ENERGY STAR® Program Requirements
Product Specification for Lamps (Light Bulbs)

Eligibility Criteria
Version 1.0, DRAFT 1

Following is the ENERGY STAR Product Specification for Lamps. A product shall meet all of the identified criteria if it is to earn the ENERGY STAR.

To qualify a lamp for ENERGY STAR, first determine which requirements in this document are applicable to the specific lamp.

Note: Partners are strongly encouraged to read the cover letter distributed with this draft, and all note boxes throughout this specification.

For purposes of this specification development process, EPA invites stakeholders to send comments to lamps@energystar.gov, with "ENERGY STAR Lamps V1.0 First Draft Comments" in the subject line.

Specification Scope & Lamp Classification

The ENERGY STAR Lamps specification ("this specification") covers lamp types outlined in this section. Qualification is limited to lamps intended to be connected to the electric power grid.

Lamp Type	Lamp Shapes	Lamp Bases
ANSI Standard Shape Omnidirectional	A, BT, G, P, PS, S, T, T/C, 2D	Screw bases: E26, E26d, E17, E12 Multiple pin bases: GU24
Non-Standard Shape Omnidirectional	Self-ballasted compact fluorescent: • Bare spiral • Bare mini-spiral • Bare twin tube • Bare triple tube • Bare quadruple tube	
ANSI Standard Shape Directional	R, BR, ER, PAR	
Non-Standard Shape Directional	Self-ballasted compact fluorescent reflector lamps	
Decorative	B, BA, C, CA, F	

Table 1: Specification scope.

This scope does not include:

- Lamps that operate on an external (i.e. not integral to the product) ballast, driver or transformer. This includes linear fluorescent lamps, discrete "pin-based" compact fluorescent lamps, LED replacement lamps for linear fluorescent, and low-voltage lamps (e.g. 12V MR-16).
- Lamps powered by an internal power source, e.g. solar.
- Lamps including other power-consuming features which do not provide useful illumination.
- Lamp technologies without applicable industry standardized methods of measurement.
- Lamps with bases not detailed in ANSI standards.
- Zhaga-standardized LED light engines.

Note: The above scope is a merging of that found in the Compact Fluorescent Lamps and Integral LED Lamps specifications ("the existing specifications"), with some exceptions, and with additional clarifications.

Per stakeholder recommendations, the E17 intermediate base has been included in the scope of the specification. However, GU10 base has not been added because at present it is most commonly employed with lamps which do not have ANSI-standardized maximum overall length (MOL) values (e.g. GU10-based line voltage MR16 lamps). Likewise, ANSI "K" shape directional lamps do not appear in the above scope due to a lack of an ANSI defined maximum overall length (MOL).

During the development of the ENERGY STAR Luminaires specification, the energy savings potential of low-voltage landscape lighting and low-voltage interior track lighting was evaluated. The potential energy savings from replacement of incandescent versions of these fixtures was found to be attributable not to the product alone, but was instead found to be highly dependent upon user behavior including whether the circuit transformer was also upgraded, and how many track heads were installed on the circuit. As was found with low-voltage luminaires, EPA does not believe that the energy savings potential of low-voltage lamps (e.g. MR16 lamps) is consistent across all applications and can be attributed to the product alone. The difference in savings can be considerable between an optimized system with a properly loaded, energy efficient transformer, and a single replacement lamp operating on an old, oversized magnetic transformer. The Program has also found with the Integral LED Lamps specification that MR16 lamp energy savings can be highly dependent on proper matching of the lamp to the type of transformer (AC or DC operation). Low-voltage lamps originally tested on DC transformers were found to provide significantly lower light output when operated on AC transformers. Finally, the MR16 form factor provides extremely limited space for fulfillment of lamp labeling requirements. Likewise, product packaging generally must be enlarged to fulfill the product packaging requirements. EPA seeks alternate views on the above, with supporting documentation.

The Integral LED Lamps specification includes scope for "non-standard" lamps. EPA understands that solid state lamps need not conform to historical ANSI-standardized shapes to provide high quality, efficient illumination, and that in some instances abandoning the limitations of ANSI shapes may enable greater application efficacy. The Agency also recognizes that some self-ballasted compact fluorescent lamps, particularly reflector lamps, do not conform to ANSI standards. For non-standard lamps outside of the above scope, EPA is evaluating continuation of the non-standard provisions outlined in V1.4 of the Integral LED Lamps specification. Given the range of applications in which non-standard lamps could be employed, a single set of performance requirements is unlikely to ensure optimized efficiency in all applications. EPA seeks input from stakeholders on an approach to labeling non-standard lamps that will ensure high efficacy, while not serving as a loophole through which lamps not meeting standard shape requirements will gain the ENERGY STAR.

Finally, the Agency supports standardization of LED light engine interfaces. However, by definition an LED light engine is not an integrated LED lamp unless it includes a driver and an ANSI standard base, and is therefore outside of the scope of this specification. EPA will continue to monitor the progress of the Zhaga Consortium, particularly as the Consortium's efforts assist with qualification using the Luminaires specification.

Effective Date

The ENERGY STAR Lamps Version 1.0 specification shall take effect on *TBD*. 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 lighting 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, methods of measurement and reference documents.

Note: In a subsequent draft, EPA will expand the specification to include applicable test methods and reference documents for discharge sources such as integrated ceramic metal halide.

Definitions

ANSI: American National Standards Institute.
ASTM: American Society for Testing of Materials.
CFL: A compact fluorescent lamp (pin based or self-ballasted screw base). See Compact Fluorescent Lamp.
CIE: Commission Internationale de l'Eclairage (International Commission on Illumination).
Color Rendering: Effect of an illuminant on the color appearance of objects by conscious or subconscious comparison with their color appearance under a reference illuminant (CIE 17.4, ANSI/IES RP-16-10).
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 the color of those same objects when illuminated by a reference source of comparable color temperature. (CIE 13.3, ANSI/IES RP-16-10)
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. (ANSI/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. (ANSI/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 Lamp: Lamps with a lamp shape B, BA, C, CA, DC, and F defined in ANSI C79.1-2002.
Directional Lamp: A lamp having at least 80% light output with a solid angle of πsr (corresponding to a cone with an angle of 120°).
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.
IEC: International Electrotechnical Commission.
IES: Illuminating Engineering Society.
Input Power: The power consumption in watts of a ballast or driver and a light source system operating in a normal mode, as determined in accordance with ANSI Standard 82.2-2002.
Integrated LED Lamp: An integrated assembly comprised of LED packages (components) or LED arrays (modules), LED driver, ANSI standard base and other optical, thermal, mechanical and electrical components. The device is intended to connect directly to the branch circuit through a corresponding ANSI standard lamp-holder (socket). (ANSI/IES RP-16-10)
Lamp: A generic term for a man-made source created to produce optical radiation. By extension, the term is also used to denote sources that radiate in regions of the spectrum adjacent to the visible. (ANSI/IES RP-16-10)
LED: See Light Emitting Diode.
LED Array or Module: An assembly of LED packages (components) or dies on a printed circuit board or substrate, possibly with optical elements and additional thermal, mechanical, and electrical interfaces that are intended to connect to the load side of a LED driver. Power source and ANSI standard base are not incorporated into the device. The device cannot be connected directly to the branch circuit. (ANSI/IES RP-16-10)
LED Package: An assembly of one or more LED dies that includes wire bond or other type of electrical connections, possibly with an optical element and thermal, mechanical, and electrical interfaces. Power source and ANSI standardized base are not incorporated into the device. The device cannot be connected directly to the branch circuit. (ANSI/IES RP-16-10)
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. (ANSI/IES RP-16-10)
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 ANSI/IES RP-16-10: "Luminous Efficacy of a Source of Light")
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)
NEMA: National Electrical Manufacturers Association.
NRTL: Nationally Recognized Testing Laboratory as recognized by OSHA's NRTL Program, which is a part of OSHA's Directorate of Technical Support.
Omni-Directional Lamp: A lamp that is not a directional lamp.
OSHA: Occupational Safety & Health Administration.

