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**PERFORMANCE EVALUATION OF THE CARTER ARCHITECTURAL PANELS INC.
“FUSION™ DRILLFREE™ PANEL SYSTEM” WALL ASSEMBLY
FOR AIR INFILTRATION, WATER PENETRATION AND STRUCTURAL PERFORMANCE**

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Report No.:	16-06-M0159 9 Pages, 2 Appendices
Proposal No.:	16-006-428466 Revision 1
Date:	June 30, 2016

1.0 INTRODUCTION

At the request of Carter Architectural Panels Inc., Exova was retained to evaluate an exterior panel system identified as the "FUSION™ DRILLFREE™ Panel System" in accordance with ASTM E283, E331 and E330 as defined in Proposal Number 16-006-428466 Revision 1.

The wall assembly was assigned the following Exova Specimen Number:

<u>Client Specimen Description</u>	<u>Exova Specimen No.</u>
FUSION™ DRILLFREE™ Panel System	16-06-M0159

Note: The ACM used in the "FUSION™ DRILLFREE™ Panel System" by Carter Architectural Panel Inc., is "Iarson 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 8 ft 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.m² @ 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.: 16-06-M0159 (Test Date: June 22, 2016)		
Test Pressure Differential (Pa)	Infiltration	Exfiltration
75 Pa (1.57 lbs./ft ²)	0.09 L/s m ² (0.02 CFM/ft ²)	0.09 L/s m ² (0.02 CFM/ft ²)
300 Pa (6.24 lbs./ft ²)	0.16 L/s m ² (0.03 CFM/ft ²)	0.15 L/s m ² (0.03 CFM/ft ²)

Table No. 2 - Summarized Water Penetration Resistance Results Configuration 1 – ASTM E331-02 (2009) Exova Specimen No.: 16-06-M0159 (Test Date: June 22, 2016)		
Test Pressure Differential (Pa)	Test Period (Minutes)	Observations
957 (20 lbs./ft ²)	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.: 16-06-M0159 (Test Date: June 22, 2016)	
Test Pressure Differential (Pa)	Infiltration ⁽¹⁾
75 Pa (1.57 lbs./ft ²)	0.64 L/s m ² (0.13 CFM/ft ²)

⁽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.: 16-06-M0159 (Test Date: June 22, 2016)			
Test Pressure Differential (Pa)	Test Period (Minutes)	Observations	Comments
137 <i>(2.86 lbs./ft²)</i>	15	No water penetration was observed or droplets present on simulated exterior sheathing	No Comment
300 <i>(6.24 lbs./ft²)</i>	15	1.83 % 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.: 16-06-M0159 (Test Date: June 23, 2016)				
Pressure (Pa)	Gauge No. and Deflection			
	1	2	3	Net Deflection
3,591 Pa ⁽¹⁾ (75.0 lbs./ft ²)	-1.5 mm (-0.059 inches)	-8.5 mm (-0.333 inches)	-2.0 mm (-0.080 inches)	-6.7 mm (-0.263 inches)
Residual Deflection	-0.1 mm (-0.003 inches)	-0.8 mm (-0.033 inches)	-0.2 mm (-0.007 inches)	-0.8 mm (-0.031 inches)

