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**JIS R 3106** : 2019  
(FGMAJ/JSA)

**Testing method for transmittance,  
reflectance and emissivity of flat  
glass and calculation of total solar  
energy transmittance of glazing**

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## Foreword

This Japanese Industrial Standard has been revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by Flat Glass Manufactures Association of Japan (FGMAJ)/Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14.

Consequently **JIS R 3106:1998** is replaced with this Standard.

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# Testing method for transmittance, reflectance and emissivity of flat glass and calculation of total solar energy transmittance of glazing

## Introduction

This Japanese Industrial Standard has been prepared based on **ISO 9050:2003**, Edition 2, with some modifications of the technical contents.

The vertical lines on both sides and dotted underlines indicate changes from the corresponding International Standard. A list of modifications with the explanations is given in Annex JC. The comparison table between previous and current editions of this Standard on technically significant revisions is given in Annex JD.

## 1 Scope

This Standard specifies methods of determining the transmittance/reflectance of visible light and the transmittance/reflectance/absorptance of solar radiation as well as the emissivity of thermal radiation at ambient temperature for glazing<sup>1)</sup>, using a spectrophotometer. Also, this Standard specifies the method to calculate the total solar energy transmittance when glazing is used as building apertures. These characteristic data can serve as a basis for light, heating/cooling and ventilation calculations of rooms and can permit comparison between different types of glazing.

This Standard also specifies the appropriate calculation formulae for single, double and triple glazing, which are applicable to more glazing.

**NOTE** The International Standard corresponding to this Standard and the symbol of degree of correspondence are as follows.

ISO 9050:2003 *Glass in building—Determination of light transmittance, solar direct transmittance, total solar energy transmittance, ultraviolet transmittance and related glazing factors* (MOD)

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

Note <sup>1)</sup> Glazing is as follows, except that having diffuse transmissivity such as figured glazing.

- a) Glazing mainly manufactured from soda lime silicate glass by continuous moulding process
- b) Glazing in a) of which the surface is processed with optical coating of wavelength-selective reflection such as a heat reflecting glass in wavelength region of solar radiation, and a low emitting glass (Low-E glass) in wavelength region of thermal radiation at ambient temperature such as a low radiation glass

- c) Laminated glass, tempered glass, heat-strengthened glass, tempered fire resistance glass, etc. on which the process of **a)** or **b)** is given for the purpose of fragment retention, strength enhancement, etc.
- d) Insulating glass and vacuum glass using the flat glass of **a)** to **c)**, except those containing lattice, etc. in a hollow layer

## 2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this Standard. The most recent edition of the standard (including amendments) indicated below shall be applied.

JIS R 3107 *Calculation of thermal transmittance of glazing*

NOTE Corresponding International Standard: ISO 10292 *Glass in building—Calculation of steady-state U values (thermal transmittance) of multiple glazing* (MOD)

## 3 Terms and definitions

For the purpose of this Standard, the following terms and definitions apply.

### 3.1

#### light transmittance, light reflectance

ratio of the transmitted luminous flux (reflected luminous flux) to the incident luminous flux, regarding the luminous flux<sup>3)</sup> of incident daylight<sup>2)</sup> perpendicular to the glass surface

Notes <sup>2)</sup> Herein, the daylight means the CIE daylight which has been established by the International Commission on Illumination (CIE). In the CIE daylight, on the basis of data of observation, the spectral illuminance distribution of daylight of the same colour temperature as that of blackbody radiation is indicated by relative values to the values at wavelength of 560 nm.

<sup>3)</sup> The luminous flux means the integration, regarding the wavelength of the product of the radiant energy flux of each wavelength of radiation and the value of spectral luminous efficacy (see **JIS Z 8113**<sup>[1]</sup> and **JIS Z 8120**<sup>[2]</sup>).

