This section presents components to be used when it is necessary to change the polarization type of optic radiation.

SOLAR LS **High-Power Thin-Film Polarizers** and **Glan-Taylor Laser Polarizing Prisms**, specified in the Catalog, are intended both for separation of polarisation types and for establishing the lineraly-polarized radiation from the non-polarized radiation.

Thin-film polarizers are high damage threshold-dielectric coatings, applied to perfectly processed substrates that can come in two available modifications: standard circular and Brewster-cut (of elliptical shape). All substrates are wedged to less than 10", thus allowing their usage both inside and outside the cavity. A thin-film polarizer is always produced for one particular wavelength.

To establish the polarized radiation over the wide wavelength range (from 400 to 2300 nm), we offer you *Glan-Taylor laser polarizing prisms*. These prisms are made in the shape of two air-spaced prisms from high-quality calcite. The air spacing makes these prisms ideal for their usage in high-power lasers. Glan-Taylor prisms with high transmission in the UV (starting from 266 nm) can be supplied upon request.

The Waveplates are used to change the polarization type of the incident radiation by unequally phase-shifting its orthogonally-polarized components. Waveplates operation is based on the birefringence linear effect - the difference in the refractive indices for the beams with parallel- and normal-polarizations towards the optic axis.

The waveplates are made from birefringence materials (most frequently from crystalline quartz) such that the optic axis is within the waveplate plane (normal to the incident radiation). Due to this feature, the waveplates are dependent on their arrangement (i.e. on orientation of the incident radiation polarization plane towards the waveplate optic axis).

Thus, the *Half-Waveplate* whose optic axis is at a θ-angle towards the incident radiation polarization plane, provides the latter rotation by an angle of $180°-2\theta$. Rotation of the half-waveplate by a α-angle results in rotation of the polarization plane of the emerging radiation by a 2α-angle, thus allowing the half-waveplate to be used as an adjustable rotator for the polarization plane.

Quater Waveplate is used for conversion of linearly-polarized radiation to circularly-polarized radiation when the input polarization is oriented at an angle of 45° to the waveplate optic axis.

High-Order and Zero-Order Waveplates for widely used Nd:YAG lasers are available in stock.

The main advantages of **High-Order Waveplates** is their low cost and high damage threshold. The waveplate operational range is restricted, however, by their temperature depedence. Because of a very narrow free spectral range, high-order waveplates are normally used for one or two particular wavelengths.

Dual High-Order Waveplates are high-order waveplates that, at adequately chosen thicknesses, can be used for two wavelengths. A dual waveplate, being a full waveplate for one from the two wavelengths, and a half waveplate for the other, allows rotation of polarization of the first wavelength, leaving the other wavelength polarization invariable.
Most frequently used dual waveplates, presented on page 6-7, are produced in series. Upon request, SOLAR LS can calculate and produce original waveplates for two wavelengths with phase properties specified by a Customer. Not always one can find a thickness that could exactly meet both wavelengths. In this case the production accuracy of a waveplate can be slightly lower for one of two wavelengths.

In contrast to high-order waveplates, **Zero-Order Waveplates** are, in fact, temperature-independent and can be used for a spectral band along with a single wavelength.
Zero-order waveplates are made of a couple of optically-contacted crystalline quartz plates with mutually-orthogonal optic axes, that differ slightly only in thicknes. Because of orthogonally-directed axes, the role of ordinary and extraordinary beams, when they travell from one to the other waveplane, changes, the effect induced by each waveplate being mutually compensated and the resulting phase difference being only determined by that in their thickness.

Due to almost complete compensation of the effects induced by thermal expansion/contraction of both waveplates, zero-order waveplates can be operated in the extremely wide temperature range. SOLAR LS offers optically-contacted zero-order waveplates for 1064nm and 532 nm produced in series. Waveplates for other wavelengths as well as air-spaced zero-order waveplates wich have high damage threshold can be produced upon request.

Rotators use the circular birefringence effect - the difference in the refractive indeces of the left- and right-circularly-polarized radiation components. This effect is observed in the crystalline quarts when the light is propagating along the optic axis.
As compared to a waveplate, a rotator has an intrinsic advantage, being independent of rotation around its own optic axis. It needs no adjustment, it needs only to be installed normal to the incident radiation.
A rotator is normally used for the specified wavelength and its narrow spectral range. In addition to the standard rotators, listed on page 6-9, SOLAR LS can produce and deliver in short time any other rotator, specified by the User.

