



# ENERGY STAR® Program Requirements for Lamps

## Elevated Temperature Life Test Method

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### 1 OVERVIEW

The following test method shall be used for determining product compliance with the Lumen Maintenance requirements in the ENERGY STAR® Eligibility Requirements for Lamps.

### 2 APPLICABILITY

This elevated temperature life test (ETLT) method applies to certain compact fluorescent and solid-state lamps as specified in the ENERGY STAR Program Requirements Product Specification for Lamps (Light Bulbs).

Medium-base compact fluorescent lamps (CFLs) as defined by 10 CFR 430.2 should be tested according to 10 CFR Part 430 Appendix W to Subpart B, not this ETLT method.

### 3 DEFINITIONS

All terms used in this document are consistent with the definitions in the ENERGY STAR Program Requirements Product Specification for Lamps (Light Bulbs).

### 4 METHODS OF MEASUREMENT AND REFERENCE DOCUMENTS

#### 4.1 IES Test Methods and Reference Documents

- A) IES LM-65-10. 2010. IES Approved Method for Life Testing of Compact Fluorescent Lamps, Illuminating Engineering Society, New York.
- B) IES LM-66-11. 2011. IES Approved Method for Electrical and Photometric Measurements of Single-Ended Compact Fluorescent Lamps, Illuminating Engineering Society, New York.
- C) IES LM-79-08. 2008. IES Approved Method for Electrical and Photometric Measurements of Solid-State Lighting Products, Illuminating Engineering Society, New York.
- D) IES LM-54-12. 2012. IES Guide to Lamp Seasoning, Illuminating Engineering Society, New York.
- E) IES LM-28-12. 2012. Guide for the Selection, Care, and Use of Electrical Instruments in the Photometric Laboratory, Illuminating Engineering Society, New York.

## 4.2 CIE Reference Document

- A) CIE-18.2.1983. 1983. The Basis of Physical Photometry, Commission Internationale de l'Eclairage, Bureau Central de la CIE, Vienna.

## 5 TEST SETUP

- A) Test Setup and Instrumentation: Test setup and instrumentation for the lamp operation portions of this procedure shall be in accordance with the requirements of IES LM-65-10, unless otherwise noted in this document. In the event of conflicting requirements, the ENERGY STAR test method and program requirements shall take precedence.
- B) Lamp Seasoning and Preburning: Prior to the first readings, compact fluorescent lamps (CFL) shall be seasoned for 100 hours in accordance with IES LM-54-12. CFLs shall be preburned in accordance with IES LM-66-11. CFLs shall be seasoned and preburned in the position that the lamps will undergo the ETLT. Seasoning shall be accomplished outside of any elevated temperature testing apparatus. LED lamps shall not be seasoned.
- C) Input Power for Photometric Measurements: During the stabilization and photometric testing of products intended to be powered from AC mains, the product shall be connected to a voltage source that meets the requirements in IES LM-66-11 or IES LM-79-08 as applicable.
- D) Input Power During Aging: During the product on time between photometric measurement points, products intended to be powered from AC mains shall be connected to a voltage source that meets the requirements in IES LM-65-10. When selecting a power supply for use with integrated lamps, it is necessary to apply the appropriate power factor when specifying the volt-amp capacity of the power supply.
- E) Ambient Temperature: Ambient temperature shall be as stated in the specification for the duration of the test. Temperature measurements shall be taken using a temperature measurement device consisting of a thermocouple junction or resistance temperature detector (RTD) probe combined with an appropriate meter. Thermocouples or probes shall be chosen to ensure accuracy within the test temperature range.
- F) Power Meter: Power meters shall be capable of measuring to the appropriate requirements of IES LM-66-11 and/or IES LM-79-08 as applicable.
- G) Environmental Conditions: The test environment shall be clean and free from large amounts of dust and moisture. During the lamps' ON cycle, drafts shall be minimized.
- H) Sample Selection: Samples shall be representative of the manufacturer's typical product. The samples shall be clean and thoroughly inspected before testing. Any flaws or inconsistencies in the lamp samples shall be noted.

