

# GORDON WATSON and ASSOCIATES

ELECTRICAL  
LIGHTING  
DESIGN  
ACN 002 105 268  
ABN 83 002 105 268

29 CURRAWONG AVENUE  
NORMANHURST  
NSW 2076  
TEL 02 9487 2119  
Mob 0412 361 633

16 March 2011

Outdoor Media Association Inc  
Suite 204, 80 Williams Street  
East Sydney NSW 2011

Attn: Ms Linda Black

Dear Madam

**Re: Comments on the Interim Guidelines for the Management of Electronic Billboard Advertising Devices Verion 0.1 – December 2010.**

I refer to our recent discussions regarding the requirements set out in the above Interim Guidelines for the Management of Electronic Billboards relating to signage utilising Light Emitting diodes as a light source.

The following are my comments and suggested proposed luminances for LED signage referred to in the Interim Guidelines.

## 1.0 INTRODUCTION

In section 1.4 of the Interim Guideline it is stated that the Department's aim is for electronic billboards to exhibit consistent apparent brightness in all lighting conditions. Ambient horizontal illuminances are grouped into 9 steps with each step having an upper and lower maximum average luminance allocated to an associated range of illuminance.

In the following sections the methods of illuminating non-electronic billboards are discussed with the associated advantageous and disadvantages compared to electronic billboards.

It is considered that a higher luminance is required during day light hours for electronic billboards with a reduced luminance for inclement weather and a further reduction for sunset/ twilight and a night time luminance.

A suggested amendment to Table 2 is included in line with discussions put forward in the following sections.

## **2.0 EXTERNALLY ILLUMINATED SIGNAGE**

Externally illuminated signage using front mounted floodlights have been a method of providing illumination for advertising signage after dark for some time. Originally incandescent lamps were used as the lighting source. In recent times discharge lamps have been employed as they provide a higher light output for less power input. Discharge lamps can also have a higher colour temperature than incandescent lamps which results in a much whiter light source and can be used to accentuate certain colours normally the reds, greens and blues. A consideration is that the luminaires used in these types of externally illuminated signs are standard discharge floodlights which have long lamp life. These floodlights have to be aimed carefully or have shades fitted in order to control light spillage to adjacent areas.

## **3.0 INTERNALLY ILLUMINATED SIGNAGE**

Internally illuminated signage generally is constructed using a box type enclosure housing a lighting source, usually a number of fluorescent lamps providing a distributed output of light across the enclosure. The front of the enclosure is provided with a translucent material on which advertising material is printed. During daylight hours sunlight illuminates the advertising material on the front of the signage and resulting in the advertising material being visualised by passing pedestrians and drivers. During the hours of darkness the fluorescent lamps within the signage enclosure provide internal illumination or backlit illumination so that the advertising material can be visualised by the public viewing the sign. New advertising material on each signage is provided by changing the material on the front of the signs on which the graphics is printed.

## **4.0 LIGHT EMITING DIODES (LED) SIGNAGE**

A relatively new method of presenting advertising material to the public is by using signage

comprising an array of Light Emitting Diodes (LED). These LEDs are presented to a viewer in the same way as pixels on a television screen. One of the advantages is that the advertising material can be changed electronically without producing printed graphics and manually changing the material on each sign. LEDs have lamp life predicted as 20,000-50,000 hours.

As the image graphics are produced by LEDs with their light output directed towards the viewer the LEDs must be switched on at all times during the operation of the signage in order for the graphics to be viewed. During night time this type of signage operates similar to internally and externally illuminated signage. That is to say all three types of signage utilises light when operating during the night hours to allow the viewer to read the signage. The level of brightness on the face of each sign is a measurement of luminance expressed in candelas per square metre ( $\text{cd/m}^2$ ).

## **5.0 DAY AND NIGHT OPERATION**

Both front and internally illuminated signage have the advertising information printed on a medium situated on the face of the signage. During daylight hours the graphics can usually be viewed in ambient daylight levels. As daylight illuminance levels decrease the graphics require to be illuminated so that they can be read by passing viewers.

