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**Publication Date**
2002-11-22

LNBL Windows and Daylighting Group

# Optics

# Version 5.1.01

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**November 2002**

**LBNL Windows and Daylighting Group**

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# Installation

These instructions refer to installing Optics5 v.5.1.01 on your computer.   If you already have v.2.0.2 or any earlier version, you cannot use a maintenance package to upgrade to v.5.1.01, you must download and install the program again.  *Depending on your operating system, some details may be different*

The Optics5 installation program may require you to reboot your computer during installation - make sure you save all data and quit other programs before you begin the installation.

1. **Backup User Data:** If you have an earlier version of Optics5 and have saved glazing layers to your user database and want to use them with the new version, you must *export the layers you want to save as text files before the new version is installed*, because your user database will be overwritten with a new empty database, and the new version of the program cannot read databases created by older versions.

2. **Save Data and Quit Other Programs:** if the computer needs to be rebooted, you could lose data in any programs that are running.   Save data and quit all other programs - this is always good practice when installing new software.

3. **Remove Old Versions:** remove any existing versions of Optics5 by using the Add/Remove Programs option in the Control Panel.

4. **Download Package:** download the file *O5_Setup_5.1.01.exe* from the Optics website http://windows.lbl.gov/materials/optics5/

5. **Install:** double-click on this file in Windows Explorer to start the installation process.  The installation program will lead you through the remaining steps needed to install Optics5.
   If your computer needs to be rebooted, it will automatically continue with the installation process when your computer restarts.

6. **Run:** the program by double clicking on *Optics5.exe* in the default location.   The default location on W98 Systems is: *C:\Program Files\LBNL\Optics5\Optics5.exe*  This file location may differ on other operating systems, or if you selected a different installation location. You can make a shortcut to this progam (see Windows Help). Help on Optics5 is available through the main window of Optics5 - click on Help|Optics5 Help Topics

7. **Restore User Data:** if you exported files from your user database in Step 1, you can now re-import them by selecting menu option File|Import Text File(s)....

# The Main Screen

## Glazing System / Laminate Tabs

You can work on a glazing system and/or a laminate using the main screen of Optics. Select which type of system you want to work on by using the 'Glazing System' and 'Laminate' tabs in the top-left corner of the screen:
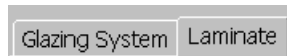


## Layer and System Properties

### Spectral Averages of Layers

The spectral averages of layers in the current system, and the spectral averages of the total system are displayed in the upper-left part of the main screen underneath their respective layer buttons:



You can change which spectral averages are displayed (see "Select the Spectral Averages Displayed" on page 36), and which standard is used to calculate them (see "Select the Standard used to Calculate Spectral Averages" on page 37).

### Spectral Averages of Selected Layer

The currently selected layer may be one of the layers in the glazing system or laminate you are working on, the total system (glazing system or laminate) you are working on, or it may be the currently selected layer from a database you are browsing.

The spectral averages of the currently selected layer are shown in the lower left part of the screen:
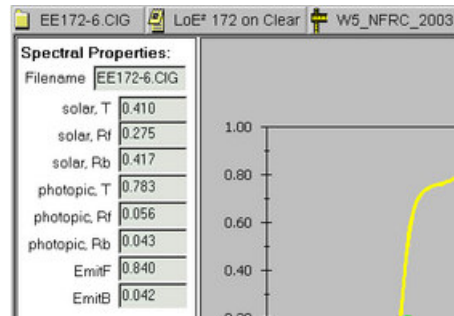


The filename of the currently selected layer and its product name are shown in the status bar in the middle of the screen, along with the standard being used to calculate spectral averages.

You can change which spectral averages are displayed (see "Select the Spectral Averages Displayed" on page 36), and which standard is used to calculate them (see "Select the Standard used to Calculate Spectral Averages" on page 37).

## View Details of Layer

You can view the most commonly referenced database information fields for the currently selected layer by:

- Choose menu option **View|View Details**
  *or*

- Press the view details toolbar button: 

- The 'View Details' dialog box will be displayed – it looks like the left-hand side of the 'Change Glazing' dialog box (see "The Change Glazing Dialog Box" on page 17)

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**Note:** You cannot edit any of the fields in the 'View Details' dialog box - if you want to edit these details, you must load the layer if it is not already loaded, then use the menu option **Edit|Change Details**

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## Spectral Data Graph

The spectral data of the currently selected layer are displayed as a graph in the lower right part of the screen:
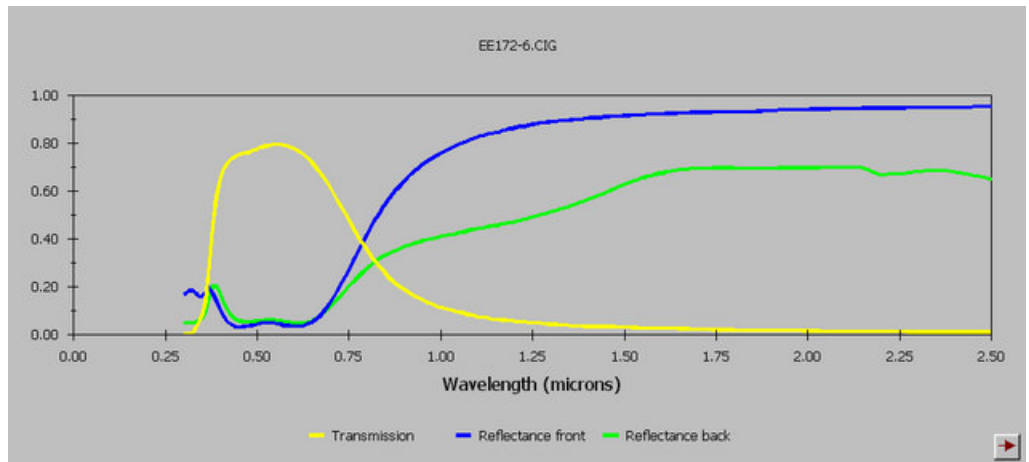


The three traces correspond to the transmittance, front reflectance and back reflectance of the layer. The convention used is that 'front' is the exterior side and 'back' is the interior side.

You can control the x-axis and y-axis ranges of the spectral data graph (see "Graphs" on page 41). You can also copy the graph to the clipboard and paste it into other applications (see "Copy Graph to Another Application" on page 42).

To view the spectral data in tabular form, see "Viewing the Spectral Data Grid" on page 4.

## Viewing the Spectral Data Grid

To view the spectral data of the currently selected layer as a grid:

- Choose menu option **View|Spectral Data Grid**
  *or*

- Press the spectral data grid toolbar button:

- The spectral data grid will be displayed:



You can scroll through the spectral data. Press 'OK' to close the window.

# Databases

## Browsing the Databases

You can browse through glazings in the database in several ways:

- Use the grouping and sorting features to organize the database (see below) – expand any group by clicking on the '+' sign next to the group heading

- Use the mouse to scroll up and down the list of glazings displayed *or*

- Use the up and down arrow keys on the keyboard to move up and down the list of glazings

The currently selected glazing will be highlighted in the database, and its spectral averages and spectral data graph will appear in the lower part of the screen.

You can scroll across to view all the display fields in the database using the scroll bar under the database – the 'Filename' and 'Type' fields do not scroll. You can also re-size any of the columns to make them easier to read by dragging the column dividers left or right, but this setting is not saved if you change views of the database.

You can also view different sub-sets of the database depending on what operation you want to perform next by using the different tabs above the database. See "Add Layers to a Glazing System" on page 12 and "Add Layers to a Laminate" on page 25 for more details. You can see all layers in the database by using the 'View All' tab.

## Sorting the Databases

You can sort by any field/column in the database.

To sort on a field:

- Click on the field/column heading – an up or down arrow appears on the column heading indicating the direction of the sort (Ascending or Descending).

- To reverse the direction of the sort, click on the field/column heading again

**Note:** Some fields may not sort in the way you expect – for example, 'NFRC ID' is sorted as text, so 750, 751 and 7500 are sorted as : 750, 7500, 751

## Grouping Data in the Databases

The data in the database can be grouped on any field. This will group together all records in the database which have the same value for that field under an expandable heading. Grouping can be 'nested' to several levels. This is most useful when used with fields that have a limited number of possible values such as 'Type', 'Manufacturer', 'Nominal Thickness' etc. For numeric values and fields with many possible values such as 'Filename', it is better to sort the data instead.

Most of the time the databases are automatically grouped by the 'Type' field.

To group data:

- Drag the column heading of the field you want to group by into the region above the database grid:
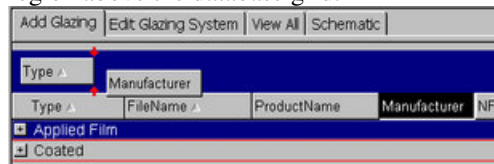


This example shows grouping by 'Type', then by 'Manufacturer'

- If you want to nest grouping levels, position the column heading relative to the grouping levels already shown.

- Expand a group by clicking on the '+' sign in the group heading.

## Find Records in the Databases

You can search for records in the database by matching text in any field. To search the current database:

- Press the Search button on the toolbar: 
  *or*

- Choose menu option **Database|Find**
  *or*

- Use the keyboard shortcut Ctrl-F

- The search database dialog box will be displayed:



- Select the field you want to search in from the drop-down list of fields

- Enter the text to search for in the 'Value' box

- If you want an exact match, check the box below before pressing 'OK' – this is recommended if you are searching on NFRC ID.

