

Instructions for Calculating Solar and Optical Properties of Select Glazing Systems Using Alternate Spectra in WINDOW 5.2

Prepared for NFRC by:

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Overview—Researchers, window and glazing manufacturers may want to determine whether the solar and optical properties of any glazing system are significantly affected by the use of any of the alternate spectra presented in the NFRC SWF Research Project. These instructions provide guidance on how to create a separate WINDOW 5.2 Glazing System Library that will reference alternate environmental conditions, namely Spectral Data and Standard files (*.ssp & *.std) within WINDOW. The differences in the solar and optical properties using different spectra can then be easily determined by comparing the results from repetitive calculations on the same Glazing System Library. Comprehensive step-by-step instructions are provided in this document.

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1. Create Glazing System Library

Although it is not essential, it is recommended that a separate WINDOW database be created that contains only those glazing systems in the Glazing System Library to be considered for comparison. This can be performed in two different ways. One is to save the entire database as another name (click on **File|Save As** in the menu bar). This will copy all the records from the original database into the new database. Another option is to make a separate “Project” database, by exporting records from one database into another. To make a Project database from a master database from the Glazing System Library, create the desired glazing systems, and then use the “Ctrl” and “Shift” keys to highlight those glazing systems in the **[List]** view of the WINDOW Glazing Library. As shown in Fig. 1, use the **[Export]** button to copy those selected glazing systems into a new WINDOW database file (*.mdb) with a different name and/or location.

