

## Designers Lighting Forum

What is 1% Dimming?

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.



## Learning Objectives

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At the end of this course, participants will be able to:

1. Explain the difference between perceived and measured light output as it relates to 1% Dimming
2. Explain why designers and manufacturers think differently about 1% dimming
3. Predict the light output at 1% based on photometric data on a cut sheet
4. Verify if a fixture has a 1% or .1% driver based on a cut sheet and light meter readings



# The First Discussion.....



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Don't need caveats, just the basics.  
Thanks

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Not Really...

Well, I'll try:

Perceptible but not egregious visible cut off at the low end.

(You think to yourself, "I miss incandescent,")

My highly educated professional understanding is that the fixture dims to 1% of its maximum intensity.

In practical terms, I think of 1% as dim, but not really dim. Certainly not theatre dim. I think of .1% as dim enough to be used in a dark space like a theatre, exhibit that dims for a multi-media event, or a residence where you dim the lights for watching a movie or sex.

But even .1% is not as good as the 'ol incandescent or halogen.

Light level of a specific Dimmer, driver and LED combination can be reduced to 1% of max total light output without noticeable flicker.

Center-Beam Candle Power dived by 100 (i.e. 1000 equals 10) \*

\*caveat... without flickering or blinking or changing color or the ass dropping out of the CRI/R9 etc.

It means it can dim down smoothly, flicker free to 1% of the max lumen or electrical(manufacturers do it both ways but it should be lumens) output before either fading or switching off

1% dimming refers to 1% drive current and not light output. Because LED get more efficient at lower currents this could translate into greater light output.

One percent of light output

The drivers low-end trim shall be 1%, we usually describe that as driver has the capability of dimming to 1%.



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Hey Mike!

It's simple. It is 1% of the programmed mA rating of the driver. Has nothing to do with light output (common mistake). If a driver is programmed at our very common 700ma (4' fixture), the driver will dim down to 7ma. As LED light output is logarithmic not linear, the LED will deliver more Lumens per Watt at 7ma than 700ma.

Make sense?

JR

Hi JR,

Thanks for this.

I'm finding there is a discrepancy in how manufactures answer this and how designers answer.

I want to do some sort of panel discussion or something to try and help address this problem I didn't even know existed.

I must say I do disagree with you based on my experience as well as the responses from all lighting designers questioned.

For me, 1% dimming means the measured output of the fixture is 1% with the understanding that the perceived brightness of the fixture is around 10%. This is what most LDs think when reading 1% dimming on a cut sheet based on the graph below.

I really appreciate your time and view on this. I wonder if/when I get legs under this thing you would like to be a part of the discussion?



So, What are they Saying?  
Who's right?

