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PERFORMANCE EVALUATION OF THE CARTER ARCHITECTURAL PANELS INC., "EVO™ RIVETLESS™ PANEL SYSTEM" WALL ASSEMBLY FOR AIR INFILTRATION, WATER PENETRATION AND STRUCTURAL PERFORMANCE

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Report No.:	16-06-M0171-1DR 9 Pages, 2 Appendices
Proposal No.:	16-006-438721
Date:	July 3, 2016

1.0 INTRODUCTION

At the request of Carter Architectural Panels Inc., Exova was retained to evaluate an exterior panel system identified as the "EVO™ RIVETLESS™ Panel System" in accordance with ASTM E283, E331 and E330 as defined in Proposal Number 16-006-438721.

The wall assembly was assigned the following Exova Specimen Number:

Client Specimen Description	**Exova Specimen No.**
EVO™ RIVETLESS™ Panel System	15-06-M0134

*Note: The ACM used in the "*EVO™ RIVETLESS™ Panel System*" by Carter Architectural Panel Inc., is "larson by ALUCOIL." A complete bill-of-materials and details for the specimen identified above is located in Appendix A.*

Test Backup Wall Description:

8 ft. x 8ft Opaque wall comprising of one vertical sheathing joint (with joint sealed)
Frame Construction: *6" Steel Z-Bar (vertical), 16 ga / 16" O/C*
2" Steel Z Bar (horizontal), 16 ga / 16" O/C
Sheathing: *1/4" thick Plexiglas (simulating exterior gypsum sheathing with installed air-tight air barrier / water resistive barrier). Note: Clear Plexiglas (simulated sheathing panels) were required for the observation of water penetration (ASTM E331).*

2.0 PROCEDURE

Test Method	Test Description
ASTM E283-04 (2012)	Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E331-02 (2009)	Water Penetration of Exterior Windows, Skylights, Doors and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E330-14 (2014)	Standard Test Method for Structural Performance of Exterior Windows, Skylights, Doors and Curtain Walls by Uniform Static Air Pressure Difference (Modified)

Note: SI units are the primary units of measure.

Configuration No. 1:

The assembly was tested with an uncompromised simulated air-tight air / water resistive barrier on sheathing *(Plexiglas sheathing intact / as delivered to Exova)*. The air-tight Plexiglas substrate was employed to simulate an air / water resistive barrier sheathing membrane in conjunction with the rainscreen system attached through the Plexiglas to the interior supporting studs.

Configuration No. 2:

The assembly was tested with a compromised air / water resistive barrier (simulation of a poorly installed air / water resistive barrier by drilling 1/8" diameter holes through the Plexiglas) in accordance with AAMA 508-14 to induce an air leakage of 0.6 L/s.m^2 @ 75 Pa through the Plexiglas sheathing.

3.0 RESULTS

Table No. 1 - Summarized Air Leakage Results Configuration 1 – ASTM E283-04 (2012) Exova Specimen No.: 15-06-M0134 *(Test Date: June 2, 2015)*	
Test Pressure Differential (Pa)	**Infiltration**
75 Pa (1.57 *lbs./ft²*)	0.05 L/s m² (0.01 CFM/ft²)
300 Pa *(6.24 lbs./ft²*)	0.05 L/s m² (0.01 CFM/ft²)

Table No. 2 - Summarized Water Penetration Resistance Results Configuration 1 – ASTM E331-02 (2009) Exova Specimen No.: 15-06-M0134 *(Test Date: June 2 to 3, 2015)*		
Test Pressure Differential (Pa)	**Test Period (Minutes)**	**Observations**
957 *(20 lbs./ft²*)	15	No water penetration was observed or droplets present on simulated exterior sheathing

Table No. 3 - Summarized Air Leakage Results Configuration 2 – ASTM E283-04 (2012) Exova Specimen No.: 15-06-M0134 *(Test Date: June 2, 2015)*	
Test Pressure Differential (Pa)	**Infiltration[(1)]**
75 Pa (1.57 *lbs./ft²*)	0.66 L/s m² (0.13 CFM/ft²)

(1) Forty-eight (48) 3 mm diameter holes were drilled through the Plexiglas substrate, equally spaced, 6" above the drainage tracks. These penetrations were employed to simulate an air / water resistive barrier sheathing membrane imperfections in general accordance with AAMA 508-14, Section 5.2.2.