### 3.2

#### solar direct transmittance, solar direct reflectance

ratio of the transmitted radiant energy flux (reflected radiant energy flux) to the incident radiant energy flux, regarding the radiant energy flux of incident solar radiation<sup>4)</sup> perpendicular to the glass surface

Note <sup>4)</sup> The solar radiation herein means the direct solar radiation, i.e., the radiation within the wavelength region (300 nm to 2 500 nm) of near ultraviolet, visible and near infrared, directly reaching the earth surface through the atmospheric layer.

### 3.3

#### light

radiation<sup>5)</sup> included in the wavelength range from ultraviolet radiation to infrared radiation

Note<sup>5)</sup> Irrespective of the distinction between the luminous flux and the radiant energy flux in the definitions of **3.1** and **3.2**, “light” and “radiation” to be used in the terms of “light spectrum”, “light measurement”, “light ray”, etc. are synonymous.

NOTE The definition specified in **b)** of **01.01.01** of **JIS Z 8120**<sup>[2]</sup> shall apply.

### 3.4

#### emissivity

ratio of the radiant energy flux (radiant power) of thermal radiation into the space to the radiant energy flux of thermal radiation from a blackbody at the temperature same as that of flat glass

### 3.5

#### total solar energy transmittance

ratio of the sum of the radiant energy flux of solar radiation transmitting the glass part and the thermal current flux absorbed in glass and transmitted to indoor side, to the radiant energy flux of incident solar radiation, regarding the incident solar radiation perpendicular to the window glass surface

NOTE The total solar energy transmittance in this Standard means that at the centre of window glass fit in a frame such as a window sash. In the calculation of the total solar energy transmittance over a whole window, the influence from the window sash frame needs to be considered (see **JIS A 2103**<sup>[3]</sup>).

### 3.6

#### component

glazing consisting of two or more sheets of flat glass arranged in parallel across a hollow layer, such as an insulating glass and a vacuum glass

Herein, an assembly of successive sheets of flat glass in a component is called a pane.

## 4 Symbols and subscripts

### 4.1 Symbols and units

Symbols and units for quantity shall be in accordance with Table 1.

**Table 1 Symbols and units**

| Symbol        | Quantity                                                                                                 | Unit                   |
|---------------|----------------------------------------------------------------------------------------------------------|------------------------|
| $\tau$        | Transmittance                                                                                            | —                      |
| $\rho$        | Reflectance                                                                                              | —                      |
| $\alpha$      | Absorptance                                                                                              | —                      |
| $\lambda$     | Wavelength                                                                                               | nm                     |
| $D$           | Spectral distribution of CIE daylight D <sub>65</sub>                                                    | —                      |
| $V$           | Spectral luminous efficiency for CIE photopic standard                                                   | —                      |
| $E$           | Standard spectral distribution of relative values of direct solar radiation                              | —                      |
| $\varepsilon$ | Emissivity                                                                                               | —                      |
| $R$           | Heat resistance, heat transfer resistance                                                                | m <sup>2</sup> · K/W   |
| $h$           | Coefficient of heat transfer, thermal conductance                                                        | W/(m <sup>2</sup> · K) |
| $n$           | Number of sheets of flat glass in component                                                              | —                      |
| $n_g$         | Refractive index of flat glass                                                                           | —                      |
| $I$           | Absorbed heat in flat glass                                                                              | W/m <sup>2</sup>       |
| $T$           | Temperature of flat glass                                                                                | K                      |
| $N$           | Ratio of the heat absorbed in flat glass and transferred towards indoor, to the incident solar radiation | —                      |

## 4.2 Subscripts

Subscripts shall be in accordance with Table 2.

**Table 2 Subscripts**

| Symbol | Meaning                             |
|--------|-------------------------------------|
| v      | Visible light                       |
| e      | Solar radiation                     |
| '      | Regarding incident from indoor side |
| n      | Normal                              |
| ext    | Outdoor side                        |
| int    | Indoor side                         |
| r      | Radiation                           |
| c      | Convection                          |
| f      | Incident of outdoor side            |
| b      | Incident of indoor side             |

## 5 Spectral transmittance and spectral reflectance measurement

### 5.1 General

In the case of a single flat glass, the measurement shall be carried out on itself. In the case of a component, the measurement shall be carried out on the flat glass of the same material.

