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PHOTOMETRIC  
TEST REPORT

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<b>Report Number</b>	GNC-19961
<b>Customer</b>	Astro Lighting Limited
<b>Contact</b>	Ross Dickson
<b>Product Type</b>	LED Downlight
<b>Test Purpose</b>	Generation of photometric data
<b>Quote Reference</b>	Q-LUX17-21659
<b>Works Order Number</b>	WO-10608
<b>Test Item Reference</b>	TI-14160
<b>LAB Test Method Reference</b>	TES-102000
<b>Test Standards</b>	LM-79-08; (BS) EN 13032-4:2015; CIE S025:2015
<b>Lab Location Reference</b>	LUX-TSI
<b>Tested by</b>	Mike Sewell
<b>Date of Test</b>	14/09/2017
<b>Reviewed by</b>	Andrew Thomas
<b>Number of products tested</b>	1

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Signed: 



Edge Reader & Enna LED head

Date: 26/09/2017

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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  $-45^{\circ}$  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  $15^{\circ}$  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  $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$ . 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.

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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>	Edge Reader & Enna LED head
<b>Part/Serial Number</b>	N/A
<b>Type of Product</b>	LED Downlight
<b>Base Type</b>	Not Applicable - Luminaire
<b>Driver Type</b>	Internal
<b>Test Time</b>	30 mins
<b>Operating Orientation</b>	Horizontal
<b>Test Orientation</b>	Horizontal
<b>Ambient Temperature</b>	24.9°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>	48.5% 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

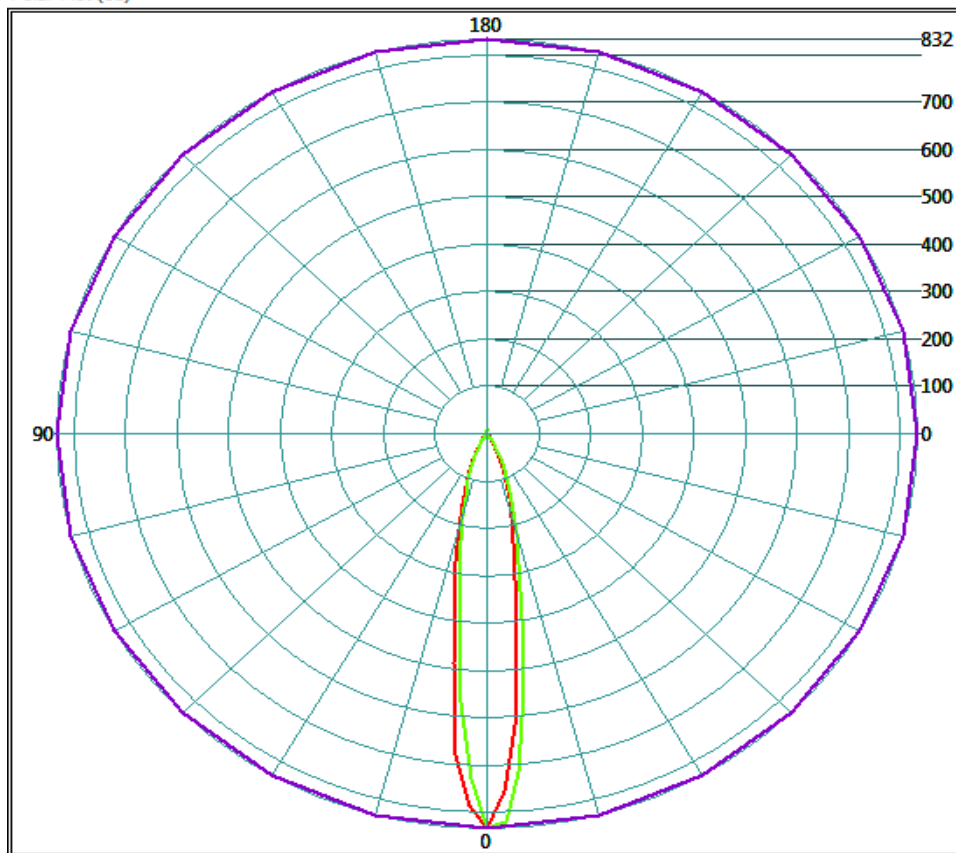
Photometric Measurements	
Luminous Flux	149 lm
Luminous Efficacy	36 lm/W

