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PHOTOMETRIC  
TEST REPORT

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<b>Report Number</b>	GNC-24268
<b>Customer</b>	Astro Lighting Limited
<b>Contact</b>	David Green
<b>Product Type</b>	LED Bathroom light
<b>Test Purpose</b>	Generation of photometric data
<b>Quote Reference</b>	Q-LUX18-300513
<b>Works Order Number</b>	WO-24268
<b>Test Item Reference</b>	TI-21257
<b>LAB Test Method Reference</b>	Goniometric (Type C) Intensity Scan - IES/LDT Files & Report - Scan Increments 15 degrees Azimuth by 2.5 degrees inclination
<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>	02-04-19
<b>Reviewed by</b>	Gareth Jones
<b>Number of products tested</b>	1

Address: LUX-TSI Ltd.,  
Pencoed Technology Park,  
Pencoed, Bridgend,  
CF35 5AQ, UK  
Telephone: +44 (0) 1656 864618  
Authorised by: G. Jones  
Email: [CustomerService@lux-tsi.com](mailto:CustomerService@lux-tsi.com)  
Signed: 



Sparta 600

Date: 02/04/2019

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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. The integrating sphere spectroradiometer system has been calibrated using a Reference Standard Lamp traceable to NPL.

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## Test Equipment

UL LSI Custom Far-Field Type C Moving Mirror Goniophotometer measures intensity as a function of angle. Spectral measurements are measured using a Labsphere 1 metre integrating sphere.

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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	Sparta 600 LED
Part/Serial Number	1322006
Type of Product	LED Bathroom light
Base Type	Not Applicable - Luminaire
Driver Type	Internal
Test Time	30 mins
Operating Orientation	Base Up
Test Orientation	Base Up
Ambient Temperature	25.2°C
Manufacturer	Astro Lighting Limited
Date of Manufacture	Not Available
Thermal Management	Passive
Dimmable	No
Pre-Burning Time	0 hours
Stabilisation Time	45 mins
Humidity	22.3% RH
Averaging Applied	NONE



Driver Details		
Manufacturer	MeanWell	
Model	LPH-18-12	
Part/Serial #	GB84327377	
Rated Voltage	200-240V	
Output	Current	1.500 A
	Voltage	12.0 V

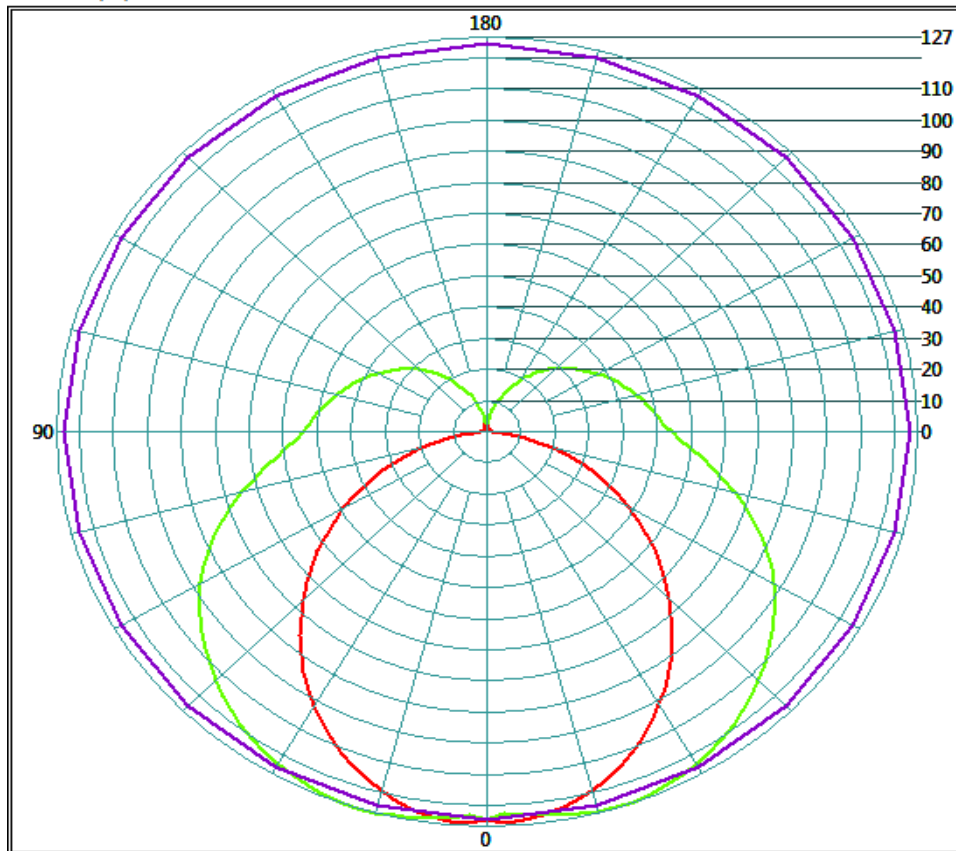
Photometric Measurements	
Luminous Flux	616 lm
Luminous Efficacy	48 lm/W