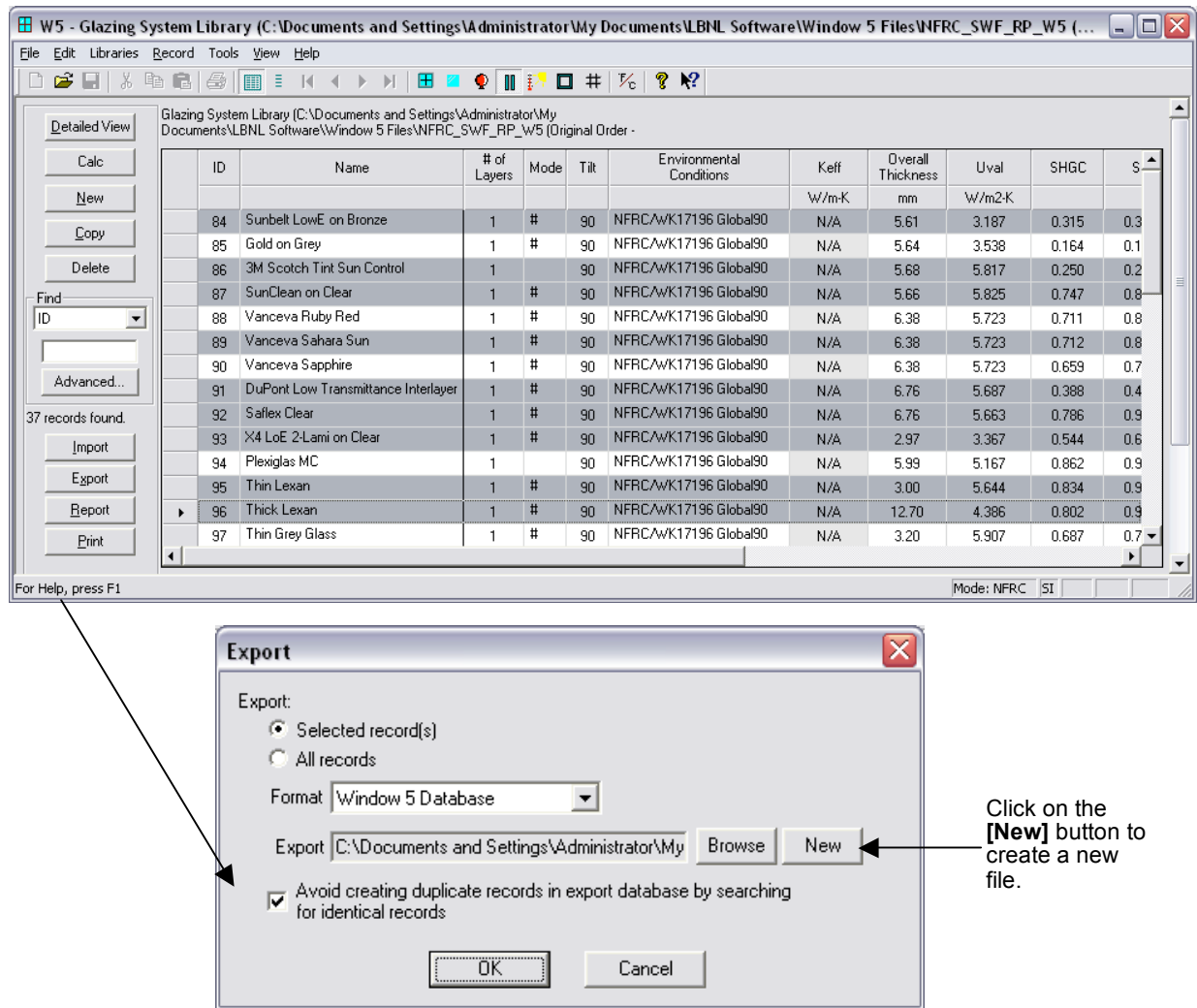


Figure 1 - Select Glazing Systems for Export to New WINDOW Database

2. Copy Spectral Data and Standard Files into the WINDOW Standards Folder

Copy the following pairs of files¹ from the attached folder to the WINDOW Standards folder²:

ASTM G 173-03, Air Mass of 1.5, Direct Normal Irradiance

"ASTM G173 AM1_5 Direct Normal.ssp"
"W5_NFRC_2003 G173 AM1_5 Direct Normal.std"

ASTM G 173-03, Air Mass of 1.5, Global Irradiance on a Surface at a 37° Tilt

"ASTM G173 AM1_5 37 Tilt Global.ssp"
"W5_NFRC_2003 G173 AM1_5 37 Tilt Global.std"

ASTM WK17196, Air Mass of 1.5, Direct Irradiance on a Surface at a 20° Tilt

"ASTM WK17196 AM1_5 20 Tilt Direct.ssp"
"W5_NFRC_2003 WK17196 AM1_5 20 Tilt Direct.std"

ASTM WK17196, Air Mass of 1.5, Global Irradiance on a Surface at a 20° Tilt

"ASTM WK17196 AM1_5 20 Tilt Global.ssp"
"W5_NFRC_2003 WK17196 AM1_5 20 Tilt Global.std"

ASTM WK17196, Air Mass of 1.5, Direct Irradiance on a Surface at a 90° Tilt (Vertical)

"ASTM WK17196 AM1_5 90 Tilt Direct.ssp"
"W5_NFRC_2003 WK17196 AM1_5 90 Tilt Direct.std"

ASTM WK17196, Air Mass of 1.5, Global Irradiance on a Surface at a 90° Tilt (Vertical)

"ASTM WK17196 AM1_5 90 Tilt Global.ssp"
"W5_NFRC_2003 WK17196 AM1_5 90 Tilt Global.std"

As shown in Fig. 2, the default location for the WINDOWS 5.2 Standards folder is:

C:\Program Files\LBNL\LBNL Shared\Standards

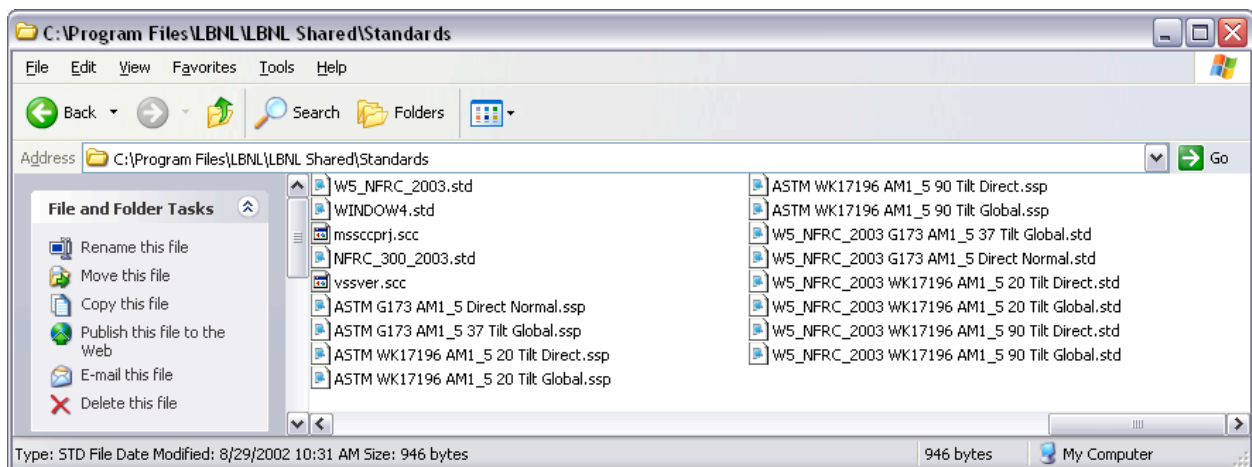


Figure 2 - Copy Spectral Data and Standard Files to WINDOW Standards Folder

¹ Although it is recommended that all the files be copied into the WINDOW 5.2 Standards folder, one can limit their selection to specific spectra from the list. Make sure that the Spectral Data files (*.ssp), and the associated Standard files (*.std) are copied in pairs, as the Standards file calls upon a specific Spectral Data file.

² Copy all these files directly into the Standards folder *without* making a subfolder.

3. Open the Glazing System Glazing Library in the Newly Created WINDOW Database

Open WINDOW, and then use the [Glazing System Library] toolbar button (or the **Libraries**[Glazing System] menu choice) to open the new Glazing System Library that was previously created in Step 1 (Fig. 3).

