

LM-79-08 TEST REPORT

for

GREEN CREATIVE LTD

756 North Zhongshan Rd., Unit B301 Zhabei District, Shanghai

LED Lamp

Model: 9PLO/840/HYBM

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

3rd Floor, Bld. 2, NO. 96 Longchuanwu Rd Qianjiang Economy Dev. Zone, YuhangDist,
Hangzhou, Zhejiang Province, China 311100

Tel: +86571 86376106

www.ledtestlab.com

Report No.: HZ19120026r

The laboratory that conducted the testing detailed in this report has been accredited for SSL by NVLAP.

Review by:



Engineer: April Zou
Dec. 30, 2019

Approved by:



Manager: Jim Zhang
Dec. 30, 2019

Note: This report does not imply product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

TEST SUMMARY

Sample Tested: **9PLO/840/HYBM**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
148.7	1323.8	8.90	0.9775
CCT (K)	CRI	Stabilization Time (Light & Power)	
3966	81.9	60	

Table 1: Executive Data Summary

Note: The above results are recorded/ derived from measurements made using an Integrating Sphere.

Test specifications:

Date of Receipt	: Dec. 19, 2019
Date of Test	: Dec. 27, 2019
Test item	: Total Luminous Flux, Luminous Distribution Intensity, Luminous Efficacy, Correlated Color Temperature, Color Rendering Index, Chromaticity Coordinate, Electrical parameters
Reference Standard	: IESNA LM-79-2008 Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products ANSI/IES TM-30-18 IES Method for Evaluating Light Source Color Rendition

TABLE OF CONTENT

LM-79-08 TEST REPORT	1
TEST SUMMARY	2
SAMPLE PHOTO	4
TEST RESULTS	5
Sphere-Spectroradiometer Method.....	5
Goniophotometer Method	6
Spectral Power Distribution - Sphere Spectroradiometer Method	7
Chromaticity Diagram - Sphere Spectroradiometer Method.....	8
Nominal CCT Quadrangles – Sphere Spectroradiometer Method	9
Color Rendition Report – Sphere Spectroradiometer Method	10
Zonal Lumen Tabulation- Goniophotometer Method	11
Illuminance Plots- Goniophotometer Method	12
Luminous Intensity Distribution Plots- Goniophotometer Method.....	13
Luminous Intensity Data- Goniophotometer Method	14
EQUIPMENT LIST	16
TEST METHODS	16
Seasoning of SSL Product.....	16
Sphere-Spectroradiometer Method- Photometric and Electrical Measurements.....	16
Goniophotometer Method	17
Photometric and Electrical Measurements	17
Color Characteristics Measurements.....	17
Color Spatial Uniformity	17

SAMPLE PHOTO



Figure 1- Overview of the sample

Equipment Under Test(EUT)

Name	: LED Lamp
Model	: 9PLO/840/HYBM
Electrical Ratings	: 120-277V, 50/60Hz, 9W
Product Description	: 4000K
Manufacturer	: GREEN CREATIVE LTD
Address	: 756 North Zhongshan Rd., Unit B301 Zhabei District, Shanghai

TEST RESULTS

Test ambient temperature was 26.0 °C.

Base orientation was light down. Test was conducted without a dimmer in the circuit.

The stabilization time of the sample was 60 minutes, and the total operating time including stabilization was 65 minutes.

Sphere-Spectroradiometer Method

Parameter	Result	
Test Voltage (V)	120.0	277.0
Voltage frequency (Hz)	60	60
Test Current (A)	0.076	0.037
Power Factor	0.9775	0.8961
Test Power (W)	8.90	9.14
THD A%	18.23	18.62
Luminous Efficacy (lm/W)	148.7	145.3
Total Luminous Flux (lm)	1323.8	1327.9
Color Rendering Index (CRI)	81.9	
R9	7.1	
Correlated Color Temperature (CCT)(K)	3966	
Chromaticity Chroma x	0.3828	
Chromaticity Chroma y	0.3811	
Chromaticity Chroma u	0.2249	
Chromaticity Chroma v	0.3359	
Duv	0.0014	
Chromaticity Chroma u'	0.2249	
Chromaticity Chroma v'	0.5039	

Special Color Rendering Indices	
R1	80.1
R2	86.9
R3	92.5
R4	82
R5	80.2
R6	82.1
R7	86.4
R8	64.9
R9	7.1
R10	69.2
R11	81
R12	60.2
R13	81.5
R14	95.8

Table 2: Test data per Sphere-Spectroradiometer Method

Note: According to CIE 1976 (u',v') diagram, $u' = u = 4x/(-2x+12y+3)$, $v' = 3v/2 = 9y/(-2x+12y+3)$.

Goniophotometer Method

Test ambient temperature was 24.8 °C.

The photometric distance is 2.47 m.

Luminous data was taken at 0.5 vertical intervals and 10 horizontal intervals.

Parameter	Result
Test Voltage (V)	120.0
Voltage frequency (Hz)	60
Test Current (A)	0.076
Power Factor	0.9782
Power (W)	8.94
Luminous Efficacy (lm/W)	149.6
Total Luminous Flux (lm)	1337.5
Beam Angle (°)	335.6 (0°-180°) / 334.7 (90°-270°)
Center Beam Candle Power (cd)	9.71
Maximum Beam Candle Power (cd)	148.1 (At: C=250.0, Gamma=86.5)
Spacing Criteria	5.28 (0°-180°) / 5.31 (90°-270°)
Zonal Lumens in the 0 °-60 °Zone	19.11%
Zonal Lumens in the 60 °-90 °Zone	32.52%
Zonal Lumens in the 90 °-120 °Zone	31.72%
Zonal Lumens in the 120 °-180 °Zone	16.65%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

