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INTERNAL DOCUMENT:

WINDOW6 VERIFICATION RESULTS

Computer modules:	*Tarcog* and *LayerOptics* (*Venetian)*
DLL versions:	*6.0.25 and 6.1.22*
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1. INTRODUCTION

This document presents results of systematic verification of the WINDOW 6 family of computer program modules, Tarcog and Venetian. The verification was done against WIS computer program, selected spreadsheet calculations, and testing of individual routines. In addition, logical checks and random checks were done on a number of intermediate results, like calculated velocities, pressure differentials, view factors, etc.

WIS is the only other known program that implements ISO 15099 venetain blind optical and thermal analysis. While it is not possible to directly compare WIS program and WINDOW 6, due to somewhat different basic algorithms for center of glass heat transfer calculations (EN 673, EN 10077-1) and relatively poor documentation of WIS program implementation, which does not precisely state which exact algorithms are implemented. However, despite these uncertainties, some valuable comparisons and important observations could be made.

2. VENETIAN VERIFICATION RESULTS

Optical properties calculations for Venetian blinds were carried out using VENETIAN module (which is a part of LayerOptics.dll), which incorporates direct implementation of ISO 15099 and several other variations. Examples from the ISO 15099 Annex C were selected so that direct comparisons could be made. Table 2-1 lists selected Venetian blind configurations that were used in this verification work. For nomenclature see Carli. 2005a.

Table 2-1**:** Venetian Blind Configurations

Venetian blind ID	**A45**	**B45**	**C45**	**C80**	**D45**
Slat distance, d [mm]	12	12	12	12	12
Slat width, W [mm]	16	16	16	16	16
Slat tilt angle, α [deg]	45	45	45	80	45
IR transmittance slat, $\tau_{s,IR}$	0.00	0.00	0.00	0.00	0.40
IR emissivity slat external (front) side, ε_s^f	0.90	0.90	0.90	0.90	0.55
IR emissivity slat internal (back) side, ε_s^b	0.90	0.90	0.90	0.90	0.55
Solar transmittance slat, τ_s	0.00	0.00	0.00	0.00	0.40
Solar reflectance slat external (front) side, ρ_s^f	0.70	0.55	0.70	0.70	0.50
Solar reflectance slat internal (back) side, ρ_s^b	0.70	0.55	0.40	0.40	0.50

Beside the standard ISO 15099 method of calculating bulk solar-optical and radiative properties of the Venetian blind (ISO. 2003), two other approaches were used to calculate these properties, primarily to verify integrity of bi-directional calculations, implemented in VENETIAN. Namely, integrating bi-directional matrices over the set of outgoing angles, bulk solar-optical or radiative properties (depending on the spectrum) can be also calculated and theoretically they should produce equivalent results. Term “equivalent” is used here to signify calculation errors introduced by the use of a finite number of outgoing angles, as opposed to infinite number, which would have to produce identical results. Table 2-2 summarizes notation used for the three methods mentioned above.

Table 2-2**:** Notation Used to Designate Different Methods to Calculate Venetian Blind Diffuse Solar-Optical and Radiative Properties in Venetian

Designator	**Description**
REF	Reference values from ISO 15099 Annex C
ISO	Direct Implementation of ISO 15099 method
UNIF DIF	Integration of Bi-Directional Matrices (Eq. 83 in Carli. 2005a), obtained using Uniform Diffuse Approach (Sec. 3.3.3, p. 28 in Carli. 2005a)
DIRECT DIF	Integration of Bi-Directional Matrices obtained using Directional Diffuse Approach (Sec. 3.3.3, p. 30 in Carli. 2005a).

2.1. Calculation Results – SOL Range

Table 2-3 shows Venetian's intermediate results that correspond to "dir-dir" results from ISO15099 Annex C. This is the portion of unscattered light, which goes through the blind without interaction with the slat material.

Table 2-4 shows Venetian's intermediate results that correspond to "dir-dif" results from ISO 15099. This is the diffuse outgoing radiation as a result of direct incident radiation and multiple bounces of purely diffuse surfaces (assumption in ISO 15099 method). Each incidence angle produces unique result. Table 2-4 gives comparisons for two example solar incidence angles, 0º and 60º . These intermediate results are part of Venetian's module "Uniform Diffuse" calculations.

Table 2-3**:** Comparison of Direct SOL Transmittance and Reflectance ("**dir-dir**")

Blind configuration ID		**A45**		**B45**		**C45**		**C80**		**D45**	
Solar incidence angle		**0º**	**60º**	**0º**	**60º**	**0º**	**60º**	**0º**	**60º**	**0º**	**60º**
"dir-dir" transm. ext (front) side	REF	0.057	0.000	0.057	0.000	0.057	0.000	0.000	0.000	0.057	0.000
	ISO	0.0572	0.0000	0.0572	0.0000	0.0572	0.0000	0.0000	0.0000	0.0572	0.0000
"dir-dir" transm. int. (back) side	REF	0.057	0.310	0.057	0.310	0.057	0.310	0.000	0.088	0.057	0.310
	ISO	0.0572	0.3098	0.0572	0.3098	0.0572	0.3098	0.0000	0.0879	0.0572	0.3098

Table 2-4**:** Comparison of Direct to Diffuse SOL Transmittance and Reflectance ("**dir-dif**")

Blind configuration ID		**A45**		**B45**		**C45**		**C80**		**D45**	
Solar incidence angle		**0°**	**60°**	**0°**	**60°**	**0°**	**60°**	**0°**	**60°**	**0°**	**60°**
Solar "dir-dif" transm. ext (front) side	REF	0.141	0.073	0.090	0.047	0.096	0.051	0.012	0.005	0.373	0.277
	ISO	0.1407	0.0730	0.0903	0.0472	0.0957	0.0508	0.0109	0.0048	0.3733	0.2756
Solar "dir-dif" transm. int. (back) side	REF	0.141	0.288	0.090	0.216	0.076	0.271	0.011	0.027	0.373	0.306
	ISO	0.1407	0.2882	0.0903	0.2161	0.0759	0.2714	0.0101	0.0268	0.3733	0.3063
Solar "dir-dif" reflectance ext. (front) side	REF	0.394	0.558	0.295	0.430	0.371	0.544	0.622	0.678	0.418	0.567
	ISO	0.3936	0.5587	0.2952	0.4308	0.3707	0.5454	0.6308	0.6788	0.4184	0.5676
Solar "dir-dif" reflectance int. (back) side	REF	0.394	0.103	0.295	0.066	0.216	0.070	0.356	0.273	0.418	0.273
	ISO	0.3936	0.1030	0.2952	0.0661	0.2158	0.0701	0.3605	0.2735	0.4184	0.2733

Some of the results shown in Table 2-4 are slightly different from reference results due to a somewhat different approach in treating partially irradiated slat segments used in Venetian. Venetian incorporates modified procedure to account for partially irradiated slats, while ISO 15099 procedure consider slat either fully irradiated or fully shaded. Therefore, the results from Venetian are considered more accurate.

Table 2-5 shows integrated (diffuse) solar optical properties (SOL range). These results should correspond to "dif-dif" part of results in ISO 15099 Annex C. Venetian results are obtained using 3 methods, as indicated in Table 2-2, which are essentially methods used for calculation of FIR properties of the Venetian blind – with the only difference that in this case SOL properties of the slat material were used as input data.

