

LM-79-08 Test Report

For

LIGHT EFFICIENT DESIGN, LLC**(Brand Name: N/A)**

188 S.Northwest Highway, Cary, IL60013, USA

LED Luminaires

Model name(s): LED-8145M40-A

Representative (Tested) Model: LED-8145M40-A

Model Different: All construction and rating are the same, except CCT

Test & Report By:

Garman Mo

Engineer: Garman Mo

Date: May.18,2018

Review By:

Univ Xie

Manager: Univ Xie

Note: 1.The results contained in this report pertain only to the tested samples.

2.This report does not imply product certification, approval, or endorsement by NVLAP, NIST,
or any agency of the Federal Government.**Laboratory: Standard-Tech Co., Ltd Testing Center**
NVLAP CODE: 201011-0

Report Format Number STD/QR4909-A/2

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1.1 Product Information:

| | | | |
|---|------------------------------|--|--|
| Organization Name | LIGHT EFFICIENT DESIGN, LLC | | |
| Brand Name | N/A | | |
| Model Number | LED-8145M40-A | | |
| SKU (if available) | N/A | | |
| Type of Luminaire (for integral lamps, list base type and lamp type) | LED Luminaires | | |
| Rated Voltage / Frequency | 120 -277Vac, 50/60 Hz | | |
| Nominal Power | 45W | | |
| Rated Initial Lamp Lumen | -- | | |
| Declared CCT | 4000K | | |
| LED Manufacturer | SAMSUNG ELECTRONICS CO., LTD | | |
| LED Model | SPMWH1228FD5WAT0SE | | |
| Sample Number | GZE1801030-H-O1 | | |
| Luminaire Aperture (for downlights) | -- | in. mm mm s | |
| Luminaire Length | -- | | |
| Luminaires Width | -- | | |
| Number of Units (modular products) | N/A | | |
| | | | |
| Photo | | | |
|  | |  | |

1.2 Test Specifications:

| | |
|----------------------------|--|
| Date of Receipt | May.01,2018 |
| Date of Test | May.02,2018 |
| Test item | <ol style="list-style-type: none"> 1. Total Luminous Flux 2. Luminous Distribution Intensity 3. Luminous Efficacy 4. Correlated Color Temperature 5. Color Rendering Index 6. Chromaticity Coordinate 7. Electrical Parameters |
| Reference Standard | <ol style="list-style-type: none"> 1. IES LM-79-2008 Electrical and Photometric Measurements of Solid-State Lighting Products 2. ANSI C78.377-2008 Specifications for the Chromaticity of Solid State Lighting Products 3. CIE 13.3-1995 Method of Measuring and Specifying Colour Rendering Properties of Light Sources 4. CIE 15-2004 Technical Report Colorimetry 5. IESNA LM-16-93 Practical Guide to Colorimetry of Light Source 6. IESNA TM-16-05 Technical Memorandum on Light Emitting Diode (LED) Sources and Systems |
| Reference Work Instruction | QD25 |

1.3 Test Methods**1) Photometric and Light Distribution Measurement – Goniophotometer Method:**

Photometric parameters were measured using the 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 sample was operated at 120 or rated Volts AC, 60Hz. It was stabilized before measurement was made. Luminous flux, luminaire efficacy, zonal lumen were calculated from the software taken at 1° vertical intervals and 22.5° horizontal intervals.

2) Chromaticity Measurement – Sphere-Spectroradiometer Method:

Chromaticity 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 sample was operated at 120 or rated Volts AC, 60Hz. It was stabilized before measurement was made. Chromaticity coordinates, correlated color temperature and color rendering index were calculated from the spectral power distribution taken at 5 nm intervals over the range of 380 to 780 nm.

3) Electrical Measurements:

Electrical parameters were measured using power meters incorporated in goniophotometer or sphere-spectroradiometer system. The ambient temperature surrounding the sample was maintained at $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$. The sample was operated at 120 or rated Volts AC, 60Hz. It was stabilized before measurement was made. Voltage, frequency, current, power, power factor and total harmonic distortion were measured by and read from the power meter.

2.1 Electrical, Photometric and Chromaticity Measurements
(Refer to Work Instruction QD25)

| | | | |
|------------------|---------------|--------------------------|---------|
| Test date | 2018-05-02 | Test Ambient: | 25.2 °C |
| Test Orientation | As intended | Stabilization Time (min) | 90 |
| Model Number | LED-8145M40-A | | |

Electrical Measurement:

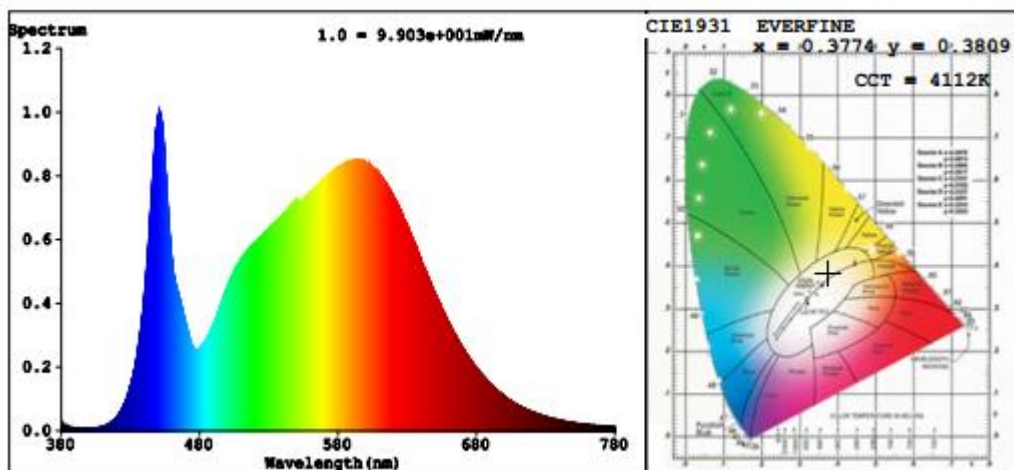
| Sample No. | Voltage (Vac) | Frequency (Hz) | Current (A) | Power (W) | Power Factor | THD % |
|------------|---------------|----------------|-------------|-----------|--------------|-------|
| GZE180103 | 120.0 | 60 | 0.3909 | 45.75 | 0.9754 | 7.27 |
| 0-H-O1 | 277.0 | 60 | 0.1801 | 45.85 | 0.9190 | 13.82 |

