

ELECTROLUMINESCENT LAMPS

BY

LUMITEK  TM
International, Inc.

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INTRODUCTION

Welcome to Lumitek International, Inc.'s Electroluminescent Lighting. Our aim is to provide you with the latest in electroluminescent lighting technologies and systems to meet your military, industrial and commercial lighting needs. Our sales and technical staff provide complete design and engineering support for your specific product requirements and deliver reliable electroluminescent lighting systems for a wide range of applications.

When purchasing electroluminescent lighting products from Lumitek, you receive one of the brightest and most efficient electroluminescent lamps on the market. If you need a lighting solution, we offer the following benefits:

- ▶ **Complex lamp shapes and geometrics** made to customer specifications; lighting systems are designed around your needs so they can be employed in areas inaccessible with conventional lighting.
- ▶ **Cold light sources**; electroluminescent lamps produce virtually no heat, making them ideal for use in areas where heat from conventional lighting is a problem.
- ▶ **Comprehensive range of lamp colors**; lamps can be manufactured in a wide range of colors to meet specific requirements.
- ▶ **Complete systems approach**, including lamps and electronic drivers to work with your power source; this eliminates electronic design work by you and provides a ready-to-use lighting system.
- ▶ **Shortest possible lead times** on custom quotes and product delivery, even though we offer custom configurations.
- ▶ **In-house product reliability testing and characterization**; when purchasing our products, you can be assured of reliable performance and conformance to requirements.

PRODUCT DESCRIPTION

- ▶ **Operating Principle:**
Electroluminescent (EL) lamps, as the name implies, are devices which convert electrical energy into light or *luminescence*; the term luminescence is generally associated with solids which generate light. In the case of electroluminescence, an electric field (voltage) is applied to a thin phosphor layer to produce light. The typical lamp consists of light emitting phosphor sandwiched between two conductive electrodes (one of the electrodes is optically clear allowing the light to escape). As an AC voltage is applied to the electrodes, the electric field causes the phosphor to rapidly charge and discharge, resulting in the emission of light. The brightness of EL lamps (in a certain range) can be controlled by varying the operating voltage and frequency.
- ▶ **Voltage and Frequency:**
The nominal voltage and frequency for EL lamps are 115 V (Volt RMS) and 400 Hz (Hertz or c/s {cycle per second}). These values originated from the initial aircraft use of EL lamps and represent the standard voltage and frequency in aircraft. However, EL lamp operation is not tied to these values and Lumitek lamps can be tailored to other voltages and frequencies. Varying the lamp voltage or frequency will change the lamp brightness and to some extent the color. For example, increasing the voltage increases lamp brightness, whereas increasing the frequency will increase lamp brightness and shift the color slightly to the blue. However, increasing voltage and frequency will tend to reduce lamp life. Therefore, selecting the optimum voltage and frequency will depend on the desired brightness and lamp life. Our sales engineer can determine the optimum condition for your application.

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PRODUCT DESCRIPTION (cont.)

▶ **Lamp Life:**

Unlike filament or fluorescent lamps, EL lamps do not catastrophically or abruptly fail. Instead the lamp brightness will gradually decrease over long periods of use. EL lamp life is affected by the applied voltage, frequency and environmental factors. Humidity is by far the strongest contributor to shortened lamp life. Lumitek lamps are constructed so as to minimize the effects of humidity on lamp life. However, even in the absence of humidity, the phosphor itself will gradually lose its efficiency over time and the lamp brightness will gradually decrease. Unfortunately, quantifying lamp life is difficult because of the variations in use, environmental and operating conditions. Generally, lamp life can be defined in terms of the time it takes the lamp brightness to decrease to a percentage of its original value under well defined operating conditions. Lumitek specifies the half-life of its lamps (i.e., the time it takes for the brightness to decrease to one-half its original value) and the limiting (usable) life (the time it takes for the lamp brightness to decrease to 1% of its original value).

▶ **Lamp Brightness:**

The light output of a lamp can be measured in terms of radiometric or photometric quantities. Radiometric quantities measure the total light output power of the lamp, regardless of wavelength. However, the human eye does not sense all wavelengths equally, and has a peak sensitivity to green wavelengths. Therefore, EL lamp brightness, or Luminance, is usually specified in terms of photometric units, which account for the eyes' sensitivity. Values of luminance are usually given in units of Foot-Lambert [FL] i.e. [lm/ft²], or [Apostilb] i.e. [lm/m²], or [Nit] i.e. Candela/m² [Cd/m²], etc.

