



ENERGY STAR® Program Requirements for Luminaires

Eligibility Criteria – Version 1.0, FINAL DRAFT

Note: This specification replaces the ENERGY STAR Residential Light Fixtures and Solid State Lighting Luminaires specifications.

Primary Contact Information

Note: For purposes of this specification development process, EPA invites stakeholders to send comments to luminaires@energystar.gov, with “ENERGY STAR Luminaires Final Draft Comments” in the subject line.

Your Primary Contact Information

To effectively communicate important news to our partners, the ENERGY STAR program needs your help keeping your company’s contact information up to date. It is one of your partner commitments and it’s easy to do: please visit www.energystar.gov/partners to log in.

Specification Scope & Luminaire Classification

The ENERGY STAR Luminaires specification (“this specification”) covers the luminaire types outlined in this section. Qualification is limited to luminaires below a total input power of 250 watts.

The next section of this specification (“How to Use This Document”) details the differences in testing and performance requirements for directional and non-directional luminaires. Refer to the Definitions section for definitions of each luminaire type detailed below.

DIRECTIONAL FOR PURPOSES OF THIS SPECIFICATION (requiring luminaire photometry):

- RESIDENTIAL grade luminaires, **specifically:**
 - accent lights
 - includes line-voltage directional track lights
 - includes directional ceiling fan light kits
 - cove mounts
 - downlights: recessed, pendant, surface mount
 - includes SSL downlight retrofits
 - outdoor post-mounted luminaires
 - under cabinet luminaires
 - all inseparable SSL luminaires
- COMMERCIAL grade luminaires, **specifically:**
 - accent lights
 - includes line-voltage directional track lights
 - cove mounts
 - downlights: recessed, pendant, surface mount
 - includes SSL downlight retrofits
 - excludes troffers or linear forms
 - under cabinet shelf-mounted task lighting
 - portable desk task lights

Note: Luminaires not classified above as directional default to non-directional classification for purposes of meeting performance requirements outlined in this specification.

NON-DIRECTIONAL FOR PURPOSES OF THIS SPECIFICATION (requiring source photometry):

RESIDENTIAL grade luminaires only, **including but not limited to:**

- Indoor:
 - bath vanity
 - ceiling and close-to-ceiling mount
 - includes non-directional ceiling fan light kits
 - includes ventilation fan light kits
 - chandeliers
 - decorative pendants
 - linear strips
 - portable luminaires
 - includes portable desk task lights
 - includes portable floor task lights
 - includes “table lamps” and “floor lamps”
 - includes torchieres
 - wall sconces
 - wrapped lens
- Outdoor:
 - ceiling and close-to-ceiling mount
 - porch
 - pendant
 - security

Note: Upon further review of the market and the current qualifying product list, two previously residential-only applications, cove mount luminaires and accent lights, also popular in commercial installations, have been added to the commercial scope. For clarity, other minor adjustments have been made to the above section.

How to Use This Document

To qualify a luminaire for ENERGY STAR, first determine which requirements in this document are applicable to the specific luminaire. ENERGY STAR requirements are specific to directional and non-directional applications:

- Directional luminaires:
 - itemized in the above Specification Scope & Luminaire Classification section
 - evaluated with luminaire photometry, accounting for luminaire optical performance
 - shall also meet specified minimum light output and zonal lumen density requirements
 - residential grade luminaires featuring inseparable solid state (LED) componentry and not otherwise itemized in the Scope shall be considered directional for purposes of this specification and therefore evaluated with luminaire photometry
 - all other luminaire types default to non-directional, below
- Non-directional luminaires:
 - examples provided in the above Specification Scope & Luminaire Classification section
 - evaluated by source photometry
 - luminaires not defined as directional are evaluated as non-directional

Please note that this specification is not organized by indoor or outdoor, or by light source technology. Performance requirements comprise each section of this document, thus the first section summarizes efficacy requirements, the second color performance, etc. Partners are advised to review each section, and take note of exceptions where specific performance criteria need not be evaluated; for instance, some exceptions are in place for outdoor luminaires.

Luminaire manufacturers may elect to use ENERGY STAR qualified GU24 based lamps featuring integral ballasts or drivers to meet performance requirements in this specification. See www.energystar.gov for a qualifying product list.

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Definitions

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 IES RP-16-10: "Accent Lighting"). Includes line-voltage directional track lights.

ALA: American Lighting Association.

ANSI: American National Standards Institute.

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

ASSIST: Alliance for Solid State Illumination Systems and Technologies

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 waveform) for starting and operating. (IES RP-16-10)

Ballast Frequency: The number of waves or cycles of electromagnetic radiation per second, usually measured in Hz. (Lighting Fundamentals Handbook, Electric Power Research Institute, 1992)

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

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.

CFL: A compact fluorescent lamp (pin based or self-ballasted screw base). See Compact Fluorescent Lamp.

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: A general expression for the effect of a light source on the color appearance of objects in conscious or subconscious comparison with their color appearance under a reference light source. (IES Handbook 9th Edition)

Color Rendering Index of a Light Source (CRI): A measure of the degree of color shift objects undergo when illuminated by the light source as compared with those same objects when illuminated by a reference source of comparable color temperature. (IES RP-16-10)

Commercial Luminaire: A luminaire marketed and intended to be used in a commercial, industrial or business environment, exclusive of a device which is marketed for use by the general public or is intended to be used in the home. (adapted from FCC 47 CFR parts 15 and 18)

Compact Fluorescent Lamp (CFL): A fluorescent lamp with a small diameter glass tube (T5 or less) that is folded, bent, or bridged to create a long discharge path in a small volume. The lamp design generally includes an amalgam and a cold chamber, or a cold spot to control the mercury vapor pressure and light output. (IES RP-16-10)

Correlated Color Temperature of a Light Source (CCT): The absolute temperature of a blackbody whose chromaticity most nearly resembles that of the light source. (IES RP-16-10).

Cove Mount (Luminaire): Lighting comprising light sources shielded by a ledge or horizontal recess, and distributing light over the ceiling and upper wall. For purposes of this specification, cove mount luminaires feature luminaire optics over the lamps, LED packages, arrays or modules, or LED light engines. (adapted from IES RP-16-10)

Covered Lamp: A lamp with an integral ballast and a translucent cover over the bare fluorescent glass tube.

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 percent 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. (IES RP-16-10)

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 (IES RP-16-10). See definition of Direct Lighting for additional information. For purposes of this specification, this definition includes down light luminaire SSL retrofits but does not include linear fluorescent troffers or linear luminaire forms such as linear fluorescent pendants, typically used to illuminate office spaces.

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)

Floor Lamp (Luminaire): a portable luminaire on a high stand suitable for standing on the floor. (IES RP-16-10)

GU24 Based Integrated Lamp: A lamp unit that integrates the lamp and its ballast. It does not include any replaceable or interchangeable parts, and utilizes the ANSI standardized GU24 base type.

GU24 Based Two-Piece Lamp: A term for a lamp-ballast unit that includes a ballast with the ANSI standardized GU24 base type paired with a standard pin based lamp. The ballast and lamp are separable, with the ballast designed to accept replacement pin based lamps.

High Frequency (Electronic) Ballast: see Electronic Ballast.

IEC: International Electrotechnical Commission.

IES: Illuminating Engineering Society.

Initial Performance Values: The photometric and electrical characteristics at the end of the 100-hour aging period in a 25°C test environment.

Input Power: The power consumption in watts of a ballast or driver and a light source system operating in a normal 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 which are user replaceable / upgradeable without the cutting of wires or the use of solder, or the specific residential luminaire types designated "directional" in the scope of this document.

Lamp: A generic term for a man-made source create 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.” (IES Handbook 9th Edition)

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.

Lamp Current Crest Factor: For 60Hz operation, the ratio of peak lamp current to the root mean square (RMS) lamp current. For high-frequency (HF) operation, the highest peak lamp current of the modulation envelope (when evaluated over a full line voltage cycle) to the root mean square (RMS) of the lamp current.

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. (IES RP-16-10)

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 a LED package (component) or an LED array (module). LED control circuitry does include power source. (IES RP-16-10)

LED Driver: A device comprised of a power source and LED control circuitry designed to operate a LED package (component), or an LED array (module) or an LED lamp. (IES RP-16-10)

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 Driver Class II: An LED driver that operates within Class II limits as defined by the latest version of the National Electrical Code (NEC) and the Canadian Electrical Code (CEC). (IES RP-16-10)

LED Light Engine: An integrated assembly comprised of LED packages (components) or LED arrays (modules), 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 and does not use an ANSI standard base. (IES RP-16-10)

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), LED Light Engine, or LED lamps. The LED luminaire is intended to connect directly to a branch circuit. (IES RP-16-10)

LED Module: See LED Array or Module.

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. (IES RP-16-10)

LED Platform: See LED Light Engine.

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 pn junction semiconductor device that emits incoherent optical radiation when forward biased. The optical emission may be in the ultraviolet, visible, or infrared wavelength regions. (IES RP-16-10)

Linear Strip Luminaire: Surface mounted luminaires 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.

Linear Fluorescent Lamp: Commonly made with straight, tubular bulbs varying in diameter from approximately 6 mm (0.25 in. T-2) to 54 mm (2.125 in. T-17) and in overall length from a nominal 100 to 2440 mm (4 to 96 in.), this light source is a low-pressure gas discharge source, in which light is produced predominantly by fluorescent powders activated by UV energy generated by a mercury arc. (adapted from IES Handbook 9th Edition)

Lumen Maintenance: The luminous flux output remaining (typically expressed as a percentage of the initial output) at any selected elapsed operating time. Lumen maintenance is the converse of lumen depreciation. (adapted from IES LM-80-08)

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 IES RP-16-10: “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, position and protect the lamps, and to connect the lamp(s) to the power supply (IES RP-16-10)

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)

Magnetic Ballast: A magnetic device used to control the starting and operation of discharge lamps. (IES Handbook 9th Edition)

Nadir: The angle pointing directly downward from the luminaire, or zero degrees.

NEMA: National Electrical Manufacturers Association.

NFPA: The National Fire Protection Association (United States), which develops the National Electrical Code (NEC).

Non-Directional Application: For purposes of this ENERGY STAR specification, luminaire application 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.

Photo Control or Light Activated Switch: A photoelectric switch that controls lighting by the level of daylight luminance (IES RP-16-10)

Photosensor: See Photo Control.

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. (IES RP-16-10)

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).

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 (IES RP-16-10)

Rated Lumen Maintenance Life (Lp): The elapsed operating time over which the LED light source will maintain the percentage, p, of its initial light output, e.g. L₇₀ (hours): Time to 70% lumen maintenance. (IES LM-80-08)

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)

RLF: Residential light fixture.

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)

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 a 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)

SSL Downlight Retrofits: A type of solid state luminaire intended to install into an existing downlight, replacing the existing light source and related electrical components.

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 C78.376-2001)

Table Lamp (Luminaire): A portable luminaire with a short stand suitable for standing on furniture. (IES RP-16-10)

Torchiere (Luminaire): An indirect floor lamp that sends all or nearly all of its light upward. (IES RP-16-10)

TMP_C: see LED Driver Case Temperature Measurement Point.

TMP_{LED}: see LED Temperature Measurement Point.

Trim: Trim is 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: Luminaires installed below an upper cabinet to direct light down to the work surface of a countertop or desk for task lighting.

Wall Sconce (Luminaire): Wall mounted luminaires not intended to accent an object or a task area within a space.

Wrapped Lens Luminaire: Surface mounted luminaires with an elongated aspect ratio and a single optic covering the light source that direct less than 90% of light downward.

Note: Refinements have been made to the definitions of:

1. Correlated Color Temperature
2. Color Rendering Index
3. Cove Lighting (now Cove Mount)
4. Down Light or Downlight
5. Inseparable SSL Luminaire
6. Linear Fluorescent Lamp
7. Lumens per Watt
8. Portable Desk Task Light

Definitions of line-voltage track lights, portable floor task lights and SSL downlight retrofits have been added.

Test Criteria

When testing luminaires, the test methods identified for each performance characteristic in the “Methods of Measurement and/or Reference Standards” column of the performance requirements tables presented within this specification shall be used to determine ENERGY STAR qualification.