*Designer: 1% of Light Output*

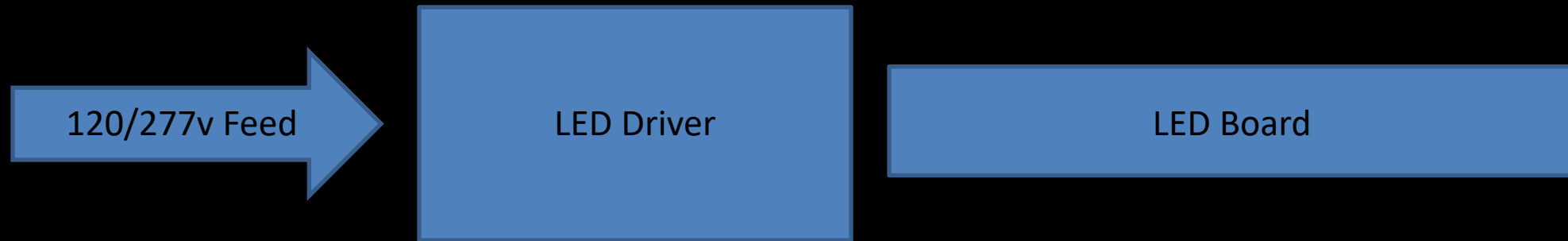
*Manufacturer: 1% Drive Current*

*Can they both be right?*





# LED System Basics

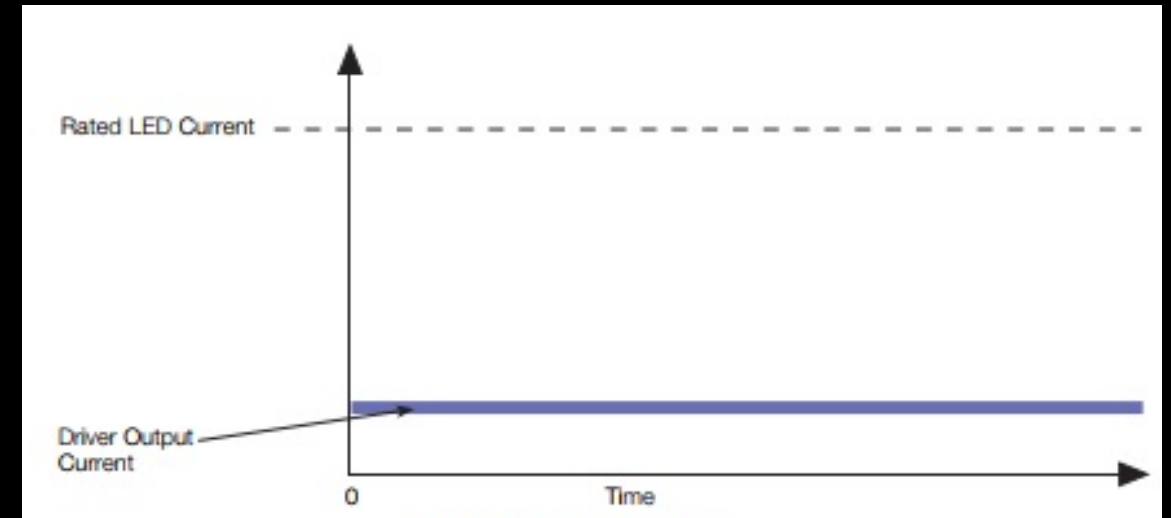


The LED driver performs several functions:

- Transforms the power from Line to Low voltage
- Rectifies the AC current to DC Current
- Regulates the Current and Voltage going to the LED
- Dims the LED's

# LED Dimming

- Most drivers dim the LED by using Constant Current Reduction
- Simply, as the control signal tells the dimmer to dim, it reduces the current going to the LED causing it to dim.
- Watch the dimmer you use! They are not all created equal and will all not hit low Dim! Check your Trim Pots!



CCR  
(Constant Current Reduction)

