ENERGY STAR® Program Requirements
Product Specification for Luminaires (Light Fixtures)

Eligibility Criteria
Draft Version 2.2

Note box: Please read the cover letter posted with this draft, and all note boxes located throughout the draft. EPA invites stakeholders to send comments to lighting@energystar.gov, with the subject "ENERGY STAR Luminaires V2.2 Comments" **by August 5, 2019**. These updates, when final, would only be applicable to new product certifications moving forward and would not impact any current certifications.

Following is the Draft Version 2.2 product specification for ENERGY STAR certified Luminaires. A product shall meet all of the identified criteria if it is to earn the ENERGY STAR.

To certify a luminaire for ENERGY STAR, first determine which requirements in this document are applicable to the specific luminaire. ENERGY STAR requirements are specific to luminaires classified by the program as directional or non-directional. This specification is generally organized by the requirements, not by luminaire type such as indoor or outdoor, or by light source technology. Partners are advised to review each section, and take note of exceptions where specific performance criteria need not be evaluated; for instance, some color exceptions are in place for outdoor luminaires.

Luminaires which do not fall into the specific directional scope default to non-directional classification.

Note box: EPA clarified what was always intended, that inseparable, solid state (LED) luminaire types not otherwise itemized in the directional scope shall be considered inseparable "other" for the purposes of ENERGY STAR certification.

- Directional luminaires (**evaluated using luminaire photometry**):
  - **specific scope** itemized in the Specification Scope & Luminaire Classification section
  - evaluated using luminaire photometry (i.e. lumens delivered from luminaire per input watt), accounting for luminaire optics
  - shall also meet specified minimum light output and zonal lumen density requirements
  - solid state (LED) luminaire types featuring inseparable components (no user replaceable/upgradeable LED light engine or integrated LED lamp) and not otherwise itemized in the directional scope shall be considered inseparable "other" SSL luminaires and evaluated using luminaire photometry
  - luminaire types not meeting the above criteria default to non-directional classification, described below

- Non-directional luminaires (evaluated using source photometry):
  - **examples** provided in the Specification Scope & Luminaire Classification section
  - evaluated using source photometry (i.e. lumens delivered from the light source per input watt), including system performance of lamp and ballast, LED light engine, ENERGY STAR certified compact fluorescent lamp or LED lamp
  - luminaires not classified above as directional are evaluated as non-directional as long as the light source is removable and can be tested by an applicable test method identified in this specification

1 SPECIFICATION SCOPE & LUMINAIRE CLASSIFICATION

The ENERGY STAR Luminaires specification ("this specification") covers luminaire types outlined in this section. This specification is limited to residential type lighting products, however to the extent that products that fall under the scope of this specification are sold into the commercial market, they may be included and listed appropriately for the applicable end user. Certification is limited to luminaires below a total input power of 250 watts intended to be connected directly to the electric power grid. Refer to the Definitions section in Section 4 for definitions of each directional luminaire type detailed below. Questions about scope may be directed to an EPA recognized Certification Body or lighting@energystar.gov.

Note box: Consumers may carry upwards of three personal devices when they travel and may use more than one device at a time when home. Because of this, table and floor lights with USB charging ports or AC outlets are now prevalent in hotel guestrooms and retailers are increasingly selling these for use in homes. Because there is a federal standard that limits the amount of power consumed by external power supplies used to enable this functionality, EPA modified the exclusion of products incorporating energy-consuming features not related to illumination to allow products such as portable desk task lights with an AC outlet or USB charger to seek ENERGY STAR certification. Products offering this optional functionality are subject to the standby power consumption requirements of Section 11.5.

Additionally, EPA clarified that integral battery packs intended solely for emergency operation of the light source(s) in the event of loss of normal power are considered a feature related to the control of illumination so are not excluded for the purposes of ENERGY STAR certification. This was always intended but never explicitly stated.

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1.1 Excluded Products:

- Commercial outdoor lighting (e.g. street and area, wall packs, canopy)
- High or low bay luminaires
- Recessed troffers and other linear fluorescent fixtures
- Luminaire types typically employed for general office illumination such as linear pendants and panel lighting
- HID sources or their SSL replacements
- Socket adapters or converters
- LED lamps intended to replace linear fluorescent, pin-based compact fluorescent or high-intensity discharge lamps.
- Products incorporating power-consuming features (e.g., luminaires with voice assistance, audio speakers, UV disinfection, or security cameras) in the active mode or off state which are not related to (1) control of illumination*, or (2) personal device charging functionality (e.g., portable desk task lights with an AC outlet or USB charger).**

*Integral battery packs intended solely for emergency operation of the light source(s) in the event of loss of normal power are considered a feature related to the control of illumination so products incorporating them are not excluded for the purposes of ENERGY STAR certification.

**See Section 11.5 for additional requirements for external power supplies enabling USB charging functionality.

Ceiling fan light kits should be certified under the ENERGY STAR specification for Ceiling Fans (https://www.energystar.gov/products/lighting_fans/ceiling_fans/partners).

1.2 Included Products:

Note box: EPA added the word "other" to "Inseparable SSL Luminaires to clarify in simpler terms what was always intended and stated, that this applies to inseparable luminaire types not specified in the directional type list in this section. Directional luminaire types listed have specific requirements and can be separable or inseparable but must be measured with luminaire photometry. Inseparable luminaire types not listed (a.k.a. Inseparable Other) must be measured with luminaire photometry due to design but do not have as many specific requirements because the type and function could vary.

LUMINAIRE TYPES MEASURED WITH LUMINAIRE PHOTOMETRY		
Inseparable Other SSL Luminaires	Luminaires **not listed below as directional** with solid state light sources that do not fit the definition of lamp or light engine	
DIRECTIONAL LUMINAIRES (Separable or Inseparable)		
Limited to the following types:	**Includes:**	
Accent Lights	Line-voltage directional track lighting Track heads	
Cove Mount and Under cabinet Lights		
Downlights	Downlight Retrofit Kits Recessed	Surface Mount Pendant Mount
Outdoor Lighting	Post mount Pendant Mount Porch Lights	Wall Mount Security Lighting
Portable Desk Task Lights		
LUMINAIRE TYPES MEASURED WITH SOURCE PHOTOMETRY		
NON-DIRECTIONAL LUMINAIRES (including but not limited to)		
Ventilation Fan Light Kits (Ceiling fan light kits are covered under the Ceiling Fan and Light Kits Specification)	Portable	
Wrapped Lens	Linear Strip	
Wall Sconces & Retrofits	Outdoor Ceiling or Close-to-Ceiling Mount, Porch or Post mount	
Decorative Pendants	Bath Vanity	
Ceiling Mount & Retrofits	Chandeliers	

2 EFFECTIVE DATE

The ENERGY STAR Luminaires Version 2 specification shall take effect on June 1, 2016. To certify a product for ENERGY STAR, the model shall meet the ENERGY STAR specification in effect on its date of manufacture. The date of manufacture is specific to each unit and is the exact date on which a unit is considered to be completely assembled.

3 FUTURE SPECIFICATION REVISIONS

EPA reserves the right to change this specification should technological and/or market changes affect its usefulness to consumers, industry, or the environment. In keeping with current policy, revisions to the specification are arrived at through industry discussions. In the event of a specification revision, please note that ENERGY STAR certification is not automatically granted for the life of a product model.

While this document currently refers to industry standards and test procedures for fluorescent and solid state sources, as new technologies emerge that have equal or better performance to the levels proposed here, consistent with a technology neutral approach, EPA may amend the program requirements by adding additional requirements, standards, and test procedures.

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4 DEFINITIONS

Note box: EPA added a definition of a luminaire's active mode (i.e. the mode when the light source is on) in alignment with the Lamps specification. Additionally, the definition of Inseparable Other SSL Luminaire was added to clarify what was always intended and stated, that these are inseparable SSL luminaire types not explicitly listed in Section 9.2 of this document that must be measured with luminaire photometry due to design. Finally, the definition of Inseparable SSL Luminaire was updated to clarify the testing requirements for directional, inseparable luminaires.

Accent Light (Luminaire): A directional luminaire employed to emphasize a particular object or surface feature, or to draw attention to a part of the field of view (adapted from ANSI/IES RP-16-17: "Accent Lighting"). This includes line-voltage directional track lighting.

Active Mode: The state where the energy using product is connected to a mains power source and the primary light-producing function is activated. (Adapted from IEC 62301 Edition 2.0 2011-01)

ANSI: American National Standards Institute.

Aperture Size (downlights): The maximum distance between the points inside the luminaire where light escapes the luminaire.

ASTM: American Society for Testing of Materials.

Ballast: A device used with an electric-discharge lamp to obtain the necessary circuit conditions (voltage, current, and wave form) for starting and operating. (ANSI/IES RP-16-17)

Bath Vanity Luminaire: Wall-mounted luminaires located adjacent to a mirror.

Beam Angle: The angle in degrees, between the two opposite directions in which the average intensity is 50% of the center beam intensity as measured in at least two rotational planes, 90° from each other, around and through the beam axis. (ANSI C78.379-2006)

Ceiling / Close-to-Ceiling Mount Luminaire: Ceiling-mounted luminaires that direct less than 90% of light downward and are not intended to accent an object or an area within a space.

Chandeliers: Decorative, often branched, luminaires suspended from the ceiling incorporating multiple light sources.

CIE: Commission Internationale de l'Eclairage (International Commission on Illumination).

Color Rendering Index (CRI): A measure of the degree of color shift objects undergo when illuminated by the light source, as compared with the color of those same objects when illuminated by a reference source of comparable color temperature. (ANSI/IES RP-16-17)

Color Shifting Dimming Luminaire: A luminaire with dimming capability designed to simulate the behavior of incandescent lamps where the chromaticity gradually shifts to a lower value as the product is dimmed. This function is not considered color tunable for the purposes of this specification, unless it can also be tuned to different colors at full output.

Color Tunable Luminaire: For the purpose of this specification, a color tunable luminaire has functionality that allows the end user to alter the color appearance of the light generated by the luminaire. This tuning must include white light that is capable of meeting the specification's color requirements, and can alter the color appearance along the black body curve, or may also extend to colors beyond the ANSI defined correlated color temperature ranges (e.g. 2700K and 5000K) outside of the seven step MacAdam ellipse or the ANSI quadrangles.

Compact Fluorescent Lamp (CFL): A fluorescent lamp with a small diameter glass tube (T5 or smaller) that is folded, bent, or bridged to create a long discharge path in a small volume. The lamp designs generally include an amalgam and a cold chamber, or a cold spot, to control the mercury vapor pressure and light output. (ANSI/IES RP-16-17)

Connected Luminaire: A luminaire or retrofit which includes elements or instructions (hardware and software or firmware) required to enable communication in response to consumer-authorized energy or performance related commands and complies with all requirements for connected in the specification. These elements may be resident inside or outside of the base luminaire or retrofit.

Correlated Color Temperature (CCT): The absolute temperature of a blackbody whose chromaticity most nearly resembles that of the light source. (ANSI/IES RP-16-17).

Cove Mount (Luminaire): Lighting comprising light sources shielded by a ledge or horizontal recess, and distributing light over the ceiling and upper wall. (Adapted from ANSI/IES RP-16-17: "Cove Lighting") For purposes of this specification, cove mount luminaires feature luminaire optics over the lamps, LED packages, arrays or modules, LED light engines or integrated LED lamps.

CSA: Canadian Standards Association.

Decorative Pendant (Luminaire): Suspended luminaires that are not intended to accent an object or an area within a space, and typically employ blown glass, or colorful glass elements.

Direct Lighting: Lighting involving luminaires that distribute 90% to 100% of the emitted light in the general direction of the surface to be illuminated. This term usually refers to light emitted in a downward direction. (ANSI/IES RP-16-17)

Directional Applications: See Direct Lighting.

Directional Luminaires: See Direct Lighting.

Down Light or Downlight (Luminaire): A small direct-lighting unit that directs the light downward and can be recessed, surface mounted, or suspended (ANSI/IES RP-16-17). See definition of Direct Lighting for additional information. For purposes of this specification, this definition includes downlight retrofit kits but does not include linear fluorescent troffers or linear luminaire forms such as linear fluorescent pendants, typically used to illuminate office spaces.

Downlight Retrofits: A type of luminaire intended to install into an existing downlight, replacing the existing light source and related electrical components, typically employing an ANSI standard lamp base, either integral or connected to the downlight retrofit by wire leads, and is a retrofit kit classified or certified to UL 1598C. This category does not include self-ballasted lamps, which are covered by the ENERGY STAR Lamps Specification, or products that utilize the existing ballast or transformer.

