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PHOTOMETRIC  
TEST REPORT

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<b>Report Number</b>	TRN-18496
<b>Customer</b>	Astro Lighting Limited
<b>Contact</b>	Stuart Wells
<b>Product Type</b>	LED Wall Mounted Reading lamp
<b>Test Purpose</b>	Generation of Photometric Data
<b>Sales Order Ref</b>	Q-LUX16-21059
<b>Works Order Number</b>	WO-9143
<b>Test Item Reference</b>	TI-12983
<b>LAB Test Method Reference</b>	TES-10050
<b>Test Standards</b>	LM-79-08
<b>Lab Location Reference</b>	LUX-TSI
<b>Tested by</b>	Mike Sewell
<b>Date of Test</b>	13/01/2017
<b>Reviewed by</b>	Menno Schakel
<b>Number of products tested</b>	1

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Date: 13/01/2017



Enna Recess Switched

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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° to Base Down

H45 - Horizontal to -45° only

VBV - Vertical Base Up ±15°

VBD - Vertical Base Down ±15°

HBU - Base Up +/- 90° (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 +/- 75° (bulb should not be operated within 15° of vertical)

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

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## Test Conditions

Measurements were made with an ambient temperature of 25°C +/- 1°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.

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## Calibrations

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

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## 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.

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## 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.

<b>Product Name</b>	Enna Recess Switched LED
<b>Part/Serial Number</b>	1058067
<b>Type of Product</b>	LED Wall Mounted Reading lamp
<b>Base Type</b>	Not Applicable - Luminaire
<b>Driver Type</b>	Mains
<b>Test Time</b>	30 mins
<b>Operating Orientation</b>	Base Up
<b>Test Orientation</b>	Base Up
<b>Ambient Temperature</b>	24.5°C
<b>Manufacturer</b>	Astro Lighting Limited
<b>Date of Manufacture</b>	Not Available
<b>Thermal Management</b>	Passive
<b>Dimmable</b>	No
<b>Pre-Burning Time</b>	0 hours
<b>Stabilisation Time</b>	60 mins
<b>Humidity</b>	38.4% RH
<b>Averaging Applied</b>	NONE



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

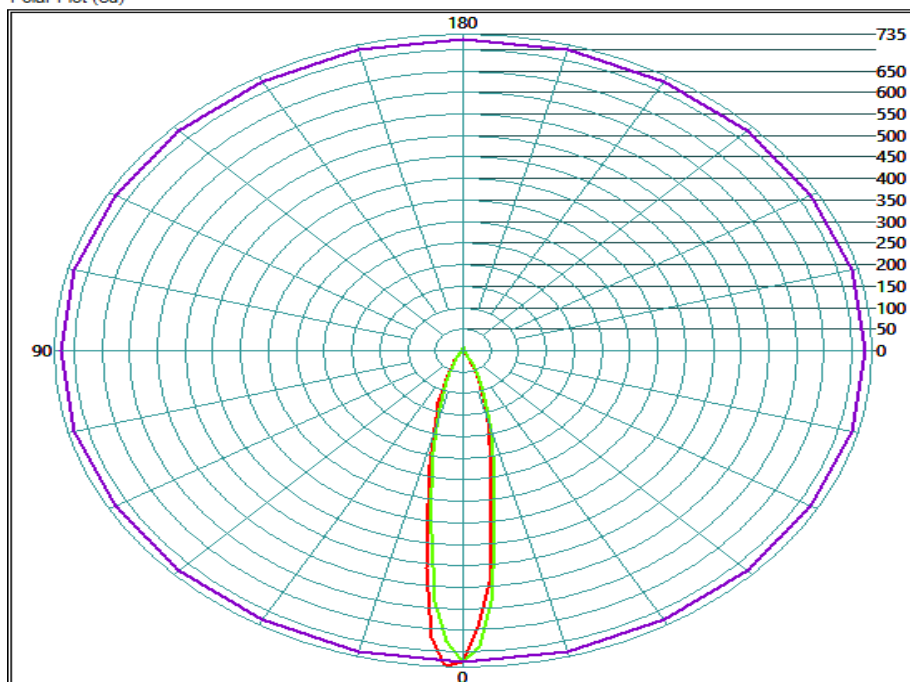
Photometric Measurements	
Luminous Flux	151 lm
Luminous Efficacy	39 lm/W

