Light Intensity

In photometry, **luminous flux** or luminous power is the measure of the perceived power of light. The other photometric dimensions such as illumination, radiance and intensity are obtained from the luminous flux.

Luminous efficacy is the ratio of luminous flux (in lumens) to power (usually measured in watts).

Luminous intensity is a measure of the wavelength-weighted power emitted by a light source in a particular direction per unit solid angle. The International System of luminous intensity is candela (cd).

Light intensity of the beacons in this catalogue are measured in Candela (Cd), where 1 Cd = 1 Lux @ 1m. Measurements are taken in photometric chamber using a luxometer and with the beacon fitted with a clear lens.

The following formula is applied:
Cd = LUX x distance^2

As a general rule, as the distance from the light source to the viewer is doubled the light intensity is reduced by ¼.

In the case of flashing lights, intensity is measured either as Peak Candela (Cd(p)) or as effective intensity Je (Cd) or candela seconds. Where the Peak Candela figure is quoted it needs to be noted that Peak intensity figures do not take into account flash duration which must be at least 5 microseconds for the human eye to react. Peak Candela is also measured in the direction of maximum light output. When comparing the light intensity of rotating, conventional lamp or LED beacons with xenon strobe beacons, the effective Je figure should be used.

The light intensity of a beacon will vary according to:

1) Power of the light source
2) Type of light source (xenon, halogen bulb, LED etc)
3) Distance from the light source and viewer
4) The lens type (brightness is increased with the use a fresnel lens)
5) Lens colour

It should also be noted that the method of measuring light intensity in countries such as the USA and Japan is different to that used in Europe. The resultant figures quoted by manufacturers in these countries are often many times greater than those that would have been obtained using the European method.

Where light intensity figures are unavailable the lamp power watts (W) or energy joules (J) data is quoted. Although these figure do give some indication of the beacon's light output, measurements of power and energy output can be misleading.

The light intensity for a given figure of watts or joules will depend on how efficiently the lamp or discharge tube converts the energy to light and also how effectively the light is then distributed by the lens optics.

For industrial applications the light intensity of warning beacons should be five times brighter than the ambient light. Emergency beacons should have a light intensity 10 times greater than the ambient level.

COMPARING LED WITH TRADITIONAL BULBS

The only values we can use today to justify or compare, in terms of brightness, a LED light source with respect to a traditional light source is the luminous efficacy:

Category	Type	Total luminous efficacy (lm/W)	Total luminous efficacy
Incandescent	100 W tungsten, incandescent (220 V)	13.8	2.0%
	100 W tungsten, halogen (220 V)	16.7	2.4%
	5 W tungsten, incandescent (120 V)	5	0.7%
	100 W tungsten, incandescent (120 V)	17.5	2.6%
	tungsten, halogen, quartz bulb (12-24 V)	24	3.5%
LED	white LED	10-189*	1.5-15%
Flash tube	xenon bulb	30-50	4.4-7.3%

*depends on the types

Colour

The intensity of light is reduced as it passes through of the lens of the beacon. The extent of this reduction is dependent to a large extent on the colour of the lens and the type of lamp used.

The table below gives an indication of the percentage of light that will pass through the beacon lens for different light sources and lens colours.

In the case of LED beacons where the colour of the LED light source is the same as the lens colour, there is almost no loss of light intensity through the lens regardless of the colour.

HUMAN VISIBLE SPECTRUM

The visible spectrum (or optical spectrum) is the portion of the electromagnetic spectrum that falls between red and violet including all colours that can be detected by the human eye. A typical human eye will respond to wavelengths from about 380 to 750 nm.

COLOUR	FILAMENT	HALOGEN	XENON
CLEAR	100%	100%	100%
AMBER	70%	70%	70%
RED	30%	27%	23%
GREEN	12%	15%	25%
BLUE	8%	10%	13%

Rotating Reflector

The Rotating Beacon uses a rotating reflector, driven by a small electric motor, which revolves around a centrally located lamp. The effect is a beam of light which rotates through 360° usually at a speed of 180rpm for industrial beacons. The rotating beacon is available with either conventional filament lamps or halogen lamps.

In general rotating beacons should only be mounted in an upright position within 30° of vertical although some designs do allow for inverted or horizontal mounting.

Although the rotating beacon is quite an effective signaling device, it has the disadvantages of relatively high current draw and the electro-mechanical drive components have a relatively short life(< 5,000 hours).

They are not suitable for applications which may involve continuous operation for long periods. The lamps also suffer from early failure due to vibrations.

Conventional Flashing

Flashing lights use conventional filament lamps or halogen lamps which are switched on and off by an electronic circuit. The light is emitted through 360° and the flash duration is relatively long.

Many flashing lights can also be supplied as continuous lights without the flasher circuit, or with a selectable flashing/static operation.

They are not particularly suitable for applications involving prolonged continuous operation, current draw is high and vibration can result in lamp failure in the case of higher voltage bulbs.

Xenon Strobe

Strobe lights use a xenon discharge tube and an electronic circuit which discharges a capacitor through the xenon tube to produce a short, high intensity burst of light. Although the strobe light is emitted through 360°, it is often most intense in one direction.

Strobes have the advantage of low current consumption relative to light output. Xenon tube life is typically 5 to 8 million flashes after which the light output progressively reduces by approximately 70%. They are available in double flash versions and some types have the capability to be synchronised allowing a number of lights to flash simultaneously.

The strobe beacon is suitable for prolonged continuous operation (particularly low power models) and the xenon tube is resistant to moderate levels of vibration. Due to the high temperature generated by the flash tube, the life of xenon beacons will tend to be reduced in applications of high ambient temperature.

LED Beacons

Light Emitting Diodes or LED based beacons offer significant advantages over other lamp technologies. The LED light source is constructed with an array of high output wide angle LED's either in the form of a bulb to fit a conventional lamp holder or integrated into the beacon flash and driver circuit. LED beacons will often include a multi-function feature allowing for different flash patterns or effects to be selected.

Although higher in cost when compared to traditional technologies, they offer the advantages of low power consumption, very long life (>100,000 hours) and high resistance to vibrations. The high initial cost is usually recovered many times over during the life of the beacon.

An additional advantage of the LED beacon is that the light intensity is not reduced by coloured lens as is the case with conventional lamps and xenon strobes. In many cases however the light output is not sufficient for use in direct sunlight.