

Changing the Colour Metrics?

Opportunities, risks and clear red line for the German lighting industry

1 Relevance

For several decades, the general Colour Rendering Index (CRI or R_a) has served as the internationally established reference metric for assessing the colour rendering of electric light sources. It is used in standards, specifications, product data sheets and lighting design projects as the means of describing light quality with regards to natural colour perception.

With the widespread use of modern LED technology, the potential limitations of the CRI, which is based on eight test colours, have been widely discussed. At the same time, replacing it with another metric has also been considered. One relevant option is the Fidelity Index (R_f) in the ANSI/IES TM-30 method. It is based on 99 test colours and is intended to assess colour fidelity.

The introduction of R_f as a replacement for the CRI as recommended by CIE PS 002:2025 would have substantial implications for the lighting industry as a whole. These implications would affect product development, supply chains, quality management processes, standardisation and certification activities, marketing and sales, as well as communication with specifiers, operators and end customers.

A SWOT analysis was conducted to provide a structured assessment of the opportunities, challenges and potential risks associated with such a transition. Its purpose is to provide a transparent view of the strategic, technical and economic implications of introducing R_f and to derive recommendations for the lighting industry.

2 Results of the SWOT Analysis

2.1 Strengths

The principal strength of R_f is its ability to provide a more precise and contemporary assessment of colour rendering than CRI/ R_a . By using 99 test colours and a modern CAM02-UCS colour space, colour fidelity can be evaluated on a more differentiated basis. Spectral gaps that are typical for LED technology can be identified more reliably, and saturated colours can be assessed with greater methodological robustness. This may provide a more resilient basis for decision-making in ambitious applications, including museums, retail environments and colour assessment, while supporting more transparent communication of colour fidelity. In addition, the official CIE recommendation CIE PS 002:2025 supports integration into the TM-30 framework and compatibility with complementary quality metrics such as CIE 253:2024, thereby contributing to international alignment and future relevance.

2.2 Weaknesses (W)

The main weaknesses are limited market awareness and higher complexity associated with calculation, interpretation and communication. R_f is not yet consistently included in product data sheets, so the transition would require substantial efforts across standards, documentation and internal processes. As a standalone value, R_f does not provide a comprehensive description of colour quality. Without supplementary information, such as saturation data (R_g), its informative value remains limited, similar to R_a /CRI. Furthermore, stricter assessment results, often shown as lower values than R_a , may also make market acceptance and communication more difficult. For many end users in general lighting, the practical added value may not be clear or may already be partly covered by existing regulatory information, such as R9.

2.3 Opportunities (O)

The opportunities primarily arise from potential future standardisation and the broader industry trend towards modernising the assessment of colour rendering. The further development of R_f in combination with R_g could provide additional and more transparent quality information, facilitate product selection for specifiers and strengthen the differentiation of high-quality luminaires, particularly in the premium segment. Early engagement with such metrics could enable suppliers to demonstrate technological leadership and to optimise

products more specifically for applications with high colour requirements. Relevant application areas include museums and galleries requiring high colour fidelity and a documented decision-making basis, retail and hospitality applications targeting deliberately more vivid colour rendering through R_g values above 100, as well as medical and diagnostic environments where reliable skin tone and tissue rendering are essential. Overall, the metric could support more efficient identification of suitable products for specialist applications and, where appropriate, enable the transfer of defined quality levels from specific applications to general lighting.

2.4 Threats (T)

The main threats concern inconsistent, delayed or hesitant market introduction. If users and manufacturers continue to rely primarily on R_a , or if R_f is reported inconsistently, comparability would be reduced and misunderstandings could arise. During a transition period, parallel requirements for R_a and R_f could create uncertainty among customers and specifiers and significantly increase the need for training and communication. Considerable cost and investment risks would also result from extensive adjustments to data sheets, packaging, specifications, standards, publications, and planning, measurement and evaluation software across the supply chain. At the same time, inconsistent software implementations could create additional uncertainty. Further risks include limited acceptance or misinterpretation if, for example, saturation information or relevant boundary conditions, such as the number of test colours, are omitted. It also remains unclear whether R_f may itself be replaced by another metric in the long term or whether sufficient market demand will emerge.

3 Conclusion

Given the significant risks identified, introducing R_f as a replacement for R_a is not supported.

Based on the current state of knowledge, R_a remains sufficient for general lighting applications. Replacing R_a with R_f is not considered to provide sufficient benefit, particularly in view of the expected implementation effort, including limited market awareness, extensive transition requirements, significant training needs and numerous changes across the value chain.

A new colour metric may be considered for applications with higher ambitions or for special applications, if it is suitable for the intended purpose and a one-time transition can be ensured. R_f and R_g may serve as a potential starting point for such a metric.

In addition to being scientifically robust, any new metric – like R_a – must be easy to understand and practical for users to apply.

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