



## DesignLights Consortium Test Report

### Reference Standards

UL1598-2008

ANSI C82.77-10-2014

IES LM-79-2008

### Prepared For

## Fulham Co., Inc.

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Wenchao Li,+86 21 64952777 ext 8021,liwenchao@fulham.com

Test Laboratory:

UL-CCIC Company Limited

Test Laboratory Address:

No.2, Chengwan Road, Suzhou Industrial Park, Suzhou 21522, China

### Catalog Number

VTR-24-MU-45-9TW-A

### Project Number

4790617185

### Report Number

4790617185\_10

### Test Date

2022-11-25~2022-11-26

### Issue Date

2022-11-28

### Revision Date

N/A

### Prepared By

*Elaine Zhou*

Zhao, Elaine

### Approved By

*Maxine Zhou*

Zhou, Maxine

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## Test Summary

### DLC Technical Requirements V5.1- issued 2020-02-14

Requirement Category	Test Method	Requirements	Tolerance	Test Result
Minimum Light Output (lm)-Luminaires	IES LM-79-2008	≥3000	-10%	4526.91
Minimum Luminaire Efficacy (lm/W)-Luminaires	IES LM-79-2008	≥125	-3%	122.52
Spacing Criteria (0-180°)	IES LM-79-2008	1.0-2.0	±0.1	1.24
Spacing Criteria (90-270°)	IES LM-79-2008	1.0-2.0	±0.1	1.28
Zonal Lumen Requirement 1(0°-60°)	IES LM-79-2008	≥75%	-3%	76.00%
Allowable CCT (3500K)	IES LM-79-2008/ANSI C78.377-2015	3465±245	N/A	3544
Allowable CCT (4000K)	IES LM-79-2008/ANSI C78.377-2015	3985±275	N/A	4163
Allowable CCT (5000K)	IES LM-79-2008/ANSI C78.377-2015	5029±283	N/A	4971
Allowable CCT (3500K)	IES LM-79-2008/ANSI C78.377-2015	3465±245	N/A	3542
Allowable CCT (3500K)	IES LM-79-2008/ANSI C78.377-2015	3465±245	N/A	3542
Minimum CRI	IES LM-79-2008/CIE 13.3-1995	≥80	-1	92
Minimum R9	IES LM-79-2008	≥0	-1	67.0
Minimum Rg	IES LM-79-2008	≥89	-1	100
Minimum Rf	IES LM-79-2008	≥70	-1	88
Rcs,h1	IES LM-79-2008	-12%-23%	-1%	-3%
Unified Glare Rating (UGR)	IES LM-79-2008	≤22	N/A	21.8
L70 Lumen maintenance (Hours)	N/A	≥50000	N/A	≥50000
L90 Lumen maintenance (Hours)	N/A	≥36000	N/A	≥36000
Power Factor	ANSI C82.77-10-2014	≥0.9	-0.03	0.9600
Total Harmonic Distortion (A%)	ANSI C82.77-10-2014	≤20%	5%	12.34%
In-Situ Temperature Measurement Test for LED 1 (°C)	UL1598-2008	≤105	N/A	47.4
In-Situ Temperature Measurement Test for Driver 1 (°C)	UL1598-2008	≤90	N/A	58.5
Max Chromaticity Shift (1000-6000h)	N/A	≤0.004	0.0004	0.0014
Minimum Luminaire Warranty (Years)	N/A	≥5	N/A	≥5



## Test List

Sample Received Date: 2022-10-27

Test Item	Test Date	Model Number	Tests Conducted By
Integrating Sphere Test	2022-11-26	VTR-24-MU-45-9TW-A	Yang, Gavin X
Integrating Sphere Test	2022-11-26	VTR-24-MU-45-9TW-A	Yang, Gavin X
Integrating Sphere Test	2022-11-26	VTR-24-MU-45-9TW-A	Yang, Gavin X
Integrating Sphere Test	2022-11-26	VTR-24-MU-45-9TW-A	Yang, Gavin X
Integrating Sphere Test	2022-11-26	VTR-24-MU-45-9TW-A	Yang, Gavin X
Goniophotometer Test	2022-11-25	VTR-24-MU-45-9TW-A	Yang, Gavin X
Goniophotometer Test	2022-11-25	VTR-24-MU-45-9TW-A	Yang, Gavin X
THD and PF Test	2022-11-25	VTR-24-MU-45-9TW-A	Yang, Gavin X
THD and PF Test	2022-11-25	VTR-24-MU-45-9TW-A	Yang, Gavin X
THD and PF Test	2022-11-25	VTR-24-MU-45-9TW-A	Yang, Gavin X
THD and PF Test	2022-11-25	VTR-24-MU-45-9TW-A	Yang, Gavin X
THD and PF Test	2022-11-25	VTR-24-MU-45-9TW-A	Yang, Gavin X
In-Situ Temperature Measurement Test	2022-11-26	VTR-24-MU-45-9TW-A	Yang, Gavin X

### Remark (if any)

1. UL test equipment information is recorded on Meter Use in UL's Aurora database.
2. The accuracy method decision rule is applied when the compliance or verdict is made to the results of this report.



**Product Description**

**Lamp/Luminaire Description:** Integrated Retrofit Kits for 2x4 Luminaires

**Model Number:** VTR-24-MU-45-9TW-A

**Electrical Parameter:** 120-277V, 50/60Hz

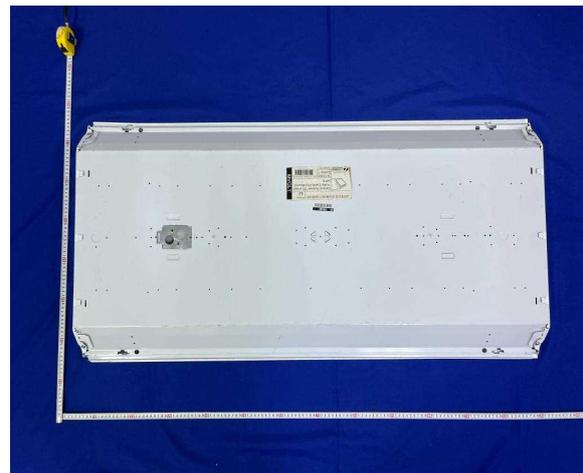
**LED Package:** BXFN-(A)G-11L-3A

**Dimming Information:** Continuous dimming capability

**Remark:** Housing model: Lithonia 2GT8 lensed 2X4

**Products Scaled Value**

Model Number	CCT	Luminous Flux	Power	Luminous Efficacy
VTR-24-MU-45-9TW-A	3500K	5580	45	124
VTR-24-MU-45-9TW-A	4000K	6030	45	134
VTR-24-MU-45-9TW-A	5000K	5670	45	126
VTR-24-MU-45-9TW-A	3500K	4902	38	129
VTR-24-MU-45-9TW-A	4000K	5282	38	139
VTR-24-MU-45-9TW-A	5000K	4978	38	131
VTR-24-MU-45-9TW-A	3500K	4522	34	133
VTR-24-MU-45-9TW-A	4000K	4862	34	143
VTR-24-MU-45-9TW-A	5000K	4590	34	135





## Integrating Sphere Test

<b>Model No.</b>	VTR-24-MU-45-9TW-A	<b>Sample ID.</b>	5475176
<b>Operate time (Min.)</b>	90	<b>Stabilization time (Min.)</b>	45

