

Table of Contents

1. Introduction
2. What is an LED light and how is it different?
3. The Attraction of LED Lighting for RVs
4. Differences between LED and incandescent bulbs

Brightness

Color Temperature

Voltage Tolerance and Warranty

Dimming Capability

Radio Interference

5. How to Choose the Right Bulb

Bulb Fitting (Base)

Fixture Types

Brightness

6. Choosing the Right Supplier

7. Where to Start

1. Introduction

Visit any RV rally and you'll see numerous vendors with brightly illuminated booths offering LED lights of various colors and styles. Check out the prices and you'll find that these bulbs are considerably more expensive than their "traditional counterparts". So what's the deal? Why are RVers spending money to replace their existing bulbs with LED's, especially when many of their existing bulbs don't need replacing?

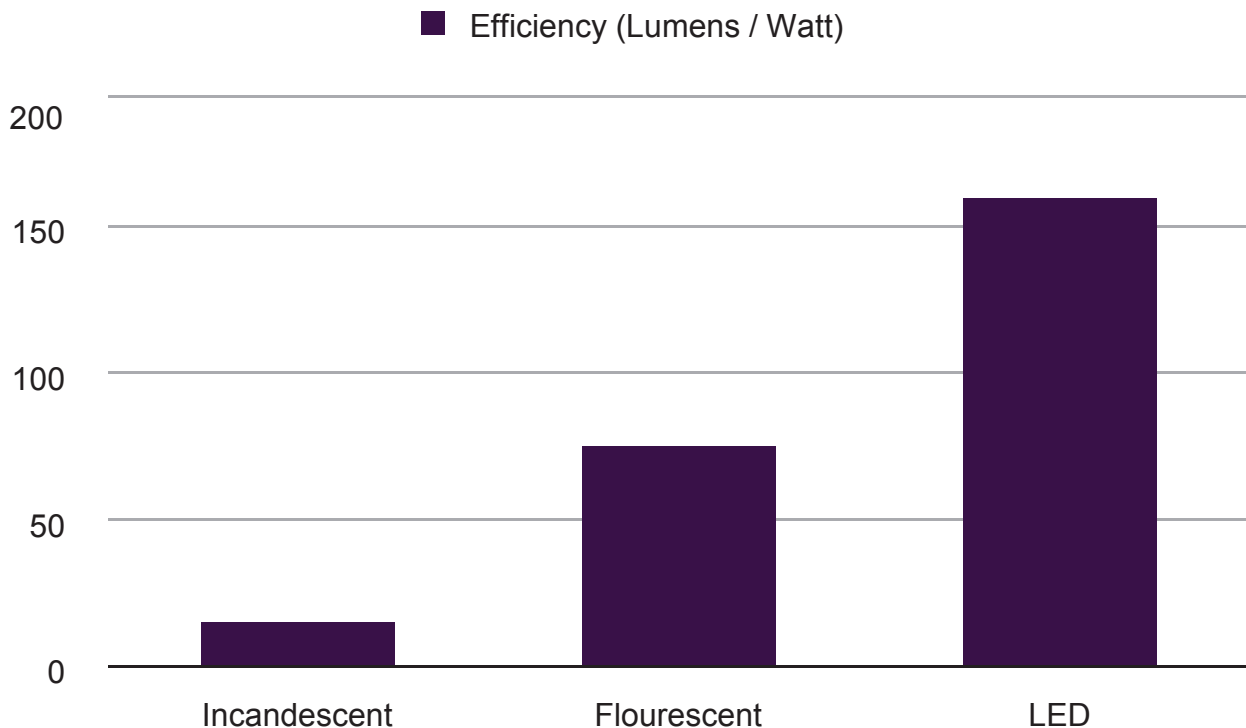
This guide is intended to explain the background to LED lighting, what makes them attractive to RV'ers, how and why are they different, what to look for when selecting a particular bulb and how to choose the right vendor.

