



Rochester Precision Optics
Problem Solved.

Standard molded and machined lens components and aspheres for rapid prototyping and volume production.

Index

Company Overview	1
Molded Glass Aspheres	2-3
Molded Glass Collimating Optics	4
Lens Diagrams and Specifications	5-9
IR Optics, Single Point Diamond Turning (SPDT)	10
Molded Plastic Optics	11
Conventional Spherical Optics Utilizing CNC Optical Manufacturing	12
RPO Molded Glass	13

About RPO

Rochester Precision Optics (RPO) helps market leaders redefine what's possible — from design through prototype, fabrication and assembly of lens components and systems.

Our standard materials and lenses help to meet product volumes, timeline and cost constraints. From design to assembly, our vertically integrated, 110,000 square foot manufacturing facility offers the capabilities you need, whether custom or standard.

- Molded glass and polymer aspheric optics
- IR molded and diamond turned aspheric optics
- Lens assemblies
- Electro-optical systems
- CNC optics manufacturing
- Precision machine shop
- Advanced in-line metrology and QC
- Supply chain management and overseas sourcing (POTC)



Rochester Precision Optics

Committed to solving complex problems,
From design to full production

- Design and engineering services
- Optical assemblies
- Precision molded glass aspheres
- Precision molded plastic optics
- High speed CNC optical fabrication
- Optical diamond turning
- Precision machining
- Thin film optical coatings
- Visible/UV/infrared (SWIR, MWIR, LWIR)
- Systems integration

Rochester Precision Optics has been a proven partner to market leaders in medical device, security, defense, life sciences and consumer goods manufacturing since 2005.

RPO's customers create some of the most critical products on the market today — from night vision goggles to virtual reality and surgical instrumentation. RPO provides the advanced proprietary technology, vertical integration, LEAN manufacturing, and supply chain management needed to meet their high-volume demands.



Medical Devices



Life Sciences



Security



Consumer



Defense



Molded Glass Aspheres

Proprietary PGM technology for volume production

Rochester Precision Optics is the only optical fabrication company utilizing Precision Glass Molding (PGM) technology for rapid production of aspheric lenses. The proprietary approach provides significant cost and lead time advantages for high volume production. Today at RPO, we are producing custom molded aspheres for market-leading, high-volume applications in sizes from 1mm to 60mm.

Aspheric Glass Molding and Overview

The highly repeatable PGM process is accomplished by heating and press forming optical grade glass blanks (preforms) using ultra precision tooling. RPO's vertical integration allows for in-house manufacturing and AR coating. The molding process produces an optic that has a free form edge and when necessary, a secondary operation of centering defines the customer specified finished diameter. These molded lenses can have spherical, aspheric, bi-aspheric and plano surfaces.

RPO Standard Glass Types

With the exception of a few glass types, many varieties of glass can be used to manufacture glass-molded optics at RPO. Molding can be accomplished with a large range of glasses, and unlike many molders, RPO is not restricted to low transformation temperature (Tg) glasses. This large selection of glass offers the optical designer more freedom when designing multi-lens systems.

Precision Glass Molding Tolerances

Feature	Standard Quality	Precision Quality
Center Thickness	+/- 0.025 mm	+/- 0.012 mm
Diameter	+/- 0.030 mm	+/- 0.010 mm
Surface Deviation Power-Irregularity (Fringes)	5 - 2	3 - 1/2
ETD (Wedge)	0.05 mm	0.01 mm
Axis Alignment	5 minutes	2.5 minutes
Scratch-Dig	60-40	20-10
Index of Refraction (Nd)	+/-0.001	+/- 0.0003
Abbe Number (Vd)	+/- .8%	+/- .5%
Sag	+/- 0.015	+/- 0.010

Lens and tool optical surface specifications (spherical or aspherical) are typically given in terms of "fringes" of surface departure from an ideal surface, which also includes irregularity of the surface in "fringes".

Check rpooptics.com for our most recent tolerances and standard products.

RPO Moldable Glass

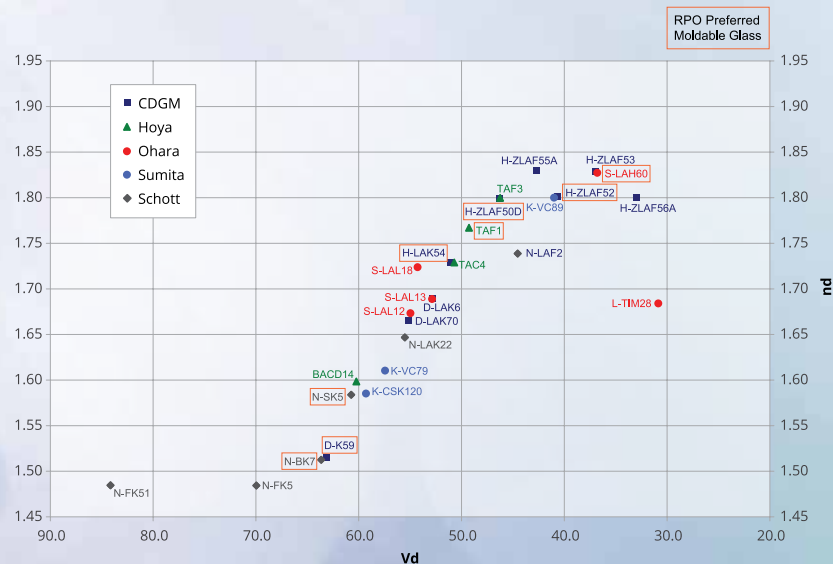
The RPO glass molding process uses a relatively rapid cooling rate after pressing the lens. This is important in reducing process cycle time and increasing efficiency. Since the glass is molded above the Tg and cooled rapidly (compared to a fine anneal cooling rate), the resulting optic exhibits a small index change when compared to its fine anneal state. The index drop is small (usually .002-.006), but the optical design needs to be optimized to compensate for this change.

