



ENERGY STAR® Program Requirements for Compact Fluorescent Lamps (CFLs)

Partner Commitments

Following are the terms of the ENERGY STAR Partnership Agreement as it pertains to the manufacture and labeling of ENERGY STAR qualified products. The ENERGY STAR Partner must adhere to the following partner commitments:

Qualifying Products

1. Comply with current ENERGY STAR Eligibility Criteria, which define performance requirements and test procedures for CFLs. A list of eligible products and their corresponding Eligibility Criteria can be found at www.energystar.gov/specifications.
2. **Prior to associating the ENERGY STAR name or mark with any product**, obtain written certification of ENERGY STAR qualification from a Certification Body recognized by EPA for CFLs. As part of this certification process, products must be tested in a laboratory recognized by EPA to perform CFL testing. A list of EPA-recognized laboratories and Certification Bodies can be found at www.energystar.gov/testingandverification.

Using the ENERGY STAR Name and Marks

3. Comply with current ENERGY STAR Identity Guidelines, which define how the ENERGY STAR name and marks may be used. Partner is responsible for adhering to these guidelines and ensuring that its authorized representatives, such as advertising agencies, dealers, and distributors, are also in compliance. The ENERGY STAR Identity Guidelines are available at www.energystar.gov/logouse.
4. Use the ENERGY STAR name and marks only in association with qualified products. Partner may not refer to itself as an ENERGY STAR Partner unless at least one product is qualified and offered for sale in the U.S. and/or ENERGY STAR partner countries.
5. Provide clear and consistent labeling of ENERGY STAR qualified CFLs.
 - 5.1. The ENERGY STAR mark must be clearly displayed on the front or primary display panel of the product packaging, in product literature (i.e., user manuals, spec sheets, etc.) and on the manufacturer's Internet site where information about ENERGY STAR qualified models is displayed.

Verifying Ongoing Product Qualification

6. Participate in third-party verification testing through a Certification Body recognized by EPA for CFLs, providing full cooperation and timely responses. EPA/DOE may also, at its discretion, conduct tests on products that are referred to as ENERGY STAR qualified. These products may be obtained on the open market, or voluntarily supplied by Partner at the government's request.

Note: It is EPA's intention that until further notice, this commitment will be satisfied by participation in the existing CFL Third Party Testing and Verification Program mentioned in the CFL specification.

7. Notify ENERGY STAR CFL Certification Body recognized by EPA for CFLs, within 30 days, if the designated suppliers of any private labeled CFLs change to a new supplier.

Providing Information to EPA

8. Provide unit shipment data or other market indicators to EPA annually to assist with creation of ENERGY STAR market penetration estimates, as follows:
 - 8.1. Partner must submit the total number of ENERGY STAR qualified CFLs shipped in the calendar year or an equivalent measurement as agreed to in advance by EPA and Partner. Partner shall exclude shipments to organizations that rebrand and resell the shipments (unaffiliated private labelers).
 - 8.2. Partner must provide unit shipment data segmented by meaningful product characteristics (e.g., type, capacity, presence of additional functions) as prescribed by EPA.
 - 8.3. Partner must submit unit shipment data for each calendar year to EPA or an EPA-authorized third party, preferably in electronic format, no later than March 1 of the following year.

Submitted unit shipment data will be used by EPA only for program evaluation purposes and will be closely controlled. If requested under the Freedom of Information Act (FOIA), EPA will argue that the data is exempt. Any information used will be masked by EPA so as to protect the confidentiality of the Partner.
9. Report to EPA any attempts by recognized laboratories or Certification Bodies (CBs) to influence testing or certification results or to engage in discriminatory practices.
10. Notify EPA of a change in the designated responsible party or contacts within 30 days using the My ENERGY STAR Account tool (MESA) available at www.energystar.gov/mesa.

Performance for Special Distinction

In order to receive additional recognition and/or support from EPA for its efforts within the Partnership, the ENERGY STAR Partner may consider the following voluntary measures, and should keep EPA informed on the progress of these efforts:

- Provide quarterly, written updates to EPA as to the efforts undertaken by Partner to increase availability of ENERGY STAR qualified products, and to promote awareness of ENERGY STAR and its message.
- Consider energy efficiency improvements in company facilities and pursue benchmarking buildings through the ENERGY STAR Buildings program.
- Purchase ENERGY STAR qualified products. Revise the company purchasing or procurement specifications to include ENERGY STAR. Provide procurement officials' contact information to EPA for periodic updates and coordination. Circulate general ENERGY STAR qualified product information to employees for use when purchasing products for their homes.
- Feature the ENERGY STAR mark(s) on Partner website and other promotional materials. If information concerning ENERGY STAR is provided on the Partner website as specified by the ENERGY STAR Web Linking Policy (available in the Partner Resources section of the ENERGY STAR website), EPA may provide links where appropriate to the Partner website.
- Ensure the power management feature is enabled on all ENERGY STAR qualified displays and computers in use in company facilities, particularly upon installation and after service is performed.
- Provide general information about the ENERGY STAR program to employees whose jobs are relevant to the development, marketing, sales, and service of current ENERGY STAR qualified products.
- Provide a simple plan to EPA outlining specific measures Partner plans to undertake beyond the program requirements listed above. By doing so, EPA may be able to coordinate, and communicate Partner's activities, provide an EPA representative, or include news about the event in the ENERGY STAR newsletter, on the ENERGY STAR website, etc. The plan may be as simple as providing a list of planned activities or milestones of which Partner would like EPA to be aware. For example, activities may include: (1) increasing the availability of ENERGY STAR qualified products by

converting the entire product line within two years to meet ENERGY STAR guidelines; (2) demonstrating the economic and environmental benefits of energy efficiency through special in-store displays twice a year; (3) providing information to users (via the website and user's manual) about energy-saving features and operating characteristics of ENERGY STAR qualified products; and (4) building awareness of the ENERGY STAR Partnership and brand identity by collaborating with EPA on one print advertorial and one live press event.

- Join EPA's SmartWay Transport Partnership to improve the environmental performance of the company's shipping operations. The SmartWay Transport Partnership works with freight carriers, shippers, and other stakeholders in the goods movement industry to reduce fuel consumption, greenhouse gases, and air pollution. For more information on SmartWay, visit www.epa.gov/smartway.
- Join EPA's Green Power Partnership. EPA's Green Power Partnership encourages organizations to buy green power as a way to reduce the environmental impacts associated with traditional fossil fuel-based electricity use. The partnership includes a diverse set of organizations including Fortune 500 companies, small and medium businesses, government institutions as well as a growing number of colleges and universities. For more information on Green Power, visit www.epa.gov/greenpower.



ENERGY STAR® Program Requirements for CFLs
ENERGY STAR Eligibility Criteria
Energy-Efficiency Criteria – Version 4.3

Below are the product criteria for ENERGY STAR qualified Compact Fluorescent Lamps (CFLs) - Version 4.3. A product must meet all of the criteria in order to be qualified as ENERGY STAR.

- 1) **SCOPE:** This ENERGY STAR criteria for CFLs covers the requirements for self-ballasted CFLs and lamp systems, including:
- A. Medium (Edison) or candelabra screw base compact fluorescent lamps with integral electronic ballasts.
 - B. Circline lamps with a maximum diameter of nine inches and square lamps, with a maximum side length of eight inches with medium screw with electronic ballasts that are tested and packaged with the lamp.
 - C. Medium (Edison) or candelabra screw base fluorescent lamps with integral electronic ballasts, which have a translucent cover over the bare fluorescent tube. The cover may be globe, bullet, pear, torpedo, candle, or any other shape.
 - D. Medium (Edison) screw base compact fluorescent lamps with integral electronic ballasts, which have a reflector that may be open or enclosed. The lamp shall be primarily intended to replace wide beam incandescent reflector lamps.
 - E. GU24-based compact fluorescent lamps with integral electronic ballasts. These lamps may be bare, covered, reflector or dimmable lamps.

The vision of this ENERGY STAR program is the replacement, by consumers and businesses, of incandescent products with energy-efficient compact fluorescent lighting.

2) **DEFINITIONS:**

- A. **A2LA:** American Association for Laboratory Accreditation.
- B. **Amalgam:** An alloy of mercury and other metals normally used to control the mercury vapor pressure in the discharge. The alloy absorbs or releases mercury in response to a change in its temperature.
- C. **ANSI:** American National Standards Institute.
- D. **Average Rated Lamp Life:** The length of time declared by the manufacturer at which 50% of any large number of lamps reaches the end of their individual lives.
- E. **Candelabra Screw Base Compact Fluorescent Lamp:** A self-ballasted compact fluorescent lamp, with a screw base, identified with the prefix E-12.
- F. **CIE:** Commission Internationale de l'Eclairage
- G. **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)
- H. **Correlated Color Temperature (CCT):** The color appearance, or actual color of the lamp is called the color temperature and is defined in terms of the spectral tri-stimulus values (color coordinates) according to the recommendations of IESNA LM-16. For color coordinates near the Black Body loci, the correlated color temperature, measured in Kelvin (K), is used.
- I. **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 GU24 base type.
- J. **ICAT Fixture:** Insulated Ceiling Air Tight fixture.
- K. **IESNA:** Illuminating Engineering Society of North America.
- L. **Kelvin:** In lighting, Kelvin is the unit of measure for Color Temperature used to indicate the overall color of the light produced from a source.
- M. **Initial Performance Values:** The photometric and electrical characteristics at the end of the 100-hour aging period.
- N. **Lamp color:** The color characteristics of a lamp as defined by the color appearance and the color rendition.
- O. **Lumen:** A measure of the luminous flux or quantity of light emitted by a source.
- P. **Lumen Maintenance:** The luminous flux or lumen output at a given time in the life of the lamp and expressed as a percentage of the initial luminous flux.
- Q. **Luminous Efficacy:** The light output (lumens) of a light source divided by the total power input (watts) to that source. It is expressed in lumens per watt.
- R. **MacAdam Color Ellipse:** An elliptical region of chromaticity coordinates that is defined using a centroid, a tilt angle relative to a horizontal axis, and a defined level of variance. Such a region defines what chromaticity coordinates can be acceptably associated with a target Correlated Color Temperature. For this criteria, standardized color ellipses are defined using centroids based upon objective chromaticities (x,y) and tilt angles (è) specified in Table 1 and 2 of ANSI C78.376-2001, and a defined variance of seven steps.
- S. **Medium (Edison) Screw Base Compact Fluorescent Lamp:** A self-ballasted compact fluorescent lamp unit, with an Edison screw base, usually identified with the prefix E-26 as referenced in the American National Standard for Electric Lamp Bases, ANSI/IEC C81.61-2003.
- T. **NVLAP:** National Voluntary Laboratory Accreditation Program.
- U. **Outdoor Reflector:** A reflector CFL that is primarily marketed for use in outdoor applications and is safety

listed for wet locations.