2. What is an LED light and how is it different?

The LED or Light Emitting Diode was invented as far back as 1927 by a Russian with the illustrious name of [Oleg Vladimirovich Losev](#). However, it wasn't until 1962 that Nick Holonyak working at General Electric Corporation produced the first practical LED. With advances in technology, the efficiency and light output continued to increase, together with the ability to product light in a wide variety of colors.

The LED produces light “directly” by utilizing semiconductor technology. As electricity (electrons) move through the semiconductor, they move from one energy level to another and release energy in the form of light (a photon). This compares to incandescent lights which produce light light by passing current through a filament. As it heats up, the hot filament releases energy (heat). Only 10% of this heat energy is what we see as light.

Fluorescent lights are four to five times more efficient than incandescent lights as they operate in a more similar manner to LED's (electrical energy releases ultra-violet light from a mercury vapor which causes light to be emitted from the phosphor coating on the inside of the tube). Although more efficient, they are less versatile, and are potentially hazardous since they contain phosphor and mercury.



3. The Attraction of LED Lighting for RVs

Because of these differences in technology, LED lights offer numerous advantages to the RV'er:

High efficiency	LED lights are currently more 10x as efficient as incandescent lights and 2x as efficient as fluorescent lights. This means that for a given light level, your overall power consumption can be drastically reduced, putting less strain on your coach batteries and converter and a longer time between charges.
Heat output	LED's generate much less heat than an incandescent bulb of similar brightness. This is especially noticeable for halogen lights which are used extensively in the ceilings of RVs and can get extremely hot (more than 500oF, enough to ignite many materials).
Long Life	LED's can last between 35-50,000 hours compared to 10-15,000 for fluorescents and 1-2,000 for incandescents
Shock Resistance	LED's are "solid-state" with no delicate filament to break, helping contribute to their long life.
Light color	LED lights can emit lights at a "color temperature" very close to natural daylight making them very easy to read by and "comfortable" on the eye.
High output	LED's offer the ability to increase the light output of a particular fitting without worrying about increasing the heat output. This can be especially useful in areas used for reading, cooking or eating.

As you know, the average RV converter supplies about 55 amps at 13.6 volts dc which charges your coach batteries and runs the 12v electrical system which is basically your lighting, fantastic fan vent, water pump, etc. If we assume that you have approx. 12 light fittings each with 2 bulbs, that's a total of 24 bulbs. If they were all on at the same time, the "draw" on your converter will be around 30 amps or about 55% of its total capacity, just to keep the lights on. Switching to LED's would reduce this draw to just 6 amps or 11% of its capacity. Put another way, you can run your LED lights for 10x longer on a single battery charge, not to mention the reducing the strain on your air conditioner on a hot day or evening.

4. Differences between LED and incandescent bulbs

We've talked about the differences in the technology and some of the advantages that gives us. But what about the other differences that we need to think about?

Brightness

Typically people measure the "brightness" of bulbs by comparing the number of watts. Actually, a watt is a measure of the amount of electricity that the bulb is consuming over time. The inference is that if a bulb consumes more electricity, then it must be brighter.

For example, we think of a 100W is twice as bright as a 50W bulb. Not true, as standard incandescent bulbs continue to get more efficient with increasing wattage so it is actually more than twice as bright. Another problem is that the human eye does not perceive brightness in a linear fashion. Put another way, if you double the light output, we only perceive a 1.5x brightness increase¹. Because LED's are much more efficient than incandescent bulbs we therefore cannot use watts to compare their brightness. We need to use a different measure, which most commonly is the lumen. A lumen is a measure of luminous flux which takes into account the eye's varying sensitivity to different wavelengths.

A typical 10W 12v halogen bulb is 140 lumens. It's replacement LED can be anywhere from 200 to 600 lumens.



Color Temperature

Have you ever noticed that the world looks different at sunset than it does at midday? That's because the "color" of the light changes during the day and causes the color of the light reflecting off objects around us to change (this is why people say you should photograph the Grand Canyon at sunset as it enhances the colors). At sunset things look richer and more orange, at midday, they look whiter.

