



UL-CCIC Company Limited  
No.2 Chengwan Road,  
Suzhou Industrial Park  
Suzhou 215122, China  
86-512-68086400



## Photometric Test Report

### Relevant Standards

- IES LM-79-2008
- ANSI C82.77-2002
- UL1598-2008/ UL1993-2012

### Prepared For

**P.Q.L., Inc.**

2285 Ward Avenue / Simi Valley, CA 93065

### Catalog Number

90443, 90444, 90445, 90446

### Project Number

4787638390

### Report Number

4787638390-2

### Test Date

10/10/2016 - 10/13/2016

### Issue Date

2016-10-13

### Prepared By

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### Approved By

*Jonathan Xu*

Jonathan Xu

The results contained in this report pertain only to the tested sample.

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NVLAP LAB CODE: 600106-0

## 1.0 Test Summary

DLC Technical Requirements v4.0

<b>Type C, Four-foot Linear Replacement Lamps</b>				
<b>Requirement Category</b>	<b>Test Method</b>	<b>Requirements</b>	<b>Test value</b>	<b>Results (Fail/Pass)</b>
Minimum Light Output (lm)	IES LM-79-2008	In Fixture: 4500 lm	5516	Pass
Minimum Lamp Output (lm)	IES LM-79-2008	Bare Lamp: 1600 lm	3345.96	Pass
Spacing Criteria (0-180°)	IES LM-79-2008	1.0-2.0	1.24	Pass
Spacing Criteria (90-270°)	IES LM-79-2008	1.0-2.0	1.32	Pass
Zonal Lumen Requirement (0-60°)	IES LM-79-2008	≥75%	85%	Pass
Zonal Lumen Requirement 2	IES LM-79-2008	N/A	N/A	N/A
Minimum Luminaire Efficacy (lm/W)	IES LM-79-2008	100	107.32	Pass
Minimum Lamp Efficacy (lm/W)	IES LM-79-2008	110	128.49	Pass
Allowable CCTs* (K)	IES LM-79-2008	≤5000	5234	Pass
Minimum CRI	IES LM-79-2008 CIE 13.3-1995	≥80	82.65	Pass
L70 Lumen maintenance (hours)	IES LM-80-2015 IES TM-21-2011	≥50000	≥50000	Pass
L90 Lumen maintenance (hours)	IES LM-80-2015 IES TM-21-2011	N/A	N/A	N/A
Power Factor	ANSI C82.77-2002	≥0.9	0.9638	Pass
Total Harmonic Distortion (A%)	ANSI C82.77-2002	≤20%	10.70%	Pass
In-Situ Temperature Measurement Test for LED (°C)	UL1598-2008/ UL1993-2012	≤105	58.3	Pass
In-Situ Temperature Measurement Test for Driver (°C)	UL1598-2008/ UL1993-2012	N/A	N/A	N/A
Minimum Luminaire Warranty (years)	N/A	5	5	Pass

\*Defined by ANSI C78.377-2011‡

‡ANSI C78.377-2015 also referred to for Duv and (x,y) chromaticity coordinates tolerances for indoor categories.



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### 3.0 Test List

Test Item	Test	Test Date	Model Number	Tests Conducted By
1	Integrating Sphere Test for the Lower CCT	2016-10-10	90444/3500K	Blaire Xiong
2	Integrating Sphere Test for the Higher CCT	2016-10-10	90444/3500K	Blaire Xiong
3	Goniophotometer Test	2016-10-10	90444/3500K	Blaire Xiong
4	THD and PF Test	2016-10-10	90444/3500K	Blaire Xiong
5	In-Situ Temperature Measurement Test	10/13/2016	90444/3500K	Blaire Xiong

#### Remark (if any)

1. UL test equipment information is recorded on Meter Use in UL's Laboratory Project Management (LPM) database.
2. The lamps were tested with an instant start ballast# U-254T5HO-1 which ballast factor is 0.88.



