Philips Lighting Response / Feedback to SSL ENERGY STAR Criteria, Version 1.0
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An underlying premise for several of our comments is that this ENERGY STAR specification should provide a level playing field for LED luminaries; the requirements for LED luminaires should be approximately the same as for other well-established technologies already accepted in the marketplace. Our comments are divided into 2 parts: major issues, more minor / editorial concerns.

<u>Major issues</u>

1. The color requirements (CCT, Color Spatial Uniformity, and Color Maintenance) in the table at the top of page 2 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.

   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."

2. p. 4, driver requirements, 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.

3. p. 5, bottom box
   We recommend that Energy Star abandon any attempt to compensate "too low CRIs" by having more lumens. Such an approach is unknown (to us) 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 this box; this is of sufficient importance to warrant a new pt. 3 below.

   The top box on p. 6 is just a sample calculation for the box at the bottom of p. 5. This entire approach should be abandoned.

4. 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 requiring that they improve on today's premium systems.

5. p. 9: Efficacy Based Performance
The luminaire efficacy figures given do not seem appropriate for a "level playing field" for general illumination lighting (not niche lighting), unless the only application seen are for selected systems 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 be premium T8 linear fluorescent systems. We further understand that the Category 1 requirements will disappear when Category B requirements become effective.
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).

    a. 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.

    b. 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.)

    c. 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.

    d. 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.

6. p. 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. Luminaire manufacturers will surely

have much more to say on this point.

<u>More minor / editorial concerns</u>

1. Definitions
   a. The definition of "Device" (p. 13) needs revisiting. Does it include LED Lamps, LED packages, LED arrays, and/or LED Modules?
   b. The definition of "LED Useful Life (L70)" needs revisiting to require some (unspecified) statistical basis for claiming this lumen depreciation level.

   c. Define "total lumens (initially)"

2. On p. 2, under "Luminaires – Thermal Management" the text says that the luminaire manufacturer shall adhere to device manufacturer … 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, this requirement does not seem appropriate.

3. p.5, top box:
   a. 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.
   b. Last bullet point: in the first sentence change "measure system efficacy …." to "measure lamp-driver system efficiency …."