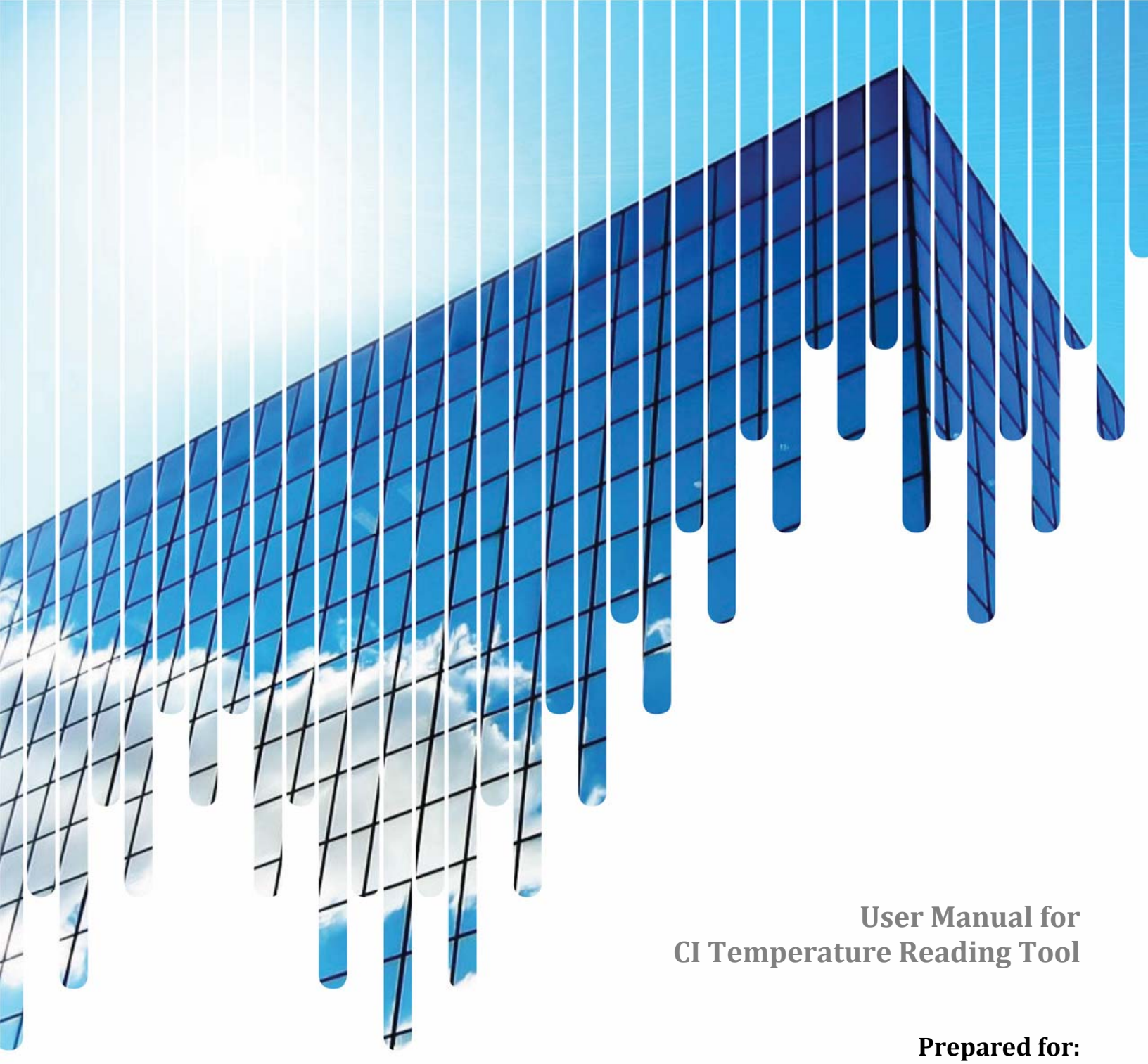

User Manual for
CI Temperature Reading Tool

Prepared for:
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NFRC | CSA Simulation Laboratory

veridis SOLUTIONS

USER MANUAL

Software:
NFRC CI Temperature Reading Tool
Release: V2.0.7.2

Prepared for:
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CONTENT

1. GENERAL

Veridis Solutions inc. was retained by National Fenestration Rating Council (NFRC) to develop a practical tool for CI temperature reading automation. This manual documents how to use the resulting NFRC CI Temperature Reading Tool (hereinafter referred to as CI Tool). The software presented here generates T_{frame} and T_{edge} for CI calculation from simulated THERM files.

