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Joint Appendix JA8

Appendix JA8 – Qualification Requirements for High Efficacy Light Sources

JA8.1 Purpose and Scope

Joint Appendix JA8 provides the qualification requirements for high efficacy light sources installed to comply with Section 150.0(k). For the purposes of this Section, high efficacy light sources include ballasts or drivers if needed for operation of the light source: light sources shall be certified together with a driver or ballast. If the light source is inseparable from the luminaire the entire luminaire shall meet the requirements of this section. All qualifying light sources shall be certified to the Energy Commission according to all of the requirements in this Appendix.

JA8.2 Certification of Test Labs

The light source under test shall be tested at a testing laboratory participating in the ISO/IEC 17025, by the National Voluntary Laboratory Accreditation Program (NVLAP) or other laboratory accreditation body operating in accordance with ISO/IEC 17011 and produced under an ongoing inspection program carried out by a Type A inspection body in accordance with ISO/IEC 17020.

JA 8.3 Tests to be performed

Compliance with the requirements of this Appendix shall be determined by performance of the following test procedures, as applicable to the type of light source.

Sample group size ~~for lamps with ANSI standard bases and that are not recessed downlight retrofits, shall be 10 units per model: 5 units tested base-up and 5 units tested base-down unless the manufacturer restricts specific use or position. If position is restricted, all units shall be tested in restricted position. Test units, including low voltage lamps, shall be operated at rated voltage~~shall be as specified in the referenced test procedures. Where a sample group is not specified for a test, a single unit shall be tested.

~~Sample size for all other sources shall be 3 units, tested in accordance with manufacturer's installation instructions for intended orientation.~~

JA 8.3.1 Efficacy Test

Efficacy at full light output shall be determined by the following test procedures, as applicable to the type of light source:

a) For incandescent and incandescent reflector lamps: 10CFR 430.23(r).
b) For medium base compact fluorescent lamps: 10CFR 430.23(w).
c) For general service fluorescent lamps: 10CFR 430.23(r).
d) For fluorescent lamps that are not Medium base compact fluorescent lamps and general service fluorescent lamps: IES LM-9.
e) For LED light sources, IES LM-79.
f) For high intensity discharge lamps, IES LM-51.
g) For induction lamps, IES LM-66.

The reported value shall be the minimum efficacy of the tested units and be rounded to the nearest tenth.

JA 8.3.2 Power Factor Test

Power factor shall be measured at full light output in accordance with ANSI C82.77, Section 6 and 7.

For lamps, the reported value shall be the average measured values of the tested units rounded to be the nearest tenth.

For all other sources, the reported value shall be the minimum power factor of the tested units rounded to the nearest tenth.

JA 8.3.3 Start Time Test

Start time shall be measured in accordance with the ENERGY STAR Program Requirements Product Specifications for Lamps ~~1~~2.1: Start Time Test Method, notwithstanding the scope of the test~~.~~, subject to the following modifications:

For lamps the reported value shall be the average start time of the tested units rounded to the nearest millisecond.

For all other light sources the reported value shall be the maximum start time of the tested units rounded to the nearest millisecond.

For light sources that provide a preprogrammed fade-in feature, the initial plateau shall be the point where the light output of the device begins following its preprogrammed fade-in curve.

For light sources with a standby mode consuming no more than 0.2 watts of power, the start time test may be performed with the product receiving power and in this mode. In this case, the start time shall be the time between the sending of an on signal to the device and the initial plateau.

JA 8.3.4 Color Characteristics Tests

Correlated Color Temperature (CCT)~~, Duv,~~ and Color Rendering Index shall be determined by the following test procedures, as applicable to the type of light source:

a) Incandescent and halogen reflector lamps: IES LM-20.

b) Incandescent non-reflector lamps: IES LM-45.

c) General service fluorescent lamps: 10CFR 430.23(r).

d) Single ended compact fluorescent lamps: IES LM-66.

e) Fluorescent lamps that are not single ended compact fluorescent lamps or general service fluorescent lamps: IES LM-9.

f) Induction lamps: IES LM-66.

g) LED light sources: IES LM 79.

h) High intensity discharge lamps: IES LM-51.

i) Other applicable test procedure approved by the Executive Director

Nominal Correlated Color Temperature (CCT) ~~and Duv~~ shall be calculated in accordance with CIE 15 (reference document ANSI C78.377). Color Rendering Index (CRI) shall be calculated in accordance with CIE 13.3.