Product Qualification

A. Product Families: grouped product submissions for ENERGY STAR qualification shall meet the following requirements:

Qualified products within a product family shall be identical to the tested, representative model with the exception of allowed variations listed in Table 1, below. The representative model shall be the variation expected to have the greatest difficulty meeting the performance criteria outlined in this specification.

Table 1: Allowable Variations Within Product Families	
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. Thermal measurements of each variation may be required (e.g. ballast case temperature, TMP_{LED} , or TMP_C).
Heat Sink / Thermal Management Components	Not allowed.
Finish	Allowed.
Mounting	
Reflector / Trim	Allowed so long as luminaire light output is not reduced.
Shade / Diffuser	Allowed so long as neither luminaire light output nor air flow are reduced.
Light Source (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.
Correlated Color Temperature (CCT) (also review Light Source above)	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. Partner shall use different luminaire model numbers to distinguish between models with different CCTs.
Ballast / Driver	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).

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 3000 Kelvin, partner may not retroactively add a 2700 Kelvin model, as this was not the lowest CCT initially tested.

B. Significant Digits and Rounding

- a. All calculations shall be carried out with actual measured or observed values. Only the final result of a calculation shall be rounded. Calculated results shall be rounded to the nearest significant digit as expressed in the corresponding specification limit.
- b. Unless otherwise specified, compliance with specification limit shall be evaluated using exact values without any benefit from rounding.

Note: EPA is currently reviewing the tolerances detailed in the enclosed methods of measurement to determine if they are sufficient for purposes of ensuring performance and quality, and also to determine where tolerance values, if needed, are not sufficiently addressed. As tolerance information is intended to account for slight variations in measurement, this information will be supplied to EPA-recognized laboratories and certification bodies.

Regarding the above “lowest CCT” provision, EPA is revisiting solid state lumen maintenance testing policies put in place in support of the existing SSL v1.1 and Integral LED Lamps V1.1 specifications, will gather input from manufacturers of LED packages, arrays and modules, and will issue new guidance in support of the Luminaires V1.0 specification.

Effective Date

The ENERGY STAR Luminaires Version 1.0 specification shall take effect on October 1, 2011. To qualify for ENERGY STAR, a product 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.

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 qualification is not automatically granted for the life of a product model.

While this document currently refers to industry standards and test procedures for fluorescent, high intensity discharge 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.

Reference Standards and Test Procedures

Organization	Identifier	Description
ANSI	C78.376-2001	Specifications for the Chromaticity of Fluorescent Lamps
ANSI	C78.377-2008	Specifications for the Chromaticity of Solid State Lighting Products
ANSI	C78.389-2004 (R2009)	High-Intensity Discharge (HID)—Methods of Measuring Characteristics
ANSI	C78.42-2009	High-Pressure Sodium (HPS) Lamps
ANSI	C78.43-2007	Single-Ended Metal Halide Lamps
ANSI	C78.5-2003	Specifications for Performance of Self-ballasted Compact Fluorescent Lamps
ANSI	C78.81-2010	Double-Capped Fluorescent Lamps—Dimensional and Electrical Characteristics
ANSI	C78.901-2005	Single-Based Fluorescent Lamps—Dimensional and Electrical Characteristics
ANSI	C81.61-2009	Specifications for Bases (Caps) for Electric Lamps
ANSI	C81.62-2009	Lampholders for Electric Lamps
ANSI	C82.1-2004	Line Frequency Fluorescent Lamp Ballast
ANSI	C82.11 Consolidated-2002	High-Frequency Fluorescent Lamp Ballasts—Supplements
ANSI	C82.14-2006	Low-Frequency Square Wave Electronic Ballasts—for Metal Halide Lamps
ANSI	C82.2-2002	Method of Measurement of Fluorescent Lamp Ballasts
ANSI	C82.4-2002	Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple Supply Types)
ANSI	C82.6-2005	Ballasts for High Intensity Discharge (HID) Lamps - Methods of Measurement
ANSI	C82.77-2002	Harmonic Emission Limits—Related Power Quality Requirements for Lighting Equipment
ANSI/IEEE	C62.41-1991	Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits
ASSIST	Vol. 4, Issue 1, May 2008	Recommendations for Testing and Evaluating White LED Light Engines and Integrated LED Lamps Used in Decorative Lighting Luminaires
ASTM	E283-04	Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
CAN/CSA	C22.2 NO. 74-96 (R2010)	Equipment for Use With Electric Discharge Lamps
CIE	Pub. No. 13.3-1995	Method of Measuring and Specifying Color Rendering of Light Sources
CIE	Pub. No. 15:2004	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
FTC	CFR Title 16 Part 240	Commercial Practice Guides for Advertising Allowances and Other Merchandizing Payments and Services
IEC	60061-1	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	Double-capped Fluorescent Lamps - Performance Specifications
IEC	60901	Single-capped Fluorescent Lamps - Performance Specifications
IEC	61347-2-3-am2 ed1.0	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)
IES	LM-9-09	Electric and Photometric Measurements of Fluorescent Lamps
IES	LM-10-96	Photometric Testing of Outdoor Fluorescent Luminaires
IES	LM-15-03	Guide for Reporting General Lighting Equipment Engineering Data for Indoor Luminaires
IES	LM-16-93	Correlated Color Temperature
IES	LM-31-95	Photometric Testing of Roadway Luminaires Using Incandescent Filament and High Intensity Discharge (HID) Lamps
IES	LM-35-02	Photometric Testing of Floodlights Using High Intensity Discharge or Incandescent Filament Lamps
IES	LM-40-01	Life Testing of Fluorescent Lamps
IES	LM 41-98	Approved Method for Photometric Testing of Indoor Fluorescent Luminaires
IES	LM-46-04	Photometric Testing of Indoor Luminaires Using High Intensity Discharge or Incandescent Filament Lamps
IES	LM 47-01	Life Testing of High Intensity Discharge (HID) Lamps
IES	LM-49-01	Life Testing of Incandescent Filament Lamps
IES	LM-51-00	Electrical and Photometric Measurements of High Intensity Discharge Lamps
IES	LM-58-94	Guide to Spectroradiometric Measurements
IES	LM-65-01	Life Testing of Compact Fluorescent Lamps
IES	LM-66-00	Electrical and Photometric Measurements of Single-Ended Compact Fluorescent Lamps.
IES	LM-79-08	Electrical and Photometric Measurements of Solid-State Lighting Products
IES	LM-80-08	Measuring Lumen Maintenance of LED Light Sources
IES	RP 16-10	Nomenclature and Definitions for Illuminating Engineering
IES	TM-21-11	Projecting Long Term Lumen Maintenance of LED Packages (in draft 12/2010)
LRC	ACTV Test 2007	Testing Guideline for the Accelerated Cycling, Thermal, and Voltage (ACTV) Stress Test
NEMA	LL 9-2009	Dimming of T8 Fluorescent Lighting Systems
NEMA	LSD 45-2009	Recommendations for Solid State Lighting Sub-Assembly Interfaces for Luminaires
NFPA	NFPA 70 (2011)	National Electric Code
UL	UL 153-2002	Standard for Safety of Portable Electric Luminaires
UL	ANSI/UL 935-2001	Standard for Safety of Fluorescent-Lamp Ballasts
UL	ANSI/UL 1029-2010	Standard for Safety of High-Intensity-Discharge Lamp Ballasts

UL	<u>UL 1012-2010</u>	Power Units Other Than Class 2
UL	<u>UL 1310-2005</u>	Class 2 Power Units
UL	<u>ANSI/UL 1574-2004</u>	Standard for Safety of Track Lighting Systems
UL	<u>ANSI/UL 1598-2008</u>	Standard for Safety of Luminaires
UL	<u>ANSI/UL 1598B-2010</u> <u>2010</u>	Standard for Supplemental Requirements for Luminaire Reflector Kits for Installation on Previously Installed Fluorescent Luminaires
UL	<u>ANSI/UL 1993-2009</u>	Standard for Safety of Self-Ballasted Lamps and Lamp Adapters
UL	<u>ANSI/UL 1994-2010</u>	Standard for Safety of Luminous Egress Path Marking Systems
UL	<u>ANSI/UL 8750-2009</u>	Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products

Photometric Performance Requirements

Luminous Efficacy and Output Requirements: NON-DIRECTIONAL RESIDENTIAL Luminaires

Note: Luminaire types not denoted as directional on the first page of this specification shall be evaluated as non-directional, based on source photometry. 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 Standards	Supplemental Testing Guidance
	Source Efficacy (initial)	Source Minimum Light Output (initial)		
Fluorescent <ul style="list-style-type: none"> • linear • compact • self ballasted compact (GU24) • circline 	<p>Until Sept. 1, 2013: ≥ 65 lm/W per lamp-ballast platform</p> <p>After Sept. 1, 2013: ≥ 70 lm/W per lamp-ballast platform</p> <p>All lamp and ballast permutations (makes and models) employed in a given luminaire model shall meet this requirement.</p>	<p>Lamp-ballast platform shall provide a minimum of 800 lumens.</p> <p><u>Exception:</u> chandeliers and bath vanity luminaires featuring ≥ 3 heads shall provide a minimum of 450 lumens per head.</p>	<p>Linear & circline: IES LM-9-09</p> <p>Compact & self ballasted compact: IES LM-66-00</p> <p>ANSI C78.81-2010 (for T8)</p> <p>IEC 60081 data sheets (for T5)</p>	<p>Laboratory test results shall be produced using the specific models of lamp and ballast that will be used in production.</p> <p>Linear fluorescent luminaires which do not ship with lamps shall be tested using a lamp model compliant with ANSI C78.81-2010 (for T8) or IEC 60081 data sheets (for T5).</p> <p>Luminaires with ballast(s) capable of operating multiple fluorescent lamp types shall be tested either with the lamp model shipped with the luminaire, or if a lamp is not supplied, with the highest power lamp type detailed on the packaging.</p> <p>Sample Size: ≥ 3 samples of each lamp-ballast model combination shall be tested.</p> <p>Passing Test: all samples shall pass.</p>
High Intensity Discharge <ul style="list-style-type: none"> • metal halide • ceramic metal halide • high pressure sodium 	<p><u>Exception:</u> Covered and dimmable versions of GU24 based integrated lamps are required to meet reduced efficacy requirements as outlined in qualification requirements for those lamps.</p>		<p>IES LM-51-00</p>	<p>Laboratory test results shall be produced using the specific models of lamp and ballast that will be used in production.</p> <p>Luminaires with ballast(s) capable of operating multiple lamp types shall be tested with the lamp model shipped with the luminaire.</p> <p>Sample Size: ≥ 3 samples of each lamp-ballast model combination shall be tested.</p> <p>Passing Test: all samples shall pass.</p>
Solid State: LED Light Engine	<p>LED light engine efficacy, installed in the luminaire, shall meet or exceed the values detailed below, as determined by comparing the <i>in situ</i> T_b value to the LED light engine LM-xx test report.</p> <p>Until Sept. 1, 2013: ≥ 65 lm/W per LED light engine</p> <p>After Sept. 1, 2013: ≥ 70 lm/W per LED light engine</p>	<p>Installed in the luminaire, each LED light engine <i>in situ</i> shall provide a minimum of 800 lumens.</p> <p><u>Exception:</u> chandeliers and bath vanity luminaires featuring ≥ 3 heads shall provide a minimum of 450 lumens per head.</p>	<p>IES LM-xx-1x</p> <p>Note: EPA is working with industry to develop the above test procedure:</p> <p><i>IES Approved Method for the Characterization of LED Light Engines and Integrated LED Lamps for Electrical and Photometric Properties as a Function of Temperature</i></p> <p><i>In situ</i> measurements: ANSI/UL 1598-2008 ANSI/UL 1574-2004 UL 153-2002</p>	<p>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.</p> <p>LM-xx test reports shall detail efficacy, luminous flux, chromaticity coordinates, CCT and CRI values at all tested temperatures. Linear interpolation shall be employed to determine LED light engine photometric performance at temperatures between the LM-xx reported temperatures higher and lower than the <i>in situ</i> temperature.</p> <p>Sample Size:</p> <ul style="list-style-type: none"> • 1 complete luminaire sample (LED light engine(s) installed); and • 2 additional LED light engine samples external to luminaire; and • Any components and/or materials required to install additional LED light engines in luminaire. <p>Passing Test: all LED light engine samples, tested <i>in situ</i> (engine installed in luminaire), shall pass.</p>

<p>Halogen Incandescent (outdoor only)</p>	<p>Qualification using halogen incandescent lamps is available for outdoor luminaires employing the following lampholders: E11, E26, G4, GX5.3, GY6.35, GY8.6 and R7S.</p> <p>Improved product efficiency is achieved through minimized operating time. Qualifying luminaire shall operate with an integral in-line motion sensor device that meets the following criteria:</p> <ul style="list-style-type: none"> • ensures automatic shut-off of the lamp(s) within 15 minutes of being manually activated by a switch or automatically activated by the sensor, and • automatically resets to sensing mode within 6 hours of a manual override or testing operation, and • has an indicator that visibly or audibly informs the device operator that the motion sensor is operating properly, or that it has failed or malfunctioned, and • meets Off-State Power Consumption Requirements in this specification <p>With the exception of manual override or testing operation, luminaires may not continuously operate the lamps. Luminaires may not offer any form of permanent motion sensor defeat. Additionally, instructions provided with luminaire may not detail permanent methods of defeat.</p>	<p>Lampholder: ANSI C81.62-2009</p>	<p>None.</p>
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Note: The Source Efficacy and Minimum Light Output column headings now indicate “initial” to clarify that the requirements are for initial performance. This change has been made for all efficacy and light output requirements in this specification.

