

Solid State Lighting (SSL) Rewards and Risk Management

Lighting Designer's Perspective

Illuminart
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Solid State Lighting (LED's) is a rapidly changing technology that is revolutionizing lighting. While LED systems provide many features and benefits; a rush to the marketplace combined with enthusiastic sales efforts has neglected to address many important factors that should be considered when using LEDs.

This document is provided to bring our perspective as independent design professionals to help our industry become more aware of the important issues when considering (and comparing) Solid State Lighting.

Illuminart has been actively involved in educational and research programs involving LED systems:

2008:

Lighting Designer Roundtable on Solid State Lighting Two one-day conversations on the pros and cons of LED technology with select industry professionals

Next Generation Luminaire Design Competition (NGLDC.ORG)

A three-day survey of dozens of LED products submitted by manufacturers and surveyed by International Association of Lighting Designers (IALD) professional lighting designers, as well as other industry design professionals on a variety of criteria, with the most important one being lighting quality.

2009:

Strategies In Light Conference

The SSL industry annual education conference and trade show.

Next Generation Luminaire Design Competition

2011:

Next Generation Luminaire Design Competition

2012:

IES Product Innovation Awards

Evaluated approximately 500 submissions of fixtures and lighting components.

Next Generation Luminaire Design Competition

2013:

DOE CALiPER LED Roundtable

Two days of conversations regarding the status of the LED industry, as well as the most current standards available from the Environmental Protection Agency (EPA) Energy Star program, the US Department of Energy (DOE) Lighting Facts labels, DesignLights Consortium (DLC) certification, etc.

IES Testing Procedures Committee

New membership with the IES Testing Procedures Committee to become informed of the most current testing standards available for integrators and specifiers.

Next Generation Luminaire Design Competition

Most of us have learned of the benefits that LED lighting technology provides. They include:

- Compact-size format
- Low connected load
- Relatively high efficiency
- Color changing ability
- No UV (ultraviolet radiation)
- Long life/reduced maintenance
- Vibration resistant
- Cold temperature operation
- Daisy chain of fixtures with low voltage connectors



There are some issues and concerns that are important to note when considering the use and specification of LED technology. Here is a summary of these issues:

- Definition – Is this a lamp or system? When we speak of LEDs and their lamp life for instance, we must remember that the LED is one part of a three part system: the LED, its driver (power supply), and a thermal management system. All may affect long term performance, and need to be surveyed for consideration.
- Standardization of published data or a set of guidelines is needed: Specification and performance information often varies from manufacturer to manufacturer, including information on color temperature, Color Rendering Index (CRI), dimming capability, ambient temperature rating, or photometrics. Testing standards are established in LM-79 for photometry and color, and LM-80 for emitter lumen depreciation, but there is not an IES established test standard for entire-luminaire system life and performance.
- Truth in advertising or false expectations – Sales information from *some* manufacturers does not reveal proper applications for the product--how it is to be used, what its limitations are, accurate lamp life (independently tested based on IES standards), or photometric reports (see page 7). It is important for the specifier to become as well informed as possible regarding the technology, including asking to see samples of the product to verify performance.
- Rapid pace of change (Haitz Law)– LED are evolving very quickly. Color, efficiency, size, optics, systems engineering, and price points are improving monthly. Will the system you specify now be replaced by a better one in six months? Will the same product be available in two years if the system needs to be expanded? If not, then what?
- Parts Availability – Will matching replacement parts be available? Will the manufacturer support this over the next 10 years?

