



# Standard & Custom Optical Filters and Coatings

2020 / 2021 Product Catalog

Control the light, see your world





# Quality and Service that make a Difference

Unlike most optical filter and coating manufacturers, we supply spectral curves and digital data with most orders at no additional charge, saving you the cost of incoming quality control. We'll even help you reduce inventory by shipping your order only when you require it.



# Contents

<b>About Andover Corporation</b>	<b>4</b>	<b>Dichroic Filters</b>	
<b>Frequently Asked Questions</b>	<b>5</b>	Products	35
		Sets	37
<b>Coating Capabilities</b>		<b>Edge Filters</b>	
Dichroic Coatings	7	Products	39
Neutral Density Filters	7	Long Wave Pass	40
Specialized Coatings	7	Short Wave Pass	40
Anti-Reflective (AR) Coatings	7		
Bandpass Filters	7	<b>Steep-Edge Longpass Filters</b>	
		Long Wave Pass	41
<b>Custom Advantage</b>		<b>Infrared Filters &amp; Coatings</b>	
Optical Polishing	9	Infrared Windows and Substrates	43
Engineering Assistance	9	Broadband AR Coatings on Germanium	45
Optical Fabrication	9	Standard IR Long Wave Pass Filters	47
Machine Fabrication	9	Standard IR Bandpass Filters	49
Quality Control	8	IR Neutral Density Filters	51
Optical Testing	8		
Image Quality Filters	10	<b>Custom IR Coatings</b>	<b>52</b>
Success Stories	11		
		<b>Colored Glass</b>	
<b>Bandpass Filters</b>		General	53
About Bandpass Filters	12	Bandpass Type	54
Minimizing Wavelength Shift	12	Heat Absorbing Type	55
10 Basic Filter Types	13	Long Wave Pass Type	55
Bandpass Filter Selection Guide	15		
Standard Bandpass Filters Products	16	<b>Calibration Filter Sets</b>	
High-Transmitting Bandpass Filters	17	AC-930	57
Hard Coat Narrowband Filters Products	18	AC-1930	57
Hard Coat Broadband Filter Products	20		
Semi-Custom Bandpass Filter Products	22	<b>Accessories</b>	
Astronomy UVB/VI Filters	26	Threaded Rings	58
		Filter Wheels	59
<b>Metallic Filters</b>		Temperature Controller	61
Neutral Density Filters	28	Epolite FH-5313 Epoxy	63
		<b>Glossary</b>	<b>65</b>
<b>Absorptive Filters</b>			
Neutral Density Filters	31	<b>Int'l Representatives</b>	<b>66</b>
<b>Filter Sets</b>		<b>Index (Alphabetical)</b>	<b>68</b>
Neutral Density Sets	32		
Metallic & Absorptive Sets	32		
<b>Heat Control Filters</b>			
Hot Mirror	33		
Ultraviolet Cold Mirror	34		
Cold Mirror	34		
850nm Cold Mirrors	34		
Infrared Suppressing	34		

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**Order online** at [www.andovercorp.com](http://www.andovercorp.com) or **call us** at 1.888.893.9992 (Toll-free in the US)

# About **Andover Corporation**

Andover Corporation was established in 1976 with the purpose of designing and manufacturing high-quality optical filters and coatings for a wide variety of applications; including medical instrumentation, fluorescence studies, machine vision, astronomical observation, telecommunications, space-borne systems and defense systems. As the company grows, our focus remains on quality. Our current facility spans 44,000 square feet on 17 acres of land in Salem, NH.

Our facility is custom-designed and state-of-the-art. It includes automated coating, glass polishing, and fabrication equipment. Our testing capabilities are extensive, comprising of both automated spectrophotometers for broadband spectral measurements, and ultra-high-resolution spectrophotometers for narrowband measurements. Our optical metrology lab features a custom-designed, computer-controlled tunable interferometer to measure transmitted wavefronts beyond the capabilities of a traditional laser interferometer.

**Engineered. Reliable. Available.**

# Frequently Asked Questions

## **How do you distinguish between an image quality and a commercial quality filter?**

Image quality filters are ideal for applications that require high resolution, such as astronomical observations. To make these products, we polish high-quality optical glass to ensure the substrate is extremely flat and parallel, and then apply anti-reflective coatings on the external surfaces to reduce ghost images and maximize energy throughput. Commercial quality filters can have the same spectral characteristics as image quality filters, however they are designed for use in instruments rather than imaging applications.

## **What do I need to do to maintain my filters in good condition?**

We recommend cleaning your filters about every three months. If the environment is particularly dusty or you often shift the filters between applications, more regular cleaning may be warranted. We suggest that you apply acetone, methanol, or alcohol to a soft tissue and then rub the filter using a circular motion.

## **Are there any particular environmental conditions to consider when using a filter?**

It's important to avoid prolonged exposure to high humidity and large temperature variations. To reduce the risk of damage due to thermal shock, we recommend a maximum operating temperature of 70°C and a maximum temperature change of 5°C per minute.

## **When placing an order, why do I need to include the operating temperature?**

The center wavelength of an interference filter shifts linearly with changes in ambient temperature. Our filter designs take this into consideration to ensure proper performance at your specific operating temperature.

## **When can I expect to receive my order?**

Standard products ship within two to three days of receipt of order.

## **Do you offer discounts on surplus stock?**

Andover offers generous price terms on our surplus inventory. Just visit our website at [www.andovercorp.com/surplus](http://www.andovercorp.com/surplus) and plug in the desired wavelength to see what's available.

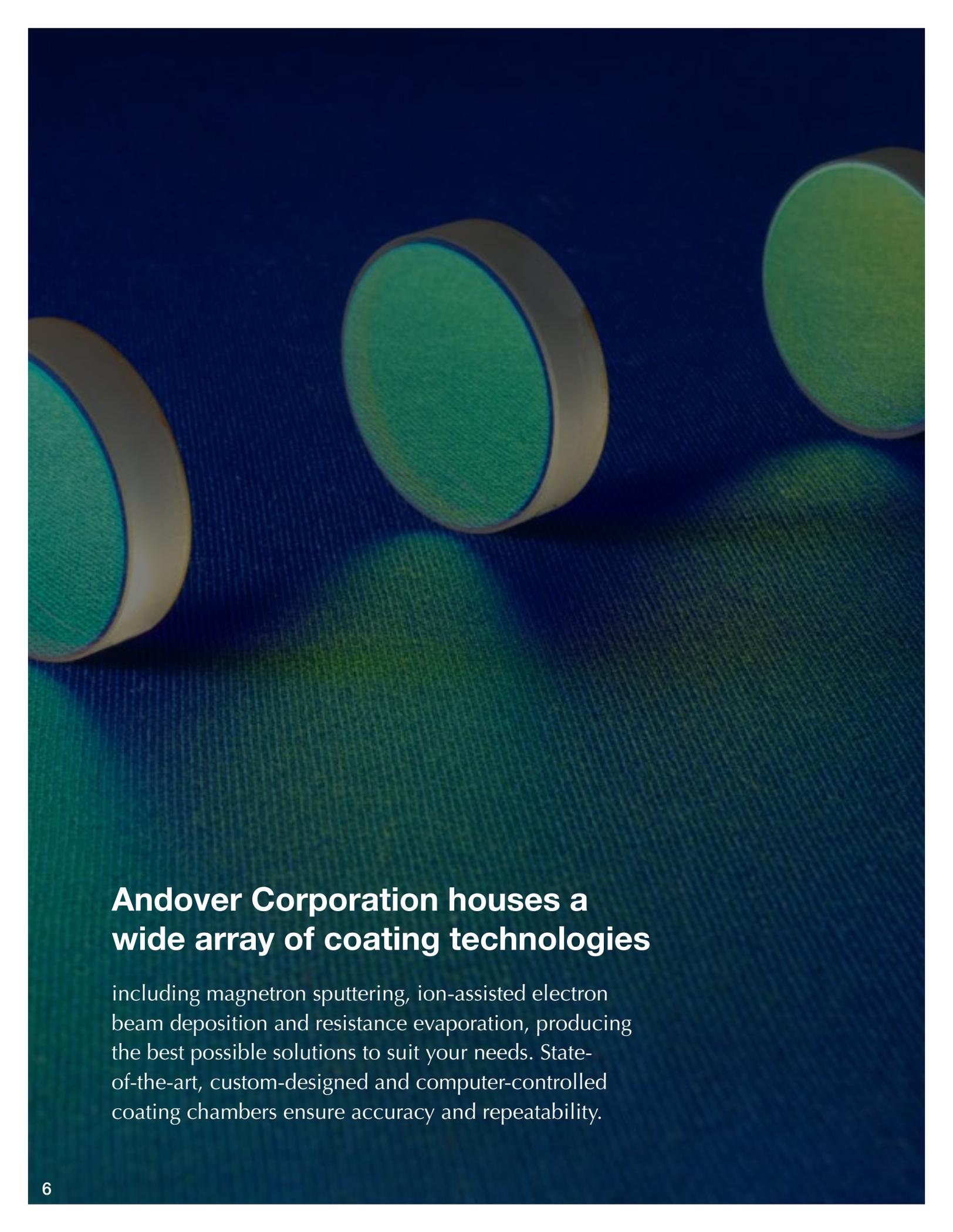
## **Do you have a minimum order value / quantity?**

No minimum value or quantity required.

## **How do I send custom specifications for quoting?**

You can do this one of three ways:

- ✦ Email your request to [info@andcorp.com](mailto:info@andcorp.com)
- ✦ Fax your specifications to 603.893.6508  
Attn: Technical Sales Department
- ✦ Call toll-free: 888-893-9992

The image features three circular, light-colored substrates, possibly metal or ceramic, arranged in a diagonal line from the top right towards the bottom left. Each substrate is coated with a thin, uniform layer of a bright green material. The background is a dark, textured blue surface that reflects the light from the substrates, creating soft, circular glows beneath them. The overall aesthetic is clean and technical, emphasizing precision and advanced manufacturing.

## **Andover Corporation houses a wide array of coating technologies**

including magnetron sputtering, ion-assisted electron beam deposition and resistance evaporation, producing the best possible solutions to suit your needs. State-of-the-art, custom-designed and computer-controlled coating chambers ensure accuracy and repeatability.



# Coating Capabilities

Andover Corporation has the unique ability to provide a diverse range of coatings spanning a broad wavelength range on a wide variety of materials. We produce coatings for a multitude of applications, ranging from environmental monitoring to space-based astronomy. Our AS9100 certification ensures compliance with aerospace as well as military standards.

- Variety of coating technologies to suit any need
- Wavelengths from 193nm to 14µm
- Custom coatings on a wide variety of substrates

## Dichroic Coatings

Andover designs and produces custom dichroic coatings for a variety of applications. Our in-house engineers can design exotic coatings to meet very stringent spectral and environmental requirements. As with all of our coatings, they can be applied to a wide variety of materials, in a myriad of shapes and sizes.

## Anti-Reflective AR Coatings

Andover produces hard oxide AR coatings from 193nm to 14µm. We routinely coat customer-supplied substrate material in all shapes and sizes: lenses, prisms, flats, domes, etc. We can coat a wide variety of materials, ranging from typical optical glass to exotic materials such as Calcium Fluoride, Zinc Sulfide and Zinc Selenide. The hard coatings not only reduce reflections to <0.1% at angles up to 50°, but also help protect optical surfaces, as the coating is more durable than the uncoated substrate.

## Neutral Density Filters

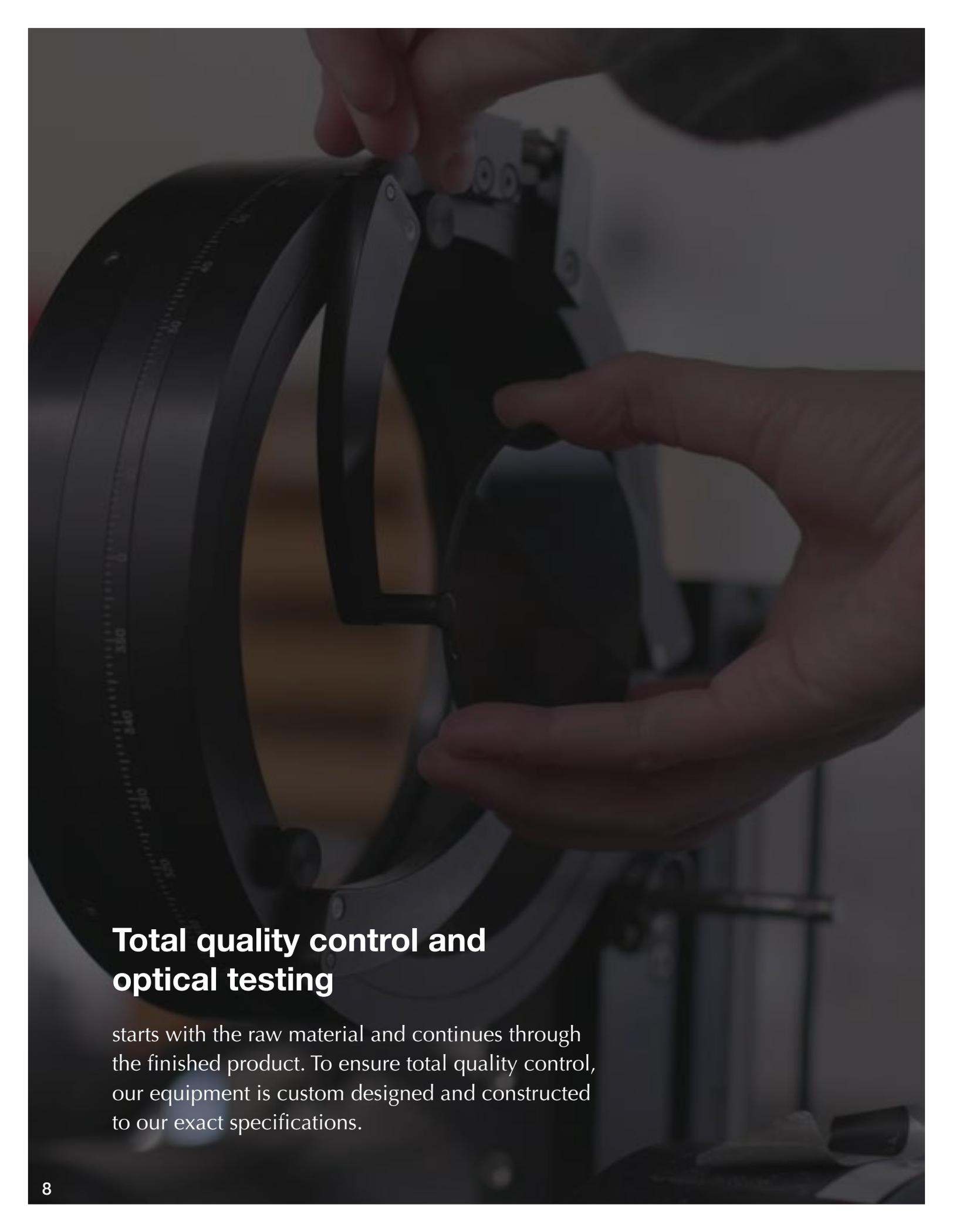
Andover is a leader in flat response neutral density filters in the UV to near infrared (250nm-2000nm) and far infrared (2000-14000nm). These coatings are hard and pinhole-free. Our ND Filters exhibit industry-leading spectral neutrality over a broad wavelength range, with optical densities up to 4.0. (We can deposit A/R coating on the uncoated surface for a nominal fee.)

## Bandpass Filters

We produce bandpass filters over a much broader range than any other coating firm, from 193nm to 14µm in wavelength. Bandwidths range from very wide, (> 10%) to extremely narrow, (< 0.02%). We can produce semi-custom bandpass filters with short lead times. We also have over 1,500 standard filters.

## Specialized Coatings

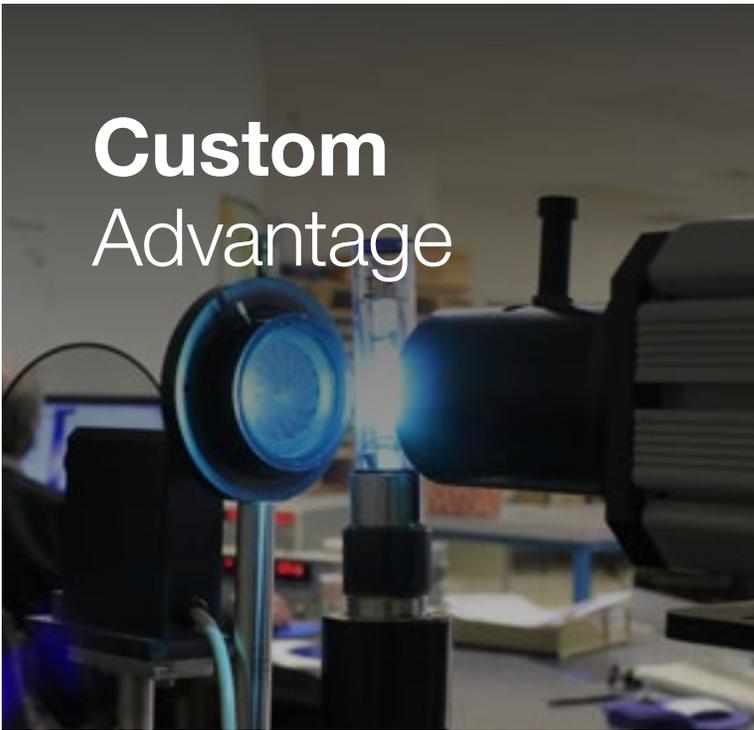
With our computer-controlled systems, we can quickly produce a variety of high-quality coatings in sizes up to 300mm with excellent repeatability using any process from resistance evaporation to magnetron sputtering.

A person is using a large, circular optical testing instrument, likely a spherometer or similar device, to inspect a lens. The instrument has a scale around its perimeter and a central lens holder. The person's hands are visible, adjusting the instrument. The background is a workshop or laboratory setting.

## **Total quality control and optical testing**

starts with the raw material and continues through the finished product. To ensure total quality control, our equipment is custom designed and constructed to our exact specifications.

# Custom Advantage



While stocking over 1,500 standard filters, Andover Corporation has built a worldwide reputation for developing custom, state-of-the-art, filters and coatings.

With our extensive engineering experience and advanced manufacturing facility, we control the entire production process to ensure that you receive only the highest-quality products, attentive service, and timely delivery.

- Fully-automated systems for excellent repeatability and rapid turnaround
- Continuously updated manufacturing processes
- Products that far exceed industry standards for quality

Utilizing the Cary 7000 spectrophotometer, Andover is able to measure absolute specular reflection over a wide range of angles, facilitating very accurate measurements of dichroic cube beamsplitter performance, and other complex measurements.

We check all filter glass for striae, bubbles and inclusions using our custom-designed inclusion tester. This instrument **detects minute defects, even in materials that do not transmit visible light.**

Our in-house environmental chambers allow us to perform routine and **custom product testing at temperatures from -62°C to over 500°C.** This capability, along with the ability to vary humidity levels, ensures compliance with your custom specification or MIL standard.

Most interferometers rely on laser light to produce interference fringes. Many bandpass filters cannot be measured with these instruments, as they do not transmit the laser wavelength. To solve this problem, **we constructed a computerized, tunable white light interferometer that produces actual transmitted wavefront interferograms of filters at any wavelength in the range of 350nm–1100nm.**

## Optical Polishing

Andover's in-house polishing facility can achieve flatness up to  $\lambda/10$  wave per inch and parallelism of 5 arc seconds or better, with a surface quality of 20/10.

## Engineering Assistance

Andover's in-house engineering staff can provide innovative assistance in optical and mechanical design, to ensure the success of your project.

## Optical Fabrication

Whether you require a filter that's 2mm or 350mm, Andover has fully automated CNC equipment to fabricate exactly what you need, with the quality you expect, and using the optical material of your choice.

## Machine Fabrication

Andover's 3-axis machining centers allow us to fabricate complex tooling quickly and accurately, greatly reducing the lead time for custom components.

# Image Quality Filters

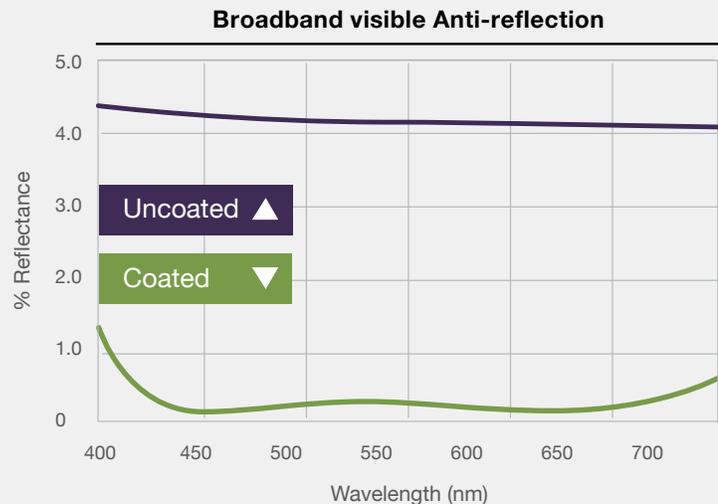
Have demanding custom imaging requirements?



Image quality filters are ideal for applications that require high resolution, such as astronomical observations, video monitoring systems, high-resolution photography, and other imaging applications. To meet these demanding requirements, Andover Corporation has developed a line of custom Image Quality (IQ) filters using high-grade optical material that is both striation and inclusion-free. The surfaces are ground and polished to a transmitted wavefront of  $\lambda/4$  per inch and parallel to 30 arc seconds or better. The internal coating positions are optimized and the exterior surfaces anti-reflection coated to eliminate multiple images and fringe patterns, maximizing energy throughput. For very high-resolution applications, we can also provide image quality filters with a transmitted wavefront of  $\lambda/10$  and parallelism of 10 arc seconds.

## Anti-Reflective Coatings

All Image Quality Filters include an anti-reflective (AR) coating. AR coatings are an effective way to limit reflections while also improving optimal system performance. Andover Corporation manufactures a variety of anti-reflective coatings designed for high efficiency, mechanical durability, and environmental stability.



All filters come with test documentation

Contact an Andover Corporation representative for questions or further information  
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# Success Stories

## A few notable achievements

### **M**ercury Surface, Space **E**nvironment, **G**eochemistry and Ranging (**M**ESSENGER)

MESSENGER launched on August 3, 2004. Its mission is to analyze the surface of Mercury, to better understand our own planet. It carries seven instruments, one of which is the Mercury Dual Imaging System (MDIS), a camera with wide and narrow fields-of-view, for monochrome, color and stereo imaging.

### **The Atmospheric Imaging Assembly (AIA) for the Solar Dynamics Observatory (SDO)**

SDO is designed to provide an unprecedented view of the solar corona, taking images that span at least 1.3 solar diameters in multiple wavelengths nearly simultaneously, at a resolution of about 1 arcsec and at a cadence of 10 seconds or better. This data will significantly improve our understanding of the physics behind the activity displayed by the Sun's atmosphere, which drives space weather in the heliosphere and in planetary environments.

### **The Michelson Doppler Imager (MDI)**

MDI is part of an international collaboration to study the interior structure and dynamics of the Sun. The MDI team was responsible for the design and fabrication, and now for the operation, of the MDI instrument on board the SOLar and Heliospheric Observatory (SOHO) spacecraft.

### **The Interface Region Imaging Spectrograph (IRIS)**

The IRIS mission is dedicated to understanding the interface between the photosphere and corona, by tracing the flow of energy and plasma through the chromosphere and transition region into the corona using spectrometry and imaging. It launched on June, 28 2013.

### **Helioseismic and Magnetic Imager (HMI)**

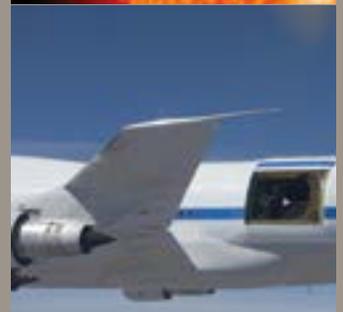
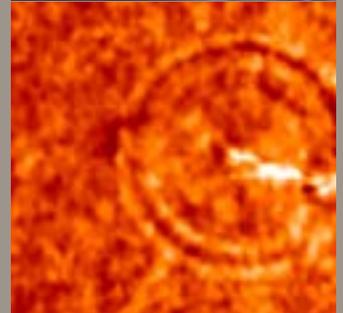
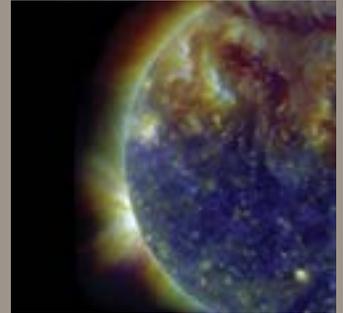
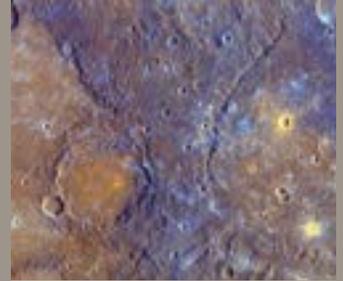
The primary goal of the HMI investigation is to study the origin of solar variability and to characterize and understand the Sun's interior and the various components of magnetic activity. The HMI investigation is based on measurements obtained with the HMI instrument as part of the Solar Dynamics Observatory (SDO) mission.

### **Stratospheric Observatory for Infrared Astronomy (SOFIA)**

SOFIA is the largest airborne observatory in the world, consisting of an extensively modified Boeing 747SP aircraft carrying a reflecting telescope with an effective diameter of 2.5 meters (100 inches). It is capable of making observations that are impossible for even the largest and highest ground-based telescopes.

### **The Cross-track Infrared Sounder (CrIS)**

CrIS is a Michelson interferometer infrared sounder that is part of the Cross-track Infrared Microwave Sounding Suite (CrIMSS). The objective of CrIMSS is to provide global three dimensional soundings of atmospheric temperature and moisture as well as provide data on other geophysical parameters.



# About Bandpass Filters

The use of bandpass filters is one of the simplest and most economical ways to transmit a well-defined band of light and to reject all other unwanted radiation. Their design is essentially a thin film Fabry-Perot interferometer formed by vacuum deposition, and consists of two reflecting stacks separated by an even-order spacer layer.

Because the Fabry-Perot filter is Lorentzian in shape, the cut-on and cut-off slopes are shallow and the rate of attenuation in the out-of-band blocking range is slow. To improve the slopes and increase the attenuation in the blocking band, we introduce more cavities into the construction of our standard dielectric bandpass filters.

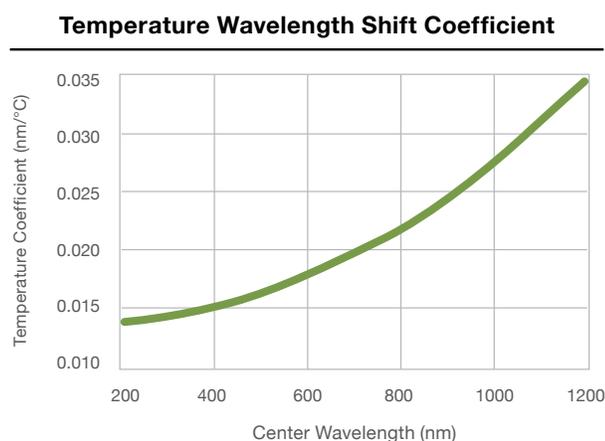
## Environmental Considerations

Ambient temperature and optical path geometry are important factors to consider in selecting or specifying bandpass filters.

### Ambient Temperature

The center wavelength of a bandpass filter shifts linearly with changes in ambient temperature—up with a positive change and down with a negative change. The temperature coefficient chart below gives a good approximation of the shift in wavelength for a given temperature change.

