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Kurt Versen Company

Brightness Data For Downlights

The most commonly used system produces misleading information because the concept does not apply to downlights. There is a better method.

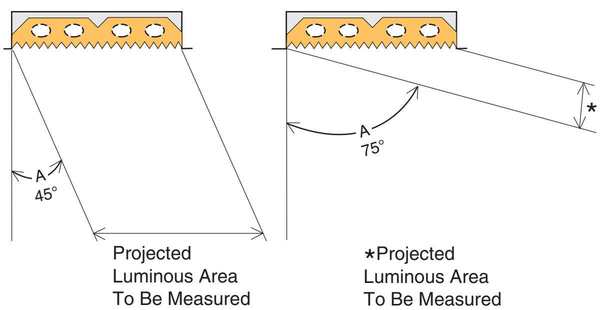
Brightness Data
Two Measurement Methods. How Accurate?

Brightness or luminance data are determined by two basic procedures, both recognized by the Illuminating Engineering Society. One method is called Average Luminance, the other is Maximum Brightness. Below is an evaluation of the data collection methodology for each and why they are not equally appropriate for open aperture downlights. Our comparison is limited to Type A luminaires, defined as those with wholly direct output and no upward component.

Average Luminance Method

This procedure envisions a theoretical horizontal plane of uniform brightness at the aperture. The footlambert data produced is a *calculated* result derived by the formula:

$$\text{Average luminance in footlamberts} = \frac{\text{Luminous intensity in candelas at Angle A} \times \pi}{\text{Projected luminous area at Angle A in square feet}}$$



This method is appropriate for luminaires with large area diffusers and relatively uniform brightness at the surface. Prismatic lens troffers are a good example. It is valid for determining a theoretical average luminance over the projected luminous area from a given sight line if there is an aperture surface (lens) to be measured. The formula is incorporated within most software programs and the data are automatically available during luminaire testing procedures without additional cost. Most downlight companies publish brightness data derived by this method.

Terminology

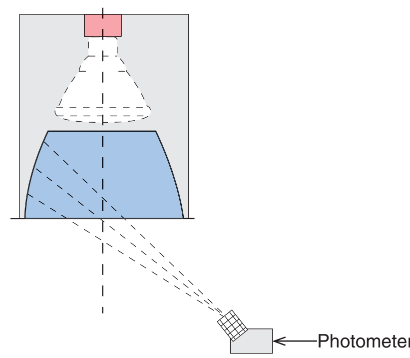
Luminance has supplanted brightness as the more correct descriptive nomenclature. Either term is commonly used to describe the same phenomenon.

Measurement

To convert footlamberts to candelas per square meter (CD/M^2) multiply footlamberts by 3.426.

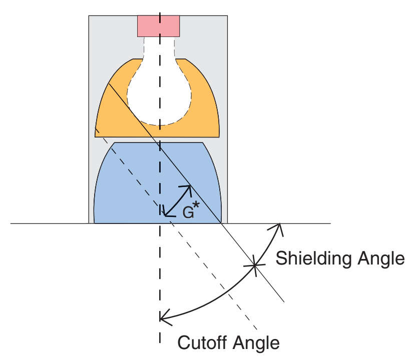
Maximum Brightness Method

This system does not use theoretical calculations. Data are obtained by calibrated meters in a photometric laboratory. An open aperture downlight has no aperture surface (lens) to be measured, so readings are taken at discrete points on the wall of the shielding cone or baffle. The meter scans the cone wall in one degree increments from each viewing angle.The highest reading for each viewing angle is then recorded and assigned to that angle, hence the term Maximum Brightness.



This approach more accurately describes relative brightness as perceived by the human eye. Footlambert values are generally higher than data calculated by the Average Luminance Method, but much more reliable. Data collected this way are not automatically available from computer programs.They require additional laboratory tests which are seldom authorized because of the extra cost. All Kurt Versen brightness data are derived from the Maximum Brightness Method.

Shielding Angle and Cutoff Angle



*G = Glare zone. Actually part of the commonly defined cutoff angle. It is that portion between line of sight to the lamp and that portion of the reflector which flashes. It is bright. It can be from the bottom of the lamp to the top of the shielding cone or, in a poorly designed luminaire, it may extend down the wall of the cone. In a single reflector system it could occur anywhere.

Why Average Luminance Data is Wrong For Downlights

This method can produce artificially reduced footlambert values at high viewing angles. It often indicates zero brightness at 85° and even at 75°, 65° and lower. It is difficult to accept zero at these angles because some brightness does occur. Conversely, elevated footlamberts at lower angles are frequently beyond normal viewing angles and are not very meaningful. Virtually all Average Luminance values are understated. The Average Method does as it name implies. It averages. While it may be reasonable for large luminaires with diffusers, it has little or no value in describing open aperture downlights.

Comparison Data

Listed below are several different luminaire types using popular lamps which illustrate the deviations in data produced by the two measuring methods. The data were taken from the exact same fixtures at the same time. Data are expressed in footlamberts, using luminaires with clear Alzak cones.

Incandescent, Vertical Lamp

C7302, 150W PAR-38 Flood, 5 7/8" Conoid Aperture

Viewing Angle	Average Luminance Method	Maximum Brightness Method
45°	0	816
55°	0	21
65°	0	13
75°	0	10
85°	0	2

Metal Halide, Vertical Lamp

R7342, 100W ED-17 MH/C, 7 1/4" Conoid Aperture

Viewing Angle	Average Luminance Method	Maximum Brightness Method
45°	1065	8844
55°	191	582
65°	0	48
75°	0	31
85°	0	10

Compact Fluorescent, Horizontal Lamps

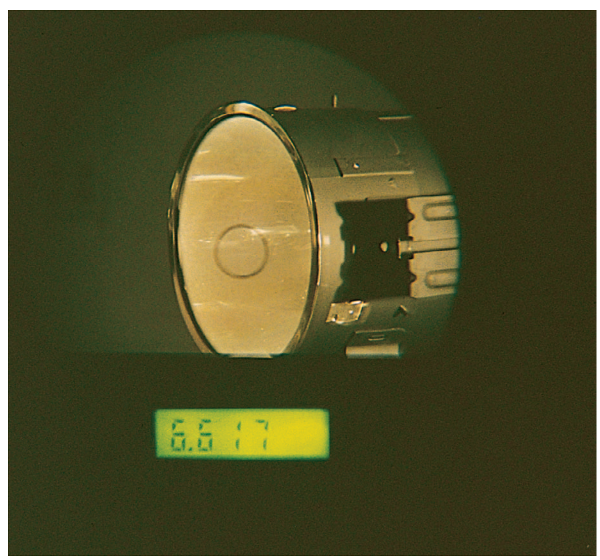
P642, Two 26W Quads, 8 3/8" Conoid Aperture

Viewing Angle	Average Luminance Method	Maximum Brightness Method
45°	1036	6934
55°	100	545
65°	0	36
75°	0	20
85°	0	2

Conclusions

Open bottom downlights do not have a horizontal luminous plane to be measured at the aperture. Brightness is typically observed on the cone wall reflecting the lamp source, upper reflector, or general luminous flux within the luminaire. Averaging these values does not describe reality accurately. Only precise incremental readings determined by the Maximum Brightness Method are relevant for downlights.

Kurt Versen's photometric laboratory showing set-up for Maximum Brightness Method testing.



View through the meter showing exact measuring point on the cone and the digital readout.

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