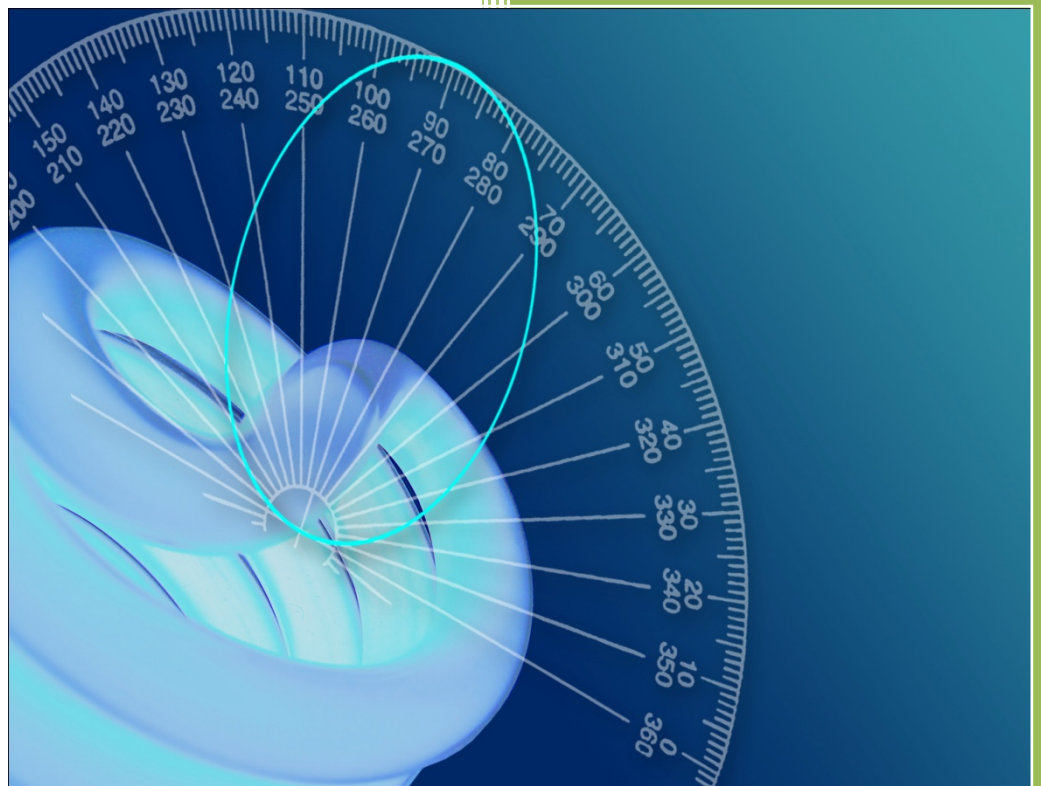


# Photometric Test Report



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/DC16193	Report Date: 29/09/2016	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: Harwood House, Park Road, Melton Mowbray, Leicestershire LE13 1TX		

### Client Details

Manufacturer: TLC Southern Ltd	Source Type: LED
Model: RTWPLED5	

### 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: TLC Southern Ltd	Source Type: LED
Model: RTWPLED5	Luminaire Type: BATTEN
Power Supply Used: Kikusui PCR1000M Voltage Stabiliser S/N SM01191	
Voltage(AC V) = 230.0	Current (mA)= 215
Power (Watts)= 47.6	Power factor= 0.959

### Integrating Sphere Test

Date of Test: 27/09/2016	Ambient Temperature: 25°C
Measurement Filename: RTWPLED5	
Instrument Used: Labsphere model 2m integrating sphere spectroradiometer AS-02949-012	
Integrating Sphere Size: 2m	Measurement Geometry ( $2\pi / 4\pi$ ): $4\pi$
Sample Orientation: Facing Downwards	Auxiliary Correction Applied: YES
Comments:	
Date of Last Calibration (Operating Hours): 16-09-2016 (1:31)	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: $\pm 0.67\%$ ( $k=2$ )	
<b>Results</b>	
Flux (lumens): 4780	
CIE 1931 Chromaticity Cx: 0.3561	CIE 1931 Chromaticity Cy: 0.3691
CRI (%): 82.6	CCT (K): 4680

