These pages describe our infrared lenses (we also offer infrared windows on page 12-5). We list a select number of sizes and focal lengths in each material, but welcome custom orders. If you don't see what you're looking for, on these pages, contact a Sales Engineer with your specifications.

INFRARED MATERIALS

We offer lenses made from the following materials:

Sapphire
- Transmissive from 150 nm to 5 µm
- Extremely hard and durable material

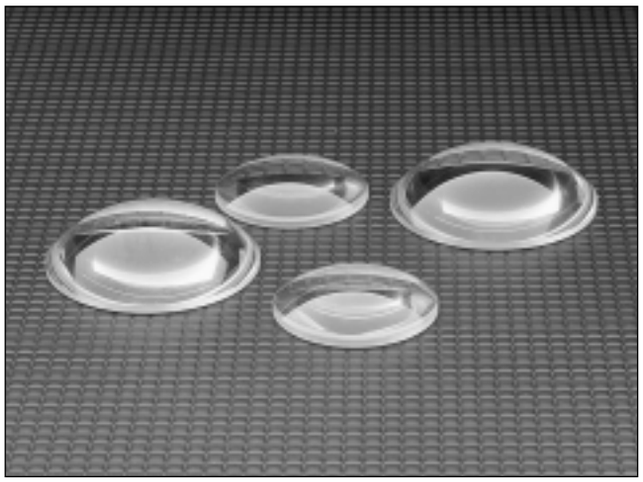
Calcium Fluoride (CaF_2)
- Transmissive from 150 nm to 8 µm
- High average transmittance, uncoated

Zinc Selenide (ZnSe)
- Transmissive from 550 nm to 16 µm
- High thermal conductivity, ideal for CO_2 lasers

Germanium (Ge)
- Transmissive from 2 to 20 µm
- Less expensive than ZnSe

AMTIR-1
- Transmissive from 800 nm to 16 µm
- Low cost material

SAPPHIRE LENSES



Various Infrared Lenses.

- **UV to NIR transmittance**
- **Extremely hard and durable**

These lenses are suitable for high power, high pressure applications, and vacuum or corrosive atmospheres. Sapphire is a single crystal form of alumina, Al_2O_3. The material is extremely hard and resistant to attack by strong acids. It has high compressive strength, a high melting point, and excellent thermal conductivity.

FOR TRANSMITTANCE DATA...

See page 15-9 for a transmittance curve of a 3 mm thick Sapphire substrate.

SPECIFICATIONS

Diameter tolerance:	+0 mm; -0.25 mm
Edge/center thickness tolerance:	±0.25 mm
Edge finish:	Fine ground, beveled
Clear aperture diameter:	95% of central diameter
Focal length tolerance:	±2%
Back focal length tolerance:	±2%
Index of refraction:	1.768 @ 589 nm (n_o) 1.760 @ 589 nm (n_e)
Hardness (Knoop):	1370 kg m^{-2}
Young's modulus:	3.4 x 10^{11} N m^{-2}
Melting point:	2053 °C
Thermal conductivity:	22 W m^{-1} K^{-1}
Surface quality:	60 - 40
Centration:	3 arc min (9 mrad)

ORDERING INFORMATION

Dia. Inch (mm)	Nom. f @5.0 µm (mm)	Nom. BFL @5.0 µm (mm)	F/#	Ctr. Thk. (mm)	Edge Thk. (mm)	Model No.	Price
Plano Convex Lenses							
0.25 (6.35)	6.35	5.1	1	2.2	1.0	**43030**	
	12.7	11.8	2	1.6	1.0	**43032**	
	25.4	24.7	4	1.2	1.0	**43035**	
0.5 (12.7)	10	7.4	0.8	4.5	1.2	**43038**	
	20	18.6	1.7	2.5	1.2	**43040**	
	50	49	3.9	1.8	1.2	**43042**	
	100	99.1	7.9	1.5	1.2	**43045**	
1.0 (25.4)	25.4	21.9	1	6.2	1.5	**43048**	
	50	47.2	2	3.0	1.5	**43050**	
	100	98.6	3.9	2.5	1.5	**43052**	
Plano Concave Lenses							
0.25 (6.35)	-6.35	-6.9	-1	1.0	2.0	**43055**	
	-12.7	-13.3	-2	1.0	1.5	**43058**	
	-25.4	-26	-4	1.0	1.2	**43060**	
0.5 (12.7)	-10	-10.6	-0.8	1.0	4.0	**43062**	
	-20	-20.6	-1.7	1.0	2.2	**43065**	
	-50	-50.6	-3.9	1.0	1.8	**43068**	
	-100	-100.6	-7.9	1.0	1.5	**43070**	
1.0 (25.4)	-25.4	-26	-1	1.0	5.5	**43072**	
	-50	-50.6	-2	1.0	3.5	**43075**	
	-100	-100.6	-3.9	1.0	2.0	**43078**	

CALCIUM FLUORIDE LENSES

- **Broad spectral range, UV to NIR**
- **Very little chromatic aberration**

These plano convex lenses transmit over a broad spectral range, and have low dispersion, resulting in little chromatic aberration. They do not need to be anti-reflection coated, as average transmittance is ~93%.

CaF_2 is an isotropic crystalline material which is very slightly soluble in water (0.0016 gm/100 gm H_2O at 18 °C). It is also slightly sensitive to thermal and mechanical shock.

FOR TRANSMITTANCE DATA ...

See page 15-8 for a transmittance curve of a 3 mm thick Calcium Fluoride substrate.

