TYPE 56 WINDOW LIBRARY

General Description

Historically, five very generic windows have been included with the multizone building model (Type56) in the TRNSYS package. Users can create new windows for use with Type 56 by running a freely downloadable software product called "Window," written by Lawrence Berkeley National Labs [1]. This document describes an expanded library of windows that were created using version 5.2 of the LBNL Window software package. The windows come from four sources; ASHRAE Standard 90.1.99 Table A17 [2], ASHRAE Standard 90.1-99 code minimum windows for various wall coverages and for a particular climate zone (defined in terms of heating and cooling degree days) [2]. a window that matches the window defined in ASHRAE Standard 140 [3] and in the BESTEST Standard [4], and a set of windows that are used in the Building America program [5].

Detailed Description

Windows available to Type56 are described in a pair of data files: W4lib.dat, and prgwin.dat. Because of syntax requirements, those files can be somewhat cryptic. The purpose of this document is to expand upon the data files, reproduce the source data, and provide additional information about the windows. It closes with a tutorial on running Window 5 and on adding new windows to TRNSYS for use with Type56.

ASHRAE Standard 90.1-99 Table B-17 Windows

ASHRAE Standard 90.1-99 Table B-17 provides the code minimum U-value and Solar Heat Gain Coefficient (SHGC) for fenestration that covers various percentages of a wall. The table is broken up into various climate zones that are defined by heating and cooling degree days. An excerpt of Table B-17 has been reproduced below for reference.

Table 1: Building Envelope Requirements Table B-17 (excerpt) for 3001 – 4000 Heating Degree Days and 1001 – 200 Cooling Degree Days

Vertical Glazing % of Wall	U-value for fixed window	SHGC	TRNSYS ID
0-10.0 %	3.29	0.49	7001
10.1 - 40.0 %	3.29	0.39	7002
40.1 - 50.0 %	2.66	0.26	7003

Table B-17 provides U values and SHGC values for operable windows as well. It further provides U values and SHGC values for various percent wall coverage and for different climate zones. Only the three windows shown in Table 1 above were recreated for use with TRNSYS. The process of creating the above windows was somewhat complex; no information is given about the nature of the window construction (frame, glazing, air space, etc.) so it was necessary to create new glazing systems to match the specified U-Values and SHGC values of the windows in the table instead of relying on materials, frames and glazing systems that already existed in the Window 5.2 data base. The three code minimum windows are given TRNSYS ID numbers 7001, 7002, and 7003.

ASHRAE Standard 90.1-99 Table A-17 Windows

ASHRAE Standard 90.1-99 presents a series of unlabeled glazed wall systems (site built windows) in Table A-17. While site built windows may not be the most common type of window needed in simulations, the table provides a very comprehensive set of windows, all of which were recreated for use with TRNSYS. An excerpt of Table A-17 is reproduced below for reference.

Table 2: Assembly U-Factors for Unlabeled Glazed Wall Systems (excerpt)

Product Type		Vertical Installation U Values [W/m^2.K]			
		Unlabeled Glazed Wall Systems (Site Built Windows) (includes site assembled fixed windows only, does NOT include operable windows)			
Frame Type		Aluminum without Thermal Break	Aluminum with Thermal Break	Wood / Vinyl	Structural Glazing
ID	Glazing Type				
	Single Glazing				
1	3 mm glass	6.93	6.30	5.55	6.30
2	6.4 mm acrylic/polycarbonate	6.11	5.48	4.75	5.48
3	3 mm acrylic/polycarbonate	6.52	5.89	5.15	5.89
	Double Glazing				
4	6.4 mm airspace	4.47	3.84	3.17	3.59
5	12.7 mm airspace	4.14	3.51	2.84	3.26
6	6.4 mm argon space	4.28	3.65	2.98	3.40
7	12.7 mm argon space	3.99	3.36	2.70	3.11
	Double Glazing (e=0.6 on surface 2 or 3)				
8	6.4 mm airspace	4.33	3.70	3.03	3.45
9	12.7 mm airspace	3.94	3.31	2.66	3.06
10	6.4 mm argon space	4.09	3.46	2.80	3.21
11	12.7 mm argon space	3.80	3.17	2.52	2.92
	Double Glazing (e=0.4 on surface 2 or 3)				
12	6.4 mm airspace	4.18	3.55	2.89	3.30
13	12.7 mm airspace	3.75	3.12	2.47	2.87
14	6.4 mm argon space	3.89	3.26	2.61	3.01
15	12.7 mm argon space	3.55	2.92	2.29	2.67
	Double Glazing (e=0.2 on surface 2 or 3)				
16	6.4 mm airspace	3.99	3.36	2.70	3.11
17	12.7 mm airspace	3.50	2.87	2.24	2.63
18	6.4 mm argon space	3.65	3.02	2.38	2.77
19	12.7 mm argon space	3.26	2.63	2.01	2.38
	Double Glazing (e=0.1 on surface 2 or 3)				
20	6.4 mm airspace	3.84	3.22	2.56	2.97
21	12.7 mm airspace	3.36	2.73	2.10	2.48
22	6.4 mm argon space	3.50	2.87	2.24	2.63
23	12.7 mm argon space	3.11	2.48	1.86	2.23
	Double Glazing (e=0.05 on surface 2 or 3)				

24	6.4 mm airspace	3.80	3.17	2.52	2.92
25	12.7 mm airspace	3.26	2.63	2.01	2.38
26	6.4 mm argon space	3.41	2.78	2.15	2.53
27	12.7 mm argon space	3.01	2.39	1.77	2.14
	Triple Glazing				
28	6.4 mm airspaces	3.58	2.97	2.33	2.65
29	12.7 mm airspaces	3.24	2.63	2.01	2.31
30	6.4 mm argon spaces	3.39	2.77	2.15	2.46
31	12.7 mm argon spaces	3.14	2.53	1.91	2.21
	Triple Glazing (e=0.2 on surfaces 2, 3, 4, or 5)				
32	6.4 mm airspaces	3.34	2.73	2.10	2.41
33	12.7 mm airspaces	2.95	2.33	1.73	2.02
34	6.4 mm argon spaces	3.09	2.48	1.87	2.16
35	12.7 mm argon spaces	2.80	2.19	1.59	1.87
	Triple Glazing (e=0.2 on surfaces 2 or 3 and 4 or 5)				
36	6.4 mm airspaces	3.14	2.53	1.91	2.21
37	12.7 mm airspaces	2.70	2.09	1.49	1.77
38	6.4 mm argon spaces	2.85	2.24	1.63	1.92
39	12.7 mm argon spaces	2.55	1.94	1.35	1.62
	Triple Glazing (e=0.1 on surfaces 2 or 3 and 4 or 5)				
40	6.4 mm airspaces	3.05	2.43	1.82	2.11
41	12.7 mm airspaces	2.60	1.99	1.40	1.67
42	6.4 mm argon spaces	2.75	2.14	1.54	1.82
43	12.7 mm argon spaces	2.40	1.79	1.21	1.47
	Quadruple Glazing (e=0.1 on surfaces 2 or 3 and 4 or 5)				
44	6.4 mm airspaces	2.80	2.19	1.59	1.87
45	12.7 mm airspaces	2.45	1.84	1.26	1.52
46	6.4 mm argon spaces	2.55	1.94	1.35	1.62
47	12.7 mm argon spaces	2.31	1.69	1.11	1.38
48	6.4 mm krypton spaces	2.31	1.69	1.11	1.38

