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**Optical Data measurement and performance indices  
calculation of a glass samples with SL 50 applied film**

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**Report prepared for:**     **A & B Films Pte Ltd**  
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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 SL 50 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<sup>-1</sup>. 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 SL 50 applied film**

Product Name	Thick-ness	Solar			Visible			Emissivity	
	mm	Tsol	R <sub>f</sub> sol	R <sub>b</sub> sol	Tvis	R <sub>f</sub> vis	R <sub>b</sub> vis	Front	Back
SL 50	4.89	0.397	0.240	0.195	0.536	0.209	0.211	0.83	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 <sup>2</sup> K	W/m <sup>2</sup> K				W/m <sup>2</sup>	Tuv	Tdw-K	Tdw-ISO
SL 50	1	5.81	5.25	0.52	0.60	0.54	419	0.003	0.190	0.390

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 <sup>2</sup>
1	NFRC 100-2002	21.0	-18.0	24.0	32.0	783

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

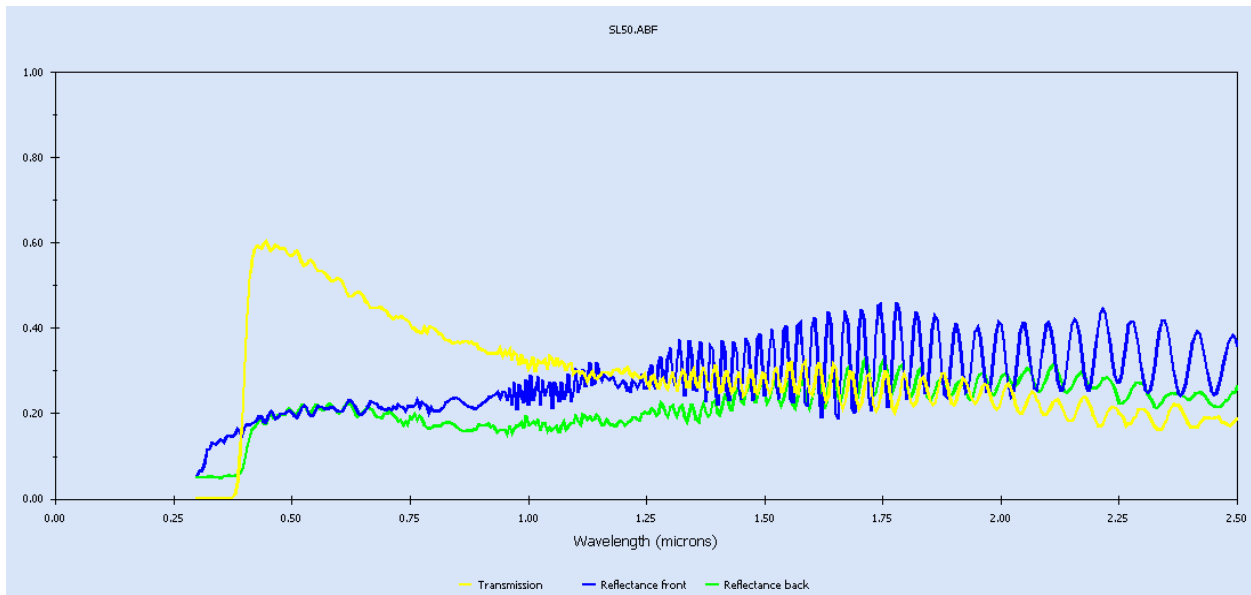


Figure 1: Spectral properties: SL 50

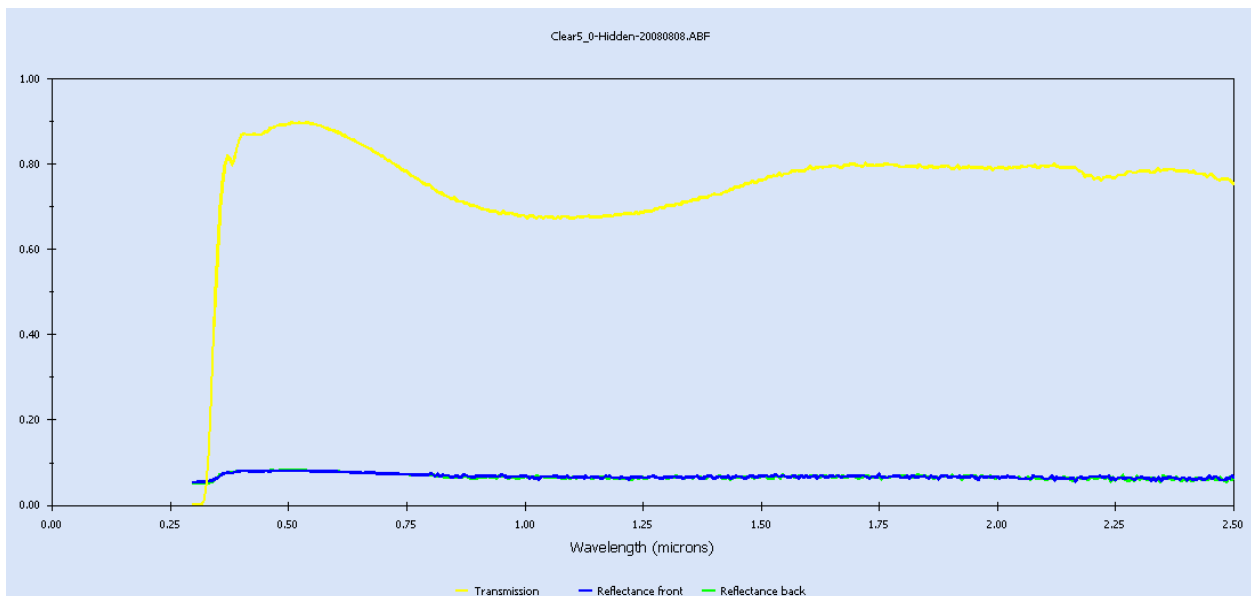


Figure 2: Spectral properties: Reference Glass sample (Substrate)

