



Prisms & Polarizers

Prisms

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Right Angle Prisms

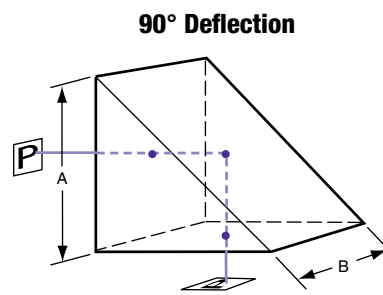
- **Laser or laboratory quality**
- **Fused silica or glass**
- **90 or 180 degree reflection**
- **Antireflection coatings available**



A Right Angle Prism is used to turn or deflect a beam through 90° or 180°. In either case this is achieved by total internal reflection and produces a very efficient broadband reflector.

It is important that the incoming beam is collimated and enters the prism at a normal angle of incidence. This is so that total internal reflection can be achieved.

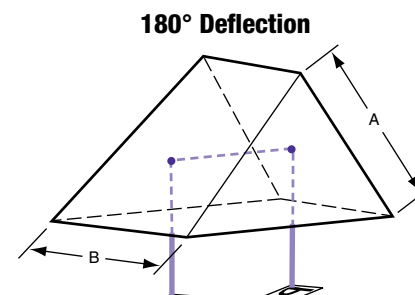
A range of both laser and laboratory quality prisms are available. These are available in either fused silica or BK7 glass.



90° Deflection

For a 90° deflection the total internal reflection occurs at the hypotenuse face.

Provided that the prism surface is clean and the incident angle on the hypotenuse is at 45°, the prism will act as a very efficient broadband reflector. The image is erect and reversed.



180° Deflection

For a 180° deflection the Right Angle Prism is used with the hypotenuse as the entrance and exit face, with the total internal reflection occurring at the right angle faces. The main application of this is to use it as a retroreflector provided that the plane of the incident beam includes the vertex.

Kinematic Prism Platforms



Kinematic Prism Platforms are also available on page 135.

Laser Quality

Ealing offers a range of laser quality right angle prisms. These have been manufactured with high precision and selected for low scatter. Surface finish and angular accuracy are tightly maintained.

Fused silica is an ideal material for most laser applications because of its thermal handling capabilities. Glass is recommended for lower power applications.

Specifications

FUSED SILICA LASER QUALITY RIGHT ANGLE PRISMS
Material: UV grade fused silica
Dimensions Tolerance: +0 - 0.25 mm
Angular Deviations Tolerance: <3 arcmin
Surface Quality: 10-5
Flatness: $\lambda/10$
Uncoated

GLASS LASER QUALITY RIGHT ANGLE PRISMS
Material: BK7 glass
Dimensions Tolerance: +0 - 0.25 mm
Angular Deviations Tolerance: <3 arcmin
Surface Quality: 20-10
Flatness: $\lambda/4$: 50.8 mm
Uncoated

Fused Silica Laser Quality Right Angle Prisms

Catalog Number	Size A=B (mm)	Price US
24-8825	10	\$100.00
24-8831	12.7	\$126.00
24-8859	20	\$175.00
24-8864	25.4	\$210.00
24-8880	38.1	\$350.00
24-8898	50.8	\$473.00

Glass Laser Quality Right Angle Prisms

Catalog Number	Size A=B (mm)	Price US
24-8039	5.0	\$53.00
24-8054	10.0	\$53.00
24-8062	12.7	\$53.00
24-8088	20.0	\$68.00
24-8096	25.4	\$68.00

Laboratory Quality

A range of laboratory quality right angle prisms is offered for general purpose laboratory use.

For UV applications, fused silica is highly recommended. For visible or NIR applications, BK7 is the best material choice.

Specifications

FUSED SILICA RIGHT ANGLE PRISMS
Material: UV grade fused silica
Wavelength Range: 200-2500 nm
Dimensions Tolerance: ± 0.5 mm
Angles Tolerance: ± 10 arcmin
Surface Quality: 60-40
Flatness: 1λ
Uncoated

GLASS RIGHT ANGLE PRISMS
Material: BK 7 glass
Wavelength Range: 330-2100 nm
Dimensions Tolerance: ± 0.25 mm
Angles Tolerance: ± 5 arcmin
Surface Quality: 80-50
Flatness: 2λ
Uncoated

Fused Silica Laboratory Quality Right Angle Prisms

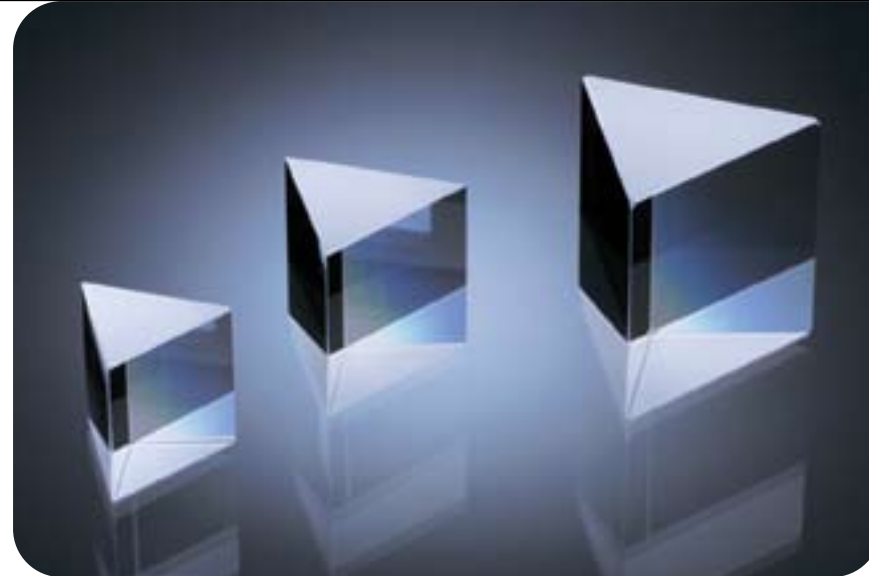
Catalog Number	Size A=B (mm)	Price US
24-4731	5.0	\$74.00
24-4749	10.0	\$95.00
24-4756	20.0	\$116.00
24-4764	25.0	\$147.00

