ENERGY STAR® Program Requirements

Product Specification for Lamps:

Elevated Temperature Life Testing

Draft Test Method

Rev. April-2013

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1 OVERVIEW

The following test method shall be used for determining product compliance with the Elevated Temperature Life Test (ETLT) requirements in the ENERGY STAR Eligibility Criteria for Lamps.

2 APPLICABILITY

ENERGY STAR test requirements are described in the specification, and are dependent upon the product category and/or power consumption of the product under evaluation. The following guidelines shall be used to determine the applicability of each section of this document:

- The test procedures in Section 7 shall be performed on products that are required to undergo the Elevated Temperature Life Test in the Supplemental Testing Guidance for Lumen Maintenance Requirements.
- The testing options that are available for the specific product in question are explained in the Supplemental Testing Guidance for Lumen Maintenance Requirements.
- 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 the methods described in this ETLT method.

3 DEFINITIONS

Unless otherwise specified, all terms used in this document are consistent with the definitions in the ENERGY STAR Eligibility Criteria for Lamps.

4 METHODS OF MEASUREMENT AND REFERENCE DOCUMENTS

4.1 IES Test Methods and Reference Documents

A) IES LM-65-01. 2010. IES Approved Method for Life Testing of Compact Fluorescent Lamps, IES Testing Procedures Committee, 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-28-89. 1989. Guide for the Selection, Care, and Use of Electrical Instruments in the Photometric Laboratory, IES Testing Procedures Committee, 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

5.1 General

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

6.1 Guidance for Implementation of Elevated Temperature Life Test Procedure

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 (Vλ). For integrating sphere measurements, see IES LM-66-11 or IES-LM-79-08 as applicable.

B) Lamp Transfer and Re-stabilizations for CFLs:

1) 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:

1) 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

7.1 General Test Procedure

A) Lamp Installation

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

B) Initial Measurement:

1) 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:

1) 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:

1) Conduct additional photometric measurements at intervals per the ENERGY STAR Requirements for section 10.1 – Lumen Maintenance Requirements.

8 ELEVATED TEMPERATURE LIFE TEST: OPTION A

8.1 Ambient Conditions

A) The ambient temperature around the housing shall be maintained at 25°C ± 5°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°C ± 10°C.

A) 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.

B) 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.

C) The operating temperature within the apparatus shall be achieved within 45 minutes upon ON cycle initiation.

9.2 Operating Cycle

A) 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 ¼-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° 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.

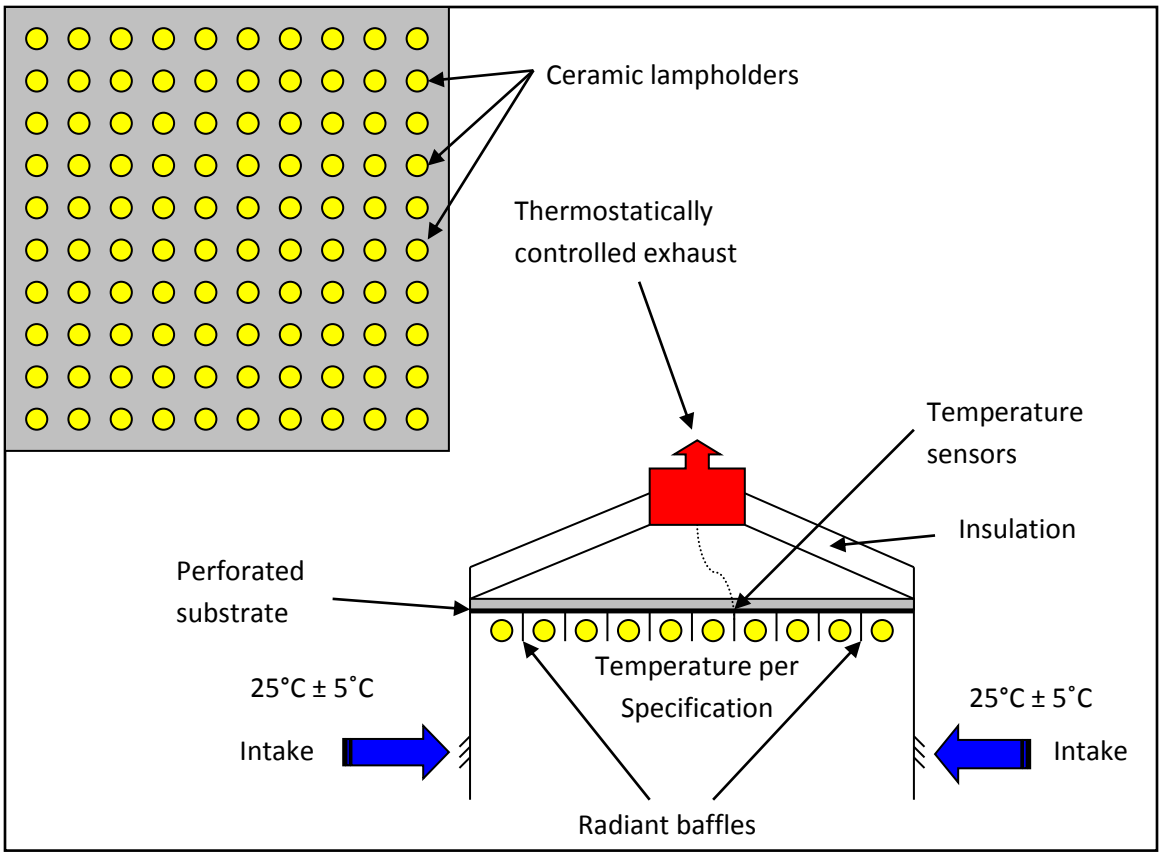

Figure 1: Option B Elevated Temperature Test Apparatus

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 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.

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.

ENERGY STAR® Program Requirements

Product Specification for Lamps:

Ambient Temperature Life Testing

Draft Test Method

Rev. April-2013

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1 OVERVIEW

The following test method shall be used for determining product compliance with the Ambient Temperature Life Test (ATLT) requirements in the ENERGY STAR Eligibility Criteria for Lamps.

2 APPLICABILITY

ENERGY STAR test requirements are dependent upon the product technology, category and/or power consumption of the product under evaluation. The following guidelines shall be used to determine the applicability of each section of this document:

- The ATLT applies to decorative solid state lighting (SSL) lamps of all wattages, omnidirectional SSL <10 watts (W), all SSL lamps labeled “not for use in recessed fixtures” and all omnidirectional SSL lamps labeled “not for use in enclosed fixtures”.
- The test procedures in Section 7 shall be performed on products that are required to undergo the Ambient Temperature Life Test in the Supplemental Testing Guidance for Lumen Maintenance Requirements.

3 DEFINITIONS

Unless otherwise specified, all terms used in this document are consistent with the definitions in the ENERGY STAR Eligibility Criteria for Lamps.

