

DOCKETED

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on 2022 Energy Code Update Standards and CEQA Documentation

Additional submitted attachment is included below.

Docket No. 21-BSTD-02
California Energy Commission
1516 Ninth Street
Sacramento, California 95814

Re: 21-BSTD-02 2022 Energy Code Update Standards and CEQA Documentation

Reading the comments from Professional Engineer Jon McHugh concerning weakening lamp flicker requirements in the proposed 2022 Energy Code¹ has not only alerted me to the proposed backwards movement on lighting flicker but also that there has not been forward progress in California on regulating flicker six years after the Institute of Electrical and Electronics Engineers has adopted IEEE Standard 1789-2015 “Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers.” At the 120 Hertz fundamental frequency for many of these light sources, the IEEE standard is recommending that health risk is low only if percent flicker (percent modulation) is less than 9.6%. In comparison, the proposed minimal compliance with Joint Appendix JA8 is 30% percent flicker. In conducting the EIR, the state should make a determination whether the changes in the 2022 Energy Code have been sufficiently protective of human health and well-being in regards to flicker. The research referenced below is clear that 30% flicker is NOT sufficiently protective.

Thus I recommend that as part of the EIR and the 2022 Energy Code updates the Energy Commission include the following actions in order of increasing stringency to protect human health:

1. Remove all of the exceptions (left-hand column) in Table 150.0-A and Table 160.5-A but have a single exception for lighting that is incapable of producing nominally white light. Nominally white light has chromaticity within the basic or extended nominal color correlated temperature (CCT) specifications of ANSI C78.377. This would exempt infrared, ultraviolet and saturated color light sources. It would **not** exempt dim to warm, and most color tunable light sources. It also would **not** exempt the legacy light sources such as CFLs, linear fluorescent and HID sources. No one should have any of these sources flickering in our homes causing headaches² and reducing mental performance.³ This is most easily done by deleting Table 150.0-A and Table 160.5-A altogether, as the long list of exceptions would no longer be needed.
2. Include an **optional low risk flicker certification** within Joint Appendix JA8 that limits flicker to no greater than the low risk limits in IEEE 1789 and specially labelled to designate this certification such as “JA8-LF,” to support customer choice or CALGreen voluntary requirements as described in next item.
3. Reference this low flicker certification in the **residential voluntary** section, Chapter A4 of CALGreen.
4. Expand the optional low risk flicker certification and marking to commercial building light sources and reference this low flicker certification in the **nonresidential voluntary** section, Chapter A5 of CALGreen.

¹ <https://efiling.energy.ca.gov/GetDocument.aspx?tn=237497&DocumentContentId=70695>

² Wilkins A J, Nimmo-Smith I, Slater A I and Bedocs L. 1989. Fluorescent lighting, headaches and eyestrain, *Lighting Research and Technology*, Vol 21, No 1, 1989, pp 11-18,

³ Veitch J A and S L McColl. 1995. Modulation of fluorescent light: Flicker rate and light source effects on visual performance and visual comfort — including Discussion, *Lighting Research and Technology*, Vol 27, No 4, 1995, pp 243-256,

5. Require **mandatory low risk flicker certification** in JA8 that matches the percent flicker at various frequencies to no greater than the low risk limits in IEEE. This would then apply as a mandatory requirement to most light sources in new **residential** dwellings (see the first bullet).
6. Expand flicker requirements of no greater than the low risk limits in IEEE 1789 to all nominally white lighting in **nonresidential** settings. Require that certified products must publish their data in a publicly available database whether it be JA8 or other database such as the DesignLights Consortium (DLC) qualifying product database.⁴
7. Similarly set maximum flicker requirements for **outdoor lighting**.

