



## ENERGY STAR® Program Requirements for Integral LED Lamps Partner Commitments

**FINAL: 12/03/09**

### Eligible Organizations: Manufacturers and Distributors of Integral LED Lamps

#### Commitment

The following are the terms of the ENERGY STAR Partnership Agreement as it pertains to the manufacturing and/or distributing of ENERGY STAR qualified integral LED lamps. The ENERGY STAR PARTNER<sup>1</sup> (PARTNER) must adhere to the following program requirements:

- Comply with current ENERGY STAR Eligibility Criteria, defining the performance criteria that must be met for use of the ENERGY STAR certification mark on product packaging and the testing criteria for integral LED lamps. The Department of Energy (DOE or The Department), at its discretion may conduct tests on products that are referred to as ENERGY STAR qualified through the third-party testing portion of the criteria. These products will be obtained on the open retail or commercial distribution market;
- Comply with current ENERGY STAR Identity Guidelines. The guidelines describe how the ENERGY STAR marks and name must be used. PARTNER is responsible for adhering to these guidelines and for ensuring that all its authorized representatives, such as advertising agencies, dealers, and distributors, are also in compliance;
- Qualify, or private label at least one ENERGY STAR qualified integral LED lamp model within one year of activating the integral LED lamps portion of the agreement. When PARTNER qualifies the product, it must meet the criteria in effect at that time;
- Provide clear and consistent labeling of ENERGY STAR qualified integral LED lamps. The ENERGY STAR certification mark must be clearly displayed on the front or primary display panel of the product packaging, on the PARTNER'S Internet web site where information about its ENERGY STAR qualified models is displayed, and in qualified product literature (e.g., catalogs, user manuals, spec sheets, etc.);
- Provide to the ENERGY STAR Integral LED Lamp Program contractor, on a semiannual basis, an updated list of its ENERGY STAR qualified integral LED lamp models. PARTNERS must inform the ENERGY STAR Integral LED Lamp Program contractor, in these updates if any existing qualified integral LED lamp models have been modified or have updated test data or reports, revised model numbers and/or retail product numbers, or will be discontinued or phased out and the timing of such. PARTNER will provide these ongoing updates in order to remain on the list of participating ENERGY STAR integral LED lamp PARTNERS;
- Notify the ENERGY STAR Integral LED Lamp Program contractor within 30 days, if the designated supplier of any qualified private labeled integral LED lamps changes to a new supplier. The PARTNER is required to submit, in writing or through an online product qualification tool, updated Private Labeler Qualification information that identifies the new original equipment manufacturer, specific model, and packaging information;
- For each qualifying integral LED lamp model, provide to the ENERGY STAR Integral LED Lamp Program contractor accredited laboratory test data reports for the specific model(s) to certify that the lamp(s) have met the required safety and performance tests criteria;

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<sup>1</sup> "Partner" is the company who is portrayed as the manufacturer to the consumer on the product packaging and on the ENERGY STAR Qualified Product List. The term is used for both Original Equipment Manufacturers and organizations who private label OEM products under different brand names.

- For each qualifying integral LED lamp model, provide to the ENERGY STAR Integral LED Lamp Program contractor product packaging samples (either electronic or hard copy for the specific model(s)) to meet the criteria packaging requirements. Products will only be added to the ENERGY STAR Qualified Product List and Searches after review and approval of the product test results and product packaging;
- PARTNER is responsible for all associated financial costs if their product(s) are selected for testing within the Integral LED Lamp Third-Party Testing and Verification Program. ENERGY STAR requires PARTNERS' participation in the Integral LED Lamp Third-Party Testing and Verification Program and will remove PARTNERS from the program if they do not participate in the program.
- Provide to the ENERGY STAR Integral LED lamp program contractor to DOE, on a semiannual basis, unit shipment data for ENERGY STAR qualified integral LED lamps. Specifically, PARTNER must submit the total number of ENERGY STAR qualified integral LED lamps shipped in units by:
  - Base type
  - Model type/designs:
    - Omnidirectional: A, BT, P, PS, S, T
    - Decorative: B, BA, C, CA, DC, F, G
    - Directional: BR, ER, K, MR, PAR, R
    - Non-standard
  - Wattage
  - Model or product number (if possible)

PARTNER is also encouraged to provide ENERGY STAR qualified unit shipment data segmented by total unit shipments for each model in its product line and percent of total unit shipments that qualify as ENERGY STAR.

The data for each half of the calendar year should be submitted to the ENERGY STAR Integral LED Lamp Program contractor, in an electronic spreadsheet format (Microsoft Excel) that is provided by ENERGY STAR, no later than **February 15th** (for July-December) and **August 15th** (for January-June), and may be provided directly from the PARTNER or through a third party that works directly with the PARTNER.

- Notify DOE of a change in the designated responsible party or main contacts for its ENERGY STAR Integral LED Lamp Program participation within 30 days.

### **Performance for Special Distinction**

In order to receive additional recognition and/or support from ENERGY STAR for its efforts within the Partnership, the PARTNER may consider the following voluntary measures and should keep ENERGY STAR informed on the progress of these efforts:

- Consider energy efficiency improvements in company facilities and pursue to benchmark their buildings through the ENERGY STAR Buildings program;
- Purchase ENERGY STAR qualified products. Revise the company purchasing or procurement criteria to include ENERGY STAR. Provide procurement officials' contact information to DOE for periodic updates and coordination. Circulate general ENERGY STAR qualified product information to employees for use when purchasing products for their homes;
- Ensure the power management feature is enabled on all ENERGY STAR qualified monitors in use in company facilities, particularly upon installation and after service is performed;
- Provide general information about the ENERGY STAR program to employees whose jobs are relevant to the development, marketing, sales, and service of current ENERGY STAR qualified product models;

- Feature the ENERGY STAR promotional or partner mark(s) on PARTNER web site and in other marketing materials. If information concerning ENERGY STAR is provided on the PARTNER web site, ENERGY STAR may provide links where appropriate to the PARTNER web site;
- Provide a simple plan to ENERGY STAR outlining specific measures PARTNER plans to undertake beyond the program requirements listed above. By doing so, ENERGY STAR may be able to coordinate, communicate, and/or promote PARTNER's activities, provide a DOE representative, or include news about the event in the ENERGY STAR newsletter, on the ENERGY STAR web pages, etc. The plan may be as simple as providing a list of planned activities or planned milestones that PARTNER would like DOE to be aware of. For example, activities may include: (1) increasing the availability of ENERGY STAR qualified products by converting the entire product line within two years to meet ENERGY STAR guidelines; (2) demonstrating the economic and environmental benefits of energy efficiency through special in-store displays twice a year; (3) providing information to users (via the web site and user's manual) about energy-saving features and operating characteristics of ENERGY STAR qualified products; and (4) building awareness of the ENERGY STAR Partnership and brand identity by collaborating with ENERGY STAR on one print advertorial and one live press event;
- Provide quarterly, written updates to DOE as to the efforts undertaken by PARTNER to increase availability of ENERGY STAR qualified products, and to promote awareness of ENERGY STAR and its message.



## ENERGY STAR® Program Requirements for Integral LED Lamps ENERGY STAR Eligibility Criteria

Final – December 3, 2009

Below are the product criteria for ENERGY STAR qualified Integral LED Lamps - Version 1.0. A product must meet all of the criteria in order to be qualified as ENERGY STAR.

**1) SCOPE:** These criteria apply to integral LED lamps<sup>2</sup>, defined as a lamp with LEDs, an integrated LED driver, and an ANSI standardized base designed to connect to the branch circuit via an ANSI standardized lampholder/socket. These criteria include integral LED lamps of non-standard form, and those intended to replace standard general service incandescent lamps, decorative (candelabra style) lamps, and reflector lamps. Other types of replacement lamps may be added in the future as improvements to LED technology make LED use in other replacement lamp types viable.

### 2) DEFINITIONS

- A. **A2LA:** American Association for Laboratory Accreditation.
- B. **ANSI:** American National Standards Institute.
- C. **ASTM:** American Society for Testing of Materials.
- D. **CIE:** Commission Internationale de l'Eclairage (translated International Commission on Illumination).
- E. **Color rendition:** The effect the spectral characteristic of the light emitted by the LED has on the color appearance of the objects illuminated by it is called color rendition. The color rendering index (CRI) is defined in terms of a comparison of the spectral tri-stimulus values of the objects under test illumination and standard illumination according to the recommendations of CIE Publication No.13.3-1995.
- F. **Correlated Color Temperature (CCT):** The actual color of the LED is called the color temperature and is defined in terms of the spectral tri-stimulus values (color coordinates) according to the recommendations of IESNA LM-16-93. For color coordinates near the blackbody loci, the correlated color temperature, measured in Kelvin (K), is used.
- G. **CSA:** Canadian Standards Association.
- H. **Duv:** the closest distance from the Planckian locus on the ( $u'$ ,  $2/3 v'$ ) diagram, with + sign for above and - sign for below the Planckian locus.
- I. **ETLT:** elevated temperature life test.
- J. **Integral LED lamp:** a lamp with LEDs, an integrated LED driver, and an ANSI standardized base designed to connect to the branch circuit via an ANSI standardized lampholder/socket.
- K. **IEC:** International Electrotechnical Commission.
- L. **IESNA:** Illuminating Engineering Society of North America.
- M. **ISTMT:** *in situ* temperature measurement test.
- N. **LED array:** An assembly of LED packages on a printed circuit board or substrate, possibly with optical elements and additional thermal, mechanical, and electrical interfaces. The device does not contain a power source, does not include an ANSI standardized base, and is not connected directly to the branch circuit.
- O. **LED driver:** A power source with integral LED control circuitry designed to meet the specific requirements of a LED lamp or a LED array.
- P. **LED lumen maintenance (L<sub>70</sub>):** The length of time declared by the manufacturer at which 70% lumen maintenance of any large sample of LEDs is reached.
- Q. **LED module:** A component part of an LED light source that includes one or more LEDs connected to the load side of LED power source or LED driver. Electrical, electronic, optical, and mechanical components may also be part of an LED module. The LED module does not contain a power source and is not connected directly to the branch circuit.
- R. **LED package:** An assembly of one or more LED dies that contains wire bond connections, possibly with an optical element and thermal, mechanical, and electrical interfaces. The device does not include a power source, does not include an ANSI standardized base, and is not connected directly to the branch circuit.
- S. **Lumen maintenance:** The luminous flux at a given time in the life of the LED and expressed as a percentage of the initial luminous flux.
- T. **MacAdam color ellipse:** An elliptical region of chromaticity coordinates that is defined using a centroid, a tilt angle relative to a horizontal axis, and a defined level of variance. Such a region defines what chromaticity

<sup>2</sup> ANSI/IESNA RP-16-05, Addendum "a". IESNA. 2008.

