PHIUS and PHI Certifications: Lessons Learned by North American Window Manufacturers

Alpen High Performance Products and Cascadia Windows and Doors
Passive house and the window industry

Since 2009, passive house growth in US exponential

Significant increase in European window imports

Influencing North America & US efficiency standards

This blending of standards and influx of import products creates challenges in identifying and using appropriate criteria for window comparison and selection.
Cascadia Windows & Doors and Alpen High Performance Products

First (and only) North American window manufacturers with all the important fenestration certifications.

**ALPEN HIGH PERFORMANCE PRODUCTS**
- NFRC
- PHIUS
- PHI (Tyrol Series™, 12/2017)
- Extensive air, water and structural testing

**CASCADIA WINDOWS AND DOORS**
- NFRC
- PHIUS
- PHI (Universal Series™, 3/2018)
- Extensive air, water and structural testing
A Closer Look at Certification Paths

NFRC

PHI

PHIUS
Orange Path

PHIUS
Blue Path
Methods

NFRC
1. ISO 15099/ NFRC 100
2. \( \Delta 70^\circ F \) (\( \Delta 38^\circ C \))
   Outside: 0\(^\circ F\)
   Inside: 70\(^\circ F\)
3. \( U_w_{\text{NFRC}} = \text{area weighted average} \)

PHI
1. ISO 10077/EN673
2. \( \Delta 54^\circ F \)
   Outside: 14\(^\circ F\)
   Inside: 68\(^\circ F\)
3. \( U_w \) with calibration panel (\( U - 0.13 \))

PHIUS ORANGE
1. ISO 10077/EN673
2. Component: \( \Delta 70^\circ F \)
   Published \( U_w \): \( \Delta \) varies
3. \( U_w \) per ISO 10077 w/ actual glass and PHIUS climate zones

PHIUS BLUE
1. ISO 15099 + \( \Psi \) conversion
2. Component: \( \Delta 70^\circ F \)
   Published \( U_w \): \( \Delta \) varies
3. \( U_w \) per ISO 10077 w/ actual glass and PHIUS climate zones
### Comparing the data

<table>
<thead>
<tr>
<th>Certification</th>
<th>Alpen</th>
<th>Cascadia</th>
<th>Alpen (extras)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tyrol PH+ Series “Balanced-9&quot;</td>
<td>Zenith Series</td>
<td>Universal Series “A” 2 Low-E</td>
</tr>
<tr>
<td>NFRC*</td>
<td>0.12</td>
<td>0.15</td>
<td>0.15</td>
</tr>
<tr>
<td>PHIUS Blue Path*</td>
<td></td>
<td></td>
<td>366-clear-180</td>
</tr>
<tr>
<td>$U_f$</td>
<td><strong>0.18</strong></td>
<td>—</td>
<td>0.18</td>
</tr>
<tr>
<td>$U_g$</td>
<td>0.065</td>
<td>—</td>
<td>0.13</td>
</tr>
<tr>
<td>$U_{w,NFRC}$</td>
<td>0.13</td>
<td>—</td>
<td>0.16</td>
</tr>
<tr>
<td>PHIUS Orange Path*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$U_f$</td>
<td><strong>0.15</strong></td>
<td>0.21</td>
<td>—</td>
</tr>
<tr>
<td>$U_g$</td>
<td>0.066</td>
<td>0.076</td>
<td>—</td>
</tr>
<tr>
<td>$U_{w,INSTALLED}$</td>
<td>0.13</td>
<td>0.14</td>
<td>—</td>
</tr>
<tr>
<td>PHI‡</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$U_f$</td>
<td><strong>0.13</strong></td>
<td>—</td>
<td>0.15</td>
</tr>
<tr>
<td>$U_g$</td>
<td>0.133</td>
<td>—</td>
<td>0.123</td>
</tr>
<tr>
<td>$U_{w PHI CALIB. PANEL}$</td>
<td>0.14</td>
<td>—</td>
<td><strong>0.14</strong></td>
</tr>
<tr>
<td>$U_{w ACTUAL GLASS}$</td>
<td>0.095</td>
<td>—</td>
<td><strong>0.13</strong></td>
</tr>
</tbody>
</table>
YOUR TAKE-HOME MESSAGE #1

Know that different standards exist

• Is your project outside of “European” ISO climate conditions (Δ 54° F)?

• Do you need NFRC Certification for Building Code or Tax Credits?

• What performance criteria are most important for your project?

Mostly glass?

Mostly frames?

Average amount of both?
Be prepared to train and market effectively

Tyrol PH+

- 3-chamber center seal
- 3 pieces insulation
- 41 mm (1-5/8”) glazing pocket  \( (U_f\ 0.14) \)
- 2x 18mm (11/16”) argon gaps  \( (U_g\ 0.095) \)

Tyrol Standard

- 2 pieces insulation
- 1-3/8 mm (1-3/8”) glazing pocket  \( (U_f\ 0.15) \)
- 2x 14mm (9/16”) argon gaps  \( (U_g\ 0.123) \)
Is NFRC Important?

Absolutely.

- You should demand it **as well as** Passive House Certified Data.

- NFRC provides evidence of quality, independent physical testing and assurance the glass units have also be tested for gas retention and durability.

- Compare the NFRC numbers to Passive House whole window numbers. If dramatically different, ask why.

And, there may be times that standards overlap...
Marketing Choices and Challenges

• What do you do when you have one window and many results?