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 detailed in ANSI Standard C82.2–2002.
Rated Lumen Maintenance Life (L_P): The elapsed operating time over which the LED light source will maintain the percentage, p, of its initial light output, e.g., L_{70} (hours): Time to 70% lumen maintenance. (IES LM-80-08)
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 an incandescent and fluorescent lighting. There are two types of solid-state light emitters: inorganic light-emitting diodes (LEDs) or organic light-emitting diodes (OLEDs). (Sandia National Laboratories)
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)
TMP_{LED}: See LED Temperature Measurement Point.
UL: Underwriters Laboratories.

Note: The definitions section will be expanded and refined in future drafts.

Test Criteria

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

Allowable Variations Within Product Families	
TBD	*TBD*

Table 2: Allowable variations within product families.

Partners may not retroactively add variations to a product family unless the variations meet the requirements in Table 1.

B. Solid State Lumen Maintenance Performance Data: Content and application of IES LM-80-08 reports shall comply with ENERGY STAR Program Guidance Regarding LED Package, LED Array and LED Module Lumen Maintenance Performance Data Supporting Qualification of Lighting Products.

C. Significant Digits and Rounding

a. All calculations shall be carried out with directly measured (unrounded) values.
b. Unless otherwise specified, compliance with specification limits shall be evaluated using directly measured or calculated values without any benefit from rounding.
c. Directly measured or calculated values that are submitted for reporting on the ENERGY STAR website shall be rounded to the nearest significant digit as expressed in the corresponding specification limit.

Note: Allowable variations within product families and provisions for successor lamps will be addressed in Draft 2. EPA requests technical justifications for any recommendations submitted.

Methods of Measurement and Reference Documents

Organization	Identifier	Description
ANSI/IEEE	C62.41.2-2002	IEEE Recommended Practice on Characterization of Surges in Low Voltage (1000V and Less) AC Power Circuits
ANSI	C78.20-2003	Electric Lamps—A, G, PS and Similar Shapes with E26 Medium Screw Bases
ANSI	C78.21-2003	Electric Lamps—PAR and R Shapes
ANSI	C78.23-1995 (R2003)	Incandescent Lamps—Miscellaneous Types
ANSI	C78.375-1997	Fluorescent Lamps—Guide for Electrical Measurements
ANSI	C78.376-2001	Specifications for the Chromaticity of Fluorescent Lamps
ANSI/NEMA/ ANSLG	C78.377-2008	Specifications for the Chromaticity of Solid State Lighting Products
ANSI	C78.389-2004 (R2009)	Electric Lamps - High-Intensity Discharge (HID) - Methods of Measuring Characteristics
ANSI	C78.5-2003	Specifications for Performance of Self-ballasted Compact Fluorescent Lamps
ANSI	C79.1-2002	Nomenclature for Glass Bulbs Intended for Use with Electric Lamps
ANSI/ANSLG	C81.61-2009	Specifications for Bases (Caps) for Electric Lamps
ANSI	C82.77-2002	Harmonic Emission Limits—Related Power Quality Requirements for Lighting Equipment
ANSI/IEEE	C62.41.2-2002	IEEE Recommended Practice on Characterization of Surges in Low Voltage (1000V and Less) AC Power Circuits
ANSI/IES	RP-16-10	Nomenclature and Definitions for Illuminating Engineering
ANSI/UL	1993-2009	Standard for Safety of Self-Ballasted Lamps and Lamp Adapters
CIE	Pub. No. 13.3-1995	Method of Measuring and Specifying Color Rendering of Light Sources
CIE	Pub. No. 15:2004	Colorimetry
FCC	CFR Title 47 Part 2	Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
FCC	CFR Title 47 Part 15	Radio Frequency Devices
FCC	CFR Title 47 Part 18	Industrial, Scientific, and Medical Equipment
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	Electrical and Photometric Measurements of Fluorescent Lamps
IES	LM 47-11	Life Testing of High Intensity Discharge (HID) Lamps (renewal anticipated in 2011)
IES	LM-51-00	Electrical and Photometric Measurements of High Intensity Discharge Lamps
IES	LM-58-11	Guide to Spectroradiometric Measurements (renewal anticipated in 2011)
IES	LM-65-10	Life Testing of Compact Fluorescent Lamps
IES	LM-66-11	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	TM-21-11	Projecting Long Term Lumen Maintenance of LED Light Sources

Photometric Performance Requirements

Luminous Efficacy Requirements: All Lamps

Lamp Type	ENERGY STAR Requirements		Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
	Lamp Input Power (watts)	Lamp Efficacy (initial lm/W)	Measurement (fluorescent): IES LM-9-09 IES LM-66-11 Measurement (high intensity discharge): IES LM-51-00 Measurement (solid state): IES LM-79-08 Reference Document: ANSI C78.375-1997	For fluorescent lamps, measurements shall be taken at the end of 100 hours of seasoning according to ANSI C78.375-1997 section 8.4. For dimmable/2-way/3-way products, measurements shall be made at the highest wattage setting listed for the model. **Sample Size**: 10 units per model: 5 units tested base-up and 5 units tested base-down unless the manufacturer restricts specific use or position. If position is restricted, all units shall be tested in restricted position. **Passing Test**: Average of unit values shall meet the requirement, and ≥ 9 units individually shall meet the required value. If units are tested both base-up and base-down, averages shall be calculated for both subsets, and the efficacy shall be the lesser of the two averages.
Omnidirectional	<10	55		
	≥10	60		
Directional	<10	40		
	≥10	45		
Decorative	<10	45		
	≥10	50		

Note: The proposed lamp efficacy values represent nominal increases above existing requirements which analyses of existing qualified products indicate are both accessible and cost effective. Higher wattage lamps are capable of achieving higher efficacy levels, so the requirements are tiered by wattage levels. Of currently qualified ENERGY STAR lamps, 92% of omnidirectional lamps and 80% of directional lamps will be able to meet these criteria. EPA seeks feedback on the proposed requirements.

