



# IES LM-79-08

## MEASUREMENT AND TEST REPORT

For

### SHENZHEN TUBU TECH CO.,LTD

Building C,Hankun Hi-tech Industrial Zone,Longteng Road,Gaoqiao  
District,Pingdi,Longgang,Shenzhen,Guangdong,China.

**Test Model: TBHBR15-350W(5000K)**

|                       |  |
|-----------------------|--|
| <b>Report Type:</b>   | Electrical and Photometric tests including: Luminous Flux, Power Factor, Chromaticity, Luminous Intensity Distribution, THD  |
| <b>Test Engineer:</b> | Hexy He <i>Hexy He</i>   |
| <b>Report Number:</b> | RSZ170527503-10  |
| <b>Test Date:</b>     | 2017-06-01   |
| <b>Report Date:</b>   | 2017-06-19   |
| <b>Reviewed By:</b>   | Blake Zhang / EE Engineer <i>Blake Zhang</i>   |
| <b>Prepared By:</b>   | Bay Area Compliance Laboratories Corp. (Dongguan).<br>No.69,Pulongcun ,Puxihu Industrial Area, Tangxia ,<br>Dongguan, Guangdong, China.<br>Tel: +86-0769-86858888<br>Fax:+86-0769-86858588 |
| <b>Accreditation:</b> | The IAS Accreditation Number TL-460.   |

**Note:** The test data was only valid for the test sample(s). This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. (Dongguan). This report is valid only with a valid digital signature. The digital signature may be available only under the Adobe software above version 7.0.

## 1. Product Description

### General Information:

One sample was received on 2017-05-27 and used for testing.

|                           |   |
|---------------------------|---|
| Model Tested:             | TBHBR15-350W(5000K)   |
| Manufacturer:             | SHENZHEN TUBU TECH CO.,LTD                                  |
| Brand Name:               | TUBU  |
| Product Designation:      | High-bay Luminaires for Commercial and Industrial Buildings |
| Burning Time Before Test: | 0hour(For New Products)                                     |

### Rated Values:

|                          |                  |
|--------------------------|------------------|
| Rated Voltage/Frequency: | 100-277V 50/60Hz |
| Rated Power:             | 350 W            |
| Nominal CCT:             | 5000K            |
| Nominal Lumen Output:    | 45500 lm         |

## 2. Standards Used

- IES LM-79-08: Approved Method: Electrical & Photometric Measurement of Solid-state Lighting Products
- ANSI C82.77-2002: Harmonic Emission Limits – Related Power Quality Requirements for Lighting
- IES TM-30-15: IES Method for Evaluating Light Source Color Rendition (This method is not in IAS accreditation scope)

## 3. Description of Test Equipment

| Device  | Manufacture | Model No    | Serial No         | Test Range             | Calibration date | Calibration due date |
|---|-------------|-------------|-------------------|------------------------|------------------|----------------------|
| 2.0m integrating sphere                       | EVERFINE    | R98         | 11010018          | R98                    | 2016-11-18       | 2017-11-17           |
| spectroradiometer                             | EVERFINE    | HAAS-2000   | 20140912          | 380-780nm              | 2016-11-18       | 2017-11-17           |
| Digital Power Meter                           | EVERFINE    | PF2010A     | 1011004           | 600V/20A               | 2016-07-11       | 2017-07-10           |
| Digital CC&CV DC Power Supply                 | EVERFINE    | WY305-V1    | 1101047           | 30V/5A                 | 2016-07-07       | 2017-07-06           |
| Rapid recording photometer                    | EVERFINE    | PHOTO-2000F | 1007010           | 0.1lm—200klm           | 2016-12-30       | 2017-12-29           |
| Standard Light Source                         | SENSING     | N/A         | LSD090808         | N/A                    | 2016-12-05       | 2017-12-04           |
| Special zero-voltage synchronous switching AC | EVERFINE    | DPS1010-YF  | 1011001T          | 0-150V, 0-300V         | 2017-03-03       | 2018-03-02           |
| AC Power Supply                               | EVERFINE    | VPS1030 PWM | 1012017           | 0-150V, 0-300V         | 2017-03-03       | 2018-03-02           |
| DC Power Supply                               | EVERFINE    | WY12010     | 1009009           | 30V/5A                 | 2017-03-03       | 2018-03-02           |
| Power Meter                                   | YOKOGAWA    | WT-210      | 91KB35700         | 15/30/60/150/300/600 V | 2017-03-03       | 2018-03-02           |
| Goniophotometer                               | EVERFINE    | GO-R5000    | YG108492N10120001 | 1600mm,3000W/10A       | 2017-03-09       | 2018-03-08           |

| Device                 | Manufacture | Model No | Serial No | Test Range          | Calibration date | Calibration due date |
|------------------------|-------------|----------|-----------|---------------------|------------------|----------------------|
| Wireless Remote Sensor | N/A         | 433MHz   | N/A       | 0°C~50°C;-20°C~60°C | 2017-03-20       | 2018-03-19           |
| Standard Light Source  | EVERFINE    | D908     | 1012003   | N/A                 | 2016-12-17       | 2017-12-17           |

Statement of Traceability: Bay Area Compliance Laboratories Corp. (Dongguan) attested that all calibration has been performed using suitable standards traceable to National Primary Standards and International System of Units (SI).

#### 4. Test Method

Product was tested with no seasoning. All stabilization and measurements were made in compliance with IES LM-79-08. The product was operated at rated voltage or at voltage required by manufacturer. The ambient temperature of the sample was maintained at 25°C±1°C during measurement. And relative humidity is less than 65%.

##### Integrating Sphere System

The system includes AC power source, digital power meter, DC power supply, Spectroradiometer, and integrating sphere. The integrating sphere system is calibrated by standard spectrum light source before measurement.

4π geometry was used during measurement. The product was operated in its intended orientation in application and was recorded in this report.

The uncertainty of the light output (luminous flux) measurements is U=1.8% (K=2), at the 95% confidence level. The uncertainty of the correlated color temperature measurements is U=20K (K=2), at the 95% confidence level. The uncertainty of the CRI is U=1.8(K=2), at the 95% confidence level.

The uncertainty of power meter AC current U=0.19 % of rdg, AC Voltage U=0.15% of rdg, Power U=0.20%) (K=2), at the 95% confidence level.

##### Goniophotometer System

The goniophotometer system is calibrated by standard light source before measurement.

Type C goniophotometer was used for measuring total luminous flux, luminous intensity distribution, and color spatial uniformity. The product was operated in its intended orientation in application and was recorded in this report. The vertical angle (γ) test intervals were set no more than 1 degree while data for 5 degree intervals is reported. The horizontal angle (C plane) test intervals were set no more than 22.5 degree.

The uncertainty of the luminous intensity is U=1.6% (K=2) , at the 95% confidence level.

##### Additional Test

The Additional Test item may not be covered by IESNA LM-79-2008. Additional test including power factor, off-state power and THD, was measured by Digital Power Meter after stabilized at 25°C±1°C. Test voltage for THD and power factor test would be equal to rated voltage or, in case of a voltage range, maximum value of that range.

The uncertainty of power meter AC current U=0.19 % of rdg, AC Voltage U=0.15% of rdg, Power U=0.20%) (K=2), at the 95% confidence level.

##### Fidelity Index and Gamut Index Calculation

The  $R_f$ ,  $R_g$  was calculated according to IES TM-30-15 by using calculation tools. The calculation was based on the measured SPD from 380nm to 780nm with 1nm intervals. All the colors in this report is for reference only.