Glass Laboratory Quality Right Angle Prisms

Size A=B (mm)	Catalog Number	Price US
2.0	24-2461	\$46.00
5.0	24-3659	\$38.00
10.0	24-3667	\$40.00
15.0	24-3675	\$40.00
20.0	24-3683	\$51.00
25.0	24-3378	\$53.00
30.0	24-3709	\$68.00
35.0	24-3717	\$108.00
40.0	24-3725	\$152.00
50.0	24-3394	\$189.00

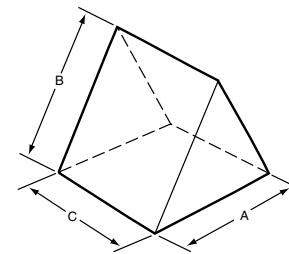
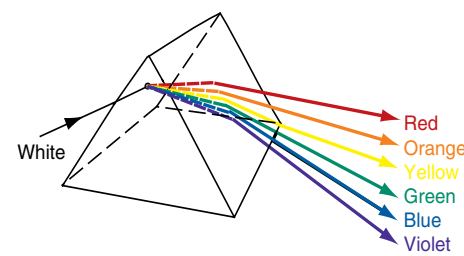
Equilateral Prisms

- Ideal for wavelength separation in broadband applications
- BK7, SF10, or F2



Equilateral Prisms are used routinely as dispersing elements where spectral separation is required. They provide better brightness (lower stray light) than diffraction gratings. They also have greater power handling capabilities and avoid possible confusion when trying to interpret overlapping spectral orders. It must be remembered that dispersion

is non-linear with wavelength and that surface reflection losses may affect throughput. Ealing offers Equilateral Prisms in three materials designed to suit a wide variety of dispersion, wavelength and surface reflection requirements. In general, a higher refractive index material produces greater angular separation.



Equilateral Prisms

Dimensions A=B (mm) C (mm)	BK7 Glass		SF10 Glass		F 2	
	Catalog Number	Price US	Catalog Number	Price US	Catalog Number	Price US
20 20	24-2158	\$50.00	-	-	-	-
25 25	24-3006	\$50.00	-	-	-	-
30 30	24-3600	\$80.00	24-2966	\$106.00	24-2156	\$260.00
40 40	24-3501	\$90.00	-	-	-	-
60 60	24-3527	\$110.00	24-2959	\$250.00	24-2944	\$320.00

Specifications

Material and Wavelength Range:

- BK7: 330-2100 nm
- SF10: 400-2400 nm
- F2: 350-2200 nm

Refractive Index:

- BK7: $n_d=1.517$
 $n_F - n_C=0.0081$
- SF10: $n_d=1.728$
 $n_F - n_C=0.0256$
- F2: $n_d=1.620$
 $n_F - n_C=0.0173$

Angular Dispersion:

- BK7: $0^\circ 42' 37''$
- SF10: $2^\circ 58' 25''$

Dimensions Tolerance: ± 0.5 mm

Angles Tolerance: ± 5 arcmin

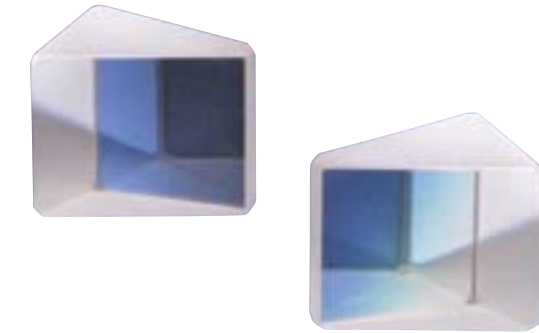
Surface Quality: 80-50

Flatness: 2λ per 25 mm

Uncoated

Anamorphic Prism Pair

- Correction of beam asymmetry
- Optimized for 650-850 nm

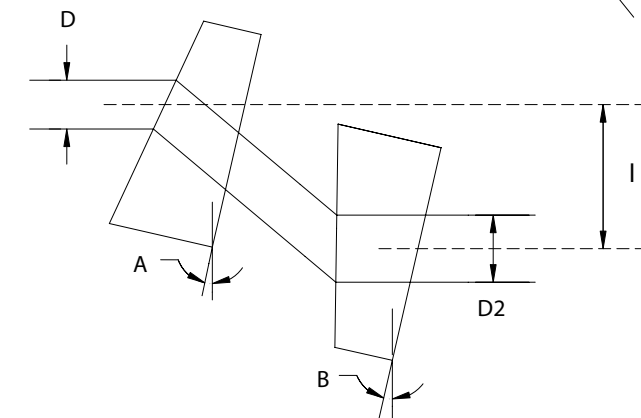
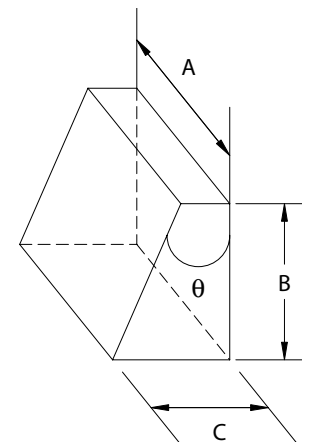


Anamorphic Prism Pairs are used mainly to correct the asymmetric beam shape of a Laser Diode – from elliptical to near circular shape. This is done by expanding (or contracting) the beam in one direction only while the other direction remains unchanged.

The aspect ratio of the elliptical beam varies according to the laser diode. Magnification is controlled by the angular position of the prisms relative to the incident beam (which has

already been collimated). The table shown lists the linear and angular dimensions of the prisms for various magnifications.

Ealing offers unmounted prisms in pairs. They are antireflection coated for use in the 650-850 nm region.



