DOCKETED

Docket Number:	15-AAER-06
Project Title:	Small Diameter Directional LED Lamps and General Purpose LED Lamps
TN #:	215137
Document Title:	Final Statement of Reasons, Updated Informative Digest and Response to Comments: Lighting Efficiency Standards
Description:	September 2016
Filer:	Soheila Pasha
Organization:	California Energy Commission
Submitter Role:	Commission Staff
Submission Date:	1/3/2017 12:36:31 PM
Docketed Date:	1/3/2017

FINAL STATEMENT OF REASONS, UPDATED INFORMATIVE DIGEST AND RESPONSE TO COMMENTS: LIGHTING EFFICIENCY STANDARDS

CALIFORNIA CODE OF REGULATIONS, TITLE 20:

CHAPTER 2, SUBCHAPTER 4, ARTICLE 4,

SECTIONS 1601-1607: APPLIANCE EFFICIENCY REGULATIONS

CALIFORNIA ENERGY COMMISSION

DOCKET NUMBER 15-AAER-06
OFFICE OF ADMINISTRATIVE LAW
NOTICE FILE NUMBER Z 2015-1005-02

California Energy Commission
Edmund G. Brown Jr., Governor

September 2016

INTRODUCTION

This document is the Final Statement of Reasons (FSOR) and includes the Updated Informative Digest required by Government Code sections 11346.5(a)(19), 11346.9, and 11347.3(b)(2). Attached to this FSOR, as Attachment A, are the responses to all comments received during the noticed comment periods related to this rulemaking.

The Commission's appliance efficiency standards, contained in California Code of Regulations, title 20, section 1601 et seq., apply to about 20 categories of appliances sold or offered for sale in California. The standards include minimum levels of operating efficiency, and other cost effective measures, to promote the use of energy and water-efficient appliances. Title 20 rulemaking is subject to Energy Commission adoption and Office of Administrative Law approval. In contrast, the Commission's Title 24 regulations, commonly known as California's Building Standards, are subject to adoption by the Energy Commission and to approval by the Building Standards Commission. The Building Standards ensure that cost-effective energy efficiency measures are incorporated into each new building during design and construction and when additions and alterations are made to existing buildings.

The amendments in this rulemaking cover two distinct areas: (1) energy efficiency standards for small diameter directional lamps (SDDL) and (2) energy efficiency standards for general service Light Emitting Diode (LED) lamps. These amendments are appropriate under the Energy Commission's California Code of Regulations title 20 appliance energy efficiency program because the regulations cover lighting appliances, are not related to building design or construction, and the point of enforcement is the sale or offer for sale of these covered appliances.

Since 1975, California's building and appliance energy efficiency standards have saved Californians an estimated $75 billion in reduced electricity bills. The state's appliance efficiency regulations saved an estimated 22,923 gigawatt hours (GWh) of electricity and 1,626 million therms of natural gas in 2012 alone, resulting in about $5.24 billion in savings to California consumers. The proposed standards represent the next step in California's long history of resource efficiency and economic savings.

The proposed SDDL and LED standards will provide cumulative electricity savings of 32,418 GWh over the first 10 years of implementation and monetary savings of $4.2 billion to California consumers over that period. Estimated job years will increase by an average of 4,161 under the proposed regulations. In addition, the proposed standards yield an estimated $5.69 billion increase in real disposable personal income between 2017 through 2029, which is beneficial for the California economy.

PROCEDURAL HISTORY OF THE RULEMAKING

On October 15, 2015, the Energy Commission (Commission) published and posted on its website a Notice of Availability and Hearing for the Initial Study and Proposed Negative Declaration for the proposed amendments.

On October 16, 2015, the Office of Administrative Law published a Notice of Proposed Action (NOPA) concerning the potential adoption of proposed amendments to the Appliance Efficiency Regulations (Express Terms or 45-day language). The NOPA and 45-day language were also posted on the Commission's website on October 15, 2015.

The first public hearing listed in the NOPA, was held on November 18, 2015, where public comments were received.

On November 23, 2015, the Commission published a notice postponing the adoption hearing from December 9, 2015 to January 13, 2016.

On December 28, 2015, the Commission published and posted on its website amendments to the express terms, 15-day language and provided a 15-day public comment period and published a supplemental Initial Statement of Reasons.

On January 7, 2016, the Commission published and posted on its website a notice postponing the adoption hearing from January 13, 2016 to January 27, 2016, revising 15-day language, and extending the comment period until January 22, 1016.

On January 27, 2016, after the end of the extended comment period, the Commission held a hearing to consider approving a resolution adopting the proposed revised 15-day language, and adopting a negative declaration under the California Environmental Quality Act.

Public comments were taken at the hearing. After considering both the public testimony at the hearing and the comments submitted during the noticed comment periods, the Commission unanimously approved the resolution adopting the revised 15-day language and negative declaration.

UPDATED INFORMATIVE DIGEST (Gov Code Sections 11346.9(b) and 11347.3(b)(2))

In accordance with Government Code section 11346.9(d), the Informative Digest contained in the NOPA is incorporated by reference. There have been no changes in applicable laws or to the effect of the proposed regulations from the laws and effects described in the NOPA relating to SDDL and LED lamps. The proposed amendments are not inconsistent or incompatible with existing state regulations. The Commission has reviewed whether there are any related state regulations in this area and has determined that the only other state regulations related to energy efficiency are in Title 24, Part 6, of the California Code of Regulations. The proposed Title 20 amendments are separate and distinct from the provisions in Title 24, Part 6, and have different points of enforcement. The proposed Title 20 amendments are neither inconsistent nor incompatible with existing Title 24 or any other state regulation.

