

# Photometric Test Report

## Relevant Standards

- ☒ IES LM-79-2008
- ☒ ANSI C82.77:2017

## Prepared For

**RAB Lighting Inc.**

Room 6A33, No.1388, Wuzhong road, Shanghai, China

Xiao Xiang, 15921313292, Gary.Xiao@rabweb.com

## Prepared By

**Deliver Co., Ltd.**

Block 11, 78 Keling Road, SSTP, Suzhou, China

0512-66801950, kevin.jia@szdeliver.com

## Project Number

**DLF2207110**

## Report Number

**DLF2207110-3a**

## Test Date

**2022/7/30**

## Issue Date

**2022/7/31**

## Prepared By



Wangzun Zhu

## Approved By



Kevin Jia

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## 1.0 Test Summary

DLC Technical Requirements v5.1

| Indoor - Linear Ambient - Direct Linear Ambient Luminaires                  |                                 |                      |                |            |
|---|---------------------------------|----------------------|----------------|------------|
| Requirement Category  | Test Method                     | Requirements         |                | Test value |
| Luminaire Output (lm)<br>(Goniophotometer - Section 4.2)                    | IES LM-79-2008                  | 1500                 |                | 1629       |
| Lumen/ft<br>(Goniophotometer - Section 4.2)                                 | IES LM-79-2008                  | ≥375                 |                | 814        |
| Minimum Luminaire Efficacy (lm/W)<br>(Goniophotometer - Section 4.2)        | IES LM-79-2008                  | Standard<br>115      | Premium<br>130 | 130.3      |
| Power (Input Wattage) (W)<br>(Goniophotometer - Section 4.2)                | IES LM-79-2008                  | Wrost Case           |                | 12.5       |
| Total Harmonic Distortion (A%)<br>(THD & PF - section 4.3)                  | ANSI C82.77:2014                | 20.00%               | 120V           | 7.67%      |
|   |                                 | 20.00%               | 277V           | 6.15%      |
| Power Factor<br>(THD & PF - section 4.3)                                    | ANSI C82.77:2014                | 0.9                  | 120V           | 0.996      |
|   |                                 | 0.9                  | 277V           | 0.936      |
| Allowable CCTs* (K)<br>(Integrating Sphere - Section 4.1)                   | IES LM-79-2008                  | 7 step               | 3985±275       | 3993       |
|   |                                 | 4 step               | 3985±154       |            |
| Minimum CRI<br>(Integrating Sphere - Section 4.1)                           | IES LM-79-2008<br>CIE 13.3-1995 | ≥80                  |                | 84         |
| Minimum R9<br>(Integrating Sphere - Section 4.1)                            | IES LM-79-2008<br>CIE 13.3-1995 | ≥0                   |                | 12         |
| Minimum Rf<br>(Integrating Sphere - Section 4.1)                            | ANSI/IES TM-30-18               | ≥70                  |                | 84         |
| Minimum Rg<br>(Integrating Sphere - Section 4.1)                            | ANSI/IES TM-30-18               | ≥89                  |                | 95         |
| Minimum IES Rcs,h1<br>(Integrating Sphere - Section 4.1)                    | ANSI/IES TM-30-18               | -12%≤IES Rcs,h1≤+23% |                | -11%       |
| Zonal Lumen Requirement (0°-60°)<br>(Goniophotometer - Section 4.2)         | IES LM-79-2008                  | ≥40%                 |                | 48.87%     |
| Corrected UGR<br>(X=4H, Y=8H, 70/50/20%)<br>(Goniophotometer - Section 4.2) | CIE 190-2010                    | <22                  |                | 22.3       |
| Input Voltage (V)   |                                 |                      |                |            |
| (Goniophotometer - Section 4.2)   | IES LM-79-2008                  | Wrost Case           |                | 277        |
| (Goniophotometer - Section 4.2)   |                                 | Non-Wrost Case       |                | 120        |
| Input Current (A)   |                                 |                      |                |            |
| (Goniophotometer - Section 4.2)   | IES LM-79-2008                  | Wrost Case           |                | 0.048      |
| (Goniophotometer - Section 4.2)   |                                 | Non-Wrost Case       |                | 0.097      |
| Power (Input Wattage - W)   |                                 |                      |                |            |
| (Goniophotometer - Section 4.2)   | IES LM-79-2008                  | Wrost Case           |                | 12.5       |
| (Goniophotometer - Section 4.2)   |                                 | Non-Wrost Case       |                | 11.6       |

## 2.0 Test List

| Test Item | Test                    | Test Date | Model Number     | Sample No. |
|-----------|-------------------------|-----------|------------------|------------|
| 1         | Integrating Sphere Test | 2022/7/30 | TOMO-2/12W/4000K | C1         |
| 2         | Goniophotometer Test    | 2022/7/30 | TOMO-2/12W/4000K | C1         |
| 3         | THD and PF Test         | 2022/7/30 | TOMO-2/12W/4000K | C1         |

