Report

Description:	Full report on street lighting for AEB VRU testing
Venue:	Upper Heyford, Oxfordshire
Date of test:	23rd January 2018

1. General background

While working with Thatcham UK, Moshon Data conducted a sample of ground luminance tests on a small selection of street lighting solutions with a view to understanding what the differences might be between them, and therefore present a range of suitable option(s) for the new 2018 AEB VRU protocol.

Street lamps tested:

- Adolf Schuch 47 2403 ABX CL
  - http://www.schuch.de/47 (Difficult to get hold of– possible phase out)
  - http://www.schuch.de/SCHUCH_48_en.pdf - possible replacement

- Zeta SmartScape Nano (With an L02 lens fitted)
- Zeta SmartScape Nano (With an L05 lens fitted)
  - http://zetaled.co.uk/my-product/smartscape-nano/

- Zeta Macro (New product)
  - http://zetaled.co.uk/my-product/smartscape-macro/

2. Test procedure

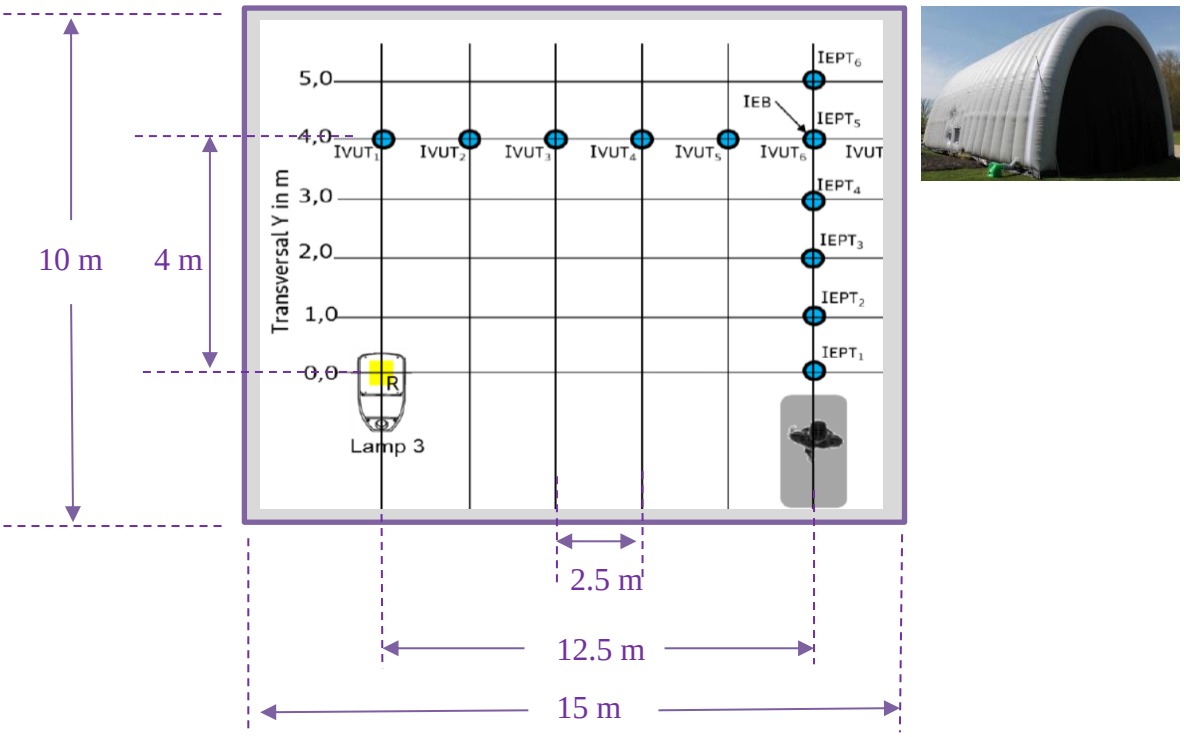
Each street lamp has been tested by Moshon Data for ground luminance at various test point locations. The points are defined by the Euro NCAP VRU protocol. An example measurement grid is outlined on page 38, and a test example on page 32.

AEB VRU Protocol here: https://cdn.euroncap.com/media/32279/euro-ncap-aeb-vru-test-protocol-v202.pdf

Tests were carried out in a simulated night-time environment with a controlled dark condition at < 1 lux using the MD Night Environment Simulation Tunnel (NEST).

