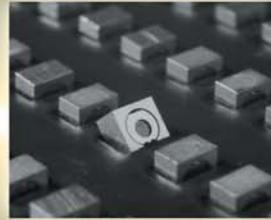


LightPath

TECHNOLOGIES™



2006 Product Catalog

focusing on optical solutions

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 Orlando, Florida 32826
 Phone 1-800-GRADIUM
 Phone 1-407-382-4003
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FACILITIES



LightPath Technologies Inc. was founded over 20 years ago with the goal of providing our customers with customized optical solutions. In the succeeding years, the company has continually built its reputation as a leading supplier of high quality and technologically advanced optical components serving the industrial, medical, defense and communications markets.

LightPath currently operates two facilities. A modern 40,000 square foot facility based in the Research Park at the University of Central Florida in Orlando, Florida which includes a 10,000 square foot class 1000 clean room for automated manufacturing, housing single-point diamond turning capabilities, precision machine shop for quick turn prototypes, and complete metrology labs.



In November 2005, LightPath added a second manufacturing location overseas to enable high-volume automated manufacturing. This modern facility located in Shanghai, China has 17,000 square feet and over 5,000 feet of clean room.

Together, LightPath's employees are dedicated to continue serving the growing demands of the optics community by supplying superior optical components and assemblies, from the simple to the most advanced, in prototype and production quantities.

LIGHTPATH QUALITY

At Lightpath Technologies Inc. we work very hard to make quality and customer satisfaction top priorities. Our Director of Quality considers his first priority to be an advocate for you, our customer. We value your business and make it our goal to ship top quality products that satisfy your requirements, on time and at competitive prices.

At Lightpath Technologies Inc., continuous improvement is an important part of our daily operation. We know that every aspect of our company can improve and we are applying this principle wherever we can by means of data collection and analysis to improve both quality and on-time delivery. Management reviews are conducted periodically with Product Managers and senior management in order to evaluate key performance indicators and make changes where necessary or desired.

The quality management system at LightPath Technologies inc. has been registered with TUV America as ISO 9001:2000 compliant since August of 2001. It includes an extensive document control system, maintained on our internal computer network, accessible throughout the facility, and managed by a full time document control person. It is composed of all the key features required for ISO 9001:2000 compliance, such as:

- 1) Standard operating procedures for company wide processes, including calibration, engineering, purchasing, management review, maintenance, corrective action, etc.
- 2) Over 150 individual work instructions, which cover the many specific processes, which are conducted at our facility.
- 3) A separate category of specification documents which govern various aspects of product performance requirements.
- 4) Engineering drawings (Solid Works and AutoCAD), supported by a full time draftsman.
- 5) Measurement and reporting systems for quality and on time delivery.

Incoming and final inspection groups are staffed with experienced personnel, with an average experience of over five years per inspector. A range of environmental chambers is available in-house for reliability testing for Telcordia and other mil standards to meet product qualification requirements.



BACKGROUND

Thank you for looking to LightPath Technologies for your optical product needs. LightPath is a recognized leader in optical solutions for industrial, defense, communications, test and measurement, and medical applications. For over 20 years, LightPath has built a strong portfolio of optical components and technologies that serve these industries. These products include molded glass aspheric lenses, optical isolators, fused fiber collimators, and gradient index Gadium lenses.

LightPath began in 1985 with the invention of Gadium glass, an axial gradient index glass that is used to make high performance, cost effective lenses for high power laser systems. As this breakthrough technology gained greater market acceptance in industrial applications, Lightpath grew from just a few employees to well over 100.

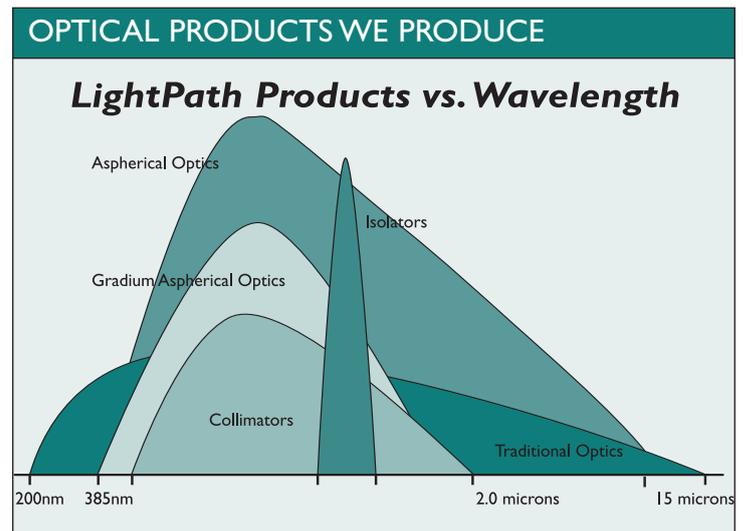
In 1996, LightPath completed its initial public offering (IPO) and joined the Nasdaq (symbol: LPTH). Lightpath leveraged these new resources to acquire two new companies in 2000 - Geltech Inc and Horizon Photonics. Geltech added the capability to mold high quality glass aspheric lenses and Horizon Photonics brought a product line of optical isolators as well as expertise in automation. This new LightPath combines these new capabilities with its own technologies, bringing a wealth of expertise to solving complex optical problems for the entire optics industry.

Our customer base is very diverse with applications that include laser welding & cutting, military laser tag, data communications, bar code scanning, particle measurement, medical endoscopes, telecom multiplexers and many, many other optical application areas. As industry needs change, LightPath's state-of-the-art R&D is designing optical solutions to meet the challenges that accompany a changing environment. We pride ourselves on high performance, customer support, quality products, value added designs and cost effective volume manufacturing.



The products we produce include a wide spectrum of molded glass aspheric optics ranging in size from 0.25mm to 25mm. GRADIUM® lenses, which give the performance of an asphere, are available for lenses between 5mm and 100mm. LightPath also offers a full range of optical isolators for communications applications and fused fiber collimators for high power beam delivery.

LightPath not only supplies components, but also offers the ability to combine optical elements into a complete assembly, providing full engineering support for both optics and mechanics. Unlike some independent optical engineering firms, LightPath uses an integrated approach. Our optical and mechanical engineers work directly with our customers on their optical system requirements. This enables the finished application to obtain the highest level of optical integration, minimizing time, size and cost while ensuring quality, performance and manufacturability. With LightPath's automation capabilities, when your product is ready for full production we are ready to take you there. The results are lower costs, higher performance, and greater consistency. LightPath is an ISO 9001 certified supplier.



MARKETS SERVED



Industrial

Many of the world's top automobile manufacturers use LightPath's GRADIUM® lenses and lens systems to focus their Nd:YAG lasers for automated welding and cutting operations. Our 1064nm Large Beam Collimators have also proven to be key for fiber delivery applications at high power. Molded glass aspheres are used in barcode scanning and package handling systems by the major shippers worldwide. The top computer-to-print manufacturers use our aspheric molded optics for unmatched performance.

Medical

When optimal performance is paramount, glass aspherical lenses are used for medical imaging systems and procedures requiring laser cutting and healing. GRADIUM® lenses and molded glass aspheres are found in many analytical instruments measuring different body functions in both the operating room and the lab. LightPath also provides lenses and collimators to the world's top manufacturers of endoscopes, providing a very wide field of view in a very small lens. We work with many companies in biotechnology developing new optics and optical systems in the fields of genetics, DNA, and protein analysis.

Defense and Government

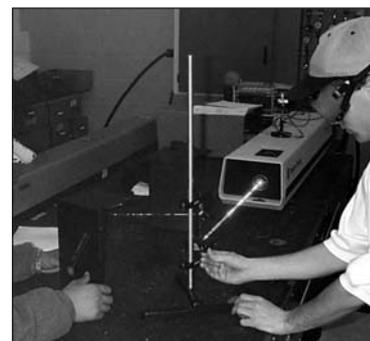
Over the last 10 years, LightPath has provided large volumes of lenses to defense contractors for many simulation training programs, which train our armed forces using lasers instead of bullets. Smart bombs and munitions utilize aspheres for communication and distance measurement. Under a development contract with the U.S. government, LightPath developed radiation hardened aspheres that are currently being used for satellite communication in both the military and commercial market. Specialty glass optical systems have also been developed for eye and instrument protection against damaging laser beams.

Communications

LightPath products have been developed for a variety of communications applications in both Telecom and Datacom. Our lenses, collimators and isolators are used to maximize light efficiency while minimizing both size and cost. Applications including mux/demux, switching and routing, amplification, dispersion compensation, sensing, transmitters, receivers and transponders all require the products and performance LightPath provides to move the light on and off the fiber.

Measurement

For optical measurement systems our lens designs offer customers a variety of sizes over a wide spectrum and integrated solutions enabling more compact designs at lower cost.



EQUIPMENT CAPABILITIES AND METROLOGY

LightPath's manufacturing and metrology capability assures customers the very best in quality and performance. Manufacturing is vertically integrated and utilizes the most recent advances in automation assuring customers an easy path from design and prototypes to full volume manufacturing. This is a partial list of LightPath's capabilities.

Manufacturing

- Automated CO2 Laser Fusion Stations
- Vytran Large Fiber Fusion Machine
- Seiko Robotic Manufacturing Systems
- Automated YAG Laser Welding Systems
- Automated CO2 Laser Micro-Shaping Equipment
- Precitec Nano 200 Single Point Diamond Turning Machines
- Precitec Optimum 2400 Single Point Diamond Turning Machines
- MTI Automated High Precision Dicing Machines
- Hardinge Automated Machine Center
- Precision Wire EDM
- Super Precision Hardinge Lath
- NC Milling Machines
- Multiple Target Vacuum Sputtering Machines
- Metroline/IPC Plasma Cleaning Station

Metrology

- Zygo 632.8 nm Laser Interferometers
- ADE Phase-shift 632.8 Laser Interferometer
- Sextant Micro Lens Laser Interferometer
- Fisba Laser Interferometer
- Zygo New View White Light Interferometer
- Taylor Hobson PGI 1240 Talysurf
- Melos 530 Optical Measurement System
- Brown and Sharpe Automated Coordinate Measuring Machine
- Mitutoyo 3D Vision Measuring System
- Nikon Measuring Microscopes
- LaserMike Non-Contact Measuring Gauge
- Nikon Refractometer
- Environmental Testing Chambers 85/85, Temp Shock and Cycling

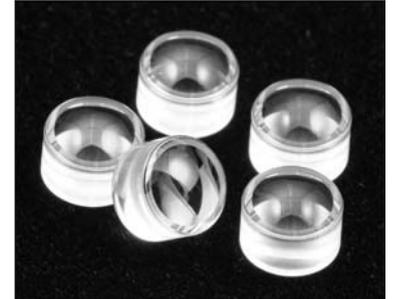


CUSTOMIZATION CAPABILITIES

LightPath is committed to manufacturing optical components that are the perfect fit for your specific application. To that end, we maintain an in-house capability to design, engineer, and manufacture custom optical components to your individual specifications.

Aspheric lenses

For aspheric lenses, we can complete new designs and provide prototypes in a matter weeks while keeping development costs among the lowest in the industry. Customers have the choice of several different types of moldable optical glasses, including the new environmentally friendly ECO550. Specific sizes and focal lengths can easily be tailored to the customer's needs and a variety of different AR coating types can be added.



Black Diamond LWIR lenses

LightPath's new Black Diamond product line can be customized for applications between 1 micron to 14 microns in wavelength, opening up new applications in thermal imaging and smart sensors. The lenses can be customized in sizes up to 25mm and can be provided molded into a metal holder or with a diffractive surface to make the systems achromatic.

Fused Fiber Collimators

LightPath's fused fiber collimators are available in a variety of different wavelengths from 400nm to 2000nm. LightPath has experience with a variety of different fibers as well – including double clad, expanded core, multimode, and polarization maintaining fibers. The collimators are available with several levels of fiber protection, such as Kevlar or steel armored jacketing. LightPath also has experience with space-qualified collimators constructed for the most extreme of environments.



Optical Isolators

Isolators can be customized for telecom wavelength ranges in single, one and a half, and two stage compositions. They are available in a variety of different sizes with and can be packaged with additional optional components such as waveplates or aspheric lenses. A variety of different housings are also available to make integrating to the customer's package easy.

Gradium lenses

Gradium lenses can be custom designed for visible or near infrared applications in diameters from 5mm to over 100mm. Their gradient-index structure often allows a Gradium singlet to replace a conventional spherical doublet. Gradium doublets are also available which can give the performance of conventional triplets, plus can be made achromatic.

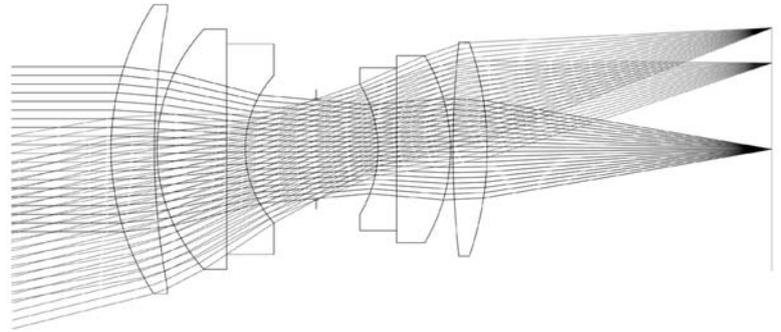
Imaging and Optical Assemblies

By leveraging our broad optical component portfolio, LightPath has a track record for implementing sophisticated integrated optical assemblies. Our in-house engineering staff can design custom assemblies, including complex imaging systems for camera systems, to your exact specifications. An in-house machine shop allows for fast turn prototypes - all tested with state-of-the-art metrology. At LightPath, we are ready to take a design from concept to finished production quickly and cost effectively.

CUSTOM ENGINEERED INTEGRATED OPTICAL SYSTEMS AND ASSEMBLIES

Engineered to your requirements

- Lens and Complete Optical Design Services
- Opto-Mechanical Design
- Prototype to full manufacturing capability
- Full NIST traceable Test and Metrology
- ITAR Compliant
- Defense Optical Systems
- Commercial Optical Systems



When it comes to designing optical systems it takes more than a computer to make it right.

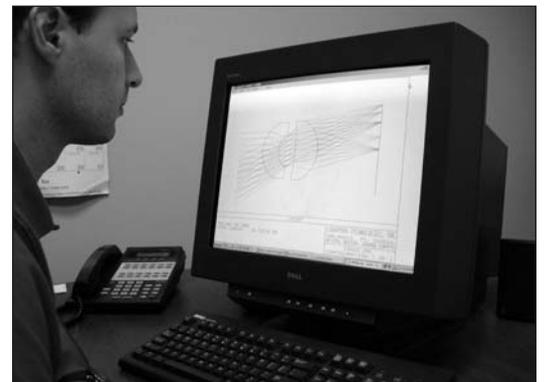
It's not just the design. By utilizing more than 20 years of optical component design and manufacturing LightPath can provide you with a complete optical solution. Understanding what it takes to build components and understanding manufacturing tolerances can make the difference between success and failure. It also can make your optical design and products more robust and cost effective.

Utilizing our in-house source of innovative products such as molded glass aspherics, infrared aspherics, Gradium optics, patented fiber fusion and traditional optics you no longer have to worry about sourcing hard to find solutions. If your design calls for cost effective aspheric elements, we can make it in-house and in typically half the time it takes elsewhere.

Our engineers work with state of the art optical and mechanical tools, such as Zemax, Oslo, Code V, and ASAP for optical design, modeling and simulation. Mechanical and complex thermal analysis is done with AutoCAD, SolidWorks, Pro Engineer, and Cosmo. Other simulations, such as diffractive and stray light analysis, can be performed and data provided to the customer throughout the design phase of a custom component or assembly.

LightPath is an optical solutions company providing a broad range of expertise and know-how for solving opto-mechanical problems. We can take a design from concept to finished production quickly and cost effective.

Please contact LightPath today to discuss how we can help you with your application.



ASPHERIC LENSES

- All-glass
- Custom Designs Available
- NA up to 0.83
- Diameters from 0.250 mm to 25.0 mm
- Diffraction-limited performance
- Available in standard and custom housings

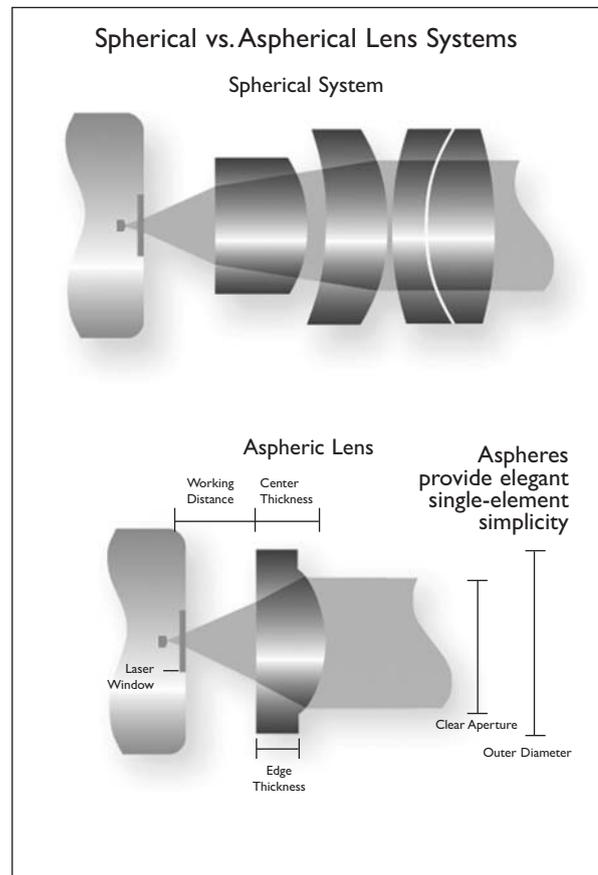
For today's sophisticated and compact laser systems, aspheres are the most powerful lenses for managing laser light. In these systems, spherical aberration is the most prevalent performance detractor. It arises from the use of spherical surfaces and artificially limits focusing and collimating accuracy.

Although it has been known for centuries that spherical geometry is not optimum for refracting light, the expense of fabricating non-spherical (aspheric) surfaces has inhibited their use. With the breakthrough of LightPath's glass molding technology, this optimal lens geometry has become a reality.

Molded lenses are used in a variety of photonic products: barcode scanners, laser diode to fiber couplings, optical data storage, and medical lasers, to name a few. In many of these applications, the material of choice is optical glass because of its durability and performance stability over a wide environmental range. High power transmittance is also an added advantage.

The benefits of glass molding technology become apparent when traditional methods of grinding and polishing become cost-prohibitive. The direct molding process eliminates the need for any grinding or polishing, offering aspheric lenses at practical prices for system designers. Molding is the most consistent and economical way to produce aspheres in large volumes.

Small and lightweight, our aspheres collimate or focus light as a single element. This means less complex systems, fewer alignment requirements, less re-work and shorter assembly time. They are molded, therefore the lenses have excellent piece-to-piece uniformity. They are made of glass, which is the most durable optical material available, capable of withstanding repeated cleanings and performing at specifications despite extreme temperature and moisture variations.



ASPHERIC LENSES

Optical Performance

The primary optical specification is the root-mean-squared transmitted wavefront error (RMS WFE). It is measured on a phase shift interferometer at the wavelength of 632.8nm. Most of our lenses are guaranteed to be diffraction limited, which means the RMS WFE $< 0.070 \lambda$ at the design wavelength.

Shapes and Sizes

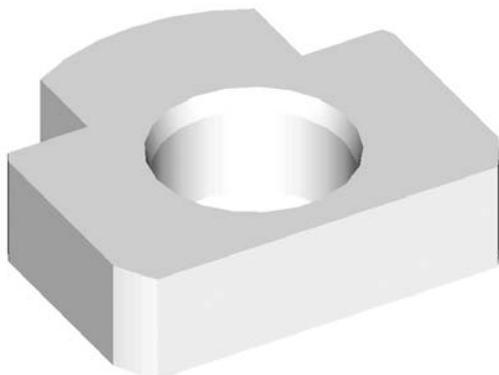
LightPath aspheric lenses can be made plano convex or bi-convex, with diameters as large as 25mm or as small as 0.250mm. Additionally, we have the capability to dice the lenses to rectangular or square shapes to make mounting them in your system easier.

Numerical Aperture

Our molded aspheric lenses are available with numerical apertures ranging from 0.15 up to 0.83. Lower NAs are best when a large depth of focus is important or when you need nearly circular beams. Examples of applications that would use a low numerical aperture are bar code scanners, surveying instruments, and small weapons sights. High numerical aperture lenses are important when you need to focus light down to a small spot size or when you need the maximum light capture from a diode laser. High numerical aperture applications include data storage and industrial printing.

Lens Holders

Several of our catalog lenses are available pre-mounted in metal holders. We can epoxy our lenses into Stainless Steel or Kovar mounts so you can weld them directly into your system. Using our new Mold-In-Place (MIP) technology, we can actually mold the lens directly inside of a steel holder, eliminating the need for adhesives in your package.



Diffraction Hybrid Lenses

By combining a refractive aspheric lens with a diffractive feature on one surface, you can do sophisticated beam shaping on your laser light. You can also use diffractive hybrid lenses to make your system achromatic over a range of wavelengths. LightPath hybrid lenses are custom designed to each particular application. See page 20.

Black Diamond™

Black Diamond™ are moldable infrared glasses operating for applications in the 1 to 14 μm regions. These glasses are ideal for molding aspheric and diffractive aspheric lenses and can be used with or as a replacement for germanium aspheric optics. See page 23.

Custom Optics

Our catalog details 37 standard types of aspheric lenses that are available off-the-shelf. If you do not see a lens that fits your particular application, we will be happy to design one for you. Our sales and engineering teams work closely together to assist you in design, prototyping, and production of custom glass aspheric lenses. LightPath offers custom lens solutions for high volume manufacturing at prices equal to that of a standard off-the-shelf lenses. We pride ourselves on being the fastest custom lens designers in the industry.

ASPHERIC LENSES

The Glass

LightPath Technologies manufactures aspheric lenses using three different types of glass. Transmittance of all three glasses is very good over a large wavelength spectrum. The optimum operating temperature should be less than 200 degrees Centigrade. The best cleaning agents are high purity grades of alcohol or acetone, lightly wiped off with a soft optical tissue or cotton-tipped swab.

The 350xxx Series of Lenses

Corning developed a special glass to allow production of highly sophisticated aspheric lenses that are cost effective. The code for this glass is CO550, and its low dispersion ($n_d=50.40$) is key for many applications. In durability, it is equivalent to Corning BCD C2060 or Schott SK16.

The 352xxx Series of Lenses

New European (RoHS) and Japanese environmental regulations have restricted the use of lead and other hazardous substances in optical components. ECO550 is an environmentally friendly alternative to conventional moldable glasses. It has similar optical properties to CO550, but does not contain any hazardous materials.

The 370xxx Series of Lenses

For aspheric lenses that require a glass with a higher index of refraction, LightPath also offers lenses made from Ohara PBH71 glass. Its high index ($n_d=1.92286$) allows designers to minimize aberrations in lenses with high numerical apertures. It has the added benefit of a lower coefficient of thermal expansion.

Black Diamond Lenses

For aspheric lenses in the mid to long infrared wavelength regions (1 to 14 μm) LightPath offers molded aspheric lenses from chalcogenide glass. See page 23 for details.

Standard Antireflective Coatings

LightPath offers a variety of multilayer broadband coatings to reduce the back reflection from a nominal 6% for uncoated lenses. The choice of which AR coating is appropriate depends on the type of glass the lens is made from and the wavelength at which the lens will be used.

350xxx and 352xxx Series of Lenses

MLBB-A coating: $R_{MAX}<1.0\%$, $R_{TYP}<0.4\%$, from 400-600nm, AOI=0°

MLBB-B coating: $R_{MAX}<1.0\%$, $R_{TYP}<0.4\%$, from 600-1050nm, AOI=0°

MLBB-C coating: $R_{MAX}<1.0\%$, $R_{TYP}<0.4\%$, from 1050-1600nm, AOI=0°

The following coatings can be done on a custom basis. Please contact your sales representative for information availability.

MLBB-D coating: $R_{MAX}<0.25\%$, $R_{TYP}<0.15\%$, from 1300-1700nm, AOI=0-20°

370xxx Series of Lenses

MLBB-Q coating: $R_{MAX}<0.25\%$, $R_{TYP}<0.15\%$, from 1300-1700nm, AOI=0-20°

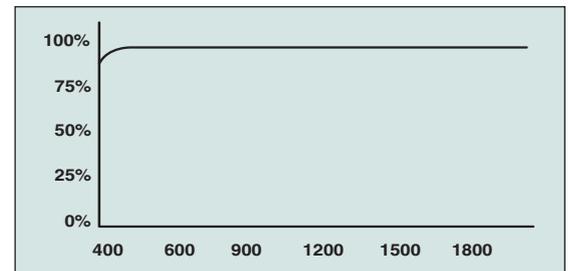
The following coatings can be done on a custom basis. Please contact your sales representative for information on availability.