Table 2-5**:** Comparison of Diffuse to Diffuse SOL Transmittance and Reflectance ("**dif-dif**")

Blind configuration ID		A45	B45	C45	C80	D45
Transmittance, external (front) side	REF	0.332	0.294	0.291	0.0380	0.495
	ISO	0.3316	0.2941	0.2913	0.0375	0.4951
	UNIF DIF	0.3280	0.2904	0.2879	0.0422	0.4926
	DIRECT DIF	0.3277	0.29	0.2871	0.0427	0.4934
Transmittance, internal (back) side	REF	0.332	0.294	0.291	0.0380	0.495
	ISO	0.3316	0.2941	0.2913	0.0375	0.4951
	UNIF DIF	0.3280	0.2904	0.2872	0.0425	0.4926
	DIRECT DIF	0.3277	0.29	0.2871	0.0427	0.4934
Reflectance, external (front) side	REF	0.345	0.260	0.323	0.604	0.380
	ISO	0.3445	0.2597	0.323	0.6041	0.3805
	UNIF DIF	0.3461	0.2609	0.3242	0.6017	0.3824
	DIRECT DIF	0.3479	0.2621	0.3256	0.5994	0.3845
Reflectance, internal (back) side	REF	0.345	0.260	0.193	0.345	0.380
	ISO	0.3445	0.2597	0.193	0.3454	0.3805
	UNIF DIF	0.3461	0.2609	0.1939	0.344	0.3824
	DIRECT DIF	0.3479	0.2621	0.195	0.3426	0.3845

Calculation of bi-directional transmittances of a Venetian blind takes into account two components: directional transmittance (part of incident radiation that passes through the blind without interaction with slat material), labeled dir-dir, and diffuse part of transmittance (which is a result of a series of Lambertian diffuse scattering of directional incident light), labeled dir-dif. Therefore, integration of BTDF matrices for SOL range across outgoing hemisphere should result in a sum of "dir-dir" and "dir-dif" properties for a given incident direction (profile angle). This result could be a property of interest as it allows direct comparison of measured results in a spectrophotometer with integrating sphere. Table 2-6 shows results of such integrations, compared to sums of "dir-dir" and "dir-dif" results from ISO 15099 Annex C.

Table 2-6**:** Comparison of Direct to Hemispherical SOL Transmittance and Reflectance.

Blind configuration ID		**A45**		**B45**		**C45**		**C80**		**D45**	
Solar incidence angle		**0**	**60**	**0**	**60**	**0**	**60**	**0**	**60**	**0**	**60**
Solar transm. ext (front) side	REF*	0.198	0.073	0.147	0.047	0.153	0.051	0.012	0.005	0.430	0.277
	UNIF DIF**	0.1979	0.0730	0.1475	0.0472	0.1529	0.0508	0.0109	0.0048	0.4305	0.2756
Solar transm. int. (back) side	REF*	0.198	0.598	0.147	0.526	0.133	0.581	0.011	0.115	0.430	0.616
	UNIF DIF**	0.1979	0.5980	0.1475	0.5260	0.1331	0.5812	0.0101	0.1147	0.4305	0.6161
Solar reflectance ext. (front) side	REF*	0.394	0.558	0.295	0.430	0.371	0.544	0.622	0.678	0.418	0.567
	UNIF DIF**	0.3936	0.5587	0.2952	0.4308	0.3707	0.5454	0.6308	0.6788	0.4184	0.5676
Solar reflectance int. (back) side	REF*	0.394	0.103	0.295	0.066	0.216	0.070	0.356	0.273	0.418	0.273
	UNIF DIF**	0.3936	0.1030	0.2952	0.0661	0.2158	0.0701	0.3605	0.2735	0.4184	0.2733

Notes:

* These results represent sum of "dir-dir" + "dir-dif" components from the reference table in ISO 15099 Appendix C.

**Integration here is done for outgoing hemisphere only (i.e., for a selected incident angle, results are integrated over all outgoing angles), so it is single integration (as opposed to double integration from Table 2-5)

2.2. Calculation Results – FIR Range

Because of the assumption of purely diffuse properties in FIR range, there are no dir-dir or dir-dif components in this range and therefore there are no directional to hemispherical values of the type in Table 2-4 or Table 2-6. Table 2-7 presents results of calculations of diffuse FIR properties for the same set of configurations shown in Table 2-1. Emissivities presented in Table 2-7 are obtained by using integration method described in Carli. 2005a (Eq. 83 and 84.), which means that integration is performed on bi-directional transmittances and reflectances, and emissivities are calculated using these bulk properties.

Table 2-7: Comparison of FIR Transmittance and Emissivity.

Blind configuration ID		A45	B45	C45	C80	D45
IR transmittance, external (front) side	REF	0.2270	0.2270	0.2270	0.0245	0.3850
	ISO	0.2270	0.2270	0.2270	0.0245	0.3849
	UNIF DIF	0.2236	0.2236	0.2236	0.0291	0.3826
	DIRECT DIF	0.2234	0.2234	0.2234	0.0292	0.3836
IR transmittance, internal (back) side	REF	0.2270	0.2270	0.2270	0.0245	0.3850
	ISO	0.2270	0.2270	0.2270	0.0245	0.3849
	UNIF DIF	0.2236	0.2236	0.2236	0.0291	0.3826
	DIRECT DIF	0.2234	0.2234	0.2234	0.0292	0.3836
IR emissivity external (front) side	REF	0.7290	0.7290	0.7290	0.8900	0.5360
	ISO	0.7294	0.7294	0.7294	0.8901	0.5356
	UNIF DIF	0.7326	0.7326	0.7326	0.8859	0.5373
	DIRECT DIF	0.7326	0.7326	0.7326	0.8861	0.5357
IR emissivity internal (back) side	REF	0.7290	0.7290	0.7290	0.8900	0.5360
	ISO	0.7294	0.7294	0.7294	0.8901	0.5356
	UNIF DIF	0.7326	0.7326	0.7326	0.8859	0.5373
	DIRECT DIF	0.7326	0.7326	0.7326	0.8861	0.5357

3. TARCOG VERIFICATION RESULTS

Results of TARCOG thermal properties calculations were compared against results obtained using WIS 3.0 program. Both WINDOW 6 (6.0.30) program and internal test program (WinCOG v6.0.32) were used in this verification.

3.1. Test results – WINDOW 6 vs. WIS

Verification specimens were created using selection of glasses, venetian blinds and gasses that were available in both programs. Table 3-1 lists selection of glasses used in this verification work.

Table 3-1: Glass Selection – basic properties of selected glasses

Glass type		Name	Width [mm]	IR transm.	Front emissivity	Back emissivity	Thermal conductivity
clear	WIS	OpCl_4.pgl	4	0	0.837	0.837	1
	W6	Clear4.pgl	3.87	0	0.84	0.840	1
low-e	WIS	OptitSN4.pgl	4	0	0.048	0.837	1
	W6	OptitSN4.pgl	4	0	0.048	0.837	1
low-e2	WIS	SGG COOL-LITE KS447.sgp	6	0	0.036	0.837	1
	W6	ESB8.AFG	5.6	0	0.034	0.840	1
low-e3	WIS	Ip-ipls4.ipe	4	0	0.048	0.837	1
	W6	TiAC36_4.afg	4	0	0.048	0.842	1

Note the difference between properties of the clear glass used in WINDOW6 and WIS. These differences can account to a very small difference in calculated U, SHGC values. IGUs considered in this verification work consisted of a single, double clear and double low-e glazing with Venetian shading device at the outdoor or indoor side, or between the two glass panes, when applicable (i.e., for double glazed units).

