April 29, 2011

NEMA Comments on Energy Star Lamps Product Specification Framework, March 2011

I. Introduction

Thank you for the opportunity to provide the following comments on this subject based on input received by NEMA staff from the NEMA Lamp and Solid State Lighting Sections. We note with interest the Energy Star goal is to move to a "technology neutral" specification for lamps. As stated by Energy Star, consumers shop for light bulbs, not specific technologies; thus energy Star requirements applied to different technologies "should not vary widely." However, some consumers are shopping for specific light bulbs and technologies to perform a specific function.

Different standards may or may not still be necessary due to the technologies. However, absent careful and clear education and message management, setting of different performance requirements based on technology holds the potential to dilute the meaning of the Energy Star brand. It can be confusing and counterproductive for consumers, who will not be able to rely on the Energy Star alone to objectively compare lamps when the standard for the Energy Star label means something different for a CFL, halogen or LED lamp. Instead, consumers should be able to use the packaging information provided under new Federal Trade Commission labeling requirements to make "apples-to-apples" comparisons.

For the sake of clarity, the following text tracks the structure of the framework and includes Energy Star's statements and questions (indicated by italics), followed by the NEMA response.

II. Scope

c) 1. *The LED lamp specification currently requires replacement lamps to fit the ANSI C79.1-2002 shapes, while CFL specification does not. Are there CFL types that should be subjected to the same dimensional limits?*

No, CFL type lamps should not be subjected to the same dimensional limits. The Energy Star program has been in effect for CFL types for many years without this limitation and many products already qualify which would not meet the proposed limits, such as certain reflector type lamps. The current Energy Star specification for CFLs divides them in Bare, Covered (Globe, Outdoor, etc.) and Reflector lamps. This sub-division is clear enough to establish efficacy limits. It must be clear that CFL products are not identical to the incandescent types they intend to replace. Doing a further subdivision as the one for all incandescent lamp shapes (A, B, C, F, G, etc.) is not practical due to the size and shape of CFLs.

However, this is a more complicated issue than that. The real issue for LEDs and other technologies here is claiming overall replacement of a current incandescent product from a mechanical and photometric point of view. There are technical hurdles to complete this that are not easy or cost effective for LEDs as well, but if they are not gotten over the consumer may get a lamp that truly does not replace the one they are used to, which can result in consumer satisfaction issues. Important here is the decision by the EPA to suspend the non-standard lamp category for LED lamps.

There must be more discussion on this issue to understand what the real goal is of having the outline shape with respect to the end user and energy usage. There is large disagreement on this issue and more time and effort is needed to address it.

What are the technical challenges and costs associated with meeting this requirement?

The main technical challenge is the size of the fluorescent tube in the CFL. Although small, it is a completely different form factor than an LED source. If CFLs are required to comply with specific dimensional limits there will be a negative impact on lamp life and lamp cost. With a mature technology such as CFLs, a change in one lamp parameter will negatively affect another. In this case, if the lamp size is reduced, efficacy is reduced. This reduction in size will drive up ballast component temperatures which will either result in lower expected lifetime, or will require more expensive components to maintain the lifetime comparable to a larger product. Currently LED lamps are designed to meet the strict ANSI guidelines and in some cases have had to innovate to make that feasbile, which makes the lamp more expensive. There needs to be more of a discussion on this issue to understand what the real goal is of having the outline shape with respect to the end user and energy usage. Also, this approach is forcing a new technology to conform to an old form factor which may not be the optimum use of its new properties.

c) 2. *What products, if any, are missing from the scope under consideration that EPA should consider?*

The present scope addresses lamps with medium Edison (E26) or candelabra (E12) and GU24 bases. We recommend the addition of GU-10, GU 5.3, and intermediate (E17) based lamps. Also, Energy Star should consider inclusion of CCFLs (Cold Cathode Fluorescent Lamps), with an efficiency of 40 LPW, and rated life ranging from 8,000 to 25,000 hours, in all shapes and bases.

c) 3. *What product development trends in the lamp industry should be considered that may have an impact on proper categorization of lamps?*

The requirement to provide 40% lifetime results before introducing products to the market seriously hampers product innovation and delays the introduction of new CFL and LED products. The 40% requirement essentially equates to 3,000 hours. The minimum life requirement for certification could be shown by different analysis at t=0 and then the manufacturer can submit data as it becomes available. This is in line with the current Energy Star LED spec of early qualification and then resubmission of data based on the lifetime requirement. This is also an opportunity to harmonize with IEC, which requires only 2,000 initial hours of testing.

