Understanding Today’s Energy-Efficient Lighting Certification Programs & Initiatives

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Table of Contents

Introduction ............................................................................................................ 1
The Growth of Energy-Efficient Lighting Certification Programs & Initiatives....... 2
Current Programs and Performance Initiatives ...................................................... 6
The Critical Role of Third-Party Testing Laboratories ............................................. 9
Summary ............................................................................................................. 10
About Intertek ...................................................................................................... 10

Appendices.......................................................................................................... 11
Introduction

The Energy Policy and Conservation Act of 1975 and its subsequent amendments established minimum efficiency standards for lighting products. These minimum efficiency standards, as well as recently-proposed penalties (including product holds, recalls, and/or fines) that the Department of Energy (DOE)/Customs and Border Protection (CBP)/Federal Trade Commission (FTC) have threatened to incur in the event of a manufacturer’s non-compliance (as publicized in the DOE’s Notice of Proposed Rulemaking, issued on March 26th, 2012) were discussed at length in Intertek’s August 2012 white paper entitled Understanding the DOE Announcement of Compliance and Enforcement: The Definitive Q&A Guide for Lighting Products.

While the DOE’s mandatory energy efficiency standards and recently-heightened surveillance efforts are designed to ensure manufacturers’ compliance with minimum U.S. energy efficiency requirements, they do not account for all of the “green” lighting certification programs and initiatives active in the U.S. and Canadian markets today. A number of other voluntary initiatives – including the EPA’s ENERGY STAR® lighting certification program, the Lighting Facts labeling and packaging standard, and energy-efficient lighting initiatives by such organizations as DesignLights Consortium (DLC), the California Energy Commission (CEC), National Resources Canada (NRCan), and the Municipal Solid-State Street Lighting Consortium (MSSL) – are enabling energy-saving lighting products to meet additional and targeted sets of efficiency standards. Products that comply with these standards can qualify for use in high-efficiency applications and cutting-edge/showcase upgrade projects, as well as become eligible for rebate in a number of leading utility incentive programs throughout the country. Overall, compliance with these voluntary programs can be a significant source of differentiation, revenue, leadership, promotion, and pride for lighting manufacturers today and a compelling reason for them to invest time and resources into the pursuit and achievement of these voluntary performance measures.

While these voluntary programs have different objectives and requirements, all involve precise measurement and unique submission requirements to assure compliance with their requirements by a skilled and accredited third-party tester. This paper will discuss the range of voluntary energy-efficient lighting certification programs and initiatives in the U.S. market today. It will also explore the benefits that compliance with these initiatives can deliver to lighting manufacturers as well as the many ways in which an accredited third-party tester can help ensure the lighting manufacturing community’s successful compliance with these programs and initiatives and the subsequent security and peace of mind that lighting manufacturers can derive from this achievement.
The Growth of Energy-Efficient Lighting Certification Programs & Initiatives

The U.S. energy crisis of the 1970s was a key event that drew national attention to our country’s escalating consumption of energy against the reality of our finite and waning natural resources, a dichotomy which led to the growth of initiatives designed to improve energy efficiency and curb demand. As examples, the emergence of utility incentives on more energy-saving lighting technologies in the 1980s and 1990s helped shift market demand to higher-efficiency products, while legislative efforts such as the enactment of the federal Energy Independence and Security Act (EISA) of 2007 similarly helped to force a shift in the manufacture and use of more energy-efficient lighting technologies such as T8 and T5 fluorescent lamps, electronic ballasts, compact fluorescent lamps, electronic HID, induction lighting, and LEDs. Amidst America’s rising “green” consciousness, the DOE ultimately confirmed that the nation’s broad use of more energy-efficient lighting technology and subsequent conservation efforts could offset the need for as much as a third of our electricity requirements going forward, enhancing our degree of both energy independence and global competitiveness.