- V. **OSHA:** Occupational Safety & Health Administration.
 - W. **Power Factor:** The active power divided by the apparent power (i.e., product of the rms input voltage and rms input current of a ballast). Power factors can range from 0 to 1.0, with 1.0 being ideal.
 - X. **Private Labeled CFL:** An ENERGY STAR qualified CFL lamp purchased and marketed under the brand of a PARTNER other than the manufacturer of the product.
 - Y. **Rated Luminous Flux or Lumen Output:** Initial lumen rating (based on the average 100-hour lumen output measurement), which is specified by the manufacturer.
 - Z. **Rated Supply Frequency:** The frequency marked on the lamp.
 - AA. **Rated Voltage:** The voltage marked on the lamp.
 - BB. **Rated Wattage:** The wattage marked on the lamp.
 - CC. **Retired or Discontinued Product:** A product that was properly qualified as ENERGY STAR, but is no longer manufactured (as of the date on the list), but may still be available in the market.
 - DD. **Run-up Time:** The time needed after switching on the supply for the lamp to reach 80.0% of its stabilized luminous flux.
 - EE. **Self-ballasted Compact Fluorescent Lamp (CFL):** A compact fluorescent lamp unit that incorporates, permanently enclosed, all elements that are necessary for the starting and stable operation of the lamp, and which does not include any replaceable or interchangeable parts.
 - FF. **Starting Temperature:** The minimum and maximum temperatures at which the lamp will reliably start.
 - GG. **Starting Time:** The time needed after switching on for the lamp to start fully and remain lighted.
 - HH. **UL:** Underwriters Laboratories.
 - II. **Watt:** Unit used to measure electric power consumed by a lamp or any electrical device.
- 3) **METHODS OF MEASUREMENT OR REFERENCE DOCUMENTS:** ENERGY STAR qualified compact fluorescent lamps and lamp systems shall comply with the relevant clauses of the following standards, unless the requirements of the ENERGY STAR CFL criteria are more restrictive:

ANSI C78.376-2001	<i>Specifications for the Chromaticity of Fluorescent Lamps</i>
ANSI C78.5 – 1997	<i>Specifications for Performance of Self-Ballasted Compacted Fluorescent Lamps</i>
ANSI/IEC C78.901– 2005	<i>American National Standard for Electric Lamps – Single Base Fluorescent Lamps – Dimensional and Electrical Characteristics</i>
ANSI/IEEE C62.41 – 1991 (01-May-1991)	<i>Surge Voltages in Low-Voltage AC Power Circuits, Recommended Practice for</i>
ANSI/IEC C81.61-2003	<i>American National Standard for Electric Lamp Bases</i>
UL 1598 – 2004	<i>UL Standard for Safety for Luminaires</i>
UL 1993 – 1993	<i>Standard for Self-Ballasted Lamps and Lamp Adapters</i>
CIE Publication No. 13.3 – 1995	<i>Method of Measuring and Specifying Color Rendering of Light Sources</i>
CIE Publication No. 18.2 – 1983	<i>The Basis of Physical Photometry</i>
IES LM-9 – 1999	<i>Electric & Photometric Measurement of Fluorescent Lamps</i>
IESNA LM-16	<i>Practical Guide to Colorimetry of Light Sources</i>
IESNA LM-28 – 1989	<i>Guide for the Selection, Care, and Use of Electrical Instruments in the Photometric Laboratory</i>
IESNA LM-40 – 2001	<i>Approved Method for Life Performance Testing of Fluorescent Lamps</i>
IESNA LM-41 – 1998	<i>Approved Method for Photometric Testing of Indoor Fluorescent Luminaires</i>
IESNA LM-54 – 1999	<i>IESNA Guide to Lamp Seasoning</i>
IESNA LM-65– 2001	<i>Life Testing of Single-ended Compact Fluorescent Lamps</i>
IESNA LM-66– 2000	<i>Electrical and Photometric Measurements of Single Ended Compact Fluorescent Lamps</i>

Performance Characteristics	Test Procedure	
	Compact Fluorescent (see notes below)	Circle design
Lumen Output and Efficacy	IESNA – LM 66-00	IESNA – LM9
Lumen Maintenance and Life	IESNA – LM65 & ANSI – C78.5	IES – LM40
Color Rendering Index	CIE Publication 13.3 - 1995	
Transient Protection	ANSI/IEEE C62.41 (01-May-1991), Category A, 7 strikes	
Electromagnetic Interference	FCC 47 CFR including Part 2 (Equipment Authorization) and Part 18 (Technical Standards and Emission Limits) for consumer RF Lighting Equipment limits	

Notes:

Testing with reference ballast shall not apply to integrally ballasted compact fluorescent lamps.

These lamps shall be measured with their integral ballasts at 120 volts and 60 Hz.

ENERGY STAR qualified compact fluorescent lamps and lamp systems must comply as applicable with the labeling requirements of the U.S. Federal Trade Commission (16 CFR Part 305.1-.19; more information can be found on this web site:

<http://www.ftc.gov/bcp/edu/pubs/business/energy/bus26.shtm>). The Electromagnetic Interference (EMI) requirements of the U.S.

Federal Communications Commission located under 47 CFR including Part 2 (Equipment Authorization) and Part 18 (Technical Standards and Emission Limits) for consumer Radio Frequency (RF) Lighting Equipment.

4A) BARE, COVERED, GLOBE, AND OUTDOOR REFLECTOR CFLS: PHOTOMETRIC TESTING REQUIREMENTS:

Criteria Item	ENERGY STAR Requirements			Sample Size / Specific Requirements
Lamp Power (Watts) & Configuration¹	Minimum Efficacy Requirements: Lumens/watt (Based on initial lumen data ²)			10 units per model: 5 base-up / 5 base-down unless the manufacturer restricts specific use or position. If position restricted, all 10 samples shall be tested in restricted position. For dimmable/2-way/3-way products, measurements must be made at the highest wattage setting listed for the model.
	Medium screw-base	Candelabra screw-base	GU24-base	
Bare lamp (fixed light output)				
Lamp power < 10W	50	50	50	
10W ≤ Lamp power < 15W	55	55	50	
15W ≤ Lamp power < 30W	65	N/A	50	
Lamp power ≥ 30W	65	N/A	60	
Bare lamp (Dimmable/2-way/3-way)				
Lamp power < 15W	50	50	40	
Lamp power ≥ 15W	60	N/A	40	
Covered lamp (no reflector)				
Lamp power ≤ 7W	40	35	40	
7W < Lamp power < 15W	45	45	40	
15W ≤ lamp power < 25W	50	N/A	40	
Lamp power ≥ 25W	60	N/A	40	
Outdoor reflectors				
Lamp power < 20	33	N/A	40	
Lamp power ≥ 20	40	N/A	40	
Color Rendering Index (CRI)	Average of the 10 samples tested must be greater than 80, and no more than 3 individual samples can have a CRI less than 77.			
Correlated Color Temperature (CCT)	PARTNER must identify one of the following designated correlated color temperatures to market their product as: 2700K, 3000K, 3500K, 4100K, 5000K, or 6500K, and at least 9 out of the 10 samples tested must fall within a 7-step ANSI MacAdam ellipse for that color temperature at the 100-hour lumen measurement. Please refer to Section 11 for CCT quality assurance requirements and Appendix C/ANSI Color Ellipses.			
1,000-hour Lumen Maintenance	Average lumen output measurement of the 10 lamps tested must be greater than 90% of initial (100-hour) average lumen output measurement @ 1,000 hours of rated life, and no more than 3 individual samples can have a lumen output measurement less than 85%.			
Lumen Maintenance at 40% of Rated Life	Average lumen output measurement of the 10 samples tested must be greater than 80% of initial (100-hour) average lumen output measurement at 40% of the model's rated life (Per ANSI C78.5, Clause 4.10), and no more than 3 individual samples can have a lumen output less than 75%.			

¹ Take performance and electrical requirements at the end of the 100-hour aging period according to ANSI C78.5. The lamp efficacy shall be the average of the lesser of the lumens per watt measured in the base-up and base-down positions or other specified/restricted position. Use wattages placed on packaging to select proper criteria efficacy in this table, not measured wattage.

² Efficacies are based on measured values for lumens and wattages from pertinent test data. Wattages and lumens placed on packages may not be used in calculation and are not governed by this criterion. For multi-level, such as 3-way, or dimmable systems, measurement must be at the highest wattage setting listed for model. Acceptable efficacy, 1,000-hour and lumen maintenance at 40% of rated life average lumen output measurement error is – 3.0%.

³ In CFL V4.3, this footnote has been removed.