Dimension	Sample	Luminous Opening
Diameter/Width	33 mm	33 mm
Length	600 mm	595 mm
Height/Depth	80 mm	25 mm

Electrical Measurements	
Frequency	50 Hz
Voltage	230.0 V
Current	0.140 A
Power	12.9 W
Power Factor	0.401
Apparent Power	32.2 VA

Goniophotometric Measurements		
Beam Angle	Horizontal	165°
	Vertical	113°
On-axis Intensity		124 cd
Peak Intensity		127 cd
Peak Direction	Horizontal	90°
	Vertical	15°

Polar Plot (cd)



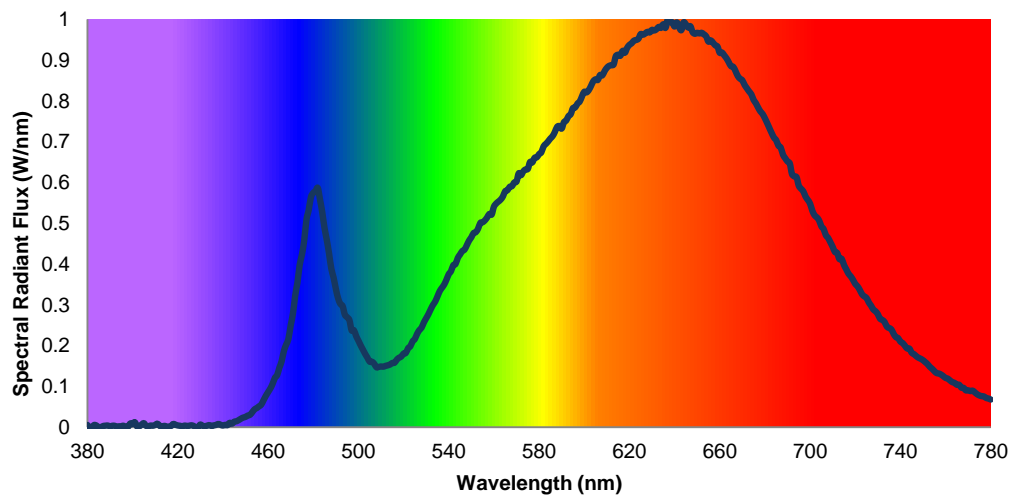
Mounting Height (m)	Beam Width (m)		Projected Illuminance (lux)
	C0-C180 plane	C90-270 plane	
0.5	7.7	1.5	498
1	15.3	3.0	124
2	30.7	6.0	31
3	46.0	9.0	14
4	61.3	12.0	8
5	76.7	15.0	5
7.5	115.0	22.5	2
10	153.3	30.0	1
20	306.6	60.0	0

## Spectral Results

### *Integrated Spectral Measurement using spectroradiometer and 1 metre integrating sphere*

The following data was determined from an integrated spectral measurement using a spectrometer. This will produce spatially averaged spectroradiometric results measured in an integrating sphere.

