



In addition to providing basic light, ventilation and beauty to a structure, windows and patio doors are expected to meet certain design, energy and glass performance standards. Understanding window and patio door performance characteristics will help with product selection and increase satisfaction.

INTRODUCTION

Windows and patio doors are designed and built to perform differently relative to environmental conditions. For example, homes in hot climates benefit from Low-E treated glass and homes in tornado or hurricane zones benefit from impact glass.

Windows and patio doors are built to withstand different levels of wind and/or water without failing. They are given performance ratings based on three different criteria:

- **Energy performance:**
The energy-efficient characteristics of the product
- **Glass performance:**
The characteristics of different types of glass such as safety, light and noise transmittance
- **Design performance:**
The product's ability to withstand various weather conditions and other elements

Product labeling indicates the minimum certified performance levels met by the product. If products fail to meet customer performance expectations, it may be a result of incorrect product selection, improper installation or lack of product care and maintenance. In some instances, product performance failure could be a result of a manufacturing defect in which case product warranty coverage could apply. If you're unsure about selecting the proper windows or patio doors for you home, contact us or your distributor.

CONTACT US

For questions, feel free to contact us by phone or email:

- Email: customerserviceagents@jeld-wen.com
- Phone: 1-(800)-JELD-WEN/1-(800)-535-3936

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ENERGY PERFORMANCE

There are three principal ways heat energy is transferred from a warm to a cool place: conduction, radiation and convection. Modern window technology works to control these processes to manage energy transfer through a window. The total energy performance of a window is measured with a value called a U-Factor.

CONDUCTION

Conduction is when heat is transferred through direct contact. A good example is the burning sensation you receive when you pick up a hot plate.

Insulating glass controls conductive energy with the air space between the panes of glass separated by a spacer (usually a piece of formed sheet metal). This air space prevents direct conductive transfer of energy through the glass between warm and cold environments.

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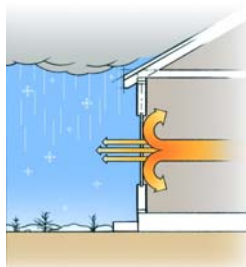
ENERGY PERFORMANCE—CONTINUED

RADIATION

Radiation is the transfer of energy by waves or rays. Sunburn even when the air temperature is cold is a result of the transfer of radiation energy by exposure to sunlight.

Low-E Coatings

Low-E is a very thin, transparent, metallic coating applied to insulating glass at the factory. It controls heat gain (or loss) by reflecting most of the radiant heat (infra-red light) caused by the sun. Some coatings focus on solar heat control while others emphasize control of interior heat loss.



In cold weather, Low-E reduces the amount of heat loss to the outdoors by reflecting radiant heat back into the house.

In warm weather, the sun's energy is reflected back outside and prevented from entering the house.



A Low-E value or emissivity is the measure of how well the product reduces radiant energy transfer. Low-E values typically range from 0.04 to 0.15. The smaller value represents the best reduction of energy transfer.

A common aesthetic concern when replacing older Low-E glass is that the new glass color (caused by the metallic coating) may not be the same color as the older Low-E glass. Call us for recommendations.

Measuring Radiant Heat Transfer Solar Heat Gain

A Solar Heat Gain Coefficient (SHGC) is the measurement of the solar heat that passes through glass from sunlight. This measurement is expressed as a number between 0 and 1. A value of 1 indicates that all solar heat passes through, and a value of 0 indicates that no solar heat passes through. A single pane of glass typically has an SHGC of about 0.80 allowing most of the solar heat to pass through. Multi-pane (insulating) glass allows less solar heat to pass through and has a lower SHGC.

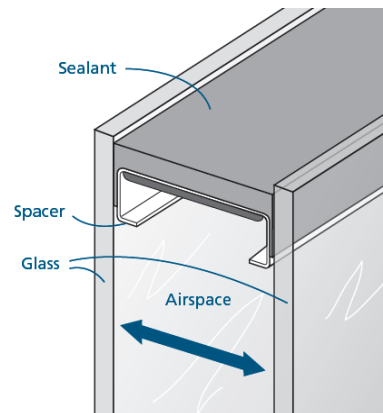
A high SHGC would be the best in cold climates where solar heat gained through glass can help tremendously with heating costs. A low SHGC can help save air-conditioning costs in warm climates by keeping solar heat out.