### Remark(If any)

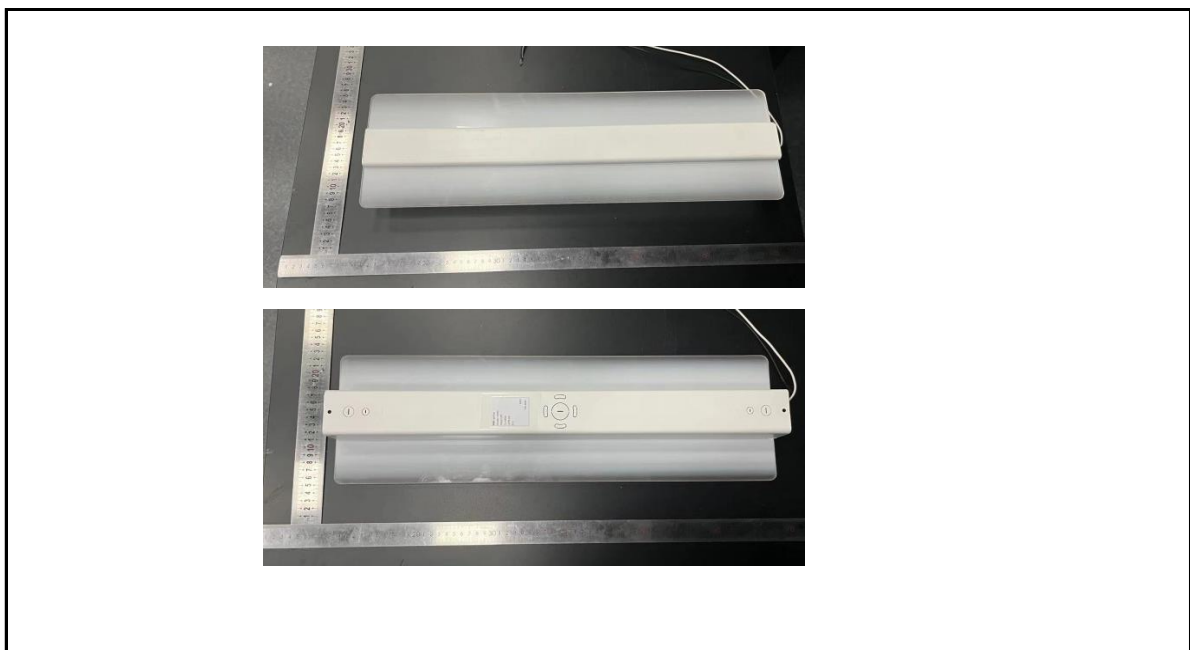
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## 3.0 Production Description

**Luminaire Description:** TOMO-2/12W/4000K

**Electrical Specification:** 120V-277V,50/60HZ

### Photos of Luminaire Characteristics



## 4.0 LM-79 Measurement and Test Results

### 4.1 Integrating Sphere Test

|                     |                  |                           |      |
|---------------------|------------------|---------------------------|------|
| Model No.           | TOMO-2/12W/4000K | Sample ID.                | C1   |
| Operate time (Min.) | 90               | Stabilization time (Min.) | 45   |
| Temperature (°C)    | 25.3             | Humidity (%RH)            | 56.0 |

#### Test Method

The samples were 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  $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$ .

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 voltage of an AC power supply (RMS voltage) or DC power supply (instantaneous voltage) applied to the device under test shall be regulated to within  $\pm 0.2$  percent under load.

The sample was measured using  $4\pi$  geometry and 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.

#### Test Result

| Voltage (Vac) | Frequency (Hz) | Current (A) | Power (W) | Power Factor |
|---------------|----------------|-------------|-----------|--------------|
| 119.99        | 60             | 0.096       | 11.5      | 0.996        |
| 276.99        | 60             | 0.048       | 12.4      | 0.936        |