Specifications

- Material: SF11 glass
- $\theta: 29.45^\circ$
- Size: 12 x 12 x 8.5 mm
- Dimension Tolerance: $\pm 0/-0.254$ mm
- Angle Tolerance: < 3
- Surface Quality: 40-20
- Flatness: $\lambda/10$
- Clear Aperture: $> 80\%$ of central dim.
- Chamfer: 0.3 mm x 45°

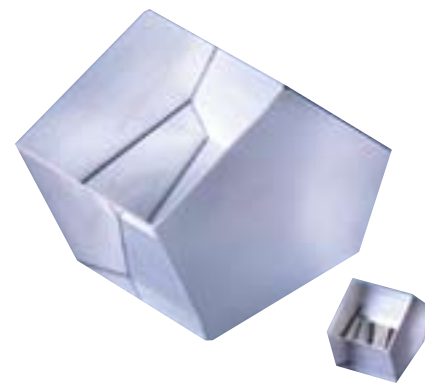
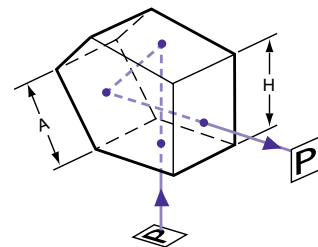
Anamorphic Prism Pair

Catalog Number	Price US
24-9078	\$125.00

Magnification (X)	Prism angles		Displacement (mm)
	A1 (Deg)	A2 (Deg)	
2.0	21.2	-6.0	5.2
3.0	30.4	-0.1	6.3
4.0	35.2	+2.5	7.0
5.0	38.2	+3.9	7.4
6.0	40.4	+4.8	7.7

Penta Prisms

- **Precise 90 degree deviation**
- **Designed for 400-700 nm**



Specifications

Material: BK7 glass
Dimension Tolerance: +0 / -0.254 mm
Surface Flatness: $\lambda/4$
Angular Tolerance: <10 arcsec
Clear Aperture: > 85% of central dim.

Penta Prisms deviate an incident beam through 90° without inverting or reversing it. They also show constant deviation (i.e. the beam is deviated through 90° irrespective of the orientation of the prism). The accuracy of the 90° deviation is therefore only dependent on the manufacturing tolerances of the prism. These prisms are extremely useful when precise orientation of

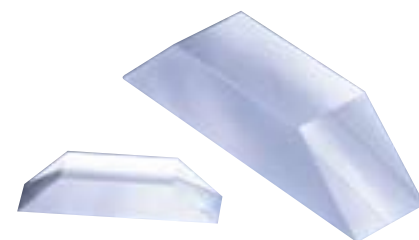
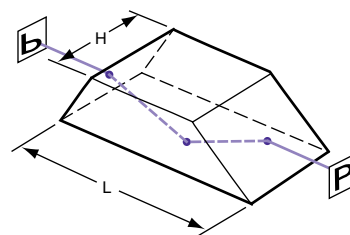
the prism is not possible and also where the path length through an instrument needs to be shortened. Typical applications include range finding, surveying, alignment and cinephotography. The reflecting faces are coated and the entrance and exit faces have an antireflection coating optimized for 400-700 nm.

Penta Prisms

Catalog Number	Side		Price US
	A (mm)	H (mm)	
24-1364	7.0	6.0	\$77.00
24-1372	10.0	10.0	\$68.00
24-3840	20.0	20.0	\$89.00

Dove Prisms

- **Image inversion and rotation**
- **Optimized for 400-700 nm**



Specifications

Material: BK7 glass
Dimension Tolerance: +0 / -0.254 mm
Angle Tolerance: <3 arcmin
Surface Quality: 20-10
Flatness: $\lambda/4$
Coating: None
Chamfer: 0.3 mm x 45°
Clear Aperture: > 85% of central dim.

Dove Prisms are a truncated form of right angle prism. They use total internal reflection to produce an inverted image which emerges without any beam deviation. The main application for these prisms are as image rotators. Rotating the prism about an optical axis results in the image rotating at double the

angular velocity of the prism. It is very important that the incident beam is collimated for optimal performance. In addition the large reflecting face must be kept very clean.

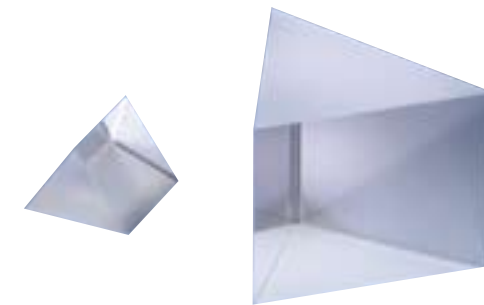
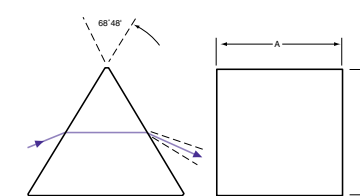
Ealing Dove Prisms are broadband antireflection coated for 400-700 nm on the entrance and exit faces for maximum transmission.

Dove Prisms

Catalog Number	Side		Price US
	H (mm)	L (mm)	
24-1414	10.0	42.3	\$74.00
24-1430	15.0	63.4	\$75.00
24-1448	20.0	80.0	\$110.00

Brewster Prisms

- **Ideal for laser tuning**
- **Laser quality**



Specifications

Material: UV grade fused silica or SF10
Dimensions: +0 / -0.254 mm
Apex Angle: <3 arcmin
Clear Aperture: >85% of central dim
Chamfer: 0.3 mm x 45°
Uncoated

Brewster Prisms are designed to have an apex angle such that a p-polarized ray incident at Brewster's angle will pass through the prism parallel to the base at minimum deviation, and exit also at Brewster's angle. In this case surface

reflection losses are negligible. Brewster Prisms are often used in situations where surface reflection losses cannot be tolerated.

Brewster Prisms are also frequently used to select a single wavelength from a multi-wavelength laser. Tuning is accomplished by tilting the prism.

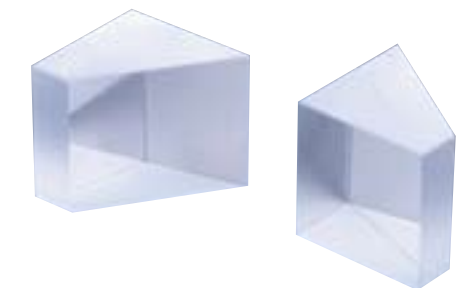
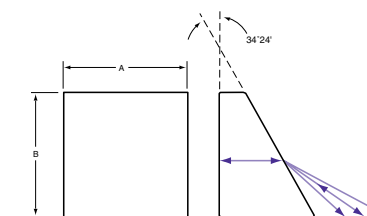
These prisms have very low surface reflection losses over the range 190-425 nm and are usable from 190-2500 nm.

