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Burning Position Correction (BPC) Setup for CIE S 025 Requirements

The extremely large size and very expensive mirror goniometers maintain the burning position of the luminaire that is critical in case of the traditional light sources. Such sources like fluorescent tubes or sodium lamps had a significant change in their luminous flux when their position regarding the gravity is changed. Anyway, a large portion of SSL luminaires do not cause such a significant burning position effect.

For example, the active cooling LED luminaires (e.g. water cooling), and heat-pipe / 1D heat sink based luminaires with deep fins may have a noticeable burning position effect on the luminous flux as their thermal management can change when measuring by the turning luminaire goniometer. The Type (C,γ) Goniometer system with horizontal optical axis (called as “horizontal C gonio”) is the best solution for cost effective measurement of any size of LED based lighting fixtures because C type gonio changes less the burning position of e.g. symmetric LED fixture than A/B type goniometer and horizontal optical path enables cost-effective and lab-space saving goniometer system.

BPC for C Type Turning Luminaire Goniometers

The BPC of the wall-mounted luminaires, whose application-specific optical axis is parallel with the horizontal direction, can be determined directly by the horizontal C gonio without using an additional BPC setup. The next measurement correction procedure in section A below describes this fully automatic correction method. For complying the newest standard CIE S 025 for vertical axis operation in the application e.g. roof lights and street lights, the burning position effect of the test luminaire can be straightforwardly characterized by the SSL goniometer software of SSL-BPC sw –tool and a special burning position corrector (BPC) setup. This is described in section B.

A) Normalization of the measured luminous intensities

In the normal goniometric measurement, the luminous intensity at the same optical direction (at γ=0°) of the lighting fixture is measured once on each C plane (different burning positions), therefore the luminous intensities at certain C plane can be scaled to correspond a user-defined burning position (C_{measBP}) e.g. horizontal / vertical position of the linear light source (e.g. LED tube):

$$I_{V,\mathrm{measBP}}(C,\gamma)=\frac{I_V(C=C_{\mathrm{measBP}},\gamma=0°)}{I_V(C,\gamma=0°)}I_V(C,\gamma)$$

Using this method the luminous flux of the luminaire under test (LUT) as shined horizontally is valid on a specified C plane C_{measBP}.

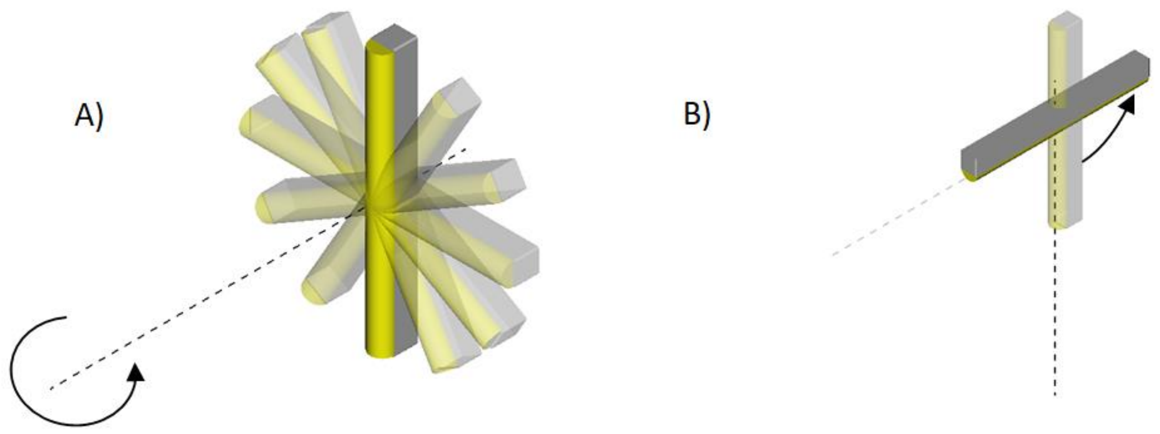

Fig. 1. Description of the burning position correction procedure in case of Type C goniometer.
A) Normalizing the luminous flux and luminous intensity values (e.g. vertical / C=0 in figure) into user-defined C plane (burning position in horizontal axis operation position) during the normal goniometric measurement. $\Phi_{V,\mathrm{measBP}}$
B) Application specific usage angle. $\Phi_{V,\mathrm{nomBP}}$

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B) Characterizing with the BPC Setup

The burning position effect can be quantified afterwards for the earlier measured luminous intensity data.

