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Manufacturer Submission Checklist

Prequalification Activities

1. Sign up as a Partner.
   - Read and understand the Program Requirements.
   - Read and understand the ENERGY STAR criteria for SSL Luminaires.
   - Fill out Partnership Agreement and send to ssl@drintl.com.
   - Read and understand the SSL Manufacturer’s Guide.

2. Find approved laboratories to test your products.
   - Photometric Testing, LM-79 Testing – *Laboratory must hold NVLAP accreditation for the LM-79-08 test procedure or must be qualified, verified, and recognized through the U.S. Department of Energy (DOE)’s CALiPER program.*
   - In-Situ Temperature Measurement Test (ISTMT) – *Laboratory must be approved by OSHA as a Nationally Recognized Testing Lab (NRTL), must be qualified, verified, and recognized through DOE’s CALiPER program, or must be recognized through UL’s Data Acceptance Program.*
     - For hardwired products, ISTMT must be conducted with the luminaire installed in the appropriate application as defined by ANSI/UL 1598.
     - For corded products, use ANSI/UL 153.
   - Lumen Maintenance Testing, LM-80 Testing – *Provided by LED package, array, or module manufacturer.*

3. Create a “Product Group”
   - If you are submitting more than one version of a product, choose one model for testing that represents a group of products. It must represent other group members within allowable variations identified in Table 1 and be consistent with additional product group guidance in Attachment A.

4. Submit 1 sample of the representative model for testing to each of the following:
   - DOE CALiPER qualified labs – test for luminaire efficacy, light output, zonal lumen density, color rendering index, correlated color temperature, color spatial uniformity (if available), and optionally, lumen maintenance and color maintenance. (See lumen maintenance test options in Table 2.)
   - OSHA approved NRTLs or Laboratory qualified, verified, and recognized through DOE’s CALiPER program or Laboratory recognized through UL’s Data Acceptance Program – conduct In Situ Temperature Measurement Testing.
   - Independent or manufacturer-based testing laboratory – test for output operating frequency, noise, electromagnetic and radio frequency interference, transient protection, and for outdoor products, minimum operation temperature.

Submission Process

1. Sign in to your My ENERGY STAR Account (MESA).
   - To obtain a username and password, you must sign up as a partner.

3. Enter product information.
   - Required Documentation to upload into on-line tool:
     A. IESNA LM-79-08 Photometric (Goniophotometry) Test Report (Formatted to LM-63-03)
     B. IESNA LM-79-08 Integrating Sphere Output Report
     C. For Lumen Maintenance, use either:
        Option 1 – Component Performance
        - LED Package Manufacturer LM-80 Test Report with results showing relative light output over time
        - In situ temperature measurement test (ISTMT) showing measured TMP<sub>LED</sub>
        - Diagram or photograph of the Temperature Measurement Points for the package, array or module
        Option 2 – Luminaire Performance
        - IESNA LM-79-08 Test Report at time = 0 and 6,000 hours respectively.
     D. For Power Supply (the ISTMT typically includes these results)
        - In situ temperature measurement test showing measured TMP<sub>PS</sub>
        - Diagram or photograph of the Temperature Measurement Point for the power source
     E. Warranty
   - Documentation for self-certification
     A. A written statement showing the manufacturer self-certifies the product/grouping for Color Spatial Uniformity, Color Maintenance, Output Operating Frequency, Noise, Electromagnetic and Radio Frequency Interference, Transient Protection, and for Outdoor Products, Minimum Operating Temperature.
     B. A written statement indicating the forward drive current (in milliamps, mA) applied to the LEDs in the luminaire.
Technical Interpretations by U.S. Department of Energy (DOE)

The following technical interpretations provide additional clarification, information, and/or examples pertaining to requirements stated in the ENERGY STAR for SSL Luminaires criteria or in the ENERGY STAR Manufacturers Guide for Qualifying SSL Luminaires.

I. Recessed, surface, and pendant-mounted downlights - Aperture
A .25” tolerance is allowed for the aperture size. “Aperture” is defined as the maximum distance between the points inside the luminaire where light escapes the luminaire.

II. Product Groupings -- CCT
If a manufacturer offers the same luminaire with different correlated color temperatures (CCTs), ENERGY STAR will allow those products to be grouped together, so long as the LED package(s)/module(s)/array(s), drive current, electronics, and thermal management are otherwise identical. At a minimum, manufacturer must submit one set of LM-80, In-situ Temperature Measurement Test (ISTMT), and LM-79 test results applicable to the product version with the lowest CCT.

III. Lumen Maintenance – Luminaires employing remote phosphors
The LED package, array, or module must contain all optics and electronics which significantly change the color and/or intensity of the light emitted from the luminaire. Luminaires incorporating remote phosphors, secondary phosphors, optics, and/or color or intensity correction electronics that are not contained within the LED package, array, or module must be tested under OPTION 2.

IV. Lumen Maintenance -- Successor LED packages/modules/arrays
LED package manufacturers continue to improve their products, incorporating various upgrades into revised and next-generation packages. Typically these are incremental improvements, rather than entirely new products. To avoid significant delays in qualifying luminaires using LED packages that are successors to those previously approved for lumen maintenance in DOE’s ENERGY STAR SSL program, DOE allows for provisional ENERGY STAR approval based on the following conditions:

1) The luminaire manufacturer must submit at least 3000 hours of lumen maintenance (based on LM-80) data for the successor LED package(s) used, at the appropriate temperature and drive current for the luminaire, and assuming all other required provisions for ENERGY STAR qualification are met by the luminaire.

2) At least 6000 hours of lumen maintenance data for the successor LED package(s) must be provided to the DOE ENERGY STAR SSL program as soon as available.

3) If complete lumen maintenance data is not provided within 6 months of the provisional approval date, all qualified luminaires using the successor packages will face de-listing.

V. Lumen Maintenance -- Required sample size for LED modules and arrays
For LM-80 lumen maintenance testing of LED modules and arrays, a sample size of less than 25 units per temperature is allowed, subject to the following conditions:

1) No fewer than 10 complete modules or arrays must be tested according to LM-80.
2) Testing may be conducted by the LED module or array manufacturer and/or by a qualified testing laboratory recognized by DOE's CALiPER program or holding NVLAP accreditation for the LM-80-08 test procedure.

VI. Lumen Maintenance -- Acceptance of historical lumen maintenance data
The final version of LM-80 was published in September 2008 with several significant changes relative to prior drafts, including how the case temperature is maintained (via ambient temperature versus current modulation) and in the three LED case temperatures at which the packages are maintained (55°C, 85°C, and one other temperature selected by the manufacturer, compared to the earlier drafts that required 45°C, 65°C and 85°C).

DOE recognizes that all LED manufacturers may not have 6,000 hours worth of data for all three case temperatures prescribed in LM-80. DOE therefore will allow prior data collected to be used for compliance purposes until March 31, 2010, after which date new product submissions will be required to include test lumen maintenance data collected in compliance with LM-80.