I insist the Commission at least adopt for the 2022 standard my proposals 1 (removing exceptions), 2 (low risk certification and labelling) , 3 (referencing low risk labelling in the residential voluntary section of CALGreen), and 4 (referencing low risk labelling in the nonresidential voluntary section of CALGreen). In preparation for the 2025 code cycle, conduct research and outreach to prepare the market for protective mandatory standards for all occupancies and outdoors: 5 (mandatory residential standard), 6 (mandatory nonresidential standard) and 7 (mandatory outdoor lighting standard).

There are many products available today that meet the IEEE Standard.

See details of each option described on the following pages.

Thank you,

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⁴ <https://www.designlights.org/> The DLC database does not currently include flicker but has the capability to add this performance metric.

Examples of Improved Standards

Below are my recommended changes in the order of the above numbered points. Edits are formatted as follows: text without underlines is 2019 Title 24 text, text with single underline or ~~striketrough~~ are changes in the express terms and changes with double underline or ~~double striketrough~~ are my proposed edits.

1. Delete Table 150.0-A and Table 160.5-A and Require JA8 Lighting Section 150.0(k)1

(k) Residential Lighting.

1. Luminaire Requirements.

A. Luminaire Efficacy. All installed luminaires or light sources shall be certified to the Commission as complying with Reference Joint Appendix JA8 and marked as required by JA8. ~~meet the requirements in TABLE 150.0 A.~~

EXCEPTION 1 to Section 150.0(k)1A: Integrated device lighting. ~~Lighting integral to exhaust fans, kitchen range hoods, bath vanity mirrors, and garage door openers, and non-removable lighting attached to ceiling fans.~~

EXCEPTION 2 to Section 150.0(k)1A: Navigation lighting. ~~Night lights, step lights, and path lights less than 5 watts. Lighting internal to drawers, cabinetry, and linen closets less than 3 watts per shelf or drawer.~~

EXCEPTION 3 to Section 150.0(k)1A: Luminaires or light sources that are incapable of producing nominally white light. ~~Nominally white light has chromaticity within the basic or extended nominal color correlated temperature (CCT) specifications of ANSI C78.377.~~

EXCEPTION 4 to Section 150.0(k)1A: Lighting installed outdoors.

~~**EXCEPTION 3 to Section 150.0(k)1A: Cabinet Lighting.** ~~Lighting internal to drawers, cabinetry, and linen closets with an efficacy of 45 lumens per watt or greater.~~~~

The addition of 150.0(k)1B “screw-based luminaires” is no longer needed as it reiterates the exceptions for dim to warm and color tunable exclusions to JA8 which would no longer be valid. This could be deleted.

2. JA8 Flicker Certified to Comply with IEEE Low Risk Recommendation

Appendix JA8 – Qualification Requirements for High Luminous Efficacy Light Sources

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JA8.4 Qualification Requirements

The following qualification requirements must be met for the light source to be considered High Luminous Efficacy as specified in Section 150(k) and Table 150.0-A.

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JA8.4.7 Optional Low Flicker Certification

The light source shall meet the following low flicker certification requirements when measured in accordance with the test method of Section JA8.3.7. Light source in combination with specified

control shall be certified Low Flicker when tested at full light output and 20% of full light output as specified in JA10, and measured percent amplitude modulation (percent flicker) values are no greater than the percent amplitude modulation values for all cut-off frequencies listed in Table JA-8.4.7

Table JA-8.4.7: Maximum Percent Modulation for light sources tested in accordance with Joint Appendix JA10.

<u>T-24 JA10 Cut-off frequency (Hz)</u>	<u>Maximum Percent Amplitude Modulation</u>
<u>40</u>	<u>1.0%</u>
<u>90</u>	<u>1.6%</u>
<u>200</u>	<u>9.6%</u>
<u>400</u>	<u>24.0%</u>
<u>1000</u>	<u>56.0%</u>

JA8.5 Marking

Light sources meeting the requirements of this Appendix shall be marked with “JA8-~~2019~~2022” 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 Product Specification for Lamps Version 2.1, or that have passed the rated life test specified in the ENERGY STAR Product Specification for Luminaires Version 2.1, shall instead be marked with “JA8-~~2019~~2022-E” to indicate that they comply with this Appendix and may additionally be installed in elevated temperature applications such as enclosed fixtures. Light sources that do not comply with this Appendix shall not be marked with “JA8-~~2019~~2022” or “JA8-~~2019~~2022-E”.

