

November 17<sup>th</sup>, 2016

Taylor Jantz-Sell  
US Environmental Protection Agency  
1200 Pennsylvania Avenue, NW  
Washington, DC 20460

Subject: Feedback on ENERGY STAR® Requirements for the Use of LM-80 Data draft (Oct 21, 2016)

Dear Ms. Jantz-Sell,

Cree has reviewed the October 21, 2016 draft of the *ENERGY STAR® Requirements for the Use of LM-80 Data* and would like to provide the enclosed comments for your considerations as you work through the process of updating this document.

Thank you in advance for your consideration.

Sincerely,

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### Note box 3:

#### **EPA seeks feedback on the proposed implementation timeline for reporting.**

Cree generally agrees with the proposed implementation timeline, with the exception of comments related to Sections 3.8 and 4.5 below.

### Section 2, Successor definition, point h:

#### **Equal or lower tested subcomponent power dissipation**

Suggest rewording to “Equal or lower tested subcomponent **electrical input power**” for clarity, as power dissipation could be interpreted as heat dissipation. Heat dissipation will be lower for the successor subcomponents and more difficult to measure than electrical input power.

### Section 3.1:

#### **LM-80 test reports must illustrate that ...**

Cree suggests rewording to “LM-80 test reports **must reference third-party accreditation** that ...” to clarify how to illustrate compliance.

### Section 3.2.i:

#### **Color Rendering Index (Ra) and R9, or spectral power distribution (SPD) for wavelengths from 380 nm to 780 nm (at a minimum), with an interval not greater than 5 nm.**

The data requirement is clear, but two issues of scope are not specified:

1. Scope of time: Is this to be reported as an initial condition (t=0) or for all LM-80 measurements?
2. Scope of samples: Is this to be reported for all samples individually? Or an average of all samples? Or only one sample to serve as a representative of the population?

Cree recommends changing the requirement to reporting CRI (Ra) and R9 as initial condition (t=0) for all LM-80 samples, similar to the requirements in Section 3.2.f.

From a practical standpoint, putting SPD data into LM-80 reports will greatly increase the size and complexity of LM-80 reports in a way that is not relevant to the vast majority of users. If the EPA seeks SPD data from LED manufacturers, then that request should be handled outside the scope of LM-80 reports and this ENERGY STAR guidance document.

### Section 3.7 & Note box 5:

The contents of these two sections seem contradictory with each other. Specifically, note box 5 states “**EPA removed the requirement that the description of the subcomponent include whether the device is an LED package, array, or module because it is irrelevant to evaluation.**”

However, Section 3.7 includes a set of scaling rules that is exclusive to COB LEDs. Looking at the Section 2 definitions, the only distinguishing characteristic of a COB versus the IES RP-16 LED Package definition seems to be the statement “with one common phosphor layer overlaying all dies.” In fact, the distinction between COBs and LED Array or Module is also unclear. It is not obvious why the guidance says in one section that distinctions between subcomponents are irrelevant, when the common phosphor layer distinction seems to be the critical evaluation point for allowing the scaling rules of Section 3.7 to be used.

Cree recommends following the logic presented in note box 5 to make the following changes:

1. Remove the phrase “For chip-on-board (COB) LED packages:” from Section 3.7
2. Remove Figure 1 from Section 3.7
3. Remove the Chip-on-board definition from Section 2

The scaling rules of Section 3.7 are just as valid for LED packages (as defined in RP-16) without a common phosphor layer overlaying all dies as for those with a common phosphor layer overlaying all dies.

#### Section 3.7.b:

**the average calculated current-per-die of the tested model or series is reported;**

Suggest changing to “the average calculated **current-density**-per-die of the tested model or series is reported;” to maintain consistency with other changes in the draft, such as Section 4.6.b.

#### Section 3.8 & Section 4.5:

Manufacturers are moving toward LED products that incorporate dynamic control of color point, such as tunable CCT or dim-to-warm. Many of these color control techniques are achievable using multiple channels of LEDs “each with their own phosphor layer.” The LED industry has demonstrated the ability to create phosphor-converted LEDs that are very similar in color point to “single-color” (i.e., non-phosphor-converted) LEDs. The assumption that all phosphor-converted LEDs have color points within the defined ANSI C78.377 quadrangles is outdated.

However, the draft presents inconsistent handling of LED arrays, based purely on the types of LED packages used in the array:

- a. Designs using all phosphor-converted LEDs are covered by Section 3.8 and do not require LED array testing, but
- b. Designs using a mix of “phosphor-converted white and single-color LED packages” are covered by Section 4.5 and do require LED array testing.