- Maintenance and contract issues – What is the plan for long term maintenance if it is needed? Does the manufacturer offer a maintenance program? Can maintenance be provided by the owner's staff? Is training available? What if a driver fails? Are all of the parts easily serviceable? Can the system be upgraded with new technology as it is released?
- Color compatibility – For color consistency, LEDs are manufactured in large quantities called 'bins'. If additional systems or replacement LEDs are needed in the future, will the color from a new bin be the same? LEDs should adhere to the American National Standards Institute (ANSI) Chromaticity standard (C78.377– currently) to ensure consistent color temperature.
- Initial cost and ROI – LED technology is currently much more expensive than most conventional lighting technologies. Independent life cycle cost analysis reveals that the ROI may be much longer than when it is provided by a sales company or manufacturer. Do your own analysis. Be sure to consider rising costs of electricity, the cost of money, markups by to the product by suppliers and costs of labor in basic maintenance.
- Specifiers risk and potential long term warranty liability – One of the most important questions is, what is the product warranty? The rated life for a Light Emitting Diode should only be claimed as 36,000–60,000 hours (6x the duration of testing data from the LM–80 report). It is only one part of the 'system'. LEDs save energy and eventually, the initial cost is returned in energy savings. However, what if the system fails before then? What if the failure is catastrophic, and all of the products in a large installation begin to fail? Who will pay for this? The individual(s) who brought the idea to the project? Will the contractor pay because they 'value engineered' the job? What if the manufacturer does not offer that product 5 years later? Will the specified manufacturer be in business at that time?



The US Department of Energy CALiPER



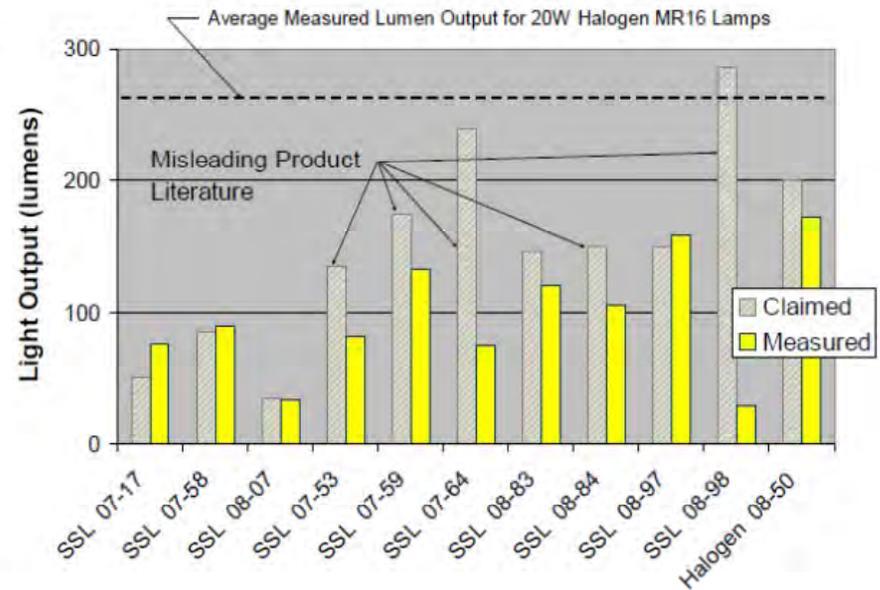
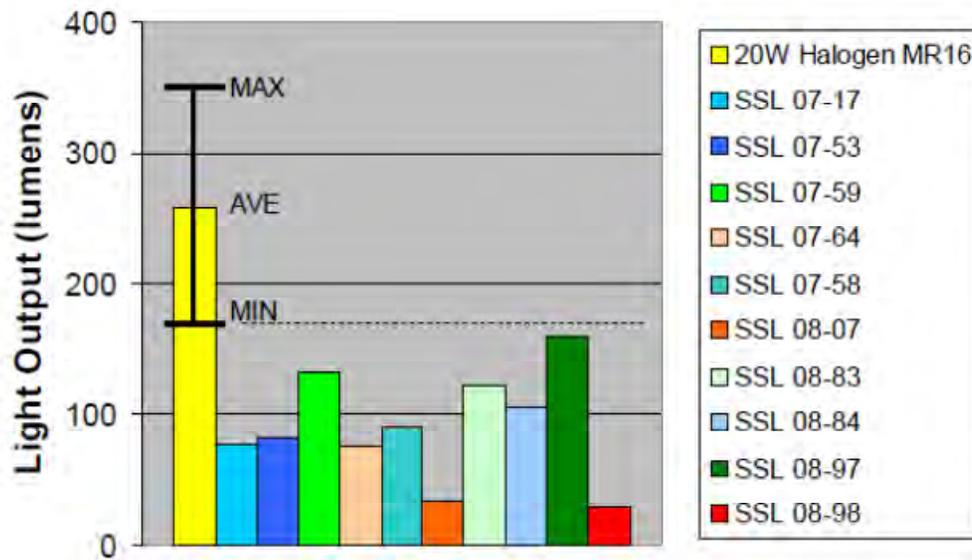
The DOE has placed the CALiPER program; Commercially Available LED Product Evaluation and Reporting, on their website, available for public use. This is a program that independently tests and publishes unbiased information on the performance of commercially available SSL products. Products are obtained independent of the manufacturer, tested, and then the results are compared to the manufacturer's claims. While some manufacturers' published data is found to be accurate, others' data is inaccurate.

