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PHOTOMETRIC  
TEST REPORT

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<b>Report Number</b>	GNC-19566
<b>Customer</b>	Astro Lighting Limited
<b>Contact</b>	Ross Dickson
<b>Product Type</b>	LED Up/Down light
<b>Test Purpose</b>	Generation of Photometric Data
<b>Sales Order Ref</b>	Q-LUX17-21659
<b>Works Order Number</b>	WO-10213
<b>Test Item Reference</b>	TI-13755
<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>	20/06/2017
<b>Reviewed by</b>	Menno Schakel
<b>Number of products tested</b>	1

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Date: 03/07/2017



7605 - Bologna LED 160 2700K

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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.

Product Name	7605 - Bologna LED 160 2700K
Part/Serial Number	N/A
Type of Product	LED Up/Down light
Base Type	Not Applicable - Luminaire
Driver Type	Internal
Test Time	30 mins
Operating Orientation	Base Up
Test Orientation	Base Up
Ambient Temperature	25.9°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	49.5% 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	145 lm
Luminous Efficacy	23 lm/W

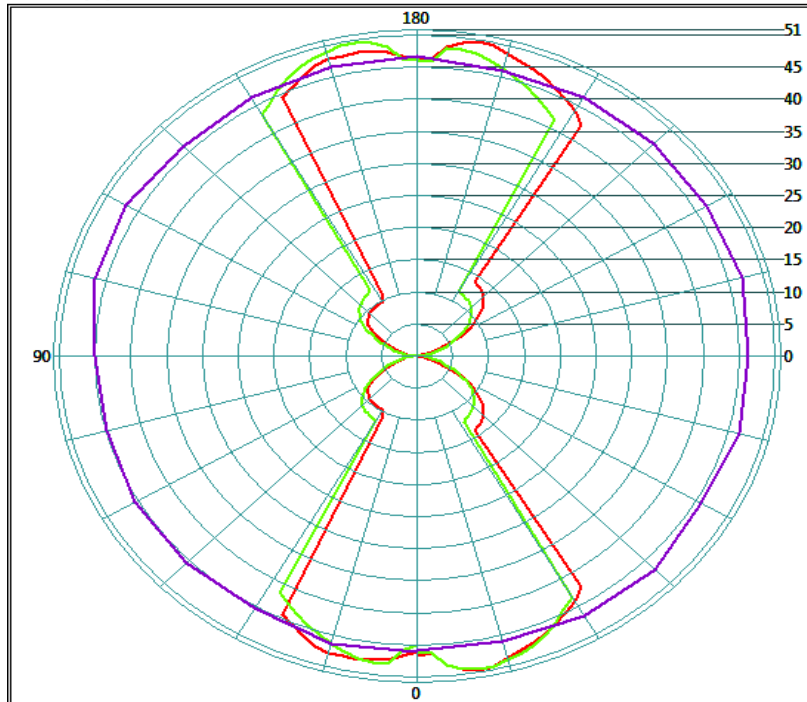
Dimension	Sample	Luminous Opening
Diameter/Width	90 mm	70 mm $\Phi$
Length	110 mm	
Height/Depth	160 mm	0 mm

Electrical Measurements	
Frequency	50 Hz
Voltage	230.060 V
Current	0.056 A
Power	6.3 W
Power Factor	0.484
Apparent Power	12.9 VA

### Goniophotometric Measurements

Beam Angle	Horizontal	60°
	Vertical	60°
On-axis Intensity		46 cd
Peak Intensity		51 cd
Peak Direction	Horizontal	225°
	Vertical	10°

Polar Plot (cd)