4 METHODS OF MEASUREMENT AND REFERENCE DOCUMENTS

4.1 IES Test Methods and Reference Documents

A) IES LM-65-01. 2010. IES Approved Method for Life Testing of Compact Fluorescent Lamps, IES Testing Procedures Committee, Illuminating Engineering Society, New York.

B) IES LM-79-08. 2008. IES Approved Method for Electrical and Photometric Measurements of Solid-State Lighting Products, Illuminating Engineering Society, New York.

C) IES LM-54-12. 2012. IES Guide to Lamp Seasoning, Illuminating Engineering Society, New York.

D) IES LM-28-89. 1989. Guide for the Selection, Care, and Use of Electrical Instruments in the Photometric Laboratory, IES Testing Procedures Committee, 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

5.1 General

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 shall take precedence.

B) Lamp Seasoning: 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 IES LM-79-08.

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-79-08.

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

6.1 Guidance for Implementation of Ambient Temperature Life Test Procedure

A) Photometric Measurements:

1) For integrating sphere measurements, refer to IES-LM-79-08 .

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-79-08 .

B) Lamp Monitoring:

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

C) Operating Cycle:

1) LED lamps may be operated continuously.

7 TEST PROCEDURE

7.1 General Test Procedure

A) Lamp Installation

1) Install the lamp in the ambient temperature situation per the test method.

B) Initial Measurement:

1) Conduct measurement of each lamp following the procedures set forth in IES LM-79-08 (hours = 0 for LED lamps). Record the results obtained at 25°C ± 1°C.

C) Additional Measurements:

1) Conduct additional photometric measurements as necessary per the ENERGY STAR Requirements for section 10.1 – Lumen Maintenance Requirements.

8 AMBIENT TEMPERATURE LIFE TEST

8.1 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 during the ON cycle.

8.2 Ambient Temperature Housing and Support

A) The lamps may be burned in open air in the required testing orientation so long as the required ambient temperature is maintained.

B) The spacing between lampholders shall be positioned such that there shall be a minimum of 2” space between lamps.

8.3 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.

9 TEST REPORT

ATLT 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) Photometric and electrical measurements at the appropriate intervals

F) Operating temperature

G) Lamp operating orientation

H) Operating duration

I) As applicable, number of hours of operation before failure or note that the lamp reached rated life

J) 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.

ENERGY STAR® Program Requirements Product Specification for Lamps: Elevated Temperature Light Output Ratio

Draft Test Method
Rev. April-2013

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1 OVERVIEW

The following test method shall be used for determining the light output ratio of directional integrated compact fluorescent lamps (CFLs) and directional integrated LED lamps ("LED lamps") ("lamps") tested in an elevated temperature environment compared to an ambient temperature environment. Two measurement methods are provided for performing Elevated Temperature Light Output Ratio test (ETLOR). The test procedure contrasts the light output of lamps in restricted airflow luminaires to the light output of lamps in an ambient temperature environment.

2 APPLICABILITY

ENERGY STAR test requirements are dependent upon the product technology and lamp category of the product under evaluation. The following guidelines shall be used to determine the applicability of each section of this document:

- This ETLOR applies to directional CFLs and directional solid-state lighting (SSL) lamps.
- The test procedures in Section 7 shall be performed on products that are required to undergo the Elevated Temperature Light Output Ratio test.

3 DEFINITIONS

Unless otherwise specified, all terms used in this document are consistent with the definitions in the ENERGY STAR Eligibility Criteria for Lamps.

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-78-07. 2007 IES Approved Method for Total Luminous Flux Measurement of Lamps Using an Integrating Sphere Photometer, Illuminating Engineering Society, New York.

E) IES LM-54-12. 2012. IESNA Testing Procedures Committee, IES Guide to Lamp Seasoning, Illuminating Engineering Society, New York.

F) IES LM-28-89. 1989. Guide for the Selection, Care, and Use of Electrical Instruments in the Photometric Laboratory, IES Testing Procedures Committee, Illuminating Engineering Society, New York.

5 TEST SETUP

5.1 General

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 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 ETLOR test. Seasoning shall be accomplished outside of any elevated temperature testing environment. 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. 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.

D) 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.

E) Power Meter: Power meters shall be capable of measuring to the appropriate metrics of IES LM-66-11 or IES LM-79-08 as applicable.

F) Environmental Conditions: The test environment shall be clean and free from large amounts of dust and moisture.

G) 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.

5.2 Elevated Temperature Measurement: Measurement in a Thermal Chamber

A) For the thermal chamber, utilize the Elevated Temperature Housing and Support found in the ENERGY STAR Program Requirements Product Specification for Lamps: Elevated Temperature Life

Testing, Option A or Option B. Refer to sections 8 and 9 of the Elevated Temperature Life Test for specific details.

B) Ambient air temperature measurements shall be taken at a location 1-in. below the base (defined as the lowest point on the metal Edison socket when installed in a base-up position) of the lamp and 2-in. from the base of the lamp toward the enclosure wall. Measurement points should be no more than one meter from the lamp in accordance to IES LM-66-11 and IES LM-79-08.

C) A controlled draft enclosure shall be used to limit air movement across the lamp to a maximum of 0.08 m/s (15.7 ft/min) when placed in the thermal chamber.

D) 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 base of the lamp. Additionally, 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.

5.3 Elevated Temperature Measurement: Measurement in an Integrating Sphere

A) A 4π sphere or a 2π sphere may be used.

B) For 2π geometry integrating sphere systems in which the lamp is external to the sphere, a thermal chamber around the lamp may be used to achieve the elevated ambient temperature without elevating the temperature of the sphere. The thermal chamber may be in accordance with the *Elevated Temperature Housing and Support* section 8.2 for Option A in the ENERGY STAR® Elevated Temperature Life Test.

C) Integrating sphere or thermal chamber shall limit air movement across the lamp, using the method described in IES LM-66-11 section 5.3.

6 TEST CONDUCT

6.1 Guidance for Elevated Temperature Light Output Ratio

D) 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.

E) Lamp Stabilization for All lamps, Transfer and Re-stabilizations for CFLs:

1) Stabilize lamps per IES LM-66-11 or LM-79-08 as applicable.

2) CFLs to be removed from the seasoning area for ETLOR testing shall be handled according to IES LM-66-11.

7 TEST PROCEDURES

7.1 General Test Procedure

A) Lamp Installation

1) Install the lamp in the thermally controlled environment or thermal chamber.

B) Initial Measurement:

1) Apply the rated lamp voltage while operating in a thermally controlled environment such that the temperature at the apparatus or integrating sphere test point is stable as determined by three measurements, 5 minutes apart at ambient temperature per the specification, and the three measurements not varying by more than ±1°C.
2) Achieve lamp light output stabilization per the “Lamp Stabilization, Transfer and Re-stabilization” section, described above. Lamp stabilization may be concurrent with temperature stabilization.
3) Measure and record light output, input electrical values and test point temperature.