▶ **Lamp Color:**

Lamp color is usually specified in terms of CIE color coordinates (x,y or u',v') or apparent color temperature. Variations in lamp colors can be obtained in one of four ways. First, the primary lamp color is determined by the phosphor type. Typical standard phosphor colors are blue, blue-green, green and yellow. In certain cases, a color different from available primary phosphor colors is required. In such cases, the color can be obtained by blending multiple phosphors, adding fluorescent dyes to the phosphor layer, or by attaching a color filter to the lamp. The most common solution is applying either a dye to the phosphor layer or an overlay color filter on the lamp. With the first process, the phosphor's primary color causes the dye to fluoresce at a different color. By careful selection of the colors, the color of choice is obtained. The second method involves overlaying a suitable color filter on the lamp which modifies the lamp color; this process is employed to obtain other colors such as NVG green. With these approaches, Lumitek can obtain a wide range of lamp colors meeting various lighting color requirements.

▶ **EL Lamp Power Source:**

Since EL Lamps generally require drive voltages and frequencies not available from batteries or AC line voltage, a conversion is needed to obtain optimum color and brightness. For battery operation, a DC-to-AC voltage/frequency inverter is needed. For line voltage operation, an AC-to-AC voltage/frequency converter is needed. However, EL lamps can be operated directly from line voltage (115V, 60Hz) where low brightness is needed. (For example, emergency, darkroom or night lights, etc.) In order to meet varying use requirements, Lumitek provides a wide range of inverter and converter packages for EL lamp operation from DC voltage (e.g., batteries) or AC line voltage. Our sales engineer can determine the optimum configuration for your needs.

▶ **Weight and Thickness:**

One of the key design attractions of EL lamps is their low weight and thicknesses. The weight of a typical Lumitek EL Lamp is a mere 0.1 gram/cm² (.001 lb/in²) and the thickness is less than 1 mm (0.040"). For certain specialized applications, other thicknesses are available.

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PRODUCT DESCRIPTION (cont.)

▶ **Minimum Bend Radius:**

Another benefit of EL lamps is that they are flexible. Typically, a bend radius of ≈ 4 cm (≈ 1.5 ") can be achieved.

▶ **Edge Seals/Bus Bars:**

A minimum protective edge seal of 1 mm (0.040"), which is considered a small seal, can be guaranteed from the lamp's lit edge. However, small edge seals have a dramatic effect on unit cost and lamp life, therefore, a seal width of 2.0 mm (0.08") is recommended. This is seldom a concern since Lumitek EL lamps have the advantage of no electrode set-back for the use of bus bar networks on the front (light-emitting side). However, a small unlit area is needed for electrical contacts and this maximizes edge seal specification flexibility as well as providing a more pleasing lamp appearance.

PRODUCT AVAILABILITY

▶ **Color Options**

Lumitek lamps are available in a wide range of standard single, mixed, and filtered colors. In addition to those listed below, Lumitek also offers custom colors to meet specific requests (our sales engineer will work with you to develop colors not listed below).

Standard: Yellow, Green, Aviation Green, Blue-Green, Blue.

Mixed: White, High-Visibility Green (chartreuse).

Filtered: NVG Green, or other colors (using color correction filters to meet customer needs).

The color of a non-powered lamp is light green, except for the white lamp which has a pink color, and the Hi-Vis lamp which has a bright green color.

▶ **Phosphor Type**

Unless specified, Lumitek manufactures EL lamps with long life micro-encapsulated phosphor and a moisture retardant "Aclar" type coating.

▶ **Sizes**

Lumitek manufactures a wide range of lamp sizes and shapes to customer specifications. For non-standard sizes, a tooling charge is applied to the first order and a drawing is usually required. Our engineering staff will work with you to develop any drawings if necessary. In addition, many sizes are available without new tooling charges.

▶ **Cables/Connectors**

All Lumitek lamps can be provided with the following choices of cables and connectors:

Connector

- * Solder Pins
- * Flex Cable with Solder Pins or Various Plugs
- * Tinned Phosphor Bronze Foil
- * Other connector type can also be specified (consult our sales engineer)

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PRODUCT AVAILABILITY (cont.)