LED light engine language has been slightly refined for clarity. Linear interpolation has been detailed to provide a conservative, consistent basis for laboratories and certification bodies to interpret specification requirements.

In response to comments received expressing concern about the potential for over-illumination, the exception for chandeliers and bath vanity luminaires has been adjusted to ≥ 3 heads.

In response to comments indicating that other halogen lampholders should be included in the halogen incandescent requirements, two additional ANSI lampholders have been added to the list.

The Agency received comments that the proposed source efficacy levels above would eliminate circline and pin-based fluorescent lamps. Further analysis of the [NEMA/ALA Lamp and Ballast Platform Matrix](#) demonstrated that there will still be a wide variety of lamp and ballast combinations, including circline and pin-based fluorescent lamps, able to meet the above system efficacy requirements.

EPA also received comments suggesting that this specification ought to include provisions for induction lighting technologies. The Agency agrees with this view, and will pursue expansion of specification language to accommodate these technologies upon availability of industry standard test methods for that technology.

Luminous Efficacy, Output and Zonal Lumen Density Requirements: DIRECTIONAL RESIDENTIAL Luminaires

Note: Luminaire types denoted as directional on the first page of this specification shall be evaluated based on luminaire photometry.

The performance values in this section pertain to the performance of the entire luminaire, including optics.

Luminaire Type	ENERGY STAR Requirements			Methods of Measurement and/or Reference Standards	Supplemental Testing Guidance
	Luminaire Efficacy (initial)	Luminaire Minimum Light Output (initial)	Luminaire Zonal Lumen Density Requirement		
Cove Mount	45 lm/W	<p>Luminaire shall deliver a minimum of 200 lumens per lineal foot.</p> <p>The minimum required light output (in lumens) is calculated by dividing the total luminaire length in inches by 12, then multiplying the result by 200.</p> <p>Note: The equation 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 linear track luminaires the “measured luminaire length” is the track length.</p>	Asymmetrically, luminaire shall deliver a minimum of 35% of total lumens within the zone 30° to 60° from the zenith.	<p>Fluorescent: IES LM-41-98</p> <p>Solid State: IES LM-79-08</p> <p>High Intensity Discharge: IES LM-46-04</p> <p>ANSI C78.81-2010 (for T8)</p> <p>IEC 60081 data sheets (for T5)</p>	<p>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.</p> <p>Linear fluorescent luminaires which do not ship with lamps shall be tested using a lamp model compliant with ANSI C78.81-2010 (for T8) or IEC 60081 data sheets (for T5).</p> <p>Fluorescent luminaires with ballast(s) capable of operating multiple fluorescent lamp types shall be tested either with the lamp model shipped with the luminaire, or if a lamp is not supplied, with the highest power lamp type detailed on the packaging.</p> <p>High intensity discharge luminaires with ballast(s) capable of operating multiple lamp types shall be tested with the lamp model shipped with the luminaire.</p> <p>For downlights, one trim ring and one reflector may be used with the three luminaire samples.</p> <p>Sample Size: ≥ 3 complete luminaires.</p> <p>Passing Test: all luminaires shall pass.</p>
Downlights: <ul style="list-style-type: none"> • recessed • surface • pendant • SSL downlight retrofits 	42 lm/W	<p>≤ 4.5” aperture: 345 lumens</p> <p>> 4.5” aperture: 575 lumens</p>	Luminaire shall deliver a minimum of 75% of total initial lumens within the 0-60° zone (axially symmetric about the nadir)		
Accent Lights <ul style="list-style-type: none"> • includes line voltage track heads • includes directional ceiling fan light kits 	35 lm/W	Luminaire shall deliver a minimum of 200 lumens per head.	Luminaire shall deliver a minimum of 80% within the 0-40° zone (axially symmetric about the center of the beam).		

Under Cabinet	29 lm/W	<p>Luminaire shall deliver a minimum of 125 lumens per lineal foot.</p> <p>The minimum required light output (in lumens) is calculated by dividing the luminaire length in inches by 12, then multiplying the result by 125.</p> <p>Note: The equation 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 linear track luminaires the “measured luminaire length” is the track length.</p>	<p>Referring to the plane perpendicular to the length of the luminaire, the luminaire shall deliver a minimum of 60% of total initial lumens within the 0-60° zone (symmetric about the nadir) and a minimum of 12.5% of total initial lumens within the 60-90° zone aimed toward the backsplash.</p> <p>Manufacturer shall provide instructions with the luminaire noting which direction to install the luminaire to ensure this performance.</p>		
Outdoor Post-Mounted Decorative Luminaires (Note: for mounting between 4 feet and 10.5 feet above grade)	35 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). No greater than 1% of total luminaire lumens may be emitted above 90°.	Fluorescent: IES LM-10-96 Solid State: IES LM-79-08 High Intensity Discharge: IES LM-31-95	
Inseparable SSL Luminaire (SSL luminaire types not otherwise noted in this table)	70 lm/W	None	None	IES LM-79-08	

Note: IES LM-10, LM-31 and LM-41 are currently being reviewed by working groups of the IES Testing Procedures Committee, with renewal of each document anticipated in the Spring of 2011.

Also, the zonal lumen density angles for cove mount luminaires have been revised to clarify the requirement. Though rephrased, the requirement remains unchanged, carried over from the current SSL v1.1 specification.

EPA received an inquiry from a partner concerned with the categorization of SSL downlight retrofits as luminaires, in consideration of the fact that these units often ship with ANSI standard lamp bases. Upon further review the Agency understands that this type of retrofit luminaire – intended to be installed into an existing recessed downlight – is evaluated by Underwriters Laboratories according to ANSI/UL 1598B, “Supplemental Requirements for Luminaire Reflector Kits for Installation on Previously Installed Fluorescent Luminaires”, in conjunction with the basic standards for luminaires, ANSI/UL 1598. While originally intended for fluorescent retrofits, UL has been applying both 1598B and ANSI/UL 8750 “Light Emitting Diode (LED) Light Sources for Use in Lighting Products” in the evaluation of such products, and is currently developing requirements specifically for LED retrofit products. EPA is therefore compelled to continue treating these products as luminaires rather than lamps, therefore these products remain within the scope of this Luminaires specification.

Luminous Efficacy, Output and Zonal Lumen Density Requirements: DIRECTIONAL COMMERCIAL Luminaires

Note: Luminaire types denoted as directional on the first page of this specification shall be evaluated based on luminaire photometry. The performance values in this section pertain to the performance of the entire luminaire, including optics.

(Note: ENERGY STAR qualification is available for only the following commercial luminaire types. Other commercial luminaire types will not be reviewed for qualification.)

Luminaire Type	ENERGY STAR Requirements			Methods of Measurement and/or Reference Standards	Supplemental Testing Guidance
	Luminaire Efficacy (initial)	Luminaire Minimum Light Output (initial)	Luminaire Zonal Lumen Density Requirement		
Portable Desk Task	29 lm/W	Luminaire shall deliver a minimum of 200 lumens.	Luminaire shall deliver a minimum of 85% of total lumens (initial) within the 0-60° zone (symmetric about the center of the beam).	Fluorescent: IES LM-41-98 Solid State: IES LM-79-08	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. Linear fluorescent luminaires which do not ship with lamps shall be tested using a lamp model compliant with ANSI C78.81-2010 (for T8) or IEC 60081 data sheets (for T5).
Downlights: • recessed • surface • pendant • SSL downlight retrofits	42 lm/W	≤ 4.5" aperture: 345 lumens > 4.5" aperture: 575 lumens	Luminaire shall deliver a minimum of 75% of total lumens (initial) within the 0-60° zone (axially symmetric about the nadir).	High Intensity Discharge: IES LM-46-04 ANSI C78.81-2010 (for T8)	Fluorescent luminaires with ballast(s) capable of operating multiple fluorescent lamp types shall be tested either with the lamp model shipped with the luminaire, or if a lamp is not supplied, with the highest power lamp type detailed on the packaging. High intensity discharge luminaires with ballast(s) capable of operating multiple lamp types shall be tested with the lamp model shipped with the luminaire.
Under Cabinet	29 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 luminaire length in inches by 12, then multiplying the result by 125. Note: The equation 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 linear track luminaires the "measured luminaire length" is the track length.	Referring to the plane perpendicular to the length of the luminaire, the luminaire shall deliver a minimum of 60% of total lumens (initial) within the 0-60° zone (symmetric about the nadir) and a minimum of 12.5% of total lumens (initial) within the 60-90° zone aimed towards the backsplash. Manufacturer shall provide instructions with the luminaire noting which direction to install the luminaire to ensure this performance.	IEC 60081 data sheets (for T5)	For downlights, one trim ring and one reflector may be used with the three luminaire samples. Sample Size: ≥ 3 complete luminaires. Passing Test: all luminaires shall pass.

Cove Mount	45 lm/W	<p>Luminaire shall deliver a minimum of 200 lumens per lineal foot.</p> <p>The minimum required light output (in lumens) is calculated by dividing the total luminaire length in inches by 12, then multiplying the result by 200.</p> <p>Note: The equation 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 linear track luminaires the "measured luminaire length" is the track length.</p>	Asymmetrically, luminaire shall deliver a minimum of 35% of total lumens within the zone 30° to 60° from the zenith.		
Accent Lights <ul style="list-style-type: none"> • includes line voltage track heads • includes directional ceiling fan light kits 	35 lm/W	Luminaire shall deliver a minimum of 200 lumens per head.	Luminaire shall deliver a minimum of 80% within the 0-40° zone (axially symmetric about the center of the beam).		

Note: IES LM-41 is currently being reviewed by a working group of the IES Testing Procedures Committee, with renewal of the document anticipated in the Spring of 2011.

The above cove mount and accent light requirements mirror those found in the residential section. The requirements are unchanged from draft 2.