Note that due to size restrictions in the length of the single section of NEST, and in some cases where only one lamp was available, it was only possible to conduct a test on one lamp at a time, meaning only half of the example test grid. We therefore expect our luminance at the EPT path using one lamp at 12.5 m from the light source to be roughly half of the luminance expected than if 2 lamps were used at a 25 m separation. I.e. if two lamps were used (in a full grid scenario) we can assume a near ‘doubled light output’ at the EPT path assuming the lamp light spread is over 12.5 m. For the VUT the ‘doubled light output’ would effectively reduce by a given percentage (we assume 20% for our tests) the further away the point gets from the light source.

The floor plan of our test area is below:



Examples of a predicted light output will be shown in the results section below, but more work is obviously required to prove the light overlap spread from the light sources and the effect this has on the luminance at the test points. Ideally, we should carry out our tests using a two-lamp scenario, but one lamp and a prediction should be able to give us an idea of what to expect.

The light meter used was the Konica Minolta T-10A (as suggested by Euro NCAP). Others were used as a comparison and the differences will be compared in a further report.

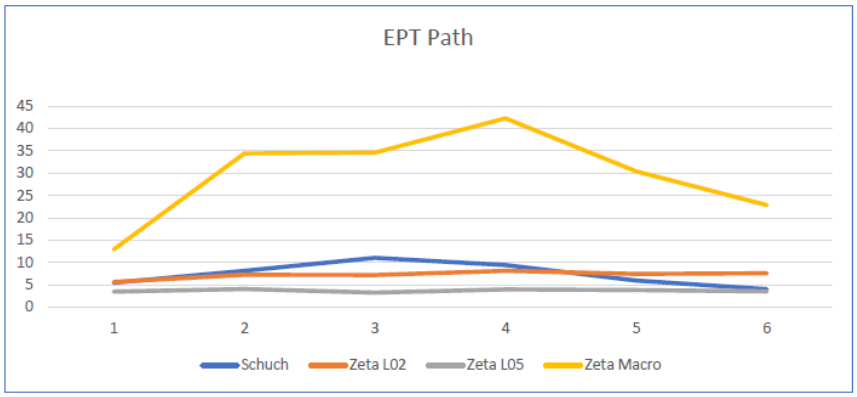
The ground conditions were wet which may result in different luminance ratings from dry conditions. The weather was wet and gusty with up to 16 mph winds reported on the day, but inside the tunnel we were not affected.

Below is a view inside, and outside the tunnel on the day.

3. Results

3.1. Results at EPT Path

	EPT Path			
	Schuch	Zeta L02	Zeta L05	Zeta Macro
	5.45	5.64	3.47	12.92
	8.15	7.22	4.05	34.4
	11.04	7.2	3.25	34.6
	9.4	8.13	3.95	42.3
	5.95	7.43	3.83	30.4
	4.02	7.6	3.53	22.88
Avg	7.3	7.2	3.7	29.6



For the EPT path the specifications are stated as > 5 lux therefore the Schuch, Zeta with L02 lens and Macro lamps are suitable. However, the Zeta with the L05 lens is not suitable and drops below 5 lux.

3.1.1. Results at the EPT path using a simulation of the extra light spread overlap of two lamps

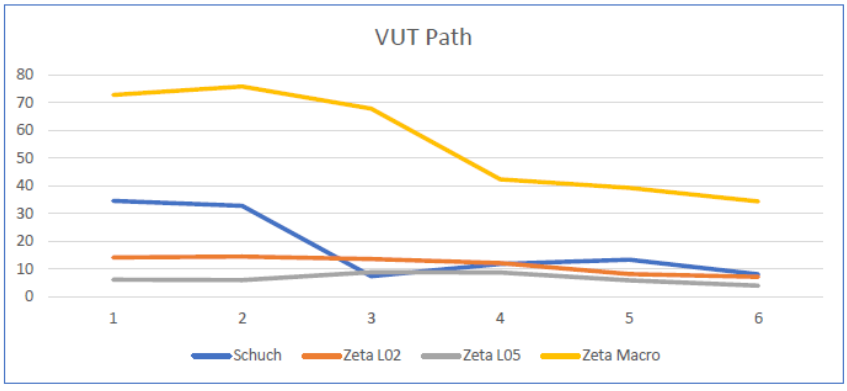
In the table below each result has been doubled working on the assumption of twice the light on the overlap

EPT Path			
Schuch	Zeta L02	Zeta L05	Zeta Macro
10.9	11.28	6.94	25.84
16.3	14.44	8.1	68.8
22.08	14.4	6.5	69.2
18.8	16.26	7.9	84.6
11.9	14.86	7.66	60.8
8.04	15.2	7.06	45.76
14.7	14.4	7.4	65.8

Here, the results show that all lamps are > 5 lux and therefore in specification.