### Test Method

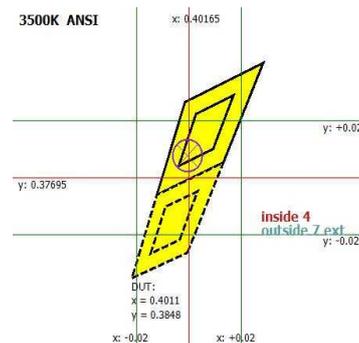
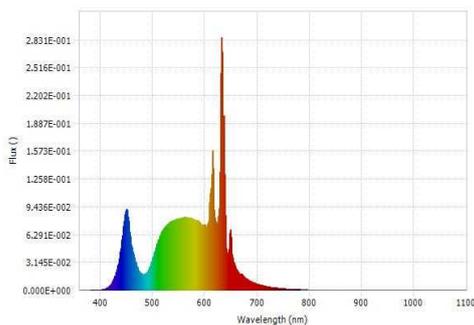
1. The sample was tested according to the IES LM-79-2008, and the product is assumed to be brand new without seasoning.  
 2. Photometric parameters were measured using an integrating sphere, a spectroradiometer and software. The ambient temperature condition inside the sphere was maintained at 25 °C ± 1 °C. The reference standard lamp is rated current 2.679A omni-directional Incandescent lamp and was calibrated by National Institute of Metrology P.R.China.  
 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. Coating reflectance of the integrating sphere was 90% to 98%. Photometric measurement conditions was using 4π geometry. The self-absorption factor is applied in the final test result. 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 Factor	Orientation
24.7	119.91	60	0.3786	45.03	0.9918	Horizontal

### Test Results

CCT (K)	CRI (Ra)	R9	Duv	Flux (lm)	Luminous Efficacy (lm/W)	Efficacy(lm/ft)
3544	92	84.0	-0.0017	5599.79	124.36	N/A



Luminous Flux (lm)	5599.79	Chrom x	0.4011
Chrom y	0.3848	Chrom u	0.2355
Chrom v	0.3388	Duv	-0.0017
Chrom u'	0.2355	Chrom v'	0.5081
CCT (K)	3544	Luminous Efficacy (lm/W)	124.36
Ra	92	R1	98.0
R2	93.0	R3	84.0
R4	91.0	R5	95.0
R6	90.0	R7	92.0
R8	94.0	R9	84.0
R10	79.0	R11	90.0
R12	72.0	R13	96.0
R14	89.0	R15	97.0
Rf	88	Rg	105
Rcs,h1	-3%		

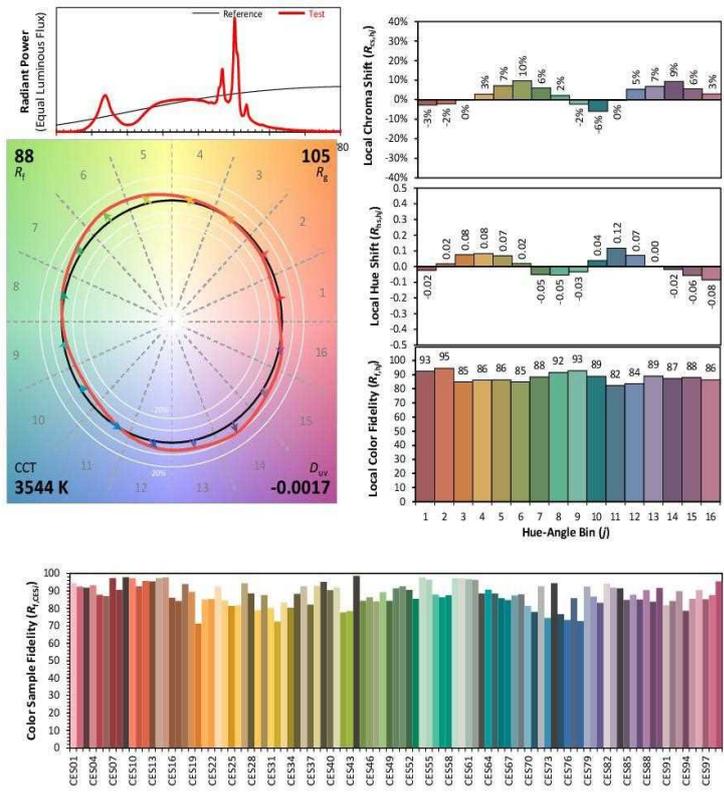


## Integrating Sphere Test (Cont'd)

### TM-30 Report

#### ANSI/IES TM-30-18 Color Rendition Report

Source: BXFN-(A)G-11L-3A      Manufacturer: Fulham Co., Inc.  
 Date: 11/26/2022      Model: VTR-24-MU-45-9TW-A



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

x	0.4011	CIE 13.3-1995 (CRI)	
y	0.3848		
$u'$	0.2355		
$v'$	0.5081		
		$R_a$	92
		$R_9$	84

Colors are for visual orientation purposes only. Created with the ANSI/IES TM-30-18 Calculator Version 2.00.



## Integrating Sphere Test

<b>Model No.</b>	VTR-24-MU-45-9TW-A	<b>Sample ID.</b>	5475176
<b>Operate time (Min.)</b>	90	<b>Stabilization time (Min.)</b>	45

### Test Method

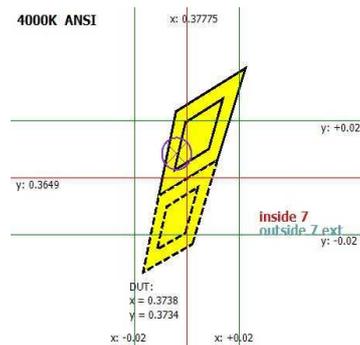
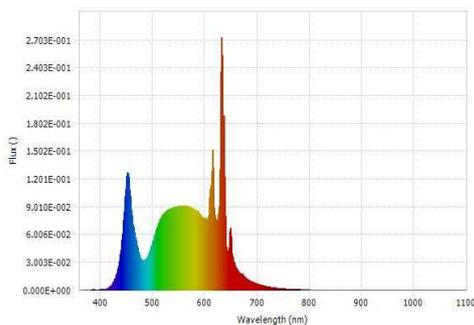
1. The sample was tested according to the IES LM-79-2008, and the product is assumed to be brand new without seasoning.  
 2. Photometric parameters were measured using an integrating sphere, a spectroradiometer and software. The ambient temperature condition inside the sphere was maintained at 25 °C ± 1 °C. The reference standard lamp is rated current 2.679A omni-directional Incandescent lamp and was calibrated by National Institute of Metrology P.R.China.  
 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. Coating reflectance of the integrating sphere was 90% to 98%. Photometric measurement conditions were using 4π geometry. The self-absorption factor is applied in the final test result. 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 Factor	Orientation
24.7	119.94	60	0.3564	42.421	0.9925	Horizontal

### Test Results

CCT (K)	CRI (Ra)	R9	Duv	Flux (lm)	Luminous Efficacy (lm/W)	Efficacy(lm/ft)
4163	94	84.0	0.0004	6188.69	145.89	N/A



Luminous Flux (lm)	6188.69	Chrom x	0.3738
Chrom y	0.3734	Chrom u	0.2220
Chrom v	0.3327	Duv	0.0004
Chrom u'	0.2220	Chrom v'	0.4991
CCT (K)	4163	Luminous Efficacy (lm/W)	145.89
Ra	94	R1	97.0
R2	94.0	R3	88.0
R4	95.0	R5	95.0
R6	91.0	R7	96.0
R8	96.0	R9	84.0
R10	83.0	R11	93.0
R12	68.0	R13	96.0
R14	92.0	R15	96.0
Rf	90	Rg	102
Rcs,h1	-3%		