Chromaticity Measurement - Sphere-Spectroradiometer Method:

| Parameter | Result | Special Color Rendering Indices | | | |
|-----------------------------|---------------------|---------------------------------|----|-----|----|
| Test Voltage (V) | 120.0 | R1 | 81 | R9 | 8 |
| Frequency (Hz) | 60 | R2 | 89 | R10 | 73 |
| CCT (K) | 4112 | R3 | 95 | R11 | 81 |
| Duv | 0.0028 | R4 | 82 | R12 | 61 |
| Chromaticity (x, y) | x=0.3774 y=0.3809 | R5 | 81 | R13 | 83 |
| Chromaticity (u', v') | u'=0.2215 v'=0.5029 | R6 | 84 | R14 | 97 |
| Color Rendering Index (CRI) | 83.0 | R7 | 87 | R15 | 75 |
| R9 | 8 | R8 | 65 | -- | -- |

Photometric Measurement – Goniophotometer Method:

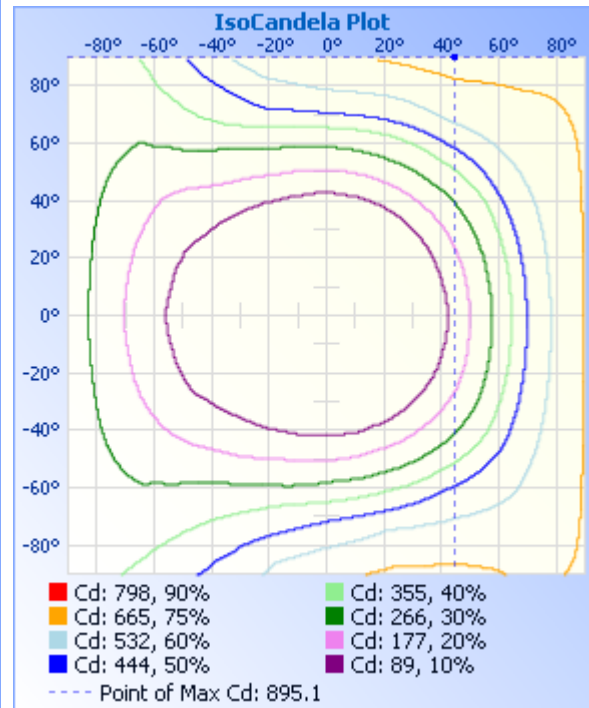
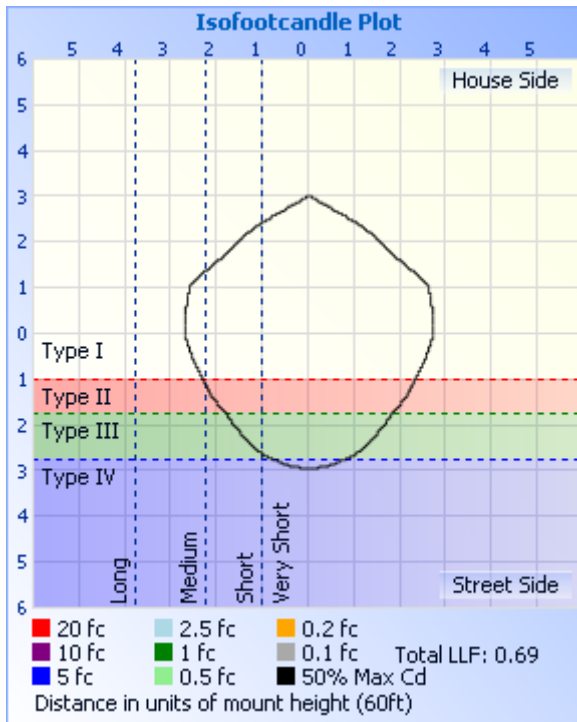
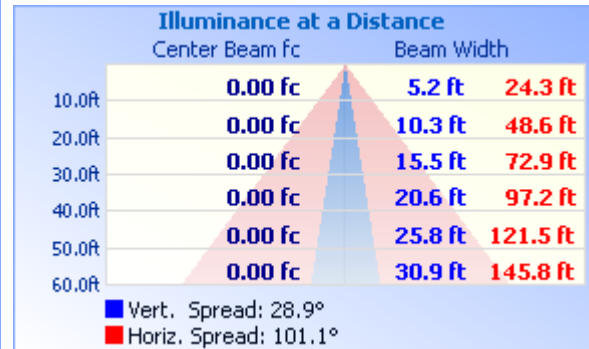
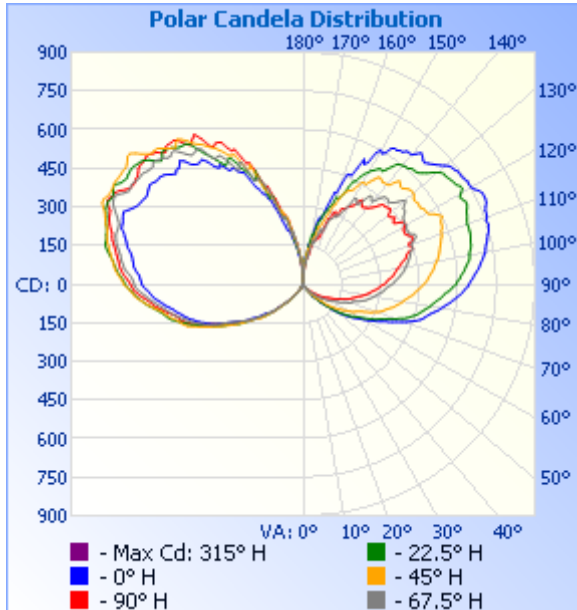
| Parameter | Result | |
|-----------------------------------|--------|--------|
| Test Voltage (V) | 120.0 | 277.0 |
| Frequency (Hz) | 60 | 60 |
| Total Luminous (lm) | 5426.4 | 5511.1 |
| Luminous Efficacy (lm/W) | 118.61 | 120.20 |
| Most worst Luminous/Highest Watts | 118.35 | |
| Beam Angle (°) | 305.3 | -- |
| Center Beam Candle Power (cd) | 0 | -- |

