TOWER
OPTICAL CORPORATION

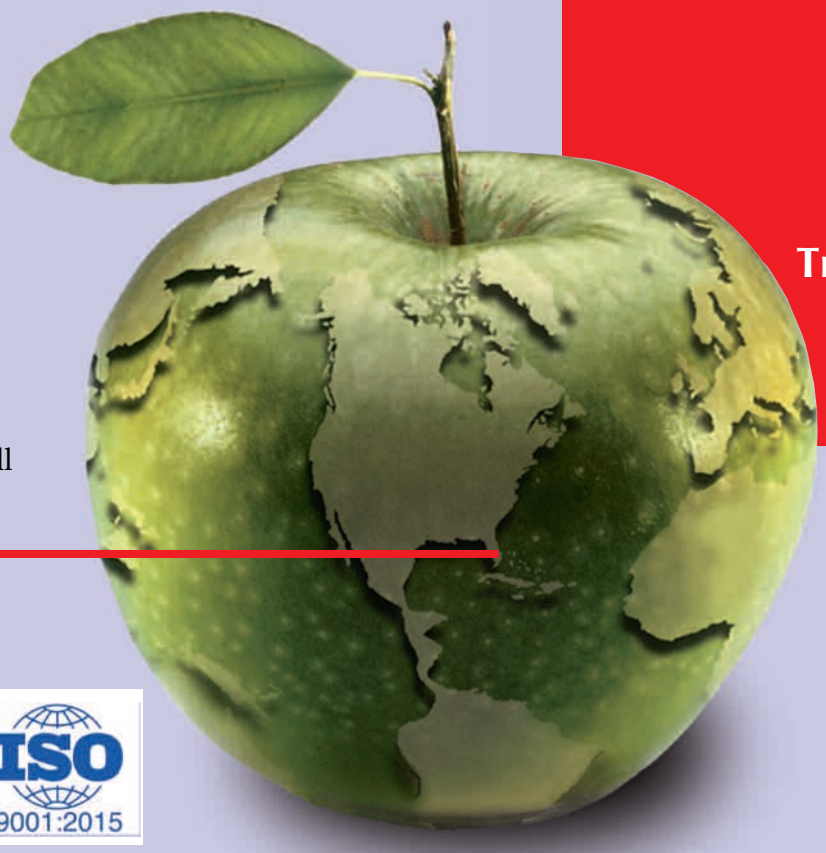
"Quality is not expensive, it's priceless!"

Optics Cookbook No. 8

New Additions

High Laser Damage (HLD) Waveplate Program for Zero and Multiple Order Waveplates

- Waveplates
- Achromatic Waveplates
- Optical Assemblies
- Micro Optics
- Mini Lenses
- Lenses
- Windows
- Hot and Cold Mirrors
- Filters and Coatings
- Polarizers
- Beamsplitters
- Prisms
- Optical Flats
- Transmission Flats
- Beam Expander
- Custom Optics



SDVOSB
Service Disabled, Veteran Owned, Small Business

ITAR

ISO 9001:2015

VALUABLE 40 YEARS EXPERIENCE

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Welcome to Tower Optical

TOWER OPTICAL CORPORATION

Dear Customer:

I am pleased to present the eighth edition of our Optics Cookbook. We have expanded our line of waveplates and added High Laser Damage Waveplates .

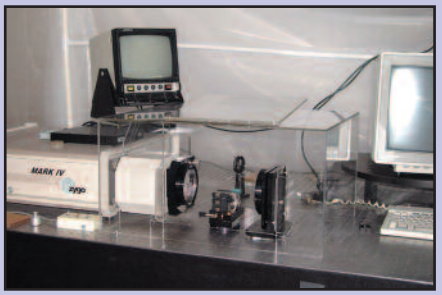
Much of our business is custom build-to-print optics and filling OEM requests. Please feel free to contact us for a quotation regarding any requirement for precision optics you may have. We take pride in being able to offer you both a quick response to your request for quotations and, of course, a quality product, with on time delivery.

Whether you are a returning customer or new to Tower Optical, we thank you for your interest in our company. We are committed to making you a customer for life!

Mel Kantor, *President / CEO*

Products You Can Trust

Waveplates • Achromatic Waveplates • Lenses • Micro Lenses
Prisms • Micro Prisms • Mirrors • Windows • Wedges • Polarizers
Beamsplitters • Filters • Multiple Element Assemblies • Optical Flats
Build to Print Precison Optics



Waveplates

Standard waveplates are available in wavelengths from 248 nm to 2020 nm in 1/4 and 1/2 wave with 10 mm, 17.5 mm, 25.4 mm, 38.1 mm, and 50.8 mm diameters which include AR coatings waveplaand optional mounting rings. Also available: square, rectangular and dual wavelength in sizes from 1 mm to 50 mm.

Achromatic waveplates in stock.

Also available are 3" and 4" diameter waveplates.

Thousandsin stock for immediate delivery

Custom Product and OEM Manufacturing

Tower Optical manufactures custom products and components that have been designed by its customers. We offer high quality, short lead time and low prices and custom optics.

Micro Optics

Waveplates from 0.5 mm x 0.5 mm x 90 µ
Prisms from 0.5 mm x 0.5 mm x 0.5 mm
Lenses from 1 mm

Quality Control

Tower Optical technicians have the experience and equipment to produce optics to the most demanding specifications. Extensive testing ensures that all our products comply with exacting specifications and precise tolerances. ISO 9001:2015 certified.

Optical Coating Capabilities

V Coat AR coatings, Broad Band (BBAR) coatings for UV, visible, IR coatings and mirror coatings based on your custom requirements.

We produce components for:

OEM manufacturers • Major catalog distributors
Research facilities • Colleges and universities
Government contractors • National laboratories

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ISO 9001: 2015 Certified

About Us / Table of Contents

Tower Optical Corporation is a premier manufacturer and producer of high quality precision optics and assemblies. Its stock and "build to spec" custom products are used in leading-edge photonics technology, electro-optics, lasers, telecommunications, medical instruments, optical imaging optical computing and Aerospace. Products include but are not limited to, crystal quartz waveplates and achromatic waveplates (retarders), lenses, filters, polarizers prisms, beamsplitters, windows, mirrors and transmission flats.

Founded in 1978, **Tower** has operated under its present ownership since 1997. Its customers represent a broad variety of national and international companies and industries including military, aircraft, aerospace, medical, process measurement and control, university researchers and key U.S. Department of Defense contractors. **Tower** is registered with the U.S. State Department to obtain export licenses as required.

Tower is ISO certified for ISO 9001:2015.

Tower prides itself on its short lead times, quality products and competitive pricing.

Our Team...

Vision — To be the supplier of choice for the most demanding and innovative organizations who are focused on improving man's quality of life through the use of light based technologies.

Mission — To find cost effective solutions and provide customers with quality optical products and services in a timely manner.

Quality — Tower technicians have the experience, skill and equipment to design and manufacture products to the most demanding specifications. The company's extensive testing equipment ensures that all products are shipped to exacting specifications.

Service — In addition to the large inventory of products for immediate shipment, Tower welcomes custom orders and working with customer's engineers to develop prototypes and OEM manufactured products that will meet special needs.

Pricing — Tower's manufacturing techniques coupled with a constant focus to contain overhead enables us to offer prices that are the most competitive in the industry. Discounts are offered for larger quantity orders.

Tower Optical is a Service Disabled, Veteran Owned, Small Business SDVOSB–Cage Code 1N2U3.

Call, fax or e-mail your requirements for special price consideration.

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ISO 9001:9015 Certified

Zero Order Waveplates–10 mm

TOWER OPTICAL CORPORATION

- Clear aperture 85% OD
- 10 mm unmounted diameter
- 12.7 or 25.4 mm mounted diameter
- Wide range of wavelengths
- ½ and ¼ wave retardation
- Waveplates are AR coated
- Very high laser quality
- High performance specifications

Tower's 10 mm zero order waveplates provide users with a high performance crystal quartz retarder with a clear aperture of 8 mm. These waveplates are air spaced, having a stainless steel spacer between two crystal quartz plates that form the zero order capability. Zero order waveplates are far less sensitive to temperature variations than mulitple orders. Air spaced waveplates have higher thermal stability and power handling capability than contacted or cemented. They are no failures as occur with contacted waveplates coming apart. Angular alignment of the waveplates is also more accurate.

Tower Optical standard 10 mm waveplates are made from laser quality crystal quartz and are AR coated. Each plate is AR coated on both sides. Standard retardations are ½ or ¼ wave. The waveplates are offered either unmounted with a diameter of 10 mm or mounted in a 12.7 mm or 25.4 mm, anodized aluminum mounting ring with an 8mm clear aperture.

The standard wavelengths available are shown in the chart below. As a special feature, Tower offers the ability to supply the 10 mm zero order waveplates at wavelengths within a range of 10–20 nm from any of those listed on the chart. Other wavelengths are available on a custom order basis.

Waveplate Specifications

Material: crystal quartz – laser quality
Waveplate thickness range: 0.3 to 2.0 mm
Wavefront distortion: λ/10 @ 632.8 nm
Surface quality: 10-5 Scratch-Dig
Parallelism (wedge): 0.5 arc seconds
Wavelength range: per table to the right
Retardation tolerance: ±0.005 waves @ 632.8 nm
Coating: anti reflective, R<0.25% per surface
Damage threshold: 1 kW/cm2 – CW, 3.5 J/cm2 @10 ns
Diameter: 10 mm, +0.0/-0.25 mm unmounted; 12.7 or 25.4 mm, +0.00/-0.25 mm mounted
Mounted thickness: 6.4 (12.7 mm) or 7.8 (25.4 mm)

See Page 17 for Waveplate Ordering Information

Standard Wavelengths

237	248	266	280	308	325	355
369	377	399	400	408	413	423
442	455	458	488	514.5	527	532
556	589	632.8	647	650	660	670
676	694	710	752	755	767	780
790	795	800	808	810	825	830
850	880	905	940	980	1030	1047
1053	1064	1112	1156	1228	1310	1319
1476	1550	1570	1762	1980	1988	2020

See Page 12 for Any Wavelength Program

Ordering Information

Unmounted
Z-10-A-R-N-WL $295
Mounted in a 12.7 mm ring
Z-10-A-R-A-WL $325
Mounted in a 25.4 mm ring
Z-10-A-R-B-WL $335
R = Retardation: .500 or .250, WL = Wavelength

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Zero Order Waveplates–12.7 mm

TOWER OPTICAL CORPORATION

- Clear aperture 85% OD
- 12.7 mm unmounted diameter
- 25.4 mm mounted diameter
- Wide range of wavelengths
- ½ and ¼ wave retardation
- Waveplates are AR coated
- Very high laser quality
- High performance specifications

Tower's 12.7 mm zero order waveplates provide users with a high performance crystal quartz retarder with a clear aperture of 10 mm. These waveplates are air spaced, having a stainless steel spacer between two crystal quartz plates that form the zero order. These waveplates are far less sensitive to temperature variations than mulitple orders. Air spaced waveplates have higher thermal stability and power handling capability than contacted or cemented. There are no failures as occur with contacted waveplates coming apart. Angular alignment of the waveplates is also more accurate.

Tower Optical standard 12.7 mm waveplates are made from laser quality crystal quartz and are AR coated. Each plate is AR coated on both sides. Standard retardations are ½ or ¼ wave. The waveplates are offered either unmounted with a diameter of 12.7 mm or mounted in a 25.4 mm, anodized aluminum mounting ring with an 10 mm clear aperture.

The standard wavelengths available are shown in the chart below. As a special feature, Tower offers the ability to supply the 12.7 mm zero order waveplates at wavelengths within a range of 10–20 nm from any of those listed on the chart. Other wavelengths are available on a custom order basis.

Waveplate Specifications

Material: crystal quartz – laser quality
Waveplate thickness range: 0.3 to 2.0 mm
Wavefront distortion: λ/10 @ 632.8 nm
Surface quality: 10-5 Scratch-Dig
Parallelism (wedge): 0.5 arc seconds
Wavelength range: per table to the right
Retardation tolerance: ±0.005 waves @ 632.8 nm
Coating: anti reflective, R<0.25% per surface
Damage threshold: 1 kW/cm2 – CW, 3.5 J/cm2 @10 ns
Diameter: 12.7 mm, +0.0/-0.25 mm unmounted; 25.4 mm, +0.00/-0.25 mm mounted
Mounted thickness: 6.4 (12.7 mm) or 7.8 (25.4 mm)

See Page 17 for Waveplate Ordering Information

Standard Wavelengths

237	248	266	280	308	325	355
369	377	399	400	408	413	423
442	455	458	488	514.5	527	532
556	589	632.8	647	650	660	670
676	694	710	752	755	767	780
790	795	800	808	810	825	830
850	880	905	940	980	1030	1047
1053	1064	1112	1156	1228	1310	1319
1476	1550	1570	1762	1980	1988	2020

See Page 12 for Any Wavelength Program

Ordering Information

Unmounted
Z-12.7-A-R-N-WL $320

Mounted in a 25.4 mm ring
Z-12.7-A-R-B-WL $365

R = Retardation: .500 or .250, WL = Wavelength

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Zero Order Waveplates–17.5 mm

TOWER OPTICAL CORPORATION

- Clear aperture 85% OD
- 17.5 mm unmounted diameter
- 1″ (25.4 mm) mounted diameter
- Wide range of wavelengths
- ½ and ¼ wave retardation
- Waveplates are AR coated
- Very high laser quality
- High performance specifications
- Most Popular design

Tower's 17.5 mm zero order waveplates provide users with a high performance crystal quartz retarder with a clear aperture of 15 mm. These waveplates are air spaced, having a stainless steel spacer between two crystal quartz plates that form the zero order capability. Zero order waveplates are far less sensitive to temperature variations than multiple orders. Air spaced waveplates have higher thermal stability and power handling capability than contacted or cemented. They are no failures as occur with contacted waveplates coming apart. Angular alignment of the waveplates is also more accurate.

Tower Optical waveplates are made from laser quality crystal quartz. Each plate is AR coated on both sides. Standard retardations are ½ or ¼ wave. The waveplates are offered either unmounted with a diameter of 17.5 mm or mounted in a 25.4 mm anodized aluminum mounting ring with a 15 mm clear aperture.

