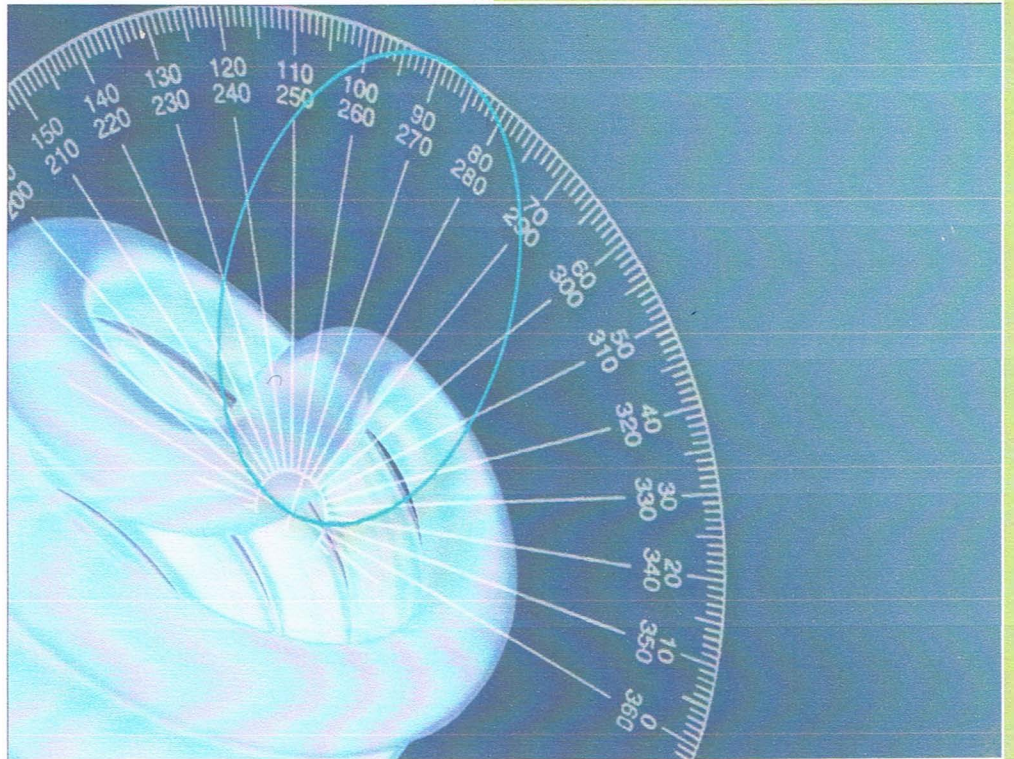


Photometric Test Report



Photometric and Optical Testing
Services
Cheltenham Film and Photographic
Studios
Hatherley Lane
Cheltenham
Gloucestershire
GL51 6PN
UK
Tel: 01242 701300

Photometric Test Report

Report Number: POTS/DC15207	Report Date: 06/11/2015	Prepared By: D CHAMBERS
Test Laboratory: Photometric and Optical Testing Services, Cheltenham Film and Photographic Studios, Hatherley Lane, Cheltenham, Gloucestershire, GL51 6PN		
Company Registration Number: Registered in England & Wales No. OC352911		
Registered Address: Thistle Down Barn, Holcot Lane, Sywell, Northampton, NN6 0BG		

Client Details

Company: <i>Cheltenham Film and Photographic Studios</i>	Email: <i>info@chelfilm.co.uk</i>
Address: <i>Cheltenham Film and Photographic Studios, Hatherley Lane, Cheltenham, Gloucestershire, GL51 6PN</i>	

Test Method(s) Used

POTS Standard Operating Procedure:	INTEGRATING SPHERE PROCEDURE POTS016
POTS Standard Operating Procedure:	NFMS OPERATION GUIDE
Standard:	LM79 08

Details of Product Tested

Manufacturer: LUMENA	Source Type: LED
Model: Lumena Ledifice 1M (20w Corn)	Luminaire Type: BOLLARD
Power Supply Used: Kikusui PCR1000M Voltage Stabiliser S/N SM01191	
Voltage(AC V) = 230.0	Current (mA)= 101
Power (Watts)= 22	Power factor= 0.948

Integrating Sphere Test

Date of Test: 20/10/2015	Ambient Temperature: 25°C
Measurement Filename: Lumena Ledifice 1M (20w Corn)	
Instrument Used: Labsphere model 2m integrating sphere spectroradiometer AS-02949-012	
Integrating Sphere Size: 2m	Measurement Geometry ($2\pi / 4\pi$): 4π
Sample Orientation: Horizontal	Auxiliary Correction Applied: YES
Comments:	
Date of Last Calibration (Operating Hours): 12-10-2015 (0:57)	Spectral Flux Standard Lamp Used: SCL-600
Standard Lamp Serial Number: L123	Traceable: to NIST standards
Calibration Certificate Number: SCL-600-L123	Calibration Certificate Date: 29/01/2014
Calibration Lamp Uncertainty: $\pm 0.67\%$ ($k=2$)	