There are systems being introduced that may require new characterizations. An example is a lamp which not only makes its electrical connection through the base, but also makes a thermal connection for heat sinking purposes. Modular concepts are also being considered. As the LED market matures, effort can be given to research what is the best method for LED modules and arrays to be approved, with a starting point being the lamp/ballast matrix of the past.

The requirement for high CRI is an issue and Energy Star could consider providing an exemption to allow for lower efficacy requirements, although there is no consensus in the industry yet. The overall LPW could be a baseline no matter what the CRI is (e.g. today the spec says a minimum of 80 and 50 LPW). When written in this manner the specification allows for companies to make a choice about getting to a higher CRI. Energy Star is an energy efficiency program and not a best in class product from all aspects including photometry.

One argument is that rather than creating a totally separate lumen scale for high CRI and running the risk of confusing an already confused consumer, why not just drop this issue and have the lumens be the lumens – reinforcing the training the consumer to stop thinking in terms of "watts" as a measure of brightness – and also allowing the customer to compare low CRI and high CRI lamps on an apples/apples basis?There is also a trend towards lamps which incorporate more than one technology, i.e., CFL+LED, or CFL+halogen to offer special features or performance. Products like this have been specifically excluded from the existing Energy Star program requirements.

We expect retrofit lamps to eventually be replaced by new luminaires, but this is likely to take decades, since the installed base changes only slowly. Energy Star needs to be aware of this slow transition and foster both categories of products, in order to save the maximum amount of energy. The form that new luminaires will take is not yet entirely clear, so flexibility will be required.

Another trend is the use of pellets for mercury dosing for CFLs. While pellets are technically amalgams, their run-up performance is between that of a pure mercury lamp (also called a non-amalgam lamp) and an amalgam design. Thus, specific run-up criteria could be proposed for these lamp types.

III. Energy Efficiency, Performance and Quality Features

a) ii. Power Factor: *EPA will work with stakeholders to evaluate the cost versus efficiency benefit of more stringent power factor requirements.*

Although there is broad attention within the industry to the issue of power factor, there is no consensus currently on how Energy Star should address it. Currently available information indicates that a high power factor CFL does not deliver any additional value either to the grid-operator or the end-user under most conditions.

With the overall influence of power factor, some advocate for the Energy Star value for lamps should be the current CFL level of 0.5. In LED lamps experts disagree somewhat on the significance of cost and technical considerations with reaching a power factor that is greater than 0.7 as the current Energy Star LED specification 1.1 states.

However, many LED lamps in the market now have 0.9 PF or greater; so LEDs are bearing this cost. In addition, the overall requirements for PF should also be checked and harmonized with other international standards.

In summary, this is another area where the lighting industry has not reached consensus and more discussion is needed with Energy Star before Energy Star takes any final decisions.

a) iii. 4. *EPA is interested in reviewing data on luminous efficacy levels for new omnidirectional and directional lamps.*

A quick analysis of the Energy Star Qualified Products List shows only a few (2) lamps that currently reach the omnidirectional specification. The directional specification has more lamps but it appears that the lamps are no more than 5% over the specification on average. The current limits set forth for the LED are truly a good representation of what the industry can currently meet.

b) ii.. Start time and run-up time: We disagree to equating all the lamp technologies and to come-up with standard and tight start-up times and run-up times. We need to consider the cost and energy benefits that different technologies bring to the market from various technologies. Is run-up time very important to consumers for non-critical applications? See further discussion below.

b.) iii. 5. *Would the consumer experience be enhanced by strengthening the existing intensity distribution requirements so as to more closely match current incandescent reflector products? What are the cost and performance tradeoffs in designing these products?*

The difficulties in providing suitable, specific intensity parameters which the consumer could easily understand suggest that the effort required to achieve this goal may be better spent elsewhere for the value received. The overall ability to claim equivalency to incumbent product is the true issue here. If a manufacturer wants to claim overall equivalency with a particular product, then looking at the wattage savings or lumens is not enough. This was seen already in the LED world with the creation of the "sno-cone" A19 type lamp. In this case, consumers purchased what they thought was omni-directional lamp when in reality what they bought was far from it – but it did save energy.

b) iii. 6. *Should EPA consider end-of-life cutoff features for LED products rather than allowing the products to continue to degrade in light output? What are the costs and performance trade-offs?*

Adding some form of control to extinguish the lamp at a certain maintenance level could add significantly to the final cost of the product to the customer. The variability of such controls could have a marked impact upon actual life of the product. The performance of the lamp may be hindered since the space, design and efficacy would have to change to accommodate this type of item. Such a product would have to be shielded from external sources of light in order to provide proper response to the lamp's own performance. Liability issues could arise from products completely extinguishing in "vision–critical" areas such as stairways and fire exits. We recommend not adding such a feature.