The CI Tool is designed to obtain interior surface temperatures per ANSI/NFRC 500, *Procedure for Determining Fenestration Product Condensation Index Ratings*, which is as follows:

> T_{frame} = Shall be the coldest temperature found along the entire interior surface of the frame/sash of the product; but, shall not be no closer than 13mm from the Frame-to-Glass-Junction (FTGJ). If the coldest temperature is 13mm from the FTGJ but if it happens to be a gasket, wet seal, or air cavity, then the program will re-calculate to obtain the coldest temperature an additional 13mm away from that point.
>
> T_{edge} = This temperature is automatically taken 25mm from the FTGJ.
>
> Frame-to-Glass-Junction (FTGJ): This is the point on the product where the glazing touches the fenestration product's frame, sash, gasket, and/or wet seal. This junction may be at or below the sightline.
>
> Sightline: The line formed by the highest opaque member (frame, sash, spacer, divider, or shading system) that is interior, exterior, or within the glazing system cavity of the fenestration cross-section and the glazing in a plane perpendicular to the surface.

Disclaimer:

Veridis Solutions inc. and its employees neither endorse nor warrant the suitability of the product simulated. Every effort was taken to accurately model the performance of the assemblies documented in this document. Because of the large amount of input data and analysis, it is possible that errors or omissions could occur. Neither Veridis Solutions inc., nor any of its employees shall be responsible for any loss or damage resulting directly or indirectly from any default, error, or omission.

2. Using the CI Temperature Reading Tool

2.1 THERM configuration

The two following options need to be checked in the THERM preferences to save the needed output files:

1) Click the option's menu

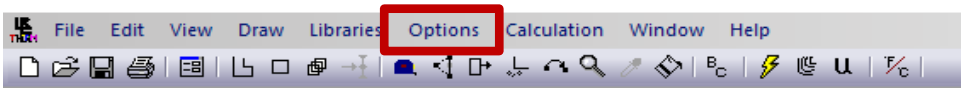

Figure 1: THERM Options menu

2) Click "Preferences…"

Figure 2: THERM Preference Menu

3) In the "Preference" tab, check the "Automatic XML Export on Save" checkbox.

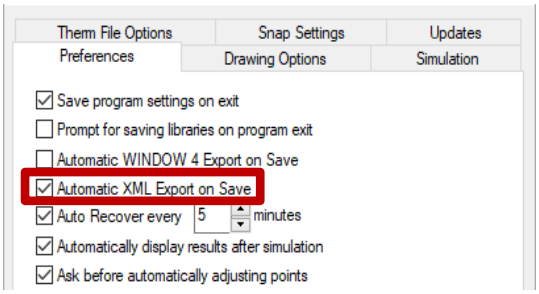

Figure 2: XML Export option

4) In the "Simulation" tab, check the "Save Conrad results file (.O)" checkbox. Note: "Save Simulation results in THM files is not required.

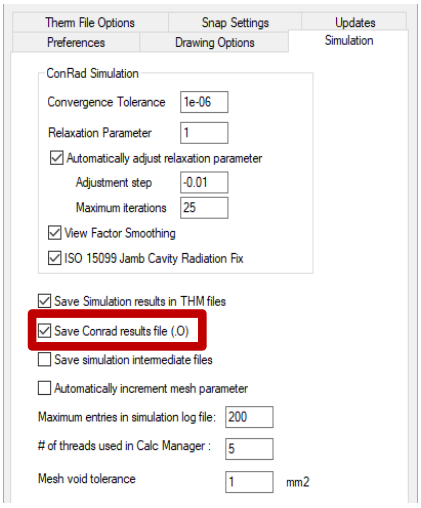

Figure 4: Conrad file option

2.2 Additional Software Downloads for use of CI Tool Interface

1. The application titled, "AccessDatabaseEngine" or "AccessDatabaseEngine_X64" is required to be installed on your local drive. Do not install both. The "_X64" application is for those computers with 64-bit operating system installed. See illustrated install Steps 1-4 below.

2. The application titled, "NDP461-KB3102438-Web" is required for older operating systems or those CPU's without ".NET Framework" already installed. See Step 5 on following page for common message for most newer CPUs.

