LIGHTING: THE NEW BASICS

Effective exhibit lighting doesn't start with fancy fixtures or intense wattage. The first step is understanding the qualities of light and how they will enhance your exhibit design.

Planning your exhibit lighting? Well, drop that sconce, ignore that spotlight and unhand those color gels. Lighting design doesn't start with fixtures, lamps (what we nonspecialists call bulbs) or accessories. Before you can select the right lighting sources, you need to understand the qualities of light – how to "visualize" light sources and use them to impact your exhibit design.

As you know, light is a medium of contrasts. It can be soft, diffuse and soothing, or hard, direct and exciting. It can be warm or cool, attracting or distracting, animated or static. All these effects depend upon how lighting is planned and designed.

The best way to approach lighting design is to start visualizing it in layers. (See a familiar example in photos at right.) With exhibitry, the first layer of light is the ambient lighting in the show hall. On top of this you may add general exhibit lighting. Then accent lights on products. Next, spotlights or rear-illumination for graphics. And finally, special lighting for demonstration areas and signage. All these layers combine to form a "system" of illumination. This system can enhance your exhibit's design by drawing attention, creating atmosphere and mood, and establishing image.

Each light source used in a system has its own characteristics that add to the overall effect. This article introduces you to two of these characteristics:

- *Color temperature:* Light can range in color from "warm" yellows to "cool" whites, which changes the mood of your exhibit.
- *Color rendering:* Different light sources will affect the way you see colors within your exhibit. Some lamps may make your colors appear richer, others may make colors flat and dull.

You can use these characteristics in combination with lighting techniques that attract attention to product areas or enhance your exhibit's design. We'll also discuss two effective techniques:

- *Contrast:* By altering the level of brightness in different areas of your exhibit, you can draw attention to products and increase "drama."
- *Movement:* Putting lights or products in motion can capture attention from across the exhibit hall. Light can also create an "illusion" of movement through strong patterns on exhibit surfaces.

The "layering" effect. **In the top photo, only the kitchen's ceiling lights are on. The middle photo adds lighting at the top of the cupboards and underneath. The bottom photo includes lighting above the cupboards. Though the light level on the countertop in the middle of the kitchen only increases by about 20 percent, the final photo appears much brighter. Why? More surfaces are illuminated.**

Ready to delve into the specifics of these lighting characteristics and techniques? Just one moment. To fully understand these concepts, we need a quick review of how light works, how to measure light (footcandles) and how light will interact with different objects in your exhibit.

Footcandles and interaction

The medium of light is very abstract and intangible. You can't touch it or feel it. And technically, light is invisible until it strikes an object. When light is generated from a source, be it the sun or an electrical lamp (bulb, remember), it is called "illuminance." You can't see illuminance; you can only see light after it is reflected off an object. This reflection is called "luminance."

At the same time as it is intangible, light is very predictable. It can be measured, calculated and engineered. Illuminance is measured in terms of "footcandles" – the amount of light falling onto a surface. ("Lux" is the metric equivalent of footcandles.) Engineering data is available to tell you how many footcandles a certain lamp will produce at a specific distance. Some comparisons: A street light may produce as little as two footcandles; full daylight, as much as 7,000 footcandles.

So buying light sources that produce a lot of footcandles will improve your exhibit lighting, right? Not necessarily. The amount of footcandles is not the only factor that affects visibility. Remember, light is invisible until it strikes an object. Therefore, the interaction between light and the object it is focused on is also important.

When light hits an object, it can react in three ways: Light can be absorbed, reflected or transmitted through the object. Dark-colored objects absorb more light; light-colored objects reflect more light. Therefore, 50 footcandles directed at a navy blue-painted wall will appear much dimmer than 50 footcandles

focused on a yellow-painted wall.

The percentage of light that an object will reflect is called "light reflectant value" (LRV). A piece of white copy paper has an LRV of about 90 percent. That means that the paper will reflect 90 percent of the light that is being radiated upon it. Mirrors and tinfoil likewise have an LRV of 90 percent.

This becomes important when designing your exhibit. If you want to create a bright atmosphere, there is only so much that footcandles can do if you are using dark colors. To create a brighter exhibit, you will want to use colors or surfaces that have higher reflectant values. How can you tell what the LRV for a specific color will be? Most paint swatches list LRV percentages. For example, the code "LR 70" or "LRV 70" means that this shade of paint will reflect 70 percent of the light. Even within the same color family, one shade of blue may have a higher LRV than another. Using the shade with the highest LRV will increase the perception of brightness in your exhibit.

In addition to light that is absorbed or reflected, light can also be transmitted through objects made of glass, plexiglass or translucent materials. The transmission value depends upon certain things: the density of material, any tinting of the surface and the material's color pigment.