CONVECTION

Convection is the transfer of heat through air movement. Many homes use convection for heating as warm air circulates through the house and gradually raises the temperature.

Insulating Glass Spacer Width

The airspace between glass panes affects the convection of an insulating glass unit. Narrow spacing between panes (or a single pane of glass) increases the risk of hot or cold temperatures passing through. Wider spacing between glass panes lowers the risk of heat or cold transfer through the glass unit. Optimum spacing occurs near 0.5".



Insulating Glass with Argon

Argon is a non-toxic, non-hazardous dense gas injected into the air space inside insulating glass units to help control convective heat transfer. Compared to normal air, argon does not move around much between the panes thus reducing heat transfer from the warm pane to the cool pane.

A mixture of argon and air can achieve higher levels of energy performance than with air alone. However, due to improvements in window technology, windows and patio doors are meeting energy efficiency requirements in other ways, therefore reducing or eliminating the use of argon.

U-FACTOR

U-factor (sometimes called U-value) is the measurement of how well the window or patio door transfers heat. The lower the U-factor, the better the window reduces energy loss. Common insulating glass U-factors range from about 0.25 to 0.55.

Variation in values is due to factors such as:

- Insulating glass (multi-pane is better than single-pane)
- Insulating air space width
- Low-E coatings
- Gas (argon) in air space
- Window size and frame material

Energy Star (a United States Environmental Protection Agency/Department of Energy program) is a great resource for finding out the recommended U-factor (or other energy information) for any location in the United States. Visit their website at www.energystar.gov (search for U-factor) or call their hotline at 1-888-782-7937.



GLASS PERFORMANCE

There are several characteristics and properties of glass in window and patio door products that directly effect customer satisfaction. These characteristics include glass type, acoustical performance, visible light transmittance (the ability to pass light to the interior), ultraviolet (UV) light transmittance and glass quality.

TYPES OF GLASS

Float Glass

Nearly all residential glass is known as float glass (also referred to as flat glass), a high-quality glass made by a process where a ribbon of molten glass is fed across a bath of heated liquid, usually molten tin, in a carefully controlled environment. The highest grades are used for mirror and cabinet-type products. A slightly lower grade may contain minor blemishes such as small air bubbles or minor scratches, and is used for residential and light commercial windows and patio doors. Lower grades are considered greenhouse quality.

Float glass may be heat-treated for additional strength. There are two basic types of heat-treated glass: heat-strengthened, and fully-tempered. Heat-strengthened float glass is twice as strong as standard float glass and breaks into large fragments as does standard float glass. Fully-tempered float glass is considered safety glass.

Safety Glass

There are two types of safety glass commonly used in window products: fully-tempered and laminated.

Fully-tempered float glass is twice as strong as heat-strengthened glass and is often required by local building codes for safety reasons. Fully-tempered glass is less likely to break by impact than standard and heat-strengthened float glass. If it breaks, it shatters into many small pieces instead of larger shards as heat-strengthened and standard float glass.

For more strength, glass may be laminated, a process where two or more sheets of glass are bonded together with one or more layers of plastic membrane or liquid resin (interlayer). Laminated glass is approximately 75% to 90% stronger than standard float glass and is used to minimize penetration of airborne objects. If broken, the glass will fragment and remain attached to the plastic membrane. Laminated glass is often required in coastal areas subject to hurricane-force winds and in vehicles.

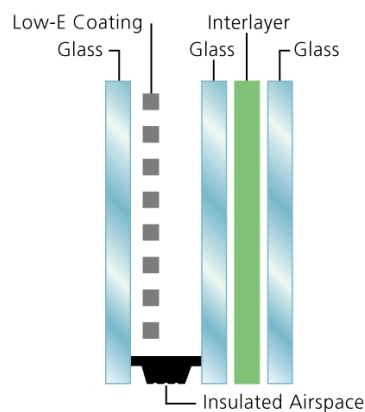


Plate and Rolled Glass

Plate glass is very strong and is commonly used in commercial structures. Rolled glass is about 50%–80% translucent, and is used in patterned glass designs such as stained glass.