## 6 TEST CONDUCT

- A) Photometric Measurements:
  - 1) For integrating sphere measurements, refer to IES LM-66-11 or IES-LM-79-08 as applicable.
  - 2) For non-integrating sphere measurements, the photodetector used for photometric measurements shall be a silicon detector corrected to closely fit the Commission Internationale de l'Eclairage (CIE) spectral luminous efficiency curve ( $V_{\lambda}$ ). For integrating sphere measurements, see IES LM-66-11 or IES-LM-79-08 as applicable.

B) Lamp Transfer and Re-stabilization for CFLs:

CFLs to be removed from the elevated temperature housing or elevated temperature area for photometric testing shall be handled in accordance to LM-66-11. All lamps shall be re-stabilized prior to taking photometric measurements.

C) Lamp Monitoring:

The lamps shall be monitored for continuous operation in accordance with IES LM-65-10, section 6.5.

D) Operating Cycle:

- 1) For CFLs the operation of the lamps shall be three hours ON and 20 minutes OFF.
- 2) For LED lamps the operation of lamps shall be continuous.

## 7 TEST PROCEDURE

A) Lamp Installation

Install the lamp in the elevated temperature situation per the test option used.

B) Initial Measurement:

Conduct measurement of each lamp following the procedures set forth in IES LM-66-11 or IES LM-79-08, as applicable (hours = 0 for LED lamps, hours = 100 for CFL lamps). Record the results obtained at 25°C.

C) Lamp Operation:

Operate lamps per the appropriate operating cycle, modified by conditions described in the testing option selected (Option A, B or C, below).

D) Additional Measurements:

Conduct additional photometric measurements at intervals per the ENERGY STAR requirements for section 10.1 – Lumen Maintenance Requirements in the ENERGY STAR Program Requirements Product Specification for Lamps (Light Bulbs).

## 8 ELEVATED TEMPERATURE LIFE TEST: OPTION A

### 8.1 Ambient Conditions

The ambient temperature around the housing shall be maintained between 25°C and 35°C.

### 8.2 Elevated Temperature Housing and Support

- A) Testing shall be conducted using the Halo® model H7UICAT incandescent downlight housing or EPA-approved substitute.
- B) No trim shall be used.
- C) Luminaires shall be oriented such that the lamp operates vertical base-up during the life test.
- D) The luminaires may be arranged in a horizontal plane or stacked vertically. If stacked vertically, a minimum spacing of 24 inches shall be maintained between the bottoms of each row.