C) Elevated Temperature Measurement

1) Apply the rated lamp voltage while operating in a thermally controlled environment such that the temperature at the test point is stable per IES LM-66-11 or IES LM-79-08, as applicable.

2) Conduct measurement of each lamp following the procedures set forth in IES LM-66-11 or IES LM-79-08, as applicable, with the exception of the elevated temperature.

8 TEST REPORT

ETLOR 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 the testing facility

C) Test date

D) Lamp base orientation

E) Electrical, photometric, and temperature values at the ambient condition

F) Electrical, photometric, and temperature values at the elevated temperature condition

G) Elevated Temperature Light Output Ratio, calculated as the light output at the elevated temperature condition divided by the light output at the ambient condition, expressed as a percentage

ENERGY STAR® Program Requirements Product Specification for Lamps: Start Time

Draft Test Method Rev. April-2013

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1 OVERVIEW

The following test method shall be used for determining product compliance with start time requirements in the ENERGY STAR Eligibility Criteria for Lamps.

2 APPLICABILITY

ENERGY STAR test requirements are dependent upon the product category of the product under evaluation. The following guidelines shall be used to determine the applicability of each section of this document:

- This start time test method applies to all compact fluorescent lamps (CFLs) and solid state lighting (SSL) lamps included in the specification.
- The test procedures in Section 7 shall be performed on products that are required to undergo the ENERGY STAR Start Time Test.

3 DEFINITIONS

Unless otherwise specified, all terms used in this document are consistent with the definitions in the ENERGY STAR Eligibility Criteria for Lamps.

Start Time: The time between the application of power to the device and the point where light output reaches 98% of the lamp's initial plateau.

Initial Plateau: The point at which the average increase in the light output over time levels out (reduces in slope). This can be determined mathematically or visually based on the lamp output trace. For an example see section 9.

4 METHODS OF MEASUREMENT AND REFERENCE DOCUMENTS

4.1 IES Test Methods and Reference Documents

A) IES LM-66-11: 2011. IES Approved Method for Electrical and Photometric Measurements of Single-Ended Compact Fluorescent Lamps, Illuminating Engineering Society, New York.
B) IES LM-79-08: 2008. IES Approved Method for Electrical and Photometric Measurements of Solid-State Lighting Products, Illuminating Engineering Society, New York.
C) IES LM-54-12: 2012. IES Guide to Lamp Seasoning, Illuminating Engineering Society, New York.

5 TEST SETUP

5.1 General

A) Test Setup and Instrumentation:

1) Regulated AC or DC power supply (as applicable to the lamp)

2) Multichannel oscilloscope with data storage capability

3) Appropriate attenuator probe(s)

4) Photodetector

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. LED lamps shall not be seasoned.

C) Input Power for Start Time Measurements: The power requirements shall be per IES LM-66-11 or LM-79-08 as applicable. When selecting a power supply for use with integrated lamps, it is necessary to apply an appropriate power factor when specifying the Volt-Amp capacity of the power supply.

D) Lamp Storage: Lamps shall be stored at 25°C ± 5°C for a minimum of 16 hours prior to the test, after which the temperature range shall be 25°C ± 1°C for at least two hours immediately prior to the test. CFL samples shall be off for 20 hours ± 4 hours prior to the test. If the sample has been off more than 24 hours, it shall be operated for 3 hours and then turned off for 20 hours ± 4 hours prior to conducing the test.

E) Ambient Temperature: Testing shall take place in an ambient temperature of 25°C ± 1°C. Drafts shall be minimized.

F) Power Meter: Power meters shall be capable of measuring to the appropriate requirements of IES LM-66-11 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.

H) Orientation: Test samples in orientation(s) as specified by the ENERGY STAR specification or manufacturer specified position if different.

I) 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

6.1 Guidance for Implementation of Start Time Test Procedure

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 (Vλ).

B) Lamp Transfer for CFLs:

1) CFLs shall be stored per requirements in the Environmental Conditions section before being transported to the start time testing equipment. Care shall be exercised to maintain lamp orientation and avoid shaking or bumping the lamp during the transfer from seasoning.

7 TEST PROCEDURE

7.1 General Test Procedure

A) Install the lamp in the test environment.

B) Position the photocell so it sees the main body of the discharge tube or array (as applicable). Shield from extraneous light as needed.

C) When testing a covered CFL, the photocell only needs to see the outer luminous face of the sample.

D) Connect oscilloscope probe to measure the input voltage to the sample, and light output.

E) Set the scope to trigger off the input voltage signal. Set trigger level at 10V.

F) Set power supply to rated voltage and frequency of the device. If a range is specified, test sample at the midpoint of the range.

G) Use an exemplar sample to determine the proper voltage and time base settings. Suggested initial time base is 200 mS/div.

H) Apply rated voltage/frequency to the device.

I) Record the input voltage and light output waveform on which the starting time was based.

J) Record starting time based on 98% of initial plateau of light output. See Examples 1 and 2 below.

8 TEST REPORT

Start Time test report data shall include the following test information:

A) Manufacturer's name and product identification

B) Name and location of testing facility

C) Test date

D) Lamp base orientation

E) Test voltage (V)

F) Test frequency (Hz)