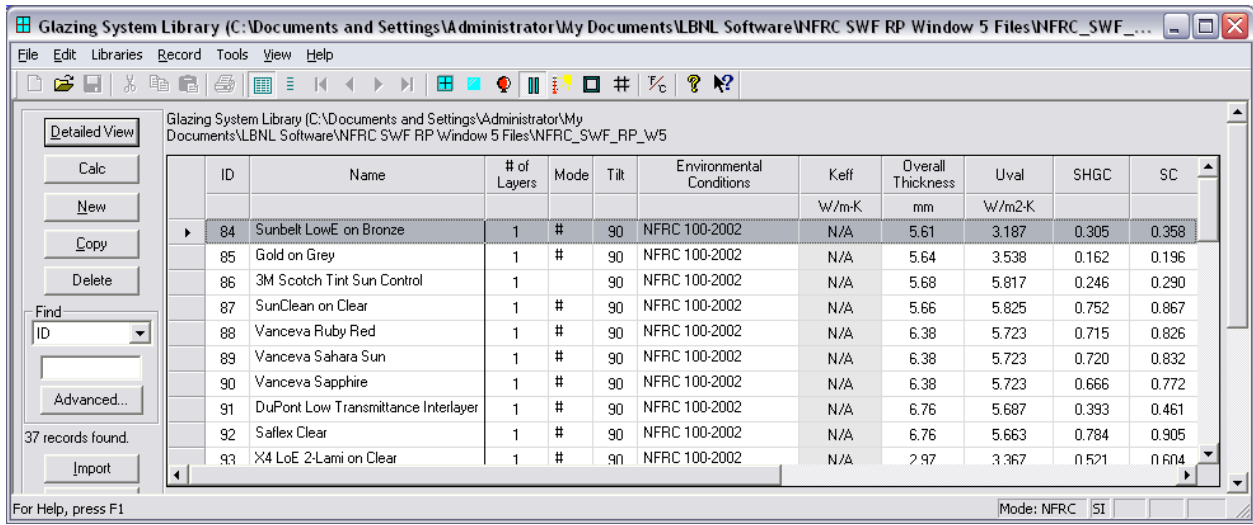


Figure 3 - Open New Glazing System Library for Analysis

4. Change the WINDOW Standards File Reference

Open the *Preferences* box in WINDOW (on the Menu Bar, click on **File**[Preferences]), and then click on the “Optical Data” Tab. Click on the [Browse] button under the “Standards File” section near the bottom (Fig. 4). Select the Standards file (*.std) representing the spectrum in question. Click on the [Open] button to select the file, and then click on the [OK] button to close the *Preferences* box. The WINDOW Spectral Data file (*.ssp) is referenced by the WINDOW Standards file, and so the Spectral Data file reference is not directly specified within WINDOW.

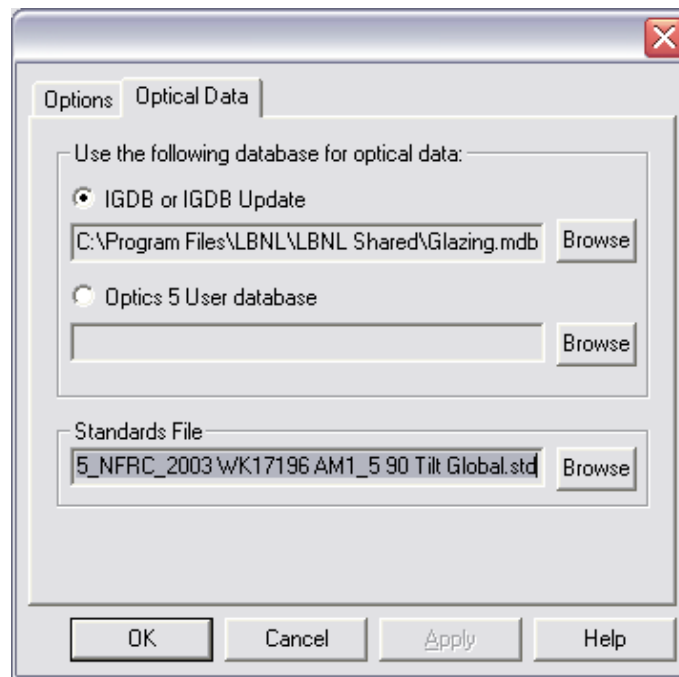


Figure 4 - Specify Location of the New Standards File in Preferences

5. Change the WINDOW Environmental Conditions

Click on the [Environmental Conditions Library] button to open that library (on the Menu Bar, click on **Libraries**[Environmental Conditions]). From within the [List] view of the Environmental Conditions Library, highlight the first ID record, titled “NFRC 100-2002,” and use the [Copy] button to make a copy of that environmental condition³ (Fig. 5). Select this new environmental condition, and click on the [Detailed View] button to edit this condition.