**Spectral Radiant Flux versus Wavelength**



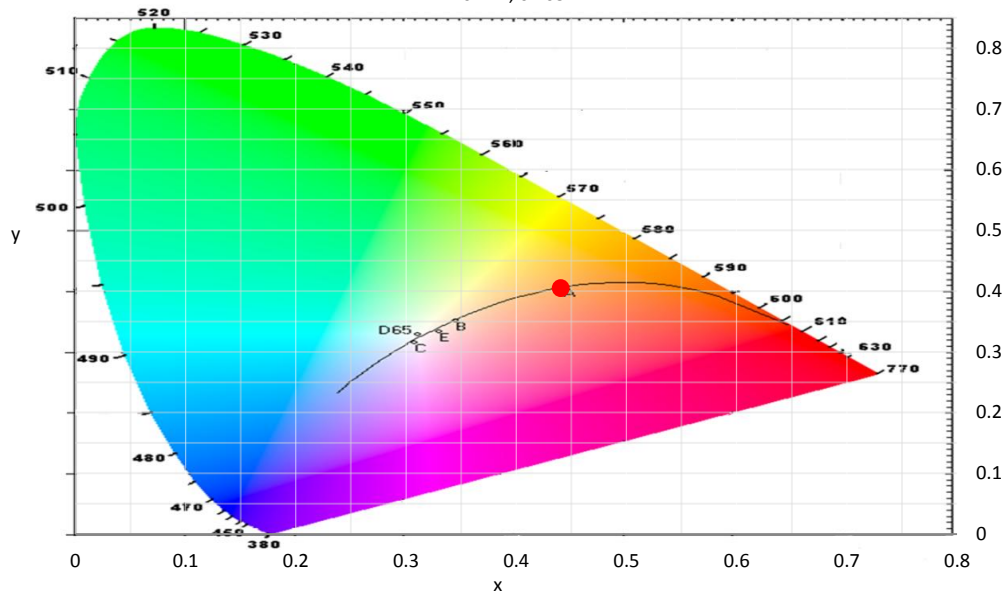
Colour Rendering Index Detail			
R1	82	R8	69
R2	89	R9	28
R3	94	R10	74
R4	82	R11	79
R5	81	R12	64
R6	85	R13	84
R7	87	R14	96

Colorimetric Details	
CCT	2941K
CRI (Ra)	84

Chromaticity Coordinates		
CIE 1931	x	0.4406
	y	0.4045
CIE 1960	u	0.2528
	v	0.3481
CIE 1976	u'	0.2528
	v'	0.5221
Duv		0.0006

