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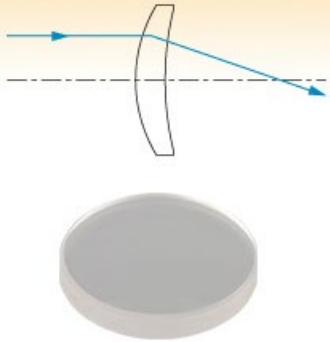
LE5414-E - August 14, 2024

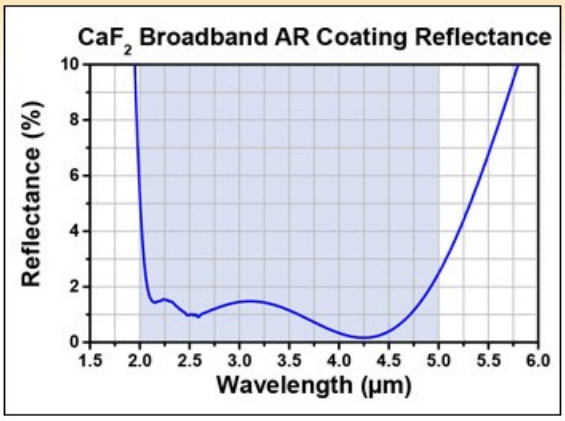
Item # LE5414-E was discontinued on August 14, 2024. For informational purposes, this is a copy of the website content at that time and is valid only for the stated product.

- **AR Coating Optimized for the 2 - 5 µm Range**
- **Choose from Ø1/2" or Ø1"**

LE5801-E
(Ø1")



LE5243-E
(Ø1/2")



OVERVIEW

Features

- Vacuum-Grade Calcium Fluoride Substrate
- Ø1/2" and Ø1" Versions Available
- Broadband AR Coating for the 2 - 5 µm Range
- Focal Lengths from 20.0 mm to 1000.0 mm

Zemax Files
Click on the red Document icon next to the item numbers below to access the Zemax file download. Our entire Zemax Catalog is also available.

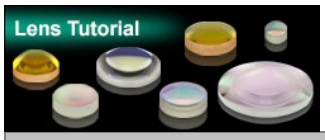
Thorlabs' Ø1/2" and Ø1" Calcium Fluoride (CaF_2) Positive Meniscus Lenses are available with a broadband AR coating optimized for the 2 µm to 5 µm spectral range deposited on both surfaces. This coating greatly reduces the surface reflectivity of the substrate, yielding high transmission and minimal absorption over the entire AR coating range. See the *Graphs* tab for detailed information. Uncoated versions are also available.

CaF_2 is commonly used for applications requiring high transmission in the infrared and ultraviolet spectral ranges. The material exhibits a low refractive index, varying from 1.35 to 1.51 within its usage range of 180 nm to 8.0 µm. Calcium fluoride is also fairly chemically inert and offers superior hardness compared to its barium fluoride, magnesium fluoride, and lithium fluoride cousins.

Positive meniscus (convex-concave) lenses, which are thicker in the middle than at the edges and cause light rays to converge, are designed to minimize third-order spherical aberration. When used to focus a collimated beam, the convex side of the lens should face the source to minimze spherical aberration. They are often used in conjunction with other lenses to decrease the focal length, and therefore increase the numerical aperture (NA), of an optical assembly. Since a positive meniscus lens has a greater radius of curvature on the concave side of the lens than on the convex side, real images can be formed.

Common Specifications	
Substrate Material	Vacuum-Grade Calcium Fluoride[a]
AR Coating Range	2 - 5 µm
Reflectance over Coating Range (Avg.)	<1.25%
Diameters Available	1/2" or 1"
Diameter Tolerance	+0.00/-0.10
Thickness Tolerance	±0.1 mm
Focal Length Tolerance	±2%
Surface Quality	40-20 (Scratch-Dig)
Spherical Surface Power[b]	3λ/2
Spherical Surface Irregularity (Peak to Valley)	λ/2
Centration	<3 arcmin
Clear Aperture	>90% of Diameter
Design Wavelength	4 µm

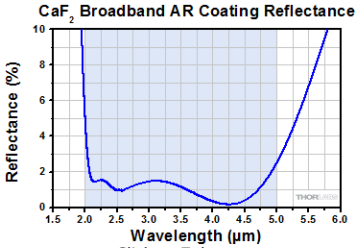
- Click Link for Detailed Specifications on the Substrate
- Much like surface flatness for flat optics, spherical surface power is a measure of the deviation between the surface of the curved optic and a calibrated reference gauge, typically for a 633 nm source, unless otherwise stated. This specification is also commonly referred to as surface fit.



