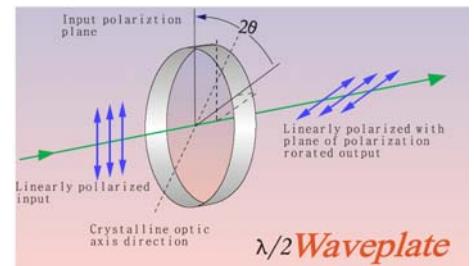


Waveplates (retarders) are made from birefringent materials which introduce a phase difference between the fast and slow principal axis of the waveplate. The optical axis of waveplate is parallel to the face. Light incident normal to the surface will be split to components polarized parallel and perpendicular to the optical axis with different refractive index and velocity in this device. The difference in velocities gives rise to a phase shift which is called retardance. At any specific wavelength the phase retardance is governed by the thickness of Waveplates. The standard waveplates we provided include half waveplates and quarter waveplates, other custom waveplates can also be provided upon request.



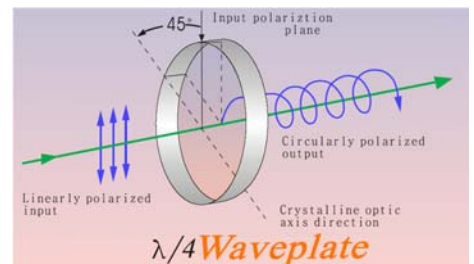
Half Waveplate

When applying a linearly polarized beam to a half waveplate, it emerges as a linearly polarized beam but its polarization plane is rotated with respect to the polarization plane of the input beam. The rotation of the polarization plane is such that the angle between the input polarization and the output polarization is twice the angle between the input polarization and the waveplate's axis. When applying a circularly polarized beam, a clockwise circular polarization will transform into a counter-clockwise circular polarization and vice versa. Half waveplates are often used as continuously adjustable polarization rotators and as a variable ratio beamsplitter when used in conjunction with a polarization beamsplitter cube.



Quarter Waveplate

When applying a linearly polarized beam with the polarization plane aligned at 45deg to the waveplate's principal plane, the output beam will be circularly polarized. Similarly when applying a circularly polarized beam to a $\lambda/4$ waveplate the output beam will be linearly polarized. When a quarter waveplate is double passed, i.e. by mirror reflection, it acts as a half waveplate and rotates the plane of polarization to a certain angle. Quarter waveplates are widely used in creating circular polarization from linear or linear polarization from circular, ellipsometry, optical pumping, suppressing unwanted reflection, optical isolation and etc.



Types of Waveplate

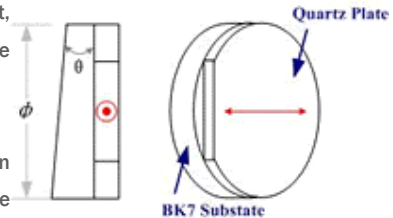
Type		Feature
True Zero Order	Cemented	<ul style="list-style-type: none"> ● Cemented by Glue ● Better Temperature Bandwidth ● Wide Wavelength Bandwidth ● Moderate Damage Threshold
	Single Plate	<ul style="list-style-type: none"> ● Single Plate ● Better Temperature Bandwidth ● Wide Wavelength Bandwidth ● High Damage Threshold ● Only 1310nm, 1550nm available
Zero Order	Cemented	<ul style="list-style-type: none"> ● Cemented by Glue ● Better Temperature Bandwidth ● Wide Wavelength Bandwidth ● Moderate Damage Threshold
	Optical Contacted	<ul style="list-style-type: none"> ● No Glue ● Better Temperature Bandwidth ● Wide Wavelength Bandwidth ● Moderate Damage Threshold ● Good Wavefront and Parallelism
	Air Spaced	<ul style="list-style-type: none"> ● No Glue, Mounted ● Better Temperature Bandwidth ● Wide Wavelength Bandwidth ● High Damage Threshold

Multi Order	<ul style="list-style-type: none"> • Low Temperature Bandwidth • Low Wavelength Bandwidth • High Damage Threshold • Low Price
Dual Wavelength	<ul style="list-style-type: none"> • Provide Specific Retardance at Two Different Wavelengths
Achromatic	<ul style="list-style-type: none"> • Better Temperature Bandwidth • Very broad Wavelength Bandwidth • Cemented and Air Spaced Available
Wedge Waveplate	<ul style="list-style-type: none"> • Eliminate Etalon Effect

How to choose a waveplate?