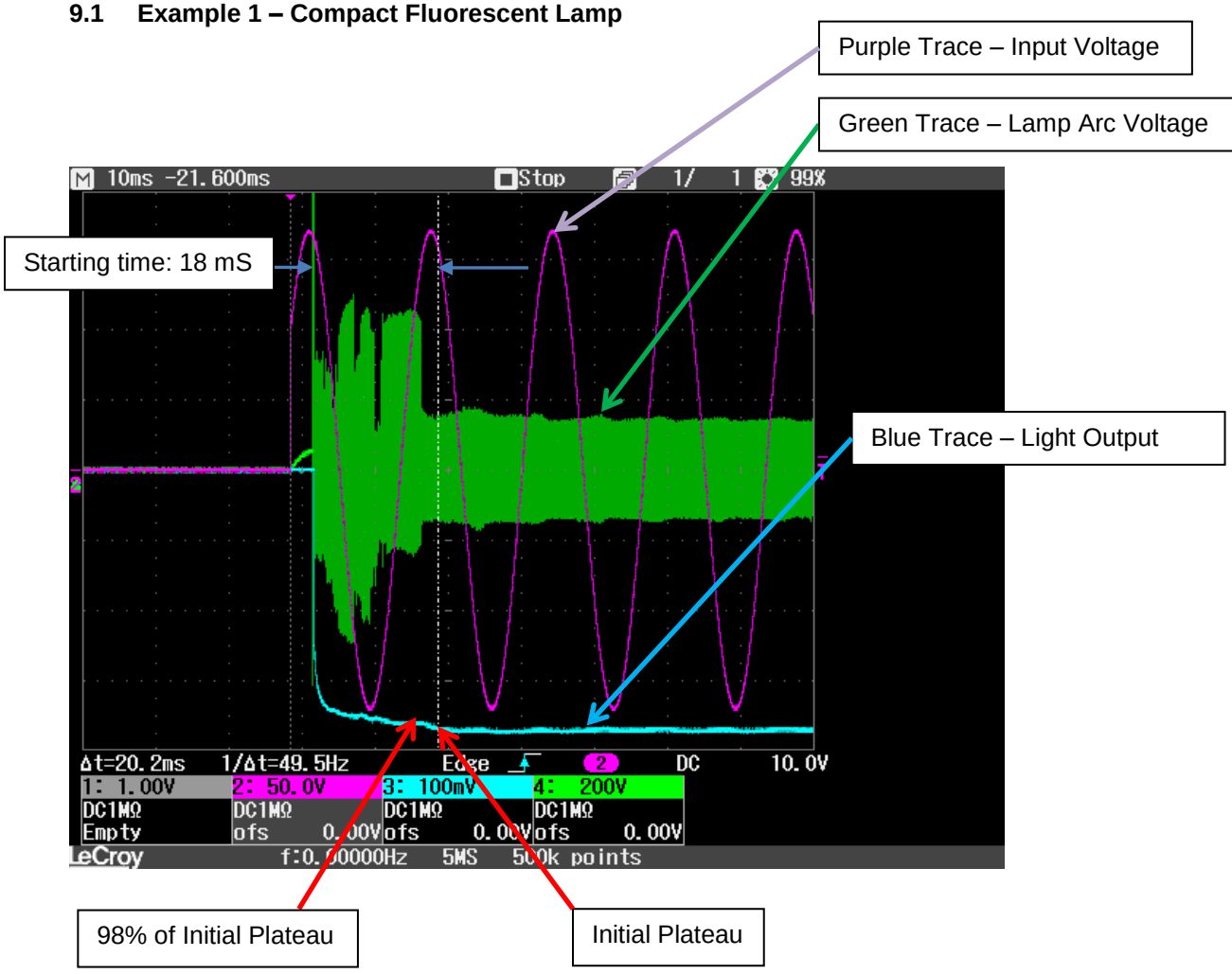
G) Time base setting (mS/div)

H) Input voltage and light output waveforms on which the starting time is based

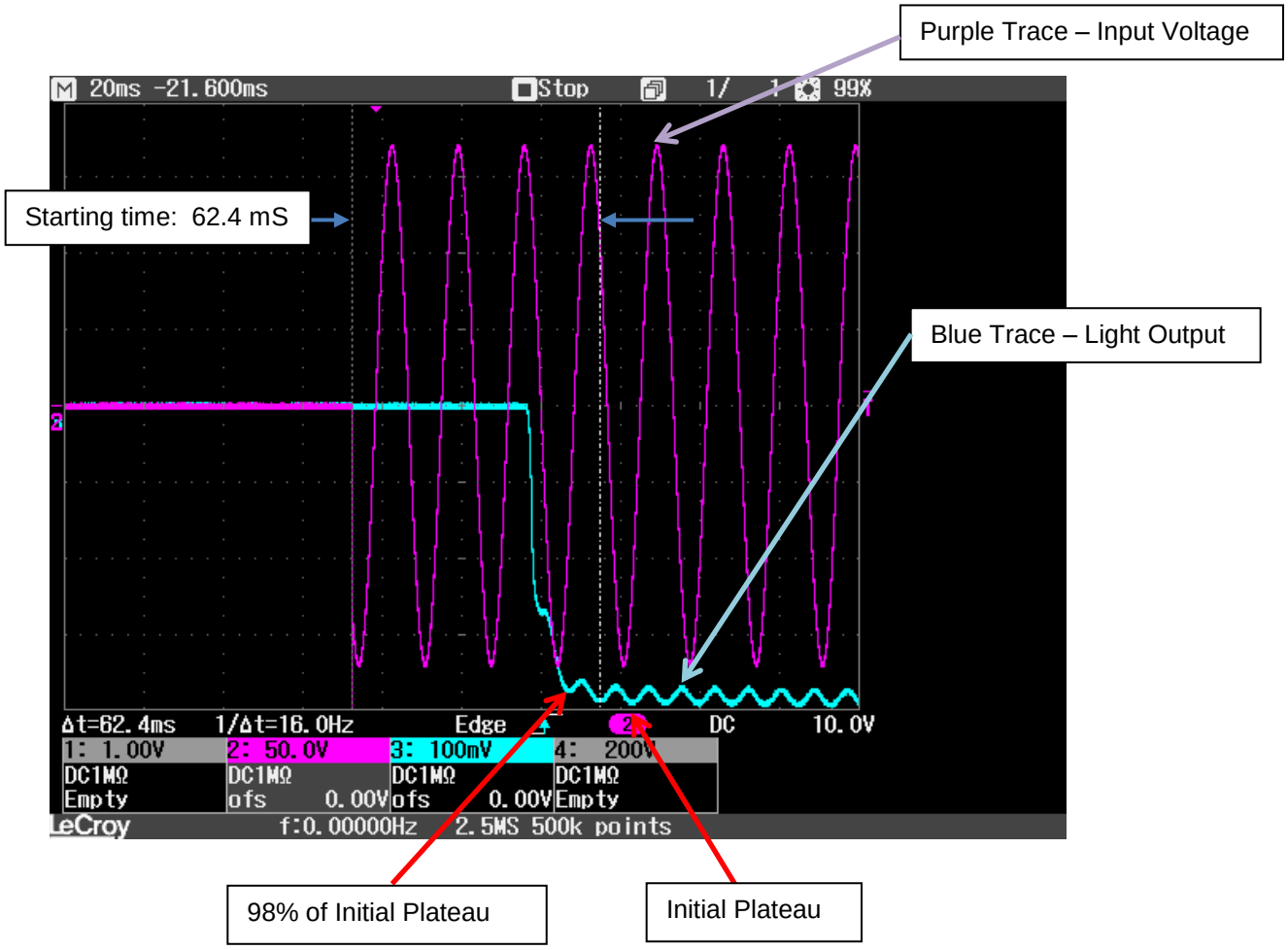
I) Starting time (mS)

9 EXAMPLES:

9.1 Example 1 – Compact Fluorescent Lamp



9.2 Example 2 – LED Lamp



ENERGY STAR® Program Requirements Product Specification for Lamps: Run-Up Time

Draft Test Method Rev. Apr-2013

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1 OVERVIEW

The following test method shall be used for determining product compliance with run-up time requirements in the ENERGY STAR Eligibility Criteria for Lamps.

