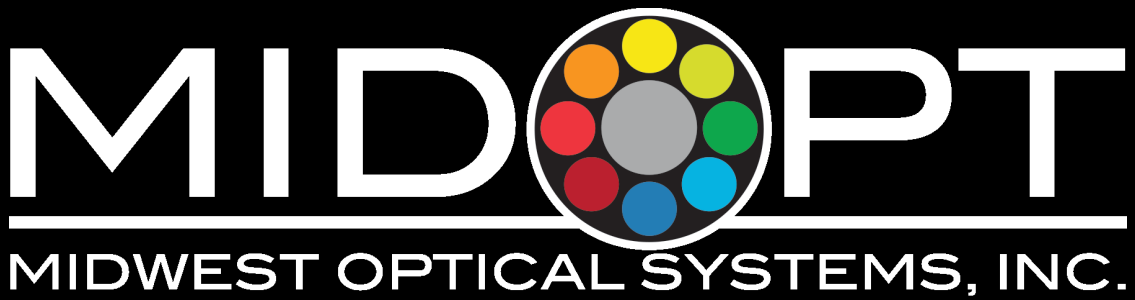


Where Image Quality Begins

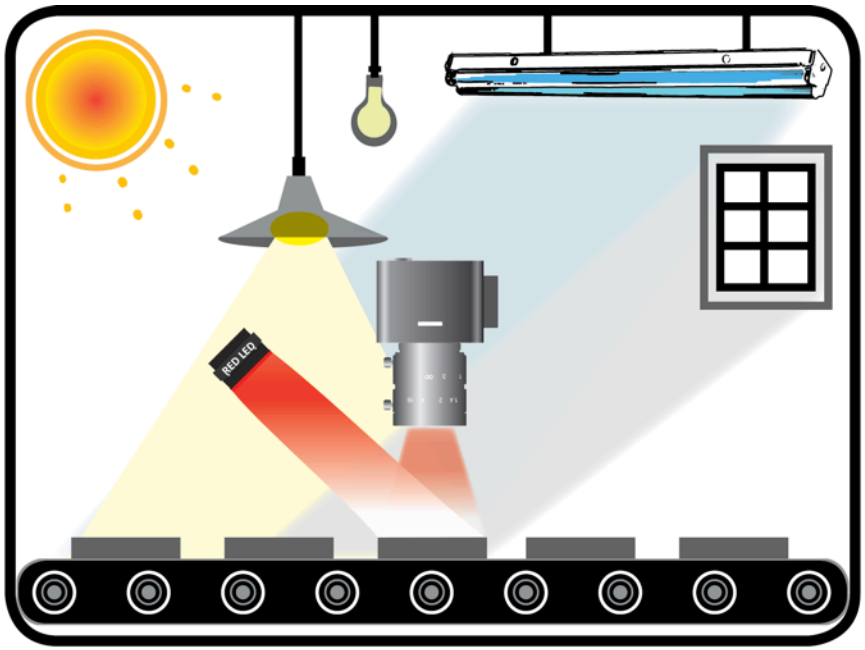
STEMMER® IMAGING

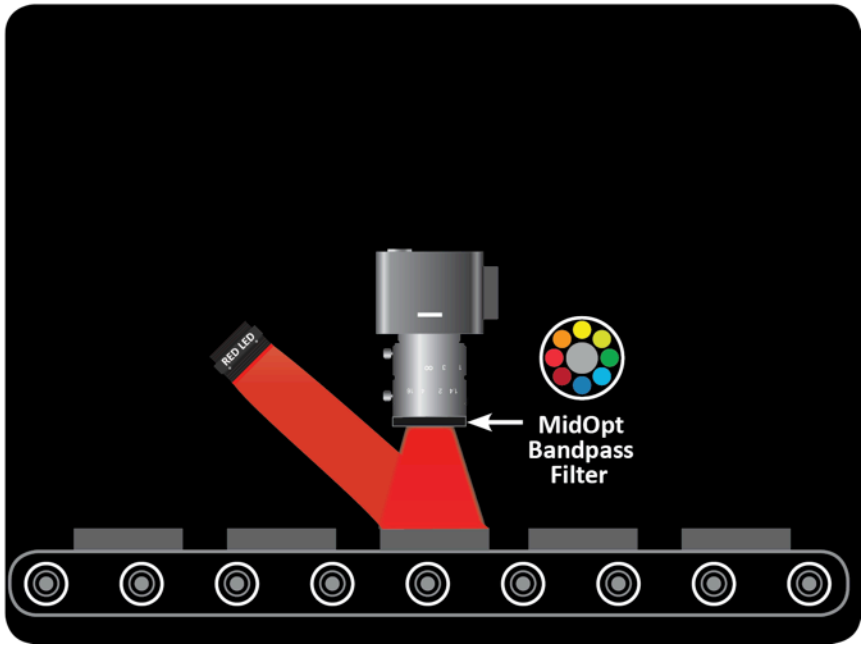
Filters are a Necessity
Not an Accessory

MIDOPT
MIDWEST OPTICAL SYSTEMS, INC.

STEMMER® IMAGING

Control Light. Block Unwanted Light. Pass Desired Wavelengths.





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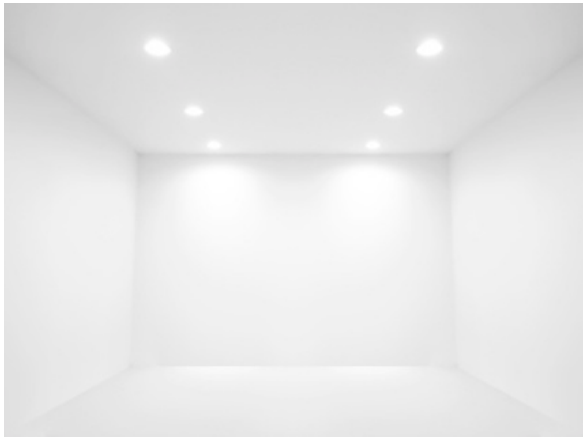
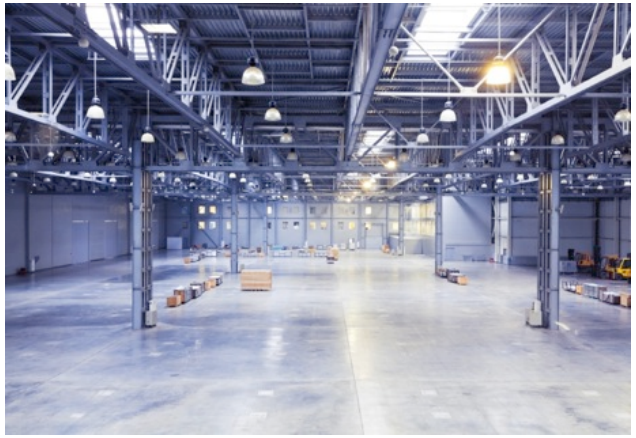
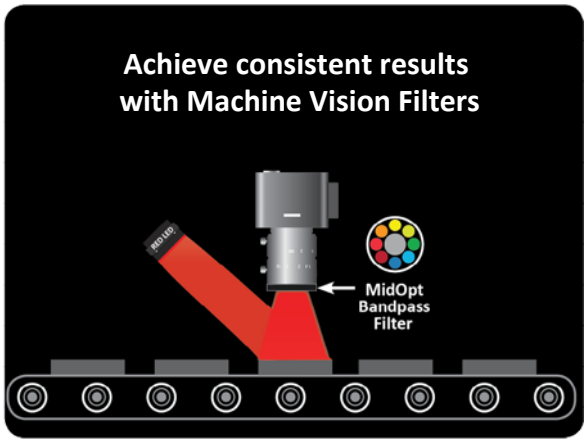
Inexpensive Insurance Policy for the System







The most cost effective way to improve repeatability and stability in any machine vision system.