In the measurement within the wavelength region of visible light and solar radiation, the spectral transmittance and spectral reflectance shall be measured according to the method specified in **5.3.2**, using the spectrophotometer specified in **5.3.1**.

The conversion methods of spectral transmittance and spectral reflectance from the measurement results above shall be in accordance with Annex A and Annex JA in the case of the combination of flat glass different in thickness, type and coating, and laminated glass different in structure.

The measurement within the wavelength region of thermal radiation at ambient temperature shall be in accordance with **5.4**.

## 5.2 Sample

In the case of a single flat glass, a segment cut out from itself shall be used as a sample. In the case of a component, the segments cut out from respective flat glass of the same material shall be used as a sample.

The sample shall be the flat glass manufactured under the same condition as that of the products. Particularly, coating processed glasses shall be under dried condition to avoid damages/stains on their surfaces, if they are stored/transported, etc. between the manufacture and the measurements of samples.

## 5.3 Measurements within wavelength region of visible light and solar radiation

### 5.3.1 Spectrophotometer

The spectrophotometer used in measurements shall be that intended for a general chemical analysis, and equipped with an integrating sphere for light acceptance in spectral photometer of near ultraviolet/visible light/near infrared wavelength regions, and shall satisfy the following conditions.

- a) **Wavelength range** The range of wavelength scale shall be 300 nm to 2 500 nm, and shall have the photometric accuracy of c) in the range of 300 nm to 2 100 nm.
- b) **Resolving power** The resolving power shall be 5 nm or under at the wavelengths of under 380 nm, 10 nm or under at the wavelengths of 380 nm to 780 nm, and 50 nm or under at the wavelengths of over 780 nm.
- c) **Photometric accuracy** Within the wavelength range of 780 nm or under, the accuracy of photometric value shall be 1 % or under of the maximum scale, and the repeatability shall be 0.5 % or under. Within the wavelength range of over 780 nm, 2 % or under and 1 % or under, respectively.
- d) **Wavelength accuracy** The bias of wavelength scale of spectrophotometer shall be 1 nm or under from the centre wavelength of the transmitting wavelength band region of spectroscopy within the wavelength range of 780 nm or under, and 5 nm or under within the wavelength range over 780 nm.

### 5.3.2 Measuring methods

The spectral transmittance and spectral reflectance shall be measured at the wavelength given in Table 3 for visible light, and Table 4 for the solar radiation.

- a) **Measurement of spectral transmittance** Inject a nearly parallel bundle of rays coming out of the exit slit of spectrophotometer specified in 5.3.1 from the normal direction of sample surface, and measure the spectral transmittance  $\tau(\lambda)$ , receiving the transmitting light by an integrating sphere. Make the condition in which a sample is not inserted into the light path the reference, and take this spectral transmittance as 1.
- b) **Measurement of spectral reflectance** Inject a nearly parallel bundle of rays coming out of the exit slit of spectrophotometer specified in 5.3.1 at an incident angle not exceeding  $15^\circ$  from the normal direction of sample surface, and measure the spectral reflectance  $\rho(\lambda)$  by receiving the reflecting light with an integrating sphere. The displacement between the optical axes of the reflecting light of sample surface and the primary reflecting light from the backside shall be 2 mm or under. Attach a light trap on the backside of sample or black-coat the spectrophotometer inside to prevent the light transmitted through the sample from re-injecting from the backside of sample. Determine the spectral reflectance according to the absolute reflectance measuring method or the relative reflectance measuring method. In the case of the absolute reflectance measuring method, determine the ratio of reflected light intensity on the sample surface to the incident light intensity. In the case of the relative reflectance measuring method, use the mirror finished surface reflecting body of which the reflectance is known as the standard sample for comparison at the wavelengths in Table 3 and Table 4. Determine the spectral reflectance for the reflecting body of reference mirror finished surface according to the absolute reflectance measuring method.