Table 1-2 shows a listing of current optical grade glass types that have been demonstrated in the RPO molding process. The glasses have gone through a molding verification process for their reaction to the temperature cycling and the effects on the tooling surfaces. The dispersion (Vd) and index (Nd) data show the after molding values for these specific glasses. RPO is verifying new glasses regularly to expand its glass molding capabilities, and an updated listing can also be found on our website at www.rpoptics.com.

Glass Type	Manufacturer	Vd	Nd
H-ZLAF55A_mold	CDGM	42.73	1.830000
H-ZLAF53_mold	CDGM	36.95	1.829200
S-LAH60_mold*	Ohara	36.79	1.827266
H-ZLAF52_mold*	CDGM	40.70	1.801298
K-VC89_mold	Sumita	40.71	1.804597
H-ZLAF56A_mold	CDGM	33.02	1.799999
TAF3_mold	Hoya	46.25	1.799800
H-ZLAF50D_mold*	CDGM	46.27	1.798700
TAF1_mold*	Hoya	49.27	1.767000
N-LAF2_mold	Schott	44.54	1.738772
TAC4_mold	Hoya	50.71	1.728999
H-LAK54_mold*	CDGM	51.10	1.728497
S-LAL18_mold	Ohara	54.27	1.723761
D-LAK6_mold	CDGM	52.80	1.689442
S-LAL13_mold	Ohara	52.86	1.688895
L-TIM28_mold	Ohara	30.86	1.684030
S-LAL12_mold	Ohara	54.97	1.673298
D-LAK70_mold	CDGM	55.14	1.665254
N-LAK22_mold	Schott	55.51	1.646725
K-VC79_mold	Sumita	57.30	1.605145
BACD14_mold	Hoya	60.23	1.598511
K-CSK120_mold	Sumita	59.19	1.5833
N-SK5_mold*	Schott	60.73	1.583930
D-K59_mold*	Schott	63.10	1.514796
N-BK7_mold*	Schott	63.65	1.512595
N-FK5_mold	Schott	69.96	1.484390

Don't see your glass type here?
Give us a call **585-292-5450**

* indicates popular material choices for molding



Molded Glass Collimating Optics

Rochester Precision Optics produces standard aspheric lenses in a wide range of focal lengths and numerical apertures, which provide diffraction limited performance. Standard catalog lenses are offered with three broadband AR coatings covering wavelengths from 400nm to 1600nm. Custom broadband coatings and V-coatings can also be provided for your specific application.

Standard Mounted Assemblies

Lens Code	NA	EFL (mm)	CA (mm)	OD (mm)
A280	0.15	18.40	5.50	6.50
A260	0.16	15.29	5.00	6.50
A220	0.25	11.00	5.50	7.20
A635	0.31	4.50	2.80	3.00
A170	0.30	6.16	3.70	4.70
A375	0.30	7.50	4.50	6.51
A397	0.30	11.00	6.59	7.20
A110	0.40	6.24	5.00	7.20
N150	0.55	2.00	2.00	3.00
A240	0.50	8.00	8.00	9.94
A390	0.53	4.60	4.89	6.00
N435	0.55	5.30	5.83	7.33
A230	0.55	4.51	4.95	6.325
A658	0.60	2.59	3.12	4.40
N330	0.062	3.10	5.40	6.325

Injection Mounted Assemblies

Lens Code	NA	EFL (mm)	CA (mm)	OD (mm)
N414	0.51	3.30	3.52	7.37
A365	0.53	4.59	4.87	7.19

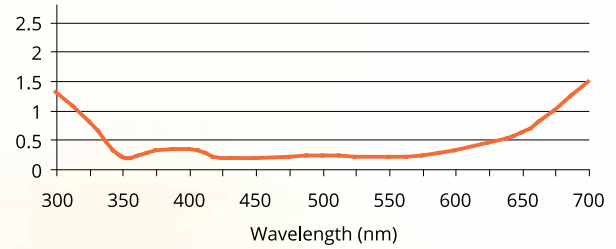
Short Wavelength Visible Lenses

Lens Code	NA	EFL (mm)	CA (mm)	OD (mm)
A610	0.60	4.00	4.80	6.325
A671	0.60	4.02	4.85	6.325