Table No. 4 - Summarized Water Penetration Resistance Results Configuration 2 – ASTM E331-02 (2012) Exova Specimen No.: 15-06-M0134 *(Test Date: June 2 to 3, 2015)*			
Test Pressure Differential (Pa)	**Test Period (Minutes)**	**Observations**	**Comments**
137 *(2.86 lbs./ft²)*	15	No water penetration was observed or droplets present on simulated exterior sheathing	**No Comment**
300 *(6.24 lbs./ft²)*	15	0.78 % of air/water barrier surface area had water misting and / or water droplets. All water that penetrated the exterior rain screen cladding was controlled and drained to the exterior with no continuous streaming observed	**Meets Requirement[(2)]**

[(2)] **AAMA 508-14, Section 5.7 Water Penetration Requirements**:

All water that penetrates the exterior rain screen cladding shall be controlled and drained to the exterior. All water that contacts the air / water barrier shall be visually observed and recorded:

a) Water mist or droplets on the air/water barrier surface; and/or
b) Water in continuous stream on the air/water barrier surface.

Failure shall be defined as water mist or water droplets appearing in excess of 5% of the air/water barrier surface, or continuous streaming at any location on the air/water barrier.

Table No. 5 - Summarized Structural Results, Positive Wind Load Direction Configuration 2 – ASTM E330/E330M-14 – SI & IP Units Exova Specimen No.: 15-06-M0134 *(Test Date: June 3, 2015)*				
Pressure (Pa)	**Gauge No. and Deflection**			
	1	**2**	**3**	**Net Deflection**
3,591 Pa (1) (75.0 lbs. /ft²)	-1.4 mm *(-0.057 inches)*	-6.5 mm *(-0.257 inches)*	-1.3 mm *(-0.049 inches)*	-5.2 mm *(-0.204 inches)*
Residual Deflection	-1.6 mm *(-0.063 inches)*	-0.3 mm *(-0.012 inches)*	-0.2 mm *(-0.008 inches)*	-0.6 mm *(0.024 inches)*

