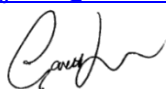


astro

PHOTOMETRIC
TEST REPORT

Report Number	GNC-19607
Customer	Astro Lighting Limited
Contact	Ross Dickson
Product Type	LED Uplight/Down Wall light
Test Purpose	Generation of Photometric Data
Sales Order Ref	Q-LUX17-21659
Works Order Number	WO-10254
Test Item Reference	TI-13834
LAB Test Method Reference	TES-102000
Test Standards	LM-79-08; (BS) EN 13032-4:2015; CIE S025:2015
Lab Location Reference	LUX-TSI
Tested by	Mike Sewell
Date of Test	28/06/2017
Reviewed by	Menno Schakel
Number of products tested	1

Address: LUX-TSI Ltd.,
Pencoed Technology Park,
Pencoed, Bridgend,
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Authorised by: Gareth Jones
Email: gjones@lux-tsi.com
Signed:



Date: 28/07/2017



8185 - Oslo 160 Concrete

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Nomenclature

Lamp Orientation described below relates to the position in which a lamp is designed to operate for maximum performance and safety, these include:

BD - Base Down (bulb is vertically positioned with the metal base at the bottom, glass up)

BU - Base Up (bulb is vertically positioned with the metal base at the top, glass hanging down)

HBD - Horizontal $+15^{\circ}$ to Base Down

H45 - Horizontal to -45° only

VBU - Vertical Base Up $\pm 15^{\circ}$

VBD - Vertical Base Down $\pm 15^{\circ}$

HBU - Base Up $\pm 90^{\circ}$ (bulb can be operated in a base up or horizontal position)

HOR - Horizontal Burn (bulb is positioned with the metal base parallel to the ground)

H75 - Horizontal $\pm 75^{\circ}$ (bulb should not be operated within 15° of vertical)

U - Universal Burn (burn can be operated in any position)

Test Conditions

Measurements were made with an ambient temperature of $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$. Measurements were taken only after sufficient time for thermal stabilisation has been allowed. Thermal stabilisation according to LM-79-08 was achieved before measurements are measured and reported.

Calibrations

The far field Type C Goniophotometer is calibrated using an intensity lamp calibrated by a NVLAP accredited calibration laboratory.

Test Equipment

UL LSI Custom Far-Field Type C Moving Mirror Goniophotometer measures intensity as a function of angle. On-axis spectral measurements taken using spectrometer, for which these measurements and outputs are not accredited.

Data Formats

IES (15 deg azimuth and 2.5 deg inclination) and LDT (15 deg C planes and 2.5 deg gamma angles)

Spectral Data file from which the calculation of chromaticity and CRI etc. have been performed and the derived results from the LightMtrX software are provided as a text file format.

All photometric data for LED products will be provided in ABSOLUTE photometric format and all non-LED data will be in relative photometric format with lamp lumens measured separately, where possible, for LOR estimation.

Product Name	Oslo 160 LED
Part/Serial Number	1298020
Type of Product	LED Uplight/Down Wall light
Base Type	Not Applicable - Luminaire
Driver Type	Internal
Test Time	30 mins
Operating Orientation	Base Up
Test Orientation	Base Up
Ambient Temperature	24.9°C
Manufacturer	Astro Lighting Limited
Date of Manufacture	Not Available
Thermal Management	Passive
Dimmable	No
Pre-Burning Time	0 hours
Stabilisation Time	60 mins
Humidity	54.8% RH
Averaging Applied	NONE

Driver Details		
Manufacturer		N/A
Model		N/A
Part/Serial #		N/A
Rated Voltage		N/A
Output	Current	N/A
	Voltage	N/A

