Department of Energy
Washington, DC 20585

September 3, 2008

Mr. Donald S. Clark, Secretary
Federal Trade Commission
Office of the Secretary
Room H-135 (Annex N)
600 Pennsylvania Avenue, N.W.
Washington, D.C. 20580

Dear Mr. Clark:

Re: Lamp Labeling, Project No. P084206

Thank you for the opportunity to provide comments on FTC's Advanced Notice of Proposed Rulemaking, Lamp Labeling, Project No. P084206. My name is Dr. James Brodrick, and for the past eight years, I have been in charge of the U.S. Department of Energy's (DOE) Solid-State Lighting (SSL) Program. During that period, DOE has implemented a broad research, development and commercialization support program that has assisted the lighting industry in significantly increasing the speed in which quality "white-light" SSL luminaires are reaching the market.

I would like to make three recommendations:

- DOE and FTC should work together to establish a consumer label and labeling process for solid-state lighting that will begin as a voluntary manufacturer pledge program administered by DOE, and continue as a mandatory program administered by the FTC.
- The FTC should only employ nationally recognized testing procedures in labeling SSLs, in particular IES LM-79 for "absolute photometric" testing.
- The FTC program for labeling SSL should require that manufacturers use only luminaire efficacy data based on IES LM-79 tests conducted at accredited test laboratories for both LED luminaires and integrated LED lamps.

Adopt Solid-State Lighting (SSL) Quality Advocates

While DOE's emphasis has always been on quality in solid-state lighting, we recognize that any new product market will have its share of underperforming products. Therefore, we are developing a voluntary quality control program to be called *SSL Quality Advocates*. When instituted (our target date is November 2009), it will entail a voluntary pledge by light-emitting diode (LED) luminaire and source manufacturers and others in the lighting marketing channel to provide lighting buyers a consistent set of performance metrics in a clear and simple format. For luminaires, the metrics include lumen output, luminaire efficacy, power input, color temperature and color rendering index. To comply with the pledge, the manufacturer must test its products, using absolute photometry, in accordance with the Illuminating Engineering Society of North America's IES LM-79,

Approved Method for the Electrical and Photometric Testing of Solid-State Lighting Devices. IES test procedures and standards are the nationally recognized norm for the lighting industry.

We were happy to learn from the FTC ANOPR that FTC "now has the authority to require energy disclosures for consumer products that use lighting technologies not currently specified in the law (e.g., solid-state lighting such as LED products)." **The Department would like to assist the Commission by coordinating its efforts on the voluntary SSL Quality Advocates Program to parallel the more formal FTC labeling program, and to serve as an interim consumer labeling procedure until the FTC program is adopted.** Attachment A contains more information on SSL Quality Advocates.

Employ Nationally Recognized Test Procedures and Standards
Under current labeling requirements, manufacturers must "possess and rely upon a reasonable basis consisting of competent and reliable scientific tests" to substantiate the information on their labels. For lamp life and light output representations, the Rule states that the Commission will accept as a reasonable basis, competent and reliable scientific tests conducted according to applicable IES (Illuminating Engineering Society) test protocols that substantiate the representations. The Rule, however, does not require manufacturers to use these protocols."

For the purposes of solid-state lighting, DOE strongly suggests that the FTC require manufacturers who label such products to use only IES LM-79 or other nationally recognized industry test procedures and standards. The Department has worked closely with many organizations to establish rigorous test procedures and reporting standards. In addition to IES, we count the American National Standards Institute (ANSI), Underwriters Laboratories (UL), the National Electrical Manufacturer's Association (NEMA), the National Institute of Standards and Technology (NIST), the International Electrotechnical Commission (IEC), the International Commission on Illumination (CIE), and the Canadian Standard's Association International (CSA International) as our partners. These organizations have all contributed to the development of test standards and the requisite test laboratory certification procedures that directly apply to SSLs.

For an organization such as IES, which has been establishing testing procedures for over 100 years, the challenges of developing relevant standards using correct photometry represents a significant undertaking. Conventional testing procedures, currently used for fluorescent and metal halide sources, are inappropriate for SSLs.

Unlike conventional lighting, SSL products are a combination of several components, including a light-emitting diode (LED) array, an electronic driver that modulates power input and a heat sink that helps dissipate heat from the light source. Both the driver and the heat sink are integral parts of the SSL luminaire and lamp.

