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The Five Lighting Metrics

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THE FIVE LIGHTING METRICS

Every discipline has its own special terminology and lighting is no exception. Fortunately, in lighting, there are only five basic metrics that need to be learned; unfortunately, they have similar names and unusual units, and may be a challenge for a beginner in lighting to comprehend and understand.

For those readers new to lighting but not to the broader field of electromagnetic radiation, **light** is defined as radiant energy that is capable of exciting the retina and producing a visual sensation.

Figure 2. Garden hose. *(Image courtesy of iStockphoto)*

1.0 LUMINOUS FLUX (Φ)

Luminous Flux is the time rate of flow of light (evaluated in terms of what the "average" human eye[1] sees) from a source summed over all directions. Unless otherwise noted, luminous flux is defined for photopic vision.[2]

The symbol for luminous flux is the Greek letter "Phi" (Φ).

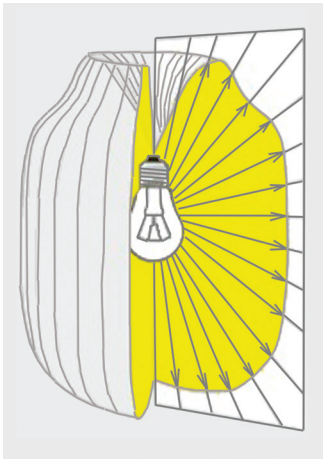

Figure 1.[3]
Light output illustration.

The SI (International System of Units) unit of luminous flux is the **lumen** (lm).

Figure 1 illustrates the light output or luminous flux leaving the lamp in nearly all directions.

The most common analogy is fluid flux, which is the time rate of flow of water, as shown in **Figure 2**; when the garden hose valve is opened, streams of water emerge and travel outward. (Were it not for gravity, the analogy would be complete, but the water streams eventually bend toward the ground.)

A second analogy is the electrical one, in which luminous flux is compared to electric current, in amperes, which is the rate of flow of electric charge through a wire.

A lamp consumes watts and produces (or emits) lumens; the measure of its success in doing this is called "efficacy" and is measured in lumens per watt. **Table 1** provides the lumen output and efficacy of a few common lamps.

2.0 LUMINOUS INTENSITY (*I*)

Luminous intensity is the luminous flux per unit solid angle (the three dimensional equivalent of the traditional two dimensional angle) of a light source in a given direction.

The symbol for luminous intensity is the capital letter ***I***.

Table 1: Lamp Efficacies

LAMP	LUMINOUS FLUX (lumens)	LAMP EFFICACY (lumens per watt)
28-watt T5 linear fluorescent*	2900	103.6
32-watt High Performance T8 linear fluorescent*	3100	96.9
54-watt T5HO (high output) linear fluorescent*	5000	92.6
100-watt ceramic metal halide*	9000	90.0
26-watt compact fluorescent (quad)*	1800	75.0
50-watt tungsten halogen (low voltage reflector)	900	18.0
60-watt incandescent (A lamp)	840	14.0

*A ballast is required to operate these lamps, therefore system efficacy will not equal lamp efficacy.