MLBB-O coating: $R_{MAX}<1.0\%$, $R_{TYP}<0.4\%$, from 600-1050nm, AOI=0°

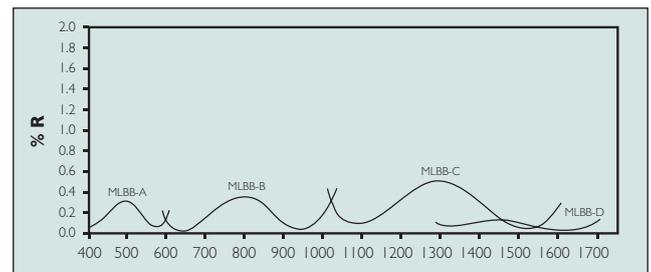
MLBB-P coating: $R_{MAX}<1.0\%$, $R_{TYP}<0.4\%$, from 1050-1600nm, AOI=0°

REFRACTIVE INDEX CHART			
Wavelength (nm)	CO550	ECO550	PBH71
404.7	1.62590	1.62636	2.00599
435.8	1.62016	1.62068	1.98112
480.0	1.61411	1.61464	1.95665
486.1	1.61341	1.61394	1.95392
546.1	1.60786	1.60837	1.93306
587.6	1.60500	1.60550	1.92286
632.8	1.60251	1.60300	1.91427
643.8	1.60198	1.60246	1.91247
656.3	1.60141	1.60189	1.91057
706.5	1.59940	1.59987	1.90397
852.1	1.59528	1.59573	1.89126
1014.0	1.59227	1.59270	1.88298
1300.0	1.58850	1.58898	1.87444
1550.0	1.58572	1.58625	1.86954
Abbe Number (V_d)	50.40	50.27	21.29
CTE ($10^{-6} / ^\circ\text{C}$)	15.0	13.1	8.9
dn/dT ($10^{-6} / ^\circ\text{C}$)	-11.0	3.39	13.1

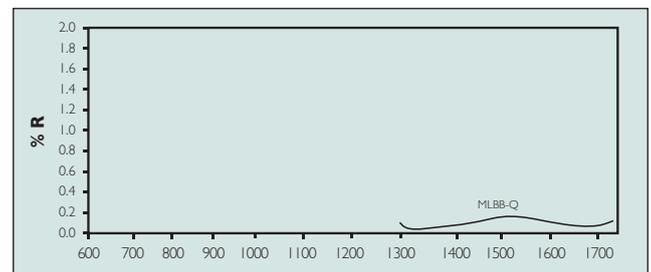
Typical Transmission for CO550, ECO550, and PBH71



Typical AR Coating Curves for CO550 and ECO550



Typical AR Coating Curves for PBH71



ASPHERIC LENSES

STANDARD LENSES				
NA	EFL (mm)	CA (mm)	OD (mm)	Lens Code
0.15	5.00	1.50	2.00	350430
0.15	18.40	5.50	6.50	350280
0.16	15.29	5.00	6.50	350260
0.17	4.00	1.37	3.00	370940
0.18	6.10	2.20	2.80	350550
0.18	13.86	5.10	6.325	350560
0.25	11.00	5.50	7.20	352220
0.30	6.16	3.70	4.70	350170
0.30	1.16	1.15	1.80	350450
0.30	1.80	1.08	3.00	370890
0.40	6.24	5.00	7.20	352110
0.42	4.50	3.70	4.70	350350
0.43	1.14	1.13	2.40	350200
0.47	4.47	4.20	5.42	350022
0.50	1.49	1.50	2.65	350710
0.50	2.00	2.00	3.00	350150
0.50	8.00	8.00	9.94	352240
0.53	2.95	4.00	4.70	350440
0.55	1.45	1.60	2.40	350140
0.55	2.72	3.00	4.00	350160
0.55	3.89	4.29	6.325	350080
0.55	4.51	4.95	6.325	350230
0.55	4.55	5.00	8.50	350782
0.55	0.382	0.40	1.20	370631
0.59	0.45	0.52	1.80	350620
0.60	0.682	0.84	2.50	370060
0.60	0.70	0.84	2.50	370880
0.60	2.97	3.60	4.00	350660
0.60	4.00	4.80	6.325	350610
0.60	4.02	4.80	6.325	352671
0.60	0.70	0.84	3.60	370930
0.62	4.03	5.00	6.325	350340
0.67	2.84	4.00	5.40	350570
0.68	2.75	3.60	4.00	350390
0.68	3.10	5.00	6.325	350330
0.80	0.75	1.20	3.00	370840
0.80	0.75	1.20	3.60	370920

Guaranteed Performance

LightPath's aspheric lenses are inspected and optical tested to ensure complete customer satisfaction. Visual cosmetic inspection is performed on 100% of all lenses per MIL-PRF-13830B with a scratch/dig spec of 40/20. Other inspection criteria including 80/40, 20/10 and 10/5 can be provided on request.



Optical performance is guaranteed by test methods utilizing 632.8nm interferometer measuring transmitted RMS wavefront error listed in the individual lens specification. LightPath can also perform customized optical tests in order to screen for the customers' specific application criteria.

Tolerances guaranteed are:

Outer Diameter (OD): $\pm 0.015\text{mm}$

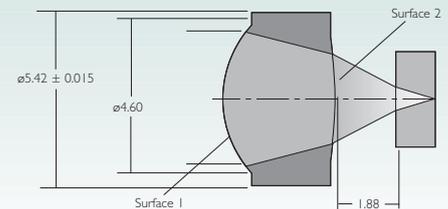
Clear Aperture (CA): $\pm 0.100\text{mm}$

Effective Focal Length (EFL): $\pm 1\%$

Working Distance (WD): $\pm 1\%$ of EFL

Lens Code 350022

NA = 0.47 EFL = 4.47 mm CT = 3.44 mm



OPTICAL DESIGN SPECIFICATIONS

Design Wavelength	780 nm
Numerical Aperture (NA)	0.47
Clear Aperture (CA)	4.20 mm
Effective Focal Length (EFL)	4.47 mm
Magnification	Infinite
RMS WFE	< Diff. Limit
Outer Diameter (OD)	5.42 mm
Working Distance (WD)	1.88 mm

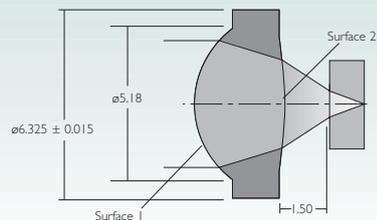
Design corrected for 1.20 mm thick polycarbonate disk (index 1.573)

Design Objective:	Focus light into an optical disk.
Lens Characteristics:	Moderate NA for good light capture; small focused spot.
Typical Products:	Optical data storage systems.

Order Nomenclature	350022-A AR Coating 400-600nm	350022-B AR Coating 600-1050nm
	350022-C AR Coating 1050-1600nm	350022-D AR Coating 1300-1700nm

Lens Code 350080

NA = 0.55 EFL = 3.89 mm CT = 3.07 mm



OPTICAL DESIGN SPECIFICATIONS

Design Wavelength	780 nm
Numerical Aperture (NA)	0.55
Clear Aperture (CA)	4.29 mm
Effective Focal Length (EFL)	3.89 mm
Magnification	Infinite
RMS WFE	< Diff. Limit
Outer Diameter (OD)	6.325 mm
Working Distance (WD)	1.50 mm

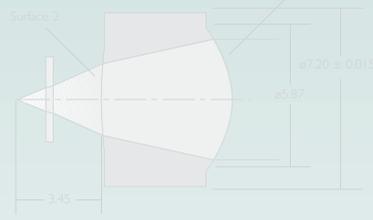
Design corrected for 1.20 mm thick polycarbonate disk (index 1.57)

Design Objective:	Focus light into an optical disk.
Lens Characteristics:	High NA for maximum light capture; small focused spot.
Typical Products:	Optical data storage systems.

Order Nomenclature 350080-A AR Coating 400-600nm 350080-B AR Coating 600-1050nm
350080-C AR Coating 1050-1600nm 350080-D AR Coating 1300-1700nm

Lens Code 350110

NA = 0.40 EFL = 6.24 mm CT = 5.36 mm



OPTICAL DESIGN SPECIFICATIONS

Design Wavelength	780 nm
Numerical Aperture (NA)	0.40
Clear Aperture (CA)	5.93 mm
Effective Focal Length (EFL)	6.24 mm
Magnification	Infinite
RMS WFE	< Diff. Limit
Outer Diameter (OD)	7.20 mm
Working Distance (WD)	3.45 mm
Laser Window Thickness	0.25 mm
Laser Window Material/Index	BK7/1.517

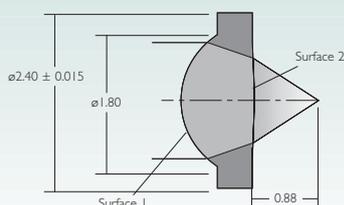
This lens has been discontinued and replaced with our RoHS compliant glass. Please see lens code 352110, Page 18

Design Objective:	Collimate or focus laser light at high magnification from a laser diode.
Lens Characteristics:	Moderate NA for good light capture; large CA for minimum beam divergence.
Typical Products:	Presentation pointers, small weapons sights, survey instruments, hand held and fixed barcode scanners, medical instruments, alignment instruments.

Order Nomenclature 350110-A AR Coating 400-600nm 350110-B AR Coating 600-1050nm
350110-C AR Coating 1050-1600nm 350110-D AR Coating 1300-1700nm

Lens Code 350140

NA = 0.55 EFL = 1.45 mm CT = 1.01 mm



OPTICAL DESIGN SPECIFICATIONS

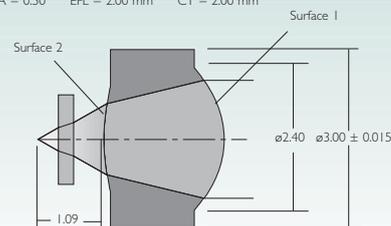
Design Wavelength	780 nm
Numerical Aperture (NA)	0.55
Clear Aperture (CA)	1.60 mm
Effective Focal Length (EFL)	1.45 mm
Magnification	Infinite
RMS WFE	< Diff. Limit
Outer Diameter (OD)	2.40 mm
Working Distance (WD)	0.88 mm

Design Objective:	Collimate or focus laser light.
Lens Characteristics:	High NA for maximum light capture; small physical size.
Typical Products:	Fiber to fiber coupling applications when used with another lens or in pairs.

Order Nomenclature 350140-A AR Coating 400-600nm 350140-B AR Coating 600-1050nm
350140-C AR Coating 1050-1600nm 350140-D AR Coating 1300-1700nm

Lens Code 350150

NA = 0.50 EFL = 2.00 mm CT = 2.00 mm



OPTICAL DESIGN SPECIFICATIONS

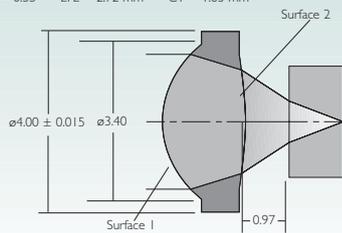
Design Wavelength	780 nm
Numerical Aperture (NA)	0.50
Clear Aperture (CA)	2.00 mm
Effective Focal Length (EFL)	2.00 mm
Magnification	Infinite
RMS WFE	< Diff. Limit
Outer Diameter (OD)	3.00 mm
Working Distance (WD)	1.09 mm
Laser Window Thickness	0.250 mm
Laser Window Material/Index	BK7/1.517

Design Objective:	Collimate or focus laser light at high magnification from a laser diode.
Lens Characteristics:	High NA for maximum light capture; small physical size.
Typical Products:	Presentation pointers, small weapons sights, survey instruments, alignment instruments, hand held and fixed barcode scanners, medical instruments.

Order Nomenclature 350150-A AR Coating 400-600nm 350150-B AR Coating 600-1050nm
350150-C AR Coating 1050-1600nm 350150-D AR Coating 1300-1700nm

Lens Code 350160

NA = 0.55 EFL = 2.72 mm CT = 1.83 mm



OPTICAL DESIGN SPECIFICATIONS

Design Wavelength	780 nm
Numerical Aperture (NA)	0.55
Clear Aperture (CA)	3.00 mm
Effective Focal Length (EFL)	2.72 mm
Magnification	Infinite
RMS WFE	< Diff. Limit
Outer Diameter (OD)	4.00 mm
Working Distance (WD)	0.97 mm

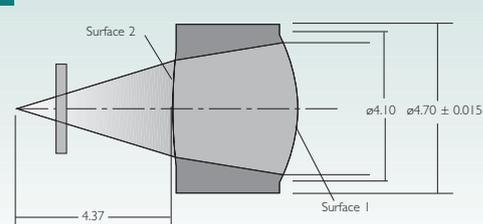
Design corrected for 1.20 mm thick polycarbonate disk (index 1.573)

Design Objective:	Focus light into an optical disk.
Lens Characteristics:	High NA for maximum light capture; small focused spot.
Typical Products:	Optical data storage system.

Order Nomenclature 350160-A AR Coating 400-600nm 350160-B AR Coating 600-1050nm
350160-C AR Coating 1050-1600nm 350160-D AR Coating 1300-1700nm

Lens Code 350170

NA = 0.30 EFL = 6.16 mm CT = 3.48 mm



OPTICAL DESIGN SPECIFICATIONS

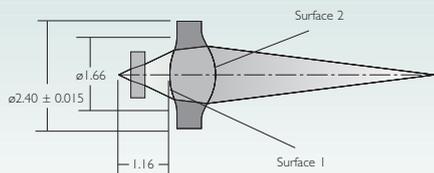
Design Wavelength	780 nm
Numerical Aperture (NA)	0.30
Clear Aperture (CA)	3.70 mm
Effective Focal Length (EFL)	6.16 mm
Magnification	Infinite
RMS WFE	< Diff. Limit
Outer Diameter (OD)	4.70 mm
Working Distance (WD)	4.37 mm
Laser Window Thickness	0.275 mm
Laser Window Material/Index	BK7/1.517

Design Objective:	Collimate or focus laser light at high magnification from a laser diode.
Lens Characteristics:	Low NA for clean circular beam; moderate physical size.
Typical Products:	Industrial barcode readers, point-of-purchase barcode readers, laser printers, laser fax machines, survey instruments.

Order Nomenclature 350170-A AR Coating 400-600nm 350170-B AR Coating 600-1050nm
350170-C AR Coating 1050-1600nm 350170-D AR Coating 1300-1700nm

Lens Code 350200

NA = 0.43 EFL = 1.14 mm CT = 1.03 mm



OPTICAL DESIGN SPECIFICATIONS

Design Wavelength	1300 nm
Numerical Aperture (NA)	0.12 (image)
	0.43 (object)
Clear Aperture (CA)	1.30 mm (image)
	1.13 (object)
Effective Focal Length (EFL)	1.14 mm
Magnification	3.64
RMS WFE	< Diff. Limit
Outer Diameter (OD)	2.40 mm
Working Distance (WD)	1.16/4.93 mm*
Laser Window Thickness	0.300 mm
Laser window Material/Index	BK7/1.517 *front/back WD

Design Objective:	Finite conjugate operates at (3.70:1) magnification.
Lens Characteristics:	Single lens couples light to single mode/multi-mode fibers; small physical size for fiber-to-fiber coupling.
Typical Products:	Laser diode pigtails (SM/MM), laser diode connectors (SM/MM), fiber-to-fiber connectors (SM/MM).

Order Nomenclature 350200-A AR Coating 400-600nm 350200-B AR Coating 600-1050nm
350200-C AR Coating 1050-1600nm 350200-D AR Coating 1300-1700nm

Lens Code 350220

NA = 0.25 EFL = 11.00 mm CT = 3.00 mm



OPTICAL DESIGN SPECIFICATIONS

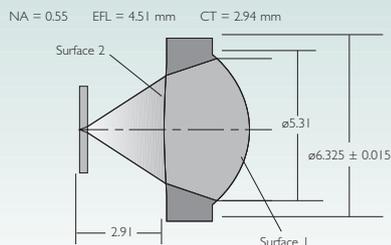
Design Wavelength	633 nm
Numerical Aperture (NA)	0.25
Clear Aperture (CA)	6.40 mm
Effective Focal Length (EFL)	11.00 mm
Magnification	Infinite
RMS WFE	< Diff. Limit
Outer Diameter (OD)	7.20 mm
Working Distance (WD)	7.96 mm
Laser Window Thickness	0.250 mm
Laser Window Material/Index	BK7/1.517

This lens has been discontinued and replaced with our RoHS compliant glass. Please see lens code 352220, Page 18

Design Objective:	Collimate or focus laser light at high magnification from a laser diode.
Lens Characteristics:	Low NA for clean circular beam; large CA for minimum beam divergence.
Typical Products:	Industrial barcode readers, point-of-purchase barcode readers, laser printers, laser fax machines, survey instruments.

Order Nomenclature 350220-A AR Coating 400-600nm 350220-B AR Coating 600-1050nm
350220-C AR Coating 1050-1600nm 350220-D AR Coating 1300-1700nm

Lens Code 350230



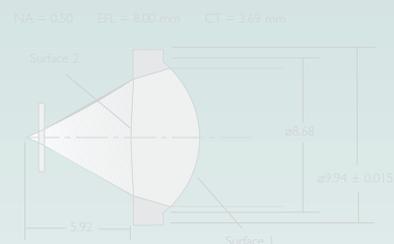
OPTICAL DESIGN SPECIFICATIONS

Design Wavelength	780 nm
Numerical Aperture (NA)	0.55
Clear Aperture (CA)	4.95 mm
Effective Focal Length (EFL)	4.51 mm
Magnification	Infinite
RMS WFE	< Diff. Limit
Outer Diameter (OD)	6.325 mm
Working Distance (WD)	2.91 mm
Laser Window Thickness	0.250 mm
Laser Window Material/Index	BK7/1.517

Design Objective: Collimate or focus laser light at high magnification from a laser diode.
Lens Characteristics: High NA for maximum light capture; large CA for minimum beam divergence.
Typical Products: Presentation pointers, small weapons sights, survey instruments, hand held and fixed barcode scanners, medical instruments, alignment instruments.

Order Nomenclature
 350230-A AR Coating 400-600nm 350230-B AR Coating 600-1050nm
 350230-C AR Coating 1050-1600nm 350230-D AR Coating 1300-1700nm

Lens Code 350240



OPTICAL DESIGN SPECIFICATIONS

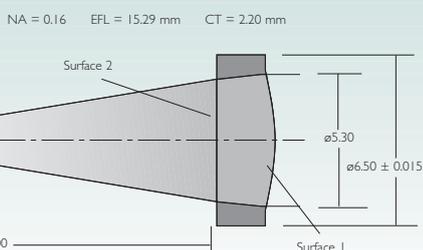
Design Wavelength	780 nm
Numerical Aperture (NA)	0.50
Clear Aperture (CA)	6.00 mm
Effective Focal Length (EFL)	8.00 mm
Magnification	Infinite
RMS WFE	< Diff. Limit
Outer Diameter (OD)	9.94 mm
Working Distance (WD)	5.92 mm
Laser Window Thickness	0.250 mm
Laser Window Material/Index	BK7/1.517

This lens has been discontinued and replaced with our RoHS compliant glass. Please see lens code 352240, Page 18

Design Objective: Collimate or focus laser light at high magnification from a laser diode.
Lens Characteristics: High NA for maximum light capture; large CA and long focal length for minimum beam divergence.
Typical Products: Presentation pointers, small weapons sights, survey instruments, alignment instruments, hand held and fixed barcode scanners, medical instruments.

Order Nomenclature
 350240-A AR Coating 400-600nm 350240-B AR Coating 600-1050nm
 350240-C AR Coating 1050-1600nm 350240-D AR Coating 1300-1700nm

Lens Code 350260



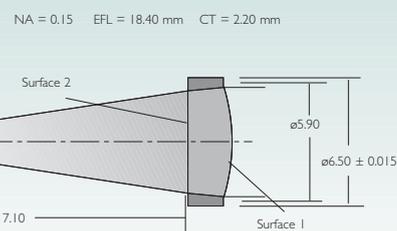
OPTICAL DESIGN SPECIFICATIONS

Design Wavelength	780 nm
Numerical Aperture (NA)	0.16
Clear Aperture (CA)	5.00 mm
Effective Focal Length (EFL)	15.29 mm
Magnification	Infinite
RMS WFE	< Diff. Limit
Outer Diameter (OD)	6.50 mm
Working Distance (WD)	14.00 mm
Laser Window Thickness	0.250 mm
Laser Window Material/Index	BK7/1.517

Design Objective: Collimate or focus laser light at high magnification from a laser diode.
Lens Characteristics: Low NA for clean circular beam; large CA for minimum beam divergence.
Typical Products: Industrial barcode readers, point-of-purchase barcode readers, laser printers, laser fax machines, survey instruments.

Order Nomenclature
 350260-A AR Coating 400-600nm 350260-B AR Coating 600-1050nm
 350260-C AR Coating 1050-1600nm 350260-D AR Coating 1300-1700nm

Lens Code 350280



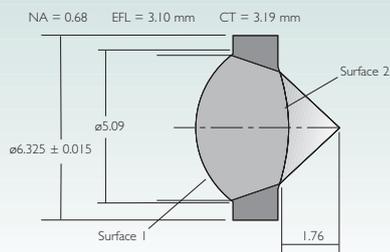
OPTICAL DESIGN SPECIFICATIONS

Design Wavelength	780 nm
Numerical Aperture (NA)	0.15
Clear Aperture (CA)	5.50 mm
Effective Focal Length (EFL)	18.40 mm
Magnification	Infinite
RMS WFE	< Diff. Limit
Outer Diameter (OD)	6.50 mm
Working Distance (WD)	17.10 mm
Laser Window Thickness	0.250 mm
Laser Window Material/Index	BK7/1.517

Design Objective: Collimate or focus laser light at high magnification from a laser diode.
Lens Characteristics: Low NA for clean circular beam; large CA for minimum beam divergence.
Typical Products: Industrial barcode readers, point-of-purchase barcode readers, laser printers, laser fax machines, survey instruments.

Order Nomenclature
 350280-A AR Coating 400-600nm 350280-B AR Coating 600-1050nm
 350280-C AR Coating 1050-1600nm 350280-D AR Coating 1300-1700nm

Lens Code 350330



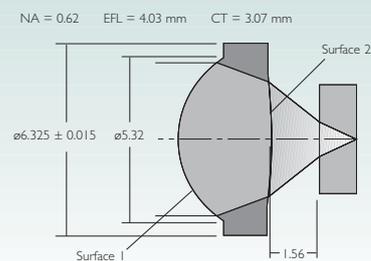
OPTICAL DESIGN SPECIFICATIONS

Design Wavelength	830 nm
Numerical Aperture (NA)	0.68
Clear Aperture (CA)	5.00 mm
Effective Focal Length (EFL)	3.10 mm
Magnification	Infinite
Outer Diameter (OD)	6.325 mm
Working Distance (WD)	1.76 mm

Design Objective: Collimate or focus laser light.
 Lens Characteristics: High NA for maximum light capture; large CA for minimum beam convergence.
 Typical Products: Fiber to fiber coupling applications when used with another lens or in pairs.

Order Nomenclature 350330-A AR Coating 400-600nm 350330-B AR Coating 600-1050nm
 350330-C AR Coating 1050-1600nm 350330-D AR Coating 1300-1700nm

Lens Code 350340



OPTICAL DESIGN SPECIFICATIONS

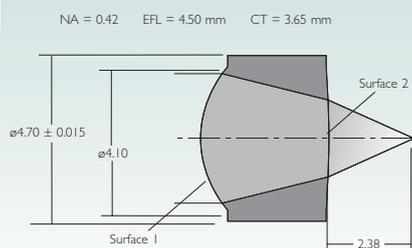
Design Wavelength	685 nm
Numerical Aperture (NA)	0.62
Clear Aperture (CA)	5.00 mm
Effective Focal Length (EFL)	4.03 mm
Magnification	Infinite
RMS WFE	< Diff. Limit
Outer Diameter (OD)	6.325 mm
Working Distance (WD)	1.56 mm

Design corrected for 1.20 mm thick K3 glass disk (index 1.518)

Design Objective: Focus light into an optical disk.
 Lens Characteristics: High NA for maximum light capture, large CA for minimum beam divergence.
 Typical Products: Optical data storage systems.

Order Nomenclature 350340-A AR Coating 400-600nm 350340-B AR Coating 600-1050nm
 350340-C AR Coating 1050-1600nm 350340-D AR Coating 1300-1700nm

Lens Code 350350



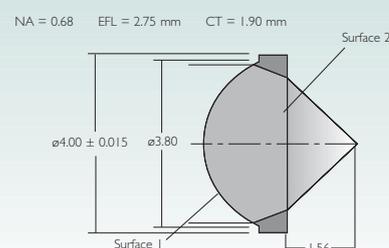
OPTICAL DESIGN SPECIFICATIONS

Design Wavelength	980 nm
Numerical Aperture (NA)	0.42
Clear Aperture (CA)	3.70 mm
Effective Focal Length (EFL)	4.50 mm
Magnification	Infinite
RMS WFE	< Diff. Limit
Outer Diameter (OD)	4.70 mm
Working Distance (WD)	2.38 mm

Design Objective: Collimate or focus laser light.
 Lens Characteristics: Moderate NA for good light capture.
 Typical Products: Fiber coupling applications.

Order Nomenclature 350350-A AR Coating 400-600nm 350350-B AR Coating 600-1050nm
 350350-C AR Coating 1050-1600nm 350350-D AR Coating 1300-1700nm

Lens Code 350390



OPTICAL DESIGN SPECIFICATIONS

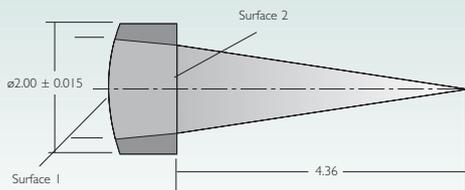
Design Wavelength	830 nm
Numerical Aperture (NA)	0.68
Clear Aperture (CA)	3.60 mm
Effective Focal Length (EFL)	2.75 mm
Magnification	Infinite
Outer Diameter (OD)	4.00 mm
Working Distance (WD)	1.56 mm

Design Objective: Collimate or focus laser light.
 Lens Characteristics: High NA for maximum light capture.
 Typical Products: Fiber to fiber coupling applications when used with another lens or in pairs.

Order Nomenclature 350390-A AR Coating 400-600nm 350390-B AR Coating 600-1050nm
 350390-C AR Coating 1050-1600nm 350390-D AR Coating 1300-1700nm

Lens Code 350430

NA = 0.15 EFL = 5.00 mm CT = 1.01 mm



OPTICAL DESIGN SPECIFICATIONS

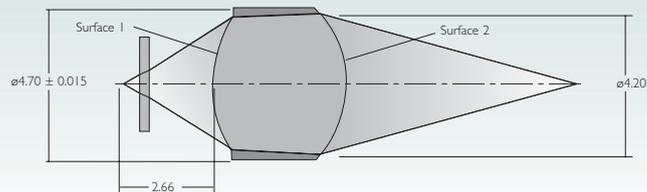
Design Wavelength	1550 nm
Numerical Aperture (NA)	0.15
Clear Aperture (CA)	1.50 mm
Effective Focal Length (EFL)	5.00 mm
Magnification	Infinite
RMS WFE	< Diff. Limit
Outer Diameter (OD)	2.00 mm
Working Distance (WD)	4.36 mm

Design Objective: Collimate or focus laser light.
 Lens Characteristics: Low NA for clean circular beam; small physical size.
 Typical Products: Fiber coupling applications.