The standard wavelengths available are shown in the chart below. As a special feature, Tower offers the ability to supply these zero order waveplates at wavelengths within a range of 10–20 nm from any of those listed on the chart. Other wavelengths are available on a custom order basis.

Waveplate Specifications

Material: crystal quartz – laser quality
Waveplate thickness range: 0.3 to 2.0 mm
Wavefront distortion: λ/10 @ 632.8 nm
Surface quality: 10-5 Scratch-Dig
Parallelism (wedge): 0.5 arc seconds
Wavelength range: per table to the right
Retardation tolerance: ±0.005 waves @ 632.8 nm
Coating: anti reflective, R<0.25% per surface
Damage threshold: 1 kW/cm2 – CW, 3.5 J/cm2 @10 ns
Diameter: 17.5 mm, +0.0/-0.25 mm unmounted;
25.4 mm, +0.00/-0.25 mm mounted
Mounted thickness: 7.8, +0.00/-0.25 mm

See Page 17 for Waveplate Ordering Information

Standard Wavelengths

237	248	266	280	308	325	355
369	377	399	400	408	413	423
442	455	458	488	514.5	527	532
556	589	632.8	647	650	660	670
676	694	710	752	755	767	780
790	795	800	808	810	825	830
850	880	905	940	980	1030	1047
1053	1064	1112	1156	1228	1310	1319
1476	1550	1570	1762	1980	1988	2020

See Page 12 for Any Wavelength Program

Ordering Information

Unmounted
Z-17.5-A-R-N-WL $335

Mounted in a 25.4 mm ring
Z-17.5-A-R-B-WL $365

R = Retardation: .500 or .250, WL = Wavelength

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VALUABLE 40 YEARS EXPERIENCE

NEW

High Laser Damage (HLD) Zero Order Waveplates–17.5 mm

TOWER OPTICAL CORPORATION

- Clear aperture 85% OD
- 17.5 mm unmounted diameter
- 1″ (25.4 mm) mounted diameter
- Wide range of wavelengths
- ½ and ¼ wave retardation
- Waveplates are AR coated
- Very high laser quality
- High performance specifications
- High Laser Damage Coating

Tower's 17.5 mm HLD zero order waveplates provide users with a high performance crystal quartz retarder with a clear aperture of 15 mm. These waveplates are air spaced, having a stainless steel spacer betweentwo crystal quartz plates that form the zero order capability.

Zero order waveplates are far less sensitive to temperature variations than multiple orders. Air spaced waveplates have higher thermal stability and power handling capability than contacted or cemented. There are no failures as occur with contacted waveplates coming apart. Angular alignment of the waveplates is also more accurate. Tower Optical waveplates are made from laser quality crystal quartz. Each HLD plate is AR coated on both sides to exhibit High Laser Damage Threshold with retardations that are ½ or ¼ wave. The waveplates are offered either unmounted with a diameter of 17.5 mm or mounted in a 25.4 mm anodized aluminum mounting ring with a 15 mm clear aperture.

The standard wavelengths available are shown in the chart below. As a special feature, Tower offers the ability to supply these zero order waveplates at wavelengths within a range of 10–20 nm from any of those listed on the chart. Other wavelengths are available on a custom order basis.

Waveplate Specifications

Material: crystal quartz – laser quality
Waveplate thickness range: 0.3 to 2.0 mm
Wavefront distortion: λ/10 @ 632.8 nm
Surface quality: 10-5 Scratch-Dig
Parallelism (wedge): 0.5 arc seconds
Wavelength range: per table to the right
Retardation tolerance: ±0.005 waves @632.8 nm
Coating: anti reflective, R<0.25% per surface
Damage threshold: 1 MW/cm2 – CW, 20 Jcm2@10 ns
Diameter: 17.5 mm, +0.0/-0.25 mm unmounted; 25.4 mm, +0.00/-0.25 mm mounted
Mounted thickness: 7.8, +0.00/-0.25 mm

Standard Wavelengths

355	408	532	800	1030	1064

Custome Wavelengths are available for HDL Waveplates

Ordering Information

Unmounted
Z-17.5-A-R-N-WL-H $435
Mounted in a 25.4 mm ring
Z-17.5-A-R-B-WL-H $465
R = Retardation: .500 or .250, WL = Wavelength

See Page 17 for Waveplate Ordering Information

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Zero Order Waveplates–1″ (25.4 mm)

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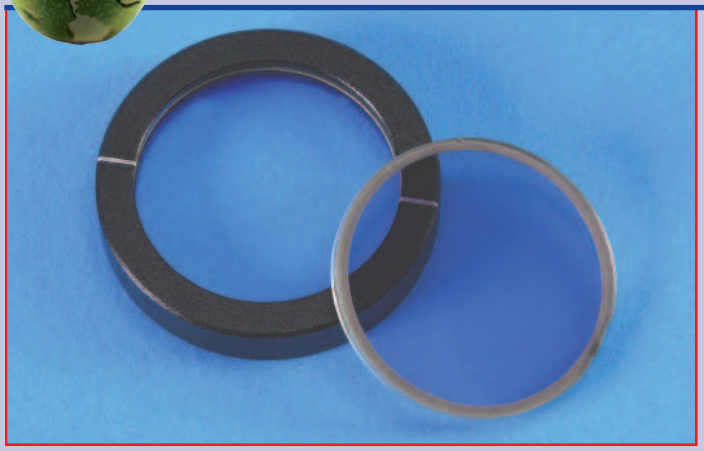

- Clear aperture 85% OD
- 25.4 mm unmounted diameter
- 30 mm mounted diameter
- Wide range of wavelengths
- ½ and ¼ wave retardation
- Waveplates are AR coated
- Very high laser quality
- High performance specifications

Tower's 1″ Zero Order Waveplates provide users with a high performance crystal quartz retarder with a clear aperture of 23 mm. These waveplates are air spaced, having a stainless steel spacer between two crystal quartz plates that form the zero order capability. Zero order waveplates are far less sensitive to temperature variations than multiple orders. Air spaced waveplates have higher thermal stability and power handling capability than contacted or cemented. They are no failures as occur with contacted waveplates coming apart. Angular alignment of the waveplates is also more accurate.

Tower Optical's standard 1″ waveplates are made from laser quality crystal quartz and are AR coated. Each plate is coated on both sides. Standard retardations are ½ or ¼ wave. The waveplates are offered either unmounted with a diameter of 25.4 mm or mounted in a 30 mm anodized aluminum mounting ring with a 23 mm clear aperture.

The standard wavelengths available are shown in the chart below. As a special feature, Tower offers the ability to supply the 1″ zero order waveplates at wavelengths within a range of 10–20 nm from any of those listed on the chart. Other wavelengths are available on a custom order basis.

Waveplate Specifications

Material: crystal quartz – laser quality

Waveplate thickness range: 0.3 to 2.0 mm
Wavefront distortion: λ/10 @ 632.8 nm

Surface quality: 10-5 Scratch-Dig

Parallelism (wedge): 0.5 arc seconds

Wavelength range: Per table to the right

Retardation tolerance: ±0.005 waves @ 632.8 nm

Coating: Anti Reflective, R<0.25% per surface

Damage threshold: 1 kW/cm2 – CW, 3.5 J/cm2 @10 ns

Diameter: 25.4 mm, +0.0/-0.25 mm unmounted;
30 mm, +0.00/-0.25 mm mounted

Mounted thickness: 6.0, +0.00/-0.25 mm

See Page 17 for Waveplate Ordering Information

Standard Wavelengths

266	355	408	423
488	514.5	532	632.8
650	670	780	800
830	980	1064	1550

See Page 12 for Any Wavelength Program

Ordering Information

Unmounted
Z-25.4-A-R-N-WL $485

Mounted in a 30 mm ring
Z-25.4-A-R-C-WL $515

R = Retardation: .500 or .250, WL = Wavelength

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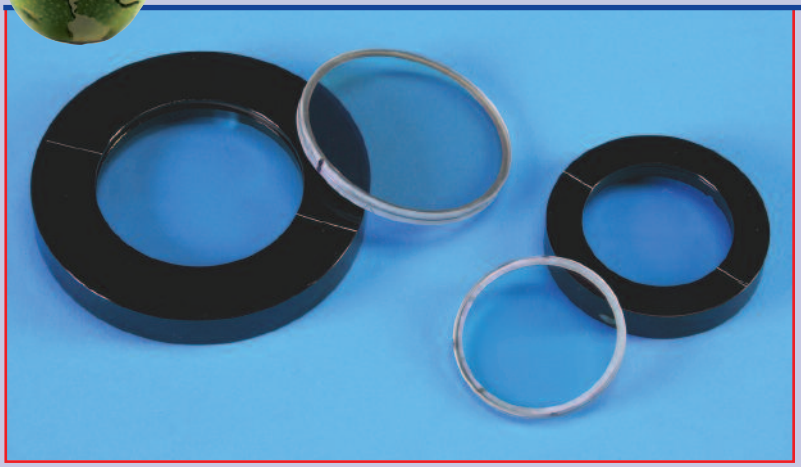
Large Zero Order Waveplates – 38.1 & 50.8 mm

TOWER OPTICAL CORPORATION



- Laser quality crystal quartz
- Air spaced for high power
- Clear aperture 85% OD
- Mounted or unmounted
- Retardations of ½ and ¼ wave
- Waveplates are AR coated
- High performance specifications

Tower's large aperture zero order waveplates provide users with the capability of handling new applications where beam size and/or beam position moves over larger distances. The waveplates described here are air spaced, having a stainless steel spacer between two crystal quartz plates that form the zero order capability. Zero order waveplates are far less sensitive to temperature variations than multiple orders. Air spaced waveplates have higher thermal stability and power handling capability than contacted or cemented.

Tower Optical large waveplates are made from laser quality crystal quartz. Each plate is AR coated on both sides. Retardations are ½ or ¼ wave. The waveplates are offered either unmounted or mounted in anodized aluminum mounting rings.

Waveplate Specifications

Material: crystal quartz – laser quality
Waveplate thickness range: 3 to 4 mm
Wavefront distortion: λ/10 @ 632.8 nm
Surface quality: 40-20 Scratch-Dig
Parallelism (wedge): 0.5 arc seconds
Wavelength range: Per table to the right
Retardation tolerance: ±0.005 waves @ 632.8 nm
Coating: Anti Reflective, R<0.25% per surface
Damage threshold: 1 kW/cm2 – CW, 3.5 J/cm2 @10 ns
Diameter: 38.1 mm, +0.0/-0.25 mm unmounted;
50.8 mm, +0.0/-0.25 mm mounted, or,
50.8 mm, +0.0/-0.25 mm unmounted,
76.2 mm +0.0/-0.25 mm mounted
Mounted thickness: 9.0, +0.00/-0.25 mm

See Page 17 for Waveplate Ordering Information

Standard Wavelengths (nm)

355	532	632.8	800	1064	1550

See Page 12 for Any Wavelength Program

Ordering Information

38.1 mm WP Unmounted
Z-38.1-A-R-N-WL $1,595

38.1 mm WP Mounted in a 50.8 mm ring
Z-38.1-A-R-E-WL $1,650

50.8 mm WP Unmounted
Z-50.8-A-R-N-WL.....$2240

50.8 mm WP Mounted in 76.2 mm ring
Z-50.8-A-R-G-WL.....$2,295

R = Retardation: .500 or .250,
WL = Wavelength

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Super Large
3" Zero Order Waveplates – 76.2mm

TOWER OPTICAL CORPORATION

Super Large Zero Order Waveplates – 76.2mm

- Laser Quality Crystal Quartz
- Air Spaced for High Power
- Clear aperture 85% OD
- Mounted or Unmounted
- Retardations of 1/2 and 1/4 Wave
- Waveplates are AR Coated
- Standard Wavelengths
- Custom Wavelengths available
- Rugged 4" Mounting Ring

A new option in zero order waveplates has been established by Tower Optical – a 3" custom zero order waveplate. This super large zero order waveplate provides users with the ability to perform new techniques with large beam lasers. In addition, these waveplates are air spaced thus providing operation at higher power levels than contacted or cemented waveplates. Standard retardations of 1/4 and 1/2 wave are provided for each wavelength offered.

You can custom order the wavelength you desire from 355nm to 2021nm.

The mounting ring for the three inch zero order waveplate is heavy duty Aluminum, 4 inch diameter and 7/8 inch thick to protect the dual plate Crystal Quartz waveplate. The crystal axis is shown as a scribe mark on the face of the ring. The waveplate is held in place with a retaining ring.

Waveplate Specifications

Material: *Crystal Quartz – Laser quality*
Waveplate Thickness Range: *4.0 to 10mm*
Wavefront Distortion: *λ /10 @ 632.8nm*
Surface Quality: *20-10 Scratch/Dig*
Parallelism (Wedge): *0.5 arc seconds*
Wavelengths: *Specify from 355 nm to 2021 nm.*
Retardation Tolerance: *±0.005 waves @ 632.8nm*
Coating: *Anti Reflective, R<0.25% per surface*
Damage Threshold: *1kW/cm² – CW 3.5 J/cm² @10ns*
Diameter: *76.2, +0.0/-0.25mm unmounted; 101.6, +0.00/-0.25mm mounted*
Mounted Thickness: *24mm*

Ordering Information

Unmounted
Z-76.2-A-R-N-WL $3,245
Mounted in a 4 inch ring
Z-76.2-A-R-H-WL $3,445
R=Retardation: 250 or .500, WL=Wavelength
Custom wavelengths are available. Lead times will vary depending on current inventory and customer demand.
Please call for pricing.

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Super Large
4″ Zero Order Waveplates – 101.6mm

TOWER OPTICAL CORPORATION

Super Large Zero Order Waveplates – 101.6mm

- Laser Quality Crystal Quartz
- Air Spaced for High Power
- Clear aperture 85% OD
- Mounted or Unmounted
- Retardations of 1/2 and 1/4 Wave
- AR Coated
- All Wavelengths Custom
- Rugged 4.5″ Mounting Ring

Tower Optical is now offering super large zero order waveplates that are 101.6mm in diameter. In addition, these Waveplaes are air spaced, thus providing operation at higher power levels than contacted or cemented Waveplaes.