With information provided in Table A-17 concerning the window construction, the above windows were recreated in Window 5.2. A few important notes should be made concerning the windows in the table. In defining windows with low emittance coatings, the table refers to the coatings being present on certain surfaces or combinations of surfaces. Figure 1 below provides a diagram of a double and triple pane window with the surfaces labeled. In the library, low emittance coatings were always placed on surface 2 or surfaces 2 and 4.

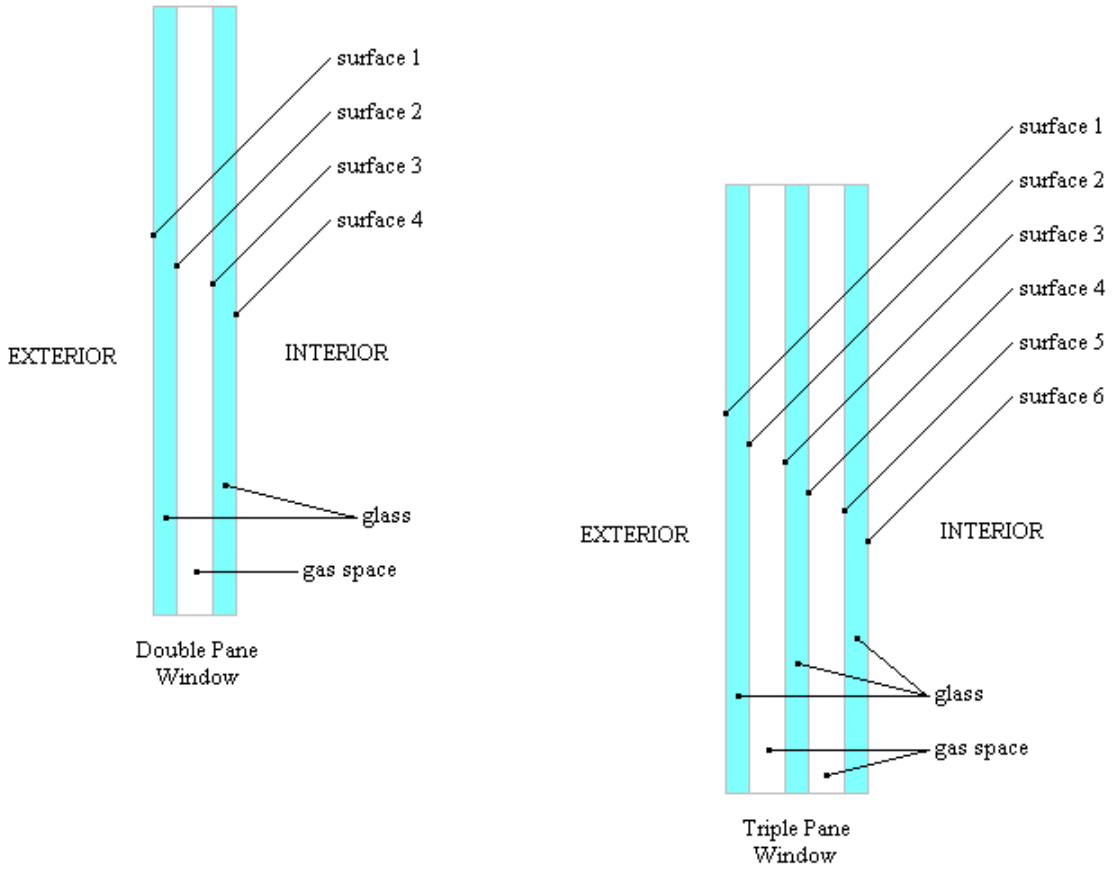


Figure 1: Double and Triple Pane Window Surfaces

The windows as recreated using Window 5.2 are detailed in below. The TRNSYS Windows ID numbers are also provided.

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TRNSYS ID	Glazing Type	Coating	Air Spaces	Frame	Window 5.2 U value [W/m2.K]	Window 5.2 SHGC [-]
7011	single	none	3 mm glass	aluminum frame without thermal break	6.93	0.795
7012	single	none	3 mm glass	aluminum frame with thermal break	6.30	0.758
7013	single	none	3 mm glass	wood frame	5.55	0.708
7021	single	none	6.4 mm acrylic/polycarbonate	aluminum frame without thermal break	6.11	0.758
7022	single	none	6.4 mm acrylic/polycarbonate	aluminum frame with thermal break	5.48	0.721
7023	single	none	6.4 mm acrylic/polycarbonate	wood frame	4.75	0.672
7041	double	none	6.4 mm airspace	aluminum frame without thermal break	4.47	0.661
7042	double	none	6.4 mm airspace	aluminum frame with thermal break	3.84	0.624
7043	double	none	6.4 mm airspace	wood frame	3.17	0.579
7051	double	none	12.7 mm airspace	aluminum frame without thermal break	4.14	0.662
7052	double	none	12.7 mm airspace	aluminum frame with thermal break	3.51	0.626
7053	double	none	12.7 mm airspace	wood frame	2.84	0.581
7061	double	none	6.4 mm argon space	aluminum frame without thermal break	4.28	0.662
7062	double	none	6.4 mm argon space	aluminum frame with thermal break	3.65	0.625
7063	double	none	6.4 mm argon space	wood frame	2.98	0.58
7071	double	none	12.7 mm argon space	aluminum frame without thermal break	3.99	0.663
7072	double	none	12.7 mm argon space	aluminum frame with thermal break	3.36	0.672
7073	double	none	12.7 mm argon space	wood frame	2.70	0.582
7081	double	e = 0.6 on surface 2	6.4 mm airspace	aluminum frame without thermal break	4.33	0.658
7082	double	e = 0.6 on surface 2	6.4 mm airspace	aluminum frame with thermal break	3.70	0.622
7083	double	e = 0.6 on surface 2	6.4 mm airspace	wood frame	3.03	0.577
7091	double	e = 0.6 on surface 2	12.7 mm airspace	aluminum frame without thermal break	3.94	0.661
7092	double	e = 0.6 on surface 2	12.7 mm airspace	aluminum frame with thermal break	3.31	0.625
7093	double	e = 0.6 on surface 2	12.7 mm airspace	wood frame	2.66	0.58
7101	double	e = 0.6 on surface 2	6.4 mm argon space	aluminum frame without thermal break	4.09	0.66
7102	double	e = 0.6 on surface 2	6.4 mm argon space	aluminum frame with thermal break	3.46	0.624
7103	double	e = 0.6 on surface 2	6.4 mm argon space	wood frame	2.80	0.579
7111	double	e = 0.6 on surface 2	12.7 mm argon space	aluminum frame without thermal break	3.80	0.662
7112	double	e = 0.6 on surface 2	12.7 mm argon space	aluminum frame with thermal break	3.17	0.626
7113	double	e = 0.6 on surface 2	12.7 mm argon space	wood frame	2.52	0.581
7121	double	e = 0.4 on surface 2	6.4 mm airspace	aluminum frame without thermal break	4.18	0.66
7122	double	e = 0.4 on surface 2	6.4 mm airspace	aluminum frame with thermal break	3.55	0.623
7123	double	e = 0.4 on surface 2	6.4 mm airspace	wood frame	2.89	0.578