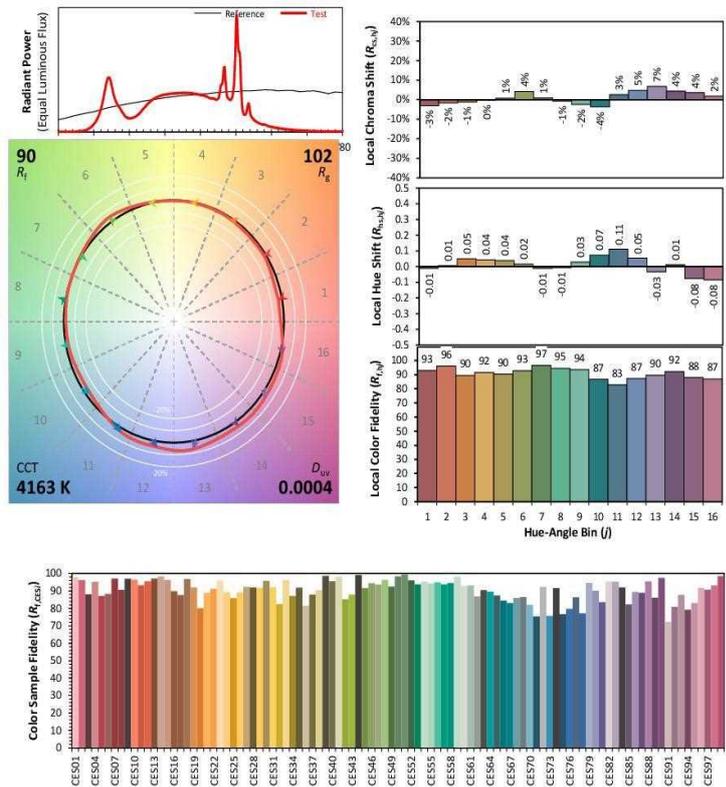


## Integrating Sphere Test (Cont'd)

### TM-30 Report

#### ANSI/IES TM-30-18 Color Rendition Report

Source: BXFN-(A)G-11L-3A      Manufacturer: Fulham Co., Inc.  
 Date: 11/26/2022      Model: VTR-24-MU-45-9TW-A



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

x	0.3738	CIE 13.3-1995 (CRI)
y	0.3734	
$u'$	0.2221	
$v'$	0.4991	
		$R_a$ 94
		$R_9$ 84

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## Integrating Sphere Test

<b>Model No.</b>	VTR-24-MU-45-9TW-A	<b>Sample ID.</b>	5475176
<b>Operate time (Min.)</b>	90	<b>Stabilization time (Min.)</b>	45

### Test Method

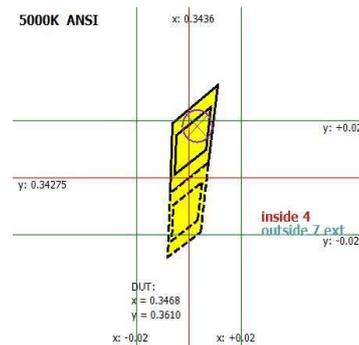
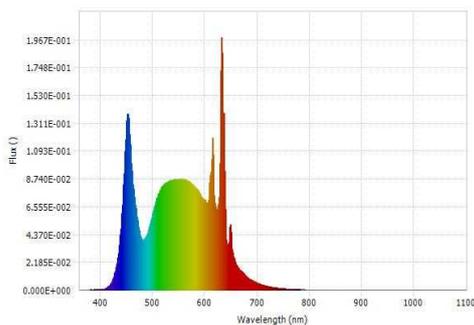
1. The sample was tested according to the IES LM-79-2008, and the product is assumed to be brand new without seasoning.  
 2. Photometric parameters were measured using an integrating sphere, a spectroradiometer and software. The ambient temperature condition inside the sphere was maintained at 25 °C ± 1 °C. The reference standard lamp is rated current 2.679A omni-directional Incandescent lamp and was calibrated by National Institute of Metrology P.R.China.  
 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. Coating reflectance of the integrating sphere was 90% to 98%. Photometric measurement conditions were using 4π geometry. The self-absorption factor is applied in the final test result. 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 Factor	Orientation
24.7	119.92	60	0.3781	44.973	0.9919	Horizontal

### Test Results

CCT (K)	CRI (Ra)	R9	Duv	Flux (lm)	Luminous Efficacy (lm/W)	Efficacy(lm/ft)
4971	92	67.0	0.0040	5839.36	129.84	N/A



Luminous Flux (lm)	5839.36	Chrom x	0.3468
Chrom y	0.3610	Chrom u	0.2090
Chrom v	0.3263	Duv	0.0040
Chrom u'	0.2090	Chrom v'	0.4894
CCT (K)	4971	Luminous Efficacy (lm/W)	129.84
Ra	92	R1	92.0
R2	93.0	R3	91.0
R4	93.0	R5	90.0
R6	89.0	R7	96.0
R8	89.0	R9	67.0
R10	80.0	R11	91.0
R12	64.0	R13	92.0
R14	95.0	R15	90.0
Rf	90	Rg	100
Rcs,h1	-5%		

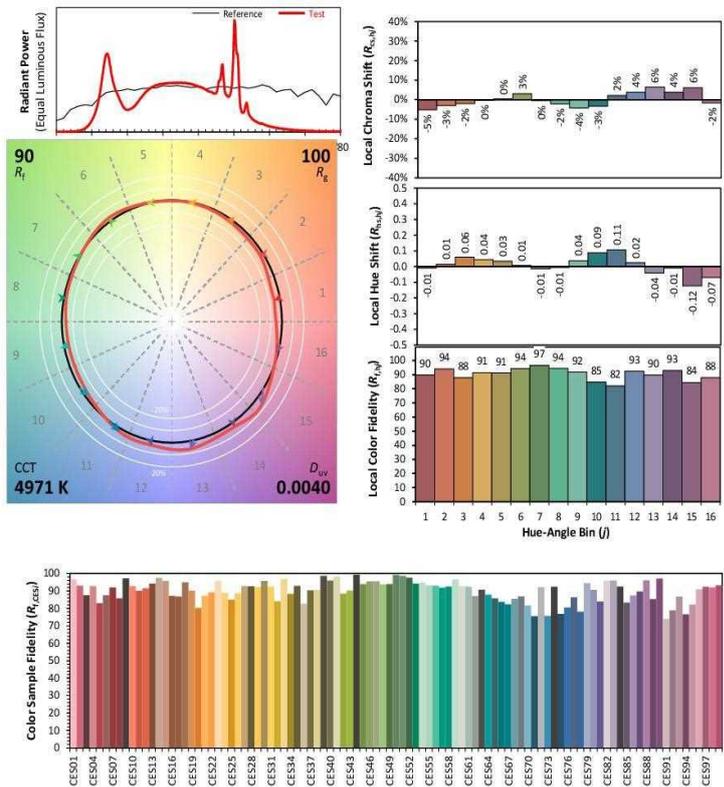


## Integrating Sphere Test (Cont'd)

### TM-30 Report

#### ANSI/IES TM-30-18 Color Rendition Report

Source: BXFN-(A)G-11L-3A      Manufacturer: Fulham Co., Inc.  
 Date: 11/26/2022      Model: VTR-24-MU-45-9TW-A



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

$x$	0.3468	CIE 13.3-1995 (CRI)	
$y$	0.3610		
$u'$	0.2090		
$v'$	0.4894		
		$R_a$	92
		$R_9$	67

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## Integrating Sphere Test

<b>Model No.</b>	VTR-24-MU-45-9TW-A	<b>Sample ID.</b>	5475176
<b>Operate time (Min.)</b>	90	<b>Stabilization time (Min.)</b>	45

### Test Method

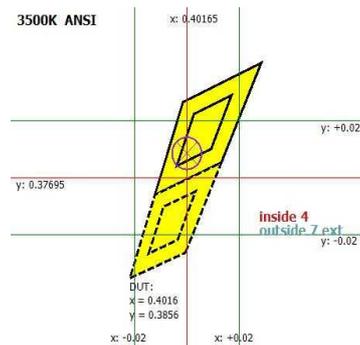
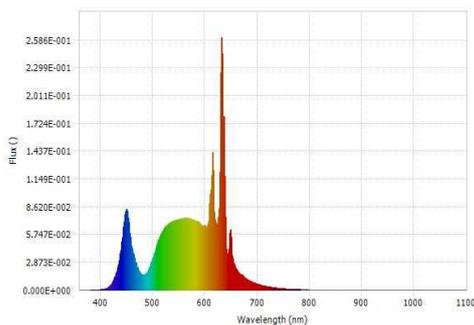
1. The sample was tested according to the IES LM-79-2008, and the product is assumed to be brand new without seasoning.  
 2. Photometric parameters were measured using an integrating sphere, a spectroradiometer and software. The ambient temperature condition inside the sphere was maintained at 25 °C ± 1 °C. The reference standard lamp is rated current 2.679A omni-directional Incandescent lamp and was calibrated by National Institute of Metrology P.R.China.  
 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. Coating reflectance of the integrating sphere was 90% to 98%. Photometric measurement conditions were using 4π geometry. The self-absorption factor is applied in the final test result. 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 Factor	Orientation
24.7	119.93	60	0.3300	39.177	0.9899	Horizontal