Light Output Requirements
(Exemption: PAR Lamps)

<table>
<tr><th>Lamp Type</th><th>ENERGY STAR Requirements</th><th>Methods of Measurement and/or Reference Documents</th><th>Supplemental Testing Guidance</th></tr>
<tr><td>Omnidirectional Except Globe (G) (see below)</td><td>Lamp shall have minimum light output (total luminous flux) corresponding to the target wattage of the standard incandescent lamp to be replaced, shown below.

<table><tr><th>Nominal Power of the Standard Incandescent Lamp to Be Replaced (Watts)</th><th>Minimum Light Output (Lumens)</th></tr><tr><td>25</td><td>250-449</td></tr><tr><td>40</td><td>450-799</td></tr><tr><td>60</td><td>800-1,099</td></tr><tr><td>75</td><td>1,100-1,599</td></tr><tr><td>100</td><td>1,600-1,999</td></tr><tr><td>125</td><td>2,000-2,549</td></tr><tr><td>150</td><td>2,550-3,000</td></tr></table></td><td rowspan="3">Measurement (fluorescent):
IES LM-9-09
IES LM-66-11

Measurement (high intensity discharge):
IES LM-51-00

Measurement (solid state):
IES LM-79-08

Reference Document:
ANSI C78.375-1997</td><td rowspan="3">For fluorescent lamps, measurements shall be taken at the end of 100 hours of seasoning according to ANSI C78.375-1997 section 8.4.

For dimmable/2-way/3-way products, measurements shall be made at the highest wattage setting listed for the model.

Sample Size: 10 units per model: 5 units tested base-up and 5 units tested base-down unless the manufacturer restricts specific use or position. If position is restricted, all units shall be tested in restricted position.

Passing Test: Average of unit values shall meet the requirement, and ≥ 9 units individually shall meet the required value. If units are tested both base-up and base-down, averages shall be calculated for both subsets, and the efficacy shall be the lesser of the two averages.</td></tr>
<tr><td>Omnidirectional Globe (G)</td><td>Lamp shall have minimum light output (total luminous flux) corresponding to the target wattage of the standard incandescent lamp to be replaced, shown below.

<table><tr><th>Nominal Power of the Standard Incandescent Lamp to Be Replaced (Watts)</th><th>Minimum Light Output (Lumens)</th></tr><tr><td>25</td><td>250-349</td></tr><tr><td>40</td><td>350-499</td></tr><tr><td>60</td><td>500-574</td></tr><tr><td>75</td><td>575-649</td></tr><tr><td>100</td><td>650-1099</td></tr><tr><td>150</td><td>1100-1300</td></tr></table></td></tr>
<tr><td>Directional (R, BR and ER)</td><td>Lamp shall have minimum light output (total luminous flux) corresponding to the target wattage of the standard incandescent lamp to be replaced, shown below.

<table><tr><th>Nominal Power of the Standard Incandescent Lamp to Be Replaced (Watts)</th><th>Minimum Light Output (Lumens)</th></tr><tr><td>20</td><td>TBD</td></tr><tr><td>40</td><td>TBD</td></tr><tr><td>60</td><td>TBD</td></tr><tr><td>75</td><td>TBD</td></tr><tr><td>100</td><td>TBD</td></tr><tr><td>125</td><td>TBD</td></tr><tr><td>150</td><td>TBD</td></tr></table></td></tr>
</table>

<table>
<tr>
<td>Decorative</td>
<td>Lamp shall have minimum light output (total luminous flux) corresponding to the target wattage of the standard incandescent lamp to be replaced, shown below.
<table>
<tr><th>Nominal Power of the Standard Incandescent Lamp to Be Replaced (Watts)</th><th>Minimum Light Output (Lumens)</th></tr>
<tr><td>10</td><td>70-89</td></tr>
<tr><td>15</td><td>90-149</td></tr>
<tr><td>25</td><td>150-299</td></tr>
<tr><td>40</td><td>300-499</td></tr>
<tr><td>60</td><td>500-699</td></tr>
</table>
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<td></td>
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</tr>
</table>

Note: The proposed levels for globe shape lamps were derived from a review of manufacturer published data on soft white standard incandescent globe lamps available on the market. The other proposed performance levels were previously established in the existing lamp specifications and have been carried forward to this specification. The application of minimum light output requirements for R, BR and ER shapes, with an exemption for PAR shapes which must satisfy other intensity distribution requirements, is carried forward from the Integral LED Lamps specification. EPA is reevaluating the existing light output requirements for R, BR and ER shapes and will issue proposed values in the next draft. The Agency seeks stakeholder feedback on the proposed performance requirements.

Correlated Color Temperature (CCT) Requirements: All Lamps

Lamp Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
Compact Fluorescent	Lamp shall meet one of the following nominal CCTs: • 2700K • 3000K • 3500K • 4000/4100K • 5000K	Measurement: IES LM-9-09 IES LM-66-11 ANSI C78.5-2003 Calculation: CIE 15.2004 References: ANSI C78.375-1997 ANSI C78.376-2001	For dimmable/2-way/3-way products, measurements shall be made at the highest wattage setting listed for the model. Measurements shall be taken at the end of 100 hours of seasoning according to ANSI C78.375-1997 section 8.4. **Sample Size**: 10 units per model: 5 units tested base-up and 5 units tested base-down unless the manufacturer restricts specific use or position. If position is restricted, all units shall be tested in restricted position. **Passing Test**: ≥ 9 units shall fall within the defined 4-step ANSI MacAdam ellipse for the target color temperature. No units shall fall outside of a 7-step ANSI MacAdam ellipse.
Solid State	Lamp shall meet the target values (with tolerance) for the intended nominal CCT: • 2700K • 3000K • 3500K • 4000/4100K • 5000K *CCT targets and tolerances to be printed in a subsequent draft.*	Measurement: IES LM-79-08 Calculation: CIE 15.2004 Reference: ANSI C78.377-201X (in draft)	For dimmable/2-way/3-way products, measurements shall be made at the highest wattage setting listed for the model. **Sample Size**: 10 units per model: 5 units tested base-up and 5 units tested base-down unless the manufacturer restricts specific use or position. If position is restricted, all units shall be tested in restricted position. **Passing Test**: ≥ 9 units shall fall within the defined 4-step ANSI quadrangle for the target color temperature. No units shall fall outside of a 7-step quadrangle.

Note: For years, color quality of CFLs has been a top concern of consumers unwilling to adopt energy efficient lighting, or to expand its use in their homes. The existing specifications for color consistency are based on 7-step MacAdam ellipses, and their corresponding 7-step quadrangles for solid state. This scheme permits qualified lamps with obvious magenta or green tints to share the same CCT designation despite these differences in appearance. EPA believes this allowance works against the efficiency community's goal of wider adoption of efficient lighting.