## Selecting and Loading Layers from the Databases

To select and load layers from the database into the glazing system or laminate that you are working on:

- Choose the destination of the new layer by selecting a layer in the current system using the layer buttons:

    - click on the layer button corresponding to the layer you want to select. The button above the selected layer will turn bright yellow – here the first layer (#1) is selected, and the tooltip for the layer button is displayed:
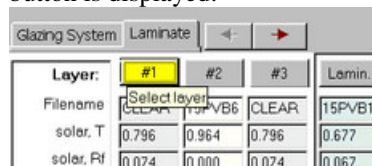
    

    - If the layer you want to select is not visible, use the arrow keys above the layer buttons to scroll left and right through the system layers.

- Choose the database containing the layer you want to load (see "Switching Between Databases" on page 7)

- Browse to and select the layer you want to load (see "Browsing the Databases" on page 5). *Hint:* use the 'Add Glazing', 'Add Interlayer' and 'Add Embedded Coating' tabs to find the layer you want to load.

- To load the layer:

    - Double-click on the layer in the database
    *or*

    - Using the mouse, drag the layer from the database over the layer button where you want to add the layer and release the mouse button
    *or*

    - Select the layer in the database, then choose the menu option **Database|Add/Replace Layer**
    *or*

    - Select the layer in the database, then right-click to display the pop-up menu then choose **Add/Replace Layer**

If you are replacing a layer, a dialog box will appear to confirm that you want to replace the existing layer.

## Switching Between Databases

There are three ways to switch between the main (IGDB) database and the user database:

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- Use the drop-down list on the toolbar to select the database:



*or*
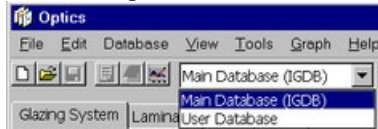
- Choose the menu option **Database|View** and select an option
  *or*

- Right-click the database to display the pop-up menu and select an option

## Deleting Layers from the User Database

To delete an individual layer from the user database:

- Select the layer in the user database to delete

- Choose menu option **Database|Delete from database**
  or

- Right-click on the layer to display the pop-up menu and select the option **Delete from database**

**Note:** You cannot delete layers from the IGDB.

**Note:** To organize your user database better, you can use more than one user database (see "Selecting a User Database" on page 31).

If you want to delete ALL layers from your default user database (`UserGlazing.mdb`):

- Quit Optics

- Delete the file '`UserGlazing.mdb`' in the '`\LBNL Shared`' subdirectory of your program installation.

- Make a copy of the file '`Empty UserGlazing.mdb`' in the '`\LBNL Shared`' subdirectory of your program installation and rename the **copy** '`UserGlazing.mdb`'.

- Restart Optics – the user database will now be empty

# Schematic View

The schematic view shows a diagram of the glazing system or laminate that you are currently working on.  By convention, the outside (exterior) is on the left, and the inside (interior) is on the right.  These correspond to the 'front' and 'back' sides of the system respectively.
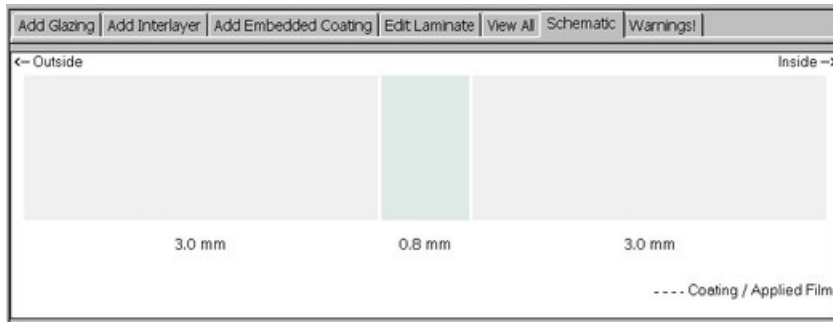
Each layer is drawn in correct relative scale, and is drawn in the color of light transmitted through that layer (if color averages are available in the selected standard). The thickness of each layer is shown, unless the text will not fit, in which case the thickness text will not display. The gap width for glazing systems is shown to scale, and can be set (see "Gap Width in Glazing Systems" on page 40).

You can see the filename and thickness of each layer as a tool tip in the schematic view by holding the cursor over the layer.

The position of coatings and applied films are indicated by a dashed line:
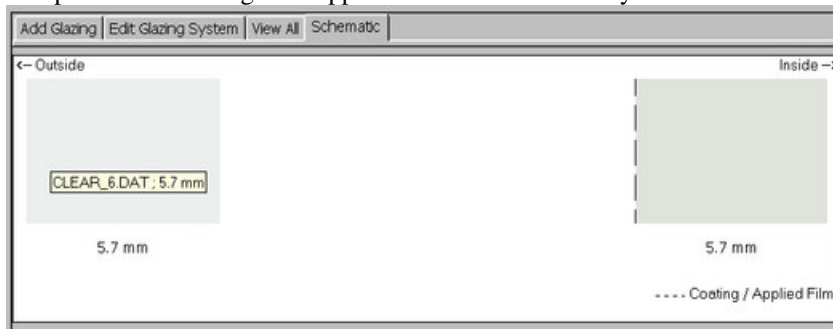


# Warnings

The 'Warnings' tab appears after you have constructed a laminate or transformed a layer. It shows which wavelengths may have unreliable calculated spectral data based on the type of calculation just performed.
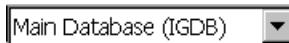
See "Calculation Warnings for Transformed Layers" on page 22 and "Calculation Warnings for Laminates" on page 29 for more information about warnings. You can save warnings to a file if you want to review them later – see "Save Layer or System Calculation Warnings to a File" on page 35.

# Toolbar

The toolbar at the top of the main screen gives you some shortcuts to common operations:



- **New**

    - "Start Building a New Glazing System" on page 12

    - "Start Building a New Laminate" on page 24

- **Open** (edit existing)
  - "Edit a Glazing System" on page 15
  - "Edit a Laminate" on page 28
- **Save**
  - "Saving Layers to the User Database" on page 32
  - "Save a Glazing System" on page 14
  - "Save a Laminate" on page 28
- **View Glazing Details**
  - "View Details of Layer" on page 3
- **View Spectral Data**
  - "Viewing the Spectral Data Grid" on page 4
- **Change Graph Options**
  - "Graphs" on page 41
- **Search Database**
  - "Find Records in the Databases" on page 6
- Main Database (IGDB) ▼ **Switch Between Databases**
  - "Switching Between Databases" on page 7

# Menus

File  Edit  Database  View  Tools  Graph  Help

The menu options perform similar operations whether you are working on a laminate or a glazing system.  The 'system' is the glazing system or laminate you are currently working on.

For detailed information on what each menu item does, check the "Command Reference" on page 43.  For a brief description of each menu's functions, see below:

- **File Menu**
  Create a new system, Edit an existing system, Export data to other programs, Import data from text files, Quit the program

- **Edit Menu**
  Operate on the current layer or system: Delete the layer, Flip the layer, Transform the selected layer (Change thickness, Change substrate, Change coating, Change Film), Rename the selected layer or system, Change details for the selected layer or system, Change the gap width for glazing systems

- **Database Menu**
  Add/Replace selected layer from the database to the current system, Insert selected layer from the database into the current system, Find layers in the database, Delete layers from the database, Switch between databases, Check current database version

- **View Menu**
  View spectral data grid for selected layer, view selected layer details, Refresh current view

- **Tools Menu**
  Change program settings: change the standard used to calculate spectral averages, the set of spectral averages displayed, the color function used for color averages, the wavelength set used when calculating laminate data. Change file locations and display options.

- **Graph Menu**
  Set X- and Y-axis scaling modes and copy the current spectral graph to the clipboard

- **Help Menu**
  View the Optics5 Help file, view information about the program, Visit the Optics5 web page, FAQ page and check for IGDB updates on the web.

# Creating a Glazing System

## Start Building a New Glazing System

When Optics5 starts, you can start building a glazing system immediately by adding layers (see "Add Layers to a Glazing System" on page 12) .

If you have created a glazing system already, but want to start over with an empty glazing system:

- Make sure the 'Glazing System' tab is selected

- Choose menu option **File|New Glazing System**

- You will be prompted to save the current glazing system if one already exists

**Note:** if you created new layers and did not save the layers or did not save the glazing system (which would save any new layers), the new layers will be lost when you start a new glazing system

## Add Layers to a Glazing System

You can add monolithic, coated, applied film, laminate and unknown type layers to a glazing system.

To add layers from the current database to a glazing system:

- Select the first available (unoccupied) layer in the glazing system by clicking on its layer button – if you select an occupied layer, it will be replaced (see "Replace a Layer in a Glazing System" on page 14)

- Select the 'Add glazing' tab in the database

- Double-click on the layer in the database
  *or*

- Using the mouse, drag the layer from the database over the layer button where you want to add the layer and release the mouse button
  *or*

- Select the layer in the database, then choose the menu option
  **Database|Add/Replace Layer**
  *or*

- Select the layer in the database, then right-click to display the pop-up menu then choose **Add/Replace Layer**

If you are replacing a layer, a dialog box will appear to confirm that you want to replace the existing layer.

**Note:** Select a layer in the database by clicking on it with the mouse, or by browsing to it by pressing the up and down arrow keys (see "Browsing the Databases" on page 5)

**Note**: 'Film' type glazings are adhesive-backed films that must be combined with a rigid substrate to form an 'Applied Film' layer before they can be added to a glazing system (see "Creating an Applied Film Layer" on page 20) or laminate.