To counter these effects, Andover has developed Temperature Controllers that help to maintain the ambient temperature of bandpass filters. (For more information see page 68 (Temperature Controller).



### Angle of Incidence

The central wavelength of the all-dielectric Fabry-Perot filter shifts lower with an increase in the incident angle. The amount of shift depends upon the incident angle and the filter's effective index ( $N^*$ ). This feature can be very useful when tuning a filter to the desired central wavelength. Use the formula below to determine the wavelength shift of a filter in collimated light with incident angles up to  $15^\circ$ .

$$\lambda_\theta = \lambda_o \left[ 1 - \frac{n_o}{n^*} \sin^2 \theta \right]^{\frac{1}{2}}$$

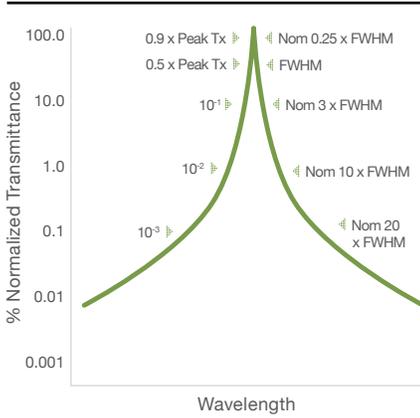
Where:

- $\lambda_\theta$  = Peak wavelength at incident angle  $\theta$
- $\lambda_o$  = Peak wavelength at normal incidence
- $n_o$  = Refractive index of incident medium (air=1.0)
- $n^*$  = Effective index of the filter assembly
- $\theta$  = Angle of incidence

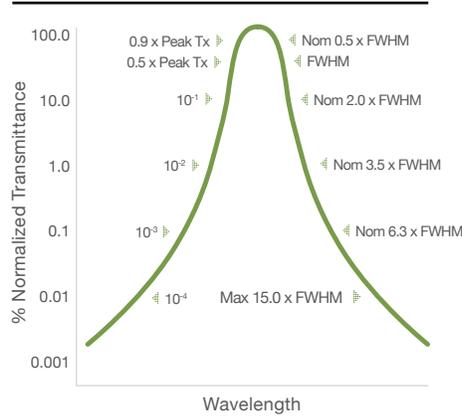
When using a filter with non-collimated light, the wavelength shift will appear somewhat less than that of collimated light at the same angle. In a cone of light, only the central ray is normal to the surface while all others are increasingly off-angle. To approximate this shift, use this same formula and divide the results by two. (This approach works in systems where the full cone angle is up to  $20^\circ$ ).

# Spectral Profiles for Andover's 10 Basic Filter Types

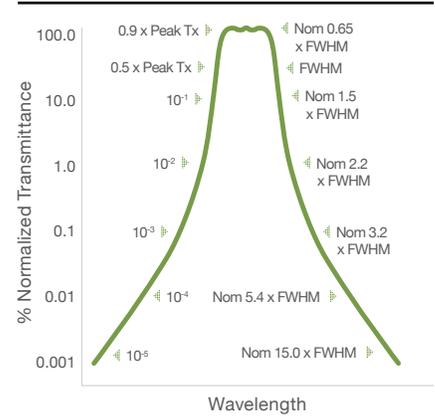
Type 1  
**1 cavity**



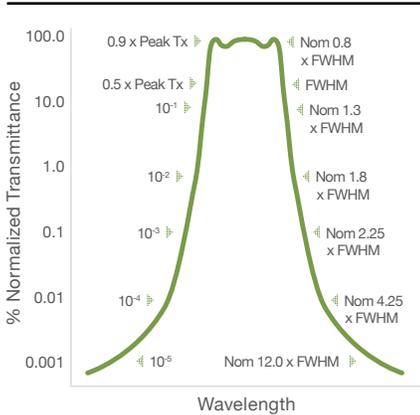
Type 2  
**2 cavity**



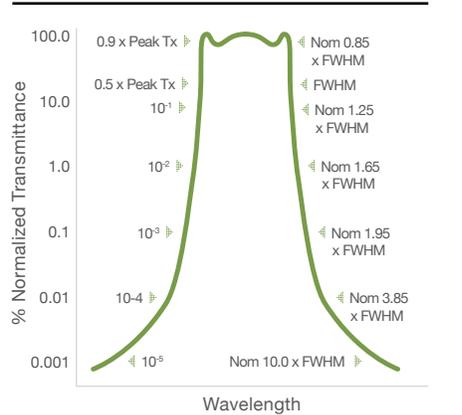
Type 3  
**3 cavity**



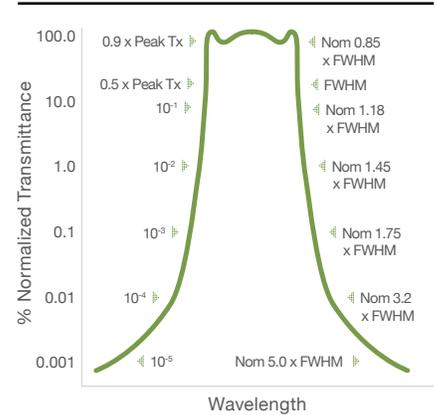
Type 4  
**4 cavity**



Type 5  
**5 cavity**



Type 6  
**6 cavity**



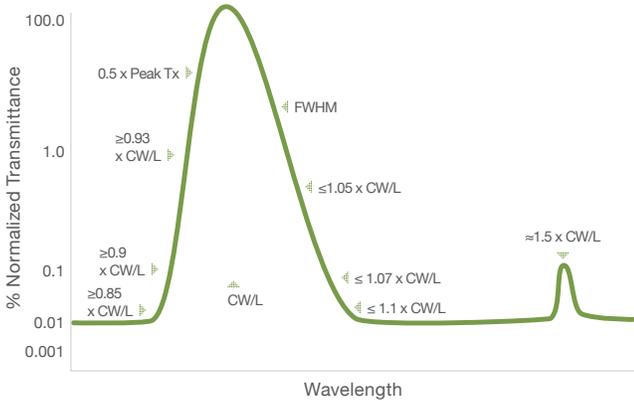
**Filter types 1-6 represent unblocked filter profiles. Bandshape may vary depending upon level of additional blocking**

Normalized Transmittance of Peak (%)	Full Bandwidth Multiplier (Nominal)					
	1 Cavity	2 Cavity	3 Cavity	4 Cavity	5 Cavity	6 Cavity
<b>90.0</b>	0.25 nom.	0.5 nom.	0.65–0.70	0.8–0.9	0.85–0.90	0.85–0.90
<b>10.0</b>	2.5–3.0	1.6–2.0	1.2–1.5	1.1–1.3	1.1–1.25	1.08–1.18
<b>1.0</b>	8.0–10.0	2.8–3.5	1.9–2.2	1.5–1.8	1.4–1.65	1.35–1.45
<b>0.1</b>	15.0–20.0	5.5–6.3	2.9–3.2	2.0–2.25	1.8–1.95	1.6–1.75
<b>0.01</b>	undefined	10.0–15.0	4.9–5.4	3.5–4.25	3.1–3.85	2.9–3.2
<b>0.001</b>	undefined	undefined	10.0–15.0	9.0–12.0	8.0–10.0	4.0–5.0

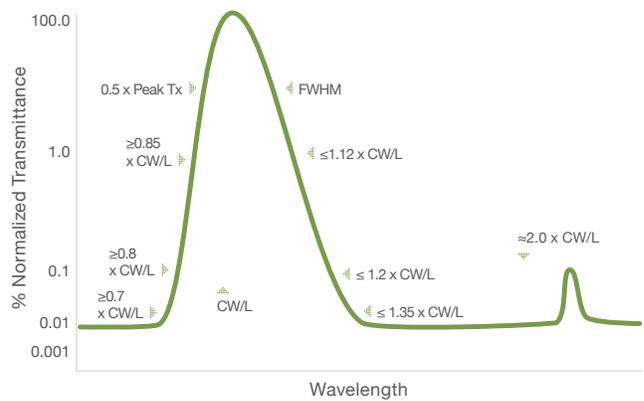


MDM filters are a special type of bandpass filter utilizing dielectric layers (D) surrounded by metallic layers (M). They provide excellent throughput over a wide spectral range, while providing good out-of-band blocking.

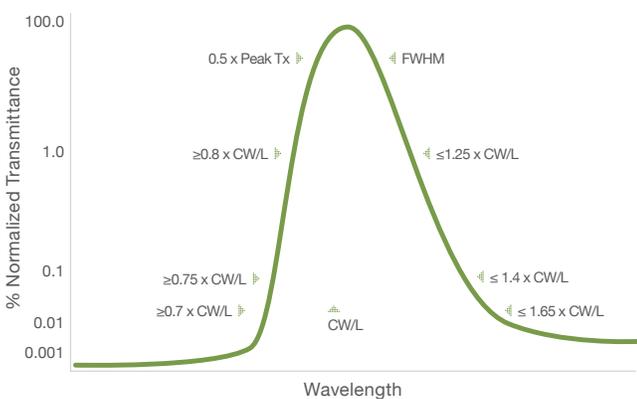
Type 7  
**MDM 10nm BANDWIDTH**



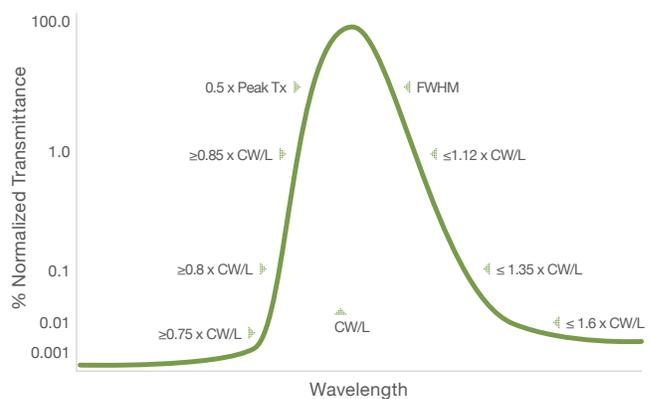
Type 8  
**MDM 25nm BANDWIDTH**



Type 9  
**MDM 10-70nm BANDWIDTH**



Type 10  
**MDM 80-100nm BANDWIDTH**



## Bandpass Filter Selection Guide

There are many variations to a bandpass filter's construction, each with specific advantages. Andover offers a variety of options so that you can select what is best-suited for your application.

Bandpass Filter Types					
Type & Page	Standard Bandpass Filters <i>Page 16</i>	High-Transmitting Bandpass Filters <i>Page 17</i>	Semi-Custom Bandpass Filters <i>Pages 22-25</i>	Hard-Coated Narrowband Filters <i>Pages 18-19</i>	Hard-Coated Broadband Filters <i>Pages 20-21</i>
<b>Description</b>	Andover's Standard Bandpass filters have been the mainstay of the industry for decades. With our proprietary stabilization and sealing method these filters will generally last for 10-20 years in the field. Their longevity, coupled with their low cost and ready availability, make these a great choice for most applications.	Andover's High-Transmitting Bandpass filters are a variant of the Standard Bandpass filter line. Designed for use with PMTs and photodiodes, they employ only dielectric coatings, and have a blocking range tailored to the detector. This results in higher transmission than their fully-blocked counterparts. For your convenience, the high-transmitting bandpass filters are listed in the Standard Bandpass section, and are highlighted for easy identification	In order to make it simple for customers to custom-tailor a bandpass filter for their application, Andover offers a line of Semi-Custom bandpass filters. Their construction is similar to both the Standard Bandpass and High-Transmitting bandpass filter offerings. We offer a wide selection of wavelengths, bandwidths and sizes, and offer two blocking options.	Andover offers one of the broadest ranges of hard-coated narrowband filters in the industry. Our filters feature very high transmission, and dense blocking from UV-1200nm. They are suitable for high-temperature applications.	This line of hard, first-surface coated filters was designed to cover the standard Raman spectroscopy lines. They feature very high transmission over a broad range about the wavelength of interest.
Key attributes					
<b>Construction</b>	Soft-coated Laminated	Soft-coated Laminated	Soft-coated Laminated	Hard First-surface coatings	Hard First-surface coatings
<b>Wavelength range</b>	193nm - 2400nm	365.0nm - 1550nm	214nm - 2400nm	334nm - 1550nm	345nm - 785nm
<b>Bandwidths</b>	1nm - 100nm	10nm - 40nm	0.15nm - 80nm	10nm	80nm - 300nm
<b>Blocking</b>	OD4 UV-FIR	OD4 UV-800nm or 1000nm	OD4 UV-1000nm or UV-FIR	Varies by W/L	OD4 UV-1200nm
<b>Sizes (diameter)</b>	12.5mm, 25mm and 50mm	12.5mm, 25mm and 50mm	12.5mm, 25mm and 50mm	25mm	12.5mm, 25mm and 50mm
Features					
<b>Low cost</b>	✓	✓			
<b>Available from stock</b>	✓	✓		✓	✓
<b>High-Transmission</b>		✓		✓	✓
<b>Highly customizable</b>			✓		
<b>First surface coatings</b>				✓	✓
<b>Suitable for high temperatures</b>				✓	✓

**Quickly locate the best suited filter for your specific application** with the following chart that summarizes major features of various filters types. **For detailed information, please refer to the pages listed. For further advice please contact our technical sales staff at [info@andcorp.com](mailto:info@andcorp.com).**

# Standard Bandpass Filters

## Typical Applications Include:

- Spectral Radiometry
- Medical Diagnostics
- Chemical Analysis
- Colorimetry



Andover offers one of the most extensive selections of bandpass filters in the industry, including many of the primary laser, mercury, biomedical, and analytical spectral lines.

We use a proprietary method to stabilize our products to prevent drift of peak wavelength with age and hermetically seal each filter for maximum protection against humidity. Each filter is mounted in a black anodized aluminum ring, adding further protection against chipping, scratching, and moisture penetration. This added protection leads to an extended shelf life.

- Wavelengths from the ultraviolet through the infrared
- Stabilized to prevent drift of peak wavelength over time
- Hermetically sealed and protected by an anodized aluminum ring
- Custom sizes available

Go to [www.andovercorp.com/products/bandpass-filters/bandpass-filter-selection-guide/](http://www.andovercorp.com/products/bandpass-filters/bandpass-filter-selection-guide/) to order online.

## General Specifications

<b>Diameter Tolerance:</b>	+0/-0.25mm	
<b>Usable Aperture:</b>	Filter Size	Usable Aperture
	12.5mm Ø	9.0mm Ø
	25.0mm Ø	21.0mm Ø
	50.0mm Ø	45.0mm Ø
<b>Surface Quality:</b>	80-50 (Per MIL-PRF-13830B)	
<b>Optical Quality:</b>	Commercial instrumentation grade	
<b>Out-of-Band Blocking:</b>	1 x 10 <sup>-4</sup> avg. from X-ray to FIR	
<b>Specification Temperature:</b>	+23°C	
<b>Max. Survival Temp Range:</b>	CW/L 214-380nm	-50°C to +50°C
	CW/L 380.1-2400nm	-50°C to +70°C
<b>Humidity Resistance:</b>	Per MIL-C-48497A	
<b>Mechanical:</b>	Mounted in an anodized aluminum ring	

*Optional: Mounted in threaded ring - see pg 58 for thread sizes*

# High-Transmitting Bandpass Filters

Andover offers a high-transmittance variant of its standard bandpass filter selection. By tailoring the blocking range to match the detector, we can provide maximum possible throughput while maintaining good blocking to meet the customer's needs. Wavelengths include all popular laser, mercury biomedical, and analytical spectral lines.

All filters are constructed using the same high-quality materials and methods as our standard bandpass filters, thus providing a highly stable, long-lasting filter.

## Typical Applications Include:

- Spectral Radiometry
- Medical Diagnostics
- Chemical Analysis
- Colorimetry

- Wavelengths from the ultraviolet through the infrared
- Stabilized to prevent drift of peak wavelength over time
- Hermetically sealed and protected by an anodized aluminum ring
- Transmission as high as 80%
- Custom sizes available

## High-Transmitting Bandpass Filters

We also offer a High-Transmitting variant of our standard bandpass filter selection. By tailoring the blocking range to match the detector, we can provide maximum possible throughput while maintaining good blocking to meet the customer's needs. Wavelengths include all popular laser, mercury, biomedical and analytical spectral lines.

Go to [www.andovercorp.com/products/bandpass-filters/high-transmitting-bandpass-filters/](http://www.andovercorp.com/products/bandpass-filters/high-transmitting-bandpass-filters/) for part numbers, pricing, and to order online.

## General Specifications

<b>Diameter Tolerance:</b>	+0/-0.25mm	
<b>Usable Aperture:</b>	Filter Size	Usable Aperture
	12.5mm Ø	9.0mm Ø
	25.0mm Ø	21.0mm Ø
	50.0mm Ø	45.0mm Ø
<b>Surface Quality:</b>	80-50 (Per MIL-PRF-13830B)	
<b>Optical Quality:</b>	Commercial instrumentation grade	
<b>Out-of-Band Blocking:</b>	1 x 10 <sup>-4</sup> avg. from X-ray to FIR	
<b>Specification Temperature:</b>	+23°C	
<b>Max. Survival Temp Range:</b>	CW/L 350-380nm	-50°C to +50°C
	CW/L 380.1-2400nm	-50°C to +70°C
<b>Humidity Resistance:</b>	Per MIL-C-48497A	
<b>Mechanical:</b>	Mounted in an anodized aluminum ring	

*Optional: Mounted in threaded ring - see pg 58 for thread sizes*

# Hard-Coated Narrowband Filters

## Typical Applications Include:

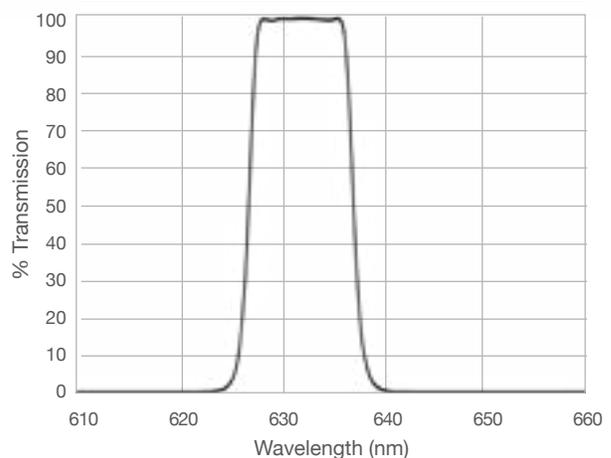
- Machine Vision
- Biotech Instrumentation
- Medical Devices

Our first-surface, hard-coat narrowband filters employ plasma-deposited, hard-oxide coatings on Borosilicate Glass and do not utilize any absorbing filter glasses, making them suitable for high temperature applications. They provide a steep transition from a high, peak transmission to OD4 blocking. Available at wavelengths from 334nm to 1550nm, including all major laser lines and atomic absorption lines. All filters are mounted in black anodized aluminum rings to provide protection and easy identification. Please contact our technical sales department for pricing and delivery.

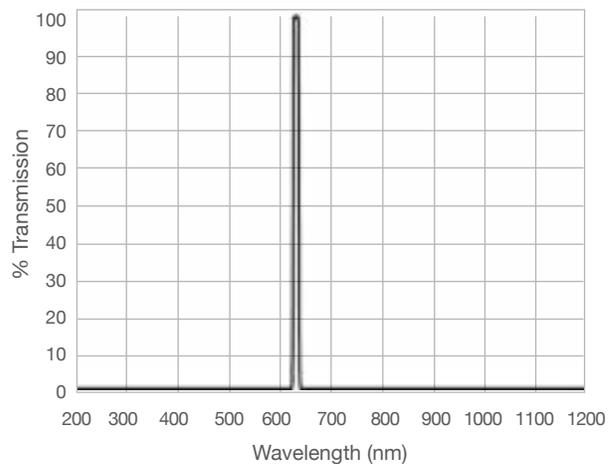
- **Hard, durable, first-surface coatings**
- **Suitable for high-temperature applications**



**632nm Narrowband - 632HC10-25**



**632nm Narrowband - 632HC10-25**



## General Specifications

<b>Thickness:</b>	5.0 ± 0.25mm
<b>Size Tolerance:</b>	+ 0.0mm / -0.1mm
<b>Minimum Clear Aperture:</b>	21mm dia.
<b>Substrate Material:</b>	Borosilicate Glass
<b>Flatness:</b>	3-5 waves
<b>Surface Quality:</b>	80-50 per MIL-C-48497A
<b>Humidity and Abrasion:</b>	Per MIL-C-675A
<b>Durability:</b>	Per MIL-C-48497A
<b>Operating Temperature:</b>	-50°C to +100°C
<b>Mechanical:</b>	Mounted in black anodized aluminum

CW/L (nm)	FWHM (nm)	Min Trans (%)	OD4 (avg.) Blocking (%)	Part Number 25mm Ø
334	10	90	200-1200nm	334HC10-25
337	10	90	200-1200nm	337HC10-25
340	10	90	200-1200nm	340HC10-25
365	10	90	200-1200nm	365HC10-25
375	10	90	200-1200nm	375HC10-25
394	10	90	200-1200nm	394HC10-25
400	10	90	200-1200nm	400HC10-25
400	25	90	200-1200nm	400HC25-25
405	10	90	200-1200nm	405HC10-25
420	10	90	200-1200nm	420HC10-25
430	10	90	200-1200nm	430HC10-25
436	10	90	200-1200nm	436HC10-25
440	10	90	200-1200nm	440HC10-25
442	10	90	200-1200nm	442HC10-25
450	25	90	200-1200nm	450HC25-25
455	10	90	200-1200nm	455HC10-25
458	10	90	200-1200nm	458HC10-25
460	10	90	200-1200nm	460HC10-25
470	10	90	200-1200nm	470HC10-25
480	10	90	200-1200nm	480HC10-25
486	10	90	200-1200nm	486HC10-25
488	10	90	200-1200nm	488HC10-25
492	10	90	200-1200nm	492HC10-25
500	10	90	200-1200nm	500HC10-25
500	25	90	200-1200nm	500HC25-25
508	10	90	200-1200nm	508HC10-25
510	10	90	200-1200nm	510HC10-25
515	10	90	200-1200nm	515HC10-25
520	10	90	200-1200nm	520HC10-25
532	10	90	200-1200nm	532HC10-25
535	10	90	200-1200nm	535HC10-25
540	10	90	200-1200nm	540HC10-25
546	10	90	200-1200nm	546HC10-25
550	10	90	200-1200nm	550HC10-25
550	25	90	200-1200nm	550HC25-25
560	10	90	200-1200nm	560HC10-25
568	10	90	200-1200nm	568HC10-25
580	10	90	200-1200nm	580HC10-25
589	10	90	200-1200nm	589HC10-25
594	10	90	200-1200nm	594HC10-25
600	10	90	200-1200nm	600HC10-25
600	25	90	200-1800nm	600HC25-25
610	10	90	200-1200nm	610HC10-25
620	10	90	200-1200nm	620HC10-25
632	10	90	200-1200nm	632HC10-25
636	10	90	200-1200nm	636HC10-25

CW/L (nm)	FWHM (nm)	Min Trans (%)	OD4 (avg.) Blocking (%)	Part Number 25mm Ø
640	10	90	200-1200nm	640HC10-25
647	10	90	200-1200nm	647HC10-25
650	10	90	200-1200nm	650HC10-25
650	25	90	200-1200nm	650HC25-25
656	10	90	200-1200nm	656HC10-25
660	10	90	200-1200nm	660HC10-25
671	10	90	200-1200nm	671HC10-25
676	10	90	200-1200nm	676HC10-25
680	10	90	200-1200nm	680HC10-25
685	10	90	200-1200nm	685HC10-25
690	10	90	200-1200nm	690HC10-25
700	10	90	200-1200nm	700HC10-25
700	25	90	200-1200nm	700HC25-25
730	10	90	200-1200nm	730HC10-25
750	10	90	200-1200nm	750HC10-25
750	25	90	200-1200nm	750HC25-25
766	10	90	200-1200nm	766HC10-25
770	10	90	200-1200nm	770HC10-25
780	10	90	200-1200nm	780HC10-25
785	10	90	200-1200nm	785HC10-25
800	10	90	200-1200nm	800HC10-25
800	25	90	200-1200nm	800HC25-25
810	10	90	200-1200nm	810HC10-25
830	10	90	200-1200nm	830HC10-25
850	10	90	200-1200nm	850HC10-25
850	25	90	200-1200nm	850HC25-25
852	10	90	200-1200nm	852HC10-25
880	10	90	200-1200nm	880HC10-25
900	25	90	200-1200nm	900HC25-25
905	10	90	200-1200nm	905HC10-25
940	10	90	200-1200nm	940HC10-25
950	10	90	200-1200nm	950HC10-25
950	25	90	200-1500nm	950HC25-25
980	10	90	200-1200nm	980HC10-25
1000	25	90	200-1500nm	1000HC25-25
1050	25	90	200-1500nm	1050HC25-25
1064	10	90	200-1200nm	1064HC10-25
1100	25	90	200-1500nm	1100HC25-25
1150	25	90	200-1500nm	1150HC25-25
1200	25	90	200-1500nm	1200HC25-25
1250	25	90	200-1800nm	1250HC25-25
1300	25	90	200-1800nm	1300HC25-25
1400	25	90	200-1800nm	1400HC25-25
1500	25	90	200-1800nm	1500HC25-25
1550	10	90	200-1800nm	1550HC10-25
1550	25	90	200-1800nm	1550HC25-25

# Hard-Coated Broadband Filters

## Typical Applications Include:

- Machine Vision
- Biotech Instrumentation
- Medical Devices

Our first-surface, hard coat broadband filters employ magnetron sputtered, hard-oxide coatings deposited on Borosilicate Glass and do not utilize any absorbing filter glasses, making them suitable for high temperature applications. They provide a steep transition from a high, peak transmission to OD4 blocking.

Available at standard Raman wavelengths: 488, 514, 532, 633, 785nm. We offer three standard sizes, with custom sizes available on request.