2 APPLICABILITY

ENERGY STAR test requirements are dependent upon the product technology and lamp category of the product under evaluation. The following guidelines shall be used to determine the applicability of each section of this document:

- The run-up time test method applies to all CFLs included in the specification.
- The test procedures in Section 7 shall be performed on products that are required to undergo the ENERGY STAR Run Up Test.

3 DEFINITIONS

Unless otherwise specified, all terms used in this document are consistent with the definitions in the ENERGY STAR Eligibility Criteria for Lamps.

Run-Up Time: The time between the application of power to the device and the time when the light output first reaches a specified percentage of stable light output, i.e., t80%, t90%, etc.

4 METHODS OF MEASUREMENT AND REFERENCE DOCUMENTS

4.1 IES Test Methods and Reference Documents

A) IES LM-66-11: 2011. IES Approved Method for Electrical and Photometric Measurements of Single-Ended Compact Fluorescent Lamps, Illuminating Engineering Society, New York.

B) IES LM-54-12: 2012. IES Guide to Lamp Seasoning, Illuminating Engineering Society, New York.

5 TEST SETUP

5.1 General

A) Test Setup and Instrumentation:

1) Regulated AC or DC power supply (as applicable to the lamp)

2) Integrating sphere, cube, or similar device and associated equipment

3) Means of recording light output vs. time (i.e., computer sampling or digital recorder) in one second intervals or less such as an oscilloscope or photometer

4) Photodetector

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.

C) Input Power for Run Up Measurements: The power requirements shall be per IES LM-66-11. When selecting a power supply for use with integrated lamps, it is necessary to apply an appropriate power factor when specifying the Volt-Amp capacity of the power supply.

D) Lamp Storage: After seasoning (as applicable), lamps shall be stored at 25°C ± 1°C for a minimum of 16 hours prior to the test. CFL samples shall be off for 20 hours ± 4 hours prior to the test. If the sample has been off more than 24 hours, it shall be operated for 3 hours and then turned off for 20 hours ± 4 hours prior to testing.

E) Ambient Temperature: Testing shall take place in an ambient temperature of 25°C ± 1°C. Drafts shall be minimized.

F) Power Meter: Power meters shall be capable of measuring to the appropriate requirements of IES LM-66-11.

G) Environmental Conditions: The test environment shall be clean and free from large amounts of dust and moisture.

H) Orientation: Test samples in orientation(s) as specified by the ENERGY STAR specification or manufacturer specified position if different.

I) 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

6.1 Guidance for Implementation of Run Up Test Procedure

A) Photometric Measurements:

1) For integrating sphere measurements, refer to IES LM-66-11.

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 ($V\lambda$).

B) Lamp Transfer and Stabilizations for CFLs:

1) CFLs shall be stored per requirements in the Environmental Conditions section before being transported to the run up testing equipment. Care shall be exercised to maintain lamp orientation and avoid shaking or bumping the lamp during the transfer from seasoning. All lamps shall be stabilized per IES LM-66-11.

7 TEST PROCEDURES

7.1 General Test Procedures

A) Test samples in orientation(s) as specified by the ENERGY STAR specification or manufacturer specified position if different or restricted.

B) Set power supply to rated voltage and frequency of the device. If a range is specified, test sample at the midpoint of the range.

C) Randomly select sample from available lamps.

7.2 Test Procedure Method 1 – Relative Method

Method 1 requires the sample to be in the test chamber until it stabilizes. As method 1 is a relative measurement, the test chamber does not need to be an integrating sphere, and may be something less sophisticated such as a cube or other shaped chamber.

A) Place lamp in integrating sphere, cube, dodecahedron, or similar device that eliminates extraneous light.

B) Apply rated voltage/frequency to the device.

C) Record light output in no greater than one second intervals until the light output has stabilized.

D) Record stabilization time.

E) Determine desired run-up characteristic, i.e., t80%, t90%, etc. from the data.

7.3 Test Procedure Method 2 – Absolute Method

Method 2 requires a short test once the stable lumens are known, but an integrating sphere is required, as an absolute lumen comparison is being made.

A) Place lamp in an integrating sphere.

B) Apply rated voltage/frequency to the device.

C) Record light output in no greater than one second intervals for the time to reach the specified percentage of measured, stable light output, i.e., t80%, t90%, etc.

D) Determine desired run-up characteristic (i.e., t80%, t90%, etc.) by comparing the data with the measured, stable luminous flux.

8 TEST REPORT

Run-Up Time Test report data may be included in an overall performance report or a standalone report, and shall include the following test information: Manufacturer's name and product identification

A) Name and location of testing facility

B) Test date

C) Lamp base orientation

D) Test voltage (V)

E) Test frequency (Hz)

F) Percentage of stable light output tested to

G) Waveform on which the run up time is based

H) Stabilized light output

I) Run-up light output

J) Run-up time (S)

ENERGY STAR® Program Requirements Product Specification for Lamps: Light Output on a Dimmer

Draft Recommended Practice Rev. Apr-2013

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1 OVERVIEW

This document provides the recommended practice for determining the maximum and minimum light output on a dimmer. This procedure can be performed concurrently with the ENERGY STAR Flicker testing.

2 APPLICABILITY

The following guidelines shall be used to determine the applicability of each section of this document:

- This test method applies to all compact fluorescent lamps (CFLs) and solid state lighting (SSL) lamps covered in the scope of the Lamps specification that are marketed as dimmable.

3 DEFINITIONS

Unless otherwise specified, all terms used in this document are consistent with the definitions in the ENERGY STAR Eligibility Criteria for Lamps.

Baseline Light Output: The baseline light output (BLO) refers to the stabilized light output of the UUT operating without a dimmer in the circuit.

Maximum Control Position: The setting on the dimmer or control device intended to achieve the maximum light output during operation.

Maximum Light Output: The maximum light output (MaxLO) refers to the light output of the lamp when operating with a dimmer in the circuit with the control at the maximum position.

Maximum Light Output Ratio: The maximum light output ratio (MaxLOR) refers to the ratio of the maximum light output when the lamp is operating with a dimmer in the circuit compared to the maximum light output of a lamp operating without a dimmer in the circuit, and is calculated as the lamp's light output with the dimmer set to the maximum setting / the lamp's light output without a dimmer. Light output may be absolute or relative measurements.

Minimum Dimming Level Claimed: The minimum light output level of a lamp when operated with a dimmer in the circuit, as declared by the lamp manufacturer. Typically expressed as a percentage.

Minimum Light Output: The minimum light output (MinLO) refers to the minimum light output when the lamp is operating with a dimmer in the circuit.

Minimum Light Output Ratio: The minimum light output ratio (MinLOR) refers to the ratio of the minimum light output when the lamp is operating with a dimmer in the circuit compared to the maximum light output of a lamp operating with a dimmer in the circuit, and is calculated as the lamp's light output with the dimmer set to the minimum claimed setting / the lamp's light output with the dimmer set to the maximum setting.