- coordinates can be acceptably associated with a target Correlated Color Temperature.
- U. **Manufacturer designated Temperature Measurement Point (TMP):** The temperature measurement point designated by the manufacturer correlating to photometric, life or warranty values.
  - V. **MOL:** Maximum overall length.
  - W. **Minimum operating temperature:** The minimum temperature at which the power supply will reliably operate.
  - X. **MRA:** Mutual Recognition Arrangement.
  - Y. **NEMA:** National Electrical Manufacturers Association.
  - Z. **NRTL:** Nationally Recognized Testing Laboratory.
  - AA. **NVLAP:** National Voluntary Laboratory Accreditation Program.
  - BB. **OSHA:** Occupational Safety and Health Administration.
  - CC. **Power factor:** The active power divided by the apparent power (i.e., product of the rms input voltage and rms input current of a driver).
  - DD. **TMP:** temperature measurement point.
  - EE. **UL:** Underwriters Laboratories

**3) REFERENCE STANDARDS AND PROCEDURES:** ENERGY STAR qualified integral LED lamps shall comply with the relevant clauses of the following standards, unless the requirements of the ENERGY STAR Integral LED Lamp criteria are more restrictive:

ANSI C78.377-2008	<i>Specifications for the Chromaticity of Solid State Lighting Products</i>
ANSI C79.1– 2002	<i>American National Standard for Electric Lamps – Nomenclature for Glass Bulbs Intended for Use with Electric Lamps</i>
ANSI C78.20 – 2003	<i>American National Standard for Electric Lamps – A, G, PS, and Similar Shapes with E26 Medium Screw Bases</i>
ANSI C78.21 – 2003	<i>American National Standard for Electric Lamps – PAR and R Shapes</i>
ANSI C78.24 – 2001	<i>American National Standard for Electric Lamps – Two-inch (51 mm) Integral-reflector Lamps with Front Covers and GU5.3 or GX 5.3 Bases</i>
ANSI/IEC C81.61-2003	<i>American National Standard for Electric Lamp Bases</i>
ANSI/IEEE C62.41 – 1991 (01-May-1991)	<i>Surge Voltages in Low-Voltage AC Power Circuits, Recommended Practice for</i>
CIE Publication No. 13.3 – 1995	<i>Method of Measuring and Specifying Color Rendering of Light Sources</i>
CIE Publication No. 18.2 – 1983	<i>The Basis of Physical Photometry</i>
IESNA LM-16-1993	<i>Practical Guide to Colorimetry of Light Sources</i>
IESNA LM-28-89 – 1989	<i>Guide for the Selection, Care, and Use of Electrical Instruments in the Photometric Laboratory</i>
UL 1993 – 1999	<i>Standard for Self-Ballasted Lamps and Lamp Adapters</i>
UL 8750 – 2009	<i>Light Emitting Diode (LED) Equipment for Use in Lighting Products</i>

<b>Performance Characteristics</b>	<b>Test Procedure</b>
Lumen Output and Efficacy	IESNA LM-79-08 Electrical and Photometric Measurement of Solid State Lighting Products
Lumen Maintenance and Life	IESNA LM-79-08 at T=0 hrs and T=6,000 hrs or other target time; OR IESNA LM-80-08, Approved Method for Measuring Lumen Maintenance of LED Light Sources + IESNA LM-79-08 at T=0 hrs, T=3000 hrs, and T=6,000 hrs or other target time
Color Rendering Index	CIE Publication 13.3 – 1995
Transient Protection	ANSI/IEEE C62.41 (01-May-1991), Category A, 7 strikes
Electromagnetic Interference	FCC 47 CFR including Part 2 (Equipment Authorization) and Part 18 (Technical Standards and Emission Limits) for consumer RF Lighting Equipment limits

#### 4) REQUIREMENTS FOR ALL LAMPS

Criteria Item	ENERGY STAR Requirements			Reference Standard/ Test Method	Sample Size/Specific Requirements	Laboratory Requirements
Correlated Color Temperature (CCT) and Duv	Lamp must have one of the following designated CCTs (per ANSI C78.377-2008) consistent with the 7-step chromaticity quadrangles and Duv tolerances listed below (see Appendix A for more information).			LM-79-08 ANSI C78-377-2008	10 units per model - 5 base-up - 5 base-down At least 9 of the 10 samples must meet the specification	DOE CALiPER Recognized or NVLAP Accredited for LM-79-08
	Nominal CCT	Target CCT (K) and tolerance	Target Duv and tolerance			
	2700 K	2725 ± 145	0.000 ± 0.006			
	3000 K	3045 ± 175	0.000 ± 0.006			
	3500 K	3465 ± 245	0.000 ± 0.006			
	4000 K	3985 ± 275	0.001 ± 0.006			
Color Maintenance	The change of chromaticity over the minimum lumen maintenance test period (6000 hours) shall be within 0.007 on the CIE 1976 (u',v') diagram.			LM-79-08 ANSI C78.377-2008	10 units per model - 5 base-up - 5 base-down 9 of 10 lamps must meet specification	DOE CALiPER Recognized or NVLAP Accredited for LM-79-08
Color Rendering Index (CRI)	Minimum CRI (R <sub>a</sub> ) of 80. In addition, the R <sub>9</sub> value must be greater than 0.			LM-79-08 ANSI C78.377-2008 CIE 13.3-1995	10 units per model - 5 base-up - 5 base-down Average of 10 samples must meet specification; none lower than 77	DOE CALiPER Recognized or NVLAP Accredited for LM-79-08
Dimming  NOTE: DOE is working with NEMA to develop a dimming standard for LED lamps and luminaires.	Lamps may be dimmable or non-dimmable. Product packaging must clearly indicate whether the lamp is dimmable or not dimmable. Manufacturers qualifying dimmable products must maintain a Web page providing dimmer compatibility information.  Minimum efficacy, light output, CCT, CRI, and power factor of dimmable lamps will be confirmed with the lamp operated at full power.			n/a	n/a	n/a
Warranty	A warranty must be provided for lamps, covering material repair or replacement for a minimum of three (3) years from the date of purchase.					

Allowable Lamp Bases	Must be a lamp base listed by ANSI.	ANSI C81.61-2007		Self certification <sup>3</sup>
Power Factor	For lamp power $\leq 5W$ and for low voltage lamps, no minimum power factor is required For lamp power $> 5W$ , power factor must be $\geq 0.70$  <b>Note:</b> Power factor must be measured at rated voltage.	ANSI C82.77-2002 LM-79-08	10 units per model - 5 base-up - 5 base-down Average of 10 samples $\geq 0.70$	DOE CALiPER Recognized or NVLAP Accredited for LM-79-08
Minimum Operating Temperature	Integral lamp shall have a minimum operating temperature of $-20^{\circ}C$ or below.			Self certification
LED Operating Frequency	$\geq 150$ Hz  <b>Note:</b> This performance characteristic addresses problems with visible flicker due to low frequency operation and applies to steady-state as well as dimmed operation. Dimming operation shall meet the requirement at all light output levels.		1 unit per model	Self certification
Electromagnetic and Radio Frequency Interference	Integral LED lamps must meet the appropriate FCC requirements for consumer use (FCC 47 CFR Part 15).		1 unit per model	FCC laboratory or manufacturer's laboratory <sup>4</sup>
Audible Noise	Integral lamp shall have a Class A sound rating.			Self certification
Transient Protection	Power supply shall comply with IEEE C.62.41-1991, Class A operation. The line transient shall consist of seven strikes of a 100 kHz ring wave, 2.5 kV level, for both common mode and differential mode.	IEEE C.62.41-1991	5 units per model	Self certification
Operating Voltage	Lamp shall operate at rated nominal voltage of 120, 240 or 277 VAC, or at 12 or 24 VAC or VDC.			Self certification

<sup>3</sup> Self-certification is a declaration of conformance by the manufacturer to the requirement. For self-certification where data are required (sample size is specified in the requirement), the manufacturer may use data obtained directly from the manufacturer's own facilities that are neither NVLAP nor A2LA accredited.

<sup>4</sup> Laboratory must be listed on FCC Office of Engineering & Technology web site, and with either NVLAP or A2LA accreditation.

