



International Commission on Illumination  
Commission Internationale de l'Eclairage  
Internationale Beleuchtungskommission

## CIE Position Statement on CRI and Colour Quality Metrics

October 15, 2015

### Background

The Colour Rendering Index (CRI), defined by CIE Publication 13.3, is widely used for assessing the colour rendering characteristics of light sources. It was first published in 1965 after fluorescent lamps had emerged, and was last improved in 1974. Colour science has progressed considerably since then, and recognized improvements are available for many of the components used in the CRI. Nevertheless, the CRI has served fairly well for most light sources and has been well accepted over the past 40 years, though revision of the CRI was occasionally investigated (CIE Publication 135/2-1999).

However, with the rapid uptake of LED lighting, which has greater freedom in spectral design, the need to update the CRI has significantly increased. For some types of light sources, the CIE General Colour Rendering Index,  $R_a$ , does not agree well with overall perceived colour rendering. The CIE investigated the problem and found that the disagreement tends to be significant for LED light sources that contain narrow-band spectral components and concluded that improvements of the CRI are now needed (CIE Publication 177:2007).

There are two different technical issues behind the problems of the CRI that have been highlighted by the current situation. The first is the inaccuracy of colour appearance evaluation arising from the original 1974 CRI formulae and the small number of colour test samples used in the CRI calculation.

The second is a limitation of the CRI due to the fact that it is simply a colour fidelity metric; that is, the CRI values are based on the colour appearance of objects compared to their appearance under the defined reference illuminant. Colour quality characteristics other than colour fidelity are also important, and different analysis methods are required to assess them in the context of lighting applications, tasks, and user preferences. This is especially important when samples undergo chroma enhancements arising from the source's narrowband spectral features. In some experiments, subjects generally preferred illumination that slightly enhanced the colour saturation of the illuminated objects they viewed, even though the chosen light sources had lower  $R_a$  values.

### CIE Position Statement

The CIE recognizes that, because the Colour Rendering Index has several significant sources of colorimetric inaccuracy, it should be updated with the latest well-accepted formulae and an improved set of test samples. CIE Technical Committee (TC) 1-90 is already in the process of developing a new improved colour fidelity metric that can update the CRI.

The CIE recognizes that the colour fidelity metrics including the CRI do not assess other important aspects of the colour qualities of light sources, in particular, those related to colour

preference. CIE TC 1-91 is developing a Technical Report on this subject, which will be the groundwork for developing colour preference metric(s).

The CIE encourages further research on these two aspects of colour quality, which may be useful inputs to the current or future work of CIE. In particular, the CIE supports the study of the recently published IES Technical Memorandum TM-30 [1], to which some CIE TC 1-90 members have contributed. This work was recently proposed for consideration in TC 1-90, which voted to make its  $R_f$  metric the basis for the TC's first working draft.

The CIE also recommends that important lighting metrics such as the Colour Rendering Index require formal international agreement. New metrics introduced at the regional level could cause confusion in the global lighting market.

The process of developing CIE recommendations by scientific consensus often requires considerable time. However, the CIE is expediting the work of TC 1-90 and TC 1-91 and they both plan to complete their Technical Reports within 2016. The CRI is widely used in many regulations and specifications, therefore an orderly transition is needed when a new metric is to be introduced. For this reason the current CRI (CIE 13.3) will not be officially replaced until a new metric is widely accepted.

## Reference

- [1] Illuminating Engineering Society of North America, TM-30, *IES Method for Evaluating Light Source Color Rendition*

## About the CIE and its Position Statements

The International Commission on Illumination – also known as the CIE from its French title, the Commission Internationale de l'Eclairage – is devoted to worldwide cooperation and the exchange of information on all matters relating to the science and art of light and lighting, colour and vision, photobiology and image technology.

With strong technical, scientific and cultural foundations, the CIE is an independent, non-profit organization that serves member countries on a voluntary basis. Since its inception in 1913, has been accepted as representing the best authority on the subject and as such is recognized by ISO as an international standardization body. As such the CIE is recognized by ISO as an international standardization body, publishing global standards on the fundamentals of light and lighting.

CIE position statements are approved by the CIE Board of Administration, which includes the Directors of all the CIE Divisions (the bodies that carry out the scientific work of the CIE), after first ensuring agreement with the relevant CIE Technical Committees.

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