ACHIEVING LIGHT COLOUR CONSISTENCY

Lighting essentials

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‘...visual truth lies in
the structure of light.’
- Richard Kelly

The Bigger Space

The visible spectrum; all colours that can be seen, falls on the colour space chromaticity diagram. These colour spaces, defined by the International Commission on Illumination (CIE) in 1931, encompass all colours that are visible to the human eye and are essential tools for colour management for any illumination application.

When a black body is significantly heated, the body will emit a multitude of white colours moving from warm to cool, which fall on the black body line, or the Planckian locus. White light, used for everyday lighting installations, is represented by specific coordinates along the Planckian locus. For professionals working within the lighting industry, the associated terminology with these coordinates is correlated colour temperature or CCT of light.

The black body line includes and extends beyond 800 Kelvin and 12,000 Kelvin. The lower the temperature, the warmer the colour of the light. These limits of extremely warm and cool white light are possible to see; take the sun as an example—the warm hues of a sunset, or the hot, but visibly cool midday sun. For indoor lighting applications, the most common CCT's used range from 2700K to 6500K.

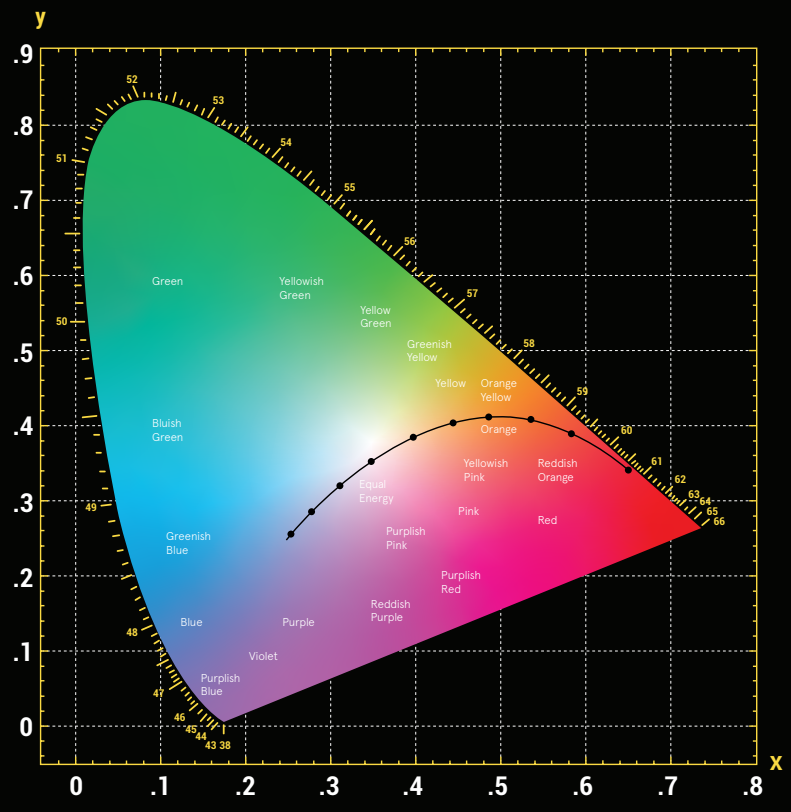

Figure 1: Colour space

Limits are in the Details

At a closer look, these colour temperatures visually create a gradient, rather than distinct or discrete points of colour on the black body line. When a particular CCT is specified, it is near impossible to achieve the exact colour from a light source every single time, neither is it necessary to do so. The human eye can only spot visual differences if the deviation is large enough. On the colour space, a MacAdam ellipse defines a region within which a specific colour is indistinguishable by the human eye.

Standard Deviation Colour Matching or SDCM uses ellipses centred at each CCT to document accepted regions of variation; the smaller the ellipse, the tighter the visual difference. It is generally accepted that there is no significant visible difference up to 3 steps; however, if several light sources are placed next to each other, it is possible to spot discrepancies.