Light sources meeting the requirements of this Appendix and the Optional Low Flicker Certification requirements in Section JA8.4.7, shall be marked “JA8-2022LF” of if they have additionally qualified for elevated temperature applications as stated above, they shall be marked “JA8-2022-ELF.”

JA8.6 Data Reporting

The following test data shall be submitted to the California Energy Commission in the format specified in Table JA-8. The entity submitting the filing shall keep all test data and documentation required for compliance for at least two years from the date of certification and shall provide copies of this documentation to the Energy Commission within 10 days of written request received from the Energy Commission.

TABLE JA-8.6. DATA TO BE RECORDED AND SUBMITTED TO THE CALIFORNIA ENERGY COMMISSION

3. Voluntary Requirement for Low Flicker Certification in Residential Chapter A4 of CALGreen

APPENDIX A4

RESIDENTIAL VOLUNTARY MEASURES

Division A4.5 – ENVIRONMENTAL QUALITY

...

SECTION A4.507

ENVIRONMENTAL COMFORT

(Reserved)

A4.507.1 Certified Low Flicker Lighting. All installed luminaires or light sources shall be certified to the Commission as complying with Optional Low Flicker Certification in Reference Joint Appendix JA8.4.7 and marked “JA8-2022LF” (low flicker) or “JA8-2022-ELF” (elevated temperature and low flicker) as required by JA8.

Exceptions:

1. Lighting integral to exhaust fans, kitchen range hoods, bath vanity mirrors, and garage door openers, and non-removable lighting attached to ceiling fans.
2. Night lights, step lights, and path lights less than 5 watts. Lighting internal to drawers, cabinetry, and linen closets less than 3 watts per shelf or drawer.
3. Luminaires or light sources that are incapable of producing nominally white light. Nominally white light has chromaticity within the basic or extended nominal color correlated temperature (CCT) specifications of ANSI C78.377.

4. Voluntary Requirement for Low Flicker Certification in Nonresidential Chapter A5 of CALGreen

APPENDIX A5

NONRESIDENTIAL VOLUNTARY MEASURES

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SECTION A5.507

ENVIRONMENTAL COMFORT

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A5.507.3 Views. Achieve direct line of sight...

A5.507.4 Certified Low Flicker Lighting. All installed luminaires or light sources shall be certified to the Commission as complying with Optional Low Flicker Certification in Reference Joint Appendix JA8.4.7 and marked “JA8-2022LF” (low flicker) or “JA8-2022-ELF” (elevated temperature and low flicker) as required by JA8.

Exceptions:

1. Lighting integral to exhaust fans, kitchen range hoods, bath vanity mirrors, and garage door openers, and non-removable lighting attached to ceiling fans.
2. Night lights, step lights, and path lights less than 5 watts. Lighting internal to drawers, cabinetry, and linen closets less than 3 watts per shelf or drawer.
3. Luminaires or light sources that are incapable of producing nominally white light. Nominally white light has chromaticity within the basic or extended nominal color correlated temperature (CCT) specifications of ANSI C78.377.

A5.507.5 Acoustical control [DSA-SS]. Public Schools and Community Colleges: Unoccupied, furnished classrooms must have a maximum background noise level ...

5. Mandatory Requirement for Low Flicker Certification in JA8 and in the Residential Energy Code

Appendix JA8 – Qualification Requirements for High **Luminous** Efficacy Light Sources

...

JA8.4 Qualification Requirements

The following qualification requirements must be met for the light source to be considered High Luminous Efficacy as specified in Section 150(k) and Table 150.0-A.