Historically, fluorescent ANSI standards were developed to control such variations to within a 4-step MacAdam ellipse. The 2008 ANSI standard for solid state lighting standardized 7 steps for this technology, but anticipated a return to 4-step quadrangles. To ensure consumer satisfaction and a consistent experience across the makes, models and technologies of qualified lamps, EPA has proposed that all qualified lamps fall within a 4-step ellipse or quadrangle. The Agency seeks feedback on this proposal to further strengthen the quality of qualified lamps.

Color Rendering Requirements: All Lamps

Lamp Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
All Lamps	Lamps shall exhibit color rendering index scores of $R_a \geq 80$ and $R_9 > 0$.	Measurement (fluorescent): IES LM-9-09 IES LM-66-11 Measurement (high intensity discharge): IES LM-51-00 Measurement (solid state): IES LM-79-08 Calculation: CIE 13.3-1995	For dimmable/2-way/3-way products, measurements shall be made at the highest wattage setting listed for the model. **Sample Size**: 10 units per model: 5 units tested base-up and 5 units tested base-down unless the manufacturer restricts specific use or position. If position is restricted, all units shall be tested in restricted position. **Passing Test**: Average of units tested shall meet the requirement and no more than 3 units shall have $R_a < 77$. No units shall have $R_a < 75$.

Note: The above is a combination of requirements from the existing lamp specifications. EPA believes that most CFLs and integrated LED lamps should be able to meet these requirements.

The Agency has been following developments with the Color Quality Scale (CQS) but understands that the metric is not yet available for use. EPA will continue to follow developments.

Color Maintenance Requirements: Solid State Lamps (Exemption: Compact Fluorescent Lamps)

Lamp Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
Solid State	Lamp change in chromaticity from initial/0-hour measurement, at any measurement point during the first 6,000 hours of lamp operation, shall be within 0.004 on the CIE 1976 u'v' diagram.	Measurement: IES LM-79-08 Calculation: CIE 15-2004 Reference: ANSI C78.377-201X (in draft)	For dimmable/2-way/3-way products, measurements shall be made at the highest wattage setting listed for the model. **Sample Size**: 10 units per model: 5 units tested base-up and 5 units tested base-down unless the manufacturer restricts specific use or position. If position is restricted, all units shall be tested in restricted position. **Passing Test**: ≥ 9 units shall meet the requirement.

Note: Along with the proposed strengthening of initial color consistency requirements (see CCT Requirements), in the interest of ensuring consumer satisfaction, EPA is proposing tightening the color maintenance requirement from the current 0.007 in the Integral LED Lamps specification to 0.004. EPA requests feedback on these proposals to ensure greater initial and long-term color consistency of qualified lamps.

Color Angular Uniformity Requirements: Solid State Directional Only (Exemption: All Other Lamps)

Lamp Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
Solid State Directional	Variation of chromaticity across the beam and field of the lamp shall be within 0.004 from the weighted average point on the CIE 1976 (u'v') diagram.	Measurement: IES LM-79-08 Calculation: CIE 15.2004 Reference: ANSI C78.377-201x (in draft)	For dimmable/2-way/3-way products, measurements shall be made at the highest wattage setting listed for the model. *Scanning angles and resolution TBD.* **Sample Size**: one unit. **Passing Test**: the unit shall meet the requirement.

Note: The requirement has been adjusted from the value appearing in the Integral LED Lamps specification to align with the requirement in the Luminaires specification. EPA's intention is to ensure that qualified solid state directional lighting products - for example down lights – provide similar performance whether a qualified down light luminaire is installed, or a qualified lamp is retrofitted into an incandescent downlight. EPA will issue further details about fulfillment of this requirement following discussions with EPA-Recognized Laboratories.

Lumen Maintenance and Reliability Requirements

Note: Please see the note box on page 17 for overarching thoughts on this section of the specification.

Lumen Maintenance Requirements: All Lamps

Lamp Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
Compact Fluorescent	Lamp shall maintain 80% of initial lumen output at 40% of rated life.	Measurement: IES LM-9-09 IES LM-66-11 ENERGY STAR Elevated Temperature Life Testing Procedure, Annex A Reference: ANSI C78.375-1997	Lumen maintenance testing of lamps ≥ 5 watts shall be operated in accordance with the Elevated Temperature Test. Measurements shall be taken at the end of 100 hours of seasoning according to ANSI C78.375-1997 section 8.4. **Sample Size**: 10 units per model: 5 units tested base-up and 5 units tested base-down unless the manufacturer restricts specific use or position. If position is restricted, all units shall be tested in restricted position. For dimmable/2-way/3-way products, measurements shall be made at the highest wattage setting listed for the model. **Passing Test**: Average lumen maintenance of the samples shall meet the requirement. No more than 3 units may have lumen maintenance < 75%. No units may have lumen maintenance < 70%.

<table>
<tr>
<td>Solid State</td>
<td>
Lamps shall be operated for a minimum of 6,000 hours. Lamps shall maintain the following percentages of initial/0-hour lumen output for selected life claims at the completion of 6,000 of testing:
<table>
<tr><th>Maximum Life Claim (hours)</th><th>Minimum Lumen Maintenance at 6,000 Hours</th><th>Status After 6,000 Hour Test</th></tr>
<tr><td>10,000</td><td>80.7%</td><td rowspan="5">Testing completed</td></tr>
<tr><td>12,000</td><td>83.7%</td></tr>
<tr><td>15,000</td><td>86.7%</td></tr>
<tr><td>20,000</td><td>89.9%</td></tr>
<tr><td>25,000</td><td>91.8%</td></tr>
<tr><td>30,000</td><td>93.1%</td><td rowspan="5">Interim qualification; additional testing required.</td></tr>
<tr><td>35,000</td><td>94.1%</td></tr>
<tr><td>40,000</td><td>94.8%</td></tr>
<tr><td>45,000</td><td>95.4%</td></tr>
<tr><td>50,000</td><td>95.8%</td></tr>
</table>
For Optional Extended Lifetime Claims:
Lamps shall maintain the following percentages of initial/0-hour lumen output to claim life beyond 10,000 hours:
<table>
<tr><th>Maximum Life Claim (hours)</th><th>Minimum Test Period</th><th>Minimum Lumen Maintenance at End of Test</th></tr>
<tr><td>30,000</td><td>7,500</td><td>91.2%</td></tr>
<tr><td>35,000</td><td>8,750</td><td>91.5%</td></tr>
<tr><td>40,000</td><td>10,000</td><td>91.5%</td></tr>
<tr><td>45,000</td><td>11,250</td><td>91.5%</td></tr>
<tr><td>50,000</td><td>12,500</td><td>91.8%</td></tr>
</table>
For Optional Early Interim Qualification at 3,000 Hours: Lamps shall maintain the following percentages of initial/0-hour lumen output for selected life claims:
<table>
<tr><th>Maximum Life Claim (hours)</th><th>Minimum Lumen Maintenance at End of Test Period</th></tr>
<tr><td>10,000</td><td>89.9%</td></tr>
<tr><td>12,000</td><td>91.5%</td></tr>
<tr><td>15,000</td><td>93.1%</td></tr>
<tr><td>20,000</td><td>94.8%</td></tr>
<tr><td>25,000</td><td>95.8%</td></tr>
</table>
A lumen maintenance projection calculation using the applicable LM-80-08 test report for the employed LED package/module/array model (“device”) and the forward drive current applied to each device shall support a rated lumen maintenance life of ≥10,000 hours.
</td>
<td>
Measurement (lamps):
IES LM 79-08 ENERGY STAR Elevated Temperature Life Testing Procedure, Annex A

Measurement (devices):
IES LM-80-08

Projection:
IES TM-21-11
</td>
<td>
Lumen maintenance testing of lamps ≥ 5 watts shall be operated in accordance with the Elevated Temperature Test.