The reported value shall be the average measured values of units tested rounded to be the nearest whole number for ~~CCT and~~ CRI ~~and to 4 decimal places (closest ten thousandth) for Duv~~.

JA8.3.5 ~~Ambient Temperature~~Lumen Maintenance and Rated Life Test

Luminaires within the scope of the ENERGY STAR Product Specification for Luminaires version 2.0 shall be tested for Lumen Maintenance and Rated Life as specified in Section 10 of the Specification. All other light sources shall be tested for Lumen Maintenance and Rated Life as specified in Section 10 of the ENERGY STAR Product Specification for Lamps Version 2.1, notwithstanding scope.~~The following light sources shall be tested in accordance with the ENERGY STAR Product Specification for Lamps Version 1.1: Ambient Temperature Life Testing, in an ambient temperature condition between 20°C and 35°C and satisfy the lumen maintenance and 6,000 hour survival rate criteria:~~

a) Omnidirectional lamps < 10 watts, and decorative lamps for which the manufacturer has not performed an elevated temperature life test to show compliance with lumen maintenance requirements in this specification;
b) Omnidirectional lamps labeled "not for use in enclosed fixtures" on the lamp ;
c) LED light engines and lamps labeled "not for use in recessed fixtures" on the product ; and
d) Inseparable SSL luminaire: Alternatively inseparable SSL luminaires may reference the in-situ measurement temperature of the LED, IES LM80 test results and TM21 projections for the light source used in the luminaire.

For lamps the reported value shall be the 9th highest measured lumen maintenance value measured (9 out of 10 units must pass life testing).

For all other sources (except those using the IES LM80 test method and the IES TM21 calculation method for projecting lumen maintenance) the reported value shall be the minimum measured lumen maintenance value of the 3 samples.

Inseparable SSL luminaires designed to be recessed, shall be ICAT (insulation contact air tight) rated in accordance with Section 150.0(k)1C and tested with sides and top of luminaire in direct contact of least 12" of R-38 fiberglass insulation.

For inseparable SSL luminaires referencing the in-situ measurement temperature of the LED, IES -LM80 test results and projecting lumen maintenance using the IES TM21 calculation method for the light source used in the luminaire, ten samples for each T_S and drive current combination (refer to IES TM-21, section 4.2) must be tested. Each sample set may be composed entirely of one nominal CCT, or may be split between no more than two adjacent nominal CCT values as outlined in ANSI C78.377 (e.g. 2700 and 3000K). Passing Test: all of the conditions below shall be met.

1. In the sample luminaire, the in situ TMP_{LED} temperature is less than or equal to the temperature specified in the LM-80 test report for the corresponding or higher drive current, within the manufacturer's specified operating current range.
2. The drive current measured in the luminaire is less than or equal to the drive current specified in the LM-80 test report at the corresponding temperature or higher.
3. The TM-21 lumen maintenance life projection report projects an L70 meeting or exceeding requirements.

JA8.3.6 Elevated Temperature Life Test

The following light sources shall be tested in accordance with the ENERGY STAR Product Specification for Lamps Version 1.1: Elevated Temperature Life Testing.

a) Omnidirectional lamps ≥ 10 Watts that are not labeled "not for use in enclosed fixtures" or "not for use in recessed fixtures"; and
b) All other light sources that are not inseparable SSL luminaires, and that are not labeled "not for use in enclosed fixtures" or "not for use in recessed fixtures."

The Option A test method ENERGY STAR Elevated Temperature Life Test shall be modified as follows: Light source shall be tested in an ICAT (insulation contact, air-tight) recessed luminaire of the appropriate size for the source under test. The ICAT luminaire shall be listed for zero clearance insulation contact (IC) by Underwriters Laboratories or other nationally recognized testing/rating laboratory and have a label that certifies that the luminaire is airtight with air leakage less than 2.0 CFM at 75 Pascals when tested in accordance with ASTM E283. The sides and top of ICAT recessed luminaire shall be in direct contact of least 12" of R-38 fiberglass insulation.

