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Subject: Seoul Semiconductor Comments to ENERGY STAR Program Requirements Product Specification for Lamps (Light Bulbs) Eligibility Criteria Version 1.0, DRAFT 4

We have reviewed the Draft 4 Specification and have concerns with the following items as they may have a significant impact to manufacturers of Solid State Integral Lamps: A summary of our concerns/comments are:

- Clarification of specification wording is needed where the in situ temperature measurements need to match the LM80 test temperatures.
- Specification requirements have been added that reference non industry approved test methods. Industry approved test standards should be utilized to assure test consistency. If these methods are not available then this specification should not be added until such approved test methods are issued.
- Dimmer test requirements have been added causing excessive testing time and not taking into account the future design changes that can occur in dimmer products potentially impacting test repeatability. All responsibility is on the lamp manufacturer with no requirements on the dimmer manufacturer.
- Flicker index and percent flicker requirements are being added to eliminate "perceived flicker", a phenomena where the human impact has not been adequately validated by studies. These new requirements will adversely affect the availailabiltiy of a wide variety of replacement lamps currently and soon-to-be on the market.

Our detailed comments/concerns are below:

1) Section 7.1.3.

For solid-state lamps, variation not allowed where, the *in situ* temperatures measured at each unit's highest temperature or the average of up to 5 unit samples TMPLED is greater than the maximum case temperature tested in the corresponding IES LM-80 report.



SSC Comments:

It is not clear if this paragraph pertains to Early Interim Certification only. If a manufacturer chooses not to use the Early Interim Certification option and completes the 6000hr test and the products meet the lumen maintenance requirement then the LM80 report is not used and there is no need to reference the TMP LED point.

**We recommend that the wording be clarified to indicate that this requirement is for lamps that are qualified using the early certification procedure only.**

2) Section 11.3. Frequency: All Lamps

Lamp light output waveform shall be measured with a photo detector, transimpedance amplifier and oscilloscope. Employed equipment models and method of measurement shall be documented. Temporal response, amplification and filtering characteristics of the system shall be suitably designed to capture the photometric waveform.

SSC Comments:

Measurements of the optical wave form should be conducted using a test procedure that has been documented for consistency across all test facilities. To make accurate and repeatable measurements, an industry standard procedure for performing the measurements should be employed. The IES has created a working group to develop a procedure for measuring optical waveforms and, when completed, should be utilized as a part of the specification.

**We recommend that this requirement remain as a reported value but not an acceptance criteria until an industry approved procedure is issued.**

3) Paragraph 12 Dimming Performance: All Lamps Marketed as Dimmable

If lamp is designed for phase cut dimming operation (alterations to the line voltage to the lamp), select 10 dimmers for testing. The 10 dimmers shall meet the following conditions:

1. From at least 2 different manufacturers
2. At least one dimmer must be specified as compatible use with energy efficient lighting (such as CFL or LED lamps)
3. At least one dimmer must be of one of the following types: Single (Forward) Phase Shift; Double Phase Shift, or Electronic Low Voltage/ Reverse Phase
4. At least one dimmer must have one of the following features: Microprocessor with Power Supply, Voltage Compensation, or Pre-set levels



SSC Comments:

As noted by the EPA in their comments, the testing of combinations of 10 dimmers with one and four bulb combinations is time consuming and adds unneeded costs to the end products. In addition to this, we would like to point out the following additional issues:

The first issue is this requirement is imposed only on the lamp manufacturer, with no requirements on the dimmer manufacturers. This can create a situation where a lamp will work correctly with a dimmer when the original test is performed but may not work correctly at a later date because the dimmer manufacturer changed the product without changing the model number. Since there is no issued interface specification on dimmer characteristics, this requirement for testing will not provide long term assurance of lamp performance with any particular dimmer.

The second issue is with the dimmers that are specified for CFL or LED lamps. These dimmers have an adjustment that varies both the initial light output and the minimum dimming level. Dimming performance can be greatly effected by the setting of the dimmer. This creates a variability in the testing performed by the manufacturer in relation to what the end user may experience.

The third issue is the requirement for one of the dimmers tested is to have a microprocessor or other feature. Because of the power requirements to operate these devices, additional complexity and cost must be added to driver topologies in order to be compatible.

**In light of these issues, we recommend elimination of this entire paragraph of dimmer requirements as it does not assure any additional dimmer/lamp compatibility versus the previous requirement. Reverting to the original requirement, where the lamp manufacturer is required to maintain an updated list of compatible dimmers on a customer accessible web site, is adequate for the industry and the consumer. It also allows manufacturers to respond to changes in dimmer models.**

- 4) For purposes of third-party certification, maximum lighting output, minimum lamp output, flicker and noise levels shall be reported by the partner to the certification body however documentation shall not be reviewed when products are certified or during verification testing.

SSC Comments:

This requirement does not make sense since the purpose of third party certification is to verify product performance. It is not clear by this statement whether or not a lamp has to meet the dimming requirements. The statement indicates that the information provided is not used for certification. It appears that this is a data gathering process and, if so, should be treated the same as frequency measurement, where the data is

collected but is not used as an acceptance criteria for gaining Energy Star Certification.

