

IESNA LM-79: 2008

Measurement and Test Report

for

Lighting Science Group Corporation

1227 S. Patrick Drive, BLDG 2A

May 16, 2013

Product Name:	LED
Model No:	xxx 16 35WE WW FL E26 120 TP (Where "xxx" designates OEM Family: ECS, DFN, LS, etc.)
Test Engineer:	David Zhang 
Report No.:	BTR66.181.13.1458.01
Sample Received Date:	Apr 27, 2013
Test Performed Date:	Apr 27, 2013 to Apr 30, 2013
Reviewed By:	Steven Hsu 
Prepared By:	BEST Test Service Shenzhen Co., Ltd. 1st Floor, 1st Building, Weitai Industrial Park, Yingrenshi, Shiyan, Baoan, Shenzhen, China TEL: +86-755-28236006 FAX: +86-755-23467087-811 Email: certification@bestcert.cn



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1 - GENERAL INFORMATION

1.1 Product Description for Equipment under Test (EUT)

Applicant : Lighting Science Group Corporation
 Product Name : LED
 Model No : xxx 16 35WE WW FL E26 120 TP (Where "xxx" designates OEM Family: ECS, DFN, LS, etc.)
 Nominal Operation Voltage : 120V
 Nominal Power : 6W
 Nominal CCT : 3000K
 Nominal CRI : 82
 Nominal Lumen Output : 380Lumens
 Nominal Life Time : 25000Hours
 Stabilization Time : 1.0 hours
 Total operating time for measurement include stabilization time : 2.5 hours

Standard Non Standard

Nominal Shape of Bulb(Designation) : Omnidirectional A, BT, P, PS, S, T
 Decorative B, BA, C, CA, DC, F, G
 Directional PAR, MR, R, BR

Date of Receiving Sample : Apr 27, 2013
 Measurement quantities measured : 1 pcs
 Orientation During Testing : Base Up
 Test Requested : 1. Electrical and Photometric Test;
 2. Luminous Intensity Distribution Test.

1.2 Objective

The following test report is prepared on behalf of Lighting Science Group Corporation in accordance with IESNA LM-79-08, used the following American National Standards or illumination Engineering Society of North America test guides:

ANSI C78.377-2008: Specifications for the Chromaticity of Solid State Lighting Products;
 ANSI C79.1- 2002: American National Standard for Electric Lamps – Nomenclature for Glass Bulbs Intended for Use with Electric Lamps;
 ANSI C78.20 – 2003: American National Standard for Electric Lamps – A, G, PS, and Similar Shapes with E26 Medium Screw Bases;
 ANSI C78.21 – 2003: American National Standard for Electric Lamps – PAR and R Shapes;
 ANSI C78.24 – 2001: American National Standard for Electric Lamps – Two-inch (51 mm); Integral-reflector Lamps with Front Covers and GU5.3 or GX 5.3 Bases;
 ANSI/IEC C81.61-2003: American National Standard for Electric Lamp Bases;
 ANSI/IEEE C62.41 – 1991 (01-May-1991): Surge Voltages in Low-Voltage AC Power Circuits, Recommended Practice for;
 CIE Publication No. 13.3 – 1995: Method of Measuring and Specifying Color Rendering of Light Sources;
 CIE Publication No. 18.2 – 1983: The Basis of Physical Photometry;
 IESNA LM-16-1993: Practical Guide to Colorimetry of Light Sources;
 IESNA LM-28-89 – 1989: Guide for the Selection, Care, and Use of Electrical Instruments in the Photometric Laboratory;
 IESNA LM-79-08 Electrical and Photometric Measurement of Solid State Lighting Products
 UL 1993 – 1999: Standard for Self-Ballasted Lamps and Lamp Adapters;
 UL 8750 – 2009: Light Emitting Diode (LED) Equipment for Use in Lighting Products.