Order Nomenclature 350430-A AR Coating 400-600nm 350430-B AR Coating 600-1050nm
 350430-C AR Coating 1050-1600nm 350430-D AR Coating 1300-1700nm

Lens Code 350440

NA = 0.53 EFL = 2.95 mm CT = 4.07 mm



OPTICAL DESIGN SPECIFICATIONS

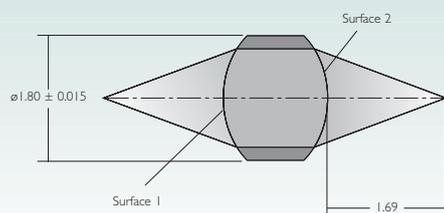
Design Wavelength	980 nm
Numerical Aperture (NA)	0.27 (image) 0.53 (object)
Clear Aperture (CA)	4.20 mm (image) 4.00 mm (object)
Effective Focal Length (EFL)	2.95 mm
Magnification	2.00
Outer Diameter (OD)	4.70 mm
Working Distance (WD)	2.66/6.91 mm*
Laser Window Thickness	0.250 mm
Laser Window Material/Index	BK7/1.517 *front/back WD

Design Objective: Finite conjugate operates at (2:1) magnification.
 Lens Characteristics: High NA for maximum light capture.
 Typical Products: Laser diode pigtails (SM/MM), laser diode connectors (SM/MM), fiber-to-fiber connectors (SM/MM).

Order Nomenclature 350440-A AR Coating 400-600nm 350440-B AR Coating 600-1050nm
 350440-C AR Coating 1050-1600nm 350440-D AR Coating 1300-1700nm

Lens Code 350450

NA = 0.30 EFL = 1.16 mm CT = 1.48 mm



OPTICAL DESIGN SPECIFICATIONS

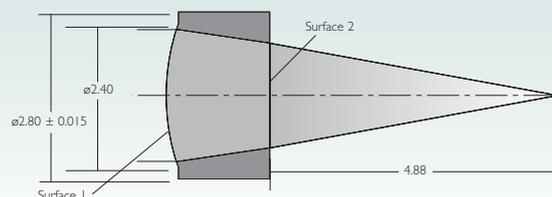
Design Wavelength	980 nm
Numerical Aperture (NA)	0.30 (image) 0.30 (object)
Clear Aperture (CA)	1.15 mm (image) 1.15 mm (object)
Effective Focal Length (EFL)	1.16 mm
Magnification	1.00
Outer Diameter (OD)	1.80 mm
Working Distance (WD)	1.69/1.69 mm* *front/back WD

Design Objective: Minimize alignment sensitivity; finite conjugate operates at (1:1) magnification.
 Lens Characteristics: Single lens couples light to single mode/multi-mode fibers; small physical size for fiber-to-fiber coupling.
 Typical Products: Fiber coupling applications.

Order Nomenclature 350450-A AR Coating 400-600nm 350450-B AR Coating 600-1050nm
 350450-C AR Coating 1050-1600nm 350450-D AR Coating 1300-1700nm

Lens Code 350550

NA = 0.18 EFL = 6.10 mm CT = 1.93 mm



OPTICAL DESIGN SPECIFICATIONS

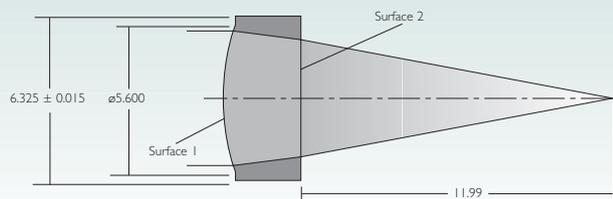
Design Wavelength	1550 nm
Numerical Aperture (NA)	0.18
Clear Aperture (CA)	2.20 mm
Effective Focal Length (EFL)	6.10 mm
Magnification	Infinite
RMS WFE	< Diff. Limit
Outer Diameter (OD)	2.80 mm
Working Distance (WD)	4.88 mm

Design Objective: Collimate or focus laser light.
 Lens Characteristics: Low NA for clean circular beam; small physical size.
 Typical Products: Fiber coupling applications.

Order Nomenclature 350550-A AR Coating 400-600nm 350550-B AR Coating 600-1050nm
 350550-C AR Coating 1050-1600nm 350550-D AR Coating 1300-1700nm

Lens Code 350560

NA = 0.18 EFL = 13.86 mm CT = 3.00 mm



OPTICAL DESIGN SPECIFICATIONS

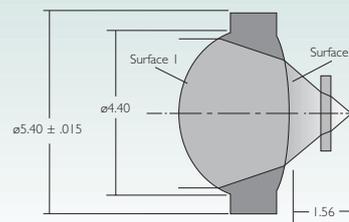
Design Wavelength	650 nm
Numerical Aperture (NA)	0.18
Clear Aperture (CA)	5.10 mm
Effective Focal Length (EFL)	13.86 mm
Magnification	Infinite
RMS WFE	< Diff. Limit
Outer Diameter (OD)	6.325 mm
Working Distance (WD)	11.99 mm

Design Objective: Collimate or focus laser light.
 Lens Characteristics: Low NA for clean circular beam; large CA for minimum beam divergence.
 Typical Products: Fiber coupling applications, data storage.

Order Nomenclature 350560-A AR Coating 400-600nm 350560-B AR Coating 600-1050nm
 350560-C AR Coating 1050-1600nm 350560-D AR Coating 1300-1700nm

Lens Code 350570

NA = 0.67 EFL = 2.84 mm CT = 2.70 mm



OPTICAL DESIGN SPECIFICATIONS

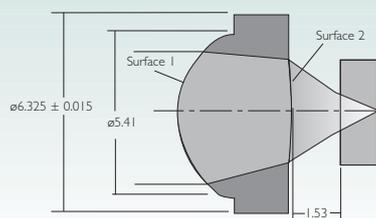
Design Wavelength	1550 nm
Numerical Aperture (NA)	0.67
Clear Aperture (CA)	4.00 mm
Effective Focal Length (EFL)	2.84 mm
Magnification	Infinite
RMS WFE	< Diff. Limit
Outer Diameter (OD)	5.40 mm
Working Distance (WD)	1.56 mm
Laser Window Thickness	0.250 mm
Laser Window Material/Index	BK7/1.517

Design Objective: Collimate laser light at high magnification.
 Lens Characteristics: High NA for maximum light capture.
 Typical Products: Telecommunications.

Order Nomenclature 350570-A AR Coating 400-600nm 350570-B AR Coating 600-1050nm
 350570-C AR Coating 1050-1600nm 350570-D AR Coating 1300-1700nm

Lens Code 350610

NA = 0.60 EFL = 4.00 mm CT = 3.04 mm



OPTICAL DESIGN SPECIFICATIONS

Design Wavelength	410 nm
Numerical Aperture (NA)	0.60
Clear Aperture (CA)	4.80 mm
Effective Focal Length (EFL)	4.00 mm
Magnification	Infinite
RMS WFE	< Diff. Limit
Outer Diameter (OD)	6.325 mm
Working Distance (WD)	1.53 mm

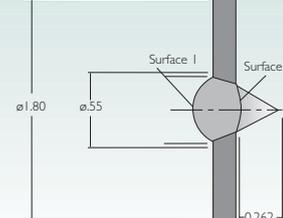
Design corrected for 1.20 mm thick K3 glass disk (index 1.518)

Design Objective: Focus light through disk onto storage media.
 Lens Characteristics: High NA for maximum light capture, small size.
 Typical Products: Data storage.

Order Nomenclature 350610-A AR Coating 400-600nm 350610-B AR Coating 600-1050nm
 350610-C AR Coating 1050-1600nm 350610-D AR Coating 1300-1700nm

Lens Code 350620

NA = 0.59 EFL = 0.45 mm CT = 0.30 mm



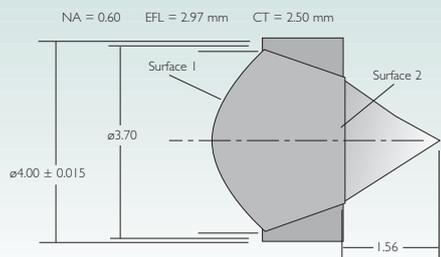
OPTICAL DESIGN SPECIFICATIONS

Design Wavelength	1310 nm
Numerical Aperture (NA)	0.59
Clear Aperture (CA)	0.52 mm
Effective Focal Length (EFL)	0.45 mm
Magnification	Infinite
RMS WFE	< Diff. Limit
Outer Diameter (OD)	1.80 mm
Working Distance (WD)	0.27 mm
Laser Window Thickness	None
Laser Window Material/Index	None

Design Objective: Collimate or focus laser light at high magnification.
 Lens Characteristics: High NA for maximum light capture, small size.
 Typical Products: Telecommunications.

Order Nomenclature 350620-A AR Coating 400-600nm 350620-B AR Coating 600-1050nm
 350620-C AR Coating 1050-1600nm 350620-D AR Coating 1300-1700nm

Lens Code 350660



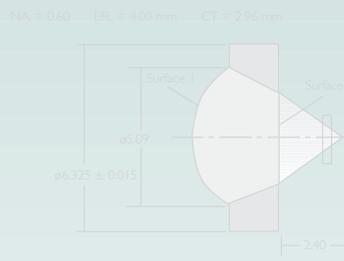
OPTICAL DESIGN SPECIFICATIONS

Design Wavelength	1550 nm
Numerical Aperture (NA)	0.60
Clear Aperture (CA)	3.60 mm
Effective Focal Length (EFL)	2.97 mm
Magnification	Infinite
RMS WFE	< Diff. Limit
Outer Diameter (OD)	4.00 mm
Working Distance (WD)	1.56 mm
Laser Window Thickness	None
Laser Window Material/Index	None

Design Objective: Collimate or focus laser light at high magnification.
 Lens Characteristics: High NA for maximum light capture.
 Typical Products: Telecommunications.

Order Nomenclature 350660-A AR Coating 400-600nm 350660-B AR Coating 600-1050nm
 350660-C AR Coating 1050-1600nm 350660-D AR Coating 1300-1700nm

Lens Code 350670



OPTICAL DESIGN SPECIFICATIONS

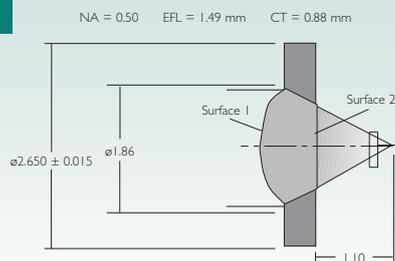
Design Wavelength	405 nm
Numerical Aperture (NA)	0.60
Clear Aperture (CA)	4.80 mm
Effective Focal Length (EFL)	4.00 mm
Magnification	Infinite
RMS WFE	< Diff. Limit
Outer Diameter (OD)	6.325 mm
Working Distance (WD)	2.40 mm
Laser Window Thickness	None
Laser Window Material/Index	N-PK52 / 1.497

This lens has been discontinued and replaced with our RoHS compliant glass. Please see lens code 352671, Page 18

Design Objective: Collimate laser light at high magnification.
 Lens Characteristics: High NA for maximum light capture.
 Typical Products: Data storage.

Order Nomenclature 350670-A AR Coating 400-600nm 350670-B AR Coating 600-1050nm
 350670-C AR Coating 1050-1600nm 350670-D AR Coating 1300-1700nm

Lens Code 350710



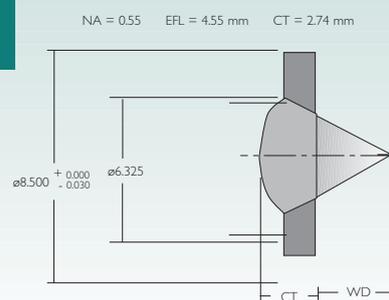
OPTICAL DESIGN SPECIFICATIONS

Design Wavelength	1550 nm
Numerical Aperture (NA)	0.50
Clear Aperture (CA)	1.50 mm
Effective Focal Length (EFL)	1.49 mm
Magnification	Infinite
RMS WFE	< Diff. Limit
Outer Diameter (OD)	2.65 mm
Working Distance (WD)	1.10 mm
Laser Window Thickness	0.250 mm
Laser Window Material/Index	BK7/1.517

Design Objective: Collimate laser light at high magnification.
 Lens Characteristics: High NA for maximum light capture, small size.
 Typical Products: Telecommunications.

Order Nomenclature 350710-A AR Coating 400-600nm 350710-B AR Coating 600-1050nm
 350710-C AR Coating 1050-1600nm 350710-D AR Coating 1300-1700nm

Lens Code 350782 Aspheric/Diffractive Lens See page 22

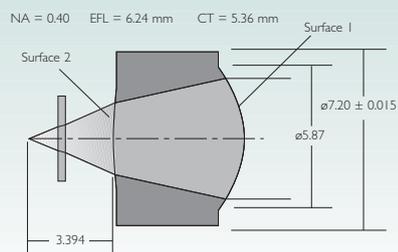


OPTICAL DESIGN SPECIFICATIONS

Design Wavelength	1575 nm
Numerical Aperture (NA)	0.55
Clear Aperture (CA)	5.00 mm
Effective Focal Length (EFL)	4.55 mm
Magnification	Infinite
Outer Diameter (OD)	8.50 mm
Working Distance (WD)	2.97 mm

Design Objective: Collimate polychromatic light for C + L band
 Lens Characteristics: High NA, stainless steel holder, achromatic
 Typical Products: Tunable lasers for communications.

Lens Code 352110



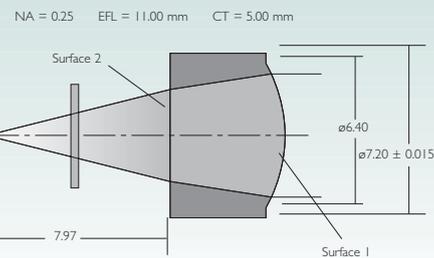
OPTICAL DESIGN SPECIFICATIONS

Design Wavelength	780 nm
Numerical Aperture (NA)	0.40
Clear Aperture (CA)	5.00 mm
Effective Focal Length (EFL)	6.24 mm
Magnification	Infinite
RMS WFE	< Diff. Limit
Outer Diameter (OD)	7.20 mm
Working Distance (WD)	3.394 mm
Laser Window Thickness	0.275 mm
Laser Window Material/Index	BK7/1.517

Design Objective: Collimate or focus laser light at high magnification from a laser diode.
Lens Characteristics: Moderate NA for good light capture; large CA for minimum beam divergence.
Typical Products: Presentation pointers, small weapons sights, survey instruments, hand held and fixed barcode scanners, medical instruments, alignment instruments.

Order Nomenclature 352110-A AR Coating 400-600nm 352110-B AR Coating 600-1050nm
 352110-C AR Coating 1050-1600nm 352110-D AR Coating 1300-1700nm

Lens Code 352220



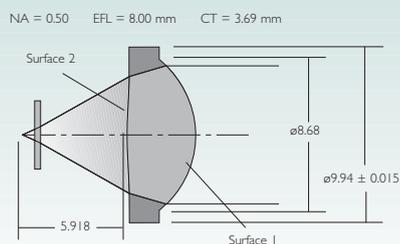
OPTICAL DESIGN SPECIFICATIONS

Design Wavelength	633 nm
Numerical Aperture (NA)	0.25
Clear Aperture (CA)	5.50 mm
Effective Focal Length (EFL)	11.00 mm
Magnification	Infinite
RMS WFE	< Diff. Limit
Outer Diameter (OD)	7.20 mm
Working Distance (WD)	7.97 mm
Laser Window Thickness	0.250 mm
Laser Window Material/Index	BK7/1.517

Design Objective: Collimate or focus laser light at high magnification from a laser diode.
Lens Characteristics: Low NA for clean circular beam; large CA for minimum beam divergence.
Typical Products: Industrial barcode readers, point-of-purchase barcode readers, laser printers, laser fax machines, survey instruments.

Order Nomenclature 352220-A AR Coating 400-600nm 352220-B AR Coating 600-1050nm
 352220-C AR Coating 1050-1600nm 352220-D AR Coating 1300-1700nm

Lens Code 352240



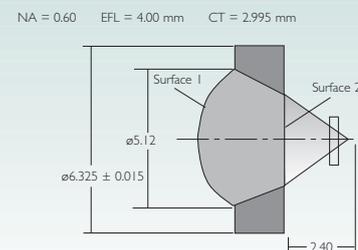
OPTICAL DESIGN SPECIFICATIONS

Design Wavelength	780 nm
Numerical Aperture (NA)	0.50
Clear Aperture (CA)	8.00 mm
Effective Focal Length (EFL)	8.00 mm
Magnification	Infinite
RMS WFE	< Diff. Limit
Outer Diameter (OD)	9.94 mm
Working Distance (WD)	5.918 mm
Laser Window Thickness	0.250 mm
Laser Window Material/Index	BK7/1.517

Design Objective: Collimate or focus laser light at high magnification from a laser diode.
Lens Characteristics: High NA for maximum light capture; large CA and long focal length for minimum beam divergence.
Typical Products: Presentation pointers, small weapons sights, survey instruments, alignment instruments, hand held and fixed barcode scanners, medical instruments.

Order Nomenclature 352240-A AR Coating 400-600nm 352240-B AR Coating 600-1050nm
 352240-C AR Coating 1050-1600nm 352240-D AR Coating 1300-1700nm

Lens Code 352671 Blue Collimating Lens See Page 21



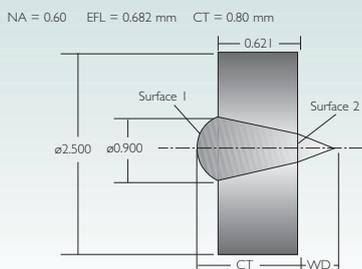
OPTICAL DESIGN SPECIFICATIONS

Design Wavelength	408 nm
Numerical Aperture (NA)	0.60
Clear Aperture (CA)	4.80 mm
Effective Focal Length (EFL)	4.02 mm
Magnification	Infinite
RMS WFE	< Diff. Limit
Outer Diameter (OD)	6.325 mm
Working Distance (WD)	2.39 mm
Laser Window Thickness	0.250 mm
Laser Window Material/Index	Borosilicate/1.507

Design Objective: Collimate laser light at high magnification.
Lens Characteristics: High NA for maximum light capture.
Typical Products: Data storage.

Order Nomenclature 352671-A AR Coating 400-600nm

Lens Code 370060



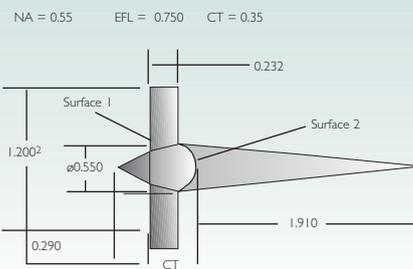
OPTICAL DESIGN SPECIFICATIONS

Design Wavelength	1550 nm
Numerical Aperture (NA)	0.60
Clear Aperture (CA)	0.84 mm
Effective Focal Length (EFL)	0.682 mm
Magnification	Infinite
RMS WFE	< Diff. Limit
Outer Diameter (OD)	2.50 mm
Working Distance (WD)	0.267 mm
Laser Window Thickness	None
Laser Window Material/Index	None

Design Objective: Collimate or focus laser light at high magnification.
 Lens Characteristics: Very high NA for maximum light capture.
 Typical Products: Laser collimator for telecommunications.

Order Nomenclature 370060-O AR Coating 600-1050nm 370060-P AR Coating 1050-1600nm
 370060-Q AR Coating 1300-1700nm

Lens Code 370631



OPTICAL DESIGN SPECIFICATIONS

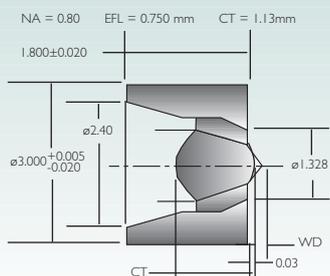
Design Wavelength	1550/1480 nm
Numerical Aperture (NA)	0.55
Clear Aperture (CA)	0.53 mm
Effective Focal Length (EFL)	0.382 mm
Magnification	4.02
RMS WFE	<Diff. Limit
Outer Diameter (OD)	1.20 mm ²
Working Distance (WD)	0.290/1.91 mm*
Distance Holder to Laser	none
Laser Window Thickness	none
Laser Window Material/Index	none

*front/back WD

Design Objective: Laser to fiber coupling lens.
 Lens Characteristics: High NA for maximum light capture, small size.
 Typical Products: Telecommunications.

Order Nomenclature 370631-O AR Coating 600-1050nm 370631-P AR Coating 1050-1600nm
 370631-Q AR Coating 1300-1700nm

Lens Code 370840



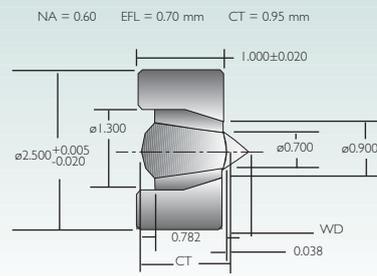
OPTICAL DESIGN SPECIFICATIONS

Design Wavelength	1550/1480 nm
Numerical Aperture (NA)	0.80
Clear Aperture (CA)	1.2 mm
Effective Focal Length (EFL)	0.750 mm
Magnification	Infinite
RMS WFE	<Diff. Limit
Outer Diameter (OD)	3.0 mm
Working Distance (WD)	0.2 mm
Distance Holder to Laser	0.23mm
Laser Window Thickness	None
Laser Window Material/Index	None
Lens Holder	304 Stainless Steel

Design Objective: Collimate or focus laser light at high magnification.
 Lens Characteristics: High NA for maximum light capture.
 Typical Products: Laser collimator for telecommunications.

Order Nomenclature 370840-O AR Coating 600-1050nm 370840-P AR Coating 1050-1600nm
 370840-Q AR Coating 1300-1700nm

Lens Code 370880



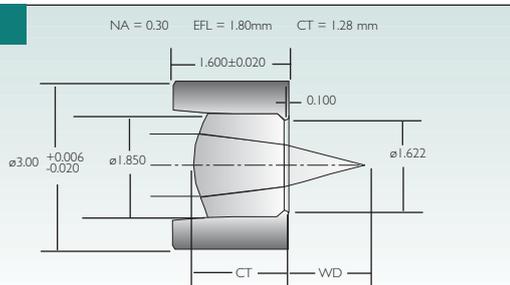
OPTICAL DESIGN SPECIFICATIONS

Design Wavelength	1550/1480 nm
Numerical Aperture (NA)	0.60
Clear Aperture (CA)	0.84 mm
Effective Focal Length (EFL)	0.70 mm
Magnification	Infinite
RMS WFE	< Diff. Limit
Outer Diameter (OD)	2.5 mm
Working Distance (WD)	0.29 mm
Distance Holder to Laser	0.33mm
Laser Window Thickness	None
Laser Window Material/Index	None
Lens Holder	304L Stainless Steel

Design Objective: Collimate or focus laser light at high magnification.
 Lens Characteristics: High NA for maximum light capture.
 Typical Products: Laser collimator for telecommunications.

Order Nomenclature 370880-O AR Coating 600-1050nm 370880-P AR Coating 1050-1600nm
 370880-Q AR Coating 1300-1700nm

Lens Code 370890



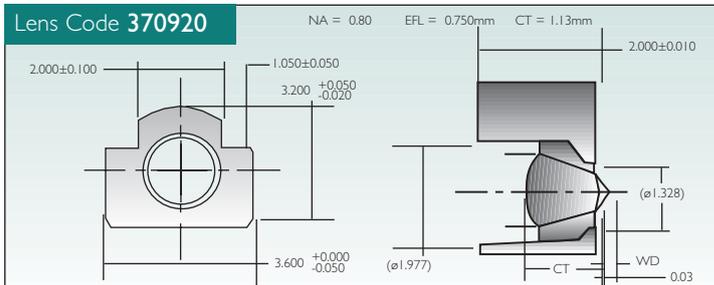
OPTICAL DESIGN SPECIFICATIONS

Design Wavelength	1550/1480 nm
Numerical Aperture (NA)	0.30
Clear Aperture (CA)	1.08 mm
Effective Focal Length (EFL)	1.80 mm
Magnification	Infinite
RMS WFE	< Diff. Limit
Outer Diameter (OD)	3.0 mm
Working Distance (WD)	1.1 mm
Distance holder to Laser	1.0mm
Laser Window Thickness	None
Laser Window Material/Index	None
Lens Holder	304 Stainless Steel

Design Objective: Collimate or focus laser light at high magnification.
 Lens Characteristics: High NA for maximum light capture.
 Typical Products: Laser collimator for telecommunications.

Order Nomenclature 370890-O AR Coating 600-1050nm 370890-P AR Coating 1050-1600nm
 370890-Q AR Coating 1300-1700nm

Lens Code 370920



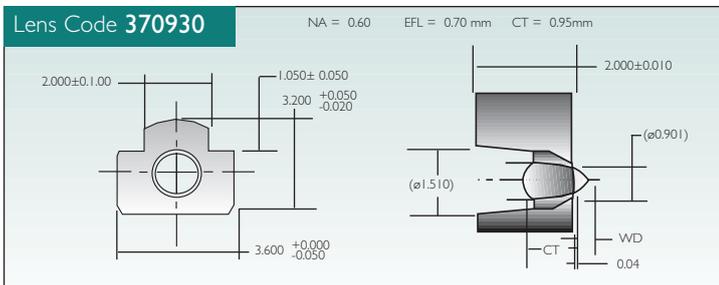
OPTICAL DESIGN SPECIFICATIONS

Design Wavelength	1550/1480nm
Numerical Aperture (NA)	0.80
Clear Aperture (CA)	1.2 mm
Effective Focal Length (EFL)	0.750 mm
Magnification	Infinite
RMS WFE	< Diff. Limit
Outer Diameter (OD)	4.0 mm
Working Distance (WD)	0.2 mm
Distance Holder to Laser	0.23 mm
Laser Window Thickness	None
Laser Window Material/Index	None
Lens Holder	304 Stainless Steel

Design Objective: Collimate or focus laser light at high magnification.
 Lens Characteristics: High NA for maximum light capture.
 Typical Products: Laser collimate for telecommunications.

