

**MIGHTY
BRIGHT®**

It's a Bright Idea!

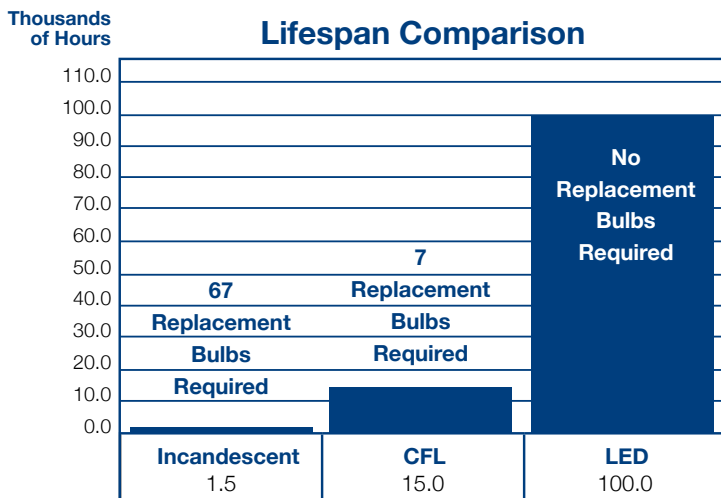
• Measuring Brightness for Music Lights •

Measuring Brightness

It is important to understand the standards used to measure light output in order to enable fair comparisons of lighting products. The terms and measurements used to rate lights have evolved as technology has provided different types of lighting.

Until recently most electric lights used incandescent bulbs, the brightness of which was measured in Watts of electrical power delivered to the lamp. The traditional, incandescent light bulb glows as electricity heats a metal thread inside of a sealed glass bulb (filament) to approximately 3,000 degrees Kelvin. This is not very energy efficient - 98% of the energy used by incandescent bulbs is in generating heat, not light.

Over the past decade, the advancements in light emitting diode (LED) technology have resulted in the broad use of LED lights for many of the applications that were historically handled by their incandescent predecessors. The wide acceptance of LED light technology has increased rapidly as LED lights have proven to be superior to incandescent bulbs in both efficiency and longevity. Compact fluorescent lights (CFL) fall into this category as well. Typical LED lights have a lifetime of up to 100,000 hours or more without generating heat. Also, they are generally far more resistant to physical trauma than incandescent or fluorescent lights.



Due to the inherent efficiency of LED lights, the simple "Watts of power" measure is no longer useful for the comparison of various light sources. More universal and fundamental standards are now used to provide a more meaningful comparison. The following provides information about measuring light in lumens and lux. At a pre-determined lux rating battery lifetime can be determined.

Measuring Light and Efficiency

Now that measuring light in Watts is no longer as meaningful, several alternative methods to measure light output have been developed.

Perhaps the most fundamental unit of measurement for any visible light source is lumens. A measurement

in lumens indicates the quantity of visible light produced by a light source. This method takes into consideration the varying sensitivity of the human eye to different wavelengths of light, but does not consider the angle of the light beam or the distance to an illuminated surface.

Lumens ratings provide a basic benchmark for evaluating various light sources and are useful in the comparison of LED lights. Mighty Bright has measured the maximum lumen ratings for each light and made them available in catalogs and in this paper.

In addition to lumen ratings each Mighty Bright light has a Lamp Efficiency rating which is measured in lumens per watt (lm/w). The average Mighty Bright LED light is very efficient with a rating of 40 lumens per watt. This means very little energy is required for illumination. This level of efficiency is much better than the Mighty Bright Classic incandescent light. The Lamp Efficiency rating of the Classic is 8 lumens per watt. Mighty Bright LED lights are 5 times more efficient than the Classic incandescent light. Higher efficiency means consuming fewer watts which translates to lower electricity usage. And lower electricity usage will save money by reducing the frequency of battery replacement.

When it comes to the illumination of an object like a book, or sheet music, or a craft project then another method of measuring light is equally important. The measurement of light in lux is used to quantify the light intensity on a surface. This indicates how well a particular surface is illuminated at a predetermined distance from a light, not the overall brightness of the light.

The range of lux can vary from a full moon at 0.25 lux to sunlight at 100,000 lux. A comfortable lighting level for an office environment on the surface of a desk is about 500 lux. For most tasks, there is no additional benefit for lighting levels over 1,500 lux. Mighty Bright has established a pre-determined threshold for personal lights that assumes a light level down to 10 lux will be useful for most people. At this level of illumination text can be easily read and objects can be viewed with clarity.



Luminance is the intensity of light that is leaving a surface and is measured in lumens.



Illuminance is the intensity of light that is falling on a surface and is measured in lux.

