

## Test Report

### No. TRPVP04048/23P/01

Commission Testing  
according to ISO 9050

Applicant: **Tongwei Solar (Hefei) Co., Ltd.**  
No.888, Changning Road, High-tech District,  
Hefei City, Anhui Province, 230088, P.R. China

File No.: PVP04048/23P-01

Designed: *May 10. 2023* by: *Jean Jm*  
(Project Engineer)

Reviewed: *May 10. 2023* by: *[Signature]*  
(Technical Certifier)

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|                                     |  |
|-------------------------------------|--|
| Applicant..... :                    | <b>Tongwei Solar (Hefei) Co., Ltd.</b><br>No.888, Changning Road, High-tech District,<br>Hefei City, Anhui Province, 230088, P.R. China  |
| Manufacturer ..... :                | <b>Tongwei Solar (Hefei) Co., Ltd.</b><br>No.888, Changning Road, High-tech District,<br>Hefei City, Anhui Province, 230088, P.R. China  |
| Order No. .... :                    | QT-PVP04048/23P  |
| Date of Application ..... :         | 04/04/2023   |
| Product ..... :                     | Crystalline Silicon Terrestrial Photovoltaic (PV) Modules  |
| Module type(s)..... :               | <b>Double Glass PV Modules with Half-cut 7" PERC Mono-crystalline Silicon Solar Cells:</b><br>144 cells: TWMND-72HD555<br><b>Double Glass PV Modules with Half-cut 7" TOPCon Mono-crystalline Silicon Solar Cells:</b><br>144 cells: TWMPD-72HD545<br><b>PV Modules with Half-cut 7" PERC Mono-crystalline Silicon Solar Cells:</b><br>144 cells: TWMND-72HS555<br><b>PV Modules with Half-cut 7" TOPCon Mono-crystalline Silicon Solar Cells:</b><br>144 cells: TWMPD-72HS555 |
| General Information                 |  |
| • Maximum System Voltage.... :      | DC 1500V   |
| • Electrical Protection Class.... : | Class II   |
| Type of examination ..... :         | Commission testing only  |
| Testing Period ..... :              | 04/13/2023   |
| Testing Laboratory..... :           | <b>Shanghai Institute of Quality Inspection and Technical Research</b><br>No. 900, Jiangyue Road, Minhang District, Shanghai 201114, China   |

Test results listed in this test report refer exclusively to the mentioned test sample.

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The submitted test samples as described in the reports hereunder are based on the requirements:  
ISO 9050:2003 "Glass in building - Determination of light transmittance, solar direct transmittance, total solar energy transmittance, ultraviolet transmittance and related glazing factors"

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## Summary of testing

According to the enquiry of the applicant, a commission testing was performed according to ISO 9050:2003, testing items are listed in page 7 in this report.

Module type TWMND-72HD555, TWMPD-72HD545, TWMND-72HS555 and TWMPD-72HS555 were delivered to testing lab as test samples and conducted with all the related tests.

Each sample was measured on two locations in the corner. 1# is located on the cell area, 2# is located on the backsheet area between the different solar cells cross. Please refer the annex 2 for the detail.

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## General remarks

|  |  |
|--|--|
| <b>Test item particulars:</b>  |  |
| Accessories and detachable parts included in the evaluation .....  | N/A  |
| Options included.....  | N/A  |
| <b>Abbreviations used in the report:</b>   |  |
| HF - Humidity Freeze   | TC - Temperature Cycling                   |
| DH - Damp Heat   | Vmpp - Maximum power voltage               |
| Imp - Maximum power current  | Voc - Open circuit voltage                 |
| Isc - Short circuit current  | FF - Fill factor                           |
| Pmpp - Maximum power   | $\alpha$ - Current temperature coefficient |
| NOCT - Nominal Operating Cell Temperature  | $\beta$ - Voltage temperature coefficient  |
| STC - Standard Test Conditions   | $\gamma$ - power temperature coefficient   |
| CTI - Comparative Tracking Index   | PD - Partial Discharge                     |
| <b>Possible test case verdicts:</b>  |  |
| Test case does not apply to the test object .....  | Not Applicable (N/A)                       |
| Test object does meet the requirement.....   | Pass (P)                                   |
| Test object does not meet the requirement.....   | Fail (F)                                   |
| <b>Other remarks:</b>  |  |
| <p>The test verdicts presented in this report relate only to the object tested.<br/>                     This report shall not be reproduced except in full, without the written approval of the issuing testing laboratory.</p> <p>“(see Annex #)” refers to additional information appended to the report.<br/>                     “(see Table #)” refers to a table appended to the report.</p> <p>Throughout this report, a point is used as the decimal separator.</p> |  |

