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## **45-Day Comments - Lighting Measures**

*Additional submitted attachment is included below.*

# Comments on Lighting Topics in 2019 Title 24, Part 6 45-Day Language

California Statewide Utility Codes and Standards Team

February 20, 2018

## 1. Introduction

The California Statewide Utility Codes and Standards Team (Statewide CASE Team) appreciates the opportunity to participate in the rulemaking and the thoughtful feedback we have received from the California Energy Commission on the Codes and Standards Enhancement (CASE) proposals.

The CASE initiative presents recommendations to support the Energy Commission's efforts to update California's Building Energy Efficiency Standards (Title 24, Part 6) to include new requirements or to upgrade existing requirements for various technologies. The four California Investor Owned Utilities – Pacific Gas and Electric Company, San Diego Gas and Electric, Southern California Edison and SoCalGas® – and several publicly Owned Utilities – Los Angeles Department of Water and Power, Sacramento Municipal Utility District, and Southern California Public Power Authority – sponsored this effort.

The Statewide CASE Team actively supports the Energy Commission in developing revisions to Title 24, Part 6 by developing code change proposals that will result in feasible, enforceable, and cost-effective enhancements to the building energy efficiency standards. In developing these proposals, the Statewide CASE Team conducts research and market surveys, holds stakeholder meetings, and evaluates the energy savings and cost-effectiveness of considered measures. The CASE Reports, which present pertinent information that supports the code change proposals, are posted within each measure topic page on [title24stakeholders.com](http://title24stakeholders.com).

The Statewide CASE Team encourages the Energy Commission to consider the following changes for nonresidential indoor lighting controls, nonresidential outdoor lighting controls, and residential lighting.

Recommended revisions to the 45-Day Language are included in this document in turquoise. The Statewide CASE Team's recommended language insertions are double underlined and recommended language ~~deletions are double struck~~. Recommended revisions to the 45-Day Language are summarized in Table 1.

**Table 1: Summary of Recommended Revisions**

Measure #	Measure Name	Recommended Revision	Sections of Standards
2019-NR-LTG3	Nonresidential Outdoor Lighting Controls	Maintain stringency of the 2016 Standards by including deleted requirements in the 45-Day Language.	130.2(c)
		Allow for 75% after hours power reduction.	130.2(c)3
		Require a maximum of 800 watts of lighting power be controlled together.	130.2(c)3
		Reduce the motion control exception wattage to 30 watts for outdoor luminaires.	Exception 1 to 130.2(c)3
		Revise scope of motion controls as an inclusive description of covered applications.	130.2(c)3
2019-NR-LTG4	Nonresidential Indoor Controls	Require that automatic time-switch controls be configured to operate in manual-ON mode.	Section 130.1(c)3
		Require dimming to no greater than the minimum dimmed state of the luminaire or the lowest setpoint in accordance with Table 130.1-A.	Section 130.1(d)3
N/A	Residential Lighting Standards	Require that sources in recessed and enclosed luminaires be Joint Appendix 8 (JA8) certified and specifically identify the "JA8-2019-E" marking requirement.	150.0(k)1.Cvi 150.0(k)1.H
		Modify Section JA8.8 to specify that luminaires and other products covered by the ENERGY STAR Luminaires v2.0 Specification and have completed the life testing in that specification, would also be marked "JA8-2019-E".	JA8.8
		Add language in Table 150.0 that specifically describes marking that specifiers, contractors and inspectors should be looking for without sending them to the Joint Appendices: "JA8-2019" or "JA8-2019-E".	Table 150.0-A
		Strike item 8 in Table 150.0-A and move it to the beginning of Section 150.0(k) as an exception to the high efficacy lighting requirement.	Table 150.0-A
		Exclude closets from being included with drawers and cabinetry, and require closets to have high efficacy sources.	Table 150.0-A
		Reinstate the 2016 JA8 correlated color temperature requirement of no greater than 3000 Kelvin maximum Correlated Color Temperature (CCT) for separable sources.	JA8.4.4(c)
		Explicitly require Color Rendering Index (CRI) and Individual Color Score requirements in Title 20.	JA8.4.4(a)

## 2. Outdoor Lighting Controls

The 45-Day Language proposal is significantly improved as compared to the Express Terms. We are pleased to see motion control requirements with a broader dimming range (50 percent to full OFF) and 15-minute time delay requirements, and defined schedules for normally occupied and unoccupied times in the acceptance testing specification.