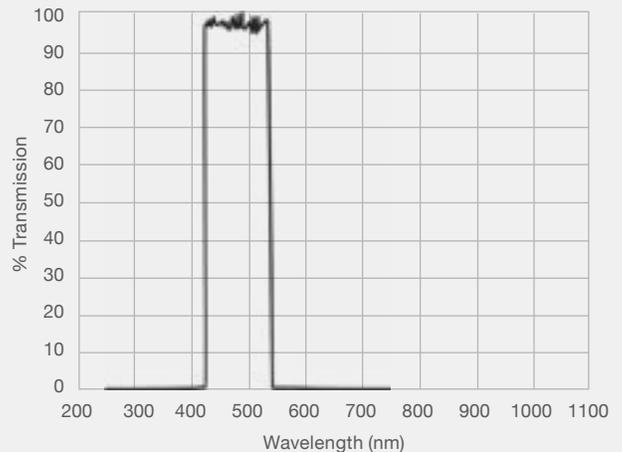
- **Hard, durable, first-surface coatings**
- **Suitable for high-temperature applications**
- **Available from stock**

## General Specifications

<b>Thickness:</b>	3.1 ± 0.25mm
<b>Size Tolerance:</b>	+ 0.0mm / -0.2mm
<b>Minimum Clear Aperture:</b>	95% of outside dimension
<b>Substrate Material:</b>	Borosilicate Glass (345nm filter utilizes Fused Silica)
<b>Flatness:</b>	3 – 5 waves
<b>Surface Quality:</b>	80 – 50 per MIL-C-48497A
<b>Humidity and Abrasion:</b>	Per MIL-C-675A
<b>Durability:</b>	Per MIL-C-48497A
<b>Operating Temperature:</b>	-50°C to +200°C
<b>Mechanical:</b>	Unmounted

*Optional: Mounted in threaded ring - see pg 58 for thread sizes*

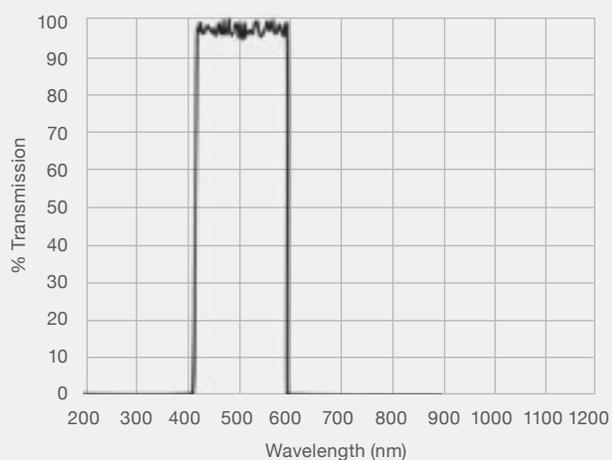
**488nm Bandpass - 488HC80-XX**



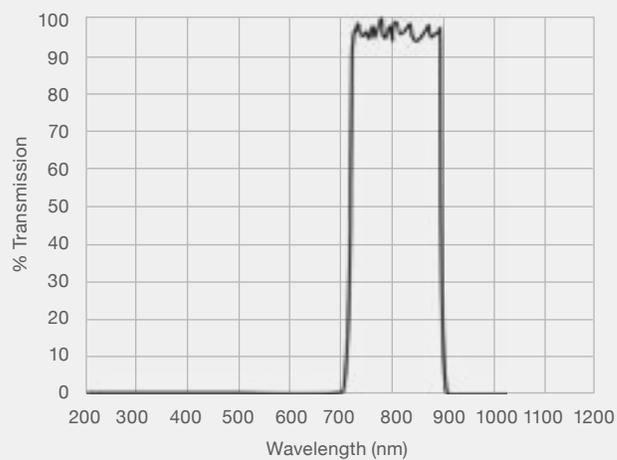
For more information about custom size hard-coated broadband filters **contact an Andover Corporation representative** at 1.888.893.9992 (Toll-free in the US)

Line	CW/L (nm)	FWHM (nm)	Transmission (%)	OD4 (avg.) Blocking @	Size, Shape & Part Number		
					12.5mm Ø	25mm Ø	50mm Ø
Argon Laser	345	80 ± 8.0	≥ 60	200-650nm	345HC80-12.5	345HC80-25	345HC80-50
Argon Laser	441.6	150 ± 15.0	≥ 80	200-750nm	442HC150-12.5	442HC150-25	442HC150-50
NaYAG	470.	100 ± 10.0	85-92	200-750nm	470HC100-12.5	470HC100-25	470HC100-50
Argon Laser	488	80 ± 8.0	85-92	200-750nm	488HC80-12.5	488HC80-25	488HC80-50
Argon Laser	514.5	90 ± 9.0	85-92	200-800nm	515HC90-12.5	515HC90-25	515HC90-50
NaYAG	532	150 ± 15.0	85-92	200-900nm	532HC150-12.5	532HC150-25	532HC150-50
LED	550	300 ± 30.0	85-92	200-900nm	550HC300-12.5	550HC300-25	550HC300-50
HeNe Laser	632.8	90 ± 9.0	85-92	200-900nm	633HC90-12.5	633HC90-25	633HC90-50
Sapphire	785	170 ± 17.0	85-92	200-1100nm	785HC170-12.5	785HC170-25	785HC170-50

**532nm Bandpass - 532HC150-XX**



**785nm Bandpass - 785HC150-XX**



# Semi-Custom Bandpass Filters

## Typical Applications Include:

- Research
- Prototyping
- Instrumentation
- Specific Wavelength Imaging Filters

- Wavelengths from the visible through infrared
- Bandwidths from 0.15nm to 80nm
- Short lead times

Reference page 16

Thanks to a large inventory of substrate materials, Andover Corporation can fabricate and deliver higher-performance commercial quality bandpass filters to your specifications in as soon as 5-10 days from receipt of order. To specify your semi-custom filter, follow the steps below.

STEP 1- Select Bandwidth, Filter Type and CW/L

STEP 2 - Select Blocking Range

STEP 3- Select Size and Corresponding Pat Numver

All other features are predetermined by these three choices. The out-of-band blocking of these filters is  $1 \times 10^{-4}$  within the defined spectral range. Optional threaded rings are available, and image quality versions are also available. Please contact our technical sales department for pricing and delivery.

STEP 1 Select Bandwidth, Filter Type and CW/L			STEP 2 Select Blocking Range				STEP 3 Select Size and Corresponding Part Number		
Bandwidth (FWHM)	Cavities/ Filter	CW/L Range	CW/L Tolerance	Min. T (%) When Blocked To			Size, Shape & Part Number		
(nm)	Type	(nm)	(nm)	1 $\mu$	FIR	n*	12.5mm $\emptyset$	25mm $\emptyset$	50mm $\emptyset$
0.15 $\pm$ 0.05	1/1	450.0–550.0	$\pm$ 0.05	40	30	1.45	001FC10-12.5	001FC10-25	001FC10-50
	1/1	550.1–750.0	$\pm$ 0.05	45	40	1.45	001FC12-12.5	001FC12-25	001FC12-50
0.20 $\pm$ 0.05	1/1	450.0–550.0	$\pm$ 0.05	45	35	1.45 / 2.05	002FC10-12.5	002FC10-25	002FC10-50
	1/1	550.1–750.0	$\pm$ 0.05	45	35	2.05	002FC12-12.5	002FC12-25	002FC12-50
0.30 $\pm$ 0.10	2/2	450.0–550.0	$\pm$ 0.05	35	25	1.45	003FC10-12.5	003FC10-25	003FC10-50
	2/2	550.1–750.0	$\pm$ 0.05	40	35	2.05	003FC12-12.5	003FC12-25	003FC12-50
0.30 - 0.40	3/3	550.0–750.0	$\pm$ 0.05	35	30	2.05	004FC12-12.5	004FC12-25	004FC12-50
0.50 $\pm$ 0.10	2/2	450.0–550.0	$\pm$ 0.05	40	30	1.45 / 2.05	005FC10-12.5	005FC10-25	005FC10-50
	2/2	550.1–750.0	$\pm$ 0.05	45	35	2.05	005FC12-12.5	005FC12-25	005FC12-50
0.60 $\pm$ 0.10	2/2	430.0–480.0	$\pm$ 0.1	40	35	1.45	006FC08-12.5	006FC08-25	006FC08-50
	2/2	480.1–550.0	$\pm$ 0.1	45	35	2.05	006FC10-12.5	006FC10-25	006FC10-50
	2/2	550.1–750.0	$\pm$ 0.1	45	25	2.05	006FC12-12.5	006FC12-25	006FC12-50
0.50 - 0.80	3/3	480.0–550.0	$\pm$ 0.1	40	30	2.05	007FC10-12.5	007FC10-25	007FC10-50
	3/3	550.1–750.0	$\pm$ 0.1	45	35	2.05	007FC12-12.5	007FC12-25	007FC12-50
	3/3	750.1–950.0	$\pm$ 0.1	45	35	2.05	007FC14-12.5	007FC14-25	007FC14-50
0.80 $\pm$ 0.20	2/2	430.0–480.0	$\pm$ 0.1	45	40	1.45	008FC08-12.5	008FC08-25	008FC08-50
	2/2	480.1–550.0	$\pm$ 0.1	45	40	2.05	008FC10-12.5	008FC10-25	008FC10-50
	2/2	550.1–750.0	$\pm$ 0.1	50	45	2.05	008FC12-12.5	008FC12-25	008FC12-50
	2/2	750.1–950.0	$\pm$ 0.1	50	45	2.05	008FC14-12.5	008FC14-25	008FC14-50
	2/2	950.1–1100.0	$\pm$ 0.1	50	40	2.05	008FC16-12.5	008FC16-25	008FC16-50

STEP 1 Select Bandwidth, Filter Type and CW/L			STEP 2 Select Blocking Range				STEP 3 Select Size and Corresponding Part Number		
Bandwidth (FWHM)	Cavities/Filter	CW/L Range	CW/L Tolerance	Min. T (%) When Blocked To			Size, Shape & Part Number		
(nm)	Type	(nm)	(nm)	1μ	FIR	n*	12.5mm Ø	25mm Ø	50mm Ø
1.0 ± 0.2	2/2	340.0–385.0	+ 0.2/-0.1	-	8	1.45	010FC04-12.5	010FC04-25	010FC04-50
	2/2	385.1–395.0	+ 0.2/-0.1	15	10	1.45	010FC05-12.5	010FC05-25	010FC05-50
	2/2	395.1–430.0	+ 0.2/-0.1	20	15	1.45	010FC06-12.5	010FC06-25	010FC06-50
	2/2	430.1–480.0	+ 0.2/-0.1	40	35	1.45/2.05	010FC08-12.5	010FC08-25	010FC08-50
	2/2	480.1–550.0	+ 0.2/-0.1	50	40	2.05	010FC10-12.5	010FC10-25	010FC10-50
	2/2	550.1–750.0	+ 0.2/-0.1	55	45	2.05	010FC12-12.5	010FC12-25	010FC12-50
	2/2	750.1–950.0	+ 0.2/-0.1	55	45	2.05	010FC14-12.5	010FC14-25	010FC14-50
1.0 ± 0.2	2/2	950.1–1100.0	+ 0.2/-0.1	55	40	2.05	010FC16-12.5	010FC16-25	010FC16-50
	3/3	480.0–550.0	+ 0.2/-0.1	50	35	1.45/2.05	010FC35-12.5	010FC35-25	010FC35-50
	3/3	550.1–750.0	+ 0.2/-0.1	55	40	2.05	010FC36-12.5	010FC36-25	010FC36-50
	3/3	750.1–950.0	+ 0.2/-0.1	55	40	2.05	010FC37-12.5	010FC37-25	010FC37-50
1.5 ± 0.3	3/3	950.1–1100.0	+ 0.2/-0.1	50	35	2.05	010FC38-12.5	010FC38-25	010FC38-50
	2/2	250.0–320.0	+ 0.3/-0.1	-	6	1.45	015FC02-12.5	015FC02-25	015FC02-50
	2/2	320.1–387.0	+ 0.3/-0.1	-	10	1.45	015FC04-12.5	015FC04-25	015FC04-50
	2/2	387.1–430.0	+ 0.3/-0.1	20	10	1.45	015FC06-12.5	015FC06-25	015FC06-50
	2/2	430.1–480.0	+ 0.3/-0.1	40	30	1.45/2.05	015FC08-12.5	015FC08-25	015FC08-50
	2/2	480.1–550.0	+ 0.3/-0.1	55	50	2.05	015FC10-12.5	015FC10-25	015FC10-50
	2/2	550.1–750.0	+ 0.3/-0.1	55	50	2.05	015FC12-12.5	015FC12-25	015FC12-50
2.0 ± 0.5	2/2	750.1–950.0	+ 0.3/-0.1	55	50	2.05	015FC14-12.5	015FC14-25	015FC14-50
	2/2	950.1–1100.0	+ 0.3/-0.1	65	50	2.05	015FC16-12.5	015FC16-25	015FC16-50
	2/2	240.0–320.0	+ 0.5/-0.2	-	6	1.45	020FC02-12.5	020FC02-25	020FC02-50
	2/2	320.1–387.0	+ 0.5/-0.2	-	10	1.45	020FC04-12.5	020FC04-25	020FC04-50
	2/2	387.1–430.0	+ 0.4/-0.2	30	25	1.45	020FC06-12.5	020FC06-25	020FC06-50
	2/2	430.1–480.0	+ 0.4/-0.2	50	45	1.45/2.05	020FC08-12.5	020FC08-25	020FC08-50
	2/2	480.1–550.0	+ 0.4/-0.2	55	50	2.05	020FC10-12.5	020FC10-25	020FC10-50
2.0 ± 0.5	2/2	550.1–750.0	+ 0.4/-0.2	55	50	2.05	020FC12-12.5	020FC12-25	020FC12-50
	2/2	750.1–950.0	+ 0.4/-0.2	65	50	2.05	020FC14-12.5	020FC14-25	020FC14-50
	2/2	950.1–1100.0	+ 0.4/-0.2	55	45	2.05	020FC16-12.5	020FC16-25	020FC16-50
	3/3	430.0–480.0	+ 0.4/-0.2	50	40	1.45/2.05	020FC34-12.5	020FC34-25	020FC34-50
	3/3	480.1–550.0	+ 0.4/-0.2	55	45	2.05	020FC35-12.5	020FC35-25	020FC35-50
	3/3	550.1–750.0	+ 0.4/-0.2	55	45	2.05	020FC36-12.5	020FC36-25	020FC36-50
3.0 ± 0.5	3/3	750.1–950.0	+ 0.4/-0.2	60	50	2.05	020FC37-12.5	020FC37-25	020FC37-50
	3/3	950.1–1100.0	+ 0.4/-0.2	65	45	2.05	020FC38-12.5	020FC38-25	020FC38-50
	2/2	240.0–320.0	+ 0.5/-0.3	-	8	1.45	030FC02-12.5	030FC02-25	030FC02-50
	2/2	320.1–387.0	+ 0.5/-0.3	-	10	1.45	030FC04-12.5	030FC04-25	030FC04-50
	2/2	387.1–430.0	+ 0.5/-0.3	40	25	1.45	030FC06-12.5	030FC06-25	030FC06-50
	2/2	430.1–480.0	+ 0.5/-0.3	45	35	1.45/2.05	030FC08-12.5	030FC08-25	030FC08-50
	2/2	480.1–550.0	+ 0.5/-0.3	55	50	2.05	030FC10-12.5	030FC10-25	030FC10-50
3.0 ± 0.5	2/2	550.1–750.0	+ 0.5/-0.3	55	50	2.05	030FC12-12.5	030FC12-25	030FC12-50
	2/2	750.1–950.0	+ 0.5/-0.3	55	50	2.05	030FC14-12.5	030FC14-25	030FC14-50
	2/2	950.1–1100.0	+ 0.5/-0.3	65	50	2.05	030FC16-12.5	030FC16-25	030FC16-50

STEP 1 Select Bandwidth, Filter Type and CW/L			STEP 2 Select Blocking Range				STEP 3 Select Size and Corresponding Part Number		
Bandwidth (FWHM)	Cavities/ Filter	CW/L Range	CW/L Tolerance	Min. T (%) When Blocked To			Size, Shape & Part Number		
(nm)	Type	(nm)	(nm)	1μ	FIR	n*	12.5mm Ø	25mm Ø	50mm Ø
3.0 ± 0.5	3/3	430.0-480.0	+ 0.5/-0.3	50	40	1.45/2.05	030FC34-12.5	030FC34-25	030FC34-50
	3/3	480.0-550.0	+ 0.5/-0.3	55	45	2.05	030FC35-12.5	030FC35-25	030FC35-50
	3/3	550.0-750.0	+ 0.5/-0.3	55	45	2.05	030FC36-12.5	030FC36-25	030FC36-50
	3/3	750.0-950.0	+ 0.5/-0.3	60	50	2.05	030FC37-12.5	030FC37-25	030FC37-50
	3/3	950.0-1100.0	+ 0.5/-0.3	55	45	2.05	030FC38-12.5	030FC38-25	030FC38-50
5.0 ± 1.0	2/2	240.0-320.0	+ 1/-0.5	-	8	1.45	050FC02-12.5	050FC02-25	050FC02-50
	2/2	320.1-385.0	+ 1/-0.5	-	25	1.45	050FC04-12.5	050FC04-25	050FC04-50
	2/2	385.1-480.0	+ 1/-0.5	45	35	1.45/2.05	050FC06-12.5	050FC06-25	050FC06-50
	2/2	480.1-550.0	+ 1/-0.5	55	50	2.05	050FC10-12.5	050FC10-25	050FC10-50
	2/2	550.1-750.0	+ 1/-0.5	55	50	2.05	050FC12-12.5	050FC12-25	050FC12-50
	2/2	750.1-950.0	+ 1/-0.5	60 <sup>a</sup>	45	2.05	050FC14-12.5	050FC14-25	050FC14-50
	2/2	950.1-1100.0	+ 1/-0.5	65 <sup>b</sup>	45	2.05	050FC16-12.5	050FC16-25	050FC16-50
	2/2	1100.1-1300.0	+ 1/-0.5	55 <sup>c</sup>	40	2.05	050FC18-12.5	050FC18-25	050FC18-50
	2/2	1300.1-1550.0	+ 1/-0.5	50 <sup>d</sup>	35	2.05	050FC19-12.5	050FC19-25	050FC19-50
2/2	1550.1-2000.0	+ 1/-0.5	50 <sup>c</sup>	-	2.05	050FC20-12.5	050FC20-25	050FC20-50	
5.0 ± 1.0	3/3	400.0-430.0	+ 1/-0.5	45	40	1.45	050FC33-12.5	050FC33-25	050FC33-50
	3/3	430.1-460.0	+ 1/-0.5	55	40	1.45	050FC34-12.5	050FC34-25	050FC34-50
	3/3	460.1-550.0	+ 1/-0.5	55	45	1.45 / 2.05	050FC35-12.5	050FC35-25	050FC35-50
	3/3	550.1-750.0	+ 1/-0.5	55	45	2.05	050FC36-12.5	050FC36-25	050FC36-50
	3/3	750.1-950.0	+ 1/-0.5	60 <sup>a</sup>	45	2.05	050FC37-12.5	050FC37-25	050FC37-50
	3/3	950.1-1100.0	+ 1/-0.5	55 <sup>b</sup>	40	2.05	050FC38-12.5	050FC38-25	050FC38-50
	3/3	1100.1-1300.0	+ 1/-0.5	50 <sup>c</sup>	35	2.05	050FC39-12.5	050FC39-25	050FC39-50
5.0 ± 1.0	4/4	460.0-550.0	+ 1/-0.5	60	50	1.45 / 2.05	050FC45-12.5	050FC45-25	050FC45-50
	4/4	550.1-750.0	+ 1/-0.5	60	50	2.05	050FC46-12.5	050FC46-25	050FC46-50
	4/4	750.1-950.0	+ 1/-0.5	55 <sup>a</sup>	45	2.05	050FC47-12.5	050FC47-25	050FC47-50
	4/4	950.1-1100.0	+ 1/-0.5	55 <sup>b</sup>	40	2.05	050FC48-12.5	050FC48-25	050FC48-50
10.0 ± 2.0	MDM/7	214.0-250.0	+ 2/-1	-	12	--	100FC00-12.5	100FC00-25	100FC00-50
	MDM/7	250.1-320.0	+ 2/-1	-	15	--	100FC02-12.5	100FC02-25	100FC02-50
	3/3	320.1-385.0	+ 2/-1	-	25	--	100FC32-12.5	100FC32-25	100FC32-50
	3/3	385.1-430.0	+ 2/-1	50	40	1.45	100FC33-12.5	100FC33-25	100FC33-50
	3/3	430.1-480.0	+ 2/-1	60	50	1.45 / 2.05	100FC34-12.5	100FC34-25	100FC34-50
	3/3	480.1-550.0	+ 2/-1	70	55	2.05	100FC35-12.5	100FC35-25	100FC35-50
	3/3	550.1-750.0	+ 2/-1	70	55	2.05	100FC36-12.5	100FC36-25	100FC36-50
	3/3	750.1-950.0	+ 2/-1	70 <sup>a</sup>	45	2.05	100FC37-12.5	100FC37-25	100FC37-50
	3/3	950.1-1100.0	+ 2/-1	70 <sup>b</sup>	45	2.05	100FC38-12.5	100FC38-25	100FC38-50
	3/3	1100.1-1300.0	+ 2/-1	70 <sup>c</sup>	35	2.05	100FC39-12.5	100FC39-25	100FC39-50
	2/2	1300.1-1550.0	+ 2/-1	70 <sup>d</sup>	35	2.05	100FC40-12.5	100FC40-25	100FC40-50
	2/2	1550.1-2400.0	+ 2/-1	60 <sup>c</sup>	-	2.05	100FC41-12.5	100FC41-25	100FC41-50

a= Blocking to 1200nm b= Blocking to 1300nm c= Blocking to 1550nm d= Blocking to 2400nm e= Blocking to 3200nm

STEP 1 Select Bandwidth, Filter Type and CW/L			STEP 2 Select Blocking Range				STEP 3 Select Size and Corresponding Part Number		
Bandwidth (FWHM)	Cavities/Filter	CW/L Range	CW/L Tolerance	Min. T (%) When Blocked To			Size, Shape & Part Number		
(nm)	Type	(nm)	(nm)	1μ	FIR	n*	12.5mm Ø	25mm Ø	50mm Ø
10.0 ± 2.0	4/4	460.0-550.0	+ 2/-1	60	40	1.45/2.05	100FC45-12.5	100FC45-25	100FC45-50
	4/4	550.0-750.0	+ 2/-1	60	45	2.05	100FC46-12.5	100FC46-25	100FC46-50
	4/4	750.0-950.0	+ 2/-1	70 <sup>a</sup>	50	2.05	100FC47-12.5	100FC47-25	100FC47-50
	4/4	950.0-1100.0	+ 2/-1	70 <sup>b</sup>	45	2.05	100FC48-12.5	100FC48-25	100FC48-50
	4/4	1100.0-1300.0	+ 2/-1	70 <sup>c</sup>	30	2.05	100FC49-12.5	100FC49-25	100FC49-50
20.0 ± 4.0	MDM/8	214.0-250.0	± 2.5	-	12	-	200FC00-12.5	200FC00-25	200FC00-50
	MDM/8	250.1-320.0	± 2.5	-	15	-	200FC02-12.5	200FC02-25	200FC02-50
	5/5	320.1-400.0	± 2.5	-	30	1.45	200FC32-12.5	200FC32-25	200FC32-50
20.0 ± 4.0	3/3	400.1-480.0	± 2.0	50	45	1.45	200FC33-12.5	200FC33-25	200FC33-50
	3/3	480.1-550.0	± 2.0	65	50	1.45	200FC35-12.5	200FC35-25	200FC35-50
	3/3	550.1-750.0	± 2.0	70	50	1.45/2.05	200FC36-12.5	200FC36-25	200FC36-50
	3/3	750.1-950.0	± 2.0	70 <sup>a</sup>	50	2.05	200FC37-12.5	200FC37-25	200FC37-50
	3/3	950.1-1100.0	± 2.0	70 <sup>b</sup>	50	2.05	200FC38-12.5	200FC38-25	200FC38-50
	3/3	1100.1-1300.0	± 2.0	70 <sup>c</sup>	30	2.05	200FC39-12.5	200FC39-25	200FC39-50
	3/3	1300.1-1550.0	± 2.0	70 <sup>d</sup>	30	2.05	200FC40-12.5	200FC40-25	200FC40-50
	3/3	1550.1-2400.0	± 2.0	60 <sup>e</sup>	30	2.05	200FC41-12.5	200FC41-25	200FC41-50
20.0 ± 4.0	4/4	480.0-550.0	± 2.0	65	45	1.45	200FC45-12.5	200FC45-25	200FC45-50
	4/4	550.1-750.0	± 2.0	70	50	1.45/2.05	200FC46-12.5	200FC46-25	200FC46-50
	4/4	750.1-950.0	± 2.0	70 <sup>a</sup>	50	2.05	200FC47-12.5	200FC47-25	200FC47-50
	4/4	950.1-1100.0	± 2.0	70 <sup>b</sup>	40	2.05	200FC48-12.5	200FC48-25	200FC48-50
40.0 ± 10.0	MDM/8	230.0-250.0	± 5.0	-	15	-	400FC00-12.5	400FC00-25	400FC00-50
	MDM/8	250.1-320.0	± 5.0	-	20	-	400FC02-12.5	400FC02-25	400FC02-50
	5/5	320.1-399.9	± 5.0	-	30	1.45	400FC52-12.5	400FC52-25	400FC52-50
50.0 ± 10.0	5/5	400.0-460.0	± 5.0	60	45	1.45	500FC53-12.5	500FC53-25	500FC53-50
	5/5	460.1-520.1	± 5.0	70	50	1.45	500FC54-12.5	500FC54-25	500FC54-50
	4/4	520.1-750.1	± 5.0	70	50	2.05	500FC46-12.5	500FC46-25	500FC46-50
	4/4	750.1-900.0	± 5.0	75 <sup>a</sup>	50	2.05	500FC47-12.5	500FC47-25	500FC47-50
	3/3	900.1-1100.0	± 5.0	75 <sup>b</sup>	45	2.05	500FC38-12.5	500FC38-25	500FC38-50
	3/3	1100.1-1300.0	± 5.0	70 <sup>c</sup>	35	2.05	500FC39-12.5	500FC39-25	500FC39-50
	3/3	1300.1-1550.0	± 5.0	70 <sup>d</sup>	30	2.05	500FC40-12.5	500FC40-25	500FC40-50
	3/3	1550.1-2400.0	± 5.0	70 <sup>e</sup>	-	2.05	500FC41-12.5	500FC41-25	500FC41-50
60.0 ± 10.0	5/5	340.0-399.0	± 6.0	-	30	1.45	600FC52-12.5	600FC52-25	600FC52-50
80.0 ± 20.0	5/5	460.0-750.0	± 10.0	75	-	1.45	800FC55-12.5	800FC55-25	800FC55-50
	4/4	750.1-900.0	± 10.0	75 <sup>a</sup>	-	1.45	800FC47-12.5	800FC47-25	800FC47-50
	4/4	900.1-1100.0	± 10.0	70 <sup>b</sup>	-	2.05	800FC48-12.5	800FC48-25	800FC48-50
	4/4	1100.1-1300.0	± 10.0	70 <sup>c</sup>	-	2.05	800FC49-12.5	800FC49-25	800FC49-50
	4/4	1300.1-1550.0	± 10.0	70 <sup>d</sup>	-	2.05	800FC50-12.5	800FC50-25	800FC50-50
	4/4	1550.1-2400.0	± 10.0	70 <sup>e</sup>	-	2.05	800FC51-12.5	800FC51-25	800FC51-50

a= Blocking to 1200nm b= Blocking to 1300nm c= Blocking to 1550nm d= Blocking to 2400nm e= Blocking to 3200nm

# Astronomy UBVRI Filters

Andover Corporation offers two sets of UBVRI filters—the Johnson/Bessel and the Kron/Cousins types—as standard items. These wideband filters isolate and measure large specific bands of light emitted by astronomical objects. Both types have the same ultraviolet, blue and visible filters but different red and infrared filters. The Johnson/Bessel type is better suited for use with a photomultiplier tube, while the Kron/Cousins type is better suited for use with a Silicon CCD.