Results

Flux (lumens): 1065	
CIE 1931 Chromaticity Cx: 0.3220	CIE 1931 Chromaticity Cy: 0.3406
CRI (%): 82.86	CCT (K): 5971

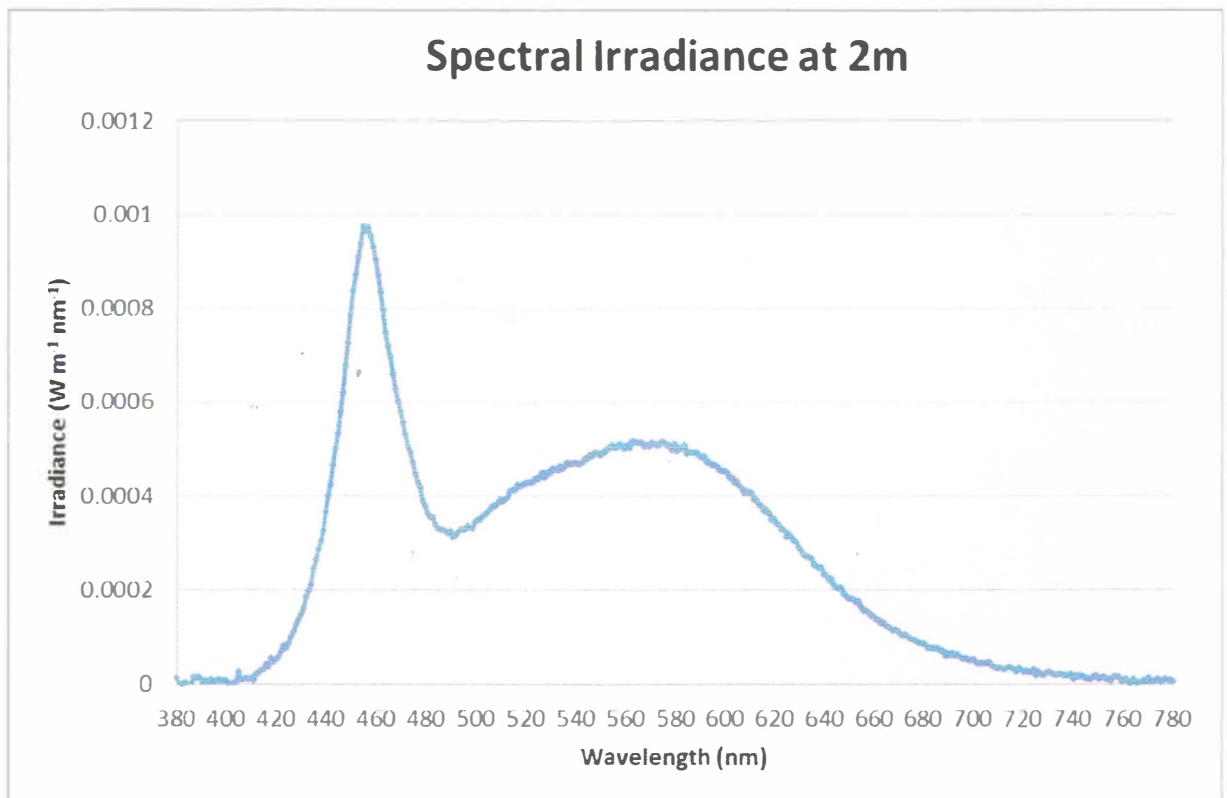


Figure 1: Spectral Irradiance

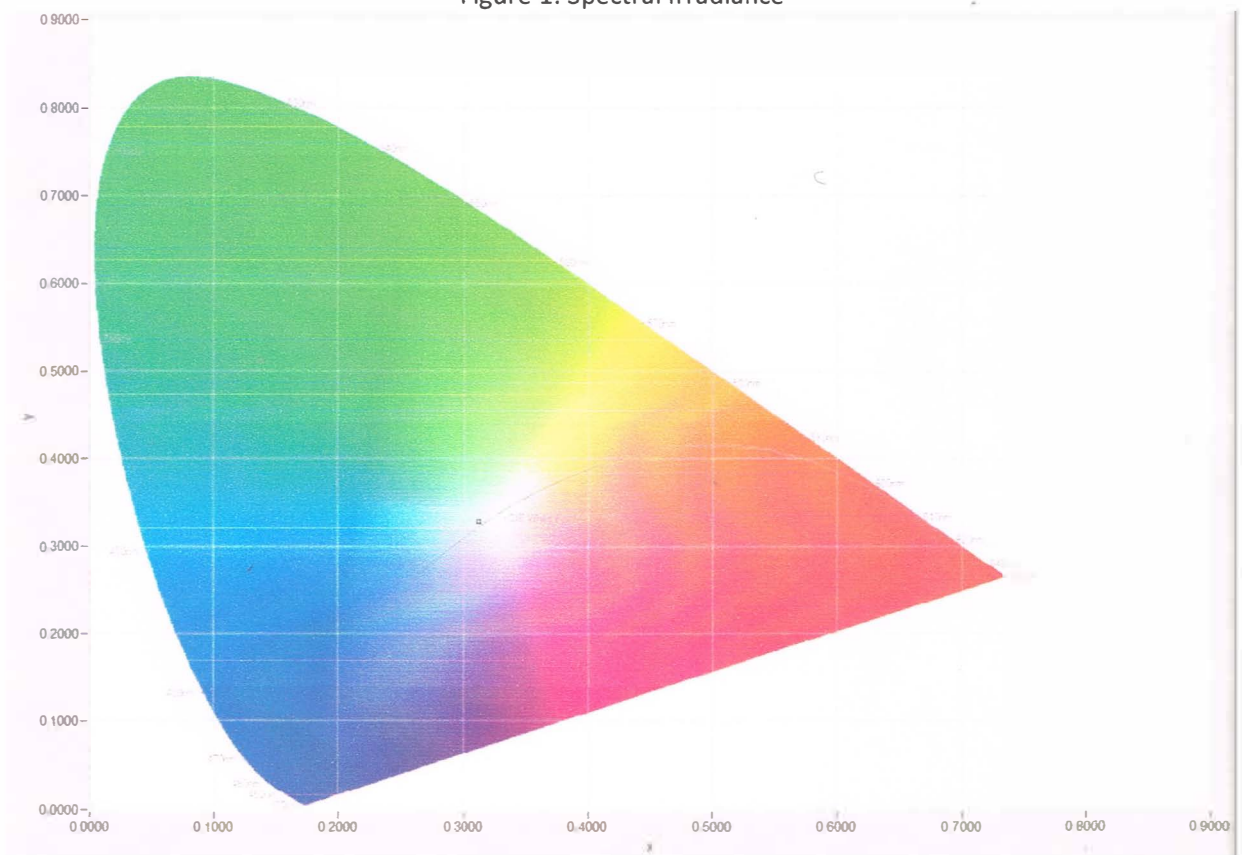


Figure 2: CIE 1931 diagram.

Goniophotometer Test		
Date of Test: 26/10/2015	Ambient Temperature: 25°C	
Measurement Filename: Lumena Ledifice 1M (20w Corn)		
Instrument Used: Radiant Imaging NFMS0800 Goniometer with ProMetric PM-1200N-1 Imaging Photometer		
Photometer Working Distance: 2m	Measurement Geometry: Near-Field	
Comments:		
Reference Photometer Used: Specbos1211	Reference Photometer Serial Number: 2014754	
Traceable: to NIST standards		