3. Obtain the above files from the NFRC Condensation Resistance Task Group page under "CI Software Tool Downloads".

Step 1: Click on AccessDatabaseEngine File to start download

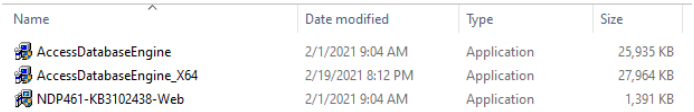

Figure 5: Software Files Needed for CI Tool

Step2: Click "Next"

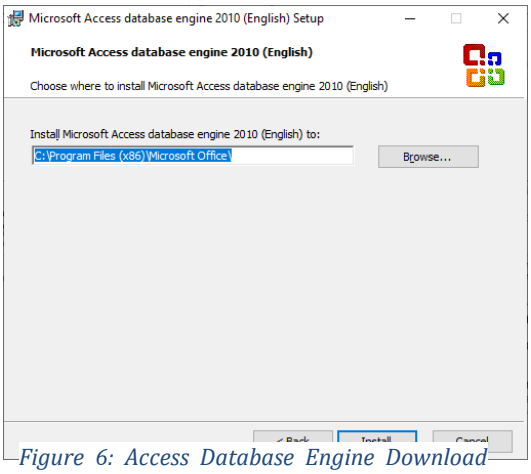

Figure 6: Access Database Engine Download Location Prompt

Step 3: Check to accept terms of License Agreement and then click "Next"

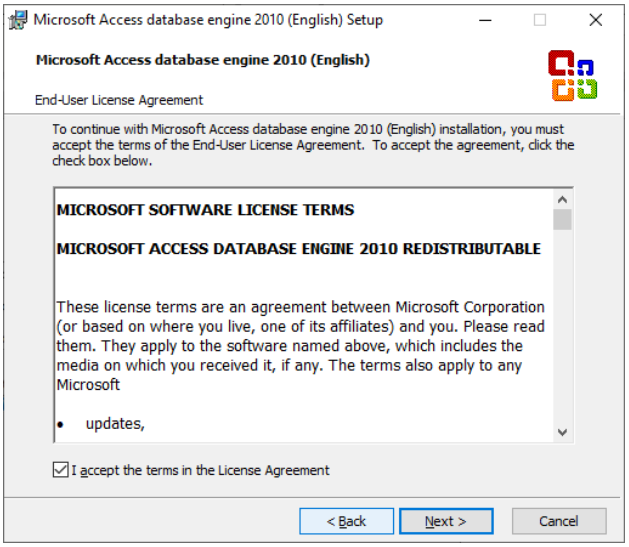

Figure 7: User License Agreement Prompt

Step 4: If okay with location of downloaded file, then click "Install"

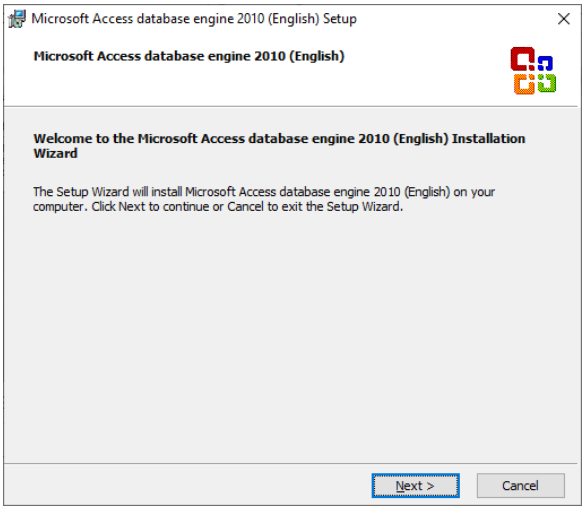

Figure 8: Database Engine Installation

Step 5: Message received if trying to install "NDP461-KB3102438-Web" but your CPU is updated already.

