Outdoor Advertising Association of America

Explanation of OAAA Recommended Brightness Guidelines

There are at least two ways to evaluate the brightness of a LED digital display. A preferred method uses a footcandle meter to determine the amount of light that reaches various points in front of the digital display. A second method uses a luminance meter (frequently called a nit gun) to determine the amount of light emitted by a light source.

Explanation of Footcandles vs. Nits

A brightness standard measured in nits (candelas/square meter) typically contains a maximum value for daytime and nighttime. The footcandle standard has only one value but is measured from different distances based on display size.

An LED sign generates luminance at the source (measured in nits), but this raw source is not what the human eye sees from a distance. The human eye sees illuminance (measured in foot candles) from a point at a certain distance from the LED sign. Illuminance is greatly affected by ambient light and surrounding conditions. As such, it is usually preferred by regulators.

Q: What is the definition of Luminance[1]?

lu·mi·nance/ˈlumənəns/ [loo-muh-nuhns]–noun
1. The state or quality of being luminous.
2. Also called luminosity, the quality or condition of radiating or reflecting light: the blinding luminance of the sun.
3. Optics - The quantitative measure of brightness of a light source or an illuminated surface, equal to luminous flux per unit solid angle emitted per unit projected area of the source or surface.

Q: What is the definition of Illuminance?

/iˈlumənəns/ Compare irradiance E v, Sometimes called: illumination the luminous flux incident on unit area of a surface. It is measured in lux[2]

Q: What is a foot candle?

n. (*Abbr.* fc or ft-c)

[foot-kan-dl]
noun Optics.

A unit of illuminance or illumination, equivalent to the illumination produced by a source of one candle at a distance of one foot and equal to one lumen incident per square foot. Abbreviation: FC[3]

Also:

A unit of illuminance on a surface that is everywhere one foot from a point source of one candle[4]

[1] Dictionary.com http://dictionary.reference.com/browse/luminance?s=t
[2] Dictionary.com http://dictionary.reference.com/browse/illuminance?s=ts
[3] Dictionary.com http://dictionary.reference.com/browse/foot+candle?s=t

[4] TheFreeDictionary.com http://www.thefreedictionary.com/Footcandle

Q: What is a nit?

A:

noun Physics.
a unit of luminous intensity equal to one candela per square meter. Abbreviation: nt[5]
-A unit of illuminative brightness equal to one candle per square meter, measured perpendicular to the rays of the source.[6]

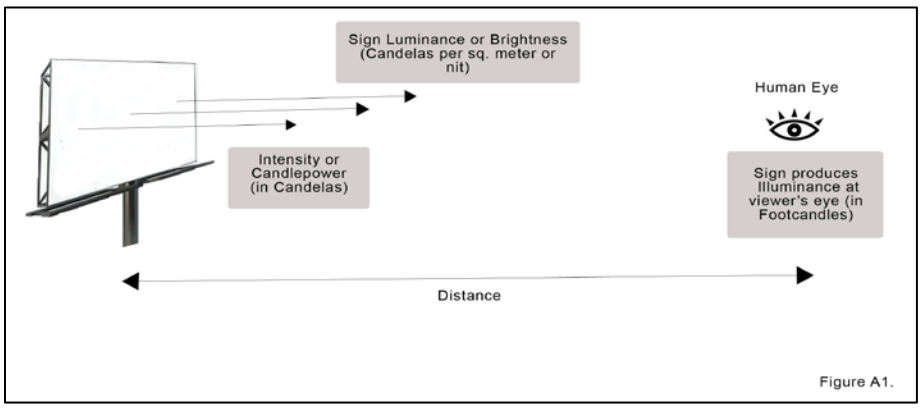

Figure A1.

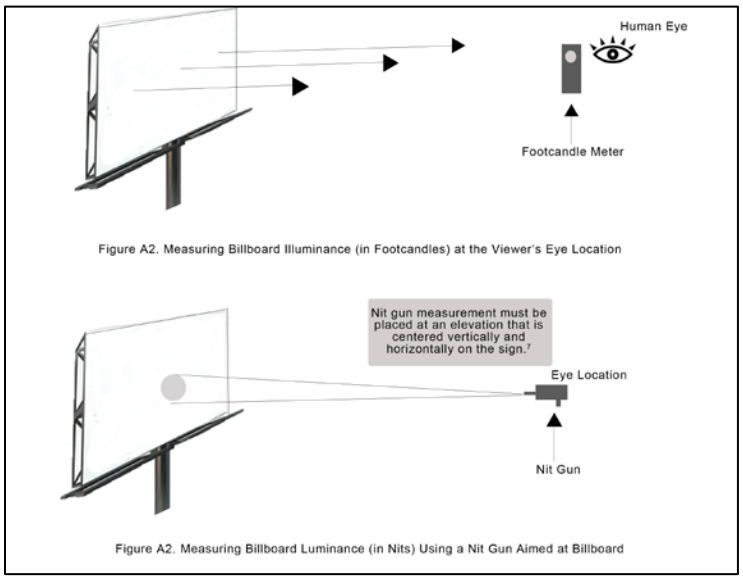

Figure A2. Measuring Billboard Illuminance (in Footcandles) at the Viewer's Eye Location