Photometric Measurements	
Luminous Flux	117 lm
Luminous Efficacy	19 lm/W

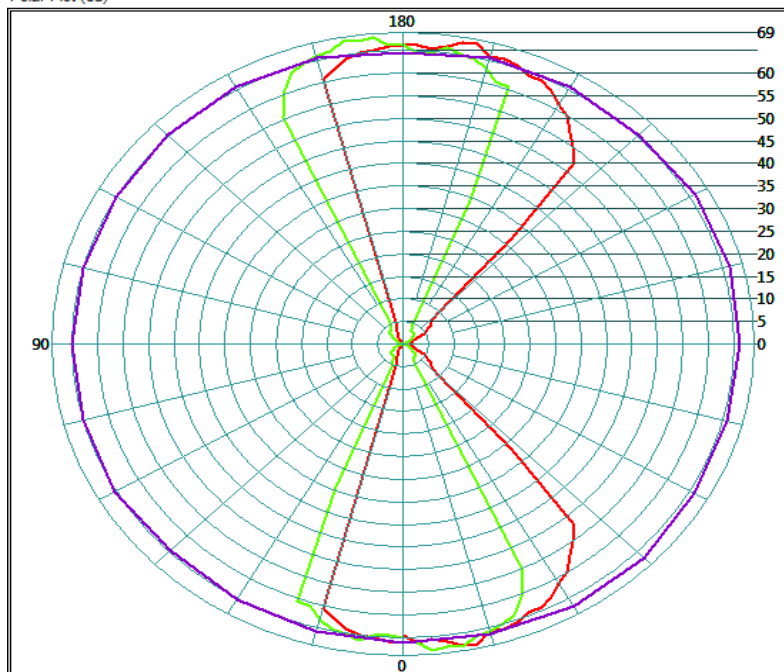
Dimension	Sample	Luminous Opening
Diameter/Width	85 mm	65 mm
Length	105 mm	95 mm
Height/Depth	160 mm	0 mm

Electrical Measurements	
Frequency	50 Hz
Voltage	230.100 V
Current	0.056 A
Power	6.1 W
Power Factor	0.472
Apparent Power	12.9 VA

Goniophotometric Measurements

Beam Angle	Horizontal	49°
	Vertical	58°
On-axis Intensity		66 cd
Peak Intensity		69 cd
Peak Direction	Horizontal	225°
	Vertical	8°

Polar Plot (cd)



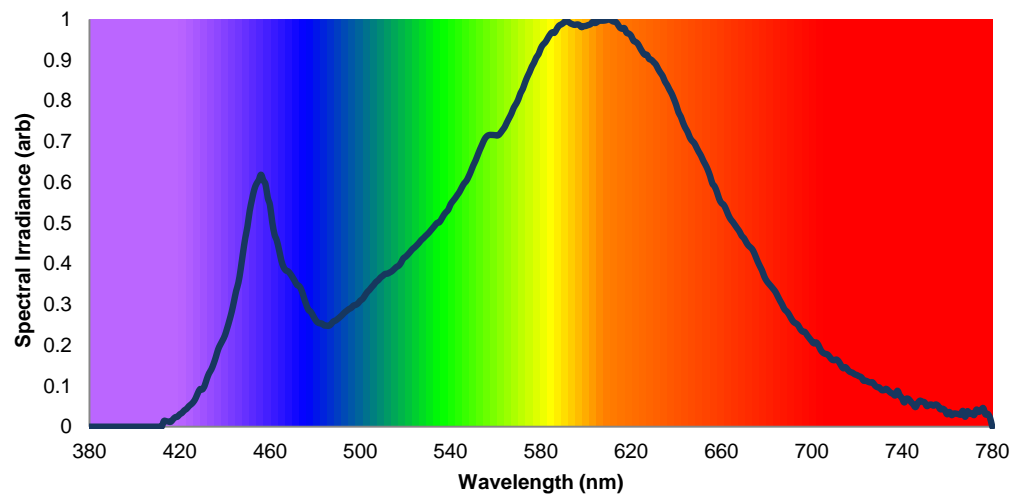
0.00	
180.00	
90.00	
270.00	
0.00	

Appendices

On-axis Spectral Measurement

The following data was determined from an on-axis spectral measurement using a SP1000 spectrometer at a distance of 500mm, for which these measurements and outputs are not accredited.