VII. Off-state Power
For products designed for use in a system configuration, i.e., multiple luminaires operating on a single power supply, off-state power requirements will be expanded from 0.5 watts to 1.5 watts. The rationale is that for such “systems”, DOE anticipates that at least three luminaires would be connected to a single power supply.

VIII. Under-cabinet shelf-mounted task lighting – Asymmetrical distribution
Zonal Lumen Density Requirement -- luminaires with asymmetrical distribution must have at least 12.5% of total luminaire lumens in the 60°-90° zone (see Figure 1). There is a 3% tolerance in the backward zone.
IX. NVLAP Accreditation Requirement

As originally stated in ENERGY STAR for SSL Luminaires version 1.0 and updated in version 1.1, DOE intends to require LM-79 and LM-80 test results from laboratories accredited for these procedures by the National Voluntary Laboratory Accreditation Program (NVLAP). DOE suspended this requirement for the first year of the ENERGY STAR SSL program through September 30, 2009. DOE hereby extends this requirement to Sept 30, 2010. Below is a brief characterization of the status of the test procedures, NVLAP accreditation process, and laboratory progress, which inform the decision to extend these deadlines.

A. LM-80-08 was published by IESNA in September 2008. Several factors limit the availability of LM-80 testing services and the timeline for NVLAP accreditation. First, due to the long-term nature of lumen maintenance testing, it is almost exclusively conducted in-house by LED manufacturers. Second, significant changes were made to the final LM-80 test procedure compared to earlier drafts, effectively eliminating any “first mover advantage” towards accreditation. Third, strict temperature control methods required by LM-80 necessitate specialized thermal chambers and auxiliary equipment. Cost and space requirements for this equipment, along with the minimum 6,000 hour test period make LM-80 testing by independent test labs impractical at this time.

B. LM-79 and LM-80 were added to the NVLAP Energy Efficient Lighting Products program and NIST began accepting applications for accreditation to these procedures in March 2009. The time required for the accreditation process varies depending on lab capabilities, existing accreditations, and other factors. NIST estimates that the first LM-79 and LM-80 accredited laboratories will complete the process by the end of 2009. Both independent and manufacturer-owned laboratories are eligible to earn LM-79 and LM-80 accreditation.
X. In situ Temperature Measurement Test

DOE will accept ISTMT results from laboratories approved by OSHA as Nationally Recognized Testing Laboratories (NRTLs). Alternatively, DOE will accept ISTMT results from independent laboratories qualified under the DOE CALiPER testing program as listed at http://www1.eere.energy.gov/buildings/ssl/test_labs.html under the heading “CALiPER Testing Laboratories, Laboratories Qualified, Verified, and Contracted for 2009 CALiPER LM-79 Testing and LM-79 Testing for ENERGY STAR for SSL”. Alternatively, ISTMT may be carried out by laboratories recognized through UL’s Data Acceptance Program.

XI. Lumen Maintenance – LM-80 thresholds

DOE established a pass/fail threshold for lumen maintenance compliance, based on the available 6,000 hour data provided by the LM-80 test report. The requirements differ for applications requiring 25,000 hours of useful life and those requiring 35,000 hours, as follows:

<table>
<thead>
<tr>
<th>Application required minimum useful life (L_70)</th>
<th>Required lumen maintenance at 6,000 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>25,000 hours</td>
<td>91.8%</td>
</tr>
<tr>
<td>35,000 hours</td>
<td>94.1%</td>
</tr>
</tbody>
</table>

These percentages result from solving an exponential decay function for 25,000 and 35,000 hours, respectively, to determine the minimum lumen maintenance necessary to achieve those thresholds.

In some cases, manufacturers continue to collect LM-80 data beyond 6000 hours (LM-80 establishes 6000 hours as a minimum test period, but recommends 10,000 hours). If additional data is available, it may be used to meet the lumen maintenance requirements, with the following thresholds:

<table>
<thead>
<tr>
<th>Required lumen maintenance at test periods exceeding 6000 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cumulative hours of testing</td>
</tr>
<tr>
<td>--------------------------------</td>
</tr>
<tr>
<td>7000</td>
</tr>
<tr>
<td>8000</td>
</tr>
<tr>
<td>9000</td>
</tr>
<tr>
<td>10000</td>
</tr>
<tr>
<td>11000</td>
</tr>
<tr>
<td>12000</td>
</tr>
<tr>
<td>13000</td>
</tr>
<tr>
<td>14000</td>
</tr>
<tr>
<td>15000</td>
</tr>
</tbody>
</table>
Scope
This document is an accompaniment to DOE’s ENERGY STAR® for SSL Luminaires Criteria and provides manufacturers with information about product submission, testing laboratories and requirements, and using “product groups” to reduce testing costs.

Pre-qualification Activities

A manufacturer should take several steps before submitting products for ENERGY STAR qualification.

A. Become an ENERGY STAR Partner
All manufacturers who wish to earn the ENERGY STAR label for their products must first become an ENERGY STAR SSL Partner. ENERGY STAR Partnership Agreements are available for download at www.energystar.gov/sslpartners or by submitting an e-mail request to ssl@energystar.gov. If your company is already an ENERGY STAR partner under a different product category, you still need to fill out a new form.

B. Find a DOE-Approved or NVLAP Accredited Laboratory
ENERGY STAR requires independent product testing to verify performance against the key requirements laid out in the criteria. DOE maintains a list of approved independent testing laboratories to perform the required testing, as outlined below and in Table 2. Laboratories can now begin the process for NVLAP accreditation for both IESNA LM-79-2008 and IESNA LM-80-2008. NVLAP accreditation involves a rigorous process demonstrating technical competence, quality control, proficiency testing, and laboratory impartiality and objectivity. As of September 30, 2010, DOE will only accept LM-79 and LM-80 test results from NVLAP-accredited labs.