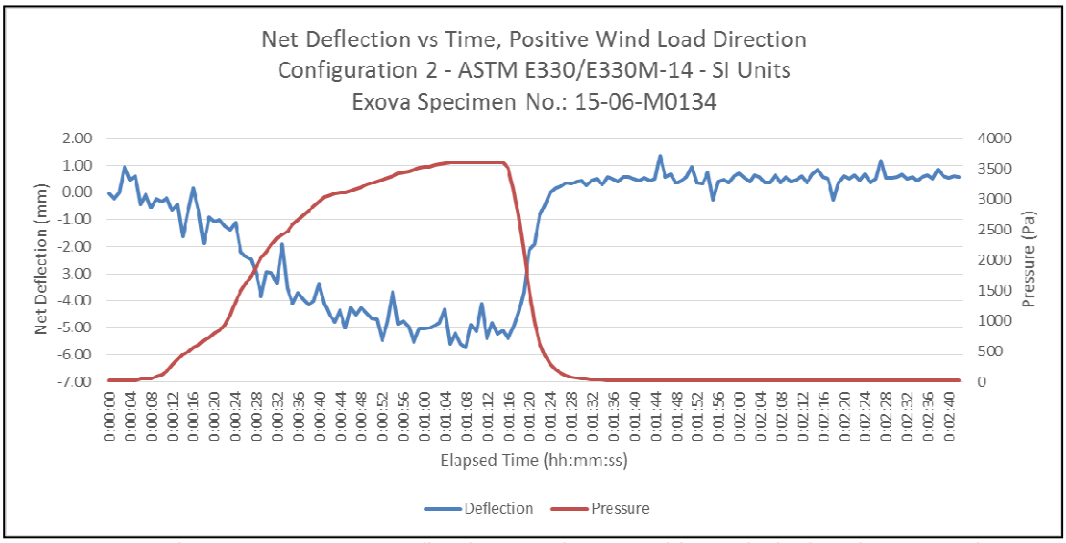

Figure No. 1 – Net Deflection vs Time, Positive Wind Direction, SI Units

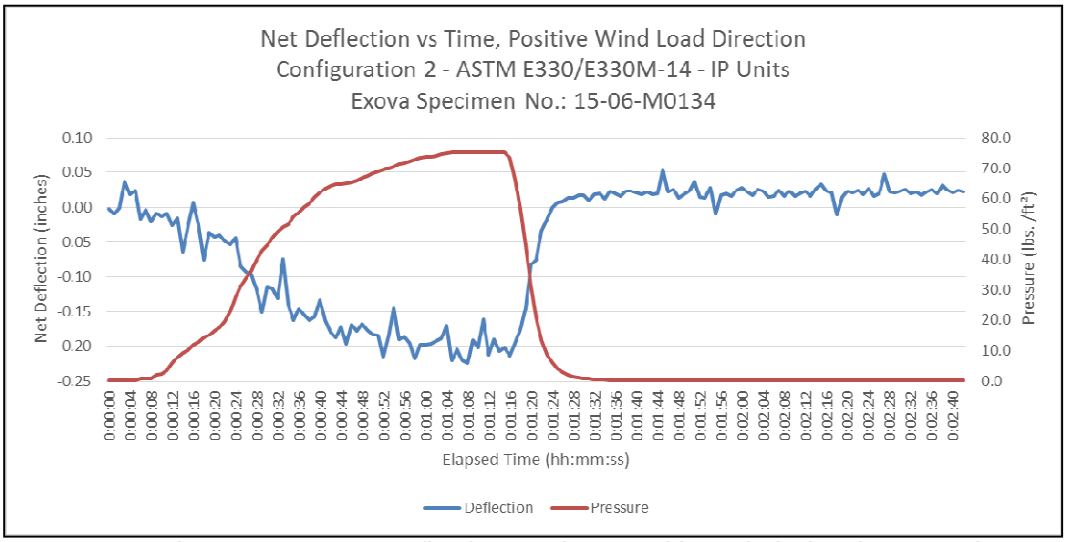

Figure No. 2 – Net Deflection vs Time, Positive Wind Direction, IP Units

Table No. 6 - Summarized Structural Results, Negative Wind Load Direction Configuration 2 – ASTM E330/E330M-14 – SI & IP Units Exova Specimen No.: 15-06-M0134 *(Test Date: June 3, 2015)*				
Pressure (Pa)	**Gauge No. and Deflection**			
	1	**2**	**3**	**Net Deflection**
3,591 Pa (1) (75.0 lbs. /ft²)	-0.1 mm *(-0.003 inches)*	7.1 mm *(0.281 inches)*	1.3 mm *(0.050 inches)*	6.6 mm *(0.258 inches)*
Residual Deflection	-0.1 mm *(-0.006 inches)*	0.3 mm *(0.014 inches)*	0.1 mm *(0.004 inches)*	0.4 mm *(0.015 inches)*

