



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

## Recommended Practice Rev. December 2015

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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

This recommended practice applies to all CFL 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.

**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 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.
- D) IES RP-16-10: 2010. IES Nomenclature and Definitions for Illuminating Engineering, 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) 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-66-14 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-66-14. 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  $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$ . 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.
- 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

#### H) 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 ( $V\lambda$ ).
  - 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  $\geq 100$  ms.
- 3) The oscilloscope sampling rate used needs to be  $\geq 2$  kHz.

#### I) 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.

#### J) 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.

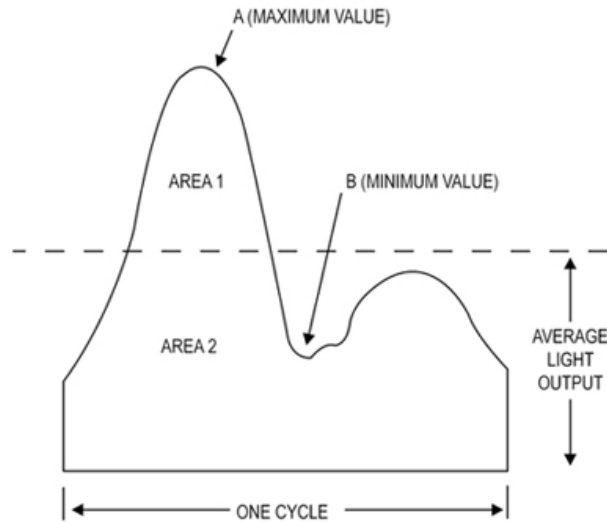
#### K) Measurements: The following data shall be collected at each measurement point:

- 1) Sampling Rate
- 2) 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-66-14 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 per Clause 6.1.D from measurement equipment to determine lamp's light output periodic frequency.
- F) Calculate the flicker index, as applicable.



$$\text{Flicker Index} = \text{Area 1} / (\text{Area 1} + \text{Area 2})$$

G) 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) 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 light output, electrical parameters, and waveform readings per Clause 6.1.D from measurement equipment and record percent flicker and calculate the 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)  $\pm$  5%.
  - 2) (The minimum dimming level claimed as 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 light output, electrical parameters, and waveform readings per Clause 6.1.D from measurement equipment to determine percent flicker and flicker index. The flicker index is the flicker MinLO.
- I) Repeat steps 7.2.A-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**

Light Source Flicker 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) Fundamental frequency, percent flicker and flicker index at BLO
- H) Electrical measurements, light output reading, flicker index and percent flicker at MaxLO for each dimmer tested
- I) Electrical measurements, light output reading, flicker index and percent flicker at MinLO for each dimmer tested
- J) Stabilization time and stabilization method used
- K) Digitized photometric waveform data and an image of the relative photometric amplitude waveform with a period  $\geq 100\text{ms}$