People refer to the color of light as it's "color temperature" using the kelvin scale. A lower number (e.g. 2,000) is more orange (such as at sunset) and a higher number (e.g. 5,000) would be noon daylight.

¹ <http://hyperphysics.phy-astr.gsu.edu/hbase/vision/bright.html>

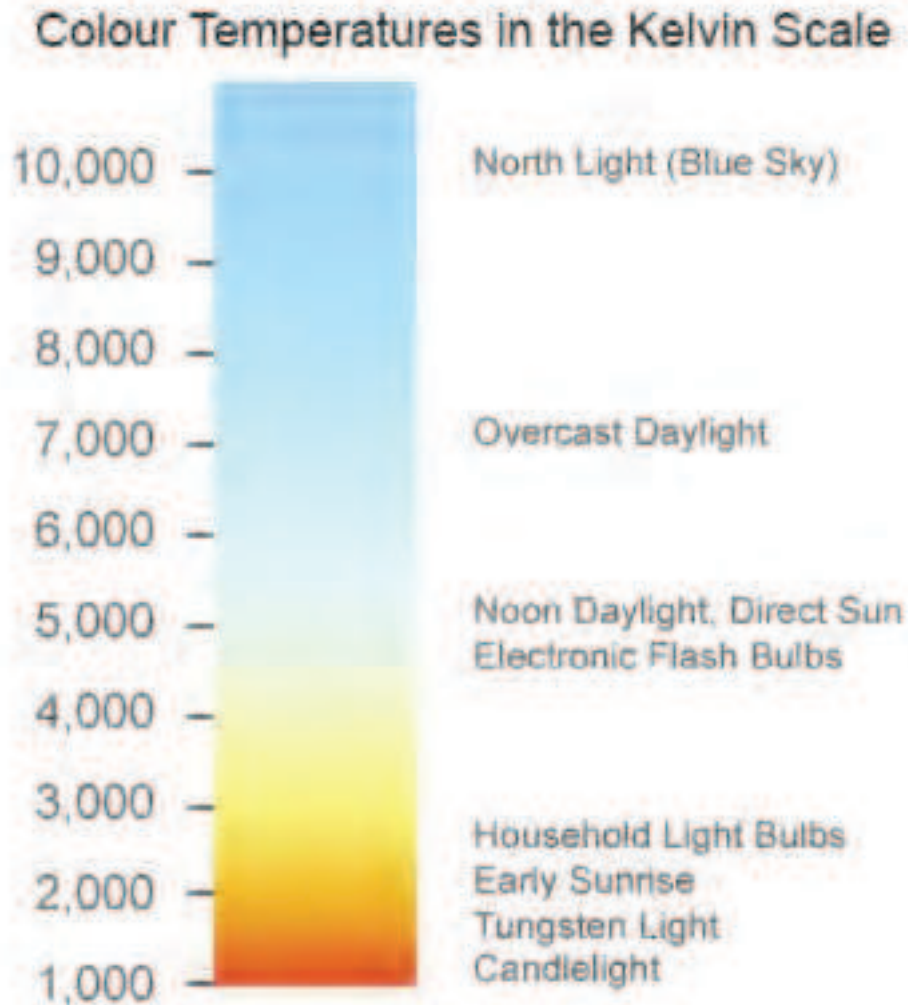


Image courtesy of www.mediacollege.com

When considering LED bulbs, it is therefore very important to think about what color temperature you require as most LED bulbs are available in “warm white” (a lower kelvin) or “cool white” (a higher kelvin). Most people prefer cool white in areas requiring more light as they perceive these to be brighter and easier to read by. Warm white LED’s are closer in color to incandescent bulbs and offer a cozier and more “homely” feel.

Remember that you don’t need to use the same color temperature throughout your RV. You could use cool white in bathroom and kitchen areas for maximum illumination and then warm white in the bedroom and over-head sitting room lights for a warmer feel.

