

Second Magenta

WIS 2T Modeller Software

User Manual

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Second Magenta

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1 Introduction

Windscreen 2T Modeller (WIS 2T) is a software tool to assist in the design of heated windscreens for aircraft and locomotive applications. It can also be used as a more general tool for calculating the thermal properties of unheated glazings. WIS 2T brings together two separate design functions into one software package:

- Anti-icing performance

WIS 2T predicts the power density requirements for anti-icing with electrically heated windscreens in accordance with the method described in Ice, Rain, Fog, and Frost Protection: SAE AIR 1168/4. This covers both anti-icing (external surface) and anti-fogging (internal surface). It also includes an option to run the analytical modelling described by George C Letton Jnr in his published paper from AFML-TR-73-126: Conference on Transparent Aircraft Enclosures; Las Vegas; 1973.

- Thermal performance

WIS 2T predicts the steady-state and dynamic temperature distribution throughout a coated laminated windscreens based on user-definable environment and boundary conditions. The mathematical model uses a 1D mesh approach, solving the heat transfer linear equations using the tri-diagonal method.

WIS 2T is designed and written to run on a modern pc platform with the following minimum requirements:

- Processor speed: >2 GHz; Intel Pentium or equivalent
- Available RAM: >256MB
- Available Disc space: > 100 MB
- CD Reader: >48x
- Screen Resolution > 1024 x 768

WIS 2T relies on a number of system and supporting software being installed on the pc platform, as follows:

- Operating system: Microsoft Windows (8, 7, Vista or XP)
- Enabled software: Microsoft .NET Framework version 4.0 or higher
- Enabled software: Microsoft Internet Explorer version 6 or higher

2 Software Installation

WIS 2T is supplied as a CD with a number of USB license dongles. The contents of the CD are not protected and can be freely copied and distributed.

The CD contains all the files necessary to automatically install and operate the software on a pc platform as specified in Section 1. After installation, the USB dongle is required to enable any calculations to be performed. Without the USB dongle in place, the software will operate but not perform any of the mathematical modelling available.

IMPORTANT: DO NOT install the USB Key before the installation of the WIS 2T software

IMPORTANT: UNINSTALL any existing versions of WS or WIS Modeller software before installing or re-installing this WIS 2T software

To install the software, insert the CD into the disk drive. The AUTORUN feature will automatically install the program and load the associated files on the computer. This will copy all the required resources into the Programs File Directory on the main hard disk drive. The application is called WIS Modeller 2T.

The installer software will also create a Start Menu entry and also set up a desk-top icon called WIS Modeller to launch the application.

When the application is first launched, it will create a WIS Modeller directory in the user's home account. This directory will create all permanent and temporary data files, such as materials libraries, needed during the operation of the application.

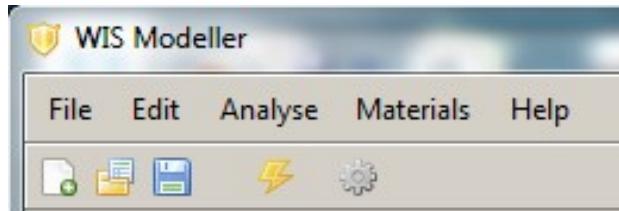
All files created or accessed by the application software are not encoded or protected. Since the data structure within the files are fixed format, bespoke to the software, it is not advisable to manually alter their contents. Editing or manipulating these files manually, could result in software instability, incorrect functionality or the production of erroneous results.

To uninstall the software, select the uninstaller application in the WIS Modeller folder in Program Files. This will remove the program and all its associated files, leaving only the data files residing in the user's home directory.

3 Using the Software

3.1 Main Menu

WIS 2T software is organised in standard Microsoft Windows format and the main functions are provided along a menu bar at the top of the screen, as shown below.



Functions from the Menu bar include:

File	Edit	Analyse	Materials	Help
New	Cut	Show Design panel	Open	About
Open	Copy	Show Analysis panel	Material Library	Tabbed Results
Save	Paste	Environmental Parameters	Re-load Material Library	SAE AIR 1168/4
Save As		Import User Search		AFML-TR-73-126; Letton
Exit		Analyse Windshield		

The Icons shown below the Menu bar are shortcuts to the Menu options. For the definitions, refer to Annex 1: Quick Reference Guide.

Selecting any of the available options under the Help menu requires a programme exit and re-start before the change is effective.

Selecting and de-selecting “Tabbed Results” switches the Analysis panel display between the default twin-pane format and a tabbed format, with larger displayed graphs. The twin-pane format is used throughout this User Manual.

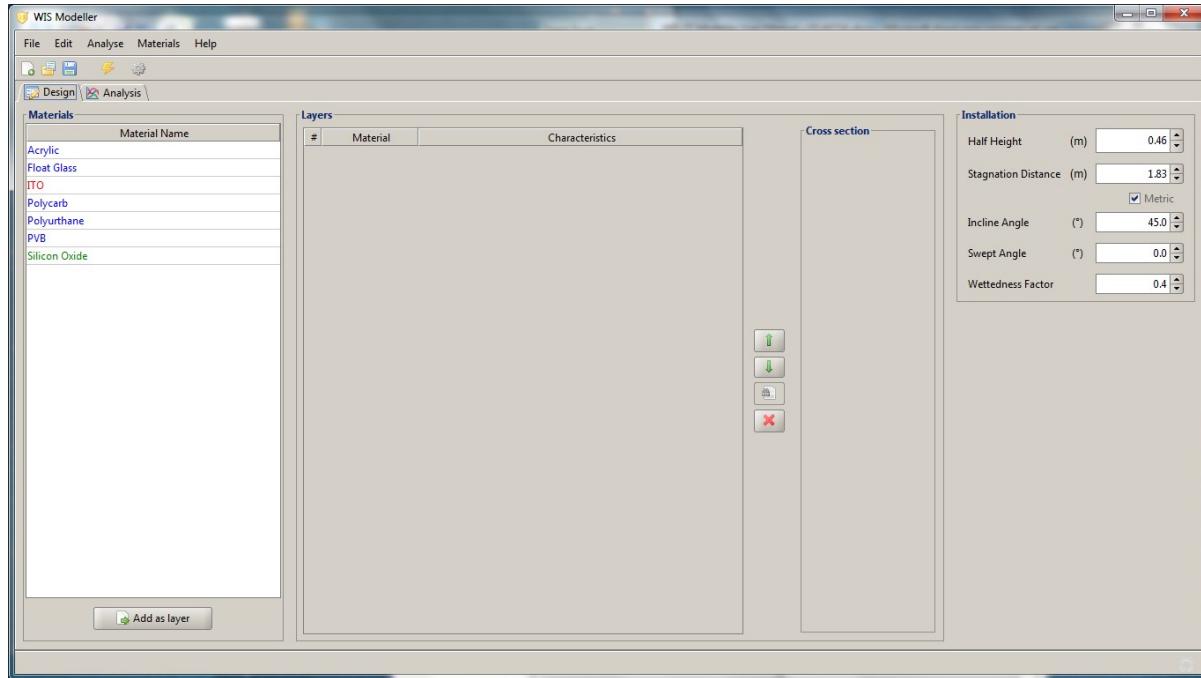
SAE AIR 1168/4 and AFML-TR-73-126; Letton are mutually exclusive and only one calculation method can be selected. The default is SAE AIR 1168/4.

TIP: Several Hot Keys and Icons are provided to allow quick navigation throughout the software. A quick reference guide to these is provided in Annex 1.

CAUTION: The Edit menu options are not available in WIS 2T.

3.2 Design Panel

After the application software is launched, the Design panel, shown below, is displayed by default. This is the main working area for constructing the windscreens by layers and busbar geometry, prior to performing the calculations and analysis.

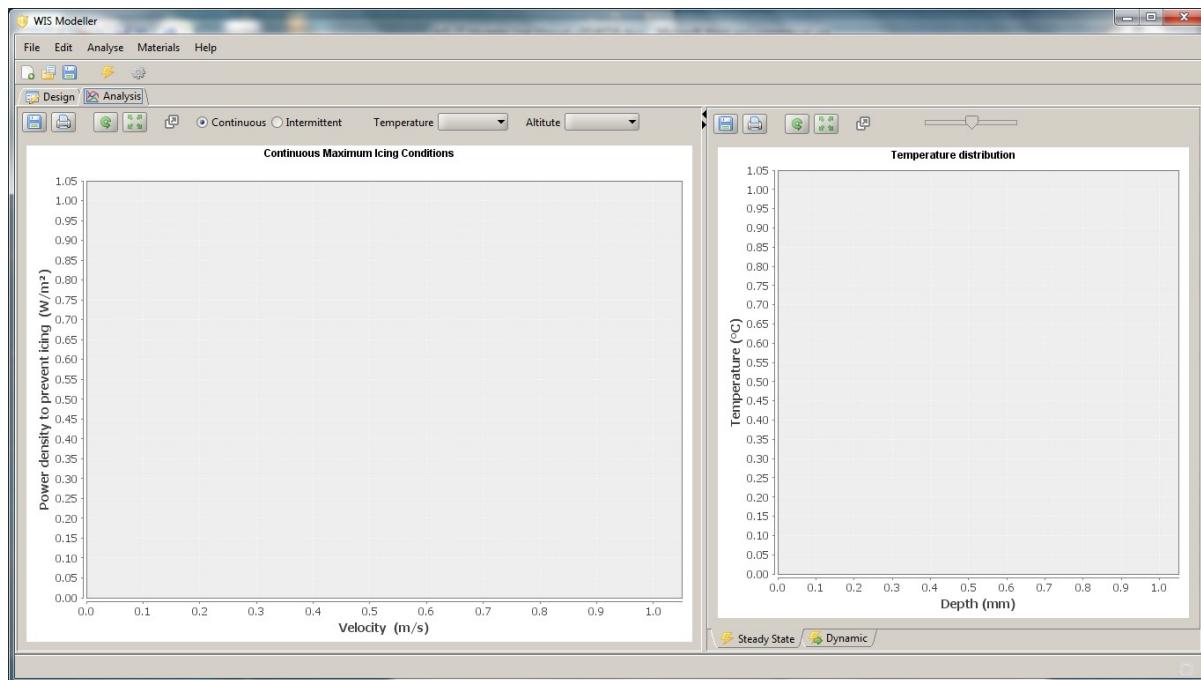


The design screen is divided into four (4) main areas:

Materials:	This area lists the materials available for constructing the windscreen design. Bulk materials, such as Float Glass, are shown in black. Heating film materials, such as ITO, are shown in red. Other coatings are shown in blue.
Layers:	This area details the construction of the windscreen design as it is being prepared. It provides an editing function for deleting or re-ordering layers after they have been created.
Cross section:	This area shows the windscreen construction in cross-section in a pictorial fashion. This cross-section picture will be used in the analysis.
Installation:	This area is for entering the windscreen installation parameters and wettedness factor as used by SAE AIR 1168/4 (and also by Letton). It provides a conversion facility to allow entry in either metric or imperial units.

3.3 Analysis Panel

The Analysis panel, shown below prior to any modelling, is the main working area for viewing the results of the mathematical modelling calculations.



