Critical Differentiating Considerations ... *Why DEG?*

For some months I have been contemplating what the criteria should be to define "differentiating" factors to elevate one product's benefits and features over another. To avoid opinionated descriptors, exaggerated but unsubstantiated claims or overreaching anecdotes, I felt strongly to stick to facts that can be proven, researched and can stand up even under the most scrutinized and thorough examination.

In today's fast-paced LED global market, sellers are literally tripping over each other to make that sale—in some cases going to great lengths to peddle their goods at any cost. Yes, even exaggerating almost every specification, claim, performance criteria and then trying to convince the buyer that every other competing product is junk in comparison to the product(s) the seller is offering. The uninformed are susceptible to just about any sales yarn because who knows—just maybe the salesperson is not selling crap and really does have a superior product.

So how do we know? Where do we look for solid facts? How do we differentiate quality from crap? Why should the buyer believe anything the seller claims about the superiority of their product(s) versus a competing or similar product? Why are some products serialized, carry the NRTL regulatory agency Mark and on others there isn't a legible mark to be found? Should buyers rely solely on the various qualified products lists (QPL) of approved products from Design Lights Consortium (DLC), Lighting Design Lab (LDL) or the federal non-profit agency that is part of the Department of Energy and based in the Pacific Northwest, the Bonneville Power Administration (BPA)?

Honesty and Integrity in dealing with product failure – they will happen

One of the most difficult issues to deal with from the customer's perspective (end-user) is all the hype about the long life of LED lights. No one talks about LED failures, the typical 1-3% general failure rate of electronic components (the LED chip itself has a very low failure rate of typically less than 1%) and the potential much greater failure rate of the components that drive LED lamps—LED Drivers and AC/DC power supplies (3-5%)—and fully integrated LED fixture or LED lamp products, which can see early failure rates as high as 20%.

If *failure is not an option*…then my advice is simply avoid energy-saving LED devices as a whole and stick with energy-wasting old and disappearing technologies: fluorescent, incandescent, halogen and HID bulbs (oh, btw, these fail as often or more often and will cost you 50-75% more to operate than that new technology—LED).

Quit listening to the media hype of "LEDs last 25 years *or forever*" … fact, they don't. For every 100 LED lamps installed we will see failures ranging from 1-3 units; and then again, if the exact same lamp has a production run of say 10,000 in a batch, look for 100-300 possible failure (1-3% as noted earlier). Initially though—in the first year of "roll-out" or commercialization—the failure rate can be in the high teens—just Google Apple iPhone where the overall failure rate of the first 2 years is a whopping 25.6% with 7.5% from hardware malfunction (http://www.squaretrade.com/htm/pdf/iPhone_failure_rates_6_22_2010.pdf). The average new electronics item has a 15% failure rate in its first 3 to 4 years with Laptops hitting 22%. Consumers Report published a study on consumer electronics failure rates and found that all items had a greater than 10% repair rate in their 4th year (with laptops up to 43%). (http://www.squaretrade.com/htm/pop/lm_failureRates.html). Here are a few more very compelling URL's to view regarding product failures: http://newproductsuccess.org/white-papers/new-product-failure-rates-2013-jpim-30-pp-976-979/

Let's view this from a much more realistic and pragmatic perspective: what if out of the batch of 10,000 units you happened to purchase 100 lamps for a project—all happen to be from this particular production run. Would

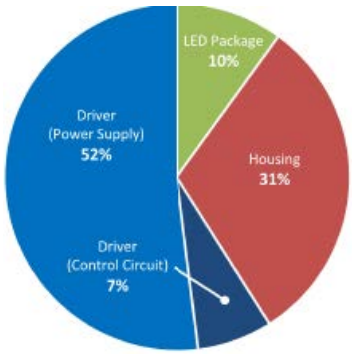
it be possible that you could have just the standard 1-3% failure—essentially 1-3 lamps? Or is it possible you could have all 100 fail?