Brewster Prisms

Catalog Number	Material	Dimensions		Price US
		A (mm)	B (mm)	
24-2115	UV Fused Silica	15.0	15.0	\$126.00
24-2198	SF10	25.4	25.4	\$242.00

Littrow Prisms

- **Ideal for laser tuning**
- **AR coatings**



Specifications

Material: UV grade fused silica
Dimensions: +0 / -0.254 mm
Apex Angle: <10 arcmin
Surface Finish: 10-5
Flatness: $\lambda/10$
Clear Aperture: >85% of central dim
Chamfer: 0.3 mm x 45°
Uncoated

Littrow Prisms are of the same design as Brewster prisms but cut in half vertically from the apex to the base.

They are normally used in a laser cavity or prism spectrometer to select a particular wavelength. In general, the beam is incident on the hypotenuse and is reflected back from the rear

surface. It exits from the hypotenuse dispersed into its constituent wavelength components. Tuning is accomplished by tilting.

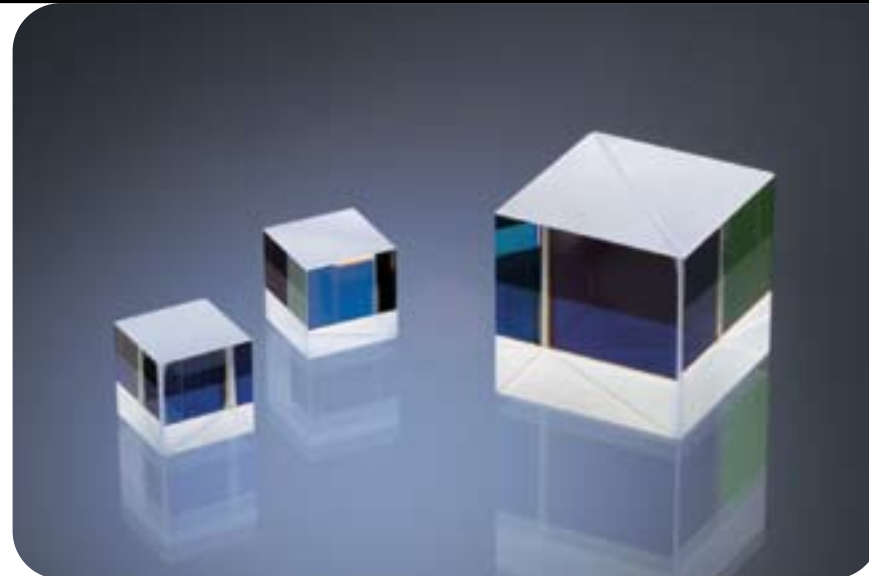
Ealing Littrow Prisms are supplied uncoated but should be coated with an antireflection coating designed for 45° for optimal performance.

Littrow Prisms

Catalog Number	Dimensions		Price US
	A (mm)	B (mm)	
24-2081	12.7	12.7	\$95.00
24-2099	25.4	25.4	\$200.00

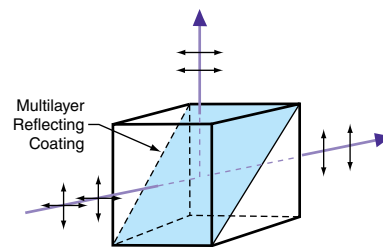
Broadband Polarizing Beamsplitter Cubes

- Laser quality
- Usable over wide wavelength ranges



These cemented Polarizing Beamsplitter Cubes are coated to enable operation over a wide range of wavelengths.

The polarization separation is excellent with the transmitted and reflected beams at 90° to each other irrespective of wavelength.



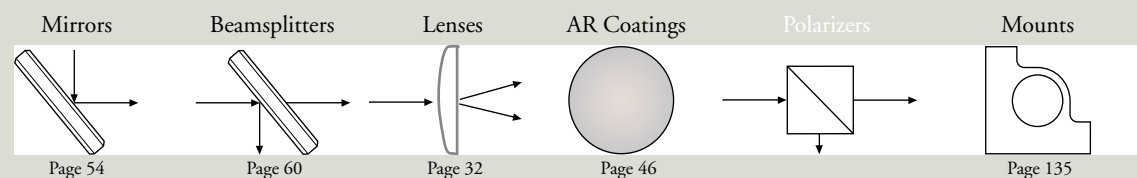
Specifications

Material: SF-2 glass
Transmission (p-polarized): >90% average
Reflection (s-polarized): >99.5% average
Transmitted wavefront: $\lambda/4$ at 633 nm
Surface quality: 20-10
Extinction ratio: >500:1
Dimensions: ± 0.508 mm
Clear aperture: > 80% of cube dim.
Laser damage threshold
Pulsed (10 ns): 100 mJ/cm²

Broadband Polarizing Beamsplitter Cubes

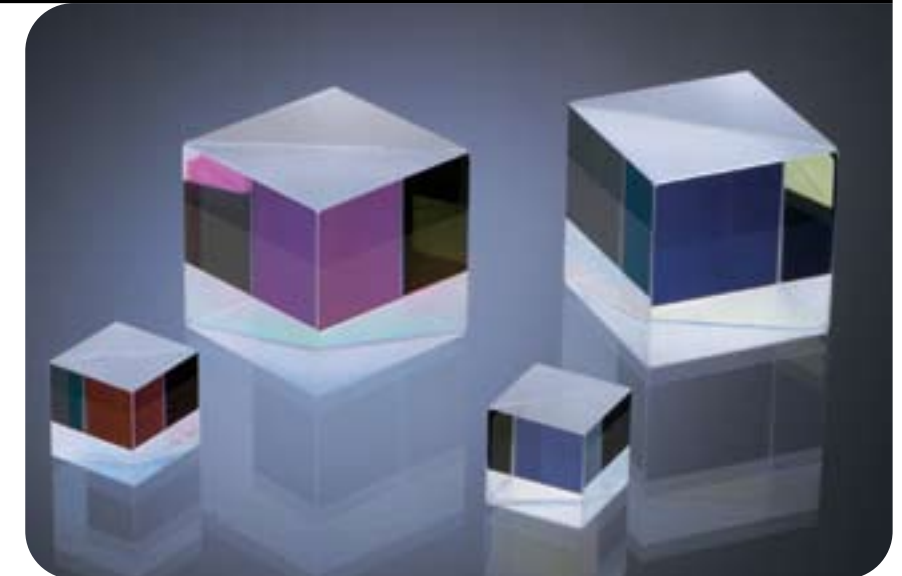
Wavelength Range (nm)	12.7 mm Cube		25.4 mm Cube	
	Catalog Number	Price US	Catalog Number	Price US
450-700	44-4703	\$270.00	44-4711	\$390.00
650-950	44-4729	\$270.00	44-4737	\$390.00
900-1300	44-4766	\$270.00	44-4783	\$390.00
1050-1620	44-4745	\$270.00	44-4752	\$390.00

