

Solar Heat Gain Coefficient (G-value) Test Report

Report number: CHB0057/S0032

Calorimeter Laboratory, SERIS



Solar Energy Research
Institute of Singapore

Client: **Inflector (Asia) Limited**

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Attention: Mr. Christopher Watson

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Client's reference: N/A

Report number: CHB0057/S0032

Test: Solar heat gain coefficient (G-value) test

Specimen: A combined system consisting of an Inflector radiant barrier window insulator and a low-e coated double glazing unit (DGU)

Specimen ID: S0032

Solar heat gain coefficient (SHGC)

Result:

G-value = 0.251 ± 0.010

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Date of test: 01/12/2011

Date of report: 08/12/2011

1. Description of the Combined System

The objective of the test is to evaluate the SHGC of the combined system, consisting of an Inflector radiant barrier window insulator specimen (hereafter referred to as “specimen”) and a low-e coated DGU (hereafter referred to as “DGU”). The specimen was installed as panel, with the silver side facing outdoor. Figure 1 shows a schematic representation of the combined system.

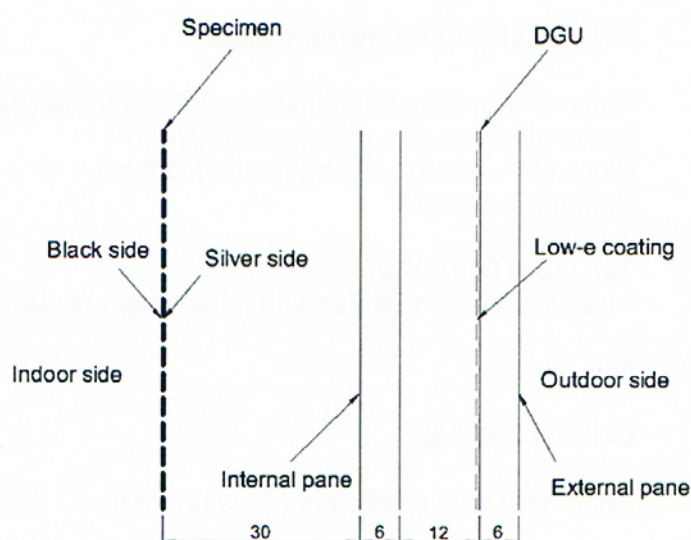


Figure 1. Schematic representation of the combined system consisting of the specimen and the DGU (unit of length: mm)

The specimen, as specified in the table below, was selected and delivered by the client. The original specimen is of trapezoidal shape, with constant width and one side slightly longer than the other.

Specimen ID	S0032
Date of receipt	10/11/2011
Product	Inflector radiant barrier window insulator
Total thickness	0.3 mm
Total width	1367 mm (constant)
Total length	1013 mm (shorter side), 1067 mm (longer side)

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One side of the specimen is of silver color (Figure 2 left) and the other side of the specimen is of black color (Figure 2 middle). There are uniformly distributed small circular holes of the diameter approximately 1 mm over the entire specimen, except the 4 mm wide edge area (Figure 2 right). The hole grid is of rectangular pattern, with 6 holes for every 10 mm. The black side of the specimen is covered by a layer of thin transparent plastic film. The plastic film is continuous, i.e. without holes on it, and is not permeable to airflow. The specimen is flexible and allows a see-through view through it.

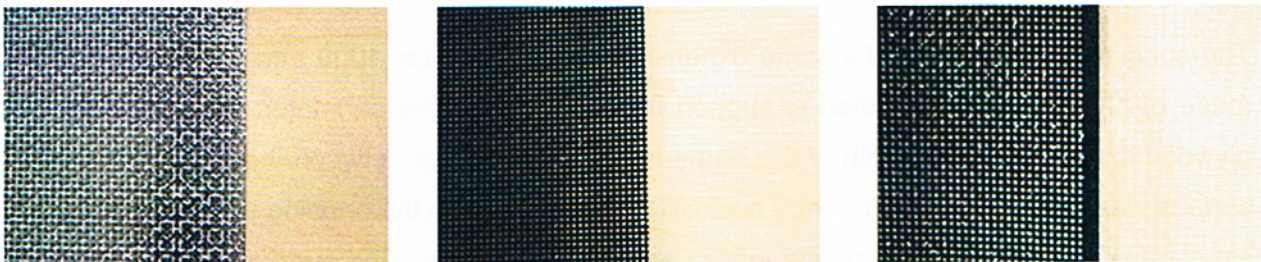


Figure 2. Detailed views of the specimens. Left: silver side of the specimen; middle: black side of the specimen; right: edge of the specimen

The DGU is an in-house sample provided by SERIS, with known SHGC value. The table below lists the specification of the DGU.