1.3 Test Facility Description

The Energy Efficiency Lab used by BEST to collect energy efficiency measurement data is located in 1st Floor, 1st Building, Weitai Industrial Park, Yingrenshi, Shiyao, Baoan, Shenzhen, China. BEST Test Service Shenzhen Co., Ltd is a National Institute of Standards and Technology (NIST) accredited laboratory, under the National Voluntary Laboratory Accredited Program (Lab Code 200770-0). BEST Test Service Shenzhen Co., Ltd is also an ELI accredited lab for lighting products (ELI Certificate No. ELI-L04-2010) and UL accredited lab for lighting products

1.4 Test Equipment List

Apparatus List	Device	Cal. Date	Cal Due Date
1	Integral Sphere	Oct 20, 2012	Oct 20, 2013
2	Integral Sphere	Oct 20, 2012	Oct 20, 2013
3	Integral Sphere	Mar 10, 2013	Mar 09, 2014
4	Spectro Meter Assy	Mar 10, 2013	Mar 09, 2014
5	Plus UV-VIS-Near IR Spectrophotometer Colorimeter	Oct 20, 2012	Oct 20, 2013
6	Plus UV-VIS-Near IR Spectrophotometer Colorimeter	Oct 20, 2012	Oct 20, 2013
7	Goniophotometer	Nov 20, 2012	Nov 19, 2013
8	6 ^{1/2} Digital Multimeter	Oct 18, 2012	Oct 17, 2013
9	AC Power Source	N/A	N/A
10	AC Power Source	N/A	N/A
11	Standard Light Source	Sep 17, 2012	Sep 16, 2013
12	Standard Light Source	Sep 17, 2012	Sep 16, 2013
13	Multi-Function AC standard Meter	Oct 18, 2012	Oct 17, 2013
14	Digital Power Meter	Oct 18, 2012	Oct 17, 2013
15	Digital Power Meter	Oct 18, 2012	Oct 17, 2013
16	Digital Power Meter	Oct 18, 2012	Oct 17, 2013
17	Digital Power Meter	Oct 18, 2012	Oct 17, 2013
18	Ballast Parameter Analyzer	Oct 18, 2012	Oct 17, 2013
19	Second Meter	Oct 18, 2012	Oct 17, 2013
20	Digital Storage Oscilloscope	Oct 18, 2012	Oct 17, 2013

Statement of Traceability: BEST Test Service Shenzhen Co., Ltd. certifies that all calibration has been performed using suitable standards traceable to the NIM China.

2 - Test Method

2.1 Photometric and Electrical Measurement (Integrated Sphere Method)

Total light output (luminous flux) for the $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$ ambient temperature conditions is measured using an Everfine integrating sphere. Temperature is measured at a position inside the sphere. Spectral radiant flux measurements are made using PMS-700 to the detector port of the integrating sphere. Each lamp is operated at rated voltage in its designated orientation. Each lamp should be stable before measurements are made. The determining method of stable is as follows:

Step 1 Take 3 measurements of the lamp light output at 15 minute interval (total time=30mintues.)This time period is in addition to the recommended pre-burning time.

Step 2 Calculate the percent difference between the maximum measured value and the minimum measured value for the three consecutive measurements.

Step 3 if the value calculated in Step 2 does not exceed 0.5 percent, the lamp is considered stable. Luminous flux, chromaticity coordinates, correlated color temperature and color rendering index for each lamp are calculated from the spectral radiant flux measurements taken at 2 nm intervals over the range 350 to 1050 nm. The calibration of the sphere photometer-spectrometer system is traceable to the NIST USA. Lamp efficacy (lumens per watts) for each lamp model is computed based on the revised luminous flux result. Electrical measurements including voltage, current, power and power factor are measured using the YOKOGAWA WT210 digital power Meter.

The total uncertainty of the light output measurements is estimated, at the 95% confidence level, not to exceed $\pm 1.12\%$ over the wavelength range 350-1050 nm.