Firstly, you should know the retardation, is it a half waveplate or a quarter waveplate? Or even a special retardation? Then, you should know the size and working wavelength. This is important for waveplate. The retardation is different at different wavelength. It depends on wavelength. After confirm these conditions, we should choose a type of waveplate. If temperature bandwidth and wavelength bandwidth is important for you, you should choose zero order or true zero order. For zero order, optical contacted has better wavefront distortion and parallelism, air spaced has high damage threshold. True zero order is better than zero order waveplate at all parameters and can be used at more critical application. When temperature bandwidth and wavelength bandwidth is not a problem for you, multi order is a better choice, it is cheap. If a zero order or true zero order waveplate does not offer retardance over a wide enough wavelength band, one solution is to use an achromatic waveplate, it has over hundreds of nanometers bandwidth. For detailed information, please refer to above table or contact us.

Sometimes, the waveplate has unwanted etalon effect, in order to eliminate this effect, Union Optic offer [Wedge Waveplate](#) to solve this problem. For detailed information, please contact us.



Due to the rotation activity of natural quartz crystal, it also can be used as polarization rotators so that the plane of input linearly polarized beam will be rotated at special angle which is determined by the thickness of quartz crystal. Left-handed and right-handed rotators can be offered by **AOTK** now.

Standard Wavelength

AOTK provides standard wavelength (nm) of half and quarter waveplates listed as below:

355	532	633	650	780	800	808	850	980	1064	1310	1480	1550
-----	-----	-----	-----	-----	-----	-----	-----	-----	------	------	------	------

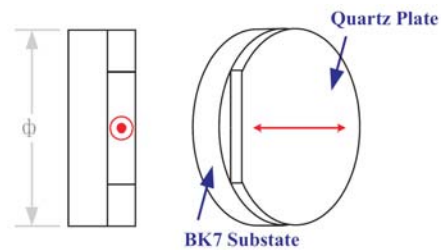
- Other wavelengths and special retardation waveplates can be provided upon request.

Specifications

Material	Crystal Quartz
Dimension Tolerance	+0.0, -0.2mm
Wavefront Distortion	$< \lambda/8$ @ 632.8nm
Retardation Tolerance	$< \lambda/300$
Parallelism (Single Quartz Plate)	< 1 arc second
Surface Quality	20/10 Scratch and Dig
Clear Aperture	$> 90\%$ central area
AR Coating	$R < 0.25\%$ at central wavelength
Standard Wavelength	Quarter-wave ($\lambda/4$), Half-wave ($\lambda/2$)
Wavelength Range	Half Waveplate 400-2200 nm Quarter Waveplate 800-2200nm

Epoxy Cemented True Zero Order Waveplate

This type of true zero order waveplate is constructed of a waveplate and a BK7 substrate. As the quartz plate is very thin and easy to be damaged, the BK7 plate's function is to strengthen the waveplate.