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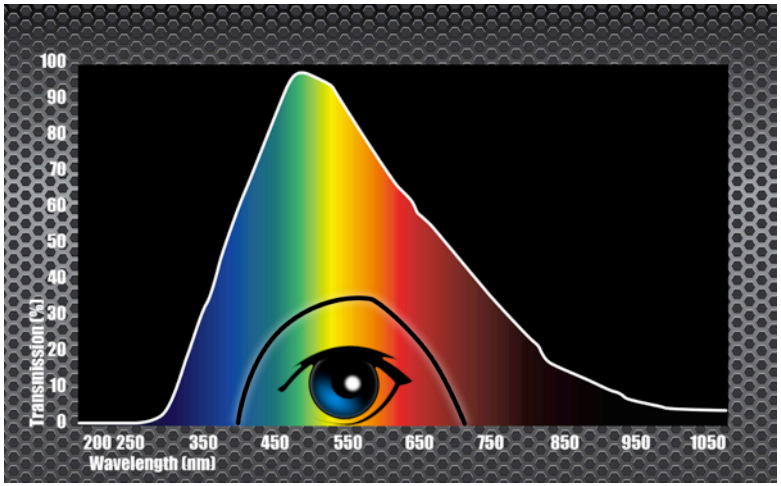
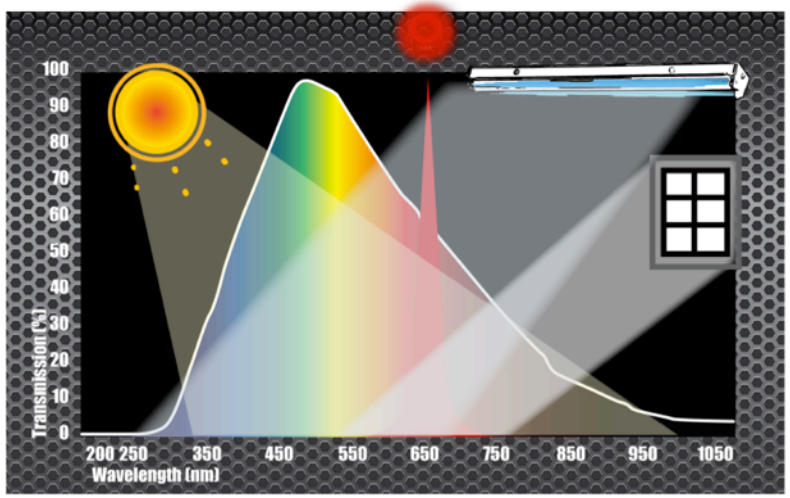


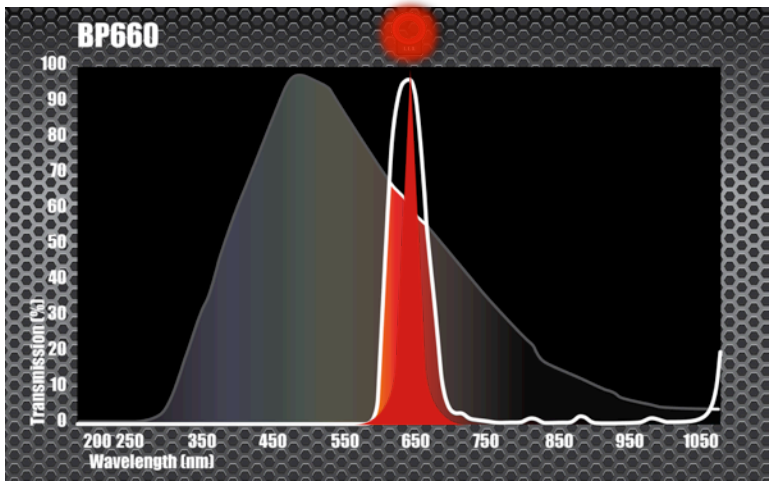
Digital sensor (typical CCD/CMOS) spectral response



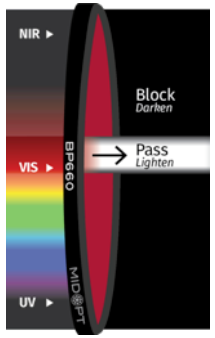
Digital sensors are extremely sensitive to interfering ambient light

Save Money & Space

Optical filters can eliminate light shields



Bandpass filters block interfering ambient light to control variability



Filters Control Light Variability

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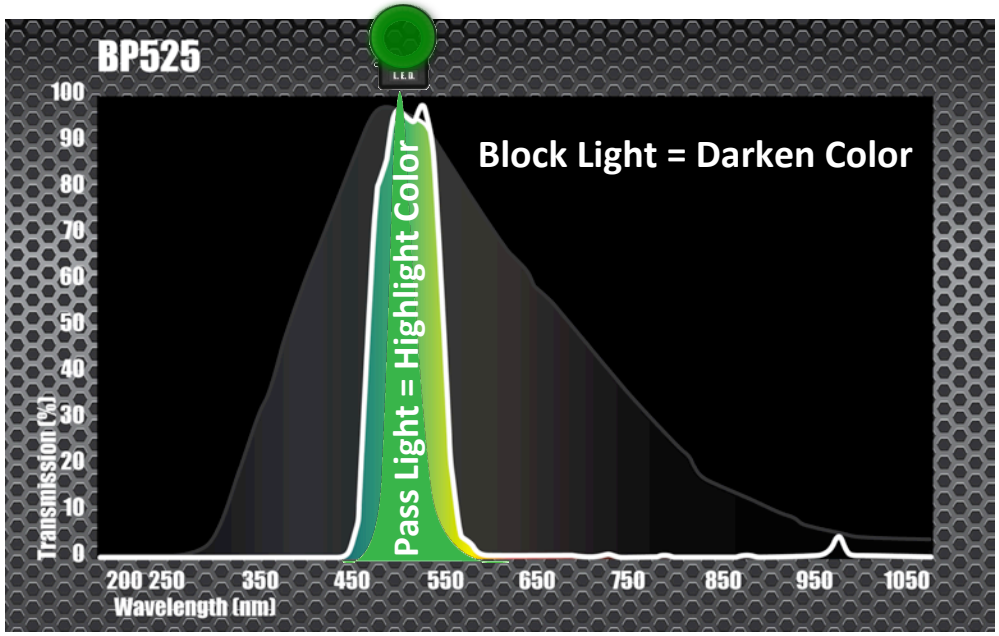
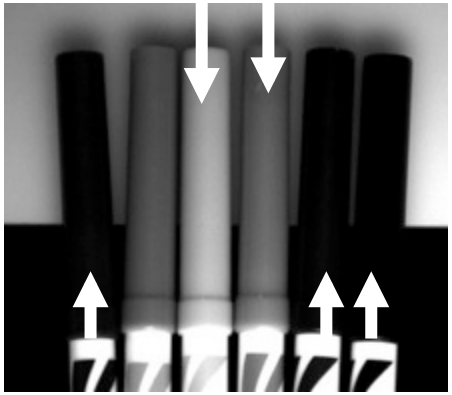
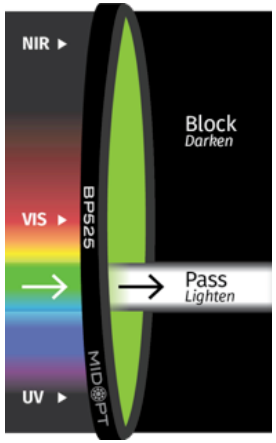
Increase Contrast

Selectively pass or block light wavelengths to highlight or darken areas of an image



