

# Calculating Laminates and Applied Films in Optics<sup>5</sup>

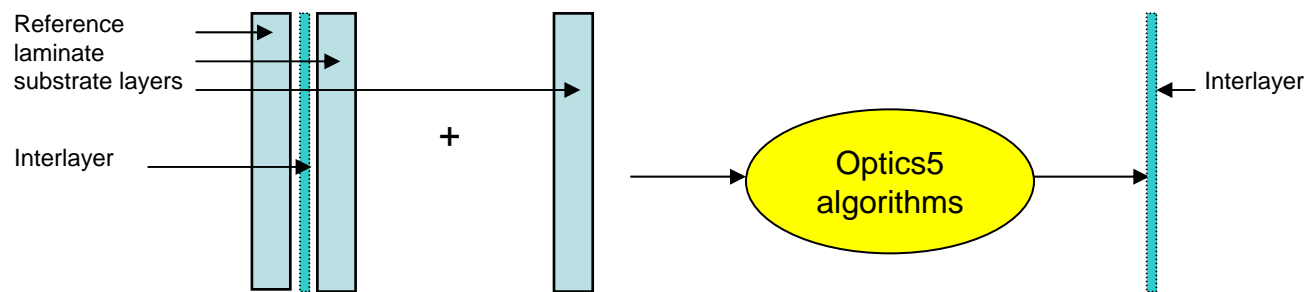
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Fall 2006

# Introduction

- Training Documentation:
  - Website:  
<http://windows.lbl.gov/software/nfrc/training/>
    - PowerPoint Presentation
    - Procedures for laminates (approved by NFRC)
    - Approved interlayer list for laminates
    - Procedures for applied films (draft)
    - Approved applied film list
- Optics5 Documentation
  - Procedures
  - Program Help
- Optics5 Help
  - Windows.lbl.gov for downloadable program, troubleshooting, Knowledge Base
  - Error messages – we will build a log of error messages and what they mean on the Knowledge Base
  - [Optics5Help@lbl.gov](mailto:Optics5Help@lbl.gov) for bug reports / questions
- Class Structure
  - Overview of Optics5
  - Laminate examples
  - Applied Film examples
  - Probably best not to try to follow along on another computer

# Laminate Interlayer Data



Spectral data is measured for a laminate construction made up of the interlayer sandwiched between two identical pieces of clear glass (the substrate layers)

Spectral data is measured for the clear glass used as the substrate layers in the previous laminate measurement

With these two sets of data, Optics5 can "back out" the optical properties of the interlayer. That interlayer then appears as a record in the "Interlayer" type in Optics5, and can be used as an interlayer in other laminates "constructed" in Optics5

The interlayer appears in Optics5 as an "Interlayer" type and can be used to make other laminates.

# Laminate Construction Rules

- Laminates *cannot* have embedded coatings, where embedded coatings are defined as a coating on a substrate that touches an interlayer
- Only NFRC glass layers with the NFRC approval indicator “#” can be used in these constructed laminates
- The glass layers can be tinted or coated as long as the coatings do not face the interlayer
- The interlayers in Optics5 do not have a “#” on them and therefore, only interlayers from the LBNL/NFRC “Approved Interlayer” list can be used

# Laminate Verification

- Laminates constructed in Optics5 will not have a #.
- Future versions of the WINDOW software could determine if the laminate was constructed from NFRC approved # layers
- The simulator specifies layers of the laminate, which shall all meet the # criteria
- The simulator shall provide base properties for the complete laminate assembly, including  $T_{sol}$ ,  $T_{vis}$ ,  $R_{sol}$  1 & 2,  $R_{vis}$  1 & 2, Emissivity
- IA can recreate the laminate from the specified layers and verify the calculated values

# Laminate Examples

- 1. Laminate with one 30 mil interlayer and 3 mm glass (Clear)**  
Clear 3 mm + 30 mil clear interlayer + Clear 3 mm
- 2. Hurricane laminate – three 30 mil interlayers (Clear)**  
Clear 3 mm + 3 layers of 30 mil clear interlayer + Clear 3 mm
- 3. Color Layering laminate**  
Low-E 3 mm + 1 layer of 15 mil red interlayer + 1 layer of 15 mil blue interlayer + Clear 3 mm

# Laminate #1

**Laminate with one 30 mil interlayer and 3 mm glass (Clear)**

**Name: 5009/030cl3\_0.soi/5009**

Description	Filename# 5009	Product Name or NFRC ID
Clear 3 mm glass	Clear_3.ppg	# 5009
30 mil clear interlayer	030cl3_0.soi	Saflex Clear 30 mil
Clear 3 mm glass	Clear_3.ppg	# 5009

# Laminate #2

**Laminate with three 30 mil interlayer and 3 mm glass (Clear)  
(Hurricane glass)**

**Name: 5009/3x030cl3\_0.soi/5009**

Description	Filename	Product Name or NFRC ID
Clear 3 mm glass	Clear_3.ppg	# 5009
30 mil clear interlayer	030cl3_0.soi	Saflex Clear 30 mil
30 mil clear interlayer	030cl3_0.soi	Saflex Clear 30 mil
30 mil clear interlayer	030cl3_0.soi	Saflex Clear 30 mil
Clear 3 mm glass	Clear_3.ppg	# 5009