UPDATE TO THE INITIAL STATEMENT OF REASONS (Gov Code Section 11346.9(a)(1))

Government Code section 11346.9(a)(1) requires the FSOR to contain an update of the information contained in the Initial Statement of Reasons and in this case, a supplemental Initial Statement of Reasons. Other than those changes noted below, no other changes to the Initial Statement of Reasons or supplemental Initial Statement of Reasons are necessary, and those items not addressed are hereby incorporated by reference. The language changes included in the 15-day and revised 15-day language are indicated in double underline or double strikeout.

Many of these changes were the result of stakeholder comments requesting the Commission to exclude some specialty lamps and to ensure there were no overlapping regulations covering both SDDL and LED products.

15-day and revised 15-day language changes included:

1. Adding a definition for “directional lamp”;

2. Changing the definition of "State-regulated SDDL" to modify the scope of the proposed standards;
3. Modifying the Tier 1 and Tier 2 effective dates for state-regulated LED lamps;
4. Modifying the Tier 1 compliance equation for state-regulated LED lamps;
5. Making changes to light distribution requirements for omnidirectional state-regulated LED lamps;
6. Referencing industry standard for chromaticity requirements;
7. Adding effective dates for marking requirements;
8. Requiring lamps to meet claims of wattage equivalency with correlated lumen output; and
9. Making other minor clarifying changes to the proposed regulations.

Section 1602. Definitions.

"Directional lamp" means a lamp that has at least 80 percent of light output within a solid angle of π steradian corresponding to a cone with an angle of 120°.

This definition was added in the 15-day language based on stakeholder comments to provide additional clarity as to the meaning of a directional lamp. The language is derived from standard industry-wide characteristics of lamps that provide directional beams of light as opposed to omnidirectional light output.

"State-regulated small diameter directional lamp" means a directional lamp ~~with a diameter of less than or equal to 2.25 inches and a GU10, GU11, GU5.3, GUX5.3, GU8, GU4, or E26 base~~ that meets all of the following criteria:

1. Capable of operating at 12 volts, 24 volts, or 120 volts;
2. Has an ANSI ANSLG C81.61-2009 (R2014) compliant pin base or E26 base;
3. Is a non-tubular directional lamp with a diameter of less than or equal to 2.25 inches;
4. Has a lumen output of less than or equal to 850 lumens, or has a wattage of 75 watts or less; and
5. Has a rated life greater than 300 hours.

State-regulated small diameter directional lamp includes incandescent filament, LED, and any other lighting technology that falls within this definition. State-regulated small diameter directional lamp does not include ~~products that use LEDs and have an E26 base, which are~~ directional lamps with an E26 base that utilize light emitting diodes (LEDs) and are covered under the definition of state-regulated Light Emitting Diode Lamps.

Changes were made to the definition of "state-regulated small diameter directional lamp" in the 15-day language and revised 15-day language based on comments and discussions with stakeholders. The language was changed to exclude some types of specialty lamps that lacked energy efficient substitutes. The language was also changed to ensure there was not overlapping coverage between the lamps that are included within the definition of SDDLs and lamps that fall under the LED definition.

The changes address many of the comments received on the 45-day language as are noted in the responses to comments. The bold text in the last paragraph of the definition, "State-regulated" was not included in the 15-day language but is being added to the definition in the final version of the language to be published by the Secretary of State. Addition of the phrase "State-regulated" maintains consistency throughout the text of the definition but otherwise has no regulatory effect and would not require 15-day notice because the entire definition is only in regards to state-regulated small diameter directional lamps.

Additional documents incorporated by reference include:

ANSI ANSLG C81.61-2009 (R2014) American National Standard for Electrical Lamp Bases – Specifications for Bases (Caps) for Electric Lamps

The changes in the definition to SDDLs include incorporation of an ANSI standard; thus, the standard was added in the 15-day language to the documents incorporated by reference.

Section 1604. Test Methods for Specific Appliances.

(k) Lamps

(4) The test methods for LED state-regulated small diameter directional lamps and state regulated LED lamps ~~is IES LM-79-08~~ are contained in Table K-1. For certification, compliance, and enforcement purposes, the sampling provisions in 80 Fed. Reg. 39664-39665 (July 9, 2015) shall be used.

Table K-1
Test Methods for State-Regulated LED Lamps and LED State-Regulated SDDL

Measurement	Test Procedure	Required or Optional*
Input power, Lumen output, Lumens per Watt, Correlated Color Temperature, Duv, Color Rendering Index, Power Factor	IES LM-79 (2008) with additional ~~guidance~~ requirements provided in 80 Fed. Reg. 39665-39666 (July 9, 2015), §430.23(dd) and Appendix BB to Subpart B of Part 430.	Required
Lumen Maintenance and Time to Failure	IES LM-84 (2014) and TM-28 (2014) with additional ~~guidance~~ requirements provided in 80 Fed. Reg. 39665-39667 (July 9, 2015), §430.23(dd) and Appendix BB to Subpart B of Part 430.	Required
Standby Power	IEC 62301 (2011) with additional ~~guidance~~ requirements provided in 80 Fed. Reg. 39667 (July 9, 2015) and with the following additional ~~guidance~~ requirements for connected LED lamps: (A) Ensure that the lamp is connected to only one network type and the lamp is in Network Mode (i) If lamp has ability to connect to multiple networks, only one network shall be tested, and the network selected for testing shall be selected using the following prioritization: 1. Wi-Fi 2. ZigBee 3. ANT 4. Bluetooth 5. RF 6. Wired 7. Other (B) Measure standby power as described in section 5.3.2 of IEC 62301 (2011) for a total period of no	Required