DOE strongly suggests that the FTC only consider IES LM-79 to measure the photometric performance qualities of SSLs. Developed in conjunction with DOE's SSL Program, IES LM-79 is the only national test procedure that has undergone the rigorous review that is typical of such standards. Further, it is specifically designed to measure the photometric properties of SSL fixtures, allowing calculation of luminaire efficacy, whether the lumiaire is an integral fixture or an integral replacement lamp

LM-79 is used to calculate reproducible measurements of total luminous flux (lumens), electrical power (watts), luminous intensity distribution (directionality) and chromaticity (color) of solid-state lighting. The test procedure covers both LED luminaires (integral fixtures incorporating light sources) as well as integrated LED lamps. An integrated LED lamp refers to an LED device with an integrated driver and a standardized base, e.g., a replacement for incandescent lamps with a screw base. An LED luminaire refers to a complete LED lighting unit consisting of a light source and driver, together with parts to distribute light, to position and protect the light source and to connect the light source to the power supply circuit. The light source itself may be an LED array, an LED module, or an LED lamp.

Differentiate SSL from Conventional Lighting Products

The most important aspect in testing SSLs is to compare products that are alike. Pre-SSL procedures allowed for the testing of individual lamps or light bulbs. Such procedures were deemed appropriate because these lamps were interchangeable and not integral to the entire fixture. The testing procedure used for common lamps or light bulbs is called "relative photometry." Since LED arrays cannot be conveniently removed from the luminaire or integrated lamp and individually tested as bare lamps (the LED array only), a SSL fixture or integrated lamp must be tested as an entire unit. This is called "absolute photometry." I won't go into detail on the physics of each type of testing in this document, but I would be happy to provide additional information on the subject on request.

Conventional testing methods are inappropriate for SSLs because unlike standard lamps, which are tested for "source efficacy" (the efficiency of a bare bulb), "luminaire efficacy," measured by absolute photometry, is the more accurate term for SSLs. The "relative photometry" tests produce a "source efficacy" result, which is the light output of the lamp in lumens per watt measurements. This is significant because all of the relative candle power (directional light intensity) data provided in the test results is relative to the rated lumen of the lamp, or light bulb, and not of the entire light fixture or integrated LED lamp.

The new "absolute photometry" test method, IES LM-79, was specifically designed to measure the photometric properties of SSL products, allowing calculation of "luminaire efficacy." Absolute testing measures actual intensity values in candle power that are generated by the luminaire during the test, and are not relative to any particular rated lumen output produced by the LED array (or light source).

The importance of luminaire efficacy is gaining recognition across the lighting industry. In the July 2007 issue of *Leukos,* IES's research journal, Editor David L. DiLauria wrote the following:

> "Luminaire efficacy accounts for the difficulty of using all the lumens generated, however high the (light) source efficacy. Naturally, poor luminaire optics can have a large canceling effect on high-source efficacy. This wide view of assessing lighting system performance is a welcome development, if only because it will make the energy comparison of lighting equipment easier and more certain. Naturally, what counts are the lumens that leave a luminaire per watt of input power. Looking only at source (efficiency) can be very misleading."

For lighting buyers, Mr. DiLauria's last sentence is the key. To use a sports analogy, source efficacy is like a football player's running speed in the 40-yard dash while wearing running shoes, gym shorts and a t-shirt; luminare efficacy is more like his speed when encumbered by spiked shoes, pads and the helmet he will wear in the actual game. Because we are interested in the actual "game" performance of lighting devices, it makes sense to use luminaire efficacy as the standard for comparison.

Good lighting and energy efficiency decisions must be based on appropriate comparisons of various light sources. Comparing LED luminaire efficacy to traditional source efficacy will give inaccurate results because the latter does not include optical or thermal losses. To ensure you are comparing apples to apples, you must compare LED and traditional light sources on the basis of luminaire efficacy, based on photometric reports provided by independent, accredited testing laboratories that employ LM-79 for LED fixtures. As DiLauria states, this approach will make the energy comparison of lighting fixtures easier and more certain.

Require Luminaire Efficacy for Labeling

To prove this point, we have begun using our Commercially Available LED Product Evaluation and Reporting (CALiPER) testing program to benchmark the performance of integrated, hard-wired CFL and linear fluorescent fixtures to measure luminaire efficacy. We are using the IES LM-41, the concurrent "absolute photometry" test procedure for fluorescent fixtures. Traditionally, the industry has employed testing for "source efficacy" rather than total "luminaire efficacy" for such products. However, we wanted to be able to benchmark the actual light output of LED products in comparison with fluorescent fixtures, thus these tests. To date, we have tested 16 such "hard-wired" fluorescent fixtures, 14 of which meet or exceed EPA's ENERGY STAR-qualifying criteria.