Spectral Power Distribution & Chromaticity Diagram

Zonal Lumen Tabulation

| Zonal Lumen Summary | | |
|---------------------|---------|-------------|
| Zone | Lumens | % Luminaire |
| 0-30 | 4.6 | 0.1% |
| 0-40 | 27.3 | 0.5% |
| 0-60 | 287.7 | 5.3% |
| 60-90 | 1,339.4 | 24.7% |
| 70-100 | 1,691.8 | 31.2% |
| 90-120 | 2,059.6 | 37.9% |
| 0-90 | 1,627.1 | 30% |
| 90-180 | 3,802.2 | 70% |
| 0-180 | 5,429.4 | 100% |

| Lumens Per Zone | | | | | |
|-----------------|--------|---------|---------|--------|---------|
| Zone | Lumens | % Total | Zone | Lumens | % Total |
| 0-10 | 0.0 | 0.0% | 90-100 | 663.0 | 12.2% |
| 10-20 | 0.7 | 0.0% | 100-110 | 705.5 | 13% |
| 20-30 | 3.9 | 0.1% | 110-120 | 691.2 | 12.7% |
| 30-40 | 22.7 | 0.4% | 120-130 | 614.1 | 11.3% |
| 40-50 | 80.5 | 1.5% | 130-140 | 495.0 | 9.1% |
| 50-60 | 179.9 | 3.3% | 140-150 | 352.6 | 6.5% |
| 60-70 | 310.6 | 5.7% | 150-160 | 199.6 | 3.7% |
| 70-80 | 454.1 | 8.4% | 160-170 | 70.9 | 1.3% |
| 80-90 | 574.7 | 10.6% | 170-180 | 10.5 | 0.2% |

Photometric Data



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 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| 10 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| 11 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 12 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 13 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 |
| 14 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 |
| 15 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 2 |
| 16 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 |
| 17 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 3 | 3 | 2 |
| 18 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 3 |
| 19 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 4 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 3 |
| 20 | 4 | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 5 | 5 | 6 | 5 | 6 | 6 | 5 | 4 | 4 |
| 21 | 4 | 4 | 4 | 3 | 3 | 4 | 4 | 5 | 5 | 6 | 6 | 6 | 6 | 7 | 6 | 5 | 4 |
| 22 | 5 | 5 | 4 | 4 | 4 | 4 | 5 | 5 | 6 | 7 | 7 | 7 | 7 | 7 | 7 | 6 | 5 |
| 23 | 6 | 5 | 5 | 4 | 4 | 5 | 6 | 6 | 7 | 8 | 8 | 8 | 8 | 8 | 8 | 7 | 6 |
| 24 | 7 | 6 | 6 | 5 | 5 | 6 | 6 | 7 | 8 | 9 | 9 | 8 | 9 | 9 | 9 | 7 | 7 |
| 25 | 7 | 7 | 6 | 5 | 5 | 6 | 7 | 8 | 9 | 10 | 10 | 9 | 10 | 10 | 10 | 8 | 7 |
| 26 | 8 | 7 | 7 | 6 | 6 | 7 | 8 | 9 | 10 | 11 | 11 | 10 | 11 | 11 | 11 | 9 | 8 |
| 27 | 9 | 8 | 8 | 7 | 7 | 7 | 9 | 9 | 11 | 12 | 12 | 11 | 12 | 12 | 12 | 10 | 9 |
| 28 | 10 | 9 | 9 | 7 | 8 | 8 | 10 | 11 | 12 | 13 | 13 | 13 | 13 | 13 | 13 | 11 | 10 |