Calibration Certificate Date: 18 June 2015	Sample Stabilisation Time (minutes): 30	
Reference Photometer Calibration Uncertainty: $\pm 2.4\%$ ($k=2$, 20-200 lux, CIE illuminant A source)		
Scan Set Up		
Direction	Range	Increment
Inclination Zone 1	0-90°	3°
Azimuth	0-360°	10°
Results		
Integrated Luminous Flux (lumens):1065	Peak Intensity (3° Spot, candelas): 164.4	Efficacy (lumens/Watt): 48.4
Photometric Filename (IES LM-63-2002): Lumena Ledifice 1M (20w Corn)		
IES File – Absolute or Relative Format? ABSOLUTE		
Photometric Filename (EULUMDAT): Lumena Ledifice 1M (20w Corn)		
EULUMDAT File – Absolute or Relative Format? ABSOLUTE		

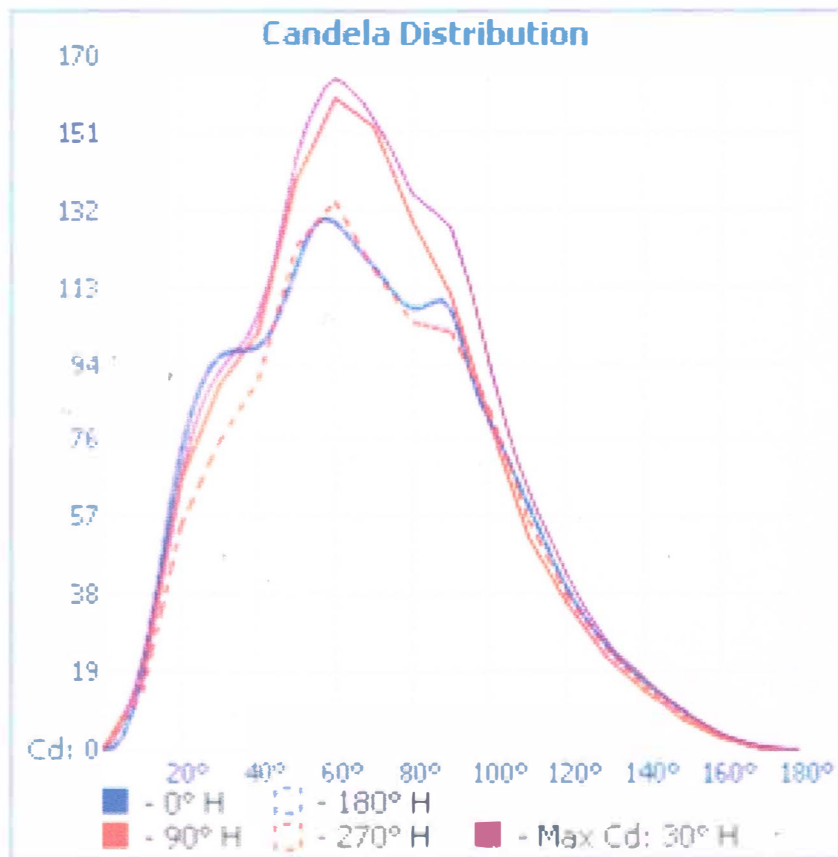


Figure 3: Far-Field Luminous Intensity (C0-180, Cartesian Coordinates)

