

## Standard & Precision Waveplates (Retarders)

Meadowlark has added a standard option to our precision waveplate (retarder) line. Meadowlark Optics specializes in precision polymer retarders for the visible to near infrared region. Our Retarders have the highest optical quality and tightest retardance tolerance of all polymer retarders. These true zero-order Retarders consist of a birefringent polymer cemented between two precision polished, optically flat N-BK7 windows. The retarder fast axis is conveniently marked for quick and easy reference.

The Precision Retarder has a retardance accuracy of  $\leq \lambda/350$ , with a wavefront distortion of  $\leq \lambda/5$ . The standard retarder has a retardance accuracy of  $\leq \lambda/150$ , with a wavefront distortion of  $\leq \lambda/3$ . Both Retarders are supplied with a broadband antireflection coating. Optical transmittance of a Precision Retarder is typically greater than 97%. The approximate retardance  $\delta$  at a wavelength  $\lambda$  that is different from the center wavelength  $\lambda_c$  is given by:

$$\delta \approx \delta_c(\lambda_c / \lambda)$$

where  $\delta_c$  is the retardance at  $\lambda_c$ .

This relationship is very important when using sources which vary in wavelength from their nominal value. The two graphs show the retardance behavior as a function of relative wavelength for a quarter- and half-wave retarder, respectively. The Mueller calculus can be used to calculate the transmitted polarization state based upon the retardance differences from the ideal case. Since polymer retarders are true zero-order devices, they offer the significant advantage of improved angular performance. You can expect <1% retardance change over  $\pm 30^\circ$  incidence angle.

Meadowlark Optics has developed precision ellipsometric techniques that can measure retardance to  $\lambda/1000$ . Our metrology for these measurements rivals the best in the industry. You can have absolute confidence that the calibration measurements supplied with your retarder are of the highest accuracy obtainable.



### Key Features

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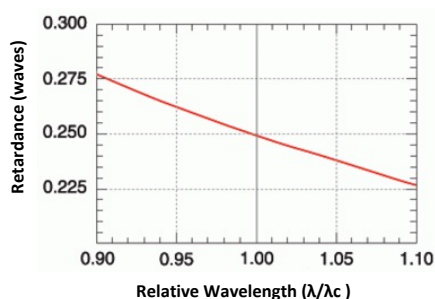
- True zero-order retarders
- Excellent off-axis performance
- Unequaled measured accuracy
- Less temperature dependence than quartz waveplates
- Lower cost than compound zero-order waveplates
- Better angular acceptance than compound zero-order quartz waveplates

### Waveplate Suite

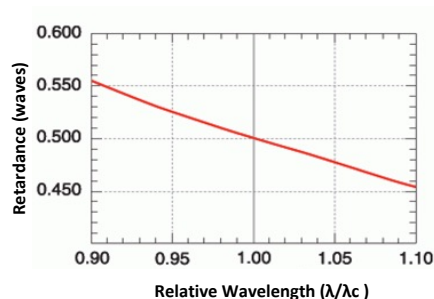
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- Standard Retarder
- Precision Retarder
- Precision Achromatic Retarder
- Precision Superachromatic Retarder
- Dual-Wavelength Retarder
- Wide Field Retarder
- Liquid Crystal Variable Retarder
- Polymer Film Retarder
- Raptor Applied Polymer Retarder
- Large Aperture Retarder
- Bi-Crystalline Achromatic Retarder

Quarter-Wave Precision Retarder Performance



Half-Wave Precision Retarder Performance





| SPECIFICATIONS                   |   |                     |
|----------------------------------|---|---------------------|
|                                  | Standard Waveplate  | Precision Waveplate |
| Retarder Material                | Birefringent Polymer  |                     |
| Substrate Material               | Fused Silica  | N-BK7               |
| Standard Wavelengths             | 532, 632, 670, 780, 850, 1064, and 1550 nm  | Any Wavelength      |
| Custom Wavelengths               | 400 – 1800 nm (please specify)  |                     |
| Standard Retardances             | $\lambda/2$ and $\lambda/4$   | Any Retardance      |
| Retardance Accuracy              | $\leq \lambda/150$  | $\leq \lambda/350$  |
| Retardance Change (at 30° tilt)  | $\leq \lambda/32$ (Half-Wave) and $\leq \lambda/59$ (Quarter-Wave)  |                     |
| Transmitted Wavefront Distortion | $\leq \lambda/3$  | $\leq \lambda/5$    |
| Surface Quality (scratch-dig)    | 40 – 20   |                     |
| Beam Deviation                   | $\leq 1$ arc-min  |                     |
| Reflectance (per surface)        | $\leq 0.5\%$ at normal incidence  |                     |
| Threshold                        | 500 W/cm <sup>2</sup> , CW<br>600 mJ/cm <sup>2</sup> , 20 ns, visible, 4 J/cm <sup>2</sup> , 20 ns, 1064 nm |                     |
| Operating Temperature Range      | -20°C to 50°C   |                     |

