



ENERGY STAR® Program Requirements for Decorative Light Strings

Test Procedure and Eligibility Criteria

Draft Version 1.2

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The intent of this initiative is to reduce seasonal peak electricity consumption by encouraging consumers to use quality, energy-efficient decorative light strings.

This document describes the test procedure and eligibility criteria that candidate decorative light strings must undergo to determine eligibility for ENERGY STAR® certification. A light string must meet all of the identified criteria if it is to be labelled as an ENERGY STAR® product by its manufacturer.

This document includes tests that assess both the energy-efficiency and quality of decorative light strings, and is comprised of the following:

- Inspection and Power Test,
- Over-Voltage Test,
- Lifetime Test, and
- Accelerated Weathering Test.

1) Definitions:

- A. Decorative Light String - String of lamps used for a decorative purpose. The lamps may be replaceable or sealed into the lampholder.
- B. Series Block - A number of lamps connected in series, or utilizing a series connection. Additional series blocks can be added to the circuit (or light string) utilizing parallel connections (e.g., a 70-lamp light string could have two 35-lamp series blocks connected in parallel).

- C. Maintained Light Output – The decrease in light output of a decorative light string after a 1000-hour testing period expressed as a percentage of light output of the string following a 24-hour seasoning period.
- D. Input Power - The total, or system, power used by the decorative string during operation, measured in watts, including transformers, adaptors, etc. For power adaptors that can accommodate multiple strings, the input power should be measured with the rated maximum number of strings attached.
- E. Watts per Lamp – The input power divided by the number of lamps on the decorative light string (or strings, in the case of power adaptors that can accommodate multiple strings).
- F. Voltage RMS AC – The measured root-mean-square value of a voltage with alternating current.

- 2) **Reference Standards:** ENERGY STAR® qualified decorative holiday strings must comply with the applicable safety standards and relevant clauses from the Canadian Standards Association, Underwriters Laboratories and any other applicable global standards organizations, unless the requirements of the ENERGY STAR® specification are more restrictive. Relevant standards include, but are not limited to:

ASTM International (ASTM)

ASTM G 154 – 05, *Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials*

Canadian Standards Association (CSA)

CSA-22.2 No.37-M1989 (R2004) *Christmas Tree and Other Decorative Lighting Outfits*

Commission Internationale de l'Eclairage (CIE)

CIE 84-1989, *The Measurement of Luminous Flux*

CIE 127-1997, *Measurement of LEDs*

Illuminating Engineering Society of North America (IESNA)

IESNA TM-16-05, *IESNA Technical Memorandum on Light Emitting Diode (LED) Sources and Systems*

Underwriters Laboratories Inc. (UL)

UL 588-2004, *Standard for Seasonal and Holiday Decorative Products*

- 3) **Qualifying Products:** In order to qualify for the ENERGY STAR® label, a decorative light string must meet the definition in Section 1.A and the specification requirements provided in Section 4, below.
- 4) **Tests and Energy-Efficiency Specifications for Qualifying Products:** In order to qualify for the ENERGY STAR® label, the product must comply with the requirements of Section 2 and the average results of a sample of three strings shall meet all the criteria in this section. Due to the physical impacts of the tests in sections 4.3 and 4.4, different strings of the same model may be used to assess compliance with the ENERGY STAR® requirements. If a decorative light string is labelled for indoor use only, it does not have to pass the Accelerated Weathering Test in section 4.4 in order to qualify for ENERGY STAR®.

4.1. Inspection and Power Test

The steps in this test shall be conducted for all strings tested by this test procedure.

- 4.1.1. Operate the decorative light string for a 24 hour ($\pm 1\%$) “seasoning” period.
- 4.1.2. Check to ensure that if lamp lifetime is stated on the box, the claim should be 25,000 hours or more.
- 4.1.3. Check lamps type: sealed or plug-in. If plug-in, the socket / lamp must have a marking or means to enable correct insertion of replacement lamps. If included with package, check that plug-in diodes, resistors, etc. cannot be incorrectly swapped with spare lamps.
- 4.1.4. Count lamps per string and ensure this is consistent with the packaging label. Measure input power and current at 120 volts $\pm 2\%$ RMS AC. For systems with power adaptors that can accommodate multiple light strings, the input power should be measured with the rated maximum number of strings attached. Calculate the input power consumed per lamp operated. The input power consumption per lamp should not exceed 0.1 watts.