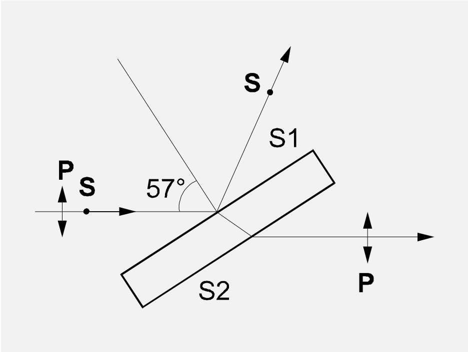
Achromatic rotators for a polarization plane are made as complicated prisms that either combine rotation of the polarization plane with alteration of the beam direction by 90° (the case from page 6-10) or preserve the initial direction of the beam. The polarisation plane rotation is achieved due to several internal reflections of the prism, therefore such rotators can be, virtually operated over the whole transmission spectral range of the material they are made of.
Upon request, the input and output faces of a rotator can be AR-coated for the required wavelength range.

Fresnel Rhomb is a device that can be used to alter polarisation type of radiation due to the unequal phase shifts arising in orthogonally polarised components of an incident wave at total internal reflection. A Fresnel rhomb is designed such that (page 6-12) two full internal reflections inside a rhomb provide a $\pi/2$- phase difference between the orthogonally-polarized components of radiation. Hence, if there is a 45° angle between the polarization of the lineraly-polarized incident radiation and the incident plane, the emerging beam is circularly-polarized, i.e. the rhomb effect is similar to that of a quater waveplate. Therefore two identical Fresnel rhombs, installed in series, will provide a π -phase difference similar to that of a half-waveplate, i.e, they can rotate the beam polarization plane by 90°, leaving the beam direction invariable.

Due to a low dispersion of the refractive indices of the materials being used (BK-7 and UVFS), Fresnel rhombs are, in fact, achromatic over a wide spectral range.
Both a $\pi/2$ ($\lambda/4$) Fresnel rhomb, and π ($\lambda/2$) -set of two Fresnel rhombs, can come with the SOLAR LS specially designed holders. The input and output faces can be AR-coated upon request.

Multi-layer film polarizers are intended for intra and extra cavity usage. They provide the achievement of strictly linear polarization of laser radiation.

SPECIFICATIONS



Material .... BK 7 or UV Fused Silica
Surface Figure .... Both surfaces λ /10 at 632.8nm
Surface Quality .... Both surfaces 20-10
Incidence Angle .... 57±2°
Diameter Tolerance .... +0.0 mm; -0.15 mm
Thickness Tolerance .... ±0.2 mm
Wedge .... 10 arc sec.
Chamfer .... 0.5 mm at 45°
Clear Aperture .... 90% of diameter
Damage Threshold .... 8-10 J/cm^2 at 10 ns-pulse duration and 1064 nm-wavelength

ORDERING INFORMATION

Part №	Wavelength (nm)	Rs (%)	Tp (%)	Diameter (mm)	Thickness (mm)
FF0254/PL11	1064	≥ 99.7	≥ 93	25	6
FF0304/PL11	1064	≥ 99.7	≥ 93	30	6
FF0504/PL11	1064	≥ 99.7	≥ 93	50	8
FF0254/PL12	532	≥ 99.7	≥ 93	25	6
FF0304/PL12	532	≥ 99.7	≥ 93	30	6
FF0504/PL12	532	≥ 99.7	≥ 93	50	8
FF0254/PL13	1053	≥ 99.7	≥ 93	25	6
FF0304/PL13	1053	≥ 99.7	≥ 93	30	6
FF0504/PL13	1053	≥ 99.7	≥ 93	50	8
FF0254/PL14	527	≥ 99.7	≥ 93	25	6
FF0304/PL14	527	≥ 99.7	≥ 93	30	6
FF0504/PL14	527	≥ 99.7	≥ 93	50	8
FF0254/PL15	694	≥ 99.7	≥ 93	25	6
FF0304/PL15	694	≥ 99.7	≥ 93	30	6
FF0504/PL15	694	≥ 99.7	≥ 93	50	8