| ORDERING INFORMATION – Precision Waveplate |  |  |   |                       |
|--|--|--|---|-----------------------|
|  | Clear Aperture<br>in. (mm)                 | Dimensions<br>$\pm 0.005$ in. ( $\pm 0.13$ mm) | Thickness<br>$\pm 0.020$ in. ( $\pm 0.51$ mm) | Part Number           |
| Mounted                                    | Half-Wave                                  |  |   |                       |
|  | 0.40 (10.2)                                | $\varnothing 1.000$ ( $\varnothing 25.4$ )     | 0.250 (6.35)                                  | NHM – 050 – $\lambda$ |
|  | 0.70 (17.8)                                | $\varnothing 1.000$ ( $\varnothing 25.4$ )     | 0.350 (8.9)                                   | NHM – 100 – $\lambda$ |
|  | 1.20 (30.5)                                | $\varnothing 2.000$ ( $\varnothing 50.8$ )     | 0.500 (12.7)                                  | NHM – 200 – $\lambda$ |
|  | Quarter-Wave                               |  |   |                       |
|  | 0.40 (10.2)                                | $\varnothing 1.000$ ( $\varnothing 25.4$ )     | 0.250 (6.35)                                  | NQM – 050 – $\lambda$ |
|  | 0.70 (17.8)                                | $\varnothing 1.000$ ( $\varnothing 25.4$ )     | 0.350 (8.9)                                   | NQM – 100 – $\lambda$ |
| Unmounted                                  | Half-Wave                                  |  |   |                       |
|  | 0.40 (10.2)                                | $\varnothing 0.500$ ( $\varnothing 12.70$ )    | 0.130 (3.3)                                   | NH – 050 – $\lambda$  |
|  | 0.80 (20.3)                                | $\varnothing 1.000$ ( $\varnothing 25.4$ )     | 0.260 (6.3)                                   | NH – 100 – $\lambda$  |
|  | 1.60 (40.6)                                | $\varnothing 2.000$ ( $\varnothing 50.8$ )     | 0.510 (13.0)                                  | NH – 200 – $\lambda$  |
|  | Quarter-Wave                               |  |   |                       |
|  | 0.40 (10.2)                                | $\varnothing 0.500$ ( $\varnothing 12.70$ )    | 0.130 (3.3)                                   | NQ – 050 – $\lambda$  |
|  | 0.80 (20.3)                                | $\varnothing 1.000$ ( $\varnothing 25.4$ )     | 0.260 (6.3)                                   | NQ – 100 – $\lambda$  |
| 1.60 (40.6)                                | $\varnothing 2.000$ ( $\varnothing 50.8$ ) | 0.510 (13.0)                                   | NQ – 200 – $\lambda$                          |                       |

| ORDERING INFORMATION – Standard Waveplate |                            |  |   |                       |
|---|----------------------------|--|---|-----------------------|
|   | Clear Aperture<br>in. (mm) | Dimensions<br>$\pm 0.005$ in. ( $\pm 0.13$ mm) | Thickness<br>$\pm 0.020$ in. ( $\pm 0.51$ mm) | Part Number           |
| Mounted                                   | Half-Wave                  |  |   |                       |
|   | 0.40 (10.2)                | $\varnothing 1.000$ ( $\varnothing 25.4$ )     | 0.25 (6.35)                                   | RHM – 050 – $\lambda$ |
|   | Quarter-Wave               |  |   |                       |
|   | 0.40 (10.2)                | $\varnothing 1.000$ ( $\varnothing 25.4$ )     | 0.25 (6.35)                                   | RQM – 050 – $\lambda$ |

Please specify your center wavelength  $\lambda$  in nanometers when ordering. Custom sizes and shapes with improved transmitted wavefront distortion and/or beam deviation are available. Please call for a quote.