1

Building a Layout: As Seen in a Different Light

From the time of Thomas Edison onward, we've judged the brightness of a light bulb by using the term watts. For instance, a 60-watt bulb was brighter than a 40-watt bulb; a 100-watt bulb was brighter than a 60-watt bulb, and so on. That has been the way we judged how bright the light was on our layouts (or on anything else, for that matter) from roughly 1879 until just a few years ago.

The problem is, we all got lazy and comfortable with a slight misunderstanding concerning what the term watts really meant. It wasn't our fault. We actually had no need to measure the brightness of a light bulb in any other way because light bulbs were all made the same way. How many watts of electricity was the only way to change or evaluate the brightness. The term watts and the brightness of a light bulb went hand-in-hand. Simply put, the brightness of the light bulb increased in direct ratio to the amount of current that was used to light the bulb.

Ah, but that was then, and this is now! With incandescent light bulbs, the real definition of watts is a measurement of how much electrical current is flowing through the filament of the light bulb to get to a certain level of brightness the light bulb is producing.

Now, however, there's a new kid on the block. This "new kid" is something called *Light Emitting Diodes*, or LEDs. Originally, LEDs were not even considered something to think of as *light producing* as much as they were just little ways to indicate whether something was turned "on" or not. They were the tiny little red or green light indicators used on nearly every electrical device we now use in our world.

But something absolutely fascinating has evolved in the past few years. Technology has found ways for the LEDs to emit more and more light of any color you'd like until they have now become an alternate way to actually produce light, eventually replacing Thomas Edison's incandescent light bulb forever. The most remarkable thing about the LED is that they produce light so efficiently that they use far less electricity to produce the same amount of light as emitted by an incandescent bulb.

But that resulted in another problem. What do we use to measure how much light an LED produces compared to an incandescent light bulb? It can't be watts like we traditionally used because the brightness of a 50-watt incandescent bulb can be exactly duplicated with a 7-watt LED bulb. Think about that! The brightness of the two bulbs are equal, but the amount of electricity they use to get there can save you up to 86% on your electricity bill simply by switching from incandescent bulbs to LED bulbs.

The new term used to measure the brightness of light produced electrically is called *lumens*. A quick trip down the lighting aisle of a Lowe's, Home Depot, Menards, or any other big box store will give you a great education on this term. Now the packaging for a light bulb and/or an equivalent LED notes the watts it uses to make the light, but also the amount of lumens the light puts out. As an example, take a look at Photo 2 showing an LED light bulb that produces the equivalent amount of light as a 50-watt incandescent light bulb. It identifies itself as a "50W Replacement" light; but because it is an LED, it only uses 7 watts of electricity to produce that much light. In the lower left corner of the packaging it also states that the amount of light is now measured as "500L"(lumens). So now we have some understanding of the terms *watts* and *lumens*. An incandescent 50-watt bulb and a 7-watt LED bulb each put out about 500 lumens.

Don't be confused by another energy-saving light that is also available. There is something called a halogen light (Photo 3), which is a technology that has been around much longer than an LED. It does save some electricity, but it is still not anywhere near as efficient as an LED light. As you can see by the packaging, it only produces about 475 lumens, as compared to 500 lumens from an equivalent LED. Furthermore, it saves only about 11 watts per 50-watt-bulb equivalent, as compared to a 43-watts savings with the LED light.

There is still a third term we need to learn something about. Have you ever noticed that the colors of things you are already familiar with sometimes look very different depending on what the source of light is? Photographers have long known of this effect due to the many different types of light used in photography. Some types of light make things look slightly *blue*, while others make the same image look more warm, or soft. There is a reference to that on the LED shown in Photo 2, where it says *Warm White*.

The real term for defining the color of light produced is *temperature*, even though it has nothing to do with the actual heat being produced by the respective bulb. When it comes to

2

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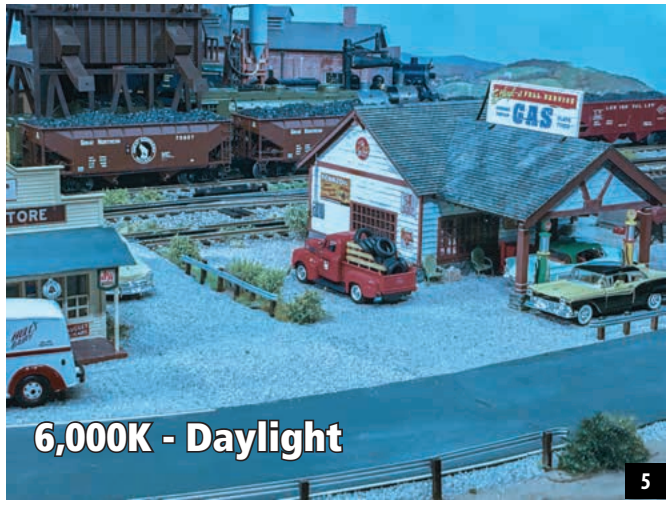

light-producing devices, temperature only means the actual color of the light it makes. Color temperature is measured in kelvin, or simply K. That is what determines how the overall color of the image is going to appear. Have you ever noticed how things look more blue when illuminated under standard workshop fluorescent light? That is because the color temperature of the light put out by standard fluorescent tubes is different than what is put out by standard incandescent light. Some fluorescent tubes are color-corrected for this and are engineered to put out a warmer light than standard fluorescent tubes. Commercially, they are often labeled as *warm white* or *kitchen and bath light*.