- Options for professionals and amateurs alike
- Ideal for photometric calibration



## Johnson / Bessel Filter Specifications

	U	B	V	R	I
Nominal CW/L:	365nm	440nm	520nm	630nm	900nm
Nominal FWHM:	60nm	100nm	90nm	120nm	300nm
Nominal Transmission:	> 50%	> 55%	> 70%	> 70%	> 70%

## Kron / Cousins Filter Specifications

	U	B	V	R	I
Nominal CW/L:	365nm	440nm	520nm	760nm	800nm
Nominal FWHM:	60nm	100nm	90nm	250nm	150nm
Nominal Transmission:	> 50%	> 55%	> 70%	> 70%	> 70%

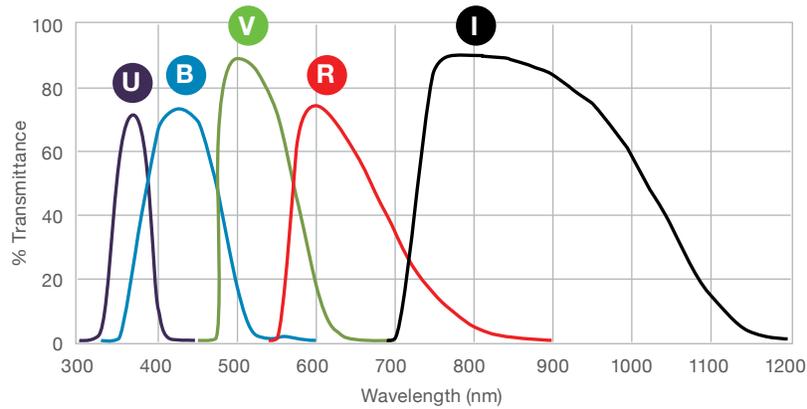
## General Specifications

<b>Thickness:</b>	5.0mm +/-0.1mm
<b>Size Tolerance:</b>	+0/-0.25mm
<b>Bevels:</b>	Break all sharp edges
<b>Coating Durability:</b>	Per MIL-C-48497A moderate abrasion
<b>Construction:</b>	3 – 5 waves
<b>Transmitter Wavefront:</b>	1/4 wave or better per 25mm
<b>Parallelism:</b>	30 arc seconds or better
<b>Surface Quality:</b>	60/40 or better per MIL-C-675
<b>Optical Quality:</b>	Image Quality
<b>AR Coatings:</b>	Exterior surfaces (appropriate to the filter passband)

For custom UBVRI filters contact an Andover Corporation representative for questions or further information  
Order online at [www.andovercorp.com](http://www.andovercorp.com) or call us at 1.888.893.9992 (Toll-free in the US)

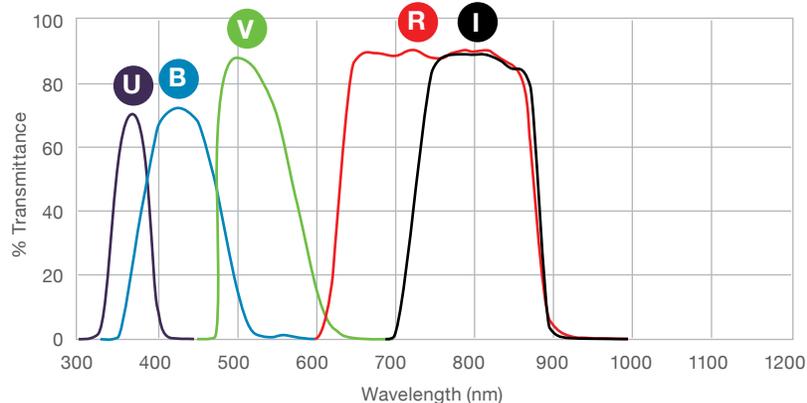
## Johnson/Bessel UBVR Filters

Size, Shape & Part Number & Type					
			Mounted	Mounted	
Type	25mm Ø	50mm Ø	50mm SQ	31mm Ø	50mm Ø
<b>U</b> Ultraviolet	JOHN-U-25	JOHN-U-50	JOHN-U-50S	JOHN-U-31M	JOHN-U-50M
<b>B</b> Blue	JOHN-B-25	JOHN-B-50	JOHN-B-50S	JOHN-B-31M	JOHN-B-50M
<b>V</b> Visible	JOHN-V-25	JOHN-V-50	JOHN-V-50S	JOHN-V-31M	JOHN-V-50M
<b>R</b> Red	JOHN-R-25	JOHN-R-50	JOHN-R-50S	JOHN-R-31M	JOHN-R-50M
<b>I</b> Infrared	JOHN-I-25	JOHN-I-50	JOHN-I-50S	JOHN-I-31M	JOHN-I-50M
5 Piece Sets	JOHN-FA-25	JOHN-FA-50	JOHN-FA-50S	JOHN-FA-31M	JOHN-FA-50M



## KRON/Cousins UBVR Filters

Size, Shape & Part Number & Type					
			Mounted	Mounted	
Type	25mm Ø	50mm Ø	50mm SQ	31mm Ø	50mm Ø
<b>U</b> Ultraviolet	KRON-U-25	KRON-U-50	KRON-U-50S	KRON-U-31M	KRON-U-50M
<b>B</b> Blue	KRON-B-25	KRON-B-50	KRON-B-50S	KRON-B-31M	KRON-B-50M
<b>V</b> Visible	KRON-V-25	KRON-V-50	KRON-V-50S	KRON-V-31M	KRON-V-50M
<b>R</b> Red	KRON-R-25	KRON-R-50	KRON-R-50S	KRON-R-31M	KRON-R-50M
<b>I</b> Infrared	KRON-I-25	KRON-I-50	KRON-I-50S	KRON-I-31M	KRON-I-50M
5 Piece Sets	KRON-FA-25	KRON-FA-50	KRON-FA-50S	KRON-FA-31M	KRON-FA-50M



# Metallic Neutral Density Filters

## Typical Applications Include:

- Calibration
- Attenuation
- Low-Power Lasers
- Scientific Measurements and Research
- Machine Vision and Other Imaging Applications

Metallic-coated neutral density (ND) filters obtain their optical density from a metal alloy coating on a substrate determined by the wavelength region of interest. Unlike the all-dielectric or absorption type, the metallic type ND filter employs a combination of absorption and reflection to reduce the intensity of light. While able to withstand more incident power than the absorptive type, metallic ND filters are suitable only for low-energy pulsed applications. (Note: If used in series, these filters should be tilted to avoid multiple reflections and any reduction of density).

- **Provides attenuation with greater linearity over a wide spectral range**
- **Reduces thermal effects in low-power laser applications**
- **Soda lime glass, fused silica and custom substrates available**
- **Delivers superior durability**



## General Specifications

<b>Thickness:</b>	1.5 ±0.5mm
<b>Dimensional Tolerances:</b>	+0/-0.2mm
<b>Clear Aperture:</b>	90% of outside dimension
<b>Surface Quality:</b>	80/50 per MIL-0-13830B
<b>Coating Adherence:</b>	Per MIL-M-13508C
<b>Humidity:</b>	Per MIL-STD-810F
<b>Max. Operating Temperature:</b>	+200°C
<b>Substrate Materials:</b>	Glass (350–2000nm region) or fused silica (250–2000nm region)
<b>Optical Quality:</b>	Glass: Flatness of 3–5 waves per inch and parallelism of 3 arc minutes or better. Fused Silica: Flatness of $\lambda/4$ per inch and parallelism of 30 arc seconds or better.
<b>Mechanical:</b>	Unmounted

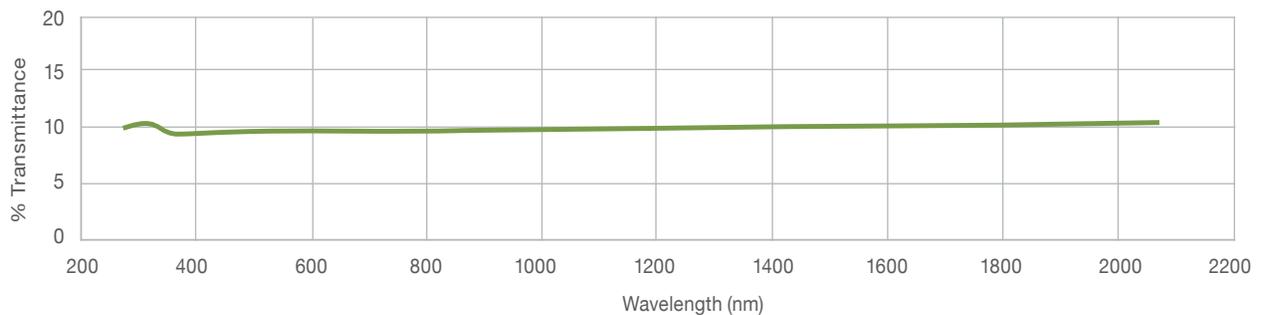
*Optional: Mounted in threaded ring - see pg 58 for thread sizes*

## Visible/near infrared region (Glass Substrate, 350–2000nm)

Optical Density	Nominal Transmission (%)	Transmission Deviation From Nominal (%)		
		250-400nm	400-800nm	800-2000nm
0.10	79.4	± 9.0	± 3.0	± 9.0
0.15	70.8	± 8.0	± 3.0	± 8.0
0.20	63.0	± 6.0	± 2.0	± 6.0
0.30	50.0	± 5.0	± 2.0	± 5.0
0.40	39.8	± 4.0	± 1.5	± 4.0
0.50	31.6	± 4.0	± 1.5	± 4.0
0.60	25.0	± 4.0	± 1.5	± 4.0
0.70	20.0	± 4.0	± 1.5	± 4.0
0.80	15.5	± 4.0	± 1.5	± 4.0
0.90	12.6	± 3.5	± 1.0	± 3.5
1.00	10.0	± 3.5	± 1.0	± 3.5
1.30	5.0	± 3.0	± 1.0	± 3.0
1.50	3.2	± 1.5	± 0.5	± 1.5
2.00	1.0	± 0.5	± 0.2	± 0.5
2.50	0.32	± 0.15	± 0.07	± 0.15
3.00	0.10	± 0.06	± 0.05	± 0.1 (nominal)
4.00	0.01	± 0.008	+ 0.01/-0.008	± 0.01 (nominal)

For sets see pg 32; Infrared NDs also available - see pg 51 for details

## Typical 1.0 ND Filter on Fused Silica



**Visible / Near Infrared Region (Glass Substrate, 350–2000nm)**

Optical Density	Nominal Transmission (%)	Size, Shape & Part Number			
		12.5mm Ø	25mm Ø	50mm Ø	50mm SQ
0.10	79.4	010FN52-12.5	010FN52-25	010FN52-50	010FN52-50S
0.15	70.8	015FN52-12.5	015FN52-25	015FN52-50	015FN52-50S
0.20	63.0	020FN52-12.5	020FN52-25	020FN52-50	020FN52-50S
0.30	50.0	030FN52-12.5	030FN52-25	030FN52-50	030FN52-50S
0.40	39.8	040FN52-12.5	040FN52-25	040FN52-50	040FN52-50S
0.50	31.6	050FN52-12.5	050FN52-25	050FN52-50	050FN52-50S
0.60	25.0	060FN52-12.5	060FN52-25	060FN52-50	060FN52-50S
0.70	20.0	070FN52-12.5	070FN52-25	070FN52-50	070FN52-50S
0.80	15.5	080FN52-12.5	080FN52-25	080FN52-50	080FN52-50S
0.90	12.6	090FN52-12.5	090FN52-25	090FN52-50	090FN52-50S
1.00	10.0	100FN52-12.5	100FN52-25	100FN52-50	100FN52-50S
1.30	5.0	130FN52-12.5	130FN52-25	130FN52-50	130FN52-50S
1.50	3.2	150FN52-12.5	150FN52-25	150FN52-50	150FN52-50S
2.00	1.0	200FN52-12.5	200FN52-25	200FN52-50	200FN52-50S
2.50	0.32	250FN52-12.5	250FN52-25	250FN52-50	250FN52-50S
3.00	0.10	300FN52-12.5	300FN52-25	300FN52-50	300FN52-50S
4.00	0.01	400FN52-12.5	400FN52-25	400FN52-50	400FN52-50S

For sets see pg 32; Infrared NDs also available - see pg 51 for details

**Ultraviolet / Visible / Near Infrared Region (Fused Silica, 250–2000nm)**

Optical Density	Nominal Transmission (%)	Size, Shape & Part Number			
		12.5mm Ø	25mm Ø	50mm Ø	50mm SQ
0.10	79.4	010FN46-12.5	010FN46-25	010FN46-50	010FN46-50S
0.15	70.8	015FN46-12.5	015FN46-25	015FN46-50	015FN46-50S
0.20	63.0	020FN46-12.5	020FN46-25	020FN46-50	020FN46-50S
0.30	50.0	030FN46-12.5	030FN46-25	030FN46-50	030FN46-50S
0.40	39.8	040FN46-12.5	040FN46-25	040FN46-50	040FN46-50S
0.50	31.6	050FN46-12.5	050FN46-25	050FN46-50	050FN46-50S
0.60	25.0	060FN46-12.5	060FN46-25	060FN46-50	060FN46-50S
0.70	20.0	070FN46-12.5	070FN46-25	070FN46-50	070FN46-50S
0.80	15.5	080FN46-12.5	080FN46-25	080FN46-50	080FN46-50S
0.90	12.6	090FN46-12.5	090FN46-25	090FN46-50	090FN46-50S
1.00	10.0	100FN46-12.5	100FN46-25	100FN46-50	100FN46-50S
1.30	5.0	130FN46-12.5	130FN46-25	130FN46-50	130FN46-50S
1.50	3.2	150FN46-12.5	150FN46-25	150FN46-50	150FN46-50S
2.00	1.0	200FN46-12.5	200FN46-25	200FN46-50	200FN46-50S
2.50	0.32	250FN46-12.5	250FN46-25	250FN46-50	250FN46-50S
3.00	0.10	300FN46-12.5	300FN46-25	300FN46-50	300FN46-50S
4.00	0.01	400FN46-12.5	400FN46-25	400FN46-50	400FN46-50S

# Absorptive Neutral Density Filters

## Typical Applications Include:

- Photomicrography
- Machine Vision
- Calibration
- Photography
- Scientific Measurements and Research



## General Specifications

<b>Thickness:</b>	5.0mm (maximum)
<b>Dimensional Tolerance:</b>	+0.0/-0.25mm
<b>Clear Aperture:</b>	90% of outside dimension
<b>Surface Quality:</b>	80/50 per MIL-0-13830B
<b>Max. Operating Temperature:</b>	+100°C
<b>Substrate Material:</b>	Schott absorption glass
<b>Spectral Range:</b>	400–700nm
<b>Optical Quality:</b>	Flatness of $\lambda/4$ per inch and parallelism of 30 arc seconds or better
<b>Mechanical:</b>	Unmounted

Threaded ring mount, optional - see pg 58 for thread sizes

With their ability to minimize back-reflections and scattered light, absorptive neutral density (ND) filters are ideal for calibration. In contrast to the metallic type, absorption-type filters achieve their optical density by absorbing light within the substrate. For this reason, thickness is a key determinant of opacity. Given their absorbing quality, these filters are suitable for low-power applications only.

Andover's absorbing ND filters are unique in that they are AR coated to reduce surface reflections. Polished to TWF 1/4 wave or better, this enables them to be stacked without concern about losses and artifacts due to multiple reflections. Absorbing ND filters are perfect for imaging applications

- Sets provide a uniform series of filters for adjusting illumination
- Custom configurations available

Size, Shape & Part Number						
Optical Density	Nominal Transmission (%)	Density Tolerance @ 550nm (%)	Thickness (nm)	25mm Ø	50mm Ø	
0.10	79.5	± 20.00	4.95	010ABND-25	010ABND-50S	
0.20	63.0	± 10.00	1.52	020ABND-25	020ABND-50S	
0.30	50.0	± 10.00	2.84	030ABND-25	030ABND-50S	
0.40	39.8	± 10.00	3.78	040ABND-25	040ABND-50S	
0.50	31.6	± 10.00	2.11	050ABND-25	050ABND-50S	
0.60	25.0	± 10.00	2.54	060ABND-25	060ABND-50S	
0.70	20.0	± 10.00	2.95	070ABND-25	070ABND-50S	
0.80	15.8	± 10.00	3.38	080ABND-25	080ABND-50S	
0.90	12.6	± 10.00	1.75	090ABND-25	090ABND-50S	
1.00	10.0	± 10.00	1.96	100ABND-25	100ABND-50S	
1.50	3.2	± 10.00	2.90	150ABND-25	150ABND-50S	
2.00	1.0	± 10.00	2.06	200ABND-25	200ABND-50S	
3.00	0.10	± 10.00	2.92	300ABND-25	300ABND-50S	
4.00	0.01	± 10.00	2.82	400ABND-25	400ABND-50S	

# Neutral Density Sets

- Standard or user-defined neutral density filter sets
- ND filters sets come in quality hardwood case for secure storage



## Metallic-Coated Sets

Andover's metallic-coated neutral density filter sets feature both round and square filters in your choice of four sizes and two substrates.

### 7 Piece Set

Includes seven filters with optical densities ranging from 0.10 to 4.00, in your choice of four set sizes, in either glass or fused silica substrates.

**0.10    0.30    0.50    1.00    2.00    3.00    4.00**

Size, Shape & Part Number				
Substrate (mm)	12.5 Ø	25 Ø	50 Ø	50 SQ
Glass	128FA52-12.5	128FA52-25	128FA52-50	128FA52-50S
Fused Silica	130FA46-12.5	130FA46-25	130FA46-50	130FA46-50S

### 17 Piece Set

Includes seventeen filters with optical densities ranging from 0.10 to 4.00, in your choice of four set sizes, in either glass or fused silica substrates.

**0.10    0.15    0.20    0.30    0.40    0.50    0.60  
0.70    0.80    0.90    1.00    1.30    1.50    2.00  
2.50    3.00    4.00**

Size, Shape & Part Number				
Substrate (mm)	12.5 Ø	25 Ø	50 Ø	50 SQ
Glass	132FA52-12.5	132FA52-25	132FA52-50	132FA52-50S
Fused Silica	134FA46-12.5	134FA46-25	130FA46-50	134FA46-50S

## Absorptive Sets

Andover's absorptive neutral density filter sets provide a choice of either round or square filters

### 7 Piece Set

Includes seven filters with optical densities ranging from 0.10 to 4.00.

**0.10    0.30    0.50    1.00  
2.00    3.00    4.00**

Size, Shape & Part Number	
25mm Ø	50mm Ø
135FAND-25	135FAND-50S

### 14 Piece Set

Includes fourteen filters with optical densities ranging from 0.10 to 4.00.

**0.10    0.20    0.30    0.40    0.50  
0.60    0.70    0.80    0.90    1.00  
1.50    2.00    3.00    4.00**

Size, Shape & Part Number	
25mm Ø	50mm Ø
135FAND-25	135FAND-50S

# Heat Control Filters

## Typical Applications Include:

- Projection Systems
- Photocopiers
- Surgical and Dental Lighting
- Film and Photographic Apparatus
- Illumination Systems
- Scientific Instruments



## General Specifications

<b>Thickness:</b>	3.0mm ±0.5mm (6.0mm ±0.5mm for IR Suppressing)
<b>Size Tolerance:</b>	+0.0mm/-0.5mm
<b>Mn. Clear Aperture:</b>	95% of outside dimension
<b>Substrate Material:</b>	Borosilicate glass
<b>Flatness:</b>	5–10 waves per 25mm
<b>Parallelism:</b>	3 arc minutes or better
<b>Surface Quality:</b>	80/50 per MIL-O-13830
<b>Humidity / Abrasion:</b>	Per MIL-C-675A
<b>Max. Op. Temp.</b>	+200°C (+100°C for IR suppressing)
<b>Mechanical:</b>	Unmounted

Optional: Mounted in threaded ring - see pg 58 for thread sizes

A combination of hot and cold mirrors can essentially eliminate 99% of the radiation generated by high-power illumination systems. The cold mirror, mounted at a 45° angle of incidence, transmits much of the heat while reflecting the visible light. The hot mirror, mounted perpendicular to the light beam, reflects the remaining heat while transmitting 90% of the visible light.

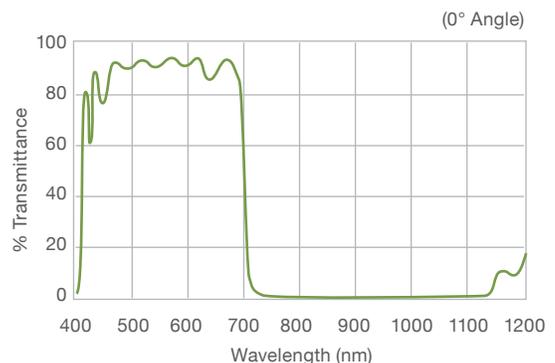
- Cold mirrors transmit near-IR and reflect visible light
- Hot mirrors reflect near-IR and transmit visible light
- Together, they effectively cool high-power illumination systems

## Hot Mirrors

Hot mirrors are heat-reflecting filters designed to transmit visible wavelengths and reflect near-infrared heat-generating wavelengths. Andover's hot mirrors have hard, first-surface dielectric coatings that meet or exceed the humidity and abrasion specifications listed above. The coatings are deposited onto a low-expansion material such as borosilicate glass to prevent cracking or crazing from high heat applications.

### Size, Shape & Part Number

25mm Ø	50mm Ø	50mm Ø
775FW82-25	775FW82-50	775FW82-50S

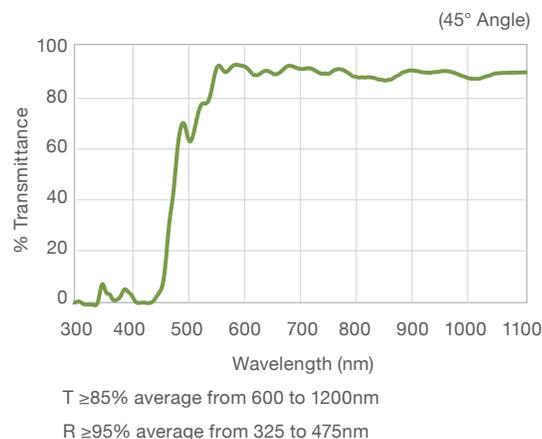


Average Transmittance: 425nm–675nm ≥91%  
 Minimum Transmittance: 450nm–675nm ≥75%  
 Average Reflection: 750nm–1150nm ≥95%

## Ultraviolet Cold Mirrors

Ultraviolet mirrors differ slightly from the standard cold mirror in that they reflect the ultraviolet and transmit the visible and infrared. They are excellent for applications that call for separating the ultraviolet from the visible and near infrared.

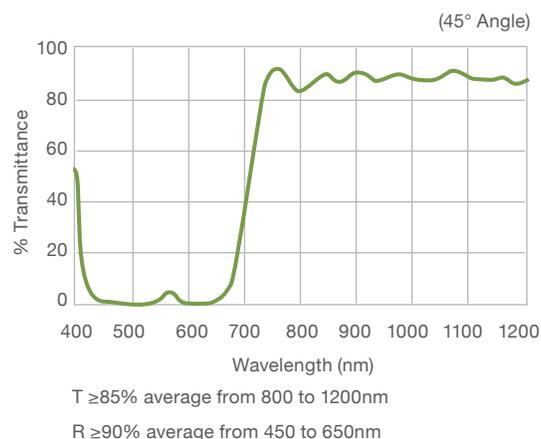
Size, Shape & Part Number		
25mm Ø	50mm Ø	50mm Ø
375FV86-25	375FV86-50	375FV86-50S



## Cold Mirrors

Cold mirrors are heat-transmitting filters designed to reflect visible wavelengths and transmit near-infrared wavelengths. Andover's cold mirrors have first-surface coatings that are deposited onto a low-expansion material such as borosilicate glass.

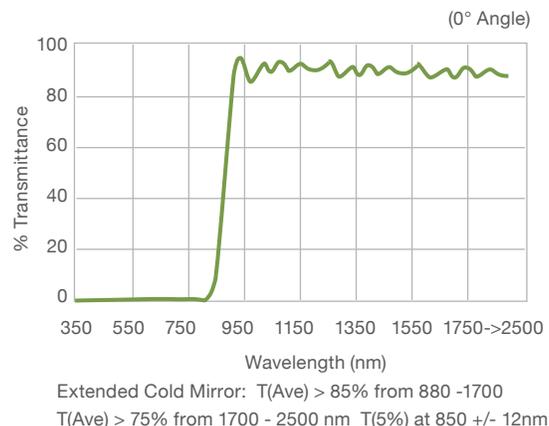
Size, Shape & Part Number		
25mm Ø	50mm Ø	50mm Ø
645FK84-25	645FK84-50	645FK84-50S



## 850nm Cold Mirrors

This version of the cold mirror is identical to the standard cold mirror, but with the reflection range extended to 850nm. It has excellent transmission throughout the NIR region.

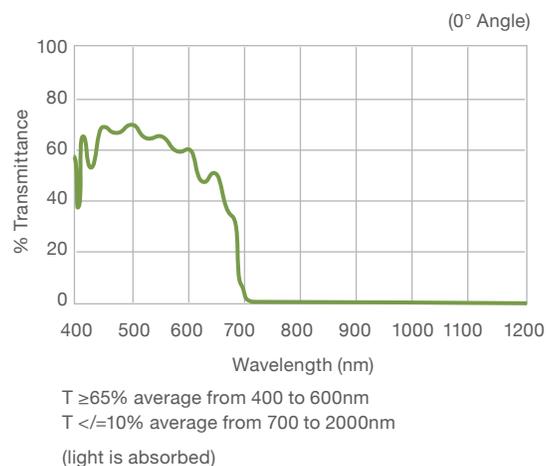
Size, Shape & Part Number		
25mm Ø	50mm Ø	50mm Ø
850FK84-25	850FK84-50	850FK84-50S



## Infrared Suppressing Filters

These filters extend the blocking of standard hot mirrors across the infrared range using a combination of reflection from the dielectric stack and absorption from an infrared absorbing filter glass. Because of this absorption factor, these filters are suitable only in low-power applications with a maximum filter temperature of 100°C.

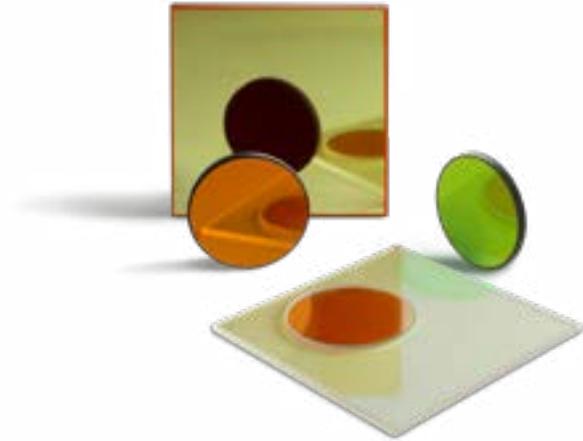
Size, Shape & Part Number		
25mm Ø	50mm Ø	50mm Ø
800FB72-25	800FB72-50	800FB72-50S



# Dichroic Filters

## Typical Applications Include:

- Fluorescence Microscopy
- UV-VIS Irradiation
- Camera Imaging
- Stage Lighting
- Architectural Lighting
- Projection Displays
- Color Enlargers
- Photocopiers



## General Specifications

<b>Thickness:</b>	1.0mm ±0.25mm
<b>Size Tolerance:</b>	+0.0mm/-0.25mm
<b>Min. Clear Aperture:</b>	95% of outside dimension
<b>Substrate Material:</b>	Soda lime glass
<b>Flatness:</b>	3–5 waves per 25mm
<b>Parallelism:</b>	3 arc minutes or better
<b>Surface Quality:</b>	80/50 per MIL-C-48497A
<b>Humidity and Abrasion:</b>	Per MIL-C-48497A
<b>Max. Operating Temperature:</b>	+200°C
<b>Mechanical:</b>	Unmounted

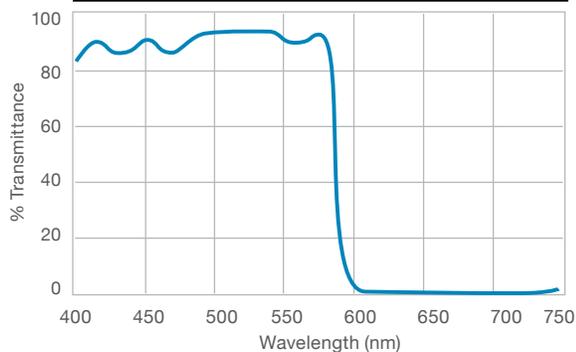
Optional: Mounted in threaded ring - see pg 58 for thread sizes

Far more durable than dyed plastic or gel-coated types, dichroic glass filters have a hard dielectric film created by thin layers of metallic oxides. These color separation filters are designed to isolate certain regions of the visible spectrum, reflecting rather than absorbing unwanted frequencies. As a result, they not only produce pure, intense color but also withstand the heat and UV energy from high-power light sources. Commonly used as light balancing filters in color enlargers and photocopiers, dichroic filters are suitable for any application that requires separating the incident light into two or more light beams.