4B) BARE, COVERED, GLOBE, AND OUTDOOR REFLECTOR CFLS: ELECTRICAL TESTING REQUIREMENTS⁴

Criteria Item	ENERGY STAR Requirements	Sample Size / Specific Requirements
Power Factor	Average of 10 samples tested must be greater than 0.5.	10 units per model – 5 base-up/5 base-down unless the manufacturer restricts specific use or position. If position restricted, manufacturer must test all 10 samples in restricted position.
Run-up Time Bare (Non-amalgam)	Average of 10 samples tested must be less than 1.0 minute per ANSI C78.5, clause 3.11 and 4.8.	
Run-up Time Bare (Amalgam), Covered, and Outdoor Reflectors	Average of 10 samples tested must be less than 3.0 minutes per ANSI C78.5, clause 3.11 and 4.8. Partners qualifying bare products must specify if their product contains amalgam during the qualification submission process to be eligible for this requirement.	
Starting Time	Time after switching on until full start (and remain lighted), average of 10 samples shall be less than 1.00 second.	
Transient Protection	Per ANSI/IEEE C62.41 (01-May-1991), Category A, 7 strikes <i>Note:</i> One failure to meet 7 strikes will result in test failure and therefore, failure to meet the criteria.	A minimum of five (5) lamps tested in the <u>base up</u> position unless the product is labeled as a position-restricted by the manufacturer. If position restricted, test lamps in specified position (<i>Must be unique sample for this test only</i>).
Operating Frequency	<u>GU24-based lamps:</u> 20 to 30kHz or ≥ 40.0 kHz <u>All other lamps:</u> ≥ 40.0 kHz	1 unit per model
Electromagnetic Interference	Compliance with FCC 47 CFR including Part 2 (Equipment Authorization) and Part 18 (Technical Standards and Emission Limits) for consumer RF Lighting Equipment requirements for consumer limits	1 unit per model
Base	Candelabra base – E12 Medium (Edison) screw base - E26	None.
Maximum Mercury Content	Lamps < 25 watts: ≤ 5 milligrams (mg) per lamp Lamps 25 to 40 watts: ≤ 6 milligrams (mg) per lamp <i>Note: Mercury labeling requirements can be found in Part 4C.</i>	Commitment form must be on file with NEMA Voluntary Commitment to Limit Mercury content in Compact Fluorescent Lights at www.cfl-mercury.org . In addition, the product may not be present on the manufacturer's list of non-conforming products.

⁴ Input voltage must be 120 V and frequency must be 60 Hz.

4C) BARE, COVERED, GLOBE, AND OUTDOOR REFLECTOR CFLS: LIFETIME PERFORMANCE TESTING AND PACKAGING REQUIREMENTS:

Criteria Item and Submission	ENERGY STAR Requirements	Sample Size / Specific Requirements
Interim Life Test	<p>@ 40% of rated life report on lamp life:</p> <ul style="list-style-type: none"> • One sample failure, acceptable; • Two sample failures, requires submission of a product failure report from the manufacturer that describes in detail the specific reasons for the sample product failures. • Three sample failures, does not qualify 	
<p>Average Rated Lamp Life (Final qualification)</p> <p><i>PARTNER must complete lifetime test to stated rated lamp life on packaging</i></p>	<p><u>Medium screw- and candelabra-based covered, globe and outdoor reflector CFLs:</u> ≥ 6,000 hours</p> <p><u>Medium screw-based bare CFLs and GU24-based covered, dimmable and reflector CFLs:</u> ≥ 8,000 hours</p> <p><u>GU24-based bare lamps:</u> ≥ 10,000 hours</p>	<p>10 units per model, 5 base-up/ 5 base-down, unless specific use or position appears on packaging. <i>Interim and final average rated lifetime tests must use the same samples.</i></p>
Rapid Cycle Stress Test	<p>Per ANSI C78.5 and IESNA LM-65 (clauses 2,3,5, and 6) <u>Exception:</u> Cycle times must be 5 minutes on, 5 minutes off. Lamp will be cycled once for every two hours of rated lamp life. At least 5 out of the 6 sample lamps <u>must meet or exceed</u> the minimum number of cycles.</p>	<p>6 units, base up or down as stated by manufacturer. <i>Must be unique sample for this test.</i></p>
End of Life Protection	<p><i>Specific new EOLL testing requirements are currently under consideration for inclusion in the UL safety standard for SB CFLs (UL1993). EPA will require all ENERGY STAR CFLs to meet these EOLL requirements under the time frame specified by UL as this standard is amended by UL.</i></p>	<p><i>To be determined</i></p>
Warranty	<p>Product packaging must state "Warranty" or "Limited Warranty" and have an "800" number, or mailing address, or web site address (if applicable) for consumer complaint resolution.</p> <p>For Residential Applications: Warranty or limited warranty statement must cover at least a minimum of 24 months, or 2 years, from date of purchase based on no less than 3 hour per day of use (follow the chart below).</p> <p>For Commercial Applications: Warranty or limited warranty statement must cover at least a minimum of 12 months, or 1 year, from date of purchase.</p>	<p>Product Packaging: Must submit electronic draft or hard-copy draft of specific CFL model. Packaging must include the following information:</p> <ul style="list-style-type: none"> - Model number - Wattage - Lumen output (must be 100 hour average) - Average rated lifetime - Correlated color temperature - Warranty (based on application type and standard average hours/day) - 800 number, or address, or web address - Equivalency to incandescent (if required) - Starting temperature - Electromagnetic interference - Known incompatibility with controls and application exceptions - Mercury Labeling
Product Packaging Language	<p>In English, or English with additional languages. For products that will be sold in Canada, packaging must include both English & French.</p>	
FTC Labeling Requirements	<p>ENERGY STAR qualified compact fluorescent lamps and lamp systems must comply with the labeling requirements of the U.S. Federal Trade Commission Packaging Laws - FTC 16CFR Part 305.1-.19.</p>	
Starting Temperature	<p>Package must state the minimum starting temperatures or geographical zone of use and any other conditions for reliable starting to meet the starting time requirements of ANSI C78.5, Clause 4.7.</p>	
Incompatibility with Controls and Application Exceptions	<p>Lamp package must clearly state any known incompatibility with photo controls, dimmers or timing devices. In addition, packaging should state specific applications exceptions. (e.g., applications that the CFL should not be used in).</p>	

Criteria Item and Submission	ENERGY STAR Requirements	Sample Size / Specific Requirements
Mercury Labeling	<p>Required product packaging language for mercury content must include the following:</p> <ul style="list-style-type: none"> • the symbol "Hg" within a circle • "Lamp Contains Mercury" • www.epa.gov/cfl <p>Alternatively, www.lamprecycle.org may be printed in place of www.epa.gov/cfl, so long as a prominent hyperlink to the EPA's web site is maintained on the alternate's home page.</p>	
CFL/Incandescent Equivalency⁹	<p>PARTNER must use the chart below to declare an incandescent equivalency based on the initial average 100-hour lumen output measurement. If the luminous flux falls outside of the specified range, either do not display an incandescent equivalent or display the lower incandescent wattage equivalence. <i>If displaying an incandescent equivalent for Globe, Decorative, or reflector CFL product, the initial luminous flux for both the CFL and the appropriate incandescent bulb must be displayed side by side in a comparison panel, along with the wattage ratings for both CFL incandescent.</i></p>	Average of data used from 100-hour lumen output measurement
Labeling on Lamp Base (GU24-Based Lamps Only)	<p>Required lamp labeling language for consumer replacement must include a manufacturer designation that encompasses the following:</p> <ul style="list-style-type: none"> • Lamp manufacturer name • Lamp wattage • Correlated Color Temperature (CCT) • Color Rendering Index (CRI) 	A copy of the actual language that is included on the base of the lamp.

ENERGY STAR Qualified CFL Warranty and Lifetime Statements Chart <i>Residential Use Only</i>	
ENERGY STAR Qualified CFL Rated Lifetime	Number of Years Claim <i>(Based on minimum use of 3 hours/day)</i>
6,000 hours	5 years
8,000 hours	7 years
10,000 hours	9 years
12,000 hours	11 years
15,000 hours	13 years

ENERGY STAR QUALIFIED CFL/INCANDESCENT EQUIVALENCY CHART	
A-Shaped Incandescent bulb (Watts)	Typical Luminous Flux (Lumens) [†] <small>[†] Lumens must be 100 hr, initial values for CFLs</small>
	<i>Note: excludes globes, reflectors, or decorative CFLs. Lumens for 3-way lamps correspond to maximum equivalency shown.</i>
25	Minimum of 250
40	Minimum of 450
60	Minimum of 800
75	Minimum of 1,100
100	Minimum of 1,600
125	Minimum of 2,000
150	Minimum of 2,600
30-70-100	Minimum of 1,200
50-100-150	Minimum of 2,150

⁹ If displaying an incandescent equivalence for commonly used A-shaped bulbs (for all bare type models and covered type models that replace an A-shaped incandescent bulb), the CFL initial 100-hour average luminous flux or lumen output must meet or exceed the levels in the table. The table shows typical luminous flux for A-shaped, soft white, incandescent bulbs. Based on research conducted by NLPPI (http://www.lrc.rpi.edu/programs/NLPPI/index.asp) luminous flux varies considerably among bulbs. The table is intended to aid in consumer choice and in no way supercedes or replaces any requirement for product performance contained in this specification.