▶ Lamp Inverter/Converter Packages

DC Source Voltage Operation: Lumitek lamps can be provided with a DC-to-AC inverter for battery or other DC powered applications. The inverters are offered as stand-alone components for customer installation, packaged for direct lamp hook-up, or pre-wired to lamps.

Line Voltage Operation: Lumitek lamps can be provided with AC/AC frequency converters. These are provided as stand-alone components or pre-wired with an AC line voltage plug for easy use.

Functions: Any of the inverter/converter packages can be provided with motion sequencing, blinking, or dimming functions for either DC or AC power sources.

All electronic drivers are manufactured to match specific lamp sizes and varying customer requirements. For specific needs, please consult our sales engineer.

▶ How to Order

When ordering an electroluminescent product, please provide the following information:

1. Lamp size (a sketch or drawing would be suitable).
2. Lamp color requirement (CIE color coordinates or peak wavelength).
3. Cable/Connector type and location.
4. Lamp inverter or converter package (if required).
5. Quantity and delivery requirements.

PRODUCT SPECIFICATIONS

▶ General

Lamp Type:.....Flexible Thick Film AC
Cover Film:PCTFE (Aclar®)*
Brightness Uniformity:.....± 15% (Typical; tighter tolerances possible upon request)
CIE Chromaticity Uniformity (x,y):± 0.03 (Typical; tighter tolerances possible upon request)
Half Brightness Time:Typically 3,000 Hours
Useful Life:> 10,000 Hours

- Aclar is a registered trademark of Allied Signal, Inc.

▶ Electrical

Nominal Lamp Operating Voltage:115 V
Nominal Lamp Operating Frequency:.....400 Hz
Max. Lamp Operating Voltage:.....140 V
Max. Operating Voltage Option:220 V*
Max. Lamp Operating Frequency:800 Hz
Max. Operating Frequency Option:5000 Hz*
Lamp Capacitance:.....~ 3 nF/in² (@ 115 V, 400 Hz)
Current Consumption:.....~ 0.9 mA/in² (@ 115 V, 400 Hz)
DC Power Option:.....DC/AC Custom Inverter
AC Power Option:AC/AC Custom Converter

* For lamp operation above 140 V or 800 Hz, the exact operating conditions must be specified.

▶ Mechanical

Max. Size (standard):10" x 20" (254 mm x 508 mm)
Max. Size (optional):.....Inquire
Min. Size:.....0.25" x 0.25" (6.3 mm x 6.3 mm)
Nominal Thickness:.....0.025" (0.63 mm)
Min. Thickness Option:.....Inquire
Nominal Edge Seal:.....0.08" (2 mm)
Min. Edge Seal Option:Inquire
Bend Radius.....1.5" (38.1 mm)

▶ Environmental

Operating Temperature:-50°C to 65°C

Storage:-50°C to 85°C; for prolonged storage, lamps should be stored in a sealed bag with a desiccant pack

