Standard Window 'R-value' Calculation Procedure (SCP)

Version 1: August 2009

Introduction

The Standard window 'R-value' Calculation Procedure (SCP) provides a consistent means of calculating the construction R-values (R_{Window}) of domestic window systems (including windows, doors and skylights) in New Zealand. It is used by NZS 4218:2009 "Thermal insulation – Housing and small buildings" to calculate the construction R-values (R_{Window}) in Appendix C. The SCP also lists additional construction R-values that do not appear in Appendix C of NZS 4218:2009, and properties of components (see the Data Tables). The SCP may be used to calculate R-values for types of domestic windows that are not in Appendix C.

Process

To determine a representative R-value of a window system in NZ compatible with the values listed in Tables C1 to C4 of Appendix C of NZS 4218:2009, the following numbered process is to be followed. This is known as the "Standard Calculation Procedure" (SCP). This procedure requires the use of software known as WINDOW5 (W5) which can be downloaded free from (http://windows.lbl.gov/software/) and can be performed by an approved modeller, as listed on the WANZ website.

Use the Window software package version W5.2 with the following options selected;

1. From the "Window Library" Screen

i. ID: user field to identify the window
ii. Name: user field to name the window
iii. Mode: NFRC
iv. Type: Custom Dual Vision Horizontal
v. Width: 1800
vi. Height: 1500
vii. Tilt: 90° (for vertical glazing)
viii. Environmental Conditions: NFRC 100-2001

Note

A combination awning window of overall size 1800 mm wide x 1500 mm high with a central mullion and one opening light shall be used to represent the R-value of a window system. Where timber reveal liners are used they shall be modelled in a size of 19mm by 114mm. Joinery such as bi-fold doors and toilet windows may not be well represented by this size window, however it provides a representative performance of New Zealand window systems. Windows can have their performance data files created in W5 by an approved modeller, and can then be used as per the standard procedure. Systems that have been through this process are listed in Table 1.

2. From the “Glass Library” Screen

Any glazing option from the current version of the IGDB with “**#**” may be used. The # sign identifies current data from the International Glazing Database maintained from the USA

Note
Glass types not listed in the IGDB can have their performance data files created in Optics by an approved modeller and transferred to the Window 5.2 glass library where they can then be used as per the standard procedure. Systems that have been through this process are listed in Table 2.

The selected glass must be made into a “Glazing System” by the process in clause 4 before it can be used.

3. From the “Gas Library” Screen

The ID option 1 for air, and the ID option 9 for 90% Argon 10% air shall be used, as the only gas fills applicable.

If the file for the gas mix of ID option 9 is not available in the W5 software, use the values as in Table 3 to create ID option 9.

Note
Gas fill types can have their performance data files created in W5 by an approved modeller, and can then be used as per the standard procedure. Systems that have been through this process are listed in Table 3 below.

4. From the “Glazing System Library” Screen

i. ID: user field to identify the glazing
ii. Name: user field to name the glazing system
iii. Tilt: is 90 degrees for vertical glazing
iv. Layers: are 1 for single glazing and 2 for an IGU
v. Environmental Conditions: are NFRC 100-2001
vi. For glass 1 and 2 use only entries in the IGDB glass library
vii. For gas select ID 1 or ID9 as above and enter gas thickness (space)
viii. Once you have made your glazing system – Click Calc/F9 to calculate

Note
Glazing systems can have their performance data files created in W5 by an approved modeller and can then be used as per the standard procedure. Systems that have been through this process are listed in Table 4 below.

5. From the "Environmental Conditions" Screen

Environmental Conditions are: ID 1 for NFRC 100-2001 as follows

i. U-factor Tin = 21.0 C,
ii. U-factor Tout = -18.0 C,
iii. SHGC Tin = 24.0 C,
iv. SHGC Tout = 32.0 C, and
v. SHGC Solar = 783 W/m²

6. From the "Frame Library" Screen

Obtain the files for WERS frame types (ID 10 to 17) or input the data as per Table 5.

The values in Table 5 have been chosen to ensure the ability to model a realistic window system which can be compared with the values in Appendix C1 to C4 of NZS 4218:2009.