Photometric Testing
Independent testing laboratories qualified, verified, and recognized through DOE’s CALiPER program shall be used for photometric testing under the ENERGY STAR program. Labs must satisfactorily complete round-robin testing verification adhering to IESNA LM-79-08 test procedures for integrating sphere and/or goniophotometric testing of SSL luminaires and lamps. Alternatively, labs must successfully acquire NVLAP accreditation for LM-79 testing or be currently accredited under the NVLAP Program for Energy Efficient Lighting (EEL) Products while in the process of attaining NVLAP LM-79 accreditation. A list of currently qualified test labs is below. Manufacturers are encouraged to check for updates to this list available at: http://www1.eere.energy.gov/buildings/ssl/test_labs.html

Integrating Sphere (LM-79 Section 9.1 and 9.2)

- Independent Testing Laboratories, Inc. – Boulder, CO
- Intertek - Cortland, NY
- Luminaire Testing Laboratory, Inc. – Allentown, PA
- Lighting Sciences, Inc. – Scottsdale, AZ
- OnSpeX/CSA International – Atlanta, GA
• Aurora International Testing Laboratory – Aurora, OH
• GE Consumer & Industrial – Lighting Product Testing Laboratory – Cleveland, OH

Goniophotometry (LM-79 Section 9.3)

• Independent Testing Laboratories, Inc. – Boulder, CO
• Intertek - Cortland, NY
• Luminaire Testing Laboratory, Inc. – Allentown, PA
• Lighting Sciences, Inc. – Scottsdale, AZ
• OnSpeX/CSA International – Atlanta, GA
• GE Consumer & Industrial – Lighting Product Testing Laboratory – Cleveland, OH

**In situ Temperature Measurement Test (ANSI/UL 1598-04 or ANSI/UL 153-05)**

ISTMT must be conducted with the luminaire installed in its appropriate application, as defined in UL 1598 (for hard-wired luminaires) or UL 153 (for corded products). ISTMT may be carried out concurrently with UL safety testing.

Product safety testing of electrical equipment is required under OSHA Safety Standards (29 CFR Part 1910). In particular, SSL luminaires submitted for ENERGY STAR qualification must be tested and certified to ANSI/UL 1598-04 or ANSI/UL 153-05 standards. OSHA has approved a number of organizations as Nationally Recognized Testing Laboratories (NRTLs), and can accept products that have been properly certified by these laboratories.

DOE will accept ISTMT results from the following NRTLs, recognized as qualified by OSHA:

• Canadian Standards Association (CSA) (also known as CSA International)
• Communication Certification Laboratory, Inc. (CCL)
• Curtis-Straus LLC (CSL)
• FM Approvals LLC (FM)(formerly Factory Mutual Research Corporation)
• Intertek Testing Services NA, Inc. (ITSNA) (formerly ETL)
• MET Laboratories, Inc. (MET)
• NSF International (NSF)
• National Technical Systems, Inc. (NTS)
• SGS U.S. Testing Company, Inc. (SGSUS) (formerly UST-CA)
• Southwest Research Institute (SWRI)
• TUV America, Inc. (TUVAM)
• TUV Product Services GmbH (TUVPSG)
• TUV Rheinland of North America, Inc. (TUV)
• Underwriters Laboratories Inc. (UL)
• Wyle Laboratories, Inc. (WL)

A current listing of NRTLs and detailed qualifications and contact information is provided on OSHA’s NRTL Program webpage (http://www.osha.gov/dts/otpca/nrtl/).
Alternatively, ISTMT may be carried out concurrently with photometric (LM-79) testing. DOE will accept ISTMT results from independent laboratories qualified under the DOE CALiPER testing program as listed at http://www1.eere.energy.gov/buildings/ssl/test_labs.html under the heading “CALiPER Testing Laboratories, Laboratories Qualified, Verified, and Contracted for 2009 CALiPER LM-79 Testing and LM-79 Testing for ENERGY STAR for SSL”.

Alternatively, ISTMT may be carried out by laboratories recognized through UL’s Data Acceptance Program.

C. Submit Products to Labs for Testing
Manufacturers are responsible for product testing costs. Each product must adhere to the appropriate standards and test procedures. To help ease the burden of testing, DOE will allow manufacturers to qualify one product as a representative sample of similar models.

D. Creating Product Groups
DOE will allow manufacturers to qualify multiple products of a similar nature using one model. For example, the same basic fixture may be available with various shade, reflector, finish, or trim options. Manufacturers will define the product group and identify the specific model used for testing to represent the entire group. When choosing this test sample, DOE advises applicants to choose the variation which will have the most difficulty meeting the ENERGY STAR criteria. This will ensure that other group members will perform at least as well as the tested product. Table 1 summarizes allowable variations under the product grouping allowance.

<table>
<thead>
<tr>
<th>Table 1 - Variations within Product Groupings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housing/Chassis</td>
</tr>
<tr>
<td>Heat Sink/Heat Management</td>
</tr>
<tr>
<td>Finish</td>
</tr>
<tr>
<td>Reflector/Trim</td>
</tr>
<tr>
<td>Shade/Diffuser</td>
</tr>
<tr>
<td>Mounting</td>
</tr>
<tr>
<td>Light Source</td>
</tr>
<tr>
<td>Power Supply</td>
</tr>
</tbody>
</table>

† The light source, heat sink, and power supply are integrated into housing/chassis variations in such a way that the thermal performance of the luminaire is not significantly degraded by the housing/chassis.

As seen in the table, housing/chassis variations and heat sink/heat management component variations within a group are not allowed because they may materially impact LED performance (a possible exception for chassis/housing variations is allowed as noted). Finish, reflector/trim, shade/diffuser, and mounting variations are allowed.

Light source and power supply variations are allowed with certain conditions:

Substitute LED packages that produce the identical quality and quantity of light...
Products qualified under a single application may include LED package(s)/module(s)/array(s) and power supplies from more than one manufacturer, but the LED package(s)/module(s)/array(s) and power supplies must be substitutable components used to manufacture essentially identical luminaires and must be intended to produce the same quantity and quality of light. All LED package(s)/module(s)/array(s) substitution components must separately comply with the Option 1 (Component Performance) requirements in the Lumen Maintenance section.

**Same luminaire available in different CCTs**
If a manufacturer offers the same luminaire with different correlated color temperatures (CCTs), ENERGY STAR will allow those products to be grouped together, so long as the LED package(s)/module(s)/array(s), drive current, electronics, and thermal management are otherwise identical. At a minimum, manufacturer must submit one set of LM-80, In-situ Temperature Measurement Test (ISTMT), and LM-79 test results applicable to the product version with the lowest CCT.

Manufacturers are allowed to retroactively add new products to a grouping.

More information on Product Grouping can be found in **Attachment A**.

**Submittal Process**

**On-line Product Submission Tool**
To submit your test results for ENERGY STAR approval, DOE has created an on-line product submission tool for partners. Partners must submit their information via the on-line tool posted at [www.energystar.gov/sslpartners](http://www.energystar.gov/sslpartners). The process is as follows:

**Step 1. Set up your “My ENERGY STAR® Account” (MESA).**
Once you register as an ENERGY STAR SSL Partner, you will receive an e-mail that contains your MESA set-up information. This information will include a user name and password required for accessing the on-line product submittal tool.

**Step 2. Launch the On-line Product Submittal Tool.**
A link to the On-line Product Data Submittal Tool will be added to your ENERGY STAR SSL Partner landing page. Launching the tool will begin the data submittal process, and take you to the tool’s main screen which displays the manufacturer’s information (i.e., name, address, contacts, etc.).

