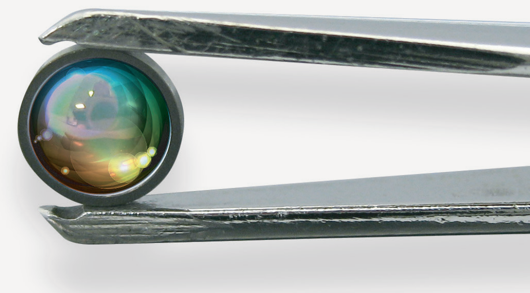
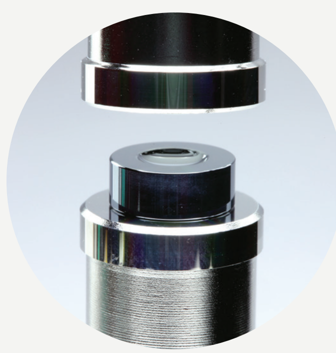
LightPath® TECHNOLOGIES

A LEADER IN OPTICAL TECHNOLOGY



Geltech Molded Aspheric Lenses



www.lightpath.com

ABOUT LIGHTPATH TECHNOLOGIES

LightPath Technologies makes quality and customer satisfaction a top priority. We value your business, and it is our goal to provide competitively priced, top quality products that satisfy customers' technical and time-to-market requirements. The quality management system at LightPath Technologies has been registered with TUV America and SGS China as ISO 9001:2008 compliant since August of 2001 and August of 2006 respectively. A range of environmental chambers are available in-house and used for reliability testing for Telcordia and other MIL standards in order to meet product qualification requirements. LightPath is an ISO 9001:2008 certified supplier.

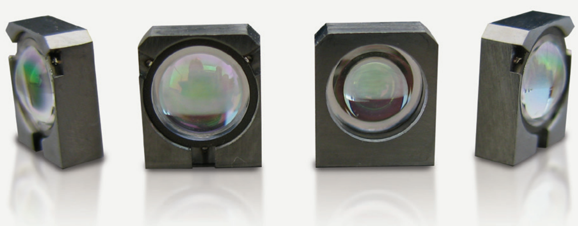
Corporate Headquarters located in Orlando, Florida has 30,000 square feet of space including 8,000 square feet of class 10,000 production floor for automated manufacturing. LightPath's Orlando facility also maintains a class 100 clean room for high performance projects and a precision machine shop with single point diamond turning capabilities for quick turn prototypes and complete metrology labs.

LightPath's Shanghai facility is wholly owned and is also fully integrated into LightPath's production and quality inspection programs. Hosting both Sales and Engineering teams.

Our new manufacturing facility in Zhenjiang, China is approximately 26,000 square feet and includes an impressive 11,000 square feet of clean room.

OUR VISION

Grow LightPath Technologies into an optical solution company that is a fully integrated manufacturer and supplier of visible and infrared optical components and sub-systems, based on world class optical manufacturing technology.




LightPath Technologies

DIODE COLLIMATION

Due to the way that the laser cavity is constructed in edge emitting diode lasers, light is emitted in a diverging, elliptical geometry - so the divergence is typically specified in both the x and y axes separately. The axis with the larger divergence is called the "fast axis" and the axis with the smaller divergence is called the "slow axis".

When selecting a lens to collimate the laser, first consider the numerical aperture of the lens. If the application requires a high amount of the laser light to be coupled through the system, a lens with a high enough NA must be chosen. The NA of a lens is a measure of the maximum amount of divergence that the lens can capture from the laser. Ideally, a lens should be used that has an NA higher than the NA of the laser's fast axis. If not, the laser will "clip" the lens causing some of the light to be wasted. To convert the NA to the divergence angle (and vice-versa), use this formula.

$$\boxed{\mathrm{NA} = n \bullet \sin(\phi)}$$

In most cases n = 1 since the NA of the laser is defined in air. Therefore, solving for the equation is simplified to:

$$\boxed{(\phi) = \sin^{-1}(\mathrm{NA})}$$

It is important to note that is the half angle of the divergence cone and is given at the marginal ray (not $1/e^2$ or half width half max). After the minimum NA is determined, next consider what beam diameter is preferred. Although ray-tracing is necessary to precisely determine the beam diameter for a given NA source with a particular lens, it can be approximated with the following formula.

$$\boxed{\text{Beam Diameter} \cong 2 \bullet \mathrm{EFL} \bullet \mathrm{NA}}$$

Where EFL is the effective focal length of the lens and NA is the numerical aperture of the source (not the NA of the lens).

Remember that most edge emitting diodes are elliptical, so the beam diameter will be different in the x-axis versus the y-axis. Use the formula above to calculate the beam diameter in both axes to determine the shape of the collimated, elliptical beam.

Important Note:

Some laser manufacturers give the NA of the source in different terms, such as half width half max (50% point) or $1/e^2$ (87% point). Whatever type of number is entered into the formula for the NA of the source will be the same type of number given for the beam diameter. For example, if the half width half max NA for a laser is used with the above formula, you will get the full width half max beam diameter. There is no simple way to convert from a half max number or a $1/e^2$ beam diameter to a full beam diameter for a specific source because it depends on the intensity profile of the source itself. A reasonable approximation, though, for most edge emitting diode lasers is to assume a Gaussian beam profile. Using this beam profile, you can convert the beam diameters as follows:

1. To convert a full width half max beam diameter to a full beam diameter (i.e. 99% power contained), multiply the diameter by 2.576.

2. To convert a $1/e^2$ beam diameter to a full beam diameter, (i.e. 99% power contained), multiply the diameter by 1.517.

DID YOU KNOW?

If you don't see the lens you need in our catalog, we can custom build it.

Our engineering team can manufacture at off-the-shelf lens prices that you won't find elsewhere.

FIBER COUPLING

Another common use for aspheric lenses is to couple laser light into optical fibers. Choosing the right lens or lenses to do the coupling is important to maintain high efficiency in the optical system. The guide below is intended to show how best to do this while using off-the-shelf components. This guide assumes that the input laser light has already been collimated (not diverging) and the fiber is multimode (single fiber requires more extensive modeling for optimum coupling efficiency). When selecting a lens to focus light into a fiber, first consider what focal length lens is needed. Let's revisit the formula given previously.

$$\boxed{\text{Beam Diameter} \cong 2 \cdot \text{EFL} \cdot \text{NA}}$$

Solving for EFL it becomes:

$$\boxed{\text{EFL} \cong \frac{\text{Beam Diameter}}{2 \cdot \text{NA}}}$$

Where NA is the numerical aperture of the fiber that is used for the coupling. It is important to note that the EFL value that is calculated above is the minimum EFL needed to couple the light completely into the fiber. Longer EFL lenses can be used, but the spot on the fiber tip will become larger. Therefore, it is best practice to use the shortest EFL lens possible that is larger than the minimum value specified above.

Example: Suppose you wish to focus a collimated beam with a full beam diameter of 2.0mm into a 50 micron multimode fiber.

The fiber NA given by the manufacturer is approximately 0.20. Fiber NA is normally given at the 99% power point (as opposed to $1/e^2$ or half max), we can use the full beam diameter given.

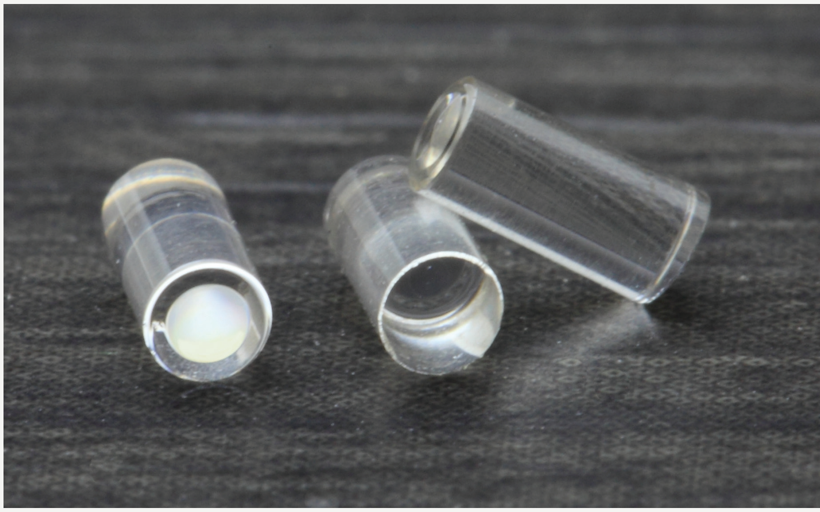
$$\boxed{\text{EFL} \cong \frac{\text{Beam Diameter}}{2\ \text{NA}} \cong \frac{2.0}{2 \cdot 0.2} \cong 5.0\text{mm}}$$

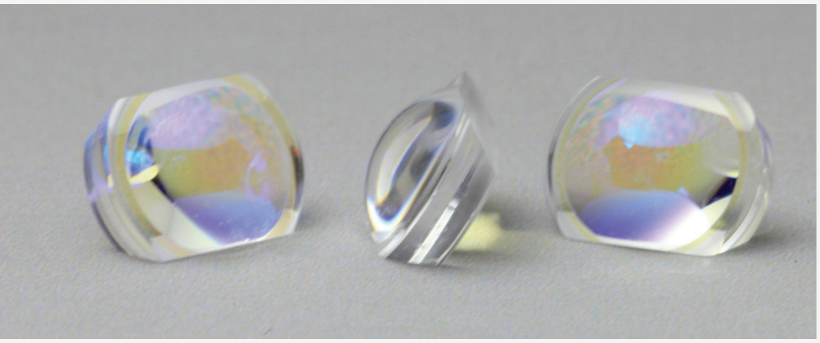
So it is best to look for a lens with an EFL of at least 5.0mm and a clear aperture 2.0mm (in order to capture the full collimated beam). One might consider the 354430 lens for its 5mm EFL (at 1550nm), but its 1.5mm clear aperture will not capture the full collimated beam. A better choice might be the 354550 lens. Its 6.10mm EFL at 1550nm becomes 5.94mm at 660nm. The lens also has a large enough clear aperture (2.2mm) to capture the entire input beam.

