

■ $\lambda/4$ and $\lambda/2$ Wavelength Plates

● Terms and Definitions

Crystal Wavelength Plate: An element that uses the velocity difference between ordinary and extraordinary light beams to create a phase difference between both beams; the difference is obtained by using the birefringence of a crystal. When this characteristic is used, a $\lambda/4$ wavelength plate converts linearly-polarized light into circularly-polarized light, and a $\lambda/2$ wavelength plate converts circularly-polarized light into linearly-polarized light with its polarization plane rotated by 90 degrees.

Wavefront aberration: This indicates the Peak-to-Valley difference of a measured wavefront as a unit of design wavelength: the Zygo Corporation's phase interference system is used to provide the data.

$P - V = (\text{maximum phase angle} - \text{minimum phase angle})$

Extinction Ratio: This indicates a value for the phase accuracy of a wavelength plate, and the conversion equation of the extinction ratio V [%] and phase difference Γ [deg] is as follows:

$$V [\%] = 100 \times \cos \Gamma$$

$$V = \frac{I_{o, 0} - I_{o, 90}}{I_{o, 0} + I_{o, 90}}$$

$$\Gamma = \frac{360}{\lambda} (n_e - n_o) \times t$$

$I_{o, 0}$: Output in a parallel Nicol state

$I_{o, 90}$: Output in an orthogonal Nicol state

n_e : Refractive index of an extraordinary beam

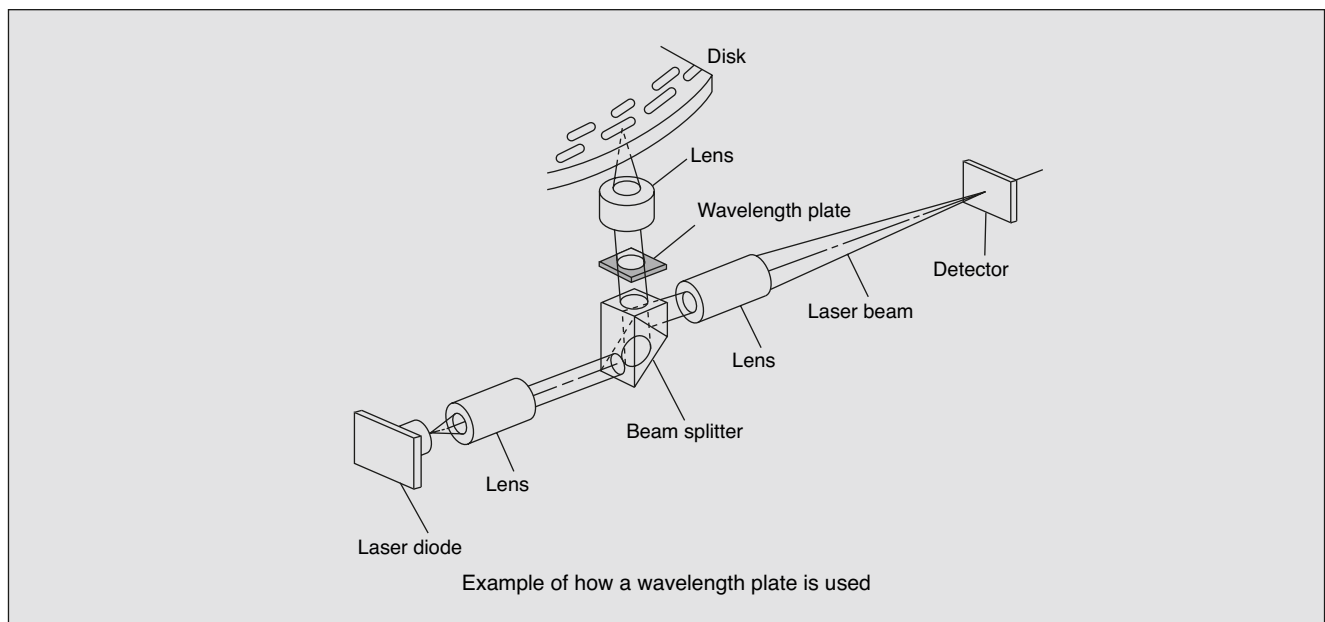
n_o : Refractive index of an ordinary beam

t : Thickness of a phase plate

λ : Design wavelength

● Application

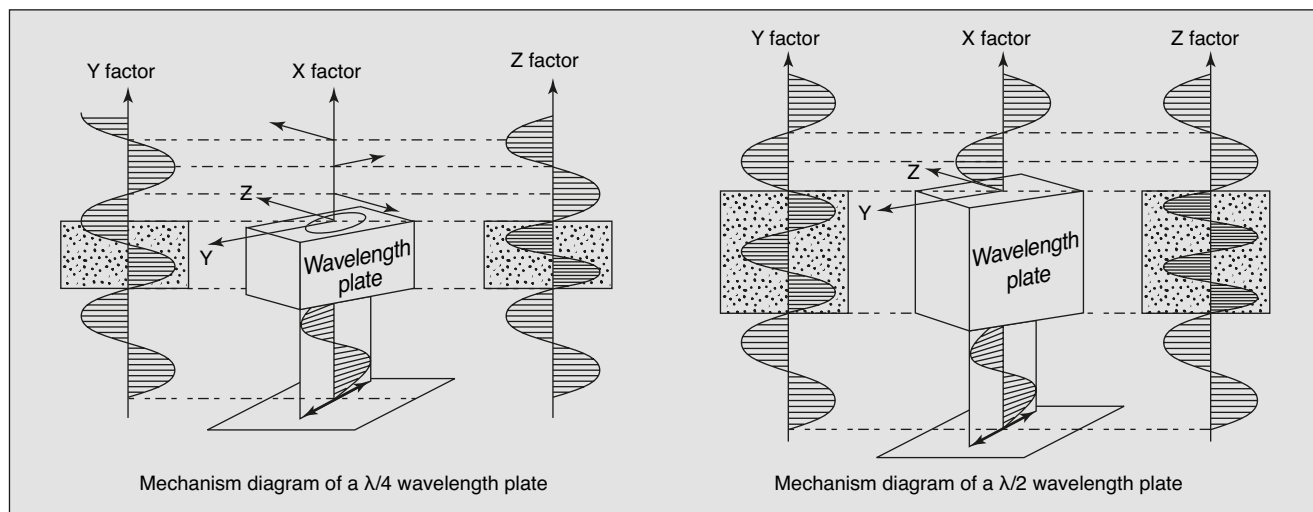
As shown in the figure below, wavelength plates are used mainly for picking up optical information files (DVD, etc) to prevent the back-talk noise of laser beams.