Spectral Irradiance versus Wavelength

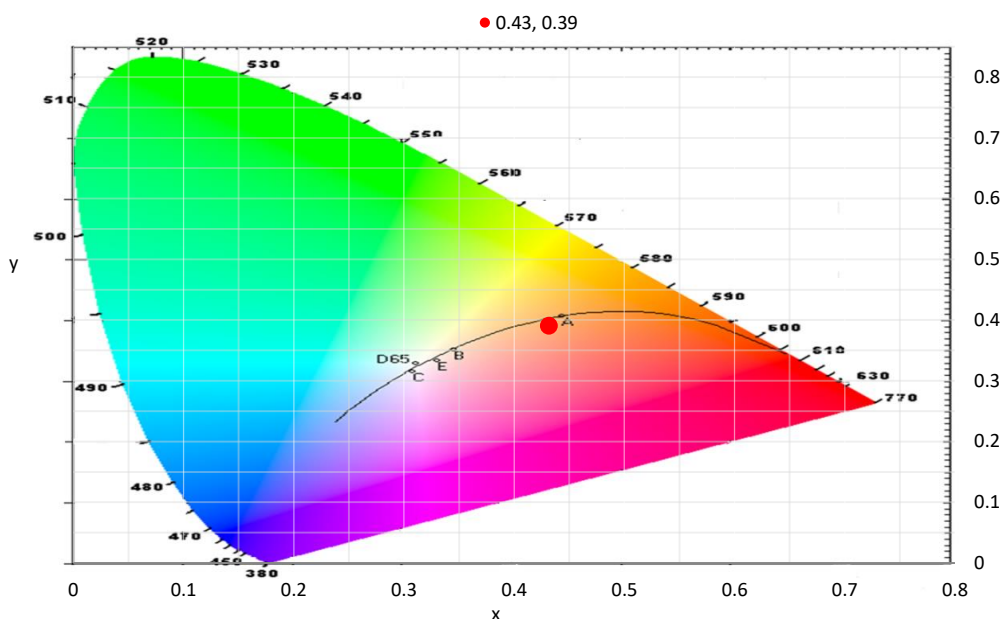


Colour Rendering Index Detail			
R1	82	R8	62
R2	94	R9	18
R3	94	R10	84
R4	78	R11	75
R5	82	R12	75
R6	91	R13	85
R7	82	R14	97

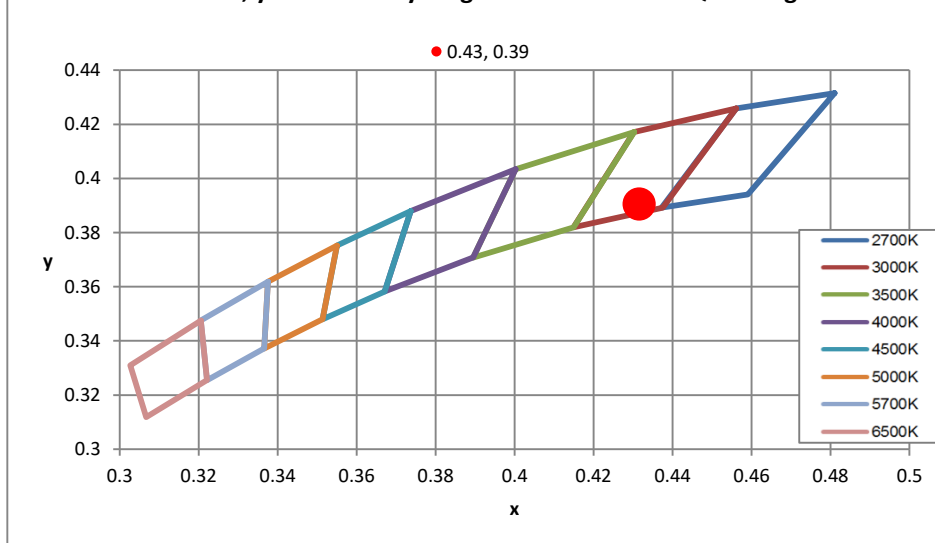
Colorimetric Details	
CCT	2978K
CRI (Ra)	83