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#### 4.0 Production Description

Luminaire Description: 120-277 V, 64 W

Lighting Source: EVERLIGHT ELECTRONICS CO., LTD, 67-21S Series (3000K

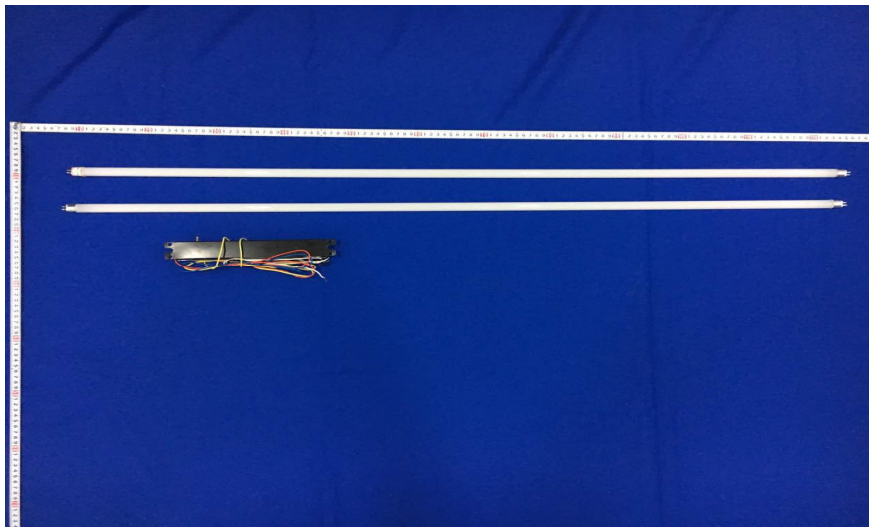
Mounting: T5 linear replacement lamps, Type A, 4 ft

Family Model: 90444/3500K

Variation: Only Variation in CCT.

#### Photos of Luminaire Characteristics

##### Bare Lamp



##### Ballast





## 5.0 LM-79 Measurement and Test Results

### 5.1 Integrating Sphere Test for the lower CCT

Model No.	90444/3500K	Sample ID.	585399-001,585399-002
Opreate time (Min.)	50	Stabilization time (Min.)	45

#### Test Method

1. The sample was tested according to the IES LM-79-2008.
2. Photometric paramters were measured using an integrating sphere, a spectroradiometer and software. The ambient temperature condition inside the sphere was maintained at 25° C ± 1° C.
3. The sample measurements were made using a spectroradiometer connected by a fiber optic cable and detector through the detector port of the integrating sphere. The sample was operated at rated voltage and was stabilized before measurement. Chromaticity coordinates, correlated color temperature and color rendering index were calculated from the spectral radiant flux measurements taken at 1 nm intervals over the range of 380 to 780 nm.

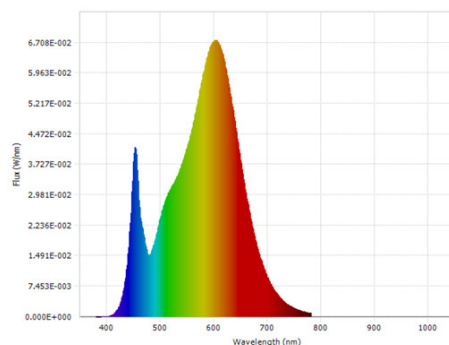
#### Integrating Sphere Test Conditions

Temperature (°C)	Voltage (Vac)	Frequency(Hz)	Current (A)	Power (W)	Power (W)/2	Power Factor
25.5	120.05	60	0.435	52.08	26.04	0.997

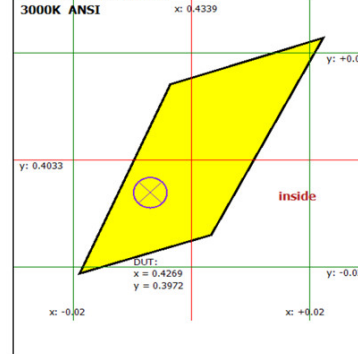
#### Test Results

Orientation	CCT (K)	CRI (Ra)	Duv	Luminous Flux (lm)	Luminous Efficacy (lm/W)
Horizontal	3117	82.7	-0.0013	3346.0	128.49