ACOUSTICAL PERFORMANCE

Windows and patio doors must be able to control a variety of conditions, including environmental sounds. Uncontrolled noise levels inside a structure can disrupt work, inhibit sleep, cause stress and fatigue and increase irritability.

Window and door design now includes ways to limit the transmission of noise. Windows and doors are tested and rated for the amount of noise they let pass through. Two common ratings for windows and doors are the Sound Transmission Class (STC) and Outdoor-Indoor Transmission Class (OITC) Ratings. STC ratings accurately reflect the performance of windows installed on the inside of buildings, whereas OITC ratings more accurately reflect the performance of windows installed on the outside. In both cases, the higher the number the better the acoustical performance.

Acoustical performance factors include:

- **Product mass or weight**
Increasing the mass of a product will reduce the transmission of sound. An example is increasing glass thickness, which will increase the overall mass of a door or window, reducing sound transmission.
- **Air space thickness between panes**
The air space between panes also limits sound transmission. Increasing the air space depth will increase the acoustical performance of the insulated glass unit.
- **Glass type**
Different types of insulated glass units offer specific benefits to limiting sound transmission. Thick glass mutes low frequency noise (e.g., road traffic). Thinner, laminated glass controls high frequency noise (e.g., conversation).

For very noisy areas, a laminated window made with thick panes of glass would work very well combining the low frequency acoustic properties of the thick glass with the high frequency acoustic properties of the laminated glass.

- **Air infiltration**
A window or door's ability to block air movement will also effect sound transmission. Products with a lower air infiltration rating will also block sound more effectively.

VISIBLE LIGHT TRANSMITTANCE

Glass production techniques and Low-E coatings can affect the amount of visible light that passes through glass.

The amount of light that passes through glass is measured and given a value between 0 and 1. The higher the number, the more light will pass through the glass.

GLASS PERFORMANCE—CONTINUED**ULTRAVIOLET (UV) LIGHT TRANSMITTANCE**

Window products containing glass with high ultraviolet (UV) protection are desired by consumers for guarding indoor furnishings against UV fading. UV fading occurs when the energy of UV radiation alters the chemical structure of dyes and other colorants. Low-E coatings can provide a reduction in UV transmittance and slow the process of fading. In addition to UV light, other causes for fading and color changes include:

- Humidity
- Dye types
- Oxygen (and other gases)
- Visible light
- Heat
- Sky conditions (sunny or cloudy)
- Window orientation

No residential glass product will completely block out all UV light and prevent fading. Various types of furnishings (wood, fabrics, paint, rugs, etc.) react at differing fading rates depending on the colorant type and its susceptibility to fading from any of these causes.

DESIGN PERFORMANCE

Windows and patio doors are designed to perform under various weather conditions and exposures. Some are designed for mild exposures and others for harsher and more extreme exposures. Products designed for mild weather or protected locations should not be installed in extreme weather areas.

When choosing a window or patio door, it is very important to consider the design and location of the structure. A large roof overhang or recessed windows may lessen performance grade requirements depending on characteristics such as the size and height of the building. Structure location determines general weather exposure and protection. For instance, a structure on a coastal bluff may need a higher performance grade than one protected by wind breaks.

Local building codes may define a minimum performance grade, but because of increased cost, it is important to select a product that does not have a performance grade higher than needed.

Manufacturers design and test their products to withstand wind loads as well as water and air leakage. Window and patio door standards help to establish minimum levels of acceptable performance for manufacturers and suppliers.

GLASS QUALITY

Float and heat-treated glass are manufactured through processes that may result in minor blemishes (e.g. slight wavy appearance or minute visible blemishes).

Very small particles from the manufacturing process can sometimes embed into the glass surface and are difficult to see but may be detected by touch. It is important to protect glass at job sites from other building materials, and to clean the glass properly to avoid embedding these particles into the glass. For proper glass cleaning procedures, visit our website, www.jeld-wen.com/resources for a copy of the appropriate Care and Maintenance Guide. Some manufacturers offer products with a protective film on the glass to protect glass surfaces at the job site that will peel off. Call your supplier for more information.