- Provide sharp separation between transmission and reflection
- Spectrally stable at changing temperatures and humidity
- Available in custom designs, colors, angles of incidence, substrates, dimensions, and coatings

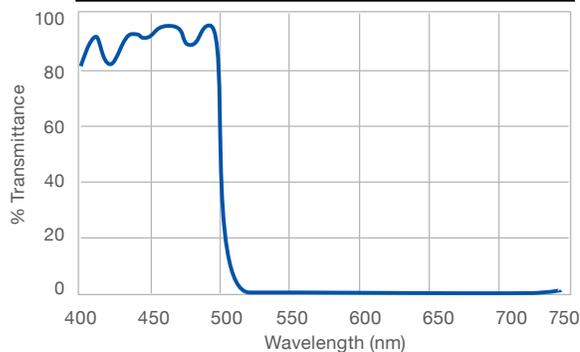
		Size, Shape & Part Number		
User-Defined Sets	Color	25mm Ø	50mm Ø	50mm Ø
Subtractive	Cyan	590FD24-25	590FD24-50	590FD24-50S
	Magenta	550FD26-25	550FD26-50	550FD26-50S
	Yellow	520FD22-25	520FD24-50	520FD22-50S
Additive	Blue	505FD64-25	505FD64-50	505FD64-50S
	Green	540FD66-25	540FD66-50	540FD66-50S
	Red	585FD62-25	585FD62-50	585FD62-50S
Reflective	Blue	475FD68-25	475FD68-50	475FD68-50S
	Red	580FD70-25	580FD70-50	580FD70-50S

**Cyan Subtractive Filter (0° Angle)**



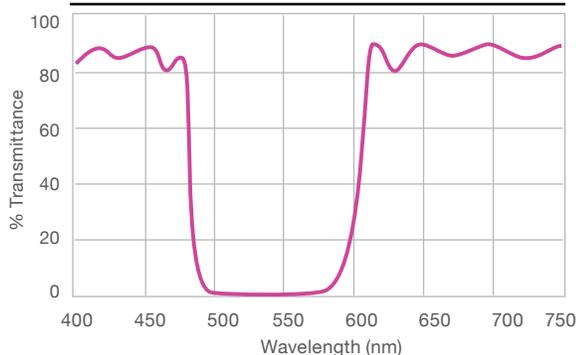
T: 80% Average 400nm–550nm 50% Point 590nm (nominal)  
R: 99% Average 640nm–740nm

**Blue Additive Filter (0° Angle)**



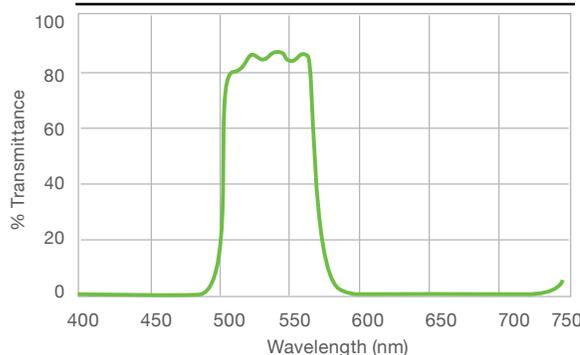
T: 80% Average 390nm–480nm 50% Point 505nm (nominal)  
R: 99% Average 540nm–750nm

**Magenta Subtractive Filter (0° Angle)**



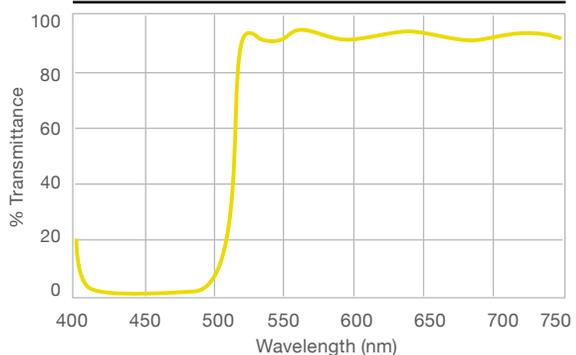
T: 80% Average 380nm–475nm 50% Points 495nm & 605nm (nominal)  
R: 99% Average 535nm–565nm T: 80% Average 650nm–750nm

**Green Additive Filter (0° Angle)**



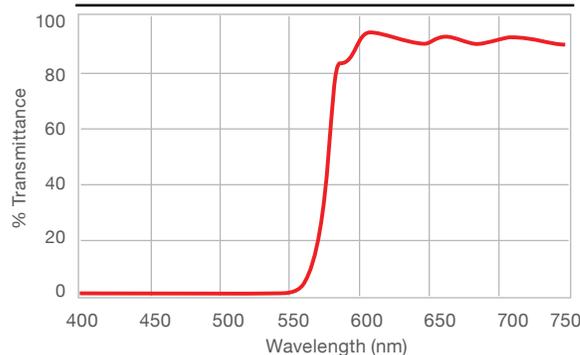
R: 99% Average 380nm–460nm 50% Points 505nm & 575nm (nominal)  
T: 85% Min at 540nm R: 99% Average 600nm–730nm

**Yellow Subtractive Filter (0° Angle)**



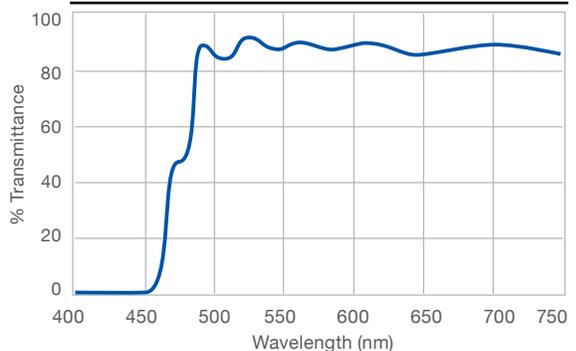
R: 99% Average 410nm–475nm 50% Point 520nm (nominal)  
T: 85% Average 550nm–750nm

**Red Additive Filter (0° Angle)**



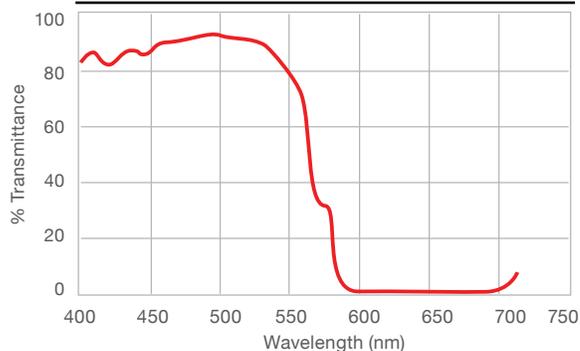
R: 99% Average 370nm–550nm 50% Point 585nm (nominal)  
T: 80% Average 610nm–730nm

**Blue Reflective Filter (45° Angle)**



R: 90% Average 380nm–450nm 50% Point 475nm (nominal)  
T: 85% Average 525nm–800nm

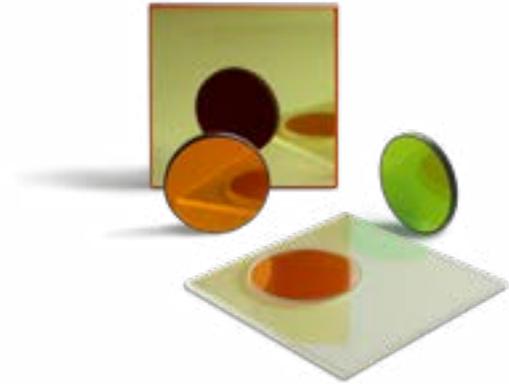
**Red Reflective Filter (45° Angle)**



T: 85% Average 400nm–550nm 50% Point 580nm (nominal)  
R: 90% Average 610nm–725nm

# Standard Dichroic Filter Sets

Excellent for color process work, Andover's select dichroic filter sets come in two configurations. Each set is accompanied by complete spectral curve data sheets and shipped in a protective storage case.



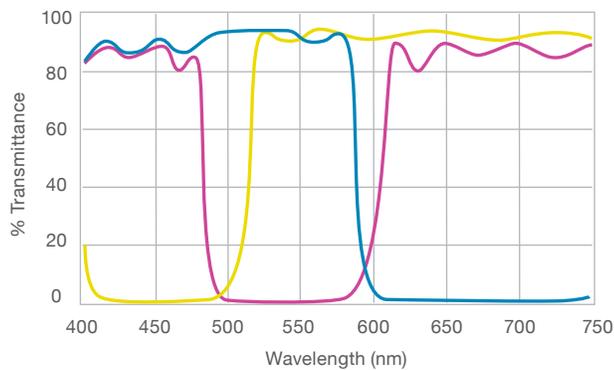
## Color **Subtractive**

### 3 Piece Set

Includes Cyan, Magenta and Yellow filters in your choice of three sizes.

Size, Shape & Part Number		
25mm Ø	50mm Ø	50mm Ø
126FA46-25	126FA46-50	126FA46-50S

- **Cyan**  
 T: 80% Average 400nm–550nm  
 R: 99% Average 640nm–740nm  
 50% Point 590nm (nominal)
- **Magenta**  
 T: 80% Average 380nm–475nm  
 R: 99% Average 535nm–565nm  
 T: 80% Average 650nm–750nm  
 50% Points 495nm & 605nm (nominal)
- **Yellow**  
 R: 99% Average 410nm–475nm  
 T: 85% Average 550nm–750nm  
 50% Cut-on 520nm (nominal)



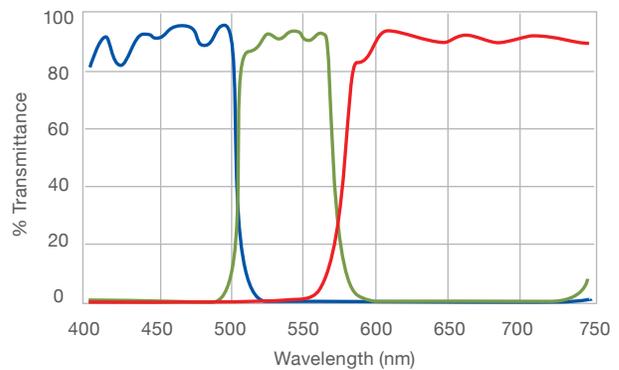
## Color **Additive**

### 3 Piece Set

Includes Blue, Green and Red filters in your choice of three sizes.

Size, Shape & Part Number		
25mm Ø	50mm Ø	50mm Ø
126FA44-25	126FA44-50	126FA44-50S

- **Blue**  
 T: 80% Average 390nm–480nm  
 R: 99% Average 540nm–750nm  
 50% Point 505nm (nominal)
- **Green**  
 R: 99% Average 380nm–460nm  
 T: 85% Minimum at 540nm  
 R: 99% Average 600nm–730nm  
 50% Points 505nm & 575nm (nominal)
- **Red**  
 R: 99% Average 370nm–550nm  
 T: 85% Average 610nm–730nm  
 50% Cut-on 585nm (nominal)



# User-Defined Dichroic Filter Sets

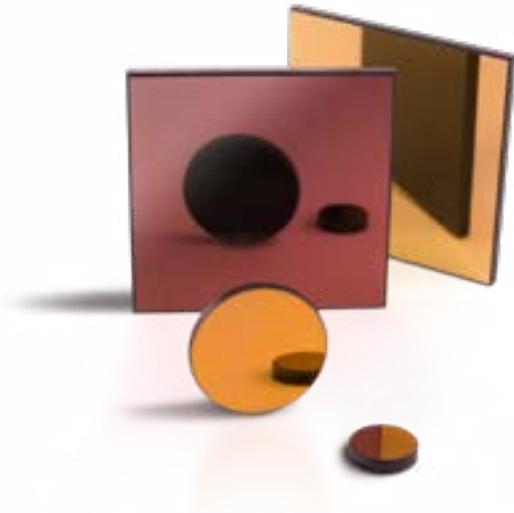


User-Defined Sets	Size, Shape & Part Number		
	25mm Ø	50mm Ø	50mm Ø
3-Piece Set	000FS03-25	000FS03-50	000FS03-50S
6-Piece Set	000FS06-25	000FS06-50	000FS06-50S
8-Piece Set	000FS08-25	000FS08-50	000FS08-50S

# Edge Filters

## Typical Applications Include:

- Fluorescence
- Photometry
- Color Enhancement and Combining



Often referred to as long wave pass (LWP) and short wave pass (SWP) filters, edge filters provide a well-defined transition between reflecting and transmitting regions. Essentially a modified quarter-wave stack, the filters use interference effects rather than absorption to isolate their spectral bands. Because edge filters will shift shorter with an increase in the angle of incidence, they are a good choice for fine-tuning the cut-on/cut-off wavelength. With their durable, first-surface dielectric coatings, Andover's edge filters are built to withstand the normal cleaning and handling required by any high-quality optical component.

- Useful for redirecting a particular band of light
- Provide steeper transition than color glass filters
- Offer coverage over the 300-1000nm range

## General Specifications

<b>Thickness:</b>	4.0mm maximum
<b>Size Tolerance:</b>	+0.0mm/-0.5mm
<b>Min. Clear Aperture:</b>	95% of outside dimension
<b>Substrate Material:</b>	BK-7, Borofloat, Fused Silica, Soda Lime Glass
<b>Flatness:</b>	3-5 waves per 25mm
<b>Surface Quality:</b>	80/50 per MIL-C-48497A
<b>Humidity and Abrasion:</b>	Per MIL-C-675A
<b>Operating Temperature:</b>	-50°C to +100°C
<b>Cut-on/cut-off Slopes:</b>	6% maximum (11% for 300nm filter)
<b>Cut-on/cut-off Tolerance:</b>	±10nm from 400nm - 1000nm ±5nm from 300nm - 375nm
<b>Mechanical:</b>	Unmounted

*Optional: Mounted in threaded ring - see pg 58 for thread sizes*

## Transmission

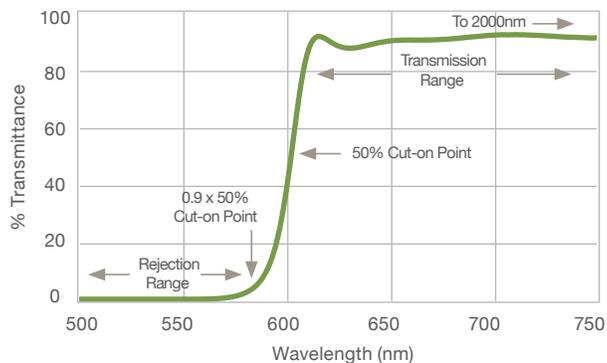
<b>Long Wave Pass:</b>	85% average from the 50% cut-on point to 2000nm
<b>Short Wave Pass:</b>	400nm 85% average from the 50% cut-on point to 300nm 450nm 85% average from the 50% cut-on point to 380nm 500 - 1000nm 85% average from the 50% cut-on point to 0.75 x the 50% cut-off point

*(Note: With the exception of the 400nm filter, all SWP filters will drop off in transmission at wavelengths under 425nm.)*

## Rejection

<b>Long Wave Pass:</b>	99% or greater from 0.9 x the 50% point to the ultraviolet
<b>Short Wave Pass:</b>	99% or greater from 1.07 x the 50% point to 1.25 x the 50% point
<b>Effective Index of Refraction (n*):</b>	1.7 (approximately)

Long Wave Pass



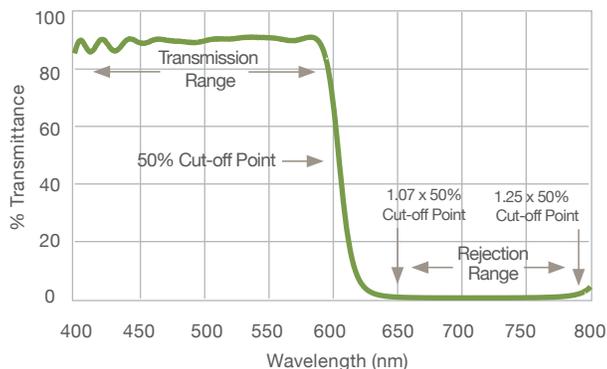
Visible

Size, Shape & Part Number				
50% Point (nm)	12.5mm Ø	25mm Ø	50mm Ø	50mm SQ
300	300FH90-12.5	300FH90-25	300FH90-50	300FH90-50S
325	325FH90-12.5	325FH90-25	325FH90-50	325FH90-50S
350	350FH90-12.5	350FH90-25	350FH90-50	350FH90-50S
375	375FH90-12.5	375FH90-25	375FH90-50	375FH90-50S
400	400FH90-12.5	400FH90-25	400FH90-50	400FH90-50S
450	450FH90-12.5	450FH90-25	450FH90-50	450FH90-50S
500	500FH90-12.5	500FH90-25	500FH90-50	500FH90-50S
550	550FH90-12.5	550FH90-25	550FH90-50	550FH90-50S
600	600FH90-12.5	600FH90-25	600FH90-50	600FH90-50S
650	650FH90-12.5	650FH90-25	650FH90-50	650FH90-50S
700	700FH90-12.5	700FH90-25	700FH90-50	700FH90-50S

Near Infrared

Size, Shape & Part Number				
50% Point (nm)	12.5mm Ø	25mm Ø	50mm Ø	50mm SQ
750	750FH90-12.5	750FH90-25	750FH90-50	750FH90-50S
800	800FH90-12.5	800FH90-25	800FH90-50	800FH90-50S
850	850FH90-12.5	850FH90-25	850FH90-50	850FH90-50S
900	900FH90-12.5	900FH90-25	900FH90-50	900FH90-50S
950	950FH90-12.5	950FH90-25	950FH90-50	950FH90-50S
1000	100FH90-12.5	100FH90-25	100FH90-50	100FH90-50S

Short Wave Pass



Visible

Size, Shape & Part Number				
50% Point (nm)	12.5mm Ø	25mm Ø	50mm Ø	50mm SQ
400	400FL07-12.5	400FL07-25	400FL07-50	400FL07-50S
450	450FL07-12.5	450FL07-25	450FL07-50	450FL07-50S
500	500FL07-12.5	500FL07-25	500FL07-50	500FL07-50S
550	550FL07-12.5	550FL07-25	550FL07-50	550FL07-50S
600	600FL07-12.5	600FL07-25	600FL07-50	600FL07-50S
650	650FL07-12.5	650FL07-25	650FL07-50	650FL07-50S
700	700FL07-12.5	700FL07-25	700FL07-50	700FL07-50S

Near Infrared

Size, Shape & Part Number				
50% Point (nm)	12.5mm Ø	25mm Ø	50mm Ø	50mm SQ
750nm	750FL07-12.5	750FL07-25	750FL07-50	750FL07-50S
800nm	800FL07-12.5	800FL07-25	800FL07-50	800FL07-50S
850nm	850FL07-12.5	850FL07-25	850FL07-50	850FL07-50S
900nm	900FL07-12.5	900FL07-25	900FL07-50	900FL07-50S
950nm	950FL07-12.5	950FL07-25	950FL07-50	950FL07-50S
1000nm	100FL07-12.5	100FL07-25	100FL07-50	100FL07-50S

# Steep-Edge Longpass Filters

Our steep-edge long pass filters employ magnetron sputtered hard oxide coatings to yield deep rejection and a sharp transition to very high transmission. The coatings are deposited on precision polished Fused Silica substrates, and do not employ any absorbing filter glasses, making them suitable for high-temperature applications. They are offered in three standard sizes, with custom sizes available on request.

- Useful for redirecting a particular band of light
- Provide very steep ( $\leq 1\%$ ) cut-on slopes
- Suitable for high-temperature applications
- Can be cut or machined to smaller sizes

## Typical Applications Include:

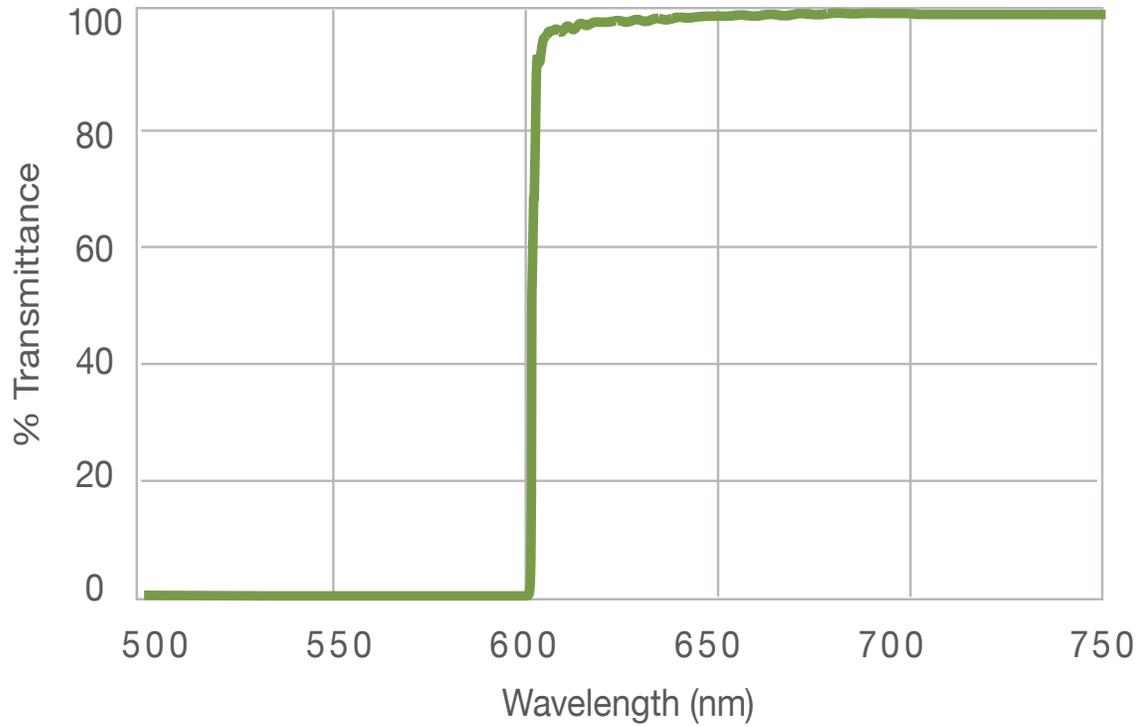
- Fluorescence
- Photometry
- Color Enhancement and Combining  
Laser studies

## General Specifications

<b>Thickness:</b>	1.5 $\pm$ 0.25mm
<b>Size Tolerance:</b>	+0.0mm/-0.2mm
<b>Min. Clear Aperture:</b>	95% of outside dimension
<b>Substrate Material:</b>	UV Grade Fused Silica
<b>Flatness:</b>	$\leq 1/4$ wave/inch TWF
<b>Surface Quality:</b>	60-40 per MIL-C-48497A
<b>Humidity and Abrasion:</b>	Per MIL-C-675A
<b>Durability:</b>	Per MIL-C-48497A
<b>Operating Temperature:</b>	-50°C to +200°C
<b>Transmission:</b>	$\geq 91\%$ average
<b>Rejection:</b>	$\geq$ OD 4.0
<b>Cut-on Slope:</b>	1% (325 < 2%)
<b>Cut-on Tolerance:</b>	$\pm 1\%$
<b>Mechanical:</b>	Unmounted

*Optional: Mounted in threaded ring - see pg 58 for thread sizes*

### Steep-Edge Longpass Filter



			Size, Shape & Part Number			
50% Point (nm)	Rejection Band (nm)	Transmission Band (nm)	12.5mm Ø	25mm Ø	50mm Ø	50mm SQ
325	200-315	335-1650	325SC01-12.5	325SC01-25	325SC01-50	325SC01-50S
350	200-340	360-1650	350SC01-12.5	350SC01-25	350SC01-50	350SC01-50S
375	200-365	385-1650	375SC01-12.5	375SC01-25	375SC01-50	375SC01-50S
400	200-390	410-1200	400SC01-12.5	400SC01-25	400SC01-50	400SC01-50S
450	200-440	460-1200	450SC01-12.5	450SC01-25	450SC01-50	450SC01-50S
500	200-490	510-1200	500SC01-12.5	500SC01-25	500SC01-50	500SC01-50S
550	200-538	560-1200	550SC01-12.5	550SC01-25	550SC01-50	550SC01-50S
600	200-588	610-1200	600SC01-12.5	600SC01-25	600SC01-50	600SC01-50S
650	200-637	660-1300	650SC01-12.5	650SC01-25	650SC01-50	650SC01-50S
700	200-686	710-1650	700SC01-12.5	700SC01-25	700SC01-50	700SC01-50S

# Infrared Filters & Coatings

Andover stocks a variety of optical-quality infrared-transmitting substrates. All substrates are optically polished. AR coatings are also available; see next page for details.

For convenience, we offer the windows in two standard sizes: 25mm and 50mm dia. In addition, we can produce custom sizes and shapes. Contact our technical sales department for a quotation.