Key Features

- Cemented by Epoxy
- High Damage Threshold
- Better Temperature Bandwidth
- Wide Wavelength Bandwidth
- AR Coated, $R < 0.25\%$

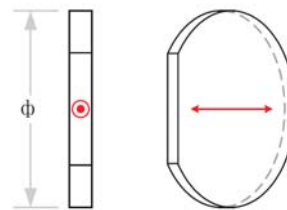
Standard Products

Diameter (mm)	Φ10.0	Φ 12.7	Φ 15.0	Φ 20.0	Φ 25.4	Φ 30.0	Φ 38.1
($\lambda/2$) Part No.	WPT2110	WPT2112	WPT2115	WPT2120	WPT2125	WPT2135	WPT2138
($\lambda/4$) Part No.	WPT4110	WPT4112	WPT4115	WPT4120	WPT4125	WPT4130	WPT4138

Single Plate Zero-Order Waveplate

Key Features

- High Damage Threshold
- Better Temperature Bandwidth
- Wide Wavelength Bandwidth
- AR Coated $R < 0.25\%$



Standard Products

Diameter (mm)	Φ10.0	Φ 12.7	Φ 15.0	Φ 20.0	Φ 25.4
($\lambda/2$) Part No.	WPS2210	WPS2212	WPS2215	WPS2220	WPS2225

Note

- Other waveplate products are also available upon request.

Zero order waveplate is a quarter or half-wave retarder made up of two plates of quartz within their fast axes crossed. The difference in thickness between the two plates determines the retardance. It has broad bandwidth, low sensitivity to temperature and wavelength changes.

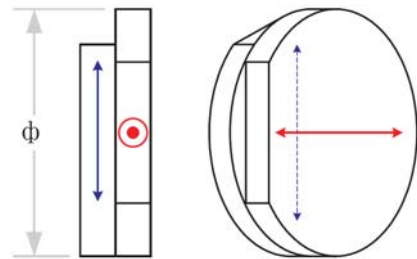
Specifications

Material	Crystal Quartz
Dimension Tolerance	+0.0, -0.2mm
Wavefront Distortion	$< \lambda/8$ @ 632.8nm
Retardation Tolerance	$< \lambda/300$
Parallelism (Single Quartz Plate)	< 1 arc second
Surface Quality	20/10 Scratch and Dig
Clear Aperture	$> 90\%$ central area
AR Coating	$R < 0.25\%$ at central wavelength
Standard Wavelength	Quarter-wave ($\lambda/4$), Half-wave ($\lambda/2$)
Wavelength Range	240-2200 nm

Cemented Zero-Order Waveplate

Key Features

- Cemented by Epoxy
- Better Temperature Bandwidth
- Wide Wavelength Bandwidth
- AR Coated, $R < 0.25\%$



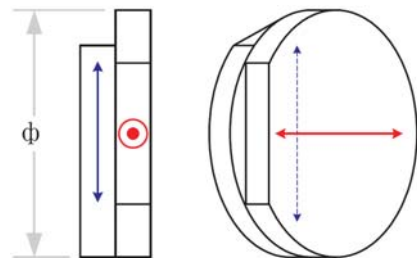
Standard Products

Diameter (mm)	Φ10.0	Φ 12.7	Φ 15.0	Φ 20.0	Φ 25.4	Φ 30.0	Φ 38.1
($\lambda/2$) Part No.	WPZ2110	WPZ2112	WPZ2115	WPZ2120	WPZ2125	WPZ2130	WPZ2138
($\lambda/4$) Part No.	WPZ4110	WPZ4112	WPZ4115	WPZ4120	WPZ4125	WPZ4130	WPZ4138

Optically Contacted Zero-Order Waveplate

Key Features

- Optically Contacted
- Better Temperature Bandwidth
- Wide Wavelength Bandwidth
- AR Coated $R < 0.25\%$



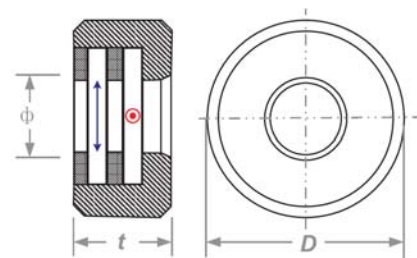
Standard Products

Diameter (mm)	Φ10.0	Φ 12.7	Φ 15.0	Φ 20.0	Φ 25.4
($\lambda/2$) Part No.	WPZ2210	WPZ2212	WPZ2215	WPZ2220	WPZ2225
($\lambda/4$) Part No.	WPZ4210	WPZ4212	WPZ4215	WPZ4220	WPZ4225