Far-fetched you say. Not so fast. Recently, Cree, Inc. had 700,000 T-LEDs (LED Tube replacement for standard 4' fluorescent tubes) recalled as a result of a potential fire hazard, Osram Sylvania had a similar recall of approximately 46,300 T8 LED replacement tubes. Lighting Sciences Group had a recall issued in cooperation with the US Consumer Product Safety Commission (CPSC) that included about 554,000 units ("the bulbs can overheat during use, posing a fire hazard and the bulb can separate, posing a possible fire risk to persons and property." The bulbs were made in China, with a small number of them undergoing final assembly in Florida or Mexico.") Large UK home enhancer and garden retailer Homebase issued a notice recently recalling "Baby start LED night lights" that under certain circumstances could trigger a small explosion. Technical Consumer Products (TCP) has had two different recalls: Connected Brand Downlights due to electrical shock hazard and a second recall involves 14 watt LED wet location PAR38 lamps sold under the TCP and Great Value Brand name. Other lesser known failed LED products on the market globally—mostly from China—that have been pulled from the market or the result of a regulatory recall include the following brand names: Iled, Winled, Eneltec, Ledtek, Limic, Omnilux, Sunseon, Eco Light Nordic, Oversol and Ledicor, just to name a few.

In summary, *Caveat emptor* or "buyer beware". Do your homework as there is much more to purchasing quality LED products than just price. As the technology matures—which it is quickly doing—there will be more and more quality offerings as the early 'less-than-sterling quality' *LED lights* are completely sidelined and buyers become much more knowledgeable about LED technology; this will lead to discerning between junk and quality.

Lifetime and Reliability

The rated lifetime assigned by a manufacturer is a statistical estimate of how long a product is expected to perform its intended functions under a specific set of environmental, electrical, and mechanical conditions. It is specifically related to normal wear out and end of life behavior. Typically, a single number is given as an estimate of a more complex distribution of failures; some products will fail before the rated lifetime, and some will fail afterwards. The rated lifetime of a product may be affected by its design, materials, component selection, manufacturing process, and use environment, among other factors. Importantly, the rated lifetime for a complete system cannot be longer than the in-situ lifetime (the in-place measured life—LED chip thermal load or measured life of a capacitor, for instance) for any of its components. The useful life of a product corresponds to the middle portion of the bathtub curve, where failures result from unexpected random events, and the failure rate is ideally constant.



Reliability is a different statistical measure of performance that, in principal, describes the ability of a product to perform its intended functions under a specific set of conditions and for a specific period of time. Reliability estimates are typically made for some portion of a product's useful life phase, prior to the point at which normal wear out starts to generate mass failures in a population of products. No matter how well engineered a product is, some products will inevitably fail early; reliability is essentially a measure of the probability of these unanticipated failures, which are typically random. In relation to the bathtub curve, reliability estimates are made for the useful life (i.e., middle) portion of the curve, and are often reported as the mean time between failures (MTBF). Note that while both lifetime and MTBF are typically reported in hours or years, the latter is actually an average failure rate metric, rendering direct comparison between the two ratings meaningless and cause for misguided conclusions. For example, while a lifetime of 100,000 hours might be considered excellent, a ballast or driver MTBF of 100,000 hours means that over a 10-year (continuous) useful life period, 87.6% of the units will likely fail and need to be

replaced. Reliability metrics are useful for approximating the average maintenance interval of service-able systems, but since MTBF only describes an average failure rate, the accuracy of such estimates is reduced for systems that do not have a constant failure rate during their useful life.

From the Department of Energy: Building Technologies Program SSL Technology Fact Sheet

Critical [differentiating] Considerations

So how do we measure differences? How do we verify quality differences? How do we gather facts and information that discern differences? How do we assure ourselves that we have selected the right product for the lighting need? What are the critical considerations that we need to know? Where do we find these facts and how do we know we can depend on the information to be reliable in making our purchasing decision?

Start with known LED trade journals such as IES's publication LD&A, Lighting News, LED……etc. There are several organizations that post QPL's (qualified product lists) that require products to meet certain pre-established criteria, testing and regulatory requirements and set benchmarks that elevate and often 'differentiate' lesser quality products from overstated and underwhelming product offerings. As noted above organizations such as BPA (Bonneville Power Administration) LDL (Lighting Design Lab), DLC (Design Lights Consortium) and many organizations established by utility companies that post their own criteria as well as an internal QPL for allowing product rebates, should be one of many measures.

