60	299.90	124.17
ZC-PM-38-38	1.5	38.1	38.1	6.60	3.00	2.30	5.90	79.98	33.57
ZC-PM-38-50	1.5	38.1	50.8	5.70	3.00	1.70	4.30	107.65	43.95
ZC-PM-38-63	1.5	38.1	63.5	5.10	3.00	1.20	3.30	161.08	58.49
ZC-PM-38-100	1.5	38.1	101	4.30	3.00	0.73	2.00	250.00	90.78
ZC-PM-38-127	1.5	38.1	127	4.00	3.00	0.60	1.60	449.80	127.35
ZC-PM-38-200	1.5	38.1	203	3.60	3.00	0.30	0.90	633.90	199.07
ZC-PM-50-50	2.0	50.8	50.8	8.40	3.50	3.20	8.00	103.05	43.95
ZC-PM-50-76	2.0	50.8	76.2	6.60	3.50	1.80	4.90	179.47	68.23
ZC-PM-50-100	2.0	50.8	101	5.80	3.50	1.40	3.60	225.90	89.13
ZC-PM-50-127	2.0	50.8	127	5.30	3.50	1.10	2.90	449.80	127.35
ZC-PM-50-200	2.0	50.8	203	4.60	3.50	0.60	1.80	633.90	199.08

Custom sizes and specifications are available

Zinc Selenide CVD (ZnSe CVD)

Coated AR 8-12 microns both sides

Diameter tolerance	+0,-0.005" (+0,-0.13 mm)
Center Thickness tolerance	+/-0.008" (+/-0.2 mm)
Design Wavelength	10.6 microns
Focal Length Tolerance	+/-2%
Surface Quality	60/40
Clear Aperture	90% Central Diameter
Wedge Angle	<3 arc min
Surface Irregularity	1/20 wave at 10.6 microns
Coating Part Number	BBAR-ZNSE-8-12

CAT#	DIA, in	DIA, mm	FOC, mm	CT, mm	ET, mm	Sag1, mm	Sag2, mm	R1cc, mm	R2ex, mm
AR812-ZC-PM-12-12	0.5	12.7	13.0	2.70	1.50	0.80	2.00	22.96	10.79
AR812-ZC-PM-12-25	0.5	12.7	25.4	2.10	1.50	???	???	64.27	23.66
AR812-ZC-PM-12-50	0.5	12.7	50.8	1.80	1.50	???	???	107.65	42.85
AR812-ZC-PM-25-25	1.0	25.4	25.4	4.40	2.00	1.50	3.90	58.34	22.91
AR812-ZC-PM-25-38	1.0	25.4	38.1	3.60	2.00	1.00	2.50	122.73	38.04
AR812-ZC-PM-25-50	1.0	25.4	50.8	3.20	2.00	0.70	1.90	107.65	43.95
AR812-ZC-PM-25-63	1.0	25.4	63.5	2.90	2.00	0.50	1.40	161.08	58.49
AR812-ZC-PM-25-76	1.0	25.4	76.2	2.80	2.00	0.40	1.10	179.47	68.23
AR812-ZC-PM-25-100	1.0	25.4	101	2.60	2.00	0.30	0.90	250.00	90.78
AR812-ZC-PM-25-127	1.0	25.4	127	2.50	2.00	0.30	0.70	449.80	127.35
AR812-ZC-PM-25-150	1.0	25.4	150	2.40	2.00	0.20	0.60	299.90	124.17

Custom sizes and specifications are available

NEGATIVE MENISCUS LENSES



Zinc Selenide CVD (ZnSe CVD)

Diameter tolerance	+0,-0.005" (+0,-0.13 mm)
Center Thickness tolerance	+/-0.008" (+/-0.2 mm)
Design Wavelength	10.6 microns
Focal Length Tolerance	+/-2%
Surface Quality	60/40
Clear Aperture	90% Central Diameter
Wedge Angle	<3 arc min
Surface Irregularity	1/20 wave at 10.6 microns