Dimension	Sample	Luminous Opening
Diameter/Width	150 mm	26 mm $\Phi$
Length	240 mm	
Height/Depth	150 mm	0 mm

Electrical Measurements	
Frequency	50 Hz
Voltage	229.5 V
Current	0.049 A
Power	4.1 W
Power Factor	0.359
Apparent Power	11.3 VA

Goniophotometric Measurements		
Beam Angle	Horizontal	17°
	Vertical	17°
On-axis Intensity		832 cd
Peak Intensity		832 cd
Peak Direction	Horizontal	0°
	Vertical	0°

Polar Plot (cd)



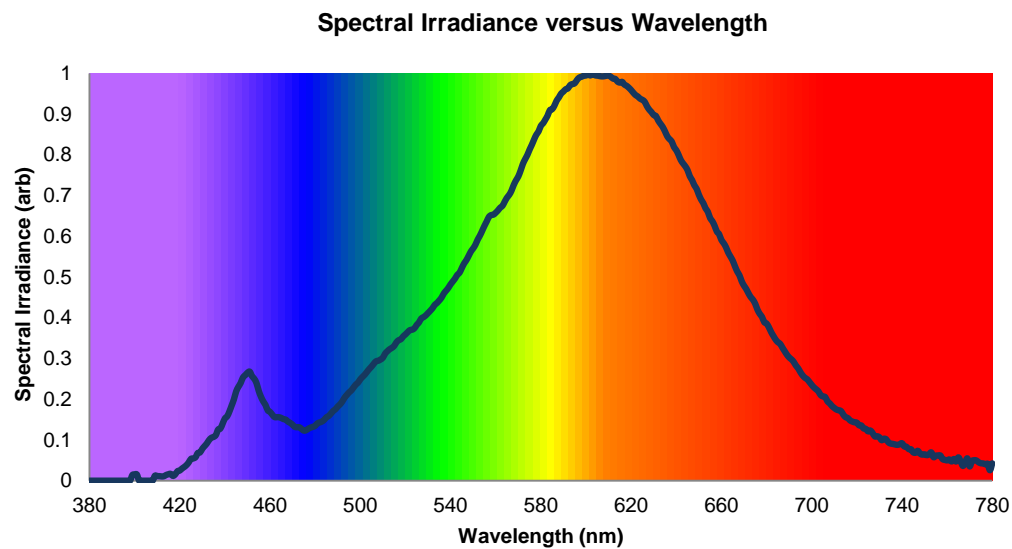
0.00	
180.00	
90.00	
270.00	
0.00	

Mounting Height (m)	Beam Width (m)		Projected Illuminance (lux)
	C0-C180 plane	C90-270 plane	
0.5	0.1	0.1	3330
1	0.3	0.3	832
2	0.6	0.6	208
3	0.9	0.9	92
4	1.2	1.2	52
5	1.5	1.5	33
7.5	2.2	2.2	15
10	3.0	3.0	8
20	5.9	5.9	2

## Appendices

### *On-axis Spectral Measurement*

The following data was determined from an on-axis spectral measurement using a SP1000 spectrometer at a distance of 1000mm, for which these measurements and outputs are not accredited.



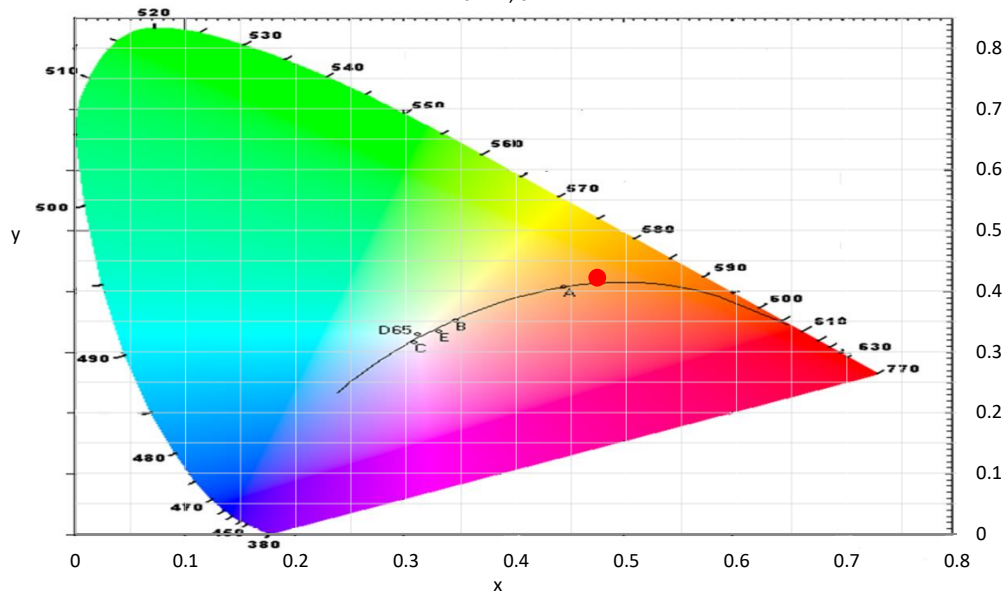
Colour Rendering Index Detail			
R1	77	R8	57
R2	88	R9	6
R3	98	R10	74
R4	77	R11	74
R5	76	R12	68
R6	85	R13	79
R7	83	R14	99

