DOCKETED

Docket Number:	17-BSTD-02
Project Title:	2019 Title 24, Part 6, Building Energy Efficiency Standards Rulemaking
TN #:	222823
Document Title:	Philips Lighting additional comments on NEMA 77
Description:	N/A
Filer:	System
Organization:	Philips/Kelly Seeger
Submitter Role:	Public
Submission Date:	3/2/2018 10:51:30 AM
Docketed Date:	3/2/2018

Comment Received From: Kelly Seeger
Submitted On: 3/2/2018
Docket Number: 17-BSTD-02

Philips Lighting additional comments on NEMA 77

Additional submitted attachment is included below.

PHILIPS

March 2, 2018

Submitted via website: https://efiling.energy.ca.gov/EComment/EComment.aspx?docketnumber=17-BSTD-02

Mr. Andrew McAllister
Commissioner
California Energy Commission
1516 Ninth Street
Sacramento, California 95814

Docket No.: 17BSTD-02

Philips Lighting Additional Comments in Support of NEMA 77 as a Method for Qualifying Products to 2016 CA Title 24 JA8

Dear Commissioner McAllister,

Philips Lighting appreciates the opportunity to provide the attached comments on the Express Terms for the 2019 California Building Energy Efficiency Standards California Code of Regulations, Title 24, Part 6.

Philips Lighting is a global leader in lighting products, systems, and services. Our understanding of how lighting positively affects people coupled with our deep technological know-how enable us to deliver digital lighting innovations that unlock new business value, deliver rich user experiences and help to improve lives. Serving professional and consumer markets, we sell more energy efficient LED lighting than any other company. We lead the industry in connected lighting systems and services, leveraging the Internet of Things to take light beyond illumination and transform homes, buildings, and urban spaces.

Please contact us if you have any questions about these comments.

Sincerely,

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Philips Lighting Additional Comments in Support of NEMA 77 as a Method for Qualifying Products to 2016 CA Title 24 JA8

In this docket entry, two items are addressed:

1. The use of a single universal limit for temporal light artifacts (TLA), that applies to all applications, all products, and varied light levels (dimmed conditions) should be chosen not based on the condition that requires the most stringent limit, but based on careful consideration of all conditions.

2. Three additional documents which were docketed between February 20-22, 2018 criticizing NEMA 77 as an alternative method to qualify products for Title 24. We respond to those criticisms below.

Universal TLA limit

Currently, California has a single TLA limit that applies across all Title 24-relevant applications, to all Title 24-relevant products, and at all Title 24-relevant light levels. We continue to encourage the Energy Commission to allow the use of NEMA 77 as an option to qualify products. The limit can either be the existing JA8 limit or a combination of the JA8 limit and NEMA 77. We are concerned that if this limit is set too stringent, then fully acceptable products will inadvertently be shut out of the California market. As an example, one of the lamps used in the NEMA 77 testing was a Philips Slimstyle A-lamp, pictured below in Figure 1.

Figure 1: Typical LED A-Lamp

This product has the SVM behavior shown in Figure 2 below. The SVM of most LED sources will show similar increase during dimming. Although SVM is less than 1.0 at full light output (about 0.9 at full output on a dimmer and about 0.6 when operated without a dimmer), it has a peak SVM of nearly 1.6 when

dimmed. The eye is less sensitive to stroboscopic effect as light levels decrease [Perz, et al.)[1], so less strict limits on SVM may be set at lower light levels (e.g. SVM = 1.6). This product has been well accepted in the marketplace, however it would not be allowed in California if SVM = 1.0 becomes the requirement (the requirement applies both at 100% and 20%). Note that if the Slimstyle lamp was redesigned to have a peak SVM when dimmed of 1.0, then the SVM at full output on a dimmer (with ~140 degree conduction angle) would be <0.6. Redesigning to meet SVM = 1.0 over the entire dimming range would result in an SVM of 0.3 – 0.4 (with no dimmer). A universal specification of SVM = 1.0 forces overdesign and corresponding added cost that is simply not necessary for general illumination products.