c) iii. Life requirements: When calculating the return on investment or cost/life time analysis, it makes sense to include lamp replacement cost for commercial application. We do not think the same formula can apply for residential application, as the cost of replacement of the lamp is low or non-existent in homes and in restaurants where the lamps are easy to reach. DOE has been working on this topic for several years. EPA should consult carefully with DOE before introducing any new specifications here.

c) v. 7. *Would increasing stringency of existing color requirements impact the cost of the products?*

Tightening color requirements, which could mean less variation in CCT or a higher CRI, can involve a partial redesign of current production equipment, as well as more process checks and phosphor corrections during lamp production. These potential changeswould reduce overall yield and increase individual product cost for CFLs and LEDs. In our view, consumers should not be asked to pay more for a product if they cannot on their own perceive the benefits, which in this case can only be done with the use of measuring instruments. Also, requiring an increased CRI could result in reduced efficacy

The current version of the ANSI color space allows for a flexible color bin as long as it meets defined requirements. In the commercial space various customers look for specific color points, like 4100K, instead of 4000K and a manufacturer should be allowed to rate the product in that manner. The flexible "bin" needs to be investigated further to better understand its true importance in the Energy Star specification.

c) v. 8. *Is the current CRI metric appropriate for EPA to use in future program requirements?*

Yes.

c) v. 9. *To what extent should CRI be augmented by other measures of color rendering?*

We believe CRI is the appropriate metric to measure color rendering. Other metrics such as the R9 value or the CQS system can provide advanced information to the very informed user and this could be available on product bulletins and internet web pages. This would help in the product selection process without confusing the general public. However, metrics that take into account color preferences can make it difficult to achieve true repeatability of color.

c) v. 10. *What color measurement metric would be most easily understood by consumers?*

At this time our experience is that the CRI scale is the most easily understood metric by the general public because it is expressed as a single value.

c) v. 11. *What would be the costs and benefits of shortening the "start time" requirement (currently one second)?*

Many current ENERGY STAR products already achieve a faster "start time" than 1 second. Reducing the starting time from this already restrictive requirement, will seriously affect the ability to offer dimmable and 3-way CFLs, as well as CFLs designed for intensive switching (e.g. occupancy sensor applications) or lamp designs intended for long life (e.g. longer than 10,000 or 12,000 hours). In order to properly dim the lamps and extend the switching and life performance of CFLs, the lamp filaments require pre-heating prior to lamp ignition.

As mentioned above, CFLs are essentially products made with a mature technology. Restricting some parameters will adversely affect others or will increase the product price or both.

The current customer expectation of LED lamps is that the startup time would be more like incandescent /halogen. One second is too long and 0.5 sec is more reasonable. The European requirements call out a 0.5sec start up. As a side note, certain standards are looking at including expected light output (in % of total) at a specified startup time.

c) v. 12. *What are the options and tradeoffs associated with improving "run-up" time?*

There are two main methods to control the mercury vapor pressure inside the CFL discharge tube and thus, an adequate level of light output for the lamps: cold spot and amalgam.

Cold spot, also called non-amalgam is mainly used for low-wattage bare lamps, where the cold spot method is good enough to maintain a proper mercury pressure inside the discharge tube.

Amalgam is typically used for lamps that run hot, e.g. covered products or higher wattage bare lamps or lamps intended for warmer applications such as recessed cans.

The amalgam method can provide a good level of light output and thus a good efficacy over a wider range of ambient temperatures, but it has the disadvantage of a slower run-up time.

The cold spot method has the advantage of a quicker run-up, but has the disadvantage that it can only be used in bare lamps, especially low-power types.

Redesign of mainstream products, in order to achieve faster "run up time", is a very expensive and uncertain proposition. Reducing the currently specified run-up time (1 minute for non-amalgam types and 3 minutes for amalgam), will severely affect the range and types of CFL products that can be offered to the market.

Current "run up time" measurements can be difficult to reproduce and are very dependent upon preexisting conditions of the lamps under test. We recommend expanding the categories to include pellet dosing (maximum run up time of 90 seconds) and to include products containing no mercury at all. Products containing amalgams should keep their current maximum run up time of 3 minutes.

In short, for LED lamps there are design tradeoffs that exist but they are not as difficult as shown by the CFL issues above.

c) v. 13. *Should EPA adopt a new definition of "life" that more clearly indicates to consumers the expected performance? What are the tradeoffs in terms of cost versus product life?*

We realize there can be customer confusion with the terms "average rated life" or "mean rated life" but our experience shows that this is the best description of the overall performance of the products with respect to life.