There are two (2) main areas presented after the analysis is completed:

Anti-icing performance:	This area presents graphical information on the calculated power density required for preventing icing on the outer surface. It calculates and searches through both continuous maximum icing or intermittent maximum icing envelope conditions, as provided by FAR Par 25 Appendix C. The calculations are performed in accordance with SAE AIR 1168/4 or AFML-TR-73-126; Letton, whichever is selected.
Temperature performance:	This area presents the calculated temperature at each interface at a given time overlaid onto a 1-D cross-section of the windscreen construction. The initial result presented is the steady state condition. Information on the Internal and External heat transfer coefficients, Dew point temperature, inner and outer surface conditions is also provided. The calculated temperatures at each interface as a function of time can also be displayed in this area.

4 Designing a Windscreen

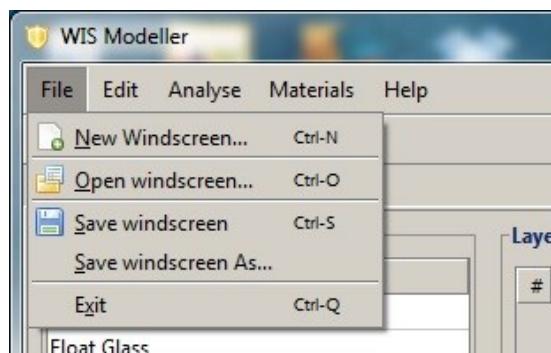
A description of all the software function and features is provided through the use of an example throughout this Section and Section 5.

In this section we will design a typical aircraft windscreen construction and shape that might be used for a large commercial jet. The construction is as follows:

- 1 3mm Float Glass outer face-ply
- 2 Anti-icing coating of ITO on inner surface of face-ply, with operating values of:
 - 7,000 KW/m² power density
 - 40°C control temperature
- 3 2mm Polyurethane interlayer
- 4 10mm Float Glass main-ply
- 5 1.5mm Polyurethane interlayer
- 6 10mm Float Glass inner-ply

4.1 File Menu

Selecting the File pull-down menu will produce the following option list:

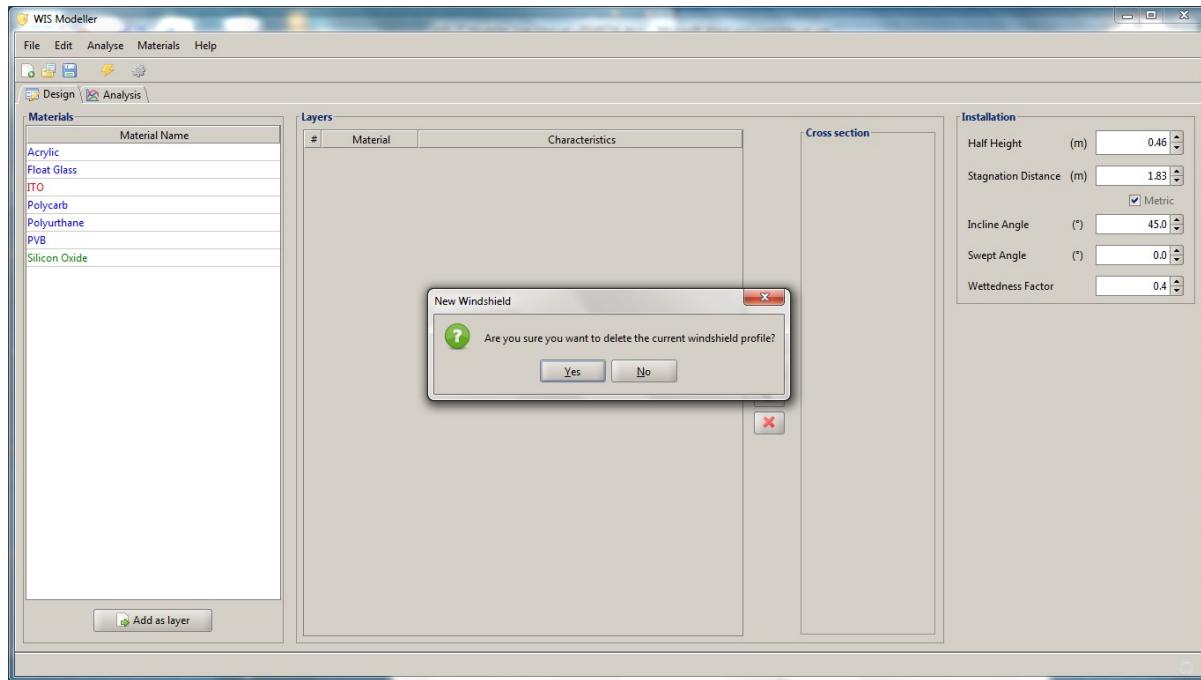


4.1.1 New Windscreen

Select this option for constructing a new design when existing data needs to be cleared. A dialogue box will appear in the centre of the screen.

4.1.1.1 New Windscreen Dialogue Box

Requires the user to confirm that deletion of current data is acceptable. This message will appear anytime the user selects an action that could potentially lose data that has not been saved.

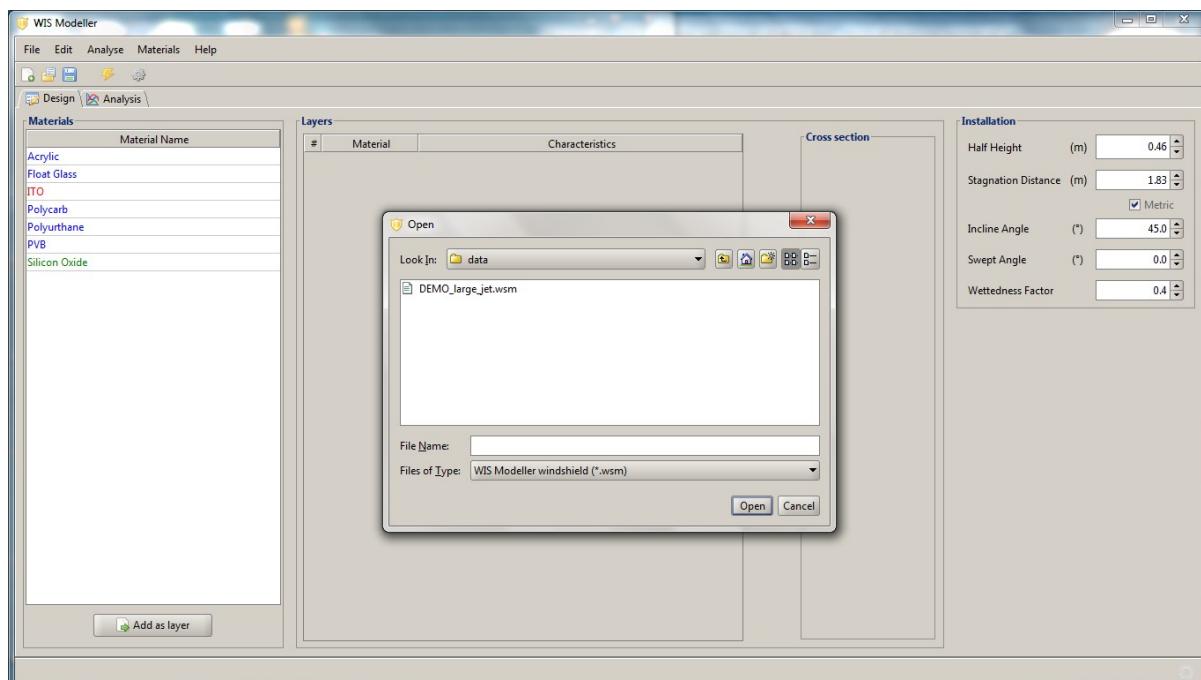


4.1.2 Open Windscreen

Select this option to retrieve a previously saved windscreen design. A dialogue box will appear in the centre of the screen.

4.1.2.1 Open Dialogue Box

Requires the user to select a *.wsm file from a list. The default directory is User/<username>/WIS Modeller/data and wsm is the default file extension. The user can navigate through file directories in normal Microsoft Windows format.

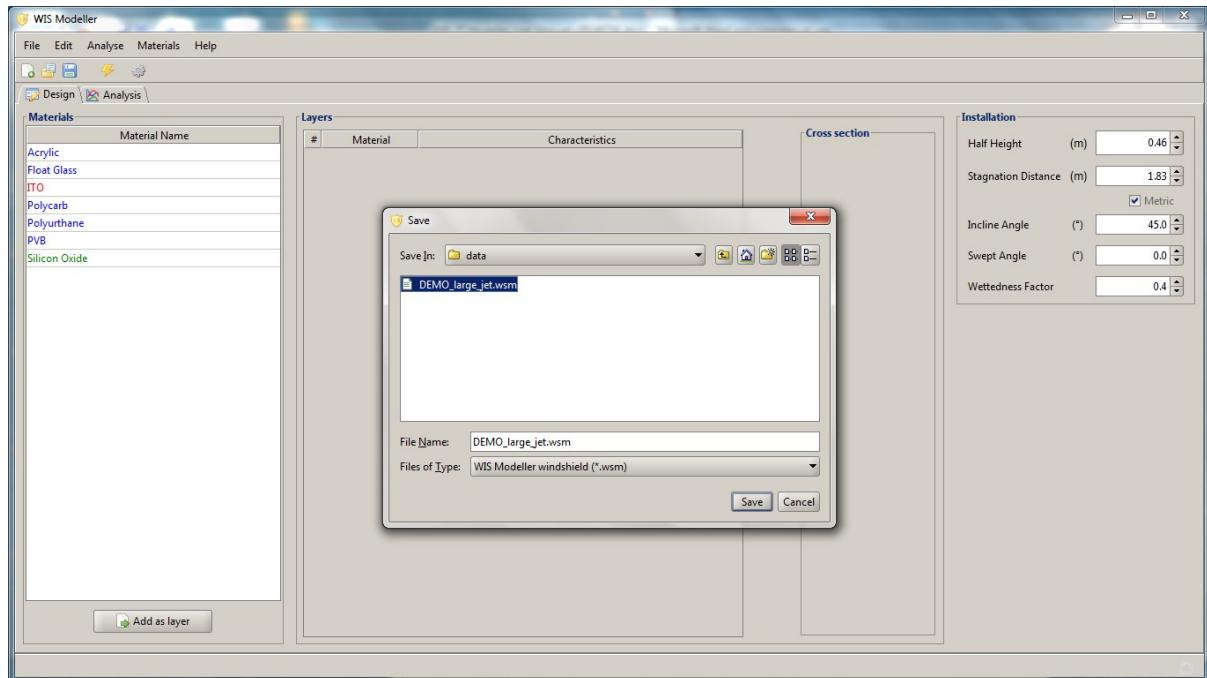


4.1.3 Save Windscreen

Select this option to save the current windscreen design. A dialogue box will appear in the centre of the screen.

4.1.3.1 Save Dialogue Box

Requires the user to select a filename for the design to be saved. The *.wsm file extension is used the default and the default directory is User/[username]/WS Modeller/data. The user can navigate through file directories in normal Microsoft Windows format.



4.1.4 Save Windscreen As

Select this option to save the current windscreen design with a different filename from the current filename. The “Save As” dialogue box will appear in the centre of the screen. Other than the title “Save As”, the dialogue box is identical to one described above.