CHOOSE FROM A VARIETY OF FORM FACTORS FOR CUSTOM DESIGNS

LightPath's unique molding process allows us to custom manufacture lenses based on specific requirements. We can provide lenses in a number of different form factors from a simple aspheric lens, to a lens array, and even a lens molded into a metal housing. Some of LightPath's lens molding capabilities include:

- Lens Arrays
- Anamorphic Lenses
- Insert Molding (molded into a metal holder)
- Cylindrical Metal Holders
- Square Holders
- T-Holders
- Custom Holders





C-LENS (MOLDED ASPHERIC)

Custom available C-Type Aspheric lenses (collimating rods) are offered as part of the small beam air-gap collimator assembly. These are available as molded lenses having an angled plano surface on one end to prevent back reflections and an aspheric surface on the other. Compared with our standard molded aspheres, these lenses offer the same superior optical performance, however, in a rod form compatible with fiber integration. These lenses offer unprecedented technological advantages for low loss fiber coupling applications such as optical telecommunications, and advanced aerospace communication systems.

NUMERICAL APERTURE

Our molded aspheric lenses are available with numerical apertures ranging from 0.15 up to 0.77. Applications that would use a low numerical aperture include bar code scanners, surveying instruments, and small weapons sights. High numerical aperture applications include data storage and industrial printing.

SHAPES AND SIZES

With lenses available in a multitude of shapes and sizes, up to 23mm in diameter, LightPath will be able to provide you with the perfect lens for your unique application.

DIFFRACTIVE HYBRID LENSES

Combining a refractive aspheric lens with a diffractive feature can achieve sophisticated beam shaping of laser light. Diffractive hybrid lenses can also be used to make a system achromatic over a range of wavelengths. LightPath hybrid lenses can be customized to each application.

DIFFRACTION LIMITED PERFORMANCE

Most LightPath lenses are designed to be diffraction limited, and are measured on a phase shift interferometer.

ASSEMBLIES

By leveraging our broad optical component portfolio, LightPath has been 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. Additional services include thermal analysis and athermalization for better performance across a large temperature range.

GLASS DICING AND LENS EDGING

LightPath has the ability to dice lenses and glass to precision shapes and sizes. We can dice optics within a tolerance of ±5μm and hold edge chipping <15μm depending on the condition of glass used. In addition, we can dice lens center lined to edge within microns. We have experience in dicing lens arrays, wafers and custom lens shapes. LightPath uses multi-blade dicing gangs to increase our capacity to dice in higher volumes.

Manufacturing Tolerances	
Parameter	Typical Tolerance
Focal Length	± 1%
Center Thickness (CT)	± 0.025mm
Outer Diameter (OD)	± 0.015mm
Wedge (arcmin)	4
Power/Irregularity (fringes)	3/1
Surface Roughness	15nm
Surface Quality (scratch/dig)	40/20
RMS WFE	Diffraction Limited

CUSTOMIZABILITY

LightPath offers the option to design a custom lens to meet your specifications. Our in-house engineering and manufacturing teams will work with you to design a lens to meet your unique needs. LightPath also offers a wide range of custom coatings. Custom coatings include dual band, triple band, and V anti-reflection coatings. LightPath can also provide reflectivity coatings for aspheric mirror applications.

INSERT MOLDING

LightPath's lenses can be molded directly into metallic holders, allowing the lenses to be welded or soldered into the package and eliminating the need to use epoxy. This can be an ideal solution for high volume automated assembly or in applications where strict outgassing requirements preclude the use of epoxy adhesives.

Contact us today for a quote on your custom design.

DID YOU KNOW?

We can blacken the edge of your lens.

HIGH-PERFORMANCE OPTICS FOR A VARIETY OF APPLICATIONS

- Benefit from the quality and performance of all-glass aspheres
- Easily transition from prototype phase to high-volume production
- Customize to fit your application or choose from over 100 standard aspheric designs
- RoHS-compliant, ultra-high quality glass

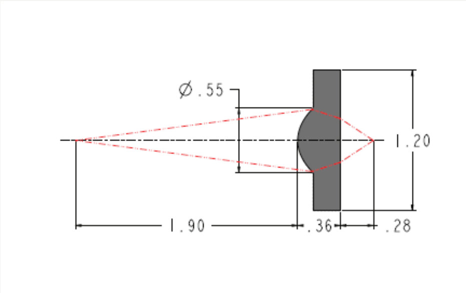
Aspheric lenses are known for their optimal performance but the expense of fabricating them has inhibited their use. LightPath's glass molding technology has enabled high volume production of aspheric optics while maintaining the highest quality at an affordable price. Because molding is the most consistent and economical way to produce aspheres in large volumes, LightPath has perfected this method to offer the most precise aspheric lens available. LightPath offers standard and custom-made lenses, all designed by our expert optical design engineers.

Geltech Asphere Performance Parameters					
Lens Code	Focal Length (mm)	Numerical Aperture	Outer Diameter (mm)	Working Distance (mm)	Page
355631	0.39	0.55 / 0.13	1.20	0.284 / 1.902	10
355070	0.43	0.06 / 0.66	1.20	5.00 / 0.270	10
355485	0.55	0.50 / 0.10	1.00	0.30 / 3.030	10
355487	0.55	0.50 / 0.11	1.00	0.276 / 2.940	10
355536	0.60	0.60	1.24	0.22	10
355880	0.70	0.60	2.50	0.33	10
355840	0.75	0.47	3.00	0.43	10
355915	0.80	0.12 / 0.50	1.30	3.931 / 0.669	10
355960	1.00	0.62	1.824	0.24	10
355200	1.14	0.43 / 0.124	2.40	4.81	10
355201	1.14	0.124 / 0.430	4.93	1.129 / 4.809	11
354450	1.16	0.30 / 0.30	1.80	1.67 / 1.67	11
357786	1.41	0.502	2.00	1.20	11
356785	1.42	0.62	2.75	0.86	11
354140	1.45	0.58	2.40	0.81	11
354710	1.49	0.53	2.65	1.02	11
355950	1.81	0.37	3.00	1.089	11

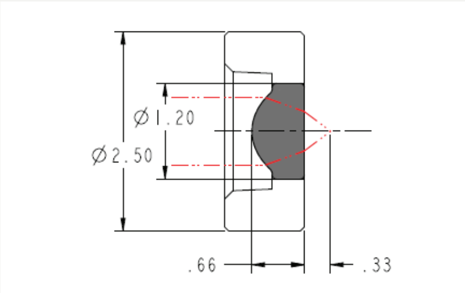
Geltech Asphere Performance Parameters					
Lens Code	Focal Length (mm)	Numerical Aperture	Outer Diameter (mm)	Working Distance (mm)	Page
355755	1.94	0.15 / 0.15	1.70	3.570 / 3.570	11
355150	2.00	0.5	3.00	1.4	11
355151	2.00	0.504	3.00	1.029	11
355410	2.51	0.20	1.805	1.84	12
355615	2.51	0.201	2.05	1.731	12
355945	2.51	0.317	3.00	1.761	12
356300	2.54	0.66	4.00	1.55	12
355160	2.73	0.55	4.00	2.37	12
355390	2.75	0.55	4.50	2.16	12
355440	2.76	0.52 / 0.26	4.70	7.090 / 2.713	12
355392	2.80	0.6	4.00	1.5	12
355660	2.976	0.52	4.00	1.56	12
354330	3.10	0.7	6.325	1.8	13
355330	3.10	0.77	6.325	1.59	13
353515	3.50	0.4	3.00	2.3	13
355545	3.50	0.38	3.50	2.3	13
355970	3.70	0.21	1.80	3.030	13

Geltech Asphere Performance Parameters					
Lens Code	Focal Length (mm)	Numerical Aperture	Outer Diameter (mm)	Working Distance (mm)	Page
352080	3.89	0.547	6.325	2.71	13
357775	4.00	0.6	6.325	2.4	13
357610	4.00	0.616	6.325	2.691	13
357765	4.00	0.61	6.325	2.37	13
355940	4.02	0.17	3.00	3.37	13
354340	4.03	0.64	6.325	2.68	14
355022	4.47	0.47	5.42	3.08	14
354350	4.50	0.4	4.70	2.2	14
354996	4.50	0.30	3.00	3.46	14
355230	4.50	0.55	6.325	3.08	14
354453	4.60	0.5	6.00	2.7	14
354430	5.00	0.15	2.00	4.37	14
354105	5.50	0.6	7.20	3.7	14
354130	6.00	0.21	3.00	4.90	14
354550	6.10	0.18	2.79	4.87	14
354171	6.20	0.30	4.70	4.10	15
355110	6.20	0.4	7.20	3.5	15
353525	6.70	0.5	6.325	4.9	15
354115	6.80	0.5	9.20	4.3	15

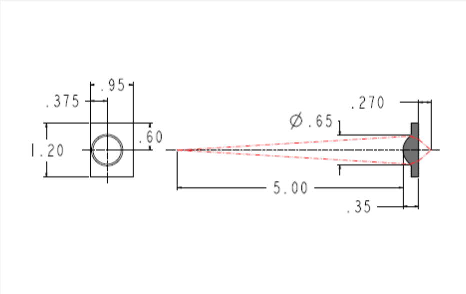
Geltech Asphere Performance Parameters					
Lens Code	Focal Length (mm)	Numerical Aperture	Outer Diameter (mm)	Working Distance (mm)	Page
355375	7.50	0.3	6.51	5.8	15
354240	8.00	0.5	9.936	5.9	15
354060	9.60	0.30	6.325	8.13	15
354306	9.90	0.3	6.335	8.4	15
354125	10.00	0.5	11.00	7.8	15
355561	10.00	0.6	15.00	7.0	15
354220	11.00	0.3	7.20	7.9	16
354061	11.00	0.24	6.325	9.56	16
354062	11.00	0.24	6.00	9.66	16
354064	11.00	0.2	6.00	9.3	16
355397	11.00	0.3	7.20	10.0	16
354058	12.00	0.22	6.325	10.57	16
354057	13.00	0.20	6.325	11.58	16
354560	13.86	0.18	6.325	12.11	16
354059	14.00	0.19	6.325	12.63	16
354120	15.04	0.15	4.985	13.19	16
354260	15.29	0.16	6.50	13.98	17
354280	18.40	0.15	6.50	17.11	17
354850	22.00	0.13	6.325	20.41	17