Thin-Film Polarizers on Brewster's Windows

Part №	Wavelength (nm)	Rs (%)	Tp (%)	Minor Diameter (mm)	Thickness (mm)
WB0204/PL11	1064	≥ 99.7	≥ 93	20	2
WB0304/PL11	1064	≥ 99.7	≥ 93	30	3
WB0404/PL11	1064	≥ 99.7	≥ 93	40	4
WB0204/PL12	532	≥ 99.7	≥ 93	20	2
WB0304/PL12	532	≥ 99.7	≥ 93	30	3
WB0404/PL12	532	≥ 99.7	≥ 93	40	4
WB0204/PL13	1053	≥ 99.7	≥ 93	20	2
WB0304/PL13	1053	≥ 99.7	≥ 93	30	3
WB0404/PL13	1053	≥ 99.7	≥ 93	40	4
WB0204/PL14	527	≥ 99.7	≥ 93	20	2
WB0304/PL14	527	≥ 99.7	≥ 93	30	3
WB0404/PL14	527	≥ 99.7	≥ 93	40	4
WB0204/PL15	694	≥ 99.7	≥ 93	20	2
WB0304/PL15	694	≥ 99.7	≥ 93	30	3
WB0404/PL15	694	≥ 99.7	≥ 93	40	4

Polarizers on other substrates for other wavelengths can be available upon request. To make an order, please, specify the type of substrate and operating wavelength.

GLAN TAYLOR LASER POLARIZING PRISMS.

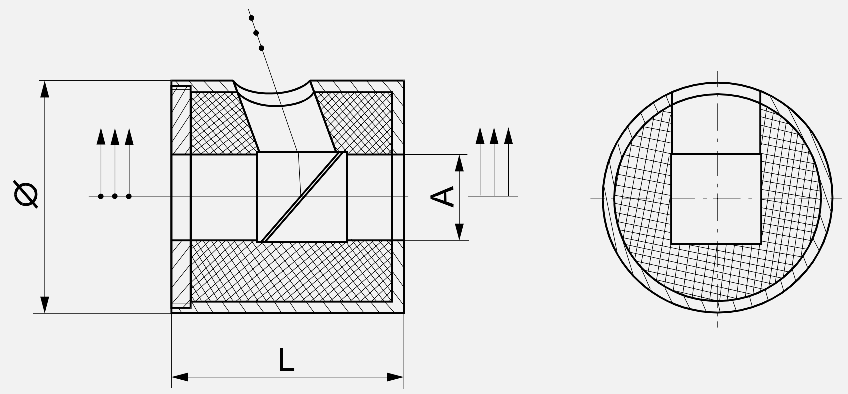
Glan Taylor laser polarizing prisms are two air-spaced prisms made of high grade calcite; the prisms are free from defects and blemishes and can be ideally suited for use with lasers that have high output energies.

The polarizer is mounted in a specially designed holder to provide independed escape of two orthogonally-polarized beams.

The polarizers have the transmittion range from 400 to 2300 nm.

SPECIFICATIONS

Material .... Calcite
Extinction Ratio .... 10^5 : 1
Surface Quality .... 60-40 scratch and dig
Surface Flatness .... λ/4 at 632 nm
Dimensions Tolerance .... ±0.25 mm
Mounting .... white anodized aluminium



ORDERING INFORMATION

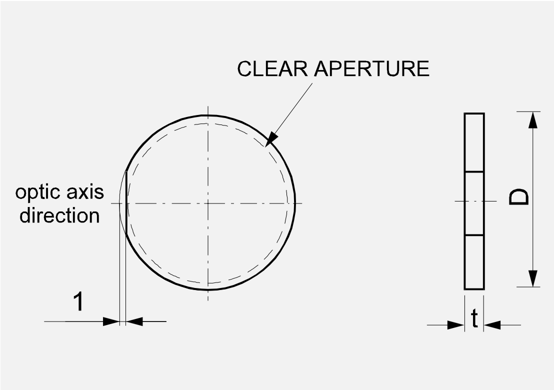
Part №	Clear Aperture A (mm)	Outside Diameter ∅ (mm)	Housing Lenght L (mm)
GT8106	10	32	32
GT8156	15	35	35

Glan laser polarizers with ARC for the desired wavelength range can be available upon request.