### Test Results

CCT (K)	CRI (Ra)	R9	Duv	Flux (lm)	Luminous Efficacy (lm/W)	Efficacy(lm/ft)
3542	92	85.0	-0.0014	5060.79	129.18	N/A



Luminous Flux (lm)	5060.79	Chrom x	0.4016
Chrom y	0.3856	Chrom u	0.2354
Chrom v	0.3390	Duv	-0.0014
Chrom u'	0.2354	Chrom v'	0.5085
CCT (K)	3542	Luminous Efficacy (lm/W)	129.18
Ra	92	R1	98.0
R2	93.0	R3	84.0
R4	91.0	R5	95.0
R6	90.0	R7	92.0
R8	94.0	R9	85.0
R10	79.0	R11	90.0
R12	72.0	R13	96.0
R14	89.0	R15	97.0
Rf	88	Rg	105
Rcs,h1	-3%		

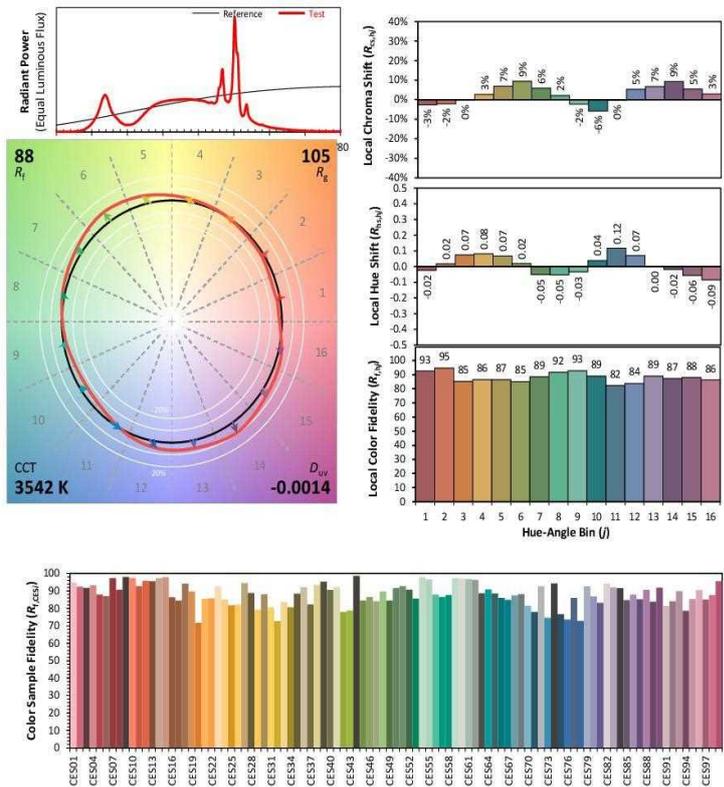


## Integrating Sphere Test (Cont'd)

### TM-30 Report

#### ANSI/IES TM-30-18 Color Rendition Report

Source: BXFN-(A)G-11L-3A      Manufacturer: Fulham Co., Inc.  
 Date: 11/26/2022      Model: VTR-24-MU-45-9TW-A



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

x	0.4016	CIE 13.3-1995 (CRI)
y	0.3856	
u'	0.2354	
v'	0.5085	

$R_a$  92  
 $R_g$  85

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## Integrating Sphere Test

<b>Model No.</b>	VTR-24-MU-45-9TW-A	<b>Sample ID.</b>	5475176
<b>Operate time (Min.)</b>	90	<b>Stabilization time (Min.)</b>	45

### Test Method

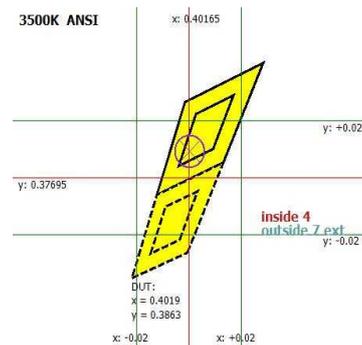
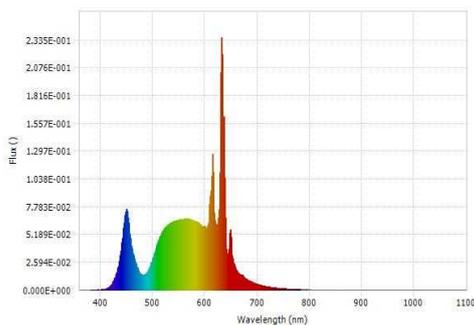
1. The sample was tested according to the IES LM-79-2008, and the product is assumed to be brand new without seasoning.  
 2. Photometric parameters were measured using an integrating sphere, a spectroradiometer and software. The ambient temperature condition inside the sphere was maintained at 25 °C ± 1 °C. The reference standard lamp is rated current 2.679A omni-directional Incandescent lamp and was calibrated by National Institute of Metrology P.R.China.  
 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. Coating reflectance of the integrating sphere was 90% to 98%. Photometric measurement conditions was using 4π geometry. The self-absorption factor is applied in the final test result. 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 Factor	Orientation
24.7	119.98	60	0.2855	33.821	0.9872	Horizontal

### Test Results

CCT (K)	CRI (Ra)	R9	Duv	Flux (lm)	Luminous Efficacy (lm/W)	Efficacy(lm/ft)
3542	92	85.0	-0.0014	4526.91	133.85	N/A



Luminous Flux (lm)	4526.91	Chrom x	0.4019
Chrom y	0.3863	Chrom u	0.2353
Chrom v	0.3393	Duv	-0.0014
Chrom u'	0.2353	Chrom v'	0.5089
CCT (K)	3542	Luminous Efficacy (lm/W)	133.85
Ra	92	R1	98.0
R2	93.0	R3	84.0
R4	91.0	R5	95.0
R6	90.0	R7	92.0
R8	94.0	R9	85.0
R10	79.0	R11	91.0
R12	71.0	R13	96.0
R14	89.0	R15	97.0
Rf	88	Rg	105
Rcs,h1	-3%		

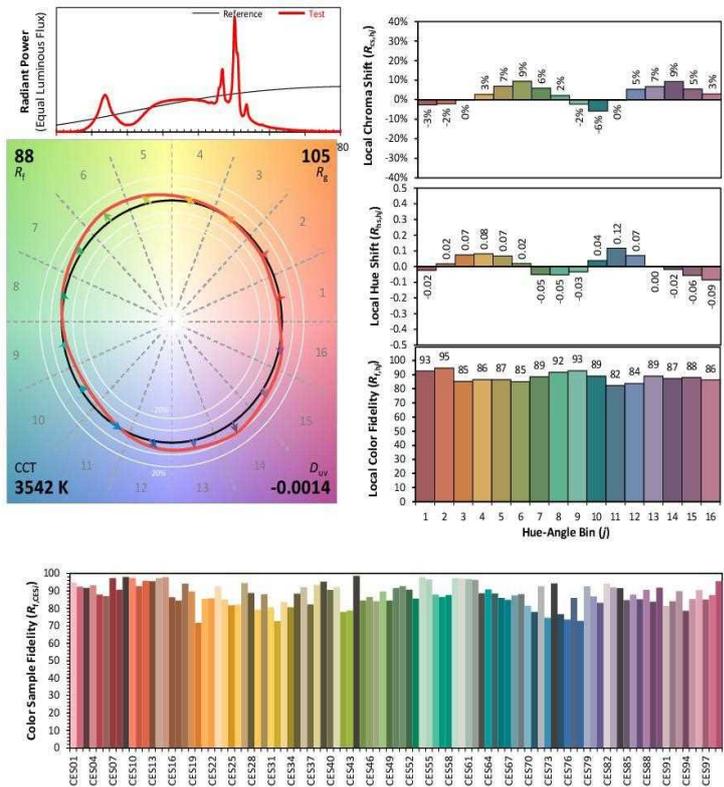


## Integrating Sphere Test (Cont'd)

### TM-30 Report

#### ANSI/IES TM-30-18 Color Rendition Report

Source: BXFN-(A)G-11L-3A      Manufacturer: Fulham Co., Inc.  
 Date: 11/26/2022      Model: VTR-24-MU-45-9TW-A



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

x	0.4016	CIE 13.3-1995 (CRI)	
y	0.3856		
$u'$	0.2354		
$v'$	0.5085		
		$R_a$	92
		$R_g$	85

Colors are for visual orientation purposes only. Created with the ANSI/IES TM-30-18 Calculator Version 2.00.