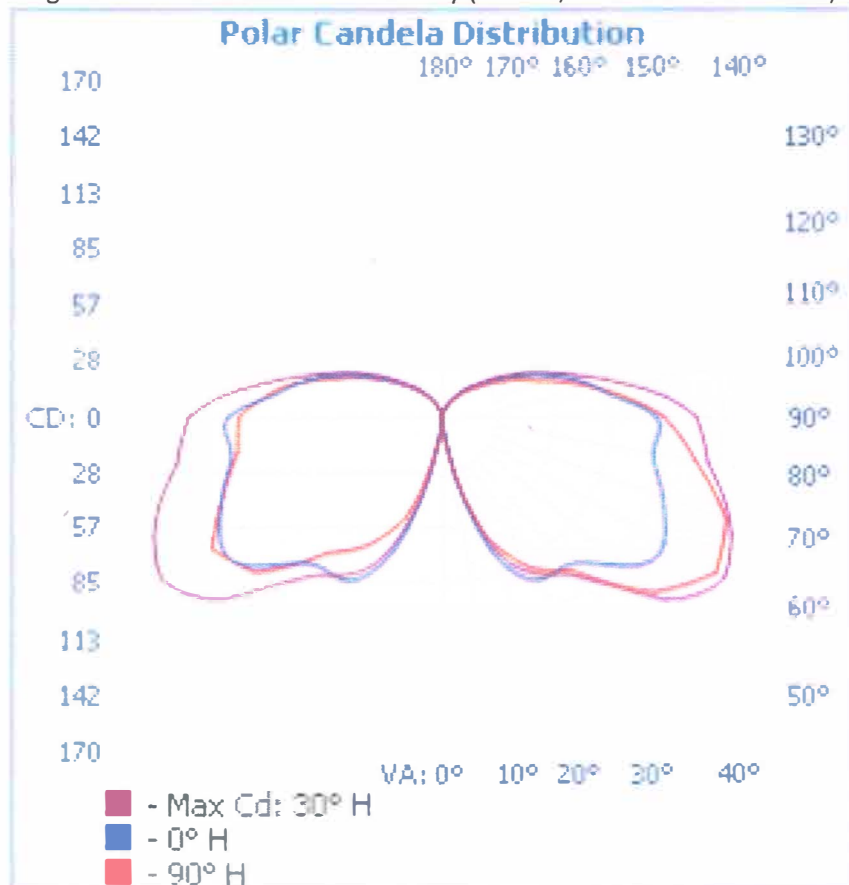


Figure 4: Far-Field Luminous Intensity (C0-180, C90-270, Polar Coordinates)

Reflectance of Ceiling		0.7	0.7	0.5	0.5	0.3	0.7	0.7	0.5	0.5	0.3
Wall		0.5	0.3	0.5	0.3	0.3	0.5	0.3	0.5	0.3	0.3
Floor Cavity		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Room dimension		View endwise (C0)					View crosswise (C90)				
x	y										
2H	2H	14.4	15.7	15.1	16.5	17.4	13.5	14.9	14.2	15.6	16.5
	3H	16.9	18.1	17.6	18.9	19.8	16.2	17.5	16.9	18.3	19.2
	4H	18.0	19.2	18.7	20.0	20.9	17.5	18.7	18.3	19.5	20.4
	6H	19.1	20.3	19.9	21.1	22.0	18.7	19.9	19.5	20.7	21.6
	8H	19.7	20.8	20.4	21.6	22.5	19.3	20.4	20.0	21.2	22.2
	12H	20.2	21.3	21.0	22.1	23.1	19.8	20.9	20.6	21.7	22.7
4H	2H	15.3	16.5	16.0	17.3	18.2	14.7	15.9	15.4	16.7	17.6
	3H	18.0	19.1	18.8	19.9	20.9	17.3	18.4	18.0	19.2	20.1
	4H	19.4	20.4	20.2	21.2	22.2	18.7	19.7	19.5	20.5	21.5
	6H	20.7	21.6	21.5	22.4	23.4	20.1	21.0	20.9	21.8	22.8
	8H	21.4	22.2	22.1	23.0	24.0	20.8	21.6	21.6	22.4	23.4
	12H	22.0	22.8	22.8	23.7	24.7	21.5	22.3	22.3	23.1	24.1
8H	4H	19.9	20.8	20.7	21.6	22.6	19.3	20.2	20.1	21.0	22.0
	6H	21.5	22.2	22.3	23.0	24.1	20.8	21.6	21.6	22.4	23.4
	8H	22.4	23.0	23.2	23.9	24.9	21.7	22.4	22.5	23.2	24.2
	12H	23.2	23.8	24.0	24.7	25.7	22.5	23.1	23.4	24.0	25.0
12H	4H	20.0	20.8	20.8	21.6	22.6	19.5	20.3	20.3	21.1	22.1
	6H	21.7	22.4	22.5	23.2	24.2	21.1	21.8	21.9	22.6	23.7
	8H	22.6	23.2	23.4	24.1	25.1	22.0	22.6	22.8	23.5	24.5

Distance between luminaires: 0.25

Due to missing symmetry characteristics the values apply only to the indicated line of sight.