Colorimetric Details	
CCT	2599K
CRI (Ra)	80

Chromaticity Coordinates		
CIE 1931	x	0.4737
	y	0.4218
CIE 1960	u	0.2663
	v	0.3557
CIE 1976	u'	0.2663
	v'	0.5336
Duv		0.0029

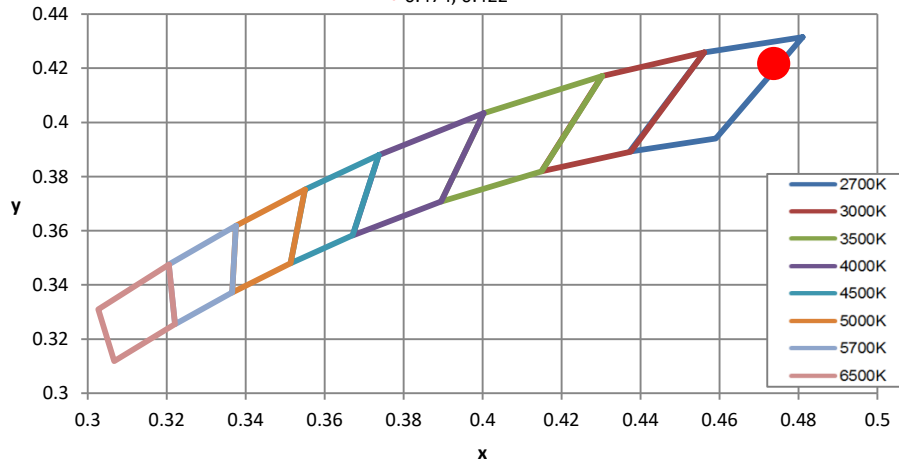
CIE 1931 Colour Chart

• 0.474, 0.422



CIE 1931 x, y Chromaticity Diagram - Nominal CCT Quadrangles

• 0.474, 0.422



### Spectral Power Distribution

$\lambda$ (nm)	Arb units	$\lambda$ (nm)	Arb units	$\lambda$ (nm)	Arb units	$\lambda$ (nm)	Arb units
380	0.00E+00	430	7.84E-02	480	1.35E-01	530	4.12E-01
381	0.00E+00	431	8.49E-02	481	1.41E-01	531	4.17E-01
382	0.00E+00	432	9.14E-02	482	1.43E-01	532	4.24E-01
383	0.00E+00	433	9.97E-02	483	1.45E-01	533	4.32E-01
384	0.00E+00	434	1.05E-01	484	1.49E-01	534	4.37E-01
385	0.00E+00	435	1.07E-01	485	1.56E-01	535	4.43E-01
386	0.00E+00	436	1.12E-01	486	1.59E-01	536	4.50E-01
387	0.00E+00	437	1.26E-01	487	1.65E-01	537	4.60E-01
388	0.00E+00	438	1.28E-01	488	1.71E-01	538	4.66E-01
389	0.00E+00	439	1.40E-01	489	1.76E-01	539	4.73E-01
390	0.00E+00	440	1.53E-01	490	1.82E-01	540	4.82E-01
391	0.00E+00	441	1.58E-01	491	1.87E-01	541	4.89E-01
392	0.00E+00	442	1.70E-01	492	1.94E-01	542	4.97E-01
393	0.00E+00	443	1.85E-01	493	2.04E-01	543	5.06E-01
394	0.00E+00	444	2.00E-01	494	2.10E-01	544	5.11E-01
395	0.00E+00	445	2.19E-01	495	2.17E-01	545	5.23E-01
396	0.00E+00	446	2.31E-01	496	2.22E-01	546	5.33E-01
397	0.00E+00	447	2.40E-01	497	2.29E-01	547	5.42E-01
398	0.00E+00	448	2.53E-01	498	2.36E-01	548	5.52E-01
399	1.38E-02	449	2.59E-01	499	2.41E-01	549	5.63E-01
400	1.55E-02	450	2.65E-01	500	2.49E-01	550	5.70E-01
