Architectural Testing

NFRC 102-2010 THERMAL PERFORMANCE TEST REPORT

Rendered to:

CMI ARCHITECTURAL PRODUCTS, INC.

SERIES/MODEL: CTS Thermal Clip Framing System

TYPE: Glazed Wall Systems (Site-built)

Summary of Results	
Standardized Thermal Transmittance (U-Factor)	0.32
Unit Size	79" x 79" (2007 mm x 2007 mm) (Model Size)
Layer 1	1/4" PPG Solarban 60 LowE (e=0.035*, #2)
Gap 1	0.50" Gap, Thermo-plastic w/ stainless steel substrate Spacer (TS-D), 90% Argon-Filled*
Layer 2	1/4" Clear

Reference must be made to Report No. A2259.01-201-46, dated 07/28/10 for complete test specimen description and data.

849 Western Avenue North
St. Paul, MN 55117
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NFRC 102-2010 THERMAL PERFORMANCE TEST REPORT

Rendered to:

CMI ARCHITECTURAL PRODUCTS, INC.
2800 Freeway Blvd Ste 205
Minneapolis, Minnesota 55430

Report Number:	A2259.01-201-46
Test Date:	06/29/10
Report Date:	07/28/10
Test Record Retention Date:	06/29/14

Test Sample Identification:

Series/Model: CTS Thermal Clip Framing System

Type: Glazed Wall Systems (Site-built)

Overall Size: 79" x 79" (2007 mm x 2007 mm) (Model Size)
NFRC Standard Size: 78.7" x 78.7" (2000 mm wide x 2000 mm high)

Test Sample Submitted by: Client

Test Procedure: U-factor tests were performed in a Guarded Hot Box in accordance with NFRC 102-2010, *Procedure for Measuring the Steady-State Thermal Transmittance of Fenestration Systems* .

Test Results Summary:

Standardized U-factor (U_{st}): 0.32 Btu/hr·ft^2·F CTS Method

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Test Sample Description:

CONSTRUCTION	**Frame**
Size (in.)	79 x 79
Daylight Opening (in.)	36-3/4 x 75-1/4 (x2)
CORNERS	Butt
Fasteners	Screws
Sealant	Yes
MATERIAL	AT (1.00")
Color Exterior	Gray
Finish Exterior	Anodized
Color Interior	Gray
Finish Interior	Anodized
GLAZING METHOD	Pressure

Glazing Information:

Layer 1	1/4" PPG Solarban 60 LowE (e=0.035*, #2)
Gap 1	0.50" Gap, Thermo-plastic w/ stainless steel substrate Spacer (TS-D), 90% Argon-Filled*
Layer 2	1/4" Clear
Gas Fill Method	Single-Probe Method*

**Stated per Client/Manufacturer*
N/A Non-Applicable
See Description Table Abbreviations

Test Sample Description: (Continued)

COMPONENTS			
	Type	**Quantity**	**Location**
WEATHERSTRIP			
	No weatherstrip		
HARDWARE			
	No hardware		
DRAINAGE			
	No drainage		

Thermal Transmittance (U-factor)

Measured Test Data

Heat Flows

1. Total Measured Input into Metering Box (Q_{total})	1098.31	Btu/hr
2. Surround Panel Heat Flow (Q_{sp})	17.64	Btu/hr
3. Surround Panel Thickness	8.00	inches
4. Surround Panel Conductance	0.0272	Btu/hr·ft^2·F
5. Metering Box Wall Heat Flow (Q_{mb})	35.92	Btu/hr
6. EMF vs Heat Flow Equation (equivalent information)	0.0201*EMF + 18.190	
7. Flanking Loss Heat Flow (Q_{fl})	30.49	Btu/hr
8. Net Specimen Heat Loss (Q_s)	1014.27	Btu/hr

Areas

1. Test Specimen Projected Area (A_s)	43.34	ft^2
2. Test Specimen Interior Total (3-D) Surface Area (A_h)	62.79	ft^2
3. Test Specimen Exterior Total (3-D) Surface Area (A_c)	51.44	ft^2
4. Metering Box Opening Area (A_{mb})	52.80	ft^2
5. Metering Box Baffle Area (A_{b1})	45.30	ft^2
6. Surround Panel Interior Exposed Area (A_{sp})	9.46	ft^2

Test Conditions

1. Average Metering Room Air Temperature (t_h)	70.70	F
2. Average Cold Side Air Temperature (t_c)	-0.09	F
3. Average Guard/Environmental Air Temperature	71.00	F
4. Metering Room Average Relative Humidity	5.25	%
5. Measured Cold Side Wind Velocity (Perpendicular Flow)	14.36	mph
6. Measured Static Pressure Difference Across Test Specimen	0.00" ± 0.04"	H_2O