This becomes important when working with backlit transparencies. One way to make them appear brighter is to increase the amount of light you put behind them: Another way is to select materials that have higher transmission values. For example, you may have a choice in thickness or transmission value of the frosted plexiglass used in your transparency. The plexiglass manufacturer should have this information available.

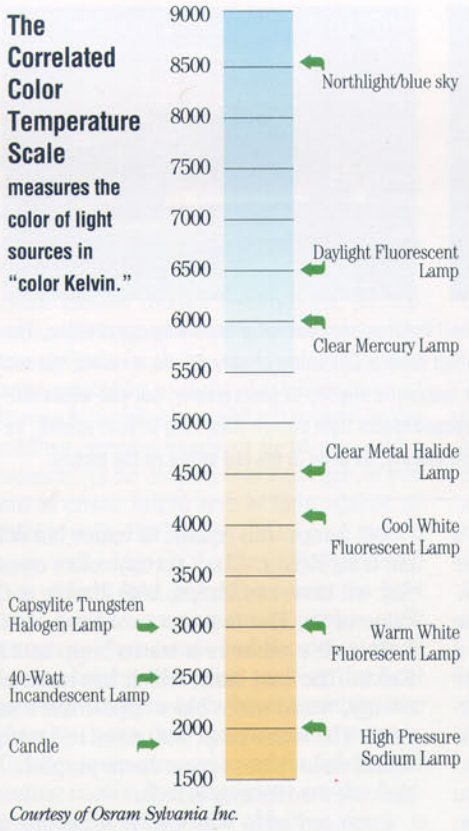
Thus, visibility is affected by whether exhibit materials absorb, reflect or transmit light. It is also affected by how the area is being lit – direct or indirect lighting.

Think of office lighting. To light a desk surface, you could use a recessed lighting system and position a lamp directly overhead. Or you could use an indirect lighting system to bounce light off the ceiling and reflect back down to the desk. Both solutions could be engineered to produce 40 footcandles at the desk surface. Yet the indirect lighting system would psychologically make the room appear much brighter. Why? Because light is reflecting off of a larger surface area in your field of view.

If one of your objectives is to make your exhibit space appear bright, don't focus all of your lighting on product areas and walkways. Instead, direct your light sources along ceilings, walls or counters – any horizontal or vertical surface. This technique will give the psychological perception that space is brighter than it actually is. In addition, the lighting will attract more attention from a distance in an exhibit hall.

Now that we understand light and its relationship to objects, we are ready to move on to qualities of light – color temperature and color rendering – and lighting techniques – contrast and movement – that can enhance exhibit design.

Color Temperature



Courtesy of Osram Sylvania Inc.

Light has color. **Compare the effects of light produced in this storefront. The warmly lit window display on the left is achieved with a 3000K incandescent light source. On the right, a 4000K metal halide light source gives much cooler or blue-white light. (Note: The sensitive photographic film exaggerates this effect slightly.)**

Color temperature

Just as you can select different "shades" of white paint, you can select different colors of light. Both daylight and electric light sources generate certain color characteristics: light can appear "warm" – like soft yellow candlelight – or "cool" – like blue-white daylight.

You can easily witness these color characteristics in the morning. When you crawl out of bed and flip the light switch, your incandescent lamp bathes the room in an orangish-yellow light. Once the sun comes up and you throw back the curtain, the daylight that enters the room almost looks blue compared to the incandescent light. (Don't look at the light fixture or the window to compare the two. Look at the wall where the light is reflecting.) This illustrates the difference that color makes in your perception of light.

Color characteristics of light are measured in "correlated color temperature" or "color Kelvin" on a scale from 1500 to 7000. (See sidebar, above.) Color Kelvin works like an upside-down thermometer: The "warmer" or more orangish-yellow a light source, the lower the number. A candle is about 1900 Kelvin. The "cooler" or more bluish-white a light source, the higher the number. Daylight is 7000 Kelvin. Incandescent light that is normally found in a home is about 2700 Kelvin. Fluorescent lamps come in six levels, ranging from 2500 Kelvin to 6000 Kelvin. Lighting manufacturers can tell you the color Kelvin for specific lamps.

Color Kelvin can be used in exhibit design to improve visibility and to create color contrast. Some examples:

- Combine and contrast colors to draw interest to display areas. Use cooler light sources for indirect lighting; warmer sources to highlight products.
- Boost the brightness level of backlit signage. The sign industry typically uses cool white lamps (4000 Kelvin) in lightboxes. If you want to create a color contrast between your signage and every other lightbox in the exhibit hall, go a step further, to 5000 Kelvin. Your sign will have a cleaner, whiter, brighter appearance.
- Select a lamp color to complement the color of your exhibit. For example, if you are using warm earth tones – browns, tans, beiges – you can complement them with a warm color Kelvin lamp. If you are building a very contemporary exhibit, you might want to choose a cooler color Kelvin lamp to achieve a brighter effect.