Spectral Flux Graph



Chromaticity Diagram



#### Spectral Result

Luminous Flux $\Phi(v)$	3345.96 (lm)	Chrom x	0.4269
Chrom y	0.3972	Chrom u	0.2471
Chrom v	0.3448	Duv	-0.0013
Chrom u'	0.2471	Chrom v'	0.5171
CCT	3117.0 (K)	Luminous Efficacy $\eta$	64.25 (lm/W)
Ra	82.65	R1	81.3
R2	92.2	R3	94.8
R4	80.3	R5	82.1
R6	90.5	R7	81.7
R8	58.2	R9	5.8
R10	82.4	R11	79.9
R12	74.4	R13	84.1
R14	97.8	R15	73.9
Rf	83	Rg	96



## 5.2 Integrating Sphere Test for the higher CCT

Model No.	90444/3500K	Sample ID.	585399-003,585399-004
Operate time (Min.)	50	Stabilization time (Min.)	45

### Test Method

- The sample was tested according to the IES LM-79-2008.
- Photometric parameters were measured using an integrating sphere, a spectroradiometer and software. The ambient temperature condition inside the sphere was maintained at 25° C ± 1° C.
- The sample measurements were made using a spectroradiometer connected by a fiber optic cable and detector through the detector port of the integrating sphere. The sample was operated at rated voltage and was stabilized before measurement. Chromaticity coordinates, correlated color temperature and color rendering index were calculated from the spectral radiant flux measurements taken at 1 nm intervals over the range of 380 to 780 nm.

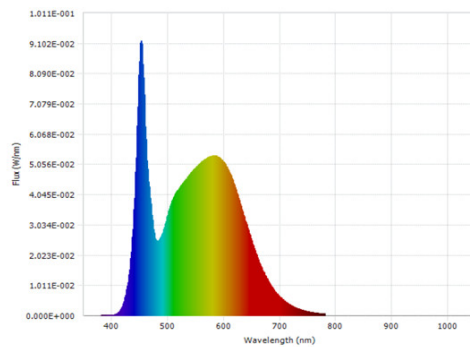
### Integrating Sphere Test Conditions

Temperature (°C)	Voltage (Vac)	Frequency(Hz)	Current (A)	Power (W)	Power (W)/2	Power Factor
25.5	120.05	60	0.4395	52.62	26.31	0.997

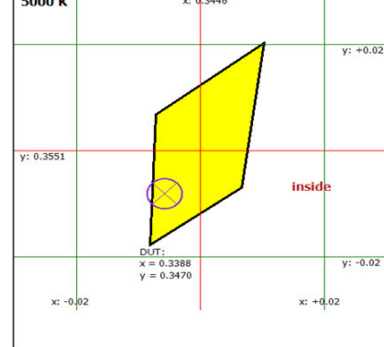
### Test Results

Orientation	CCT (K)	CRI (Ra)	Duv	Luminous Flux (lm)	Luminous Efficacy (lm/W)
Horizontal	5234	84.5	0.0003	3387.6	128.76

Spectral Flux Graph



Chromaticity Diagram



### Spectral Result

Luminous Flux $\Phi(v)$	3387.57 (lm)	Chrom x	0.3388
Chrom y	0.3470	Chrom u	0.2089
Chrom v	0.3210	Duv	0.0003
Chrom u'	0.2089	Chrom v'	0.4815
CCT	5234.0 (K)	Luminous Efficacy $\eta$	64.37 (lm/W)
Ra	84.47	R1	83.2
R2	90.1	R3	93.5
R4	83.8	R5	83.8
R6	85.1	R7	87.1
R8	69.1	R9	13.5
R10	75.7	R11	83.1
R12	64.8	R13	85.2
R14	96.8	R15	78.7
Rf	82	Rg	95