Results

1. Thermal Transmittance of Test Specimen (U_s)	0.33	Btu/hr·ft^2·F
2. Standardized Thermal Transmittance of Test Specimen (U_{st})	0.32	Btu/hr·ft^2·F

Thermal Transmittance (U-factor)

Calculated Test Data

CTS Method

1.	Emittance of Glass (e_1)	0.84	
2.	Cold Side Emittance of Glass	0.84	
3.	Warm Side Frame Emittance	0.80	
4.	Cold Side Frame Emittance	0.80	
5.	Warm Side Sash/Panel/Vent Emittance	N/A	
6.	Cold Side Sash/Panel/Vent Emittance	N/A	
7.	Warm Side Baffle Emittance (e_{b1})	0.92	
8.	Equivalent Warm Side Surface Temperature	53.64	F
9.	Equivalent Cold Side Surface Temperature	4.57	F
10.	Warm Side Baffle Surface Temperature	71.57	F
11.	Measured Warm Side Surface Conductance (h_h)	1.37	Btu/hr·ft^2·F
12.	Measured Cold Side Surface Conductance (h_c)	5.03	Btu/hr·ft^2·F
13.	Test Specimen Thermal Conductance (C_s)	0.48	Btu/hr·ft^2·F
14.	Convection Coefficient (K_c)	0.28	Btu/(hr·ft^2·F$^{1.25}$)
15.	Radiative Test Specimen Heat Flow (Q_{r1})	593.61	Btu/hr
16.	Conductive Test Specimen Heat Flow (Q_{c1})	420.66	Btu/hr
17.	Radiative Heat Flux of Test Specimen (q_{r1})	13.70	Btu/hr·ft^2·F
18.	Convective Heat Flux of Test Specimen (q_{c1})	9.71	Btu/hr·ft^2·F
19.	Standardized Warm Side Surface Conductance (h_{sth})	1.20	Btu/hr·ft^2·F
20.	Standardized Cold Side Surface Conductance (h_{stc})	5.28	Btu/hr·ft^2·F
21.	Standardized Thermal Transmittance (U_{st})	0.32	Btu/hr·ft^2·F

Test Duration

1. The environmental systems were started at 14:50 hours, 06/28/10.
2. The test parameters were considered stable for two consecutive four hour test periods from 01:12 hours, 06/29/10 to 09:12 hours, 06/29/10.
3. The thermal performance test results were derived from 05:12 hours, 06/29/10 to 09:12 hours, 06/29/10.

The reported Standardized Thermal Transmittance (Ust) was determined using CTS Method, per Section 8.2(A) of NFRC 102.

Glazing Deflection (in):

	Left Glazing	Right Glazing
Edge Gap Width	0.50	0.50
Estimated center gap width upon receipt of specimen in laboratory (after stabilization)	0.54	0.49
Center gap width at laboratory ambient conditions on day of testing	0.54	0.49
Center gap width at test conditions	0.47	0.45

Glass collapse determined using a digital glass and air space meter

The sample was inspected for the formation of frost or condensation, which may influence the surface temperature measurements. The sample showed no evidence of condensation/frost at the conclusion of the test.

A calibration of the Architectural Testing Inc. 'thermal test chamber' (ICN N000235) in St. Paul, Minnesota was conducted in October 2009 in accordance with Architectural Testing Inc. calibration procedure.

"This test method does not include procedures to determine the heat flow due to either air movement through the specimen or solar radiation effects. As a consequence, the thermal transmittance results obtained do not reflect performances which may be expected from field installations due to not accounting for solar radiation, air leakage effects, and the thermal bridge effects that may occur due to the specific design and construction of the fenestration system opening. Therefore, it should be recognized that the thermal transmittance results obtained from this test method are for ideal laboratory conditions and should only be used for fenestration product comparisons and as input to thermal performance analyses which also include solar, air leakage and thermal bridge effects."

"Ratings included in this report are for submittal to an NFRC-licensed IA for certification purposes and are not meant to be used for labeling purposes. Only those values identified on a valid Certification Authorization Report (CAR) are to be used for labeling purposes."

The test sample was installed in a vertical orientation, the exterior of the specimen was exposed to the cold side. The direction of heat transfer was from the interior (warm side) to the exterior (cold side) of the specimen.

ANSI/NCSL Z540-2-1997 type B uncertainty for this test was 1.59%.