Order Nomenclature 370920-O AR Coating 600-1050nm 370920-P AR Coating 1050-1600nm
 370920-Q AR Coating 1300-1700nm

Lens Code 370930



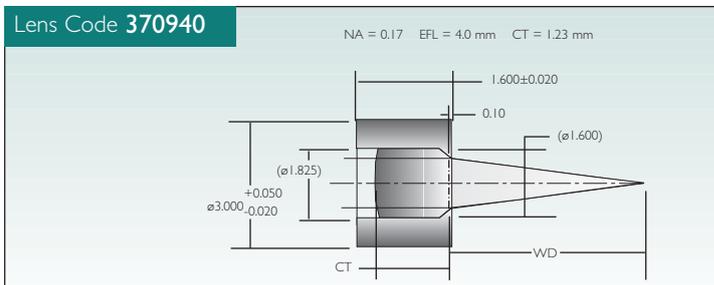
OPTICAL DESIGN SPECIFICATIONS

Design Wavelength	1550/1480 nm
Numerical Aperture (NA)	0.60
Clear Aperture (CA)	0.84 mm
Effective Focal Length (EFL)	0.70 mm
Magnification	Infinite
RMS WFE	< Diff. Limit
Outer Diameter (OD)	4.0 mm
Working Distance (WD)	0.29 mm
Distance Holder to Laser	0.33 mm
Laser Window Thickness	None
Laser Window Material/Index	None
Lens Holder	304 Stainless Steel

Design Objective: Collimate or focus laser light at high magnification.
 Lens Characteristics: High NA for maximum light capture.
 Typical Products: Laser collimator for telecommunications.

Order Nomenclature 370930-O AR Coating 600-1050nm 370930-P AR Coating 1050-1600nm
 370930-Q AR Coating 1300-1700nm

Lens Code 370940



OPTICAL DESIGN SPECIFICATIONS

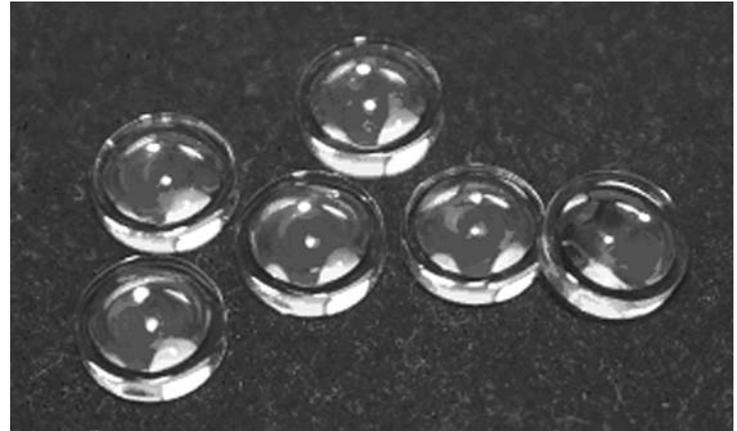
Design Wavelength	1550/1480 nm
Numerical Aperture (NA)	0.17
Clear Aperture (CA)	1.37 mm
Effective Focal Length (EFL)	4.0 mm
Magnification	Infinite
RMS WFE	< Diff. Limit
Outer Diameter (OD)	3.0 mm
Working Distance (WD)	3.36 mm
Distance Holder to Laser	3.36mm
Laser Window Thickness	None
Laser Window Material/Index	None
Lens Holder	304 Stainless Steel

Design Objective: Collimate or focus laser light at high magnification.
 Lens Characteristics: High NA for maximum light capture.
 Typical Products: Laser collimator for telecommunications.

Order Nomenclature 370940-O AR Coating 600-1050nm 370940-P AR Coating 1050-1600nm
 370940-Q AR Coating 1300-1700nm

BLUE LASER COLLIMATING LENS

- Optimized for Nichia® Blue Laser
- Compatible with Other Blue Diode Lasers
- Aspheric Molded Glass Lens
- Diffraction Limited Performance
- Compact, Single Lens Design
- Short Wavelength Provides Smallest Spot



LightPath's new 352671 molded glass aspheric lens is optimized to collimate Nichia's* blue laser diode, and is manufactured and designed to meet extremely stringent optical standards.

Achieving good beam quality is particularly difficult for shorter wavelength lasers. The 352671 is designed for the specific beam divergences, peak wavelength and window material of commercial blue diode lasers, enabling blue laser applications to achieve excellent beam quality and performance.

Working with lasers from 400nm to 415nm with a design centered at 408nm per the laser manufacturers' specification, this design was optimized with a very large and forgiving clear aperture and is also compensated for the laser manufacturers' variation in window thickness.

The 352671 lens now utilizes LightPath's ECO-550 glass, a lead-free alternative to traditional moldable glasses. This glass is fully RoHS compliant, in accordance with the new European restrictions on hazardous substances.

It is currently available for production from LightPath for integration into OEM designs. Please contact sales for more information.

Lens Code 352671 NA = 0.60 EFL = 4.00 mm CT = 2.995 mm

OPTICAL DESIGN SPECIFICATIONS	
Design Wavelength	408 nm
Numerical Aperture (NA)	0.60
Clear Aperture (CA)	4.80 mm
Effective Focal Length (EFL)	4.02 mm
Magnification	Infinite
RMS WFE	< Diff. Limit
Outer Diameter (OD)	6.325 mm
Working Distance (WD)	2.39 mm
Laser Window Thickness	0.250 mm
Laser Window Material/Index	Borosilicate/1.507

Design Objective:	Collimate laser light at high magnification.
Lens Characteristics:	High NA for maximum light capture.
Typical Products:	Data storage.

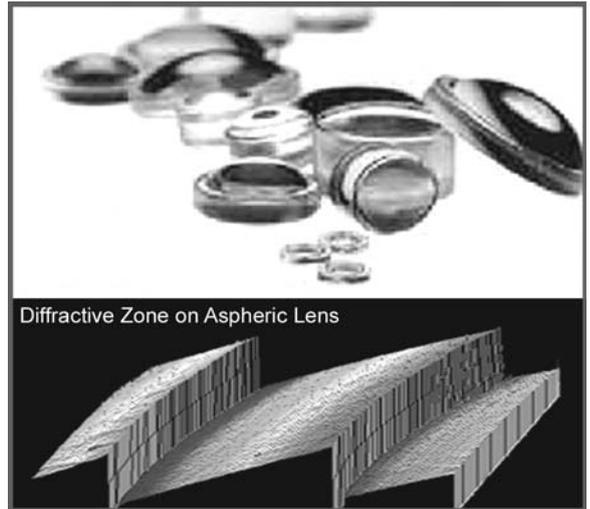
Order Nomenclature 352671-A AR Coating 400-600nm

*Nichia is a registered trademark of the Nichia Corporation

ASPHERIC HYBRID OPTICS

ACHROMATIC PERFORMANCE IN A SINGLE LENS

- Refractive-Diffractive Design
- Color Corrects with a Single Element
- Diffraction Limited Performance
- Custom F/I and Faster Achromats Available
- High Performance, Cost Effective

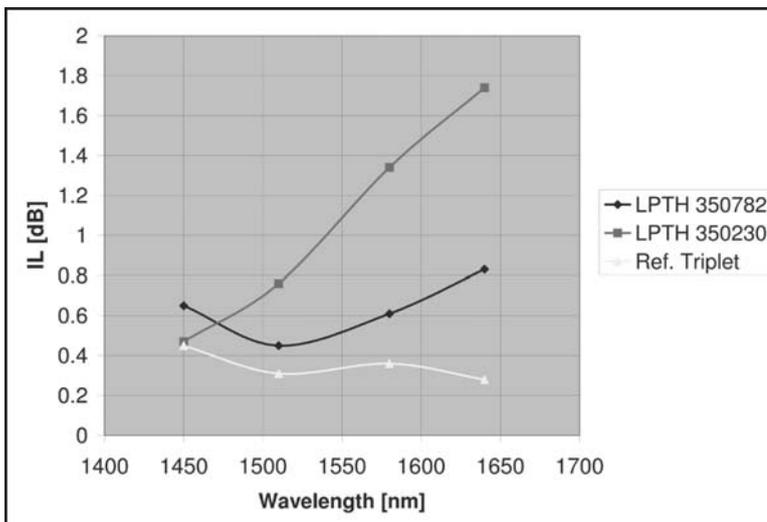


In multi-wavelength or polychromatic applications, the change in focal length due to wavelength can compromise lens performance. For example, if the application requires minimum spot size, as is required in data storage or communications systems, the spot size will change with wavelength, which can degrade system performance. In imaging applications, an uncorrected lens results in a blurry image. A color-corrected lens is needed to minimize these effects.

Until recently, optical designers needed to use doublets or even triplet lenses to achieve color correction. These lenses can be bulky and difficult to align and fabricate.

LightPath is pleased to introduce a new line of optical products for minimizing chromatic aberrations using only a single optical element. These new glass, molded aspheric-diffractive lenses, also called hybrid lenses, can be used over a range of wavelengths for many applications, such as endoscopes for medical and industrial applications, CCD cameras for imaging, as well as tunable lasers for communications products.

Using LightPath's unique precision molded glass hybrid lenses, customers can now solve chromatic performance issues in a single glass lens, and reduce weight, volume and parts count at the same time.



Lens Code 350782 NA = 0.55 EFL = 4.55 mm CT = 2.74 mm

OPTICAL DESIGN SPECIFICATIONS

Design Wavelength	1575 nm
Numerical Aperture (NA)	0.55
Clear Aperture (CA)	5.00 mm
Effective Focal Length (EFL)	4.55 mm
Magnification	Infinite
Outer Diameter (OD)	8.50 mm
Working Distance (WD)	2.97 mm

Design Objective: Collimate polychromatic light for C + L band
 Lens Characteristics: High NA, stainless steel holder, achromatic
 Typical Products: Tunable lasers for communications.

MOUNTED ASPHERIC LENSES

- Easy to handle
- Durable stainless-steel
- Threaded design
- Compact size
- Cost effective

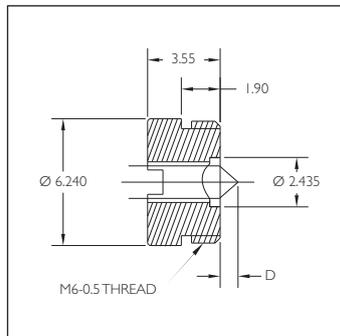
LightPath's line of mounted aspheric lenses makes assembly work quick and easy. The housings are made from durable stainless steel, which is suitable for welding or soldering. The mounts also have a threaded exterior, allowing you to simply screw the lens into place. Standard design mounts are available for nineteen of our most popular lens types, but any of the lenses in the catalog can be mounted into a custom designed holder of your preference. Contact LightPath at 1-800-GRADIUM to discuss your particular requirements.



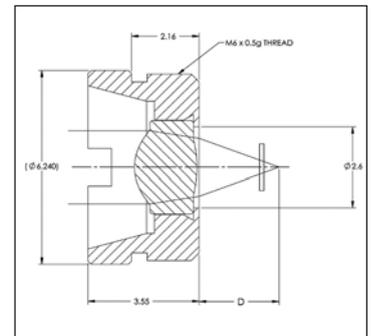
ORDERING INFORMATION				
Part Number	EFL (mm)	NA	Holder Type	D (mm)
350140-X-MT	1.45	0.55	MT6A	0.87
350150-X-MT	2.00	0.50	MT6B	1.02
350170-X-MT	6.16	0.30	MT8	3.60
350350-X-MT	4.50	0.42	MT8	1.61
350390-X-MT	2.75	0.68	MT8	1.16
350660-X-MT	2.97	0.60	MT8	1.26
350330-X-MT	3.10	0.68	MT9	1.71
350080-X-MT	3.89	0.55	MT9	2.47
350610-X-MT	4.00	0.60	MT9	2.42
352671-X-MT	4.02	0.60	MT9	2.12
350340-X-MT	4.03	0.62	MT9	2.49
350440-X-MT	2.95	0.27/0.53	MT8	2.53
350230-X-MT	4.51	0.55	MT9	2.59
352110-X-MT	6.24	0.40	MT9	3.12
352240-X-MT	8.00	0.50	MT12	5.59
352220-X-MT	11.00	0.25	MT9	7.57
350560-X-MT	13.86	0.18	MT9	11.74
350260-X-MT	15.29	0.16	MT9	13.60
350280-X-MT	18.40	0.15	MT9	16.70

GENERAL SPECIFICATIONS AND TOLERANCES	
Holder Material	Stainless Steel 304
Holder Outer Diameter	+/- 0.025mm
Holder Inner Diameter	+/- 0.100mm
Holder Length	+/- 0.100mm
Length of Threaded Section	+/- 0.100mm

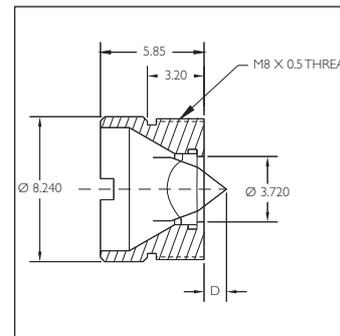
Lens Holder Design MT6A



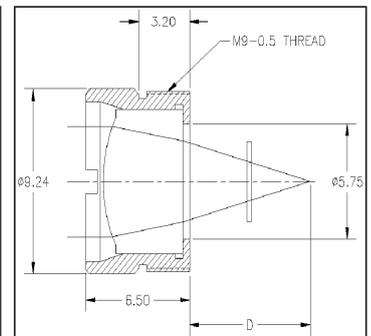
Lens Holder Design MT6B



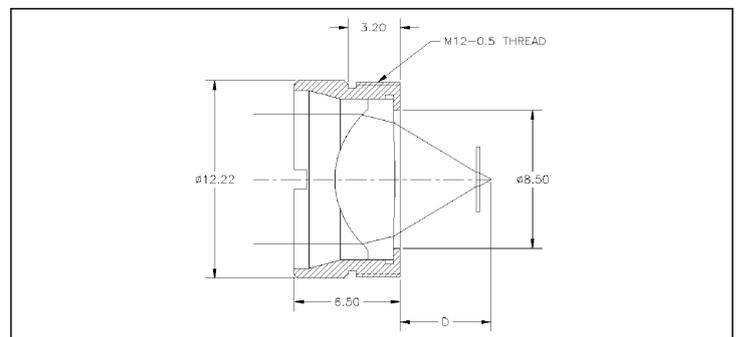
Lens Holder Design MT8



Lens Holder Design MT9



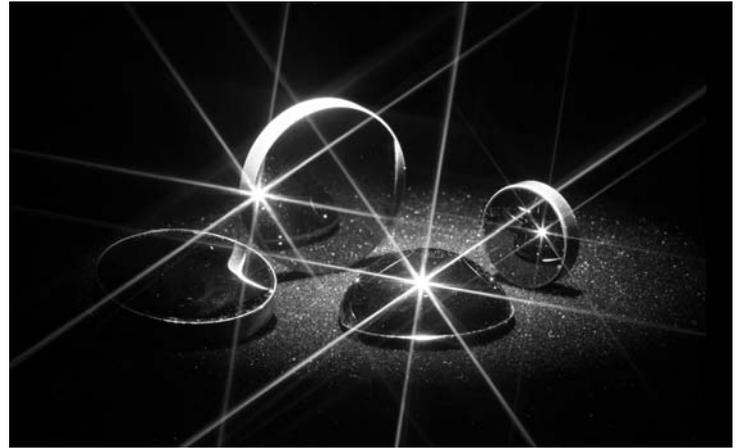
Lens Holder Design MT12



BLACK DIAMOND™

LONG WAVELENGTH INFRARED ASPHERES

- Wavelength Range 1-14 μ m
- Aspheric Lenses Reduce Number of Lenses in System
- Molded Optics Improve Fidelity
- Diffractive Features for Thermal Compensation
- Low Dispersion
- Improved Transmission at Elevated Temperatures
- Custom Designs Available



LightPath is recognized as a world leader in press molded aspherical optics. Traditionally these aspheric lenses have been limited to visible and near-infrared wavelengths. Recent advances in optical materials now provide a common technology path to produce long-wavelength infrared (LWIR) aspheres by compression molding. LightPath's Black Diamond™ technology enables high performance, cost-effective LWIR aspheric lenses that do not rely on traditional diamond turning or lengthy polishing methods.

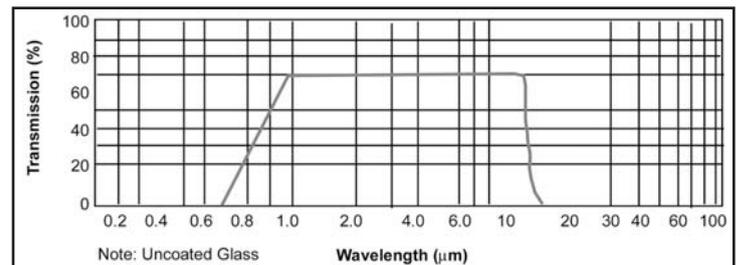
With its original technology purchased from Corning Inc in 1994, LightPath has produced millions of glass aspheric lenses that are used in a variety of industries and markets. LightPath's state of the art facility includes in-house diamond turning capabilities that produce molds with sub-micron accuracies, which is a key to producing precision quality lenses.

Utilizing aspheric optics significantly reduces the number of lenses required for typical thermal imaging systems. Traditional Germanium aspheres are manufactured by diamond turning, which is time-consuming and expensive. Since they are made one at a time, the lenses may also suffer from variations in surface figure leading to variations in performance from lens to lens. The Black Diamond™ molding process allows lenses to be manufactured with highly repeatable, consistent performance. Additional diffractive features can be molded directly into the surfaces of the lens, allowing sophisticated beam shaping or achromatization over a range of wavelengths.

LightPath's Black Diamond™ LWIR moldable glass has several advantages over Germanium, which is traditionally used for aspheric LWIR optics. Germanium suffers from transmission loss as temperature increases, especially as the temperature reaches 100°C. Germanium's transmission decreases by 20-30% at 100°C. Black Diamond™ aspheric lenses can be used in environments up to 300°C, enabling a range of applications that were not previously possible with Germanium.

LightPath's Black Diamond™ aspheres are currently available on a custom basis in diameters up to 25mm. Future development is in progress which will allow the manufacture of these lenses in diameters up to 75mm.

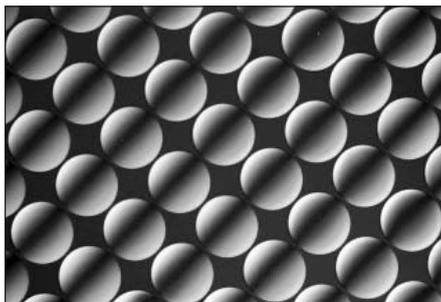
INDEX OF REFRACTION	
Wavelength (mm)	Index
1	2.606
2	2.531
3	2.519
4	2.514
5	2.511
6	2.508
7	2.506
8	2.503
9	2.501
10	2.498
11	2.494
12	2.490
13	2.485
14	2.483



ADDITIONAL CUSTOM CAPABILITIES

Circulight Anamorphic Optics

Most commercially available laser diodes project an elliptical beam due to the diode junction having a rectangular shape. This elliptical beam can create difficulties in many applications, such as laser to fiber coupling. LightPath's CircuLight™ lens technology creates a simple solution to circularize and collimate many of the available laser diodes. By positioning the lens very close to the laser chip itself, these lenses provide a small circular and collimated beam, providing a very elegant and compact solution. Diode to single-mode fiber coupling can be increased to over 90% in some cases. An alignment tab is built-in to aid in adjusting the rotational orientation. Custom designs are available covering wavelengths from 385nm to 1.7 microns.

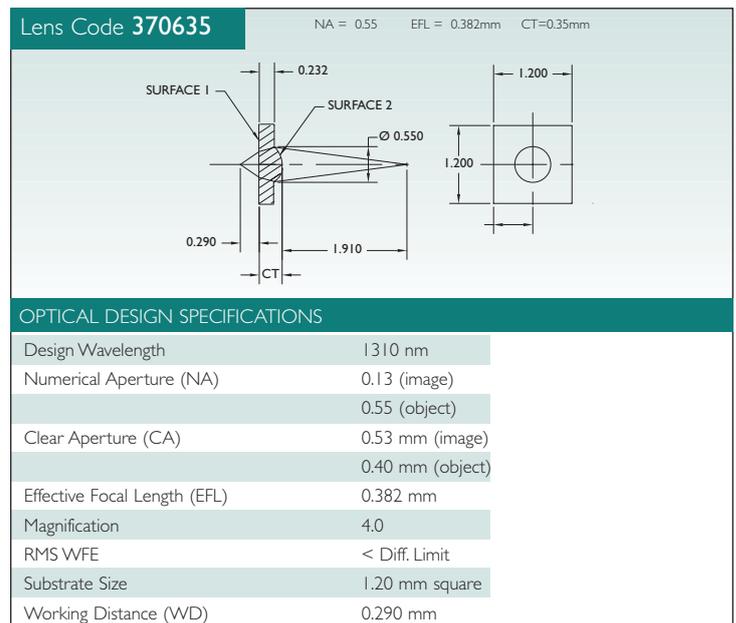


Molded Glass Lens Arrays

By utilizing LightPath's molded lens technology it is now possible to manufacture lens arrays with high precision. Unlike etched lens arrays, where there is a great deal of non-uniformity from array to array, molding will consistently produce the same structure and performance from prototype to large production builds. Consistent focal lengths and form ease the manufacturing requirement for the end user. The molding technology also allows optical designs that require greater sag (lens thickness) such as high numerical aperture collimators for laser diode arrays. Lens arrays can be produced for direct coupling (finite conjugative) or collimating applications. Pitch tolerances are typically less than one micron and lenses can also be placed with varying pitches across the array.

TxAsphere Wafer-Based Molded Optics

Designed and manufactured for today's high performance transmitters, Tx Aspheric™ lenses utilize LightPath's proprietary wafer-scale glass manufacturing techniques, delivering performance, size and price. By molding an entire wafer of lenses at one time and then dicing them individually, production cost is significantly reduced over single lens molding. The dicing operation results in a square form factor lens that can make mounting easier. All lenses are 100% inspected, tested and AR coated.



GRADIUM[®] LENSES

- Aspheric like performance
- Smaller focused spot size
- Low wavefront distortion
- High power handling
- Power threshold exceeds 1.3 KW/cm²*
- Single lens can replace conventional doublets
- High performance, cost effective



Spherical aberration, chromatic aberration and astigmatism induce sweat on the brows of optical designers in many diverse application areas.

Avoiding these deviations from “perfect” optical systems is often difficult without using multiple elements. However, with utilization of LightPath’s unique line of GRADIUM[®] optics, correcting these aberrations using just a single optical element is now a practical reality.

GRADIUM[®] lenses are made from LightPath’s proprietary axial gradient index glass. Its unique refractive qualities can be exploited to reduce spherical aberrations – resulting in performance similar to single-term aspheres.

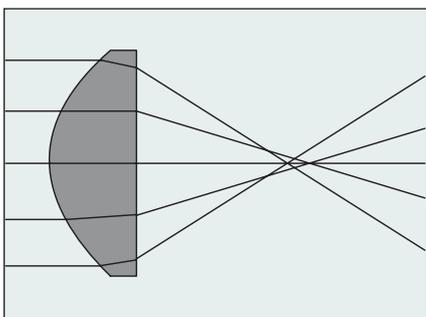
In industry, the lenses have been applied as simple singlets or doublets in complex multi-element systems. In particular, they have been very well received for use in high-power industrial lasers; many of the world’s largest Nd:YAG laser manufacturers now incorporate GRADIUM[®] optics in their laser systems.

LightPath’s DuraYAG assemblies provide a drop-in replacement for focusing and collimating assemblies on some of the most popular YAG laser systems. Their unique coverplate design extends the life of the assembly while the GRADIUM[®] lens provides a smaller focused spot size, increasing power density at the workpiece and enhancing overall system performance.

LightPath’s achromatic doublets are designed for use with collimated, polychromatic light in the visible spectrum. The GRADIUM[®] glass element is used to reduce the spherical aberration which is a common side effect of a cemented doublet design.

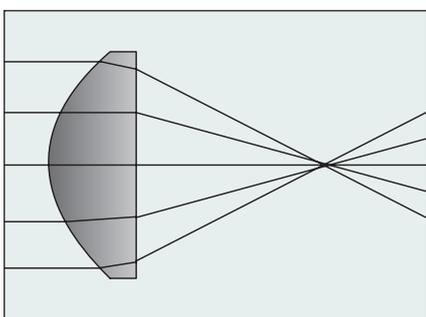
GRADIUM[®] lenses provide a cost-effective solution for many high-performance applications.

Standard Spherical Lens



Standard spherical lenses suffer from spherical aberration, which artificially limits the focused spot size.

Gradium[®] Lens



GRADIUM’s[®] unique refractive index profile bends rays while traveling through the lens, resulting in a better focused, smaller spot.