Interim and final testing shall be conducted on the same units.

The in situ TMP_{LED} temperature of the hottest device in the lamp shall be measured. The in situ temperature test report shall be submitted by an OSHA NRTL laboratory.

For dimmable/2-way/3-way products, measurements shall be made at the highest wattage setting listed for the model.

Lamp Sample Size: 10 lamps per model: 5 units tested base-up and 5 units tested base-down unless the manufacturer restricts specific use or position. If position is restricted, all units shall be tested in restricted position.

Device Sample Size for Optional Early Qualification: Minimum sample size of 20 units for LED packages, or 10 units for LED arrays or LED modules, for each T_S and drive current combination (refer to IES TM-21-11, section 4.2).

Lamp Sample Size for Optional Early Qualification: One lamp per model for in situ temperature measurements.

Passing Tests:
The average lumen maintenance of the ≥ 9 surviving lamps shall meet the 6,000 hour requirement for the designated life claim. The same units shall satisfy the 6,000 hour reliability requirements (next section).
For early qualification at 3,000 hours, the average lumen maintenance of the 10 lamps shall meet the 3,000 hour requirement for the designated life claim, shall meet the 3,000 hour reliability requirement (next section), and the lumen maintenance projection requirement shall be met. For full qualification, the same units shall satisfy the 6,000 hour reliability requirement (next section).
</td>
</tr>
</table>

Note: Historically, ENERGY STAR specifications have required between 6,000 and 10,000 hours of rated life for compact fluorescent lamps, and between 15,000 and 25,000 hours of rated lumen maintenance life for integrated LED lamps. EPA believes that aligning these requirements across both technologies will have a number of benefits for consumers.

First, consistent with a technology-neutral approach to specification development, EPA believes that setting one performance requirement will simplify consumer decision-making when deciding between ENERGY STAR qualified light bulbs. Second, CFL performance has steadily improved over the past decade to make a rated life of 10,000 hours readily achievable while maintaining quality and cost effectiveness. Third, while elongated life claims of 25,000 hours may have some appeal, cost is a consistent consumer detractor to the adoption of solid state lighting products. The additional cost involved in such designs often negates the appeal of the elongated life claims, and many partners have stated to EPA that the additional cost inhibits their ability to engage consumers with this new technology. The perception of LED bulbs as prohibitively expensive is further exaggerated when their price points are compared to CFLs on the same shelf of ENERGY STAR qualified light bulbs.

EPA has therefore proposed a lumen maintenance life requirement of 10,000 hours for LED lamps in the lumen maintenance requirements table above. As reflected in the following section, EPA is also proposing a 10,000 hour life requirement for compact fluorescent lamps. With this, the Agency believes that consumers will enjoy simplified purchasing decisions, and qualified LED lamps at more palatable price points. LED lamp manufacturers will be enabled to earn the ENERGY STAR using fewer LED subcomponents, potentially driven harder than they would be in lamps designed to last 25,000 hours. EPA seeks feedback on the concept and execution of a single unified requirement across technologies.

The lamp-level lumen maintenance percentages in the table above are in part carried forward from the Integral LED Lamps specification. While the IES TM-21 projection method was intended to replace the projection methods historically employed by the Program, it was developed to project LED package, array or module lumen maintenance, not product-level lumen maintenance. Among the options considered when developing this draft, EPA evaluated a scheme wherein lumen maintenance data would be gathered at the lamp level, with lumen maintenance life projections calculated using TM-21 with the collected data. The Agency is interested in continuing discussions about the potential applicability of TM-21 for product-level lumen maintenance projections.

Originally employed in the Compact Fluorescent Lamp specification and later referenced in the Integral LED Lamps spec, the Elevated Temperature Test has proven an effective means to evaluate the robustness of a lamp in the thermal environments created by luminaires. Experience has shown that despite information on product packaging and myriad consumer education efforts, consumers frequently install the wrong type of lamp (esp. CFLs) into fixtures for which the lamp was not designed. A common example of this misapplication is the installation of bare spiral CFLs – marked “not for recessed” – into recessed can fixtures. This misapplication, EPA believes, is feeding a misunderstanding that CFLs do not last as long as the claimed rated life. For this reason, the Agency is proposing to extend the Elevated Temperature Test to all lamps with an input power greater than or equal to 5 watts. With this, EPA believes consumers are less likely to have disappointing experiences with qualified lamps which often lead to generalizations that efficient lighting does not live up to long life claims.

Reliability Requirements: All Lamps

Lamp Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
Compact Fluorescent	Lamps shall have a rated life ≥ 10,000 hours. All tested units shall be operational at 40% of rated life or 6,000 hours, whichever comes first. If the testing intervals are coincident, ≥ 90% of the tested units shall be operational. ≥ 90% of the tested units shall be operational at 40% of rated life or 6,000 hours, whichever comes second. ≥ 50% of the tested units shall be operational at rated life.	Measurement: IES LM 65-10 (clauses 2,3,5,6) ENERGY STAR Elevated Temperature Life Testing Procedure, Annex A	Lamps ≥ 5 watts shall be operated in accordance with the Elevated Temperature Test. **Sample Size**: the same sample used for lumen maintenance testing shall be employed. **Passing Test**: all of the requirements shall be met.
Solid State	All tested units shall be operational at 3,000 hours. ≥ 90% of the tested units shall be operational at 6,000 hours.	Measurement: ENERGY STAR Elevated Temperature Life Testing Procedure, Annex A	Lamps ≥ 5 watts shall be operated in accordance with the Elevated Temperature Test. **Sample Size**: the same sample used for lumen maintenance testing shall be employed. **Passing Test**: all of the requirements shall be met.

Note: Above is EPA's proposal to harmonize requirements for reliability across technologies. The specification draft applies the term "life" wherever the referenced industry standards apply the term, but does not employ the term as a formal requirement (i.e. section of the specification) for lamp qualification because conventions established for solid state lighting do not establish a catastrophic life claim as is conventional for fluorescent.