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|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 29 | 11 | 10 | 10 | 8 | 8 | 9 | 11 | 12 | 13 | 14 | 14 | 14 | 14 | 15 | 14 | 12 | 11 |
| 30 | 13 | 11 | 10 | 9 | 9 | 10 | 12 | 14 | 15 | 16 | 16 | 15 | 17 | 18 | 16 | 14 | 13 |
| 31 | 14 | 13 | 12 | 10 | 9 | 11 | 14 | 15 | 17 | 19 | 18 | 17 | 19 | 21 | 19 | 16 | 14 |
| 32 | 16 | 15 | 13 | 11 | 10 | 12 | 17 | 19 | 20 | 22 | 21 | 20 | 22 | 25 | 23 | 20 | 16 |
| 33 | 19 | 19 | 18 | 13 | 11 | 14 | 21 | 23 | 27 | 27 | 28 | 28 | 29 | 28 | 26 | 24 | 19 |
| 34 | 21 | 24 | 23 | 15 | 12 | 15 | 24 | 32 | 33 | 37 | 34 | 34 | 41 | 35 | 31 | 28 | 21 |
| 35 | 32 | 28 | 27 | 18 | 13 | 18 | 35 | 40 | 41 | 48 | 42 | 39 | 39 | 44 | 39 | 41 | 32 |
| 36 | 43 | 34 | 32 | 21 | 14 | 22 | 34 | 47 | 49 | 51 | 48 | 51 | 50 | 49 | 49 | 40 | 43 |
| 37 | 42 | 45 | 39 | 24 | 15 | 25 | 45 | 52 | 53 | 62 | 55 | 52 | 50 | 54 | 55 | 50 | 42 |
| 38 | 60 | 57 | 42 | 27 | 17 | 29 | 50 | 61 | 62 | 69 | 67 | 60 | 65 | 63 | 63 | 54 | 60 |
| 39 | 58 | 56 | 47 | 29 | 20 | 30 | 51 | 65 | 69 | 77 | 75 | 69 | 67 | 66 | 67 | 69 | 58 |
| 40 | 65 | 66 | 53 | 34 | 23 | 35 | 57 | 72 | 76 | 84 | 82 | 77 | 69 | 78 | 77 | 66 | 65 |
| 41 | 70 | 70 | 58 | 38 | 26 | 37 | 63 | 79 | 83 | 88 | 89 | 85 | 81 | 88 | 85 | 74 | 70 |
| 42 | 77 | 76 | 64 | 40 | 28 | 39 | 68 | 87 | 94 | 95 | 96 | 93 | 98 | 93 | 92 | 87 | 77 |
| 43 | 89 | 90 | 67 | 45 | 31 | 43 | 75 | 96 | 101 | 107 | 105 | 98 | 98 | 102 | 105 | 95 | 89 |
| 44 | 100 | 94 | 78 | 48 | 33 | 48 | 81 | 101 | 110 | 113 | 109 | 106 | 104 | 111 | 111 | 102 | 100 |
| 45 | 106 | 99 | 83 | 52 | 37 | 51 | 88 | 109 | 116 | 126 | 122 | 113 | 117 | 117 | 121 | 108 | 106 |
| 46 | 112 | 112 | 91 | 57 | 40 | 56 | 96 | 122 | 128 | 140 | 141 | 132 | 130 | 127 | 133 | 117 | 112 |
| 47 | 123 | 122 | 96 | 56 | 43 | 62 | 103 | 135 | 143 | 150 | 156 | 150 | 152 | 144 | 145 | 137 | 123 |
| 48 | 134 | 130 | 106 | 66 | 48 | 66 | 113 | 142 | 158 | 165 | 164 | 162 | 165 | 159 | 160 | 158 | 134 |
| 49 | 152 | 141 | 121 | 73 | 53 | 74 | 121 | 150 | 168 | 177 | 176 | 165 | 170 | 175 | 176 | 167 | 152 |
| 50 | 164 | 155 | 128 | 81 | 57 | 78 | 128 | 162 | 176 | 191 | 192 | 175 | 181 | 190 | 189 | 176 | 164 |
| 51 | 175 | 170 | 136 | 85 | 59 | 83 | 137 | 172 | 181 | 199 | 208 | 186 | 192 | 206 | 201 | 185 | 175 |
| 52 | 187 | 180 | 144 | 90 | 64 | 87 | 142 | 182 | 186 | 209 | 218 | 198 | 204 | 213 | 213 | 194 | 187 |
| 53 | 199 | 190 | 153 | 93 | 71 | 92 | 151 | 189 | 203 | 218 | 224 | 214 | 216 | 218 | 222 | 206 | 199 |
| 54 | 211 | 200 | 162 | 92 | 76 | 97 | 157 | 195 | 221 | 229 | 232 | 226 | 226 | 228 | 234 | 219 | 211 |
| 55 | 221 | 213 | 170 | 101 | 81 | 103 | 161 | 203 | 229 | 241 | 244 | 238 | 238 | 240 | 245 | 231 | 221 |
| 56 | 232 | 222 | 177 | 111 | 86 | 110 | 169 | 211 | 237 | 257 | 256 | 249 | 253 | 256 | 259 | 244 | 232 |
| 57 | 242 | 232 | 185 | 116 | 90 | 117 | 181 | 223 | 258 | 272 | 273 | 258 | 262 | 273 | 276 | 258 | 242 |
| 58 | 251 | 238 | 193 | 123 | 97 | 125 | 188 | 235 | 272 | 290 | 288 | 268 | 275 | 286 | 290 | 270 | 251 |
| 59 | 263 | 247 | 201 | 129 | 102 | 133 | 197 | 246 | 283 | 300 | 303 | 278 | 289 | 303 | 303 | 281 | 263 |
| 60 | 277 | 260 | 212 | 134 | 106 | 138 | 208 | 256 | 288 | 312 | 316 | 291 | 301 | 318 | 315 | 290 | 277 |