Pass Light with Green Bandpass Filter and **Highlight** Green Colored Marker





Block Wavelengths with Green Bandpass Filter to **Darken Blocked Colors**

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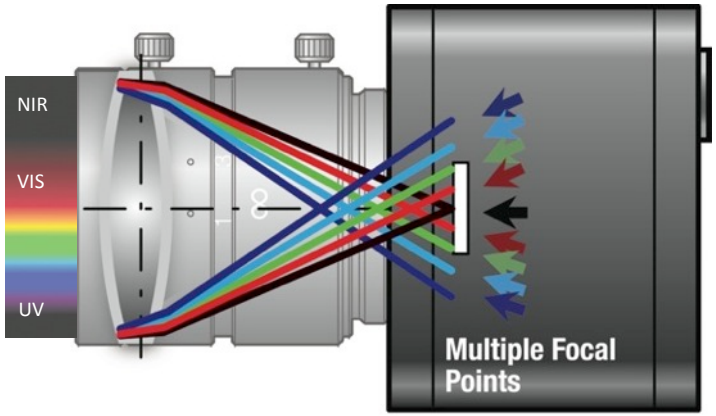
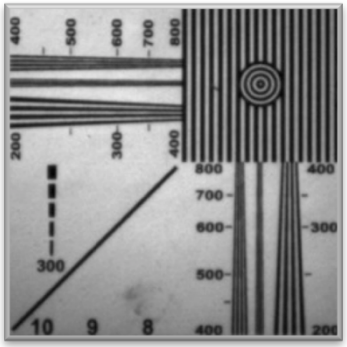
Increase Resolution

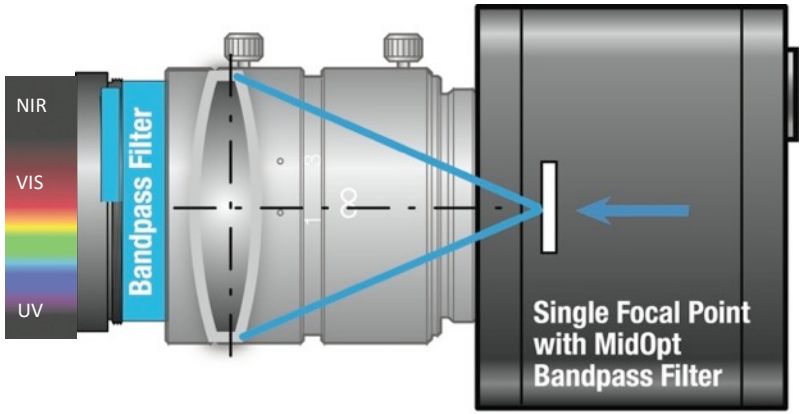
Before Bandpass Filter

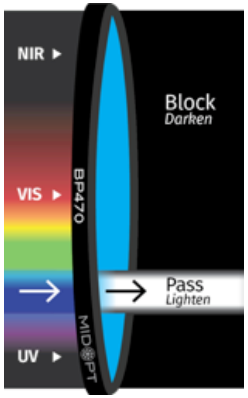


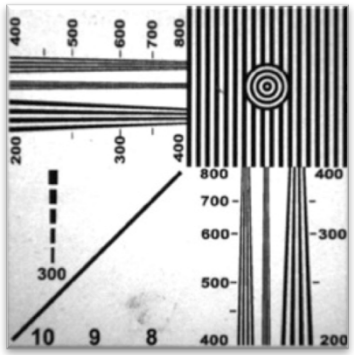
CHROMATIC ABERRATION



After Bandpass Filter







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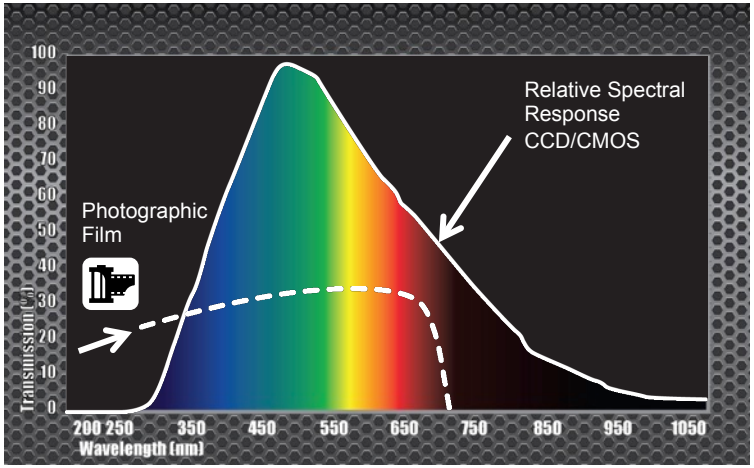
Does the quality of the filter matter?

Filters designed for photographic film are not suitable for digital imaging systems!



Relative Spectral Response:
Black and White Film vs Digital CCD/CMOS Sensor

Color Image, No Filter

Red Photographic Filter – Lightens (passes) red wavelength

Green Photographic Filter – Darkens (blocks) red wavelength

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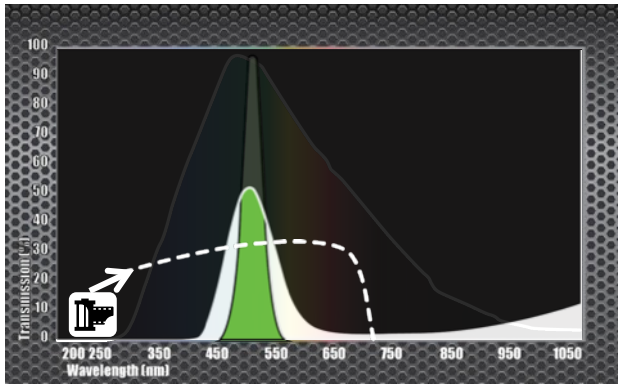
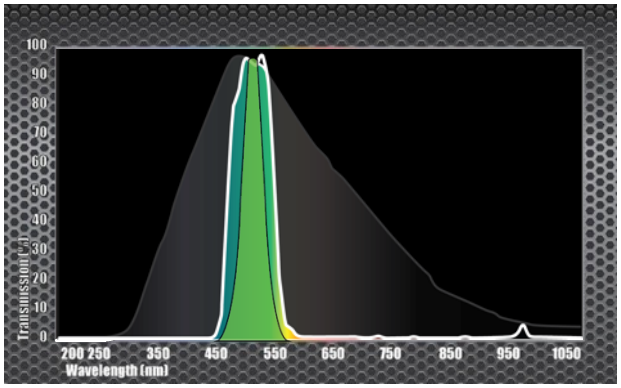
Photographic Filter



Photographic filters limit camera efficiency

Machine Vision Bandpass Filter



Machine vision bandpass filters transmit more light to the sensor allowing for shorter exposure times and faster line speeds.

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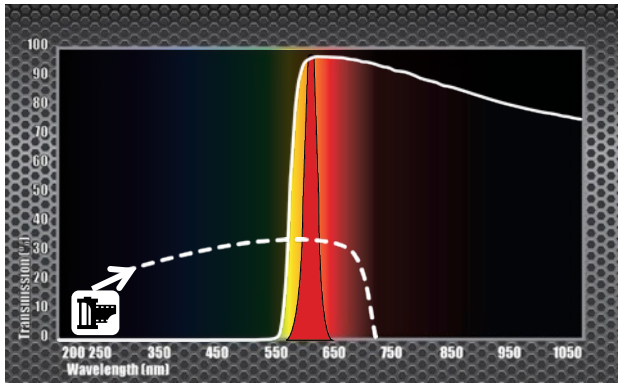
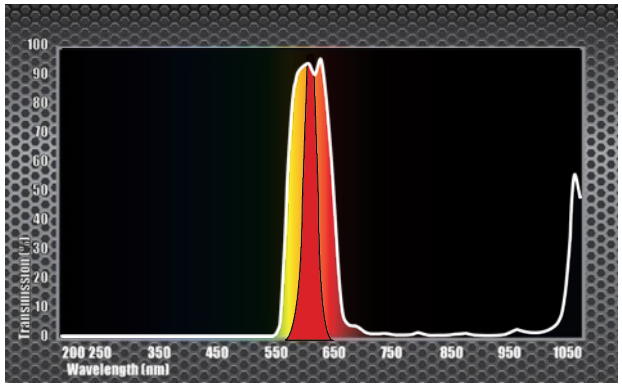
Photographic Filter



Machine Vision Bandpass Filter



Machine vision bandpass filters pass only the desired application illumination and blocks surrounding ambient light from interfering

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MIDWEST OPTICAL SYSTEMS, INC.