Broadband Laser Optics

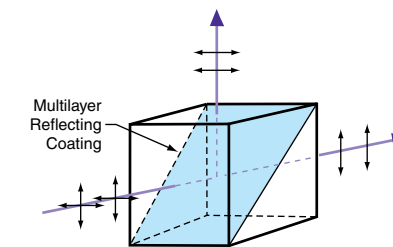


Narrowband Polarizing Beamsplitter Cubes

- Laser quality
- Common laser wavelengths



Narrowband polarizing beamsplitter cubes split the polarization states of an incoming beam. The P-polarization passes straight through the cube, while the S-polarization is reflected 90°. This split is the result of the multi-layer dielectric coating that has been placed on the internal hypotenuse surface. The entrance and exit faces have been AR coated with multi-layer coatings to maximize transmission.



Kinematic Prism Platforms



Kinematic Prism Platforms are also available on page 135.

Narrowband Polarizing Beamsplitter Cubes

Wavelength (nm)	12.7 mm Cube		25.4 mm Cube	
	Catalog Number	Price US	Catalog Number	Price US
488	44-4380	\$190.00	44-4398	\$270.00
514.5	44-4406	\$190.00	44-4414	\$270.00
532	44-4422	\$190.00	44-4430	\$270.00
632.8	44-4448	\$190.00	44-4455	\$270.00
670	44-4489	\$190.00	44-4497	\$270.00
780	44-4505	\$190.00	44-4513	\$270.00
808	44-4521	\$190.00	44-4539	\$270.00
830	44-4547	\$190.00	44-4554	\$270.00
850	44-4562	\$190.00	44-4570	\$270.00
1064	44-4588	\$190.00	44-4596	\$270.00
1319	44-4604	\$190.00	44-4612	\$270.00
1550	44-4620	\$190.00	44-4638	\$270.00

Specifications

Material: BK7 glass
Transmission (p-polarized): >95%
Reflection (s-polarized): >99.9%
Transmitted Wavefront: $\lambda/4$ at 633nm
Surface Quality: 20-10
Extinction Ratio: 1000:1
Dimensions: ± 0.508 mm
Clear Aperture: >80% of cube dim.
Laser Damage Threshold
Pulsed (10 ns): 100mJ/cm²

Calcite Polarizers

- **Broadband linear polarizers**
- **High extinction ratio**
- **Laser quality**

Calcite Polarizers are laser quality, linear polarizers. They can be used over a broad wavelength region, making them suitable for multiple applications. Calcite Polarizers consist of two prisms made of a high birefringent calcite material. The internal interface between the prisms is cut at Brewster's angle. This design allows for linear polarization of the incoming light with a high extinction ratio over a very wide wavelength region.

Ealing offers five different types of calcite polarizers, each with their own unique advantages. Care should be taken to select the best one for the application at hand based on the lasers' power density, wavelength, and required acceptance angle. All Calcite polarizers are supplied cemented in a slotted black anodized aluminum cylinder, which can be mounted with polarizers mounts.

Glan Laser Polarizers

- **Ideal for high power lasers**
- **Low beam divergence**

Glan Laser polarizers are intended for use with high power laser beams. Their many applications include intra-cavity gain switching, beam combination, pulse extraction and feedback elimination. Glan Laser Polarizers are air spaced, and have side windows to enable rejected beams to escape, thus avoiding damage due to excess heating. Care must be taken to terminate the rejected beams, though.



Specifications

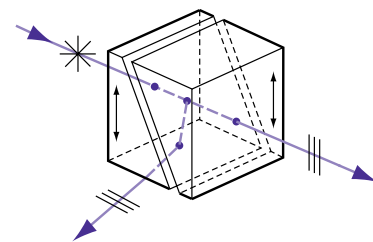
Material: Laser grade calcite
Wavelength Range: 220-2800 nm
Peak Transmission: 88%
Extinction Ratio: 10^5
Beam Deviation: <3 arcmin
Flatness: $\lambda/8$ at 589 nm
Surface Quality: 20-10
Field Angle: 8°

Mount Dimensions	Diameter (mm)	Length (mm)
10 mm Aperture:	25.4	32.0
15 mm Aperture:	31.8	38.0
20 mm Aperture:	38.1	44.0

Dimensions Tolerance: ± 0.1 mm
Laser Damage Threshold
 CW: 100 W/cm²
 Pulsed (1ns): 300 MW/cm²

Glan Laser Polarizers

Catalog Number	Clear Aperture (mm)	Price US
43-6741	10.0	\$775.00
43-6766	15.0	\$1,175.00
43-6774	20.0	\$1,935.00



Calcite Polarizer Mounts



Calcite Polarizer Mounts are also available on page 130.

High Transmission Glan Laser Polarizers

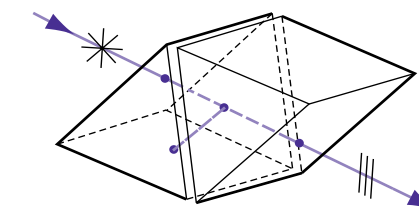
- **Ideal for high power lasers**
- **High transmission**

Specifications

Material: Laser grade calcite
Wavelength range: 220-2800 nm
P-polarized Transmission: 98%
Extinction Ratio: 10^5
Flatness: $\lambda/8$ at 589 nm
Surface Quality: 20-10
Field Angle: 8°
Beam Displacement
 10mm Aperture: 5 mm
 15mm Aperture: 7.5 mm

Mount Dimensions	Diameter (mm)	Length (mm)
10mm Aperture:	25.4	32.0
12mm Aperture:	25.4	34.0
15mm Aperture:	31.8	38.0

Dimensions Tolerance: ± 0.1 mm
Laser Damage Threshold
 CW: 100 W/cm²
 Pulsed (1ns): 300 MW/cm²



High Transmission Glan Laser Polarizers

Catalog Number	Clear Aperture (mm)	Price US
43-6782	10.0	\$936.00
43-6808	15.0	\$1,365.00