**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  
15:34:14

ID : 29  
 Name : SL 50  
 Tilt : 90.0  
 Glazings: 1  
 KEFF : 0.1000  
 Width : 4.892  
 Uvalue : 5.81  
 SHGCc : 0.52  
 SCc : 0.60  
 Vtc : 0.54  
 RHG : 418.51

Glass and Gas Data for Glazing System '29 SL 50'

ID	Name	D(mm)	Tsol	1 Rsol	2 Tvis	1 Rvis	2 Tir	1 Emis	2 Keff			
Outside												
	30000FSL50.ABF	# 4.9	.397	.195	.240	.536	.211	.209	.000	.840	.830	.974
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 '29 SL 50'

Angle	0	10	20	30	40	50	60	70	80	90	Hemis
Vtc	: 0.536	0.540	0.533	0.525	0.515	0.497	0.456	0.371	0.223	0.000	0.469
Rf	: 0.211	0.205	0.203	0.206	0.215	0.230	0.259	0.335	0.538	0.999	0.251
Rb	: 0.209	0.202	0.201	0.204	0.212	0.228	0.257	0.333	0.537	0.999	0.249
Tsol	: 0.397	0.400	0.394	0.388	0.381	0.368	0.337	0.275	0.165	0.000	0.347
Rf	: 0.195	0.188	0.187	0.190	0.199	0.214	0.244	0.322	0.529	0.999	0.236
Rb	: 0.240	0.233	0.232	0.235	0.243	0.258	0.286	0.359	0.555	0.999	0.278
Abs1	: 0.408	0.412	0.419	0.422	0.420	0.418	0.419	0.404	0.306	0.001	0.406
SHGCc	: 0.516	0.519	0.516	0.511	0.503	0.489	0.459	0.392	0.253	0.000	0.465
Tdw-K	: 0.190										
Tdw-ISO	: 0.390										
Tuv	: 0.003										

Temperature Distribution (degrees C)

	Winter		Summer	
	Out	In	Out	In
Lay1	-10.3	-9.1	40.7	40.8