5A) REFLECTOR CFLS FOR RECESSED DOWNLIGHTS/INDOOR USE: PHOTOMETRIC TESTING REQUIREMENTS:

Criteria Item and Submission	ENERGY STAR Requirements		Sample Size / Specific Requirements
	Minimum Efficacy (Lumens/watt based upon initial lumen data)		10 units per model, all base-up position. For dimmable products, measurements must be made at the highest wattage setting listed for the model.
Lamp Power (Watts) & Configuration¹⁰	Medium Screw base	GU24-base	
Lamp power < 20	33	40	
Lamp power ≥ 20	40		
Correlated Color Temperature (CCT)	Manufacturer must identify one of the following designated correlated color temperatures to market their product as: 2700K, 3000K, 3500K, 4100K, 5000K, or 6500K, and at least 9 out of the 10 samples tested must fall within a 7-step ANSI MacAdam ellipse for that color temperature at the 100 hour lumen measurement. Please refer to Section 11 for CCT quality assurance requirements and Appendix C/ANSI Color Ellipses.		
Color Rendering (CRI)	Average of the 10 samples tested must be greater than 80, and no more than 3 individual samples can have a CRI less than 77.		
Initial Elevated Temperature Light Output Ratio	Product will meet the minimum requirement of maintaining 90% of initial rated light output. <i>The test must be performed according to the Initial Elevated Temperature Light Output Ratio test procedure, as described within Appendix B.</i>		1 unit per model, base-up position.
Elevated Temperature 1,000-hour Lumen Maintenance	Average lumen output measurement of the 10 lamps tested must be greater than 90% of initial (100-hour) lumen output measurement at 1,000 hours of life, and no more than 3 individual samples can have a lumen output measurement less than 85%. <i>Samples must be tested according to Option A or Option B Elevated Temperature Life Testing procedure, as described within Appendix B.</i>		10 units per model, all base-up position.
Elevated Temperature Lumen Maintenance at 40% of Rated Life	Average lumen output of the 10 samples tested must be greater than 80% of initial (100-hour) lumen output measurement at 40% of model's rated life (Per ANSI C78.5, Clause 4.10), and no more than 3 individual samples can have a lumen output less than 75%. <i>Samples must be tested according to Option A or Option B Elevated Temperature Life Testing procedure, as described within Appendix B.</i>		10 units per model, all base-up position.

¹⁰ Take performance and electrical requirements at the end of the 100-hour aging period according to ANSI C78.5. The lamp efficacy shall be the average of the lesser of the lumens per watt measured in the base-up and base-down positions or other specified/restricted position. Use wattages placed on packaging to select proper criteria efficacy in this table, not measured wattage.

¹¹ Efficacies are based on measured values for lumens and wattages from pertinent test data. Wattages and lumens placed on packages may not be used in calculation and are not governed by this criterion. For multi-level products, such as 3-way, or dimmable systems, measurement must be at the highest wattage setting listed for model. Acceptable efficacy, 1,000-hour and lumen maintenance at 40% of rated life average lumen output measurement error is – 3.0%.

5B) REFLECTOR CFLS FOR RECESSED DOWNLIGHTS/INDOOR USE: ELECTRONIC TESTING REQUIREMENTS¹²:

Criteria Item and Submission	ENERGY STAR Requirements	Sample Size / Specific Requirements
Power Factor	Average of 10 samples tested must be greater than 0.5.	10 units per model, all base-up position.
Run-up Time	Average of 10 samples tested must be less than 3.0 minutes per ANSI C78.5, clause 3.11 and 4.8.	
Starting Time	Time after switching on until full start (and remain lighted), average of 10 samples shall be less than 1.00 second.	
Transient Protection	Per ANSI/IEEE C62.41 (01-May-1991), Category A, 7 strikes <i>Note:</i> One failure to meet 7 strikes will result in test failure and therefore, failure to meet the criteria.	A minimum of five (5) lamps tested in the <u>base up</u> position unless the product is labeled as a position-restricted by the manufacturer. If position restricted, test lamps in specified position. <i>Must be unique sample for this test only.</i>
Operating Frequency	<u>GU24-based lamps:</u> 20 to 33kHz or ≥40kHz <u>All other lamps:</u> ≥ 40.0 kHz	1 unit per model
Electromagnetic Interference	Compliance with FCC 47 CFR including Part 2 (Equipment Authorization) and Part 18 (Technical Standards and Emission Limits) for consumer RF Lighting Equipment requirements for consumer limits	1 unit per model
Base	Medium (Edison) screw base - E26	
Maximum Mercury Content	Lamps less than 25 watts: ≤ 5 milligrams (mg) per lamp Lamps 25 to 40 watts: ≤ 6 milligrams (mg) per lamp <i>Note: Mercury labeling requirements can be found in Part 5C.</i>	Commitment form must be on file with NEMA Voluntary Commitment to Limit Mercury Content in Compact Fluorescent Lights at www.cfl-mercury.org . In addition, the product may not be present on the manufacturer's list of nonconforming products.

¹² Input voltage must be 120 V and frequency must be 60 Hz.

5C) REFLECTOR CFLS FOR RECESSED DOWNLIGHTS/INDOOR USE: LIFETIME PERFORMANCE TESTING AND PACKAGING REQUIREMENTS:

Criteria Item and Submission	ENERGY STAR Requirements	Sample Size/Specific Requirements
Maximum Ambient Temperature Rating for Reflectors	Maximum temperature rating of at least 50° C for which the warranty is valid.	None.
Rapid Cycle Stress Test	Per ANSI C78.5 and IESNA LM-65 (clauses 2,3,5, and 6) <u>Exception:</u> Cycle times must be 5 minutes on, 5 minutes off. Lamp will be cycled once for every two hours of rated lamp life. At least 5 out of the 6 sample lamps must meet or exceed the minimum number of cycles.	6 units per model, base up or down as stated by manufacturer. <i>Must be unique sample for this test.</i>
Elevated Temperature Interim Life Test	@ 40% of rated life report on lamp life: <ul style="list-style-type: none"> • One sample failure, acceptable; • Two sample failures, requires submission of a product failure report from the manufacturer that describes in detail the specific reasons for sample product failures. • Three sample failures, does not qualify <i>Samples must be tested at in one of the Elevated Temperature Test apparatus, as described within Appendix B.</i> 	10 units per model, all base-up position.
Elevated Temperature Life Testing <i>(Final qualification)</i> <i>PARTNER must complete lifetime test to stated rated lamp life on packaging</i>	> 6,000 hours as declared by the manufacturer on submitted packaging and qualification form for medium based reflectors for recessed downlights or indoor use. ≥ 8,000 hours for GU24-based reflectors <i>Must follow the testing procedures, as described within Appendix B.</i>	10 units per model, all base-up position.
End of Life Protection	<i>Specific new EOLL testing requirements are currently under consideration for inclusion in the UL safety standard for SB CFLs (UL1993). EPA will require all ENERGY STAR CFLs to meet these EOLL requirements under the time frame specified by UL as this standard is amended by UL.</i>	<i>To be determined</i>
Warranty	Product packaging must state “Warranty” or “Limited Warranty” and have an “800” number, or mailing address, or web site address <i>(if applicable)</i> for consumer complaint resolution. For Residential Applications: Warranty or limited warranty statement must cover at least a minimum of 24 months, or 2 years , from date of purchase based on no less than 3 hours per day of use (follow the chart below). For Commercial Applications: Warranty or limited warranty statement must cover at least a minimum of 12 months, or 1 year , from date of purchase.	Product Packaging: Must submit electronic draft or hardcopy draft of specific CFL model. Packaging must include the following information: <ul style="list-style-type: none"> - <i>Model number</i> - <i>Wattage</i> - <i>Lumen output (must be 100 hour average)</i> - <i>Average rated lifetime</i> - <i>Correlated color temperature</i> - <i>Warranty (based on application type and standard average hours/day)</i> - <i>800 number, or address, or web address</i> - <i>Equivalency to incandescent (if applicable)</i> - <i>Starting temperature</i> - <i>Electromagnetic interference</i> - <i>Known incompatibility with controls and application exceptions (e.g., outdoor reflectors)</i> - <i>Mercury Labeling</i>
Product Packaging Language	In English, or English with additional languages. For products that will be sold in Canada, packaging must include both English and French.	
FTC Labeling Requirements	ENERGY STAR qualified compact fluorescent lamps and lamp systems must comply with the labeling requirements of the U.S. Federal Trade Commission Packaging Laws - FTC 16CFR Part 305.1-.19.	
Starting Temperature	Package <u>must</u> state the minimum starting temperatures or geographic zone of use and any other conditions for reliable starting to meet the starting time requirements of ANSI C78.5, Clause 4.7.	

Criteria Item and Submission	ENERGY STAR Requirements	Sample Size / Specific Requirements
Incompatibility with Controls and Application Exceptions	Lamp package <u>must clearly state</u> any known incompatibility with photo controls, dimmers or timing devices. In addition, packaging should state specific applications exceptions. (e.g., applications that the CFL should not be used in).	
Mercury Labeling	<p>Required product packaging language for mercury content must include the following:</p> <ul style="list-style-type: none"> • the symbol "Hg" within a circle • "Lamp Contains Mercury" • epa.gov/cfl <p>Alternatively, www.lamprecycle.org may be printed in place of www.epa.gov/cfl, so long as a prominent hyperlink to the EPA's web site is maintained on the alternate's home page.</p>	
Labeling on Lamp Base (GU24-Based Lamps Only)	<p>Required lamp labeling language for consumer replacement must include a manufacturer designation that encompasses the following:</p> <ul style="list-style-type: none"> • Lamp manufacturer name • Lamp wattage • Correlated Color Temperature (CCT) • Color Rendering Index (CRI) 	A copy of the actual language that is included on the base of the GU24 product.

6) **CERTIFICATION:** In CFL V4.3, this section was removed to align this specification with EPA's third-party certification requirements.

7) **QUALIFICATION FOR BARE, GLOBE, COVERED, OR OUTDOOR REFLECTOR PRODUCTS:** The following 2-step procedure allows for initial qualification prior to completion of full lifetime testing:

A. STEP 1: Initial Qualification

A product shall meet all the requirements of the specification as certified by an EPA-recognized Certification Body. A product photo is required to identify the current version of the qualified product.

Packaging Review: Electronic or hard copy labeling and packaging samples are required for the specific CFL model. Packaging must meet all of the requirements that are identified under the Lifetime Performance and Packaging Requirements. The specific qualified model must be distributed within this approved product packaging.

Due Date: A due date for the final average rated life time test report must be established based on the date the average rated lifetime test began and the rated lifetime of the CFL.