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## 5.0 LM-79 Measurement and Test Results

### 5.3 Goniophotometer Test

Model No.	90444/3500K	Sample ID.	585399-001,585399-002
Operate time (Min.)	50	Stabilization time (Min.)	45

#### Test Method

1. The sample was tested according to the IES LM-79-2008 in fixture Lithonia 2GT5 3 32 A12 MVOLT 1/4 GEB10IS.
2. Photometric parameters were measured using a type C goniophotometer and software.
3. The ambient temperature shall be maintained at 25° C ± 1° C, measured at a point not more than 1 m from the sample and at the same height as the sample.
4. The samples were operated at rated voltage and was stabilized before measurement. Luminous flux, luminaire efficacy, zonal lumen were calculated from the software taken at 0.5° vertical intervals and 22.5° horizontal intervals.

#### Goniophotometer Test Conditions

Temperature (°C)	Voltage (Vac)	Frequency	Current (A)	Power (W)	Power Factor	Orientation
25.3	119.99	60	0.42956	51.40	0.997	Horizontal

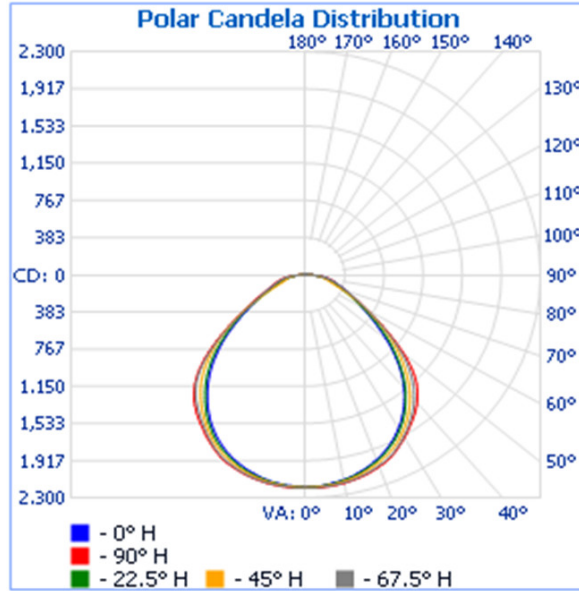
#### Test Result

Flux (lm)	Zonal Lumen Requirement (0-60°)	Field Angle (10%)		Beam Angle (50%)		Luminous Efficacy (lm/W)
		Horizontal Spread	Vertical Spread	Horizontal Spread	Vertical Spread	
5516	85%	160.4	154.5	104.3	97.6	107.32
Center Candela (cd)	Spacing Criteria (0-180°)		Spacing Criteria (90-270°)			
2193	1.24		1.32			

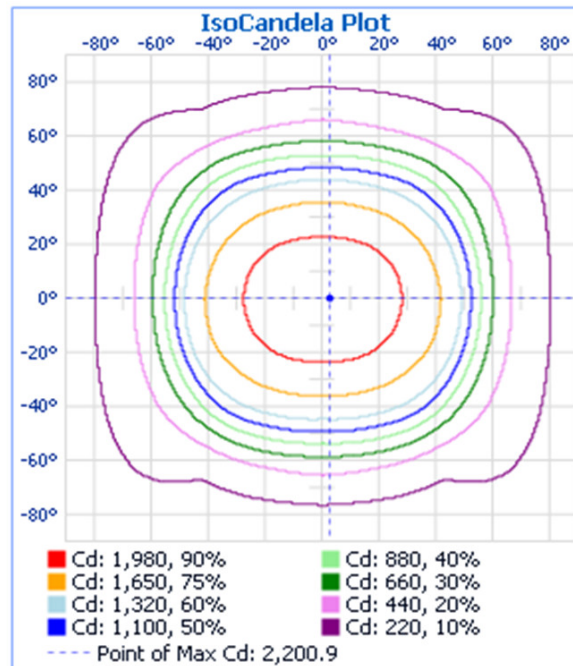


## 5.2 Goniophotometer Test (Cont'd)

### Light Distribution Curve



### IsoCandela Plot







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## 5.2 Goniophotometer Test (Cont'd)