Unit Under Test: The unit under test (UUT) refers the the specific lamp sample being tested.

4 METHODS OF MEASUREMENT AND REFERENCE DOCUMENTS

4.1 IES Test Methods and Reference Documents

A) IES LM-66-11: 2011. IES Approved Method for Electrical and Photometric Measurements of Single-Ended Compact Fluorescent Lamps, Illuminating Engineering Society, New York.
B) IES LM-79-08: 2008. IES Approved Method for Electrical and Photometric Measurements of Solid-State Lighting Products, Illuminating Engineering Society, New York.
C) IES LM-54-12: 2012. IES Guide to Lamp Seasoning, Illuminating Engineering Society, New York.

5 TEST SETUP

5.1 General

A) Test Setup and Instrumentation: The test can be performed using an absolute photometry method or a relative photometry method, and the equipment required depends on the method used.

    1) Equipment required for absolute photometry measurement:

        a) Power supply and meter that complies with IES LM-79-08 or IES LM-66-11 as applicable. See 5.1.C and 5.1.E.

        b) Photometer or similar equipment for comparing output readings from a photodetector

        c) Photodetector

        d) Integrating sphere

    2) Equipment required for relative photometry measurement:

        a) Power supply and meter that complies with IES LM-79-08 or IES LM-66-11 as applicable. See 5.1.C and 5.1.E.

        b) Photodetector capable of measuring relative light output

        c) Method of ensuring the light measured comes only from the UUT.

B) Lamp Seasoning and Preburning: Prior to the first readings, compact fluorescent lamps (CFLs) shall be seasoned for 100 hours in accordance with IES LM-54-12. CFLs shall be preburned in accordance with IES LM-66-11. LED lamps shall not be seasoned.

C) Input Power for Measurements: The power requirements shall be per IES LM-66-11 or LM-79-08 as applicable. Note: When selecting a power supply for use with integrated lamps, it is necessary to apply an appropriate power factor when specifying the Volt-Amp rating of the power supply.

D) Ambient Temperature: Lamp testing shall take place in an ambient temperature of 25°C ± 5°C. Drafts shall be minimized.

E) 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. Any power measurements should measure the power of the lamp under test, and not the dimmer.

F) Environmental Conditions: The test environment shall be clean and free from large amounts of dust and moisture.

G) 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

6.1 Guidance for Implementation Maximum Light Output on a Dimmer Test Procedure

A) Photometric Measurements:

1) For absolute measurements, refer to IES LM-66-11 or IES-LM-79-08 as applicable with the exception of the guidance for lamp stabilization.

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 (Vλ).

a) Ensure that the measurement equipment receives the appropriate voltage range from the photodetector, using an amplifier if necessary.

B) Lamp Transfer for CFLs:

1) Care shall be exercised to maintain lamp orientation and avoid shaking or bumping the lamp during the transfer from seasoning area.

C) Measurements:

1) The following data shall be collected at each measurement point:

a) Light output

b) Power consumption

c) Power factor

d) Total harmonic distortion

7 TEST PROCEDURES FOR LAMPS CLAIMING DIMMABILITY

7.1 Test Procedure for Lamp Baseline output

A) Install the lamp in the test environment without a dimmer in the circuit.

B) Set power supply to rated voltage and frequency of the device. If a range is specified, test sample at the midpoint of the range.

C) Apply rated voltage/frequency to the device.

D) Allow lamp to stabilize per IES LM-66-11 or IES-LM-79-08 as applicable.

E) Record readings from measurement equipment; these are the measurements at the Baseline Light Output (BLO).

F) Remove power from lamp

7.2 Test Procedures for Lamp Dimmability

A) Install dimmer into the lamp test circuit

B) Apply rated voltage/frequency to the dimmer or control device.

C) Adjust dimmer to the maximum control position.

D) Take light output measurements every minute until consecutive measurements are no more than 0.5% apart or verify by mathematical means that the lamp is stabilized.

E) Record readings from measurement equipment. These are the measurements at the MaxLO.

F) Adjust dimmer so that the light output is of the lower of:

   1) 20% of the MaxLO ± 5%.

   2) The minimum dimming level claimed as a percentage of the MaxLO ± 5%

G) Take light output measurements every minute, until consecutive measurements are no more than 0.5% apart or verify by mathematical means that the lamp is stabilized.

H) Verify that the lamp light output is still within the range in F)

   1) If not, repeat step F) and G)

   2) If light output is within range, record readings from measurement equipment. These are the measurements at the MinLO.

I) Repeat steps 7.2A-I for each dimmer to be tested.

J) Repeat steps 7.2A-I for each dimmer to be tested with 4 lamps on the dimmer circuit, taking measurements from one lamp.

8 TEST REPORT

Maximum and Minimum Light Output on a Dimmer report data shall include the following test information and be submitted on the ENERGY STAR Dimming Data Sheet:

A) Manufacturer's name and product identification

B) Name and location of testing facility

C) Test date

D) Lamp base orientation

E) Test voltage (V)

F) Test frequency (Hz)

G) Light output and power consumption at BLO

H) Test data at the MaxLO for 1 and 4 lamp configurations for each dimmer tested

I) Test data at the MinLO for 1 and 4 lamp configurations for each dimmer tested

J) Average MaxLOR

K) Average MinLOR

ENERGY STAR® Program Requirements Product Specification for Lamps: Light Source Flicker

Draft Recommended Practice Rev. Apr-2013

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1 OVERVIEW

This document provides the recommended practice for evaluating flicker with and without a dimmer. This test can be performed concurrently with the ENERGY STAR Light Output on a Dimmer testing.

2 APPLICABILITY

The following guidelines shall be used to determine the applicability of each section of this document:

- This recommended practice applies to all CFL and solid state lighting (SSL) lamps covered in the scope of the Lamps specification that are marketed as dimmable.

3 DEFINITIONS

Unless otherwise specified, all terms used in this document are consistent with the definitions in the ENERGY STAR Eligibility Criteria for Lamps.

Baseline Light Output: The baseline light output (BLO) refers to the stabilized light output of the UUT operating without a dimmer in the circuit.

Maximum Control Position: The setting on the dimmer or control device intended to achieve the maximum light output during operation.

Maximum Light Output: The maximum light output (MaxLO) refers to the light output of the lamp when operating with a dimmer in the circuit with the control at the maximum position.

Minimum Dimming Level Claimed: The minimum light output level of a lamp when operated with a dimmer in the circuit, as declared by the lamp manufacturer. Typically expressed as a percentage.

Minimum Light Output: The minimum light output (MinLO) refers to the minimum light output when the lamp is operating with a dimmer in the circuit.

Unit Under Test: The unit under test (UUT) refers the the specific lamp sample being tested.