Through the manufacturing and shipping process, glass may collect a non-visible residue that may become visible under moist conditions. This is not considered a glass defect.

UNITED STATES STANDARDS & CERTIFICATION

Two primary North American organizations developed voluntary certification programs and standards:

- The American Architectural Manufacturers Association (AAMA)
- Window and Door Manufacturers Association (WDMA)

These are trade associations of window and door manufacturers, component suppliers and test laboratories. Their purpose includes formulating and promoting high standards of performance and administering an ANSI (American National Standards Institute) accredited third party certification program for fenestration products.

Under the Certification Program, a third party administrator verifies the products are tested using the proper procedures. A minimum of two unannounced factory inspections are conducted per year to ensure products are equivalent to the samples that were tested. The manufacturer must submit samples for retesting periodically to maintain certification.

Structural standards for the AAMA & WDMA include:

- AAMA/NWWDA 101 /I.S. 2-97
- AAMA/WDMA/CSA 101 /I.S.2/A440-05

These structural standards:

- Provide overall performance ratings for window and door products to assist customers in selecting the appropriate products for their homes.
- Allow manufacturers to certify the performance grade of their products through independent testing laboratories for structural, air, water, and forced entry resistance performance.
- Define window products by performance class and performance grade.

DESIGN PERFORMANCE—CONTINUED

CANADIAN STANDARDS & CERTIFICATION

The CSA (Canadian Standards Association) established a certification program with a set of standards for windows (CAN/CSA-A440-05 Windows) that is referenced by the Building Code of Canada (BCC). This certification program allows manufacturers to certify the performance grade of their products through independent laboratory testing. Customers can then select windows suitable for their climatic conditions, installation height, building type etc.

Window and patio door manufacturers test their products at qualified independent laboratories to the A440 specifications to comply with these standards through CSA International, the Certification and Testing Division of CSA Group.

This set of standards tests window products in three different categories: "A" for air leakage, "B" for water penetration resistance, and "C" for structural rating. Commercial structures require higher level ratings than residential.

Window products are defined by the building size, residential being three stories or less, or not exceeding 600 square meters. Larger buildings are considered commercial. CSA A440 specifies minimum ratings for each product designation based on the structure's location and exposure.

TESTING

Both the U.S. and Canada use the same testing methods. They both report a separate air leakage rating. For water and structure the United States uses a design pressure (DP) rating system combining the two; Canada reports them separately.

To meet all standards, a product must be tested in an independent laboratory to receive a performance grade. A performance grade rates the performance of a product against a set of specific tests. Higher grade numbers represent higher performance grade ratings.

Testing methods:

- **Uniform Load Deflection Test:**
Determines the degree of deflection to a product when under pressure
- **Uniform Load Structural Test:**
Determines the product's ability to withstand wind pressure
- **Air Infiltration:**
Determines if the amount of air that passes through the product meets requirements
- **Water Resistance:**
Determines the windows' resistance to a wind-driven rain.
- **Forced Entry Resistance Test:**
Determines on a pass/fail basis if the product adequately prevents easy opening from the exterior when locked. Some areas may require higher testing levels for some window operator types

UNITED STATES RATING SYSTEM

Test results are reported in DP (design pressure) numbers (e.g. DP20, DP50). A window that has a DP20 rating (mild weather or protected location) means that the window passed with 20 pounds of pressure for each square foot (psf) of window.

A DP rating includes both the water test and the structural test. If the water test results in 35 psf and the structural test results in 20 psf, the window receives a DP rating of DP20.

In order to pass the air leakage test, all windows must not allow more than 0.3 cubic feet of air per hour per square foot to pass through.

CANADIAN RATING SYSTEM

Test results are reported in A, B, or C letters followed by a 1, 2, or 3. (e.g. A1, B1, C1 or A3, B3, C3). Letters denote the type of test, while numbers represent the level of performance. Residential windows designed for mild weather or well-protected locations typically receive A1, B1, and C1 ratings.

Air Tightness

Air leakage ratings range from Storm, A1 through A3, to Fixed. The maximum air leakage rate for a window with a Storm rating is about 8.35 cubic meters per hour per meter of the crack length of the sash. A Fixed rate applies only to fixed windows and would allow 0.25. The following table shows the maximum air leakage for each rating.