This could make *dimmable* lamps unfavorable in the market place. Non-dimmable lamps could simply be designed for SVM = 1.0 (at full output) whereas dimmable lamps would have to be overdesigned to meet SVM = 0.3 – 0.4 at full output, thus dis-incentivizing the use of dimmable lamps.

Because stroboscopic effect is less visible during dimming, we recommend that the Title 24 JA8 requirements allow a higher SVM during dimming.

In addition, there are many LED lamps with small form factors, such as capsule lamps, T5 linear lamps, and E12-base decorative lamps, which will not be usable in California if the TLA specifications are too strict. It is simply physically impossible at present to add sufficient energy storage components (typically capacitors) in these small shapes/sizes, to filter the waveform sufficiently to achieve a limit of SVM = 1.0. It is not a matter of cost; rather this is a function of current LED technology for small form factor lamps.

[1] M. Perz, D. Sekulovski, I Vogels, and I Heynderickx “Stroboscopic effect: contrast threshold function and dependence on illumination level”, J. of the Optical Soc. of America, Vol 35, No. 2, Feb. 2018, pp. 309-319.

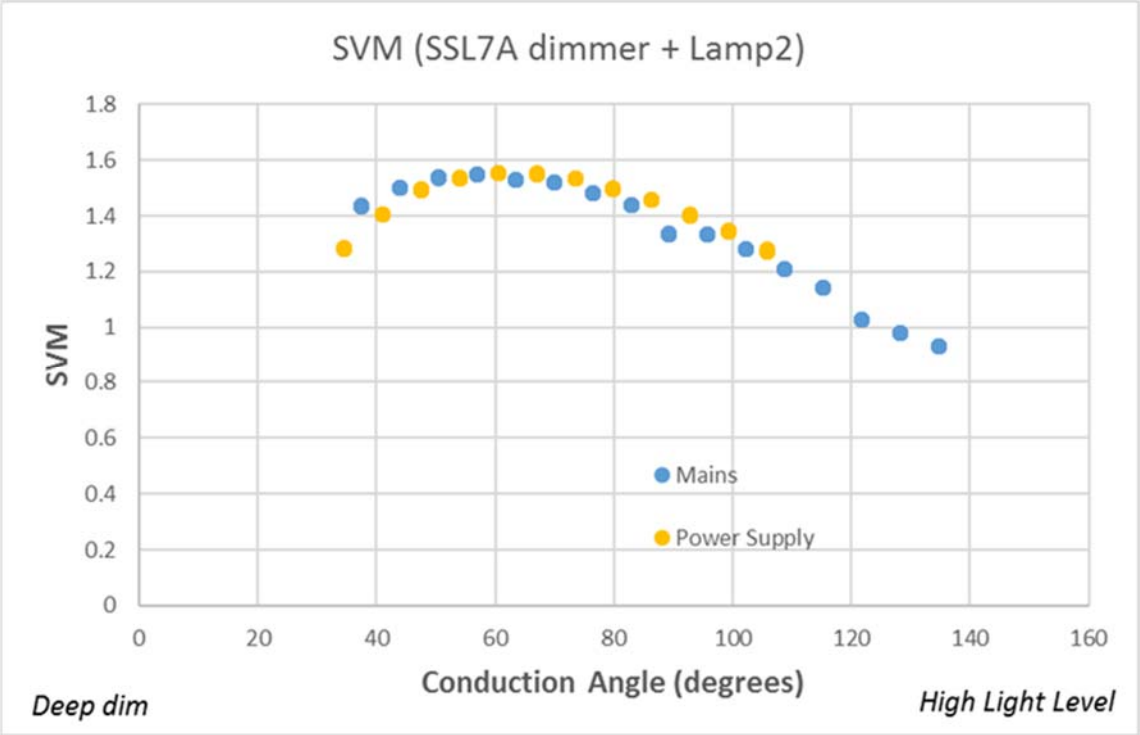

Figure 2: SVM behavior during dimming of a typical A-lamp.

