

ENERGY STAR Program Requirements for Residential Light Fixtures: Version 4.2 – ANNEX A

Table 4 – Indoor & Outdoor Fixtures Employing LED Light Engines for Primary Illumination

Performance Characteristic	ENERGY STAR Requirements	Methods of Measurement Reference Standards
Note: These requirements apply only to fixtures to be qualified using LED light engines. Recessed canister fixtures using LED Light Engines are not eligible to earn the ENERGY STAR using these test procedures.		
LED Light Engine Requirements		
LED Light Engine Efficacy <i>Per LED light engine in lumens per watt (LPW)</i>	≥ 50 LPW for uncovered LED light engines ≥ 40 LPM for covered LED light engines (engines featuring integral secondary optics)	<i>ASSIST Recommends: Recommendations for Testing and Evaluating White LED Light Engines and Integrated LED Lamps Used in Decorative Lighting Luminaires. Vol 4, Issue 1, May 2008. (ASSIST, May 2008)</i> ^{1, 2}
LED Light Engine Color Rendering Index (CRI) <i>Required for indoor fixtures only.</i>	≥ 75	ASSIST, May 2008; ANSI C78.377-2008
LED Light Engine Correlated Color Temperature (CCT) <i>Required for indoor fixtures only.</i>	Light output must meet one of the following nominal correlated color temperature (CCT) values: 2700K, 3000K, 3500K, 4000K, 4500K, 5000K, 5700K, 6500K.	ASSIST, May 2008; ANSI C78.377-2008
LED Light Engine Maximum Measured Driver/Driver Case Temperature (During <i>in situ</i> Operation)	T _c not to exceed the LED driver manufacturer maximum recommended case temperature when measured during <i>in situ</i> operation. Note: This performance characteristic is separate and distinct from safety requirements.	ASSIST, May 2008 (See page 8)
Lumen Maintenance	Indoor fixtures: $\geq 25,000$ hours to 70% Lumen Maintenance (L ₇₀) Outdoor fixtures: $\geq 35,000$ hours to 70% Lumen Maintenance (L ₇₀)	<i>ASSIST Recommends: LED Life for General Lighting Vol. 1, February 2005, rev. August 2007 (ASSIST, rev. August 2007)</i> ^{3, 4}
Color Stability	Chromaticity shift for LED packages over time shall not exceed 0.007 on the CIE 1976 (u', v') diagram (corresponds with a 7-step MacAdam ellipse).	
Power Factor	≥ 0.7	ANSI C82.77
¹ ASSIST, May 2008: Available at http://www.lrc.rpi.edu/programs/solidstate/assist/pdf/AR-LEDLightEngine-May2008.pdf . ² Note: EPA understands that IESNA LM-79 ("IESNA Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products") may in the future incorporate LED light engine test procedures; as such EPA may reference LM-79 in future revisions of this specification. ³ ASSIST, rev. August 2007: Available at http://www.lrc.rpi.edu/programs/solidstate/assist/pdf/ASSIST-LEDLife-revised2007.pdf . ⁴ Note: EPA understands IESNA LM-80 ("IESNA Approved Method For Measuring Lumen Maintenance of LED Light Sources") to be under development as of June 2008, and may reference LM-80 in future revisions of this specification.		

ENERGY STAR Program Requirements for Residential Light Fixtures: Version 4.2 – ANNEX A

Table 4 – Indoor & Outdoor Fixtures Employing LED Light Engines for Primary Illumination

Performance Characteristic	ENERGY STAR Requirements	Methods of Measurement Reference Standards
Output Operating Frequency	<p>≥ 120 Hz</p> <p>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.</p>	Oscilloscope instruction manual
Noise	Class A sound rating for power supplies within the fixture, not to exceed a measured level of 24 dBA (audible) when the power supplies are installed in the fixture.	Class A sound rating for power supplies within the fixture, not to exceed a measured level of 24 dBA (audible) when the power supplies are installed in the fixture and are measured using a sound meter (similar in performance to B&K type 2209) where the microphone is located 12 inches from the fixture in any direction.
Transient Protection	Power supply shall comply with ANSI/IEEE C62.41, 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
Electromagnetic and Radio Frequency Interference	Power supplies must meet FCC requirements for consumer use (FCC 47 CFR Part 15/18 Consumer Emission Limits)	Consumer Limits per FCC 47 CFR Part 15/18
Off State Power Consumption	<p>Fixtures using integral occupancy sensors, motion sensors, or photosensors, or portable fixtures, shall consume no more than 0.5 watts in the off state.</p> <p>All other fixtures shall not consume power in the off state.</p> <p>Note: EPA encourages manufacturers to comply with requirements outlined in the <i>ENERGY STAR Program Requirements for Single Voltage AC-AC and AC-DC External Power Supplies</i>.</p>	No Standard Available (Use manufacturer protocol)
Fixture Requirements		
<p>Minimum Operating Temperature</p> <p><i>Required for Outdoor Fixtures Only.</i></p>	Fixture shall have a minimum operating temperature of -20°C or below.	No Standard Available (Use manufacturer protocol)

ENERGY STAR Program Requirements for Residential Light Fixtures: Version 4.2 – ANNEX A

Table 4 – Indoor & Outdoor Fixtures Employing LED Light Engines for Primary Illumination