"A"—AIR TIGHTNESS	
Window Rating	Maximum Air Leakage (m3/h)/m
Storm	8.35 (5.00 minimum)
A1	2.79
A2	1.65
A3	0.55
Fixed	0.25

Water Tightness

A window with a water leakage rating of B1 will take 150 Pascals of pressure before water spills into the room. A B3 rating will take about 300 Pascals of pressure. B ratings range from B1 to B7. The following table shows the maximum pressure for each rating.

"B"—WATER TIGHTNESS		
Window Rating		Pressure Differential—Pa
For use in small buildings	For use in other buildings	
Storm		0
B1	B1	150
B2	B2	200
B3	B3	300
	B4	400
	B5	500
	B6	600
	B7	700

DESIGN PERFORMANCE—CONTINUED

CANADIAN RATING SYSTEM—CONTINUED

Load Resistance

“C” is a load resistance rating representing a combination of deflection under wind load and the blowout failure pressure under wind load. A window with a C1 would take up to 180kph of wind speed before failure. A C5 would take about 330kph before failure. “C” ratings range from C1 to C5. The following table shows the deflection test pressure under wind load and the blowout failure pressure under wind load for each rating.

“C”—LOAD RESISTANCE				
Window Rating		Pressure Differential—Pa		
		Deflection	Deflection	Blowout
For use in small buildings (L/125)	For use in other buildings (L/175)	Sash		
	Mullions			
	Blowout			750
C1	C1	500	1000	1500
C2	C2	750	1330	2000
C3	C3	1200	2000	3000
	C4	1600	2660	4000
	C5	2000	3330	5000

PRODUCT DESIGNATION

After a product is tested and given a performance grade, it receives a product designation. When certified, the product is labeled by the manufacturer with a designation like this:

HS-R20 120 x 59

Where:

HS = Product Type (Horizontal Sliding Window)

R = Performance Class (Residential)

20 = Performance Grade (DP20)

120 x 59 = Maximum Size Tested

The following tables list the code and its definition for product type and performance class.

PRODUCT CODE-TO-PRODUCT TYPES			
AP	Awning, hopper projected windows	JA	Jalousie-awning windows
BW	Basement windows	RW	Roof windows
C	Casement windows	SGD	Sliding glass doors
DA	Dual action windows	SHW	Side hinged in-swing windows
DAH GD	Dual action hinged glass doors	SLT	Side lite
F	Fixed windows	SP	Specialty products
GH	Greenhouse windows	SKG	Skylights/glass glazed
H	Hung windows (single, double, triple)	SKP	Skylights/plastic glazed
HE	Hinged rescue windows	TA	Tropical awning windows
HP	Horizontally pivoted windows	TH	Top hinged windows
HGD	Hinged glass doors	TR	Transom
HS	Horizontal sliding windows	VP	Vertically pivoted windows
J	Jalousie windows	VS	Vertical sliding windows

PERFORMANCE CODE & PERFORMANCE CLASSES		
R	Residential	Primarily used for single family homes.
LC	Light Commercial	Typically used for low-rise multi-family dwellings, professional buildings such as doctor's offices, libraries, and motels.
C	Commercial	Primarily used for lighter use industrial buildings, factories, hotels and retail sales buildings.
HC	Heavy Commercial	Typically used buildings such as hospitals, schools, public buildings, or other buildings where heavy use is expected.
AW	Architectural	Commonly used for architectural structures such as hospitals, schools, institutions, and high-rise buildings.

PERFORMANCE LABELING

There are two main types of performance labels: structural performance and energy performance. Most window and patio door products display one, if not both of these.

STRUCTURAL PERFORMANCE

There are two major organizations that provide certification labels with information on structural performance in the United States. AAMA provides the AAMA certification label, and WDMA provides the WDMA Hallmark certification label. These are typically permanent labels affixed to the window frame in a protected location. In Canada, look for certification information on a CSA or other label (permanent or temporary) on the product.

United States

AAMA Certification Label

The product type, performance class, performance grade and maximum size in conformance to ANSI/AAMA/NWDA 101/I.S. 2-97 are listed clearly on the label as illustrated here. This is a likeness only. Actual labels may look different, but contain the same type of information.

