

January 19, 2007

To: Richard Karney, Energy Star Program Manager

From: NEMA Solid State Lighting Section

Re: Comments on December 20 Draft of Energy Star Criteria  
for Solid State Lighting Luminaires

Thank you for the opportunity to provide comments on the first draft of Energy Star Program Requirements for Solid State Lighting Luminaires, released on December 20, 2006. We look forward to continuing to work with you to improve the program criteria and to the February 8 stakeholder meeting in Washington. As the Solid State Lighting Section of the National Electrical Manufacturers Association, we request an opportunity to address the stakeholder meeting with our views.

In the interim, we offer the following comments, which range from discussion of major issues to requesting clarifications and typographical matters. You will see that three themes that run through our comments are promoting simplicity, consistency and a level playing field.

Scope, page 2

The introduction of Category A and Category B raise the basic question of whether, over the short and longer term, LED fixtures should be on a level Energy Star playing-field with current sources, such as Energy Star compact fluorescent lamps (CFLs) or Energy Star fluorescent residential light fixtures, or should they be given special consideration? It is our position that LEDs should neither be given preference nor be penalized for their status as new technology products at a stage of aggressive development.

Also, how are luminaires that include both solid-state and fluorescent light sources to be covered by this specification?

General Requirements: "Devices", page 2-3

The color requirements (CCT, Color Spatial Uniformity, and Color Maintenance) in the table at the top of page 3 should not be part of "Device Requirements," but rather moved to "Luminaire Requirements." Especially for CCT requirements, the values given are exactly those developed for a draft ANSI standard, and it was explicit in these ANSI working group meetings that the CCT parameters applied to luminaires, not to individual LED packages. This was perhaps the

most difficult and contentious of the ANSI draft standards to agree upon, and we feel strongly that the Energy Star specification should mirror the output of the draft ANSI document as luminaire requirements, not “device requirements.” For this same reason, both the “Nominal CCT” and “Flexible CCT” approaches should be kept in the specification.

We note that the last line in this table refers to LED Useful Life. This was not a part of the ANSI color discussions, but part of a developing LM standard that is meant for the LEDs themselves (whether as packages, arrays, or modules), and this line of the table should remain as a device requirement. Also, the term “LED Useful Life” should be changed to agree with the LM80xx draft language “Lumen Depreciation of LED Light Sources.”

#### General Requirements: “Luminaires:”, page 3

##### Warranty

As drafted, it is not clear that returning parts to the parts manufacturer is an option. To clarify, we suggest modifying it as follows: “...which covers repair or replacement of defective parts returned to the manufacturer...”

#### General Requirements: Drivers, page 4

##### Transient Protection

Guidelines for transient protection in non-roadway applications shall be IEEE C.62.41-1991, Class A operation. The line transient shall consist of seven strikes of a 100 kHz ring wave, 2.5 kV level, for both common mode and differential mode.

#### Top Box, page 5

The last bullet in the first box on page 5 indicates that no standards or test procedures exist or are planned in the foreseeable future to measure “system” efficacy of LEDs. We assume this means “LED only” or “LED + driver only” efficacy, since Energy Star is proposing a luminaire efficacy specification. We assume that, but would like to achieve more clarify on this matter.

#### Category A: Methodology for Establishing Luminaire Efficacy, pages 5-6

We are troubled by the inclusion of the formula on the top of page 6 to determine luminaire efficacy, and believe that the formula should be discarded.

We recommend strongly that Energy Star abandon any attempt to compensate “too low CRIs” by having more lumens. Such an approach is

unknown for other light sources, and for purposes of a level playing field, should not be introduced here. Even the CIE acknowledges that small CRI differences are not meaningful, and to adjust the required LPW requirements based on a “CRI 5 points too low” does not seem meaningful or warranted. Further, NIST has argued persuasively that the CRI metric unfairly penalizes narrow band sources like LEDs, which tend to render colors more saturated than traditional sources. More important is the CRI standard itself mentioned in the box on page 6.

