

FreMarq Innovations  
8300 Highland Drive  
Wausau, WI 54455

Todd,

Per your request, Quast Consulting and Testing, Inc. performed thermal modeling and U-factor calculations for a fiberglass/aluminum composite curtainwall system. QCT utilized the THERM 6.3 and WINDOW 6.3 computer software developed by Lawrence Berkeley Laboratory to perform thermal analysis of the system.

THERM 6.3 calculates heat loss through frame and edge-of-glazing components using finite element analysis. The program solves for temperature and heat flow distribution throughout the cross section. The temperature distribution can then be used to determine overall heat loss, total and component U-factors and local temperatures at points of interest.

WINDOW 6.3 calculates U-factor and temperatures for the center-of-glazing using a two dimensional heat flow analysis.

**Standards:**

NFRC 100-2014: *Procedure for Determining Fenestration Product U-Factors.*

NFRC 200-2014: *Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence.*

NFRC 500-2014: *Procedure for Determining Fenestration Product Condensation Resistance Values.*

Standard NFRC environmental conditions were used to analyze the system, which are -0.4°F exterior ambient temperature with a 12.3 mph wind acting perpendicular to the wall. An exterior film coefficient of 4.579 Btu/hr\* $\text{ft}^2$ \*°F was used to represent the exterior wind. Interior conditions were modeled as 69.8°F ambient temperature with natural convection only.

**QUAST CONSULTING AND TESTING, INC.**

*Exterior Façade/Fenestration Consulting & Testing*

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Two insulating glass systems were used in this analysis. The first glass system consisted of ¼” VE2M (e=0.040) on surface #2, ½” argon gap with the Technoform spacer, ¼” clear. The center of glass U-factor for the first insulating glass system calculated as 0.247 Btu/hr\*ft<sup>2</sup>\*°F. The second glass system consisted of 3/16” LoE366 (e=0.022) on surface #2, 3/8” 90% Krypton gap with Technoform spacer, HeatMirror®88, 3/8” 90% Krypton with Technoform spacer, 3/16” clear. The center of glass U-factor for the second insulating glass system calculated as 0.116 Btu/hr\*ft<sup>2</sup>\*°F.

U-factor calculations were performed on standard NFRC rating size consisting of two lite wide specimen with an overall size of 79” x 79.

Thermal model graphical outputs with frame surface temperature identification can be found in Exhibit A.

Thermal models were generated based upon drawings (Exhibit B) supplied by FreMarq Innovations.

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Results:

	U-Factor (Btu/h-ft <sup>2</sup> -F)	SHGC	VT	CR
VE-2M	0.300	0.368	0.648	54
LoE366 and HeatMirror®88	0.181	0.220	0.502	66

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This thermal analysis is prepared for the convenience of our customer and endeavors to provide accurate and timely project information. It contains thermal models prepared by a qualified technician at Quast Consulting and Testing, Inc. The simulations performed in this report are based on controlled steady state environmental conditions. Field condensation on interior surfaces is affected by many variables including product thermal performance, interior trim coverage and convection conditions, weather and mechanical system design. Since many of these variables are outside of our control, we can make no representations or warranties against the formation of condensation, except on pre-defined configurations under controlled laboratory conditions.

This report is intended to help in your Quality Assurance Program, but it does not represent a continuous nor exhaustive evaluation. A copy of this report will be retained by QCT for a period of four years. This report is the exclusive property of the client so named herein and is applicable to the samples simulated.

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QUAST CONSULTING & TESTING, INC.

A handwritten signature in black ink, reading "Brian M. Sasman". The signature is written in a cursive style and is positioned above the printed name and title.

Brian M. Sasman P.E.  
NFRC Certified Simulator

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