Chromaticity Coordinates		
CIE 1931	x	0.4315
	y	0.3905
CIE 1960	u	0.2529
	v	0.3434
CIE 1976	u'	0.2529
	v'	0.5151
Duv		0.0049

CIE 1931 Colour Chart



CIE 1931 x, y Chromaticity Diagram - Nominal CCT Quadrangles



Spectral Power Distribution

λ (nm)	Arb units	λ (nm)	Arb units	λ (nm)	Arb units	λ (nm)	Arb units
380	0.00E+00	430	9.14E-02	480	2.63E-01	530	4.74E-01
381	0.00E+00	431	1.00E-01	481	2.56E-01	531	4.80E-01
382	0.00E+00	432	1.17E-01	482	2.54E-01	532	4.87E-01
383	0.00E+00	433	1.31E-01	483	2.53E-01	533	4.94E-01
384	0.00E+00	434	1.41E-01	484	2.49E-01	534	5.00E-01
385	0.00E+00	435	1.55E-01	485	2.48E-01	535	5.02E-01
386	0.00E+00	436	1.71E-01	486	2.48E-01	536	5.10E-01
387	0.00E+00	437	1.90E-01	487	2.51E-01	537	5.20E-01
388	0.00E+00	438	2.02E-01	488	2.58E-01	538	5.27E-01
389	0.00E+00	439	2.12E-01	489	2.60E-01	539	5.33E-01
390	0.00E+00	440	2.24E-01	490	2.65E-01	540	5.46E-01
391	0.00E+00	441	2.42E-01	491	2.69E-01	541	5.54E-01
392	0.00E+00	442	2.61E-01	492	2.74E-01	542	5.61E-01
393	0.00E+00	443	2.82E-01	493	2.80E-01	543	5.69E-01
394	0.00E+00	444	3.07E-01	494	2.85E-01	544	5.77E-01
395	0.00E+00	445	3.33E-01	495	2.89E-01	545	5.88E-01
396	0.00E+00	446	3.54E-01	496	2.92E-01	546	5.97E-01
397	0.00E+00	447	3.87E-01	497	2.97E-01	547	6.04E-01
398	0.00E+00	448	4.26E-01	498	2.99E-01	548	6.14E-01
399	0.00E+00	449	4.62E-01	499	3.03E-01	549	6.27E-01
400	0.00E+00	450	4.92E-01	500	3.10E-01	550	6.41E-01
401	0.00E+00	451	5.30E-01	501	3.14E-01	551	6.53E-01
402	0.00E+00	452	5.57E-01	502	3.22E-01	552	6.67E-01
403	0.00E+00	453	5.82E-01	503	3.30E-01	553	6.80E-01
404	0.00E+00	454	5.96E-01	504	3.36E-01	554	6.93E-01
405	0.00E+00	455	6.05E-01	505	3.42E-01	555	7.05E-01
406	0.00E+00	456	6.19E-01	506	3.49E-01	556	7.13E-01
407	0.00E+00	457	6.05E-01	507	3.56E-01	557	7.16E-01
408	0.00E+00	458	5.95E-01	508	3.60E-01	558	7.16E-01
409	0.00E+00	459	5.62E-01	509	3.66E-01	559	7.16E-01
410	0.00E+00	460	5.44E-01	510	3.70E-01	560	7.16E-01
411	0.00E+00	461	5.02E-01	511	3.75E-01	561	7.15E-01
412	0.00E+00	462	4.72E-01	512	3.76E-01	562	7.21E-01
413	1.40E-02	463	4.57E-01	513	3.79E-01	563	7.28E-01
414	1.34E-02	464	4.34E-01	514	3.82E-01	564	7.36E-01
415	1.26E-02	465	4.08E-01	515	3.87E-01	565	7.48E-01
416	1.18E-02	466	3.92E-01	516	3.92E-01	566	7.58E-01
417	1.80E-02	467	3.84E-01	517	3.95E-01	567	7.70E-01
418	2.32E-02	468	3.81E-01	518	4.02E-01	568	7.83E-01
419	2.46E-02	469	3.75E-01	519	4.13E-01	569	7.92E-01
420	3.04E-02	470	3.67E-01	520	4.17E-01	570	8.04E-01
421	3.38E-02	471	3.57E-01	521	4.22E-01	571	8.19E-01
422	4.00E-02	472	3.48E-01	522	4.29E-01	572	8.29E-01
423	4.36E-02	473	3.45E-01	523	4.35E-01	573	8.45E-01
424	5.00E-02	474	3.34E-01	524	4.40E-01	574	8.59E-01
425	5.48E-02	475	3.17E-01	525	4.45E-01	575	8.71E-01
426	6.04E-02	476	3.01E-01	526	4.51E-01	576	8.84E-01
427	6.93E-02	477	2.87E-01	527	4.58E-01	577	8.94E-01
428	8.21E-02	478	2.83E-01	528	4.63E-01	578	9.07E-01
429	9.23E-02	479	2.73E-01	529	4.69E-01	579	9.15E-01
						580	9.29E-01