Nonetheless, the 45-Day Language proposes controls requirements that result in a reduction in stringency as compared to the 2016 Title 24 standards, as they no longer require scheduling controls in addition to motion controls for those applications where motion controls are required. The Statewide CASE Team recommends that the 15-Day Language establish parity with the controls requirements of 2016 standards and consider what parts of the advanced outdoor lighting controls requirements

proposed in the [2019 Outdoor Lighting Controls CASE Report](#) might also be incorporated into the 2019 standard.<sup>1</sup>

## 2.1 2016 Control Requirements for Luminaires Required to Have Motion Controls

In the 2016 standards, the following control requirements apply to luminaires mounted less than 24 feet above grade serving general hardscape, outdoor sales lots, gas station canopy and gas station hardscape in Sections 130.2(c)1 to 130.2(c)3:

1. *All installed outdoor lighting shall be controlled by a photocontrol or outdoor astronomical time-switch control, or other control capable of automatically shutting OFF the outdoor lighting when daylight is available.*
2. *All installed outdoor lighting shall be independently controlled from other electrical loads by an automatic scheduling control.*
3. *All installed outdoor lighting, where the bottom of the luminaire is mounted 24 feet or less above the ground, shall be controlled with automatic lighting controls that meet all of the following requirements:*
  - A. *Shall be motion sensors or other lighting control systems that automatically controls lighting in accordance with Item B in response to the area being vacated of occupants; and*
  - B. *Shall be capable of automatically reducing the lighting power of each luminaire by at least 40 percent but not exceeding 90 percent, or provide continuous dimming through a range that includes 40 percent through 90 percent, and*
  - C. *Shall employ auto-ON functionality when the area becomes occupied; and*
  - D. *No more than 1,500 watts of lighting power shall be controlled together.*

The 45-Day Language does not have some of the important features of the 2016 Standards:

- Luminaires required to have motion controls are also required to have scheduling controls, which are clearly divided from the requirements for motion controls.
- Because larger control zones have a higher probability of being occupied somewhere in the zone than smaller zones, motion control zones are limited to no more than 1,500 watts being controlled together.
- Luminaires are required to be capable of partial off control, which is important because the control is not disabled but recommissioned to partial off if occupants' perception of safety requires some illumination, even when no activity is detected.

The 2013 and 2016 CASE Reports documented the feasibility and cost-effectiveness of motion control requirements for the following applications which are currently included in the 45-Day Language proposal: general hardscape, outdoor sales lot, vehicle service station hardscape, or vehicle service station canopy lighting. Defining a requirement by exclusions often results in applications being inadvertently covered. The 45-Day Language (and the 2016 standards) as written includes these applications which were not included in the 2013 or 2016 CASE reports: building entrances, drive up windows, vehicle service station uncovered dispensers, ATM machines, sales canopies, non-sales canopies, guard stations, student pick-up and drop off areas. We recommend revising the code language

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<sup>1</sup> [http://docketpublic.energy.ca.gov/PublicDocuments/17-BSTD-02/TN222190\\_20180118T144848\\_CASE\\_Report\\_Nonresidential\\_Outdoor\\_Lighting\\_Controls.pdf](http://docketpublic.energy.ca.gov/PublicDocuments/17-BSTD-02/TN222190_20180118T144848_CASE_Report_Nonresidential_Outdoor_Lighting_Controls.pdf)

to clearly identify the space types that require motion sensing controls, rather than having a long list of exempted applications.

## 2.2 Minimum Recommended Revisions to the 45-Day Language: Bring Controls Coverage Back to Parity with the 2016 Standards

The following changes proposed by the Statewide CASE Team represent minimum revisions to the current 45-Day Language that will result in the same controls requirements as in the 2016 Standards, and provide more clarity on what applications are covered. Recommended revisions to the 45-Day Language are included in this document in turquoise. The Statewide CASE Team's recommended language insertions are double underlined and recommended language deletions are double struck.

**(c) Controls for Outdoor Lighting.** Outdoor lighting controls shall be installed that meet all of the following applicable requirements ~~as applicable for reducing lighting when daylight is available and when the space is unoccupied:~~

**EXCEPTION 1 to Section 130.2(c):** Outdoor lighting not permitted by a health or life safety statute, ordinance, or regulation to be turned OFF.

**EXCEPTION 2 to Section 130.2(c):** Lighting in tunnels required to be illuminated 24 hours per day and 365 days per year.

**1. Daylight Availability.** All installed outdoor lighting shall be controlled by a photo control, ~~or outdoor~~ astronomical time-switch control, automatic scheduling control, or other control capable of automatically shutting OFF the outdoor lighting when daylight is available.

**2. Scheduling Control.** All installed outdoor lighting shall be independently controlled from other electrical loads by an automatic scheduling control All installed outdoor lighting shall be controlled by a control capable of reducing the outdoor lighting power by at least 50 percent, and also capable of turning the lighting OFF, during unoccupied periods. This control shall be either an automatic scheduling controls or a motion sensing control, and shall provide control of the lighting separate from control of other electrical loads.