4.2. Over-Voltage Test

Light strings will be energized at 132 volts RMS AC for one hour and examined for failure. Failure can be either the entire string or series block becoming inoperative or an individual lamp or lamps cease to emit light or are much dimmer than other lamps on the string. Count the number of lamps that have failed and calculate the failed lamps as a

percentage of total lamps on the string and round the percentage up to the nearest whole number. The number of failed lamps on the string should be less than X%.

4.3. Lifetime Test

A decorative light string shall be tested for maintaining light output as described in the steps below.

- 4.3.1. Assemble the decorative light string into a testing configuration by bundling the string together so that all lamps are directed outward. The assembly shall be made as compact as possible and taped together with Teflon[®] tape to maintain the relative positioning of the lamps throughout this test.



Figure 1. Sample Test Setup

Figure 1 shows a sample test setup.

- 4.3.2. Measure the light output of the assembly following the guidelines contained in CIE Publication 84-1989, *The Measurement of Luminous Flux*.
- 4.3.3. Keeping the testing assembly intact (i.e., do not remove the tape, or move any of the lamps), operate the assembly for 1000 hours ($\pm 1\%$) continuously. This period of operation (41 days, 16 hours) may be conducted using a test bench facility (i.e., outside the measuring device), provided that none of the lamps in the assembly have been moved relative to each other.
- 4.3.4. Conduct a second measurement of the light output following the same procedure in step 4.3.3 above. Calculate the maintained light output which shall not have degraded by more than XX%.
- 4.3.5. Count the number of failed lamps (as per test 4.2) and record the failed lamps as a percentage of total lamps on the string and round the percentage up to the nearest whole number. The number of failed lamps on the string should be less than X%.

4.4. Accelerated Weathering Test

This test assesses the integrity of lamp mounting sockets and the durability of lamp lenses/diffusers when exposed to simulated weathering conditions. Strings that are labelled for indoor use only should not be subjected to this test. The steps to follow for

this test are outlined below.

- 4.4.1. Measure the light output of the string following steps 4.3.1 through 4.3.3 in test 4.3 above.
 - 4.4.2. Being careful not to disturb the assembly, load it into a testing chamber and subject the string to the exposure conditions contained in Cycle 7 of Table X2.1 of ASTM G154-05. Each cycle of this test includes 8 hours of UV light (340 nm at 1.55 W/m²/nm) at 60°C, 0.25 hours of water spray, and 3.75 hours of condensation at 50°C. The decorative lamp strings under test shall be operated for the duration of this test at 120 volts AC RMS inside the ASTM G154-05 testing chamber. The strings shall be subjected to 10 consecutive iterations of Cycle 7 under Table X2.1 for a total of 120 hours.
 - 4.4.3. The light string assembly shall then be removed from the ASTM G154-05 testing chamber and inserted into an integrating sphere per step 4.3.3 above, and a second light output measurement taken. Calculate the percent maintained light output, rounded up to the nearest whole number, which shall not have degraded by more than XX%.
 - 4.4.4. Count the number of failed lamps (as per test 4.2) and record the failed lamps as a percentage of total lamps on the string, with that percentage rounded up to the nearest whole number. The percentage of failed lamps on the string shall be less than X%.
- 5) **Product Approval:** All decorative light strings shall have CSA, UL or other appropriate safety rating. Those strings labelled for outdoor / exterior use shall be CSA or UL approved for outdoor / exterior use.
 - 6) **Warranty:** All decorative light strings shall be offered with a minimum 3-year warranty against all product defects.
 - 7) **Packaging:** The packaging containing the product shall specify:
 - Product's suitability for use indoor and/or outdoor,
 - Number of LED lamps,
 - Total lighted length of string in appropriate metric and SAE units, and

- Wattage of light string.

The light string should be labelled with the following information:

- Certification agency,
- Rating for indoor or outdoor use, and
- Maximum number of light strings that can be connected end to end.

- 8) **Testing Criteria:** In order to qualify their products for ENERGY STAR[®], manufacturers are required to submit three samples of each product model (i.e., **Stock Keeping Unit (SKU) number**) they wish to qualify to a third-party laboratory approved by Natural Resources Canada. Manufacturers are invited to submit names of candidate testing laboratories to Natural Resources Canada for consideration.
- 9) **Effective Date:** The date that a manufacturer begins to qualify products as ENERGY STAR[®] will be defined as the *effective date* of the agreement.
- 10) **Future Specification Revisions:** ENERGY STAR[®] reserves the right to change the 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 will be arrived at through stakeholder discussion and consultation.