## Goniophotometer Test

<b>Model No.</b>	VTR-24-MU-45-9TW-A	<b>Sample ID.</b>	5475176
<b>Operate time (Min.)</b>	90	<b>Stabilization time (Min.)</b>	45

### Test Method

- 1.The sample was tested according to the IES LM-79-2008, and the product is assume to be brand new without seasoning.
- 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. The reference standard lamp is rated current 3.8581A, 3.8558A, 3.8466A omni-directional Incandescent lamp and was calibrated by National Institute of Metrology P.R.China.
- 4.The samples were operated at rated voltage and was stabilized before measurement. Luminous flux, luminaire efficacy, zonallumen were calculated from the software taken at 1° vertical intervals and 22.5° horizontal intervals. Photometric distance was more than five times of the largest dimension of the test SSL product.

### Goniophotometer Test Conditions

Temperature (°C)	Voltage (Vac)	Frequency (Hz)	Current (A)	Power (W)	Power Factor	Current THD	Orientation
24.6	120.08	60	0.3779	45.04	0.9927	10.01%	Horizontal

### Test Results

Luminous Flux (lm)	Zonal Lumen Requirement 1	Zonal Lumen Requirement 2	Beam Angle (50%)		Luminous Efficacy (lm/W)
	0°-60°	N/A	Horizontal Spread	Vertical Spread	
5518.1	76.10%	N/A	117.2	106.9	122.52

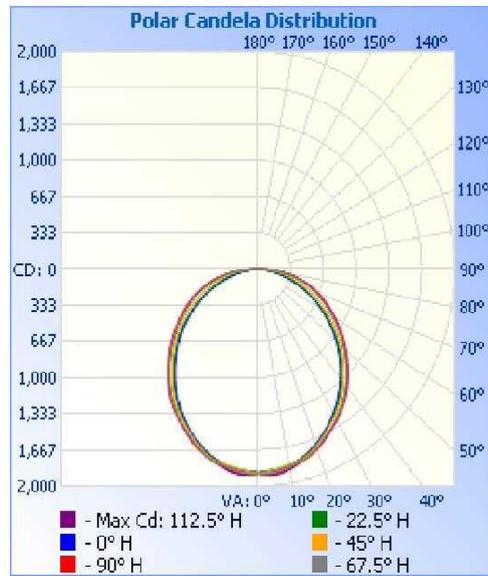
Backlight	Uplight	Glare
N/A	N/A	N/A

UGR		Spacing Criteria (0-180°)	Spacing Criteria (90°-270°)
Crosswise	Endwise		
19.3	21.8	1.22	1.28

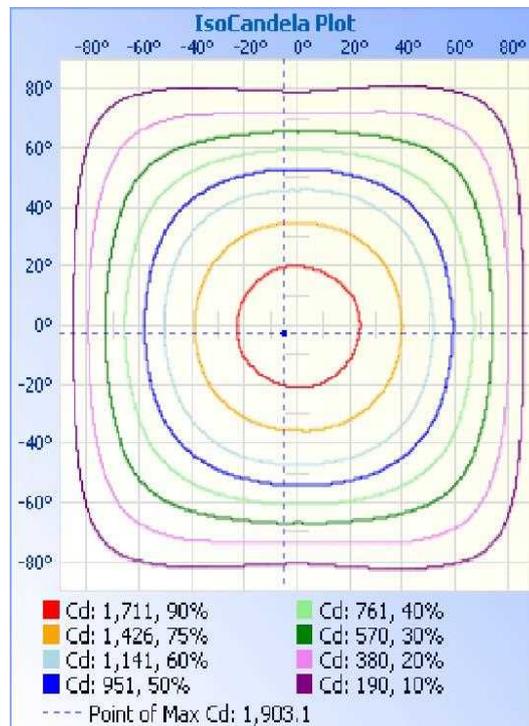


## Goniophotometer Test (Cont'd)

### Polar Candela Distribution



### IsoCandela Plot





**Goniophotometer Test (Cont'd)**  
Zonal Lumen Summary

Zonal Lumen Summary		
Zone	Lumens	% Luminaire
0-30	1452.4	26.30%
0-40	2373.8	43.00%
0-60	4199.3	76.10%
60-90	1302.8	23.60%
70-100	616.6	11.20%
90-120	6.5	0.10%
0-90	5502.1	99.70%
90-180	16.0	0.30%
0-180	5518.1	100.00%

Lumens Per Zone

Lumens Per Zone					
Zone	Lumens	%Total	Zone	Lumens	%Total
0-5	45.0	0.80%	90-95	1.9	0.00%
5-10	133.5	2.40%	95-100	1.2	0.00%
10-15	217.0	3.90%	100-105	1.0	0.00%
15-20	292.1	5.30%	105-110	0.9	0.00%
20-25	356.2	6.50%	110-115	0.8	0.00%
25-30	408.6	7.40%	115-120	0.8	0.00%
30-35	448.5	8.10%	120-125	0.8	0.00%
35-40	473.0	8.60%	125-130	0.8	0.00%
40-45	480.6	8.70%	130-135	0.9	0.00%
45-50	473.9	8.60%	135-140	1.0	0.00%
50-55	453.0	8.20%	140-145	1.0	0.00%
55-60	418.0	7.60%	145-150	1.0	0.00%
60-65	371.7	6.70%	150-155	0.9	0.00%
65-70	317.6	5.80%	155-160	0.9	0.00%
70-75	258.1	4.70%	160-165	0.8	0.00%
75-80	192.4	3.50%	165-170	0.7	0.00%
80-85	119.9	2.20%	170-175	0.4	0.00%
85-90	43.1	0.80%	175-180	0.1	0.00%