- High optical quality
- Available from stock
- Custom sizes available

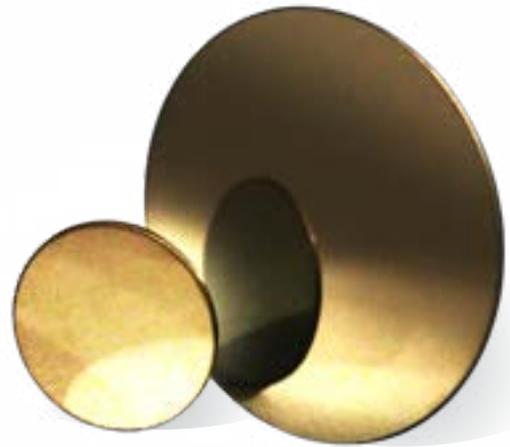
## Typical Applications Include:

- Thermal Imaging
- Weapons Systems
- Detector Windows
- IR Photography

## General Specifications

<b>Thickness:</b>	1.0 ± 0.2mm
<b>Diameter Tolerance:</b>	+0/-0.2mm
<b>Surface Quality:</b>	60/40 per MIL-C-48497A
<b>CTE:</b>	Coefficient of Thermal Expansion (see tables)

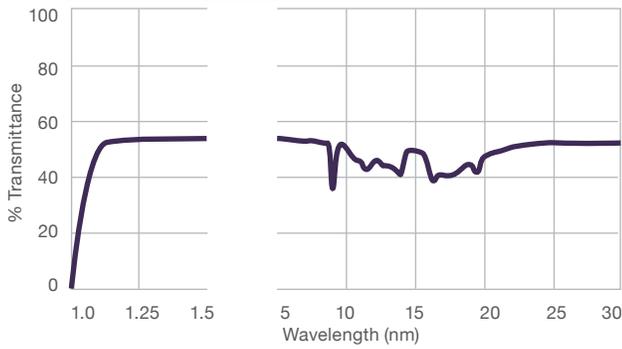
*Threaded ring mounting available - see pg 58 for thread sizes*



Substrate Material	Size, Shape & Part Number	
	25mm Ø	50mm Ø
Silicon (Si)	IRWS100-25	IRWS100-50
Germanium (Ge)	IRWS200-25	IRWS200-50
Sapphire (Al <sub>2</sub> O <sub>3</sub> )	IRWS300-25	IRWS300-50
Water-Free Fused Silica (SiO <sub>2</sub> )	IRWS400-25	IRWS400-50
Calcium Fluoride (CaF <sub>2</sub> )	IRWS500-25	
Zinc Selenide (ZnSe)	IRWS600-25	

**Silicon**

1mm thick uncoated sample

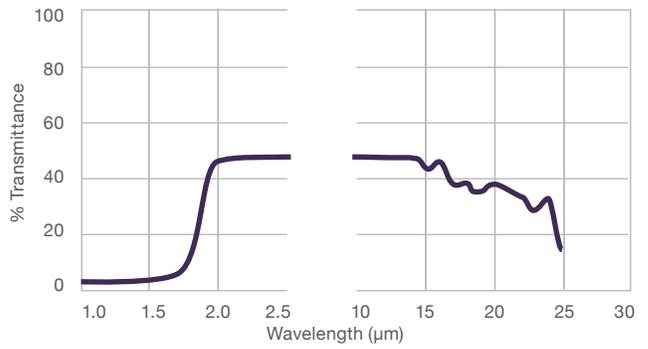


**Silicon (Si) is an economical choice for many IR applications.**

Refractive index: 3.43 at 3.0 $\mu$ m  
 CTE (10-6/ $^{\circ}$ C): 2.55  
 Hardness (Knoop): 1150

**Germanium**

1mm thick uncoated sample

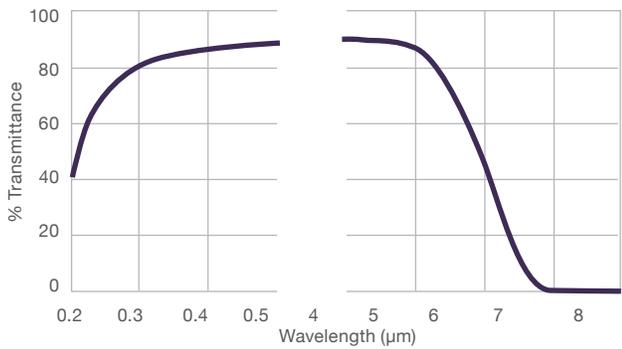


**Germanium (Ge) is widely used for lenses and windows in the Mid-IR & FIR regions.**

Refractive index: 4.00 at 10.6 $\mu$ m  
 CTE (10-6/ $^{\circ}$ C): 5.7  
 Hardness (Knoop): 780

**Sapphire**

1mm thick uncoated sample

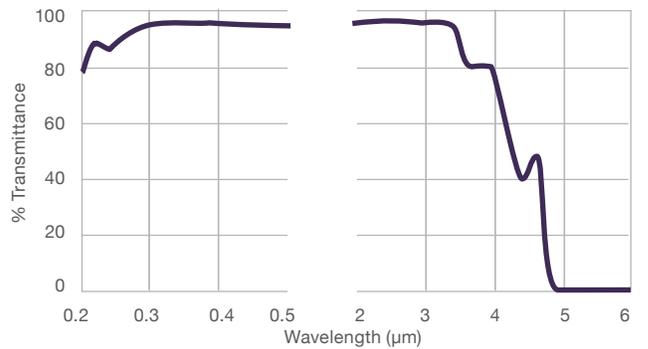


**Sapphire (Al<sub>2</sub>O<sub>3</sub>) is transparent over a wide range, and has excellent mechanical strength.**

Refractive index: 1.737 at 2.0 $\mu$ m  
 CTE (10-6/ $^{\circ}$ C): 8.4  
 Hardness (Knoop): 1920

**Water-Free Fused Silica**

1mm thick uncoated sample

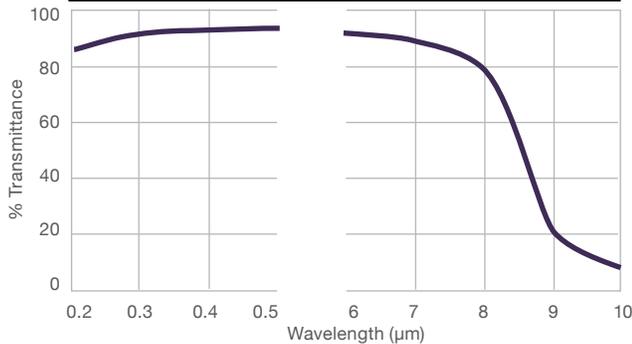


**WF Fused silica (SiO<sub>2</sub>) has excellent transmission in VIS and near IR and exhibits minimal fluorescence.**

Refractive index: 1.45 at 1.0 $\mu$ m  
 CTE (10-6/ $^{\circ}$ C): 0.58  
 Hardness (Knoop): 461

**Calcium Fluoride**

1mm thick uncoated sample

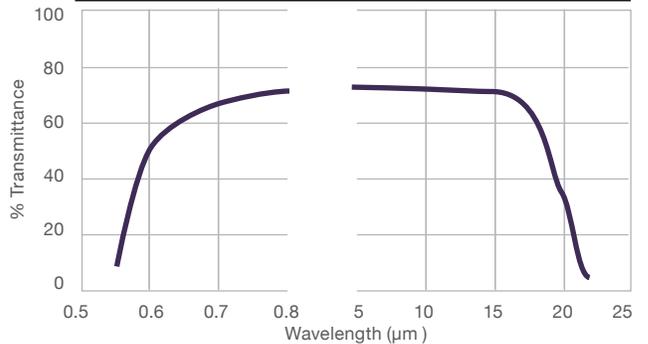


**Calcium Fluoride (CaF<sub>2</sub>) has good transmission from the UV to the Mid-IR.**

Refractive index: 1.40 at 5.0 $\mu$ m  
 CTE (10-6/ $^{\circ}$ C): 18.9  
 Hardness (Knoop): 160

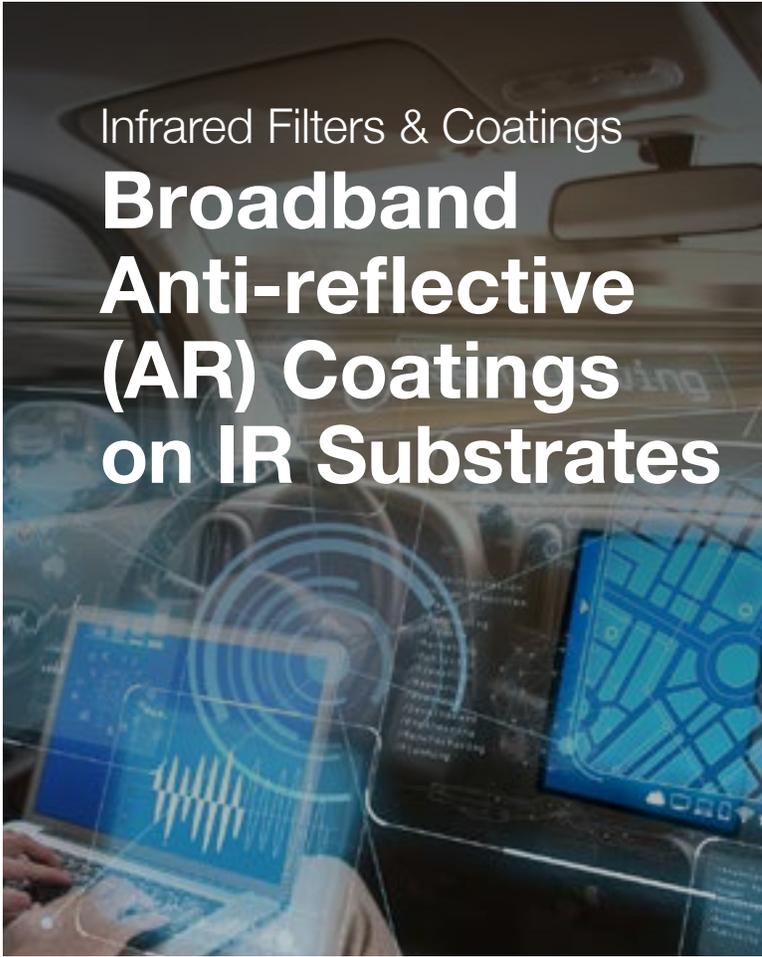
**Zinc Selenide**

1mm thick uncoated sample



**Zinc Selenide (ZnSe) is widely used for lenses and windows in the Mid-IR region.**

Refractive index: 2.40 at 10.6 $\mu$ m  
 CTE (10-6/ $^{\circ}$ C): 7.6  
 Hardness (Knoop): 110



# Infrared Filters & Coatings Broadband Anti-reflective (AR) Coatings on IR Substrates

Andover produces a non-radioactive dielectric multilayer coating designed to reduce the reflection of Germanium, Silicon, and other substrates in the infrared. Reflection is reduced from 36% per surface to less than 1% per surface.

Constructed of hard, durable first-surface dielectric coatings on optical-quality germanium substrates, these filters will withstand cleaning and handling associated with any high-quality optical component.

For convenience, we offer filters in two standard sizes: 25mm and 50mm dia. In addition, we offer custom sizes and shapes, as well as custom optical characteristics. Contact our technical sales department for a quotation.

- Reduces reflection from 36% to 1% per surface
- Constructed of hard, durable, non-radioactive materials
- Meets MIL-C-48497

## Typical Applications Include:

- Thermal Imaging
- Weapon Systems
- Detector Windows
- Dewar Windows

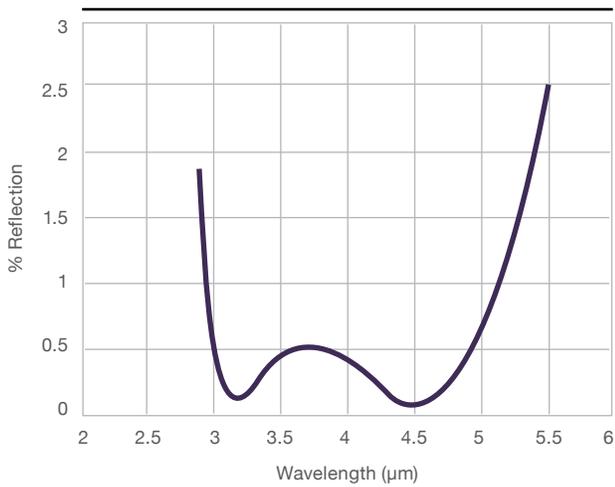
## General Specifications

<b>Thickness:</b>	1.0 ±.2mm
<b>Diameter Tolerance:</b>	+0/- .2mm
<b>Min. Clear Aperture:</b>	90% of outside dimension
<b>Substrate Material:</b>	Germanium or Silicon (other substrates available)
<b>Flatness:</b>	<5 waves at 632.8nm
<b>Parallelism:</b>	<5 arc minutes
<b>Surface Quality:</b>	80/50 per MIL-C-48497A
<b>Coating Quality:</b>	80/50 per MIL-C-48497A
<b>24-hour humidity:</b>	per MIL-C-48497A
<b>Moderate Abrasion:</b>	per MIL-C-48497A
<b>Adhesion:</b>	per MIL-C-48497A
<b>Operating Temperature:</b>	-62°C to +71°C
<b>Mechanical:</b>	Unmounted

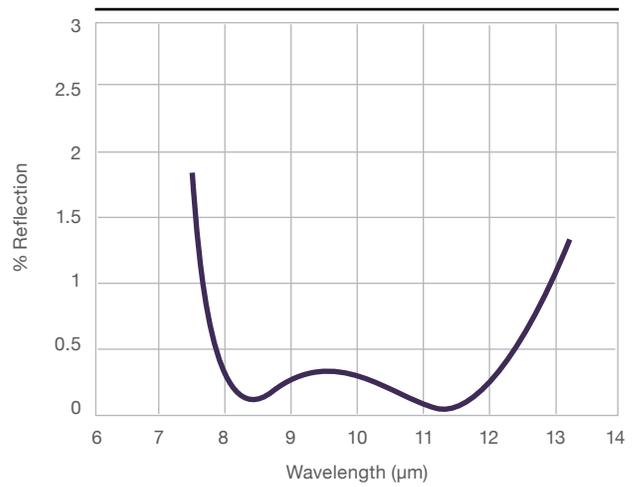
*Optional: Mounted in threaded ring - see pg 58 for thread sizes*

Size, Shape & Part Number		
AR Coating ( $\mu\text{m}$ coated)	25mm $\varnothing$	50mm $\varnothing$
2-14 Germanium Window	GEBBAR-2-14-25	GEBBAR-2-14-50
3-5 Germanium Window	GEBBAR-3-5-25	GEBBAR-3-5-50
8-12 Germanium Window	GEBBAR-8-12-25	GEBBAR-8-12-50
8-14 Germanium Window	GEBBAR-8-14-25	GEBBAR-8-14-50
2-14 Silicon Window	SIBBAR-2-14-25	SIBBAR-2-14-50
3-5 Silicon Window	SIBBAR-3-5-25	SIBBAR-3-5-50
8-12 Silicon Window	SIBBAR-8-12-25	SIBBAR-8-12-50
8-14 Silicon Window	SIBBAR-8-14-25	SIBBAR-8-14-50

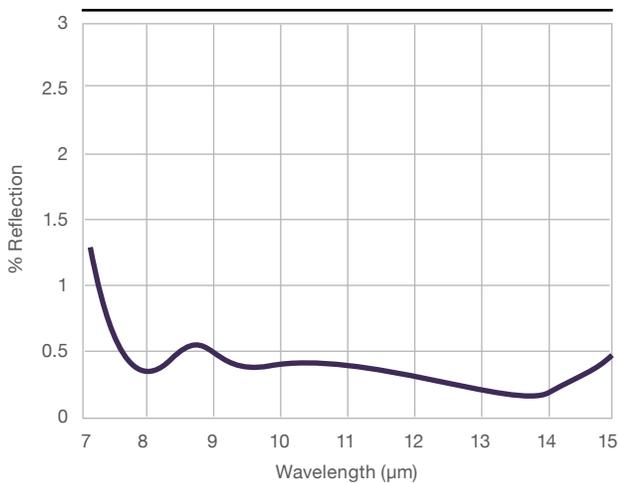
**3-5 $\mu\text{m}$  AR Coating**



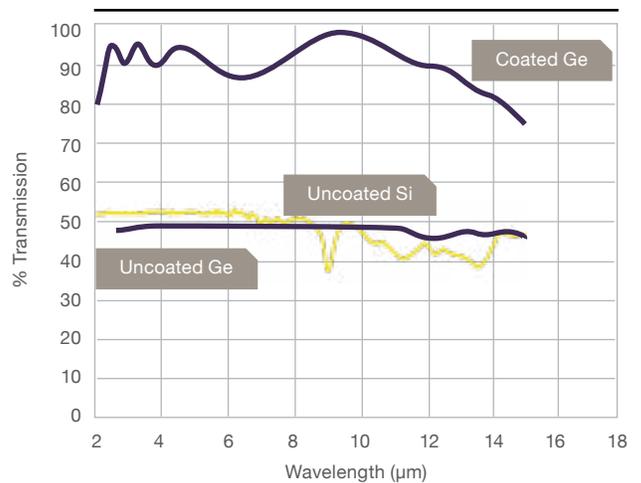
**8-12 $\mu\text{m}$  AR Coating**



**8-14 $\mu\text{m}$  AR Coating**



**2-14 $\mu\text{m}$  AR Coating**



# Infrared Filters & Coatings

## Standard Long Wave Pass Filters

Long wave pass filters provide a sharp cut-off below a particular wavelength. Often used for order sorting, they isolate broad regions of the spectrum, simultaneously providing high transmission of desired energy, and deep rejection of unwanted energy.

Constructed of hard, durable first-surface dielectric coatings on optical-quality IR-transmitting substrates, these filters will withstand normal cleaning and handling associated with any high-quality optical component.

For convenience, we offer the filters in three standard sizes: 12.5mm, 25mm and 50mm dia. In addition, we offer custom sizes and shapes, as well as custom optical characteristics. Contact our technical sales department for a quotation.

- Useful for isolating broad spectral regions
- Constructed of hard, durable first-surface coating
- Available in standard and custom wavelengths

### Typical Applications Include:

- Order Sorting
- FTIR Spectroscopy
- Thermal Imaging

## General Specifications

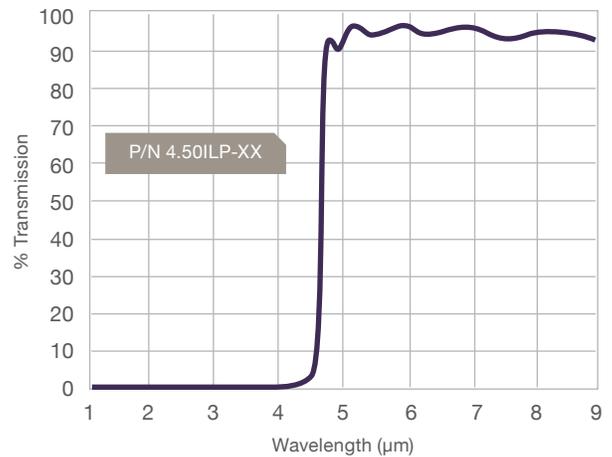
<b>Thickness:</b>	1.0±0.2mm
<b>Diameter Tolerance:</b>	+0/-0.1mm
<b>Min. Clear Aperture:</b>	90% of outside dimension
<b>Substrate Material:</b>	Silicon or Germanium
<b>Flatness:</b>	<5 waves at cut-on W/L
<b>24-hour Humidity:</b>	per MIL-C-48497A
<b>Operating Temperature:</b>	-62°C to +71°C
<b>Parallelism:</b>	<10 arc minutes
<b>Transmission (Ave):</b>	>85% from 1.05 x cut-on to 2.0 x cut-on
<b>Rejection (Ave):</b>	<0.1%
<b>Slope:</b>	<7% (12% for 1.05µm filter)

*Optional: Mounted in threaded ring - see pg 58 for thread sizes*

## Standard Long Pass Filters

5% point cut-on W/L ( $\mu\text{m}$ )	Size, Shape & Part Number		
	12.5mm $\emptyset$	25mm $\emptyset$	50mm $\emptyset$
1.05 $\pm$ 0.04	1.05ILP-12.5	1.05ILP-25	1.05ILP-50
1.65 $\pm$ 0.07	1.65ILP-12.5	1.65ILP-25	1.65ILP-50
2.40 $\pm$ 0.09	2.40ILP-12.5	2.40ILP-25	2.40ILP-50
3.60 $\pm$ 0.14	3.60ILP-12.5	3.60ILP-25	3.60ILP-50
4.50 $\pm$ 0.18	4.50ILP-12.5	4.50ILP-25	4.50ILP-50
6.00 $\pm$ 0.24	6.00ILP-12.5	6.00ILP-25	6.00ILP-50
7.30 $\pm$ 0.29	7.30ILP-12.5	7.30ILP-25	7.30ILP-50

Typical 4.5 $\mu\text{m}$  Long Pass Filter



## Custom IR Long Wave Pass Filters

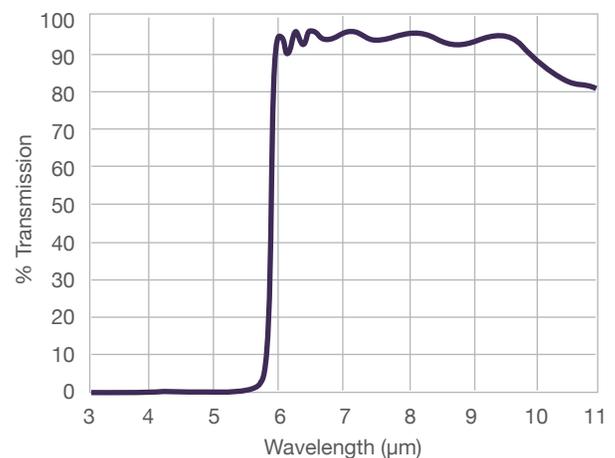
Andover can design and fabricate long pass and short pass filters to suit your particular requirements. Every phase of the process is performed in-house, including thin-film coating design, mechanical design, substrate fabrication and coating, inspection, and environmental testing.

We can coat a variety of substrate materials, including Germanium, Sapphire, Silicon, Zinc Sulfide, and Zinc Selenide.

## Custom Long Pass Filters

5% point cut-on W/L ( $\mu\text{m}$ )	Size, Shape & Part Number		
	12.5mm $\emptyset$	25mm $\emptyset$	50mm $\emptyset$
1.0-2.1	IRLWP08-12.5	IRLWP08-25	IRLWP08-50
2.2-5.0	IRLWP10-12.5	IRLWP10-25	IRLWP10-50
5.1-7.0	IRLWP12-12.5	IRLWP12-25	IRLWP12-50
7.1-11.0	IRLWP14-12.5	IRLWP14-25	IRLWP14-50

Typical IR Long Pass Filter



Contact an Andover Corporation representative for prototype and production quantities.

Order online at [www.andovercorp.com](http://www.andovercorp.com) or call us at 1.888.893.9992 (Toll-free in the US)

Infrared Filters & Coatings

# Standard IR Bandpass Filters



Bandpass filters isolate specific regions of the spectrum, simultaneously providing high transmission of desired energy, and deep rejection of unwanted energy. Available in wide or narrow bandwidths, they can be tailored to suit your specific requirements.

Constructed of hard, durable first-surface dielectric coatings on optical-quality, IR-transmitting substrates, these filters will withstand normal cleaning and handling associated with any high-quality optical component.

Our standard IR bandpass filters are 25mm in diameter. However, we can produce custom sizes and shapes, as well as custom optical characteristics. Contact our technical sales department for a quote.

- Useful for isolating narrow spectral regions
- Constructed of hard, durable first-surface coatings
- Available in standard and custom wavelengths up to 14 $\mu$ m

## Typical Applications Include:

- Environmental
- Monitoring
- Security Systems
- Thermal Imaging
- Avionics

## General Specifications

<b>Diameter Tolerance:</b>	+0/-0.1mm
<b>Min. Clear Aperture</b>	21mm Dia.
<b>Transmission (Typ.):</b>	90% typical
<b>Blocking:</b>	T < 0.1% Average to 30 $\mu$ m
<b>24-hour Humidity:</b>	per MIL-C-48497A
<b>Moderate Abrasion:</b>	per MIL-C-48497A
<b>Adhesion:</b>	per MIL-C-48497A

*Optional: Mounted in threaded ring, see pg 58 for thread sizes*

Andover can design and fabricate custom bandpass filters to suit your particular requirements. Every phase of the process is performed in-house, including thin-film coating design, mechanical design, substrate fabrication and polishing, coating, inspection, and environmental testing.

For ease of selection, we have created a matrix of typical wavelength ranges and bandwidths which are readily manufacturable. Simply specify the wavelength and bandwidth within the range, and select the appropriate part number.

If there is not a suitable filter in the table, please contact us. We can coat a variety of substrate materials, including Germanium, Sapphire, Silicon, Calcium Fluoride, Zinc Sulfide, and Zinc Selenide. Contact us for a quotation, whether it is for prototype quantities, or production quantities.

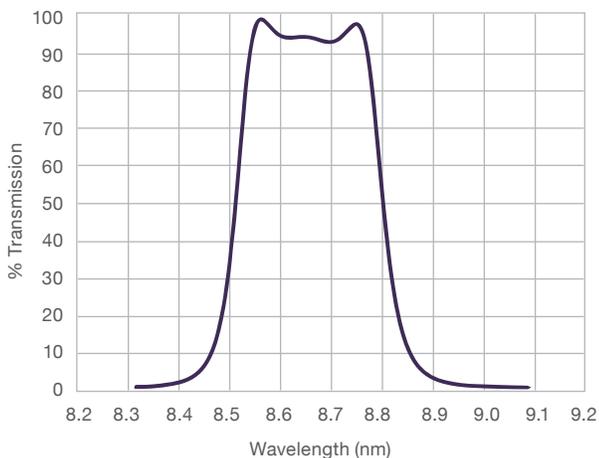
**Standard IR Gas Analysis Bandpass Filters**

Gas	Center W/L (μm)	Bandwidth	Trans(%)	Blocking	Part Number
<b>Water Vapor</b>	2.70 ± .03μm	110 ± 30nm		UV to 30μm	2.70GA05-25
	2.95 ± .03μm	110 ± 30nm		UV to 30μm	2.95GA05-25
<b>Methane and Ethanol</b>	3.46 ± .04μm	140 ± 30nm		UV to 30μm	3.46GA05-25
<b>Formaldehyde</b>	3.60 ± .04μm	140 ± 30nm		UV to 30μm	3.60GA05-25
<b>SWIR</b>	4.00 ± .20μm	2000 ± 200nm	80	UV to 7μm	4.00GA20-25
<b>CO2</b>	4.26 ± .04μm	120 ± 30nm		UV to 30μm	4.26GA05-25
<b>CO</b>	4.67 ± .05μm	150 ± 30nm		UV to 30μm	4.70GA05-25
<b>NO</b>	5.30 ± .05μm	420 ± 50nm	90	UV to 30μm	5.30GA05-25
<b>FIR Broadband</b>	10.0 ± .30μm	4000 ± 500nm	80	UV to 17μm	10.00GA40-25
<b>CO2</b>	10.6 ± .10μm	1500 ± 100nm	80	UV to 16.5μm	10.60GA15-25

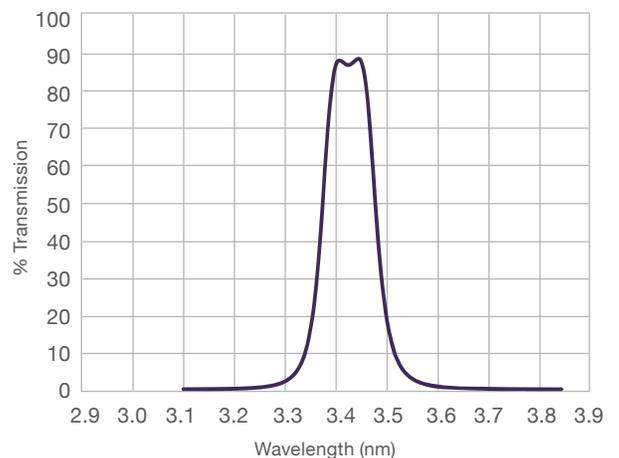
**Custom IR Bandpass Filters**

Substrate	CW/L Range (nm)	FWHM (%)	Trans (%)	Blocking	Part Numbers
<b>Sapphire</b>	2500-5300	1-3	70	UV to 30μm	IRFC10-25
	2500-5300	3-10	75	UV to 30μm	IRFC12-25
	2500-5300	10-14	80	UV to 30μm	IRFC14-25
<b>Germanium</b>	7500-9500	3-8	75	UV to CW/Lx1.65	IRFC16-25
	7500-9500	8-14	80	UV to CW/Lx1.65	IRFC18-25
	9500-11000	3-8	75	UV to CW/Lx1.65	IRFC20-25
	9500-11000	8-14	80	UV to CW/Lx1.65	IRFC22-25
	7500-9500	3-8	80	7500 to 13500nm	IRFC24-25
	7500-9500	8-14	85	7500 to 13500nm	IRFC26-25
	9500-12000	3-8	80	7500 to 13500nm	IRFC28-25
	9500-12000	8-14	80	7500 to 13500nm	IRFC30-25

**Typical 3% IR Bandpass Filter**



**Typical 1% IR Bandpass Filter**



Contact an Andover Corporation representative for custom spectral and physical properties. Order online at [www.andovercorp.com](http://www.andovercorp.com) or call us at 1.888.893.9992 (Toll-free in the US)

# Infrared Filters & Coatings

## Neutral Density Filters

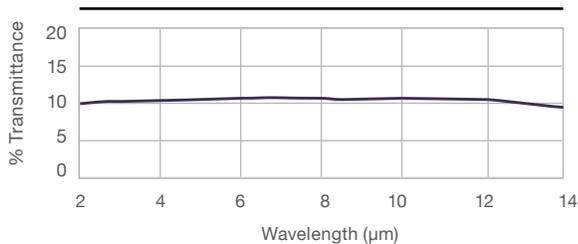
Metallic-coated infrared neutral density (ND) filters obtain their optical density from a metal alloy coating on a Germanium substrate. Unlike the all-dielectric or absorption type, the metallic type ND filter employs a combination of absorption and reflection to reduce the intensity of light.

