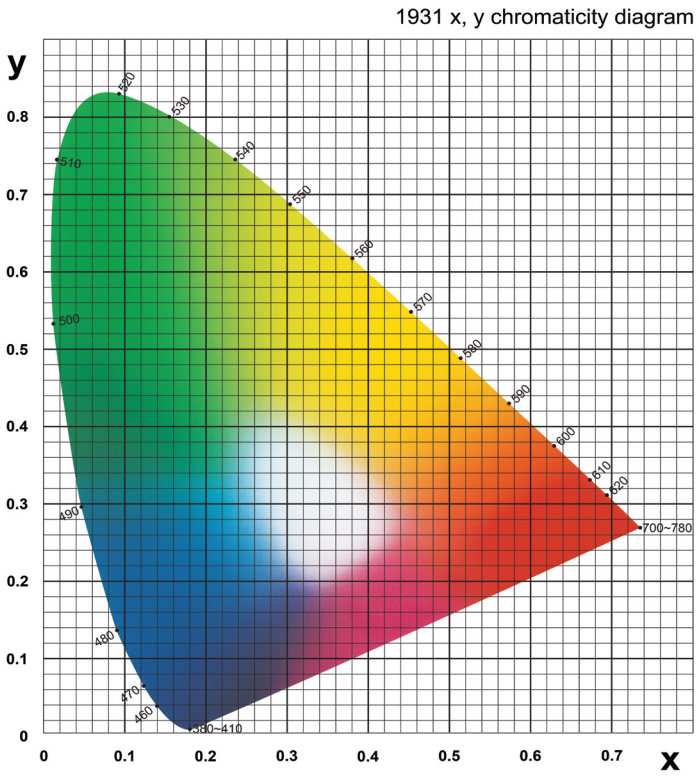
Display White Point
Is Specification by Color Temperature Sufficient?

Overview

Image quality is one of the decisive factors when buying electronic displays and white point is an important factor in image quality evaluation. An incorrect white point setting will affect the color appearance of the images. In characterizing a white point, the concept of color temperature is often used; hence, the display white point is also known as color temperature of the display.

"Color temperature" is used to describe the color of white light emitted by a light source or display in this context. It simplifies communication of the color of a light source or display which would otherwise be inconveniently described in 2 or 3 chromaticity coordinates (e.g. xy, or u'v' or tristimulus values XYZ). Another advantage of using color temperature is that the single number provides color information intuitively, whereas a 2 or 3 chromaticity coordinates does not. This is possible because, a low color temperature has a yellowish or reddish white while a high color temperature appears bluish white.



CIE Yxy Chromaticity Color Space

However, it is possible for two displays with the same color temperature to appear distinctly different from each other. This presents a problem when there is a need to achieve a consistent color among several displays, used in a facility or part of a process.

Color Temperature and Correlated Color Temperature

The color temperature concept originates from the color of a black body radiator. The temperature of the radiator is in Kelvin (K) and it describes the color of the light it produces.

Color temperature of a black body can be graphed as a line running through the CIE Yxy Chromaticity color space. This line is known as the Blackbody Locus or the Planckian Locus, the chromaticity of the display white point does not fall directly on the Planckian locus in the color space diagram. We refer to these white points as having a correlated color temperature (CCT).

The CCT of a non Planckian white point can be established through the extension of an isotemperature line from the blackbody locus out to the white point chromaticity coordinates. Variations perpendicular to the blackbody curve are written as Δuv, while variations along the blackbody curve are measured in degrees K. Δuv measures the distance from the blackbody curve, representing the degree of color difference. The color difference above the blackbody curve is indicated as a positive Δuv, while the color difference below the curve is indicated as a negative Δuv.

Δuv is an important parameter for color quality of display white point, but it is often neglected in CCT specifications. Most of the time during specification, only a single number (K) is used to report the CCT of non Planckian white points and this leads to noticeable color differences.

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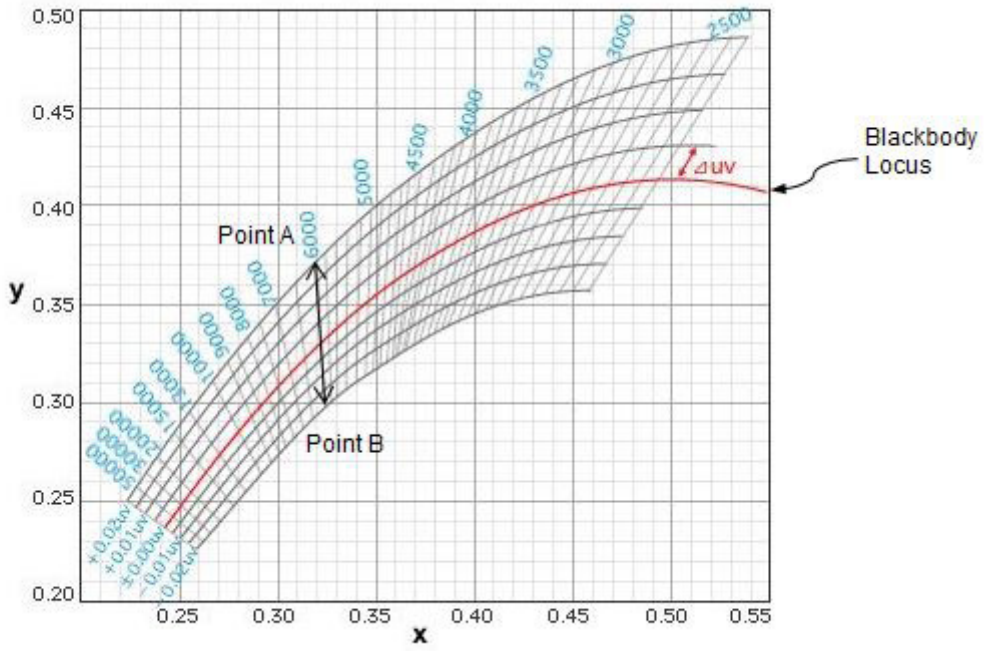

xy Chromaticity chart indicating the blackbody locus, the isotemperature lines and equal Δuv lines

Based on the definition of CCT, both points A and B in the above chart can be reported as having a CCT of 6000K even though their actual chromaticity coordinates deviate largely from the blackbody source by up to Δuv = 0.040. Given that a color difference of Δuv 0.001 to 0.002 can be discerned by the human eyes the definition of CCT allows the color of white point to deviate 20 times beyond the point where an observer would start to notice the difference.

The use of CCT and Δuv are recommended to accurately specify the chromaticity of display white points. In the above example, point A should be reported as having a CCT of 6000K Δuv = +0.020, and point B having a CCT of 6000 K Δuv = -0.020.

To understand more about correlated color temperature, download a free copy of "Language of Light" which explains correlated color temperature in detail.

Konica Minolta offers a wide range of light and display measuring instruments. For more product information, please visit Konica Minolta website at http://sensing.konicaminolta.asia/applications/display-light-measurement/.