# JR Does a Mockup

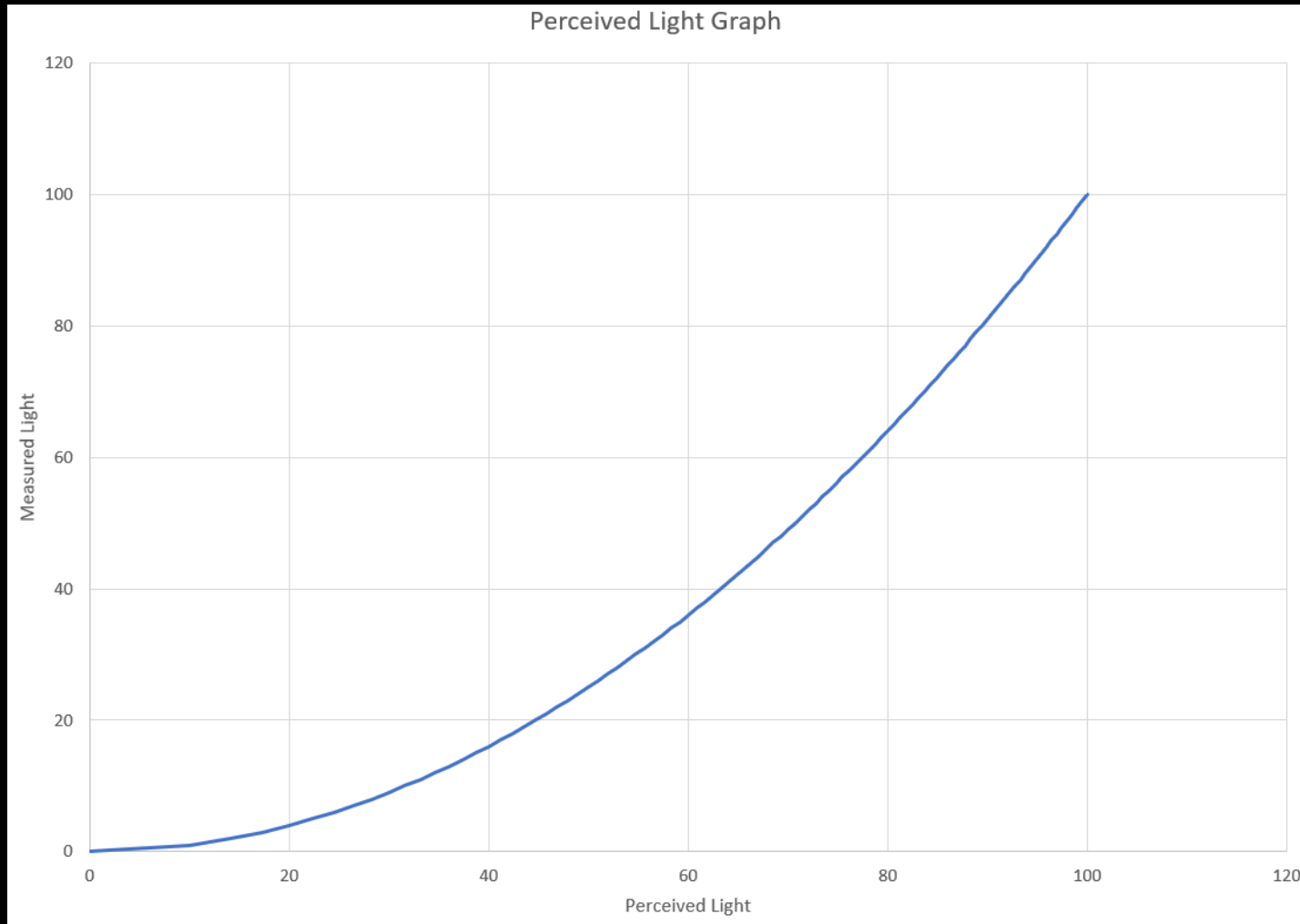
Drive Current	% Dimming	Foot Candles	% of Initial FC
1000 mA	100%	2940	100%
10mA	1%	36.1	1.2%
2mA	.2%	13.6	.45%



# Here's the Mockup – All fixtures programmed to 700mA

Fixture	Drive Current at dimmed output	% Dimming
Left	70 mA	10%
Middle	7mA	1%
Right	.7mA	.1%