For our example, select “New windscreen” from the File menu. Click Yes to continue

4.2 Selecting Material Layers for a Windscreen Construction

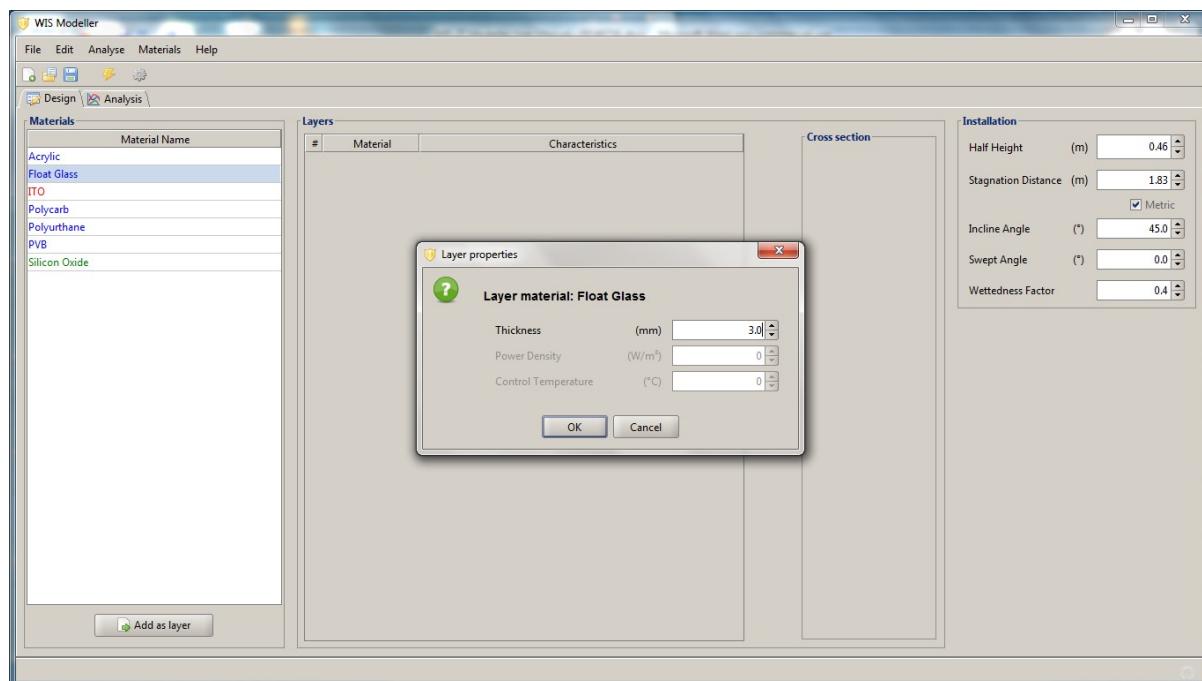
Enter a layer by selecting a material from the list in the Materials area using the mouse and then clicking on the “Add this Layer” button below the list. The Layer properties dialogue box will appear in the centre of the screen.

TIP: Materials are colour coded:

- Bulk materials, such as *Float Glass*, are shown in black.
- Heating film materials, such as *ITO*, are shown in red.
- Other coatings are shown in blue.

4.2.1 Layer Properties Dialogue Box:

The Layer Properties dialogue box allows the user to set the basic parameter variables for the particular layer in the construction. The values that can be adjusted will depend on the material type.



For bulk materials, enter the thickness of the layer in MILLIMETRES (mm) and click OK when complete.

For a heating layer of ITO, enter the layer thickness in NANOMETRES (nm), then enter the power density and the control temperature parameter values in KW/m² and °C respectively. Click OK when complete.

CAUTION: Take care to use the correct thicknesses and dimensions

The layers will build up in the Layers area and Cross-section area. Once the layers have been added to the construction, they cannot be edited. To effect a change, the layer needs to be deleted and then re-added correctly.

4.2.2 Layer Order and Delete Icons

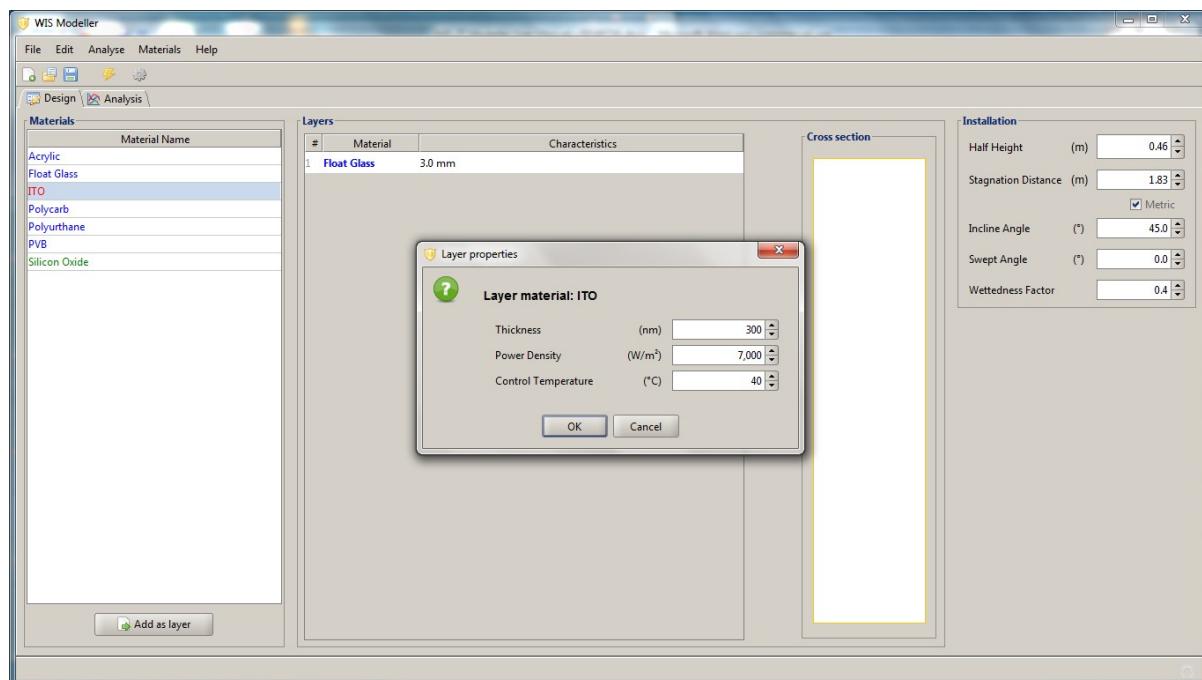


Select a layer in the Layer area and select the green arrows to move this layer up and down on the order of the windscreens construction. Use the red cross to delete the selected layer.

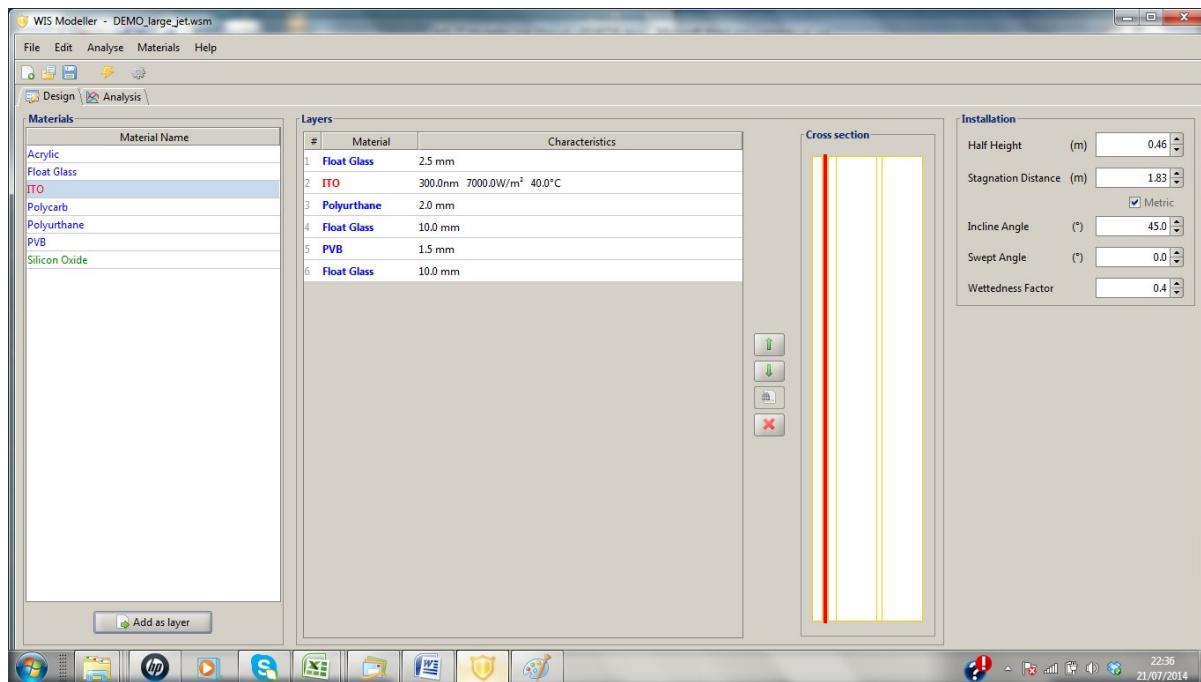
TIP: If the parameter values for any of the layers in the construction are incorrect or need to be changed, use the red cross to delete the layer and re-add the layer with the correct parameter values. Then use the green arrows to put the new (changed) layer in the correct place.

In our example, we select Float Glass first and “Add this layer”. This opens the Layer properties dialogue box. Enter 3 for the Thickness, then click OK. This will now be confirmed in the Layers area and the Windshield cross section will be filled.

Select the second layer, in our case the anti-icing coating, ITO and “Add to this layer”. Enter 300 for the Thickness, then 7000 for the Power Density and 40 for Control Temperature.



Continue to select the subsequent four (4) layers of Polyurethane, Float Glass, Polyurethane and Float Glass, in sequence, completing the Layer Properties dialogue box for each of the layers of the windscreens construction. For our example this will look like:



4.3 Windscreen Installation

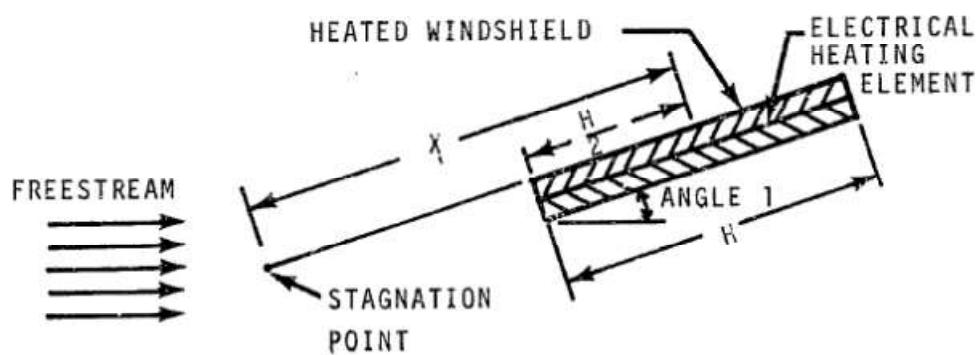
Moving over to the far right of the upper working area on the design screen, this is where the windscreens installation parameters are set. This information is required for the SAE AIR 1168/4 (and AFML-TR-73-126; Letton) calculations. There are five (5) values required and default parameters are provided. These are:

Parameter	Description
Half Height	The average height of the windscreens divided by two (2).
Stagnation Distance	The distance from the nearest stagnation point (generally the nose of aircraft) to the centre of the heated windscreens area.
Inclination Angle	Angle of the windscreens to the undisturbed free-stream ahead of the aircraft.
Swept Angle	Angle of rotation of the base of the windscreens from the perpendicular to the undisturbed free-stream ahead of the aircraft.
Wettedness Factor	The Surface Wettedness, values between 0 and 1, where 1 is completely wet. Normal values are: untreated glass = 0.4; acrylic = 0.2. Note: Setting this value to 0 under AFML-TR-73-126; Letton, enables the Wettedness factor to be calculated in accordance with this analytical method.

