NOMADIC™

Comparing ANSI Lumens And RGB Laser Lumens : What's the Difference

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NOMVDIC follows industry standard ANSI methods to establish our projector brightness specifications, but ANSI brightness alone can’t always provide enough information to fully characterize the brightness performance of the latest generation of high-color gamut projectors with RGB laser light sources. This is mainly due to something called the HK (Helmholtz-Kohlrausch) effect, which causes observers to perceive images with higher color saturation to be brighter than the less saturated ones.

Now imagine two projectors with the same measured ANSI lumens brightness that appear to be at different brightness levels. To understand how this is possible, we must also understand that the human eye is more sensitive to certain wavelengths of light (Figure 1), and any projector with a light source that more closely matches the light response of the human eye will naturally have a higher perceived brightness.

Figure 1 shown below helps to further illustrate the Helmholtz-Kohlrausch effect. Most observers would assume that the colored patches on the left are brighter than the grey scale patches in the center; in actuality, they have the same measured ANSI lumens brightness. In addition, while the colored patches on the right may appear to have the same brightness as the center grey scale patches; however, the ANSI lumens brightness of the colored patches on the right is much lower than the center grey patches.

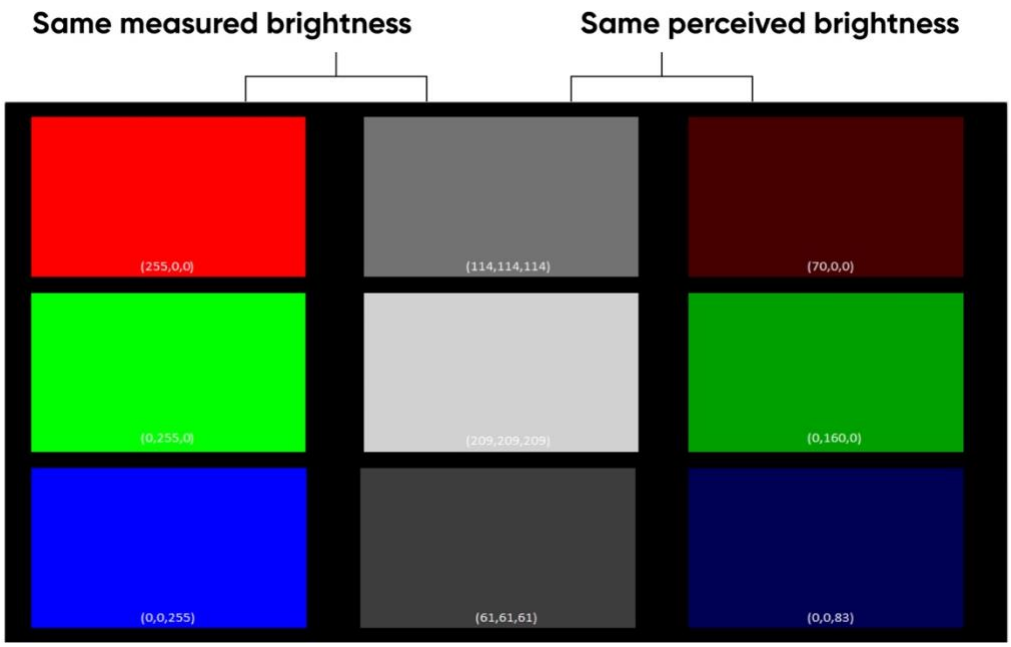

Figure 1. Measured vs. Perceived Brightness (Simulated image to illustrate the HK effect)

Figure 2. attempts to illustrate how the perceived brightness level varies color by color. The x-axis of this chart shows each individual RGB color compositing the light source on the RGB laser projector. The y-axis shows the brightness comparison between the colors on the left and right column on Figure 1. The perceived brightness ratio is the difference between the perceived brightness with the measured brightness, while the average perceived brightness ratio is the difference with all the colors combined. Both ratios can be calculated by using the formulas below.

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

$$\text{Average Perceived Brightness Ratio}^{1} = \frac{\text{(Red 100\%+Green 100\%+ Blue 100\%) Lumens}}{\text{(Red visual +Green visual + Blue visual) Lumens}}$$

[1] The Times average perceived brightness ratio is determined by NOMVDIC RGB laser projectors, other RGB laser projectors may have a different result.

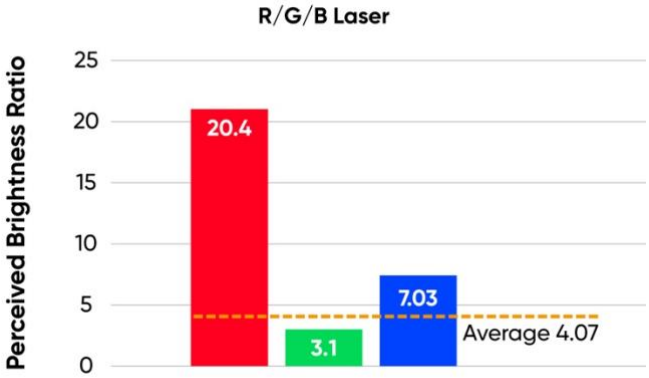

Figure 2. Magnitude of the HK effect with Red, Green, and Blue monochromatic lights

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. To understand why, simply refer back to Figure 1 and understand that the colored patches on the left only appear to be brighter because the human eye is more receptive to highly saturated colored light, so a RGB laser projector with colors that are more concentrated in wavelengths will be perceived as being brighter. Therefore, NOMVDIC has committed to provide 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 R, G, B currents of the RGB laser 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 RGB laser 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 “RGB Laser Lumens” rating.