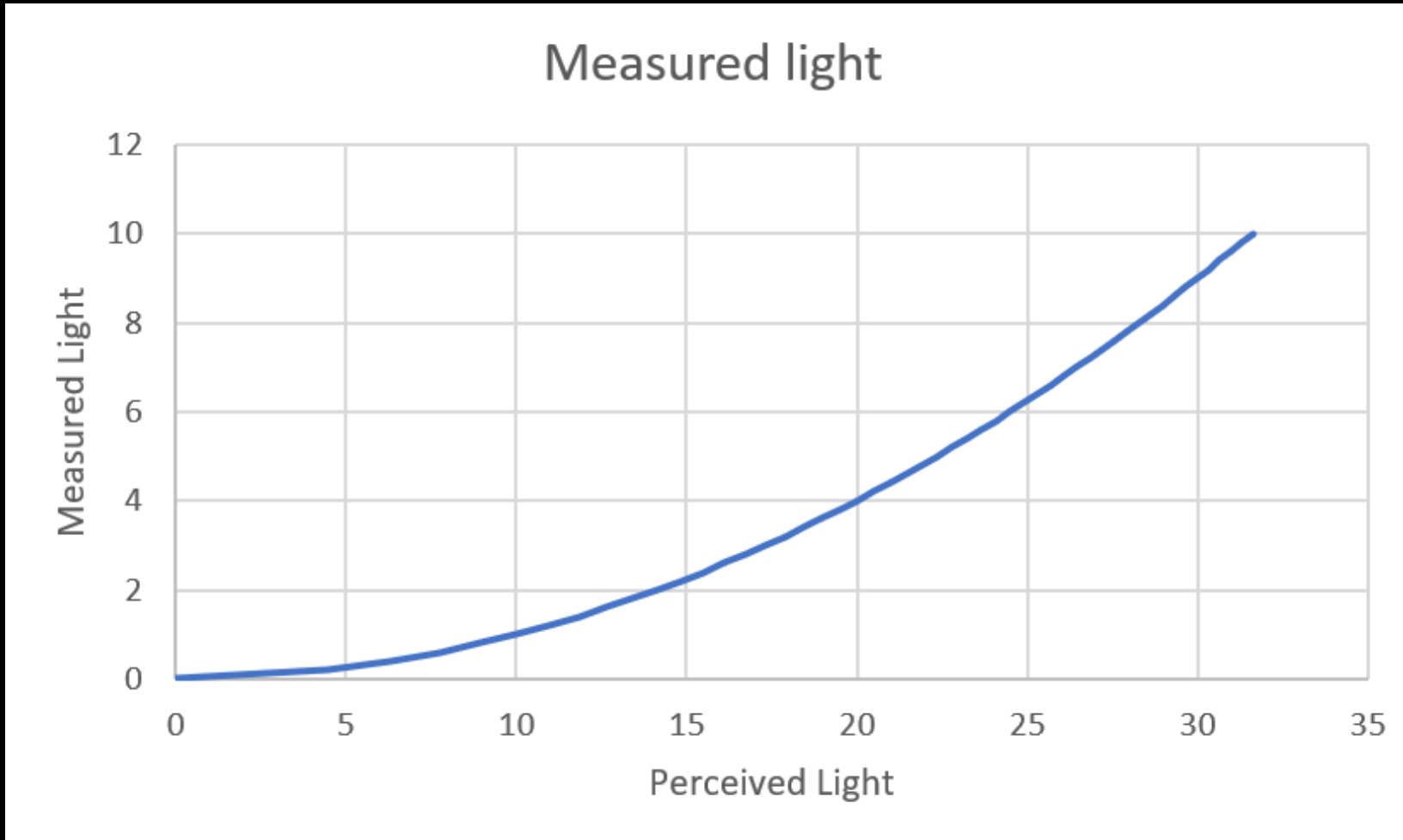
# What is meant by Perceived Brightness



$$\text{Perceived Light \%} = 100 * \text{SQRT}(\text{Measured Light}/100)$$

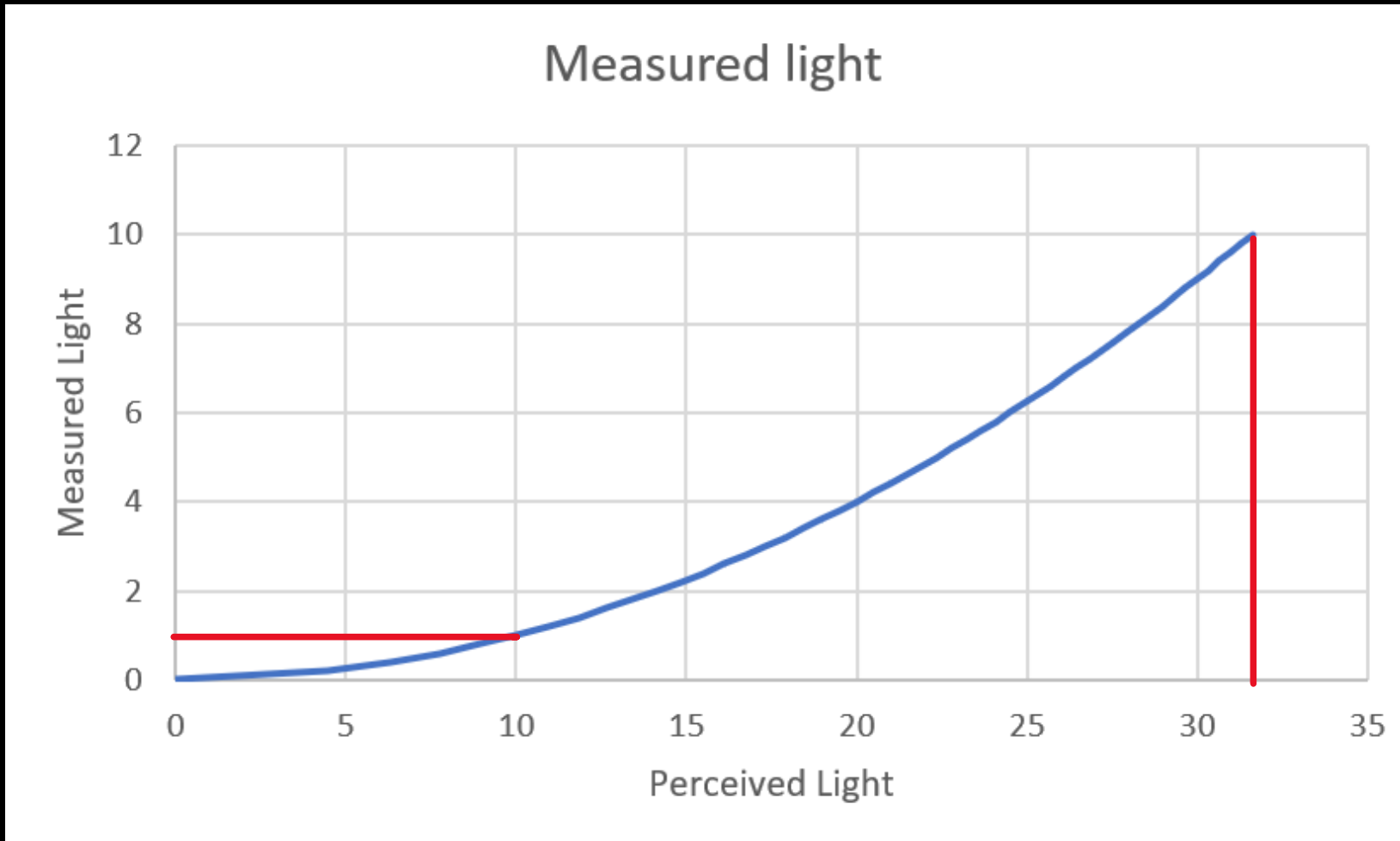


# Zooming In on the Low End



Perceived Light % =  
 $100 * \text{SQRT}(\text{Measured Light}/100)$

# Zooming In on the Low End



Perceived Light % =  
 $100 * \text{SQRT}(\text{Measured Light}/100)$

## Some Numbers from the Data

Measured Light %	~ Perceived Light %
100%	100%
50%	71%
25%	50%
10%	32%
5%	22%
1%	10%
.1%	3%