~~A. For automatic scheduling controls, the control shall be capable of providing an override function that turns the lighting ON during its scheduled dim or OFF period for no more than 2 hours when an override is initiated.~~

~~B. For automatic scheduling controls, acceptance tests of outdoor lighting controls shall be conducted as specified in Section 130.4(a) and 130.4(a)6 to verify the scheduled occupied and unoccupied periods.~~

~~C. For motion sensing controls, the control shall return the lighting to its dim state of at least 50 percent of lighting power reduction or OFF state no later than 15 minutes after the area has been vacated.~~

**3. Areas where Motion Sensing Controls are required.** ~~The following luminaires~~ Luminaires that are providing parking lot general hardscape lighting, outdoor sales lot lighting, vehicle service station hardscape lighting, or vehicle service station canopy lighting and where the bottom of the luminaire is mounted 24 feet or less above the ground shall be controlled by motion sensing controls complying with 130.2(c)2, or other controls that react to the area being vacated of occupants and meet all of the following requirements:

A. The lighting power of each luminaire shall be automatically reduced by at least 50 percent or OFF when no activity has been detected in the area illuminated by the controlled luminaires for a time no longer than 15 minutes, and

B. Shall restore lighting to normal operating power when the area becomes occupied; and

C. No more than 1,500 watts of lighting power shall be activated in a single motion sensing control zone. and

D. The lighting system shall be capable of being configured to automatically reduce power of each luminaire by at least 50 percent, but not exceeding 90 percent without turning the

luminaires OFF.

~~D. Outdoor luminaires where the bottom of luminaire is mounted 24 feet or less above grade and that are not for Building Façade, Ornamental Hardscape, Outdoor Sales Frontage, or Outdoor Dining lighting.~~

~~E. Outdoor wall mounted luminaires installed for Building Façade, Ornamental Hardscape or Outdoor Dining lighting that have a bilaterally symmetric distribution as described in the IES Handbook (typically referred to as “wall packs”) mounted 24 feet above grade or lower.~~

**EXCEPTION 1 to Section 130.2(c)3:** Luminaires with a maximum rated wattage of 40 watts each;

**EXCEPTION 2 to Section 130.2(c)3:** Applications listed as Exceptions to Section 140.7(a) shall not be required to meet the requirements of Section 130.2(c)3.

### 2.3 Improvements Associated with the 45-Day Language Outdoor Lighting Proposal

The following two additions are not required to return to 2016 Title 24 parity, but were improvements included by CEC staff in the 45-Day Language that we support with a few modifications.

The exception to Section 130.2(c)3 addresses those few areas where motion sensors are not feasible. This is rare as the location blocked by trees or other obstructions is not a good site for the luminaire either.

The timed manual override of Section 130.2(c)4 is also a good feature, though we recommend that this be an option and not a mandatory feature. The timed manual override is only easily accomplished for timeclocks and timed manual overrides are rarely available for stand-alone motion controls or part night scheduling controls. The savings from these two measures are not quantifiable, but they increase retention of the controls.

**EXCEPTION 3 to Section 130.2(c)3:** Luminaires located where trees or other obstructions block motion sensing between the luminaire and the area illuminated by the luminaire.

4. Timed Manual Override. Timed manual overrides are not required, but shall be allowed to override motion or scheduling controls for a duration not to exceed two hours. No more than 1,800 watts may be controlled per manual override control.

### 2.4 Recommendation to Allow but Not Require Advanced Motion Controls

The Statewide CASE Team recommends additional changes to achieve greater savings beyond the 2016 requirements. These additional changes include requiring that the lighting system power be reduced by at least 75 percent when unoccupied after-hours. This level of control has a benefit to cost ratio in excess of four to one and saves an additional 6 GWh/yr statewide for new construction and retrofit projects. A detailed description of benefits and costs, are contained in the [Outdoor Lighting Controls CASE Report](#) and in letters from the Statewide CASE Team and lighting manufacturers.<sup>2</sup>

If the proposed advanced outdoor lighting controls is not considered feasible as a requirement at this time, we recommend that the Commission include the exceptions listed below that would allow but not

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<sup>2</sup> Statewide CASE Team comments: [http://docketpublic.energy.ca.gov/PublicDocuments/17-BSTD-01/TN221679\\_20171103T170734\\_Statewide\\_UTILITY\\_Codes\\_and\\_Standards\\_Team\\_Comments\\_Statewide\\_U.pdf](http://docketpublic.energy.ca.gov/PublicDocuments/17-BSTD-01/TN221679_20171103T170734_Statewide_UTILITY_Codes_and_Standards_Team_Comments_Statewide_U.pdf)

Wattstopper Comments: [http://docketpublic.energy.ca.gov/PublicDocuments/17-BSTD-01/TN221773\\_20171114T153029\\_Legrand\\_Wattstopper\\_Comments\\_In\\_Support\\_of\\_CASE\\_Team\\_Topics\\_Do.pdf](http://docketpublic.energy.ca.gov/PublicDocuments/17-BSTD-01/TN221773_20171114T153029_Legrand_Wattstopper_Comments_In_Support_of_CASE_Team_Topics_Do.pdf)

Philips Lighting Comments: [http://docketpublic.energy.ca.gov/PublicDocuments/17-BSTD-01/TN221803\\_20171117T055121\\_Kelly\\_Seeger\\_Comments\\_Philips\\_Lighting\\_Comments\\_in\\_Support\\_of\\_C.pdf](http://docketpublic.energy.ca.gov/PublicDocuments/17-BSTD-01/TN221803_20171117T055121_Kelly_Seeger_Comments_Philips_Lighting_Comments_in_Support_of_C.pdf)

require that these advanced controls be used. These additional exceptions to the scheduling requirements will yield additional energy savings when these exceptions are used and prepare the market for future proposals to require this strategy. The added changes are in double underlined text and are listed here as exceptions.

