Window Thermal Testing

Thermal testing and thermal test report values can be a confusing issue when dealing with customers, Architects, spec writers and others involved in a retrofit or new construction project. The following information has been assembled to try and alleviate some of the confusion.

There are two U.S. testing programs for windows to determine thermal performance. The American Architectural Manufacturers Association (AAMA) and the National Fenestration Rating Council (NFRC). These two programs yield similar, but not identical, thermal performance.

U-Value describes thermal conductivity, that is, the heat flow through the glazing and is expressed in terms of BTUs per hour per square foot per degree Fahrenheit temperature difference. **The lower the U-value the better**. The U-value is calculated for the entire window, including the frame material and the glass. The test procedure includes a minor air flow on the test specimen (15 mph), therefore an operable window, with the same glass type as a fixed window, will have a higher U-value rating.

U-value can be either physically tested or simulated with a computer program.
- Physical tests – AAMA 1503 or NFRC 100
- Computer Simulations – NFRC 100 using computer programs written by Lawrence Berkeley National Laboratory

Condensation resistance
- Physical test – AAMA 1503 (CRF)
- Computer simulation – NFRC 500 (CR)

Solar heat gain coefficient (SHGC)
- Computer simulation – NFRC200

So for any given window 3 different U-Values can be determined, AAMA 1503 physical test, NFRC physical test, and NFRC computer simulation. Again these values may be close or in some instances identical, but this is not always the case.

AAMA was established in 1936 to develop standards providing third-party validation of product performance and quality. The AAMA 1503 thermal test standard uses physical testing, to measure window assembly U-Factor and condensation resistance factor (CRF), but cannot determine solar heat gain coefficient (SHGC) or visible light transmission (VT). There is another procedure, AAMA 507, rating system that is applicable to storefront, curtain wall, window wall and other fenestration products for commercial buildings, and not limited to just windows. The performance ratings generated by this standard are building-specific. AAMA 507 accounts for vision and spandrel areas, size variations, and the effect of any type of architectural glass.

NFRC was established in 1989, the result of a joint effort of government, residential window manufacturers and other stakeholders. NFRC uses thermal simulations and physical testing to determine whole window assembly U-Factors (NFRC 100) and SHGC (NFRC 200). A physical test is required to “validate” the simulation results. The NFRC Certified Products Directory lists all products that are authorized to be labeled. NFRC also has a procedure for determining condensation resistance (CR) it is NFRC 500. NFRC has also recently implemented the new Component Modeling Approach (CMA) for non-residential projects.

NFRC rating and labeling is the only accepted thermal performance rating system currently referenced in national Model Energy Codes. The AAMA 507 procedure has not been successful to date as becoming an alternative method referenced in the energy codes.

What to look for when determining window thermal performance values:

What standard is referenced in the project spec? Is AAMA 1503 or NFRC 100 or both required for thermal transmittance?

Is CRF (AAMA) or CR (NFRC) specified?

Is there a SHGC (NFRC simulation only) requirement?

Dependent on the answers to these questions different test reports will have the required information. Graham Architectural Products has been performing AAMA 1503 thermal testing since its inception. The NFRC 100 testing started in 2004. Not all NFRC testing yields NFRC certification. The certification process is more than just a NFRC simulation test and involves a lengthy and costly procedure.

If you have any questions about this paper contact:

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