Electronic Ballast: A device which operates at a supply frequency of 50 or 60 Hz and operates the lamp at frequencies greater than 10 kHz. (ANSI standard C82.13-2002)

Enclosed fixture or enclosed luminaire: A luminaire that contains enclosed lamp compartment(s) where ventilation openings are less than 3 square inches per lamp in the lamp compartment or where the cross-sectional area of the opening of the lamp compartment is less than the maximum cross sectional area of the lamp compartment (adapted from UL 1598 Fig 7.2.1).

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Floor Lamp (Luminaire): a portable luminaire on a high stand, suitable for standing on the floor. (ANSI/IES RP-16-17)

IEC: International Electrotechnical Commission.

IES: Illuminating Engineering Society.

Input Power: The power consumption in watts of a ballast or driver and a light source system operating in a normal or active mode, as determined in accordance with the test procedure (ANSI Standard 82.2-2002)

Inseparable SSL Luminaire: A luminaire featuring solid state lighting components (i.e. LEDs and driver components) which cannot be easily removed or replaced by the end user, thus requiring replacement of the entire luminaire. Removal of solid state lighting components would require (for instance) the cutting of wires, use of a soldering iron, or damage to or destruction of the luminaire. This definition does not encompass luminaires which feature LED light engines or integrated LED lamps which are user replaceable / upgradeable without the cutting of wires or the use of solder.

Inseparable Other SSL Luminaire: An inseparable SSL luminaire type not explicitly listed in Section 9.2 of this document (e.g. downlights, track lights, accent lights, etc.) that must be measured with luminaire photometry due to design.

Integrated LED Lamp: An integrated assembly composed of light emitting diode (LED) packages (components) or LED arrays (modules), as well as an LED driver, an ANSI standard base, and other optical, thermal, mechanical and electrical components. The device is intended to connect directly to the branch circuit through a corresponding ANSI standard lamp-holder (socket). (ANSI/IES RP-16-17: “LED lamp, integrated”)

Lamp: A generic term for a manufactured source created to produce optical radiation. By extension, the term is also used to denote sources that radiate in regions of the spectrum adjacent to the visible.” (ANSI/IES RP-16-17)

Lamp-Ballast Platform: A pairing of one ballast with one or more lamps that can operate simultaneously on that ballast. A unique platform is defined by the manufacturer and model number of the ballast and lamp(s) and the quantity of lamps that operate on the ballast. A lamp-ballast platform also may refer to a lamp with an integral ballast, such as a GU24 based integrated lamp.

Lampholder: A component of a luminaire which supplies power to the lamp and also holds the lamp in place.

LED: See Light Emitting Diode.

LED Array or Module: An assembly of LED packages (components), or dies on a printed circuit board or substrate, possibly with optical elements and additional thermal, mechanical, and electrical interfaces that are intended to connect to the load side of a LED driver. Power source and ANSI standard base are not incorporated into the device. The device cannot be connected directly to the branch circuit. (ANSI/IES RP-16-17)

LED Control Circuitry: Electronic components designed to control a power source by adjusting output voltage, current, or duty cycle to switch or otherwise control the amount and characteristics of the electrical energy delivered to an LED package (component) or an LED array (module). LED control circuitry does include a power source. (ANSI/IES RP-16-17)

LED Driver: A device comprised of a power source and LED control circuitry designed to operate an LED package (component), an LED array (module), or an LED lamp. (ANSI/IES RP-16-17)

LED Driver Case Temperature Measurement Point (TMP_C): A location on an LED driver case, designated by its manufacturer, which will have the highest temperature of any point on the driver case during normal operation.

LED Light Engine: An integrated assembly composed of LED packages (components) or LED arrays (modules), as well as an LED driver and other optical, thermal, mechanical and electrical components. The device is intended to connect directly to the branch circuit through a custom connector compatible with the LED luminaire for which it was designed. It does not use an ANSI standard base (ANSI/IES RP-16-17). For purposes of this specification, light engines that rely on the luminaire for optical control, and/or thermal management, assemblies featuring remote-mounted drivers ("non-integrated"), and/or GU24 based integrated SSL sources not in the scope of the ENERGY STAR Lamps specification shall also be considered LED light engines.

LED Luminaire: A complete lighting unit consisting of LED-based light emitting elements and a matched driver together with parts to distribute light, to position and protect the light emitting elements, and to connect the unit to a branch circuit. The LED-based light emitting elements may take the form of LED packages (components), LED arrays (modules), an LED Light Engine, or LED lamps. The LED luminaire is intended to connect directly to a branch circuit. (ANSI/IES RP-16-17)

LED Package: An assembly of one or more LED dies that includes wire bond or other type of electrical connections, possibly with an optical element and thermal, mechanical, and electrical interfaces. Power source and ANSI standardized base are not incorporated into the device. The device cannot be connected directly to the branch circuit. (ANSI/IES RP-16-17)

LED Temperature Measurement Point (TMP_{LED}): A location on an LED package/module/array, designated by its manufacturer, which provides a surrogate temperature measurement location for the actual LED junction. The TMP_{LED} may be a solder joint at the board attachment site, a point on the LED package case, or a location on the board of an LED module or array.

Light Emitting Diode (LED): A p-n junction semiconductor device that emits incoherent optical radiation when forward biased. The optical emission may be in the ultraviolet, visible, or infrared wavelength regions. (ANSI/IES RP-16-17)

Linear Strip Luminaire: A surface mounted luminaire with an elongated aspect ratio and either no optics over the light source(s) or individual optics over each light source.

Line-Voltage Track Light (Luminaire): See Accent Light definition. Includes luminaires interoperable with line-voltage track installed without a transformer or power supply.

Lumen Maintenance: Luminous flux maintenance (often referred to as “lumen maintenance”) is the remaining luminous flux output (typically expressed as a percentage of the initial luminous flux output) at any selected elapsed operating time. Luminous flux maintenance (or “lumen maintenance”) is the converse of luminous flux depreciation (or “lumen depreciation”). (ANSI/IES LM-80-15).

Lumens per Watt (lm/W): The quotient of the total luminous flux emitted by the total light source power input. It is expressed in lm/W. (adapted from ANSI/IES RP-16-17: “Luminous Efficacy of a Source of Light”)

Luminaire (Light Fixture): A complete lighting unit consisting of lamp(s) and ballast(s) (when applicable) together with the parts designed to distribute the light, to position and protect the lamps, and to connect the lamp(s) to the power supply (ANSI/IES RP-16-17).

Luminaire Efficacy: The luminous flux delivered by a luminaire, divided by its input power.

MacAdam Color Ellipse: A series of ellipses around the chromaticity coordinates of a number of different colors. Each ellipse sets the boundary at which a given percentage of people are able to determine that two colors, one with the chromaticity coordinates at the center of the ellipse, and one with chromaticity coordinates on the ellipse, are just noticeably different. (IES Handbook 9th Edition)

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Measured value: The directly measured value from testing equipment for a given unit under test.
Nadir: The angle pointing directly downward from the luminaire, or zero degrees.
NEMA: National Electrical Manufacturers Association.
Non-Directional Application: For purposes of this ENERGY STAR specification, luminaire types which are not designated directional. See Direct Lighting definition.
Non-Directional Luminaire: See Non-Directional Application.
NRTL: Nationally Recognized Testing Laboratory as recognized by OSHA's NRTL Program, which is a part of OSHA's Directorate of Technical Support.
Optics: Include reflectors, baffles, lenses and/or diffusers, all of which control the light distribution and the appearance of the lighted luminaire.
OSHA: Occupational Safety & Health Administration.
Outdoor Pendant Luminaire: An outdoor suspended luminaire.
Outdoor Porch Luminaire: An outdoor ceiling, surface or wall-mounted luminaire.
Outdoor Post-Mounted Luminaire: An outdoor luminaire supported by a post inserted into the ground and mounted between 4 feet and 10.5 feet above grade.
Outdoor Security Luminaire: Wall mounted luminaires intended to light areas immediately adjacent to a building's perimeter.
Photocontrol or Light-Activated Switch: A photoelectric switch that controls lighting by the level of daylight luminance (ANSI/IES RP-16-17), also referred to as a photosensor.
Platform: See Lamp-Ballast Platform.
Portable Desk Task Light (Luminaire): A light fixture resting on a desk that directs light to a specific surface or area to provide illumination for visual tasks such as reading and writing, and employs a NEMA 1-15P or 5-15P plug for its electrical connection.
Portable Floor Task Light (Luminaire): A light fixture resting on the floor that directs light to a specific surface or area to provide illumination for visual tasks such as reading and writing, and employs a NEMA 1-15P or 5-15P plug for its electrical connection.
Portable Luminaire: A lighting unit that is not permanently fixed in place. (ANSI/IES RP-16-17)
Power Factor: The power input in watts divided by the product of ballast input voltage and input current of a fluorescent lamp ballast, as measured under test conditions. (ANSI Standard C82.2–2002 (R2016))
Power Source: A transformer, power supply, battery, or other device capable of providing current, voltage, or power within its design limits. This device contains no additional control capabilities. (ANSI/IES RP-16-17: "LED Power Source")
Rated Lumen Maintenance Life (L_p): The elapsed operating time over which the LED light source will maintain the percentage, p, of its initial light output, e.g. L_{70} (hours): Time to 70% lumen maintenance. (IES TM-21-11)
Reported value: The value reported for purposes of compliance with DOE and/or ENERGY STAR requirements according to the criteria in each applicable section.
Residential Luminaire: A luminaire marketed and intended to be used in a residential environment notwithstanding use in commercial, business and industrial environments. (Adapted from FCC 47 CFR parts 15 and 18)
Run-up Time: The time needed after switching on the supply for the lamp to reach 80.0% of its stabilized luminous flux. (ANSI C78.5-2003 (R2015))
Secondary Optics: Materials modifying the distribution or amount of light from, but not integral to a light source, including but not limited to diffusers, reflectors, and total internal reflection optics.
Solid State Lighting (SSL): The term "solid state" refers to the fact that the light is emitted from a solid object—a block of semiconductor—rather than from a vacuum or gas tube, as in the case of an incandescent and fluorescent lighting. There are two types of solid-state light emitters: inorganic light-emitting diodes (LEDs) or organic light-emitting diodes (OLEDs). (Sandia National Laboratories)
Standby Mode: The condition in which energy-using product is connected to a main power source; and offers one or more of the following user-oriented or protective functions: to facilitate the activation or deactivation of other functions (including active mode) by remote switch (including remote control), internal sensor, or timer; or continuous functions, including information or status displays (including clocks) or sensor-based functions. (US DOE)
Standardized Color Ellipse: A MacAdam color ellipse defined by center chromaticity coordinates (CIE x, y) and a measure of certainty for detecting a color difference specified in standard deviation units called steps. (ANSI C78.376-2014)
Surface Mount Retrofit Kits: A type of solid state lighting product intended to replace existing light sources and systems including incandescent and fluorescent light sources in previously installed luminaires that already comply with safety standards. These kits replace the existing light source and related electrical components, and are classified or certified to UL 1598C. This may employ an ANSI standard lamp base, either integral or connected to the retrofit by wire leads. This category does not include self-ballasted lamps, which are covered by the ENERGY STAR Lamps Specification, or products that utilize the existing ballast or transformer.
Table Lamp (Luminaire): A portable luminaire with a short stand suitable for standing on furniture. (ANSI/IES RP-16-17)
Torchiere or Torchère (Luminaire): An indirect floor lamp that sends all or nearly all of its light upward. (ANSI/IES RP-16-17)
TMP_C: see LED Driver Case Temperature Measurement Point.
TMP_{LED}: see LED Temperature Measurement Point.
Trim: The part of a downlight that covers the ragged edge of the ceiling cut-out. The trim may be a separate ring, or trim ring, or it may be integrated with the optics (i.e., a self-flanged reflector). A trim can be airtight or non-airtight.
UL: Underwriters Laboratories.
Under-Cabinet Luminaire: A luminaire installed below an upper cabinet to direct light down to the work surface of a countertop or desk for task lighting.
Wall Sconce (Luminaire): A wall mounted luminaire not intended to accent an object or a task area within a space.
Wrapped Lens Luminaire: A surface mounted luminaire with an elongated aspect ratio and a single optic covering the light source that directs less than 90% of light downward.

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5 TEST CRITERIA

When testing luminaires, the methods of measurement identified for each performance requirement in the "Methods of Measurement and/or Reference Documents" column of the performance requirements tables presented within this specification shall be used to determine ENERGY STAR certification.