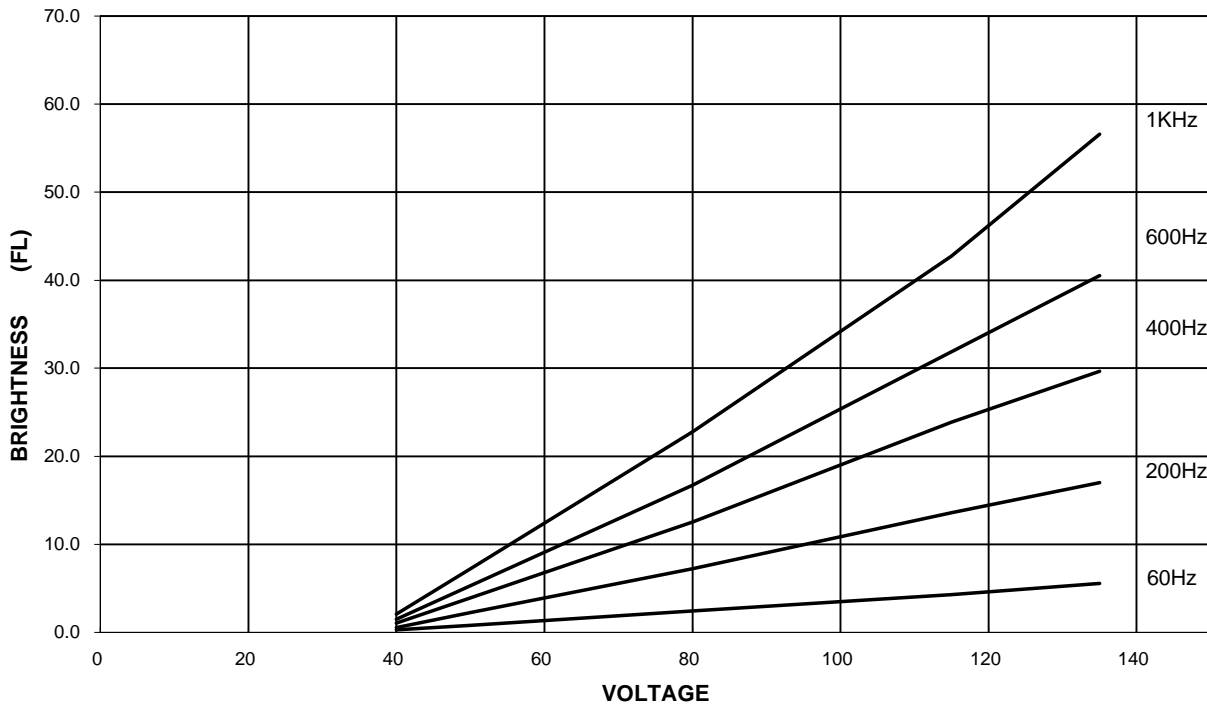
Chemical Resistance:.....The Aclar cover film resists a wide range of industrial chemicals and solvents (your sales engineer can provide a list of specific chemicals); if lamps are specified with exposed leads, they should not come in contact with corrosive materials.

Typical Performance Data (at 115 Volt, 400 Hz)

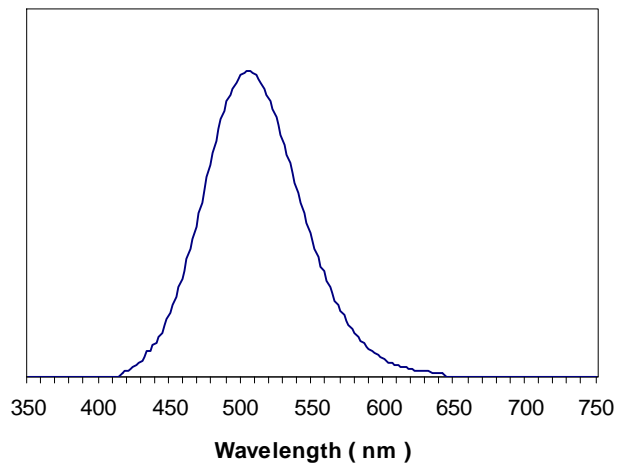
Color	Luminance		Spectral Emission Peak [nm]	Chromaticity (+/- .03)	
	[FL]	[Cd / m ²]		x	y
Green	16-22	55-75	510	0.18	0.43
NVG Green	07-10	25-35	518	0.18	0.66
Blue/Green	15-20	50-70	510	0.18	0.37
Hi-Vis Green	16-22	55-75	514	0.22	0.61
White	15-20	50-70	N/A	0.31	0.38
Blue	07-10	25-35	462	0.16	0.20

* Higher or lower brightness and other colors are available.
Consult our sales engineer about your specific needs.