All manufacturers are required to test and publish critical criteria about their products, diode manufacturers publish LM80 chip benchmarks for the manufacturer, LM79 and TM21 testing provide critical information about product reliability, heat and chip junction temperature measurements (in-situ) and product diode lifetimes as well as power supply/driver heat tests. Insuring that this information is obtained and published from reliable test facilities is critical. Be wary of the one-page test documents from foreign test facilities—many test documents are at least 5-6 pages and the standard LM79, for instance, is generally 6-10 pages. LM80's from the chip manufacturers can be a dozen pages and TM21 data encompasses In-situ and other measures that can take 4-6 pages of data to present proper results.

Require this documentation, ask the manufacturer for their CDR (Construction Data Report and ATM (Authority to Mark) from the NRTL (Nationally Recognized Testing Laboratory). These document the manufacturers UL, CSA, TUV or other NRTL test results. Mandate all regulatory and testing data specification sheets that the manufacturer should openly publish; this information and the critical criteria allows the buyer to insure the seller has a solid, quality and sustainable product.

Tracking and Serialization of Products is Key

One of the most widely used manners any manufacturer of electronics tracks and monitors its products is to serialize and list the date of manufacture. How else can a manufacturer determine the critical data necessary to correct deficiencies, component failures and dates of placement? While *batch* and *lots* can be traced for recall purposes, can the manufacturer truly identify when, where, to whom the product was sold and trace within a very limited timeframe when a certain component, CM placement error, assembly mistake or any number of other product potential failure points began?

Traceability is critical in manufacturing electronics—particularly complicated electronic components and products where there can often be dozens to hundreds of integrated components. With LED, where a product is expected to perform its intended functions under a specific set of environmental, electrical, and mechanical conditions, there are so many variables that failures are almost certain to occur. The key is determining why

and insuring the manufacturer is attentive, performs proper FA (failure analysis) and as quickly as possible corrects any deficiency—whether a design flaw, in-product component or third-party purchased product component (such as the power supply or LED driver).

While the electrical codes require certain data be placed on every product, you would be surprised—maybe even shocked—to know that very few manufacturers actually post the required *Markings* that UL, CSA, TUV and other Nationally Recognized Testing Laboratories (NRTL) require. Look at almost any current technology light bulb or tube…see the markings, wattage, name of the company

So, *why DEG?*

- We serialize every single product we make with a Date of Mfg. and individual product Serial No.
- We follow and perform every required regulatory test by recognized testing agencies in the U.S. (NRTL)
- We submit every product for the full testing and reporting requirements for LM79, TM21, In-situ LED junction temperature testing and power supply testing
- We perform additional tests required by qualified product listing (QPL) agencies for listing approval
- We track and follow-up with our customers to insure we have continuous improvement, immediately assess and correct product malfunctions or failures—we want to know why, how and when
- We have a commitment to our customers to stay ahead of the technology in one of the most rapidly changing and disruptive innovation markets since the computer chip and personal computer
- We are completely transparent with regard to product failures and have completed a 3-year analysis of DEG's product failures from inception, and will update this analysis each and every year going forward
- We are committed to serving our customers with 'best-in-class' LED products in those niche markets where we offer DEG's products
- With some companies they will simply tell you to "throw away the product" if it fails, or "don't worry, we'll just send you a new one" (that is if the company is still in business or the seller can be found). DEG wants the product returned so that we can perform a full and transparent Failure Analysis (F/A) to determine why the product may have failed, resolve any component issues, and insure that we have not encountered a safety issue. In other words, we don't turn our back on the customer; we address the core issue and resolve any and all problems to continuously make our products the best they can be.

Finally, we care about the environment we live in, the legacy we leave to our children and their children—leaving behind a better planet than when we arrived and having had the ability to change the energy dependence landscape. In the scheme of things this alone may not inspire the reader to purchase DEG's products. However, what we have outlined herein should provide a glimpse into what makes DEG *a differentiating consideration* and why you should choose DEG for those opportunities that require and meet the needs for a product or products DEG offers.

Thank you for your interest, reading these Knowledge Segments and I trust we were able to lend some level of understanding and basis of knowledge for choosing a quality LED lighting product from any manufacturer.

Richard A. Flaherty
President & CEO
Differential Energy Global Ltd.
Leader International Corporation