

Proposal for Standards – LED Lamps

Appliance Efficiency Standards and Measures

for California Energy Commission’s Invitation to Submit Proposals

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1 Executive summary

The growing popularity and energy-efficiency potential of Light Emitting Diode (LED) products has contributed to a surge in sales and interest in these products in the last 5 years. Because LED, or Solid State Lighting (SSL), technology is in its infancy, concerns exist about product performance and reliability. Likewise, there is a desire to do what can reasonably be done to prevent poor quality products, from having a deleterious impact on consumer acceptance of this more energy-efficient product. . Carefully chosen minimum performance standards for LED products can assist in forming and promoting positive consumer reaction to this new technology. In this proposal, NEMA offers suggested minimum performance requirements for screw-based retrofit LED lamps, which are supplied today to both the residential and commercial markets. Because the market is rapidly evolving, we do not focus on maximizing energy savings, which could focus on one design option or on a subset of design options and in so doing could inadvertently restrict innovation and lose greater energy savings down the road. Instead, we present several well-known performance parameters which can be used as tools to help grow the market through the establishment and enforcement of simple, effective minimum performance regulations. These parameters are based on our existing Standard NEMA SSL-4 2012¹.

2 Product Description and Proposal Scope

2.1 Technical Description

This proposal applies to integral Light Emitting Diode (LED) lamps, as defined below. This proposal applies to an LED Lamp which:

- (1) intended for general service applications;
- (2) has a medium screw base;
- (3) has a lumen range of not less than 310 lumens and not more than 2,600 lumens; and
- (4) is capable of being operated at a voltage range at least partially within 110 and 130 volts.

Proposed new definitions: (adapted from the ENERGY STAR Lamps specification)

Covered Lamp: A lamp with an integral ballast or driver and a translucent envelope over the light source(s).

Decorative Lamp: A lamp with a candle-like or globe shape envelope including shapes B, BA, C, CA, DC, G and F as defined in ANSI C79.1-2002.

¹ <http://www.nema.org/Standards/Pages/Retrofit-Lamps-Minimum-Performance-Requirements.aspx>

Integrated LED Lamp: An integrated assembly comprised of LED packages (components) or LED arrays (modules), LED driver, ANSI standard base and other optical, thermal, mechanical and electrical components. The device is intended to connect directly to the branch circuit through a corresponding ANSI standard lamp-holder (socket). (ANSI/IES RP-16-10)

Omnidirectional Lamp: A general service replacement lamp with an ANSI standard base that emits the majority of light produced in an even distribution. See Luminous Intensity Distribution requirement for omnidirectional lamps. These lamps can be standard; having an ANSI standard lamp shape of A, BT, P, PS, S or T, or non-standard

2.2 Technologies and Best Practices for Energy/Water Efficiency

Many regulators, specifiers and consumers have noted the energy-savings potential in LED lighting, and we believe that regulations-based encouragement of good-quality, well-performing products will increase their popularity and the associated energy savings therewith.

2.3 Design Life

NEMA does not have a recommended design life, nor is there an accepted public figure to use for typical LED Lamp design life for the purposes of estimating lifetime energy savings. In existing code requirements, we note that CEC follows Federal guidelines for CFL minimum lifetime. NEMA agrees with a Federal approach, rather than a State-by-State approach. Because there is no Federal minimum lifetime requirement for LEDs we suggest the CEC not mandate one at this time. However, if the CEC feels strongly about requiring a minimum lifetime for LED Lamps, we suggest harmonizing with the ENERGY STAR Lamps program.

2.4 Manufacturing Cycle

LEDs are a growing technology and many new products are being introduced every year.

2.5 Product Classes

NEMA suggests two classes of products: Omnidirectional, and Decorative. We propose this new regulation apply only to integrally ballasted medium screw base products at this time, as per our proposed definitions in item 2.1.

3 Unit Energy/Water Usage

The unit energy usage of these products is as much as 80% less than the products they are designed to replace. The purpose of our proposal is to assure quality and integrity of LED Lamps. Since there is no long-established product class to “improve” as is often the case with efficiency regulations, our proposal does not focus on the energy improvements of the class or “raising the bar”, this proposal establishes that first bar. As consumers begin to try out these products, satisfactory performance is critical to proliferation of these highly-efficient products throughout homes and offices.