## **9 ELEVATED TEMPERATURE LIFE TEST: OPTION B**

### **9.1 Ambient Conditions**

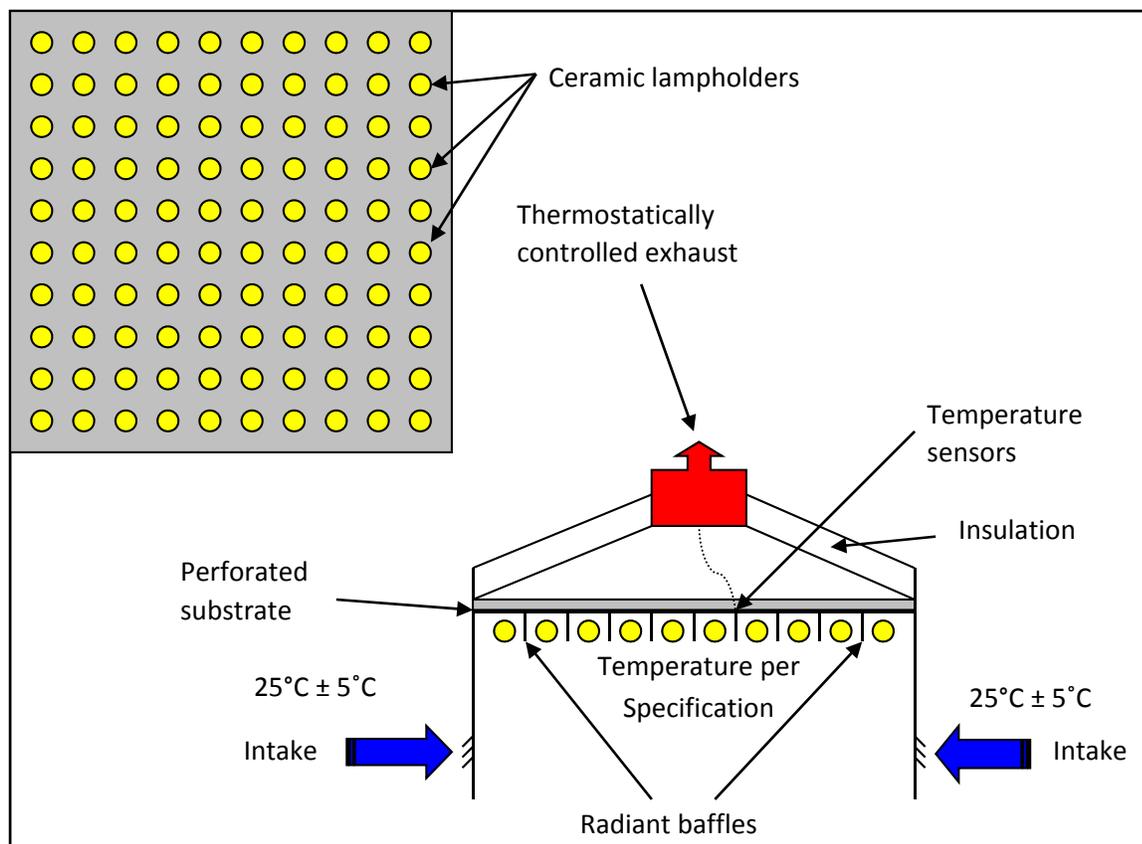
- A) The ambient temperature around the apparatus shall be maintained at  $25^{\circ}\text{C} \pm 10^{\circ}\text{C}$ .
- B) The perimeter of the apparatus shall be kept clear of obstacles so that airflow is not inhibited from entering the apparatus during the purge portion of the test cycle.
- C) The operating temperature within the apparatus shall be represented as the average of at least four measurement locations as specified in the "Temperature Measurement Locations" section (below) and shall be maintained at the temperature designated in the Supplemental Testing Guidance for section 10.1 – Lumen Maintenance Requirements during the ON cycle.
- D) The operating temperature within the apparatus shall be achieved within 45 minutes upon ON cycle initiation.

### **9.2 Operating Cycle**

During the operating cycle, at the onset of the OFF cycle, the exhaust fan shall automatically operate to purge the apparatus with ambient air.

### **9.3 Elevated Temperature Testing Apparatus (See Figure 1)**

- A) The interior of the Elevated Temperature Testing Apparatus (ETTA) shall be a flat section of perforated substrate with ceramic lampholders arranged in a rectangular array.
- B) The perforated substrate shall have holes of a minimum diameter of  $\frac{1}{4}$ -in. spaced at a maximum spacing of 1-in. on center.
- C) The spacing between lampholders shall be no less than 8-in. on center and no greater than 12-in. on center.
- D) Radiant baffles shall be installed at the mid-point between all lampholders and along the perimeter of the lampholder array. The radiant baffles shall be constructed of an opaque, rigid material and shall be a minimum of 10-in. in height.
- E) The exterior of the ETTA shall be sealed and insulated to a minimum level of R-13 on all four sides and the hood.
- F) The sides of the apparatus shall extend a minimum of 12-in. below the bottom of the radiant baffles and shall have an intake section a minimum of 6-in. in height below the sides of the apparatus.
- G) The slope of the hood of the apparatus shall be at least  $30^{\circ}$  above the horizontal.
- H) The top of the hood shall be equipped with an exhaust fan and louver. The fan shall be sized to deliver a minimum of 4.0 cubic feet per minute (cfm) per square foot of apparatus area net of intake and exhaust restrictions.
- I) The exhaust fan shall be thermostatically controlled to maintain the appropriate ambient temperature within the apparatus.
- J) The louver shall automatically close when the fan is not operating.