7131	double	e = 0.4 on surface 2	12.7 mm airspace	aluminum frame without thermal break	3.75	0.663
7132	double	e = 0.4 on surface 2	12.7 mm airspace	aluminum frame with thermal break	3.12	0.626
7133	double	e = 0.4 on surface 2	12.7 mm airspace	wood frame	2.47	0.581
7141	double	e = 0.4 on surface 2	6.4 mm argon space	aluminum frame without thermal break	3.89	0.662
7142	double	e = 0.4 on surface 2	6.4 mm argon space	aluminum frame with thermal break	3.26	0.625
7143	double	e = 0.4 on surface 2	6.4 mm argon space	wood frame	2.61	0.58
7151	double	e = 0.4 on surface 2	12.7 mm argon space	aluminum frame without thermal break	3.55	0.664
7152	double	e = 0.4 on surface 2	12.7 mm argon space	aluminum frame with thermal break	2.92	0.628
7153	double	e = 0.4 on surface 2	12.7 mm argon space	wood frame	2.29	0.583
7161	double	e = 0.2 on surface 2	6.4 mm airspace	aluminum frame without thermal break	3.99	0.661
7162	double	e = 0.2 on surface 2	6.4 mm airspace	aluminum frame with thermal break	3.36	0.625
7163	double	e = 0.2 on surface 2	6.4 mm airspace	wood frame	2.70	0.58
7171	double	e = 0.2 on surface 2	12.7 mm airspace	aluminum frame without thermal break	3.50	0.665
7172	double	e = 0.2 on surface 2	12.7 mm airspace	aluminum frame with thermal break	2.87	0.629
7173	double	e = 0.2 on surface 2	12.7 mm airspace	wood frame	2.24	0.584
7181	double	e = 0.2 on surface 2	6.4 mm argon space	aluminum frame without thermal break	3.65	0.664
7182	double	e = 0.2 on surface 2	6.4 mm argon space	aluminum frame with thermal break	3.02	0.627
7183	double	e = 0.2 on surface 2	6.4 mm argon space	wood frame	2.38	0.582
7191	double	e = 0.2 on surface 2	12.7 mm argon space	aluminum frame without thermal break	3.26	0.667
7192	double	e = 0.2 on surface 2	12.7 mm argon space	aluminum frame with thermal break	2.63	0.631
7193	double	e = 0.2 on surface 2	12.7 mm argon space	wood frame	2.01	0.585
7201	double	e = 0.1 on surface 2	6.4 mm airspace	aluminum frame without thermal break	3.84	0.662
7202	double	e = 0.1 on surface 2	6.4 mm airspace	aluminum frame with thermal break	3.22	0.626
7203	double	e = 0.1 on surface 2	6.4 mm airspace	wood frame	2.56	0.581
7211	double	e = 0.1 on surface 2	12.7 mm airspace	aluminum frame without thermal break	3.36	0.667
7212	double	e = 0.1 on surface 2	12.7 mm airspace	aluminum frame with thermal break	2.73	0.631
7213	double	e = 0.1 on surface 2	12.7 mm airspace	wood frame	2.10	0.585
7221	double	e = 0.1 on surface 2	6.4 mm argon space	aluminum frame without thermal break	3.50	0.665
7222	double	e = 0.1 on surface 2	6.4 mm argon space	aluminum frame with thermal break	2.87	0.629
7223	double	e = 0.1 on surface 2	6.4 mm argon space	wood frame	2.24	0.584
7231	double	e = 0.1 on surface 2	12.7 mm argon space	aluminum frame without thermal break	3.11	0.669
7232	double	e = 0.1 on surface 2	12.7 mm argon space	aluminum frame with thermal break	2.48	0.633
7233	double	e = 0.1 on surface 2	12.7 mm argon space	wood frame	1.86	0.587
7241	double	e = 0.05 on surface 2	6.4 mm airspace	aluminum frame without thermal break	3.80	0.663
7242	double	e = 0.05 on surface 2	6.4 mm airspace	aluminum frame with thermal break	3.17	0.627
7243	double	e = 0.05 on surface 2	6.4 mm airspace	wood frame	2.52	0.582