Performance Characteristic	ENERGY STAR Requirements	Methods of Measurement Reference Standards
Warranty	<p>A written warranty must be included with fixture packaging at the time of shipment, covering repair or replacement of replaceable defective electrical parts:</p> <p>Indoor fixtures: for a minimum of three years from the date of purchase.</p> <p>Outdoor fixtures: for a minimum of four years from the date of purchase.</p>	<p>No Standard Available (Use manufacturer protocol)</p>
Additional Requirements for Indoor Fixtures	<p>Indoor fixtures must also meet the following performance characteristics outlined in table 1:</p> <ul style="list-style-type: none"> • Safety - Portable Fixtures • Safety - Hard-Wired Fixtures 	<p>Refer to table 1.</p>
Additional Requirements for Outdoor Fixtures	<p>Outdoor fixtures must also meet the following performance characteristics outlined in table 2A:</p> <ul style="list-style-type: none"> • Maximum Input Power • Safety • Automatic Daylight Shutoff (fixtures >13 watts only) 	<p>Refer to table 2A.</p>
Product Packaging for Consumer Awareness	<p><u>CCT Labeling:</u> Product packaging language is required that clearly describes the nominal color designation of the LED light engine in units of Kelvin.</p> <p><u>Dimming Capability and Compatibility:</u> External packaging must state any known incompatibilities with dimmers, occupancy or vacancy sensors, timing devices or any other external lighting controls. For LED fixtures that are dimmable, external packaging must clearly state the percentage range of dimming,</p> <p><u>Minimum Operating Temperature (outdoor fixtures only):</u> Product packaging must indicate the minimum (lowest) starting temperature of the fixture.</p>	<p>No Standard Available (Use manufacturer protocol)</p>

ENERGY STAR Program Requirements for Residential Light Fixtures: Version 4.2 – ANNEX A

Table 4 – Indoor & Outdoor Fixtures Employing LED Light Engines for Primary Illumination

Performance Characteristic	ENERGY STAR Requirements		Methods of Measurement Reference Standards
<p>Product Packaging for Consumer Awareness (con't)</p>	<p><u>Incandescent Equivalency:</u> Fixtures incorporating LED light engines generating < 800 lumens must clearly state on product packaging the incandescent light output equivalency of the LED light engine based on the table below:</p>		<p>No Standard Available (Use manufacturer protocol)</p> <p>Note: EPA seeks to ensure that qualified fixtures meet consumer expectations for light output. Consumer preference for light output varies widely, and the same is true for fixture design intent. Therefore it is impractical to prescribe lumen values for various residential lighting fixture applications. This consumer awareness requirement is intended to help consumers understand the limitations of LED light engines producing less than 800 lumens (equivalent to 60 watts incandescent).</p>
	<p>Luminous Flux (Lumens)</p>	<p>Incandescent Equivalency (W)</p>	
	<p>≥ 40</p>	<p>6</p>	
	<p>≥ 70</p>	<p>10</p>	
	<p>≥ 250</p>	<p>25</p>	
<p>≥ 450</p>	<p>40</p>		
<p>Example packaging declaration: “This fixture produces light equivalent to a 25 watt incandescent bulb.”</p>			

ENERGY STAR Program Requirements for Residential Light Fixtures: Version 4.2 – ANNEX A

Table 4 – Indoor & Outdoor Fixtures Employing LED Light Engines for Primary Illumination

Performance Characteristic	Required Documentation
<ul style="list-style-type: none"> • Efficacy • Color Rendering Index (CRI) • Correlated Color Temperature (CCT) 	<p>Provide: A test report from a laboratory:</p> <ul style="list-style-type: none"> • trained by a representative of the Lighting Research Center (RPI) on behalf of the Alliance for Solid-State Illumination Systems and Technologies (ASSIST); or • qualified to participate in the Department of Energy’s CALiPER program. <p><i>Note: Upon availability of NVLAP accreditation for LED test methods, EPA will investigate test procedures under the proposed NVLAP scope and evaluate for inclusion here as an additional test report option.</i></p> <p>Sample Size:</p> <ul style="list-style-type: none"> • 1 complete fixture sample (light engine installed); and • 2 additional light engine samples external to fixture; and • Any components and/or materials required to install additional LED light engines in fixture.
<ul style="list-style-type: none"> • Lumen Maintenance • Color Stability 	<p>Provide:</p> <ul style="list-style-type: none"> • Lumen maintenance and color stability data declared by LED package manufacturer, in accordance with ASSIST Sample Data Sheet for High-Power LEDs (Issue 4); or • LED package datasheets conforming to IESNA LM-80 protocols, once the metric is available.
<ul style="list-style-type: none"> • Maximum Measured Driver/Driver Case Temperature • Power Factor • Transient Protection 	<p>Provide:</p> <ul style="list-style-type: none"> • Laboratory test report <p>Sample Size:</p> <ul style="list-style-type: none"> • One light engine sample must be tested.
<p>Warranty</p>	<p>Provide: A copy of the actual fixture manufacturer written warranty that is included with product packaging.</p>
<p>Additional Requirements for Indoor Fixtures</p>	<p>Refer to table 1.</p>
<p>Additional Requirements for Outdoor Fixtures</p>	<p>Refer to table 2A.</p>
<p>Product Packaging for Consumer Awareness</p>	<p>Provide: A written copy or a PDF graphic of the language that will be displayed on product packaging, and within the packaging as required (e.g., installation instructions for air-tight rated fixtures).</p> <p>If product is marketed as dimmable, a copy of the language that includes dimming range and known lighting control incompatibilities.</p>