We appreciate that the combination of the minimum light output requirements and the minimum luminaire efficacy requirements prevent manufacturers from designing Energy Star fixtures with high efficacy based on low light output. Also, we understand the Zonal Lumen Density Requirement is key to this category due to the need for the fixture to cast light to be reflected from the wall under the cabinets as well as deliver light directly to the work surface.

#### Near-Term Niche Applications, pages 6-8

The CRI requirement for many indoor applications in the draft document is 80. This places a requirement on LED luminaires that does not exist for fluorescent systems. The most common fluorescent SKUs today have a CRI in the low 60s, and they are widely used indoors in the residential / industrial / and commercial market segments. Even for T8 lamps, most product in the market are color 700 series, with CRI values in the mid 70s. It is not equitable to require more of LEDs. We recommend that the requirement for all indoor applications (pages 6, 7, 8, 9) be set at CRI = 75, the nominal value for most T8s (already a premium system). As the market changes to 800 series fluorescent lamps, as it may do over the next decade, this specification can change to a comparably higher CRI value. Again, we note that NIST has shown that CRI is not the most suitable metric for LEDs in any case. New quality LED systems will have a hard enough time penetrating the market without the requirement that they improve on today’s premium systems.

We also question the proposed luminaire efficacy values for the various applications. While we realize that DOE wishes to establish a high performance bar that does not favor one technology over another, we are concerned that this bar is set unrealistically high, especially if DOE expects to have qualifying luminaires in the near future. There are several factors that we believe should be discussed and evaluated before consensus can be reached on this issue:

- The Energy Star Residential Lighting Fixture (RLF) specification is based upon ballasted sources such as fluorescent and HID. It appears that fluorescent performance --- particularly compact fluorescent performance – was used as a baseline to guide selection

of the SSL luminaire efficacy values. It is important to note that RLF Version 4.0 uses lamp/ballast efficacy, not luminaire efficacy. We think it is a good idea to use luminaire efficacy for SSL luminaires, but in doing so, there are several loss factors that must be very carefully considered:

- a. Steady state operation
- b. Driver
- c. Power supply
- d. Luminaire optics/lensing

Conversion losses must be studied, understood better and accounted for before the specification is finalized.

- Beyond these loss factors, it is also important to consider that LEDs with higher CCT generally have higher efficacy than LEDs with lower CCT. Lower CCT LEDs seem to be favored over high CCT in residential applications, which suggests that we should carefully consider a tiered luminaire efficacy based upon CCT.

Today's white LED technologies produce higher LPW at higher color temperatures, and this trend will continue for some time. Accordingly, using the same CCT ranges from Category B, we propose consideration of an approach that would assign each Category A application three LPW minima, rather than simply one. This would keep the proposed LPWs for LED luminaires of 5000K or higher, but would create two lower LPWs for the other two CCT ranges (3000K to 5000K and <3000K).

#### Category B: Efficacy Based Performance, page 9

Under Category B, the luminaire efficacy figures given do not seem appropriate for a "level playing field" for general illumination lighting (not niche lighting), unless the only applications foreseen are for selected areas that are today lit by premium T8 fluorescent systems. We understand that this Category B is meant for widespread non-niche general illumination applications, not all of which are addressed even today by premium T8 linear fluorescent systems. We further understand that the Category A requirements will disappear when Category B requirements become effective. Are these understandings correct?

With this background, we give these examples to illustrate why the efficacy targets given are not suitable for high volume general lighting market segments. We don't have a good counterproposal at this point. Perhaps different "general illumination – Category B" applications need different system efficacy targets (for example: ceiling troffers, recessed downlights, track lighting, table lamps).

- Standard 32W T8 on electronic ballast:  
lamp efficacy = 92 lpw, lamp ballast efficacy = 87 lpw. For a 4100K source, the 60 system lpw figure only allows for luminaires with coefficient

of utilizations (CUs) greater than .68, and we think there are many general illumination applications with CUs less (even much less) than this. Especially with the superior potential optical control of LED systems, we would not want to see the application criteria be more stringent than for existing quality systems. Even for many quality T8 systems, the efficacy targets are too high to provide a level playing field.

