

How to know if an illumination device will be able to illuminate the scene you want to capture?

When an illuminator is used to illuminate a scene for image capture, the amount of light reaching the scene depends on multiple factors including:

- the intensity of the beam of light coming out of the illuminator: the more intense, the farther reaching,
- the distance from the illuminator to the scene.

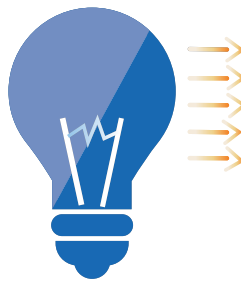
Thus, it is important to quantify the beam intensity.

For continuous light, with a video camera, the **lux** value is important to figure out if a scene is correctly illuminated to expose an image. With a still camera, this translates into an **Exposure Value**.

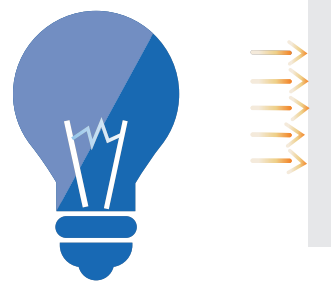
HOW MUCH LIGHT IS COMING OUT OF THE LAMP?



HOW INTENSE IS THE LIGHT EMITTED IN ONE PARTICULAR DIRECTION?



HOW MUCH LIGHT IS ACTUALLY REACHING THE DISTANT TARGET?



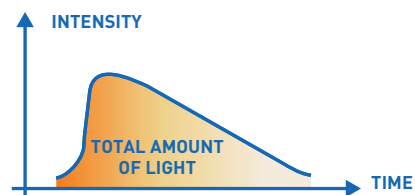
<p>The luminous flux is a measure of the overall flow of light emitted by a source.</p>	<p>The luminous intensity is the quantity of the luminous flux emitted in a given direction per solid angle (in steradian). The addition of an optical system (reflector, lens...) can increase the figure dramatically.</p>	<p>The illuminance is a measure of the concentration of luminous flux falling upon a surface. The illuminance will decrease when the surface is farther from the source.</p>
<p>Unit: lumen (lm)</p>	<p>Unit: candela (cd) 1 cd = 1 lm per steradian</p>	<p>Unit: lux (lx) 1 lx = 1 lumen per square meter (lm/m²)</p>

EQUIVALENT FOR A FLASH: VALUES ARE INTEGRATED OVER TIME

<p><i>lumen x second (lm.s)</i></p>	<p><i>candela (cd) x second (cd.s)</i></p>	<p><i>lux x second (lx.s)</i></p>
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Why integrate over time?

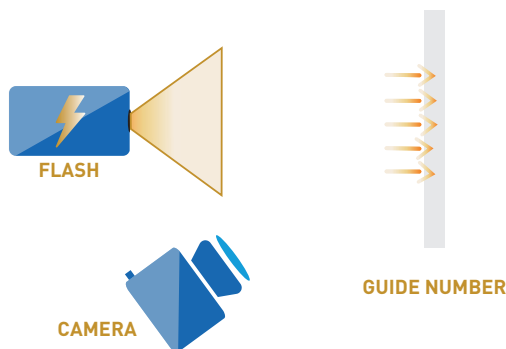
Usually, a flash develops over time with a varying intensity. Thus, on the contrary to continuous light, the peak intensity is no more a relevant value to quantify the emitted light. The total amount of light is best represented by the integration of the intensity over time.



How to quantify the light emitted by a flash?

For a flash, the photometric values are strictly correct, but unpractical.

The Guide Number expresses how much light is seen by the camera on the target.



The **Guide Number** is a value directly coming from the world of photography, and based on the photographic units. It is the product of an aperture (f-stop or f-figure) by the distance between the flash device and the subject usually expressed in metres. It is usually expressed for a sensor sensitivity of ISO 100. Other values and units are possible, but shall be specified (ISO 200, foot...).

$$GN = f\text{-figure} \times \text{distance}$$

The table below gives examples of working conditions (distance, and aperture) for a correct illumination with a flash unit featuring a Guide Number of 50 (at ISO 100, in meters):

Aperture	GN = 50		
	DISTANCE AT ISO 100	DISTANCE AT ISO 200 (*)	DISTANCE AT ISO 400 (*)
f/1	50 m	70,8 m	100 m
f/2	25 m	35,25 m	50 m
f/2.8	17,8 m	25,2 m	35,7 m
f/4	12,5 m	17,6 m	25 m
f/5.6	8,9 m	12,6 m	17,8 m

(*): a factor 2 in camera sensitivity leads to a factor $\sqrt{2}$ in operating distance, all other things being equal. This increase in distance is expressed by the "inverse square law": see the dedicated application note.

Why Guide Number is more relevant than Joule?

Joule (or Watt.second) is the expression of an electrical energy and describes what happens inside the flash unit from the electrical perspective. It does not say anything about light.

Guide Number expresses the amount of light actually reaching the scene. This is the real performance of the flash illuminator.

Consider a flash device as a supply chain where Joule is at the beginning, and Guide Number at the end. There are many factors in-between, reducing the energy level at each step.