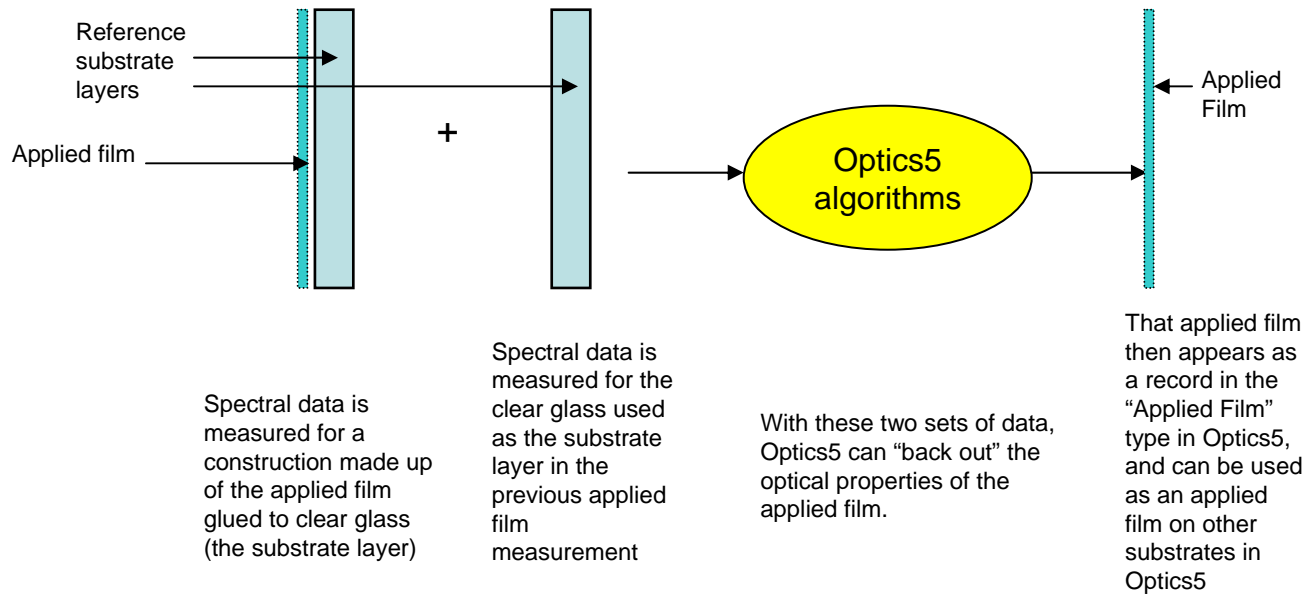
# Laminate #3

**Laminate with two 15 mil colored interlayers and 3 mm coated Low-E glass (coating facing out)**

**Name: 2026/015\_8050.soi/015\_8250.soi/9801**

Description	Filename	Product Name or NFRC ID
Low-E 3 mm glass	EE270_3.cig	# 2026
15 mil red interlayer	015_8050.soi	Vanceva Ruby Red 15 mil
15 mil blue interlayer	015_8250.soi	Vanceva Sapphire 15 mil
Clear 3 mm	Clear3.lof	# 9801

# Applied Film Data



# Applied Film Rules

- The applied films *cannot* have embedded coatings, where embedded coatings are defined as a coating on a film that touches the substrate
- Only NFRC glass layers with the NFRC approval indicator “#” can be used as the substrate for applied film layers
- The glass layers used as the substrate for the applied film can be tinted or coated as long as the coatings do not face the applied film
- Only the layers of the Type “Applied Films” in Optics5 that have a “#” on them and are also on the “Applied Films Measured with Clear Glass” list can be used
  - not all films have “#” yet, but most probably will by the time this procedure is implemented
  - Some films in the “Films” category will be moved to the “Applied Film” category

# Applied Film Verification

- Glass Layers with an applied film constructed by simulators in Optics5 will not have a # next to them.
- Future versions of the WINDOW software could determine if the applied film layer was constructed from NFRC approved # layers, and report/display this information.
- The simulator shall specify in simulation reports the applied film and the substrate, which shall all meet the # criteria, such as:

**2802 / 5038**

- The simulator shall provide the properties for the applied film layer (from Optics and WINDOW5 Detailed Report in Glazing System Library), including:

Tsol, Tvis, Rsol 1 & 2, Rvis 1 & 2, Emissivity

- An IA (or anyone else wanting to check the results) can recreate the applied film layer from the specified film and substrate and verify the calculated values

# Applied Film Example

**6 mm clear glass with applied film on the interior**

**Name: 2004/1563**

Description	Filename# 5009	Product Name or NFRC ID
Clear 6 mm glass	CLR_6.cig	# 2004
Applied Film - V-Kool 75	VK75.swt	# 1563