

# Do Europeans *Really* Make The Best Windows?

These cold-weather windows are new to our shores and perform well, but some lesser known North American products may be just as good

BY MARTIN HOLLADAY

A good window seals out cold, windy weather and admits as much light as possible into a house's interior. While those functions seem rather obvious, some claim a new class of window can perform these duties better than any window made in the United States.

Only a handful of window manufacturers in the United States and Canada sell high-performance windows suitable for cold-climate homes. Sensing an opportunity, manufacturers from Germany and Austria have eagerly filled the market niche by introducing a host of high-performance units to American builders.

## Defining high performance

The two most important measures of a window's performance are its U-factor and its solar heat-gain coefficient (SHGC), numbers that can be found on a new window's National Fenestration Rating Council (NFRC) label.

A window's U-factor is the inverse of its R-value; the lower the U-factor, the better the window is at resisting heat flow. A low U-factor is desirable in all climates. While the best double-glazed windows have a U-factor of about 0.27, triple-glazed windows have U-factors as low as 0.17.

SHGC is a measure of how much solar heat is admitted through a window. In general, windows with a high SHGC help to heat a house (a desirable feature during the winter),



## EFFICIENT WOOD WINDOWS FROM ACROSS THE POND

Optiwin windows, which exemplify Passive House-certified European windows, are manufactured by Müller Schreinerei in Lautenbach, Germany. The company produces two cold-climate windows, the Three-Wood (Drei-Holz) window and the Two-Wood (Zwei-Holz), pictured here.

Like all European tilt-turn windows, Optiwin windows open inward. This feature allows the windows to be installed in a recessed location so that foam sheathing (a common feature on superinsulated walls) can be extended to cover the exterior of the window frames. This installation detail—sometimes referred to as “overinsulating the exterior of the window frames”—improves the windows' overall thermal performance.



A core of cork increases thermal performance.

The interior of the frame, which is made of either fir or spruce, is left exposed.

Triple glazing with warm-edge spacers is filled with argon or krypton.

**Optiwin**  
U-factor: 0.137  
SHGC: 0.53  
VT: 0.72 (glass only)

Kerfed-in bulb weatherstripping

Aluminum cladding increases durability.

Locking hardware that's been compared to that of a bank vault helps to compress extensive weatherstripping to limit air infiltration.

Cork acts as a thermal break.

## It's difficult to compare U-factors

The U-factors reported by European window manufacturers—whether given in European units ( $W/m^2 \cdot K^\circ$ ) or North American units ( $Btu/ft^2 \cdot F^\circ$ )—are difficult to compare with U-factors reported by North American manufacturers. European and North American laboratories use different protocols to test window U-factors, and most glazing experts agree that European U-factors would look worse if the windows were tested according to NFRC requirements.

U.S. distributors of European windows don't follow a consistent method for reporting U-factors. Some use European metric units, while others report North American U-factors or even R-values.

Although the NFRC requires U-factors and SHGC to be based on the performance of the whole window, including the frame, many European manufacturers report U-factor and SHGC numbers that measure the performance of the glazing alone.

There is a straightforward conversion factor for converting a European U-factor in  $W/m^2 \cdot K^\circ$  to a North American U-factor in  $Btu/ft^2 \cdot F^\circ$ : Simply divide by 5.678. Unfortunately, while this method converts the units, it doesn't account for the fact that the European protocol tests windows of a different size from the size used in North American testing, or for the fact that European windows are tested at different temperatures than required for North American tests.

## AN AMERICAN STANDARD

To appreciate the performance of the windows featured here, it's helpful to look closely at a typical window made by an American manufacturer. This argon-filled, double-paned window made by Marvin is an example of a unit suitable for houses built to code minimums.

**Zertifikat**  
ausgegeben am 01.10.2009  
Hersteller: OPTIWIN GmbH  
Produktname: Dreifachholz

Folgende Kriterien wurden für die Zuordnung des Zertifikates geprüft:

Ergebnisse Bauteil-Eigenschaften:  
Unter Standard-Bedingungen (Temperatur  $t_L = -10^\circ C$  /  $50^\circ F$ ), Passivstrahlung  $L_{ext} = 100 W/m^2$ , Passivstrahlung  $L_{int} = 10 W/m^2$  und  $U_{g,0.75} = 0,72 W/m^2 \cdot K^\circ$

Parameter	Leistung und Strahlung	Abwärtswärme	Abwärtswärme
$U_{g,0.75}$ ( $W/m^2 \cdot K^\circ$ )	0,72	$U_{g,0.75}$ ( $W/m^2 \cdot K^\circ$ )	0,036
Bräule (mm)	134	$U_{g,0.75}$ ( $W/m^2 \cdot K^\circ$ )	0,036

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Das Zertifikat ist wie folgt zu verwenden:  
PASSIV HAUS  
geprüfte KOMponente  
Dr. Wolfgang Feist