Table 1. UGR values

	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.5	0	1	2	2	3	3	4	4	4	4	4	4	4	4	3	3	2	1	0
5	3	5	6	7	7	8	7	8	8	8	9	9	9	9	9	8	7	5	3
7.5	10	12	13	14	14	13	13	12	12	13	13	14	15	16	16	16	15	12	10
10	18	20	22	22	21	20	18	17	16	17	18	20	23	25	26	26	24	22	18
12.5	32	34	33	32	30	28	27	27	26	29	30	32	34	35	37	37	37	36	32
15	46	47	46	43	39	39	39	37	36	41	42	46	48	48	48	50	51	50	46
17.5	61	61	59	54	51	51	51	49	47	53	55	59	62	62	62	63	64	64	61
20	73	72	70	66	64	62	61	61	57	65	68	73	74	74	74	75	75	75	73
22.5	82	81	79	76	74	72	72	70	64	71	76	83	86	85	84	84	84	84	82
25	89	88	85	83	82	81	78	75	71	77	83	88	92	94	91	90	91	90	89
27.5	93	92	89	89	87	86	83	81	77	83	89	94	96	97	96	95	95	95	93
30	96	94	93	93	91	90	88	87	83	89	96	99	99	99	98	98	98	97	96
32.5	97	97	95	96	94	92	91	90	85	92	99	102	102	99	99	101	100	98	97
35	98	98	98	98	98	95	93	89	86	96	102	104	103	99	101	104	102	100	98
37.5	98	99	101	102	102	98	95	88	87	99	104	105	104	100	103	106	105	102	98
40	99	100	103	107	107	102	97	88	87	102	106	107	105	102	105	109	108	104	99
42.5	101	103	108	113	114	108	101	89	92	111	113	110	106	105	108	113	114	107	101
45	106	109	117	122	123	116	105	93	97	121	121	116	109	109	112	119	121	112	106
47.5	111	118	127	133	133	124	110	96	102	130	128	121	115	112	116	127	129	118	111
50	118	127	137	145	143	133	116	99	106	139	136	127	122	116	121	138	138	126	118
52.5	125	133	146	153	153	141	123	103	111	144	142	132	128	119	127	147	147	133	125
55	129	139	153	158	158	147	128	106	116	149	147	136	131	120	132	155	155	139	129
57.5	130	142	157	162	162	153	128	109	121	154	153	140	131	121	137	160	159	141	130
60	129	143	160	164	164	154	128	110	126	159	159	142	131	122	140	162	161	142	129
62.5	127	141	159	163	163	155	128	110	124	158	157	143	131	124	142	162	161	139	127
65	124	137	157	161	157	155	126	109	121	156	155	141	129	124	140	161	160	136	124
67.5	121	133	155	158	151	152	123	108	118	154	152	139	125	122	137	159	158	133	121
70	118	130	149	154	146	147	119	107	116	152	150	138	122	119	134	154	150	130	118
72.5	115	128	144	150	142	142	115	104	113	147	145	135	119	116	129	149	144	128	115
75	112	124	138	146	138	137	114	100	109	141	141	132	117	113	124	143	138	125	112
77.5	109	122	134	141	136	134	114	97	106	135	136	129	116	113	121	139	135	122	109