#### 5.4 Measurement within wavelength region of thermal radiation at ambient temperature

In accordance with Annex JB.

### 6 Spectral transmittance, spectral reflectance and spectral absorptance calculation

The spectral transmittance of component consisting of  $n$  sheets of flat glass  $\tau_{1,n}(\lambda)$ , the spectral reflectance regarding the incident from outdoor side  $\rho_{1,n}(\lambda)$  and the spectral reflectance regarding the incident from indoor side  $\rho'_{n,1}(\lambda)$  are obtained by successive calculation from Formula (1) to Formula (3), which respectively indicates the spectral transmittance of pane consisting of  $(j-i+1)$  sheets of flat glass from  $i$ th to  $j$ th counted from outdoor side  $\tau_{ij}(\lambda)$ , the spectral reflectance regarding the incident from outdoor side  $\rho_{ij}(\lambda)$  and the spectral reflectance regarding the incident from indoor side  $\rho'_{ji}(\lambda)$ . Also, the spectral absorptance of  $j$ th flat glass counted from outdoor side  ${}_n\alpha_j(\lambda)$  in this component is obtained according to Formula (4).

$$\tau_{i,j}(\lambda) = \frac{\tau_{i,j-1}(\lambda) \cdot \tau_{j,j}(\lambda)}{1 - \rho_{j,j}(\lambda) \cdot \rho'_{j-1,i}(\lambda)} \quad \text{..... (1)}$$

$$\rho_{i,j}(\lambda) = \rho_{i,j-1}(\lambda) + \frac{\tau_{i,j-1}^2(\lambda) \cdot \rho_{j,j}(\lambda)}{1 - \rho_{j,j}(\lambda) \cdot \rho'_{j-1,i}(\lambda)} \quad \text{..... (2)}$$

$$\rho'_{j,i}(\lambda) = \rho'_{j,j}(\lambda) + \frac{\tau_{j,j}^2(\lambda) \cdot \rho'_{j-1,i}(\lambda)}{1 - \rho'_{j-1,i}(\lambda) \cdot \rho_{j,j}(\lambda)} \quad \text{..... (3)}$$

$${}_n\alpha_j(\lambda) = \frac{\tau_{1,j-1}(\lambda) \cdot \alpha_j(\lambda)}{1 - \rho_{j,n}(\lambda) \cdot \rho'_{j-1,1}(\lambda)} + \frac{\tau_{1,j}(\lambda) \cdot \rho_{j+1,n}(\lambda) \cdot \alpha'_j(\lambda)}{1 - \rho'_{j,1}(\lambda) \cdot \rho_{j+1,n}(\lambda)} \dots\dots\dots (4)$$

where,  $\tau_{ij}(\lambda)$ : spectral transmittance of pane consisting of flat glass from  $i$ th to  $j$ th

$\rho_{ij}(\lambda)$ : spectral reflectance regarding incident from outdoor side of pane consisting of flat glass from  $i$ th to  $j$ th

$\rho'_{ji}(\lambda)$ : spectral reflectance regarding incident from indoor side of pane consisting of flat glass from  $i$ th to  $j$ th

${}_n\alpha_j(\lambda)$ : spectral absorptance of  $j$ th flat glass counted from outdoor side in component consisting of  $n$  sheets of flat glass

$\alpha_j(\lambda)$ : spectral absorptance regarding incident from outdoor side of single flat glass of same type as  $j$ th flat glass

$$\alpha_j(\lambda) = 1 - \tau_{ji}(\lambda) - \rho_{ji}(\lambda)$$

$\alpha'_j(\lambda)$ : spectral absorptance regarding incident from indoor side of single flat glass of same type as  $j$ th flat glass

$$\alpha'_j(\lambda) = 1 - \tau_{ji}(\lambda) - \rho'_{ji}(\lambda)$$

where,  $1 \leq i \leq j \leq n$

If  $i=j$ ,  $\tau_{ji}(\lambda)$ ,  $\rho_{ji}(\lambda)$  and  $\rho'_{ji}(\lambda)$  shall be the spectral transmittance and the spectral reflectance of single flat glass of same type as  $j$ th flat glass from outdoor side.

where,  $\tau_{1,0}(\lambda) = 1$ ,  $\rho'_{0,1}(\lambda) = 0$  and  $\rho_{n+1,n}(\lambda) = 0$

The formulae to calculate the spectral transmittance, spectral reflectance and spectral absorptance of component consisting of single to triple flat glass are shown in Example 1 to Example 3.