## 5) PACKAGING REQUIREMENTS

Warranty	Product packaging must state “Warranty” or “Limited Warranty” terms and provide a toll-free (e.g., “800”) number, or mailing address, or Web site address ( <i>if applicable</i> ) for consumer complaint resolution. The written warranty must be included with the lamp packaging at the time of shipment.
Product Packaging Language	In English, or English with additional languages. For products that will be sold in Canada, packaging must include both English and French.
Incompatibility with Controls and Application Exceptions	Lamp package <u>must clearly state</u> any known incompatibility with photo controls, occupancy sensors, or timing devices. In addition, packaging should state specific application exceptions, such as totally enclosed fixtures, insulated air-tight (ICAT) recessed downlights, damp locations, and any other application restrictions.
Dimmable lamps	Lamp package and product information sheet must include a caution label indicating the lamp may not be compatible with all dimmers and identifying the Web address (URL) to find up-to-date dimmer compatibility information.
LED MR-16 Lamps Intended for use on Low-Voltage Circuits	Lamp package must state compatibility with low-voltage transformers.  Lamp package and product information sheet must include a caution label indicating the lamp may not be compatible with all low-voltage transformers used in existing light fixtures and identifying the Web address (URL) to find up-to-date low-voltage transformer compatibility and appropriate use information.
Non-Standard Lamps	Lamp package or package inserts must indicate lighting applications and fixture types for which the non-standard lamp is intended. Please see Appendix C for sample icons recommended to communicate appropriate applications.
Product Equivalency Claims (for Replacement Lamps)	For replacement lamps (excluding non-standard lamps), product packaging, supporting documents, and marketing material may only reference ANSI standard lamp type indicated on ENERGY STAR product application. Performance comparisons to other types of lamps or lamp powers are not allowed.
Lighting Facts Label	Manufacturers must participate in DOE’s Quality Advocates program and use the Lighting Facts label that is part of that program: <a href="http://www.lightingfacts.com">www.lightingfacts.com</a> . Data submitted for ENERGY STAR qualification will automatically be sent to Quality Advocates to generate a label. Manufacturers will not need to send duplicate test reports for each program.
Model Number	Packaging must include model number. Model number must be different from any earlier, non-ENERGY STAR qualified versions of the product.



**6) Non-Standard Lamps – for LED lamps of non-standard lamp type or form**

Lamps in this category may not state equivalency to existing standard electric lamps in terms of wattage or type on lamp packaging, promotional materials, or cut sheets, either in print or electronic form. In addition to the requirements above, the following performance and information requirements apply to Non-standard Lamps. These criteria are not applicable to LED lamps intended to replace linear fluorescent or high-intensity discharge (HID) lamps.

Criteria Item	ENERGY STAR Requirements	Reference Standard/Test Procedure	Sample Size/Specific Requirements	Laboratory Requirements
Minimum Luminous Efficacy - LED lamp power <10W - LED lamp power ≥10W	50 lm/W 55 lm/W	LM-79-08	10 units per model - 5 base-up - 5 base-down 9 of 10 lamps must meet specification	DOE CALiPER Recognized or NVLAP Accredited for LM-79-08
Minimum Light Output	200 lumens	LM-79-08	10 units per model - 5 base-up - 5 base-down 9 of 10 lamps must meet specification	DOE CALiPER Recognized or NVLAP Accredited for LM-79-08
Luminous Intensity Distribution	No specific distribution is required. Must submit goniophotometry report showing luminous intensity distribution produced by the lamp.	LM-79-08, Section 10	1 unit per model	DOE CALiPER Recognized or NVLAP Accredited for LM-79-08
Lumen Maintenance	≥ 70% lumen maintenance (L <sub>70</sub> ) at 25,000 hours of operation	LM-79-08; Elevated Temperature Test per ENERGY STAR CFL version 4.0; LM-80-08 (for early initial qualification option)	10 units per model - 5 base-up - 5 base-down - LED lamp power <10W must operate at 25°C between measurements. - LED lamp power ≥10W must operate at 45°C between measurements. -Average of 10 samples must be ≥ 91.8% at 6000 hours	DOE CALiPER Recognized or NVLAP Accredited for LM-79-08
Rapid-Cycle Stress Test	Cycle times: 2 minutes on, 2 minutes off. Lamp cycled once for every two hours of required minimum L <sub>70</sub> life	ANSI C78.5 LM-65-01 (clauses 2,3,5, 6)	10 units per model - 5 base-up - 5 base-down 9 of 10 lamps must meet required number of cycles	DOE CALiPER Recognized or NVLAP Accredited for LM-79-08 or NVLAP Accredited for LM-65-01

**7) Replacement Lamps – for lamps intended to replace existing standard electric lamps (per ANSI C79.1-2002)**

All lamps stating equivalency to a standard lamp wattage or type in product packaging, literature, or other materials must provide the following information about the lamp to be replaced (i.e., the target lamp):

- 1) Target lamp type, using standard lamp designations defined in ANSI C79.1-2002. For example, A, R, MR, PAR, etc.
- 2) Target lamp diameter in eighths of an inch. For example, A19, MR16, PAR38, etc.
- 3) Target lamp nominal wattage.
- 4) For directional lamp types, target lamp beam angle in degrees.

These criteria are not applicable to LED lamps intended to replace linear fluorescent or high-intensity discharge (HID) lamps.

Minimum performance and dimensional criteria are provided below for omnidirectional, decorative, and directional lamp replacements.

**7A) Omnidirectional Lamps**

Applicable lamp types: A, BT, P, PS, S, T (per ANSI C79.1-2002)

Criteria Item	ENERGY STAR Requirements	Reference Standard/Test Procedure	Sample Size/Specific Requirements	Laboratory Requirements
Minimum Luminous Efficacy - LED lamp power <10W - LED lamp power ≥10W	50 lm/W 55 lm/W	LM-79-08	10 units per model - 5 base-up - 5 base-down 9 of 10 lamps must meet specification	DOE CALiPER Recognized or NVLAP Accredited for LM-79-08
Minimum Light Output	Lamp shall have minimum light output (initial total luminous flux) at least corresponding to the target wattage of the lamp to be replaced, as shown below. Target wattages between the given levels may be interpolated.	LM-79-08	10 units per model - 5 base-up - 5 base-down 9 of 10 lamps must meet specification	DOE CALiPER Recognized or NVLAP Accredited for LM-79-08
	Nominal wattage of lamp to be replaced (watts)	Minimum initial light output of LED lamp (lumens)		
	25	200		
	35	325		
	40	450		
	60	800		
	75	1,100		
	100	1,600		
	125	2,000		
150	2,600			

Luminous Intensity Distribution	Products shall have an even distribution of luminous intensity (candelas) within the 0° to 135° zone (vertically axially symmetrical). Luminous intensity at any angle within this zone shall not differ from the mean luminous intensity for the entire 0° to 135° zone by more than 20%. At least 5% of total flux (lumens) must be emitted in the 135°-180° zone. Distribution shall be vertically symmetrical as measured in three vertical planes at 0°, 45°, and 90°. See Appendix B for illustration.	LM-79-08, Section 10	1 unit per model	DOE CALiPER Recognized or NVLAP Accredited for LM-79-08
Maximum lamp diameter	Not to exceed target lamp diameter as per ANSI C78.20-2003.	ANSI C78.20-2003		Self-certification
Maximum overall length (MOL)	Not to exceed MOL for target lamp as per ANSI C78.20-2003.	ANSI C78.20-2003		Self-certification
Lumen Maintenance	≥ 70% lumen maintenance (L <sub>70</sub> ) at 25,000 hours of operation	LM-79-08; Elevated Temperature Test per ENERGY STAR CFL version 4.0; LM-80-08 (for early initial qualification option)	10 units per model - 5 base-up - 5 base-down - LED lamp power <10W must operate at 25°C between measurements. - LED lamp power ≥10W must operate at 45°C between measurements. -Average of 10 samples must be ≥ 91.8% at 6000 hours	DOE CALiPER Recognized or NVLAP Accredited for LM-79-08
Rapid-Cycle Stress Test	Cycle times must be 2 minutes on, 2 minutes off. Lamp will be cycled once for every two hours of required minimum L <sub>70</sub> life.	ANSI C78.5 LM-65-01 (clauses 2,3,5, 6)	10 units per model - 5 base-up - 5 base-down 9 of 10 lamps must required number of cycles	DOE CALiPER Recognized or NVLAP Accredited for LM-79-08 or NVLAP Accredited for LM-65-01

**7B) Decorative Lamps**

Applicable lamp types: B, BA, C, CA, DC, F, G (per ANSI C79.1-2002)

Criteria Item	ENERGY STAR Requirements	Reference Standard/Test Procedure	Sample Size/Specific Requirements	Laboratory Requirements
Minimum Luminous Efficacy	40 lm/W	LM-79-08	10 units per model - 5 base-up - 5 base-down 9 of 10 lamps must meet specification	DOE CALiPER Recognized or NVLAP Accredited for LM-79-08
Minimum Light Output	Lamp shall have minimum light output (total luminous flux) at least corresponding to the target wattage of the lamp to be replaced, as shown below. Target wattages between the given levels may be interpolated.	LM-79-08	10 units per model - 5 base-up - 5 base-down 9 of 10 lamps must meet specification	DOE CALiPER Recognized or NVLAP Accredited for LM-79-08
	Nominal wattage of lamp to be replaced (watts)	Minimum light output of LED lamp (lumens)		
	10	70		
	15	90		
	25	150		
	40	300		
	60	500		
Maximum lamp diameter	Not to exceed target lamp diameter.			Self certification
Lumen Maintenance	≥ 70% lumen maintenance (L <sub>70</sub> ) at 15,000 hours of operation	LM-79-08, LM-80-08 (for early initial qualification option)	10 units per model - 5 base-up - 5 base-down -Must operate at 25°C between measurements. -Average of 10 samples must be ≥ 86.7% at 6000 hours	DOE CALiPER Recognized or NVLAP Accredited for LM-79-08
Rapid-Cycle Stress Test	Cycle times must be 2 minutes on, 2 minutes off. Lamp will be cycled once for every two hours of required minimum L <sub>70</sub> life.	ANSI C78.5 LM-65-01 (clauses 2,3,5, 6)	10 units per model - 5 base-up - 5 base-down 9 of 10 lamps must required number of cycles	DOE CALiPER Recognized or NVLAP Accredited for LM-79-08 or NVLAP Accredited for LM-65-01

## 7C) Directional Lamps

Applicable lamp types BR, ER, K, MR, PAR, R (per ANSI C79.1-2002)

For MR and PAR lamps, the following lamp diameters are included at this time: MR16, PAR16, PAR20, PAR30S (short neck), PAR30L (long neck), PAR38

