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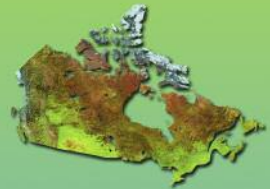
Ressources naturelles  
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ecoENERGY  
an ecoACTION initiative

# Energy-Efficient Residential Windows, Doors and Skylights

Updated October 2010



Canada 

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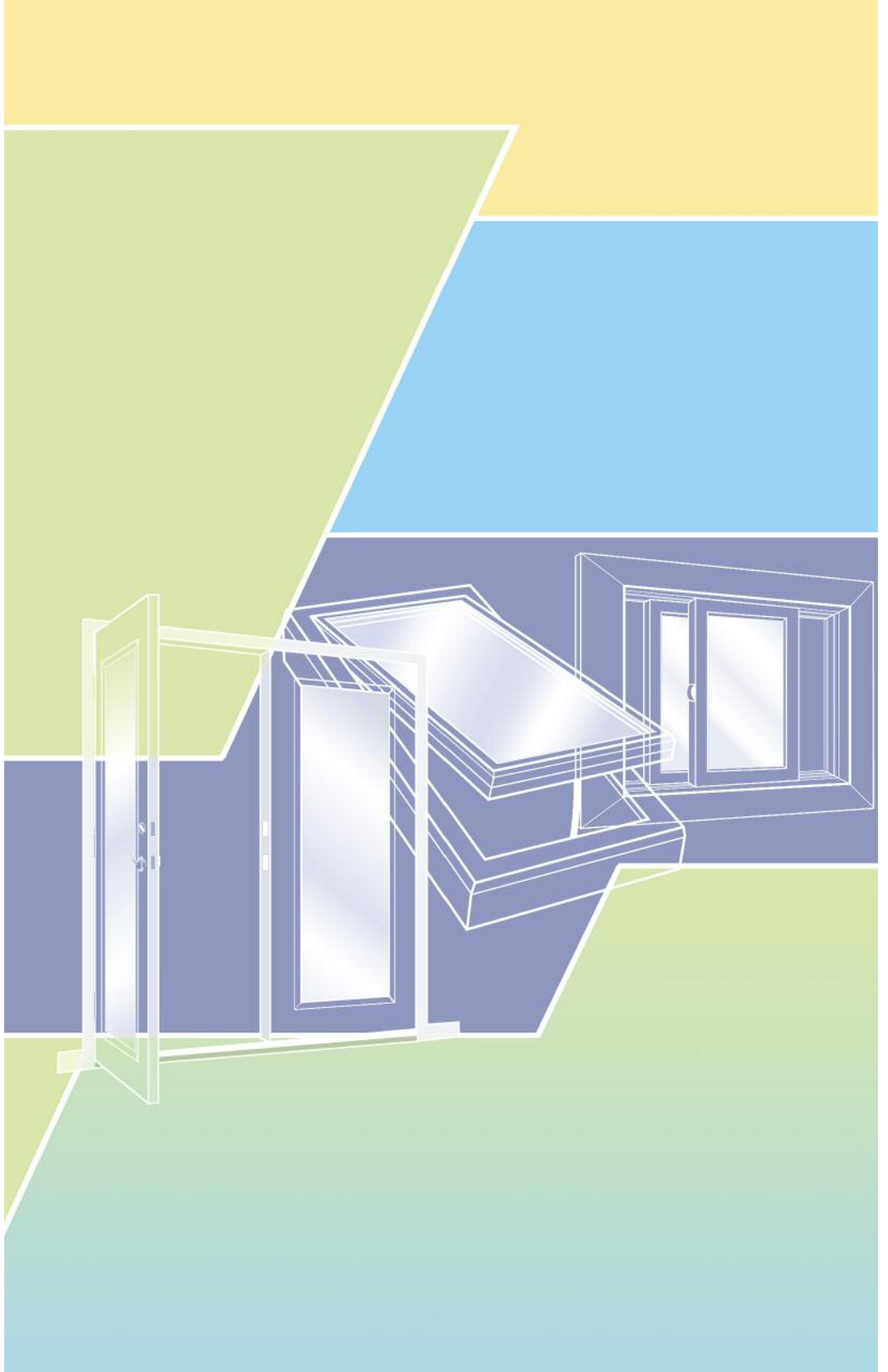


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*Aussi disponible en français sous le titre :*  
Portes, fenêtres et puits de lumière éconergétiques  
pour le secteur résidentiel

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## Introduction

Windows, doors and skylights are an integral part of our homes. Poorly-performing products can be a significant source of heat loss and uncomfortable drafts. These products will often have condensation or even frost on them during cold weather, possibly causing mould.

A properly installed new, energy-efficient product will

- reduce your energy consumption and save you money
- increase your comfort
- reduce condensation on glass in cold weather
- often reduce noise and dust penetration from outside the home

Homeowners who replace all their old windows and doors with energy-efficient products will typically save about 7 percent on their energy bills, depending on how many windows and doors they replace, how old they were and how much air leakage they allowed. Buyers of new homes can save about 16 percent on their energy bills over what they would pay for with standard products. The savings are greater because new homes are typically larger, with more windows and doors.

*The windows in my home are more than 25 years old. How do they compare with new products on the market?*

Today's high-performance windows, doors and skylights are far more energy-efficient than products built 25 years ago. Today's products are more airtight, with advanced technology such as low-emissivity (low-E) glass, inert gas between the panes and better-designed hardware.

## *Will energy-efficient windows, doors and skylights make my home more comfortable?*

The short answer is yes – depending on the condition of your existing windows and doors. They can reduce or eliminate uncomfortable drafts, allow you to have a higher indoor humidity during the winter and keep your home cooler in the summer.

## *How can I be sure I am purchasing an energy-efficient product?*

Look for the ENERGY STAR® symbol and label. It indicates that a window, door or skylight has been certified to meet strict technical requirements that make it one of the most energy-efficient products on the market.

## **Repair, improve or replace?**

If the frame and sashes of the window, door or skylight are still in good condition, you can improve their airtightness by adjusting or replacing hardware and weatherstripping and adding caulking on exterior walls around the frames. If there is fogging or condensation between the panes, you may be able to replace the panes with glass that reduces heat loss. Heat loss can also be reduced by installing a storm window (exterior or interior) or a storm door. (For more information on window retrofit and repair options, see Natural Resources Canada's [NRCan's] fact sheet, *Improving Window Energy Efficiency*.)

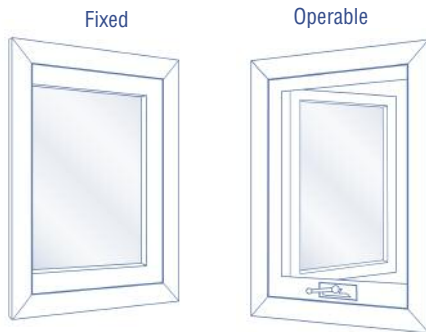
However, if your window, door or skylight is more than 25 years old, or if the frames, sashes and weatherstripping have deteriorated beyond repair, then it is time to start thinking about buying a new product.

## The basics

Here are some basic tips about buying a new energy-efficient window, door or skylight for your home.