In the BPC setup of the C type goniometer, the luminaire and photometer are both assembled onto the C axis of goniometer according to the Fig. 2 (Fig. 3) shown as an example to SSL LUMI 90 (LUMI 180) goniometer. When rotating C axis the burning position is changing and the photometer is all the time measuring the light output from the LUT in the same direction (e.g. normal of surface). In this way, the relative luminous flux at different burning positions of the LUT can be analysed. When rotating the C axis i.e. the LUT is facing down towards floor and photometer is facing up towards roof, the illuminance/spectral irradiance value E_{nomBP} from an auxiliary photometer/spectrometer SSL L-10/SPEKTRI 80 is achieved for the nominal burning position. To compare this value to the illuminance/spectral irradiance value E_{measBP} at the normalized (or scaled) burning position of the goniometric measurement, the C axis of the BPC setup is adjusted i.e. the burning position corresponds to the normalized goniometric burning position. Then the luminous flux at nominal application-specific burning position as

$$\Phi_{\mathrm{V,nomBP}} = \frac{E_{\mathrm{nomBP}}}{E_{\mathrm{measBP}}} \Phi_{\mathrm{V,\,measBP}} \,.$$

Fig. 2. SSL BPC-C. The burning position corrector setup at normalized measurement position (E_{measBP}) in case of type C goniometer (photo: SSL LUMI 90 goniometer).

Fig. 3. SSL BPC-C setup in nominal burning position (E_{nomBP}) **of linear light source.** (photo: SSL LUMI 180 goniometer).

BPC for B Type Goniometers

In case of the B type gonio, the BPC method is a bit different. In the normal B type goniometric measurement (without auxiliary photosensor of BPC setup), the usage the effect of tilt angle of the LUT on its luminous output is not known. This is because the B type gonio measures only once the luminous intensity at any angular position.

In the BPC setup of the B type goniometer, both an auxiliary photometer/spectrometer and luminaire is assembled onto the horizontal B plane axis. Fig. 4 shows the BPC setup operated at nominal horizontal position of Type B goniometer for LUMI 120. The illuminance/ spectral irradiance signal $E(B)$ as a function of burning position is recorded by turning the B axis to all B planes of the normal goniometric measurement and nominal application-specific usage angle B_{nomBP}. The BPC value is then calculated for each B plane

$$I_{\mathrm{V,nomBP}}(B,\beta) = \frac{E\left(B = B_{\mathrm{nomBP}}\right)}{E(B)} I_{\mathrm{V}}(B,\beta).$$

The BPC measurement of Type B gonio is more time consuming compared to the one of Type C gonio (two measurement positions and stability waiting times). Instead, the mechanical setuping time of BPC-B is much shorter because the LUT is not needed to be reinstalled and the photometer/spectrometer can be mounted in a few seconds to the BPC measurement position.

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Fig. 4. **SSL BPC-B.** The burning position corrector setup in case of type B goniometer (photo: SSL LUMI 120 goniometer).

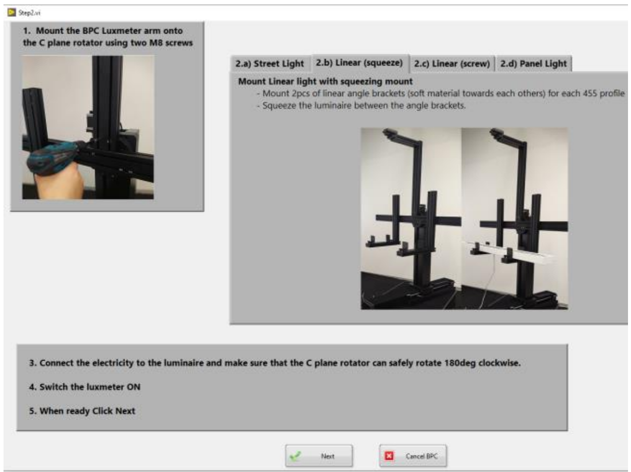

Fig. 5. SSL BPC-C sw burning position corrector test software.

Automated Software

Our dedicated burning position corrector software called as SSL BPC-sw makes the correction automatically from the GPF (SSL goniophotometer file format) data and saves as an output in a new corrected LDT / IES file. In case of spectral SCF measurement, the GCF file in a goniospectral file format is used as an input for correcting spectral data into the application-specific usage position.

The software automatically recognizes the type of gonio, and the measurement angles of the normal goniometric test. The SSL BPC-sw wizard monitors the light signal from the luminaire and record the signal when stable. After the measurement is finished, the software saves the burning position corrected luminous intensity data into a new LDT / IES file.

Fig. 5 shows the detailed instructions (in case of type C gonio) for mechanical mounting of the BPC setup that is visible in the BPC test software. The mounting instructions are shown for four lamp types that covers the most typical luminaires.