Voltage Tolerance and Warranty

Since incandescent lights use a heated filament to produce light, they are very resilient to changes to voltage. For example, a 12v bulb will run on 6v (just more dimly) and can

stand 24v for short durations. By comparison, LED bulbs are designed to operate at a certain voltage. Outside of that range, they can malfunction or be even be irreparably damaged. The problem is that even though an RV's lighting is 12v sometimes it can get as low as 10v when boondocking. More troublesome is voltage spikes caused by motors such as the water pump or exhaust vent switching on and off.

It's very important when looking at replacement LED's for your RV to understand what voltage range and surge suppression they offer. Most low-cost bulbs will not offer this type of information as they are "generic" LED lights not designed specifically for an RV.

Another way of getting an indication of their voltage tolerance is to look at the warranty offered. Even though LED's can last 50,000 hours (almost 6 years), manufacturers know that they rarely get this life due to voltage spikes, especially if they aren't designed for RVs. The warranty offered is therefore a good guide to their level of protection. For example, Camping World offers 1 year, and many vendors don't specify the warranty at all (if it doesn't say, there probably isn't any)

Dimming Capability

It discussed above, most LED's won't work below a certain voltage. This makes dimming them more difficult as many dimmers found in RVs simply reduce the voltage to dim the lights. If you have dimmers on your circuit, be sure to check that the LED's you are considering will work with dimmer switches. Since there are different types of dimmer switches, it's actually very hard to predict if a dim-able LED light will work with your dimmer, the best way is just to try it.

Radio Interference

As we've discussed already, LED's work differently to incandescent or fluorescent bulbs. In order to maximize efficiency and diode longevity, each LED requires switching drive circuitry to maintain a constant current. This circuitry operates at very high frequency and can cause RF (radio frequency) interference, particular to TV stations. Each LED bulb tends to have different circuitry, so it's a very hard thing to predict, so the best advice is to try-before-you-buy.

5. How to Choose the Right Bulb

Choosing the right replacement bulb for your light fitting isn't as easy as you might think. Here is a list of things that you should think about:

Bulb Fitting (Base)

12v RV bulbs come in a variety of fittings. The best thing to do is to take the bulb out of the fixture and look at the end to see what style it is. Here's a collection of the most common fitting styles with their names:

G4 / JC10W (halogen)

Can be back-facing or side facing (i.e. is the bulb perpendicular to or parallel to the ceiling)



T10 (wedge)

BA15S (single contact)



BA15D (dual contact)



E27 (screw)



Fixture Types

Once you've determined the correct base, you should think about the type of fixture that you are using. The two basic styles here are the "down-facing" fixtures and the fixtures with shades or globes.

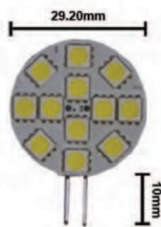
Clear Lens Down-lighter

If the bulb is horizontal and is lighting downwards, then a “pancake” style of LED light might be best as all the LED’s face in one direction.



Halogen “puck” Style

These halogen lights usually have a glass cover with a side holder which is released with a 1/4 twist. Always check to see if your halogen light is like this (side facing pins) or vertical (back facing pins). Also check to see if you have a dimmer on the circuit as not all LED’s will work with dimmers (HannaRV.com’s do).



A 10W halogen bulb is around 140 lumens. A 13 LED replacement bulb will give you around 150 - 200 lumens. HannaRV.com offers a replacement LED with 32 LED’s providing over 400 lumens, ideal for areas requiring more illumination.

Shaded Wall Light or Sconce

If the fixture features a shade such as a sconce or globe, then a 360 degree “stick style” of replacement LED might be best giving an even distribution of light.



These LED's are polarity dependent, if they don't work, simply reverse them in the fitting

Shaded Ceiling Light

If you want to increase the illumination from this fixture, then we would suggest a pancake style LED in which all the LED's are facing down. This will produce the brightest light, but will not provide even illumination across the shade. For that, you would need to go with the "stick-style" bulb.



