

When is Monochrome Light More Appropriate than White?



Fig. 1
Color Wheel

Historically, vision inspection has used white light, primarily because it was readily available from incandescent or fluorescent sources. And certainly broad spectrum white light is necessary for color vision camera inspection applications, and other inspections that require a specific white color temperature calibrated in degrees Kelvin. However, there are applications best suited for using color monochrome light, particularly when maximizing the contrast of an object against its immediate background.

A color wheel (Fig. 1) is a simple, yet effective tool for understanding the relationship between colors, and how to apply color light to enhance or diminish contrast. In this diagram, the “warm” color family is represented by the colors, red, orange, and yellow, whereas, the “cool” color family is represented by green, blue and violet. It is important to remember 2 rules of thumb: 1) like colors (or color family) brighten, and 2) opposite colors darken.



Fig. 2a
Postal Stamp w/ Red
(660nm) Light

A common application using color lighting to enhance contrast is in the printing industry, in this case, an ink based postal stamp or cancelling mark. Most often these stampings are red or orange. By applying various colors, we can gauge how effective each color is in enhancing the contrast of the red print against

the white paper background. As expected, illuminating with the standard red LED light (See Fig. 2a), the postal stamp effectively disappears because the red light brightens the red print, thus decreasing the contrast between the print and its immediate background.

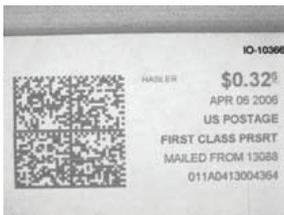


Fig. 2b
Postal Stamp w/ Blue
(470nm) Light

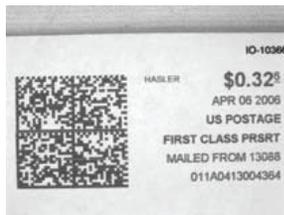


Fig. 2c
Postal Stamp w/
Green (530nm) Light

Based on our understanding of the color wheel, we might then consider illuminating with an opposing, or “cool” color. Using blue light (Fig. 2b), we see there is sufficient contrast, but can we do better?

Typically, the strongest response between a sample and the opposite color family lighting is when their respective colors appear directly opposed on the color wheel, thus it would be appropriate to test green next. Notice that the contrast is even more pronounced (Fig. 2c). Of course, white light is also an option, but how effective would we expect this broad spectrum light to be, considering it comprises both warm and cool family colors?

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Also as expected, the contrast is somewhat diminished compared to the green response (See Figs. 2d vs. 2c). A single color monochrome LED light works well in this simple application, but how do we illuminate the stamps if they are different colors?



Fig. 3
RL4260-RGB

The simplest solution is to use white light, recognizing that contrast is compromised somewhat in favor of flexibility. Another possible solution is to use a multi-color RGB light, such as the RL4260-RGB (Fig. 3), whereby the light color can be changed.

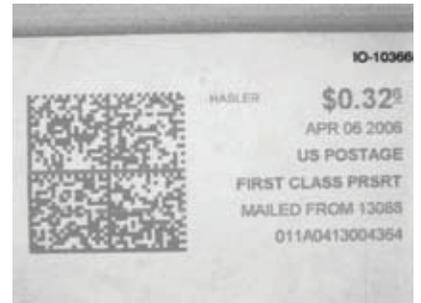


Fig. 2d
Postal Stamp w/
White Light

Finally, the use of monochrome light also confers the advantage of using a wavelength-matched band pass filter, which is very effective in blocking ambient light, which can interfere with an inspection (See Fig. 4).



Fig. 4
Filters