Standard Product Multilayer Broadband Coatings

(Please contact sales for custom coatings)

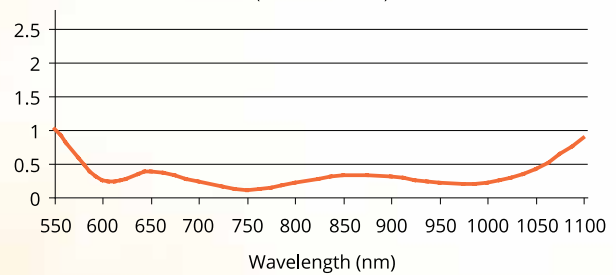
Standard A-Coating
(350-600nm)



MLBB - A coating RMAX

<1%, RTYP <0.4% from 400nm - 600nm

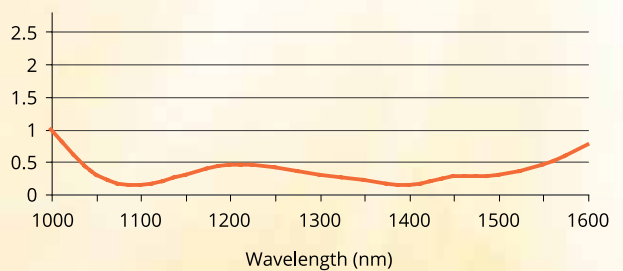
Standard B-Coating
(600-1050nm)



MLBB - B coating RMAX

<1%, RTYP <0.4% from 600nm - 1050nm

Standard C-Coating
(1050-1550nm)

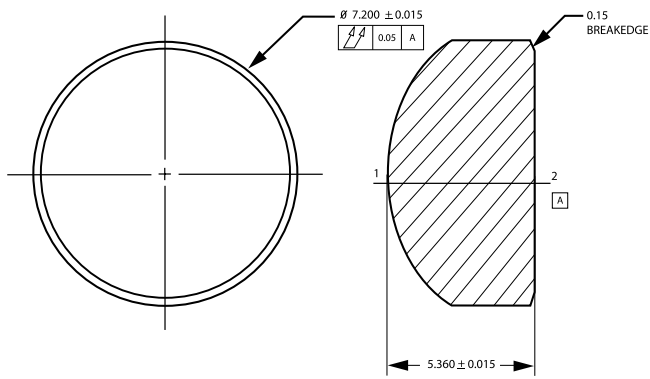


MLBB - C coating RMAX

<1%, RTYP <0.4% from 1050nm - 1600nm



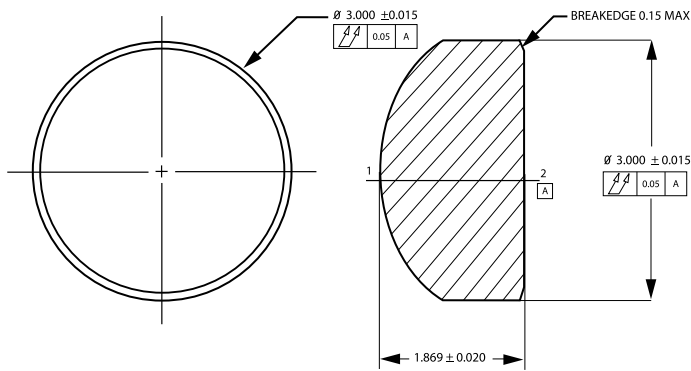
A-110 Collimator Lens - Glass



Optical Design Specifications

PARAMETER	
Focal Length	6.24 mm
Numerical Aperture (NA)	0.40
Back Focal Length	3.394 mm
Clear Aperture	S1 5.00 mm, S2 2.92 mm
Axial Wavefront Distortion	≤ .10 Waves (RMS) at 632.8nm
Window Thickness	0.275 mm (BK-7)
Center Thickness (CT)	5.36 mm
RoHS Compliant	YES
AR Coating Options	A Coating 400-600nm B Coating 600-1050nm C Coating 1050-1550nm

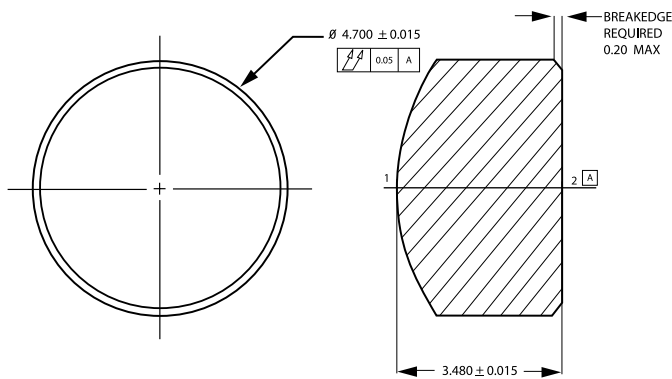
N-150 Collimator Lens - Glass



Optical Design Specifications

PARAMETER	
Focal Length	2.00 mm
Numerical Aperture (NA)	0.50
Back Focal Length	1.10 mm
Clear Aperture	S1 2.00 mm, S2 1.15 mm
Axial Wavefront Distortion	≤ .10 Waves (RMS) at 632.8nm
Window Thickness	0.25 mm (BK-7)
Center Thickness (CT)	1.869 mm
RoHS Compliant	YES
AR Coating Options	A Coating 400-600nm B Coating 600-1050nm C Coating 1050-1550nm