All tests shall be conducted with the product connected to a supply circuit of rated frequency. For products with multiple operating voltages, the product shall be operated at 120 volts throughout testing. If the product is not rated for 120 volts, it shall be operated at the highest rated voltage. For dimmable or multi-power products, measurements shall be taken at the highest wattage setting listed for the model, unless otherwise specified. IES LM-9, LM-65 and LM-66 are applied to both hot and cold cathode lamps, and LM-65 and LM-66 apply to induction lamps.

5.1 Testing Color Tunable Luminaires

For the purpose of this specification, a color tunable luminaire has functionality that allows the end user to alter the color appearance of the light generated by the luminaire. This tuning must include white light that is capable of meeting the specification's CCT requirements, and can include the ability to alter the color appearance along the black body curve, or may also extend to colors beyond the ANSI defined correlated color temperature ranges. When testing color tunable luminaires, photometric performance testing (per section 9) shall be performed at an undimmed state, and testing should be performed as follows:

- All tests and evaluations shall be performed at the Least Efficient white light setting included in this specification (Section 9.3).
- Additionally, watts, lumens, chromaticity, and CRI shall be tested and reported for Default and Most Consumptive white light settings as applicable (if different from least efficient white light setting).

In order to facilitate compliance testing, the partner shall provide detailed instructions for the control settings or control signals (as applicable) for reaching the least efficient, default, and most consumptive modes.

5.2 Certified Lighting Subcomponent Database

The Certified Subcomponent Database (CSD) supports certification of ENERGY STAR Luminaires by providing partners with third-party certified performance data for lighting subcomponents. The use of the CSD is optional for luminaire manufacturers. It is intended to streamline the certification process; subcomponents are not required to be listed on the CSD to be employed in an ENERGY STAR certified luminaire.

The CSD is designed to contain certified performance data for illumination related subcomponents such as: fluorescent lamps, fluorescent ballasts, fluorescent lamp-ballast platforms, and LED light engines, and can be found at www.energystar.gov/csd.

5.2.1 Listing Subcomponents:

Subcomponents in this database are not ENERGY STAR qualified as a result of being listed and:

- May not carry any of the Program's certification or promotional marks on the products, on product packaging, or in associated literature either printed or electronic.
- May not be referred to as ENERGY STAR qualified, certified, rated, or approved.
- May be referred to as "listed on the ENERGY STAR CSD".

To have subcomponents listed on the CSD, manufacturers must follow the third-party certification procedures and have products tested at an EPA-recognized laboratory, and the test data certified by an EPA-recognized certification body.

- Subcomponent manufacturers' test laboratories must provide the same test reports required by the Luminaires specification, and the sample sizes for subcomponents must follow the required sample sizes in the specification.
- If the subcomponent meets the Luminaires specification performance levels attributable to the subcomponent, the CB may certify the subcomponent data for listing on the CSD.
- When luminaire manufacturers provide materials for ENERGY STAR certification, they can reference the CSD for performance data of subcomponents used in their luminaires.

5.2.2 Using Subcomponents:

Partners that utilize the subcomponents in their luminaire may only reference performance metrics applicable to the specific type of luminaire, and its classification as a directional or non-directional luminaire.

5.2.3 Testing LED Light Engines without Integrated Heat Sinks

When performing LM-82 testing of LED light engines that will rely on the luminaire for heat dissipation, it is permissible to use a representative heat sink that provides similar heat dissipation to the luminaire that the LED light engine is going to be installed in.

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6 PRODUCT CERTIFICATION

6.1 Product Families

Grouped product submissions for ENERGY STAR certification shall meet the following requirements:
Certified products within a product family shall be identical to the tested, representative model with the exception of allowed variations listed in the table below. The representative model shall be the variation expected to have the greatest difficulty meeting the performance requirements outlined in this specification. **Any configuration included in a family grouping that shares the same model number is representative of the performance of all configurations; any sampled configuration (e.g., downlight with black reflector/trim finish) that fails to meet the requirements during verification testing will result in a failed determination for all product configurations sharing the same model number.**

Allowable Variations Within Product Families		
Luminaire Attribute	**Allowable Variation**	**Additional Test Data Required for Each Variant[1]**
Ballast/Driver (no change in nominal wattage or current)	Allowed so long as variations will not negatively impact luminaire's compliance with any performance criteria in this specification.	Thermal measurements of each variation may be required (e.g. ballast case temperature or TMP_C).
Correlated Color Temperature (CCT) (also review Light Source variation below)	Allowed so long as the lamp series or LED package/module/array series (and associated drive current), ballast or driver, and thermal management components are identical, and so long as variations will not negatively impact luminaire's compliance with any performance criteria in this specification. The representative model shall be the version within the product family with the lowest CCT for SSL products and the highest CCT for discharge products. Partner shall use different luminaire model numbers to distinguish between models shipped with light sources of varying CCTs.	None
Electrical Connection (Downlight Retrofit Kits)	Allowed (e.g. E26 and GU24).	None
Finish	Luminaire body color/pigment.	None
Heat Sink / Thermal Management Components	Not allowed.	None
Housing/ Chassis	Allowed so long as the light source or lampholder, ballast or driver, and heat sink (as applicable) are integrated into housing / chassis variations in such a way that the thermal performance of the luminaire is not degraded by changes to the housing / chassis.	Engineering rationale or thermal measurements of each variation may be required (e.g. ballast case temperature, TMP_{LED}, or TMP_C).

[1] Testing required to document the additional test data listed in this table shall be performed by an EPA-recognized laboratory; further data to support a partner's engineering rationale for the worst-case variant does not.

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Allowable Variations Within Product Families		
Luminaire Attribute	**Allowable Variation**	**Additional Test Data Required for Each Variant[1]**
Light Source[2] (refers to the make and/or model of the source; also review CCT below)	Allowed so long as variations will not negatively impact luminaire's compliance with any performance criteria in this specification.	• Certified performance data from additional light source if separable • Integrating sphere test for inseparable product
Mounting	Allowed. Luminaire photometry test reports generated for outdoor post-mounted luminaires may be used to certify outdoor porch (wall-mounted), outdoor ceiling or close-to-ceiling mounted and outdoor pendant luminaires within the same product family, in place of the source photometry requirements, so long as the bill of materials for each luminaire type is identical except for mounting hardware.	None
Product Wattage[3] (directional luminaires)	For SSL products: • The LED package, array, or module model must not change, although CCT remains an allowable variation. • The only performance change to the luminaire is to a driver that provides a different drive current to the LED package, array or module. • The model tested should be the highest wattage, and lowest CCT variant.	• LED drive current measurement • Integrating sphere scan to represent performance of variants including: o CCT o Lumen Output o CRI o Power Consumption o Chromaticity
	For Fluorescent products: • The lamp wattage may change, but not the general type or configuration. Example: A 32W triple tube pin based fluorescent representing a 26W triple tube pin based fluorescent would be acceptable, but not representing a 26W twin tube fluorescent. • The only performance change to the luminaire is to the lamp (or lamp and ballast) with a lower wattage. • The model tested should be the highest wattage, highest CRI, and highest CCT variant.	• Certified lamp data for variants • Integrating sphere scan to represent performance of variants including: o CCT o Lumen Output o CRI o Power Consumption o Chromaticity
Reflector / Trim	Allowed so long as luminaire light output exceeds that of the darkest or least efficient reflector variation.	Luminous flux for each basic trim or for the reflector variation with the darkest or least efficient finish should be reviewed.
Shade / Diffuser	Allowed so long as neither luminaire light output nor air flow are reduced.	None

6.2 Significant Digits and Rounding

a. Measurements shall be recorded at the resolution of the test instrumentation for each unit in the sample set.
b. All calculations shall be carried out on a per unit basis with directly measured (unrounded) values.
c. Compliance with the specification limits shall be evaluated against the reported value for each model.
d. Rounding is defined as follows:
   i. A fractional number at or above the midpoint between two consecutive decimal places or whole numbers shall be rounded up to the higher of the two decimal places or whole numbers; or
   ii. A fractional number below the midpoint between two consecutive decimal places or whole numbers shall be rounded down to the lower of the two decimal places or whole number.

6.3 Solid State Lumen Maintenance Performance Data

Content and application of IES LM-80 reports for LED luminaires shall comply with the ENERGY STAR Requirements for the Use of LM-80 Data.

[2] Partners may not retroactively add variations to a product family unless requirements in Table 1 are still met. For example, if the representative model tested is a SSL product with a 3000 Kelvin nominal CCT, partner may not retroactively add a 2700 Kelvin model without additional testing, as this was not the lowest CCT initially tested.
[3] When wattage as a variation is used, changes to optics and LED package, array or module (where applicable) are not permitted, as these changes would result in a change in distribution which must be re-evaluated against the luminaire specific requirements. The additional models would still require an integrating sphere LM-79 test to verify other photometric and electrical performance requirements. Each wattage variation should be listed individually.

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7 METHODS OF MEASUREMENT AND REFERENCE DOCUMENTS

Note box: The IES has updated LM-79 since the release of the Luminaires V2.1 specification. EPA has evaluated it for consistency and included it as an acceptable method of measurement for new product certifications and has included it as a method of measurement in the draft V2.2 specification.

Organization	Identifier	Description
ANSI/IEEE	C62.41.1-2002	IEEE Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits
ANSI/IEEE	C62.41.2-2002	IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000V and Less) AC Power Circuits
ANSI	C78.5-2003 (R2015)	Specifications for Performance of Self-ballasted Compact Fluorescent Lamps (Reaffirmed 2015)
ANSI	C78.81-2010 or C78.81-2016	Double-Capped Fluorescent Lamps—Dimensional and Electrical Characteristics
ANSI	C78.376-2014	Specifications for the Chromaticity of Fluorescent Lamps
ANSI	C78.377-2015 or C78.377-2017	Specifications for the Chromaticity of Solid State Lighting Products
ANSI	C78.901-2014 or C78.901-2016	Single-Based Fluorescent Lamps—Dimensional and Electrical Characteristics
ANSI/ANSLG	C81.61-2009 (R2014) or C81.61-2017	Specifications for Bases (Caps) for Electric Lamps (Reaffirmed 2014)
ANSI/ANSLG	C81.62-2009 (R2014) or C81.62-2017	Lampholders for Electric Lamps (Reaffirmed 2014)
ANSI	C82.2-2002 (R2016)	Method of Measurement of Fluorescent Lamp Ballasts (Reaffirmed 2016)
ANSI	C82.11-2011 or C82.11-2017	High-Frequency Fluorescent Lamp Ballasts
ANSI/ANSLG	C82.16-2015	Light Emitting Diode Drivers—Methods of Measurement
ANSI	C82.77-10-2014	Harmonic Emission Limits—Related Power Quality Requirements for Lighting Equipment
ANSI/UL	153-2002 or 153-2014	Standard for Safety of Portable Electric Luminaires
ANSI/UL	935-2009	Standard for Safety of Fluorescent-Lamp Ballasts
ANSI/UL	1310-2010	Standard for Safety of Class 2 Power Units
ANSI/UL	1574-2004	Standard for Safety of Track Lighting Systems
ANSI/UL	1598-2008	Standard for Safety of Luminaires
ANSI/UL	1598B-2010	Standard for Supplemental Requirements for Luminaire Reflector Kits for Installation on Previously Installed Fluorescent Luminaires
ANSI/UL	1598C	Light-Emitting Diode (LED) Retrofit Luminaire Conversion Kits
ANSI/UL	1993-2012 or 1993-2017	Standard for Safety of Self-Ballasted Lamps and Lamp Adapters
ANSI/UL	2108-2004 or 2108-2015	Standard for Low-Voltage Lighting Systems
ANSI/UL	8750-2009 or 8750-2015	Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products
ASTM	E283-04(2012)	Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen (Reapproved 2012)
CIE	Pub. No. 13.3-1995	Method of Measuring and Specifying Color Rendering of Light Sources
CIE	Pub. No. 015:2004	Colorimetry
EU	Directive 2002/95/EC	Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the Restriction of the Use of Certain Hazardous Substances In Electrical and Electronic Equipment
FCC	CFR Title 47 Part 15	Radio Frequency Devices
FCC	CFR Title 47 Part 18	Industrial, Scientific, and Medical Equipment
IEC	60061-1 (2012)	Lamp Caps and Holders Together with Gauges for the Control of Interchangeability and Safety – Part 1: Lamp Caps
IEC	60081 Amend 4 Ed 5.0 (2010)	Double-capped Fluorescent Lamps - Performance Specifications
IEC	60901 (2011)	Single-capped Fluorescent Lamps - Performance Specifications
IEC	62301 ED.2.0 B:2011	Household electrical appliances - Measurement of standby power
IEC	61347-2-3-am2 ed1.0 b.2011	Amendment 2 - Lamp Control Gear - Part 2-3: Particular Requirements for A.C. Supplied Electronic Ballasts for Fluorescent Lamps
IEC	62321 Ed. 1.0	Electrotechnical Products - Determination Of Levels Of Six Regulated Substances (lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls, polybrominated diphenyl ethers)
IEEE	1789-2015	Recommending Practices for Modulating Current in High Brightness LEDs for Mitigating Health Risks to Viewers
IES	LM-9-09	Electric and Photometric Measurements of Fluorescent Lamps
IES	LM-10-96	Photometric Testing of Outdoor Fluorescent Luminaires
IES	LM-31-95	Photometric Testing of Roadway Luminaires Using Incandescent Filament and High Intensity Discharge (HID) Lamps
IES	LM-40-10	Life Testing of Fluorescent Lamps
IES	LM-41-14	Approved Method for Photometric Testing of Indoor Fluorescent Luminaries
IES	LM-46-04	Photometric Testing of Indoor Luminaires Using High Intensity Discharge or Incandescent Filament Lamps
IES	LM-49-12	Life Testing of Incandescent Filament Lamps
IES	LM-58-13	Method for Spectroradiometric Measurement Methods for Light Sources
IES	LM-65-14	Life Testing of Compact Fluorescent Lamps
IES	LM-66-14	Electrical and Photometric Measurements of Single-Ended Compact Fluorescent Lamps