Criteria Item	ENERGY STAR Requirements	Reference Standard/Test Procedure	Sample Size/Specific Requirements	Laboratory Requirements
Definition	Directional lamp means a lamp having at least 80% light output within a solid angle of $\pi$ sr (corresponding to a cone with angle of 120°)	EC No 244/2009; LM-79-08, Section 10	1 unit per model	DOE CALiPER Recognized or NVLAP Accredited for LM-79-08
Minimum luminous efficacy - Lamp diameter $\leq$ 20/8 inch - Lamp diameter $>$ 20/8 inch	40 lm/W 45 lm/W	LM-79-08	10 units per model - 5 base-up - 5 base-down 9 of 10 lamps must meet specification	
Color Spatial Uniformity	The variation of chromaticity within the beam angle shall be within 0.006 from the weighted average point on the CIE 1976 (u',v') diagram.	LM-79-08 ANSI C78.379-2006, section 5	1 unit per model - Angular chromaticity measurements shall be made at the center and edge of the beam. The measurements shall be made in at least two vertical planes 90° apart. Results shall be averaged from the different vertical planes.	DOE CALiPER Recognized or NVLAP Accredited for LM-79-08
Maximum lamp diameter	Not to exceed target lamp diameter	ANSI C78.21-2003		Self certification
Maximum overall length (MOL)	Not to exceed MOL for target lamp	ANSI C78.21-2003		Self certification
Minimum light output – <b>BR, ER, K, and R lamps</b>	Lamp shall have minimum light output (total luminous flux) equal to the target wattage of the lamp to be replaced multiplied by 10.	LM-79-08	10 units per model - 5 base-up - 5 base-down 9 of 10 lamps must meet specification	DOE CALiPER Recognized or NVLAP Accredited for LM-79-08

Minimum center beam intensity <sup>5</sup> – <b>PAR and MR16 lamps</b>		LM-79-08, Section 10	1 unit per model	DOE CALiPER Recognized or NVLAP Accredited for LM-79-08
- PAR lamps	Link to online tool at <a href="http://www.drintl.com/htmlmail/Energystar/Dec09/ESIntLampCenterBeamTool.zip">http://www.drintl.com/htmlmail/Energystar/Dec09/ESIntLampCenterBeamTool.zip</a> Enter the following information into the online tool: PAR diameter in eighths of an inch (i.e., 16, 20, 30, 38) Target lamp nominal wattage Target lamp beam angle in degrees (Note: maximum allowable beam angle = 65°.)			
- MR16 lamps	Link to online tool at <a href="http://www.drintl.com/htmlmail/Energystar/Dec09/ESIntLampCenterBeamTool.zip">http://www.drintl.com/htmlmail/Energystar/Dec09/ESIntLampCenterBeamTool.zip</a> Enter the following information into the online tool: Target lamp nominal wattage Target lamp beam angle in degrees (Note: maximum allowable beam angle = 50°.)			
Lumen Maintenance	≥ 70% lumen maintenance (L <sub>70</sub> ) at 25,000 hours of operation	LM-79-08; Elevated Temperature Test per ENERGY STAR CFL version 4.0; LM-80-08 (for early initial qualification option)	10 units per model - 5 base-up - 5 base-down - LED lamp power <10W must operate at 25°C between measurements. - LED lamp power ≥10W must operate at 45°C between measurements. -Average of 10 samples must be ≥ 91.8% at 6000 hours	DOE CALiPER Recognized or NVLAP Accredited for LM-79-08
Rapid-Cycle Stress Test	Cycle times must be 2 minutes on, 2 minutes off. Lamp will be cycled once for every two hours of required minimum L <sub>70</sub> life.	ANSI C78.5 LM-65-01 (clauses 2,3,5, 6)	10 units per model - 5 base-up - 5 base-down 9 of 10 lamps must required number of cycles	DOE CALiPER Recognized or NVLAP Accredited for LM-79-08 or NVLAP Accredited for LM-65-01

<sup>5</sup> Models based on statistical analysis of 432 PAR and 122 MR16 lamps produced by NEMA manufacturers are used to set minimum center beam intensity requirements. For a given target lamp wattage and target beam angle, mathematical functions for each lamp type yield the minimum required center beam intensity in candelas (cd). The minimum requirement is within two standard deviations of the center beam intensity predicted by the model.

## 8) LUMEN MAINTENANCE TESTING AND LIFE CLAIMS

Minimum life requirement: 15,000 hours to 70% lumen maintenance ( $L_{70}$ ) for Decorative lamps (section 7B); 25,000 hours for all other lamp types. At least 6,000 hours of lumen maintenance testing of the full integral lamp is required of all lamp types. Products may not be qualified on the basis of component testing alone. Longer  $L_{70}$  life may be claimed based on verified lumen maintenance levels after 6,000 hours of lumen maintenance testing, as follows:

	<b>Minimum lumen maintenance at end of 6000 hours (% of initial lumens; -3% tolerance)</b>	<b>Maximum <math>L_{70}</math> Life Claim (hours)</b>	<b>ENERGY STAR Approval Available After 6000-hour test</b>
Minimum for Decorative	86.7%	15,000	<b>Full approval</b> (no additional lumen maintenance testing required)
Optional for Decorative	89.9%	20,000	
Minimum for Non-standard, Omnidirectional, and Directional Optional for Decorative	91.8%	25,000	
Optional for All Lamp Types	93.1%	30,000	<b>Initial approval,</b> pending completion of total required test period (see Table 2 below)
	94.1%	35,000	
	94.8%	40,000	
	95.4%	45,000	
	95.8%	50,000	

Longer life claims are allowed, based on longer required test periods and associated lumen maintenance thresholds, as shown in Table 2.

<b>Minimum cumulative test period (hours)</b>	<b>Minimum lumen maintenance at end of test period (% of initial lumens; -3% tolerance)</b>	<b>Maximum <math>L_{70}</math> Life Claim (hours)</b>
7,500	91.2%	30,000
8,750	91.5%	35,000
10,000	91.5%	40,000
12,500	91.8%	50,000

Lumen maintenance operation is conducted at specific ambient temperatures shown in Table 3 below, for each lamp category. Periodic photometric tests are conducted at room temperature (25°C).

<b>Lamp category</b>	<b>Lamp subcategory</b>	<b>Minimum ambient temperature</b>
Non-standard lamps Omnidirectional lamps Directional lamps	LED lamp power <10W	25°C
	LED lamp power ≥10W	45°C
Decorative lamps	All	25°C

### 8A) OPTION FOR EARLY INITIAL QUALIFICATION WITH LM-80 AND IN SITU TEMPERATURE MEASUREMENT TEST

This option is available for integral LED lamps using single color or phosphor-converted LED package(s)/array(s)/module(s) for which LM-80-08 test data is available. The manufacturer may submit

LM-80-08 data along with results of an in situ temperature measurement test (ISTMT)<sup>6</sup> to verify the temperature of the LED package(s)/array(s)/module(s) when operated in the integral LED lamp. LED temperature is measured at the manufacturer-designated temperature measurement point (TMP). If the LM-80-08 data consistent with the ISTMT meets threshold requirements corresponding to the target L<sub>70</sub> lifetime, the integral LED lamp is eligible for provisional approval after 3000 hours of long term integral lamp testing. Full qualification depends on successful completion of the full test period.

<b>Table 4. Requirements for Interim Qualification with LM-80 and TMP Verification</b>			
<b>Lumen Maintenance Test</b>	<b>Reference Standard / Test Procedure</b>	<b>Sample Size</b>	<b>Passing Threshold</b>
LM-80-08 data for LEDs used in the integral lamp	LM-80-08	LED packages: 25 LED modules: 10	At least 91.8% lumen maintenance at 6000 hours at Ts ≥ TMP of LED inside integral lamp and at drive current ≥ LED drive current inside integral lamp
TMP verification of LEDs inside integral lamp + declared drive current	In situ Temperature Measurement Test (ISTMT), ENERGY STAR SSL v 1.1	1 unit per model	OSHA approved NRTLs or DOE CALiPER Recognized or UL Data Acceptance Program labs
Operate lamps continuously for 3000 hours at 45°C (5 base up, 5 base down) NOTE: Decorative lamps and all lamps <10W test at 25°C	Elevated Temperature Life Test (ETLT), ENERGY STAR CFL v 4.0; LM-79-08	10 units per model - 5 base-up - 5 base-down	Initial qualification: average lumen maintenance of 10 lamps ≥95.8%. NOTE: ≥ 93.1% for decorative lamps.

**9) CERTIFICATION:** Manufacturers shall certify that ENERGY STAR qualified integral LED lamps sold using the ENERGY STAR certification mark have:

1. Been tested by a third party and listed to UL Standard 1993 for Self-Ballasted Lamps and Lamp Adapters by a Nationally Recognized Testing Laboratory (NRTL) accredited by the Occupational, Safety, and Health Administration (OSHA).
2. Met the manufacturers' declared performance and use criteria that are found on the packaging.
3. Met or exceeded the minimum performance requirements contained in these ENERGY STAR Criteria for the characteristics shown above.

**10) QUALIFICATION FOR INTEGRAL LED LAMP PRODUCTS:** PARTNERS can submit their integral LED lamps for ENERGY STAR qualification by the following the 2-step procedure below: To qualify LED Lamps without using the early initial qualification, submit all the test data from STEP 1 below except for LM-80-08 and TMP data, and submit 6,000 hour lumen maintenance data. Decorative lamps with a lifetime of 15,000 hours and other lamps with a lifetime of 25,000 hours may be fully qualified on the basis of 6,000 hour data. Longer lifetime lamps will only receive an initial qualification and then proceed to STEP 2 below.