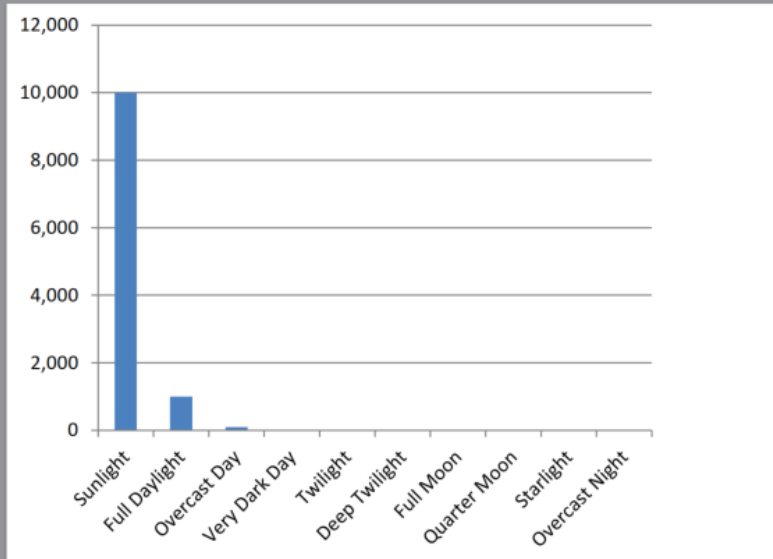


# So, What's going on?



## Relative Illuminance

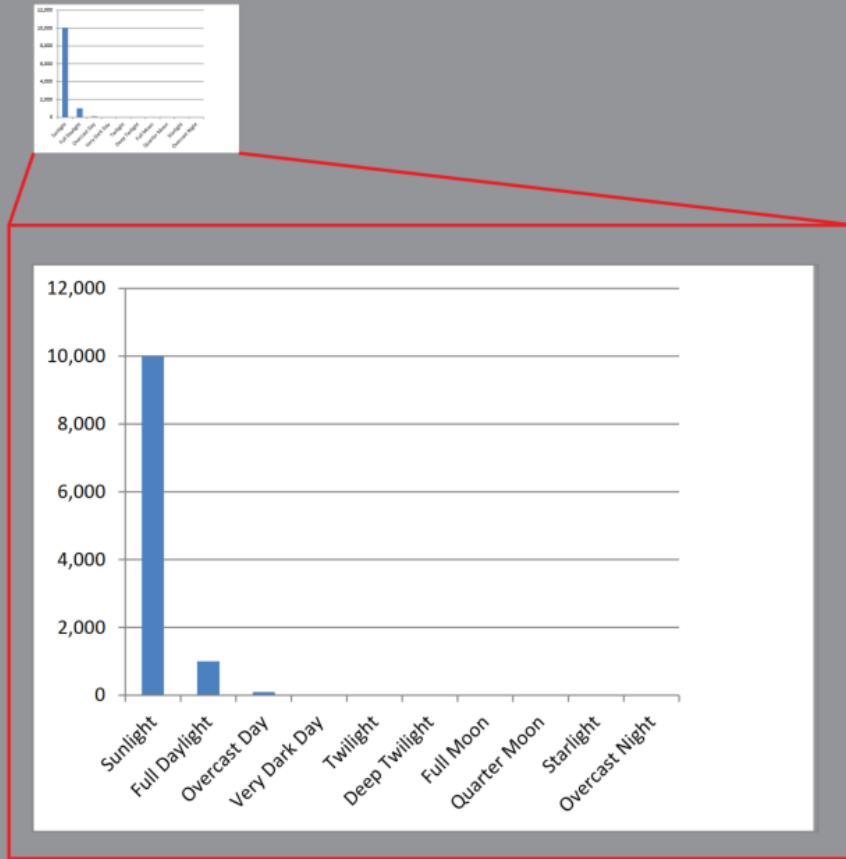
**FOOTCANDLES**



Our eyes have evolved to adapt to great differences in brightness.