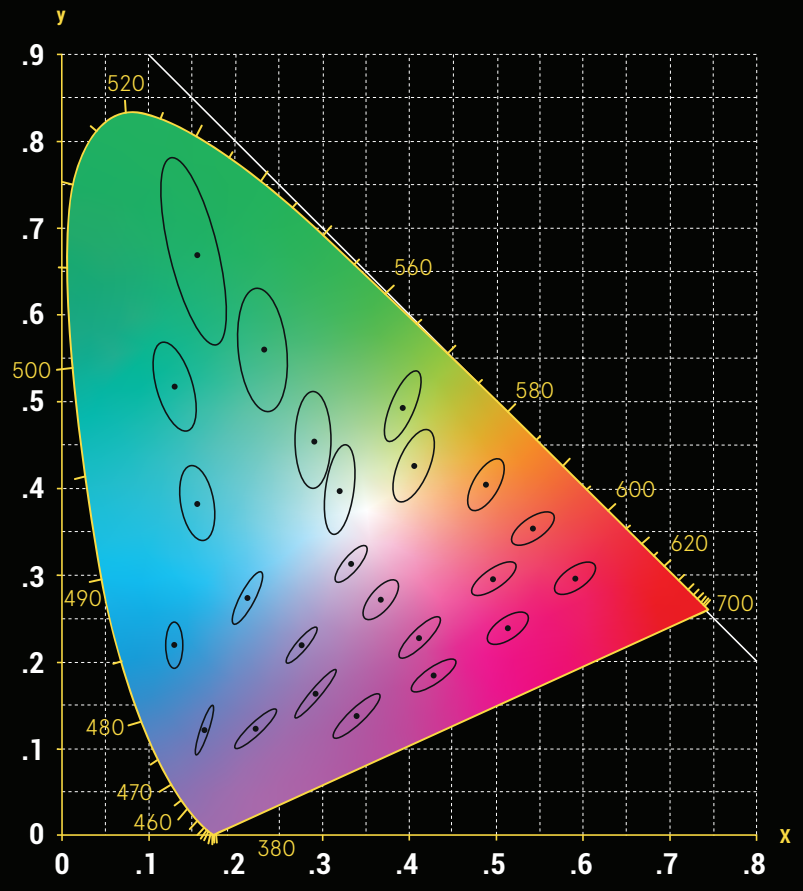

Figure 2: Colour space with ellipses

For LED light sources, this difference can be significant; as the number of individual point sources has increased, so has the probability for visual differences. It is not uncommon to see red or green tints as the LEDs fall within the extremities of the ellipses. This tinting is amplified if the light sources are illuminating a white surface, where there is no room to hide.

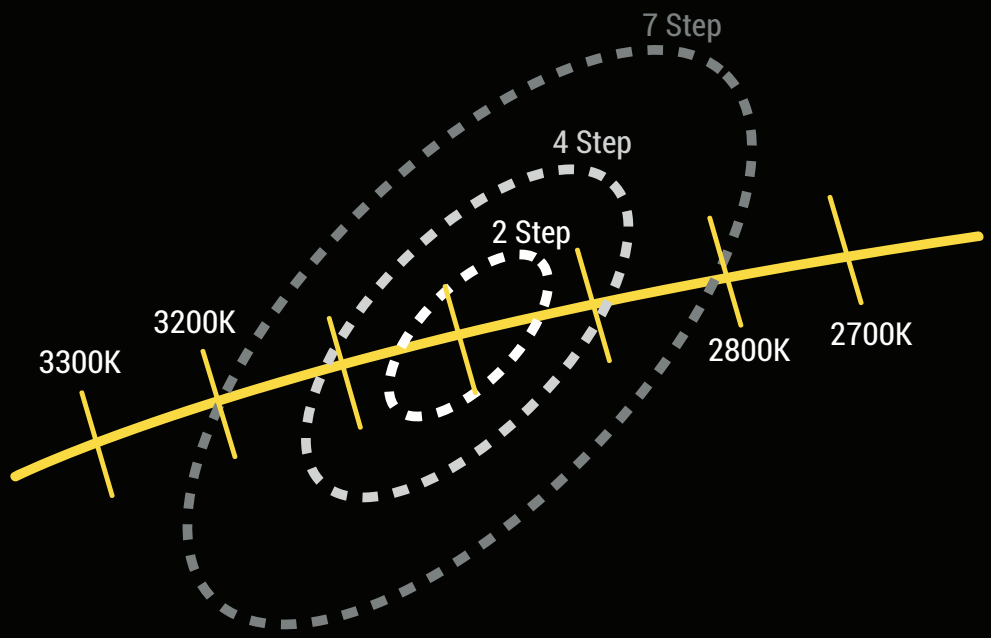

Figure 3: MacAdam Ellipses

An SDCM of 3 seems acceptable, but in pushing the boundaries of what can be engineered using LEDs, achieving an SDCM of 2 would provide reassurance of consistency when specifying luminaires; avoiding any defects in the white light output, resulting in beautiful, even colour.

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