**A. STEP 1: EARLY INITIAL QUALIFICATION WITH LM-80-08 AND TMP VERIFICATION**

PARTNER must submit a report that includes the following **completed** tests (see below) from an accredited or DOE CALiPER-recognized lab, which must certify to the authenticity and integrity of the test data. In addition, PARTNER must complete PAGE 1 and the accredited laboratory must complete PAGE 2 of the ENERGY STAR Integral LED Lamps Qualification Form and submit it with the packaging proofs and a product image or photo. A product photo will be required for qualification to assist in identifying the current version of the qualified product. This will also provide identification of the correct product for the Integral LED Lamps Third-Party Testing and Verification Program. The test reports must indicate that the model meets all initial requirements. Incomplete test reports, product packaging, or qualification forms will

<sup>6</sup> See Appendix D for additional information on the In situ Temperature Measurement Test.



not be accepted or processed for ENERGY STAR qualification. PARTNERS must complete the following tests or certifications before they will be considered for INITIAL ENERGY STAR qualification:

- LM-80-08 data for LED package(s), array(s), or module(s) used in the integral LED lamp
- Temperature Measurement Point (TMP) temperature verification of LED in the integral LED lamp
- Lamp Base
- Efficacy
- Rapid-Cycle Stress Test
- 3,000-hour lumen maintenance
- Color Rendering (CRI)
- Correlated Color Temperature (CCT)
  - o Chromaticity measurements for each sample
- Power Factor
- Transient Protection
- Operating Frequency
- Electromagnetic Interference

**Packaging Review:** All PARTNERS who are qualifying an integral LED lamp must submit electronic or hard copy labeling and packaging samples for the specific integral LED lamp model. Packaging must meet all of the requirements that are identified under the Lifetime Performance and Packaging Requirements. Failure to meet the packaging requirements will delay the qualification process and the integral LED lamp model in question will not be qualified until all packaging requirements are met. The specific qualified model must be distributed within this approved product packaging. If products are found being sold or distributed in alternative non-approved packaging, that model will be immediately disqualified from the ENERGY STAR program for failure to meet the criteria. If a PARTNER has multiple cases where products are being sold in unapproved packaging, this may cause their ENERGY STAR Partnership Agreement to be terminated.

Products that meet the above requirements will be considered initially qualified for ENERGY STAR and the PARTNER will receive correspondence (via e-mail or letter) stating the product has met all necessary **initial** requirements and can begin to market the integral LED lamp model as ENERGY STAR by using the certification mark on the product packaging, and identifying the product within marketing materials, and the company's Web site.

## **B. STEP 2: FULL QUALIFICATION:**

PARTNERS will be given a due date in their initial qualification correspondence to submit the **final average rated life time** test report to complete their ENERGY STAR Integral LED Lamp qualification process and fulfill the Full Qualification requirements. This due date will be based on the date the average rated lifetime test began and the rated lifetime of the integral LED lamp, which was recorded on the ENERGY STAR Qualification Form. Failure to submit this final test report within 60 days of completion of the test will result in an immediate disqualification of the model. After the final test report review, if a product does not meet the recorded average rated lifetime, then the disqualification process will be put into effect (see Sections 12 and 13).

Once a model has reached full qualification, it must be re-qualified every **36 months** to ensure ongoing design or manufacturing changes maintain overall performance against the program requirements. See Section 16 for more information on the **ENERGY STAR INTEGRAL LED LAMP RE-QUALIFICATION PROCEDURE**.

## **C. UPGRADING THE LIFE CLAIM OF A PREVIOUSLY-QUALIFIED PRODUCT**

Once a product has been qualified under the procedures above, ENERGY STAR PARTNERS may increase the lifetime of a product only by demonstrating full compliance with the ENERGY STAR criteria at the new lifetime. Specifically, to increase the lifetime of a lamp, PARTNER must submit a report that includes the following **completed** tests from either their properly accredited laboratory or properly accredited third-party testing facility, which must certify to the authenticity and integrity of the test data:

- Rapid-Cycle Stress Test as required at new lifetime

- Lumen Maintenance at minimum required test period

In addition, PARTNERS must complete PAGE 1 and submit it with the packaging proofs, which will be subject to the same review as in the initial qualification process. The accredited laboratory must complete PAGE 2 of the ENERGY STAR Integral LED Lamp Qualification Form and submit it with the test report. If PARTNER plans to initially qualify a product at 6000 hours, then later upgrade the lifetime, it is suggested that initial Rapid-Cycle Stress Test be completed in anticipation of final product lifetime.

**11) PRIVATE LABELING PRODUCTS:** ENERGY STAR PARTNERS may purchase existing qualified integral LED lamp products and submit them for ENERGY STAR qualification by completing and submitting a Private Labeler Qualification Form (*available from your ENERGY STAR Integral LED Lamp Account Manager*) and product packaging draft for review and approval. Once the private labeler form and product packaging have been reviewed and accepted, the private labeling PARTNER will receive correspondence from ENERGY STAR stating that the model will be added to the integral LED lamp qualified product list and can begin to use the ENERGY STAR certification mark on its packaging and marketed as an ENERGY STAR qualified product.

**A. Packaging for Private Labeled Integral LED Lamps:** PARTNERS must submit packaging proofs for each private labeled integral LED lamp. Packaging must identify the exact information (wattage, lumen output, rated lifetime, equivalency, etc.) their supplier has submitted to ENERGY STAR, since the products are exactly the same. If packaging is submitted with incorrect information, the model will not be qualified as ENERGY STAR until the correct packaging is submitted.

**B. Changing of Qualified Integral LED Lamp Supplier:** PARTNERS are required to inform ENERGY STAR within 30 days of changing their supplier of one or more of their private labeled integral LED lamps. PARTNERS must submit a new Private Labeler Form or enter new information into an online product qualification tool along with new product packaging for each product to reflect the updated information.

NOTE: The private labeled products, or products with different model or product numbers, fall under the same quality assurance and disqualification protocol as the originally tested model. Therefore, if the original qualified model is disqualified from the ENERGY STAR program, the corresponding private labeled model(s) will also be disqualified from the ENERGY STAR program.

**12) COMMERCIAL PACKAGING OF PRODUCTS:** ENERGY STAR qualified integral LED lamp products that will be bulk packaged for retail or commercial sales must submit a package proof for the container that the qualified products will be shipped in and that clearly displays all of the required criteria to fulfill the packaging requirements for ENERGY STAR.

NOTE: Those PARTNERS found distributing qualified integral LED lamp products in unidentified packaging or white boxes will be contacted immediately and may have that specific model disqualified from the program. Once all requirements have been met for packaging, ENERGY STAR will add the new private labeled integral LED lamps to the ENERGY STAR qualified lists and searches. All labeling must be in accordance with ENERGY STAR Identity Guidelines found in the Partnership Agreement/Program Requirements and FTC's Appliance Labeling Act regulations. Packaging and promotional materials using the certification mark should be submitted to your ENERGY STAR Integral LED Lamp Account Manager for final review and approval.

**13) QUALITY ASSURANCE:** Original Equipment Manufacturers (OEM) PARTNERS will be required to provide documentation that describes the measures they are taking to assure their ENERGY STAR qualified integral LED lamp and those products they sell to private labelers meet program and criteria requirements.

**A. Manufacturing Quality Control Documentation:** DOE will accept any of the following industry quality control processes:

- Adherence to the International Standards Organization (ISO) 9000 family of international quality management standards and guidelines, used as the basis for establishing quality management systems.

- Employment of the Six Sigma methodology to measure and improve a company's operational performance, practices and systems; or an equally recognized industry process.
- Other quality control systems or formats that are accepted industry standards.

**B. Color Consistency:** The following quality requirements must be met during the production runs of each lamp model:

1. The lamp manufacturer is required to maintain color control such that a minimum of 90 percent of the ongoing production (as represented by samples tested from each production shift for the same color and when typically evaluated over 12 month period) will fall within the ANSI C78.377-2008 chromaticity quadrangle associated with the designated (manufacturer declared) target color.
2. For the purposes of meeting color control, the lamp manufacturer must maintain testing equipment calibrated to international practices and standards and must compile the ongoing color control data in a manner so that it can be easily reviewed upon DOE request.
3. At a minimum, the manufacturer's color quality control program must maintain the following information for a 3-year period:
  - a. Test dates and sample size (minimum of two lamps per production shift)
  - b. Test results (x,y) for each sample lamp measured
  - c. Test results (all x,y data) for sample lamps plotted graphically against the designated chromaticity quadrangle and available for review at least on a quarterly basis (See Appendix A)
  - d. Records to substantiate that 90 percent of the (x,y) data points fall within the applicable chromaticity quadrangle. Manufacturers are encouraged to exceed this target.

**14) INDEPENDENT ENERGY STAR INTEGRAL LED LAMP THIRD-PARTY TESTING AND VERIFICATION PROGRAM:** Manufacturer (including Private Labelers), distributor, and retailer PARTNERS who are active members of the ENERGY STAR Integral LED Lamp Program must participate in the ongoing, integral LED lamp Third-Party Testing and Verification Program, which uses independent, third-party, NVLAP accredited facilities. This third-party testing program is necessary to provide an active system to verify quality of ENERGY STAR qualified integral LED lamp products in the marketplace. This program will conduct random off-the-shelf testing of ENERGY STAR qualified integral LED lamps and provide the results to the PARTNER.

**A.** An independent program has been selected as the means for third party testing for several fundamental reasons, including:

- It will allow for fair and open assessment of third party test data for the U.S. Department of Energy.
- It will serve as an effective firewall for proprietary data sent to the ENERGY STAR Integral LED Lamp Program contractor.

**B.** The goals of the Third-Party Testing and Verification Program are to:

- Develop an integral LED lamp testing program that will aid DOE in maintaining quality control of the ENERGY STAR Integral LED Lamp Program ;
- Develop a mechanism providing added assurance to ENERGY STAR PARTNERS that sponsor Integral LED Lamp Programs and to manufacturer competitors alike that qualified products do in fact meet the ENERGY STAR criteria;
- Provide a basis upon which the DOE can reasonably make decisions on disqualifying products not exhibiting the necessary qualifications to keep its ENERGY STAR qualification status; and
- Maintain the precepts of the ENERGY STAR Program, the highest of which is that the consumer receives superior products that perform as advertised.