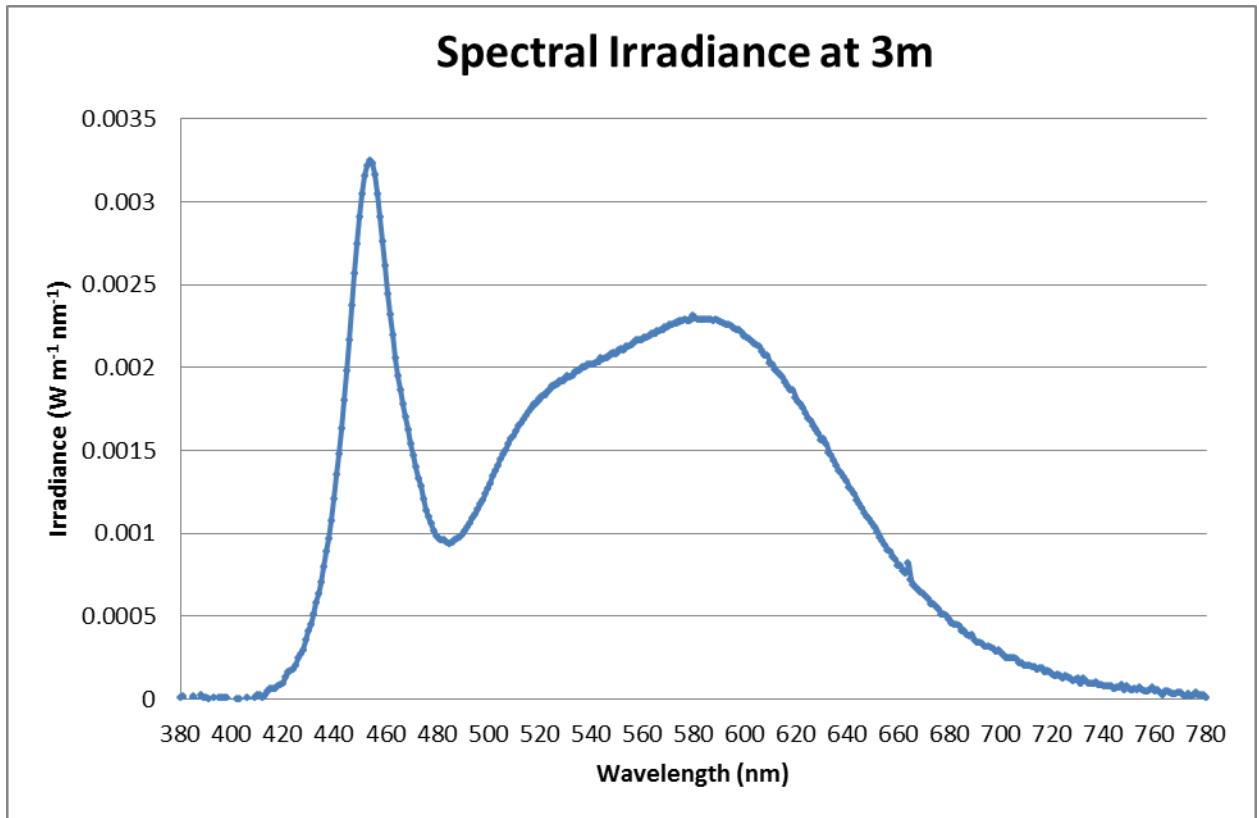


Figure 1: Spectral Irradiance



Figure 2: CIE 1931 diagram.

Goniophotometer Test		
Date of Test: 28/09/2016	Ambient Temperature: 25°C	
Measurement Filename: RTWPLED5		
Instrument Used: Radiant Imaging NFMS0800 Goniometer with ProMetric PM-1200N-1 Imaging Photometer		
Photometer Working Distance: 3m	Measurement Geometry: Near-Field	
Comments:		
Reference Photometer Used: Specbos1201	Reference Photometer Serial Number: 2911670	
Traceable: to NIST standards		
Calibration Certificate Date: 11 November 2015	Sample Stabilisation Time (minutes): 60	
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	0-180°	3°
Azimuth	0-360°	10°
Results		
Integrated Luminous Flux (lumens):4780	Peak Intensity (3° Spot, candelas): 1264.8	Efficacy (lumens/Watt): 100.4
Beam Angle (50% of max intensity C0-180, degrees): 106.3		
Photometric Filename (IES LM-63-2002): RTWPLED5		
IES File – Absolute or Relative Format? ABSOLUTE		
Photometric Filename (EULUMDAT): RTWPLED5		
EULUMDAT File – Absolute or Relative Format? ABSOLUTE		