These waveplates are made of Crystal Quartz and are intended to change polarization of laser radiation.

SPECIFICATIONS

Material .... Crystal Quartz
Wave Front Distortion λ/10
Parallelism .... <2 arc sec.
Optic Axis .... normal to facet on circumference of retarder
Surface Quality 20-10
Diameter Tolerance .... +0.0 mm; -0.1 mm
Clear Aperture .... 85% of diameter
AR Coating (both sides).......... R<0.2%



ORDERING INFORMATION

Part № λ/2	Part № λ/4	Wavelength (mm)	Diameter (mm)
WH20205/AR05	WH25205/AR05	1064	20
WH20255/AR05	WH25255/AR05	1064	25
WH21205/AR04	WH26205/AR04	532	20
WH21255/AR04	WH26255/AR04	532	25
WH22205/AR03	WH27205/AR03	355	20
WH22255/AR03	WH27255/AR03	355	25

HOLDER

Part №	Reatrder's Diameter (mm)	Holder's Diameter (mm)	Holder's Thickness (mm)
HO90200	20	30	7
HO90250	25	30	7

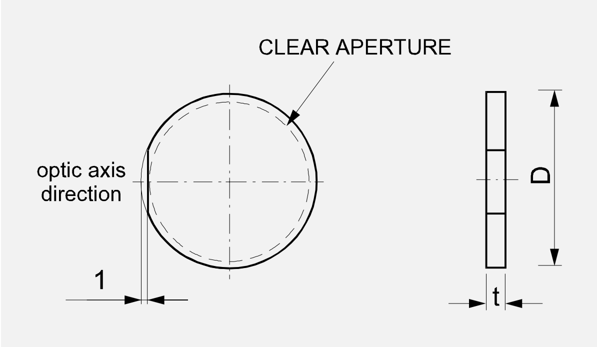
Waveplates for any wavelength over the 400 to 2300 nm can be available upon request. To make an order, please, spesify the wavelength, type of waveplate (λ/2 or λ/4) and diameter.

Waveplates in specially-designed holders can be available upon request.

In some cases it may be necessary to control polarization of two wavelengths simultaneously. This is accomplished by using original dual waveplates.

SPECIFICATIONS

Material .... Crystal Quartz
Wave Front Distortion .... λ /10
Parallelism .... 0.5 arc sec.
Optic Axis .... normal to facet on circumference of retarder
Surface Quality 20-10
Diameter Tolerance .... +0.0 mm; -0.1 mm
Clear Aperture .... 85 % of diameter
AR Coating (both sides).... R<0.2%



ORDERING INFORMATION

Part № dia. 20 mm	Part № dia. 25 mm	Wavelength (mm)	Ratardation
WD20205/AR07	WD20255/AR07	1064	λ/4
		532	λ
WD21205/AR07	WD21255/AR07	1064	λ/2
		532	λ
WD22205/AR07	WD22255/AR07	1064	λ
		532	λ/2
WD23205/AR10	WD23255/AR10	532	λ
		355	λ/2
WD24205/AR10	WD24255/AR10	532	λ/2
		355	λ

HOLDER

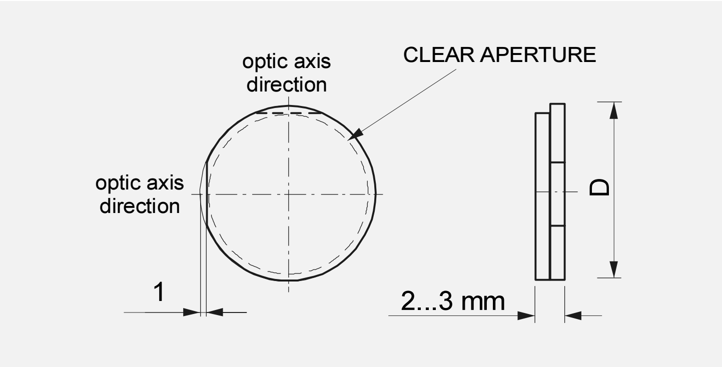
Part №	Reatrder's Diameter (mm)	Holder's Diameter (mm)	Holder's Thickness (mm)
HO91200	20	30	8
HO91250	25	30	8

Dual waveplates for any wavelength combination can be available upon request. To make an order, please, specify the wavelengths, retardation for each wavelength and diameter.