401	1.53E-02	451	2.68E-01	501	2.55E-01	551	5.79E-01
402	0.00E+00	452	2.57E-01	502	2.61E-01	552	5.92E-01
403	0.00E+00	453	2.50E-01	503	2.68E-01	553	6.02E-01
404	0.00E+00	454	2.40E-01	504	2.74E-01	554	6.13E-01
405	0.00E+00	455	2.21E-01	505	2.80E-01	555	6.26E-01
406	0.00E+00	456	2.06E-01	506	2.87E-01	556	6.36E-01
407	0.00E+00	457	1.95E-01	507	2.93E-01	557	6.48E-01
408	0.00E+00	458	1.86E-01	508	2.95E-01	558	6.52E-01
409	1.23E-02	459	1.73E-01	509	2.98E-01	559	6.53E-01
410	1.13E-02	460	1.69E-01	510	3.02E-01	560	6.58E-01
411	1.11E-02	461	1.62E-01	511	3.12E-01	561	6.64E-01
412	1.05E-02	462	1.56E-01	512	3.18E-01	562	6.71E-01
413	1.10E-02	463	1.56E-01	513	3.23E-01	563	6.75E-01
414	1.40E-02	464	1.56E-01	514	3.26E-01	564	6.85E-01
415	1.58E-02	465	1.54E-01	515	3.31E-01	565	6.95E-01
416	1.70E-02	466	1.51E-01	516	3.40E-01	566	7.02E-01
417	1.17E-02	467	1.50E-01	517	3.45E-01	567	7.12E-01
418	1.55E-02	468	1.45E-01	518	3.47E-01	568	7.26E-01
419	2.33E-02	469	1.42E-01	519	3.54E-01	569	7.38E-01
420	2.49E-02	470	1.37E-01	520	3.59E-01	570	7.47E-01
421	2.97E-02	471	1.32E-01	521	3.65E-01	571	7.61E-01
422	3.36E-02	472	1.31E-01	522	3.70E-01	572	7.77E-01
423	3.84E-02	473	1.31E-01	523	3.71E-01	573	7.89E-01
424	4.51E-02	474	1.27E-01	524	3.74E-01	574	8.00E-01
425	5.37E-02	475	1.23E-01	525	3.83E-01	575	8.13E-01
426	5.47E-02	476	1.24E-01	526	3.89E-01	576	8.25E-01
427	5.76E-02	477	1.28E-01	527	3.98E-01	577	8.38E-01
428	6.79E-02	478	1.30E-01	528	4.02E-01	578	8.50E-01
429	6.94E-02	479	1.32E-01	529	4.06E-01	579	8.58E-01
						580	8.71E-01



