

# Are LED Screw-Ins Ready To Take On The 60W A-lamp?

by Craig DILOUIE

America is calling for a super-efficient light bulb, and has pinned its hopes on solid-state lighting. Are LED screw-in replacement lamps ready to step up and take on that venerable workhorse, the 60W incandescent A-lamp, confirming industry talk that the CFL is going to turn out to be just a transition technology between incandescent and LED light sources?

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In December 2007, the Energy Independence and Security Act (EISA) scheduled the elimination of today’s 40–100W general-service incandescent and halogen screw-in lamps starting in 2012–2014. Demand is expected to shift to compact fluorescent lamps, energy-saving halogen lamps and, if developed, high-efficiency incandescent lamps.

But the U.S. Department of Energy (DoE) is already looking past these sources to a super-efficient LED lamp. EISA 2007 also created the Bright Tomorrow Lighting Prizes (L Prize) competition, which establishes cash awards and other incentives for developing effective alternatives for 60W incandescent and PAR38 halogen lamps.

The stakes are incredibly high. After all, DoE estimates that nearly a billion 60W A19 lamps will be installed in the U.S. by 2010.

There are LED lamps on the market today that claim already to be effective alternatives to 60W incandescents. They claim to produce no ultraviolet energy and little heat, are shock- and vibration-resistant, require little power, offer problem-free operation in cold temperature environments, contain zero mercury, and promise a rated life up to 50,000 hours.

So are LED screw-ins ready to replace 60W bulbs while also competing successfully against their CFL replacements?

Product testing conducted by DoE’s Commercially Available LED Product Evaluation and Reporting (CALiPER) program suggests that the answer, at least for now, is “no” for replacement lamps in fixtures requiring omnidirectional light distribution.

“The number of omnidirectional LED lamps on the market is increasing every month, including A-type lamps, candelabra lamps, nightlights and many non-standard formats of replacement

lamps,” says Mia Paget, senior research engineer for Pacific Northwest National Laboratory, lead for DoE’s CALiPER LED product testing program. “While LED technology holds great potential for energy savings in the long term, this potential may be hindered if poor quality products proliferate in the market in the near term. CALiPER tests these products to establish reliable, unbiased product performance information and to help the industry better understand and compare these alternatives with more traditional lamps.”

DoE began quarterly testing in 2006. As of Round 6, the most recent round at the time of writing, CALiPER tested 10 LED omnidirectional A-lamp replacement lamps and found a wide range of performance. Most significantly, the CALiPER results suggest that many omnidirectional LED replacement lamps are not yet ready for prime time based on a variety of standard lighting metrics including efficacy, color quality, ability to fit the same light fixtures, and power factor.

In terms of efficacy, the best-performing tested product produced 62 lumens of light output per watt of electrical input, about 4–4.5 times more efficient than today’s incandescent A-lamps and on par with the efficacy of compact fluorescent lamps. That’s good. But the lamp produced less than 300 lumens, about one-third of the light output of a 60W incandescent.

This level of light output puts the lamp somewhere between 25W and 40W incandescent A-lamps. So it is not suitable to replace a 60W bulb in fixtures requiring omnidirectional light distribution. What about 25–40W bulbs in the same types of fixtures?

Again, CALiPER results suggest the answer is more hopeful, but still negative.

“As replacements for lower-wattage incandescent replacement lamps from 4–40W, some LED replacement lamps appear to perform well and could provide energy savings,” says Paget. “However, even targeting these lower wattage levels, some LED products that have been tested clearly do not provide the light output levels or the omnidirectional light distribution that would traditionally be expected in these replacement lamps, and a number of products sold as ‘white’ do not actually meet ANSI chromaticity standards for white light.”

For example, the above lamp producing nearly 300 lumens exhibited two problems making this lamp unacceptable for most applications. First, the color temperature was measured at 7272K, which is a very cold, bluish light, and the power factor was a low 0.48.

Other lamps exhibited additional problems, such as a distorted light distribution pattern, color distortion, low color rendering, incompatibility with dimmers, and forms or dimensions that make them unable to fit light fixtures designed for incandescent A-lamps.

“With each round of testing, CALiPER is seeing improvement in product performance for the best-performing products,” notes Paget. “Unfortunately, we are also seeing products that push the lower range of performance even lower.”

From a big-picture perspective, this is not so bad; after all, the technology has come a long way in a short amount of time and is still developing rapidly and making improvements at least on a quarterly basis. CFLs, after all, also suffered a rocky introduction. For example, form and size were problems for many CFL products through the middle of the 1990s, and dimmable screwbase products were not available until the late 1990s.