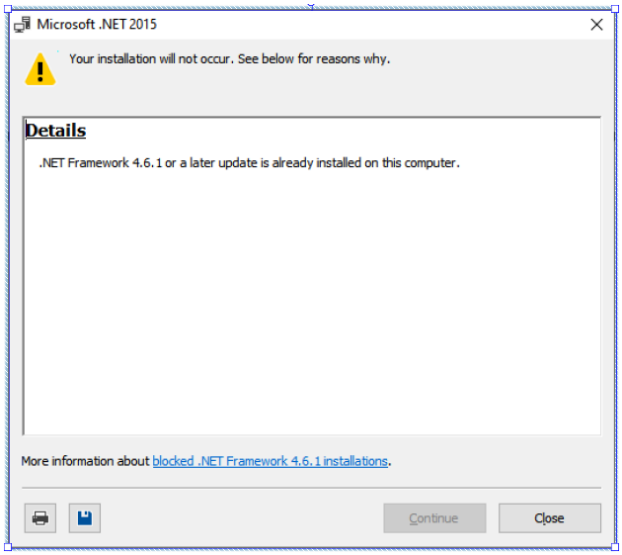

Figure 9: .NET Framework Message

2.3 User interface description

When the user opens the CI_Tool.exe, the interface shown below will appear.

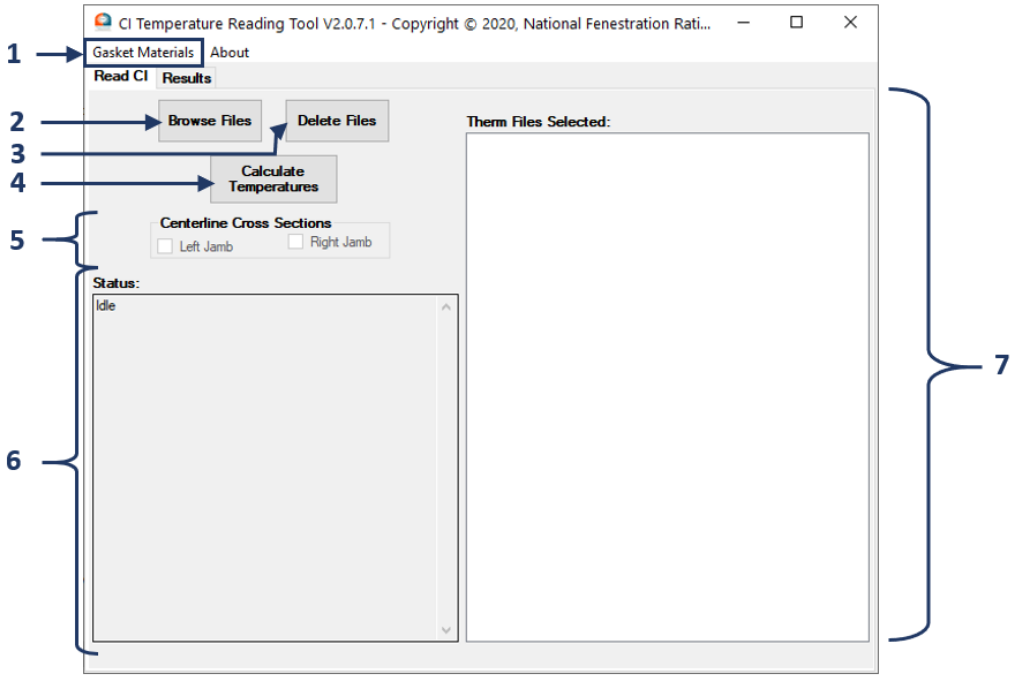

Figure 10: Interface Description

1) *Gasket Materials* Menu: allows user to view or edit the tool's Gasket library. See section 4.3.
2) *Browse Files* button: allows user to select THERM files to calculate.
3) *Delete Files* button: removes the selected files from the THERM file list.
4) *Calculate Temperatures* button: Starts the process of reading CI temperatures of loaded THERM files
5) Centerline Cross Sections checkboxes: required for left and right jambs of glazed wall systems only. See section 5.2.
6) Status box: Will display the software states: "Idle", "Processing", "Done" or "Error".
7) THERM Files Selected box: once files are loaded with the Browse button, selection(s) will be displayed here.