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Organization	Identifier	Description
IES	LM-79-08	Electrical and Photometric Measurements of Solid-State Lighting Products
ANSI/IES	LM-79-19	Optical and Electrical Measurements of Solid-State Lighting Products
IES	LM-80-08 and its Addendum A	Measuring Lumen Maintenance of LED Light Sources
ANSI/IES	LM-80-15	Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules
IES	LM-82-12	Method for the Characterization of LED Light Engines and Integrated LED Lamps for Electrical and Photometric Properties as a Function of Temperature
IES	LM-84-14	Measuring Luminous Flux and Color Maintenance of LED Lamps, Light Engines, and Luminaires
ANSI/IES	RP-16-17	Nomenclature and Definitions for Illuminating Engineering
IES	TM-21-11 and its Addendum B	Projecting Long Term Lumen Maintenance of LED Sources
IES	TM-28-14	Projecting Long-Term Luminous Flux Maintenance of LED Lamps and Luminaries
NEMA	LSD 45-2009	Recommendations for Solid State Lighting Sub-Assembly Interfaces for Luminaires
NEMA	77-2017	Temporal Light Artifacts: Test Methods and Guidance for Acceptance Criteria
NEMA	SSL 7A-2013 or SSL 7A-2015	Phase Cut Dimming for Solid State Lighting: Basic Compatibility

8 SHIPPING WITH ENERGY STAR CERTIFIED LAMPS:

All lamps that ship with a luminaire must meet the ENERGY STAR lamp specification effective on the date of manufacture of luminaire and be included in the luminaire certification documentation.

Additional requirements for enclosed or recessed luminaires:

- Enclosed luminaires may not ship with a lamp marked with the restriction “not for use in totally enclosed fixtures” or similar.
- Recessed luminaires may not ship with a lamp marked with the restriction “not for use in recessed fixtures” or similar.
- For enclosed and recessed luminaires, an in situ measurement of ambient air temperature inside the fixture must be taken by locating a thermocouple halfway between the surface of the bulb and the interior surface of the fixture. In situ air temperature must not exceed the temperature at which the lamp’s life testing was performed.

8.1 Directional Luminaires Shipped with ENERGY STAR Certified Lamps

To satisfy the requirements of this specification, directional luminaires shipping with ENERGY STAR certified lamps shall meet the requirements outlined in sections 9.2, 13, 14, 16, 17, and 18 and be packaged with ENERGY STAR certified lamp(s).

8.2 Non-Directional Luminaires Shipped with ENERGY STAR Certified Lamps

To satisfy the requirements of this specification, non-directional luminaires shall either:

1. Meet the requirements outlined in this section and be packaged with ENERGY STAR certified lamp(s) that meet the requirements in this section,

   OR

2. Meet the relevant requirements in Sections 9 through 18.

Requirement	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents
Source Efficacy	≥ 65 lm/W per lamp All lamp permutations (makes and models) employed in a given luminaire model shall meet this requirement.	ENERGY STAR Lamps Specification
Source Minimum Light Output (initial)	Source shall provide a minimum of 800 lumens. Exception: • Outdoor porch and bath vanity luminaires featuring ≥ 3 heads shall provide a minimum of 450 lumens per head. • Chandeliers, decorative pendants, wall sconces, and other multi-head indoor luminaires shall provide a minimum of 250 lumens per head.	ENERGY STAR Lamps Specification
Safety Rating	Luminaire must meet applicable safety rating in section 14. Additionally, the lamp used must be suitable for the luminaire type it will be shipped with, e.g. a lamp shipped with an enclosed fixture must be safety tested in a totally enclosed situation and may not be rated or labeled “not for use in totally enclosed fixtures” or similar.	ANSI/UL 1993-2012 or 2017, and ANSI/UL 8750-2009 or 2015
Product Packaging & Labeling	Luminaire must comply with section 16. Unless shipped with lamps directly installed, ENERGY STAR certified lamps shipped with luminaires must comply with lamps packaging requirements.	See Section 16
Warranty	Luminaire must comply with section 17	See Section 17
Toxics	Luminaire must comply with section 18	See Section 18
Enclosed Fixture Testing	See Section 8.	

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Note: For this certification pathway, many performance requirements are fulfilled through the certification of the lamp. For non-directional fixtures, lamp efficacy, minimum light output and CCT performance can be referenced on the ENERGY STAR Lamps product listing. Certain luminaire specific requirements (as noted above) still apply to the luminaire.

9 PHOTOMETRIC PERFORMANCE REQUIREMENTS

9.1 Luminous Efficacy and Output: NON-DIRECTIONAL Luminaires

Note box: EPA updated the solid state methods of measurement to include ANSI/IES LM-79-19.

Luminaire types not classified as directional in the Scope section of this specification shall be evaluated as non-directional, based on source photometric performance. The performance values in this section pertain to the performance of the source (system including ballast or driver) within a luminaire.

Source Type	ENERGY STAR Requirements		Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
	Source Efficacy (initial)	Source Minimum Light Output (initial)		
Fluorescent • **compact** • **circline**	≥ 65 lm/W per lamp-ballast platform All lamp and ballast permutations (makes and models) employed in a given luminaire model shall meet this requirement.	Lamp-ballast platform(s) shall provide a minimum of 450 total lumens. Exemption: Lamp-ballast platform(s) utilized in decorative pendants, wall sconces/single head bath vanity shall provide a minimum of 250 total lumens in situ.	**Methods of Measurement:** IES LM-9-09 (circline) IES LM-66-14 (compact non-self-ballasted)	Laboratory test results shall be produced using the specific models of lamp and ballast that will be used in production. Luminaires with ballast(s) capable of operating multiple fluorescent lamp types shall be tested with the lamp model shipped with the luminaire. **Sample Size**: 1 sample of each lamp-ballast model combination. **Passing Test**: Sample shall pass.
Solid State: • **LED Light engine**	Replaceable LED light engine ("source") efficacy shall meet or exceed the values detailed below, as determined by comparing the in situ (installed in the luminaire) T_b value to the source's LM-82 test report. ≥ 65 lm/W per light engine	Installed in the luminaire, LED light engine(s) in situ shall provide a minimum of 450 total lumens. Exemption: LED light engines utilized in decorative pendants, wall sconces/single head bath vanity shall provide a minimum of 250 total lumens in situ.	**Methods of Measurement:** IES LM-82-12 In situ temperature measurement: ANSI/UL 153:2002 (Sections 124-128A) ANSI/UL 1574:2004 (Section 54) ANSI/UL 1598:2008 (Sections 19.7, 19.10-16)	Laboratory test results shall be produced using the specific models of LED package, LED module or LED array and LED driver (i.e. LED light engine) that will be used in production. In situ temperature measurement value shall be determined in accordance with ANSI/UL 153:2002 (Sections 124-128A), ANSI/UL 1574:2004 (Section 54), or ANSI/UL 1598:2008 (Sections 19.7, 19.10-16), as applicable. LM-82 test reports shall detail luminous efficacy, luminous flux, chromaticity coordinates, CCT, and CRI values at all tested temperatures. Linear interpolation shall be employed to determine LED light engine or module ("source") photometric performance at temperatures between the LM-82 reported temperatures higher and lower than the in situ temperature. Luminaires incorporating more than one source shall have all sources installed and operational during in situ temperature testing. **Sample Size**: 1 sample of each lamp-driver model combination. **Passing Test**: Sample, tested in situ (installed in luminaire), shall pass.
Solid State: • **Surface-mounted retrofit for diffused wall sconces**	≥ 65 lm/W per retrofit	Retrofit kit shall provide a minimum of 250 lumens. Retrofit kit shall deliver a minimum of 80% of total lumens between 0-90 degrees from center of the beam.	**Method of Measurement:** IES LM-79-08 or ANSI/IES LM-79-19	Products in this category should be tested at the line voltage for which the product is rated. If the product is rated for multiple voltages, the product shall be tested at the most consumptive voltage. **Sample Size**: 1 sample of retrofit kit **Passing Test**: Sample shall pass.
Solid State: • **Surface mounted retrofits for diffused ceiling mounted lights**	≥ 65 lm/W per retrofit	Retrofit kit shall provide a minimum of 800 lumens. Retrofit kit shall deliver a minimum of 80% of total lumens between 0-90 degrees from center of the beam.	**Method of Measurement:** IES LM-79-08 or ANSI/IES LM-79-19	Products in this category should be tested at the line voltage for which the product is rated. If the product is rated for multiple voltages, the product shall be tested at the most consumptive voltage. **Sample Size**: 1 sample of retrofit kit **Passing Test**: Sample shall pass.

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9.2 Luminous Efficacy, Output and Zonal Lumen Density: DIRECTIONAL Luminaires

Note box: EPA updated the solid state methods of measurement to include ANSI/IES LM-79-19.

Luminaire types classified as directional in Section 1 shall be evaluated based on luminaire photometry. The performance values in this section pertain to the performance of the entire luminaire, including optical losses.

Luminaire Type	ENERGY STAR Requirements			Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
	Luminaire Efficacy (initial)	Luminaire Minimum Light Output (initial)	Luminaire Zonal Lumen Density Requirement		
Cove or Under Cabinet Mount	50 lm/W	Luminaire shall deliver a minimum of 125 lumens per lineal foot. The minimum required light output (in lumens) is calculated by dividing the measured luminaire length in inches by 12, then multiplying the result by 125.	Referring to the plane perpendicular to the length of the luminaire, the luminaire shall deliver a minimum of 60% of total lumens within the 0-60° zone (symmetric about the nadir).	**Methods of Measurement:** IES LM-41-14 IES LM-79-08 or ANSI/IES LM-79-19 **Reference Document:** ANSI/UL 1598C	Laboratory test results shall be produced using the complete luminaire and the specific models of lamp and ballast or LED package, LED module or LED array and LED driver that will be used in production. Fluorescent luminaires with ballast(s) capable of operating multiple fluorescent lamp types shall be tested with the lamp model shipped with the luminaire. The equation for minimum light output divided by the length of the luminaire applies to all luminaire configurations. For rectangular geometries the "measured luminaire length" is the longest dimension of the luminaire. For circular geometries the "measured luminaire length" is the diameter. For downlights, one trim ring and one reflector may be used. For downlight retrofits: the retrofit product shall be installed in a can size within the dimensions and limitations prescribed in the ANSI\UL1598C safety listing. The test report shall note the can model tested. For luminaires with multiple mounting orientations, the luminaire shall be tested in the orientation designated by the partner. **Sample Size**: 1 complete luminaire. **Passing Test**: The luminaire shall pass. Products that have the International Dark Sky Fixture Seal of Approval must be listed at http://www.darksky.org
Downlights: • Recessed • Surface • Pendant	55 lm/W	≤ 4.5" aperture: 345 lumens > 4.5" aperture: 575 lumens	Luminaire shall deliver a minimum of 75% of total lumens within the 0-60° zone (axially symmetric about the nadir)		
Downlight retrofits:	60 lm/W				
Accent Lights including: • Track light luminaires • Line voltage track heads	55 lm/W	Luminaire shall deliver a minimum of 200 lumens per head.	Luminaire shall deliver a minimum of 80% of total initial lumens within the 0-60° zone (axially symmetric about the center of the beam).		
Outdoor, Wall-, Porch-, Pendant-, Post-Mounted and Security Luminaires (Note: for post mounting between 4 feet and 10.5 feet above grade)	60 lm/W	Luminaire shall deliver a minimum of 300 lumens.	Luminaire shall deliver 95% of total lumens within the 0°- 85° zone (symmetric about the nadir). Luminaire shall not emit more than 0.5% of the overall light output above 90°. Exempt: Products that have the International Dark Sky Fixture Seal of Approval.	**Methods of Measurement:** IES LM-10-96 (fluorescent) IES LM-79-08 or ANSI/IES LM-79-19 (solid state)	
Portable Desk Task	50 lm/W	Luminaire shall deliver a minimum of 200 lumens.	Luminaire shall deliver a minimum of 60% of total lumens within the 0-75° zone (symmetric about the center of the beam).		
Inseparable Other SSL Luminaire (applies to SSL luminaire types not otherwise noted in this table)	70 lm/W	Luminaire shall deliver a minimum of 200 lumens.	None.	**Method of Measurement:** IES LM-79-08 or ANSI/IES LM-79-19	

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9.3 Correlated Color Temperature (CCT): All Indoor Luminaires (Exempt: Outdoor Luminaires and Luminaires shipped with ENERGY STAR certified Lamps)

Note box: EPA updated the solid state methods of measurement to include ANSI/IES LM-79-19.