These large Waveplates are available with 1/4 and 1/2 wave retardation. You can custom order the wavelength you desire from 355nm to 2021nm.

The mounting ring for the 4″ Zero Order Waveplate is made of heavy duty Aluminum, 4.5″ diamter and 7/8″ thick to protect the dual plate Crystal Quartz Waveplate assembly. The optical axis is shown by a scribe mark on the face of the ring. The Wareplate is held in place with a retaining ring. Custom designed rings are also available, or the 4″ Waveplate can be supplied unmounted.

Waveplate Specifications

Material: *Crystal Quartz – Laser quality*

Waveplate Thickness Range: *4.0 to 10mm*

Wavefront Distortion: *λ /10 @ 632.8nm*

Surface Quality: *20-10 Scratch/Dig*

Parallelism (Wedge): *0.5 arc seconds*

Wavelengths: *Specify from 355nm to 2021nm*

Retardation Tolerance: *±0.005 waves @ 632.8nm*

Coating: *Anti Reflective, R<0.25% per surface IBS Lo R, Hi Pwr, optional*

Damage Threshold: *1kW/cm² – CW 3.5 J/cm² @10ns*

Diameter: *101.6, +0.0/-0.25mm unmounted; 114.3, +0.00/-0.25mm mounted*

Mounted Thickness: *24mm*

Ordering Information

Z-101.6-A-Ret-J/U-Wavelenth (3 or 5 digits nm)

Ret=.250 or .500; J=4.5″ mount, U=unmounted

Lead times will vary depending on current inventory and customer demand. ***Call for pricing***

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VALUABLE 40 YEARS EXPERIENCE

Zero Order Waveplates – Any Wavelength

TOWER OPTICAL CORPORATION

- Any wavelength waveplates
- Laser quality
- ½ and ¼ wave retardation
- Optical axis marked on mounted and unmounted waveplates
- All waveplates are AR coated
- Custom sizes and shapes available
- Simple ordering selection

Any Wavelength Waveplate Program

Virtually any wavelength waveplate in now available in a matter of days compared to making a custom production run, which takes 8 weeks. Until now the waveplates were offered in over about 60 different wavelengths between 248 nm and 2021 nm. The waveplates can now be ordered at any wavelength between 248 nm and 2020 nm. This range represents 95% of current requests. This new approach optimizes a customer's system performance since he/she is not concerned with retardation errors from the use of an off the shelf near wavelength waveplate.

This new technique is available to our Zero Order product line at either ½ wave or ¼ wave retardation. All four surfaces are AR (Anti-Reflection) coated, and the assembly offered mounted or unmounted.

All of these waveplates sell for the same low prices as our standard items. Any-Wavelength Waveplates are normally available within 3-5 business days.

Use our Standard Part Number (see page 16) and merely insert your desired wavelength.

General Product Description

Zero order waveplates are constructed of two crystal quartz plates that are oriented so that the optical axes are orthogonal. Our standard waveplates are air spaced; cemented and contacted versions are also available. Zero order waveplates are far less sensitive to temperature changes than multiple orders.

Tower Optical standard waveplates are laser quality crystal quartz which are AR coated. **Other wavelengths and custom dimensions are available on a special order basis.**

Our standard waveplates are available in 10 mm, 17.5 mm, 25.4 mm, 38.1 mm and 50.8 mm diameter in a variety of different mounts or unmounted.

Call for pricing.

Multiple Order Waveplates – All Sizes

TOWER OPTICAL CORPORATION

- Laser quality crystal quartz
- Clear aperture 85% OD
- Mounted or unmounted
- Retardations of ½ and ¼ wave
- Waveplates are AR coated
- High performance specifications

Tower's multiple order waveplates comprise a single piece of laser quality crystal quartz. Because their retardation is the desired fraction (λ/4, λ/2) plus some integer number of waves, they are many times more sensitive to temperature and wavelength than zero order waveplates. Therefore they perform well only in laboratory environments and in mono-chromatic light.

Tower Optical multiple order waveplates are AR coated on both sides. Standard retardations are λ/4 and λ/2; other values are available upon request. They are offered either unmounted or mounted in an anodized aluminum ring.

Waveplate Specifications

Material: crystal quartz – laser quality
Waveplate thickness range: 0.3 to 2 mm
Wavefront distortion: λ/10 @ 632.8 nm
Surface quality: 10-5 Scratch-Dig
Parallelism (wedge): 0.5 arc seconds
Wavelength range: Per table to the right
Retardation tolerance: ±0.005 waves @ 632.8 nm
Coating: Anti Reflective, R<0.25% per surface
Damage threshold: 1 kW/cm2 – CW, 3.5 J/cm2 @10 ns
Diameter: 10, 12.5, 17.5, 25.4, 38.1 and 50.8 mm, +0.0/-0.25 mm unmounted; or mounted in appropriate sized mounting rings
Mounted thickness: Depends on mount diameter

Wavelengths Available

237	248	266	280	308	325	355
369	377	399	400	408	413	423
442	455	458	488	514.5	527	532
556	589	632.8	647	650	660	670
676	694	710	752	755	767	780
790	795	800	808	810	825	830
850	880	905	940	980	1030	1047
1053	1064	1112	1156	1228	1310	1319
1476	1550	1570	1762	1980	1988	2020

Ordering Information

WP Unmounted example for 17.5 mm Dia
M-17.5-D-R-N-WL $235
WP Mounted in a 25.4 mm ring
M-17.5-D-R-B-WL $250

WP Unmounted example for 25.4 mm Dia
M-25.4-D-R-N-WL.....$330
WP Mounted in a 30 mm ring
M-25.4-D-R-C-WL.....$360

R = Retardation: .500 or .250, WL = Wavelength

Dual Wavelength Waveplates Available

See Page 17 for Waveplate Ordering Information

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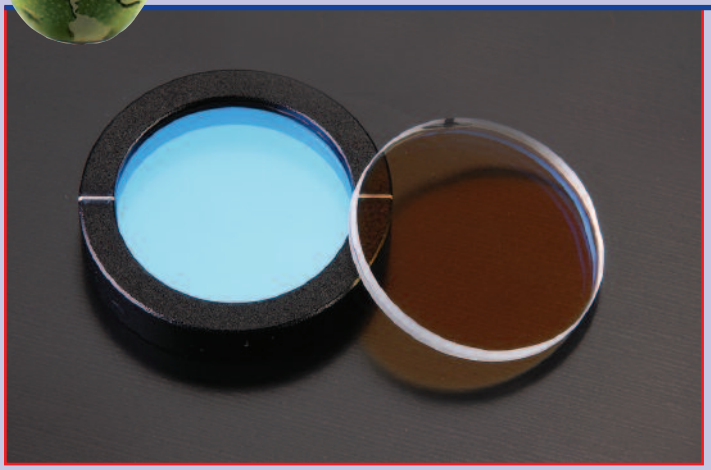
VALUABLE 40 YEARS EXPERIENCE

Achromatic Waveplates – Cemented

TOWER OPTICAL CORPORATION



- Low retardation variations
- Four broad spectral ranges
- Cemented construction
- Clear aperture 85% OD
- Unmounted diameter of 25.4 mm
- Mounted in a 30 mm ring
- Retardations of ½ and ¼ wave

Tower Optical offers this second series of Achromatic Waveplates (AWP's) which are built using 25.4 mm substrates of crystal quartz and magnesium fluoride. These substrates are cemented together. This technique helps to control costs by reducing the number of surfaces requiring AR coating while increasing the physical size thus accommodating larger beam diameters. As with the original series of AWPs these AWPs are available in the following ranges:

VIS	465 to 610 nm
VIS/NIR	610 to 850 nm
NIR	700 to 1000 nm
IR	1200 to 1650 nm

Each is broadband AR coated for its respective range. The retardation performance is shown graphically on the page "Achromatic Waveplates - Retardation Curves".

See Retardation Curves on Page 15

Ordering Information

Unmounted version

A-25.4-B-R-N X.....$810

Mounted version

A-25.4-B-R-C-X.....$845

R = Retardation, .250 or .500

X = Wavelength range, 1, 2, 3 or 4

Waveplate Specifications

Substrate material: crystal quartz & MgF2

Retardance: λ/4 and λ/2

Retardation tolerance: λ/100 over wavelength range ***Clear aperture:*** 85% OD

Temp coefficient of retardation: < λ/500 per °C

Wavelength ranges: 1 = 465-610 nm, 4 = 610-850 nm, 2 = 700-1000 nm, 3 = 1200-1650 nm

Transmitted wavefront distortion: λ/4@633 nm

Surface quality: 20-10 Scratch-Dig

Beam deviation: <1 arc minute

Parallelism: <1 arc minute

AOI range for < 1% change in retardance: +/-3°

Optical axis: Marked on the mounting ring

Temperature storage range: -40°C to +75°C

Damage threshold: 2J/cm2 (8 ns pulse @ 1064 nm); 500 kW/cm2, CW

Diameter mounted: 30 mm

Ring thickness: 6 mm

Coating: Ravg<1% at 465-610 nm per surface
Ravg<0.7% at 610-850 nm per surface
Ravg<0.6% at 700-1000 nm per surface
Ravg<0.5% at 1200-1650 nm per surface

See Page 17 for Waveplate Ordering Information

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Achromatic Waveplates – Air Spaced

TOWER OPTICAL CORPORATION

- Low retardation variations
- Four broad spectral ranges
- Air spaced for high power
- Clear aperture 85% OD
- Mounted in a 25.4 mm ring
- Retardations of ½ and ¼ wave

Tower's achromatic waveplate (AWP) is similar to a zero-order waveplate, which is made from two pieces of crystal quartz except that the AWP is composed of one piece of crystal quartz and one piece of magnesium fluoride, MgF2. Both of these materials are birefringent, however, by proper matching of the birefringent changes of the two materials, retardation changes are minimized as the wavelength changes. This phenomenon produces a waveplate whose change in retardation is extremely small for large variations in wavelength.

For tunable sources or lasers with large spectral widths, you'll want an AWP – one whose performance is nearly independent of wavelength.

Tower's AWPs are designed to effectively eliminate the wavelength dependence over a wide spectral range, typically several hundred nanometers. The AWPs are available for four wavelength ranges: 465-610 nm (VIS), 610-850 nm (VIS/NIR), 700-1000 nm (NIR), and 1200-1650 nm (IR.) These AWPs operate beyond these ranges; however the retardation change exceeds the specification. The standard versions are air-spaced. Custom AWPs are available to meet your specific requirements. Send us your drawing for a quote on a custom AWP.

Ordering Information

A-12.7-A-R-B-X $735

R = Retardation, .250 or .500
X = Wavelength range, 1, 2, 3 or 4

Waveplate Specifications

Substrate material: crystal quartz & MgF2
Retardance: λ/4 and λ/2
Retardation tolerance: λ/100 over wavelength range ***Clear aperture:*** 85% OD
Temp coefficient of retardation: < λ/500 per °C
Wavelength ranges: 1 = 465-610 nm, 4 = 610-850 nm, 2 = 700-1000 nm, 3 = 1200-1650 nm
Transmitted wavefront distortion: λ/4@633 nm
Surface quality: 20/10 scratch dig
Beam deviation: 0.5″
Parallelism: <1 arc minute
AOI range for < 1% change in retardance: +/-3°
Optical axis: Marked on the mounting ring
Temperature storage range: -40°C to +75°C
Damage threshold: 2J/cm2 (8 ns pulse @ 1064 nm); 500 kW/cm2, CW
Diameter mounted: 25.4 mm
Ring thickness: 8 and 9 mm
Coating: Ravg<1% at 465-610 nm per surface
Ravg<0.7% at 610-850 nm per surface
Ravg<0.6% at 700-1000 nm per surface
Ravg<0.5% at 1200-1650 nm per surface

See Retardation Curves on Page 15

See Page 17 for Waveplate Ordering Information

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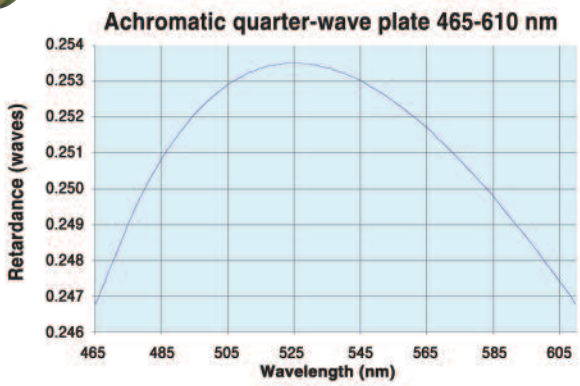
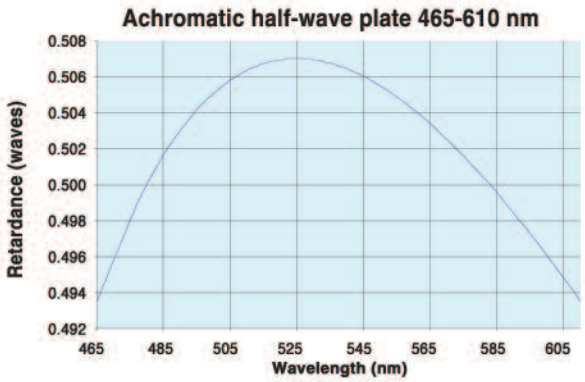
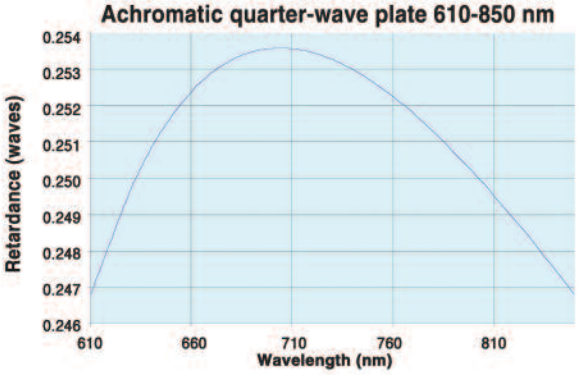
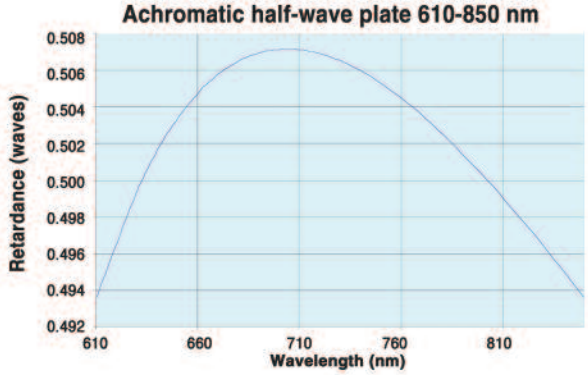
Achromatic Waveplates – Retardation Curves