Example of lux versus lumens

Lux is directly related to the area over which lumens are spread. A light with 1,000 lumens, concentrated into an area of one square meter, lights up that square meter with an illuminance of 1,000 lux. The same 1,000 lumens, spread out over ten square meters, produces only 100 lux.

How do you compare a 60 Watt light bulb to an LED light?

This is a popular question that may lead to an apples-oranges comparison if you use lumens. If you only compare the lumens rating of each light it will not explain the difference of illumination on the page. To understand the difference in illumination from incandescent and LED sources a comparison should be made between the lux levels on the page from each light source. The lux level that illuminates your page when you're reading a book is a factor of the brightness of the light source, the angle the light travels, and the distance from your book. LED book lights are typically clipped on close to the subject and incandescent lights are usually in a lamp farther away, so we can make some assumptions about distance and calculate a meaningful comparison.

Light Type	Lumen rating	Distance between light and book	Lux measured on page
Incandescent Table Lamp (60 Watt Bulb)	900	5 feet	31
LED XtraFlex 2 (2 LED lights)	12	4 inches	382

What This Means To You

A book, music or craft light should be evaluated for other features in addition to light output and illumination. The usefulness of a personal light is its ability to illuminate the subject when and where light is needed – portability. Battery life plays a key role in providing the required amount of portable illumination. Eco-friendly LEDs last a very long time and are energy efficient. Long LED lifetime and efficiency saves consumers money in replacement lights and batteries.

Light output measurements in lumens are typically captured with batteries that are fully charged. Light output decreases gradually as battery power is decreased with usage. Although a manufacturer can indicate a battery lifetime, a standard way of identifying the minimum light output for reading or tasks does not exist yet. The lighting application and eyesight determine when to replace batteries. This results in some people not replacing batteries until an LED light is extremely dim.

The following table summarizes Mighty Bright LED Electronic and Photometric Characteristics of each Mighty Bright light.

LED Light Description	LEDs per Head	LED Heads	White LED Total	Red LED Total	Total LEDs	Batteries (Quantity & Type)	Includes Batteries	A/C Adapter Compatible
Micro Lights (Carabiner, Keychain, Micro Clip, Roadie Lights)	1	1	1	0	1	2 CR2016	Y	N
XtraFlex Music Light	1	1	1	0	1	3 AAA	Y	N
Duet	1	2	2	0	2	3 AAA	Y	N
Triple LED Music Light	3	1	3	0	3	3 AAA	Y	Y
Pedal Board Light (White/Red LED)	2	2	2	2	4	3 AAA	Y	Y
Duet2 (with AC Adapter)	2	2	4	0	4	3 AAA	Y	Y
Duet2 (no AC Adapter)	2	2	4	0	4	3 AAA	Y	Y
Orchestra Light - High/Low Settings (US, UK, Euro)	9	2	9	0	9	3 AA	Y	Y

Without a standard way for consumers to measure the amount of battery charge remaining it is difficult to predict when battery life is perceived to “expire.” As a general rule a comparison to the light of a full moon is a good way to gauge battery life and the effect on LED brightness.

Mighty Bright has measured battery life relative to how long the light output stays above 10 lux (a minimum amount of light required for reading or tasks). Please keep in mind that while battery lifetime ratings are available for Mighty Bright lights, many LED lights will continue to provide some level of illumination for hours or even days beyond these ratings.

A/C Adapter Included	Input Voltage (DC V)	LED Lifetime Rating (Hours)	Total Lumens (lm)	Lamp Efficiency (lm/w)	Battery Lifetime @ >10 Lux (hrs)	Products Available from Mighty Bright (Item Numbers)
N	6 V	100,000	8	40	24	50612, 8061A-24 8071A-48, 8191A-36
N	4.5 V	100,000	6	40	32	50410, 50412
N	4.5 V	100,000	12	40	28	50810
N	4.5 V	100,000	14	40	24	50210, 50212
N	4.5 V	100,000	12/4	40	20	52010
Y	4.5 V	100,000	24	40	20	51810
N	4.5 V	100,000	24	40	20	51820
Y	4.5 V	100,000	54/36	40	16/24	53510

Notes:

- 1) Lamps were tested with new Hi-Watt fully charged batteries. Longer battery life is available with Alkaline batteries.
- 2) Results may be different with AC adapter power.
- 3) Lamps were tested with all LEDs in the ON position.
- 4) Results may vary with standard deviation ~10%.
- 5) Battery lifetime defined as 10% of initial output power or as 10 Lux level.
- 6) Lux measurements are taken at a distance of about 4 inches (or 10 cm).

Luminous Flux (lumens): The most universally accepted unit of measure for total light flux (output power) from a light source with consideration for the varying sensitivity of the human eye to different wavelengths of light. This unit is independent of the beam angular distribution or distance to measurement surface such as luminous intensity (candela) or illuminance (lux).

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