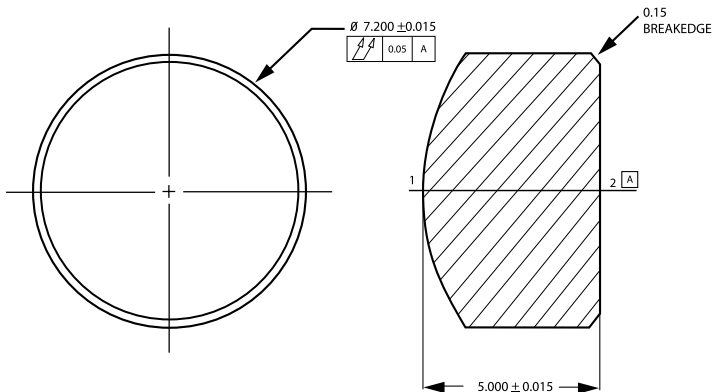
A-170 Collimator Lens - Glass



Optical Design Specifications

PARAMETER	
Focal Length	6.16 mm
Numerical Aperture (NA)	0.30
Back Focal Length	4.25 mm
Clear Aperture	S1 3.70 mm, S2 2.57 mm
Axial Wavefront Distortion	≤ .10 Waves (RMS) at 632.8nm
Window Thickness	0.275 mm (BK-7)
Center Thickness (CT)	3.480 mm
RoHS Compliant	YES
AR Coating Options	A Coating 400-600nm B Coating 600-1050nm C Coating 1050-1550nm

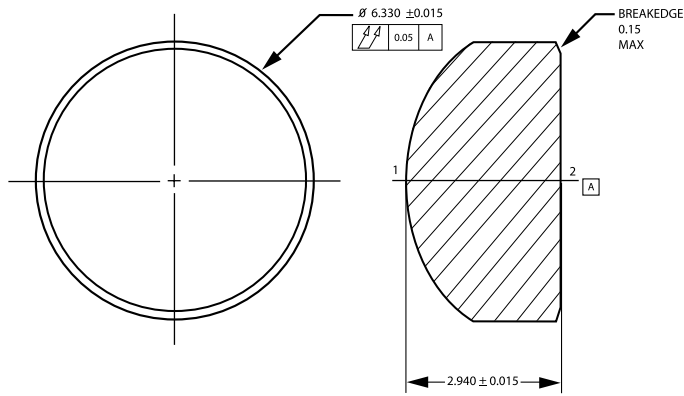
A-220 Collimator Lens - Glass



Optical Design Specifications

PARAMETER	
Focal Length	11.00 mm
Numerical Aperture (NA)	0.26
Back Focal Length	7.95 mm
Clear Aperture	S1 5.50 mm, S2 4.14 mm
Axial Wavefront Distortion	≤ .10 Waves (RMS) at 632.8nm
Window Thickness	0.250 mm (BK-7)
Center Thickness (CT)	5.00 mm
RoHS Compliant	YES
AR Coating Options	A Coating 400-600nm B Coating 600-1050nm C Coating 1050-1550nm

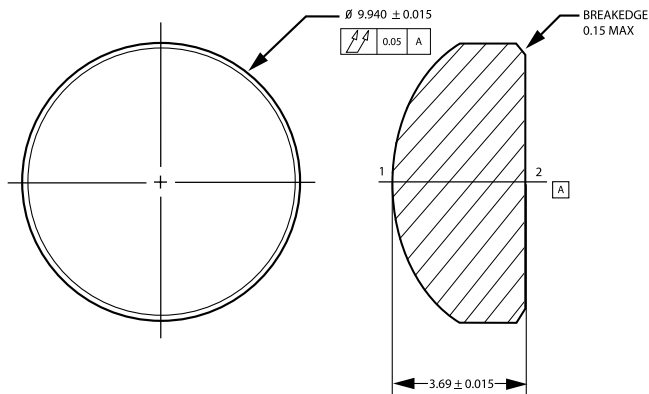
A-230 Collimator Lens - Glass



Optical Design Specifications

PARAMETER	
Focal Length	4.51 mm
Numerical Aperture (NA)	0.55
Back Focal Length	2.91 mm
Clear Aperture	S1 4.95 mm, S2 3.66 mm
Axial Wavefront Distortion	≤ .10 Waves (RMS) at 632.8nm
Window Thickness	0.250 mm (BK-7)
Center Thickness (CT)	2.940 mm
RoHS Compliant	YES
AR Coating Options	A Coating 400-600nm B Coating 600-1050nm C Coating 1050-1550nm

