

APPENDIX BB TO SUBPART B OF PART 430—UNIFORM TEST METHOD FOR MEASURING THE INPUT POWER, LUMEN OUTPUT, LAMP EFFICACY, CORRELATED COLOR TEMPERATURE (CCT), COLOR RENDERING INDEX (CRI), POWER FACTOR, TIME TO FAILURE, AND STANDBY MODE POWER OF INTEGRATED LIGHT-EMITTING DIODE (LED) LAMPS

NOTE: On or after December 28, 2016, any representations made with respect to the energy use or efficiency of integrated light-emitting diode lamps must be made in accordance with the results of testing pursuant to this appendix.

1. *Scope*: This appendix specifies the test methods required to measure input power, lumen output, lamp efficacy, CCT, CRI, power factor, time to failure, and standby mode power for integrated LED lamps.

2. *Definitions*

2.1. The definitions specified in section 1.3 of IES LM-79-08 except section 1.3(f) (incorporated by reference; see § 430.3) apply.

2.2. *Initial lumen output* means the measured lumen output after the lamp is initially energized and stabilized using the stabilization procedures in section 3 of this appendix.

2.3. *Interval lumen output* means the measured lumen output at constant intervals after the initial lumen output measurement in accordance with section 4 of this appendix.

2.4. *Rated input voltage* means the voltage(s) marked on the lamp as the intended operating voltage. If not marked on the lamp, assume 120 V.

2.5. *Test duration* means the operating time of the LED lamp after the initial lumen output measurement and before, during, and including the final lumen output measurement, in units of hours.

2.6. *Time to failure* means the time elapsed between the initial lumen output measurement and the point at which the lamp reaches 70 percent lumen maintenance as measured in section 4 of this appendix.

3. *Active Mode Test Method for Determining Lumen Output, Input Power, CCT, CRI, Power Factor, and Lamp Efficacy*

In cases where there is a conflict, the language of the test procedure in this appendix takes precedence over IES LM-79-08 (incorporated by reference; see § 430.3).

3.1. *Test Conditions and Setup*

3.1.1. Establish the ambient conditions, power supply, electrical settings, and instrumentation in accordance with the specifications in sections 2.0, 3.0, 7.0, and 8.0 of IES

LM-79-08 (incorporated by reference; see § 430.3), respectively.

3.1.2. Position an equal number of integrated LED lamps in the base-up and base-down orientations throughout testing; if the position is restricted by the manufacturer, test units in the manufacturer-specified position.

3.1.3. Operate the integrated LED lamp at the rated voltage throughout testing. For an integrated LED lamp with multiple rated voltages including 120 volts, operate the lamp at 120 volts. If an integrated LED lamp with multiple rated voltages is not rated for 120 volts, operate the lamp at the highest rated input voltage. Additional tests may be conducted at other rated voltages.

3.1.4. Operate the lamp at the maximum input power. If multiple modes occur at the same maximum input power (such as variable CCT or CRI), the manufacturer can select any of these modes for testing; however, all measurements described in sections 3 and 4 of this appendix must be taken at the same selected mode. The test report must indicate which mode was selected for testing and include detail such that another laboratory could operate the lamp in the same mode.

3.2. *Test Method, Measurements, and Calculations*

3.2.1. The test conditions and setup described in section 3.1 of this appendix apply to this section 3.2.

3.2.2. Stabilize the integrated LED lamp prior to measurement as specified in section 5.0 of IES LM-79-08 (incorporated by reference; see § 430.3). Calculate the stabilization variation as [(maximum—minimum)/minimum] of at least three readings of the input power and lumen output over a period of 30 minutes, taken 15 minutes apart.

3.2.3. Measure the input power in watts as specified in section 8.0 of IES LM-79-08.

3.2.4. Measure the input voltage in volts as specified in section 8.0 of IES LM-79-08.

3.2.5. Measure the input current in amps as specified in section 8.0 of IES LM-79-08.

3.2.6. Measure lumen output as specified in section 9.1 and 9.2 of IES LM-79-08. Do not use goniophotometers.

3.2.7. Determine CCT according to the method specified in section 12.0 of IES LM-79-08 with the exclusion of section 12.2 and 12.5 of IES LM-79-08. Do not use goniophotometers.

3.2.8. Determine CRI according to the method specified in section 12.0 of IES LM-79-08 with the exclusion of section 12.2 and 12.5 of IES LM-79-08. Do not use goniophotometers.

