Lighting factors that affect the performance and efficiency of security systems

Outdoor lighting is an important security tool. A well-lit site – whether it is the entire site, a specific area such as a perimeter fence, or simply an entrance – is a less attractive target for would-be intruders than a site where they can hide under the cover of darkness. When used as part of a larger security system, outdoor lighting plays an even more important role, primarily by helping improve camera performance, which can mean the difference between identifying intruders and allowing them to get away scot-free.

Sample perimeter with LED-based security lighting

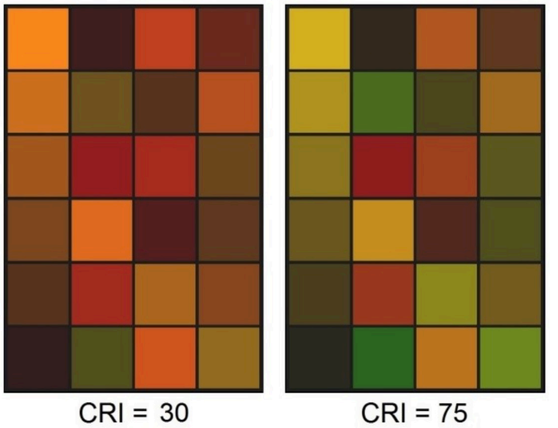
But not all lighting is same. There are a number of core technologies – Low Pressure Sodium (LPS), High Pressure Sodium (HPS), Metal Halide (MH), and Light Emitting Diode (LED) – all of which have different advantages and disadvantages, especially when it comes to four of the most important factors of outdoor lighting as a security tool – Colour Rendering Index (CRI), lumens per Watt (lm/W), color temperature, and lamp life.

This paper discusses these four factors and how they affect the performance and efficiency of perimeter security systems.

1. Color Rendering Index (CRI)

CRI is a quantitative measure of the ability of a light source to reveal the colors of various objects faithfully in comparison with an ideal (incandescent lamp) or natural light source (the sun). In essence, it describes illuminating an object to where the human eye or a camera is able to perceive all of the colors that make up the object, including the various shades of each color. Another term used to describe this concept is “full spectrum light source”, where the source emits the full spectrum of light wavelengths (or colors) bordering between infrared and ultraviolet and makes it possible to see an object with its full spectrum of colors.

The CRI scale ranges from 0 to 100; the higher the CRI value, the wider the spectrum of colors being emitted. A light source with a low CRI leads to an object appearing with less color definition and variation as only colors emitted by the light source itself are seen. This is why, for example, in an area lit by an LPS light (which has a CRI of 0) everything appears in a monochromatic orange hue (LPS gives off an orange color as a result of the chemical reaction its components create).



Color palette showing the effects of different CRI values

The accompanying diagram depicts the same color palettes showing the effects of a low and high CRI lamp shining on them. Colors in the lower CRI palette are less distinguishable because they are affected by the color being given off by the light source itself. The higher CRI palette provides a closer representation of how color is seen with an ideal or natural light source.

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2. Lumens per Watt (lm/W)

The term lumens per Watt (lm/W) describes the luminous efficiency of a lamp. The more efficiently a light can produce photons (light) for a given amount of electrical energy, the higher resulting lumens per watt output. For example, compare 400W lamps from different manufacturers. If the first produces 55,000 lm while the second produces 51,000 lm, the first lamp would have a higher efficiency at 138 lm/W (55,000 lm/400 W) compared to the second which would only have 128 lm/W.

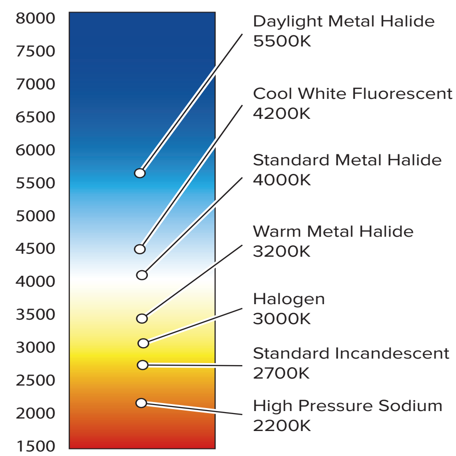
High lighting efficiency is important because it provides similar illumination using less power. From a perimeter security perspective, this means lower operational costs while maintaining a well lit perimeter to allow cameras to operate at optimal performance.

3. Color Temperature

Color temperature is used to describe the light appearance provided by a lamp. It is measured in Kelvin (K) degrees and typically ranges from 2,000 K to 6,500 K.

The color temperature of a lamp is the temperature of an ideal black-body radiator that radiates light of a color comparable to that of the lamp. The term 'black-body' is really a just fancy name for a heated object - for example, an incandescent lamp is a heated object and therefore a black-body. When the filament of an incandescent lamp is heated to a temperature of 2,700 K, it emits a particular range of light wavelengths (or colors) which give it the slightly yellowish light, commonly referred to as "Soft White". When the filament is heated to 6,500 K, a different range of light wavelengths is emitted, shifting towards the blue spectrum, which gives it a more blue/white color, commonly referred to as "Daylight".

For security applications, the closer to "Daylight" a light source is, the better since the captured image is more representative of its true colors. Also, the human eye naturally respond best to this color temperature for video surveillance viewing.



Color temperature comparision of different lighting technologies

4. Lamp Life

Long-lasting lamps mean a more effective secure perimeter while reducing maintenance and therefore overall cost.

For security, lamp life directly relates to the effectiveness of a perimeter security lighting system. Short lamp life leads to a system where there is a higher likelihood of having a gap in the perimeter lighting from failed lamps which will affect the deterrent effectiveness of the system. Longer lamp life decreases this potential in order to maintain a strong deterrence capability of the system.

Summary

The four lighting factors discussed above – CRI, lm/W, color temperature and lamp life – play major roles in lighting. All lighting technologies on the market have different combinations of these factors, which is why it is important to research which technology best meets the requirements for the application being targeted.

For perimeter security applications, the right combination can improve performance and add efficiency to security systems, as each of these factors plays a critical part in its effectiveness. High quality lighting allows low cost cameras to operate at a higher performance level, and minimizes any breaks in the uniform light along the perimeter increasing the deterrent factor, all while keeping operating costs low.

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