Products that meet the above requirements may be considered initially qualified for ENERGY STAR and may be labeled.

B. STEP 2: Full Qualification for Bare, Covered, or Outdoor Reflector Products:

The final average rated life time test results must be certified within 60 days of completion of the test and must demonstrate that the product meets the rated lifetime claim established during initial qualification.

C. Upgrading the Lifetime of a Previously Qualified Product:

The lifetime of a product qualified using the procedures above may be increased only by demonstrating full compliance with the ENERGY STAR criteria at the new lifetime. The following tests must be completed:

- Rapid Cycle Stress Test as required at new lifetime
- Lumen Maintenance at 40% of new rated lifetime
- Interim Life Test at 40% of new rated lifetime
- Average Rated Lifetime Test at new lifetime

Packaging proofs must be reviewed as in the initial qualification process.

Subsequent to initial qualification, to upgrade the lifetime of a product initially qualified for 6000 hours it is suggested that initial Rapid Cycle Stress Test be completed in anticipation of final product lifetime.

8) **QUALIFICATION FOR REFLECTOR CFLS FOR RECESSED DOWNLIGHTS/INDOOR USE:** The following 2-step procedure allows for initial qualification prior to completion of full lifetime testing:

A. STEP 1: Initial Qualification

A product shall meet all the requirements of the specification as certified by an EPA-recognized Certification Body. A product photo is required to identify the current version of the qualified product.

Packaging Review: Electronic or hard copy labeling and packaging samples are required for the specific CFL model. Packaging must meet all of the requirements that are identified under the Lifetime Performance and Packaging Requirements. The specific qualified model must be distributed within this approved product packaging.

Due Date: A due date for the elevated temperature life testing test report must be established based on the date the average rated lifetime test began and the rated lifetime of the CFL.

Products that meet the above requirements may be considered initially qualified for ENERGY STAR and may be labeled.

B. STEP 2: Full Qualification For Reflector CFLs for Recessed Downlights/Indoor Use:

The final elevated temperature life testing test results must be certified within 60 days of completion of the test and must demonstrate that the product meets the recorded average rated lifetime established at the time of initial qualification.

C. Upgrading the Lifetime of a Previously Qualified Product:

The lifetime of a product qualified using the procedures above may be increased only by demonstrating full compliance with the ENERGY STAR criteria at the new lifetime. The following tests must be completed:

- Rapid Cycle Stress Test as required at new lifetime
- Elevated Temperature Lumen Maintenance at 40% of new rated lifetime
- Elevated Temperature Interim Life Test at 40% of new rated lifetime
- Elevated Temperature Average Rated Lifetime Test at new lifetime

Packaging proofs must be reviewed as in the initial qualification process.

Subsequent to initial qualification, to upgrade the lifetime of a product initially qualified for 6000 hours it is suggested that initial Rapid Cycle Stress Test be completed in anticipation of final product lifetime.

9) **PRIVATE LABELING PRODUCTS:** In version 4.3 of this specification, this section has been removed. Questions regarding private labeling should be directed to lamps@energystar.gov.

10) **COMMERCIAL PACKAGING OF PRODUCTS:** For ENERGY STAR qualified CFL products that will be bulk packaged for retail or commercial sales, bulk packaging must meet all of the required criteria in this specification. Questions regarding bulk packaging should be directed to lamps@energystar.gov.

11) **QUALITY ASSURANCE:** Documentation must be maintained by the Original Equipment Manufacturer (OEM) describing the measures they are taking to ensure their ENERGY STAR qualified CFLs and those products they sell to private labelers meet program and criteria requirements.

A. **Manufacturing Quality Control Documentation:** Any of the following industry quality control processes are acceptable:

- Adherence to the International Standards Organization (ISO) 9000 family of international quality management standards and guidelines, used as the basis for establishing quality management systems.
- Employment of the Six Sigma methodology to measure and improve a company's operational performance, practices and systems; or an equally recognized industry process.
- Other quality control systems or formats that are accepted industry standards.

B. **Color Consistency:** The following quality requirements must be met during the production runs of each lamp model:

1. The lamp manufacturer is required to maintain color control such that a **minimum of 90 percent** of the ongoing production (*as represented by samples tested from each production shift for the same color and when typically evaluated over 12 month period*) will fall within the seven-step MacAdam color ellipse associated with the designated (manufacturer declared) target color.
2. For the purposes of meeting color control, the lamp manufacturer must maintain testing equipment calibrated to international practices and standards and must compile the ongoing color control data in a manner so that it can be easily reviewed upon EPA or certification body request.
3. At a minimum, the manufacturer's color quality control program must maintain the following information for a 3-year period:
 - a. Test dates and sample size (minimum of two lamps per production shift)
 - b. Test results (x,y) for each sample lamp measured
 - c. Test results (all x,y data) for sample lamps plotted graphically against the designated seven-step color MacAdam ellipse and available for review at least on a quarterly basis (*See Appendix C*)
 - d. Records to substantiate that 90 percent of the (x, y) data points fall within the applicable seven-step MacAdam ellipse. Manufacturers are encouraged to exceed this target.

12) **INDEPENDENT ENERGY STAR CFL THIRD PARTY TESTING AND VERIFICATION PROGRAM:** Manufacturer, distributor, and retailer PARTNERS who are active members of the ENERGY STAR CFL program must participate in the ongoing, CFL Third Party Testing and Verification Program, which uses independent, third-party, EPA recognized testing laboratories. This third-party testing program is necessary to provide an active system to verify quality of ENERGY STAR qualified CFL products in the marketplace. This program will conduct random off-the-shelf testing of ENERGY STAR qualified CFLs and provide the results to the PARTNER.

A. An **independent program** has been selected as the means for third party testing for several fundamental reasons, including:

- It will allow for fair and open assessment of third party test data for the U.S. Environmental Protection Agency.
- It will serve as an effective firewall for proprietary data sent to the U.S. Environmental Protection Agency.

- B.** The goals of the Third Party Testing and Verification Program are to:
- Develop a CFL testing program that will aid EPA in maintaining quality control of its ENERGY STAR CFL Program;
 - Develop a mechanism providing added assurance to ENERGY STAR PARTNERS that sponsor CFL Programs and to manufacturer competitors alike that qualified products do in fact meet the ENERGY STAR criteria;
 - Provide a basis upon which the EPA can reasonably make decisions on disqualifying products not exhibiting the necessary qualifications to keep its ENERGY STAR qualification status; and
 - Maintain the precepts of the ENERGY STAR Program, the highest of which is that the consumer receives superior products that perform as advertised.
- C.** Third Party Testing and Verification Program will be managed using funds derived from a percentage of testing fees and will have **product selection** and **technical and research working groups**. These working groups shall be representative of both manufacturer and non-manufacturer stakeholders.

1. **Product Selection Working Group:** The Product Selection Working Group will oversee the final product selection process for each testing cycle.

The Product Selection Working Group will be comprised of five representatives – two members from industry (ENERGY STAR CFL manufacturers, retailers, or distributors), two members from an ENERGY STAR state, utility, or energy efficiency program sponsor partners and EPA, which will serve as the committee chair. The Third Party Testing Program Administrator will assist the committee.

To be eligible to serve on the Product Selection Working Group, candidates must be recommended or nominated by a current ENERGY STAR PARTNER (which includes manufacturers, retailers, utilities, states, or energy efficiency program sponsors). The main criteria for membership on the product selection working group will be an unbiased view of the existing CFL marketplace, knowledge of current lighting market trends and consumer practices, and a demonstrated ability and desire to contribute to improving the overall quality of ENERGY STAR qualified CFLs. EPA will review nominations and select the candidates to serve on the working group. Once the working group has been established, the members will serve for a period of two years. Working Group members can be re-nominated to serve another two years once their term is completed.

2. **Technical and Research Working Group:** The Technical and Research Working Group will monitor technical and scientific developments involving lighting industry specifications, regulations, and testing processes. The working group's responsibilities include identifying new or updated product test procedures to incorporate into the program, evaluating testing uncertainties and data anomalies, identifying and recommending testing tolerance levels, and developing management protocols to address these topics. The working group will provide technical expertise to EPA and the Third Party Testing Program Administrator.

The membership of the Technical and Research Working Group will consist of CFL manufacturers, accredited testing laboratories, ENERGY STAR state, utility, and energy efficiency program sponsor partners. EPA will select a Technical and Research Chair from the initial group. The Third Party Testing Administrator will assist the working group. This working group has no limit on the number of participating members.

To be eligible to serve on the Technical and Research Working Group, candidates must have experience or be able to demonstrate their proficiency in CFL design, measurement testing, or statistics, along with a demonstrated ability and desire to contribute to improving the overall quality of ENERGY STAR qualified CFLs. A technical and research working group participation form will be developed and distributed to all ENERGY STAR CFL program partners once the criteria is finalized. Once the Technical and Research Working Group has been established, the members will serve for a period of two years and are eligible to renew their membership after the two years is complete.