7251	double	e = 0.05 on surface 2	12.7 mm airspace	aluminum frame without thermal break	3.26	0.668
7252	double	e = 0.05 on surface 2	12.7 mm airspace	aluminum frame with thermal break	2.63	0.631
7253	double	e = 0.05 on surface 2	12.7 mm airspace	wood frame	2.01	0.586
7261	double	e = 0.05 on surface 2	6.4 mm argon space	aluminum frame without thermal break	3.41	0.666
7262	double	e = 0.05 on surface 2	6.4 mm argon space	aluminum frame with thermal break	2.78	0.63
7263	double	e = 0.05 on surface 2	6.4 mm argon space	wood frame	2.15	0.584
7271	double	e = 0.05 on surface 2	12.7 mm argon space	aluminum frame without thermal break	3.01	0.67
7272	double	e = 0.05 on surface 2	12.7 mm argon space	aluminum frame with thermal break	2.39	0.634
7273	double	e = 0.05 on surface 2	12.7 mm argon space	wood frame	1.77	0.588
7281	triple	none	6.4 mm airspaces	aluminum frame without thermal break	3.58	0.587
7282	triple	none	6.4 mm airspaces	aluminum frame with thermal break	2.97	0.551
7283	triple	none	6.4 mm airspaces	wood frame	2.33	0.509
7291	triple	none	12.7 mm airspaces	aluminum frame without thermal break	3.24	0.589
7292	triple	none	12.7 mm airspaces	aluminum frame with thermal break	2.63	0.553
7293	triple	none	12.7 mm airspaces	wood frame	2.01	0.511
7301	triple	none	6.4 mm argon spaces	aluminum frame without thermal break	3.39	0.588
7302	triple	none	6.4 mm argon spaces	aluminum frame with thermal break	2.77	0.552
7303	triple	none	6.4 mm argon spaces	wood frame	2.15	0.51
7311	triple	none	12.7 mm argon spaces	aluminum frame without thermal break	3.14	0.59
7312	triple	none	12.7 mm argon spaces	aluminum frame with thermal break	2.53	0.553
7313	triple	none	12.7 mm argon spaces	wood frame	1.91	0.511
7321	triple	e = 0.2 on surface 2	6.4 mm airspaces	aluminum frame without thermal break	3.34	0.593
7322	triple	e = 0.2 on surface 2	6.4 mm airspaces	aluminum frame with thermal break	2.73	0.557
7323	triple	e = 0.2 on surface 2	6.4 mm airspaces	wood frame	2.10	0.515
7331	triple	e = 0.2 on surface 2	12.7 mm airspaces	aluminum frame without thermal break	2.95	0.601
7332	triple	e = 0.2 on surface 2	12.7 mm airspaces	aluminum frame with thermal break	2.33	0.565
7333	triple	e = 0.2 on surface 2	12.7 mm airspaces	wood frame	1.73	0.522
7341	triple	e = 0.2 on surface 2	6.4 mm argon spaces	aluminum frame without thermal break	3.09	0.598
7342	triple	e = 0.2 on surface 2	6.4 mm argon spaces	aluminum frame with thermal break	2.48	0.561
7343	triple	e = 0.2 on surface 2	6.4 mm argon spaces	wood frame	1.87	0.519
7351	triple	e = 0.2 on surface 2	12.7 mm argon spaces	aluminum frame without thermal break	2.80	0.605
7352	triple	e = 0.2 on surface 2	12.7 mm argon spaces	aluminum frame with thermal break	2.19	0.569
7353	triple	e = 0.2 on surface 2	12.7 mm argon spaces	wood frame	1.59	0.526
7361	triple	e = 0.2 on surfaces 2 and 4	6.4 mm airspaces	aluminum frame without thermal break	3.14	0.585
7362	triple	e = 0.2 on surfaces 2 and 4	6.4 mm airspaces	aluminum frame with thermal break	2.53	0.549
7363	triple	e = 0.2 on surfaces 2 and 4	6.4 mm airspaces	wood frame	1.91	0.507

7371	triple	e = 0.2 on surfaces 2 and 4	12.7 mm airspaces	aluminum frame without thermal break	2.70	0.589
7372	triple	e = 0.2 on surfaces 2 and 4	12.7 mm airspaces	aluminum frame with thermal break	2.09	0.553
7373	triple	e = 0.2 on surfaces 2 and 4	12.7 mm airspaces	wood frame	1.49	0.511
7381	triple	e = 0.2 on surfaces 2 and 4	6.4 mm argon spaces	aluminum frame without thermal break	2.85	0.588
7382	triple	e = 0.2 on surfaces 2 and 4	6.4 mm argon spaces	aluminum frame with thermal break	2.24	0.551
7383	triple	e = 0.2 on surfaces 2 and 4	6.4 mm argon spaces	wood frame	1.63	0.509
7391	triple	e = 0.2 on surfaces 2 and 4	12.7 mm argon spaces	aluminum frame without thermal break	2.55	0.59
7392	triple	e = 0.2 on surfaces 2 and 4	12.7 mm argon spaces	aluminum frame with thermal break	1.94	0.554
7393	triple	e = 0.2 on surfaces 2 and 4	12.7 mm argon spaces	wood frame	1.35	0.512
7401	triple	e = 0.1 on surfaces 2 and 4	6.4 mm airspaces	aluminum frame without thermal break	3.05	0.586
7402	triple	e = 0.1 on surfaces 2 and 4	6.4 mm airspaces	aluminum frame with thermal break	2.43	0.55
7403	triple	e = 0.1 on surfaces 2 and 4	6.4 mm airspaces	wood frame	1.82	0.508
7411	triple	e = 0.1 on surfaces 2 and 4	12.7 mm airspaces	aluminum frame without thermal break	2.60	0.59
7412	triple	e = 0.1 on surfaces 2 and 4	12.7 mm airspaces	aluminum frame with thermal break	1.99	0.554
7413	triple	e = 0.1 on surfaces 2 and 4	12.7 mm airspaces	wood frame	1.40	0.512
7421	triple	e = 0.1 on surfaces 2 and 4	6.4 mm argon spaces	aluminum frame without thermal break	2.75	0.589
7422	triple	e = 0.1 on surfaces 2 and 4	6.4 mm argon spaces	aluminum frame with thermal break	2.14	0.553
7423	triple	e = 0.1 on surfaces 2 and 4	6.4 mm argon spaces	wood frame	1.54	0.511
7431	triple	e = 0.1 on surfaces 2 and 4	12.7 mm argon spaces	aluminum frame without thermal break	2.40	0.592
7432	triple	e = 0.1 on surfaces 2 and 4	12.7 mm argon spaces	aluminum frame with thermal break	1.79	0.556
7433	triple	e = 0.1 on surfaces 2 and 4	12.7 mm argon spaces	wood frame	1.21	0.513
7441	quadruple	e = 0.1 on surfaces 2 and 4	6.4 mm airspaces	aluminum frame without thermal break	2.80	0.538
7442	quadruple	e = 0.1 on surfaces 2 and 4	6.4 mm airspaces	aluminum frame with thermal break	2.19	0.501
7443	quadruple	e = 0.1 on surfaces 2 and 4	6.4 mm airspaces	wood frame	1.59	0.462
7451	quadruple	e = 0.1 on surfaces 2 and 4	12.7 mm airspaces	aluminum frame without thermal break	2.45	0.547
7452	quadruple	e = 0.1 on surfaces 2 and 4	12.7 mm airspaces	aluminum frame with thermal break	1.84	0.511
7453	quadruple	e = 0.1 on surfaces 2 and 4	12.7 mm airspaces	wood frame	1.26	0.47
7461	quadruple	e = 0.1 on surfaces 2 and 4	6.4 mm argon spaces	aluminum frame without thermal break	2.55	0.543
7462	quadruple	e = 0.1 on surfaces 2 and 4	6.4 mm argon spaces	aluminum frame with thermal break	1.94	0.507
7463	quadruple	e = 0.1 on surfaces 2 and 4	6.4 mm argon spaces	wood frame	1.35	0.467
7471	quadruple	e = 0.1 on surfaces 2 and 4	12.7 mm argon spaces	aluminum frame without thermal break	2.31	0.551
7472	quadruple	e = 0.1 on surfaces 2 and 4	12.7 mm argon spaces	aluminum frame with thermal break	1.69	0.515
7473	quadruple	e = 0.1 on surfaces 2 and 4	12.7 mm argon spaces	wood frame	1.11	0.475
7481	quadruple	e = 0.1 on surfaces 2 and 4	6.4 mm krypton spaces	aluminum frame without thermal break	2.31	0.551
7482	quadruple	e = 0.1 on surfaces 2 and 4	6.4 mm krypton spaces	aluminum frame with thermal break	1.69	0.515
7483	quadruple	e = 0.1 on surfaces 2 and 4	6.4 mm krypton spaces	wood frame	1.11	0.475

It was noted in recreating windows that the U-values calculated by Window 5.2 did not perfectly match the U-values specified in the ASHRAE table. Figure below shows the correspondence in U-value between the ASHRAE table and Window 5.2 results.

