CALiPER

SUMMARY REPORT

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DOE Solid-State Lighting CALiPER Program

Summary of Results: Pilot Round of Product Testing

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DOE Solid-State Lighting Commercial Product Testing Program

Summary of Results: Pilot Round of Product Testing

During the program development phase of the SSL Commercial Product Testing Program (CPTP), a pilot round of testing was conducted. Four products were selected for testing, representing a range of applications, designs, and manufacturers. Lighting testing laboratories were instructed to follow test procedures specified in LM-79 draft 2 (IESNA Guide for Electrical and Photometric Measurement of Solid-State Lighting Products).

Table 1. Pilot Round Test Partial Results[1]

Photometrics based on LM-79 for • Complete luminaires • 25º C ambient temperature	**Light Output (lumens)**	**Luminaire Efficacy (lm/W)**	**Correlated Color Temperature (K)**	**Color Rendering Index**
CPTP 06-01 Downlight[2] (manufacturer published LED luminous efficacy = 40 lm/W)	193	12.82	3012	70
CPTP 06-02 Under-cabinet Light (manufacturer published LED luminous efficacy = 55 lm/W)	166	16.07	*See note*[3]	
CPTP 06-03 Downlight (manufacturer published LED luminous efficacy = 45 lm/W)	298	19.3	2724	67.3
CPTP 06-04 Task Light (manufacturer published LED luminous efficacy = 36 lm/W)	114	11.6	*See note*[3]	

Because downlights are known to be subject to thermal factors, the downlight product CPTP 06-01 was also tested in an insulated enclosure (as per UL 1598 environment specifications) with results as follows: light output = 170 lm; luminaire efficacy = 11.82 lm/W.

In addition to performing product testing following LM-79 draft 2, photometric data published by manufacturers for SSL products (in the form of standard IES photometric data files) were collected and analyzed for purposes of comparison.

Observations and Analysis of Test Results

To put these test results in context, we can examine them in comparison to traditional lighting technologies. Based on manufacturer published photometric data for under-cabinet lights, in a per linear foot comparison, the under-cabinet LED light included in the pilot testing produces

[1] Testing of additional products is not yet completed.
[2] Downlight product test results were confirmed through two separate testing laboratories and using both a goniophotometer and an integrating sphere with spectroradiometer.
[3] Test procedures do not provide guidance on obtaining color metrics for SSL luminaires that are not suited to testing in an integrating sphere with a spectroradiometer. Questions concerning this issue have been submitted to the LM79 drafting committee.

only ½ to 1/5th of the light output of similar incandescent and fluorescent products (i.e., it is considerably dimmer). Regarding energy use, the LED product tested demonstrates somewhat better efficacy than the incandescent under-cabinet lights, whereas the fluorescent under-cabinet lights out-perform this LED product with efficacies which are generally 1 ½ to 2 ½ times higher. Results were similar in the task light category, but suitable benchmarking data for quantitatively comparing this product to similar incandescent and fluorescent products is not yet available. In particular, further testing is needed to enable evaluation of the directional characteristics of LED task lights as compared to task lights using fluorescent and incandescent sources.

In the downlight category, the first LED luminaire that was tested delivers less than 1/3 of the light output of similar compact fluorescent (CFL) and incandescent downlights (26W pin-based CFL downlights; 15W reflector CFLs; and downlights using 65W incandescent 'R' lamps). The second LED downlight product tested performs somewhat better, delivering ½ to 1/3 of the light output of similar fluorescent and incandescent downlights. With regard to luminaire efficacy, both LED downlight products out-perform similar incandescent downlights; whereas CFL downlights out-perform the tested LED downlights attaining luminaire efficacies from 1 ½ to 3 times higher than the LED downlights.

These test results show that traditional lighting performance metrics (primarily based on lamp efficacy as opposed to overall luminaire efficacy) do not provide an adequate indication of an SSL luminaire's performance and could be misleading if used to compare light output or energy efficiency of an SSL product to a product using another light source.

Based on these results, it is inappropriate to suggest that a high LED luminous efficacy (lamp efficacy) indicates that a luminaire using those LEDs has high efficacy. Measures of LED efficacy (lamp efficacy) can be useful for manufacturers to evaluate the performance of available lamp components, however these data relate to subcomponents and should not be used in product literature for luminaires to convey an indication of the performance of the luminaire at this time.

Conclusions from Pilot Round of Product Testing

Because SSL technologies are undergoing rapid change and improvements, a wide range of performance is currently seen among products arriving on the general illumination market. SSL-based luminaires have the potential to provide high-quality light which consumes far less energy than more traditional lighting technologies, but recent testing of commercially available products show that some being sold today actually provide less light output than traditional light sources and are less efficacious than products using fluorescent light sources.

Industry groups, standards organizations, and the DOE are working quickly to fill the voids in product standards and testing procedures for SSL technologies, but in the meantime, manufacturers could knowingly or unknowingly take advantage of the novelty of SSL, the public's lack of familiarity with it, and of the lag in appropriate standards and rules to promote products as energy efficient, where in fact they perform more poorly than incandescent or fluorescent lamps.

Until standards and testing procedures are established and rulings are adapted to account for particularities of SSL technologies, industry professionals can and should use their vigilance to help ensure that product performance data is not used misleadingly. Players in the field of SSL technology—manufacturers, testing laboratories, energy experts, and regulators—have a key role in protecting the potential of SSL. Until the field of SSL technologies and supporting knowledge matures, any claims regarding performance of SSL luminaires should be based on overall luminaire efficacy (i.e., from testing of the entire luminaire, including LEDs, drivers, heat sinks, optical lenses and housing), to avoid misleading buyers and causing long-term damage to the SSL market.

Further testing, as planned in the DOE SSL Commercial Product Testing Program, is needed to better understand the discrepancies observed: to gain a clearer understanding of how to assess the performance of SSL products as compared to products using traditional light sources; to identify how different testing procedures may affect results; and to clarify how traditional photometric practices apply or do not apply to SSL products.