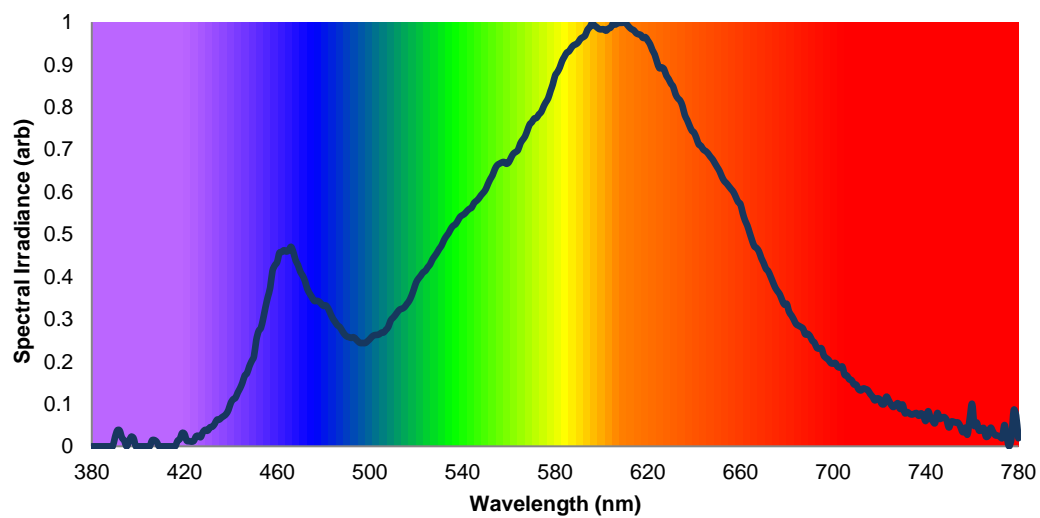


## Appendices

### *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**



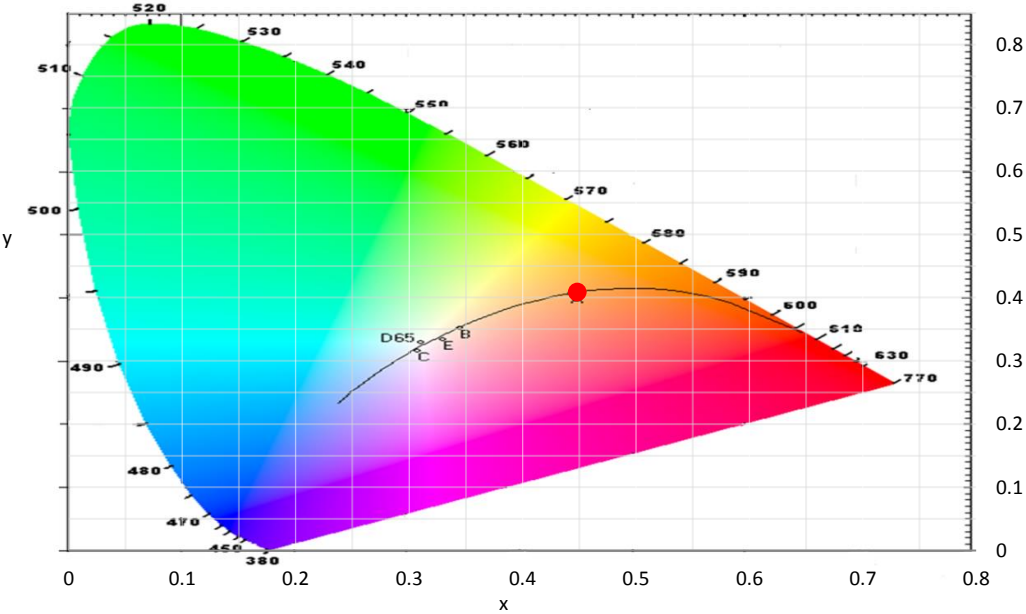
Colour Rendering Index Detail			
R1	81	R8	59
R2	94	R9	11
R3	94	R10	83
R4	76	R11	72
R5	80	R12	72
R6	91	R13	84
R7	81	R14	98