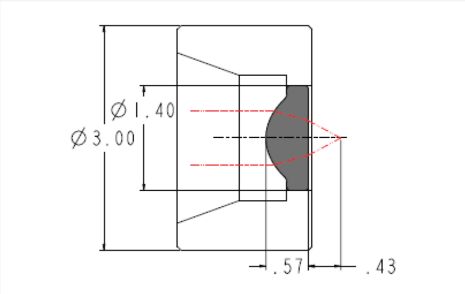
355631	
Design Wavelength	1310
Focal Length	0.39
Numerical Aperture	0.55/0.13
Clear Aperture	0.37/0.53



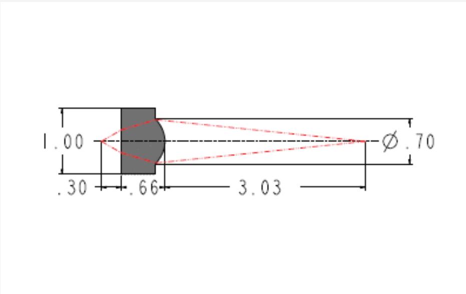
355880	
Design Wavelength	1550
Focal Length	0.70
Numerical Aperture	0.60
Clear Aperture	0.84/0.49



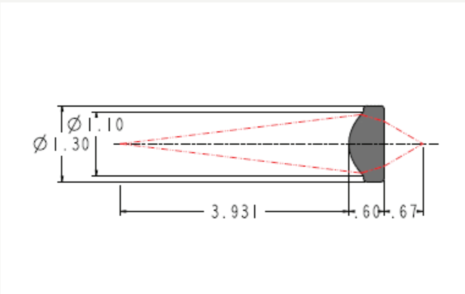
355070	
Design Wavelength	1550
Focal Length	0.43
Numerical Aperture	0.06/0.66
Clear Aperture	0.62/0.47



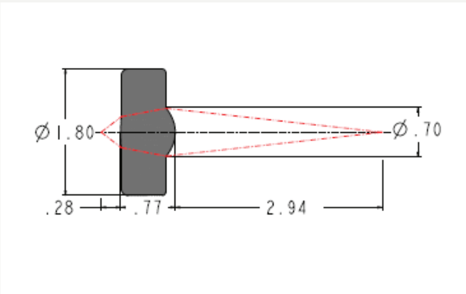
355840	
Design Wavelength	940
Focal Length	0.75
Numerical Aperture	0.47
Clear Aperture	0.71/0.46



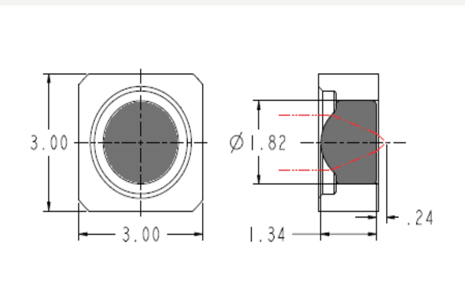
355485	
Design Wavelength	1550
Focal Length	0.55
Numerical Aperture	0.50/0.10
Clear Aperture	0.35/0.66



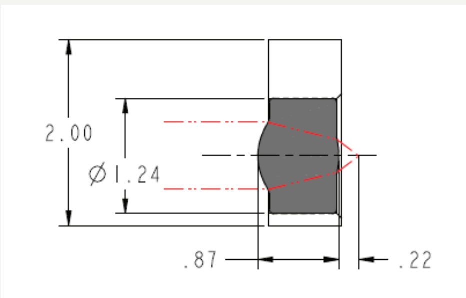
355915	
Design Wavelength	1550
Focal Length	0.80
Numerical Aperture	0.12/0.50
Clear Aperture	1.00/0.77



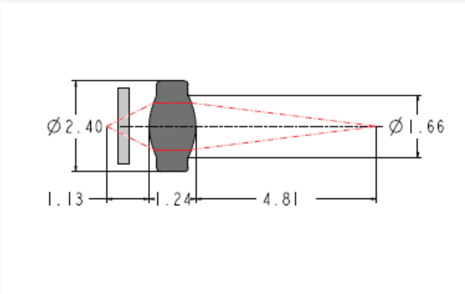
355487	
Design Wavelength	1500
Focal Length	0.55
Numerical Aperture	0.50/0.11
Clear Aperture	0.35/0.68



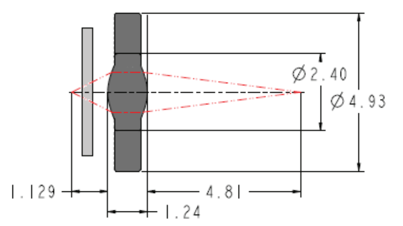
355960	
Design Wavelength	1500
Focal Length	1.00
Numerical Aperture	0.62
Clear Aperture	1.20/0.39



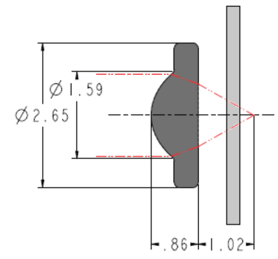
355536	
Design Wavelength	1310
Focal Length	0.60
Numerical Aperture	0.60
Clear Aperture	0.72/0.35



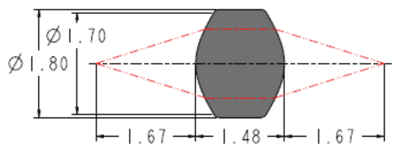
355200	
Design Wavelength	1300
Focal Length	1.14
Numerical Aperture	0.43/0.124
Clear Aperture	1.24/1.24



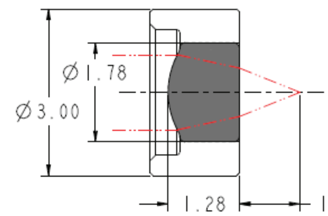
355201	
Design Wavelength	1300
Focal Length	1.14
Numerical Aperture	0.124
Clear Aperture	1.24/1.24



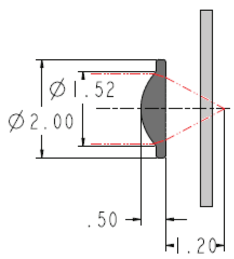
354710	
Design Wavelength	1550
Focal Length	1.49
Numerical Aperture	0.53
Clear Aperture	1.50/1.15



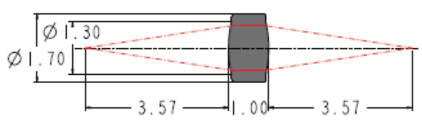
354450	
Design Wavelength	980
Focal Length	1.16
Numerical Aperture	0.30
Clear Aperture	1.14/1.14



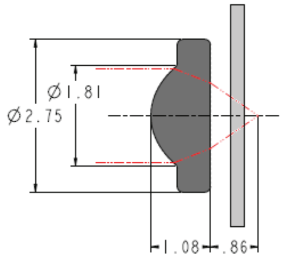
355950	
Design Wavelength	1550
Focal Length	1.81
Numerical Aperture	0.37
Clear Aperture	1.35/0.87



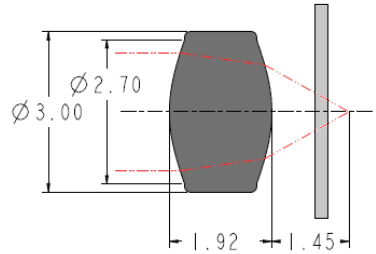
357786	
Design Wavelength	488
Focal Length	1.41
Numerical Aperture	0.502
Clear Aperture	1.42/1.28



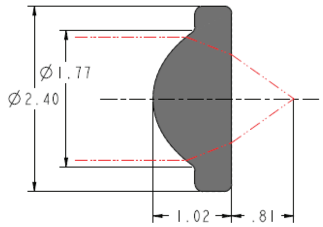
355755	
Design Wavelength	1577
Focal Length	1.94
Numerical Aperture	0.15/0.15
Clear Aperture	1.10/1.10



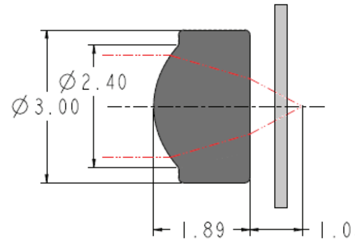
356785	
Design Wavelength	488
Focal Length	1.42
Numerical Aperture	0.62
Clear Aperture	1.70/1.18



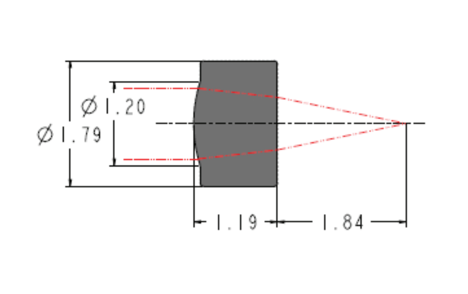
355150	
Design Wavelength	780
Focal Length	2.00
Numerical Aperture	0.5
Clear Aperture	2.20/2.20



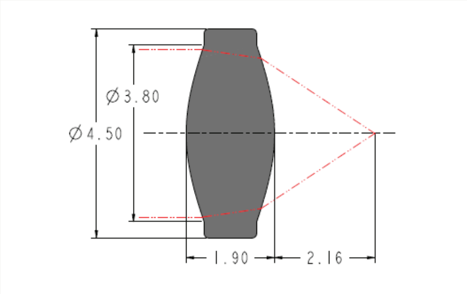
354140	
Design Wavelength	780
Focal Length	1.45
Numerical Aperture	0.58
Clear Aperture	1.60/1.14



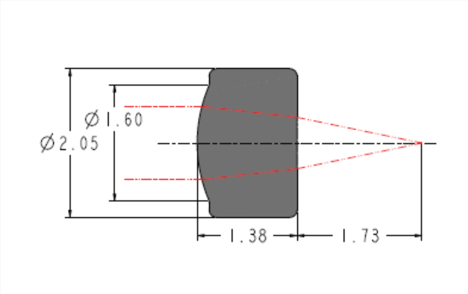
355151	
Design Wavelength	780
Focal Length	2.00
Numerical Aperture	0.504
Clear Aperture	2.00/1.09