**Note:** The 'Add Glazing' tab restricts the view of the database to only those layers which can be loaded into a glazing system. If you use the 'View All' tab to view all layers in the database, and you attempt to load an invalid glazing into a glazing system, an error message will be displayed.

# Flip Layers in a Glazing System

Asymmetric layers must be stored in the database in one particular orientation – when they are loaded, they have this orientation by default. If you want to flip the layer:

- Select the layer to flip by clicking on the layer button

- Choose the menu option **Edit|Flip Layer**
  *or*

- Right-click on the layer button to display the pop-up menu and select **Flip Layer**

**Note:** Check the schematic view and the layer spectral averages if you are not sure which way a layer is oriented.

# Insert Layers in a Glazing System

You can insert a layer from a database in between two layers in a glazing system. To insert a layer:

- Select a layer in the glazing system by clicking on the layer button – the inserted layer will be inserted to the left (exterior) side of the selected layer

- Select the 'Add glazing' tab in the database

- Select a layer in the database

- Choose the  menu option **Database|Insert Layer**
  *or*

- Right-click on the layer in the database to display the pop-up menu and select **Insert Layer**

# Delete Layers in a Glazing System

You can delete any layer in a glazing system.  To delete a layer:

- Select the layer to delete by clicking on the layer button

- Choose the menu option **Edit|Delete Layer**
  *or*

- Right-click on the layer button to display the pop-up menu and select **Delete Layer**

# View the Properties of a Glazing System

To view the calculated spectral data, spectral averages and other properties of a glazing system:

- Select the glazing system by clicking on the 'System' layer button

- The glazing system is now the current layer, so the total system's spectral data and spectral averages are displayed in the lower part of the screen

- To view a schematic diagram of the glazing system, select the 'Schematic' tab in the upper right part of the screen

- To view the spectral data in a table, choose menu option **View|Spectral Data Grid** (see "Viewing the Spectral Data Grid" on page 4)

- To see more information about the glazing system, choose menu option **View|View Details** (see "View Details of Layer" on page 3)

# Replace a Layer in a Glazing System

To replace a layer in a glazing system with another layer from the database:

- Select the layer to replace by clicking on the layer button

- Select a layer from the database

- Choose the menu option **Database|Add/Replace Layer**
  *or*

- Right-click the layer in the database to display the pop-up menu and select **Add/Replace Layer**

- The program will ask you to confirm the replacement

# Save a Glazing System

To save a glazing system to the user database:

- Select the glazing system by clicking on the 'System' layer button

- Click the 'Save' button on the toolbar: 🖫
  *or*

- Choose the menu option **File|Save** *filename*
  *or*

- Right-click the layer button to display the pop-up menu and select **Save** *filename*

---

**Note:** To save the glazing system under a different name, choose the menu item **Save As…**

---

**Note:** Glazing systems saved in Optics 5.1 cannot be exported to WINDOW 5.1 – only individual glazing layers of monolithic, coated, laminate, unknown or applied film type can be exported.

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# Edit a Glazing System

To edit a glazing system that you previously saved to the user database:

- Switch to the user database

- Click on the 'Edit Glazing System' tab
  *or*

- Choose the menu option **File|Open Glazing System**

- Load the saved glazing system you wish to edit like you would a layer (see "Add Layers to a Glazing System" on page 12)

**Note:** The IGDB does not have any editable glazing systems in it, only the user database can contain glazing systems.

# Transform a Glazing Layer

## About Transforming Layers

Using Optics5, you can transform glazing layers by changing their thickness, applying or changing coatings and films or by swapping substrates. These transformations are performed on layers loaded into a glazing system or laminate. All of these operations create one or more new glazing layers which can be saved to the user database. These calculations are prone to errors for certain combinations of input data – Optics5 will give a list of warnings where data is likely to be unreliable after a transformation operation. You will get the best results by following the guidelines under each transformation topic.

Not all transformations are allowed for all glazing types, and some operations require certain optional data to be present in the database. If it is not possible to perform a transformation operation, it will not be available to you, or you will see a message describing the problem.

### Transforming Layers in Glazing Systems

To transform a layer in a glazing system:

- Select the layer by clicking on a layer button

- Choose an item from the menu **Edit** (not all choices may be available)

**Note:** You cannot transform glazings of unknown type, laminates, coated layers without a valid substrate reference in the database or applied film layers without a valid substrate reference in the database

### Transforming Layers in Laminates

To transform a layer in a laminate:

- Select the layer by clicking on a layer button

- Choose an item from the menu **Edit** (not all choices may be available)

**Note:** You cannot transform glazings of unknown type, interlayers, coated layers without a valid substrate reference in the database or applied film layers without a valid substrate reference in the database

### *The Change Glazing Dialog Box*

The Change Glazing dialog box is used to enter new information when transforming layers or editing information fields for a layer:



The left side of the dialog box shows the details of the current layer – the right side of the dialog box shows the details of the modified layer. Fields you can edit are shaded blue. Hold the cursor over each blue field for a tool tip describing how you can edit that field (some fields use drop-down lists or pop-up browsers to select from a range of values). When you have finished modifying the fields, click 'OK' to create the modified glazing. If you enter an invalid value in a field, you will receive a message telling you what the problem is immediately or when you try to commit the changes.

# Change Thickness

You can change the thickness of monolithic layers and coated or applied film layers where the substrate is known and is also present in the database. You cannot change the thickness of interlayers, laminates or glazings of unknown type.

If you change the thickness of a coated or applied film glazing, you are really changing the thickness of the substrate layer, then re-applying the coating or film to the new substrate. This means that if you perform this transformation you will be creating two new layers – so you will be asked to enter filenames for a new substrate and a new coated or applied film layer.

To change the thickness of a layer:

- Select the layer by clicking on a layer button

- Choose the menu option **Edit|Change Thickness**

- In the Change Glazing dialog box, the thickness box appears highlighted – click on it to enter a new thickness (in mm). It is strongly recommended that you always increase the thickness (see "Getting the Best Results when Changing Thickness" on page 18).

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- You will be prompted to enter a new name for the glazing (and the new substrate if applicable)

- If you want to keep the new layer, save it to the user database (see "Saving Layers to the User Database" on page 32).

## Getting the Best Results when Changing Thickness

The change thickness operation adjusts the internal absorptance of the layer for the new value of the thickness and re-calculates the spectral optical properties of the whole layer.

If the transmittance of the original layer at a given wavelength is very low, it is likely that the internal absorptance of the layer is very large. If the transmittance falls below the limit of resolution of the measurement, the internal absorptance is known to be large, but cannot be calculated exactly. This means that its value cannot be adjusted to the new thickness accurately. If the change thickness operation is used to increase the thickness, the layer will become less transmitting, and inaccurate absorptance values in regions where the transmittance is essentially zero will have no influence on the results. If the change thickness operation is used to decrease the thickness, the layer will become more transmitting, and inaccurate absorptance values will result in inaccurate predicted optical properties at wavelengths where the original layer had a low transmittance.

For coated or applied film glazings, there is an additional operation involved before the thickness can be changed – the coating or applied film must be 'stripped' from the substrate. If the substrate does not have a high transmittance, there is no information available about the substrate-side coating reflectance, and this value may be unreliable. If the coating is re-combined with a substrate of increased thickness, the unreliable substrate-side reflectance will be 'hidden' behind the substrate, and this problem will not affect the final results for the whole layer. If the change thickness operation is used to decrease the thickness, these unreliable reflectance values can result in inaccurate predicted optical properties at wavelengths where the original layer's substrate had a low transmittance.

For this reason, when using the change thickness operation **it is recommended that you always increase the thickness**. If you do not, you will see warnings about unreliable data at those wavelengths where the original layer (substrate) had a low transmittance, and you may see obviously incorrect values in the spectral data at those wavelengths.

# Change Substrate

You can change the substrate of coated or applied film layers where the substrate is known and is also present in the database. You cannot change the substrate of a double-coated layer.

To change the substrate of a layer:

- Select the layer by clicking on a layer button

- Choose the menu option **Edit|Change Substrate**

- In the Change Glazing dialog box, the substrate filename box appears highlighted – click on it to select a new substrate from the database (you must select a monolithic layer). It is strongly recommended that you always choose a less transmitting substrate than the substrate of the

current layer (see "Getting the Best Results when Changing Substrate" on page 19)

- You will be prompted to enter a new name for the glazing

- If you want to keep the new layer, save it to the user database (see "Saving Layers to the User Database" on page 32).

## Getting the Best Results when Changing Substrate

The change substrate operation separates the optical properties of the coating or applied film from the substrate, and substitutes the properties of the new substrate before recombining the components and re-calculating the properties of the whole layer.

For coated or applied film glazings, the coating or applied film must first be 'stripped' from the substrate of the original layer. If the substrate does not have a high transmittance, there is no information available about the substrate-side coating reflectance, and this value may be unreliable. If the coating is then re-combined with a substrate with a lower transmittance, the unreliable substrate-side reflectance will be 'hidden' behind the substrate, and this problem will not affect the final results for the whole layer. If the change substrate operation is used to substitute a substrate with a higher transmittance, these unreliable reflectance values can result in inaccurate predicted optical properties at wavelengths where the original layer's substrate had a low transmittance.