The waveplate can be mounted in a specially-designed holder (∅30 mm) upon request.

Zero-order waveplates are assembled from pairs of optically contacted crystalline quartz plates having orthogonal optic axis directions.

The effects of these waveplates partially counterbalance each other. Due to this, and in contrast to high order waveplates, the retardation of zero-order retarders is essentially invariant with temperature.



ORDERING INFORMATION

Part №		Wavelength (mm)	Diameter (mm)
λ/2	λ/4		
WZ20155/AR05	WZ25155/AR05	1064	15
WZ20205/AR05	WZ25205/AR05	1064	20
WZ20255/AR05	WZ25255/AR05	1064	25
WZ21155/AR04	WZ26155/AR04	532	15
WZ21205/AR04	WZ26205/AR04	532	20
WZ21255/AR04	WZ26255/AR04	532	25

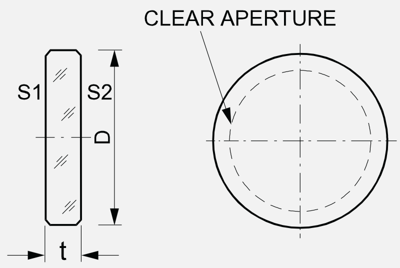
HOLDER

Part №	Reatrder's Diameter (mm)	Holder's Diameter (mm)	Holder's Thickness (mm)
HO93150	15	25	10
HO93200	20	30	10
HO93250	25	30	10

Waveplates for any wavelength over the 200 to 2300 nm can be available upon request. To make an order, please, specify the wavelength, type of waveplate (λ /2 or λ /4) and diameter.

Waveplates in specially-designed holders can be available upon request.

The rotators are made of Crystal Quartz and are intended to rotate the beam polarization plane strictly to an appropriate angle. These units are only slightly dependent of the hanging ambient temperature and wavelength. The rotators operation is based on Crystal Quartz optical activity.



SPECIFICATIONS

Material .... Crystal Quartz
Wave Front Distortion .... λ /10
Surface Quality 20-10
Diameter 20mm
Diameter Tolerance .... +0.0 mm; -0.1 mm
Thickness .... depends on wavelength and rotation angle (0.5-15 mm)
Parallelism .... 2 arc sec.
Optic Axis .... normal to operating faces S_1 and S_2
Clear Aperture .... 85 % of diameter
AR Coating (both sides) .... R<0.2%

ORDERING INFORMATION

Part №	Wavelength (nm)	Rotation angle of polarization plane
RP20205/AR05	1064	45°
RP21205/AR05	1064	90°
RP22205/AR04	532	45°
RP23205/AR04	532	90°
RP24205/AR03	355	45°
RP25205/AR03	355	90°
RP26205/AR02	266	45°
RP27205/AR02	266	90°

HOLDER

Part №	Diameter (mm)	Thickness
HO95200	30	depends on rotator's partџ (7-19)mm

Polarization plane rotators for any wavelength from 200 to 2300 nm can be available upon request. To make an order, please, specify operating wavelength, rotation angle for polarization plane. The rotator can be mounted in specially-designed holder (∅30 mm) upon request.

The prism is intended for 90° angle-rotation of the radiation plane. In contrast to other polarization plane rotators and retarders, the prism is fully achromatic to allow operation over the entire transmission spectral range of the material it is made of (for UVFS - from 195 to 2000 nm). Simultaneously with the polarization plane rotation, the prism alters the film propagation height by a value of t and the beam propagation direction by 90° either clockwise (Type I prism) or counter clockwise (Type II prism). The Type III prism preserves the initial direction of the beam propagation.