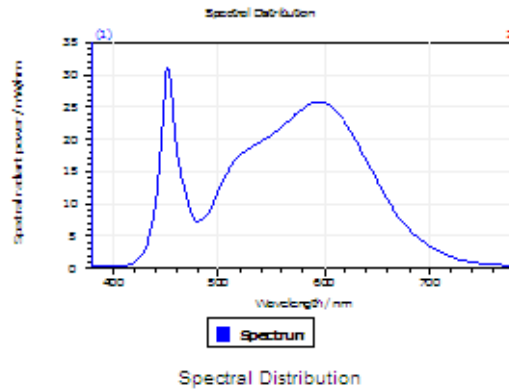
#### Test Result

| CCT (K) | CRI | R9 | Duv     |
|---------|-----|----|---------|
| 3993    | 84  | 12 | 0.00081 |

| Rf | Rg | IES Rcs,h1 |
|----|----|------------|
| 84 | 95 | -11%       |

## 4.1 Integrating Sphere Test

### Results



#### Spectral values

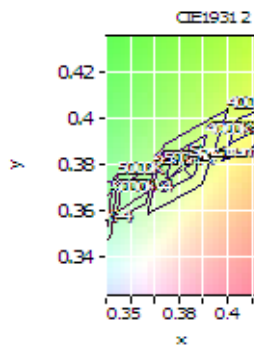
DominantWavelength 578.66 nm  
Purity 0.282  
PeakWavelength 452.05 nm  
Radiant Power 4.528 W  
Width50%:

#### Color Coordinates

Correlated Color Temperat 3993 K  
x: 0.3813 u: 0.2248 u': 0.2248  
y: 0.3790 v: 0.3351 v': 0.5027

|       |      |       |      |
|-------|------|-------|------|
| CRI01 | 82.2 | CRI09 | 12.1 |
| CRI02 | 89.7 | CRI10 | 75.1 |
| CRI03 | 94.9 | CRI11 | 81.6 |
| CRI04 | 82.5 | CRI12 | 59.5 |
| CRI05 | 81.9 | CRI13 | 84.1 |
| CRI06 | 85.3 | CRI14 | 97.4 |
| CRI07 | 86.8 | CRI15 | 76.0 |
| CRI08 | 66.0 | CRI16 | 73.5 |

ResultsCRI 83.7



PlanckDistance 8.1E-004

## 4.1 Integrating Sphere Test

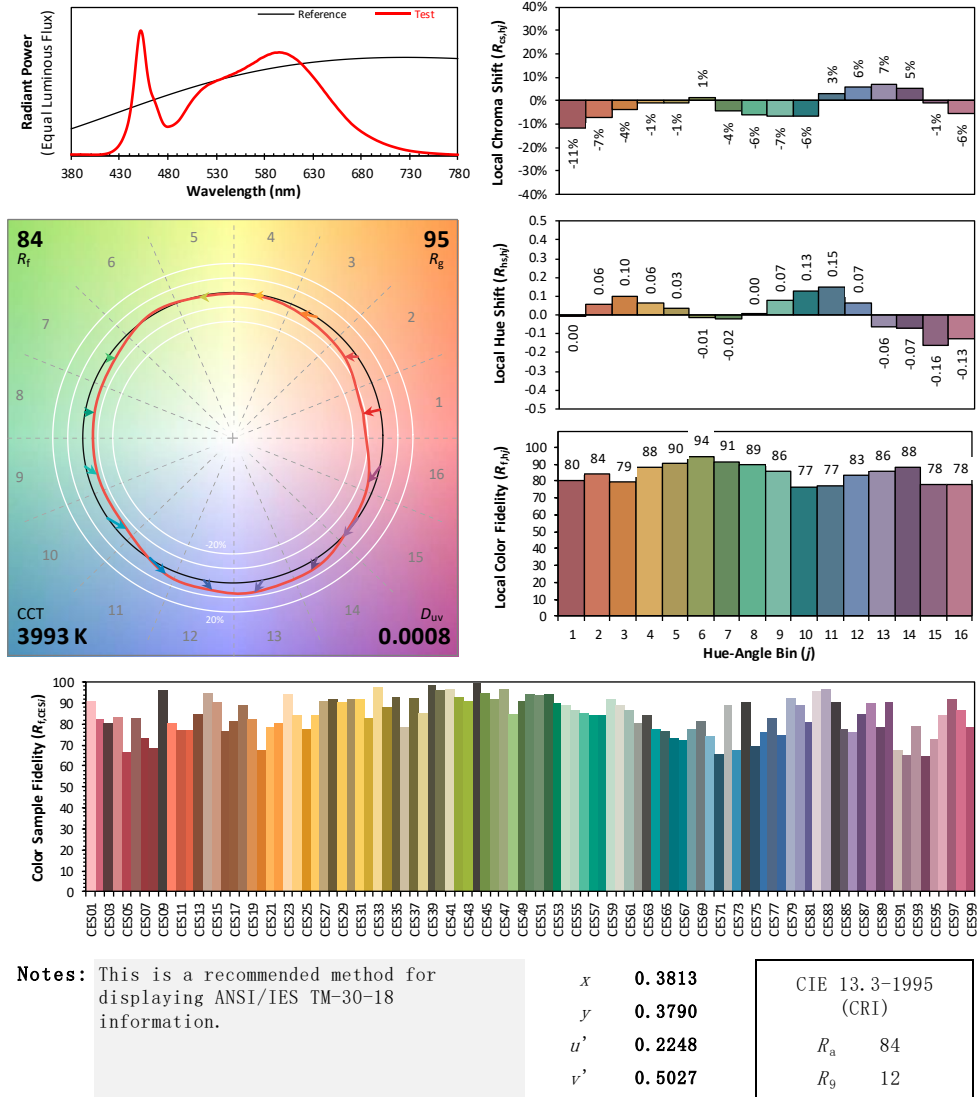
### IES TM-30-18 Color Rendition Report

Source: DLF2207110-3a

Manufacturer: RAB Lighting Inc.