For this reason, when using the change thickness operation **it is recommended that you always decrease the transmittance of the substrate** by starting with the desired coating or applied film on the thinnest, clearest substrate available and substituting a thicker or darker substrate. If you do not, you will see warnings about unreliable data at those wavelengths where the original layer (substrate) had a low transmittance, and you may see obviously incorrect values in the spectral data at those wavelengths.

# Add or Change Coating

### Creating a Coated Layer

You can add a coating to monolithic layers to create new coated layers.

To add a coating to a monolithic layer:

- Select the monolithic layer by clicking on a layer button

- Choose the menu option **Edit|Add Coating**

- In the Change Glazing dialog box, the coating name box appears highlighted – click on it to select a new coating from the database (you must select a coated layer with the desired coating). It is strongly recommended that you always choose a coated glazing with a highly transmitting substrate (see "Getting the Best Results when Adding or Changing a Coating" on page 20).

- You will be prompted to enter a new name for the glazing

- If you want to keep the new layer, save it to the user database (see "Saving Layers to the User Database" on page 32).

### *Change a Coating or Create a Double-Coated Layer*

You can change the coating of coated layers which are coated on one side only and where the substrate is known and is also present in the database. You can also transform these layers into "double-coated" layers (coated on both sides).

To change the coating of a layer or create a double-coated layer:

- Select the coated layer by clicking on a layer button

- Choose the menu option **Edit|Change/Add Coating**

- In the Change Glazing dialog box, the coating name box appears highlighted – click on it to select a new coating from the database (you must select a coated layer with the desired coating). It is strongly recommended that you always choose a coated glazing with a highly transmitting substrate (see "Getting the Best Results when Adding or Changing a Coating" on page 20)

- You can choose to apply the coating to the same side of the layer as the current coating (default) which will replace the current coating and create a new coated layer, or you can choose to apply the coating to the opposite side of the layer to create a double-coated layer. Make this selection by choosing 'Front of Glazing' or 'Back of Glazing' in the 'Apply coating to:' section of the dialog box.

- You will be prompted to enter a new name for the glazing

- If you want to keep the new layer, save it to the user database(see "Saving Layers to the User Database" on page 32).

**Note:** You cannot perform any further transformations on a double-coated layer.

## Getting the Best Results when Adding or Changing a Coating

Adding or changing a coating is equivalent to changing the substrate of the glazing used to extract the new coating properties.

For this reason, **it is recommended that when you add or change a coating, you choose a coated glazing to represent the new coating with the thinnest, clearest substrate possible**. See Getting the Best Results when Changing Substrate for more details. This also applies when creating a double-coated layer.

# Add or Change Applied Film

You can add a film to a monolithic or coated glazing where the substrate is known and is also present in the database, or you can change the film of an applied film glazing where the substrate is known and is also present in the database. You cannot apply a film to a laminate, but you can build a laminate using an applied film layer, which will achieve the same result.

### *Creating an Applied Film Layer*

You can apply a film to a monolithic layer to create a new applied film layer. To apply a film to a monolithic layer:

To add a film to a monolithic layer:

- Select the monolithic layer by clicking on a layer button

- Choose the menu option **Edit|Change/Add Film**

- In the Change Glazing dialog box, the film name box appears highlighted – click on it to select a new film from the database (you must select a film or applied film layer with the desired film). If you choose an applied film layer, it is strongly recommended that you always choose a glazing with a highly transmitting substrate (see "Getting the Best Results when Adding or Changing an Applied Film" on page 22)

- The new film will be added to the side you select in the 'Apply Film to' section of the dialog box:



- You will be prompted to enter a new name for the glazing

- If you want to keep the new layer, save it to the user database (see "Saving Layers to the User Database" on page 32).

## *Change a Film*

To change the film applied to an applied film layer:

- Select the applied film layer by clicking on a layer button

- Choose the menu option **Edit|Change/Add Film**

- In the Change Glazing dialog box, the film name box appears highlighted – click on it to select a new film from the database (you must select a film or applied film layer with the desired film). If you choose an applied film layer, it is strongly recommended that you always choose a glazing with a highly transmitting substrate (see "Getting the Best Results when Adding or Changing an Applied Film" on page 22)

- The new film will replace the current film – this is indicated in the 'Apply Film to' section of the dialog box

- You will be prompted to enter a new name for the glazing

- If you want to keep the new layer, save it to the user database (see "Saving Layers to the User Database" on page 32).

## *Apply a Film to a Coated Layer*

You can apply a film to the uncoated side of a coated glazing, creating a double-coated layer with the coating on one side and the film on the other.

To apply a film to a coated layer:

- Select the coated layer by clicking on a layer button

- Choose the menu option **Edit|Change/Add Film**

- In the Change Glazing dialog box, the film name box appears highlighted – click on it to select a new film from the database (you must select a film or applied film layer with the desired film). If you choose an applied film layer, it is strongly recommended that you always choose a glazing with a highly transmitting substrate (see

"Getting the Best Results when Adding or Changing an Applied Film" on page 22)

- The new film will be applied to the uncoated side of the glazing to create a double-coated layer with the film on one side and the coating on the other – this is indicated in the 'Apply Film to' section of the dialog box.

- You will be prompted to enter a new name for the glazing

- If you want to keep the new layer, save it to the user database (see "Saving Layers to the User Database" on page 32)..

## Getting the Best Results when Adding or Changing an Applied Film

Adding or changing an applied film is equivalent to changing the substrate of the glazing used to extract the new film properties.

For this reason, **it is recommended that when you add or change an applied film, you either choose a film type glazing or choose an applied film glazing to represent the new coating with the thinnest, clearest substrate possible**. See Getting the Best Results when Changing Substrate for more details.

# Calculation Warnings for Transformed Layers

Most layer transformations will result in warnings about unreliable data at one or more wavelengths. To minimize the number of unreliable data points, follow the guidelines under "Getting the Best Results…" for each layer transformation. Experiment with different layers, sometimes results can be improved by using different combinations of layers.

Warnings in the UV region are very common, because most substrate materials are absorbing in this region, and it is difficult to extract reliable optical properties from the substrate, coatings or applied films in this case to perform transformation operations. Be aware that if the calculated spectral data is unreliable in the UV region, spectral averages that cover that region will also be unreliable.

Very absorbing substrates (e.g. strongly body-tinted materials) will also cause difficulties in transformations if you attempt to extract coating or applied film properties from a glazing with an absorbing substrate.

Don't forget that you can save calculation warnings to a file – see "Save Layer or System Calculation Warnings to a File" on page 35.

# Viewing Calculation Warnings for Transformed Layers

To view calculation warnings for a transformed layer:

- Select the transformed layer by clicking on a layer button

- Select the 'Warnings' tab

**Note:** you can only view the calculation warnings for the most recently transformed layer. If you transform more than one layer, the warnings from the previous transformations are lost. If you want to keep the warnings to review them later, save

the warnings to a file (see "Save Layer or System Calculation Warnings to a File" on page 35).

# Renaming a Layer, Laminate or Glazing System

To rename a layer, laminate or glazing system:

- Select the layer or system you want to rename by clicking on a layer button.

- Choose menu option **Edit|Rename** *filename*
  *or*

- Right-click on the layer button to display the pop-up menu, and select item **Rename** *filename*

- Enter a new filename and click 'OK'

- If you want to save the layer under the new name, save it to the user database (see "Saving Layers to the User Database" on page 32). You could also achieve the same result by using the **File|Save As…** menu option to rename and save the layer in one operation.

# Change Details for a Layer, Laminate or Glazing System

To edit the product name, appearance or NFRC ID for a layer, laminate or glazing system:

- Select the layer or system you want to edit by clicking on a layer button.

- Choose menu option **Edit|Change Details**
  *or*

- Right-click on the layer button to display the pop-up menu, and select item **Change Details**

- Enter new information for the layer and click 'OK' (see "The Change Glazing Dialog Box" on page 17)

- If you made changes to the layer, you will need to rename it.

# Creating a Laminate

## Start Building a New Laminate

When Optics5 starts, you can start building a laminate immediately by switching to the 'Laminate' tab and adding layers (see "Add Layers to a Laminate" on page 25).

If you have created a laminate already, but want to start over with an empty laminate:

- Make sure the 'Laminate' tab is selected
- Choose menu option **File|New Laminate**
- You will be prompted to save the current laminate if one already exists

**Note:** if you created new layers and did not save the layers or did not save the laminate (which would save any new layers), the new layers will be lost when you start a new laminate

### Wavelength Sets

Laminate data is calculated for each wavelength in the selected wavelength set for which there is data available.

To select the wavelength set used to calculate laminate data:

- Choose the menu option **Tools|Select Wavelength Set** and make a selection

The default wavelength set (Optics5) contains the minimum required set of wavelengths for solar data required for layers in the IGDB, plus the minimum required set of wavelengths for IR data out to 40 µm. If you want to calculate laminate data on a different wavelength set, you will first need to create your own wavelength set file (copy the Optics5.wvl file in the Standards directory, rename the copy and edit it). The next time you start Optics5, the file will be available under the menu option **Tools|Select Wavelength Set**.

**Note:** data is often not available for all layers at all wavelengths in the selected wavelength set – in this case, the first line in the 'Warnings' tab for a laminate will explain that the calculated data set was truncated to the region where data was

available for all layers:

| Wl. (μm) | Warning Description |
|---|---|
| N/A | CalcLam.usr - Laminate<br><br>Results could not be calculated at all wavelengths in the selected wavelength set.<br>Wavelength set truncated to: 0.300 - 2.500 μm |

Tabs shown: Add Glazing | Add Interlayer | Add Embedded Coating | Edit Laminate | View All | Schematic | Warnings!