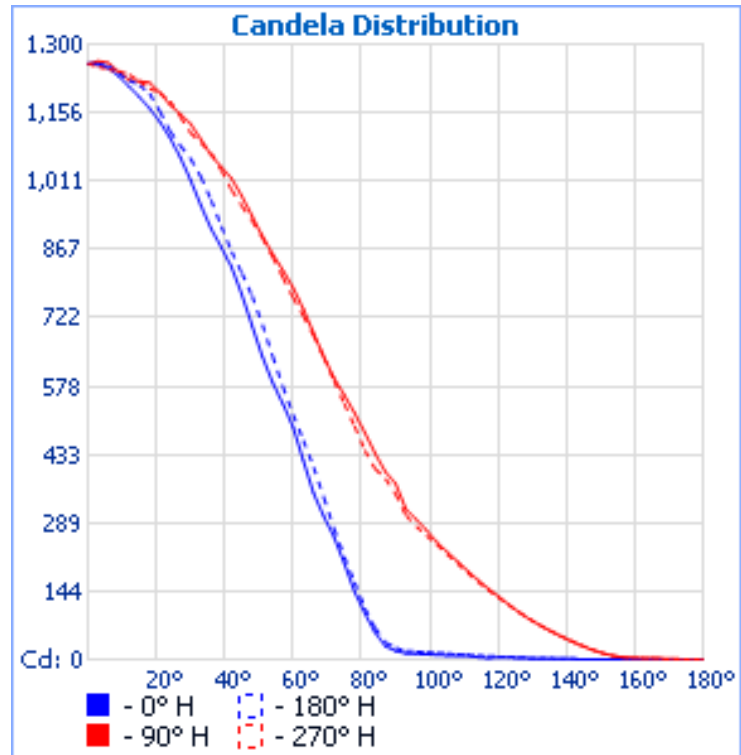


Figure 3: Far-Field Luminous Intensity (C0-180, Cartesian Coordinates)

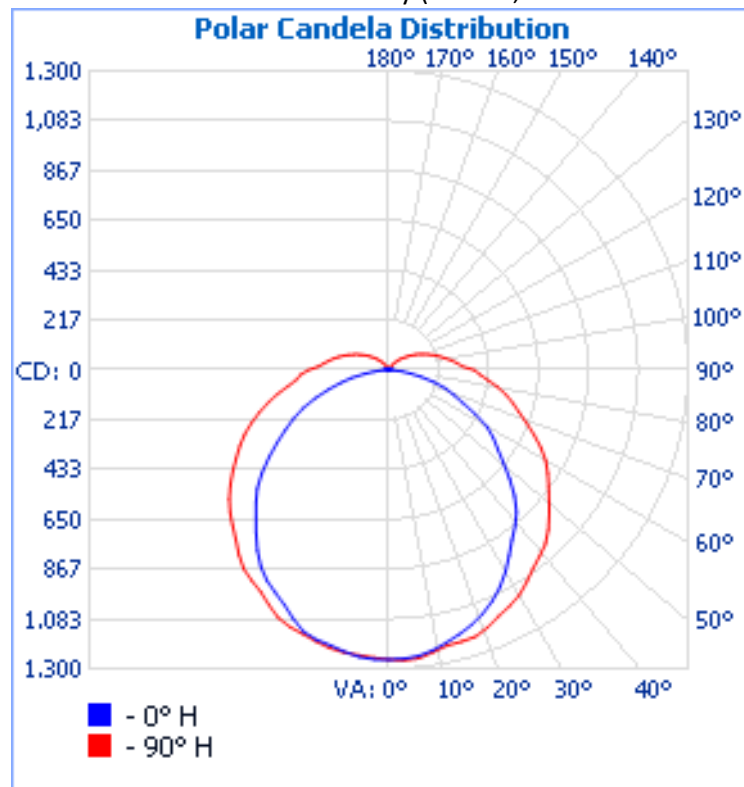


Figure 4: Far-Field Luminous Intensity (C0-180, C90-270, Polar Coordinates)