Light Source Life Requirements: All Luminaires

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Standards	Supplemental Testing Guidance
<p>Fluorescent</p> <ul style="list-style-type: none"> • linear • compact • self ballasted compact (GU24) • circline <p>High Intensity Discharge</p> <ul style="list-style-type: none"> • metal halide • ceramic metal halide • high pressure sodium 	<p>For lamps shipped with luminaires, the average rated life of the source shall be $\geq 10,000$ hours.</p> <p>If the lamp is not shipped with the luminaire, product packaging shall meet the requirements set forth in the "Product Labeling & Packaging Requirements" section of this spec.</p> <p><u>Exception:</u> Covered and dimmable versions of GU24 based integrated lamps are required to meet reduced life requirements as outlined in qualification requirements for those lamps.</p> <p>Conditional qualification may be granted if both of the following are met:</p> <ol style="list-style-type: none"> 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. <p>Conditional qualification shall be immediately withdrawn if final testing results do not meet the above requirement.</p>	<p>Linear & circline: IES LM-40-01</p> <p>Compact & self ballasted compact: IES LM-65-01</p> <p>IES LM-47-01</p>	<p>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.</p> <p>Sample Size: ≥ 10 samples of each lamp model shall be tested.</p> <p>Passing Test: $\geq 50\%$ of the sample set shall be functioning at the lifetime requirement.</p>
<p>Halogen Incandescent (outdoor only)</p>	<p>Lamps shipped with luminaires shall feature a rated life of $\geq 3,000$ hours.</p>	<p>IES LM-49-01</p>	<p>Laboratory test results shall be produced using the specific lamp model that will operate in the luminaire (as applicable).</p> <p>Sample Size: ≥ 10 samples of each lamp model shall be tested.</p> <p>Passing Test: $\geq 50\%$ of the sample set shall be functioning at the lifetime requirement.</p>
<p>Solid State</p>	<p>LED packages, LED arrays or LED modules shall meet the following L_{70} rated lumen maintenance life values:</p> <ul style="list-style-type: none"> • 25,000 hours for residential grade indoor luminaires • 35,000 hours for residential grade outdoor luminaires • 35,000 hours for commercial grade luminaires <p>Rated lumen maintenance life claims in excess of the above requirements shall be substantiated with LM-80-08 test report data and lumen maintenance projections based upon guidelines in IES TM-21-11.</p> <p>Refer to Lumen Maintenance Requirements in the next section.</p>		

Note: The Agency received inquiries about what may be provided to satisfy the above life requirements for non-SSL sources. EPA-recognized certification bodies, as part of the qualification process, will be responsible for ensuring that acceptable documentation has been provided demonstrating compliance with the above referenced standards.

The above solid state language has been refined to clarify that rated lumen maintenance life values pertain to the LED packages or arrays within the luminaire, not the luminaire itself.

Lumen Maintenance Requirements: Directional and Non-Directional Luminaires

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Standards	Supplemental Testing Guidance
<p>Fluorescent</p> <ul style="list-style-type: none"> • linear • compact • self ballasted compact (GU24) • circline <p>High Intensity Discharge</p> <ul style="list-style-type: none"> • metal halide • ceramic metal halide • high pressure sodium 	<p>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% (4,000 hours minimum) rated lamp life.</p>	<p>Linear & circline: IES LM-40-01 IES LM-09-99</p> <p>Compact & self ballasted compact: IES LM-65-01 IES LM-66-00</p> <p>IES LM-47-01</p>	<p>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.</p> <p>Sample Size: ≥ 10 samples of each lamp model shall be tested.</p> <p>Passing Test: ≥ 80% of the samples shall achieve the required lumen maintenance value.</p>
<p>Solid State Option 1: LED Package, Module or Array Performance</p> <p>(select either option 1 or option 2, below)</p>	<p>The LED package(s) / LED module(s) / LED array(s) shall meet the following L_{70} rated lumen maintenance life values, <i>in situ</i>:</p> <ul style="list-style-type: none"> • L_{70} (25,000 hours) for residential indoor • L_{70} (35,000 hours) for residential outdoor, or commercial <p>Lumen maintenance projections shall be based on guidance from IES TM-21, the <i>in situ</i> TMP_{LED} temperature of the hottest LED in the luminaire, the forward drive current applied to each LED package/module/array model ("device"), and the IES LM-80 test report for the device which, in addition to LM-80 reporting requirements, shall provide each of the following:</p> <ul style="list-style-type: none"> • sampling method and sample size (per LM-80 section 4.3) • 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 • $\Delta u'v'$ 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) <p>Access to the TMP_{LED} for the hottest LED may be accomplished via a hole in the luminaire housing, tightly resealed with a suitable sealant if created for purposes of testing.</p> <p>All thermocouple attachments and intrusions to luminaire housing shall be photographed.</p>	<p>Measurement: IES LM-80-08</p> <p>Lumen maintenance projection: IES TM-21-11 (in draft)</p> <p>Note: EPA is following industry efforts to develop the above test procedure:</p> <p><i>Projecting Long Term Lumen Maintenance of LED Packages</i></p> <p>Upon its publication, EPA intends to reference this technical memorandum.</p> <p>Chromaticity specifications: ANSI C78.377-2008</p> <p>CCT calculation: CIE 15.2004</p>	<p>For downlights, one trim ring and one reflector may be used with the three luminaire samples.</p> <p>Luminaire Sample Size: three complete luminaires.</p> <p>LM-80 Sample Size: minimum sample size of 25 units for LED packages, or 10 units for LED modules or arrays, for each T_S and drive current combination. Each sample set may be composed entirely of one target CCT, or may be split between no more than two adjacent target CCT values as outlined in ANSI C78.377 (e.g. 2700 and 3000K, or 3500K and 4000K).</p> <p>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.</p> <ol style="list-style-type: none"> 1. In each sample luminaire, the TMP_{LED} temperature, measured <i>in situ</i>, 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. <p>If the TMP_{LED} temperature is between two temperature points specified in the LM-80 test report and the lumen maintenance for the higher test report temperature does not meet requirements, linear interpolation between the LM-80 temperature points shall be used to determine requirement compliance at the TMP_{LED} temperature.</p> <ol style="list-style-type: none"> 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. Guidance from TM-21 indicates L_{70} projection meets or exceeds requirements.

<p>Solid State Option 2: Luminaire or LED Light Engine Performance</p> <p>(select either option 2 or option 1, above)</p>	<p>Directional luminaires: the luminaire shall deliver at 6,000 hours the fraction of initial lumens specified below:</p> <p>Non-directional luminaires: each LED light engine shall deliver at 6,000 hours the fraction of initial lumens specified below:</p> <ul style="list-style-type: none"> • indoor luminaires: ≥ 91.8% • outdoor luminaires: ≥ 94.1% • commercial luminaires: ≥ 94.1% <p>These percentages are based on exponential decay functions for 25,000 hours and 35,000 hours to determine the 6,000 hour lumen maintenance necessary to achieve those rated lumen maintenance life values.</p>	<p>Directional luminaires: IES LM-79-08</p> <p>Non-directional luminaires: IES LM-xx-1x</p> <p>Interim operation: ANSI/UL 1598-2008 ANSI/UL 1574-2004 UL 153-2002</p> <p>NOTE: EPA is working with industry to develop the above test procedure:</p> <p><i>IES Approved Method for the Characterization of LED Light Engines and Integrated LED Lamps for Electrical and Photometric Properties as a Function of Temperature</i></p>	<p>For downlights, one trim ring and one reflector may be used with the three luminaire samples.</p> <p>Directional: luminaire shall be operated continuously in accordance with ANSI/UL 1598-2008, ANSI/UL 1574-2004 or UL 153-2002 during the interim 6,000 hours; any deviations from this shall be reported.</p> <p>Non-directional: LED light engines shall be operated continuously <i>in situ</i> (in the luminaire), with the luminaire operating in accordance with ANSI/UL 1598-2008, ANSI/UL 1574-2004 or UL 153-2002 during the interim 6,000 hours. During initial and final LM-xx measurements, T_b temperature shall be controlled to match T_b temperature measured when LED light engine is operated <i>in situ</i>.</p> <p>LM-xx test reports shall detail efficacy, luminous flux, chromaticity coordinates, CCT and CRI values at all tested temperatures.</p> <p>Sample Size: Directional: three complete luminaires.</p> <p>Non-directional: three LED light engines and the necessary number of luminaires required to operate the engines continuously <i>in situ</i>.</p> <p>Passing Test: all luminaires or LED light engines shall pass.</p>
<p>Halogen Incandescent (outdoor only)</p>	<p>Exempt</p>		

Note: EPA is revisiting solid state lumen maintenance testing policies, including LM-80 samples sizes, put in place in support of the existing SSL v1.1 and Integral LED Lamps V1.1 specifications. The Agency will gather input from manufacturers of LED packages, arrays and modules, and will issue new guidance in support of the Luminaires V1.0 specification.

Under solid state option 1, the photography requirement has been expanded to document intrusions to luminaire housing.

Data interpolation instructions have been added to option 1 passing test requirements.

Solid state option 2 supplemental testing guidance language has been refined for clarity.

The Agency received comment that various types of HID lamps should be permitted to qualify with lower lumen maintenance requirements than stated above - between 65% and 75% depending on lamp type. Such a provision has not been included in this draft, as this does not align with EPA's goal to ensure lumen maintenance performance which meets consumer expectations.

**Correlated Color Temperature (CCT) Requirements: All Indoor Luminaires
(Exemption: Outdoor Luminaires)**

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Standards	Supplemental Testing Guidance
Fluorescent <ul style="list-style-type: none"> • linear • compact • self ballasted compact (GU24) • circline 	Lamps shipped with luminaires shall have one of the following nominal correlated color temperatures (CCT): <ul style="list-style-type: none"> • 2700 Kelvin • 3000 Kelvin • 3500 Kelvin • 4100 Kelvin • 5000 Kelvin (commercial only) 	Measurement (linear & circline): IES LM-9-09 Measurement (compact & self ballasted compact): IES LM-66-00 Calculation: CIE 15.2004 Chromaticity tolerance: ANSI C78.376-2001	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: ≥ 10 samples of each lamp model shall be tested. Passing Test: ≥ 90% of the lamps 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 C78.376-2001, and the referenced MacAdam publication.
High Intensity Discharge <ul style="list-style-type: none"> • metal halide • ceramic metal halide • high pressure sodium 	Lamps shipped with luminaire shall consistently meet the above requirement, as verified by consistency data provided by the lamp vendor to the luminaire manufacturer. If the lamp is not shipped with the luminaire, product packaging shall meet the requirements set forth in Product Labeling & Packaging Requirements.	Measurement: IES LM-51-00 Calculation: CIE 15.2004 Chromaticity tolerance: ANSI C78.376-2001	
Solid State	The luminaire (directional luminaires) or LED light engine (non-directional luminaires) shall have one of the following nominal correlated color temperatures (CCTs): <ul style="list-style-type: none"> • 2700 Kelvin • 3000 Kelvin • 3500 Kelvin • 4000 Kelvin • 5000 Kelvin (commercial only) The luminaire or LED light engine shall also fall within the corresponding 7-step chromaticity quadrangles as defined in ANSI C78.377-2008.	Chromaticity tolerance: ANSI C78.377-2008 Measurement (directional): IES LM-79-08 Measurement (non-directional): IES LM-xx-1x NOTE: EPA is working with industry to develop the above test procedure: <i>IES Approved Method for the Characterization of LED Light Engines and Integrated LED Lamps for Electrical and Photometric Properties as a Function of Temperature</i> <i>In situ</i> measurements (non-directional): ANSI/UL 1598-2008 ANSI/UL 1574-2004 UL 153-2002 Calculation: CIE 15.2004	For downlights, one trim ring and one reflector may be used with the three luminaire samples. Non-directional: LED light engine CCT shall meet the requirement as determined by comparing the <i>in situ</i> T _b value to the LM-xx test report. LM-xx test reports shall detail efficacy, luminous flux, chromaticity coordinates, CCT and CRI values for all tested temperatures. Linear interpolation shall be employed to determine LED light engine photometric performance at temperatures between the LM-xx reported temperatures higher and lower than the <i>in situ</i> temperature. Sample Size: three complete luminaires, or three LED light engines and one luminaire. Passing Test: all luminaires or LED light engines (installed in the luminaire) shall pass.
Halogen Incandescent (outdoor only)	Exempt.		

Note: ANSI C78.376-2001 has been added above for fluorescent and HID. EPA recognizes that ANSI C78.376-2001 is a fluorescent standard, however, in the interest of providing a pathway for qualification of HID indoor products, the same standard is referenced for HID because a chromaticity tolerance standard for HID does not presently exist. Refinements to Supplemental Testing Guidance language have been made for all technologies.

