Understanding the Difference Between ANSI Lumens and RGB Laser Lumens

ViewSonic follows industry-standard methods to determine our projector brightness specifications defined by the American National Standards Institute (ANSI). However, ANSI brightness ratings alone do not always accurately represent the brightness performance in the latest generation of wide-color gamut RGB laser projectors. This is due to the Helmholtz-Kohlrausch (HK) effect.

The HK effect causes observers to perceive highly saturated images to be brighter than less saturated images. This is because the human eye is more sensitive to certain wavelengths of light, therefore any projector with a light source that more closely matches the light response of the human eye will naturally have a higher perceived brightness. As a result, two projectors with the same ANSI Lumens brightness rating can appear to offer two different brightness levels.

To understand how this is possible, Figure 1 clearly illustrates the HK effect. Most observers would assume that the colored patches on the left are brighter than the greyscale patches in the center, however, they have the same measured ANSI Lumens of brightness. In addition, while the colored patches on the right may appear to be the same brightness as the center grey scale patches, their ANSI Lumens of brightness is much lower than the center grey patches.

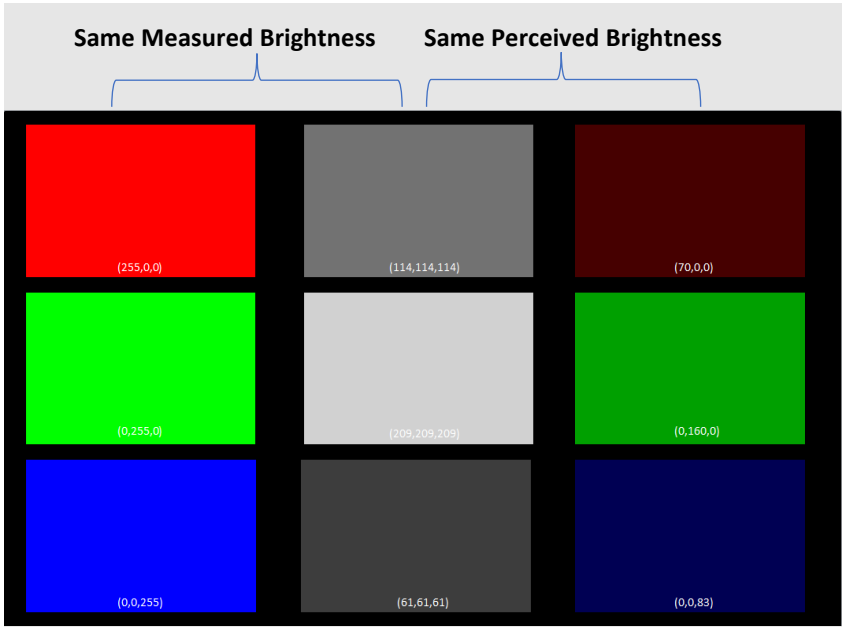

Figure 1. Measured vs. Perceived Brightness (Simulated image to illustrate the HK effect)

Figure 2 further illustrates how people perceive brightness to vary from color to color. It presents the constituent red, green, and blue colors of the RGB laser projector on the x-axis, while the y-axis shows the perceived brightness ratio of each color. The perceived brightness ratio indicates the variance between how bright something appears and its objectively measured brightness, while the average perceived brightness ratio is the difference when all the colors are combined. Both ratios can be calculated using the formulas below.

$$Perceived\ Brightness\ Ratio\ = \frac{(Red\ 100\%\ or\ Green\ 100\%\ or\ Blue\ 100\%\ )lumens}{(\ Red\ visual\ or\ Green\ visual\ or\ Blue\ visual)\ lumens}$$

$$Average\ Perceived\ Brightness\ Ratio = \frac{(Red\ 100\%+Green\ 100\%+\ Blue\ 100\%\ )\ lumens}{(\ Red\ visual\ +Green\ visual\ +\ Blue\ visual)\ lumens}$$

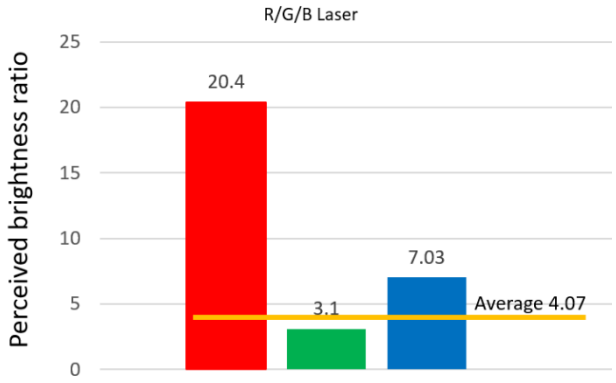

Figure 2. Magnitude of the HK effect with Red, Green, and Blue monochromatic lights

**The times average perceived brightness ratio is determined by ViewSonic RGB laser projectors, other RGB laser projectors may have a different result.*

By observation, we know that many projectors with RGB laser-based light sources have higher perceptible brightness than many lamp-based projectors, even though they may have the same measured ANSI Lumens rating, as illustrated in Figure 1's depiction of how the human eye's heightened sensitivity to highly saturated colors causes the colored patches on the left to appear brighter. As a result, an RGB laser projector with colors that are more concentrated in wavelengths will be perceived as brighter. Because of this phenomenon, ViewSonic is committed to providing both ANSI Lumens and RGB Laser Lumens ratings for our latest RGB laser projectors.

Determining the typical Lumen specification for a given RGB laser projector first requires the selection of a lamp-based reference projector with an RGBRGB color wheel. The individual red, green, and blue light sources from the RGB laser projector are then adjusted until the perceived brightness closely matches that of the reference lamp-based projector. Another ANSI Lumens measurement of the adjusted RGB laser projector is then taken, and the ratio of these two measurements is multiplied by the ANSI Lumens measurement of the reference lamp-based projector to determine the equivalent “RGB Laser Lumens” rating.

Figure 3. Sample image of a 2000 ANSI Lumens lamp-based projector (RGBRGB, ViewSonic PX728-4K) vs. a 550 ANSI Lumens RGB laser projector (RGB, ViewSonic M10)

**The ViewSonic RGB laser projector versus a ViewSonic lamp-based projector, we can see a 4.07x average perceived brightness ratio.*

In addition to higher perceived brightness, projectors with RGB laser light sources typically have a higher luminous efficiency. This means they are more energy-efficient despite providing a higher perceived light output and a wider color gamut for an overall more stunning image quality. These factors combine to make the latest ViewSonic RGB laser projectors a very compelling solution.

References

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2) Wyszecki G. and Stiles W. S. Color Science – Concepts and Methods, Quantitative Data and Formulae 3rd edition (John Wiley and Sons, New York, 2000)

3) Mike Wood – Lightness- The Helmholtz-Kohlrausch effect (Out of Wood, Summer 2012)

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