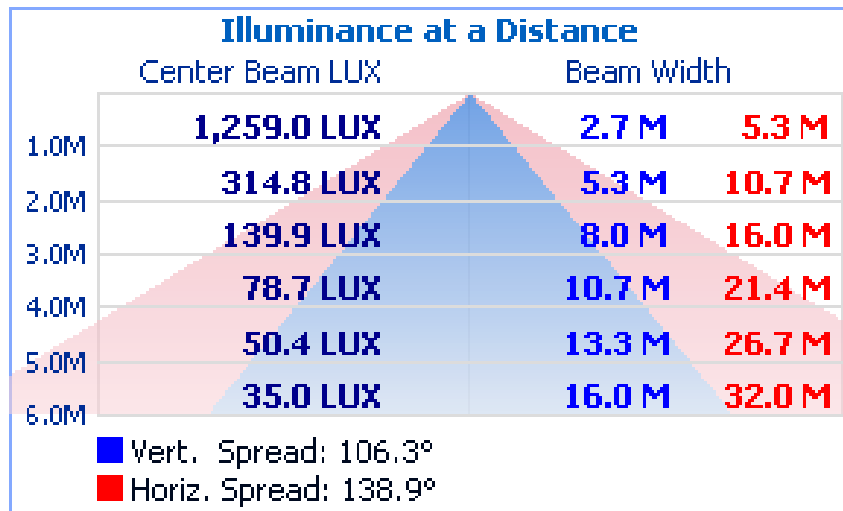


Figure 5. Cone diagram for mounting height of 6 metres.

Reflectance of	View endwise (C0)					View crosswise (C90)				
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	17.2	18.6	17.7	19.2	19.7	20.0	21.5	20.5	22.0	22.6
	3H	18.3	19.7	18.8	20.2	20.8	22.4	23.8	23.0	24.3	24.9
	4H	18.7	20.0	19.3	20.6	21.1	23.7	25.0	24.3	25.6	26.2
	6H	18.9	20.2	19.5	20.7	21.3	25.0	26.3	25.6	26.8	27.4
	8H	19.0	20.1	19.5	20.7	21.3	25.7	26.9	26.2	27.4	28.1
12H	18.9	20.1	19.5	20.6	21.3	26.4	27.6	27.0	28.1	28.8	
4H	2H	18.3	19.6	18.9	20.2	20.8	20.5	21.8	21.0	22.3	22.9
	3H	19.7	20.8	20.2	21.4	22.0	23.1	24.2	23.7	24.8	25.5
	4H	20.3	21.3	20.8	21.9	22.5	24.6	25.6	25.2	26.2	26.9
	6H	20.6	21.5	21.2	22.1	22.8	26.1	27.0	26.7	27.6	28.3
	8H	20.6	21.5	21.3	22.1	22.8	26.9	27.7	27.5	28.3	29.0
12H	20.7	21.5	21.3	22.1	22.8	27.8	28.6	28.4	29.2	29.9	
8H	4H	21.1	22.0	21.7	22.6	23.3	24.8	25.6	25.4	26.3	26.9
	6H	21.6	22.4	22.3	23.0	23.7	26.4	27.2	27.1	27.8	28.5
	8H	21.9	22.6	22.6	23.2	23.9	27.4	28.1	28.1	28.7	29.4
	12H	22.0	22.6	22.7	23.2	24.0	28.5	29.1	29.1	29.7	30.4
12H	4H	21.4	22.2	22.0	22.8	23.5	24.8	25.6	25.4	26.2	26.9
	6H	22.1	22.8	22.8	23.4	24.1	26.5	27.2	27.2	27.9	28.6
	8H	22.4	23.0	23.1	23.6	24.4	27.5	28.1	28.2	28.8	29.5