# Using Laminates in Glazing Systems

If you want to build a laminate, and then use it in the glazing system you are building:

- Switch to the laminate using the 'Laminate' tab

- Build the laminate (see "Add Layers to a Laminate" on page 25)

- Save the laminate to the user database (see "Save a Laminate" on page 28)

- Switch to the glazing system using the 'Glazing System' tab

- Load the new laminate layer into the glazing system from the user database (see "Add Layers to a Glazing System" on page 12)

# Add Layers to a Laminate

You can add monolithic, coated, applied film and interlayer type layers to a laminate. There are a number of 'rules' for building laminates:

8. The first and last layer in a laminate must be a non-interlayer type (e.g. monolithic, coated or applied film)

9. You can place as many interlayers as you like adjacent to each other, but you must separate rigid layers non-interlayers with at least one interlayer.

10. You must place applied film layers so that the film is on an exterior surface.

11. You can only place a coating next to an interlayer if there is sufficient data in the database to perform this operation (see "Add Embedded Coatings" on page 26)

If you break any of these rules, the program will give you a warning message. If you break rule 1 or 2, the operation will be cancelled. If you break rule 3 or 4, the program will try to help you by offering to flip the layer – if the flipped layer cannot be added, the operation will be cancelled.

Use the 'Add Interlayer' tab above the database to add interlayers, and the 'Add Embedded Coating' tab to add a coated layer where the coating will be embedded in the laminate (adjacent to an interlayer). To add other layers, use the 'Add Glazing' tab. Only those database records with enough data to be loaded into a laminate will be shown in these views – if you want to see all records in the database, including those which cannot be used in laminates, use the 'View All' tab. If you try to load an invalid layer into a laminate from the 'View All' view of the database, an error message will be displayed.

## *Add Glazings to a Laminate*

You can add monolithic, coated, applied film and interlayer type layers to a laminate as long as you follow the laminate-building 'rules' (see "Add Layers to a Laminate" on page 25).

To add layers from the current database to a laminate:

- Select the first available (unoccupied) layer in the laminate by clicking on its layer button – if you select an occupied layer, it will be replaced (see "Replace a Layer in a Laminate" on page 28)

- Select the 'Add glazing', 'Add interlayer' or 'Add embedded coating' tab in the database

- Double-click on the layer in the database
  *or*

- Using the mouse, drag the layer from the database over the layer button where you want to add the layer and release the mouse button
  *or*

- Select the layer in the database, then choose the menu option
  **Database|Add/Replace Layer**
  *or*

- Select the layer in the database, then right-click to display the pop-up menu then choose **Add/Replace Layer**

If you are replacing a layer, a dialog box will appear to confirm that you want to replace the existing layer.

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**Note:** Select a layer in the database by clicking on it with the mouse, or by browsing to it by pressing the up and down arrow keys (see "Browsing the Databases" on page 5)

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## *Add Interlayers*

To add an interlayer to a laminate:

- Select the first available (unoccupied) layer by clicking on a layer button

- Select the 'Add Interlayer' tab

- Select the interlayer you want to add, and load it into the laminate (see "Add Layers to a Laminate" on page 25)

## *Add Embedded Coatings*

If you want to place a coating adjacent to an interlayer (called an embedded coating), you can only use coatings for which there is additional data in the database (see Note below).  To help you find coated layers with coatings that can be used in embedded positions, there is a special view of the database that only contains those layers.

To add a coated layer to a laminate so that the coating is in an embedded position:

- Select the first available (unoccupied) layer by clicking on a layer button

- Select the 'Add Embedded Coating' tab

- Select the coated layer you want to add, and load it into the laminate

- If the layer is not oriented correctly, flip the layer (see "Flip Layers in a Laminate" on page 27)

**Note:** you can also add coated glazings from the 'Add glazing' tab. If you try to place the coating in an embedded position and sufficient data is not available, a warning message will be displayed and the program will offer to flip the layer so that the coating is placed on one of the surfaces of the laminate.

**Note:** The same coating has different properties in an embedded position (next to an interlayer) as opposed to a position where it faces an air or gas environment. An additional 'reference laminate' layer must be stored in the IGDB to allow Optics to correctly determine the properties of a coating in an embedded position. Not all manufacturers have supplied this data for all of their coatings, so only some of the coatings represented in the database can be used in an embedded position. For information about submitting reference laminates, see the *International Glazing Database: Data Submission Procedure and Reference Manual* .

# Flip Layers in a Laminate

To flip layers in a laminate:

- Select the layer to flip by clicking a layer button

- Choose the menu option **Edit|Flip Layer**
  *or*

- Right-click on the layer button to display the pop-up menu and select **Flip Layer**

- If flipping the layer would place a coating or an applied film adjacent to an interlayer, and this would break the laminate-building rules (see "Add Layers to a Laminate" on page 25), a message will appear describing the problem and the operation will be cancelled.

**Note:** Check the schematic view and the layer spectral averages if you are not sure which way a layer is oriented.

# View the Properties of a Laminate

To view the calculated spectral data, spectral averages and other properties of a laminate:

- Select the laminate by clicking on the 'Lamin.' layer button

- The laminate is now the current layer, so its spectral data and spectral averages are displayed in the lower part of the screen

- To view a schematic diagram of the laminate, select the 'Schematic' tab in the upper right part of the screen

- To view the spectral data in a table, choose menu option **View|Spectral Data Grid** (see "Viewing the Spectral Data Grid" on page 4)

- To view calculation warnings for the laminate data, select the 'Warnings' tab in the upper right part of the screen

- To see more information about the laminate, choose menu option **View|View Details** (see "View Details of Layer" on page 3)

# Replace a Layer in a Laminate

Replace a layer in a laminate in the same way as you would replace a layer in a glazing system – you must respect the laminate-building rules (see "Add Layers to a Laminate" on page 25), or the operation will be cancelled.

You cannot insert layers into a laminate – you must delete and add layers from the interior side of the laminate to modify the structure.

# Delete a Layer in a Laminate

You can only delete the last (interior side) layer in a laminate. To delete the last layer:

- Select the last layer by clicking the layer button

- Choose the menu option **Edit|Delete Layer**
  *or*

- Right-click on the layer button to display the pop-up menu and select **Delete Layer**

# Save a Laminate

To save a laminate to the user database:

- Select the laminate by clicking on the 'Lamin.' layer button

- Click the 'Save' button on the toolbar: 🖫
  *or*

- Choose the menu option **File|Save *filename***
  *or*

- Right-click the layer button to display the pop-up menu and select **Save *filename***

**Note:** To save the laminate under a different name, choose the menu item **Save As…**

# Edit a Laminate

To edit a laminate saved in the IGDB or user database:

- Make sure the 'Laminate' tab is selected above the layer buttons

- Select the 'Edit Laminate' tab in the upper right part of the screen
  *or*

- Choose the menu option **File|Edit Laminate**

- Load the laminate you wish to edit like you would add a layer (see "Add Glazings to a Laminate" on page 26) into any layer position – the current laminate will be cleared, and the saved laminate loaded.

**Note:** Some laminates in the databases may not have enough information about their structure or component layers to allow them to be edited. If you attempt to load a laminate for editing which is missing some of this information, an error message will be displayed. The 'Add Laminate' tab restricts the database view to only those database records with valid structural information, but some of these records may still be missing component data.

**Note:** You cannot edit laminates in 'Glazing' mode, you must switch to 'Laminate' mode first. In order to use the edited laminate in a glazing system, save the laminate to the user database, switch to 'Glazing' mode and re-load the laminate layer into the glazing system from the user database.

**Note:** You cannot use a laminate as a component of another laminate

**Note:** You can edit laminates from either the IGDB or the user database, but you must save edited laminates to the user database

# Calculation Warnings for Laminates

The optical properties of most laminates without coatings or applied films can be calculated without generating warnings, except that it is likely that some components will not have spectral data across the whole range of the selected wavelength set (see "Wavelength Sets" on page 24), so the wavelength set will be truncated.

When coatings or applied films are used on the external surfaces of the laminate, you may see a few calculation warnings associated with 'stripping' the coating from its substrate in order to recombine it with the other layers in the laminate. Unlike layer transformations, if the substrate is transmitting these warnings are more likely since the coating can be 'seen' through the opposite side of the laminate. If the substrate is less transmitting, any unreliable reflectance values are hidden behind the substrate and other layers in the laminate.

When you place an embedded coating in a laminate, you may see calculation warnings associated with extracting the coating properties from a special 'reference laminate'. This operation relies on all the components of the reference laminate being transparent, so that the coating can be 'seen' through both sides of the laminate. Where the substrate, interlayer or opposing lite of the reference laminate has a higher absorption than the components you are using to construct your own laminate, you may see calculation warnings.

# Viewing Calculation Warnings for Laminates

If you transform a layer in a laminate, you may see warnings associated with the transformation operation (see "Calculation Warnings for Transformed Layers" on page 22). Calculating laminate properties also involves 'extracting' and re-

combining the optical properties of individual components, and may result in some calculation warnings being generated.

To view calculation warnings for a laminate:

- Select the laminate by clicking on the 'Lamin.' layer button
- Select the 'Warnings' tab

# Glazing Databases

## About the International Glazing Database

The International Glazing Database (IGDB) is a publicly available database containing spectral optical properties and other information on more than 1000 glazing products available in the United States and other parts of the world. Maintenance of the database is done by the Windows and Daylighting Group of the Lawrence Berkeley National Laboratory (LBNL) and is supported by the U.S. Department Of Energy (DOE).

