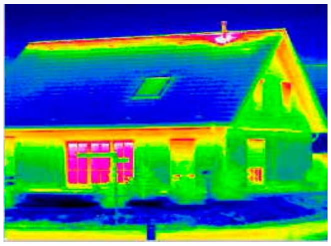
Clopay®
America's Favorite Garage Doors®

technically SPEAKING

THERMAL PROPERTIES

BACKGROUND



Thermal, or insulating, properties of building products have become more important as energy conservation has increased in significance and home energy rates continue to rise. Garage doors are a building product that helps enclose the building's envelope and therefore, is a key influence on the energy used to maintain a building's comfortable interior temperature.

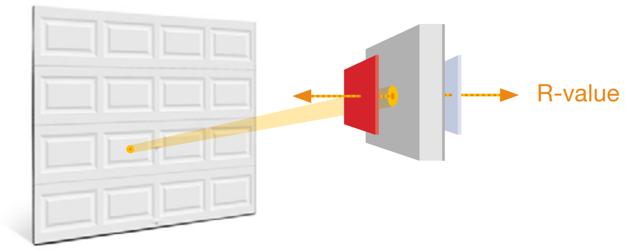
Thermal requirements for garage doors are also showing up in building codes. Often, the requirements vary by region, typically with colder climates having tougher standards to meet.

Not all insulated garage doors are created equal. Some doors have more or less insulation than others. There are different types of insulation, each with different thermal properties. Different section designs influence the heat transfer through the door. Therefore, the garage door industry has attempted to rate these insulating qualities with two different measuring scales.

R-VALUE

R-value is one measure of thermal property used for garage doors. R-value is a measure of the resistance of heat flow through the center of an insulated section. **The higher the R-value, the better the insulation can withstand heat transfer.**

Testing for R-value typically uses a cut down sample of the door section that might be only 12" × 12" fitted between two plates, one hot and one cold, used to measure the heat flow resistance of the insulated panel. Since R-value is calculated through the middle of the insulated section, R-value does not take into account variables such as section joints, thermal breaks, end stiles and door perimeter.



HIGHER R-VALUE = **BETTER**

U-FACTOR

U-factor is defined as the amount of thermal energy transmitted through the garage door. U-factor is in units of (Btu/hr-ft2-°F). U-factors are often less than 1.0, and can be expressed as 0.32, 0.25, or 0.16, where 0.16 is the best door for insulating properties.

U-factor testing involves a full size door and can be tested with or without windows. The U-factor test door consists of the multiple sections, section joints, thermal breaks, end stiles and the door perimeter of a standard door.

LOWER U-FACTOR = **BETTER**

The U-factor test has a door installed in the middle of an enclosed chamber where the amount of energy used to maintain a constant temperature from one side of the chamber to the other side (through the entire door) is measured. This energy, measured in BTU's, is then used to calculate the U-factor of the garage door.

U-factor testing is described in detail in DASMA Standard No. 105. DASMA is the Door and Access System Manufacturers Association and represents over 95% of all garage door producers in North America.

U-FACTOR VS. R-VALUE

Since U-factor is a measure of actual energy used, it is more representative of real world applications. Building engineers or architects use U-factors for garage doors and other building products to estimate the total energy usage in a building required for heating and cooling. R-value measures only a component of the insulating properties, not the complete door.

U-factor is used in building codes and building standards such as those published by the International Code Council (International Building Code, International Residential Code, and International Energy Conservation Code) and ASHRAE (American Society of Heating, Refrigerating and Air-conditioning Engineers). Entry doors, windows and many building products use U-factor in their published data.

