

We bring quality to light.

A woman with long dark hair, smiling, is holding two glowing white spheres in her hands. A faint technical grid is overlaid on the sphere in her right hand. The background is a vibrant blue with various bokeh light effects in white and yellow.

Impact of New SSL Standards on Goniospectroradiometric Measurements

By

Dr. Đenan Konjhodžić, Application Engineer

Presented by

Justin Blanke, International Sales Manager



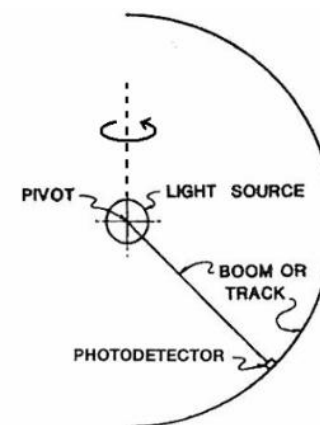
Outline

- Goniophotometry and goniophotometer types
- LM-79-08 review
- New standards EN 13032-4 and CIE S 025
- Resulting requirements on measurement equipment
- Example: Correction of burning position
- Solution for turning luminaire
- Comparative application study

Moving detector & mirror goniophotometer

➔ Moving detector type

- Detector moves around the source on an arm or rail
- Large samples require large space for far field measurements
- Not best solution for luminous intensity but good for luminous flux integration



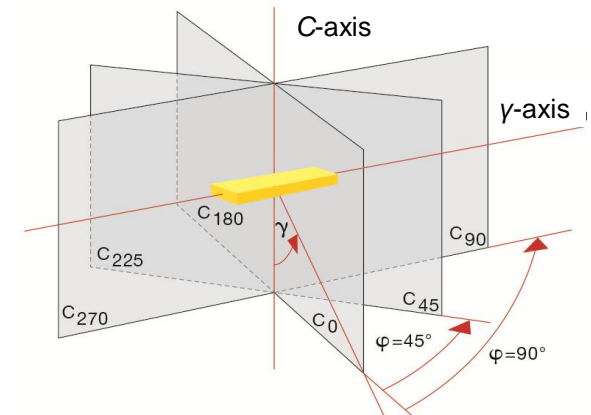
➔ Moving mirror type

- Detector is fixed
- Luminaire turns around the vertical axis only
- Mirror moves around luminaire
- Polarisation sensitive
- Very large and expensive systems



Turning Luminaire Goniophotometer

- ➔ Horizontal optical axis in conformity with C, γ - coordinate system (CIE 121-1996)
- ➔ Advantages:
 - Relatively small and compact envelope
 - Far field measurement can be easily realized even for large samples
 - Less expensive than moving mirror type
- ➔ Disadvantage:
 - Burning position not maintained
- ➔ Solution:
 - Correction of the burning position in conformity with new standards EN 13032-4 and CIE S 025