Other proposed changes include: scheduling controls are not just capable of reducing power by 50% but shall reduce power by 50% after hours as verified by the acceptance tests, and maximum wattage controlled together as a single motion controlled zone is 800 watts as proposed by the Commission in the Draft Express Terms proposal.

**(c) Controls for Outdoor Lighting.** Outdoor lighting controls shall be installed that meet all of the following applicable requirements

**EXCEPTION 1 to Section 130.2(c):** Outdoor lighting not permitted by a health or life safety statute, ordinance, or regulation to be turned OFF.

**EXCEPTION 2 to Section 130.2(c):** Lighting in tunnels required to be illuminated 24 hours per day and 365 days per year.

**1. Daylight Availability.** All installed outdoor lighting shall be controlled by a photo control, astronomical time-switch control, or other control capable of automatically shutting OFF the outdoor lighting when daylight is available.

**2. Scheduling Control.** All installed outdoor lighting shall be independently controlled from other electrical loads by an automatic scheduling control. During normally scheduled unoccupied hours, power shall be reduced by at least 50%.

Exception 1 to Section 130.1(c)2: Lighting power reduction of controlled lighting may be overridden to normal operating power when occupancy is sensed by a control compliant with Section 130.2(c)3.

Exception 2 to Section 130.1(c)2: Scheduling controls are not required if lighting is controlled by controls compliant with Section 130.2(c)3 and that reduce lighting power between 50 and 75 percent when no activity has been detected in the area illuminated by the controlled luminaires for a time no longer than 15 minutes and reduce lighting power by at least 75% when no activity has been detected no longer than 60 minutes.

**3. Areas where Motion Sensing Controls are required.** Luminaires that are providing parking lot general hardscape lighting, outdoor sales lot lighting, vehicle service station hardscape lighting, or vehicle service station canopy lighting and where the bottom of the luminaire is mounted 24 feet or less above the ground shall be controlled by motion sensing controls or other controls that react to the area being vacated of occupants and meets all of the following requirements:

A. The lighting power of each luminaire shall be automatically reduced by at least 50 percent or OFF when no activity has been detected in the area illuminated by the controlled luminaires for a time no longer than 15 minutes.

B. Shall restore lighting to normal operating power when the area becomes occupied; and

C. No more than ~~800~~ 500 watts of lighting power shall be activated in a single motion sensing control zone, and

D. The lighting system shall be capable of being configured to automatically reduce power of each luminaire by at least 50 percent, but not exceeding 90 percent without turning the luminaires OFF

**EXCEPTION 1 to Section 130.2(c)3:** Luminaires with a maximum rated wattage of 40 watts each;

**EXCEPTION 2 to Section 130.2(c)3:** Applications listed as Exceptions to Section 140.7(a) shall not be required to meet the requirements of Section 130.2(c)3.

**EXCEPTION 3 to Section 130.2(c)3:** Luminaires located where trees or other obstructions block motion sensing between the luminaire and the area illuminated by the luminaire.



4. Timed Manual Override. Timed manual overrides are not required, but shall be allowed to override motion or scheduling controls for a duration not to exceed two hours. No more than 1,800 watts may be controlled per manual override control.

### 3. Indoor Lighting Controls

#### 3.1 Automatic Time-Switch Controls Configured to Operate in Manual-ON Mode

The Statewide CASE Team recommends requiring automatic time-switch controls to be configured to operate in manual-ON mode. This measure is conservatively estimated to result in 1.5 GWh/yr of statewide energy savings. The Statewide CASE Team estimates no incremental cost for this measure, and hence the measure is deemed to be cost-effective. Staff Supplement to the Final CASE Report on Indoor Controls (TN# 222482) states that the Energy Commission's staff agrees with the proposed measure. However, 45-Day code language does not contain the proposed requirement.