Date: 2022/7/30

Model: TOMO-2/12W/4000K



## 4.0 LM-79 Measurement and Test Results

### 4.2 Goniophotometer Test

|                     |                  |                           |      |
|---------------------|------------------|---------------------------|------|
| Model No.           | TOMO-2/12W/4000K | Sample ID.                | C1   |
| Operate time (Min.) | 90               | Stabilization time (Min.) | 45   |
| Temperature (°C)    | 25.3             | Humidity (%RH)            | 54.0 |

#### Test Method

The samples were tested according to the IES LM-79-2008.

Photometric parameters were measured using a type C goniophotometer and software.

The ambient temperature shall be maintained at  $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$ , measured at a point not more than 1 m from the sample and at the same height as the sample.

The voltage of an AC power supply (RMS voltage) or DC power supply (instantaneous voltage) applied to the device under test shall be regulated to within  $\pm 0.2$  percent under load.

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  $0.5^{\circ}$  vertical intervals and  $10^{\circ}$  horizontal intervals.

#### Test Conditions

| Condition      | Voltage (Vac) | Frequency (Hz) | Current (A) | Power (W) | Power Factor |
|----------------|---------------|----------------|-------------|-----------|--------------|
| WROST CASE     | 277.07        | 60             | 0.048       | 12.5      | 0.933        |
| NON-WROST CASE | 120.03        | 60             | 0.097       | 11.6      | 0.996        |

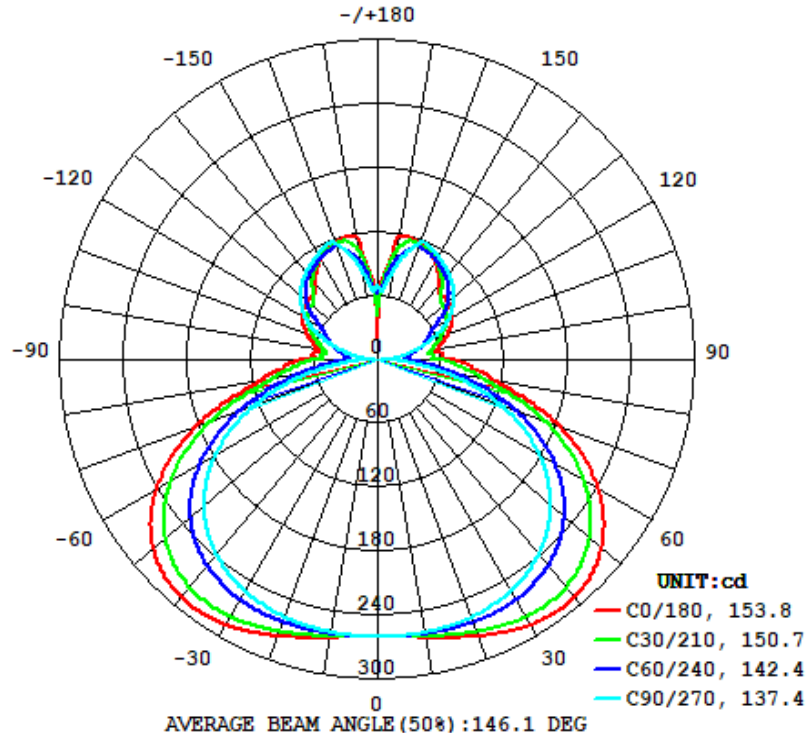
#### Test Result

| Flux (lm) | Field Angle(10%) |         | Beam Angle(50%) |         | Luminous Efficacy (lm/W) |
|-----------|------------------|---------|-----------------|---------|--------------------------|
|           | C0-180           | C90-270 | C0-180          | C90-270 |                          |
| 1629      | 358.2            | 360.0   | 153.8           | 137.4   | 130.3                    |