The test results guide DOE planning for ENERGY STAR and technology procurement activities, provide objective product performance information to the public, and inform the development and refinement of standards and test procedures for SSL products. It works like a 'Consumers' Report' for users and specifiers of LED products.

The DOE recognizes the long term potential of SSL technology to dramatically reduce future energy consumption from lighting systems. They are also concerned, however, that the users have a 'positive' experience with the technology, and that their expectations are realized. Therefore, they are doing what they can to help inform consumers and specifiers of the many issues critical to the success of the programs.

The next three slides illustrate some of the product information available on the DOE website. We encourage you to visit it often to gain knowledge of solid state lighting.

Here is an example of recent CALiPER findings LED Retrofit Lamps - MR16



- CALiPER testing data has been released for 10 different MR16 replacement lamps that were evaluated
- The output and product data of most MR16 replacement lamps fell well short of the manufacturers claims
- All produced less light than the lowest output 20W MR16

LED Basics

LED technology continues to develop rapidly as a general light source. As more LED products and light fixtures are introduced on the market, what do retailers, energy efficiency advocates, and consumers need to know to make informed buying decisions?



LED Application Series:

Using LEDs to Their Best Advantage

LEDs are often touted for energy efficiency and long life. While these are important considerations, lighting selection is based on many other factors as well. This fact sheet explores some of the unique attributes of LEDs, which may make them the right choice for some applications.

How do building owners, facility managers, and lighting specifiers choose



LED Application Series:

Residential Recessed Downlights

Recessed downlights are the most commonly installed type of lighting fixture in residential new construction. New developments in LED technology and luminaire design may enable significant energy savings in this application. This fact sheet compares the energy and lighting performance of downlights using different light sources.



Color Quality of White LEDs

Color quality has been one of the key challenges facing white light-emitting diodes (LEDs) as a general light source. This fact sheet reviews the basics regarding light and color and summarizes the most important color issues related to white light LEDs, including recent advances.

Correlated Color Temperature (CCT)

CCT describes the relative color appearance of a white light source, indicating whether it appears more yellow/gold or more blue, in terms

12000K

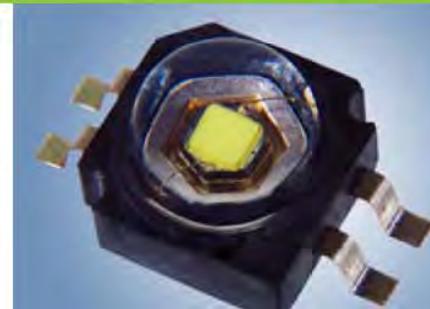
7000K

4000K

Thermal Management of White LEDs

LEDs won't burn your hand like some light sources, but they do produce heat. In fact, thermal management is arguably the most important aspect of successful LED system design. This fact sheet reviews the role of heat in LED performance and methods for managing it.