Light sources tested in accordance with the ENERGY STAR Elevated Temperature Life Test, notwithstanding scope, shall use the modified Option A test method as described above or Option B or C with an operating temperature of:

-45degC +/-5degC for omnidirectional sources between 10 and 20 Watts;

~~45degC +/- 5degC for all sources other than omnidirectional not greater than 20 Watts;~~

~~55degC +/-5degC for all sources greater than 20 Watts.~~

~~If units are tested both base-up and base-down, the average of surviving unit measured values shall be calculated for each orientation and the reported lumen maintenance shall be the lesser of the two averages rounded to the nearest tenth of a percent if the difference between the averages is greater than 3%; if less than 3% difference, then the reported lumen maintenance shall be the average of all surviving units rounded to the nearest tenth percent. If units are tested in one orientation, the reported lumen maintenance value shall be the average of surviving unit measured values rounded to the nearest tenth percent.~~

~~For all other sources the reported value shall be the minimum measured lumen maintenance value of the three samples.~~

JA 8.3.7 Tests for Minimum Dimming Level, Flicker, and Audible Noise

Light sources shall be tested for flicker using either Joint Appendix 10 or NEMA 77.

The ~~flicker test is performed for light sources as specified in Joint Appendix JA10 and the~~ audible noise test shall be performed as specified in the ENERGY STAR Program Requirements Product Specification for Lamps Version ~~1~~2.1: Test Method – Noise ~~Recommended Practices~~, notwithstanding scope.

For dimming light sources, ~~M~~minimum dimming level is measured by comparing the stabilized light output of the light source with the dimming control set to full light output with the dimming control being set to the manufacturer's minimum rated output. Full light output and minimum light output is measured after the light output has stabilized according to the test procedures specific to light source type in Section JA 8.3.1.

In addition to the reporting of flicker results as described in Section JA8.6, flicker test data for each combination of light source, ballast or driver (if applicable), transformer type and dimmer type claiming compliance with JA8 shall be submitted to the California Energy Commission in the format as defined in Joint Appendix JA10.

Testing for minimum dimming level, flicker, and audible noise is required for each combination of light source, ballast or driver (if applicable), transformer type and dimmer type as follows:

1. Low voltage light sources shall be tested with a representative transformer for each transformer type that the light source is claiming compatibility.
2. Light sources claimed as compatible with forward phase-cut dimmers shall be tested in combination with a NEMA SSL 7A compliant dimmer.
3. Light sources claimed as compatible with dimmers other than forward phase-cut dimmers, dimmability, low noise and low flicker operation shall be tested for each ballast or driver combination (if applicable) with at least one representative dimmer for each dimmer type for which compatibility is claimed.

JA 8.4 Qualification Requirements

The following qualification requirements must be met for the light source to be considered High Efficacy as specified in Section 150(k) and Table 150.0-A.

JA8.4.1 Luminous Efficacy

The light source shall meet the following requirements when measured in accordance with the test method of Section JA8.3.1:

The luminous efficacy of the light source shall be equal to or greater than either the applicable State or federal appliance efficiency standard or 45 lumens/Watt, whichever is higher, when tested at its full light output.

JA8.4.2 Power Factor

The light source shall meet the following requirements when measured in accordance with the test method of Section JA8.3.2:

For light sources with a nominal rated wattage greater than five watts, t~~T~~he light source shall have a power factor equal to or greater than 0.90 when tested at its full light output. For light sources with a nominal rated wattage of five watts or less, the light source shall have a power factor equal to or greater than 0.70 when tested at its full light output.

JA8.4.3 Start Time

The light source shall meet the following requirements when measured in accordance with the test method of Section JA8.3.3:

The light source shall have a start time no greater than 0.5 seconds.