...

JA8.4.6 Dimming, ~~Reduced~~ Low Flicker Operation and Audible Noise

The light source shall meet the following dimming, reduced flicker operation, and audible noise requirements when measured in accordance with the test method of Section JA8.3.7:

- (a) The light source shall be dimmable down to 10 percent light output where 100 percent full light output is defined as operating the light source at the maximum setting provided by the control.
- (b) LED-based light sources designed to be connected with or dimmed by forward phase cut dimmers shall meet the requirements of NEMA standard SSL 7A.
- (c) Light source in combination with specified control shall provide “~~reduced low flicker operation~~” when tested at full light output as specified in JA10, where ~~reduced low flicker operation~~ is defined as having percent amplitude modulation no greater than the percent amplitude modulation values for all cut-off frequencies listed in Table JA-8.4.6 (~~percent flicker) less than 30 percent at frequencies less than 200Hz.~~
- (d) Light source shall not emit audible noise above 24dBA measured at 1 meter from the light source when tested at full light output.
- (e) Light sources shall also be tested and shown to comply with (c) and (d) while at 20% light output.

Table JA-8.4.6: Maximum Percent Modulation for light sources tested in accordance with Joint Appendix JA10.

<u>T-24 JA10 Cut-off frequency (Hz)</u>	<u>Maximum Percent Amplitude Modulation</u>
<u>40</u>	<u>1.0%</u>
<u>90</u>	<u>1.6%</u>
<u>200</u>	<u>9.6%</u>
<u>400</u>	<u>24.0%</u>
<u>1000</u>	<u>56.0%</u>

...

JA8.6 Data Reporting

The following test data shall be submitted to the California Energy Commission in the format specified in Table JA-8.6. The entity submitting the filing shall keep all test data and documentation required for compliance for at least two years from the date of certification and shall provide copies of this documentation to the Energy Commission within 10 days of written request received from the Energy Commission.

TABLE JA-8.6. DATA TO BE RECORDED AND SUBMITTED TO THE CALIFORNIA ENERGY COMMISSION

Required Information	Permissible Answers	Compliance Threshold
Manufacturer, Model number, Description		

...														
Flicker:														
See JA10 Table 10-1 for flicker data requirements and permissible answers		<u>At Full light Output</u> <table border="1"> <thead> <tr> <th><u>T-24 JA10 Cut-off frequency (Hz)</u></th> <th><u>Maximum Percent Amplitude Modulation</u></th> </tr> </thead> <tbody> <tr> <td><u>40</u></td> <td><u>1.0%</u></td> </tr> <tr> <td><u>90</u></td> <td><u>1.6%</u></td> </tr> <tr> <td><u>200</u></td> <td><u>9.6%</u></td> </tr> <tr> <td><u>400</u></td> <td><u>24.0%</u></td> </tr> <tr> <td><u>1000</u></td> <td><u>56.0%</u></td> </tr> </tbody> </table>	<u>T-24 JA10 Cut-off frequency (Hz)</u>	<u>Maximum Percent Amplitude Modulation</u>	<u>40</u>	<u>1.0%</u>	<u>90</u>	<u>1.6%</u>	<u>200</u>	<u>9.6%</u>	<u>400</u>	<u>24.0%</u>	<u>1000</u>	<u>56.0%</u>
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Audible Noise														

6. Mandatory Requirement for Low Flicker Certification in JA8 and in the Nonresidential Energy Code

Section 119.0(b)3

SECTION 110.9 – MANDATORY REQUIREMENTS FOR LIGHTING CONTROLS

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(b) All Lighting Controls. Lighting controls listed in Section 110.9(b) shall comply with the requirements listed below; and all components of the system considered together as installed shall meet all applicable requirements for the application for which they are installed as required in Sections 130.0 through 130.5, Sections 140.6 through 140.8, Section 141.0, and Section 150.0(k).

...