2.2 Photometric and Electrical Measurement (GonioPhotometer Method)

Before each measurement, the method below should be used to determine the lamp is stable or not.

Step 1 Take 3 measurements of the lamp intensity at 15 minute interval (total time=30mintues.)This time period is in addition to the recommended pre-burning time.

Step 2 Calculate the percent difference between the maximum measured value and the minimum measured value for the three consecutive measurements.

Step 3 if the value calculated in Step 2 does not exceed 0.5 percent, the lamp is considered stable.

A Everfine GOR-5000 Goniometer was used to measure the intensity (candelas) at each angle of distribution for each sample; the photometric distance is 2.436m. Ambient temperature was measured equal to the height of the sample mounted on the Goniometer equipment. Each sample was operated at input rated voltage in its designated orientation. Each sample was allowed to be stable before measurement was made. Electrical measurements including voltage, current, power and power factor were measured using the YOKOGAWA WT210 Power Analyzer.

Some graphics were created with Photometric Plus software.

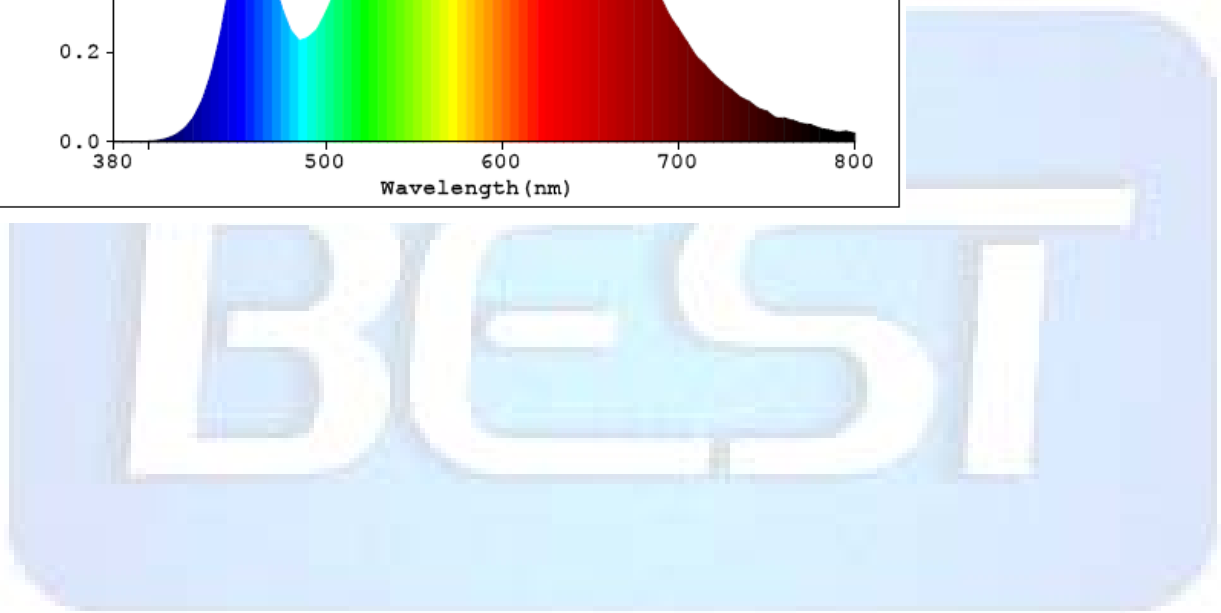
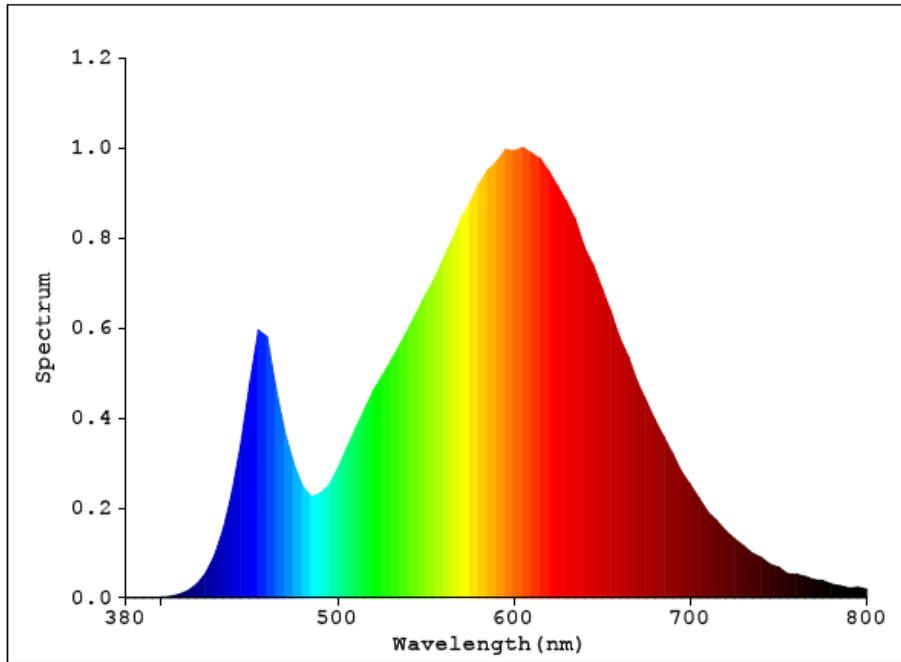
2.3 Deviation from standard operating procedure

