

A Practical Guide to LED Lighting in Residential Application



Introduction:

There are more LED products and alternatives available on the market today than there ever have been for traditional incandescent and compact fluorescent (CFL), energy-efficient bulbs. However, **“Buyer Beware”** when you see low price products, look at the critical components presented within this article to identify the differences. In most cases, you will find that *“you get what you pay for!”* You will find this article to be very informative in providing you with a satisfying **ROE (Return on Enjoyment!)**

While some LED products might just look like any other products such as light bulbs or fluorescent tubes, the variety of products available, new terminology introduced by the lighting industry LED’s are designed by a different technology. What we have been used to for decades with old traditional light bulbs and fluorescent tubes, can make the switch to LED lighting quite challenging.

The purpose of this article is to explain *the “must-know”* terms introduced by the lighting industry. By educating homeowners or contractors about these terms will provide the necessary guidance on how to choose the correct products for different areas in a residential environment. Also, it points out some of the pitfalls to avoid and be aware of to make the switch to LED products a success. Keep in mind that ***not all LED products are created equal!***

Why make the change to LED?

Besides LEDs being significantly more energy-efficient than incandescent and CFL options, they last much longer, do not contain Mercury like CFL’s and provide more brightness and light appearance options like warm-light vs. cool-light.

Throughout the world, every new construction or renovation project is being subject to Energy Efficiency Standards, In California, for example, Title 24. LED products are a perfect

solution to meet or exceed the stringent energy consumption requirements outlined in the Title 24 standard.

Also, LED's don't only come in a traditional light bulb shape. Due to their compact shape, LED lighting solutions are available in all forms, shapes, and sizes, providing an almost unlimited amount of ways light can be used and added to a home environment.

Terminology

Before LEDs became available when buying traditional incandescent light bulbs, all we needed to do is pay attention to the bulb shape, wattage (*which indicated the brightness of the bulb*). Also, the screw base size to make sure it fits into the lamp.

With fluorescent tubes and bulbs came the option of choosing the light appearance described mostly as soft-white, bright-white, and daylight. Soft white resembles the warm tone of an incandescent bulb, whereas bright and daylight being crisper and cooler with a blueish appearance.

When using LED's, it is essential to understand three lighting concepts:

- **Brightness (*measured in lumens, not watts*)**
- **Light appearance (*measured in kelvins*)**
- **Color rendering (*Accuracy of the light appearance*)**

LED products are more expensive than the obsolete incandescent products; they are longer-lasting and efficient. It is our intent at Custom Product Works to make sure our customers are buying the right product for the job.

Brightness (*Lumens*):

The misconception that wattage equals brightness is an inaccurate measurement for LEDs. While for incandescent bulbs, wattage and brightness had a direct correlation; however, for LED products, extensive greater brightness (*Lumens*) is achieved while consuming much less power (*Watts*), it's impossible to compare the brightness of an incandescent and an LED bulb based on wattage.

Lumens is the only factor to pay attention to when looking for the brightness of an LED light. Lumen is the unit of measure for brightness and tells us how much light a particular lighting product emits.

For reference, a typical incandescent 60 W bulb emits approximately 800 lumens.

Light Appearance (*Kelvins*):



When we want to know if a lighting fixture or bulb creates a warmer or crisper, cooler light, we need to look for the kelvin number. The color appearance or Correlated Color Temperature (CCT) of light is measured in kelvins (K). The lower the number, the warmer the light color temperature will be, and the higher the Kelvin number, the more cool and blue the light will appear. A typical incandescent bulb has a color temperature between 2700K and 3000K. The sun at noon on a clear day produces a light of approximately 5500K.

Consumers have often complained about the cool sterile light appearance of CFL bulbs compared to incandescent bulbs. The solution is to choose a lower kelvin, warm color temperature instead of the cool color temperature.