- Pin-based CFLs used in recessed downlights: a very common, energy efficient application  
CFL efficacy = 69 lpw, lamp-ballast efficacy = 66 lpw, fixture efficiency = 50% yields a system efficacy of 33 lpw. This is consistent with the value given for recessed downlights on p. 8, but we do not see this as a niche product and we think the “general illumination” requirements (Category B) should allow for this. (This is especially true since Category A will disappear.)
- Reflector CFLs possess lamp efficacy values near 50 LPW, but the beam patterns are very wide. Because of the very wide beam distribution of CFL-R lamps, any fixture effect ( $CU < 1$ ) will significantly reduce the efficacies of these systems. Applications of these “systems” go beyond niche products (Category A), and LED systems with lower efficacies than the target values given on p. 9 can provide much more effective lighting. Compared with soon-to-be Energy Star listed CFL-R products, SSL systems can result in delivered illuminance to be significantly increased, even with efficacies below the p. 9 targets.
- There are many millions of track lighting applications with low voltage MR16 sources. LEDs can be a good “general illumination – Category B” replacement for these at system efficacies far higher than the MR16 systems but far lower than the p. 9 targets.

As for Category B CCT, who is to make these measurements?

#### Standards and Documentation, pages 10-11

In many cases the required documentation says that the lab test results must be produced “using the specific device(s) and driver combination that will be used in production.” This sounds very reasonable at first, but in practice will be a terrible burden for luminaire manufacturers. This is especially so for the parameter “LED Useful Life”, but it also applies to other characteristics as well. Luminaire manufacturers will surely want to have multiple suppliers of drivers and LEDs, and the number of testing combinations can skyrocket quickly. Again, this requirement tilts the playing field against LEDs and may have the effect of retarding the introduction of long life, energy efficient SSL products. For other light sources and drivers/ballasts, there are ANSI standards, and luminaire

makers only have to rely on interchangeability traceable to the applicable ANSI standards. ANSI standards for LEDs and drivers do not exist today, but to place the burden of testing (even life testing) every combination of light source and driver seems unreasonable to us.

### Definitions, page 13

We believe it would be helpful to add definitions for the following terms: quadrangle, IC, ICAT, ASHRAE.

The definition of “Device” (p. 13) needs revisiting. Does it include LED Lamps, LED packages, LED arrays, and/or LED Modules?

The definition in the evolving ANSI standard “LED Useful Life (L70) [Lumen depreciation]” needs revisiting to require some (unspecified) statistical basis for claiming this lumen depreciation level.

Define “total lumens (initially)”

### Additional Clarifications and Editorial Comments

#### Devices, page 2

“These bins, when superimposed on the CIE color space....” Should be changed to “These bins, when superimposed on the CIE 1931 x,y chromaticity diagram....”

#### Luminaires – Thermal Management, page 3

The draft text says that the luminaire manufacturer “shall adhere to device manufacture guidelines, certification programs...” It is not clear to us what “certification programs” mean. If this means safety approbations, like UL, it is OK. If it means the various LED manufacturer voluntary certification groups that exist, then this requirement does not seem appropriate. We suggest the following wording be used to replace the current wording: “The luminaire will comply with the LED manufacturers’ thermal management application requirements.”

#### Outdoor Luminaires, page 3

We suggest changing the wording in the second line to read “...that prevents automatic operation when minimum daylight light levels are present during daytime hours.”

Luminaire Efficacy Concept, page 5

It is not necessarily true that an LED array (or even a luminaire, for that matter) cannot be measured in an integrating sphere (it depends on the size of the sphere). The text should be re-worded.

On the last bullet point: in the first sentence change “measure system efficacy ....” to “measure lamp-driver system efficiency ....”

Category A: Near-term Niche Applications, Methodology, page 5

All references to “IES” throughout the document should be changed to “IESNA.”

Figure 1, page 15

Add a pointer for “Quadrangles (SSL)” because there is one for “7-step MacAdam ellipses (CFL)”. This would provide clarity to the graph.

END