**Step 3. Enter Product Information.**
The On-line Product Submittal Tool provides entry fields for all information needed for ENERGY STAR qualification. Next to each data entry field is guidance on its required minimum level of detail. You can upload LM-79 test reports directly to the tool and receive instant feedback on how the photometric results compare with specific ENERGY STAR product category requirements. The tool also allows you to upload other test reports and packaging proofs for review by ENERGY STAR.
At any time during the submittal process, you can save your work for completion at a later date. A progress meter indicates your stage of completion in the data submittal/qualification process.

**Step 4. Submit Application**

Once you have completed the appropriate data entry fields, click “Submit.”

Once a product has been submitted by a manufacturer, ENERGY STAR will review the results and notify the applicant within one calendar week of acceptance, rejection, or the need for additional information. If you experience problems with the On-line Product Submission Tool, please contact ssl@drintl.com.
Testing

Temperature Measurement Point (TMP)
LED package, array, or module manufacturers and power supply/driver manufacturers designate specific locations on their products which act as surrogate points for measuring junction temperature \((t_j)\) or, in the case of power supplies, the point to which the warranted temperature is measured. DOE generically designates these locations as the temperature measurement points (TMPs) for the purposes of measurement in testing.

TMP for the LED (TMP\(_{LED}\))
Knowledge of the thermal pathway between the LED die junction and a designated external measurement point on the package, array, or module allows manufacturers to accurately estimate junction temperature. The surrogate temperatures and their measurement locations vary from manufacturer to manufacturer. Some manufacturers use temperatures measured at the solder joint \((t_s)\) at the board attachment site; some use the package case temperature \((t_c)\); and others use the board temperature \((t_b)\) on the module. Collectively, these locations serve the same function, i.e., to correlate an external temperature to the junction temperature, which is critical for determining LED lumen maintenance. For purposes of this document, the measurement locations for \(t_s\), \(t_c\), and \(t_b\) are Temperature Measurement Points for LEDs (TMP\(_{LED}\)).

TMP for the Power Supply (TMP\(_{PS}\))
The longevity of power supplies is highly dependent upon operating temperature and thermal environment. It is standard practice in the lighting industry to tie the product warranty to maintained operating temperature—referred to as the case temperature \((t_c)\)—for which most manufacturers designate a measurement location on the power supply case. For purposes of this document, the measurement locations for \(t_c\) (or other manufacturer designated location) are Temperature Measurement Points for power supplies (TMP\(_{PS}\)).

Required Test Reporting and Tolerance
Manufacturers are required to test their products at approved testing laboratories, and provide the results to DOE as part of the submittal process. Table 2 defines the required testing and reporting, sample size, and applicable tolerance for the ENERGY STAR criteria. Table 3 presents the zonal lumen tolerances for the individual Category A applications.
<table>
<thead>
<tr>
<th>Performance Characteristic</th>
<th>Methods of Measurement/Reference</th>
<th>Approved Test Facility</th>
<th>Required Documentation</th>
<th>Sample Size</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Luminaire Efficacy</strong></td>
<td>IESNA LM-79-08 Section 9.1, 9.2 or 9.3 and ANSI C82.2</td>
<td>DOE CALiPER Recognized or NVLAP Accredited</td>
<td>IESNA LM-63-03 Formatted Photometric Report (required for electronic submission) and/or Goniophotometer Test Report and/or Integrating Sphere Output Report</td>
<td>One</td>
<td>-3%</td>
</tr>
<tr>
<td><strong>Minimum Light Output</strong></td>
<td>IESNA LM-79-08 Section 9.1, 9.2 or 9.3</td>
<td>DOE CALiPER Recognized or NVLAP Accredited</td>
<td>IESNA LM-63-03 Formatted Photometric Report (required for electronic submission) and/or Goniophotometer Test Report and/or Integrating Sphere Output Report</td>
<td>One</td>
<td>-10%</td>
</tr>
<tr>
<td><strong>Zonal Lumen Density</strong></td>
<td>IESNA LM-79-08 Section 9.3</td>
<td>DOE CALiPER Recognized or NVLAP Accredited</td>
<td>IESNA LM-63-03 Formatted Photometric Report (required for electronic submission) and/or Goniophotometer Test Report</td>
<td>One</td>
<td>See Table 3</td>
</tr>
<tr>
<td><strong>Lumen Maintenance (L_{70})</strong></td>
<td>IESNA LM-80-08</td>
<td>NVLAP Accredited or LED Package, Module, or Array Manufacturer (must begin process of NVLAP accreditation)</td>
<td>LED package, module, or array manufacturer test report (data table and chart) showing relative light output over time. For L_{70} of 25,000 hours, average of sample at 6,000 hours shall have lumen maintenance of ≥ 91.8%. For L_{70} of 35,000 hours, average of sample at 6,000 hours shall have lumen maintenance of ≥ 94.1%. (continued on next page)</td>
<td>For LED packages, the average of at least 25 samples for each temperature measured. For LED modules and arrays, the average of at least 10 samples for each temperature</td>
<td>0%</td>
</tr>
</tbody>
</table>

1 After September 30, 2010, DOE will only accept LM-79 and LM-80 test results from NVLAP-accredited laboratories.

ENERGY STAR Manufacturer’s Guide for Qualifying SSL Luminaires
October 2009
### In Situ Temperature Measurement Test (ISTMT)
ANSI/UL 1598-04, ANSI/UL 153-05

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Testing Method</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Test report indicating the Temperature Measurement Point for the hottest LED (TMP(_{\text{LED}})) in the luminaire.</td>
<td>ANSI/UL 1598-04, ANSI/UL 153-05</td>
<td>One</td>
</tr>
<tr>
<td>2. Diagram/picture of the TMP(_{\text{LED}}) location with an arrow indicating the thermocouple attachment point.</td>
<td>DOE CALiPER Recognized or UL Data Acceptance Program labs</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### OPTION 2: Luminaire Performance

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Testing Method</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Color Rendering Index</strong></td>
<td>IESNA LM-79-08 Section 9.1, 9.2 or 9.3</td>
<td>DOE CALiPER Recognized or NVLAP Accredited</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Integrating Sphere Output Report</td>
</tr>
<tr>
<td></td>
<td></td>
<td>One</td>
</tr>
<tr>
<td>1. Report @ (T = 0) hours</td>
<td>IESNA LM-63-03 Formatted Photometric Report and/or Goniophotometer Test Report and/or Integrating Sphere Output Report</td>
<td>One</td>
</tr>
<tr>
<td>2. Report @ (T = 6000) hours</td>
<td>- 2 points of required CRI</td>
<td></td>
</tr>
<tr>
<td><strong>Correlated Color Temperature</strong></td>
<td>IESNA LM-79-08 Section 9.1 ANSI C78.377-08</td>
<td>DOE CALiPER Recognized or NVLAP Accredited</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Integrating Sphere Output Report</td>
</tr>
<tr>
<td></td>
<td></td>
<td>One</td>
</tr>
<tr>
<td><strong>Color Spatial Uniformity</strong></td>
<td>IESNA LM-79-08 CIE 15: 2004 IESNA LM-58 IESNA LM-16</td>
<td>DOE CALiPER Recognized or NVLAP Accredited</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Self Certification</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ANSI C78.377 Defined</td>
</tr>
<tr>
<td></td>
<td></td>
<td>One</td>
</tr>
<tr>
<td><strong>Color Maintenance</strong></td>
<td>IESNA LM-80-08 CIE 15: 2004 IESNA LM-58 IESNA LM-16</td>
<td>NVLAP Accredited or LED Package, Module, or Array Manufacturer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Self Certification</td>
</tr>
<tr>
<td></td>
<td></td>
<td>One</td>
</tr>
<tr>
<td><strong>Power Factor</strong></td>
<td>ANSI C82.77</td>
<td>OSHA approved NRTLs or DOE CALiPER Recognized or UL Data Acceptance Program labs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Laboratory test report</td>
</tr>
<tr>
<td></td>
<td></td>
<td>One</td>
</tr>
</tbody>
</table>