##### 3.1.1 Recommended Revisions to the 45-Day Language

###### Section 130.1(c)3:

- ~~1. If an automatic time-switch control, other than an occupant sensing control, is installed to comply with Section 130.1(c)1, it shall incorporate an override lighting control that:  
A. Complies with Section 130.1(a); and  
B. Allows the lighting to remain ON for no more than 2 hours when an override is initiated.  
**EXCEPTION to Section 130.1(c)3B:** In the following function areas, the override time may exceed 2 hours: Malls, auditoriums, single tenant retail, industrial, and arenas where captive key override is utilized.~~
- ~~2. If an automatic time-switch control, other than an occupant sensing control, is installed to comply with Section 130.1(c)1, it shall incorporate an automatic holiday "shut-OFF" feature that turns OFF all loads for at least 24 hours, and then resumes the normally scheduled operation.  
**EXCEPTION to Section 130.1(c)4:** In retail stores and associated malls, restaurants, grocery stores, churches, and theaters, the automatic time-switch control is not required to incorporate an automatic holiday shut-OFF feature.~~
3. If an automatic time-switch control is installed to comply with Section 130.1(c)1, it shall incorporate all of the following features:
  - A. Automatic time-switch controls shall have manual override controls that allow the lighting to remain ON for no more than 2 hours when an override is initiated or when occupancy controls turn lights on when occupancy is sensed.  
**EXCEPTION to Section 130.1(c)2A:** In the following function areas, the manual override time may exceed 2 hours: malls, auditoriums, single tenant retail, industrial, and arenas where captive-key override is utilized.
  - B. Automatic time-switch controls shall be configured to operate in manual-ON mode.  
**EXCEPTION to Section 130.1(c)2B:** Automatic ON mode for automatic time-switch control is allowed in the following function spaces: industrial, single tenant retail, malls, auditoriums, concourses, lobbies, and areas open to the general public.
  - C. Automatic time-switch controls shall have an automatic holiday shut-OFF feature that turns lighting OFF for a 24-hour period then resumes its normal scheduled operation.  
**EXCEPTION to Section 130.1(c)2C:** In retail stores and associated malls, restaurants, grocery stores, churches, and theaters, the automatic time-switch control is not required to incorporate an automatic holiday shut-OFF feature.

#### 3.2 Daylighting Controls Dimming to Deeper Levels

The Statewide CASE Team estimates that adopting dimming plus OFF controls in nonresidential buildings will result in 18.7 GWh/yr of statewide energy savings as presented in the [Final CASE Report](#)

[on Indoor Lighting Controls](#).<sup>3</sup> However, more evidence may be needed to demonstrate that daylight dimming plus OFF controls are accepted by occupants where they expect to have more control over their electric lighting such as in: offices, and classrooms.

In the interim, the Statewide CASE Team recommends a modified measure requiring dimming to no greater than the minimum dimmed state of the luminaire or the lowest setpoint in accordance to Table 130.1-A. The 2016 Title 24 standards require reducing lighting power to 35 percent of total light lighting power. Table 130.1-A requires LED luminaires to have the capability to dim to ten percent of lighting power. Many LED luminaires are capable of dimming to five percent of lighting power, with some luminaires having a low set point of 0.01 to one percent of lighting power.

The Statewide CASE Team estimates that the modified measure will result in 9.3 GWh/yr in statewide energy savings. In the base case for this modified measure, the affected luminaires are assumed to dim to 20 percent of full lighting output. In the standards case, the affected luminaires are assumed to dim to 10 percent of full lighting output.

### 3.2.1 Recommended Revisions to the 45-Day Language

#### Section 130.1(d)3:

##### (d) Automatic Daylighting Controls.

3. The automatic daylighting controls shall:

[...]

~~iv.C. In areas served by lighting that is daylight controlled~~ For areas other than parking garages, ensure that when the daylight illuminance is greater than 150 percent of the design illuminance received from the general lighting system at full power, the general lighting power in that daylight zone shall be reduced to no greater than the by a minimum dimmed state or minimum step in Table 130.1-A of 65 percent.

## 4. Residential Lighting

Below are several recommendations to the residential lighting requirements that we believe will clarify enforcement requirements, streamline compliance processes, and retain high quality, efficacious light sources in residential buildings.

### 4.1 Enclosed and Recessed Luminaires

**Section 150.0(k)1Cvi and Section 150.0(k)1H:** Reference to the "JA8" label has been removed and replaced with language that references marking requirements in Joint Appendix 8 (JA8). The 2016 Title 24 residential standards simplified compliance by allowing designers, contractors, and inspectors to focus on a single metric as it applies to Light-emitting Diode (LED) lighting: the "JA8" marking. The language proposed in the 45-Day Language in section 150.0(k)1.H now reads:

**Light Sources in Enclosed or Recessed Luminaires.** ~~Lamps and other separable light sources that are not compliant with the JA8 elevated temperature requirements, including marking requirements, "JA8 2016 E"~~ shall not be installed in enclosed or recessed luminaires.

This implies that the implementers of the residential Title 24 standards need to familiarize themselves with the elevated temperature and marking requirements in JA8. A simpler approach would be to just describe what marking to look for in enclosed and recessed luminaires.