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## Testing procedure

### **Module type: TWMND-72HD555**

- |   |
|---|
| <input type="checkbox"/> Random sampling from production          |
| <input checked="" type="checkbox"/> Prototype submitted by client |

Supplementary information: N/A

### **Module type: TWMPD-72HD545**

- |   |
|---|
| <input type="checkbox"/> Random sampling from production          |
| <input checked="" type="checkbox"/> Prototype submitted by client |

Supplementary information: N/A

### **Module type: TWMND-72HS555**

- |   |
|---|
| <input type="checkbox"/> Random sampling from production          |
| <input checked="" type="checkbox"/> Prototype submitted by client |

Supplementary information: N/A

### **Module type: TWMPD-72HS555**

- |   |
|---|
| <input type="checkbox"/> Random sampling from production          |
| <input checked="" type="checkbox"/> Prototype submitted by client |

Supplementary information: N/A

# Test Report



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## Module group assignment

### Module type: TWMND-72HD555

| Sample #       | Serial number      | Dimension (l x w x h) [mm] | Remark                    |
|----------------|--------------------|----------------------------|---------------------------|
| W02310500093-1 | GEADMPPM22C0301188 | 2278 x 1134 x 35           | Visible light reflectance |

### Module type: TWMPD-72HD545

| Sample #       | Serial number       | Dimension (l x w x h) [mm] | Remark                    |
|----------------|---------------------|----------------------------|---------------------------|
| W02310500093-2 | EEADMPPM23104101818 | 2278 x 1134 x 35           | Visible light reflectance |

### Module type: TWMND-72HS555

| Sample #       | Serial number       | Dimension (l x w x h) [mm] | Remark                    |
|----------------|---------------------|----------------------------|---------------------------|
| W02310500093-3 | FCADMPPM22C06007702 | 2278 x 1134 x 35           | Visible light reflectance |

### Module type: TWMPD-72HS555

| Sample #       | Serial number       | Dimension (l x w x h) [mm] | Remark                    |
|----------------|---------------------|----------------------------|---------------------------|
| W02310500093-4 | FCADMPPM22C08000829 | 2278 x 1134 x 35           | Visible light reflectance |

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| Clause | Requirement + Test | Result - Remark | Verdict |
|--------|--------------------|-----------------|---------|
|--------|--------------------|-----------------|---------|

## Test result overview

| <b>Measurement of spectral optical reflectance</b> |   |                 | - |
|--|---|-----------------|---|
| ISO 9050   | External light reflectance of glazing ..... | See table 3.4.1 | - |



**Test results of ISO 9050**

| 3.4.1 External light reflectance of glazing |                            |                      |      | - |
|---|----------------------------|----------------------|------|---|
| Test date [MM/DD/YYYY].....:                |                            | 04/13/2023           |      | - |
| Sample #                                    | External light reflectance | Measurement location |      | - |
|   |                            | 1#                   | 2#   | - |
| W023105<br>00093-1                          | Diffuse reflectance [%]    | 1.1                  | 12.7 | - |
|   | Regular reflectance [%]    | 0.8                  | 0.6  | - |
|   | Total reflectance [%]      | 1.9                  | 13.3 | - |
| W023105<br>00093-2                          | Diffuse reflectance [%]    | 1.0                  | 10.4 | - |
|   | Regular reflectance [%]    | 1.2                  | 1.1  | - |
|   | Total reflectance [%]      | 2.3                  | 11.5 | - |
| W023105<br>00093-3                          | Diffuse reflectance [%]    | 1.1                  | 14.3 | - |
|   | Regular reflectance [%]    | 1.0                  | 1.4  | - |
|   | Total reflectance [%]      | 2.2                  | 15.8 | - |
| W023105<br>00093-4                          | Diffuse reflectance [%]    | 1.2                  | 13.6 | - |
|   | Regular reflectance [%]    | 1.1                  | 0.9  | - |
|   | Total reflectance [%]      | 2.3                  | 14.5 | - |