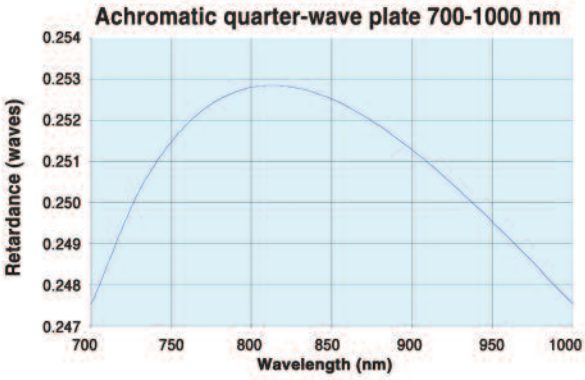
TOWER OPTICAL CORPORATION

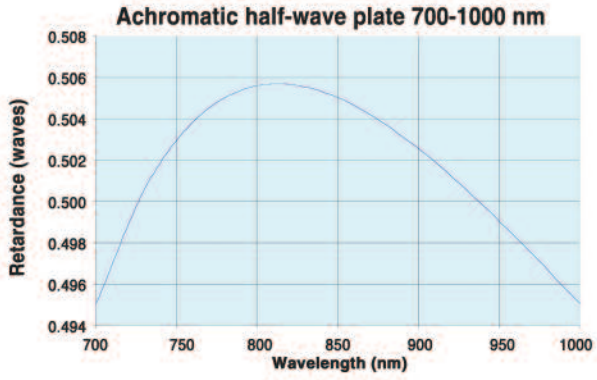


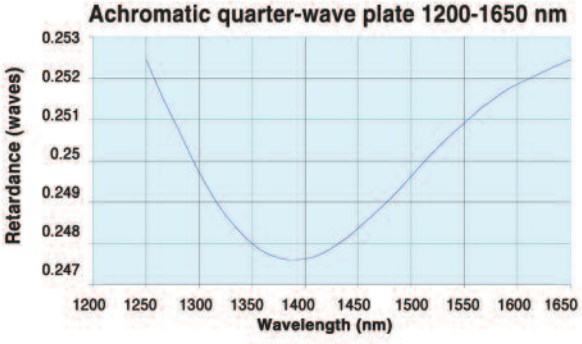


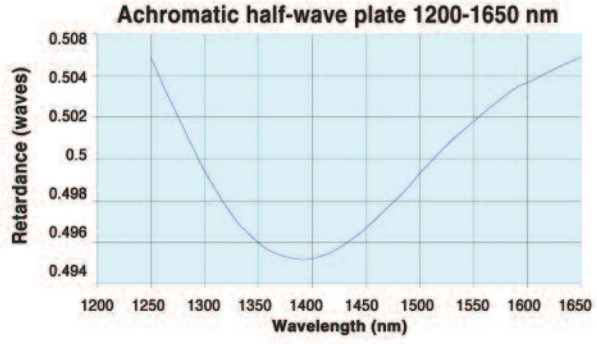












Waveplate Ordering Information

TOWER OPTICAL CORPORATION

The following is an explanation of the part numbering system used for Tower Optical Waveplates. Your familiarity will make it extremely easy to order any combination of parameters required.

Waveplate Part Numbers

Type (Order)	Unmounted Diameter	Construction	Retardation	Mounting Ring Diameter	Wavelength
Z-Zero	10 mm	A-Air Gap	.500	A-12.7 mm	
M-Multi	12.7 mm	B-Cemented	.250	B-25.4 mm	
T-True Zero	17.5 mm	C-Contacted	Other	C-30 mm	
D-Dual Wave	25.4 mm	D- Single Plate		D-38.1 mm	
A-Achromatic	38.1 mm			E-50.8 mm	
	43 mm			F-63.5 mm	
	50.8 mm			G-76.2 mm	
	76.2mm			H-101.6	
	101.6mm			J-114.3	
				N-None	

High Laser Damage (-H)

Example: Z-17.5-A-.250-B-1064

Example HLD: Z-17.5-A-.250-B-1064-H

For achromatic WP's select wavelengths as follows:
1 = 465-610 nm
2 = 700-1000 nm
3 = 1200-1650 nm
4 = 610-850 nm

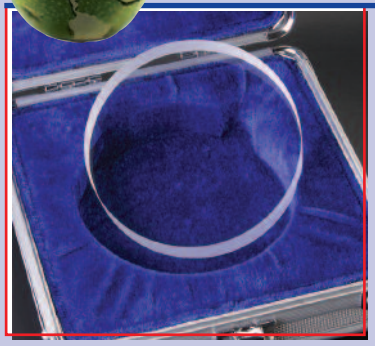
237	248	266	280	308	325	355
369	377	399	400	408	413	423
442	455	458	488	514.5	527	532
556	589	632.8	647	650	660	670
676	694	710	752	755	767	780
790	795	800	808	810	825	830
850	880	905	940	980	1030	1047
1053	1064	1112	1156	1228	1310	1319
1476	1550	1570	1762	1980	1988	2020

Part Number Creation

The part number matrix is shown above. A part number is created by selecting the variables as shown above in the top line of parameter boxes starting with the type of waveplate. For a zero order waveplate select Z from the pull-down choices. The assembly of a part number is shown in the example in the middle of the matrix. This is followed by selecting the next variable which is the diameter of the unmounted waveplate,which in the example is 17.5 mm. The construction of the waveplate is next and in this case is A for air gap. The next parameter is the retardation which is .250 representing ¼ wave. The mounting option is next and if no mounting is required you would select N but in the case of the example a 25.4 mm mounting ring is selected. It should be mentioned here that some ring sizes are not available. In the example, an A ring would not work and you would not use any ring larger than a B.

Precision Optical Flats

TOWER OPTICAL CORPORATION



Precision optical flats are fused silica optical components that are used as a reference against which the flatness of an unknown surface can be determined. For less demanding jobs Tower ofers them made from BK7 with a flatness specified as λ/4 or better. These optical flats may also be used as windows.

Single Sided and Double Sided Optical Flats

- **Fused silica**
- **Flatness of λ/10 or λ/20**
- **Single and double sided**
- **Easy to use**
- **From 25 mm to 200 mm**
- **Precision ground and polished**
- **BK7 available at lower cost**

Specifications

for single and dual surface optical flats

Material:	**BK7**	**fused silica**
Exp. coefficient:	7.1×10^{-6}/°C	0.55×10^{-6}/°C
Surface quality:	60/40	
Parallelism:	<1 arc minute	
Back surface (single):	1-2 λ @633nm	
Diameter tolerance:	± 1 mm	
Thickness tolerance:	± 1.5 mm	

Custom versions also available

Diameter (mm)	Thickness (mm)	Material	Single or Dual Surface	Lambda/10		Lambda/20	
				Catalog No.	Price	Catalog No.	Price
25	12.5	Fused Silica	Single	4542-0002	$140.00	4542-0022	call for price
25	12.5	Fused Silica	Dual	4542-0004	$240.00		
50	15	Fused Silica	Single	4542-0006	$400.00	4542-0024	call for price
50	15	Fused Silica	Dual	4542-0008	$520.00		
100	20	Fused Silica	Single	4542-0010	$680.00	4542-0026	call for price
100	20	Fused Silica	Dual	4542-0012	$860.00		
150	25	Fused Silica	Single	4542-0014	$1,447.00		
150	25	Fused Silica	Dual	4542-0016	$1,630.00		
200	38	Fused Silica	Single	4542-0018	$2,872.00		
200	38	Fused Silica	Dual	4542-0020	$3,052.00		
				Lambda/4 or better			
25	12.5	BK7	Single	4542-0001	$75.00		
25	12.5	BK7	Dual	4542-0003	$83.00		
50	15	BK7	Single	4542-0005	$75.00		
50	15	BK7	Dual	4542-0007	$100.00		
100	20	BK7	Single	4542-0009	$215.00		
100	20	BK7	Dual	4542-0011	$300.00		
150	25	BK7	Single	4542-0013	$450.00		
150	25	BK7	Dual	4542-0015	$580.00		
200	38	BK7	Single	4542-0017	$800.00		
200	38	BK7	Dual	4542-0019	$1,200.00		

If a carrying case is required order 1405-0008 for up to 100 mm for $50, and 1405-0009 for 150 & 200 mm for $75.

Transmission Flats 4″ and 6″

TOWER OPTICAL CORPORATION

Model TX Flat 4″ and 6″

- Fused silica
- Surface accuracy λ/20
- Wedge of 15 arc minutes
- Clear aperture: 4″ TX Flat = 100 mm
  6″ TX Flat = 153 mm
- Compatible with bayonet-style mount
- Custom storage case included
- Low cost

The surface flatness of plano elements such as mirrors, prisms and windows can be verified by the use of an interferometer in conjunction with a transmission flat.

Transmission flats are used when measuring the surface flatness or transmitted wavefront of flat surfaces or optics. The Tower 4″ TX Flat provides a clear aperture of 100mm, while the Tower 6″ TX Flat provides a clear aperture of 153mm. The TX Flat is an assembly of a precision optical window mounted in an anodized aluminum ring that provides mounting compatibility with most bayonet-style housings. The transmission flat assembly is supplied in an aluminum shipping/storage case.

The TX Flat is supplied with one surface AR coated with R≤ 0.25% @ 633 nm. The uncoated side has a reflectivity of about 4%. It is accompanied by a documented interferogram and Certificate of Compliance.

Ordering Information

	4″ TX Flat	6″ TX Flat
Catalog number:	0535-0005	0535-0011
Price:	$2,950	$5,250

Specifications

Window

Material: *fused silica*
Front Surface (Reference Surface): λ/20

	4″TX Flat	6″ TX Flat
Diameter:	114.2 mm	161.5 mm
Thickness:	19.0 mm	28.2 mm

Surface quality: 20/10, both sides
Wedge: 15±1 arc minutes
Protective bevel: 1.0 mm x 45°
Anti reflective coating: one side, R≤0.25% @ 633 nm

Housing

Material: aluminum, 6061-T6

	4″TX Flat	6″ TX Flat
Diameter:	127.0 mm	181.1 mm
Height:	28.1 mm	36.8 mm

Finish: black anodize

Case

Material: wood and foam insert
Size: 4″ TX Flat ~170 x 170 x 50 mm
6″ TX Flat ~220 x 220 x 70 mm

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Beam Expander, 4″ to 6″

TOWER OPTICAL CORPORATION

Beam Expander, 4″ to 6″

- Precision Optics
- Quality Mechanics
- User Friendly
- Simple Setup
- Low cost

Tower's new BeamEx1000 provides a low cost solution to expanding the capability of a standard 4" Fizeau Interferometer to measure up to 6" optics. The BeamEx 1000 mounts to the front of a standard interferometer using the industry standard bayonet mount.

The combination of the BeamEx1000 and the interferometer provides for testing of very precise optical surfaces.

The BeamEx1000 also provides an adjustable tip and tilt capability incorporated with a 6" bayonet mounting to accommodate a suitable transmission flat, a reference flat or a transmission sphere.

Tower offers a 6" Transmission Flat which snaps into the Beam Ex 1000.

The 6" flat has a surface error of λ/20 and is AR coated for 632.8nm.

Specifications

Mechanical Interfaces

Input: 4" industry standard bayonet mount
Output: 6" industry standard bayonet mount

Adjustment: 2 Axis Tip and Tilt of optional 6" Transmission Flat optic

Input Wavelength: 632.8nm

AR Coating for internal optics: R<0.25%@633nm, per surface

Wavefront Deformation: Single pass @ 23°C,< λ/3

Input Diameter:	104mm
Output Diameter:	155mm
Overall Length:	210mm
Overall Width:	204mm
Overall Height:	204mm
Weight:	11.7 Lbs no Tx Flat 15.4 Lbs with Tx Flat

BeamEx 1000 with 6″ Transmission Flat installed.

Ordering Information

	Catalog No.	Price
BeamEx1000	**0535-0018**	**$12,995**
Tranmission Flat 6″	**0535-0011**	**$5,250**

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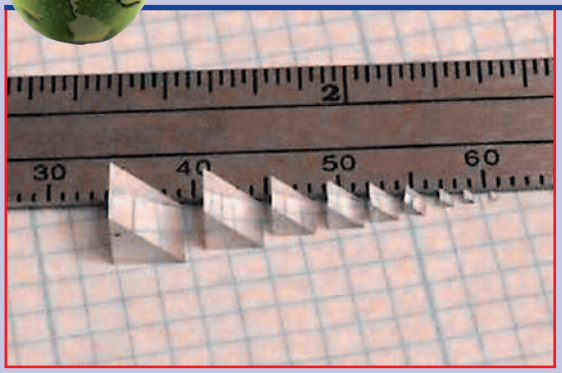
Micro Prisms – Coated and Uncoated

TOWER OPTICAL CORPORATION



- **Nine standard sizes available: 0.5, 0.7, 1.0, 1.5, 2.0, 2.5, 3.0, 4.0 and 5.0 mm**
- **45° - 90° - 45°**
- **Uncoated or enhanced aluminum on hypotenuse**
- **Use for concept testing or production**
- **Low cost**

Specifications

Material: NBK-7 or H-K9L

Sizes: **nine as follows:** 0.5 mm, 0.7 mm, 1.0 mm, 1.5 mm, 2.0 mm, 2.5 mm, 3.0 mm, 4.0 mm and 5.0 mm

Dimensional tolerance:
For 0.5 and 0.7 mm: ± 0.05 mm
For balance: =+0.0, -0.2 mm

Angular tolerance: ± 3 arc minutes

Surface quality: 40-20 Scratch-Dig

Corner chips: none allowed

Coating: MPCH Series = enhanced aluminum, MPU Series = none

Clear aperture: >80%

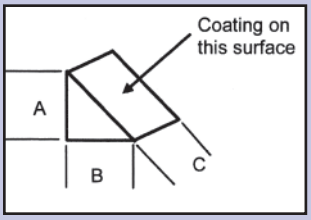
Flatness: λ/2 @ 632.8 nm

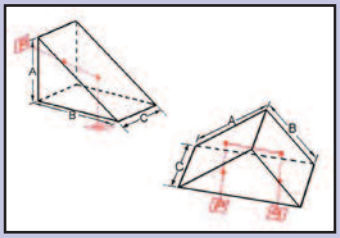
Bevel: allowed up to 0.1 mm

Tower has expanded its line of precision optics to include standard micro prisms, coated and uncoated, for use with laser sources and imaging applications. The micro prisms are right angle, 45°-90°-45° prisms, whose sizes range from 0.5 mm to 5.0 mm with a format of A=B=C.