EPA received numerous comments that the solid state requirements should detail 4100 Kelvin rather than 4000 Kelvin. The Agency notes that ANSI C78.377 includes 4000 K among listed nominal CCT categories, rather than the 4100 K which appears in the fluorescent lamp standard ANSI C78.376.

**Color Rendering Requirements: All Indoor Luminaires
(Exemption: Outdoor Luminaires)**

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Standards	Supplemental Testing Guidance
Fluorescent <ul style="list-style-type: none"> • linear • compact • self ballasted compact (GU24) • circline 	Lamps shipped with luminaires shall meet or exceed $R_a \geq 80$.	Measurement (linear & circline): IES LM-9-09 Measurement (compact and self ballasted compact): IES LM-66-00 Calculation: 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: ≥ 10 samples of each lamp model shall be tested. Passing Test: $\geq 80\%$ of the samples shall achieve the required color rendering index value.
High Intensity Discharge <ul style="list-style-type: none"> • metal halide • ceramic metal halide • high pressure sodium 		Measurement (high intensity discharge): IES LM-51-00 Calculation: CIE 13.3-1995	
Solid State	The luminaire (directional luminaires) or LED light engine (non-directional luminaires) shall meet or exceed $R_a \geq 80$.	Directional measurement: IES LM-79-08 Non-directional measurement: IES LM-xx-1x NOTE: EPA is working with industry to develop the above test procedure: <i>IES Approved Method for the Characterization of LED Light Engines and Integrated LED Lamps for Electrical and Photometric Properties as a Function of Temperature</i> <i>In situ</i> measurements (non-directional): ANSI/UL 1598-2008 ANSI/UL 1574-2004 UL 153-2002 Calculation: CIE 13.3-1995	For downlights, one trim ring and one reflector may be used with the three luminaire samples. LED light engine CRI shall meet the requirement as determined by comparing the <i>in situ</i> T_b value to the LM-xx test report. LM-xx test reports shall detail efficacy, luminous flux, chromaticity coordinates, CCT and CRI values for all tested temperatures. Linear interpolation shall be employed to determine LED light engine photometric performance at temperatures between the LM-xx reported temperatures higher and lower than the <i>in situ</i> temperature. Sample Size: three complete luminaires, or three LED light engines and one luminaire. Passing Test: all luminaires or LED light engines (installed in the luminaire) shall pass.
Halogen Incandescent (outdoor only)	Exempt.		

Note: Refinements to solid state supplemental testing guidance have been made, including the addition of LM-xx interpolation instructions.

**Color Angular Uniformity Requirements: Directional Solid State Indoor Luminaires Only
(Exemption: Outdoor Luminaires)**

ENERGY STAR Requirements	Methods of Measurement and/or Reference Standards	Supplemental Testing Guidance
Throughout the zonal lumen density angles detailed on pages 13 to 16, and five degrees beyond, the variation of chromaticity shall be within 0.004 from the weighted average point on the CIE 1976 (u',v') diagram.	Measurement: IES LM-79-08 IES LM-58-94 Calculations: CIE 15: 2004	Vertical angular scanning resolution shall be 1 degree on the 0 and 90 degree vertical planes, and $\Delta u', v'$ distance shall be reported for each vertical angle measured. Sample Size: one complete luminaire. Passing Test: the luminaire shall pass.

Note: The above requirement language has been refined to limit the requirement to those angles (+5 degrees) detailed in the zonal lumen density requirements in the Luminous Efficacy and Output Requirements section of the specification.

IES LM-58 is currently being reviewed by members of the Illuminating Engineering Society's Testing Procedures Committee, with renewal of the document anticipated in the Summer of 2011.

**Color Maintenance Requirements: Solid State Indoor Luminaires Only
(Exemption: Outdoor Luminaires)**

ENERGY STAR Requirements	Methods of Measurement and/or Reference Standards	Supplemental Testing Guidance
<p>The change of chromaticity over the first 6,000 hours of luminaire operation shall be within 0.007 on the CIE 1976 (u',v') diagram, as demonstrated by either:</p> <ul style="list-style-type: none"> the IES LM-80 test report for the employed LED package/array/module model, or as demonstrated by a comparison of luminaire chromaticity data in LM-79 reports at zero and 6,000 hours, or as demonstrated by a comparison of LED light engine chromaticity data in LM-xx reports at zero and 6,000 hours 	<p>IES LM-80-08 IES LM-79-08 IES LM-xx-1x</p> <p>NOTE: EPA is working with industry to develop the above test procedure:</p> <p><i>IES Approved Method for the Characterization of LED Light Engines and Integrated LED Lamps for Electrical and Photometric Properties as a Function of Temperature</i></p> <p>Interim operation: ANSI/UL 1598-2008 ANSI/UL 1574-2004 UL 153-2002</p>	<p>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.</p> <p>For the LM-79 option, luminaire shall be operated continuously in accordance with ANSI/UL 1598-2008, ANSI/UL 1574-2004 or UL 153-2002 during the interim 6,000 hours; any deviations from this shall be reported.</p> <p>For the LM-xx option, LED light engines shall be operated continuously <i>in situ</i> and in accordance with ANSI/UL 1598-2008, ANSI/UL 1574-2004 or UL 153-2002 during the interim 6,000 hours. During initial and final LM-xx measurements, T_b value shall be controlled to match T_b value measured when LED light engine is operated <i>in situ</i>.</p> <p>LM-xx test reports shall detail efficacy, luminous flux, chromaticity coordinates, CCT and CRI values for all tested temperatures.</p> <p>Sample Size (LM-80 option): same as Lumen Maintenance, Option 1.</p> <p>Sample Size (LM-79 option): three complete luminaires.</p> <p>Sample Size (LM-xx option):</p> <ul style="list-style-type: none"> 1 complete luminaire sample (LED light engine installed); and 2 additional LED light engine samples external to luminaire; and Any components and/or materials required to install additional LED light engines in luminaire. <p>Passing Test (LM-80 option): for all LM-80 samples, at any measurement point from zero through 6,000 hours, 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 <i>in situ</i> TMP_{LED} temperature, and at the corresponding drive current.</p> <p>Example 1: an LM-80 test report provides data at $T_s= 55^\circ C, 85^\circ C$ and $105^\circ C$, and the measured <i>in situ</i> TMP_{LED} temperature value is $89^\circ C$. Neither the $85^\circ C$ nor the $105^\circ C$ 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 $55^\circ C$ is disregarded.</p> <p>Example 2: an LM-80 test report provides data at $T_s= 58^\circ C, 87^\circ C$ and $106^\circ C$, and the measured <i>in situ</i> TMP_{LED} temperature value is $53^\circ C$. The LM-80 data at $58^\circ C$ 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 $87^\circ C$ and $106^\circ C$ is disregarded.</p> <p>Passing Test (LM-79 option): at 6,000 hours the distance of the chromaticity coordinates from the initial chromaticity coordinates shall not exceed 0.007. The output at zero degrees on both vertical planes shall be compared.</p> <p>Passing Test (LM-xx option): at 6,000 hours the distance of the chromaticity coordinates from the initial chromaticity coordinates shall not exceed 0.007.</p>

Note: A third bullet has been added to the above requirements detailing a means of compliance using LM-xx for LED light engines.

Supplemental Testing Guidance has been revised to detail LM-xx guidance separately, and to include ANSI/UL 1574-2004.

Lamp Shipment Requirements: Directional and Non-Directional Luminaires

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Standards	Supplemental Testing Guidance
<p>Fluorescent</p> <ul style="list-style-type: none"> • compact • self ballasted compact (GU24) • circline <p>High Intensity Discharge</p> <ul style="list-style-type: none"> • metal halide • ceramic metal halide • high pressure sodium <p>Halogen Incandescent (outdoor only)</p>	<p>All luminaires shall be shipped with a lamp for each lampholder.</p> <p>Manufacturers of 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).</p> <p><u>Exceptions:</u></p> <ol style="list-style-type: none"> 1. Linear fluorescent luminaires. 2. Outdoor luminaires employing ANSI E26 lampholder(s). 3. Downlights incorporating multi-wattage ballast(s) and lampholder(s) accepting lamps of all wattages supported by the ballast. <p>Lamps shall utilize an ANSI/IEC standardized lamp base configuration.</p> <p>Fluorescent and high intensity discharge lamps or lamp bases shall include markings which detail the lamp manufacturer name, wattage, correlated color temperature, and color rendering index. Generic NEMA or ANSI lamp descriptions including a color designation are acceptable. Alternatively information may be included on lamp packaging only in instances where a lamp's physical dimensions will not allow lamp or lamp base labeling.</p> <p>In addition, lamp dimensions and electrical parameters shall either:</p> <ul style="list-style-type: none"> • Meet the requirements of an ANSI/IEC standardized lamp specification sheet if an applicable standard exists; or, • If no ANSI/IEC lamp standard exists (e.g., a spiral compact fluorescent lamp), provide a manufacturer lamp specification sheet that describes the following (use the ANSI lamp data sheets found in ANSI C78.901-2005 and C78.81-2010 as a reference for the format and type of information requested): <ol style="list-style-type: none"> 1. lamp description, including lamp model number, nominal wattage bulb designation / lamp size (i.e. T4, T5, T8) and lamp base type as defined by ANSI C81.61-2009; <p style="text-align: center;">or,</p> <ol style="list-style-type: none"> IEC 60061-1(i.e. 2G13, GR10q, etc.), starting circuit application (i.e., rapid start, preheat, etc.) 2. Dimensional characteristics, including diagram 3. Lamp operating characteristics, including: approximate wattage (W), voltage(V), current (A) 	<p>Lamp base configuration: ANSI C81.61-2009</p> <p>Lamps compliant with an ANSI-IEC standard (for lamp dimensions and electrical parameters):</p> <p style="padding-left: 40px;">For compact fluorescent lamps: ANSI C78.901-2005; IEC 60901</p> <p style="padding-left: 40px;">For linear lamps: ANSI C78.81-2010; IEC 60081</p> <p>Lamps not compliant with an ANSI-IEC standard (for lamp dimensions and electrical parameters):</p> <p>ANSI C78.901-2005; ANSI C78.81-2010</p> <p>(used as a reference for the format and type of information required on a custom lamp specification sheet)</p>	<p>None.</p>
<p>Solid State</p>	<p>Complete light source components shall be provided with the luminaire.</p>	<p>No standard available.</p>	<p>No documentation required.</p>

Note: Fluorescent and HID lamp labeling requirements have been slightly modified for clarity.

Language has been added regarding the lamp shipment requirement for recessed downlights.

An exception to the lamp shipment requirement has been added for downlights which ship with both multi-wattage ballasts and lampholders accepting lamps of all wattages supported by the ballast.

Electrical Performance Requirements

Source Start Time Requirements: Directional and Non-Directional Luminaires (Exemption: Outdoor Luminaires)

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Standards	Supplemental Testing Guidance
Fluorescent <ul style="list-style-type: none"> • linear • compact • self ballasted compact (GU24) • circline 	Light source shall remain continuously illuminated within one second of application of electrical power.	ANSI C82.11 Consolidated-2002 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: ≥ 3 samples of each lamp-ballast model combination, or LED package/LED module/LED array and LED driver model combination shall be tested. Passing Test: all samples shall pass.
High Intensity Discharge <ul style="list-style-type: none"> • metal halide • ceramic metal halide • high pressure sodium 		None referenced. Note: For indoor luminaires EPA does not allow the starting times detailed in ANSI C82.4-2002.	
Solid State		No standard available (as of December 2010).	
Halogen Incandescent (outdoor only)			

Source Run-Up Time Requirements: Directional and Non-Directional Luminaires (Exemption: Outdoor Luminaires)

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Standards	Supplemental Testing Guidance
Fluorescent <ul style="list-style-type: none"> • linear • compact • self ballasted compact (GU24) • circline 	Elapsed time for lamps to reach 90% of stabilized lumen output after application of electrical power shall be: <ul style="list-style-type: none"> • ≤ 1 minute for non-amalgam lamps • ≤ 3 minutes for amalgam lamps 	Linear & circline: No standard available (as of December 2010). Compact & self-ballasted compact: ANSI C78.5-2003, clause 4.8.	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: ≥ 3 samples of each lamp-ballast model combination, or LED package/LED module/LED array and LED driver model combination shall be tested. Passing Test: all samples shall pass.
High Intensity Discharge <ul style="list-style-type: none"> • metal halide • ceramic metal halide • high pressure sodium 		None referenced. Note: For indoor luminaires EPA does not allow the warm-up times detailed in ANSI C82.4-2002.	
Solid State		No standard available (as of December 2010).	
Halogen Incandescent (outdoor only)	Exempt		

Note: Source run-up requirement language has been revised slightly to indicate 'stabilized' rather than 'rated' lumen output.

