Window Energy Performance Ratings and Technologies

WHITE PAPER

A house would not be a home without windows. Windows decorate our homes, channel warm sunlight onto our skin and create a feeling of spaciousness. However, as windows get older, it is likely they become less effective in protecting against the elements, increase energy bills and start to lose heat to the environment.

According to the U.S. Department of Energy, buildings consume 40 percent of all the energy nationwide. Achieving optimal energy efficiency in buildings can drastically reduce overall energy consumption and windows can play a key role in achieving improved performance.

Heat Loss

"Windows account for 10% of heat loss in a home."

The primary sources of heat entering and leaving a home include sealed ducts, fireplaces, walls, doors and windows. The use of windows for natural lighting and temperature regulation can save money when windows are strategically placed. Highly efficient placement maximizes the use of natural daylight in a building, lowering the need for artificial lighting without causing heating or cooling problems.

www.energy.gov/energysaver/articles/thermographic-inspections

Air Flow and Ventilation

Air enters and leaves a house by infiltration, natural ventilation, and mechanical ventilation. Infiltration occurs when outdoor air flows into the house through openings, joints, and cracks. In natural ventilation, air moves through opened windows and doors. Air infiltration is measured using the Air-leakage rating (AL), expressed as cfm/sq ft. Air-leakage rating is a measure of the rate of air-leakage through a window, door, or skylight in the presence of a specific pressure difference. Airtight windows have lower air-leakage ratings.

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The rate at which outdoor air replaces indoor air is described as the air exchange rate. When there is little infiltration, natural ventilation, or mechanical ventilation, the air exchange rate is low and pollutant levels and interior condensation can increase.

www.nps.gov/tps/how-to-preserve/briefs/3-improve-energy-efficiency

Solar Heat Gain Coefficient

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Depending on where a person lives, the amount of heat a person wants to retain or lose from their home varies, and windows can be an excellent tool to meet this goal. Solar Heat Gain Coefficient (SHGC) is used to measure how well windows block heat from the sun. SHGC is expressed as a number from 0- 1, the lower the SHGC, the less solar heat is transmitted into the home.

Depending on the climate, orientation and shading conditions, SHGC numbers can be adapted by changing the Low E glass formula to either increase or decrease SHGC. As an example, in the northern U.S., solar heat is captured during minimal winter time daylight hours and retained to reduce heating costs during longer nights, thus a higher SHGC such as 0.40 may be required. In southern climates a lower SHGC is desired to reduce heat build-up, such as 0.25.

U-Factor

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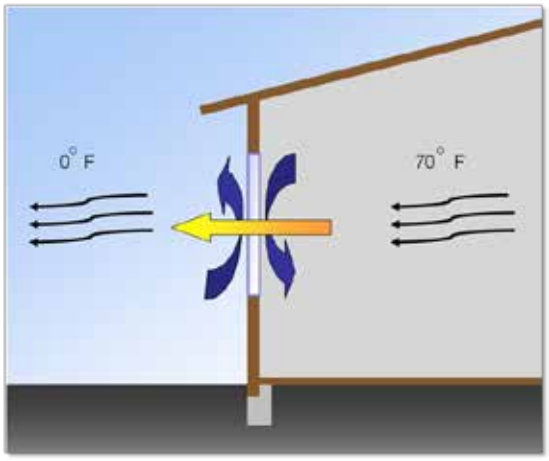
Insulation is the next step towards reducing heat exchange and increasing energy efficiency. The U-factor is the measurement of how well a product prevents heat from escaping. Depending on the product, typical ratings are between 0.20 and 1.20 Btu/h per S/F. The lower the U- factor, the greater a window's resistance to heat flow.



Most manufacturers in the U.S. include insulating glass units in either dual or triple pane options. After the insulating process, Argon or Krypton gas can be used to further influence the U-Factor.

Visible Transmittance

Choosing windows, doors, or skylights that allow light to pass through will brighten and open spaces within a home. Visible Transmittance (VT) measures the amount of visible light that passes through the glazing material and is expressed as a number between 0 and 1. A product with a higher VT allows more visible light. Any intersecting components, such as frame or sash members, will reduce the VT rating of the product.

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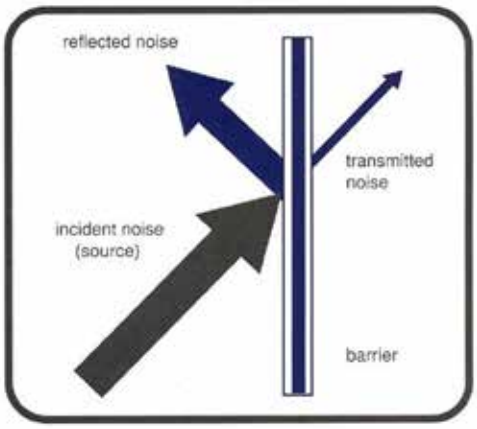
Noise



Today, many architects and designers can select windows that are not only energy efficient but also have been tested to reduce noise infiltration near urban settings. Sound Transmission Class or Co-efficient (STC) can be improved in dual or triple glazed windows by varying the thicknesses of the glass. A typical vinyl window would average a STC rating of 28 while the same vinyl window with two different glass thicknesses, such as 7/32" laminate over 3/16" glass, could have an STC of 35.