New data is added regularly to the IGDB. Updates are available for download from: http://windows.lbl.gov/materials/IGDB/

## About User Databases

User databases have the same format as the IGDB, but they are used to store data that the user has imported, or generated with Optics5. It is not possible to add layers to the IGDB, so all new layers are saved to the user database.

You can switch between viewing the main IGDB database and the current user database at any time a database grid is visible – see "Switching Between Databases" on page 7.

## Selecting a User Database

The default user database is 'UserGlazing.mdb' in the '\LBNL Shared' directory of your program installation. You can specify the location of the user database – this allows you to use as many user databases as you like (one at a time) with Optics5.

To create a new (empty) user database:

- Make a copy of the file 'Empty UserGlazing.mdb' in the '\LBNL Shared' directory of your program installation and rename the copy – it will become your new empty user database

- in Optics, switch the user database location to point at this new file (see "File/Folder Locations" on page 39). You can switch back to your default user database, or any other user database that you create in the same way. Also see "Switching Between Databases" on page 7.

# Saving Layers to the User Database

You can save a layer to the user database if it has a different filename to any layer currently in the user database or in the IGDB. If you save a layer that has components (such as a coated layer that has a substrate, or a laminate which has component layers), the component layers will be saved to the user database at the same time (unless they already exist in the IGDB or user database). This allows you to load and edit those layers at a later time.

If you want to save an unmodified layer from the IGDB to the user database, you must change its filename first (see "Renaming a Layer, Laminate or Glazing System" on page 23).

To save a layer to the user database:

- Select the layer or system to save by clicking on a layer button

- Click the 'Save' button on the toolbar: 
  *or*

- Choose menu option **File|Save *filename***
  *or*

- Right-click to display the pop-up menu and select the option **Save *filename***

- If the layer or system you saved had components, or if the save operation fails, you will be asked 'Do you want to view the details of the save operation?'. If you answer yes, you can view information about components that were saved to the user database, and components that were not saved to the user database along with an explanation of why some components were not saved.

**Note:** to change the filename and save in one operation, choose menu option **Save As..** instead.

**Note:** You cannot save data for a layer with the same filename as another layer in the IGDB or your current user database. If a conflict is detected, Optics will ask you to rename the layer before saving it, or cancel the import. The most common reason a component is not saved is that its filename already exists in the IGDB or user database. In this case Optics assumes that the component layer information is already available and does not need to be saved again.

# Importing and Exporting Data

## Import a Layer from a Spectral Data Text File

You can import data from spectral data text files which conform to the format described in the *International Glazing Database: Data Submission Procedure and Reference Manual* – this file format is an extension of the format used for the spectral data library in WINDOW 4.1. It is possible to import files from a WINDOW 4.1 spectral data library, but if you are preparing new spectral data files, they should be in the extended format described in the manual.

When you import a file, the program will check to see if any of the extended information is missing from the file – if it is, you will have a chance to enter the information before saving the imported layer to the user database, however the preferred method is to modify the text file before importing it into Optics.

To import spectral data text files into the user database:

- Choose the menu option **File|Import Text File(s)…**

- Select the file or files you want to import
  (you can import many files at once using a multiple selection – see Windows help on how to make a multiple selection)

- Click 'Open' to begin importing

- If the file is missing any extended header information, you will see the following message:
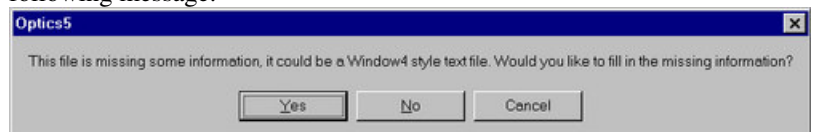


- Choose 'Yes' to display the Change Glazing dialog box, where you can enter the missing data. Consult the *Data Submission Procedure and Reference Manual* for details on how to fill in the fields. If you do not want to manipulate this layer in Optics and do not want any extra information to be added to the database, Optics will fill in the minimum required data for you – press 'OK' on the Change Glazing dialog box, and Optics will describe the changes it has made. If these changes are acceptable, press 'OK' again to continue.

- The imported file will be saved to the user database (see "Saving Layers to the User Database" on page 32)

- Once the data is saved, the layer can be used in Optics, or imported into WINDOW.  Make sure you look in the user database to find the imported data.

**Note:**  The dialog box that allows you to select files always opens in the same directory – you can set which directory is opened by default (see "File/Folder Locations" on page 39)

**Note:**  Optics requires some data about the layer in order to allow layer transformation operations and to allow you to use the layer in a laminate.  You will need to add the extra information to imported data that does not comply with the *Data Submission Manual* if you want to perform these operations in Optics.

# Export Layer or System Properties to a Spectral Data Text File

You can export a glazing layer, glazing system or laminate layer to a text file that can be read by other users of Optics5.  Use this format to exchange data by email.

To export a spectral data text file:

- Select the layer or laminate that you want to export

- Choose the menu option **File|Export** *filename* **Text File**

- Choose a name and location for the file, Click 'OK'

**Note:** If you export a layer that has component layers (e.g. a laminate, applied film layer or coated layer) and the components are not in the IGDB, export the component layers as well so that the recipient of the files can re-create the original layer with all of its components.

# Export Layer or System Properties to a Radiance File

You can export a glazing layer or system to a file that Radiance can use.

To export a Radiance file:

- Select the layer or laminate that you want to export

- Choose the menu option **File|Export** *filename* **Radiance File**

- Choose a name and location for the file, Click 'OK'

**Note:**  The color averages in the Radiance file are calculated with a special standard file (Radiance.std) and are not affected by the currently selected standard (see "Select the Standard used to Calculate Spectral Averages" on page 37).

# Save Layer or System Calculation Warnings to a File

You can export the warnings generated for any layer to a text file in order to review them later.

To export warnings to a file:

- Select the layer or laminate that the warnings apply to
- Choose the menu option **File|Export** *filename* **Warnings File**
- Choose a name and location for the file, Click 'OK'

# Import Layers in WINDOW 5.1

You can import layers from the IGDB or user databases into a WINDOW 5.1 glass library.

To save layers to the user database:

- See "Saving Layers to the User Database" on page 32

To find out how to import layers from the IGDB or user database into WINDOW:

- See the WINDOW manual (available from the WINDOW website: http://windows.lbl.gov/software/window)

# Spectral Averages

## Select the Spectral Averages Displayed

You can display different combinations of spectral averages on the screen. The front (exterior) and back (interior) side emittance for each layer are always displayed.

To change the spectral averages displayed:

- Choose menu option **Tools|Select Spectrum**

- Select one of the options:

  1. *Energy Properties* – this will display solar T, solar Rf, solar Rb, photopic T, photopic Rf, photopic Rb

  2. *Solar Properties* – this will display solar T, solar Rf, solar Rb

  3. *Photopic Properties* – this will display photopic T, photopic Rf, photopic Rb

  4. *Color Transmittance* – this will display the selected color averages for light transmitted through the layer (see "Select the Color Function Used to Display Color Averages" on page 38)

  5. *Color Front Reflectance* – this will display the selected color averages for light reflected from the front (exterior side) of the layer

  6. *Color Back Reflectance* – this will display the selected color averages for light reflected from the back (interior side) of the layer

  7. *UV Transmittance* – this will display Tuv, SPF and Tdw

**Note:** Not all standard files support all types of average – if an average is not available for the standard selected, the result will be displayed as 'N/A' and a message will appear when the mouse is positioned over the text 'N/A' explaining the problem. (See "Select the Standard used to Calculate Spectral Averages" on page 37)

**Note:** To find out which source and detector spectra are used to calculate spectral averages in a given standard or to define your own standard, use the program 'StandardFileEditor.exe' found in the same directory as the standard files.

# Select the Standard used to Calculate Spectral Averages

A standard file is a file which stores the settings for a number of different averaging methods, each of which can be used by Optics5 to calculate a different type of spectral average.  You can select from a set of pre-defined standard files which contain commonly used averaging methods, or you can define your own standard file and select it.

The currently selected standard is displayed in the status bar in the center of the screen:

.

To change the standard  used to calculate spectral averages:

- Choose menu item **Tools|Select Standard**
  *or*

- Click on the Standard button on the status bar in the center of the screen: 

- Select one of the options – pre-defined standards include:

    1. *W5_NFRC_2003* – this is the default standard – it gives results identical to WINDOW5.1 and is consistent with NFRC 300 (2003 version)

    2. *WINDOW4* – this gives results close to **but not identical** to WINDOW4.1

    3. *ISO_9050* – this gives results consistent with published standard ISO 9050 – it does not include color averages

    4. *prEN_410* – this gives results consistent with published standard prEN 410, including color rendering index

    5. *CRI* – this is a special standard only used for calculating color rendering index, it does not include solar or visible averages.

    6. *Radiance* – this is a special standard only used for calculating results for exporting to Radiance files.

    7. User-defined standard files will appear in this list if they are stored in the same directory as the other standard files.

**Note:** To find out which source and detector spectra are used to calculate spectral averages in a given standard or to define your own standard, use the program 'StandardFileEditor.exe' found in the same directory as the standard files.

**Note:** Not all standard files support all types of average – if an average is not available for the standard selected, the result will be displayed as 'N/A' and a message will appear when the mouse is positioned over the text 'N/A' explaining the problem.