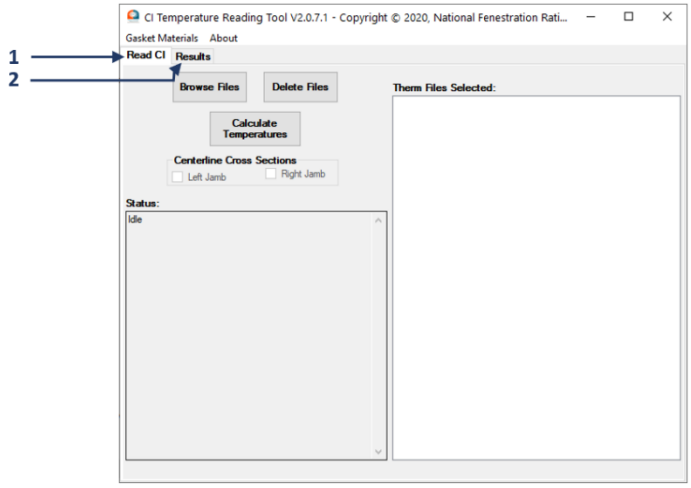

Figure 11: Tab Menu Description

CI Temperature reading tool has 2 tabs. #1 contains the interface described above, while the #2 displays the last obtained results, as shown below:

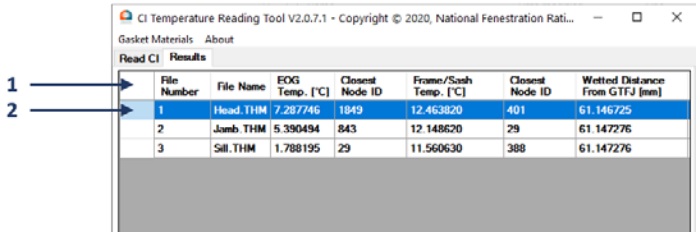

Figure 12: Results Table Description

The data presented in the result tab is described in section 3.
Useful tips:

A) User can click #1 of Figure to select the entire table.
B) User can click the left-most cell of each row like #2 of Figure to select entire rows.

2.4 Gasket materials library

To view and/or edit the CI Tool's Gasket materials library, User must click the Gasket Materials menu in the top left corner. The interface shown below will appear:

User may modify a gasket material's name or add a new one by clicking the last row of the table. The library will be saved every time the gasket material table shown above is closed. See section 4.3 for further explanation on the CI Tool's gasket library.

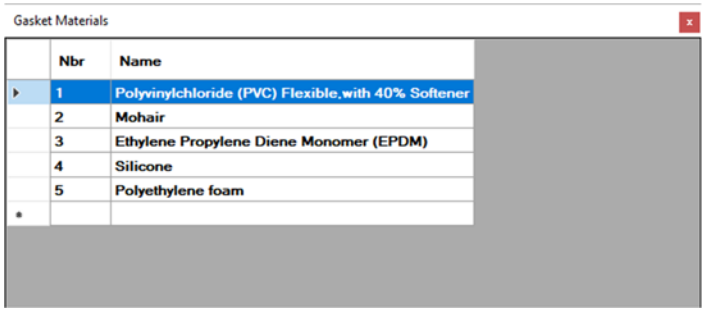

Figure 13: Gasket library table

3. Results

The data contained in the results is detailed in the following:

1) File name
2) Edge of glass temperature in Celsius (EOG Temp [C])
3) Closest Node ID from edge of glass reading location (Closest node ID)
4) Frame/sash temperature in Celsius (Frame/Sash Temp [C])
5) Closest node ID from the Frame/Sash temperature reading location (Closest Node ID)
6) Wetted distance between the Glass-to-Frame Junction (GTFJ) and the frame/sash temperature reading location in millimeters (Wetted Distance from GTFJ [mm])
7) Execution time in seconds (Execution time [s])

Caution must be used when comparing manual results and CI Temperature Reading Tool results. The temperatures might differ slightly (<1 ºC). This difference is explained by the fact that the "Temperature at Cursor" will provide the temperature of the closest node (if reading is between two nodes) while the CI tool will perform a linear interpolation calculation.

Wetted distance from glass to frame junction is the perimeter length between the coldest eligible temperature on the frame/sash and the GTFJ, given in millimetres.

4. Requirements

4.1 Input files

4.1.1 How to ensure up-to-date THERM output files

The THERM files to be used in the CI Temperature Reading Tool must contain current results and be saved. It is important to save the ".THM" files after calculation completion to ensure up to date THERM output files. This requirement applies when calculating an opened THERM file manually using F9/ button. If the ".THM" are calculated by the calc manager, everything will be updated without any further manipulation.