CAT#	DIA, in	DIA, mm	FOC, mm	CT, mm	ET, mm	Sag1, mm	Sag2, mm	R1cc, mm	R2ex, mm
ZC-NM-12-12	0.5	12.7	-13.0	2.2	3.5	2.1	0.7	10.72	29.38
ZC-NM-25-25	1.0	25.4	-25.0	3.0	5.8	4.2	1.4	21.23	58.49
ZC-NM-25-38	1.0	25.4	-38.0	3.0	4.6	3.0	0.6	37.15	130.62
ZC-NM-25-50	1.0	25.4	-50.0	3.2	4.4	1.9	0.6	43.47	118.84
ZC-NM-25-63	1.0	25.4	-63.5	3.0	3.9	1.3	0.3	64.27	236.02
ZC-NM-25-76	1.0	25.4	-75.0	2.7	3.5	1.2	0.5	66.25	182.39
ZC-NM-25-100	1.0	25.4	-100	3.0	3.6	0.8	0.2	104.24	414.00
ZC-NM-25-127	1.0	25.4	-127	3.2	3.7	0.6	0.2	127.98	483.06

Custom sizes and specifications are available

Zinc Selenide CVD (ZnSe CVD) Coated

AR 8-12 microns both sides

Diameter tolerance	+0,-0.005" (+0,-0.13 mm)
Center Thickness tolerance	+/-0.008" (+/-0.2 mm)
Design Wavelength	10.6 microns
Focal Length Tolerance	+/-2%
Surface Quality	60/40
Clear Aperture	90% Central Diameter
Wedge Angle	<3 arc min
Surface Irregularity	1/20 wave at 10.6 microns
Coating Part Number	BBAR-ZNSE-8-12

CAT#	DIA, in	DIA, mm	FOC, mm	CT, mm	ET, mm	Sag1, mm	Sag2, mm	R1cc, mm	R2cx, mm
AR812-ZC-NM-25-50	1.0	25.4	-50.0	3.2	4.4	1.9	0.6	43.47	118.84
AR812-ZC-NM-25-63	1.0	25.4	-63.5	3.0	3.9	1.3	0.3	64.27	236.02
AR812-ZC-NM-25-76	1.0	25.4	-75.0	2.7	3.5	1.2	0.5	66.25	182.39
AR812-ZC-NM-25-100	1.0	25.4	-100	3.0	3.6	0.8	0.2	104.24	414.00

Custom sizes and specifications are available

HEMISPHERES



Calcium Fluoride (CaF₂)

Dia tolerance $\pm 0.0004''$ ($\pm 0.01\text{mm}$)
Thickness tolerance $\pm 0.002''$ ($\pm 0.05\text{ mm}$)
Surface Finish 60/40

CAT #	DIA, in	DIA, mm	CT, in	CT, mm
CF-HS-2	0.079	2.0	0.039	1.0
CF-HS-3	0.118	3.0	0.059	1.5
CF-HS-4	0.157	4.0	0.079	2.0
CF-HS-8	0.315	8.0	0.157	4.0
CF-HS-14	0.551	14.0	0.276	7.0
CF-HS-18	0.709	18.0	0.354	9.0
CF-HS-25	1.000	25.4	0.500	12.7

Custom sizes and specifications are available

Fused Silica UV Grade (SiO₂)

Diameter tolerance $\pm 0.0004''$ (± 0.01 mm)

Thickness tolerance $\pm 0.002''$ (± 0.05 mm)

Surface Quality 60/40

CAT#	DIA, in	DIA, mm	CT, in	CT, mm
QU-HS-2	0.08	2.0	0.04	1.0
QU-HS-6	0.24	6.0	0.12	3.0
QU-HS-8	0.32	8.0	0.16	4.0
QU-HS-10	0.39	10.0	0.20	5.0
QU-HS-12	0.47	12.0	0.24	6.0
QU-HS-14	0.55	14.0	0.28	7.0
QU-HS-20	0.79	20.0	0.40	10.0
QU-HS-25	1.00	25.4	0.50	12.7

Custom sizes and specifications are available

Silicon (Si)