STEMMER® IMAGING

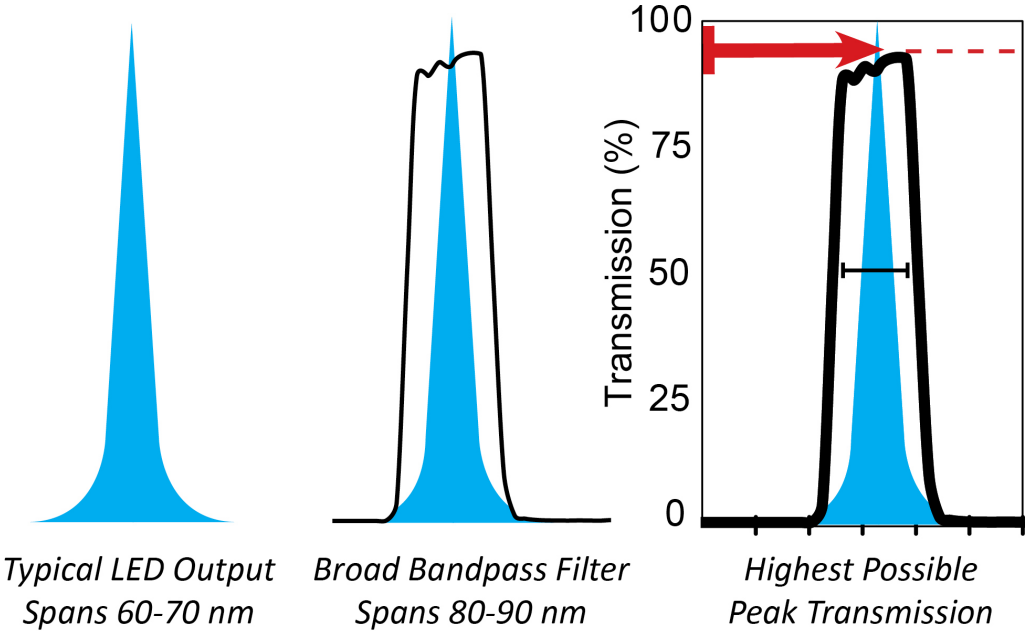
Bandpass Filters Developed for Machine Vision

Highest Possible Peak Transmission

Improve LED & Overall System Performance

Less Susceptible to AOI shifting

Precision Optical Quality



Typical LED Output Spans 60-70 nm

Broad Bandpass Filter Spans 80-90 nm

Highest Possible Peak Transmission

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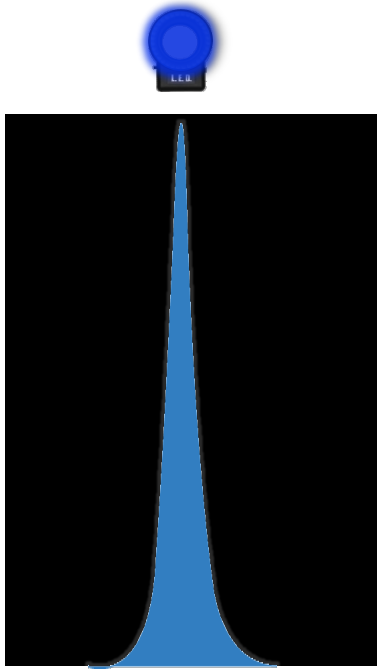
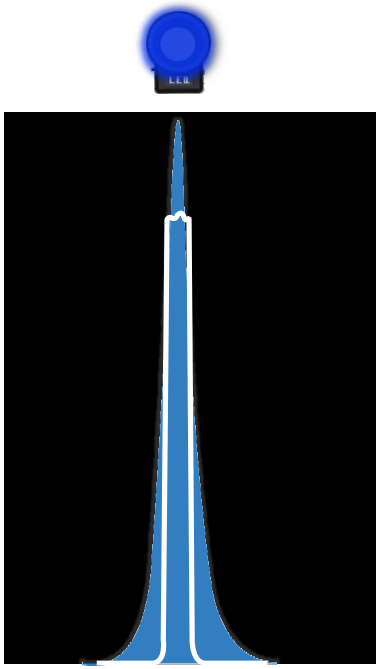
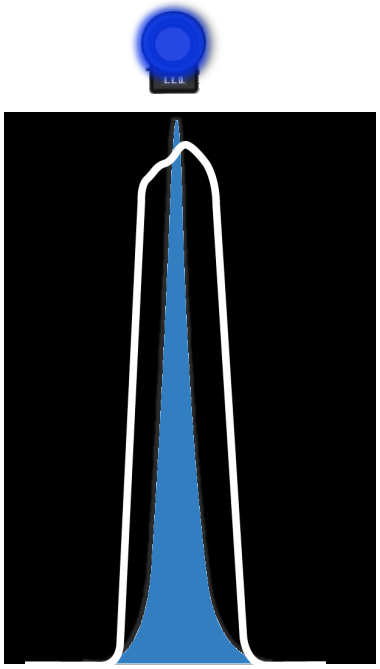
Filters Designed for Machine Vision Illumination



Solid Blue 470 LED
Spans 60-70 +/-10nm
typical



Acutely Narrow Filters
Span 20 nm



Bandpass Filters
Span 80-90 nm

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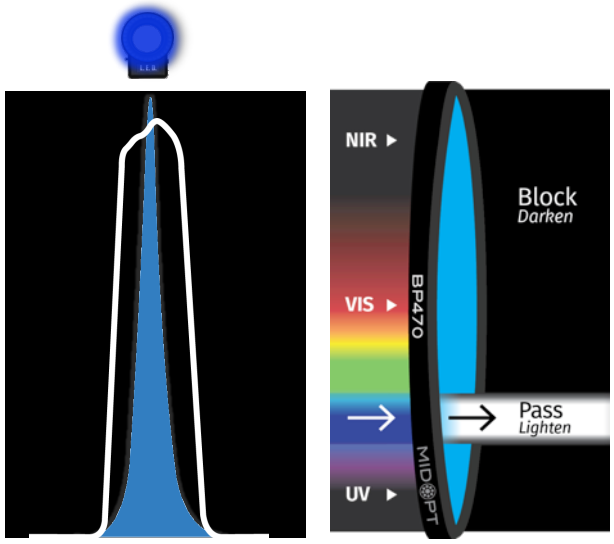
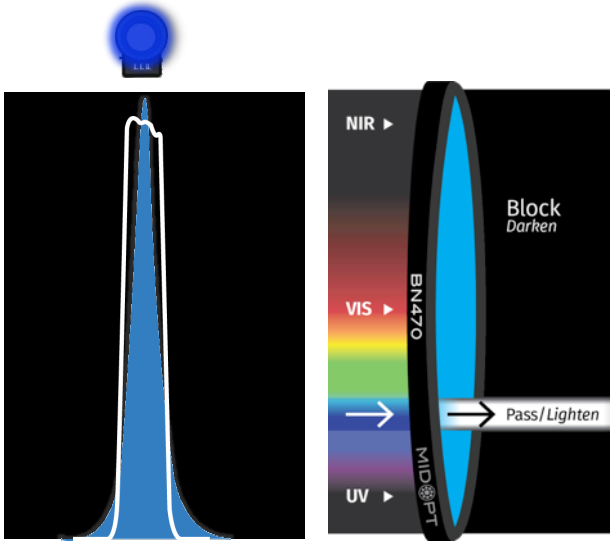
Narrower Bandwidth Design for for Improved Spectral Separation



Broader Filter Bandwidth (BP Series)
Spans 80-90 nm

- Ideal for use with LED Illumination and most fluorescence applications



Narrower Filter Bandwidth (BN Series)
Spans 40-50 nm

- Suitable for laser diodes
- Useful for: outdoor applications & fluorescence applications requiring reduced cross talk