4 METHODS OF MEASUREMENT AND REFERENCE DOCUMENTS

4.1 IES Test Methods and Reference Documents

A) IES LM-66-11: 2011. IES Approved Method for Electrical and Photometric Measurements of Single-Ended Compact Fluorescent Lamps, Illuminating Engineering Society, New York.
B) IES LM-79-08: 2008. IES Approved Method for Electrical and Photometric Measurements of Solid-State Lighting Products, Illuminating Engineering Society, New York.
C) IES LM-54-12: 2012. IES Guide to Lamp Seasoning, Illuminating Engineering Society, New York.

5 TEST SETUP

5.1 General

A) Test Setup and Instrumentation: The test can be performed using an absolute photometry method or a relative photometry method , and the equipment required depends on the method used.

1) Equipment required for absolute photometry measurement:

a) Power supply and meter that complies with IES LM-79-08 or IES LM-66-11 as applicable. See 5.1.C and 5.1.E.

b) Multichannel oscilloscope with data storage capability or similar equipment for comparing output readings from a photodetector

c) Appropriate attenuator probe(s), if applicable

d) Photodetector

e) Integrating sphere

2) Equipment required for relative photometry measurement:

a) Power supply and meter that complies with IES LM-79-08 or IES LM-66-11 as applicable. See 5.1.C and 5.1.E.

b) Multichannel oscilloscope with data storage capability or similar equipment for comparing output readings from a photodetector

c) Appropriate attenuator probe(s), if applicable

d) Photodetector capable of measuring relative light output

e) Method of ensuring the light measured comes only from the UUT.

B) Lamp Seasoning and Preburning: Prior to the first readings, compact fluorescent lamps (CFLs) shall be seasoned for 100 hours in accordance with IES LM-54-12. CFLs shall be preburned in accordance with IES LM-66-11. LED lamps shall not be seasoned.

C) Input Power for Measurements: The power requirements shall be per IES LM-66-11 or LM-79-08 as applicable. Note: When selecting a power supply for use with integrated lamps, it is necessary to apply an appropriate power factor when specifying the Volt-Amp rating of the power supply.

D) Ambient Temperature: Lamp testing shall take place in an ambient temperature of 25°C ± 5°C. Drafts shall be minimized.

E) 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.

F) Environmental Conditions: The test environment shall be clean and free from large amounts of dust and moisture.

G) 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. The sample(s) used for flicker testing shall be the same sample(s) used for the ENERGY STAR Light Output on a Dimmer testing, if applicable, and can be the same sample(s) used for other testing.

6 TEST CONDUCT

6.1 Guidance for Implementation Flicker Test Procedure

A) Photometric Measurements:

1) 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 (Vλ).

a) Ensure that the measurement equipment receives the appropriate voltage range from the photodetector, using an amplifier if necessary.

2) The oscilloscope measurement period needs to be ≥ 100 ms.

3) The oscilloscope sampling rate used needs to be ≥ 2 kHz.

B) Lamp Transfer for CFLs:

1) Care shall be exercised to maintain lamp orientation and avoid shaking or bumping the lamp during the transfer from seasoning area.

C) Measurements:

1) The following data shall be collected at each measurement point:

a) Sampling Rate

b) Lamp light output waveform captured over a minimum of 8 periods

7 TEST PROCEDURES FOR PRODUCTS CLAIMING DIMMABILITY

7.1 Test Procedure for Flicker at Baseline Light Output

A) Install the lamp in the test environment without a dimmer in the circuit.

B) Set power supply to rated voltage and frequency of the device. If a range is specified, test sample at the midpoint of the range.

C) Apply rated voltage/frequency to the device.

D) Allow lamp to stabilize per IES LM-66-11 or IES-LM-79-08 as applicable.

E) Record waveform readings from measurement equipment to determine lamp's light output fundamental frequency.

   1) Calculate the flicker index, as applicable.

F) Remove power from lamp

7.2 Test Procedure for Lamp Flicker

A) Install dimmer into the lamp test circuit

B) Apply rated voltage/frequency to the dimmer or control device.

C) Adjust dimmer to the maximum control position.

D) Take light output measurements every minute until consecutive measurements are no more than 0.5% apart or verify by mathematical means that the lamp is stabilized.

E) Record waveform readings from measurement equipment and record percent flicker and calculatethe flicker index. The flicker index is the flicker at the MaxLO.

F) Adjust dimmer so that the light output is the lower of:

   1) 20% of the MaxLO ± 5%.

   2) The minimum dimming level claimed as percentage of the MaxLO ± 5%.

G) Take light output measurements every minute, until consecutive measurements are no more than 0.5% apart or verify by mathematical means that the lamp is stabilized.

H) Verify that the lamp light output is still within the range in F)

   1) If not, repeat step F) and G)

   2) If light output is within range, record waveform readings from measurement equipment to determine percent flicker and flicker index. The flicker index is the flicker MinLO.

I) Repeat steps 7.2.A-I for each dimmer to be tested.

J) Repeat steps 7.2.A-I for each dimmer to be tested with 4 lamps on the dimmer circuit, taking measurements from one lamp.

8 TEST REPORT

Maximum and Minimum Light Output on a Dimmer report data shall include the following test information and be submitted on the ENERGY STAR Dimming Data Sheet:

A) Manufacturer's name and product identification

B) Name and location of testing facility

C) Test date

D) Lamp base orientation

E) Test voltage (V)

F) Test frequency (Hz)

G) Fundamental frequency and flicker index at BLO

H) Flicker index at MaxLO for 1 and 4 lamp configurations for each dimmer tested

I) Flicker index at MinLO for 1 and 4 lamp configurations for each dimmer tested

J) Percent flicker at MaxLO for 1 and 4 lamp configurations for each dimmer tested

K) Percent flicker at MinLO for 1 and 4 lamp configurations for each dimmer tested

L) Digitized photometric waveform data and an image of the relative photometric amplitude waveform with a period ≥ 100ms

ENERGY STAR® Program Requirements Product Specification for Lamps: Noise

Draft Recommended Practice Rev. Apr-2013

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1 OVERVIEW

This document provides the recommended practice for evaluating audible noise produced by a lamp.

2 APPLICABILITY

The following guidelines shall be used to determine the applicability of each section of this document:

- This lamp noise test method applies to all compact fluorescent lamps (CFLs) and solid state lighting (SSL) lamps covered in the scope of the lamps specification that are marketed as dimmable.

3 DEFINITIONS

Unless otherwise specified, all terms used in this document are consistent with the definitions in the ENERGY STAR Eligibility Criteria for Lamps.

Baseline Light Output: The baseline light output (BLO) refers to the stabilized light output of the UUT is operating without a dimmer in the circuit.

Maximum Control Position: The setting on the dimmer or control device intended to achieve the maximum light output during operation.

Maximum Light Output: The maximum light output (MaxLO) refers to the light output of the lamp when operating with a dimmer in the circuit with the control at the maximum position.