**C. Third-Party Testing and Verification Program** will be managed using funds derived from a percentage of testing fees and will have a **product selection working group**. This working group shall be representative of both manufacturer and non-manufacturer stakeholders, as described below.

**Product Selection Working Group:** The Product Selection Working Group will oversee the final product selection process for each testing cycle.

The Product Selection Working Group will be comprised of **five representatives** – two members from industry (ENERGY STAR integral LED lamp manufacturers, retailers, or distributors), two members from an ENERGY STAR state, utility, or energy-efficiency program sponsor partners and DOE, which will serve as the committee chair. The Third-Party Testing Program Administrator will assist the committee.

To be eligible to serve on the Product Selection Working Group, candidates must be recommended or nominated by a current ENERGY STAR partner (which includes manufacturers, retailers, utilities, states, or energy efficiency program sponsors). The main criteria for membership on the product selection working group will be an unbiased view of the existing integral LED lamp marketplace, knowledge of current lighting market trends and consumer practices, and a demonstrated ability and desire to contribute to improving the overall quality of ENERGY STAR qualified integral LED lamps. DOE will review nominations and select the candidates to serve on the working group. Once the working group has been established, the members will serve for a period of two years. Working Group members can be re-nominated to serve another two years once their term is completed.

**D. Third-Party Tests and Verification to be conducted:** All tests and certifications listed below will be conducted as per the qualification stipulations of the current ENERGY STAR criteria for integral LED lamps. These tests and certifications will form the basis for product qualification verification:

- Base
- Efficacy
- Luminous Intensity Distribution
- Rapid-Cycle Stress Test
- Correlated Color Temperature (CCT)
  - Chromaticity measurements for each sample
- Color Rendering Index (CRI)
- Color Spatial Uniformity
- Lumen Maintenance at appropriate interval according to product's claimed lifetime (Table 1 above)
- Power Factor

**E. Product Nomination, Selection and Procurement Process:** Nomination and testing cycles will be conducted biannually. The product nomination and selection timetable and process will begin after the criteria are finalized. The schedule below is an example and subject to change based on effective date of the criteria:

1st Cycle Distribution of Nomination Forms: March 15  
1st Cycle Random Product Generation: March 20  
1st Cycle of Product Nomination Due: April 15  
1st Cycle Review of Product Nominations (with randomly selected products): April 28  
1st Cycle Final List of Products: May 15  
1st Cycle Product Procurement: May 10-June 30  
1st Cycle Product Testing Begins: July 1  
2nd Cycle Distribution of Nomination Forms: September 15  
2nd Cycle Random Product Generation: September 20  
2nd Cycle of Product Nomination Due: October 15  
2nd Cycle Review of Product Nominations (with randomly selected products): November 1  
2nd Cycle Final List of Products: November 15  
2nd Cycle Product Procurement: November 15-Jan 31  
2nd Cycle Product Testing Begins: February 1

**F. Product Nominations:**

1. Products will be selected for third party testing on both a random and nomination selection basis. The program will target to test 20% of the total number of current qualified bulbs during a calendar year; half of the products will be selected via a random generator, the other half will be selected by DOE and participating ENERGY STAR partners (utilities, manufacturers, states, energy-efficiency program sponsors, or other government entities (e.g., Natural Resources

- Canada)).
2. The product testing pool will be comprised of all ENERGY STAR qualified integral LED lamps models.
  3. A maximum of six models per integral LED lamp PARTNER may be tested within the fiscal year (two-cycle timeframe).
  4. Qualified integral LED lamp products that are within six months of its requalification date will be excluded from an upcoming testing cycle.
  5. Following the suggested schedule timeline, the Third-Party Testing Program Administrator will send all PARTNERS a nomination form to complete. The parties who wish to nominate products will be required to submit their nominations electronically by the specified deadline to the Third-Party Testing Program Administrator.
  6. During the 30-day product nomination timeframe, the Third-Party Testing Program Administrator will generate a list of qualified products through the random generator. This initial product list will be reviewed to identify which products are readily available in the marketplace and which products are not. Those products that are not readily available in the marketplace will be removed from the nomination group.
  7. Integral LED lamp PARTNERS who wish to nominate other PARTNERS' ENERGY STAR qualified integral LED lamps will be required to follow the nomination guidelines. The basic guidelines will address the following:
    - Product nomination limits: Nominations will be limited to no more than two models per manufacturer per testing cycle. There is no upper limit for total number of nominations.
    - Rationale for product nomination: Will need to supply evidence on the poor performance of a product, which can include test data, consumer complaints, product returns, etc. Nominations submitted without ample evidence to demonstrate the need for third party testing will be disregarded. All other PARTNERS (e.g. state, utility, or energy-efficiency program sponsor partners) can nominate an unlimited number of integral LED lamp products.

**G. Product Selection:** Submitted product nominations forms will be collected and compiled with the list of randomly selected products by the Third-Party Testing Program Administrator.

The Third-Party Testing Program Administrator will distribute the overall list of product nominations (random generator and PARTNER nominations) to the Product Selection Committee to review. The Third-Party Testing Program Administrator will organize a conference call (or meeting) with the Product Selection Committee to discuss the product nominations and finalize a list of products to test within each cycle. The Product Selection Committee will have five business days to review the nominations and approve the final list of products to test per testing cycle.

DOE will approve the final product list and then the Third-Party Testing Program Administrator will contact each INTEGRAL LED LAMP PARTNER to inform them their product or products will be tested. In addition, the Third-Party Testing Program Administrator will also notify the PARTNER which participating NVLAP accredited laboratory they will be working with.

**H. Costs of Third-Party Testing and Verification Program and Laboratory-PARTNER Logistics:** PARTNERS will pay for the testing of their products. The testing fee will vary as a function of the rated lifetime of the product and all participating laboratories will provide fixed fees. Included in the fee will be a per model charge for the Third Party Program Administrator services, which will not exceed 20%.

Each participating laboratory will provide the established quotation (based on the rated lifetime of the product) to the specific ENERGY STAR integral LED lamp PARTNER. This quotation will include the fixed fee for testing, procurement, and shipment. In addition, the laboratory will provide a confidentiality clause that automatically permits the test laboratory to release the data only to the Third Party Testing Program Administrator and to the manufacturer. PARTNERS will send payment directly to the testing facility within the allotted timeframe. Administrator fees will be distributed by the laboratory to the Third-Party Testing Program Administrator.

Costs for product procurement will be set at a flat fee plus the total retail costs of the samples (to be

determined by participating laboratory(ies)). The flat fee costs cover the logistical costs to purchase the products (transportation, telephone, hotel, etc.). The laboratories will work to identify the best retail price to procure the products. The procurement prices will be reviewed after each cycle to identify whether the cost needs to be adjusted.

Costs for product shipment to the testing facility will be a uniform cost (to be determined once participating laboratory(ies) have been selected for the program).

Third-Party Testing Program Administrator Fees will cover (estimating 20% of overall testing costs):

- Test Report Development
- Coordination of accredited NVLAP laboratories
- Verification of Qualified Product Information
- Coordination of Technical and Nomination Committees
- Notify PARTNERS of product selection and provide selected laboratory information
- Administrative tasks (conference calls; mailings; etc.)

1. Product Procurement: PARTNERS will assist the assigned laboratory in identifying distribution channels to purchase products from and products will be purchased from these identified retail sources or Internet shopping venues. At a minimum, at least two different date or lot codes will make up the samples of bulbs per model tested. Products will be purchased in accordance with these procurement guidelines:
  - Store Selection: If available, samples must be purchased from a minimum of three different retail or commercial outlets.
  - Geographic location selection: At a minimum, samples must be purchased from two (2) separate geographic regions of the U.S. The recommended number of locations is four (4).

The following information will be recorded to assist in clarifying any issues that may arise in the testing process:

- Lot numbers
  - Date code
  - Geographic location of purchase (city, State, zip code, store number)
  - Retailer or distributor where product was purchased
  - Product Photo
  - Product Packaging
2. Information Flow and Data Management: Each PARTNER having product tested will receive the complete test reports for its product(s) directly from the testing laboratory. The Third-Party Testing Program Administrator will also receive the complete testing reports from the testing laboratory. The Third-Party Testing Program Administrator will deliver the compiled test results to DOE to review and identify which products met the ENERGY STAR criteria.

DOE will notify PARTNERS of one of the following outcomes:

- Qualification verification
- Intent to disqualify the product

The Third-Party Testing Program Administrator will be responsible for archiving information for each testing cycle to develop consolidated trend data reports. These data reports will include:

- Overall pass/fail statistics
- Pass/fail statistics by product type
- Statistical scatter plots of measured performance test data
- Statistical analysis of mean, median
- Year-by-year or round-by-round trend data

The Third-Party Testing Program Administrator will prepare a consolidated trend data report that will include all trend data of the tests identified in section 14.D. This report will be made available to interested parties.

3. Testing Review Process: Based on the results and incorporation of measurement tolerances,

DOE will categorize the tested products into two groups:

- Qualification verification
- Intent to disqualify

**Qualification verification** is defined when a product meets or exceeds all of the ENERGY STAR qualification testing requirements of the Third-Party Testing and Verification Program.

**Intent to disqualify** is defined when a product fails one or more of any of the ENERGY STAR qualification testing or Third-Party Testing requirements. If a product is so categorized, DOE will begin the disqualification and appeals process.

**15) DISQUALIFICATION AND APPEALS PROCESS:** The following product disqualification process applies to both the normal ENERGY STAR qualification process and the Third-Party Testing and Verification Program.