Be careful to look at the bulb fixtures inside as some are back facing and some are side facing.

Directional "Reading" Light

Some fixtures such as these "eyeball" style reading lights are directional. Replacements for these are specific bulbs with directional LED's to product a spot-light effect.



Fluorescent Tubes



Fluorescent tubes are quite popular in RV's as they are more efficient than incandescents. They can be replaced for LED's, however most require you to by pass the ballast (see the section on flourescents. HannaRV.com's replacement tubes are plug-and-play and do not require the ballast to be bypassed.

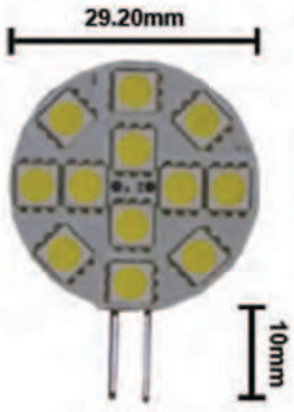



Brightness

Some LED bulbs come in different brightness or lumen ratings. Think about where this bulb is going and do you want more or less light than you already have. Color temperature (discussed already) influences the perceived brightness with cool white being brighter.

For example, HannaRV.com offers two different halogen replacement bulbs. One with 13

LED's provides around 200 lumens which is about 40% brighter. They also offer a 36 LED halogen replacement which provides almost 600 lumens which is more than 3x as bright. Customers have found these extremely useful for increasing their illumination in areas such as over a kitchen counter, over a reading chair or over a table.

	
<p>13 LED halogen replacement providing 200 lumens</p>	<p>36 LED halogen replacement providing over 400 lumens</p>

6. Choosing the Right Supplier

There are countless suppliers of replacement LED lights for your RV (a search on Google brought up over 9 million hits). Here are some things to think about as you are choosing your supplier.

<p>Reputation and Customer Service</p>	<p>How reputable is the supplier? How long have they been in business? What sort of customer reviews do they publish? What is their return policy? Do they have any negative reviews on the forums or complaints at the Better Business Bureau?</p>
<p>RV Experience and Suitability</p>	<p>It is very easy nowadays to import cheap LED lights from China and sell them on the internet claiming that they are suitable for RVs. What testing has the company performed on their products? Do they offer RV specific advice?</p>
<p>Warranty</p>	<p>What warranty is offered with the LED's?</p>

Product Range	As we have discussed, LED's differ in their color temperature. If your supplier doesn't offer a complete range you will be forced to buy from different suppliers, each of which will have a slightly different color temperature causing an unsightly "blotchy" look to your interior.
Industry Presence	If you have a problem, will the company stand by their product? Do they attend the various RV rallies and offer free product exchange and assistance with installation?

7. Where to Start

All of this can be a little overwhelming I'm sure. I remember when we first started thinking about carry RV LED lights it took us over two years of research before we finally selected a supplier. Luckily our supplier Eco-LED is a Canadian company and one of the reasons that we selected them is that they are designed specifically for RVs and so have a wealth of knowledge. During my training at our first rally (the GoodSam Rally in Louisville) I remember being completely bamboozled with all the different types, styles and names. Hopefully this guide is useful in passing along some of what I've learned:

- Think about why you're considering it and let that guide you
- Start where you'll get the most "bang-for-your-buck". For example, your halogen bulbs give out the most heat, use the most current, fail more frequently, and are most expensive to replace making them an ideal place to start.
- Choose your supplier carefully.
- Start small. Try a few different styles and color temperatures, after all, you're spending a lot of money and you want it to look right (and you want *everyone* to be happy if you get my drift!).

Hopefully this guide has been a useful resource for you. HannaRV.com strives to help educate our customers to enable them to make informed comparisons. If you have any questions, feel free to contact us at hannatrailers@yahoo.com or you can call us at 414-762-7950. If you need help choosing the right bulb, many of our customers take photos of their bulb and fixture with their smart phones and then email them to us.