**Note:** A laboratory test report must be submitted upon DOE request.
| Power Supply TMP<sub>PS</sub> | ISTMT ANSI/UL 1598-04, ANSI/UL 153-05 | NRTLs or DOE CALiPER Recognized or UL Data Acceptance Program labs | 1. Test report indicating the Temperature Measurement Point for the power supply (TMP<sub>PS</sub>) in the luminaire.  
2. Diagram/picture of in the TMP<sub>PS</sub> location with an arrow indicating the thermocouple attachment point. | One | N/A |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Output Operating Frequency</td>
<td>Oscilloscope Manual</td>
<td>Any</td>
<td>Self Certification. Output operating frequency is measured by attaching an oscilloscope between the driver and the LED package. It is conducted simultaneously with the measurement of the output drive.</td>
<td>One</td>
<td>N/A</td>
</tr>
</tbody>
</table>
| Noise                       | Not to exceed 24 dB when measured 12" in any direction. Class A sound rating for power supplies installed within the fixture are not to exceed a measured level of 24 dBA (audible). | Any                                             | Self Certification. Sound is measured using a sound meter (similar in performance to B&K type 2209) where the microphone is located 12 inches from the fixture in any direction.  
**Note:** A laboratory test report must be submitted upon DOE request. | One | N/A |
**Note:** A laboratory test report must be submitted upon DOE request. | One | N/A |
| Transient Protection        | Comply with IEEE C.62.41-1991, Class A operation. Seven strikes of a 100 kHz ring wave, 2.5 kV level, for both common and differential mode. | Any                                             | Self-Certification  
**Note:** A laboratory test report must be submitted upon DOE request. | One | N/A |
### Minimum Operation Temperature

| Temperature (Outdoor) | -20°C ≥ |

| Any               | Self-Certification |

| Note: A laboratory test report must be submitted upon DOE request. |

| One | N/A |

### Table 3 - Zonal Lumen Tolerances

<table>
<thead>
<tr>
<th>Category A Application</th>
<th>Zonal Lumen Density Requirement</th>
<th>Tolerance</th>
<th>Method of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Zone (bilaterally symmetrical)</td>
<td>Minimum Percentage of Total Lumens</td>
<td>Maximum Percentage of Total Lumens</td>
</tr>
<tr>
<td>Under-cabinet kitchen lighting</td>
<td>0-60°</td>
<td>60%</td>
<td>--</td>
</tr>
<tr>
<td>Under-cabinet shelf-mounted task lighting</td>
<td>60-90°</td>
<td>25%</td>
<td>--</td>
</tr>
<tr>
<td>Under-cabinet shelf-mounted task lighting (asymmetrical distribution)</td>
<td>0-60°</td>
<td>60%</td>
<td>--</td>
</tr>
<tr>
<td>Under-cabinet shelf-mounted task lighting (asymmetrical distribution)</td>
<td>60-90°</td>
<td>25%</td>
<td>--</td>
</tr>
<tr>
<td>Portable desk task lights</td>
<td>0-60°</td>
<td>12.5%</td>
<td>--</td>
</tr>
<tr>
<td>Recessed, surface, and pendant-mounted downlights</td>
<td>0-60°</td>
<td>85%</td>
<td>--</td>
</tr>
<tr>
<td>Cove lighting</td>
<td>0 - 90°</td>
<td>85%</td>
<td>--</td>
</tr>
<tr>
<td>Cove lighting</td>
<td>120 - 150°</td>
<td>35%</td>
<td>--</td>
</tr>
<tr>
<td>Wall wash luminaires</td>
<td>20 - 40°</td>
<td>50%</td>
<td>--</td>
</tr>
<tr>
<td>Outdoor wall-mounted porch lights</td>
<td>0-90°</td>
<td>85%</td>
<td>--</td>
</tr>
<tr>
<td>Outdoor step lights</td>
<td>0-90°</td>
<td>85%</td>
<td>--</td>
</tr>
<tr>
<td>Outdoor pathway lights</td>
<td>0-90°</td>
<td>85%</td>
<td>--</td>
</tr>
<tr>
<td>Outdoor pole/arm-mounted decorative luminaires</td>
<td>0-90°</td>
<td>85%</td>
<td>--</td>
</tr>
<tr>
<td>Outdoor pole/arm-mounted decorative luminaires</td>
<td>110° and above</td>
<td>--</td>
<td>0%</td>
</tr>
<tr>
<td>Bollards</td>
<td>90 – 110%</td>
<td>--</td>
<td>0 – 15%</td>
</tr>
<tr>
<td>Bollards</td>
<td>110° and above</td>
<td>--</td>
<td>0%</td>
</tr>
</tbody>
</table>

IESNA LM-79-08 Section 9.1
Lumen Maintenance Testing
The ENERGY STAR program offers two compliance methods for lumen maintenance testing: 1) Component Performance and 2) Luminaire Performance. Given the potential delays in market introduction required for full luminaire testing, DOE anticipates the majority of products submitted will be qualified via component performance testing.

OPTION 1: Component Performance
The Component Performance option allows the applicant to demonstrate compliance with the lumen maintenance requirement by demonstrating the highest temperature LED package(s), array(s), or module(s) used in the luminaire operate at or below temperatures yielding an L70 of 25,000 or 35,000 hours, respectively.

IESNA LM-80-2008
The IESNA LM-80-2008 Approved Method for Measuring Lumen Maintenance of LED Light Sources prescribes the measurement of lumen maintenance for LED-based packages, arrays, and modules only and does not entail testing of the entire luminaire. LED packages, arrays or modules are tested for at least 6,000 hours at a minimum of three discrete case temperatures: 55°C, 85°C and a third temperature at the discretion of the manufacturer ± 2°C. At a minimum, light output is measured every 1,000 hours and recorded for a minimum of 6,000 hours.

