



BSI Standards Publication

Thermal performance of windows and doors — Determination of solar heat gain coefficient using solar simulator

National foreword

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Thermal performance of windows and doors — Determination of solar heat gain coefficient using solar simulator

Performance thermique des fenêtres et portes — Détermination du coefficient de gain thermique solaire au moyen d'un simulateur solaire





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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 163, *Thermal performance and energy use in the built environment*, Subcommittee SC 1, *Test and measurement methods*.

Introduction

The terms solar heat gain coefficient (SHGC), total solar energy transmittance (TSET), solar factor and g-value are all used to describe the same quantity. Small differences might be caused by different reference conditions (e.g. differences in the reference solar spectrum). In this document, solar heat gain coefficient is used.

This document is designed to provide solar heat gain coefficient values by standardized measurement method and to enable a fair comparison of different products. It specifies standardized apparatus and criteria. The solar heat gain coefficient measuring apparatus applied in this document includes solar simulator, climatic chamber, and metering box. Solar heat gain coefficient values of windows and doors with or without shading devices shall be determined more precisely by means of combination between calculation and measurement.

This document does not deal with the centre of glazing solar heat gain coefficient measurement. However, the centre of glazing solar heat gain coefficient can be measured by either this method or cooled plate method (see Reference [\[12\]](#)).

Thermal performance of windows and doors — Determination of solar heat gain coefficient using solar simulator

1 Scope

This document specifies a method to measure the solar heat gain coefficient of complete windows and doors.

This document applies to windows and doors

- a) with various types of glazing (glass or plastic; single or multiple glazing; with or without low emissivity coatings, and with spaces filled with air or other gases),
- b) with opaque panels,
- c) with various types of frames (wood, plastic, metallic with and without thermal barrier or any combination of materials),
- d) with various types of shading devices (blind, screen, film or any attachment with shading effects),
- e) with various types of active solar fenestration systems [building-integrated PV systems (BIPV) or building-integrated solar thermal collectors (BIST)].

This document does not include the following:

- a) shading effects of building elements (e.g. eaves, sleeve wall, etc.);
- b) heat transfer caused by air leakage between indoors and outdoors;
- c) ventilation of air spaces in double and coupled windows;
- d) thermal bridge effects at the rebate or joint between the window or door frame and the rest of the building envelope.

This document does not apply to the following:

- a) non-vertical windows;
- b) curtain walls;
- c) industrial, commercial and garage doors.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

ISO 9845-1, *Solar energy — Reference solar spectral irradiance at the ground at different receiving conditions — Part 1: Direct normal and hemispherical solar irradiance for air mass 1,5*

ISO 12567-1, *Thermal performance of windows and doors — Determination of thermal transmittance by the hot-box method — Part 1: Complete windows and doors*

ISO 15099:2003, *Thermal performance of windows, doors and shading devices — Detailed calculations*

ISO 52022-3¹⁾, *Energy performance of buildings — Thermal, solar and daylight properties of building components and elements — Part 3: Detailed calculation method of the solar and daylight characteristics for solar protection devices combined with glazing*

IEC 60904-9, *Photovoltaic devices — Part 9: Solar simulator performance requirements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 7345, ISO 8990, ISO 9288, ISO 9845-1, ISO 12567-1, ISO 15099 and IEC 60904-9 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

4 Symbols and subscripts

Symbol	Quantity	Unit
A	Area	m ²
g	Solar heat gain coefficient (also known as total solar energy transmittance, solar factor or g-value)	—
h	Surface coefficient of heat transfer	W/(m ² ·K)
H	Height	m
I	Irradiance, density of heat flow rate of incident radiation (energy per unit area per unit time resulting from incident radiation)	W/m ²
q	Density of heat flow rate (energy per unit area per unit time resulting from radiative and/or convective and/or conductive heat transfer)	W/m ²
U	Thermal transmittance	W/(m ² ·K)
W	Width	m
θ	Celsius temperature	°C
Φ	Heat flow rate (energy per unit time resulting from radiative and/or convective and/or conductive heat transfer)	W

Subscripts	Significance
B	Planes of peripheral wall of the metering box
C	Cooling device
ex	External
F	Internal fan
g	Glazing
H	Heating device
in	Internal
m	Measured
N	Without irradiance
ne	Environmental external

1) To be published.