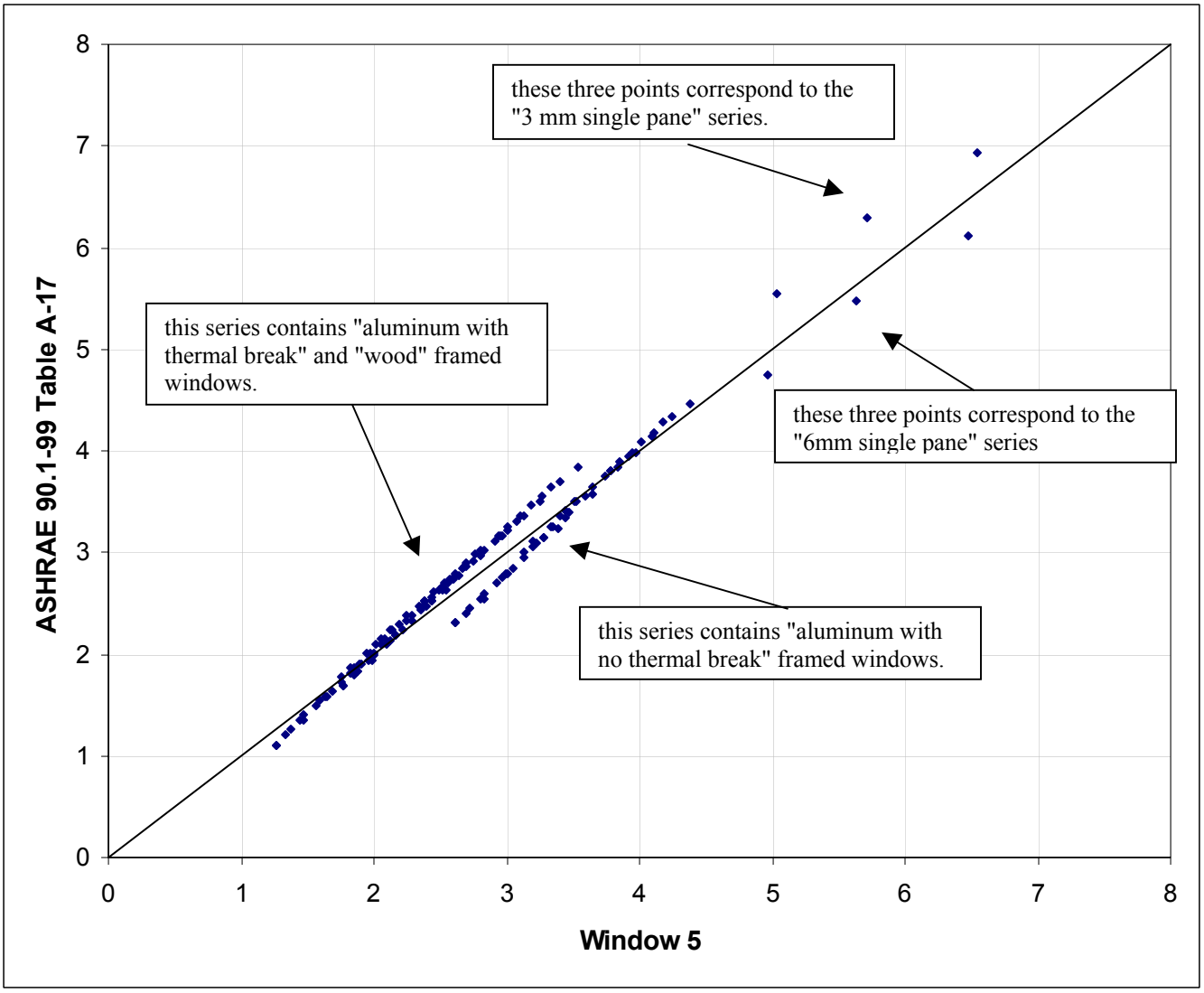


Figure 2: U-value Correspondence Between ASHRAE Table and Window 5.2 Results

As can be seen from Figure 2, Window 5.2 predicts a narrower range of u values than are provided in the ASHRAE table regardless of the window construction. In other words if a window chosen from the ASHRAE table has a comparatively high u-value, its u-value as calculated by Window 5.2 (and therefore the window as applied in TRNSYS) will have a slightly lower u value. Conversely windows chosen from the lower end of the u-value range in the ASHRAE table will be found to have a slightly higher u-value when applied in TRNSYS. Without greater knowledge of the algorithms in Window 5.2 or the source of the ASHRAE data it is impossible to tell which u-value would be more correct. However, Figure 2 shows that the u-value differences between the ASHRAE table and Window 5.2 are comparatively small. The worst correspondence is with single pane windows. Three millimeter thick single pane windows are predicted to have lower u-values by Window 5.2 than are shown in the table.

Conversely, six millimeter thick single pane windows are found to have higher u-values in Window 5.2 than are shown in the ASHRAE Tables.

ADDING NEW WINDOWS TO TYPE 56

This tutorial will lead the TRNSYS user through the process of adding a new window technology, generated by the Lawrence Berkeley National Labs Windows 5.x software to Prebid for use with Type56. Users working with this tutorial should have a basic understanding of using Prebid and of how Prebid and Type56 model windows.

A nearly endless variety of windows are available commercially. Window standards and the data available to describe their performance differ from region to region and certainly from county to country. Furthermore, the modeling of window performance is complex; numerous pieces of specialized software exist for simply modeling windows. For these reasons, a conscious decision was made on the part of the TRNSYS development team not to attempt to redo work already completed in modeling windows but instead to depend upon specialized software to create new windows, and then provide a method for importing those results into TRNSYS for use with Type56. Specifically, you will be using a freely available piece of software called WINDOW, developed by Lawrence Berkeley National Labs in Berkeley, California. The current version of the software at the writing of this tutorial is 5.2 (September 2003).

