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# U-factor and R-value for Residential and Commercial Garage Doors

## Introduction

This document is intended to provide a standard definition for manufacturers, and the customers they supply, to determine, communicate, and interpret the thermal values of commercial and residential garage doors.

For building materials, U-factor is an expression of thermal transmittance, reported in Btu/(h·ft$^2$·°F); the lower the U-factor, the better the insulation. By contrast, R-value is an expression of thermal resistance, based on material type and thickness, and is reported in units of (h·ft$^2$·°F)/Btu; the greater the R-value, the better the insulation.

To determine thermal properties for garage doors, there are two methods for consideration.

1. Testing - This involves the entire, installed garage door assembly, and results in a U-factor
2. Calculation - This involves the door section only and results in an R-value

Please note, these two methods are not comparable and are obtained by entirely different methods reflecting different aspects of thermal performance. For purposes of garage door thermal properties, U-factor and R-value are not reciprocals of each other.

For garage doors, R-value ≠ 1/U-factor

## Tested Door Assembly (U-factor)

In actual use, a garage door consists of multiple sections coupled together, plus track, hardware, and accessories. The assembled door may include features that greatly impact the thermal performance, such as section joints, stiles, thermal breaks, air spaces, weather seals, etc. These design elements, whether all being present or just some, generally affect thermal conductance in a door (refer to Figure 1).

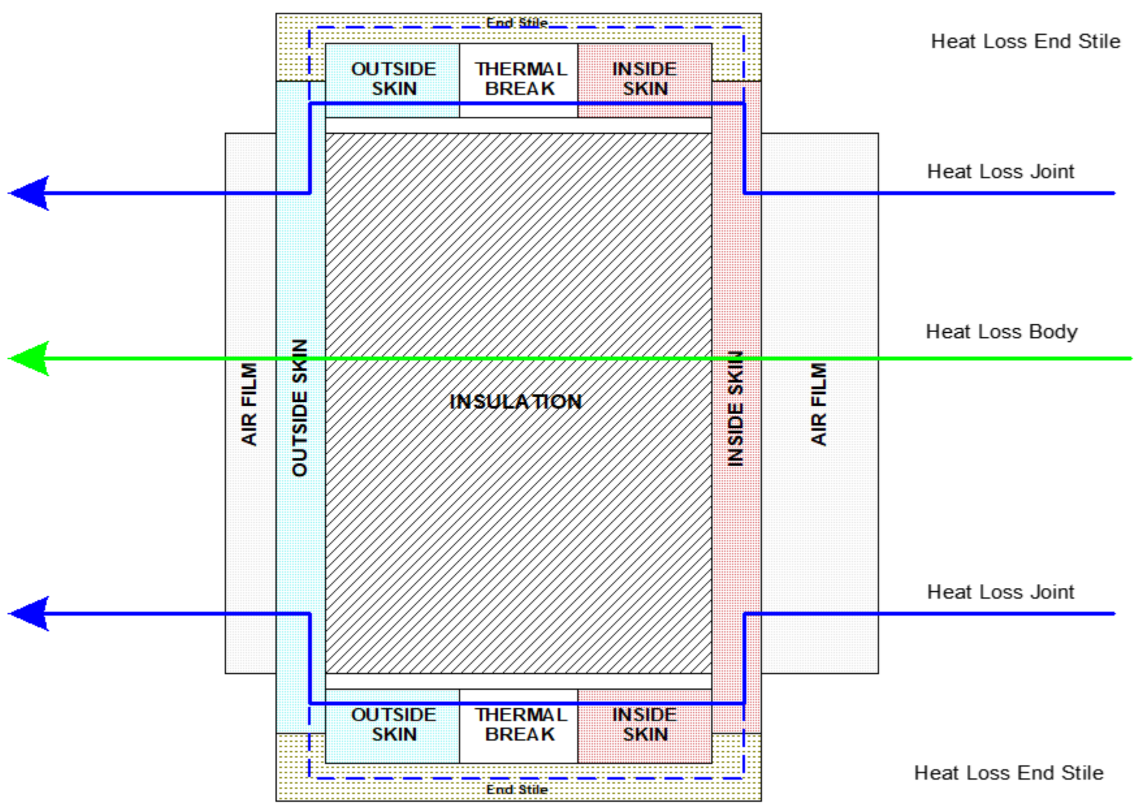
Some elements of door construction can provide a "thermal shortcut" around the insulation in a door section, thereby increasing heat flow. Other elements such as thermal breaks and weather seals resist heat flow. To capture the overall effect of the complex assembly of components, DASMA has developed the nationally recognized test standard ANSI/DASMA 105, providing a lab with a test measurement for the U-factor of a complete garage door assembly.