These right angle prisms are used to deflect a light beam 90° or 180° as shown to the left. Depending on prism orientation, images will be inverted, but correct left to right. If the prism is rotated 90°, images viewed through it will be erect, but reversed left to right.

Coated prisms can also be used as mirror reflectors with respect to incoming light. Uncoated prisms act as mirrors for light incident on one of the short sides since incident light is totally internally reflected at the hypotenuse.





Pricing and Ordering Information

Micro Prism	Uncoated			Coated		
Size A=B=C	Catalog #	Model	Price 1-9	Catalog#	Model	Price 1-9
0.5 mm	4531-0001	MPU-0.5	$53	4531-0020	MPCH-0.5	$69
0.7 mm	4531-0002	MPU-0.7	$39	4531-0021	MPCH-0.7	$69
1.0 mm	4531-0003	MPU-1.0	$36	4531-0022	MPCH-1.0	$63
1.5 mm	4531-0004	MPU-1.5	$36	4531-0023	MPCH-1.5	$63
2.0 mm	4531-0005	MPU-2.0	$33	4531-0024	MPCH-2.0	$63
2.5 mm	4531-0006	MPU-2.5	$33	4531-0025	MPCH-2.5	$63
3.0 mm	4531-0007	MPU-3.0	$30	4531-0026	MPCH-3.0	$60
4.0 mm	4531-0008	MPU-4.0	$30	4531-0028	MPCH-4.0	$60
4.0 mm	4531-0009	MPU-5.0	$29	4531-0029	MPCH-5.0	$60

Contact factory for quantity pricing or special coatings *sales@toweroptical.com*

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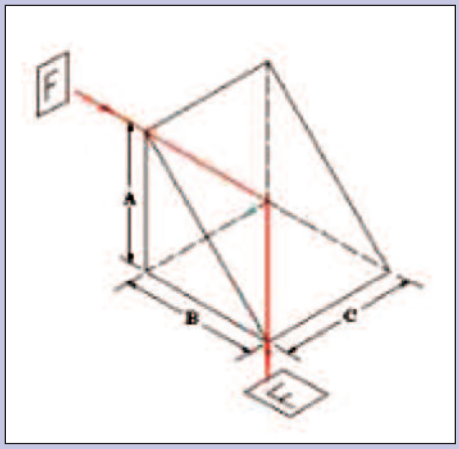
Large Right Angle Prisms

TOWER OPTICAL CORPORATION

50, 25, 20, 15 and 12.5 mm Prisms

Series LPU – Large Prisms Uncoated

- 12.5 mm to 50 mm
- BK7 or UV fused silica
- High quality
- Uncoated
- Coated on special order
- Custom variations



Tower Optical offers large format, high quality, right angle prisms for experimentation, research and education. These prisms are stock products for immediate shipment. Prisms are available in BK7 or fused silica type glass.

Specifications

Material: BK7 (or equiv) or UV fused silica

Dimensional tolerance: ±0.1 mm

Flatness: λ/4 @ 632.8 nm

Surface quality: 40-20 Scratch-Dig

Angle tolerance: ±30 arc seconds

Pyramid error: Less than 10 arc minutes

Bevel: 0.2-0.5 mm x 45°

Coating: Not coated

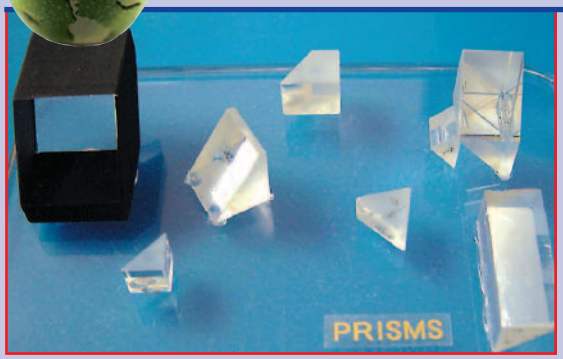
Pricing and Ordering Information

Catalog Number	Model No.	Glass	Size mm A=B=C	Price Each $
4531-0010	LPU-112	BK7	12.5	25
4531-0011	LPU-115	BK7	15.0	28
4531-0012	LPU-120	BK7	20.0	41
4531-0013	LPU-125	BK7	25.0	49
4531-0014	LPU-150	BK7	50.0	120
4531-0015	LPU-212	FS	12.5	98
4531-0016	LPU-215	FS	15.0	108
4531-0017	LPU-220	FS	20.0	130
4531-0018	LPU-225	FS	25.0	246
4531-0019	LPU-250	FS	50.0	480

For sizes larger than 50 mm or variations in the dimensions, or coatings on the prism surfaces contact Sales@TowerOptical.com

Custom and Standard Prisms

TOWER OPTICAL CORPORATION



Prisms are transparent optical blocks having at least two flat polished sides inclined relative to each other, at precisely controlled angles, so as to deflect, deviate, and rotate beams of light as well as dispersing their wavelengths.There are many types of prisms, each having a particular shape to achieve the necessary reflections to perform a specific optical task.

Tower Optical's prism capability includes penta prisms, right angle prisms, Dove prisms, roof prisms, Amici prisms, corner cube reflectors, anamorphic prisms, wedge prisms and polarizers including Glan-Taylor prisms, Wollaston prisms and Rochon prisms.

For right angle prisms, Tower Optical offers three different quality standards: Standard Grade, High Grade and Laser Grade.

The basic specifications are shown below.

Specification	Standard Grade	High Grade	Laser Grade
Material	BK7 grade A glass	BK7 grade A glass	BK7 grade A glass
Dimensional tolerance	±0.2 mm	±0.1 mm	±0.1 mm
Flatness	λ/2 @ 632.8 nm	λ/4 @ 632.8 nm	λ/10 @ 632.8 nm
Surface quality	60-40 Scratch-Dig	40-20 Scratch-Dig	20-10 Scratch-Dig
Angle tolerance	±3 arc minutes	±30 arc seconds	±30 arc seconds
Pyramid Error	< 10 arc minutes	< 10 arc minutes	< 5 arc minutes
Bevel	0.2-0.5 mm x 45°	0.2-0.5 mm x 45°	0.25 mm x 45°

These prisms are also available in UV grade Fused Silica as well as other material.
Optical coatings are also available for AR, mirror or beamsplitter applications.

Tower Optical manufactures custom prisms.

If you have a design simply email it to Sales@TowerOptical.com and indicate the quantity required.

We will respond with a quotation ASAP!

Custom Prism Capabilities

Sizes	**0.5 - 100 mm**
Angle tolerance to	**1 arc second**
Dimensional tolerance	**+0.10 mm**
Surface quality (Scratch/ Dig)	**10/5**
Flatness	**λ/10 @ 632.8nm**

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Cage Code: 1N2U3 **SDVOSB** **ITAR Compliant**

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VALUABLE 40 YEARS EXPERIENCE

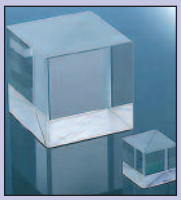
Beamsplitters

TOWER OPTICAL CORPORATION

Beamsplitters are used to split or combine beams of light. Tower Optical provides some standard beamsplitters, but most are custom per drawings submitted by a customer. Some standard cubes and plate beamsplitters are shown below.

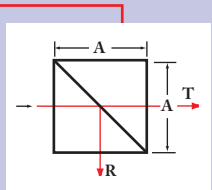
Plates are used for most laser applications as they exhibit low absorption. Cubes are a convenient, protected form for low power applications. The performance of the beamsplitters is a function of the beamsplitter coating.

Polarization Beamsplitter Cubes



These beamsplitters are based upon using two complementary prisms. The output beam that is parallel to the input beam is **p-polarized**, while the orthogonal output beam is **s-polarized**. Non-polarized beam-splitter cubes can be provided.

Specifications

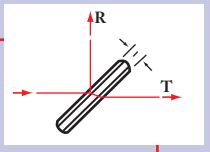


Material: BK-7 grade A optical glass
Dimension range: 3.2 mm to 50.8 mm
Dimensional tolerance: ± 0.2 mm
Angular tolerance: ± 3 arc minutes
Surface quality: 60-40 Scratch-Dig
Beam deviation: 3 arc minutes
Extinction ratio: >100:1
Principal transmittance: T_p>95% and T_s<1%
Principal reflectance: R_s>99% and R_p<5%
Wavelength range: 226 nm to 2300 nm
Polarization beamsplitter coating: on hypotenuse
AR coating: R<0.25% per face for 4 faces

Beamsplitter Plates

Beamsplitter plates are primarily used to split or recombine a beam of light, especially in high power lasers. When using beamsplitter plates the two partial beams travel different optical paths. The optical paths depend on the incident angle and the thickness of the plates. The beam can be shifted.

Specifications



Material: BK-7 grade A optical glass
Diameter range: 10 mm to 50.8 mm
Dimensional tolerance: ± 0.2 mm
Thickness tolerance: ± 0.2 mm
Flatness: λ/4@632.8 nm per 25 mm
Surface quality: 60-40 Scratch-Dig
Parallelism: 1 arc minute
T/R: 50/50 ± 5% for random polarization
$T=(T_s + T_p)$, $R=(R_s + R_p)/2$
Coatings: 45° incidence
S1: Single wavelength partial reflectance
S2: "V" AR-coatings

Pricing and Ordering Information

Model	Narrow or Broad	Size mm	Price $
BSPN1-5-X	N	5 x 5 x 5	148
BSPN1-10-X	N	10 x 10 x 10	148
BSPN1-15-X	N	15 x 15 x 15	185
BSPN1-20-X	N	20 x 20 x 20	209
BSPB1-10-Y	B	10 x 10 x 10	160
BSPB1-15-Y	B	15 x 15 x 15	190
BSPB1-20-Y	B	20 x 20 x 20	203

Model	Narrow or Broad	Size mm	Shape RND SQ	Price $
BSNN1-12.7S-X	N	12.7 x 12.7 x 3	SQ	56
BSNN1-25.4S-X	N	25.4 x 25.4 x 3	SQ	78
BSNN1-25.4R-X	N	25.4 x 3	RND	78
BSNN1-50.8S-X	N	50.8 x 50.8 x 3	SQ	129
BSNB1-12.7S-Y	B	12.7 x 12.7 x 3	SQ	67
BSNB1-25.4S-Y	B	25.4 x 25.4 x 3	SQ	83
BSNB1-25.4R-Y	B	25.4 x 3	RND	83
BSNB1-50.8S-Y	B	50.8 x 50.8 x 3	SQ	133

X = Narrow band wavelengths: 488, 514, 633, 780, 850, 1064, 1300, 1550 nm
Y = Broad band ranges (nm): 1 = 450 - 680, 2 = 650 - 850, 3 = 900 - 1200, 4 = 1200 - 1550 nm

The Beamsplitter specifications are general - We are happy to quote other specifications.

Optical Filters and Coatings

TOWER OPTICAL CORPORATION

Custom Filters

Tower custom filters cover applications for biomedical bandpass, narrow bandpass, broad banpass or long pass. Using ion-beam sputtering together with volume manufacturing methods, Tower is able to offer cost-effective solutions.