- Provides attenuation with greater linearity over a wide spectral range
- Delivers superior durability
- Custom substrates available

### Typical Applications Include:

- Thermal Imaging
- Medical Imaging
- IR Test Bench
- IR Photography

Typical 1.0 ND Filter



## General Specifications

Wavelength Range: 2.0μm - 14.0μm

Dimensional Tolerances: ±0.2mm

Thickness: 1.0mm

Clear Aperture: 90% of outside dimension

Surface Quality: 80/50 per MIL-0-13830B

Coating Quality: 80/50 per MIL-0-13830B

Coating Adherence: Per MIL-M-13508C

Humidity: Per MIL-STD-810F

Substrate Material: Germanium

Optical Quality: Flatness of <5 waves per inch and parallelism of 10 arc minutes or better

Mechanical: Unmounted

Optional: Mounted in threaded ring - see pg 58 for thread sizes

### Custom IR Neutral Density Filter Specifications

Optical Density	Nominal Transmittance (%)	Max Deviation From Nom. (%)	Size, Shape & Part Number		
			12.5mm Ø	25mm Ø	50mm Ø
0.3	50.12	± 4.0	030FNIR-12.5	030FNIR-25	030FNIR-50
0.5	31.62	± 2.0	050FNIR-12.5	050FNIR-25	050FNIR-50
0.6	25.00	± 2.0	060FNIR-12.5	060FNIR-25	060FNIR-50
0.9	12.60	± 1.5	090FNIR-12.5	090FNIR-25	090FNIR-50
1.0	10.00	± 1.5	100FNIR-12.5	100FNIR-25	100FNIR-50
1.3	5.00	± 1.25	130FNIR-12.5	130FNIR-25	130FNIR-50
1.5	3.20	± 0.7	150FNIR-12.5	150FNIR-25	150FNIR-50
2.0	1.00	± 0.25	200FNIR-12.5	200FNIR-25	200FNIR-50
3.0	0.10	+ .08 / -0.05	300FNIR-12.5	300FNIR-25	300FNIR-50
Set of nine filters (includes storage box)			FNIR-SET-12.5	FNIR-SET-25	FNIR-SET-50

# Custom IR Coatings

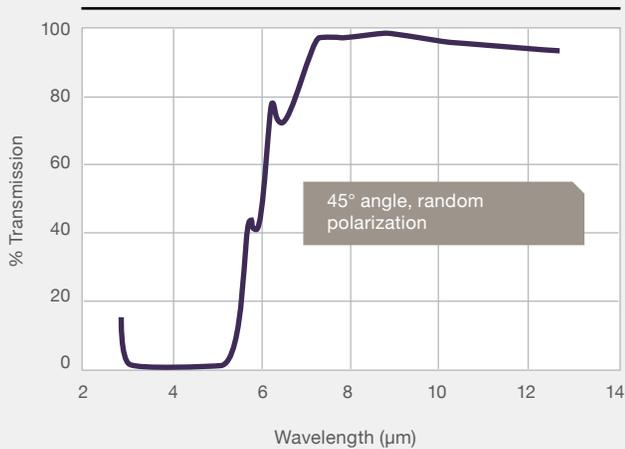


Andover Corporation offers optical coatings for the long wave infrared band, on substrate materials such as Germanium, Zinc Selenide, Zinc Sulfide, Silicon and Sapphire. Coating types include AR, bandpass, long and short pass, dichroic, and more. Andover can also design infrared coatings to function as dichroics, reflecting one region while allowing the transmittance of another. While generally operating at 0° or 45°, the coatings can be optimized for any particular angle or range of angles of incidence. Also available are custom dichroics that transmit visible while simultaneously reflecting far infrared light.

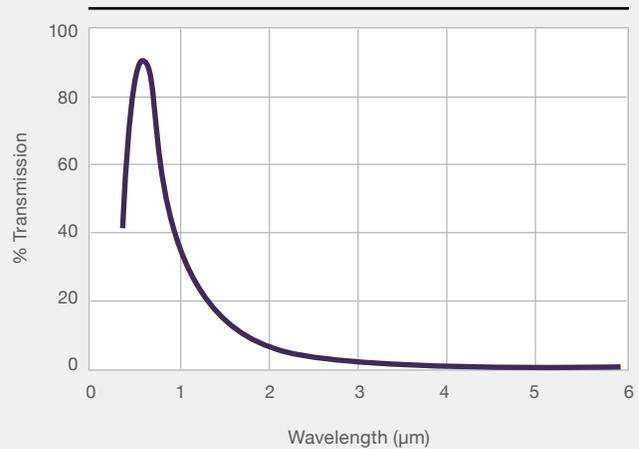


Computer-controlled dicing saw produces extremely precise and chip-free parts.

**Custom IR Dichroic Beamsplitter**



**Custom VIS/IR Beamsplitter**



# Colored Glass Filters

## Typical Applications Include:

- Machine Vision
- Astronomy
- Electronic Instrumentation
- Calibration
- Medical Devices

Colored glass filters are unique in their ability to transmit a very broad band of light. The long wave pass type, often used as order/wavelength sorting filters, transmit the longer wavelengths and absorb the shorter wavelengths. The bandpass type, useful for enhancing the signal-to-noise ratio of illumination systems, transmits a broad band of energy while blocking the shorter and longer wavelengths. As with all optical components, colored glass filters should not be exposed to high temperatures or sharp temperature changes.

- **Fabricated from high-quality optical filter glass**
- **Excellent color consistency as well as sharp contrast**
- **Both surfaces precision polished**
- **Options span ultraviolet to infrared region**



## General Specifications

Optical Thickness:	3mm ±0.5mm
Mechanical Thickness:	Add 0.8mm for ring mount
Size Tolerance:	+0.00/-0.25mm
Surface Quality:	80/50 per MIL-M-13508
Max. Operating Temperature:	+100°C
Transmitted Wavefront (TWF):	1/4 wave per inch
Parallelism:	30 arc seconds or better
Spectral Data:	Stated as internal transmittance
Mechanical:	Mounted (except for 165mm sq.)

*Optional: Mounted in threaded ring - see pg 58 for thread sizes*

### 3 Class Types

#### Bandpass Type

Ultraviolet Transmitting  
Blue and Blue - Green

#### Heat Absorbing Type

Infrared Absorbing

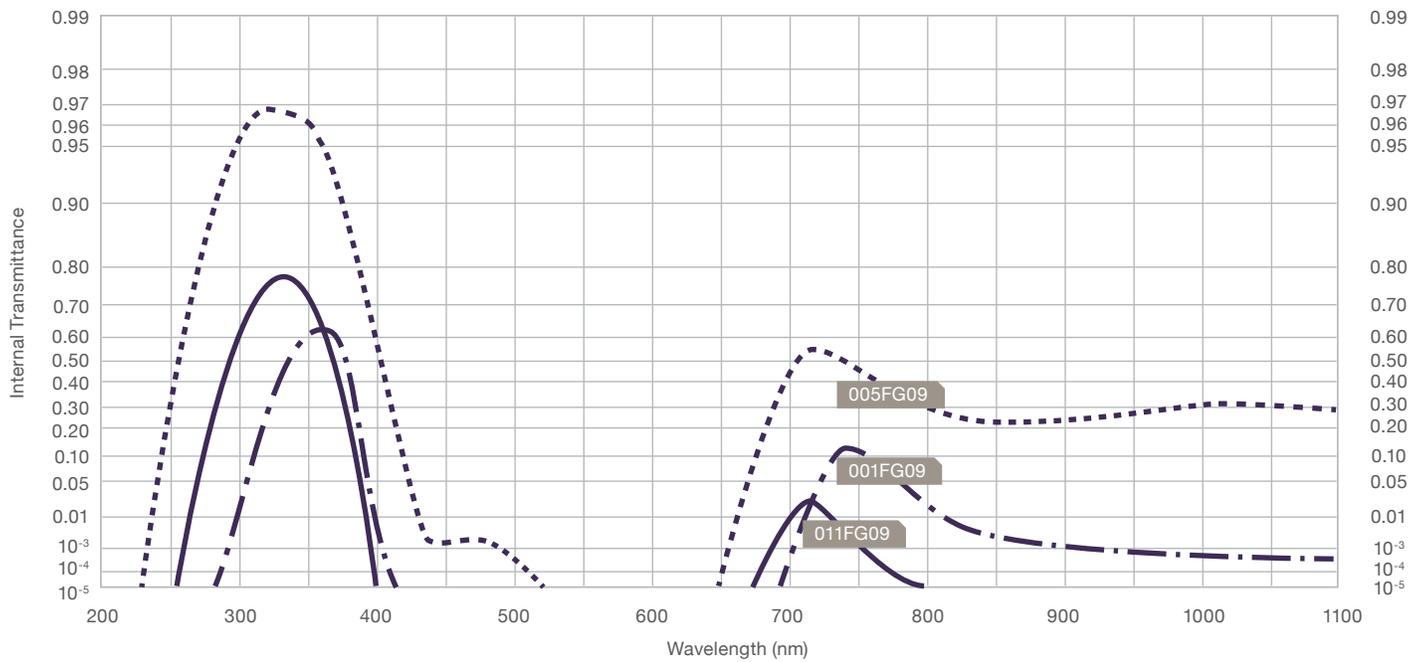
#### Long Wave Pass Type Near

Infrared Transmitting  
Yellow  
Orange  
Ultraviolet Transmitting

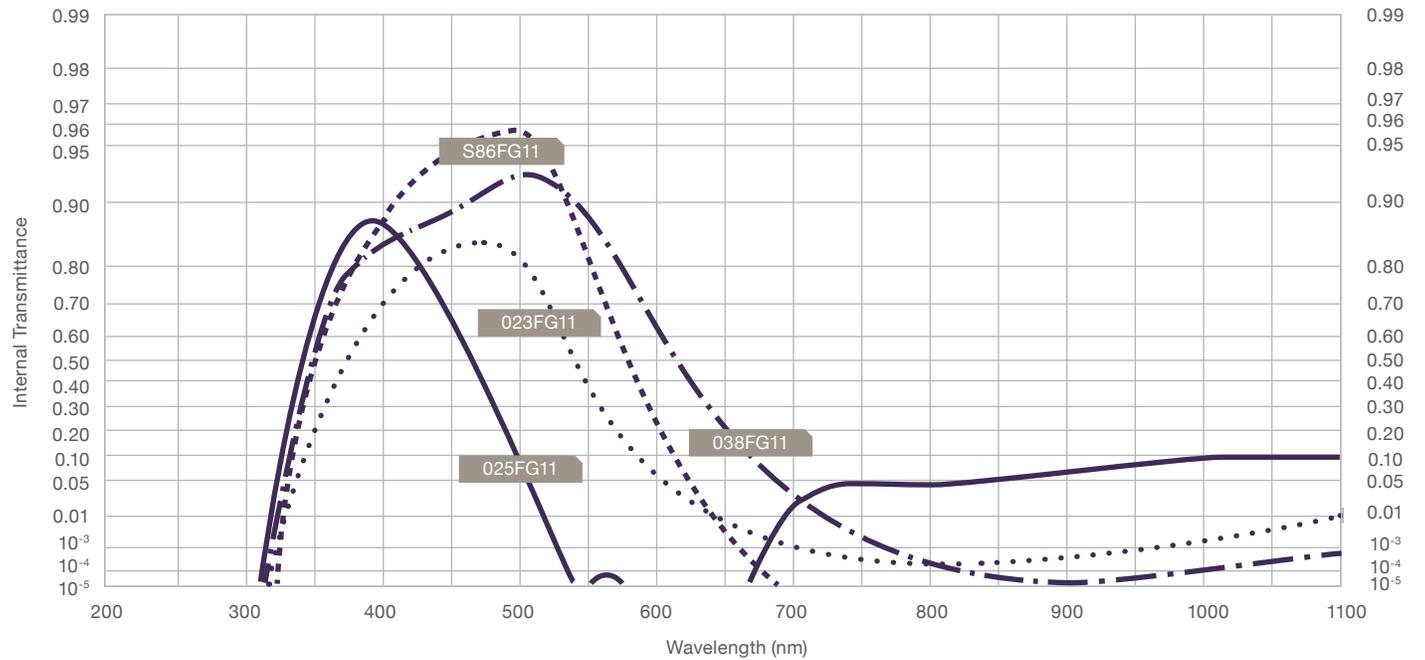


All filter glass is inspected for striae, bubbles, and inclusions using our custom-designed inclusion tester. These instruments detect minute defects, even in materials that do not transmit visible light.

**Bandpass type (3mm THICK)**

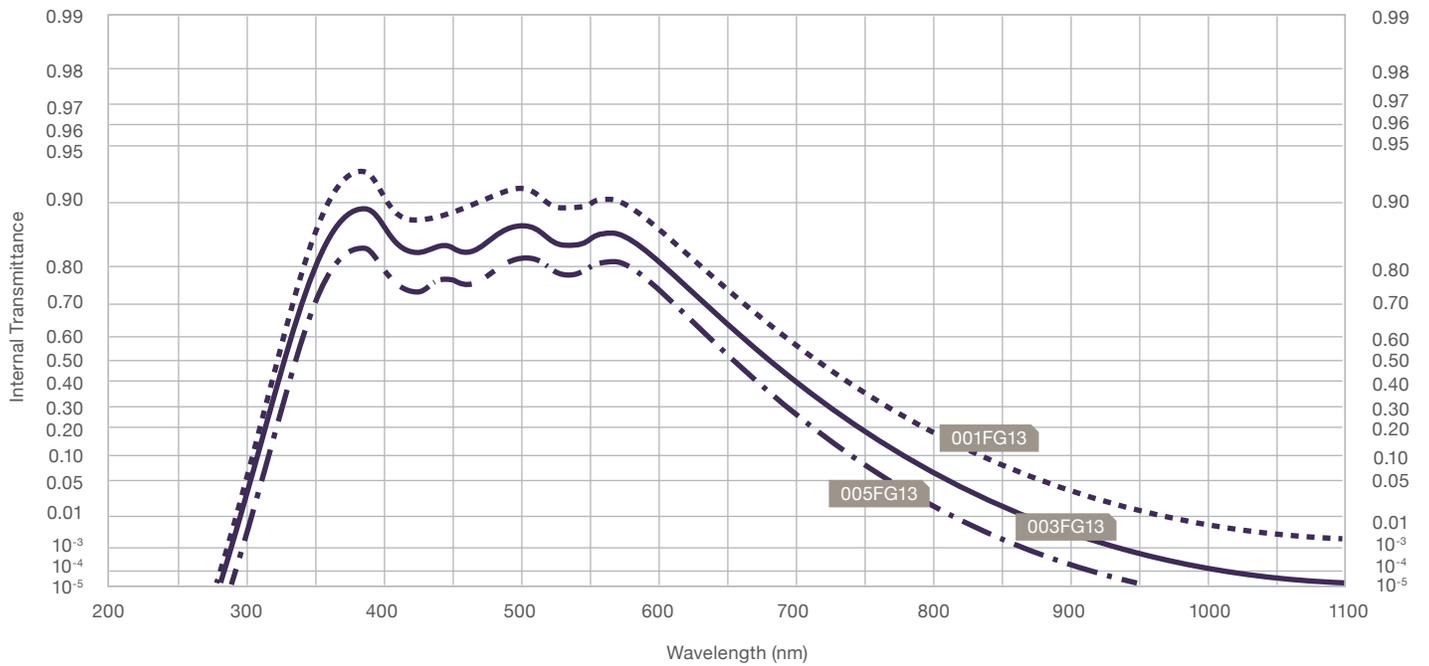


**Bandpass type (3mm THICK)**

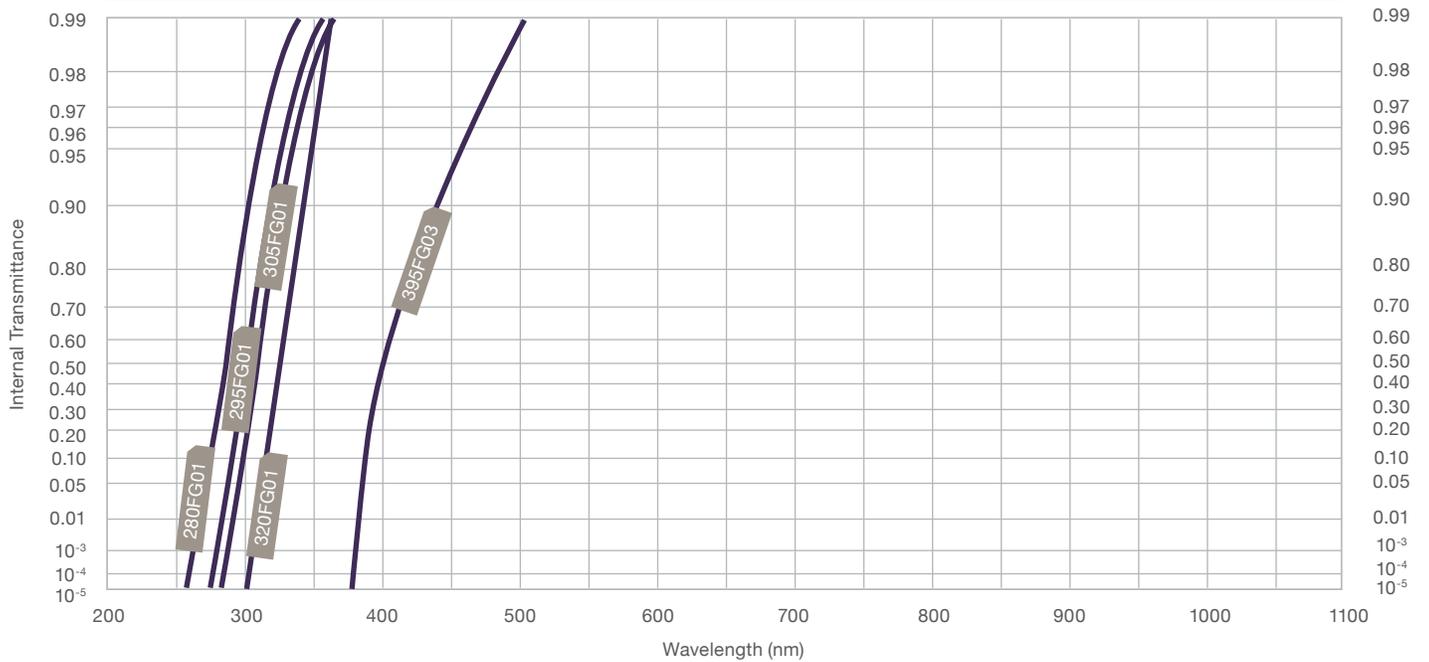


Size, Shape & Part Number				
Glass Type	25mm Ø	50mm Ø	50mm SQ	165mm SQ
UV Transmitting	001FG09-25	001FG09-50	001FG09-50S	001FG09-165S
	005FG09-25	005FG09-50	005FG09-50S	005FG09-165S
	011FG09-25	011FG09-50	011FG09-50S	011FG09-165S
Blue glass	023FG11-25	023FG11-50	023FG11-50S	023FG11-165S
	025FG11-25	025FG11-50	025FG11-50S	025FG11-165S
	038FG11-25	038FG11-50	038FG11-50S	038FG11-165S
	S86FG11-25	S86FG11-50	S86FG11-50S	S86FG11-165S

### HEAT ABSORBING Type (3mm THICK)

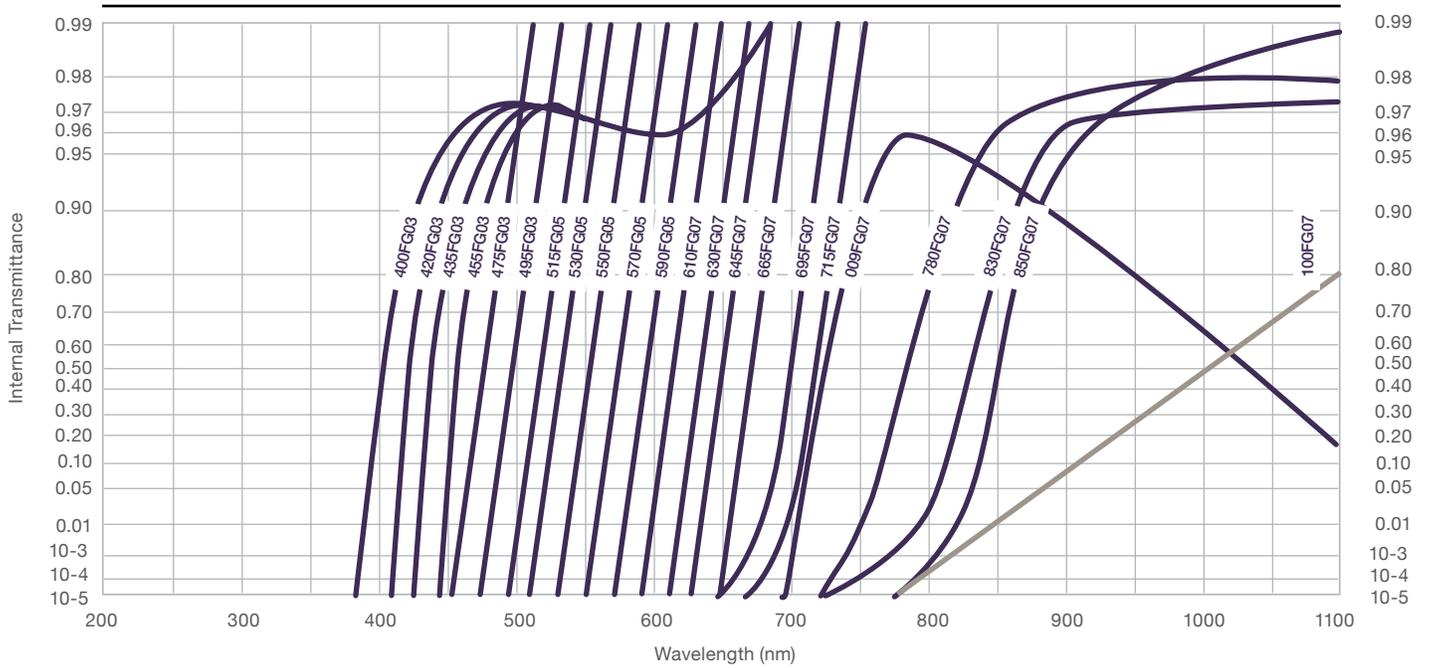


### LONG WAVE PASS Type (3mm THICK)



Glass Type	Size, Shape & Part Number			
	25mm Ø	50mm Ø	50mm SQ	165mm SQ
Heat Absorbing	001FG13-25	001FG13-50	001FG13-50S	001FG13-165S
	003FG13-25	003FG13-50	003FG13-50S	003FG13-165S
	005FG13-25	005FG13-50	005FG13-50S	005FG13-165S
White Glass	280FG01-25	280FG01-50	280FG01-50S	280FG01-165S
	295FG01-25	295FG01-50	295FG01-50S	295FG01-165S
	305FG01-25	305FG01-50	305FG01-50S	305FG01-165S
	320FG01-25	320FG01-50	320FG01-50S	320FG01-165S
Green Glass	395FG03-25	395FG03-50	395FG03-50S	395FG03-165S

**LONG WAVE PASS Type (3mm THICK)**



Glass Type	Size, Shape & Part Number			
	25mm Ø	50mm Ø	50mm SQ	165mm SQ
Green Glass	400FG03-25	400FG03-50	400FG03-50S	400FG03-165S
	420FG03-25	420FG03-50	420FG03-50S	420FG03-165S
	435FG03-25	435FG03-50	435FG03-50S	435FG03-165S
	455FG03-25	455FG03-50	455FG03-50S	455FG03-165S
	475FG03-25	475FG03-50	475FG03-50S	475FG03-165S
	495FG03-25	495FG03-50	495FG03-50S	495FG03-165S
Orange Glass	515FG05-25	515FG05-50	515FG05-50S	515FG05-165S
	530FG05-25	530FG05-50	530FG05-50S	530FG05-165S
	550FG05-25	550FG05-50	550FG05-50S	550FG05-165S
	570FG05-25	570FG05-50	570FG05-50S	570FG05-165S
	590FG05-25	590FG05-50	590FG05-50S	590FG05-165S
Red Glass	610FG07-25	610FG07-50	610FG07-50S	610FG07-165S
	630FG07-25	630FG07-50	630FG07-50S	630FG07-165S
	645FG07-25	645FG07-50	645FG07-50S	645FG07-165S
	665FG07-25	665FG07-50	665FG07-50S	665FG07-165S
	695FG07-25	695FG07-50	695FG07-50S	695FG07-165S
	715FG07-25	715FG07-50	715FG07-50S	715FG07-165S
IR Transmitting	009FG07-25	009FG07-50	009FG07-50S	009FG07-165S
	780FG07-25	780FG07-50	780FG07-50S	780FG07-165S
	830FG07-25	830FG07-50	830FG07-50S	830FG07-165S
	850FG07-25	850FG07-50	850FG07-50S	850FG07-165S
	100FG07-25	100FG07-50	100FG07-50S	100FG07-165S

# Calibration Filter Sets

## Typical Applications Include:

- Machine Vision
- Astronomy
- Electronic Instrumentation
- Calibration
- Medical Devices



Andover offers two filter sets for verifying the transmittance and absorbance scales of visible absorption spectrophotometers with maximum bandwidths of 2.2nm and 6.5nm. Made of uncoated Schott NG-4 and NG-5 glass, the filters are polished over the central 5mm x 20mm area to a transmitted wavefront of 1/4 wave or better at 633nm, with a parallelism of 30 arc seconds or better. The transmittance value of each filter is measured on a spectrophotometer calibrated with standards directly traceable to the National Institute of Standards and Technology (NIST).

- **Spectrophotometric glass filters for verifying transmittance and absorbance scales**
- **Calibration standards traceable to NIST**
- **Shipped in a durable aluminum storage case**

Each filter is mounted in a black anodized aluminum holder compatible with the 1cm cuvette holder supplied with most spectrophotometers. Individual filters have removable shutters to protect the glass from damage.

Description	Transmittance Values	Part Number
AC-930 Filter Set	10%, 20%, 30%	AC-930
AC-1930 Filter Set	1%, 3%, 50%	AC-1930



Every filter set is shipped with a **Certificate of Calibration** stating the transmission value of each filter at wavelengths of 440nm, 465nm, 546.1nm, 590nm and 635nm.

## AC-930 Filter Set

The AC-930 calibration filter set consists of three absorption glass filters and one blank holder to be used as a balancing filter. The nominal transmittance values of these filters are 10%, 20%, and 30%.

## AC-1930 Filter Set

The AC-1930 filter set consists of three absorption glass filters and one blank holder to be used as a balancing filter. The nominal transmittance values of these filters are 1%, 3%, and 50%.

## Recertification Service

Each calibration filter set is certified for two years. At the end of that period, sets should be returned to Andover Corporation in their original shipping box for cleaning and recertification. Please contact the sales department at (888) 893-9992 for pricing and lead time, before returning your filter set.

# Threaded Filter Rings

## Typical Applications Include:

- Color CCD Photography
- Fluorescence Microscopy
- Photometry

In addition to our standard rings, Andover offers a variety of threaded ring mounts. Standard sizes and thread pitches enable the user to securely attach the filter to equipment. Please contact our technical sales department to discuss your requirements.

- **Industry-standard sizes**
- **Adaptable to most of our standard products**
- **Laser-engraved identification**



Threaded Ring Sizes Available

Thread size (mm)	OD (mm)	Clear aperture (mm)	Part Number
M27.0 x 0.5	29.5	23	RING-M27
M30.5 x 0.5	32.5	26.5	RING-M30.5
M37.0 x 0.75	39	32	RING-M37
M40.5 x 0.5	42	36.5	RING-M40.5
M46.0 x 0.75	48.5	41	RING-M46
M49.0 x 0.75	51.5	44	RING-M49
M52.0 x 0.75	54	47	RING-M52

# Motorized Filter Wheel

## Typical Applications Include:

- Color CCD Photography
- Fluorescence Microscopy
- Photometry



Filter wheels are used in a host of applications, including color CCD photography, fluorescence microscopy, and photometry. Two 4" diameter wheels are available: a six-position 25mm filter wheel and a twelve-position 12.5mm filter wheel.