Here’s what is bad: DoE’s testing data often contradicted manufacturers’ sales claims about their products, suggesting manufacturers are overstating product performance—a situation likely to go on until the industry produces a standardized means to compare products, such as ENERGY STAR criteria for this type of LED product.

“The testing of omnidirectional LED lamps, like all SSL products, reveals huge ranges of performance in products available today,” Paget says.

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“Manufacturer claims regarding performance of LED replacement lamps are usually inaccurate or misleading.”

For example, the highest-output LED lamp in Round 6 testing produces the same light output as a 40W incandescent, but is claimed to produce the same light output as a 100W incandescent. In other cases, products claiming to be replacements for 40W or 60W incandescents produce light output more in line with 15W or 25W lamps.

Often, the manufacturer may not be trying to be intentionally misleading, but may simply believe (wrongly) that the light output of their products is the output of the LEDs themselves and not the integrated unit including the LEDs, optics, thermal management and so on. Just as the performance of an LED light fixture is not the

Continued on page 12

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performance of the LEDs it houses, similarly, the performance of an LED replacement lamp is not the performance of the LEDs it houses. In every case, the performance of the light fixture or replacement lamp will be lower.

While DoE is concerned that underperforming products could disappoint early adopters and threaten the technology's future market potential, Paget remains optimistic. “LED replacement lamps are likely to be competitive within the next couple of years, but they are likely to be expensive in the near term, and will be most effectively used where users are seeking energy savings, but for some reason have rejected much lower-cost CFLs.”

These applications might include cold temperature applications, use with occupancy sensors, applications prone to vibration or breakage, hard to reach or maintain fixtures, and other spaces where LED technology can deliver a unique benefit that is needed.

Until then, what should lighting management companies do when considering an LED replacement lamp?

“Consider a CFL first; it's an energy-efficient alternative to incandescent lamps, and offers a much lower cost than LED lamps today, even when slightly higher-priced CFLs are specified to meet application needs such as for particular color temperature, controllability or operating conditions,” Paget advises. “Prior to the availability of ENERGY STAR replacement LED lamps, there is no standardized means to compare products, so they must be evaluated on a case-by-case basis. Ask the manufacturer for test reports from an independent testing laboratory; search the CALiPER website [[www.netl.doe.gov/ssl/comm\\_testing.htm](http://www.netl.doe.gov/ssl/comm_testing.htm)] for any available test reports; compare the results of the tests to the manufacturer's claims and to your application needs; evaluate the lamp's light output and color quality in person; check carefully or

personally test for compatibility of lamps with installed dimming controls; and try out a smaller sample of lamps installed in your intended application for some time before committing to larger volumes.”

She adds: “Overall, buyer beware. Seek independent information to verify manufacturer claims, and select products carefully.”

There are three developments, meanwhile, that we can watch for:

First, ENERGY STAR criteria for integrated LED replacement lamps are under development and may be published in final format as early as this summer. Once they are in effect, choose products that receive ENERGY STAR labeling, which ensures the product not only achieves a certain level of efficiency but also general performance.

Second, a joint committee of DoE and the Next Generation Lighting Industry Alliance (NGLIA) is building a community of “SSL Quality Advocates” who agree to test their products according to industry standards and report the results in a standardized format (called Lighting Facts™) on their product labeling for easy reference and comparison. Currently targeted only toward LED fixtures, this new program may become available for LED replacement lamps in the future.

Third, watch for winners of DoE's L Prize initiative. These lamps are likely to be game-changing alternatives to incandescent lamps. The products that win the L Prize competition will have light output, light distribution and color quality to make them true replacements for incandescent lamps. They will also have luminous efficacy that will make them much more efficient than any LED omnidirectional lamp currently available.

The bottom line is that LED replacement lamps may not be ready yet to take on the 60W incandescent lamp, but they are coming right along and may be competitive within a few years. ■

## GE Suspends Work On The HEI Lamp To Focus On LEDs

EISA 2007 regulates the efficiency of general-service 40-100W incandescent and halogen screw-in lamps starting in 2012. With only a few exceptions among energy-saving screw-in halogen lamps, today's incandescents do not comply and will be eliminated.

The Act does not outright ban incandescent lamps but instead requires incandescent efficacy to approximately double. Since the passage of the Act, GE stated that it intended to launch a compliant high-efficiency incandescent (HEI) lamp by 2010.

In late 2008, however, GE announced that it had stopped work on the lamp. The company explained: “GE Consumer & Industrial and GE Global Research have suspended the development of the [HEI lamp] to place a greater focus and investment on what we believe will be the ultimate in energy-efficient lighting—light-emitting diodes (LEDs) and organic light-emitting diodes (OLEDs). Research and development of these technologies is moving at an impressive pace and will be ready for general lighting in the near future.”



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