## 5. Test Result

### [Integrating Sphere System]

Total operating time for integrating sphere test: **1.0 hour**

Test orientation: **Downward**

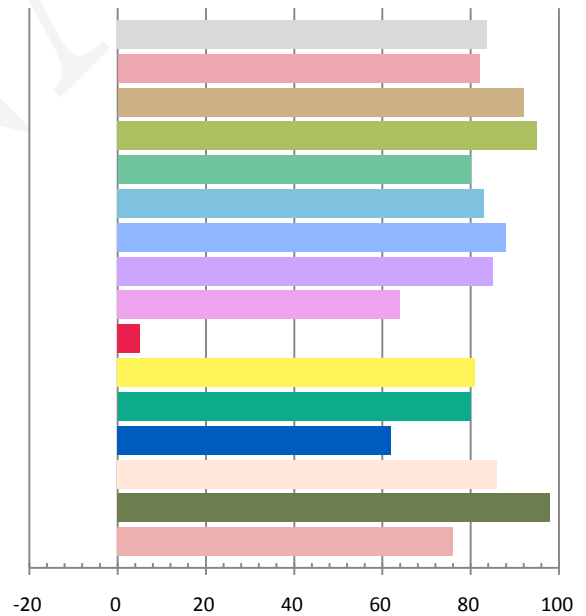
### Photometric and Electrical Measurement Result

| Voltage (V) | Frequency (Hz) | Current (A) | Power (W) | Power Factor | Luminous Flux(lm) | Efficacy (lm/W) |
|-------------|----------------|-------------|-----------|--------------|-------------------|-----------------|
| 120.0       | 60             | 2.817       | 337.2     | 0.9974       | 44289             | 131.35          |

| Radiant Flux (W) | CCT (K) | Duv     | x      | y      | u'     | v'     |
|------------------|---------|---------|--------|--------|--------|--------|
| 138.42           | 5240    | 0.00279 | 0.3390 | 0.3522 | 0.2071 | 0.4840 |

### Color Rendering Index

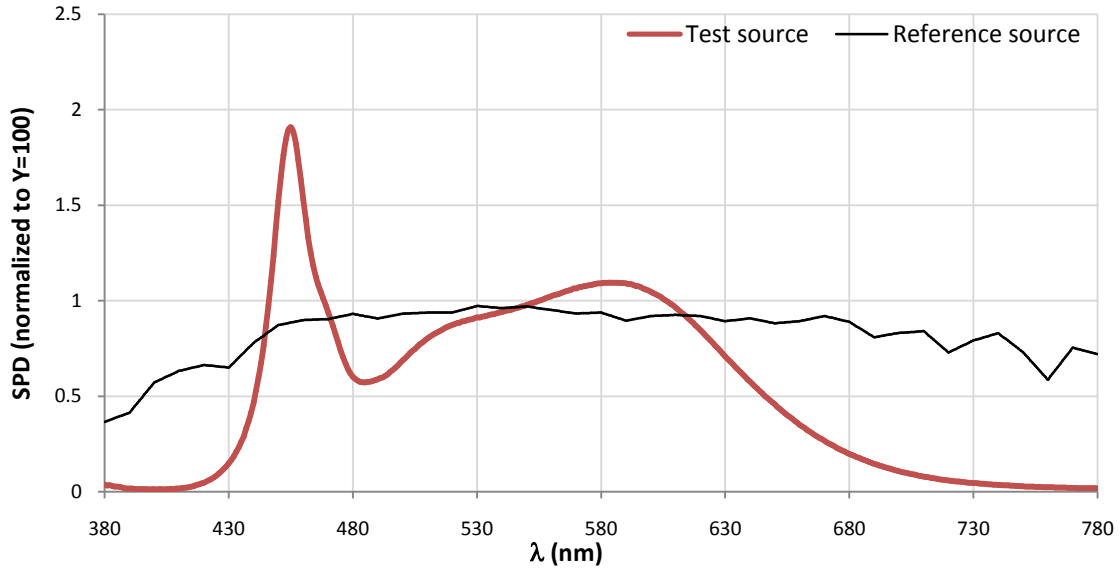
| Ra          |     |     |     |
|-------------|-----|-----|-----|
| <b>83.7</b> |     |     |     |
| R1          | R2  | R3  | R4  |
| 82          | 92  | 95  | 80  |
| R5          | R6  | R7  | R8  |
| 83          | 88  | 85  | 64  |
| R9          | R10 | R11 | R12 |
| 5           | 81  | 80  | 62  |
| R13         | R14 | R15 |     |
| 86          | 98  | 76  |     |



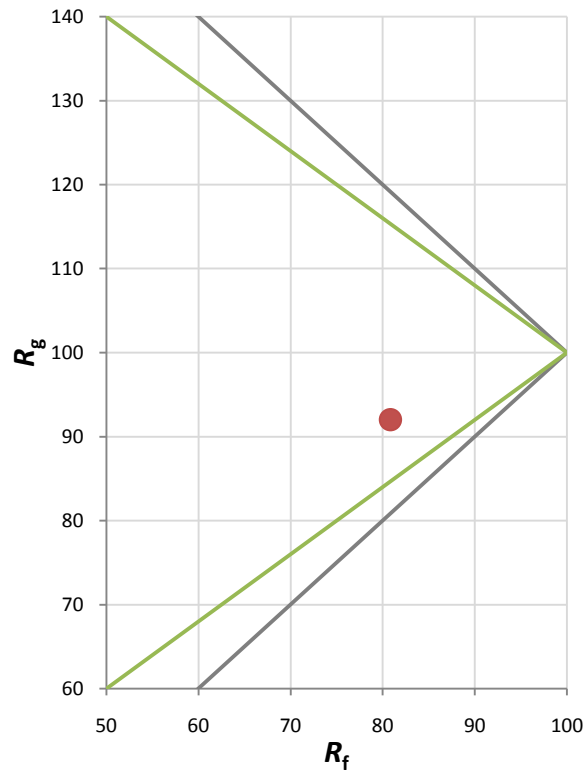
Fidelity Index and Gamut Index

|                      |    |
|----------------------|----|
| Fidelity Index $R_f$ | 81 |
| Gamut Index $R_g$    | 92 |