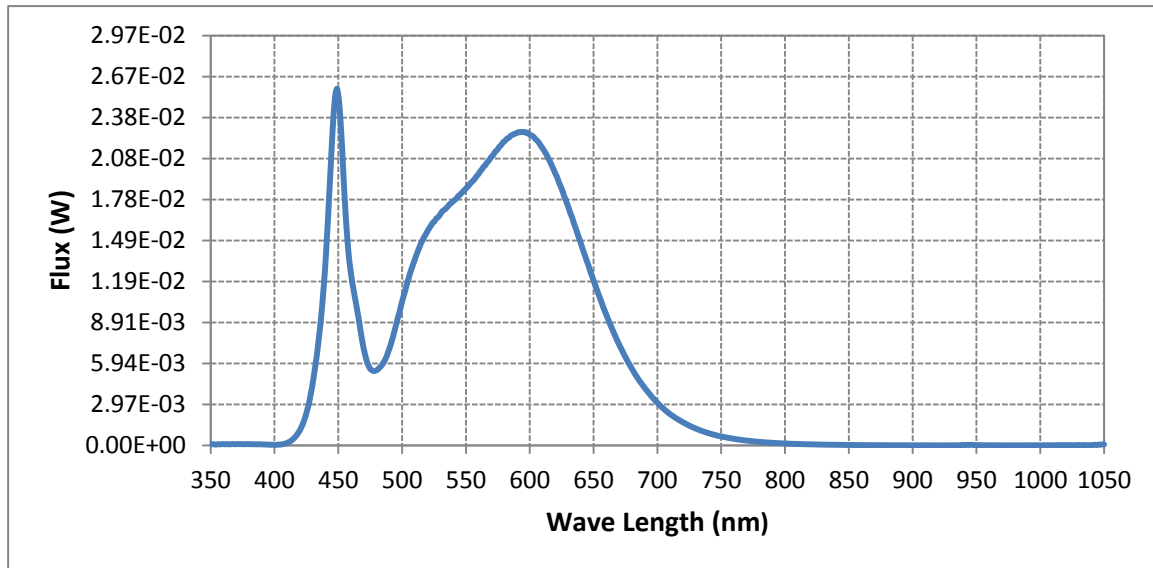
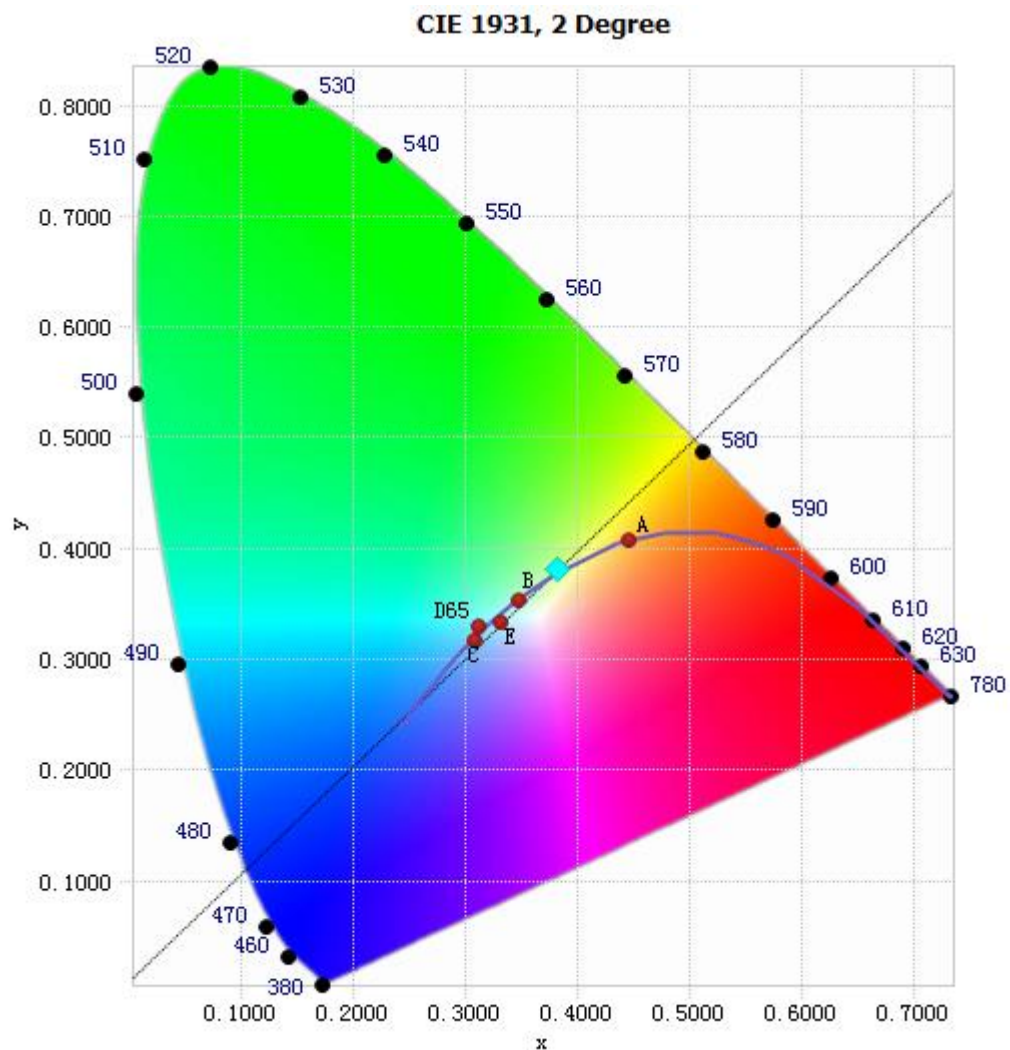