Glan Taylor Polarizers

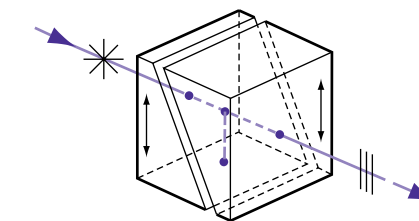
- **Useful with low or medium power lasers**

Specifications

Material: Optical grade calcite
Wavelength range: 220-2800 nm
Peak transmission: 88%
Extinction ratio: 10^5
Beam deviation: <3 arcmin
Flatness: $\lambda/8$ at 589 nm
Surface quality: 20-10
Field angle: 8°

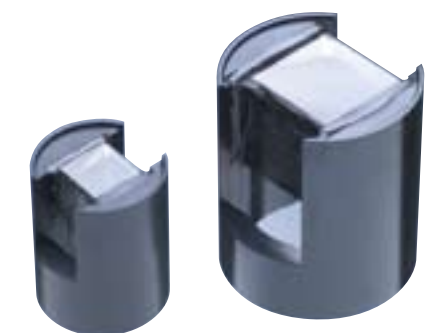
Mount Dimensions	Diameter (mm)	Length (mm)
10mm Aperture:	25.4	32.0
15mm Aperture:	31.8	38.0
20mm Aperture:	38.1	44.0

Dimensions Tolerance: ± 0.1 mm
Laser Damage Threshold
 CW: 10 W/cm²
 Pulsed (1ns): 20 MW/cm²



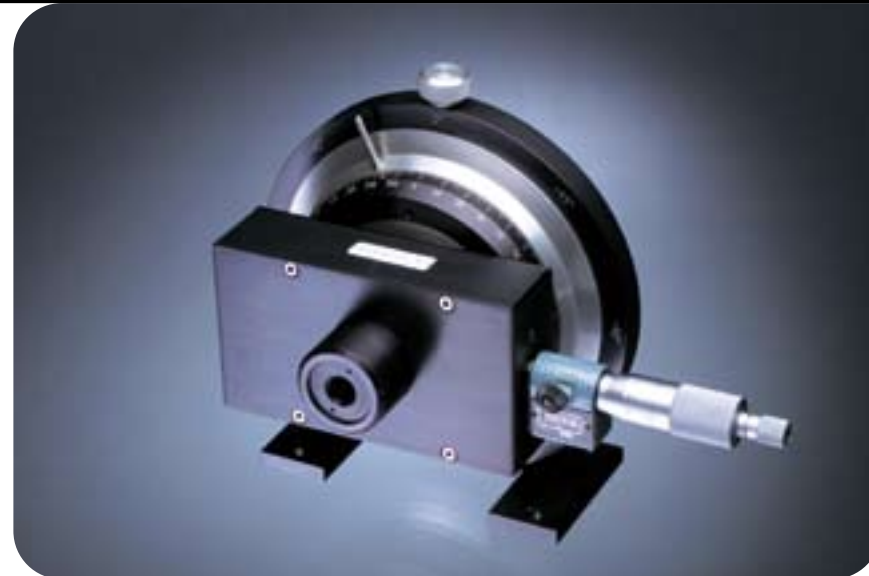
Glan Taylor Polarizers

Catalog Number	Clear Aperture (mm)	Price US
43-6824	10.0	\$695.00
43-6840	15.0	\$1,095.00
43-6857	20.0	\$1,859.00



Soleil-Babinet Compensator, Adjustable Retarder

- An instrument for precise determination of retardation



A Soleil-Babinet Compensator functions as an adjustable zero order retarder over the wavelength range 200-2700 nm. It allows complete analysis and selection of the state of polarization of a beam and can be used for inspection and comparative work.

The Ealing Soleil-Babinet Compensator consists of two crystalline quartz wedges with their optic axes parallel and at 45° to the polarization direction of the input beam. One wedge is fixed and the other, which is attached to a crystalline quartz compensating block with its axis at 90° to the wedge, is adjustable by a micrometer screw. This adjustment changes the path difference through the instrument and hence the retardation.

It can be used to select a uniform phase difference between the extraordinary and ordinary rays of 0-2π. As a result incident elliptically or circularly polarized light can be converted into linearly polarized light by introducing

the appropriate compensation. Conversely any desired polarization form can be obtained by pre-setting the appropriate values.

The Soleil-Babinet Compensator is mounted conveniently on a precision ballbearing indexing head which has a fixed outer circumference graduated 0°, 180°, +45°, +90°, +135°, -45°, -90° and -135°. The inner circumference is rotatable through 360° and has indicator marks at one degree increments with each 10° being labelled. The outer circumference has a knurled locking screw for absolute fixing. A 1/4-20 tapped hole is located at the 180° mark for post mounting. The micrometer adjustment screw has a four-place digital readout. The fifth place can be interpolated from alignment marks on the micrometer barrel. All Compensators are supplied in wooden instrument cases with instruction manual and calibration data.

Soleil-Babinet Compensator — Adjustable Retarder

Catalog Number	Price US
34-5918	\$3,450.00

Cleaning Optics

Lenses:

- Initially: pressurized clean air or nitrogen can remove most all debris/dust
- Further cleaning: hold the lens in lens tissue and apply a few drops of reagent-grade acetone or lens cleaning solution; slowly turn the lens while applying pressure in the center and working outward which will pull the dirt and dust off of the lens instead of spreading it around
- Even further cleaning: use a mild soap solution to gently wash the lens and then repeat procedure using acetone to remove streaks and soap residue
- Fingerprints on a coated lens: clean the lens immediately (asap) to avoid damage
- Larger dirt particles: use a dust-free blower before cleaning with the lens tissue

Mirrors and Large Optics:

- Initially: blow off dirt and dust using pressurized clean air or nitrogen
- Further cleaning: use drag method—saturate a lens tissue with reagent-grade isopropyl alcohol or reagent-grade acetone and slowly drag it across the surface
- Bare metallic coatings: Any dirt or fingerprints will permanently damage the optic so use caution when handling them

Zinc Sulfide Coatings:

- Preferably: use ultra sonic cleaning
- Alternate: use methanol or alcohol to clean the optic with a lens tissue

Filters:

- To clean filters, use an absorbent towel, such as a Kimwipes to prevent any oils from your hands from soaking though your cleaning towel and onto the optic.
- Use powder-free gloves to prevent fingerprints from accidentally coming into contact with the optic.
- Always handle the optic by its edges.
- Spray the folded edge of the towel with isopropyl alcohol, or any anhydrous reagent grade ethanol.
- Gently wipe the surface of the filter with a straight, sweeping motion.
- Do not reuse the towel multiple times because the remaining residue could damage the subsequent optics.

