

Categorizing Fenestration Attachment Products

Placing attachment products into categories to develop relative ranking and for analyzing their thermal and solar optical, illumination and other performance

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Topic

- Defining Attachment products to be ranked
 - Categorizing products to be ranked
 - Simplification
 - Development of relative ranking of attachment products based on energy (and illumination) performance.
 - Determining the technical needs
 - Infrastructure needs for different categories
- Testing, Simulation, Quality Assurance, Database, Verification and Compliance

Definition – Complex or Attachment?

- Complex products
 - Attached
 - Fixed (part of building)
- This presentation focuses on attached products only



ASHRAE Fundamentals

Definition

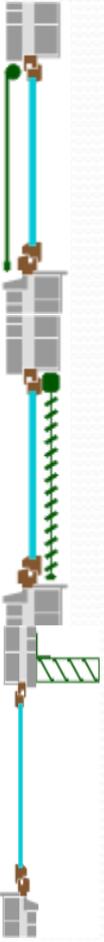
- **FENESTRATION** is an architectural term that refers to the arrangement, proportion, and design of window, skylight, and door systems within a building. Fenestration components include glazing material, either glass or plastic; framing, mullions, muntins, dividers, and opaque door slabs; **external shading devices; internal shading devices; and integral (between-glass) shading systems.**

Categorization for Relative Ranking Performance

- Defining the purpose
 - Consumer, Building Professionals, Code officials
 - Incentive program – Utilities, EnergyStar, Codes, Tax credits,
- Performance Indices to be measured/calculated
 - U-Factor, SHGC, VT, EP, AEP
 - Daylighting, Thermal comfort, Illumination quality, Glare
- Define the method - independent or in combination (Attachment and Fenestration)
 - Attachments alone - this may require only one reference fenestration or glazing.
 - Attachment and fenestration product combination - This is more complex and will require to address fenestration ranking, NFRC has 5 reference windows)
- Defining the fixed environmental condition to determine energy performance
 - Exterior (Natural convection, Summer (2.75 m/s), Winter (5.5 m/s)
 - Exterior attachments exposure to high wind speed is cause of concern
 - Interior (Natural convection)
 - Solar spectrum
- Defining the reference fenestration or glazing
 - NFRC has 5 reference windows
 - Single Known Reference for attachments?: Single glazing, clear 3 or 6 mm or an IG unit
 - Use of IG is to address testing issues. (* currently single glazing are hard to test in hot box).

Defining the products to be ranked

- Define fenestration attachments to be ranked.
- Building type
 - Residential
 - Small offices
 - Commercial (> 10,000 sq. ft, multi story)
- Attachment Installation
 - Prefabricated and site installed
- Location
 - On wall (facade), Interior or Exterior
 - On fenestration frame
 - On fenestration Reveal



Strategy of Categorization

Characteristics

- **Orientation**
 - Co-Planer
 - Non Planer (Projecting)
- **Placement**
 - Exterior
 - Between the panes
 - Interior
- **Operation**
 - Fixed
 - Adjust
 - Retract
 - Retract and Adjust

Attributes

- **Optical performance**
 - Specular
 - Diffuse
 - Block light versus redistribute by direction
 - Nature of the optical management element(s)
- **Thermal Performance**
 - Material
 - Emissivity

Shading Component Category

- Opaque planar sheet
- Crossed wires insect screen
- Woven fabric planar material
- Translucent planar sheet
- Louvered array – diffusing
- Louvered array – reflecting
- Pleated cells
- Translucent linear cells
- Two-dimensional honeycomb cellular array
- Electrochromic, thermochromic
- Perforated sheet
- Fabric drape

Product Line (PL)

A fenestration attachment product line is a series of products with distinct structural configuration. Location (such as exterior and interior) and orientation (such as vertical or horizontal) to the fenestration product constitute separate PL. Allowable Variation within PL

- Orientation of slats, pleats, shutters, louvers, operating hardware, and mounting hardware (vertical or horizontal);
- Width or thickness;
- Material composition such as wood, polymer, fabric, or metal; ?
- Solar optical variation and openness of material (e.g. Color, solar reflectance, opaque to translucent variations or perforated;
- Emissivity of material; and
- The number of cells or compartments to trap air.