Solar optical properties of slat material and of venetian blinds, calculated by Window 6 program (using Venetian module) and WIS program, are given in Table 2-1 and Table 3-2.

Table 3-2**:** Venetian blind configurations and their bulk IR properties

Config ID	**Slat type**	**Slat tilt [deg]**	**IR transmittance**			**IR emissivity external (front) side**			**IR emissivity internal (back) side**		
			W6	**WIS**	**Diff [%]**	**W6**	**WIS**	**Diff [%]**	**W6**	**WIS**	**Diff [%]**
A0	A	0	0.365	0.348	4.7%	0.615	0.631	2.6%	0.615	0.631	2.6%
A45		45	0.233	0.227	2.6%	0.733	0.729	0.5%	0.733	0.729	0.5%
A90		90	0	1E-07	-	0.905	0.905	0%	0.905	0.905	0%
B0	B	0	0.365	0.348	4.7%	0.615	0.631	2.6%	0.615	0.631	2.6%
B45		45	0.223	0.227	2.6%	0.773	0.729	0.5%	0.773	0.729	0.5%
B90		90	0	1E-07	-	0.905	0.905	0	0.905	0.905	0
C0	C	0	0.365	0.348	4.7%	0.615	0.631	2.6%	0.615	0.631	2.6%
C45		45	0.233	0.227	0.5%	0.733	0.729	0.0%	0.733	0.729	0.5%
C80		80	0.029	0.0245	15.5%	0.886	0.89	-0.5%	0.886	0.89	-0.5%
C90		90	0	1E-07	-	0.905	0.905	0%	0.905	0.905	0%
D45	D	45	0.384	0.385	-0.3%	0.536	0.536	0%	0.536	0.536	0%
D90		90	0.320	0.32	0%	0.628	0.628	0%	0.628	0.628	0%

Table 3-3 presents details of glazing configurations used. Gap is the distance between two glass panes (in double glazing cases) and external SD distance is the distance between the outdoor/indoor glass surface and the center plane of the SD, in IGUs with external (outdoor or indoor) SD configurations. Table 3-4 presents free ventilation parameters, used in Window 6 and WIS simulations. Table 3-5 shows indicators of SD position within the glazing system, which are used in configuration names.

Table 3-3: Glazing Configuration

	Glass 1	Gap [mm]	Gap gas	Glass2	External SD distance [mm]
Single	clear	-	-	-	**10**
Double clear	clear	**20**	air	clear	**10**
Double Low-E	low-e	**20**	10 % argon	clear	**10**
Low-E – Low-E	low-e2	**20**	10% argon	lowe-e3	**10**

Table 3-4: Free ventilation parameters (hole areas)

WINDOW 6					WIS		
Dtop [mm]	**Dbot [mm]**	**Dleft [mm]**	**Dright [mm]**	**Hole frct.**	**d1 [mm]**	**d2 [mm]**	**d3 [mm]**
40	**40**	**0**	**0**	**0.05**	**40**	**40**	**40**

Table 3-5: Nomenclature – SD position

SD position	
i	indoor
b	in between
o	outdoor

After defining test glazing system configurations (IGUs), the following boundary conditions were used:

1. WIS boundary conditions, which correspond to the typical EN standard conditions,

   T_e = 0 °C

   T_i = 20 °C

   I = 500 W/m^2

   h_e = 15.0 W/(m^2·K)

   h_i = 3.0 W/(m^2·K)

2. NFRC 2002 boundary conditions, which correspond to standard NFRC boundary conditions used in US:

   T_e = -18 °C

   T_i = 21 °C

   I = 783 W/m^2

   h_{ce} = calculated by program, from wind velocity of 5.5 m/s (~25.0 W/(m^2·K))

   h_{ci} = calculated by the program, depending on glass temperature (~2.5 W/(m^2·K))

h_{re} = calculated by program, from glass surface temperature (~5.0 W/(m^2·K))

h_{ri} = calculated by the program, depending on glass temperature (~4.5 W/(m^2·K))

The tests were done in WINDOW6 research version 6.0.30. Directional diffuse method was used in calculation of solar-optical properties of Venetian blinds (in both SOL and FIR range), with W6 standard angular basis. Thermal calculations were performed for full spectral data, using ISO 15099 thermal model. These conditions apply to all results, unless stated otherwise.

Table 3-6 presents details for the full set of test configurations: type of SD used, type(s) of glasses used, ordering of glazing/shading layers, gas mixtures and dimensions.

Table 3-6: Test configurations for Window 6 vs. WIS 3 test runs

Num.	Config ID	Glazing type	Venetian blind: SD type	Venetian blind: Slat tilt angle	Venetian blind: Slat Width	Venetian blind: SD position	Forced air velocity	Glazing system configuration: Layer1	Layer1 thickness	Gap1	Gap1 width	Layer2	Layer2 thickness	Gap2	Gap2 width	Layer3	Layer3 thickness	Total thickness
1	ww_sc_A0_i_0	Single clear	A	0	16.00	i	0		4		10		16.00					30
2	ww_sc_A0_i_2						2											
3	ww_sc_A0_o_0					o	0		16.00		10		4					30
4	ww_sc_A0_o_2						2											
5	ww_sc_A45_i_0			45	11.31	i	0		4		10		11.31					25.31
6	ww_sc_A45_i_2						2											
7	ww_sc_A45_o_0					o	0		11.31		10		4					25.31
8	ww_sc_A45_o_2						2											
9	ww_sc_A90_i_0			90	0.60	i	0		4		10		0.60					14.60
10	ww_sc_A90_i_2						2											
11	ww_sc_A90_o_0					o	0		0.60		10		4					14.60
12	ww_sc_A90_o_2						2											
13	ww_dc_A0_i_0	Double clear	A	0	16.00	i	0		4		20		4		10		16.00	54
14	ww_dc_A0_i_2						2											
15	ww_dc_A0_b_0					b	0		4		10		16.00		10		4	44
16	ww_dc_A0_b_2						2											
17	ww_dc_A0_o_0					o	0		16.00		10		4		20		4	54
18	ww_dc_A0_o_2						2											
19	ww_dc_A45_i_0			45	11.31	i	0		4		20		4		10		11.31	49.31
20	ww_dc_A45_i_2						2											
21	ww_dc_A45_b_0					b	0		4		10		11.31		10		4	39.31
22	ww_dc_A45_b_2						2											
23	ww_dc_A45_o_0					o	0		11.31		10		4		20		4	49.31
24	ww_dc_A45_o_2						2											
25	ww_dc_A90_i_0			90	0.60	i	0		4		20		4		10		0.60	38.60
26	ww_dc_A90_i_2						2											
27	ww_dc_A90_b_0					b	0		4		10		0.60		10		4	28.60
28	ww_dc_A90_b_2						2											
29	ww_dc_A90_o_0					o	0		0.60		10		4		20		4	38.60
30	ww_dc_A90_o_2						2											
31	ww_dc_B0_i_0		B	0	16.00	i	0		4		20		4		10		16.00	54
32	ww_dc_B0_b_0					b	0		4		10		16.00		10		4	44
33	ww_dc_B0_o_0					o	0		16.00		10		4		20		4	54
34	ww_dc_B45_i_0			45	11.31	i	0		4		20		4		10		11.31	49.31
35	ww_dc_B45_b_0					b	0		4		10		11.31		10		4	39.31
36	ww_dc_B45_o_0					o	0		11.31		10		4		20		4	49.31
37	ww_dc_B90_i_0			90	0.60	i	0		4		20		4		10		0.60	38.60
38	ww_dc_B90_b_0					b	0		4		10		0.60		10		4	28.60
39	ww_dc_B90_o_0					o	0		0.60		10		4		20		4	38.60