Selection Guide		
Calcium Fluoride Lenses More [+]	Other MIR Lenses More [+]	Other Spherical Singlets More [+]

GRAPHS

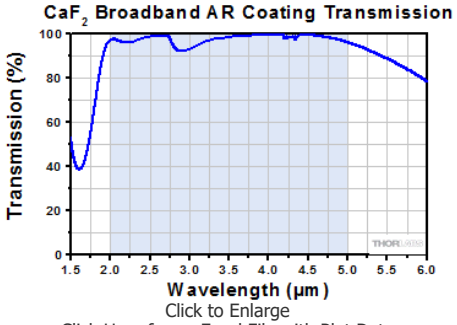
2 - 5 µm AR Coating Graphs



Click to Enlarge

Click Here for an Excel File with Plot Data

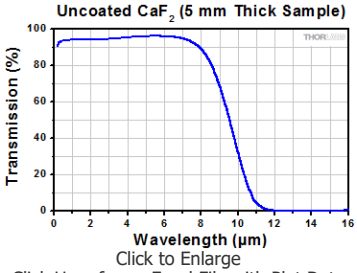
Shown above is a graph of the measured percent reflectance of the enhanced AR coating as a function of wavelength. The average reflectance in the 2 - 5 µm range is <1.25%. The blue shading indicates the region for which the AR coating is optmized. Performance outside of the specified range is not guaranteed and varies from lot to lot. The excel file above provides the coating curve data over an extended wavelength range.



Click to Enlarge

Click Here for an Excel File with Plot Data

Shown above is a graph of the measured percent transmission of the enhanced AR coating as a function of wavelength. The blue shading indicates the region for which the AR coating is optmized. Performance outside of the specified range is not guaranteed and varies from lot to lot. The excel file above provides the coating curve data over an extended wavelength range.



Click to Enlarge

Click Here for an Excel File with Plot Data

Shown above is a graph of the measured transmission of an uncoated, 5 mm thick sample of CaF_2.

Total Transmission of Optic (CaF_2 Substrate, Uncoated)

The table below gives the approximate theoretical transmission of these uncoated optics for a few select wavelengths in the 0.18 - 8.0 µm range. To see an excel file that lists all measured transmission values for this wavelength range, please click here.

Wavelength (µm)	Total Transmission	Wavelength (µm)	Total Transmission	Wavelength (µm)	Total Transmission	Wavelength (µm)	Total Transmission
0.2	0.910	2.2	0.939	4.2	0.943	6.2	0.947
0.4	0.929	2.4	0.939	4.4	0.943	6.4	0.947
0.6	0.935	2.6	0.940	4.6	0.943	6.6	0.948
0.8	0.937	2.8	0.940	4.8	0.944	6.8	0.949
1.0	0.938	3.0	0.940	5.0	0.945	7.0	0.949

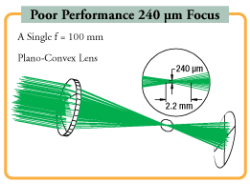
1.2	0.938	3.2	0.941	5.2	0.945	7.2	0.948
1.4	0.938	3.4	0.941	5.4	0.945	7.4	0.947
1.6	0.938	3.6	0.941	5.6	0.946	7.6	0.946
1.8	0.939	3.8	0.942	5.8	0.946	7.8	0.945
2.0	0.939	4.0	0.942	6.0	0.947	8.0	0.944

USE INFO

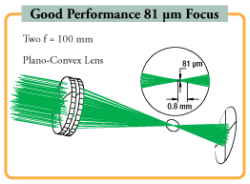
Using Positive Meniscus Lenses

- Achieve Tighter Focusing by Combining a Meniscus Lens with Plano-Convex Lenses
- Build Multi-Element Lens Systems to Achieve Higher NA without Significant Increases in Aberrations

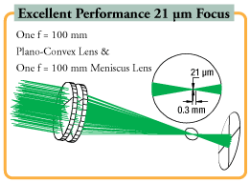
Positive meniscus lenses are designed to minimize spherical aberration. They have one convex and one concave surface. When used in combination with another lens, a positive meniscus lens will shorten the focal length and increase the NA of the system. Figure 1c shows a meniscus lens being used to shorten the focal length of a 100 mm focal length plano-convex lens. In addition, the transverse and lateral aberrations are greatly reduced. The convex surface of both lenses should be facing away from the image.