* Tested at Fraunhofer Institute, Detroit, Michigan 2003

GENERAL LENS SPECIFICATIONS

Design Wavelength	546nm
Operating Temperature	-20°C to +200°C
Storage Temperature	-40°C to +300°C
Outer Diameter (OD) Tolerance	+/-0.250mm
Center Thickness (CT) Tolerance	+/-0.100mm
Effective Focal Length (EFL) for GAD Series	+/- 2%
Effective Focal Length for GPX, GBX, and GMN Series	+/- 1%
Working Distance (WD) for GAD Series	+/- 2%
Working Distance for GPX, GBX, and GMN Series	+/-1%
Surface Quality	40-20 Scratch-Dig
Chamfered with Safety Bevel	

GRADIUM[®] LENSES

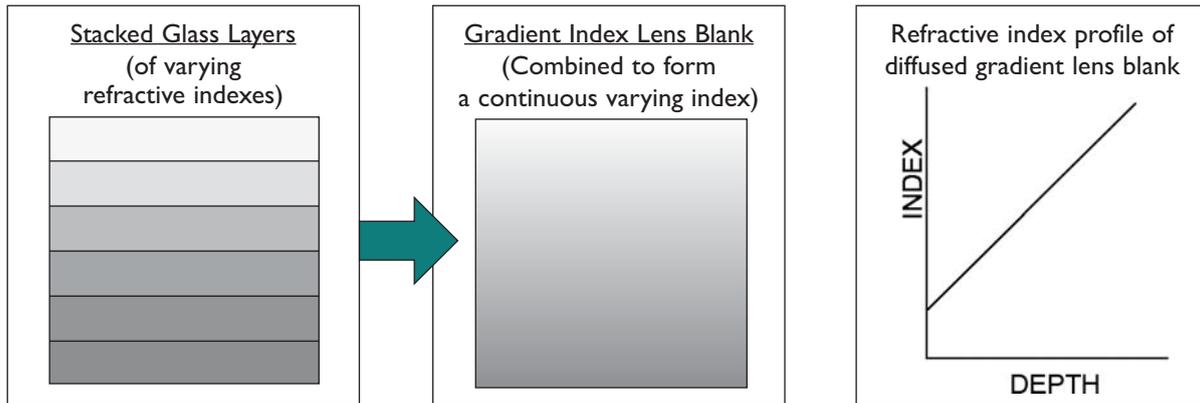
GRADIUM[®] lenses take advantage of recent advances in the manufacturing of axial gradient glass. Large diameter blanks are fabricated with index changes (Δn) of up to 0.15, about 100 times that available from radial GRIN (GRadient INdex) technology. The large range in Δn available provides a substantial ability to correct aberration, especially spherical.

The process used to produce the GRADIUM[®] glass turns a series of SF glass layers into a single piece of gradient material. Unlike radial GRIN lenses, this process provides large diameter optical blanks with controlled index and dispersion profiles. Proper gradient profile selection allows a simple spherical lens to act as an asphere.

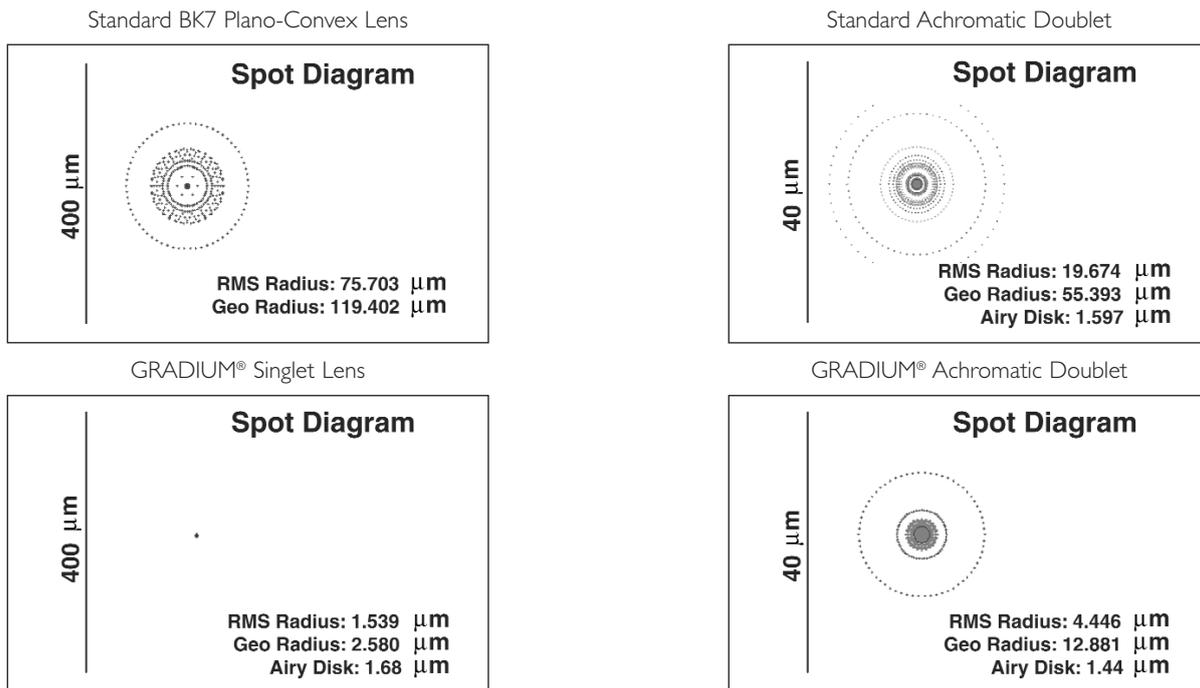
GRADIUM[®] lenses should be used wherever small spot size, high numerical aperture (NA), increased beam energy, or excellent wavefront quality are important. A GRADIUM[®] singlet does not have the limited laser damage threshold of a conventional cemented doublet, so laser power can be increased, leading to increased production throughput.

GRADIUM[®] glass offers the additional benefit of chromatic correction. The dispersion, as well as the optical index, varies in a controlled fashion within the lens. A finished lens can be viewed as a seamless, contiguous combination of many glass types. This continuous variation results in a transfer aberration correction not possible with homogeneous lenses. By combining GRADIUM[®] flint glass with a homogeneous crown glass, achromatic doublets are fabricated with superior color correction.

The Gradium Process

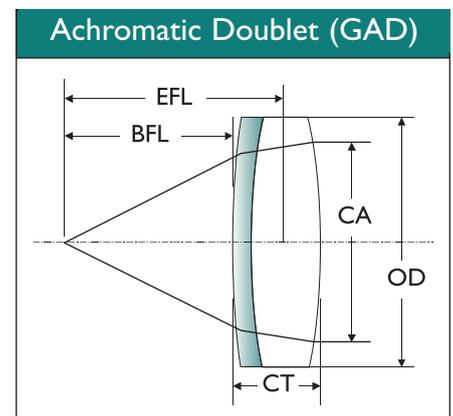
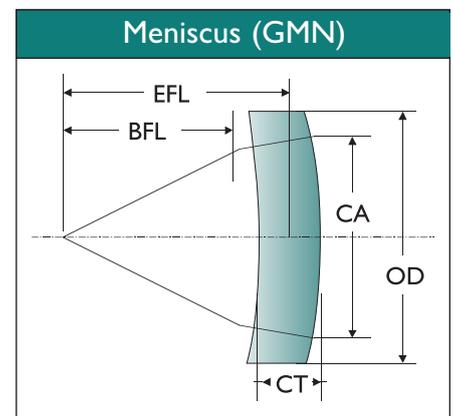
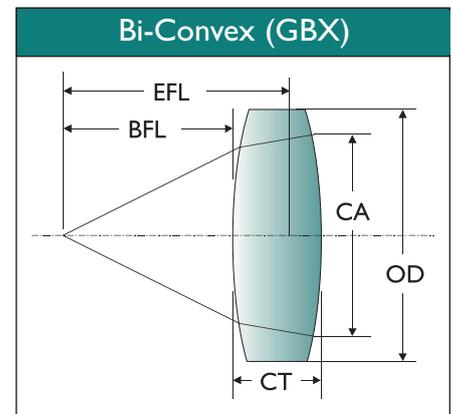
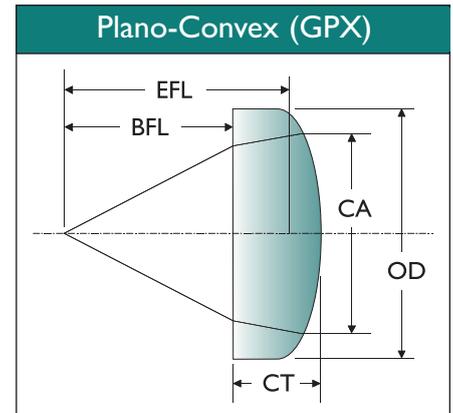


Typical Spot Diagram



GRADIUM® LENSES

	Lens Code	Outer Diameter	Clear Aperture	F/#	Effective Focal Length	Center Thickness	Back Focal Length
Plano-Convex	GPX-5-5	5mm	4mm	1.0	5mm	2.90mm	3.09mm
	GPX-5-12.5	5mm	4mm	2.8	12.5mm	2.00mm	11.30mm
	GPX-10-10	10mm	9mm	1.1	10mm	3.00mm	8.00mm
	GPX-10-18	10mm	9mm	2	18mm	2.50mm	16.52mm
	GPX-10-22	10mm	9mm	2.5	22mm	2.50mm	20.54mm
	GPX-10-25	10mm	9mm	2.8	25mm	2.50mm	23.55mm
	GPX-10-30	10mm	9mm	3.3	30mm	2.50mm	28.53mm
	GPX-10-40	10mm	9mm	4.5	40mm	2.00mm	38.84mm
	GPX-15-15	15mm	13mm	1.1	15mm	4.20mm	12.24mm
	GPX-15-40	15mm	13mm	3	40mm	2.00mm	38.83mm
	GPX-20-50	20mm	18mm	2.8	50mm	3.00mm	48.24mm
	GPX-25-60	25mm	22mm	2.6	60mm	6.00mm	56.46mm
	GPX-25-80	25mm	22mm	3.5	80mm	4.00mm	77.69mm
	GPX-30-60	30mm	27mm	2.2	60mm	6.00mm	56.44mm
	GPX-30-70	30mm	27mm	2.6	70mm	6.00mm	66.47mm
	GPX-30-80	30mm	27mm	3.0	80mm	4.00mm	77.68mm
	GPX-30-100	30mm	27mm	3.7	100mm	6.00mm	96.53mm
	GPX-40-80	40mm	36mm	2.2	80mm	6.00mm	76.47mm
	GPX-40-100	40mm	36mm	2.8	100mm	6.00mm	96.56mm
	GPX-40-125	40mm	36mm	3.5	125mm	6.00mm	121.52mm
GPX-40-150	40mm	36mm	4.2	150mm	6.00mm	146.49mm	
GPX-50-100	50mm	45mm	2.2	100mm	8.00mm	94.90mm	
GPX-50-120	50mm	45mm	2.7	120mm	8.00mm	115.33mm	
GPX-50-125	50mm	45mm	2.8	125mm	8.00mm	120.37mm	
GPX-50-150	50mm	45mm	3.3	150mm	8.00mm	145.25mm	
GPX-50-160	50mm	45mm	3.6	160mm	8.00mm	155.25mm	
GPX-50-200	50mm	45mm	4.5	200mm	8.00mm	195.27mm	
GPX-80-125	80mm	72mm	1.7	125mm	12.25mm	116.91mm	
Bi-Convex	GBX-25-40	25mm	22mm	1.8	40mm	4.60mm	37.51mm
	GBX-30-40	30mm	27mm	1.5	40mm	5.76mm	36.72mm
	GBX-50-80	50mm	45mm	1.8	80mm	8.00mm	75.46mm
Achromat	GAD-5-15	5mm	4mm	3.3	15mm	4.00mm	13.07mm
	GAD-10-20	10mm	9mm	2.2	20mm	6.00mm	17.17mm
	GAD-25-50	25mm	22mm	2.2	50mm	11.00mm	44.37mm
ME	GMN-30-50	30mm	27mm	1.9	50mm	5.00mm	46.82mm



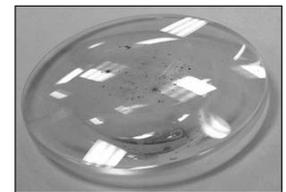
GRADIUM[®] DURAYAG[™] OPTICS MODULE

- Smaller spot size provides better quality cuts
- Increases life of laser and optics
- Pre-assembled for quick, easy installation
- Simple One-Lens Design



The High Cost of Contamination

Many of the problems associated with today's high power laser applications are a result of contamination on optical surfaces. Contaminants on the lens surface absorb the laser light, heat up, and damage the AR coating and the lens itself. Cleanliness is one of the most important steps in keeping a system on-line and performing it's work consistently. The focusing optic takes the brunt of the abuse in most systems. They are subjected to work piece splatter, dust, dirt and handling contamination. Most laser heads provide glass coversheets, which protect the lens from splatter, but do little to protect the lens from other contaminants.



Even in the best sealed or air filtered laser heads, small particulates find their way onto the top surface of the focusing lens. Typically these lenses are removed and cleaned on a routine basis. Each time the lens is removed more contaminants find their way into the head assembly. SEM EDAX analyses of focusing optics shows that the primary contaminants are waste products (Figure A) of the cutting, welding or drilling operation.

When contaminants fall on an unprotected lens, the heat can cause the lens to crack. With DuraYAG[™], the window acts as a shield for the lens, protecting it from breaking.

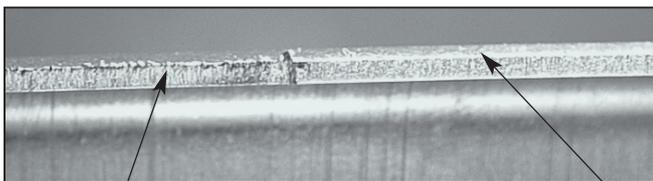
Lowering Your Cost of YAG Laser Ownership

LightPath's DuraYAG[™] modules provide a barrier from these contaminants. The lens modules are designed to replace the lens holder and the two silica lenses found in many laser systems. By utilizing a singlet GRADIUM[®] lens in conjunction with protective plano optic, lens lifetime is increased and the cost of operating your laser system is decreased. LightPath's DuraYAG[™] modules are cleaned and assembled in Class 100 clean room conditions.

When routine maintenance must be performed, just unscrew the optics module, carefully clean the plano optic, and with a few turns of the assembly you are ready to go. Modules require no alignment and are easy to clean (plano optics are much easier to clean than a convex optical element). When your module does need replacing, just send it back to LightPath and you will have a replacement in 24 hours with our 24 Hour Priority Plan.

GRADIUM[®] Lenses vs. Competitors

GRADIUM[®] assembly DYTP2770F used on the right provides a higher quality cut reducing dross.



Traditional silica doublets have a large spot size, which produces poor quality cuts with a large amount of dross. This must be ground down

GRADIUM[®] lenses provide a much higher quality cut, requiring little or no post-cut grinding

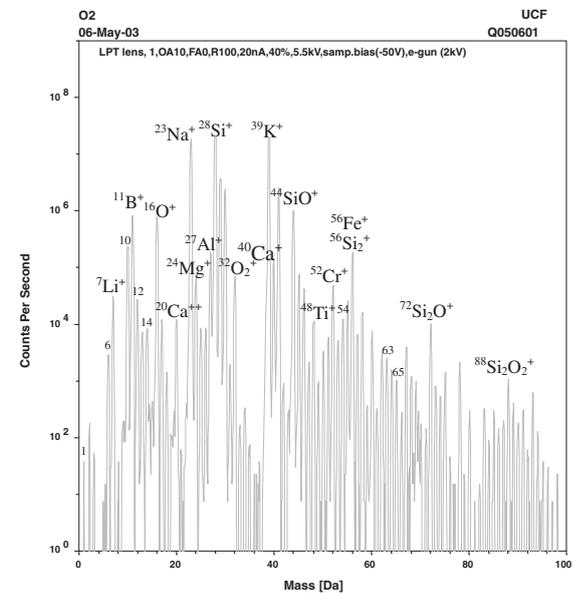


Figure A

SEM analysis on a failed lens shows traces of contamination from the cutting process: Titanium, Chromium, Vanadium, Iron, Sodium, Lithium, Boron, Maganese, Copper, Chlorine, and Potassium.

GRADIUM[®] DURAYAG[™] OPTICS MODULE

The assemblies below list LightPath's current off-the-shelf DuraYAG[™] optics module. LightPath also has a very strong capability to manufacture custom DuraYAG[™] assemblies to your individual specifications. Please contact sales for more information.



The DYTP2770F is designed to be a drop in replacement for the focusing lens assembly of the Precitec YH27 head for use with Trumpf Nd:YAG lasers.



The DYRP3070F is designed to be a drop in replacement for the focusing lens assembly of the Precitec YR30 head for use with Rofi-Sinar Nd:YAG lasers

DURAYAG [™] DYTP2770F ASSEMBLY SPECIFICATIONS	
Lens material:	GRADIUM [®] Glass
Lens diameter:	27mm
Lens focal length:	70mm
Design wavelength:	1064nm
AR coating reflectivity:	<0.25% at 1064nm
Maximum laser power:	4kW (CW)
Holder material:	Stainless steel

DURAYAG [™] DYRP3070F ASSEMBLY SPECIFICATIONS	
Lens material:	GRADIUM [®] Glass
Lens diameter:	30mm
Lens focal length:	70mm
Design wavelength:	1064nm
AR coating reflectivity:	<0.25% at 1064nm
Maximum laser power:	4kW (CW)
Holder material:	Stainless steel

Anti-reflective Coatings

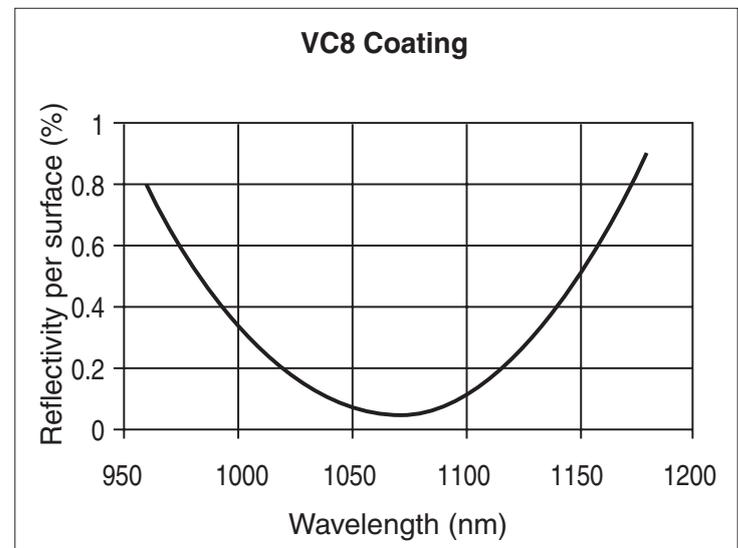
All of LightPath's Nd:YAG lenses and modules are available with high quality anti-reflective coatings. The VC-8 coating is designed to withstand the high power, rugged environment of YAG laser manufacturing. Reflectivity is typically less than <0.15% per surface and guaranteed to be <0.25% at 1064nm. GRADIUM[®] lenses and DuraYAG[™] modules have been tested at the Fraunhofer Institute and are suitable for applications up to 4000 watts CW. Please contact LightPath if you need coatings for applications which are greater than 4000 watts CW.

Customization

LightPath would be happy to design a custom GRADIUM[®] lens to your individual specifications. We can customize the focal length, diameter, and design wavelength to meet your specific needs. Lenses can also be provided with custom anti-reflective coatings or mounted in custom housings.

24-Hour Quick Replacement Priority Plan

LightPath's 24-Hour Priority Plan provides 24-hour delivery of your DuraYAG[™] module to replace an assembly that has failed. LightPath offers Gradium[®] lenses and modules off-the-shelf for most common YAG laser systems and heads including Trumpf, Rofin-Sinar, GSI Lumonics, Precitec and others. Customized optics and modules can also be designed for your specific application.



FUSION™ FIBER COLLIMATORS

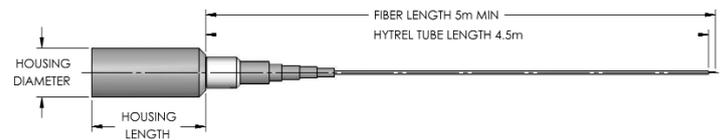
- Ideal for Fiber Laser Applications
- Patented Fiber Fusion Technology
- Standard Beam Diameters up to 12.5mm
- Designed for Single Mode Applications up to 100W
- Uses High Performance GRADIUM® Lenses
- Rugged Stainless Steel Design
- New Armored Cabling Available

LightPath's large beam fiber collimators utilize patented fiber fusion technology to enable the collimators to be used at very high power. The fiber is laser fused directly to a plano-plano silica rod, resulting in an index matched transition from fiber to rod without any glass to air interface to cause unwanted back-reflections. The technology alleviates the need to angle polish the fiber, which allows the system to remain coaxial. The light expands as it passes out of the fiber through the rod, which results in a much lower power density at the exit of the rod. The lower density keeps the collimator stable in the event that contamination falls on its surface. The result is an optical system with superior performance and very low loss.

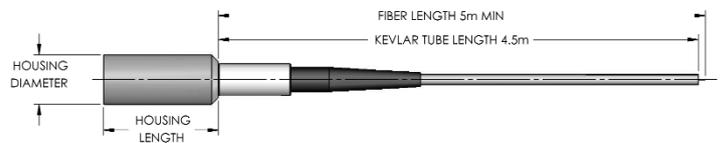
LightPath also has a strong capability to design and manufacture custom collimators to the specs of your choice. Custom beam diameters, fiber types, connectors, and wavelengths can be chosen to fit your individual application.



FUSION™ FIBER COLLIMATOR WITH HYTREL TUBING



FUSION™ FIBER COLLIMATOR WITH PVC / KEVLAR TUBING

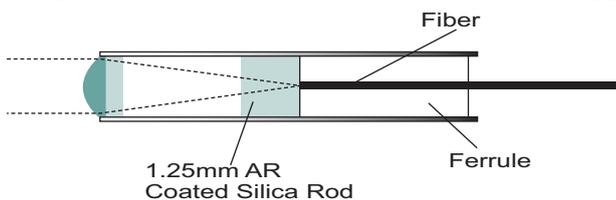


FUSION™ FIBER COLLIMATOR WITH STAINLESS STEEL ARMOR

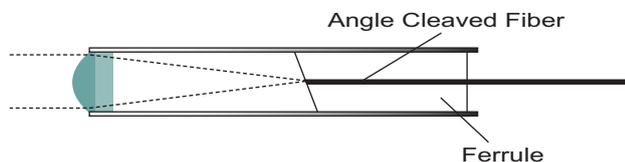


LightPath Fusion™ Advantage

LightPath's Patented Fusion™ Technology



LightPath's patented process fuses the silica fiber directly to a large silica rod. In applications involving Corning's HI 1060 fiber, light expands within the silica rod and exits in an area 12,000 times larger than competitive collimators greatly reducing the power density and improving the reliability at higher power levels.



Light exits fiber and tip and expands in air until collimated by the optical lens. Using Corning's HI 1060 fiber as an example, energy is concentrated in area only 6.2 microns in diameter at the exit fiber tip. Sub-micron defects from contamination, polishing or AR coating the fiber will have catastrophic consequences at high power. In this type of system the fiber must also be angle polished and non-coaxial to the package in order to reduce back reflections

Custom Options Available:

For custom designs and configurations please contact LightPath Sales.

- Lens Cap
- Protective Lens Window
- Fiber Connectors
- Other Design Wavelengths
 - ◆ 1550nm
 - ◆ 1310nm
 - ◆ 1064nm
 - ◆ 980nm
 - ◆ 780nm
 - ◆ 633nm
 - ◆ 546nm
 - ◆ 532nm
 - ◆ 408nm
 - ◆ Others
- Other Fibers Available
 - ◆ Corning SMF 28
 - ◆ Corning TB-II
 - ◆ Corning PM 15-U25A
 - ◆ Corning 50/125 MMF
 - ◆ Nufem LMA-GDF-20-400
 - ◆ Nufem 1060-XP
 - ◆ Nufem 1550B-HP
 - ◆ Nufem 630-HP
 - ◆ HWT-FIB-05D02
 - ◆ INO50301
 - ◆ Fujikura SM.98-P-6/125-UV/UV-400

HIGH POWER FUSION™ FIBER COLLIMATORS

- Ideal for Fiber Laser Applications
- Patented Fiber Fusion Technology
- Standard Beam Diameters up to 12.5mm
- Designed for Single Mode Applications up to 100W
- Uses High Performance GRADIUM® Lenses
- Rugged Stainless Steel Design
- New Armored Cabling Available

LightPath's large beam fiber collimators utilize patented fiber fusion technology to enable the collimators to be used at very high power. The fiber is laser fused directly to a plano-plano silica rod, resulting in an index matched transition from fiber to rod without any glass to air interface to cause unwanted back-reflections. The technology alleviates the need to angle polish the fiber, which allows the system to remain coaxial. The light expands as it asses out of the fiber through the rod, which results in a much lower power density at the exit of the rod. The lower density keeps the collimator stable in the event that contamination falls on its surface. The result is an optical system with superior performance and very low loss.

The collimators incorporate LightPath's proprietary GRADIUM® lens technology, providing aspheric-like performance in a cost-effective package. Beam diameters are available ranging from 1mm to 12.7mm for standard products. The collimators are housed in a stainless steel housing and can be made with a variety of different cable options.

LightPath also has a strong capability to design and manufacture custom collimators to the specs of your choice. Custom beam diameters, fiber types, connectors, and wavelengths can be chosen to fit your individual application.

1064NM BEAM DELIVERY OPTICS	
Center Wavelength	1064nm
Return Loss	-55dB
Pointing Accuracy	1° max
Beam Roundness	> 90%
M ²	< 1.2
Output Beam Offset	1.5mm max
Transmission	>97%
Working Distance	Infinite
Storage Temperature	-40°C to +85°C
Fiber Type	Corning HI1060
Fiber Length	5 meters
Note: Above specifications are measured and guaranteed at room temperature (25°C) only.	