- A. For those products intended to be disqualified, DOE will work with its ENERGY STAR Integral LED Lamp Program contractor to develop an official letter to inform the PARTNER of DOE's intent to disqualify the product based on the Third-Party Testing results.
  1. DOE will contact the PARTNER by e-mail or by hard copy letter to inform of the intent to disqualify the model(s) and will provide 30 days for the PARTNER to respond to the notification. Within this 30-day period, the product(s) in question will remain designated as ENERGY STAR qualified to avoid any consumer confusion or unnecessary logistical costs.
  2. If a product is designated for disqualification as a result of the Third Party Testing, the PARTNER can submit a request to the testing laboratory to receive the failed lamp(s) so that the manufacturer can perform an autopsy analysis to try and determine the root cause of the failures.
  3. During the 30-day appeals timeframe, a PARTNER can present to DOE conclusive manufacturing or design evidence, or quality assurance information on why their product did not perform up to ENERGY STAR standards and how the manufacturer has addressed the identified performance issues (poor efficacy or lumen maintenance, early failures, etc.).
  4. If the PARTNER does not respond within 30 days or does not supply sufficient evidence or quality assurance information to why their product should continue to be ENERGY STAR qualified, DOE will move forward and disqualify the PARTNER'S product(s) (and any corresponding retail products or SKUs or private labeled products) and will send a letter to the PARTNER to specify the following actions they must complete:
    - The PARTNER must immediately stop shipment of the specific model(s) and corresponding product or packaging configurations so it inhibits the product from entering into the retail or distribution markets further;
    - The PARTNER must cease use of the ENERGY STAR certification mark on the disqualified model's packaging design, web page, and other marketing materials. The ENERGY STAR Partnership Agreement stipulates the PARTNER'S commitment to fulfill these requirements.
    - To re-qualify a product, the manufacturer must make the necessary improvements to the product(s) design or manufacturing process and resubmit all completed test reports, qualification forms and corresponding packaging proofs demonstrating full compliance with the current ENERGY STAR criteria for integral LED lamps.
    - Products that have been disqualified from the ENERGY STAR Integral LED Lamp Program must wait six months from the disqualification date to submit for requalification.
    - In addition, a pattern of disqualifications may result in termination of the Partnership Agreement.
- B. After the 30-day appeals timeframe, DOE will compile the final list of products that are disqualified from the program and will distribute this information to these groups via the following communication avenues:
  - E-mail announcement
  - Posting as "disqualified" on the ENERGY STAR integral LED lamp qualified product list and search
- C. After a product is officially disqualified, retailers, distributors, or other consumer channels will have 90 days from the disqualification date to remove or sell off existing inventory or cover up the

ENERGY STAR certification mark on the product packaging so that it is not identified as an ENERGY STAR qualified product.

- D. In addition, within the Third-Party Testing and Verification Program, if a PARTNER has at least three products selected for testing (out of the maximum six) and all of the tested products fail, then this will automatically initiate mandatory testing for all of the manufacturer's qualified products.
- E. Disqualification of a model can also result from evidence of non-compliance with the ENERGY STAR Partnership Agreement and/or criteria.

**16) ENERGY STAR INTEGRAL LED LAMP RE-QUALIFICATION PROCEDURE:** Once a model is qualified, it must be re-qualified every 36 months to ensure ongoing design or manufacturing changes maintain overall performance against the program requirements. To re-qualify a product, PARTNERS must follow the current ENERGY STAR INTEGRAL LED LAMP qualification testing procedure and complete all of the required tests. The ENERGY STAR Integral LED Lamp Program contractor will track and inform PARTNERS when their qualified products must begin testing for re-qualification.

The 36-month re-qualification clock will not start until the product has achieved full qualification under (completion of all required tests including average rated lifetime test). Specifically, PARTNERS must:

- A. Submit their product for requalification testing at an accredited NVLAP testing facility within 45 days of notification from the ENERGY STAR integral LED lamp Account Manager.
- B. Submit the test qualification reports and product packaging to the ENERGY STAR integral LED lamp Account Manager for review and approval.

Products that meet the ENERGY STAR criteria will continue to be recognized as ENERGY STAR qualified. Products that fail to meet the criteria will be categorized for immediate disqualification.

**17) RETIREMENT/DISCONTINUATION OF PRODUCTS:** PARTNERS who are discontinuing or retiring a model need to submit to their ENERGY STAR integral LED lamp Account Manager a formal letter stating the specific date this model will be out of the marketplace so it can be identified on the qualified product list as "retired/discontinued" since it will no longer be available.

**18) EFFECTIVE DATE:** The effective date for the ENERGY STAR Program Requirements and Criteria for Integral LED Lamps – Version 1.0 will be August 31, 2010.

All products must re-qualify for ENERGY STAR within three years of the full qualification date.

**19) FUTURE CRITERIA REVISIONS:** ENERGY STAR reserves the right to change the criteria should technological and/or market changes affect its usefulness to consumers, industry, or the environment. Within one year of the effective date of this version, ENERGY STAR will review comments and suggestions for future revisions to the current criteria.



## Appendix A: Chromaticity Specification and Tolerance Quadrangles

This chromaticity specification below was developed by ANSI to be as consistent as possible with existing fluorescent lamp standards, and to reflect the current (and near future) state of SSL technology and color binning capabilities. Each of the eight quadrangles as defined below overlap the six current the ANSI 7-step MacAdam ellipses (consistent with the current ENERGY STAR lighting criteria), and thus have the same nominal CCT as ENERGY STAR fluorescent lamps. Two additional CCTs (4500 and 5700K) are included to encompass the additional CCTs available in SSL. Each quadrangle is defined by the range of CCT and the distance from the Planckian locus on the chromaticity diagram. Refer to ANSI C78.377-2008 for the details of these definitions. Figure 1 shows the plot of these chromaticity quadrangles and the table below shows (x,y) coordinates of the center points and the corners of each quadrangle.

	2700 K		3000 K		3500 K		4000 K		4500 K		5000 K		5700 K		6500 K	
	x	y	x	y	x	y	x	y	x	y	x	y	x	y	X	y
Center point	0.4578	0.4101	0.4338	0.4030	0.4073	0.3917	0.3818	0.3797	0.3611	0.3658	0.3447	0.3553	0.3287	0.3417	0.3123	0.3282
Tolerance quadrangle	0.4813	0.4319	0.4562	0.4260	0.4299	0.4165	0.4006	0.4044	0.3736	0.3874	0.3551	0.3760	0.3376	0.3616	0.3205	0.3481
	0.4562	0.4260	0.4299	0.4165	0.3996	0.4015	0.3736	0.3874	0.3548	0.3736	0.3376	0.3616	0.3207	0.3462	0.3028	0.3304
	0.4373	0.3893	0.4147	0.3814	0.3889	0.3690	0.3670	0.3578	0.3512	0.3465	0.3366	0.3369	0.3222	0.3243	0.3068	0.3113
	0.4593	0.3944	0.4373	0.3893	0.4147	0.3814	0.3898	0.3716	0.3670	0.3578	0.3515	0.3487	0.3366	0.3369	0.3221	0.3261