We have made these comparisons for four lighting applications that will be among the first to be labeled under the DOE SSL ENERGY STAR Program, which is scheduled to begin on September 30, 2008. These products include downlights, undercabinet lights, desk task lights and outdoor lights. The information in the table below is another

indication of why we believe that luminaire efficacy ratings are so important for LED products, especially when portraying relative light output to lighting buyers. Of the 14 ENERGY STAR-qualified compact fluorescent and linear residential light fixtures tested, the actual lumen output of the fixture was anywhere from 23–67 percent lower than the manufacturer's published figures for lamp output. As a consequence, the lighting buyer, who was expecting a certain amount of light based on the packaging information, finds that the fixture's light output is much lower than expected.

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CALiPER Benchmark Testing

ENERGY STAR-Qualified Compact Fluorescent and Linear Residential Light Fixtures

Type	Total Watts	Lumen Output	Luminaire Efficacy	CCT[1]	CRI[2]	Mfrs. Published Lamp Output	Mfrs. Implied Source Efficiency	Fixture Plus System Loss (%)
Downlight	**12.8**	**346**	**27.1**	**3,928**	**79**	**900**	**69**	**61**
Downlight	**12.2**	**514**	**42.0**	**2,729**	**82**	**860**	**66**	**40**
Downlight	**13.0**	**653**	**48.6**	**2,730**	**82**	**844**	**53**	**23**
Downlight	**10.0**	**466**	**45.8**	**2,717**	**82**	**808**	**69**	**42**
Undercabinet	**18.9**	**689**	**36.4**	**3,015**	**84**	**2,100**	**96**	**67**
Undercabinet	**11.7**	**237**	**20.3**	**5,734**	**71**	**690**	**53**	**66**
Undercabinet	**16.0**	**360**	**23.0**	**3,865**	**60**	**870**	**58**	**59**
Desk-Task	**16.0**	**700**	**43.0**	**2,819**	**81**	**1,100**	**61**	**36**
Desk-Task	**26.4**	**1349**	**51**	**3,050**	**84**	**1,971**	**66**	**32**
Desk-Task	**19.7**	**759**	**39**	**2,740**	**82**	**1,800**	**69**	**58**
Desk-Task	**19.4**	**869**	**45**	**3,092**	**80**	**1,800**	**69**	**52**
Outdoor Wall Fixture	**14.0**	**639**	**46.0**	**2,648**	**83**	**860**	**66**	**26**
Outdoor Wall Fixture	**16.3**	**590**	**36**	**2,710**	**82**	**1,350**	**75**	**56**
Outdoor Wall Fixture	**11.9**	**615**	**52**	**2,775**	**85**	**900**	**69**	**32**

Taking the first downlight listed as an example, a buyer expecting a 900-lumen output that got only 346 lumens would be disappointed for a variety of reasons, including lower than expected light levels for the intended application. In this instance, the manufacturer implied a source efficacy of 69 lumens per watt based solely on the source efficacy of the lamp, but the overall luminaire efficacy, measured by DOE's CALiPER tests, was only 27.1 lumens per watt. If the first undercabinet light listed in the table were purchased with the intention of properly illuminating a food cutting surface, the buyer is not going to be happy with a 67% reduction in the amount of light that reaches the counter surface.

From this evidence, we have concluded that a range of 23–67 percent optical losses is not atypical. Obviously, for integral fixtures, luminaire efficacy can differ greatly from source efficacy.

[1] Color Correlated Temperature is a measure of chromaticity and the relative color of the light emanating from a light source.

[2] Color Rendering Index is a quantitative measure of the ability of a light source to reproduce the colors of various objects faithfully compared to an ideal or natural light source.

While a similar table cannot be displayed for SSL products because LM-79 was designed to solely test an integrated fixture, and not the LED array, the fluorescent product test figures clearly illustrates the importance of luminaire efficacy. **Therefore, we strongly recommend that luminaire efficacy be the FTC requirement for SSL products once its labeling program is adopted.**

Recommendations

- DOE and FTC should work together to establish a consumer label and labeling process for solid-state lighting that will begin as a voluntary manufacturer pledge program administered by DOE, and continue as a mandatory program administered by the FTC.
- DOE recommends that FTC only employ nationally recognized testing procedures in labeling SSLs, in particular IES LM-79 for "absolute photometric" testing.
- The FTC program for labeling SSL should require that manufacturers use only luminaire efficacy data based on IES LM-79 tests conducted at accredited test laboratories for both LED luminaires and integrated LED lamps.

We appreciate your consideration of these issues and we look forward to working with you on this very important topic.

Sincerely,

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