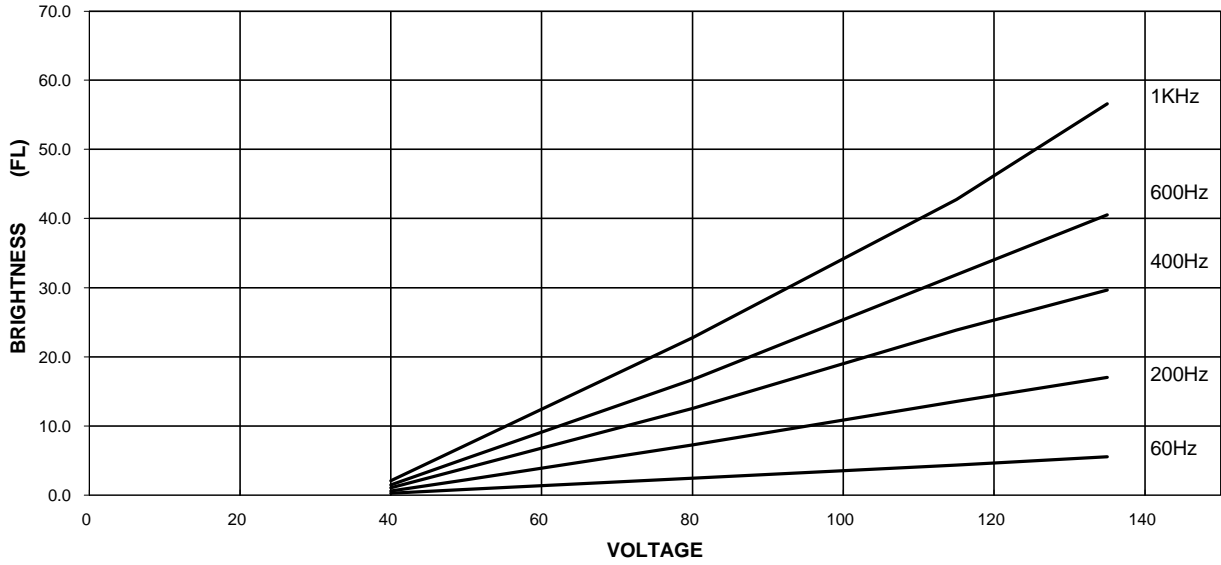
EL Lamp Brightness vs. Voltage GREEN



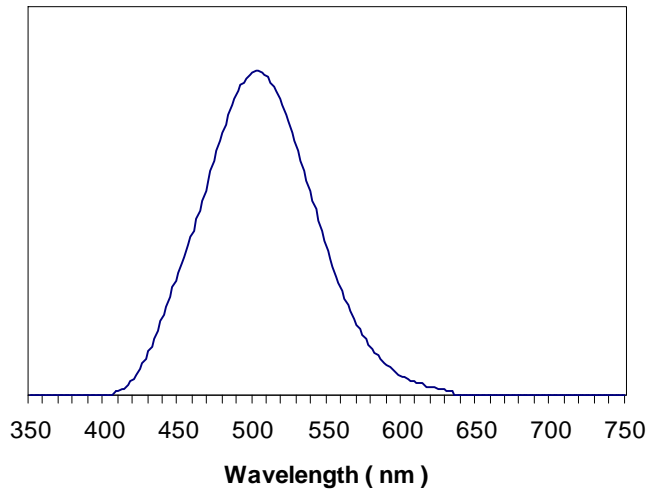
Emission of Green Lamp



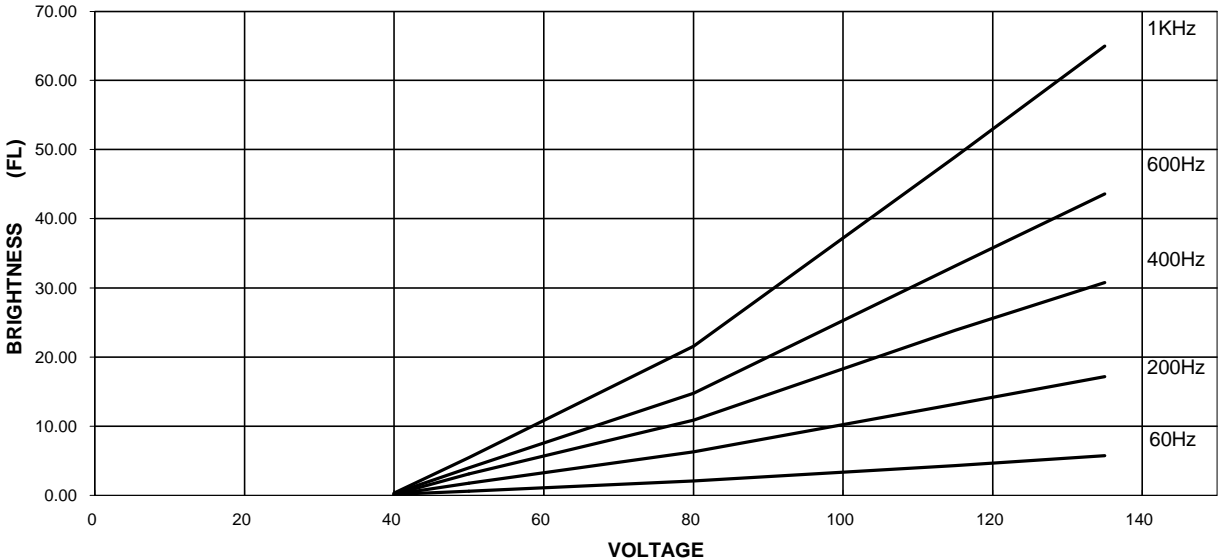
**EL Lamp Brightness vs. Voltage
BLUEGREEN**