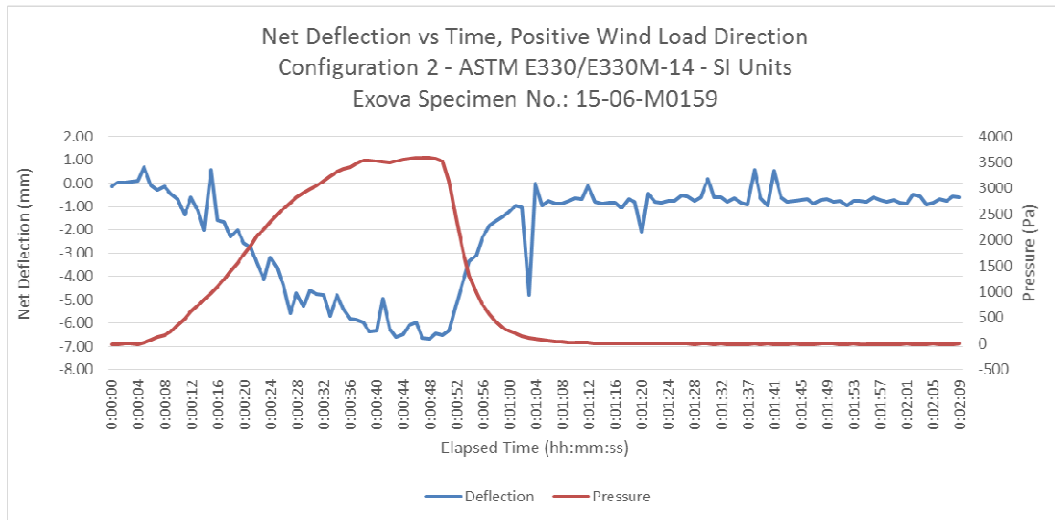


Figure No. 1 – Net Deflection vs Time, Positive Wind Direction, SI Units

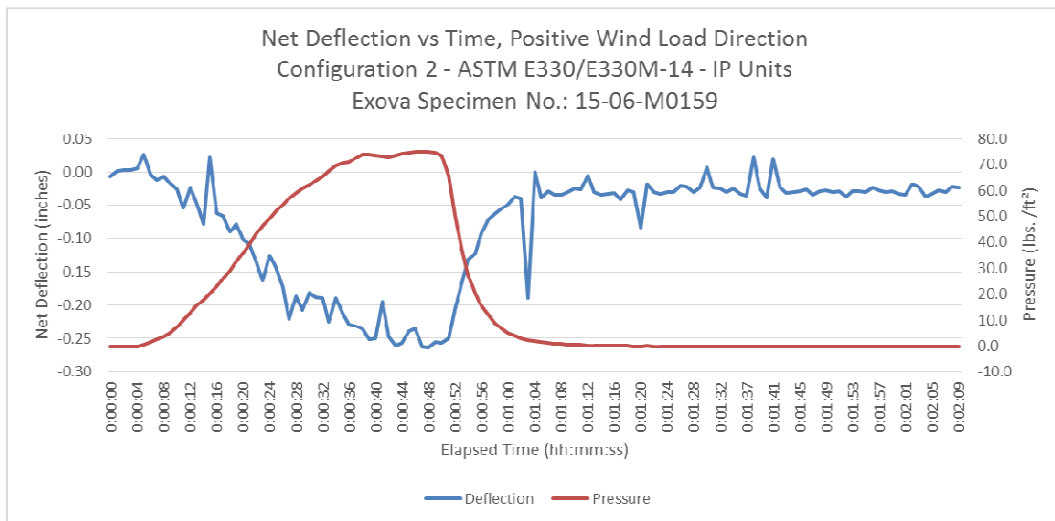


Figure No. 2 – Net Deflection vs Time, Positive Wind Direction, IP Units

Table No. 6 - Summarized Structural Results, Negative Wind Load Direction Configuration 2 – ASTM E330/E330M-14 – SI & IP Units Exova Specimen No.: 16-06-M0159 (Test Date: June 23, 2016)				
Pressure (Pa)	Gauge No. and Deflection			
	1	2	3	Net Deflection
3,591 Pa ⁽¹⁾ (75.0 lbs./ft ²)	1.0 mm (0.041 inches)	7.7 mm (0.302 inches)	2.4 mm (0.095 inches)	6.0 mm (0.234 inches)
Residual Deflection	0.1 mm (0.004 inches)	1.6 mm (0.006 inches)	0.3 mm (0.011 inches)	1.4 mm (0.056 inches)