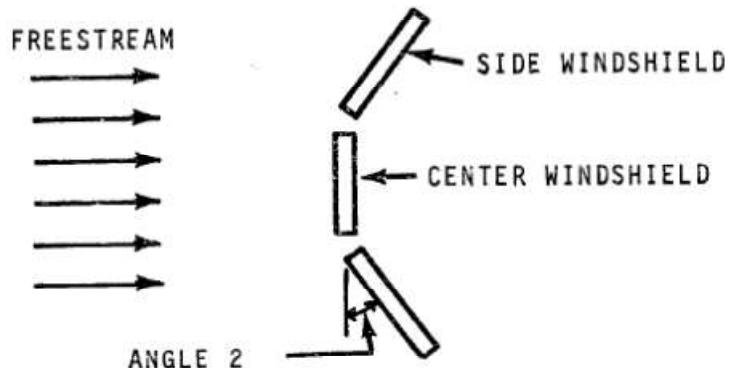
A check box is provided to allow entry of the values in either metric (checked) or imperial (unchecked) units. This is provided because SAE AIR 1168/4 and FAR Part 25 Appendix C (and AFML-TR-73-126; Letton) normally use imperial units. The consequential effect of the change of units is automatically passed forward, the units are updated on the panels and the calculations converted accordingly.

TIP: Checking and unchecking the metric box will perform the conversion for the user.

A pictorial description is provided below for further clarity.

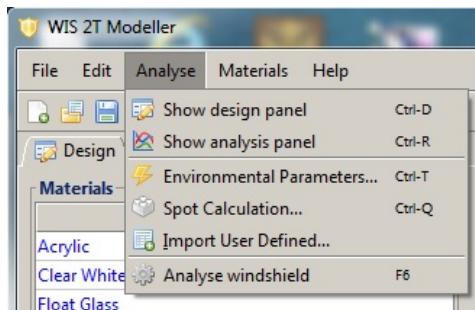


(a) WINDSHIELD SIDE VIEW



(b) WINDSHIELD PLAN VIEW

4.4 Analyse Menu



4.4.1 Show Design Panel

Changes the current view to the Design panel.

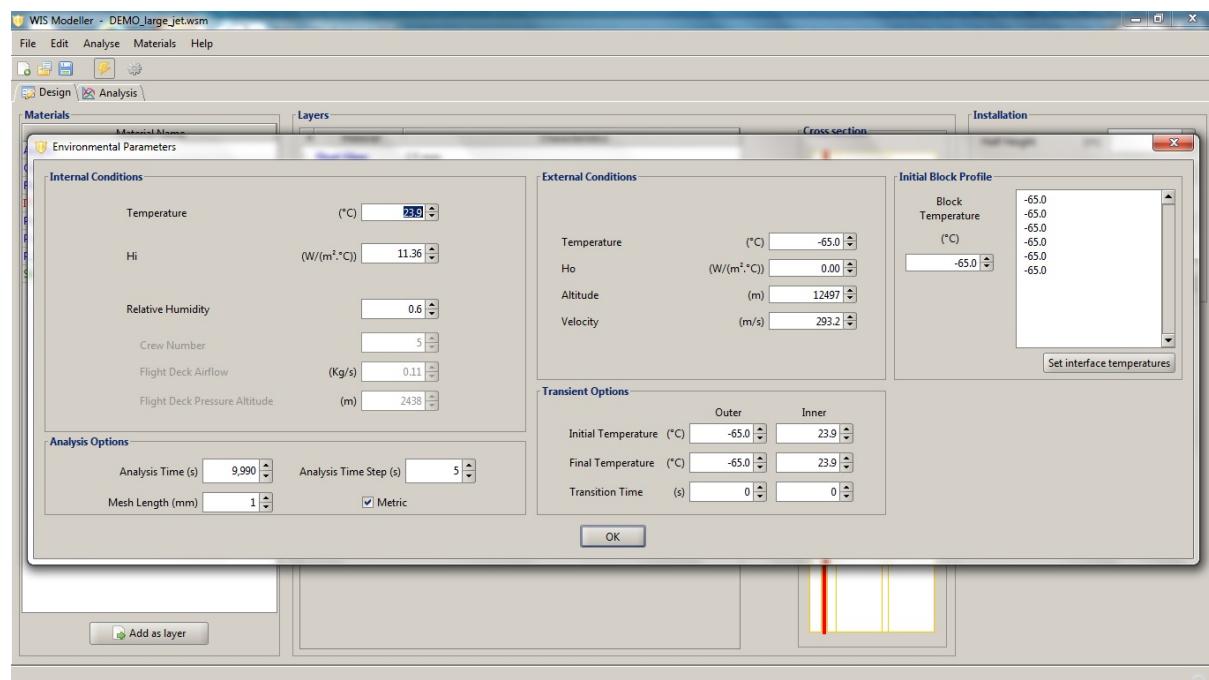
4.4.2 Show Analysis Panel

Changes the current view to the Analysis panel.

4.4.3 Environmental Parameters

Displays the Environmental Parameters dialogue box to allow the user to change the default settings.

4.4.3.1 Environmental Parameters Dialogue Box



In this dialogue box the environmental conditions are set defining the assumption and boundaries for the analysis. There are eighteen (18) parameter variables that need to be set, unless the default is acceptable, and a further three (3), if information is available on the flight deck, to perform the de-fogging calculation as exemplified in SAE AIR 1168/4. WIS 2T also provides the option to set the interface temperatures of the windscreen for the start of the analysis in the Initial Block Profile area.

Values are set by clicking on the number in the appropriate box and typing in the desired number or selecting the increase/decrease buttons by the right hand side of the number.

Internal Conditions	Temperature	The ambient internal air temperature (either °C or °F)
	Transition time	The time taken for the temperature to rise from the Block Temperature to the ambient internal temperature. This provides the user with a first level approximation for the use of cabin air conditioning (seconds)
	Hi	The internal heat transfer coefficient at the external surface of the windshield (either W/m ² or BTU/(hr.ft ² .°F)).
	Relative Humidity	The relative humidity on the flight deck as a fraction of 1 (ie 0.6 = 60% RH). If RH is set to 0, the calculation will use values for crew number, flight deck airflow and pressure altitude.
	Crew number	The number of crew on the flight deck.
	Flight Deck Airflow	The circulating mass airflow on the flight deck (either Kg/s or lbs/min).
	Flight Deck Pressure Altitude	The effective pressure altitude on the flight deck (either metres or feet).
External Conditions	Temperature	The ambient external air temperature (either °C or °F)
	Ho	The external heat transfer coefficient at the external surface of the windshield (either W/m ² or BTU/(hr.ft ² .°F)).
	Altitude	The altitude of the aircraft (either m or feet).
	Velocity	The velocity of the aircraft (either m/s or knots (True Air Speed)).
Analysis Options	Analysis time	The total time period for the Dynamic Temperature analysis (seconds).
	Time step	The time interval between each calculation of the temperatures at the interfaces (seconds).
	Frequency	The time interval between the graphed or tabulated results at the interfaces (seconds).
	Mesh Length	The basic distance between each calculation position within the block (mm)
	Metric	This check box is provided to allow entry of the values in either metric (checked) or imperial (unchecked) units. This is provided because SAE1168/4, FAR Part 25 (Appendix C) and AFML-TR-73-126; Letton normally use imperial units. The consequential effect of the change of units is automatically passed forward, the units are updated on the panels and the calculations converted accordingly.
Transient Options	Initial Temperature	Sets the initial temperature to allow for a linear change in either, or both, the outer and inner ambient temperatures, if desired. Default is the same values for outer and inner as Internal and External temperatures (°C or °F).
	Final Temperature	Sets the final temperature for the linear change. Default is the same values for outer and inner as Internal and External temperatures (°C or °F).
	Transition Time	Time taken for the linear change from intial to final, if desired. Default is zero (0) (seconds).
Initial Block Profile	Block Temperature	Defines the temperature of the block at time zero for the dynamic calculation. Assumes the windscreen is in equilibrium with the ambient temperature, which itself is the same both internally and externally (°C or °F).
	Set Interface Temperatures	Allows the interface temperatures to be defined individually (°C or °F).

In our example, these parameter values have been left as the defaults.

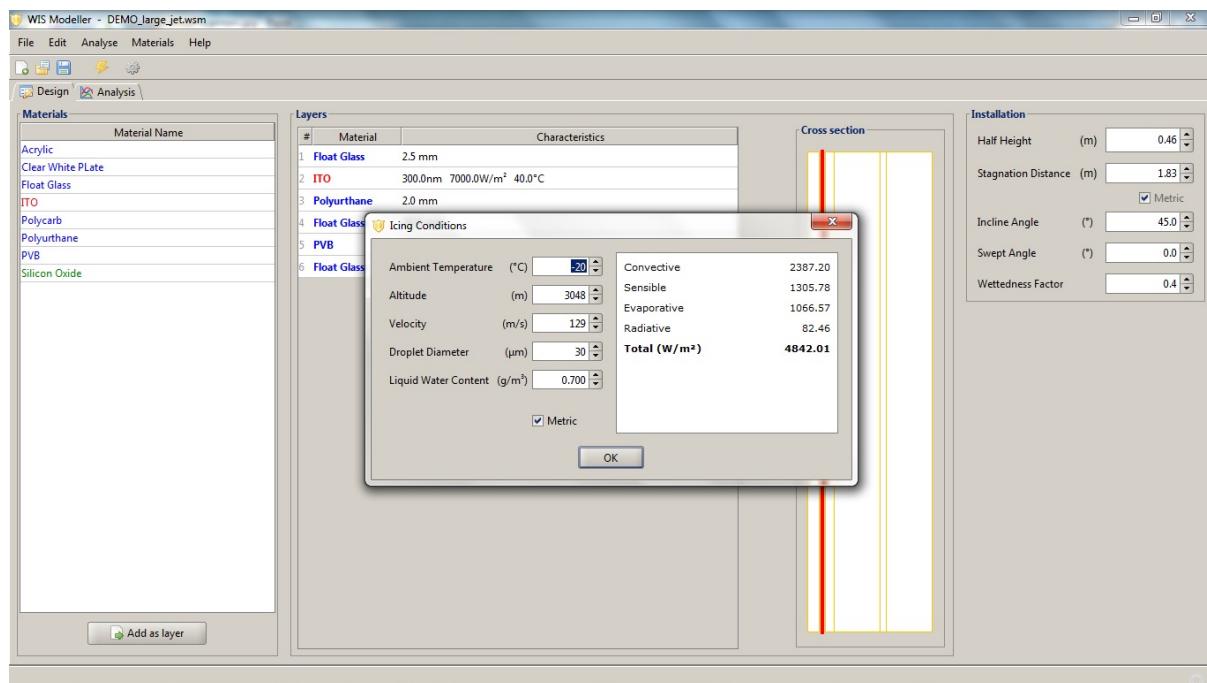
TIP: Checking and unchecking the metric box will perform the conversion for the user.