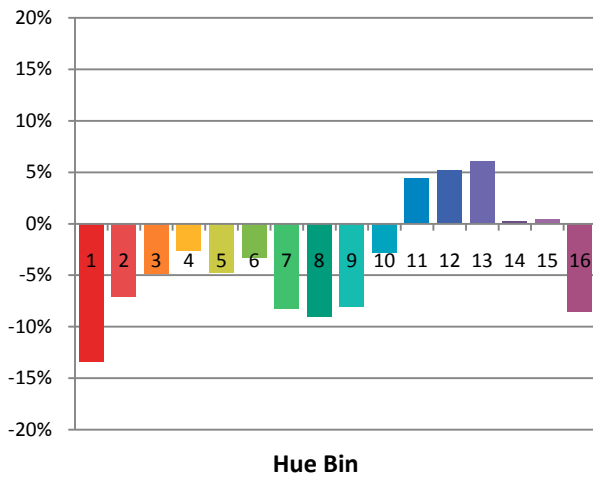
Spectral Power Distribution Comparison



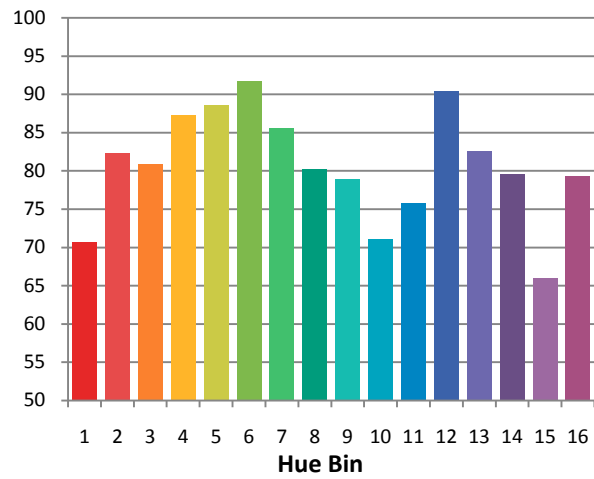
Plot of  $R_g$  versus  $R_f$



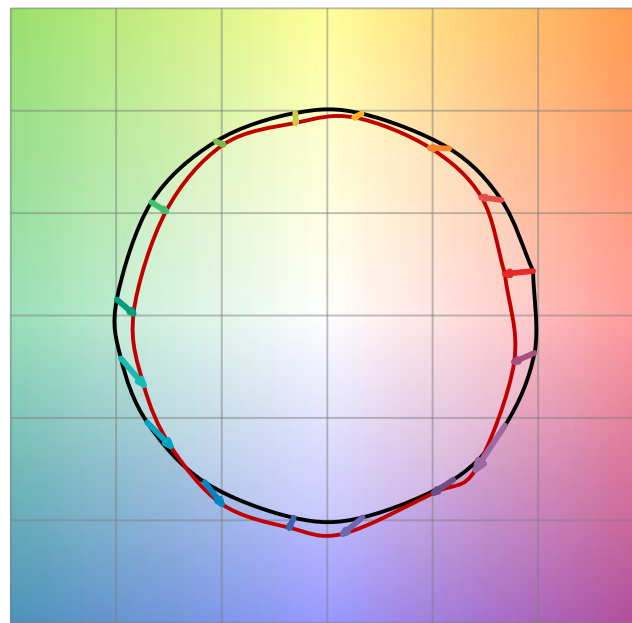
**Chroma Shift by Hue**



**R<sub>f</sub> by Hue**

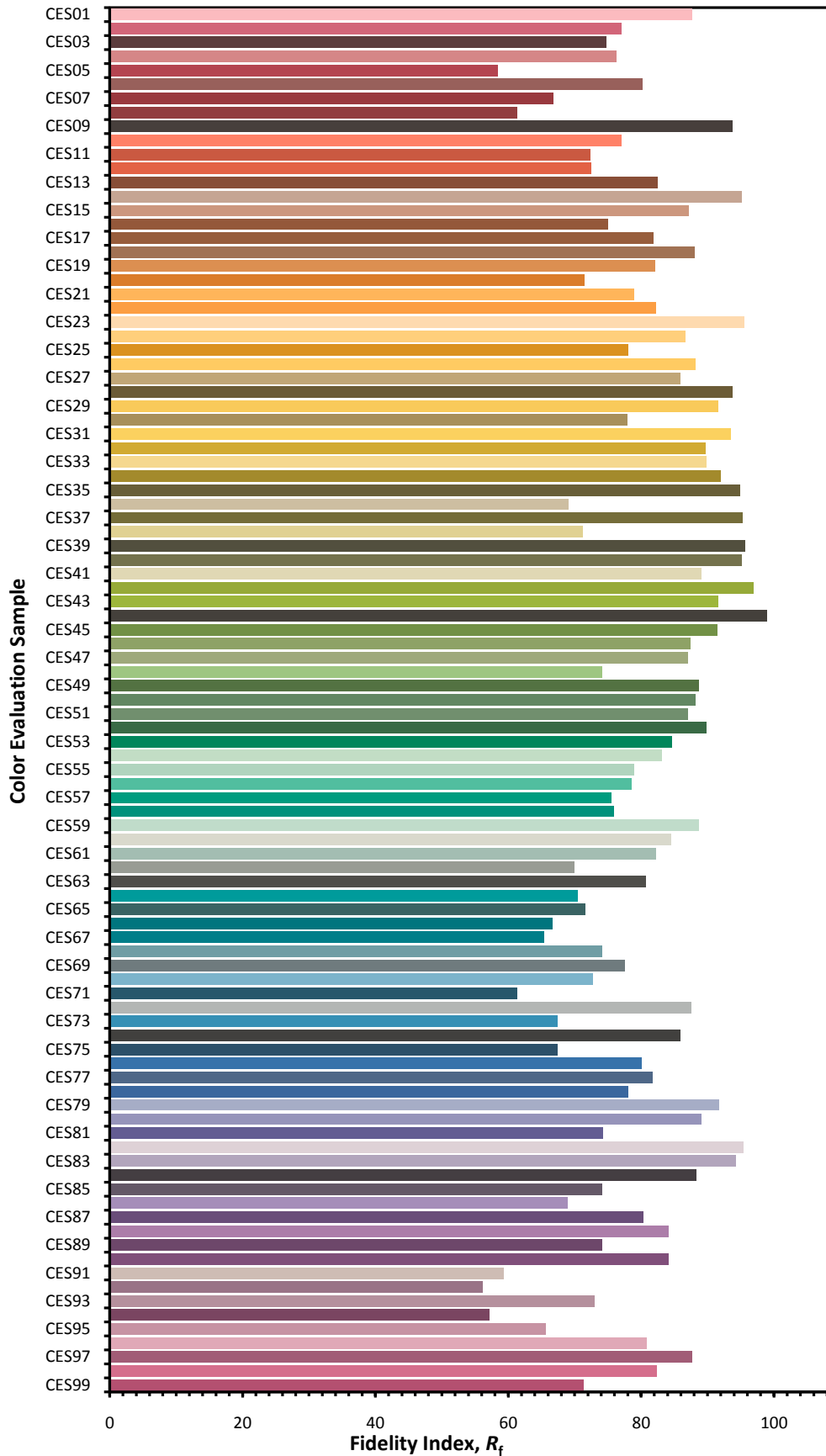


**Color Vector Graphic**

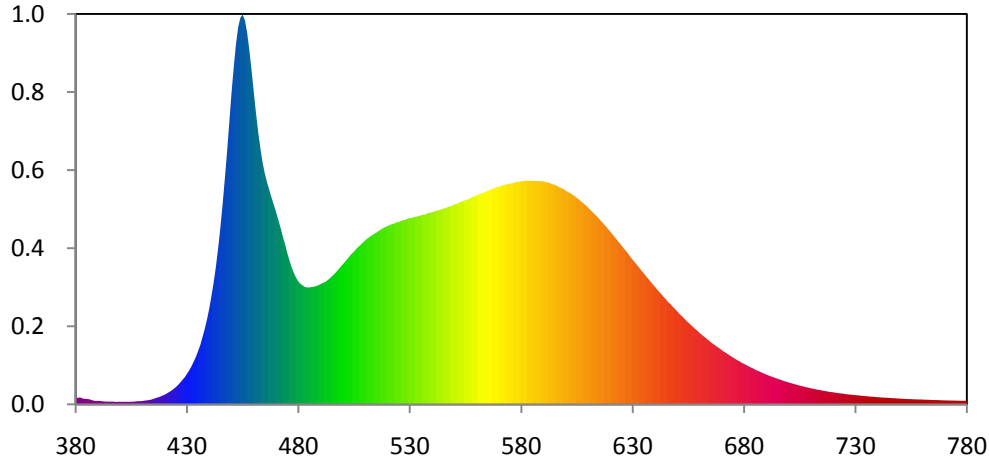


— Reference Illuminat    — Test Source

**Color Fidelity by CES Sample**



Relative Spectral Power Distribution

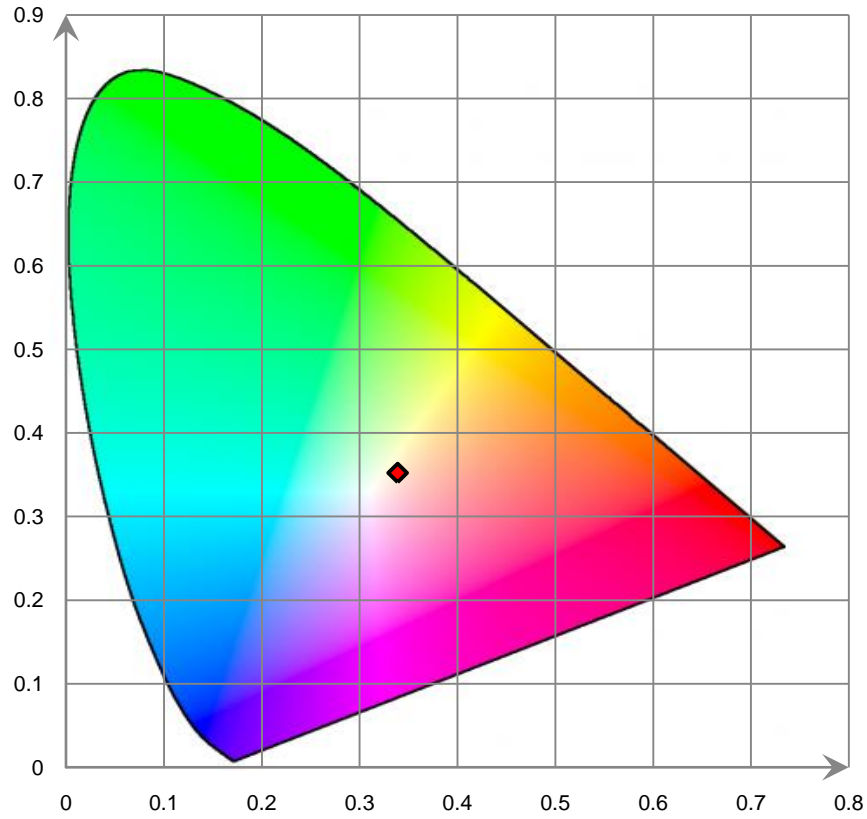


| nm  | mW        | nm  | mW        | nm  | mW        | nm  | mW        | nm  | mW        |
|-----|-----------|-----|-----------|-----|-----------|-----|-----------|-----|-----------|
| 380 | 2.469E+01 | 421 | 3.452E+01 | 462 | 8.635E+02 | 503 | 4.703E+02 | 544 | 6.178E+02 |
| 381 | 2.050E+01 | 422 | 3.923E+01 | 463 | 8.109E+02 | 504 | 4.784E+02 | 545 | 6.211E+02 |
| 382 | 2.204E+01 | 423 | 4.337E+01 | 464 | 7.666E+02 | 505 | 4.848E+02 | 546 | 6.230E+02 |
| 383 | 1.929E+01 | 424 | 4.887E+01 | 465 | 7.314E+02 | 506 | 4.934E+02 | 547 | 6.258E+02 |
| 384 | 1.727E+01 | 425 | 5.463E+01 | 466 | 7.041E+02 | 507 | 5.006E+02 | 548 | 6.284E+02 |
| 385 | 1.731E+01 | 426 | 6.132E+01 | 467 | 6.798E+02 | 508 | 5.067E+02 | 549 | 6.304E+02 |
| 386 | 1.648E+01 | 427 | 6.936E+01 | 468 | 6.559E+02 | 509 | 5.136E+02 | 550 | 6.342E+02 |
| 387 | 1.446E+01 | 428 | 7.778E+01 | 469 | 6.330E+02 | 510 | 5.204E+02 | 551 | 6.362E+02 |
| 388 | 1.202E+01 | 429 | 8.597E+01 | 470 | 6.110E+02 | 511 | 5.262E+02 | 552 | 6.400E+02 |
| 389 | 1.080E+01 | 430 | 9.654E+01 | 471 | 5.865E+02 | 512 | 5.316E+02 | 553 | 6.424E+02 |
| 390 | 1.132E+01 | 431 | 1.074E+02 | 472 | 5.613E+02 | 513 | 5.361E+02 | 554 | 6.452E+02 |
| 391 | 1.083E+01 | 432 | 1.203E+02 | 473 | 5.336E+02 | 514 | 5.412E+02 | 555 | 6.485E+02 |
| 392 | 9.956E+00 | 433 | 1.350E+02 | 474 | 5.094E+02 | 515 | 5.451E+02 | 556 | 6.504E+02 |
| 393 | 9.115E+00 | 434 | 1.502E+02 | 475 | 4.816E+02 | 516 | 5.498E+02 | 557 | 6.537E+02 |
| 394 | 8.756E+00 | 435 | 1.689E+02 | 476 | 4.572E+02 | 517 | 5.548E+02 | 558 | 6.579E+02 |
| 395 | 8.698E+00 | 436 | 1.883E+02 | 477 | 4.355E+02 | 518 | 5.589E+02 | 559 | 6.601E+02 |
| 396 | 8.739E+00 | 437 | 2.135E+02 | 478 | 4.169E+02 | 519 | 5.623E+02 | 560 | 6.634E+02 |