Part Number	Cable Type	Beam Dia. (1/e ² , mm)	Divergence (mRad)	Housing Diameter	Housing Length*	GRADIUM Lens Used
10265164	3.0mm PVC / Kevlar*	1.0 ± 0.1	1.9	9.5mm	13.1mm	GPX5-5VC8
10275164	3.0mm Stainless Steel					
10265264	3.0mm PVC / Kevlar*	2.0 ± 0.2	0.96	9.5mm	18.4mm	GPX5-10VC8
10275264	3.0mm Stainless Steel					
10265364	3.0mm PVC / Kevlar*	2.4 ± 0.2	0.90	14.0mm	20.5mm	GPX10-12.5VC8
10275364	3.0mm Stainless Steel					
10265464	3.0mm PVC / Kevlar*	3.6 ± 0.4	0.50	14.0mm	25.6mm	GPX10-18VC8
10275464	3.0mm Stainless Steel					
10265664	3.0mm PVC / Kevlar*	5.1 ± 0.5	0.37	14.0mm	33.2mm	GPX10-25VC8
10275664	3.0mm Stainless Steel					
10265764	3.0mm PVC / Kevlar*	6.0 ± 0.6	0.30	14.0mm	38.1mm	GPX10-30VC8
10275764	3.0mm Stainless Steel					
10265864	3.0mm PVC / Kevlar*	8.0 ± 0.8	0.24	21.0mm	48.6mm	GPX15-40VC8
10275864	3.0mm Stainless Steel					
10265964	3.0mm PVC / Kevlar*	12.0 ± 1.2	0.18	25.0mm	72.1mm	GPX20-60VC8
10275964	3.0mm Stainless Steel					

* Hytrel and Kevlar cabling is not recommended for use over 10W. For high power applications, please use stainless steel cabling.

1550NM FUSION™ FIBER COLLIMATORS

- Ideal for Fiber Laser Applications
- Patented Fiber Fusion Technology
- Standard Beam Diameters up to 12.5mm
- Designed for Single Mode Applications up to 100W
- Uses High Performance GRADIUM® Lenses
- Rugged Stainless Steel Design
- New Armored Cabling Available

LightPath's large beam fiber collimators provide a unique solution for coupling light into and out of fibers. By utilizing patented fiber fusion technology, these collimators exhibit extremely low loss and high reliability. LightPath laser fuses a plano-plano silica rod to directly to the tip of the fiber, virtually eliminating back-reflections without the need to angle cleave the fiber. That, in turn, allows the optical system to remain coaxial keeps the return loss very low.

These collimators are now available with a variety of different cabling options (Hytrel tube, Kevlar cable, steel armor), providing the appropriate level of protection given the environment the collimator will be exposed to. There are also options for adding a protective window to the output side, a lens cap to seal the collimator when not in use, or fiber connectors to make installation quick and simple.

Standard configurations are available for 1550nm and 1310nm in beam diameters from 1mm up to 12.5mm. Custom designs for other wavelengths can also be made per your specific requirements, from 400 up to 2000nm. LightPath also has experience working with other types of fibers, such as expanded core fibers, polarization maintaining fibers, and multimode fibers.

1550NM BEAM DELIVERY OPTICS	
Center Wavelength	1550nm
Return Loss	-55dB
Pointing Accuracy	1° max
Beam Roundness	> 90%
M ²	< 1.2
Transmission	> 97%
Working Distance	Infinite
Storage Temperature	-40°C to +85°C
Fiber Type	Corning SMF28
Fiber Length	5 meters
Note: Above specifications are measured and guaranteed at room temperature (25°C) only.	

Part Number	Cable Type	Beam Dia. (1/e ² , mm)	Divergence (mRad)	Housing Diameter	Housing Length*	GRADIUM Lens Used
I0255100	0.9mm Hytrel	0.9 ± 0.1	3.1	9.5mm	13.1mm	GPX5-5VDB3
I0265100	3.0mm PVC / Kevlar					
I0275100	3.0mm Stainless Steel					
I0255200	0.9mm Hytrel	1.8 ± 0.2	1.6	9.5mm	18.4mm	GPX5-10DB3
I0265200	3.0mm PVC / Kevlar					
I0275200	3.0mm Stainless Steel					
I0255300	0.9mm Hytrel	2.2 ± 0.2	1.3	14.0mm	20.5mm	GPX10-12.5DB3
I0265300	3.0mm PVC / Kevlar					
I0275300	3.0mm Stainless Steel					
I0255400	0.9mm Hytrel	3.3 ± 0.3	0.82	14.0mm	25.6mm	GPX10-18DB3
I0265400	3.0mm PVC / Kevlar					
I0275400	3.0mm Stainless Steel					
I0255600	0.9mm Hytrel	4.5 ± 0.5	0.59	14.0mm	33.2mm	GPX10-25DB3
I0265600	3.0mm PVC / Kevlar					
I0275600	3.0mm Stainless Steel					
I0255700	0.9mm Hytrel	5.4 ± 0.5	0.49	14.0mm	38.1mm	GPX10-30DB3
I0265700	3.0mm PVC / Kevlar					
I0275700	3.0mm Stainless Steel					
I0255800	0.9mm Hytrel	7.3 ± 0.7	0.38	21.0mm	48.6mm	GPX15-40DB3
I0265800	3.0mm PVC / Kevlar					
I0275800	3.0mm Stainless Steel					
I0255900	0.9mm Hytrel	10.8 ± 1.1	0.24	25.0mm	72.1mm	GPX20-60DB3
I0265900	3.0mm PVC / Kevlar					
I0275900	3.0mm Stainless Steel					

CONNECTORIZED ASPHERIC COLLIMATORS

- Diffraction limited performance
- Rugged stainless steel housing
- Pre-aligned for popular wavelengths
- Connectorized for quick assembly
- Threaded exterior for easy mounting
- Epoxy free optical path
- Compact size

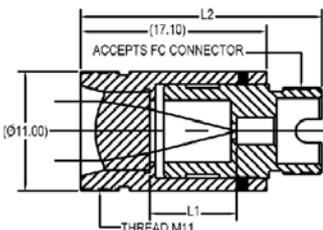


LightPath's line of aspheric collimator assemblies combine the outstanding performance of glass molded aspheric lenses with the ease of assembly of a fiber connector interface. The assemblies have a threaded exterior, which allows a quick connection to an optical bench or within an instrument. LightPath's connectorized collimators are available with either FC or SMA fiber optic connectors and are individually aligned and tested for the specified wavelengths, and will offer excellent performance throughout the entire range of their AR coatings.

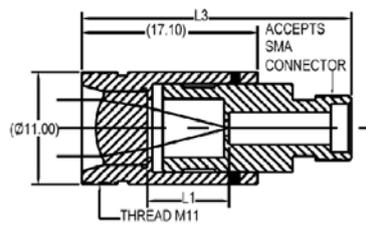
Standard design assemblies are available for two of our most popular lens types, but any asphere in our catalog can be mounted into a custom assembly of your choice. Please contact sales for more information.

	DESIGN λ	L1 (mm)	L2 (mm)	L3 (mm)	Typical Beam Dia. ¹	Beam Waist Location
352220(FC/SMA)-A	543nm	7.79	21.99	26.05	2	Infinity
352220(FC/SMA)-B	780nm	7.97	22.17	26.23	2.2	Infinity
352220(FC/SMA)-C	1310nm	8.12	22.32	26.38	2	Infinity
352220(FC/SMA)-D	1550nm	8.16	22.36	26.42	2	Infinity
350260(FC/SMA)-A	543nm	13.65	25.04	29.11	3	Infinity
350260(FC/SMA)-B	780nm	13.91	25.3	29.37	3	Infinity
350260(FC/SMA)-C	1310nm	14.13	25.52	29.59	2.8	Infinity
350260(FC/SMA)-D	1550nm	14.20	25.59	29.66	3	Infinity

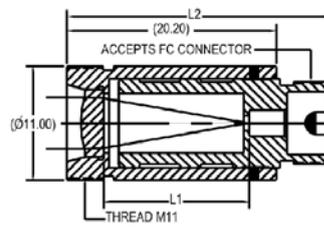
352220-FC



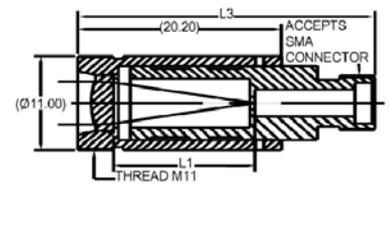
352220-SMA



350260-FC

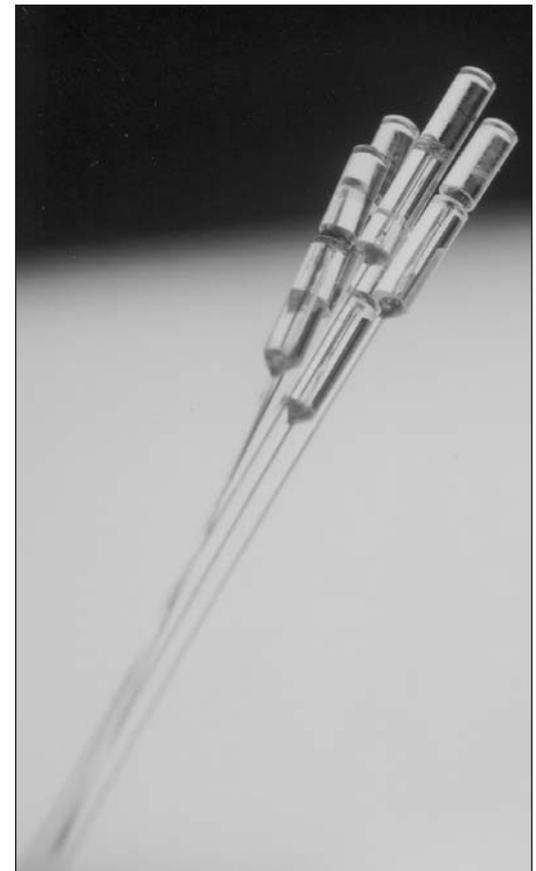


350260-SMA



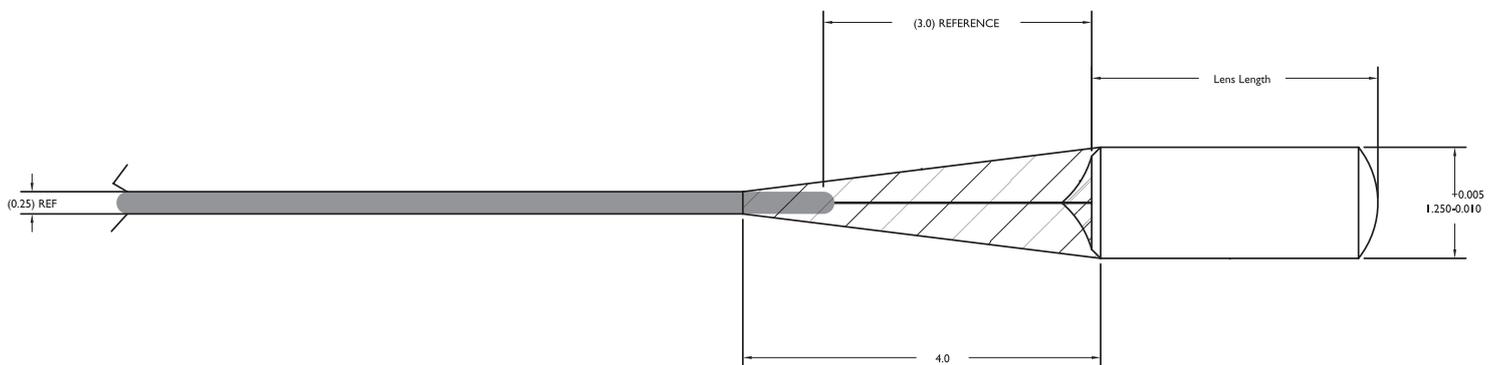
SMALL BEAM COLLIMATORS

- Aspheric lens profile
- Fiber laser fused directly to lens
- Superior coupling efficiency
- Small form factor



LIGHTPATH'S STANDARD SMALL BEAM COLLIMATORS	
Center Wavelength	1310 or 1550nm
Fiber Type	Corning SMF28
Fiber Length	2 Meters
Return Loss	< -55dB
Operating Temperature	-20°C to +60°C
Storage Temperature	-40°C to +85°C
Pointing Accuracy	1° Maximum
Power Handling	10 Watts CW
Lens Diameter	1.25mm +0.005 / -0.010mm
M ²	< 1.3

PART NUMBER	CENTER WAVELENGTH	INSERTION LOSS	WORKING DISTANCE	BEAM DIAMETER I/E ² / FULL	LENS LENGTH
TI005Y0S1-20A	1550nm	0.3 dB	10-30mm	0.42 / 0.58mm	3.2mm
TI055Y0S1-20A	1310nm	0.3 dB	40-65mm	0.40 / 0.56mm	3.2mm
TI527Y0S1-20A	1550nm	0.3 dB	2-15mm	0.42 / 0.58mm	3.2mm
TI557Y0S1-20A	1310nm	0.3 dB	30-50mm	0.40 / 0.56mm	3.2mm
T3005S0S1-20A	1550nm	0.5 dB	80-120mm	0.58 / 0.81mm	4.4mm
T3055S0S1-20A	1310nm	0.5 dB	120-160mm	0.55 / 0.76mm	4.4mm
T3105S0S1-20A	1550nm	0.5 dB	120-160mm	0.58 / 0.81mm	4.4mm
T3155S0S1-20A	1310nm	0.5 dB	130-170mm	0.56 / 0.78mm	4.4mm



OPTICAL ISOLATORS

- Innovative Patented Robotic Manufacturing & Test
- Process automation yields superior uniformity
- Epoxy free optical path available
- Flexible optical and physical design
- Design variations without major process or tooling changes
- Isolators can be converted into a variety of finished products through proprietary robotic processes



Optical Isolators provide lasers with immunity from back-reflection, thereby improving the signal to noise ratio for laser diode based transmitters. This is especially important for high data rate transceivers and transponders, or those devices requiring long span lengths between transceiver pairs. All of our isolators are based on dichroic polarizing glass and Faraday rotating crystals for highest performance. These devices are available in a single stage, 1.5 stages, or double stages, with multiple stages providing progressively higher isolation.

We offer isolators in the following form factors: Cylindrical, Surface-Mount, and Sub-Mount. In addition, we manufacture isolators with either an epoxy-free optical path or with a laminated core. LightPath works with customers on the front-end to tailor isolators for the manufacture of next generation products. We have extensive capability to design and build custom products where the flexibility of our platform-based processes provides a responsive and competitive advantage.

The primary benefits of our approach to manufacturing include reduced costs as a result of higher yields, throughput and product consistency as a result of automation. LightPath is capable of delivering a total solution to its OEM customers, from prototype and development contracting through high-volume production.

The Automated Difference

- Reduced costs through higher yields and increased throughput
- Improved product uniformity and consistency
- Short development times and flexibility
- Scalable manufacturing capacity

The table below shows typical specifications for single, 1.5, and double stage isolators.

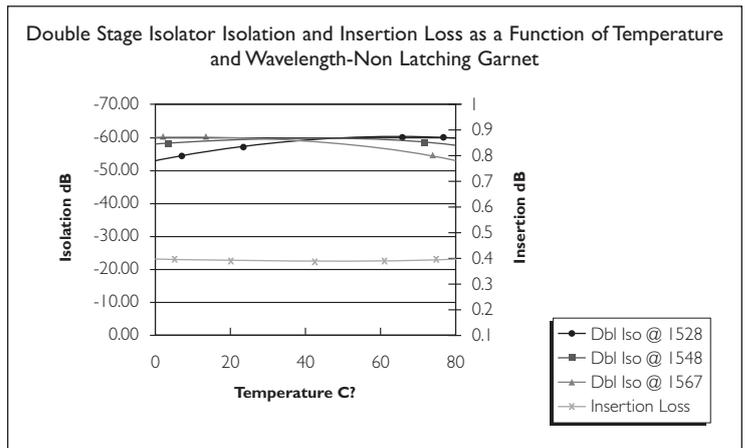
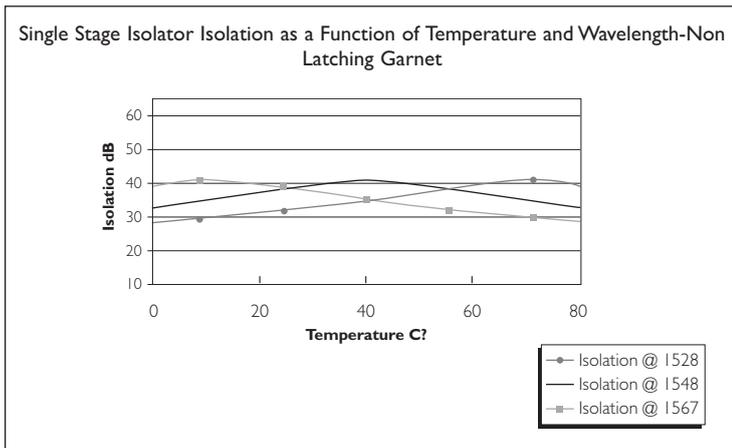
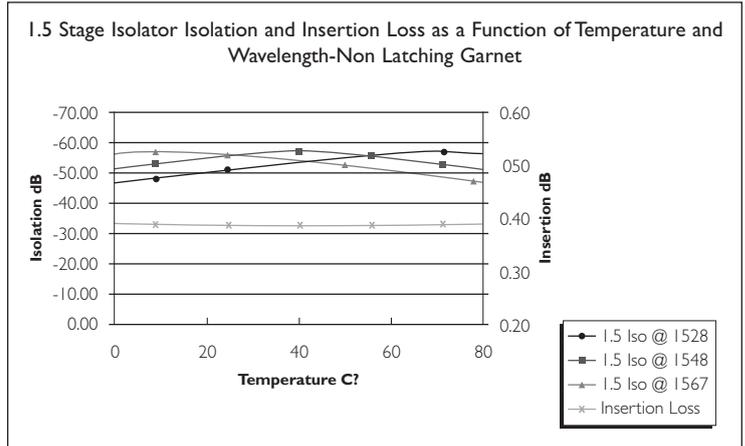
Typical Performance Parameters for Temperature 0 to 85° λ (center) \pm 20 nm		
Isolator Type	Medium Isolation (dB)	Maximum Insertion Loss (dB)
Single Stage	25	0.3
1.5 State	42	0.5
Double Stage	47	0.5

OPTICAL ISOLATORS

Typical temperature and wavelength dependence of isolators.

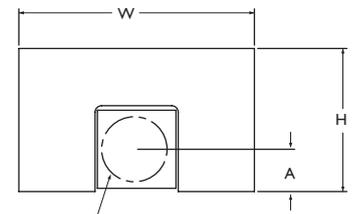
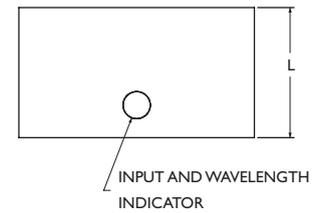
The following graphs show how the isolation changes over various temperatures and wavelengths for single stage, 1.5 stage, and double stage isolators. As you can see, isolation increases as you add stages to the isolator. Additional stages also offer more stability of isolation over wavelength and temperature shifts than isolators with fewer stages.

LightPath can also customize isolators to be optimized at any specific temperature and wavelength of the customer's choosing. These custom isolators can be made in mass production very quickly, at prices comparable to the standard isolators listed here.



SURFACE MOUNT ISOLATORS

- Small form factor
- Laminate core
- Solder or epoxy attach
- Suitable for pick-and-place assembly

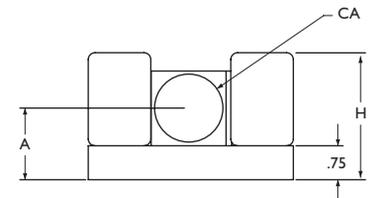
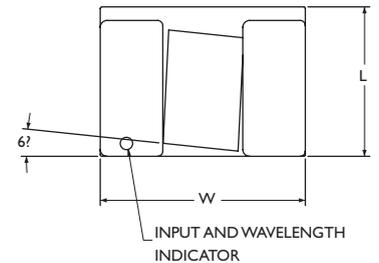


9020 Dimensions in mm										
Part #	CA	A	L	H	W	Number of Stages			Wavelength	
						Single	1.5	Double	1310nm	1550nm
9020-XXX-Y	0.500	0.325	1.00	1.10	1.80	-010	-015*	N/A	-A	-B
9022-XXX-Y	0.780	0.465	1.80	1.75	2.50	-010	-015	-020	-A	-B
9023-XXX-Y	1.000	0.575	1.80	2.20	3.30	-010	-015	-020	-A	-B

* Available in 1310nm style only

SUB MOUNT ISOLATORS

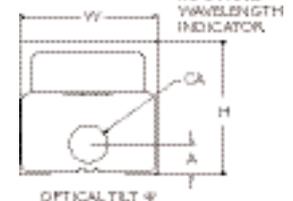
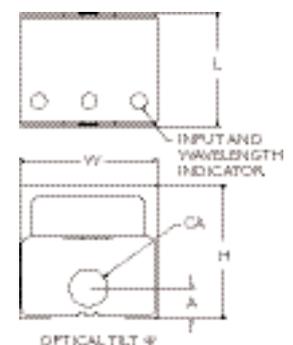
- Small form factor
- Laminate core
- Solder or epoxy attach
- Optical axis height determined by sub-mount thickness



9030 Dimensions in mm										
Part #	CA	A	L	H	W	Number of Stages			Wavelength	
						Single	1.5	Double	1310nm	1550nm
9030-XXX-Y	1.000	1.6	2.00	2.40	3.40	-010	-015	-020	-A	-B

MICRO FIXTURE ISOLATORS

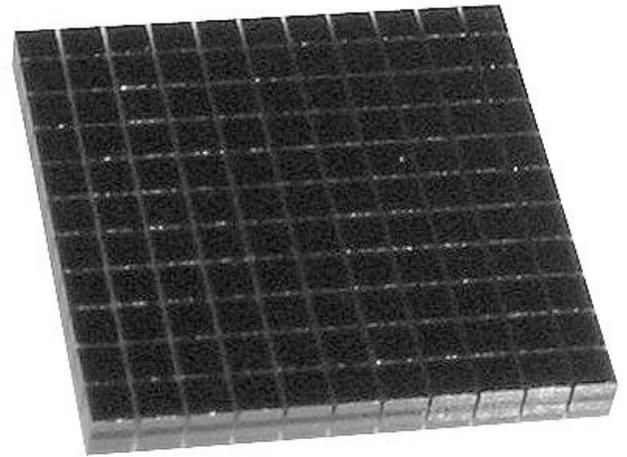
- Epoxy free core optical path
- Laser welded construction



9040 Dimensions in mm										
Part #	CA	A	L	H	W	Number of Stages			Wavelength	
						Single	1.5	Double	1310nm	1550nm
9040-XXX-Y	0.900	0.75	3.00	3.50	3.50	N/A	N/A	-020	-A	-B

T_x ISOLATORS™

- Metro, Access, Long Haul and Hybrid Fiber Coax
- High volume Wafer-Scale manufacturing
- High isolation, low insertion loss
- Square form factor for ease of mounting
- One stage, 1.5 stage and two stage isolation



Many of today's transmitters require optical isolators to eliminate back reflections and feedback in the laser diode. This feedback and noise creates jitter in the system. LightPath's Tx Isolators™ are manufactured in a very economical and scalable process. By utilizing a wafer based platform you can be assured of premium performance at an outstanding value. LightPath's processes allow manufacturing, test and inspection on hundreds of isolators in wafer format. The Tx Isolators™ are manufactured with a latched garnet, which eliminates the need and extra cost associated with traditional magnet. Latched garnet has the orientation of its magnetic dipoles frozen by poling in an external magnetic field at an elevated temperature. This elevated temperature reduces the coercivity (ability of material to resist a change in its dipole orientation) of the material. Latched garnet requires lower post processing temperatures - if temperatures in your process are higher than 170 degrees centigrade a post process magnetization after assembly is required or else LightPath recommends the use of isolators including a magnet. For further technical information and pricing please contact your local LightPath sales representative.

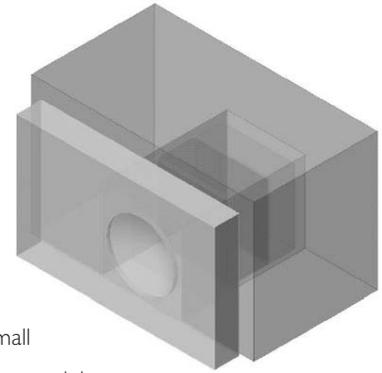
9000 series Dimensions in mm											
Part Number	CA	Height	Width	Length	Typical Isolation	Insertion Loss	Number of Stages			Wavelength	
							single	1.5	Double	1310nm	1550nm
9001-XXX-Y	0.500	0.600	0.600	see chart 2	see chart 1	see chart 1	-010	-015	-020	-A	-B
9002-XXX-Y	0.625	0.730	0.730	see chart 2	see chart 1	see chart 1	-010	-015	-020	-A	-B
9003-XXX-Y	0.780	0.880	0.880	see chart 2	see chart 1	see chart 1	-010	-015	-020	-A	-B
9004-XXX-Y	0.880	0.980	0.980	see chart 2	see chart 1	see chart 1	-010	-015	-020	-A	-B
9005-XXX-Y	1.000	1.100	1.100	see chart 2	see chart 1	see chart 1	-010	-015	-020	-A	-B

Chart 1: Optical Specifications		
Number of Stages	Typical Isolation	Maximum Insertion Loss
Single	25dB	0.3dB
1.5	42dB	0.5dB
Double	47dB	0.5dB

Chart 2: Optical Specifications			
Part Number	Number of Stages	Wavelength	Length
900X-010-A	Single	1310nm	0.770mm
900X-010-B	Single	1550nm	0.900mm
900X-015-A	1.5	1310nm	1.140mm
900X-015-B	1.5	1550nm	1.400mm
900X-020-A	Double	1310nm	1.340mm
900X-020-B	Double	1550nm	1.600mm

OASIS™ MONOLITHIC ISOLATOR & ASPHERIC LENS

- Small form factor
- Alignment of one optical component
- Diffraction limited performance
- Typical isolation >40 dB (1.5 stage)

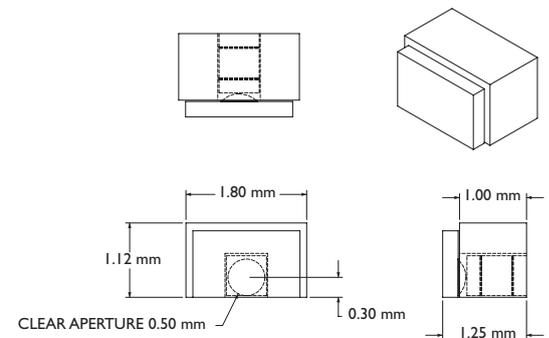
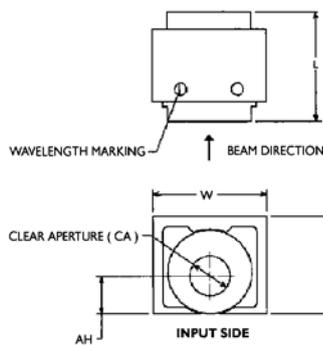
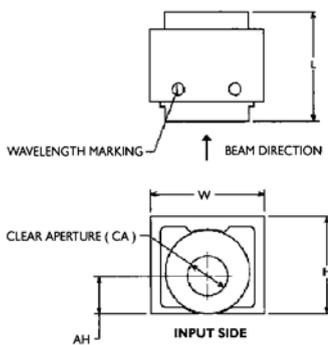


Oasis™ provides a compact solution by combining both an aspheric lens and an isolator. Built as a monolithic design, it offers diffraction limited performance optics along with outstanding isolation. The designs are ideal for small form factor laser diodes in both single and multi-channel configurations. The Micro Fixture Bench configuration offers a stainless steel holder, which can be easily mounted and aligned with standard pick and place equipment and then soldered or welded into the package. It contains an .8NA or .6NA collimating lens, perfect for collimating most laser diodes. The isolator offers a choice of single, 1.5 and double stages of isolation dependent on your requirements. The Surface Mount configuration offers smaller form factors and exceptional value. The standard Surface Mount Oasis™ contains a .55 NA Finite Conjugate lens that couples a laser directly into a single mode fiber. As with all of our products, LightPath offers extensive support to our customers in designing and manufacturing custom configurations. These would include a wide selection of aspheric lenses and single, 1.5 and double stage isolation.