In Situ Temperature Measurement Test (ISTMT)
IESNA LM-80 defines lumen maintenance testing for LED packages, arrays, and modules. Because LEDs are incorporated into luminaires with heat sinks, optical elements, power supplies, etc. and then operated in a variety of ambient environments, LM-80 by itself is not a predictor of luminaire lumen maintenance. To relate the results of the LM-80 test to the luminaire, DOE requires verification of LED and power supply temperatures in environments that simulate real-world applications (in situ) with tests that measure the temperature of both the highest temperature LED in the luminaire and the power supply at steady-state thermal equilibrium. The procedure is called the In-situ Temperature Measurement Test (ISTMT) which follows ANSI/UL 1598-2004 Luminaires or ANSI/UL 153-2005 Portable Luminaires. It includes the addition of two (or more) thermocouples, one for the LED package, array, or module and one for the power supply.

According to UL, hard-wired luminaires are separated into two broad categories: 1) Surface—products that are surface-mounted, suspended or freestanding where the fixture housing is exposed to free air and 2) Recessed—products recessed into ceilings or walls and often placed in direct contact with insulation. ANSI/UL1598 prescribes enclosures for luminaires for the purposes of simulating in situ operation and conducting temperature measurements for electrical safety (see Figure 2). In efforts to facilitate testing and minimize costs, DOE has reduced the number of environments to the fewest possible without significantly affecting the resulting steady-state temperatures. Table 4 lists the appropriate section references in ANSI/UL 1598.

Portable luminaires shall follow the procedures contained within ANSI/UL 153.
Table 4 – In Situ Test Environments

<table>
<thead>
<tr>
<th>Luminaire Types</th>
<th>Mounting Orientation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Horizontal</td>
</tr>
<tr>
<td>Surface</td>
<td></td>
</tr>
<tr>
<td>Surface</td>
<td>Section 19.10</td>
</tr>
<tr>
<td>Surface-mounted</td>
<td></td>
</tr>
<tr>
<td>under-cabinet</td>
<td>Section 19.12</td>
</tr>
<tr>
<td>Suspended</td>
<td>No apparatus required except if in situ mounting is ( \leq 4&quot; ) from the surface. In this case mount to apparatus defined in Section 19.10</td>
</tr>
<tr>
<td>Freestanding</td>
<td>No apparatus required</td>
</tr>
<tr>
<td>Recessed</td>
<td></td>
</tr>
<tr>
<td>Non-IC</td>
<td>Section 19.13</td>
</tr>
<tr>
<td>IC</td>
<td>Section 19.15</td>
</tr>
</tbody>
</table>

Conditions for Use
To be eligible for the component performance option, **ALL** conditions below must be met. If
ANY of the conditions are not met, the component performance option may not be used and the applicant must use the luminaire performance option for compliance.

1. The LED package, array, or module used in the fixture has been tested according to LM-80.
2. The LED package, array, or module manufacturer prescribes/indicates a TMP on the package, array, or module.
3. The LED package, array, or module TMP is accessible to allow temporary attachment of a thermocouple for measurement of in situ operating temperature. Access via a temporary hole in the housing (no larger than 0.375" diameter), tightly resealed during testing with putty or other flexible sealant, is allowable. The size and location of the access port shall be documented in the submittal for the purposes of repeatability.
4. The LED package, array, or module must contain all optics and electronics which significantly change the color and/or intensity of the light emitted from the luminaire. Luminaires incorporating remote phosphors, secondary phosphors, optics, and/or color or intensity correction electronics that are not contained within the LED package, array, or module must be tested under OPTION 2.

Test Procedure

The ISTMT follows all requirements of ANSI/UL 1598/153 with the following additions:

1. One or more additional thermocouples are attached to the highest temperature LED package or module in the luminaire (i.e., TMP_{LED}).
2. One or more additional thermocouples are attached to the power supply/driver at the TMP_{PS}. For off-the-shelf remote power supplies manufacturers typically provide a measurement location (case temperature designated by a “dot” adjacent to a (t_c) symbol) for warranty purposes. In situations where the TMP_{PS} is not designated by the manufacturer, or where power supplies are integrated with the LED package(s), array or module(s), fixture manufacturers should identify the TMP_{PS} to be used for warranty purposes.

Guidance for Thermocouple Attachment

- Manufacturers shall select and designate the highest temperature LED package, array, or module in the luminaire. In most cases the individual LED in the middle of symmetric arrays should be hottest. A well designed thermal management solution will minimize the temperature gradient across packages.
  - For square/rectangular/circular arrays the individual LED closest to the center
  - For other configurations it is recommended manufacturers sample several LEDs to find the highest temperature device within the luminaire.
- Temperature probes shall be in contact with the TMP and permanently adhered. Permanent adhesion consists of high temperature solder, conductive adhesives (e.g. accelerator/UV activated or epoxy), or melting the tip into plastic or other approved product recommended by the temperature probe manufacturer. Tape alone is not acceptable for providing good thermal contact at the thermocouple/TMP interface.
- The thermocouple tolerance shall conform to ASTM E230 Table 1 “Special Limits” (≤ 1.1°C or 0.4%, whichever is greater).
**TMP Evaluation**

DOE has established a pass/fail threshold for lumen maintenance compliance, based on the available 6,000 hour data provided by the LM-80 test report. The requirements differ for applications requiring 25,000 hours of useful life and those requiring 35,000 hours, as follows:

<table>
<thead>
<tr>
<th>Application required minimum useful life (L\textsubscript{70})</th>
<th>Required lumen maintenance at 6,000 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>25,000 hours</td>
<td>91.8%</td>
</tr>
<tr>
<td>35,000 hours</td>
<td>94.1%</td>
</tr>
</tbody>
</table>

These percentages result from solving an exponential decay function for 25,000 and 35,000 hours, respectively, to determine the minimum lumen maintenance necessary to achieve those thresholds.

In some cases, manufacturers continue to collect LM-80 data beyond 6000 hours (LM-80 establishes 6000 hours as a minimum test period, but recommends 10,000 hours). If additional data is available, it may be used to meet the lumen maintenance requirements, with the following thresholds:

<table>
<thead>
<tr>
<th>Cumulative hours of testing</th>
<th>For 25000 hour projected L\textsubscript{70} life</th>
<th>For 35000 hour projected L\textsubscript{70} life</th>
</tr>
</thead>
<tbody>
<tr>
<td>7000</td>
<td>90.5%</td>
<td>93.1%</td>
</tr>
<tr>
<td>8000</td>
<td>89.2%</td>
<td>92.2%</td>
</tr>
<tr>
<td>9000</td>
<td>88.0%</td>
<td>91.2%</td>
</tr>
<tr>
<td>10000</td>
<td>86.7%</td>
<td>90.3%</td>
</tr>
<tr>
<td>11000</td>
<td>85.5%</td>
<td>89.4%</td>
</tr>
<tr>
<td>12000</td>
<td>84.3%</td>
<td>88.5%</td>
</tr>
<tr>
<td>13000</td>
<td>83.1%</td>
<td>87.6%</td>
</tr>
<tr>
<td>14000</td>
<td>81.9%</td>
<td>86.7%</td>
</tr>
<tr>
<td>15000</td>
<td>80.7%</td>
<td>85.8%</td>
</tr>
</tbody>
</table>

**Note:** The final version of LM-80 was published September 2008 with several significant changes relative to prior drafts, including how the case temperature is maintained (via ambient temperature versus current modulation) and in the three LED case temperatures at which the packages are maintained 55°C, 85°C, and one other temperature selected by the manufacturer (compared to the earlier drafts that required 45°C, 65°C and 85°C).

