U.S. Department of Energy - Energy Efficiency and Renewable Energy

A Consumer's Guide to Energy Efficiency and Renewable Energy

Energy Performance Ratings for Windows, Doors, and Skylights

You can use the energy performance ratings of windows, doors, and skylights to tell you their potential for gaining and losing heat, as well as transmitting sunlight into your home.

Heat Gain and Loss

Windows, doors, skylights can gain and lose heat in the following ways:

- Direct conduction through the glass or glazing, frame, and/or door
- The radiation of heat into a house (typically from the sun) and out of a house from room-temperature objects, such as people, furniture, and interior walls
- Air leakage through and around them.

These properties can be measured and rated according to the following energy performance characteristics:

- **U-factor**

  The rate at which a window, door, or skylight conducts non-solar heat flow. It's usually expressed in units of Btu/hr-ft^2-ºF. For windows, skylights, and glass doors, a U-factor may refer to just the glass or glazing alone. But National Fenestration Rating Council U-factor ratings represent the entire window performance, including frame and spacer material. The lower the U-factor, the more energy-efficient the window, door, or skylight.

- **Solar heat gain coefficient (SHGC)**

  A fraction of solar radiation admitted through a window, door, or skylight—either transmitted directly and/or absorbed, and subsequently released as heat inside a home. The lower the SHGC, the less solar heat it transmits and the greater its shading ability. A product with a high SHGC rating is more effective at collecting solar heat gain during the winter. A product with a low SHGC rating is more effective at reducing cooling loads during the summer by blocking heat gained from the sun. Therefore, what SHGC you need for a window, door, or skylight should be determined by such factors as your climate, orientation, and external shading. For more information about SHGC and windows, see passive solar window design.

- **Air leakage**

  The rate of air infiltration around a window, door, or skylight in the presence of a specific pressure difference across it. It's expressed in units of cubic feet per minute per square foot of frame area (cfm/ft^2). A product with a low air leakage rating is tighter than one with a high air leakage rating.

Sunlight Transmittance

A window's, door's, or skylight's ability to transmit sunlight into a home can be measured and rated according to the following energy performance characteristics:

- **Visible transmittance (VT)**

  A fraction of the visible spectrum of sunlight (380 to 720 nanometers), weighted by the sensitivity of the human eye, that is transmitted through a window's, door's, or skylight's glazing. A product with a higher VT transmits more visible light. VT is expressed as a number between 0 and 1. The VT you need for a window, door, or skylight should be determined by your home's daylighting requirements and/or whether you need to reduce interior glare in a space.

- **Light-to-solar gain (LSG)**

  The ratio between the SHGC and VT. It provides a gauge of the relative efficiency of different glass or glazing types in transmitting daylight while blocking heat gains. The higher the number, the more light transmitted without adding excessive amounts of heat. This energy performance rating isn't always provided.

Energy Performance Testing, Certification and Labeling

The National Fenestration Rating Council (NFRC) operates a voluntary program that tests, certifies, and labels windows, doors, and skylights based on their energy performance ratings. The NFRC label provides a reliable way to determine a window's energy properties and to compare products.

The NFRC label can be found on all ENERGY STAR® qualified window, door, and skylight products, but ENERGY STAR bases its qualification only on U-factor and SHGC ratings.

See Learn More on the right side of this page (or below if you've printed it out) for links to NFRC and ENERGY STAR information.

Learn More

Codes & Standards

- Solar Heat Gain Coefficient FAQs
  DOE Building Energy Codes Program

Evaluation Tools

- FenSpec
  DOE Building Energy Software Tools Directory

Product Information

- Independently Tested and Certified Energy Performance
  ENERGY STAR®
- Residential Windows, Doors, and Skylights
  ENERGY STAR®
- Product Ratings
  National Fenestration Rating Council

Related Links

- Climate Zone Recommendations
  Efficient Windows Collaborative

Reading List

- *The Facts about Windows and Heat Loss* (PDF 196 KB). (January 2005). National Fenestration Rating Council. 2 pp.
- *The Facts about Solar Heat Gain and Windows* (PDF 187 KB). (January 2005). National Fenestration Rating Council. 2 pp.
- *Selecting Windows for Energy Efficiency* (PDF 543 KB). (January 1997). DOE/GO-DE-AC03-76SF00098. U.S. Department of Energy. 16 pp.
- Selkowitz, S.; Arasteh, D.; Heschong, L; Carmody, J. (Editor). (October 9, 2000). *Residential Windows: A Guide to New Technology and Energy Performance*. W. W. Norton & Company; 2nd edition. 224 pp.