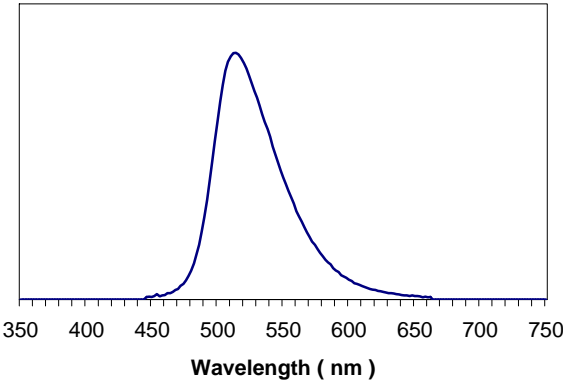
Emission of Blue-Geen Lamp



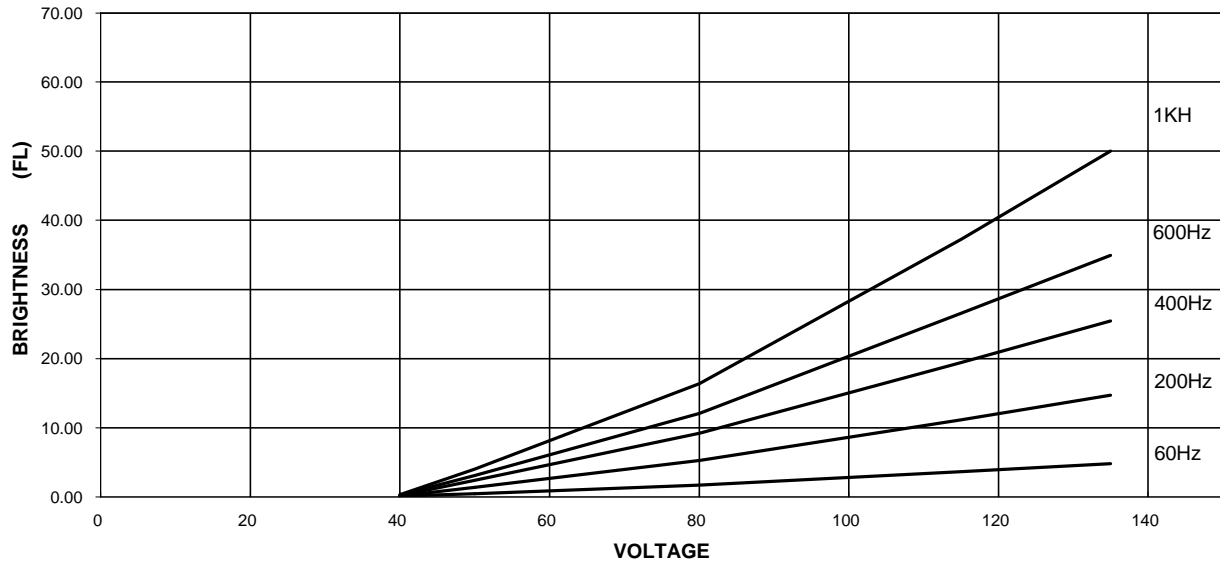
**EL Lamp Brightness vs. Voltage
HI-VIS GREEN**