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<sup>3</sup> [http://docketpublic.energy.ca.gov/PublicDocuments/17-BSTD-02/TN222193\\_20180118T144124\\_CASE\\_Report\\_Nonresidential\\_Indoor\\_Controls.pdf](http://docketpublic.energy.ca.gov/PublicDocuments/17-BSTD-02/TN222193_20180118T144124_CASE_Report_Nonresidential_Indoor_Controls.pdf)

The intent of the 2016 Title 24 standard was to ensure that JA8 light sources are appropriate for enclosed and recessed sources by requiring the "JA8-2019-E" markings (indicating elevated temperature testing had been completed) in these applications. The Statewide CASE Team recommends the following changes to clarify and simplify enforcement:

**Light Sources in Enclosed or Recessed Luminaires.** ~~Lamps and other separable light sources installed in enclosed or recessed luminaires shall be marked "JA8-2019-E." that are not compliant with the JA8 elevated temperature requirements, including marking requirements, "JA8-2016 E" shall not be installed in enclosed or recessed luminaires.~~

This makes it clear that JA8 sources in recessed or enclosed luminaires must be JA8 certified, and it specifically identifies the "JA8-2019-E" marking requirement in Section 150.

#### 4.2 Life Testing Requirements and the JA8-2019-E Marking

As proposed, only products undergoing elevated temperature testing through the ENERGY STAR Lamps Version 2.1 Specification would be able to use the "JA8-2019-E" marking and products that use the ENERGY STAR Luminaires Version 2.0 Specification would not use the "E" marking. However, Section 150.0(k) was designed to require all recessed and enclosed fixtures to carry the "E" marking, including dedicated luminaires and retrofit kits, indicating that they are designed for the application. By requiring all recessed and enclosed fixtures (or the sources installed in them) to carry the "E" marking, enforcement processes are simplified. Builders and inspectors do not need to understand what testing the products have undergone, they only need to ensure the proper marking.

We recommend that Section JA8.8 be modified to specify that luminaires and other products covered by the ENERGY STAR Luminaires Version 2.0 Specification and have completed the life testing in that specification, would also be marked "JA8-2019-E" as follows:

Light sources meeting the requirements of this Appendix shall be marked with ~~either "JA8-20162019" or "JA8-2019-E"~~ to indicate their compliance with the criteria of this Appendix. Light sources that have passed the Elevated Temperature Life Test ~~specified in the ENERGY STAR Lamp Specification Version 2.1 and products that have passed the Life Test specified in the ENERGY STAR Luminaire Specification Version 2.0~~ shall ~~instead~~ be marked with "JA8-~~20162019~~-E", to indicate that they comply with this Appendix and may additionally be installed in elevated temperature applications, such as enclosed ~~and recessed~~ fixtures ~~and ceiling recessed fixtures~~. ~~All other products complying with this appendix shall pass the Ambient Temperature Life Test in ENERGY STAR Lamp Specification Version 2.1 and be marked "JA8-2019."~~ Light sources that do not comply with this Appendix shall not be marked with "JA8-~~20162019~~" or "JA8-~~20162019~~-E".

#### 4.3 High Efficacy Luminaires - Identifying the "JA8-2019" and "JA8-2019E" Label

##### Table 150.0-A Classification of High Efficacy Light Sources

We commend the Energy Commission on the many efforts to simplify and streamline compliance. In keeping with the other compliance improvements, we recommend that the Table 150.0 specifically describe marking that specifiers, contractors, and inspectors should be looking for without requiring them to read through the Joint Appendices.

The Statewide CASE Team recommends the following changes to Table 150.0-A:

##### Table 2: Recommended changes to Table 150.0A

<p><b>High Efficacy Light Sources</b></p> <p>Luminaires installed with only the lighting technologies in this table shall be classified as high efficacy. Light sources shall comply with one of the columns below:</p>
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<p>Light sources in this column other than those installed in ceiling recessed downlight luminaires are classified as high efficacy and are <b>not</b> required to comply with Reference Joint Appendix JA8</p>	<p>Light sources in this column <del>shall be</del> <u>are only considered to be high efficacy if they are certified to the Commission as High Efficacy Light Sources in accordance with Reference Joint Appendix JA8 and be marked "JA8-2019" or "JA8-2019-E" (suitable for enclosed or recessed luminaires) as meeting required by JA8.</u></p>
<ol style="list-style-type: none"> <li>1. Pin-based linear or compact fluorescent light sources using electronic ballasts.</li> <li>2. Pulse-start metal halide.</li> <li>3. High pressure sodium.</li> <li>4. <del>GU 24 sockets containing light sources other than LEDs.</del> <sup>a,b</sup></li> <li>5. Luminaires with hardwired high frequency generator and induction lamp.</li> <li>6. <del>Inseparable SSL luminaires that are LED light sources installed outdoors.</del></li> <li>7. Inseparable SSL luminaires containing colored light sources that are installed to provide decorative lighting.</li> <li>8. <del>Lighting internal to drawers, cabinetry or closets other than walk-in closets with controls that automatically turn the lighting off when the drawer, cabinet or closet is closed.</del></li> </ol>	<p><del>9.</del> All light sources <u>installed in</u> ceiling recessed downlight luminaires. Note that ceiling recessed downlight luminaires shall not have screw bases regardless of lamp type as described in Section 150.0(k)1C.</p> <p><del>9.</del> <del>GU 24 sockets containing LED light sources.</del></p> <p><del>10.</del> Any light source not otherwise listed in this table <u>and certified to the Commission as complying with Joint Appendix 8.</u></p>
<p>Notes:</p> <p><del>a. GU 24 sockets containing light sources such as compact fluorescent lamps and induction lamps. b. California Title 20 Section 1605(k)3 does not allow incandescent sources to have a GU 24 base.</del></p>	