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	9.64E-05	485	5.95E-03	590	2.27E-02	695	3.60E-03
385	8.43E-05	490	7.02E-03	595	2.27E-02	700	3.10E-03
390	7.92E-05	495	8.64E-03	600	2.25E-02	705	2.65E-03
395	5.27E-05	500	1.04E-02	605	2.22E-02	710	2.27E-03
400	4.75E-05	505	1.21E-02	610	2.15E-02	715	1.96E-03
405	7.29E-05	510	1.35E-02	615	2.07E-02	720	1.68E-03
410	2.02E-04	515	1.47E-02	620	1.97E-02	725	1.44E-03
415	5.01E-04	520	1.56E-02	625	1.86E-02	730	1.23E-03
420	1.12E-03	525	1.62E-02	630	1.73E-02	735	1.05E-03
425	2.35E-03	530	1.68E-02	635	1.60E-02	740	8.95E-04
430	4.55E-03	535	1.72E-02	640	1.47E-02	745	7.64E-04
435	7.97E-03	540	1.77E-02	645	1.33E-02	750	6.55E-04
440	1.34E-02	545	1.81E-02	650	1.20E-02	755	5.59E-04
445	2.19E-02	550	1.86E-02	655	1.07E-02	760	4.82E-04
450	2.54E-02	555	1.91E-02	660	9.47E-03	765	4.14E-04
455	1.79E-02	560	1.97E-02	665	8.35E-03	770	3.53E-04