Subscripts	Significance
ni	Environmental internal
P	Surround panel
r	Reflection
Solar	Incident radiation
sp	Test specimen
st	Standardized

5 Principle

5.1 General

The solar heat gain coefficient can be determined according to the same principle equations that are described as in ISO 15099:2003, Formula (14) and ISO 52022-3. Therefore, the determination of the solar heat gain coefficient of windows and doors involves two stages. The first stage is to measure the density of heat flow rate through the test specimen with irradiance (solar heat gain + thermal transmission). The second stage is to measure the density of heat flow rate through the test specimen without irradiance (thermal transmission).

The net density of heat flow rate of incident radiation is determined by the radiometer in front of the test specimen during the first stage.

The net density of heat flow rate of the solar heat gain is determined as the difference between the net density of heat flow rate measured in the first stage and the net density of heat flow rate due to thermal transmission, which is evaluated using the thermal transmittance measured in the second stage.

Since the measured solar heat gain coefficient, g_m , of windows and doors is the ratio of the net density of heat flow rate of the solar heat gain to the net density of heat flow rate of incident radiation, it shall be calculated using [Formula \(1\)](#) with or without shading devices:

$$g_m = \frac{q_{in} - q_{in}(q_{Solar} = 0)}{q_{Solar}} \quad (1)$$

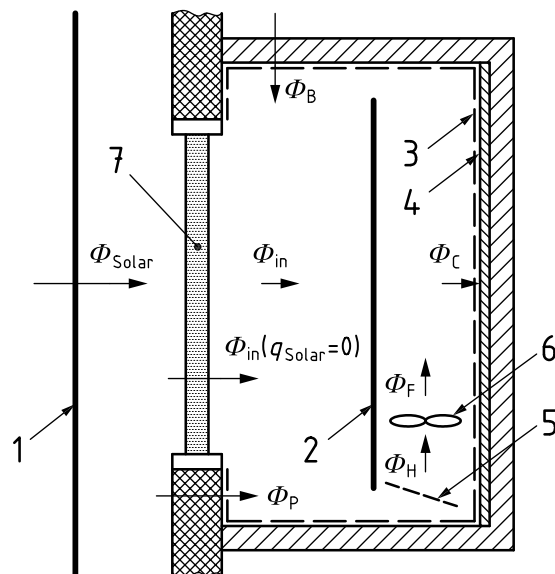
where

- q_{Solar} is the net density of heat flow rate of incident radiation, in W/m^2 ;
- q_{in} is the net density of heat flow rate through the test specimen with irradiance, in W/m^2 ;
- $q_{in}(q_{Solar} = 0)$ is the net density of heat flow rate through the test specimen due to thermal transmission without irradiance when the temperature difference between internal side and external side is $(\theta_{ne} - \theta_{ni})$, in W/m^2 .

All of the effects such as changes in the surface coefficient of heat transfer caused by the irradiance shall be included in the solar heat gain coefficient.

5.2 Measurement of heat flow rates with irradiance

The heat flow rates with irradiance are shown in [Figure 1](#).



Key

1	external side baffle (optional)	Φ_B	heat flow rate through the planes of peripheral wall of the metering box with irradiance
2	internal side baffle (optional)	Φ_C	heat flow rate removed by the cooling device with irradiance
3	heat flow measuring device	Φ_F	heat flow rate supplied by the one or more internal fans with irradiance (optional)
4	cooling device	Φ_H	heat flow rate supplied by the heating device with irradiance (optional)
5	heating device (optional)	Φ_{in}	net heat flow rate through the test specimen with irradiance
6	one or more internal fans (optional)	$\Phi_{in}(q_{Solar}=0)$	net heat flow rate through the test specimen due to thermal transmission without irradiance when the temperature difference between internal side and external side is $(\theta_{ne} - \theta_{ni})$
7	test specimen	Φ_P	heat flow rate through the surround panel with irradiance
		Φ_{Solar}	net heat flow rate of incident radiation

NOTE This figure shows the case of a condition when the environmental external temperature is higher than the environmental internal temperature. In the case of a reverse condition, the directions of the heat flow through the test specimen and the surround panel due to thermal transmission will be reversed.