The main issue is that Section 3.8 does not include specific guidance on how to handle multi-channel designs of any type.

### Recommended Changes to Section 3.8

Cree suggests adding explicit guidance to Section 3.8 in order to communicate the following:

1. For LEDs in the LED array that are within a defined ANSI C78.377 quadrangle, these LEDs can be covered by LM-80 reports consistent with the guidance in Section 4.3.
2. For LEDs in the array that are outside the ANSI C78.377 quadrangles, each different type of LED (e.g., phosphor-converted green, phosphor-converted amber, 1800K CCT phosphor-converted white, single-color red) must be supported by its own LM-80 report.
3. If the LM-80 reports of each different LED type in the array independently meets the program requirements, then the entire array can be assumed to meet the program requirements.

Cree recommends an implementation period of 9 months minimum, with 1 year preferred, for this section to give LED suppliers time to modify their LM-80 package testing to align with this new guidance.

### Addressing the Concerns of Section 4.5

While not stated explicitly, we can infer that the main concern in requiring LED array LM-80 testing in Section 4.5 for “a product employing both phosphor-converted white and single-color LED packages” is to test the ability of the required control circuitry to maintain a stable color point. However, phosphor-converted LED packages are available in many different color points that fall outside of the ANSI C78.377 quadrangles. As written, Section 4.5 is inadequate in achieving the inferred goal of requiring LED array testing of all multi-channel LED designs.

In the case of the Lamps program, Cree questions the necessity of the LED array testing requirement in Section 4.5 when ENERGY STAR already requires long-term testing of the entire product, which includes the required control circuitry.

In the case of the Luminaires program, these proposed changes seem to be aimed at introducing some kind of system level testing requirement, which has not been present in the Luminaires program at any time. While Cree feels system-level testing is a worthy topic to discuss, this discussion does not belong in the scope of the subcomponent LM-80 guidance document and should be addressed in another forum. At best, the proposed changes are inconsistent in their scope of what types of multi-channel LED arrays need to be tested as LED arrays.

For both Lamps and Luminaires, Cree recommends making the suggested changes to Section 3.8 above and removing Section 4.5 because it would then be redundant. If the EPA feels that all multi-channel LED arrays need to provide LED array LM-80 testing data, then the language of Section 4.5 needs to be rewritten to include all multi-channel LED arrays that use color control circuitry, regardless of the type of LED packages used. However, Cree has identified several problems with going in that direction:

1. EPA would be placing a testing burden on all multi-channel designs, which creates a strong disincentive for manufacturers to innovate in the area of dynamic color control.
2. LED array LM-80 testing has not been required by ENERGY STAR in the past. If LED array testing does become a requirement, then the 90 day implementation timeline is too short for this new requirement. Cree suggests a minimum of 1 year for implementation.
3. Products with color control circuitry may separate the control circuitry from the LED array in such a way that the control circuitry is maintained at a lower temperature than the LED array. However, LM-80 testing of LED arrays with control circuitry could require the control circuitry to be maintained at a temperature higher than what would ever be seen in the finished product. Manufacturers could be forced to redesign control circuitry and to add cost to their products for the sole purpose of passing LM-80 testing as required by the EPA. Again, this is another disincentive for manufacturers to innovate in the area of dynamic color control.

#### Sections 5.1.d.ii & 5.1.e:

Cree recommends deleting these statements:

1. **“and after 6,000 hours of LM-80 testing”** in Section 5.1.d.ii
2. **“or if the test report does not demonstrate equal or improved performance relative to the referenced original LM-80 test report.”** In Section 5.1.e

Using a successor LM-80 report should be a time-limited exception from the standard process. The exception begins when at least 3,000 hours of LM-80 data for the successor is published that meet the criteria, as stated in Section 5.1.c. The exception ends after 170 days, as stated in Section 5.1.e, and is subject to the criteria in Section 5.1.d to be considered valid.

At the end of the exception period, when the “complete” LM-80 report is published (as stated in Section 5.1.e), then the new subcomponent (formerly called the successor) should no longer have any special status, considerations or requirements relative to the original subcomponent. If the now-complete LM-80 report for the new subcomponent does not meet the requirements for a given product, then there should certainly be consequences for the partner. However, there is no need to compare the new subcomponent to the original subcomponent once the complete LM-80 report is available for the new subcomponent.