## Types and styles

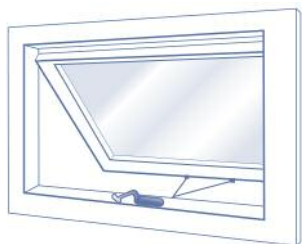
Residential windows and skylights come in two basic types: operable and non-operable (or “fixed”). Non-operable products are more airtight, but it is often desirable to be able to open a window or skylight for ventilation or to provide an escape route in case of emergency.



Among operable products, hinged windows (casement, awning, hopper, tilt, turn) are generally more airtight than sliding-style windows because the closing mechanism pulls them tight against the frame. Skylights should have a low curb (the part that holds the glass at the roof line) for better energy efficiency.

A tubular skylight can be used instead of the traditional flat-glazed or large domed skylight. This product consists of a small-domed lens on the roof and a flat lens inserted into the ceiling. A flexible or rigid tube that has a reflective interior surface is connected between the two lenses and natural light is transmitted into the home. These are more energy efficient than traditional skylights and easier to install, although they do not provide as much natural daylight or any ventilation. Some tubular skylights also have

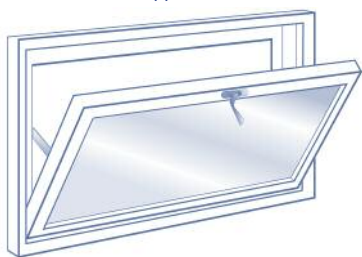
Awning



Casement



Hopper



Vertical slider  
(single-hung)



Vertical slider  
(double-hung)



Horizontal slider  
(single)



Horizontal slider  
(double)



Tilt and Turn



Skylight (flat-glazed)



Skylight (dome)





integral lighting fixtures. There are also “roof windows” that operate like “hung-style” windows but are designed to be installed at an angle.

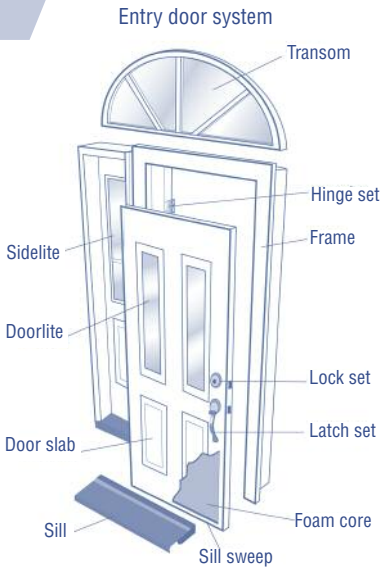
Doors come in two operable styles: swinging (hinged) and sliding. They can range from having no glass to being full-glass models with optional windows beside the door (sidelight) or above the door (transom). Doors can be made from one material, such as wood (flush door) or constructed with a wood or metal “skeleton” that is covered with a “skin” on both sides, protecting an inner core of insulating foam (stile and rail door). Doors made from one material conduct heat (see sidebar) more readily than insulated core doors. However, the more glass there is, the less resistance there is to heat loss. Depending on where the door is located, one with more glass can also allow the sun’s heat into the home.

## Sources of heat loss

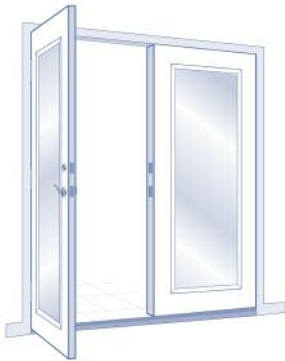
Heat energy naturally moves from warmer areas to colder areas. In the case of windows, doors and skylights, this process occurs in a number of ways.

- *Radiation* – Heat energy is absorbed by the window glass, then moves (radiates) toward the cooler side.
- *Conduction* – Heat energy moves through solid materials such as the frame, sash and spacer bar materials.
- *Convection* – Heat is lost through the movement of air near and in the space between the glass.
- *Air Leakage* – Heat is lost when the air moves through the seals or gaps in the frame. Air leakage may also occur around the frame due to poor installation.

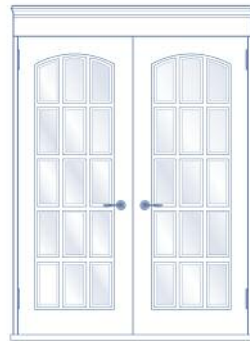
While there is no way to completely eliminate heat loss through windows, doors and skylights, good-quality construction and the use of appropriate materials can minimize it.



Swinging (hinged) patio or garden door



French door



## Material choices

Windows, doors and skylights installed in houses and low-rise buildings can be manufactured from a variety of materials such as metal (aluminum, steel), fiberglass, vinyl and wood, or a combination of these materials. As a rule, metal tends to conduct heat more than non-metals. However, the overall energy efficiency depends on the product's design and is reflected in its energy-performance ratings. (See "Standards and certification.") Most windows, doors and skylights installed in high-rise and multi-residential dwellings and commercial buildings are made primarily from metal

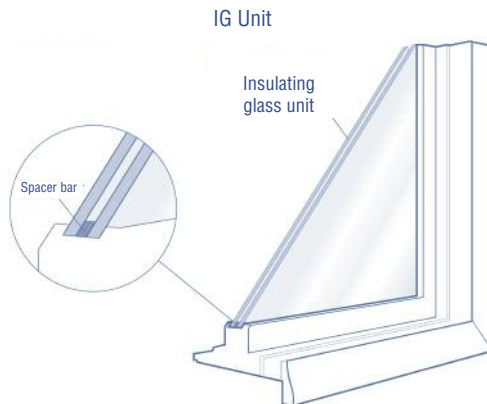
because of the material's reduced-flame-spread rating and resistance to high winds, and for security considerations.

## Glazing

Glazing is the generic term for the transparent material – usually glass – in a window, door or skylight. Ordinary glass is called annealed glass. Glass can also be tempered (heat-strengthened) or laminated, to make it more shatter-resistant. Laminated glass is a combination of two or more glass sheets with one or more interlayers of clear plastic or resin.

**Glazing layers:** A single-glazed product has one pane of glass; a double-glazed product has two panes; a triple-glazed, three; and a quad-glazed, four. One of the panes inside a triple- or quad-glazed product may be substituted for a thin layer of suspended polyester film to reduce the overall weight. In Canada, all windows, skylights and doors with glazing should be at least double-glazed.

**Insulating glazing (IG) unit:** The IG unit consists of at least two panes of glass that have been sealed around the edges to make the window airtight. A spacer bar is placed around the edge of the glass in an IG unit to hold the panes apart. The spacer bar also has desiccant in it to absorb all the moisture remaining inside the glazing unit after it had been sealed. This prevents fogging between the panes.



**Frosted, patterned and tinted glass:** Frosted translucent glass and patterned artistic glass do not significantly reduce the amount of the sun's heat and visible light coming into the home. Tinted glass, however, is made to reduce both. In summer, cooling costs are lowered but, in winter, heating costs may rise because of the reduction of the sun's heat.