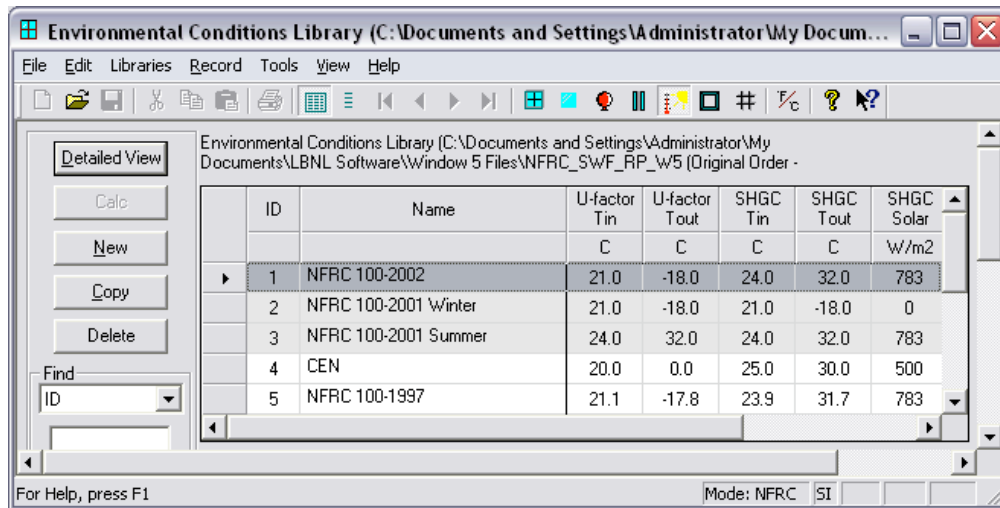


Figure 5 - Copy NFRC 100-2002 Environmental Conditions to Edit

By editing a copy of the NFRC 100-2002 Environmental Conditions, all of the specific environmental parameters (i.e., temperatures, emissivity, wind speed and direction, solar irradiance, and surface conductance coefficient models) for U-factor and SHGC will be initially defined. Only two fields need to be modified. First, change the environmental condition *Name* to reflect the use of the new spectrum, (i.e., “NFRC/ASTM G173 Global37”). Second, click on the “SHGC Outside” Tab, and change the *Direct Solar Radiation* value⁴ based on the last column of Table 1 (Fig. 6).

Table 1 – *Direct Solar Radiation* Values for WINDOW 5.2 Standards Files

Spectrum	Standards File	Direct Solar Radiation, W/m ²
ASTM E 891 (NFRC 300)	W5_NFRC_2003.std	783.0
ASTM G 173, Direct Normal	W5_NFRC_2003 G173 AM1_5 Direct Normal.std	900.1
ASTM G 173, Global, 37° Tilt	W5_NFRC_2003 G173 AM1_5 37 Tilt Global.std	1000.4
ASTM WK17196, Direct, 20° Tilt	W5_NFRC_2003 WK17196 AM1_5 20 Tilt Direct.std	791.1
ASTM WK17196, Global, 20° Tilt	W5_NFRC_2003 WK17196 AM1_5 20 Tilt Global.std	889.0
ASTM WK17196, Direct, 90° Tilt	W5_NFRC_2003 WK17196 AM1_5 90 Tilt Direct.std	669.7
ASTM WK17196, Global, 90° Tilt	W5_NFRC_2003 WK17196 AM1_5 90 Tilt Global.std	810.3

³ If the NFRC 100-2002 Condition is not available, use the [Import] button to copy it from the original “w5.mdb” file initially supplied with WINDOW 5.2.

⁴ The term “Direct Solar Radiation” is not exactly correct since some new spectra refer to global radiation, but is used in these instructions to be consistent with the current version of WINDOW.