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
Fluorescent • **compact** • **circline**	Lamps shipped with luminaires shall have one of the following nominal correlated color temperatures (CCT): • 2700 Kelvin • 3000 Kelvin • 3500 Kelvin • 4000 / 4100 Kelvin • 5000 Kelvin Lamps shipped with luminaire shall consistently meet the above requirement, as verified by data provided by the lamp vendor to the luminaire partner.	**Methods of Measurement:** IES LM-9-09 (circline) IES LM-66-14 (compact non-self-ballasted) **Calculation:** CIE 15.2004 **Reference Document:** ANSI C78.376-2014	Laboratory test results shall be produced using the specific lamp model that will operate in the luminaire and either the ballast model that will operate in the luminaire or a commercially-available ballast model that meets the applicable ANSI ballast requirements, if applicable, for the light source being tested. **Sample Size**: 1 sample of each lamp model shall be tested. **Passing Test**: The lamp tested shall fall within a 7-step MacAdam ellipse for the designated CCT, with ellipses constructed using the Objective Chromaticities detailed in Table 1 of ANSI C78.376-2014, and the referenced MacAdam publication.
Solid State	The luminaire, retrofit kit, or replaceable LED light engine shall be capable of providing at least one of the following nominal correlated color temperatures (CCTs): • 2700 Kelvin • 3000 Kelvin • 3500 Kelvin • 4000 Kelvin • 5000 Kelvin The luminaire, retrofit kit, or replaceable LED light engine or module chromaticity shall also fall within the corresponding 7-step chromaticity quadrangles as defined in ANSI C78.377-2015 or C78.377-2017.	**Methods of Measurement:** IES LM-79-08 or ANSI/IES LM-79-19 IES LM-82-12 **Calculation:** CIE 15.2004 **Reference Document:** ANSI C78.377-2015 or C78.377-2017	For downlights, one trim ring and one reflector may be used. Non-directional: LED light engine or module ("source") CCT shall meet the requirement as determined by comparing the in situ (installed in the luminaire) T_b value to the LM-82 test report. In situ temperature measurement value shall be determined in accordance with ANSI/UL 153:2002 (Sections 124-128A), ANSI/UL 1574:2004 (Section 54), or ANSI/UL 1598:2008 (Sections 19.7, 19.10-16), as applicable. LM-82 test reports shall detail luminous efficacy, luminous flux, chromaticity coordinates, CCT and CRI values for all tested temperatures. Linear interpolation shall be employed to determine source photometric performance at temperatures between the LM-82 reported temperatures higher and lower than the in situ temperature. Luminaires incorporating more than one source shall have all sources installed and operational during in situ temperature testing. **Sample Size**: 1 complete luminaire (directional), or 1 source and 1 luminaire (non-directional). **Passing Test**: The luminaire, retrofit kit, or source (when installed in the luminaire) shall pass.

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9.4 Color Rendering Index: All Indoor Luminaires (Exempt: Outdoor Luminaires and Luminaires shipped with ENERGY STAR certified Lamps)

Note box: EPA updated the solid state methods of measurement to include ANSI/IES LM-79-19.

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
Fluorescent • **compact** • **circline**	Lamps shipped with luminaires shall meet or exceed $R_a \geq 80$ and report R_9.	**Methods of Measurement:** IES LM-9-09 (circline) IES LM-66-14 (compact) CIE 13.3-1995	Laboratory test results shall be produced using the specific lamp model that will operate in the luminaire and either the ballast model that will operate in the luminaire or a commercially-available ballast model that meets the applicable ANSI ballast requirements, if applicable, for the light source being tested. **Sample Size**: 1 sample of each lamp model shall be tested. **Passing Test**: The sample shall achieve the required color rendering index value.
Solid State	The luminaire, retrofit kit, or LED light engine shall be capable of meeting or exceeding $R_a \geq 80$ and $R_9 > 0$.	**Methods of Measurement:** IES LM-79-08 or ANSI/IES LM-79-19 (directional) IES LM-82-12 **Reference Documents:** In situ temperature measurements (non-directional): ANSI/UL 153:2002 (Sections 124-128A) ANSI/UL 1574:2004 (Section 54) ANSI/UL 1598:2008 (Sections 19.7, 19.10-16) CIE 13.3-1995	For downlights, one trim ring and one reflector may be used. Non-directional: LED light engine ("source") CRI shall meet the requirement as determined by comparing the in situ (installed in the luminaire) T_b value to the LM-82 test report. In situ temperature measurement value shall be determined in accordance with ANSI/UL 153:2002 (Sections 124-128A), ANSI/UL 1574:2004 (Section 54), or ANSI/UL 1598:2008 (Sections 19.7, 19.10-16), as applicable. LM-82 test reports shall detail luminous efficacy, luminous flux, chromaticity coordinates, CCT and CRI values for all tested temperatures. Linear interpolation shall be employed to determine source photometric performance at temperatures between the LM-82 reported temperatures higher and lower than the in situ temperature. Luminaires incorporating more than one source shall have all sources installed and operational during in situ temperature testing. **Sample Size**: 1 complete luminaire, retrofit kit, or 1 source and 1 luminaire (non-directional). **Passing Test**: The luminaire, retrofit kit, or source (when installed in the luminaire) shall pass.

9.5 Color Angular Uniformity: Directional Solid State Indoor Luminaires Only (Exempt: Inseparable Other, Outdoor Luminaires, and Luminaires shipped with ENERGY STAR certified Lamps)

Note box: EPA updated the title of Section 9.5 to clarify that inseparable other luminaires are exempt from the Color Angular Uniformity requirement. This was always intended but never explicitly stated.

EPA also updated the solid state methods of measurement to include ANSI/IES LM-79-19.

ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
Throughout the beam angle, the variation of chromaticity shall be within a total linear distance of 0.006 from the weighted average point on the CIE 1976 (u',v') diagram.	**Methods of Measurement:** IES LM-79-08 or ANSI/IES LM-79-19 IES LM-58-13 CIE 15: 2004	Vertical angular scanning resolution shall be 1 degree on the 0 and 90 degree vertical planes, and Δ u',v' distance shall be reported for each vertical angle measured. Only the measurements within the beam angle are evaluated for color angular uniformity. Downlights that utilize interchangeable trims may be tested without a trim to demonstrate compliance with the color angular uniformity requirement. This applies to the color angular uniformity requirement only and does not extend to other photometric requirements. **Sample Size**: 1 complete luminaire. **Passing Test**: The luminaire shall pass.

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10 LUMEN MAINTENANCE AND RATED LIFE REQUIREMENTS

10.1 Lumen Maintenance: All Luminaires (Exempt: Luminaires shipped with ENERGY STAR certified Lamps)

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
Fluorescent • **compact** • **circline**	For lamps indicated on the luminaire packaging or shipped with the luminaire, the lamp shall have an average rated lumen maintenance of at least 80% of initial lamp lumens at 40% rated lamp life.	**Methods of Measurement:** IES LM-40-10 IES LM-09-09 (Circline) IES LM-65-14 IES LM-66-14 (Compact)	Laboratory test results shall be produced using the specific lamp model that will operate in the luminaire and either the ballast model that will operate in the luminaire or a commercially-available ballast model that meets the applicable ANSI ballast requirements, if applicable, for the light source being tested. **Sample Size**: ≥ 3 samples of each lamp model shall be tested. **Passing Test**: ≥ 100% of the samples shall achieve the required lumen maintenance value.
Solid State **Option 1:** **Luminaire, Retrofit kit, LED Light Engine LED Package, Module or Array**	The LED package(s) /module(s)/array(s), including those incorporated into luminaires, retrofit kits and LED light engines, shall meet the following L_{70} rated lumen maintenance life values, in situ: • L_{70}(6k) ≥ 25,000 hours for indoor • L_{70}(6k) ≥ 35,000 hours for outdoor • L_{70} ≥ 50,000 hours for inseparable luminaires	**Method of Measurement:** **Option 1:** Lumen Maintenance: IES LM-80-08 and its Addendum A or ANSI/IES LM-80-15 Lumen Maintenance Projection Method: IES TM-21-11 and its Addendum B CCT Calculation: CIE 15.2004 ANSI/UL 153:2002 (Sections 124-128A) ANSI/UL 1574:2004 (Section 54) ANSI/UL 1598:2008 (Sections 19.7, 19.10-16) **Reference Documents:** Chromaticity Specifications: ANSI/NEMA/ANSLG C78.377-2011 Lumen Maintenance: ENERGY STAR TM-21 Calculator	**Luminaire Sample Size**: 1 complete luminaire, retrofit kit or LED light engine. **LM-80 Sample Size:** Minimum sample size of 20 units for LED packages, or 10 units for LED arrays or LED modules, for each T_S and drive current combination (refer to IES TM-21-11, section 4.2). 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. 2700K and 3000K, or 3000K and 3500K). **Passing Test**: All of the conditions below shall be met. If any of the conditions are not met, the component performance option may not be used and the applicant shall use Option 2, below, for compliance. 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 L_{70} meeting or exceeding requirements. Lumen maintenance projections must support all LED colors used. Compliance with the above shall be documented with a TM-21 lumen maintenance life projection report as detailed in TM-21, section 7. The report shall be generated using data from the LM-80 test report for the employed LED package/module/array model ("device"), the forward drive current applied to each device, and the in situ TMP_{LED} temperature of the hottest device in the luminaire. In addition to LM-80 reporting requirements, the following information shall be reported: • sampling method and sample size (per LM-80) • test results for each T_S and drive current combination • description of device including model number and whether device is an LED package, module or array (see Definitions) • ANSI target, and calculated CCT value(s) for each device in sample set • Δ u'v' chromaticity shift value on the CIE 1976 diagram for each device in sample set • a detailed rationale, with supporting data, for application of results to other devices (e.g. LED packages with other CCTs) Access to the TMP_{LED} for the hottest LED may be accomplished via a minimally sized hole in the luminaire housing, tightly resealed with a suitable sealant if created for purposes of testing. All thermocouple attachments and intrusions to luminaire housing shall be photographed. Important information regarding LM-80 test reports, their application, and provisions for successor subcomponents are detailed in the ENERGY STAR Requirements for the Use of LM-80 Data.