DOE recognizes that all LED manufacturers may not have 6,000 hours worth of data for all three case temperatures prescribed in LM-80. DOE therefore will allow prior data collected to be used for compliance purposes until March 31, 2010, after which date new product submissions will be required to include full LM-80 test results.
This next section describes how DOE will evaluate LM-80 data. There are three possible scenarios for determining the lumen maintenance for the product submitted to ENERGY STAR:

**SCENARIO 1**
The in situ measured $\text{TMP}_{\text{LED}}$ is greater than the highest case temperature collected according to LM-80 procedures. In this case the product cannot qualify under Option 1 as there is no test data to substantiate manufacturer claims. Products that fall under this scenario must be successfully tested according to Option 2 in order to qualify.

**SCENARIO 2**
The in situ measured $\text{TMP}_{\text{LED}}$ is less than the lowest case temperature ($T_c$) or solder-joint ($T_s$) temperature at which LM-80 data was collected. In this case the product must use the data from the lowest case temperature measured according to LM-80 procedures.

**SCENARIO 3**
The in situ measured $\text{TMP}_{\text{LED}}$ is bounded above and below by case temperature data collected according to LM-80 procedures. In this case linear interpolation shall be used to determine the lumen maintenance for the proposed product, as follows:

$$
\text{L}_{\text{TMP}} = \text{L}_{\text{below}} + \left( \frac{\text{L}_{\text{above}} - \text{L}_{\text{below}}}{T_{s, \text{above}} - T_{s, \text{below}}} \right) (\text{TMP}_{\text{LED}} - T_{s, \text{below}})
$$

Where:
- $\text{L}_{\text{below}}$ = Lumen maintenance (%) below the $\text{TMP}_{\text{LED}}$ @ 6000 hours
- $\text{L}_{\text{above}}$ = Lumen maintenance (%) above the $\text{TMP}_{\text{LED}}$ @ 6000 hours
- $T_{s, \text{below}}$ = LM-80 case temperature (°C) below the $\text{TMP}_{\text{LED}}$
- $T_{s, \text{above}}$ = LM-80 case temperature (°C) above the $\text{TMP}_{\text{LED}}$
- $\text{TMP}_{\text{LED}}$ = In situ measured TMP of the hottest LED within the luminaire
- $\text{L}_{\text{TMP}}$ = Calculated lumen maintenance of the hottest in situ LED within the luminaire

**EXAMPLE:**

In situ measured $\text{TMP}_{\text{LED}}$ = 67°C

<table>
<thead>
<tr>
<th>LED Manufacturer LM-80 test data for XYZ Package</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Case Temperature</strong></td>
</tr>
<tr>
<td>Time (hours)</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>...</td>
</tr>
<tr>
<td>6000</td>
</tr>
</tbody>
</table>

Applying the equation above:
\[ L_{\text{TMP}} = 95 + \left( \frac{90 - 95}{85 - 55} \right) (67 - 55) \]
\[ \therefore L_{\text{TMP}} = 93.0\% \]

**Component Performance “Passing” Threshold**

The luminaire **PASSES** the Component Performance Lumen Maintenance requirements if the following three conditions are met:

1. The LM-80 test report for the package, array, or module demonstrates lumen maintenance of \( \geq 91.8\% \) for a projected \( L_{70} \) of 25,000 hours (indoor residential) or \( \geq 94.1\% \) for a projected \( L_{70} \) of 35,000 hours (outdoor residential and all commercial).²
2. The ISTMT temperature at the TMP is less than the lowest temperature that correlates to a lumen maintenance \( \geq 91.8\% \) (residential) or \( \geq 94.1\% \) (commercial) in the LM-80 test. Or the in-situ temperature at the TMP, when input into the linear interpolation equation, results in a lumen maintenance \( \geq 91.8\% \) for residential products or \( \geq 94.1\% \) for outdoor residential and commercial products.
3. The drive current measured in the fixture is less than or equal to the drive current specified in the LM-80 test report.

**Submittal requirement**

Applicant submits the following information to ENERGY STAR:

1. LM-80 test report (data table and chart) showing relative light output over time at various case (\( T_c \)), board (\( T_b \)), or solder-joint (\( T_s \)) temperatures and at a drive current greater than or equal to the measured current of the LED package, array, or module used in the luminaire. A template will be released shortly and will be available at [www.energystar.gov/sslpartners](http://www.energystar.gov/sslpartners).
2. In situ temperature measurement test report with the measured temperature of the hottest LED (\( T_{\text{TMP(LED)}} \)).
3. Diagram/picture of the \( T_{\text{TMP(LED)}} \) location with an arrow indicating the thermocouple attachment point.

NOTE: If more than one type of LED is used in a luminaire, an LM-80 test report and the above described ISTMT and interpolation procedures must be applied to each type of LED used in the luminaire. If LM-80 test reports do not exist for the different packages used in the luminaire, the product must undergo Option 2 to verify lumen maintenance.

**Successor or next generation LED packages.** LED package manufacturers continue to improve their products, incorporating various upgrades into revised and next-generation packages. Typically these are incremental improvements, rather than entirely new products. To avoid

² Note that 91.8\% and 94.1\% are the passing thresholds for 6000 hour LM-80 data. For longer test periods, please see thresholds listed in Table 6 above.
significant delays in qualifying luminaires using LED packages that are successors of LED packages previously approved for lumen maintenance in DOE's ENERGY STAR SSL program, DOE allows for provisional ENERGY STAR approval based on the following conditions:

1) Luminaire manufacturer must submit at least 3000 hours of lumen maintenance (based on LM-80) data for the successor LED package(s) used, at the appropriate temperature and drive current for the luminaire, and assuming all other required provisions for ENERGY STAR qualification are met by the luminaire.

2) At least 6000 hours of lumen maintenance data for the successor LED package(s) must be provided to the DOE ENERGY STAR SSL program as soon as available.

3) If complete lumen maintenance data is not provided within 6 months of the provisional approval date, all qualified luminaires using the successor packages will face de-listing.