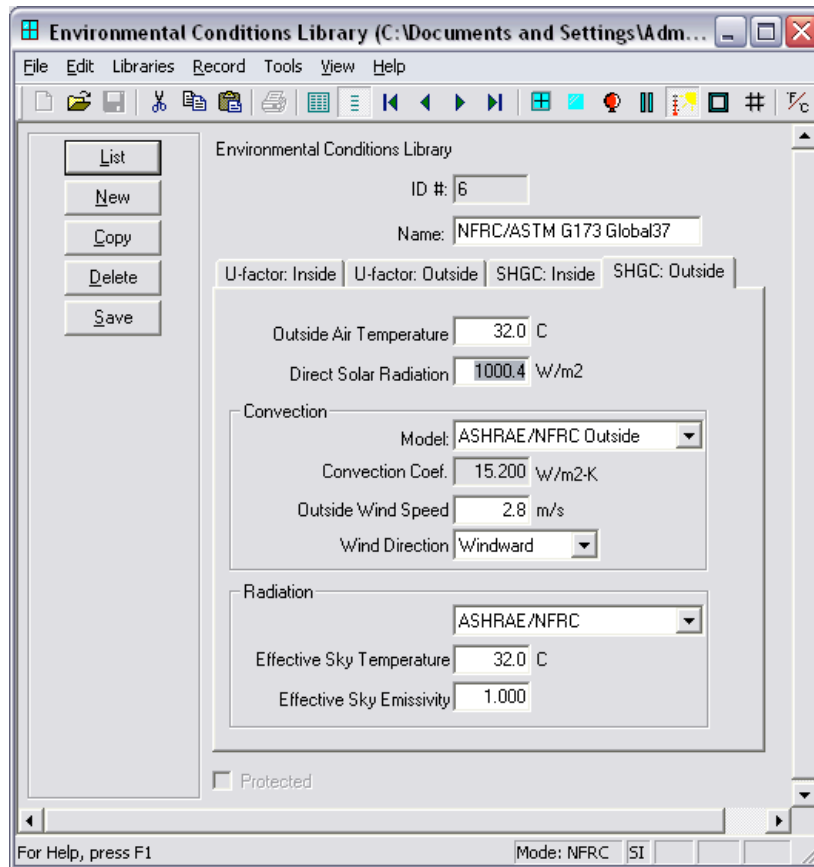


Figure 6 – Rename and Edit Copy of Existing NFRC 100-2002 Environmental Conditions

Click on the [Save] button to save the changes to this new Environmental Conditions file.

Once new Environmental Conditions have been created, the referenced Environmental Conditions must be individually changed for each glazing system by selecting the appropriate *Environmental Conditions* designation in the [Detailed View] of the Glazing System Library (Fig. 7). All of the *Environmental Conditions* entries in the Glazing System Library can be easily changed by scrolling through each glazing system using the [Next Record] button. This also a convenient time to change the tilt angle as described in the next step if necessary. To speed up the process of changing multiple records, press the [Calc] and [Save] button after each record is changed.

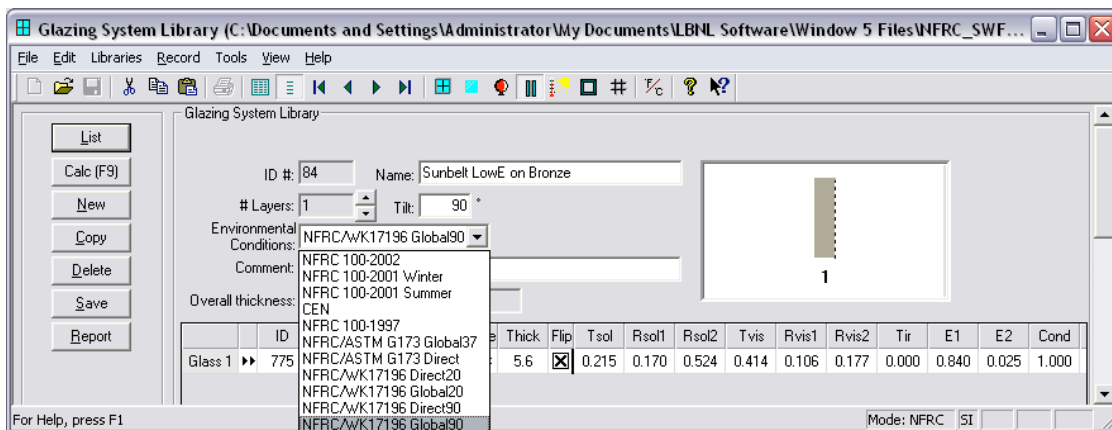


Figure 7 - Select New Environmental Conditions for Each Individual Glazing System