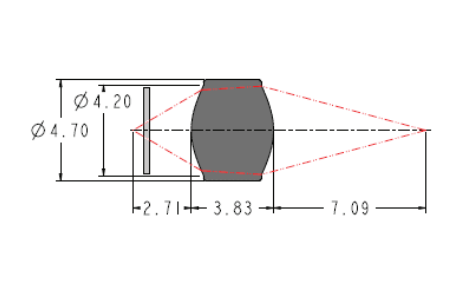
355410	
Design Wavelength	1550
Focal Length	2.51
Numerical Aperture	0.20
Clear Aperture	1.01/0.75



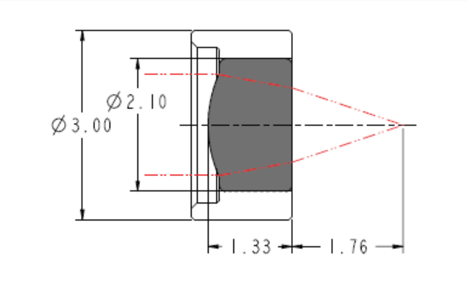
355390	
Design Wavelength	830
Focal Length	2.75
Numerical Aperture	0.55
Clear Aperture	3.60/3.24



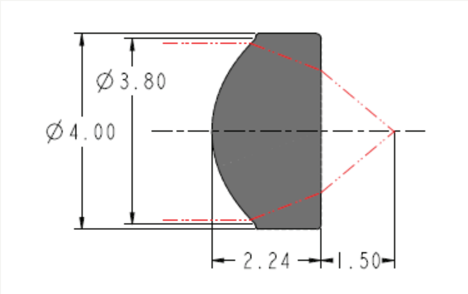
355615	
Design Wavelength	1550
Focal Length	2.51
Numerical Aperture	0.201
Clear Aperture	1.01/0.71



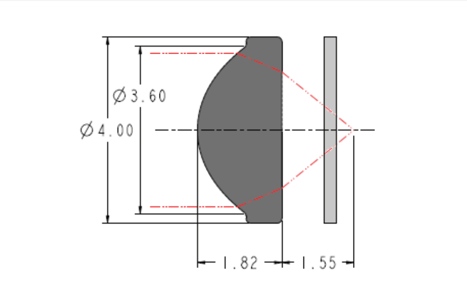
355440	
Design Wavelength	980
Focal Length	2.76
Numerical Aperture	0.52/0.26
Clear Aperture	4.12/4.12



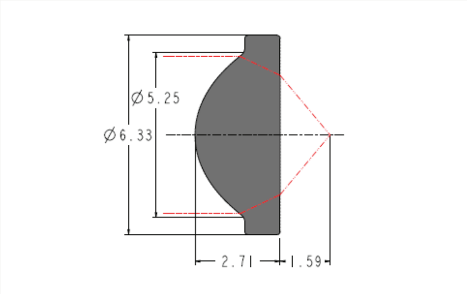
355945	
Design Wavelength	1550
Focal Length	2.51
Numerical Aperture	0.317
Clear Aperture	1.60/1.18



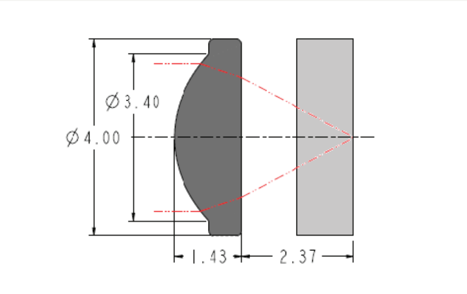
355392	
Design Wavelength	830
Focal Length	2.80
Numerical Aperture	0.6
Clear Aperture	3.60/2.50



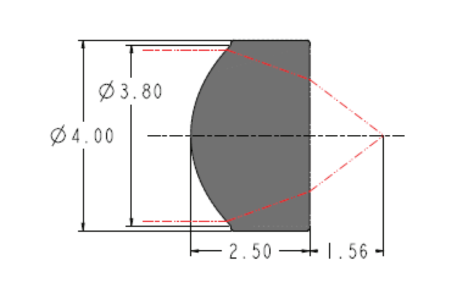
356300	
Design Wavelength	405
Focal Length	2.54
Numerical Aperture	0.66
Clear Aperture	3.30/2.50



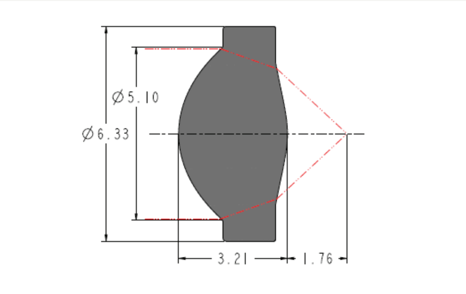
355330	
Design Wavelength	830
Focal Length	3.10
Numerical Aperture	0.77
Clear Aperture	5.00/3.79



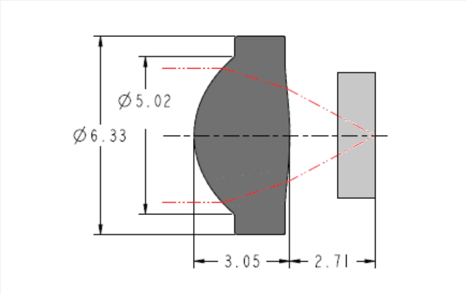
355160	
Design Wavelength	780
Focal Length	2.73
Numerical Aperture	0.55
Clear Aperture	3.00/2.44



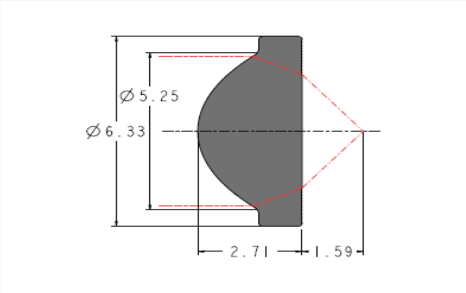
355660	
Design Wavelength	1550
Focal Length	2.976
Numerical Aperture	0.52
Clear Aperture	3.60/2.35



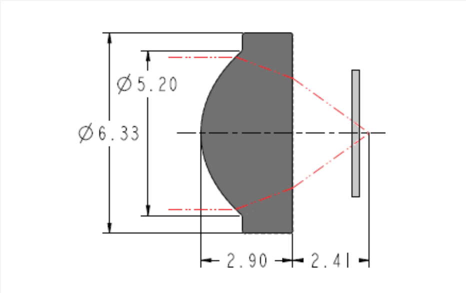
354330	
Design Wavelength	830
Focal Length	3.10
Numerical Aperture	0.7
Clear Aperture	5.00/3.84



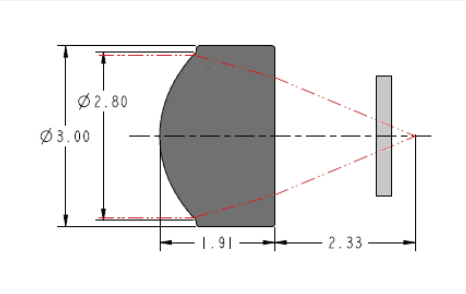
352080	
Design Wavelength	780
Focal Length	3.89
Numerical Aperture	0.547
Clear Aperture	4.29/4.00



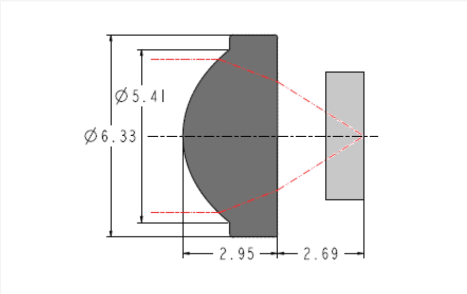
355330	
Design Wavelength	830
Focal Length	3.10
Numerical Aperture	0.77
Clear Aperture	5.00/3.61



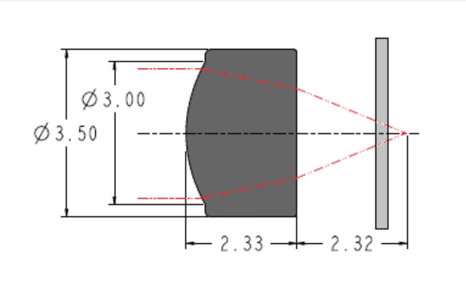
357775	
Design Wavelength	408
Focal Length	4.00
Numerical Aperture	0.6
Clear Aperture	4.80/3.45



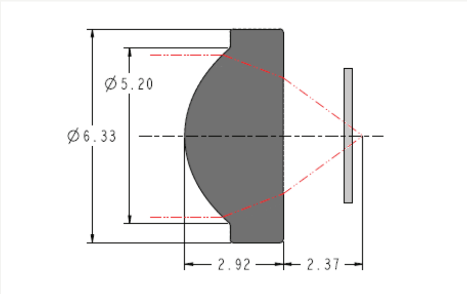
353515	
Design Wavelength	515
Focal Length	3.50
Numerical Aperture	0.4
Clear Aperture	2.70/1.95



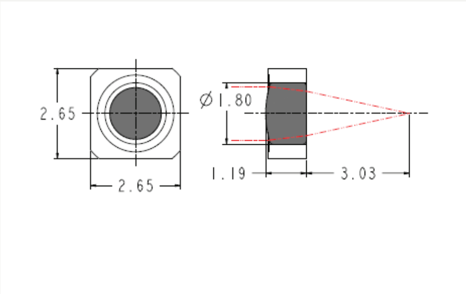
357610	
Design Wavelength	410
Focal Length	4.00
Numerical Aperture	0.616
Clear Aperture	4.80/3.39



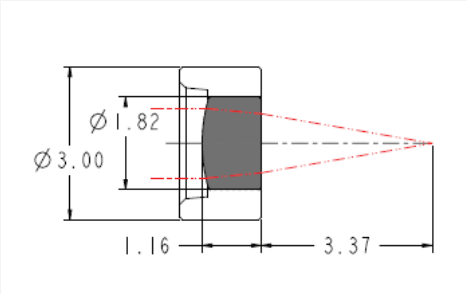
355545	
Design Wavelength	515
Focal Length	3.50
Numerical Aperture	0.38
Clear Aperture	2.71/1.88