Spectral Power Distribution

λ (nm)	Arb units	λ (nm)	Arb units	λ (nm)	Arb units	λ (nm)	Arb units
581	9.38E-01	631	8.89E-01	681	3.51E-01	731	9.00E-02
582	9.44E-01	632	8.78E-01	682	3.45E-01	732	8.98E-02
583	9.53E-01	633	8.69E-01	683	3.38E-01	733	9.30E-02
584	9.62E-01	634	8.61E-01	684	3.31E-01	734	8.84E-02
585	9.68E-01	635	8.48E-01	685	3.20E-01	735	8.34E-02
586	9.67E-01	636	8.39E-01	686	3.09E-01	736	8.07E-02
587	9.76E-01	637	8.27E-01	687	2.99E-01	737	7.66E-02
588	9.85E-01	638	8.17E-01	688	2.88E-01	738	8.83E-02
589	9.88E-01	639	8.04E-01	689	2.83E-01	739	7.70E-02
590	9.91E-01	640	7.90E-01	690	2.75E-01	740	7.02E-02
591	9.97E-01	641	7.72E-01	691	2.65E-01	741	5.95E-02
592	9.95E-01	642	7.61E-01	692	2.57E-01	742	6.86E-02
593	9.91E-01	643	7.46E-01	693	2.54E-01	743	6.77E-02
594	9.88E-01	644	7.34E-01	694	2.49E-01	744	6.06E-02
595	9.87E-01	645	7.24E-01	695	2.39E-01	745	5.48E-02
596	9.88E-01	646	7.10E-01	696	2.34E-01	746	4.81E-02
597	9.87E-01	647	7.02E-01	697	2.33E-01	747	5.77E-02
598	9.81E-01	648	6.96E-01	698	2.24E-01	748	6.39E-02
599	9.83E-01	649	6.85E-01	699	2.17E-01	749	6.13E-02
600	9.84E-01	650	6.75E-01	700	2.10E-01	750	5.99E-02
601	9.86E-01	651	6.65E-01	701	2.05E-01	751	5.06E-02
602	9.88E-01	652	6.53E-01	702	2.07E-01	752	5.35E-02
603	9.94E-01	653	6.43E-01	703	2.00E-01	753	5.44E-02
604	9.91E-01	654	6.30E-01	704	1.88E-01	754	5.16E-02
605	9.94E-01	655	6.15E-01	705	1.82E-01	755	5.46E-02
606	9.97E-01	656	5.97E-01	706	1.79E-01	756	5.13E-02
607	9.97E-01	657	5.90E-01	707	1.77E-01	757	4.28E-02
608	9.97E-01	658	5.77E-01	708	1.71E-01	758	4.42E-02
609	9.98E-01	659	5.60E-01	709	1.65E-01	759	4.03E-02
610	1.00E+00	660	5.49E-01	710	1.63E-01	760	3.05E-02
611	9.98E-01	661	5.45E-01	711	1.65E-01	761	3.62E-02
612	9.95E-01	662	5.34E-01	712	1.60E-01	762	2.84E-02
613	9.95E-01	663	5.21E-01	713	1.51E-01	763	3.23E-02
614	9.89E-01	664	5.10E-01	714	1.43E-01	764	3.20E-02
615	9.80E-01	665	5.03E-01	715	1.46E-01	765	3.09E-02
616	9.77E-01	666	4.95E-01	716	1.40E-01	766	2.97E-02
617	9.79E-01	667	4.87E-01	717	1.34E-01	767	3.88E-02