### Spectral Power Distribution

$\lambda$ (nm)	Arb units	$\lambda$ (nm)	Arb units	$\lambda$ (nm)	Arb units	$\lambda$ (nm)	Arb units
581	8.78E-01	631	8.95E-01	681	3.77E-01	731	9.94E-02
582	8.87E-01	632	8.85E-01	682	3.65E-01	732	1.03E-01
583	8.97E-01	633	8.76E-01	683	3.56E-01	733	1.02E-01
584	9.10E-01	634	8.69E-01	684	3.47E-01	734	9.41E-02
585	9.12E-01	635	8.58E-01	685	3.40E-01	735	9.12E-02
586	9.21E-01	636	8.46E-01	686	3.36E-01	736	9.03E-02
587	9.33E-01	637	8.39E-01	687	3.27E-01	737	8.89E-02
588	9.41E-01	638	8.33E-01	688	3.18E-01	738	8.80E-02
589	9.50E-01	639	8.19E-01	689	3.10E-01	739	8.95E-02
590	9.55E-01	640	8.12E-01	690	3.03E-01	740	9.20E-02
591	9.61E-01	641	8.00E-01	691	2.98E-01	741	8.43E-02
592	9.63E-01	642	7.88E-01	692	2.92E-01	742	8.32E-02
593	9.71E-01	643	7.79E-01	693	2.83E-01	743	7.75E-02
594	9.74E-01	644	7.72E-01	694	2.76E-01	744	7.71E-02
595	9.76E-01	645	7.63E-01	695	2.66E-01	745	6.97E-02
596	9.84E-01	646	7.48E-01	696	2.58E-01	746	6.87E-02
597	9.90E-01	647	7.38E-01	697	2.53E-01	747	7.34E-02
598	9.92E-01	648	7.26E-01	698	2.49E-01	748	6.67E-02
599	9.94E-01	649	7.17E-01	699	2.42E-01	749	6.40E-02
600	9.95E-01	650	7.02E-01	700	2.35E-01	750	6.49E-02
601	9.97E-01	651	6.90E-01	701	2.29E-01	751	6.26E-02
602	9.95E-01	652	6.81E-01	702	2.24E-01	752	6.49E-02
603	1.00E+00	653	6.69E-01	703	2.19E-01	753	6.95E-02
604	9.95E-01	654	6.60E-01	704	2.10E-01	754	5.77E-02
605	9.95E-01	655	6.45E-01	705	2.07E-01	755	6.13E-02
606	9.94E-01	656	6.37E-01	706	2.05E-01	756	6.19E-02
607	9.93E-01	657	6.26E-01	707	1.95E-01	757	6.19E-02
608	9.93E-01	658	6.12E-01	708	1.90E-01	758	5.29E-02
609	9.94E-01	659	6.05E-01	709	1.83E-01	759	5.13E-02
610	9.95E-01	660	5.91E-01	710	1.79E-01	760	4.98E-02
611	9.92E-01	661	5.83E-01	711	1.75E-01	761	5.22E-02
612	9.87E-01	662	5.74E-01	712	1.73E-01	762	4.72E-02
613	9.86E-01	663	5.60E-01	713	1.71E-01	763	5.32E-02
614	9.80E-01	664	5.51E-01	714	1.62E-01	764	4.71E-02
615	9.78E-01	665	5.40E-01	715	1.56E-01	765	5.73E-02
616	9.79E-01	666	5.27E-01	716	1.54E-01	766	4.73E-02
617	9.73E-01	667	5.14E-01	717	1.48E-01	767	3.62E-02
618	9.70E-01	668	5.04E-01	718	1.45E-01	768	4.52E-02
619	9.65E-01	669	4.90E-01	719	1.43E-01	769	5.47E-02
620	9.59E-01	670	4.79E-01	720	1.43E-01	770	3.50E-02
621	9.52E-01	671	4.71E-01	721	1.36E-01	771	4.82E-02
622	9.47E-01	672	4.60E-01	722	1.36E-01	772	5.02E-02
623	9.43E-01	673	4.51E-01	723	1.28E-01	773	4.96E-02
624	9.38E-01	674	4.44E-01	724	1.27E-01	774	4.51E-02
625	9.35E-01	675	4.34E-01	725	1.21E-01	775	4.28E-02
626	9.30E-01	676	4.20E-01	726	1.23E-01	776	4.23E-02
627	9.20E-01	677	4.10E-01	727	1.17E-01	777	4.03E-02
628	9.11E-01	678	4.02E-01	728	1.09E-01	778	4.11E-02
629	9.05E-01	679	3.89E-01	729	1.09E-01	779	2.57E-02
630	8.98E-01	680	3.86E-01	730	1.07E-01	780	4.26E-02

### Measurement Uncertainty

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

Parameter	Uncertainty
Total Luminous Flux (%)	$\pm 4.9$
Luminous Intensity (%)	$\pm 4.9$
Temperature ( $^{\circ}\text{C}$ )	$\pm 1.0$
Voltage DC TY720 (%)	$\pm 0.017$
Current DC TY720 (%)	$\pm 0.10$
Voltage AC WT210 (%)	$\pm 0.059$
Current AC WT210 (%)	$\pm 0.025$
Power AC WT210 (%)	$\pm 0.23$
Frequency (50/60 Hz) WT210 (%)	$\pm 0.004$
Power Factor WT210 (%)	$\pm 0.06$

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.

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