	less than 60 minutes. (i) Standby power ~~should~~ shall be measured at a lamp that is a distance of 10 meters (+/- 0.5 meters) from the hub, or wireless controller if no hub exists. If connection is not possible at this distance, conduct testing within 1 meter of the maximum connection distance. (C) To calculate standby power, divide the accumulated energy consumption in watt-hours by the duration of the test in hours. Record this value as the average Network Standby Power. For lamps that are not connected LED lamps, record this value as "not applicable."	
Flicker	Title 24, part 6, Joint Appendix 10 (2015), tested at both 100% and 20% output. Lamps with a percent amplitude modulation (percent flicker) less than 30 percent at frequencies less than 200Hz shall report "yes" for "reduced flicker operation" described in section 1606, otherwise report "no."	Optional
Lumen Maintenance, Rated Life, and Survival Rate for Compliance with Title 24 Joint Appendix 8 and minimum dimming level.	Title 24, part 6, Joint Appendix 8 (2015).	Optional
Audible Noise	ENERGY STAR Recommended Practice – Noise (2013) with the following modification: measurements shall be taken at 100 percent output as well as at 20 percent output if dimmable.	Optional

The language changes were included in the 15-day language based on stakeholder comments on applicable test methods. In addition the language was changed for consistency within title 20 and overall clarity of how the test methods are to be applied. Specifically terms such as "should" and "guidance" were replaced with the more appropriate regulatory language as "shall" and "required".

The Energy Commission incorporated federal sampling provisions in response to stakeholder comments to provide a sufficient sample size of light bulbs for testing and from which conclusions about their efficiency could be drawn. This is different from standard practice under Title 20, in which only one sample of a product need be tested for compliance purposes, and only two for enforcement.

Note regarding all K tables: The general structure of the 1600s in Title 20 is to continue table numbering from one subsection to the next. For example the first K table, K-1, occurs in section 1604 but rather than start over at K-1 in the next section, 1605.1, the tables continue with K-2. Because the set of K tables did not follow this convention with duplicate numbered tables and because a new K-1 table was added, staff is taking the opportunity to renumber the entire set of K tables so that they follow sequentially throughout the regulations.

80 Federal Register ~~39665~~39664-39667 (July 9, 2015)

Energy Conservation Program: Test Procedures for Integrated Light-Emitting Diode Lamps, Proposed Rule

The 15-day language corrected the referenced Federal Register section for the integrated LED lamp test procedures.

~~IES LM-49 (2011)~~ ~~Life Testing of General Lighting Incandescent Filament Lamps~~

The 15-day language included a citation to IES LM-49(2011) as a document incorporated by reference. Addition of this reference was an error as there is no corresponding text in the express terms requiring the referenced test method. Because the regulatory language does not identify the use of IES LM-49, removal of this document incorporated by reference has no regulatory effect. There would be no change in how a manufacturer complies with the standards with deletion of IES LM-49 as a document incorporated by reference because the adopted language does utilize the IES LM-49 test method.

Section 1605.3. State Standards for Non-Federally-Regulated Appliances.

(k) Lamps

(2) Standards for State-Regulated LED Lamps, State-Regulated General Service Incandescent Lamps, General Service Lamps, ~~and~~ and Modified Spectrum Incandescent Lamps~~, and State-Regulated LED Lamps~~. The energy consumption rate of state-regulated general service incandescent lamps, general service lamps, ~~and~~ and modified spectrum general service incandescent lamps~~, and state-regulated LED lamps~~ manufactured on or after the effective dates shown in Tables K-1~~0~~1, K-1~~1~~2, ~~and~~and K-1~~2~~3~~, and K-14~~ shall meet the standards shown in these Tables. The energy consumption rate of state-regulated LED lamps with a lumen output of ~~less than~~ 150 lumens or greater for candelabra bases, or ~~less than~~ 200 lumens or greater for other bases, manufactured on or after the effective dates shown in Table K-14 shall meet the standards shown in that table.

The 15-day language and revised 15-day language was added based on comments received from stakeholders who expressed concerns regarding the standards covering very low lumen lamps. To address these concerns section 1605.3 was changed to add a 150 and 200 lumen threshold depending on the type of LED lamp. Due to erroneously reversing the "less than" and "greater than" terms, the 15-day language accidentally limited the regulatory scope to below 150 lumens for candelabra lamps and below 200 lumens for other lamps when it should have been above 150 lumens and above 200 lumens. The revised 15-day language corrected this obvious error to ensure the correct lumen coverage.

(B) Each lamp described in Section 1605.3(k)(~~3~~ 2)(A) shall have a color rendering index that is greater than or equal to:

1. 80 for nonmodified spectrum lamps; or

2. 75 for modified spectrum lamps.

This change corrects an erroneous cross reference that resulted from renumbering parts of subdivision (k) throughout the regulations. This change has no regulatory effect.