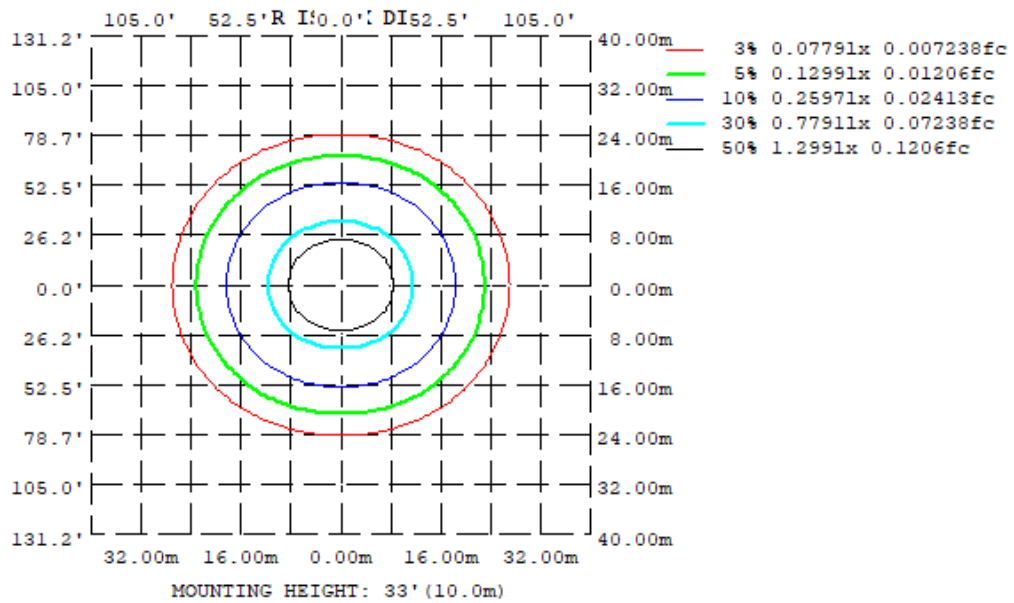
| Zonal Lumen Requirement ( $0^{\circ}$ - $60^{\circ}$ ) | UGR (X=4H, Y=8H, 70/50/20%) | Length(ft) | Lumen/ft |
|--|-----------------------------|------------|----------|
| 48.87%   | 22.3                        | 2.00       | 814      |

## 4.2 Goniophotometer Test

### Light Distrubtion Curve



### Isolux Plot





## 4.2 Goniophotometer Test

### Zonal Lumen Summary

| $\gamma$ | C0                    | C45   | C90   | C135  | C180  | C225  | C270  | C315  |
|----------|-----------------------|-------|-------|-------|-------|-------|-------|-------|
| 10       | 264.8                 | 262.3 | 259.7 | 262.3 | 264.8 | 262.3 | 259.7 | 262.3 |
| 20       | 276.1                 | 267.1 | 257.3 | 267.1 | 276.1 | 267.1 | 257.3 | 267.1 |
| 30       | 287.4                 | 269.7 | 251.0 | 269.7 | 287.4 | 269.7 | 251.0 | 269.7 |
| 40       | 290.2                 | 264.7 | 237.8 | 264.7 | 290.2 | 264.7 | 237.8 | 264.7 |
| 50       | 276.1                 | 246.3 | 214.2 | 246.3 | 276.1 | 246.3 | 214.2 | 246.3 |
| 60       | 241.0                 | 209.1 | 176.5 | 209.1 | 241.0 | 209.1 | 176.5 | 209.1 |
| 70       | 182.4                 | 153.1 | 122.5 | 153.1 | 182.4 | 153.1 | 122.5 | 153.1 |
| 80       | 110.8                 | 88.52 | 57.26 | 88.52 | 110.8 | 88.52 | 57.26 | 88.52 |
| 90       | 67.68                 | 43.97 | 4.089 | 43.97 | 67.68 | 43.97 | 4.089 | 43.97 |
| 100      | 58.03                 | 43.68 | 20.99 | 43.68 | 58.03 | 43.68 | 20.99 | 43.68 |
| 110      | 71.23                 | 56.79 | 51.92 | 56.79 | 71.23 | 56.79 | 51.92 | 56.79 |
| 120      | 82.67                 | 68.83 | 78.60 | 68.83 | 82.67 | 68.83 | 78.60 | 68.83 |
| 130      | 87.21                 | 79.42 | 95.35 | 79.42 | 87.21 | 79.42 | 95.35 | 79.42 |
| 140      | 91.28                 | 99.76 | 106.2 | 99.76 | 91.28 | 99.76 | 106.2 | 99.76 |
| 150      | 109.2                 | 110.7 | 114.5 | 110.7 | 109.2 | 110.7 | 114.5 | 110.7 |
| 160      | 117.8                 | 116.2 | 116.2 | 116.2 | 117.8 | 116.2 | 116.2 | 116.2 |
| 170      | 116.7                 | 97.06 | 85.08 | 97.06 | 116.7 | 97.06 | 85.08 | 97.06 |
| 180      | 20.63                 | 54.87 | 70.21 | 54.87 | 20.63 | 54.87 | 70.21 | 54.87 |
| DEG      | LUMINOUS INTENSITY:cd |       |       |       |       |       |       |       |