Biomedical Filters

From: 340 nm to 766 nm
Size: as required
CWL tolerance: ±2 nm
FWHM: 8-10 nm, typical
FWHM tolerance: ±1 nm
Transmission: >50%
Blocking: 300 nm – 1200 nm
Rejection: OD=4, 0.01% or 10^{-4}

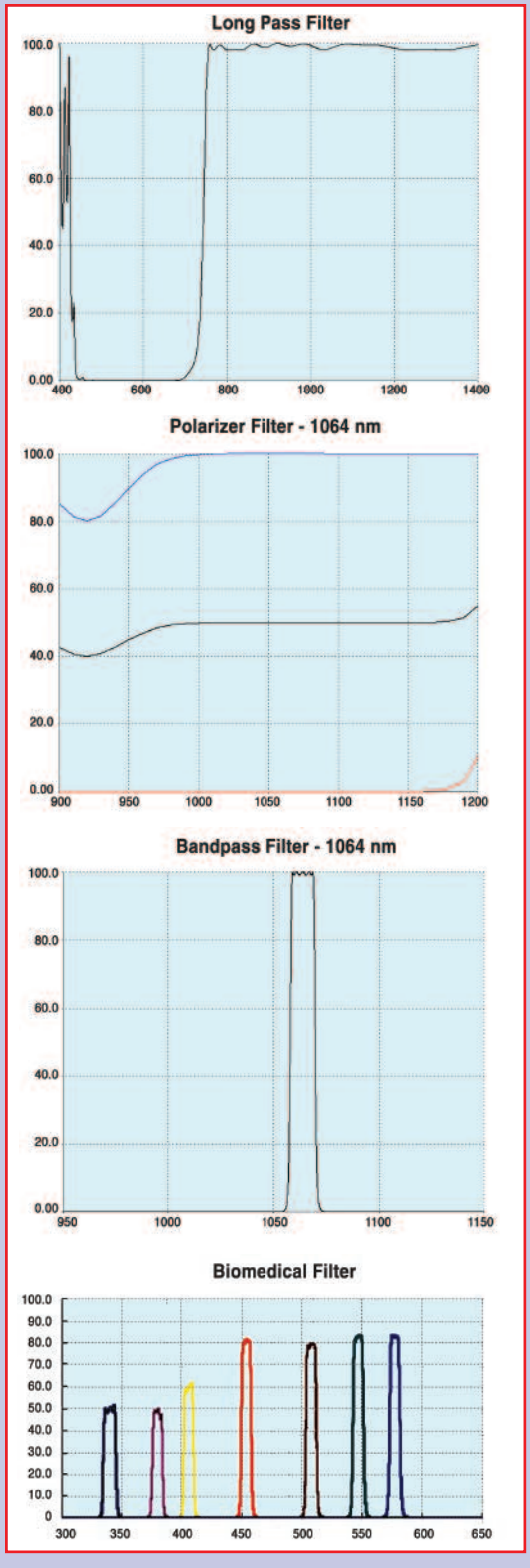
Narrow Bandpass

From: 340 nm to 1570 nm
Size: as required
CWL tolerance: 0.4 nm – 2 nm
FWHM: 2 nm – 50 nm
Transmission: >90%
Blocking: 300 nm – 1200 nm
300 nm – 1800 nm
Rejection: OD>4, OD>6

Broad Bandpass

From: 340 nm to 1570 nm
Size: as required
CWL tolerance: >10 nm
FWHM: >50 nm
Transmission: >70%*
Blocking: 300 nm – 1200 nm
300 nm – 1800 nm
Rejection: OD>3, OD>4

* Specify desired level



Coatings

- **Highpower laser coatings:**
  anti-reflection, reflective,
  partial reflectors, beamsplitters and polarizers
- **Metallic coatings**
  Aluminum – UV and protected
  Silver – protected
  Reflectance >98% 800 nm to IR
  Gold – protected and unprotected
- **Broadband dichroic beamsplitter coatings**
- **Polarizing beamsplitter coatings**
- **Multi-wavelength and extended coatings**
- **Anti-reflective coatings from UV to IR**
- **Dielectric high reflective coatings high power**
- **Filters short pass, long pass and bandpass filters**

The above coatings are available for wavelengths ranging from UV, VIS, and near IR, including laser wavelengths from 193 nm to 3 microns. Custom and specialized coatings available upon request.

IBS Ion beam sputttered thin films for the most complex optical image. We can provide computer design of optical systems and thin film coatings. Tower offers Laser damage and envioromental testing per customer request.

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Hot and Cold Mirrors

TOWER OPTICAL CORPORATION

Hot Mirrors are used in applications when there is the requirement to separate visible light from heat. The hot mirror accomplishes this by reflecting the heat. The use of borosilicate type glass allows operation in high temperatures. Operation at an AOI of 0° is preferred. The most common wavelength range for an average transmission of 85% through the hot mirror is 420 – 700 nm. The reflective range for the hot mirror for R>95% is 800–1000 nm. Additionally, R>50% from 735 – 1080 nm.

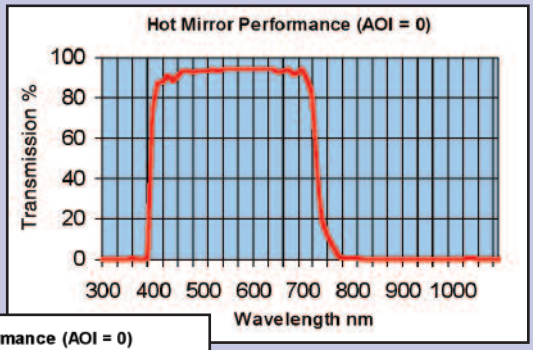
Cold Mirrors are used where the requirements are to reflect visible light and remove the heat by transmission. Operation at an AOI of 45° is preferred. The most common wavelength range for transmission through the cold mirror is 800–1200 nm. The average-transmission range is T>85%. Additionally, R>95% for 400 - 700 nm.

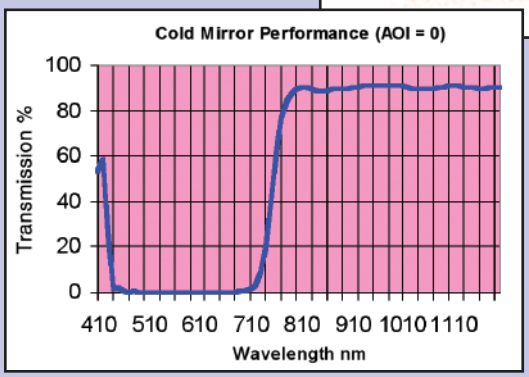
Features of Hot Mirrors

- High transmission for the visible range
- High reflection for infrared
- Removes heat
- Uses Borofloat® type glass
- Dielectric coating
- AOI's of 0° or 45°
- Custom mirrors to your configuration

Features of Cold Mirrors

- High reflection for the visible range
- High transmission for infrared





Typical Specifications

Hot Mirrors

Material: borosilicate type glass
Size: 15 mm to 300 mm
Thickness: 3.3 mm
Mirror coating: dielectric multilayer
Transmission: Tave>85% for 425–700nm
Reflection: Rave>90% for 750–1050nm
Surface Finish: 80-50
Flatness: λ/2 @633 nm per inch
Protective Bevel: 0.3 mm x 45°

Cold Mirrors

Material: borosilicate type glass
Size: 15 mm to 300 mm
Thickness: 3.3 mm
Mirror coating: dielectric multilayer
Transmission: tave>85% for 750–1000 nm
Reflection: rave>90% for 400–700 nm
Surface Finish: 80-50
Flatness: λ/2 @633 nm per inch
Protective Bevel: 0.3 mm x 45°

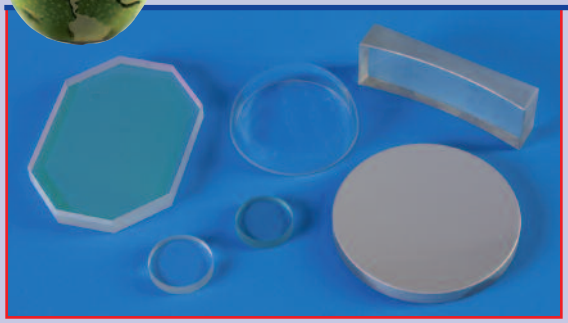
Standard Cold/Hot Mirrors

Type	Model	AOI	Price
Cold	MC0-25.4	0	$50
	MC0-50.8	0	$61
	MC45-25.4	45	$50
	MC45-50.8	45	$61
Hot	MH0-25.4	0	$53
	MH0-50.8	0	$79
	MH45-25.4	45	$54
	MH45-50.8	45	$72

Custom Cold/Hot Mirrors available.

Windows and Mirrors

TOWER OPTICAL CORPORATION



Windows are used to isolate different physical environments while allowing light to pass. The selection of a window should consider the properties of the different optical materials, transmission, wavelength range, and resistance to the environment. Tower offers a wide range of materials and a variety of anti-reflecting coatings that can be deposited on the windows.

Tower Optical manufactures windows from BK7, UV grade fused silica and sapphire. Other materials are available on a custom basis. In addition, we offer three different quality standards as described below. Contact factory for info on sapphire windows.

Specifications	Standard Grade	High Grade	Laser Grade	High Grade
Material	BK7 grade A	BK7 grade A	UV fused silica	sapphire
Dimensional tolerance	+0.0/-0.1 mm	+0.0/-0.1 mm	+0.0/-0.1 mm	±0.1 mm
Flatness (TWF)	λ/2 @ 632.8 nm	λ/10 @ 632.8 nm	λ/10 @ 632.8 nm	λ/4 per 25.4 mm
Surface quality	40-20 Scratch-Dig	20-10 Scratch-Dig	20-10 Scratch-Dig	40-20 Scratch-Dig
Thickness tolerance	±0.2 mm	±0.2 mm	±0.2 mm	±0.1 mm
Parallelism	< 1 arc minute	< 10 arc seconds	< 10 arc seconds	<30 arc seconds
Bevel	0.2 mm x 45°	0.2 mm x 45°	0.2 mm x 45°	—

BK7 grade A optical glass, Standard WB11 and High WB12								UV grade fused silica, High WB22			
Model No.	Dia mm	Thick	Price $	Model No.	Dia mm	Thick	Price	Model No.	Dia mm	Thick	Price $
WB11-005	5.0	2.0	12	WB12-005	5.0	2.0	31	WF22-005	5.0	2.0	39
WB11-010	10.0	2.0	18	WB12-010	10.0	2.0	39	WF22-010	10.0	2.0	45
WB11-012	12.5	2.0	19	WB12-012	12.5	6.0	40	WF22-012	12.5	6.0	52
WB11-020	20.0	2.0	21	WB12-020	20.0	6.0	52	WF22-020	20.0	6.0	64
WB11-025	25.0	2.0	25	WB12-025	25.0	6.0	62	WF22-025	25.0	6.0	78
WB11-038	38.0	4.0	29	WB12-038	38.0	10.0	84	WF22-038	38.0	10.0	130
WB11-050	50.0	4.0	39	WB12-050	50.0	10.0	151	WF22-050	50.0	10.0	315

Mirrors have one surface with a highly reflective coating, usually aluminum or silver. Most mirrors for optical applications are called first surface types since the coating is on the front surface thereby eliminating the optical properties of the glass from affecting the incident or reflected light. The rear surface is usually fine ground. *All of the following mirrors have a protected aluminum coating applied to the front surface.*

Specifications	Standard grade	High grade
Material	BK7 grade A	BK7 grade A or fused silica
Dimensional tolerance	+0.0/-0.1 mm	+0.0/-0.1 mm
Flatness:	λ/5 @ 632.8 nm	λ/10 @ 632.8 nm
Surface quality	40-20 Scratch-Dig	10-5 Scratch-Dig
Thickness tolerance	±0.2 mm	±0.2 mm
Parallelism	< 3 arc minutes	< 3 arc minutes

BK7 grade A optical glass, Standard MB11 and High MB12								UV grade fused silica, High MF22			
Model No.	Dia mm	Thick	Price $	Model No.	Dia mm	Thick	Price $	Model No.	Dia mm	Thick	Price $
MB11-010	10.0	2.0	20	MB12-010	10.0	2.0	36	MF22-010	10.0	2.0	46
MB11-012	12.5	2.0	20	MB12-012	12.5	6.0	36	MF22-012	12.5	6.0	53
MB11-020	20.0	2.0	23	MB12-020	20.0	6.0	46	MF22-020	20.0	6.0	66
MB11-025	25.0	2.0	26	MB12-025	25.0	6.0	56	MF22-025	25.0	6.0	79
MB11-038	38.0	4.0	30	MB12-038	38.0	10.0	63	MF22-038	38.0	10.0	254
MB11-050	50.0	4.0	40	MB12-050	50.0	10.0	122	MF22-050	50.0	10.0	304

Lenses – Custom and Cylindrical

TOWER OPTICAL CORPORATION

Custom Lenses

- Lenses and micro lenses
- Custom made to your specifications
- Singlets, doublets, triplets
- Multi-element assemblies
- Precision tolerances available
- Free consultation

General Lens Capabilities

Sizes: 1 mm to 350 mm
Diameter tolerance: ±0.02 mm
Decentration (wedge): ± 10 second
Irregularity: 0.05 waves @ 632.8
Spherical error: 0.10 waves @ 632.8
Surface quality: 10-5 Scratch-Dig
Thickness tolerance: ± 0.01 mm

Send us your drawing

Cylindrical Lenses

Plano Convex Cylindrical Lenses

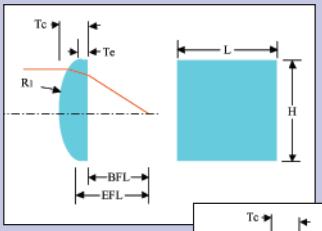
Model	H x L mm	EFL mm	BFL mm	R1 mm	Tc mm	Te mm	Price $
CYX15-010-012	10 x 10	12.7	9.862	6.56	4.31	2.0	75
CYX15-010-020	10 x 10	20	17.835	10.33	3.29	2.0	70
CYX15-010-025	10 x 10	25	23.016	12.92	3.01	2.0	70
CYX15-020-012	10 x 20	12.7	9.862	6.56	4.31	2.0	81
CYX15-020-020	10 x 20	20	17.835	10.33	3.29	2.0	76
CYX15-020-025	10 x 20	25	23.016	12.92	3.01	2.0	76
CYX15-040-050	20 x 40	50	47.352	25.82	4.02	2.0	87
CYX15-040-075	20 x 40	75	72.822	38.73	3.31	2.0	81
CYX15-040-100	20 x 40	100	97.381	51.64	3.98	3.0	81
CYX15-040-150	20 x 40	150	147.6	77.46	3.65	3.0	81

Plano Concave Cylindrical Lenses

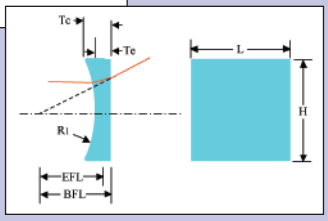
Model	H x L mm	EFL mm	BFL mm	R1 mm	Tc mm	Te mm	Price $
CYV16-010-012	10 x 10	-12.7	-14.023	-6.56	2.0	4.31	75
CYV16-010-025	10 x 10	-25.0	-26.320	-12.91	2.0	3.01	70
CYV16-020-012	10 x 20	-12.7	-14.030	-6.56	2.0	4.31	81
CYV16-020-025	10 x 20	-25.0	-26.320	-12.91	2.0	3.01	76
CYV16-040-050	20 x 40	-50.0	-51.981	-25.82	2.0	4.02	87
CYV16-040-075	20 x 40	-75.0	-76.983	-38.73	3.0	4.31	81
CYV16-040-100	20 x 40	-100.0	-101.325	-51.64	3.0	3.98	81
CYV16-040-150	20 x 40	-150.0	-151.987	-77.46	3.0	3.65	81
CYV16-040-250	20 x 40	-250.0	-251.974	-129.09	3.0	3.39	81
CYV16-040-500	20 x 40	-500.0	-501.969	-258.18	3.0	3.19	81

Specifications

Material: BK7 or equivalent
Design wavelength: 587.6nm
Dimensional tolerance: ±0.2 mm
Focal length tolerance: ±2%
Centering tolerance: 5-15 arc minutes
Clear aperture: 90%
Surface quality: 60-40 Scratch-Dig
Bevel: 0.2 mm x 45°
Coating: none



Convex



Concave

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Ball and Drum Lenses

TOWER OPTICAL CORPORATION

Ball Lenses are used for various tasks such as improving the coupling between optical fibers and the emitters or detectors they interface with. Standard size lenses range from 1.0 mm to 5.0 mm. Custom-made sizes or special materials are also available. All ball lenses can be ordered with full-surface anti-reflection (AR) coating.