Fenster rahmen:  
 $U_{g,0.75} = 0,72 W/m^2 \cdot K^\circ$   
 $U_{g,0.75} = 0,036 W/m^2 \cdot K^\circ$   
Bräule = 134 mm

**World's Best Window Co.**  
Millennium 2000+  
Vinyl-Cast Wood Frame  
Double Glazing - Argon Fill - Low E  
Product Type: Vertical Slider

**ENERGY PERFORMANCE RATINGS**

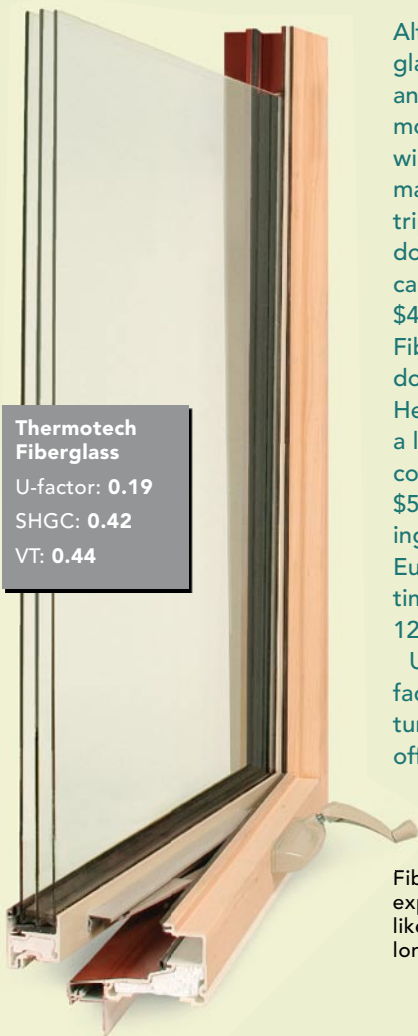
U-Factor (U.S.A.)	0.35	Solar Heat Gain Coefficient	0.32
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**ADDITIONAL PERFORMANCE RATINGS**

Visible Transmittance	0.51	Air Leakage (U.S.A.-P)	0.2
Condensation Resistance	51		

Manufacturer disclaimer: These ratings conform to applicable NFRC procedures for determining window product performance. NFRC ratings are determined for a fixed set of environmental conditions and a specific product size. Consult Manufacturer's literature for other product performance information. www.nfrc.org

**Marvin Ultimate Push-Out Casement**  
U-factor: 0.28  
SHGC: 0.25  
VT: 0.42  
Cost: \$670



**Thermotech Fiberglass**  
 U-factor: 0.19  
 SHGC: 0.42  
 VT: 0.44

Although European triple-glazed windows are well built and attractive, they cost far more than North American windows with similar performance specs. (For an operable triple-glazed casement window measuring 8 sq. ft., you can expect to pay between \$400 and \$520 for an Inline, Fibertec, or Thermotech window. A Serious window with Heat Mirror glazing will have a lower VT rating, but it will cost about the same—\$400 to \$560, depending on the glazing chosen.) Windows from Europe also have a long lead time—anywhere from 10 to 12 weeks.

Unlike almost all U.S. manufacturers, Canadian manufacturers of fiberglass windows, offer full-thickness (1 $\frac{3}{8}$  in.)

Fiberglass frames don't expand and contract like vinyl, which leads to longer lasting windows.

triple-glazing. Even when U.S. manufacturers offer triple glazing, it's usually thin (1 in. or  $\frac{7}{8}$  in.), low-performance glazing. While Canadian window manufacturers offer both low-solar-gain and high-solar-gain triple glazing, it's difficult to buy high-solar-gain triple glazing from a U.S. manufacturer.

Canadian fiberglass windows have other attributes that make them more attractive than European offerings. Canadian windows have narrower frames than European windows. Because frames have a lower R-value than a superinsulated wall, narrower frames mean better thermal performance overall. Also, narrow-framed windows allow more light and more solar heat gain than wide-framed windows.

When looking for high-performance windows made domestically, you'll come across the following materials.



**Serious Windows**  
 U-factor: 0.13  
 SHGC: 0.20  
 VT: 0.30

Heat Mirror glazing is high performance, but comes with skepticism.

### Pultruded fiberglass frames

The pultruded fiberglass used for the best Canadian window frames is similar to the fiberglass used to make stepladders, only denser and smoother. Even when left unpainted, pultruded fiber-

while windows with a low SHGC help to prevent a house from overheating (a desirable feature during the summer). Cold-climate houses need windows with a high SHGC (at least 0.39), especially on the south elevation. On the other hand, hot-climate houses need windows with a low SHGC (0.30 or lower), especially on the west elevation. Cold-climate builders should look for windows with a low U-factor and a high SHGC. The higher a window's visible-light transmittance (VT), the better. VT indicates the amount of visible light that enters a window.