### UGR Table - Corrected

#### UGR Table - Corrected

|                |                      |      |      |      |      |                    |      |      |      |      |  |
|----------------|----------------------|------|------|------|------|--------------------|------|------|------|------|--|
| Reflectances   |                      |      |      |      |      |                    |      |      |      |      |  |
| Ceiling Cavity | 70                   | 70   | 50   | 50   | 30   | 70                 | 70   | 50   | 50   | 30   |  |
| Walls          | 50                   | 30   | 50   | 30   | 30   | 50                 | 30   | 50   | 30   | 30   |  |
| Floor Cavity   | 20                   | 20   | 20   | 20   | 20   | 20                 | 20   | 20   | 20   | 20   |  |
| Room Size      |                      |      |      |      |      |                    |      |      |      |      |  |
| X=2H Y=2H      | UGR Viewed Crosswise |      |      |      |      | UGR Viewed Endwise |      |      |      |      |  |
|                | 14.3                 | 15.5 | 15.0 | 16.3 | 17.2 | 15.9               | 17.1 | 16.6 | 17.9 | 18.8 |  |
| 3H             | 16.4                 | 17.5 | 17.2 | 18.3 | 19.2 | 18.4               | 19.5 | 19.2 | 20.3 | 21.2 |  |
| 4H             | 17.2                 | 18.3 | 18.0 | 19.1 | 20.0 | 19.5               | 20.5 | 20.3 | 21.3 | 22.3 |  |
| 6H             | 17.9                 | 18.8 | 18.6 | 19.6 | 20.6 | 20.5               | 21.4 | 21.2 | 22.2 | 23.2 |  |
| 8H             | 18.1                 | 19.0 | 18.9 | 19.8 | 20.8 | 21.0               | 21.9 | 21.8 | 22.7 | 23.7 |  |
| 12H            | 18.2                 | 19.1 | 19.0 | 19.9 | 20.9 | 21.6               | 22.4 | 22.3 | 23.2 | 24.2 |  |
| 4H 2H          | 15.3                 | 16.3 | 16.1 | 17.1 | 18.1 | 16.5               | 17.5 | 17.3 | 18.3 | 19.3 |  |
| 3H             | 17.6                 | 18.5 | 18.4 | 19.3 | 20.3 | 19.2               | 20.1 | 20.0 | 20.9 | 21.9 |  |
| 4H             | 18.5                 | 19.4 | 19.3 | 20.2 | 21.2 | 20.5               | 21.3 | 21.3 | 22.1 | 23.1 |  |
| 6H             | 19.3                 | 20.0 | 20.1 | 20.9 | 21.9 | 21.7               | 22.4 | 22.5 | 23.2 | 24.2 |  |
| 8H             | 19.6                 | 20.2 | 20.4 | 21.1 | 22.1 | 22.3               | 23.0 | 23.1 | 23.8 | 24.8 |  |
| 12H            | 19.7                 | 20.3 | 20.5 | 21.2 | 22.2 | 23.0               | 23.6 | 23.8 | 24.5 | 25.5 |  |
| 8H 4H          | 19.2                 | 19.8 | 20.0 | 20.7 | 21.7 | 20.8               | 21.5 | 21.6 | 22.3 | 23.3 |  |
| 6H             | 20.1                 | 20.7 | 21.0 | 21.6 | 22.6 | 22.2               | 22.8 | 23.0 | 23.6 | 24.6 |  |
| 8H             | 20.5                 | 21.0 | 21.3 | 21.9 | 22.9 | 23.0               | 23.5 | 23.9 | 24.4 | 25.4 |  |
| 12H            | 20.7                 | 21.2 | 21.6 | 22.0 | 23.1 | 23.9               | 24.4 | 24.8 | 25.2 | 26.3 |  |
| 12H 4H         | 19.3                 | 19.9 | 20.1 | 20.8 | 21.8 | 20.8               | 21.4 | 21.7 | 22.3 | 23.3 |  |
| 6H             | 20.4                 | 20.9 | 21.2 | 21.7 | 22.8 | 22.3               | 22.8 | 23.1 | 23.6 | 24.7 |  |
| 8H             | 20.8                 | 21.3 | 21.7 | 22.1 | 23.2 | 23.2               | 23.6 | 24.0 | 24.5 | 25.6 |  |