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	1259	1259	1259	1259	1259	1259	1259	1259	1259	1259	1259	1259	1259	1259	1259	1259	1259	1259	1259
3	1257	1258	1259	1260	1260	1262	1263	1264	1264	1265	1265	1264	1264	1263	1262	1261	1260	1260	1259
6	1250	1250	1251	1252	1252	1253	1255	1258	1259	1261	1261	1260	1259	1257	1255	1254	1254	1253	1254
9	1233	1234	1236	1236	1236	1237	1238	1239	1240	1242	1245	1249	1250	1248	1245	1243	1242	1239	1239
12	1211	1215	1221	1224	1226	1226	1225	1223	1222	1225	1232	1241	1245	1242	1238	1234	1231	1227	1224
15	1189	1193	1203	1209	1211	1212	1213	1215	1218	1222	1229	1235	1234	1228	1221	1217	1214	1213	1214
18	1165	1166	1174	1187	1189	1190	1193	1202	1212	1219	1222	1219	1211	1201	1193	1190	1185	1193	1196
21	1137	1129	1137	1158	1163	1162	1169	1180	1190	1199	1204	1199	1186	1172	1166	1159	1152	1158	1159
24	1102	1089	1097	1121	1133	1137	1147	1156	1162	1172	1179	1177	1160	1144	1132	1117	1114	1110	1117
27	1061	1058	1064	1089	1103	1112	1128	1132	1140	1153	1152	1150	1137	1119	1106	1082	1068	1082	1086
30	1013	1027	1034	1051	1066	1081	1102	1108	1120	1132	1123	1126	1109	1092	1081	1057	1022	1037	1059
33	960	983	991	1005	1026	1046	1072	1081	1093	1100	1098	1096	1072	1058	1045	1034	984	979	1020
36	911	925	938	958	985	1010	1041	1055	1065	1066	1074	1061	1039	1023	992	999	954	919	971
39	872	864	891	905	945	974	1006	1026	1038	1042	1047	1029	1016	992	942	938	922	865	916
42	830	808	844	857	906	932	969	987	1006	1017	1014	995	985	954	912	884	861	817	862
45	772	761	793	809	862	882	923	949	968	980	976	952	939	900	872	839	796	774	817
48	705	713	749	766	819	837	875	914	929	937	937	913	895	849	822	799	741	732	769
51	641	665	703	723	771	803	836	876	893	895	905	880	857	809	779	754	672	690	708
54	585	613	648	665	714	771	794	836	856	857	871	849	810	769	741	693	621	642	642
57	541	548	576	618	666	731	753	793	817	823	827	810	761	727	703	634	571	590	577
60	491	498	520	579	619	686	715	750	774	786	775	761	715	688	648	582	525	533	518
63	421	437	479	534	567	635	676	713	730	741	729	712	673	642	589	534	479	473	464
66	351	373	421	480	519	586	627	673	685	690	685	666	632	594	545	487	430	411	407
69	302	319	366	420	472	541	578	628	639	640	640	622	588	553	498	432	371	350	342
72	259	281	317	375	433	496	536	582	594	595	596	579	543	512	452	384	322	293	277
75	203	224	269	323	388	452	494	535	551	559	549	537	498	465	404	337	278	239	218
78	144	171	222	275	344	408	453	485	512	521	504	491	458	416	358	291	234	187	164
81	98	128	188	245	308	373	416	452	475	480	464	450	417	371	312	247	190	134	109
84	57	94	146	214	266	327	378	411	438	436	419	405	381	329	272	216	152	102	67
87	29	65	120	175	236	304	342	375	389	398	387	370	344	299	238	184	123	68	36
90	19	43	102	151	207	257	310	339	369	372	363	347	310	264	212	153	103	48	25
93	14	27	71	122	177	226	268	296	311	318	312	306	280	241	191	138	80	34	18

96	13	21	59	107	160	205	247	275	291	297	292	283	259	220	176	122	70	28	18
99	11	18	51	95	141	184	223	248	270	274	271	253	230	197	155	105	59	23	16
102	10	14	42	82	126	170	201	227	244	249	245	230	205	178	139	90	48	17	14
105	9	11	36	71	111	152	185	208	221	228	225	211	188	159	123	80	41	14	13
108	8	10	29	60	98	135	165	187	201	209	204	191	169	141	108	69	33	11	11
111	9	8	23	52	86	119	146	168	183	188	184	173	152	126	94	59	27	9	10
114	5	7	19	43	74	103	129	151	164	169	163	153	134	110	81	49	23	7	9
117	4	6	15	36	63	90	113	133	145	151	145	135	118	96	69	42	19	6	8
120	5	5	12	29	54	78	99	116	128	134	128	119	104	84	59	35	15	6	7
123	5	4	9	24	46	66	86	101	112	117	112	103	89	71	49	29	12	5	6
126	4	3	7	20	38	57	74	87	97	101	98	89	77	60	41	22	9	5	5
129	3	3	6	14	31	47	62	75	83	87	85	77	65	50	34	17	8	4	4
132	2	3	4	11	24	39	52	64	72	74	73	66	55	41	27	13	6	3	4
135	2	3	4	8	18	31	43	53	60	62	60	55	45	33	21	9	5	3	3
138	2	2	3	6	13	23	34	43	48	51	49	44	36	25	15	7	4	3	2
141	2	2	3	4	9	17	26	33	39	40	39	34	28	18	10	5	4	2	2
144	1	2	3	4	6	12	19	25	30	31	30	26	20	12	7	4	3	2	1
147	1	1	2	3	4	8	13	17	22	22	21	18	14	8	5	3	3	1	1
150	1	1	2	3	4	5	8	11	14	15	14	11	8	5	4	3	2	1	1
153	0	1	2	3	4	4	5	7	8	9	8	8	6	4	4	3	2	1	1
156	0	1	2	2	3	4	5	5	5	6	6	5	4	4	3	3	2	1	0
159	0	1	1	2	3	3	4	4	5	4	4	4	4	3	3	2	2	1	0
162	0	1	1	2	2	3	3	4	4	4	4	4	3	3	2	2	1	1	0
165	0	1	1	1	2	2	3	3	3	3	3	3	3	2	2	2	1	1	0
168	0	0	1	1	1	2	2	2	3	3	3	3	3	2	2	1	1	1	1
171	0	1	1	1	1	1	2	2	2	2	2	2	2	1	1	1	1	1	1
174	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
177	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
180	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