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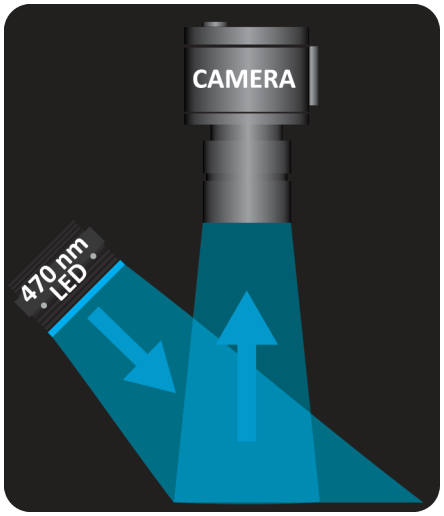
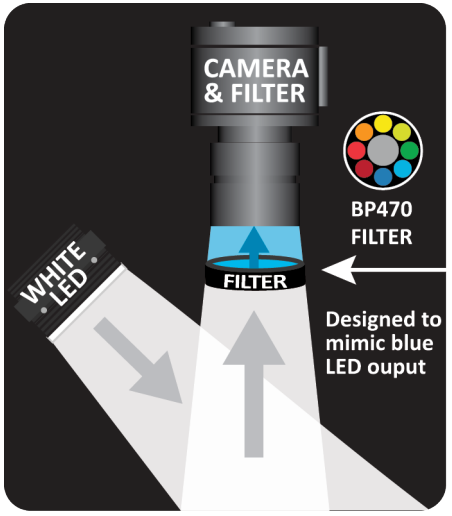
STEMMER IMAGING

Test the Effects of Monochromatic Illumination



White LED no filter, no contrast

Blue Bandpass Filter highlights blue push pin



Blue LED highlights push pin

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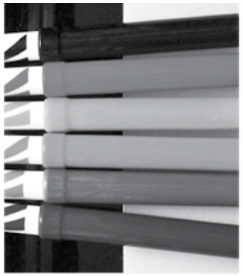
Test to Determine Your Optimal LED wavelength

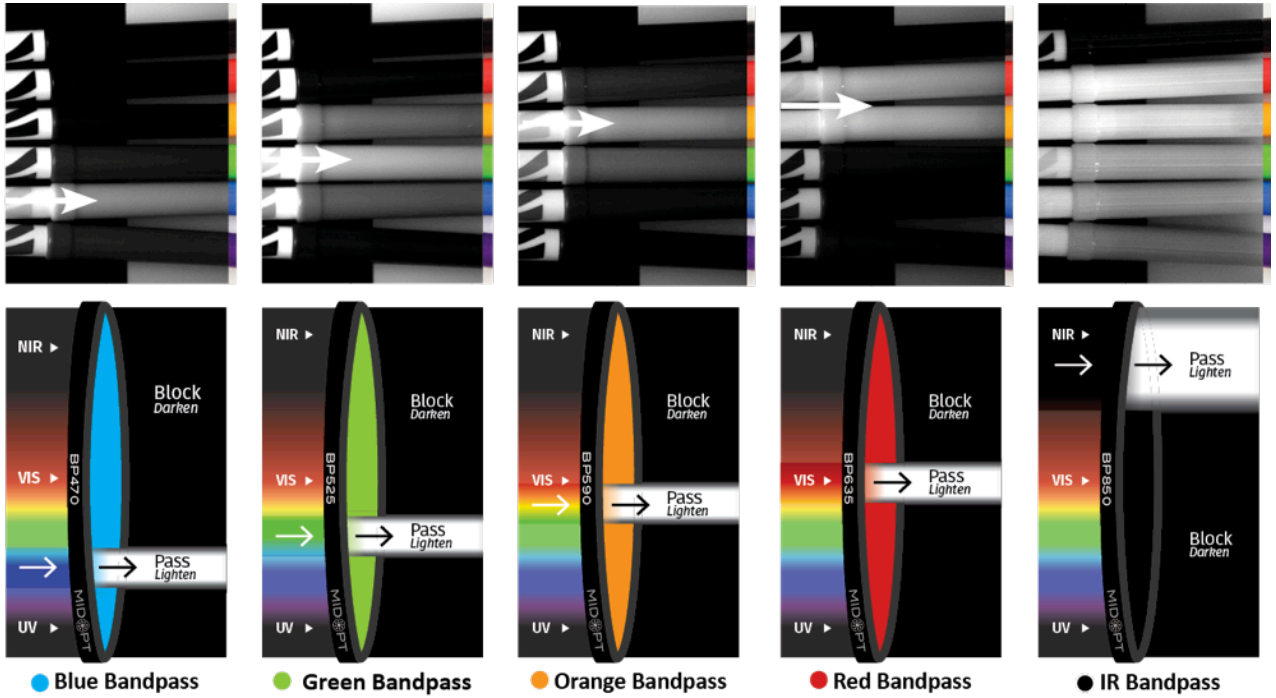
Utilize a broad spectrum light source with Bandpass Filters to test & determine the optimal LED wavelength for your application

Original Color Image



Monochromatic Image

White Light



Blue Bandpass | Green Bandpass | Orange Bandpass | Red Bandpass | IR Bandpass

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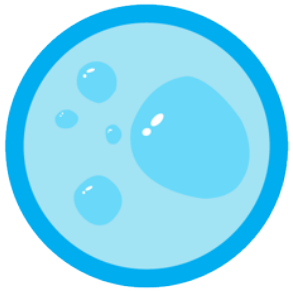
Extreme durability



NON-HYDROSCOPIC

WITHSTAND VIBRATION

LONG LIFE

CLEANABLE

Application Examples

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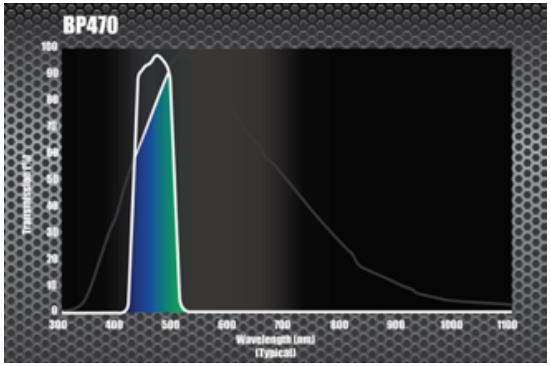
Increase Contrast with Bandpass Filters

White Text Yellow Background

White LED, MidOpt BP470 Blue Bandpass



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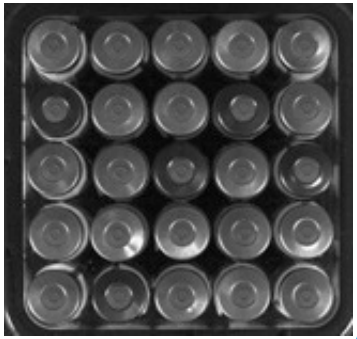
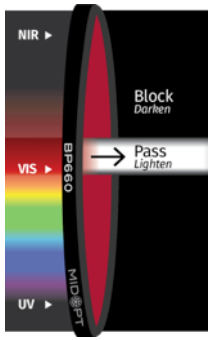
Color Sorting Results