Dimension	Sample	Luminous Opening
Diameter/Width	95 mm $\Phi$	20 mm $\Phi$
Length		
Height/Depth	190 mm	0 mm

Electrical Measurements	
Frequency	50 Hz
Voltage	229.890 V
Current	0.032 A
Power	3.9 W
Power Factor	0.525
Apparent Power	7.3 VA

Goniophotometric Measurements		
Beam Angle	Horizontal	18°
	Vertical	19°
On-axis Intensity		723 cd
Peak Intensity		735 cd
Peak Direction	Horizontal	15°
	Vertical	3°

Polar Plot (cd)



0.00	Red
180.00	Red
90.00	Green
270.00	Green
0.00	Purple

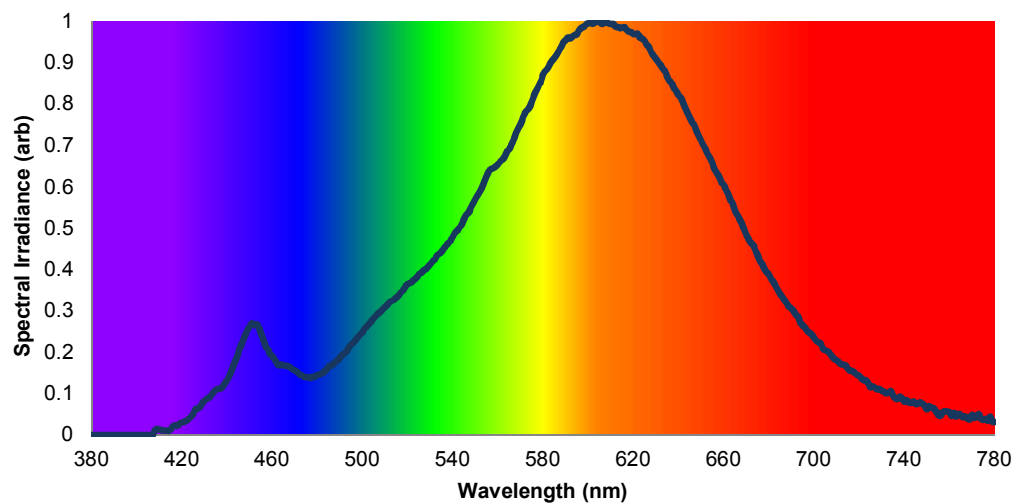
Mounting Height (m)	Beam Cone Width (m)	Orthogonal Beam Cone Width (m)	Projected Illuminance (lux)
0.5	0.16	0.16	2890.4
1	0.32	0.32	722.6
2	0.65	0.64	180.7
3	0.97	0.96	80.3
4	1.30	1.28	45.2
5	1.62	1.60	28.9
6	1.94	1.92	20.1
8	2.59	2.56	11.3
10	3.24	3.21	7.2
20	6.48	6.41	1.8

## Appendix

### 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**



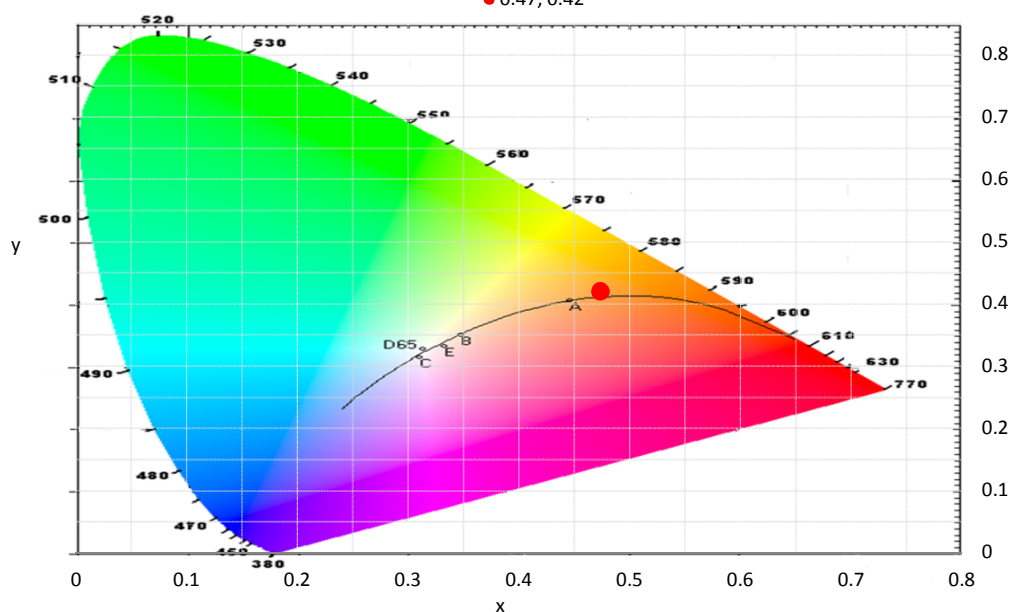
Colour Rendering Index Detail			
R1	78	R8	58
R2	89	R9	8
R3	97	R10	76
R4	77	R11	74
R5	77	R12	70
R6	86	R13	80
R7	83	R14	99