Table K- 1~~2~~3
Standards for State-Regulated Modified Spectrum General Service Incandescent Lamps - Tier I

(C) State-regulated LED lamps with lumen output of ~~150 lumens or greater~~less than ~~less than~~ 150 lumens or greater for candelabra bases, or ~~less than~~ 200 lumens or greater for other bases, and manufactured on or after January 1, ~~2017~~ 2018 shall have:

The 15-day language was added based on comments received from stakeholders who expressed concerns regarding the standards covering very low lumen lamps. To address these concerns section 1605.3(c) was changed to add a 150 and 200 lumen threshold depending on the type of LED lamp. Due to erroneously reversing the "less than" and "greater than" terms, the 15-day language accidentally limited the regulatory scope to below 150 lumens for candelabra lamps and below 200 lumens for other lamps when it should have been above 150 lumens and above 200 lumens. The revised 15-day language corrected this obvious error to ensure the correct lumen coverage.

The effective date for the chromaticity, color rendering, light distribution, product life, and power factor requirements remain in line with the new Tier 1, and so are proposed to take effect on January 1, 2018. More information on this selected date is provided regarding the compliance score, below.

~~(i) a color point with a Duv that is:~~

~~(1) No less than -0.0033~~

~~(2) No greater than 57700 x (1/T)2 – 44.6 x (1/T)+0.0118540.01184 where T means the measured correlated color temperature.~~

(1) A color point that meets the requirements in Table 1 of Annex B of ANSI C78.377-2015 for color targets and color consistency.

Stakeholders raised concerns regarding the use of a Duv as opposed to the Annex B of ANSI C78.377-2015 for color targets and color consistency. Annex B is an industry-developed standard that uses quadrangles instead of ellipses to assess the color consistency (called chromaticity) of a light bulb. Both metrics cover approximately the same color space. Based on these concerns the 15-day language changes were made.

(2) A CRI (Ra) of 82 or greater.

(3) Individual color scores of R1, R2, R3, R4, R5, R6, R7, and R8 of 72 or greater.

(4) A power factor of 0.7 or greater.

(5) A rated life of 10,000 hours or greater as determined by the lumen maintenance and time to failure test procedure.

(6) State-regulated LED lamps that have an ANSI standard lamp shape of A shall meet the ~~following~~ omnidirectional light distribution requirements of ENERGY STAR's Product Specification for Lamps Version 2.0 (December 2015).~~: of ENERGY STAR's Product Specification for Lamps Version 1.1.~~

~~i)~~ ~~80% of the measured luminous intensity values (candelas) shall vary by no more than 35% from the average of all measured values in the 0° to 130° zone.~~

~~ii) All measured luminous intensity values (candelas) shall vary by no more than 60% from the average of all measured values in the 0° to 130° zone.~~

~~iii) No less than 5% of total flux (zonal lumens) shall be emitted in the 130° to 180° zone.~~

~~Where 180° represents light emitted towards a lamp's base and 0° represents light emitted in the opposite direction.~~

The original 15-day language proposed changes to the requirements for omnidirectional light distribution. These were updated in the revised 15-day language to incorporate ENERGY STAR's Product Specification for Lamps Version 2.0, which was updated just after the Energy Commission released its first 15-day language, and that reflects the same set of requirements. The omnidirectional light distribution requirements were amended by both programs to account for challenges that LED lamps have in distributing lumens evenly and consistently throughout every area that an incandescent can. The changes will make it cheaper to comply with the standards while maintaining a distribution that customers expect from incandescent lamps. Updating the reference to ENERGY STAR version 2.0 merely simplifies requirements, as manufacturers are familiar with the ENERGY STAR program.

(7) State-regulated LED lamps that have an ANSI standard lamp shape of B, BA, C, CA, F, or G shall meet the decorative light distribution requirements of ENERGY STAR's Product Specification for Lamps Version 1.1 (August 2014).

The August 2014 date for decorative light distribution was added for clarity and is not a substantive change in the reference incorporated in the regulation.

(D) In addition to the requirements in section 1605.3(k)(2)(C), state-regulated LED lamps manufactured on or after ~~January~~ July 1, 2019 shall have a standby mode power of 0.2 watts or less.

The effective date for the connected standby requirements was updated to align with Tier 2, taking effect July 1, 2019. More information on this selected date is provided regarding the compliance score, below.

Table K-14
Standards for State-Regulated LED Lamps

Effective Date	*Minimum Compliance Score*	*Minimum Efficacy Lumens Per Watt*
January 1, ~~2017~~ 2018	~~277~~ 282	~~65~~ 68
~~January~~ July 1, 2019	297	80
The compliance score shall be calculated as the sum of the efficacy and 2.3 times the CRI of a lamp.		

These changes are proposed to address stakeholder concerns raised during the public comment period on the 45-day language. Stakeholders expressed two primary concerns with the original Tier 1 standard: (a) that the least-cost pathway for meeting the standard was inconsistent with current manufacturer processes with respect to "binning" LED packages and chips, and (b) that the lifetime test would take approximately 4 months to complete, reducing the actual time that manufacturers had to redesign their products. Extending the effective date for Tier 1 addresses both of these concerns by giving manufacturers additional time – more than a year from the originally proposed effective date – to optimize their processes to meet the standards at the least cost. As the cycle time for lamp design is 6-8 months, this gives manufacturers approximately two design cycles as well as time for testing to meet the proposed standard. The Tier 2 effective date

was similarly extended to provide manufacturers time to further improve efficacy and color rendering at low cost.