6. Change the Tilt of the Glazing System (20° Tilted Spectra Only)

The outdoor and indoor surface heat transfer coefficients and the effective conductivity of glazing cavities vary with the tilt of the glazing system. Their effect on SHGC may appear small in many cases, but they can be of the same magnitude as those that result from a change in spectral distribution. Proper calculation of the SHGC therefore requires that the tilt of each glazing system be changed from 90° to 20° when using spectra for surfaces tilted at 20°. This modification must be performed individually for each glazing system by changing the *Tilt* value to 20 in the **[Detailed View]** (Fig. 8). All of the *Tilt* values in the Glazing Library can be easily changed by scrolling through each glazing system using the **[Next Record]** button. Remember to press the **[Calc]** and **[Save]** button after each record is changed.

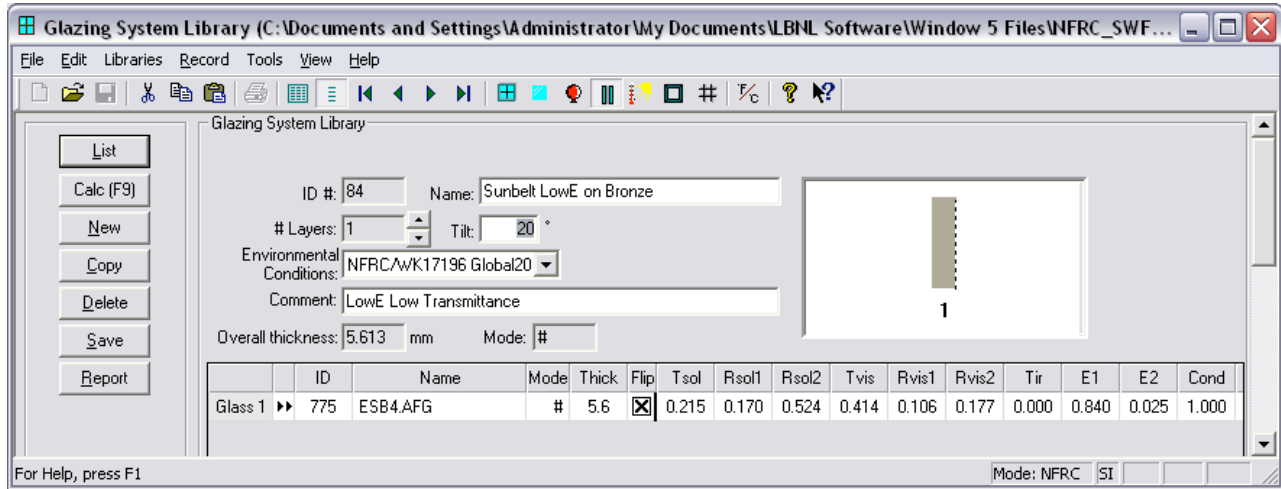


Figure 8 - Change the Tilt Angle for Each Glazing System

7. Calculate

If you have not recalculated the results for all of the glazing systems while modifying the Environmental Conditions or tilt, then results may need to be calculated. From the Glazing Library **[List]** view, click on the **[Calc]** button, and check the *All records* option before clicking on the **[OK]** button to calculate new solar and optical properties of all the glazing systems in the library. This will calculate new results for all the glazing systems using the new Spectral Data file referenced by the Standards file specified in the *Preferences* box⁵. Changing the Standards file is a program setting, so all records are affected by those settings⁶.

Use the **[Report]** button to create a text file of the results (Fig. 9). After deselecting *Use default column widths*, and *Wrap column* boxes in the “Text file options” section, press **[OK]** in the *Report* box to generate the report for *All records*. This report can then be saved as a comma delimited file (*.csv) using a name identifying the spectrum by pressing the **[Save]** button in the *Report* window. The comma delimited file needs to be specified in the *Save as type* field in the *Save As* box before pressing the **[Save]** button.