**Goniophotometer Test (Cont'd)**  
**Intensity Data(cd)**

Candela Table - Type C

	0	22.5	45	67.5	90	112.5	135	157.5	180	202.5	225	247.5	270	292.5	315	337.5	360
0	1877	1877	1877	1877	1877	1877	1877	1877	1877	1877	1877	1877	1877	1877	1877	1877	1877
1	1866	1870	1872	1890	1896	1887	1876	1871	1869	1869	1877	1893	1900	1887	1877	1870	1866
2	1869	1865	1873	1890	1900	1894	1884	1877	1870	1866	1872	1892	1899	1893	1883	1876	1869
3	1868	1859	1868	1888	1900	1899	1891	1880	1868	1863	1868	1889	1901	1899	1892	1881	1868
4	1866	1856	1862	1881	1897	1903	1896	1885	1868	1859	1860	1880	1897	1901	1897	1883	1866
5	1867	1854	1854	1876	1894	1903	1898	1884	1866	1855	1854	1877	1894	1903	1897	1885	1867
6	1866	1851	1849	1869	1890	1902	1897	1882	1863	1853	1848	1872	1888	1900	1895	1884	1866
7	1861	1847	1843	1865	1884	1897	1894	1879	1861	1851	1843	1866	1883	1895	1891	1880	1861
8	1855	1844	1836	1858	1879	1889	1890	1875	1856	1847	1838	1859	1881	1890	1887	1875	1855
9	1851	1838	1829	1850	1873	1882	1880	1868	1852	1843	1836	1851	1874	1882	1881	1866	1851
10	1841	1834	1829	1846	1864	1870	1869	1858	1844	1840	1832	1848	1864	1870	1869	1859	1841
11	1833	1828	1824	1838	1859	1862	1860	1850	1834	1832	1830	1842	1856	1859	1858	1847	1833
12	1823	1821	1823	1834	1848	1846	1846	1836	1824	1824	1827	1838	1852	1849	1845	1836	1823
13	1811	1812	1817	1828	1841	1836	1833	1827	1813	1816	1826	1833	1841	1838	1833	1825	1811
14	1802	1804	1814	1826	1829	1826	1820	1813	1803	1806	1817	1831	1833	1825	1815	1810	1802
15	1788	1791	1806	1819	1821	1813	1804	1797	1790	1796	1811	1825	1824	1814	1803	1795	1788
16	1773	1779	1794	1812	1813	1800	1789	1780	1777	1785	1801	1816	1813	1802	1788	1778	1773
17	1760	1765	1781	1804	1803	1787	1774	1765	1765	1773	1787	1807	1803	1787	1771	1764	1760
18	1746	1752	1768	1788	1792	1777	1761	1751	1749	1758	1771	1793	1794	1775	1757	1750	1746
19	1732	1738	1753	1774	1779	1766	1745	1737	1734	1744	1755	1778	1783	1763	1744	1733	1732
20	1715	1725	1736	1758	1768	1752	1732	1722	1719	1727	1739	1760	1768	1752	1728	1717	1715
25	1629	1639	1648	1670	1685	1682	1660	1642	1635	1646	1655	1676	1689	1683	1659	1638	1629
30	1532	1546	1565	1594	1606	1596	1573	1549	1537	1552	1573	1598	1607	1596	1573	1546	1532
35	1424	1441	1472	1506	1518	1503	1470	1445	1432	1451	1482	1513	1522	1503	1470	1438	1424
40	1305	1321	1350	1391	1412	1399	1362	1329	1314	1330	1360	1398	1415	1399	1359	1322	1305
45	1177	1192	1227	1269	1292	1276	1240	1207	1184	1202	1237	1278	1294	1278	1239	1200	1177
50	1042	1062	1103	1149	1168	1147	1105	1071	1052	1076	1119	1163	1176	1152	1104	1064	1042
55	898	919	966	1019	1042	1019	967	926	914	941	996	1035	1053	1024	966	918	898
60	747	770	825	885	912	888	832	782	761	790	844	901	923	895	832	774	747
65	593	617	680	752	784	757	691	634	612	639	703	774	800	769	695	627	593
70	443	469	545	624	657	632	560	489	465	496	571	649	676	645	564	481	443
75	302	334	420	492	521	501	434	353	320	358	446	517	541	513	440	346	302
80	172	212	287	345	371	354	301	229	190	235	316	372	390	365	303	221	172
85	59	97	144	185	204	194	160	114	74	120	169	204	215	196	154	104	59
90	3	2	5	10	17	19	16	9	4	9	16	18	17	11	6	3	3
95	2	2	2	3	3	2	3	2	2	2	2	3	3	2	2	2	2
100	2	2	2	3	2	2	2	2	2	2	2	2	3	2	2	2	2
105	2	2	1	2	2	2	1	2	2	2	2	1	2	2	2	2	2
110	1	1	1	2	1	2	1	2	1	1	1	2	2	2	2	1	1
115	1	2	2	2	2	2	2	1	2	2	1	2	2	1	1	2	1
120	1	1	2	2	2	2	1	2	2	2	1	2	1	2	1	1	1
125	2	1	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2
130	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
135	2	2	2	3	2	3	3	2	2	3	3	2	3	3	3	3	2
140	3	2	3	3	3	3	3	2	2	3	3	3	3	3	3	3	3
145	3	3	4	4	4	3	3	3	3	3	3	3	3	3	3	3	3
150	4	4	4	4	4	4	3	4	4	4	3	4	3	4	3	3	4
155	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
160	5	4	5	4	4	4	4	4	4	5	5	4	4	4	5	5	5
165	6	6	6	6	5	5	5	5	6	5	6	6	6	5	5	5	6
170	6	6	6	6	6	6	6	6	6	6	6	6	6	7	6	6	6
175	6	6	6	6	6	6	6	6	7	6	6	7	7	6	6	6	6
180	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6



## Goniophotometer Test

<b>Model No.</b>	VTR-24-MU-45-9TW-A	<b>Sample ID.</b>	5475176
<b>Operate time (Min.)</b>	90	<b>Stabilization time (Min.)</b>	45

### Test Method

- 1.The sample was tested according to the IES LM-79-2008, and the product is assume to be brand new without seasoning.
- 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. The reference standard lamp is rated current 3.8581A, 3.8558A, 3.8466A omni-directional Incandescent lamp and was calibrated by National Institute of Metrology P.R.China.
- 4.The samples were operated at rated voltage and was stabilized before measurement. Luminous flux, luminaire efficacy, zonallumen were calculated from the software taken at 1° vertical intervals and 22.5° horizontal intervals. Photometric distance was more than five times of the largest dimension of the test SSL product.

### Goniophotometer Test Conditions

Temperature (°C)	Voltage (Vac)	Frequency (Hz)	Current (A)	Power (W)	Power Factor	Current THD	Orientation
24.5	120.09	60	0.3774	45.01	0.9928	9.96%	Horizontal

### Test Results

Luminous Flux (lm)	Zonal Lumen Requirement 1	Zonal Lumen Requirement 2	Beam Angle (50%)		Luminous Efficacy (lm/W)
	0°-60°	N/A	Horizontal Spread	Vertical Spread	
5773.8	76.00%	N/A	117.4	107.2	128.28

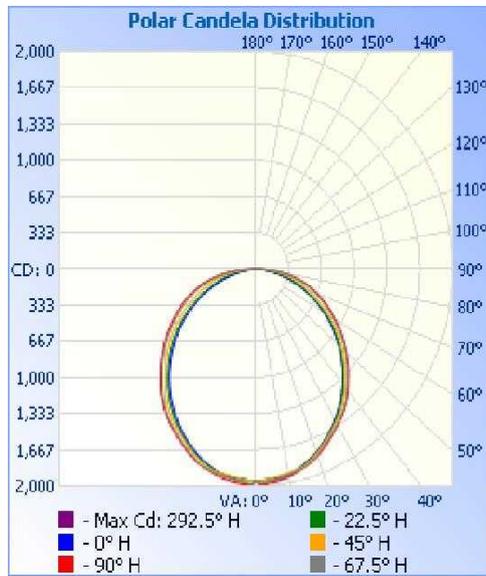
Backlight	Uplight	Glare
N/A	N/A	N/A

UGR		Spacing Criteria (0-180°)	Spacing Criteria (90°-270°)
Crosswise	Endwise		
19.8	21.8	1.24	1.28

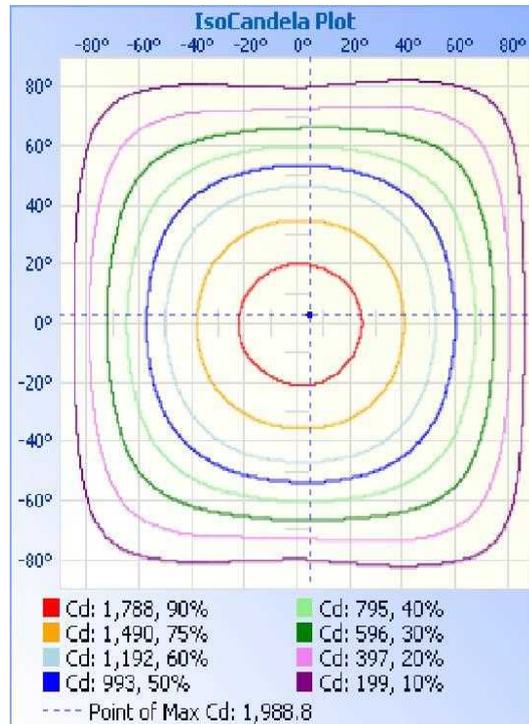


### Goniophotometer Test (Cont'd)

#### Polar Candela Distribution



#### IsoCandela Plot





**Goniophotometer Test (Cont'd)**  
Zonal Lumen Summary

Zonal Lumen Summary		
Zone	Lumens	% Luminaire
0-30	1516.7	26.30%
0-40	2479.9	43.00%
0-60	4390.1	76.00%
60-90	1366.9	23.70%
70-100	648.5	11.20%
90-120	6.9	0.10%
0-90	5757.0	99.70%
90-180	16.8	0.30%
0-180	5773.8	100.00%