The compliance numbers were modified in the 15-day language to increase the level of energy efficiency to ensure that the standard is not made irrelevant by the rapid improvements being made in terms of efficacy, quality, and cost of general service LED lamps. Staff has found that a significant number of lamp models already meet the CRI-efficacy tradeoff equation proposed in 15-day language for Tier 1: 349 medium screw-base omnidirectional lamps; 280 medium screw-base directional lamps; and 73 decorative lamps. This demonstrates that the revised compliance equation, all other standards being held constant, remains technically feasible.

(3) State-regulated Small Diameter Directional Lamps. State-regulated small diameter directional lamps manufactured on or after January 1, 2018 must have a rated life of 25,000 hours or greater as determined by the lumen maintenance and time to failure test procedure and meet one of the following requirements:

(A) have luminous efficacy of ≥ at least 80 lumens per watt.

(B) have a minimum luminous efficacy of 70 lumens per watt or greater and a minimum compliance score of 165 or greater, where compliance is calculated as the sum of the luminous efficacy and CRI.

A "≥" was replaced with "at least" for regulatory clarity and is not a substantive change in the proposed 45-day language.

The following documents are incorporated by reference in Section 1605.3.

Number	*Title*
FEDERAL REQUIREMENTS	
AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)	
ANSI C81.61-2006	Specifications for Electric Bases
ANSI C78.377-2015	American National Standard for Electric Lamps – Specifications for the Chromaticity of Solid State Lighting (SSL) Products
Copies available from:	American National Standards Institute 1819 L Street, NW, 6th Floor Washington, DC 20036 www.ansi.org Phone: (202) 293-8020 FAX: (202) 293-92

EPA ENERGY STAR® Program Requirements Product Specification for Lamps (Light Bulbs) Version 1.1 (August 2014)

EPA ENERGY STAR® Program Requirements Product Specification for Lamps (Light Bulbs) Version 2.0 (December 2015)

The documents incorporated by reference were added in the 15-day language to account for the inclusion of the ANSI C78.377-2015 test and the updated Energy Star 2.0 requirements.

Section 1606. Filing by Manufacturers; Listing of Appliances in Database.

Table X Continued - Data Submittal Requirements			
…			
K	State-regulated small diameter directional lamps	Base Type	~~GU-11, GU-5.3, GUX-5.3, GU8, GU-4 and medium screw base~~
		Lamp Type (examples PAR-16, MR-11, MR-16, or R)	
		Lamp Power (Watts)	
		Lamp Output (Lumens)	
		Beam Angle	
		Center Beam Candle Power (CBCP)	
		Efficacy (Lumens per watt) ~~Lumens Per Watt~~	
		~~Minimum lamp efficacy (LPW)~~	
		Color Rendering Index (CRI)	
		Combined CRI + Efficacy	
		Correlated Color Temperature	
		Rated Lifetime (hours)	
	State-regulated medium screw base general service ~~Light Emitting Diode (LED) lamps, and~~ Organic LED (OLED) lamps	Rated lumens	
		Rated lamp wattage	
		Average lamp efficacy	
	State-regulated Light Emitting Diode (LED) lamps	Base Type	E12, E17, E26, GU-24, retrofit kit
		Lamp Shape	
		Light Distribution	Directional, Omnidirectional, Decorative, Spot, Recessed Can
		Dimmable	Yes, no
		Minimum dimming level (%)	
		Reduced Flicker Operation	Yes, no
		Correlated Color Temperature	
		Duv	
		Rated Lifetime (hours)	
		Lifetime test environment temperature	Ambient, Elevated
		Lamp Power (Watts)	
		Lumen Output (Lumens)	
		Efficacy (Lumens per watt)	
		Color Rendering Index (R_a)	
		Compliance Score	
		Power Factor	
		Standby Power (watts)	
		R_1	
		R_2	
		R_3	

		R4	
		R5	
		R6	
		R7	
		R8	
		R9 [2]	
		Meets applicable luminous intensity distribution requirements	~~ENERGY STAR~~ ENERGY STAR® Omnidirectional, California Quality Specification Omnidirectional, ENERGY STAR® Decorative, California Quality Specification Recessed Can Housing Retrofit Kit, California Quality Specification Spotlight, California Quality Specification Floodlight, none.
		Warranty Length (years) [2]	
		Audible Noise at 100% output (decibels)	
		Audible Noise at 20% output (decibels)	
		Start Time [2]	
		6000 hour lumen maintenance [2]	
		6000 hour survival rate [2]	
		Projected time to L70~~?~~ [2]	
		Dimming Control Compatibility	Forward, Phase cut control, reverse phase cut, powerline carrier, digital, 0-10 VDC, other.
		NEMA SSL 7A Compatible~~?~~ [2] (If compatible with forward phase cut dimmer control answer "Yes," If not answer "No.")	Yes, no
		Marked in accordance with Title 24 JA-8 [2]	Yes, no
		Meets the Voluntary California Quality Specification 2.0 requirements applicable to the lamp type	Yes, no

* "Identifier" information as described in Section 1602(a).
1 = Voluntary for federally-regulated appliances
2 = Voluntary for state-regulated appliances

The 15-day language changes were determined to simplify the information requested, to update references based on changes in section 1605.3 (such as incorporating Energy Star omnidirectional light distribution requirements), and to remove unnecessary language that is duplicative.

Section 1607. Marking of Appliances.

(d) Energy Performance Information

…[skipping (1)-(11)]

(12) State-regulated LED lamps shall meet the criteria below before making any of the relevant claims in marketing materials, including retail packaging or on the lamp itself.