| 397 | 8.634E+00 | 438 | 2.394E+02 | 479 | 4.018E+02 | 520 | 5.661E+02 | 561 | 6.669E+02 |
| 398 | 7.765E+00 | 439 | 2.693E+02 | 480 | 3.901E+02 | 521 | 5.690E+02 | 562 | 6.689E+02 |
| 399 | 8.212E+00 | 440 | 3.032E+02 | 481 | 3.823E+02 | 522 | 5.719E+02 | 563 | 6.717E+02 |
| 400 | 8.351E+00 | 441 | 3.434E+02 | 482 | 3.772E+02 | 523 | 5.736E+02 | 564 | 6.749E+02 |
| 401 | 7.988E+00 | 442 | 3.874E+02 | 483 | 3.724E+02 | 524 | 5.779E+02 | 565 | 6.781E+02 |
| 402 | 8.167E+00 | 443 | 4.371E+02 | 484 | 3.713E+02 | 525 | 5.787E+02 | 566 | 6.813E+02 |
| 403 | 8.279E+00 | 444 | 4.948E+02 | 485 | 3.710E+02 | 526 | 5.818E+02 | 567 | 6.832E+02 |
| 404 | 7.912E+00 | 445 | 5.606E+02 | 486 | 3.725E+02 | 527 | 5.848E+02 | 568 | 6.857E+02 |
| 405 | 8.579E+00 | 446 | 6.331E+02 | 487 | 3.736E+02 | 528 | 5.857E+02 | 569 | 6.903E+02 |
| 406 | 8.264E+00 | 447 | 7.147E+02 | 488 | 3.755E+02 | 529 | 5.888E+02 | 570 | 6.899E+02 |
| 407 | 9.538E+00 | 448 | 8.003E+02 | 489 | 3.786E+02 | 530 | 5.915E+02 | 571 | 6.940E+02 |
| 408 | 1.001E+01 | 449 | 8.939E+02 | 490 | 3.815E+02 | 531 | 5.914E+02 | 572 | 6.954E+02 |
| 409 | 1.027E+01 | 450 | 9.865E+02 | 491 | 3.852E+02 | 532 | 5.945E+02 | 573 | 6.978E+02 |
| 410 | 1.055E+01 | 451 | 1.070E+03 | 492 | 3.882E+02 | 533 | 5.956E+02 | 574 | 6.987E+02 |
| 411 | 1.201E+01 | 452 | 1.143E+03 | 493 | 3.933E+02 | 534 | 5.977E+02 | 575 | 7.010E+02 |
| 412 | 1.267E+01 | 453 | 1.197E+03 | 494 | 3.990E+02 | 535 | 6.003E+02 | 576 | 7.012E+02 |
| 413 | 1.393E+01 | 454 | 1.228E+03 | 495 | 4.064E+02 | 536 | 6.020E+02 | 577 | 7.040E+02 |
| 414 | 1.530E+01 | 455 | 1.237E+03 | 496 | 4.124E+02 | 537 | 6.026E+02 | 578 | 7.059E+02 |
| 415 | 1.743E+01 | 456 | 1.220E+03 | 497 | 4.201E+02 | 538 | 6.063E+02 | 579 | 7.068E+02 |
| 416 | 1.986E+01 | 457 | 1.181E+03 | 498 | 4.282E+02 | 539 | 6.079E+02 | 580 | 7.074E+02 |
| 417 | 2.229E+01 | 458 | 1.126E+03 | 499 | 4.366E+02 | 540 | 6.096E+02 | 581 | 7.090E+02 |
| 418 | 2.458E+01 | 459 | 1.061E+03 | 500 | 4.448E+02 | 541 | 6.122E+02 | 582 | 7.095E+02 |
| 419 | 2.788E+01 | 460 | 9.912E+02 | 501 | 4.528E+02 | 542 | 6.148E+02 | 583 | 7.098E+02 |
| 420 | 3.084E+01 | 461 | 9.248E+02 | 502 | 4.614E+02 | 543 | 6.163E+02 | 584 | 7.098E+02 |

