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A New Look at Commercial Ambient LED Lighting

This week, the U.S. Department of Energy's (DOE) CALiPER program released an exploratory study on the problems and benefits likely to be encountered as LED products intended to replace linear fluorescent lamps and luminaires become increasingly popular. Linear fluorescent lamps – specifically, T8s and T5s – are the most-common light sources in our country's classrooms and offices and are used in a wide range of fixtures, including recessed 2'x 4's, 2'x 2's, and 1'x 4's as well as linear pendants (both indirect and direct/indirect), chalkboard/whiteboard lights, and linear wallwashers. But a growing number of LED products are being offered as energy-efficient alternatives – including T8 LED replacement lamps, integral LED luminaires (2' x 4' or 2' x 2'), and kits to upgrade fluorescent troffers to an LED option.

For the CALiPER study, DOE brought together 18 lighting designers and facility engineers to compare 24 identical pairs of troffers in a simulated office space. Three of those pairs involved fluorescent benchmark troffers, and the rest were LED products – including five pairs of fluorescent troffers retrofitted with LED tubes, four pairs of troffers with LED non-tube retrofit kits, and 12 pairs of dedicated LED troffers. The products were tested at Pacific Northwest National Laboratory for flux, color, power quality, and flicker before being evaluated by the 18 experts for photometric distribution, uniformity of light on the task surface, and suitability of the light output for the task, as well as flicker, dimming performance, color quality, safety and certification issues, ease of installation, and energy efficiency.

Compared to the last CALIPER tests on such products, conducted in 2011, the new study shows considerable improvement. On the whole, the LED luminaires proved to be slightly more efficacious than their fluorescent luminaire counterparts, which ranged from 57 to 62 lm/W (with an average of 59.6 lm/W), compared with a range of 55 to 107 lm/W for the LED products (with an average of 80.3 lm/W). But the evaluators identified a number of areas of concern, one being color consistency. The color of the LED troffers varied from manufacturer to

manufacturer, even though most were claimed to be 4000K white. This means that architectural projects with multiple luminaire types in a single room could end up with the downlights looking “greener” than the troffers or task lights, for example.

Some of the luminaires with dramatic or odd brightness patterns on the lens or diffuser were identified as being more glaring and as causing more noticeable reflections on glossy computer screens. This was worse for the LED luminaires than for the fluorescents, especially where the manufacturers had not carefully considered the appearance of the troffer lens. But glare proved somewhat enigmatic, in that no traditional measured or calculated photometric quantities were reliable predictors of whether it would be a problem for a given luminaire – except that troffers with maximum lens luminances greater than 20,000 cd/m^2 seemed to be more objectionable.

Another issue noted by the study involved LED T8 replacement lamps. Because they emit no light from their back sides, they changed the appearance of troffers (both lensed and parabolic) by increasing the luminance contrast between the lamp and the unlighted reflector behind it – which, when used with an omnidirectional fluorescent tube, would reflect back plenty of light. The result was apparent stripes on troffer lenses, as well as greater perceived lamp brightness in the parabolic louvers.

When it came to dimming, LED products were on par with fluorescents. Both source types were equipped with 0-10V dimming ballasts or drivers, and neither dimmed smoothly and predictably, especially when raised from the “off” setting. More notably, however, about a third of the LED products exhibited annoying flicker in dimmed mode. At this point in time there are no established flicker metrics that would warn specifiers about this problem.

A number of issues were encountered during the installation of the LED tubes and non-tube retrofit kits – for example, there wasn’t enough wire in some troffers to reach across the fixture once the ballast was cut out, and the need for some non-tube retrofit kits to be installed in deeper troffer housings wasn’t noted prominently enough on the spec sheet. These kinds of things could be avoided if manufacturers would observe their products being installed in a range of existing troffer types, and make the necessary product modifications to better facilitate installation as well as approval by the electrical inspector. An electrical inspector could have disqualified more than half of the installed LED tubes and non-tube LED retrofit kits because of either poor assembly or a lack of safety documentation, so it would behoove manufacturers to address this issue in order to avoid costly site certifications.

The CALiPER study shows that LED dedicated troffers can compete with fluorescents in terms of efficacy, and while lighting quality is of some concern, it's no more so than with fluorescents. The other LED options – replacement tubes and non-tube retrofit kits – don't perform as well. Although the present study found them to be as efficacious as their fluorescent counterparts, there were concerns about color consistency, glare, dimming, flicker, installation issues, and code approval. Many of these concerns were due to the fact that the existing housings were designed for omnidirectional fluorescents rather than for directional LEDs. Nevertheless, it's advisable to mock up and visually evaluate LED retrofit products before ordering them for large installations.

Despite the considerable improvement in this class of LED products, there remains more to be accomplished before they emerge as the clear choice over fluorescents. To see a copy the full CALiPER report, please visit www.ssl.energy.gov/exploratory.html.

As always, if you have questions or comments, you can reach us at postings@lightingfacts.com.