(A) For lamps manufactured on or after January 1, 2018, ~~T~~the following shall be demonstrated before making a claim of being "dimmable."

(B) State-regulated LED lamps manufactured on or after January 1, 2018 shall meet all of the following requirements before including comparisons to incandescent lamps~~, including wattage equivalencies~~:

. . . [skipping rest of (12)(B)]

(~~iv~~C) If the manufacturer makes incandescent wattage equivalency claims for medium screw-base and GU-24 base omnidirectional state regulated LED lamps manufactured on or after January 1, 2018, the lamps ~~Claims of incandescent wattage equivalence~~ shall have a minimum lumen output~~s in the respective ranges contained~~ in Table K-15.

Table K-15
Incandescent Wattage Equivalences for State-Regulated LED Lamps

Incandescent wattage equivalence	Minimum Lumen Output ~~minimum~~
~~Medium screw base and GU-24 base omnidirectional lamps~~	
40 W	310
60 W	750
75 W	1050
100 W	1490
150 W	2500

(~~C~~D) A lamp manufactured on or after January 1, 2018 that is certified with a ~~light~~ lumen output of less than 150 lumens for candelabra bases, or less than 200 lumens for other bases, shall be labeled on the retail packaging as "for decorative purposes."

(~~D~~E) For lamps manufactured on or after February 1, 2017, if the manufacturer makes any marketing, label, or mark regarding a model's qualification for the California Quality LED Lamp Specification, the ~~Lamps~~ manufacturer shall certify that the lamp model meets each and every portion of the California Quality LED Lamp Specification ~~is met before making any marketing, label, or mark regarding a model's qualification for the specification~~.

The 15-day language changes improved the clarity of the text and removed unnecessary language that was repetitive or changed text for consistency with other newly added provisions. Effective dates were changes in response to stakeholder comments regarding the appropriate time table to have compliant products to market.

The 15-day language also requires manufacturers to meet minimum lumen output requirements if they make claims of wattage equivalence (e.g., "This LED is equivalent to a 60 W incandescent!"). The 45-day language required these wattage equivalencies only if the manufacturer claimed that the lamp was equivalent to an incandescent in multiple ways. The Commission received comments on the 45-day language expressing concern that not all LEDs would claim to be like incandescents, and therefore wouldn't have to meet this wattage equivalency requirement, despite wattage equivalencies being an important factor in a consumer's choice of purchase. As a result, this section was updated to require minimum lumen outputs for any claim of wattage equivalency.

The phrase "be reduced flicker operation" is taken directly from Title 24, Part 6, Joint Appendix 8 (2016), and is a term of art to indicate that a lamp with "reduced flicker operation" must meet specified requirements in Joint Appendix 8.

The subdivision was renumbered from (12) to (13) due to new requirements for another appliance type that took effect July 1, 2016, and are located under subdivision (d)(12). The renumbering has no substantive effect.

The following documents are incorporated by reference in Section 1607.

Number	*Title*
CALIFORNIA ENERGY COMMISSION	
California Energy Commission Voluntary California Quality Light Emitting Diode (LED) Lamp Specification (December 2014)	

Copies available from:

California Energy Commission
Energy Hotline
1516 Ninth Street, MS-25
Sacramento, California 95814
Phone: (916) 654-5106
FAX: (916) 654-4304

Changes reflect the most recent publications and information. The 15-day language changes included addition of the Quality Light Standards given the marking requirements and updated contact information to order federal publications.

MATERIALS RELIED UPON THAT WERE NOT AVAILABLE FOR PUBLIC REVIEW PRIOR TO THE CLOSE OF THE PUBLIC COMMENT PERIOD (Gov Code Section 11346.9(a)(1))

No new materials were relied upon that were not already identified in the Initial or supplemental Statement of Reasons or related notices and all materials relied upon were available for public review. Documents identified in the notices and initial and supplemental statement of reasons include:

Singh, Harinder, Ken Rider, 2014. *Analysis of Small Diameter Directional Lamp and General Service Light-Emitting Diode Lamp Efficiency Opportunities*, California Energy Commission. Publication Number: CEC-400-2014-020-SD

Singh, Harinder, Ken Rider, 2015. *Analysis of Small-Diameter Directional Lamp and General Service Light-Emitting Diode Lamp Efficiency Opportunities,* California Energy Commission. Publication Number: CEC-400-2015-034

Rider, Ken, Pierre duVair, Harinder Singh, Jared Babula, Michael Murza. 2015. *Standardized Regulatory Impact Assessment of 2015 Proposed Appliance Efficiency Regulations.* California Energy Commission. CEC-400-2015-028.

Rider, Ken, Pierre duVair, Harinder Singh, Jared Babula, Michael Murza. 2015. *Revised Standardized Regulatory Impact Assessment of 2015 Proposed Appliance Efficiency Regulations.* California Energy Commission. CEC-400-2015-028-REV

Singh, Harinder, Ken Rider, Jared Babula, Michael Murza, 2015. *Supplemental Initial Statement of Reasons (ISOR), Proposed Amendments to Appliance Efficiency Regulations*, California Energy Commission. Publication Number: CEC-400-2015-035

McGaraghan, Michael, 2015. *LED Lamps, Response to CEC's Express Terms 45-Day Language Proposals*, Codes and Standards Enhancement (CASE) Initiative, available at http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-06/TN206868_20151207T161702_Michael_McGaraghan_Comments_CA_IOU_Comments_on_LED_Lamps.pdf.