Colorimetric Details	
CCT	2852K
CRI (Ra)	82

Chromaticity Coordinates		
CIE 1931	x	0.4482
	y	0.4085
CIE 1960	u	0.2559
	v	0.3499
CIE 1976	u'	0.2559
	v'	0.5248
Duv		0.0003

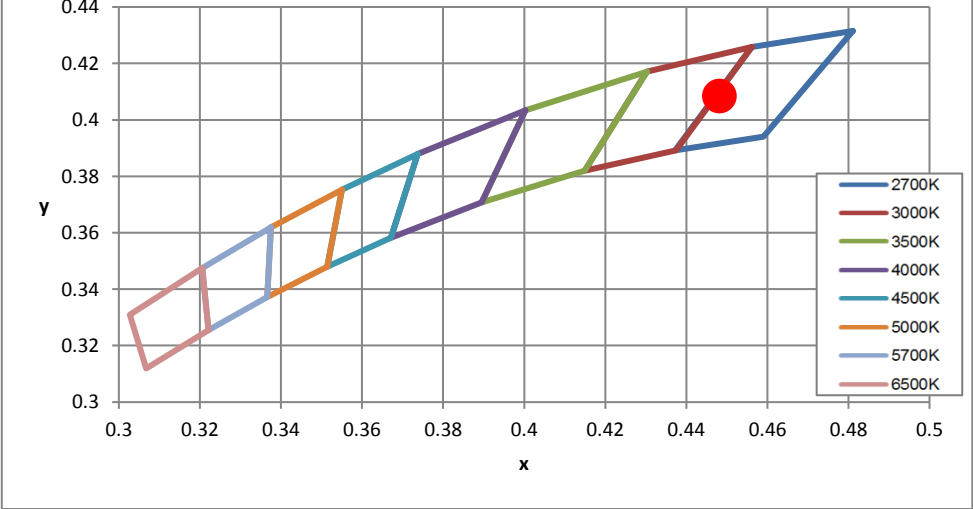
CIE 1931 Colour Chart

● 0.45, 0.41



CIE 1931 x, y Chromaticity Diagram - Nominal CCT Quadrangles

● 0.45, 0.41



### Spectral Power Distribution

$\lambda$ (nm)	Arb units	$\lambda$ (nm)	Arb units	$\lambda$ (nm)	Arb units	$\lambda$ (nm)	Arb units
380	0.00E+00	430	3.69E-02	480	3.31E-01	530	4.66E-01
381	0.00E+00	431	4.49E-02	481	3.32E-01	531	4.74E-01
382	0.00E+00	432	4.62E-02	482	3.26E-01	532	4.86E-01
383	0.00E+00	433	5.27E-02	483	3.13E-01	533	4.95E-01
384	0.00E+00	434	6.26E-02	484	3.02E-01	534	5.03E-01
385	0.00E+00	435	6.30E-02	485	2.94E-01	535	5.13E-01
386	0.00E+00	436	6.78E-02	486	2.86E-01	536	5.20E-01
387	0.00E+00	437	7.15E-02	487	2.82E-01	537	5.24E-01
388	0.00E+00	438	7.64E-02	488	2.73E-01	538	5.32E-01
389	0.00E+00	439	8.61E-02	489	2.65E-01	539	5.41E-01
390	2.13E-02	440	1.02E-01	490	2.59E-01	540	5.45E-01
391	3.74E-02	441	1.11E-01	491	2.58E-01	541	5.49E-01
392	3.74E-02	442	1.14E-01	492	2.56E-01	542	5.55E-01
393	2.07E-02	443	1.27E-01	493	2.57E-01	543	5.60E-01
394	1.34E-02	444	1.37E-01	494	2.53E-01	544	5.63E-01
395	0.00E+00	445	1.50E-01	495	2.47E-01	545	5.74E-01
396	1.10E-02	446	1.67E-01	496	2.44E-01	546	5.79E-01
397	2.27E-02	447	1.72E-01	497	2.44E-01	547	5.84E-01
398	1.94E-02	448	1.89E-01	498	2.43E-01	548	5.92E-01
399	0.00E+00	449	2.01E-01	499	2.48E-01	549	5.98E-01
400	0.00E+00	450	2.12E-01	500	2.53E-01	550	6.06E-01
