

**From:** Wright, Craig [mailto:CWright@progresslighting.com]  
**Sent:** Tuesday, September 16, 2008 4:21 PM  
**Subject:** Cat A Comments

Please consider the following from one of our sister brands, Kim, with specific regards to pole mount street lighting. I'm sending verbatim, so please accept the reference to 'they' meaning DOE. The criteria directed toward indoor seem to fall in line with the previously released categories. I would like to discuss what the 'ceiling-mounted luminaires with diffusers' category encompasses. I'm assuming this leaves decorative out, but it does include close-to-ceiling products.

Comments on beam uniformity metric referencing intensity rather than lumens.

**Comments on beam uniformity metric:**

- Goniophotometry measures luminous intensity only. Luminous flux can be derived from intensity data using zonal constants (a trigonometric function).
- Illuminance is also derived from intensity. The cosine law (a modified version of the inverse square law) states that illuminance = intensity x  $\cos \Theta$  / distance<sup>2</sup>, i.e., higher intensity is required at higher vertical angles than at nadir to produce equivalent illuminances across the luminaire beam spread. Therefore, when concerned with regulating illuminance uniformity, it is more relevant to address intensity than luminous flux.
- Note also that luminous flux and intensity are not corollaries. Whereas zonal lumens represent a total and must sum to 100%, luminous intensity is an infinite measure and specific to the angle of measurement. This "disconnect" between flux and intensity underlies, in part, IESNA nullifying its luminaire cutoff classifications (superceded by the Luminaire Classification System, per IESNA TM-15-07).

But:

They reference that the maximum cd intensity should be 55-deg to 65-deg vertical zone which essentially amount to having the light hit the ground between 1.43 mounting heights to 2.14 mounting heights. This would suggest that, on a 20-foot pole, the light will hit the ground between 28.6 feet to 42.8 feet. The next fixture in the lot would have to be about four mounting heights apart to accomplish good uniformity. Simply stated, they maximum cd angle is too low for outdoor lighting.

Typically a good outdoor lighting system places the maximum intensity from 60-deg to 70-deg vertical, thereby allowing better pole spacing and good uniformity. To compare, this will allow the light to hit the ground from 1.73 mounting heights to 2.75 mounting heights. This will produce light on the ground 34.6 feet to 55.0 feet away from the pole. This doesn't sound like a lot, but the poles can now be five mounting heights apart and produce great uniformity from under the pole out to between the poles.

I know what you're thinking, the 70-deg is too high and will produce glare. That isn't true, but when looking at the LED area lighting on the market today, the LEDs are so close to the lens that they produce a tremendous amount of glare as your eyes come under the luminaire. Even at 80-deg, they appear glary because the back-drop is a dark sky. If the luminaire was designed correctly, the LEDs would not be visible from the angles of 80-deg to 90-deg and yet provide good candlepower at 68-deg.

The proof will be in the design, but the Energy Star program should not confuse bad LED optic design with outdoor lighting fundamentals. They understand that the intensity is different then it is for indoor

lighting, but they dropped to levels on outdoor that will hurt the industry. Sure, we'll sell more fixtures because they will need more to get the minimum requirements of 1-foot candle, but we're trying to achieve energy independence and energy savings at the same time. Having more fixtures will require more wattage. Less wattage is part of this standard, so it would be nice to know which one they want.

<b>Application Requirements</b>	
Minimum Light Output	Luminaire shall deliver a minimum of 2,300 lumens (initial).
Zonal Lumen Density Requirement	Luminaire shall deliver 100% of total lumens within the 0°- 90° zone, with a maximum of 10% of total lumens delivered within the 80°- 90° zone (bilaterally symmetrical).
Beam Uniformity	<p><u>IES Outdoor Luminaire Classification Type II/III</u></p> <p>Maximum intensity (in candelas, cd) to be produced in the 55°- 65° zone (vertical), at a horizontal angle per IESNA TM-15 definitions, with the following requirements:</p> <ul style="list-style-type: none"> <li>• 10% - 35%<sup>†</sup> of the max. cd in the 0°- 25° range</li> <li>• 35% - 60%<sup>†</sup> of the max. cd in the 25°- 45° range</li> <li>• 35% - 95%<sup>†</sup> of the max. cd in the 65°- 75° range</li> <li>• ≤5%<sup>†</sup> of the max cd in the 80°- 90° range</li> </ul> <p><u>IES Outdoor Luminaire Classification Type IV</u></p> <p>Maximum intensity (cd) to be produced in the 55°- 65° zone (vertical), with the following requirements:</p> <ul style="list-style-type: none"> <li>• ≤50%<sup>†</sup> of the max. cd in the 0°- 40° range</li> <li>• ≤5%<sup>†</sup> of the max cd in the 80°- 90° range</li> </ul> <p><u>IES Outdoor Luminaire Classification Type V</u></p> <p>Maximum intensity (cd) to be produced in the 55°- 65° zone (vertical), with the following requirements:</p> <ul style="list-style-type: none"> <li>• 10% - 35%<sup>†</sup> of the max. cd in the 0°- 25° range</li> <li>• 35% - 60%<sup>†</sup> of the max. cd in the 25°- 45° range</li> <li>• 35% - 95%<sup>†</sup> of the max. cd in the 65°- 75° range</li> <li>• ≤5%<sup>†</sup> of the max cd in the 80°- 90° range</li> </ul> <p><sup>†</sup>All percentages are ±5%</p> <p>(Refer to IESNA TM-15-07 for luminaire classifications distribution types)</p>
Minimum Luminaire Efficacy	50 lm/W

But:

They didn't finish when they state the Zonal Lumen Density Requirements. The 85% of total lumens simply confuses the issue when we talk about outdoor lighting. They already mention that we need to work with intensity rather than lumens, but then they go back to lumens again in this table.

Outdoor lighting with good optical design is attempting to achieve uniformity and glare control. High angle beams decrease the efficiency of a product simply because of index of refraction and cosine factors.

Outdoor lighting must be judged by footcandles on the task and that is derived by having intensity in the right angles from the luminaire.

There are several ordinances that stipulate 1-foot candle minimum on a project and that project can be any shape. The luminaire that achieves the right angles to obtain the minimum with good uniformity is the superior system. Wish we had a guideline for task lighting, not for efficiency. You can get 100% efficiency from a bare bulb, but you would not light the ground with it. Spot reflectors used in floodlights have great efficiency, but you would not aim it straight down to light a street.

<b>Application Requirements</b>	
Minimum Light Output	Luminaire shall deliver a minimum of 2,300 lumens (initial).
Zonal Lumen Density Requirement	Luminaire shall deliver a minimum of 85% of total lumens within the 0°- 90° zone (bilaterally symmetrical).
Minimum Luminaire Efficacy	40 lm/W

The rest of the standard appears to be based on parameters to direct manufacturers. Things like this prevent companies from developing new way to improve the industry. It is fine to say we want full-cutoff, but don't lock in criteria that directs specifications to one source.

The data for the other sections like bollards and wall wash luminaires have the same generic issues regarding lumen versus intensity. When a Specifier picks a luminaire, they base it on what their task is and they try to find the luminaire that will do it the best with what they have. Lumens have very little value in outdoor lighting, it is simply a matter of lighting the task and trying to do it without sky glow and waste. The minimum light output criteria of any luminaire is irrelevant for outdoor lighting and should be based on task lighting performance.

Craig Wright - Recessed & Linear Fluorescent Product Manager  
701 Millennium Blvd  
Greenville, SC 29607  
P: (864)678-1201  
F: (864)678-1411  
e: [cwright@progresslighting.com](mailto:cwright@progresslighting.com)