Table 3-6 - continued

Num.	Config ID	Glazing type	Venetian blind: SD type	Venetian blind: Slat tilt angle	Venetian blind: Slat Width	Venetian blind: SD position	Forced air velocity	Glazing system configuration: Layer1	Layer1 thickness	Gap1	Gap1 width	Layer2	Layer2 thickness	Gap2	Gap2 width	Layer3	Layer3 thickness	Total thickness
40	ww_le_C0_i_0	Double Low-E	C	0	16.00	i	0	Low-E glass	4	10% Argon	20	Clear glass	4	Air	10	Venetian blind	16	54
41	ww_le_C0_b_0					b	0	Low-E glass	4	10% Argon	10	Venetian blind	16	10% Argon	10	Clear glass	4	44
42	ww_le_C0_o_0					o	0	Venetian blind	16	Air	10	Low-E glass	4	10% Argon	20	Clear glass	4	54
43	ww_le_C45_i_0			45	11.31	i	0	Low-E glass	4	10% Argon	20	Clear glass	4	Air	10	Venetian blind	11.31	49.31
44	ww_le_C45_b_0					b	0	Low-E glass	4	10% Argon	10	Venetian blind	11.31	10% Argon	10	Clear glass	4	39.31
45	ww_le_C45_o_0					o	0	Venetian blind	10	Air	4.34	Low-E glass	4	10% Argon	20	Clear glass	4	42.34
46	ww_le_C80_i_0			80	2.78	i	0	Low-E glass	4	10% Argon	20	Clear glass	4	Air	10	Venetian blind	2.78	40.78
47	ww_le_C80_b_0					b	0	Low-E glass	4	10% Argon	10	Venetian blind	2.78	10% Argon	10	Clear glass	4	30.78
48	ww_le_C80_o_0					o	0	Venetian blind	2.78	Air	10	Low-E glass	4	10% Argon	20	Clear glass	4	40.78
49	ww_le_C90_i_0			90	0.60	i	0	Low-E glass	4	10% Argon	20	Clear glass	4	Air	10	Venetian blind	0.60	38.60
50	ww_le_C90_b_0					b	0	Low-E glass	4	10% Argon	10	Venetian blind	0.60	10% Argon	10	Clear glass	4	28.60
51	ww_le_C90_o_0					o	0	Venetian blind	0.60	Air	10	Low-E glass	4	10% Argon	20	Clear glass	4	38.60
52	ww_le_D45_i_0		D	45	11.31	i	0	Low-E glass	4	10% Argon	20	Clear glass	4	Air	10	Venetian blind	11.31	49.31
53	ww_le_D45_b_0					b	0	Low-E glass	4	10% Argon	10	Venetian blind	11.31	10% Argon	10	Clear glass	4	39.31
54	ww_le_D45_o_0					o	0	Venetian blind	11.31	Air	10	Low-E glass	4	10% Argon	20	Clear glass	4	49.31
55	ww_le_D90_i_0			90	0.60	i	0	Low-E glass	4	10% Argon	20	Clear glass	4	Air	10	Venetian blind	0.60	38.60
56	ww_le_D90_b_0					b	0	Low-E glass	4	10% Argon	10	Venetian blind	0.60	10% Argon	10	Clear glass	4	28.60
57	ww_le_D90_o_0					o	0	Venetian blind	0.60	Air	10	Low-E glass	4	10% Argon	20	Clear glass	4	38.60
58	ww_ee_C45_i_0	Low-E – Low_E	C	45	0.60	i	0	Low-E glass	5.6	10% Argon	20	Low-E glass	4	Air	10	Venetian blind	11.31	50.91
59	ww_ee_C45_b_0					b	0	Low-E glass	5.6	10% Argon	10	Venetian blind	11.31	10% Argon	10	Low-E glass	4	40.91
60	ww_ee_C45_o_0					o	0	Venetian blind	11.31	Air	10	Low-E glass	5.6	10% Argon	20	Low-E glass	4	50.91

Legend:			
	(cyan)	-	Clear glass
	(magenta)	-	Low-E glass
	(hatched)	-	Venetian blind
	(light green)	-	Air
	(light orange)	-	10% Argon

Table 3-7, Table 3-8 and Table 3-9 present results of WINDOW 6 and WIS test runs.