The effective focal length of a ball lens is given by the following formula:

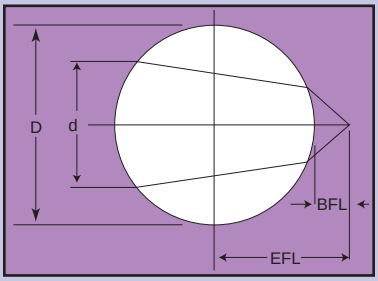
BFL = F – D/2 and EFL = nD/4(n-1)

The Numerical Aperture (NA) of a ball lens is dependent on the focal length of the ball and on the input diameter, d.

NA = 2d(n-1)/nD

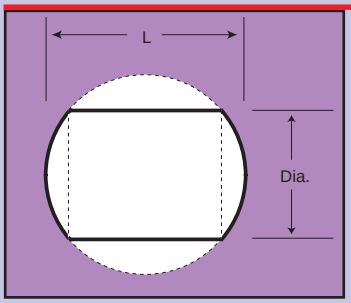
Pricing and ordering info

Ball Lens Diameter	Material	Model Number	Price
1.0 mm	BK7	LB1-001	$22
2.0 mm	BK7	LB1-002	$21
3.0 mm	BK7	LB1-003	$20
4.0 mm	BK7	LB1-004	$20
5.0 mm	BK7	LB1-005	$22
1.0 mm	UV FS	LB2-001	$34
2.0 mm	UV FS	LB2-002	$28
3.0 mm	UV FS	LB2-003	$28
4.0 mm	UV FS	LB2-004	$28
5.0 mm	UV FS	LB2-005	$30
6.0 mm	UV FS	LB2-006	$41
8.0 mm	UV FS	LB2-008	$43
10.0 mm	UV FS	LB2-010	$58



Specifications

Material: BK7 grade A or equivalent or UV fused silica
Diameter tolerance: ±0.01 mm
Sphericity: ±0.003 mm
Surface quality: 40-20 Scratch-Dig
Coating: none



Drum Lenses

A drum lens is a variation of a ball lens where a portion of the ball is ground down to a smaller diameter. These lenses are used in similar applications to those of ball lenses. The drum lens adds the ability to handle and package it in a different way.

Specifications

Material: BK7 grade A optical glass
Diameter tolerance: +0.0/-0.05 mm
Length: ±0.01 mm
Surface quality: 40-20 Scratch-Dig
Coating: none

Models available. Call for prices

Model No.	Diameter	Length
LD1-020-025	2.0 mm	2.5 mm
LD1-020-030	2.0 mm	3.0 mm
LD1-020-040	3.0 mm	4.0 mm
LD1-020-050	4.0 mm	5.0 mm

LD2-XXX-yyy is Fused Silica drum lenses. Contact factory for pricing.

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Cage Code: 1N2U3 SDVOSB ITAR Compliant

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Plano Concave Lenses

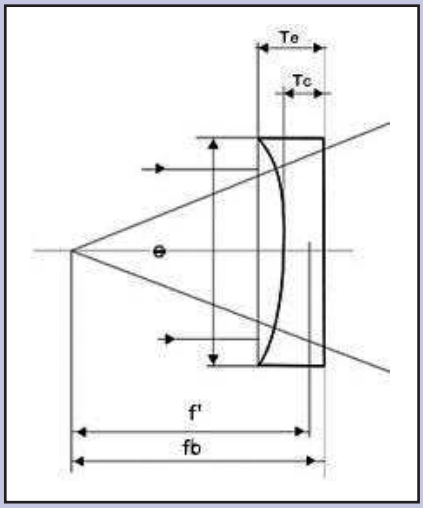
TOWER OPTICAL CORPORATION

Tower Optical's plano concave lenses have a negative focal length, diverge collimated incident light, and form only virtual images which are seen through the lens. They are often used to expand light beams or increase focal lengths in existing systems.

They are widely used in telescopes, collimaters, optical transceivers, magnifiers, radiometers and condensers.

Specifications

Material: BK7, grade A, fine anneal, or K9 substitute
Design wavelength: 632.8 nm
Diameter tolerance: +0/-0.10 mm
Focal length tolerance: ±1%
Centering: ±3 arc minutes
Clear aperture: 90% of diameter
Surface quality: 60-40 Scratch-Dig
Bevel: 0.25 mm x 45°
Coating: none



Part No. Number	Dia. (mm)	EFL (mm)	R1 (mm)	R2 (mm)	CT (mm)	ET (mm)	BFL (mm)
LNCV001	6	-18	-9.26	∞	2	2.5	-19.32
LNCV002	6	-24	-12.35	∞	2	2.37	-25.32
LNCV003	12.7	-25	-12.87	∞	3	4.68	-26.98
LNCV004	12.7	-30	-15.44	∞	3	4.37	-31.98
LNCV005	12.7	-50	-25.73	∞	3.5	4.3	-52.31
LNCV006	25.4	-50	-25.7	∞	3.5	6.9	-52.3
LNCV007	25.4	-75	-38.6	∞	3.5	5.65	-77.31
LNCV008	25.4	-100	-51.46	∞	4	5.59	-102.64
LNCV009	50.8	-75	-38.6	∞	3.5	13.04	-77.31
LNCV010	50.8	-100	-51.46	∞	4	10.71	-102.64
LNCV011	50.8	-150	-77.19	∞	4	8.3	-31.97

Please check with Tower for availability.

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VALUABLE 40 YEARS EXPERIENCE

Plano Convex Lenses

TOWER OPTICAL CORPORATION

Tower Optical's plano convex lenses have positive focal lengths, converge incident light, and form both real images (as might be focused in a piece of paper), and virtual images (as are seen through the lenses when they are used as magnifiers.)

They are widely used in telescopes, collimators, optical transceivers, magnifiers, radiometers and condensers.

Plano Convex Lenses

Part No. Number	Diameter (mm)	EFL (mm)	R1 (mm)	CT (mm)	ET (mm)	BFL (mm)	Price each
LNCX001	6	10	5.15	2.46	1.5	8.37	18
LNCX002	6	12	6.18	2.28	1.5	10.5	16
LNCX003	6	15	7.73	2.11	1.5	13.61	16
LNCX004	6	30	15.54	1.79	1.5	28.82	18
LNCX005	12.7	15	7.73	5.12	1.8	11.62	23
LNCX006	12.7	20	10.3	3.99	1.8	17.37	21
LNCX007	12.7	25	12.88	3.47	1.8	22.71	21
LNCX008	12.7	30	15.45	3.17	1.8	27.91	21
LNCX009	12.7	40	20.6	2.8	1.8	38.15	21
LNCX010	12.7	50	25.75	2.6	1.8	48.29	21
LNCX011	12.7	100	51.51	2.19	1.8	98.55	23
LNCX012	25.4	25.4	13.08	11.74	1.8	17.65	29
LNCX013	25.4	30	15.45	8.65	2	24.29	25
LNCX014	25.4	35	18.03	7.23	2	30.23	24
LNCX015	25.4	40	20.6	6.38	2	25.79	24
LNCX016	25.4	50	25.75	5.35	2	46.47	24
LNCX017	25.4	60	30.9	4.73	2	56.88	24
LNCX018	25.4	75	38.63	4.15	2	72.26	24
LNCX019	25.4	100	51.51	3.59	2	97.63	24
LNCX020	25.4	125	64.39	3.26	2	122.85	24
LNCX021	25.4	150	77.26	3.05	2	147.99	24
LNCX022	25.4	175	90.14	2.9	2	173.09	24
LNCX023	25.4	200	103.02	2.79	2	198.16	24
LNCX024	25.4	250	128.77	2.63	2	248.27	24

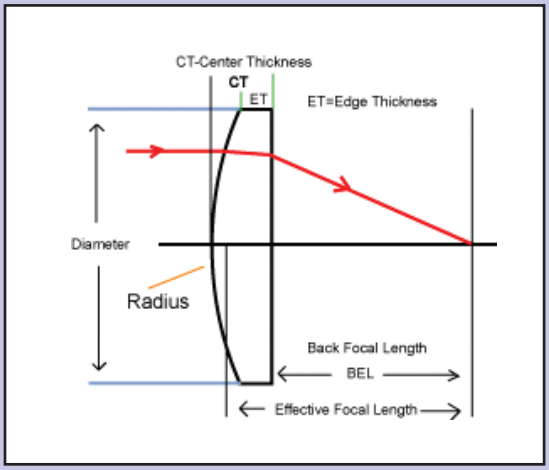
(continued on next page)

Please check with Tower for availability. ***Contact us for quantity pricing.*** *sales@toweroptical.com*

Plano Convex Lenses *(continued)*

Part No. Number	Diameter (mm)	EFL (mm)	R1 (mm)	CT (mm)	ET (mm)	BFL (mm)	Price each
LNCX025	25.4	300	154.52	2.52	2	298.33	24
LNCX026	25.4	400	206.03	2.39	2	398.42	24
LNCX027	25.4	500	257.54	2.31	2	498.47	27
LNCX028	25.4	750	386.31	2.21	2	748.54	28
LNCX029	25.4	1000	515.08	2.16	2	998.58	29
LNCX030	50.8	60	30.9	16.3	3	49.24	42
LNCX031	50.8	75	38.63	12.52	3	66.73	41
LNCX032	50.8	100	51.51	9.7	3	93.6	40
LNCX033	50.8	125	64.39	8.22	3	119.57	40
LNCX034	50.8	150	77.26	7.29	3	145.19	40
LNCX035	50.8	175	90.14	6.65	3	170.61	40
LNCX036	50.8	200	103.02	6.18	3	195.92	40
LNCX037	50.8	250	128.77	5.53	3	246.35	40
LNCX038	50.8	300	154.52	5.1	3	296.63	40
LNCX039	50.8	400	206.03	4.57	3	396.98	40
LNCX040	50.8	500	257.54	4.26	3	497.19	41
LNCX041	50.8	750	386.31	3.84	3	747.47	42
LNCX042	50.8	1000	515.08	3.63	3	997.61	42
LNCX043	75	85	43.78	24.19	3	69.04	58
LNCX044	75	100	51.51	19.2	3	87.33	56
LNCX045	75	150	77.26	12.71	3	141.61	55
LNCX046	75	200	103.02	10.07	3	193.35	55

Please check with Tower for availability.



Specifications

Material: BK7, grade A, fine anneal, or K9

Design wavelength: 632.8 nm

Diameter tolerance: +0/-0.10 mm

Focal Length tolerance: ±1%

Centering: ±3 arc minutes

Clear aperture: 90% of diameter

Surface quality: 60-40 Scratch-Dig

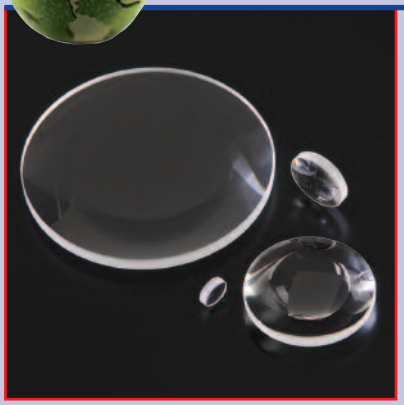
Bevel: 0.25 mm x 45°

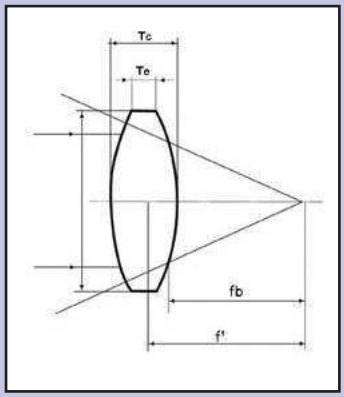
Coating: none

Contact us for quantity pricing. *sales@toweroptical.com*

Bi Convex Lenses

TOWER OPTICAL CORPORATION





Part No. Number	Dia. (mm)	EFL (mm)	R1 (mm)	R2 (mm)	CT (mm)	ET (mm)	BFL (mm)	Price each
LNBX001	6	10	9.87	9.87	2.43	1.5	9.16	22
LNBX002	6	12	11.97	11.97	2.76	1.5	11.73	20
LNBX003	6	15	15.09	15.09	2.1	1.5	14.29	20
LNBX004	6	30	30.6	30.6	1.79	1.5	29.4	22
LNBX005	9	12	11.72	11.72	3.6	1.8	10.75	23
LNBX006	9	20	20.11	20.11	2.82	1.8	19.05	23
LNBX007	12.7	15	14.61	14.61	4.7	1.8	13.36	25
LNBX008	12.7	20	19.92	19.92	3.88	1.8	18.68	23
LNBX009	12.7	25	25.16	25.16	3.43	1.8	23.84	23
LNBX010	12.7	30	30.36	30.36	3.14	1.8	28.95	23
LNBX011	12.7	40	40.72	40.72	2.8	1.8	39.07	23
LNBX012	12.7	50	51.06	51.06	2.59	1.8	49.14	23
LNBX013	12.7	100	102.64	102.64	2.19	1.8	99.27	25
LNBX014	25.4	25.4	24.54	24.54	8.98	1.8	22.24	27
LNBX015	25.4	30	29.53	29.53	7.74	2	27.33	24
LNBX016	25.4	35	34.86	34.86	6.79	2	37.68	22
LNBX017	25.4	40	40.14	40.14	6.12	2	37.93	22
LNBX018	25.4	50	50.6	50.6	5.24	2	48.24	22
LNBX019	25.4	60	61.01	61.01	4.67	2	58.44	22
LNBX020	25.4	75	76.56	76.56	4.12	2	73.62	22
LNBX021	25.4	100	102.4	102.4	3.58	2	98.81	22
LNBX022	25.4	125	128.21	128.21	3.26	2	123.92	22
LNBX023	25.4	150	154	154	3.05	2	148.99	22
LNBX024	25.4	175	179.78	179.78	2.9	2	174.04	22
LNBX025	25.4	200	205.56	205.56	2.79	2	199.06	22
LNBX026	25.4	250	257.09	257.09	2.63	2	249.13	22
LNBX027	25.4	300	308.62	308.62	2.52	2	299.17	22
LNBX028	25.4	400	411.66	411.66	2.39	2	399.21	22
LNBX029	25.4	500	514.69	514.69	2.31	2	499.34	22
LNBX030	25.4	750	772.25	772.25	2.21	2	749.27	24
LNBX031	25.4	1000	1029.8	1029.8	2.16	2	999.29	26
LNBX032	50.8	60	59.25	59.25	14.44	3	55.03	35
LNBX033	50.8	75	75.19	75.19	11.84	3	70.99	33
LNBX034	50.8	100	101.38	101.38	9.47	3	96.82	32
LNBX035	50.8	125	127.38	127.38	8.12	3	122.29	32
LNBX036	50.8	150	153.28	153.28	7.24	3	147.59	32
LNBX037	50.8	175	139.15	139.15	6.62	3	172.8	32
LNBX038	50.8	200	204.98	204.98	6.16	3	197.96	32
LNBX039	50.8	250	256.6	256.6	5.52	3	248.17	32
LNBX040	50.8	300	308.16	308.16	5.1	3	298.31	32
LNBX041	50.8	400	411.29	411.29	4.57	3	398.49	32
LNBX042	50.8	500	514.36	514.36	4.26	3	498.59	32
LNBX043	50.8	750	771.97	771.97	3.84	3	748.73	32
LNBX044	50.8	1000	1029.55	1029.55	3.63	3	998.8	35