## Relative Illuminance

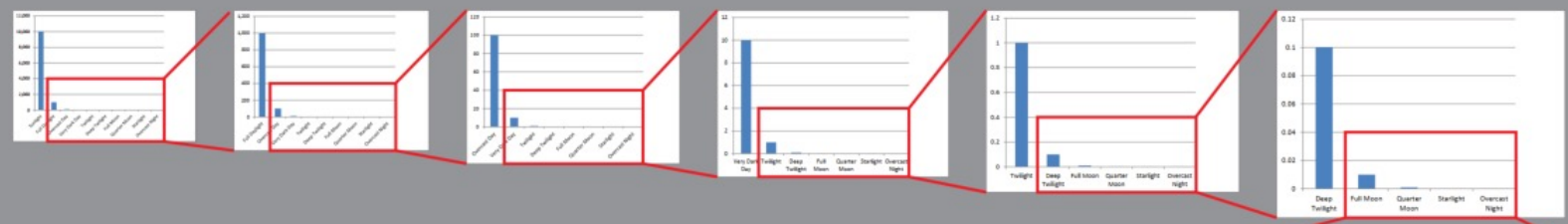
**FOOTCANDLES**



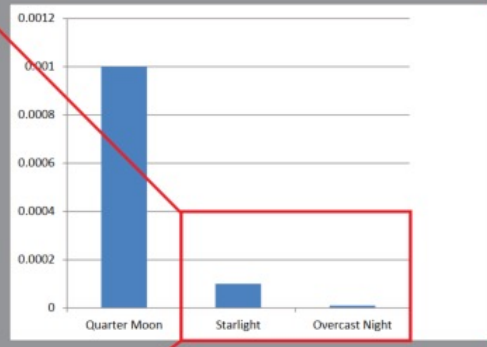
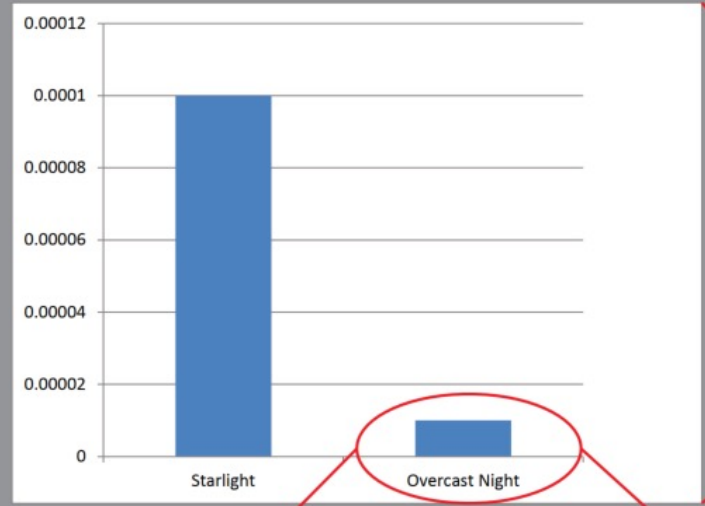