3. ~~Dimmers~~ Dimming. Dimming luminaires in combination with specified control Controls that provide dimming functionality shall:

A. Be capable of reducing lighting power consumption by a minimum of 65% when at its lowest setting;

B. ~~Provide~~ At full light output provide reduced low flicker operation, meaning that directly controlled light sources shall be provided electrical power such that the light output has an amplitude modulation of ~~less than~~ no greater than the percent amplitude modulation values for all cut-off frequencies listed in Table 110.9-B ~~30 percent for frequencies less than 200 Hz~~ without causing premature lamp failure;

C. At the greater of 20% of full light output and minimum light output provide low flicker operation meaning that directly controlled light sources shall be provided electrical power such that the light output has an amplitude modulation of no greater than the percent amplitude modulation values for all cut-off frequencies listed in Table 110.9-B without causing premature lamp failure;

D. Compliance of luminaires or light sources with items B and C shall be demonstrated by certification to the Commission as complying with Reference Joint Appendix JA8 and marked as required by JA8 or the manufacturer shall provide test documentation of compliance.

E. Provide an off setting that produces a zero lumen output; and

~~D~~ E. For wall box dimmers and associated switches designed for use in three way circuits, be capable of turning lights off, and on to the level set by the dimmer if the lights are off.

....

Table 110.9-B: Maximum Percent Modulation for light sources tested in accordance with Joint Appendix JA10.

<u>T-24 JA10 Cut-off frequency (Hz)</u>	<u>Maximum Percent Amplitude Modulation</u>
<u>40</u>	<u>1.0%</u>
<u>90</u>	<u>1.6%</u>
<u>200</u>	<u>9.6%</u>
<u>400</u>	<u>24.0%</u>
<u>1000</u>	<u>56.0%</u>

7. Mandatory Requirement for Low Flicker Certification in JA8 and for Outdoor Lighting

Section 130.2(a)

SECTION 130.2 – OUTDOOR LIGHTING CONTROLS AND EQUIPMENT

Nonresidential, ~~high-rise residential~~ and hotel/motel buildings shall comply with the applicable requirements of Sections 130.2(a) through 130.2(c).

(a) ~~RESERVED~~ All outdoor lighting shall be tested at full light output in accordance with Joint Appendix JA10, and shall have an amplitude modulation no greater than the percent amplitude modulation values for all cut-off frequencies listed in Table 110.9-B. If the outdoor lighting is dimming, the light source, in combination with specified control, shall be tested in accordance with Joint Appendix JA10 at the greater of 20% of full light output and minimum light output and shall have an amplitude modulation no greater than the percent amplitude modulation values for all cut-off frequencies listed in Table 110.9-B.

Section 150.0(k)1

(k) Residential Lighting.

1. Luminaire Requirements.

A. Luminaire Efficacy. All installed luminaires or light sources shall be certified to the

Commission as complying with Reference Joint Appendix JA8 and marked as required by JA8. ~~meet the requirements in TABLE 150.0 A.~~

EXCEPTION 1 to Section 150.0(k)1A: ~~Integrated device lighting.~~ Lighting integral to exhaust fans, kitchen range hoods, bath vanity mirrors, and garage door openers, and non-removable lighting attached to ceiling fans.

EXCEPTION 2 to Section 150.0(k)1A: ~~Navigation lighting.~~ Night lights, step lights, and path lights less than 5 watts. Lighting internal to drawers, cabinetry, and linen closets less than 3 watts per shelf or drawer.

EXCEPTION 3 to Section 150.0(k)1A: Luminaires or light sources that are incapable of producing nominally white light. Nominally white light has chromaticity within the basic or extended nominal color correlated temperature (CCT) specifications of ANSI C78.377.

EXCEPTION 4 to Section 150.0(k)1A: ~~Lighting installed outdoors.~~

(Note this requirement would apply to outdoor lighting so Exception 4 is removed.)