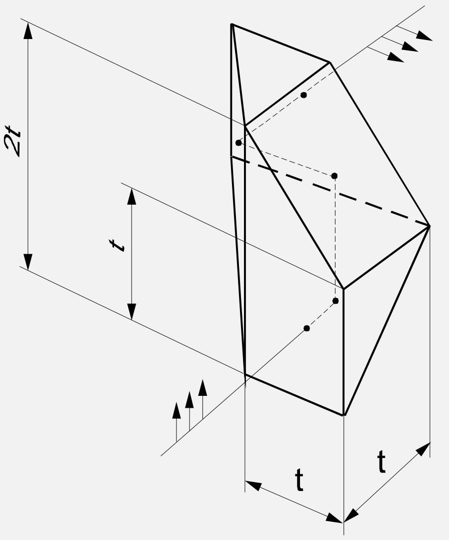
SPECIFICATIONS

Material .... UVFS
Surface Figure .... λ /10
Surface Quality 20-10
Tolerances .... +0.0 mm; -0.1 mm
Angle Between Input and Output Beam .... 90°±3′ (type I, type II)
Beem angular deviation .... ±3′ (type III)
Chamfer .... 0.5 mm at 45°
Clear Aperture 85%

Type I (left-hand prism)

Type II (right-hand prism)

Type III



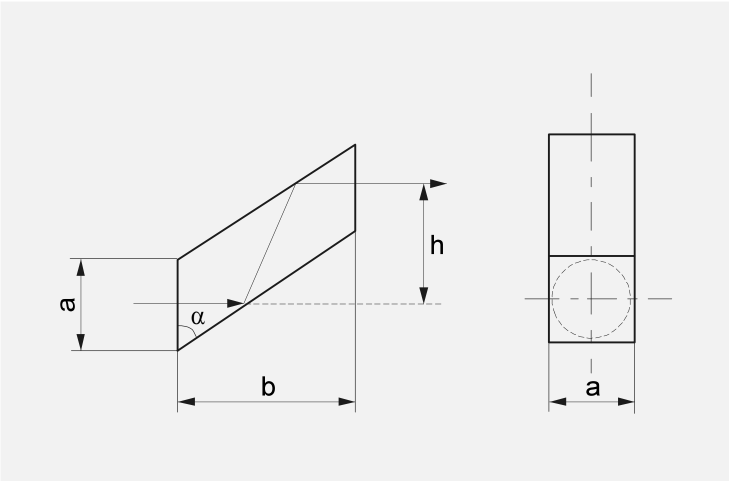
ORDERING INFORMATION

Part №			t (mm)
Type I	Type II	Type III	
RA1151L	RA1151R	RA1151	15
RA1191L	RA1191R	RA1191	19

Achromatic polarization plane rotators with the dimensions other than those specified in the Table as well as from other materials (BK-7; LiF; CaF_2 and BaF_2) can be available upon request.

SPECIFICATIONS

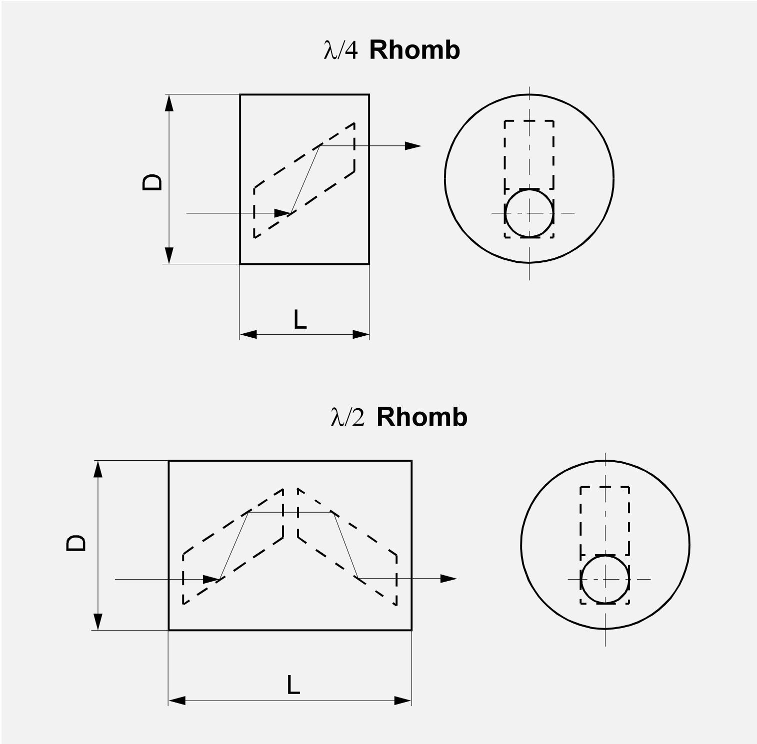
Material .... BK7, UV Fused Silica
Surface Fugure.. λ /10 at 632.8 nm
Surface Quality .... 20-10 (all polished surfaces)
Spectral range
for BK7 .... 340-2000 nm
for UVFS.. 200-340 nm
Retardation Tolerance .... ±2°
Reflectance of the Broadband ARC .... <0.5%
Clear Aperture .... refer to the table below
Holder's Diameter .... refer to the table below
Holder's Length .... refer to the table below