None

3 – Summary of Test Result

	Item	Test Result		Accreditation
Required Fields	Lumen Output (Lumens)	407.39		NVLAP/EPA
	Luminous Efficacy (lm/w)	63.10		NVLAP/EPA
	Correlated Color Temperature (CCT)	3070		NVLAP/EPA
	Color Rendering Index- CRI	83.1		NVLAP/EPA
	Input Power (W)	6.46		NVLAP/EPA
Optional Fields	Power Type	<input checked="" type="checkbox"/> AC	<input type="checkbox"/> DC	/
	Input Voltage (V)	120.0		NVLAP/EPA
	Input Current (A)	0.0754		NVLAP/EPA
	Power Factor	0.7131		NVLAP/EPA
	x(CIE 1931)	0.4285		NVLAP/EPA
	y(CIE 1931)	0.3948		NVLAP/EPA
	u' (CIE 1976)	0.2491		NVLAP/EPA
	v' (CIE 1976)	0.5164		NVLAP/EPA
	Duv(CIE 1976)	0.0026		NVLAP/EPA
	R9	20		NVLAP/EPA
	Beam Angle: (Degree)	33.8		NVLAP/EPA
	Center beam candlepower: (cd)	874		NVLAP/EPA
	Zonal lumen density (0-60°):	96.5%		NVLAP/EPA
	Zonal lumen density (60-90°):	3.5%		NVLAP/EPA
	Zonal lumen density (90-120°):	0%		NVLAP/EPA
Zonal lumen density (120-180°):	0%		NVLAP/EPA	

