Impact of Spectral Features of Typical Indoor Contemporary Light Sources on Their Color Rendering Properties Described by CIE CRI and IES TM-30-15 Color Rendering Indices

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Contemporary we are witnessing the lighting revolutions where fluorescent and incandescent lamps are replaced by LEDs. There is very important to achieve by this replacement the same quality of lighting in given application. The color quality of light sources can be described by nearest color temperature CCT, chromaticity coordinates x,y and color rendering index CRI. The values of CCT and x,y are describing light source color. The CRI is describing the visual color quality of objects lighted by given light source under consideration. In the case of LEDs light sources, is well known that evaluating the color quality of lighting by CRI could be inadequate and misaligned [1-3]. Introduced in the 1960s, by the International Lighting Commission CIE metric CRI [4] is still obligatory. Nowadays were under development so many lighting metrics for describing color rendering of light sources. The North American Illuminating Engineering Society (IES) in 2015 recommended the use of the TM-30-15 method in the United States, which is based on the introduction of two color rendering benchmarks - the color fidelity index, which is equivalent to CRI described by CIE 13.3-1995 and the color gamut index, i.e. the index referred to as Gamut Area Index [5]. The new measure meets the recommendations of the CIE in technical report CIE: 177:2007 "Color rendering of White LED Light Sources" and can be applied to all types of light sources [6]. The new color rendering index TM-30-15 introduces more color samples, and a more homogeneous color space (CAM02-UCS) eliminates many of the errors highlighted in the CIE CRI system and present results in vector diagram gives a lot more information about the color appearance of the illuminated items than was available at CIE CRI. Despite many improvements, it is important to remember that both CIE CRI and TM-30-15 are comparative methods for which the source of light is the pattern.

This article aims at presenting the IES and CIE metrics and comparing their performance on the example of spectral distributions of typical indoor light sources. We examine the difference between the newly developed IES TM-30-15 color indices and some of the most common previously established by CIE 13.3-1995 CRI color rendering index for typical indoor contemporary light sources.

[1] K. Houser, M. Mossman, K. Smet, L. Whitehead, “Tutorial: Color Rendering and Its Applications in Lighting”, Leukos, 12(2016)
[2] A. Žukauskas, M.S. Shur, “Handbook of Advanced Lighting Technology”, Spiringer International Publishing, Switzerland (2016)
[3] K. Smet, L. Whitehead, J. Schanda, MR. Luo, “Toward a replacement of the CIE color rendering index for white light sources”, Leukos, vol.12, (2016)
[4] CIE 13.3-1995 “Method of Measuring and Specifying Colour Rendering Properties of Light Sources”.
[5] A. David, P.T. Fini, K. Houser, Y. Ohno, M.P. Royer, K.A.G. Smet, M. Wei, L. Whitehead, “Development of the IES method for evaluating the color rendition of light sources”, Optics Express, vol.23, no.12, (2015)
[6] CIE 177:2007 “Colour Rendering of White LED Light Sources”