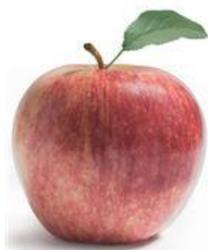
Color Accuracy (*Color Rendering Index*)

Have you ever been to a store and couldn't quite make out if the piece of clothing you were looking at was a dark green or blue? If so, then you experienced poor color rendering by the light fixture inside that store.

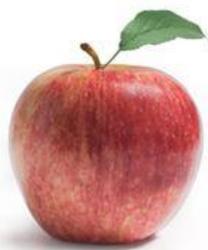
Light sources differ in their ability to display the colors of objects "correctly." And by correctly, we mean compared to a natural light source like the sun or an incandescent bulb.



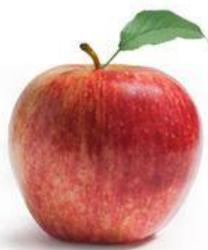
LED light with low CRI makes colors look dull and unappealing versus 95+ CRI render warm tones accurate and beautiful.



CRI 78



CRI 85



CRI 90



CRI 95

The "color rendering" is defined by the term **Color Rendering Index** or **CRI**. The scale goes from 0 to 100. A 2700K incandescent light bulb has a CRI of 100.

With current LED technology, a value of above 80 is considered a good CRI and will be sufficient for many applications. However, for some areas, better color rendering of 90 or above can be desirable; this will be explained in the next section.

Choosing the correct light for different light functions and areas in your home

Lighting functions are typically categorized by:

- Ambient
- Task
- Accent
- Decorative

Each category provides a different purpose. When planning the light for a home, it is helpful to understand how these different light levels can complement each other.

Ambient Lighting:

Ambient (or normal) lighting provides a uniform amount of illumination throughout an area or room for general vision and orientation.

Recessed downlights, cove lighting, or pendant-hung fixtures are typical examples of ambient lighting.

Task Lighting:

The definition of task lighting provides light in an area where an activity takes place, e.g., the kitchen countertop where meals are prepared, a reading lamp, or a make-up mirror. Task lighting is meant to highlight a specific area in addition to the ambient light in that room.

Accent Lighting:

Highlighting objects is the best definition to describe accent lighting like works of art, architectural features or plants, by creating contrast in brightness. This is often achieved using recessed or surface-mount adjustable fixtures, interior cabinets with glass doors, track lighting, wall grazing, and wall washing.

Decorative Lighting:

The jewelry for the home is decorative lighting. The primary function of decorative lighting fixtures is to look attractive. Chandeliers and wall sconces are typical examples.

This layered approach to lighting is useful to create a comfortable, visually balanced atmosphere.

After selecting the type of fixture and placement of the fixture for the various functions, it's time to think about the color temperature.

The light should complement the interior design, furniture, colors, and other decoration in your home.

In general, color temperature is very much a personal choice and preference; however, there are a few rules that can be applied to help choose a light that compliments the interior design.

Color Temperatures for Ambient Light

The ambient lighting in a room is typically the primary source of light; therefore, a key element in setting the overall mood and ambiance for a room.

While warm lighting fixtures are often preferred in living rooms and bedrooms to create a cozy atmosphere, particular attention must be placed on the selection of the kelvin temperature.

The kelvin numbers offered for LED lights are typically 2700K to 3000K. These warm white lights are a good choice to complement earthy tones and wood furniture.

If more than one type of ambient light is installed, e.g., downlights and cove lighting, choose the same color temperature for both to ensure an even, harmonic effect.

Though many people seem to prefer warm white, rooms that are decorated with light-colored furniture and crisper colors, like white, blue, and light grey, e.g., in a modern kitchen, can benefit from a more relaxing neutral, cooler light.

Lighting with kelvin numbers in the range from 3500K to 4000K are considered neutral white and accentuate lighter colors better than warm white lights.

Also, studies show that neutral and cool white light has an energizing effect on people and is, therefore, are the right choice for home offices and studies.

Since neutral and cool white light creates better contrast than warm white, they are also a good choice for the leading ambient light in bathrooms. The cooler light will provide a more realistic idea of what we look like in the real world. Look for kelvin numbers between 4000K and 5000K for your main ambient bathroom fixture.

