The Use of LED Lamps in Critical Color Viewing

GTI Graphic Technology, Inc.

In certain applications LEDs offer benefits including reduced maintenance, longer life, and lower energy use. But, they also have a higher acquisition cost, are not fully regulated by standards, and light quality is inconsistent from lamp-to-lamp, batch-to-batch, and manufacturer-to-manufacturer.

There is a big difference between general or commercial lighting applications and highly demanding applications that need to conform to international industry standards, such as lighting systems for critical color viewing, matching, and assessment. LEDs cannot be considered as the optimum solution for every application.

What is GTI's Position on the use of LED lamps in standard color viewing?

GTI is excited about the potential of LED lighting technology. We are working with a number of manufacturers and are testing the latest LED technology in search of a solution that will meet our goal, which is to deliver an LED solution that conforms to industry standards, is adaptable to existing GTI booths, and is at a price point that the market will accept.

As LED technology matures and stabilizes GTI will further implement it into our product portfolio. Until that time we recommend that critical color judgements be made under ISO 3664:2009 and ASTM D1729 viewing conditions with fluorescent lamps. LED light can be used as a secondary source to further test for metamerism and to check how an item will appear in its end use environment such as retail.

The facts about the use of LED light in critical color matching as it stands today.

Standardization

When current industry specifications were written, they were based on existing lighting technologies ability to accurately simulate daylight. All GTI lamps conform to ISO 3664:2009, ASTM D1729, SAE J361, BS-950, AS 1580, ISO 3668, AATCC Procedure #9, TAPPI T-515, and TAPPI T-1212 standards. GTI lamps are supplied with a certificate of product conformance (NIST traceable). This ensures that all participants in a supply chain are viewing color in the same industry compliant light when using a properly maintained light booth.

The lack of standardization around LED technology is an issue and can result in inconsistencies between manufacturers and a variance in lamp quality.

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LEDS are pieces of electronic equipment that have four main components.

LED Chip
A light source that becomes illuminated by the movement of an electrical current passing through a semiconductor material.

Driver
Regulates input current similar to a ballast in a fluorescent light. LED light output is proportional to its current; a variation in current can result in unacceptable changes in light output.

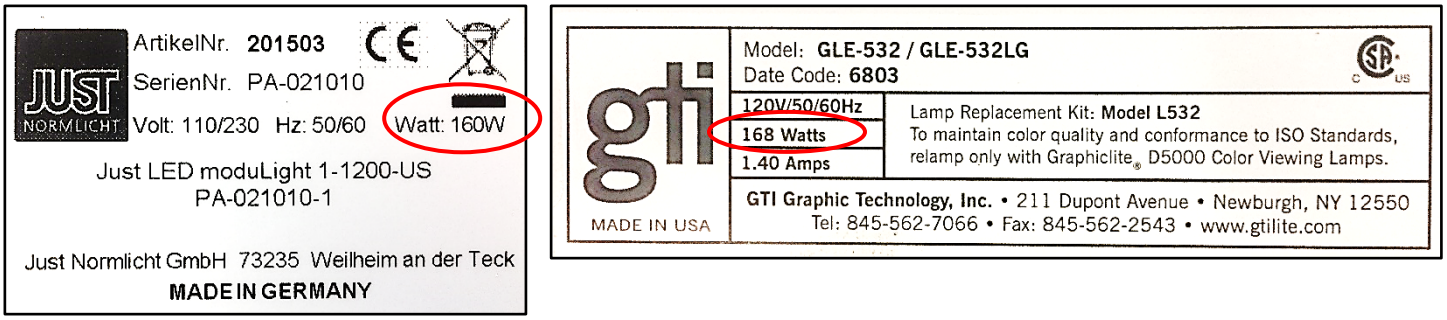
Heat Sink
Draws heat away from the LED chip. LEDs do not generate much external ambient heat, but they do generate internal heat within the junction. High temperatures near the LED junction affect the life expectancy and performance of the LED. Heat must be removed from the LED chip to maintain expected light output, life, and color.

Optic Lens and Phosphors
Controls the characteristic of the light output.

Energy

The majority of energy comparisons published are comparing general purpose white LED lamps to incandescent lamps. LEDs are more energy efficient than incandescent bulbs because they use less electricity and do not generate heat from infrared radiation, which makes incandescent bulbs hot to touch. However, LEDs do produce heat at the semiconductor junction within the device. Without proper heat management an LED may experience lower light output, a wave length color shift, and shorter lamp life.

In a critical color viewing application an LED fixture and fluorescent fixture will require about the same amount of energy. This is due to the fact that the LED source produces heat which require heat sinks to control it. The LED also uses numerous diodes to create a full daylight spectrum that need to be monitored and controlled to maintain light quality. GTI fluorescent lamps, in combination with modern electronic ballasts produce very little heat and what little there is can be managed with simple ventilation.

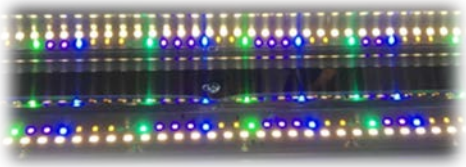


Left: The product tag from a viewing station that uses LED technology, it requires 160 watts of electricity. Right: The product tag from a comparable size viewing station that uses fluorescent lamps, it requires 168 watts of electricity. Using the national average of 12 cents per kWh, a user could expect around $5.64 of annual energy cost savings with LED.