Obtaining the software:
The program either in its current version (5.2) or its previous DOS version (4.1 can be downloaded for free from the Lawrence Berkeley National Labs website at

http://windows.lbl.gov/software/window/window.html

To obtain a hard a copy, contact

Windows and Daylighting Group
Building Technologies Program
Energy and Environment Division
Lawrence Berkeley National Labs
Berkeley, CA 94720 USA

As a refresher, the first section of this tutorial shows the user how to access the default window library already built into Prebid.

1. Run Prebid either from the start menu or from Explorer and create a project by clicking on **File: New**.
2. Make sure that the American window library is being used by selecting **Options: Settings**. Enter the pathname \trnsys15\Prebid\lib\American under “Path for Libraries”
3. Create a temporary zone by selecting **Zones: Add Zone**. You will be prompted for a zone name, type in “TEMP.” A screen will come up with information about the new zone. The left hand side of the screen contains information about walls. The right hand side contains information about windows.
4. Select “Additional Windows” on the left and Click the “Add” button under the windows section on the right. Select “Library” from the upper pull-down menu. This will display all the window types that are available to TRNSYS in the American window library. The five default window

types are single pane, double pane, triple pane, double pane with low-e glazings, and double pane with low-e glazings and an argon filled gap. Please note that you may have a different list of windows depending upon whether or not you have purchased such TRNSYS add ons. For more information about expanded standard libraries, please contact your distributor. In this case, we would like to add a vinyl framed, double pane window backfilled with argon gas but without the low-e glazings. That does not exist in the library, so we need to add it.

5. Exit Prebid by clicking "Cancel" in the current window and then by selecting **File: Exit**. There is no need to save the project.

The second section of this tutorial deals with the Window 5.x software used to create new glazing systems for use with TRNSYS.

1. Launch Window 5.x by locating the LBNL Software directory in your Start Menu and then by clicking on the item called WINDOW 5.

   WINDOW 5 is a data base program – you will create your new window either as part of a new data base or as part of an existing data base. The window will be assembled from component pieces (such as glazing systems, frames, dividers, etc.) that are found in preexisting libraries or which you will create. By default a new window is created (with an ID number of 1) when you launch the program.

2. Enter a descriptive name for the window in the field below the ID number. Perhaps "Triple Pane Vinyl Frame Argon."

3. In the window Type field, we are able to select from a number of different window types such as sliding glass doors, picture windows, skylights, casement windows etc. We will select a FIXED, picture window, which should be the default value. It is important to select a FIXED window because TRNSYS uses the DOE-2 report format, which does not support other types of windows such as operable windows, vertical sliders, double doors etc.. As you select a window type, a representative picture appears in the frame to the right of the screen.

4. Now, we are ready to start defining components of the window. You can either select components using the menu items, or you can click on the component in the representative picture in the upper right of the screen. Click on one of the four frame components and you will notice that below the picture, information about that component is displayed as well as a pull down menu showing all possible options included in the frame library.

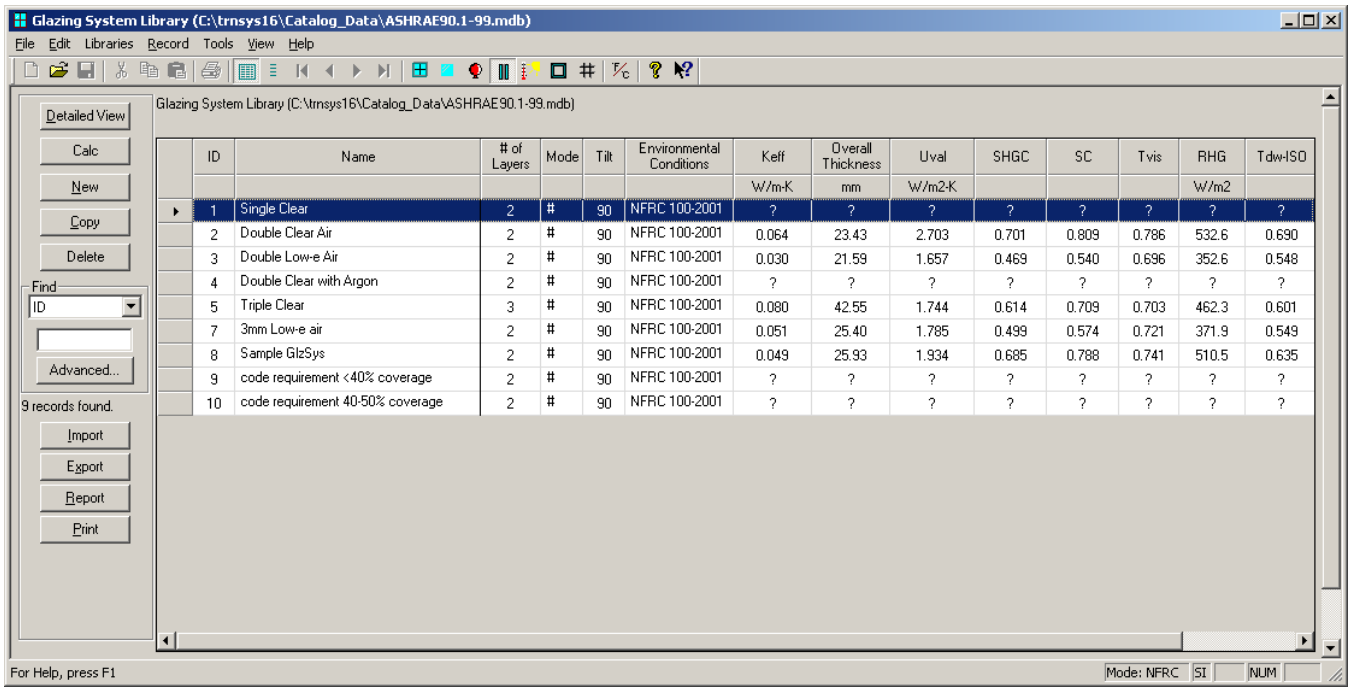
5. In our case, the vinyl frame that we want is option 5 so you may select it directly. If you want some more information about an option, you can click on the button to the right of the pull down menu. If you cannot find the option that you are looking for, you can add items to the frame library by selecting "Frame" from the Libraries menu at the top of the page. Refer to the Window 5.x help for information on adding to the default libraries. As soon as you select a new type of frame, you may notice that the representative picture above, changes to match. Again for future reference, the DOE-2 file format does not support windows that have different types of frames; the window must have the same kind of frame on all four sides.

6. Sequentially change all four frame components to "vinyl" by clicking them each individually and modifying the pull down menu.

7. Next, we have to modify the glazing system itself by clicking in the middle of the representative picture. When the glazing system is selected, it is shown with hatched, diagonal lines instead of as a solid color.