Maximum UGR = 26.3

## 4.2 Goniophotometer Test

### ZONAL LUMEN SUMMARY

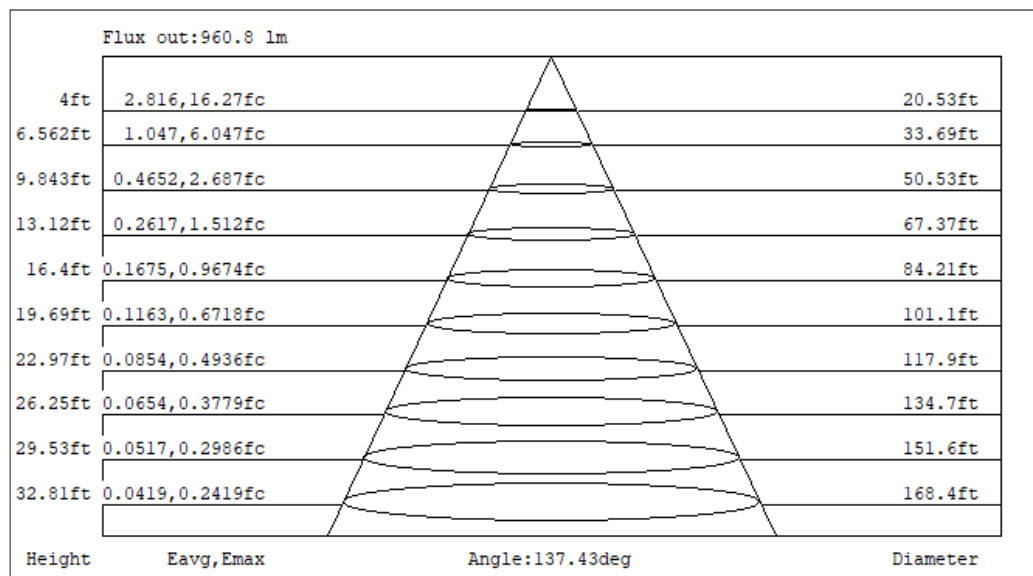
|         | Zonal (lm) |         | Total (lm) | Percent |
|---------|------------|---------|------------|---------|
| 0-10    | 24.95      | 0 - 10  | 24.95      | 1.53%   |
| 10-20   | 75.06      | 0 - 20  | 100.01     | 6.14%   |
| 20-30   | 124.33     | 0 - 30  | 224.34     | 13.77%  |
| 30-40   | 168.17     | 0 - 40  | 392.51     | 24.10%  |
| 40-50   | 198.39     | 0 - 50  | 590.90     | 36.27%  |
| 50-60   | 205.13     | 0 - 60  | 796.03     | 48.87%  |
| 60-70   | 180.76     | 0 - 70  | 976.79     | 59.96%  |
| 70-80   | 125.24     | 0 - 80  | 1102.03    | 67.65%  |
| 80-90   | 66.72      | 0 - 90  | 1168.75    | 71.75%  |
| 90-100  | 42.40      | 0 - 100 | 1211.15    | 74.35%  |
| 100-110 | 51.52      | 0 - 110 | 1262.67    | 77.51%  |
| 110-120 | 65.56      | 0 - 120 | 1328.23    | 81.54%  |
| 120-130 | 72.14      | 0 - 130 | 1400.37    | 85.97%  |
| 130-140 | 71.22      | 0 - 140 | 1471.59    | 90.34%  |
| 140-150 | 65.77      | 0 - 150 | 1537.36    | 94.38%  |
| 150-160 | 52.43      | 0 - 160 | 1589.79    | 97.60%  |
| 160-170 | 31.35      | 0 - 170 | 1621.14    | 99.52%  |
| 170-180 | 7.81       | 0 - 180 | 1628.95    | 100.00% |