Air Spaced Zero-Order Waveplate

Key Features

- AR Coated, $R < 0.2\%$ and Mounted
- High Damage Threshold
- Better Temperature Bandwidth
- Wide Wavelength Bandwidth



Standard Products

Outside Diameter (mm)	25.4	25.4	25.4	30.0	30.0
Aperture (mm)	Φ10.0	Φ 12.7	Φ 15.0	Φ 20.0	Φ25.4
Thickness (mm)	8.0	8.0	8.0	8.0	8.0
(λ/2) Part No.	WPZ2310	WPZ2312	WPZ2315	WPZ2320	WPZ2325
(λ/4) Part No.	WPZ4310	WPZ4312	WPZ4315	WPZ4320	WPZ4325

Note

- Other products are also available upon request.

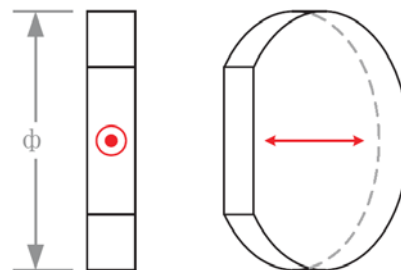
Multiple Order Waveplate is less expensive, so it can be used in many applications where the temperature and wavelength sensitivity is not important.

Key Features

- Thickness: 0.3-0.5mm
- Wide Wavelength Bandwidth
- Better Temperature Bandwidth
- Low Cost

Specifications

Material	Crystal Quartz
Dimension Tolerance	+0.0, -0.2mm
Wavefront Distortion	$< \lambda/8$ @ 632.8nm
Retardation Tolerance	$< \lambda/300$
Parallelism	< 1 arc second
Surface Quality	20/10 Scratch and Dig
Clear Aperture	$> 90\%$ central area
AR Coating	$R < 0.25\%$ at central wavelength
Standard Wavelength	Quarter-wave ($\lambda/4$), Half-wave ($\lambda/2$)
Wavelength Range	240-2200 nm



Standard Products

Diameter (mm)	Φ10.0	Φ 12.7	Φ 15.0	Φ 20.0	Φ 25.4	Φ 30.0	Φ 38.1
($\lambda/2$) Part No.	WPM2310	WPM2312	WPM2315	WPM2320	WPM2325	WPM2330	WPM2338
($\lambda/4$) Part No.	WPM4310	WPM4312	WPM4315	WPM4320	WPM4325	WPM4330	WPM4338

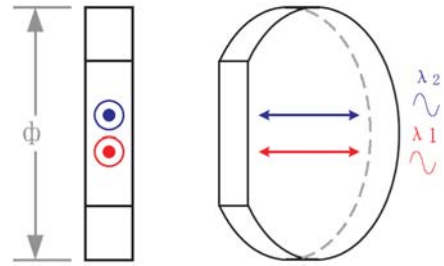
Note

- Any special waveplate products are also available upon request.

This waveplate is a kind of multiple waveplates which can provide specific retardance at two different wavelengths. It's very useful to manage the states of polarization of laser beams to obtain maximum conversion efficiency.

Key Features

- Thickness: <1.5mm
- Optional Wavelength
- Main Application:
 - Type II (SHG) + Type II (THG)
 - Type I (SHG) + Type I (THG)
 - Type II (SHG) + Type I (THG)



Specifications

Material	Crystal Quartz
Dimension Tolerance	+0.0, -0.2mm
Wavefront Distortion	$<\lambda/8$ @ 632.8nm
Retardation Tolerance	$<\lambda/300$
Parallelism	<1 arc second
Surface Quality	20/10 Scratch and Dig
Clear Aperture	>90% central area
Wavelength Range	240-2200 nm

Standard Products

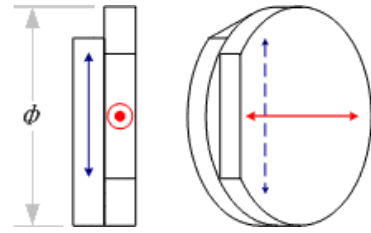
Diameter (mm)	Φ10.0	Φ 12.7	Φ 15.0	Φ 20.0	Φ 25.4	Φ 30.0	Φ 38.1
Part No.	WPD0510	WPD0512	WPD0515	WPD0520	WPD0525	WPD0530	WPD0538

Note

- Please Inform us what wavelength and target retardation you want are when you are ordering Dual Wavelength Waveplates.