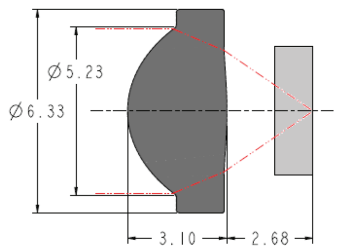
357765	
Design Wavelength	488
Focal Length	4.00
Numerical Aperture	0.61
Clear Aperture	4.80/3.43



355970	
Design Wavelength	1550
Focal Length	3.70
Numerical Aperture	0.21
Clear Aperture	1.56/1.30

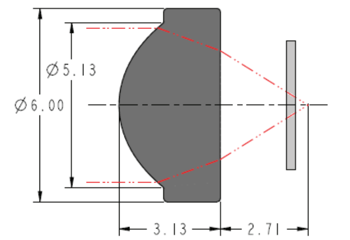


355940	
Design Wavelength	1550
Focal Length	4.02
Numerical Aperture	0.17
Clear Aperture	1.37/1.16



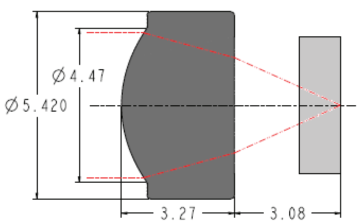
354340

Design Wavelength	685
Focal Length	4.03
Numerical Aperture	0.64
Clear Aperture	5.10/3.77



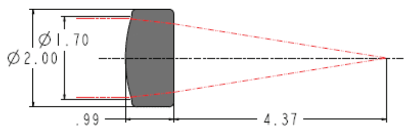
354453

Design Wavelength	655
Focal Length	4.60
Numerical Aperture	0.5
Clear Aperture	4.80/3.38



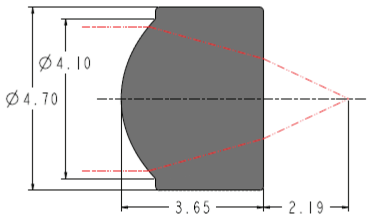
355022

Design Wavelength	780
Focal Length	4.47
Numerical Aperture	0.47
Clear Aperture	4.20/2.77



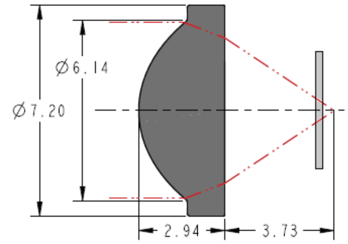
354430

Design Wavelength	1550
Focal Length	5.00
Numerical Aperture	0.15
Clear Aperture	1.60/1.40



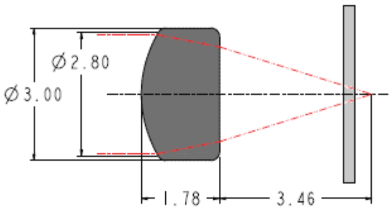
354350

Design Wavelength	980
Focal Length	4.50
Numerical Aperture	0.4
Clear Aperture	3.70/2.05



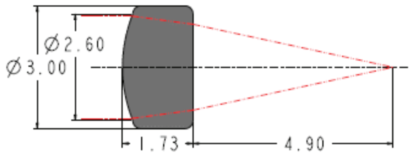
354105

Design Wavelength	633
Focal Length	5.50
Numerical Aperture	0.6
Clear Aperture	6.00/4.96



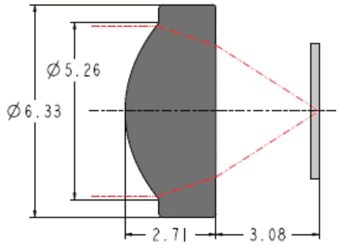
354996

Design Wavelength	634
Focal Length	4.50
Numerical Aperture	0.30
Clear Aperture	2.70/2.15



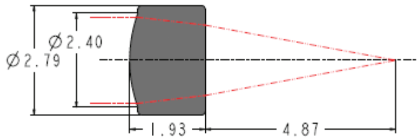
354130

Design Wavelength	1550
Focal Length	6.00
Numerical Aperture	0.21
Clear Aperture	2.50/2.10



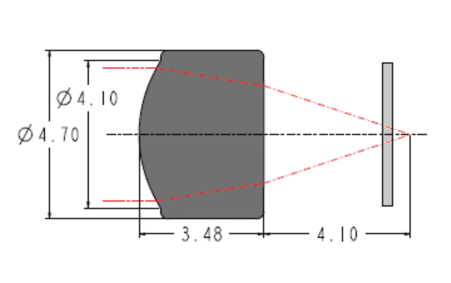
355230

Design Wavelength	780
Focal Length	4.50
Numerical Aperture	0.55
Clear Aperture	5.07/3.93

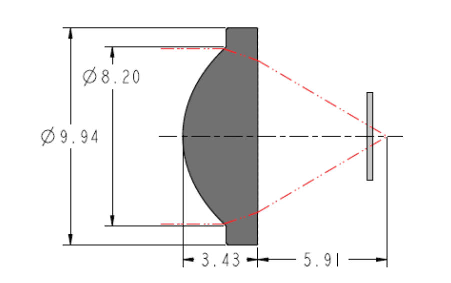


354550

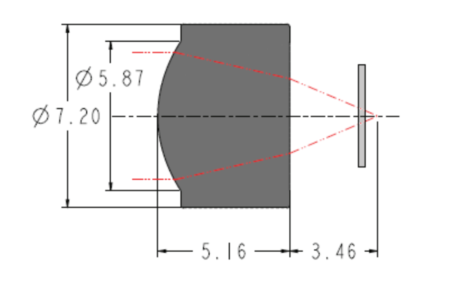
Design Wavelength	1550
Focal Length	6.10
Numerical Aperture	0.18
Clear Aperture	2.20/1.79



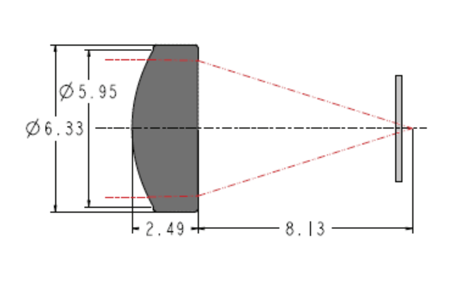
354171	
Design Wavelength	633
Focal Length	6.20
Numerical Aperture	0.30
Clear Aperture	3.70/2.72



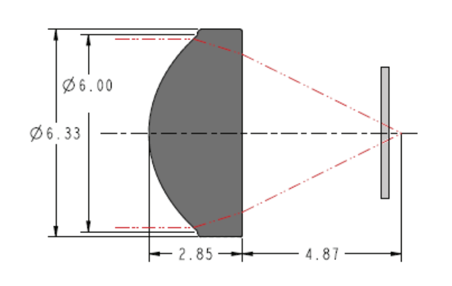
354240	
Design Wavelength	780
Focal Length	8.00
Numerical Aperture	0.5
Clear Aperture	8.00/6.94



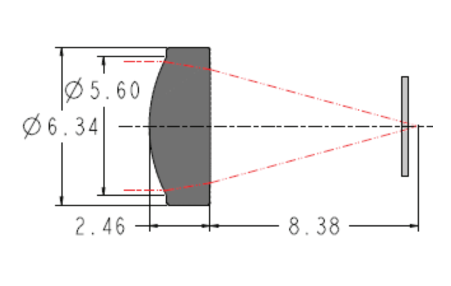
355110	
Design Wavelength	780
Focal Length	6.20
Numerical Aperture	0.4
Clear Aperture	5.00/2.93



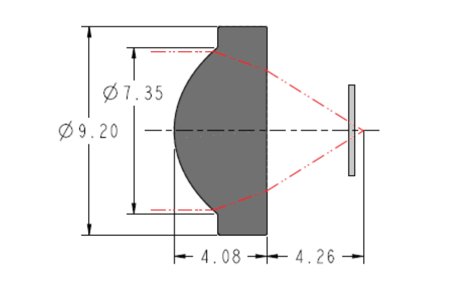
354060	
Design Wavelength	633
Focal Length	9.60
Numerical Aperture	0.30
Clear Aperture	5.20/5.13



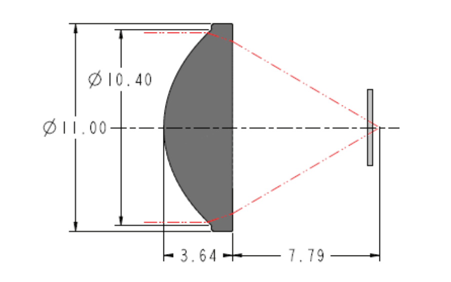
353525	
Design Wavelength	515
Focal Length	6.70
Numerical Aperture	0.5
Clear Aperture	5.75/4.82



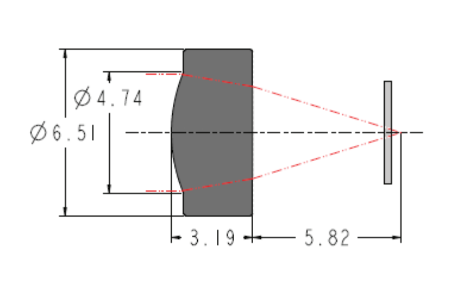
354306	
Design Wavelength	650
Focal Length	9.90
Numerical Aperture	0.3
Clear Aperture	5.20/4.57



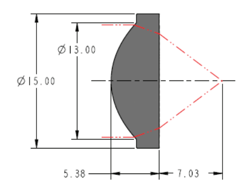
354115	
Design Wavelength	633
Focal Length	6.80
Numerical Aperture	0.5
Clear Aperture	7.00/5.30



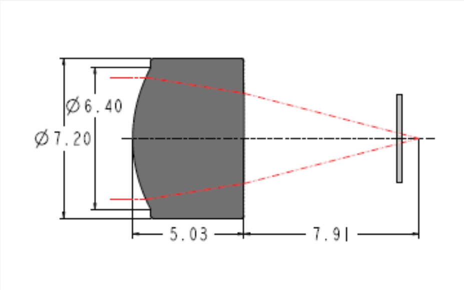
354125	
Design Wavelength	633
Focal Length	10.00
Numerical Aperture	0.5
Clear Aperture	10.00/9.12