**OPTION 2: Luminaire Performance**

The Luminaire Performance option allows the applicant to show compliance with the lumen maintenance requirement by demonstrating that the light output from the luminaire at 6,000 yields ≥ 91.8% lumen maintenance for a projected L₇₀ of 25,000 hours (indoor residential) or ≥ 94.1% lumen maintenance for a projected L₇₀ of 35,000 hours (outdoor residential and all commercial).

**Luminaire Performance “Passing” Threshold**

The luminaire PASSES the Lumen Maintenance requirements if:

1. Based on the LM-79 test report, light output determined at 6000 hours divided by the light output at 0 hours multiplied by 100 yields ≥ 91.8% lumen maintenance for a projected L₇₀ of 25,000 hours (indoor residential) or ≥ 94.1% lumen maintenance for a projected L₇₀ of 35,000 hours (outdoor residential and all commercial).

2. The luminaire must be operated continuously in the appropriate UL 1598/153 environment except when it is removed to perform the LM-79 light output tests.

**Submittal requirement**

Applicant submits the following information to ENERGY STAR:

1. LM-79 test report at 0 hours
2. LM-79 test report at 6000 hours after continuous operation in the appropriate UL1598/153 environment

**Power Supply Qualification**

Power supplies integrated with the LED package(s), array(s) or module(s), or enclosed within the fixture shall be tested in situ under steady-state operating conditions, with power supply case temperature measured at the designated TMPₚₛ. The luminaire passes power supply requirements if the measured temperature at the TMPₚₛ is less than or equal to the warranted temperature specified by the power supply manufacturer.

**Power Supply “Passing” Threshold**

The power supply PASSES if:

1. The power supply measured in situ at the TMPₚₛ is less than the power supply
manufacturer’s three year minimum warranted temperature.

**Submittal requirement**

Applicant submits the following information to ENERGY STAR:

1. ANSI/UL1598/153 Test Report with the measured temperature from the $\text{TMP}_{\text{PS}}$.
2. Diagram/picture of the $\text{TMP}_{\text{PS}}$ location (if not permanently marked on the circuit board or power supply case) with an arrow indicating the thermocouple attachment point.
3. Warranty from the driver manufacturer indicating the maximum power supply case temperature for which a minimum three year warranty is offered.
Attachment A

Product Groups

Luminaires are often available in multiple variations and options. For example, the same basic fixture may be available with different shades, diffusers, trim, reflectors, mountings, and/or sizes. To avoid the need to test all product variations in the ENERGY STAR SSL program, DOE allows for qualification of product groups. Allowable variations within a qualified group may be a function of:

- **Component substitution**: where components of a single version of a luminaire may be substituted in the manufacturing process based on component availability, cost, etc., while not substantively affecting product performance.
- **Product variations**: where multiple versions of a luminaire are based on the same LED platform (i.e., LED module(s)/array(s) and driver), deliver similar function and performance, but vary in physical appearance.

ENERGY STAR partners may self-define product groups consisting of a collection of products sharing similar features, and submit a single luminaire from the group for testing. DOE will verify the applicant’s grouping rationale and—if the submitted product passes testing—will extend the ENERGY STAR qualification to the entire product group. Continued group qualification will be contingent on successful follow-up testing under DOE’s Quality Assurance (QA) program, as described in the ENERGY STAR Program Requirements for SSL Luminaires (ver. 1.1).

LED Platform

All luminaires in a product group must share the same type of LED platform. The LED platform consists of an LED package, array, or module with integrated thermal management (e.g., heat sinking), and a power supply (driver), assembled and operated to produce a specified quantity and quality of light. Substitution of platform components is allowed, provided that it does not significantly alter light output or color properties.

Substitute power supplies must provide the same input power as that used in the tested product, and may not exceed the drive current specified in LM-80 testing for the associated LED package(s)/module(s)/array(s). Substitution of LED package, array or modules is allowed, subject to the light quantity and quality restrictions described above. Further, the package, array, or module must be tested according to LM-80 and demonstrate the required lumen maintenance ($L_{70}$) characteristics.

Consistent LED platform performance is critical to group qualification, as any luminaire in the group is subject to follow-up QA testing and must demonstrate compliance with the current ENERGY STAR criteria in effect at the time of testing.
Component Substitution

Multiple luminaires qualified under a single application may incorporate LED packages, arrays, or modules and power supplies from more than one manufacturer, but the substituted components and resulting LED platform must produce the same quantity and quality of light as the LED platform used in the qualifying luminaire. Further, all LED package, array, or module substitution components must comply separately with ENERGY STAR lumen maintenance qualification requirements.

Additional Requirements

For manufacturers seeking to qualify product groups on the basis of tests on a single product, DOE requires partners to submit for qualification the luminaire likely to be the lowest-performing (relative to ENERGY STAR requirements) luminaire within a group. Selecting the lowest performing luminaire within a group is the responsibility of the manufacturer. Successful qualification of the lowest-performing version will help ensure that other luminaires in the group will meet or exceed ENERGY STAR requirements, pass any subsequent QA testing, and maintain qualification status for the product grouping. Manufacturers are allowed to retroactively add models to a product group; to start the process they must inform their D&R account manager. Product groups may not span more than one of the lighting applications contained in Category A, e.g., individual porch lights and walkway lights may not be combined into a single product group.

Applicants are reminded that thermal management is a key element of LED luminaire performance and that heat must be removed from the package, array, or module—by conduction or convection—to maintain required light output, efficacy, and color quality. For this reason, DOE will not allow significant variations in luminaire housings and chassis within product groupings that are likely to affect thermal performance because material and design changes can alter the LED thermal pathway and diminish lighting performance.

However, product variations including those to housing and chassis that do not significantly degrade thermal performance are allowed. For example, outdoor wall-mounted porch lights within a product group could include a coach lantern with metal mullions or an opaque glass cylinder with a top shade while sharing the same LED platform and internal mounting hardware. Similarly, outdoor pathway lights with the same LED platform and similar basic structure may be offered in a range of ornamental shapes and embellishments.

Limited variations of luminaire housings within product groups are allowed for ENERGY STAR qualification. Applicants self-define their product groups, and should explain their rationale for each product group proposed, including selection of the version submitted for testing. DOE will evaluate grouping rationales on a case-by-case basis and, where appropriate, advise the applicant of any recommended modifications to the product group. Note that applicants ultimately bear the risk of inappropriate product grouping, which could result in failed follow-up QA testing, non-compliance, and revocation of product grouping eligibility.

As the ENERGY STAR eligibility criteria document details, applicants may also include
variations in luminaire finish, reflectors/trims, shades/diffusers, and mountings within product groups. In all cases, however, DOE encourages applicants to be conservative in their selection of grouped luminaires, and adhere to the following basic requirements and guidelines:

1) It is mandatory to use the same type of LED platform for all luminaires in a product grouping;
2) To help ensure product group qualification, submit the lowest-performing compliant luminaire in the group for testing;
3) Limit product variations in a group to ensure all members meet the ENERGY STAR requirements.