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## Relative Illuminance



**FOOTCANDLES**

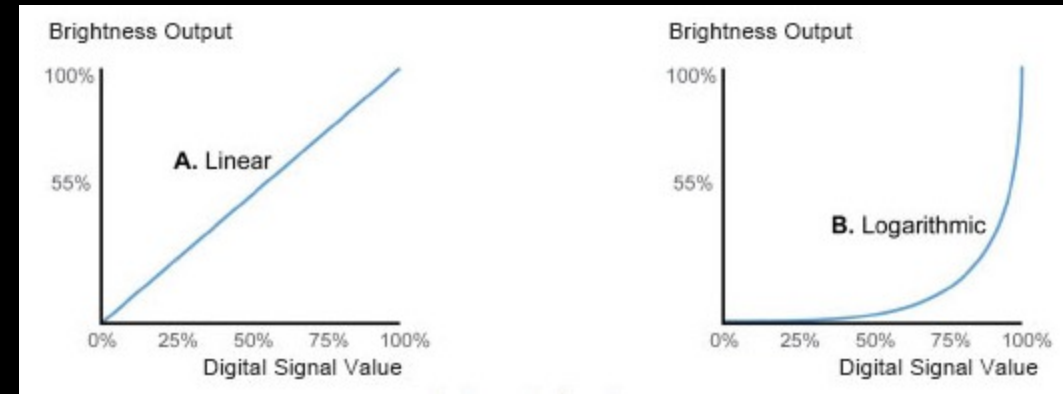
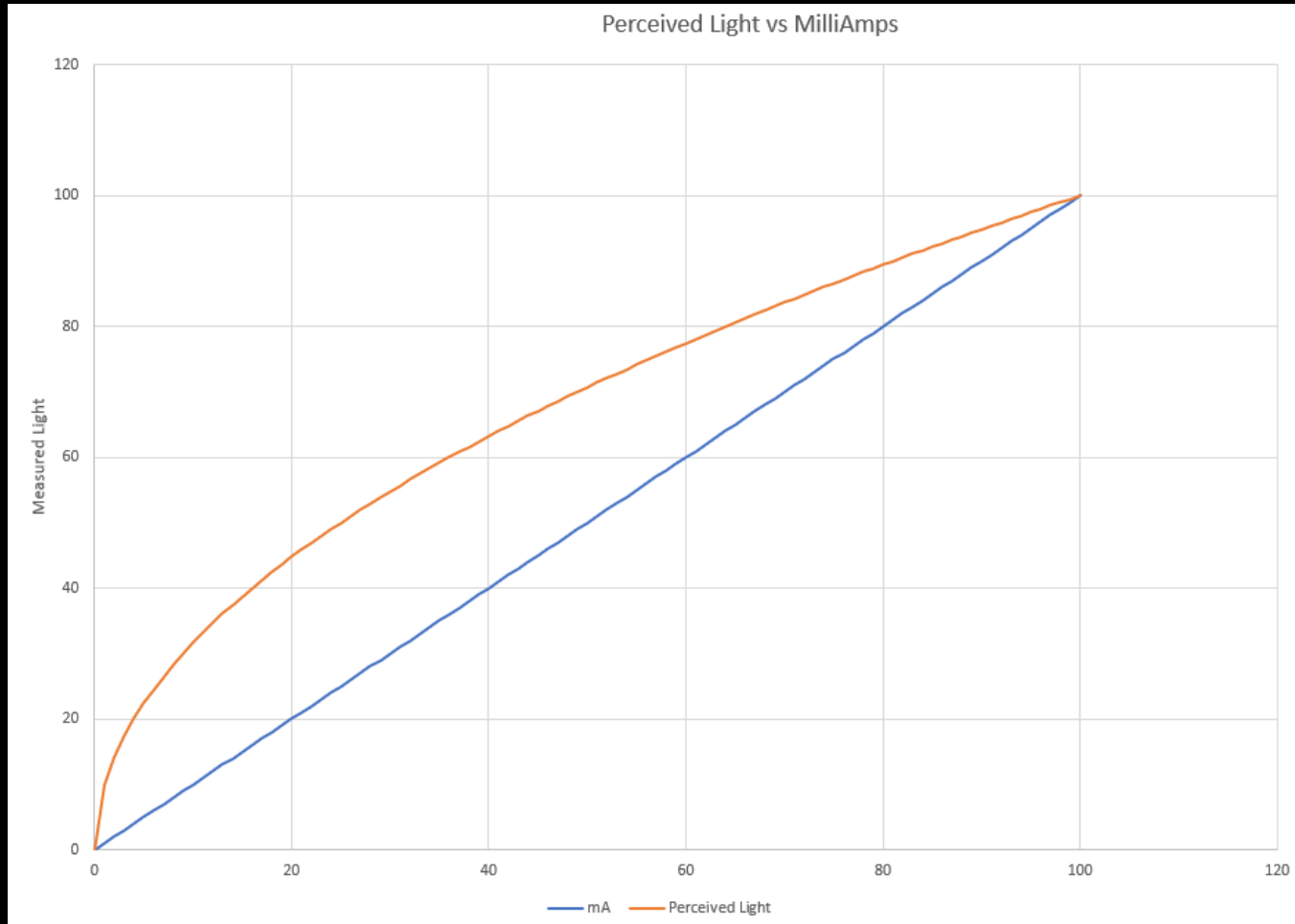