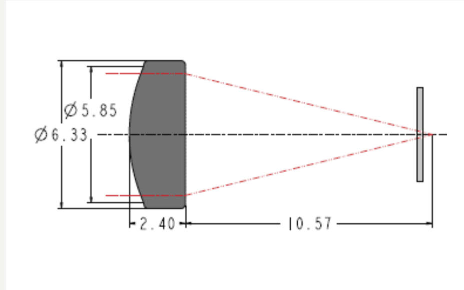
355375	
Design Wavelength	780
Focal Length	7.50
Numerical Aperture	0.3
Clear Aperture	4.54/3.61



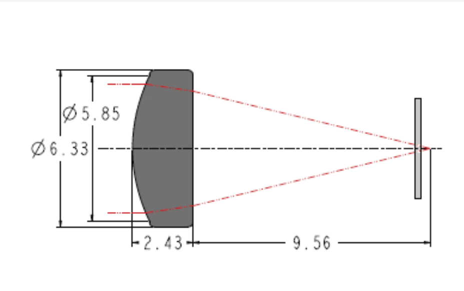
355561	
Design Wavelength	850
Focal Length	10.00
Numerical Aperture	0.6
Clear Aperture	12.50/10.53



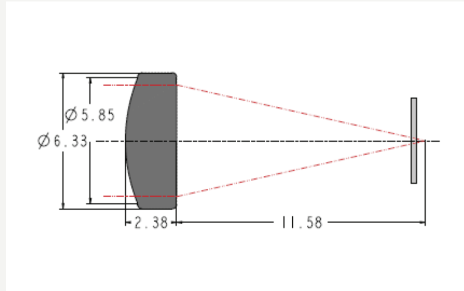
354220	
Design Wavelength	633
Focal Length	11.00
Numerical Aperture	0.3
Clear Aperture	5.50/4.07



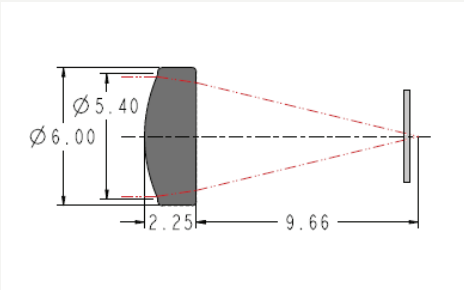
354058	
Design Wavelength	633
Focal Length	12.00
Numerical Aperture	0.22
Clear Aperture	5.20/5.20



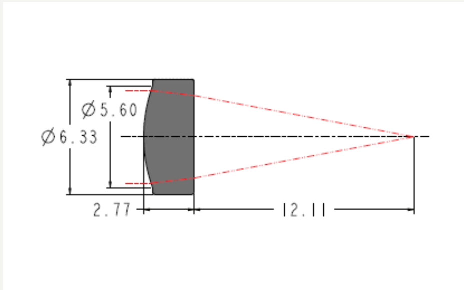
354061	
Design Wavelength	633
Focal Length	11.00
Numerical Aperture	0.24
Clear Aperture	5.20/4.63



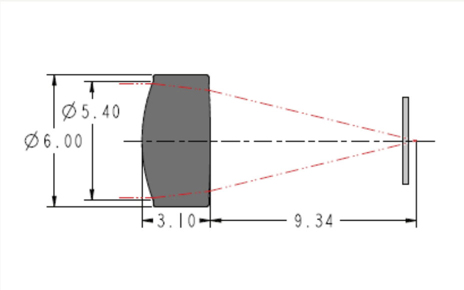
354057	
Design Wavelength	633
Focal Length	13.00
Numerical Aperture	0.20
Clear Aperture	5.20/5.20



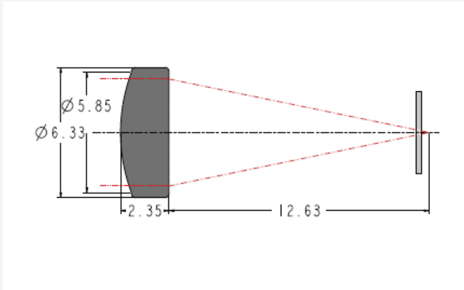
354062	
Design Wavelength	633
Focal Length	11.00
Numerical Aperture	0.24
Clear Aperture	5.20/4.68



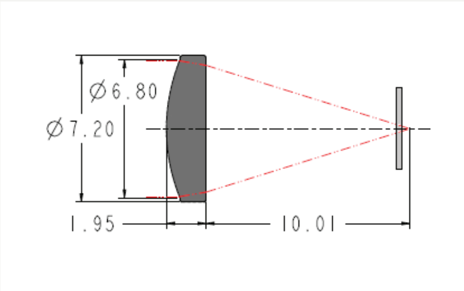
354560	
Design Wavelength	650
Focal Length	13.86
Numerical Aperture	0.18
Clear Aperture	5.10/4.54



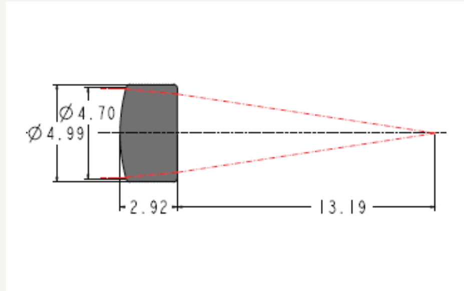
354064	
Design Wavelength	633
Focal Length	11.00
Numerical Aperture	0.2
Clear Aperture	5.20/4.59



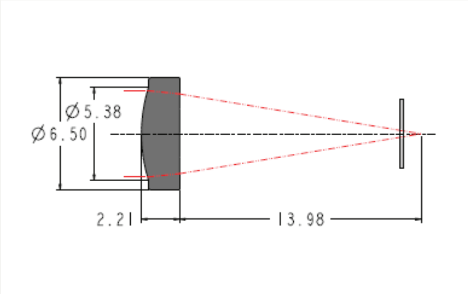
354059	
Design Wavelength	633
Focal Length	14.00
Numerical Aperture	0.19
Clear Aperture	5.20/5.20



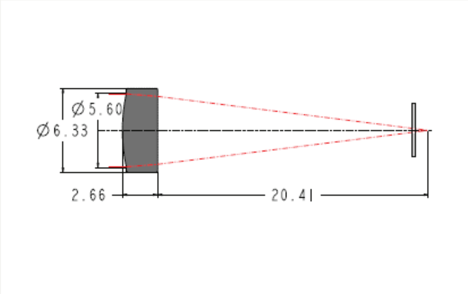
355397	
Design Wavelength	670
Focal Length	11.00
Numerical Aperture	0.3
Clear Aperture	6.68/6.24



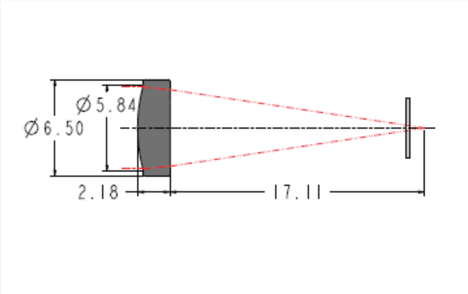
354120	
Design Wavelength	670
Focal Length	15.04
Numerical Aperture	0.15
Clear Aperture	4.50/4.00



354260	
Design Wavelength	780
Focal Length	15.29
Numerical Aperture	.016
Clear Aperture	5.00/4.61



354850	
Design Wavelength	670
Focal Length	22.00
Numerical Aperture	0.13
Clear Aperture	5.50/5.13



354280	
Design Wavelength	780
Focal Length	18.40
Numerical Aperture	0.15
Clear Aperture	5.50/5.15

DID YOU KNOW?

To learn more about QCL lenses, request a copy of LightPath's Infrared Brochure

HIGH PERFORMANCE ASPHERES FOR LASER COLLIMATION IN THE INFRARED

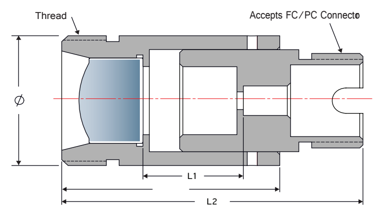
- High numerical aperture for maximum collection efficiency
- Compact, single lens design
- Diffraction limited performance
- RoHS Compliant

Infrared Laser Collimation Lenses							
Part Number	Design Wavelength	Numerical Aperture	Clear Aperture	Effective Focal Length	Outer Diameter	Working Distance	Center Thickness
390036	2.5µm	0.56	5.0mm	4.0mm	6.5mm	3.05mm	2.50mm
390042	2.5µm	0.23	10.0mm	19.04mm	12.5mm	16.63mm	5.00mm
390017	2.7µm	0.72	2.6mm	1.50mm	3.5mm	1.24mm	1.10mm
390028	4.1µm	0.56	7.6mm	5.95mm	8.0mm	5.0mm	2.50mm
390029	4.2µm	0.86	2.5mm	0.91mm	3.0mm	0.66mm	0.90mm
390093	7.8µm	0.71	5.0mm	3.0mm	6.5mm	2.35mm	2.62mm
390010	9.2µm	0.83	3.0mm	1.47mm	4.5mm	0.63mm	2.18mm
390037	9.2µm	0.85	4.0mm	1.87mm	5.5mm	0.72mm	3.00mm
390137	9.5µm	0.85	4.0mm	1.87mm	6.3mm	0.72mm	3.00mm

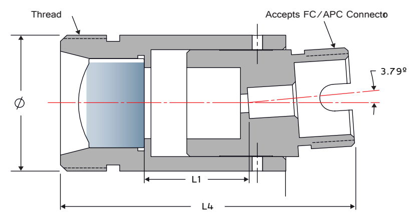
MOLDED ASPHERIC LENSES PRE-ALIGNED FOR USE WITH FIBER PATCH CORDS

LightPath's connectorized collimators are available with FC/PC, FC/APC, or SMA fiber optic connectors. Each collimator is individually aligned and tested for the specified wavelength, and will offer excellent performance throughout the entire range of their AR coatings. Standard design assemblies are available for our most popular lens types, but any asphere in our catalog can be mounted into a custom assembly of your choice. Please contact LightPath sales for more information.