TIP: Data entry for the interface temperatures is free format. Once the Set Interface Temperatures is clicked, WIS 2T will check the correct number of interface temperatures has been entered and present the data in a column.

4.4.4 Spot Calculation

Displays the Spot Calculation dialogue box to allow the user to change the default settings.

4.4.4.1 Spot Calculation Dialogue Box

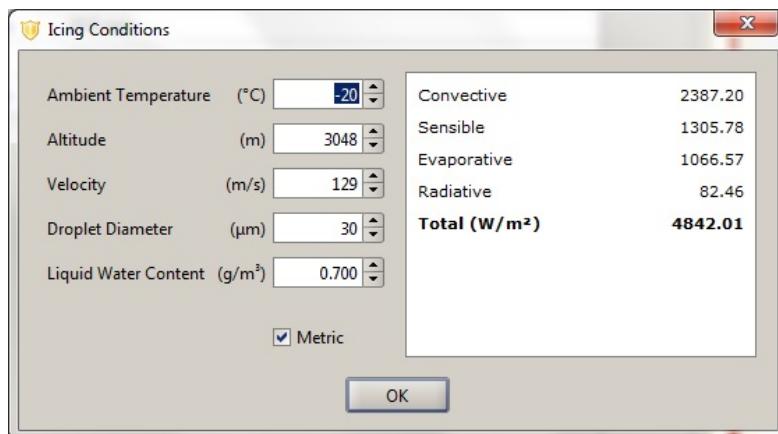


In this dialogue box the environmental conditions are set for a single calculation for the analysis, as opposed to a search and hence the term Spot Calculation. There are five (5) parameter variables that need to be set.

Ambient Temperature	The ambient external air temperature (either °C or °F).
Altitude	The altitude of the aircraft (either m or feet).
Velocity	The velocity of the aircraft (either m/s or knots (True Air Speed)).
Droplet Diameter	The appropriate droplet diameter (in microns) for the temperature and altitude and whether maximum, mixed, periodic or continuous icing conditions
Liquid Water content	The appropriate liquid water content, LWC, (in g/m ³) for the temperature and altitude and whether maximum, mixed, periodic or continuous icing conditions
Metric	This check box is provided to allow entry of the values in either metric (checked) or imperial (unchecked) units.

Values are set by clicking on the number in the appropriate box and typing in the desired number or selecting the increase/decrease buttons to the right hand side of the number.

Any changes to any of the above parameter values will instigate a new SpotCalc automatically and the new calculated heat losses will be shown in the area above the Calculate button as shown below



Click OK or to close this dialogue box.

TIP: Checking and unchecking the metric box will perform the conversion for the user.

4.4.5 User Defined Icing Conditions

Allows the User to define a bespoke set of search conditions and import these from a spread sheet into WIS 2T. This facility is currently at Beta phase and particular care is required to ensure the data is loaded correctly.

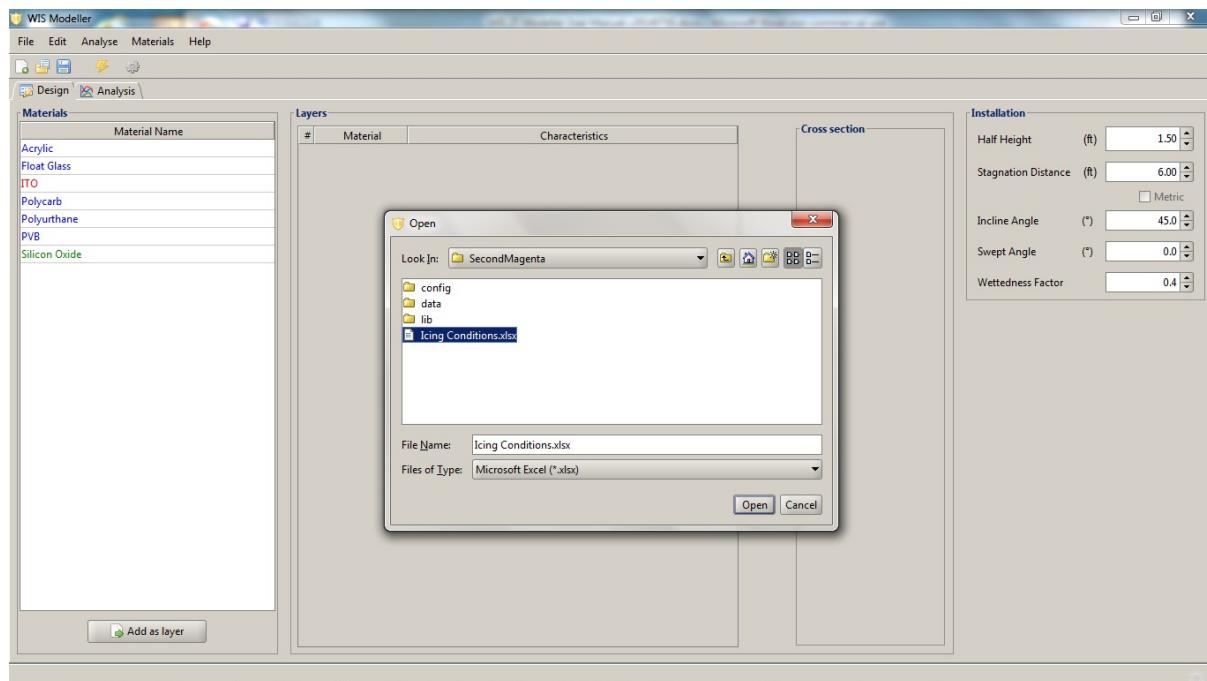
The structure of the spreadsheet is predefined and an example is provided below.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1														
2		Speed (knots)												
3							LWC (g/cm³)							
4				Amb Temp (F)	41	32	14	-4	-22	0	0			
5		50		Altitude (ft)	0	0.225	0.2	0.15	0.075	0.05				15
6		75			1000	0.225	0.2	0.15	0.075	0.05				20
7		100			2000	0.45	0.4	0.3	0.15	0.1				25
8		125			3000	0.675	0.6	0.45	0.225	0.15				30
9					4000	0.9	0.8	0.6	0.3	0.2				
10														
11														
12														
13														
14														
15														
16														
17														

Notes for the Beta phase:

- The limits of the table are set and not extendable;
- The cell positions are fixed, any changes will result in failure to read the data correctly;
- The units are not switchable and must be entered in the specified units;
- The ambient temperature must go across the spreadsheet in descending order;

Once the spreadsheet is correctly populated with the desired search parameters, click on Import User Defined icing conditions to open the spread sheet as shown below.



The software will respond with a message once the data is loaded, shown below. Click OK to proceed.



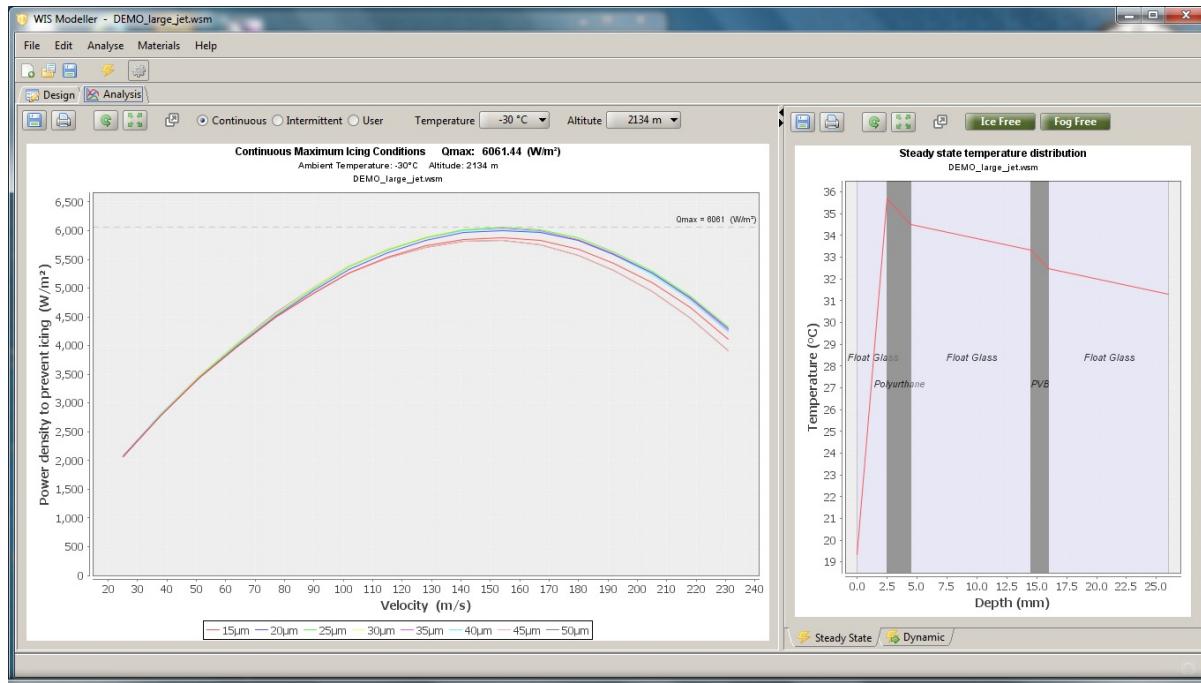
4.4.6 Analyse Windshield

Select the Analyse Windshield function to run the calculations and execute all mathematical models based on the data entered. As all the necessary parameter variables will have values, either set by the user or the defaults, all three mathematical models will produce results and automatically display them in the Analysis panel.