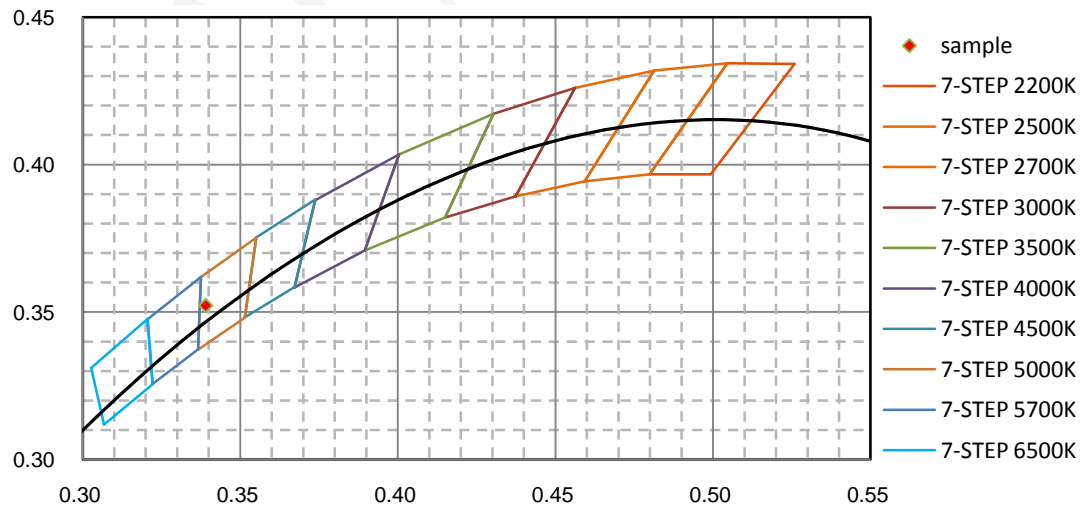


| nm  | mW        | nm  | mW        | nm  | mW        | nm  | mW        | nm  | mW        |
|-----|-----------|-----|-----------|-----|-----------|-----|-----------|-----|-----------|
| 585 | 7.094E+02 | 626 | 4.957E+02 | 667 | 1.877E+02 | 708 | 5.449E+01 | 749 | 1.875E+01 |
| 586 | 7.090E+02 | 627 | 4.873E+02 | 668 | 1.824E+02 | 709 | 5.269E+01 | 750 | 1.833E+01 |
| 587 | 7.090E+02 | 628 | 4.783E+02 | 669 | 1.780E+02 | 710 | 5.122E+01 | 751 | 1.779E+01 |
| 588 | 7.083E+02 | 629 | 4.686E+02 | 670 | 1.723E+02 | 711 | 4.979E+01 | 752 | 1.748E+01 |
| 589 | 7.082E+02 | 630 | 4.593E+02 | 671 | 1.672E+02 | 712 | 4.833E+01 | 753 | 1.703E+01 |
| 590 | 7.076E+02 | 631 | 4.510E+02 | 672 | 1.631E+02 | 713 | 4.665E+01 | 754 | 1.679E+01 |
| 591 | 7.055E+02 | 632 | 4.425E+02 | 673 | 1.582E+02 | 714 | 4.540E+01 | 755 | 1.660E+01 |
| 592 | 7.048E+02 | 633 | 4.336E+02 | 674 | 1.538E+02 | 715 | 4.431E+01 | 756 | 1.608E+01 |
| 593 | 7.022E+02 | 634 | 4.246E+02 | 675 | 1.491E+02 | 716 | 4.271E+01 | 757 | 1.597E+01 |
| 594 | 6.987E+02 | 635 | 4.162E+02 | 676 | 1.449E+02 | 717 | 4.154E+01 | 758 | 1.564E+01 |
| 595 | 6.972E+02 | 636 | 4.076E+02 | 677 | 1.405E+02 | 718 | 4.033E+01 | 759 | 1.561E+01 |
| 596 | 6.936E+02 | 637 | 3.990E+02 | 678 | 1.367E+02 | 719 | 3.914E+01 | 760 | 1.532E+01 |
| 597 | 6.898E+02 | 638 | 3.905E+02 | 679 | 1.320E+02 | 720 | 3.847E+01 | 761 | 1.493E+01 |
| 598 | 6.867E+02 | 639 | 3.817E+02 | 680 | 1.286E+02 | 721 | 3.719E+01 | 762 | 1.474E+01 |
| 599 | 6.833E+02 | 640 | 3.735E+02 | 681 | 1.249E+02 | 722 | 3.615E+01 | 763 | 1.449E+01 |
| 600 | 6.786E+02 | 641 | 3.652E+02 | 682 | 1.212E+02 | 723 | 3.519E+01 | 764 | 1.416E+01 |
| 601 | 6.743E+02 | 642 | 3.568E+02 | 683 | 1.174E+02 | 724 | 3.447E+01 | 765 | 1.392E+01 |
| 602 | 6.705E+02 | 643 | 3.493E+02 | 684 | 1.146E+02 | 725 | 3.349E+01 | 766 | 1.365E+01 |
| 603 | 6.659E+02 | 644 | 3.408E+02 | 685 | 1.103E+02 | 726 | 3.239E+01 | 767 | 1.360E+01 |
| 604 | 6.611E+02 | 645 | 3.332E+02 | 686 | 1.071E+02 | 727 | 3.152E+01 | 768 | 1.334E+01 |
| 605 | 6.551E+02 | 646 | 3.243E+02 | 687 | 1.043E+02 | 728 | 3.083E+01 | 769 | 1.289E+01 |
| 606 | 6.499E+02 | 647 | 3.183E+02 | 688 | 1.008E+02 | 729 | 2.997E+01 | 770 | 1.281E+01 |
| 607 | 6.439E+02 | 648 | 3.103E+02 | 689 | 9.793E+01 | 730 | 2.934E+01 | 771 | 1.256E+01 |
| 608 | 6.380E+02 | 649 | 3.033E+02 | 690 | 9.478E+01 | 731 | 2.874E+01 | 772 | 1.230E+01 |
| 609 | 6.320E+02 | 650 | 2.960E+02 | 691 | 9.198E+01 | 732 | 2.817E+01 | 773 | 1.219E+01 |
| 610 | 6.253E+02 | 651 | 2.876E+02 | 692 | 8.912E+01 | 733 | 2.708E+01 | 774 | 1.197E+01 |
| 611 | 6.176E+02 | 652 | 2.810E+02 | 693 | 8.660E+01 | 734 | 2.657E+01 | 775 | 1.194E+01 |
| 612 | 6.108E+02 | 653 | 2.739E+02 | 694 | 8.394E+01 | 735 | 2.585E+01 | 776 | 1.182E+01 |
| 613 | 6.037E+02 | 654 | 2.664E+02 | 695 | 8.161E+01 | 736 | 2.515E+01 | 777 | 1.155E+01 |
| 614 | 5.970E+02 | 655 | 2.596E+02 | 696 | 7.891E+01 | 737 | 2.453E+01 | 778 | 1.143E+01 |
| 615 | 5.888E+02 | 656 | 2.536E+02 | 697 | 7.666E+01 | 738 | 2.413E+01 | 779 | 1.145E+01 |
| 616 | 5.810E+02 | 657 | 2.471E+02 | 698 | 7.403E+01 | 739 | 2.354E+01 | 780 | 1.147E+01 |
| 617 | 5.734E+02 | 658 | 2.403E+02 | 699 | 7.205E+01 | 740 | 2.285E+01 |     |           |
| 618 | 5.651E+02 | 659 | 2.343E+02 | 700 | 6.965E+01 | 741 | 2.245E+01 |     |           |
| 619 | 5.569E+02 | 660 | 2.275E+02 | 701 | 6.768E+01 | 742 | 2.177E+01 |     |           |
| 620 | 5.483E+02 | 661 | 2.216E+02 | 702 | 6.561E+01 | 743 | 2.134E+01 |     |           |
| 621 | 5.396E+02 | 662 | 2.157E+02 | 703 | 6.355E+01 | 744 | 2.130E+01 |     |           |
| 622 | 5.311E+02 | 663 | 2.100E+02 | 704 | 6.159E+01 | 745 | 2.047E+01 |     |           |
| 623 | 5.221E+02 | 664 | 2.041E+02 | 705 | 5.990E+01 | 746 | 2.006E+01 |     |           |
| 624 | 5.136E+02 | 665 | 1.982E+02 | 706 | 5.812E+01 | 747 | 1.968E+01 |     |           |
| 625 | 5.047E+02 | 666 | 1.926E+02 | 707 | 5.610E+01 | 748 | 1.912E+01 |     |           |

