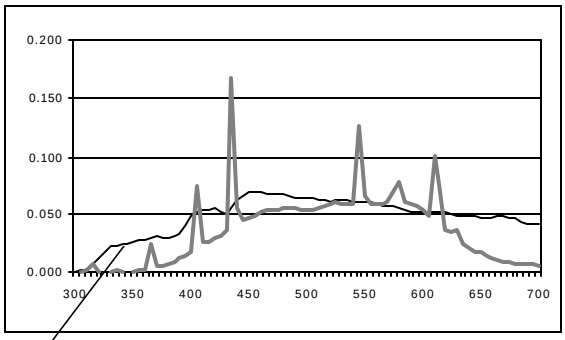
Technical & Applications Information on the Products of GTI Graphic Technology, Inc.

Simulated D65 Sources - Advantages of Daylight Fluorescent Technology

Industry has been searching for the perfect Daylight simulator for decades. The challenge has been to match Daylight (whether it is D65, D75 or D50) as closely as possible, but still allow for a product that industry can afford.

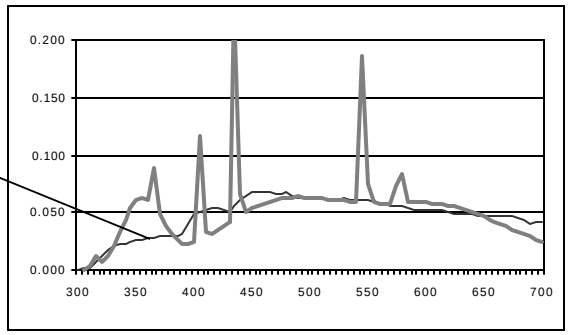
At right are spectral graphs which show three commonly used D65 light sources compared to the CIE D65 aim. The example at top demonstrates why using just any D65 source is not a good idea. Although the fluorescent lamp illustrated is rated as a D65 source, it is plain to see that it does not match the aim curve for D65 well at all.



Commercially available D65 lamp

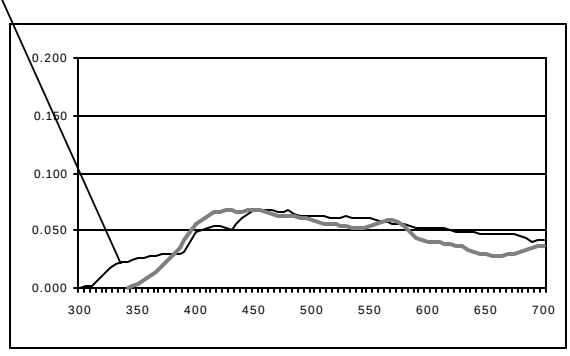
The second curve shows what a well-engineered light source achieves. Like the lamp illustrated in the top graph, it is a fluorescent lamp. The similarities end there though. The ***GTI ColorMatcher***® lamps available from GTI Graphic Technology, Inc. are specifically engineered to provide a superior match to the D65 daylight curve. Not only do they match exceptionally well in the visible spectrum (400 to 700 nm) but also in the UV portion of the spectrum (300 to 400 nm). The lamps provide the necessary amounts of UV energy to see the effects of optical whiteners now found in a host of materials including textiles, plastics, paper and more. They have one of the best ratings in the industry, B/C, as described in CIE Publication 51.

CIE D65



GTI ColorMatcher D65 lamp

The final curve shows a popular filtered tungsten source. Although at first glance this source *seems* to match the CIE D65 curve the best, if the curves are compared closely to that of the ***ColorMatcher*** lamps, some significant differences will be seen. First, although the ***ColorMatcher*** lamps have the spectral "spikes" indicative of every fluorescent source, the ***ColorMatcher*** lamps actually hold tighter to the curve, particularly in the red and green regions of the spectrum. And although the tungsten source by itself has large amounts of red energy, the blue filter used to simulate daylight with the tungsten source actually causes filtered tungsten to have *less* red energy than ***GTI ColorMatcher*** lamps. Finally, it is easy to see that there is very little UV energy in the Filtered Tungsten source. In fact, the only way to obtain enough UV energy is to add it using a separate fluorescent UV lamp.



