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Green Surgical Luminaires

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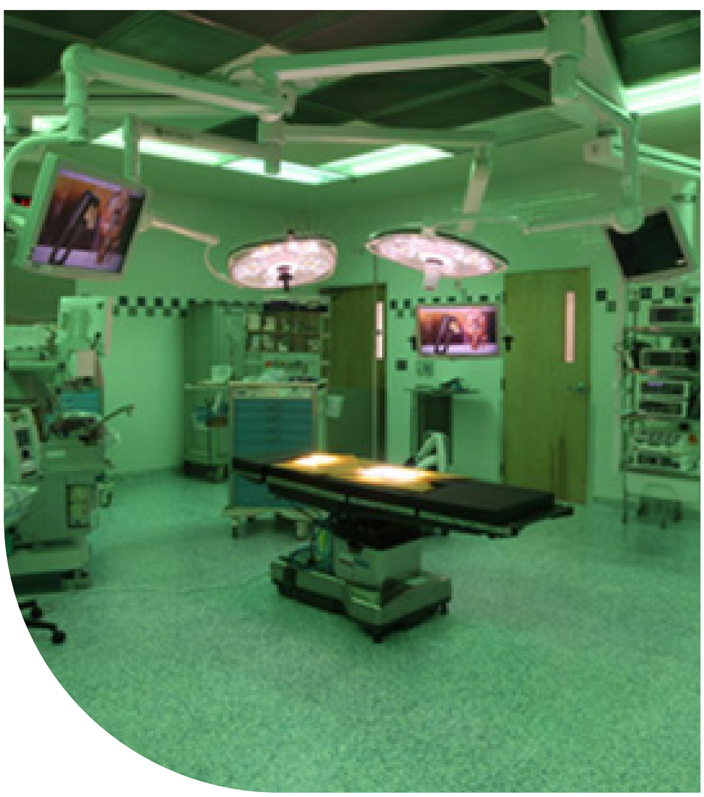

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Surgical Luminaires

Green Supplemental Surgical Lighting

Surgeons performing minimally invasive procedures found debilitating glare problems right from the start. The high intensity of standard surgical suite lighting causes poor visibility of cameras or microscopes, due to veiling reflections and the loss of contrast. This is caused by the supplemental light levels used for ordinary surgery which are specified at 200fc in order to minimize the transition from the surgical field which was typically 7500 to 10,000 foot-candles.

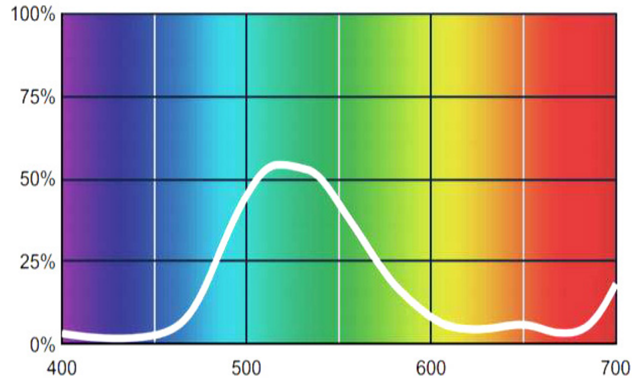
However, because microscopes and cameras have their images displayed on monitors, they are now competing for the sensitivity of the surgeon's eyes. In this same era, surgical suite lights were all fluorescent with minimal options for dimming. For this new type of surgery it was hard to balance light levels for the surgeon, the anesthesiologist, and the support staff, creating difficulties, to perform their tasks. When adjusted for the surgeon, the support staff would be working in less than optimal lighting causing a decline in efficiency and increase in potential for errors.

The patient's health and safety is crucial during surgery and is monitored accordingly.

Dedicated Green Lamps for Surgery

It was then GE emerged with the first dedicated green lamps for surgery called F40T12/G89. The "G89" stood for the color number of the LEE Filters™ green dyed sleeve secured to a GE white fluorescent lamp. After extensive research, GE chose this color for its spectral curve that closely matched the CIE curve of the human eye's sensitivity.

It was discovered that by using a filtered lamp that was close to the eye's highest sensitivity, less light energy was needed to perform supplemental visual tasks such as reading instruments and charts. Monitors and scopes were also now easy to see in the reduced spectrum and intensity. The effect was that even though there was about 20-40 fc of green light it was perceived to be brighter than that. While there were many benefits to this method, it was quickly uncovered that the fixture performance suffered due to the dark green filters absorbing the white light when the fixture was used for ordinary surgery.

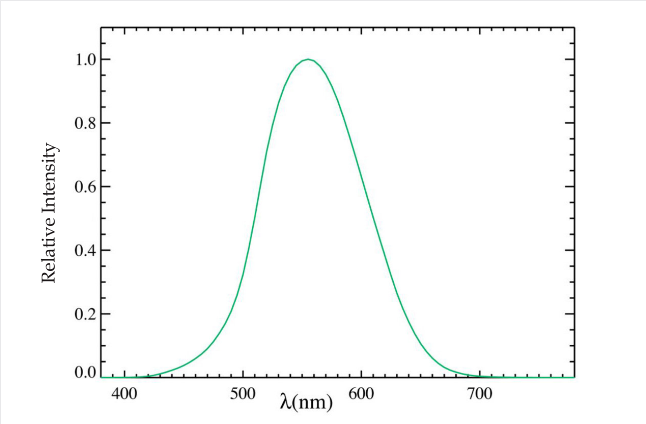


Lee Filters™ #89 Spectral Curve

Enter LED

When supplemental surgical fixtures transitioned to LEDs, we were given a better light source with higher purity and longer useful life. The native green LED makes its light directly through the chemistry of the LED. Not only does the purity of the LED allow for a more effective green light, it also supports the ability to have higher CRI white light for general surgeries as well as allowing a full range of illumination levels.