All THERM files have several output files (2 or 3). One XML (.thmx) and 1 or 2 conrad file (.O). All output files must remain in the same directory as the main ".THM" files, i.e. their default location.

4.1.2 Which file to load in the CI Tool?

Select only the THERM files (.thm or .THM) when using the browse button. The CI tool only expect those as input, even if the tool ultimately reads the corresponding THERM output files. Select only the THERM files that contain a single glazing option. Every glazing option to calculate must be selected individually.

4.1.3 Prohibited characters in Window and THERM

4.1.3.1 Prohibited Characters in WINDOW

When naming glazing systems in Window's Glazing Library, the following characters are prohibited when naming glazing in the Glazing Systems Library. Using any of the following characters will render the ".thmx" output files unreadable. If the THERM file already contains a glazing system imported from WINDOW with the prohibited character(s), user shall change the name of the glazing system in WINDOW and re-import, re-generate all boundary conditions, and re-calculate.

1. Quotation (")
2. Ampersand (&)
3. Less than symbol (<)
4. Greater than symbol (>)

4.1.3.2 Prohibited Characters in in THERM

When naming THERM files, avoid the following characters:

1. Period, Dot (.) The CI Tool expects a period only between file name and extension.
2. Ampersand (&)
3. Quotation (")
4. Asterisk (*)
5. Pipe (|)
6. Back Slash (\),
7. Forward Slash (/)
8. Question (?)
9. Greater than symbol (>)
10. Less than symbol (<)

NOTE: Notify an NFRC staff member if there is any character used that causes an error in the CI Tool

4.2 Temperature readings calculation

After starting the main calculation, edge of glass and frame/sash temperature readings will be obtained for all THERM files listed in the user interface. The diagnostic box will change from "Idle" to "Processing…" and finally to "Done" when calculation is over. While in progress, it is expected that the interface will be unresponsive. It is recommended to resume interaction only once the "Done" status appears.

4.3 Gasket materials library

Following the method described in ANSI/NFRC-500-2020$_{E0A0}$, section 4.3.1 for determining the coldest temperature from the frame, sash, or panel surfaces (T_{frame}), the CI tool considers specific materials encountered in the THERM models as gasket or sealant. The CI Tool's default list of gaskets/sealants contain the commonly used materials for that purpose from NFRC 101.

The CI Tool's gasket library can be edited. User may need to add material names, for example, when using materials that have the gasket or sealant purpose in THERM models but are not included in the CI Tool's default gasket library. It is the simulator's responsibility to ensure that all gasket/sealant materials used in THERM are listed in the CI Tool, otherwise the T_{frame} results may not be accurate. Allowing user edits of the gasket library is provided so the CI may be adapted to the industry's needs and to maintain accurate results despite user modifications or additions to THERM's Material Library.

4.3.1 What are the default gasket materials?

The default gasket library includes the following:

1) Polyvinylchloride (PVC) Flexible, with 40% Softener
2) Mohair
3) Ethylene Propylene Diene Monomer (EPDM)
4) Silicone
5) Polyethylene Foam

4.3.2 How the CI Tool recognizes gasket materials?

The CI Tool identifies a material as gasket/sealant whenever its **name** in the THERM files matches one of the names in the tool's gasket library. The matching conditions include:

1) Material library's name and Gasket library's name are identical.
2) Gasket library's name is found within the Material library's name.

Simulators may input part of a material's full name for the CI Tool to consider several similar THERM materials as the same.

4.3.3 Gasket Library file and location

The CI Tool's Gasket library is stored in a database file named **Settings.accdb** stored in the following directory:

C:\Users\Public\NFRC\CI Temp Reading Tool

It is possible, but **not** recommended, to edit the gasket library from outside the CI Tool's interface. Modifying the format of the database, the name of the file, the existing numbering of the materials listed or the format of the *Gasket_Materials* table is prohibited.

5. Special Features

5.1 Selecting THERM Files: Multi-select/multi-directories

User may select multiple files at once in the file browser (see section 9). User may also use the file browser multiple times before calculating to select files from different directories.

5.2 Glazed wall system's additional input

For centerline cross sections of glazed wall systems in THERM, the left jamb is required to have the "None" U-factor-surface tag applied to the upper half and the right jamb is required to be the opposite (or "None" tag on lower half) of the systems. Refer to the NFRC THERM7 / WINDOW7 Simulation Manual, Section 8.9 for modeling rules and illustration examples with Figures 8-94 and 8-95 for reference.