Design Wavelength	1550/1480 nm
Numerical Aperture (NA)	0.80
Clear Aperture (CA)	1.2 mm
Effective Focal Length (EFL)	0.750 mm
Magnification	Infinite
RMS WFE	<Diff. Limit
Outer Diameter (OD)	3.0 mm
Working Distance (WD)	0.2 mm
Distance Holder to Laser	0.23 mm

Design Wavelength	1550/1480 nm
Numerical Aperture (NA)	0.60
Clear Aperture (CA)	0.84 mm
Effective Focal Length (EFL)	0.70 mm
Magnification	Infinite
RMS WFE	<Diff. Limit
Outer Diameter (OD)	2.5 mm
Working Distance (WD)	0.29 mm
Distance Holder to Laser	0.33 mm

Design Wavelength	1550/1480 nm
Numerical Aperture (NA)	0.55
Clear Aperture (CA)	0.53 mm
Effective Focal Length (EFL)	0.382 mm
Magnification	4.02
RMS WFE	<Diff. Limit
Outer Diameter (OD)	1.20 mm
Working Distance (WD)	0.290/1.91 mm



9060 Dimensions in mm								
Part #	Wavelength (nm)			Isolator Type	AH	L	W	H
9060-010	1310	1480	1550	Single	0.9	2.0	2.5	2.9
9060-015	1310	1480	1550	1.5 Stage-P Output	0.9	2.0	2.5	2.9
9060-020	1310	1480	1550	Double Stage-P Output	0.9	2.0	2.5	2.9

Typical Performance Parameters for Temperature 0 to 85° λ (center) ± 20 nm		
Isolator Type	Medium Isolation (dB)	Maximum Insertion Loss (dB)
Single Stage	25	0.3
1.5 State	42	0.5
Double Stage	47	0.5

TRADITIONAL OPTICS

LightPaths's Toolbox

Traditional Optics are a new addition to LightPath's optical toolbox that includes diffraction limited molded glass aspheres, Gradium™ Optics, Fusion™ Collimators, and Isolators. This toolbox is open to you and LightPath has the expertise that can show you its benefits.

Custom & Stock Items

This catalog provides only a fraction of traditional optics LightPath offers. Because you don't see it in our catalog doesn't mean we cannot supply it. Most of our sales are custom manufactured to our customer's specifications. If you do not find what you are looking for please give us a call. Our sales and application engineers can help guide you through the selection or our optical designers can take information you provide and co-design your component or entire system.

Optical Materials Available

Depending on your design needs, we offer a wide selection of materials from the most common BK7 to the more exotic Zinc Selenide, Germanium, and Calcium Fluoride.

AR Coatings

From the simplest MgF₂ to complex multi layer AR, reflective and splitter designs are no problem for us. Our coatings cover the entire spectrum from UV to IR and if power is a concern, we have coatings that can withstand thousand of watts of laser energy.

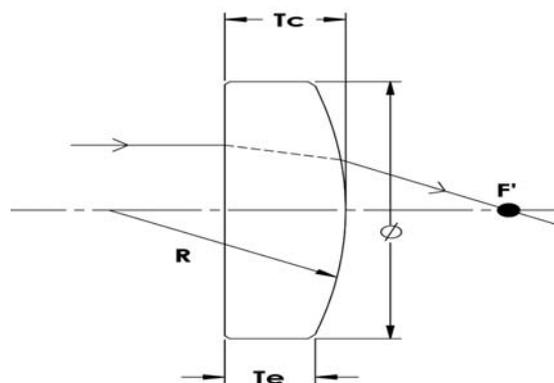
Specifications Tolerances

Table below can be used as a reference for design of optical components, please discuss these specifications with LightPath Sales and Applications Engineers.

OPTICS MANUFACTURING TOLERANCES			
Attribute	Commercial Quality	Precision Quality	MFG Limits
Glass Quality (n_d)	± 0.001	± 0.0005	Melt controlled
Diameter (mm)	+0.00/-0.1	+0.000/-0.025	+0.000/-0.10
Center Thickness (mm)	± 0.150	± 0.050	± 0.010
SAG (mm)	± 0.050	± 0.025	± 0.010
Radius	± 0.2%	± 0.1%	± 0.025%
Irregularity (fringe)	2	0.5	0.1
Wedge Lens (ETD, mm)	0.050	0.010	0.002
Wedge Prism (TIA, arc min)	± 3	± 0.5	± 0.1
Bevels (Max face width @ 45°, mm)	1.0	0.5	No Bevel
Scratch - DIG	80 - 50	60 - 40	10 - 5
AR Coating (R_{ave})	MgF ₂ R<1.5%	BBAR, R < 0.5%	Custom Design

PLANO-CONVEX LENS

GENERAL SPECIFICATIONS	
Material	BK7
Diameter Tolerance	+0/-0.1mm
Thickness tolerance	+/-0.1mm
Focus length tolerance	+/-1%
Surface Accuracy	$\lambda/4$ irregularity @ 632.8nm
Surface Quality	40-20
Centration	3 arcmin
Clear Aperture	>90%
Bevel	0.3mm x 45°
Coating	MgF ₂ or Custom by client



D(mm)	f(mm)	Tc(mm)	Te(mm)	Product Number
6.35	6.4	4.0	1.55	PCX-6.35-6.4
6.35	12.7	3.0	2.18	PCX-6.35-12.7
6.35	25.4	3.0	2.61	PCX-6.35-25.4
6.35	38.1	3.0	2.74	PCX-6.35-38.1
6.35	50.0	3.0	2.80	PCX-6.35-50
6.35	75.0	3.0	2.87	PCX-6.35-75
6.35	100.0	3.0	2.90	PCX-6.35-100
8.00	15.0	3.0	1.89	PCX-8-15
8.00	30.0	3.0	2.48	PCX-8-30
10.00	20.0	3.0	1.71	PCX-10-20
10.00	40.0	3.0	2.39	PCX-10-40
10.00	60.0	4.0	3.59	PCX-10-60
12.70	19.0	4.0	1.67	PCX-12.7-19
12.70	25.4	3.0	1.36	PCX-12.7-25.4
12.70	38.1	3.0	1.95	PCX-12.7-38.1
12.70	50.0	3.0	2.21	PCX-12.7-50
12.70	65.0	3.0	2.39	PCX-12.7-65
12.70	75.0	3.0	2.48	PCX-12.7-75
12.70	88.0	3.0	2.55	PCX-12.7-88
12.70	100.0	3.0	2.61	PCX-12.7-100
12.70	127.0	3.0	2.69	PCX-12.7-127
12.70	150.0	3.0	2.74	PCX-12.7-150
12.70	200.0	3.0	2.80	PCX-12.7-200
12.70	254.0	3.0	2.85	PCX-12.7-254
15.00	25.0	4.0	1.60	PCX-15-25
15.00	30.0	4.0	2.07	PCX-15-30
15.00	40.0	4.0	2.59	PCX-15-40
15.00	60.0	4.0	3.08	PCX-15-60
15.00	100.0	4.0	3.45	PCX-15-100
18.00	45.0	4.0	2.19	PCX-18-45
18.00	65.0	4.0	2.77	PCX-18-65
20.00	35.0	5.0	1.98	PCX-20-35
20.00	40.0	5.0	2.42	PCX-20-40
20.00	50.0	5.0	2.99	PCX-20-50
20.00	55.0	5.0	3.18	PCX-20-55
20.00	75.0	5.0	3.69	PCX-20-75

D(mm)	f(mm)	Tc(mm)	Te(mm)	Product Number
20.00	80.0	5.0	3.77	PCX-20-80
20.00	100.0	5.0	4.02	PCX-20-100
20.00	150.0	5.0	4.35	PCX-20-150
20.00	200.0	5.0	4.52	PCX-20-200
20.00	250.0	5.0	4.61	PCX-20-250
20.00	300.0	5.0	4.68	PCX-20-300
20.00	350.0	5.0	4.72	PCX-20-350
20.00	400.0	5.0	4.76	PCX-20-400
20.00	500.0	5.0	4.81	PCX-20-500
20.00	600.0	5.0	4.84	PCX-20-600
20.00	700.0	5.0	4.86	PCX-20-700
20.00	1000.0	5.0	4.90	PCX-20-1000
20.00	2000.0	5.0	4.95	PCX-20-2000
20.00	5000.0	5.0	4.98	PCX-20-5000
20.00	10000.0	5.0	4.99	PCX-20-10000
25.40	25.4	12.5	2.69	PCX-25.4-25.4
25.40	38.1	6.5	1.86	PCX-25.4-38.1
25.40	50.0	6.0	2.66	PCX-25.4-50
25.40	75.0	5.0	2.86	PCX-25.4-75
25.40	88.0	5.0	3.19	PCX-25.4-88
25.40	100.0	6.0	4.42	PCX-25.4-100
25.40	125.0	5.0	3.74	PCX-25.4-125
25.40	150.0	5.0	3.95	PCX-25.4-150
25.40	200.0	5.0	4.22	PCX-25.4-200
25.40	250.0	5.0	4.37	PCX-25.4-250
25.40	300.0	5.0	4.48	PCX-25.4-300
25.40	500.0	5.0	4.69	PCX-25.4-500
25.40	750.0	5.0	4.79	PCX-25.4-750
25.40	1000.0	5.0	4.84	PCX-25.4-1000
38.10	75.0	7.0	2.00	PCX-38.1-75
38.10	100.0	6.0	2.36	PCX-38.1-100
38.10	125.0	6.0	3.13	PCX-38.1-125
38.10	150.0	6.0	3.62	PCX-38.1-150
38.10	200.0	6.0	4.23	PCX-38.1-200
38.10	250.0	6.0	4.59	PCX-38.1-250
38.10	300.0	6.0	4.83	PCX-38.1-300

PLANO-CONVEX LENS

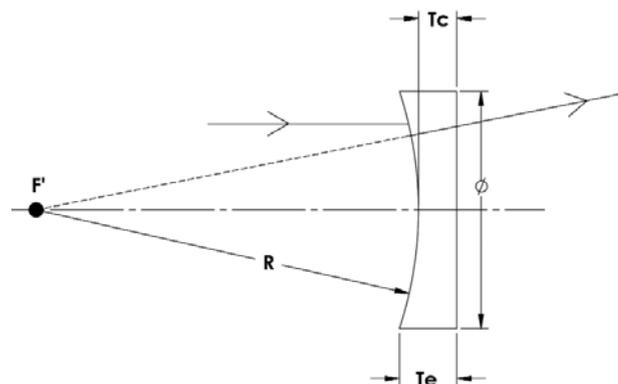
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D(mm)	f(mm)	Tc(mm)	Te(mm)	Product Number
38.10	300.0	6.0	4.83	PCX-38.1-300
38.10	750.0	6.0	5.53	PCX-38.1-750
50.80	75.0	12.5	3.02	PCX-50.8-75
50.80	88.0	10.0	2.25	PCX-50.8-88
50.80	100.0	10.0	3.33	PCX-50.8-100
50.80	150.0	8.0	3.72	PCX-50.8-150
50.80	175.0	6.0	2.36	PCX-50.8-175
50.80	200.0	6.0	2.83	PCX-50.8-200
50.80	300.0	6.0	3.91	PCX-50.8-300

D(mm)	f(mm)	Tc(mm)	Te(mm)	Product Number
50.80	400.0	6.0	4.43	PCX-50.8-400
50.80	500.0	6.0	4.75	PCX-50.8-500
50.80	750.0	6.0	5.17	PCX-50.8-750
50.80	1000.0	6.0	5.38	PCX-50.8-1000
76.20	150.0	12.0	1.99	PCX-76.2-150
76.20	200.0	12.0	4.72	PCX-76.2-200
100.00	200.0	18.0	5.10	PCX-100-200
100.00	1000.0	8.0	5.58	PCX-100-1000

PLANO-CONCAVE LENS

GENERAL SPECIFICATIONS	
Material	BK7
Diameter Tolerance	+0/-0.1mm
Thickness tolerance	+/-0.1mm
Focus length tolerance	+/-1%
Surface Accuracy	$\lambda/4$ irregularity @632.8nm
Surface Quality	40-20
Centration	3 arcmin
Clear Aperture	>90%
Bevel	0.3mm x 45°
Coating	MgF ₂ or Custom by client

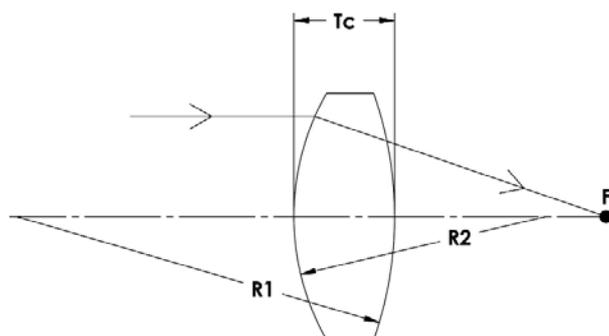


D(mm)	f(mm)	Tc(mm)	Te(mm)	Product Number
6.35	-6.4	1.5	4	PCC-6.35-6.4
6.35	-12.7	2.2	3	PCC-6.35-12.7
6.35	-25.4	2.6	3	PCC-6.35-25.4
10.00	-20.0	1.7	3	PCC-10-20
10.00	-50.0	2.5	3	PCC-10-50
12.70	-19.1	1.7	4	PCC-12.7-19.1
12.70	-25.4	1.4	3	PCC-12.7-25.4
12.70	-38.1	1.9	3	PCC-12.7-38.1
12.70	-50.0	2.2	3	PCC-12.7-50
12.70	-75.0	2.5	3	PCC-12.7-75
12.70	-100.0	2.6	3	PCC-12.7-100
12.70	-300.0	2.9	3	PCC-12.7-300
20.00	-40.0	1.4	4	PCC-20-40
20.00	-50.0	2.0	4	PCC-20-50
20.00	-75.0	1.7	3	PCC-20-75
20.00	-100.0	2.0	3	PCC-20-100
20.00	-125.0	2.2	3	PCC-20-125
20.00	-150.0	2.4	3	PCC-20-150

D(mm)	f(mm)	Tc(mm)	Te(mm)	Product Number
20.00	-200.0	2.5	3	PCC-20-200
20.00	-250.0	2.6	3	PCC-20-250
20.00	-500.0	2.8	3	PCC-20-500
25.40	-50.0	1.7	5	PCC-25.4-50
25.40	-75.0	1.9	4	PCC-25.4-75
25.40	-100.0	2.4	4	PCC-25.4-100
25.40	-150.0	3.0	4	PCC-25.4-150
25.40	-200.0	2.2	3	PCC-25.4-200
30.00	-300.0	3.3	4	PCC-30-300
30.00	-400.0	3.5	4	PCC-30-400
30.00	-500.0	3.6	4	PCC-30-500
30.00	-1000.0	3.8	4	PCC-30-1000
38.10	-300.0	3.8	5	PCC-38.1-300
38.10	-500.0	4.3	5	PCC-38.1-500
50.80	-200.0	1.8	5	PCC-50.8-200
50.80	-500.0	3.7	5	PCC-50.8-500
76.20	-762.0	6.2	8	PCC-76.2-762
76.20	-1270.0	6.9	8	PCC-76.2-1270

BI-CONVEX LENS

GENERAL SPECIFICATIONS	
Material	BK7
Diameter Tolerance	+0/-0.1mm
Thickness tolerance	+/-0.1mm
Focus length tolerance	+/-1%
Surface Accuracy	$\lambda/4$ irregularity @632.8nm
Surface Quality	40-20
Centration	3 arcmin
Clear Aperture	>90%
Bevel	0.3mm x 45°
Coating	MgF ₂ or Custom by client



D(mm)	f(mm)	Tc(mm)	Te(mm)	Product Number
6.35	6.35	3	1.36	BCX-6.35-6.35
6.35	12.70	3	2.22	BCX-6.35-12.7
6.35	19.00	3	2.48	BCX-6.35-19
6.35	25.40	3	2.61	BCX-6.35-25.4
10.00	20.00	5	2.42	BCX-10-20
10.00	40.00	4	2.77	BCX-10-40
10.00	55.00	3	2.11	BCX-10-55
10.00	80.00	3	2.39	BCX-10-80
10.00	100.00	3	2.52	BCX-10-100
12.70	12.70	5	1.72	BCX-12.7-12.7
12.70	15.00	5	2.28	BCX-12.7-15
12.70	19.00	4	1.89	BCX-12.7-19
12.70	25.40	4	2.44	BCX-12.7-25.4
12.70	35.00	3	1.88	BCX-12.7-35
12.70	38.10	3	1.97	BCX-12.7-38.1
12.70	40.00	3	2.02	BCX-12.7-40
12.70	50.80	3	2.23	BCX-12.7-50.8
12.70	63.50	3	2.38	BCX-12.7-63.5
12.70	76.20	3	2.49	BCX-12.7-76.2
12.70	100.00	3	2.61	BCX-12.7-100
12.70	125.00	3	2.69	BCX-12.7-125
12.70	150.00	3	2.74	BCX-12.7-150
12.70	200.00	3	2.80	BCX-12.7-200
12.70	300.00	3	2.87	BCX-12.7-300
12.70	500.00	3	2.92	BCX-12.7-500
20.00	20.00	6	0.84	BCX-20-20
20.00	25.00	5	0.97	BCX-20-25
20.00	35.00	4	1.18	BCX-20-35
20.00	50.00	4	2.05	BCX-20-50
20.00	75.00	3	1.70	BCX-20-75
20.00	100.00	3	2.03	BCX-20-100
20.00	125.00	3	2.22	BCX-20-125
20.00	150.00	3	2.35	BCX-20-150
20.00	200.00	3	2.52	BCX-20-200
20.00	250.00	3	2.61	BCX-20-250

D(mm)	f(mm)	Tc(mm)	Te(mm)	Product Number
20.00	350.00	3	2.72	BCX-20-350
20.00	400.00	3	2.76	BCX-20-400
20.00	500.00	3	2.81	BCX-20-500
20.00	600.00	3	2.84	BCX-20-600
20.00	800.00	3	2.88	BCX-20-800
25.40	19.00	12	2.68	BCX-25.4-19
25.40	25.40	10	3.45	BCX-25.4-25.4
25.40	38.10	7	2.79	BCX-25.4-38.1
25.40	40.00	7	3.00	BCX-25.4-40
25.40	50.80	6	2.88	BCX-25.4-50.8
25.40	60.00	5	2.37	BCX-25.4-60
25.40	75.60	5	2.92	BCX-25.4-75.6
25.40	80.00	5	3.04	BCX-25.4-80
25.40	88.30	5	3.22	BCX-25.4-88.3
25.40	100.00	5	3.43	BCX-25.4-100
25.40	125.00	5	3.75	BCX-25.4-125
25.40	150.00	5	3.96	BCX-25.4-150
25.40	175.00	4	3.11	BCX-25.4-175
25.40	200.00	4	3.22	BCX-25.4-200
25.40	250.00	4	3.38	BCX-25.4-250
25.40	300.00	4	3.48	BCX-25.4-300
25.40	400.00	4	3.61	BCX-25.4-400
25.40	500.00	4	3.69	BCX-25.4-500
25.40	600.00	4	3.74	BCX-25.4-600
25.40	700.00	4	3.78	BCX-25.4-700
25.40	800.00	4	3.80	BCX-25.4-800
25.40	1000.00	4	3.84	BCX-25.4-1000
38.10	40.00	12	2.70	BCX-38.1-40
38.10	50.00	10	2.72	BCX-38.1-50
38.10	60.00	10	4.00	BCX-38.1-60
38.10	75.00	7	2.25	BCX-38.1-75
38.10	100.00	6	2.46	BCX-38.1-100
38.10	125.00	5	2.18	BCX-38.1-125
38.10	150.00	5	2.65	BCX-38.1-150
38.10	175.00	5	2.99	BCX-38.1-175

BI-CONVEX LENS

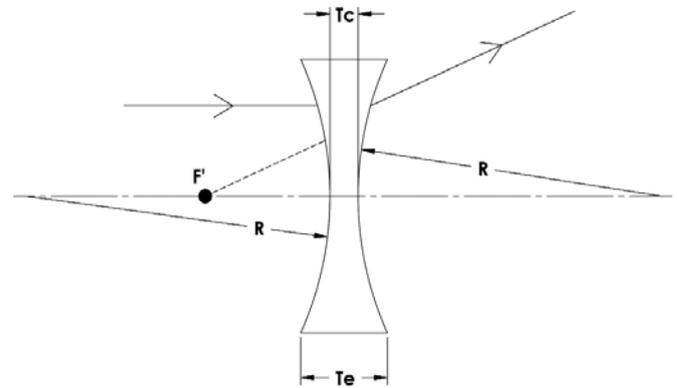
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D(mm)	f(mm)	Tc(mm)	Te(mm)	Product No.
38.10	200.00	5	3.24	BCX-38.1-200
38.10	250.00	5	3.59	BCX-38.1-250
38.10	500.00	5	4.30	BCX-38.1-500
38.10	600.00	5	4.41	BCX-38.1-600
38.10	700.00	5	4.50	BCX-38.1-700
38.10	800.00	5	4.56	BCX-38.1-800
38.10	900.00	5	4.61	BCX-38.1-900
38.10	1000.00	5	4.65	BCX-38.1-1000
50.80	38.10	25	6.43	BCX-50.8-38.1
50.80	50.20	18	4.72	BCX-50.8-50.2
50.80	62.90	16	5.67	BCX-50.8-62.9
50.80	75.60	12	3.51	BCX-50.8-75.6
50.80	88.30	10	2.79	BCX-50.8-88.3
50.80	100.00	10	3.66	BCX-50.8-100
50.80	125.00	8	2.96	BCX-50.8-125
50.80	150.00	8	3.81	BCX-50.8-150
50.80	175.00	8	4.42	BCX-50.8-175
50.80	200.00	6	2.87	BCX-50.8-200
50.80	300.00	6	3.92	BCX-50.8-300

D(mm)	f(mm)	Tc(mm)	Te(mm)	Product No.
50.80	400.00	6	4.44	BCX-50.8-400
50.80	500.00	6	4.75	BCX-50.8-500
50.80	750.00	6	5.17	BCX-50.8-750
50.80	1000.00	6	5.38	BCX-50.8-1000
75.00	75.00	25	5.65	BCX-75-75
75.00	100.00	18	3.91	BCX-75-100
75.00	150.00	12	2.79	BCX-75-150
75.00	200.00	10	3.14	BCX-75-200
75.00	250.00	10	4.53	BCX-75-250
75.00	350.00	10	6.10	BCX-75-350
75.00	500.00	10	7.28	BCX-75-500
75.00	750.00	10	8.18	BCX-75-750
75.00	1000.00	10	8.64	BCX-75-1000
100.00	150.00	22	5.43	BCX-100-150
100.00	200.00	18	5.72	BCX-100-200
100.00	500.00	10	5.15	BCX-100-500
100.00	750.00	10	6.77	BCX-100-750
100.00	1000.00	10	7.58	BCX-100-1000

BI-CONCAVE LENS

GENERAL SPECIFICATIONS	
Material	BK7
Diameter Tolerance	+0/-0.1mm
Thickness tolerance	+/-0.1mm
Focus length tolerance	+/-1%
Surface Accuracy	$\lambda/4$ irregularity @632.8nm
Surface Quality	40-20
Centration	3 arcmin
Clear Aperture	>90%
Bevel	0.3mm x 45°
Coating	MgF ₂ or Custom by client



D(mm)	f(mm)	Tc(mm)	Te(mm)	Product Number
6.35	-6.3	1.3	3	BCC-6.35-6.3
6.35	-13.0	2.2	3	BCC-6.35-13
10.00	-15.0	1.3	3	BCC-10-15
10.00	-20.0	1.8	3	BCC-10-20
10.00	-22.0	1.9	3	BCC-10-22
10.00	-40.0	2.4	3	BCC-10-40
10.00	-55.0	2.6	3	BCC-10-55
12.70	-13.0	1.7	5	BCC-12.7-13
12.70	-15.0	1.3	4	BCC-12.7-15

