Test Method for LED Lamps, LED Luminaires & LED Modules

CIE DIS 025 – 2014
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Presented by Steve Coyne
CIE DIS 025:2014 Test method for LED Lamps, LED luminaires and LED modules

from TC 2-71 (chair, Y. Ohno)

- First CIE standard related to products
- This will be CIE S 025 after comments/approval by National Committees
- Planned for IEC/ISO/CIE joint standard

TC2-71 collaborated with CEN (European Standardization Committee)

EN 13032  Lighting Applications — Measurement and presentation of photometric data of lamps and luminaires — Part 4: LED lamps, modules and luminaires

is also to be published.
1 Scope

This standard specifies the requirements for measurement of electrical, photometric, and colorimetric quantities of LED lamps, LED modules and LED luminaires, for operation with AC or DC supply voltages, possibly with associated LED control gear. LED light engines are assimilated to LED modules and handled accordingly. Photometric and colorimetric quantities covered in this standard include total luminous flux, luminous efficacy, partial luminous flux, luminous intensity distribution, centre-beam intensity, luminance and luminance distribution, chromaticity coordinates, correlated colour temperature (CCT), colour rendering index (CRI), and angular colour uniformity. This standard does not cover LED packages and products based on OLEDs (organic LEDs).

Products covered

- LED lamps (integrated, non-integrated)
- LED luminaires
- LED modules (including light engines)
- AC/DC power inputs

NOT covered

- LED packages
- OLED products
Measurement quantities covered

- electrical quantities (AC/DC current, voltage, power, power factor)
- total luminous flux
- partial luminous flux
- luminous efficacy
- luminous intensity distribution
- center beam intensity
- luminance
- color quantities (chromaticity coordinates, CCT, CRI)
- angular color uniformity

**NOT covered**

- long-term maintenance test (life test) of luminous flux, etc.
- beam angle
- waveform (flicker)
- start-up time
- test methods for specific applications (e.g., road lighting luminaire)
Instruments Covered

- Sphere-photometer
- Sphere-spectroradiometer
- Goniophotometer
- Gonio-spectroradiometer
- Luminance meter

**Instruments accepted with equivalence demonstration**

- Integrating hemisphere
- Near-field goniophotometer
- Imaging luminance measurement device (ILMD)

Other types of measurement instruments including integrating hemisphere, near-field goniophotometer and ILMD, are acceptable if they are demonstrated to produce equivalent results as a conventional integrating sphere system or conventional goniophotometer system.

How to demonstrate “equivalent” is an issue.
Standard Test Conditions

- Ambient temperature (LED lamps, luminaires) 25 °C ±1.2 °C
- Surface temperature (LED module) ±2.5 °C from specified $t_p$
- Air movement 0 to 0.25 m/s
- Test voltage 0 to ±0.4 % from rated supply voltage

Introducing tolerance interval and acceptance interval

Example for ambient temp.

Tolerance interval ±1.2 °C

Acceptance interval ±1.0 °C

Ref. JCGM106 - ISO/IEC 98-4

Range of reading of instrument
Specific Requirements

- Calibration uncertainty of AC Voltmeters and ammeters $\leq 0.2 \%$ for AC, $\leq 0.1 \%$ for DC
- Calibration uncertainty of AC power meter $\leq 0.5 \%$
- Bandwidth of AC power meter $\geq 100 \text{kHz}$.
- Internal impedance of the voltage measurement: $\geq 1 \text{ M}\Omega$
- AC power supply THD $\leq 1.5\%$ ($\leq 3 \%$ for PF $> 0.9$) at DUT terminal
- AC power supply frequency uncertainty $\leq 0.2 \%$
- DC power supply voltage AC ripple $\leq 0.5 \%$
- Stabilization $\geq 30 \text{ min}$ and $\leq 0.5 \%$ in 15 min (lamp, luminaire)
- $t_p \leq 1 \%$ in 15 min (LED module)
Specific Requirements (con’t)