**Low-E:** Low-E glass has a fine coating of metal to reduce heat loss in the winter and heat gain in the summer, through the glass, by up to 30 percent. There are two types of low-E coatings: hard coat and soft coat. Both increase energy efficiency; however, some types of soft-coat, low-E glass can dramatically reduce the amount of the sun's heat coming into the home.

**Gas fill:** The inside of the IG unit is filled with an odourless, colourless, harmless inert gas, such as argon or krypton, to reduce heat transfer through the glass. For maximum efficiency, argon is normally put into double-glazed units and krypton is put into triple- or quad-glazed units.

**Spacer bars:** Traditional aluminum-box spacer bars in IG units contribute to heat loss and condensation problems. Spacer bars designed with thermal breaks that use materials such as foam, plastic or glass, or that are made with other types of metal, such as stainless steel, will reduce heat loss.

**Grilles and dividers:** Metal or plastic bars called grilles are often placed inside the IG unit to give the effect of many individual panes of glass. Dividers may be placed over a single IG unit and attached to the sash or frame, or a number of small IG units may be placed inside the dividers to achieve the same effect. While grilles and dividers are popular choices to enhance the look of windows and doors, they also reduce the amount of the sun's heat coming into the home.

**Vacuum, aerogel and electrochromic glazing:** These technologies are new to the market and are not widely available. A vacuum IG unit has no air or inert gas inside, dramatically reducing heat transfer. The unit is tightly sealed around the edges, and the panes of glass are held apart by tiny, invisible pillars. Aerogel glazing has a highly insulating, low-density silica-based solid

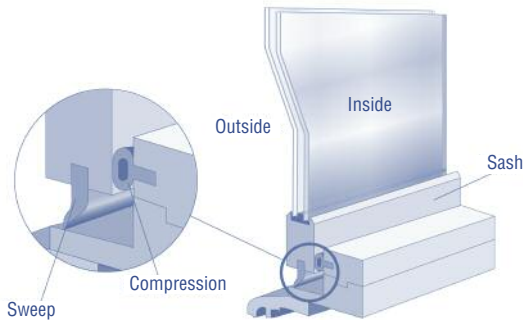
called aerogel between the glass panes. Aerogel eliminates the need for low-E coatings and inert gas fills. Electrochromic or “smart” glazing (also known as switchable or active glazing) can save energy by reducing solar gain only when it’s necessary. All these developing technologies promise significant improvements in energy efficiency.

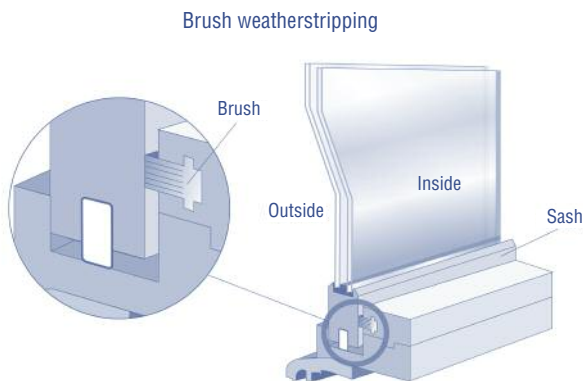
## Weatherstripping and hardware

Weatherstripping is used to create a seal between the frame and door or window sash to block rain and dust and to minimize air leakage. There are three basic types of seals: compression, brush and sweep. A fourth type, called a magnetic seal, may be found on some door systems.

Compression and magnetic seals provide superior airtightness. Casement, awning, hopper and tilt-turn-style windows, most operable skylights and swinging doors have compression seals to provide the primary air barrier. Sliding and hung windows have brush seals. Sliding doors also have a sweep seal between the bottom of the door slab and the sill, which tends to be the area with the most air leakage in a door system. High-quality hardware, such as cranks, handles, latches and locksets, also help to provide a good seal. If possible, they should not conduct heat through the product.

Compression and sweep weatherstripping





## Standards and certification

### Energy performance

The Canadian test standard for the energy performance of windows, doors and skylights is the CSA A440.2. Some products sold in Canada may also be tested to the United States standards of the National Fenestration Rating Council (NFRC) (100 and 200 standards). Tests are performed using standard sample sizes to fairly rank their overall structural and energy performance. Frequently, the energy efficiency ratings are derived by using computer software developed specifically for fenestration products.

Currently, testing the energy performance of factory-built windows, doors and skylights is not mandatory in Canada, except in Ontario, British Columbia and Nova Scotia. Windows, doors and skylights in British Columbia and windows and sliding glass doors in Ontario and Nova Scotia must meet a minimum efficiency standard. The values that are most often used in Canada to represent the energy performance of windows, doors and skylights are the following.

- **U-value:** Indicates the rate of heat transfer from warm to cold areas in watts per square metre Kelvin ( $W/m^2 \cdot K$ ) or British thermal units per hour per square foot Fahrenheit ( $Btu/h \cdot sq. ft. \cdot ^\circ F$ ). The lower the value, the slower the rate of heat transfer.

- **R-value:** This value is the opposite of the U-factor and is not part of the energy performance standards. It indicates the resistance to heat transfer in square feet per hour in Fahrenheit degrees of temperature per British thermal unit (sq. ft•h•°F/Btu). The higher the number, the higher the resistance to heat transfer.
- **Solar heat gain coefficient (SHGC):** A ratio indicating the amount of the sun's heat that can pass through the product (solar gain). The higher the number, the greater the solar gain.
- **Energy rating (ER):** For windows and doors only, this unitless number reflects the balance between heat transfer (U-factor or U-value), solar gain and air leakage. Higher numbers indicate a slower heat transfer without significantly reducing the amount of solar gain.
- **Visible transmittance (VT):** A ratio that indicates the amount of visible light that can pass through the product. The higher the number, the more visible light that can pass through.
- **Centre-of-glass:** Often called "centre-of-glass ratings," these values make the product appear more energy-efficient than it really is because the values are not for the whole product but only for the glass portion.

## Physical performance

The current Canadian physical performance test standards are the CSA A440.0 (windows), the CGSB 82.1 (sliding glass doors) and the CGSB 82.5 (insulated steel doors). Building codes in Canada require that all windows and doors be rated for their physical performance before they are installed in new homes or buildings. Provincial, territorial and local building codes require different minimum ratings, depending on the climatic conditions. The standards for windows and sliding glass doors produce a range of performance categories whereas the insulated door standard is a pass or fail standard.

The following tables show the different physical performance ratings and their ranges for windows and sliding glass doors.

### Airtightness ratings for windows and sliding glass doors

Type	Least airtight	Most airtight
Most operable windows	A1	A3
Single-hung windows*	A1/fixed	A3/fixed
Single sliding windows*	A1/fixed	A3/fixed
Non-operable (fixed) casement windows	A1	A3
Picture windows	Fixed (pass/fail rating)	
Sliding glass doors	A1	A3

\* The operable and non-operable sashes may be tested and rated separately for single-hung and single sliding windows.

### Other ratings for windows

Type	Minimum level	Highest level
Water tightness	B1	B7
Wind load strength	C1	C5
Insect screen strength*	S1	S2
Resistance to forced entry	F10 or F1	F20 or F2

\*This test measures only how well the screen mesh stays fastened to the screen mesh frame, not how well the insect screen stays fastened to the window frame. Most insect screens can be easily removed from the window to allow for exit in an emergency. An S1 rating is adequate for residential applications.