The narrow bandwidth and improved performance of the LEDs increased the perceived light levels of the surgical space, improving visibility for everyone. Green LED light allows the specification community to have a much more simplified process when choosing a source that will provide light level sufficient enough to perform tasks such as reading labels, choosing instruments, and moving about the room while not creating contrast on the monitors. As a result, Green LED fixtures ensure the full surgical team is provided with the visual acuity needed without all the glare and visual fatigue.

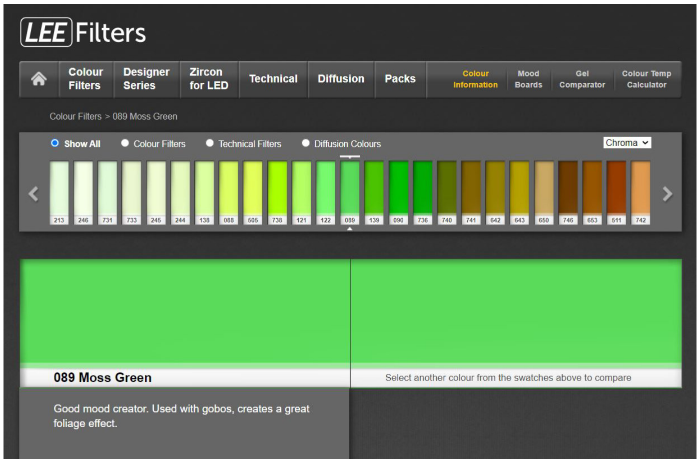


Human eye sensitivity based on spectrum. Taken from the CIE 1931 standard.

Which Green Is Right?

While there is a need to be attentive to the Green LED's spectral peak, selecting a source that emits in the range of 520-550 nm will keep the emitted source close enough to the human eye's spectral sensitivity curve so as to promote the positive impacts Green LED has to offer. However, even though there is an acceptable range to work within, it has been discovered that even just 5nm difference in color between adjacent fixtures may be noticeable to the human eye and therefore could trigger operational complaints.

Therefore, it is imperative that when completing a space, it is done with the same manufacturer who can ensure that the Green LED's are generated from the same source and batch.

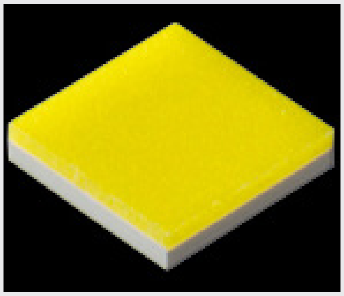


LED Selection

There are two basic kinds of processes to create Green LEDs; Native, as mentioned above, is the process of creating a green LED through the chemical composition of the LED. Pure green light is created directly from electrical current. Another process to make a green LED is through Phosphor Conversion (PC) which uses a blue LED and phosphors to emit light in the Green spectrum. The challenge with PC-Green LED's is the light created is not very pure. The phosphors widen the spectral curve so that the fixture will be producing significant percentages of amber and red light (See Chart).

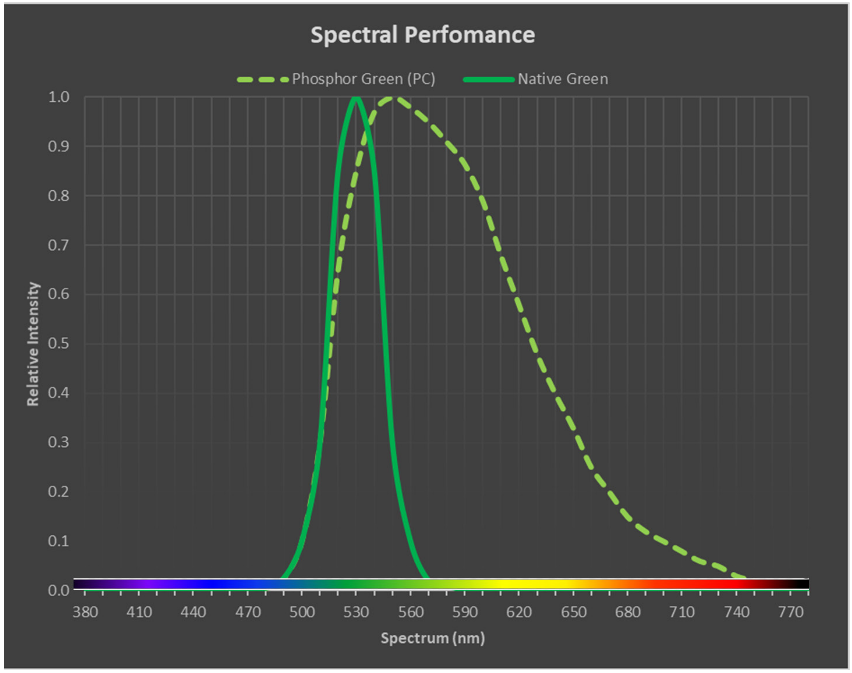
The PC green LEDs are more efficient and therefore easier to achieve high illumination levels when using PC green.

Left - Native Green LED's



Right - PC Green (Phosphor Coated)

Spectral Performance Chart



Spectral Curve of Pure Native Green compared with PC Green

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