Window Installation in Passive Houses – ways to achieve superior insulation, airtightness and durability

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What makes a window perform?

**Glass**
- U-value
- SHGC
- Clarity (VT, color)

**Frame**
- U-value
- Tight seal
- Durability

**Spacer**
- Non-metallic
- Structurally sound
- Aesthetics

**Install**
- Overinsulation
- Airtightness
- Water tightness
American high performance Windows

- Main suppliers: Serious, Thermotech, Cascadia
- Fiberglass frames
- Thin frames
- Shorter lead times

Heat demand as low as 5.35 kbtu/ft.yr
Euro windows I - uPVC

- Lowest cost PH window available
- Steel reinforced
- Toxic in production and disposal
- Estimated lifespan 25 years

Heat demand 4.55 kbtu/ft².yr

<table>
<thead>
<tr>
<th>Energy Demands with Reference to the Treated Floor Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treated Floor Area: 2755 ft²</td>
</tr>
<tr>
<td>Specific Space Heat Demand: 4.55 kBTU/(ft²·yr)</td>
</tr>
<tr>
<td>Pressurization Test Result:</td>
</tr>
<tr>
<td>Specific Primary Energy Demand (DER: Heating, Cooling, A/C and Hot Water)</td>
</tr>
<tr>
<td>(Primary Energy Demand (DER): Heating and Auxiliary Electricity)</td>
</tr>
<tr>
<td>Specific Primary Energy Demand Energy Conservation by Solar Electricity</td>
</tr>
<tr>
<td>Heating Load:</td>
</tr>
<tr>
<td>Frequency of Overheating:</td>
</tr>
<tr>
<td>Specific Useful Cooling Energy Demand:</td>
</tr>
<tr>
<td>Cooling Load:</td>
</tr>
</tbody>
</table>

Ph Certificate: 4.75 kBTU/(ft²·yr)  0.5 ACHₚₐ  38.0 ACHₚₐ  38.0 ACHₚₐ  Yes  Yes
Euro Windows II - wood

- Craftsmanship
- Need to be repainted about every six to ten years
- Factory finished
- Lifespan if well maintained 40+ years

Heat demand as low as 4.55 kbtu/ft.yr
Euro Windows III – aluminum clad

- Nearly Maintenance free
- Rain screen aluminum cladding
- Wood interior
- Thermally broken frames

Heat demand as low as 4.45 kbtu/ft.yr
Installation positions

- Flush outside (easiest, best solar gain potential)

- Centered (more difficult install, better thermal performance)

- Overinsulated & centered (most difficult install, best performance)
Installation positions

- Flush outside (easiest, best solar gain potential)
- Sample wall: 2x4 plus TJI, solid window buck from ply
- Psi install: 0.023 BTU/hrftF
Installation positions

- Center of wall
- Sample wall: 2x4 plus TJI, solid window buck from ply
- Psi install: 0.014 BTU/hrftF
Installation positions

- Center of wall, overinsulated inside and outside
- Sample wall: 2x4 plus TJI, solid window buck from ply
- Psi install: -0.005 BTU/hrftF
Most Euro windows are designed for an airtight connection on the inside – wrap your air barrier into the rough opening. Tip: cladding your R.O. with OSB will make this easier and more durable.
Rough Opening Prep  Window Install  Overinsulation
Rough Opening Prep → Window Install → Overinsulation

Install objectives

- Mechanical attachment
- Air tightness
- Insulation (Gap between R.O and window)
- Weather proofing
Brackets for fixed frames, screws for operable frames. Spacing 24” o.c. but first attachment point no more than 8” from corner.
• Move the window to your work area, tools: suction cups and forearm forklifts
- Remove sash, predrill for install screws (operable)
• Remove sash, predrill for install screws (operable) or mount brackets to frame (fixed)
Consider when deciding on an install method:

• Goals – inside/outside drying
• Timing of install – is the finish façade already on or can we use tapes on the outside still?
• How precise and reliable will your R.O.’s be?
• Labor cost / material cost
<table>
<thead>
<tr>
<th></th>
<th>Air tightness</th>
<th>Insulation</th>
<th>Weather Proofing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tape / Foam / Tape</td>
<td>Specialty tape to window butt or face</td>
<td>Spray applied foam or stuffed with mineral wool</td>
<td>Specialty tape to face of window</td>
</tr>
<tr>
<td>Tape / Foam / Compression tape</td>
<td>same</td>
<td>same</td>
<td>Compression tape at butt or face, allowing full install from inside</td>
</tr>
<tr>
<td>3 in 1</td>
<td>Single compression</td>
<td>tape on butt side</td>
<td>fulfills all functions</td>
</tr>
<tr>
<td>Caulk / Air / Caulk</td>
<td>Specialty caulk</td>
<td>Air space</td>
<td>Caulk / w drainage points</td>
</tr>
</tbody>
</table>
Impact of foam vs void r.o gap – dry condition

Foam psi-install 0.015 BTU/hrftF

Air gap psi-install 0.024 BTU/hrftF
Jim Maduena / Jonah Stanford inside drying install:
- Illbruck Duo attached to side of frame
- Set from outside
- Zip tape over outside face
Jim Maduena / Jonah Stanford inside drying install:
• Illbruck Duo attached to side of frame
• Set from outside
• Zip tape over outside face
Results:
- Install completed within 24hrs of arrival of Zola truck
- Blower door test 30hrs after arrival of windows: 0.18ACH50
<table>
<thead>
<tr>
<th>Type</th>
<th>U-Value</th>
<th>R-Value</th>
<th>Frame Dimensions</th>
<th>Thermal Bridge</th>
<th>Thermal Bridge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frame</td>
<td>BTU/hr.ft²</td>
<td>hr.ft²/BTU</td>
<td>Width - Left</td>
<td>Width - Right</td>
<td>Width - Below</td>
</tr>
<tr>
<td>ZOLA – Thermo operable</td>
<td>0.16</td>
<td>6.31</td>
<td>4.92</td>
<td>4.92</td>
<td>4.92</td>
</tr>
<tr>
<td>ZOLA – Thermo fixed</td>
<td>0.16</td>
<td>6.31</td>
<td>3.50</td>
<td>3.50</td>
<td>3.50</td>
</tr>
</tbody>
</table>

**Diagram**

- **Rough Opening Prep**
- **Window Install**
- **Overinsulation**

**European Windows**

1.5" THICK X 6" WIDE EXTERIOR POLYSIO POST INSULATION
3" THICK X 9" WIDE POLYSIO POST INSULATION

**Glass Values:** Uglass=0.09 BTU/hr.ft², SHGC= 0.48
Thank you!

- Questions? Call or email

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