Diameter tolerance $\pm 0.0004''$ (± 0.01 mm)

Thickness tolerance $\pm 0.002''$ (± 0.05 mm)

Surface Quality 60/40

CAT#	DIA, in	DIA, mm	CT, in	CT, mm
SI-HS-25	1.00	25.4	0.50	12.7

Custom sizes and specifications are available

Silicon Hyper Hemisphere (Hi-Res)

Diameter tolerance (inch)	+/-0.0004"
Diameter tolerance (mm)	+/-0.01
Height tolerance (mm)	+/-0.02
Surface Finish	60/40

CAT #	DIA, in	DIA, mm	CT. mm
HRSI-HS-10-5.0	0.39	10.0	5.0
HRSI-HS-10-5.1	0.39	10.0	5.1
HRSI-HS-10-6.0	0.39	10.0	6.0
HRSI-HS-10-6.1	0.39	10.0	6.1
HRSI-HS-10-6.3	0.39	10.0	6.3
HRSI-HS-10-6.5	0.39	10.0	6.5
HRSI-HS-10-7.0	0.39	10.0	7.0
HRSI-HS-10-7.5	0.39	10.0	7.5

Custom sizes and specifications are available

Zinc Selenide CVD Grade (ZnSe)

Diameter tolerance $\pm 0.0004''$ (± 0.01 mm)

Thickness tolerance $\pm 0.002''$ (± 0.05 mm)

Surface Quality 60/40

CAT#	DIA, in	DIA, mm	CT, in	CT, mm
ZC-HS-4	0.16	4.0	0.08	2.0
ZC-HS-5	0.20	5.0	0.10	2.5
ZC-HS-6	0.24	6.0	0.12	3.0
ZC-HS-8	0.32	8.0	0.16	4.0
ZC-HS-10	0.39	10.0	0.20	5.0
ZC-HS-25	1.00	25.4	0.50	12.7

Custom sizes and specifications are available

BALL LENSES



Fused Silica UV Grade (SiO₂)

Diameter tolerance $\pm 0.0004''$ (± 0.01 mm)

Thickness tolerance $\pm 0.002''$ (± 0.05 mm)

Surface Quality 60/40

CAT#	DIA, in	DIA, mm
QU-B-5	0.20	5.0

Custom sizes and specifications are available

Zinc Selenide CVD Grade (ZnSe)

Diameter tolerance $\pm 0.0004''$ (± 0.01 mm)

Thickness tolerance $\pm 0.002''$ (± 0.05 mm)

Surface Quality 60/40

CAT#	DIA, in	DIA, mm
ZC-B-2	0.08	2.0
ZC-B-5	0.20	5.0

Custom sizes and specifications are available

MOLDED COLLIMATING LENSES



IR Glass $\text{Ge}_{28} \text{Sb}_{12} \text{Se}_{60}$ Coated 1.8-3 (BD2)

Dia tolerance	$\pm 0.0006"$($\pm 0.015\text{mm}$)
Thickness tolerance	0.030 mm is typical - 0.100 mm max
Surface Quality	80/50
Clear Aperture	90% Central Diameter
Wedge Angle	<arc mi

CAT #	DIA, mm	FOC, mm	EFL tolerance, %	Design λ , nm	Numerical aperture, mm	Clear aperture, S1/S2,mm	Working distance, mm	CT, mm	CT tolerance, mm
390029IR4-00	3.0	0.91	$\pm 1.0\%$	4200	0.86	2.5/2.5	0.66	0.900	± 0.020
390017IR4-00	3.5	1.50	$\pm 1.0\%$	2300	0.72	2.60/2.16	1.24	1.100	± 0.030
390010IR4-00	4.5	1.47	$\pm 1.0\%$	9200	0.83	3.0/1.85	0.63	2.175	± 0.100
390037IR4-00	5.5	1.87	$\pm 1.0\%$	9500	0.85	4.00/2.50	0.72	3.000	± 0.050
390093IR4-00	6.5	3.00	$\pm 1.0\%$	7800	0.71	5.00/3.87	2.35	2.623	± 0.030
390036IR4-00	6.5	4.00	$\pm 1.0\%$	2500	0.56	5.00/4.11	3.05	2.500	± 0.050
390028IR4-00	8.0	5.95	$\pm 1.0\%$	4100	0.56	7.56/6.78	5.00	2.500	± 0.040
390042IR4-00	12.5	19.04	$\pm 1.0\%$	2534	0.23	10.00/10.00	16.63	5.000	± 0.050