### Other ratings for sliding glass doors

Type	Minimum level	Highest level
Water tightness	B1	B4
Wind load strength	C1	C3
Ease of operation	E1	E3
Resistance to forced entry	F1	F2



The current Canadian standards are being phased out in favour of the new harmonized North American Fenestration Standard (NAFS) that covers all windows, doors and skylights in both Canada and the United States. The NAFS replaced the older Canadian-only standards in the 2010 National Building Code of Canada, which will soon be adopted by the provinces, territories and other jurisdictions. The main measurement of performance in the NAFS is derived through "design pressure," and the product is assigned a "performance grade." The current standard has the main performance grade designators of R, LC, CW and AW. Each main performance grade in the NAFS will include a number. The higher the number, the greater the product's structural strength and resistance to water penetration.

Performance grade	Range of values
R	20 – 100
LC	30 – 100
CW	35 – 100
AW	45 – $\geq 100$

Products designed for single family homes, townhouses and low-rise apartment buildings typically have a performance grade of R or LC. Products designed for high-rise apartment buildings and commercial office buildings will typically have a performance grade of CW or AW. To facilitate the transition to the NAFS standard, a Canadian supplement has been issued. The supplement allows the test results from the NAFS standard to be used to produce the air tightness, water tightness and other performance categories in the CSA A440.0 and CGSB 82.1 standards.

## Certification

Certification ensures that the testing is done by an accredited laboratory against the current standards and that the results have been verified by an independent third party. Certification also helps to ensure that no unauthorized changes have been made to the certified products that would change their quality or performance ratings. Windows, doors and skylights sold in Canada may be certified for their energy performance by the following accredited agencies:

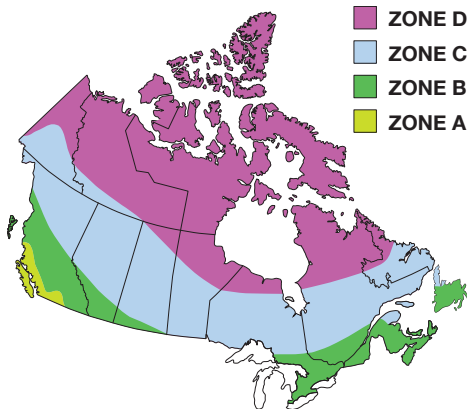
- CSA International (CSA)
- Intertek Testing Services (ITS)
- Quality Auditing Institute Ltd. (QAI)
- The National Fenestration Rating Council (NFRC) United States

The IG units may also be certified for their durability by the Insulating Glass Manufacturers Alliance (IGMA). This certification program tests a manufacturer’s ability to build a unit that will not fog or have premature seal failure and that will gas-fill units properly and consistently.

## ENERGY STAR®

Windows, doors and skylights are on the growing list of products that can qualify for the ENERGY STAR international symbol for energy efficiency. This makes the buying process simpler because ENERGY STAR has determined for you what an energy-efficient product is. Buying an ENERGY STAR qualified window, door or skylight can be as easy as 1, 2, 3.

1. Look for the ENERGY STAR symbol in the showroom or on promotional literature, or ask your salesperson, contractor or renovator about ENERGY STAR.
2. Using the climate map below, find the zone where the product will be installed.






\* See Appendix A for a list of locations, their heating-degree day values and ENERGY STAR zones

- Make sure that the product model you are buying is qualified for that zone or for colder zones, to save even more energy.

## Labelling

By the end of 2011, all qualified models will have a removeable label showing the ENERGY STAR zones of qualification and the certified performance ratings. This information should be kept for future reference. A permanent label will also be on the product, normally hidden from view but easily accessible. There will also be a permanent marking either on the glass or on the spacer bar to indicate that the manufacturer has passed the insulating glass (IG) durability test.




Sample Window Label With a Map of Canada Showing ENERGY STAR Qualification for all of Canada (certified by CSA)

Qualified for area indicated. Admissible pour les régions indiquées.		
<p>Canada</p>  <p>■ = Zones A B C D</p>		
 <p>1 800 387-2000 energystar.nrcan-rncan.gc.ca</p>		
U-Factor Facteur-U <b>1.10</b> <small>W/m<sup>2</sup>·K</small>	Solar Heat Gain Coefficient Coefficient de gain de chaleur solaire <b>0.35</b>	Visual Transmittance Transmission visible <b>0.63</b>
Energy Rating Rendement énergétique <b>36</b>	Air Leakage Fuite d'air <b>0.55</b> <small>m<sup>3</sup>/m</small>	
<p><b>Window Company Ltd.</b></p> <p>Triple X Operable Casement Vinyl frame, Triple glaze, Low-e coating (e=0.022, S3, S5), Krypton/air filled (both cavities), Grills &lt;=13mm NR9999-999999-ES</p>		
 <p>Thermal performance and visual transmittance ratings certified to CSA A440.2-09. Ratings are determined for a fixed set of environmental conditions and a specific product. Certification agency does not recommend or warrant product for any specific use. Les taux de performance thermique et de transmission visible sont certifiés CSA A440.2-09. Les taux sont déterminés selon une série de conditions environnementales fixes et une taille de produit particulière. L'agence de certification ne recommande ni ne garantit le produit aux fins d'utilisation particulières.</p>		
<p>CSA A440.0-00 <b>A3 B5 C3 S1 F2</b></p>		




Sample Window Label (no map version) Showing ENERGY STAR Qualification for all of Canada (certified by QAI)

Canada • Zones <b>A B C D</b> energystar.nrcan-rncan.gc.ca		
U-Factor Facteur-U <b>1.10</b> <small>W/m<sup>2</sup>·K</small>	Solar Heat Gain Coefficient Coefficient de gain de chaleur solaire <b>0.35</b>	Visual Transmittance Transmission visible <b>0.63</b>
Energy Rating Rendement énergétique <b>36</b>		
<p><b>Window Company Ltd.</b></p> <p>Triple X Operable Casement Vinyl frame, Triple glaze, Low-e coating (e=0.022, S3, S5), Krypton/air filled (both cavities), Grills &lt;=13mm NR9999-999999-ES</p>		
 <p>Thermal performance and visual transmittance ratings certified to CSA A440.2-09. Ratings are determined for a fixed set of environmental conditions and a specific product. Certification agency does not recommend or warrant product for any specific use. Les taux de performance thermique et de transmission visible sont certifiés CSA A440.2-09. Les taux sont déterminés selon une série de conditions environnementales fixes et une taille de produit particulière. L'agence de certification ne recommande ni ne garantit le produit aux fins d'utilisation particulières.</p>		

Sample Door Label With a Map of Canada and the U.S. showing ENERGY STAR qualification for all of the U.S. and Zones A, B and C in Canada (certified by NFRC)