- D.** Third Party Tests and Verification to be conducted: All tests or verification listed below will be conducted as per the qualification stipulations of the current ENERGY STAR criteria for CFLs. These tests will form the basis for product qualification verification:

1. Bare, Covered, and Outdoor Reflector Products:

- Base
- Efficacy
- Rapid Cycle Stress Test
- Correlated Color Temperature (CCT)
 - Chromaticity measurements for each sample
 - Submission of ANSI Color Ellipse graph (optional)
- Color Rendering Index (CRI)
- Run-up Time
- Starting Time
- 1,000 Hour Lumen Maintenance
- Lumen Maintenance at 40% of rated lifetime
- Interim Life Test at 40% of rated lifetime

- Power Factor
- End of Life Protection (TBD)

2. Reflector Products for Recessed Downlights/Indoor Use:

- Base
- Efficacy
- Rapid Cycle Stress Test
- Correlated Color Temperature (CCT)
 - Chromaticity measurements for each sample
 - Submission of ANSI Color Ellipse graph (optional)
- Color Rendering Index (CRI)
- Run-up Time
- Starting Time
- Initial Elevated Temperature Light Output
- Elevated Temperature 1,000 hour Lumen Maintenance
- Elevated Temperature Lumen Maintenance at 40% of Rated Lifetime
- Elevated Interim Life Test at 40% of Rated Lifetime
- Power Factor
- End of Life Protection (TBD)

E. Product Nomination, Selection and Procurement Process: The timing of the nomination and testing cycles will be scheduled around the normal ENERGY STAR lighting market transformation activities (e.g., Change A Light Campaign) to provide ample time for product discontinuations or disqualifications. The product nomination and selection timetable and process will begin after the criteria are finalized. The schedule below is an example and subject to change based on effective date of the criteria:

1 st Cycle Distribution of Nomination Forms:	March 15
1 st Cycle Random Product Generation:	March 20
1 st Cycle of Product Nomination Due:	April 15
1 st Cycle Review of Product Nominations (with randomly selected products):	April 28
1 st Cycle Final List of Products:	May 15
1 st Cycle Product Procurement:	May 10-June 30
1 st Cycle Product Testing Begins:	July 1
2 nd Cycle Distribution of Nomination Forms:	September 15
2 nd Cycle Random Product Generation:	September 20
2 nd Cycle of Product Nomination Due:	October 15
2 nd Cycle Review of Product Nominations (with randomly selected products):	November 1
2 nd Cycle Final List of Products:	November 15
2 nd Cycle Product Procurement:	November 15-Jan 31
2 nd Cycle Product Testing Begins:	February 1

F. Product Nominations:

1. Products will be selected for third party testing on both a random and nomination selection basis. The program will target to test 20% of the total number of current qualified bulbs during a calendar year; half of the products will be selected via a random generator, the other half will be selected by EPA and participating ENERGY STAR partners (utilities, manufacturers, states, efficiency program sponsors, or other government entities (e.g., Natural Resources Canada)).
2. The product testing pool will be comprised of all distinct ENERGY STAR qualified CFLs models (technical designs).
3. (item #3 was removed in version 4.3)
4. Qualified CFL products that are within six months of its requalification date will be excluded from an upcoming testing cycle.
5. Following the suggested schedule timeline, the Third Party Testing Program Administrator will send all PARTNERS a nomination form to complete. The parties who wish to nominate products will be required to submit their nominations electronically by the specified deadline to the Third Party Testing Program Administrator.
6. During the 30-day product nomination timeframe, the Third Party Testing Program Administrator will generate a list of qualified products through the random generator. This initial product list will be reviewed to identify which products are readily available in the marketplace and which products are not. Those products that are not readily available in the marketplace will be removed from the nomination group.
7. CFL PARTNERS who wish to nominate other PARTNERS' ENERGY STAR qualified CFLs will be required to follow the nomination guidelines. The basic guidelines will address the following:

- Product nomination limits: Nominations will be limited to no more than two models per manufacturer per testing cycle. There is no upper limit for total number of nominations.
- Rationale for product nomination: Will need to supply evidence on the poor performance of a product, which can include test data, consumer complaints, product returns, etc. Nominations submitted without ample evidence to demonstrate the need for third party testing will be disregarded.

All other PARTNERS (e.g. state, utility, or energy efficiency program sponsor partners) can nominate an unlimited number of CFL products.

- G. Product Selection:** Submitted product nominations forms will be collected and compiled with the list of randomly selected products by the Third Party Testing Program Administrator.

The Third Party Testing Program Administrator will distribute the overall list of product nominations (random generator and PARTNER nominations) to the Product Selection Committee to review. The Third Party Testing Program Administrator will organize a conference call (or meeting) with the Product Selection Committee to discuss the product nominations and finalize a list of products to test within each cycle. The Product Selection Committee will have five business days to review the nominations and approve the final list of products to test per testing cycle.

EPA will approve the final product list and then the Third Party Testing Program Administrator will contact each CFL PARTNER to inform them their product or products will be tested. In addition, the Third Party Testing Program Administrator will also notify the PARTNER which EPA-recognized laboratory they will be working with.

- H. Costs of Third Party Testing and Verification Program and Laboratory-PARTNER Logistics:** PARTNERS will pay for the testing of their products. The testing fee will vary as a function of the rated lifetime of the product and all participating laboratories will provide fixed fees. Included in the fee will be a per model charge for the Third Party Program Administrator services, which will not exceed 20%.

Each participating laboratory will provide the established quotation (based on the rated lifetime of the product) to the specific ENERGY STAR CFL PARTNER. This quotation will include the fixed fee for testing, procurement, and shipment. In addition, the laboratory will provide a confidentiality clause that automatically permits the test laboratory to release the data only to the Third Party Testing Program Administrator and to the manufacturer. PARTNERS will send payment directly to the testing facility within the allotted timeframe. Administrator fees will be distributed by the laboratory to the Third Party Testing Program Administrator.

Costs for product procurement will be set at a flat fee plus the total retail costs of the samples (*to be determined by participating laboratory(ies)*). The flat fee costs cover the logistical costs to purchase the products (transportation, telephone, hotel, etc.). The laboratories will work to identify the best retail price to procure the products. The procurement prices will be reviewed after each cycle to identify whether the cost needs to be adjusted.

Costs for product shipment to the testing facility will be a uniform cost (*to be determined once participating laboratory(ies) have been selected for the program*).

Third Party Testing Program Administrator Fees will cover (*estimating 20% of overall testing costs*):

- Test Report Development
- Coordination of laboratories
- Verification of Qualified Product Information
- Coordination of Technical and Nomination Committees
- Notify PARTNERS of product selection and provide selected laboratory information
- Administrative tasks (conference calls; mailings; etc.)

PARTNERS whose products are retested due to marginal failure will pay for the retest and any additional product samples and shipment costs needed to complete the retest.

- 1. Product Procurement:** PARTNERS will assist the assigned laboratory in identifying distribution channels to purchase products from and products will be purchased from these identified retail sources or Internet shopping venues. To the extent practicable, two different date or lot codes will make up the samples of bulbs per model tested and products will be purchased in accordance with these procurement guidelines:

- Store Selection: If available, samples must be purchased from a minimum of three different retail or commercial outlets.
- Geographic location selection: At a minimum, samples must be purchased from two (2) separate geographic regions of the U.S. The recommended number of locations is four (4).

The following information will be recorded to assist in clarifying any issues that may arise in the testing process:

- Lot numbers
- Date code
- Geographic location of purchase (city, State, zip code, store number)
- Retailer or distributor where product was purchased

- Product Photo
- Product Packaging

2. **Information Flow and Data Management:** Each PARTNER having product tested will receive the complete test reports for its product(s) directly from the testing laboratory. The Third Party Testing Program Administrator will also receive the complete testing reports from the testing laboratory. The Third Party Testing Program Administrator will deliver the compiled test results to EPA to review and identify which products met the ENERGY STAR criteria.

EPA will notify PARTNERS of one of the following outcomes:

- Qualification verification
- Marginal failure
- Disqualification of the product

The Third Party Testing Program Administrator will be responsible for archiving information for each testing cycle to develop consolidated trend data reports. These data reports will include:

- Overall pass/fail statistics
- Pass/fail statistics by product type
- Statistical scatter plots of measured performance test data
- Statistical analysis of mean, median
- Year-by-year or round-by-round trend data

The Third Party Testing Program Administrator will prepare a consolidated trend data report that will include all trend data of the tests identified in section 12.D. This report will be made available to interested parties.

3. **Testing Review Process:** Based on the results and incorporation of measurement tolerances, EPA will categorize the tested products into three groups:

- Qualification verification
- Marginal failure
- Disqualification of the product

Qualification verification is defined when a product meets or exceeds all of the ENERGY STAR qualification testing requirements of the Third Party Testing and Verification Program.

Marginal failure is defined as having one sample exceed the allowable failure rate for one test. An example of a marginal failure is a result of 4 out of 6 samples passing the rapid cycle stress test or if the interim lifetime testing results in failure of 2 samples (out of the 10 samples). The reason behind the establishment of a marginal failure is that if a product meets or exceeds all of the other testing requirements, especially the efficacy and 1,000-hour lumen maintenance tests and fails the rapid cycle stress test, it then causes a conflict on the quality of the product. To provide a reasonable and fair alternative, EPA will follow the process below to gather additional data to help resolve the performance issues.

Marginal Failure Process:

1. After testing has been completed through 40% of rated lifetime, products will be reviewed to identify a marginal failure. If a product is deemed a marginal failure, EPA will immediately contact the PARTNER and inform them.
2. At this time, EPA will institute an immediate retest for the test that was failed to verify the initial results. EPA will instruct the Third Party Testing Program Administrator to coordinate with the participating testing laboratory(ies) to procure the samples and ship them to one of the approved third party testing laboratories. The manufacturer of the product is responsible for all retesting costs (as stated in Section H).
3. In addition, the PARTNER can request to receive the failed lamp(s) so they can perform an autopsy analysis on the product.
4. During this retesting process, the product in question will retain its ENERGY STAR qualification status to avoid confusion or unnecessary administration costs to prematurely remove product from the retail channels.
5. If the retest results in the product meeting the originally failed test requirement, it will remain ENERGY STAR qualified.
6. If the product fails the requirement retest, then EPA will institute the disqualification process (see below).

Disqualification is defined when a product fails one or more of the ENERGY STAR qualification testing or Third Party Testing requirements.

- 13) **DISQUALIFICATION PROCESS:** PARTNERS shall refer to EPA's stakeholder letter dated July 20, 2010 (available at www.energystar.gov/lightingDQ/) for the product disqualification procedures and corrective action requirements.

- 14) **ENERGY STAR CFL REQUALIFICATION PROCEDURE:** In version 4.3 of this specification, this section has been removed.