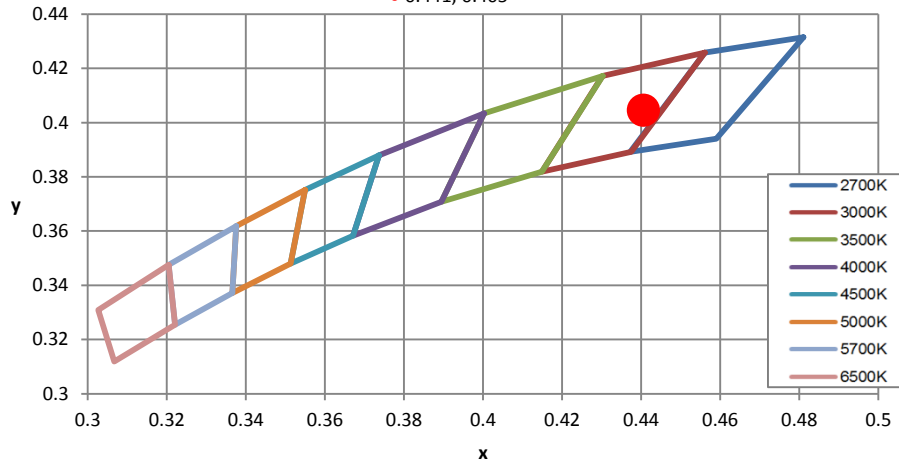
CIE 1931 Colour Chart

• 0.441, 0.405



CIE 1931 x, y Chromaticity Diagram - Nominal CCT Quadrangles

• 0.441, 0.405



### Spectral Power Distribution

$\lambda$ (nm)	W/nm	$\lambda$ (nm)	W/nm	$\lambda$ (nm)	W/nm	$\lambda$ (nm)	W/nm
380	5.45E-03	430	6.43E-03	480	5.74E-01	530	2.67E-01
381	0.00E+00	431	3.51E-03	481	5.79E-01	531	2.77E-01
382	0.00E+00	432	2.31E-03	482	5.87E-01	532	2.89E-01
383	5.37E-03	433	3.61E-03	483	5.58E-01	533	3.00E-01
384	4.01E-03	434	5.04E-03	484	5.27E-01	534	3.08E-01
385	1.56E-04	435	2.75E-03	485	4.88E-01	535	3.20E-01
386	1.88E-04	436	4.38E-03	486	4.59E-01	536	3.33E-01
387	2.89E-03	437	5.50E-03	487	4.26E-01	537	3.42E-01
388	3.51E-03	438	7.90E-03	488	3.88E-01	538	3.50E-01
389	3.98E-03	439	5.62E-03	489	3.67E-01	539	3.62E-01
390	2.11E-03	440	3.92E-03	490	3.39E-01	540	3.75E-01
391	3.34E-03	441	5.61E-03	491	3.16E-01	541	3.83E-01
392	3.42E-03	442	4.82E-03	492	3.02E-01	542	3.97E-01
393	1.52E-03	443	1.07E-02	493	2.97E-01	543	4.00E-01
394	2.07E-03	444	8.48E-03	494	2.76E-01	544	4.15E-01
395	2.26E-03	445	1.33E-02	495	2.70E-01	545	4.23E-01
396	3.61E-03	446	1.44E-02	496	2.63E-01	546	4.32E-01
397	5.26E-04	447	1.73E-02	497	2.37E-01	547	4.35E-01
398	8.29E-04	448	2.07E-02	498	2.38E-01	548	4.46E-01
399	9.15E-03	449	2.35E-02	499	2.23E-01	549	4.57E-01
400	7.55E-03	450	2.51E-02	500	2.12E-01	550	4.66E-01
401	1.22E-02	451	2.84E-02	501	2.00E-01	551	4.76E-01
402	1.27E-03	452	3.02E-02	502	1.90E-01	552	4.78E-01
403	1.80E-03	453	3.67E-02	503	1.80E-01	553	4.87E-01
404	6.45E-03	454	4.36E-02	504	1.70E-01	554	5.01E-01
405	9.74E-03	455	4.68E-02	505	1.61E-01	555	5.02E-01
406	3.15E-03	456	5.11E-02	506	1.60E-01	556	5.07E-01
407	2.17E-03	457	5.54E-02	507	1.55E-01	557	5.14E-01
408	4.04E-03	458	6.61E-02	508	1.47E-01	558	5.23E-01
409	3.51E-03	459	7.65E-02	509	1.48E-01	559	5.21E-01
410	5.55E-03	460	8.58E-02	510	1.49E-01	560	5.40E-01
411	8.47E-03	461	9.48E-02	511	1.48E-01	561	5.48E-01
412	3.53E-03	462	1.06E-01	512	1.50E-01	562	5.53E-01
413	0.00E+00	463	1.21E-01	513	1.52E-01	563	5.58E-01
414	3.29E-03	464	1.27E-01	514	1.54E-01	564	5.66E-01
415	1.61E-03	465	1.46E-01	515	1.57E-01	565	5.79E-01
416	1.47E-03	466	1.61E-01	516	1.58E-01	566	5.81E-01
417	2.73E-03	467	1.87E-01	517	1.66E-01	567	5.89E-01
418	7.90E-03	468	2.02E-01	518	1.70E-01	568	5.91E-01
419	5.95E-03	469	2.16E-01	519	1.73E-01	569	6.00E-01
420	4.17E-03	470	2.49E-01	520	1.80E-01	570	6.02E-01
421	3.41E-03	471	2.78E-01	521	1.82E-01	571	6.23E-01
422	2.25E-03	472	3.22E-01	522	1.93E-01	572	6.18E-01
423	3.82E-03	473	3.55E-01	523	1.98E-01	573	6.27E-01
424	3.09E-03	474	3.98E-01	524	2.10E-01	574	6.32E-01
425	3.35E-03	475	4.23E-01	525	2.16E-01	575	6.33E-01
426	4.51E-03	476	4.58E-01	526	2.29E-01	576	6.50E-01
427	3.06E-03	477	5.09E-01	527	2.38E-01	577	6.49E-01
428	0.00E+00	478	5.33E-01	528	2.44E-01	578	6.60E-01
429	5.75E-04	479	5.64E-01	529	2.57E-01	579	6.62E-01
						580	6.69E-01



