



# ENERGY STAR® Program Requirements

## Product Specification for Lamps: Light Output on a Dimmer

### Recommended Practice Rev. December 2015

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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 apply to all compact fluorescent lamps (CFLs) and solid-state 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 to the specific lamp sample being tested.

## 4 METHODS OF MEASUREMENT AND REFERENCE DOCUMENTS

### 4.1 IES Test Methods and Reference Documents

- A) IES LM-66-14: 2014. 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-66-14 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-66-14 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-66-14. LED lamps shall not be seasoned.
- C) Input Power for Measurements: The power requirements shall be per IES LM-66-14 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-66-14 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. The sample(s) used for light output on a dimmer 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 Implementation Maximum Light Output on a Dimmer Test Procedure

#### A) Photometric Measurements:

- 1) For absolute measurements, refer to IES LM-66-14 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 ( $V_{\lambda}$ ).
  - a) Ensure that the measurement equipment receives the appropriate voltage range from the photodetector, using an amplifier if necessary.
  - b) The UUT and the photometer shall not be moved during testing.

#### B) Lamp Transfer for CFLs: care shall be exercised to maintain lamp orientation and avoid shaking or bumping the lamp during the transfer from seasoning area.

#### C) Low Voltage Lamps

- 1) Lamps designed for operation on low voltage transformers shall be operated on a compatible transformer specified or supplied by the lamp manufacturer.
- 2) Electrical measurements shall include characteristics of the lamp.

#### D) Measurements: the following data shall be collected at each measurement point:

- 1) Light output
- 2) Power consumption
- 3) Power factor
- 4) 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-66-14 or IES-LM-79-08 as applicable. If lamp has been stabilized for measurements previously and the stabilization time recorded, the lamp may be considered stabilized after operating for this period of time.
- 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) Allow lamp to stabilize and verify by taking light output measurements every minute until consecutive measurements are no more than 0.5% apart, utilizing previously recorded lamp stabilization time or verify by mathematical means that the lamp is stabilized.
- E) Record readings from measurement equipment per Clause 6.1.D. These are the measurements at the MaxLO.
- F) Adjust dimmer so that the light output is the lower of:
  - 1) (20% of the MaxLO)  $\pm$  5%.
  - 2) (The minimum dimming level claimed as a percentage of the MaxLO)  $\pm$  5%

For example: a lamp with a MaxLO of 1,000 lumens and a minimum claimed dimming level of 20% should be adjusted to a light output level that is between 190 and 210 lumens.
- G) Allow lamp to stabilize and verify by taking light output measurements every minute, until consecutive measurements are no more than 0.5% apart, utilizing previously recorded lamp stabilization time 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 per Clause 6.1.D. These are the measurements at the MinLO.
- I) Repeat steps 7.2A-H for each dimmer to be tested. A test setup that includes a device that allows hot switching between dimmers may be utilized to bypass stabilization time.

## 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 for the lamp and dimmers tested
- 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) Electrical and photometric test data at the MaxLO for each dimmer tested
- I) Electrical and photometric test data at the MinLO for each dimmer tested
- J) Stabilization time and stabilization method used
- K) Average MaxLOR
- L) Average MinLOR