Filtered Tungsten D65 lamp

(continued)

gti graphic technology, inc.
211 DUPONT AVENUE • P.O. BOX 2938 • NEWBURGH, NY 12550
(T) 845-562-7099 • (F) 845-562-2542 • www.gtilite.com

However, the graphs only tell part of the story. In addition to the spectral challenges associated with reproducing a Daylight source, there are other challenges, the most significant of these being a source having the ability to maintain consistent and stable light output, both in color quality and intensity, over an extended amount of time.

To maintain proper color temperature with filtered tungsten technology, system calibration is necessary in the event a single lamp failure occurs (a typical system uses at least two lamps) to ensure a color temperature of 6500K, ± 200. In addition, system recalibration is recommended within 280 hours of lamp operation to ensure a color temperature of 6500K is maintained. It is recommended that the tungsten lamps be replaced after *400 hours of usage.*

With Daylight Fluorescent, on the other hand, proper calibration is ensured when the system is manufactured properly. Through the use of electronic lamp ballasts and carefully engineered lamps, maintaining 6500K within specified levels can be easily achieved, to the point that in most cases, to maintain calibration, all that is required is to replace the old lamps with a new certified lamp set for the system needing them. The technology can be that stable and consistent. In addition, ***GTI ColorMatcher*** lamps are rated at *2500 hours*, giving over 6 times the life of filtered tungsten.

Another aspect of concern for filtered tungsten are the filters themselves. In order to achieve the necessary levels of light required to perform effective color matches (1210 lux, ±20%), a very deep blue filter must be used to reduce the red and yellow light produced by the tungsten lamp. Since a tungsten lamp has very little *Blue* energy, high wattage lamps must be used to achieve a light level high enough for effective color matching applications (1500 watts is common, drawing as much as 18 amps of power). Trying to maintain stable energy at this high power level is not easy and adds significantly to the cost of a fixture. A voltage change of as little as 5% will cause a significant shift in color temperature. A shift of this magnitude is not uncommon, particularly in the warmer summer months when electricity usage by a community is at its highest. If a tungsten source producing 3000K in color temperature varies by only 45K, the resulting change after filtering this same source will be 200K or more, pushing it outside acceptable industry specifications. Finally, the special filter this technology employs is susceptible to color shifts due to the high wattage lamps that must be used, a condition known as "solarization." They can break due to extreme heat (the two 750 watt lamps produce high levels of heat) and are expensive to replace.

ColorMatcher fluorescent lamps from GTI do not need this high level of amperage, are very cool in comparison to tungsten lamps and are engineered to produce the required color temperatures *without* the need for special filters. GTI also engineers its lamps to produce the necessary levels of UV energy required for the accurate simulation of daylight, without the need for additional lamps. The nature of the lamp allows them to remain much more stable than a tungsten lamp can generally achieve. It is much more stable over time and systems are less costly to produce. Studies similar to those done for tungsten lamps have shown that the voltage can vary by as much as 10% before the color temperature shift even approaches the limits of the allowable tolerances.

It is interesting to note that a study conducted through the Institute of Textiles and Clothing at the Hong Kong Polytechnic University* has shown that the practical visual results indicate that filtered tungsten and properly engineered fluorescent D65 simulators have the same average visual match point. The conclusions from these tests also showed "no statistical significant differences are found" in the pair comparison test between filtered tungsten and properly engineered fluorescent D65 daylight simulators.

GTI Graphic Technology, Inc. has engineered a series of color matching systems that are truly state of the art. They are easy to use and easy to maintain. They also require less energy to operate them. GTI has developed some of the best products available for visual color assessment and color matching and has been doing it for over 25 years.

* *"Study of the influence of various D65 simulators on colour matching",*
Yuk Ming Lam, John H. Xin and Kwan Moon Sin
Institute of Textiles and Clothing, The Hong Kong Polytechnic University
Coloration Technology, Society of Dyers and Colourists, 2001

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211 DUPONT AVENUE • P.O. BOX 2938 • NEWBURGH, NY 12550
(T) 845-562-7008 • (F) 845-562-2542 • www.gtilite.com