#### Example 1 Single flat glass

The spectral transmittance and the spectral reflectance of single flat glass become  $\tau_{1,1}(\lambda)$ ,  $\rho_{1,1}(\lambda)$  and  $\rho'_{1,1}(\lambda)$  in Formula (1) to Formula (3), assuming  $i=j=1$ . The spectral absorptance becomes  ${}_1\alpha_1(\lambda) = \alpha_1(\lambda)$  in Formula (4), assuming  $n=j=1$ .

where,  $\tau_{1,1}(\lambda)$ : spectral transmittance of flat glass

$\rho_{1,1}(\lambda)$ : spectral reflectance regarding incident from outdoor side of flat glass

$\rho'_{1,1}(\lambda)$ : spectral reflectance regarding incident from indoor side of flat glass

$\alpha_1(\lambda)$ : spectral absorptance regarding incident from outdoor side of flat glass

$$\alpha_1(\lambda) = 1 - \tau_{1,1}(\lambda) - \rho_{1,1}(\lambda)$$

For the values of spectral transmittance and spectral reflectance, the measured values obtained in accordance with 5.3 shall be used.

## Example 2 Insulating glass consisting of double flat glass

The spectral transmittance and the spectral reflectance of insulating glass consisting of double flat glass are obtained according to Formula (5) to Formula (7), assuming  $i=1$  and  $j=2$  in Formula (1) to Formula (3).

$$\tau_{1,2}(\lambda) = \frac{\tau_{1,1}(\lambda) \cdot \tau_{2,2}(\lambda)}{1 - \rho_{2,2}(\lambda) \cdot \rho'_{1,1}(\lambda)} \dots\dots\dots (5)$$

$$\rho_{1,2}(\lambda) = \rho_{1,1}(\lambda) + \frac{\tau_{1,1}^2(\lambda) \cdot \rho_{2,2}(\lambda)}{1 - \rho_{2,2}(\lambda) \cdot \rho'_{1,1}(\lambda)} \dots\dots\dots (6)$$

$$\rho'_{2,1}(\lambda) = \rho'_{2,2}(\lambda) + \frac{\tau_{2,2}^2(\lambda) \cdot \rho'_{1,1}(\lambda)}{1 - \rho'_{1,1}(\lambda) \cdot \rho_{2,2}(\lambda)} \dots\dots\dots (7)$$

The spectral absorptance is obtained according to Formula (8) and Formula (9), assuming  $n=2$  and  $j=1, 2$  in Formula (4).

$${}_2\alpha_1(\lambda) = \alpha_1(\lambda) + \frac{\tau_{1,1}(\lambda) \cdot \rho_{2,2}(\lambda) \cdot \alpha'_1(\lambda)}{1 - \rho'_{1,1}(\lambda) \cdot \rho_{2,2}(\lambda)} \dots\dots\dots (8)$$

$${}_2\alpha_2(\lambda) = \frac{\tau_{1,1}(\lambda) \cdot \alpha_2(\lambda)}{1 - \rho_{2,2}(\lambda) \cdot \rho'_{1,1}(\lambda)} \dots\dots\dots (9)$$

where,  $\tau_{1,1}(\lambda)$  : spectral transmittance of outdoor side flat glass

$\rho_{1,1}(\lambda)$  : spectral reflectance of outdoor side flat glass (incident from outdoor side direction)

$\rho'_{1,1}(\lambda)$  : spectral reflectance of outdoor side flat glass (incident from indoor side direction)