3.1 Duty Cycle

Duty cycle varies by application.

3.2 Efficiency Levels

Recommended efficiency levels are contained in the text of our proposal under item 6.

3.3 Energy and/or Water Consumption

Significant energy savings are possible by migrating to LED lamp technology.

4 Market Saturation and Sales

4.1 California Stock and Sales

NEMA does not collect state-specific stock and sales figures.

4.2 Efficiency Options: Current Market and Future Market Adoption

This proposal encourages adoption of LED technology by ensuring customer satisfaction, which will result in energy savings as older technologies are displaced.

5 Statewide Energy Usage

NEMA does not gather State-level energy usage figures. However, this information is available from other stakeholders and we expect to leverage that data during the proposal refinement process.

6 Proposal

6.1 Summary of proposal

NEMA proposals minimum performance requirements for LED Lamps be established for the parameters of; 1) Correlated Color Temperature (CCT), 2) Color Rendering Index (CRI), 3) Luminous efficacy, 4) Lumen/light output, and 5) Lumen maintenance (life).

6.2 Implementation Plan

As with existing California Title 20 requirements, compliance would be self-reported to a CEC-managed database and enforced per existing (and emerging) processes.

6.3 Proposed Test Procedure(s)

CCT: IES LM-79-08, ANSI C78-377-2008

CRI: IES LM-79-08, ANSI C78.377-2008, CIE 13.3-1995

Luminous Efficacy: IES LM-79-08

Light Output: IES LM-79-08

Lumen Maintenance: IES LM-79-08 and IES LM-80-08

6.4 Proposed Regulatory Language

Minimum Performance Parameters for All Lamps

Criteria Item	Minimum Requirements			Reference Standard/ Test Method	Sample Size/Specific Requirements	Laboratory Requirements
Correlated Color Temperature (CCT) and Duv	Lamp must have one of the following designated CCTs (per ANSI C78.377-2008) consistent with the 7-step chromaticity quadrangles and Duv tolerances listed below.			LM-79-08 ANSI C78-377-2008	10 units per model - 5 base-up - 5 base-down* At least 9 of the 10 samples must meet the specification	NVLAP accredited laboratory ² for LM-79-08
	Nominal CCT	Target CCT (K) and tolerance	Target Duv and tolerance			
	2700 K	2725 ± 145	0.000 ± 0.006			
	3000 K	3045 ± 175	0.000 ± 0.006			
	3500 K	3465 ± 245	0.000 ± 0.006			
	4000 K	3985 ± 275	0.001 ± 0.006			

² This will align CEC requirements with existing DOE Federal requirements

Color Rendering Index (CRI)	Minimum CRI (Ra) of 80. In addition, the R9 value must be greater than 0.	LM-79-08 ANSI C78.377-2008 CIE 13.3-1995	10 units per model - 5 base-up - 5 base-down* Average of 10 samples must meet specification; none lower than 77	NVLAP accredited laboratory ³ for LM-79-08
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* In the case of lamps where the manufacturer specifies restricted use or position, test the total number of samples in the recommended position.

Additional Requirements for Omnidirectional Lamp Types

Criteria Item	Minimum Requirements	Reference Standard/ Test Method	Sample Size/Specific Requirements	Laboratory Requirements
Minimum Luminous Efficacy - LED lamp power <10W - LED lamp power ≥10W	40 lm/W 45 lm/W	LM-79-08	6 units per model - 3 base-up - 3 base-down* At least 4 of the 6 samples must meet the specification	NVLAP accredited laboratory ⁴ for LM-79-08
Minimum Light Output	Lamp shall have minimum light output (initial total luminous flux) at least corresponding to the target wattage of the lamp to be replaced, as shown below. Target wattages between the given levels may be interpolated.	LM-79-08	6 units per model - 3 base-up - 3 base-down* 4 of 6 samples must Meet specification;	NVLAP accredited laboratory ⁵ for LM-79-08
	LM-79-08 Nominal wattage of lamp to be replaced (watts)	Minimum initial light output of LED lamp (lumens)		
	25	180		
	35	270		
	40	310		
	60	750		
	75	1,050		
	100	1,490		
	125	1,870		
	150	2,250		