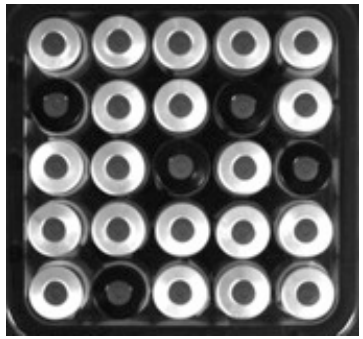
Original color image

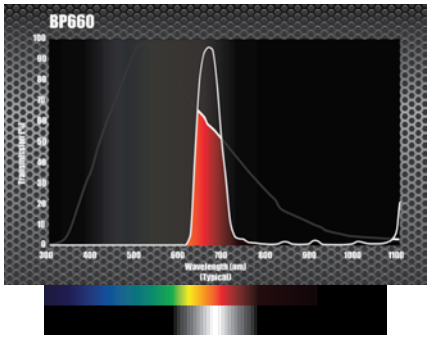


No Filter

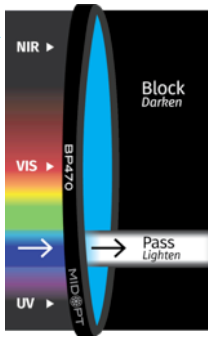
MidOpt BP660 Red Bandpass Filter

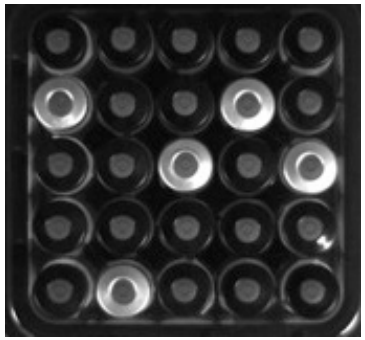


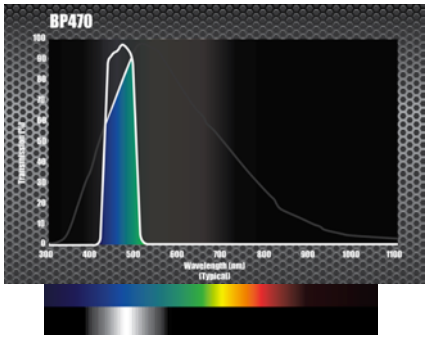




MidOpt BP470 Blue Bandpass Filter







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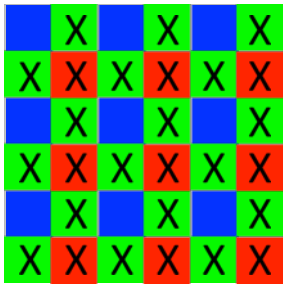
STEMMER IMAGING

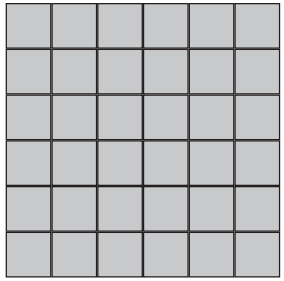
Monochromatic imaging with optical filters significantly increases camera efficiency

Color

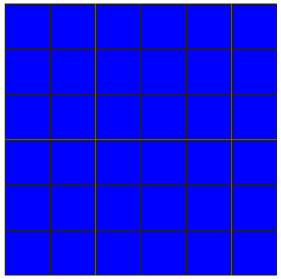


25% Efficient

Monochrome

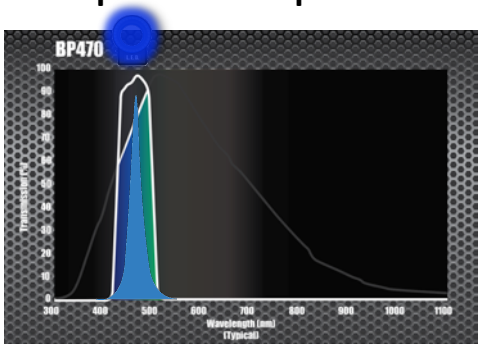


Monochrome with Filter



90% Efficient

MidOpt Blue Bandpass Filter



Each pixel in a monochrome sensor is used to detect intensity.

Combined with a blue bandpass filter that transmits 90+%, a monochrome sensor vs a color sensor is at least 3 times more efficient

Original Color Image, UV 395nm LED

Blue fluorescence; No Filter

Blue Bandpass Filter

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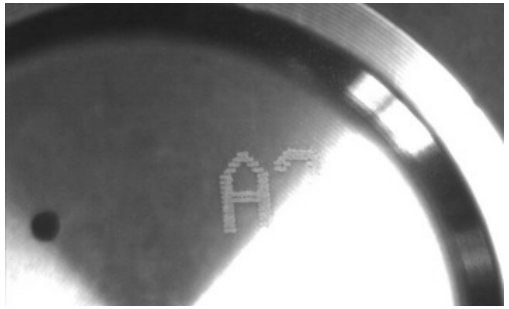
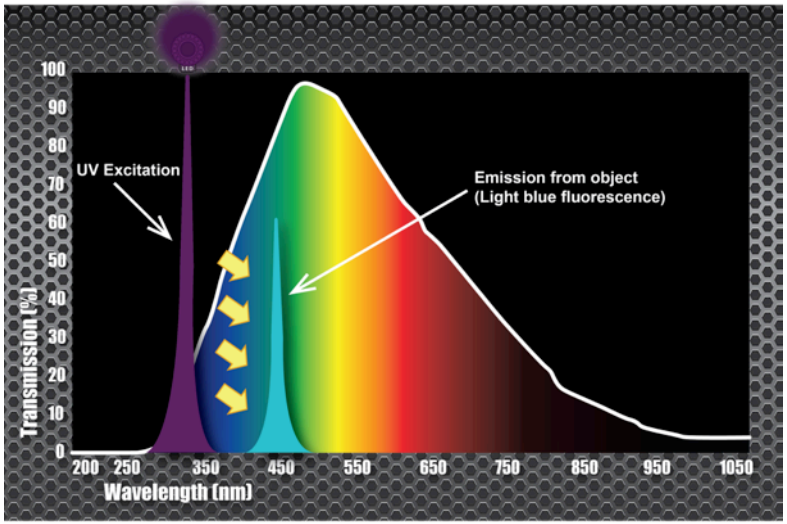
UV Fluorescence Imaging

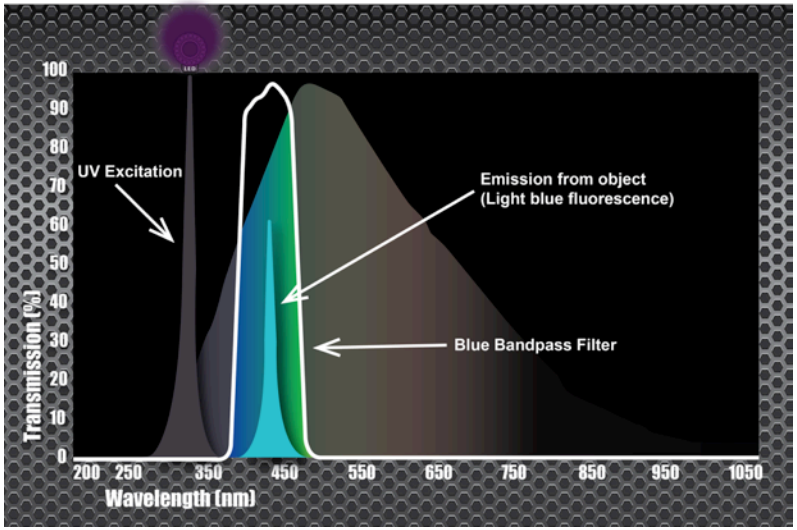
Excitation light source interferes with weaker emitted fluorescence without the use of filters



No Filter, 395nm UV Light

395nm UV Light with MidOpt BP470 Blue Bandpass Filter





MIDOPT
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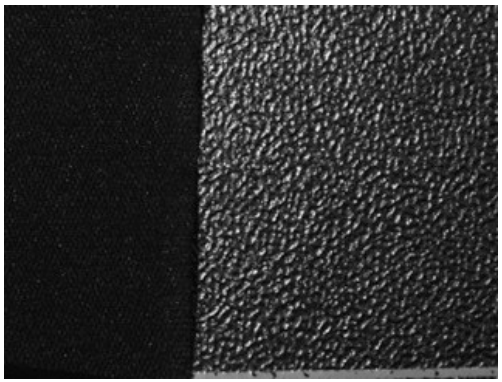
STEMMER IMAGING

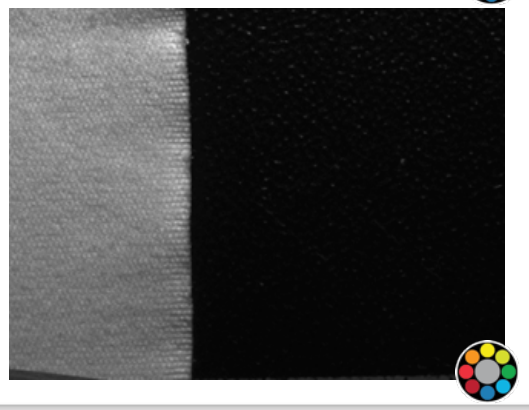
Convert your Camera into an Infrared Imager