Table 3-7: Comparison of results (U factors) of WINDOW 6 and WIS test runs

Num.	Config ID	Results U factor W6r30 (WIS BC)	WIS	ΔU [%]	W6r30 (NFRC BC)	ΔU [%]
1	ww_sc_A0_i_0	4.2530	4.2216	-0.7%	4.9252	-14.3%
3	ww_sc_A0_o_0	3.3465	3.3291	-0.5%	3.4029	-2.2%
5	ww_sc_A45_i_0	4.0584	4.0547	-0.1%	4.7227	-14.1%
7	ww_sc_A45_o_0	3.2788	3.2698	-0.3%	3.3610	-2.7%
9	ww_sc_A90_i_0	3.7117	3.7067	-0.1%	4.3668	-15.1%
11	ww_sc_A90_o_0	3.1511	3.1411	-0.3%	3.2800	-4.2%
13	ww_dc_A0_i_0	2.2493	2.2062	-1.9%	2.4382	-9.5%
15	ww_dc_A0_b_0	2.3125	2.2933	-0.8%	2.3278	-1.5%
17	ww_dc_A0_o_0	1.9888	1.9589	-1.5%	1.9918	-1.7%
19	ww_dc_A45_i_0	2.1816	2.1494	-1.5%	2.3695	-9.3%
21	ww_dc_A45_b_0	2.2282	2.2202	-0.4%	2.3479	-5.4%
23	ww_dc_A45_o_0	1.9621	1.9359	-1.3%	1.9754	-2.0%
25	ww_dc_A90_i_0	2.0549	2.0241	-1.5%	2.2432	-9.8%
27	ww_dc_A90_b_0	2.0654	2.0567	-0.4%	2.0926	-1.7%
29	ww_dc_A90_o_0	1.9107	1.8848	-1.4%	1.9433	-3.0%
31	ww_dc_B0_i_0	2.2493	2.2062	-1.9%	2.4382	-9.5%
32	ww_dc_B0_b_0	2.3125	2.2933	-0.8%	2.3278	-1.5%
33	ww_dc_B0_o_0	1.9888	1.9589	-1.5%	1.9918	-1.7%
34	ww_dc_B45_i_0	2.1816	2.1494	-1.5%	2.3695	-9.3%
35	ww_dc_B45_b_0	2.2282	2.2202	-0.4%	2.2468	-1.2%
36	ww_dc_B45_o_0	1.9621	1.9359	-1.3%	1.9754	-2.0%
37	ww_dc_B90_i_0	2.0549	2.0241	-1.5%	2.2432	-9.8%
38	ww_dc_B90_b_0	2.0654	2.0567	-0.4%	2.0926	-1.7%
39	ww_dc_B90_o_0	1.9107	1.8848	-1.4%	1.9433	-3.0%
40	ww_le_C0_i_0	1.1407	1.0694	-6.3%	1.3994	-23.6%
41	ww_le_C0_b_0	1.3123	1.3054	-0.5%	1.4035	-7.0%
42	ww_le_C0_o_0	1.0512	0.9949	-5.4%	1.1935	-16.6%
43	ww_le_C45_i_0	1.1181	1.0526	-5.9%	1.3701	-23.2%
44	ww_le_C45_b_0	1.3141	1.3071	-0.5%	1.4062	-7.0%
45	ww_le_C45_o_0	1.0411	0.9870	-5.2%	1.1856	-16.7%
46	ww_le_C80_i_0	1.0807	1.0175	-5.8%	1.3229	-23.1%
47	ww_le_C80_b_0	1.3062	1.2974	-0.7%	1.3990	-7.3%
48	ww_le_C80_o_0	1.0247	0.9718	-5.2%	1.1726	-17.1%
49	ww_le_C90_i_0	1.0737	1.0117	-5.8%	1.3142	-23.0%
50	ww_le_C90_b_0	1.3034	1.2953	-0.6%	1.3963	-7.2%
51	ww_le_C90_o_0	1.0215	0.9693	-5.1%	1.1700	-17.2%

Table 3-7 - continued

Num.	Config ID	Results				
		U factor				
		W6r30 (WIS BC)	WIS	ΔU [%]	W6r30 (NFRC BC)	ΔU [%]
52	**ww_le_D45_i_0**	1.1352	1.0667	-6.0%	1.3923	-23.4%
53	**ww_le_D45_b_0**	1.3009	1.2945	-0.5%	1.3916	-7.0%
54	**ww_le_D45_o_0**	1.0464	0.9917	-5.2%	1.1871	-16.5%
55	**ww_le_D90_i_0**	1.1306	1.0641	-5.9%	1.3862	-23.2%
56	**ww_le_D90_b_0**	1.3098	1.3017	-0.6%	1.4012	-7.1%
57	**ww_le_D90_o_0**	1.0458	0.9910	-5.2%	1.1883	-16.6%
58	**ww_ee_C45_i_0**	1.0463	0.9870	-5.7%	1.3098	-24.6%
59	**ww_ee_C45_b_0**	0.9828	0.9899	0.7%	1.0911	-9.3%
60	**ww_ee_C45_o_0**	0.9759	0.9253	-5.2%	1.1349	-18.5%

Table 3-8: Comparison of results (SHGC) of WINDOW 6 and WIS test runs

Num.	Config ID	Results SHGC W6r30 (WIS BC)	WIS	∆SHGC [%]	W6r30 (NFRC BC)	∆SHGC [%]
1	ww_sc_A0_i_0	0.8467	0.8480	0.2%	0.8456	-0.1%
3	ww_sc_A0_o_0	0.8745	0.8750	0.1%	0.8787	0.5%
5	ww_sc_A45_i_0	0.4464	0.4536	1.6%	0.4563	2.2%
7	ww_sc_A45_o_0	0.2136	0.2113	-1.1%	0.2300	7.7%
9	ww_sc_A90_i_0	0.2366	0.2448	3.5%	0.2420	2.3%
11	ww_sc_A90_o_0	0.0388	0.0404	4.1%	0.0524	35.1%
13	ww_dc_A0_i_0	0.7409	0.7406	0.0%	0.7439	0.4%
15	ww_dc_A0_b_0	0.7508	0.7509	0.0%	0.7524	0.2%
17	ww_dc_A0_o_0	0.7747	0.7740	-0.1%	0.7785	0.5%
19	ww_dc_A45_i_0	0.4626	0.4760	2.9%	0.4857	5.0%
21	ww_dc_A45_b_0	0.3173	0.3195	0.7%	0.3049	-3.9%
23	ww_dc_A45_o_0	0.1780	0.1726	-3.0%	0.1873	5.2%
25	ww_dc_A90_i_0	0.2861	0.3039	6.2%	0.3110	8.7%
27	ww_dc_A90_b_0	0.1412	0.1462	3.6%	0.1458	3.3%
29	ww_dc_A90_o_0	0.0253	0.0257	1.8%	0.0332	31.6%
31	ww_dc_B0_i_0	0.7409	0.7406	0.0%	0.7439	0.4%
32	ww_dc_B0_b_0	0.7508	0.7509	0.0%	0.7524	0.2%
33	ww_dc_B0_o_0	0.7747	0.7740	-0.1%	0.7785	0.5%
34	ww_dc_B45_i_0	0.4995	0.5115	2.4%	0.5266	5.4%
35	ww_dc_B45_b_0	0.3231	0.3256	0.8%	0.3323	2.8%
36	ww_dc_B45_o_0	0.1467	0.1434	-2.2%	0.1587	8.2%
37	ww_dc_B90_i_0	0.3592	0.3755	4.5%	0.3878	8.0%
38	ww_dc_B90_b_0	0.1886	0.1934	2.6%	0.1955	3.7%
39	ww_dc_B90_o_0	0.0337	0.0338	0.3%	0.0450	33.7%
40	ww_le_C0_i_0	0.5548	0.5795	4.5%	0.5545	0.0%
41	ww_le_C0_b_0	0.5588	0.5849	4.7%	0.5583	-0.1%
42	ww_le_C0_o_0	0.5813	0.6068	4.4%	0.5780	-0.6%
43	ww_le_C45_i_0	0.3865	0.4289	11.0%	0.4019	4.0%
44	ww_le_C45_b_0	0.3041	0.3291	8.2%	0.3160	3.9%
45	ww_le_C45_o_0	0.1039	0.1079	3.9%	0.1042	0.3%
46	ww_le_C80_i_0	0.2748	0.3215	17.0%	0.2917	6.2%
47	ww_le_C80_b_0	0.1846	0.2045	10.8%	0.1922	4.1%
48	ww_le_C80_o_0	0.0227	0.0229	0.7%	0.0228	0.1%
49	ww_le_C90_i_0	0.2564	0.3023	17.9%	0.2735	6.7%
50	ww_le_C90_b_0	0.1657	0.1836	10.8%	0.1722	4.0%
51	ww_le_C90_o_0	0.0159	0.0155	-2.1%	0.0159	0.1%

Table 3-8 - continued

Num.	Config ID	Results				
		SHGC				
		W6r30 (WIS BC)	WIS	ΔSHGC [%]	W6r30 (NFRC BC)	ΔSHGC [%]
52	ww_le_D45_i_0	0.3873	0.4291	10.8%	0.3933	1.6%
53	ww_le_D45_b_0	0.3375	0.3621	7.3%	0.3394	0.6%
54	ww_le_D45_o_0	0.2513	0.2650	5.5%	0.2487	-1.1%
55	ww_le_D90_i_0	0.3395	0.3844	13.2%	0.3460	1.9%
56	ww_le_D90_b_0	0.2866	0.3107	8.4%	0.2880	0.5%
57	ww_le_D90_o_0	0.2088	0.2233	6.9%	0.2061	-1.3%
58	ww_ee_C45_i_0	0.1854	0.1671	-9.9%	0.1843	-0.6%
59	ww_ee_C45_b_0	0.1230	0.1208	-1.8%	0.1238	0.7%
60	ww_ee_C45_o_0	0.0589	0.0545	-7.5%	0.0591	0.3%

Table 3-9: Comparison of Components of Solar-Optical Properties.