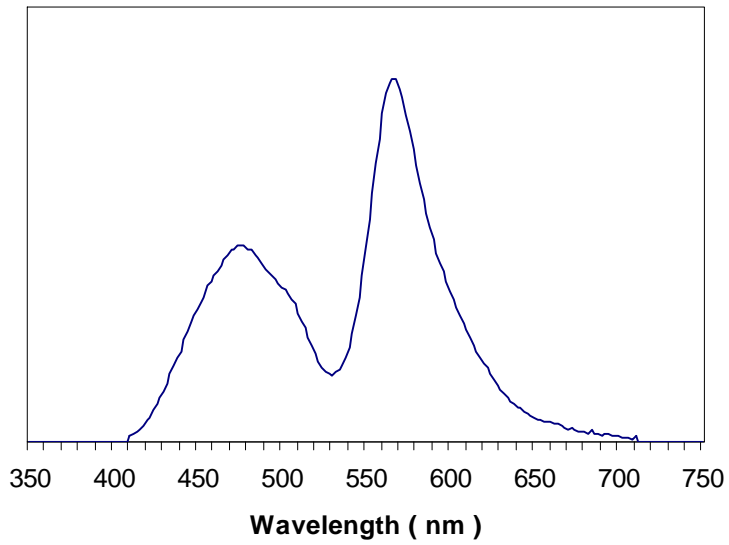
Emission of Hi-Vis Lamp



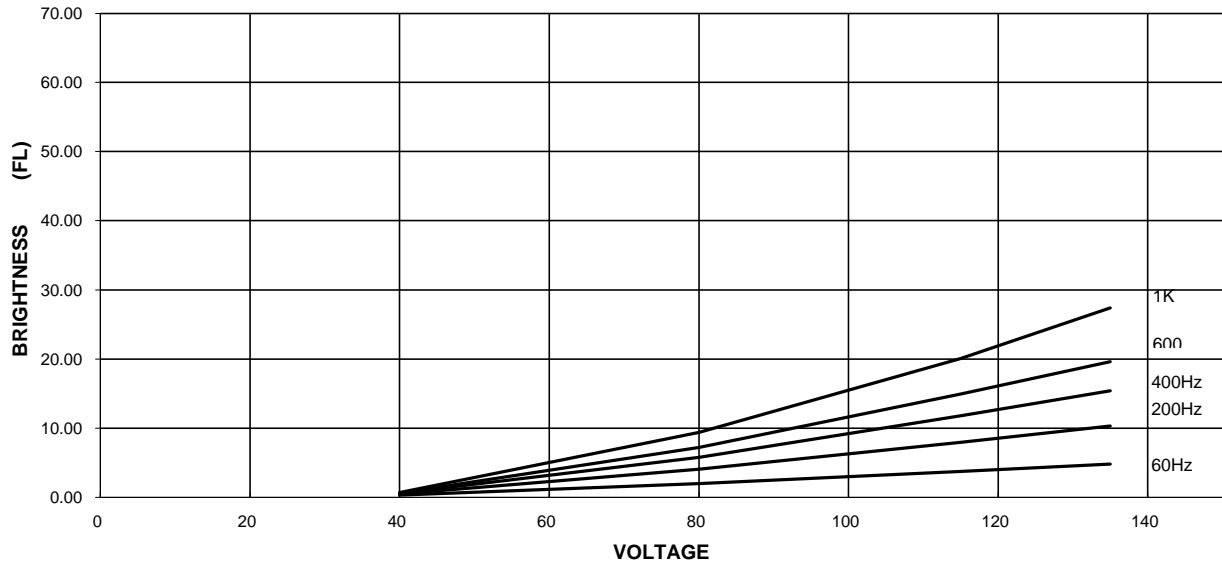
**EL Lamp Brightness vs. Voltage
PINK/WHITE**



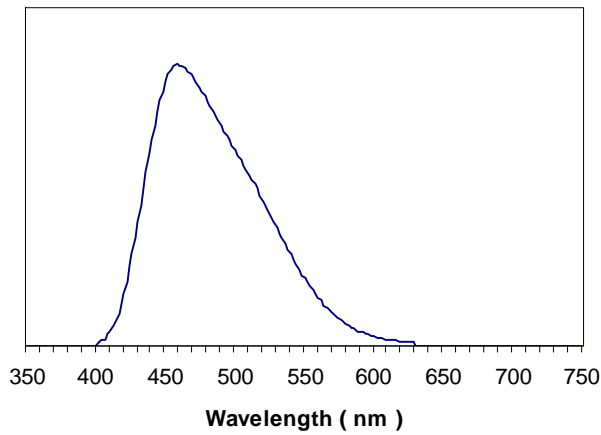
Emission of Pink-White Lamp



**EL Lamp Brightness vs. Voltage
BLUE**



Emission of Blue Lamp



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