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|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 61 | 291 | 272 | 222 | 136 | 110 | 145 | 216 | 269 | 302 | 323 | 330 | 303 | 314 | 330 | 328 | 299 | 291 |
| 62 | 303 | 286 | 227 | 143 | 113 | 154 | 224 | 284 | 316 | 342 | 344 | 315 | 326 | 338 | 342 | 310 | 303 |
| 63 | 317 | 298 | 234 | 152 | 119 | 162 | 235 | 299 | 331 | 360 | 360 | 329 | 341 | 343 | 351 | 323 | 317 |
| 64 | 331 | 312 | 243 | 162 | 126 | 171 | 246 | 313 | 348 | 373 | 378 | 347 | 354 | 355 | 365 | 335 | 331 |
| 65 | 342 | 321 | 252 | 168 | 135 | 179 | 255 | 327 | 363 | 388 | 391 | 368 | 368 | 376 | 383 | 350 | 342 |
| 66 | 358 | 331 | 264 | 176 | 140 | 189 | 267 | 337 | 381 | 402 | 408 | 383 | 380 | 399 | 400 | 369 | 358 |
| 67 | 375 | 343 | 279 | 184 | 145 | 192 | 275 | 349 | 393 | 416 | 427 | 400 | 397 | 420 | 419 | 389 | 375 |
| 68 | 390 | 359 | 291 | 193 | 152 | 197 | 283 | 358 | 404 | 429 | 442 | 415 | 416 | 441 | 442 | 410 | 390 |
| 69 | 409 | 376 | 303 | 200 | 160 | 203 | 295 | 363 | 417 | 441 | 460 | 431 | 435 | 462 | 460 | 428 | 409 |
| 70 | 428 | 392 | 314 | 203 | 168 | 213 | 304 | 371 | 430 | 458 | 477 | 443 | 453 | 481 | 476 | 444 | 428 |
| 71 | 443 | 410 | 322 | 205 | 178 | 225 | 309 | 381 | 439 | 475 | 487 | 455 | 467 | 495 | 492 | 457 | 443 |
| 72 | 460 | 424 | 331 | 216 | 186 | 232 | 312 | 392 | 450 | 486 | 495 | 464 | 480 | 503 | 504 | 470 | 460 |
| 73 | 474 | 435 | 336 | 227 | 193 | 242 | 319 | 404 | 462 | 502 | 502 | 473 | 490 | 512 | 517 | 481 | 474 |
| 74 | 485 | 446 | 345 | 238 | 197 | 249 | 328 | 414 | 470 | 516 | 510 | 484 | 499 | 524 | 533 | 490 | 485 |
| 75 | 491 | 458 | 354 | 246 | 204 | 255 | 339 | 422 | 479 | 531 | 520 | 497 | 502 | 533 | 548 | 501 | 491 |
| 76 | 500 | 466 | 365 | 255 | 211 | 262 | 346 | 429 | 487 | 540 | 534 | 509 | 509 | 544 | 558 | 512 | 500 |
| 77 | 509 | 472 | 369 | 259 | 215 | 267 | 353 | 437 | 497 | 547 | 541 | 520 | 520 | 557 | 566 | 523 | 509 |
| 78 | 520 | 481 | 378 | 267 | 225 | 274 | 359 | 445 | 508 | 555 | 551 | 529 | 536 | 569 | 571 | 536 | 520 |
| 79 | 534 | 491 | 387 | 273 | 235 | 281 | 367 | 454 | 515 | 565 | 559 | 539 | 549 | 585 | 582 | 547 | 534 |
| 80 | 543 | 499 | 394 | 279 | 243 | 288 | 374 | 466 | 526 | 577 | 573 | 547 | 562 | 599 | 595 | 562 | 543 |
| 81 | 553 | 506 | 398 | 286 | 250 | 294 | 382 | 475 | 539 | 590 | 589 | 558 | 575 | 612 | 609 | 572 | 553 |
| 82 | 565 | 515 | 407 | 291 | 257 | 302 | 387 | 479 | 550 | 606 | 603 | 571 | 587 | 623 | 627 | 585 | 565 |
| 83 | 577 | 524 | 415 | 297 | 263 | 311 | 392 | 486 | 560 | 618 | 617 | 583 | 596 | 634 | 642 | 596 | 577 |
| 84 | 587 | 535 | 424 | 306 | 270 | 320 | 397 | 496 | 573 | 630 | 630 | 595 | 606 | 646 | 655 | 608 | 587 |
| 85 | 598 | 543 | 431 | 313 | 278 | 326 | 406 | 507 | 584 | 642 | 645 | 606 | 620 | 657 | 669 | 624 | 598 |
| 86 | 610 | 550 | 437 | 317 | 287 | 333 | 414 | 519 | 592 | 653 | 656 | 617 | 635 | 669 | 681 | 637 | 610 |
| 87 | 619 | 562 | 445 | 322 | 292 | 339 | 422 | 521 | 599 | 661 | 664 | 630 | 647 | 680 | 693 | 647 | 619 |
| 88 | 627 | 574 | 453 | 328 | 299 | 348 | 428 | 524 | 609 | 671 | 673 | 641 | 658 | 692 | 704 | 657 | 627 |
| 89 | 639 | 583 | 461 | 336 | 304 | 357 | 436 | 528 | 620 | 683 | 685 | 652 | 665 | 700 | 713 | 669 | 639 |
| 90 | 644 | 594 | 468 | 345 | 315 | 363 | 444 | 533 | 626 | 692 | 697 | 656 | 670 | 705 | 724 | 676 | 644 |
| 91 | 650 | 599 | 476 | 353 | 322 | 369 | 451 | 541 | 630 | 697 | 703 | 660 | 679 | 708 | 736 | 685 | 650 |
| 92 | 660 | 608 | 483 | 358 | 326 | 377 | 456 | 547 | 634 | 705 | 710 | 665 | 687 | 716 | 743 | 694 | 660 |