Num.	Config ID	Itemized Solar-Optical Results											
		TotSol			Asol 1			Asol 2			Asol 3		
		W6 r30	WIS	Δ [%]	W6 r30	WIS	Δ [%]	W6 r30	WIS	Δ [%]	W6 r30	WIS	Δ [%]
1	ww_sc_A0_i_0	0.8206	0.8230	0.3%	0.1055	0.1010	-4.3%	0.0000	0.0000	-			-
3	ww_sc_A0_o_0	0.8206	0.8230	0.3%	0.0000	0.0000	-	0.1055	0.1010	-4.3%			-
5	ww_sc_A45_i_0	0.1775	0.1800	1.4%	0.1420	0.1400	-1.4%	0.3444	0.3520	2.2%			-
7	ww_sc_A45_o_0	0.1606	0.1580	-1.6%	0.4138	0.4170	0.8%	0.0237	0.0227	-4.3%			-
9	ww_sc_A90_i_0	0.0023	0.0028	25.1%	0.1707	0.1700	-0.4%	0.2929	0.3050	4.1%			-
11	ww_sc_A90_o_0	0.0021	0.0026	23.7%	0.3281	0.3350	2.1%	0.0003	0.0004	24.4%			-
13	ww_dc_A0_i_0	0.6823	0.6810	-0.2%	0.1113	0.1080	-2.9%	0.0816	0.0838	2.7%	0.0000	0.0000	-
15	ww_dc_A0_b_0	0.6823	0.6810	-0.2%	0.1113	0.1080	-2.9%	0.0000	0.0000	-	0.0816	0.0838	2.7%
17	ww_dc_A0_o_0	0.6823	0.6810	-0.2%	0.0000	0.0000	-	0.1113	0.1080	-2.9%	0.0816	0.0838	2.7%
19	ww_dc_A45_i_0	0.1555	0.1570	0.9%	0.1331	0.1320	-0.8%	0.1131	0.1200	6.1%	0.2924	0.3000	2.6%
21	ww_dc_A45_b_0	0.1449	0.1430	-1.3%	0.1426	0.1410	-1.1%	0.3523	0.3610	2.5%	0.0199	0.0207	3.8%
23	ww_dc_A45_o_0	0.1315	0.1260	-4.2%	0.4188	0.4230	1.0%	0.0262	0.0257	-1.8%	0.0177	0.0181	2.3%
25	ww_dc_A90_i_0	0.0020	0.0025	25.3%	0.1509	0.1530	1.4%	0.1396	0.1510	8.2%	0.2563	0.2680	4.6%
27	ww_dc_A90_b_0	0.0019	0.0023	22.6%	0.1707	0.1700	-0.4%	0.2930	0.3050	4.1%	0.0003	0.0004	32.8%
29	ww_dc_A90_o_0	0.0018	0.0021	19.3%	0.3282	0.3350	2.1%	0.0004	0.0005	31.5%	0.0002	0.0003	33.2%
31	ww_dc_B0_i_0	0.6823	0.6810	-0.2%	0.1113	0.1080	-2.9%	0.0816	0.0838	2.7%	0.0000	0.0000	-
32	ww_dc_B0_b_0	0.6823	0.6810	-0.2%	0.1113	0.1080	-2.9%	0.0000	0.0000	-	0.0816	0.0838	2.7%
33	ww_dc_B0_o_0	0.6823	0.6810	-0.2%	0.0000	0.0000	-	0.1113	0.1080	-2.9%	0.0816	0.0838	2.7%
34	ww_dc_B45_i_0	0.1143	0.1150	0.6%	0.1274	0.1260	-1.1%	0.1048	0.1110	5.9%	0.3945	0.4020	1.9%
35	ww_dc_B45_b_0	0.1063	0.1050	-1.2%	0.1329	0.1300	-2.2%	0.4752	0.4830	1.7%	0.0145	0.0149	3.1%
36	ww_dc_B45_o_0	0.0970	0.0940	-3.1%	0.5687	0.5710	0.4%	0.0190	0.0185	-2.6%	0.0129	0.0132	2.2%
37	ww_dc_B90_i_0	0.0006	0.0008	25.6%	0.1415	0.1420	0.4%	0.1257	0.1340	6.6%	0.3598	0.3710	3.1%