Rapid Cycle Stress Test: All Lamps

Lamp Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
All Lamps	Lamp shall survive cycling once for every hour of rated life (minimum of 10,000 cycles). Each cycle shall be 5 minutes on, 5 minutes off.	Measurement: IES LM-65-10 (clauses 2,3,5,6) ANSI C78.5-2003	For dimmable/2-way/3-way products, measurements shall be made at the highest wattage setting listed for the model. **Sample Size**: 10 lamps per model: 5 units tested base-up and 5 units tested base-down unless the manufacturer restricts specific use or position. If position is restricted, all units shall be tested in restricted position. The sample shall be a unique sample for this test. **Passing Test**: ≥ 9 units shall survive the minimum number of cycles.

Note: The CFL Third Party Testing and Verification Program has shown that rapid cycling is the most common reason for early failures in ENERGY STAR qualified compact fluorescent lamps. As part of EPA's effort to ensure that consumers find qualified lamps to be robust replacements for incandescent lamps, the Agency is proposing to increase Rapid Cycle Stress Testing requirements, from one cycle per two hours of rated life, currently found in both of the existing specifications, to one cycle per hour of rated life.

In addition, the proposed sample size for this test has been increased from 6 units to 10 units, maintaining the allowable single unit failure. This proposed change would effectively apply the existing requirement in the Integral LED Lamps specification to all qualified lamps.

Finally, EPA proposes to maintain the 5 minutes on / 5 minutes off cycling times detailed in the CFL specification. The shorter 2 minutes on / 2 minutes off cycling times found in the Integral LED Lamps specification produce lower ΔT values; these reduced thermal variations may not adequately stress lamps under test.

EPA believes these proposed changes will help to reduce instances of premature lamp failures in qualified lamps.

Luminous Intensity Distribution Requirements

Luminous Intensity Distribution Requirements (Exemption: Bare CFLs and Decorative Lamps)

Lamp Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
Omnidirectional	*TBD*	Measurement: *TBD*	**Sample Size**: *TBD* **Passing Test**: *TBD*
Directional	*TBD*	Measurement: *TBD*	**Sample Size**: *TBD* **Passing Test**: *TBD*

Center Beam Candle Power Requirement: PAR Lamps (Exemption: All Other Lamps)

Lamp Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
PAR	*TBD*	Measurement: *TBD*	**Sample Size**: *TBD* **Passing Test**: *TBD*

Note: EPA is evaluating the luminous intensity distribution requirements in the current specifications and will issue proposed requirements in draft 2. The Agency has determined that application of intensity distribution requirements will not be necessary for bare CFLs, and decorative lamps.

Electrical Performance Requirements

Electrical Safety Requirements: All Lamps

Lamp Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
All Lamps	Lamp shall comply with ANSI/UL 1993-2009.	Measurement: ANSI/UL 1993-2009	**Sample Size**: 1 unit per model. **Passing Test**: unit shall meet the requirement.

Note: The safety requirement has been carried forward from the existing specifications.

Power Factor Requirements (Exemption: Lamps ≤ 5 Watts)

Lamp Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
All Lamps	Lamp shall have a power factor ≥ 0.7.	Measurement (fluorescent): ANSI C82.2-2002 Measurement (solid state): ANSI C82.77-2002 sections 6 and 7	Tested units shall be operated at rated voltage. For dimmable/2-way/3-way products, measurements shall be made at the highest wattage setting listed for the model. **Sample Size**: 10 units per model: 5 units tested base-up and 5 units tested base-down unless the manufacturer restricts specific use or position. If position is restricted, all units shall be tested in restricted position. **Passing Test**: Average of units tested shall meet the requirement.

Note: Partner and stakeholder feedback from the specification framework indicated an interest in moving towards higher minimum power factor requirements. For solid state lamps there is general support for maintaining the existing 0.7 minimum. For compact fluorescent lamps, while some comments acknowledged the potential for increased form factors and design complexity, interest was also expressed for alignment of requirements across technologies. Some comments supported a move towards a 0.9 minimum power factor, though support was not broad. EPA seeks partner and stakeholder feedback on the feasibility of moving towards this increased requirement for all qualified lamps.

Operating Frequency Requirements: All Lamps

Lamp Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
Compact Fluorescent and HID	Lamp shall have an operating frequency within 20 to 33kHz, or ≥ 40kHz.	Measurement: *TBD*	**Sample Size**: 1 unit per model. **Passing Test**: Unit shall meet the requirement.
Solid State	*TBD*		

Note: Operating frequency requirements and methods of measurement will be refined in a subsequent draft. EPA is working with the IEEE PAR 1789 working group, IES, and the Alliance for Solid-State Illumination Systems and Technologies (ASSIST) to identify appropriate performance requirements and methods of measurement to ensure that qualified lamps do not produce visible flicker, stroboscopic effects, or adverse health effects.

Start Time Requirements: All Lamps

Lamp Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
All Lamps	Lamp shall remain continuously illuminated within 0.5 second of application of electrical power.	Measurement: *TBD*	For dimmable/2-way/3-way products, measurements shall be made at the highest wattage setting listed for the model. **Sample Size**: 10 units per model: 5 units tested base-up and 5 units tested base-down unless the manufacturer restricts specific use or position. If position is restricted, all units shall be tested in restricted position. **Passing Test**: Average of units tested shall meet the requirement.

Note: Comments received on the specification framework indicated a general interest in moving towards shorter start times if the change would be feasible. An analysis of currently qualified lamps found that 89% were qualified with a start time less than half a second. Among dimmable and 3-way lamps, 74% were qualified with values meeting this requirement. EPA seeks feedback on the proposed improvement to the start time requirement.

To develop a method of measurement for start time, EPA is working with the CFL Technical and Research Working Group, established with the introduction of the CFL V4.0 specification. The draft method will be added to a subsequent draft of this specification for broad stakeholder review and comment.

Run-Up Time Requirements

Lamp Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
Covered Compact Fluorescent	Lamp shall achieve full stabilized light output in ≤ 90 seconds.	Measurement (fluorescent): ANSI C78.5-2003 Measurement (solid state): *TBD* Reference: ANSI C78.375-1997	For dimmable/2-way/3-way products, measurements shall be made at the highest wattage setting listed for the model. For fluorescent lamps, measurements shall be taken at the end of 100 hours of seasoning according to ANSI C78.375-1997 section 8.4. **Sample Size**: 10 units per model: 5 units tested base-up and 5 units tested base-down unless the manufacturer restricts specific use or position. If position is restricted, all units shall be tested in restricted position. **Passing Test**: Average of units tested shall meet the requirement.
All Other Lamps	Lamp shall achieve: ≥ 50% of stabilized light output in ≤ 30 seconds; and, ≥ 80% of stabilized light output in ≤ 45 seconds; and, full stabilized light output in ≤ 60 seconds.		

Note: A common consumer complaint about compact fluorescent lamps is that they are not bright enough. EPA believes this is not due to the light output of the lamps, but instead due to the slow warm up times relative to the incandescent lamps they replace (they are not bright enough when first energized). To improve upon the requirements in the existing specifications the proposed values have been adopted from the Super Lamps specification, developed by the California electric utilities.

