

Energy Code Requirements for Post-Frame Windows and Doors

By Harvey Manbeck, P.E., Ph.D.

Manufacturers of some components for post-frame buildings report that recently they are receiving calls from customers requesting U-Values for doors and windows. It is likely that more customers will request this information as post-frame building systems garner a larger portion of the commercial, residential and institutional market.

Customers in some areas report that building inspectors won't allow them to occupy new buildings unless U-value ratings are provided for doors and windows. The requirement generally applies to commercial structures that are climate controlled. Builders of these structures may be required to use COMCheck software, which is a free download from the Department of Energy, to show proof of compliance with the IBC and that this software requires the U-Values for the doors, windows, and all other materials involved in the envelope of the building.

According to the Department of Energy website:

COMcheck was developed to clarify and simplify commercial building energy codes. The materials focus on code requirements that apply to most small or simple commercial buildings and offer a streamlined process for demonstrating code-equivalent levels of energy efficiency. COMcheck can be used with most commercial energy codes based on ASHRAE/IES Standard 90.1-1989/1999/2001/2004 or the 1998, 2000, 2001, 2003, 2004, or 2006 IECC. Contractors and designers who use COMcheck can save time and effort in documenting code compliance. Officials who receive COMcheck certification forms can confidently view these submissions as "deemed to comply" with the code.

Some manufacturers may have a wide variety of door/window models, however, many of the assemblies may be similar. There are methods to calculate (simulate) the U-values of many door and window assemblies based upon limited testing of a smaller sample of a company's product line.

I have reviewed briefly the IECC (International Energy Conservation Code) for commercial and residential building envelopes (Chapters 4 and 5 of the IECC). Here is the essence of what I found:

1. Required minimum U-values for opaque doors in the building envelope are given in Table 502.2(1) for commercial buildings.
2. Required minimum U-values for fenestration in the building envelope are given in Table 502.3 for commercial buildings.
3. Section 502.4 addresses air leakage issues. In Subsection 502.4.1, air leakage tests are specified for windows, swinging doors or sliding doors in the building envelope of commercial buildings. Site built windows and doors that are weather-stripped are exempted from this section requirement.
4. Required minimum U-values or R-values for windows and doors are given in Table 402.2.2 for residential building envelopes.
5. Air leakage issues for residential building components in the building envelope are addressed in section 402.4. Section 404.4.2 specifies leakage tests for windows, sliding doors, and swinging doors in the building envelope in a fashion similar to section 502.4.1 for commercial buildings.

U-values for a product line of doors and windows are obtained by a combination of limited testing and simulation (calculation) techniques. These procedures are presented in a series of documents published by the National Fenestration Rating Council (NFRC) available at www.nfrc.org. Key NFRC documents are:

NFRC 100-2004, "Procedures for Determining Fenestration Product U-Factors"
NFRC 101, "Procedures for Determining the Thermo-physical Properties of Materials for Use in NFRC-Approved Software Programs"
NFRC 200-2004, "Procedures for Determining Fenestration Solar Heat Gain Coefficients and Visible Transmission"
NFRC Simulation Manual

NFRC 200-2004 presents test and calculation procedures for determining U-values for fenestration and door components. The document also outlines the criteria by which U-values for door/window assemblies from a test panel can be extended to a family of similar door/window assemblies by calculation (simulation) procedures. That is, for doors/windows of similar construction, one assembly can be tested, and if calculated (simulated) results agree to within prescribed tolerances with test results, then U-values for other similar doors/windows in the product line can be determined by calculation (simulation) procedures. The criteria for establishing which door/window products are similar to the test specimen are also prescribed in this document.

The NFRC Simulation Manual includes specific methods for calculating U-values of doors and fenestration using ISO 15099 approved calculation procedures for determining U-values. NFRC 101 includes key material properties, such as density, thermal conductivity, thermal emissivity, and solar absorption of component parts of door/window assemblies. These properties are important inputs to the calculation (simulation) procedures presented in NFRC 100, NFRCs Simulation Manual, and ISO 15099. NFRC 200-2004 includes procedures for determining the solar heat gain and visible solar transmission of building envelope fenestration.

In summary, the U-values of doors and windows located in the building envelope areas of residential and commercial buildings often need to meet the minimum values specified in the IECC. These can be determined by limited testing of a few door/window assemblies. Similar door/window assembly U-values can be calculated based on thermal resistances or conductivities of component parts of the door/window assembly. Window and door assemblies used in the building envelope may also need to be tested to show that they meet the air leakage levels specified in IECC. There is some verbiage in IECC that exempts some windows and doors from air leakage test requirements if properly weather-stripped on site.

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