**CIE 1931 x y Chromaticity Diagram**



**7-Step Chromaticity Quadrangles**



**[Goniophotometer System]**

Total operating time for luminous intensity distribution: **1.0 hour**

Test orientation: **Downward**

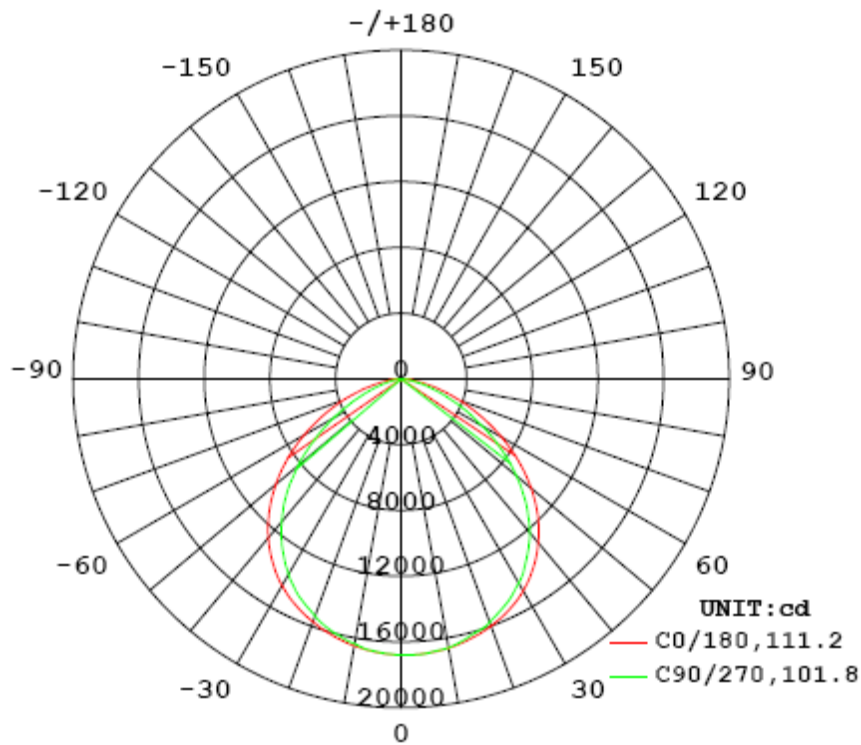
**Electrical Measurement**

| Input Voltage (V) | Frequency (Hz) | Input Current (A) | Power (W) | Power Factor |
|-------------------|----------------|-------------------|-----------|--------------|
| 120.0             | 60             | 2.8050            | 336       | 0.9985       |

**Photometric Measurement**

| Luminous Flux (lm) | Efficacy (lm/W) | I <sub>max</sub> (cd) | S/MH (C0/180) | S/MH (C90/270) |
|--------------------|-----------------|-----------------------|---------------|----------------|
| 44294.1            | 131.83          | 16800.0               | 1.31          | 1.27           |

**Luminous Intensity Distribution**



|                                      | C0/180 | C45/225 | C90/270 | C135/315 | AVG.  |
|--------------------------------------|--------|---------|---------|----------|-------|
| Beam Angle (50% I <sub>max</sub> ):  | 111.2  | 109.3   | 101.8   | 109.4    | 107.9 |
| Field Angle (10% I <sub>max</sub> ): | 155.5  | 152.4   | 145.5   | 152.3    | 151.4 |