401	0.00E+00	451	2.50E-01	501	2.59E-01	551	6.18E-01
402	0.00E+00	452	2.72E-01	502	2.62E-01	552	6.30E-01
403	0.00E+00	453	2.79E-01	503	2.63E-01	553	6.39E-01
404	0.00E+00	454	3.02E-01	504	2.64E-01	554	6.54E-01
405	0.00E+00	455	3.29E-01	505	2.68E-01	555	6.63E-01
406	1.39E-02	456	3.52E-01	506	2.69E-01	556	6.66E-01
407	1.47E-02	457	3.74E-01	507	2.75E-01	557	6.69E-01
408	1.05E-02	458	4.14E-01	508	2.82E-01	558	6.71E-01
409	0.00E+00	459	4.27E-01	509	2.97E-01	559	6.66E-01
410	0.00E+00	460	4.34E-01	510	3.03E-01	560	6.70E-01
411	0.00E+00	461	4.57E-01	511	3.09E-01	561	6.81E-01
412	0.00E+00	462	4.58E-01	512	3.17E-01	562	6.90E-01
413	0.00E+00	463	4.63E-01	513	3.23E-01	563	6.94E-01
414	0.00E+00	464	4.59E-01	514	3.25E-01	564	6.99E-01
415	0.00E+00	465	4.62E-01	515	3.28E-01	565	7.14E-01
416	0.00E+00	466	4.70E-01	516	3.36E-01	566	7.23E-01
417	1.27E-02	467	4.58E-01	517	3.43E-01	567	7.31E-01
418	1.76E-02	468	4.39E-01	518	3.55E-01	568	7.45E-01
419	3.14E-02	469	4.28E-01	519	3.70E-01	569	7.59E-01
420	2.92E-02	470	4.12E-01	520	3.86E-01	570	7.65E-01
421	1.32E-02	471	4.03E-01	521	3.95E-01	571	7.73E-01
422	1.23E-02	472	3.90E-01	522	4.02E-01	572	7.75E-01
423	1.11E-02	473	3.71E-01	523	4.10E-01	573	7.83E-01
424	1.29E-02	474	3.61E-01	524	4.14E-01	574	7.88E-01
425	2.36E-02	475	3.52E-01	525	4.22E-01	575	8.01E-01
426	2.49E-02	476	3.43E-01	526	4.29E-01	576	8.11E-01
427	2.17E-02	477	3.43E-01	527	4.40E-01	577	8.21E-01
428	3.39E-02	478	3.42E-01	528	4.48E-01	578	8.38E-01
429	3.90E-02	479	3.36E-01	529	4.56E-01	579	8.54E-01
						580	8.74E-01