We think that lifetime, expressed in hours, is a good definition for product performance regarding life. Current incandescent products use this definition. The warranties (residential or commercial) currently required to qualify for the Energy Star label already address this in the most suitable fashion.

If EPA adopted a new definition of life, one different from the current industry standard used by DOE and FTC, the life testing requirements for these lamps would double. Products would have to be tested under one scheme for DOE/FTC and another for Energy Star. This would increase product testing costs.

Regarding tradeoffs for cost versus life, it is evident that the lifetime of CFLs is based on a) life of the lamp filaments and b) life of the electronic ballast.

Regarding a), in order to extend the life of the lamp filaments, it is necessary to have a good filament design, appropriate to the current that they are handling and a good pre-heat current before the lamp starts. Reducing the starting time of the lamps will severely affect the switching performance and the lamp life of the products, particularly for products intended for long life times.

Regarding b), in order to increase lamp life, it is evident that we need to use higher temperature rated electronic components to increase lamp life and thus increase the cost of the products and / or increase the size of the products to be able to manage the electronic component temperatures.

Both of these alternatives would be contrary to consumer expectations to have lower cost and smaller products.

It would be preferable to keep the current requirements for lifetime. Otherwise the Energy Star requirements will severely restrict the type of products offered in the market. If the lifetime requirement is increased, then only expensive and /or larger products will be able to be marketed under the Energy Star mark.

Moreover, the overall life should be based on the application and not the technology being used. The current specification for LEDs is essentially adding significant cost to the design for a lamp that needs to run greater than 25K hours and at 3 hours a day – that is around 22 years. The true goal for the lifetime is to meet the customer need and that the test for lifetime to be the same so that the comparison is a true comparison. One example is that if a lamp is design for a LED lifetime of L70 instead of B50 (50% of the lamps failing), the lamp itself has 25% increased cost in both LEDs and electronics to make the much different and more stringent lifetime requirement which the consumer doesn't really want or understand.

IV. General Topics and Other Questions

i. Product labeling/packaging: *The existing specifications contain separate sets of packaging requirements, both affected by the new Federal Trade Commission labeling requirements taking effect later in 2011. Product packaging requirements will be revisited. EPA aims to provide consumers with relevant product information regarding features, proper use, benefits, and energy consumption. During this process EPA will evaluate various means to effectively provide proper use and energy consumption information to consumers, leveraging the FTC label where applicable, and similar guidance for lamps without Edison bases.*

The industry has already been required to incur substantial costs in the major redesign of all packaging under the new FTC requirements. We strongly contest yet another change. The cost of the products involved has already increased due to the prior change and this would only add to that. With all the current information requirements there is very little space left already on many point of sale packages.

The current Lighting Facts program is an extra set of requirements and in some cases cause for an incorrect rating of the product. The Lighting Facts specification for rating CRI, lumens, etc., do not allow for a manufacturer to take into account manufacturing data that is made available today. The manufacturers should be allowed to rate the product on a larger set of data rather than a simple LM-79 report for one lamp out of a batch. Special care should be taken to streamline this process to ensure it is a true value-add and not a hindrance.

ii. Harmonization, where appropriate, with developments in international product efficiency standards: *EPA will examine international test procedures for energy efficiency and other key criteria to determine if harmonization would bring benefits in the development of "global" products.*

Global power systems vary substantially by supply voltages and frequencies, as well as lamp and base design. Simply designing a product to accept the different voltages and frequencies would not make a lamp "global" in this case, due to the different basing systems. We do not see how this could provide the American consumer any advantage under current conditions and form factors.

iii. Other environmental benefits: *EPA will investigate adding restrictions on hazardous substances, as was included in the recently released the ENERGY STAR Luminaires specification.*

We note that Energy Star supports use of the current European Union "RoHS" requirements, which were specified in the recent Luminaires program requirements. However, we do wish to comment that there is no single agreed upon test standard for the measurement of mercury in lamp products and that any form of mercury testing upon a completed product is expensive. Many products covered under the scope of this proposal receive their mercury dose in the form of a pellet containing a mercury amalgam or other chemical compound. Other vehicles for mercury dosing can be used as a metal strip or capsule. The mercury content of these various vehicles is known very precisely already. We recommend accepting that data where possible if such a requirement is considered.

iv. 14. *How should the performance of dimming products be characterized or measured?*

This is a very complex problem/issue, considering the number of dimming systems available and installed. Lamp performance can vary from one model of dimmer to the other. Thus the number of combinations that could be tested increases rapidly. The CFL manufacturers are in the best position to make these tests and make available via the internet a list of dimmer brands and models compatible with their dimmable CFLs.

iv. 15. *Could non-dimmable lamps be designed to be "dimming tolerant", so that if operated on a dimming circuit, the performance would meet consumer expectations? If so, what would be the challenges and cost tradeoffs?*

To our knowledge, this suggestion is not feasible. CFLs (and fluorescent lamps in general) need a specific current through the lamp filaments to maintain proper operation of the lamp. If the RMS voltage received by the lamp is lowered, the lamp would need an intelligent circuit (e.g. an IC) to provide the proper current compensation to the lamp filaments.