#### 4.4 Table 150.0-A Classification of High Efficacy Light Sources

##### 4.4.1 Incandescent Cabinet Lighting should not be redefined as "high efficacy"

The Statewide CASE Team recommends that item 8 in Table 150.0-A, (Table 2 previously shown above) be stricken and moved to the beginning of Section 150.0(k) as an exception to the high-efficacy lighting requirement. Item 8 was added as follows in the 45-Day Language:

8. Lighting internal to drawers, cabinetry or closets other than walk-in closets with controls that automatically turn the lighting off when the drawer, cabinet or closet is closed.

Adding this item to the legacy high efficacy light sources is inconsistent with these legacy high efficacy light sources as this would allow an incandescent light source to be called a high efficacy light source. These products should not be redefined as high efficacy, but should be added as an exception to the high-efficacy requirement. We propose the following edits to Section 150.0(k)1A:

**A. Luminaire Efficacy:** All installed luminaires shall meet the requirements ~~be high efficacy in accordance with~~ TABLE 150.0-A.

EXCEPTION to Section 150.0(k)1A: Lighting internal to drawers or cabinetry with controls that automatically turn the lighting off when the drawer or cabinet is closed.

##### 4.4.2 Closet lighting should not be included in this exception

The Statewide CASE Team recommends removing closets from this exception as using an incandescent lamp even just 5 minutes per day would result in higher life cycle cost. In other words, it is not life cycle cost justified to provide an exception for incandescent lamps in closets even if they are open only 5 minutes per day. The life cycle costing analysis below considers the life cycle cost savings of a 9-watt LED lamp over a 43-watt halogen lamp when operating from 5 minutes per day to 30 minutes per day. Assumption information on the representative lamps can be seen in Table 3.

**Table 3: Assumptions for LCC Analysis on Closet Lighting**

Lamp metric	LED <sup>4</sup> Assumed Value	Halogen <sup>5</sup> Assumed Value
Input wattage	8.8	43
Delivered Lumens (lm)	800	615
Life (hours)	25,000	2,000
Cost	\$3.66	\$1.74

This example shows that with low cost LED lamps, it does not take many hours of operation for an LED lamp to be cost-effective. Operating just 5 minutes a day, a typical JA8 compliant lamp is cost-effective over a traditional halogen lamp, as shown in Table 3. Cost effectiveness increases with run time and can produce a benefit-to-cost ratio of 13.5 when operated for 30 minutes per day. Furthermore, additional benefits are achieved from the maintenance savings due to the 12.5 times longer life of the LED.

**Table 4: LCC Analysis of LED over Halogen Lamp**

Run time (min/day)	Run time (hr/year)	Energy Savings kWh/year	Energy savings PV\$ <sup>6</sup>	Maintenance Savings PV\$	LCC Savings PV\$	B/C Ratio
5	30	1.04	\$3.96	\$0.00	\$1.99	2.0
10	61	2.08	\$7.93	\$0.00	\$5.90	4.1
15	91	3.12	\$11.89	\$0.91	\$10.72	6.6
20	122	4.16	\$15.85	\$1.07	\$14.78	8.7
25	152	5.20	\$19.81	\$1.98	\$19.60	11.2
30	183	6.24	\$23.78	\$2.17	\$23.69	13.4

Even using an incandescent lamp that costs as low as \$0.49, a replacement LED lamp in this application still produces a positive benefit-to-cost ratio. To ensure these savings, closets should not be included along with drawers and cabinetry and be required to have high efficacy sources.

#### 4.5 JA8.4.4 Color Characteristics: Correlated Color Temperature (CCT)

The Statewide CASE Team recommends reinstating the 2016 Joint Appendix JA8 correlated color requirements of no greater than 3000 degrees Kelvin (K) maximum CCT for separable sources to increase the retention of high efficacy sources and reducing the risk of circadian disruption.