Specimen ID	S0030
Product	DGU with low-e coating
Total thickness	24 mm
Total width	1000 mm
Total length	1000 mm
External pane type	6 mm thick clear tempered glass with low-e coating on the inner side
Internal pane type	6 mm thick clear tempered glass
Gas fill type	12 mm thick dry air
SHGC	0.429 ± 0.014, summer condition

According to the client's website information, the Inflector radiant barrier window insulator is to be used as window attachment for improved thermal insulation and solar heat gain control. The

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window insulator can be installed as panel, roller blinds or vertical blinds on the indoor side of existing windows. In the summer, the silver side of the window insulator faces outdoor to reflect solar radiation back and achieve low solar gain; in the winter, the black side of the window insulator faces outdoor to absorb more solar radiation and achieve high solar gain. When installed as panel, the window insulator is usually attached onto the frame of the window by Velcro hooks, with a gap size of 20 mm – 40 mm between the window insulator and glass surface. The laboratory installation of the combined system simulates the summer operation mode of the window insulator and the window insulator was installed as panel.

The specimen was cut into the same dimension of the DGU, i.e. 1000 mm x 1000 mm. A frame made of plywood was fabricated to support the specimen at the perimeter. The thickness of the plywood is 6 mm and the width of the frame is 12 mm. The gap between the specimen and glass surface was adjusted to 30 ± 5 mm. The DGU was installed into the opening of surround panel with small gaps filled by cotton wool and joints between the DGU and the surround panel were further sealed by tape to ensure airtightness. The joints between the specimen and the surround panel are not airtight, but airflow is restricted as the gap between plywood frame and surround panel opening is very small (less than 2 mm). The perimeters of the combined system were masked by 20 mm wide insulation material on both indoor and outdoor sides, so that the edge portion of the system does not affect the measured SHGC and the SHGC result reported is center-of-glazing SHGC. Figure 3 shows photos of the installation, taken before testing.



Figure 3. Photos of the installation. Left: view from outdoor side; middle: view from indoor side; right: zoom-in view of the edge mask at the perimeter (the specimen is on the left)

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2. Test Procedure

2.1 Test Method

The measurement equipment and procedure are in compliance with NFRC interim standard 201-2010.

Method	NFRC 201-2010: Procedure for interim standard test method for measuring the solar heat gain coefficient of fenestration systems using calorimetry hot box methods
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Exception	N/A
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2.2 Test Apparatus

Calorimetric hot box and solar simulator were used in the testing. Both apparatuses are located indoors with air-conditioning. Figure 4 shows the schematics of calorimetric hot box in SHGC measurement mode. The room side boxes, i.e. metering box and guarding box, are maintained at steady state temperature and airflow condition. On the weather side, the specimen is exposed to room air and solar radiation from the solar simulator. An external air curtain is available to maintain a required airflow velocity. Steady state heat flow through specimen due to the transmission of solar radiation is measured to deduce SHGC value. The method defined in NFRC 201 standard is used for SHGC calculation.

Test apparatus	Guarded hot box and indoor solar simulator
Dimension of metered area	1.7 m (width) x 1.9 m (height)
Surround panel ID	SP001 (nominal opening size 1.0 m x 1.0 m)
Latest calibration date	CTS calibration: 18/07/2011 Wall loss calibration: 05/10/2011 Flanking loss calibration: 28/11/2011