# Select the Color Function Used to Display Color Averages

When the spectral averages displayed are color averages, the type of color average displayed is determined by setting this option.

To change the color function displayed when color averages are shown:

- Choose menu item **Tools|Select Color Function**

- Select one of the options:

    8. *CIE Chromaticity* – this will display the chromaticity co-ordinates x, y and z

    9. *CIE Tristimulus* – this will display the tristimulus values X, Y and Z

    10. *CIE L a\*b\** – this will display the color co-ordinates L, a\* and b\*

    11. *CIE L u\*v\** – this will display the color co-ordinates L, u\* and v\*

    12. *Hunter Lab* – this will display the Hunter color co-ordinates L, a and b

    13. *Color Rendering Index (prEN 410)* – this will display the general color rendering index calculated according to standard prEN 410.

**Note:** If color averages are not displayed, set the type of spectral averages to display to an option including color (see "Select the Spectral Averages Displayed" on page 36)

**Note:** To find out which source and detector spectra are used to calculate spectral averages, use the program 'StandardFileEditor.exe' found in the same directory as the standard files.

**Note:** Not all standard files support all types of average – if color averages are not available for the standard selected, they will be displayed as 'N/A' and a message will appear when the mouse is positioned over the text 'N/A' explaining the problem. In this case the color of the glazing in the schematic view will be white.

The exception to this is the Color Rendering Index – this is always calculated using the prEN_410.std standard file regardless of which standard file is currently selected.
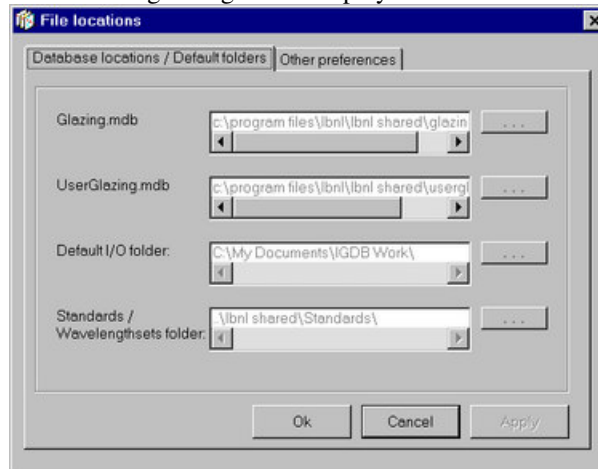
# Options

## File/Folder Locations

The location of the main International Glazing Database file (Glazing.mdb) and the user database (UserGlazing.mdb) can be specified – use this feature to correct installation problems or to use more than one user database.  In addition, the default folder for importing or exporting data and the folder containing spectral averaging standards and wavelength sets can be specified.

To specify file and folder locations:

- Choose menu item **Tools**|**Options**

- The following dialog box is displayed:



- To browse to a new file or folder for any of the options, select the button '…'

**Note:** User databases from previous versions of Optics5 cannot be used with version 5.1

**Note:** The 'Default I/O Folder' is the default folder shown when importing or exporting data from Optics.

# Manufacturer Name and Extension

Each time a new layer, system or laminate is created, it must have a Manufacturer name associated with it. Each manufacturer has a matching three-letter file extension. The default manufacturer name and file extension for all new layers can be set as an option so that Optics5 will automatically fill in this information when you create a layer (you can always change it later).

To specify a default manufacturer name and file extension:

- Choose menu item **Tools|Options**

- A dialog is displayed – switch to the 'Other preferences' tab

- The 'Other preferences tab' looks like this:
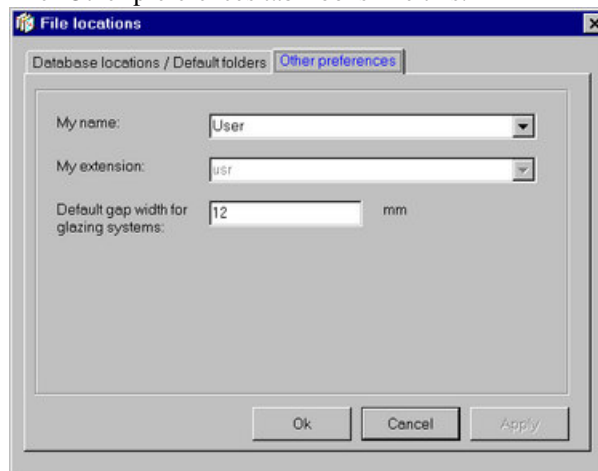


To set a new manufacturer name for all new layers, select from the drop-down list next to 'My name'. The matching file extension is set automatically. If your preferred name does not appear, scroll to the top of the list and select '(new name)'. You will then be able to enter a new manufacturer name and file extension.

# Gap Width in Glazing Systems

Optics5 calculates optical properties of glazing layers and systems, and does not need to account for the properties of the gaps between glazing layers (gaps do not affect optical properties). However, a default gap width is used when displaying the schematic view of glazing systems. If you would prefer to use a different default gap width in the schematic view, you can adjust this value.

To specify a default gap width for the schematic view:

- Choose menu item **Tools|Options**

- A dialog is displayed – switch to the 'Other preferences' tab

- Enter a new value for the gap width (in mm).

# Graphs

## Y-Axis Scaling

The y-axis range of the graph can be set to fixed values, or it can be set automatically according to the scaling mode used.  There are four possible y-axis scaling modes:

1.  *From 0 to 1* – always displays a y-axis range of 0.0 to 1.0

2.  *Near Zero* – always displays a y-axis range of –0.1 to +0.1

3.  *Auto change* – automatically re-scales the y-axis of the graph to show all the data

4.  *Fixed values* – always displays a fixed y-axis range set by the user

To set the y-axis scaling mode:

- Select the menu item **Graph|Set Y-axis** and choose an option
  *or*

- Right-click anywhere over the graph to display the pop-up graph options menu, then select **Set Y-Axis** and choose an option

- If the option *Fixed values* is selected, a dialog box will appear allowing the user to set the upper and lower limits of the y-axis.  Spectral data is stored as fractional values (0.0 – 1.0).

## X-Axis Scaling

The minimum range of wavelengths that the spectral data for each glazing should cover is 0.3 – 2.5 µm.  Some database records have spectral data extending beyond 2.5 µm.  The x-axis (wavelength) range of the graph is set automatically according to the scaling mode selected.  There are two x-axis scaling modes:

5.  *Hide IR* – always display the wavelength range 0.3 – 2.5 µm.

6.  *Show IR* – extend the upper limit of the x-axis range to the highest wavelength available in the currently selected spectral data

To set the x-axis scaling mode at any time:

- Select the menu item **Graph|Set X-axis** and choose **Hide IR** or **Show IR**

To set the x-axis scaling mode when the currently selected layer has IR data:

- Right-click anywhere over the graph to display the pop-up graph options menu, then select **Set X-Axis** and choose **Hide IR** or **Show IR**
  *or*
- Press the red right- or left-arrow button in the lower right corner of the graph to toggle the x-axis scaling mode between the two settings

# Show or Hide IR Data

The minimum range of wavelengths that the spectral data for each glazing should cover is 0.3 – 2.5 µm. Some database records have spectral data extending beyond 2.5 µm – to control display of this data in the spectral graph, set the x-axis scaling mode (see "X-Axis Scaling" on page 41).

# Copy Graph to Another Application

The spectral data graph can be copied to another application that can handle cut-and-paste operations including graphics (for example, a word processor).

To copy the graph to another application:

- Click over the graph – 'selection handles' should appear around the graph.
- Right-click to show the pop-up graph options menu, and select **Copy**
- Switch to the application where you want to paste the graph. In the **Edit** menu, find the **Paste Special** option. If this is not available, try **Paste**
- In the **Paste Special** dialog box, you may see several formats listed – select one of the graphics options ('Picture' or 'Device Independent Bitmap') and click on 'OK'.

# Command Reference

Use this section to look up the details of what each menu item does.

## File Menu

| Menu Item | For Glazing Systems | For Laminates |
|---|---|---|
| **New Glazing System / New Laminate** | See "Start Building a New Glazing System" on page 12 | See "Start Building a New Laminate" on page 24 |
| **Open Glazing System / Open Laminate** | See "Edit a Glazing System" on page 15 | See "Edit a Laminate" on page 28 |
| **Save** | See "Save a Glazing System" on page 14 | See "Save a Laminate" on page 28 |
| **Save As** | See "Save a Glazing System" on page 14 | See "Save a Laminate" on page 28 |
| **Export Text File** | See "Export Layer or System Properties to a Spectral Data Text File" on page 34 | |
| **Export Radiance File** | See "Export Layer or System Properties to a Radiance File" on page 34 | |
| **Export Warnings File** | See "Save Layer or System Calculation Warnings to a File" on page 35 | |
| **Import Text File(s)** | See "Import a Layer from a Spectral Data Text File" on page 33 | |
| **Print Screen** | Saves the graphic image of the Optics5 screen to the clipboard – you can paste this into other applications | |
| **Quit** | Exits Optics5 | |