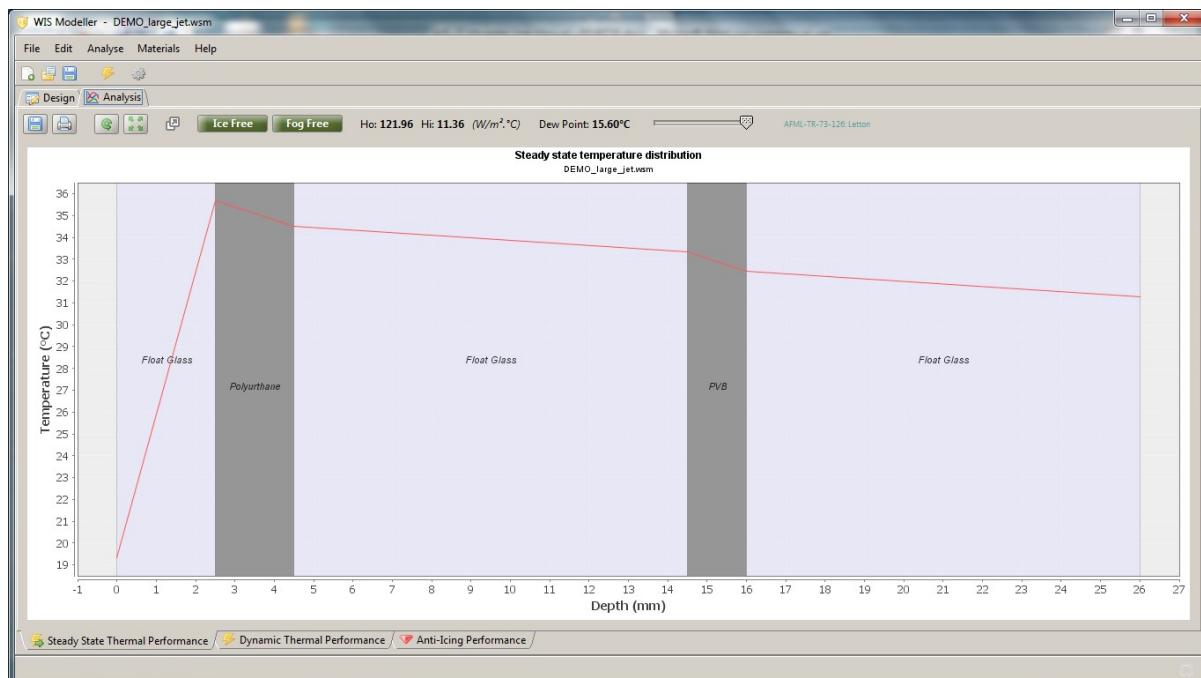
CAUTION: Ensure that all the parameter variables have been changed from the defaults where required. Check these in the Thermal, Optical and Grading dialogue boxes if uncertain.

5 Analysis of a Windscreen

In this Section, the results of the analytical calculations for the example windscreen described in Section 3 are given. On selecting the Analyse Windshield action, as described in section 3.4.6 above, the results are shown on the Analysis panel. The analysis result for our example is shown below:



This display is the Quad format. If “Tabbed Results” has been selected under the “Help Menu”, the analysis results for our example will be presented in the tabbed format as shown below, with three (3) Tabs along the bottom of the Analysis panel:



5.1 Analysis Area Icons

Each of the four (4) display areas has the following action icons:



5.1.1 Save

This icon saves the current results graph as a *.png file in the default, or last used, directory.

5.1.2 Print

This icon prints the current results graph to the installed printer choices on your computer.

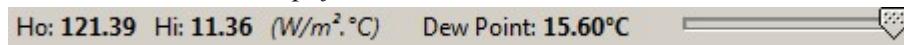
5.1.3 Restore

This icon will activate the restore function and return the graph displayed to its original sizing.

5.1.4 Expand

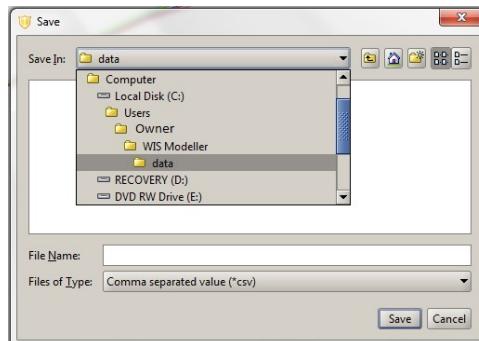
This icon will expand the current results graph to be expanded to full screen on a new panel.

TIP: The expanded panel for Steady-State Thermal Performance, provides additional information above the chart, as exemplified below:



5.1.5 Export CSV

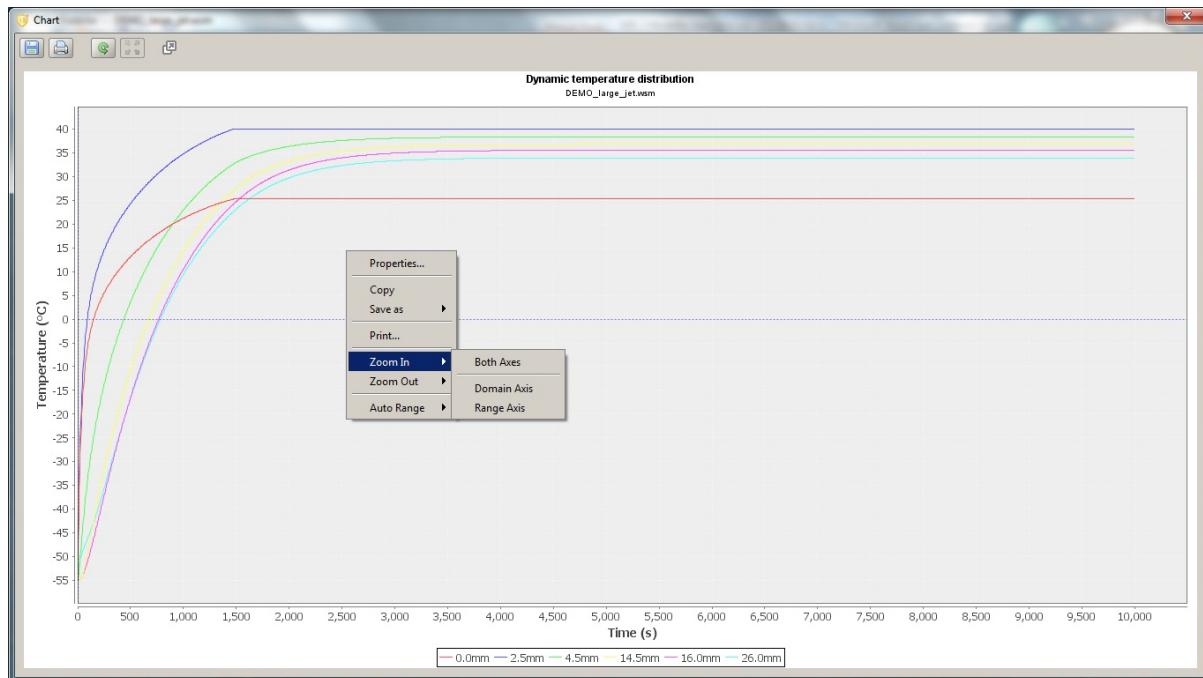
This icon allows the user to export tabular results data from the calculation. Clicking this icon will open a Save dialogue box with the default File Type Comma separated value (*.csv), as shown below:



TIP: Expanded panels maintain the action icons described above. To close an expanded panel simply click on the in the top right hand corner.

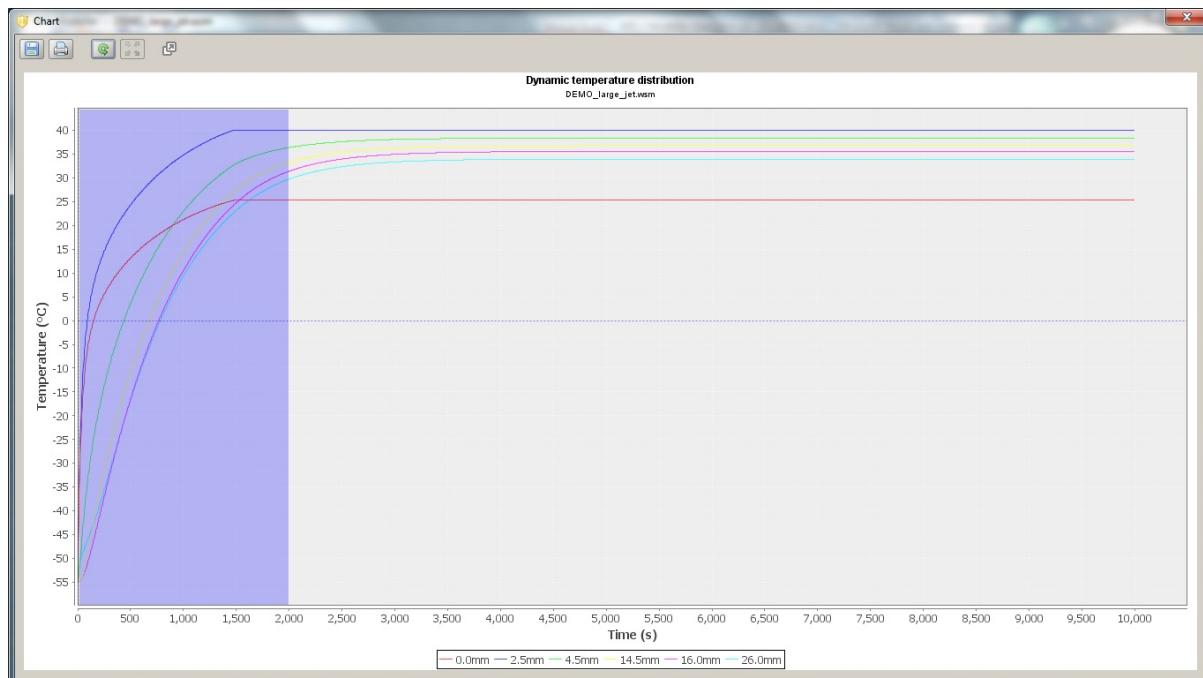
5.2 Graph Functions

The graphical displays have sizing, re-scaling, datapoint information as well as graphical text formatting. By right-clicking in the graphical area, a menu is provided, as shown below.



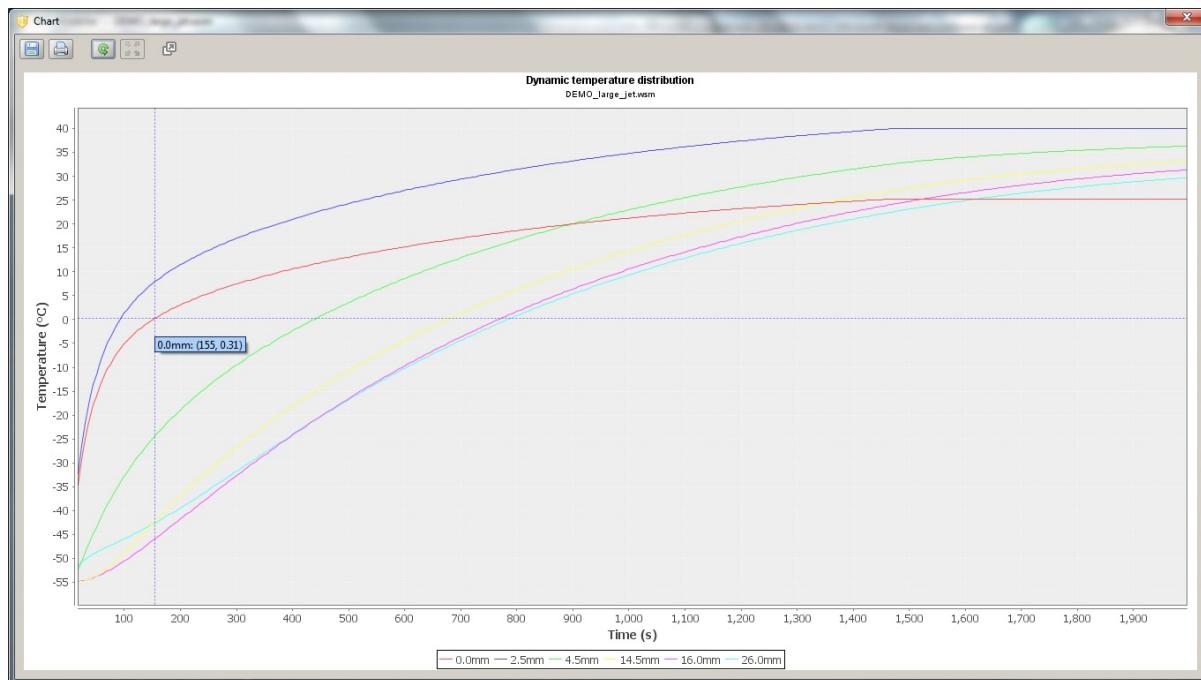
These are standard options and self-evident, so the details of these options are not described here. However, the following two tips are exemplified below:

(a): Click and drag to define the area for zoom. On releasing, the chart will re-size to that area.