 National Fenestration Rating Council® <b>CERTIFIED</b>	<b>Door Company Ltd.</b> Product Line: CPD: XYZ-B-8  <b>Steel sidelites with wood-edge</b>			
	<b>ENERGY PERFORMANCE RATINGS</b>			
Product Description*	U-Factor: Win <sup>2</sup> /K (Btu/h <sup>2</sup> /°F) / Solar Heat Gain Coefficient (SHGC)			
	1/4 Lite (0.640 m <sup>2</sup> /sq ft)	1/2 Lite (1.280 m <sup>2</sup> /sq ft)	3/4 Lite (1.920 m <sup>2</sup> /sq ft)	Full Lite (3.200 m <sup>2</sup> /sq ft)
2/clear/air/0.75	1.02 (0.18) / 0.03	1.70 (0.30) / 0.21	N/A	N/A
2/clear/air/0.75 grids	1.02 (0.18) / 0.03	1.70 (0.30) / 0.19	N/A	N/A
3/clear/air/0.31 deco	0.96 (0.17) / 0.04	1.48 (0.26) / 0.17	1.76 (0.31) / 0.25	1.93 (0.34) / 0.30
2/LowE(3)air/0.75	0.96 (0.17) / 0.03	<b>1.48 (0.27) / 0.20</b>	1.82 (0.32) / 0.30	1.99 (0.35) / 0.37
2/LowE(3)air/0.75 grids	0.96 (0.17) / 0.03	1.48 (0.27) / 0.18	1.82 (0.32) / 0.27	1.99 (0.35) / 0.33
Manufacturer stipulates that these ratings conform to applicable NFRC procedures for determining whole product performance. NFRC ratings are determined for a fixed set of environmental conditions and a specific product size. NFRC does not recommend any product and does not warrant the suitability of any product for any specific use. Consult manufacturer's literature for other product performance information.				
* Glazing layers/Low E surface/air gap fill/air gap width <a href="http://www.nfrc.org">www.nfrc.org</a>				
<b>Qualified for area indicated.          Admissible pour les régions indiquées.</b>				
<b>Canada</b> <a href="http://energystar.nrcan-rnrcan.gc.ca">energystar.nrcan-rnrcan.gc.ca</a>  <b>U.S. / É.U.</b> <a href="http://energystar.gov">energystar.gov</a>	 <b>■ = Qualified/Admissible</b>			

Sample Skylight Label With a Map of Canada Showing ENERGY STAR Qualification for Zones A, B and C (certified by ITS)

<b>Qualified for area indicated.          Admissible pour les régions indiquées.</b>		
<b>Canada</b>  <b>1 800 387-2000</b> <a href="http://energystar.nrcan-rnrcan.gc.ca">energystar.nrcan-rnrcan.gc.ca</a>	 <b>■ = Zones A B C</b>	
U-Factor Facteur U <b>2.35</b> <small>W/m<sup>2</sup>/K</small>	Solar Heat Gain Coefficient Coefficient de gain de chaleur solaire <b>0.25</b>	Visual Transmittance Transmission visible <b>0.40</b>
<b>Skylight Company Ltd.</b> Elite Venting Skylight (self-flashing) Aluminum clad wood frame. Triple glaze. Low-e coating Tempered/Tempered/Laminated (e6,220, S2, S4). NR9999-9999999-ES		
	Thermal performance and visual transmittance ratings certified to CSA A440.2-05. Ratings are determined for a fixed set of environmental conditions and a specific product. Certification agency does not recommend or warrant product for any specific use. Les taux de performance thermique et de transmission visible sont certifiés CSA A440.2-05. Les taux sont déterminés selon une série de conditions environnementales fixes et une taille de produit particulière. L'agence de certification ne recommande ni ne garantit le produit aux fins d'utilisation particulières.	

## Key features

An ENERGY STAR qualified window, door or skylight will have many of the following features:

1. double- or triple-glazing, with a sealed insulating glass unit
2. low-E glass
3. inert gas, such as argon or krypton, in the sealed unit
4. low-conductivity or “warm edge” spacer bars
5. insulated frames, sashes and door cores
6. good air tightness

## Certification

All ENERGY STAR qualified windows, doors and skylights have been certified by an independent accredited agency for their energy performance and insulating glass (IG) durability. Because of this, manufacturers frequently offer longer warranties for these products.

## Climate zones

The four climate zones in Canada are based on an average annual temperature indicator called a heating degree-day (HDD). This temperature is then averaged over 30 years to provide a good indication of the average temperature in a certain location. The higher the average HDD value, the colder a location and the longer the heating season is, usually with very cold winter temperatures. Zone A is the warmest region in Canada, with the lowest HDDs, and Zone D is the coldest region, with the highest HDDs.

The following list indicates the range of HDDs by temperature zone.

Zone A:  $\leq 3500$  HDDs

Zone B: 3501 – 5500 HDDs

Zone C: 5501 – 8000 HDDs

Zone D:  $\geq 8000$  HDDs

If you live at a significantly higher elevation than the surrounding area, purchase a product at least one zone colder than indicated on the climate map. This applies especially to areas in southern and central British Columbia, where the energy efficiency levels have been determined for major urban centres, which are normally in valleys or at sea level.

## Criteria

Windows and doors qualify for ENERGY STAR with either an energy rating (ER) or a U-factor (U-value). There is a maximum U-factor (U-value) for the ER qualification for windows and doors. Also, there are minimum ER values for each of the four zones in Canada for the U-factor (U-value) qualification for windows only. Skylights qualify with their U-factor (U-value) only. The ER and U-factor (U-value) qualification levels are equated together based on their ability to lower the overall energy costs of a typical single-family home in each of the four climate zones. A window or door that qualifies for acceptability in the specified ENERGY STAR zone through its ER will save about the same amount of energy as another model that qualifies for the same zone through its U-factor (U-value). Windows and sliding glass doors must also have an airtightness of  $\leq 1.65$  m<sup>3</sup>/h/m (1.5 L/s/m<sup>2</sup>) (A2 or higher).

ENERGY STAR Requirements for Windows (Effective October 1, 2010)					
Zone	Heating Degree-Day Range	Compliance Paths			
		Energy Rating (ER)	or	U-Factor	
		Minimum ER (unitless) Maximum U-Factor 2.00 W/m <sup>2</sup> •K (0.35 Btu/h•ft. <sup>2</sup> •°F)		Maximum U-Factor W/m <sup>2</sup> •K (Btu/h•ft. <sup>2</sup> •°F)	Minimum ER (unitless)
A	$\leq 3500$	21	or	1.80 (0.32)	13
B	$> 3500$ to $\leq 5500$	25	or	1.60 (0.28)	17
C	$> 5500$ to $\leq 8000$	29	or	1.40 (0.25)	21
D	$> 8000$	34	or	1.20 (0.21)	25

**ENERGY STAR Requirements for Doors**  
(Effective October 1, 2010)

Zone	Heating Degree-Day Range	Compliance Paths		
		Energy Rating (ER)	or	U-Factor
		Minimum ER (unitless) Maximum U-Factor 2.00 W/m <sup>2</sup> •K (0.35 Btu/h•ft. <sup>2</sup> •°F)		Maximum U-Factor W/m <sup>2</sup> •K (Btu/h•ft. <sup>2</sup> •°F)
A	< = 3500	21	or	1.80 (0.32)
B	> 3500 to < = 5500	25	or	1.60 (0.28)
C	> 5500 to < = 8000	29	or	1.40 (0.25)
D	> 8000	34	or	1.20 (0.21)

**ENERGY STAR Requirements for Skylights\***  
(Effective October 1, 2010)

Zone	Heating Degree-Day Range	Maximum U-Factor W/m <sup>2</sup> •K (Btu/h•ft. <sup>2</sup> •°F)
A	< = 3500	2.80 (0.50)
B	> 3500 to < = 5500	2.60 (0.46)
C	> 5500 to < = 8000	2.40 (0.42)
D	> 8000	2.20 (0.39)

\* includes Tubular Skylights

Windows, doors and skylights are not normally assigned an R-value when tested. However, contractors and window salespeople may refer to the R-value as a way to measure performance. To help you understand the R-value system, in the table below, sample U-factors in both metric and imperial units have been converted to R-values. Because ER values are derived from a formula that uses both U-factor and solar heat gain, there is no method for converting the ER value to an R-value.

