



Kim Lighting published an LED "white paper" in May 2008 that includes several inaccurate conclusions and inaccurate facts about LED technology. BetaLED acknowledges that we are "Manufacturer B" and have corrected, updated and provide a current perspective to items addressed in the paper.

The paper addresses many of the hot topics surrounding Solid State Lighting technology, and in some cases we agree with their conclusions; however there are several statements and explanations we must take exception to because they are incorrect and based on inaccurate data.

BetaLED would like to set the record straight with the following responses:

Kim Statement: "Unfortunately, the bottom line is that the general performance of LED site luminaires on the market today are not properly designed or adequate for large area outdoor, roadway, or site lighting use." "This white paper illustrates how prematurely introduced LED site and area luminaires are not performing as marketed when tested under current IES standards, and consequently may ultimately be detrimental to users, commerce, and the environment."

BetaLED Response:

- 1) There are LED luminaires available in the market today that are properly designed and are successfully installed in area lighting applications. (see <http://betaLED.com/gallery.htm>). Studies from the Department of Energy (DOE), utilities, municipalities and private interest groups support the feasibility of LED products successfully installed in outdoor lighting applications.
- 2) Manufacturers who are credible support their claims by providing performance data in accordance with the new testing standards established by IESNA for solid state lighting products (LM-79 and LM-80). BetaLED is one manufacturer that has been testing and reporting data per the draft standards even before they were published (LM-79 was released in May 2008 by IES).
- 3) The Kim paper is correct, not all products are performing as marketed. The DOE has published data under their CALiPER program (see http://www.netl.doe.gov/ssl/comm_testing.htm) to educate and inform the public about what products are and are not living up to marketed performance claims. BetaLED has participated in CALiPER and currently meets or exceeds all published performance data.
- 4) BetaLED products are RoHS compliant, contain no mercury, have a rated life of greater than 100,000 hours (L_{70}) and carry a five-year warranty on all electrical components, while saving energy. Based on this, it is hard for us to understand the quote; "ultimately be detrimental to users, commerce, and the environment." When integrated into a system with proper thermal management, LED displays better lumen maintenance after operating 5 to 10 times longer than an HID.



Kim Statement: "... the total efficiency of a luminaire is less relevant when lighting outdoor tasks."

BetaLED Response: This statement is not meaningful without evidence to support the claim. To fairly evaluate product performance, it must be done on a case by case basis at the application level. In outdoor lighting applications, what is important is getting the output of the luminaire to the target areas. This can be defined as the application efficacy. BetaLED luminaires provide excellent optical control through the use of our patented NanoOptics™. These optics allow the BetaLED luminaires to deliver photometric distributions optimized for a variety of outdoor lighting applications. Therefore, the efficiency of the BetaLED luminaires are very relevant for meeting required application performance criteria such as power density (ie. energy efficiency) and photometrics.

KIM Statement: "Manufacturer 'B' publishes data for their LED area light promising 100% total flux as an indication of total luminaire efficiency, not total flux with luminaire losses. With this said, the total flux of 4468 for sixty (60) 1.15 watt LEDs suggests that the fixture actually performs at 58 lumens per watt, not the 90 LPW that Manufacturer B claims using bare lamp testing"

BetaLED Response: Independent testing laboratories are required per LM-79 to publish LED luminaire systems results in **absolute photometry**, not the relative photometry used in prior lighting systems. LED's are not designed to operate independently from the luminaire "system". They will operate differently once separated from the system due to changes in thermal properties. In absolute photometry the total luminous flux out of the system is published as 100 percent because the testing laboratory cannot feasibly obtain accurate reference data for the bare or raw LED's outside of the system excluding whatever optical, gear or thermal conditions may be occurring.

The 4468 total flux from (60) 1.15 watt LED's actually delivers 58 lumens per watt including all applicable optical and power system losses for that product. By comparison, before optical losses a 70 watt metal halide fixture provides 62.2 initial lumens per watt (5600 lumens/90 total system watts). Looking at a quality HID optical efficiency of 70 percent, the HID system actually delivers 43.5 initial lumens per watt after optical and power system losses. Therefore, the LED system today delivers a 33% improvement in initial lumens.

Kim Statement: "Correcting beam spread and controlling optical output is essential to reduce discomforting glare and obtrusiveness, however, no fixture manufacturer has yet introduced a proper LED site lighting product that achieves this."

"Kim Lighting will be first."

BetaLED Response: BetaLED's patented NanoOptics deliver exceptional optical control and photometric performance. The brightness emanating from BetaLED luminaires is comparable to or less than existing HID area lighting products. All BetaLED area lighting optics meet full cutoff classification. In addition, we have developed over ten different optical choices to improve the ability to meet the application needs.

Kim is not first.