Custom sizes and specifications are available

IR Glass $\text{Ge}_{28} \text{Sb}_{12} \text{Se}_{60}$ Coated 3-5 (BD2)

Dia tolerance	$\pm 0.0006"$ ($\pm 0.015\text{mm}$)
Thickness tolerance	0.030 mm is typical - 0.100 mm max
Surface Quality	80/50
Clear Aperture	90% Central Diameter
Wedge Angle	<arc mi

CAT #	DIA, mm	FOC, mm	EFL tolerance, %	Design λ , nm	Numerical aperture, mm	Clear aperture, S1/S2,mm	Working distance, mm	CT, mm	CT tolerance, mm
390029IR3-00	3.0	0.91	$\pm 1.0\%$	4200	0.86	2.5/2.5	0.66	0.900	± 0.020
390017IR3-00	3.5	1.50	$\pm 1.0\%$	2300	0.72	2.60/2.16	1.24	1.100	± 0.030
390010IR3-00	4.5	1.47	$\pm 1.0\%$	9200	0.83	3.0/1.85	0.63	2.175	± 0.100
390037IR3-00	5.5	1.87	$\pm 1.0\%$	9500	0.85	4.00/2.50	0.72	3.000	± 0.050
390093IR3-00	6.5	3.00	$\pm 1.0\%$	7800	0.71	5.00/3.87	2.35	2.623	± 0.030
390036IR3-00	6.5	4.00	$\pm 1.0\%$	2500	0.56	5.00/4.11	3.05	2.500	± 0.050
390028IR3-00	8.0	5.95	$\pm 1.0\%$	4100	0.56	7.56/6.78	5.00	2.500	± 0.040
390042IR3-00	12.5	19.04	$\pm 1.0\%$	2534	0.23	10.00/10.00	16.63	5.000	± 0.050

Custom sizes and specifications are available

IR Glass $\text{Ge}_{28} \text{Sb}_{12} \text{Se}_{60}$ Coated 8-12 (BD2)

Dia tolerance	$\pm 0.0006"$ ($\pm 0.015\text{mm}$)
Thickness tolerance	0.030 mm is typical - 0.100 mm max
Surface Quality	80/50
Clear Aperture	90% Central Diameter
Wedge Angle	<arc mi

CAT #	DIA, mm	FOC, mm	EFL tolerance, %	Design λ , nm	Numerical aperture, mm	Clear aperture, S1/S2,mm	Working distance, mm	CT, mm	CT tolerance, mm
390029IR1-00	3.0	0.91	$\pm 1.0\%$	4200	0.86	2.5/2.5	0.66	0.900	± 0.020
390017IR1-00	3.5	1.50	$\pm 1.0\%$	2300	0.72	2.60/2.16	1.24	1.100	± 0.030
390010IR1-00	4.5	1.47	$\pm 1.0\%$	9200	0.83	3.0/1.85	0.63	2.175	± 0.100
390037IR1-00	5.5	1.87	$\pm 1.0\%$	9500	0.85	4.00/2.50	0.72	3.000	± 0.050
390093IR1-00	6.5	3.00	$\pm 1.0\%$	7800	0.71	5.00/3.87	2.35	2.623	± 0.030
390036IR1-00	6.5	4.00	$\pm 1.0\%$	2500	0.56	5.00/4.11	3.05	2.500	± 0.050
390028IR1-00	8.0	5.95	$\pm 1.0\%$	4100	0.56	7.56/6.78	5.00	2.500	± 0.040
390042IR1-00	12.5	19.04	$\pm 1.0\%$	2534	0.23	10.00/10.00	16.63	5.000	± 0.050