An analysis of currently qualified CFLs found that 70% of bare lamps were qualified with a run up time of 45 seconds, and 92% were qualified with a run up time of 60 seconds. For qualified covered CFLs, 63% were qualified with a run up time of 90 seconds.

The CFL Technical and Research Working Group is also examining the effectiveness of the current approach to testing and evaluation of run up time. Results of these investigations – most pertinent to compact fluorescent lamps – will be included in a subsequent draft for stakeholder review and comment.

Dimming Requirements: All Lamps Marketed as Dimmable

Lamp Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
All Lamps Marketed As Dimmable	*TBD*	Measurement: *TBD*	**Sample Size**: *TBD* **Passing Test**: *TBD*

Note: EPA is working with industry stakeholders and the Lighting Research Center (LRC) to develop a definition, method of measurement, and compatibility metric for dimmable lamps. The Agency seeks to establish a definition of dimming which emphasizes quality, ensuring that qualified dimmable lamps dim down to levels meeting consumer expectations, are compatible with the majority of the installed base of dimmers, and are free from noise and flicker, among other criteria.

Important ongoing and completed work by ANSI, ASSIST, LRC, NEMA, Pacific Northwest National Laboratory, and others will be included in this effort, the results of which will be entered into a subsequent draft for partner and stakeholder comment.

Transient Protection Requirements: All Lamps

Lamp Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
All Lamps	Lamp shall survive 7 strikes of a 100 kHz ring wave, 2.5 kV level, for both common mode and differential mode.	Measurement: ANSI/IEEE C62.41.2-2002, Category A operation.	**Sample Size**: 5 units per model. Units shall be tested base-up unless the manufacturer restricts specific use or position. If position is restricted, units shall be tested in restricted position. The sample shall be a unique sample for this test. **Passing Test**: All units shall be fully operational at the completion of testing.

Note: The above is an update of the requirement appearing in the existing specifications.

Electromagnetic and Radio Frequency Interference Requirements: All Lamps

Lamp Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
All Lamps	Lamps shall meet applicable FCC requirements for consumer or non-consumer use.	Measurement: Code of Federal Regulations: Title 47 Part 2 Title 47 Part 15 Title 47 Part 18	**Sample Size**: 1 unit per model. **Passing Test**: Unit shall meet the applicable requirements.

Note: The above references to federal regulations are carried forward from the existing specifications.

Noise Requirements

Lamp Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
All Lamps	*TBD*	Method of Measurement: *TBD*	*TBD*

Note: Historically ENERGY STAR lighting specifications have included requirements for noise/sound ratings. EPA has observed that some qualified lamps do emit audible noise when operating, including those operating in keyless sockets without resonating fixture components. The Agency will explore options for this new specification, to be included in a subsequent draft, with the intent of minimizing testing burden.

Lamp Toxics Reduction Requirements: All Lamps

Lamp Type	ENERGY STAR Requirements	Method of Compliance
All Lamps	Lamps ≤ 23.0 watts shall contain ≤ 2.5 milligrams (mg) mercury per lamp Lamps > 23.0 watts shall contain ≤ 3.0 milligrams (mg) mercury per lamp Lamps shall contain restricted levels of the following materials, where the maximum concentration values allowed by weight in homogeneous materials are: • lead (0.1%) • cadmium (0.01%) • hexavalent chromium (0.1%) • polybrominated biphenyls (PBB) (0.1%) • polybrominated diphenyl ethers (PBDE) (0.1%)	For purposes of third-party certification, lamp toxics documentation shall not be reviewed when products are initially certified or during verification testing. Instead, consistent with EU RoHS requirements, manufacturers shall maintain documentation on file to demonstrate that certified products meet these requirements. EPA reserves the right to request this documentation at any time. Partner may rely on component suppliers to provide certification or declaration documents to show that homogenous materials used in lamps comply with the requirement. Alternatively, Partner may have 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.

Note: The above requirements for mercury content are based upon analyses of what is technically feasible today for compact fluorescent lamps. Beyond the mercury requirements, in the interest of transparency the relevant toxics reduction requirements have been printed in the specification draft, rather than a reference to

Dimensional Requirements

Lamp Base Dimensions and Tolerances: All Lamps

Lamp Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
All Lamps	Lamp base shall fully comply with ANSI C81.61-2009.	Reference: ANSI C81.61-2009	*TBD*

Lamp Shape Dimensions and Tolerances: All Lamps Claiming Shape and/or Wattage Equivalency with Standard or Halogen Incandescent

Lamp Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
All Lamps	Lamp shape shall fully comply with relevant ANSI minimum overall length (min OAL), maximum overall length (MOL) and maximum lamp diameter values if claims of equivalency with a standard or halogen incandescent lamp are made on any of the following: • lamp base • lamp packaging • product literature (printed or electronic) • point-of-purchase materials (printed or electronic)	References: ANSI C78.20-2003 ANSI C78.21-2003 ANSI C78.23-1995 (R2003)	*TBD*

Note: EPA is concerned with ensuring that qualified lamps are able to fit into the fixtures in which consumers will install them, and notes that many of the ANSI dimensional limits articulated above are considerably larger than the typical incandescent forms found on the market today. Partners are encouraged to compare their lamp designs to the ANSI dimensional limits.

As indicated in the scope section, for lamps not fitting within the relevant ANSI limits, the Agency is evaluating continuation of the non-standard requirements outlined in V1.4 of the Integral LED Lamps specification, and is interested in stakeholder feedback on a sensible approach to handling such lamps.

Lamp Labeling & Packaging Requirements

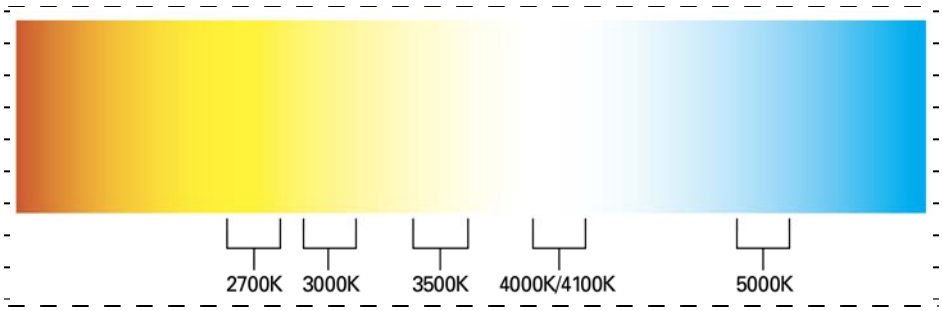
Lamp Labeling Requirements: All Lamps

Lamp Type	ENERGY STAR Requirement
All Lamps	Each of the following shall be printed on the lamp: • lamp manufacturer or brand name • phone number for questions or complaint resolution • lamp model number • lamp input power in watts including "watts" or "W" • lamp rated lumen output including "lumens" or "lm" • lamp nominal correlated color temperature including "Kelvin" or "K" • "dimmable", "non-dimmable", "not dimmable", "not for dimming" or the like • "Do not use in totally enclosed fixtures" or the like, as applicable • "Do not use in recessed fixtures" or the like, as applicable • "contains mercury" (for compact fluorescent lamps) • electrical safety marking

Lamp Packaging Requirements: All Lamps

Note: Products to be sold exclusively outside of the United States shall have packaging that complies with the legal requirements of the country(ies) into which they will be sold; such packaging need not comply with U.S. federal labeling requirements.