So, in essence to make a "dimming tolerant" CFL, which "would meet consumer expectations" when operated on a dimming circuit, we would need to make the lamp fully dimmable. In summary, for a lamp to dim on currently existing systems, it has to be designed specifically for that purpose. This will make the lamp more expensive as additional circuitry will be needed in the lamp ballast to perform this function. This substantially increases the cost of the dimmable product and can affect the efficacy and life of the product as well. It is difficult enough to design dimmable lamps to be compatible with the wide variety of dimming systems currently available on the market. Consumers should only pay for this additional circuitry when it is needed.

In addition, this is a matter of consumer education. A CFL lamp is not an incandescent lamp and customers should become familiar with ways to use them. This will come with time as CFL use increases.

iv. 16. *What requirements should EPA include regarding dimmer compatibility? Are there tests that can be applied? If not, where might they be developed?*

As stated above, this is a very complex issue given the availability of dimmers installed and available in the market.

We believe the current requirements for package labeling and listings of compatible systems to be sufficient. . The lamp manufacturer should post the list of dimmers compatible with their dimming CFLs. If EPA wishes to introduce requirements on dimmer compatibility it should only apply them to products (both dimmer and lamp) developed after that introduction. The industry is already developing standards to help assure the compatibility of dimming lamps and controls. An example is NEMA SSL 6-2010, "Solid State Lighting for Incandescent Replacement — Dimming".

iv. 17. *Under what circumstances would minor product variations necessitate complete unique testing?*

Minor product variations are needed for a variety of reasons, e.g. component suppliers who stop supplying lamp sub-components, process manufacturing changes, etc.

It is evident, that re-testing the product for every engineering change is not viable and will increase the product cost significantly, since the testing is rather expensive, not to mention the time involved for re-testing, which most of the times is not available.

It is also obvious that re-testing the product is not necessary for every minor product variation, e.g. if the lamp base is changed, this will have absolutely no impact on lamp life or performance.

The lamp should only be re-tested when the product model or wattage change. Otherwise the cost to the manufacturer and eventually to the end-user who pays for this will become extremely heavy. Moreover, the supply of products will be seriously jeopardized.

More specifically on changes to color performance: When a product is introduced which is the same as an existing product except with a higher Correlated Color Temperature, it should not require unique testing. When a lower CCT is qualified, all higher CCT's should qualify. Note that in this case, however, if a higher CCT product is disqualified a later date, that disqualification should only apply to the specific CCT. If a qualified product is improved with respect to one or more characteristics, requalification at the improved levels should only be required in the specific characteristics that were improved. A directional product family where the products only differ in beam angle should all qualify when one of them qualifies.

Also, in Appendix D of the current Integral LED Lamp specification, we wish to note that the 1.1°C tolerance called for in "in situ" tests of similar products is much too tight. ASTM E320 allows 1.1°C variation between thermocouples, alone. Having the specified tolerance set at 1.1°C suggests that the only source of variation is the thermocouple. There are actually multiple sources of variation. There is variation in the product (lamp to lamp), variation in the thermocouples, variation in the meters, and even variation in ambient temperatures.

V. Conclusion

In general, the costs associated with Energy Star testing and approval and third party testing are too high. What can Energy Star to reduce redundant and unnecessary cost burdens that end up costing the customer more and making the technology more difficult to justify by the customer? For example, as noted above, can Energy Star clearly state that different CCT versions of the same base lamp model do not all have to be tested? Let's work together on other measures that can be taken to streamline requirements without negatively affecting the consumer's experience.

Lastly, following its review of comments on the Framework, we strongly encourage EPA to convene a face-to-face discussion with industry. In the past, the industry was invited to participate in these types of conversations prior to revisions of the CFL specification, and we believe it resulted in a stronger process and resulting specification.

Thank you for your consideration of these comments. We look forward to working with you further on the new Lamp specification. If you have any questions regarding these comments, please contact Craig Updyke of NEMA at 703 841 3294 or cra_updyke@nema.org.