McGaraghan, Michael, 2015. *Small Diameter Directional Lamps, Response to CEC's Express Terms 45-Day Language Proposals*, Codes and Standards Enhancement (CASE) Initiative, available at http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER06/TN206867_20151207T161554_Michael_McGaraghan_Comments_CA_IOU_Comments_on_Small_Diameter_D.pdf.

Pitsor, Kyle, 2015. *NEMA Comments on Proposed Amendments to Appliance Efficiency Regulations*, National Electrical Manufacturers Association, available at http://docketpublic.energy.ca.gov/PublicDocuments/15-AAER-06/TN206828_20151204T051310_Alex_Boesenberg_Comments_NEMA_Comments_to_Title_20_45day_Langua.pdf.

Driskell, Kristen, 2015. Memorandum to Docket: Supplemental Staff Analysis for General Service Light-Emitting Diodes (LEDs), California Energy Commission.

INCORPORATION BY REFERENCE OF MATERIAL FROM THE NOTICE OF PROPOSED ACTION (Gov Code Section 11346.9(d))

The revised 15-day language does not substantially deviate from the originally proposed text covering SDDL and LED lamps; therefore, in accordance with Government Code section 11346.9(d), the Commission determines that this FSOR can satisfy the following requirements by incorporating by reference various parts of the October 16, 2015, NOPA.

- Section 11346.9(a)(2). The commission has determined that regulations will not impose a mandate on local agencies or school districts.

- Section 11346.9 (a)(5). The Small Business Impacts and Economic Impact on Business determinations from the NOPA are incorporated by reference. The Commission has determined that the regulations have no adverse economic impact on small businesses. Thus, alternatives to lessen any impact were not considered, and none were identified.

- Section 11346.9(c). The relationship to federal law discussion from the NOPA is incorporated by reference.

CONSIDERATION OF ALTERNATIVE PROPOSALS (Gov Code Section 11346.9(a)(4) and (5))

The Commission determined that no alternative before it would be more effective in carrying out the purpose for which this action is proposed, would be as effective as and less burdensome to affected private persons than the adopted regulations, or would be more cost-effective to affected private persons and equally effective in implementing the statutory policy or other provision of law.

Staff considered all alternative proposals presented to develop the final proposed regulatory language that maximized energy efficiency and cost savings. As discussed at page 2 of the revised Standardized Regulatory Impact Assessment (SRIA) Commission staff used a macroeconomic model to estimate the effects of proposed and alternative regulations within the California economy. Three scenarios were modeled and evaluated (more stringent, proposed, and less stringent). The proposed scenario uses the stringency level that the Commission introduced at the outset of the rulemaking.

The less stringent level was selected from input provided by interested stakeholders in the pre-rulemaking process and also corresponded to comments made during the formal public comment periods. The more stringent level incorporated stakeholder feedback and was chosen at the maximum stringency level that Commission staff could propose and still meet the time frame and statutory limitations regarding technical feasibility and cost effectiveness. Based on the results of this modeling, the lower color rendition index (CRI) and efficiency levels proposed by stakeholders would not capture all the cost effective energy savings. Alternatively, the most stringent standards would save more energy but may cost more. Staff's proposed standards achieved a middle ground to maximize energy savings and also ensure adequate products are available to meet the standard in the proposed time frame.

SDDLs

The Commission considered alternative language relating to different CRI requirements and efficiency levels suggested by stakeholders and made corresponding changes resulting in 15-day language and revised 15-day language. The Commission found that any standard less than what was adopted would not be as effective and less burdensome to affected private persons and small businesses in carrying out the purpose of the Warren-Alquist Act namely to reduce wasteful, uneconomic, inefficient, or unnecessary energy use by prescribing standards for minimum levels of operating efficiency for appliances.

LEDs

The Commission considered alternative language relating to different CRI requirements and efficiency levels suggested by stakeholders and made corresponding changes resulting in 15-day language and revised 15-day language. The Commission found that any standard less than what was adopted would not be as effective and less burdensome to affected private persons and small businesses in carrying out the purpose of the Warren-Alquist Act namely to reduce wasteful, uneconomic, inefficient, or unnecessary energy use by prescribing standards for minimum levels of operating efficiency for appliances.

LED lamps and CRI

Considerable discussion was generated among stakeholders and staff regarding the minimum color rendering index (CRI) score, the relationship with efficacy in the compliance equation for both LEDs and SDDLs, and the individual color sample scores. Eight color samples (R1-R8) are measured to derive CRI, meant to cover much of the visible spectrum, like reds, and blues and greens. The scores of each of these samples are averaged and the result is the CRI score. A good CRI score can be achieved by having most of the error in a single color. This is, in fact, the characteristic in many LED lamps today. With error concentrated in sample 8, referred to as R8 and which is a pinkish, purple color strongly linked with red. The proposed regulations set two standards for color rendering to prevent particularly poor single color scores. Commission staff proposes an average score of 82 CRI, as well as a score no lower than 72 for each individual color.

The Energy Commission agrees with the general assertion that higher CRI lamps tend to be less efficient on a lumens-per-watt basis. Because of this fact, a minimum CRI of 82 was selected. But the relationship between CRI and efficiency is complex, and standards that did not consider CRI and only focused on lumens per watt could result in lower quality lamps with less market penetration.