3.1. Results at VUT Path

	VUT Path			
	Schuch	Zeta L02	Zeta L05	Zeta Macro
	34.6	14.25	6.23	72.8
	32.8	14.53	6.08	75.8
	7.45	13.62	8.9	67.8
	11.87	12.22	8.8	42.4
	13.45	8.23	5.95	39.3
	8.15	7.22	4.05	34.4
Avg	18.1	11.7	6.8	51.9



For the VUT path the specifications are stated as 19 +/- 3 lux. This is a much tighter requirement than EPT.

This means all points were out of specification at this rating, on average the Zeta with L02 lens is arguably the closest overall.

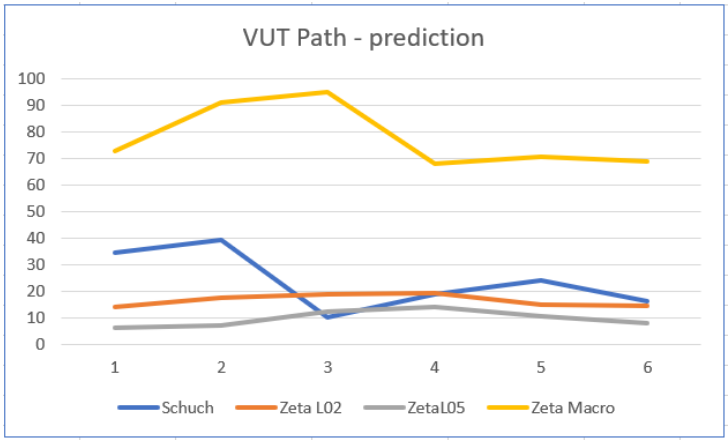
However, what if we are to predict the results of a light overlap spread from a two-lamp scenario?

3.1.1. Results at the VUT path for a ‘doubled’ light overlap.

The prediction in the table below poses a theoretical ‘light overlap’ for the VUT path using a 20% reduction on the ‘extra light’ we might presume is present from the overlap at each point as you get further away from the 2nd lamp light source.

VUT Path					
Test point	Schuch	Zeta L02	ZetaL05	Zeta Macro	Notes
VUT1	34.6	14.25	6.23	72.8	no reduction - normal light from onelamp
VUT2	39.36	17.436	7.296	90.96	80% reduction on extra light overlap
VUT3	10.43	19.068	12.46	94.92	60% reduction on extra light overlap
VUT4	18.992	19.552	14.08	67.84	40% reduction on extra light overlap
VUT5	24.21	14.814	10.71	70.74	20% reduction on extra light overlap
VUT6	16.3	14.44	8.1	68.8	double
	24.0	16.6	10.5	78.7	

Here, the Zeta with the 02 lens was the **only** unit in specification on three points (VUT2,3,4), the Schuch within specification on 2 points (VUT4,6). However, overall the Zeta 02 was also more consistent in overall light output and averages 16.6 – only one on the edge of the lower limit! However, this is only a prediction…



4. Conclusion

In brief it appears clear that some lamps are brighter, but others more consistent in light output albeit at a lower overall level. The Zeta’s L02 and L05 appear both more consistent in their light spread than the others, but the Schuch is brighter the nearer to the lamp source you get but making very little difference the further away you get from the light source. The Zeta Macro outperformed all the others in sheer brightness by a long way but was far too bright for the 19 lux +/- 3 lux light conditions asked for by the protocol on the VUT path.

In short, using our prediction theory, all appear to be fine for the > 5 lux of the EPT path, but the VUT path needs some consideration of our prediction by using two lamps in the test and not one.

After talks with Zeta, we understand it may be possible to ‘overdrive’ the Zeta L02 to make the output brighter if required. This may result in a shorter life expectancy, but the life expectancy of a streetlamp is based on being on every night 365 days a year, so this may not be too much of a problem for occasional testing. Conversely, we may also be able to reduce the light output of the Zeta Macro if it is felt the output of this would be a better spread – i.e. a more homogenous spread might be possible from multiple LEDs and not from a single light source. However, oddly the single source appears to be more consistent in our tests.

We are aiming to provide a further report with more studies looking into the effects of using different lighting environments and the importance of different light meter choices as these can vary dramatically.

We look forward to receiving feedback from engineers regarding this analysis.

5. Acknowledgments:

- Thatcham UK for their support and use of their airfield area at Upper Heyford
- Zeta Lighting for their support and providing a sample of lights for us to try
- Konica for use of the Luxmeter T-10A as recommended by Euro NCAP

/Moshon Data