### Spectral Power Distribution

$\lambda$ (nm)	Arb units	$\lambda$ (nm)	Arb units	$\lambda$ (nm)	Arb units	$\lambda$ (nm)	Arb units
581	8.83E-01	631	8.48E-01	681	3.17E-01	731	7.81E-02
582	8.93E-01	632	8.30E-01	682	3.09E-01	732	8.10E-02
583	9.08E-01	633	8.21E-01	683	2.99E-01	733	7.73E-02
584	9.19E-01	634	8.15E-01	684	2.89E-01	734	7.49E-02
585	9.28E-01	635	8.02E-01	685	2.85E-01	735	7.69E-02
586	9.32E-01	636	7.81E-01	686	2.82E-01	736	7.85E-02
587	9.40E-01	637	7.70E-01	687	2.78E-01	737	7.20E-02
588	9.46E-01	638	7.56E-01	688	2.64E-01	738	7.79E-02
589	9.48E-01	639	7.45E-01	689	2.65E-01	739	7.19E-02
590	9.53E-01	640	7.40E-01	690	2.60E-01	740	5.99E-02
591	9.61E-01	641	7.27E-01	691	2.50E-01	741	8.28E-02
592	9.65E-01	642	7.12E-01	692	2.44E-01	742	6.85E-02
593	9.69E-01	643	7.08E-01	693	2.32E-01	743	5.99E-02
594	9.83E-01	644	7.00E-01	694	2.30E-01	744	5.49E-02
595	9.89E-01	645	6.96E-01	695	2.31E-01	745	7.87E-02
596	9.98E-01	646	6.91E-01	696	2.14E-01	746	6.53E-02
597	9.92E-01	647	6.83E-01	697	2.08E-01	747	6.70E-02
598	9.88E-01	648	6.77E-01	698	2.04E-01	748	6.89E-02
599	9.84E-01	649	6.67E-01	699	1.96E-01	749	6.20E-02
600	9.83E-01	650	6.58E-01	700	1.95E-01	750	4.45E-02
601	9.84E-01	651	6.49E-01	701	1.96E-01	751	5.81E-02
602	9.80E-01	652	6.36E-01	702	1.88E-01	752	5.80E-02
603	9.85E-01	653	6.26E-01	703	1.86E-01	753	5.60E-02
604	9.88E-01	654	6.20E-01	704	1.88E-01	754	5.58E-02
605	9.97E-01	655	6.13E-01	705	1.69E-01	755	4.58E-02
606	9.95E-01	656	6.06E-01	706	1.67E-01	756	3.33E-02
607	9.98E-01	657	6.00E-01	707	1.58E-01	757	4.38E-02
608	9.99E-01	658	5.88E-01	708	1.56E-01	758	2.77E-02
609	9.99E-01	659	5.76E-01	709	1.46E-01	759	6.55E-02
610	1.00E+00	660	5.71E-01	710	1.45E-01	760	1.00E-01
611	9.95E-01	661	5.50E-01	711	1.35E-01	761	4.85E-02
612	9.88E-01	662	5.33E-01	712	1.32E-01	762	5.63E-02
613	9.84E-01	663	5.20E-01	713	1.37E-01	763	3.75E-02
614	9.81E-01	664	5.03E-01	714	1.35E-01	764	3.91E-02
615	9.74E-01	665	4.86E-01	715	1.32E-01	765	4.29E-02
616	9.72E-01	666	4.72E-01	716	1.24E-01	766	2.30E-02
617	9.70E-01	667	4.67E-01	717	1.17E-01	767	2.58E-02
618	9.63E-01	668	4.59E-01	718	1.08E-01	768	4.39E-02
619	9.65E-01	669	4.44E-01	719	1.13E-01	769	3.46E-02
620	9.57E-01	670	4.32E-01	720	1.11E-01	770	2.64E-02
621	9.48E-01	671	4.19E-01	721	1.00E-01	771	2.52E-02
622	9.34E-01	672	4.13E-01	722	1.00E-01	772	2.32E-02
623	9.24E-01	673	4.01E-01	723	1.17E-01	773	1.96E-02
624	9.06E-01	674	3.88E-01	724	1.09E-01	774	5.04E-02
625	8.92E-01	675	3.75E-01	725	9.86E-02	775	2.16E-02
626	8.94E-01	676	3.66E-01	726	9.26E-02	776	0.00E+00
627	8.89E-01	677	3.58E-01	727	9.74E-02	777	1.99E-02
628	8.75E-01	678	3.45E-01	728	1.01E-01	778	8.55E-02
629	8.66E-01	679	3.34E-01	729	8.80E-02	779	7.28E-02
630	8.56E-01	680	3.36E-01	730	9.87E-02	780	1.91E-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 (°C)	$\pm 1.0$
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.

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 -----