³ This will align CEC requirements with existing DOE Federal requirements

⁴ This will align CEC requirements with existing DOE Federal requirements

⁵ This will align CEC requirements with existing DOE Federal requirements

Maximum Lamp Diameter	Not to exceed target lamp diameter as per ANSI C78.20-2003.	ANSI C78.20-2003		Self-certification
Maximum Overall Length (MOL)	Not to exceed MOL for target lamp as per ANSI C78.20-2003.	ANSI C78.20-2003		Self-certification
Lumen Maintenance	≥ 70% lumen maintenance (L70) at 10,000 hours of operation.	LM-79-08; Elevated Temperature Test per ENERGY STAR CFL version 4.0; LM-80-08 (for early initial	10 units per model - 5 base-up - 5 base-down* - LED lamp power <10W must operate at 25°C between measurements. - LED lamp power ≥10W must operate	NVLAP accredited laboratory ⁶ for LM-80

* In the case of lamps where the manufacturer specifies restricted use or position, test the total number of samples in the recommended position.

Additional Requirements for Decorative Lamp Types

Criteria Item	Minimum Requirements	Reference Standard/ Test Method	Sample Size/Specific Requirements	Laboratory Requirements
Minimum Luminous Efficacy	30 lm/W	LM-79-08	6 units per model - 3 base-up - 3 base-down* At least 4 of the 6 samples must meet the specification	NVLAP accredited laboratory ⁷ for LM-79-08
Minimum Light Output	Lamp shall have minimum light output (total luminous flux) at least corresponding to the target wattage of the lamp to be replaced, as shown below. Target wattages between the given levels may be interpolated.	LM-79-08	6 units per model - 3 base-up - 3 base-down* 4 of 6 samples must meet the specification	NVLAP accredited laboratory ⁸

⁶ This will align CEC requirements with existing DOE Federal requirements

⁷ This will align CEC requirements with existing DOE Federal requirements

⁸ This will align CEC requirements with existing DOE Federal requirements

	Nominal wattage of lamp to be replaced (watts) 10 15 25 40 60	Minimum initial light output of LED lamp (lumens) 50 70 1225 250 400		
Lumen Maintenance	≥ 70% lumen maintenance (L70) at 10,000 hours of operation	LM-79-08; LM-80-08 (for early initial qualification option)	10 units per model - 5 base-up - 5 base-down* - Must operate at 25°C between measurements. -Average of 6 samples must be ≥ 89.9% at 3000 hours	NVLAP accredited laboratory ⁹

* In the case of lamps where the manufacturer specifies restricted use or position, test the total number of samples in the recommended position.

7 Technological Feasibility

All proposed parameters are within the limits of current technology.

8 Economic Analysis

There is no anticipated increase in the cost of products as a result of adherence to these proposed parameters.

8.1 Incremental First Costs

N/A

8.2 Incremental Operating Costs and Savings

N/A

8.3 Infrastructure Costs and Savings

N/A

8.4 State or Local Government Costs and Savings

N/A

8.5 Business Impacts

N/A

⁹ This will align CEC requirements with existing DOE Federal requirements

8.6 Lifecycle Cost and Net Benefit

N/A

9 Savings Potential

This proposal encourages adoption of LED technology by ensuring customer satisfaction, which will result in energy savings as older technologies are displaced.

10 Acceptance Issues

It is our belief that acceptance and promulgation of these performance requirements will increase acceptance, with no negative impacts.

11 Environmental and Societal Impacts

N/A

12 Federal Preemption or Other Regulatory or Legislative Considerations

There are currently no Federal or Other Regulatory preemption considerations for this technology. The U.S. DOE is authorized to conduct a rulemaking to establish minimum energy-efficiency requirements for these products.

13 Methodology for Calculating Cost and Savings

N/A

14 Bibliography and Other Research

N/A

APPENDIX: Cost Analysis Assumptions

NEMA supports the figures as suggested during the August 31, 2011 scoping workshop.

“The cost of electricity: \$0.15 per kWh

The cost of natural gas: \$1 per therm

The cost of water: \$0.0052 per gallon

Discount rate: 3%”