U-factor conversion to R-value		
U-factor (W/m <sup>2</sup> •K)	U-factor (Btu/h•ft. <sup>2</sup> •°F)	R-value (ft. <sup>2</sup> •h•°F/Btu)
3.40	0.60	1.7
3.20	0.56	1.8
3.00	0.53	1.9
2.80	0.50	2.0
2.60	0.46	2.2
2.40	0.42	2.4
2.20	0.39	2.6
2.00	0.35	2.9
1.80	0.32	3.2
1.60	0.28	3.6
1.40	0.25	4.0
1.20	0.21	4.8
1.00	0.18	5.6
0.80	0.14	7.1
0.60	0.11	9.1

## Other considerations

### Installation

Have a knowledgeable professional install windows, doors and skylights according to the manufacturer's instructions. A poorly installed product may not operate properly and could cause cold drafts even though the product itself is energy efficient. Poor installation may also allow water to leak into the home, leading to costly damage.



Here are some installation criteria.

1. The installation should provide an airtight, insulated seal.
2. After installation, the window or door should retain its original shape and should be level and vertical. Windows may be installed at an angle (e.g., in an attic) only if they are designed to do so.
3. The window or door should not support any load other than its own weight unless it is designed to do so.
4. Any exterior finishing, such as flashing, should prevent water penetration.
5. A skylight should be well-sealed where it meets the roofing material. Any tunnel from the ceiling to the skylight should be well-insulated.

When replacing an existing window or door, there are two types of installation: retrofit and “complete tear out.” A retrofit involves installing a new window or door into the frame of the window or door that is being replaced. However, a retrofit should be done only if the existing frame has not deteriorated and is properly sealed and insulated. A retrofit is usually less expensive and minimizes the disturbance to the surrounding wall and trim. It also narrows a door opening and reduces the glass area of a window by about 10 percent. Skylights are typically not retrofitted.

A complete tear out involves removing the old window, door or skylight, including the frame. A tear out allows the installer to make an airtight insulated seal between the product and the rough opening. The original door opening or window glass area is usually retained or enlarged.

For certified window installations through the Window Wise program, visit the Web site at [windowwise.com](http://windowwise.com).

## Humidity issues and condensation

A certain amount of humidity in your home is desirable for comfort during the cold months. Windows, doors and skylights that are not energy-efficient will often have condensation or frost on them even when the indoor humidity is at a reasonable level. This condensation, in addition to obscuring the view, can lead to the formation of mould on the frames and sashes or can damage insulation and wood within the wall. An ENERGY STAR qualified product will allow for higher indoor humidity before condensation occurs. You may even be able to turn down your thermostat and still feel comfortable. Because humidity levels are higher in bathrooms and kitchens, consider installing a product qualified for Zone D in those rooms to reduce, or eliminate, condensation. The table below shows when condensation is likely to form.

Maximum humidity before condensation occurs		
Outside temperature	Standard window	High-performance window
0°C	40%	50%
-10°C	30%	40%
-20°C	20%	30%
-30°C	15%	25%
-40°C	10%	20%

If the indoor humidity in your home is too high, try the following.

1. Turn off the humidifier on your furnace.
2. Ensure that the clothes dryer and the bathroom and kitchen fans are vented to the outside.
3. Reduce the number of plants in your home.
4. Store firewood outside.

If you have a mechanical ventilation system (heat recovery ventilator [HRV]), make sure that it is turned on and working properly. Some airtight houses were built without mechanical ventilation systems. If high humidity is a chronic problem in your home, consider having an HRV installed.

### A note about exterior window condensation

Condensation may appear on the outside surface of the exterior pane of glass of energy-efficient windows and doors for brief periods. This condensation generally occurs on cool mornings in the spring or fall, just before sunrise, if there is little or no wind. Because the glass is minimizing heat loss, the outside glass surface becomes cool enough to reach the dew point, which causes condensation to form. This type of condensation will rapidly disappear after sunrise. If the condensation is persistent and appears as a circle in the centre of the glass, or is between the glass panes, there may be a problem with the glazing unit, and it may have to be replaced.

NRCan's Office of Energy Efficiency (OEE) and the Canada Mortgage and Housing Corporation (CMHC) have free publications that can help you address condensation problems in your home. Contact information for the OEE and CMHC is found on pages 27 and 28.

## Designing a new home

The sun's energy is free. However, how you use it is critical. If you are building a new home, decisions on how many windows, doors and skylights to include in your plans, and where to install them, can have a big impact on your comfort and on your heating and cooling bills.

Homes without sufficient glass (relative to the exterior wall area) receive less heat from the sun. Too much glass can cause unnecessary heat loss in winter and excessive heat gain in summer. The tables below give the recommended area for windows, doors and skylights for bungalows and two-storey houses of varying sizes.

Bungalows		
Floor area	Wall area	Glass area
1000 sq. ft. (93 m <sup>2</sup> )	1130 sq. ft. (105 m <sup>2</sup> )	170 sq. ft. (16 m <sup>2</sup> )
2000 sq. ft. (186 m <sup>2</sup> )	1600 sq. ft. (149 m <sup>2</sup> )	240 sq. ft. (22 m <sup>2</sup> )
3000 sq. ft. (279 m <sup>2</sup> )	1860 sq. ft. (173 m <sup>2</sup> )	280 sq. ft. (26 m <sup>2</sup> )

Two-storey homes		
Floor area	Wall area	Glass area
1000 sq. ft. (93 m <sup>2</sup> )	1600 sq. ft. (149 m <sup>2</sup> )	240 sq. ft. (22 m <sup>2</sup> )
2000 sq. ft. (186 m <sup>2</sup> )	2260 sq. ft. (210 m <sup>2</sup> )	340 sq. ft. (32 m <sup>2</sup> )
3000 sq. ft. (279 m <sup>2</sup> )	2770 sq. ft. (257 m <sup>2</sup> )	415 sq. ft. (39 m <sup>2</sup> )
4000 sq. ft. (372 m <sup>2</sup> )	3200 sq. ft. (297 m <sup>2</sup> )	480 sq. ft. (45 m <sup>2</sup> )

The placement and orientation of a window, door or skylight relative to the sun is the greatest factor affecting solar heat gain. More of a home's glazing area should be oriented to the south and west, if possible, with minimal glazing on the north and east sides of the home. However, do not concentrate too much glass in any one area. For example, a sunroom with little wall area can be nice in the winter but too hot in the summer. Heat loss

through doors can be reduced by situating the door out of the path of prevailing winds or providing windbreaks, such as a porch or vestibule. Skylights should not be located where there is high humidity, such as in a bathroom near a shower or over a kitchen sink, as condensation may form in colder weather and drip onto the floor.