Click to Enlarge
Figure 1a



Click to Enlarge
Figure 1b



Click to Enlarge
Figure 1c

Figure 1. These figures illustrate the performance gains that can be achieved by using multi-element imaging systems. The combination of a meniscus lens and a plano-convex lens yields a 21 µm focused spot versus a 240 µm spot from the single plano-convex lens.

FOCAL LENGTH SHIFT

Wavelength-Dependent Focal Length Shift

The paraxial focal length of a lens is wavelength dependent. The focal length listed below for a given lens corresponds to the value at the design wavelength (i.e., the focal length at 4 µm). Since CaF_2 offers high transmission from 0.18 - 8.0 µm, users may wish to use these lenses at other popular wavelengths. Click on the icons below to view theoretically-calculated focal length shifts for wavelengths within the 0.18 - 8.0 µm range.

The blue shading indicates the region for which the AR coating is optimized. Please see the *Graphs* tab for more information.

Ø1/2" Positive Meniscus Lenses

Item #	LE5838-E	LE5243-E	LE5234-E
Focal Length @ 4 µm	20.0 mm	50.0 mm	80.0 mm
Focal Length Shift (Click for Details)			
Raw Data (Click to Download)	Data	Data	Data

Ø1" Positive Meniscus Lenses

Item #	LE5183-E	LE5801-E	LE5802-E	LE5803-E	LE5382-E	LE5414-E	LE5990-E	LE5656-E	LE5714-E
Focal Length @ 4 µm	40.0 mm	50.0 mm	75.0 mm	100.0 mm	150.0 mm	200.0 mm	500.0 mm	750.0 mm	1000.0 mm
Focal Length Shift (Click for Details)									
Raw Data (Click to Download)	Data	Data	Data	Data	Data	Data	Data	Data	Data

MOUNTING OPTIONS

Click to Enlarge
LMR1 Fixed Mount with
Ø1" Lens

Click to Enlarge
CXY1A Translation Mount
and
SM1 Lens Tube Mounted
in a
30 mm Cage System

Click to Enlarge
LM2XY Translating Mount
with Ø2" Lens

Click to Enlarge
Ø1" Optic Mounted in a
ST1XY-S XY Translator

Recommended Mounting Options for Thorlabs Lenses		
Item #		**Mounts for Ø2 mm to Ø10 mm Optics**
Imperial	**Metric**	
(Various)		Fixed Lens Mounts and Mini-Series Fixed Lens Mounts for Small Optics, Ø5 mm to Ø10 mm
(Various)		Small Optic Adapters for Use with Standard Fixed Lens Mounts, Ø2 mm to Ø10 mm
Item #		**Mounts for Ø1/2" (Ø12.7 mm) Optics**
Imperial	**Metric**	
LMR05	LMR05/M	Fixed Lens Mount for Ø1/2" Optics
MLH05	MLH05/M	Mini-Series Fixed Lens Mount for Ø1/2" Optics
LM05XY	LM05XY/M	Translating Lens Mount for Ø1/2" Optics
SCP05		16 mm Cage System, XY Translation Mount for Ø1/2" Optics
(Various)		Ø1/2" Lens Tubes, Optional SM05RRC Retaining Ring for High-Curvature Lenses (See Below)
Item #		**Mounts for Ø1" (Ø25.4 mm) Optics**
Imperial	**Metric**	
LMR1	LMR1/M	Fixed Lens Mount for Ø1" Optics
LM1XY	LM1XY/M	Translating Lens Mount for Ø1" Optics
ST1XY-S	ST1XY-S/M	Translating Lens Mount with Micrometer Drives (Other Drives Available)
CXY1A		30 mm Cage System, XY Translation Mount for Ø1" Optics
(Various)		Ø1" Lens Tubes, Optional SM1RRC Retaining Ring for High-Curvature Lenses (See Below)
Item #		**Mount for Ø1.5" Optics**
Imperial	**Metric**	
LMR1.5	LMR1.5/M	Fixed Lens Mount for Ø1.5" Optics
(Various)		Ø1.5" Lens Tubes, Optional SM1.5RR Retaining Ring for Ø1.5" Lens Tubes and Mounts
Item #		**Mounts for Ø2" (Ø50.8 mm) Optics**
Imperial	**Metric**	
LMR2	LMR2/M	Fixed Lens Mount for Ø2" Optics
LM2XY	LM2XY/M	Translating Lens Mount for Ø2" Optics
CXY2		60 mm Cage System, XY Translation Mount for Ø2" Optics
(Various)		Ø2" Lens Tubes, Optional SM2RRC Retaining Ring for High-Curvature Lenses (See Below)
Item #		**Adjustable Optic Mounts**
Imperial	**Metric**	