Lumens Per Zone

Lumens Per Zone					
Zone	Lumens	%Total	Zone	Lumens	%Total
0-5	46.9	0.80%	90-95	2.1	0.00%
5-10	139.3	2.40%	95-100	1.3	0.00%
10-15	226.5	3.90%	100-105	1.1	0.00%
15-20	305.0	5.30%	105-110	0.8	0.00%
20-25	372.0	6.40%	110-115	0.8	0.00%
25-30	427.0	7.40%	115-120	0.8	0.00%
30-35	468.7	8.10%	120-125	0.9	0.00%
35-40	494.5	8.60%	125-130	0.9	0.00%
40-45	502.6	8.70%	130-135	0.9	0.00%
45-50	495.6	8.60%	135-140	1.0	0.00%
50-55	474.1	8.20%	140-145	1.1	0.00%
55-60	437.8	7.60%	145-150	1.0	0.00%
60-65	389.2	6.70%	150-155	1.0	0.00%
65-70	332.6	5.80%	155-160	0.9	0.00%
70-75	270.7	4.70%	160-165	0.8	0.00%
75-80	202.2	3.50%	165-170	0.7	0.00%
80-85	126.2	2.20%	170-175	0.5	0.00%
85-90	46.1	0.80%	175-180	0.2	0.00%



**Goniophotometer Test (Cont'd)**  
**Intensity Data(cd)**

Candela Table - Type C

	0	22.5	45	67.5	90	112.5	135	157.5	180	202.5	225	247.5	270	292.5	315	337.5	360
0	1957	1957	1957	1957	1957	1957	1957	1957	1957	1957	1957	1957	1957	1957	1957	1957	1957
1	1949	1949	1957	1970	1983	1967	1955	1951	1945	1950	1953	1975	1982	1967	1959	1953	1947
2	1951	1946	1951	1972	1981	1975	1962	1955	1945	1947	1953	1975	1983	1974	1967	1957	1947
3	1952	1942	1949	1968	1982	1977	1968	1959	1947	1943	1950	1971	1985	1981	1974	1962	1951
4	1949	1937	1940	1959	1975	1982	1977	1961	1948	1939	1946	1964	1982	1985	1981	1968	1950
5	1950	1934	1932	1954	1972	1984	1979	1964	1948	1934	1938	1960	1978	1989	1982	1968	1948
6	1944	1932	1925	1949	1969	1979	1978	1963	1945	1934	1931	1956	1977	1988	1980	1965	1946
7	1940	1928	1919	1943	1963	1973	1973	1961	1942	1931	1926	1947	1972	1983	1979	1963	1944
8	1936	1924	1913	1934	1956	1966	1967	1955	1936	1927	1919	1944	1966	1976	1974	1959	1937
9	1932	1920	1907	1926	1947	1957	1958	1947	1930	1923	1914	1938	1960	1967	1966	1948	1932
10	1924	1915	1906	1922	1941	1945	1949	1940	1921	1917	1915	1931	1955	1959	1953	1942	1924
11	1914	1906	1901	1914	1932	1935	1935	1927	1914	1916	1913	1929	1945	1945	1942	1929	1915
12	1906	1900	1900	1910	1922	1923	1923	1916	1903	1908	1909	1923	1940	1938	1933	1920	1904
13	1892	1890	1892	1905	1912	1911	1906	1903	1893	1897	1907	1921	1930	1924	1918	1904	1892
14	1878	1878	1888	1897	1900	1899	1893	1886	1880	1888	1901	1914	1919	1913	1905	1893	1881
15	1867	1868	1882	1892	1892	1884	1874	1872	1867	1878	1893	1910	1910	1902	1889	1878	1869
16	1853	1857	1868	1885	1883	1871	1859	1858	1856	1862	1881	1904	1903	1887	1873	1862	1853
17	1838	1843	1854	1873	1871	1855	1843	1840	1840	1851	1870	1894	1895	1874	1857	1846	1838
18	1824	1829	1839	1859	1858	1844	1828	1822	1824	1839	1857	1878	1884	1864	1844	1832	1826
19	1811	1812	1823	1842	1848	1831	1814	1806	1809	1826	1843	1865	1874	1854	1831	1815	1810
20	1796	1797	1806	1825	1836	1818	1798	1792	1793	1810	1826	1848	1860	1841	1817	1799	1796
25	1704	1711	1717	1735	1748	1742	1723	1704	1705	1720	1736	1764	1778	1768	1746	1718	1706
30	1605	1612	1627	1651	1662	1650	1631	1610	1605	1626	1654	1684	1698	1683	1656	1626	1607
35	1494	1505	1532	1560	1568	1550	1522	1497	1491	1519	1557	1594	1607	1590	1550	1514	1493
40	1373	1380	1403	1440	1457	1444	1406	1376	1368	1394	1433	1478	1501	1485	1438	1397	1373
45	1241	1245	1273	1312	1329	1314	1278	1247	1233	1262	1304	1353	1374	1356	1315	1269	1241
50	1102	1109	1145	1188	1202	1180	1136	1104	1093	1126	1179	1232	1249	1224	1174	1129	1102
55	953	967	1008	1053	1069	1045	992	951	941	978	1038	1096	1121	1094	1034	980	954
60	798	817	858	912	932	906	847	797	785	822	890	958	989	960	893	830	799
65	640	653	707	774	799	770	701	643	623	662	742	824	859	826	749	678	642
70	486	500	569	642	668	638	563	490	466	510	601	692	728	698	612	528	486
75	338	362	439	504	530	502	431	347	317	368	472	553	586	560	483	387	339
80	199	232	303	358	374	350	293	217	181	238	330	397	425	404	343	255	201
85	79	114	159	193	204	185	144	99	62	114	171	217	238	227	188	132	79
90	5	9	16	18	16	10	6	3	3	3	8	16	24	26	23	12	6
95	2	2	3	3	3	3	3	2	2	2	3	3	3	3	3	2	2
100	2	2	2	2	3	2	2	2	2	2	2	2	2	3	2	2	2
105	2	1	2	2	2	2	2	2	1	2	2	2	2	2	2	1	1
110	1	1	1	2	2	2	2	2	2	1	2	2	1	2	1	1	2
115	2	2	2	1	1	2	2	1	1	1	2	2	2	2	2	1	2
120	2	2	2	2	2	2	2	1	2	2	1	2	2	2	2	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	3	2	2	2	2	2	2	2	2	2	2	2
135	3	2	2	2	3	2	3	2	3	2	2	2	2	3	2	2	3
140	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
145	3	3	4	3	3	3	3	4	3	4	3	3	4	4	3	3	3
150	4	3	4	4	3	3	3	4	4	4	4	3	4	4	4	3	4
155	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
160	5	5	5	5	4	4	5	4	4	4	4	4	4	5	5	5	4
165	6	6	5	6	5	6	6	6	6	6	6	6	6	6	5	5	6
170	7	6	6	7	6	7	7	7	6	6	7	7	6	6	6	7	6
175	6	6	6	6	7	7	6	6	7	6	7	7	6	6	7	7	7
180	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7



