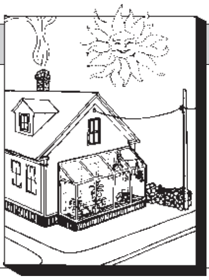

Measuring Heat Loss in Energy-Efficient Windows

by Alex Wilson

Last month I discussed the most important factor controlling the energy efficiency of windows: the R-value of the glass. The glass, however, is by no means the whole story. This month I'll discuss two other important factors that determine a window's energy performance: sash/frame material and air leakage.

Conductivity Through Window Sash and Frame

Window sash and frames, like any building-skin component, contribute to heat loss. Of the materials used in manufacturing windows—wood, vinyl, aluminum and steel—wood usually is the most energy efficient, followed by vinyl, then aluminum and steel. Aluminum frames typically have thermal breaks (layers of low-conductivity material separating the inside and outside of the frame) to reduce conduction, but not always. If you're building houses you want to call energy efficient, keep away from metal windows that lack thermal breaks.

The R-values given in window manufacturers' literature usually take into account heat loss through both the glass and the structural components. The windows are tested using the "guarded hot-box test" (ASTM C-236) or a modified test known as AAMA 1503 developed by the American Architectural Manufacturer's Association. Some manufacturers, however, calculate thermal performance from ASHRAE tables and forgo the actual testing, which is less accurate.

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Infiltration Through Windows

Infiltration through windows accounts for a quite significant—and often overlooked—component of overall heat loss. In our existing housing stock, windows are estimated to account for about 15 to 20 percent of the overall infiltration. Windows manufactured today, however, are far more airtight.

Window air leakage usually is presented in terms of cubic feet of air leakage per minute per linear foot of crack between sash and frame (c.f.m./ft.). The standard test is ASTM E-283, "Air Leakage of Residential Windows." In this test, the window is exposed to a steady pressure differential of 1.57 pounds per square foot, which is equivalent to a 25-mile-per-hour wind.

Numbers cited in manufacturers' literature therefore should not be regarded as measurements of a window's actual average performance in the area of heat loss, but rather as comparative numbers similar to EPA mileage ratings.

Table 2 shows the leakage rates of various windows tested by the Lawrence Berkeley Laboratory in California. A leakage rate of 0.5 c.f.m./ft. is considered the industry standard. As indicated by the table, certain window types are far more airtight than others. However, the ranges for most types of windows overlap, so check manufacturers' literature carefully.

Comparing Window Models

Manufacturers' claims of leakage rates for various model types are shown in Table 3. It should be noted that the table does not always compare apples to apples or oranges to oranges. Whether windows are vinyl-clad or simply primed affects the tightness; in the interest of conserving space, however, only the value for primed windows is included if a manufacturer offers both.

Due to the gasket or compression seal and a closure mechanism that draws the window tight, casement windows generally are the tightest. Many super-insulated houses use only casement and awning windows for these reasons.

Double-hung windows vary considerably in airtightness, largely as a result of differences in their tracking mechanisms. None of the double-hung units listed in Table 3 is the old, loose-fitting type with sash weights to counterbalance the window. These old-timers are real energy wasters—not only because they are loose, but because the open plenums housing the sash weights otherwise could be filled with insulation.

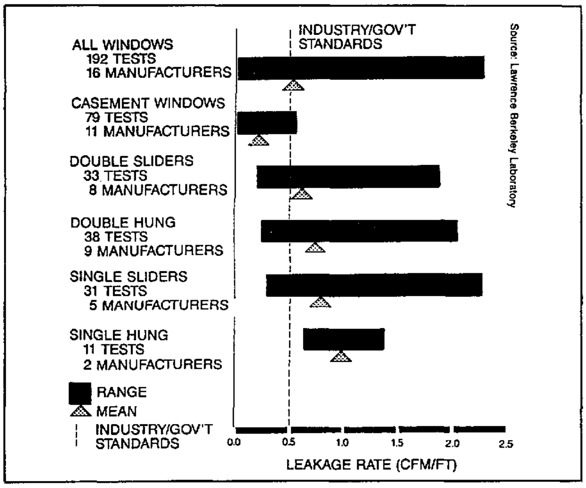
New double-hung windows are very tight-fitting and well weatherstripped. Some rely only on friction to prevent the sash from sliding down unassisted, while others use spring-mounted cables.

Factors to Consider

Windows play an important role in the energy efficiency and comfort of buildings. The new windows available today from most major manufacturers are a far cry from what most of us currently have in our homes.

When looking for replacement windows or units for new houses, pay attention to all the factors that relate to energy efficiency: the type of glass, the spacing between glazing layers, the sash and frame material, the type of window itself, the tracking mechanism and the weatherstripping. Read through the manufacturer's literature and study

Table 2
Comparative Leakage Rates of Common Windows



Reprinted from Energy Design Update Window Supplement.

Table 1
R-Values for Windows with Various Frame Types

Frame Type	Single	Double (½" air space)	Triple (½" air space)
All Glass	0.91	2.04	3.20
Wood Frame	1.00—1.07	2.04 — 2.28	3.20 — 3.40
Metal Frame	0.83 — 0.91	1.57 — 1.70	2.15 — 2.48
Thermally Broken Metal Frame	0.91 — 1.01	1.77 — 2.15	2.58 — 3.20

Source: *Energy Design Update,* "Windows and Energy Efficiency: Principles, Practices and Available Products" (from ASHRAE 1981 *Handbook of Fundamentals.*

Table 3
Manufacturer Claims of Window Tightness
(in c.f.m./ft.[1])

Manufacturer	Type of Window: Casement	Awning	Double-Hung	Slider	Patio Door
Andersen	.09	.15	.20	.20	NA
BiltBest	.03	NA	.24	NA	NA
Caradco	.03	.05	.22	.15	.11
Hurd	.06	.06	.12	NA	.10
JX-7	.01	NA	.04	.23	.24
Louisiana Pacific	.11	.08	.31	NA	.28
Malta	.04	NA	.16	NA	NA
Marvin	.05	NA	.17	.11	.22
Norco	.06	NA	.18	NA	NA
Nor-Guard	.03	NA	NA	.46	NA
Peachtree	.05	.05	NA	NA	NA
Pella	.03	.03	.15	NA	NA
SealRite	.01	.01	.25	NA	NA
Sunflake	.03	.03	NA	NA	NA
Weather Shield	.02	.15	.14	.17	NA

Source: *Energy Design Update,* "Windows and Energy Efficiency" Supplement.

[1]Where numbers are given for both clad and primed windows, figures are given only for primed windows.

Consider where the window will be used. Some locations require the absolute maximum in airtightness, while others (in the bathroom, for example) are not as demanding.

the R-value ratings, the air-leakage figures and the general quality of construction. Test out the opening and closing mechanisms and the basic "feel" of the window.

Finally, consider where the window will be used. Some locations require the absolute maximum in airtightness, while others (in bathrooms, for example) are not as demanding. Unless you have an unlimited budget, of course, you will have to make compromises—perhaps going with higher-priced, higher-quality windows in the living room and making do with mid-range windows in the bathrooms and bedrooms. Let common sense be your guide. ■

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