The proposed language would require all lighting sources to be capable of providing a CCT of 4000K or less. In the 2016 Title 24 standards, 3000K was specifically selected as the upper limit for separable

<sup>4</sup> LED cost and metrics were gathered from HomeDepot.com for a JA8-2016 compliant 60-watt incandescent replacement LED A-lamp. Accessed from <https://www.homedepot.com/p/Feit-Electric-60W-Equivalent-Soft-White-2700K-A19-Dimmable-CEC-Title-24-Compliant-LED-90-CRI-Energy-Star-Light-Bulb-3-Pack-OM60DM-927CA-3/302467325> on February 16, 2018

<sup>5</sup> Halogen cost and metrics were gathered from HomeDepot.com for a 60-watt incandescent replacement halogen A-lamp. Accessed from <https://www.homedepot.com/p/60-Watt-Equivalent-Halogen-A19-Long-Life-Light-Bulb-4-Pack-457374/206111398> on February 16, 2018

<sup>6</sup> 2016 TDV Electricity Cost savings, averaged across all climate zones is \$3.75PV\$/kWh as calculated in the 2016 Residential Lighting CASE Report: <http://title24stakeholders.com/wp-content/uploads/2015/02/2016-T24-CASE-Report-Res-Lighting-Oct2014-V5.pdf>

sources to mimic incandescent lamps (which are historically 2700K). The rationale for maintaining a 3000K limit for removable sources is as follows:

- The majority of residential lighting in new construction scenarios is selected by builders, not homeowners.
- If new homeowners are given higher CCT lighting and they don't like it, there is a risk they will replace it with low-efficacy sources with a CCT closer to 2700K. For residential indoor lighting which is operated primarily at night, a cautious approach would be not to increase allowable CCTs. Lower CCTs are associated with lighting spectra that in general are less disruptive to circadian cycles.<sup>7,8</sup>

While the eventual occupants of new homes will still have the option to change out their lighting after they move in, the building standards represent a tool to help steer builders and designers towards optimal solutions before the occupant is involved in the decision-making process.

Alternatively, requiring a 3000K maximum CCT for all lamps with an ANSI base and a 4000K maximum CCT for all other sources would provide the retention benefits for the light sources most at risk of being replaced with a low efficacy light source and provide a compromise position between the 2016 Standard and the 45-Day Language.

#### 4.6 Color Characteristics: Color Rendering Index (CRI)

The proposed 45-Day Language would require LED lamps regulated by Title 20 to comply with the CRI requirements in Title 20. However, there are two important components within the CRI requirements in Title 20: one is the minimum CRI requirement of 82 (CRI is also referred to as  $R_a$ ), and the other is the minimum requirement of 72 for each of the eight color samples known as  $R_1$ - $R_8$ . The language proposed may introduce confusion by referring only to the CRI requirements, without specifically mentioning both aspects of the CRI requirements – the  $R_a$  value and the  $R_1$ - $R_8$  values.

The Statewide CASE Team recommends the following edits to JA8.4.4(a):

~~Inseparable SSL luminaires, LED light engines, and GU24 based LED lamps shall be capable of providing a nominal Correlated Color Temperature (CCT) that is 4000 Kelvin or less and within 0.0033 Duv of the black body locus in the 1976 CIE color space.~~ LED lamps regulated by the Title 20 Appliance Efficiency Regulations and subject to minimum Color Rendering Index and/or Individual Color Score (R1-R8) requirements under Title 20 shall comply with the Color Rendering Index and Individual Color Score requirements in Title 20.

The potential for confusion is increased because the 45-Day Language version Table JA8 only requires reporting of CRI and lists CRI greater than 82 as an acceptable data entry. The reader can be referred to Title 20, as proposed below:

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<sup>7</sup> AMA in their public policy statement on outdoor lighting has recommended the use of 3000K or lower lighting American Medical Association *Human and Environmental Effects of Light Emitting Diode (LED) Community Lighting H-135.927* <https://policysearch.ama-assn.org/policyfinder/detail/H-135.927?uri=%2FAMADoc%2FHOD-135.927.xml>

<sup>8</sup> AMA outdoor recommendations are also based the impact of blue rich sources indoors on circadian disruption. American Medical Association. *Report of the Council on Science and Public Health: Human and Environmental Effects of Light Emitting Diode (LED) Community Lighting*. CSAPH Report 2-A-16. Action of the AMA House of Delegates 2016 Annual Meeting: <https://www.ama-assn.org/sites/default/files/media-browser/public/about-ama/councils/Council%20Reports/council-on-science-public-health/a16-csaph2.pdf>

**Table 5: Recommended changes to Table JA-8 DATA TO BE RECORDED AND SUBMITTED TO THE CALIFORNIA ENERGY COMMISSION**

Required Information	Permissible Answers	Compliance Threshold
<a href="#">Complies with applicable Title 20 minimum Color Rendering Index (CRI) and minimum Color Scores (R1-R8)</a>	<u>Yes/No</u>	<del>Yes, for T20 lamps</del> <a href="#">for light sources required to meet a minimum CRI or minimum Color Scores (R1 through R8) by Title 20</a>
Color Rendering Index (CRI)	0-100	≥ 90 <del>for all products other than T20 lamps</del> <a href="#">≥ 82 for T20 lamps</a>
Color Rendering R9 (red)	0-100 or below 0	≥ 50 <del>for all products other than T20 lamps</del> <a href="#">where a minimum CRI or a minimum R1 through R8 is specified</a>