Supplementary information:

The external light reflectance of glazing  $\rho_{v,o}$  shall be calculated using the following formula

$$\rho_{v,o} = \frac{\sum_{\lambda = 380 \text{ nm}}^{780 \text{ nm}} \rho_o(\lambda) D_\lambda V(\lambda) \Delta\lambda}{\sum_{\lambda = 380 \text{ nm}}^{780 \text{ nm}} D_\lambda V(\lambda) \Delta\lambda}$$

$\rho_o(\lambda)$ , is the spectral external reflectance of the glazing;

$D_\lambda$ , is the relative spectral distribution of illuminant D65 (see ISO/CIE 10526);

$V(\lambda)$ , is the spectral luminous efficiency for photopic vision defining the standard observer for photometry (see ISO/CIE 10527);

$\Delta\lambda$ , is the wavelength interval.

1# is located on the cell area; 2# is located on the backsheet area between the different solar cells cross.

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## Annex 1: List of measurement equipment

| Measurement / testing                 | Measuring equipment  | Equipment ID | Calibration due date |
|---------------------------------------|--|--------------|----------------------|
| External light reflectance of glazing | Ultraviolet visible spectrophotometer (Integrating sphere with 150mm inner diameter) | Lambda 950   | 05/31/2023           |

**Annex 2: Photos**



W02310500093-1 front



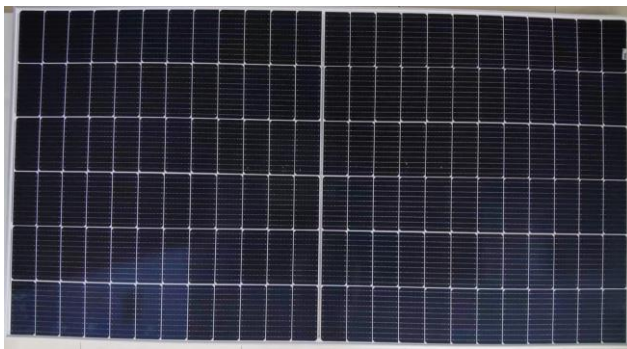
W02310500093-1 rear



W02310500093-2 front



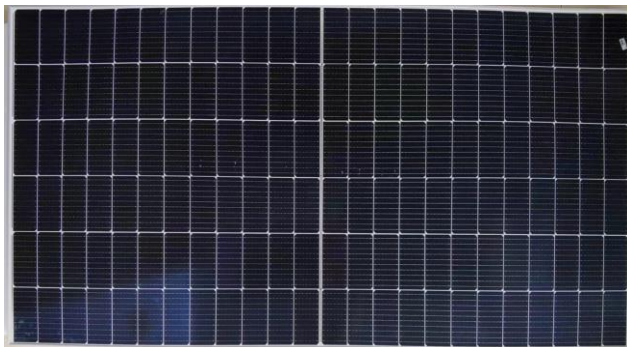
W02310500093-2 rear



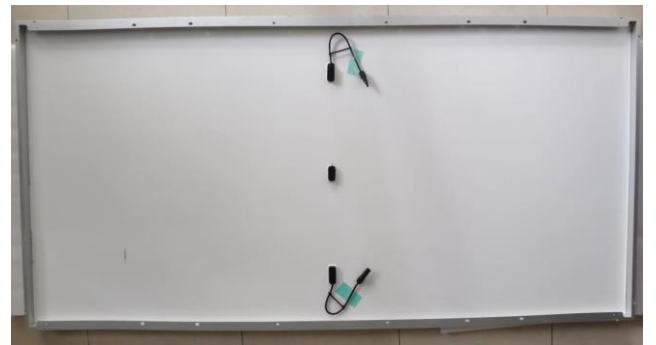
W02310500093-3 front



W02310500093-3 rear



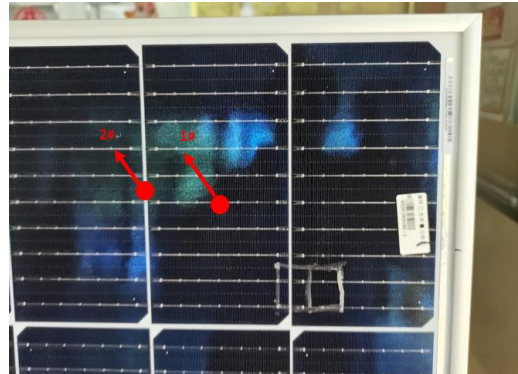
W02310500093-4 front



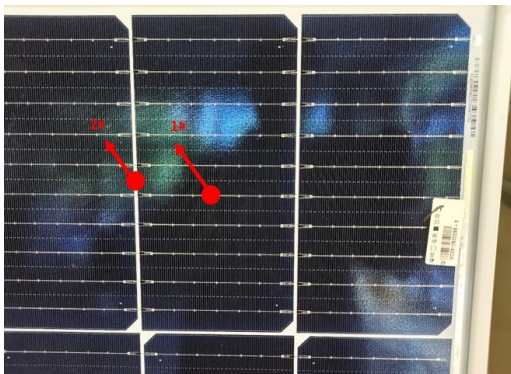
W02310500093-4 rear



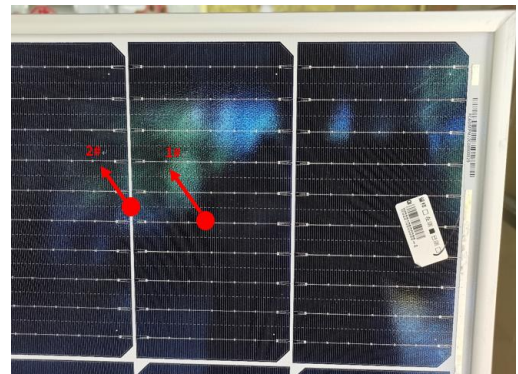
W02310500093-1 measured position



W02310500093-2 measured position



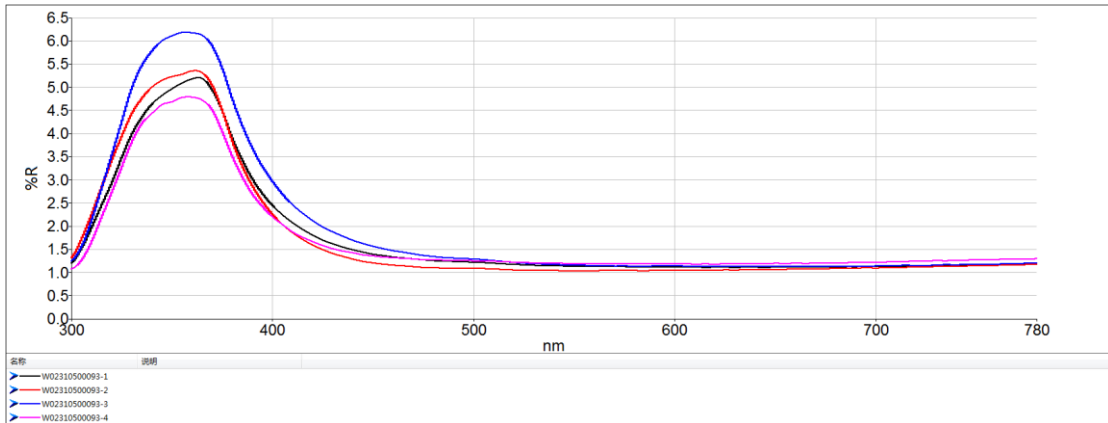
W02310500093-3 measured position



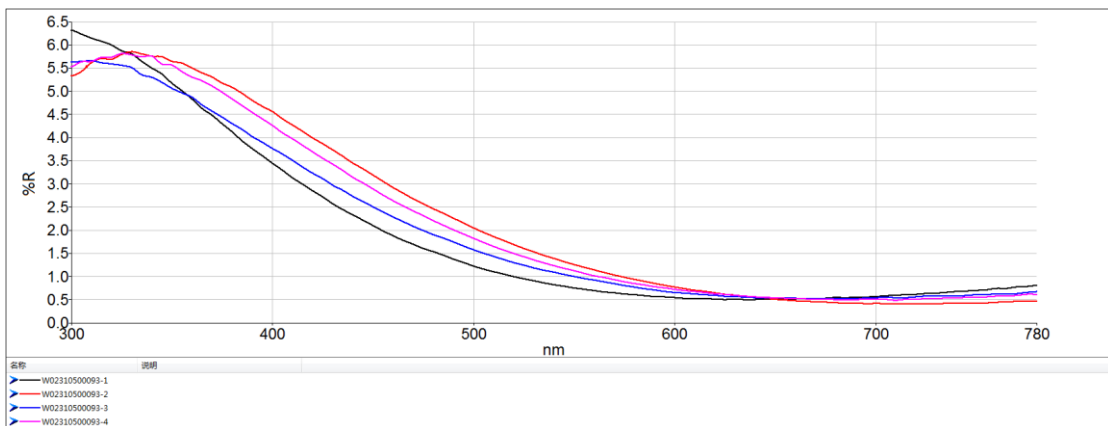