460	1.24E-02	565	2.03E-02	670	7.32E-03	775	3.03E-04
465	9.68E-03	570	2.09E-02	675	6.40E-03	780	2.63E-04
470	6.96E-03	575	2.15E-02	680	5.57E-03		
475	5.55E-03	580	2.20E-02	685	4.82E-03		
480	5.45E-03	585	2.24E-02	690	4.17E-03		

Table 4: Spectral Power Distribution Numerical Data per Sphere - Spectroradiometer Method

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3828, 0.3811)

Chart 2: Chromaticity Diagram per Sphere - Spectroradiometer Method

Note: The location on the diagram of the tristimulus coordinates are indicated by the blue diamond.

Nominal CCT Quadrangles – Sphere Spectroradiometer Method

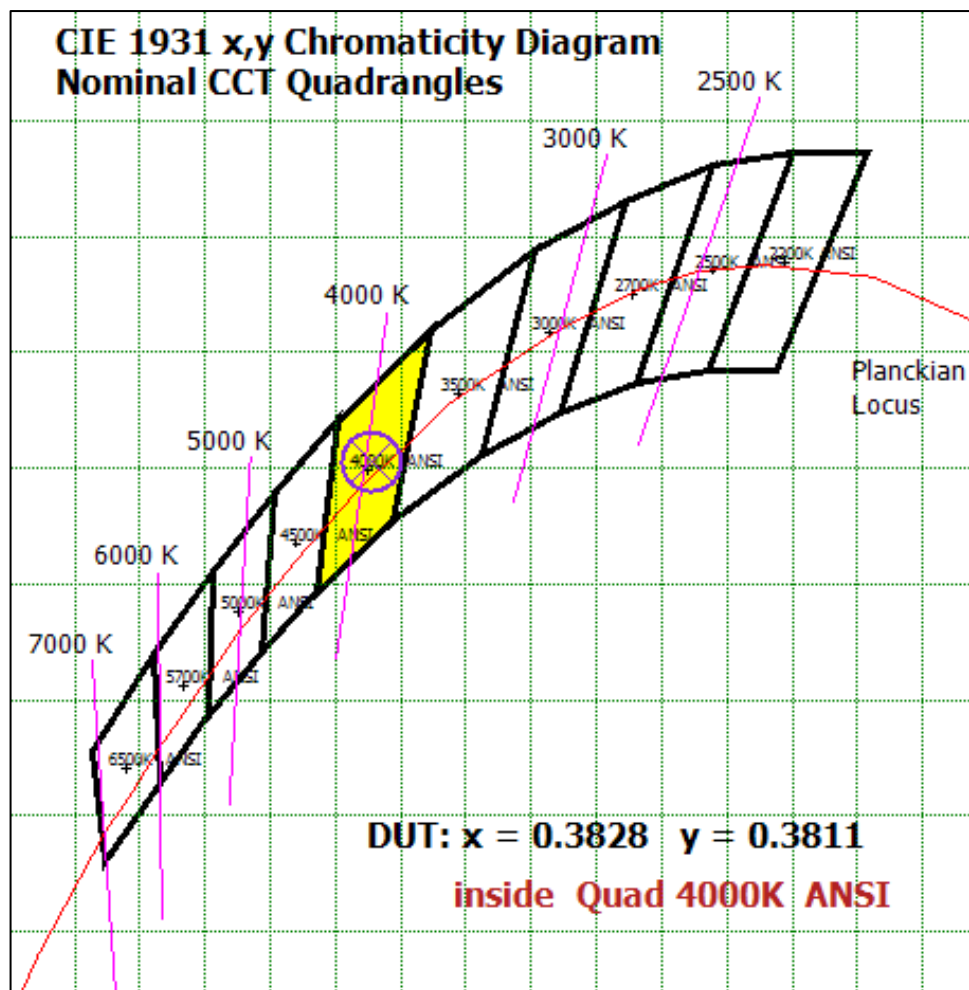
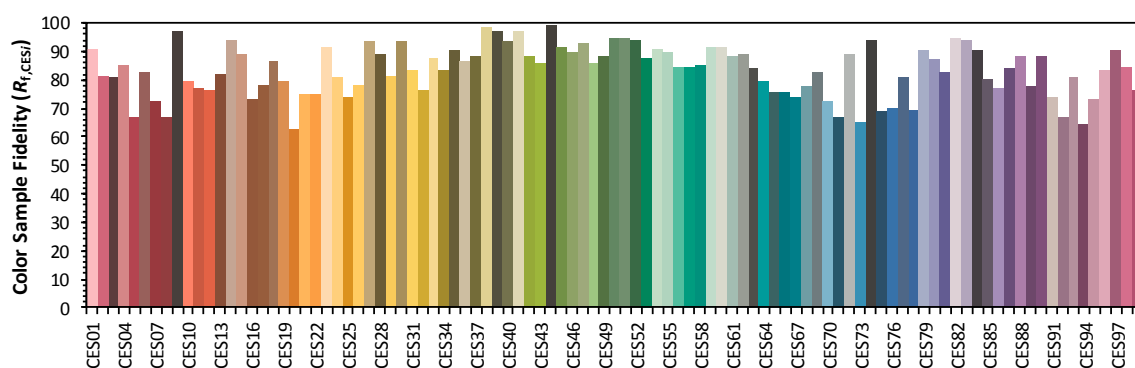
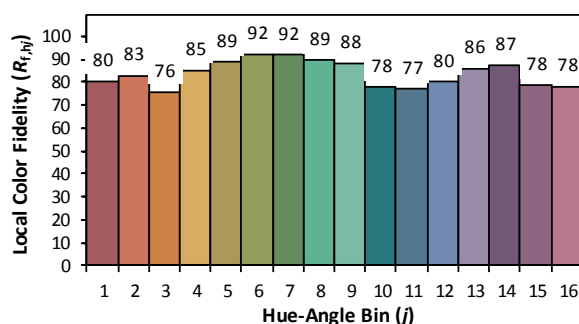
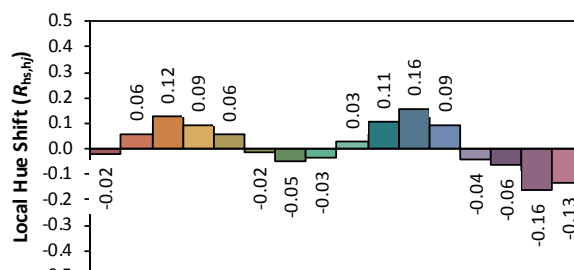
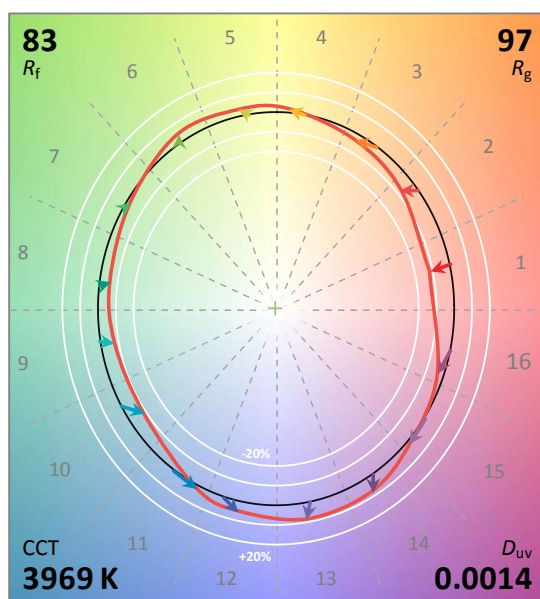
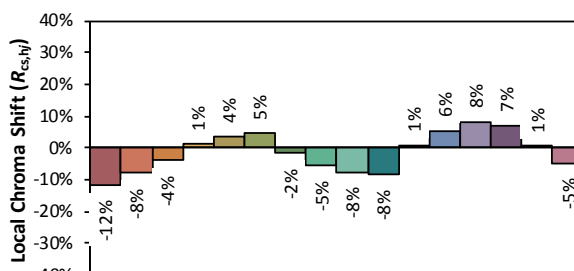