3.2.9. Determine lamp efficacy by dividing measured initial lumen output by the measured input power.

3.2.10. Determine power factor for AC-input lamps by dividing measured input power by the product of the measured input voltage and measured input current.

4. Active Mode Test Method to Measure Time to Failure

In cases where there is a conflict, the language of the test procedure in this appendix takes precedence over IES LM-84 (incorporated by reference; see § 430.3) and IES TM-28 (incorporated by reference; see § 430.3).

4.1. Lamp Handling, Tracking, and Time Recording

4.1.1. Handle, transport, and store the integrated LED lamp as described in section 7.2 of IES LM-84 (incorporated by reference; see § 430.3).

4.1.2. Mark and track the integrated LED lamp as specified in section 7.3 of IES LM-84.

4.1.3. Measure elapsed operating time and calibrate all equipment as described in section 7.5 of IES LM-84.

4.1.4. Check the integrated LED lamps regularly for failure as specified in section 7.8 of IES LM-84.

4.2. *Measure Initial Lumen Output.* Measure the initial lumen output according to section 3 of this appendix.

4.3. *Test Duration.* Operate the integrated LED lamp for a period of time (the test duration) after the initial lumen output measurement and before, during, and including the final lumen output measurement.

4.3.1. There is no minimum test duration requirement for the integrated LED lamp. The test duration is selected by the manufacturer. See section 4.6 of this appendix for instruction on the maximum time to failure.

4.3.2. The test duration only includes time when the integrated LED lamp is energized and operating.

4.4. Operating Conditions and Setup Between Lumen Output Measurements

4.4.1. Electrical settings must be as described in section 5.1 of IES LM-84 (incorporated by reference; see § 430.3).

4.4.2. LED lamps must be handled and cleaned as described in section 4.1 of IES LM-84.

4.4.3. Vibration around each lamp must be as described in section 4.3 of IES LM-84.

4.4.4. Ambient temperature conditions must be as described in section 4.4 of IES LM-84. Maintain the ambient temperature at $25\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$.

4.4.5. Humidity in the testing environment must be as described in section 4.5 of IES LM-84.

4.4.6. Air movement around each lamp must be as described in section 4.6 of IES LM-84.

4.4.7. Position a lamp in either the base-up and base-down orientation throughout testing. An equal number of lamps in the sample must be tested in the base-up and base-down orientations, except that, if the manufacturer restricts the position, test all of the

units in the sample in the manufacturer-specified position.

4.4.8. Operate the lamp at the rated input voltage as described in section 3.1.3 of this appendix for the entire test duration.

4.4.9. Operate the lamp at the maximum input power as described in section 3.1.4 of this appendix for the entire test duration.

4.4.10. Line voltage waveshape must be as described in section 5.2 of IES LM-84.

4.4.11. Monitor and regulate rated input voltage as described in section 5.4 of IES LM-84.

4.4.12. Wiring of test racks must be as specified in section 5.5 of IES LM-84.

4.4.13. Operate the integrated LED lamp continuously.

4.5. *Measure Interval Lumen Output.* Measure interval lumen output according to section 3 of this appendix.

4.5.1. Record interval lumen output and elapsed operating time as described in section 4.2 of IES TM-28 (incorporated by reference; see § 430.3).

4.5.1.1. For test duration values greater than or equal to 3,000 hours and less than 6,000 hours, measure lumen maintenance of the integrated LED lamp at an interval in accordance with section 4.2.2 of IES TM-28.

4.5.1.2. For test duration values greater than or equal to 6,000 hours, measure lumen maintenance at an interval in accordance with section 4.2.1 of IES TM-28.

4.6. Calculate Lumen Maintenance and Time to Failure

4.6.1. Calculate the lumen maintenance of the lamp at each interval by dividing the interval lumen output " x_i " by the initial lumen output " x_0 ". Measure initial and interval lumen output in accordance with sections 4.2 and 4.5 of this appendix, respectively.

4.6.2. For lumen maintenance values less than 0.7, including lamp failures that result in complete loss of light output, time to failure is equal to the previously recorded lumen output measurement (at a shorter test duration) where the lumen maintenance is greater than or equal to 0.7.

4.6.3. For lumen maintenance values equal to 0.7, time to failure is equal to the test duration.

4.6.4. For lumen maintenance values greater than 0.7, use the following method:

4.6.4.1. For test duration values less than 3,000 hours, do not project time to failure. Time to failure equals the test duration.