Optics

Lenses & Microscope Components

Coatings

Mirrors & Beamsplitters

Prisms & Polarizers

Filters

Pinholes

Opto-mechanics

Rails

Mounting Hardware

Mirror & Component Mounts

Manual Micro Positioners

Motorized Positioners

Optical Instruments

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Light Sources

Optics

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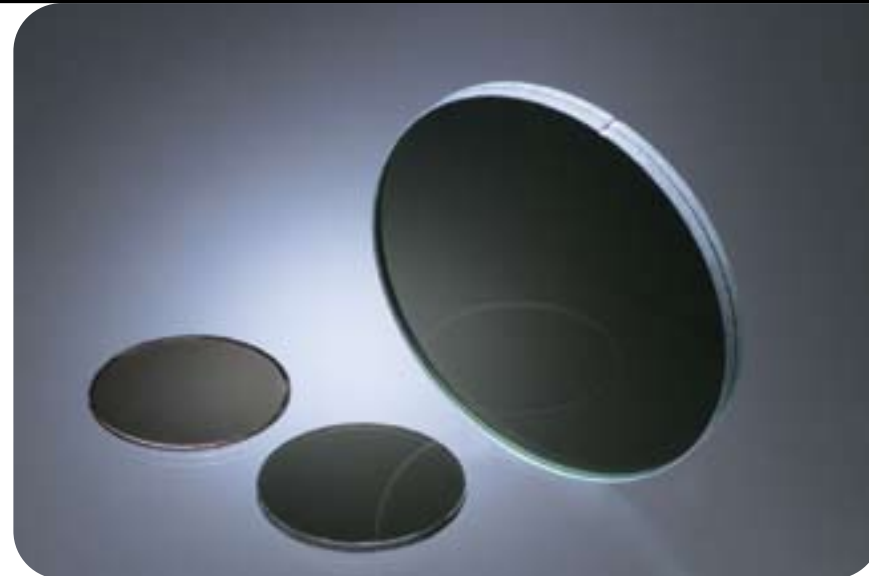
Optical Instruments

Microscopes

Light Sources

Sheet Polarizers

- Ideal for broadband applications
- Cost effective



For low power applications Sheet Polarizers can often provide a simple cost effective solution.

Unpolarized light passing through a Sheet Polarizer emerges as linearly polarized light. Sheet Polarizers are often used in pairs. When the two polarizers have their axes aligned transmission is at a maximum. When the axes are orthogonal to each other

transmission is nearly zero. For intermediate positions the transmission is given by the equation:

$$I = I_{\max} \cos^2\theta$$

where θ = angle between the axes of the polarizers.

Ealing offers Sheet Polarizers for the visible, ultraviolet and infrared spectrums.

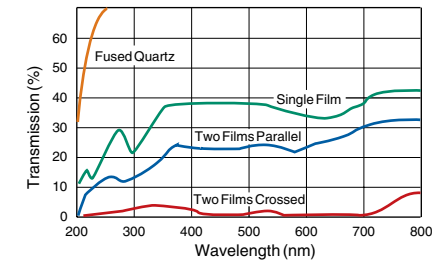
Sheet Polarizers are not suitable for high power use. Their main applications are for production and analysis of polarized radiation, and the elimination of unwanted beams.

The degree of polarization is virtually independent of the incident angle. This allows them to be used with highly convergent or divergent beams and still produce uniform polarization.

UV-Visible Linear Polarizers

- Useful for 200-800 nm
- UV fused silica substrate

Providing excellent linear polarization from 200-800 nm in a single special coating, these polarizers are mounted on UV quality, fused silica. The coated surface is delicate and care should be taken while handling or cleaning. Normal cleaning solvents should not be used. For best results only clean with blown air. The coating is neutral green in color. Maximum survival temperature is 95°C. Polarization and transmission characteristics do not deteriorate with time or long exposure to UV, visible, or IR irradiation. Thickness is nominally 1.6 mm.



UV-Visible Linear Polarizers

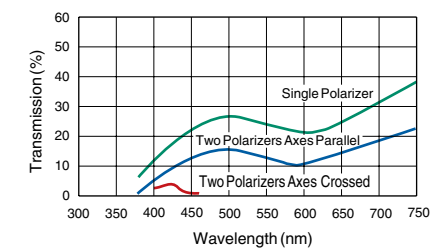
Catalog Number	Diameter (mm)	Price US
23-2520	25.4	\$407.00
23-2363	50.8	\$620.00
22-9039	101.6	\$1,554.00

Visible Linear Polarizers

- Usable over 350-750 nm
- Ideal for broadband applications

These sheet polarizers are designed for 350-750 nm. Total luminous transmittance is 22% for white light; total integrated transmission for two crossed polarizers is 0.05%. The polarizing sheet is sandwiched between two optically ground and polished pieces of glass. Polarization and transmission characteristics are stable with time and prolonged

visible irradiation. High intensity ultraviolet or infrared irradiation will degrade both the polarizing properties and total transmission of the unit. Recommended temperature extremes are -60°C and +80°C. Maximum survival temperature is 90°C. High relative humidity will tend to cause a separation of the glass sandwich and should be avoided.



Visible Linear Polarizers

Catalog Number	Diameter (mm)	Thickness (mm)	Price US
23-5671	50.8	3.2	\$280.00
22-9062	101.6	7.2	\$357.00

Waveplates

- Quarter and half waveplates
- Zero or multiple order available



Applications for Half Waveplates include rotating the plane of polarization (e.g. in a laser), electro-optic modulation and as a variable ratio beamsplitter (when used in conjunction with a polarizing cube).

Waveplates are made from materials which exhibit birefringence. The velocities of the extraordinary and ordinary rays through the birefringent material vary inversely with their refractive indices. For the case of crystal quartz the extraordinary beam has a higher refractive index and therefore a slower velocity. For this reason its direction is known as the 'slow' axis. Likewise, the direction of the ordinary beam is known as the 'fast' axis and is indicated by the marked lines on the mount.