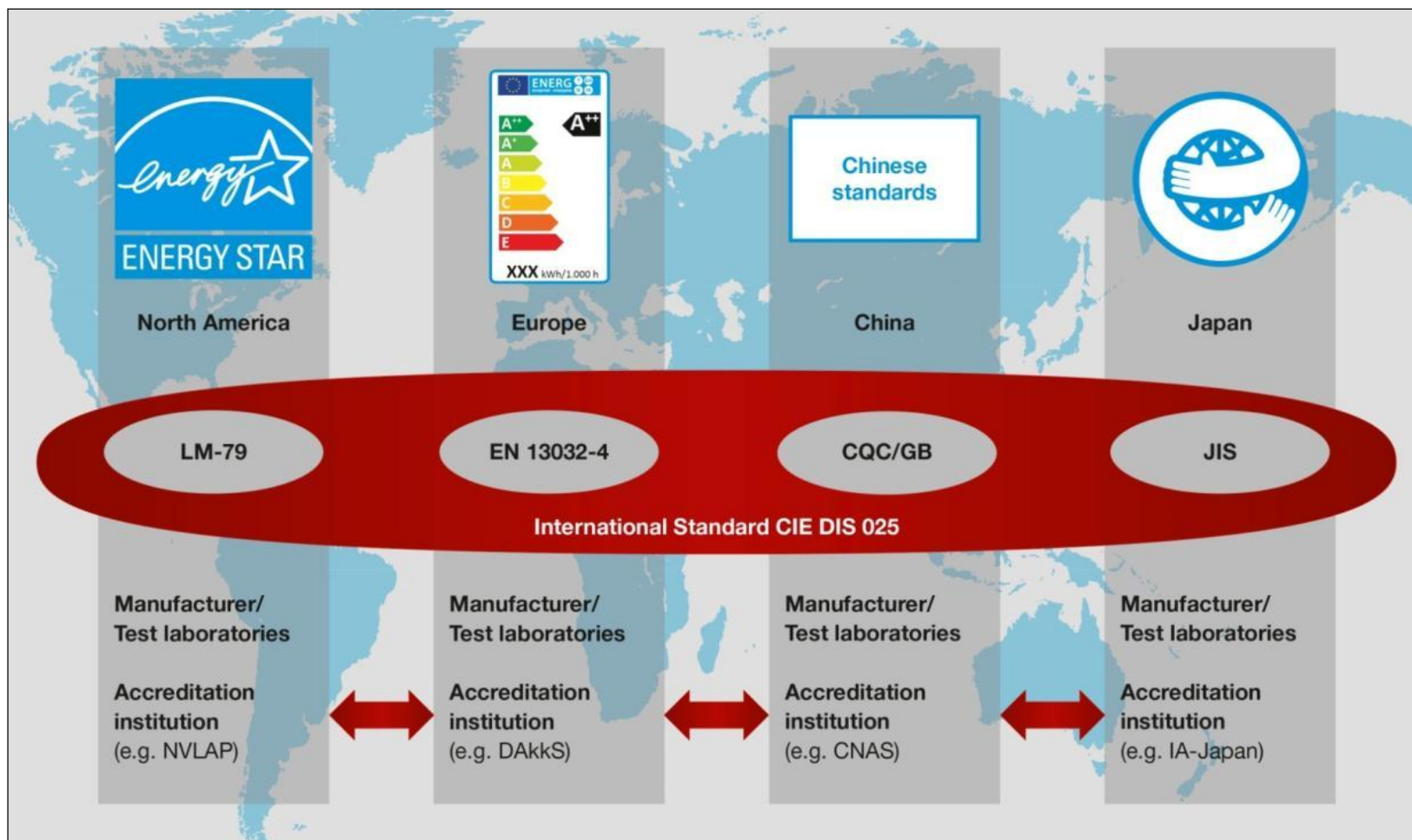
LM-79: Goniophotometer requirements

- ➔ Type C geometry **maintaining the burning position**
- ➔ Detector distance $\geq 5 \times$ sample diameter (less for flux)
- ➔ No ventilation from air flow affecting the measurement
(**speed dependent!**)
- ➔ Ambient temperature $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$, measured up to 1 m away from the SSL product, same height
- ➔ Stabilization / warming up: typ. 30 min – 2 h until stable within 0,5 % when 15 min apart
- ➔ **Sample orientation as intended by the manufacturer**

New standards EN 13032-4 and CIE S 025

- ➔ Draft of an European standard EN 13032-4 has been published end 2013. Final standard published in August 2015.
- ➔ International Standard CIE S 025:2015 has been published in March 2015.
- ➔ Both standards have identical technical content.
- ➔ CIE S 025 is planned as an ISO/CIE/IEC „Triple Logo“ standard.
- ➔ It is the first international guideline to cover the measurement procedures for SSL products and will exert a significant influence on the proposed harmonization.

Worldwide impact of CIE S 025



Coverage of the standard

- Standard covers photometric and colorimetric measurements of LED lamps, LED modules (light engines) and LED luminaires (DIN 5032-9 covers OLEDs).
- It includes total (partial) luminous flux, luminous efficacy, luminous intensity distributions, center-beam intensity, luminance and luminance distribution, chromaticity coordinates, CCT, CRI and angular color uniformity.

Scope and principles of measurements

- No restrictions on the used measurement technique.
Techniques other than the explicitly mentioned are acceptable if demonstrated to produce equivalent results.
- Specific requirements on test equipment and test conditions are given by a set value and a tolerance interval.
- The test result has to be within the acceptance interval or a correction has to be applied.
- The user has to set up an uncertainty budget according to ISO/IEC Guide 98-3 or CIE 198.
- Further guidance will be prepared as a supplement to the standard and published as a “technical note“.