LH1	LH1/M	Adjustable Mount for Ø0.28" (Ø7.1 mm) to Ø1.80" (Ø45.7 mm) Optics
LH2	LH2/M	Adjustable Mount for Ø0.77" (Ø19.6 mm) to Ø2.28" (Ø57.9 mm) Optics
VG100	VG100/M	Adjustable Clamp for Ø0.5" (Ø13 mm) to Ø3.5" (Ø89 mm) Optics
SCL03	SCL03/M	Self-Centering Mount for Ø0.15" (Ø3.8 mm) to Ø1.77" (Ø45.0 mm) Optics
SCL04	SCL04/M	Self-Centering Mount for Ø0.15" (Ø3.8 mm) to Ø3.00" (Ø76.2 mm) Optics
LH160C	LH160C/M	Adjustable Mount for 60 mm Cage Systems, Ø0.50" (Ø13 mm) to Ø2.00" (Ø50.8 mm) Optics
SCL60CA	SCL60C/M	Self-Centering Mount for 60 mm Cage Systems, Ø0.15" (Ø3.8 mm) to Ø1.77" (Ø45.0 mm) Optics

Mounting High-Curvature Optics

Thorlabs' retaining rings are used to secure unmounted optics within lens tubes or optic mounts. These rings are secured in position using a compatible spanner wrench. For flat or low-curvature optics, standard retaining rings manufactured from anodized aluminum are available from Ø5 mm to Ø4". For high-curvature optics, extra-thick retaining rings are available in Ø1/2", Ø1", and Ø2" sizes.

Extra-thick retaining rings offer several features that aid in mounting high-curvature optics such as aspheric lenses, short-focal-length plano-convex lenses, and condenser lenses. As shown in the animation to the right, the guide flange of the spanner wrench will collide with the surface of high-curvature lenses when using a standard retaining ring, potentially scratching the optic. This contact also creates a gap between the spanner wrench and retaining ring, preventing the ring from tightening correctly. Extra-thick retaining rings provide the necessary clearance for the spanner wrench to secure the lens without coming into contact with the optic surface.

Ø1/2" CaF_2 Positive Meniscus Lenses, AR Coated: 2 - 5 µm

Item #	Diameter	Focal Length	Diopter[a]	Radius of Curvature 1	Radius of Curvature 2	Center Thickness	Edge Thickness[b]	Back Focal Length[c]	Reference Drawing
LE5838-E	1/2" (12.7 mm)	20.0 mm	+50.0	7.5 mm	72.4 mm	4.7 mm	1.5 mm	16.3 mm	
LE5243-E	1/2" (12.7 mm)	50.0 mm	+20.0	15.0 mm	52.8 mm	3.0 mm	2.0 mm	47.1 mm	
LE5234-E	1/2" (12.7 mm)	80.0 mm	+12.5	20.0 mm	49.1 mm	3.0 mm	2.4 mm	76.5 mm	

Suggested Fixed Lens Mount: LMR05(/M)

a. Reciprocal of the Focal Length in Meters
b. Edge Thickness Given Before 0.2 mm at 45° Typical
c. Chamfer Measured at the Design Wavelength, 4 µm