U-factor and R-value are tested with different samples, different test methods, and are calculated differently. Comparing U-factors to R-values is the same as comparing apples to oranges. **A common misconception is that one is the reciprocal or inverse of the other.** That is not the case in the way these values are calculated in the garage door industry. Therefore:

$$\text{U-FACTOR} \neq \frac{1}{\text{R-VALUE}}$$

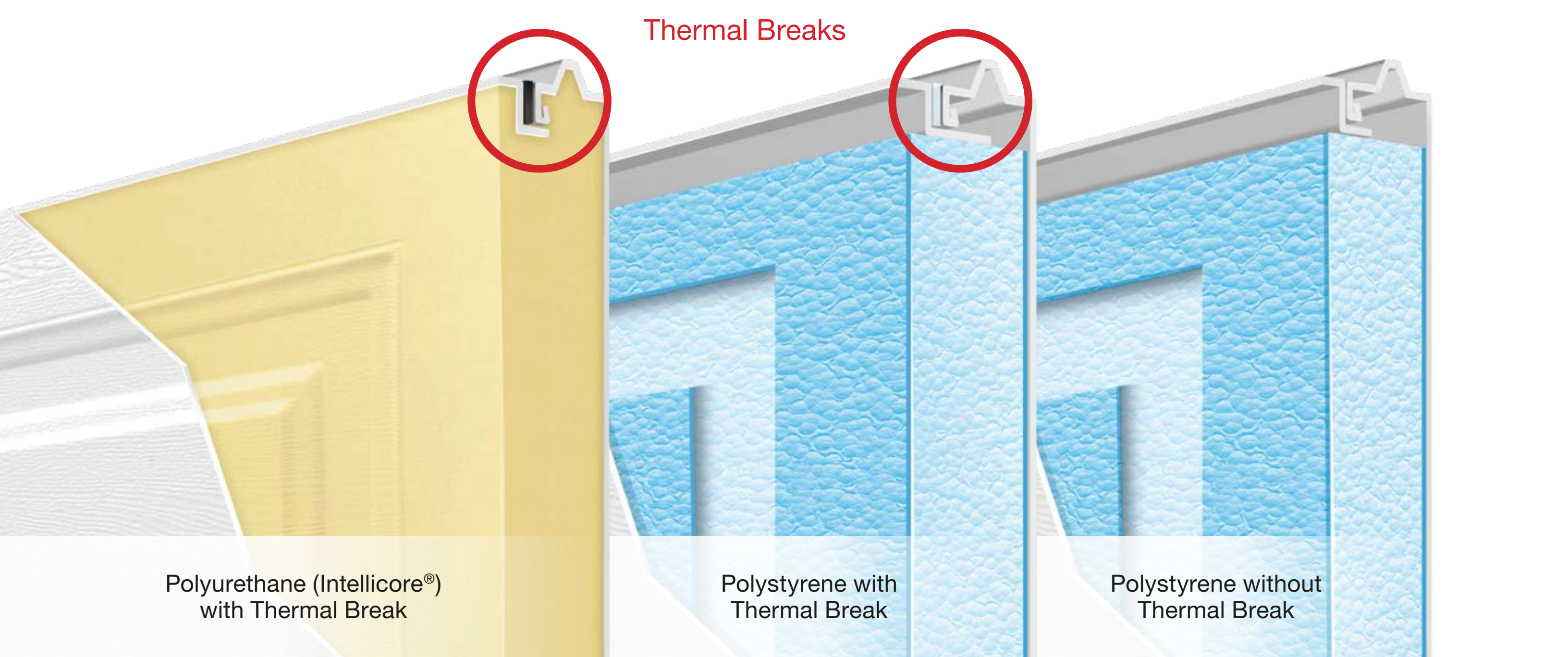
HOW DESIGN AFFECTS THE U-FACTOR

What product designs contribute to make a garage door result in a lower (better) U-factor? Some variables are obvious and some maybe less so. For example, all else being equal, the thicker the insulation, the lower the U-factor.