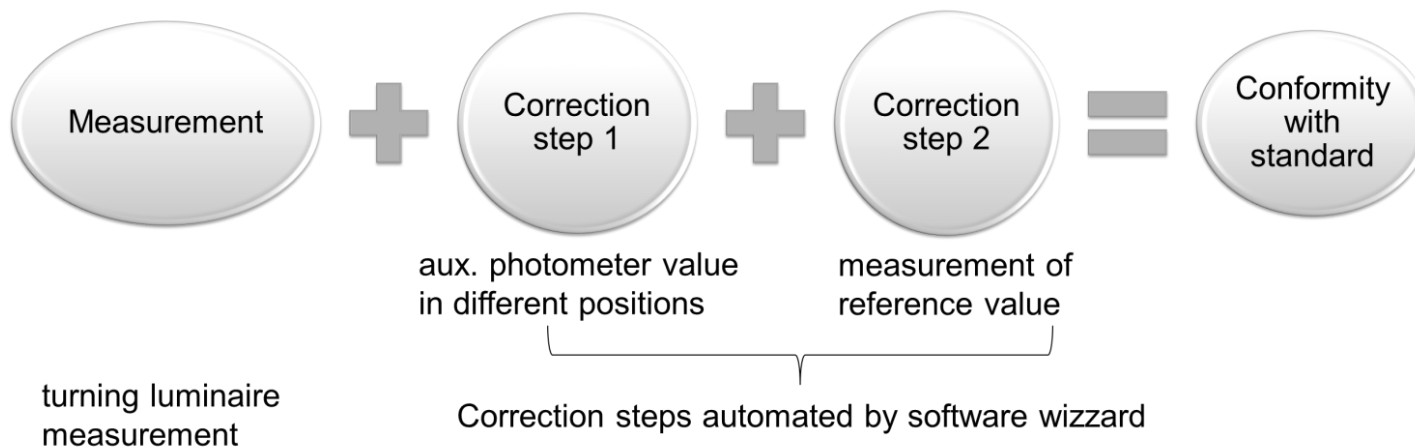
Standard test conditions

	Set value	Tolerance Interval	Applicable for
Ambient Temperature	25.0 °C	±1.2 °C	LED-Lamps/Luminaires, Light Engines
Surface Temperature	Rated performance temperature t_p	±2.5 °C	LED-modules
Air Movement	Still air	0 m/s to 0.25 m/s	
Test Voltage and Current	Rated supply voltage or current	±0.4 % for root mean square AC voltage; ±0.2 % for DC voltage and current	

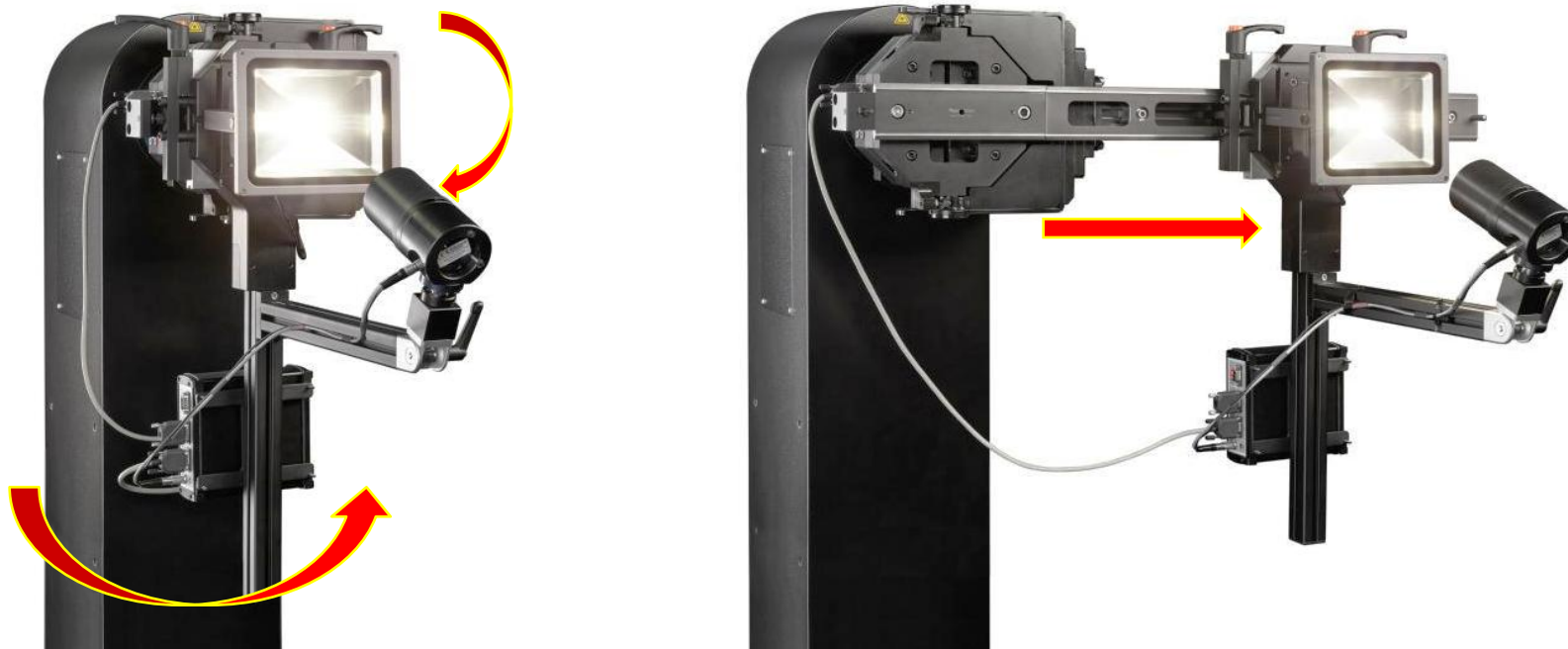
➔ Standard test conditions given by a set value and a tolerance interval