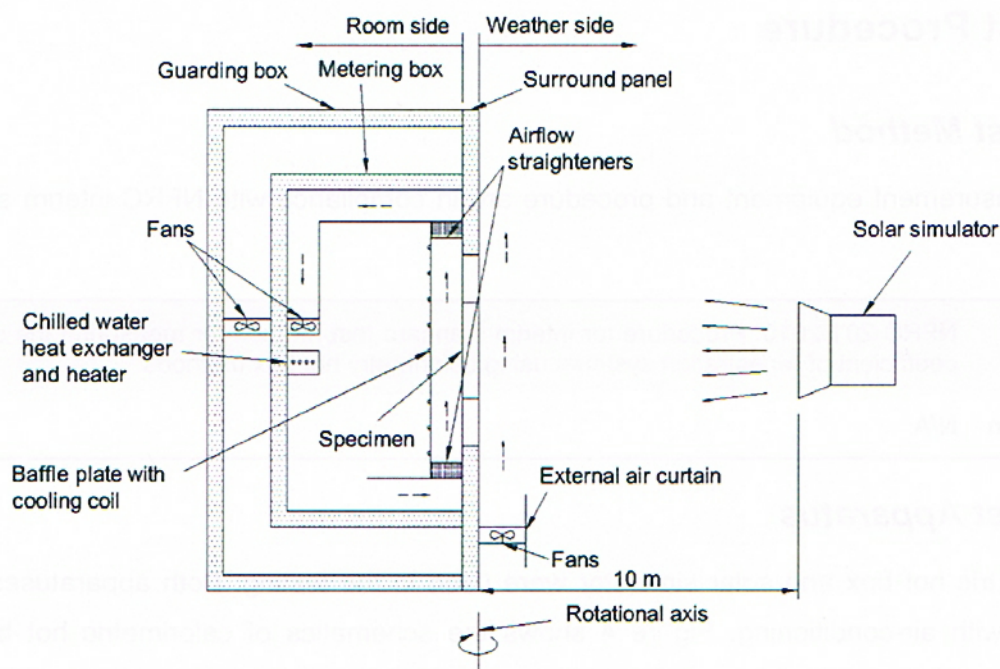


Figure 4. Schematics of the SERIS calorimetric hot box and solar simulator in SHGC measurement mode

2.3 Boundary Conditions

The SHGC test was carried out with the following environmental condition, as given in the table below.

Radiation spectrum	Near AM1.5
Incident angle	0°
Room side surface heat transfer coefficient	7.7 W/(m ² K) ± 5%
Weather side surface heat transfer coefficient	18 W/(m ² K) ± 10%
Room side temperature	24 ± 0.025 °C
Weather side temperature	24 - 27 °C
Solar irradiance	> 500 W/m ²

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3. Test Results

Date of test	01/12/2011
Test duration	5 hours
Operator	Mr. DU Hui, Laboratory Technologist
Laboratory ambient temperature	24.6 °C
Laboratory relative humidity	61 %
Laboratory barometric pressure	100096 Pa
Metering air temperature	24.0 °C
External air curtain temperature	25.4 °C
Metering airflow velocity	0.3 m/s
External air curtain velocity	2.0 m/s
Heat exchange with chilled water loops, $Q_{Chilled\ water}$	-187.04 W
Heat exchange with electrical devices, $Q_{Electrical\ devices}$	40.18 W
Metering box wall heat transfer, Q_{Wall}	9.86 W
Flanking heat transfer, $Q_{Flanking}$	6.67 W
Surround panel heat transfer, $Q_{Surround\ panel}$	3.51 W
Specimen heat transfer correction, Q_U	1.79 W
Specimen heat transfer, $Q_{Specimen}$	125.02 W
Mean solar irradiance, I_{Solar}	539 W/m ²
Specimen area exposed to solar radiation, $A_{Specimen}$	0.9232 m ²
Solar heat gain coefficient (G-value), G	0.251
Estimated uncertainty of G-value	±0.010

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Note:

a) $Q_{Specimen} = -(Q_{Chilled\ water} + Q_{Electrical\ devices} + Q_{Wall} + Q_{Flanking} + Q_{Surround\ panel} + Q_U)$;

b) $G = \frac{Q_{Specimen}}{I_{Solar} \times A_{Specimen}}$;

c) The estimated uncertainty is the expanded uncertainty estimated with a coverage factor of $k = 2$ and a level of confidence of approximately 95%.

4. Disclaimer, Limitation of Liability

The test method NFRC 201-2010 does not include separate procedures to determine the heat flows due to either air movement or nighttime U-factor effects. As a consequence, the SHGC results obtained do not reflect the overall performance which may be found in field installations due to temperature differences, wind, shading, air leakage effects and the thermal bridge effects specific to the design and construction of the fenestration system opening. Since there are a wide variety of fenestration openings in residential, commercial and industrial buildings, it is not feasible to select a “typical” surround panel construction in which to mount the fenestration test specimen. The selection of a relatively high thermal resistance surround panel places the focus of the test on the thermal performance of the fenestration system alone. Therefore, it should be recognized that the thermal transmittance results obtained from this method, for ideal laboratory conditions in a highly insulating surround panel, should only be used for fenestration product comparisons or as input to thermal performance analyses which also include thermal, air leakage and thermal bridge effects due to the surrounding building structure. To determine air leakage effects for windows and doors, refer to ASTM E 283. For thermal transmittance refer to ASTM C 1199.

The results stated in this test report only relate to the specimen tested. This test report shall not be reproduced, except in full, without the approval of the laboratory.

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operation or increased expense of operation of other equipment or systems, cost of capital, or cost of purchase or replacement equipment systems or power.