Luminous Intensity (cd) Distribution Data

| C<br>γ | 0°    | 22.5° | 45°   | 67.5° | 90°   | 112.5° | 135°  | 157.5° |
|--------|-------|-------|-------|-------|-------|--------|-------|--------|
| 0.0°   | 16792 | 16792 | 16792 | 16792 | 16792 | 16792  | 16792 | 16792  |
| 5.0°   | 16693 | 16696 | 16699 | 16692 | 16668 | 16678  | 16704 | 16748  |
| 10.0°  | 16481 | 16498 | 16473 | 16405 | 16356 | 16383  | 16497 | 16594  |
| 15.0°  | 16156 | 16149 | 16066 | 15997 | 15965 | 15961  | 16101 | 16308  |
| 20.0°  | 15731 | 15690 | 15552 | 15464 | 15366 | 15419  | 15609 | 15907  |
| 25.0°  | 15201 | 15097 | 14920 | 14713 | 14661 | 14668  | 15002 | 15353  |
| 30.0°  | 14531 | 14405 | 14076 | 13860 | 13736 | 13821  | 14193 | 14709  |
| 35.0°  | 13653 | 13483 | 13177 | 12810 | 12626 | 12772  | 13334 | 13797  |
| 40.0°  | 12609 | 12420 | 12054 | 11590 | 11345 | 11552  | 12233 | 12744  |
| 45.0°  | 11381 | 11196 | 10797 | 10177 | 9879  | 10132  | 10984 | 11490  |
| 50.0°  | 9987  | 9827  | 9396  | 8608  | 8205  | 8549   | 9569  | 10080  |
| 55.0°  | 8453  | 8395  | 7891  | 6925  | 6451  | 6866   | 8024  | 8586   |
| 60.0°  | 6849  | 6877  | 6251  | 5227  | 4763  | 5161   | 6326  | 6997   |
| 65.0°  | 5248  | 5333  | 4630  | 3632  | 3243  | 3569   | 4645  | 5366   |
| 70.0°  | 3720  | 3813  | 3086  | 2281  | 1982  | 2228   | 3048  | 3769   |
| 75.0°  | 2358  | 2372  | 1761  | 1213  | 1004  | 1173   | 1696  | 2280   |
| 80.0°  | 1202  | 1135  | 726   | 434   | 319   | 405    | 661   | 1026   |
| 85.0°  | 344   | 242   | 85    | 61    | 51    | 54     | 69    | 164    |
| 90.0°  | 2     | 13    | 2     | 2     | 2     | 2      | 3     | 2      |
| 95.0°  | 3     | 3     | 3     | 3     | 3     | 3      | 3     | 3      |
| 100.0° | 3     | 4     | 4     | 3     | 3     | 4      | 4     | 4      |
| 105.0° | 4     | 4     | 4     | 4     | 4     | 4      | 4     | 4      |
| 110.0° | 4     | 4     | 5     | 5     | 5     | 5      | 5     | 4      |
| 115.0° | 4     | 4     | 5     | 5     | 5     | 5      | 5     | 4      |
| 120.0° | 5     | 5     | 5     | 5     | 5     | 5      | 5     | 5      |
| 125.0° | 5     | 6     | 6     | 6     | 6     | 6      | 6     | 6      |
| 130.0° | 6     | 7     | 7     | 7     | 7     | 7      | 7     | 7      |
| 135.0° | 8     | 8     | 8     | 9     | 9     | 9      | 8     | 8      |
| 140.0° | 9     | 10    | 11    | 11    | 11    | 11     | 11    | 10     |
| 145.0° | 12    | 13    | 14    | 15    | 15    | 15     | 14    | 12     |
| 150.0° | 14    | 15    | 17    | 18    | 18    | 18     | 17    | 15     |
| 155.0° | 16    | 17    | 19    | 20    | 20    | 20     | 19    | 17     |
| 160.0° | 18    | 18    | 20    | 21    | 21    | 21     | 21    | 18     |
| 165.0° | 19    | 19    | 20    | 21    | 21    | 21     | 20    | 18     |
| 170.0° | 18    | 18    | 18    | 18    | 18    | 18     | 18    | 18     |
| 175.0° | 18    | 17    | 18    | 17    | 17    | 18     | 18    | 18     |
| 180.0° | 16    | 15    | 15    | 14    | 16    | 15     | 16    | 16     |

Luminous Intensity (cd) Distribution Data (cont.)

| C<br>Y | 180°  | 202.5° | 225°  | 247.5° | 270°  | 292.5° | 315°  | 337.5° |
|--------|-------|--------|-------|--------|-------|--------|-------|--------|
| 0.0°   | 16792 | 16792  | 16792 | 16792  | 16792 | 16792  | 16792 | 16792  |
| 5.0°   | 16765 | 16749  | 16755 | 16755  | 16771 | 16771  | 16751 | 16705  |
| 10.0°  | 16618 | 16604  | 16536 | 16572  | 16607 | 16603  | 16541 | 16508  |
| 15.0°  | 16362 | 16315  | 16252 | 16177  | 16184 | 16219  | 16256 | 16166  |
| 20.0°  | 16003 | 15924  | 15738 | 15748  | 15752 | 15801  | 15723 | 15730  |
| 25.0°  | 15523 | 15461  | 15237 | 15070  | 15122 | 15123  | 15203 | 15220  |
| 30.0°  | 14884 | 14836  | 14491 | 14304  | 14330 | 14370  | 14433 | 14552  |
| 35.0°  | 14038 | 13966  | 13711 | 13393  | 13335 | 13457  | 13603 | 13654  |
| 40.0°  | 12998 | 13011  | 12748 | 12262  | 12194 | 12324  | 12600 | 12678  |
| 45.0°  | 11782 | 11784  | 11583 | 10919  | 10784 | 10993  | 11410 | 11494  |
| 50.0°  | 10346 | 10431  | 10264 | 9411   | 9187  | 9477   | 10090 | 10162  |
| 55.0°  | 8758  | 8926   | 8716  | 7775   | 7446  | 7841   | 8570  | 8721   |
| 60.0°  | 7067  | 7356   | 7038  | 6013   | 5690  | 6103   | 6961  | 7224   |
| 65.0°  | 5361  | 5732   | 5340  | 4350   | 4056  | 4428   | 5310  | 5671   |
| 70.0°  | 3759  | 4103   | 3663  | 2859   | 2625  | 2927   | 3692  | 4124   |
| 75.0°  | 2343  | 2581   | 2189  | 1653   | 1500  | 1700   | 2239  | 2656   |
| 80.0°  | 1177  | 1292   | 1030  | 733    | 649   | 769    | 1101  | 1391   |
| 85.0°  | 287   | 327    | 243   | 161    | 145   | 163    | 284   | 410    |
| 90.0°  | 1     | 1      | 1     | 13     | 13    | 14     | 16    | 19     |
| 95.0°  | 2     | 2      | 2     | 2      | 1     | 1      | 1     | 1      |
| 100.0° | 2     | 2      | 2     | 2      | 2     | 2      | 2     | 2      |
| 105.0° | 3     | 3      | 3     | 2      | 2     | 2      | 2     | 2      |
| 110.0° | 3     | 3      | 3     | 3      | 3     | 3      | 3     | 3      |
| 115.0° | 4     | 4      | 4     | 4      | 3     | 3      | 3     | 3      |
| 120.0° | 4     | 4      | 4     | 4      | 4     | 4      | 4     | 4      |
| 125.0° | 5     | 5      | 5     | 5      | 5     | 4      | 4     | 5      |
| 130.0° | 6     | 6      | 6     | 6      | 5     | 5      | 5     | 5      |
| 135.0° | 7     | 7      | 7     | 7      | 7     | 6      | 6     | 7      |
| 140.0° | 8     | 8      | 8     | 8      | 8     | 8      | 8     | 8      |
| 145.0° | 9     | 9      | 9     | 10     | 10    | 10     | 9     | 9      |
| 150.0° | 10    | 9      | 10    | 11     | 11    | 11     | 10    | 10     |
| 155.0° | 11    | 10     | 11    | 12     | 13    | 12     | 12    | 12     |
| 160.0° | 13    | 12     | 12    | 13     | 13    | 13     | 13    | 13     |
| 165.0° | 13    | 13     | 12    | 13     | 13    | 13     | 13    | 13     |
| 170.0° | 14    | 14     | 13    | 13     | 12    | 12     | 13    | 14     |
| 175.0° | 15    | 15     | 14    | 14     | 13    | 12     | 14    | 15     |
| 180.0° | 16    | 16     | 16    | 15     | 15    | 15     | 15    | 16     |