Another product feature that can make a significant difference in U-factor is the use of thermal breaks. A thermal break is a design that does not allow energy transfer from one side of the product to the other. Most thermal breaks in garage doors are at the section joints consisting of a measurable separation from the interior and exterior steel skins to help minimize heat transfer. In other words, the energy transfer path is ‘broken’ from front to back. Doors with thermal breaks demonstrate lower U-factors than doors without thermal breaks.

Garage doors with windows exhibit worse (higher) U-factors than doors without windows as more energy is lost through the windows than a solid door. This heat loss can be minimized with the use of insulated glass as compared to single pane glazing.

Garage doors insulated with polyurethane (Intellicore®) have a better U-factor than equivalent doors insulated with polystyrene.



BUILDING CODES AND STANDARDS

The International Energy Conservation Code (IECC) calls out the use of U-factors as determined by DASMA 105 testing. The 2015 IECC lists default door U-factors in lieu of specific door model test data. Most garage doors typically have a much lower U-factor.

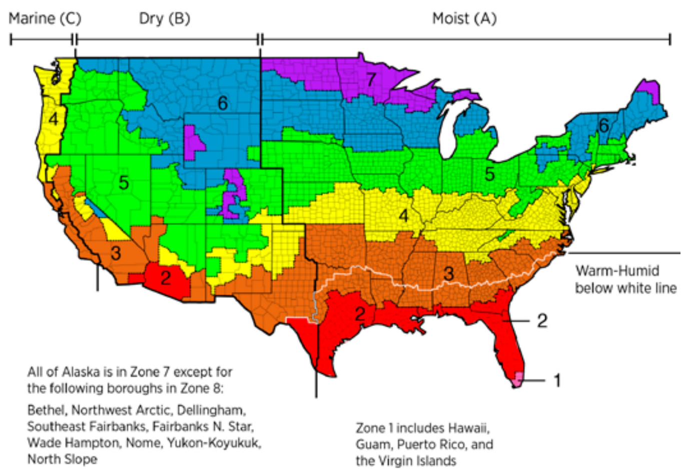
The IECC uses climate zones for different regions of the United States (Fig. 1). Climate zones run from south to north, with climate zone 1 being Hawaii, Puerto Rico and South Florida and climate zone 8 for northern Alaska. Each climate zone requires increasing thermal properties from all building products moving from zone 1 up through zone 8.

For each climate zone, the IECC uses “Opaque Doors – Nonswinging” as an alternate term for garage doors. The IECC divides building types between residential, non-residential and semi-heated. Within the same climate zone, the U-factor requirement for a garage door might be different depending on the building.

Note that not all garage doors are subject to the provisions of the IECC. Typically garages that are considered “conditioned space” are subject to the U-factor provisions of the IECC. A conditioned space would have a controlled environment via heating and air conditioning, while a semi-heated space would have heating, but not air conditioning. Non-conditioned space would be a detached garage or attached garage where the walls separating the garage from the rest of the building are insulated.

The ASHRAE energy standard 90.1 also uses climate zones and includes a section for determining climate zones in Canada. ASHRAE 90.1 includes much of the same information and is a basis for the code language in the IECC.

Fig. 1



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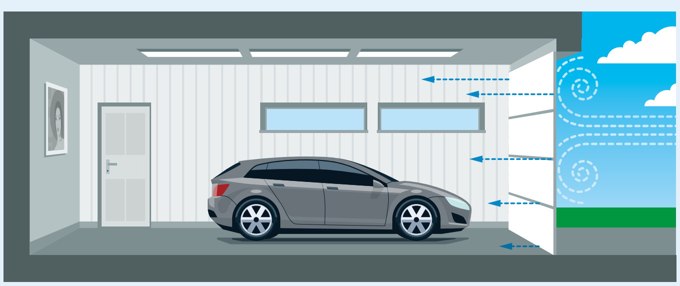
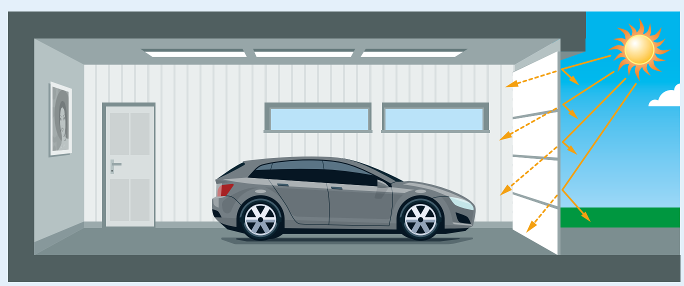