Such economic, legislative, and societal forces helped spur additional investments in R&D and advances in lighting technology, which have all led to recent improvements in fluorescent, halogen, and HID technology. From this also came the growth and rapid evolution of solid-state lighting and LED technology, one of the lighting industry’s most promising new technologies regarding its potential for energy savings. As part of its evolution, LEDs and their many component parts have amassed a growing list of considerations and requirements from a variety of vested stakeholders (see diagram below). These considerations range from performance standards related to distribution, color, and longevity, to operating requirements in unique locales such as roadways and hazard locations, as well as compatibility with specific lighting controls and adherence to FCC electronic noise standards; some of these issues apply to other lighting technologies as well.

* Among other directives, the federal Energy Independence and Security Act (EISA) of 2007 mandated the outlaw of incandescent lamp production beginning in 2011/2012; other legislative forces driving the adoption of energy-efficient electrical products include the 2005 Energy Policy Act’s “Commercial Buildings Tax Deduction,” which provides tax credits to companies who install qualifying products by December 31st, 2013.
Overall, the growth and increasing variety of energy-efficient lighting products over the past two decades has led to the development of numerous voluntary certification programs and initiatives designed to measure and reflect their performance and efficiency. Today, compliance with any or all of these voluntary programs can be a significant source of differentiation, revenue, leadership, promotion, and pride for lighting manufacturers - factors which represent compelling reasons for manufacturers to invest time and resources into the pursuit and achievement of these voluntary standards.
Performance Testing for Lighting Products
While reputable manufacturers typically participate in mandatory safety testing to enable their products’ retail sale in recognized establishments, performance testing is not mandatory for installation. Instead, it addresses how a product will perform when used by a consumer. Throughout the lighting industry, comprehensive performance testing typically consists of assessments in three different, universally-accepted areas: distribution, color, and stress/longevity.

- **Distribution Testing** – this type of performance testing measures the light pattern out of a fixture or its total light output at all different angles. For all light sources, the most accurate means of measuring a light’s distribution is through the use of a Type-C Goniometer, a 30-foot-high piece of equipment used to test most residential and commercial lighting products while enabling fixtures to rotate in a horizontal plane to measure their entire light distribution. IES standard LM-63 specifies how the results of a distribution test should be formatted and will typically require a text file showing all lighting values at each angle.

- **Color Testing** – this type of performance testing measures the energy of light at each wavelength and is used to calculate color temperature. The most accurate means of measuring a light’s color is through the use of an *Integrating Sphere-Spectrometer system*, a specially-coated apparatus most commonly available in 1, 2, and 3-meter sizes which collects a light’s energy and measures it at all wavelengths. Typically measurements with such systems include lumen or brightness level, correlated color temperature (CCT) in Kelvins ranging from 2700-6500 for consumers, color rendering index (CRI), which measures how “true” a color looks under the subject lighting, and such other performance measures as chromaticity, which is a coordinate mapping of the light’s color.

- **Stress and Longevity Testing** – one key means of measuring a light’s lifespan is by testing it on a specially-designed and controlled piece of equipment known as a *Life Test Rack*. These long racks can provide up to thousands of sockets that measure the longevity and durability of the market’s broad range of lamp types in different orientations (base up, down, or horizontal) and in different ambient conditions. For LEDs, the use of IES standard LM-80 measures the individual chips that make up the lamps or fixtures; they are typically burned for 6,000 hours to determine how much their light output degrades at different levels (according to this standard, an LED would fail a stress/longevity test if its light output at 6,000 hours fell below 70% of its initial output). In contrast, a *Surge Generator* is a key piece of equipment used in the testing of stress and is typically applied to the testing of compact fluorescent and LED lamps as well as ballasts.
used in linear fluorescent lamps. This equipment tests to ensure that lamp samples can withstand a ringwave or combination surge waveform without sparking or failing.

**Standards vs. Specifications**

As shown in Appendix 1, “standards” identify recommended ways to perform a test and are measured by a passing or failing score, while “specifications” identify specific minimum criteria and include minimum levels.