Table 3-9 - continued

Num.	Config ID	Itemized Solar-Optical Results											
		TotSol			Asol 1			Asol 2			Asol 3		
		W6 r30	WIS	Δ [%]	W6 r30	WIS	Δ [%]	W6 r30	WIS	Δ [%]	W6 r30	WIS	Δ [%]
38	ww_dc_B90_b_0	0.0006	0.0007	23.1%	0.1556	0.1530	-1.7%	0.4162	0.4280	2.8%	0.0001	0.0001	31.3%
39	ww_dc_B90_o_0	0.0005	0.0006	19.6%	0.4750	0.4810	1.3%	0.0001	0.0001	29.5%	0.0001	0.0001	31.5%
40	ww_le_C0_i_0	0.5041	0.5180	2.8%	0.2022	0.2000	-1.1%	0.0486	0.0638	31.2%	0.0000	0.0000	-
41	ww_le_C0_b_0	0.5041	0.5180	2.8%	0.2022	0.2000	-1.1%	0.0000	0.0000	-	0.0486	0.0638	31.2%
42	ww_le_C0_o_0	0.5041	0.5180	2.8%	0.0000	0.0000	-	0.2022	0.2000	-1.1%	0.0486	0.0638	31.2%
43	ww_le_C45_i_0	0.0927	0.0987	6.4%	0.2273	0.2240	-1.4%	0.0693	0.0933	34.7%	0.2552	0.2730	7.0%
44	ww_le_C45_b_0	0.0867	0.0912	5.2%	0.2340	0.2310	-1.3%	0.3050	0.3310	8.5%	0.0107	0.0131	23.0%
45	ww_le_C45_o_0	0.0712	0.0748	5.1%	0.5016	0.5000	-0.3%	0.0376	0.0332	-11.8%	0.0079	0.0105	32.7%
46	ww_le_C80_i_0	0.0109	0.0109	-0.1%	0.2484	0.2450	-1.4%	0.0878	0.1190	35.6%	0.2101	0.2340	11.4%
47	ww_le_C80_b_0	0.0092	0.0097	5.1%	0.2649	0.2620	-1.1%	0.2465	0.2760	12.0%	0.0015	0.0015	1.6%
48	ww_le_C80_o_0	0.0051	0.0057	13.0%	0.3629	0.3680	1.4%	0.0032	0.0028	-12.4%	0.0006	0.0009	42.1%
49	ww_le_C90_i_0	0.0004	0.0005	33.5%	0.2527	0.2490	-1.4%	0.0920	0.1240	34.9%	0.1985	0.2210	11.3%
50	ww_le_C90_b_0	0.0004	0.0005	29.5%	0.2719	0.2680	-1.4%	0.2317	0.2590	11.8%	0.0000	0.0001	53.3%
51	ww_le_C90_o_0	0.0003	0.0004	30.0%	0.3325	0.3400	2.3%	0.0002	0.0002	10.5%	0.0000	0.0001	71.6%
52	ww_le_D45_i_0	0.2452	0.2610	6.4%	0.2315	0.2280	-1.5%	0.0730	0.0978	34.0%	0.0806	0.0879	9.0%
53	ww_le_D45_b_0	0.2357	0.2460	4.4%	0.2435	0.2400	-1.4%	0.0989	0.1110	12.3%	0.0284	0.0368	29.7%
54	ww_le_D45_o_0	0.2046	0.2140	4.6%	0.1649	0.1680	1.9%	0.1129	0.1000	-11.4%	0.0233	0.0318	36.7%
55	ww_le_D90_i_0	0.1976	0.2160	9.3%	0.2407	0.2370	-1.5%	0.0812	0.1090	34.2%	0.0733	0.0790	7.7%
56	ww_le_D90_b_0	0.1928	0.2050	6.3%	0.2559	0.2520	-1.5%	0.0895	0.0987	10.2%	0.0236	0.0313	32.6%
57	ww_le_D90_o_0	0.1681	0.1790	6.5%	0.1439	0.1430	-0.6%	0.0971	0.0862	-11.2%	0.0196	0.0273	39.1%
58	ww_ee_C45_i_0	0.0254	0.0288	13.6%	0.7301	0.668	-8.5%	0.0643	0.038	-40.9%	0.0699	0.0749	7.2%
59	ww_ee_C45_b_0	0.0239	0.0261	9.4%	0.7364	0.667	-9.4%	0.1085	0.112	3.2%	0.0101	0.0056	-44.9%
60	ww_ee_C45_o_0	0.0173	0.02	15.5%	0.6569	0.495	-24.6%	0.0981	0.102	4.0%	0.0070	0.0042	-39.8%

Table 3-10, Table 3-11,and Table 3-12 show the effect of the use different spectral data (full spectral data and various condensed spectral sets) and different angular bases. Table 3-10 presents results using full angular basis, while, Table 3-11 and Table 3-12, show results using half-and quarter-angular basis, respectively.

Table 3-10: Comparison of SHGC results obtained by using full and condensed spectral data – Full angular basis

	SHGC – FULL ANGULAR BASIS											
	Full Spectral Data	Condensed Wavelength bands (VIS+NIR)										
Glazing		51+25	25+51	30+15	15+30	20+10	10+20	10+5	5+10	5+3	3+5	1+1
SG1 (Single: Clear Glazing)	0.846	0.843	0.843	0.843	0.843	0.844	0.843	0.846	0.843	0.849	0.843	0.834
IGU43 (Double: Clr+Low-e)	0.402	0.402	0.402	0.402	0.402	0.403	0.402	0.405	0.401	0.410	0.371	0.381
IGU43a (Double: Clr+Low-e)	0.289	0.289	0.289	0.290	0.289	0.290	0.289	0.294	0.289	0.301	0.290	0.304
IGU43b (Double: Clr+Low-e)	0.256	0.255	0.255	0.256	0.255	0.258	0.255	0.265	0.256	0.275	0.260	0.256
IGU43c (Double: Clr+Low-e)	0.299	0.300	0.300	0.300	0.299	0.301	0.300	0.307	0.298	0.314	0.300	0.287
IGU43d (Double: Clr+Low-e)	0.389	0.388	0.388	0.389	0.388	0.389	0.388	0.391	0.387	0.394	0.387	0.398
IGU43e (Double: Clr+evergreen Low-e)	0.179	0.179	0.179	0.179	0.179	0.180	0.179	0.182	0.177	0.182	0.174	0.115
IGU 58 (Double: evergreen Low-e + Low-e)	0.184	0.185	0.185	0.185	0.185	0.186	0.184	0.187	0.182	0.187	0.178	0.104

SG1: **Single glazing** with A0 Venetian blind (0º angle) on indoor side
IGU43: **Double glazing (clear + low-e) with C45 blind on indoor side**. Low-e is ID4000 (Pilkington Optitherm SN)
IGU43a: Same as IGU43 except for low-e glass, which is ID932 (AFG Comfort TiAC Low-e on clr)
IGU43b: Same as IGU43 except for low-e glass, which is ID966 (AFG Comfort TiAC36 Low-e on clr)
IGU43c: Same as IGU43 except for low-e glass, which is ID3112 (Guardian Performance Plus II on clr)
IGU43d: Same as IGU43 except for low-e glass, which is ID5144 (PPG Sungate 100 on clr)
IGU43e: Same as IGU43 except for low-e glass, which is ID779 (AFG Sunbelt Low-e on evergreen)
IGU58: **Double glazing (low-e + low-e) with C45 blind on indoor side**. AFG Sunbelt Low-e on evergreen (ID779); AFG Comfort TiAC low-e (ID966).
Deep Red color indicates differences beyond 0.015 (beyond 0.2 when presented with two decimal points)
Light Red color indicates differences between 0.005 and 0.015 (on the order of 0.01)

Table 3-11 : Comparison of SHGC results obtained by using full and condensed spectral data – Half angular basis

	SHGC	SHGC – HALF ANGULAR BASIS										
	Full Spectral Data /	Condensed Wavelength bands (VIS+NIR)										
Glazing	Full Basis	51+25	25+51	30+15	15+30	20+10	10+20	10+5	5+10	5+3	3+5	1+1
SG1 (Single: Clear Glazing)	0.846	0.843	0.843	0.843	0.843	0.844	0.843	0.846	0.843	0.849	0.843	0.834
IGU43 (Double: Clr+Low-e)	0.402	0.399	0.399	0.399	0.399	0.400	0.399	0.403	0.399	0.407	0.369	0.378
IGU43a (Double: Clr+Low-e)	0.289	0.288	0.287	0.288	0.287	0.289	0.287	0.293	0.287	0.300	0.289	0.302
IGU43b (Double: Clr+Low-e)	0.256	0.254	0.254	0.255	0.253	0.256	0.254	0.263	0.254	0.273	0.259	0.255
IGU43c (Double: Clr+Low-e)	0.299	0.298	0.298	0.299	0.298	0.300	0.298	0.305	0.297	0.312	0.298	0.286
IGU43d (Double: Clr+Low-e)	0.389	0.386	0.386	0.386	0.386	0.386	0.386	0.388	0.385	0.392	0.385	0.395
IGU43e (Double: Clr+evergreen Low-e)	0.179	0.178	0.178	0.178	0.178	0.179	0.178	0.181	0.176	0.181	0.173	0.114
IGU 58 (Double: evergreen Low-e + Low-e)	0.184	0.184	0.184	0.184	0.184	0.185	0.184	0.186	0.181	0.186	0.177	0.104