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| 93 | 665 | 613 | 487 | 365 | 331 | 383 | 463 | 552 | 637 | 715 | 720 | 674 | 698 | 728 | 752 | 706 | 665 |
| 94 | 674 | 622 | 494 | 373 | 341 | 388 | 472 | 562 | 646 | 725 | 729 | 687 | 706 | 738 | 760 | 716 | 674 |
| 95 | 683 | 629 | 500 | 378 | 350 | 393 | 481 | 570 | 655 | 730 | 735 | 697 | 712 | 751 | 767 | 725 | 683 |
| 96 | 690 | 635 | 506 | 385 | 354 | 399 | 487 | 579 | 662 | 739 | 739 | 701 | 718 | 759 | 770 | 731 | 690 |
| 97 | 696 | 642 | 511 | 392 | 358 | 404 | 495 | 583 | 664 | 743 | 746 | 709 | 721 | 767 | 781 | 736 | 696 |
| 98 | 705 | 650 | 516 | 398 | 365 | 409 | 500 | 587 | 668 | 754 | 753 | 714 | 727 | 777 | 790 | 744 | 705 |
| 99 | 710 | 655 | 522 | 400 | 370 | 419 | 505 | 590 | 672 | 764 | 757 | 718 | 733 | 782 | 795 | 751 | 710 |
| 100 | 718 | 656 | 528 | 407 | 376 | 426 | 509 | 597 | 679 | 774 | 765 | 725 | 739 | 788 | 803 | 758 | 718 |
| 101 | 721 | 659 | 533 | 412 | 385 | 432 | 513 | 599 | 688 | 782 | 769 | 732 | 746 | 792 | 810 | 764 | 721 |
| 102 | 725 | 665 | 539 | 415 | 390 | 441 | 519 | 603 | 699 | 784 | 777 | 740 | 752 | 795 | 815 | 770 | 725 |
| 103 | 733 | 669 | 542 | 421 | 400 | 448 | 523 | 603 | 703 | 783 | 782 | 745 | 761 | 803 | 819 | 777 | 733 |
| 104 | 737 | 670 | 546 | 426 | 409 | 454 | 529 | 606 | 709 | 788 | 785 | 749 | 765 | 814 | 824 | 783 | 737 |
| 105 | 742 | 673 | 550 | 431 | 415 | 459 | 538 | 612 | 717 | 789 | 787 | 752 | 768 | 821 | 830 | 789 | 742 |
| 106 | 749 | 676 | 555 | 433 | 419 | 465 | 553 | 625 | 724 | 793 | 793 | 751 | 777 | 825 | 839 | 790 | 749 |
| 107 | 752 | 678 | 559 | 439 | 427 | 468 | 560 | 638 | 737 | 800 | 801 | 750 | 785 | 828 | 846 | 790 | 752 |
| 108 | 757 | 679 | 563 | 448 | 448 | 481 | 566 | 633 | 738 | 804 | 807 | 752 | 791 | 828 | 854 | 789 | 757 |
| 109 | 751 | 679 | 569 | 448 | 448 | 486 | 567 | 631 | 741 | 809 | 814 | 759 | 796 | 827 | 861 | 784 | 751 |
| 110 | 759 | 679 | 572 | 447 | 437 | 487 | 572 | 636 | 745 | 814 | 820 | 769 | 799 | 832 | 867 | 787 | 759 |
| 111 | 762 | 681 | 574 | 456 | 439 | 481 | 579 | 637 | 750 | 820 | 831 | 781 | 802 | 841 | 876 | 791 | 762 |
| 112 | 763 | 686 | 582 | 467 | 460 | 479 | 589 | 636 | 751 | 822 | 842 | 791 | 818 | 847 | 887 | 799 | 763 |
| 113 | 770 | 691 | 585 | 476 | 462 | 481 | 587 | 626 | 737 | 823 | 843 | 802 | 826 | 849 | 891 | 812 | 770 |
| 114 | 779 | 694 | 586 | 474 | 458 | 481 | 575 | 608 | 725 | 815 | 835 | 806 | 824 | 854 | 888 | 822 | 779 |
| 115 | 781 | 702 | 591 | 461 | 448 | 481 | 560 | 605 | 714 | 815 | 830 | 808 | 813 | 862 | 887 | 828 | 781 |
| 116 | 781 | 708 | 601 | 457 | 442 | 481 | 563 | 603 | 709 | 819 | 828 | 797 | 812 | 862 | 895 | 829 | 781 |
| 117 | 780 | 707 | 591 | 456 | 441 | 481 | 569 | 600 | 706 | 828 | 829 | 780 | 800 | 868 | 889 | 818 | 780 |
| 118 | 773 | 701 | 579 | 455 | 442 | 485 | 573 | 601 | 701 | 825 | 831 | 767 | 782 | 860 | 876 | 813 | 773 |
| 119 | 760 | 695 | 560 | 459 | 446 | 492 | 572 | 600 | 697 | 810 | 830 | 767 | 769 | 863 | 866 | 803 | 760 |
| 120 | 753 | 708 | 555 | 461 | 454 | 495 | 571 | 601 | 699 | 803 | 828 | 771 | 766 | 860 | 864 | 790 | 753 |
| 121 | 752 | 721 | 553 | 459 | 461 | 518 | 568 | 606 | 703 | 799 | 826 | 767 | 763 | 862 | 869 | 784 | 752 |
| 122 | 753 | 719 | 552 | 464 | 455 | 519 | 571 | 617 | 707 | 801 | 827 | 762 | 767 | 866 | 882 | 781 | 753 |
| 123 | 748 | 708 | 544 | 464 | 437 | 503 | 574 | 618 | 708 | 803 | 824 | 758 | 767 | 859 | 887 | 775 | 748 |
| 124 | 744 | 706 | 543 | 469 | 424 | 499 | 575 | 622 | 705 | 803 | 826 | 758 | 772 | 856 | 889 | 775 | 744 |