$\alpha_1(\lambda)$  : spectral absorptance of outdoor side flat glass (incident from outdoor side direction)

$$\alpha_1(\lambda) = 1 - \tau_{1,1}(\lambda) - \rho_{1,1}(\lambda)$$

$\alpha'_1(\lambda)$  : spectral absorptance of outdoor side flat glass (incident from indoor side direction)

$$\alpha'_1(\lambda) = 1 - \tau_{1,1}(\lambda) - \rho'_{1,1}(\lambda)$$

$\tau_{2,2}(\lambda)$  : spectral transmittance of indoor side flat glass

$\rho_{2,2}(\lambda)$  : spectral reflectance of indoor side flat glass (incident from outdoor side direction)

$\alpha_2(\lambda)$  : spectral absorptance of indoor side flat glass (incident from outdoor side direction)

$$\alpha_2(\lambda) = 1 - \tau_{2,2}(\lambda) - \rho_{2,2}(\lambda)$$

For the values of spectral transmittance and spectral reflectance, the values of flat glass obtained in accordance with 5.3 shall be used.

**Example 3** Insulating glass consisting of triple flat glass

The spectral transmittance and the spectral reflectance of insulating glass consisting of triple flat glass are obtained according to Formula (10) to Formula (12), assuming  $i=1$  and  $j=3$  in Formula (1) to Formula (3).

$$\tau_{1,3}(\lambda) = \frac{\tau_{1,2}(\lambda) \cdot \tau_{3,3}(\lambda)}{1 - \rho_{3,3}(\lambda) \cdot \rho'_{2,1}(\lambda)} \quad (10)$$

$$\rho_{1,3}(\lambda) = \rho_{1,2}(\lambda) + \frac{\tau_{1,2}^2(\lambda) \cdot \rho_{3,3}(\lambda)}{1 - \rho_{3,3}(\lambda) \cdot \rho'_{2,1}(\lambda)} \quad (11)$$

$$\rho'_{3,1}(\lambda) = \rho'_{3,3}(\lambda) + \frac{\tau_{3,3}^2(\lambda) \cdot \rho'_{2,1}(\lambda)}{1 - \rho'_{2,1}(\lambda) \cdot \rho_{3,3}(\lambda)} \quad (12)$$

The spectral absorptance is obtained according to Formula (13) to Formula (15), assuming  $n=3$  and  $j=1, 2, 3$  in Formula (4).

$${}_3\alpha_1(\lambda) = \alpha_1(\lambda) + \frac{\tau_{1,1}(\lambda) \cdot \rho_{2,3}(\lambda) \cdot \alpha'_1(\lambda)}{1 - \rho'_{1,1}(\lambda) \cdot \rho_{2,3}(\lambda)} \quad (13)$$

$${}_3\alpha_2(\lambda) = \frac{\tau_{1,1}(\lambda) \cdot \alpha_2(\lambda)}{1 - \rho_{2,3}(\lambda) \cdot \rho'_{1,1}(\lambda)} + \frac{\tau_{1,2}(\lambda) \cdot \rho_{3,3}(\lambda) \cdot \alpha'_2(\lambda)}{1 - \rho'_{2,1}(\lambda) \cdot \rho_{3,3}(\lambda)} \quad (14)$$

$${}_3\alpha_3(\lambda) = \frac{\tau_{1,2}(\lambda) \cdot \alpha_3(\lambda)}{1 - \rho_{3,3}(\lambda) \cdot \rho'_{2,1}(\lambda)} \quad (15)$$

$\tau_{1,2}(\lambda)$ ,  $\rho_{1,2}(\lambda)$  and  $\rho'_{2,1}(\lambda)$  are obtained according to Formula (5) to Formula (7).  $\rho_{2,3}(\lambda)$  is obtained according to Formula (16) derived from Formula (2).

$$\rho_{2,3}(\lambda) = \rho_{2,2}(\lambda) + \frac{\tau_{2,2}^2(\lambda) \cdot \rho_{3,3}(\lambda)}{1 - \rho_{3,3}(\lambda) \cdot \rho'_{2,2}(\lambda)} \quad (16)$$

where,  $\tau_{1,1}(\lambda)$ : spectral transmittance of outdoor side flat glass

