

Application News

No. A607

Spectrophotometric Analysis

Determination of Daylight Transmittance/Reflectance Using LabSolutions™ UV-Vis: JIS R 3106 Testing Method for Transmittance/Reflectance of Flat Glass

Various optional analysis functions can be added to LabSolutions UV-Vis software for control of Shimadzu ultraviolet and visible light (UV-VIS) spectrophotometers. This article introduces a daylight transmittance/reflectance measurement function, which is one of those options.

Among standards related to determination of daylight transmittance and reflection, the Japanese Industrial Standard JIS R 3106 provides a "Testing method on transmittance, reflectance and emissivity of flat glasses and calculation of total solar energy transmittance." As indexes showing the properties of plate glass, JIS R 3106 specifies measurement methods and calculation methods for visible light transmittance and reflectance, daylight transmittance and reflectance, the solar heat gain coefficient (total solar energy transmittance), and normal emittance.

Here, the light transmittance/reflectance and daylight transmittance/reflectance of two different samples of flat glass were calculated.

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Possible Measurement Items

Daylight transmittance/reflectance is defined as the ratio of transmitted light flux (reflected light flux) to incident light flux for light flux perpendicularly incident on a glass surface. Calculations conforming to various standards are possible by using the daylight reflectance measurement function of this LabSolutions UV-Vis software option. Table 1 shows the possible measurement items.

Table 1 List of Possible Measurement Items

Standard supported	Possible measurement items *1
ISO 9050:2003	Light transmittance/reflectance, solar direct transmittance/reflectance, ultraviolet light transmittance, CIE (International Committee on Illumination) damage factor, skin damage factor
JIS R 3106:1998 *2	Light transmittance/reflectance, solar direct transmittance/reflectance
JIS K 5602:2008	Light transmittance/reflectance, solar direct transmittance/reflectance, near infrared reflectance
JIS A 5759:2016	Light transmittance/reflectance, solar direct transmittance/reflectance, ultraviolet transmittance
JIS S 3107:2013	Light transmittance/reflectance, solar direct transmittance/reflectance, ultraviolet transmittance
GB/T 2680:1994	Light transmittance/reflectance, solar direct transmittance/reflectance, ultraviolet transmittance

*1 "Solar direct transmittance/reflectance" has the same meaning as "Daylight transmittance/reflectance."

*2 LabSolutions UV-Vis software only supports calculations for single glazing and does not support multiple glazing.

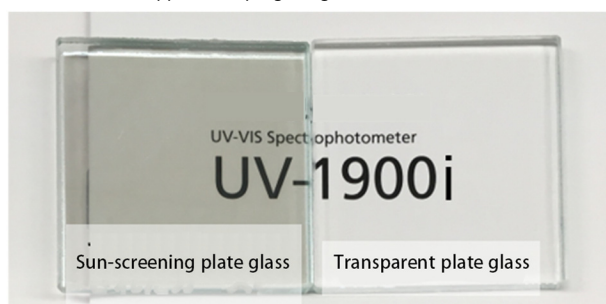


Fig. 1 Appearance of Measurement Samples

JIS R 3106-Compliant Determination of Transmittance/Reflectance

In JIS R 3106:1998, determination of daylight transmittance/reflectance is based on calculations using transmittance and reflectance in the 300 nm to 2,100 nm wavelength region and a weighting factor. Similarly, visible light transmittance and reflectance are calculated using transmittance and reflectance in the 380 nm to 780 nm region and a weighting factor. For details concerning the calculation equations, please refer to Application News No. A404A.

In the present study, two types of commercial plate glass were prepared as samples, one being transparent plate glass and the other sun-screening processed plate glass, and measurements were conducted with a Shimadzu UV-3600i Plus UV-VIS spectrophotometer with an ISR-603 integrating sphere attachment. Fig.1 and Fig.2 show the appearance of the measurement samples and the measurement system, respectively, and Table 2 shows the measurement conditions.

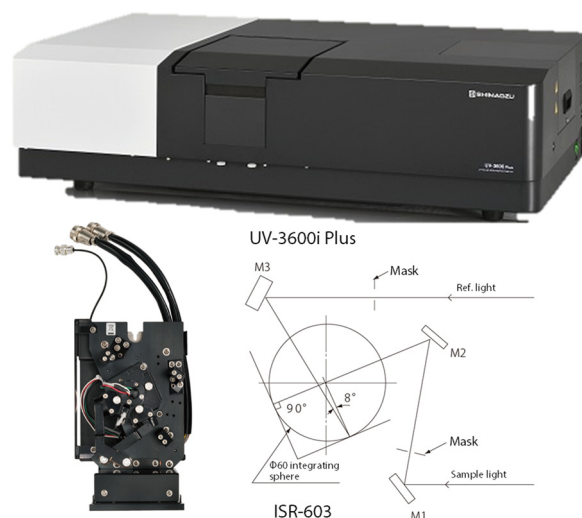


Fig. 2 Appearance of UV-3600i Plus Measurement System and Optical Path Diagram

Table 2 Measurement Conditions

Measurement wavelength range	: 300 nm - 2,100 nm
Scan speed	: Medium
Sampling pitch	: 2.0 nm
Slit width	: (20) nm
Light source switching wavelength	: 310 nm
Grating switching wavelength	: 720 nm
Detector switching wavelength	: 830 nm / 1,650 nm