Laboratory: Standard-Tech Co., Ltd Testing Center

NVLAP CODE: 201011-0

Report Format Number STD/QR4909-A/2

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| | | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 125 | 744 | 703 | 546 | 482 | 429 | 510 | 574 | 623 | 696 | 800 | 834 | 754 | 781 | 847 | 890 | 770 | 744 |
| 126 | 744 | 699 | 542 | 488 | 441 | 501 | 578 | 626 | 694 | 794 | 843 | 747 | 784 | 841 | 889 | 774 | 744 |
| 127 | 737 | 694 | 541 | 487 | 431 | 488 | 586 | 618 | 694 | 790 | 842 | 743 | 782 | 833 | 884 | 780 | 737 |
| 128 | 734 | 695 | 545 | 498 | 424 | 470 | 590 | 608 | 687 | 782 | 825 | 740 | 783 | 842 | 884 | 779 | 734 |
| 129 | 730 | 688 | 553 | 512 | 426 | 469 | 586 | 601 | 678 | 766 | 803 | 750 | 785 | 847 | 885 | 776 | 730 |
| 130 | 717 | 675 | 556 | 507 | 440 | 471 | 576 | 599 | 663 | 743 | 785 | 748 | 782 | 842 | 870 | 766 | 717 |
| 131 | 704 | 660 | 555 | 488 | 447 | 464 | 568 | 582 | 654 | 730 | 776 | 738 | 773 | 833 | 856 | 756 | 704 |
| 132 | 694 | 644 | 552 | 472 | 442 | 455 | 560 | 569 | 662 | 736 | 777 | 732 | 765 | 831 | 844 | 751 | 694 |
| 133 | 684 | 633 | 544 | 465 | 439 | 453 | 553 | 572 | 660 | 750 | 772 | 719 | 746 | 816 | 834 | 735 | 684 |
| 134 | 675 | 622 | 535 | 460 | 438 | 451 | 542 | 577 | 667 | 753 | 759 | 716 | 741 | 810 | 825 | 722 | 675 |
| 135 | 667 | 618 | 535 | 465 | 438 | 443 | 538 | 578 | 677 | 743 | 745 | 721 | 754 | 782 | 811 | 716 | 667 |
| 136 | 670 | 617 | 542 | 466 | 425 | 439 | 527 | 579 | 664 | 735 | 735 | 721 | 755 | 779 | 812 | 718 | 670 |
| 137 | 679 | 615 | 548 | 463 | 410 | 454 | 503 | 573 | 635 | 724 | 726 | 701 | 751 | 773 | 808 | 718 | 679 |
| 138 | 685 | 606 | 532 | 452 | 401 | 456 | 477 | 571 | 624 | 716 | 737 | 680 | 752 | 751 | 786 | 714 | 685 |
| 139 | 671 | 605 | 510 | 434 | 393 | 470 | 475 | 554 | 620 | 713 | 745 | 663 | 739 | 733 | 777 | 704 | 671 |
| 140 | 656 | 601 | 505 | 418 | 386 | 465 | 473 | 534 | 622 | 711 | 733 | 662 | 710 | 722 | 777 | 684 | 656 |
| 141 | 655 | 597 | 505 | 420 | 384 | 453 | 483 | 507 | 623 | 698 | 715 | 664 | 695 | 716 | 768 | 673 | 655 |
| 142 | 655 | 590 | 502 | 431 | 378 | 434 | 479 | 491 | 603 | 665 | 694 | 668 | 703 | 726 | 771 | 661 | 655 |
| 143 | 643 | 570 | 507 | 430 | 378 | 411 | 457 | 486 | 573 | 636 | 681 | 656 | 712 | 721 | 773 | 644 | 643 |
| 144 | 641 | 550 | 510 | 404 | 388 | 407 | 436 | 485 | 557 | 613 | 671 | 613 | 719 | 706 | 745 | 649 | 641 |
| 145 | 633 | 536 | 506 | 382 | 399 | 417 | 450 | 461 | 565 | 591 | 656 | 593 | 689 | 702 | 727 | 649 | 633 |
| 146 | 637 | 539 | 490 | 373 | 389 | 411 | 471 | 446 | 551 | 567 | 640 | 597 | 647 | 687 | 709 | 634 | 637 |
| 147 | 628 | 533 | 474 | 383 | 366 | 389 | 463 | 424 | 526 | 550 | 630 | 596 | 637 | 669 | 706 | 630 | 628 |
| 148 | 601 | 522 | 457 | 392 | 358 | 377 | 427 | 415 | 526 | 556 | 614 | 575 | 644 | 670 | 717 | 624 | 601 |
| 149 | 592 | 513 | 459 | 387 | 353 | 384 | 411 | 436 | 528 | 565 | 597 | 545 | 643 | 652 | 714 | 627 | 592 |
| 150 | 603 | 501 | 457 | 349 | 348 | 381 | 388 | 451 | 506 | 566 | 576 | 514 | 635 | 621 | 684 | 622 | 603 |
| 151 | 583 | 489 | 436 | 330 | 332 | 365 | 372 | 420 | 497 | 541 | 572 | 510 | 603 | 614 | 646 | 594 | 583 |
| 152 | 534 | 471 | 416 | 308 | 333 | 359 | 356 | 381 | 490 | 510 | 569 | 533 | 585 | 614 | 630 | 578 | 534 |
| 153 | 523 | 448 | 407 | 299 | 328 | 333 | 364 | 376 | 457 | 493 | 531 | 531 | 588 | 593 | 623 | 577 | 523 |
| 154 | 540 | 444 | 403 | 289 | 292 | 317 | 358 | 374 | 420 | 473 | 492 | 489 | 546 | 571 | 596 | 561 | 540 |
| 155 | 498 | 415 | 396 | 296 | 293 | 299 | 339 | 346 | 408 | 443 | 494 | 447 | 516 | 546 | 555 | 521 | 498 |
| 156 | 463 | 382 | 383 | 278 | 309 | 283 | 312 | 324 | 386 | 451 | 509 | 440 | 517 | 501 | 511 | 491 | 463 |