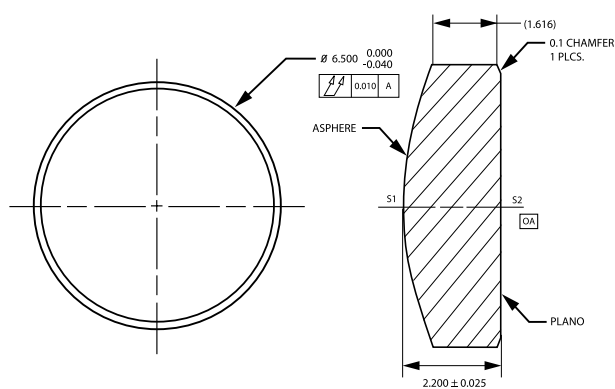
A-240 Collimator Lens - Glass



Optical Design Specifications

PARAMETER	
Focal Length	8.00 mm
Numerical Aperture (NA)	0.50
Back Focal Length	5.918 mm
Clear Aperture	S1 8.00 mm, S2 6.70 mm
Axial Wavefront Distortion	≤ .10 Waves (RMS) at 632.8nm
Window Thickness	0.250 mm (BK-7)
Center Thickness (CT)	3.690 mm
RoHS Compliant	YES
AR Coating Options	A Coating 400-600nm B Coating 600-1050nm C Coating 1050-1550nm

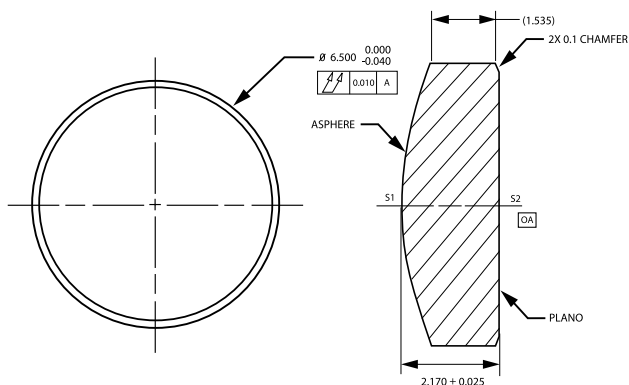
A-260 Collimator Lens - Glass



Optical Design Specifications

PARAMETER	
Focal Length	15.29 mm
Numerical Aperture (NA)	0.16
Back Focal Length	14.09 mm
Clear Aperture	S1 5.80 mm, S2 4.20 mm
Axial Wavefront Distortion	≤ .10 Waves (RMS) at 632.8nm
Window Thickness	0.25 mm (BK-7)
Center Thickness (CT)	2.200 mm
RoHS Compliant	YES
AR Coating Options	A Coating 400-600nm B Coating 600-1050nm C Coating 1050-1550nm

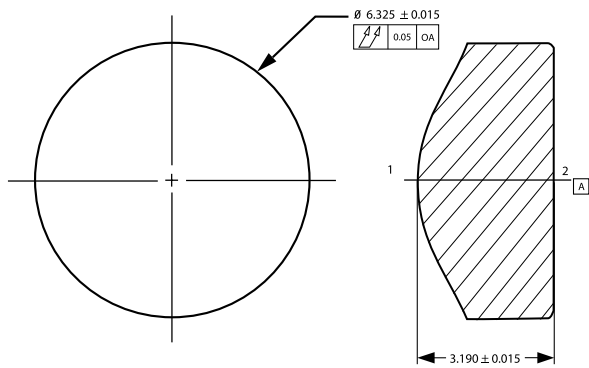
A-280 Collimator Lens - Glass



Optical Design Specifications

PARAMETER	
Focal Length	18.40 mm
Numerical Aperture (NA)	0.15
Back Focal Length	17.13 mm
Clear Aperture	S1 5.50 mm, S2 5.30 mm
Axial Wavefront Distortion	≤ .10 Waves (RMS) at 632.8nm
Window Thickness	0.25 mm (BK-7)
Center Thickness (CT)	2.170 mm
RoHS Compliant	YES
AR Coating Options	A Coating 400-600nm B Coating 600-1050nm C Coating 1050-1550nm

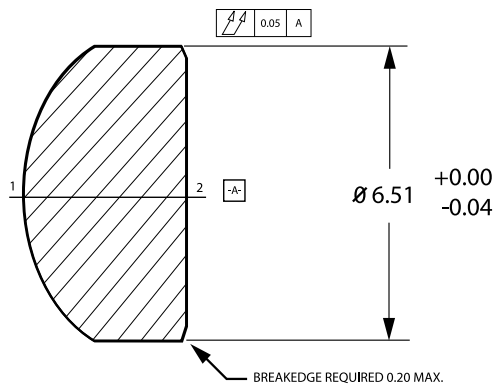
N-330 Collimator Lens - Glass



Optical Design Specifications

PARAMETER	
Focal Length	3.10 mm
Numerical Aperture (NA)	0.62
Back Focal Length	1.760 mm
Clear Aperture	S1 5.40 mm, S2 4.20 mm
Axial Wavefront Distortion	≤ .10 Waves (RMS) at 632.8nm
Window Thickness	NA
Center Thickness (CT)	3.190 mm
RoHS Compliant	YES
AR Coating Options	A Coating 400-600nm B Coating 600-1050nm C Coating 1050-1550nm