TIP: To return to the original sizing click on  button

(b) Click near a point of interest and intercepts will be provided defining the x and y positions. Hover at that point and the data point details will appear temporarily.



5.3 Anti-Icing Performance

The Anti-icing results are shown in the left hand side. The software calculates the power density required for an external surface temperature of 1.7 °C (35 °F) and performed a search for the maximum power required.

The search covers approximately 11,500 scenarios for each of Continuous (Stratiform Clouds) and Intermittent (Cumuliform Clouds) maximum icing conditions, varying aircraft speed (50 to 450 knots (TAS)), altitude (0 to 22,000ft), external temperature (-22 to 32 °F), mean droplet diameter (15 to 50 microns) and liquid water content (0.04 to 0.8 and 0.09 to 2.9 g/m³, respectively) as constrained and defined within the icing conditions described in FAR Part 25 Appendix C.

If a search over a user-defined set of icing conditions has been set up (see 4.4.5) these are also calculated and presented here.

The results are shown graphically and are automatically selected to show the set of parameter variables requiring the maximum heat flow to prevent icing. The output automatically chooses different colours and a legend for each curve is provided at the bottom of the chart.

The radio buttons allow the user to select between Continuous Maximum Icing Conditions, Intermittent Maximum Icing Conditions and user-defined Icing Conditions. The analysis for our example, expanded to full size mode, is shown below.

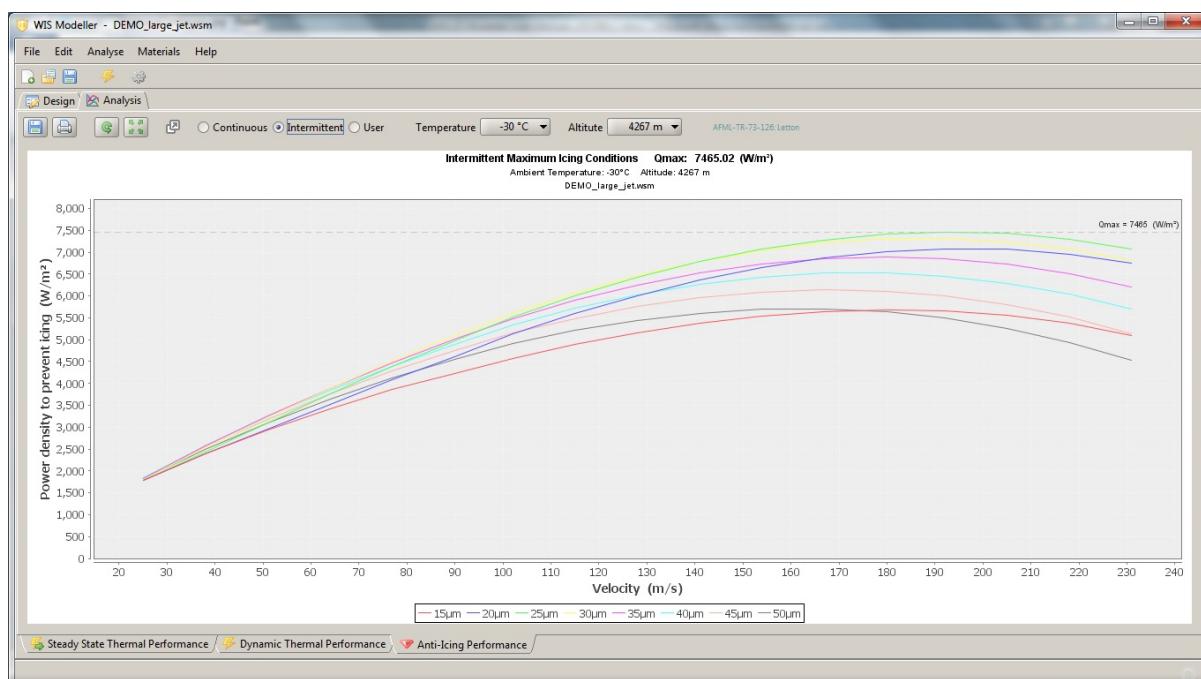
5.3.1 Continuous Maximum Icing Conditions (FAR Part 25 Appendix C)



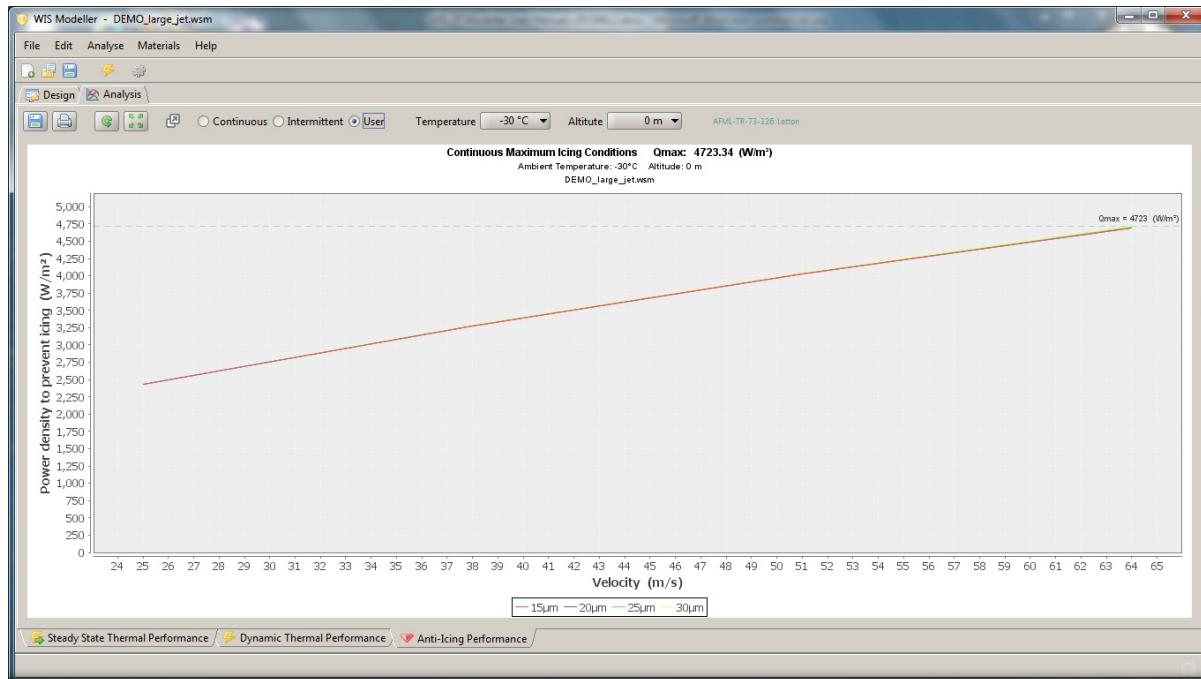
The Temperature and Altitude pull-down menus allow the user to select a results chart for different conditions. By definition these will always give lower power requirements than the initial chart that was automatically selected. The maximum power density requirement for all conditions, is shown as a dashed horizontal line on all charts, regardless of the Temperature and Altitude selected.

Note: Charts are not calculated for Temperatures and Altitudes that are not in the icing envelopes.

5.3.2 Intermittent Maximum Icing Conditions (FAR Part 25 Appendix C)



5.3.3 User-defined Icing Conditions

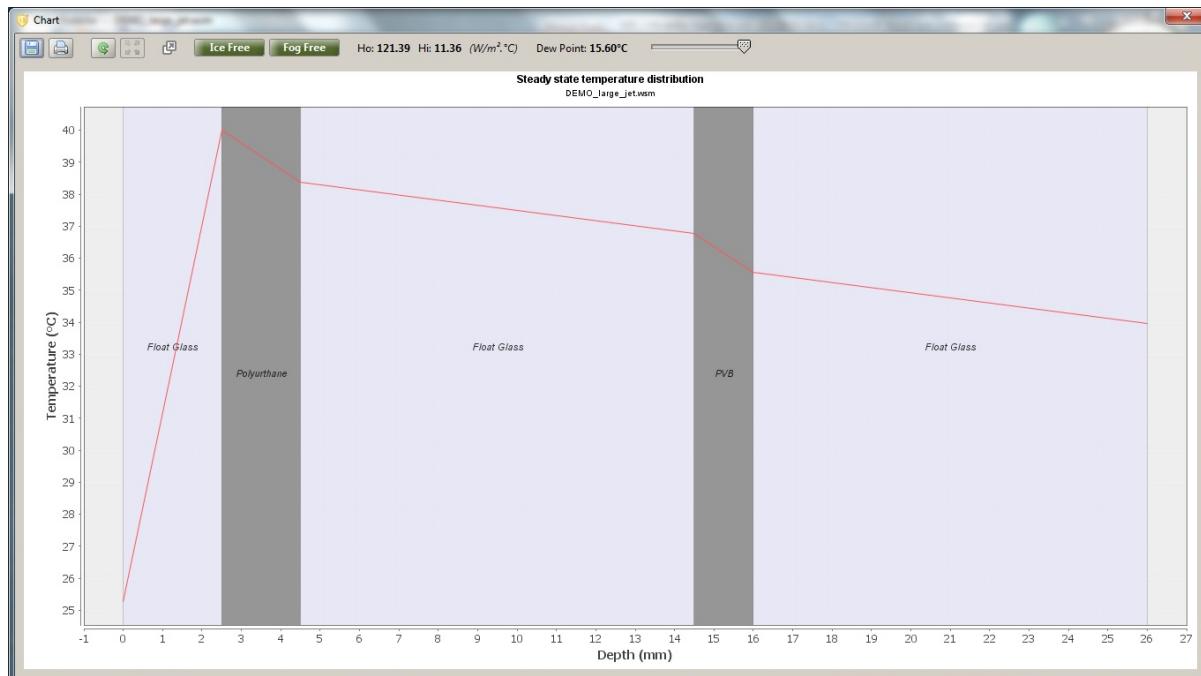


5.4 Thermal Performance

The thermal performance is shown in the top right hand quadrant. In this area there are two tabs: Steady-state and Dynamic.

5.4.1 Steady State Thermal Performance

The analysis for our example has provided the following steady-state temperature distribution based on the parameter values set in Section 3. This graph has been expanded to full size mode.



In addition to the action Icons described in Section 4.1 above, this result panel includes a slider bar, allowing the user to select and look at the temperature distribution at any of the time intervals during the analysis.

