

A LED Lighting System Doesn't Always Mean Efficiency

A look at how lighting technology helps commercial and industrial project owners make a smart investment



Quality lighting generates revenue and supports the bottom line for organizational success for building owners. Lighting creates intensity and uniformity, which helps in guest satisfaction and workforce engagement. Technology that's geared toward enhancing lamp life makes your lighting system an investment by decreasing maintenance, labor and HVAC costs. However, not all LED lighting systems are the same. Therefore, it's important to make sure you're installing quality LED lamps to get the maximum return on your lighting investment.

In order to have superb LED performance, you need quality chips, drivers, optics and thermals in your lighting system. This white paper will look at the anatomy of a LED lamp to determine what components have the biggest impact on quality. After all, lamp quality is the sum of the LED components and the way the manufacturer brings them together to form the finished product.

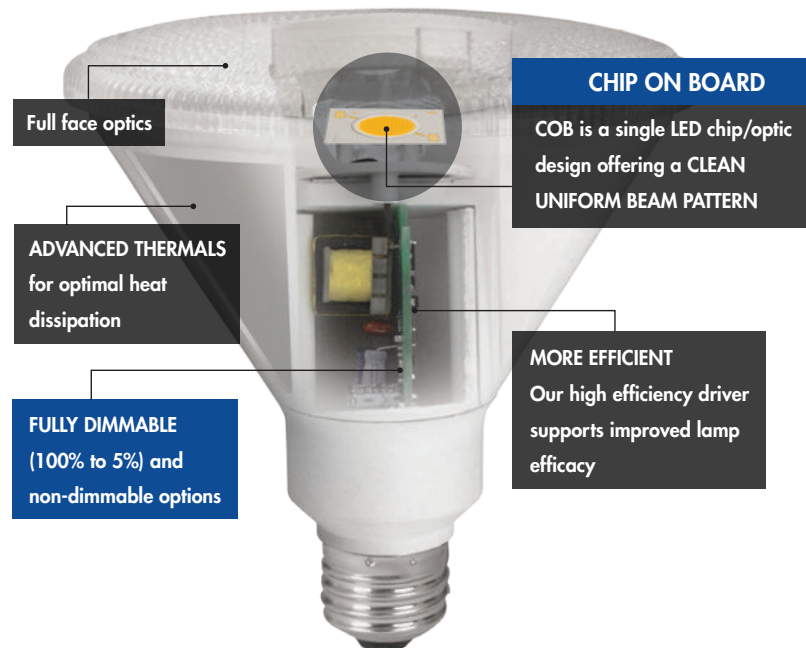
Everyday, it seems new LED lamps are appearing in the marketplace. How can you tell the difference between high quality lamps and those lamps meeting lesser specifications? The inability to distinguish could cause potential problems, including unacceptable light levels, beam spread and shortened lamp life. Finding this out after purchase is not only a headache, but having to make additional changes negates any potential savings.

A manufacturer of high quality LED lamps will have collaborative partnerships in place with vendors. The manufacturer creates a design specification for the lamp and then works with their partners to develop components that can deliver those specs. Lighting technology is quickly evolving, and it can be a very technical production process to provide quality lighting. Strategic partnerships are a must if you're going to get quality components within the lamp. A lighting manufacturer will know the specifications and guide the type of LED lamp to produce for that particular application. Lamp manufacturers must work to ensure the ideal combination of chips, optics, driver and thermals are combined to maximize lamp life and customer experience.

A LOOK at the LAMP PRODUCTION PROCESS

A knowledgeable lighting manufacturer will choose the most appropriate materials to work together in the lamp, so the product meets the needs of that particular application. A good LED lamp engineer will ask these questions:

- What is the application for this lamp?
- How much light should this lamp produce?
- What is the delivered lumen expectation for the application?
- How will effective air flow be produced to keep the LED chips and circuit boards cool?
- Should sacrifices be made to achieve American National Standards Institute (ANSI) size for retrofit?
- Are there other performance characteristics that are a must? (dimming, color rendering, etc.)