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Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
Solid State **Option 2:** **Luminaire, Retrofit kit or LED Light Engine**	The LED luminaires, retrofit kits, and LED light engines, shall meet the following L_{70} rated lumen maintenance life values, in situ: • L70 ≥ 25,000 hours for indoor • L70 ≥ 35,000 hours for outdoor • L70 ≥ 50,000 hours for inseparable luminaires	**Option 2:** **Methods of Measurement:** Lumen Maintenance: IES LM-84-14 Lumen Maintenance Projection Method: IES TM-28-14 – Projection Method 1, Direct Extrapolation CCT Calculation: CIE 15.2004 ANSI/UL 153:2002 (Sections 124-128A) ANSI/UL 1574:2004 (Section 54) ANSI/UL 1598:2008 (Sections 19.7, 19.10-16) ANSI/UL 1598C-2014 **Reference Document:** Chromaticity Specifications: ANSI/NEMA/ANSLG C78.377-2011	Directional: luminaire or retrofit kit shall be operated continuously in accordance with ANSI/UL 1598-2008, ANSI/UL 1598C-2014, ANSI/UL 1574-2004, ANSI/UL 153-2002, or 2014 during the testing; any deviations from this shall be reported. Non-directional: LED light engines ("source") or retrofit kit shall be operated continuously in situ (installed in the luminaire), with the luminaire operating in accordance with ANSI/UL 153-2002 or 2014, ANSI/UL 1574-2004, ANSI/UL 1598C-2014 or ANSI/UL 1598-2008 during the testing. Luminaires incorporating more than one source shall have all sources installed and operational during the testing. During initial and final measurements, T_b temperature shall be controlled to match T_b temperature measured when source is operated in situ. Test reports shall detail efficacy, luminous flux, chromaticity coordinates, CCT, and CRI values at all test intervals. Test intervals shall be conducted according to IES TM-28-14 §4.2 with a maximum interval length of 1,000 hours. Lumen maintenance projections must support all LED colors used. **Sample Size**: According to IES TM-28-14 – §5.1.5 Directional: 3 or more complete luminaires or retrofit kits. For downlights, one trim ring and one reflector may be used with the 3 luminaire samples. Non-directional: 3 or more sources or retrofit kits and the necessary number of luminaires required to operate the sources continuously in situ. **Passing Test**: All luminaires or sources shall pass.

10.2 Light Source Life: All Luminaires (Exempt: Luminaires shipped with ENERGY STAR certified Lamps)

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
Fluorescent • **compact** • **circline**	≥ 10,000 hours for luminaires shipping with other fluorescent lamps Conditional certification may be granted if both of the following are met: 1. Testing has been completed for at least 40% of rated life. 2. A date for testing completion has been established by the test laboratory. Conditional certification shall be immediately withdrawn if final testing results do not meet the above requirement.	**Methods of Measurement:** IES LM-40-10 (circline) IES LM-65-14 (compact)	Laboratory test results shall be produced using the specific lamp model that will operate in the luminaire and either the ballast model that will operate in the luminaire or a commercially-available ballast model that meets the applicable ANSI ballast requirements, if applicable, for the light source being tested. **Sample Size**: ≥ 3 samples of each lamp model shall be tested. **Passing Test**: ≥ 50% of the sample set shall be functioning at the lifetime requirement.
Solid State	The LED package(s) / LED module(s) / LED array(s), including those incorporated into LED light engines or retrofit kits, shall meet the following L_{70} lumen maintenance life values (refer to Lumen Maintenance Requirements in the preceding section): • ≥ 25,000 hours for indoor luminaires • ≥ 35,000 hours for outdoor luminaires • ≥ 50,000 hours for inseparable luminaires Lumen maintenance life projection claims in excess of the above requirements shall be substantiated with a TM-21 or TM-28 lumen maintenance life projection report.		

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10.3 Color Maintenance: Solid State Indoor Luminaires Only (Exempt: Outdoor Luminaires and Luminaires shipped with ENERGY STAR certified Lamps)

ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
Luminaire change in chromaticity coordinates from 0-hour measurement, at any measurement point during operation, shall be ≤ a total linear distance of 0.007 on the CIE 1976 u'v' diagram. All units must meet this requirement. The change of chromaticity at each measurement point over the tested hours of operation shall be ≤ 0.007 on the CIE 1976 (u',v') diagram, as demonstrated by either: • the IES LM-80 test report for the employed LED package/array/module model, or a comparison of luminaire chromaticity data in LM-84 reports	**Methods of Measurement:** IES LM-80-08 and its Addendum A or IES LM-80-15 or IES LM-84-14 **Reference Documents:** Interim operation: ANSI/UL 153-2002 or 2014 ANSI/UL 1574-2004 ANSI/UL 1598-2008 ANSI/UL 1598C-2014	Laboratory test results shall be produced using the specific models of lamp or LED package, LED module or LED array and LED driver that will be used in production. For the LM-84 option, luminaire or retrofit kit shall be operated continuously in accordance with ANSI/UL 1598-2008, ANSI/UL 1598C, ANSI/UL 1574-2004, or ANSI/UL 153-2002 or 2014 during the testing period; any deviations from this shall be reported. See section 10.1 for testing intervals when using IES LM-84-14. **Sample Size (LM-80 option)**: same as Lumen Maintenance, Option 1. **Sample Size (LM-84 option)**: same as Lumen Maintenance, Option 2. **Passing Test (LM-80 option)**: for all LM-80 samples, at any measurement point, the distance of the chromaticity coordinates from the initial (zero-hour) chromaticity coordinates shall not exceed 0.007 at the temperature(s) adjacent to the measured in situ TMP_{LED} temperature, and at the corresponding drive current. *<u>Example 1</u>: an LM-80 test report provides data at T_S = 55 °C, 85 °C and 105 °C, and the measured in situ TMP_{LED} temperature value is 89 °C. Neither the 85 °C nor the 105 °C LM-80 data may show chromaticity shift exceeding 0.007 at any measurement point from zero through 6,000 hours, for the corresponding drive current. The LM-80 chromaticity data at 55 °C is disregarded.* *<u>Example 2</u>: an LM-80 test report provides data at T_S = 58 °C, 87 °C and 106 °C, and the measured in situ TMP_{LED} temperature value is 53 °C. The LM-80 data at 58 °C may not show chromaticity shift exceeding 0.007 at any measurement point from zero through 6,000 hours, for the corresponding drive current. The LM-80 chromaticity data at 87 °C and 106 °C is disregarded.* **Passing Test (LM-84 option)**: the distance of the chromaticity coordinates from the initial chromaticity coordinates shall not exceed 0.007 at any measurement point.

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11 ELECTRICAL PERFORMANCE REQUIREMENTS

11.1 Source Start Time: All Luminaires (Exempt: Outdoor Luminaires and Luminaires shipped with ENERGY STAR certified Lamps)

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
Fluorescent **Solid State**	Light source shall remain continuously illuminated within 750 milliseconds of application of electrical power.	**Method of Measurement:** ENERGY STAR Start Time Test Method **Reference Document:** ANSI C82.11-2011 or 2017 Section-5.2	Laboratory test results shall be produced using the specific models of lamp and ballast or LED package, LED module or LED array and LED driver that will be used in production. **Sample Size**: 1 sample of each lamp-ballast model combination, or LED package/LED module/LED array and LED driver model combination shall be tested. **Passing Test**: Sample shall pass.
Connected Luminaires **All sources**	Light source shall remain continuously illuminated within 1 second of application of electrical power.		

11.2 Source Run-Up Time: All Fluorescent Luminaires (Exempt: Solid State, Outdoor Luminaires, and Luminaires shipped with ENERGY STAR certified Lamps)

ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
Reported value of time for lamps to reach 80% of stabilized lumen output after application of electrical power shall be ≤ 45 seconds	**Method of Measurement:** ENERGY STAR Run Up Time Test Method	Laboratory test results shall be produced using the specific models of lamp and ballast that will be used in production. Measurements shall be taken at the end of 100 hours of seasoning. The reported value shall be the average measured values of units tested, rounded to the nearest second. **Sample Size**: 1 sample of each lamp-ballast model combination. **Passing Test**: Sample shall pass.

11.3 Power Factor: All Luminaires (Exempt: Luminaires shipped with ENERGY STAR Lamps)

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
Fluorescent • **compact** • **circline**	Total luminaire input power ≤ 5 watts: PF ≥ 0.5 Total luminaire input power > 5 watts: PF ≥ 0.5	**Method of Measurement:** C82.77-10:2014	Laboratory test results shall be produced using the specific models of lamp and ballast or LED package, LED module or LED array and LED driver that will be used in production. **Sample Size**: ≥ 1 samples of each model combination shall be tested. **Passing Test**: all samples shall pass.
Solid State	Total luminaire input power ≤ 5 watts: PF ≥ 0.5 Total luminaire input power > 5 watts: PF ≥ 0.7		

11.4 Transient Protection: All Luminaires (Exempt: Luminaires shipped with ENERGY STAR certified Lamps)

ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
Ballast or driver shall comply with ANSI/IEEE C62.41.1-2002 and ANSI/IEEE C62.41.2-2002, Category A operation. The line transient shall consist of seven strikes of a 100 kHz ring wave, 2.5 kV level, for both common mode and differential mode.	**Method of Measurement:** None referenced **Reference Documents:** ANSI/IEEE C62.41.1-2002 ANSI/IEEE C62.41.2-2002 Category A Location.	Laboratory test results shall be produced using the specific models of ballast, LED package, LED module or LED array and LED driver combination that will be used in production. **Sample Size**: ≥ 1 samples of each ballast model, LED package, LED module or LED array and LED driver model combination, or LED light engine shall be tested. **Passing Test**: All samples shall pass. Unit power may be cycled as necessary to determine if UUT is still operational.

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11.5 Standby Power Consumption: All Luminaires (Exempt: Luminaires shipped with ENERGY STAR certified Lamps)

Note box: Consistent with allowing products such as portable desk task lights with a USB charger to seek ENERGY STAR certification, EPA has added a standby power exception for external power supplies (EPS) enabling USB charging functionality.

ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
Luminaires shall not draw power in the off state. Exceptions: • Luminaires with integral motion sensors, occupancy sensors or photosensors, or connected functionality may draw up to 0.5 watts in standby mode. • Luminaires with energy saving features i.e. integral motion sensors, occupancy sensors or photosensors and connected functionality may draw up to 1 watt in standby mode. • Power supplies connected to multiple luminaires may draw up to 1.5 watts in standby mode. • External power supplies (EPS) employed to power luminaires shall meet the level V or higher performance requirements under the International Efficiency Marking Protocol and include the level V or higher marking on the EPS. • External power supplies (EPS) enabling USB charging functionality shall meet the level VI or higher performance requirements under the International Efficiency Marking Protocol and include the level VI or higher marking on the EPS.	**Method of Measurement:** IEC 62301 ED.2.0 B-2011 **Reference document:** International Efficiency Marking Protocol http://www.regulations.gov/#!documentDetail;D=EERE-2008-BT-STD-0005-0218	Laboratory test results shall detail standby power consumption to the tenth of a watt.

11.6 Operating Frequency: All Luminaires

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
Fluorescent • **compact** • **circline**	20 to 33 kHz or ≥ 40 kHz	**Method of Measurement:** ANSI C82.2-2002	Laboratory test results shall be produced using the specific ballast model that will operate in the luminaire. **Sample Size**: 1 samples of each ballast model shall be tested. **Passing Test**: Sample shall pass.
Solid State	Frequency ≥ 120 Hz Note: This performance characteristic addresses problems with visible flicker due to low frequency operation and applies to steady-state as well as dimmed operation. Dimming operation shall meet the requirement at all light output levels.	**Method of Measurement:** None referenced **Reference Document:** IEEE PAR1789	Laboratory test results shall be produced using the specific luminaire, or LED light engine used in the luminaire. Light output waveform shall be measured with a photodetector with a rise time of 10 microseconds or less, transimpedance amplifier and oscilloscope. Employed equipment models and method of measurement shall be documented. Temporal response, amplification and filtering characteristics of the system shall be suitably designed to capture the photometric waveform. Digitized photometric waveform data and an image of the relative photometric amplitude waveform shall be recorded. Measured data shall be recorded to a digital file with an interval between each measurement no greater than 0.00005 sec (50 microseconds) corresponding to an equipment measurement rate of no less than 20 kHz, and capture at least 1 second of data. **Sample Size**: 1 luminaire, LED light engine, or retrofit kit shall be tested.

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11.7 Flicker: All Luminaires (Exempt: Luminaires shipped with ENERGY STAR certified Lamps)

<table>
<tr><th>ENERGY STAR Requirements</th><th>Methods of Measurement and/or Reference Documents</th><th>Supplemental Testing Guidance</th></tr>
<tr>
<td>The following flicker-related metrics shall be reported for certifications as of September 1, 2018:
• Short Term Flicker Indicator (P_{st})
• Stroboscopic Visibility Measure (SVM)

Optional: meet NEMA 77-2017 for temporal light modulation limits.

These requirements address problems with visible flicker due to low frequency operation and applies to steady-state as well as dimmed operation.</td>
<td>Method of Measurement:
NEMA 77-2017

Reference Document:
IEEE PAR1789</td>
<td>Sample Size: 1 luminaire, LED light engine, or retrofit kit shall be tested.