Example: Correction of burning position

- Some special requirements may be corrected, e.g. burning position
- CIE S 025 allows goniometric measurements to be performed in an orientation other than the designed burning position, if corrected.
- Turning-luminaire type may be used.
- One possible correction is the auxiliary photometer method.
- This method is implemented by a short additional test with correction steps that are easily automated in software.

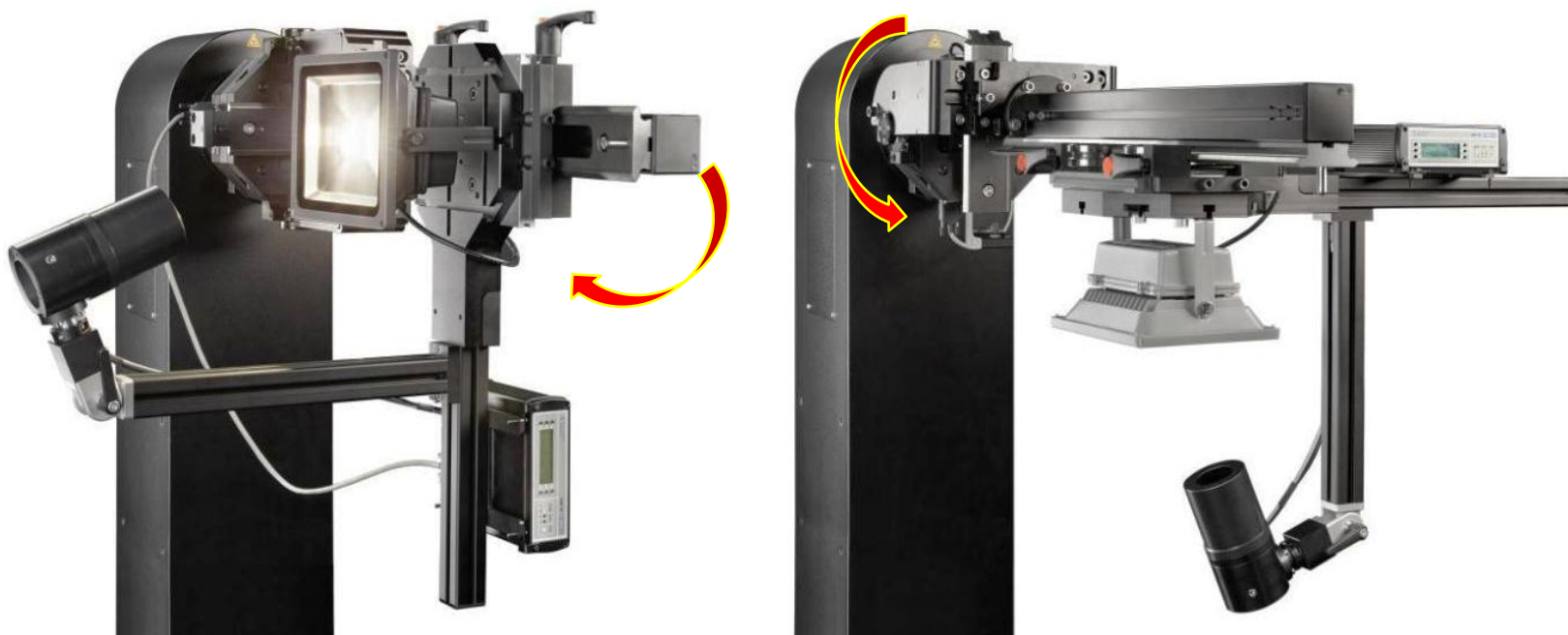


Auxiliary photometer method



- An adapter with an auxiliary photometer fixed to the mounting plate.
- A change in luminous flux of the DUT, caused by changing the burning position, results in a proportional photocurrent.

Auxiliary photometer method



- Additional cantilever allows turning the sample into designed burning position even when it is switched on.
- The subsequent measurement of a reference without interruption.

Outline

- Goniophotometry and goniophotometer types
- LM-79-08 review
- New standards EN 13032-4 and CIE S 025
- Resulting requirements on measurement equipment
- Example: Correction of burning position
- Solution for turning luminaire
- **Comparative application study**

Setup for Turning Luminaire



- ➔ Photometer head or a probe for spectroradiometer as detector
- ➔ Stray light tube as a shield
- ➔ Distance min. 10 x source dimension
- ➔ Correction of the burning position using the auxiliary photometer method in conformity with CIE S 025

Setup for Luminous Flux Integrator



- Transformation to a goniometer with a rotating detector
- Additional sample holder maintains the burning position
- Photometer or / and spectrometer as detector
- For small light sources all spatial radiation patterns can be measured