### Zonal Lumen Summary

Zonal Lumen Summary		
Zone	Lumens	% Luminaire
0-30	1,725.4	31.3%
0-40	2,819.0	51.1%
0-60	4,669.4	84.7%
60-90	833.5	15.1%
70-100	383.5	7%
90-120	4.9	0.1%
0-90	5,502.9	99.8%
90-180	13.1	0.2%
0-180	5,516.0	100%

### Lumens Per Zone

Lumens Per Zone					
Zone	Lumens	% Total	Zone	Lumens	% Total
0-5	52.3	0.9%	90-95	1.4	0%
5-10	155.6	2.8%	95-100	0.8	0%
10-15	254.5	4.6%	100-105	0.7	0%
15-20	345.9	6.3%	105-110	0.7	0%
20-25	426.3	7.7%	110-115	0.6	0%
25-30	490.8	8.9%	115-120	0.7	0%
30-35	535.2	9.7%	120-125	0.7	0%
35-40	558.4	10.1%	125-130	0.8	0%
40-45	555.3	10.1%	130-135	0.8	0%
45-50	515.3	9.3%	135-140	0.9	0%
50-55	437.1	7.9%	140-145	0.9	0%
55-60	342.6	6.2%	145-150	0.9	0%
60-65	257.8	4.7%	150-155	0.8	0%
65-70	194.5	3.5%	155-160	0.7	0%
70-75	150.6	2.7%	160-165	0.7	0%
75-80	118.6	2.1%	165-170	0.6	0%
80-85	82.0	1.5%	170-175	0.4	0%
85-90	30.1	0.5%	175-180	0.1	0%



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## 5.2 Goniophotometer Test (Cont'd)