Figure 1 — Heat flow rates with irradiance

The net density of heat flow rate of the incident radiation, q_{Solar} , shall be calculated using [Formula \(2\)](#):

$$q_{Solar} = \frac{\Phi_{Solar}}{A_{sp}} = \frac{I_{Solar} \times A_{sp} - I_r \times A_g}{A_{sp}} \quad (2)$$

where

Φ_{Solar} is the net heat flow rate of incident radiation, in watts;

I_{Solar} is the density of heat flow rate of the incident radiation, in W/m²;

A_{sp} is the projected area of the test specimen, in m²;

I_r is the density of heat flow rate of the incident radiation that is transmitted to the external side of the metering box after being reflected in the internal side of the metering box, in W/m²;

A_g is the glazing area of the test specimen, in m².

If I_r is proved to be negligible (I_r approximately 0), the net density of heat flow rate of the incident radiation, q_{Solar} , shall be calculated using [Formula \(3\)](#) which results in the second term on the right side of [Formula \(2\)](#) to become 0.

$$q_{\text{Solar}} = \frac{\Phi_{\text{Solar}}}{A_{\text{sp}}} = I_{\text{Solar}} \quad (3)$$

Whether I_r is negligible or not, it shall be evaluated by means of [7.2](#) and [Annex C](#). In the case of ripped cooling devices with multi reflection between the cooling lamella, I_r can be neglected if the coating of the cooling lamella has a solar reflectance of 0,05 or lower.

The net density of heat flow rate through the test specimen with irradiance, q_{in} , shall be calculated using [Formula \(4\)](#):

$$q_{\text{in}} = \frac{\Phi_{\text{in}}}{A_{\text{sp}}} = \frac{\Phi_{\text{C}} - \Phi_{\text{B}} - \Phi_{\text{F}} - \Phi_{\text{H}} - \Phi_{\text{P}}}{A_{\text{sp}}} \quad (4)$$

where

Φ_{in} is the net heat flow rate through the test specimen with irradiance, in watts;

Φ_{C} is the heat flow rate removed by the cooling device with irradiance, in watts;

Φ_{B} is the heat flow rate through the planes of peripheral wall of the metering box with irradiance, in watts;

Φ_{F} is the heat flow rate supplied by the one or more internal fans with irradiance (optional), in watts;

Φ_{H} is the heat flow rate supplied by the heating device with irradiance (optional), in watts;

Φ_{P} is the heat flow rate through the surround panel with irradiance, in watts.

5.3 Determination of the net density of heat flow rate due to thermal transmission

The net density of heat flow rate through the test specimen due to thermal transmission without irradiance, $q_{\text{in}}(q_{\text{Solar}} = 0)$, shall be calculated using [Formula \(5\)](#):

$$q_{\text{in}}(q_{\text{Solar}} = 0) = \frac{\Phi_{\text{in}}(q_{\text{Solar}} = 0)}{A_{\text{sp}}} = U_{\text{N}} \times (\theta_{\text{ne}} - \theta_{\text{ni}}) \quad (5)$$

where

$\Phi_{\text{in}}(q_{\text{Solar}} = 0)$ is the net heat flow rate through the test specimen due to thermal transmission without irradiance when the temperature difference between internal side and external side is $(\theta_{\text{ne}} - \theta_{\text{ni}})$, in watts;

U_{N} is the thermal transmittance of the test specimen without irradiance, in $\text{W}/(\text{m}^2 \cdot \text{K})$;

θ_{ne} is the environmental external temperature with irradiance, in $^{\circ}\text{C}$;

θ_{ni} is the environmental internal temperature with irradiance, in $^{\circ}\text{C}$.

5.4 Measurement of heat flow rates without irradiance

The thermal transmittance of the test specimen without irradiance, U_{N} , shall be calculated using [Formula \(6\)](#):

$$U_{\text{N}} = \frac{q'_{\text{in}}(q_{\text{Solar}} = 0)}{\theta'_{\text{ne}} - \theta'_{\text{ni}}} \quad (6)$$