The goal of a regulatory requirement should be to set acceptable minimum performance, and then allow product differentiation within the remaining space. A regulation should not set minimum performance for the application requiring the strictest conditions, which forces unnecessary over-design and higher cost in other applications and effectively eliminates products from the market and reduces consumer choice.

Responses to Docketed Comments

The three docket items are:
http://docketpublic.energy.ca.gov/PublicDocuments/17-BSTD-02/TN222606_20180220T021028_Dave_Bannister_Comments_Additional_Comments_on_the_Title_24_Fli.pdf
http://docketpublic.energy.ca.gov/PublicDocuments/17-BSTD-02/TN222595_20180217T045026_Prof_Arnold_Wilkins_Comments_Re_submission_by_NEMA_and_Philips.pdf
http://docketpublic.energy.ca.gov/PublicDocuments/17-BSTD-02/TN222625_20180221T055741_Luke_Price_Comments_Simpler_alternative_to_NEMA_77_to_implement.pdf

The three docketed comments were apparently written in close collaboration, and we will address them as one. The underlying theme is not actually an argument against NEMA 77 and for the Title 24 limits, but

rather an argument for IEEE 1789. We continue to argue that a regulation that eliminates LED lamps with equivalent flicker to existing technologies (e.g. incandescent, HPS), which have been fully accepted by the public for years, is simply not a reasonable choice for a regulation on general illumination light sources. The incandescent lamp had acceptable TLA for 100 years.

IEEE 1789 implies an equivalence between visibility and acceptability. The fact that a person may be able to observe light modulation effects when a rapidly moving object is present in the lit space or may be able to view a phantom array occasionally when moving one's eyes rapidly[2] is not equivalent to saying that their health is affected, or that they are somehow adversely affected by the light.

Their comments address phantom array effect. Wilkins is particularly concerned about frequencies near 300 Hz. Frequencies above 200 Hz are **not** regulated in the present Title 24 TLA requirements. So we are somewhat surprised that the commenters do not see NEMA 77 as a step in the right direction, when adopting NEMA 77 would **add** limits for frequencies above 200 Hz up to ~1000 Hz.

The concept of a static observer is also criticized because it assumes no eye motion. This is not the correct understanding. A 'static observer' is defined in CIE TN-006[3]:

> **2.4.5**
> **static observer**
> observer who does not move her / his eye(s)
> Note 1 to entry: Only large eye movements (saccades) fall under this definition. An observer that only does involuntary micro-saccades is considered static.

The definition allows for the presence of some eye motion, and therefore some phantom array effect. By the way, if eye motion is inevitable as the commenters suggest, then it was also happening during the experimentation used to develop the SVM metric, and was accounted for implicitly (at least the small micro-saccades mentioned in the definition).

There is no method for quantifying phantom array yet. It is therefore not possible to define visibility limits for phantom array effect. The commenters have argued that limits may need to be stricter than those of IEEE 1789. There is no established connection between phantom array and health effects. It is contradictory to argue for adoption of IEEE 1789 in a mandatory regulation for all applications amid so much uncertainty.

The commenters stated:

[2] Also commonly visible with cell phones and other displays/indicators about which the commenters raise no concerns

[3] Visual Aspects of Time-Modulated Lighting Systems – Definitions and Measurements Models

"Therefore, in summary, SVM limits exposure to the relatively less serious forms of TLA, to an extent that would be deemed acceptable by half the population, or less, whilst neglecting more serious forms." This statement contains two major misconceptions.

First, as stated above, there is no evidence that phantom array is more serious than stroboscopic effect or flicker. In fact, there is ample evidence that flicker[4] is a trigger for photosensitive epilepsy and migraines, which the commenters should know but choose to ignore. NEMA 77 places much **stricter** limits on flicker in this area (large red region in Figure 3) than does Title 24 2016.

Second, the fact that half of the population can detect stroboscopic effect at a certain condition (no matter how weak the effect may be) is not equivalent to saying that half of the population would deem it unacceptable. The ASSIST program[5], for instance, has shown that visibility is not equal to acceptability for stroboscopic effect.