Think of a LED lamp as an electronic device instead of just a light source. For the LED to function properly,
all the components in the lamp must work well together
 and be built to last in order for the user to reap the benefits of the system.

HOW TO GET CONSISTENT BEAM SPREAD AND LIGHT INTENSITY

The LED optic is more than a plastic lens covering the LED. The most efficient light sources would be useless without quality optics. Optical efficiency is typically defined by measuring how much of the total lumens sent into that component come out of it. The efficiency lets you know how the optical is handling the light coming into it.

A LED has a protective casing called the primary optic, which protects and shapes the light output. Lighting manufacturers often use the shape of the light when describing the type of LED; so, it's important to note that when you buy a LED rated at 120 degrees, it

doesn't mean you're going to get 100 percent of that light across the spectrum. The light source is stronger as you travel to the center. The secondary optic will increase the relative luminous intensity of that beam angle.

Manufacturers must be careful with the placement of the primary and secondary optics as this affects the beam pattern. While the secondary optic may seem necessary because of the intensity, it can also get expensive and makes up most of the cost of the LED lamp. If not done carefully, it can create harsh transitions in brightness.

Some manufacturers have general optics for various LED types. They are only adjusted in height to get the correct focal plane. Using

the same optic for a light source that is different from what that optic was originally designed for, leads to decreased performance.¹

Just like the chip, a larger optic means better performance and higher pricing. The price of your project can be controlled by looking at the application and the amount of light needed for that space.

THE LED CHIP—the Key to Quality Light Output and Color Consistency

The LED chip is the heart of an LED lamp. A quality lamp has good chip integration. It's about how the chip is driven and the management of the whole LED lamp's system. For instance, two manufacturers can have different types of LED chips. Because there are variations in LED chips, the chip supplier bins for brightness and color parameters. The supplier is looking for warmer and cooler color temperatures and groups those chips by their similar characteristics.

A quality lighting manufacturer pays more for tighter binning. Since the chip supplier does the binning, the lighting manufacturer needs to specify what they want. If they don't, the lighting manufacturer could end up with a completely different lamp. That's why it's good to work with a lighting manufacturer who has complete control of the production process.

Working with a top tier LED chip manufacturer ensures the LED footprint maximizes light output, managing current variation and extending the life of your lamp source.

Also, how the chip is driven will affect the life of the chip. For example, if a lamp design overdrives the chip, it will have a shorter life. If a lamp design underdrives the chip, the result is lower lumen output. Working with a top tier LED chip manufacturer ensures the LED footprint maximizes

light output, managing current variation and extending the life of your lamp source. When manufacturers do not narrowly define the design requirements of the chip, they are taking a gamble on the overall success of their lighting product.

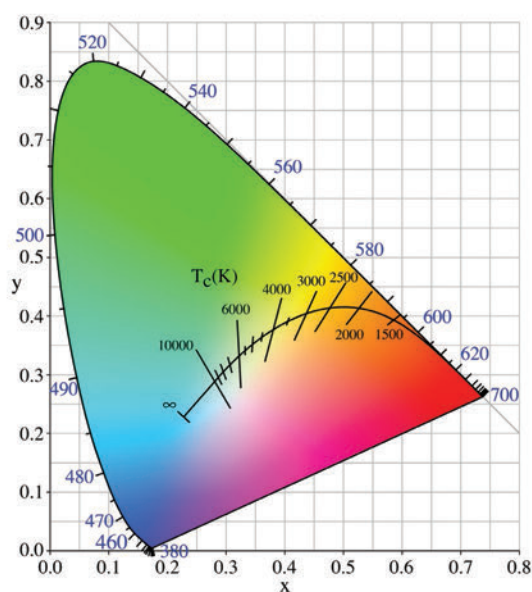
To help determine if you have a quality LED lamp, look at the lumen output from the chip. Ask yourself, "How much light am I delivering?" Illumination intensity is typically measured in lux or footcandles, which measures the luminous flux per unit area. One

lux is equal to one lumen per square meter. While high illumination levels may increase efficiency, it can also cause discomfort. It just depends on the desired light output for that particular application.