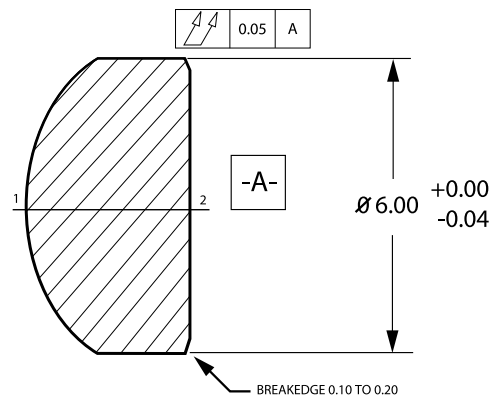
A-375 Collimator Lens - Glass



Optical Design Specifications

PARAMETER	
Focal Length	7.50 mm
Numerical Aperture (NA)	0.30
Back Focal Length	5.90 mm
Clear Aperture	S1 4.50 mm, S2 3.70 mm
Axial Wavefront Distortion	≤ .10 Waves (RMS) at 632.8nm
Window Thickness	0.275 mm (BK-7)
Center Thickness (CT)	2.75 mm
RoHS Compliant	YES
AR Coating Options	A Coating 400-600nm B Coating 600-1050nm C Coating 1050-1550nm

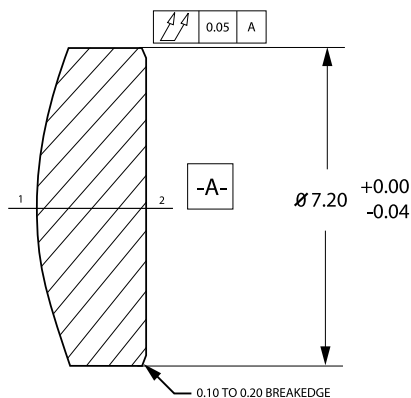
A-390 Collimator Lens - Glass



Optical Design Specifications

PARAMETER	
Focal Length	4.60 mm
Numerical Aperture (NA)	0.53
Back Focal Length	2.70 mm
Clear Aperture	S1 4.89 mm, S2 3.52 mm
Axial Wavefront Distortion	≤ .10 Waves (RMS) at 632.8nm
Window Thickness	0.275 mm (BK-7)
Center Thickness (CT)	3.102 mm
RoHS Compliant	YES
AR Coating Options	A Coating 400-600nm B Coating 600-1050nm C Coating 1050-1550nm

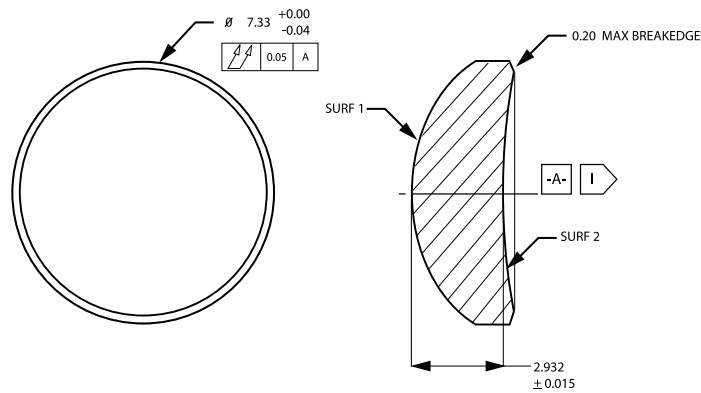
A-397 Collimator Lens - Glass



Optical Design Specifications

PARAMETER	
Focal Length	11.00 mm
Numerical Aperture (NA)	0.30
Back Focal Length	9.70 mm
Clear Aperture	S1 6.59 mm, S2 6.05 mm
Axial Wavefront Distortion	≤ .10 Waves (RMS) at 632.8nm
Window Thickness	0.275 mm (BK-7)
Center Thickness (CT)	2.200 mm
RoHS Compliant	YES
AR Coating Options	A Coating 400-600nm B Coating 600-1050nm C Coating 1050-1550nm

N-435 Collimator Lens - Glass

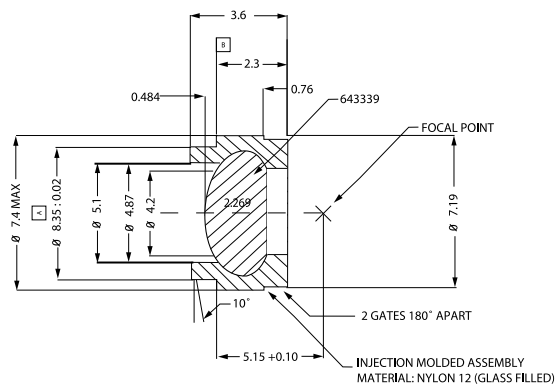


Optical Design Specifications

PARAMETER	
Focal Length	5.30 mm
Numerical Aperture (NA)	0.55
Back Focal Length	3.59 mm
Clear Aperture	S1 5.83 mm, S2 4.46 mm
Axial Wavefront Distortion	≤ .10 Waves (RMS) at 632.8nm
Window Thickness	0.275 mm (BK7)
Center Thickness (CT)	2.932 mm
RoHS Compliant	YES
AR Coating Options	A Coating 400-600nm B Coating 600-1050nm C Coating 1050-1550nm

