

# What Can Performance Testing Do For Your Solid-State Lighting Products?



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## Growth and Adoption of Solid-State Lighting Technology and Applications Continues

Solid-state lighting products have experienced rapid expansion into virtually all sectors of the lighting industry, including:

- Automotive Interior & Exterior Lighting
- Airport Lighting
- Traffic Signaling Devices
- Residential & Commercial Lighting
- Architectural Lighting
- Signs and Displays
- Backlighting Applications
- Street Lighting
- Flashlights
- Marine Lighting
- Landscape Lighting

The continuing evolution of solid-state lighting has been driven by ever-present market factors such as improved energy efficiency, increased product life, reduction of maintenance costs, and lessening environmental impacts.

These market drivers have generated a desire for energy-efficient products such as solid-state lighting, but before a full-scale industry transformation can take place, it is necessary to prove that the product performance characteristics of solid-state lighting products will meet or exceed those of traditional lighting technologies.

Initially, the lack of industry-accepted solid-state lighting measurement techniques allowed for the presentation of inconsistent data to the marketplace and consumers. Often times, manufacturers' marketing claims did not live up to expectations, leaving consumers feeling cheated or misled.

Key issues that have lead to inconsistent data in the past include:

- LED Warm-up or Stabilization Time
- Lack of Standardized Photometry Test Methods
- Lack of Lumen Maintenance and Life Test Protocols

The transportation lighting sector was the first market segment to broadly utilize solid-state lighting in various applications such as automotive and traffic signal lighting. Many existing industry standards only addressed the minimum performance requirements for traditional light sources, leaving industry and standards writing organizations scrambling to revise and edit existing specifications and test methods to include solid-state lighting products.

The general illumination sector has been slower to adopt solid-state lighting, as the technology simply hasn't matured to the point where the performance characteristics would allow for full-scale adoption of these product types. However, continued improvement in technology, along with the creation and adoption of new test methods and specifications, is quickly positioning the products in this market sector for explosive growth.

## What Drove Standards Development?

The need for uniform standards and test methods, allowing the flow of consistent product performance data to the market was needed, specifically for the following four performance characteristics:

- *Energy-Efficiency:* Solid-state lighting products must provide a distinct advantage over current fluorescent, halogen, or incandescent technologies.
- *Color:* Different color temperatures are required based on the specific intended application for various lighting products. Solid-state lighting must adapt to currently utilized color temperature characteristics from traditional light sources to gain consumer approval.

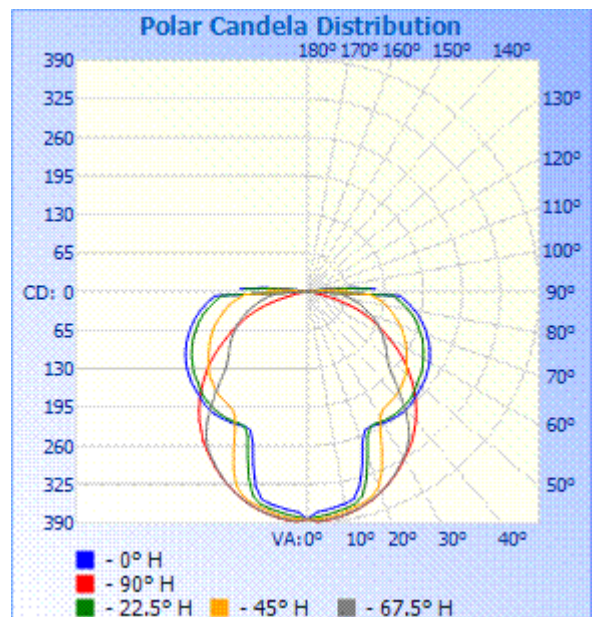
- *Thermal Management of LED's:* Heat dissipation and proper thermal management techniques are required for solid-state lighting to minimize potential performance degradation and reliability issues that could adversely affect Lumen Output, Efficacy, Lumen Maintenance, and Life of the product.
- *Lumen Maintenance & Life:* Consistent testing to determine how quickly lumens depreciate over time, as well as the true product longevity was needed to effectively evaluate solid-state lighting products.