Colorimetric Details	
CCT	2600K
CRI (Ra)	81

Chromaticity Coordinates		
CIE 1931	x	0.4728
	y	0.4204
CIE 1960	u	0.2664
	v	0.3553
CIE 1976	u'	0.2664
	v'	0.5329
Duv		0.0024

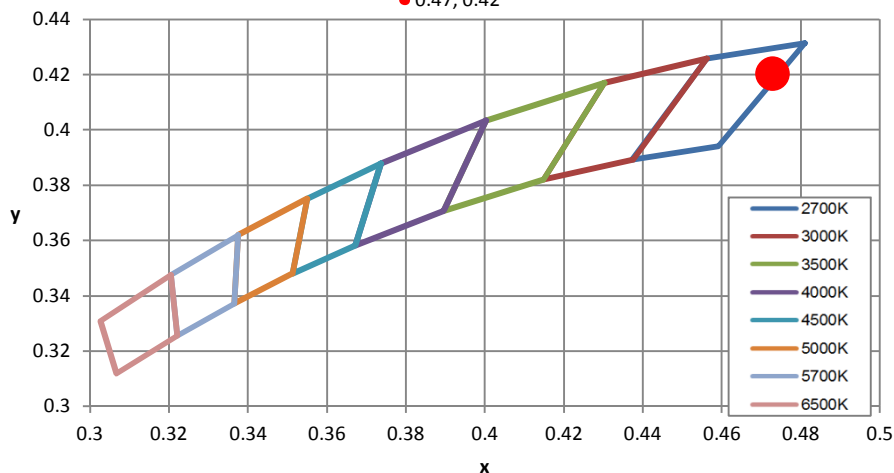
CIE 1931 Colour Chart

● 0.47, 0.42



CIE 1931 x, y Chromaticity Diagram - Nominal CCT Quadrangles

● 0.47, 0.42



### Spectral Power Distribution

$\lambda$ (nm)	Arb units	$\lambda$ (nm)	Arb units	$\lambda$ (nm)	Arb units	$\lambda$ (nm)	Arb units
380	0.000000	430	8.24E-02	480	1.44E-01	530	4.13E-01
381	0.00E+00	431	8.78E-02	481	1.46E-01	531	4.20E-01
382	0.00E+00	432	8.96E-02	482	1.49E-01	532	4.24E-01
383	0.00E+00	433	9.57E-02	483	1.53E-01	533	4.34E-01
384	0.00E+00	434	1.04E-01	484	1.57E-01	534	4.38E-01
385	0.00E+00	435	1.09E-01	485	1.65E-01	535	4.43E-01
386	0.00E+00	436	1.11E-01	486	1.67E-01	536	4.51E-01
387	0.00E+00	437	1.12E-01	487	1.72E-01	537	4.57E-01
388	0.00E+00	438	1.16E-01	488	1.77E-01	538	4.64E-01
389	0.00E+00	439	1.25E-01	489	1.80E-01	539	4.70E-01
390	0.00E+00	440	1.32E-01	490	1.88E-01	540	4.81E-01
391	0.00E+00	441	1.43E-01	491	1.93E-01	541	4.89E-01
392	0.00E+00	442	1.57E-01	492	1.97E-01	542	4.94E-01
393	0.00E+00	443	1.71E-01	493	2.03E-01	543	5.02E-01
394	0.00E+00	444	1.84E-01	494	2.13E-01	544	5.10E-01
395	0.00E+00	445	2.02E-01	495	2.19E-01	545	5.23E-01
396	0.00E+00	446	2.15E-01	496	2.24E-01	546	5.33E-01
397	0.00E+00	447	2.29E-01	497	2.30E-01	547	5.38E-01
398	0.00E+00	448	2.42E-01	498	2.37E-01	548	5.51E-01
399	0.00E+00	449	2.54E-01	499	2.43E-01	549	5.60E-01
400	0.00E+00	450	2.63E-01	500	2.49E-01	550	5.71E-01