Energy Standards

The ENERGY STAR® label was established to reduce greenhouse gas emissions and other pollutants caused by the inefficient use of energy.

Windows must meet strict third party tests and performance standards for the purpose of reducing energy consumption. Most states with green-building and energy conservation goals adopt codes issued by the International Code Council. Some jurisdictions adopt one or more of the International Codes, and then make their own amendments at the state or local level.

ENERGY STAR® is a voluntary program administered by the Environmental Protection Agency (EPA) and the Department of Energy (DOE). The ENERGY STAR label was established to reduce greenhouse gas emissions and other pollutants caused by the inefficient use of energy and make it easy for consumers to identify and purchase energy-efficient products that offer savings on energy bills without sacrificing performance, features, and comfort

LEED is a certification program that recognizes building professionals for environmental and public health excellence. This voluntary system encourages the adoption of sustainable green building and development practices. While building components themselves are not individually certified, they can contribute to points awarded to a project as a whole. Windows can play an important role in obtaining this green building certification. By optimizing energy performance, increasing ventilation and using low-emitting materials, paints, coatings and recycled content, windows can boost a project's LEED rating.

Performance standards are set by the American Architectural Manufacturer's Association (AAMA) National Certification Program. A window's performance grade communicates the overall performance of the window and includes design pressure (max wind pressure),, product type, performance class, water, and air infiltration.

Improving Energy Performance

There are three fundamental approaches to improving the energy performance of glazing products (two or more of these approaches may be combined). The first approach is to alter the glazing material itself by changing its chemical/physical properties (e.g.: tinted glazing). The second approach is to apply a coating to the glazing material surface (e.g.: reflective coatings). The third approach is to assemble various layers of glazing and control the properties of the spaces between the layers (e.g.: thermally improved edge spacers).

Types of Glass Spacers

Glass spacers separate multiple layers of glass and provide energy and sound insulation. The most typical materials used in today's market are aluminum, tin-plated steel, stainless steel or foam. Though thermally conductive, aluminum is the material of choice. Other less thermally conductive materials such as stainless steel or foam are used to reduce the u-value to improve the thermal performance.

These types of spacers can also reduce condensation and heat loss. There are two types of spacers, foam and box spacers. A foam spacer is a closed cell polymer material that uses a high-performance acrylic adhesive and moisture vapor seal. A foam spacer is used in arches or windows with curved shapes. A Box spacer is available in aluminum or stainless steel and is stronger than foam spacers. The box spacer is sealed to the glass with a butyl sealant and then a secondary sealant that usually contains silicone.

Argon and Krypton Gas Fill

An improvement that can be made to the thermal performance of insulating glazing units is by removing the air using inert gases such as argon, krypton, or a combination. Because both gases are non-toxic and colorless the convection currents within the space reduce overall transfer of heat between the indoor and outdoor temperatures.

When manufacturing glass filled with inert gases breather and capillary tubes must be used when the difference in elevation between manufacturing and installation is 2,500 feet or more. This is because they equalize the pressure between the sealed panes, preventing glass from expanding or contracting. Once the insulated glass reaches the intended job site breather tubes should be crimped (closed).

Durable Window Material Selection

Window frames used today consist of aluminum, thermally improved aluminum, fiberglass, vinyl, or wood/composite substrates. The most sustainable design materials are fiberglass, vinyl, or wood. They require substantially less energy and fuel to produce.

Vinyl is one of the least expensive and most energy efficient options. Many manufacturers can reinforce vinyl to create minimal frame area which allows more daylight and utilizes solar energy to reduce heating costs in the winter. Vinyl formulas also incorporate titanium dioxide to resist ultra-violet damage and improve longevity. These factors and the use of recycled content contribute to vinyl as a green-building choice.

Fiberglass uses the least amount of energy to produce and is made from an abundant resource, silica sand. Fiberglass has similar energy ratings as vinyl and because it is dimensionally more stable it can be painted. Like boats sitting in a marina, fiberglass is able to withstand very harsh conditions.

Wood windows clad with vinyl or fiberglass are also considered a 'green-design' choice. Wood offers a look and feel that other substrates cannot, and can be painted or stained to align better with changing design trends.

Summary

Achieving optimal energy efficiency in buildings can drastically reduce overall energy consumption. Windows can meet this need by increasing air flow, providing natural ventilation, and increasing the amount of daylight available. There are many frame and glass options to easily meet different climates, regional energy codes, and design preferences. Thus, meeting and exceeding building energy codes and voluntary program requirements is achievable.