### Intensity Data(cd)

	0	22.5	45	67.5	90	113	135	158	180	203	225	247.5	270	292.5	315	338	360
0	2193	2193	2193	2193	2193	2193	2193	2193	2193	2193	2193	2193	2193	2193	2193	2193	2193
1	2183	2189	2190	2197	2201	2195	2192	2190	2186	2190	2192	2195	2201	2197	2190	2189	2183
2	2183	2188	2191	2197	2200	2195	2190	2191	2184	2191	2190	2195	2200	2197	2191	2188	2183
3	2182	2187	2188	2194	2200	2195	2189	2188	2182	2188	2189	2195	2200	2194	2188	2187	2182
4	2181	2184	2184	2196	2200	2193	2185	2185	2179	2185	2185	2193	2200	2196	2184	2184	2181
5	2175	2180	2182	2192	2196	2192	2185	2182	2179	2182	2185	2192	2196	2192	2182	2180	2175
6	2170	2176	2181	2189	2195	2189	2182	2179	2175	2179	2182	2189	2195	2189	2181	2176	2170
7	2162	2171	2177	2186	2192	2187	2179	2174	2168	2174	2179	2187	2192	2186	2177	2171	2162
8	2159	2165	2172	2184	2189	2184	2174	2167	2165	2167	2174	2184	2189	2184	2172	2165	2159
9	2153	2159	2167	2180	2186	2180	2169	2164	2160	2164	2169	2180	2186	2180	2167	2159	2153
10	2146	2151	2161	2175	2182	2176	2165	2159	2148	2159	2165	2176	2182	2175	2161	2151	2146
11	2139	2144	2155	2170	2176	2172	2158	2150	2143	2150	2158	2172	2176	2170	2155	2144	2139
12	2130	2138	2147	2165	2170	2166	2153	2141	2133	2141	2153	2166	2170	2165	2147	2138	2130
13	2121	2127	2140	2159	2163	2160	2144	2132	2121	2132	2144	2160	2163	2159	2140	2127	2121
14	2106	2117	2133	2152	2159	2154	2137	2124	2109	2124	2137	2154	2159	2152	2133	2117	2106
15	2096	2107	2124	2143	2151	2146	2128	2114	2100	2114	2128	2146	2151	2143	2124	2107	2096
16	2085	2095	2112	2135	2145	2138	2119	2103	2089	2103	2119	2138	2145	2135	2112	2095	2085
17	2071	2082	2102	2126	2136	2128	2108	2092	2076	2092	2108	2128	2136	2126	2102	2082	2071
18	2059	2070	2091	2116	2127	2119	2097	2080	2060	2080	2097	2119	2127	2116	2091	2070	2059
19	2041	2056	2081	2105	2118	2108	2085	2066	2046	2066	2085	2108	2118	2105	2081	2056	2041
20	2028	2042	2067	2095	2107	2096	2072	2050	2032	2050	2072	2096	2107	2095	2067	2042	2028
25	1939	1955	1992	2027	2039	2026	1997	1966	1941	1966	1997	2026	2039	2027	1992	1955	1939
30	1819	1842	1888	1925	1936	1919	1887	1850	1822	1850	1887	1919	1936	1925	1888	1842	1819
35	1675	1697	1752	1800	1825	1800	1754	1705	1673	1705	1754	1800	1825	1800	1752	1697	1675
40	1492	1515	1587	1654	1701	1676	1604	1534	1493	1534	1604	1676	1701	1654	1587	1515	1492
45	1275	1301	1378	1458	1522	1502	1418	1331	1288	1331	1418	1502	1522	1458	1378	1301	1275
50	1023	1065	1145	1202	1245	1216	1175	1088	1050	1088	1175	1216	1245	1202	1145	1065	1023
55	794	824	889	903	916	892	894	836	797	836	894	892	916	903	889	824	794
60	606	602	647	659	654	627	616	598	593	598	616	627	654	659	647	602	606
65	473	440	449	491	476	457	400	410	442	410	400	457	476	491	449	440	473
70	366	332	306	379	362	351	264	296	321	296	264	351	362	379	306	332	366
75	272	255	225	289	293	279	203	222	234	222	203	279	293	289	225	255	272
80	198	180	178	208	223	210	171	163	177	163	171	210	223	208	178	180	198
85	104	98	99	117	123	123	102	94	94	94	102	123	123	117	99	98	104
90	5	6	8	10	10	10	6	5	2	5	6	10	10	10	8	6	5
95	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
100	1	1	1	1	1	2	1	1	2	1	1	2	1	1	1	1	1
105	1	1	1	1	2	1	1	1	1	1	1	1	2	1	1	1	1
110	1	1	1	1	1	2	2	1	1	1	2	2	1	1	1	1	1
115	2	1	1	1	2	1	1	1	1	1	1	1	2	1	1	1	2
120	2	1	1	2	2	1	1	1	2	1	1	1	2	2	1	1	2
125	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
130	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2	2
135	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2	2
140	3	3	2	2	2	2	2	3	3	3	2	2	2	2	2	3	3
145	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
150	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
155	4	4	3	3	3	3	3	4	4	4	3	3	3	3	3	4	4
160	4	4	4	4	3	3	4	4	4	4	4	3	3	4	4	4	4
165	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5
170	5	5	6	5	5	5	5	5	5	5	5	5	5	5	6	5	5
175	5	6	6	6	6	6	6	5	5	5	6	6	6	6	6	6	5
180	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6



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### 6.0 THD and PF Test

<b>Model No.</b>	90444/3500K	<b>Sample ID.</b>	585399-001,585399-002
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#### Test Method

1. The samples were tested according to the ANSI C82.77-2002.  
 2. The ambient temperature condition was maintained at 25° C ± 1° C. The sample measurement was made using a digital power meter and power supply. The sample was operated at rated voltage and stabilized before measurement. The total harmonic distortion were calculated from the digital power meter.