D(mm)	f(mm)	Tc(mm)	Te(mm)	Product Number
12.70	-20.0	2.0	4	BCC-12.7-20
12.70	-25.0	2.4	4	BCC-12.7-25
12.70	-30.0	1.7	3	BCC-12.7-30
12.70	-35.0	1.9	3	BCC-12.7-35
12.70	-40.0	2.0	3	BCC-12.7-40
12.70	-50.0	2.2	3	BCC-12.7-50
12.70	-60.0	2.3	3	BCC-12.7-60
12.70	-75.0	2.5	3	BCC-12.7-75
12.70	-100.0	2.6	3	BCC-12.7-100

BI-CONCAVE LENS

CONTINUED

D(mm)	f(mm)	Tc(mm)	Te(mm)	Product Number
12.70	-125.0	2.7	3	BCC-12.7-125
12.70	-150.0	2.7	3	BCC-12.7-150
12.70	-200.0	2.8	3	BCC-12.7-200
12.70	-250.0	2.8	3	BCC-12.7-250
20.00	-20.0	1.8	7	BCC-20-20
20.00	-25.0	2.0	6	BCC-20-25
20.00	-35.0	2.2	5	BCC-20-35
20.00	-50.0	3.0	5	BCC-20-50
20.00	-75.0	3.7	5	BCC-20-75
20.00	-100.0	4.0	5	BCC-20-100
20.00	-125.0	4.2	5	BCC-20-125
20.00	-150.0	4.4	5	BCC-20-150
20.00	-200.0	4.5	5	BCC-20-200
20.00	-250.0	4.6	5	BCC-20-250
20.00	-350.0	4.7	5	BCC-20-350
25.40	-25.0	1.3	8	BCC-25.4-25
25.40	-30.0	1.6	7	BCC-25.4-30
25.40	-40.0	2.0	6	BCC-25.4-40
25.40	-50.0	1.8	5	BCC-25.4-50
25.40	-60.0	2.4	5	BCC-25.4-60
25.40	-75.0	2.9	5	BCC-25.4-75
25.40	-100.0	3.4	5	BCC-25.4-100
25.40	-125.0	3.7	5	BCC-25.4-125
25.40	-150.0	4.0	5	BCC-25.4-150
25.40	-200.0	4.2	5	BCC-25.4-200
25.40	-250.0	4.4	5	BCC-25.4-250

D(mm)	f(mm)	Tc(mm)	Te(mm)	Product Number
25.40	-300.0	4.5	5	BCC-25.4-300
25.40	-400.0	4.6	5	BCC-25.4-400
25.40	-500.0	4.7	5	BCC-25.4-500
38.10	-40.0	2.7	12	BCC-38.1-40
38.10	-50.0	2.7	10	BCC-38.1-50
38.10	-100.0	2.5	6	BCC-38.1-100
38.10	-125.0	3.2	6	BCC-38.1-125
38.10	-150.0	3.7	6	BCC-38.1-150
38.10	-200.0	4.2	6	BCC-38.1-200
38.10	-250.0	4.6	6	BCC-38.1-250
38.10	-500.0	5.3	6	BCC-38.1-500
38.10	-750.0	5.5	6	BCC-38.1-750
38.10	-750.0	5.5	6	BCC-38.1-750
50.80	-50.0	2.7	16	BCC-50.8-50
50.80	-75.0	3.4	12	BCC-50.8-75
50.80	-100.0	3.7	10	BCC-50.8-100
50.80	-125.0	3.0	8	BCC-50.8-125
50.80	-150.0	3.8	8	BCC-50.8-150
50.80	-200.0	2.9	6	BCC-50.8-200
50.80	-250.0	3.5	6	BCC-50.8-250
50.80	-300.0	3.9	6	BCC-50.8-300
50.80	-400.0	4.4	6	BCC-50.8-400
50.80	-500.0	4.8	6	BCC-50.8-500
50.80	-750.0	5.2	6	BCC-50.8-750
50.80	-1000.0	5.4	6	BCC-50.8-1000

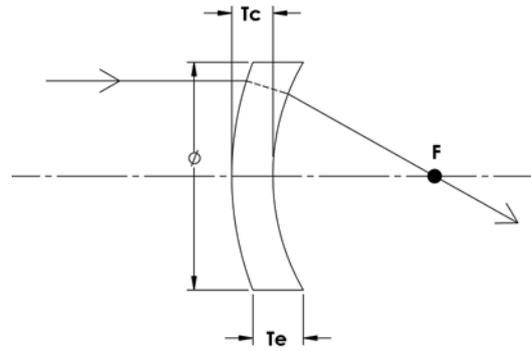
BALL LENS

GENERAL SPECIFICATIONS	
Dimension Tolerance:	+/-0.002mm
Spherical Tolerance:	0.0005mm
Surface Quality:	40-20
Coating:	MgF ₂ or custom

D(mm)	Material	f(mm)	CA	Product Number
1	LaSFN9	0.55	0.8	BAL-1-.55
2	LaSFN9	1.1	1.6	BAL-2-1.1
3	LaSFN9	1.65	2.4	BAL-3-1.65
5	LaSFN9	2.75	4	BAL-5-2.75
1	BK7	0.73	0.8	BAL-1-.73
2	BK7	1.47	1.6	BAL-2-1.47
3	BK7	2.2	2.4	BAL-3-2.2
4	BK7	2.93	3.2	BAL-4-2.93

MENISCUS LENS

GENERAL SPECIFICATIONS	
Diameter Tolerance	+0/-0.1mm
Thickness tolerance	+/-0.1mm
Focus length tolerance	+/-1%
Surface Accuracy	$\lambda/4$ irregularity @632.8nm
Surface Quality	40-20
Centration	3 arcmin
Clear Aperture	>90%
Bevel	0.3mm x 45°
Coating	MgF ₂ or Custom

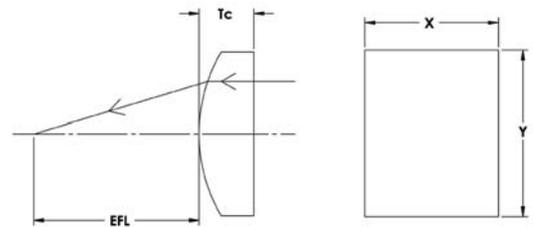


D(mm)	f(mm)	Tc (mm)	Te (mm)	Material	Product Number
18.0	73.5	4.0	3.0	SF8	MEC-18-73.5
18.0	-116.0	4.0	3.4	SF8	MEC-18-116
19.0	130.2	4.0	3.4	SF8	MEC-19-130.2
19.0	-215.0	4.0	3.7	SF8	MEC-19-215
25.4	50.0	5.4	1.5	BK7	MEC-25.4-50
25.4	-75.0	3.7	1.5	BK7	MEC-25.4-75
25.4	100.0	4.0	2.5	BK7	MEC-25.4-100
25.4	-150.0	4.0	3.0	BK7	MEC-25.4-150

D(mm)	f(mm)	Tc (mm)	Te (mm)	Material	Product Number
25.4	200.0	3.5	2.8	BK7	MEC-25.4-200
31.5	-146.0	6.0	4.7	SF8	MEC-31.5-146
31.5	233.6	6.0	5.2	SF8	MEC-31.5-233.6
31.5	-363.0	6.0	5.5	SF8	MEC-31.5-363
40.0	175.2	7.0	5.2	SF8	MEC-40-175.2
40.0	-291.0	7.0	6.0	SF8	MEC-40-291
40.0	507.8	7.0	6.4	SF8	MEC-40-507.8

PL-CX CYLINDRICAL LENS

GENERAL SPECIFICATIONS	
Tolerance of focal length:	+/-2%
Material:	N-BK7, grade A
Surface quality:	60-40
Centration:	5 arc min
Length tolerance:	+0/-0.2
Tc tolerance:	+/-0.2 mm
Te tolerance:	nominal
Coating:	MgF ₂ or custom



f(mm)	Width (mm)	Length (mm)	Tc(mm)	Te(mm)	Product Number
6.4	12.7	6.4	5.42	3	CYX-6.4-12.7-6.4
12.7	25.4	12.7	7.83	3	CYX-12.7-25.4-12.7
19.0	25.4	12.7	5.32	3	CYX-19-25.4-12.7
22.0	12.5	20.0	7.97	2	CYX-22-12.5-20
25.4	25.4	12.7	4.63	3	CYX-25.4-25.4-12.7
38.1	50.8	25.4	7.62	3	CYX-38.1-50.8-25.4
40.0	15.0	20.0	5.58	3	CYX-40-15-20
50.8	50.8	25.4	6.26	3	CYX-50.8-50.8-25.4
60.0	20.0	20.0	4.66	3	CYX-60-20-20

PL-CX CYLINDRICAL LENS

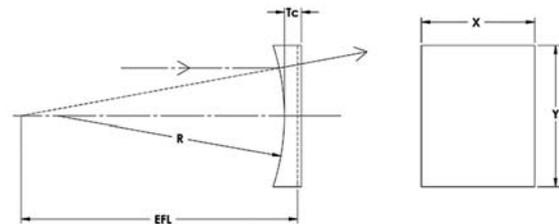
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f(mm)	Width (mm)	Length (mm)	Tc(mm)	Te(mm)	Product Number
75.6	50.8	25.4	5.11	3	CYX-75.6-50.8-25.4
80.0	30.0	10.0	3.30	3	CYX-80-30-10
100.0	50.8	50.8	9.64	3	CYX-100-50.8-50.8
150.0	50.8	50.8	7.26	3	CYX-150-50.8-50.8
200.0	50.8	50.8	6.16	3	CYX-200-50.8-50.8
250.0	50.8	50.8	5.51	3	CYX-250-50.8-50.8
300.0	50.0	60.0	5.93	3	CYX-300-50-60

PL-CV CYLINDRICAL LENS

GENERAL SPECIFICATIONS

Tolerance of focal length:	+/-2%
Material:	N-BK7, grade A
Surface quality:	60-40
Centration:	5 arc min
Length tolerance:	+0/-0.2
Tc tolerance:	+/-0.2 mm
Te tolerance:	nominal
Coating:	MgF ₂ or custom

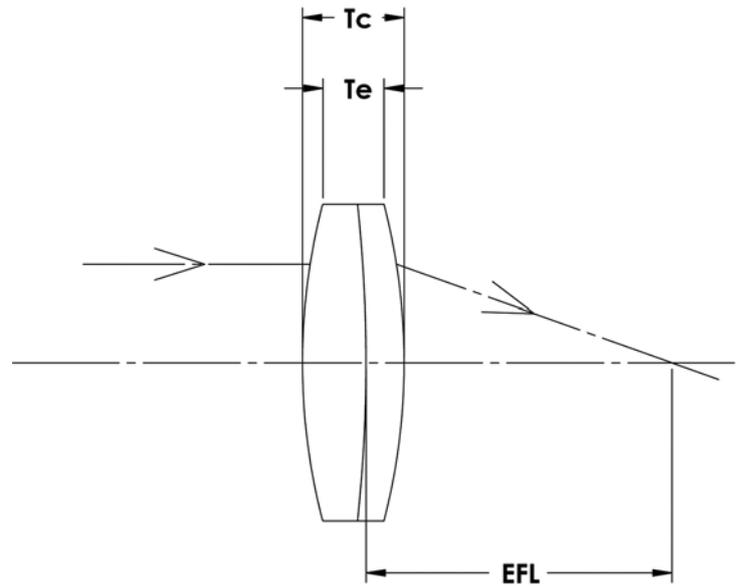


f(mm)	Width (mm)	Length (mm)	Tc(mm)	Te(mm)	Product Number
-6.35	12.7	6.35	2.5	3.87	CYC-6.35-12.7-6.35
-12.70	25.4	12.70	2.5	6.06	CYC-12.7-25.4-12.7
-19.00	10.0	12.00	5.0	7.05	CYC-19-10-12
-19.00	25.4	12.70	2.5	4.42	CYC-19-25.4-12.7
-25.40	25.4	12.70	2.5	3.87	CYC-25.4-25.4-12.7
-38.10	50.8	25.40	2.5	6.72	CYC-38.1-50.8-25.4
-50.80	50.8	25.40	2.5	5.49	CYC-50.8-50.8-25.4
-75.60	50.8	25.40	2.5	4.45	CYC-75.6-50.8-25.4
-100.00	50.8	50.80	2.5	8.87	CYC-100-50.8-50.8
-150.00	50.8	50.80	2.5	6.59	CYC-150-50.8-50.8
-200.00	50.8	50.80	2.5	5.53	CYC-200-50.8-50.8
-250.00	50.8	50.80	2.5	4.91	CYC-250-50.8-50.8

ACHROMATIC DOUBLET LENS

GENERAL SPECIFICATIONS FOR GENERAL GRADE	
Tolerance of focal length:	+/-2%
Surface accuracy:	1/2λ
Surface quality:	60-40
Centration:	3 arc min
Diameter tolerance:	+0/-0.2
Tc tolerance:	+/-0.4 for <50mm Dia; +/-0.6 for >50mm Dia.
Te tolerance:	nominal
Coating:	single layer MgF ₂ or custom
Clear aperture:	>90%

GENERAL SPECIFICATIONS FOR PRECISION GRADE	
Tolerance of focal length:	+/-2%
Surface accuracy:	1/8λ
Surface quality:	20-10
Centration:	3 arc min
Diameter tolerance:	+0/-0.1
Tc tolerance:	+/-0.2 mm
Te tolerance:	nominal
Te tolerance:	nominal



D (mm)	f (mm)	Tc (mm)	Te (mm)	Product No(Precision)	Product No(General)
6.0	10.0	4.4	3.5	ADP-6-10	ADG-6-10
6.0	12.7	3.4	2.7	ADP-6-12.7	ADG-6-12.7
6.0	19.0	3.2	2.2	ADP-6-19	ADG-6-19
6.0	25.4	3.0	2.0	ADP-6-25.4	ADG-6-25.4
6.0	38.1	4.5	4.2	ADP-6-38.1	ADG-6-38.1
8.0	16.0	4.9	3.9	ADP-8-16	ADG-8-16
8.0	25.0	5.1	4.4	ADP-8-25	ADG-8-25
8.0	30.0	4.5	4.0	ADP-8-30	ADG-8-30
10.0	20.0	5.6	4.4	ADP-10-20	ADG-10-20
12.0	25.0	5.8	4.0	ADP-12-25	ADG-12-25
12.5	30.0	5.3	4.1	ADP-12.5-30	ADG-12.5-30
12.7	19.0	6.9	4.9	ADP-12.7-19	ADG-12.7-19
12.7	25.4	5.5	4.1	ADP-12.7-25.4	ADG-12.7-25.4
12.7	31.8	5.4	4.3	ADP-12.7-31.8	ADG-12.7-31.8
12.7	38.1	4.5	3.3	ADP-12.7-38.1	ADG-12.7-38.1
12.7	50.8	4.5	3.5	ADP-12.7-50.8	ADG-12.7-50.8
16.0	31.0	8.9	6.8	ADP-16-31	ADG-16-31
16.0	36.0	6.9	5.2	ADP-16-36	ADG-16-36
16.0	48.0	5.2	4.0	ADP-16-48	ADG-16-48
18.0	40.0	8.0	6.1	ADP-18-40	ADG-18-40
18.0	50.0	6.0	4.2	ADP-18-50	ADG-18-50
18.0	60.0	5.2	3.9	ADP-18-60	ADG-18-60
18.0	80.0	5.2	4.3	ADP-18-80	ADG-18-80
25.4	50.8	9.8	7.0	ADP-25.4-50.8	ADG-25.4-50.8
25.4	63.5	8.5	6.3	ADP-25.4-63.5	ADG-25.4-63.5

D (mm)	f (mm)	Tc (mm)	Te (mm)	Product No(Precision)	Product No(General)
6.0	10.0	4.4	3.5	ADP-6-10	ADG-6-10
6.0	12.7	3.4	2.7	ADP-6-12.7	ADG-6-12.7
6.0	19.0	3.2	2.2	ADP-6-19	ADG-6-19
6.0	25.4	3.0	2.0	ADP-6-25.4	ADG-6-25.4
6.0	38.1	4.5	4.2	ADP-6-38.1	ADG-6-38.1
8.0	16.0	4.9	3.9	ADP-8-16	ADG-8-16
8.0	25.0	5.1	4.4	ADP-8-25	ADG-8-25
8.0	30.0	4.5	4.0	ADP-8-30	ADG-8-30
10.0	20.0	5.6	4.4	ADP-10-20	ADG-10-20
12.0	25.0	5.8	4.0	ADP-12-25	ADG-12-25
12.5	30.0	5.3	4.1	ADP-12.5-30	ADG-12.5-30
12.7	19.0	6.9	4.9	ADP-12.7-19	ADG-12.7-19
12.7	25.4	5.5	4.1	ADP-12.7-25.4	ADG-12.7-25.4
12.7	31.8	5.4	4.3	ADP-12.7-31.8	ADG-12.7-31.8
12.7	38.1	4.5	3.3	ADP-12.7-38.1	ADG-12.7-38.1
12.7	50.8	4.5	3.5	ADP-12.7-50.8	ADG-12.7-50.8
16.0	31.0	8.9	6.8	ADP-16-31	ADG-16-31
16.0	36.0	6.9	5.2	ADP-16-36	ADG-16-36
16.0	48.0	5.2	4.0	ADP-16-48	ADG-16-48
18.0	40.0	8.0	6.1	ADP-18-40	ADG-18-40
18.0	50.0	6.0	4.2	ADP-18-50	ADG-18-50
18.0	60.0	5.2	3.9	ADP-18-60	ADG-18-60
18.0	80.0	5.2	4.3	ADP-18-80	ADG-18-80
25.4	50.8	9.8	7.0	ADP-25.4-50.8	ADG-25.4-50.8
25.4	63.5	8.5	6.3	ADP-25.4-63.5	ADG-25.4-63.5

ACHROMATIC DOUBLET LENS

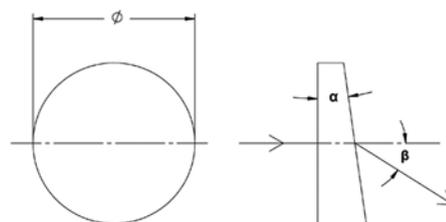
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D (mm)	f (mm)	Tc (mm)	Te (mm)	Product No(Precision)	Product No(General)
25.4	76.2	7.5	5.2	ADP-25.4-76.2	ADG-25.4-76.2
25.4	90.0	6.5	4.4	ADP-25.4-90	ADG-25.4-90
25.4	100.0	7.2	5.2	ADP-25.4-100	ADG-25.4-100
25.4	125.0	6.5	4.9	ADP-25.4-125	ADG-25.4-125
25.4	150.0	6.2	4.9	ADP-25.4-150	ADG-25.4-150
25.4	175.0	6.3	5.2	ADP-25.4-175	ADG-25.4-175
30.0	60.0	12.5	8.4	ADP-30-60	ADG-30-60
30.0	100.0	8.7	6.3	ADP-30-100	ADG-30-100
30.0	120.0	10.7	8.4	ADP-30-120	ADG-30-120
30.0	140.0	9.0	7.1	ADP-30-140	ADG-30-140
30.0	160.0	6.5	5.2	ADP-30-160	ADG-30-160
30.0	180.0	8.1	6.6	ADP-30-180	ADG-30-180
30.0	200.0	8.1	7.1	ADP-30-200	ADG-30-200
30.0	250.0	7.2	6.2	ADP-30-250	ADG-30-250
30.0	300.0	9.4	8.6	ADP-30-300	ADG-30-300
38.1	76.2	14.0	9.9	ADP-38.1-76.2	ADG-38.1-76.2
38.1	100.0	12.4	9.3	ADP-38.1-100	ADG-38.1-100
38.1	125.0	12.4	9.9	ADP-38.1-125	ADG-38.1-125
38.1	150.0	9.0	6.1	ADP-38.1-150	ADG-38.1-150
38.1	200.0	11.0	8.8	ADP-38.1-200	ADG-38.1-200
38.1	250.0	11.5	9.8	ADP-38.1-250	ADG-38.1-250
38.1	400.0	10.5	9.4	ADP-38.1-400	ADG-38.1-400

D (mm)	f (mm)	Tc (mm)	Te (mm)	Product No(Precision)	Product No(General)
40.0	120.0	11.2	7.6	ADP-40-120	ADG-40-120
40.0	140.0	10.1	7.1	ADP-40-140	ADG-40-140
40.0	160.0	9.4	6.8	ADP-40-160	ADG-40-160
40.0	180.0	9.6	7.2	ADP-40-180	ADG-40-180
40.0	300.0	9.3	7.9	ADP-40-300	ADG-40-300
40.0	400.0	8.0	7.1	ADP-40-400	ADG-40-400
50.8	150.0	12.5	7.3	ADP-50.8-150	ADG-50.8-150
50.8	200.0	12.0	8.1	ADP-50.8-200	ADG-50.8-200
50.8	250.0	12.8	9.7	ADP-50.8-250	ADG-50.8-250
50.8	300.0	14.0	11.4	ADP-50.8-300	ADG-50.8-300
50.8	400.0	13.0	11.1	ADP-50.8-400	ADG-50.8-400
50.8	500.0	11.7	10.1	ADP-50.8-500	ADG-50.8-500
50.8	750.0	17.5	16.5	ADP-50.8-750	ADG-50.8-750
63.0	400.0	12.0	9.4	ADP-63-400	ADG-63-400
63.0	500.0	12.0	10.2	ADP-63-500	ADG-63-500
63.0	600.0	11.0	9.5	ADP-63-600	ADG-63-600
63.0	800.0	10.0	8.9	ADP-63-800	ADG-63-800
76.2	500.0	17.5	14.0	ADP-76.2-500	ADG-76.2-500
76.2	750.0	17.5	15.2	ADP-76.2-750	ADG-76.2-750
80.0	300.0	19.6	13.7	ADP-80-300	ADG-80-300
80.0	1000.0	10.0	8.5	ADP-80-1000	ADG-80-1000

WEDGE

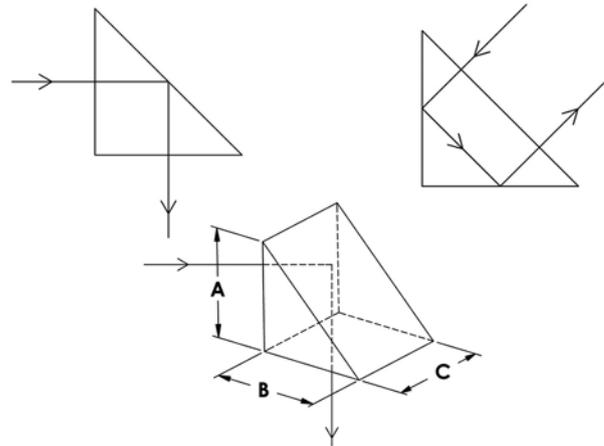
GENERAL SPECIFICATIONS	
Dimension tolerance:	+/-0.2mm
Surface accuracy:	$\lambda/4$ over 90% diameter
Wedge angle tolerance:	+/-30 arcsec
Surface Quality:	60-40
Bevel:	0.3+/-0.1mm
Coating:	MgF ₂ or custom



D(mm)	Material	Wedge Angle (α)	Wedge Angle (β)	Product Number
25.4	BK7	1°56'	1°	WBK001
25.4	BK7	3°52'	2°	WBK002
25.4	BK7	7°41'	4°	WBK003
25.4	BK7	11°21'	6°	WBK004
25.4	BK7	14°51'	8°	WBK005
25.4	BK7	18°8'	10°	WBK006
25.4	fused silica	2°4'	1°	WBK007
25.4	fused silica	4°7'	2°	WBK008
25.4	fused silica	8°14'	4°	WBK009

RIGHT ANGLE PRISM

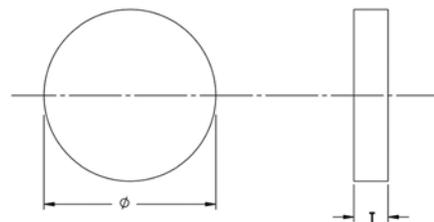
GENERAL SPECIFICATIONS	
Material:	BK7 grade A
Surface quality:	20-10 for precision 60-40 for general
Tolerance of dimensions:	+/-0.1mm for precision +/-0.25mm for general
Tolerance of angle:	30 sec for precision 3 min for general
Surface accuracy:	1/10λ for precision 1/2λ for general
Clear aperture:	>90%
Bevel:	0.2~0.5mm x 45°
Coating:	Protected AL or custom



Length A (mm)	Length B (mm)	Length C (mm)	Product No. (Precision)	Product No. (General)
3.0	3.0	3.0	RPP-3	RPG-3
5.0	5.0	5.0	RPP-5	RPG-5
10.0	10.0	10.0	RPP-10	RPG-10
12.7	12.7	12.7	RPP-12.7	RPG-12.7
15.0	15.0	15.0	RPP-15	RPG-15
20.0	20.0	20.0	RPP-20	RPG-20
25.4	25.4	25.4	RPP-25.4	RPG-25.4
30.0	30.0	30.0	RPP-30	RPG-30
40.0	40.0	40.0	RPP-40	RPG-40
50.8	50.8	50.8	RPP-50.8	RPG-50.8

WINDOW

GENERAL SPECIFICATIONS	
Dimension Tolerance:	+/-0.1mm
Surface accuracy:	λ/10 over 90% diameter
Parallelism:	+/-30 arcsec
Surface Quality:	40-20
Bevel:	0.2+/-0.1mm
Coating:	custom



Diameter (mm)	Material	Thickness (mm)	Product Number
10.0	BK7	3	WBK-10
10.0	Fused Silica	3	WFS-10
12.7	BK7	3	WBK-12.7
12.7	Fused Silica	3	WFS-12.7
20.0	BK7	4	WBK-20
20.0	Fused Silica	4	WFS-20
25.4	BK7	4	WBK-25.4
25.4	Fused Silica	4	WFS-25.4

WINDOW

CONTINUED

Diameter (mm)	Material	Thickness (mm)	Product Number
30.0	BK7	5	WBK-30
30.0	Fused Silica	5	WFS-30
38.1	BK7	5	WBK-38.1
38.1	Fused Silica	5	WFS-38.1
50.8	BK7	10	WBK-50.8
50.8	Fused Silica	10	WFS-50.8
80.0	BK7	10	WBK-80
80.0	Fused Silica	10	WFS-80