**We recommend that this be removed or further clarified.**

5) 12.3. Flicker:

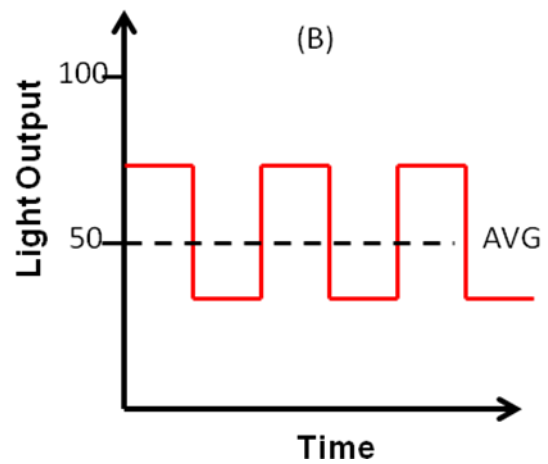
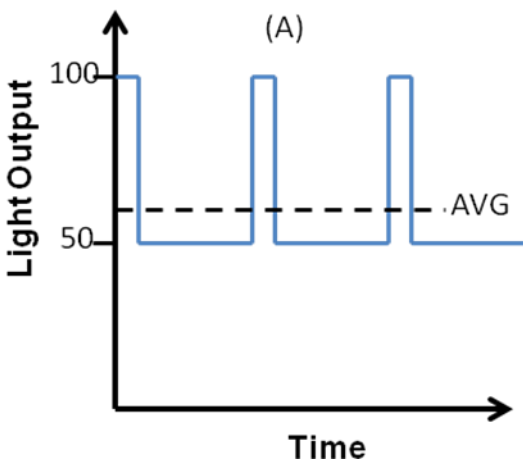
Lamp shall have a light output waveform periodic frequency of  $\geq 120$  Hz and have a flicker index less than or equal to the values in the table below when evaluated at dimmer's maximum setting and dimmed conditions

Light output waveform periodic frequency (in Hertz)	Flicker Index
120 – 800	(0.001 times the periodic frequency)
Greater than 800	Not applicable

SSC Comments:

At this time there are no definitive studies that correlate the Flicker Index measurement to acceptability, perception, or hazards. There are also other factors that might influence direct or indirect flicker perception. A representative study was one performed at RPI but it was performed using only light modulated at 100% flicker and 50% duty cycle. This study did not take into account any differences in duty cycle or waveform shape, and peak intensity level. Today's modern AC architectures typically run at much higher duty cycles than 50%.

For example, if there are two light sources which have same Flicker Index and same frequency but have different duty cycles and different peak intensities, the human eye can perceive flicker easily from the one with the shorter duty cycle and higher peak intensity.



Waveform	A	B
Max Level	100	66.67
Average Level	58.33	50
Peak to Peak Amplitude	50	33.33
Percent Flicker	33.33	33.33
Flicker Index	0.119	0.167
Flicker Perception	More	Less

The references that were provided after the Energy Star webinar do not provide support for the proposed specification requirements for Flicker Index. In fact, in a second paper by the same authors that is cited in the first reference, (VISIBLE ARTEFACTS OF LEDS, Vogels, I. Sekulovski, D. Perz, M.), the authors state that "The IESNA Flicker Index was shown not to be a suitable metric for the stroboscopic effect, demonstrating the need for development of a new metric." This second paper was not even used as a reference by the EPA.

**We recommend that, until there are studies and data to validate these requirements, the flicker index and percent flicker should be removed as requirements. The requirement should revert to being based only on operating frequency  $\geq$  120 Hz and that customer acceptance should be the overriding criteria for products.**

- 6) ENERGY STAR® Program Requirements Product Specification for Lamps: Light Output on a Dimmer  
Draft Recommended Practice

SSC Comments:

Measurements of parameters like this should be made in accordance with an industry approved test standard to assure repeatable results between measurement laboratories. As an example, the current draft allows the choice of performing the measurement with absolute or relative photometry measurements, but in the test conduct, does not provide procedures for each measurement type. The procedure also calls for the measurement of light output, power consumption, power factor and total harmonic distortion, but in the report section, there is no required reporting of the power factor or total harmonic distortion. Furthermore, the requirements in the Lamps Specification do not agree with the parameters required by the test document. Only the maximum and minimum light output on a dimmer is required. This adds additional testing costs to the end products.



7) ENERGY STAR® Program Requirements Product Specification for Lamps: Light Source Flicker Draft  
Recommended Practice

SSC Comments:

The same comments on the Light Output Recommended practice apply in terms of the need for an industry approved standards document for testing as well as the inconsistencies in the required measurements and reported parameters. In addition, there is no specific method for the calculation of flicker index and there is no documented studies that show the validity of the measurements. The light output waveforms are of a complex nature, and unless a consistent method of calculation is used, errors can be introduced. Furthermore, the requirement for stabilization of the light output to 0.5% is unrealistic.

**We recommend that the data from these recommended practices not be utilized for acceptance criteria until the procedures can be validated and formalized by industry/standards bodies and until Flicker Index (or another parameter) are proven to be needed.**

Thank you for your consideration and attention to our comments.

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