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HIGH-PERFORMANCE WINDOWS

BUILDING ENVELOPE IMPROVEMENT

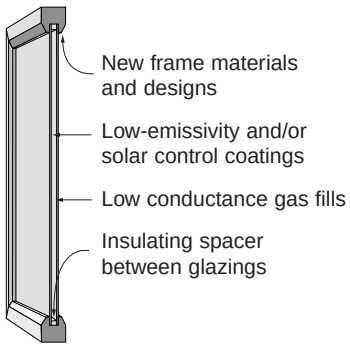
The U.S. Environmental Protection Agency's **ENERGY STAR® Program** promotes the use of high-efficiency technologies and equipment. ENERGY STAR labeled homes use at least 30% less energy than homes built to meet the national Model Energy Code while maintaining or improving indoor air quality. These fact sheets are designed to help consumers learn more about the energy-efficient improvements to their ENERGY STAR labeled homes.

Windows typically comprise 10 to 25 percent of the exterior wall area of new homes. Research studies report that windows in heating-dominated climates account for up to 25 percent of a typical house's heating load and that in cooling-dominated climates, windows account for up to 50 percent of the cooling load.

In recent years, many technological advances have been made that significantly enhance the thermal performance of windows. As shown in Figure 1, these technologies include improved framing materials, low-emissivity and solar control coatings, low-conductance gas fills, improved thermal breaks and edge spacers, and better edge sealing techniques. These technologies can be used independently or in combination, but must be selected based on climate to optimize performance.

Windows can improve the thermal performance of homes by minimizing heat loss in heating-dominated climates and by minimizing solar heat gain in cooling-dominated climates. Thus windows with lower U-factors or higher R-values perform better in heating-dominated climates and windows with lower solar heat gain coefficients (SHGC) perform better in cooling-dominated climates (see Figure 2). SHGC is a measure of the amount of solar energy that a glazing material allows to pass.

FIGURE 1: HIGH-PERFORMANCE WINDOW



The materials and design of the frame also influence thermal performance. Low conductance materials, such as wood, vinyl, and fiberglass, perform better than high conductance materials such as aluminum. Look for "thermal breaks" where aluminum frames are used in heating-dominated climates to avoid condensation. And finally, insulated frames perform better than uninsulated.

Air tightness is another important consideration. Windows are now being tested and rated for air tightness. A rating of 0.2 cfm/ft (cubic feet per minute of air leakage per linear foot of window edge) or lower is considered good. The best windows have a rating of 0.1 cfm/ft or lower.

An effective building envelope is a key element for an energy-efficient home. ENERGY STAR labeled homes are often constructed with high-performance windows that can improve the effectiveness of the building envelope and improve comfort.

FIGURE 2: THERMAL PERFORMANCE CHARACTERISTICS OF VARIOUS WINDOW SYSTEMS

Window System Description	U-factor *[R-value]*	SHGC	Air Leakage (cfm/ft)
Triple glazing with 2 Low-E coatings and argon gas fill in an insulated vinyl frame.	0.15 *[6.2]*	0.37	0.08
Double glazing with a Low-E coating and argon gas fill in a wood or vinyl frame.	0.33 to 0.30 *[3.0 to 3.3]*	0.55 to 0.44	0.15
Double glazing in a wood or vinyl frame.	0.49 *[2.0]*	0.58	0.56
Single glazing in an aluminum frame with no thermal break.	1.30 *[0.77]*	0.79	0.98

from *Residential Windows*, John Carmody, et. al., Norton & Company, 1996.

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RESOURCES

The Consumer Guide to Home Energy Savings, (Wilson and Morrill) 5th Edition, 1996, available from the American Council for an Energy Efficient Economy at 510-549-9914

Homemade Money (Heede and the staff of RMI), 1995, available from the Rocky Mountain Institute at 970-927-3851

The following fact sheets are available by calling the Environmental Protection Agency's toll-free ENERGY STAR Hotline at 1-888-STAR-YES (1-888-782-7937): ***Increased Insulation*** and ***Air Sealing***

Energy Efficiency in Windows fact sheet available from the Energy Efficiency and Renewable Energy Clearinghouse (EREC), P.O. Box 3048, Merrifield, VA 22116, 1-800-DOE-EREC (1-800-363-3732)

BENEFITS

High-performance windows can provide many benefits including:

Improved comfort. High-performance windows reduce conductive heat losses and gains resulting in warmer interior surfaces during the winter and cooler interior surfaces during the summer. In homes, approximately 40 percent of our physical comfort is due to the radiant heat exchange between our bodies and the surrounding interior surfaces. Thus, high-performance windows improve comfort by reducing this radiant heat exchange. In addition, improved frames reduce drafts and provide more consistent temperatures throughout the house.

Quieter home. High-performance windows often utilize multiple glazing and insulated frames. These features reduce unwanted noise from the outside.

Increased quality. High-performance windows are often constructed with better quality materials that can result in stronger, easier to operate, and longer lasting windows. As a result of these improvements, manufacturers frequently offer extended warranties on these products.

Improved indoor air quality. High-performance windows often have air tightness ratings of 0.2 cfm/ft or less which reduce the amount of unconditioned air leakage into a house. This air leakage can bring in dirt, dust, and other impurities that can negatively affect indoor air quality.

Lower utility bills. High-performance windows are better insulated and more air-tight. These features reduce energy consumption for heating and cooling which results in lower utility bills, making homes less expensive to operate.

Reduced obsolescence. Based on recent trends for improved efficiency, high-performance windows are expected to become standard practice for the building industry. Since it is both difficult and costly to replace windows after a house is built, it is best to install high-performance products during the original construction. ENERGY STAR labeled homes constructed with high-performance windows are, therefore, expected to be less vulnerable to obsolescence.

Fewer condensation problems. High-performance windows stay warmer in the winter resulting in drier windows with fewer condensation-related problems. Condensation can stain fabrics, lead to mold and mildew build-up, and in cold climates cause damage due to the freeze/thaw cycle.

Reduced wear on home furnishings. Low-E coatings can block up to 98 percent of the ultraviolet radiation emitted by the sun. This radiation causes curtains, window treatments, carpeting, and furniture to fade and wear faster.

Improved resale position. High-performance windows can provide the many impressive benefits listed above resulting in a more comfortable, quieter, and higher quality home with lower utility bills and fewer condensation and fading problems. These benefits can translate into higher resale value.