JA8.4.4 Color ~~Characteristics~~Rendering

The light source shall meet the following ~~CCT, Duv, and~~ color rendering requirements when measured in accordance with the test method of Section JA8.3.4:

(a) ~~Inseparable SSL luminaires, LED light engines, and GU24-based LED lamps shall be capable of providing a nominal Correlated Color Temperature (CCT) that is 4000 Kelvin or less and within 0.0033 Duv of the black body locus in the 1976 CIE color space.~~LED lamps regulated by the Title 20 Appliance Efficiency Regulations shall meet the Color Rendering Index requirements in Title 20.

~~(b) All other light sources shall be capable of providing a nominal Correlated Color Temperature (CCT) that is 3000 Kelvin or less and within 0.0033 Duv of the black body locus in the 1976 CIE color space.~~

~~(c)~~(b) All other light sources shall provide a Color Rendering Index (CRI) of 90 or higher and color rendering R9 value of 50 or higher ~~when measured at a correlated color temperature and Duv value that comply with Section JA8.4.4~~.

JA8.4.5 Lumen Maintenance, Rated Life and Survival Rate

The light source shall meet the lumen maintenance, rated life, and survival rate criteria when measured in accordance with the test method of Section JA8.3.5 and JA8.3.6.

(a) Lumen Maintenance: The percentage of initial light output shall either be 86.7 percent after ~~the~~ 6,000 hours ~~test~~ or 93.1 percent after 3,000 hours~~must be equal to or greater than 86.7 percent. For inseparable SSL luminaires referencing the in-situ measurement temperature of the LED, complying products shall have IES LM-80 test results that produce an IES TM-21 projected L70 of at least 25,000 hours~~.

(b) Rated Life: The light source shall have a minimum rated lifetime of 15,000 hours.

(c) Survival Rate: For tests using a sample group of ten units, 90 percent of tested units shall be operational at the completion of the ~~6,000 hour life~~ test. For tests using a sample size less than ten, all tested units shall be operational at the completion of the test.

~~Exception to Section JA8.4.6(c): Inseparable SSL luminaires referencing the in-situ measurement temperature of the LED.~~

JA8.4.6 Dimming, Reduced Flicker Operation and Audible Noise

The light source shall meet the following dimming, reduced flicker operation, and audible noise requirements when measured in accordance with the test method of Section JA8.3.7:

(a) ~~The~~ Dimming light source~~s~~ shall be dimmable down to 10 percent light output where 100 percent full light output is defined as operating the light source at the maximum setting provided by the control.

(b) LED-based light sources designed to be connected with or dimmed by forward phase cut dimmers shall meet the requirements of NEMA standard SSL 7A as Type 1 or Type 2 products.

~~EXCEPTION to JA8.4.6(b): LED based light sources designed to be dimmed by controls other than forward phase cut dimmers.~~

(c) Light source in combination with specified control shall either have a P_{st} (for frequencies of 80Hz or less) and SVM (for frequencies above 80Hz up to and including 2000Hz) of 1.0 or less or provide "reduced flicker operation" when tested at ~~100 percent and 20 percent of~~ full light output as specified in JA10, where reduced flicker operation is defined as having percent amplitude modulation (percent flicker) less than 30 percent at frequencies less than 200Hz~~, tested according to the requirements in Joint Appendix JA-10~~.

(d) Light source shall not emit audible noise above 24dBA measured at 1 meter from the light source when tested at ~~100 percent and 20 percent of~~ full light output.

(e) Dimming light sources shall also be tested and shown to comply with (c) and (d) while at 20% light output.

JA8.5 Marking

Light sources meeting the requirements of this Appendix shall be marked with "JA8-~~2016~~2019" to indicate their compliance with the criteria of this Appendix. Light sources that have passed ~~the~~ an Elevated Temperature Life Test shall instead be marked with "JA8-~~2016~~2019-E", to indicate that they comply with this Appendix and may additionally be installed in elevated temperature applications such as enclosed fixtures. Light sources that do not comply with this Appendix shall not be marked with "JA8-~~2016~~2019" or "JA8-~~2016~~2019-E".

JA8.6 Data Reporting

The following test data shall be submitted to the California Energy Commission in the format specified in Table JA-8. The entity submitting the filing shall keep all test data and documentation required for compliance for at least two years from the date of certification and shall provide copies of this documentation to the Energy Commission within 10 days of written request received from the Energy Commission.