Defining Individual products (ranking attachments only)

Attachment Individual Product		Open	Close		
Reference	Placement	Orientation	Operation	Geometry	Property
3 mm glass or Double glazed 3 mm glass with aluminum standard spacer and air gap of 12mm	Interior	Co-planer	Fixed	Thickness, width, gap	Material- Metal, Wood, Fabric, and/or Film
	between glazing	Projecting	Retract	Cell structure – differentiated by cell count through the depth <ul style="list-style-type: none"> o Single Cell o Cell within a cell <ul style="list-style-type: none"> § Full cell within a cell § Split cell within a cell o Two cells through depth o Three cells through depth 	emissivity, Reflectance
?	Exterior		Adjust	intervals	Opacity and openness
			Retract and Adjust	profiles	Color, Solar Refl.

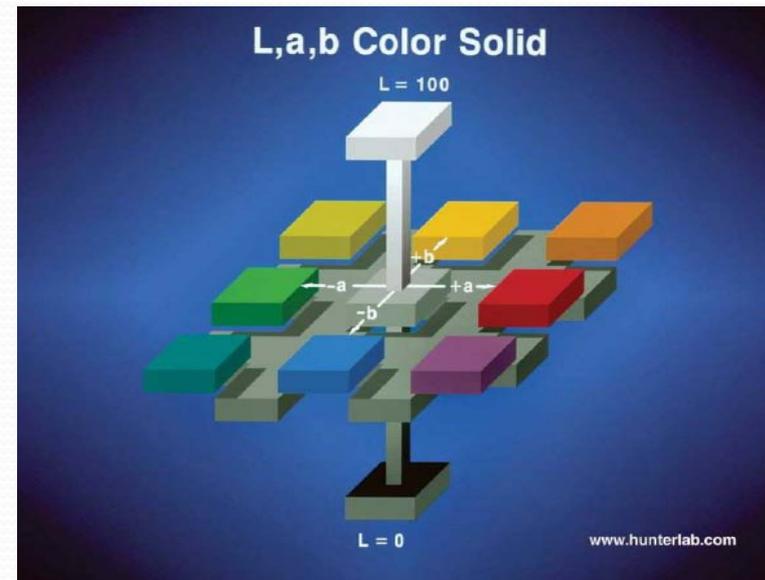
Defining Individual products Categories for Fenestration Performance

Attachment Individual Product		Open		Close		
Reference (Glazing NFRC)	Frame	Placement	Orientation	Operation	Geometry	Property
3mm (1/8in) clear	Metal	Interior	Co-planer	Fixed	Intervals, width, gap, Cell size	Material- Metal, Wood, Fabric, and/or Film
3mm (1/8in) clear + 6mm (1/4in) air + 3mm (1/8in) clear	Metal	between glazing	Projecting	Retract	Cell structure – differentiated by cell count through the depth <ul style="list-style-type: none"> o Single Cell o Cell within a cell <ul style="list-style-type: none"> § Full cell within a cell § Split cell within a cell o Two cells through depth o Three cells through depth 	
3mm (1/8in) clear + 13mm (1/2in) air + 3mm (1/8in) high solar low-e	Non Metal					
3mm (1/8in) mid solar low-e + 13mm (1/2in) air + 3mm (1/8in) clear	Non Metal					
3mm (1/8in) low solar low-e + 13mm (1/2in) air + 3mm (1/8in) clear	Non Metal	Exterior		Adjust	Thickness	Opacity and openness
				Retract and Adjust	profiles	Color

Simplification by Category

(Number of Simulations needed)

