FRAEN Srl
Maximizing Light

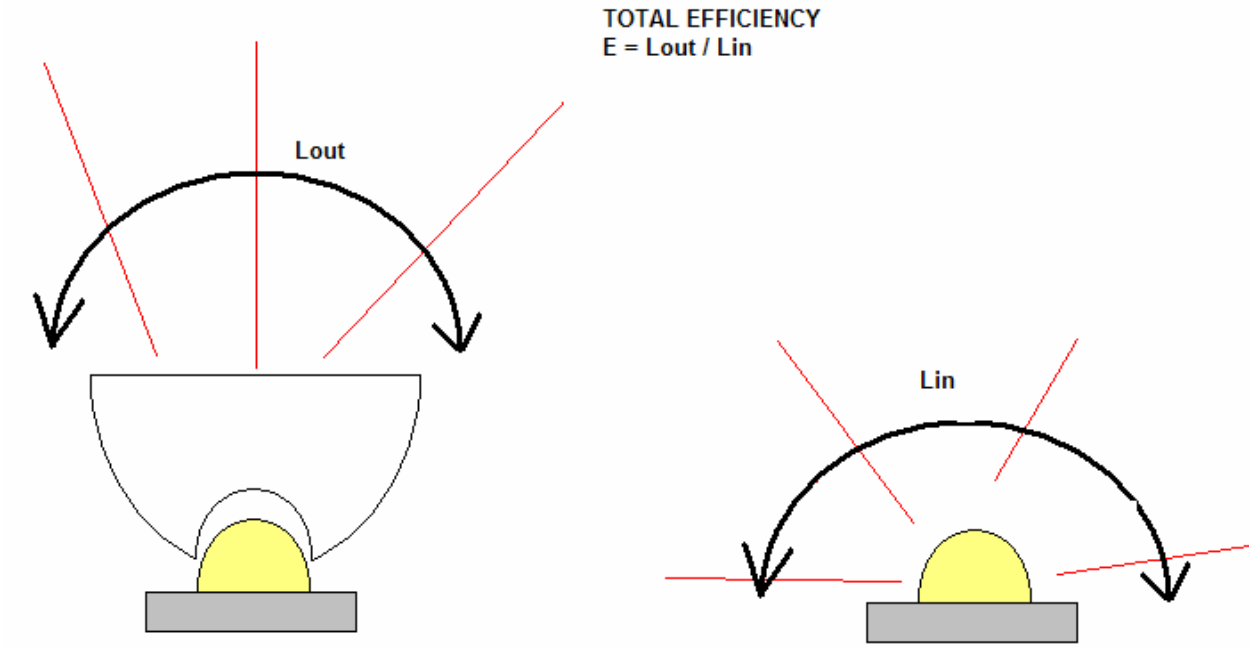
FRAEN APPLICATION NOTE (FAN)	Procedure:	FAN-03EN
TOTAL EFFICIENCY and ON-AXIS EFFICIENCY	Rev date: Revision:	07 October, 2005 A
	Issuer: Approved by:	M. Thorailler C. Jones

1. PURPOSE AND SCOPE

The purpose of this document is to explain the difference between the *total efficiency* and the *on-axis efficiency* of an optic. Also this document explains when to apply each characteristic. Some examples are also given to illustrate this topic.

2. TOTAL EFFICIENCY

The total efficiency of a lens characterizes the ratio of the total amount of light coming out of the lens in the whole space (4*pi steradians) to the total amount of light coming out of the LED in whole space, i.e., E = Lout/Lin.