SG1: **Single glazing** with A0 Venetian blind (0º angle) on indoor side
IGU43: **Double glazing (clear + low-e) with C45 blind on indoor side**. Low-e is ID4000 (Pilkington Optitherm SN)
IGU43a: Same as IGU43 except for low-e glass, which is ID932 (AFG Comfort TiAC Low-e on clr)
IGU43b: Same as IGU43 except for low-e glass, which is ID966 (AFG Comfort TiAC36 Low-e on clr)
IGU43c: Same as IGU43 except for low-e glass, which is ID3112 (Guardian Performance Plus II on clr)
IGU43d: Same as IGU43 except for low-e glass, which is ID5144 (PPG Sungate 100 on clr)
IGU43e: Same as IGU43 except for low-e glass, which is ID779 (AFG Sunbelt Low-e on evergreen)
IGU58: **Double glazing (low-e + low-e) with C45 blind on indoor side**. AFG Sunbelt Low-e on evergreen (ID779); AFG Comfort TiAC low-e (ID966).
Deep Red color indicates differences beyond 0.015 (beyond 0.2 when presented with two decimal points)
Light Red color indicates differences between 0.005 and 0.015 (on the order of 0.01)

Table 3-12 : Comparison of SHGC results obtained by using full and condensed spectral data – Quarter angular basis

	SHGC	SHGC – QUARTER ANGULAR BASIS										
	Full Spectral Data /	Condensed Wavelength bands (VIS+NIR)										
Glazing	Full Basis	51+25	25+51	30+15	15+30	20+10	10+20	10+5	5+10	5+3	3+5	1+1
SG1 (Single: Clear Glazing)	0.846	0.843	0.843	0.843	0.843	0.844	0.843	0.846	0.843	0.849	0.844	0.834
IGU43 (Double: Clr+Low-e)	0.402	0.397	0.396	0.397	0.396	0.397	0.396	0.400	0.396	0.405	0.366	0.376
IGU43a (Double: Clr+Low-e)	0.289	0.286	0.286	0.286	0.286	0.287	0.286	0.291	0.285	0.298	0.287	0.301
IGU43b (Double: Clr+Low-e)	0.256	0.252	0.252	0.253	0.252	0.254	0.252	0.261	0.253	0.271	0.257	0.253
IGU43c (Double: Clr+Low-e)	0.299	0.296	0.296	0.297	0.296	0.298	0.296	0.303	0.295	0.310	0.296	0.285
IGU43d (Double: Clr+Low-e)	0.389	0.383	0.383	0.384	0.383	0.384	0.383	0.386	0.382	0.389	0.382	0.393
IGU43e (Double: Clr+evergreen Low-e)	0.179	0.177	0.177	0.177	0.177	0.178	0.177	0.180	0.175	0.180	0.172	0.114
IGU 58 (Double: evergreen Low-e + Low-e)	0.184	0.184	0.183	0.184	0.183	0.184	0.183	0.186	0.181	0.185	0.177	0.103

SG1: **Single glazing** with A0 Venetian blind (0º angle) on indoor side
IGU43: **Double glazing (clear + low-e) with C45 blind on indoor side**. Low-e is ID4000 (Pilkington Optitherm SN)
IGU43a: Same as IGU43 except for low-e glass, which is ID932 (AFG Comfort TiAC Low-e on clr)
IGU43b: Same as IGU43 except for low-e glass, which is ID966 (AFG Comfort TiAC36 Low-e on clr)
IGU43c: Same as IGU43 except for low-e glass, which is ID3112 (Guardian Performance Plus II on clr)
IGU43d: Same as IGU43 except for low-e glass, which is ID5144 (PPG Sungate 100 on clr)
IGU43e: Same as IGU43 except for low-e glass, which is ID779 (AFG Sunbelt Low-e on evergreen)
IGU58: **Double glazing (low-e + low-e) with C45 blind on indoor side**. AFG Sunbelt Low-e on evergreen (ID779); AFG Comfort TiAC low-e (ID966).
Deep Red color indicates differences beyond 0.015 (beyond 0.2 when presented with two decimal points)
Light Red color indicates differences between 0.005 and 0.015 (on the order of 0.01)

Table 3-13 presents details of purely specular single- and double glazing test configurations. Glazing systems 1-3 are single glazing configurations. Glazing system 1 has coating on surface 1, while glazing system 2 has coating on surface 2. Glazing systems 4-6 are double glazing configurations. Glazing system 4 has coating on surface 2, while glazing system 5 has coating on surface 3

Table 3-13: Purely specular test configurations.

Num.	Config ID	Glazing type	Glazing system configuration						
			Layer1	Layer1 thickness	Gap1	Gap1 width	Layer2	Layer2 thickness	Total thickness
1	**Pilkington_LowE**	**Single**		4					4.00
2	**Pilkington_LowE2**			4					4.00
3	**Pilkington_Clr**			4					4.00
4	**Pilkington_dLowE**	**Double**		4		12.7		4	20.70
5	**Pilkington_dLowE2**			4		12.7		4	20.70
6	**Pilkington_dClr**			4		12.7		4	20.70

Legend:			
		-	Clear glass
		-	Low-E glass
		-	Air
		-	10% Argon

Table 3-14 and Table 3-15 show results of test runs conducted for several purely specular glazing systems

Table 3-14: Comparison of results (U factor) of WINDOW 6 and WIS test runs for purely specular glazing systems.

Num.	Config ID	Results				
		U value				
		W6.0.30 (WIS BC)	WIS	ΔU [%]	W6.0.30 (NFRC BC)	ΔU [%]
1	**Pilkington_LowE**	4.9132	4.9099	-0.1%	5.7294	-14.3%
2	**Pilkington_LowE2**	2.7444	2.7437	0.0%	3.2915	-16.6%
3	**Pilkington_Clr**	5.2504	5.2338	-0.3%	5.8829	-11.0%
4	**Pilkington_dLowE**	1.2766	1.2420	-2.7%	1.4287	-13.1%
5	**Pilkington_dLowE2**	1.2761	1.2420	-2.7%	1.4279	-13.0%
6	**Pilkington_dClr**	2.7040	2.6900	-0.5%	2.7168	-1.0%

Table 3-15: Comparison of results (SHGC) of WINDOW 6 and WIS test runs for purely specular glazing systems.

Num.	Config ID	Results				
		SHGC				
		W6.0.30 (WIS BC)	WIS	ΔSHGC [%]	W6.0.30 (NFRC BC)	ΔSHGC [%]
1	Pilkington_LowE	0.6279	0.6638	5.7%	0.6316	0.6%
2	Pilkington_LowE2	0.6142	0.6468	5.3%	0.6144	0.0%
3	Pilkington_Clr	0.8499	0.8511	0.1%	0.8515	0.2%
4	Pilkington_dLowE	0.5525	0.5812	5.2%	0.5522	-0.1%
5	Pilkington_dLowE2	0.5964	0.6306	5.7%	0.5973	0.1%
6	Pilkington_dClr	0.7488	0.7520	0.4%	0.7505	0.2%

4. REFERENCES

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