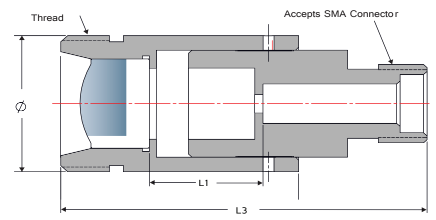
FC/PC Connectors



FC/APC Connectors



SMA Connectors

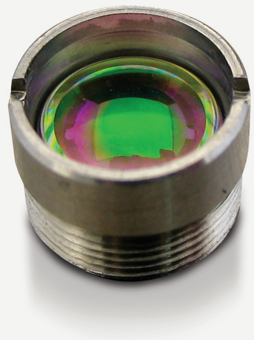


For all Connectorized Collimators, Pointing Accuracy = 0.5° and Waist Position = Infinity
Connectorized Collimators can also be ordered as an unaligned kit for custom wavelength alignment

Part Number	Wavelength (nm)	Beam ø (mm)*	AR Coating	Thread ø	ø (mm)
355110 - (FCPC/FCAPC/SMA) - 543	543	1.2	A	M11 x 0.5-6g	11
355110 - (FCPC/FCAPC/SMA) - 633	633	1.2	B	M11 x 0.5-6g	11
355110 - (FCPC/FCAPC/SMA) - 780	780	1.2	B	M11 x 0.5-6g	11
355110 - (FCPC/FCAPC/SMA) - 1064	1064	1.4	C	M11 x 0.5-6g	11
355110 - (FCPC/FCAPC/SMA) - 1310	1310	1.1	C	M11 x 0.5-6g	11
355110 - (FCPC/FCAPC/SMA) - 1550	1550	1.2	C	M11 x 0.5-6g	11
355110 - (FCPC/FCAPC/SMA) - Y - KIT			A, B, or C	M11 x 0.5-6g	11
354220 - (FCPC/FCAPC/SMA) - 543	543	2.2	A	M11 x 0.5-6g	11
354220 - (FCPC/FCAPC/SMA) - 633	633	2.1	B	M11 x 0.5-6g	11
354220 - (FCPC/FCAPC/SMA) - 780	780	2.2	B	M11 x 0.5-6g	11
354220 - (FCPC/FCAPC/SMA) - 1064	1064	2.4	C	M11 x 0.5-6g	11
354220 - (FCPC/FCAPC/SMA) - 1310	1310	2.0	C	M11 x 0.5-6g	11
354220 - (FCPC/FCAPC/SMA) - 1550	1550	2.1	C	M11 x 0.5-6g	11
354220 - (FCPC/FCAPC/SMA) - Y - KIT			A, B, or C	M11 x 0.5-6g	11
355230 - (FCPC/FCAPC/SMA) - 543	543	0.9	A	M11 x 0.5-6g	11
355230 - (FCPC/FCAPC/SMA) - 633	633	0.8	B	M11 x 0.5-6g	11
355230 - (FCPC/FCAPC/SMA) - 780	780	0.9	B	M11 x 0.5-6g	11
355230 - (FCPC/FCAPC/SMA) - 1064	1064	1.0	C	M11 x 0.5-6g	11
355230 - (FCPC/FCAPC/SMA) - 1310	1310	0.8	C	M11 x 0.5-6g	11
355230 - (FCPC/FCAPC/SMA) - 1550	1550	0.9	C	M11 x 0.5-6g	11
355230 - (FCPC/FCAPC/SMA) - Y KIT			A, B, or C	M11 x 0.5-6g	11
352240 - (FCPC/FCAPC/SMA) - 543	543	1.6	A	M12 x 0.5-6g	12
352240 - (FCPC/FCAPC/SMA) - 633	633	1.5	B	M12 x 0.5-6g	12
352240 - (FCPC/FCAPC/SMA) - 780	780	1.6	B	M12 x 0.5-6g	12
352240 - (FCPC/FCAPC/SMA) - 1064	1064	1.8	C	M12 x 0.5-6g	12
352240 - (FCPC/FCAPC/SMA) - 1310	1310	1.5	C	M12 x 0.5-6g	12
352240 - (FCPC/FCAPC/SMA) - 1550	1550	1.5	C	M12 x 0.5-6g	12
352240 - (FCPC/FCAPC/SMA) - Y - KIT			A, B, or C	M12 x 0.5-6g	12
354260 - (FCPC/FCAPC/SMA) - 543	543	3.0	A	M11 x 0.5-6g	11
354260 - (FCPC/FCAPC/SMA) - 633	633	2.8	B	M11 x 0.5-6g	11
354260 - (FCPC/FCAPC/SMA) - 780	780	3.1	B	M11 x 0.5-6g	11
354260 - (FCPC/FCAPC/SMA) - 1064	1064	3.3	C	M11 x 0.5-6g	11
354260 - (FCPC/FCAPC/SMA) - 1310	1310	2.8	C	M11 x 0.5-6g	11
354260 - (FCPC/FCAPC/SMA) - 1550	1550	2.9	C	M11 x 0.5-6g	11
354260 - (FCPC/FCAPC/SMA) - Y - KIT			A, B, or C	M11 x 0.5-6g	11
357775 - (FCPC/FCAPC/SMA) - 405	405	0.7	UVA	M11 x 0.5-6g	11
357775 - (FCPC/FCAPC/SMA) - Y - KIT			UVA	M11 x 0.5-6g	11

MOLDED ASPHERIC LENSES MOUNTED FOR EASY ASSEMBLY

Part Number*	Holder Type	EFL (mm)	NA
357775Y-00-MT	MT9	4.02	0.6
357765Y-00-MT	MT9	4.00	0.61
357610Y-00-MT	MT9	4.00	0.62
355397Y-00-MT	MT9	11.00	0.3
355375Y-00-MT	MT9	7.50	0.3
355330Y-00-MT	MT9	3.10	0.77
355230Y-00-MT	MT9	4.51	0.55
355110Y-00-MT	MT9	6.24	0.4
354850Y-00-MT	MT9	22.00	0.13
354560Y-00-MT	MT9	13.86	0.18
354453Y-00-MT	MT9	4.6	0.55
354340Y-00-MT	MT9	4.03	0.64
354306Y-00-MT	MT9	9.85	0.27
354280Y-00-MT	MT9	18.4	0.15
354260Y-00-MT	MT9	15.29	0.16
354220Y-00-MT	MT9	11.00	0.25
354105Y-00-MT	MT9	5.50	0.56
354064Y-00-MT	MT9	11.00	0.24
354062Y-00-MT	MT9	11.00	0.24
354061Y-00-MT	MT9	11.00	0.24
354060Y-00-MT	MT9	9.60	0.27
354059Y-00-MT	MT9	14.00	0.19
354058Y-00-MT	MT9	12.00	0.22
354057Y-00-MT	MT9	13.00	0.2
353525Y-00-MT	MT9	6.69	0.45
352080Y-00-MT	MT9	3.89	0.55
356300Y-00-MT	MT8	2.54	0.66
355660Y-00-MT	MT8	2.97	0.6
355440Y-00-MT	MT8	2.76	0.52
355392Y-00-MT	MT8	2.75	0.64
355390Y-00-MT	MT8	2.75	0.68
355160Y-00-MT	MT8	2.73	0.55
355022Y-00-MT	MT8	4.47	0.47
354350Y-00-MT	MT8	4.50	0.43
357786Y-00-MT	MT6B	1.41	0.5
356785Y-00-MT	MT6B	1.42	0.62
355200Y-00-MT	MT6B	1.14	0.43
355151Y-00-MT	MT6B	2.00	0.5
355150Y-00-MT	MT6B	2.00	0.51
354996Y-00-MT	MT6B	4.50	0.3
354710Y-00-MT	MT6B	1.49	0.53
354550Y-00-MT	MT6B	6.10	0.18
354430Y-00-MT	MT6B	5.00	0.15
353515Y-00-MT	MT6B	3.52	0.4
354140Y-00-MT	MT6A	1.45	0.58
354115Y-00-MT	MT12	6.75	0.54
352240Y-00-MT	MT12	8.00	0.5

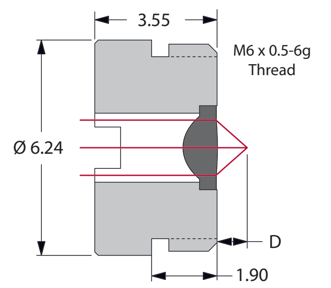


DID YOU KNOW?

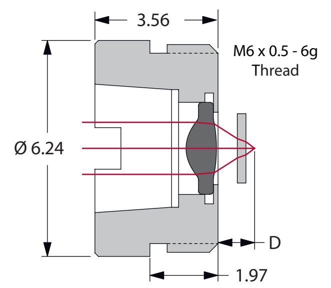
There are a variety of custom coatings available.

- Cost-effective solution for mounting Geltech aspheres
- Easy to handle assembly
- Durable stainless steel housing
- Threaded extension for easy mounting

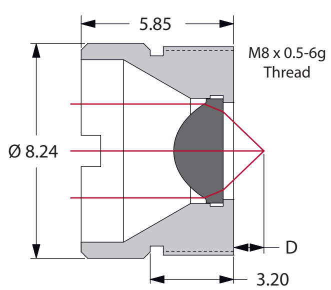
Lens Holder MT6A



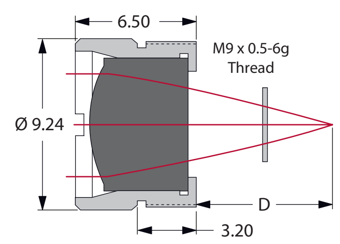
Lens Holder MT6B



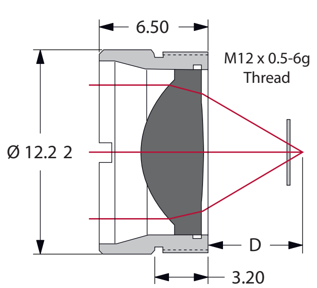
Lens Holder MT8



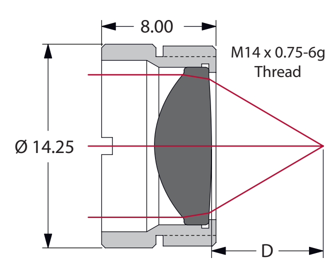
Lens Holder MT9



Lens Holder MT12



Lens Holder MT14



* "Y" in the Part Number, is a placeholder for the coating type that the customer selects.