80	108	120	132	136	135	131	114	93	102	130	132	127	115	112	120	135	132	120	108
82.5	108	120	131	134	134	127	113	91	102	125	128	123	112	112	119	132	132	118	108
85	109	120	130	132	132	125	111	90	103	121	125	119	108	109	116	130	130	118	109
87.5	110	120	129	130	130	122	108	89	103	116	121	116	104	105	111	125	127	117	110
90	108	116	127	128	127	120	105	88	103	112	117	112	100	102	106	119	122	114	108
92.5	101	110	118	121	119	112	100	86	97	104	109	105	94	95	99	111	112	106	101
95	92	101	109	113	111	104	94	83	91	96	101	98	87	89	92	102	102	96	92
97.5	85	93	99	104	103	96	89	81	85	88	93	91	81	82	85	94	92	88	85
100	80	86	90	94	94	88	82	77	79	80	84	84	75	77	79	86	85	83	80
102.5	76	79	82	85	85	81	76	71	73	73	77	76	69	71	74	78	78	77	76
105	70	74	76	77	78	74	69	66	67	66	70	69	64	65	68	70	71	71	70
107.5	65	67	70	70	71	67	62	60	61	59	62	62	58	60	61	63	65	64	65
110	60	62	64	64	64	61	57	55	56	52	55	55	54	54	55	58	58	58	60
112.5	54	56	57	58	58	55	51	51	51	48	50	50	49	49	50	53	52	53	54
115	49	50	51	53	52	49	46	47	47	44	46	46	44	44	45	48	47	48	49
117.5	44	45	46	48	47	44	42	43	42	40	41	41	40	40	40	43	43	43	44
120	39	40	40	43	42	39	38	39	38	36	36	37	36	36	37	38	38	39	39
122.5	35	36	37	38	37	35	35	35	34	33	33	34	33	32	33	34	35	35	35
125	32	32	34	34	34	32	31	32	31	29	30	31	30	29	30	30	32	31	32
127.5	29	29	30	30	30	29	28	28	28	26	27	27	27	27	27	27	28	28	29
130	26	26	27	27	27	26	26	25	24	23	24	24	25	25	24	25	24	25	26
132.5	23	24	25	24	24	23	23	23	22	21	21	22	22	22	23	22	23	23	23
135	21	21	22	22	22	21	21	21	20	19	19	20	20	20	20	20	21	21	21
137.5	19	19	20	20	19	19	19	18	18	16	17	17	18	18	18	18	19	19	19
140	17	17	18	18	17	17	17	16	15	14	15	15	16	16	16	16	17	17	17
142.5	15	15	15	15	15	15	15	14	14	13	13	13	14	14	14	14	15	15	15
145	13	13	13	13	13	13	13	12	12	11	11	12	12	12	12	12	13	13	13
147.5	11	11	11	11	11	11	11	10	10	9	10	10	10	10	11	11	11	11	11
150	9	10	10	10	9	10	9	9	9	7	8	8	9	9	9	9	9	10	9
152.5	8	8	8	8	8	8	8	8	8	6	7	7	7	7	7	8	8	8	8
155	6	7	7	7	7	6	6	6	6	5	5	6	6	6	6	6	6	6	6
157.5	5	5	5	5	5	5	5	5	5	4	4	4	4	4	5	5	5	5	5

160	4	4	4	4	4	4	4	4	4	4	3	3	3	4	4	4	4	4	4
162.5	3	3	3	3	3	3	3	3	3	2	2	2	2	3	3	3	3	3	3
165	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
167.5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
170	1	1	1	1	1	1	1	1	0	0	0	0	1	1	1	1	1	1	1
172.5	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
175	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
177.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
180	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2a. Luminous intensity values, azimuth 0-180°

	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.5	1	2	2	3	3	4	4	4	4	4	4	4	4	3	3	2	1
5	5	6	7	7	8	7	8	7	7	8	8	9	9	9	8	7	5
7.5	12	13	14	14	13	13	12	11	10	12	14	15	16	16	16	15	12
10	20	22	22	21	20	18	17	15	14	17	20	23	25	26	26	24	22
12.5	34	33	32	30	28	27	27	25	24	29	32	34	35	37	37	37	36
15	47	46	43	39	39	39	38	36	34	42	45	48	48	48	50	51	50
17.5	61	59	55	51	51	51	49	47	44	55	59	62	62	62	63	64	64
20	72	70	66	64	62	61	61	57	55	68	73	74	74	74	75	75	75
22.5	81	79	76	74	72	72	70	64	60	76	83	86	85	84	84	84	84
25	88	85	83	82	81	78	75	71	65	83	88	92	94	91	90	91	90
27.5	92	89	89	87	86	83	81	77	70	89	94	96	97	96	95	95	95
30	94	93	93	91	90	88	87	83	76	96	99	99	99	98	98	98	97
32.5	97	95	96	94	92	91	90	85	79	99	102	102	99	99	101	100	98
35	98	98	98	98	95	93	89	86	83	102	104	103	99	101	104	102	100
37.5	99	101	102	102	98	95	88	87	87	104	105	104	100	103	106	105	102
40	100	103	107	107	102	97	88	87	90	106	107	105	102	105	109	108	104
42.5	103	108	113	114	108	101	89	92	99	113	110	106	105	108	113	114	107
45	109	117	122	123	116	105	93	97	107	121	116	109	109	112	119	121	112
47.5	118	127	133	133	124	110	96	102	115	128	121	115	112	116	127	129	118
50	127	137	145	143	133	116	99	106	123	136	127	122	116	121	138	138	126
52.5	133	146	153	153	141	123	103	111	126	142	132	128	119	127	147	147	133