However, during daylight hours LED signage is required to compete with high levels of daylight and requires a corresponding increase in luminance to allow the signage to be readable. It is also the case that the public viewing the signage will have their eyes in a high light adaptation mode. Therefore, the luminance of LED signage must be increased commensurate with the ambient day time luminance in order that the viewing public can visualise the signage graphics.

Under the Interim Guideline for Management of Electronic Billboard Advertising Devices Version 0.1 – December 2010, Table 2 Maximum luminance levels for electronic billboards, it sets the Maximum Average Luminance for an ambient illuminance of 100,000 lux at  $2000 \text{ cd/m}^2$ . It has been indicated by signage manufacturers and others that have carried out studies in this field that the maximum luminance set out in the Interim Guideline does not provide sufficient luminance on the face of an LED sign to allow viewers to properly visualise the graphics. A more practical signage luminance suggested and field tested is  $6000 - 7000 \text{ cd/m}^2$ .

## **6.0 DAY OPERATION - FULL SUN**

There may be occasions when the electronic billboard requires to be installed facing in a direction approximately east or west where, at certain times of the day, the face of the signage will receive direct sun light. This will result in the maximum average luminance of the signage being less than the luminance on the face of the signage provided by the direct sun light with the result that the signage will be unreadable. In order to provide

sufficient luminance from the LED sources to compete with the direct sun they would require to have their outputs increased to maximum output.

Sun shining directly on to the face of the signage would be a condition existing for a relatively short time before sunset and after sunrise dependant on the orientation of the signage. As this situation is not applicable to all signage it is suggested that a special requirement is applied to include control equipment which will sense direct sun shining on to the face of the signage and switch to maximum luminance of the signage only for the period when the sun shines directly on to the face of the signage.

## **7.0 DAY AND NIGHT OPERATION**

Front illuminated and internally illuminated signage both have the advertising information printed on a medium situated on the face of the signage. During daylight hours the graphics can usually be viewed in ambient daylight levels. As daylight illuminance levels decrease the graphics require to be illuminated so that they can be read by passing viewers.

LED electronic billboards rely on the luminance of the LED sources to display the advertising graphics. Therefore, the Maximum Average Luminance of the LED signage is required to be increased as the ambient illuminance increases as required during day light so that the information on the electronic billboard will be readable.

It is assumed that the Maximum Average Luminance set out in Table D1 of Appendix D for the 3 Zones is the night time luminance for all illuminated signage. Therefore, the steps below the luminances for Zones 1-3, i.e. the bottom 5 steps, should be removed so that illuminance requirements are consistent for all forms of illuminated signage operating during night hours.

As indicated in Section 5 of this document the Maximum Average Luminance would require to be increased to 6000 - 7000 cd/m<sup>2</sup> with the next steps being relevant to ambient daylight in inclement weather, twilight and night operation i.e. relative to the Zones applicable in Table D1.

## **8.0 SIGNAGE OUTPUT CONTROL**

There are many installations of externally and internally illuminated signage that are controlled by light sensors such that the signage is switched On at sunset and Off at sunrise. As these sensors are light sensitive it is possible that they may activate the signage illumination during periods of heavy overcast clouds.

Similar controls can be installed for the LED type of signage. The sensor controls proposed for LED signage would switch the signage to the night luminance, to a higher level of luminance for twilight and inclement weather, to the day time luminance and to maximum when the direct sun is on the face of the signage when required.

In cases where the maximum level of luminance was required due to direct sun light on the face of the signage a composite sensor may be required with one measurement sensor for ambient light and a second sensor for direct sun light on the face of the signage.

## **9.0 LIGHTING SCIENCES LED SIGNAGE RECOMMENDATIONS**

Dr Ian Lewin who is the Principal of Lighting Sciences, Scottsdale, Arizona, USA has produced a report providing recommendations for electronic digital billboards during night time conditions.