HS-R20 120 x 59



Where:

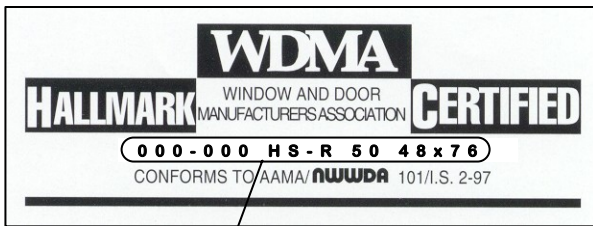
HS=Product Type (Horizontal Slider)

R20=Performance Class (Residential)/Performance Grade (DP20)

120x59=Maximum Size Tested

WDMA Hallmark Certification Label

The WDMA Hallmark certification label is black and white. The manufacturer number, product line number, product type, performance class, performance grade and maximum size of the product are shown clearly. This is a likeness only. Actual labels may look different, but contain the same type of information.



000-000 HS-R 50 48x76

Where:

000-000=Manufacturer Number-Product Line Number

HS-R=Product Type-Performance Class (Horizontal Slider-Residential)

50=Performance Grade (DP50)

48x76=Maximum Size Tested

Canada

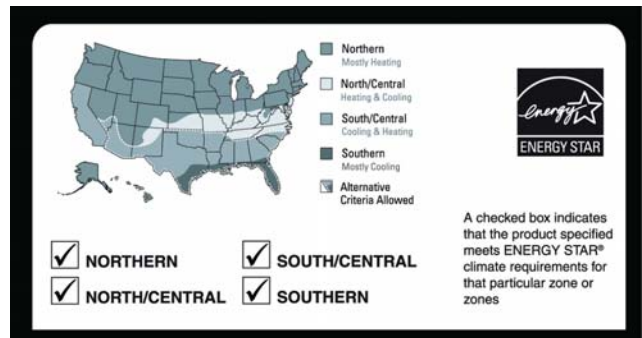
CSA Certification Label

The CSA Certification Label contains the CSA logo, information about the manufacturer, the product and the certification ratings such as "A3 B3 C3 F2" for that product. Certification ratings can also be found on other product labeling.



ENERGY PERFORMANCE

Products which meet the Energy Star program requirements will have a label similar to the following. This label shows the geographical regions that correspond with the product's design characteristics. Qualification for each region is determined by the energy performance values shown on the NFRC label (shown next).



Energy performance values are displayed on the NFRC Label.

This label may be found on products manufactured in the United States and Canada. NFRC (National Fenestration Rating Council) is an industry organization that focuses on developing comparative energy performance for the consumer in evaluating different products. These labels are temporary and are removed after final inspection.



WEBSITES & WARRANTY INFORMATION

For more information about window and patio door performance, visit the following websites:

- Window and Door Manufacturers Association (WDMA): www.wdma.com
- American Architectural Manufacturers Association (AAMA): www.aamanet.org
- Canadian Standards Association International (CSA): www.csa-international.org
- National Fenestration Rating Council: www.nfrc.org
- Energy Star: www.energystar.gov
- Office of Energy Efficiency and Renewable Energy: www.eere.energy.gov/consumer
- Glass Association of North America: www.glasswebsite.com

Some information in this document was derived from the following sources:

- The Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows, Glass Doors (ANSI/AAMA/NWDA/101/I.S. 2-97)
- The North American Fenestration Standard (NAFS-1)
- Cardinal® IG Technical Service Bulletins
- The User Selection Guide to CSA Standard A440-00, Windows

PRODUCT WARRANTY INFORMATION

Proper window selection is crucial to product satisfaction. It is important to use the right product with the right performance grade for a particular exposure. Proper handling, installation and care and maintenance are also essential to satisfactory window performance and long life.

In the event of product failure due to a defect in the manufacturer's workmanship or materials, warranty coverage could apply.

Product failure due to improper installation, improper maintenance and acts of nature (hurricane, tornado, earthquake, flood, etc.) are excluded from most manufacturers' warranties. See your warranty for full details. If you do not have a copy of your warranty, visit our website: www.jeld-wen.com/resources.