55	139	153	158	158	147	128	106	116	129	147	136	131	120	132	155	155	139
57.5	142	157	162	162	153	128	109	121	132	153	140	132	121	137	160	159	141
60	143	160	164	164	154	128	110	126	134	159	142	131	122	140	162	161	142
62.5	141	159	163	163	155	128	110	124	130	157	143	131	124	142	162	161	139
65	137	157	161	157	155	126	109	121	126	155	141	129	124	140	161	160	136
67.5	133	155	158	151	152	123	108	118	122	152	139	125	122	137	159	158	133
70	130	149	154	146	147	119	107	116	118	150	138	122	119	134	154	150	130
72.5	128	144	150	142	142	115	104	113	114	145	135	119	116	129	149	144	128
75	124	138	146	138	137	114	100	109	111	141	132	117	113	124	143	138	125
77.5	122	134	141	136	134	114	97	106	108	136	129	116	113	121	139	135	122
80	120	132	136	135	131	114	93	102	105	132	127	115	112	120	135	132	120
82.5	120	131	134	134	127	113	91	102	104	128	123	112	112	119	132	132	118
85	120	130	132	132	125	111	90	103	104	125	119	108	109	116	130	130	118
87.5	120	129	130	130	122	108	89	103	103	121	116	104	105	111	125	127	117
90	116	127	128	127	120	105	88	103	102	117	112	100	102	106	119	122	114
92.5	110	118	121	119	112	100	86	97	98	109	105	93	95	99	111	112	106
95	101	109	113	111	104	94	83	91	93	101	98	87	89	92	102	102	96
97.5	93	99	104	103	96	89	81	85	88	93	91	81	82	85	94	92	88
100	86	90	94	94	88	82	77	79	83	84	84	75	77	79	86	85	83
102.5	79	82	85	85	81	76	71	73	76	77	76	69	71	74	78	78	77
105	74	76	77	78	74	69	66	67	70	70	69	64	65	68	70	71	71
107.5	67	70	70	71	67	62	60	61	63	62	62	58	60	61	63	65	64
110	62	64	64	64	61	57	55	56	56	55	55	54	54	55	58	58	58
112.5	56	57	58	58	55	51	51	51	52	50	50	49	49	49	53	52	53
115	50	51	53	52	49	46	47	47	47	46	46	44	44	45	48	47	48
117.5	45	46	48	47	44	42	43	42	42	41	41	40	40	40	43	43	43
120	40	40	43	42	39	38	39	38	38	36	37	36	36	37	38	38	39
122.5	36	37	38	37	35	35	35	34	35	33	34	33	32	33	34	35	35
125	32	34	34	34	32	31	32	31	31	30	31	30	29	30	30	32	31
127.5	29	30	30	30	29	28	28	28	28	27	27	27	27	27	27	28	28
130	26	27	27	27	26	26	25	24	25	24	25	25	24	25	24	25	25
132.5	24	25	24	24	23	23	23	22	22	21	22	22	22	23	22	23	23
135	21	22	22	22	21	21	21	20	20	19	20	20	20	20	20	21	21
137.5	19	20	20	19	19	19	18	18	18	17	17	18	18	18	18	19	19
140	17	18	18	17	17	17	16	15	16	15	15	16	16	16	16	17	17
142.5	15	15	15	15	15	15	14	14	14	13	13	14	14	14	14	15	15
145	13	13	13	13	13	13	12	12	12	11	12	12	12	12	12	13	13

147.5	11	11	11	11	11	11	10	10	10	10	10	10	10	11	11	11	11
150	10	10	10	9	10	9	9	9	8	8	8	9	9	9	9	9	10
152.5	8	8	8	8	8	8	8	8	7	7	7	7	7	7	8	8	8
155	7	7	7	7	6	6	6	6	6	5	6	6	6	6	6	6	6
157.5	5	5	5	5	5	5	5	5	5	4	4	4	5	5	5	5	5
160	4	4	4	4	4	4	4	4	3	3	3	4	4	4	4	4	4
162.5	3	3	3	3	3	3	3	3	3	2	2	3	3	3	3	3	3
165	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
167.5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
170	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1
172.5	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
175	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
177.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
180	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2b. Luminous intensity values, azimuth 190-350°

Zone	Lumens	% Total	Zone	Lumens	% Total
0-5	0.1	0.00%	90-95	57.6	5.70%
05-10	1	0.10%	95-100	49.2	4.90%
10-15	3.9	0.40%	100-105	41.2	4.10%
15-20	9.4	0.90%	105-110	33.5	3.30%
20-25	16.3	1.60%	110-115	26.7	2.60%
25-30	22.6	2.20%	115-120	20.9	2.10%
30-35	28.2	2.80%	120-125	16.1	1.60%
35-40	33.2	3.30%	125-130	12.3	1.20%
40-45	39.5	3.90%	130-135	9.3	0.90%
45-50	48.2	4.80%	135-140	6.8	0.70%
50-55	57.8	5.70%	140-145	4.8	0.50%
55-60	65.3	6.50%	145-150	3.2	0.30%
60-65	69.3	6.80%	150-155	1.9	0.20%
65-70	69.8	6.90%	155-160	1	0.10%
70-75	68.2	6.70%	160-165	0.5	0%
75-80	66.2	6.50%	165-170	0.2	0%
80-85	64.9	6.40%	170-175	0	0%
85-90	63.1	6.20%	175-180	0	0%