If the bathroom features a bathtub and you want to be able to create a warm atmosphere as well, consider using an additional layer of light, e.g., a wall sconce with a warm white light in the range of 2700K that can be switched separately from the main light.

Color Temperatures for Task Lighting

Task lighting is used to provide an additional, higher level of light than the surrounding area where a visual task takes place.

It is, therefore, crucial that the light can create good contrast, which is best achieved with a neutral to cool white in the 3500K to 5000K range.

Besides the color temperature, the color rendering index (CRI) and brightness are particularly important for task lighting.

While for ambient lighting, a CRI of 80+ is often sufficient; alternately for task lighting, a CRI of 90 and above should be considered.

Food that gets prepared on a kitchen counter will look much more appealing when rendered well by the under cabinet light.

A make-up light with excellent color rendering will also provide a more realistic picture.

Dimming

As opposed to standard incandescent lamps, all LEDs are dimmable, but not all fixtures are built to dim or are installations designed for dimming. Therefore, it is important to look at the product label and ensure that the fixture is marked as dimmable.

Dimming is an important feature of ambient and task lighting. It enables us to set the light level to create the desired atmosphere in an area or create the ideal brightness for a task. Besides, dimming provides energy savings by reducing the electric load of a light fixture.

When making the change to LED, be prepared to switch out your dimmer switches. Most dimmers were built for incandescent bulbs. However, LEDs are based on very different technology, and therefore, these two will not work well together. It's like trying to connect your old analog TV to the HD digital signal.

Most manufacturers, including Custom Product Works manufacturers, provide a compatibility list that shows dimmer manufacturers and models that have been tested and are compatible with the LED fixture.

Using incompatible dimmers can lead to flickering lights or insufficient dimming levels. It is highly recommended to stick to the manufacturer's recommendations, which will ensure optimal lighting experiences.

Installation

Though most LED lighting fixtures are considered low-voltage (12 or 24 volts Direct Current), which means they either have a driver (transformer) build-in to produce the 12VDC or require an external driver, the good news is, it is not necessary to rewire a house to use LEDs. All the wiring that is commonly used in homes is perfectly fine for use with LED fixtures that contain drivers or control an external LED driver mounted outside a LED fixture.

Many LED fixtures have a driver (transformer) already built-in and can be connected to a standard electrical outlet. Some LED products, i.e., LED strip lights, require an external driver (power supply.) These come in two formats, either with an AC (Alternating Current) cord attached, similar to a laptop power supply, or they need to be connected to an outlet. For these types of fixtures, check the label on the product to see if they are dimmable.

Dimmable fixtures or dimmable drivers can be dimmed; however, there are other ways to dim LEDs with a non-dimming (constant voltage) driver. This configuration is beyond the scope of this article, contact Custom Product Works customer support.

info@customproductworks.com.

It is recommended to have a licensed electrician perform any installation that requires electrical connections to the line voltage.

Do pay attention to the product label; it will indicate if a driver (power supply) is required.

How to choose a quality product

There are many LED products on the market; however, they are not all built the same.

-   Look for the UL or ETL mark on the product or packaging. For safety reasons, ensure that an independent laboratory tested the product. Note that the UL or ETL listing is not a requirement to sell products in the US, but will present a problem when the installation is subject to an electrical inspection. The inspector will reject the product if it has not been tested for safety.
- The warranty should be at least 5 years or more due to the generally long lifetime of LED products. Though this is a long time, do keep your receipts for proof of purchase in case the product fails prematurely.
- Look at the product description or label. These specifications should be clearly outlined:
 - Light Output Brightness (*Lumens per square foot*)
 - Color Temperature (*Kelvin, should be stated as a number, i.e., 2700K not just warm white or cool white.*)
 - Color Accuracy (*CRI greater than 80*)
 - Power Consumption (*Watt*)
 - Lumens per Watt (*Efficiency*)
 - Warranty of the LED Product (*3 to 12 years available*)