Look at the LM79 measurement. It takes the total luminous flux, luminous intensity distribution, electrical power, efficacy (lumens per watt delivered) and color characteristics (chromaticity, CCT and CRI). It will help you know what you are buying. The LM80 measurement is there to help ensure that you are getting the most out of your LED lamp. It helps validate the usable amount of light for as long as the lamp says it will perform.

Another factor in determining quality is to examine the phosphor, which is usually placed on the LED chip. Look at the Color Rendering Index (CRI). It's a system derived from visual experiments. To achieve a good CRI, you must use a high quality phosphor. LED lamps offering CRI greater than 80 will provide excellent color rendering.

The two most important measurements are CRI and Correlated Color Temperature (CCT). To understand Correlated Color Temperature (CCT) for a lighting lamp, you need to understand that there can be a number of color combinations used to create white light. Color is defined by degrees Kelvin (K) in the image. A knowledgeable LED lighting manufacturer uses various LED chip selection schemes to ensure color consistency.



Lines of constant correlated color temperature (CCT)

¹ Retrieved November 2015 ledil.fi/sites/default/files/Documents/Technical/Articles/Article_1.pdf

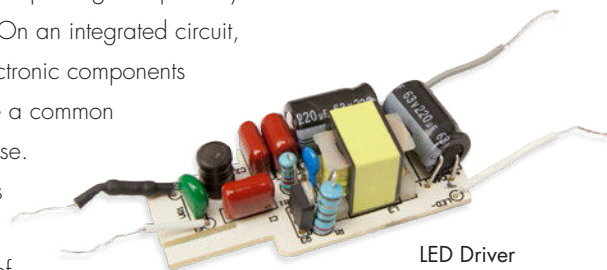
To achieve a quality environment of color rendition and quality light, the R9 value (or saturated red) is an important value to look at because it's where LEDs are the weakest. For instance, a negative R9 value is seen in cheaper manufactured LED lamps.

ACHIEVING A DEPENDABLE POWER SUPPLY

The LED driver regulates the power to a LED, and it responds to the changing needs of the LED. It's basically the power supply. Drivers are important, because they control the power being supplied to the chip and regulate the overall lamp operation.

LED drivers may offer dimming with pulse width modulation circuits, and they may have more than one channel for separate control of different LEDs or LED arrays. The power level is maintained by the driver. Therefore, without a high quality driver, the LED lamp may become unstable, which causes poor performance.

There are many kinds of drivers. Traditional circuit boards have components packaged separately and then wired together. On an integrated circuit, many electronic components can share a common silicon base. This saves enormous amounts of space and can be a fraction of the size of traditional equivalent circuits. It's good if a manufacturer achieves a lightweight, size compactness LED lamp, because that's needed for some applications.



MANAGING HEAT AND IMPROVING EFFICIENCY

Most LED lighting systems require the use of heat sinks to reduce thermal stress. A LED that has improper heat management will typically lose its efficiency and have an impact on the overall performance of the lamp. If the heat is not dissipated away from the LED chip and driver properly, the LED could become unstable and will not last as long. That's why quality thermal management is needed in the LED lamp so that performance is not compromised.

There are different ways to achieve efficient thermal management. Utilizing passive technology to manage the heat generated from the LED chip is an effective and efficient way to properly manage heat. Utilizing an additional fan is also an option in managing a lamp's excess heat; however, this is an additional component that will utilize power and has the potential to fail.

All of a lamp's components need to work together to achieve the ultimate efficiency. Every component has a role. If one isn't up to par, the lamp will lack performance. A knowledgeable lighting manufacturer will know what components work together to achieve quality light for that particular application. Therefore, just because you're buying LEDs, that doesn't mean you got a quality LED lighting system. You need to take it one step further and look at the production of the lamp and the kind of components the manufacture is using to create "quality."

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