Part Number	Description	Price	Availability
LE5838-E	Ø1/2" CaF_2 Positive Meniscus Lens, f = 20.0 mm, AR-Coated: 2 - 5 µm	$339.74	Today
LE5243-E	Ø1/2" CaF_2 Positive Meniscus Lens, f = 50.0 mm, AR-Coated: 2 - 5 µm	$339.74	Today
LE5234-E	Ø1/2" CaF_2 Positive Meniscus Lens, f = 80.0 mm, AR-Coated: 2 - 5 µm	$339.74	Today

Ø1" CaF_2 Positive Meniscus Lenses, AR Coated: 2 - 5 µm

Item #	Diameter	Focal Length	Diopter[a]	Radius of Curvature 1	Radius of Curvature 2	Center Thickness	Edge Thickness[b]	Back Focal Length[c]	Reference Drawing
LE5183-E	1" (25.4 mm)	40.0 mm	+25.0	15.0 mm	146.9 mm	8.9 mm	2.4 mm	33.1 mm	
LE5801-E	1" (25.4 mm)	50.0 mm	+20.0	15.5 mm	55.2 mm	7.1 mm	2.0 mm	43.3 mm	
LE5802-E	1" (25.4 mm)	75.0 mm	+13.3	15.5 mm	28.0 mm	5.6 mm	2.0 mm	67.2 mm	
LE5803-E	1" (25.4 mm)	100.0 mm	+10.0	20.0 mm	36.8 mm	4.0 mm	1.7 mm	94.1 mm	
LE5382-E	1" (25.4 mm)	150.0 mm	+6.7	35.0 mm	78.6 mm	4.0 mm	2.6 mm	145.0 mm	
LE5414-E	1" (25.4 mm)	200.0 mm	+5.0	40.0 mm	75.9 mm	4.0 mm	3.0 mm	194.2 mm	
LE5990-E	1" (25.4 mm)	500.0 mm	+2.0	125.0 mm	317.8 mm	4.0 mm	3.6 mm	495.4 mm	
LE5656-E	1" (25.4 mm)	750.0 mm	+1.3	150.0 mm	290.8 mm	4.0 mm	3.7 mm	744.2 mm	
LE5714-E	1" (25.4 mm)	1000.0 mm	+1.0	250.0 mm	638.5 mm	4.0 mm	3.8 mm	995.4 mm	

Suggested Fixed Lens Mount: LMR1(/M)

a. Reciprocal of the Focal Length in Meters
b. Edge Thickness Given Before 0.2 mm at 45° Typical
c. Chamfer Measured at the Design Wavelength, 4 µm

Part Number	Description	Price	Availability
LE5183-E	Ø1" CaF_2 Positive Meniscus Lens, f = 40.0 mm, AR-Coated: 2 - 5 µm	$424.09	Today
LE5801-E	Ø1" CaF_2 Positive Meniscus Lens, f = 50.0 mm, AR-Coated: 2 - 5 µm	$424.09	Today
LE5802-E	Ø1" CaF_2 Positive Meniscus Lens, f = 75.0 mm, AR-Coated: 2 - 5 µm	$424.09	Today
LE5803-E	Ø1" CaF_2 Positive Meniscus Lens, f = 100.0 mm, AR-Coated: 2 - 5 µm	$424.09	Today
LE5382-E	Ø1" CaF_2 Positive Meniscus Lens, f = 150.0 mm, AR-Coated: 2 - 5 µm	$424.09	Today
LE5414-E	Ø1" CaF_2 Positive Meniscus Lens, f = 200.0 mm, AR-Coated: 2 - 5 µm	$424.09	Today
LE5990-E	Ø1" CaF_2 Positive Meniscus Lens, f = 500.0 mm, AR-Coated: 2 - 5 µm	$424.09	Today
LE5656-E	Ø1" CaF_2 Positive Meniscus Lens, f = 750.0 mm, AR-Coated: 2 - 5 µm	$424.09	Today
LE5714-E	Ø1" CaF_2 Positive Meniscus Lens, f = 1000.0 mm, AR-Coated: 2 - 5 µm	$424.09	Today