Many high-performance European windows meet stringent standards established by the Passivhaus Institut in Darmstadt, Germany. (For more information on the Passive House standard, see "The Passive House: Green Without Gizmos," *FHB* #210 and online at [FineHomebuilding.com](http://FineHomebuilding.com).) To

be certified, a Passive House window needs a European U-factor no greater than 0.80 W/m<sup>2</sup>•K° (see sidebar p. 51).

In central Europe, such low-U-factor windows maintain an interior pane temperature of 17°C (62.6°F) or more on the coldest day of the year. The Passive House U-factor requirement can be achieved only by windows with insulated frames and triple glazing with two low-e coatings and warm-edge spacers.

U.S. distributors now sell Passive House windows from several European manufacturers, including Internorm and Silber in Austria, and Henzmann, Optiwin, Pazen ENERsign, and Unilux UltraTherm in Germany.

### The European difference

For the most part, the glass in European Passive House windows is quite similar to the glass used in the best Canadian windows:

argon- or krypton-filled triple glazing with two low-e coatings and warm-edge spacers. That's why many energy experts report that the thermal performance of the best European windows is about the same as that of fiberglass-framed, triple-glazed Canadian windows. Katrin Klingenberg, founder of the Passive House Institute US, gives a bottom-line analysis: "Our experience has been that the overall performance of the fiberglass-framed Canadian and U.S. windows is almost as good as the German Passive House windows if you look at the overall systems design [using Passive House Planning Package software]."

However, European window manufacturers continue to push the performance envelope, and glazing manufacturers are always striving to improve their products. The latest versions of low-U triple glazing

glass is extremely durable and weather resistant. Because it has a coefficient of thermal expansion that closely matches that of glass, it's a much more suitable material for window frames than vinyl.

### Heat Mirror glazing

Heat Mirror glazing has only two panes of glass; the performance of the glazing is improved by one or more stretched plastic films suspended between the two panes. The plastic films create two or three separate air spaces between the inner and outer panes of glass, mimicking the performance of triple or quadruple glazing but with less weight.

The best-known manufacturer of Heat Mirror windows is Serious Materials. Serious offers windows with lower U-factors than any triple-glazed window. Its best-performing operable window (a 1125 series casement or awning window with three plastic films) has a whole-window U-factor of 0.13. The low-U-factor glazing comes with a downside, however: a very low SHGC

(0.20) and a very low visible transmittance (0.30). In other words, the windows don't let in much light or heat. European window manufacturers (and most Passive House builders in the United States) have been reluctant to use Heat Mirror windows due to lingering skepticism about the long-term durability of the plastic films and an unwillingness to accept lower SHGC and VT ratings.

### Vinyl frames with triple glazing

Builders experiencing triple-glazing sticker shock may want to consider a lower-cost option: vinyl windows. Paradigm Windows of Portland, Maine, offers casement windows with foam-injected frames. Paradigm's best performing krypton-filled triple-glazed casement windows have a whole-window U-factor as low as 0.17. Unfortunately, these windows also have a low SHGC (0.23). Like almost all U.S. window manufacturers, Paradigm Windows doesn't yet offer high-solar-gain triple-glazed products.

Triple-glazed windows are a must on high-performance homes, and vinyl frames help to reduce cost.

**Paradigm Windows**  
U-factor: 0.22  
SHGC: 0.23  
VT: 0.38



from Europe may have a higher SHGC than comparable low-U triple glazing available in North America. According to some window experts, European manufacturers are already selling windows with better insulated frames and glazing with a slightly lower U-factor than any frames or glazing available from North American manufacturers.

Typical European Passive House windows have composite frames, often including a wood lamination on the interior, a core of foam or cork to act as a thermal break, and a weather-resistant exterior cladding of aluminum or rot-resistant wood.

Although the wide frames on European windows reduce the windows' thermal performance—especially their potential for solar heat gain—compared to narrow-framed North American fiberglass windows, the thermal breaks incorporated in European

frames are usually more effective than those used by North American manufacturers.

### High-performance windows don't make sense in all homes

The high cost of triple-glazed windows is hard to justify unless you're building a superinsulated house in a cold climate. But once your wall specs reach the R-40 level, triple-glazed windows start to make sense. A triple-glazed Optiwin tilt-turn window will cost at least \$880, while a window from Bieber will cost almost twice as much. Fortunately, Canadian windows with comparable performance specs cost roughly half the price of an Optiwin window.

Because of their positive latching hardware, casement, awning, and tilt-turn windows always outperform single- or double-hung windows. □

Martin Holladay is a contributing editor.

## SOURCES

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Duxton

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### EUROPEAN

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Heinzmann

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Internorm

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Optiwin

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Unilux Ultratherm

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