All light sources convert electric power into radiant energy and heat in various proportions. Incandescent lamps emit primarily infrared (IR), with a small amount of visible light. Fluorescent

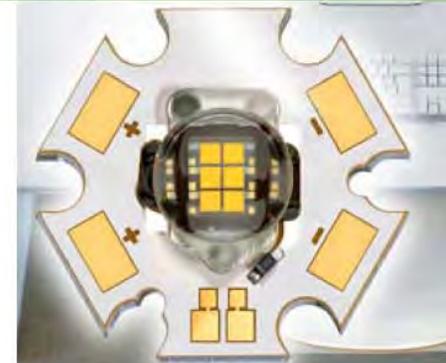


Lifetime of White LEDs

One of the main "selling points" of LEDs is their potentially very long life. Do they really last 50,000 hours or even 100,000 hours? This fact sheet discusses lumen depreciation, measurement of LED useful life, and the features to look for in evaluating LED products.

Lumen Depreciation

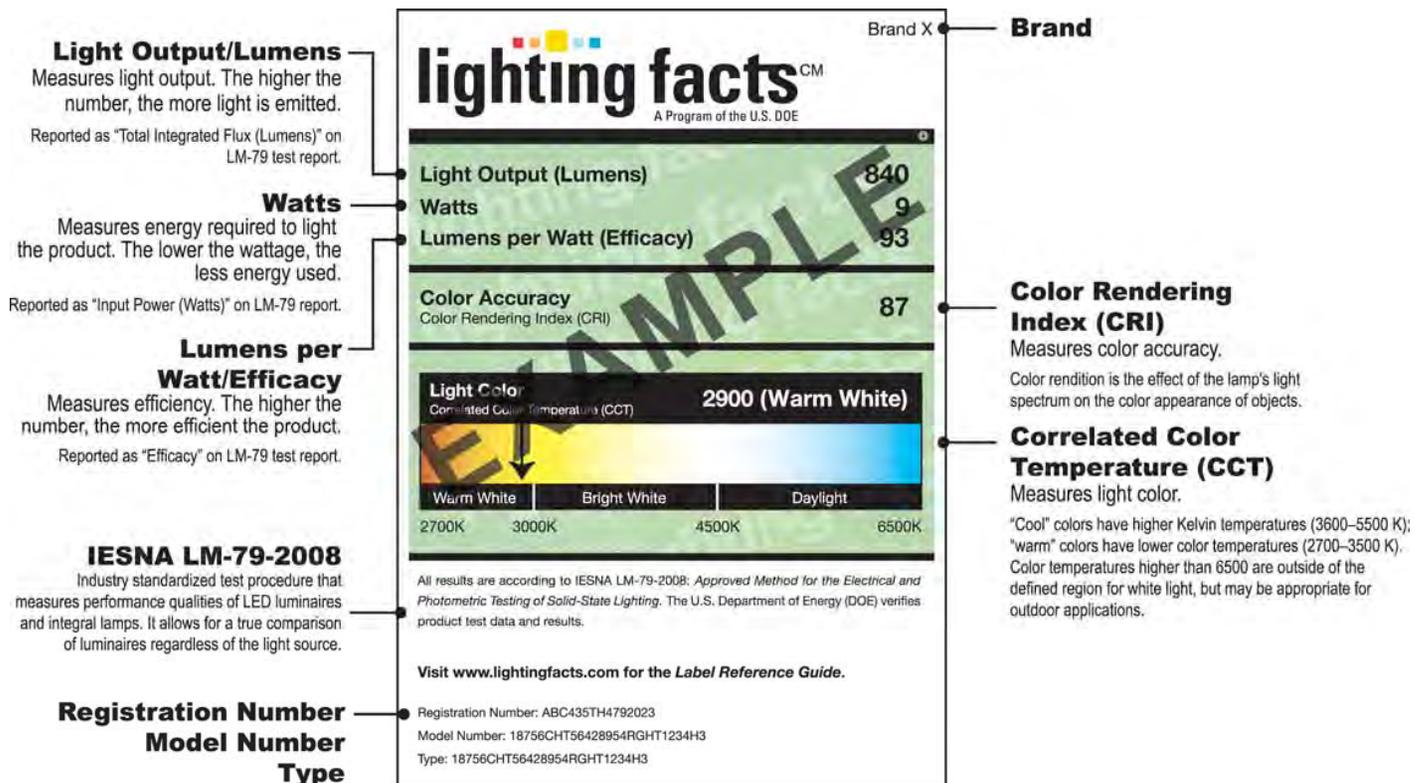
All electric light sources experience a decrease in the amount of light they emit over time, a process known as lumen depreciation. Incandescent filaments evaporate over time and the tungsten particles collect on the bulb wall. This typically results in 10-15% depreciation