## 4.2 Goniophotometer Test

### COEFFICIENTS OF UTILIZATION - ZONAL CAVITY METHOD

| RC | 80  |     |     |     | 70  |     |     |     | 50 |    |    | 30 |    |    | 10 |    |    | 0  |
|----|-----|-----|-----|-----|-----|-----|-----|-----|----|----|----|----|----|----|----|----|----|----|
| RW | 70  | 50  | 30  | 10  | 70  | 50  | 30  | 10  | 50 | 30 | 10 | 50 | 30 | 10 | 50 | 30 | 10 | 0  |
| 0  | 112 | 112 | 112 | 112 | 106 | 106 | 106 | 106 | 95 | 95 | 95 | 85 | 85 | 85 | 76 | 76 | 76 | 72 |
| 1  | 101 | 95  | 90  | 86  | 95  | 90  | 86  | 82  | 81 | 77 | 74 | 72 | 69 | 67 | 64 | 62 | 60 | 56 |
| 2  | 90  | 82  | 74  | 68  | 85  | 77  | 71  | 65  | 69 | 64 | 59 | 62 | 57 | 54 | 55 | 51 | 48 | 45 |
| 3  | 82  | 71  | 62  | 55  | 77  | 67  | 59  | 53  | 60 | 54 | 48 | 53 | 48 | 44 | 47 | 43 | 40 | 36 |
| 4  | 74  | 62  | 53  | 46  | 70  | 59  | 50  | 44  | 52 | 46 | 40 | 47 | 41 | 37 | 42 | 37 | 33 | 30 |
| 5  | 68  | 55  | 45  | 39  | 64  | 52  | 43  | 37  | 46 | 39 | 34 | 41 | 36 | 31 | 37 | 32 | 28 | 25 |
| 6  | 62  | 49  | 40  | 33  | 58  | 46  | 38  | 32  | 42 | 34 | 29 | 37 | 31 | 27 | 33 | 28 | 24 | 22 |
| 7  | 57  | 44  | 35  | 29  | 54  | 42  | 33  | 28  | 37 | 30 | 25 | 34 | 28 | 23 | 30 | 25 | 21 | 19 |
| 8  | 53  | 40  | 31  | 25  | 50  | 38  | 30  | 24  | 34 | 27 | 22 | 31 | 25 | 21 | 27 | 22 | 19 | 17 |
| 9  | 49  | 36  | 28  | 22  | 47  | 34  | 27  | 21  | 31 | 24 | 20 | 28 | 22 | 18 | 25 | 20 | 17 | 15 |
| 10 | 46  | 33  | 25  | 20  | 44  | 31  | 24  | 19  | 29 | 22 | 18 | 26 | 20 | 16 | 23 | 18 | 15 | 13 |

### CONE OF LIGHT DIAGRAM



## 4.0 LM-79 Measurement and Test Results

### 4.3 THD and PF Test

|                  |                  |                |      |
|------------------|------------------|----------------|------|
| Model No.        | TOMO-2/12W/4000K | Sample ID.     | C1   |
| Temperature (°C) | 25.3             | Humidity (%RH) | 56.0 |

#### Test Method

The samples were tested according to the ANSI C82.77:2002.

The total harmonic distortion shall be measured to the 40th order.

The ambient temperature condition was maintained at  $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$ . The sample measurements were made using a digital power meter and power supply. The sample was operated at rated voltage and was stabilized before measurement. The total harmonic distortion were calculated.

#### Test Results

| Voltage (Vac) | Frequency (Hz) | Current (A) | Power (W) | Power Factor | THD   |
|---------------|----------------|-------------|-----------|--------------|-------|
| 119.99        | 60             | 0.096       | 11.5      | 0.996        | 7.67% |
| 276.99        | 60             | 0.048       | 12.4      | 0.936        | 6.15% |

## 5.0 Equipment Information

| Test Equipment |   |                       |                      |
|----------------|---|-----------------------|----------------------|
| Equipment ID   | Equipment Name  | Last Calibration Date | Calibration Due Date |
| DLF107         | Integrating Sphere System   | 2021/12/26            | 2022/12/25           |
| DLF108         | Auxiliary Lamp  | 2021/12/26            | 2022/12/25           |
| DLF122         | Measurement Standard Lamp<br>Standard Lamp Type: 220 V, 0.4720 A,<br>Tungsten, Omni-derectional | 2021/12/26            | 2022/12/25           |
| DLF116         | AC Power Source   | 2021/12/26            | 2022/12/25           |
| DLF113         | Power Meter   | 2021/12/26            | 2022/12/25           |
| DLF112         | Temperature Recorder  | 2021/12/26            | 2022/12/25           |
| DLF114         | Temperature & Humidity Datalogger   | 2021/12/26            | 2022/12/25           |
| DLF101         | Goniophotometer   | 2021/12/26            | 2022/12/25           |
| DLF125         | Standard Lamp<br>Standard Lamp Type: 76.58 V, 6.7875 A,<br>Tungsten, Omni-derectional           | 2021/12/26            | 2022/12/25           |
| DLF104         | AC Power Source   | 2021/12/26            | 2022/12/25           |
| DLF507         | DC Power Source   | 2021/12/26            | 2022/12/25           |
| DLF102         | Power Meter   | 2021/12/26            | 2022/12/25           |
| DLF111         | Temperature & Humidity Datalogger   | 2021/12/26            | 2022/12/25           |
| DLF119         | Power Meter   | 2021/12/26            | 2022/12/25           |
| DLF031         | Temperature data logger   | 2021/12/26            | 2022/12/25           |
| DLF022         | Digital power meter   | 2021/12/26            | 2022/12/25           |
| DLF003         | Temperature & Humidity Datalogger   | 2021/12/26            | 2022/12/25           |

\*\*\*\*\* End of Test Report\*\*\*\*\*