

Waveplates

Optics

Lenses

Mirrors & Beamsplitters

Prisms & Polarizers

Filters

Pinholes

- **Quarter and half waveplates**
- **Zero or multiple order available**



Opto-mechanics

Breadboards & Rails

Mounting Hardware

Mirror & Component Mounts

Manual Micro Positioners

Motorized Positioners

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:

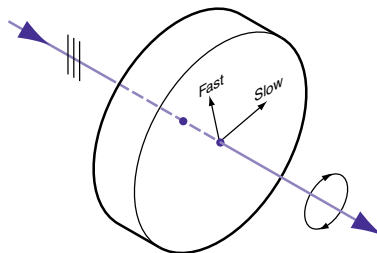
θ = phase difference

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.



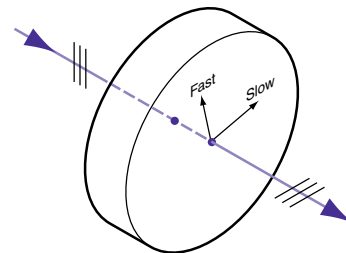
Quarter Waveplate

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 input beam is resolved into two

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 $\pm 0.0/-0.15$ mm

Aperture: 15 mm

Thickness: 8 $\pm 0.0/-0.25$ mm

Laser Damage Threshold: 500 MW/cm²

Zero Order Waveplates

Wavelength (nm)	Quarter Waveplate	Half Waveplate
	Catalog Number	Catalog Number
266	45-7572	45-7796
355	45-7598	45-7812
405	45-7661	45-7811
488	45-7606	45-7820
514	45-7614	45-7838
532	45-7622	45-7846
633	45-7648	45-7861
670	45-7663	45-7887
780	45-7697	45-7911
808	45-7705	45-7929
830	45-7721	45-7945
850	45-7739	45-7952
1064	45-7754	45-7978
1300	45-7762	45-7986
1550	45-7770	45-7994

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 of 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 $\pm 0.0/-0.15$ mm

Aperture: 15 mm

Thickness: 8 $\pm 0.0/-0.25$ mm

Laser Damage Threshold: 500 MW/cm²

Multiple Order Waveplates

Wavelength (nm)	Quarter Waveplate	Half Waveplate
	Catalog Number	Catalog Number
266	45-6855	45-7069
355	45-6871	45-7085
405	45-6881	45-7081
488	45-6889	45-7093
514	45-6897	45-7101
532	45-6905	45-7119
633	45-6921	45-7135
670	45-6947	45-7150
780	45-6970	45-7184
808	45-6988	45-7192
830	45-7010	45-7226
850	45-7016	45-7234
1064	45-7028	45-7238
1300	45-7036	45-7242
1550	45-7048	45-7262

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