Custom sizes and specifications are available

MIRRORS





Substrate material	Pyrex glass or substitute
Dia tolerance	+0,-0.005" (+0,-0.13 mm)
Th tolerance	±0.010" (±0.25 mm)
Clear Aperture	85% Central Diameter
Parallelism	3 arc min
Flatness	1/4 wave at 633 nm
Surface Quality	40/20
Coating	Protected Gold

CAT#	DIA, in	DIA, mm	CT, mm
P-MF-AU-12	0.5	12.7	3.15
P-MF-AU-25	1.0	25.4	6.35

Custom sizes and specifications are available

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EQUILATERAL PRISMS



Barium Fluoride (BaF₂)

Dimensions tolerance	±0.010" (±0.25 mm)
Clear Aperture	85%
Angle Tolerance	±10 min
Flatness	2 waves at 633 nm
Surface Finish	40/20 polished three faces
NOTE	Dimensions before chamfers are applied

CAT #	SIZE A=B=C, in	SIZE A=B=C, mm	Height H, mm
BF-EP-25	1.0	25.4	25.4

Custom sizes and specifications are available

Calcium Fluoride (CaF₂)

Dimensions tolerance	±0.010" (±0.25 mm)
Clear Aperture	85%
Angles tolerance	±10 min
Flatness	2 waves at 633 nm
Surface Finish	40/20, polished three faces
NOTE	Dimensions before chamfers are applied

CAT#	SIZE A=B=C, in	SIZE A=B=C, mm	Height H,mm
CF-EP-12	0.5	12.7	12.7
CF-EP-25	1.0	25.4	25.4
CF-EP-38	1.5	38.1	38.1

Custom sizes and specifications are available

Germanium (Ge)

Dimensions tolerance $\pm 0.010''$ (± 0.25 mm)

Clear Aperture 85%

Angles tolerance ± 10 min

Flatness 2 waves at 633 nm

Surface Finish 60/40, polished three faces

NOTE Dimensions before chamfers are applied

CAT#	SIZE A=B=C, in	SIZE A=B=C, mm	Height H,mm
GE-EP-12	0.5	12.7	12.7
GE-EP-25	1.0	25.4	25.4

Custom sizes and specifications are available

Zinc Selenide CVD Grade (ZnSe)

Dimensions tolerance	$\pm 0.010''$ (± 0.25 mm)
Clear Aperture	85%
Angles tolerance	± 10 min
Flatness	2 waves at 633 nm
Surface Finish	60/40, polished three faces
NOTE	Dimensions before chamfers are applied

CAT#	SIZE A=B=C, in	SIZE A=B=C, mm	Height H,mm
ZC-EP-12	0.5	12.7	12.7
ZC-EP-25	1.0	25.4	25.4

Custom sizes and specifications are available

NON-POLARIZING, RIGHT ANGLE PRISMS



Calcium Fluoride (CaF₂)

Dimensions tolerance	±0.010" (±0.25 mm)
Clear Aperture	85%
Angles tolerance	±10 min
Flatness	2 waves at 633 nm
Surface Finish	40/20, polished three faces
NOTE	Dimensions before chamfers are applied

CAT#	SIZE A=B, in	SIZE A=B, mm	Height H,mm
CF-RP-12	0.5	12.7	12.7
CF-RP-25	1.0	25.4	25.4
CF-RP-38	1.5	38.1	38.1

Custom sizes and specifications are available

Germanium (Ge)

Dimensions tolerance	±0.010" (±0.25 mm)
Clear Aperture	85%
Angles tolerance	±10 min
Flatness	2 waves at 633 nm
Surface Finish	60/40, polished three faces
NOTE	Dimensions before chamfers are applied

CAT#	SIZE A=B, in	SIZE A=B, mm	Height H,mm
GE-RP-12	0.5	12.7	12.7
GE-RP-25	1.0	25.4	25.4

Custom sizes and specifications are available

Zinc Selenide CVD Grade (ZnSe)