# Edit Menu

| Menu Item | For Glazing Systems | For Laminates |
|---|---|---|
| **Delete Layer** | See "Delete Layers in a Glazing System" on page 14 | See "Delete a Layer in a Laminate" on page 28 |
| **Flip Layer** | See "Flip Layers in a Glazing System" on page 13 | See "Flip Layers in a Laminate" on page 27 |
| ***(Layer Transformation Menu Items…)*** | See "Transforming Layers in Glazing Systems"on page 16 | See "Transforming Layers in Laminates" on page 16 |
| **Change Thickness** | See "Change Thickness" on page 17 | |
| **Change Substrate** | See "Change Substrate" on page 18 | |
| **Add/Change Coating** | See "Add or Change Coating" on page 19 | |
| **Add/Change Film** | See "Add or Change Applied Film" on page 20 | |
| **Rename** | See "Renaming a Layer, Laminate or Glazing System" on page 23 | |
| **Change Details** | See "Change Details for a Layer, Laminate or Glazing System" on page 23 | |
| **Glazing System Gap Width** | See "Gap Width in Glazing Systems" on page 40 | |

# Database Menu

| Menu Item | For Glazing Systems | For Laminates |
|---|---|---|
| **Add/Replace Layer** | See "Add Layers to a Glazing System" on page 12 and "Replace a Layer in a Glazing System" on page 14 | See "Add Layers to a Laminate" on page 25 and "Replace a Layer in a Laminate" on page 28 |
| **Insert Layer** | See "Insert Layers in a Glazing System" on page 13 | You cannot insert layers into a laminate. |
| **Find Layer** | See "Find Records in the Databases" on page 6 | |
| **Delete from database** | See "Deleting Layers from the User Database" on page 8 | |
| **View** | See "Switching Between Databases" on page 7 | |

# View Menu

| Menu Item | Function |
|---|---|
| **Spectral Data Grid** | See "Viewing the Spectral Data Grid" on page 4 |
| **View Details** | See "View Details of Layer" on page 3 |
| **Refresh** | Refresh the display and the connections to the databases |

# Tools Menu

| Menu Item | Function |
|---|---|
| **Select Standard** | See "Select the Standard used to Calculate Spectral Averages" on page 37 |
| **Select Spectrum** | See "Select the Spectral Averages Displayed" on page 36 |
| **Select Color Function** | See "Select the Color Function Used to Display Color Averages" on page 38 |
| **Select Wavelength Set** | See "Wavelength Sets" on page 24 |
| **Options…** | See "Options" on page 39 |

# Graph Menu

| Menu Item | Function |
|---|---|
| **Set X-axis** | See "X-Axis Scaling" on page 41 |
| **Set Y-axis** | See "Y-Axis Scaling" on page 41 |
| **Copy** | See "Copy Graph to Another Application" on page 42 |

# Help Menu

| Menu Item | Function |
|---|---|
| **Contents** | Opens the Optics5 Help file |
| **About** | Shows information about the program, including version number |
| **Optics5 homepage** | Opens the Optics5 homepage in your web browser |
| **Frequently Asked Questions** | Opens the Optics5 FAQ page in your web browser |
| **International Glazing Database** | Opens the IGDB homepage in your web browser – you can check for updates to the IGDB here |

# Keyboard Shortcuts

| Menu Item | Keyboard Shortcut |
|---|---|
| **File\|New** | Ctrl + N |
| **File\|Open** | Ctrl + O |
| **File\|Save** | Ctrl + S |
| **File\|Export Text File** | Ctrl + E |
| **File\|Import Text File(s)** | Ctrl + I |
| **File\|Print Screen** | Ctrl + P |
| **Database\|Find** | Ctrl + F |

# Error Messages

Most error messages generated by Optics are fairly self-explanatory, however if you do not understand an error message, or would like to understand the reason behind it, look it up here to find more information.

- **Could not connect to International Glazing Database. Select Tools|Options from the menu to check and change the database location.**

- **Could not connect to User Database. Select Tools|Options from the menu to check and change the database location.**

  If you see either or both of these messages when starting the program, the main IGDB database file (Glazing.mdb) and/or the user database file (default UserGlazing.mdb) could not be found in the expected locations. See "File/Folder Locations" on page 39 for more information about setting these file locations. You will not be able to perform any operations until the program can find the locations of valid main and user databases.

- **NFRC_ID should be larger than 30000**

  If you are entering a new value for the NFRC ID using Optics, you must select a value larger than 30000 to avoid conflicts with IGDB records. If you want to set this value below 30000 for a record in your user database, you must modify the value in the text file before importing the data.

- **The NFRC ID of the current glazing (filename) may conflict with another record in the user database -  Select 'Yes' to automatically reset the NFRC_ID to the next available, 'No' to keep the existing NFRC_ID:**

  Optics attempts to avoid conflicts between NFRC ID values in the user database to facilitate importing data into WINDOW 5.1 (which requires unique NFRC ID values). If you are not concerned about NFRC ID values, select 'Yes' and Optics will automatically set a unique value for the NFRC ID of the record you are trying to save.

- **This filename already exists in one of the databases, in the laminate or in the glazing system. Choose a different filename.**

  The filename uniquely identifies a glazing record in the IGDB and user databases – this is why Optics will not allow you save a record with the same filename as a layer already in one of the open databases. In addition, you cannot rename a layer or create a new layer that has the same name as a layer already loaded or in one of the databases.

- **The filename should be DOS 8.3 compatible (xxxxxxxx.yyy)**

    Spectral data text files are still compatible with WINDOW 4.1 – to retain this compatibility, the filename cannot have more than 8 letters followed by a 3-letter extension. This restriction may be removed when WINDOW 4.1 is no longer used.

- **Laminate structure invalid. This laminate cannot be saved. Do you want to continue?**

    You cannot save an 'incomplete' laminate to the user database, or export it to a text file. The laminate must have at least 3 components, and begin and end with a non-interlayer component to have a valid structure. See "Add Layers to a Laminate" on page 25.

- **One or more of the information fields (Productname, Appearance, NFRC ID) has been reset by the operation. Do you want to review/change these fields?**

    Creating a new layer by transforming an existing layer will result in the productname, appearance and NFRC ID fields being reset to default values for the new layer. If you want to give the new layer a descriptive productname, enter some appearance information or change its NFRC ID, you can do so by selecting 'Yes' when you see this message. You can also change these details at any later time by using the Change Details menu option in the Edit menu.

- **One or more of the glazing references could not be retrieved. You may not have full functionality to use or manipulate (filename)**

    You are loading a coated or applied film layer where the substrate layer cannot be found in the current IGDB or user database. You can load the layer into a glazing system, but you will not be able to load the layer into a laminate, or perform any layer transformations on it until the substrate layer is added to the IGDB or user database.

- **This glazingtype (type) cannot be used in a glazing system/ laminate**

    You cannot add all types of glazings to glazing systems or laminates – use the 'Add Glazing', 'Add Interlayer' and 'Add Embedded Coating' tabs to restrict your view of the database to layers that can be loaded into the current system. See "Add Layers to a Glazing System" on page 12, and "Add Layers to a Laminate" on page 25.

- **The current glazing will become the substrate of the new glazing. You have to supply a name for the new glazing.**

    You are creating a new coated or applied film type glazing – you must supply a unique filename for the new coated or applied film layer.

- **The filename of the current substrate (filename) already exists in the glazing system, the laminate or one of the databases. You will have to change the filename of this substrate to continue the operation.**

    When you change the thickness of a coated or applied film layer, you actually create two new layers – a new substrate which is the original substrate transformed to the new thickness, and a new coated or applied film layer which is the coating or applied film combined with the new substrate. You must give unique filenames to both the new substrate and the new coated or applied film layer to complete the operation.

- **This file is missing some information, it could be a Window4 style text file. Would you like to fill in the missing information?**

     This message is displayed when the file being imported has been read successfully, but some of the information expected in the spectral data text file header was missing.  Because this information may be important in allowing you to manipulate the glazing in Optics, you can add the information manually at this point.  The preferred solution is to change the spectral data text file so that it complies with the *International Glazing Database: Data Submission Procedure and Reference Manual* and re-import the data.  See "Import a Layer from a Spectral Data Text File" on page 33.

# Terminology

**Applied Film Layer:**  An adhesive-backed Film applied to a Monolithic substrate

**Back:**  The interior side of a layer or system

**Coated Layer:**  A Monolilthic substrate with a thin-film coating deposited on it. This includes coated rigid substrates (glass, polymer) and also coated suspended films.

**Coated Laminate:**  Sometimes used to mean a Laminate with an Embedded Coating, sometimes used to mean a Laminate with a coating on an outer surface

**Component:**  A separate layer that forms part of the structure of a glazing layer – e.g. the substrate of a Coated layer or Applied Film layer, the layers that make up a Laminate

**Double-Coated Layer:**  A Monolithic substrate that is coated on both sides, or that has a coating on one side and an adhesive-backed Film on the other

**Embedded Coating:**  A coating positioned in a Laminate so that the coating is adjacent to an interlayer

**Film Layer:**  An adhesive-backed polymer film

**Front:**  The exterior side of a layer or system

**Glazing System:**  One or more glazing layers separated by air or gas gaps

**Glazing Type:**  One of: Monolithic, Coated, Applied Film, Film, Interlayer, Laminate or Unknown

**Interlayer:**  An adhesive layer used to join components in a Laminate

**Laminate:**  A glazing layer consisting of several Components joined together by adhesive Interlayers

**Monolithic Layer:**  An uncoated glazing layer

**Spectral Data Text File:**  A text file describing a glazing layer

**Standard File:**  A file describing a set of calculation methods for obtaining spectral averages

**Suspended Film:**  A flexible polymer layer which may be Monolithic or Coated used in a Glazing System or a Laminate like a rigid Monlolithic or Coated layer.

# Index

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