Differences in Lab and Field Measurements Explained

Introduction

As a light source with performance dependent upon thermal conditions, **Light Emitting Diodes (LEDs)** are tested ***in-situ*** while installed in the luminaire rather than tested separately as can be done with traditional light sources. This includes measurement of **photometric** or light output performance.

The Illuminating Engineering Society (IES, www.iesna.org) is widely recognized as the leading authority on lighting. Publications from the IES include the *Lighting Handbook*, the chief technical source for the lighting industry. Other technical documents are created from the *Handbook* and continuing IES efforts including **Lighting Measurement LMs** that prescribe uniform methods aimed at repeatability and consistency of photometric measurements. However, differences are not unexpected. Even for the exact same luminaire – LED luminaires included – it is possible to have differences in photometric measurements from one laboratory to another. Further, when that luminaire is moved from the lab and installed in an uncontrolled environment in the field, it is evident that differences will occur.

IES LM-79 for the LED Luminaire

LED luminaire photometric performance is measured in labs per **IES LM-79** *Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products*. To avoid photometric differences that occur when the LEDs are removed from the luminaire, LM-79 requires **absolute photometry** which is the measurement of the LEDs ***in-situ*** while installed in the luminaire. A more detailed explanation of LM-79 is provided in the Information Brief "LM-79 and LM-80". A more detailed explanation of absolute photometry is provided in the Information Brief "Understanding Relative and Absolute Photometry".

LM-79 specifies lab considerations including ambient conditions, electrical equipment and measurement equipment. It also specifies test methods regarding how to perform the measurements as well as proper treatment and operating orientation of the luminaires being measured[1].

Test equipment used in labs that conduct LM-79, such as **integrating spheres, spectroradiometers and goniophotometers** must conform to the specifications in LM-79 in terms of precision, accuracy, reproducibility of measurements, tolerances and correction factors[2]. As you can imagine, lab test equipment is typically very expensive and it must be maintained and calibrated to ensure years worth of return on the considerable investment.

In some cases, such as **our in-house photometric lab**, the lab itself and our moving mirror goniophotometer were **custom designed and built** to accommodate the myriad of various sized and shaped luminaires we manufacture and to ensure the correct distance from the luminaires to the photometer head that is required for precise far-field photometry. See Figure 1.

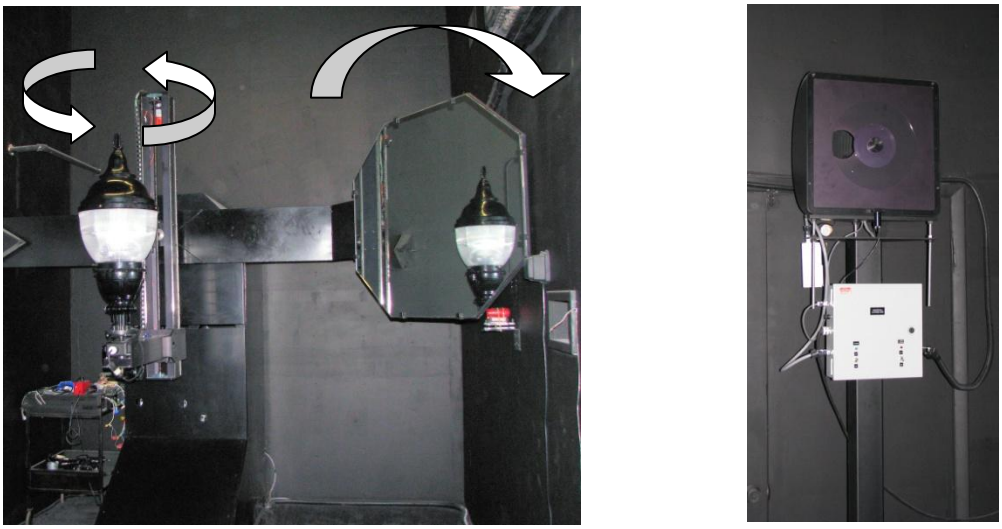

Figure 1. Custom goniophotometer (left) and photodetector (right).

Applying the approved method in LM-79 will minimize differences in photometric data, but it will not totally eliminate them. For example, differences in test equipment used and allowable tolerances can result in measurement differences. Treatment of **reflected light** inside the lab will also affect data. The IES, in which we are an active participant, continues to update LM-79 in order to further hone the uniformity of LED luminaire photometric measurements.

From the Lab to the Field

LM-79 is applicable to the controlled environment of the test lab. As soon as the LED luminaire is installed out in the field, ambient and operating conditions change. We are leading the effort within the IES to consider a new LM for lab versus field photometric measurements of LED luminaires. In the meantime, **IES LM-61** *IESNA Approved Guide for Identifying Operating Factors Influencing Measured vs. Predicted Performance for Installed Outdoor High Intensity Discharge (HID) Luminaires* can be used as a helpful guide.

Similar to LM-79, LM-61 includes measurement equipment considerations such as accuracy, correction factors and calibration. **Additional considerations** when measuring installed outdoor LED luminaires include:

- Precision, accuracy, tolerances and calibration of the light meter.
- Variations in drivers, LEDs and optics (e.g. TIR lenses, refractors, glass lenses) among luminaires due to acceptable manufacturing tolerances.
- Ambient light variations such as contribution from nearby luminaires or buildings, moon phase and positioning that contributes to ambient light, shadows from overhanging objects or the person taking measurements.
- Installation variations such as mounting height, spacing, aiming and tilt.
- Weather condition variations such as ambient temperature and humidity, atmospheric transmissivity (e.g. fog, haze), other weather conditions (e.g. cloudy, snow, rain, ice, etc.).

- Field condition variations such as luminaire contaminant conditions, topography and obstructions (or the “lay of the land”) that affects light meter positioning or impedes light from reaching the meter.

These **variations and considerations**[3] further contribute to differences between LED luminaire photometric measurements, particularly when moving from inside the controlled environment of the lab outside to field installations.

Conclusion

IES documents including LMs provide technical lighting information as well as approved lighting measurements. Even with these uniform methods, differences occur in the measured photometric performance data. This is to be expected due to variations in equipment and test labs. Further consideration regarding differences must be expanded to include other variations when installing luminaires outdoors in an environment that is less controlled than the lab. These photometric differences pertain to all luminaires, including LED luminaires. To learn more about HADCO’s LED luminaires as well as our complete commercial and landscape product lines, go to www.hadco.com and www.hadcoled.com.

References

1. Subcommittee on Solid State Lighting of the IESNA Testing Procedures Committee, *Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products*, LM-79-08, New York: Illuminating Engineering Society of North America, 2008.

2. Ibid.

3. Subcommittee on Photometry of Outdoor Luminaires of the IESNA Testing Procedures Committee, *IESNA Approved Guide for Identifying Operating Factors Influencing Measured vs. Predicted Performance for Installed Outdoor High Intensity Discharge (HID) Luminaires*, LM-61-06, New York: Illuminating Engineering Society of North America, 2006.

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