AIR INFILTRATION

Air infiltration measures the amount of air flow through a complete door assembly. Air flow is created by pressurizing one side of an enclosed chamber with the garage door installed in the center of the chamber. Air leakage is measured by simulating a 25 MPH (1.57 psf) wind on the exterior surface of the door. The test setup is very similar to that used for U-factor testing. In fact, both air infiltration and U-factor testing for garage doors is defined in DASMA 105. Also, like U-factors, the lower the air infiltration rate, the better the door assembly.

Air infiltration requirements are listed in the IECC and ASHRAE 90.1 for conditioned spaces. Both list a maximum air infiltration rate of 0.40 cfm/ft^2 for sectional garage doors. Rolling steel door requirements for air infiltration is a maximum of 1.00 cfm/ft^2.



SOLAR HEAT GAIN COEFFICIENT

Solar Heat Gain Coefficient (SHGC) is the amount of radiation energy allowed through a building product caused by direct exposure to sunlight. The higher the SHGC, the more radiation energy is allowed into the building. Garage doors with no windows have a very low SHGC, around 0.05. Doors with windows have higher SHGC, but since windows typically are less than 15% of the total garage door area, the weighted average SHGC for a garage door with a single glazed section has been measured at less than 0.10.

DEFINITIONS

British Thermal Unit (BTU) – BTU is a measure of energy. One BTU is equal to the amount of energy required to raise the temperature of one pound of liquid water by one degree Fahrenheit.

R-value – The capacity of an insulating material to resist heat flow. The higher the R-value, the greater the insulating power.

U-factor – The measure of overall heat transfer through a building product like a window or door. The lower the U-factor means less energy transmitted through the building product. U-factors for garage doors are measured in units of BTU/hr-ft2-°F as tested per DASMA Standard 105.

Door and Access Systems Manufacturers Association (DASMA) – Trade association representing 95% of all garage door manufacturers. DASMA creates standards, technical data sheets and guidelines on topics affecting the garage door industry.

DASMA Standard 105, Test Method for Thermal Transmittance and Air Infiltration of Garage Doors - This is the garage door industry test method for measuring U-factor and air infiltration on garage doors.

International Code Council (ICC) – The ICC is an association of building code officials and other interested parties that creates and publishes the International Building Code (IBC) and the International Energy Conservation Code (IECC) as well as other building codes.

American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE) – Organization that serves as a source of technical standards and guidelines with its focus on indoor-environment technology in the heating, ventilation and air conditioning (HVAC) industry.

ASHRAE Standard 90.1 , Energy Standard for Buildings Except Low-Rise Residential Buildings – This standard is used to promote energy efficiency in the building industry. Many of its provisions are adopted into the IECC.

Thermal Break – A barrier in the design of a building product, that restricts, hinders or otherwise “breaks” the path of thermal heat transfer from the exterior side of the building product to the interior side. Thermal breaks are made of a non-conductive material designed specifically for this purpose.

Climate Zone – A geographic region based on similar climatic criteria. U.S. climate zones are presented in the IECC.

Air Infiltration – The leakage or passage of air through a garage door as tested and measured per DASMA Standard 105.

Solar Heat Gain Coefficient (SHGC) – Measure of solar radiation energy admitted through a building product (window, door, skylight). SHGC is between 0 and 1. The lower the SHGC for a building product, the less solar energy transmitted.