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
<b>0</b>	1259	1259	1259	1259	1259	1259	1259	1259	1259	1259	1259	1259	1259	1259	1259	1259	1259
<b>3</b>	1259	1259	1258	1257	1256	1255	1254	1253	1252	1252	1252	1252	1253	1254	1255	1255	1256
<b>6</b>	1255	1257	1258	1258	1258	1256	1253	1250	1247	1246	1245	1246	1246	1247	1248	1249	1249
<b>9</b>	1240	1244	1247	1253	1256	1256	1253	1248	1244	1241	1239	1237	1235	1232	1230	1231	1230
<b>12</b>	1222	1223	1228	1237	1245	1249	1247	1241	1236	1234	1231	1228	1222	1216	1208	1206	1207
<b>15</b>	1209	1204	1204	1211	1223	1229	1228	1223	1222	1224	1225	1217	1209	1198	1192	1191	1189
<b>18</b>	1191	1178	1176	1181	1196	1202	1201	1202	1207	1214	1214	1199	1186	1174	1173	1175	1173
<b>21</b>	1153	1144	1146	1158	1172	1178	1176	1183	1197	1197	1189	1171	1156	1146	1142	1145	1144
<b>24</b>	1106	1104	1113	1135	1151	1154	1151	1163	1180	1168	1155	1141	1129	1116	1102	1102	1102
<b>27</b>	1063	1063	1088	1116	1125	1130	1135	1140	1147	1137	1126	1116	1102	1087	1069	1060	1059
<b>30</b>	1018	1028	1060	1084	1089	1099	1123	1119	1113	1111	1103	1087	1071	1054	1034	1025	1017
<b>33</b>	967	996	1023	1040	1050	1060	1096	1095	1093	1090	1072	1057	1044	1024	998	982	973
<b>36</b>	913	963	975	987	1018	1027	1059	1064	1071	1062	1035	1025	1012	988	958	931	923
<b>39</b>	863	927	916	941	990	1004	1026	1033	1034	1027	1004	990	971	942	905	887	864
<b>42</b>	817	869	871	908	949	974	989	1002	993	993	975	954	927	898	856	842	807
<b>45</b>	775	807	838	861	891	931	947	965	959	963	940	913	880	850	804	789	758
<b>48</b>	729	741	806	808	840	891	911	923	928	930	899	871	834	803	756	740	710
<b>51</b>	683	676	758	770	800	852	878	885	892	889	857	833	790	759	712	690	660
<b>54</b>	631	631	695	737	756	804	839	848	851	844	822	792	748	709	657	639	606
<b>57</b>	576	583	643	699	711	756	793	812	808	804	785	747	705	665	610	572	548
<b>60</b>	519	510	593	645	675	709	743	773	765	764	739	696	662	615	562	515	491
<b>63</b>	459	466	542	591	634	665	693	730	726	720	690	650	614	558	511	473	433
<b>66</b>	399	413	488	545	587	620	649	682	685	671	648	610	566	511	460	417	369
<b>69</b>	340	363	427	491	541	573	612	634	639	624	608	571	517	463	406	359	312
<b>72</b>	282	315	381	443	498	529	572	589	589	581	565	526	474	419	361	307	267
<b>75</b>	228	271	336	396	455	486	525	542	540	537	516	479	437	372	313	257	218
<b>78</b>	178	227	290	351	409	441	478	496	493	492	467	438	394	332	268	209	161
<b>81</b>	129	183	244	299	354	389	431	442	443	441	422	394	345	298	234	178	121
<b>84</b>	94	140	214	258	310	358	395	404	403	400	387	356	304	258	196	135	88
<b>87</b>	66	109	177	228	275	322	354	368	383	369	355	313	271	230	158	111	56
<b>90</b>	47	94	152	212	255	295	319	331	351	349	321	290	251	197	144	86	35
<b>93</b>	30	74	125	174	226	265	290	303	305	297	291	261	218	170	120	70	25