4 – Spectral Flux Plots



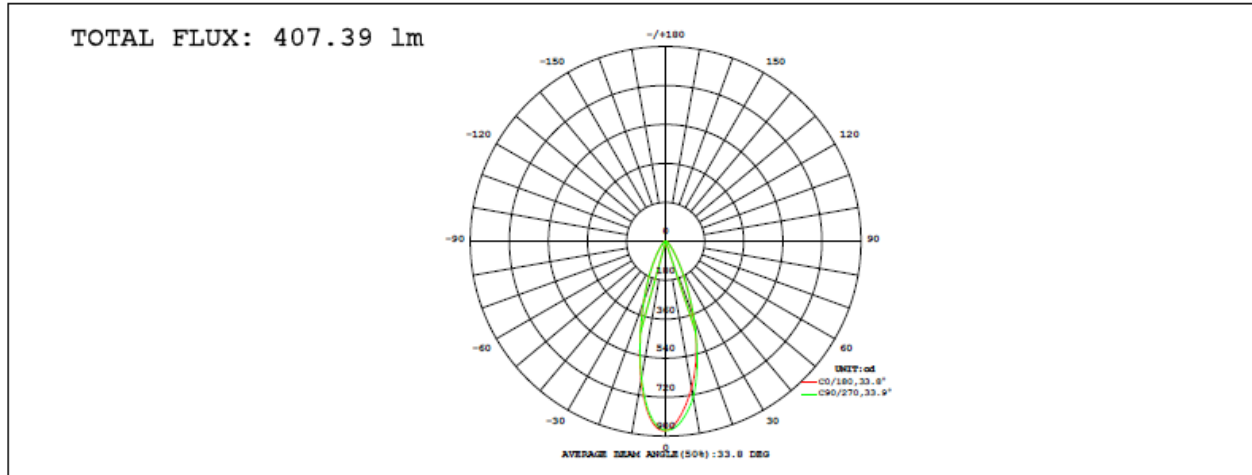
5 – EUT Photos



6 – Luminous Intensity Distribution Test Plots (CIE Chromaticity)

LAMP PHOTOMETRIC REPORT

Electrical: Voltage:120.1V Current:0.0754A Power:6.456W Factor:0.7131		
MODEL: xxx 16 35WE WW FL E26 120 TP		
POWER: 6W	VOLTAGE: 120V	WORKING VOLTAGE: 120.0V
MANUFACTURER: Lighting Science		Eff.: 63.10 lm/W



γ	C0	C45	C90	C135	C180	C225	C270	C315	γ	Φ zone	Φ total	%
10	652.8	625.4	641.3	676.3	687.6	689.8	730.5	708.3	0- 10	73.44	73.44	18
20	298.0	285.0	296.2	329.6	377.6	394.9	382.8	335.0	10- 20	137.6	211.0	51.8
30	110.4	110.0	112.7	121.1	137.4	144.5	138.8	122.3	20- 30	97.06	308.1	75.6
40	42.68	44.18	42.38	42.39	48.77	51.17	47.58	43.05	30- 40	47.60	355.7	87.3
50	21.01	21.69	20.46	19.48	20.58	21.32	20.47	20.35	40- 50	23.45	379.1	93.1
60	11.07	11.05	10.92	11.26	11.69	12.19	11.85	11.63	50- 60	13.81	392.9	96.5
70	5.135	4.915	5.149	6.258	7.081	7.661	7.029	6.400	60- 70	8.533	401.5	98.5
80	1.374	1.117	1.488	2.640	3.572	4.185	3.422	2.591	70- 80	4.488	406.0	99.6
90	0	0	0	0.0126	0.7785	1.230	0.6579	0	80- 90	1.360	407.3	100
100	0	0	0	0	0	0	0	0	90-100	0.0682	407.4	100
110	0	0	0	0	0	0	0	0	100-110	0	407.4	100
120	0	0	0	0	0	0	0	0	110-120	0.0000	407.4	100
130	0	0	0	0	0	0	0	0	120-130	0	407.4	100
140	0	0	0	0	0	0	0	0	130-140	0	407.4	100
150	0	0	0	0	0	0	0	0	140-150	0	407.4	100
160	0	0	0	0	0	0	0	0	150-160	0	407.4	100
170	0.0009	0	0.0009	0.0002	0.0011	0	0	0.0002	160-170	0.0000	407.4	100
180	0	0	0	0	0	0	0	0	170-180	0.0000	407.4	100
DEG	LUMINOUS INTENSITY:cd									UNIT:lm		

C Range: 0 - 360DEG
 C Interval: 22.5DEG
 Test Speed: HIGH
 Temperature:25.2DEG
 Operators:David