618	9.67E-01	668	4.79E-01	718	1.33E-01	768	2.42E-02
619	9.65E-01	669	4.69E-01	719	1.29E-01	769	3.80E-02
620	9.60E-01	670	4.63E-01	720	1.27E-01	770	3.20E-02
621	9.48E-01	671	4.53E-01	721	1.24E-01	771	3.23E-02
622	9.45E-01	672	4.45E-01	722	1.21E-01	772	2.87E-02
623	9.40E-01	673	4.40E-01	723	1.13E-01	773	4.20E-02
624	9.30E-01	674	4.33E-01	724	1.13E-01	774	3.64E-02
625	9.21E-01	675	4.20E-01	725	1.10E-01	775	3.97E-02
626	9.13E-01	676	4.07E-01	726	1.09E-01	776	4.58E-02
627	9.13E-01	677	3.95E-01	727	1.09E-01	777	3.03E-02
628	9.03E-01	678	3.84E-01	728	1.01E-01	778	3.14E-02
629	9.01E-01	679	3.69E-01	729	9.73E-02	779	2.24E-02
630	8.95E-01	680	3.58E-01	730	9.62E-02	780	0.00E+00

Measurement Uncertainty

The following is the reported expanded uncertainty of the UL 6440T Type C Mirror Goniophotometer.

Parameter	Uncertainty
Total Luminous Flux (%)	± 4.9
Luminous Intensity (%)	± 4.9
Temperature (°C)	± 1.0
Voltage DC TY720 (%)	± 0.02
Current DC TY720 (%)	± 0.10
Voltage AC WT210 (%)	± 0.0585
Current AC WT210 (%)	± 0.0251
Power AC WT210 (%)	± 0.2261
Frequency (50/60 Hz) WT210 (%)	± 0.0040
Power Factor WT210 (%)	± 0.0601

The reported expanded uncertainty is based on the combined standard uncertainty multiplied by a coverage factor of $k = 2$. This value of k gives a coverage probability of approximately 95%, assuming a normal distribution. This determination of the measurement uncertainty has been done in accordance with international requirements including UKAS, BIPM Guide to the Expression of Uncertainty in Measurement and CIE 198:2011 and CIE S 025/E:2015.

Electrical measurement equipment used for the determination of results for this report, are compliant and meet the performance requirements of the measurement standards used.

(*) The measurements were performed on a pre-production sample provided by the customer. Final samples may show different results. This may affect final photometric results (luminous flux, used power, intensity distribution) as well as colour results (colour point, CCT, CRI).

----- END OF REPORT -----