



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

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POSITION STATEMENT

**CIE Position Statement on Colour
Quality Metrics**
2nd Edition

THE INTERNATIONAL COMMISSION ON ILLUMINATION

The International Commission on Illumination (CIE) is an organization devoted to international co-operation and exchange of information among its member countries on all matters relating to the art and science of lighting. Its membership consists of the National Committees in about 40 countries.

The objectives of the CIE are:

1. To provide an international forum for the discussion of all matters relating to the science, technology and art in the fields of light and lighting and for the interchange of information in these fields between countries.
2. To develop basic standards and procedures of metrology in the fields of light and lighting.
3. To provide guidance in the application of principles and procedures in the development of international and national standards in the fields of light and lighting.
4. To prepare and publish standards, reports and other publications concerned with all matters relating to the science, technology and art in the fields of light and lighting.
5. To maintain liaison and technical interaction with other international organizations concerned with matters related to the science, technology, standardization and art in the fields of light and lighting.

The work of the CIE is carried out by Technical Committees, organized in six Divisions. This work covers subjects ranging from fundamental matters to all types of lighting applications. The standards and technical reports developed by these international Divisions of the CIE are accepted throughout the world.

A plenary session is held every four years at which the work of the Divisions and Technical Committees is reported and reviewed, and plans are made for the future. The CIE is recognized as the authority on all aspects of light and lighting. As such it occupies an important position among international organizations.

LA COMMISSION INTERNATIONALE DE L'ECLAIRAGE

La Commission Internationale de l'Eclairage (CIE) est une organisation qui se donne pour but la coopération internationale et l'échange d'informations entre les Pays membres sur toutes les questions relatives à l'art et à la science de l'éclairage. Elle est composée de Comités Nationaux représentant environ 40 pays.

Les objectifs de la CIE sont :

1. De constituer un centre d'étude international pour toute matière relevant de la science, de la technologie et de l'art de la lumière et de l'éclairage et pour l'échange entre pays d'informations dans ces domaines.
2. D'élaborer des normes et des méthodes de base pour la métrologie dans les domaines de la lumière et de l'éclairage.
3. De donner des directives pour l'application des principes et des méthodes d'élaboration de normes internationales et nationales dans les domaines de la lumière et de l'éclairage.
4. De préparer et publier des normes, rapports et autres textes, concernant toutes matières relatives à la science, la technologie et l'art dans les domaines de la lumière et de l'éclairage.
5. De maintenir une liaison et une collaboration technique avec les autres organisations internationales concernées par des sujets relatifs à la science, la technologie, la normalisation et l'art dans les domaines de la lumière et de l'éclairage.

Les travaux de la CIE sont effectués par Comités Techniques, organisés en six Divisions. Les sujets d'études s'étendent des questions fondamentales, à tous les types d'applications de l'éclairage. Les normes et les rapports techniques élaborés par ces Divisions Internationales de la CIE sont reconnus dans le monde entier.

Tous les quatre ans, une Session plénière passe en revue le travail des Divisions et des Comités Techniques, en fait rapport et établit les projets de travaux pour l'avenir. La CIE est reconnue comme la plus haute autorité en ce qui concerne tous les aspects de la lumière et de l'éclairage. Elle occupe comme telle une position importante parmi les organisations internationales.

DIE INTERNATIONALE BELEUCHTUNGSKOMMISSION

Die Internationale Beleuchtungskommission (CIE) ist eine Organisation, die sich der internationalen Zusammenarbeit und dem Austausch von Informationen zwischen ihren Mitgliedsländern bezüglich der Kunst und Wissenschaft der Lichttechnik widmet. Die Mitgliedschaft besteht aus den Nationalen Komitees in rund 40 Ländern.

Die Ziele der CIE sind:

1. Ein internationales Forum für Diskussionen aller Fragen auf dem Gebiet der Wissenschaft, Technik und Kunst der Lichttechnik und für den Informationsaustausch auf diesen Gebieten zwischen den einzelnen Ländern zu sein.
2. Grundnormen und Verfahren der Messtechnik auf dem Gebiet der Lichttechnik zu entwickeln.
3. Richtlinien für die Anwendung von Prinzipien und Vorgängen in der Entwicklung internationaler und nationaler Normen auf dem Gebiet der Lichttechnik zu erstellen.
4. Normen, Berichte und andere Publikationen zu erstellen und zu veröffentlichen, die alle Fragen auf dem Gebiet der Wissenschaft, Technik und Kunst der Lichttechnik betreffen.
5. Liaison und technische Zusammenarbeit mit anderen internationalen Organisationen zu unterhalten, die mit Fragen der Wissenschaft, Technik, Normung und Kunst auf dem Gebiet der Lichttechnik zu tun haben.

