



May 28, 2013

ENERGY STAR Products Program  
U.S. Environmental Protection Agency (EPA)  
1200 Pennsylvania Ave., NW  
Washington, DC 20460

RE: Once Innovations, Inc. Comments on the “ENERGY STAR® Program Requirements Product Specification for Lamps (Light Bulbs) Eligibility Criteria Version 1.0, DRAFT 4

VIA EMAIL:

Dear Sir/Madam:

We would like to thank ENERGY STAR for giving us an extension and an opportunity to receive additional information from ENERGY STAR prior to comment. Once Innovations, Inc. (ONCE) is a small business engaged in the business of developing, manufacturing and selling AC-based LED products. Based on the review of DRAFT 4 we have significant concerns with the new flicker requirements. In particular, based upon multiple studies, the requirements are overly restrictive and will cause net energy losses in the marketplace.

COMPLIANCE WITH ADMINISTRATIVE PROCEDURES ACT (APA)

As an initial matter, following up on previous comments by ONCE related to the “Enhanced Program Plan for ENERGY STAR Products”, ONCE persistently urges that ENERGY STAR procedures be modified to follow the APA’s notice and comment procedures with publication in the Federal Register. We believe this is especially important in instances similar to this where 1). In the highly competitive general illumination market even a \$5 rebate based on ENERGY STAR compliance has a major impact on sales, thereby making compliance virtually mandatory in the industry, and 2). ENERGY STAR is making requirements based on a consumer protection perspective rather than an energy savings basis.

On August 24, 2012 the National Electrical Manufacturers Association (NEMA) in Comments on Energy Star® Program Requirements Product Specification for Lamps (Light Bulbs) Eligibility Criteria Version 1.0, Draft 2 states: “Administrator McCarthy acknowledged in her 2011 letters to Senators Bingamen and Murkowski that the widespread use of ENERGY STAR in Federal, State and Local purchasing guidance has made the program increasingly regulatory in nature, viz mandatory. By mandating numerous non-energy performance requirements, ENERGY STAR proposes to tell manufacturers how to design their products. This has a likely effect of resulting in commoditization. The EPA should and must recognize the contradiction of mandating numerous performance improvements at corresponding higher cost, while consumer adoption is influenced most strongly by lowering costs for the product . . . The Energy Star program should be a vehicle for accelerating the adoption of energy efficient technologies. If the requirements are adopted as proposed, there will be fewer ENERGY STAR-qualified products on the market . . . This will reduce consumer choice and in turn adoption.”

Honeywell in a Nov. 27, 2009 letter states “we believe that the proposed draft will add cost by adding features that are not needed by most consumers, stifles industry innovation through design constraints, and represents a step backwards in achieving energy savings via this category of products.”

The American Gas Association in a letter dated July 10, 2009 states: “AGA continues to maintain, as stated in previous comments on the ENERGY STAR HOMES program, that EPA’s approach for review and comment on draft guidelines is insufficient. The new Guidelines proposed by EPA should be promulgated as a rule in accordance with the notice and comment procedures of the Administrative Procedures Act (“APA”). The decision making process regarding proposed 2011 program requirements would be significantly improved if such requirements were published in the Federal Register. . . . Recent legislative efforts to promote efficiency have highlighted the role of the Energy Star program in achieving efficiency goals. Both the Energy Policy Act of 2005 and the Energy Independence and Security Act of 2007 contain provisions mandating that federal agencies increase efficiency through procurement of Energy Star rated products . . .”

ONCE continues to be part of an apparently growing list of companies and organizations that would like to see more scrutiny applied to the ENERGY STAR program. Further, in our opinion this scrutiny should be heightened when potential consumer protection concerns (e.g. such as the instant case of flicker) are at issue. Here, ENERGY STAR appears to be attempting to design products to an arbitrary standard, or perhaps to the liking of a person or constituent, rather than to an established standard focused on promoting energy savings. While typically consumer protection type requirements are done in the name of gaining wider acceptance in the marketplace, added restrictions eliminate manufacturers, eliminate consumer options, eliminate technology advancements, and increase design costs. The most unfortunate result is ENERGY STAR directly reducing consumer purchases of energy-reducing and energy efficient products thereby minimizing energy savings. These unintended consequences are the exact type of result the heighten scrutiny of compliance with the APA are intended to avoid.