#### Test Results

Temperature (°C)	Voltage (Vac)	Frequency	Current (A)	Power (W)	Power Factor	Current THD
25.5	277.1	60	0.194	51.78	0.964	10.7%



## 7.0 In-Situ Temperature Measurement Test

<b>Model No.</b>	90444/3500K	<b>Sample ID.</b>	585399-001,585399-002
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### Test Method

- In-Situ Temperature Measurement Test is conducted according to the UL1598-2008, Section 14 or UL1993-2012, Section 8.5 in fixture Lithonia 2GT5 3 32 A12 MVOLT 1/4 GEB10IS.
- The testing was conducted in a room with ambient temperature of 25°C ± 5°C. The apparatus construction followed those described in UL1598-2008 for normal temperature testing. Thermocouples were placed on the LED package in the locations indicated by LM-80 report. The temperature was recorded after the lamp was operated by 3.5 hours in stability or by 7.5 hours.

### In-Situ Temperature Measurement Test Conditions

Temperature (°C)	Voltage (Vac)	Frequency	Current (A)	Power (W)	Power Factor	Orientation
27.1	120.05	60	0.42956	51.43	0.997	Horizontal

### Test Results

Thermocouple Location	Manufacturer Declared Current (mA)	Temperature for Lighting source (°C)		LED Model Number	LM-80 Limit Current (mA)	LM-80 Limit Temp. (°C)
		Test result column 1	Test result (Correct to 25 °C)			
TMP1 of LEDs	150	60.4	58.3	67-21S Series (3000K)	150	85
TMP2 of LEDs		66.7	64.6			
TMP3 of LEDs		54.3	52.2			
Ambient temperature	N/A	27.1	25.0			



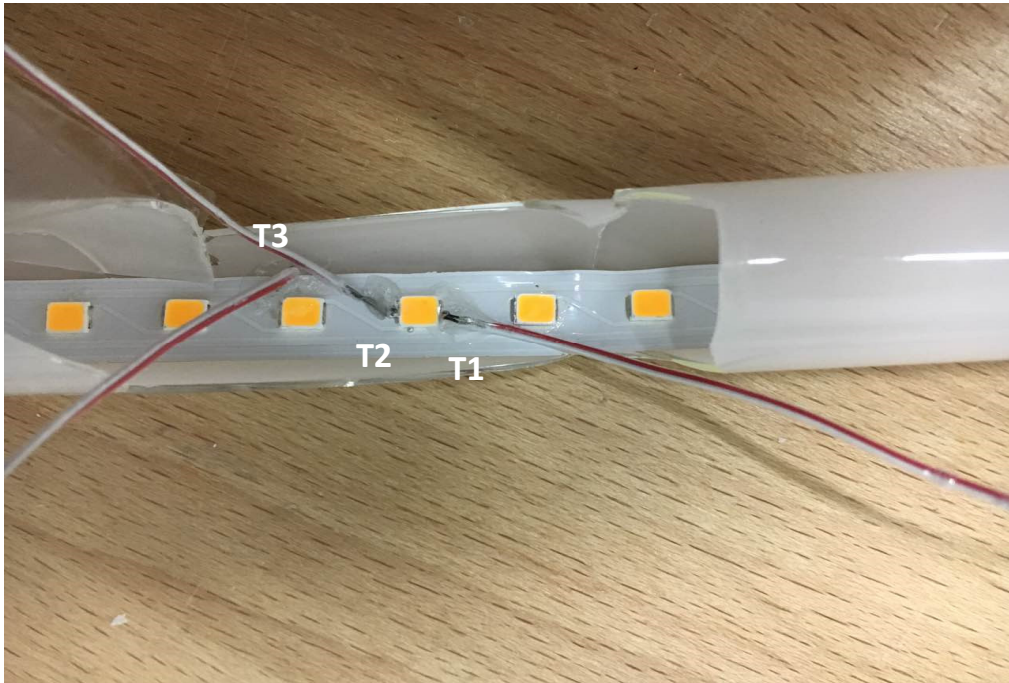
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## 7.0 In-Situ Temperature Measurement Test (Cont'd)

### Test Photos for Tc Point of LED Packages







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