γ Range: 0 - 180DEG
 γ Interval: 1.0DEG
 Test System:EVERFINE GO-R5000_V2 SYSTEM V2.0.265
 Humidity:62.7%
 Test Distance:2.429m [K=1.0000]

LUMINOUS DISTRIBUTION INTENSITY DATA

Electrical: Voltage:120.1V Current:0.0754A Power:6.456W Factor:0.7131		
MODEL: xxx 16 35WE WW FL E26 120 TP		
POWER: 6W	VOLTAGE: 120V	WORKING VOLTAGE: 120.0V
MANUFACTURER: Lighting Science		Eff.: 63.10 lm/W

Table--1

UNIT: cd

C (DEG) γ (DEG)	0	23	45	68	90	113	135	158	180	203	225	248	270	293	315	338			
0	874	873	874	874	873	873	873	873	874	873	874	874	873	873	873	873			
5	820	815	804	811	808	815	812	810	806	801	812	818	834	837	839	830			
10	653	642	625	638	641	665	676	690	688	677	690	707	731	724	708	676			
15	457	446	433	445	453	477	499	529	545	541	555	558	561	536	517	481			
20	298	293	285	295	296	314	330	355	378	381	395	386	383	357	335	315			
25	184	184	180	186	187	197	204	218	231	234	244	237	233	217	208	193			
30	110	112	110	115	113	119	121	131	137	137	144	138	139	128	122	114			
35	66.7	68.6	67.6	69.8	67.9	69.6	70.6	75.4	80.6	82.0	85.1	81.7	79.9	73.7	71.1	67.4			
40	42.7	44.4	44.2	44.8	42.4	42.1	42.4	45.2	48.8	49.9	51.2	48.9	47.6	44.0	43.1	42.0			
45	29.2	30.6	30.5	30.5	28.7	27.7	27.4	28.6	30.5	30.9	32.0	30.3	29.6	28.1	28.3	28.4			
50	21.0	21.8	21.7	21.6	20.5	19.8	19.5	19.8	20.6	20.7	21.3	20.6	20.5	19.9	20.3	20.5			
55	15.3	15.7	15.5	15.6	15.0	14.8	14.7	14.8	15.1	15.2	15.6	15.2	15.3	15.0	15.3	15.2			
60	11.1	11.2	11.0	11.0	10.9	11.0	11.3	11.4	11.7	11.9	12.2	11.9	11.9	11.6	11.6	11.3			
65	7.78	7.79	7.62	7.65	7.72	8.14	8.52	8.76	9.15	9.41	9.70	9.32	9.22	8.93	8.79	8.15			
70	5.14	5.09	4.92	5.01	5.15	5.75	6.26	6.58	7.08	7.39	7.66	7.18	7.03	6.67	6.40	5.61			
75	3.04	2.94	2.81	2.90	3.12	3.76	4.32	4.72	5.23	5.58	5.84	5.34	5.11	4.69	4.35	3.55			
80	1.37	1.24	1.12	1.24	1.49	2.08	2.64	3.08	3.57	3.94	4.19	3.70	3.42	2.99	2.59	1.85			
85	0.11	0.01	0.00	0.03	0.21	0.68	1.16	1.63	2.09	2.44	2.66	2.21	1.94	1.49	1.07	0.48			
90	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.41	0.78	1.05	1.23	0.88	0.66	0.23	0.00	0.00			
95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00			
100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
105	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
110	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
115	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
120	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
125	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
130	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
135	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
140	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
145	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
150	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
155	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
160	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
165	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
170	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
175	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
180	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			

C Range: 0 - 360DEG
 C Interval: 22.5DEG
 Test Speed: HIGH
 Temperature:25.2DEG
 Operators:David

γ Range: 0 - 180DEG
 γ Interval: 1.0DEG
 Test System:EVERFINE GO-R5000_V2 SYSTEM V2.0.265
 Humidity:62.7%
 Test Distance:2.429m [K=1.0000]