## Glazing selection

Many salespeople in the window and door industry still talk about hard-coat low-E glazing versus soft coat low-E glazing, but these categories are becoming obsolete. The typical hard coat low-E glazing has high solar gain and makes a moderate reduction in heat loss while the soft coat low-E glazing reduces heat loss dramatically but also reduces solar gain considerably. However, new low-E coatings in the past few years give a wide range of energy performance and can be classed in three general categories: high solar gain, moderate solar gain and low solar gain. The following table is a guide to these categories.

Low-E category	Solar heat gain coefficient
High solar gain	>0.45
Moderate solar gain	0.30 – 0.45
Low solar gain	<0.30

Choosing an energy-efficient product is a good start, but you can optimize your choice by selecting windows and exposed glazed doors with properties that more precisely meet your needs.

Homes that have a southern and/or eastern exposure not obstructed by another home or building can take advantage of the passive solar energy from the sun by choosing glazings that have a high or moderate solar gain. Ideally, any roof overhang should be angled to shade the windows in the summertime, especially on the south side.

On the north side of the home, choose window and door models that have the lowest overall U-factor that you can afford. Models with a lower U-factor

normally have glazing with a low or moderate solar gain and are very resistant to heat loss. You may also want low solar gain glazing on the west side if the windows are not properly shaded during the summertime. You should know that rooms with a higher than average amount of glass area on the west or south sides may experience too much solar gain at certain times of the year. To reduce unwanted solar gain, choose windows with moderate to low solar gain. Lastly, to reduce heat loss, choose skylights with the lowest possible U-factor that you can afford.

## Windows with dynamic performance

Dynamic windows are becoming available for the residential market. A dynamic window has an integrated insulating blind system or a special coating on the window glass. Both of these options will increase the energy efficiency when used appropriately.

For example, during the winter, the blind can be closed at night to reduce heat loss and opened during the day to allow for passive solar gain. In the summer, the blind can be closed during the day to reduce solar gain and opened at night to allow for ventilation. The blind may be opaque, translucent or clear. Models with changeable coatings on the glass can be made to increase reflection and/or darken in reaction to the amount of natural light or the lack of it. These changes can be done manually or automatically according to a control system that can be preset by the homeowner, similar to a climate control thermostat.

The ENERGY STAR program recognizes the energy savings potential of such products but qualifies them based on the ratings achieved only when the dynamic options are not used. This practice is used because the increase in energy efficiency is dependant on appropriate use of the blinds and because the ENERGY STAR zone qualification may change when the dynamic options are used.

## Window coverings and film

Window coverings, such as blinds, internal shutters and insulated curtains, can also help reduce heat loss at night during cold weather and heat gain during the day in summer. They should be installed tight to the window opening, although this is likely to increase the amount of frost and condensation on the glass. (External shutters will not create this problem.) Be sure to leave the window coverings open during cool, sunny weather to allow solar gain. As with tinted glass, window films can reduce unwanted glare and solar gain during warm weather, but they do not significantly slow the rate of heat transfer. As the installation is permanent, the lack of solar gain may lead to increased heating costs in winter that exceed the reduced cooling costs during the summer.

## Where can I obtain more information?

More information about ENERGY STAR qualified windows, doors and skylights, including a list of qualified products, is available on the Canadian ENERGY STAR Web site at [energystar.nrcan.gc.ca](http://energystar.nrcan.gc.ca).

To order additional free copies of this publication or fact sheets entitled *Improving Window Energy Efficiency, Air Leakage Control and Moisture Problems*, contact

Energy Publications  
Office of Energy Efficiency  
Natural Resources Canada  
c/o St. Joseph Communications  
Order Processing Unit  
1165 Kenaston Street  
PO Box 9809, Station T  
Ottawa ON K1G 6S1  
Tel.: in the National Capital Region, call 613-995-2943  
Tel.: 1-800-387-2000 (toll-free)  
Fax: 613-740-3114  
TTY: 613-996-4397 (teletype for the hearing-impaired)  
Web site: [oe.nrcan.gc.ca](http://oe.nrcan.gc.ca)

Technical information on windows, doors and skylights, and home construction and renovations is also available from

Canada Mortgage and Housing Corporation  
Canadian Housing Information Centre  
700 Montreal Road, Suite 1000  
Ottawa ON K1A 0P7  
Tel.: in the National Capital Region, call 613-748-2367  
Tel.: 1-800-668-2642 (toll-free)  
Fax: 613-748-4069  
Web site: [cmhc-schl.gc.ca](http://cmhc-schl.gc.ca)

More information may also be available from your provincial or territorial energy and environment ministries and electric and gas utilities.

The Canadian Window and Door Manufacturers Association (CWDMA) is another source of information. CWDMA resources include *Sill to Sash*, an informative guide to buying energy-efficient windows, doors and skylights. *Sill to Sash* is available on the CWDMA Web site or can be ordered by mail or telephone at

Canadian Window and Door Manufacturers Association  
130 Albert Street, Suite 1208  
Ottawa ON K1P 5G4  
Tel.: 613-235-5511  
Fax: 613-235-4664  
Web site: [cwdma.ca](http://cwdma.ca)



As well, you may also wish to contact

Siding and Window Dealers Association of Canada

84 Adam Street

Cambridge ON N3C 2K6

Tel.: 519-651-2812

Tel.: 1-800-813-9616 (toll-free)

Fax: 519-658-4753

Web site: [sawdac.com](http://sawdac.com)

Web site for the Window Wise program: [windowwise.com](http://windowwise.com)

Insulating Glass Manufacturers Alliance

1500 Bank Street, Suite 300

Ottawa ON K1H 1B8

Tel.: 613-233-1510

Fax: 613-482-9436

Web site: [igmaonline.org](http://igmaonline.org)

## Appendix A.

List of heating degree-days and ENERGY STAR zones. For more locations, visit [energystar.nrcan.gc.ca](http://energystar.nrcan.gc.ca)

### British Columbia

Location	Heating degree-days	Zone
Abbotsford	2981	A
Alert Bay	3459	A
Atlin	6343	C
Bella Coola	3689	B
Castlegar	3678	B
Chilliwack	2833	A
Comox	3083	A
Cranbrook	4576	B
Dawson Creek	5981	C
Dease Lake	6845	C
Estevan Point	3150	A
Fort Nelson	6836	C
Fort St. John	5847	C
Golden	4886	B
Hope	3057	A
Kamloops	3571	B
Kelowna	3869	B
Lillooet	3493	A
Lytton	3309	A
Mackenzie	5714	C
McBride	4971	B
Merritt	3994	B
Merry Island	2726	A

### British Columbia (cont'd)

Location	Heating degree-days	Zone
Nanaimo	3056	A
Osoyoos	3210	A
Penticton	3431	A
Port Alberni	3173	A
Port Hardy*	3552	A
Powell River	3210	A
Prince George	5132	B
Prince Rupert	3967	B
Quesnel	4742	B
Revelstoke	4148	B
Salmon Arm	4044	B
Sandspit	3531	B
Smithers	5135	B
Squamish	3366	A
Stewart	4389	B
Summerland	3525	B
Terrace	4307	B
Tofino	3236	A
Vancouver	2927	A
Vernon	3820	B
Victoria	3041	A
Whistler	4287	B
Williams Lake	5073	B

\*This location has been placed in Zone A so that southwestern British Columbia can be one continuous zone.