Kim Footnote: Manufacturer B's LED luminaire can only be tested with absolute photometry because, due to the fact that the LEDs are clustered to act as one source during a photometric test, there is no adequate way to measure the LEDs against the diode manufacturers' published data. Therefore, a gain test for relative photometry cannot be factored into this report either.

BetaLED Response: The reason Manufacturer B's luminaire was tested with absolute photometry is because that is the solid state lighting test and measurement standard as defined in LM-79.



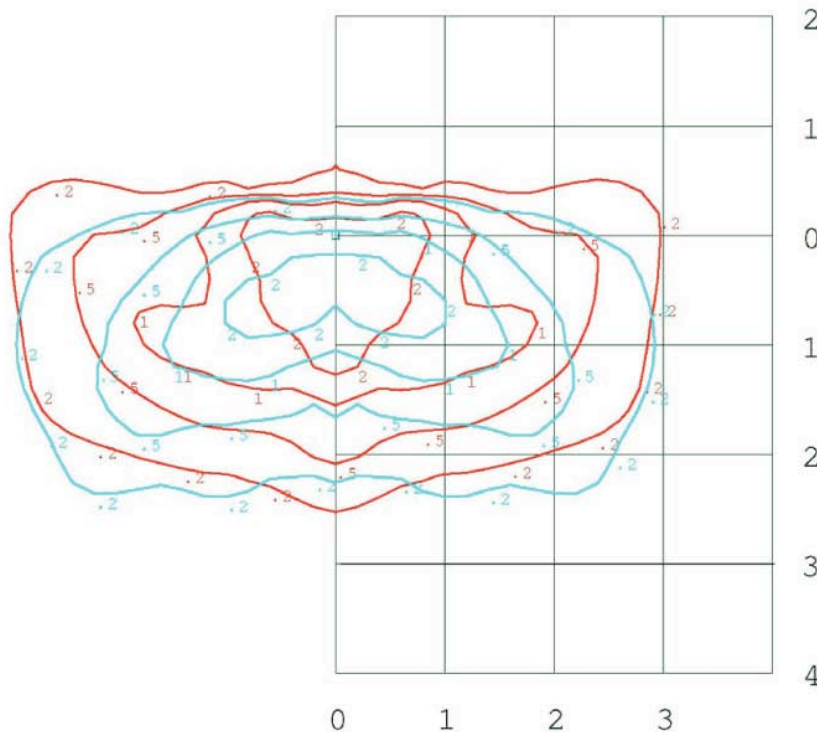
BetaLED Conclusions:

- 1.** The LED isofootcandle plot is wrong in the original white paper. After a call to KIM, they have acknowledged the error and have corrected the error but not the conclusions based on that error. The LED isofootcandle template labeled as 5 FC by KIM is actually a 2 FC isofootcandle template. This fact is an error by KIM and invalidates their theory about LED's having too much light directly under the luminaire when properly utilizing directional optics.
- 2.** The data used for this comparison was from a test in October of 2007 and is outdated. BetaLED has already enhanced the optical and system performance. All current lighting layouts at the factory utilize up to date information.
- 3.** Distribution comparisons should be done incorporating more current LEDs performance with higher lumen output and newer optical designs including two Type II patterns for comparison on 2 x 3 grids, or better yet incorporate them into actual roadway and area applications via computer generated layouts.
- 4.** Accessory devices have also been engineered to diminish the amount of backlight emitted from asymmetric roadway LED luminaires without any detrimental impact on the street side distribution.
- 5.** Photometric performance is best evaluated on an application by application basis. Distribution comparisons using marketing isofootcandle plots are excellent for preliminary/precursory evaluations, but most lighting professionals seek the utmost confidence in their data. This requires incorporating all necessary variables into a job specific point-by-point layout.
- 6.** KIM is trying to dispel the viability of LED's in roadway and area lighting applications, yet all of their comparisons take place on the pedestrian scale at 15' mounting heights. Most area applications begin at 20' afg and most roadway applications utilize a 23' to 28' minimum mounting heights.
- 7.** Two of KIM's greatest contradictions are evident in the distribution comparisons. They claimed LED had too much light below the fixture and then state, "The direct light below the fixture in both cases appears to be adequate...". In their conclusions, they state that the LED will be more glary yet they criticize the 54 degree main beam. In the polar candela charts of figure 3, it is evident that the 70 watt Pulse-start metal-halide with a 67.5 degree main beam has higher candela values at the higher vertical angles thereby producing more apparent brightness or glare.
- 8.** Some major advantages of LED vs HID that were ignored by Kim are:
 - a. LED has no hazardous materials (ie.-mercury in HID sources) that need special disposal.
 - b. LED lumen depreciation is generally less than 1% per year in a properly designed outdoor lighting fixture vs. approximately 15% per year in a metal halide product.
 - c. The life of a 70 watt metal halide lamp is 11,500 to 15,000 vs. 50,000 to 100,000 hours+ for LED fixtures depending upon product design