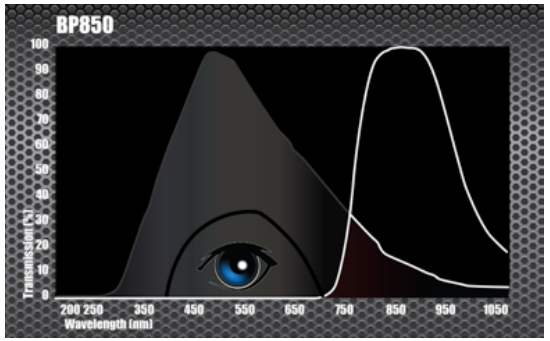
View the invisible with IR Bandpass filters

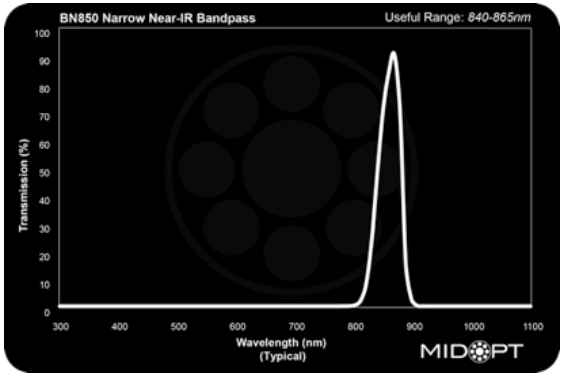
Before Filter

After Filter









Other Filters Used in Vision Applications

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STEMMER IMAGING

Reduce Glare with Polarizing Filters & Film

No Filter

Glare from LED & ambient light

Polarizing Filter

Significant glare remains

Polarizing Filter & Film

Minimal glare from ambient light remains

BP660 + Polarizing Filter & Film

Further reduces glare & improves contrast

- Minimize specular glare by using a **polarizer** over the lens and a **polarizer film** over the light source
- For imaging above 700 nm **Infrared polarizer** must be used

Lens polarizer with locking thumb screw to prevent change of orientation

Custom sheet shapes & sizes to fit the light source

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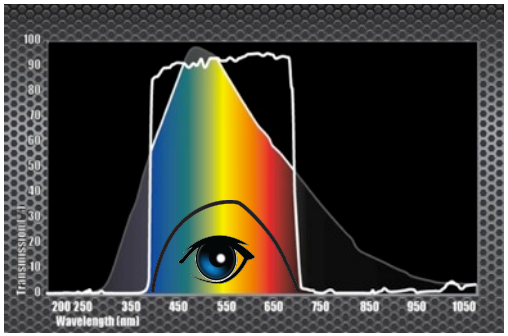
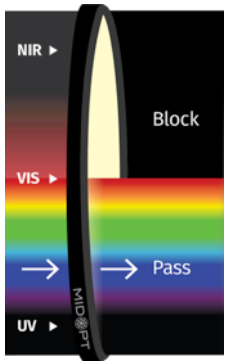
Shortpass / Near-IR Cut Filters

Before Filter

After Filter

- Lets shorter wavelengths pass while blocking the longer ones
- Block IR light from interfering with color rendition in CCD/CMOS cameras
- Commonly placed over the image sensor





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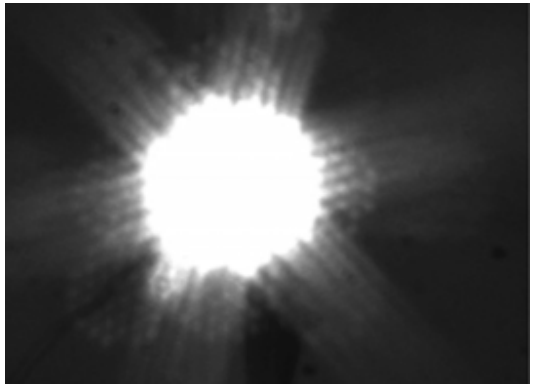
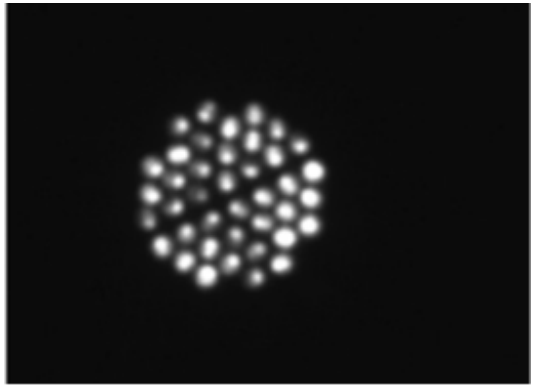
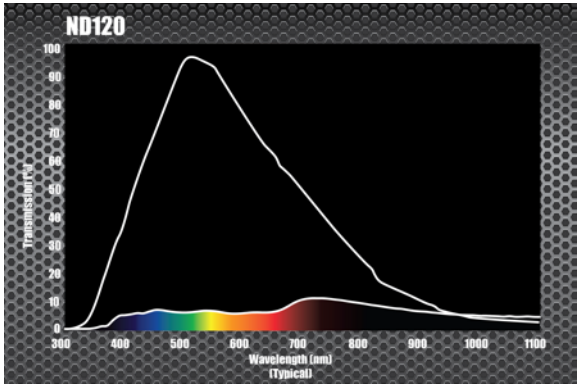
Neutral Density Filters



Before Filter



After Filter



- **Reduce light intensity** without affecting color
- **Achieve shallow depth of field**
- Can be **used with monochrome & color cameras** in the visible spectrum

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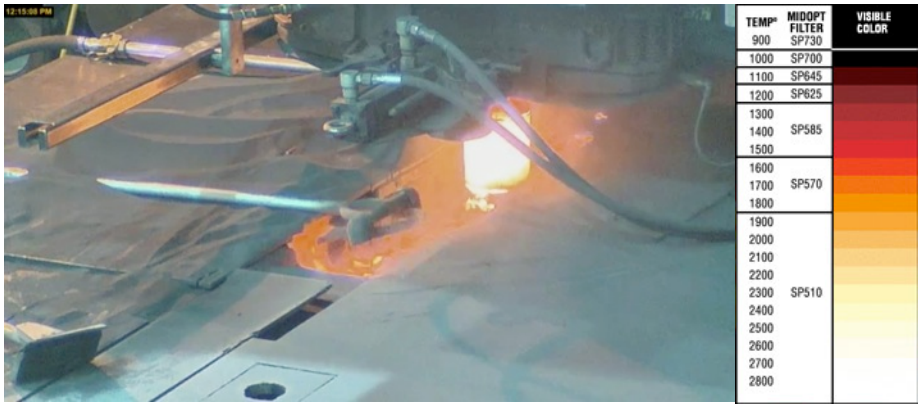
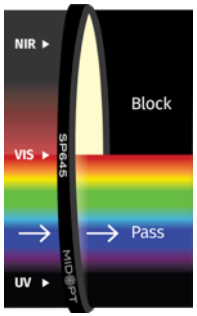
Combine Shortpass and Neutral Density Filters to Reduce Image Blooming/Saturation



High temperature, Light Intensity and Image Saturation

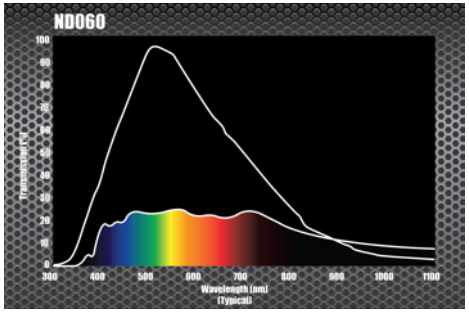
Reduce intensity, saturation & interfering red channels with a neutral density filter in combination with a shortpass filter