Color rendering index

Along with having individual color characteristics, light sources can alter the appearance of color. Have you ever matched items of clothing in a store, only to wear the outfit outside and see two distinct hues? Or have you taken two photographs of the same indoor scene,

Color Rendition

Light affects color perception. **Typical exhibit hall lighting has poor color rendering capabilities. The hall's metal halide lamps in the photo on the left have a CRI value of only 45. As a result, the red sports car appears flat and gray. (The effect is increased slightly in photography, but you would still perceive a difference in person.) By using an incandescent light source (CRI 100) in your exhibit, as in the photo on the right, red colors appear more vibrant, as seen in the red stripe on the pickup.**

one with flash and one without, and noticed a color shift? These examples illustrate the effect that light has on our perception of color.

While the color Kelvin scale measures the color characteristics of light generated by a source, the "color rendering index" measures how a light source will affect the color appearance of objects. The number tells you how natural colors will appear under that light source.

The color rendering index (CRI) works on a scale from 0 to 100. The higher the number, the better the color rendition. The rating for a light source will depend upon the type of visible light energy it produces. Remember working with prisms in your elementary science class? A prism separates the invisible and visible light energy into its wavelengths – ultraviolet, blue, green yellow, orange, red and infrared. The presence and pattern of these wavelengths in different light sources alters the way we "see" colors.

For example, daylight has a CRI of 100. This means that the whole color spectrum is represented in daylight; the color we see is true, or more accurate. On the other hand, cool white fluorescent lamps have an erratic pattern of light energy and radiate very little red light energy. As a result, cool white lamps have a CRI value of 60; 40 percent of the color spectrum isn't represented in this light. This shifts our perception of color under these lamps, particularly colors that have red tones in them. (Lamp manufacturers can provide "spectral energy curves" that show the pattern of wavelengths for each light source.)

Color rendering abilities are not necessarily dependent upon color temperature. Lamps at all levels of color temperature (color Kelvin) can have low or high CRI ratings. For example, you can buy a fluorescent lamp with a color temperature of 3000 Kelvin, but the CRI values could range from 55 to 80. Under the lamp with a CRI of 55, a red product may appear gray and flat, but with the higher CRI value, the red will appear truer and more vibrant.

Still, lamps with equal CRI values but different color Kelvin will not portray colors equally. Say we have two lamps, both having a CRI value of 90. The first is a cool lamp at 5000 Kelvin; the other is a warm lamp at 2750 Kelvin. The cool lamp, which has more blue energy, would make blues appear more saturated. The warm lamp, with more red energy, would make blues appear more purplish, but increase the vibrancy of reds.

Confused as to why CRI is important if it varies with color temperature? Don't worry. Obviously, if true color rendition is important to your product presentation, you'll want to make sure your all of your lamps, regardless of color temperature, have high CRI ratings.

In fact, you may want to test the color rendition of your exhibit's materials or product samples under different light sources. You can do this with a "lamp color evaluation system," available from lighting designers or lamp manufacturers. This box-like apparatus allows you to place your materials and color samples inside, then turn on different light sources to compare the effects of lamps of different colors and CRI values.

Another application for this knowledge of how lamps affect color appearance is in conjunction with backlit transparencies. You can use lamps to boost the vibrancy of your graphics. For example, if your transparency is of an ocean scene, you will want a "cool" fluorescent lamp (high color Kelvin for blue-white light) that has a high CRI value with lots of blue and green energy in its color spectrum. This type of light will give the blue tones a rich, natural color appearance. Conversely, if your transparency has lots of reds, use a warmer lamp (lower color Kelvin) with high CRI to make the reds more powerful.

Contrast

Along with enhancing exhibit design using color temperature and color rendition qualities of light, you can use lighting techniques such as contrast. Contrast affects people's reaction to a space. Think of the difference in light between a cloudy and a sunny day. On a cloudy day, light is soft and shadowless, producing little contrast. If it is sunny, the light is hard and direct, creating strong shadow castings. This translates into very high contrast ratios of illuminance.

Now consider how you feel on those days. Cloudy days are generally associated with gloomy dispositions, while sunny days usually make people feel upbeat and cheerful. The difference in attitude is not brought on by the measured brightness level: A sunny day might be 5,000 footcandles, while a cloudy day could still generate 1,000 footcandles. You can still see well under both conditions. The change in attitude is brought on by the difference in lighting contrast ratios.