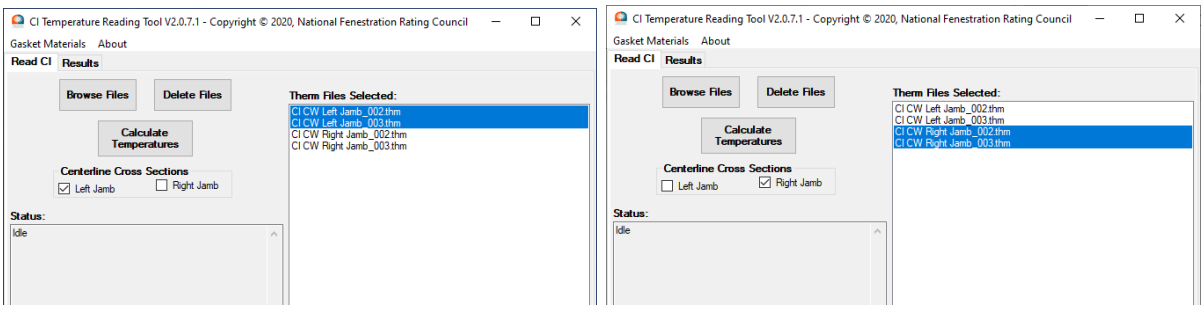

Figure 14: Selection of Centerline Cross Sections for Left & Right Jambs

Once the THERM files are properly identified and ran for the left and rights jambs, user must provide an additional input in the CI Tool to help it identify which THERM models are left and right. For that purpose, the user interface has two checkboxes to describe the loaded ".thm" files . First, user must select the Left or Right jamb file(s) in the list, then click the corresponding checkboxes. See Figure 14.

The centerline cross section's checkboxes will update to the current selection in the THERM file list. Therefore, user can read the already saved configuration from the 2 checkboxes, as well as change it. Multiples entries from the THERM file list may be selected at once using the supported standard keyboard shortcuts (see section 9).

5.3 Result CSV files

The information contained in the "Result tab" (see Figure 12) **Error! Reference source not found.** is also available in the automatically generated result CSV files. They are named "CI_TemperatureReadings.csv" by default.

5.3.1 Where to expect the result files?

If the user has selected files from multiple directories, one result CSV file per directory will be created.

5.3.2 Result file default naming

At every calculation, the CI temperature reading tool will overwrite the existing result CSV files in the directories concerned. If, for example, a result file is opened and cannot be overwritten, a separate result CSV file will be generated with an incremental counter, i.e. CI_TemperatureReading_*.csv, where (*) will increment as needed starting at 1. Subsequent CI calculations may generate result files with incremented counter if all existing CSV files cannot be

overwritten.

6. Handled Product Types

Handled product types include all common window types like CSSV, PRAW, FIXD, VSDH, VSSH, HSXX, HSOX, etc.

Special cases listed below can also be calculated:

1) Dividers: Internal grids, simulated divided lights and true divided lights
2) Tilted products at 20° or skylights
3) Glazed wall systems
4) Sloped glazed wall systems
5) Blinds-between-the glass (BBG)

7. Supported LBNL software versions

Output files generated by the following THERM versions are compatible with the CI tool V2.0.7.2:

- THERM 7.4.4.0
- THERM 7.7.10.0
- THERM 7.8.14 (version .14 subject to change due to concurrent Beta testing)

8. Common Error Messages

The following are common error messages when the "Status" box indicates "Error occurred" and how to correct or troubleshoot the issue.

Error Message	Possible Solution
Could not find file <directory of file location>\<THERM filename.o>.	The *.o file is missing Ensure when you ran THERM file configuration setups is correct. See Section 2.1.
Error occurred while reading ".thmx" file. Possible causes: 1) The glazings are named using the (") character. 2) The THERM files are named using more than one (.) character.	(1) The two errors noted in Status Box are issues with the glazing systems built in WINDOW or THERM file name. Do not use prohibitive characters listed in 4.1.3.1 and 4.1.3.2. (2) This error can also occur if the *.thmx file is missing from your project folder. If not using THERM's Calc Manager to run calculations, user must manually hit 'Save" for each THERM file to ensure *.thmx file is saved.
Could not find file <directory of file>\<filename.thmx>'.	This error occurs if the *.thmx file is missing from your project folder where the THERM file was saved.
Error occurred wile creating settings.accdb file. Possible causes: The correct version of Access runtime engine wasn't successfully installed prior to using CI Temperature Tool.	The error message in Status Box is self-explanatory.