The Lighting Sciences report Section 3.2, Determining the Maximum Allowance Billboard Luminance, addresses a method of measuring the eye illuminance produced by billboards above ambient then setting a limit. In Dr Lewin's report the eye illuminance was 3.22 lux and this illuminance was used to calculate the allowable maximum billboard luminance.

It can be seen from the worked example that the allowable billboard average luminance would be, in this case, 342 cd/m<sup>2</sup> for night time operation. This report also proposes viewer distances for various sizes of billboards.

Section 3.3 Determining the Allowable Dimmer Setting, addresses how percentage dimmer settings can be calculated. This is advantageous as manufacturers of electronic billboards using LEDs as the light source normally set the dimming via software programs which relate to a percentage of the maximum average luminance of the billboard.

It is understood that this report has been adopted for use in proposed Standards based on the IESNA Lighting Zone E2.

## **10.0 DAKTRONICS RECOMMENDATIONS**

Daktronics, Brookings, South Dakota, USA, is one of the leading manufacturers of digital electronic billboards who also have an office and workshop in Sydney.

Discussions have been held with Daktonics, Sydney and two of the Dakronic engineers in Brooking, South Dakota.

During discussions, Daktonics indicated that an appropriate maximum day time luminance for electronic billboards with LED sources would be  $6000 \text{ cd/m}^2$  in situations where no direct sun is shining on the face of the sign. It was also agreed that during the time before sunset or after sunrise when the face of a billboard is receiving direct sun the output should be increased to the maximum output of the LEDs.

Within Zones 1 - 3 of the Interim Guideline, December 2010, the maximum day time luminance would be  $6000 \text{ cd/m}^2$  or increased to the maximum output of the signage LEDs if the sun was directly on the face of the sign.

Between sunset and the end of evening twilight and between the beginning of morning twilight and sunrise an appropriate luminance would be  $1000 \text{ cd/m}^2$  for Zone 1,  $700 \text{ cd/m}^2$  for Zone 2 and  $600 \text{ cd/m}^2$  for Zone 3 in relation to Table D1

Night time luminances were discussed and for Zone 1 -  $500 \text{ cd/m}^2$ , Zone 2 –  $350 \text{ cd/m}^2$  and Zone 3 –  $300 \text{ cd/m}^2$  were considered appropriate for electronic billboards so that they can be read without causing excessive glare to passing motorists and pedestrians within these zones.

In-built light sensors to each billboard would control the luminance levels such that during cloud cover or inclement weather the luminance would reduce accordingly.

The Daktonic engineers confirmed that the luminances discussed are similar to those used within the USA for digital electronic billboards using LED light sources.

## **11.0 CONFIRMATION TESTS**

After discussions with the Daktronic engineers in South Dakota tests were arranged at Chatswood, NSW to confirm that the luminances discussed would be acceptable for Australian conditions.

A sample electronic billboard was erected outside the Daktronics workshop at Chatswood in January 2011. Tests were conducted at 11.00am when the day time illuminance was measured as  $105,000 \text{ lux}$ . The sign was positioned within the outdoor car park and set to a maximum output with the average luminance measured as  $7500 \text{ cd/m}^2$ . The average output of the sign was reduced to  $6000 \text{ cd/m}^2$ . Coloured images were then shown on the electronic billboard and viewed from a distance of 25m from the sign. The images on the sign could be viewed clearly without causing visual discomfort.

The method of measuring the luminance was that set out in the Lighting Science document using an illuminance meter. However, as these measurements were taken in day light a short tube was installed over the sensor of the illuminance meter which looked at an area covering the area of the electronic sign and excluding a large proportion of ambient day light.

Tests were also carried out at sunset and at the end of twilight.

At sunset the ambient illuminance was measured as 240 lux and the sign luminance was measured as 710 cd/m<sup>2</sup>. At the end of twilight the ambient illuminance was measured as 1 lux and the sign luminance was measured as 340 cd/m<sup>2</sup>. Neither of these luminances caused visual discomfort when viewed from a distance of 25m in a relatively low ambient illuminance.

The luminance of the sign was further reduced to 260 cd/m<sup>2</sup> and the images could be viewed clearly and without visual discomfort from a distance of 25m in a relatively low ambient illuminance.