Die Arbeit der CIE wird durch Technische Komitees geleistet, die in sechs Divisionen organisiert sind. Diese Arbeit betrifft Gebiete mit grundlegendem Inhalt bis zu allen Arten der Lichtenwendung. Die Normen und Technischen Berichte, die von diesen international zusammengesetzten Divisionen ausgearbeitet werden, sind auf der ganzen Welt anerkannt.

Alle vier Jahre findet eine Session statt, in der die Arbeiten der Divisionen berichtet und überprüft werden, sowie neue Pläne für die Zukunft ausgearbeitet werden. Die CIE wird als höchste Autorität für alle Aspekte des Lichtes und der Beleuchtung angesehen. Auf diese Weise unterhält sie eine bedeutende Stellung unter den internationalen Organisationen.

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CIE Position Statement on Colour Quality Metrics 2nd Edition¹

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Background

The CIE General Colour Rendering Index (CRI), designated by the symbol R_a and defined in CIE 013.3-1995 (CIE, 1995), 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 1974². Colour science has progressed considerably since then, and recognized improvements are available for many of the components used in the CIE General Colour Rendering Index. Nevertheless, the CRI has served fairly well for most white light sources and has been well accepted over the past 50 years, despite occasional investigations into revision of the CIE General Colour Rendering Index (CIE 135/2-1999 (CIE, 1999)).

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

Three technical issues underlie the problems with the CIE General Colour Rendering Index. The first is the inaccuracy arising from using the outdated 1960 CIE (u,v) colour space. The second is the small number of test-colour samples used in the calculation.

The third issue is a conceptual limitation of the CIE General Colour Rendering Index. It is a colour fidelity metric; that is, the values are based on the colour appearance of objects compared to their appearance under a defined reference illuminant. It is now widely recognized that colour quality characteristics other than colour fidelity are also important, and that different analysis methods are required to assess them. This is especially important, for example, when samples undergo chroma enhancements arising from narrowband spectral features in the spectral distribution of the light source. 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 (Iwata, 2023; Teunissen et al., 2017).

¹ This edition replaces the 2015 CIE Position Statement on the same subject, which was titled "Position Statement on CRI and Colour Quality Metrics".

² The 1995 edition corrected some errors in the 1974 edition, updated some tables and terminology, and provided two software programs for calculating colour rendering indices on a PC.

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The CIE developed a new metric, the CIE General Colour Fidelity Index, designated by the symbol R_f , which is described in CIE 224:2017 (CIE, 2017). This metric is calculated in the CIECAM02-UCS colour space and uses a set of 99 test colour samples chosen (a) to provide an even distribution across a gamut of common colours, (b) for their spectral uniformity, and (c) that come from a variety of natural and manufactured objects.

At the time of publication of CIE 224:2017, the CIE stated that R_f should not be used as a replacement for the CIE General Colour Rendering Index (R_a) without further evaluation. The CIE General Colour Fidelity Index, R_f , has now been available and in scientific use for seven years, no data have emerged that contradict the applicability of R_f to the full range of white light sources, and it is generally considered to be a superior index than R_a (Royer, 2018). The CIE now believes, therefore, that the time has come to start adopting the CIE General Colour Fidelity Index (R_f).

The CIE General Colour Rendering Index, R_a , is widely used in many regulations, specifications and standards, and therefore, an orderly transition is needed. For this reason, CIE 013.3-1995, *Method of measuring and specifying colour rendering properties of light sources* (CIE, 1995) remains a current CIE publication. It will not be withdrawn until R_f is widely adopted in relevant regulations, specifications and standards. The CIE recommends that the adoption of the CIE General Colour Fidelity Index, R_f , should be actively pursued. During the interim, the CIE recommends that parallel reporting of both the CIE General Colour Rendering Index and the CIE General Colour Fidelity Index should be encouraged when declaring colorimetric values for white light sources.

The CIE also upholds the principle that fundamental lighting quantities, including colorimetric quantities, require formal international agreement. It recommends that alternative metrics introduced at a regional level be avoided in order to prevent confusion in the global lighting market.

The CIE recognizes that colour fidelity alone does not encompass all aspects of the colour qualities of light sources, and in particular, does not characterize colour preference. The newly published Technical Report of TC 1-91 (CIE, 2024) supports a more complete specification of the colour rendering characteristics of white light sources and lays the groundwork for developing colour preference metric(s).

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About the CIE and its Position Statements

The International Commission on Illumination – also known as the CIE from its French title, Commission Internationale de l’Éclairage – 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. The CIE publishes internationally recognized standards, reports and other publications concerned with all matters related to science, technology, and standardization in the fields of light and lighting.

CIE Position Statements are approved by the CIE’s Governing Board and Technical Management Board.

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