where

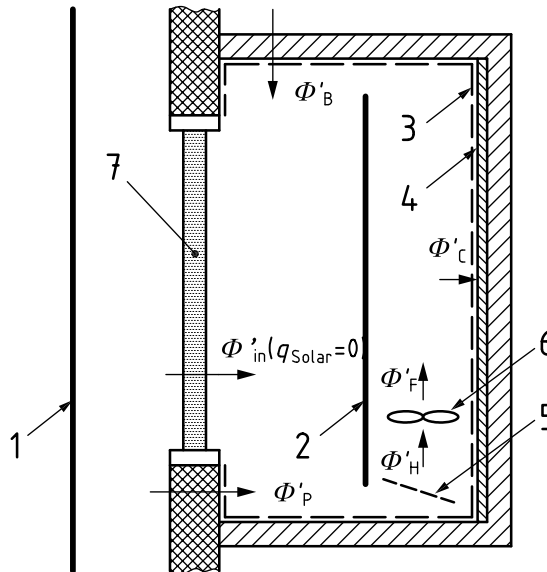
$q'_{\text{in}}(q_{\text{Solar}} = 0)$ is the net density of heat flow rate through the test specimen due to thermal transmission without irradiance when the temperature difference between internal side and external side is $(\theta'_{\text{ne}} - \theta'_{\text{ni}})$, in W/m^2 ;

θ'_{ne} is the environmental external temperature without irradiance, in $^{\circ}\text{C}$;

θ'_{ni} is the environmental internal temperature without irradiance, in $^{\circ}\text{C}$.

In the case when $(\theta'_{\text{ne}} - \theta'_{\text{ni}})$ is too small, U_{N} shall be estimated by means of [Annex B](#).

The heat flow rates without irradiance are shown in [Figure 2](#).

**Key**

1	external side baffle (optional)	Φ'_B	heat flow rate through the planes of peripheral wall of the metering box without irradiance
2	internal side baffle (optional)	Φ'_C	heat flow rate removed by the cooling device without irradiance
3	heat flow measuring device	Φ'_F	heat flow rate supplied by the one or more internal fans without irradiance (optional)
4	cooling device	Φ'_H	heat flow rate supplied by the heating device without irradiance (optional)
5	heating device (optional)	$\Phi'_{in}(q_{Solar} = 0)$	net heat flow rate through the test specimen due to thermal transmission without irradiance when the temperature difference between internal side and external side is $(\theta'_{ne} - \theta'_{ni})$
6	one or more internal fans (optional)	Φ'_P	heat flow rate through the surround panel without irradiance
7	test specimen		

NOTE This figure shows the case of a condition when the environmental external temperature is higher than the environmental internal temperature. In the case of a reverse condition, the directions of the heat flow through the test specimen and the surround panel due to thermal transmission will be reversed.

Figure 2 — Heat flow rates without irradiance

The net density of heat flow rate through the test specimen due to thermal transmission without irradiance, $q'_{in}(q_{Solar} = 0)$, shall be calculated using [Formula \(7\)](#):

$$q'_{in}(q_{Solar} = 0) = \frac{\Phi'_{in}(q_{Solar} = 0)}{A_{sp}} = \frac{\Phi'_C - \Phi'_B - \Phi'_F - \Phi'_H - \Phi'_P}{A_{sp}} \quad (7)$$

