MCD to Lux conversion notes from various places

http://www.ledrise.com/shop_content.php?coID=18

this calculator shows that
1 lux at 1 meter = 1000 mcd no matter what the angle of viewing

1 feet = 0.304 8 meter

1 lux = 93 mcd at one ft.

1 **Lux** = 1 **lumen**/square meter.

Luminous flux is measured in *lumen*, while luminous intensity is measured in *lumen per steradian*, also called a *candela*. The brightness of LEDs is measured in millicandela (mcd), or thousandths of a candela.

a 2000 mcd 30° LED puts out just as much light as am 8000 mcd LED with a 15° viewing angle.

By way of comparison, a typical 100 watt incandescent bulb puts out around 1700 lumen - if that light is radiated equally in all directions, it will have a brightness of around 135,000 mcd. Focused into a 20° beam, it will have a brightness of around 18,000,000 mcd.

As an example, the total light output (luminous flux) of a 40-watt incandescent light bulb is about 500 lm, while that of a 40-watt fluorescent tube is about 2300 lm.

Light meters measure luminous flux

When luminous flux strikes a surface, the surface is said to be *illuminated*. The intensity of illumination, analogous to the intensity of electromagnetic radiation (which is power per unit area) is the *luminous flux per unit area*, called the *illuminance*, denoted by *E*. The unit of illuminance is the lumen per square meter, also called the *lux*:

$$1 \text{ lux} = 1 \text{ lm/m}^2$$

http://www.gizmology.net/LEDs.htm

So, taking all of this together, we can now interpret our original definition of a lumen as 1(lm) = 1(cd) x 1(sr). One lumen in this case is a measure of the amount of luminous flux emitted into an area by 1/60 of a single square centimeter of platinum at its melting point into a certain angle. A lumen measurement is often used along with wattage to determine the luminous efficiency of a light-emitting body.

For example, a normal 100 watt light-bulb has a luminous efficiency of about 17.5, emitting 1750 lumens of light. A 13 watt fluorescent bulb, by contrast, has an efficiency of about 56, emitting around 730 lumens of light. The sun, in contrast, has an efficiency of around 93.

http://www.wisegeek.com/what-is-a-lumen.htm

on line calulator
http://www.ledrise.com/shop_content.php?coID=18

Illuminance (lux)

Illuminance is the total luminous flux which falls on a surface and it shows the intensity of the incident light. The value is affected by the wavelength of the emitted light and the distance between the light source and the illuminated area.

The human eye is most sensitive to light that has a wavelength of around 550nm (amber) and thus an amber light source will have more lux than a blue one (for example). This is called the luminosity function.

The larger the distance between the light source and the illuminated area the lower the illuminance will be. Below we show some examples of optimal illuminace for day to day activities:

Activity	Illumination on task surface(lux)
Public areas with dark surroundings	20 - 50
Simple orientation for short visits	50 - 100
Working areas where visual tasks are only occasionally performed (storage rooms)	100 - 150
Easy Office Work, Classes	250
Normal Office Work, PC Work, Study Library, Groceries, Show Rooms, Laboratories	500
Supermarkets, Mechanical Workshops, Office Landscapes	750
Normal Drawing Work, Quality control	1,000
Detailed Drawing Work, Very Detailed Mechanical Works (watchmaking)	1500 - 2000
Performance of visual tasks of low contrast and very small size for prolonged periods of time	2000 - 5000
Performance of very prolonged and exacting visual tasks	5000 - 10000
Performance of very special visual tasks of extremely low contrast and small size	10000 - 20000

Luminous Intensity (Candela-cd=1000, milicandela-mcd)

The candela is the foundation unit for the measurement of visible light. It is one of the seven foundation SI units. It's formal definition is:
The candela is the luminous intensity, in a given direction of a source that emits light that has a wavelength of aprox.

555 nm (yellowish-green) and that has a radiant intensity in that direction of 1/683 watt per steradian. One candela is 1000 milicandelas or 1 cd = 1000 mcd.

The candela value is independent of distance. One can think of it as the emission from the lamp without the interest in what happens to the photons it has ejected. The candela is mostly used when dealing with focused light - for LEDs, flashlights or spots.

From candelas to lumens:

The candela can be used for measuring the light intensity of nonfocusing light sources but this can lead confusion . For example: a LED made by CREE can have up to 100 Cd while a 100 Watt incandescent light bulb has around 105 Cd. Does that mean that the LED is a bright as a 100 W light bulb? The answer comes from view angle: Cree 80 deg, light bulb: 360 deg.

To clarify this problem we will give some examples of light intensity in day to day life (in candelas per square meter):

- good street light 2 Cd
- corridors 3-6 Cd
- living rooms 3-12 Cd
- office 12-18 Cd
- drawing office 18-30 Cd
- shop windows 60-300 Cd

Viewangle

The viewangle shows the angle of radiation for a light source. For example a view angle on 30 deg means the light has a shape of a cone and its borders form a 15 deg angle with the center axis.
A change in the view angle affects the luminous intensity of an LED (candela) but not the luminous flux (lumen).

Viewing angle is actually the most important element in the performance of a light source. A very wide viewing angle means that a large percentage of light ends up going in non-useful directions (for example: up). Incasing the light source and using a reflector has limited efficiency.