#### THE FLICKER REQUIREMENT

DRAFT 4 has presented Requirement 12.3 Flicker as part of the Eligibility Criteria. ONCE believes the requirement proposed is overly and unnecessarily restrictive. Many studies exist showing the negative health effects of flicker at very low frequencies (i.e. < 70 Hz), including being responsible for seizures, headaches and eyestrain. See Wilkins et al., LED Lighting Flicker and Potential Health Concerns: IEEE Standard PAR1789 Update, Appendix Table I Flicker and Biological Effects.<sup>1</sup> The table also shows one study that has even demonstrated the possibility of reduced visual performance at 120 Hz. Still as noted in A Review of the Literature on Light Flicker: Ergonomics, Biological Attributes, Potential Health Effects, and Methods in Which Some LED Lighting May Introduce Flicker 2/26/10, IEEE Standard P1789:

As noted in the table below, much of the literature might suggest that 160 Hz – 200 Hz *may* (emphasis added) be a sufficient limit for flicker to have negligible biological effects in some lighting application, but note that none of the literature considers the eyes in motion across a high spatial contrast. Finally, it is important to mention that the fact that there is “biological effect” (ERG or notice of visual flicker in special circumstances) does *not necessarily* (emphasis added) imply health risk to viewers. For example, flickering light at 200 Hz may theoretically be

annoying to spectators of tennis or ping-pong games, but may not pose any health risks (Rea and Ouellette, 1988).

So, at least until this point, it seems the scientific community is in agreement that while at low level frequencies flicker can have detrimental or serious health effects, studies simply are not showing actual health risks for frequencies at or above 100 Hz. In addition, from a review of the available literature, the health effects that are documented (even in the 100 Hz range) appear to be very minor (i.e. headache and eyestrain) and effect only a very small percentage of the population.

Even if this is taken as entirely accurate and the extremely subjective “acceptability” is considered, research still shows that flicker of 100 Hz is acceptable to test subjects. See Effects of Flicker Characteristics from Solid-State Lighting on Detection, Acceptability and Comfort, Bullough et. al Feb. 2011. In that study multiple LEDs having multiple flicker indexes were provided to subjects at varying frequencies from 50 Hz to 300 Hz. Id. Subjects indicated whether they could detect flicker in the following situations 1) When using a computer; 2) When looking at the luminaire; 3) When looking at point A (approximately 40° from the luminaire); 4) When shifting their gaze between point A and B in the room (separated by a visual angle of approximately 54°); 5) When waving their hand underneath the luminaire. Id. Then, if the subjects could detect a flicker or stroboscopic effect they were asked to provide the acceptability of the flicker with -2 being very uncomfortable, -1 somewhat unacceptable, 0 neither acceptable or unacceptable, +1 somewhat acceptable and +2 very acceptable. Id. The end result, for each situation 1-5 for frequencies 100 Hz and above, even in the few cases where flicker could actually be perceived, the acceptability rating was over 1, or “somewhat to very acceptable” to subjects. Id.

From the Bullough et. al. studies an additional paper was published Detection and Acceptability of Stroboscopic Effects from Flicker. While this paper itself is not currently available to ONCE, ASSIST Recommends published by the Lighting Research Center provided literature entitled Flicker Parameters for Reducing Stroboscopic Effects from Solid-State Lighting Systems Volume 11, Issue 1 May 2012. This literature offers additional analysis of the data presented in the second Bullough paper. In particular, an additional experiment was conducted where subjects provided acceptability ratings of detectable flicker on the same acceptability scale -2 – 2 when a light-colored rod was waved against a dark background. Id. In this one situation, in the 100 Hz to approximately 160 Hz range for percent flickers well above 25% and typically above 54%, some ratings in the 0 to -1 acceptability range were provided. Id.

So, as indicated by the ASSIST paper:

Because the study that assessed stroboscopic effects (Bullough et al. in press) used a light-colored, rapidly moving object viewed against a dark background, it comprises a ***near-worst-case condition*** (emphasis added) for perception of stroboscopic effects. Slower movements, objects with lower contrast, and the presence of non-flickering light sources such as daylight would all be expected to reduce the likelihood of detecting, and to increase the acceptability of, stroboscopic effects from a flickering light source.

Id. Thus, in nearly the worst conditions possible, with the worst performing lights, with the highest contrast, with no ambient light, subjects found the flicker or stroboscopic effects to be somewhere between “neither acceptable or unacceptable” to “somewhat unacceptable”.

Upon reviewing these studies ONCE concludes little is to be gained from the proposed flicker requirements proposed by ENERGY STAR. There simply is no evidence the additional ENERGY STAR restrictions will have any effect whatsoever in the marketplace, or any evidence these restrictions will save energy.