A

Achromatic waveplate is similar to zero order waveplate except that the two plates are made from different birefringent crystals. Since the dispersion of the birefringence of two materials is different, it is possible to specify the retardation values at a broad wavelength range. So, the retardation will be less sensitive to wavelength change. In other words, it can be used at a broadband wavelength range.



Key Features

- Epoxy Cemented or Air Spaced available
- Broad Bandwidth

Specifications

Material	Birefringent Crystals
Dimension Tolerance	+0.0, -0.2mm
Wavefront Distortion	$<\lambda/4$ @ 632.8nm (for air spaced type)
Retardation Tolerance	$<\lambda/100$
Parallelism	<10 arc second (for cemented type)
Surface Quality	20/10 Scratch and Dig
Clear Aperture	$>90\%$ central area
Coating	Uncoated
Standard Wavelength	Quarter-wave ($\lambda/4$), Half-wave ($\lambda/2$)
	450-650nm
	550-750nm
Standard Wavelength	650-1100nm
	900-2100nm

Standard Products

Cemented Type

Diameter (mm)	$\Phi 10.0$	$\Phi 15.0$	$\Phi 25.4$
($\lambda/2$) Part No.	WPA2610	WPA2615	WPA2625
($\lambda/4$) Part No.	WPA4610	WPA4615	WPA4625

Air Spaced Type

Diameter (mm)	$\Phi 10.0$	$\Phi 15.0$	$\Phi 25.4$
($\lambda/2$) Part No.	WPA2610	WPA2615	WPA2625
($\lambda/4$) Part No.	WPA4610	WPA4615	WPA4625

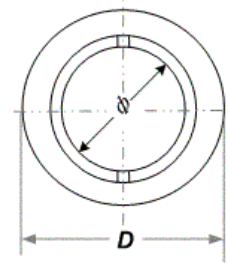
Note

- Other special waveplates are also available upon request.

All statements, technical information and recommendations related to the products herein are based upon information believed to be reliable or accuracy or completeness thereof is not guaranteed, and no responsibility is assumed for any inaccuracies. The user assumes all risks and liability whatsoever in connection with the use of a product or its application, AOTK reserves the right to change at any time of a product offered for sale herein. AOTK makes no representations that the products herein are free from any intellectual property claims of others. Please contact AOTK for more information.

Specifications

Material	Black Anodized Aluminum
Outside Diameter (D) Tolerance	+/-0.2 mm
Thickness Tolerance	+/-0.2 mm
Clear Aperture (ϕ) Tolerance	+/-0.2 mm



Standard Products

Part No.	Outer Diameter D (mm)	Clear Aperture ϕ (mm)	Thickness (mm)
MWP6010	25.4	9.0	6.0
MWP6012	25.4	11.5	6.0
MWP6015	25.4	13.5	6.0
MWP6020	25.4	18.0	6.0
MWP6120	30.0	18.0	6.0
MWP6025	30.0	22.9	6.0

Note

- Other mount with special aperture can also be provided upon request.

All statements, technical information and recommendations related to the products herein are based upon information believed to be reliable or accuracy or completeness thereof is not guaranteed, and no responsibility is assumed for any inaccuracies. The user assumes all risks and liability whatsoever in connection with the use of a product or its application, AOTK reserves the right to change at any time of a product offered for sale herein. AOTK makes no representations that the products herein are free from any intellectual property claims of others. Please contact AOTK for more information.