9. Supported Keyboard Shortcuts

The following keyboard shortcuts are enabled when using the THERM file list and when using the "Browse files" button (See item #2 of Figure 10):

9.1 Ctrl+Click:

User can multi-select by holding down the "Ctrl" key and clicking multiple entries in the list.

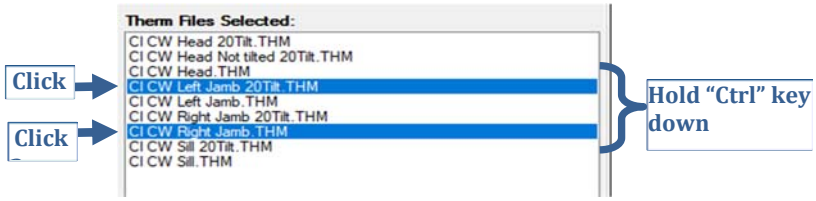

Figure 14: Ctrl+Click keyboard shortcut

9.2 Shift+Click:

User can multi-select from one entry to another by holding down the "Shift" key and clicking the first and last desired files.

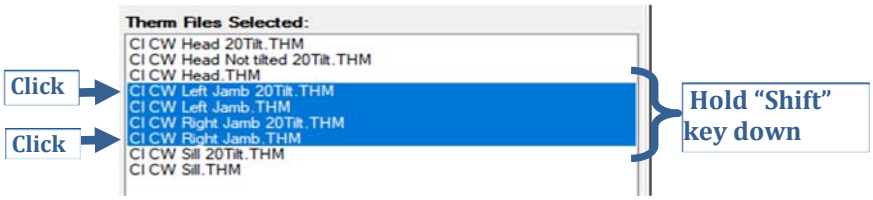

Figure 15: Shift+Click keyboard shortcut

9.3 Combination of Ctrl+Click and Shift+Click:

It is possible to use both shortcuts described above consecutively.

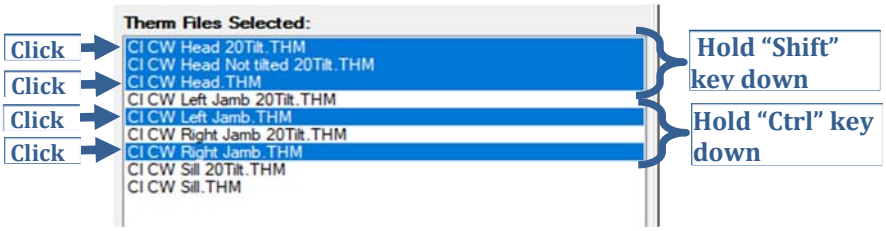

Figure 16: Shortcut combination

9.4 Select all with Ctrl+A:

Standard "Select all" keyboard shortcut is also supported. User can select anything in the THERM file list and press "Ctrl+A" keys to select all entries.

10. REFERENCES

National Fenestration Rating Council, Linear Energy Analysis for Fenestration (LEAFF), "Trendline Approach Component Based Calculation and Condensation Index Simulation Manual" 2021.

National Fenestration Rating Council, "ANSI/NFRC 100-2020 Procedure for Determining Fenestration Product U-factors", 2020.

National Fenestration Rating Council, "ANSI/NFRC 500-2020 Procedure for Determining Fenestration Product Condensation Index Ratings", 2020.

MANUAL REVISIONS LOG

Revision Number	Tool version	Date	Revision
1	V1	2020-05-21	Original Manual
2	V1.03	2020-05-30	New features and bug fixes added
3	V1.04	2020-06-30	New features and bug fixes added
4	V1.05	2020-08-07	Minor bug fixes
5	V2.0.6.4	2020-10-06	Standalone version
6	V2.0.7.1	2020-12-22	Gasket Materials list implemented in interface, improved error handling, bug fixes.
7	V2.0.7.2	2020-03-16	Installation requirement change, error messages revision, ctrl+A shortcut enabled
8	V2.07.2	2020-05-07	Language in manual changed for expanded list of prohibitive characters to be used in Glazing System names and THERM file names.