## Alberta

Location	Heating degree-days	Zone
Banff	5473	B
Calgary	5108	B
Camrose	5603	C
Cold Lake	5970	C
Coronation	5781	C
Edmonton	5708	C
Edson	5645	C
Fort Chipewyan	7295	C
Fort McMurray	6346	C
Grande Prairie	5883	C
High Level	7036	C
High River	5194	B
Jasper	5374	B
Lethbridge	4599	B
Lloydminster	5892	C
Medicine Hat	4632	B
Oyen	5305	B
Peace River	6156	C
Red Deer	5696	C
Rocky Mountain House	5744	C
Slave Lake	5974	C
Whitecourt	5617	C

## Saskatchewan

Location	Heating degree-days	Zone
Assiniboia	5294	B
Broadview	5892	C
Buffalo Narrows	6312	C
Collins Bay	8036	D
Cree Lake	7434	C
Cypress Hills	5457	B
Estevan	5361	B
Eston	5573	C
Gravelbourg	5160	B
Kindersley	5595	C
La Ronge	6671	C
Leader	5238	B
Maple Creek	4755	B
Meadow Lake	6317	C
Melfort	6235	C
Moose Jaw	5276	B
Moosomin	5721	C
Nipawin	6389	C
North Battleford	5930	C
Prince Albert	6277	C
Regina	5659	C
Rosetown	5625	C
Saskatoon	5860	C
Swift Current	5245	B
Uranium City	7857	C
Weyburn	5448	B
Wynyard	5971	C
Yorkton	6066	C

## Manitoba

Location	Heating degree-days	Zone
Brandon	5951	C
Churchill	9073	D
Dauphin	5940	C
Emerson	5514	C
Flin Flon	6705	C
Gillam	8107	D
Gimli	6051	C
Island Lake	7023	C
Lynn Lake	7794	C
Norway House	6956	C
Steinbach	5727	C
Swan River	6083	C
The Pas	6598	C
Thompson	7743	C
Winnipeg	5785	C

## Ontario

Location	Heating degree-days	Zone
Atikokan	6052	C
Big Trout Lake	7577	C
Chapleau	5989	C
Cochrane	6411	C
Cornwall	4234	B
Dryden	5912	C
Earlton	5837	C

## Ontario (cont'd)

Location	Heating degree-days	Zone
Fort Erie	3789	B
Fort Frances	5637	C
Geraldton	6496	C
Gore Bay	4769	B
Hagersville	3800	B
Hamilton	4012	B
Kapuskasing	6372	C
Kenora	5749	C
Kingston	4289	B
Kirkland Lake	6048	C
Lansdowne House	7087	C
London	4062	B
Manitouwadge	6121	C
Moosonee	7017	C
Muskoka	4883	B
Niagara Falls	3661	B
North Bay	5295	B
Ottawa	4600	B
Petawawa	5178	B
Peterborough	4537	B
Point Pelee	3565	B
Red Lake	6319	C
Sarnia	3882	B
Sault Ste. Marie	5052	B
St. Catharines	3659	B

## Ontario (cont'd)

Location	Heating degree-days	Zone
Stratford	4210	B
Sudbury	5344	B
Thunder Bay	5718	C
Timmins	6149	C
Toronto	4066	B
Trenton	4222	B
Wawa	5963	C
Warton	4442	B
Windsor	3525	B

## Quebec

Location	Heating degree-days	Zone
Bagotville	5793	C
Baie-Comeau	6014	C
Drummondville	4621	B
Gaspé	5530	C
Granby	4604	B
Inukjuak	9090	D
Kuujuuaq	8644	D
Maniwaki	5321	B
Mont-Joli	5478	B
Montreal	4575	B
Natashquan	6178	C

## Quebec (cont'd)

Location	Heating degree-days	Zone
Nitchequon	8105	D
Québec City	5202	B
Rimouski	5217	B
Roberval	5821	C
Sainte-Anne-des-Monts	5514	C
Schefferville	8476	D
Sept-Îles	6277	C
Sherbrooke	5151	B
Thetford Mines	5203	B
Val-d'Or	6213	C

## New Brunswick

Location	Heating degree-days	Zone
Bathurst	5056	B
Charlo	5469	B
Fredericton	4751	B
Kouchibouguac	4865	B
Miramichi	4970	B
Moncton	4806	B
Saint John	4755	B
Saint-Léonard	5457	B

## Nova Scotia

Location	Heating degree-days	Zone
Chéticamp	4393	B
Halifax	4367	B
Louisbourg	4588	B
New Glasgow	4644	B
Sable Island	3818	B
Sydney	4618	B
Yarmouth	4041	B

## Prince Edward Island

Location	Heating degree-days	Zone
Charlottetown	4715	B
Summerside	4631	B

## Newfoundland and Labrador

Location	Heating degree-days	Zone
Baie Verte	5612	C
Churchill Falls	7918	C
Corner Brook	4732	B
Deer Lake	5384	B
Gander	5198	B

## Newfoundland and Labrador (cont'd)

Location	Heating degree-days	Zone
Goose Bay	6787	C
Nain	7653	C
Port Saunders	5696	C
Rocky Harbour	5269	B
Springdale	5382	B
St. Anthony	6404	C
St. John's	4882	B
Stephenville	4899	B
Wabush Lake	7838	C

## Yukon Territory

Location	Heating degree-days	Zone
Beaver Creek	8580	D
Burwash Landing	7945	C
Dawson	8165	D
Faro	7334	C
Mayo	7664	C
Old Crow	9761	D
Pelly Ranch	7954	C
Teslin	6967	C
Watson Lake	7620	C
Whitehorse	6811	C

## Northwest Territories

Location	Heating degree-days	Zone
Cape Parry	10939	D
Fort Liard	7045	C
Fort Reliance	8946	D
Fort Simpson	7771	C
Fort Smith	7439	C
Hay River	7648	C
Inuvik	9767	D
Mould Bay	12945	D
Norman Wells	8615	D
Sachs Harbour	11442	D
Tuktoyaktuk	10414	D
Yellowknife	8267	D

## Nunavut

Location	Heating degree-days	Zone
Alert	13115	D
Baker Lake	10860	D
Cambridge Bay	11818	D
Clyde River	11218	D
Coral Harbour	10773	D
Eureka	13732	D
Iqaluit	10117	D
Resolute Bay	12526	D











Natural Resources Canada's Office of Energy Efficiency  
*Leading Canadians to Energy Efficiency at Home, at Work and on the Road*

Canada 