4.6.4.2. For test duration values greater than or equal to 3,000 hours but less than 6,000 hours, time to failure is equal to the lesser of the projected time to failure calculated according to section 4.6.4.2.1 of this appendix or the test duration multiplied by the limiting multiplier calculated in section 4.6.4.2.2 of this appendix.

4.6.4.2.1. Project time to failure using the projection method described in section 5.1.4 of IES TM-28 (incorporated by reference; see § 430.3). Project time to failure for each indi-

vidual LED lamp. Do not use data obtained prior to a test duration value of 1,000 hours.

4.6.4.2.2. Calculate the limiting multiplier from the following equation:

$$\text{Limiting multiplier} = \frac{1}{600} * \text{test duration} - 4$$

4.6.4.3. For test duration values greater than 6,000 hours, time to failure is equal to the lesser of the projected time to failure calculated according to section 4.6.4.3.1 or the test duration multiplied by six.

4.6.4.3.1. Project time to failure using the projection method described in section 5.1.4 of IES TM-28 (incorporated by reference; see § 430.3). Project time to failure for each individual LED lamp. Data used for the time to failure projection method must be as specified in section 5.1.3 of IES TM-28.

5. Standby Mode Test Method for Determining Standby Mode Power

Measure standby mode power consumption for integrated LED lamps capable of operating in standby mode. The standby mode test method in this section 5 may be completed before or after the active mode test method for determining lumen output, input power, CCT, CRI, power factor, and lamp efficacy in section 3 of this appendix. The standby mode test method in this section 5 must be completed before the active mode test method for determining time to failure in section 4 of this appendix. In cases where there is a conflict, the language of the test procedure in this appendix takes precedence over IES LM-79 (incorporated by reference; see § 430.3) and IEC 62301 (incorporated by reference; see § 430.3).

5.1. Test Conditions and Setup

5.1.1. Establish the ambient conditions, power supply, electrical settings, and instrumentation in accordance with the specifications in sections 2.0, 3.0, 7.0, and 8.0 of IES LM-79 (incorporated by reference; see § 430.3), respectively. Maintain the ambient temperature at 25 °C ± 1 °C.

5.1.2. Position a lamp in either the base-up and base-down orientation throughout testing. An equal number of lamps in the sample must be tested in the base-up and base-down orientations.

5.1.3. Operate the integrated LED lamp at the rated voltage throughout testing. For an integrated LED lamp with multiple rated voltages, operate the integrated LED lamp at 120 volts. If an integrated LED lamp with multiple rated voltages is not rated for 120 volts, operate the integrated LED lamp at the highest rated input voltage.

5.2. Test Method, Measurements, and Calculations

5.2.1. The test conditions and setup described in section 3.1 of this appendix apply to this section.

5.2.2. Connect the integrated LED lamp to the manufacturer-specified wireless control network (if applicable) and configure the integrated LED lamp in standby mode by sending a signal to the integrated LED lamp instructing it to have zero light output. Lamp must remain connected to the network throughout the duration of the test.

5.2.3. Stabilize the integrated LED lamp as specified in section 5 of IEC 62301 (incorporated by reference; see § 430.3) prior to measurement.

5.2.4. Measure the standby mode power in watts as specified in section 5 of IEC 62301.

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APPENDIX CC TO SUBPART B OF PART 430—UNIFORM TEST METHOD FOR MEASURING THE ENERGY CONSUMPTION OF PORTABLE AIR CONDITIONERS

1. Scope

This appendix covers the test requirements used to measure the energy performance of single-duct and dual-duct portable air conditioners, as defined at 10 CFR 430.2.

2. Definitions

2.1 *ANSI/AHAM PAC-1-2015* means the test standard published by the Association of Home Appliance Manufacturers, titled “Portable Air Conditioners,” ANSI/AHAM PAC-1-2015 (incorporated by reference; see § 430.3).

2.2 *ASHRAE Standard 37-2009* means the test standard published by the American National Standards Institute and American Society of Heating, Refrigerating and Air-Conditioning Engineers and, titled “Methods of Testing for Rating Electrically Driven Unitary Air-Conditioning and Heat Pump Equipment,” ASHRAE Standard 37-2009 (incorporated by reference; see § 430.3).

2.3 *Combined energy efficiency ratio* is the energy efficiency of a portable air conditioner as measured in accordance with this