**Figure 1: Option B Elevated Temperature Test Apparatus**

#### 9.4 Temperature Measurement Locations

- A) The apparatus shall be equipped with at least four ambient temperature measurement devices.
- B) These devices shall be placed in at least two locations between 16 and 24 inches measured inwards from the perimeter of the apparatus and at least two locations between 16 and 24 inches measured outwards from the center of the apparatus.
- C) The operating temperature of the testing area is then defined as the average of at least four temperature readings within the testing area.
- D) The measurement points shall be located at the height of the lamps under test.

#### 9.5 Photometric Measurements

There are two methods of photometric measurement, as applicable, for Elevated Temperature Testing Option B.

- A) Option B Photometric Measurement Method 1: Applicable to CFL and omnidirectional LED lamps only
  - 1) The photometric measurement device shall consist of a securely mounted photodetector positioned such that the plane of its detector is horizontal. Sufficient shielding shall be incorporated such that only the light from the lamp under test is measured. This shielding can be accomplished by the use of a flat-black-painted tube that extends from the photodetector to the bottom edge of the radiant baffles.

- 2) It is recommended that a piece of diffuse transmissive material be installed above the photodetector to diminish the sensitivity of the measurement from minor misalignments of the photodetector.
- 3) For lamps requiring cycling, photometric measurements shall be acquired at a point at least two hours after the beginning of an ON cycle, allowing the light output of the lamp to reach a steady state. In the situation where the specified measurement time occurs before the lamp has reached its steady state operating time, the lamp shall be measured at the closest steady state period.

**B) Option B Photometric Measurement Method 2: Applicable to all lamps**

- 1) The operating cycle shall be stopped at the appropriate measurement points during one of the OFF cycles, and lamps shall be measured in an integrating sphere according to IES LM-66-11 or LM-79-08, as applicable.
- 2) In transferring to the integrating sphere and back to the test apparatus, compact fluorescent lamps shall be handled in accordance with section 10.3 of IES LM-66-11.
- 3) Any pre-burning and stabilization time while the lamps have been removed from the apparatus for photometric testing shall be recorded and incorporated into tested time.
- 4) If applicable, when all lamps have completed photometric testing, the lamps can be returned to the same socket in the apparatus and the elevated temperature life testing can continue.

## **10 ELEVATED TEMPERATURE LIFE TEST: OPTION C**

### **10.1 Ambient Conditions**

- A) The ambient temperature around the housing shall be maintained at the temperature designated in the Supplemental Testing Guidance for section 10.1 – Lumen Maintenance Requirements in the ENERGY STAR Program Requirements Product Specification for Lamps (Light Bulbs) during the ON cycle.

### **10.2 Elevated Temperature Housing and Support**

- A) The lamps may be burned in open air in the required testing orientation so long as the specified ambient temperature per the lumen maintenance requirements is maintained. The ETTA from Option B with baffles removed may be used for this purpose.
- B) The spacing between lampholders shall be positioned such that there shall be a minimum of 2 inches of space between lamps.

### **10.3 Temperature Measurement Locations**

- A) If burned in open air, the testing area shall be equipped with at least four ambient temperature measurement devices.
- B) These devices shall be placed in at least two locations between 16 and 24 inches measured inwards from the perimeter of the testing area and at least two locations between 16 and 24 inches measured outwards from the center of the testing area.
- C) The operating temperature of the testing area is then defined as the average of at least four temperature readings within the testing area.
- D) The measurement point shall be located at the height of the lamps under test.

## 11 TEST REPORT

ETLT report data may be included in an overall performance report or a stand alone report, and shall include the following test information:

- A) Manufacturer's name and product identification
- B) Name and location of testing facility
- C) Name of person(s) performing the test
- D) Test dates
- E) Elevated Temperature Life Testing Option used
- F) Operating temperature
- G) Lamp operating orientation
- H) Operating duration
- I) Photometric and electrical measurements at the appropriate intervals
- J) As applicable, number of hours of operation before failure or note that the lamp reached rated life
- K) Notes describing any non-lumen maintenance failure (e.g., envelope failure, broken glass, cracking, failed LEDs or excessive discoloration) of any lamp that completes testing.