

Title: Revision and extension of standards for test methods for LED lamps, luminaires and modules

Abstract

Since the ban of tungsten filament lamps, LED-based lighting products are the market's most rapidly evolving light sources for general lighting. Test laboratories are therefore faced with a wide variety of different LED-based light sources, for which they must deliver reproducible and reliable test results. An international standard test method for LED-based sources exists but it does not cover some important metrological aspects, such as imaging-based luminance measurements, intensity distributions and concepts for assessing the uncertainty of spectral measurements and coloured sources. Most of these outstanding issues have not yet been resolved. Proposals addressing this SRT should contribute to the revision of standards by providing test methods, guidelines and a metric for validating and comparing light distribution.

Keywords

LED test methods, light distribution, imaging luminance measurement device (ILMD), spectral mismatch, LED illuminant, Ecodesign regulation

Background to the Metrological Challenges

Reliability and validity are of great importance in the general lighting market, which is unsettled by unfulfilled performance promises of cheap lighting products. Trust can only be rebuilt if test laboratories can evaluate the application-relevant properties of the products with modern measurement methods and suitable standards. For this reason, the International Commission on Illumination, CIE, has identified the need for further metrological work on test methods for LED lamps, luminaires, and modules, to support the revision and extension of standards CIE S 025 / EN 13032-4.

The light distribution of LED-based sources can be considerably more complex and versatile than those of conventional lamps and luminaires. For a classical goniophotometer to measure this distribution, it needs far-field measurement conditions, which can result in very large measurement setups. Imaging luminance measurement devices (ILMDs) offer much potential for the measurement of luminance, but standards CIE S 025 / EN 13032-4 only allow the use of ILMDs and near-field goniometers for testing if they demonstrate to produce equivalent results. However, there are still no procedures available for ILMDs to provide traceable measurements with an assigned uncertainty.

ISO/CIE 19476:2014 defines spectral mismatch index f_1' for broadband LEDs and calibrations using incandescent light sources are assumed. EMPIR project 15SIB07 PhotoLED developed a new LED reference spectrum which was further published in CIE 15:2018 in cooperation with Division 1 of CIE. An alternative f_1' mismatch index based on this LED reference spectrum should be developed for coloured LEDs to be included in Annex C.3.5 "Spectral Mismatch of Photometers" of CIE S 025 / EN13032-4.

While the performance of different testing laboratories should be compared to increase the confidence in testing procedures, this can only be achieved if a harmonised metric to compare luminous intensity distributions is available.

Objectives

Proposers should address the objectives stated below, which are based on the PRT submissions. Proposers may identify amendments to the objectives or choose to address a subset of them in order to maximise the overall impact, or address budgetary or scientific / technical constraints, but the reasons for this should be clearly stated in the protocol.

The JRP shall focus on metrology research necessary to support standardisation in characterisation of LED-based light sources.

The specific objectives are

1. To develop a strategy for the evaluation, validation and traceability of spatially and angularly resolved luminance and luminous intensity distributions of LED-based lamps, luminaires, and modules. This should be based on measurements using imaging luminance measurement devices (ILMDs). Additionally, to develop guidelines on the determination of uncertainty and tolerance intervals required in the revision of CIE S 025:2015.
2. To develop guidelines on the estimation and uncertainty of i) the spectral mismatch of integral (filtered) measurements for sources emitting coloured light, and ii) integral quantities derived from spectral measurements. Additionally, to propose an extension of CIE S 025 and EN 13032-4 for an alternative f_1' spectral mismatch index, based on the new LED reference spectrum published in CIE 15:2018 for white LEDs.
3. To propose a harmonised metric to compare luminous intensity distributions, including the definition of the associated tolerance intervals and uncertainties, with a focus on test methods that require the declaration of measurement uncertainties.
4. To contribute to the revision of CIE S 025 / EN 13032-4 through CIE Division 2, CEN/TC 169 and IEC - TC 34. Outputs should be in a form that can be incorporated into the standards at the earliest opportunity and communicated through a variety of media to the standards community and to end users. Additionally, to promote the take up of the results by end users e.g. manufacturers of LED-based sources.

The proposed research shall be justified by clear reference to the measurement needs within strategic documents published by the relevant Regulatory body or Standards Developing Organisation or by a letter signed by the convener of the respective TC/WG. EURAMET encourages proposals that include representatives from industry, regulators and standardisation bodies actively participating in the projects. The proposal must name a "Chief Stakeholder", not a member of the consortium, but a representative of the user community that will benefit from the proposed work. The "Chief Stakeholder" should write a letter of support explaining how their organisation will make use of the outcomes from the research, be consulted regularly by the consortium during the project to ensure that the planned outcomes are still relevant, and be prepared to report to EURAMET on the benefits they have gained from the project.

Proposers should establish the current state of the art, and explain how their proposed research goes beyond this. In particular, proposers should outline the achievements of the EMPIR project 15SIB07 PhotoLED and how their proposal will build on those.

EURAMET expects the average EU Contribution for the selected JRPs in this TP to be 0.8 M€, and has defined an upper limit of 1.0 M€ for this project.

EURAMET also expects the EU Contribution to the external funded partners to not exceed 30 % of the total EU Contribution across all selected projects in this TP.

Any industrial partners that will receive significant benefit from the results of the proposed project are expected to be unfunded partners.

Potential Impact

Proposals must demonstrate adequate and appropriate participation/links to the "end user" community, describing how the project partners will engage with relevant communities during the project to facilitate knowledge transfer and accelerate the uptake of project outputs. Evidence of support from the "end user" community (e.g. letters of support) is also encouraged.

You should detail how your JRP results are going to:

- Address the SRT objectives and deliver solutions to the documented needs,
- Feed into the development of urgent documentary standards through appropriate standards bodies,
- Transfer knowledge to the lighting sector.

You should detail other impacts of your proposed JRP as specified in the document "Guide 4: Writing Joint Research Projects (JRPs)"

You should also detail how your approach to realising the objectives will further the aim of EMPIR to develop a coherent approach at the European level in the field of metrology and include the best available contributions from across the metrology community. Specifically, the opportunities for:

- improvement of the efficiency of use of available resources to better meet metrological needs and to assure the traceability of national standards
- the metrology capacity of EURAMET Member States whose metrology programmes are at an early stage of development to be increased
- organisations other than NMIs and DIs to be involved in the work.

Time-scale

The project should be of up to 3 years duration.

Additional information

CIE identified this topic as one of their priorities. Details are available at:

https://msu.euramet.org/current_calls/pre_norm_2019/documents/cie_priority_001.pdf