Figure A2. Measuring Billboard Luminance (in Nits) Using a Nit Gun Aimed at Billboard

[5] Dictionary.com http://dictionary.reference.com/browse/nits?s=t

[6] TheFreeDictionary.com http://www.thefreedictionary.com/nit

[7] Nit gun readings are most accurate when the readings are taken directly perpendicular from the light source. As a result, the best place to take Nit gun readings is from a elevated height perpendicular to the digital display. If this is not possible, moving back from the digital display 350' to 500' on the center line will minimize the loss of accuracy. However, the distance away from the digital display cannot cause the nit gun measurement circle to fall outside the lighted digital billboard face.

-Source: Dr. Ian Lewin, Ph.D. Lighting Sciences, Inc. Digital Billboard Recommendations and Comparisons to Conventional Billboards.

Why use Foot candles over Nits as a unit of measurement?

- Foot candles measure the variance from ambient light. This assures a government that the sign will not be too bright for conditions. At different parts of a day the ambient lighting can be significantly different with clouds or fog. Conversely, the same can be true about nighttime conditions when an adjacent commercial lot turns on or off their parking lot lighting. Regulation using Nits merely sets a maximum and minimum level for day and night time conditions. Using the foot candle standard will not allow the sign to be too bright under a variety of conditions. (See Figure A2)

- Nits measure the brightness of the light at its source, without regard to ambient light. Establishing a lighting standard that ignores the brightness of the area (ambient light) allows the digital billboard to be too bright in dark environments and too dim in highly illuminated areas. In other words, fixed nit standards can allow the digital to operate at significantly higher luminance than is needed over the course of a 24 hour period.

- Nits: To measure nits you need to be directly perpendicular to the sign to measure, and get an accurate measurement. This is factored horizontally and vertically. There is a little bit of leeway on angle. Nits are directional in nature and billboard signs are usually aimed directly at the middle of the roadway. This in many cases puts the person performing the measurement in the travel lanes. In addition, due to the height of the average digital billboard a truck with a man-lift may be required. There is no specified distance you must be away from the sign to measure. (See Figure A2)

- Footcandles: With the footcandle standard you should be as perpendicular to the face as you can, but you do not have to be, to get a valid, accurate measurement. Footcandles can be measured multi directionally. You can take measurements at an angle to the sign face and receive valid measurements. The distance from which to measure is set at 250 ft away from the sign face for 14 x 48 size. This gives a regulator more options on places to stand.
- This makes the footcandle standard superior in ease of implementation. But even if we assumed they are both different, but similar in this regard, other more important factors tip the scales.

    - The footcandle standard is more restrictive in terms of lighting allowed, in a variety of conditions. As such, is usually preferred by regulators once they are educated on the differences.
    - The industry footcandle standard is tied to a required light sensor and dimming software.
    - Footcandles measure what the driver sees through their windshield in terms of light, where his car is.
    - Nits measure the light emanating from the sign face, typically a few hundred feet away. Not necessarily what the driver is seeing.

- It also can benefit a government to use foot-candles instead of Nits as Nit guns are very expensive (estimated cost $3,000.00). Light meters can cost as little as $250.00.

There are 3 necessary components to insure a digital billboard will never be too bright for conditions.

1. Maximum brightness limits incorporating a footcandle standard
2. An ambient light sensor installed on the sign structure
3. Dimming software

The ambient light level of a digital billboard will not vary significantly from that of a traditional billboard display and, in many cases it will be less. The light output levels will be set to be appropriate for the surroundings.

OAAA recognized/member companies utilize a photocell on digital billboards so that the display will easily be seen by motorists under changing light conditions. Sophisticated dimming software constantly changes the brightness of the display in response to changing ambient lighting conditions. This insures a digital billboard will never be too bright for conditions.

The range of brightness varies greatly between daytime and nighttime conditions. In bright daylight, the unit must have higher intensity in order to be seen. During darkness conditions, the brightness can be set low and still be easily seen by motorists.

Why was 0.3 Footcandles chosen as the limit?

The 0.3 footcandle maximum illuminance level was carefully derived from a report completed by a former president of the IESNA.[8] The recommended technique is based on accepted IESNA practice for "light trespass."