EPA received comment that discrete lamp/ballast systems are not engineered to meet specific run-up time requirements, and therefore the above requirement should be struck. With the understanding that long run-up time is a consumer detractor to adoption of energy efficient lighting, the Agency has not removed this requirement, as it is important that the luminaire partner carefully select subcomponents which, operating together, will meet the above performance requirement.

Source Replaceability Requirements: Directional and Non-Directional Luminaires

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Standards	Supplemental Testing Guidance
Fluorescent <ul style="list-style-type: none"> • linear • compact • self ballasted compact (GU24) • 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. Note: With the exception of halogen incandescent lamps used in outdoor models and some high intensity discharge luminaires, luminaires employing screw base lampholders without dedicated ballasts (i.e. ANSI E26, E26d E12, E17, E39, E39d) are not eligible to earn the ENERGY STAR.	Lampholder configuration: ANSI/IEC C81.62-2009	None.
High Intensity Discharge <ul style="list-style-type: none"> • metal halide • ceramic metal halide • high pressure sodium 			
Halogen Incandescent (outdoor only)			
Solid State: Non-Directional	For non-directional luminaires, LED light engines shall make use of electrical interconnects which allow for consumer replacement of the engine without the cutting of wires or the use of solder. Luminaires which cannot meet this requirement are to be evaluated as inseparable SSL luminaires (see directional luminaire requirements below and throughout this specification).	No standard available (as of December 2010). Recommendations outlined in NEMA LSD 45-2009 shall be followed.	
Solid State: Directional	Exempt.		

Note: EPA has received comment that for various reasons, some luminaire manufacturers employ multi-wattage ballasts, capable of operating lamps of various wattages, in luminaires designed to operate lamps of only one specific input power. In the interest of expanding the breadth of qualified products available to consumers, the above requirement language has been modified to accommodate configurations where the employed lampholder, designed to accept a lamp of one specific input power, is wired to a multi-wattage ballast.

**Dimming Requirements: All Luminaires Marketed as Dimmable
(Exemption: Non-Dimmable Luminaires)**

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Standards	Supplemental Testing Guidance
Fluorescent <ul style="list-style-type: none"> • linear 	<p>The luminaire and its components shall meet the applicable requirements outlined in currently available industry dimming standards. Step dimming, if employed, shall provide at least two discrete light output levels $\geq 35\%$ of total light output and not including 100% output.</p> <p>Luminaires employing linear T8 lamps shall meet dimming requirements outlined in NEMA LL 9-2010.</p> <p>Luminaires employing linear T5 lamps shall meet dimming requirements outlined in the IEC 60081 lamp data sheets. Note: as of December 2010, dimming requirements are pending.</p>	<p>Linear T8: NEMA LL 9-2010</p> <p>Linear T5: IEC 60081 lamp data sheets (as of December 2010, being updated to include dimming requirements):</p> <p>6520: 14 watt 6530: 21 watt 6620: 24 watt 6640: 28 watt 6650: 35 watt 6730: 39 watt 6750: 49 watt 6840: 54 watt 6850: 80 watt</p>	<p>Laboratory test results shall be produced using the specific ballast model that will operate in the luminaire.</p> <p>Linear fluorescent luminaires which do not ship with lamps shall be tested using a lamp model detailed on the luminaire and its packaging.</p> <p>Sample Size: ≥ 3 samples of each ballast model shall be tested.</p> <p>Passing Test: all samples shall pass.</p>
Fluorescent <ul style="list-style-type: none"> • compact • self ballasted compact (GU24) • circline 	<p>The luminaire and its components shall provide continuous dimming from 100% to 35% of total light output. Step dimming, if employed, shall provide at least two discrete light output levels $\geq 35\%$ of total light output and not including 100% output.</p>	<p>No standard available (as of December 2010).</p>	<p>Laboratory test results shall be produced using the specific lamp and ballast models that will be used in production.</p> <p>Sample Size: ≥ 3 samples of each lamp-ballast model combination shall be tested.</p> <p>Passing Test: all samples shall pass.</p>
High Intensity Discharge <ul style="list-style-type: none"> • metal halide • ceramic metal halide • high pressure sodium 	<p>The luminaire and its components shall provide continuous dimming from 100% to 50% of lamp power. Step dimming, if employed, shall provide at least two discrete light output levels $\geq 35\%$ of total light output and not including 100% output.</p>		
Solid State	<p>The luminaire and its components shall provide continuous dimming from 100% to 35% of total light output. Step dimming, if employed, shall provide at least two discrete light output levels $\geq 35\%$ of total light output and not including 100% output.</p>		<p>Laboratory test results shall be produced using the models of LED package, LED module or LED array and LED driver that will be used in production.</p> <p>Sample Size: ≥ 3 samples of each model combination shall be tested.</p> <p>Passing Test: all samples shall pass.</p>
Halogen Incandescent (outdoor only)	<p>May not feature dimming.</p>		<p>None.</p>

Note: The requirements language for fluorescent, HID and solid state has been slightly refined for clarity. Step dimming options have also been added.

**Photosensor Control Requirement: Halogen Incandescent Outdoor Luminaires Only
(Exemption: Indoor Luminaires)**

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Standards	Supplemental Testing Guidance
Halogen Incandescent (outdoor only)	The luminaire shall contain an integrated photosensor that automatically prevents operation during daylight hours. In addition, the control shall automatically reactivate within 6 hours of a manual override or testing operation.	No standard available.	None.

Power Factor Requirements: Directional and Non-Directional Luminaires

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Standards	Supplemental Testing Guidance
Fluorescent <ul style="list-style-type: none"> • linear • compact • self ballasted compact (GU24) • circline 	Residential : ≥ 0.5 Commercial: ≥ 0.9	Measurement: ANSI C82.2 - 2002	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: ≥ 3 samples of each model combination shall be tested. Passing Test: all samples shall pass.
High Intensity Discharge <ul style="list-style-type: none"> • metal halide • ceramic metal halide • high pressure sodium 	≥ 0.90	ANSI C82.6-2005	
Solid State	<u>Luminaire total input power ≤ 5 watts:</u> ≥ 0.5 <u>Luminaire total input power > 5 watts:</u> Residential: ≥ 0.7 Commercial: ≥ 0.9	No standard available.	
Halogen Incandescent (outdoor only)	Exempt.		

Note: Updates have been made to this table, namely reducing the power factor requirement for solid state luminaires with total luminaire input power less than or equal to 5 watts.

The summary of laboratory and field studies regarding power factor referenced in draft 2 has been published, and is available for [download](#).

EPA received comment stating that power factor need not be tested using the shipped lamp, and that power factor was purely a function of the ballast. With the understanding that the power factor of some ballasts may vary with the load, the Agency has kept the Supplemental Testing Guidance unchanged to ensure accurate testing results using the applicable load.

Transient Protection Requirements: All Luminaires

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Standards	Supplemental Testing Guidance
Fluorescent <ul style="list-style-type: none"> • linear • compact • self ballasted compact (GU24) • circline 	Ballast or driver shall comply with ANSI/IEEE C62.41-1991, Class 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.	ANSI/IEEE C62.41-1991	Laboratory test results shall be produced using the specific models of ballast that will be used in production. Sample Size: ≥ 3 samples of each ballast model shall be tested. Passing Test: all samples shall pass.
High Intensity Discharge <ul style="list-style-type: none"> • metal halide • ceramic metal halide • high pressure sodium 			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. Sample Size: ≥ 3 samples of each LED package, LED module or LED array and LED driver model combination shall be tested. Passing Test: all samples shall pass.
Solid State			Laboratory test results shall be produced using the specific lamp model that will be used in production (if applicable). Sample Size: ≥ 3 luminaire samples shall be tested. Passing Test: all samples shall pass.
Halogen Incandescent (outdoor only)	Whole luminaire, including photosensor and motion sensor, shall comply with ANSI/IEEE C62.41-1991, Class 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.		

Note: EPA received comment that ballasts can be satisfactorily tested to meet this requirement without the lamp in place. This change has been made to the supplemental testing guidance for fluorescent and HID. Solid state lighting supplemental testing guidance however has been separated and continues to include the light source as part of the test, due to the lack of design standards for solid state drivers.

Lamp Current Crest Factor Requirements: Directional and Non-Directional Luminaires

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Standards	Supplemental Testing Guidance
Fluorescent <ul style="list-style-type: none"> • linear • compact • circline 	≤ 1.7	Linear & circline: ANSI C82.11 Consolidated-2002 Sections 3.3.3 and 5.6 unless otherwise specified in ANSI C78.81. Compact: ANSI C78.901-2005	Laboratory test results shall be produced using the specific ballast model that will operate in the luminaire. Sample Size: ≥ 3 samples of each ballast model shall be tested. Passing Test: all samples shall pass.
High Intensity Discharge <ul style="list-style-type: none"> • metal halide • ceramic metal halide • high pressure sodium 	≤ 1.8	Metal halide: ANSI C78.43-2007 High pressure sodium: ANSI C78.42-2007 Measurement: ANSI C82.6-2005 section 6.9	
Fluorescent <ul style="list-style-type: none"> • self ballasted compact (GU24) 	Exempt.		
Solid State			
Halogen Incandescent (outdoor only)			

Note: GU24 lamps have been exempted from this requirement based on comments received stating that integrated lamps by necessity must be designed to ensure proper performance including lamp longevity; ballast testing to the above requirement is impractical and unnecessary.

Off-State Power Consumption Requirements: Directional and Non-Directional Luminaires

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Standards	Supplemental Testing Guidance
<p>All Source Types</p>	<p>Luminaires shall not draw power in the off state.</p> <p><u>Exception:</u> Luminaires with integral motion sensors, photosensors or individually addressable luminaires with external control and intelligence shall consume no more than 1 watt in the off state.</p> <p><u>Exception:</u> Power supplies connected to multiple luminaires may draw up to 1.5 watts in the off state.</p> <p><u>Exception:</u> External power supplies (EPS) employed to power luminaires shall meet the level V performance requirements under the International Efficiency Marking Protocol and include the level V marking on the EPS.</p> <p>Additional information on the Marking Protocol is available at www.energystar.gov/powersupplies</p>	<p>No standard available. (Use manufacturer protocol)</p>	<p>Laboratory test results shall detail off-state power consumption to the tenth of a watt.</p>

Note: Language has been added to Supplemental Testing Guidance.

Operating Frequency Requirements: Directional and Non-Directional Luminaires

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Standards	Supplemental Testing Guidance
Fluorescent <ul style="list-style-type: none"> • linear • compact • self ballasted compact (GU24) • circline 	20 to 33 kHz or ≥ 40 kHz	ANSI C82.2-2002	Laboratory test results shall be produced using the specific ballast model that will operate in the luminaire. Sample Size: ≥ 3 samples of each ballast model shall be tested. Passing Test: all samples shall pass.
High Intensity Discharge <ul style="list-style-type: none"> • metal halide • ceramic metal halide • high pressure sodium 	120 to 400 Hz or ≥ 100 kHz	Measurement: ANSI C78.43-2007 ANSI C78.389-2004(R2009) ANSI C82.14-2006	
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.	No standard available (as of December 2010).	Luminaire light output waveform shall be measured with a photodetector, 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. Sample Size: ≥ 3 luminaires or LED light engines shall be tested. Passing Test: all samples shall pass.
Halogen Incandescent (outdoor only)	Exempt		

Note: The modulation depth requirement entered into draft 2 has been removed in this draft. EPA will continue to follow research efforts to develop more in depth guidance, and will consider those findings in the development of future revisions to this specification. Working with the Lighting Research Center ([LRC](#)), the Alliance for Solid-State Illumination Systems and Technologies ([ASSIST](#)) is currently conducting visual performance research to define and quantify the perception of flicker.