8. Again, the pull down menu beneath the representative picture appears and gives choices of predefined glazing systems. In our case, we want to define a new glazing system because the triple pane window with argon in one gap and air in the other is not contained in the list. Select "Glazing System" from the Libraries menu at the top of the screen – you will be asked whether you want to save the changes to your window, click yes or press return.

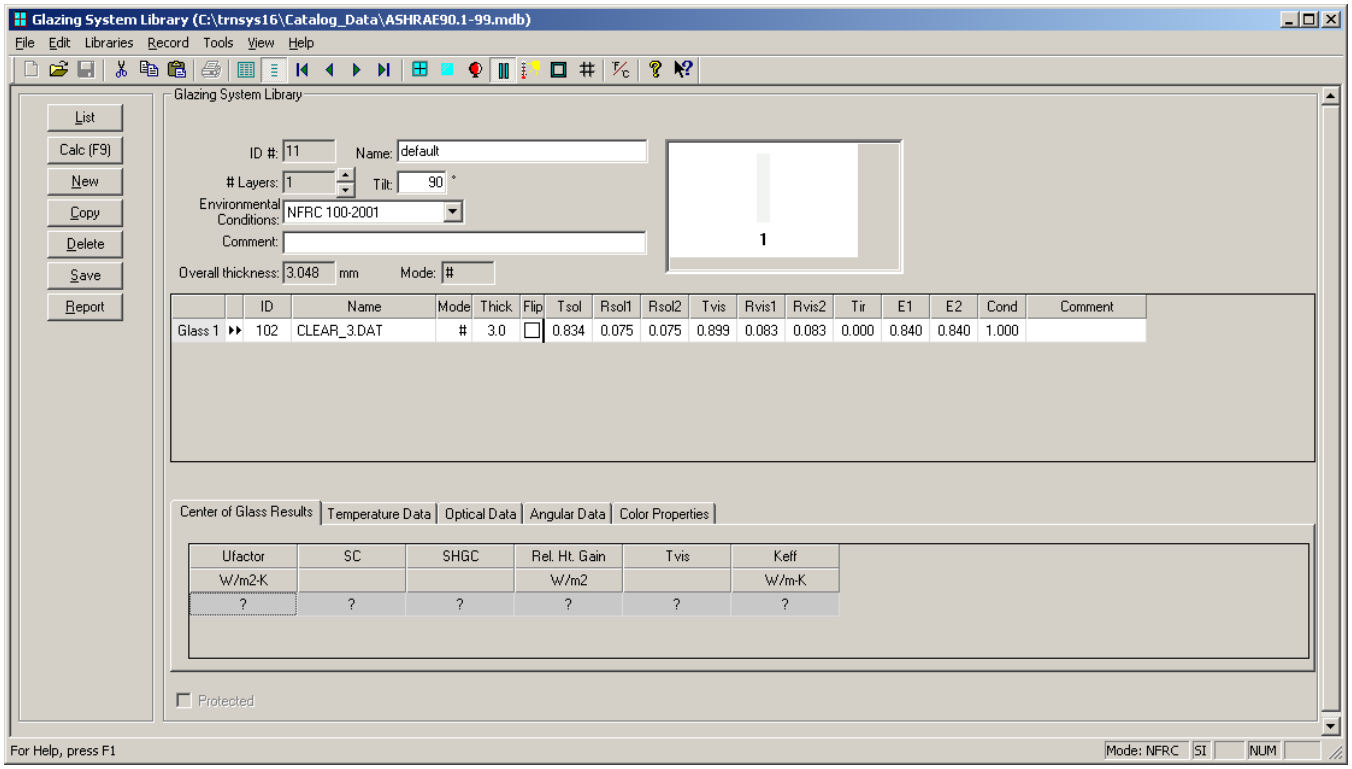
9. A window showing the available glazing systems should appear, looking something like the following:



If the above list does not appear, it may be that the "Detailed View" of a particular glazing system is already selected. If this is the case, click on the "List View" button in the upper left hand corner of the screen.

10. Click on the "New" button on the left to indicate that you would like to create a new glazing system.

11. Accept the proposed ID number of 11, being the next number in the sequence of IDs, and with the new entry selected, click on the "Detailed View" button at the left. The following window should appear:



12. You may now give your glazing system a new name: “Triple, Argon, Air” for example.

13. Set the number of windows layers in the “# Layers” field to 3. Both the detailed list of layer properties and the representative picture should change to reflect the new number of layers. In the picture, the left hand side represents the exterior of the glazing. The check box column entitled “Flip” allows you to reverse the side of the glass on which a low-e coating or tinting is applied.

14. You can change the default types of glass by clicking on the double arrow button before the ID field in each entry if you want. Creating new kinds of glass is a bit more difficult than creating new types of frames because complex spectral and optical properties are needed. To create new glass components, you may want to use another free, LBNL piece of software called OPTICS. For the purposes of this tutorial generic 3mm clear glass will be sufficient.

15. Click on the double arrows by the field labeled “Gas 1.” The library of possible gas types will pop up.

16. Highlight the line labeled “Argon” and click the “Select” button in the upper left.

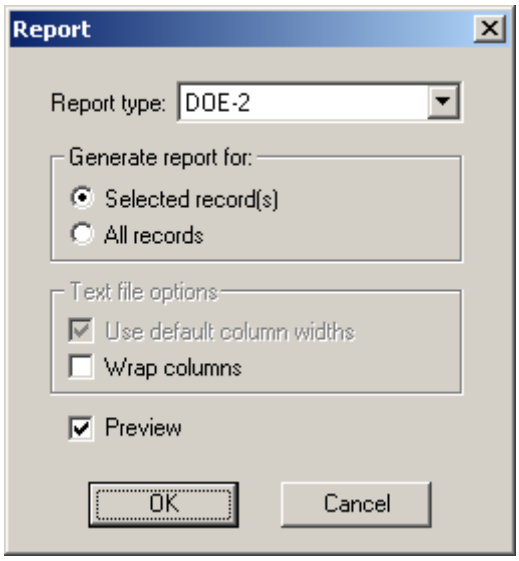
17. In the main glazing system window, you can change the thickness of the gas layer. Highlight the field and type in a new value: 8.0 for example. **NOTE!** You have to press Return at this point or the new number that you have entered will not be recorded. The representative picture should now have changed.

18. When you have completed making changes to the glazing system, return to the window that we are creating by selecting "Window" from the "Libraries" menu. You will be asked whether you would like to save the changes that you made to the glazing system. Click "Yes."

19. Make sure that the glazing system that you just created is the one selected and displayed in the pull down menu beneath the representative picture.

20. Next, you need to generate a standard report on your window so that it can be accessed by TRNSYS. Switch to the "List View" in the window library (a button labeled "List" should be in the upper left corner of the window.