Laboratory: Standard-Tech Co., Ltd Testing Center

NVLAP CODE: 201011-0

Report Format Number STD/QR4909-A/2

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| | | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 157 | 461 | 366 | 364 | 277 | 299 | 289 | 280 | 305 | 378 | 477 | 442 | 448 | 482 | 462 | 482 | 465 | 461 |
| 158 | 461 | 360 | 332 | 267 | 273 | 293 | 256 | 280 | 360 | 401 | 400 | 431 | 431 | 431 | 445 | 465 | 461 |
| 159 | 420 | 361 | 326 | 235 | 270 | 288 | 244 | 300 | 347 | 357 | 384 | 411 | 399 | 415 | 434 | 454 | 420 |
| 160 | 376 | 327 | 298 | 218 | 222 | 251 | 243 | 300 | 316 | 370 | 370 | 385 | 405 | 397 | 430 | 400 | 376 |
| 161 | 376 | 319 | 281 | 213 | 191 | 216 | 270 | 279 | 295 | 358 | 339 | 334 | 366 | 397 | 420 | 396 | 376 |
| 162 | 340 | 300 | 262 | 226 | 193 | 193 | 231 | 254 | 258 | 314 | 318 | 292 | 348 | 363 | 365 | 359 | 340 |
| 163 | 309 | 291 | 244 | 213 | 182 | 199 | 207 | 221 | 238 | 295 | 288 | 267 | 313 | 330 | 320 | 330 | 309 |
| 164 | 275 | 277 | 233 | 191 | 181 | 226 | 184 | 188 | 219 | 269 | 297 | 272 | 273 | 313 | 285 | 309 | 275 |
| 165 | 261 | 255 | 229 | 167 | 178 | 208 | 161 | 195 | 216 | 268 | 273 | 273 | 283 | 291 | 296 | 279 | 261 |
| 166 | 267 | 247 | 193 | 163 | 175 | 191 | 177 | 190 | 212 | 266 | 273 | 250 | 266 | 281 | 286 | 264 | 267 |
| 167 | 254 | 229 | 185 | 177 | 169 | 173 | 185 | 178 | 186 | 236 | 250 | 205 | 261 | 258 | 271 | 248 | 254 |
| 168 | 223 | 197 | 181 | 160 | 153 | 152 | 152 | 167 | 175 | 204 | 195 | 191 | 219 | 227 | 214 | 228 | 223 |
| 169 | 169 | 199 | 153 | 144 | 119 | 133 | 127 | 155 | 164 | 173 | 194 | 210 | 193 | 199 | 200 | 183 | 169 |
| 170 | 155 | 192 | 146 | 124 | 119 | 121 | 120 | 145 | 151 | 155 | 177 | 186 | 180 | 175 | 189 | 167 | 155 |
| 171 | 162 | 165 | 139 | 103 | 106 | 115 | 124 | 128 | 138 | 139 | 160 | 161 | 165 | 147 | 172 | 160 | 162 |
| 172 | 152 | 143 | 139 | 105 | 101 | 111 | 117 | 104 | 113 | 126 | 143 | 137 | 140 | 129 | 121 | 142 | 152 |
| 173 | 109 | 116 | 124 | 93 | 94 | 101 | 96 | 108 | 106 | 127 | 127 | 130 | 136 | 129 | 132 | 118 | 109 |
| 174 | 100 | 115 | 105 | 80 | 87 | 92 | 95 | 100 | 97 | 108 | 116 | 108 | 111 | 114 | 145 | 118 | 100 |
| 175 | 108 | 100 | 94 | 83 | 76 | 81 | 83 | 83 | 91 | 92 | 94 | 91 | 84 | 87 | 118 | 100 | 108 |
| 176 | 85 | 84 | 74 | 63 | 63 | 68 | 75 | 72 | 65 | 81 | 77 | 72 | 63 | 67 | 88 | 75 | 85 |
| 177 | 61 | 67 | 54 | 42 | 43 | 45 | 50 | 61 | 50 | 69 | 51 | 48 | 42 | 46 | 59 | 56 | 61 |
| 178 | 37 | 50 | 34 | 23 | 22 | 22 | 24 | 50 | 34 | 58 | 26 | 24 | 21 | 26 | 29 | 37 | 37 |
| 179 | 13 | 33 | 15 | 0 | 0 | 0 | 0 | 38 | 19 | 46 | 0 | 0 | 0 | 5 | 0 | 17 | 13 |
| 180 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

3. Test Equipment

| Equipment ID | Equipment Name | Last Calibration Date | Next Calibration Date |
|--|------------------------------------|-----------------------|-----------------------|
| ST-R-331 | 2 meter Integrating Sphere | 2017-07-01 | 2018-06-30 |
| ST-R-327 | Spectral analysis system HAAS-2000 | 2017-07-01 | 2018-06-30 |
| D204 | Standard Lamp | 2017-07-12 | 2018-07-11 |
| PF2010 | Power Meter for Integrating Sphere | 2017-07-01 | 2018-06-30 |
| GO-R5000 | Goniophotometer system | 2017-07-01 | 2018-06-30 |
| D908S | Standard Lamp | 2017-07-12 | 2018-07-11 |
| PF210 | Power Meter for Goniophotometer | 2017-07-07 | 2018-07-06 |
| Expand Uncertainty: Photometric Measurement (Sphere):2.04%, k=2 Chromaticity Measurement(Sphere):28.8K, k=2 Photometric Measurement(Goniophotometer):2.36%, k=2 | | | |

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