Understanding the Difference Between ANSI Lumens and LED Lumens

ViewSonic follows the industry-standard ANSI methods to determine our projector brightness specifications, However, ANSI brightness ratings alone do not always accurately represent the brightness performance in the latest generation of high-color gamut projectors with LED light sources. 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.

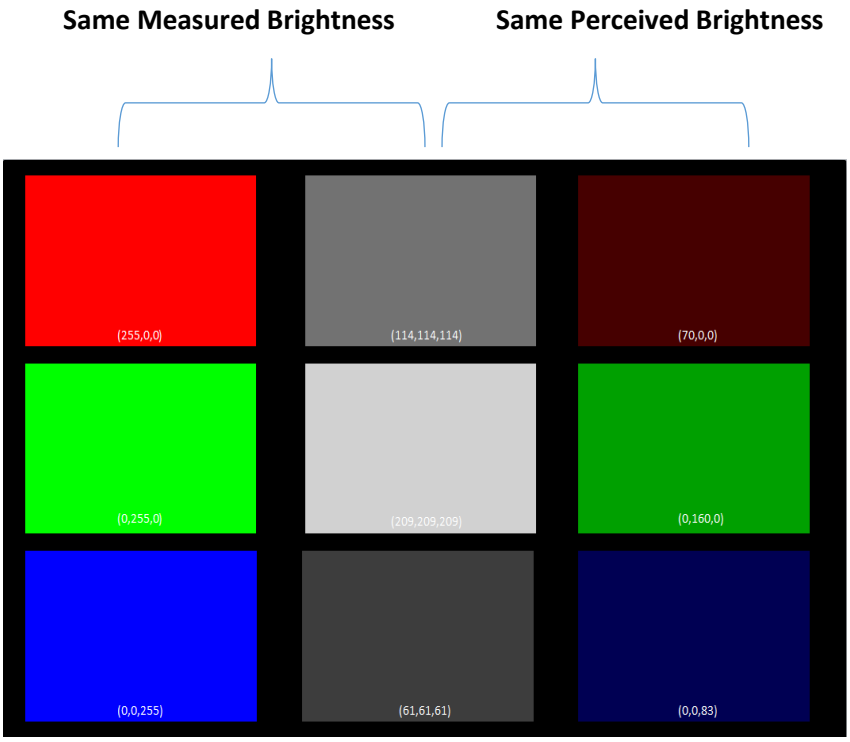

Figure 1. Measured vs. Perceived Brightness (Simulated image to illustrate the HK effect)

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 LED projector's light source in the LED projector, 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.

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

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

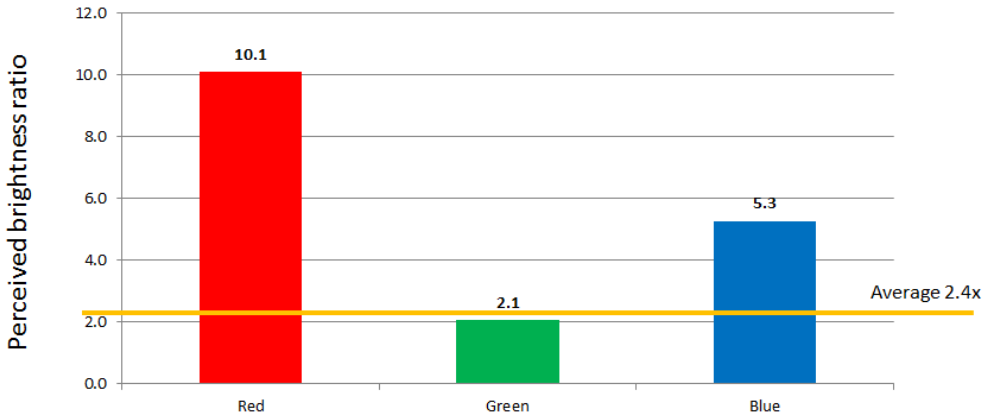

Figure 2. Magnitude of the HK effect with Red, Green, and Blue monochromatic lights

**The 2.4x average perceived brightness ratio is determined using ViewSonic LED projectors. Other LED projectors may have a different result.*

By observation, we know that many projectors with LED-based light sources have higher perceptible brightness than many lamp-based projectors, even though they may have the same measured ANSI Lumens rating. To understand why, just refer back to Figure 1, where the colored patches on the left appear brighter because the human eye is more receptive to highly saturated colored light. As a result, an LED projector with colors that are more concentrated in wavelengths will be perceived as - brighter. This is why ViewSonic is committed to providing both ANSI Lumens and LED Lumen ratings for our latest LED projectors.