OPTIMUM PERFORMANCE WITH OPTIMUM LENSES

Lens Code	Glass Type	Refractive Index, n_d	Abbé Number, ν_d	CTE	dn/dT	Equivalent Glasses	RoHS ✓ Compliance
352xxx	ECO-550	1.603	50.02	11.62×10^{-6}/°C	2.39×10^{-6}/°C	N/A	✓
353xxx	H-FK61	1.495	81.20	13.8×10^{-6}/°C	-6.6×10^{-6}/°C	Hoya-FCD1 & Ohara S-FPL51	✓
354xxx	D-ZK3	1.586	60.71	7.6×10^{-6}/°C	3.2×10^{-6}/°C	Hoya M-BACD5N & Ohara L-BAL35	✓
355xxx	D-ZLaF52La	1.806	40.79	6.9×10^{-6}/°C	6.5×10^{-6}/°C	Ohara L-LAH53, Hoya M-NBFD130, Sumita K-VC89	✓
356xxx	L-LAL12	1.674	55.00	6.9×10^{-6}/°C	6.5×10^{-6}/°C	CDGM D-Lak5	✓
357xxx	D-LaK6	1.690	52.65	6.9×10^{-6}/°C	6.5×10^{-6}/°C	Hoya M-LAC130 & Ohara L-LAL13	✓

D-ZLaF52La → 355xxx Series of Lenses

This glass has a higher index of refraction than ECO-550 and is best suited for those applications that require a higher numerical aperture and need to maintain RoHS compliance.

D-ZK3 → 354xxx Series of Lenses

This glass is best suited for those applications that require a low cost glass for higher volume manufacturing.

ECO-550 → 352xxx Series of Lenses

European and Japanese environmental regulations have restricted the use of lead and other hazardous substances in optical components. ECO-550 is an environmentally friendly alternative to conventional moldable glasses.

D-LaK6 → 357xxx Series of Lenses

These glasses have been selected for their outstanding UV & Blue transmission properties.

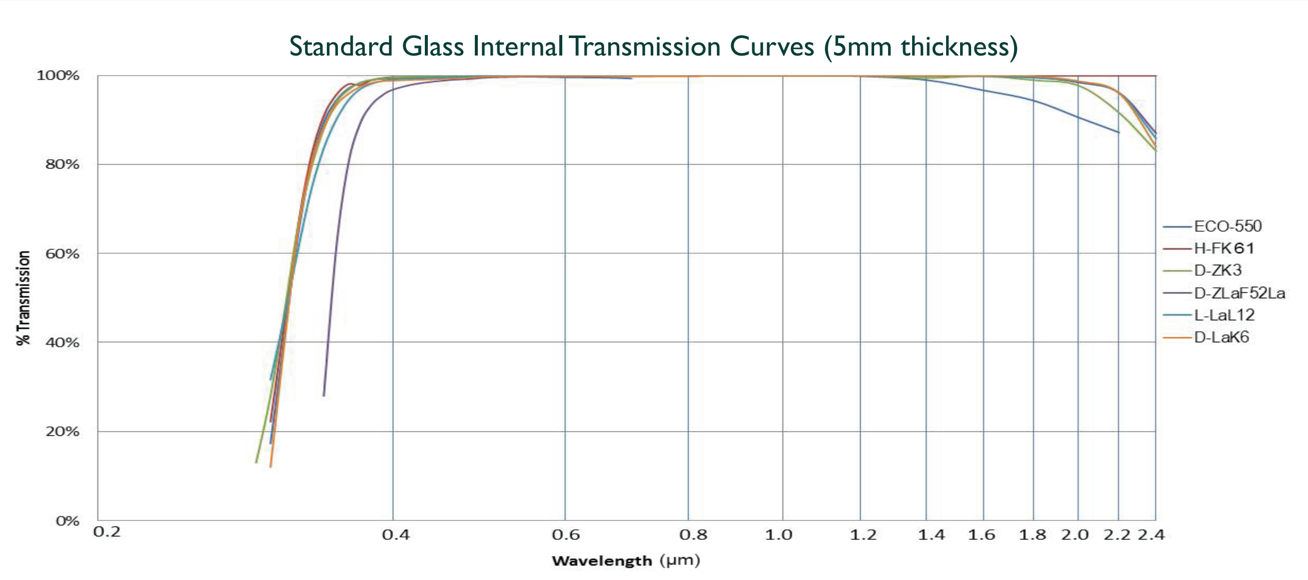
H-FK61 → 353xxx Series of Lenses

These glasses have been selected for their outstanding UV & Green transmission properties.

L-LAL12 → 356xxx Series of Lenses

SPECIALTY GLASS TYPES

There are well over 200 available moldable glass types. LightPath focuses on a select few types in order to provide our customers the fastest lead times at the lowest cost. Our standard selections meet most of our customers' needs but sometimes that special application requires a unique glass. LightPath can provide these glasses, starting with material qualification.



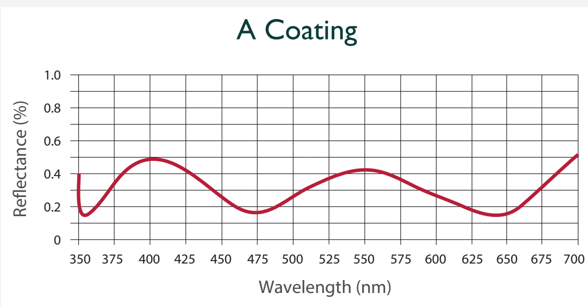
STANDARD ANTI-REFLECTIVE COATINGS

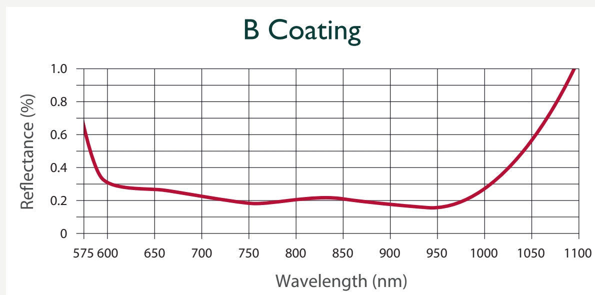
LightPath offers a variety of multilayer broadband coatings to reduce the back reflection from a nominal 6% for uncoated lenses. The choice of which AR coating is appropriate depends on the type of glass the lens is made from and the wavelength at which the lens will be used.

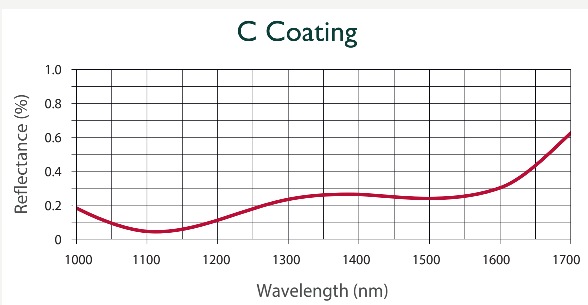
Standard Coatings*			
Lens Series	Coating	λ Range (nm)	Reflectivity
352xxx, 353xxx, 354xxx, 355xxx	MLBB-A	350 - 700	$R_{avg} \leq 0.50\%$
352xxx, 354xxx, 355xxx	MLBB-B	600 - 1050	$R_{max} < 1.00\%$
352xxx, 354xxx, 355xxx	MLBB-C	1050 - 1600	$R_{max} < 1.00\%$
355xxx	MLBB-Q	1300 - 1700	$R_{max} < 0.25\%$
356xxx, 357xxx	UVA	350 - 500	$R_{max} < 1.00\%$

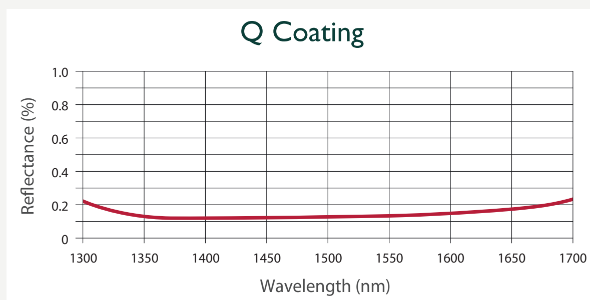
* LightPath's rigorous qualification process ensures all standard coatings will pass the abrasion and adhesion resistance requirements of ISO+9211-4-196.

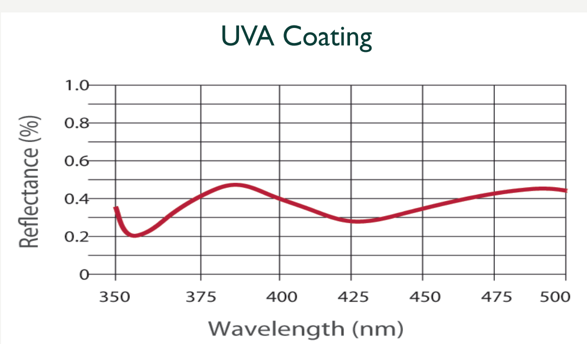
Typical Coating Curves

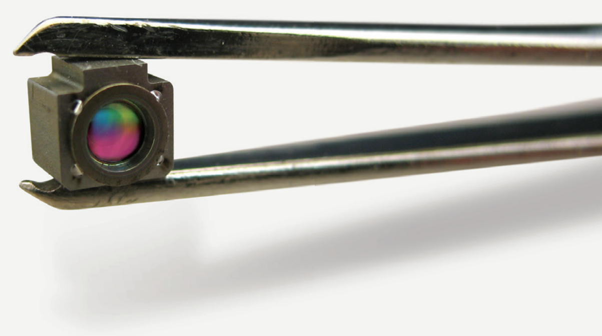












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