$\rho_{1,1}(\lambda)$ : spectral reflectance of outdoor side flat glass (incident from outdoor side direction)

$\rho'_{1,1}(\lambda)$ : spectral reflectance of outdoor side flat glass (incident from indoor side direction)

$\tau_{2,2}(\lambda)$ : spectral transmittance of centre flat glass

$\rho_{2,2}(\lambda)$ : spectral reflectance of centre flat glass (incident from outdoor side direction)

$\rho'_{2,2}(\lambda)$ : spectral reflectance of centre flat glass (incident from indoor side direction)

$\tau_{3,3}(\lambda)$ : spectral transmittance of indoor side flat glass

$\rho_{3,3}(\lambda)$ : spectral reflectance of indoor side flat glass (incident from outdoor side direction)

$\alpha_1(\lambda)$  : spectral absorptance of outdoor side flat glass (incident from outdoor side direction)

$$\alpha_1(\lambda) = 1 - \tau_{1,1}(\lambda) - \rho_{1,1}(\lambda)$$

$\alpha'_1(\lambda)$  : spectral absorptance of outdoor side flat glass (incident from indoor side direction)

$$\alpha'_1(\lambda) = 1 - \tau_{1,1}(\lambda) - \rho'_{1,1}(\lambda)$$

$\alpha_2(\lambda)$  : spectral absorptance of centre flat glass (incident from outdoor side direction)

$$\alpha_2(\lambda) = 1 - \tau_{2,2}(\lambda) - \rho_{2,2}(\lambda)$$

$\alpha'_2(\lambda)$  : spectral absorptance of centre flat glass (incident from indoor side direction)

$$\alpha'_2(\lambda) = 1 - \tau_{2,2}(\lambda) - \rho'_{2,2}(\lambda)$$

$\alpha_3(\lambda)$  : spectral absorptance of indoor side flat glass (incident from outdoor side direction)

$$\alpha_3(\lambda) = 1 - \tau_{3,3}(\lambda) - \rho_{3,3}(\lambda)$$

For the values of spectral transmittance and spectral reflectance, the values of flat glass obtained in accordance with 5.3 shall be used.

## 7 Light transmittance and light reflectance calculation

### 7.1 General

The light transmittance and the light reflectance are obtained by multiplying the values of spectral transmittance and spectral reflectance by a weighting factor obtained from the spectrum of CIE daylight  $D_{65}$  and the wavelength distribution of spectral luminous efficiency for CIE photopic standard, then carrying out the weighted average. The values of spectral transmittance and spectral reflectance shall be in accordance with Clause 6.

### 7.2 Basic formulae

In  $n$  sheets ( $n \geq 1$ ) of flat glass or a component, the light transmittance  $\tau_v$  and the light reflectance  $\rho_v$  and  $\rho'_v$  are obtained according to Formula (17), Formula (18) and Formula (19), respectively.

The numerical values within the wavelength range of 380 nm to 780 nm given in Table 3 shall be used for  $D_\lambda \cdot V_\lambda$ .

$$\tau_v = \frac{\sum_{\lambda} D_{\lambda} \cdot V_{\lambda} \cdot \tau_{1,n}(\lambda)}{\sum_{\lambda} D_{\lambda} \cdot V_{\lambda}} \quad \dots\dots\dots (17)$$

$$\rho_v = \frac{\sum_{\lambda} D_{\lambda} \cdot V_{\lambda} \cdot \rho_{1,n}(\lambda)}{\sum_{\lambda} D_{\lambda} \cdot V_{\lambda}} \quad \dots\dots\dots (18)$$

$$\rho'_v = \frac{\sum_{\lambda} D_{\lambda} \cdot V_{\lambda} \cdot \rho'_{n,1}(\lambda)}{\sum_{\lambda} D_{\lambda} \cdot V_{\lambda}} \quad \dots\dots\dots (19)$$