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● Features

1. A computer controlled and grown synthetic quartz crystal for optical components is used, and by accurately processing the thickness of the plate, the extinction ratio is kept within a range of $\pm 5\%$.
2. A single board-type plate has good wavefront aberration and is thin. Therefore, it is convenient to use when bonded to a beam splitter, etc.
3. The bonding-type plate enables the influence on phase accuracy caused by variations in optical rotation and the laser incident angle to be ignored. Therefore, it can be embedded in an optical system more easily.

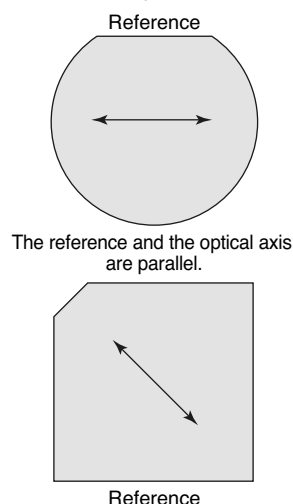


● Standard specifications

Product name		Single-board Type I (x or y-cut)	Single-board Type II (θ°Z-cut)	Bonding Type
Specifications				
Wavelength range		Laser oscillation wavelength between 400 to 2,000 nm		
Size	Outline	Round plate of φ5 to 10 mm or square plate of 5 x 5 to 10 x 10 mm		
	Thickness	0.3 to 1.0 mm		0.5 to 1.0 mm
Wavefront aberration		Max. λ/4 (λ = 633 nm transmission)		
Extinction ratio		±5 %		
Transmittance		Min. 99% (AR coating on both surfaces)		Min. 98% (AR coating on both surfaces)
Directional accuracy of the light axis		±60' (see the right)		

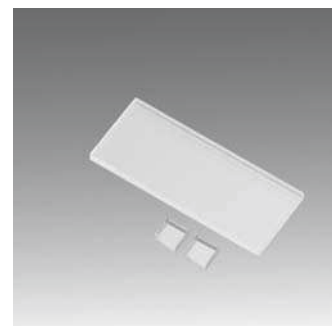
* The size and thickness of wavelength plates can be changed upon request.

● Directional accuracy of the optical axis



The angle between the reference and the optical axis is 45° .

* The arrow shows the light axis.



● Environment Resistance

The following reliability tests guarantee the specified optical characteristics of NDK's optical components.

Subjected to high temperature	For 96 hours at $+85^\circ\text{C}$
Subjected to low temperature	For 96 hours at -40°C
Subjected to high temperature and high humidity	For 96 hours at $+60^\circ\text{C}$ and 95 %
Heat shock	10 cycles (one cycle is conducted for 30 minutes at -40°C and 30 minutes at $+85^\circ\text{C}$)
Mechanical strength	No flaws after the surface is rubbed with absorbent cotton

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● How to Determine Wavelength Plate Specifications

When placing an order or asking for information, please inform us of the following items. (Check the boxes.)

1. Wavelength plate type

☐ Single-board type : ☐ Bonding type

2. Phase difference

☐ $\lambda/4$ wavelength plate : ☐ $\lambda/2$ wavelength plate

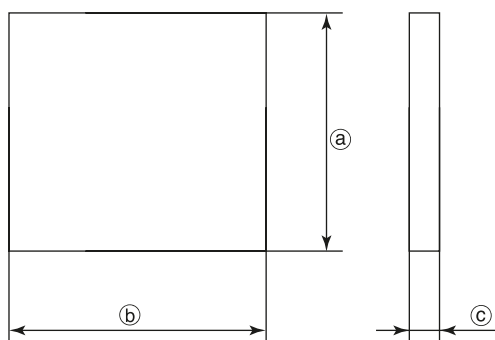
3. Used frequency _____ mm

4. Coating

☐ Both surfaces : ☐ One surface : ☐ None

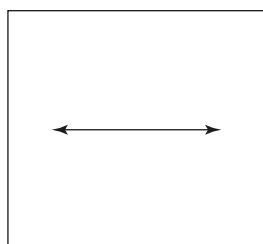
5. Dimensions

①×②×③ :

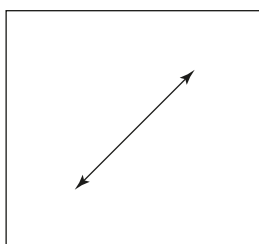


* Concerning wavelength plates other than square ones,
please give us your individual specifications.

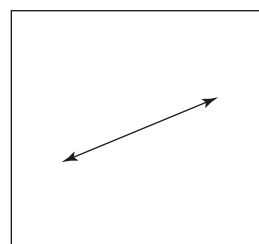
6. Light axis direction



A : 0°



B : 45°



C : 22.5°