where

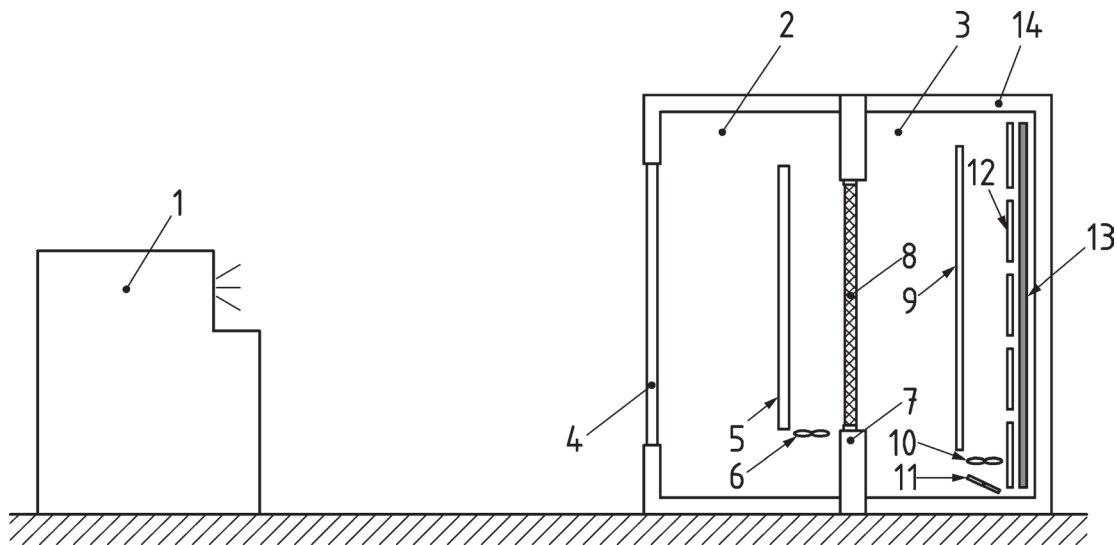
- $\Phi'_{in}(q_{Solar} = 0)$ is the net heat flow rate through the test specimen due to thermal transmission without irradiance when the temperature difference between internal side and external side is $(\theta'_{ne} - \theta'_{ni})$, in watts;
- Φ'_C is the heat flow rate removed by the cooling device without irradiance, in watts;
- Φ'_B is the heat flow rate through the planes of peripheral wall of the metering box without irradiance, in watts;
- Φ'_F is the heat flow rate supplied by the one or more internal fans without irradiance (optional), in watts;
- Φ'_H is the heat flow rate supplied by the heating device without irradiance (optional), in watts;
- Φ'_p is the heat flow rate through the surround panel without irradiance, in watts.

6 Test apparatus and specimens

6.1 Construction and summary of the test apparatus

6.1.1 Construction of the test apparatus

The measuring apparatus consists of a solar simulator, a climatic chamber, and a metering box. The overall construction of the measuring apparatus is shown in [Figure 3](#).



Key

- | | | | |
|---|---------------------------------|----|--------------------------------------|
| 1 | solar simulator | 8 | test specimen |
| 2 | climatic chamber | 9 | internal side baffle (optional) |
| 3 | metering box | 10 | one or more internal fans (optional) |
| 4 | transparent aperture | 11 | heating device (optional) |
| 5 | external side baffle (optional) | 12 | heat flow measuring device |
| 6 | external airflow generator | 13 | cooling device |
| 7 | surround panel | 14 | peripheral wall of the metering box |

Figure 3 — Construction of the test apparatus

6.1.2 Summary of the test apparatus

The measuring apparatus can be summarized as follows.

- a) Light emitted by the solar simulator passes through the transparent aperture and is then directed towards the test specimen. The light passing through the test specimen is absorbed by the cooling device.
- b) The transparent aperture is installed in the climatic chamber in order to allow the light from the solar simulator to pass through to the test specimen.
- c) The external airflow generator and the external side baffle with transparency may be installed in the climatic chamber in order to adjust the external surface coefficient of heat transfer and environmental external temperature.
- d) The cooling device is installed opposite the test specimen in the metering box in order to remove the solar heat gain and the thermal transmission that has entered the metering box.
- e) The heating device and the internal side baffle with transparency may be installed in the metering box in order to adjust the internal surface coefficient of heat transfer and environmental internal temperature.
- f) One or more internal fans may be installed in the metering box in order to stir the internal air to obtain a uniform temperature distribution and/or to adjust the internal surface coefficient of heat transfer.
- g) All of the heat flow rates passing through the metering box are measured by the heat flow measuring device in order to determine the net heat flow rate through the test specimen.
- h) All the walls and the floor shall be covered with the coating of solar reflectance of 0,05 or lower in order to avoid stray light.

6.2 Solar simulator

A steady-state solar simulator shall be used, which meets with the following requirements.

- a) Spectral match of the irradiance: The spectral match of the irradiance on the test plane is defined by the deviation from the global reference solar spectral irradiance for air mass 1,5 in accordance with ISO 9845-1. For nine wavelength ranges, the percentage of total irradiance is specified in [Table 1](#). The spectral match to all wavelength ranges specified in [Table 1](#) shall be measured in accordance with IEC 60904-9 and shall be within 0,55 to 1,45. Examples of spectral match of solar simulator are shown in [Table D.1](#).

