Postings: from the desk of Jim Brodrick

I was really gratified by the response to the *Posting* a few weeks back about DOE's fact sheet on the performance specifications of LED T8 replacement lamps. In our booth at LIGHTFAIR last month, that fact sheet went like hotcakes, because it blows the whistle on a mushrooming class of products that are not ready for prime time. The topic is such a timely and important one that DOE has now come out with a second fact sheet that takes a deeper dive into design and application issues that are critical if you're considering LED T8s for use in ceiling fixtures (such as 2'x4' troffers) that are so common in offices and other commercial spaces. Entitled LED Replacements for Four-Foot Linear Fluorescent Lamps, this new fact sheet not only goes into more detail about how these products don't measure up to their fluorescent counterparts when used in 2'x4' troffers, but also focuses on *why* this is the case.

Why a second fact sheet on this topic? Because in this country alone there are tens of millions of recessed troffer fixtures with 4' fluorescent T8 lamps in use in commercial and institutional applications – and a ton of LED products being touted as energy-saving "drop-in" equivalents that can be substituted right off the shelf. Since at this stage of the game those LED products are a far cry from matching the performance of fluorescent T8s, it all adds up to a surefire recipe for consumer disappointment.

That doesn’t mean LED T8 replacement lamps will never make the grade; it just means that right now they’ve got quite a ways to go – not only in terms of cost, but also in terms of light output,

distribution, and lumen maintenance. This is not to say that LED T8s are inappropriate for all applications – they can be a reasonable option in locations where fluorescent doesn't work well, such as in display case lighting. But when it comes to general ambient lighting for offices and other commercial spaces, LED T8s have not proven competitive with linear fluorescent lamps. This is not a vague impression "sensed" from the marketplace; it's a DOE finding based on careful analysis and testing results from DOE's CALiPER program, which has systematically benchmark-tested these products with the linear fluorescent lamps they're designed to replace. The results of that testing have shown that LED T8s produce far less light than the fluorescents they're intended to replace, out of proportion to the energy savings.

For example, the average initial bare-lamp light output of the LED replacement products was only about one-third of the average for the fluorescent lamps tested – with the best-performing LED T8 producing only half of the light output of a typical 4' fluorescent. Not exactly what I'd call a stellar performance.

What's more, because the LED products are directional, they don't work well with the optical elements in the troffers, which are designed for omnidirectional light sources. That explains why, even though troffers using LED T8s have higher fixture efficiencies (because less light gets trapped in the fixture), they don't distribute the light as well as those using fluorescent lamps, whose omnidirectional light they're specially designed to reflect, shape, spread, and diffuse across a large area.

CALiPER testing found this to be the case for both lensed and parabolic louver troffers; although fixture efficiency was higher with LEDs, fluorescent fixtures had higher light output and higher overall efficacy. Lensed troffers generally shape light in a cosine distribution, but LED replacement lamps were found to produce a narrower cosine than T12 fluorescents, with significantly lower

luminous intensity. In parabolic louver troffers, LED lamps failed to produce the desired batwing light distribution provided by the benchmark T8 fluorescents. This means that for LED replacement lamps to match the illuminance levels and uniformity of fluorescent lamps in either lensed or parabolic louver troffers, more fixtures would need to be installed, with closer spacing – which would increase the total cost and reduce or negate the energy savings.

In terms of light color, CALiPER found that the CCT values for most of the LED linear replacement lamps were similar to the fluorescent benchmarks (3200K to 4500K), but several of the LED lamps tested had atypical chromaticities that gave the light a greenish or purplish appearance. The CRI values of the LED products ranged from 63 to 76, with most of them approximating those of lower-quality fluorescent lamps.

Another important consideration with linear LED replacement lamps is the way they interact with existing fluorescent ballasts. Some LED products tested by CALiPER required bypassing the existing ballast to connect directly to a line-voltage circuit, which adds additional labor costs. Those that could operate with the existing ballast tended to perform unpredictably, depending on the ballast. Some newer products come with a dedicated LED driver that replaces the existing ballast.

As for lifetime, many LED linear replacement lamps use 5-mm "through hole" LEDs, which are not designed for general illumination applications or for long life. Other LED linear replacements use higher-output LEDs that may offer longer life. However, no long-term testing or field performance data is available to substantiate manufacturers' long-life claims, which ranged from 50,000 to an incredible 100,000 hours. Fluorescent T8s have rated and tested lifetimes that range from 24,000 to 42,000 hours or more, depending on start times and the type of ballast used. What's more, fluorescent T8s have 92% lumen

maintenance at end of life, compared with 70% lumen maintenance typically assumed for LEDs.

Add to all of this the fact that it costs a whole lot more to light a commercial office space with LED linear replacement lamps than with their fluorescent counterparts (with cost per square foot ranging from four to more than 50 times higher, and payback periods of more than 40 years in some cases), and you can see that it doesn't make sense to use LED products for that application – at least, not yet. Solid-state lighting technology is improving all the time, but for now, when it comes to LED replacement T8s, the best policy is to "just say no."

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