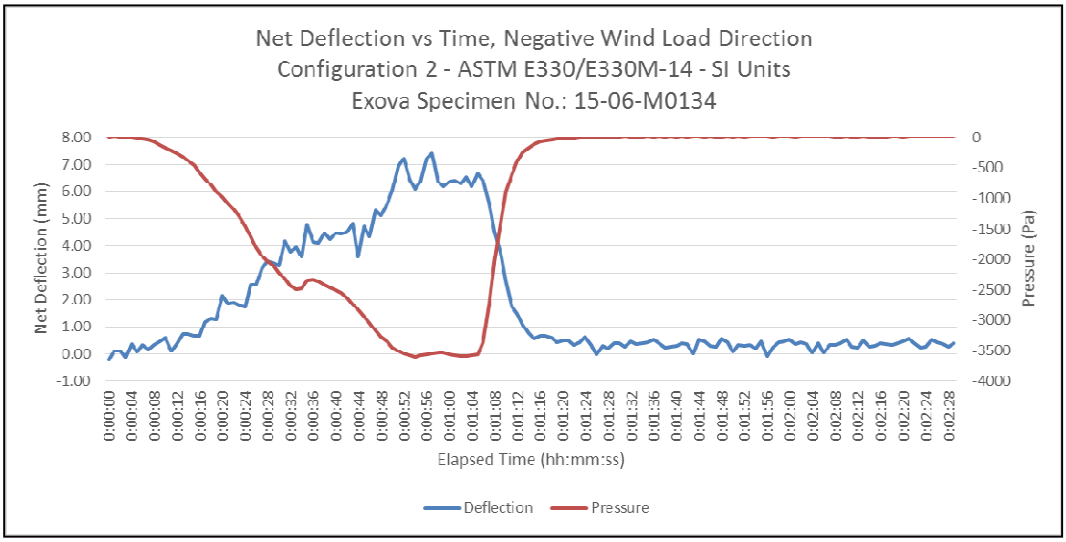

Figure No. 3 – Net Deflection vs Time, Negative Wind Direction, SI Units

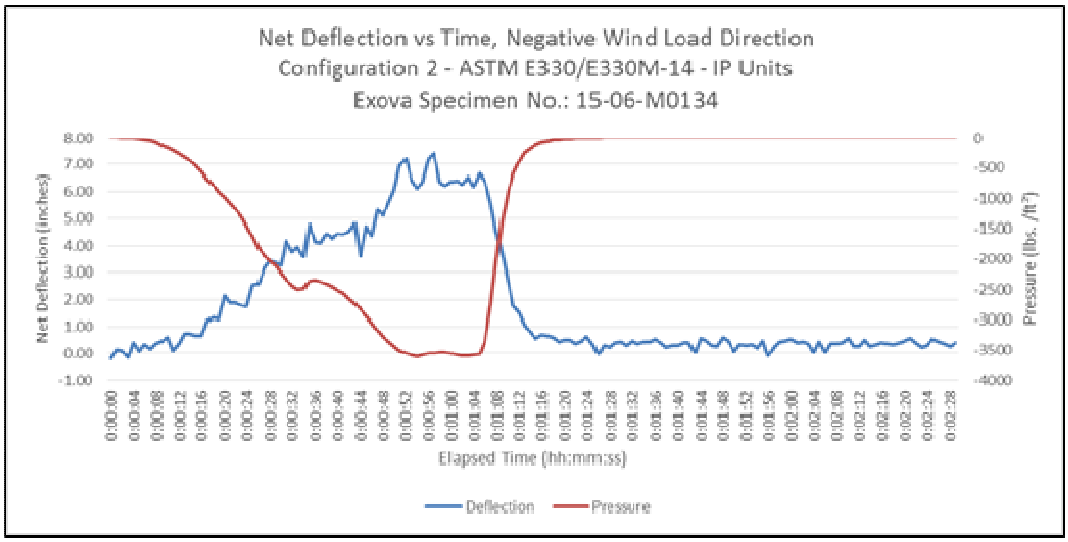

Figure No. 4 – Net Deflection vs Time, Negative Wind Direction, IP Units

Note: The default deflection limit of the support framing was restricted to L/180 referencing AAMA 508 Section 5.1.2

Positive Loading Net Deflection Design Load: (+3591 Pa) = 5.2 mm < *13.6 mm Requirement*
Negative Loading Net Deflection Design Load (-3591 Pa) = 6.6 mm < *13.6 mm Requirement*

Positive Loading Net Deflection Design Load: (+75.0 lbs. /ft²) = 0.204 inches < *0.536 Inch Requirement*
Negative Loading Net Deflection Design Load (-75.0 lbs. /ft²) = 0.258 inches < *0.536 Inch Requirement*

(1) 3,591 Pa = 76.5 m/s (or 171 mph / 275 km/h).
Calculation based on the Ensewiler formula, where $P = 0.613 \cdot V^2$, V is m/s & P is N/m²

Note: Deflection measurement (gauge) locations employed during structural loading are shown below.