There is information indicating that human perception of the brightness of a higher CRI lamp can be as bright as a lower CRI lamp even if the lower CRI lamp actually emits greater lumens. Thus, one could install a lower lumen, high CRI lamp, saving energy while continuing to meet the lighting needs of the room. (See pages 38-40, 52-53 Singh, Harinder, Ken Rider, 2015. *Analysis of Small-Diameter Directional Lamp and General Service Light-Emitting Diode Lamp Efficiency Opportunities,* California Energy Commission. Publication Number: CEC-400-2015-034.)

Staff considered the suggested changes to the regulatory text regarding CRI and the rationale for the text change during the development of the 15-day language but declined to adopt the proposed alternatives. The color rendering requirements (in terms of both CRI and individual color scores) were determined based on technical input during the rulemaking proceeding from a number of stakeholders on the ability of a lamp to light a room with accurate color fidelity. The exact levels for CRI and R1-R8 were chosen to balance cost and benefit of the proposed standard, to ensure that the standard was still cost-effective to the consumer while being technologically feasible as required by Public Resources Code section 25402(c)(1). Adopting the language as suggested by some stakeholders would allow industry to hide poorly performing color rendition in a larger average. This meant that it would not be as effective or more effective at achieving the Energy Commission's stated goals, even though it would perhaps be less burdensome to industry.

Detailed discussion of the color rendering requirements and the technical background regarding CRI can be found at pages 38-40, 52-53, 57-58, and 76-77: Harinder Singh, Ken Rider, 2015. *Analysis of Small Diameter Directional Lamp and General Service Light-Emitting Diode Lamp Efficiency Opportunities,* California Energy Commission. Publication Number: CEC-400-2015-034.

INCORPORATION BY REFERENCE (1 CCR 20(C))

The following documents were incorporated by reference within the 15-day language or revised 15-day language:

ANSI ANSLG C81.61-2009 (R2014): American National Standard for Electrical Lamp Bases – Specifications for Bases (Caps) for Electric Lamps.

ANSI C78.377-2015: American National Standard for Electric Lamps - Specifications for the Chromaticity of Solid-state Lighting (SSL) Products.

EPA, ENERGY STAR Program Requirements, Product Specification for Lamps (Light Bulbs) Version 2.0 (December 2015).

California Energy Commission, Voluntary California Quality Light Emitting Diode (LED) Lamp Specification (December 2014).

Documents identified as being incorporated by reference are national industry standards which are reasonably available from commonly known private organizations or through the US EPA's Energy Star program. In addition, the express terms specify how copies may be obtained. It would not be possible to publish the full text of these documents into the regulations given the

volume of technical data and copyright issues. Identifying these types of industry technical standards as documents incorporated by reference is consistent with the types of information currently incorporated by reference in Title 20 and the practice of the US Department of Energy for federally-regulated products.

The California Energy Commission's Voluntary California Quality Light-Emitting Diode (LED) Lamp Specification is a white paper that staff prepared in response to a California Public Utilities Commission decision specifying that the Energy Commission should provide what it considers to be a "high quality" lamp. The white paper does not set any requirements for manufacturers and therefore it would be confusing to manufacturers and lengthy to incorporate into Title 20 as a whole. Nonetheless, because manufacturers may certify compliance with the specification, the document is necessary to incorporate by reference into the regulation.

The original Notice of Proposed Action dated October 16, 2015 identified 10 C.F.R. section 430.23(dd), including Appendix BB to Subpart B of part 430 as a document incorporated by reference. Title 20 section 1604 already references C.F.R. section 430.23 which sufficiently encompasses the relevant provisions related to the identified lighting test methods. Therefore, it is not necessary and duplicative to include 10 C.F.R. section 430.23 as a document incorporated by reference.

The original Notice of Proposed Action also identified IES LM-79: Electrical and Photometric Measurements of Solid-State Lighting Products (Revised 2008). That document is an existing document incorporated by reference in section 1604, the same section which includes reference to IES LM-79. Therefore there is no need to include IES LM-79 as a document incorporated by reference in this rulemaking.

In the 45-day language the following document was added in section 1606 as a document incorporated by reference, but left off the list of such documents in the Notice of Proposed Action*: NEMA SSL 7A-2013 Qualification Requirements for High Efficacy Light Sources.* While the document's National Electrical Manufacturers Association code was correct, NEMA SSL 7A-2013, the document erroneously contained the wrong title. The correct title should be *Phase Cut Dimming for Solid State Lighting: Basic Compatibility*. The language in the final express terms has been corrected. This error is non-substantive and does not require 15-day language because it was obvious given the regulatory text in section 1606 which references phase cut dimmer control and the fact that the topic code, NEMA SSL 7A-2013 was correct. Using the topic code in a simple web search for NEMA SSL 7A-2013 provides information on phase cut dimming for solid state lighting. No confusion was evidenced in the numerous comments received as the context of the document incorporated by reference and its topic code made it clear what that phase cut dimming was being referenced.

SUMMARY OF COMMENTS RECEIVED AND THE ENERGY COMMISSION'S RESPONSES (Gov Code Section 11346.9(a)(3))

See Attachment A for responses to all comments on the 45-day, 15-day and revised 15-day language received during the comment period that are directed at the regulations or the process by which they were updated. Responses are also included for all written and oral comments received at the workshop and adoption hearing. Responses explain how the language was amended to accommodate the comment or the reasoning for rejecting the comment.

ATTACHMENT A
RESPONSE TO COMMENTS