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram



Notes: This is a recommended method for displaying ANSI/IES TM-30-18 information.

 $x = 0.3828$ $y \quad 0.3811$
$$U' \quad 0.2249$$

V' 0.5039

Chart 4: Full Report Created with the IES TM-30 Calculator

Note: The values in this diagram might be a little different from the values in Table 2 due to rounding.

Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	1.454	0.11%
10- 20	8.759	0.65%
20- 30	23.983	1.79%
30- 40	46.196	3.45%
40- 50	73.223	5.47%
50- 60	101.926	7.62%
60- 70	128.319	9.59%
70- 80	148.252	11.08%
80- 90	158.389	11.84%
90-100	157.188	11.75%
100-110	144.508	10.80%
110-120	122.618	9.17%
120-130	95.097	7.11%
130-140	66.13	4.94%
140-150	39.688	2.97%
150-160	18.167	1.36%
160-170	3.566	0.27%
170-180	0.044	0.00%
Total	1337.5	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	255.541	19.11%
60- 90	434.96	32.52%
0-90	690.501	51.63%
90- 180	647.006	48.37%
0- 180	1337.5	100%

Table 5: Zonal Lumen

Illuminance Plots- Goniophotometer Method

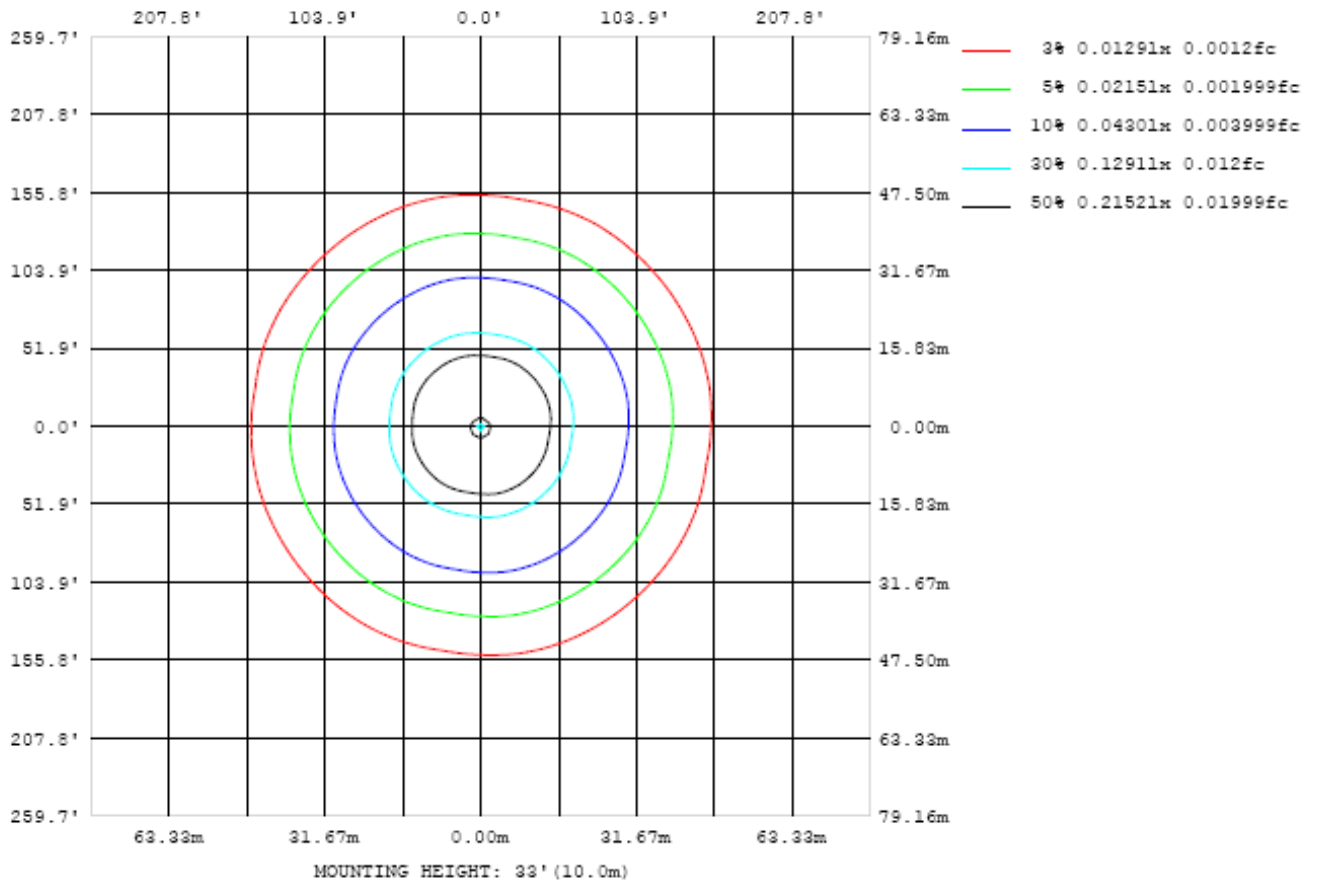


Chart 5: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

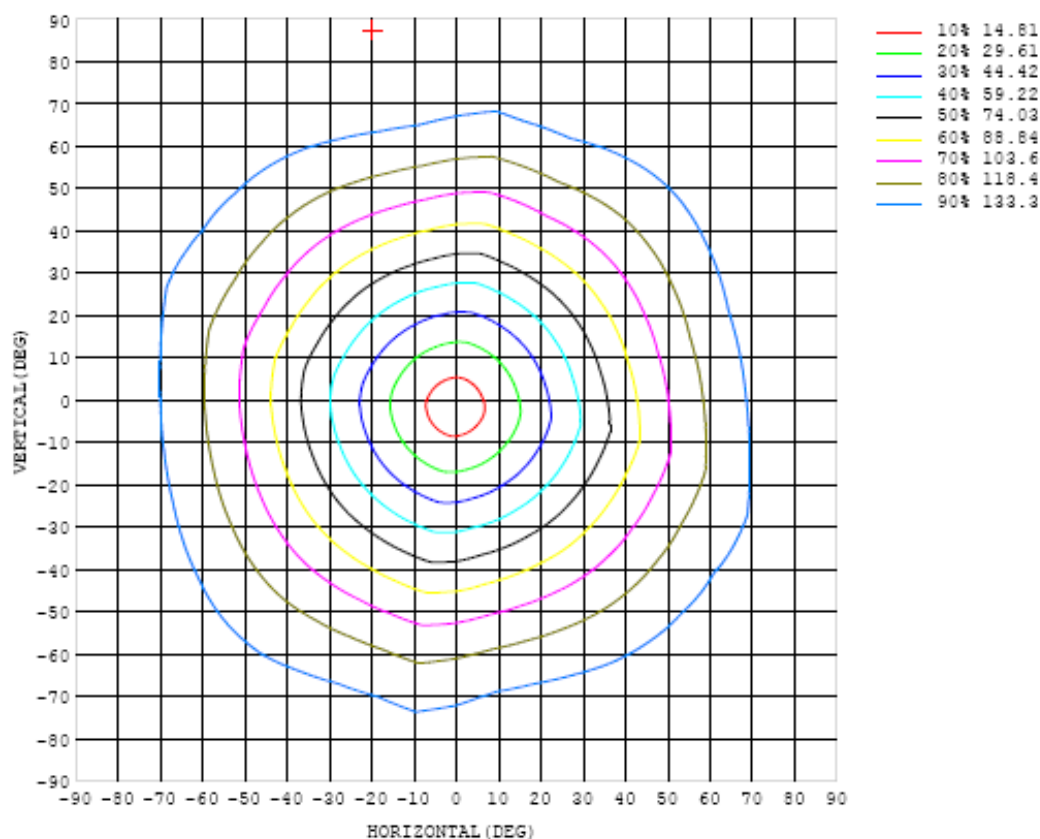


Chart 6: Isocandela Plot

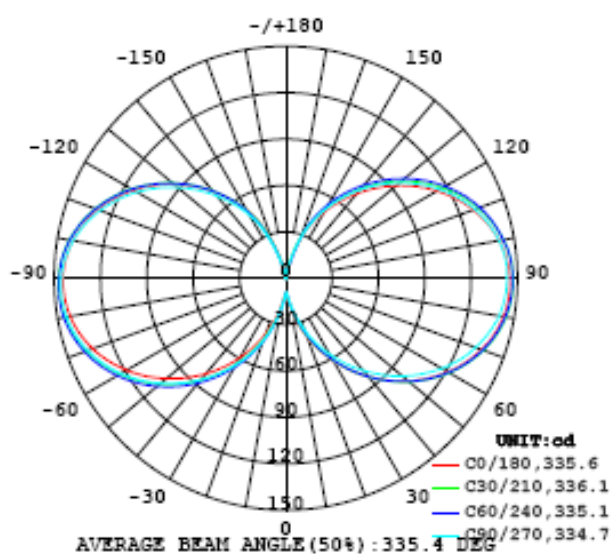


Chart 7: Polar Candela Distribution

Luminous Intensity Data- Goniophotometer Method

Table--1

UNIT: cd

C (DEG) Y (DEG)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	9.71	9.71	9.71	9.71	9.71	9.71	9.71	9.71	9.71	9.71	9.71	9.71	9.71	9.71	9.71	9.71	9.71	9.71	9.71
5	13.1	12.7	12.3	12.0	11.7	11.5	11.3	11.1	10.9	10.8	10.8	10.8	11.0	11.2	11.4	11.5	11.8	12.0	12.4
10	20.5	19.7	19.2	19.0	18.8	18.5	18.1	17.7	17.4	17.0	16.8	17.1	17.4	17.8	18.1	18.3	18.6	18.8	19.3
15	30.0	28.7	28.5	28.4	28.3	27.9	27.6	27.0	26.5	25.7	25.4	26.0	26.5	27.0	27.4	27.7	27.9	28.0	28.3
20	40.3	38.7	38.7	39.0	38.9	38.6	38.3	37.5	36.8	35.6	35.1	36.1	36.9	37.4	37.9	38.2	38.4	38.3	38.3
25	51.0	49.0	49.6	50.0	50.1	49.9	49.5	48.6	47.7	46.1	45.4	46.7	47.7	48.5	49.0	49.3	49.4	49.0	48.8
30	61.7	59.4	60.5	61.2	61.4	61.2	60.8	59.7	58.7	56.7	55.9	57.5	58.8	59.6	60.2	60.4	60.4	59.9	59.4
35	72.5	69.8	71.4	72.3	72.7	72.4	72.1	70.9	69.7	67.4	66.3	68.3	69.8	70.7	71.2	71.5	71.4	70.9	70.2
40	83.1	80.2	82.2	83.2	83.6	83.4	83.0	82.0	80.5	78.0	76.7	78.9	80.6	81.6	82.1	82.3	82.3	81.5	80.8
45	93.5	90.3	92.7	93.9	94.2	94.0	93.7	92.6	91.1	88.3	86.8	89.3	91.1	92.1	92.5	92.8	92.8	92.0	91.1