On a cloudy day, the light is filtered and diffused. For example, there is still plenty of light to see, but you won't notice the sharp shadows that trees or buildings will throw on the ground. The mood that the light generates is more subdued. On a clear, sunny day, the light is direct, and shadows are dramatic and strong. Studies show that people tend to like those high contrast ratios better. Even in an office, where people need shadowless lighting to perform visual tasks, areas of high contrast can add a sense of drama and interest to a space. Simply spotlighting a picture on the wall can add the contrast to generate more excitement and may even increase productivity.

How does this relate to exhibiting? By increasing or decreasing the dynamic range in lighting, you can change the psychological reaction to a space. You have to ask yourself how you want your exhibit to feel. Do you want it to be stimulating, exciting, dramatic? If so, increase the contrast ratio. Do you want an environment that is soothing and calm? Decrease the contrast ratio.

So, if you are shooting for high drama, exactly what should the contrast ratio be? Take an example from nature. Direct sunlight generates about 5,000 footcandles; in the shadows, there is still 1,000 footcandles. Studies have found that 5:1 ratio to be a good formula for engineering exhibit lighting, especially when you want to attract attention to a certain area. For example, by making your product lighting five times brighter than the ambient lighting, you can draw attention to your product area.

How do you know how bright the ambient lighting will be? In a typical exhibit hall, if all the overhead lights are on, the average light level is about 60 footcandles. Using that as a base, your accent lighting should be five times brighter, or 300 footcandles.

Of course, some halls have much higher light levels, such as the upper level of McCormick Place East that is surrounded with windows. Light levels there can be as bright as 200 footcandles. In situations like this, you may have to work with your exhibit designer on solutions for controlling light lev-

els in your exhibit. In any case, a lighting designer can help you determine ambient light levels and design accent lighting to be five times brighter.

Another way to increase contrast between areas is to work with your exhibit materials. The greater the contrast between an object and the background, the better the visibility.

As we noted in the beginning of the article, the perception of brightness will vary with the interaction of light upon objects. Darker colored objects absorb light; lighter colored objects reflect light. When it comes to product lighting then, to make a dark-colored product more visible, you can contrast that item against a light-colored background. And a light-colored object will be more visible against a darker background.

You can also contrast textures and reflective values – shiny against matte, rough against smooth. For example, if you were displaying sparkling diamonds, you wouldn't improve visibility by placing them on a mirror surface. Instead, you would want a softer, darker background, like black felt. By creating contrast with both your lighting and exhibit properties, you can increase visibility and draw attention.

Movement

The final aspect of light that helps draw attention and create mood and atmosphere is movement. Lighting can have two types of motion: kinetic (changing or being animated) and static (creating patterns or the illusion of motion).

Kinetic motion is achieved with roving spotlights moving across products or the exhibit floor; sequential or chaser lights, such as a flashing marquis sign; lights that become brighter or dimmer; or rotating lights, such as a police beacon. Another tactic is to place the product in motion, which makes the light "move." A car on a turntable creates a kinetic movement of light. All of these tactics draw attention with motion.

Static motion, though it sounds like an oxymoron, is a second technique that generates interest. Static motion is achieved by creating strong patterns of light. Just like rows of columns in architecture add a "rhythm" to the building, strong pools of light can add a "cadence" to an exhibit. For example, if you were to create bright arcs of light against an exhibit's walls, the light would take on motion as you walked by. Or if ceiling lights projected pools of light into an exhibit space, the light would take on movement as people walk through it. Their heads and shoulders would become bright, then dim, making the light seem animated. In both these examples, the light adds rhythm and movement to the space.

It may seem strange to credit lighting for creating motion in instances where the lighting fixture is still and the object or viewer is moving. Yet the change in light is what will attract your attention. Consider this example: A white ceiling fan is mounted on a white ceiling. When the fan is off, it doesn't attract attention. If the fan is on and the room is dark, it still won't attract attention. But as soon as you add light to reflect off the fan's surface, the movement of the fan will attract your attention.

That's why turntables are so effective. You may think that the movement is attracting your attention, but it's actually the play of light off the product that creates the animation. Lighting movement – whether kinetic or static – can be designed into your exhibit to increase attraction levels.

Combine motion with the other three qualities of light – color temperature, color rendering and contrast – and you have four tools to enhance your exhibit's design, add mood and atmosphere, and draw attention on a crowded trade show floor. As you start to plan your exhibit's lighting system, think about how these qualities can influence your exhibit's and product's visibility and attraction. ■

– By Stefan Graf and Lois Wallentine. Graf is design director at Illuminart and Fantasee Lighting, a lighting firm located in Ypsilanti, MI. He will be conducting seminars on lighting at Exhibitor Show 94. Wallentine is managing editor, Exhibitor magazine. Watch for more lighting articles in coming months.