### THD and PF Test

<b>Model No.</b>	VTR-24-MU-45-9TW-A	<b>Sample ID.</b>	5475176
<b>Operate time (Min.)</b>	90	<b>Stabilization time (Min.)</b>	45

#### Test Method

1. The samples were tested according to the ANSI C82.77-10-2014.  
 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 (Hz)	Current (A)	Power (W)	Power Factor	Current THD	Orientation
24.6	120.08	60	0.3779	45.04	0.9927	10.01%	Horizontal
24.6	277.12	60	0.1681	45.41	0.9749	8.34%	Horizontal



### THD and PF Test

<b>Model No.</b>	VTR-24-MU-45-9TW-A	<b>Sample ID.</b>	5475176
<b>Operate time (Min.)</b>	90	<b>Stabilization time (Min.)</b>	45

#### Test Method

1. The samples were tested according to the ANSI C82.77-10-2014.  
 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 (Hz)	Current (A)	Power (W)	Power Factor	Current THD	Orientation
24.6	120.08	60	0.3551	42.35	0.9932	9.32%	Horizontal
24.6	277.08	60	0.1589	42.78	0.9717	8.61%	Horizontal



### THD and PF Test

<b>Model No.</b>	VTR-24-MU-45-9TW-A	<b>Sample ID.</b>	5475176
<b>Operate time (Min.)</b>	90	<b>Stabilization time (Min.)</b>	45

#### Test Method

1. The samples were tested according to the ANSI C82.77-10-2014.  
 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 (Hz)	Current (A)	Power (W)	Power Factor	Current THD	Orientation
24.6	120.08	60	0.3774	45.01	0.9928	9.96%	Horizontal
24.6	277.05	60	0.1676	45.26	0.9746	8.38%	Horizontal



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#### Test Method

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 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 (Hz)	Current (A)	Power (W)	Power Factor	Current THD	Orientation
24.6	120.09	60	0.3286	39.10	0.9909	11.13%	Horizontal
24.6	277.06	60	0.1500	40.26	0.9686	8.84%	Vertical



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<b>Operate time (Min.)</b>	90	<b>Stabilization time (Min.)</b>	45

#### Test Method

1. The samples were tested according to the ANSI C82.77-10-2014.  
 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 (Hz)	Current (A)	Power (W)	Power Factor	Current THD	Orientation
24.6	119.97	60	0.2834	33.65	0.9885	12.34%	Horizontal
24.6	277.06	60	0.1334	35.48	0.9600	9.72%	Horizontal



## In-Situ Temperature Measurement Test

<b>Model No.</b>	VTR-24-MU-45-9TW-A	<b>Sample ID.</b>	5475176
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### Test Method

1. In-Situ Temperature Measurement Test is conducted according to the UL 1598-2008, Section 14.
2. 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. Thermocouples were placed on the LED driver case in the locations specified by the manufacture if necessary. The temperature was recorded after the lamp was operated by 7.5 hours.
3. The data and photos in LM-80 test report is provided by the customer/ The data and photos in driver specification is provided by the customer.

### In-Situ Temperature Measurement Test Conditions

Temperature (°C)	Voltage (Vac)	Frequency (Hz)	Current (A)	Power (W)	Power Factor	Current THD	Orientation
23.2	120.08	60	0.3779	45.04	0.9927	10.01%	Horizontal

### Test Results (LEDs)

Thermocouple Location	Declared Light Source Current (mA)	Temperature for Light Source (°C)		Max Chromaticity Shift (1000-6000h)	LED Model Number	LM-80 Limit Current (mA)	LM-80 Limit Temp (°C)
		Test Result	Test Result (Correct to 25 °C)				
Ambient TEMP	N/A	23.2	25.0				
TMP of Location 1	120	45.6	47.4	0.0014	BXFN-(A)G-11L-3A	150	105

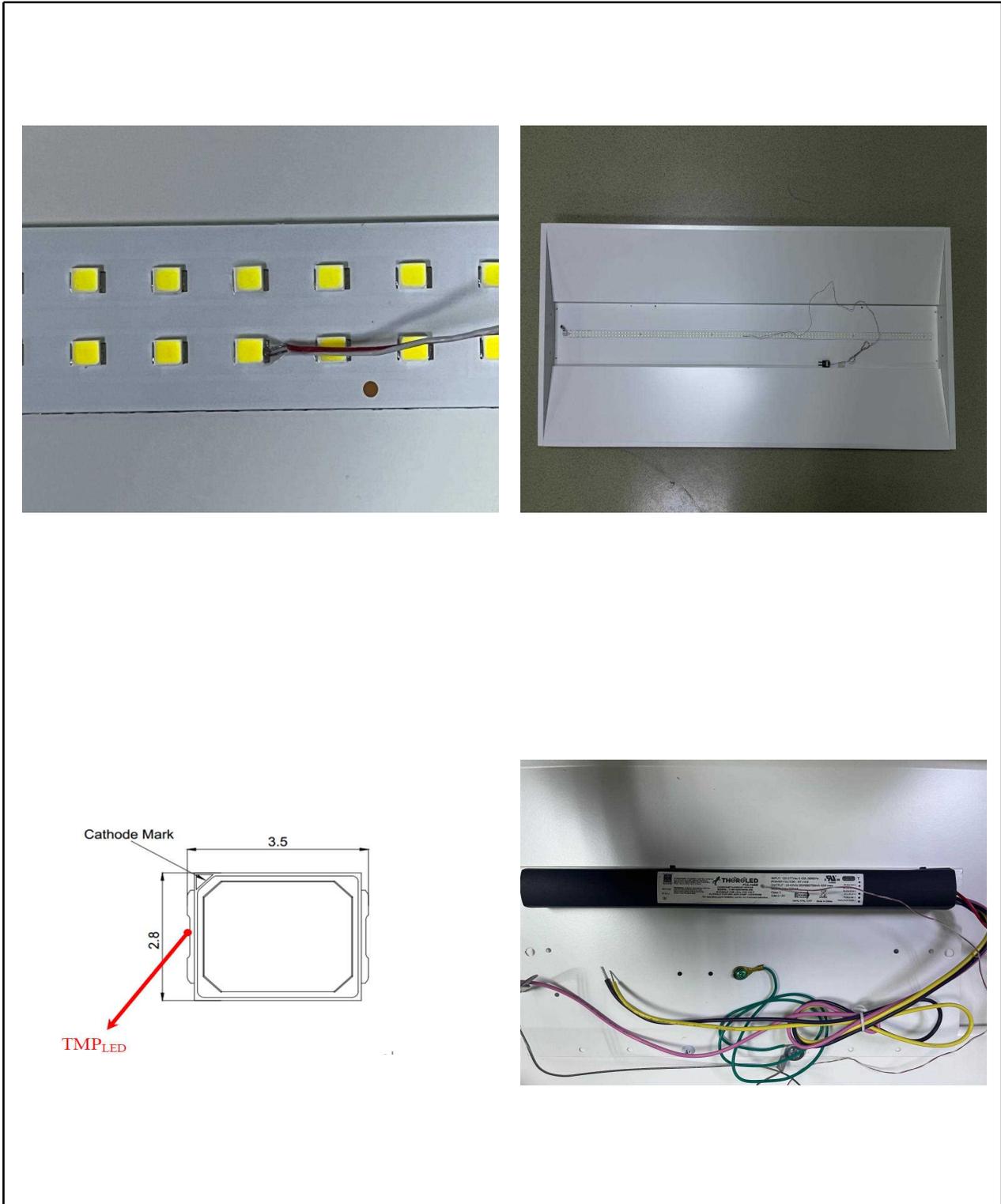
### Test Results (Drivers)

Thermocouple Location	Temperature for Driver (°C)		Driver Model Number	Driver Limit Temp (°C)
	Test Result	Test Result (Correct to 25 °C)		
Ambient TEMP	23.2	25.0		
TMP of Location 1	56.7	58.5	T1M1UNV095S-40L	90



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

Test Photos for Ts Point of Light Sources & Tc Point of Drivers





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