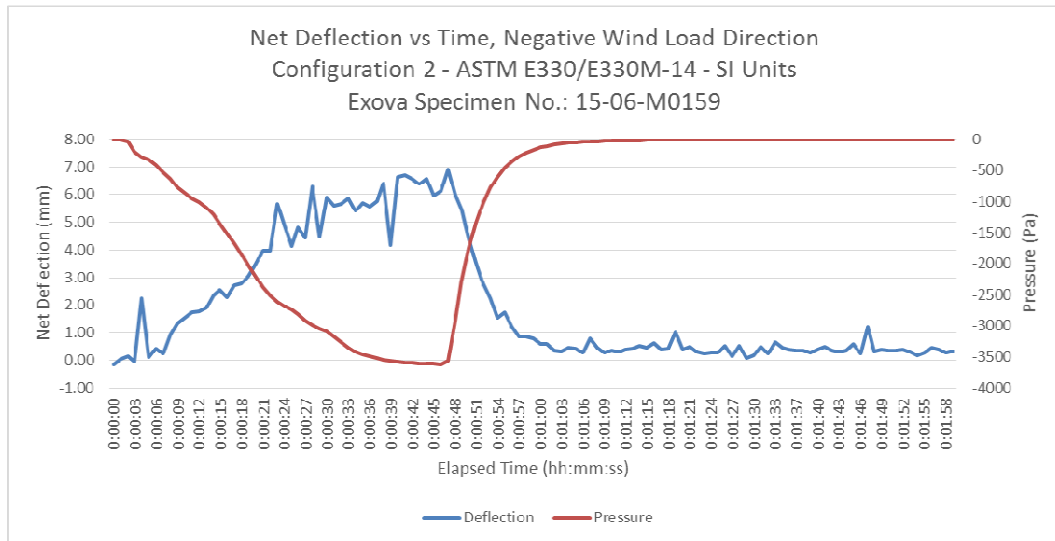


Figure No. 3 – Net Deflection vs Time, Negative Wind Direction, SI Units

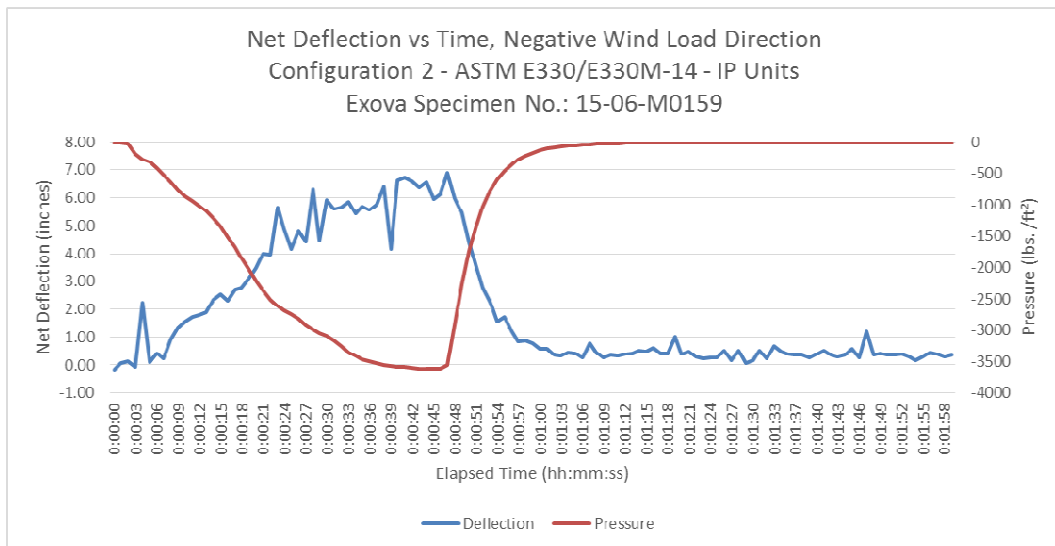


Figure No. 4 – Net Deflection vs Time, Negative Wind Direction, IP Units

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) = 6.7 mm < 13.6 mm Requirement
Negative Loading Net Deflection Design Load (-3591 Pa) = 6.0 mm < 13.6 mm Requirement

Positive Loading Net Deflection Design Load: (+75.0 lbs. /ft²) = 0.263 inches < 0.536 Inch Requirement
Negative Loading Net Deflection Design Load (-75.0 lbs. /ft²) = 0.234 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.