Laboratory test results shall be produced using the specific luminaire, or LED light engine used in the luminaire.

For luminaires not marketed as dimmable, measurements shall be taken at full light output.

For luminaires marketed as dimmable, measurements shall be taken at the dimmed levels recommended in NEMA 77.

The reported values of P_{st} and SVM shall be the highest value measured.

For the purposes of ENERGY STAR, the waveform digitizer (e.g., oscilloscope) used to capture the waveform data used for the calculation of the reported metrics must have:
<table>
<tr><th colspan="2">Parameter</th><th>Units</th><th>Value</th></tr>
<tr><td rowspan="2">Dynamic range of waveform amplitude</td><td>P_{st}</td><td></td><td>≥ 1000:1 (60 dB)</td></tr>
<tr><td>SVM</td><td></td><td>≥ 100:1 (40 dB)</td></tr>
<tr><td rowspan="2">Sampling Time</td><td>P_{st}</td><td>Seconds</td><td>≥ 180</td></tr>
<tr><td>SVM</td><td>Seconds</td><td>≥ 1</td></tr>
<tr><td rowspan="2">Sampling Rate</td><td>P_{st}</td><td>kHz</td><td>≥ 10</td></tr>
<tr><td>SVM</td><td>kHz</td><td>≥ 20</td></tr>
<tr><td rowspan="2">Temporal bandwidth (-3 dB cutoff frequency)</td><td>P_{st}</td><td>kHz</td><td>≥ 0.5</td></tr>
<tr><td>SVM</td><td>kHz</td><td>≥ 5</td></tr>
</table>
Waveform data shall be submitted in CSV format to support the reported values of P_{st} and SVM</td>
</tr>
</table>

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12 LUMINAIRE SERVICEABILITY REQUIREMENTS

Note box: EPA clarified that Inseparable Other and Directional Luminaires are exempt from the requirements of Section 12.1. This was intended with the previous language exempting "inseparable" however with the introduction of the definition of inseparable other, we belive the clarification for all inseparable to be warranted.

12.1 Light Source Replaceability: All Luminaires (Exempt: Inseparable Other and Directional Luminaires, Retrofit Kits, and Luminaires shipped with ENERGY STAR certified Lamps)

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents
Fluorescent • **compact** • **circline**	The luminaire's lampholder(s) shall be designed to accept lamps with ANSI/IEC standardized lamp base configurations for each lamp input power for which the luminaire and packaging is labeled.	**Reference Document:** Lampholder configuration: ANSI/IEC C81.62-2009 (R2014) or 2017
Solid State: Non-Directional • **LED light engine** • **Retrofit kits**	LED light engines or retrofit kits shall make use of electrical interconnects that allow for consumer replacement of the engine or kit without the cutting of wires or the use of solder. Wire nuts and other reusable connectors are allowed. Luminaires that cannot meet this requirement are to be evaluated as inseparable SSL luminaires (see directional luminaire requirements below and throughout this specification).	**Reference Document:** NEMA LSD 45-2009

Note box: EPA clarified that all inseparable SSL Luminaires (i.e., including Inseparable Other and Directional luminaires with inseparable light sources) are exempt from the requirements of Section 12.2. This was always intended with the previous language, however with the introduction of the definition of inseparable other, we belive the clarification for all inseparable to be warranted.

12.2 Ballast/Driver Replaceability: All Luminaires (Exemption: All Inseparable SSL Luminaires and Luminaires shipped with ENERGY STAR certified Lamps)

Source Type	ENERGY STAR Requirements
Fluorescent • **compact** • **circline**	Ballasts or drivers shall be accessible and removable by an electrician without the cutting of wires and without damage to the luminaire housing, trim, decorative elements or the carpentry (e.g., ceiling drywall) to which the luminaire is attached. Instructions shall be provided with the luminaire, detailing guidance on ballast or driver replacement by a "qualified electrician". Exceptions: 1. Luminaires employing self-ballasted lamps 2. Line voltage directional track lights 3. Solid state cove mount luminaires 4. Under cabinet luminaires 5. Retrofit kits
Solid State: Directional	
Solid State: Non-Directional	See Source Replaceability Requirements.

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13 THERMAL PERFORMANCE REQUIREMENTS

13.1 Maximum Measured Ballast or Driver Case Temperature: All Luminaires

This performance characteristic is separate and distinct from safety requirements and can be measured by an EPA recognized laboratory. Partners may update product certifications on an ongoing basis to document modifications, including changes in maximum recommended ballast or driver case temperature. Revisions to the maximum recommended ballast or driver case temperature value may not, however, be made after product verification testing has begun, until the product has been confirmed to pass.

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
Fluorescent • **compact** • **circline**	Ballast case temperature measured at thermal equilibrium, at the hot spot location provided by the ballast manufacturer, shall not exceed the maximum recommended ballast case temperature, as provided by ballast manufacturer, during *in situ* (installed in the luminaire) operation. <u>Exceptions</u>: • Indoor portable luminaires using lamps, where the lamp is centered between a shade that is open on the top and bottom.	**Reference Documents:** ANSI/UL 153:2002 (Sections 124-128A) ANSI/UL 1574:2004 (Section 54) ANSI/UL 1598:2008 (Sections 19.7, 19.10-16).	Laboratory test results shall be produced using the specific lamp and ballast models that will be used in production. Laboratory test results shall be produced using the luminaire with the highest operating temperature among all luminaires in a product family being certified (as applicable). **Sample Size**: 1 luminaire shall be tested. **Passing Test**: Measured temperature at the hot spot location provided by the ballast manufacturer shall be less than or equal to the manufacturer recommended maximum.
Solid State: Directional Non-Directional • **replaceable LED light engine or ENERGY STAR certified lamp**	At the temperature measurement point for the hottest location on the driver case (TMP_C as detailed by the driver manufacturer), the measured driver case temperature at thermal equilibrium shall not exceed the driver manufacturer's maximum recommended temperature during in situ (installed in the luminaire) operation.	**Reference Documents:** ANSI/UL 153:2002 (Sections 124-128A) ANSI/UL 1574:2004 (Section 54) ANSI/UL 1598:2008 (Sections 19.7, 19.10-16)	Laboratory test results shall be produced using the specific models of LED package, LED module or LED array and LED driver that will be used in production. Laboratory test results shall be produced using the luminaire with the highest operating temperature among all luminaires in a product family being certified (as applicable). **Sample Size**: 1 luminaire shall be tested, or 1 source sample shall be tested in situ (installed in the luminaire). **Passing Test**: Measured temperature at the TMP_C shall be less than or equal to the manufacturer recommended maximum.
Solid State: • **retrofit kits (surface mounted and recessed)**	At the temperature measurement point for the hottest location on the driver case (TMP_C as detailed by the driver manufacturer), the measured driver case temperature at thermal equilibrium shall not exceed the driver manufacturer's maximum recommended temperature during in situ (installed in the luminaire) operation.	**Reference Document:** ANSI/UL 1598C	Laboratory test results shall be produced using the specific models of LED package, LED module or LED array and LED driver (i.e. LED light engine) ("source") that will be used in production. Luminaire retrofit kit shall be tested in the worst case thermal condition for which it is rated per ANSI/UL1598C-2014. Recessed downlight retrofit kits shall be tested in the worst-case thermal environment that the product is rated for per ANSI/UL1598C-2014. **Sample Size**: 1 sample shall be tested in situ per the included manufacturer provided installation instructions in a representative luminaire per UL1598C-2014. **Passing Test**: Measured temperature at the TMP_c shall be less than or equal to the manufacturer recommended maximum.

13.2 Recessed Downlight Thermal Performance

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
All Source Types	**Insulation contact (Type IC):** Recessed downlights marketed as Type IC shall be approved for zero clearance insulation cover by an OSHA NRTL laboratory. **Airtight construction:** Recessed downlight housings or certified/listed accessories marketed as airtight shall exhibit leakage less than 2.0 cubic feet per minute (CFM) at 75 Pascals (or 1.57 lbs/ft^2) when tested in accordance with ASTM E283-04(2012), and shall be sealed with a gasket or caulk.	**Reference Documents:** ANSI/UL 1598-2008 ASTM E283-04(2012)	See packaging section for packaging requirements related to IC and airtight products.

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14 SAFETY REQUIREMENTS

14.1 Luminaire Safety: All Luminaires

Luminaire Type	Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
Portable Luminaires	**Fluorescent** • **compact** • **circline**	Demonstrate compliance with ANSI/UL 153-2002 or 2014.	**Reference Documents:** ANSI/UL 153-2002 or 2014	Documentation shall be produced by an OSHA NRTL laboratory. Connected products must continue to comply with the applicable product safety standards – the addition of the functionality shall not override existing safety protections and functions.
	Solid State	Demonstrate compliance with ANSI/UL 153-2002 or 2014 and ANSI/UL 8750-2009 or 2015.	**Reference Documents:** ANSI/UL 153-2002 or 2014 and ANSI/UL 8750-2009 or 2015	
Indoor & Outdoor Hardwired Luminaires	**Fluorescent** • **compact** • **circline**	Demonstrate compliance with ANSI/UL 1574-2004, ANSI/UL 1598-2008, ANSI/UL 2108-2004 or 2015, as applicable.	**Reference Documents:** ANSI/UL 1574-2004 ANSI/UL 1598-2008 ANSI/UL 2108-2004 or 2015	
	Solid State	Demonstrate compliance with ANSI/UL 1574-2004, ANSI/UL 1598-2008, ANSI/UL 1598C-2014, ANSI/UL 2108-2004 or 2015, ANSI/UL 8750-2009 or 2015, as applicable.	**Reference Documents:** ANSI/UL 1574-2004 ANSI/UL 1598-2008 ANSI/UL 1598C-2014 ANSI/UL 2108-2004 or 2015 ANSI/UL 8750-2009 or 2015	
Retrofit Kits	**Solid State**	Demonstrate compliance with ANSI/UL 8750-2009 or 2015 – LED Component ANSI/UL 1598C-2014 – LED Retrofit	**Reference Documents:** ANSI/UL 8750-2009 or 2015 – LED Component ANSI/UL 1598C-2014 – LED Retrofit	

14.2 Electronic Ballast or Driver Safety: Ballasts, Drivers and "Non-Edison Base Fluorescent Adapters"

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
Fluorescent • **compact** • **circline**	Demonstrate compliance with ANSI/UL 935-2009, ANSI/UL 1310-2010, ANSI/UL 1993-2012 or 2017, as applicable. Demonstrate compliance with CSA 22.2 Number 74, or IEC 61374-2-3-am2 ed1.0 b.2006, as appropriate.	**Reference Documents:** ANSI/UL 935-2009 ANSI/UL 1310-2010 ANSI/UL 1993-2012 or 2017	Documentation shall be produced by an OSHA NRTL laboratory. Connected products must continue to comply with the applicable product safety standards – the addition of the functionality shall not override existing safety protections and functions.
Solid State: Non-Directional • **replaceable LED light engine**	Demonstrate compliance with ANSI/UL 1310-2010, ANSI/UL 2108-2004 or 2015, or ANSI/UL 8750-2009 or 2015, as applicable.	**Reference Documents:** ANSI/UL 1310-2010 ANSI/UL 2108-2004 or 2015 ANSI/UL 8750-2009 or 2015	
Solid State: Directional	Demonstrate compliance with ANSI/UL 1310-2010, ANSI/UL 2108-2004 or 2015, or ANSI/UL 8750-2009 or 2015, as applicable.	**Reference Documents:** ANSI/UL 1310-2010 ANSI/UL 2108-2004 or 2015 ANSI/UL 8750-2009 or 2015	

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15 CONTROL REQUIREMENTS: Luminaires Employing any Control Mechanism

15.1 Dimming: All Luminaires Marketed as Dimmable (Exempt: Luminaires shipped with ENERGY STAR certified Lamps)

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
Fluorescent • **compact** • **circline**	The luminaire and its components shall provide continuous dimming from 100% to 20% of light output. At minimum light output, the luminaire shall not emit noise above 24 dBA when measured within one meter of the luminaire.	**Method of Measurement:** None Referenced **Reference Document:** NEMA SSL 7A-2013 or 2015	Laboratory test results shall be produced using the specific lamp and ballast models that will be used in production. **Sample Size**: 1 sample of the luminaire shall be tested. **Passing Test**: the sample shall pass.
Solid State	The luminaire and its components shall provide continuous dimming from 100% to 20% of light output. At minimum light output, the luminaire shall not emit noise above 24 dBA when measured within one meter of the luminaire.		Laboratory test results shall be produced using the models of LED package, LED module or LED array and LED driver combination that will be used in production. The test should be performed at the lowest dimming level recommended by partner. **Sample Size**: 1 sample of the complete luminaire, retrofit kit, or LED light engine shall be tested. **Passing Test**: the sample shall pass.