W02310500093-4 measured position

**Annex 3: Calculation of ISO 9050 external light reflectance**

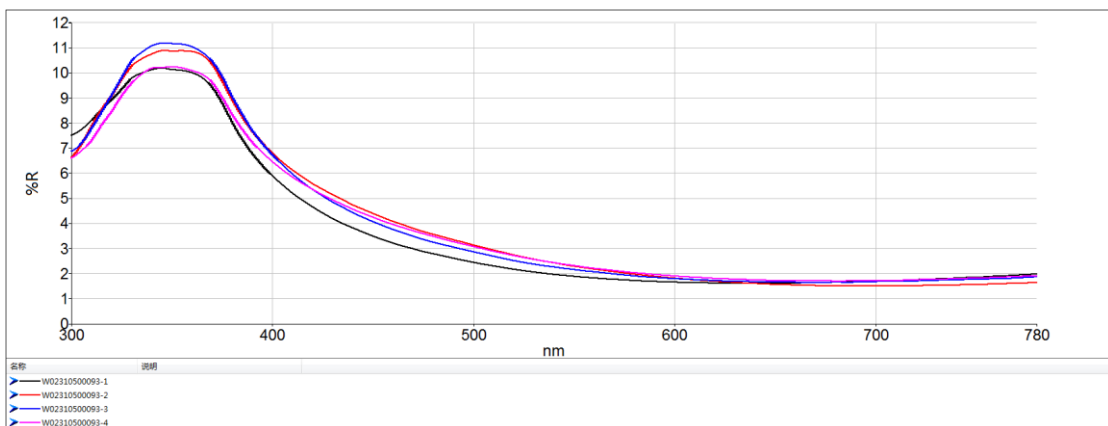
**Location 1#:**



Measured spectral diffuse reflectance curves

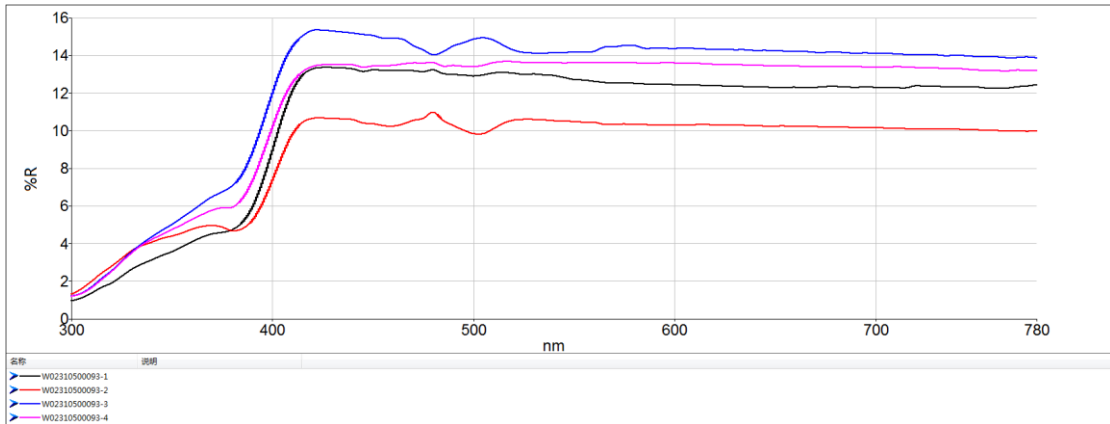


Measured spectral regular reflectance curves

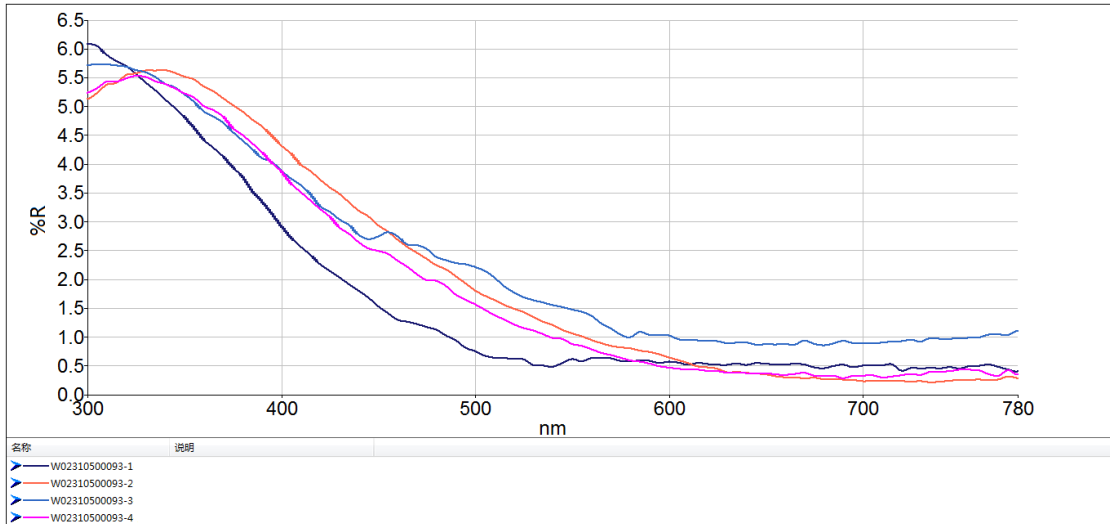


Measured spectral total reflectance curves

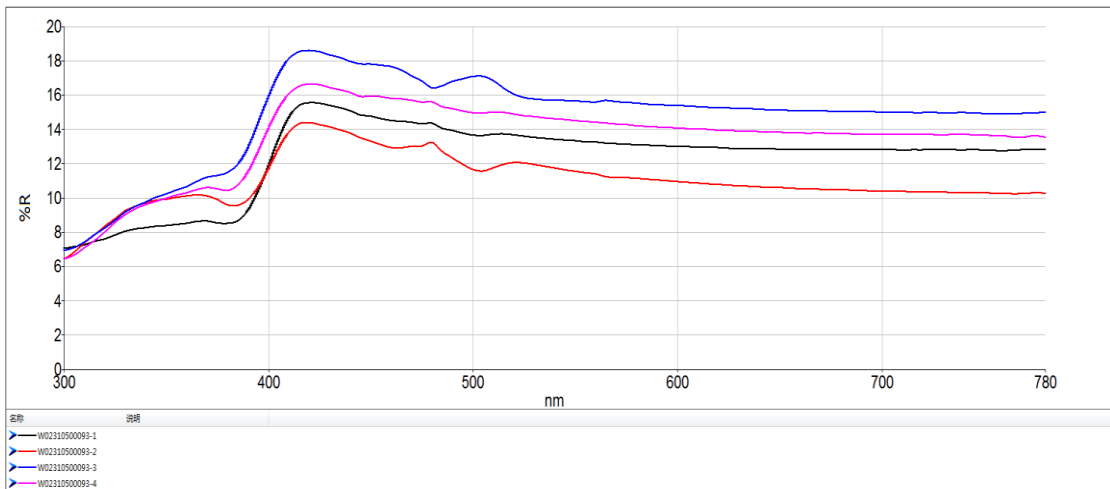
Location 2#:



Measured spectral diffuse reflectance curves



Measured spectral regular reflectance curves



Measured spectral total reflectance curves  
----- End of test report -----