## General Specifications

### Interfaces included:

Serial:	RS - 232
USB:	USB 2.0
Manual:	Push button switches
Mounting:	1/4-20 & #8-32 (M6 & M4)
Size:	5.0" x 4.49" x 1.85"

- **Motorized or Manual**
- **Local or Remote Control**
- **Accepts 12.5mm and 25mm diameter filters**
- **Labeled filter positions**
- **Base and post mountable**
- **Programmable filter sequences**
- **Very small footprint suitable for tight space requirements**

## Programming and Remote Control

Automation of filter sequences is available through the USB 2.0 or serial (RS - 232 interface) using LabVIEW software for both Mac and Windows platforms. A simple command language facilitates retrieving filter status and making filter selections. The unit comes with the controller, filter housing, filter wheel, a 5 VDC power supply and threaded retaining rings to hold the optics in place.



## Remote or Manual Operation

Filter selection can be made manually from push buttons on the unit, or remotely from either a USB 2.0 or serial (RS - 232) interface.

### Motorized Filter Wheel

Description	Size & Part Number	
	12-Position / 12.5mm	6-Position / 25mm
Motorized filter wheel	FW-MOT-12.5	FW-MOT-25
Extra wheel only	FW-12.5	FW-25



## Interchangeable Filter Wheels

The 4" diameter wheel is easily changed, allowing quick conversions between applications. Additional wheels are available.

### Manual Filter Wheel

Description	Size & Part Number	
	12-Position / 12.5mm	6-Position / 25mm
Manual filter wheel	FW-MAN-12.5	FW-MAN-25

# Temperature Controller

The performance of very narrow bandwidth interference filters can suffer significantly due to changes in ambient temperature. The regulated temperature controller provides protection against the influences of fluctuating ambient temperatures, and provides a means of tuning the center wavelength to an exact value.

All temperature controllers include an assembly kit which enables the user to install their own filters in the controller, if desired. The assembly kit includes optical-quality BK-7 or Fused Silica windows which are A/R coated in a user-selectable range.

Shipped in a sturdy, reusable weatherproof case, all of our temperature controllers include a universal power adaptor, which will operate from 110 to 220 volts, 50–60 Hz, and include plugs for US, UK, Australia, and Europe.

- Provides added control over ambient temperatures
- Effective for conducting outdoor experiments
- Custom sizes and temperature ranges also available
- Provides stability with varying ambient temperatures
- Our Temperature Controllers are subjected to a 120 hour stability test.
- Calibration of wavelength tuning with temperature setting is available

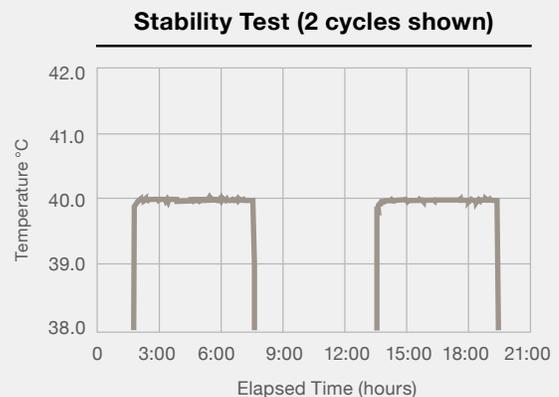


Andover's temperature controllers are extremely stable, and regulate over a broad range (30° to 60°C).

## General Specifications

<b>Regulation Accuracy:</b>	+/-0.25°C
<b>Ambient Temperature Range:</b>	0-30°C
<b>Min. Regulated Temperature:</b>	30°C
<b>Max. Regulated Temperature:</b>	60°C
<b>Power Requirements:</b>	110-220VAC, 50-60Hz, 1.0A
<b>Filter Size:</b>	50mm or 75mm diameter

Custom adapters for smaller sizes available at a nominal charge.



# Proceed with the following steps to order:



## Step 1

### Select temperature controller size

Temperature Controller	Part Number
50mm	101FRDC01-50
75mm	101FRDC01-75

## Step 2

### Select assembly kit

AR Coating W/L Range	Part Number
300nm to 450nm	101FRDC01-KIT
450nm to 700nm	101FRDC02-KIT
700nm to 1200nm	101FRDC03-KIT
1200nm to 1600nm	101FRDC04-KIT

The assembly kits include the necessary hardware to mount a filter into the filter oven, as well as instructions for assembly. The windows supplied are broadband anti-reflective (AR) coated over the specified wavelength range for an average reflectance of  $\leq 0.5\%$  per surface. The substrate material is either Schott BK-7 or Fused Silica, as appropriate, and polished to a 1/4 wave flatness, with a parallelism of 30 arc seconds or better.

# Epolite FH-5313 Epoxy



Fuller Epolite FH-5313 is a 100% solid, room-temperature curing, optically clear, electrical grade epoxy. Proven to be a superior bonding agent for ferrite pot cures, this system is designed for continuous operation at temperatures up to 200°F. Resin and hardener are sold individually or in kits, and in pre-measured A-Paks.

- **Ideal for bonding a variety of substrates and potting electronic assemblies**
- **Excellent chemical resistance, and mechanical strength**

Type	Weight & Content	Part Number
<b>Pre-measured A-Pak</b>	5.2 grams Resin, .8 grams Hardener	FH-5313A-A-PAK
<b>Resin &amp; Hardener Kit</b>	16oz. Resin, 2oz. Hardener & 6 Droppers	FH-5313A-KIT
<b>Resin Only</b>	16oz.	FH-5313A-RESIN/16
	64oz.	FH-5313A-RESIN/64
	128oz.	FH-5313A-RESIN/128
<b>Hardener Only</b>	2oz.	FH-5313A-HARD/2
	8oz.	FH-5313A-HARD/8
	16oz.	FH-5313A-HARD/16

## Certified results from an independent testing lab

General Properties	Value	Test Method
<b>Specific Gravity</b>	1.17	ASTM-D-792-00
<b>Hardness, Shore D</b>	81	ASTM-D-2240-04E1
<b>Strength</b>		
Tensile	7,940 Psi	ASTM-D-683-03
Shear	782 Psi	ASTM-D-1002-01
Compressive	15,440 Psi	ASTM-D-695-02A
Flexural	13,860 Psi	ASTM-D-790-03
<b>Coefficient Of Linear Thermal Expansion</b>	93.5 Ppm/°c	ASTM-E-831-03
<b>Mixed Viscosity</b>	1,970 Cp	Mil-Std-883E
<b>Pot Life Minutes At 77°f</b>	30	Erf 13-70
<b>Cure Schedule Hours At 77°F</b>	12	
<b>Cure Schedule Hours At 150°F</b>	1	
<b>Mix Ratio By Weight (A:b)</b>	100:15	
<b>Electrical Properties</b>		
<b>Dielectric Strength</b>	2,128 Volts/Mil	ASTM-D-149-97A
<b>Dielectric Constant @100 Hz</b>	4.06	ASTM-D-150.98
<b>Dissipation Factor @100 Hz</b>	0.001	ASTM-D-150.98
<b>Volume Resistivity, Ohm/Cm</b>	8.4 X 10 <sup>14</sup>	ASTM-D-257.99
<b>Chemical Resistance</b>		
<b>Isopropyl Alcohol</b>		
Weight Change	0.15%	ASTM-D-543.95
Thickness Change	0.902%	ASTM-D-543.95
<b>Jet A</b>		
Weight Change	0.055%	ASTM-D-543.95
Thickness Change	0.519%	ASTM-D-543.95
<b>Outgassing Properties</b>		
<b>Total Mass Loss</b>	0.56%	ASTM-E-595-03E2
<b>Collected Volatile Condensable Material</b>	<0.01%	ASTM-E-595-03E2
<b>Water Vapor Regain</b>	0.29%	ASTM-E-595-03E2

# Glossary

<b>A</b>	<b>AR Coating</b>	Anti-reflective coating that reduces the surface reflection of an optic
	<b>Absorbance</b>	The ratio of absorbed to incident radiation
<b>B</b>	<b>BW</b>	Bandwidth
	<b>Bandpass Filter</b>	A filter that transmits a specific band of energy and rejects all other energy at higher and lower wavelengths
	<b>Bandwidth</b>	The spectral width of a filter measured at half of the peak transmission; also referred to as full width at half maximum (FWHM)
	<b>Blocking Range</b>	The spectral range of unwanted radiation
<b>C</b>	<b>Cavity</b>	An internal structure of a bandpass filter, consisting of two reflecting stacks of dielectric material separated by an even-ordered spacer. The number of cavities determines the shape of the passband
	<b>Center Wavelength</b>	The wavelength coinciding with the midpoint of the passband
	<b>Cold Mirror</b>	A filter which reflects the visible energy and transmits the near infrared energy
	<b>Commercial Quality</b>	A filter designed for use in non-imaging instrumentation applications
	<b>CW/L</b>	Center wavelength
<b>F</b>	<b>Fabry-Perot Filter</b>	Dielectric filter construction based on the Fabry-Perot interferometer. Consists of two reflective stacks separated by an even-ordered spacer
	<b>FIR</b>	Far Infrared (wavelengths from 6 $\mu$ m to 30 $\mu$ m)
	<b>FWHM</b>	Full width at half maximum or the bandwidth of the filter
<b>H</b>	<b>Hot Mirror</b>	A filter that reflects the near infrared energy (heat) and transmits the visible energy
<b>I</b>	<b>Image Quality</b>	A filter designed for use in imaging applications
	<b>Index of Refraction</b>	The ratio of the velocity of light in a vacuum to the velocity of light in a refractive material
	<b>Interferometer</b>	An instrument that measures the accuracy of an optical element utilizing interference phenomena based on the wave characteristics of light
	<b>IR</b>	Infrared Spectrum (wavelengths from 2.5 $\mu$ m to 30 $\mu$ m)
<b>L</b>	<b>Long Pass Filter</b>	A filter which transmits the longer wavelengths and rejects the shorter wavelengths
<b>M</b>	<b>MDM</b>	Metal-Dielectric-Metal
	<b>MWIR</b>	Midwave Infrared Spectrum (2.6 $\mu$ m to 6.0 $\mu$ m)
<b>N</b>	<b>N*</b>	The effective refractive index of the filter
	<b>ND Filter</b>	A neutral density filter that transmits a specific amount of energy equally over all wavelengths
	<b>NIR</b>	Near Infrared Spectrum (wavelengths from 750nm to 2.5 $\mu$ m )
<b>P</b>	<b>Passband</b>	The band of energy that is transmitted (passed) by the filter
	<b>Polarization</b>	A process or state in which rays of light exhibit different properties in different directions, especially the state in which all vibration takes place in one plane
<b>R</b>	<b>R/T ratio</b>	The ratio of reflectance to transmittance
	<b>Reflectance</b>	The ratio of the total amount of radiation reflected by a surface to the total amount of radiation incident on the surface
	<b>Refractive Index</b>	The ratio of the velocity of light in a vacuum to the velocity of light in a refractive material
<b>S</b>	<b>Short Pass Filter</b>	A filter that transmits the shorter wavelengths and rejects the longer wavelengths
	<b>Spectrophotometer</b>	An instrument that measures intensity of light at varying wavelengths
	<b>SWIR</b>	Shortwave Infrared Spectrum (1.5 $\mu$ m to 3.0 $\mu$ m)
<b>T</b>	<b>T or Tx</b>	Transmittance
	<b>Transmittance</b>	Transmittance is the fraction of incident light which passes through a filter
<b>U</b>	<b>UV</b>	Ultraviolet spectrum, typically defined as the (wavelengths from 200-400nm)
<b>V</b>	<b>VIS</b>	Visible spectrum (wavelengths from 400nm to 750nm)

# International Representatives

## Canada

**Delta Photonics**  
Unit A-6, 2285 St. Laurent Blvd  
Ottawa, ON, K1G 4Z4, Canada  
Tel: +1 613 688 3784  
Fax: +1 613 688 1370  
Email: sales@deltaphotonics.com  
[deltaphotonics.com](http://deltaphotonics.com)

## China

**DynaSense Photonics Co., Ltd.**  
E-915, Morgen Center, No. 6  
Taipingjie, Xicheng District  
Beijing 100050, China  
Tel: 0086-10-83503853  
Tel: 0086-10-83503673  
Fax: 0086-10-83503622  
E-mail: info@dyna-sense.com  
[dyna-sense.com](http://dyna-sense.com)

**Titan Electro-Optics Co., Ltd. - China**  
Rm. 1706, North Wing, The Gate Tower B  
No.19, Zhongguancun Avenue, Haidian  
District  
Beijing 100080 P.R., China  
Mob: +86 139 1190 0241  
Tel: +86 10 6263 4840 ext. 15  
Fax: +86 10 8261 8238  
E-mail: daniel-feng@teo.com.cn  
[teo.com.cn](http://teo.com.cn)

**Wuhan BeiYe Tech Co., Ltd.**  
Room 2003 A, ZhaoFuGuoJi Bldg.  
No. 717, Wuluo Road, Hongshan  
Wuhan 430070 P.R., China  
Tel: 027-86704160  
Cell: 13995549447  
Fax: 027-86704160  
Email: sales@wait-tech.cn  
[wait-tech.cn](http://wait-tech.cn)

## France

**LOT-QuantumDesign s.a.r.l.**  
Immeuble Les Conquérants  
Bâtiment Mac Kinley  
1, avenue de l'Atlantique  
91940 LES ULIS, France  
Tel: +33 (0)1 69194949  
Fax: +33 (0)1 69194930  
E-mail: marin@qd-europe.com  
[qd-europe.com/fr](http://qd-europe.com/fr)

## Germany

**LOT-QuantumDesign GmbH**  
Im Tiefen See 58  
64293 Darmstadt, Germany  
Tel.: +49 (0)6151 8806 56  
Fax: +49 (0)6151 8806 956  
E-Mail: filter@qd-europe.com  
[qd-europe.com/de](http://qd-europe.com/de)

## Hong Kong

**Wait Technology (HK) Limited**  
5/F Hong Kong Trade Centre,  
161-167 Des Voeux Road Central,  
Hong Kong, Hong Kong  
Tel: 00852-21527311  
Fax: 00852-30121311  
Email: sales@wait-tech.cn  
[wait-tech.cn](http://wait-tech.cn)

## India

**Liberty International  
dba: Molac Systems, Inc.**  
14402 Bethany Avenue  
Chino, CA 91710, USA  
Tel: 909-606-8417  
Fax: 909-606-8408  
Email: bobliberty@sprintmail.com  
[liberty-intl.com](http://liberty-intl.com)

## Ireland & UK

**LOT-QuantumDesign Ltd.**  
1 Mole Business Park  
Leatherhead  
Surrey KT22 7BA UK  
Tel: +44 (0) 1372 378822  
Fax: +44 (0) 1372 375353  
Email: ben@qd-uki.co.uk  
[qd-uki.co.uk/](http://qd-uki.co.uk/)

## Italy

**LOT-QuantumDesign s.r.l.**  
Via Francesco Saporì 27  
00143 Roma, Italy  
Tel: +39-06-5004204  
Fax: +39-06-5010389  
Email: renzi@qd-europe.com  
[qd-europe.com/it](http://qd-europe.com/it)

## Japan

**Hi Technology Trading Inc.**  
2-7 Nihonbashi-ohdenmacho  
Chuo-ku  
Tokyo 103-0011, Japan  
Tel: +81 3 5614 8221  
Fax: +81 3 5614 8222  
Email: sales@hi-technology.co.jp  
[hi-technology.co.jp](http://hi-technology.co.jp)

## Indeco, Inc.

11-14, Kasuga 1-chome  
Bunkyo-ku, Tokyo 112-0003, Japan  
Tel: +81 3 3818 4011  
Fax: +81 3 3818 4015  
Email: ind@indec.co.jp  
[indec.co.jp](http://indec.co.jp)

## Korea

**Dongwoo Optron Co., Ltd.**  
102-8 Hoean-Daero  
Opo-Eup, Gwangju-si,  
Gyeonggi-Do, 12798, South Korea  
Tel: +82 031 765 0300  
Fax: +82 031 765 0222  
Email: optron@optron.co.kr  
[optron.co.kr](http://optron.co.kr)

## L2K Co., Ltd.

530-ho, 187, Techno 2-ro  
Yuseong-gu, Daejeon, 34025, Korea  
Tel: +82-42-934-7744  
Fax: +82-42-934-7740  
Email: sales@l2k.kr  
[l2k.kr](http://l2k.kr)

## MJL Crystek, Inc.

# 1117 Expotel  
381, 44, 117beon-gil Dunsan-daero  
Seo-Gu, Daejeon, 35203, South Korea  
Tel: +82-42-471-8070  
Fax: +82-42-471-8073  
Email: jason@mjlinc.com  
[mjlinc.com](http://mjlinc.com)

## The Netherlands & Belgium

**Laser 2000 Benelux CV**  
P.O. Box 20  
3645 ZJ Vinkeveen, Netherlands  
Tel: +31-(0)297-266191  
Fax: +31(0)-297-266134  
Email: filter@qd-europe.com  
[qd-europe.com\be](mailto:filter@qd-europe.com)

**LOT-QuantumDesign BeNeLux**  
Victor Soensstraat 40  
B-1853 Strombeek-Bever, Belgium  
Tel: +32 2 3084324  
Fax: +32 2 3088575  
Email: filter@qd-europe.com  
[qd-europe.com\be](mailto:filter@qd-europe.com)

**Te Lintelo Systems BV**  
Mercurion 28A  
6903 PZ Zevenaar, Netherlands  
Tel: +31 316 340804  
Fax: +31 316 340805  
Email: contact@tlsbv.nl  
[tlsbv.nl](mailto:contact@tlsbv.nl)

## Poland

**LOT-QuantumDesign Polska**  
ul. Szttygarska 12/3  
41-500 Chorzow, Poland  
Tel: +48 32 2482048  
Mobile: +48 515 166893  
Fax: +48 32 7021160  
Email: filter@qd-europe.com  
[qd-europe.com\pl](mailto:filter@qd-europe.com)

## Russia

**AcademLot**  
ul. Butlerova 15  
117342 Moscow, Russia  
Tel: +7-495-938-1866  
Fax: +7-495-938-1907  
Email: academ@lot-qd.com  
[lot-qd.com](mailto:academ@lot-qd.com)

## Spain & Portugal

**LOT-QuantumDesign Iberia**  
Roca i Roca, 45  
08226 Terrassa (Barcelona), Spain  
Tel: +34 937 349168  
Fax: +34 937 349 168  
Email: filter@qd-europe.com  
[qd-europe.com\es](mailto:filter@qd-europe.com)

## Sweden, Denmark, Finland & Norway

**LOT-QuantumDesign Nordic**  
Nordic Division  
Roddarestigen 3 182 35 Danderyd, Sweden  
Tel: +46-8 410 71791  
Fax: +46-8 500 90791  
Email: filter@qd-europe.com  
[qd-europe.com\se](mailto:filter@qd-europe.com)

## Switzerland

**LOT-QuantumDesign AG**  
Moulin-du-Choc C  
CH-1122 Romanel-sur-Morges, Switzerland  
Tel: +41 21 869 90 33  
Fax: +41 21 869 93 08  
Email: filter@qd-europe.com  
[qd-europe.com\ch](mailto:filter@qd-europe.com)

## Taiwan ROC

**Unice E-O Services, Inc.**  
No. 5, Andong Road  
Chung Li District Taoyuan, Taiwan 32063  
(R.O.C.)  
Tel: 886 3462 6569  
Fax: 886 3462 5586  
Email: unicehq@unice.com.tw  
[unice.com.tw/](mailto:unicehq@unice.com.tw)

## USA, Corporate Headquarters

**Andover Corporation**  
4 Commercial Drive  
Salem, New Hampshire 03079-2800, USA  
Tel: +00 1 603 893 6888  
Fax: +00 1 603 893 6508  
US Toll-free: +1 888 893 9992  
Email: info@andcorp.com  
[andovercorp.com](mailto:info@andcorp.com)

# Index

Absorbance Calibration Filters	57	Color Reflective Filter Set	37
Absorbance Calibration Filter Set	57	Color Subtractive Filters	35
Absorptive Neutral Density Filters	31	Color Subtractive Filter Set	37
Absorptive Neutral Density Filter Sets	32	Colored Filter Glass	53
<b>Accessories</b>		Controller (Filter Temperature)	61
Epoxy, Optical	63	<b>Custom Filters</b>	
Filter Wheels	59	Bandpass, UV-VIS-NIR	23
Temperature Controllers	61	Bandpass, IR	50
Threaded Rings	58	Long and Short Pass, IR	48
Adhesive, Optical	63	<b>Cut-On Filters (LWP)</b>	
Analytical Line Filters	16	UV-VIS-NIR	40
Angle of Incidence Effects	12	IR	47
Anti-reflective Coatings - Infrared	45	<b>Cut-Off Filters (SWP)</b>	
<b>Astronomy Filters</b>		UV-VIS-NIR	40
UBVRI	26	<b>Density, (Neutral Density)</b>	
<b>Bandpass Filters</b>		Absorbing Glass Type	31
Infrared	49	Absorbance Calibration Filters	57
Image Quality	10	Ultraviolet/Visible/Near Infrared	30
Near Infrared	16	Visible/Near Infrared	30
Semi-Custom	22	Neutral Density Sets	32
Standard Products	16	Metallic Coated	28
High Transmitting	17	Absorption	31
Ultraviolet	16	<b>Dichroic Filters</b>	
Visible	16	Color Additive and Subtractive	35
Calcium Fluoride (CaF <sub>2</sub> ) windows	44	Color Reflective Filters, Blue/Red	35
Calibration Filters, Absorbance Type	57	<b>Dichroic Filter Sets</b>	
<b>Coatings</b>		Color Additive	37
Infrared	45	Color Processing	38
Metallic Neutral Density Filters, VIS	28	Color Subtractive	37
Metallic Neutral Density Filters, IR	51	<b>Edge Filters (LWP/SWP)</b>	
Cold Mirrors	34	Near Infrared Long Wave Pass	40
Color Additive Filters	35	Near Infrared Short Wave Pass	40
Color Additive Filter Set	37	Visible Long Wave Pass Filters	40
Color Processing Filters	35	Visible Short Wave Pass Filters	40
Color Processing Filter Set	38	Epolite FH-5313 Epoxy	63
Color Reflective Filters	35	Epoxy, Optical	63

Fabrication and Polishing	9	Glossary	65
<b>Filters</b>		Hard Coat Narrowband Filters	18
Bandpass	16,17,22	High-Transmitting Bandpass Filters	17
Color Additive, Color Subtractive	35	<b>Heat Control Filters</b>	
Color Processing Filters	38	Hot Mirrors	33
Colored Filter Glass	53	Cold Mirrors	34
Dichroic	35	Infrared Suppression	34
Dichroic Filter Sets	37	Ultraviolet Cold Mirror	34
Edge Filters LWP/SWP	40	Image Quality Filters	10
Heat Control Filters	33	Infrared Suppression Filter	34
Cold Mirrors	34	Infrared Antireflective Coatings	45
High-Transmitting Bandpass Filters	17	Infrared Bandpass Filters	49
Hot Mirrors	33	Infrared Long Wave Filters	47
Infrared Bandpass	49	<b>Interference Filters (Bandpass)</b>	
Infrared Long Wave Pass	47	Ultraviolet Filters	16
Infrared Neutral Density	51	Visible	16
Infrared Suppression Filters	34	Near Infrared	16
Ultraviolet Cold Mirrors	34	Infrared	49
Image Quality Filters	10	<b>Interference Filters (Cut-On, Cut-Off)</b>	
Long Wave Pass	40	Visible Long Wave Pass	40
Neutral Density Filters	28	Visible Short Wave Pass	40
Short Wave Pass	40	Near Infrared Long and Short Pass	40
Ultraviolet Filters	16	Infrared Long Wave Pass	47
Filter Ovens (Temperature Controllers)	61	<b>Interference Filter Sets</b>	
Filter Rings	58	Dichroic Filter Sets	37
<b>Filter Sets</b>		International Representatives	64
Dichroic Filter Sets	37	Long Wave Pass (Dielectric)	40
Neutral Density Filter Sets	32	Visible Long Wave Pass	40
Filter Wheels	59	Near Infrared Long Wave Pass	40
Fused Silica Windows (IR)	44	Infrared Long Wave Pass	47
General/Technical Information	12	Long Wave Pass (Filter Glass)	56
Germanium Windows	44	<b>Metallic Neutral Density Filters</b>	
<b>Glass</b>		Ultraviolet/Visible/Near Infrared	28
Filter Glass	53	Visible/Near Infrared	30
Infrared Windows and Substrates	44	Metallic Neutral Density Filter Sets	32

# Index

<b>Mirrors</b>			
Cold Mirror (Heat Transmitting)	34	Polishing and Fabrication	9
Hot Mirrors (Heat Reflecting)	33	Red Dichroic Filter	35
Infrared Suppression	34	Reflective Filter (Blue)	35
Ultraviolet Cold Mirror	34	Reflective Filter (Red)	35
Narrowband Hard Coat Filters	18	Sapphire Windows	44
Narrowband Interference Filters	16	Schott Filter Glass	53
Near Infrared Interference Filters (Semi-Custom)	22	Semi-Custom Bandpass Filters	22
Near Infrared Interference Filters (Standard)	20	Sharp Cut Filters (LWP/SWP)	41
Near Infrared Long Wave Pass Filters	40	Sharp Cut Filter Glass	56
Near Infrared Short Wave Pass Filters	40	Short Wave Pass Filters	40
Near Infrared Suppressors	34	Silicon Windows	44
<b>Neutral Density Filters</b>		Spectrophotometer Calibration Filters	57
Absorption	31	Standard Bandpass Filters	16
Metallic Coated (UV-VIS-NIR)	28	Steep-Edge Longpass Filters	41
Metallic Coated (IR)	51	Substrates, Infrared	43
<b>Neutral Density Filter Sets</b>		Temperature Controllers	61
Absorption	32	Temperature Coefficient Chart	12
Metallic Coated (UV-VIS-NIR)	32	Threaded Rings	58
Metallic Coated (IR)	51	UBVRI Filters	26
Optical Fabrication and Polishing	9	Ultraviolet Cold Mirror	34
<b>Optical Interference Filters</b>		Ultraviolet Interference Filters (Semi-Custom)	22
Bandpass (UV-VIS-NIR)	16	Ultraviolet Interference Filters (Standard)	16
Bandpass (IR)	49	Universal Oven Controller	61
Dichroics	35	Visible Interference Filters (Semi-Custom)	22
Heat Control (Hot/Cold Mirrors)	33	Visible Interference Filters (Standard)	16
Image Quality	10	Wavelength Shift With Angle of Incidence	12
Infrared	43	Wavelength Shift With Temperature	12
Long Wave and Short Wave (UV-VIS-NIR)	40	Windows, Infrared-Transmitting	43
Long Wave (IR)	47	Zinc Selenide Windows	44



## Ordering Information

### Pricing

Current prices are available at [www.andovercorp.com](http://www.andovercorp.com) by clicking on the part numbers for particular items. For a complete price list or a specific quote, contact Andover at 603.893.6888 or [info@andcorp.com](mailto:info@andcorp.com).

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### Andover Corporation

4 Commercial Drive  
Salem, NH 03079  
603.893.6888  
[www.andovercorp.com](http://www.andovercorp.com)  
[info@andcorp.com](mailto:info@andcorp.com)

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