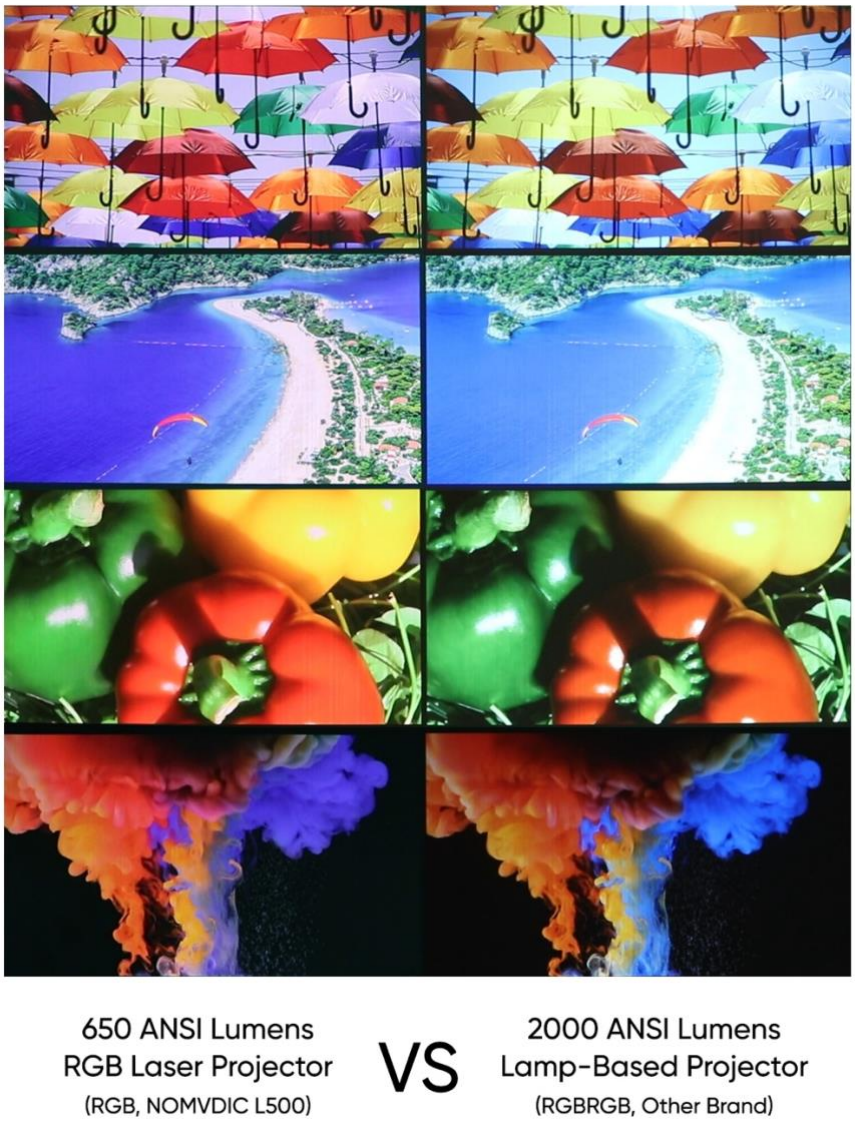

Figure 3. Sample image of a 650 ANSI Lumens RGB Laser projector (RGB, NOMVDIC L500) vs. 2000 ANSI Lumens lamp-based projector (RGBRGB, other brand)[2]

In addition to a higher perceived brightness, projectors with RGB laser light sources also tend to have a higher luminous efficiency, meaning less wasted energy, more energy efficient, higher perceived light output, wider color gamut, and stunning image quality all help to make the latest NOMVDIC RGB laser projectors a very compelling solution.

[2] If the same methodology applied to the NOMVDIC RGB laser projector versus lamp-based projector, we can get 4.07x average perceived brightness ratio.

References

- E. Fred Schubert Light Emitting Diodes 3rd Edition (E. Fred Schubert, New York, 2018)
- Wyszecki G. and Stiles W. S. Color Science – Concepts and Methods, Quantitative Data and Formulae 3rd edition (John Wiley and Sons, New York, 2000)
- Mike Wood – Lightness- The Helmholtz-Kohlrausch effect (Out of Wood, Summer 2012)

Disclaimer

This white paper is intended for discussion and information purposes only. The information and specifications contained herein are subject to change without notice.