50	103	100	103	104	104	104	104	103	101	98.4	96.7	99.4	101	102	102	103	103	102	101
55	113	109	112	114	114	114	113	112	111	108	106	109	111	111	112	112	112	112	110
60	121	118	121	122	122	122	122	121	120	117	114	117	119	120	120	120	121	120	119
65	129	125	129	130	130	129	129	129	127	124	122	125	127	127	127	128	128	128	127
70	135	132	135	136	136	136	136	135	134	131	129	132	133	134	133	134	135	134	133
75	140	137	140	141	141	141	141	140	140	136	134	137	139	139	138	139	139	139	138
80	143	140	144	145	144	144	144	144	143	140	138	141	142	142	142	142	143	143	142
85	145	142	146	147	146	146	146	146	146	142	140	143	144	144	144	144	145	145	144
90	145	142	146	147	147	146	147	147	146	143	141	144	145	145	144	145	145	145	144
95	143	141	145	146	146	146	146	146	145	143	140	143	144	144	144	144	144	144	143
100	140	138	142	143	143	143	143	144	143	140	138	141	142	142	141	141	142	141	140
105	136	134	137	139	139	139	139	139	139	136	134	137	138	138	137	137	137	137	135
110	129	128	131	133	133	134	134	134	133	130	128	131	132	132	132	132	132	131	130
115	122	120	124	126	126	127	127	127	126	123	121	124	125	125	125	125	125	124	122
120	113	112	116	117	118	119	119	119	118	115	113	115	118	118	117	117	117	116	114
125	104	103	106	108	109	110	110	110	109	106	104	106	108	109	109	108	108	106	105
130	93.2	92.7	95.9	97.8	99.1	99.9	100	100	98.0	95.9	93.6	95.7	99.0	99.1	98.9	98.4	97.8	96.4	94.5
135	82.4	82.2	85.3	87.1	88.3	89.2	89.7	89.7	86.6	85.4	82.3	85.0	88.6	88.9	88.5	88.0	87.4	85.9	83.9
140	71.5	71.3	74.1	76.0	77.2	78.1	78.7	78.5	74.9	74.6	70.9	73.9	77.7	78.1	77.7	77.3	76.4	74.9	73.1
145	60.4	60.4	62.9	64.6	65.7	66.7	67.2	66.6	63.4	63.2	59.2	62.8	66.4	67.0	66.6	66.1	65.3	63.7	62.0
150	49.2	49.5	51.5	53.1	54.1	54.9	55.3	54.4	52.0	51.6	47.6	51.5	55.0	55.4	55.1	54.6	54.0	52.5	50.9
155	38.2	38.6	40.2	41.3	42.1	42.6	43.0	42.7	40.2	39.6	36.3	40.4	43.5	43.5	42.6	41.6	41.2	39.7	38.7
160	24.9	25.7	27.0	28.0	28.7	29.1	27.0	24.2	25.8	26.5	24.4	28.0	30.3	29.9	28.8	27.4	26.7	24.5	23.7
165	11.6	12.3	13.1	13.8	14.4	13.4	8.61	7.36	12.8	13.3	12.6	14.8	15.9	15.4	14.5	13.0	12.4	10.7	10.3
170	1.51	1.95	2.39	2.76	3.08	3.31	2.61	3.50	3.70	2.88	3.39	4.20	4.00	1.14	1.23	2.47	2.28	1.25	0.74
175	0.16	0.15	0.15	0.15	0.16	0.17	0.17	0.18	0.20	0.22	0.21	0.21	0.21	0.21	0.21	0.21	0.19	0.20	0.18
180	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07