Okay, let's review. Temperature, as it applies to lighting, is measured as kelvin, or simply *K*. That number is how you determine the overall effect that is going to be produced by the lighting product you are going to use. Photo 4 shows the packaging on a pair of standard 48″ long fluorescent tubes (the ones shown are the smaller 1″ diameter tubes) like the ones commonly used in workshops or laundry rooms. They are called a *cool white* tube because, as they show on the little scale, they put out a 4100 K (or kelvin) light value, which is cooler or bluer than a warm white tube. To reduce all that jargon to the simpler kelvin temperature ratings, we consider a *warm white* tone to be anything in the range of 2700 to 3000 kelvin, or K. A light in the range of 4000K to 6000K would be referred to as a *cool white* light.

Photo 5 shows the same scene used at the opening of this article, but with the temperature (kelvin) ratings of the light used to make the four different appearances. This will give you a clear example of kelvin temperature rating on light and what the result will be on objects on your layout. The *warm white* temperature range between 2700 and 3000 kelvin gives things a warm tone, more like the color your eye would see with outdoor sunshine. The higher number K ratings shown (4000K to 6000K) are the *bright/cool white* color tones given off by standard commercial fluorescent tubes.

Most recently, there is even a new tube on the market for us to use that makes things really simple. Yes, there are even LED tubes out now to replace fluorescent tubes. Photo 6 shows the end of a 48″ long, 1″ diameter LED tube that exactly replaces a fluorescent tube of the same dimensions. The fluorescent tube pictured in Photo 4 uses 32 watts of electricity to put out about 1900 lumens of cool white brightness; but the LED tube uses only 18 watts to put out 2000 lumens of 3000K (or warm white) light. But here comes the best part.

The expected life of the LED tube is 50,000 hours! Let me do the math on this. If you burn the lights in your train room an average of four hours every day for five nights every single week, you won't be replacing tubes for about 48 years! I don't know about you, but I think these LED tubes are going to outlast me! And the amount of electricity you will use will drop by 43% as well.

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Until recently, one catch was that a slight amount of rewiring was needed on your overhead light fixtures to convert them to be able to use LED tubes, but even that has gone away now. If you Google "Luxrite 4FT LED Tube Light, T8, 18W (32W Equivalent), 3000K Soft White, 2000 Lumens, Fluorescent Light Tube Replacement, Direct or Ballast Bypass," the 25-tube pack displayed will sell for about $314, or about $12.56 per tube. Just remember, you will never need to replace them for about 48 years. That makes the $12.56 look pretty darn good compared to five or six standard fluorescent tube replacements over that same time period.

My layout room has both 4′ tubes and also track lights for regular screw-in bulbs. I did this because I wanted to be able to dim the lighting on the layout to produce any number of effects. Fluorescent tubes (and 48″ LED tube replacements) don't dim, but incandescent as well as LED light bulbs *do* dim. That's what the track lights are for. Back before LED bulbs, when I installed my track lights, I bought and installed a commercial grade light dimmer (Photo 7) that would handle 2,000 watts, or a total of about 40 incandescent bulbs.

It should be noted that a dimmer works by holding back the watts that don't make it to the light bulb and converting them to heat. On a commercial grade dimmer, that heat is absorbed in the fluted heat sink base shown under the faceplate of the dimmer switch visible in Photo 7. I quickly found out that dimming down as many as 40 incandescent bulbs produces a great amount of heat in the finned baseplate! To be on the safe side, I cut back the number of lights being dimmed to only 25. That did cut the heat down, but it sort of defeated my purpose of using a dimmer in the first place. I wanted to use a large number of "spot" bulbs as compared to "flood bulbs" to highlight interesting scenes on the layout. The result was there wasn't enough overall light on the layout to satisfy me. When 7-watt LED lights came out, that changed things dramatically. Now, I could use as many as 175 LED lights if I wanted to and have no more total watts than 25 incandescent lights on the dimmer. Wow!

That one change allowed me to convert to ONLY "spot" type LED bulbs and still have more than enough light for the entire layout. And they could all be dimmed from intense noonday sun to dusk or dawn light simply by turning the dimmer wheel. Since my overall number of LEDs was still only about 75, as compared to 35 incandescent bulbs, my total energy consumption was still down by 70%. I love it when technology works in our favor for a change!

So let's have a short review relating to watts, lumens, and temperature.

Back when we only had incandescent and fluorescent lights to deal with, we only used to think about lighting in terms of watts. Now, with LEDs replacing both standard light bulbs and standard fluorescent tubes, we need to think about watts, lumens, and temperature. Watts is how much electricity they use, lumens means how bright they are, and temperature relates to the color of the light that is produced.

On a broader note, don't just think about this in relation to your train layout. Think about converting absolutely *everything* in your home to LEDs. The more you do, the more you save!