As the output of the signs are controlled in steps set by software it was found difficult to set the sign luminance to exactly 700, 350 and 300 cd/m<sup>2</sup>.

Further tests were carried out with the same sign relocated to within the Daktronics workshop to control and provide selected ambient illuminances.

These tests were carried out with each sign illuminance setup on an all white screen then graphics displayed and viewed at the associated ambient illuminance. The results were as follows: -

<b>Sign Luminance</b>	<b>Ambient Illuminance</b>	<b>Observed Result</b>
200 cd/m <sup>2</sup>	950 lux	Sign appearance OK
125 cd/m <sup>2</sup>	390 lux	Sign did not appear bright
110 cd/m <sup>2</sup>	98 lux	Sign did not appear bright
76 cd/m <sup>2</sup>	42 lux	Sign did not appear bright
59 cd/m <sup>2</sup>	10 lux	Sign did not appear bright

At a sign luminance of 200 cd/m<sup>2</sup> and ambient illuminance of 950 lux the sign, with graphic displayed, was sufficiently bright to read the graphics without any visual discomfort. When the sign luminance was set to 125 cd/m<sup>2</sup> with the ambient illuminance below 400 lux and graphics displayed, the sign did not appear bright with the result that

the graphics appeared dull and there was a degree of difficulty in visualising the signage material.

The above tests indicate that a sign luminance of 200 cd/m<sup>2</sup> is just acceptable but luminances below this level with lower levels of ambient illuminances do not provide the required luminance or brightness to adequately display advertising graphics.

The illuminances were measured using a NATA calibrated illuminance meter with the calibration certificate dated 29 November 2010.

## **12.0 VARIABLE MESSAGE SIGNS**

Variable message signs (VMS) are often installed on freeways and major roads. . The source used in the VMS units are LEDs and normally have a yellow coloured group of LEDs making up the digits on the sign. Axent is a manufacturer of these VMSs and include in their technical data sheets published on their web site that the minimum luminance of their VMS units is 15,000 cd/m<sup>2</sup>.

## **13.0 PROPOSAL**

Based on the field tests which were carried out and referred to in this document, it is suggested that the Maximum Average Luminances as set out in Appendix D Table D1 of the Guide for the 3 zones are retained for electronic billboards utilizing LED (light emitting diodes). The Maximum Average Luminances for Zone 1 is 500 cd/m<sup>2</sup> , Zone 2 is 350 cd/m<sup>2</sup> and Zone 3 is 300 cd/m<sup>2</sup> all for night operation . These Zones are related to different environments with the maximum being determined following field investigations in the Brisbane and Gold Coast areas.

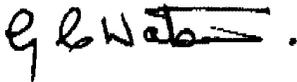
It is proposed that electronic billboards illuminated during night hours should operate with the same luminance as other illuminated signage such as front or internally illuminated billboards to provide consistency.

Based on the above it is proposed to submit the following luminances for Zones 1, 2 and 3 in the Roadside Advertising Guide, Appendix D Brightness / Luminance Levels Table D1 Maximum Average Luminance of LED Illuminated Advertising Devices operating in the lighting conditions specified.

Lighting Condition	Zone 1	Zone 2	Zone 3
Full Sun on Face of Signage	Maximum Output	Maximum Output	Maximum Output
Day Time Luminance	6000 cd/m <sup>2</sup>	6000 cd/m <sup>2</sup>	6000 cd/m <sup>2</sup>
Day Time Luminance Morning and Evening Twilight and Inclement Weather	1000 cd/m <sup>2</sup>	700 cd/m <sup>2</sup>	600 cd/m <sup>2</sup>
Night Time	500 cd/m <sup>2</sup>	350 cd/m <sup>2</sup>	300 cd/m <sup>2</sup>

I trust my comments and suggested proposals will be of assistance to you regarding the luminance requirements of electronic billboards.

Yours faithfully



G.C.Watson PhD MBS Sc IEng MIET FIES