



Report:

**Optical Data measurement and performance indices
calculation of a glass samples with Lite Pearl 30
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 Lite Pearl 30 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 Lite Pearl 30 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
Lite Pearl 30	5.07	0.250	0.348	0.227	0.290	0.299	0.183	0.77	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
Lite Pearl 30	1	5.62	5.05	0.40	0.47	0.29	334	0.002	0.103	0.208

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.

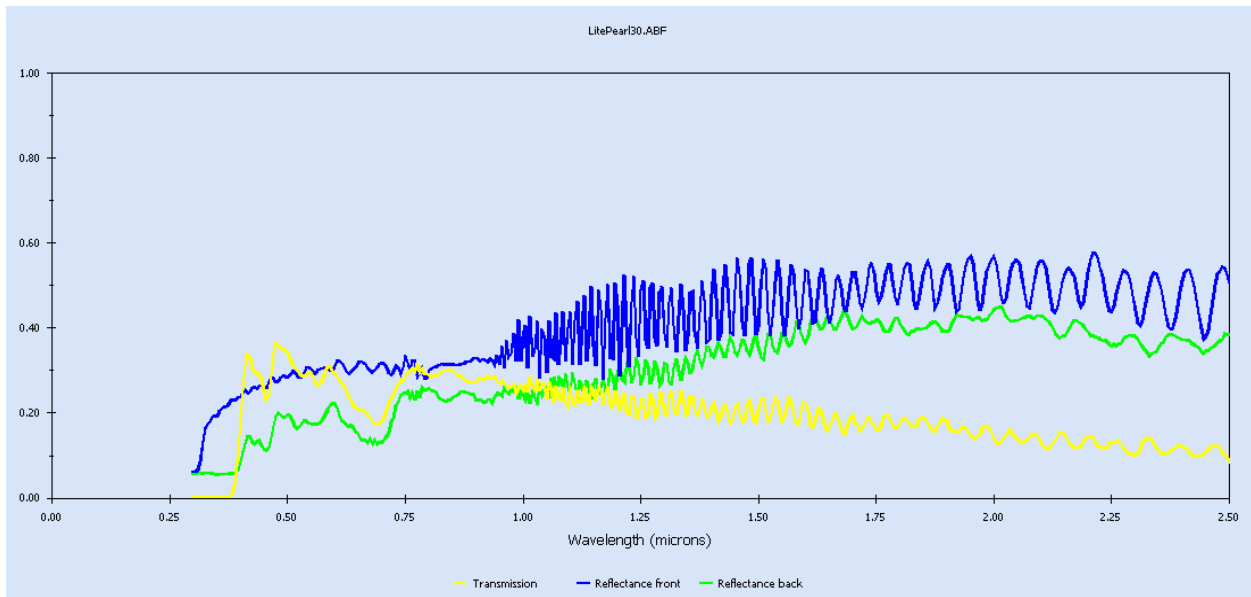


Figure 1: Spectral properties: Lite Pearl 30

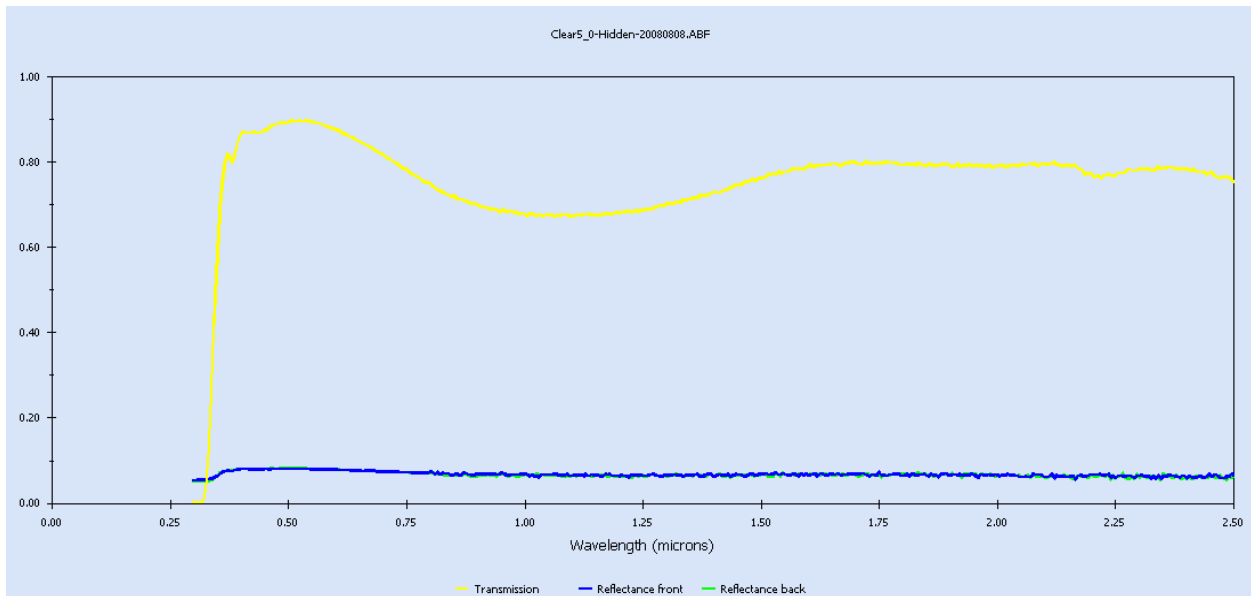


Figure 2: Spectral properties: Reference Glass sample (Substrate)

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
12:07:57

ID : 10
 Name : Lite Pearl 30
 Tilt : 90.0
 Glazings: 1
 KEFF : 0.1000
 Width : 5.067
 Uvalue : 5.62
 SHGCc : 0.40
 SCc : 0.47
 Vtc : 0.29
 RHG : 333.92

Glass and Gas Data for Glazing System '10 Lite Pearl 30'

ID	Name	D(mm)	Tsol	1	Rsol	2	Tvis	1	Rvis	2	Tir	1	Emis	2	Keff

Outside															
	30012FLitePearl30.ABF#	5.1	.250	.227	.348	.290	.183	.299	.000	.840	.770	.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 '10 Lite Pearl 30'

Angle	0	10	20	30	40	50	60	70	80	90	Hemis
Vtc	: 0.290	0.292	0.288	0.284	0.278	0.268	0.246	0.201	0.121	0.000	0.253
Rf	: 0.183	0.176	0.175	0.178	0.187	0.202	0.232	0.312	0.522	0.999	0.225
Rb	: 0.299	0.294	0.292	0.295	0.303	0.316	0.342	0.410	0.590	0.999	0.334
Tsol	: 0.250	0.252	0.249	0.245	0.240	0.232	0.213	0.173	0.104	0.000	0.219
Rf	: 0.227	0.220	0.219	0.222	0.230	0.245	0.273	0.348	0.547	0.999	0.266
Rb	: 0.348	0.343	0.342	0.344	0.351	0.364	0.388	0.451	0.619	0.999	0.380
Abs1	: 0.523	0.528	0.532	0.534	0.529	0.523	0.514	0.478	0.349	0.001	0.505
SHGCc	: 0.400	0.403	0.401	0.398	0.392	0.382	0.360	0.309	0.202	0.000	0.363
Tdw-K	: 0.103										
Tdw-ISO	: 0.208										
Tuv	: 0.002										

Temperature Distribution (degrees C)

	Winter		Summer	
	Out	In	Out	In
Lay1	-10.5	-9.3	43.8	44.0