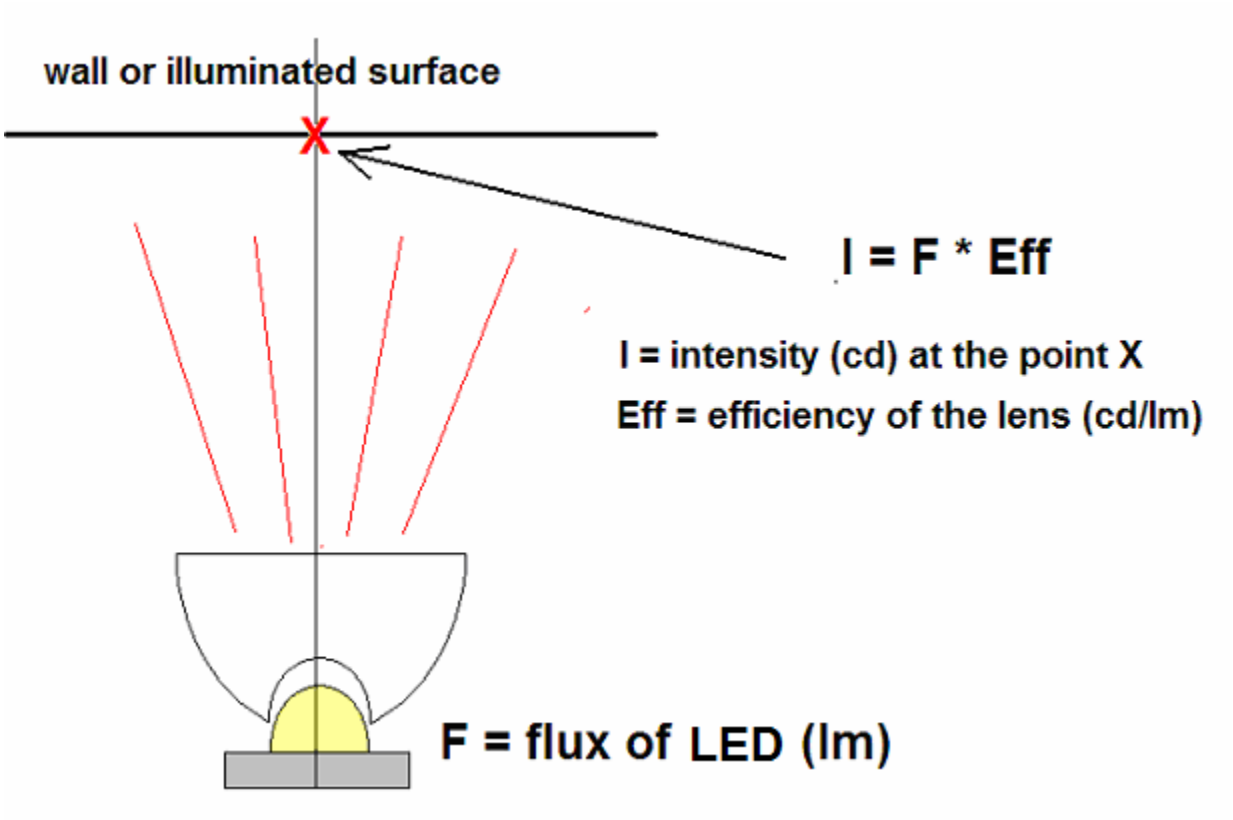


That total efficiency is useful to understand the losses of an optical system.

If the total efficiency is 85%, then the lost amount of light is 15%. Within this 15% loss, some light is reflected at the input surface (near to the LED), the lens material absorbs some light, and some light exits the side of the lens.

However, with this parameter, it is not possible to deduce or calculate the level of intensity or irradiance on a wall or on an illuminated surface; for that, the on-axis efficiency is required.

3. ON-AXIS EFFICIENCY



4. CONCLUSION and EXAMPLES

In order to calculate the intensity I(cd) of light on a wall or on an illuminated surface, the following data are required :

- Flux of the LED used - F (lm)
- On-axis efficiency of the lens - Eff(cd/lm)

Then **the intensity (cd)** is: **I = Eff * F**

In order to calculate the irradiance J(lux) of light on a wall or on an illuminated feature, the following data are required :

- Flux of the LED used - F(lm)
- On-axis efficiency of the lens - Eff(cd/lm)
- The distance between the lens and the wall or illuminated surface - D(m)
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Then the **irradiance (lux)** is: **J = (Eff * F) / (D * D)**

Example:
The Fraen FHS narrow beam lens (part number FHS-HNB1-LL01-0) with a Luxeon I white Lambertian LED has an on-axis efficiency of 23.3cd/lm.

So, if the white Luxeon LED has a flux of 44 lumens:

- The on-axis intensity is 23.3*44 = 1025.2cd
- The on-axis irradiance at 2 meters is 23.3*44/(2*2) = 256.3lux