Table 1 — Global reference solar spectral irradiance distribution given in ISO 9845-1

No.	Wavelength range nm	Percentage of total irradiance in the wavelength range 300 nm to 2 500 nm
1	300 to 400	4,6 %
2	400 to 500	14,1 %
3	500 to 600	15,4 %
4	600 to 700	14,0 %
5	700 to 800	11,3 %
6	800 to 900	9,4 %
7	900 to 1 100	12,2 %
8	1 100 to 1 700	14,1 %
9	1 700 to 2 500	4,8 %

- b) Non-uniformity of the irradiance: The non-uniformity of the irradiance on the test plane shall be measured in accordance with IEC 60904-9 and shall be within 5 %. However, the designated test area shall be divided into at least 16 points, alternatively.
- c) Temporal instability of the irradiance: Temporal instability of the irradiance on the test plane shall be measured by the procedure for long term instability (LTI) in accordance with IEC 60904-9 and shall be within 5 %.
- d) Maximum angle of irradiance: The maximum angle of irradiance to the test specimen shall be within 10°.
- e) Area of effective irradiance: The width and height of the area of effective irradiance shall be 100 % or greater than each dimension of the test specimen width, W_{sp} , and height, H_{sp} .

6.3 Climatic chamber

The climatic chamber is constructed of the following: a transparent aperture, an external airflow generator, an external side baffle (optional), and the surround panel aperture. It maintains the environmental external conditions (see [Figure 3](#)).

- a) Transparent aperture: The transparent aperture is installed in order to allow the light from the solar simulator to pass through the climatic chamber to the test specimen. The transparent aperture shall be made from high-transmittance glass specified as follows:
 - 1) the solar transmittance of each glass pane according to ISO 9050 shall be 88,0 % or higher;
 - 2) the difference between the maximum and minimum value of the spectrum transmittance according to ISO 9050:2003, Table 2 within a range of 380 nm to 2 100 nm shall be 0,050 or lower.
- b) External airflow generator: The external airflow generator is installed in order to maintain the external surface coefficient of heat transfer on the test specimen. The airflow shall be parallel to the test specimen and the surround panel. The appropriate air speed shall be set to maintain the external surface coefficient of heat transfer.
- c) External side baffle (optional): The external side baffle with transparency may be installed in order to form and maintain the environmental external conditions between the test specimen and the surround panel. The external side baffle is very useful to set up the environmental external conditions. More details are presented in ISO 12567-1. In this case, the environmental temperature may be considered as the air temperature. The external side baffle shall be made from high-transmittance glass.

6.4 Metering box

The metering box is constructed from the following: a cooling device, an internal side baffle (optional), one or more internal fans (optional), and a heating device (optional). It maintains the environmental internal conditions (see [Figure 3](#)).

The appropriate heat flow measuring devices such as heat flow meter and so forth shall be used in order to measure all of the heat flow rates passing through the metering box.

- a) Cooling device: The cooling device is installed opposite to the test specimen in order to remove all the heat entering the metering box. The surface of the cooling device shall have a solar absorptance of 0,90 or greater and have a matte finished to maximize heat absorption. The heat flow meters or the calorimeter may be used as the heat flow measuring device. The refrigerant set a temperature lower than environmental internal temperature, is circulated over the rear surface of the cooling device. Environmental internal temperature is controlled by either the heating device, the inlet temperature of the refrigerant or the volumetric flow rate of the refrigerant or by a combination of these three.

- b) Internal side baffle (optional): The internal side baffle with transparency may be installed in order to form and maintain the environmental internal conditions between the test specimen and the surround panel. The internal side baffle is very useful to set up the environmental internal conditions. More details are presented in ISO 12567-1. In this case, the environmental temperature may be considered as the air temperature. The internal side baffle shall be made from high-transmittance glass.
- c) Heating device (optional): The heating device may be installed in the metering box to control environmental internal temperature. The electrical power used for heating shall be measured.
- d) One or more internal fans: The one or more internal fans may be installed in the metering box in order to stir the internal air to obtain a uniform temperature distribution and/or to adjust the internal surface coefficient of heat transfer. The electrical power used for stirring the air shall be measured.

6.5 Surround panels

The surround panels shall be used to hold the test specimen in the correct position and to separate the climatic chamber side from the metering box side.

The heat flow rate through the surround panels shall be determined, for example, by measuring it with heat flow measuring devices that are attached to the surface of the surround panel on the metering box side and/or climatic chamber side or by calculating it based on the temperature difference between the surface of the surround panel on the metering box side and climatic chamber side.