The Illuminating Engineering Society issues Light Measurement guides (LMs), Technical Memorandums (TMs), and Recommended Practices (RPs). New standards governing the performance of LEDs, as well as guidelines on how to test them, include:

- LM-79 – involving electrical and photometric measurements
- LM-80 – involving lumen maintenance
- LM-82 – involving the quantification of the performance of LED light engines and integrated lamps over time

For more information on these tests, see Appendix 2.
Current Programs and Performance Initiatives

Separate from the DOE’s mandated minimum energy efficiency standards, the growth of the energy-efficient lighting market has triggered the development of a number of voluntary energy-efficient lighting certification programs, performance initiatives, and labeling standards. Compliance with any or all of these can support a company’s sales and marketing objectives as well as enhance a product’s eligibility for use in high-efficiency applications and upgrade projects of distinction, as well as qualify for rebate in a number of leading utility incentive programs throughout the country. Following is an overview of some of the industry’s most popular voluntary energy-efficient lighting certification programs, performance initiatives, and labeling/packaging standards for lighting products in the U.S. and Canada.

Energy-Efficient Lighting Certification Programs

- **ENERGY STAR** – This EPA-sponsored certification program covers a variety of residential and light-commercial luminaires, lamps, light kits, and retrofit kits - particularly in the fluorescent and LED arena (previous standards in the halogen and HID technologies are currently being reviewed) - and aims to distinguish higher-efficiency products from standard or lower-performing ones. ENERGY STAR certification requires minimum performance standards in the three critical areas of Distribution, Color, and Longevity/Stress and all test data *must* be submitted through an EPA-Recognized Certification Body.

  “ENERGY STAR manufacturing partners must have products tested in EPA-recognized laboratories and certified by a Certification Body prior to labeling. All certified products will also be subject to ongoing verification testing and challenge testing as described in the Conditions and Criteria for Recognition of Certification Bodies. As part of EPA’s activities to maintain the integrity of ENERGY STAR, products that fail to meet ENERGY STAR requirements will be subject to EPA’s disqualification procedures.”

  Further details on the program are available at [www.energystar.gov](http://www.energystar.gov); links to current CFL and LED requirements for ENERGY STAR certification are shown below.†

Energy-Efficient Lighting Performance Initiatives

- **DesignLights Consortium (DLC)** – This voluntary initiative applies only to LED technology and typically covers the products not commonly comprehended by ENERGY STAR, such as high bays, wallpacks, cobra and pulse-style lighting for roadway fixtures, decorative LEDs, and LED panels for use in heavier commercial, industrial, or outdoor applications such as warehouses, manufacturing, and roadways. In addition, DLC is a

† ENERGY STAR CFL and LED certification requirements can be found at the following links: [www.energystar.gov/ia/partners/product规格s/program_reg/ENERGY_STAR_CFL_V4.3.pdf?4fdf-4418](http://www.energystar.gov/ia/partners/product规格s/program_reg/ENERGY_STAR_CFL_V4.3.pdf?4fdf-4418) and [www.energystar.gov/ia/partners/product规格s/program_reg/Integral_LED_Lamps_Program_Requirements.pdf?5c47-9563](http://www.energystar.gov/ia/partners/product规格s/program_reg/Integral_LED_Lamps_Program_Requirements.pdf?5c47-9563)
utility-based initiative in that it currently feeds some 40 utilities nationwide which base rebate programs around DLC standards.

Like ENERGY STAR, DLC certification requires minimum performance standards in the three critical areas of distribution, color, and longevity/stress, but, unlike ENERGY STAR, manufacturers must take responsibility for having their products tested by an accredited body and then must submit testing reports directly to the DLC.