Our eyes have evolved to adapt to great differences in brightness.

1,000,000,000 Xs  
Dimmer Than Sunlight



# Let's Graph Perceived Light vs Milliamps



# Testing a Sample – What % Dim is it?

Testing a fixture

- If lights aren't dimming low enough, the minimum driver output can easily be tested with a light meter. Just fill in the chart below!

Dimmer Level	Foot Candle % from Max
100%	100%
Minimum Dim	X%

Your driver is confirmed based on the value of X! Remember this is a measured value, not perceived!

If X= $\sim$ 10% you have a 10% Driver,  $\sim$ 30% perceived light

If X= $\sim$ 2% you have a 1% Driver,  $\sim$ 10% perceived light

If X= $\sim$ .5% you have a .1% driver,  $\sim$ 3% perceived light



# How can we use this info?

Now that we have learned all this, what do we do with it?

- Designers can better think about their design intent and make the following decisions:
  - Dimming % Driver needed
  - Will the driver go low enough based on the perceived light?
  - Does the starting output need to change to get lower?
  - Can we light the space with less light?
- Manufactures can now better communicate with the Designers:
  - Better explain why they provide 1% and .1% options
  - Better explain the effect of the driver choice in a space.



# Energy Savings?

Looking at the data presented, there is an opportunity to save energy through dimming!

Measured Light %	Measured FC's	Perceived Light %	Perceived FC's	Energy Savings
100%	40fc	100%	40fc	0%
81%	32fc	90%	36fc	19%
75%	30fc	87%	35fc	25%
50%	20fc	71%	28fc	50%





# So, Now What?



Designers and Manufacturers need to communicate on these issues to ensure the design intent is understood by all and the proper gear is selected.

This concludes The American Institute of Architects Continuing  
Education Systems Course

