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Report:

Optical Data measurement and performance indices calculation of a glass samples with DS 15 OL 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 DS 15 OL 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 Spectrophometer 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^o and 7^o, 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^o and 7^o, 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 DS 15 OL 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
DS 15 OL	5.07	0.196	0.304	0.244	0.193	0.196	0.194	0.79	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^2K	W/m^2K				W/m^2	Tuv	Tdw-K	Tdw-ISO
DS 15 OL	1	5.68	5.12	0.36	0.42	0.19	305	0.000	0.056	0.125

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/m2
	1	NFRC 100-2002	21.0	-18.0	24.0	32.0	783

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

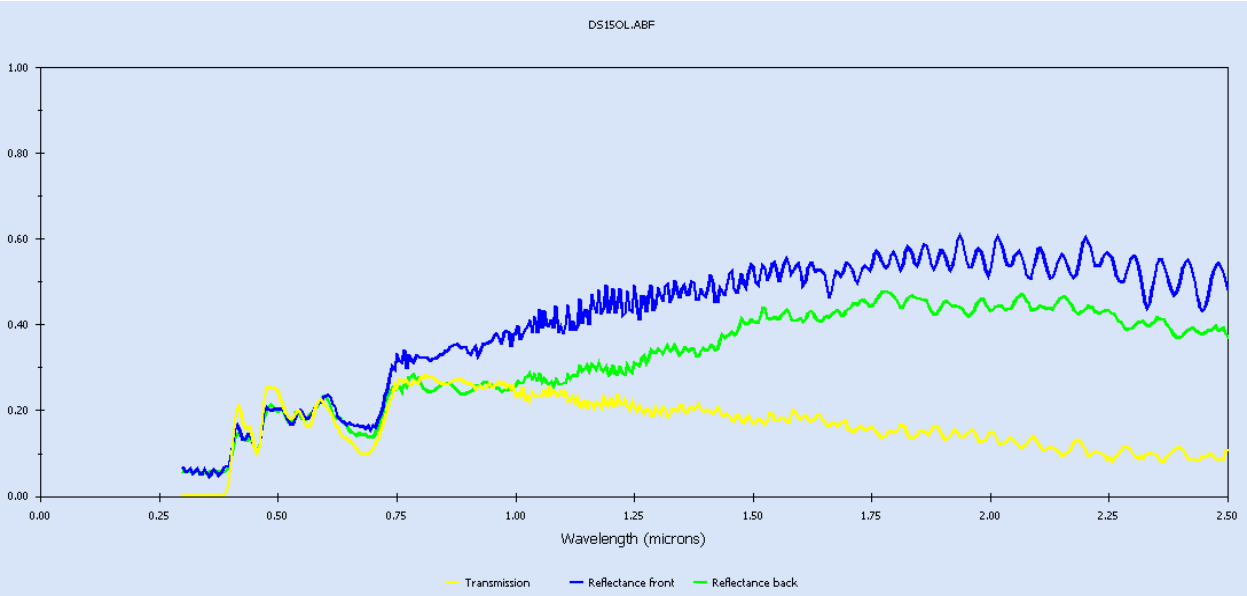

Figure 1: Spectral properties: DS 15 OL

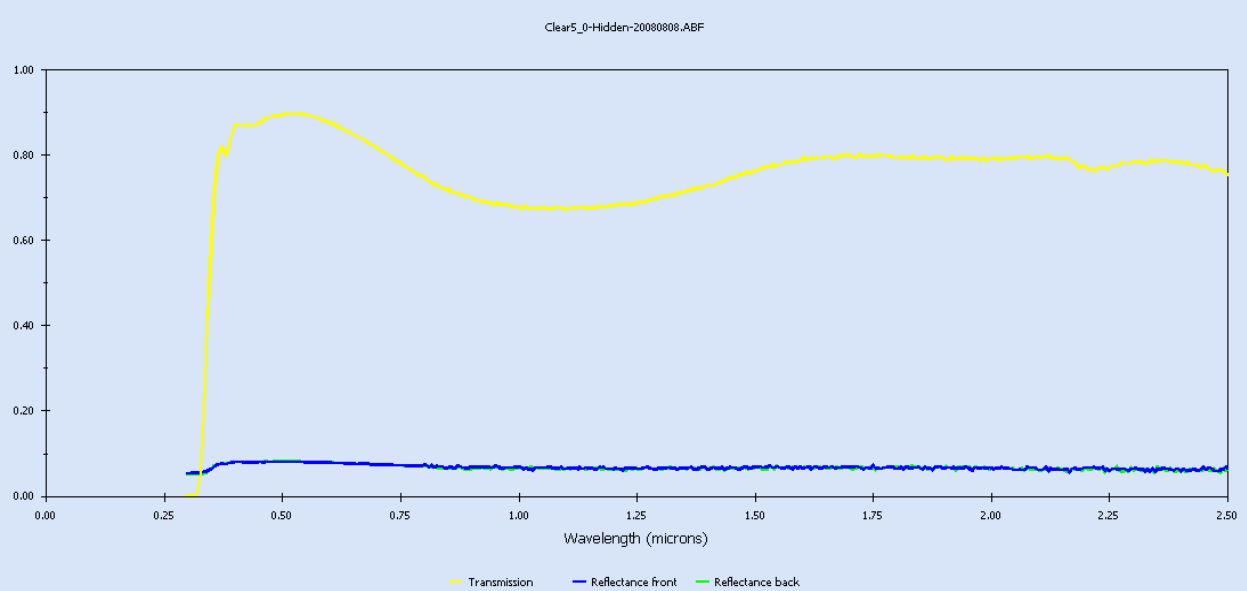

Figure 2: Spectral properties: Reference Glass sample (Substrate)

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 14:46:17

ID : 23
Name : DS 15 OL
Tilt : 90.0
Glazings: 1
KEFF : 0.1000
Width : 5.065
Uvalue : 5.68
SHGCc : 0.36
SCc : 0.42
Vtc : 0.19
RHG : 304.77

Glass and Gas Data for Glazing System '23 DS 15 OL'

ID	Name	D(mm)	Tsol	1 Rsol 2	Tvis	1 Rvis 2	Tir	1 Emis 2	Keff
Outside									
30017FDS15OL.ABF	#	5.1	.196	.244 .304	.193	.194 .196	.000	.840 .790	.913
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 '23 DS 15 OL'

Angle	0	10	20	30	40	50	60	70	80	90	Hemis
Vtc :	0.193	0.194	0.192	0.189	0.185	0.179	0.164	0.133	0.080	0.000	0.169
Rf :	0.194	0.187	0.186	0.188	0.197	0.213	0.242	0.321	0.528	0.999	0.235
Rb :	0.196	0.189	0.187	0.190	0.199	0.215	0.244	0.322	0.529	0.999	0.237
Tsol :	0.196	0.198	0.195	0.192	0.188	0.182	0.167	0.136	0.082	0.000	0.172
Rf :	0.244	0.238	0.236	0.239	0.248	0.262	0.290	0.363	0.557	0.999	0.282
Rb :	0.304	0.298	0.297	0.299	0.307	0.320	0.346	0.413	0.592	0.999	0.338
Abs1 :	0.560	0.565	0.569	0.569	0.564	0.556	0.543	0.501	0.361	0.001	0.536
SHGCc:	0.359	0.362	0.360	0.357	0.352	0.343	0.324	0.280	0.184	0.000	0.327

Tdw-K : 0.056
Tdw-ISO: 0.125
Tuv : 0.000

Temperature Distribution (degrees C)

	Winter		Summer	
	Out	In	Out	In
Lay1	-10.4	-9.2	44.6	44.9