Additional information is provided in this panel: Ice free, Fog free, Ho, Hi and Dew Point. Note the Ho value in this case has been calculated, because the variable was set to zero in Section 3.5.3.1.

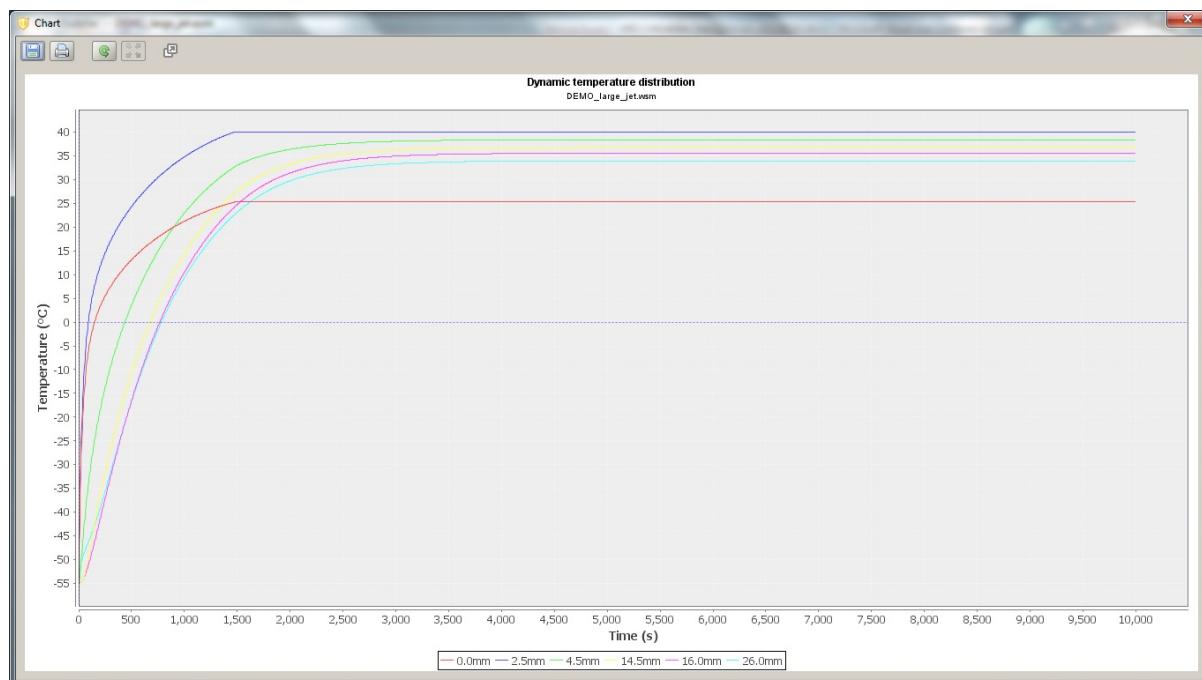
The   icons indicate that the external surface is above 1.7 °C (35 °F) and the internal surface is above the Dew point temperature. In the event that either or both are below these values, the icons will turn red and indicate risk, as exemplified here:   or  

TIP: Hovering the cursor over any of the curves will display the (x,y) coordinates at that point, as shown in the example figure above.

CAUTION: The heater layer is not annotated in this cross section. Only the bulk materials are annotated.

5.4.2 Dynamic Thermal Performance

The analysis for our example has provided the following dynamic temperature distribution based on the parameter values set in Section 3. This graph has been expanded to full size mode



This graphical output automatically chooses different colours for each curve and a legend is provided identifying the curves. Each curve represents an interface and the labels reflect the distance of that interface from the front surface.

6 Materials Library

WIS 2T is supplied with a range of common materials used in manufacture of aircraft windshields. The properties of these materials have been sourced from public domain sources and are available via the internet.

This data is stored in an XML format file called materials.xml which is automatically saved in the user's directory when the WIS 2T software is installed. For example,

C:\Users\<Username>\WIS Modeller\config.

The Materials function allows the user to edit the current material data and add new materials. Selecting the Materials pull-down menu will produce the following option list:



6.1 Open Material Library

Select this option for editing and adding new materials to the material database. Unlike the other menu selection options, a dialogue box will not appear. Instead, WIS 2T will open a new tab in your browser as shown below:

Property	Value	Unit
Density	1400	Kg/m ³
Specific Heat Capacity	1465	J/Kg°C
Thermal Conductivity	0.208	W/m°C

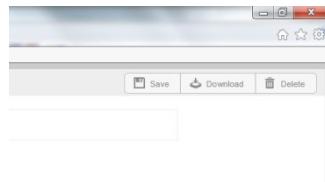
Optical Data		
Wavelength (μm)	Absorption (cm ⁻¹)	Refractive Index
0.300,	10.211174,	1.523228
0.305,	10.211174,	1.523228
0.310,	9.059410,	1.515530
0.315,	8.687547,	1.515530
0.320,	9.059529,	1.523228
0.325,	10.211174,	1.523228
0.330,	11.362934,	1.530882
0.335,	11.362934,	1.530882
0.340,	50.000000,	1.530882
0.345,	50.000000,	1.533496
0.350,	11.359446,	1.533496
0.355,	9.528425,	1.533496
0.360,	7.893745,	1.538420
0.365,	5.929424,	1.538193
0.370,	3.846195,	1.527902
0.375,	2.140862,	1.530348
0.380,	0.989402,	1.529278
0.385,	0.414844,	1.528590

The materials available in the Material Library are shown in the column on the left and the data stored is shown in the centre of the screen. WIS 2T requires the physical thermal data to be present (Density, Specific Heat Capacity and Thermal Conductivity). WIS 2T does not require the Optical data to be present. The optical data is required by other versions of WIS Modeller in the series and these use the same central materials library.

6.2 Editing Existing Material Data

To edit data, simply overwrite or add additional entries in the same format, ensuring that the data entered is in the correct units.

Once completed, click on the save button.



CAUTION: WIS 2T does not use the Download and Delete functions.

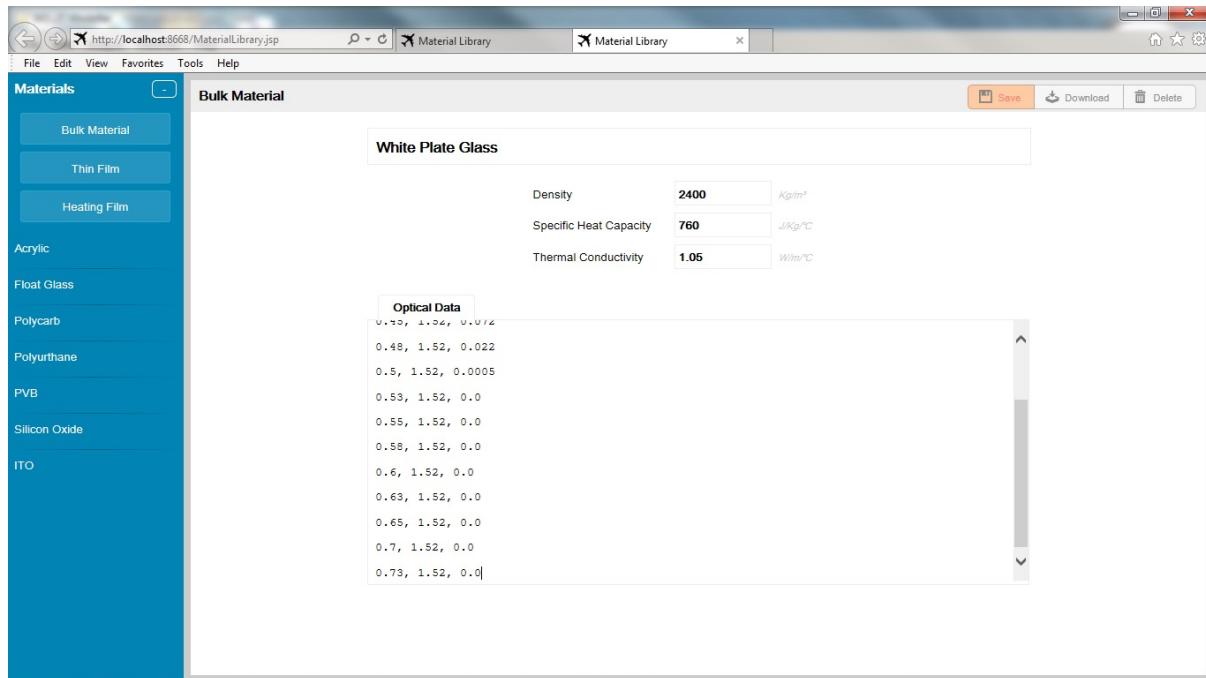
CAUTION: The edited data becomes resident in the materials library when save is clicked. The new data becomes available to WIS 2T either through the Reload Material Library option or on closing and re-starting WIS 2T.

6.3 Adding New Material Data

To add a new material, click on the button to produce the following sub-menu.

Wavelength (nm)	Absorption (cm ⁻¹)	Refractive Index
0.300	10.211174	1.523228
0.305	10.211174	1.523228
0.310	9.059410	1.515530
0.315	8.687504	1.515530
0.320	9.059529	1.523228
0.325	10.211174	1.523228
0.330	11.362934	1.530852
0.335	11.362934	1.530852
0.340	50.000000	1.530852
0.345	50.000000	1.530852
0.350	11.339446	1.533496
0.355	9.528425	1.533496
0.360	7.893745	1.533420
0.365	5.929424	1.538193
0.370	3.846195	1.527902
0.375	2.140862	1.530348
0.380	0.989402	1.529278
0.385	0.414844	1.528590

Click on the appropriate material type for the new material. For example, ITO would be a heating film. Populate the blank entries with the appropriate data in the correct units. In the example below, a bulk material is being added.



Once completed, click on the save button. The Materials list will now be updated.

Tip: Use the browser refresh button to ensure the latest data is available after entering new materials.

CAUTION: WIS 2T only uses the save function. Download and delete are not used.

CAUTION: The edited data becomes resident in the materials library when save is clicked. The new data becomes available to WIS 2T after either selecting the Reload Material Library option or on closing and re-starting WIS 2T.

6.4 Reload Material Library

Select this function to use any edited or new data.

Since the materials library is independent of the WIS 2T software, once any changes have been made to the materials library, it must be re-loaded using this function for the edited or new data to become available for modelling.

Closing and re-starting WIS 2T will automatically load the last saved version of the Material Library.

ANNEX 1: Quick Reference Guide

Function	Icon	Hot Key	Description
New Windscreen		Ctrl-N	Start new windshield design. Clears existing data
Open Windscreen		Ctrl-O	Retrieve and open windshield design from file
Save Windscreen		Ctrl-S	Save windscreens design to file with existing file name
Save Windscreen as			Save windscreens design to file with the opportunity to change file name
Show design panel		Ctrl-D	Move from current screen to Design panel
Show analysis panel		Ctrl-R	Move from current screen to Analysis panel
Thermal Properties		Ctrl-T	Enter or amend the Thermal condition parameter variables
Analyse Windshield		F8	Run the mathematical models and performs the calculations
Print			Print the current chart
Resize			Return the chart to the original size
Maximum size			Maximise the chart size on the screen
Export Data			Export data to a CSV file. Facility can be used for tabulated results.