Shortpass Filter



+

Neutral Density Filter



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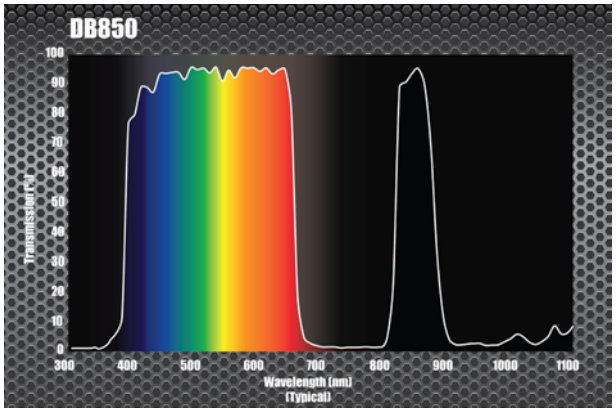
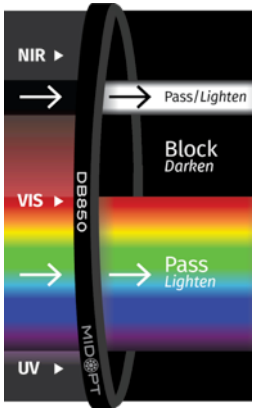
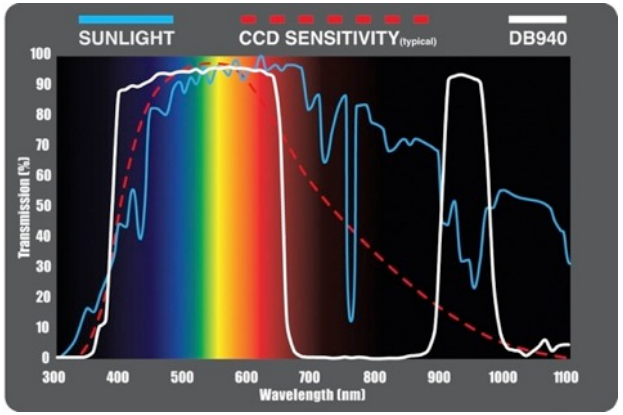
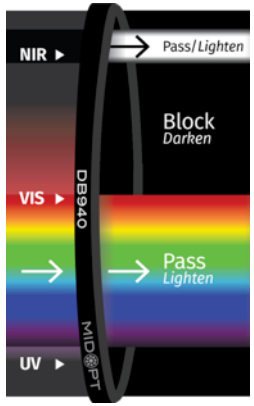
Dual (Visible + Infrared) Bandpass Filters

- Use for color camera day/night applications along with IR illumination
- Blocks interfering IR wavelength range to achieve accurate color rendition
- Ability to view with IR illumination at night









Less interference from the sun at 940nm

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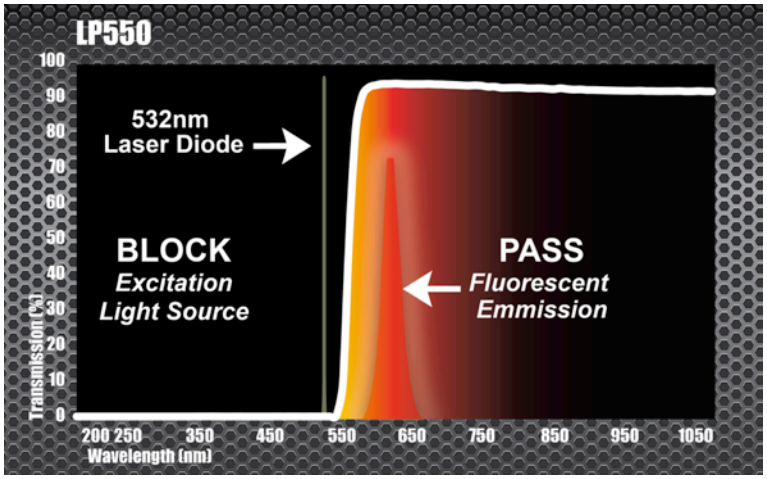
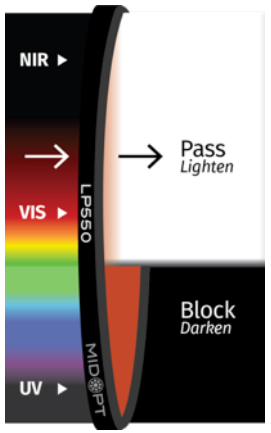
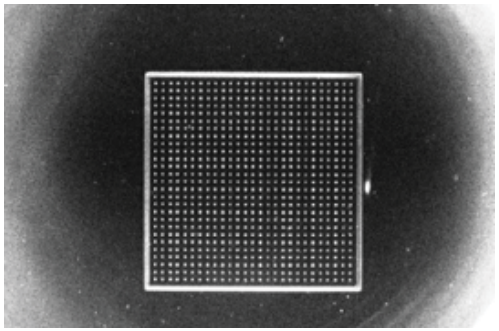
Longpass Filters

(High Pass, Sharp Cut)

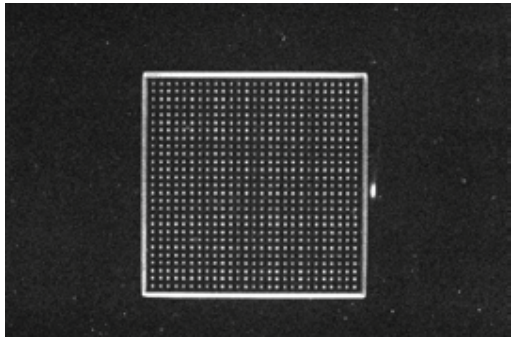
- Useful in blocking excitation light source while passing all emission where ambient light is not an issue
- Longpass filters can be used to pass multiple LEDs Ex. 590 & 850 nm
- A/R coating increases transmission
- For traffic & security applications, the acrylic Infrared Longpass is ideal







Before Filter



After Filter

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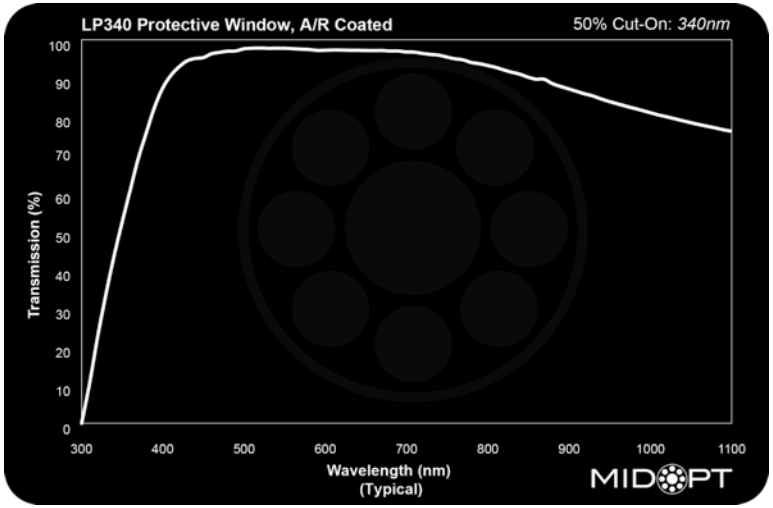
Protective / UV Blocking Filters

- Protect lenses from dust and harsh industrial environments
- Anti-reflection coatings maximize transmission
- Hard coated acrylic protective windows are an economical solution and useful for FDA requirements & outdoor applications



Materials:

- High efficiency anti-reflection coatings standard on AC380, LP285, LP340 & LP415
- Acrylic or glass options; anti-reflection coated or uncoated alternatives

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Mounts for Any System

Solutions for any lens – with or without filter threads;
C/CS camera mounts & custom shaped filter glass

Threaded Mount

Slip-On Mount

C/CS Mount

Unmounted

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Lens Accessories

CS Mount Lens Enclosure

Step Rings

Lens Extension Tubes

Right Angle Attachment

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Custom optical components for industrial vision & lighting

- Precision Optical Windows
- Focusing Lenses
- Light Pipes
- Polarizers
- Prisms
- Dust Covers
- Diffusers
- Mirrors
- Filters
- Beamsplitters
- Wedges

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Machine Vision Filter Test Kits

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MidOpt Optical Filters are the **simplest, quickest** and **most cost effective** way to improve repeatability and stability in any machine vision system.

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Thank You

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