Injection Mounted Assemblies

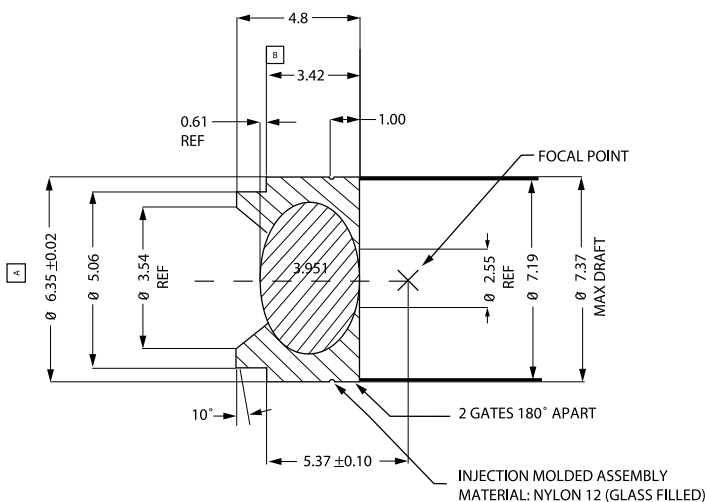
A-365 CD Objective Lens - Glass



Optical Design Specifications

PARAMETER	
Focal Length	4.59 mm
Numerical Aperture (NA)	0.94
Back Focal Length	3.718 mm
Clear Aperture	S1 4.89 mm, S2 3.95 mm
Axial Wavefront Distortion	≤ .10 Waves (RMS) at 632.8nm
Window Thickness	NA
Center Thickness (CT)	2.269 mm
RoHS Compliant	YES
AR Coating Options	A Coating 400-600nm B Coating 600-1050nm C Coating 1050-1550nm

N-414 Collimator Lens - Glass



Optical Design Specifications

PARAMETER	
Focal Length	3.30 mm
Numerical Aperture (NA)	0.51
Back Focal Length	2.00 mm
Clear Aperture	S1 3.52 mm, S2 2.54 mm
Axial Wavefront Distortion	≤ .10 Waves (RMS) at 632.8nm
Window Thickness	0.250 mm (BK-7)
Center Thickness (CT)	3.868 mm
RoHS Compliant	YES
AR Coating Options	A Coating 400-600nm B Coating 600-1050nm C Coating 1050-1550nm

Short Wavelength Visible Lenses

A-610 Collimator Lens - Glass	Optical Design Specifications	
	PARAMETER	
	Focal Length	4.00 mm
	Numerical Aperture (NA)	0.60
	Back Focal Length	2.73 mm
	Clear Aperture	S1 4.80 mm, S2 3.43 mm
	Axial Wavefront Distortion	≤ .10 Waves (RMS) at 632.8nm
	Window Thickness	1.20 mm (K-3)
	Center Thickness (CT)	3.040 mm
	RoHS Compliant	YES
	AR Coating Options	A Coating 400-600nm B Coating 600-1050nm C Coating 1050-1550nm

A-635 Collimator Lens - Glass	Optical Design Specifications	
	PARAMETER	
	Focal Length	4.50 mm
	Numerical Aperture (NA)	0.311
	Back Focal Length	3.536 mm
	Clear Aperture	S1 2.80 mm, S2 2.50 mm
	Axial Wavefront Distortion	≤ .10 Waves (RMS) at 632.8nm
	Window Thickness	0.275 mm (BK-7)
	Center Thickness (CT)	1.500 mm
	RoHS Compliant	YES
	AR Coating Options	A Coating 400-600nm B Coating 600-1050nm C Coating 1050-1550nm

A-658 Collimator Lens - Glass	Optical Design Specifications	
	PARAMETER	
	Focal Length	2.59 mm
	Numerical Aperture (NA)	0.60
	Back Focal Length	1.19 mm
	Clear Aperture	S1 3.12 mm, S2 1.90 mm
	Axial Wavefront Distortion	≤ .10 Waves (RMS) at 632.8nm
	Window Thickness	NA
	Center Thickness (CT)	3.056 mm
	RoHS Compliant	YES
	AR Coating Options	A Coating 400-600nm B Coating 600-1050nm C Coating 1050-1550nm

A-671 Collimator Lens - Glass	Optical Design Specifications	
	PARAMETER	
	Focal Length	4.02 mm
	Numerical Aperture (NA)	0.60
	Back Focal Length	2.40 mm
	Clear Aperture	S1 4.85 mm, S2 3.43 mm
	Axial Wavefront Distortion	≤ .10 Waves (RMS) at 632.8nm
	Window Thickness	0.250 mm (Borosilicate)
	Center Thickness (CT)	2.995 mm
	RoHS Compliant	YES
	AR Coating Options	A Coating 400-600nm B Coating 600-1050nm C Coating 1050-1550nm

IR Optics

The expertise of Rochester Precision Optics molding technology coupled with the demand for low cost IR optics germanium has created a requisite for use of the chalcogenide glasses. Chalcogenide materials can be altered and provide optical and systems designers more options than historic IR material offerings without compromise. Rochester Precision Optics are experts at using conventional grinding and polishing techniques, single point diamond turning or molding to support high-volume manufacturing.