Dimensions tolerance	$\pm 0.010''$ (± 0.25 mm)
Clear Aperture	85%
Angles tolerance	± 10 min
Flatness	2 waves at 633 nm
Surface Finish	60/40, polished three faces
NOTE	Dimensions before chamfers are applied

CAT#	SIZE A=B, in	SIZE A=B, mm	Height H,mm
ZC-RP-12	0.5	12.7	12.7
ZC-RP-25	1.0	25.4	25.4

Custom sizes and specifications are available

BEAMSPLITTERS



50/50 Beamsplitter (CaF₂) 1.5-5 microns

Dia tolerance	+0,-0.005" (+0,-0.13mm)
Th tolerance	±0.005" (±0.13mm)
Clear Aperture	85%
Parallelism	3 arc min
Flatness	2 waves at 633 nm
Surface Finish	60/40
Coating	50/50 ± 10% R/T for 2-8 um

CAT #	DIA, in	DIA, mm	TH, in	TH, mm
BSP50-SWIR-MWIR-25-2	1.0	25.4	0.079	2.0
BSP50-SWIR-MWIR-38-3	1.5	38.1	0.118	3.0
BSP50-SWIR-MWIR-50-3	2.0	50.8	0.118	3.0

Custom sizes and specifications are available

50/50 Beamsplitter (CaF₂) 2-8 microns

Dia tolerance	+0,-0.005" (+0,-0.13mm)
Th tolerance	±0.005" (±0.13mm)
Clear Aperture	85%
Parallelism	3 arc min
Flatness	2 waves at 633 nm
Surface Finish	60/40
Coating	50/50 ± 10% R/T for 2-8 um

CAT #	DIA, in	DIA, mm	TH, in	TH, mm
BSP50-CF-25-2	1.0	25.4	0.079	2.0
BSP50-CF-25-3	1.0	25.4	0.118	3.0
BSP50-CF-38-3	1.5	38.1	0.118	3.0
BSP50-CF-50-2	2.0	50.8	0.079	2.0
BSP50-CF-50-5	2.0	50.8	0.197	5.0

Custom sizes and specifications are available

50/50 Beamsplitter (ZnSe) 7-14 microns

Dia tolerance	+0,-0.005" (+0,-0.13mm)
Th tolerance	±0.005" (±0.13mm)
Clear Aperture	85%
Parallelism	3 arc min
Flatness	2 waves at 633 nm
Surface Finish	60/40
Angle fo Incidence	45 deg
Coating Front Side	50/50 ± 10% R/T for 7-14 um
Coating Rear Side	Anti-reflective Coating for 7-14 um

CAT #	DIA, in	DIA, mm	TH, in	TH, mm
BSP50-ZC-25-3	1.0	25.4	0.118	3.0
BSP50-ZC-38-3	1.5	38.1	0.118	3.0
BSP50-ZC-50-3	2.0	50.8	0.118	3.0

Custom sizes and specifications are available

Beamsplitter Platinum Dichroic 0.4-12.0 microns reflects VIS (400-700 nm) light and transmits IR (3-12 microns) radiation

Dia tolerance	+0,-0.005" (+0,-0.13mm)
Th tolerance	±0.005" (±0.13mm)
Clear Aperture	90%
Parallelism	3 arc min
Flatness	1/4 waves at 633 nm
Surface Finish	40/20
Coating	Reflectance 85% average for 400-700 nm
	Transmittance 85% average for 3-12 microns
	Antireflectance coating on rear surface, R < 5% average for 3-12 microns
	Angle of Incidence 45 deg

CAT #	DIA, in	DIA, mm	TH, in	TH, mm
BSP-PD-25-2	1.0	25.4	0.079	2.0
BSP-PD-50-3	2.0	50.8	0.118	3.0

Custom sizes and specifications are available

Beamsplitter Gold Dichroic 0.4-12.0 microns separates VIS (400-700 nm) light from IR (3-12 microns) radiation

