National Fenestration Rating Council
REQUEST FOR PROPOSAL

Approved RFP: 05-103-AP

Title: *Development of Condensation Resistance Procedure for the Component Modeling Approach*

Issue Date: September 5, 2006

Bidder Response Due Date: October 5, 2006

All bidders shall submit two copies of all bid proposals to the NFRC office on or before the 5:00 pm (Eastern Time) on due date at this address:

National Fenestration Rating Council
Attn: Ray McGowan
8484 Georgia Avenue, Suite 320
Silver Spring, Maryland 20910

All bidders will bid by the NFRC Agreement in the 2005 NFRC Research Manual, appendix G. If government funding is used for the project then the bidder shall bid by form K requirements (staff will provide upon request).

Proponent: Charlie Curcija, Carli, Inc.

Background:

Condensation Resistance is an important non-energy index in the NFRC rating and certification program. This index is non-mandatory, but it is nevertheless sought by architects, specifiers, building owners, etc. While it is nominally a non-energy index, a low temperature on the room-side surface of the glazing or framing may create an uncomfortable environment in the conditioned space leading to higher temperature set points and ultimately to higher energy use. The component modeling approach, or CMA, is being developed as an answer to the concerns of non-residential manufacturers and their desire for simple, effective energy ratings for their products. While it is possible to develop this new procedure for U-factor, SHGC, and VT, the methodology does not lend itself well to Condensation Resistance. Currently, Condensation Resistance can be calculated using the standard modeling approach when the whole product is modeled. This approach is still workable, but it is definitely more time consuming and more complex than if there were a CMA approach for Condensation Resistance. AAMA (American Architectural Manufacturers Association) has an alternative condensation

resistance index, the CRF (Condensation Resistance Factor), which has been in use for many years and has significant market presence. However, CRF is determined through physical testing only, and there is currently no simulation procedure for this index.

OBJECTIVES:

Develop a Component Modeling Approach (CMA) simulation procedure for Condensation Resistance so it can be used in conjunction with the CMA methodology currently being developed for U-factor, SHGC, and VT. Review and comment on the AAMA test-only procedure for CRF. Investigate if some hybrid procedure can be developed that produces a CRF like number, and is applicable to CMA methodology.

SCOPE

Identify leading factors used in the calculation of Condensation Resistance indices of fenestration products. In this process, derive links and relationships between CMA and the current Condensation Resistance procedure. Based on the physics of the situation, develop a recommendation for the course of further work as the most likely candidate to produce successful correlation between CMA and Condensation Resistance.

Investigate similarities and differences between NFRC Condensation Resistance and AAMA *CRF*. Investigate the feasibility of calculating an index equivalent to CRF using a CMA-based methodology.

Condensation Resistance is the product of multiple averaging processes, both area and temperature weighted. The final performance index is calculated by raising the product of area and temperature weighted quantities (*SS*) to the power of 1/3, which is done to provide a better spread among the numbers (i.e., better resolution). The non-linearity of Condensation Resistance calculated in such way makes it very difficult to develop an effective correlation between Condensation Resistance and the CMA-based four best/worst options (see Curcija 2004). In order to develop a successful correlation for use in the CMA methodology, it will likely be necessary to correlate more basic quantities used in the development of Condensation Resistance, such as surface temperature, relative humidity and area. It is the task of contractor to positively identify the quantities that will be correlated and to develop final correlations.

The IG spacer plays an important role in the ability of a fenestration product to resist condensation. Even if the whole product performs well on an average level, reflected by U-factors, a poorly designed spacer system or the use of highly conducting materials may substantially reduce condensation resistance. Because the CMA methodology utilizes the effective conductivity of the spacer assembly, it is expected that the CMA-based

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Condensation Resistance will incorporate the effective conductivity of the spacer assembly.

Investigation of how well the effective conductivity of the spacer assembly represents the local temperature distribution on the interior side of fenestration systems will be required. If the present average effective conductivity does not provide a reasonable approximation of the local temperature distribution, then it will be necessary to determine if some modification of the effective conductivity would be required. Alternatively, if the effective conductivity of the spacer assembly, or some modification of it does not provide useful information for a CMA-based Condensation Resistance procedure, the contractor will need to develop a new procedure utilizing some new approach and suggest how that new approach would be incorporated into the CMA for U-factors, SHGC and VT, if applicable.

Evaluate if further assumptions need to be made in terms of spacer and spacer assembly representation for the purpose of Condensation Resistance calculations.

Identify representative fenestration products that will be used in the validation of this procedure. Establish a matrix of different glazing systems and spacer designs in addition to the selection of representative products so the proposed new methodology can be tested and validated. At a minimum, the list of fenestration products shall include the 14 products against which NFRC 2001 procedures were validated (Curcija 2001). Additional products shall include NFRC interlaboratory comparison samples that have been tested since the validation of 2001 procedures. Because the list so far includes mostly residential products, additional non-residential products shall be included. The final matrix shall be approved by the PMTG before validations are completed.

The new Condensation Resistance procedure should be relatively easily implemented into existing computer tools so that the same *"bucket"* approach, used for U-factor, SHGC, and VT, can be utilized. Condensation Resistance should be just one more index displayed when performance of the whole product is calculated for the selected components.

Identify any potential issues with the existing algorithms in THERM and WINDOW, in terms of component calculations and recommended changes so that the new procedure could be implemented in the NFRC Product Certification Program.

DELIVERABLES

- Progress Reports at the NFRC meetings
- Report with the recommendation for the course of further work as the most likely candidate to produce successful correlations between CMA and Condensation

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Resistance. Also, document all findings about the feasibility of calculating an AAMA *CRF* using the CMA methodology.

- Report with the proposed validation matrix.
- Final report, detailing the new CMA-based Condensation Resistance procedure which also includes proposed language for inclusion in NFRC 500
- Peer reviewed technical paper

ESTIMATED DURATION:

12 months

POTENTIAL CO-SPONSORS:

Non-Residential Manufacturers, Spacer Manufacturers

SOLE SOURCING:

None

TERMS:

Any prospective bidder shall submit a proposal that identifies the total cost of performing all the documented requirements in this RFP. Any terms of payment shall also be outlined in the proposal. A schedule outlining all RFP tasks shall be included with the bid submittal including all associated dates and times.

References: none

NFRC resources: Staff labor: Not to exceed 25 hours.

Non-NFRC resources: None

NFRC Staff contact:

The NFRC staff contact for the project is Ray McGowan, NFRC, Georgia Avenue, suite 320, Silver Spring, Maryland 20910. Phone: (301) 589-1776, Facsimile: (301) 589-3884; email: rmcgowan@nfrc.org

Payment: See 2005 NFRC Research Manual, section 5.K.