<b>96</b>	25	62	111	157	202	240	267	277	282	276	265	238	197	152	105	58	21
<b>99</b>	21	52	96	139	182	215	241	256	262	255	240	214	179	137	92	49	17
<b>102</b>	17	44	85	129	170	198	226	237	244	237	224	200	169	128	83	44	15
<b>105</b>	14	36	74	115	153	182	206	218	224	218	205	183	151	114	74	36	12
<b>108</b>	12	30	64	102	138	164	186	199	204	200	184	164	135	101	64	30	10
<b>111</b>	10	24	55	90	123	147	166	180	184	181	167	148	121	88	54	25	8
<b>114</b>	8	20	46	78	107	130	147	162	165	163	149	131	106	76	46	21	7
<b>117</b>	7	15	39	67	93	114	130	145	148	145	132	116	93	66	39	17	6
<b>120</b>	6	13	33	56	80	100	115	129	132	129	117	102	81	57	33	13	5
<b>123</b>	5	10	26	47	68	86	101	113	116	111	102	88	69	49	27	10	4
<b>126</b>	4	8	21	39	59	74	88	98	101	97	89	76	58	40	22	8	3
<b>129</b>	3	6	15	32	49	63	76	84	87	84	77	65	49	33	16	6	3
<b>132</b>	3	5	10	25	40	54	65	71	74	73	65	55	41	27	11	4	3
<b>135</b>	3	4	8	19	32	44	54	60	62	61	55	45	33	20	9	3	3
<b>138</b>	2	4	5	13	24	36	44	49	51	50	44	36	25	14	6	3	2
<b>141</b>	2	3	4	9	17	28	35	39	41	40	35	28	18	8	4	3	1
<b>144</b>	1	2	3	4	12	19	26	30	32	31	27	20	11	6	3	2	1
<b>147</b>	1	2	2	4	8	13	18	22	23	22	19	13	7	4	2	2	1
<b>150</b>	1	1	2	3	5	7	12	14	15	14	11	7	5	3	2	1	1
<b>153</b>	1	1	2	2	3	4	7	7	9	7	6	4	3	2	2	1	1
<b>156</b>	1	1	2	2	2	3	4	4	5	4	3	3	3	2	1	1	1
<b>159</b>	1	1	1	2	2	2	3	3	3	3	3	3	2	2	1	1	1
<b>162</b>	1	1	1	1	2	2	2	2	2	2	2	2	2	1	1	1	1
<b>165</b>	1	1	1	1	1	1	2	2	2	2	2	2	1	1	1	1	1
<b>168</b>	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
<b>171</b>	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
<b>174</b>	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
<b>177</b>	1	1	1	0	0	0	0	1	1	1	1	1	1	0	0	0	0
<b>180</b>	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

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

Zone	Lumens	% Total	Zone	Lumens	% Total
0-5	30.2	0.60%	90-95	105.6	2.30%
05-10	88.8	1.90%	95-100	86.8	1.90%
10-15	145.5	3.10%	100-105	72.8	1.60%
15-20	197.5	4.20%	105-110	60	1.30%
20-25	240.1	5.10%	110-115	47.3	1%
25-30	278.5	5.90%	115-120	36.6	0.80%
30-35	308.4	6.60%	120-125	27.7	0.60%
35-40	325.5	6.90%	125-130	19.8	0.40%
40-45	337	7.20%	130-135	13.7	0.30%
45-50	338.9	7.20%	135-140	8.9	0.20%
50-55	329.7	7.00%	140-145	5.1	0.10%
55-60	315.5	6.70%	145-150	2.6	0.10%
60-65	293.8	6.30%	150-155	1.1	0%
65-70	261.7	5.60%	155-160	0.5	0%
70-75	229.6	4.90%	160-165	0.3	0%
75-80	195.1	4.20%	165-170	0.2	0%
80-85	158	3.40%	170-175	0.1	0%
85-90	129.2	2.80%	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	1.17	1.17	1.17	1.17	1.13	1.13	1.13	0.9	1.05	1.05	1.05	0.99	0.99	0.99	0.92	0.92	0.92	0.9
1	1.04	0.98	0.93	0.89	1	0.95	0.9	0.71	0.89	0.85	0.82	0.83	0.8	0.77	0.78	0.75	0.73	0.7
2	0.94	0.85	0.77	0.71	0.9	0.82	0.75	0.58	0.76	0.71	0.66	0.72	0.67	0.63	0.67	0.63	0.6	0.57
3	0.85	0.74	0.65	0.58	0.82	0.71	0.63	0.49	0.67	0.6	0.54	0.63	0.57	0.52	0.59	0.54	0.5	0.47
4	0.78	0.65	0.56	0.48	0.74	0.63	0.54	0.41	0.59	0.52	0.46	0.55	0.49	0.44	0.52	0.47	0.42	0.4
5	0.71	0.58	0.48	0.41	0.68	0.56	0.47	0.36	0.53	0.45	0.39	0.49	0.43	0.38	0.47	0.41	0.36	0.34
6	0.66	0.52	0.42	0.36	0.63	0.5	0.42	0.31	0.47	0.4	0.34	0.45	0.38	0.33	0.42	0.36	0.32	0.3
7	0.61	0.47	0.38	0.31	0.58	0.45	0.37	0.28	0.43	0.35	0.3	0.41	0.34	0.29	0.38	0.33	0.28	0.26
8	0.56	0.43	0.34	0.28	0.54	0.41	0.33	0.25	0.39	0.32	0.27	0.37	0.31	0.26	0.35	0.29	0.25	0.23
9	0.53	0.39	0.31	0.25	0.51	0.38	0.3	0.22	0.36	0.29	0.24	0.34	0.28	0.23	0.33	0.27	0.23	0.21
10	0.49	0.36	0.28	0.23	0.48	0.35	0.27	0.2	0.33	0.26	0.22	0.32	0.25	0.21	0.3	0.25	0.21	0.19