The difference in velocities gives rise to a phase difference when the two beams recombine. In the case of an incident linearly polarized beam this is given by

$$\theta = \pm \frac{2\pi d(n_e - n_o)}{\lambda}$$

where:

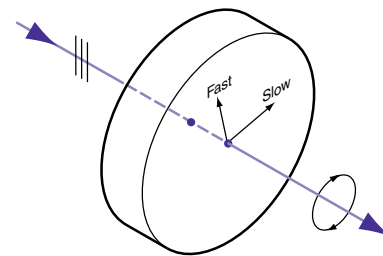
θ = phase difference

d = thickness of waveplate in mm

n_e, n_o = refractive indices of extraordinary and ordinary rays respectively

λ = wavelength in nm

At any specific wavelength the phase difference is governed by the thickness of the retarder. Quarter and Half Waveplates are two specific cases of this.



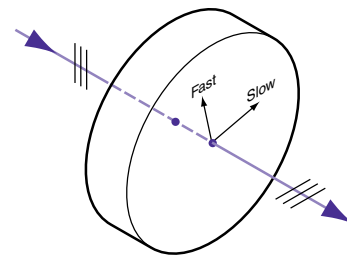
Quarter Waveplate

A Quarter Waveplate is used to convert linearly polarized beams into circularly polarized beams (and vice versa).

The construction of a Quarter Waveplate is such that the fast axis, indicated by the marked line, lies in the surface at 45° to the input polarization. The Half Waveplate therefore introduces a 90° rotation of the plane of polarization.

components of equal amplitude, but each with a different velocity.

Applications for Quarter Waveplates include creating circular polarization from linear or linear polarization from circular, ellipsometry, optical pumping, suppressing unwanted reflections (when used in conjunction with a polarizer) and optical isolation (when used with a Polarizing Beamsplitter Cube.)



Half Waveplates

The thickness of a Half Waveplate is such that the phase difference is π (zero order) or 3π , 5π , 7π , etc (multiple orders). A linearly polarized beam incident on a Half Waveplate emerges as a linearly polarized beam but rotated such that its angle to the optic axis is twice that of the incident beam. It is usual to have the fast axis lying in the surface of the retarder at 45° to the input polarization. The Half Waveplate therefore introduces a 90° rotation of the plane of polarization.

Zero Order Waveplates

Ealing Zero Order Waveplates are the preferred type of waveplate. They are not as sensitive to changes in temperature, wavelength, angle of incidence or collimation. A wavelength shift of 15 nm will result in approximately a 1% retardation change. They are supplied in a 25.4 mm mount.

Specifications

Material: Crystalline quartz
Retardation: $\pm 0.005\lambda$
Wavefront Distortion: $\lambda/8$
AR Coating: <0.25%R per surface
Diameter: 25.4 +0.0 -0.15 mm
Aperture: 15 mm
Thickness: 8 +0.0 -0.25 mm
Laser Damage Threshold: 500 MW/cm²

Zero Order Waveplates

Wavelength (nm)	Quarter Waveplate		Half Waveplate	
	Catalog Number	Price US	Catalog Number	Price US
248	45-7564	\$372.00	45-7788	\$372.00
266	45-7572	\$372.00	45-7796	\$372.00
308	45-7580	\$372.00	45-7804	\$372.00
355	45-7598	\$372.00	45-7812	\$372.00
488	45-7606	\$372.00	45-7820	\$372.00
514	45-7614	\$372.00	45-7838	\$372.00
532	45-7622	\$372.00	45-7846	\$372.00
633	45-7648	\$372.00	45-7861	\$372.00
670	45-7663	\$372.00	45-7887	\$372.00
780	45-7697	\$372.00	45-7911	\$372.00
808	45-7705	\$372.00	45-7929	\$372.00
820	45-7713	\$372.00	45-7937	\$372.00
830	45-7721	\$372.00	45-7945	\$372.00
850	45-7739	\$372.00	45-7952	\$372.00
905	45-7747	\$372.00	45-7960	\$372.00
1064	45-7754	\$372.00	45-7978	\$372.00
1300	45-7762	\$372.00	45-7986	\$372.00
1550	45-7770	\$372.00	45-7994	\$372.00

Multiple Order Waveplates

Ealing Multiple Order Waveplates are available in a range of laser-line wavelengths, mounted in a 25.4 mm diameter mount. Multiple Order Waveplates are sensitive to changes in temperature, angle or incidence and degree of collimation. They are intended for use at the design wavelength only. If used at a different wavelength, a retardation change of 10% occurs for every 0.2 nm deviation.

Specifications

Material: Crystalline quartz
Retardation: $\pm 0.005\lambda$
Wavefront Distortion: $\lambda/8$
AR Coating: <0.25%R per surface
Diameter: 25.4 +0.0 -0.15 mm
Aperture: 15 mm
Thickness: 8 +0.0 -0.25 mm
Laser Damage Threshold: 500 MW/cm²

Multiple Order Waveplates

Wavelength (nm)	Quarter Waveplate		Half Waveplate	
	Catalog Number	Price US	Catalog Number	Price US
248	45-6848	\$305.00	45-7200	\$305.00
266	45-6855	\$305.00	45-7069	\$305.00
308	45-6863	\$305.00	45-7077	\$305.00
355	45-6871	\$305.00	45-7085	\$305.00
488	45-6889	\$305.00	45-7093	\$305.00
514	45-6897	\$305.00	45-7101	\$305.00
532	45-6905	\$305.00	45-7119	\$305.00
633	45-6921	\$305.00	45-7135	\$305.00
670	45-6947	\$305.00	45-7150	\$305.00
780	45-6970	\$305.00	45-7184	\$305.00
808	45-6988	\$305.00	45-7192	\$305.00
820	45-7002	\$305.00	45-7218	\$305.00
830	45-7010	\$305.00	45-7226	\$305.00
850	45-7016	\$305.00	45-7234	\$305.00
905	45-7044	\$305.00	45-7259	\$305.00
1064	45-7028	\$305.00	45-7238	\$305.00
1300	45-7036	\$305.00	45-7242	\$305.00
1550	45-7048	\$305.00	45-7262	\$305.00

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