21. Select the window for which you want to generate a report and click on the "Report" button along the left. The following screen should appear.



22. Make sure that you are about to create a DOE-2 style report and that you are only doing so for the selected window. Also, select "Preview" as shown above. When you click "OK" a text window will pop up containing all the information that TRNSYS needs.

23. Do not quit WINDOW 5 yet! We will need to copy the information from the text window into a few other files before Type56 and Prebid can make use of them.

The last section of the tutorial will step you through adding the newly created window file to the TRNSYS library.

1. Copy the text of the window data file and paste it into the file \trnsys15\Prebid\lib\American\W4-lib.dat below the rest of the windows but before the line that reads *** END OF LIBRARY *** **NOTE!** You need to paste the new text directly following the previous entry. DO NOT leave any spaces between entries. Spaces between entries will lead to Fortran errors during simulation.
2. Modify the Name of the new window entry to read "TRNSYS 15 Window Lib"
3. Modify the Window ID to read "x001" where x is the next available number following the other TRNSYS windows. If you are starting from the default library, the window ID might be 6001.

4. Lastly, you need to add a brief description of your window in two places. The first is at the bottom of the W4-lib.dat file. The line you should add follows:

6001 Triple,Ar,Air 3.0/8.0/3.0/12.7/3.0 1.91 0.561 0.598 0.167 0.594

The fields are described in the following table:

Value	Description	Source
6001	TRNSYS ID	Next sequential value (user selected)
Triple,Ar,Air	Description	Unique identifier (user selected)
3.0/8.0/3.0/12.7/3.0	Layer Thicknesses	Layer and Air gap information (best to be taken from the "detailed" view of the appropriate glazing in the Window 5.x Glazing Library)
1.91	Overall U Value	Window 5.x "total window results" field
0.561	Solar heat gain factor	Window 5.x "total window results" field
0.598	Tsol	Tsol at angle 0 (from DOE-2 report window)
0.167	Rfsol	Rfsol at angle 0 (from DOE-2 report window)
0.594	Transmittance of visible energy	Window 5.x "total window results" field

5. The second place that you need to add information is to the file \trnsys15\Prebid\lib\American\prgwin.dat. The information is much the same as in step 6 above. This information is used as default values in Prebid. User can modify them from within Prebid by accessing the Windows Type Manager.

```
TRIPAIRAR  : Triple Pane, vinyl frame, argon, air
;6001, 90, 1.910 , 0.561, 11.000, 64.000, 0.150, 8.170, 0.600, 0.000,
0.000, 0.500, 0.100, 0.500,
```

The fields are described in the following table:

Value	Description	Source
TRIPAIRAR	Prebid ID	Unique identifier (user selected)
Triple Pane, Argon, Air	Description	Unique identifier (user selected)
6001	TRNSYS ID	Next sequential value (must correspond with w4-lib.dat)
90.000	Window Angle	Window 5.x "total window results" field
1.91	Overall U value	Window 5.x "total window results" field
0.561	Solar heat gain coefficient	SHGC at angle 0 (from DOE-2 report window) also called g-value
11.000	Inside convective heat transfer coefficient	User selected (units are kJ/h m^2 K)
64.000	Outside convective heat transfer coefficient	User selected (units are kJ/h m^2 K)

0.150	Ratio of (frame area)/(window area)	User selected (units are dimensionless). This value can be calculated by clicking on each frame member in Window 5.x's representative window picture and totaling the "Area" field, then dividing by the reported window area.
8.170	U-Value of frame	User selected (units are kJ/h m^2 K). This value can be found by clicking on a frame member in Window 5.x's representative window picture and reading the corresponding "Ufactor" value.
0.600	Solar absorptance of frame	User selected (dimensionless). This value can be found by clicking on a frame member in Window 5.x's representative window picture and reading the corresponding "Abs" value.
0.000	Additional heat resistance (inside)	User selected (units are h m^2 K/kJ). The window created by Window 5.x is generic and does not include any additional inside heat resistance. (see NOTE below)
0.000	Additional heat resistance (inside)	User selected (units are h m^2 K/kJ). The window created by Window 5.x is generic and does not include any additional outside heat resistance. (see NOTE below)
0.500	Reflection coefficient of internal device (towards window)	User selected (dimensionless). The window created by Window 5.x is generic and does not include this reflection coefficient. (see NOTE below)
0.100	Reflection coefficient of internal device (towards zone)	User selected (dimensionless). The window created by Window 5.x is generic and does not include this reflection coefficient. (see NOTE below)
0.500	Fraction of absorbed solar radiation to zone air node	User selected (dimensionless). The window created by Window 5.x is generic and does not include this value. (see NOTE below)

NOTE! In some cases, you may not know the appropriate values to enter. Because these are generic base windows that are being set up and because specific windows may be specified based upon these generic versions, it is perfectly acceptable to leave the default information from the table above. The windows in the default American window library have been set up with default information. The windows specifically created based on ASHRAE or Building America information include specific information wherever possible.

6. Repeat steps 1-5 of the first section of this tutorial to verify that your window has been added properly and can be accessed by Prebid. If you get some kind of incomprehensible Fortran error when you run the building with your new window then probably the syntax in the W4-lib.dat file is most likely at fault. Type56 is expecting to read an older style DOE-2 report file and the latest version of Window (5.2 at the writing of this tutorial) writes out full descriptions in certain fields. These descriptions can be longer than Type56 allows. For example, in one window the

frame description created was too long causing the frame U value to be read incorrectly. The description had to be shortened from:

```
Frame       : 10 Code Minimum GT 40% coverage            9.5
```

to:

```
Frame       : 10 CodMinGT40            9.5
```

For more information:

On adding new windows to TRNSYS contact:	**On the use of Windows 5.x software, contact:**
TRNSYS Coordinator Thermal Energy System Specialists, LLC 2916 Marketplace Drive – suite 104 Madison, WI 53719 USA Phone: +1 (608) 274 2577 Fax: +1 (608) 278 1475 Email: trnsys@sel.me.wisc.edu	Windows and Daylighting Group Building Technologies Program Energy and Environment Division Lawrence Berkeley National Labs Berkeley, CA 94720 USA

References

[1] Window 5.0 User Manual (2003). LBL-44789 Berkeley, CA: Lawrence Berkeley National Laboratory.

[2] ASHRAE Standard 90.1-1999, “ASHRAE Energy Standard for Buildings Except Low-Rise Residential Buildings.”

[3] ASHRAE Standard 140-2001, “ASHRAE Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs.”

[4] Judkoff, R. and J. Neymark. (1995). International Energy Agency Building Energy Simulation Test (BESTEST) and Diagnostic Method. NREL/TP-472-6231. Golden, CO: National Renewable Energy Laboratory

[5]