Determining the typical LED Lumens specification for a given LED 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 LED projector are then adjusted until the perceived brightness most closely matches that of the reference lamp-based projector. Another ANSI Lumens measurement of the adjusted LED projector is then taken, and the ratio of these two measurements is multiplied with the ANSI Lumens measurement of the reference lamp-based projector to determine the equivalent “LED Lumens” rating.

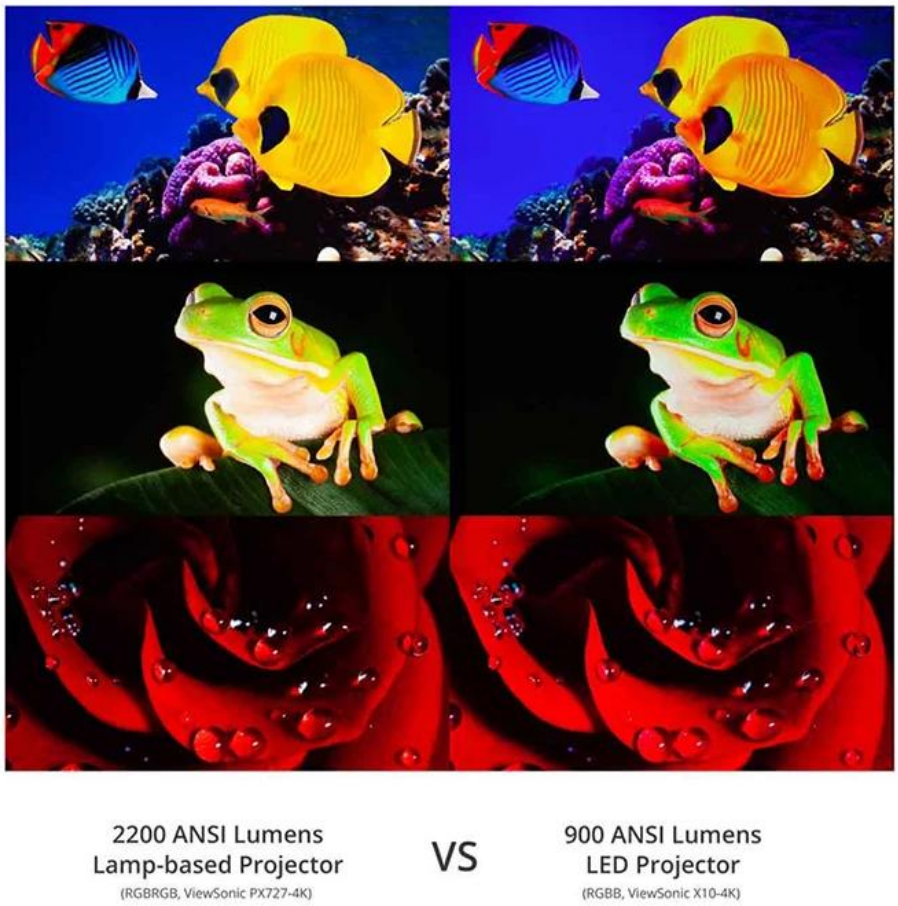

Figure 3. Sample image of a 2200 ANSI Lumens lamp-based projector (RGBRGB, ViewSonic PX727-4K) vs. a 900 ANSI Lumens LED projector (RGBB, ViewSonic X10-4K)

**The 900 ANSI Lumens LED projector was adjusted from 1000 ANSI to 900 ANSI to match the approximate brightness of the 2200 ANSI Lumens lamp-based projector while maintaining the same 2.4x average perceived brightness ratio.*

In addition to a higher perceived brightness, projectors with LED light sources also tend to 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 LED projectors a very compelling solution.

References

1) E. Fred Schubert Light Emitting Diodes 3rd Edition (E. Fred Schubert, New York, 2018)

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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