Note
Non-generic frame types which are not referred to in the frame-types used in Tables C1 to C4 of NZS4218:2009 can have their performance data files created in Therm Software by an approved modeller, and transferred to the Window 5.2 glass library where they can then be used as per the standard procedure. Framing that has been through this process is listed in Table 6.

7. From the "Window Library" Screen

Enter the frame type and glass type to make up the window, then click on the "Calc/F9" button, and read off the U-factor for the complete window system – The inverse of the U-factor is the R-value or R_{Window} which is then used as the R-value for NZS 4218:2009 purposes.

Note
Table 1 may include the R-value of total products that have been modelled and may be used for Building Code compliance purposes, and will be updated on demand, so please check that you have a current version of this SCP, and download an updated version as necessary from the BRANZ website.

SKYLIGHTS

In the absence of manufacturers data on the Construction R-values (R_{Window}) for skylights this same procedure can be used, with modifications to the window library as follows;

From the "Window Library" Screen

i. ID – user field to identify the window
ii. Name –user field to name window
iii. Mode: NFRC
iv. Type: Skylight
v. Width: 1200
vi. Height: 1200
vii. Tilt: 30°
viii. Environmental Conditions: NFRC 100-2001

Table 7 may include total Skylight products that have been modelled and may be used for Building Code compliance purposes.

APPROVED MODELLERS

Persons must be assessed as being competent before they are able to model windows, glazing systems, frames, glass or gases, and produce R-values that can be used for compliance purposes. A list of approved modellers will be available on the WANZ website, www.wanz.org.nz.

Data Tables

R-values for windows								
ID	Product Name	Type	Width (mm)	Height (mm)	U-factor W/m°K	SHGC	VT	CR

Table 1: Verified R-values for total window products beyond NZS 4218:2009 tables C1 to C4.

R-values for glass products												
ID	Name of Product	Colour	Thick	Tsol	$Rsol_1$	$Rsol_2$	Tvis	$Rvis_1$	$Rvis_2$	Tir	$Emis_1$	$Emis_2$

Table 2: Verified R-values for glass products beyond IGDB library in W5 software.

Specification for gas-fills							
ID	Name of Product	Type	Conductivity W/m-K	Viscosity kg/m-s	Cp J/kg-K	Density Kg/m3	Prandtl
9	Air (10%) / Argon (90%)	Mix	0.017063	0.000021	558.03314	1.732866	0.6758

Table 3: Verified performance data for gas-fill products beyond W5 library

R-values for glazing systems											
ID	Product Name	Number of layers	Tilt	Env Cond	Overall Thickness	U-factor	SC	SHGC	RHG	Tvis	Keff

Table 4: Verified performance data for glazing systems beyond NZS 4218:2009 tables C1 to C4.

R-values for framing products					
ID	Product Name	Frame-U-value W/m²-K	Edge Correlation	Projected Frame Dimension	Material Absorption
10	WERS frame 1 for single Al	11.9	Class 1	57.2	0.90
11	WERS frame 2 for single Composite Al	11.16	Class 1	57.2	0.90
12	WERS frame 3 for single Thermally broken Al	7.9	Class 1	57.2	0.90
13	WERS frame 4 for single PVC or Wooden frame	2.96	Class 1	57.2	0.90
14	WERS frame 5 for double Al	9.31	Class 1	57.2	0.90
15	WERS frame 6 for double Composite Al	9.11	Class 1	57.2	0.90
16	WERS frame 7 for double Thermally broken Al	5.167	Class 1	57.2	0.90
17	WERS frame 8 for IGU PVC or Wooden frame	2.34	Class 1	57.2	0.90

Table 5: Verified frame products in WERS library

Verified alternative performance for frame products beyond WERS library					
ID	Product Name	Frame U-value W/m²-K	Edge Correlation	Projected Frame Dimension	Material Absorption

Table 6: Verified alternative performance for frame products beyond WERS library

Verified alternative R-values for total Skylight products								
ID	Product Name	Type	Width (mm)	Height (mm)	U-factor W/m°K	SHGC	VT	CR

Table 7: Verified alternative R-values for total Skylight products beyond NZS 4218:2009