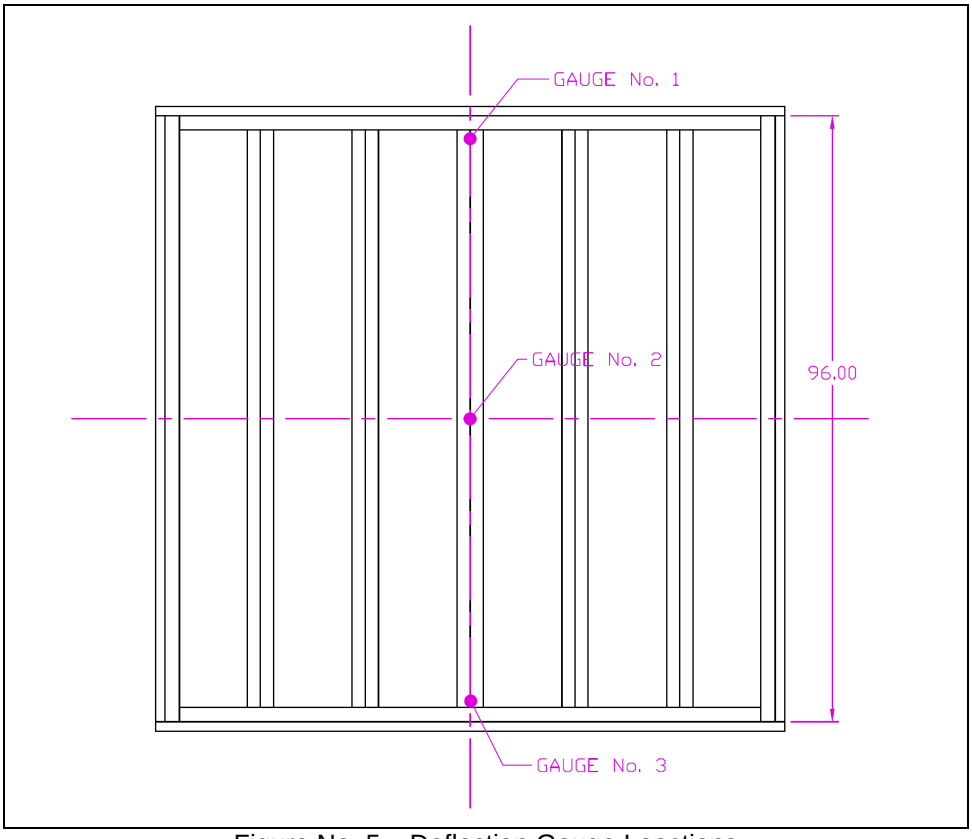

Figure No. 5 – Deflection Gauge Loactions

Table No. 7 - Summarized Structural Results Test to Failure in the Negative Wind Load Direction Configuration 2 – ASTM E330 – SI & IP Units Exova Specimen No.: 15-06-M0134 *(Test Date: June 3, 2015)*	
Maximum Pressure Achieved	**Comments**
13,325 Pa[(2)]	Cladding System did not disengage from wall assembly. However, vertical supporting steel studs buckled in the center
278 lbs. /ft²	

[(2)] 13,325 Pa = 147.4 m/s (or 330 mph / 531 km/h).
Calculation based on the Ensewiler formula, where $P = 0.613 \cdot V^2$, V is m/s & P is N/m²

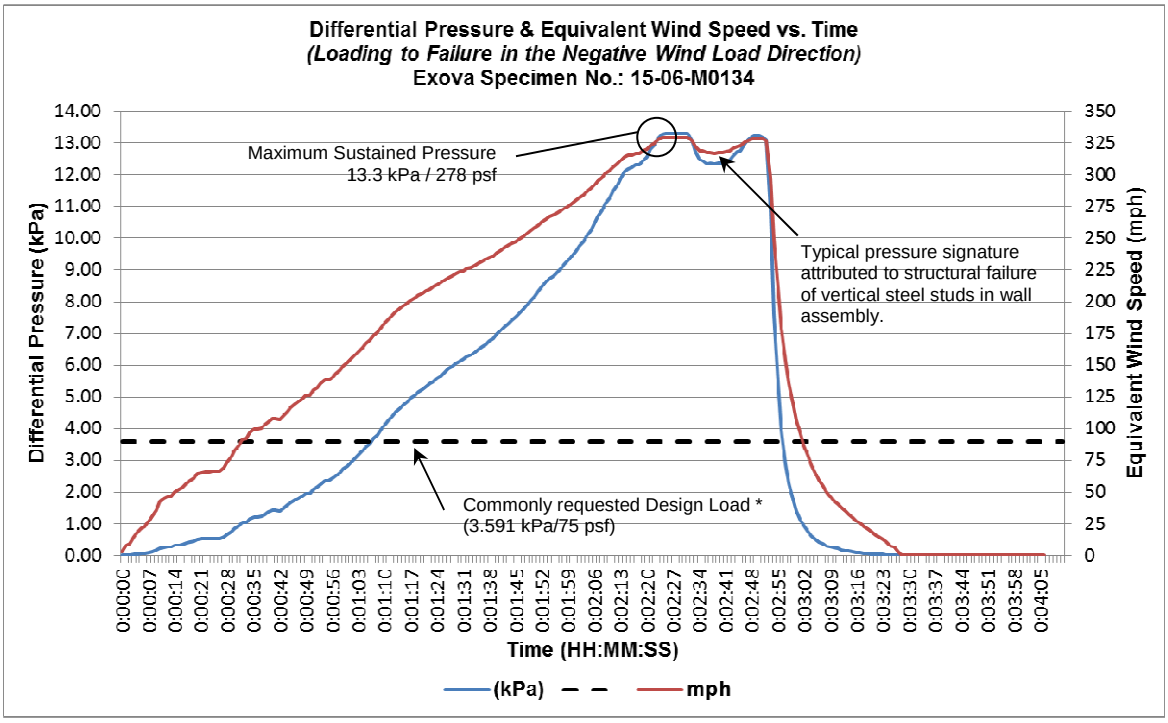

Figure No. 6 – Load to Failure vs. Time, Negative Wind Direction, IP Units

*Note: Design loads are building and location specific. Please refer to architect or design engineer for specific building load requirements.