The Outdoor Advertising Association of America (OAAA) commissioned Dr. Ian Lewin, in 2008 a principal at Lighting Sciences, Inc., Scottsdale, AZ, to recommend criteria for brightness levels on digital billboards[9]. The standards are designed to minimize the risk of glare or unreasonable driver distraction.

Footcandle measurements are commonly used throughout the United States. Footcandle measures are widely used in the lighting industry, photography, film, television, conservation lighting, and construction related engineering and building code regulations[10]. In addition, footcandles are frequently cited in OSHA regulations. The OAAA believes that these lighting standards reflect the best practices of the Out of Home Industry.

[8] IESNA – Illuminating Engineering Society of North America

[9] Digital Billboard Recommendations and Comparisons to Conventional Billboards, by Dr. Ian Lewin Ph.D., FIES, L.C. Lighting Sciences, Inc., 7826 East Evans Road, Scottsdale, Arizona 85260

[10] wikipedia.org/wiki/Footcandles

Appendix

OAAA Recommended Brightness Guidelines

Criteria #1 - Lighting Standards – Measurements:

The industry recommended criteria follows the lighting standards established by the Illuminating Engineering Society of North America (IESNA). The OAAA and member companies voluntarily adhere to the following guidance.

Recommended regulatory criteria:
Lighting levels should not exceed 0.3 foot candles (over ambient levels) as measured using a foot candle meter at a pre-set distance.

Pre-set distances to measure the foot candles impact vary with the expected viewing distances of each size sign. Measurements should be taken as close to perpendicular to the face as practical.

Measurement distance criteria:

Nominal Face Size	Distance to Measure From
12’ x 24’	150’
10’6 x 36’	200’
14’ x 48’	250’
20’ x 60’	350’

Each display must have a light sensing device that will adjust the brightness as ambient light conditions change.

Criteria #2 - Alternate Regulatory Criteria

The brightness of light emitted from a changeable message sign should not exceed 0.3 foot candles over ambient light levels measured at a distance of one hundred fifty feet (150') feet for those sign faces less than or equal to three hundred square feet (300 sq. ft.), measured at a distance of two hundred feet (200 ft.), for those sign faces greater than three hundred square feet (300 sq. ft.) but less than or equal to three hundred eighty-five square feet (385 sq. ft.), measured at a distance of two hundred fifty feet (250 ft.), for those sign faces greater than three hundred eighty-five square feet (385 sq. ft.) and less than or equal to six hundred eighty square feet (680 sq. ft.), measured at a distance of three hundred fifty feet (350 ft.) for those sign faces greater than six hundred eighty square feet (680 sq. ft.)

Or use Alternate Table:

Sign Face Size	Distance of Measurement
681-1200 square feet	350 feet
385-680 square feet	250 feet
300-385 square feet	200 feet
200-300 square feet	150 feet

Each display must have a light sensing device that will adjust the brightness as ambient light conditions change.

Criteria #3 - Optional Regulatory Addendum - (If standardized distances cannot be achieved in compliance with MUTCD roadside work, or if the site conditions will not allow measurements from the previous distances.)

In the event it is found not to be practical to measure a digital billboard at the set distances prescribed above, a measurer may opt to measure the sign at any of the alternative measuring distances described in the applicable table set forth below. In the event the sign measurer chooses to measure the sign using an alternative measuring distance, the prescribed footcandle level above ambient light shall not exceed the prescribed level, to be determined based on the alternative measuring distances set forth in the following tables (A), (B), (C), and (D), as applicable:

(A) For changeable message signs less than or equal to 300 square feet:

Alternative Measuring Distance	Prescribed Foot Candle Level
100	0.68
125	0.43
150	0.3
200	0.17
250	0.11
275	0.09
300	0.08
325	0.06
350	0.06
400	0.04

(B) For changeable message signs greater than 300 square feet but less than or equal to 385 square feet:

Alternative Measuring Distance	Prescribed Foot Candle Level
100	1.2
125	0.77
150	0.53
200	0.3
250	0.19
275	0.16
300	0.13
325	0.11
350	0.1
400	0.08

(C) For changeable message signs greater than 385 square feet but less than or equal to 680 square feet:

Alternative Measuring Distance	Prescribed Foot Candle Level
100	1.88
125	1.2
150	0.83
200	0.47
250	0.3
275	0.25
300	0.21
325	0.18
350	0.15
400	0.12

(D) For changeable Message Sign greater than 680 square feet: Alternative Measuring Distance: Prescribed Foot Candle Level:

Alternative Measuring Distance	Prescribed Foot Candle Level
100	3.675
125	2.35
150	1.63
200	0.92
250	0.59
275	0.49
300	0.41
325	0.35
350	0.3
400	0.23
425	0.2
450	0.18
500	0.15