Dia tolerance	+0,-0.005" (+0,-0.13mm)
Th tolerance	±0.005" (±0.13mm)
Clear Aperture	85%
Parallelism	3 arc min
Flatness	1/4 waves at 633 nm
Surface Finish	40/20
Coating	Transmittance 70% average for 400-700 nm
	Reflectance 95% for 3-12 microns
	Angle of Incidence from 0 to 45 deg

CAT #	DIA, in	DIA, mm	TH, in	TH, mm
BSP-DI-25-2	1.0	25.4	0.079	2.0
BSP-DI-25-3	1.0	25.4	0.118	3.0
BSP-DI-50-2	2.0	50.8	0.079	2.0
BSP-DI-50-5	2.0	50.8	0.197	5.0

Custom sizes and specifications are available

IR POLARIZERS & IR WAVEPLATES



IR Polarizers

Diameter Tolerance +0, -0.05"
Thickness Tolerance +/-0.01"
Transmission Axis +/-2°

CAT #	OD, in*	OD, mm*	CA, in	CA, mm	ET, mm	Spectral Line, um
POL-1.5-5-SI-25	1.0	25.4	0.6	15.4	4.5	1.5-5
POL-1.5-5-SI-38	1.5	38.1	1.0	25.4	4.5	1.5-5
POL-1.5-5-SI-50	2.0	50.8	1.5	38.1	4.5	1.5-5
POL-3-5-SI-25	1.0	25.4	0.6	15.4	4.5	3-5
POL-3-5-SI-38	1.5	38.1	1.0	25.4	4.5	3-5
POL-3-5-SI-50	2.0	50.8	1.5	38.1	4.5	3-5
POL-8-12-SI-25	1.0	25.4	0.6	15.4	4.5	8-12
POL-8-12-SI-38	1.5	38.1	1.0	25.4	4.5	8-12
POL-8-12-SI-50	2.0	50.8	1.5	38.1	4.5	8-12
BSP-POL-4-11	1.0	25.4	0.7	18.0	3.0	4-1

Custom sizes and specifications are available

*OD Includes Mount

IR Waveplates

Diameter Tolerance ± 0.2 mm
Thickness Tolerance ± 0.2 mm
Retardance Tolerance $\lambda/100$

QUARTER WAVEPLATES

CAT #	OD, in	OD, mm	CA, in	CA, mm	ET, mm	Spectral Line, μm
WP-Z-Q-2940	1.0	25.4	0.4	11.0	8.0	2.9
WP-Z-Q-3000	1.0	25.4	0.4	11.0	8.0	3.0
WP-Z-Q-3500	1.0	25.4	0.4	11.0	8.0	3.5
WP-Z-Q-4000	1.0	25.4	0.4	11.0	8.0	4.0
WP-Z-Q-4500	1.0	25.4	0.4	11.0	8.0	4.5
WP-Z-Q-5000	1.0	25.4	0.4	11.0	8.0	5.0
WP-Z-Q-5500	1.0	25.4	0.4	11.0	8.0	5.5
WP-Z-Q-6000	1.0	25.4	0.4	11.0	8.0	6.0
WP-Z-Q-6500	1.0	25.4	0.4	11.0	8.0	6.5
WP-Z-Q-7000	1.0	25.4	0.4	11.0	8.0	7.0
WP-Z-Q-7500	1.0	25.4	0.4	11.0	8.0	7.5
WP-Z-Q-8000	1.0	25.4	0.4	11.0	8.0	8.0
WP-Z-Q-9000	1.0	25.4	0.4	11.0	8.0	9.0