401	0.00E+00	451	2.70E-01	501	2.58E-01	551	5.81E-01
402	0.00E+00	452	2.65E-01	502	2.64E-01	552	5.89E-01
403	0.00E+00	453	2.67E-01	503	2.70E-01	553	6.00E-01
404	0.00E+00	454	2.59E-01	504	2.77E-01	554	6.14E-01
405	0.00E+00	455	2.43E-01	505	2.83E-01	555	6.27E-01
406	0.00E+00	456	2.30E-01	506	2.88E-01	556	6.38E-01
407	0.00E+00	457	2.14E-01	507	2.95E-01	557	6.44E-01
408	1.11E-02	458	2.07E-01	508	2.98E-01	558	6.46E-01
409	1.45E-02	459	1.94E-01	509	3.05E-01	559	6.50E-01
410	1.29E-02	460	1.90E-01	510	3.10E-01	560	6.55E-01
411	1.09E-02	461	1.83E-01	511	3.15E-01	561	6.61E-01
412	1.09E-02	462	1.73E-01	512	3.22E-01	562	6.66E-01
413	1.05E-02	463	1.68E-01	513	3.25E-01	563	6.74E-01
414	9.60E-03	464	1.69E-01	514	3.28E-01	564	6.85E-01
415	1.38E-02	465	1.68E-01	515	3.32E-01	565	6.92E-01
416	2.13E-02	466	1.66E-01	516	3.38E-01	566	7.02E-01
417	2.34E-02	467	1.66E-01	517	3.45E-01	567	7.15E-01
418	2.20E-02	468	1.62E-01	518	3.50E-01	568	7.31E-01
419	2.78E-02	469	1.58E-01	519	3.59E-01	569	7.42E-01
420	2.98E-02	470	1.55E-01	520	3.65E-01	570	7.52E-01
421	3.18E-02	471	1.52E-01	521	3.67E-01	571	7.68E-01
422	3.46E-02	472	1.47E-01	522	3.71E-01	572	7.80E-01
423	3.96E-02	473	1.44E-01	523	3.76E-01	573	7.85E-01
424	4.41E-02	474	1.40E-01	524	3.82E-01	574	7.94E-01
425	5.12E-02	475	1.39E-01	525	3.89E-01	575	8.07E-01
426	6.23E-02	476	1.39E-01	526	3.92E-01	576	8.22E-01
427	6.35E-02	477	1.37E-01	527	3.98E-01	577	8.34E-01
428	6.78E-02	478	1.41E-01	528	4.01E-01	578	8.45E-01
429	7.85E-02	479	1.41E-01	529	4.07E-01	579	8.54E-01
						580	8.73E-01