Table 6: Luminous Intensity Data

Table--2

UNIT: cd

C (DEG) Y (DEG)	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350		
0	9.71	9.71	9.71	9.71	9.71	9.71	9.71	9.71	9.71	9.71	9.71	9.71	9.71	9.71	9.71	9.71	9.71		
5	12.8	13.2	13.5	13.8	14.1	14.3	14.4	14.4	14.4	14.3	14.4	14.4	14.3	14.2	14.0	13.8	13.5		
10	20.0	20.8	21.4	21.9	22.3	22.6	22.7	22.7	22.5	22.4	22.6	22.8	22.7	22.5	22.2	21.8	21.3		
15	29.2	30.4	31.3	31.9	32.5	32.8	32.9	32.7	32.3	32.0	32.5	32.9	32.9	32.7	32.4	31.9	31.1		
20	39.4	40.9	42.0	42.9	43.4	43.8	43.8	43.4	42.7	42.4	43.2	43.8	43.9	43.7	43.3	42.7	41.8		
25	49.8	51.8	53.2	54.1	54.8	55.2	55.0	54.5	53.5	52.9	54.1	54.9	55.2	55.1	54.6	53.9	52.8		
30	60.3	62.7	64.3	65.4	66.1	66.5	66.2	65.7	64.3	63.4	65.1	66.1	66.5	66.3	66.0	65.1	63.9		
35	70.8	73.6	75.4	76.6	77.2	77.7	77.5	76.7	75.1	74.1	76.1	77.2	77.7	77.5	77.1	76.3	74.9		
40	81.2	84.2	86.3	87.3	88.1	88.6	88.4	87.5	85.7	84.7	86.7	88.1	88.5	88.2	87.9	87.1	85.7		
45	91.3	94.6	96.7	97.9	98.5	99.0	98.9	98.0	96.0	94.7	96.9	98.7	98.8	98.7	98.4	97.6	96.3		
50	101	105	107	108	108	109	109	108	106	104	107	109	109	109	108	107	106		
55	110	114	116	117	117	118	118	117	115	114	116	118	118	117	117	117	116		
60	118	122	124	125	125	126	126	126	123	122	124	126	126	125	125	125	124		
65	126	130	132	132	133	133	133	133	131	129	131	133	133	132	132	132	132		
70	132	136	138	138	138	139	139	139	136	135	138	139	139	138	138	138	138		
75	137	141	142	142	143	143	144	143	141	139	142	143	143	142	142	143	143		
80	140	144	145	145	145	146	147	146	144	142	145	146	145	145	145	146	146		
85	142	146	147	147	147	147	148	148	145	144	146	148	147	146	147	147	147		
90	143	146	147	147	147	147	148	148	145	143	146	147	147	146	147	147	148		
95	141	145	146	145	145	145	146	146	143	142	144	145	145	144	145	146	146		
100	138	142	142	142	142	142	142	142	140	138	141	142	141	141	142	142	143		
105	133	137	138	137	137	137	137	137	135	133	136	137	136	136	137	138	138		
110	127	131	131	131	131	131	131	131	128	126	129	131	130	130	131	132	132		
115	120	123	124	124	124	124	124	123	120	119	121	123	123	123	123	124	124		
120	112	115	115	116	115	115	115	114	112	110	113	114	114	115	115	115	115		
125	102	105	106	106	106	106	105	104	102	100	103	104	105	105	106	106	106		
130	92.3	94.8	95.7	96.0	95.9	95.6	94.9	93.7	91.4	90.3	92.7	94.4	94.8	95.3	95.6	95.7	95.2		
135	81.8	84.0	84.9	85.2	85.1	84.8	84.0	82.8	80.6	79.6	81.9	83.5	84.0	84.6	84.8	84.8	84.3		
140	71.0	72.9	73.8	74.1	73.9	73.6	72.7	71.5	69.6	68.7	70.7	72.3	72.8	73.4	73.6	73.6	73.1		
145	60.1	61.6	62.4	62.6	62.5	62.2	61.3	60.2	58.4	57.7	59.4	60.7	61.4	62.0	62.2	62.2	61.6		
150	49.3	50.2	50.7	50.9	50.5	49.8	49.5	48.6	47.2	46.7	47.9	49.0	49.6	50.0	50.2	50.3	50.1		
155	38.0	38.3	38.1	37.6	37.0	36.3	35.9	35.3	34.2	34.1	34.8	35.4	35.7	36.0	37.0	37.9	38.4		
160	23.6	23.3	22.9	22.6	22.0	21.2	20.7	20.2	19.3	19.4	19.7	19.9	20.3	20.7	22.0	22.8	24.0		
165	10.5	10.3	9.55	9.02	8.53	8.01	7.30	7.15	6.61	6.72	6.91	6.82	6.85	7.07	8.23	8.97	10.1		
170	0.81	0.80	0.51	0.43	0.51	0.46	0.37	0.31	0.28	0.25	0.24	0.25	0.30	0.40	0.57	0.50	0.76		
175	0.18	0.18	0.19	0.20	0.19	0.18	0.18	0.19	0.19	0.18	0.17	0.16	0.16	0.15	0.15	0.16	0.16		
180	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07		