Table 3. Zonal Flux Table

Effective Floor Cavity Reflectance: 20%																			
RCC %:	80				70				50				30			10			0
RW %:	70	50	30	0	70	50	30	0	50	30	20	50	30	20	50	30	20	0	
RCR: 0	1.12	1.12	1.12	1.12	1.06	1.06	1.06	0.72	0.95	0.95	0.95	0.85	0.85	0.85	0.76	0.76	0.76	0.72	
1	0.96	0.89	0.82	0.76	0.9	0.83	0.78	0.48	0.74	0.69	0.65	0.65	0.61	0.58	0.57	0.54	0.51	0.47	
2	0.84	0.73	0.64	0.56	0.79	0.69	0.61	0.35	0.61	0.54	0.48	0.53	0.47	0.43	0.46	0.41	0.37	0.33	
3	0.75	0.62	0.52	0.44	0.7	0.58	0.49	0.27	0.51	0.43	0.37	0.44	0.38	0.33	0.38	0.33	0.29	0.25	
4	0.68	0.53	0.43	0.35	0.63	0.5	0.4	0.21	0.44	0.36	0.29	0.38	0.31	0.26	0.33	0.27	0.23	0.19	
5	0.61	0.46	0.36	0.28	0.57	0.44	0.34	0.17	0.38	0.3	0.24	0.33	0.26	0.21	0.28	0.23	0.18	0.15	
6	0.56	0.41	0.31	0.24	0.52	0.38	0.29	0.14	0.34	0.26	0.2	0.29	0.23	0.17	0.25	0.19	0.15	0.12	
7	0.52	0.36	0.27	0.2	0.48	0.34	0.25	0.12	0.3	0.22	0.17	0.26	0.2	0.15	0.22	0.17	0.13	0.1	
8	0.48	0.33	0.23	0.17	0.44	0.31	0.22	0.1	0.27	0.2	0.14	0.24	0.17	0.13	0.2	0.15	0.11	0.08	
9	0.44	0.3	0.21	0.15	0.41	0.28	0.2	0.09	0.25	0.17	0.12	0.21	0.15	0.11	0.19	0.13	0.09	0.07	
10	0.41	0.27	0.19	0.13	0.38	0.25	0.18	0.07	0.22	0.16	0.11	0.2	0.14	0.09	0.17	0.12	0.08	0.06	

Table 4. Utilisation Factor Table

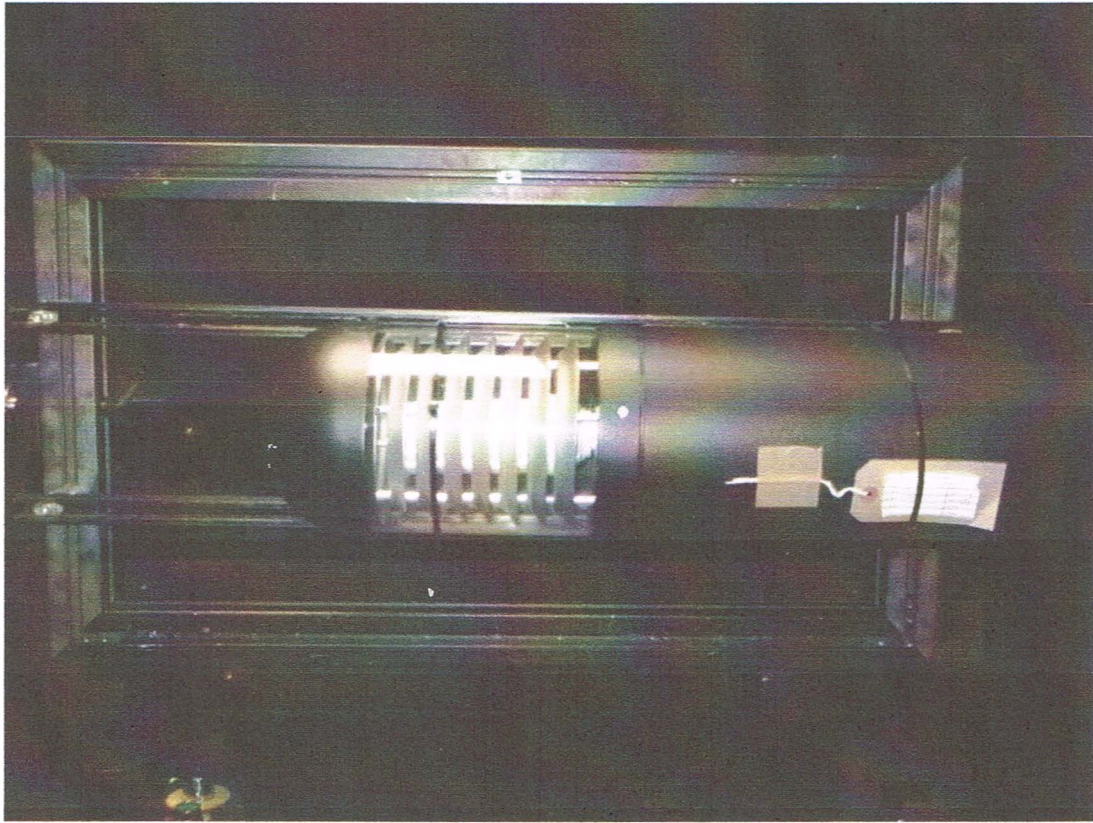


Photo 1: Luminaire on goniometer mount

Signature:

Print Name:

D CHAMBERS

Date:

06/11/2015


Test Engineer

Duly authorised to sign on behalf of:

Photometric and Optical Testing Services LLP

Checked by:

Signature:



Print Name:

G John

Date: 6-11-2015

Technical Director

Duly authorised to sign on behalf of:

Photometric and Optical Testing Services LLP