15.2 Products with Connected Functionality – Optional (Exempt: Luminaires shipped with ENERGY STAR certified Lamps)

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
All source types	Product must continue to comply with the applicable product safety standards – the addition of the functionality shall not override existing safety protections and functions. Must comply with section 11.5 Standby Power	**Method of Measurement:** None	Connected products without color tuning capabilities shall be tested at full power for all applicable requirements. Connected products with color tuning capabilities shall be tested under the conditions specified under Section 5.1. Compliance with connected functionality requirements shall be demonstrated through examination of product and/or product documentation.

15.2.1 Connected Product Criteria:

To be recognized as connected, a "connected luminaire" (or retrofit) shall include the base luminaire or retrofit kit plus elements (hardware and software or firmware) or instructions required to enable communication in response to consumer-authorized energy or performance related commands (e.g. instructions for downloading a mobile application, Bluetooth syncing guidance) and shall meet the requirements in sections 15.2.2-15.2.6. These elements may be resident inside or outside of the base luminaire. Connected luminaires typically communicate with controls via a radio frequency system, although some versions use other methods (such as DMX or DALI). The specific design and implementation of the connected luminaire is at the partner's discretion provided it is interoperable with other devices and enables economical, consumer-authorized third party access to the functions provided for in sections 15.2.3, 15.2.4, and 15.2.5.

15.2.2 Open-access

To enable interconnection with the product; an interface specification, Application Programming Interface (API) or similar documentation shall be made available to interested parties that enables section 15.2.3, 15.2.4 and 15.2.5 connected functionality, and includes accuracy, units and measurement intervals for Energy Consumption Reporting.

15.2.3 Energy Consumption Reporting

The product shall be capable of interconnecting with consumer authorized entities to communicate data representative of its interval energy consumption. It is recommended that data be reported in watt-hours for intervals of 15 minutes, however, representative data may also be reported in alternate units and intervals as specified in the partner's interface specification or API.

15.2.4 Operational Status Reporting

At a minimum, the product shall be capable of providing the on/off status to energy management systems and other consumer authorized devices, services or applications via a communication link.

15.2.5 Remote Management

The product shall be capable of receiving and responding to energy management system or other consumer authorized remote requests, via devices, services or applications, similar to hard-wired consumer controllable functions.

15.2.6 Information to Consumers

If additional devices, services, and/or infrastructure are required to activate the product's connected capabilities, prominent labels, or other forms of consumer notifications shall be displayed at the point of purchase and in the product literature. (e.g. "This product has Z-wave control capability and requires interconnection with a Z-wave controller to enable local lighting control.")

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16 PRODUCT LABELING & PACKAGING REQUIREMENTS:

16.1 Labeling & Packaging: All Luminaires

Source Type	ENERGY STAR Requirements

All	• Packaging and marketing claims shall represent the product consistent with its certification.
	• Packaging shall clearly describe the nominal color designation of the lamp in units of Kelvin (e.g. 2700K, 3000K) and may display recommended corresponding nomenclature as outlined below. This can also be met through use of a Lighting Facts label (as applicable).
	  • 2700 – Soft White
	  • 3000 – Warm White
	  • 3500 – Neutral White
	  • 4000/4100K – Cool White
	  • 5000K – Daylight
	
	For luminaires shipped with lamps containing mercury:
	• Both the lamp and the luminaire packaging shall have a label indicating mercury content which must be managed and disposed of properly, and shall reference: www.epa.gov/cfl
	
	For outdoor luminaires:
	Packaging shall indicate the minimum (lowest) starting temperature for the lamp and ballast platform of the luminaire.
	
	For luminaires marketed as dimmable:
	• Luminaire packaging shall indicate dimming range (as applicable), a list or web site address with compatible dimmers or other controls, and known incompatibilities with dimmers, occupancy or vacancy sensors, timing devices or other external lighting controls, or a message noting limitations and web site address to find out more specific information. Partner shall periodically review this packaging language to determine if updates are needed. Partner is encouraged to also maintain an up to date web address where additional compatibility information is detailed.
	• Step dimming capability, if employed, shall be clearly indicated.
	
	Optional certification marking:
	While not a requirement for certification, EPA recommends partners provide a conspicuous ENERGY STAR certification mark (e.g. sticker, hangtag) on certified luminaires themselves:
	• to facilitate building inspectors confirming certification status of installed luminaires
	• to provide out-of-the-box marketing of a luminaire's ENERGY STAR certification
	• to demonstrate to consumers a partner's commitment to advancing energy efficiency in lighting

All directional luminaires	Demonstrate the light distribution of the luminaire on a cut sheet, marketing materials or packaging.
Recessed downlight fixtures	**For recessed downlight luminaires that are insulation-contact (Type IC) rated:** Packaging shall clearly state this rating. Sample language: "IC-rated for direct contact with insulation". **For recessed downlight luminaires that are airtight (AT) certified:** Packaging shall indicate that the luminaire permits air leakage less than 2.0 CFM at 75 Pascals when tested in accordance with ASTM E283-04(2012). Sample language: "Certified airtight per ASTM E283-04." If marketed as airtight, the luminaire itself shall include a label certifying "airtight", or similar designation, to show air leakage less than 2.0 CFM at 75 Pascals when tested in accordance with ASTM E283-04(2012). The label shall be clearly visible to a building inspector. Installation instructions shall be included listing all components of the assembly that will be necessary to ensure an airtight installation and how the components should be properly installed. For example, depending on the method used to achieve airtight installation, the instructions should alternatively show how a gasket is to be attached, what type of caulk to use and how it should be applied, or which certified airtight trim kits are designed to be installed with the luminaire housing. Partners selling recessed downlights are strongly encouraged to employ a packaging method ensuring that shipped lamps remain with the luminaire during drywall installation and painting (e.g. taping the lamp carton to the inside of the canister, employing shrink wrapping of the canister aperture to enclose the lamp carton within, employing a compression-fitted cardboard insert to enclose the lamp carton within the canister).

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16.2 Light Source Shipment: Directional and Non-Directional Luminaires

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents
Fluorescent • **compact** • **circline**	All luminaires shall be shipped with a lamp for each lampholder. All lamps that ship with a luminaire must be included in the certification documentation. Lamps shall utilize an ANSI/IEC standardized lamp base configuration. In addition, lamp dimensions and electrical parameters shall either: 1. Meet the requirements of an ANSI/IEC standardized lamp specification sheet if an applicable standard exists; or, 2. If no ANSI/IEC lamp standard exists, provide* a lamp manufacturer specification sheet that describes the following: a. Lamp description, including: i. Lamp model number, ii. Nominal wattage, iii. Bulb designation / lamp size (e.g. T4), and iv. Lamp base type as defined by ANSI/ANSLG C81.61-2009 (R2014) or C81.61-2017; or IEC 60061-1(e.g. 2G13, GR10q), starting circuit application (i.e., rapid start, preheat, etc.). b. Dimensional characteristics, including diagram. c. Lamp operating characteristics, including: approximate wattage (W), voltage (V), and current (A).	**Reference Documents:** Lamp base configuration: ANSI/ANSLG C81.61-2009 (R2014) or C81.61-2017 Lamps compliant with an ANSI-IEC standard (for lamp dimensions and electrical parameters): For compact fluorescent lamps: ANSI C78.901-2014 or 2016; IEC 60901 Lamps not compliant with an ANSI-IEC standard (for lamp dimensions and electrical parameters): ANSI C78.901-2014 or 2016; (used as a reference for the format and type of information required on a custom lamp specification sheet)
Solid State: Non-Directional • **LED light engine**	Complete light source components shall be provided with the luminaire or retrofit kit. Optional: The luminaire certification may indicate compliance with a Zhaga book if the light engine utilized is on the Zhaga Consortium's Certified Products Database.	**Reference Document:** Recommendations outlined in NEMA LSD 45-2009 shall be followed.
Solid State: Directional		**Reference Document:** Zhaga Consortium's Certified Products Database http://www.zhagastandard.org/products/certified/

*Use the ANSI lamp data sheets found in ANSI C78.901-2014 (or C78.901-2016) and ANSI/ANSLG C78.81-2010 (or C78.61-2016) as a reference for the format and type of information requested.

17 WARRANTY REQUIREMENTS: All Luminaires

Note: Partners must provide a copy of the actual luminaire warranty that is included with the product packaging. Partner is solely responsible for honoring warranty; intermediate parties (e.g. showrooms, electrical distributors, retailers) are not responsible for warranty requirements.

Source Type	ENERGY STAR Requirements
Fluorescent • **compact** • **self-ballasted compact** • **circline**	For luminaires incorporating replaceable ballasts, a written warranty shall be included with luminaire packaging at the time of shipment which covers repair or replacement of defective parts of the luminaire housing, mounting hardware, optics, ballast and trim for a minimum of 3 years from the date of purchase. Self-ballasted lamps shipped with the luminaire shall carry a minimum 3 year warranty, based on usage of no less than 3 hours per day. For luminaires incorporating non-replaceable ballasts, the above warranty requirement is extended to 5 years.
Solid State	For luminaires incorporating replaceable drivers, a written warranty shall be included with luminaire packaging at the time of shipment which covers repair or replacement of defective parts of the luminaire housing, mounting hardware, optics, driver and trim for a minimum of 3 years from the date of purchase. Retrofit kits and Integrated LED lamps shipped with the luminaire shall carry a minimum 3 year warranty. For luminaires incorporating non-replaceable drivers, the above warranty requirement is extended to 5 years. Warranty language shall place no limitations on coverage based on duration of luminaire operation (e.g. hours per day).

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18 Lighting Toxics Reduction Requirements: All Luminaires

Source Type	ENERGY STAR Requirements	Method of Compliance
All Source Types	Luminaires and lamps shall not exceed hazardous substance concentrations set for in the European Union's (EU) Restriction of the Use of Certain Hazardous Substances (RoHS) Directive, 2003. Luminaires and lamps shall not exceed: • 0.1% by weight in homogenous material (1000 ppm): Mercury, Lead, Hexavalent Chromium, PBB (polybrominated biphenyls), and PBDE (polybrominated diphenyl ethers) • 0.01% by weight in homogenous material (100 ppm): Cadmium A list of RoHS exemptions that will be accepted by the ENERGY STAR program that may be relevant to luminaires and lamps is detailed below: <u>Exemptions</u>: 1. Mercury in single capped (compact) fluorescent lamps not exceeding (per burner): a. Lamps ≤ 23.0 rated watts shall contain ≤ 2.5 milligrams (mg) mercury per lamp b. Lamps ≥ 23.0 rated watts shall contain ≤ 3.0 milligrams (mg) mercury per lamp 2. Lead in glass of fluorescent tubes not exceeding 0.2% by weight 3. Lead in high melting temperature type solders (i.e. lead-based alloys containing 85% by weight or more lead) 4. Electrical and electronic components containing lead in a glass or ceramic other than dielectric ceramic in capacitors, e.g. piezoelectronic devices, or in a glass or ceramic matrix compound 5. Cadmium and its compounds in electrical contacts 6. Lead in solders to complete a viable electrical connection between semiconductor die and carrier within integrated circuit flip chip packages 7. Lead with PbBiSn-Hg and PbInSn-Hg in specific compositions as main amalgam and with PbSn-Hg as auxiliary amalgam in very compact energy saving lamps. 8. Cadmium in color-converting II-IV LEDs (< 10 µg Cd per mm^2 of light-emitting area) for use in solid state illumination or display systems.	For purposes of third-party certification, lamp toxics documentation shall not be reviewed when products are initially certified or during verification testing. Instead partner shall maintain documentation on file to demonstrate that certified products meet these requirements. EPA reserves the right to request this documentation at any time. For the purposes of documenting mercury content, the following test procedure shall be used: IEC 62554 Ed 1.0 Sample Preparation for Measurement of Mercury Level in Fluorescent Lamps (2011-08-19). For materials other than mercury, partner may rely on component suppliers to provide certification or declaration documents to show that homogenous materials used in lamps comply with the requirement. Alternatively, partner may have components tested in accordance with IEC 62321 or other appropriate analytical technique to verify that homogenous materials do not exceed the concentration limits of the six regulated substances. Handheld XRF analyzers/scanners may also be used to verify compliance.

END OF SPECIFICATION

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