- 9. Adding to item number 8, we would like to point out the dramatic impact LED's extended life can have on the longevity of an LED application versus an HID application. When designing for "mean" HID output, industry professionals will utilize OEM's "mean lumen output" as stated in their lamp catalogs. For metal halide, this comes at 40% of rated life, which in the case of a 70-watt lamp is maxed at 15,000 hours. A cross-section of lamp manufacturer's data shows 35% lamp lumen depreciation for low wattage metal halide systems. This yields 65% of initial output after 6000 hours of operation. By comparison, a properly designed LED product can last in excess of 100,000 hours. LM-80 refers to L₇₀ as the useful life of LED solid state lighting systems. This is the point at which the LED has experienced 30% lumen depreciation from its initial output. Even if we were to arbitrarily represent "mean" LED life at 25,000 hours (more than 4 times that of the 70 watt MH), the lumen depreciation displayed by the LED's in our standard product would only be 5%.

Initial Lumen Output For:
70W PSMH - Approx. 90 Total Watts
60 LED Type III - Approx. 78 Total Watts

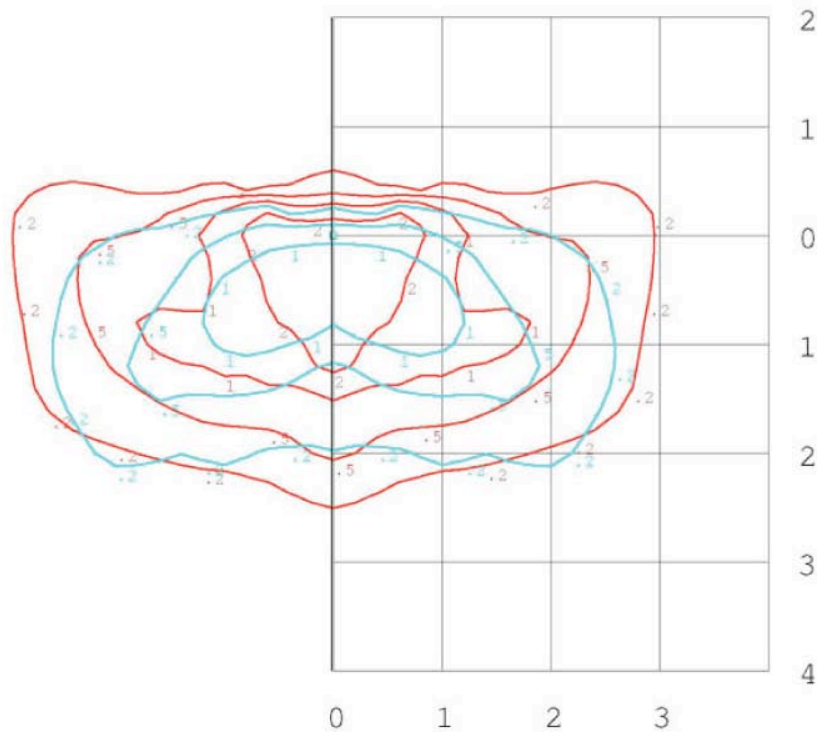


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“Mean” Lumen Output at:
6,000 Hours for 70W PSMH - Approx. 90 Total Watts
25,000 Hours for 60 LED Type III - Approx. 78 Total Watts



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10. In general, we find that lighting layouts using BetaLED fixtures reduce energy by 50% compared to HID sources. With this energy savings we are able to improve minimum light levels as well as significantly improve uniformity ratios. This is because of higher total luminaire efficacy as well as improved uniformity and better light control. The result is a better quality lighting environment with improved visibility.

11. Beta Lighting made the decision two years ago that LED was the future. We have responded quickly to develop unique technology that allows LED lighting to work most effectively. We have applied for more than 100 patents to protect our intellectual property and enable us to maintain our industry leadership position.



12. We agree with Kim that LED is the future, but it is also clear that LED is the answer for a large percentage of today's projects. The Gallery section on <http://www.betaled.com/gallery.htm> clearly demonstrates many excellent examples of how our customers are finding LED lighting to be the right solution – TODAY.

13. Beta Lighting is a major HID manufacturer. We have shifted our R&D efforts exclusively to LED products because we believe that tube type lamp sources will quickly be replaced by solid state light sources.

Beta Lighting agrees with KIM in that many manufacturers are producing products that do not meet marketed performance. In fact, many choose not to market performance that is generated or backed up by independent testing laboratories or independent studies. Beta Lighting does both.

For more information, applications, IES files and information about LED technology visit www.BetaLED.com.