**Note: Technical Data Sheets are information tools only and should not be used as substitutes for instructions from individual manufacturers. Always consult with individual manufacturers for specific recommendations for their products and check the applicable local regulations.**

This Technical Data Sheet was prepared by the members of DASMA's Commercial & Residential Garage Door Division Technical Committee. DASMA is a trade association comprising manufacturers of rolling doors, fire doors, grilles, counter shutters, sheet doors, and related products; upward-acting residential and commercial garage doors; operating devices for garage doors and gates, sensing devices, and electronic remote controls for garage doors and gate operators; as well as companies that manufacture or supply either raw materials or significant components used in the manufacture and installation of the Active Members' products.

ANSI/DASMA 105 specifies door sizes for testing. A complete door system is provided by a manufacturer and installed in a special chamber constructed such that the inside face of the door is kept at a constant temperature and the outside face of the door is cooled. The energy required to maintain the constant temperature is measured and used to determine the rate of heat flow (U-factor) through the complete door system. Similar test methods are used for many building products for which the performance of a complete product is relevant, such as windows and entry doors.

**Figure 1**

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**Calculated Door Section (R-value)**

This method estimates the insulating value of a door section without accounting for the complexities of door section joints, stile attachments, etc., and therefore should not be used for garage door assemblies.

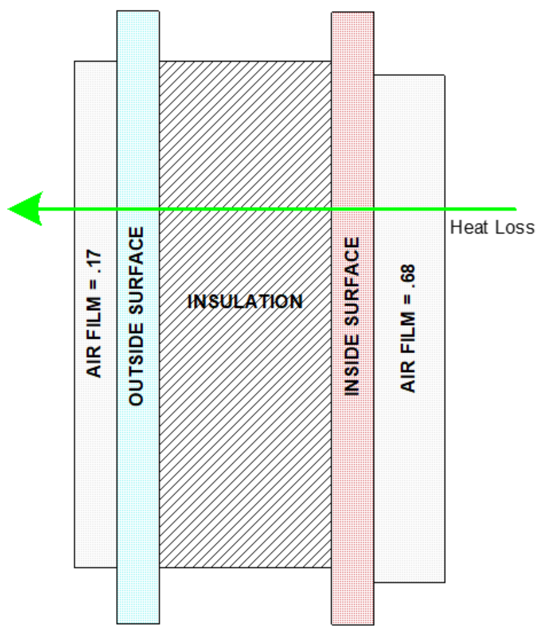
Refer to Figure 2. A typical insulated door has an exterior surface, interior surface, and an insulating core material. Also present is the insulating effect of air on a vertical surface, termed "air film". Each of these elements has a unique R-value that added together create the door section R-value.

$$R_{section} = R_{air\ films} + R_{outside\ surface} + R_{insulation} + R_{inside\ surface}$$

For a door, we assume air will be stagnant on the inside of a closed door and the exterior will have air moving against it at 15 MPH. Based on data published by ASHRAE[1], these air films will total an R-value of 0.85.

ASHRAE also publishes values for materials used as outside and inside surfaces. R-values of steel and other metal facings are considered negligible.

**Figure 2**

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Insulation R-values are based on a k-factor (thermal conductivity). The k-factor for a particular material is traced to testing in accordance with ASTM C177 or C518, using an average material temperature of 40°F. The k-factor is used in the calculation:

$$R_{insulation} = (\text{Insulation Thickness}) / k$$

Some doors have varying insulation thicknesses across the section. In this case, the R-value of the section can be estimated by examining the R-value at each insulation thickness and proportionally combining the values.

**Example**: A 22-inch-tall section has 1 3/8 in thick polyurethane foam for 16 inches, 1 7/8 inch thick for the remaining 6 inches of the height, and a k-factor of 0.12. The R-value for the section would be as follows:

$$R_{section} = R_{air\ films} + R_{16\text{''}\ portion} + R_{6\text{''}\ portion}$$

$$R_{air\ films} = .68 + .17 = .85$$

$$R_{16\text{''}\ portion} = (1.375) \times (16/22)/.12 = 11.36$$

$$R_{6\text{''}\ portion} = (1.875) \times (6/22)/.12 = 4.26$$

$$R_{section} = .85 + 11.36 + 4.26 = 16.47$$

## Conclusion

The two most common ways garage door thermal performance can be reported are the “Tested Door Assembly” (U-factor) and the “Calculated Door Section” (R-value). These two values are not comparable to each other. The U-factor represents a complete door, while the R-value represents an individual door section. U-factor provides the highest degree of confidence when evaluating and comparing the thermal performance of garage door assemblies. Purchasers and specifiers should be aware that when available, the accuracy of a tested door assembly U-factor exceeds other types of thermal performance ratings, and that recognized building codes and standards deal with garage door thermal performance in terms of U-factor.

[1] 2017 ASHRAE® Handbook - Fundamentals, page 26.21, Table 10. Still Air, Vertical Surface, Non-reflective shows R = 0.68. Moving Air, 15 MPH wind, Non-reflective shows R = 0.17. Therefore, $R_{total\ air\ film} = 0.68 + 0.17 = 0.85$.

[2] 2017 ASHRAE® Handbook - Fundamentals, page 33.3, Table 3.

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