Spectral Power Distribution

$\lambda$ (nm)	Arb units	$\lambda$ (nm)	Arb units	$\lambda$ (nm)	Arb units	$\lambda$ (nm)	Arb units
581	8.81E-01	631	9.02E-01	681	3.77E-01	731	1.04E-01
582	8.87E-01	632	8.94E-01	682	3.70E-01	732	9.99E-02
583	8.98E-01	633	8.86E-01	683	3.60E-01	733	1.02E-01
584	9.06E-01	634	8.79E-01	684	3.50E-01	734	1.06E-01
585	9.13E-01	635	8.66E-01	685	3.40E-01	735	9.55E-02
586	9.19E-01	636	8.56E-01	686	3.33E-01	736	8.92E-02
587	9.28E-01	637	8.50E-01	687	3.25E-01	737	8.61E-02
588	9.39E-01	638	8.38E-01	688	3.17E-01	738	9.18E-02
589	9.50E-01	639	8.31E-01	689	3.09E-01	739	8.82E-02
590	9.55E-01	640	8.21E-01	690	3.05E-01	740	8.00E-02
591	9.61E-01	641	8.16E-01	691	2.98E-01	741	8.37E-02
592	9.59E-01	642	8.02E-01	692	2.90E-01	742	7.84E-02
593	9.63E-01	643	7.89E-01	693	2.85E-01	743	7.74E-02
594	9.67E-01	644	7.77E-01	694	2.71E-01	744	8.07E-02
595	9.69E-01	645	7.67E-01	695	2.64E-01	745	7.47E-02
596	9.79E-01	646	7.57E-01	696	2.60E-01	746	7.50E-02
597	9.85E-01	647	7.48E-01	697	2.51E-01	747	7.86E-02
598	9.87E-01	648	7.33E-01	698	2.47E-01	748	7.51E-02
599	9.92E-01	649	7.21E-01	699	2.42E-01	749	7.08E-02
600	9.95E-01	650	7.12E-01	700	2.34E-01	750	6.16E-02
601	9.97E-01	651	7.00E-01	701	2.27E-01	751	6.88E-02
602	9.95E-01	652	6.90E-01	702	2.24E-01	752	6.60E-02
603	9.99E-01	653	6.78E-01	703	2.21E-01	753	6.42E-02
604	1.00E+00	654	6.68E-01	704	2.07E-01	754	5.70E-02
605	9.98E-01	655	6.57E-01	705	2.05E-01	755	4.83E-02
606	9.94E-01	656	6.42E-01	706	2.02E-01	756	4.59E-02
607	9.96E-01	657	6.33E-01	707	1.96E-01	757	5.49E-02
608	1.00E+00	658	6.24E-01	708	1.90E-01	758	5.70E-02
609	9.95E-01	659	6.11E-01	709	1.84E-01	759	5.64E-02
610	9.94E-01	660	6.04E-01	710	1.81E-01	760	5.45E-02
611	9.94E-01	661	5.92E-01	711	1.75E-01	761	4.55E-02
612	9.87E-01	662	5.82E-01	712	1.71E-01	762	5.30E-02
613	9.87E-01	663	5.67E-01	713	1.70E-01	763	4.41E-02
614	9.84E-01	664	5.59E-01	714	1.68E-01	764	5.06E-02
615	9.85E-01	665	5.42E-01	715	1.60E-01	765	4.80E-02
616	9.86E-01	666	5.32E-01	716	1.55E-01	766	4.24E-02
617	9.79E-01	667	5.21E-01	717	1.54E-01	767	4.45E-02
618	9.75E-01	668	5.11E-01	718	1.50E-01	768	3.95E-02
619	9.74E-01	669	4.97E-01	719	1.45E-01	769	3.73E-02
620	9.70E-01	670	4.85E-01	720	1.43E-01	770	4.86E-02
621	9.69E-01	671	4.73E-01	721	1.37E-01	771	4.09E-02
622	9.70E-01	672	4.64E-01	722	1.32E-01	772	4.47E-02
623	9.60E-01	673	4.60E-01	723	1.32E-01	773	4.99E-02
624	9.58E-01	674	4.46E-01	724	1.25E-01	774	3.88E-02
625	9.52E-01	675	4.34E-01	725	1.15E-01	775	3.62E-02
626	9.43E-01	676	4.21E-01	726	1.17E-01	776	3.81E-02
627	9.37E-01	677	4.13E-01	727	1.14E-01	777	3.40E-02
628	9.24E-01	678	4.02E-01	728	1.10E-01	778	4.39E-02
629	9.17E-01	679	3.93E-01	729	1.11E-01	779	3.23E-02
630	9.09E-01	680	3.87E-01	730	1.07E-01	780	3.09E-02

### Measurement Uncertainty

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

Parameter	Uncertainty
Total Luminous Flux (%)	$\pm 7.5$
Luminous Intensity (%)	$\pm 7.5$
Temperature ( $^{\circ}\text{C}$ )	$\pm 0.5$
Voltage DC TY720 (%)	$\pm 0.02$
Current DC TY720 (%)	$\pm 0.10$
Voltage AC WT210 (%)	$\pm 0.0585$
Current AC WT210 (%)	$\pm 0.0251$
Power AC WT210 (%)	$\pm 0.2261$
Frequency (50/60 Hz) WT210 (%)	$\pm 0.0040$
Power Factor WT210 (%)	$\pm 0.0601$

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 (based on RGB type LEDs).

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

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