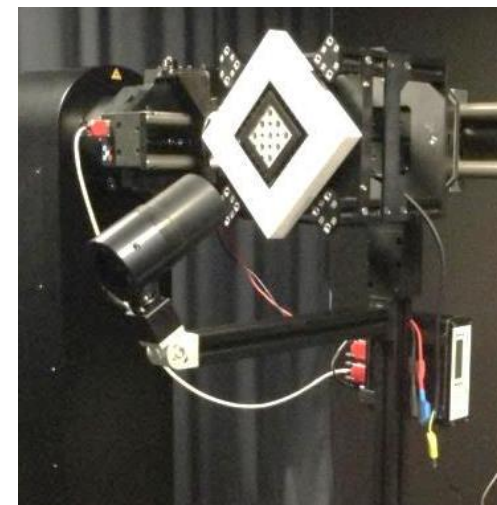
Test comparison

Light source	beam angle	Φ_v [lm] lum. flux integrator	Φ_v [lm] luminous flux integrator		Φ_v [lm] turning luminaire	
		Photometer	Spectrometer		Photometer	
SSL downlight 1	97°	798.0	806.0	1.0%	806.9	1.1%
SSL downlight 2	80°	665.3	673.5	1.2%	671.9	1.0%
SSL downlight 3	52°	1834	1854	1.1%	1878	2.4%
SSL downlight 4	29°	403.0	408.7	1.4%	409.4	1.6%
LED module with cooler	104°	1167	1181	1.2%	1178	0.9%
LED floodlight	103°	1697	1693	-0.2%	1743	2.7%
Sun lamp (halogen)	32°	4150	4231	2.0%	4021	-3.1%

- SSL downlights → The deviations within measurement uncertainties
- Other sources → The deviations are still low but a position correction can be applied

Correction of the burning position

Light source	Φ_v [lm] turning luminaire		Φ_v [lm] turning luminaire corrected	
	Value	Deviation	Value	Deviation
LED floodlight	1743	2.7%	1702	0.3%
Sun lamp (halogen)	4021	-3.1%	4111	-0.9%
SSL downlight 1 @ 215 V	721.8	-9.5%	805.8	1.0%
SSL downlight 1 @ 200 V	650.9	-18.4%	806.9	1.1%



➤ Induced position dependence for SSL downlights:

SSL downlight 1 was measured at lower operating voltages (215 and 200 V). The reference value was recorded in the designed burning position at the rated voltage of 230 V and used for position correction.

Conclusions

- New standards EN 13032-4 and CIE S 025 allow goniophotometric measurements in a luminaire orientation other than the designed burning position, if properly corrected.
- Correction with an auxiliary photometer method presented.
- Turning luminaire with a compact footprint provides a genuine alternative to a large and expensive rotating mirror goniophotometer even for position sensitive samples.

Thank you for your attention!



www.instrumentsystems.com