HALF WAVEPLATES

CAT #	OD, in	OD, mm	CA, in	CA, mm	ET, mm	Spectral Line, μm
WP-Z-H-2940	1.0	25.4	0.4	11.0	8.0	2.9
WP-Z-H-3000	1.0	25.4	0.4	11.0	8.0	3.0
WP-Z-H-3500	1.0	25.4	0.4	11.0	8.0	3.5
WP-Z-H-4000	1.0	25.4	0.4	11.0	8.0	4.0
WP-Z-H-4500	1.0	25.4	0.4	11.0	8.0	4.5
WP-Z-H-5000	1.0	25.4	0.4	11.0	8.0	5.0
WP-Z-H-5500	1.0	25.4	0.4	11.0	8.0	5.5
WP-Z-H-6000	1.0	25.4	0.4	11.0	8.0	6.0
WP-Z-H-6500	1.0	25.4	0.4	11.0	8.0	6.5
WP-Z-H-7000	1.0	25.4	0.4	11.0	8.0	7.0
WP-Z-H-7500	1.0	25.4	0.4	11.0	8.0	7.5
WP-Z-H-8000	1.0	25.4	0.4	11.0	8.0	8.0
WP-Z-H-9000	1.0	25.4	0.4	11.0	8.0	9.0

Custom sizes and specifications are available

DIFFUSERS



Infrared Diffuser 0.2-8.0 microns for transmission or reflection; one side polished, the other "frosted"

Spectral Range 0.2-8.0 microns
Dia tolerance +0,-0.005" (+0,-0.13 mm)
Th tolerance +/-0.005" (+/-0.13 mm)

Polished side:
Clear Aperture 85%
Parallelism 3 arc min
Flatness 2 waves at 633 nm
Surface Finish 40/20

CAT #	Dia, in	Dia, mm	Th, in	Th, mm
DIF-IR-25-3	1.0	25.4	0.118	3.0
DIF-IR-38-3	1.5	38.1	0.118	3.0
DIF-IR-50-5	2.0	50.8	0.197	5.0

Custom sizes and specifications are available

Infrared Diffuser 8.0-12.0 microns for transmission or reflection; one side polished, the other "frosted"

Spectral Range 8.0-12.0 microns
Dia tolerance +0,-0.005" (+0.-0.13 mm)
Th tolerance +/-0.005" (+/-0.13 mm)

Polished side:
Clear Aperture 85%
Parallelism 3 arc min
Flatness 2 waves at 633 nm
Surface Finish 40/20

CAT #	Dia, in	Dia, mm	Th, in	Th, mm
DIF2-IR-25-3	1.0	25.4	0.118	3.0
DIF2-IR-38-3	1.5	38.1	0.118	3.0
DIF2-IR-50-5	2.0	50.8	0.197	5.0

Custom sizes and specifications are available

FILTERS



Bandpass Filter 8-12 microns transmits 8-12 microns range; blocks all other wavelength

Dia tolerance	+0,-0.005" (+0,-0.13mm)
Th tolerance	±0.005" (±0.13mm)
Clear Aperture	80%
Parallelism	3 arc min
Surface Finish	40/20
Coating	Transmittance 80% average Blocking <0.1% Transmittance from UV to 20 microns

CAT #	DIA, in	DIA, mm	TH, in	TH, mm
FIL-BP-812	1.0	25.4	0.040	1.0

Custom sizes and specifications are available

IR IMAGING LENSES



Fixed Focal Length Lens Assemblies

CAT #	Spectral Range, μm	F#	Focal Length, mm	Front Surface Coating	Smallest Detector Pitch	Max. FOV	Athermalized	Mounting Threads
LWIR-FFOV-19-1.1-A	8-12	1.1	19	AR	17 μm	32°	YES	M35 x 0.5-6g
LWIR-FFOV-25-1.0	8-12	1.0	25	AR	17 μm	30.4°	NO	M34 x 0.5
LWIR-FFOV-25-1.0-DLC	8-12	1.0	25	DLC	17 μm	30.4°	NO	M34 x 0.5
LWIR-FFOV-25-1.0-A	8-12	1.0	25	AR	15 μm	27°	YES	M42 x 0.5
LWIR-FFOV-35-1.2-A	8-12	1.2	35	AR	15 μm	22°	YES	M42 x 0.5
LWIR-FFOV-50-1.2-A	8-12	1.2	50	AR	15 μm	20.4°	NO	M54 x 0.5-6g
SWIR-MWIR-FFOV-23-4.0	1.5-5	4.0	23	AR	15 μm	30.2°	NO	C-Type Thread: 1"-32

Custom sizes and specifications are available