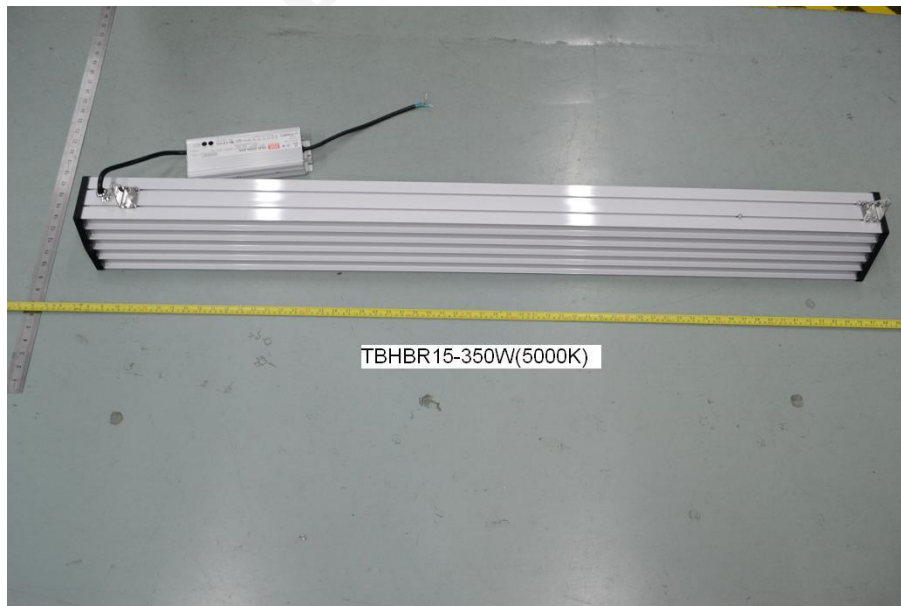
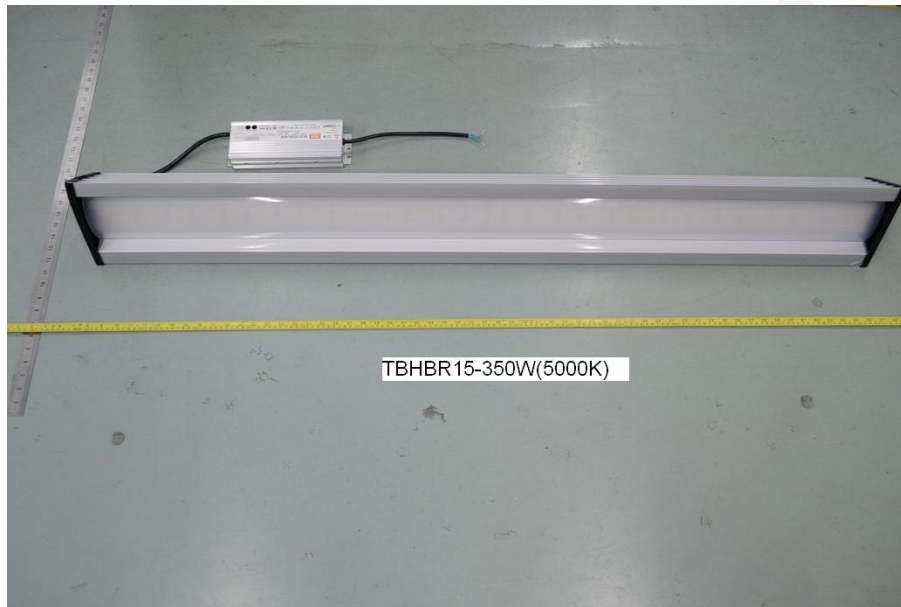
Zonal Lumen Density Measurement

| Deg     | Flux (lm) | %    | Deg   | Flux (lm) | %      |
|---------|-----------|------|-------|-----------|--------|
| 0-5     | 400.7     | 0.90 | 0-5   | 400.7     | 0.90   |
| 5-10    | 1189.1    | 2.69 | 0-10  | 1589.8    | 3.59   |
| 10-15   | 1939.0    | 4.38 | 0-15  | 3528.8    | 7.97   |
| 15-20   | 2626.0    | 5.93 | 0-20  | 6154.7    | 13.90  |
| 20-25   | 3228.5    | 7.28 | 0-25  | 9383.3    | 21.18  |
| 25-30   | 3728.7    | 8.42 | 0-30  | 13111.9   | 29.60  |
| 30-35   | 4090.9    | 9.24 | 0-35  | 17202.8   | 38.84  |
| 35-40   | 4297.8    | 9.70 | 0-40  | 21500.6   | 48.54  |
| 40-45   | 4333.3    | 9.78 | 0-45  | 25833.8   | 58.32  |
| 45-50   | 4173.7    | 9.43 | 0-50  | 30007.6   | 67.75  |
| 50-55   | 3831.0    | 8.65 | 0-55  | 33838.5   | 76.40  |
| 55-60   | 3325.3    | 7.50 | 0-60  | 37163.8   | 83.90  |
| 60-65   | 2697.9    | 6.09 | 0-65  | 39861.7   | 89.99  |
| 65-70   | 2011.5    | 4.54 | 0-70  | 41873.2   | 94.53  |
| 70-75   | 1335.5    | 3.02 | 0-75  | 43208.7   | 97.55  |
| 75-80   | 736.1     | 1.66 | 0-80  | 43944.8   | 99.21  |
| 80-85   | 268.6     | 0.61 | 0-85  | 44213.4   | 99.82  |
| 85-90   | 39.7      | 0.09 | 0-90  | 44253.1   | 99.91  |
| 90-95   | 1.3       | 0.00 | 0-95  | 44254.5   | 99.91  |
| 95-100  | 1.3       | 0.00 | 0-100 | 44255.8   | 99.91  |
| 100-105 | 1.6       | 0.01 | 0-105 | 44257.4   | 99.92  |
| 105-110 | 1.8       | 0.00 | 0-110 | 44259.2   | 99.92  |
| 110-115 | 1.9       | 0.01 | 0-115 | 44261.2   | 99.93  |
| 115-120 | 2.1       | 0.00 | 0-120 | 44263.3   | 99.93  |
| 120-125 | 2.3       | 0.01 | 0-125 | 44265.5   | 99.94  |
| 125-130 | 2.5       | 0.00 | 0-130 | 44268.0   | 99.94  |
| 130-135 | 2.8       | 0.01 | 0-135 | 44270.8   | 99.95  |
| 135-140 | 3.1       | 0.00 | 0-140 | 44273.9   | 99.95  |
| 140-145 | 3.5       | 0.01 | 0-145 | 44277.4   | 99.96  |
| 145-150 | 3.7       | 0.01 | 0-150 | 44281.1   | 99.97  |
| 150-155 | 3.6       | 0.01 | 0-155 | 44284.7   | 99.98  |
| 155-160 | 3.3       | 0.01 | 0-160 | 44288.0   | 99.99  |
| 160-165 | 2.7       | 0.00 | 0-165 | 44290.7   | 99.99  |
| 165-170 | 1.9       | 0.01 | 0-170 | 44292.6   | 100.00 |
| 170-175 | 1.1       | 0.00 | 0-175 | 44293.7   | 100.00 |
| 175-180 | 0.4       | 0.00 | 0-180 | 44294.1   | 100.00 |

**[Additional Test]**

| Test Item                  | Test Voltage (V) | Frequency (Hz) | Test Result |
|----------------------------|------------------|----------------|-------------|
| Power Factor:              | 277.0            | 60             | 0.9736      |
| Total Harmonic Distortion: | 277.0            | 60             | 5.11%       |
| Total Harmonic Distortion: | 120.0            | 60             | 4.16%       |
| Total Harmonic Distortion: | 100.0            | 60             | 4.84%       |
| Power Factor:              | 100.0            | 60             | 0.9991      |

**6. Product Photo**



## 7. Product Test orientation in the Goniophotometer



\*\*\*\*\*END OF REPORT\*\*\*\*\*