## What Specific Standards & Programs Have Been Developed?

In 2008, the Illuminating Engineering Society of North America (IESNA) published two long-awaited standards in support of solid-state lighting:

*IESNA LM-79-08 Approved Method for Electrical and Photometric Measurements of Solid-State Lighting Products* applies to both LED Luminaires and LED Light Sources to be used in retrofit or replacement scenarios. Specific requirements are stated with respect to important test parameters such as ambient conditions, power supply characteristics, product stabilization time, and operating orientation. Typical measurements include:

- Total Luminous Flux
- Electricals (Input Voltage, Current, & Power)
- Luminous Intensity Distribution
- Color
  - Chromaticity
  - Correlated Color Temperature
  - Color Rendering Index
- Spectral Power Distribution



Traditional photometry test methods employ what is referred to as “Relative Photometry,” which produces data that relates the rated lumen output of the individual lamp or light source alone and again as used inside the luminaire. Because it is often difficult to remove the specific LED array from a Solid-State Luminaire, the IES LM-79 Test procedure utilizes what is referred to as “Absolute Photometry,” which is centered around the photometric testing of the entire Luminaire. Actual intensity values generated by the entire luminaire are recorded in candlepower (candelas), and are not relative to a particular rated lumen output produced by the source.

*IESNA LM-80-08 Approved Method for Measuring Lumen Maintenance of LED Light Sources* details specifics with regard to measuring the Lumen Depreciation of LED Arrays and LED Modules. This test method does is not intended for solid-state luminaires. This test method also takes into consideration the impact that varying temperatures may have upon the lumen depreciation of the LED Array or Module.

Other solid-state lighting product performance testing specifications have been developed by other industry organizations for specific applications including:

- Automotive Lighting - Society of Automotive Engineers (SAE)
- Traffic Signaling Devices - Institute of Transportation Engineers (ITE)
- Airport Lighting Products – Federal Aviation Administration (FAA)

In 2008, there was much activity surrounding manufacturers interested in obtaining ENERGY STAR approval for their solid-state lighting products. Currently there are two options that manufacturers may consider depending upon their product type:

- *U.S. Department of Energy (DOE) Solid-State Lighting Luminaire Program* which has established application specific criteria for definitive types of solid-state lighting products. The scope of the criteria will be reviewed and expanded at regular intervals as needed.
- *U.S. Environmental Protection Agency (EPA)* expanded the scope of their existing Residential Light Fixture Program to allow qualification of decorative fixtures that utilize LED Light Engines.



## Ingress Protection Testing

For solid-state lighting products that may be employed outdoors or be subjected to varying degrees of moisture and dust intrusion, many purchasers and specifiers of lighting products want to ensure that these products and their enclosure will meet the certain Ingress Protection rating requirements that are detailed in IEC 60529. A specific product's IP rating may be determined by testing to the following combinations of dust and moisture:

### First Number (Dust)

IP 0x – No Protection  
IP 1x - Objects > 50mm  
IP 2x - Objects > 12mm  
IP 3x - Objects > 2.5 mm  
IP 4x - Objects > 1 mm  
IP 5x - Dust Protected (Vacuum)  
IP 5x - Dust Protected (Non-Vacuum)  
IP 6x - Dust Tight

### Second Number (Moisture)

IP x0 - No Protection  
IP x1 - Vertically Dripping Water  
IP x2 - 75 to 90 Degrees Dripping Water  
IP x3 - Sprayed Water  
IP x4 - Splashed Water  
IP x5 - Water Jets  
IP x6 - Powerful Water Jets  
IP x7 - Effects of Immersion  
IP x8 - Indefinite Immersion

## Performance Testing is Critical for Solid-State Lighting

As the lighting industry continues to develop new applications for solid-state lighting, especially in the area of general illumination, it will become increasingly important to prove that this technology can provide all of the benefits that consumers, end-users, and utilities seek without sacrificing performance in comparison to existing technology.

The continuing evolution of new product standards and performance testing will play a critical role in the success of the expansion and transition to solid-state lighting. At every juncture of the product life cycle, from design to implementation, manufacturers need to consider the value of performance testing and how it can be of benefit.



Conducting performance testing can be beneficial in many ways including:

- Improving overall product quality
- Distinguishing your product in a competitive market
- Minimizing product failures
- Minimizing warranty issues
- Increasing consumer confidence in your product(s)
- **SAVING MONEY!!!!!!** (No Re-Tooling, Re-Design, Packaging, Shipping, Handling)

*Intertek offers a wide variety of Performance Testing services, including luminaire photometry, environmental testing, accelerated stress testing, materials testing and failure analysis. For more information on how your organization can implement Performance Testing or for a quote, please contact [icenter@intertek.com](mailto:icenter@intertek.com) or call 1-800-WORLDLAB.*