Criteria	ENERGY STAR Requirement
Product Packaging Language	In English with or without additional languages.
Model Number	Packaging shall include model number. The model number shall be different from any earlier, non-qualified versions of the product already introduced into the market.
Federal Trade Commission (FTC) Lighting Facts Label	Lamp packaging for ENERGY STAR qualified lamps sold in the United States shall comply with the labeling requirements of the U.S. Federal Trade Commission.
Incandescent Lamp Equivalency Claims	Lamp packaging shall display on the front panel equivalent incandescent target wattage based on its total measured light output and equivalency as outlined in the Light Output Requirements section of this specification. PAR lamp packaging shall display (*TBD)*.
Warranty	Lamps shall be backed by a minimum 2 year warranty, based on a usage of no less than 3 hours a day. Lamp packaging shall state "Warranty" or "Limited Warranty" terms and provide a phone number or website address for consumer complaint resolution. In addition, the complete written warranty shall be included on exterior packaging or within the lamp packaging.
Mercury Content Labeling	Lamp packaging shall state "Lamp contains mercury". The FTC's Lighting Facts label for lamps containing mercury, if used, shall satisfy this requirement. Packaging for lamps not within the scope of FTC labeling requirements shall include "epa.gov/cfl".
Dimmable Lamps	Lamp packaging shall display on the front panel an indication of lamp's dimming capability, e.g. "dimmable" or "non-dimmable". Dimmable lamp packaging shall indicate, on any panel except the bottom panel, that lamp may not be compatible with all dimmers, and shall reference a website address providing regularly updated dimmer compatibility information for the lamp model.
Incompatibility with Controls	Lamp packaging for lamps not designed for operation with photosensors, motion sensors or timing devices shall indicate, on any panel except the bottom panel, in a minimum of 8 point type, "non-dimmable", "not compatible with photosensors", "not compatible with timers", "not compatible with motion sensors", "not compatible with photosensors, motion sensors, or timers", or the like.
Incompatible Applications	Lamp packaging exterior shall state specific applications that would compromise the performance of the lamp. This includes installations which would result in a lamp's noncompliance with the ENERGY STAR specification performance requirements. Examples include totally enclosed fixtures, insulated ceiling air-tight (ICAT) recessed downlights, damp locations, and any other application restrictions.
Restricted Position	Lamp packaging shall indicated restricted operating position (e.g. base up, base down) if applicable.
Maximum/Minimum Starting Temperature	Lamp shall have a minimum ambient operating temperature of 0°F (-18°C) or below. Package shall state the maximum and minimum recommended starting temperatures or geographical zone of use and any other conditions required for reliable starting.

Color Spectrum Educational Tool (Exemption: commercial bulk packaging)	Lamp packaging front panel shall include the color spectrum educational tool, available for free download without royalties in high resolution TIFF file format at www.energystar.gov/lamps. A visual indicator of the partner's choosing (e.g. an arrow) shall be placed adjacent to or overlaid on the spectrum, indicating the lamp's nominal CCT value. The visual indicator shall be placed within the portion of the spectrum applicable to the lamp indicated by the brackets and CCT values included in the spectrum file. The brackets and values shall be employed for indicator placement purposes and then removed (not printed). The spectrum may be adjusted as follows: • may be cropped along the dimension perpendicular to the red-blue gradient • may be cropped to be incorporated into a shape so long as the continuous red to blue gradient is maintained • may be scaled, i.e. adjusted proportionally in both horizontal and vertical dimensions, to a total length from red to blue no less than half the shortest dimension (i.e. length, width, height) of the lamp packaging; brackets shall also be scaled, prior to removal • may be rotated The term "warm white" shall be printed at the red end of the spectrum, adjacent or overlaid, in a typeface and type size of the partner's choosing. The term "cool white" shall be printed at the blue end of the spectrum with the same treatment. The dimension perpendicular to the red-blue gradient shall not be diminished by the above adjustments to less than the height of 8 point font at any point along the gradient. The spectrum may not be printed in gray scale, or horizontally cropped (removing a portion of the gradient), or horizontally compressed.  **Figure 1**: Reprint of the color spectrum educational tool.
Nominal Color Temperature Name	Lamp packaging front panel shall include the term "warm white", "neutral white" or "cool white" in no less than 8 point type as defined below. Warm White (2700K) Neutral White (3000-3500K) Cool White (4100K-5000K)

Note: During the development of this specification draft, EPA reassessed the effectiveness of the existing specifications' lamp labeling and packaging requirements. The proposal above includes much of the existing requirements, with additional items for stakeholder consideration.

EPA believes certain information must be printed on the lamp itself to inform the consumer regarding the selection and proper application of qualified lamps, and to assist with questions or concerns. The lamp labeling proposal, much of which has been successfully applied with qualified GU24 lamps, has been entered for stakeholder review and comment.

The Agency believes that despite more than a decade of extensive efforts by manufacturers, retailers and utilities, selecting the desired correlated color temperature (CCT) remains a challenge for many consumers, and a point of frustration that for many results in the wholesale dismissal of energy efficient lighting. As an example, it is still an all-too-often occurrence that consumers, seeking to replace incandescent lamps with an efficient lamp of equivalent appearance, mistakenly select cool white CFLs, and conclude that CFLs are "too blue" or that the light is "too harsh". EPA has observed the same situation happening in numerous articles in the press, perpetuating the misunderstandings. The reasons for this are understandable, as standard incandescent lamps do not offer the range of color temperatures afforded by fluorescent and solid state lighting. It is for these reasons that EPA is proposing the above front-of-package requirement for conveying first that a range of color temperatures exists, and second the color temperature of the product within that range. In discussions with retail partners, the Agency has come to understand that while point-of-purchase literature and displays can be effective, they are often ignored – but messaging on the front of packaging is not. The Agency believes that with consistent application of a standard color gradient across all qualified lamps, this challenge can be overcome, leading to more widespread adoption of qualified lighting. Understanding that product packaging is a tool used by manufacturers to convey identity, EPA has proposed requirements which allow flexibility in the application of the gradient. The Agency would like to engage stakeholders in a dialog about how best to implement a common system for conveying correlated color temperature, and seeks feedback on the above proposal. Examples of usage of the color spectrum educational tool will be shown at the November 30th stakeholder round table.

Annex A: ENERGY STAR Elevated Temperature Testing Procedure

Note: For accreditation purposes, draft 2 will include an annexed version of the Elevated Temperature Testing Procedure in the existing specifications, including all versions currently employed for compact fluorescent and integrated LED lamps.

END OF SPECIFICATION