Detailed drawings, data sheets, representative samples of test specimens, a copy of this report, or other pertinent project documentation will be retained by Architectural Testing, Inc. for a period of four years from the original test date. At the end of this retention period such materials shall be discarded without notice and the service life of this report by Architectural Testing will expire. Results obtained are tested values and were secured by using the designated test methods. This report does not constitute certification of this product nor an opinion or endorsement by this laboratory. Ratings included in this report are for submittal to an NFRC licensed IA for certification purposes and are not meant to be used for labeling purposes. Only those values identified on a valid Certification Authorization Report (CAR) are to be used for labeling purposes. It is the exclusive property of the client so named herein and relates only to the specimen(s) tested. This report may not be reproduced, except in full, without the written approval of Architectural Testing, Inc.

For ARCHITECTURAL TESTING, INC.

Tested By:

Digitally Signed by: John A. Westlund

John A. Westlund
Technician

Reviewed By:

Digitally Signed by: Michael Resech

Michael P. Resech
Senior Project Manager
Individual-In-Responsible-Charge

JAW:jaw
A2259.01-201-46

Attachments (pages): This report is complete only when all attachments listed are included.

Appendix-A: Description Table Abbreviations (1)
Appendix-B: Drawings (1)

Revision Log

Rev. #	Date	Page(s)	Revision(s)
0	07/28/10	All	Original Report Issue. Work requested by Phillip Leonard of CMI Architectural Products, Inc.

Appendix A: Description Table Abbreviations

CODE	Frame / Sash Types
AI	Aluminum w/ Vinyl Inserts (Caps)
AL	Aluminum
AP	Aluminum w/ Thermal Breaks - Partial
AS	Aluminum w/ Steel Reinforcement
AT	Aluminum w/ Thermal Breaks - All Members (≥ 0.21")
AU	Aluminum Thermally Improved - All Members (0.062" - 0.209")
AV	Aluminum / Vinyl Composite
AW	Aluminum-clad Wood
FG	Fiberglass
PA	ABS Plastic w/ All Members Reinforced
PC	ABS Plastic-clad Aluminum
PF	ABS Plastic w/ Foam-filled Insulation
PH	ABS Plastic w/ Horizontal Members Reinforced
PI	ABS Plastic w/ Reinforcement - Interlock
PL	ABS Plastic
PP	ABS Plastic w/ Reinforcement - Partial
PV	ABS Plastic w/ Vertical Members Reinforced
PW	ABS Plastic-clad Wood
ST	Steel
VA	Vinyl w/ All Members Reinforced
VC	Vinyl-clad Aluminum
VF	Vinyl w/ Foam-filled Insulation
VH	Vinyl w/ Horizontal Members Reinforced
VI	Vinyl w/ Reinforcement - Interlock
VP	Vinyl w/ Reinforcement - Partial
VV	Vinyl w/ Vertical Members Reinforced
VW	Vinyl-clad Wood
VY	Vinyl
WA	Aluminum / Wood composite
WD	Wood
WV	Vinyl / Wood composite
WF	Fiberglass/Wood Combination
WC	Composite/Wood Composite (Shaped vinyl/wood composite members)
CW	Copper Clad Wood
CO	Vinyl/Wood Composite Material

CODE	Spacer Types (See sealant)
A1	Aluminum
A2	Aluminum (Thermally-broken)
A3	Aluminum-reinforced Polymer
A4	Aluminum / Wood
A5	Aluminum-reinforced Butyl (Swiggle)
A6	Aluminum / Foam / Aluminum
A7	Aluminum U-shaped
A8	Aluminum-Butyl (Corrugated) (Duraseal)
ER	EPDM Reinforced Butyl
FG	Fiberglass
GL	Glass
OF	Organic Foam
P1	Duralite
PU	Polyurethane Foam
SU	Stainless Steel, U-shaped
CU	Coated Steel, U-shaped (Intercept)
S2	Steel (Thermally-broken)
S3	Steel / Foam / Steel
S5	Steel-reinforced Butyl
S6	Steel U-channel w/ Thermal Cap
SS	Stainless Steel
CS	Coated Steel
TP	Thermo-plastic
WD	Wood
ZE	Elastomeric Silicone Foam
ZF	Silicone Foam
ZS	Silicone / Steel
N	Not Applicable
TS	Thermo-plastic w/ stainless steel substrate