- 15) **RETIREMENT/DISCONTINUATION OF PRODUCTS:** The specific date that a model will no longer be manufactured and distributed to the marketplace is required when products are retired or discontinued.
- 16) **EFFECTIVE DATE:** The effective date for the ENERGY STAR Program Requirements and Criteria for CFLs (Version 4.3) will be December 2, 2008, and replaces all previous versions.
- 17) **FUTURE CRITERIA REVISIONS:** ENERGY STAR reserves the right to change the criteria should technological and/or market changes affect its usefulness to consumers, industry, or the environment

Appendix A:

DUTIES AND RESPONSIBILITIES OF THE THIRD PARTY TESTING AND VERIFICATION PROGRAM ADMINISTRATOR:

1) MANAGEMENT OF THE PARTICIPATION OF NVLAP ACCREDITED TESTING LABORATORIES:

- Identifies which laboratory will conduct the testing for each product.
- Develops a rotating testing schedule, to include all laboratories participating in the program, taking into account each facility's testing capacity.
- Monitors the laboratory's work to assure the laboratory(ies) are following the testing schedule and are meeting the identified deadlines for report submissions and updates. If there are delays in the product procurement or other areas of the schedule, the Administrator will work with EPA and the laboratories to revise the testing schedule and will notify the selected CFL PARTNERS of the updated schedule.

2) MANAGEMENT OF THE THIRD PARTY TESTING AND VERIFICATION PROCEDURE:

- Third Party Testing Program Administrator will notify the PARTNERS which testing laboratory will conduct its tests.
- Each participating laboratory will provide the established quotation to the specific ENERGY STAR CFL PARTNER. This quotation will include the fixed testing, procurement, and shipment costs and a confidentiality clause that automatically permits the test laboratory to release the data to the Third Party Testing Program Administrator and to the manufacturer.
- PARTNERS will send payment directly to the testing facility and will assist in identifying distribution channels to purchase products from.
- The testing laboratory will distribute up to 20% of the testing cost to the Third Party Testing Program Administrator for management and administrative costs. The testing laboratory will be responsible for product procurement and delivery to their testing facility.
- The testing laboratory will deliver the final testing reports to the individual manufacturers and the Third Party Testing Program Administrator.
- The Third Party Testing Program Administrator will deliver the cycle summary test reports to EPA to review and identify which products met the ENERGY STAR criteria. EPA will notify PARTNERS of one of the following outcomes:
 - Qualification verification
 - Marginal failure
 - Disqualification of the product
- The Third Party Testing Program Administrator will prepare generic consolidated trend data reports and provide these to all interested parties. Consolidated trend data reports will include overall pass/fail statistics, pass/fail statistics by product type, statistical scatter plots of measured performance test data, statistical analysis of mean, median, and year-by-year or round-by-round trend data without identifying specific manufacturers or model numbers.

3) VERIFICATION OF QUALIFIED PRODUCTS:

The ENERGY STAR CFL program contractor will work with the Third Party Testing Program Administrator to review the following parameters to assure the most accurate information is being used to manage the program:

- Which products are manufactured and which are private labeled
- Verification of Where Products are Sold/Distributed
- Product Disqualifications or Discontinuations
- PARTNER Contact Information

**ANNEX A: ENERGY STAR®
ELEVATED TEMPERATURE TEST PROCEDURES**

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1. Introduction

This document provides a description of the test method for the initial elevated temperature light output ratio and life testing of integrated compact fluorescent reflector lamps (R-CFLs) in an elevated temperature environment. Two options, "A" and "B," are provided for Elevated Temperature Life Testing. The procedure simulates the environment of an R-CFL in an IC-rated airtight (ICAT) downlight installed within an insulated ceiling. Non-reflector compact fluorescent lamps and non-integrated compact fluorescent lamps are excluded from this test procedure.

2. Power Requirements

The power supply utilized in the testing shall be capable of providing the nominal rated input voltage and frequency for the lamp(s) under test. The input voltage of the power supply shall be regulated to within $\pm 2\%$ of the rated rms value. In addition to the preceding voltage regulation requirements, the power supply shall meet the criteria as detailed in IES LM-28¹ and IES LM-65².

Note: When selecting a power supply for use with integrated R-CFLs, it is necessary to apply an appropriate power factor when specifying the Volt-Amp rating of the power supply. Many integrated compact fluorescent reflector lamps have a power factor in the range of 0.5 to 0.6.

3. Photometric Measurements

The photodetector used for photometric measurements shall be a silicon detector corrected to closely fit the Commission Internationale de l'Eclairage (CIE) spectral luminous efficiency curve (V_λ).

3.1 Lamp Seasoning

Prior to the first readings, the lamps shall be seasoned for 100 hours in accordance with IES-LM-54-99⁵ and shall be preburned in the base-up position. This seasoning shall be accomplished outside of the elevated temperature testing apparatuses.

3.2 Lamp Stabilization

Lamps shall be considered stabilized when monitoring of light output over a 30-minute period produces differences of sequential readings no greater than 0.5% with a minimum of three readings approximately 15 minutes apart.

3.3 Lamp Transfer and Restabilization

Lamps to be removed from the elevated temperature housing for photometric testing shall be allowed to cool down for at least 15 minutes before being transported to the photometric equipment. Care shall be exercised to maintain base-up lamp orientation and avoid shaking or bumping the lamp during the transfer. Lamps shall be restabilized prior to taking any measurements.

4. Temperature Measurement

Temperature measurements shall be acquired using a thermocouple junction and measuring instrument. Thermocouples shall be chosen based on the range of temperatures that are likely to be experienced in the course of ambient temperature testing (typically between 25°C and 100°C). Specially designed ambient temperature probes are commercially available and may be used for ambient temperature measurements.

¹ For complete list of Standards and Test Procedures referenced in this Appendix, see Section 9.

5. Sample Selection

Samples for Initial Elevated Temperature Light Output Ratio Testing and Elevated Temperature Life Testing shall be representative of the manufacturer's typical product. The samples shall be cleaned and thoroughly inspected before testing. Any flaws or inconsistencies in the lamp samples shall be noted.

6. Initial Elevated Temperature Light Output Ratio

6.1 Thermal Chamber

The test environment shall be clean and free from large amounts of dust and moisture.

6.2 Controlled Draft Enclosure

Some air movement within the thermal chamber is necessary to prevent stratification. A controlled draft enclosure shall be used to limit air movement across the lamp to a maximum of 0.08 m/s (15.7 ft/min) as suggested by IES LM-41⁶ when placed in the thermal chamber.

6.3 Temperature Measurement Location

Temperature measurements shall be taken at a location 1-in. below the base (defined as the lowest point on the metal Edison socket when installed in a base-up position) of the lamp and 2-in. from the base of the lamp toward the enclosure wall.

6.4 Photometric Measurement Location

The photodetector shall be secured such that it remains in the same position during the test.

6.5 Test Procedure

- a) Season one lamp according to Section 3.1 above.
- b) Situate the controlled draft enclosure in the thermal chamber.
- c) Install the lamp in the enclosure.
- d) Apply the rated lamp voltage while operating the thermal chamber such that the temperature at the test point is stable at 25°C within 1°C for 15 minutes as determined by three measurements 5 minutes apart.
- e) Achieve lamp stabilization per Section 3.2
- f) Record the light output, the input electrical values and the test point temperature.
- g) Repeat steps d) thru f) with the thermal chamber maintained at 50°C ± 5°C.
- h) Reduce the temperature to 25°C and shutdown the system as required.

6.6 Test Report

The test report shall include at least the following test information:

- a) Manufacturer's name and product identification
- b) Name and location of the testing facility
- c) Test date
- d) Electrical and photometric reading at the 25°C ambient condition.
- e) Electrical and photometric reading at the 50°C ambient condition.
- f) Initial Elevated Temperature Light Output Ratio, calculated as the light output at the 50°C ambient condition divided by the light output at the 25°C ambient condition, expressed as a percentage.

7. Elevated Temperature Life Testing (Option A)

7.1 Operating Cycle

Operation of the lamps shall be consistent with the provisions set forth in IES LM-65² Section 6.1; three hours ON and 20 minutes OFF.

7.2 Ambient Conditions

The test environment shall be clean and free from large amounts of dust and moisture. The ambient temperature shall be maintained at 25°C + 10°C. Drafts shall be minimized and the perimeter of the test apparatus shall be kept clear of obstacles.

7.3 Elevated Temperature Housing and Support

Testing shall be conducted using the Halo[®] model H7UICAT incandescent downlight housing. No substitutions shall be allowed. No trim shall be used. Luminaires shall be oriented such that the lamp operates vertical base-up during the life test. The luminaires may be arranged in a horizontal plane or stacked vertically. If stacked vertically, a minimum spacing of 24 inches must be maintained between the bottoms of each row.

7.4 Lamp Monitoring

The lamps shall be monitored for continued operation at a period in accordance with Section 6 of IES LM-65.

7.5 Test Procedure

- a) Season ten lamps according to Section 3.1.
- b) At the 100-hour point, transfer the lamps to photometric measurement equipment and conduct measurement of each lamp following the procedures set forth in LM-66⁷. Record the results.
- c) Install the lamps in their respective elevated temperature housings. Operate lamps according to Section 7.1.
- d) Monitor the lamps according to Section 7.4.
- e) At the 1000-hour point, repeat steps b) thru d).
- f) At 40% of the lamps' rated life repeat steps b) thru d).
- g) Continue to monitor the lamps according to Section 7.4 until rated life is achieved.