### Spectral Power Distribution

$\lambda$ (nm)	W/nm	$\lambda$ (nm)	W/nm	$\lambda$ (nm)	W/nm	$\lambda$ (nm)	W/nm
581	6.74E-01	631	9.73E-01	681	7.46E-01	731	2.66E-01
582	6.89E-01	632	9.76E-01	682	7.33E-01	732	2.63E-01
583	6.94E-01	633	9.82E-01	683	7.21E-01	733	2.58E-01
584	7.01E-01	634	9.79E-01	684	7.10E-01	734	2.47E-01
585	7.08E-01	635	9.88E-01	685	7.04E-01	735	2.43E-01
586	7.14E-01	636	9.79E-01	686	6.90E-01	736	2.40E-01
587	7.24E-01	637	1.00E+00	687	6.86E-01	737	2.29E-01
588	7.36E-01	638	9.94E-01	688	6.68E-01	738	2.21E-01
589	7.38E-01	639	9.93E-01	689	6.59E-01	739	2.18E-01
590	7.32E-01	640	9.82E-01	690	6.52E-01	740	2.10E-01
591	7.48E-01	641	9.93E-01	691	6.47E-01	741	2.06E-01
592	7.52E-01	642	9.81E-01	692	6.20E-01	742	1.99E-01
593	7.62E-01	643	9.73E-01	693	6.15E-01	743	1.93E-01
594	7.67E-01	644	9.93E-01	694	6.13E-01	744	1.93E-01
595	7.82E-01	645	9.88E-01	695	5.92E-01	745	1.82E-01
596	7.84E-01	646	9.80E-01	696	5.85E-01	746	1.79E-01
597	7.93E-01	647	9.83E-01	697	5.78E-01	747	1.74E-01
598	7.98E-01	648	9.69E-01	698	5.65E-01	748	1.70E-01
599	8.11E-01	649	9.65E-01	699	5.57E-01	749	1.68E-01
600	8.22E-01	650	9.67E-01	700	5.48E-01	750	1.64E-01
601	8.21E-01	651	9.65E-01	701	5.31E-01	751	1.59E-01
602	8.26E-01	652	9.67E-01	702	5.19E-01	752	1.55E-01
603	8.37E-01	653	9.63E-01	703	5.14E-01	753	1.48E-01
604	8.48E-01	654	9.58E-01	704	5.07E-01	754	1.43E-01
605	8.53E-01	655	9.45E-01	705	4.93E-01	755	1.38E-01
606	8.51E-01	656	9.49E-01	706	4.86E-01	756	1.33E-01
607	8.63E-01	657	9.43E-01	707	4.71E-01	757	1.32E-01
608	8.63E-01	658	9.36E-01	708	4.64E-01	758	1.29E-01
609	8.73E-01	659	9.33E-01	709	4.53E-01	759	1.25E-01
610	8.81E-01	660	9.18E-01	710	4.42E-01	760	1.21E-01
611	8.86E-01	661	9.19E-01	711	4.30E-01	761	1.19E-01
612	8.87E-01	662	9.12E-01	712	4.27E-01	762	1.14E-01
613	8.89E-01	663	9.04E-01	713	4.12E-01	763	1.10E-01
614	9.10E-01	664	8.95E-01	714	4.13E-01	764	1.09E-01
615	9.13E-01	665	8.85E-01	715	3.98E-01	765	1.04E-01
616	9.11E-01	666	8.83E-01	716	3.87E-01	766	1.04E-01
617	9.23E-01	667	8.73E-01	717	3.76E-01	767	9.69E-02
618	9.18E-01	668	8.61E-01	718	3.70E-01	768	9.62E-02
619	9.30E-01	669	8.55E-01	719	3.61E-01	769	9.02E-02
620	9.37E-01	670	8.50E-01	720	3.51E-01	770	9.04E-02
621	9.41E-01	671	8.39E-01	721	3.45E-01	771	8.84E-02
622	9.48E-01	672	8.31E-01	722	3.37E-01	772	8.95E-02
623	9.49E-01	673	8.23E-01	723	3.26E-01	773	8.51E-02
624	9.53E-01	674	8.16E-01	724	3.21E-01	774	8.06E-02
625	9.64E-01	675	8.02E-01	725	3.17E-01	775	7.77E-02
626	9.62E-01	676	7.94E-01	726	3.06E-01	776	7.60E-02
627	9.65E-01	677	7.84E-01	727	2.98E-01	777	7.52E-02
628	9.69E-01	678	7.74E-01	728	2.89E-01	778	7.15E-02
629	9.68E-01	679	7.68E-01	729	2.84E-01	779	7.01E-02
630	9.74E-01	680	7.57E-01	730	2.77E-01	780	6.77E-02

### Measurement Uncertainty

The following is the reported expanded uncertainty of the UL 6440T Type C Mirror Goniophotometer. Colrimetric expanded uncertainty is estimated using the 1 metre integrating sphere

Parameter	Uncertainty
Total Luminous Flux (%)	$\pm 4.9$
Luminous Intensity (%)	$\pm 4.9$
Correlated Color Temperature	$\pm 100$ K
CRI	$\pm 2$
Chromaticity $x$	$\pm 0.005$
Chromaticity $y$	$\pm 0.005$
Temperature ( $^{\circ}$ 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 -----