⁵ The variations in the ultra-violet (UV) results calculated by WINDOW in the “Optical Data” tab are not reported in this research project. By specifying the Standards files provided with these instructions, the spectra used to calculate the Krochman Damage Weighted Average (Tdw-K), the UV Damage Weighted Transmittance based on CIE 89/3 (Tdw-ISO), and the Unweighted UV Average (Tuv) are all calculated using the new spectra instead of ASTM E 891.

⁶ For this reason, it is important that the new Standards file be replaced with the original “W5_NFRC_2003.std” file once this analysis is complete as this initial Standards file will not be restored when opening your original database.

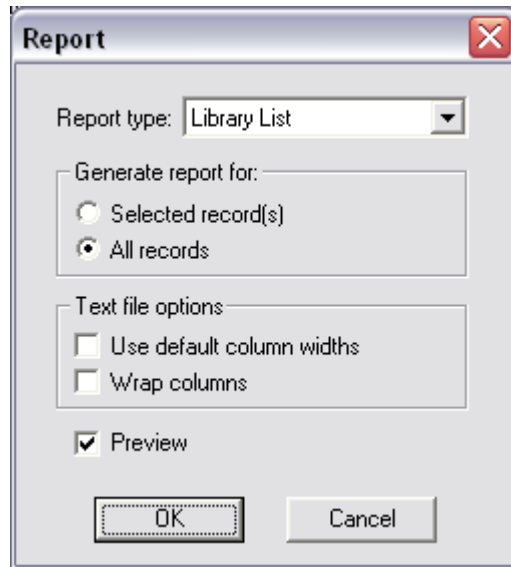


Figure 9 - Create Text File Using WINDOW 5.2 [Report] Button

8. Compare

Repeat Steps 4 through 7 for each spectrum under consideration. The results from calculations of all the spectra can be easily compared by opening each of the comma-delimited files (*.csv) in a spreadsheet (Fig. 10), and copying the appropriate data from each file into the same worksheet.

ID	Name	# of Layers	Mode	Tilt	Environmental Conditions	Kefff W/m ² -K	Overall Thickness mm	Uval W/m ² -K	SHGC	SC	Tvis	RHG	Tdw-ISO W/m ²
84	Sunbelt LowE on Bronze	1	#	90	NFRC 100-2002	N/A	5.61	3.187	0.305	0.358	0.414	243.3	0.279
85	Gold on Grey	1	#	90	NFRC 100-2002	N/A	5.64	3.538	0.162	0.196	0.049	144.3	0.051
86	3M Scotch Tint Sun Control	1	#	90	NFRC 100-2002	N/A	5.68	5.817	0.246	0.29	0.165	223.6	0.141
87	SunClean on Clear	1	#	90	NFRC 100-2002	N/A	5.66	5.825	0.752	0.867	0.783	587.9	0.637
88	Vanceva Ruby Red	1	#	90	NFRC 100-2002	N/A	6.38	5.723	0.715	0.826	0.482	561.5	0.381
89	Vanceva Sahara Sun	1	#	90	NFRC 100-2002	N/A	6.38	5.723	0.72	0.832	0.777	565	0.236
90	Vanceva Sapphire	1	#	90	NFRC 100-2002	N/A	6.38	5.723	0.666	0.772	0.516	527.1	0.498
91	DuPont Low Transmittance Interlayer	1	#	90	NFRC 100-2002	N/A	6.76	5.687	0.393	0.461	0.09	330.8	0.043
92	Saflex Clear	1	#	90	NFRC 100-2002	N/A	6.76	5.663	0.784	0.905	0.883	610.8	0.619
93	X4 LoE 2-Lami on Clear	1	#	90	NFRC 100-2002	N/A	2.97	3.367	0.521	0.604	0.789	399.6	0.608
94	Plexiglas MC	1	#	90	NFRC 100-2002	N/A	5.99	5.167	0.858	0.988	0.921	660.2	0.712

Figure 10 - Open Exported Text File in Spreadsheet