• When it comes to marketing your new passive house window, how will you publish results?
  ▪ What single value would you promote?
  ▪ Is it accurate to what you build?
  ▪ Can you game the system without lying? Would you?
“Myth” of Ug-0.088

OPTIMAL ARGON GAP WIDTHS:

- NFRC: 12.7 mm (1/2”)
  - EN 673 Ug- 0.123
  - NFRC Ug- 0.121
- EN 673: 18 mm (11/16”)
  - EN 673 Ug- 0.096
  - NFRC Ug- 0.125

Myth of Ug- 0.088

IF AS LITTLE AS +/- 0.1 mm (0.003”) CAN AFFECT Ug …

• How is Ug- 0.088 so common?
  ▪ Varying overall IG widths
  ▪ Varying glass thicknesses
  ▪ Varying argon gap sizes
"Myth" of Ug- 0.088

GUARDIAN GLASS CONFIGURATOR

<table>
<thead>
<tr>
<th>Make-up Name</th>
<th>Transmittance</th>
<th>U-Value (Ug in W/m²-K)</th>
<th>Solar Factor (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CG Prem4 x 18ARG x Clear4 x 18ARG x CGPrem4</td>
<td>74.1</td>
<td>0.5</td>
<td>52.8</td>
</tr>
</tbody>
</table>

= Ug- 0.088 Btu/h.ft².F
YOUR TAKE-HOME MESSAGE #2

Verify your values

NFRC
www.nfrc.org

Passive House Institute US
http://www.phi.us.org

Passive House Institute
passivehouse.com

Ask the Manufacturer to provide reports
Choose the right product for your project

- Select key thermal performance metrics that reflect your project design
- Think beyond thermal data
  - Is your frame *material* suitable for North American climates?
  - Is your color foil tested and warranted for North America?
  - Does the manufacturer’s warranty meet your needs?

### Comparison of Foil Durability Test in Arizona

<table>
<thead>
<tr>
<th>Years</th>
<th>Approved for North American Exteriors</th>
<th>NOT Approved for North American Exteriors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.5 Years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 Years</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Choose the right product for your project

CLIMATE HAS A BIG IMPACT ON FILM SELECTION
30,000’ View Conclusion

- Can be intimidating
- IS time intensive
- Hire a great consultant/modeler
  - Someone willing to support frequent “model- results- re-model” feedback loop
- Results WILL change your product line-up
- Be prepared to invest in your team – educate, train, equip
CASCADIA’S EXPERIENCE

A MANUFACTURER’S DESIGN JOURNEY LEARNING EUROPEAN NORMS ON-THE-GO
# Balancing Design Choices for One Product but Multiple Certification Targets

<table>
<thead>
<tr>
<th>IGU THICKNESS</th>
<th>FRAME-ONLY FOCUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFRC optimal spacer</td>
<td>Full window modelling</td>
</tr>
<tr>
<td>vs</td>
<td>vs</td>
</tr>
<tr>
<td>PHI optimal spacer</td>
<td>Frame-only</td>
</tr>
<tr>
<td>vs</td>
<td>=</td>
</tr>
<tr>
<td>Long-term durability recommendations from IG supplier</td>
<td>More detailed look at optimizing frame performance</td>
</tr>
</tbody>
</table>
IGU Thickness - Multiple Glass Stops is only one Consideration

Optimal for NFRC

Optimal for PHI

IG manufacturer’s guidance:
Avoid a bigger “balloon” to maintain long term durability

Ultimately, a balanced choice was a slight compromise for all

**Frame-Only Focus In PHI**

**PHI Certification for a Window Uses a “Calibration Panel” Instead of an IGU in the Frame Model**

- Panel’s U-value set to “worst-allowed” U-glass 0.70 W/m²/K
- Forces manufacturer to optimize frame design at detailed level
- No help from rounding; your U-window must be Usi-0.80 (U-0.1409), and not U-0.1449 rounded to U-0.14

**Thermal model with calibration panel in lieu of IGU**
What About Material Standards?
European Norm vs ASTM

- PHI is not used to some materials used more commonly in North America – *eg. pultruded fiberglass*

- PHI did not recognize commonly accepted k-value (thermal conductivity) of fiberglass frame material

- k-value testing yielded different results under EN standard

- 0.30 (ASTM) vs. 0.33 (EN)
Reacting to Material Differences

**K-VALUE TESTING NOT UNEXPECTED**

- lengthy process
- resulted in design changes

**INSULATION TYPE**

**NOVEL MILLING PATTERN IN SASH**
Reacting to Material Differences

1. Insulation type
   - EPS to PU
   - How do you cut thermoset insulation?

Polyurethane (PU) insulation cut to fit frame cavities
Reacting to Material Differences

**Novel milling pattern**

- Thankfully, we over-design the sash profile (structurally)
- Cut out some material that crosses the isotherms

_Milling pattern in over-designed material reduces thermal bridging from frame wall that crosses isotherms_
30,000’ View Conclusions

FOR MANUFACTURERS

Learn what your certification body will want early on

- including proofs and testing
- especially PHI (for material conductivity)

Be careful when designing PHI-optimized IGUs

- Consult with IG supplier
- Careful about too big a balloon

FOR SPECIFIERS

Many manufacturers that offer NFRC and PHI certified products will have two or more variants

- Specify the right one
- Can have different price tags
- Consider NFRC version’s price vs performance
  - sometimes PHI data is available for these versions too
Questions?

ALPEN HIGH PERFORMANCE PRODUCTS
www.thinkalpen.com
303-834-3600
ALI RAY
aray@thinkalpen.com

CASCADIA WINDOWS & DOORS
www.cascadiawindows.com
604-857-0048
MICHAEL BOUSFIELD
mbousfield@cascadiawindows.com