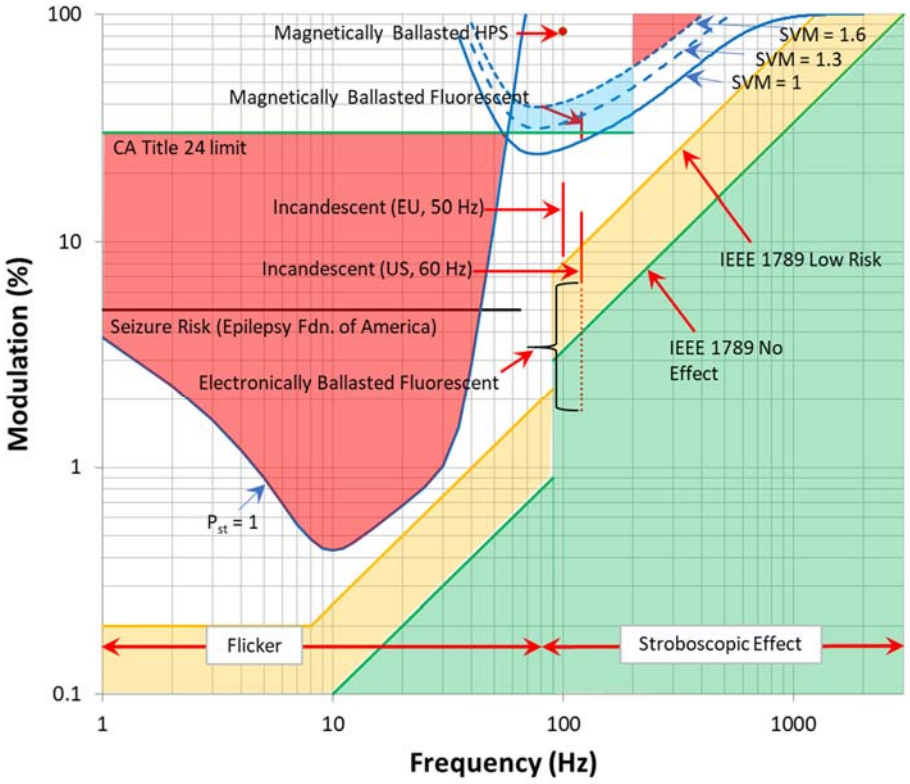

Figure 3: Comparison of TLA measures and conventional light sources.

[4] Using the CIE definition of flicker, which does not include motion, either of the object or of the eye (other than the micro-saccades mentioned above). It is important at frequencies below about 70-80 Hz. See figure 3.

[5] ASSIST recommends, "Flicker Parameters for Reducing Stroboscopic Effects from Solid-state Lighting Systems", Vol. 11, Issue 1, May 2012. http://www.lrc.rpi.edu/programs/solidstate/assist/pdf/AR-Flicker.pdf

The commenters further stated:

“In conclusion, therefore, SVM is no substitute for the current JA8 procedure”. We are not suggesting that the Title 24 test method be substituted by SVM; we are advocating for the acceptance of both SVM *and* Pst as an option for qualification to Title 24.

The commenters state that NEMA 77 does not describe the applications for which IEEE 1789 is too strict. Those applications are described in Figure 3, which clearly shows that if you rule out LED lamps with equivalent flicker to existing technologies (e.g. incandescent, HPS), you rule out their use in all applications that used those lamps in the past.

To reiterate, NEMA 77 is an improvement over the current Title 24 requirements for TLA, since it is much stricter where serious health effects have been observed. It also places limits at frequencies above 200 Hz, where Title 24 presently has no requirements. It is based on human perception and is a robust, real-world approach that applies the latest science and metrics (SVM and P_{st}) to the measurement of temporal light artifacts (TLA) and recommends appropriate limits for general lighting applications.

Please consider this document as a further elaboration to our previously docketed comments and those of NEMA, and a rebuttal to recent docketed comments. Thank you for consideration of these comments.