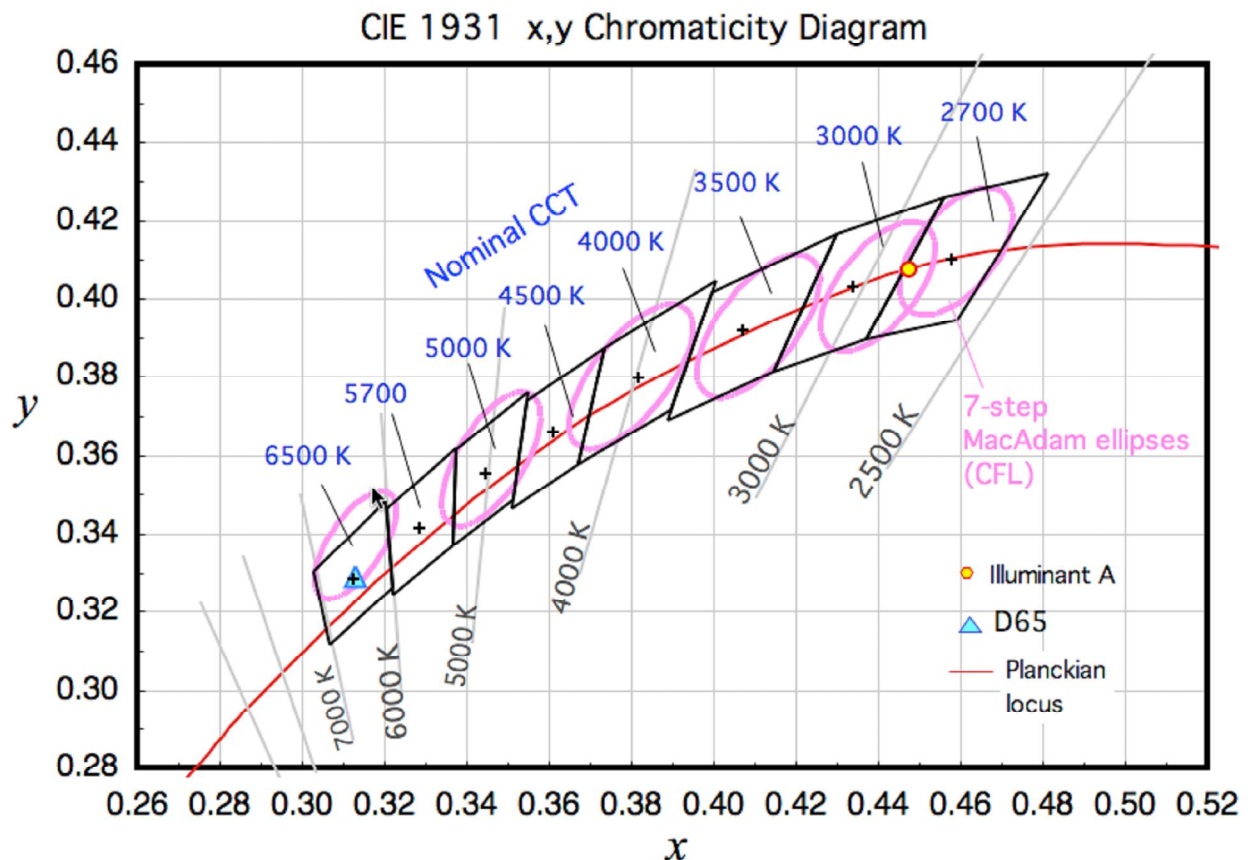
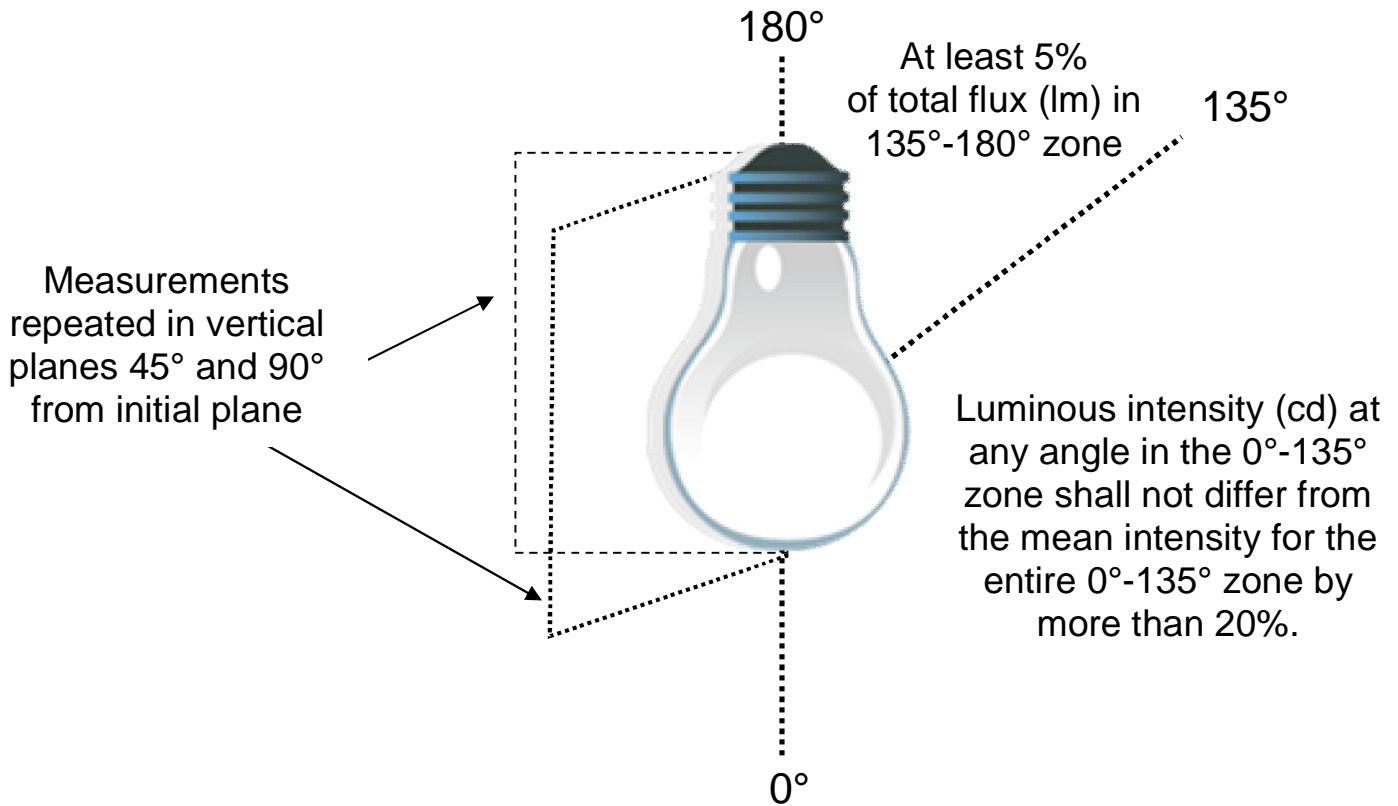


Figure 1. CIE 1931 Chromaticity Diagram Showing the Eight Nominal CCT Quadrangles

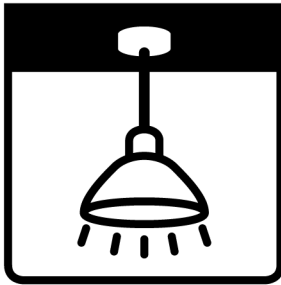
## Appendix B: Diagram of Omnidirectional Lamp Zones

### Omnidirectional lamp in base-up position

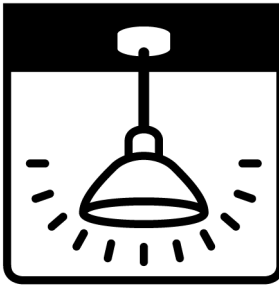


Appendix C: Application Icons for Non-Standard Lamps

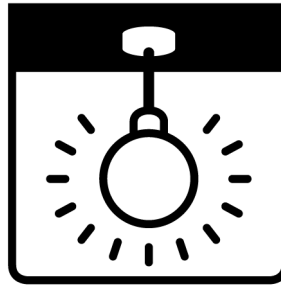
Pendant 1



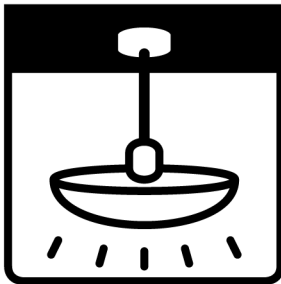
Pendant 2



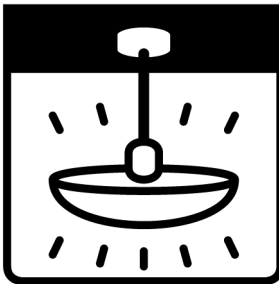
Pendant 3



Suspended 1



Suspended 2



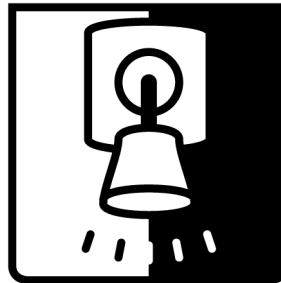
Wall 1



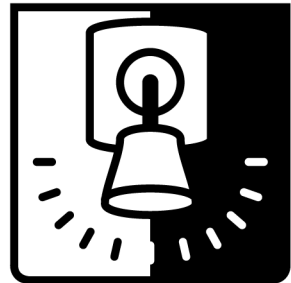
Wall 2



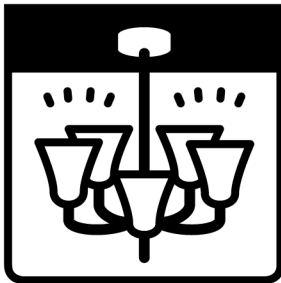
Wall 3



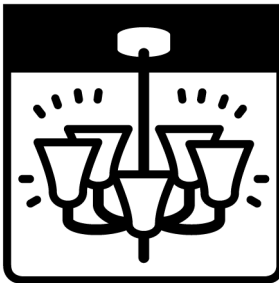
Wall 4



Chandelier 1



Chandelier 2



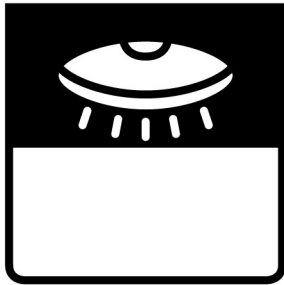
Chandelier 3



Chandelier 4



Recessed



Track



Ceiling



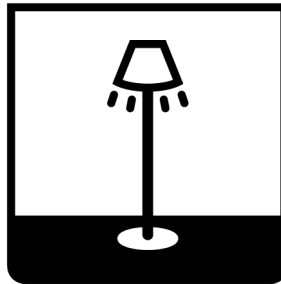
Table



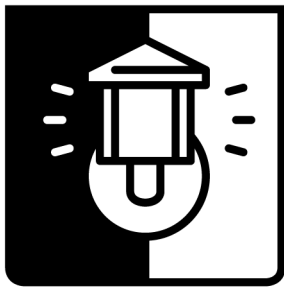
Floor



Floor 2



Outdoor 2



## Appendix D: In situ Temperature Measurement Test (ISTMT)

NOTE: the ISTMT is required only for products using the option for early initial qualification with LM-80-08 test data and ISTMT described in Section 8A.

IESNA LM-80-08 defines lumen maintenance testing for LED packages, arrays, and modules. Because LEDs are incorporated into integral lamps with heat sinks, optical elements, power supplies, etc. and then operated in a variety of ambient environments, LM-80-08 by itself is not a predictor of integral lamp lumen maintenance. To relate the results of the LM-80-08 test to the integral lamp, DOE requires verification of LED temperature in environments that simulate real-world applications (in situ) with tests that measure the temperature of the highest temperature LED in the integral lamp at steady-state thermal equilibrium. The procedure is called the *In situ Temperature Measurement Test (ISTMT)* which follows *ANSI/UL 1993-1999 Standard for Self-Ballasted Lamps and Lamp Adapters*. It includes the addition a thermocouple attached to the LED package, array, or module used in the integral lamp.

### Temperature Measurement Point (TMP)

LED package, array, or module manufacturers designate specific locations on their products which act as surrogate points for measuring junction temperature ( $T_j$ ). DOE generically designates these locations as the temperature measurement points (TMPs) for the purposes of measurement in testing.

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 TMPs.

### Conditions for Use

To be eligible for the optional early initial qualification with LM-80-08 and ISTMT, **ALL** conditions below must be met. If **ANY** of the conditions is not met, the early initial qualification option may not be used.

1. The LED package(s), array(s), or module(s) used in the integral lamp have been tested according to LM-80-08.
2. The LED package/array/module manufacturer prescribes/indicates a temperature measurement point (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 lamp (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.

The ISTMT follows UL 1993 with the addition of a thermocouple attached to the highest temperature LED package or module in the integral lamp (i.e., at TMP).

### Guidance for Thermocouple Attachment

- Manufacturers shall select and designate the highest temperature LED package, array, or module in the integral lamp. 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 integral lamp.
- 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" ( $\leq 1.1^{\circ}\text{C}$  or 0.4%, whichever is greater).