- **Cycle time:** shorter ramp times to achieve required temperatures
- **Tooling lifetimes:** “softer” glass can cause less wear and tear on surface of optical inserts
- **Tooling choices:** more potential materials for optical inserts (cheaper, easier to machine, more readily available) and molding technology allows for higher volumes with a lower cost advantage

Single Point Diamond Turning (SPDT)

RPO have extensive experience and equipment for diamond turning and deterministic grinding of any materials. This expertise is offered as build-to-print services and provides prototypes to high-volume production. Our diamond turning facility is staffed with toolmakers with 15+ years of experience in diamond turning and optical tool surface generation.

- 10 multi axis diamond machine centers
 - Infrared optics
 - Carbides
 - Polymers
 - Non-ferrous materials
- Machine feedback resolution: 8 nanometers
- Machining ability: diamond turning, diamond grinding, diamond flycutting
- Shapes: rotational and non-rotationally symmetric surfaces, aspheres, cylinders, acylinders, array patterns
- Form accuracy capability: $\frac{1}{4} \lambda$ to $\frac{1}{2} \lambda$
- Surface finishes: 10 – 40 Å RMS
- Profilometric and interferometric measurement capabilities





Low cost simple
or complex aspheric
surfaces

Molded Plastic Optics

- 1mm to 150mm in diameter
- Precision and Ultra Precision Tolerances for spherical and aspheric lenses 10mm to 25mm in diameter
- Wide variety of materials including:
 - Polycarbonate
 - Cyclic Olefin Polymer - Includes Zeonex and Zeonor
 - Cyclic Olefin Co-polymer - Trade name Topas
 - Polystyrene
 - Acrylic
 - Optical Polyesters like OKP4
- Rapid prototypes, precision diamond turned and molded
- Advanced automation and inspection
- 3D measuring of aspheric optical surfaces
- Freeform, diffractive, Fresnel lens and lens array optics available
- 24/7 attended operation with other machines running lights out for low cost
- Laser etched barcoding below 2mm x 2mm to improve traceability

Freeform and aspheric plastic optics offer significant cost, weight and assembly advantages. Our fully integrated plastic optics division has the expertise and equipment to meet high volume, tight tolerance demands.

Optical Components Utilizing CNC Optical Manufacturing

For optical lenses, RPO provides a broad range of excellence in traditional optics utilizing state of the art high speed Computer-Numerically Controlled (CNC) equipment to perform lens grinding, polishing and centering. From prototypes to high volume, your optics are produced with utmost accuracy, precise performance, and unsurpassed quality control. A large selection of glass types are in stock for rapid prototyping at affordable prices.

Precision Machining

Our in-house machine shop is equipped with extensive CNC capabilities to support our ability to make high precision components. We are highly experienced in the manufacturing of optical lens barrels, eye pieces, retainers, lens cells spacers; optical test fixtures, mounts and lens tooling. We strive to always make our parts error free and delivered on time.

Thin Film Coatings

RPO offers a wide range of standard, durable, single-layer, broadband and dual band antireflection coatings. In addition, we will custom design and implement high-efficiency antireflection coatings (HEAR), beamsplitter, balance filters, short and long wave pass filters, and metal and dichroic mirrors for use in the UV, VIS and SWIR regions on a variety of substrates. We also provide coating process development, optical and non-optical materials research.



Looking for a custom lens?

Early involvement with our engineering team can ensure you achieve cost and performance needs.



Expert Engineering at Every Step

Design, Prototype, Production

Expert level personnel at every step:

- Optical and mechanical designers and engineers
- Engineering and lab technicians
- Material scientists and embedded software developers

Collaborate in the software you use:

- ZEMAX, Code V, LightTools
- SolidWorks, CAD
- MSC Marc Mentat, Nastran
- MATLAB, Mathematica

Fully integrated from design to fabrication and assembly

- Molded glass and polymer aspheric optics
- IR molded and diamond turned aspheric optics
- Lens assemblies
- Electro-optical systems
- CNC optics manufacturing
- Precision machine shop
- Advanced in-line metrology and QC

Discovery Service

Don't know where to start? Problem solved.

\$2950 / 20 hours Discovery Service

- Lens design troubleshooting
- Optical engineering
- Manufacturability

rpoptics.com/discovery

Rochester Precision Optics
CNOD System





Rochester Precision Optics

Rochester Precision Optics

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