By taking into the account both viewing angles and lumen output the comparison between LEDs and other light sources looks like this:

Light source	Lm	Lm/W	Viewing angle	Usefull viewing angle*	Useful lm
CREE X-RE R2 White LED	242	92	90	100%	**242**
100 Watt incandescent	1200	12	360	33%	**396**
25 Watt Halogen	260	9	360	33%	**85.8**
15 W T8 neon	1350	90	360	33%	**445.5**

*without case or reflector

Viewing angle and the environment

Next time when you go out at night look up in the sky. Do you see stars, or the Milky Way? In you live in a big city the answer is: only a white glow. For people that live outside a big city in North America, Europe, India, Japan or China the answer will be: a white glow and a few stars. The Milky Way can only be seen from remote regions or non-developed countries.

The reason? Bad lighting design and use of sources with ultra wide view angles creates light pollution, light that is wasted in the sky. The effects of such pollution are wide, they affect animals and insects and also our sleep.

Does anyone know how to figure out the lumens per watt from these?
>>>>
>>>> http://cgi.ebay.com/50pc-10mm-MEGA-B...QQcmdZViewItem
>>> The ad gives the brightness in millicandela (mcd), so to convert to
>>> lumens you need to know the solid angle through which the light is
>>> emitted. The ad also gives a "50% power angle," which I take to be half
>>> the angle through which the light is transmitted. You can then use the
>>> wizard at http://led.linear1.org/lumen.wiz to do the conversion.
>>>
>>> With a brightness of 130,000 mcd and an angle of 12 degrees, the wizard
>>> give 4.475 lumens.
>>>
>>
>> If you mean lumens per watt, that would make these LEDs very inefficient.
>> A rating of 10-20 lumens per watt is common for incandescent lamps and
>> they are not considered efficient. Fluorescents are often rated 50-100
>> lumens per watt.
>
> No, I mean lumens. I only converted the brightness from mcd to lm.
> According to the page the OP linked to the LED typically consumes 68 mW,
> so I guess that would work out to something like 65 lm/W.

http://led.linear1.org/lumen.wiz

candela (millicandela) to lumen conversion wizard

This calculator allows you to do an approximate conversion between millicandelas (or candelas) and lumens for an LED where you know the beam angle. The reason it's approximate is because the specs don't usually include information about how the luminous intensity (in candelas) was measured. This calculator is perhaps most useful in comparing the light output of LEDs with different beam angles.

To briefly explain the math the wizard does, it simply applies the conversion 1 candela = 1 lumen/steradian. To do this, it converts the beam angle you supply into a solid angle in units of steradians.

The likely thing for a manufacturer to do is to list their luminous intensity spec in the most favorable way possible. So it can be the case that this wizard provides inaccurate values--this happens because the assumption in the wizard is that the luminous intensity value you supply represents an average value across the beam angle you supply. It's too tempting for the suppliers to list a maximum value instead, since there is not a standard for measuring this. Beware especially of wide-angle LEDs, which will probably be distorted the most by this calculation.

On Nov 15, 12:49 pm, Nobody <nob...@xxxxxxxxxxx> wrote:
On Wed, 14 Nov 2007 16:50:37 -0800, TazaTek wrote:
I'm trying to pick out some LED's for to make a 10,000 Lux @ 36 inches (or 1 meter) LED lamp. My problem is that I'm not quite sure of how to convert the lumens spec on the LED to the Lux to figure out how many LED's I need to buy.

I know that Lux = Lumens/ m2 , but I'm not exactly sure of how that applies to something that is 1 meter away, and would be, say the size of a small book.

The lux depends upon the size of the spot, and thus the illumination angle. A wide-angle LED will produce a lower lux figure for the same lumens.

To determine a rough lux value, divide the lumens figure by the area of the LED's "spot". E.g. for even illumination over a 90-degree (+/- 45-degree) cone at 1 metre, the spot radius will be 1m*45*pi/180 ~= 785mm, and the area will be ~1.94 square metres, so lux ~= lumens/1.94.

If the "size of a small book" refers to focusing the entire output of the LED on a small area, then the only factor is the area on which you're focusing it, not the distance (obviously, you'll need to narrow the angle as the distance increases to keep the smaller area).

E.g. if you're focusing on a 10cm square, lux = lumens / 0.01, so you would need 100 lumens to get 10000 lux.

OK. I think I understand. This would apply to the case where we are slicing the cone for the whole output angle.
but how do I calculate the lux for an object that is less than the output area?

for instance, (taking your numbers),
how would I calculate the lux on an object that has a spot radius of only 500mm at 1 meter where the LED has a width pattern of 785mm? This would have a portion of the light going past the object on all sides

Can I *assume* that the light is uniform and therefore just take the difference ie. lux = lumens/(1.94 - .785) (if its within a fair margin, I'll call it good)

Thanks

Matt

1 lux = 1 lumen/meter^2 = .001 Lumen/CM^2

```
function LuminousFlux(f) {
        var theta = parseFloat(f.theta.value) * 0.017453;
        var cd = parseFloat(f.mcd.value) / 1000;
        var sr = 6.283185 * (1 - Math.cos(theta / 2));
        f.lm.value = cd * sr;
```