Look for this label when specifying LED products

Jointly developed by DOE and the Next Generation Lighting Industry Alliance (NGLIA), SSL Quality Advocates is a voluntary pledge program to assure that LED lighting, as it reaches the market, is represented accurately. Encouraging the development of high-quality products that perform as claimed is essential to buyer satisfaction and will help drive market acceptance of solid-state lighting (SSL) products. SSL Quality Advocates pledge to use the Lighting Facts label, similar to a nutrition label. The Lighting Facts label provides a quick and simple summary of product performance data as measured by the new industry standard for testing photometric performance, IES LM-79-2008

<http://www1.eere.energy.gov/buildings/ssl/advocates.html>



When specifying LED's, consider the following

1. Whose LED emitters are used? Can you get a bill of materials to verify that the testing data is for the emitters claimed?
2. Verify Lumen Depreciation. Is the product LM80 tested? What was the result? Ask to see the TM21 report that helps extrapolate the LM80 testing data into a user-friendly format just to get an idea how long the emitter should last (note: this test is for emitters only, there is no full-system test equivalent yet)
3. Can it be dimmed? What is the dimming range? What is the dimming method?
4. What is the warranty? Is there an extended warranty? Does the warranty include labor costs?
5. Does the manufacturer have longevity in the industry or is it a startup? Will they be around if there are product failures?
6. How will they address replacement components over time? Is the product upgradeable with new technology components?
7. Will the manufacturer warranty color consistency over time? If not, how will this be addressed?
8. Is the fixture LM79 tested? Do they have an current IES file?
9. What is the BUG (Backlight/Uplight/Glare) rating for exterior LED fixtures?
10. What is the ambient temperature range suitable for the fixture? How does that relate to the environment you're specifying it for?
11. Quality: Is the fixture:
 1. UL Listed
 2. DLC Certified
 3. Energy Star rated
 4. ANSI C78.377 compliant (relates to "binning" and color consistency)

Conclusion

When specifying LEDs, Illuminart recommends that you:

1. Do not rely only on published product information. Verify that testing was provided using LM-79 or LM-80 standards.
2. Carefully survey product samples and do mockups
3. Discuss and establish a long term warranty solutions.
4. Specify only reputable manufacturers
5. Write specifications to manage initial cost to the project.
6. Do not allow 'value engineering' once you have a reputable product specified.
7. Be sure that there is user training for future programming or maintenance services
8. Run photometric calculations to verify manufacturers claim for lumen output and optics (distribution)
9. Do not use LED retrofit lamps in incandescent housing for new construction unless you can verify that both are UL listed for that application



We hope you have found this information valuable. Consider contacting Illuminart to help you with design consulting, particularly on projects for which the owner considers lighting to be an important part of the project design.

The many services we offer include:

- Comprehensive lighting design
- Audio Video Design Services
- Initial budget planning
- Daylighting design and integration
- Control systems
- Electrical design layout
- Decorative or custom lighting
- Life cycle cost analysis
- Photometric studies
- Stage, video, and special effects
- Equipment cost management
- Energy management studies
- LED specialists
- Detailed equipment specifications
- Supplier sourcing consulting
- Computer renderings of lighting
- Educational seminars
- Lunch and learn events

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