7.6 Test Report

The test report shall include at least the following test information:

- a) Manufacturer's name and product identification
- b) Name and location of testing facility
- c) Test date
- d) Photometric measurements at 100 hours, 1,000 hours, and 40% of rated life.
- e) Elevated Temperature 1000-hour Lumen Maintenance calculated as the 1000-hour light output divided by the 100-hour light output, expressed as a percentage.
- f) Elevated Temperature Lumen Maintenance at 40% of Rated Life calculated as the 40% of rated life light output divided by the 100-hour light output, expressed as a percentage.
- g) Number of hours of operation before failure or note that the lamp reached rated life.
- h) Notes describing the envelop failure (broken glass, cracking or excessive discoloration) of any lamp that competes testing

8. Elevated Temperature Life Testing (Option B)

8.1 Operating Cycle

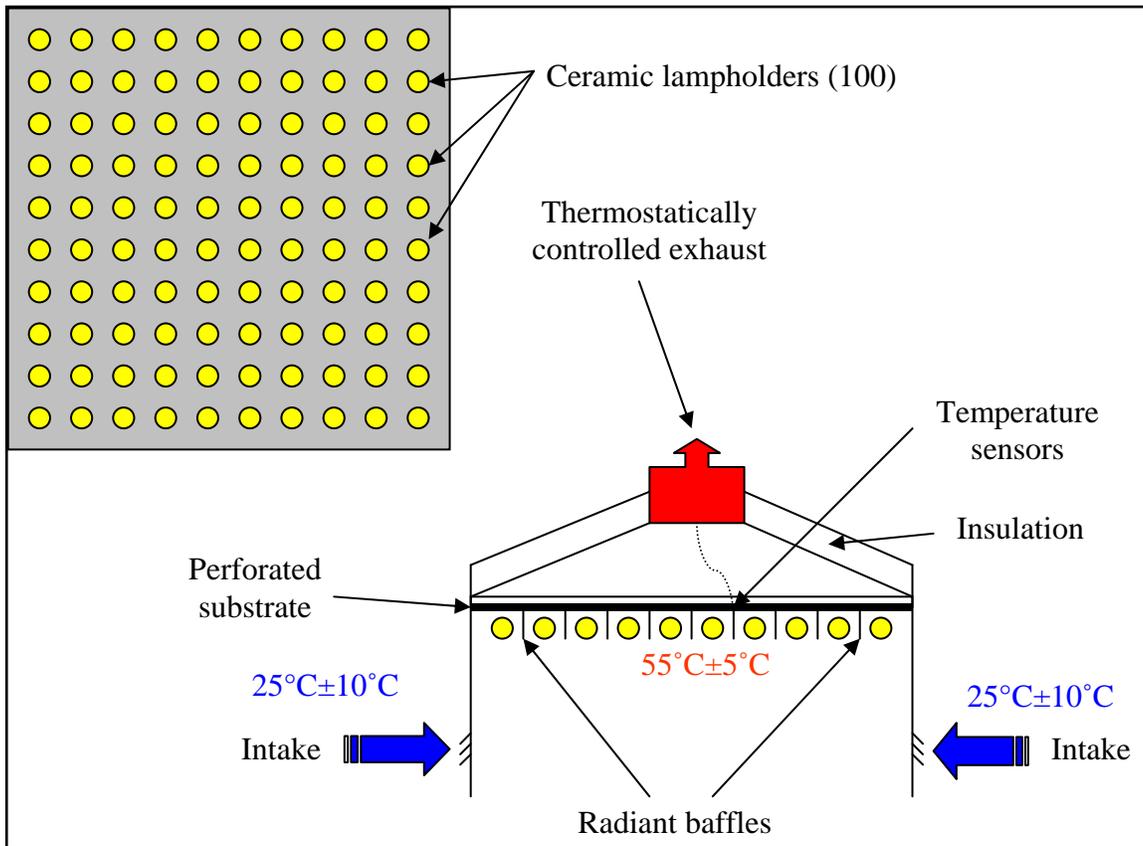
Operation of the lamps shall be consistent with the provisions set forth in IES LM-65² Section 6.1; three hours ON and 20 minutes OFF. At the onset of the OFF cycle, the exhaust fan shall automatically operate to purge the apparatus with ambient air.

8.2 Ambient Conditions

The test environment shall be clean and free from large amounts of dust and moisture. The ambient temperature shall be maintained at $25^{\circ}\text{C} \pm 10^{\circ}\text{C}$. The perimeter of the apparatus shall be kept clear of obstacles so that airflow is not inhibited from entering the apparatus during the purge portion of the test cycle. The operating temperature within the apparatus (represented as the average of at least four measurement locations specified in Section 8.4 (below) shall be maintained at $55^{\circ}\text{C} \pm 5^{\circ}\text{C}$ during the on-cycle. The operating temperature within the apparatus shall be achieved within 45 minutes upon on-cycle initiation (additional incandescent lamps may be added as heat sources to achieve this).

8.3 Elevated Temperature Testing Apparatus

The interior of the Elevated Temperature Testing Apparatus shall be a flat section of perforated substrate with ceramic lampholders arranged in a rectangular array. The perforated substrate shall have holes of a minimum diameter of $\frac{1}{4}$ -in. spaced at a maximum spacing of 1-in. on center. The spacing between lampholders shall be no less than 8-in. on center and no greater than 12-in. on center. Radiant baffles shall be installed at the mid-point between all lampholders and along the perimeter of the lampholder array. The radiant baffles shall be constructed of an opaque, rigid material and shall be a minimum of 10-in. in height. The exterior of the Elevated Temperature Testing Apparatus shall be sealed and insulated to a minimum level of R-13 on all four sides and the hood. The sides of the apparatus shall extend a minimum of 12-in. below the bottom of the radiant baffles and shall have an intake section a minimum of 6-in. in height below the sides of the apparatus. The slope of the hood of the apparatus shall be at least 30° above the horizontal. The top of the hood shall be equipped with an exhaust fan and louver. The fan shall be sized to deliver a minimum of 4.0 cubic feet per minute (cfm) per square foot of apparatus area net of intake and exhaust restrictions. The exhaust fan shall be thermostatically controlled to maintain the appropriate ambient temperature within the apparatus. The louver shall automatically close when the fan is not operating.



8.4 Temperature Measurement Locations

The apparatus shall be equipped with at least four ambient temperature measurement locations. These locations shall include at least two locations between 16 and 24 inches measured inwards from the perimeter of the apparatus and at least two locations between 16 and 24 inches measured outwards from the center of the apparatus. The operating temperature of the apparatus is then defined as the average of at least four temperature readings within the apparatus. The location of the ambient temperature measurement points shall be midway between the ballast housing midpoint (defined as half of the distance between the reflectorized glass and the metal screw-in contact) and the closest portion of the radiant baffles. The measurement point shall be located vertically at the height of the ballast housing midpoint.

8.5 Photometric Measurement

The photometric measurement device shall consist of a securely mounted photodetector positioned such that the plane of its detector is horizontal. Sufficient shielding shall be incorporated such that only the light from the lamp under test is measured. This shielding can be accomplished by the use of a flat-black-painted tube that extends from the photodetector to the bottom edge of the radiant baffles. Additionally, it is recommended that a piece of diffuse transmissive material be installed above the photodetector to diminish the sensitivity of the measurement from minor misalignments of the photodetector.

Photometric measurements need to be acquired at a time when the light output of the lamp has reached a steady state. As a result, the photometric measurements shall be acquired at a point at least two hours after the beginning of an on-cycle of the lamps. In the situation where the specified measurement time occurs before the lamp has reached its steady state operating time, the lamp shall be measured at the closest steady state period.

8.6 Lamp Monitoring

The lamps shall be monitored for continued operation at a period in accordance with Section 6 of IES LM-65.

8.7 Test Procedure

- a) Season ten lamps according to Section 3.1.
- b) At the 100-hour point, record the photometric measurement for each lamp per Section 8.5.
- c) Operate lamps according to Section 8.1.
- d) Monitor the lamps according to Section 8.6.
- e) At the 1,000-hour point, repeat steps b) thru d).
- f) At 40% of the lamps' rated life, repeat steps b) thru d).
- g) Continue to monitor the lamps according to Section 8.6 until rated life is achieved.

8.8 Test Report

The test report shall include at least the following test information:

- a) Manufacturer's name and product identification
- b) Name and location of testing facility
- c) Test date
- d) Photometric measurements at 100 hours, 1,000 hours, and 40% of rated life.
- e) Elevated Temperature 1000-hour Lumen Maintenance calculated as the 1000-hour illuminance divided by the 100-hour illuminance, expressed as a percentage.
- f) Elevated Temperature Lumen Maintenance at 40% of Rated Life calculated as the 40% of rated life illuminance divided by the 100-hour illuminance, expressed as a percentage.
- g) Number of hours of operation before failure or note that the lamp reached rated life.
- h) Notes describing the envelop failure (broken glass, cracking or excessive discoloration) of any lamp that completes testing.

9. References

1. IES LM-28-89. 1989. *Guide for the Selection, Care, and Use of Electrical Instruments in the Photometric Laboratory*, IES Testing Procedures Committee, Illuminating Engineering Society of North America, New York.
2. IES LM-65-01. 2001. *IES Approved Method for Life Testing of Compact Fluorescent Lamps*, IES Testing Procedures Committee, Illuminating Engineering Society of North America, New York.
3. CIE-18.2.1983. *The Basis of Physical Photometry*, Commission Internationale de l'Eclairage, Bureau Central de la CIE, Vienna.
4. UL 1598-2004. 2004. *UL Standard for Safety for Luminaires*, ANSI/UL, Underwriters Laboratories, Northbrook, Illinois.
5. IES LM-54-99. 1999. *IESNA Testing Procedures Committee, IES Guide to Lamp Seasoning*, Illuminating Engineering Society of North America, New York.
6. IES LM-41-98. 1998. *IES Testing Procedures Committee, Approved Method for Photometric Testing of Indoor Fluorescent Luminaires*, Illuminating Engineering Society of North America, New York.
7. IES LM-66-00. 2000. *IES Testing Procedures Committee, Electrical and Photometric Measurements of Single-Ended Compact Fluorescent Lamps*, Illuminating Engineering Society of North America, New York.