Specifications

Material: BK7, grade A, fine anneal, or K9 substitute

Design wavelength: 632.8 nm

Diameter tolerance: +0/-0.10 mm

Focal Length tolerance: ±1%

Centering: ±3 arc minutes

Clear aperture: 90% of diameter

Surface quality: 60-40 Scratch-Dig

Bevel: 0.25 mm x 45°

Coating: none

Please check with Tower for availability

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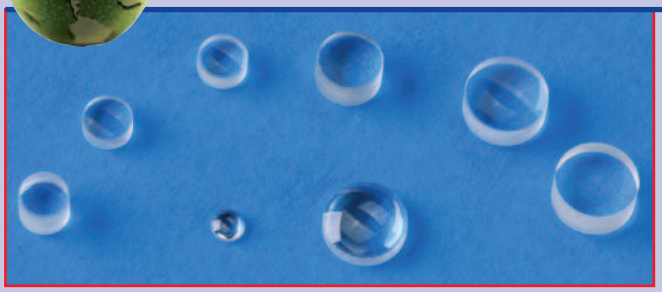
Mini Lenses

TOWER OPTICAL CORPORATION



Biconvex Mini Lenses

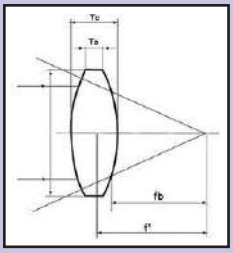
Part Number	Dia (mm)	FL (mm)	Material	Tc (mm)	Te (mm)	Price Each
LMBX001	3.0	4.5	BK7	2.0	1.5	$26
LMBX002	3.0	6.0	BK7	1.8	1.4	$26
LMBX003	3.0	9.0	BK7	1.6	1.4	$26
LMBX004	5.0	4.5	BK7	3.0	1.3	$26
LMBX005	5.0	7.0	BK7	3.0	2.0	$26
LMBX006	5.0	10.0	BK7	2.6	2.0	$26

Plano Convex Mini Lenses

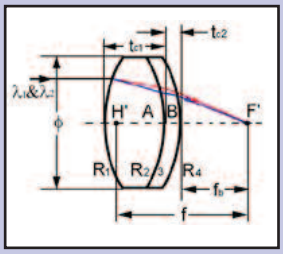
Part Number	Dia (mm)	FL (mm)	Material	Tc (mm)	Te (mm)	Price Each
LMPX001	1.0	0.6	LaSFN9	0.50	0.39	$36
LMPX002	1.5	1.0	LaSFN9	0.80	0.30	$36
LMPX003	1.5	1.5	LaSFN9	0.80	0.56	$36
LMPX004	1.5	29.0	BK7	0.50	0.46	$36
LMPX005	2.0	1.5	LaSFN9	0.80	0.32	$35
LMPX006	2.0	2.0	LaSFN9	0.80	0.48	$35
LMPX007	2.5	1.6	LaSFN9	0.99	0.17	$34
LMPX008	2.5	2.0	LaSFN9	0.80	0.25	$34
LMPX009	2.5	2.5	LaSFN9	0.80	0.39	$34
LMPX010	2.5	3.0	LaSFN9	0.80	0.48	$34
LMPX011	3.0	3.0	SF11	2.00	1.46	$26
LMPX012	3.0	4.5	SF6	1.80	1.47	$26
LMPX013	3.0	6.0	BK7	1.80	1.41	$26
LMPX014	3.0	9.0	BK7	1.50	1.25	$26
LMPX015	3.0	12.0	BK7	1.08	0.90	$26
LMPX016	3.0	15.0	BK7	1.26	1.12	$26
LMPX017	4.0	4.0	SF6	1.70	1.00	$25
LMPX018	4.0	6.0	BK7	2.26	1.53	$25
LMPX019	4.0	8.0	BaF10	1.39	1.00	$25
LMPX020	4.0	10.0	BK7	1.64	1.24	$25
LMPX021	4.0	12.0	BK7	1.52	1.19	$25
LMPX022	5.0	5.0	SF6	1.87	1.00	$25
LMPX023	5.0	10.0	BK7	1.64	1.00	$25
LMPX024	5.0	12.0	BK7	1.77	1.25	$25
LMPX025	5.0	15.0	BK7	1.60	1.19	$25

Mini Achromatic Lenses *(MgF2 coated)*

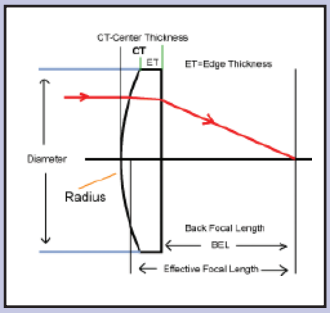
Part Number	Dia (mm)	FL (mm)	Tc (mm)	Te (mm)	Price Each
LMD001	3.0	9.0	2.50	2.19	$60
LMD002	3.0	12.0	2.68	2.45	$60
LMD003	4.0	8.0	2.53	2.09	$60
LMD004	5.0	7.5	4.75	3.98	$60
LMD005	5.0	10.0	2.75	2.22	$60
LMD006	5.0	15.0	2.58	2.23	$60
LMD007	5.0	20.0	2.64	2.37	$60



Biconvex Mini Lenses



Mini Achromatic Lenses



Convex Mini Lenses

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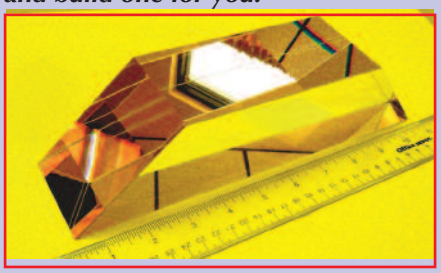
Large Optics

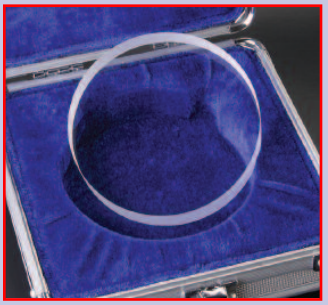
TOWER OPTICAL CORPORATION

2″ Beamsplitter

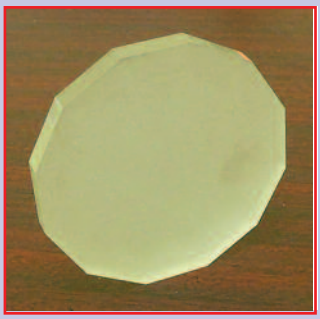
These are a sampling of **Tower's** capability in fabricating large, precision optics. ***Send us your drawings so we can quote them and build one for you.***



10″ custom Dove Prism

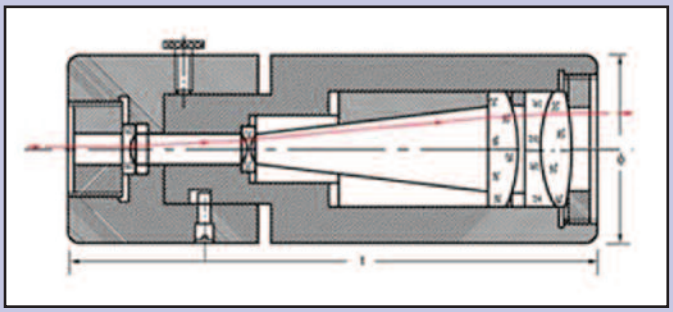


Optical Flats up to 10"



12 sided Optic Scanner Prism

Optical Assemblies



- **Multi-element assemblies**
- **Beam combiners**
- **Custom prism assemblies**
- **Window assemblies**
- **Cell null lens assembly**
- **Mirror mounts**
- **IR optics for military**
- **Reflector assemblies**
- **And more!**

Take advantage of **Tower Optical's** knowledge and experience with precision assembly by allowing Tower Optical, and its worldwide network of optical partners, to provide you with optical assembly services for even the most challenging tasks and exacting specifications. Note, of course, that Tower can also manufacture the optical components required in your assembly thereby allowing you to achieve your end objective in fewer, more efficient, steps. Tower is dedicated to being a top-quality source for both optical components and assembly services. ***Tower Optical will bring you the precision and quality you want at lower prices than our competitors!***

Experienced Staff

Tower's in-house staff of optics professionals includes experienced technicians with a track record in a wide variety of assemblies. Our worldwide partner network adds to the in-house capability and allows the expansion of the force to accommodate large jobs as well as small ones.

Please submit your requirements to sales@toweroptical.com for a prompt quote.

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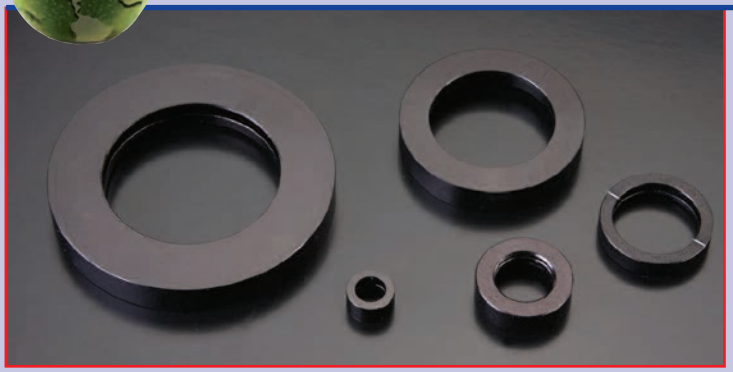
VALUABLE 40 YEARS EXPERIENCE

Waveplate and Similar Optics Mounting Rings

TOWER OPTICAL CORPORATION

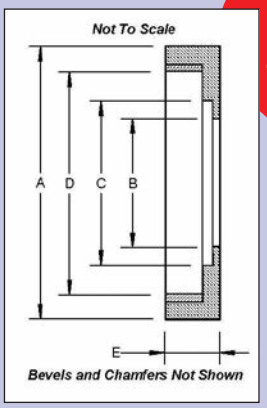


- Mounting ring includes retainer
- All retainers use fine threads
- High grade aluminum
- Hard coat black anodize
- Six sizes
- With or without axis mark

New Offering

Tower Optical optics mounts are precision machined optical assemblies consisting of a housing and a retaining ring. The interface between the housing and ring is a fine metric thread. The retaining rings all have slots to simplify insertion and securing the internal optic being held. The mounts can be used for waveplates, mirrors, windows and lenses.

The mounts shown here are standard products, in stock, for immediate shipment. Tower welcomes requests for custom mounts that you may require. Simply email your drawings with quantities to quote to sales@TowerOptical.com. We will respond promptly.



Pricing and Odering Information

Mount P/N	A Diameter	B Clear Aperture	C Optics Diameter	D Internal Clearance	E Thickness	F Axis	Price
0515-0002	12.7	8	10	11	6.4	No	$25
0515-0002-L	12.7	8	10	11	6.4	Yes	$25
0515-0003	25.4	8	10	18	7.8	No	$35
0515-0003-L	25.4	8	10	18	7.8	Yes	$35
0515-0001	25.4	15	17.5	18	7.8	No	$40
0515-0001-L	25.4	15	17.5	18	7.8	Yes	$40
0515-0004	30	23	25.4	25.8	6	No	$44
0515-0004-L	30	23	25.4	25.8	6	Yes	$44
0515-0005	50.8	34	38.1	42.5	9	No	$50
0515-0005-L	50.8	34	38.1	42.5	9	Yes	$50
0515-0006	76.2	46.8	50.8	62	10	No	$65
0515-0006-L	76.2	46.8	50.5	62	10	Yes	$65

American Systems
REGISTRAR
5281 Clyde Park Ave. SW, Suite 1
Wyoming, MI 49509 USA
www.asrworldwide.com
616-942-6273

American Systems Registrar, LLC, a provider of third-party system registration and accredited by the ANSI National Accreditation Board attests that:

TOWER OPTICAL CORPORATION

3600 S. CONGRESS AVENUE
UNIT J
BOYNTON BEACH, FL 33426

with a scope of:

MANUFACTURE, SALES AND MARKETING OF PRECISION OPTICS

has established a quality management system that is in conformance with the International Quality System Standard

ISO 9001:2015

ASR Certificate Number:	**6418**
Date of Certification:	**February 6, 2022**
Date of Certification Expiration:	**February 5, 2025**
Date of Initial Registration:	**March 28, 2007**
Revision:	
Re-Issue Date:	

Richelle Kurtzi
President

CERTIFICATE OF REGISTRATION

Specifications and prices subject to change without notice.

ISO 9001: 2015 Certified