More information on DLC can be found at www.designlights.org; current technical requirements can be accessed through the link shown below.‡

- **California Energy Commission (CEC)** – Established in 1974 and headquartered in Sacramento, the California Energy Commission is responsible for planning California’s energy policy and promoting energy efficiency through the development of building and product standards. CEC standards for lamps, controls, luminaires, and other lighting products address efficiency only, not distribution, color, or longevity/stress, though their standards for ballasts and portable luminaires do serve to differentiate them from other voluntary lighting performance initiatives. CEC certification is based on the meeting of stringent product standards which can render some products eligible for utility rebates in California and other states, and which also support California-specific Title 20 and Title 24 building code standards. Like the DLC, manufacturers must take responsibility for having their products tested by an accredited body and must then submit testing reports directly to the CEC.

The CEC website is located at www.energy.ca.gov. For more information on CEC testing requirements and performance standards for lighting, see the link below.§

- **National Resources Canada (NRCan)** – Addressing lighting product standards throughout Canada, NRCan is largely focused on performance measures related to efficiency and energy-using devices imported into Canada or shipped between provinces must bear an energy efficiency verification mark. Minimum standards are laid out in CSA Energy Efficiency Standards and the mark must be from an SCC (Standards Council of Canada) approved certification body. Lighting products covered under NRCan include ceiling fan lighting, compact fluorescent lamps (CFLs), exit signs, fluorescent lamp ballasts, general service fluorescent and incandescent lamps, torchieres, and traffic signals and pedestrian modules. ENERGY STAR is recognized in Canada, however, and ENERGY STAR testing (if applicable) can replace NRCan testing.

For more information on NRCan specifications, visit the link below.**

‡ DLC Technical requirements are available at www.designlights.org/solidstate.manufacturer.requirements.php.

§ For more information on CEC testing requirements and performance standards for lighting, visit www.energy.ca.gov/appliances/database/forms_instructions_cert/lighting

** For more information on NRCan specifications, visit http://oee.nrcan.gc.ca

www.intertek.com/lighting
- **Municipal Solid-State Street Lighting Consortium (MSSL)** – This specialized DOE-sponsored organization offers “technical information and experiences related to LED street and area lighting demonstrations and serves as an objective resource for evaluating new products on the market intended for street and area lighting applications.” MSSL testing is largely focused on measures of distribution, color, transient, vibration, corrosion protection, and longevity.

For more information on this organization or current standards/recommendations or standards in progress for this unique application, visit [www.eere.energy.gov/buildings/ssl/standards.html](http://www.eere.energy.gov/buildings/ssl/standards.html).

### Energy-Efficient Lighting Labeling and Packaging Standards

- **Lighting Facts Label** – Neither a certification program nor a standards-setting initiative, the DOE-sponsored Lighting Facts Label represents a new labeling standard that is currently mandatory on all packaging for screw-based replacement lamps (including incandescent, halogen, CFL, and LED models). Modeled after the “Nutrition Facts” label on modern food packages, the Lighting Facts Label provides information on a light’s brightness, energy cost, life expectancy, light appearance (warm or cool), and wattage, as well as whether it contains mercury. The label was designed to provide a uniform and user-friendly way for consumers to review product specifications and make comparisons between products. Note that of the three critical areas of distribution, color, and longevity/stress, the Lighting Facts Label includes only color-related values.

“`We want to help lighting users convert from the previous metric of ‘watts’ to one of ‘lumens’ so that the purchase decisions they make will be focused on the light output these lamps deliver and not on the power they consume, a reality which has often confused users and made it difficult for them to make comparisons between different lighting products at the point of sale,” according to DOE Spokesperson Jen Stutsman. The new FTC-sponsored Lighting Facts Label has subsequently been designed to help simplify and standardize the information shared on lighting product packaging and includes easy-to-understand metrics such as “Estimated Yearly Energy Cost,” “Lumens,” “Lifetime,” “Light Appearance (Temperature),” and “Energy Used” to enable more apples-to-apples comparisons between products. For more information on the Lighting Facts Label, visit [www.lightingfacts.com](http://www.lightingfacts.com).