CODE	Tint Codes
AZ	Azurlite
BL	Blue
BZ	Bronze
CL	Clear
EV	Evergreen
GD	Gold
GR	Green
GY	Gray
LE	Low 'e' Coating
OT	Other (use comment field)
RC	Solar or Reflective Coating
RG	Roller Shades between glazing
RS	Silver (reflective coating)
SF	Suspended Polyester Film
SR	Silver
BG	Blinds between the Glazing
DV	Dynamic Glazing-Variable
DY	Dynamic Glazing-NonVariable

CODE	Gap Fill Codes
AIR	Air
AR2	Argon/Krypton Mixture
AR3	Argon / Krypton / Air
ARG	Argon/Air
CO2	Carbon Dioxide
KRY	Krypton/Air
SF6	Sulfur Hexaflouride
XE2	Xenon/Krypton/Air
XE3	Xenon/Argon/Air
XEN	Xenon/Air
N	Not Applicable

DOOR DETAILS	
N	Not Applicable
CODE	Door Type
EM	Embossed
FL	Flush
LF	Full Lite
LH	1/2 - Lite
LQ	1/4 - Lite
LT	3/4 - Lite
RP	Raised Panel
CODE	Skin
AL	Aluminum
FG	Fiberglass
GS	Galvanized Steel
ST	Steel
WD	Wood
VY	Vinyl
CODE	Panel
FG	Fiberglass
PL	Plastic
WP	Wood - Plywood
WS	Wood - Solid
CODE	Sub-Structure
GS	Galvanized Steel
ST	Steel
WD	Wood
VY	Vinyl
CODE	Core Fill
CH	Cellular - Honeycomb
EP	Expanded Polystyrene
PI	Polyisocyanurate
PU	Polyurethane
WP	Wood - Plywood
WS	Wood - Solid
XP	Extruded Polystyrene

CODE	Spacer Sealant
D	Dual Seal Spacer System
S	Single Seal Spacer System

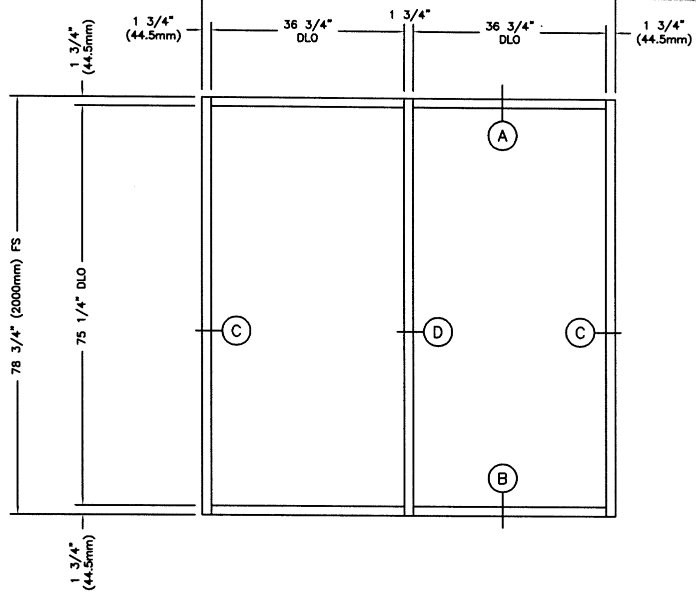
CODE	Grid Description
N	No Muntins
G	Grids between glass
S	Simulated Divided Lites
T	True Muntins

CODE	Grid Size Codes
	Blank for no grids
0.75	Grids < 1"
1.5	Grids >= 1"

CODE	Thermal Breaks
F	Foam
U	Urethane
V	Vinyl
FB	Fiberglass
O	Other
AB	ABS
NE	Neoprene
AI	Air
N	Not Applicable
P	Polyamide

Appendix B: Drawings

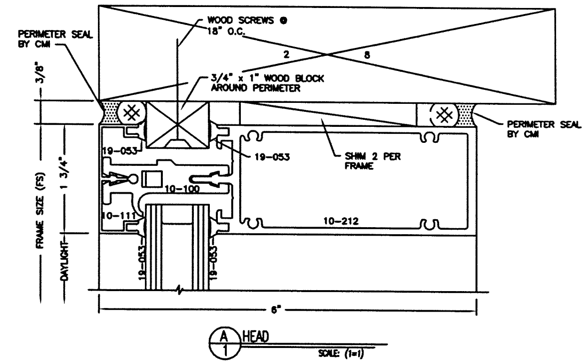
Architectural Testing
Test sample complies with these details.
Deviations are noted.
Report# A2259
Date 6/29/10
Tech

