



Report:

**Optical Data measurement and performance indices
calculation of a glass samples with R 8 SB applied
film**

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A & B Films Pte Ltd contracted Carli Inc for the optical data measurement and data preparation of a glass samples with R 8 SB applied film. The films were mounted on a 5 mm clear reference glass sample.

Test Methods and Procedures

Optical data Measurements

UV-Vis-NIR Measurements:

Total transmittance and total reflectance factor measurements were performed with ODA's Varian™ Cary 500E™ UV-Vis-NIR Double Beam Spectrophotometer equipped with a 150 mm diameter Labsphere™ Spectralon™ reference standard. Baselines are measured before and after the sample measurements, a zeroline is measured after the sample measurements and a didymia transmittance standard is measured during each set of measurements to verify the wavelength scale. For transmittance and reflectance factor, the angle of incidence is 0° and 7°, respectively. The typical wavelength interval is 5nm.

IR Measurements:

Specular transmittance and specular reflectance factor measurements are performed with ODA's Perking-Elmer™ 9836 G IR Double-Beam IR Spectrophotometer equipped with Perking-Elmer™ Specular Reflectance Accessory. The wavelength range is 2 to 56 μm. In reflectance, measurements are made with respect to a protected aluminum specular reflectance reference standard from National Physical Laboratory™ [NPL] in the United Kingdom. Baselines are measured before and after the sample measurements, a zeroline is measured after the sample measurements, and a polystyrene transmittance standard is measured during each set of measurements to verify the wavelength scale. For transmittance and reflectance factor, the angle of incidence is 0° and 7°, respectively. The wavelength interval is 10cm⁻¹. This is the method adopted by the Lawrence Berkeley National Laboratory [LBNL].

The optical properties of glasses with films are summarized in Table 1 and the graphical details are shown in Appendix 1.

Table 1: Optical properties of the glass with R 8 SB applied film

Product Name	Thick-ness	Solar			Visible			Emissivity	
	mm	Tsol	R _f sol	R _b sol	Tvis	R _f vis	R _b vis	Front	Back
R 8 SB	4.84	0.079	0.356	0.450	0.038	0.071	0.499	0.76	0.84

Note: Subscript f and b represent front and back respectively. Films are applied at the front side. T and R denote transmittance and reflectance respectively.

Optical Data Calculations

The centre of glass U factor, SHGC (Solar Heat Gain Coefficient), Shading Coefficient, Visible Transmittance and Relative heat gains of the glass with applied film, assuming it as a single glazed unit, was calculated using WINDOW5 and the values are given in Table 2 below: **The film side of the glass faces the indoor environment.**

Table 2: Thermal and optical properties of single glazing unit

Product Name	# of glass layer	Winter U-Factor	Summer U- Factor	SHGC	SC	Tvis	Relative Heat Gain	UV Indices		
		W/m ² K	W/m ² K				W/m ²	Tuv	Tdw-K	Tdw-ISO
R 8 SB	1	5.61	5.04	0.21	0.25	0.04	197	0.001	0.026	0.040

The NFRC standard boundary conditions given below were used for the calculations in Table 2:

ID	Name	U-factor Tin	U-factor Tout	SHGC Tin	SHGC Tout	SHGC Solar
		C	C	C	C	W/m ²
1	NFRC 100-2002	21.0	-18.0	24.0	32.0	783

Appendix 1.: Spectral properties of the glass sample with film.