Appendices 3-6 highlight details on all of these programs/initiatives and their specification requirements.
The Critical Role of Third-Party Testing Laboratories

Along with mandatory energy efficiency requirements established by the DOE, new voluntary energy-efficient lighting certification programs and performance initiatives run by such organizations as ENERGY STAR, DLC, CEC, NRCan, MSSL, and Lighting Facts involve specific standards and submission procedures which can be very tedious and precise to administer, but which are highly critical to a company’s growth and sales objectives.

While mandatory and voluntary energy-efficient lighting certification programs and performance initiatives can be very tedious and precise to administer, they’re highly critical to a company’s growth and sales objectives. Accredited third-party safety and performance testing organizations, like Intertek, can help take the guess-work out of the all-important process of testing and the pursuit and successful achievement of compliance.

In today’s fast-moving lighting industry, a number of issues can delay or derail a manufacturer’s efforts to achieve compliance with any or all of these programs or initiatives if undertaking their own “first-party” testing procedures. For example, the inability to structure appropriate and consistent, repeatable testing conditions could alter results, while the submission of an incorrect number of samples could render the submission invalid. In addition, technology, particularly in the LED arena, is changing quickly and manufacturers might find themselves challenged to keep up with the latest products and program requirements.

For all of these reasons and more, accredited third-party (external) safety and performance testing organizations, like Intertek, can help take the guess-work out of the all-important process of testing and the pursuit and successful achievement of compliance. Their possession of and investment in the highest-tech and most precise and capital-intensive testing equipment ensures consistent testing procedures and accurate results, while their demonstrated expertise in the unique details and current requirements of all industry certification programs and initiatives assures manufacturers of the utmost in quality coverage and representation. Along with the relationships they’ve established with all of the industry’s key certifying organizations over the years, a third-party testing lab’s exceptional understanding of and experience with the broad range of products and testing procedures in the rapidly-evolving lighting industry can proactively support a manufacturer’s compliance while delivering security and peace of mind to both manufacturers and customers alike.
Summary

The U.S. and Canadian markets have seen an increase in "green" lighting certification programs and initiatives over the years. The opportunity to differentiate one’s product on the market has led manufacturers to invest time and resources into the pursuit and achievement of these voluntary program performance measures. Now that you understanding the key requirements and history of each of these programs and initiatives, you may have a better grasp on how to qualify your product for use in high-efficiency applications, and to ensure eligibility for rebate in a number of leading utility incentive programs throughout the country. Get the most out of your compliance program when you partner with an accredited third-party testing lab that can help you navigate the requirements and development of these programs and initiatives.

About Intertek

Intertek is a leading provider of quality and safety solutions serving a wide range of industries around the world. From auditing and inspection, to testing, quality assurance and certification, Intertek people are dedicated to adding value to customers’ products and processes, supporting their success in the global marketplace. Intertek has the expertise, resources and global reach to support its customers through its network of more than 1,000 laboratories and offices and over 30,000 people in more than 100 countries around the world. Intertek Group plc (ITRK) is listed on the London Stock Exchange in the FTSE 100 index.

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   Telephone: 1-800-WORLDLAB
   Web: www.intertek.com/lighting

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Appendices

1: The following chart highlights the characteristics of a standard vs. a specification.

<table>
<thead>
<tr>
<th>Standards</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identifies recommended ways to perform the test</td>
<td>Identifies some specific minimum criteria</td>
</tr>
<tr>
<td>Certification standards will identify P/F criteria</td>
<td>Can vary from one specification to another</td>
</tr>
<tr>
<td>Typically standardized amongst labs.</td>
<td>Requirements can change at any given time</td>
</tr>
<tr>
<td>Standard frequency for revisions or new editions</td>
<td>Can reference a standard or have additional requirements by specifier</td>
</tr>
</tbody>
</table>

2: As shown below, the Illuminating Engineering Society of North America (IESNA) issues Light Measurement guides (LMs) and Technical Memorandums (TMs) to help establish performance standards for solid-state lighting.