Table 4. Utilisation Factor Table

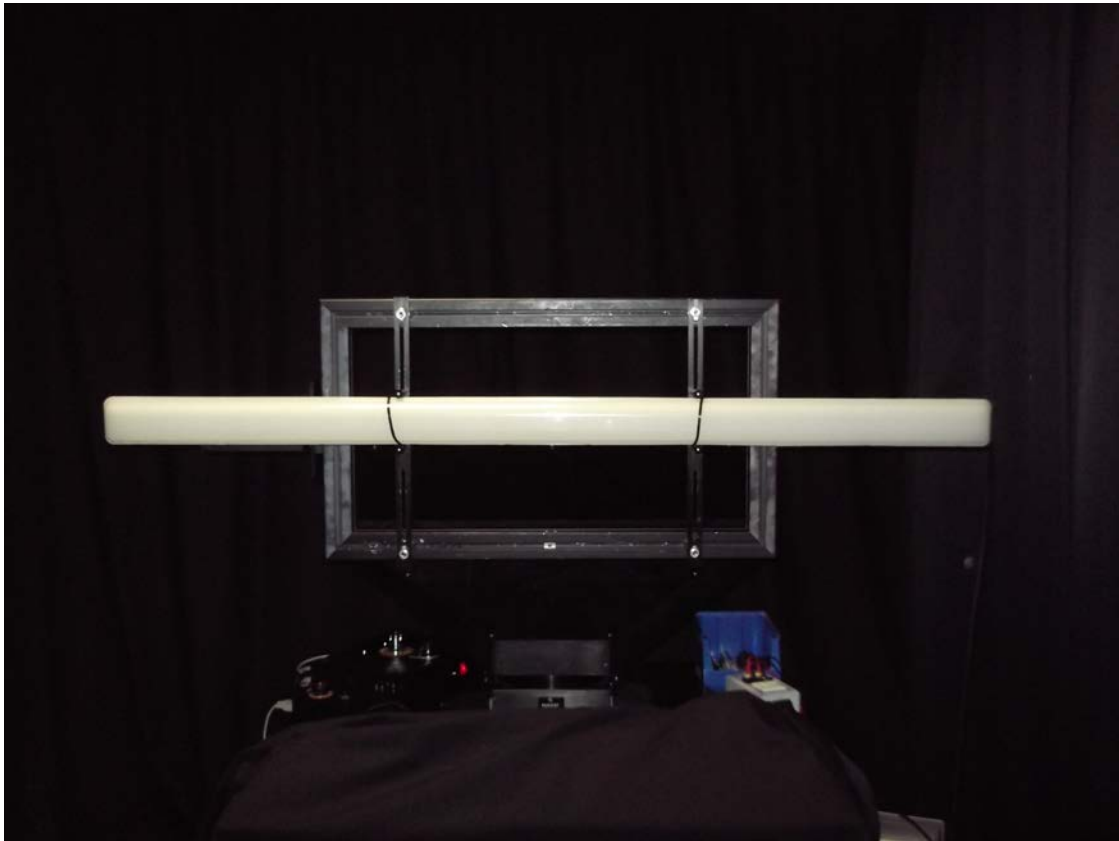


Photo 1: Luminaire on goniometer mount

Signature:

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Print Name:

D CHAMBERS

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Date:

29/09/2016

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Technical Manager

*Duly authorised to sign on behalf of:*

Photometric and Optical Testing Services LLP