Life

LEDs have a long burn time and are often quoted of having a lifespan of 50,000 hours. These figures are based on mathematical calculations (to operate a lamp for 50,000 hours it would take 5.7 years running 24/7 – the LED would be obsolete before the test was finished) and may be misleading. LED's degrade over time, so, their ability to produce the necessary quality of light for critical color viewing applications may fall to an unacceptable level long before total lamp failure occurs.

When an LED array mixes colors to replicate different daylight or light sources it is highly unlikely that individual diodes will have equal usage. As a result a color mixing array may require more frequent calibration and be less able to deliver accurate colors after significant usage.



A color mixing LED array.

Like LEDs, fluorescent lamps degrade over time and their use in color matching applications will be less than their actual burn time. GTI fluorescent lamps are guaranteed to comply with the rigid specifications of ISO 3664:2009, ISO 3668, ASTM D1729, and other specifications for at least 2,500 operating hours.

Maintenance

To maintain consistency and color quality in critical color applications LED lamps require consistent monitoring and adjustment. This is a time consuming and costly process that requires a sophisticated measuring instrument. It is recommended that the fluorescent based viewers be relamped after every 2,500 hours of use. This process is as simple as changing a light bulb at home and is completed by the end user. Intermittent monitoring is not required.

Consistency

LED characteristics change with time, temperature, current, and from batch-to-batch and manufacturer-to-manufacturer. For this reason, manufacturers bin LED components by variations in luminous and color frequency. Combined with the lack of standardization and rapid advancement of LED technology, this makes it difficult to ensure that there will be consistency from viewing booth to viewing booth.

GTI manufactures light booths that conform to industry standards. Our 100% measurement and verification production process and in-house spectroradiometric laboratory guarantees that precision and accuracy is built into all products.

Consistency and controlling the variables are two important aspects of color management. The design team and production teams must see the same color. The best way to ensure this is to have all parties in the supply chain view color in compliant light booths and to have all booths use the same viewing technology.

Light Quality

The spectral match to CIE D50 of any D50 LED source currently on the market is not as good as GTI's proprietary fluorescent lamps (based on what we have seen and measured to date), with the exception of extremely expensive LED systems that would not be viable in any commercial application. LED lights cannot emulate fluorescents (CWF, TL84, TL83) so if you need to color match or test for metamerism under fluorescent conditions you'll need to add an extra lamp to the booth.

GTI's fluorescent lamps are custom built with a blend of proprietary fluorescent phosphors that is unequaled by any other 5000K or 6500K lamp in the industry. They provide a true full spectrum white light which renders colors with the highest degree of accuracy and efficiency. When used in GTI viewing systems, the 5000K Graphiclite 100 and 6500K Color Matching lamps produce an actual system CRI approaching 95 and 98 respectively.

Cost

LED based viewing is expensive. A 30" x 52" LED based luminaire would cost twice as much as a GTI based fluorescent luminaire of the same size. With the LED solution you would also need access to an expensive measuring device to perform routine calibrations.

Fluorescent based light booths do require relamping every 2,500 hours. No special instruments are needed and relamping is completed by the user. The cost to relamp a 29" x 52" booth is $165.00. You can relamp this booth once a year for nine years before you recover the cost of a higher priced LED booth.

Environment

LED arrays contain small amounts of heavy metal and need to be recycled in the same fashion as an LED TV or computer monitor. GTI fluorescent lamps do have a minimum amount of mercury, however, the lamps can be recycled through established recycling channels.

Dimming

The dimming capability of LED technology has improved but there are still issues. These include sudden turn on or off when you try to adjust levels, dead travel (moving the dimming switch but light levels are not changing), and flickering. GTIs fluorescent lamps can be used in dimming applications without issue. We have successfully been supplying light booths with dimming capability for over 30 years.

Key Take Aways

1. There is a big difference between general lighting applications and highly demanding applications that need to conform to industry standards, such as critical color matching and visual color assessment lighting.
2. LEDs cannot be viewed as the optimum solution for every use.
3. LEDs are electronic equipment with chips and drivers that require heat management.
4. GTI is excited about the potential of LED lighting technology. But, until it further stabilizes and matures we recommend that critical color judgements be made under ISO 3664:2009 and ASTM D1729 viewing conditions with fluorescent lamps.
5. The cost to relamp a 29” x 52” fluorescent booth is currently $165.00. You can relamp this booth once a year for nine years before you recover the cost of a higher priced LED booth.
6. The lack of standardization around LED technology is an issue and can result in inconsistencies between manufacturers and a variance in daylight lamp quality.
7. There is minimal energy savings from a daylight LED. An LED and fluorescent luminaire designed to illuminate a 52” wide viewing area will require 160 and 168 watts of energy respectively.
8. Both require maintenance. LED luminaires require regular monitoring and calibration, while fluorescents require relamping every 2,500 hours.
9. LED characteristics change with time, temperature, current, and from batch-to-batch and manufacturer-to-manufacturer. For this reason manufacturers bin LED components.
10. GTI’s fluorescent lamps have a blend of fluorescent phosphors that is unequaled by any other 5000K or 6500K lamp in the industry.
11. LED technology is expensive in comparison to fluorescent.

About GTI Graphic Technology, Inc.

GTI Graphic Technology, Inc. is the leading manufacturer of tight tolerance lighting systems for critical color viewing, color communication, and color matching assessment. The company services the graphic arts and many industrial and consumer segments including the ink, plastic, paint, colorant, automotive, fashion, textile, food, and retail.

GTI designs and manufactures its industry leading viewing systems in its 30,000 square foot headquarters in Newburgh, NY. An in-house spectroradiometric laboratory and 100% measurement and verification production process guarantees that precision and accuracy is built into all products. The company also has an office in Germany.

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