NOTE An example of the design of the surround panel is shown in [Annex D](#).

6.6 Calibration panels

The calibration panels shall be of a size similar to the test specimen. They are used to set up the measuring conditions of the surface coefficients of heat transfer.

The calibration panel conforms to ISO 12567-1.

6.7 Metering location of temperatures and irradiance

Metering location of temperatures and irradiance shall be as follows.

- a) The surface temperatures of the calibration panels shall be measured on the climatic chamber side and the metering box side. Temperatures shall be measured by appropriate methods at appropriate locations.
- b) The air temperatures and the baffle surface temperatures of the metering box side shall be measured using the same layout of the surface temperatures grid on the calibration panel. Examples of the temperature measurement are shown in [Annex E](#).
- c) The distance between the air temperature sensors and the surfaces of the surround panel of both the climatic chamber and metering box sides shall be approximately 100 mm.
- d) The net density of heat flow rate of the incident radiation, q_{Solar} , shall be measured by a radiometer installed on the climatic chamber side directly facing the light source. The position of the radiometer shall be near the centre of the test specimen and not cast a shadow on the temperature sensor. The distance between the radiometer and the surface of the surround panel shall be approximately 50 mm.
- e) The temperature sensors shall have the mechanism to eliminate the effects due to irradiance as much as possible.

6.8 Test specimens

The test specimen shall fill the surround panel aperture, in accordance with the actual construction.

The clearance between the surround panel and the test specimen frame shall be 5 mm or less, and the perimeter joints between the surround panel and the specimen shall be sealed with tape, caulking or mastic material.

7 Measurement procedure

7.1 Measurement

Measurements shall be performed in each case with and without irradiance. Recommended environmental conditions are shown in [Table 2](#).

The environmental conditions may be decided according to local standards, national standards or regulations. Alternate environmental conditions shall be reported in [8.1 d](#)).

Table 2 — Recommended environmental conditions

Element	Conditions according to ISO 15099		Conditions according to ISO 52022-3	
	Summer	Winter	Summer	Reference
Internal temperature, θ_{in} °C	25	20	25	20
External temperature, θ_{ex} °C	30	0	25	5
Internal surface coefficient of heat transfer ^a , h_{si} W/(m ² ·K)	8	8	8	8
External surface coefficient of heat transfer ^a , h_{se} W/(m ² ·K)	14	24	14	23
Density of heat flow rate of incident radiation ^b , q_{Solar} W/m ²	500	300	500	300
NOTE 1 The performance requirements of windows and doors are the solar shading in summer and the solar heat gain in winter. Therefore, this document specifies each of the environmental conditions.				
NOTE 2 Whether the heat flow rate due to thermal transmission is negligible or not should be decided according to Annex B .				
^a Internal and external surface coefficients of heat transfer shall be determined as specified in Annex A .				
^b Irradiance shall be normal incidence to the test plane. If the solar simulator cannot meet the density of heat flow rate of the incident radiation, q_{Solar} , under summer conditions, the value may be 400 W/m ² or higher and the maximum density of heat flow rate.				

The tolerance for the air temperature or environmental temperature difference between internal side and external side during measurements shall be ± 2 °C or ± 5 °C, respectively, of the set value. The difference between the environmental temperatures and the reference temperatures shall be less than 5 K.

The metering location of the metering box side shall be used the same layout of the air temperatures grid in the case when the surface temperatures of the test specimen and baffle are measured. Examples of the temperature measurement are shown in [Annex E](#).

The relative humidity in the climatic chamber and metering box shall be kept at low enough levels to avoid condensation or other factors.

The heat flow rate pass through the test specimen and others are as shown in [Clause 5](#).

The measurement set-up shall reach thermally stable conditions before valid measurements with or without irradiation can be performed. The required time to reach stability for steady-state tests depends upon such factors as irradiance, thermal resistance and thermal capacity of the specimen, surface coefficients of heat transfer, presence of mass transfer and/or moisture redistribution within the specimen, type and performance of automatic controllers of the apparatus. Due to variation of these factors, it is impossible to give a single criterion for steady-state. An example of a requirement for steady-state is the following: In order to check the stability of the measurement set-up, the thermal