ORDERING INFORMATION

Rhombs without holder

Part №	Rhomb's material	Clear Aperture (mm)	a (mm)	b (mm)	h (mm)	α (deg)
RF0120	BK 7	10	12	23.7	16.3	55.46
RF1120	UVFS	10	12	20.6	15.4	53.2



Rhombs with holder

Part №	Rhomb's material	Clear Aperture (mm)	Retardation	Holder's diameter D (mm)	Holder's lenght L (mm)
RF90100/☐	BK 7	10	λ/2	35	56
RF90101/☐	BK 7	10	λ/4	35	30
RF91100/☐	UVFS	10	λ/2	35	50
RF91101/☐	UVFS	10	λ/4	35	27

To order,select a part number from the product table and complete the ordering blocks in the following way: add, instead of ☐, ARC part number (see the antireflection coating section page 5-1) to Fresnel Phombs part number. For example:

RF91100/AR15

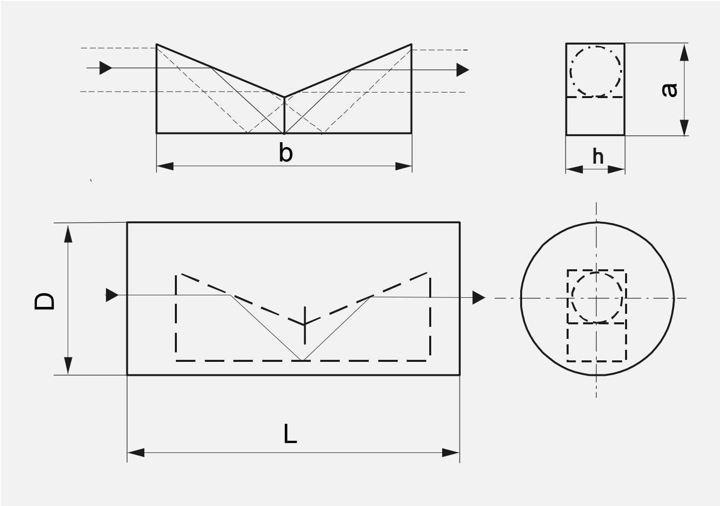
/AR15 - ARC part number for 248-355 nm

Fresnel Phombs with other sizes and parameters can be available upon request.

The “K” prism provides a phase difference of λ/4. This is the prism which is free of beam displacement. The “K” prism may be supplied mounted in a cylindrical holder.

SPECIFICATIONS

Material BK7
Surface Figure .... λ/4 at 632.8 nm
Surface Quality 40-20
Spectral range .... 420-2000 nm
Retardation Tolerance .... ±2°
Clear Aperture .... refer to the table below



ORDERING INFORMATION

Part №	Clear Aperture (mm)	a (mm)	b (mm)	h (mm)
KP0682	9	16.5	68	11

Holder

Part №	Holder's Diameter, D (mm)	Holder's Lenght, L (mm)
HO96720	35	72

To order, select a part number from the product table and complete the ordering blocks in the following way: add, instead of ☐, ARC part number (see the antireflection coating section page 5-1) to "K" prism part number. For example:

KP0682/AR 18
/AR18 – ARC part number for 425-675 nm

"K" prism with other sizes and parameters can be available upon request.