SPECIFICATIONS

Diameter tolerance:	+0 mm; -0.13 mm
Edge/center thickness tolerance:	±0.25 mm
Edge finish:	Fine ground, beveled
Focal length tolerance:	±1%
Back focal length tolerance:	±1%
Index of refraction:	
At 200 nm:	1.50
At 500 nm:	1.43
At 5.0 µm:	1.40
Hardness (Knoop):	158.3 kg mm^{-2}
Young's modulus:	7.6 x 10^{10} N m^{-2}
Surface quality:	40 - 20
Centration:	3 arc min (0.9 mrad)

ORDERING INFORMATION

Dia. Inch (mm)	Nom. f @5.0 µm (mm)	Nom. BFL @5.0 µm (mm)	F/#	Ctr. Thk. (mm)	Edge Thk. (mm)	Model No.	Price
1.0 (25.4)	50	45.27	2	6.3	2.0	**43150**	
	100	96.92	4	4.1	2.0	**43160**	
	500	498.20	20	2.4	2.0	**43190**	
1.5 (38.1)	75	68.26	2	8.9	2.0	**43220**	
	150	146.77	4	4.3	2.0	**43240**	

ZINC SELENIDE LENSES

- **Visible to Mid IR transmittance**
- **Durable material, high thermal conductivity**

ZnSe lenses are widely used for CO_2 lasers; they have a very low absorption coefficient, 5 x 10^{-4} cm^{-1}, at 10.6 µm. We also use them to focus the collimated beams from the SiC and other IR sources on page 1-144. Because of the good visible transmittance, alignment of IR beams is simplified; use a HeNe laser to mark the path.

We offer plano convex and negative meniscus lenses. The meniscus lenses are those used in our Laser Beam Expanders (page 9-48).

Because of the high (2.403 @ 10.6 µm) index of refraction, the reflection losses are 17% per surface at 10.6 µm. The meniscus lenses are anti-reflection coated on both sides for the 9 to 11 µm region. On special request, we can coat the plano convex lenses.

FOR TRANSMITTANCE DATA ...

See page 15-8 for a transmittance curve of a 3 mm thick Zinc Selenide substrate.

SPECIFICATIONS

Diameter tolerance:	+0 mm; -0.25 mm
Edge/center thickness tolerance:	±0.25 mm
Edge finish:	Fine ground, beveled
Focal length tolerance:	±1%
Back focal length tolerance:	±1%
Index of refraction:	
At 550 nm:	2.675
At 5.0 µm:	2.430
At 10.6 µm:	2.403
Hardness (Knoop):	120 kg mm^{-2}
Young's modulus:	6.7 x 10^{10} N m^{-2}
Surface quality:	40 - 20
Centration:	3 arc min (9 mrad)

ORDERING INFORMATION

Dia. Inch (mm)	Nom. f @5.0 µm (mm)	Nom. BFL @5.0 µm (mm)	F/#	Ctr. Thk. (mm)	Edge Thk. (mm)	Model No.	Price
Plano Convex Lenses							
1.5 (38.1)	33	30.52	8.7	6	1.98	**43433**	
	66	64.35	1.7	4	2.06	**43432**	
Negative Meniscus Lenses							
0.37 (9.5)	-11.8	-12.1	-1.2	1.16	2.4	**16070**	
0.5 (12.7)	-16.5	-17.5	-1.3	1.5	2.5	**16072**	
0.75 (19.1)	-32.4	-33.4	-1.3	1.4	2.4	**16075**	

GERMANIUM LENSES

- **Near to Mid IR transmittance**
- **Broadband and narrowband Anti-reflection coatings available**

If you only need infrared transmittance, Germanium is a more economical alternative to ZnSe. These lenses transmit from 2 to 20 µm. Germanium is opaque in the visible; you will need an Infrared Viewer (page 1-148) or card (page 1-149) to align IR beams.

Germanium has a very high index of refraction, 4.063@2.5 µm, and therefore has high surface reflections, ~36%. We offer the lenses uncoated, but can coat them with a broadband or narrowband anti-reflection coating on both sides. The coatings are described on page 14-6.

FOR TRANSMITTANCE DATA ...

See page 15-9 for a transmittance curve of a Germanium substrate

SPECIFICATIONS

Diameter:	1.5 inch (38 mm)
Index of refraction:	
At 2.5 µm:	4.063
At 2.6 µm:	4.059
At 3.0 µm:	4.042
At 5.2 µm:	4.014
At 8.2 µm:	4.005
At 12.4 µm:	4.002

ORDERING INFORMATION

Dia inch (mm)	Nom f @ 5.0 µm (mm)	Nom BFL @ 5.0 µm (mm)	F/#	Ctr. Thk. (mm)	Edge Thk. (mm)	Model No.	Price
1.5 (38.1)	33	32	F/0.87	4	2.16	**43431**	
	66	65	F/1.7	4	3.08	**43430**	

AMTIR-1 LENSES

- **800 nm to 16 µm transmittance range**
- **Low cost lenses**

These are our most economical infrared lenses. They are manufactured from AMTIR-1, a synthetic material transmissive in the near to mid infrared. Transmittance is 70% over the entire range. You can reduce reflection losses with an anti-reflection coating from page 14-6.

FOR TRANSMITTANCE DATA ...

See page 15-9 for a transmittance curve of a 10 mm thick AMTIR-1 substrate.

SPECIFICATIONS

Diameter:	1.0 inch (25.4 mm)
Index of refraction:	
At 1.0 µm:	2.6055
At 2.0 µm:	2.5310
At 5.0 µm:	2.5112
At 10.0 µm:	2.4977
At 14.0 µm:	2.4825

ORDERING INFORMATION

Dia inch (mm)	Nom f @ 5.0 µm (mm)	F/#	Model No.	Price
1.0 (25.4)	25	F/1	**43402**	
	38	F/1.5	**43403**	