- $f_1'$ of the photometer system (gonio, sphere) $\leq 3\%$
- $f_2$ of the detector head of sphere system $\leq 15\%$
- Repeatability of sphere (open/close) $\leq 0.5\%$
- Stability of the sphere between recalibrations $\leq 0.5\%$
- Spectroradiometer bandwidth and interval $\leq 5\text{ nm}$
- Spectroardiometer wavelength uncertainty $\leq 0.5\text{ nm}$
- Angle uncertainty of goniophotometers $\leq 0.5^\circ$
- Photometric distance of goniophotometers
  - Near cosine (beam angle $\geq 90^\circ$): $\geq 5 \times D$
  - Broad distribution (b.a.$\geq 60^\circ$): $\geq 10 \times D$
  - Narrower distribution: $\geq 15 \times D$
8. Measurement Uncertainties
The uncertainties shall be evaluated according to ISO/IEC Guide 98-3 and its supplements. Guidance is also available from CIE 198.

For all measured quantities the expanded uncertainty shall be given and expressed for a confidence level of 95 %.

For the purposes of testing, if all tolerance conditions are met without any corrections, each test report may show uncertainty values for a typical product of the similar type, with a statement that indicates so in the test report.

In this case, labs shall have a detailed uncertainty budget for a typical product of the same type; e.g., phosphor white LED type or RGB type, omnidirectional or directional, at CCTs close to DUT (e.g., 3000 K, 4000 K, 6500 K)
Measurement Uncertainty Requirements

NOTE 1  In this context, products could be considered similar type if the following properties are the same as the DUT: phosphor type or RGB(A) type; compact or tubular type; similar intensity distributions; omnidirectional or directional (beam angle between +50% and -25% of the value of the DUT); CCT within ±15% of the CCT value of the DUT.

NOTE 2  An example statement in the test report: "The uncertainty values stated in this test report are those for a similar type of product: phosphor type LED lamp (compact), directional (beam angle 60°), CCT 3 500 K." If the type of DUT does not match the type categories listed in NOTE 1, the product type should be described specifically.

NOTE 3  When corrections are applied to the results, the correction must always use the characteristics of the DUT (or product of the same model).
Title: Guide for Practical Uncertainty Evaluation for Testing of LED lamps and LED luminaires

1 Introduction

This Technical Note provides guidance on practical steps for evaluation of uncertainties for measurement of photometric and colorimetric quantities of LED lighting products for testing purposes. This document is intended for testing laboratories, manufacturers, and industrial laboratories, especially to meet the requirements in CIE DIS025 [1]. This document does not cover general theories and rigorous treatment of uncertainties as needed for calibration laboratories, which are covered in CIE 198. This document introduces practical approaches that are simplified from the rigorous approaches and uses different formats than described in CIE 198 [2], while, still following the international recommendation [3]. Figure 1 illustrates the steps for the uncertainty budget approach introduced in this document.

Diagram:
- List up all the components of uncertainties with information on the components (1,2)
  - Determine the uncertainty value of the component (3A)
  - Obtain characteristics data of the component (2)
## Parameters not covered by CIE DIS 025

<table>
<thead>
<tr>
<th>Performance Criteria (in IEA Performance Tiers)</th>
<th>Covered in IC Test Method</th>
<th>Covered in CIE DIS 025</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total luminous flux (lm)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Active power (W)</td>
<td>Yes</td>
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<tr>
<td>RMS current (A)</td>
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<td>Yes</td>
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<tr>
<td>Luminous efficacy (lm/W)</td>
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<tr>
<td>Correlated Color temperature (K)</td>
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<tr>
<td>Chromaticity coordinates</td>
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<td>Yes</td>
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<tr>
<td>CRI Ra</td>
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<td>Yes</td>
</tr>
<tr>
<td>Power factor</td>
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<td>Center beam luminous intensity</td>
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<td>Color spacial uniformity</td>
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<td>Harmonic distortion</td>
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<td>Luminous intensity distribution 0-180°</td>
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<tr>
<td>Partial luminous flux (useful flux)</td>
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<tr>
<td>Lag start time (ms) or start time or ramp up time</td>
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<td>Flicker (Flicker Index)</td>
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<td>Photobiological hazard class (UV &amp; blue light)</td>
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<td>Luminous flux maintenance life (L70)</td>
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<tr>
<td>Rated Lamp lifetime (B50)</td>
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<td>Color Maintenance (Δu'v' at 6,000h)</td>
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<td>Rapid Cycling, Cycle on-off time TBD</td>
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