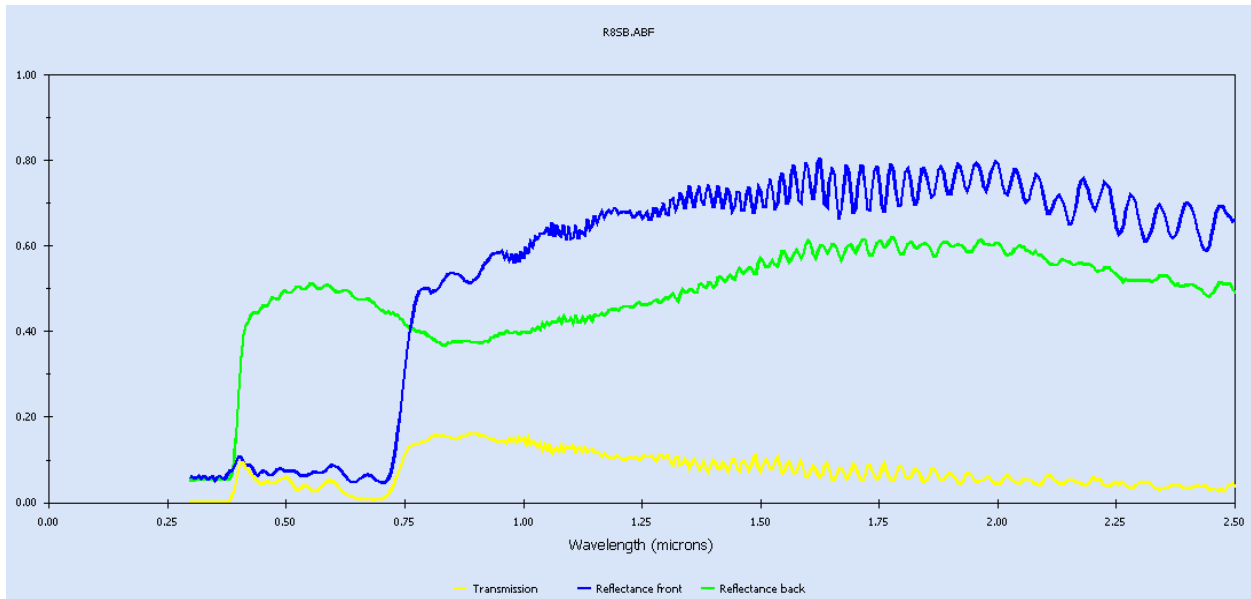


Figure 1: Spectral properties: R 8 SB

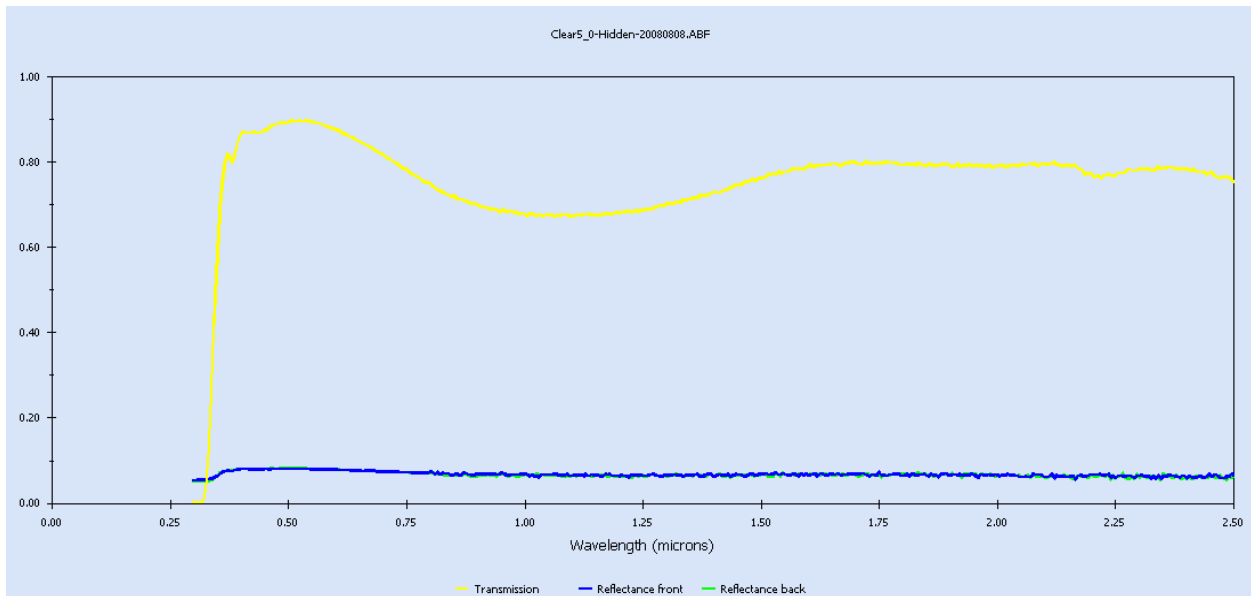


Figure 2: Spectral properties: Reference Glass sample (Substrate)

Appendix 2.: Detailed glazing data of a single glazed unit with film

Window 5.2a v5.2.17a Glazing System Thermal and Optical Properties 08/12/08
15:19:16

ID : 27
Name : R 8 SB
Tilt : 90.0
Glazings: 1
KEFF : 0.1000
Width : 4.837
Uvalue : 5.61
SHGCc : 0.21
SCc : 0.25
Vtc : 0.04
RHG : 197.25

Glass and Gas Data for Glazing System '27 R 8 SB'

ID	Name	D(mm)	Tsol	1 Rsol	2 Tvis	1 Rvis	2 Tir	1 Emis	2 Keff			
Outside												
	30003FR8SB.ABF	# 4.8	.079	.450	.356	.038	.499	.071	.000	.840	.760	.996
Inside												

Environmental Conditions: 1 NFRC 100-2002

	Tout (C)	Tin (C)	WndSpd (m/s)	Wnd Dir	Solar (W/m2)	Tsky (C)	Esky
Uvalue	-18.0	21.0	5.50	Windward	0.0	-18.0	1.00
Solar	32.0	24.0	2.80	Windward	783.0	32.0	1.00

Optical Properties for Glazing System '27 R 8 SB'

Angle	0	10	20	30	40	50	60	70	80	90	Hemis
Vtc	: 0.038	0.038	0.038	0.037	0.036	0.035	0.032	0.026	0.016	0.000	0.033
Rf	: 0.499	0.495	0.494	0.496	0.502	0.511	0.530	0.578	0.707	0.999	0.521
Rb	: 0.071	0.063	0.062	0.065	0.075	0.093	0.127	0.217	0.456	0.999	0.120
Tsol	: 0.079	0.080	0.079	0.078	0.076	0.074	0.068	0.055	0.033	0.000	0.070
Rf	: 0.450	0.445	0.444	0.446	0.453	0.463	0.483	0.537	0.678	0.999	0.475
Rb	: 0.356	0.350	0.349	0.351	0.359	0.371	0.395	0.457	0.623	0.999	0.387
Abs1	: 0.471	0.475	0.477	0.476	0.471	0.463	0.449	0.408	0.289	0.001	0.445
SHGCc	: 0.212	0.214	0.213	0.212	0.209	0.204	0.194	0.169	0.112	0.000	0.195
Tdw-K	: 0.026										
Tdw-ISO	: 0.040										
Tuv	: 0.001										

Temperature Distribution (degrees C)

	Winter		Summer	
	Out	In	Out	In
Lay1	-10.5	-9.5	42.5	42.7