The Truth about Lumen Ratings

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If you've ever looked into LED lighting, it's almost certain you've crossed paths with the term "lumen." Lumens, quite simply, are the standard unit of measure used to describe how well a light source will illuminate objects. Because output is typically one of the major factors people use to evaluate LED lights, many manufacturers prominently display this figure on product literature and boast high lumen numbers.

What these manufacturers may fail to tell you, however, is that those big numbers are actually the raw lumen output rather than the effective lumen output. What's the difference? Why does it matter?

Raw Lumens

The raw lumen output of a light is actually a "theoretical" value rather than an actual measure of "useful" light output. Manufacturers calculate the number of raw lumens by taking the number of LEDs in a light and multiplying that by the maximum output rating for those LEDs.

For example, if a light uses 10 LEDs that have a maximum output rating of 100 lumens, the raw lumen output would be 1,000 lumens (10 x 100 = 1,000). No photometric testing is necessary to come up with this number - it's just simple math.

The reason that raw lumens should not be relied upon for evaluating LED lights is that the metric doesn't take into account real world factors that can decrease the light output as much as 75%.

What causes these decreases in light output? Well, there are a couple of major contributing factors.

First, there are thermal losses. LEDs, you see, produce less light the hotter they get. And, as LEDs are powered for longer and longer periods of time, they typically heat up. In fact, it is not uncommon for LEDs to reach temperatures of over 212ºF (100ºC).

So, it stands to reason that if you measure the light output of an LED when you initially light it up (when it is cooler) vs. after it has been on for 30 minutes (when it is hot), you're going to see a decrease in the light output.

Remember how the raw lumen calculation relies on the maximum output rating of the component LEDs? LED manufacturers calculate their maximum output ratings by measuring the light output of the component LED after 25 milliseconds (equivalent in duration to the burst of a flash bulb).

We can't speak for everyone, but we're pretty sure that most of you reading this article probably use your lights longer than 25 milliseconds at a time, which means that your light output is going to be less than the raw lumen value. How much less? That will depend upon the thermal management of the light, but the loss is typically in the neighborhood of 10% to 25%.

The other major factors that raw lumen output figures fail to take into account are the current used to drive the LEDs, optical losses and assembly variations. Driving a higher current through an LED will produce more light, but it also make the LED hotter (thus creating thermal losses and shortening the life of the LED).

Whenever light travels through or reflects off of a material (ex. optics, lens, reflector optics etc.), it loses some of its intensity. This loss of intensity is due to inherent losses internal to the material as well as losses that occur at the surface of the material as the light travels from air through the lens and back to air.

Any light that has optics, reflector optics or a lens will fall victim to these losses - there's no getting around it. Couple these optical losses with assembly variations, and you've got an additional 20% to 50% decrease in light output that the raw lumen figure doesn't account for.

Effective Lumens

So now that we've covered why raw lumens is a theoretical measure that fails to account for real world losses, let's talk about effective lumens. The effective lumen output is an actual measurement of light output that does take into account all of the real world losses we've just discussed.

Measuring the effective lumen output of a light requires the use of high-tech photometry equipment. Because of the cost and expertise involved in conducting photometric testing, some manufacturers opt to "cut corners" and simply use the theoretical raw lumen numbers. This makes it very difficult to make an apples-to-apples comparison between lights and often results in consumers receiving less useable light than what's advertised.

To illustrate this point, let's take a look at a practical example. LED Light #1 has an output rating of 2,000 raw lumens and 1,000 effective lumens. LED Light #2 has an output rating of 3,000 raw lumens, but only 500 effective lumens.

If you were basing your decision solely on raw lumens, Light #2 would be the clear choice. Once you turn both lights on, however, Light #1 would be twice as bright as Light #2. Light #1 is brighter because it has the higher effective lumen output.

J.W. Speaker wants you to be informed when selecting LED lighting, so we encourage you to challenge manufacturers and lighting sales reps to provide both the raw and the effective output numbers so that you have the whole picture.

Additional information can be found on J.W. Speaker’s website: www.jwspeaker.com.