Minimum Dimming Level Claimed: The minimum light output level of a lamp when operated with a dimmer in the circuit, as declared by the lamp manufacturer. Typically expressed as a percentage.

Minimum Light Output: The minimum light output (MinLO) refers to the minimum light output when the lamp is operating with a dimmer in the circuit.

Peak Noise: The highest noise level recorded at a measurement point.

Unit Under Test: The unit under test (UUT) refers the the specific lamp sample being tested.

4 METHODS OF MEASUREMENT AND REFERENCE DOCUMENTS

4.1 IES Test Methods and Reference Documents

A) IES LM-66-11: 2011. IES Approved Method for Electrical and Photometric Measurements of Single-Ended Compact Fluorescent Lamps, Illuminating Engineering Society, New York.
B) IES LM-79-08: 2008. IES Approved Method for Electrical and Photometric Measurements of Solid-State Lighting Products, Illuminating Engineering Society, New York.
C) IES LM-54-12: 2012. IES Guide to Lamp Seasoning, Illuminating Engineering Society, New York.
D) ISO 7574-4 B.2.1: 1985. Statistical methods for determining and verifying stated noise emission values of machinery and equipment, International Organization for Standardization, Geneva, Swizerland.
E) ASA S12.55-2006/ISO3745:2003: 2006. Acoustical Society of America, New York.

5 RECOMMENDED PRACTICE TEST SETUP

5.1 General

A) Test Setup and Instrumentation: The test can be performed using a single microphone and rotating the product, or by using multiple microphones.

    1) Equipment required for measurement is as follows:

        a) Regulated AC or DC power supply (as applicable to the lamp)

        b) Multichannel oscilloscope with data storage capability or similar equipment for comparing output readings from a photodetector

        c) Appropriate attenuator probe(s), if applicable

        d) Photodetector capable of measuring relative light output

        e) Noise level measurement equipment

        f) Microphone(s)

        g) Isolated sound chamber (e.g. anechoic chamber)

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. LED lamps shall not be seasoned.

C) Input Power for Measurements: The power requirements shall be per IES LM-66-11 or LM-79-08 as applicable. Note: When selecting a power supply for use with integrated lamps, it is necessary to apply an appropriate power factor when specifying the Volt-Amp rating of the power supply.

D) Ambient Temperature: Lamp testing shall take place in an ambient temperature of 25°C ± 5°C. Drafts shall be minimized.

E) 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.

F) Environmental Conditions: The test environment shall be clean and free from large amounts of dust and moisture.

G) 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. The sample(s) used for noise testing shall be the same sample(s) used for the ENERGY STAR Flicker testing, if applicable, and can be the same sample(s) used for other testing.

6 TEST CONDUCT

6.1 Guidance for Noise Test Procedure

A) Photometric Measurements:

1) For absolute measurements, refer to IES LM-66-11 or IES-LM-79-08 as applicable with the exception of the guidance for lamp stabilization.

2) 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 (Vλ).

   a) Ensure that the measurement equipment receives the appropriate voltage range from the photodetector, using an amplifier if necessary.

B) Measurement Equipment:

1) The sound chamber shall provide an environment suitable for the sound testing of lamps. External sources of noise shall be minimized.
2) The sound measurement equipment shall be capable of measuring A-weighted decibels.
3) The microphone(s) shall be placed at a distance of one (1) meter from the lamp to be measured.
   a) If multiple microphones are used, 6 microphones shall be placed about the lamp spaced 90° apart and aimed at the lamp.
   b) If a single microphone is used, the microphone shall be aimed at the lamp and the lamp holding device shall be capable of moving and holding the lamp so that six measurements about the lamp can be made 90° apart.
4) The sound level of the lamp shall be calculated from the measurement taken, with the baseline level corrected for and in accordance with ISO 7574-4:1985, B.2.1. All other aspects of the measurements to be taken in accordance with ANSI standard S12.55-2006/ISO3745:2003 (calibration, etc.)

C) Lamp Transfer for CFLs:

1) Care shall be exercised to maintain lamp orientation and avoid shaking or bumping the lamp during the transfer from seasoning area.

D) Measurements:

1) The following data shall be collected at each measurement point:
   a) Light output
   b) Peak Noise Reading
   c) Microphone Position at which the Peak Noise Reading occurs (e.g. 0 degrees / opposite lamp base).

7 RECOMMENDED PRACTICE FOR PRODUCTS CLAIMING DIMMABILITY

7.1 General Test Procedures for Noise at Baseline output

A) Install the lamp in the test environment without a dimmer in the circuit.

B) Set power supply to rated voltage and frequency of the device. If a range is specified, test sample at the midpoint of the range.

C) Record noise readings from measurement equipment to determine sound level in dBA. This is the control noise level.

D) Apply rated voltage/frequency to the device.

E) Allow lamp to stabilize per IES LM-66-11 or IES-LM-79-08 as applicable.

F) Record noise readings from measurement equipment about the lamp to determine the peak sound level in dBA. This is the noise at the Basline Light Output (BLO).

   1) If using a single microphone, note the position with the highest sound level (if applicable).

G) Remove power from lamp

7.2 General Test Procedures for Noise on a Dimmer

A) Install dimmer into the lamp test circuit

   1) The dimmer shall be located outside of the sound chamber

B) Apply rated voltage/frequency to the dimmer or control device.

C) Adjust dimmer to the maximum control position.

D) Take light output measurements every minute until consecutive measurements are no more than 0.5% apart or verify by mathematical means that the lamp is stabilized.

E) Record noise readings from measurement equipment about the lamp to determine the peak sound level in dBA. This is the noise at the MaxLO.

F) Adjust dimmer so that the light output is the lower of:

   1) 20% of the MaxLO ± 5%.

   2) The minimum dimming level claimed as a percentage of the MaxLO ± 5%.

G) Take light output measurements every minute until consecutive measurements are no more than 0.5% apart or verify by mathematical means that the lamp is stabilized.

H) Verify that the lamp light output is still within the range in F)

   1) If not, repeat step A) and G)

   2) If light output is within range, record noise readings from measurement equipment about the lamp to determine the peak sound level in dBA. This is the noise at MinLO.

I) Repeat steps 7.2A-H for each dimmer to be tested.

J) Repeat steps 7.2A-H for each dimmer to be tested with 4 lamps on the dimmer circuit, taking measurements from one lamp.

8 TEST REPORT

Lamp Noise on a Dimmer report data shall include the following test information and be submitted on the ENERGY STAR Dimming Data Sheet:

A) Manufacturer's name and product identification

B) Name and location of testing facility

C) Test date

D) Lamp base orientation

E) Test voltage (V)

F) Test frequency (Hz)

G) Noise at BLO

H) Noise and light output reading at MaxLO for 1 and 4 lamp configurations for each dimmer tested

I) Noise and light output reading at MinLO for 1 and 4 lamp configurations for each dimmer tested