The Illuminating Engineering Society is assembling working group S408-10 to develop a methodology for measurement of photometric waveforms and flicker. Once available, EPA will evaluate the product of this working group's efforts for potential inclusion in a future revision of this specification. In the interim, the supplemental testing guidance language above is proposed, with the goal of gathering data which could support industry development of testing standards.

The [IEEE P1789 working group](#) is developing recommended practices to aid design of LED driving systems to modulate at safe frequencies for their particular applications in order to protect against health risks such as headaches, eye strain and epileptic seizure. Recommended practices issued by the group will be evaluated for inclusion in future revisions of the safety requirements in this specification.

**Ballast/Driver Replaceability Requirements: Directional and Non-Directional Luminaires
(Exemption: Inseparable SSL Luminaires)**

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Standards	Supplemental Testing Guidance
Fluorescent <ul style="list-style-type: none"> • linear • compact • self ballasted compact (GU24) • 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.	No standard available.	None.
High Intensity Discharge <ul style="list-style-type: none"> • metal halide • ceramic metal halide • high pressure sodium 	Exceptions: <ol style="list-style-type: none"> 1. luminaires employing GU24 based integrated lamps 2. line voltage directional track lights 3. solid state cove mount luminaires 4. under cabinet luminaires 		
Solid State: Directional	Instructions shall be provided with the luminaire, detailing guidance on ballast or driver replacement by a "qualified electrician".		
Solid State: Non-Directional	See Source Replaceability Requirements on page 26.		
Solid State: Inseparable SSL Luminaires	Exempt.		
Halogen Incandescent (outdoor only)	Not applicable.		

Note: The above list of exceptions has been revised. The first item has been reworded to also encompass GU24 based integrated LED lamps. The three additional bullets have been added for luminaire types for which it is impractical to enable a consumer to replace the ballast or driver due to the small form factor of the luminaire. Where manufacturers elect to take this exception, an extended luminaire warranty requirement is proposed; see Warranty Requirements section of this specification.

**Noise Requirements: Directional and Non-Directional Luminaires
(Exemption: Outdoor Luminaires)**

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Standards	Supplemental Testing Guidance
Fluorescent <ul style="list-style-type: none"> • linear • compact • self ballasted compact (GU24) • circline 	All ballasts & drivers used within the luminaire shall have a Class A sound rating. Ballasts and drivers are recommended to be installed in the luminaire in such a way that in operation, the luminaire will not emit sound exceeding a measured level of 24 dBA.	No standard available.	None.
High Intensity Discharge <ul style="list-style-type: none"> • metal halide • ceramic metal halide • high pressure sodium 			
Solid State			
Halogen Incandescent (outdoor only)	Exempt.		

Note: Requirements language above has been further refined from previous drafts.

The above referenced "Class A" designation is found within a system developed in the 1950s to characterize ambient noise levels, particularly those created by jet aircraft. "Class A" denotes an ambient noise level likely to cause 'no annoyance' to residents of a given neighborhood. While this system was devised to characterize ambient noise levels, it has been adopted by manufacturers of lighting subcomponents to characterize the sound performance of individual components which would contribute to a background noise level. The system is generally regarded by noise characterization specialists to be outmoded, as there are alternate methods available to characterize the acoustical performance of individual products.

In the absence of an industry standard test procedure, EPA will continue the reference to Class A ratings, however, the Agency strongly encourages lighting industry trade organizations to develop a new designation system which references performance levels specifically applicable to individual lighting product subcomponents, rather than the ambient noise levels to which they contribute. The Agency will revisit this performance requirement during future revisions to this specification.

**Electromagnetic and Radio Frequency Interference Requirements: Directional and Non-Directional Luminaires
(Exemption: Halogen Incandescent Luminaires)**

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Standards	Supplemental Testing Guidance
Fluorescent <ul style="list-style-type: none"> • linear • compact • self ballasted compact (GU24) • circline High Intensity Discharge <ul style="list-style-type: none"> • metal halide • ceramic metal halide • high pressure sodium 	Ballasts shall meet FCC requirements: <ul style="list-style-type: none"> • Non-consumer emission limits for ballasts or power supplies designated for commercial use • Consumer emission limits for ballasts or power supplies designated for residential use 	Code of Federal Regulations: CFR Title 47 Part 18	Sample Size: one complete luminaire. Passing Test: the luminaire shall pass.
Solid State	Power supplies and/or drivers shall meet FCC requirements: <ul style="list-style-type: none"> • Class A for power supplies or drivers that are marketed for use in a commercial, industrial or business environment, exclusive of a device which is marketed for use by the general public or is intended to be used in the home. • Class B for power supplies or drivers that are marketed for use in a residential environment notwithstanding use in commercial, business and industrial environments. Requirement shall be met at all dimming levels, as applicable.	Code of Federal Regulations: CFR Title 47 Part 15	
Halogen Incandescent (outdoor only)	Exempt.		

Note: Sample size and passing test requirements have been added to the Supplemental Testing Guidance.

The Agency received inquiries about what may be provided to satisfy the above requirements. EPA-recognized certification bodies, as part of the qualification process, will be responsible for ensuring that acceptable documentation has been provided demonstrating compliance with the above referenced standards.

Thermal Performance Requirements

Maximum Measured Ballast or Driver Case Temperature Requirement: Directional and Non-Directional Luminaires

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Standards	Supplemental Testing Guidance
Fluorescent <ul style="list-style-type: none"> • linear • compact • self ballasted compact (GU24) • 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 normal operation inside the luminaire.	ANSI/UL 1598-2008 (Acceptable when the thermocouple is placed at the hot-spot location indicated by the ballast manufacturer.)	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 qualified (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.
High Intensity Discharge <ul style="list-style-type: none"> • metal halide • ceramic metal halide • high pressure sodium 	Note: This performance characteristic is separate and distinct from thermal requirements governing safety rather than longevity of the ballast. All qualified luminaires are expected to meet this requirement, including linear, suspended, close-to-ceiling, IC, ICAT and non-IC recessed canisters, etc. as well as those luminaires that may be exempt from ANSI/UL 1598-2008. <u>Exceptions:</u> <ul style="list-style-type: none"> • Indoor portable luminaires using GU24 lamps, where the lamp is centered between a shade that is open on the top and bottom 		
Solid State: Directional	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 <i>in situ</i> operation. Note: This performance characteristic is separate and distinct from safety requirements.		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 qualified (as applicable). Sample Size: 1 luminaire shall be tested. Passing Test: Measured temperature at the TMP _C shall be less than or equal to the manufacturer recommended maximum.

Solid State: Non-Directional	<p>At the temperature measurement point for the hottest location on the driver case (TMP_d 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 <i>in situ</i> operation.</p> <p>Note: This performance characteristic is separate and distinct from safety requirements.</p>	<p>IES LM-xx-1x</p> <p>NOTE: EPA is working with industry to develop the above test procedure:</p> <p><i>IES Approved Method for the Characterization of LED Light Engines and Integrated LED Lamps for Electrical and Photometric Properties as a Function of Temperature</i></p>	<p>Laboratory test results shall be produced using the specific models of LED package, LED module or LED array and LED driver (LED light engine) that will be used in production.</p> <p>Laboratory test results shall be produced using the luminaire with the highest operating temperature among all luminaires in a product family being qualified (as applicable).</p> <p>Sample Size: One LED light engine sample shall be tested <i>in situ</i>.</p> <p>Passing Test: Measured temperature at the TMP_d shall be less than or equal to the manufacturer recommended maximum.</p>
Halogen Incandescent (outdoor only)	Not applicable.		

Note: Supplemental testing guidance has been added indicating that for solid state luminaires, lab test results shall reflect the highest operating temperature among all luminaires being qualified in a product family.

The passing test language for fluorescent and HID has been corrected to reflect the acceptability of test values which are equal to the manufacturer recommended maximum temperature.

Minimum Operating Temperature Requirements: Directional and Non-Directional Outdoor Luminaires (Exemption: Indoor Luminaires)

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Standards	Supplemental Testing Guidance
All Source Types	Luminaire shall have a minimum operating temperature of 0°F (-18°C) or below.	No standard available.	None.

Note: EPA received comment that lighting subcomponents such as ballasts are typically rated for 0° F (-18° C) operation. The above requirement has been adjusted from -20° C to -18° C to align with this industry convention.

Recessed Downlight Thermal Performance Requirements

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Standards	Supplemental Testing Guidance
<p>All Source Types</p>	<p>Insulation contact: Recessed downlight luminaires that are either IC-Rated for direct contact with insulation or non IC-Rated may qualify as ENERGY STAR.</p> <p>For luminaires to be considered IC-Rated they shall be approved for zero clearance insulation cover (IC) by an OSHA NRTL laboratory. Recessed downlight luminaires that are IC-Rated shall also meet the requirements for airtight luminaires, listed below.</p> <p>Airtight construction: Recessed downlight luminaires that are either airtight or not airtight may qualify as ENERGY STAR.</p> <p>For luminaires to be considered airtight, the housing or certified/listed accessory shall have leakage less than 2.0 cubic feet per minute (CFM) at 75 Pascals (or 1.57 lbs/ft²) when tested in accordance with ASTM E283-04 and shall be sealed with a gasket or caulk.</p> <p>For recessed downlight luminaires that are airtight, the following measures shall be taken to ensure that luminaires can be properly installed and inspected:</p> <ol style="list-style-type: none"> 1. Product packaging shall meet the requirements set forth in the Product Labeling & Packaging Requirements. 2. 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. The label shall be clearly visible to a building inspector. 3. 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. 	<p>ASTM E283-04</p>	<p>None.</p>

Safety Requirements

Indoor Luminaire Safety: Portable Luminaires

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Standards	Supplemental Testing Guidance
Fluorescent <ul style="list-style-type: none"> • linear • compact • self ballasted compact (GU24) • circline 	Demonstrate compliance with ANSI/UL 153-2002.	ANSI/UL 153-2002	None.
High Intensity Discharge <ul style="list-style-type: none"> • metal halide • ceramic metal halide • high pressure sodium 			
Solid State	Demonstrate compliance with ANSI/UL 153-2002 and ANSI/UL 8750-2009.	ANSI/UL 153-2002 ANSI/UL 8750-2009	
Halogen Incandescent (outdoor only)	Not applicable.		

Indoor and Outdoor Luminaire Safety: Hardwired Luminaires

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Standards	Supplemental Testing Guidance
Fluorescent <ul style="list-style-type: none"> • linear • compact • self ballasted compact (GU24) • circline 	Demonstrate compliance with ANSI/UL 1598-2008 or ANSI/UL 1574-2004.	ANSI/UL 1598-2008 ANSI/UL 1574-2004.	None.
High Intensity Discharge <ul style="list-style-type: none"> • metal halide • ceramic metal halide • high pressure sodium 			
Solid State	Demonstrate compliance with ANSI/UL 1598-2008 or ANSI/UL 1574-2004, and ANSI/UL 1598-2008.	ANSI/UL 1598-2008 ANSI/UL 1574-2004. ANSI/UL 8750-2009	
Halogen Incandescent (outdoor only)	Not applicable.		