- Thickness (in increments)
- Emissivity (in increments)
- Reflectance (Color, Solar Refl.)
- Openness factor for screens and perforated shades
- Fabric transmittance and Refl.
- Cell size, intervals, width, gap
- Intervals, width and overlap (e.g. blinds, pleated, shutters)
- Operable: Open, Closed, Partial



e.g. Color Grouping for Cool Roof Products

	Color Family	Hunter “L” range	Hunter “a” range	Hunter “b” range	Default SR	Default TE
1	Red	17 to 29	+7 to +36	0 to +15	0.25	0.83
2	Terra Cotta	20 to 38	+15 to +30	+6 to +16	0.35	0.83
3	Bright Red	23 to 38	+35 to +49	+10 to +48	0.35	0.83
4	Beige / Off-White	59 to 86	-5 to +5	-3 to +23	0.55	0.83
5	Tan	51 to 65	-2 to +7	+6 to +21	0.45	0.83
6	Dark Blue	13 to 33	-7 to +6	-25 to -2	0.25	0.83
7	Med to Light Blue	34 to 55	-12 to -3	-25 to -8	0.32	0.83
8	Dark Brown	17 to 30	-1 to +9	0 to +10	0.25	0.83
9	Med to Light Brown	25 to 58	-2 to 17	+5 to +26	0.32	0.83
10	Dark Green	18 to 45	-20 to -3	-25 to +11	0.25	0.83
11	Med to Light Green	24 to 70	-20 to 0	-25 to +11	0.32	0.83
12	White	76 to 89	-3 to +2	-3 to +10	0.65	0.83
13	Bright White	>85	-3 to +1	-3 to +6	0.70	0.83
14	Black	<26	-1.5 to +1.5	-1.5 to +1.5	0.25	0.83
15	Dark Gray	24 to 42	-4 to +2	-8 to +4	0.25	0.83

Can we keep attachment ranking independent from Fenestration performance ?

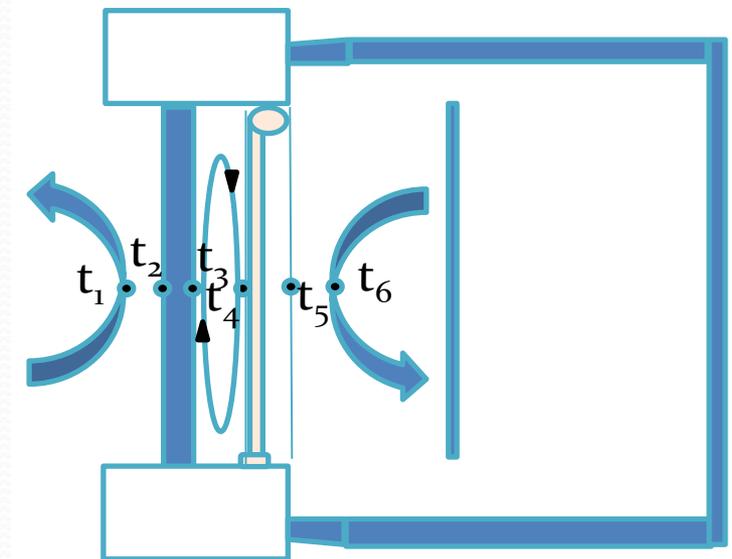
(i.e. Can A Single Known Reference be used for Ranking Attachment against each other?)

Advantage:

- Can develop ranking independent of fenestration
- Lesser number of testing and validation
- Consumer can better understand the ranking
- Code agencies not confused with different values on label.
- Can SHGC be rated at solar angles of 20, 30 and 60 deg?

Issues:

- U-factor will be more conservative if single glazing is chosen
- Solar heat gain will be higher - single pane of glass SHGC is greater than frame SHGC.
- VT will be higher - single pane of glass VT is greater than frame VT
- How attachments perform with fenestration



Test Only Option

Products that cannot be simulated are to be tested

- Identification of product to be tested
 - Should all individual product have to be tested?
 - Can group leader be tested?
- Installation procedures
- Establish Environmental condition for testing
 - Wind speeds for climate chambers
 - High speed can affect exterior mounted attachment products results
- Define acceptable tolerance between testing laboratories for repeatability

Infrastructure Requirements for ranking Categories

- Accreditation of Testing and Simulation laboratories for testing all product categories and material properties
 - Reporting requirements: U-factor, SHGC, VT, Optical properties
- Licensed Inspection Agencies requirements
 - How product compliance is verified
- Administrative office
 - Database design for listing of categories