<table>
<thead>
<tr>
<th>Standard</th>
<th>Title</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>IESNA LM-79-08</td>
<td>Electrical and Photometric Measurements of Solid-State Lighting Products</td>
<td>• Covers LED-based SSL products with control electronics and heat sink incorporated. • Does not cover LED chips, LED Packages • Absolute vs Relative photometry</td>
</tr>
<tr>
<td>IESNA LM-80-08</td>
<td>Measuring Lumen Maintenance of LED Light Sources</td>
<td>• Measurement of lumen maintenance testing for LED light sources</td>
</tr>
<tr>
<td>IESNA LM-82-12</td>
<td>Characterization of LED Light Engines and LED Lamps for Electrical and Photometric Properties as a Function of Temperature</td>
<td>• Quantifies the performance of LED Light engines and integrated lamp as function of time</td>
</tr>
<tr>
<td>IESNA TM-21</td>
<td>Projecting Long Term Lumen Maintenance of LED Light Sources</td>
<td>• Method for projecting lumen maintenance based on LM 80</td>
</tr>
</tbody>
</table>
3. The following matrix summarizes the key performance measures (distribution, color, and/or longevity/stress) addressed by five major energy-efficient lighting certification initiatives.

<table>
<thead>
<tr>
<th>Program</th>
<th>Distribution</th>
<th>Color</th>
<th>Longevity/Stress</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENERGY STAR®</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>DLC</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Lighting Facts</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>NRCAN</td>
<td>X (Reflector Lamps)</td>
<td>X (Efficiency)</td>
<td></td>
</tr>
<tr>
<td>CEC</td>
<td></td>
<td>X (Efficiency)</td>
<td></td>
</tr>
</tbody>
</table>

4: According to the matrix below, the six major energy-efficient lighting certification initiatives measure LEDs using a variety of difference performance criteria related to distribution, color, efficacy, and stress/longevity.

<table>
<thead>
<tr>
<th>Program</th>
<th>Allowable CCT</th>
<th>L70 Lumen Maintenance</th>
<th>Minimum CRI</th>
<th>Minimum Light Output</th>
<th>Minimum Efficacy</th>
<th>Vibration</th>
<th>Transient</th>
<th>Warranty</th>
<th>Zonal Lumen Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEC</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>DLC</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Energy Star</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Lighting Facts</td>
<td>YES</td>
<td>YES*</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>YES*</td>
<td>NO</td>
</tr>
<tr>
<td>MSSL</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>NRCAN</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
</tbody>
</table>

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5: The following matrix outlines objectives and specifications for several lighting products covered by energy-efficient certification initiatives ENERGY STAR, DLC, and MSSL.

<table>
<thead>
<tr>
<th>Specification</th>
<th>Title</th>
<th>Comments</th>
</tr>
</thead>
</table>
| ENERGY STAR® Luminaires V1.1| Program Requirements Product Specifications for Luminaires            | • Primarily for residential products but does cover some products used in both residential and commercial applications.  
  • New standard effective April 1, 2012*                                    |
| ENERGY STAR® LED Lamps      | Program Requirements for Integral LED Lamps                           | • For SSL Lamps.                                                            
  • New standard pending for all lamps                                      |
| ENERGY STAR® CFL Lamps      | Program Requirements for Compact Fluorescent Lamps (CFLs)            | • For CFL Lamps.                                                            
  • New standard pending for all lamps                                      |
| DLC Category Specifications V1.6| DLC Category Specifications V1.6                                  | • Specifies minimum light performance values and warranty requirements    |
| MSSL                        | Model Specifications for LED Roadway Luminaires                       | • Identifies minimum requirements for roadway luminaires. Includes requirements beyond photometrics |

NOTE: The above represents the typical standards used. There are other industry standards (ANSI, ASTM, IEEE, NEMA, etc.) that are used during an evaluation of LED Lighting Product.

6: While these voluntary programs have different objectives and requirements, all involve precise measurement and unique submission requirements to assure compliance with their requirements by a skilled and accredited third-party tester. As shown by the following matrix, all of the major energy-efficient lighting certification initiatives require some degree of first or third party performance testing.