4.0 SYSTEM MODIFICATIONS

No modifications were made to the system as shown respectively in Appendix A.

5.0 CONCLUSION

The Carter Architectural Panels Inc. exterior panel system identified as the "EVO™ RIVETLESS™ Panel System" as detailed in this report was tested in accordance ASTM E283-04(2012), ASTM E331-00(2009) and ASTM E330-14 and achieved the following:

- Air Infiltration: 0.05 L/s m^2 (0.01 CFM/ft^2) @ 75 Pa (1.57 lbs/ft^2)
  0.05 L/s m^2 (0.01 CFM/ft^2) @ 300 Pa (6.24 lbs/ft^2)
- Water Penetration Configuration No. 1: 957 Pa (20 lbs. /ft^2)
  Configuration No. 2: 300 Pa (6.24 lbs. /ft^2)
- Structural- Performance: 3,591 Pa (75.0 lbs. /ft^2) – Specified Design Load
  13,325 Pa[(3)] (278 lbs. /ft^2) – Maximum Pressure Achieved
  (Equivalent to 330 mph / 531 km/h based on Ensewiler formula)

[(3)] Cladding system did not disengage from the wall assembly. The "EVO™ RIVETLESS™ Panel System" did not fail at 13,325 Pa, whereas, the vertical steel studs behind the wall assembly buckled in the center, thereby, concluding the test procedure.

Note: This report is reissued in the name of Carter Architectural Panels Inc., through written authorization from Carter Fabricating Inc. to whom the original report was rendered. The original tested specimen was manufactured and assembled by Carter Fabricating Inc. as outlined in Exova Report No.: 15-06-M0134, Revision 2 (dated: 2016 March 26).

6.0 REPORT REVISION HISTORY

Date:	**Revision:**	**Comments:**
2016-July-3	Original Document	N/A

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APPENDIX A

Specimen Bill or Materials and Detailed Drawing as Provided by Carter Architectural Panels Inc.

(3 Pages)

EXOVA

Bill of Materials

- 4 "EVO™" RIVETLESS™ PANELS (PANEL SIZE 47" x 47")
- EACH PANEL CONSISTED OF 4MM LARSON ACM
- #8 SELF DRILLING SCREWS ON 16" CENTERS USED TO FASTEN THE PERIMETER PANEL EXTRUSION TO THE 4MM ACM.
- WEEP HOLES @ .375" DIAMETER ON 24" CENTERS WITH FOAM BUG SCREEN BACKING
- CUSTOM DIE PERIMETER EXTRUSION AROUND THE PERIMETER OF EACH OF THE 4 ACM PANELS (6063-T6 ALUMINUM CUSTOM PROFILE)
- MID CLIPS (MOUNTING CLIPS 6063-T6 ALUMINUM CUSTOM DIE PROILE) EACH MOUNTED TO THE PERIMETER EXTRUSION ON 16" CENTERS, AND AFFIXED TO THE SUBSTRATE OR Z-GIRT (18 GA G-90 GALVANIZED STEEL) USING .25" SELF DRILLING PAN HEAD SCREWS.
- WIDE FILLER STRIP MATERIAL (4MM ACM) USED TO COVER THE PANEL JOINTS, CUT AS REQUIRED.
- EXTRUDED ALUMINUM STARTER STRIP (6063-T6 ALUMINUM CUSTOM PROFILE) INSTALLED AT THE BASE OF THE WALL CONSTRUCTION.

Note: The ACM used in the "EVO™ RIVETLESS™ Wall Panel System" is "larson by ALUCOIL" manufactured in Manning, South Carolina, USA. The larson® Aluminum Composite Material (ACM) utilized is a fully tested and certified, architectural wall cladding material available in both polyethylene (PE) and fire retardant (FR) core panels.

Specimen detail drawings have been removed from this page to protect proprietary information.
Please contact the original report recipient for information pertaining to system details and assembly.

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APPENDIX B

Photographs

(1 Page)

Figure B1 – Test Specimen (Exterior View)

Figure B2 – Test Specimen (Interior View)