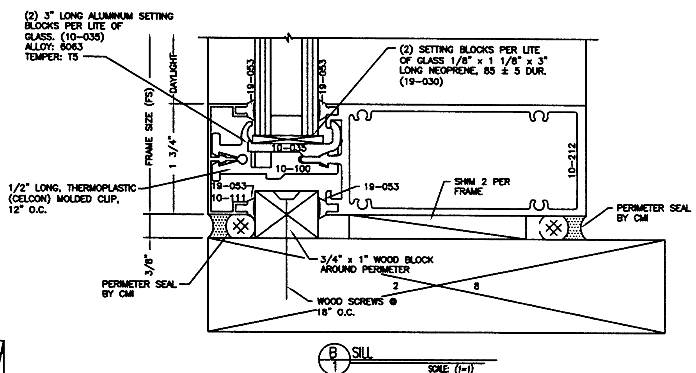


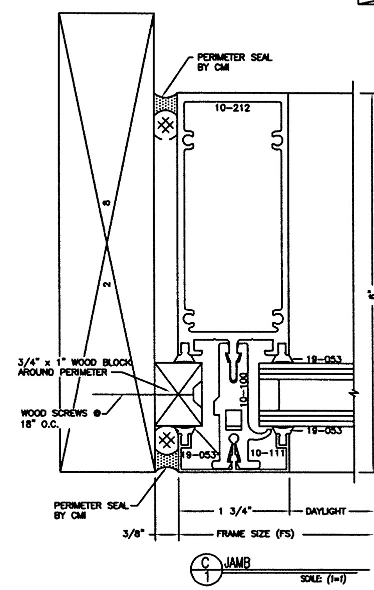
1 3/4"x6" CTS THERMAL TEST — 1" GLAZING

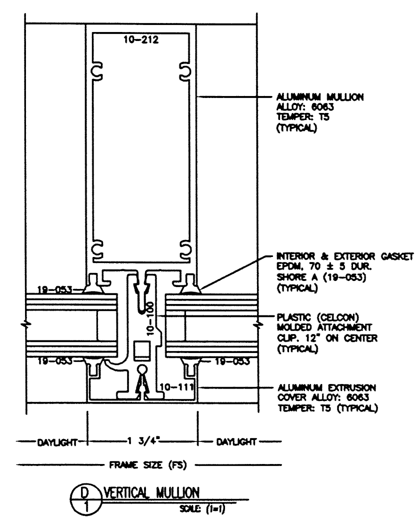
1 THUS
CTS (1 3/4" x 6")

SCALE: 1/2"=1'-0"









GLASS TYPE:

CLEAR 1" INSULATED GLASS UNITS
1/4" CLEAR WITH PPG SOLARBAN 60 SOLAR CONTROL LOW-E #2 ANNEALED
1/2" AIRSPACE – TECHNOFORM I-SPACER WARM EDGE SPACER / 90% ARGON FILLED
1/4" CLEAR ANNEALED

GLASS SIZE = 2 PIECES 37 3/4" x 76 1/4"

TESTING PARAMETERS:

AAMA 1503-09 VOLUNTARY TEST METHOD FOR THERMAL TRANSMITTANCE AND CONDENSATION RESISTANCE OF WINDOWS, DOORS AND GLAZED CURTAIN WALL SECTIONS.

NFRC 102-2010 PROCEDURE FOR MEASURING THE STEADY STATE THERMAL TRANSMITTANCE OF FENESTRATION SYSTEMS.

AAMA 507-03 STANDARD PRACTICE FOR DETERMINING THE THERMAL PERFORMANCE CHARACTERISTICS OF FENESTRATION SYSTEMS INSTALLED IN COMMERCIAL BUILDING.

- STANDARD AAMA 507 INSULATED GLASS UNIT COMPOSITION WITH ALUMINUM SPACER.

NOTES:

FACTORY INSTALL FRAME IN WOOD BUCK PERIMETER

FACTORY INSTALL GLAZING

FACTORY INSTALL EXTERIOR AND INTERIOR PERIMETER CAULK SEAL TO WOOD BUCK PERIMETER

FACTORY INSTALL TEMPORARY DIAGONAL WOOD BRACING FOR SHIPPING PROTECTION.

CMI Architectural
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PROJECT: CMI THERMAL TEST
CTS THERMAL WINDOW TEST

ARCHITECT:

GLAZING CONTRACTOR:

REVISIONS		
REV	INT'L	DATE

DATE DRAWN: 2-23-10

DRAWN BY: BEW | SOLD BY: PJL

PO#:

SCALE: AS NOTED

PROJECT MGR.

CMI S.O.#

SHEET: 1