Table 7: Luminous Intensity Data

EQUIPMENT LIST

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due date
Goniophotometer system	GO-R5000	HZTE011-01	Aug. 02, 2019	Aug. 01, 2020
Digital Power Meter	PF2010A	HZTE028-01	Aug. 02, 2019	Aug. 01, 2020
AC Power Supply	DPS1060	HZTE001-06	Aug. 02, 2019	Aug. 01, 2020
DC Power Supply	WY12010	HZTE004-03	Aug. 02, 2019	Aug. 01, 2020
Temperature recorder	JM624U	HZTE018-08	Aug. 02, 2019	Aug. 01, 2020
Temperature and humidity recorder	JR900	HZTE018-01	Aug. 02, 2019	Aug. 01, 2020
Standard source	D908	HZTE012-01	Aug. 02, 2019	Aug. 01, 2020
Integrate Sphere system	3M	HZTE015-04	Aug. 02, 2019	Aug. 01, 2020
Digital Power Meter	WT210	HZTE008-01	Aug. 02, 2019	Aug. 01, 2020
AC Power Supply	PCR 500L	HZTE001-07	Aug. 02, 2019	Aug. 01, 2020
DC Power Supply	IT6154	HZTE004-04	Aug. 02, 2019	Aug. 01, 2020
Standard source	SCL-1400	HZTE012-02	Aug. 02, 2019	Aug. 01, 2020
Temperature and humidity recorder	JR900	HZTE018-02	Aug. 02, 2019	Aug. 01, 2020
Temperature Meter	TES1310	HZTE017-01	Aug. 02, 2019	Aug. 01, 2020

Table 8: Test Equipment List

TEST METHODS

Seasoning of SSL Product

For the purpose of rating new SSL products, SSL products shall be tested with no seasoning. Therefore, no seasoning was performed.

Sphere-Spectroradiometer Method- Photometric and Electrical Measurements

A Labsphere Model CDS 2100 Spectroradiometer and Two Meter Sphere was used to measure correlated color temperature, chromaticity coordinates, and the color rendering index for each SSL unit. The coating reflectance of each sphere is 98%. The measure geometry is 4π . Self-absorption correction is conducted in testing. Bandwidth of spectroradiometer is 350nm-1050nm.

Ambient temperature was measured at a position inside the sphere. Each SSL unit was operated on the client provided driver at the rated input voltage in its designated orientation.

The stabilization time typically ranges from 30 min (small integrated LED lamps) to 2 or more hours for large SSL luminaires). It can be judged that stability is reached when the variation (maximum – minimum) of at least 3 readings of the light output and electrical power over a period of 30 min, taken 15 minutes apart, is less than 0.5 %.

Electrical measurements including voltage, current, and power were measured using the Yokogawa Power Analyzer.

The standard reference of the integrated sphere system is halogen incandescent lamp, the intensity distribution type is omni-directional, and is traceable to the National Institute of Standards and Technology.

The uncertainty of integrating sphere system reported in this document is expanded uncertainty is 2.1% with a coverage factor $k=2$.

Goniophotometer Method

Photometric and Electrical Measurements

An EVERFINE Type C Model GO-R5000 Goniophotometer was used to measure the intensity at each angle of distribution for each sample. The photometric distance is 2.475m for near-field measurement or 30m for far-field measurement. Bandwidth of spectroradiometer is 380nm-780nm.

Ambient temperature was measured at the same height of the sample mounted on the Goniophotometer equipment. Each SSL unit was operated on the client provided driver at the rated input voltage in its designated orientation.

The stabilization time typically ranges from 30 min (small integrated LED lamps) to 2 or more hours for large SSL luminaires). It can be judged that stability is reached when the variation (maximum – minimum) of at least 3 readings of the light output and electrical power over a period of 30 min, taken 15 minutes apart, is less than 0.5 %.

Electrical measurements including voltage, current, and power were measured using the Everfine Digital Power Meter.

Some graphics were created with Photometric Plus software.

The standard reference of the Goniophotometer system is halogen incandescent lamp, the intensity distribution type is omni-directional, and is traceable to the National Institute of Metrology P.R. China.

The uncertainty of goniophotometer system reported in this document is expanded uncertainty is 2.3% with a coverage factor $k=2$.

Color Characteristics Measurements

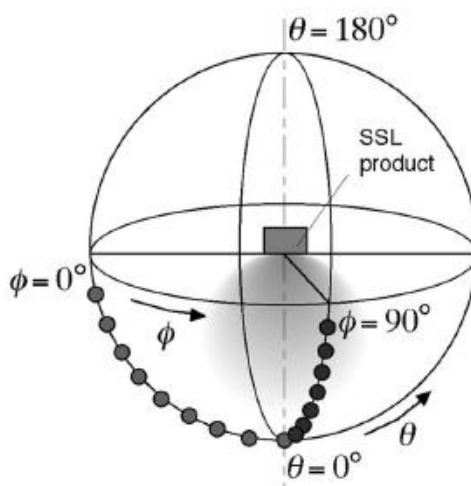
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as values that are spatially average, weighted to intensity, over the angular range where light is intentionally emitted from the SSL product. The color characteristics measurements are using gonio-spectroradiometer.

Color Spatial Uniformity

The characteristics of SSL products may be spatially non-uniform, the chromaticity coordinate shall be measured at two vertical planes ($C=0^\circ/180^\circ$ and $C=90^\circ/270^\circ$) and at 10° or less intervals for vertical angle until the light output dropped to below 10% of the peak intensity. The averaged weighted chromaticity coordinate

was calculated from these points. The data was then analyzed to check for delta color differences of the u' , v' chromaticity coordinates. The spatial non-uniformity of chromaticity, $\Delta u'v'$, is determined as the maximum deviation (distance on the CIE (u' , v') diagram) among all measured points from the spatially averaged chromaticity coordinate.

The geometry for the chromaticity measurement using gonio-spectroradiometer is shown as following.



*** End of Report ***

This report is considered invalidated without the Special Seal for Inspection of the LTL. This report shall not be altered, increased or deleted. The results shown in this test report refer only to the sample(s) tested. Without written approval of LTL, this test report shall not be copied except in full and published as advertisement.