SSL Postings
U.S. DEPARTMENT OF ENERGY

August 11, 2015

Strong Evidence of SSL's Potential

After energy efficiency, solid-state lighting's best-known potential advantage is long lifetime. It's not unusual these days to see LED lighting products on the market that carry lifetime claims of 50,000 hours, or even longer. Although some of those claims are exaggerated, and product quality still varies widely, SSL definitely has the potential for much longer lifetimes than we're used to with conventional lighting technologies.

Evidence of this potential can be seen in the results from the continuous testing of the L Prize® winner. When the L Prize in the 60W replacement lamp category was awarded to Philips Lighting North America in August 2011, samples of the winning product had already survived more than 8,000 hours of accelerated long-term testing in a specially constructed apparatus at Pacific Northwest National Laboratory under elevated ambient temperatures (45°C). A selection of 31 of those lamps — which when new emitted at least 900 lumens while consuming less than 10W — recently passed the 40,000-hour point of continuous operation, and measurements that were taken at that time (40,890 hours) are as instructive as they are impressive.

The average lumen maintenance for the 31 lamps after 40,890 hours was 95.6% — and not a single lamp among them had failed. At that rate it would take an average of 194,765 hours of operation for the lamps to reach 70% lumen maintenance (L_{70}), a commonly used industry benchmark. Of course, other failure modes will likely come into play before L_{70} is reached, but this high lumen maintenance after 40,000 hours is notable. And don't think that the average lumen maintenance of those 31 samples was skewed by a few high-performing outliers, because the best-performing lamp among those tested had 97.5% lumen maintenance, while the worst had 93.7%. What's more, the average chromaticity change ($\Delta u'v'$) of the 31 lamps after 40,890 hours of operation was 0.00093 — a minuscule difference indicating that there was no detectable color shift, and that the light emitted today is indistinguishable from the light emitted four years ago.

Granted, Philips Lighting North America pulled out all the stops to win the L Prize, making large investments to meet the competition requirements, which were very challenging in 2009. Some of the L Prize-winning technology and design approaches have found their way into millions of subsequent Philips LED lighting products (justifying the company's efforts many times over, and racking up significant energy savings), while others have been modified to suit the highly competitive lightbulb replacement market.

SSL manufacturers often find themselves facing tough choices. Value engineering in highly competitive markets to achieve reasonable price points has to be weighed against achieving reliability and performance levels that are important to end users. To help, DOE has been providing assistance to industry, all across the board, to improve product performance and reliability right along with cost, in order to maximize both adoption and energy savings. The good news is that SSL technology, materials, optics, product design, and manufacturing all continue to improve, and prices continue to decrease. The fact that the L Prize-winning bulbs are still going strong after more than 40,000 hours serves as a powerful reminder of the exceptional performance possible with well-designed LED products.

For more details on the latest long-term testing results of the L Prize-winning samples, visit the L Prize website.

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