Electronic Ballast or Driver Requirements - Safety – Ballasts, Drivers and “Non-Edison Base Fluorescent Adapters”

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Standards	Supplemental Testing Guidance
Fluorescent <ul style="list-style-type: none"> • linear • compact • circline 	Demonstrate compliance with ANSI/UL 935-2009 or ANSI/UL 1993-2009, as appropriate; and, Demonstrate compliance with CSA 22.2 Number 74, or IEC 61347-2-3/A1/Ed. 1, as appropriate.	ANSI/UL 935-2001 or ANSI/UL 1993-2009 End of life (linear T5): CSA 22.2 Number 74, or IEC 61347-2-3/A1/Ed. 1	None.
Fluorescent <ul style="list-style-type: none"> • self ballasted compact (GU24) 	Demonstrate compliance with ANSI/UL 1993-2009.	ANSI/UL 1993-2009	
High Intensity Discharge <ul style="list-style-type: none"> • metal halide • ceramic metal halide • high pressure sodium 	Demonstrate compliance with ANSI/UL 1029-2009 or CAN/CSA-C22.2 No. 74-96 (R2010)	ANSI/UL 1029-2009 CAN/CSA-C22.2 No. 74-96 (R2010)	
Solid State	Demonstrate compliance with ANSI/UL 8750-2009.	ANSI/UL 8750-2009	
Halogen Incandescent (outdoor only)	Not applicable.		

Note: Adjustments have been made to the above safety requirements, namely the expansion of the Electronic Ballast or Driver Requirements table to detail requirements for technologies other than fluorescent, and the merging of outdoor luminaire safety requirements with the indoor table.

EPA will continue to follow the developments of the [IEEE P1789 working group](#), developing recommended practices to aid design of LED driving systems to modulate at safe frequencies for their particular applications in order to protect against health risks such as headaches, eye strain and epileptic seizure. Recommended practices issued by the group will be evaluated for inclusion in future revisions of this specification.

Product Labeling & Packaging Requirements

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Standards	Supplemental Testing Guidance
<p>Fluorescent</p> <ul style="list-style-type: none"> • linear • compact • self ballasted compact (GU24) • circline <p>High Intensity Discharge</p> <ul style="list-style-type: none"> • metal halide • ceramic metal halide • high pressure sodium 	<p>For luminaires shipped with lamps:</p> <ul style="list-style-type: none"> ▪ Packaging shall clearly describe the nominal color designation of the lamp in units of Kelvin (e.g., 2700K, 3000K, etc). <p>For luminaires shipped with lamps containing mercury:</p> <ul style="list-style-type: none"> ▪ 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 or www.lamprecycle.org <p>For luminaires not shipped with lamps:</p> <ul style="list-style-type: none"> ▪ Packaging shall include a list of lamp types that would ensure compliance with this specification when paired with the qualifying luminaire. Packaging shall not list lamp types which will not ensure performance compliant with this specification. This list shall be clearly visible to the consumer on the luminaire packaging. These can be generic NEMA or ANSI lamp descriptions, and shall include a color designation (e.g., F32T8/830 or CFQ26W/G24q/827) ▪ Packaging shall recommend that consumers select a lamp with a rated life of 10,000 hours or more. <p>For recessed downlight luminaires that are insulation-contact (IC) rated: Packaging shall clearly state this rating. Sample language: "IC-rated for direct contact with insulation".</p> <p>For recessed downlight luminaires that are airtight (AT) certified: Packaging shall clearly show that the luminaire produces less air leakage than 2.0 CFM at 75 Pascals when tested in accordance with ASTM E283-04. Sample language: "Certified airtight per ASTM E283-04."</p> <p>For outdoor luminaires: Packaging shall indicate the minimum (lowest) starting temperature for the lamp and ballast platform of the luminaire.</p> <p>For luminaires marketed as dimmable:</p> <ul style="list-style-type: none"> • Luminaire packaging shall indicate dimming range (as applicable), compatible dimmers or other controls, and known incompatibilities with dimmers, occupancy or vacancy sensors, timing devices or other external lighting controls. Partner shall periodically review this packaging language to determine if updates are needed. • Step dimming capability, if employed, shall be clearly indicated. 	<p>No standard available.</p>	<p>None.</p>

<p>Solid State</p>	<p>Packaging shall clearly describe the nominal color designation in units of Kelvin (e.g., 2700K, 3000K, etc).</p> <p>For recessed downlight luminaires that are insulation-contact (IC) rated: Packaging shall clearly state this rating. Sample language: "IC-rated for direct contact with insulation".</p> <p>For recessed downlight luminaires that are airtight (AT) certified: Packaging shall clearly show that the luminaire produces less air leakage than 2.0 CFM at 75 Pascals when tested in accordance with ASTM E283-04. Sample language: "Certified airtight per ASTM E283-04."</p> <p>For outdoor luminaires: Product packaging shall indicate the minimum (lowest) starting temperature of the luminaire.</p> <p>For luminaires marketed as dimmable:</p> <ul style="list-style-type: none"> • External packaging shall print dimming range (if applicable), a list of compatible dimmers or other controls, any known incompatibilities with dimmers, occupancy or vacancy sensors, timing devices or any other external lighting controls. • Step dimming capability, if employed, shall be clearly indicated. 		
<p>Halogen Incandescent (outdoor only)</p>	<p>For luminaires not shipped with lamps:</p> <ul style="list-style-type: none"> ▪ Packaging shall include a list of lamp types that would ensure compliance with this specification when paired with the qualifying luminaire. This list shall be clearly visible to the consumer on the luminaire packaging. These can be generic NEMA or ANSI lamp descriptions. ▪ Packaging shall recommend that consumers select a halogen incandescent lamp with a rated life of 3,000 hours or more. ▪ Packaging shall not recommend lamping luminaire with self ballasted compact fluorescent lamps ("CFLs"). <p>For recessed downlight luminaires that are insulation-contact (IC) rated: Packaging shall clearly state this rating. Sample language: "IC-rated for direct contact with insulation".</p> <p>For recessed downlight luminaires that are airtight (AT) certified: Packaging shall clearly show that the luminaire produces less air leakage than 2.0 CFM at 75 Pascals when tested in accordance with ASTM E283-04. Sample language: "Certified airtight per ASTM E283-04."</p>		

Note: For clarity, halogen requirements have been broken out from other technologies.

Language has been added requiring that lamp compatibility lists on product packaging be limited only to those lamps which meet the specification. Additional language has been added indicating partner responsibility for periodically reviewing dimming compatibility to determine if packaging compatibility recommendations should be updated. A requirement has been added to clearly indicate step dimming, if applicable.

Lighting Toxics Reduction Requirements: Directional and Non-Directional Luminaires

Source Type	ENERGY STAR Requirements	Method of Compliance	Supplemental Testing Guidance
All Source Types	<p>Luminaires and lamps shall not exceed hazardous substance concentrations set forth in the European Union's (EU) Restriction of the Use of Certain Hazardous Substances (RoHS) Directive, 2003.</p> <p>Luminaires shall not exceed:</p> <ul style="list-style-type: none"> • 5 mg of mercury in fluorescent lamps (all types). • 0.1% by weight (1000 ppm): Mercury, Lead, Hexavalent Chromium, PBB (polybrominated biphenyls), and PBDE (polybrominated diphenyl ethers) • 0.01% by weight (100 ppm): Cadmium <p>A list of RoHS exemptions that have been adopted by EPA and may be relevant to luminaires/lamps is detailed below. <u>Exemptions:</u></p> <ol style="list-style-type: none"> 1. Mercury in single capped (compact) fluorescent lamps not exceeding (per burner): <ol style="list-style-type: none"> a. For general lighting purposes $\geq 150W$: 15 mg b. For general lighting purposes with circular or square structural shape and tube diameter (< 17 mm): currently no limit 2. Mercury in double-capped linear fluorescent lamps for general lighting purposes not exceeding (per lamp): <ol style="list-style-type: none"> a. Tri-band phosphor with long lifetime ($\geq 25,000$ hr): 8 mg 3. Mercury in other fluorescent lamps not exceeding (per lamp): <ol style="list-style-type: none"> a. Linear halophosphate lamps with tube > 28 mm (e.g. T10 and T12): 10 mg b. Non-linear halophosphate lamps (all diameters): 15 mg c. Non-linear tri-band phosphor lamps with tube diameter > 17 mm (e.g. T9): currently no limit 4. Mercury in other High Pressure Sodium (vapor) lamps for general lighting purposes not exceeding (per burner): currently no limit 5. Mercury in High Pressure Mercury (vapor) lamps (HPMV): currently no limit 6. Mercury in metal halide lamps: currently no limit 7. Lead in glass of fluorescent tubes not exceeding 0.2% by weight 8. Lead in high melting temperature type solders (i.e. lead-based alloys containing 85% by weight or more lead) 9. 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 10. Cadmium and its compounds in electrical contacts 11. Lead in solders to complete a viable electrical connection between semiconductor die and carrier within integrated circuit flip chip packages 12. 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. 13. Cadmium in color-converting II-IV LEDs ($< 10 \mu\text{g Cd per mm}^2$ of light-emitting area) for use in solid state illumination or display systems. 	<p>Documentation of RoHS Directive compliance not required for initial qualification. Partner shall prepare and maintain technical documentation to demonstrate compliance, and upon request shall provide certification body such documentation showing that the luminaires/lamps comply with the requirements of the RoHS Directive.</p> <p>Partner may rely on component suppliers to provide certification or declaration documents to show that homogenous materials used in luminaires/lamps comply with the RoHS Directive. Alternatively, Partner may have luminaire/lamp 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.</p>	None.

Note: The above section has been further refined for clarity. Exemptions previously detailed on an external website have been printed above.

EPA recognizes the efforts of NEMA and other groups to develop RoHS-like legislation in the United States, and will consider transitioning at a later date if domestic policy is signed into law.

Warranty Requirements: Directional and Non-Directional Luminaires

Source Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Standards	Supplemental Testing Guidance
Fluorescent <ul style="list-style-type: none"> • linear • compact • self ballasted compact (GU24) • circline 	<p>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 three years from the date of purchase. GU24 based integrated lamps shipped with the luminaire shall carry a minimum 3 year warranty, based on usage of no less than 3 hours per day.</p>	<p>No standard available.</p>	<p>Provide: A copy of the actual luminaire manufacturer written warranty that is included with product packaging.</p>
High Intensity Discharge <ul style="list-style-type: none"> • metal halide • ceramic metal halide • high pressure sodium 	<p>For luminaires incorporating non-replaceable ballasts, the above warranty requirement is extended to 5 years. Manufacturer is solely responsible for honoring warranty; intermediate parties (e.g. showrooms, electrical distributors, retailers) are not responsible for meeting manufacturer's warranty requirements.</p>		
Solid State	<p>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 three years from the date of purchase. GU24 based integrated lamps shipped with the luminaire shall carry a minimum 3 year warranty.</p> <p>For luminaires incorporating non-replaceable drivers, the above warranty requirement is extended to 5 years.</p> <p>Warranty language shall place no limitations on coverage based on duration of luminaire operation (e.g. hours per day).</p> <p>Manufacturer is solely responsible for honoring warranty; intermediate parties (e.g. showrooms, electrical distributors, retailers) are not responsible for meeting manufacturer's warranty requirements.</p>		
Halogen Incandescent (outdoor only)	<p>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, electronics and trim for a minimum of three years from the date of purchase.</p> <p>Manufacturer is solely responsible for honoring warranty; intermediate parties (e.g. showrooms, electrical distributors, retailers) are not responsible for meeting manufacturer's warranty requirements.</p>		

Note: For clarity, warranty requirements have been broken out by technology. Extended warranties of five years have been proposed for specific luminaires which may be qualified without replaceable ballasts or drivers (these luminaires are proposed under “Exceptions” to Ballast/Driver Replaceability Requirements on page 33).

Recognizing that drivers are generally regarded as the weak point in the reliability of a solid state lighting product, that driver testing standards do not yet exist, and that solid state lighting technology is particularly attractive for extended operation installations (>3 hours/day), the Agency seeks to ensure that the usefulness of warranties for qualified solid state luminaires is not diminished by operation limitations normally imposed upon fluorescent sources (i.e. usage of 3 hours/day). Language has therefore been proposed guarding against such warranty limitations.

ENERGY STAR Labeling of Luminaires (Optional)

While not a requirement for qualification, EPA strongly recommends manufacturers provide a conspicuous ENERGY STAR certification mark (e.g. sticker, hangtag) on qualified luminaires themselves:

- to facilitate building inspectors confirming qualification status of installed luminaires
- to provide out-of-the-box marketing of the luminaire's ENERGY STAR qualification
- to demonstrate to consumers a partner's commitment to advancing energy efficiency in lighting

END OF SPECIFICATION