TABLE JA-8. DATA TO BE RECORDED AND SUBMITTED TO THE CALIFORNIA ENERGY COMMISSION

Required Information	Permissible Answers	Compliance Threshold
Manufacturer, Model number, Description		
Light Source Type	LED, OLED, Fluorescent, HID, Incandescent, Other	
Product type	Omnidirectional lamp, Directional lamp, Decorative lamp, LED light engine,	

Required Information	Permissible Answers	Compliance Threshold
	inseparable SSL luminaire, other	
Lab accredited by NVLAP or accreditation body operating in accordance with ISO/IEC 17011?	Yes/No	Yes
Initial Efficacy	Value (lumens/Watt)	≥ 45 lumens/Watt
Power Factor at Full Rated Power	0 – 1 Fraction	≥ 0.90 for products > 5 watts, 0.70 for products 5w or less
Start time	Value (seconds)	≤ 0.5 sec
Correlated Color Temperature (CCT)	Number Kelvin	~~For inseparable SSL luminaires, LED light engines and GU24 LED lamps, ≤4000 Kelvin.~~ ~~For all other sources,≤ 3000 Kelvin.~~
~~Duv~~	~~Number Duv~~	~~≥ -0.0033 and ≤ +0.0033~~
Color Rendering Index (CRI)	0-100	≥ 90 for all products other than T20 lamps, ≥ 82 for T20 lamps
Color Rendering R9 (red)	0-100 or below 0	≥ 50 for all products other than T20 lamps
Ambient or elevated temperature test for rated life, lumen maintenance, and survival rate	Ambient or Elevated	~~"Ambient" allowed only for omnidirectional lamps <10W, and decorative lamps, or labeled "not for use in enclosed fixtures", lamps and light engines that are labeled "not for use in recessed fixtures" and "inseparable SSL luminaires". All others must report "Elevated".~~
~~6,000 hour~~ lumen maintenance	Value (percent), N/A	≥ 86.7% after 6,000 hours, or 93.1 after 3,000 hours~~or NA for integral luminaires providing TM-21 L70 projections based on light source LM80 data~~
~~LM-80 and TM-21 Projected Time to L70~~test duration	Value (hours)~~, N/A~~	~~≥ 25,000 hours, or N/A for light sources providing 6,000 hour lumen maintenance testing~~3,000 or 6,000
Rated life	Value (hours)	≥ 15,000 hours

Required Information	Permissible Answers	Compliance Threshold
~~6,000 hour~~ survival rate	Value (percent)	≥ 90%~~ or NA for integral luminaires whose lumen maintenance/rated life is evaluated using light source LM-80 data.~~
Minimum dimming level	Value (percent)	≤ 10%
Dimming control compatibility	Forward Phase cut control, reverse phase cut, powerline carrier, digital, 0-10 VDC, other.	At least one type must be listed for dimming units
NEMA SSL 7A compatible?	Yes/No, NA	If compatible with forward phase cut dimmer control, "Yes". If not, "NA~~e~~".
Flicker:		
See JA10 Table 10-1 for flicker data requirements and permissible answers		<30% for frequencies of 200 Hz or below, at 100% ~~and 20%~~ light output, or NA if using NEMA 77
See JA10 Table 10-1 for flicker data requirements and permissible answers		<30% for frequencies of 200 Hz or below, at 20% light output, or NA if using NEMA 77 or if not dimming
100% light output P_{st}	Value (number)	≤ 1.0 or NA if using JA10
100% light output SVM	Value (number)	≤ 1.0 or NA if using JA10
20% light output P_{st}	Value (number)	≤ 1.0 or NA if using JA10 or if not dimming
20% light output SVM	Value (number)	≤ 1.0 or NA if using JA10 or if not dimming
Audible Noise		
100% light output: Audible Noise	Value (dBA)	≤ 24 dBA
20% light output: Audible Noise	Value (dBA), NA	≤ 24 dBA if dimming, otherwise NA
Marking		
Marked in accordance with JA8.5	Yes/No	Yes. "No" allowed only for lamps and LED light engines with diameter less than 1.0" and decorative lamps with a diameter less than 2.0"