Measurement Results

Fig. 3 and Fig. 4 show the measured transmission spectra and reflection spectra, respectively. The transparent glass transmitted light well in the full wavelength region of 350 nm and longer, while the sun-screening glass had lower transmittance than the transparent glass in the near-infrared region. Furthermore, the transparent glass reflected about 10% of light in the full wavelength region, but in contrast, the sun-screening glass displayed high reflectance of around 40% in the visible light region. The values of light transmittance/reflectance and daylight transmittance/reflectance were calculated from these transmission and reflection spectra by using the daylight transmittance/reflectance measurement software. Fig. 5 shows the setting screen.

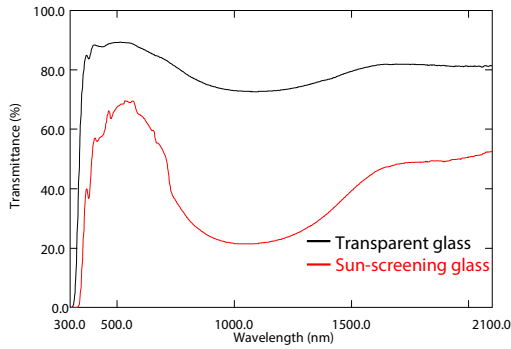


Fig. 3 Transmission Spectra

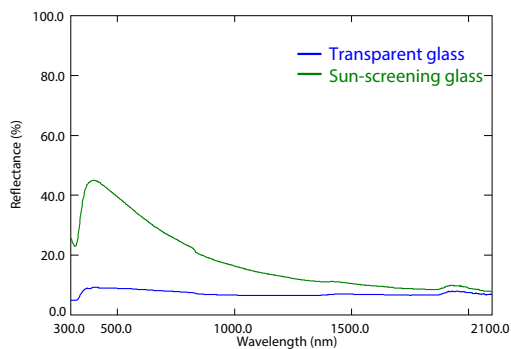


Fig. 4 Reflection Spectra

Table 3 shows the results for transmittance. In comparison with the transparent glass, the transmittance of the sun-screening glass was lower for both types of light. Table 4 shows the results for reflectance. Here, it was found that the sun-screening glass shows higher reflectance for both types.

It is also possible to make pass/fail judgments of daylight transmittance/reflectance with this software. In this experiment, the pass/fail criteria were transmittance of 50% or higher or reflectance of 5% or higher. The daylight transmittance of the sun-screening glass was 44.12%, indicating failure. With this software, samples that fail are indicated automatically in rose, as shown in Table 3, and can be spotted at a glance.

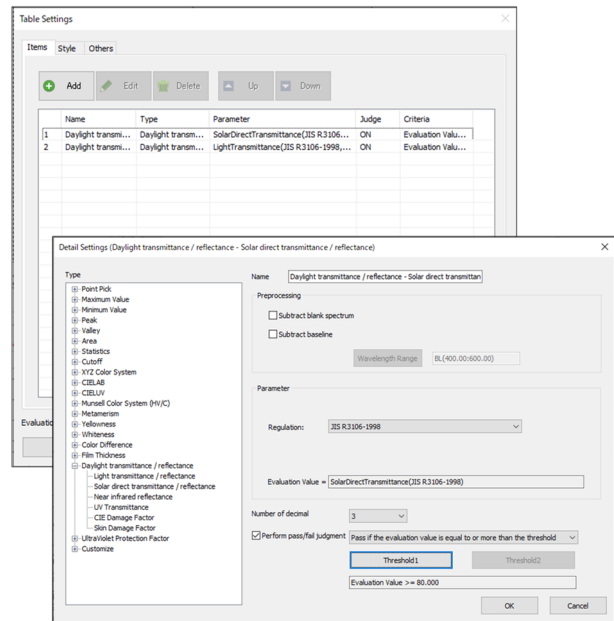


Fig. 5 Evaluation Function Setting Screen

Table 3 Transmittance Calculation Results

	Legend	Type	File Name	General Judgment	Light transmittance		Solar direct transmittance		Comments
					Value	Judgment	Value	Judgment	
1	☑	SMP	Glass_Transmittance.vspd	PASS	88.40	PASS	81.04	PASS	
2	☑	SMP	Sun-cut_Transmittance.vspd	FAIL(1)	67.24	PASS	44.17	FAIL	

Table 4 Reflectance Calculation Results

	Legend	Type	File Name	General Judgment	Light reflectance		Solar direct reflectance		Comments
					Value	Judgment	Value	Judgment	
1	☑	SMP	Glass_Reflectance.vspd	PASS	8.70	PASS	7.63	PASS	
2	☑	SMP	Sun-cut_Reflectance.vspd	PASS	35.77	PASS	24.85	PASS	

Conclusion

In this experiment, the calculations provided in JIS R 3106 were conducted using the optional daylight transmittance/reflectance measurement software for Shimadzu LabSolutions UV-Vis. Pass/fail judgments of calculation results can also be made at the same time by using the evaluation function of LabSolutions UV-Vis.

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