According to the note on Page 24 of 30 of the Draft “current research supports that the flicker requirement will begin to address unacceptable flicker, and may continue to refine the requirements as additional data becomes available.” At a webinar, Energy Star provided a slide show and indicated on slide 46 the articles referenced in determining the flicker requirement.

The first paper was Modeling the Visibility of Stroboscopic Effect in Temporally Modulated Light Systems, M. Perz, I. Vogels, D. Sekulovski, Dec. 2011. In that paper, three tests were conducted and reviewed. Id. In the first they varied illumination levels between 650 lux and 1300 lux, CCT at 3300K, 7200K and 4600K at 100 Hz with a Reference being a 400 lux, 4600 K fluorescent with HF driver. Id. While specific results were not provided the researchers concluded ***flicker was imperceptible up to 650 lux***, but at higher illumination levels (up to 1300 lux) became slightly annoying. Id. (emphasis added). For most light conditions flicker was evaluated as perceptible but not annoying by most participants. Id. The researchers thus concluded ***“This suggest that flicker was not a major issue for these ACLEDs.”*** Id. (emphasis added).

With this said, all light conditions, even the fluorescent reference, were rated overall as unpleasant to neutral. Id. As concluded by the article, “Apparently, people were not fully satisfied with the light of these ACLEDs, although they had difficulties to describe what was wrong. Because the amount of flicker was not perceived as annoying, ***flicker could not be the attribute fully quantifying the overall experience*** of people.” Id. (emphasis added).

The second test took measurements at 500 lux, 750 lux and 1000 lux at frequencies of 35 Hz, 50 Hz, 100 Hz, 400 Hz and DC. No significant difference between 100 Hz, 400 Hz and DC was found. At 50 Hz the light registered as “not annoying but perceptible”, and ***imperceptible at 100 Hz and more***. Id. The third test was on stroboscopic illumination with presenting the ‘not real world’ rotating disk with a dot on it moving faster and faster to determine stroboscopic effects. Id. From the paper, no determination of annoyance was determined. Id.

So, this study shows that at normal luminance outputs seen in real world settings flicker is either imperceptible or is acceptable. Only at luminance levels that were considered too bright and unacceptable to the individuals in the tests, was the flicker considered just slightly annoying.

The second paper used to support the requirement is the ASSIST Recommends paper discussed above that investigates the Bullough et al. studies. From what Once has been able to review, these papers

show, other than for the ‘colored wand waiving’ population of the world, that flicker, even if perceivable at 100 and 120 Hz is completely acceptable to individuals. The third paper meanwhile, Solid State Technology Fact Sheet: Flicker, U.S. Department of Energy and PNNL, March 2013 provides no testing or evidence of acceptability.

So, the totality of the documents and studies underlying the references provided by ENERGY STAR as justification for the new flicker requirement show that in real world or practical situations, when at 100 Hz or above that during the occasional event when flicker is perceivable, this flicker is completely acceptable to such test subjects. Meanwhile, in obscure test settings, such as having a subject look at a colored waving wand in a dark room or forcing a subject to look at a 1300 lux light, these situations are slightly annoying or somewhat unacceptable.

As it stands, the potential for health risks or even unacceptability associated with real life and practical settings with frequencies of  $\geq 100$  Hz are minimal at best. ENERGY STAR has failed to demonstrate this restrictive flicker requirement will have any market effect whatsoever. However, and in opposite, the limited scientific research shows the added requirement as wholly unneeded and unnecessary.

According to Boyce in On Seeing High Frequency Flicker, July 5<sup>th</sup>, 2010, Boyce estimates that at 120 Hz only 1 in 10,000 people has enough sensitivity to flicker to even perceive such flicker. The tests above show that even when special conditions are presented to cause flicker to be more perceivable, the flicker perceived is more than acceptable. Once believes that at a minimum, more testing needs to take place regarding the effects of flicker. Because eliminating choice and increasing design costs will have a negative energy impact in the market, until testing demonstrates that proposed flicker requirements will cause customers in practical situations to be more likely to adopt a luminaire as a result of such added requirements and that such adoption will fully offset such negative impact, we believe no requirements should be adopted.

Respectfully submitted,

Joe

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<sup>i</sup> See attached Once Innovations, Inc. Requested Changes – Comments to Draft Risk Assessment prepared by IEEE PAR1789 Hazard Assessment Subcommittee.