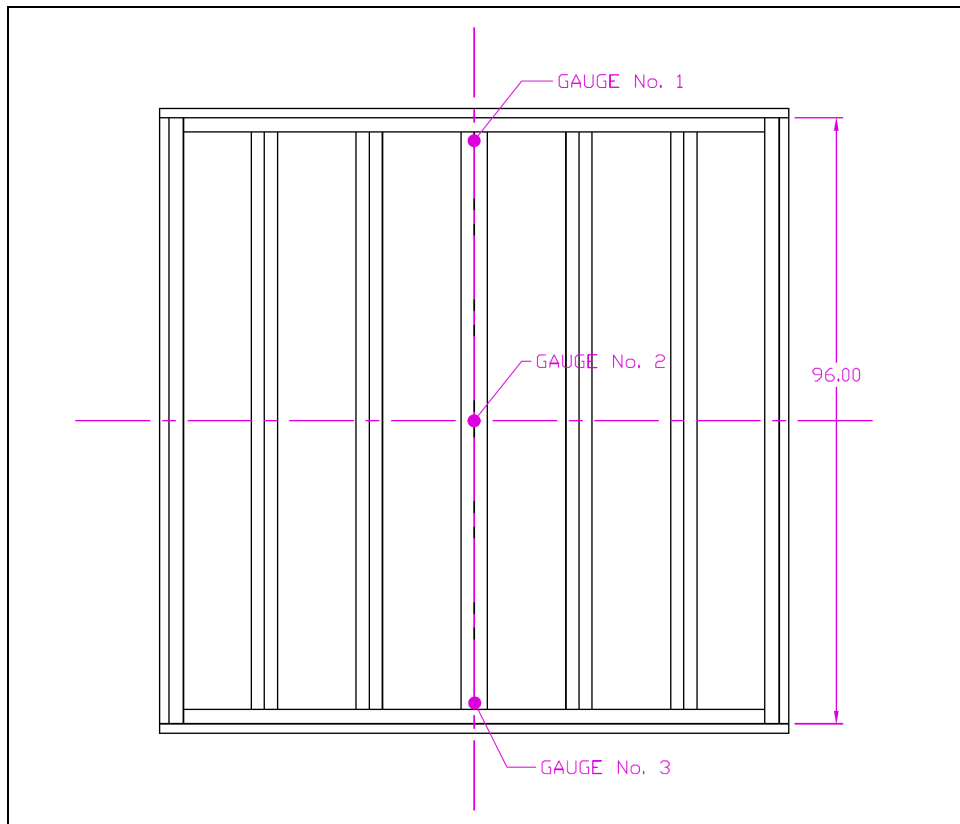


Figure No. 5 – Deflection Gauge Locations

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-M0159 (Test Date: June 24, 2016)	
Maximum Pressure Achieved	Comments
8,260 Pa ⁽²⁾	Cladding System did not disengage from wall assembly. However, vertical supporting steel studs buckled in the center
172.5 lbs. /ft ²	

⁽²⁾ 8,260 Pa = 116.1 m/s (or 260 mph / 418 km/h).
Load Calculation based on the Enswiler formula, where $P = 0.613 \cdot V^2$, V is m/s & P is N/m²

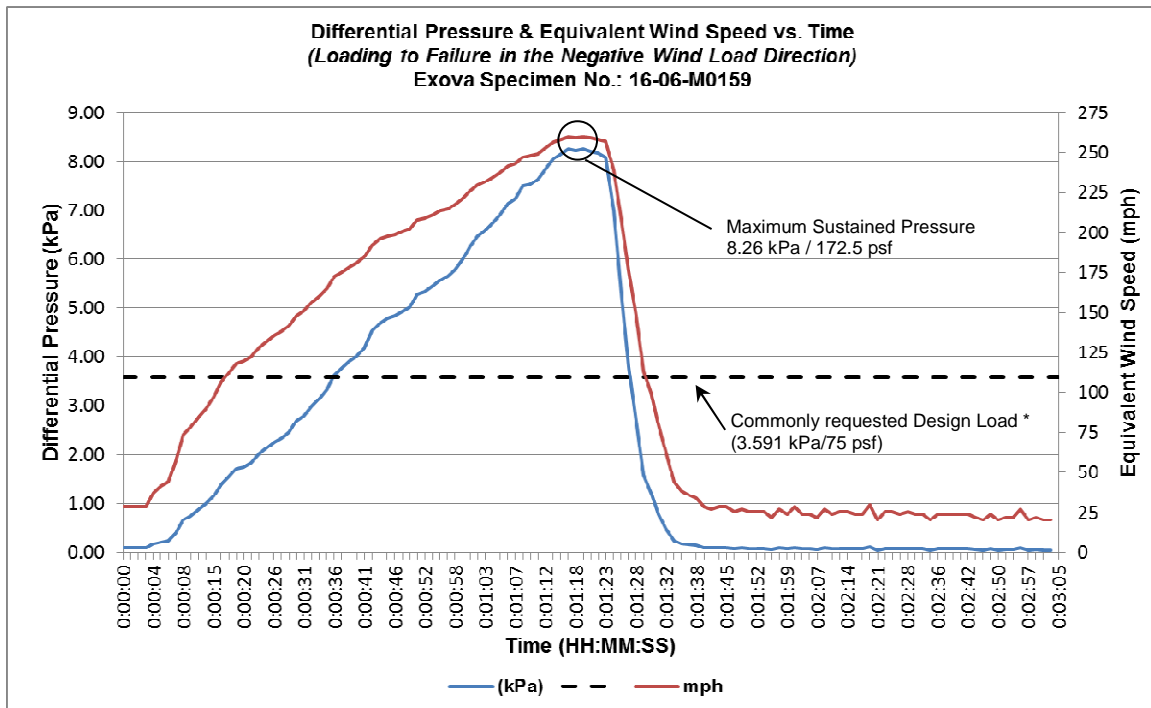


Figure No. 6 – Differential Pressure & Equivalent Wind Speed vs. Time (during testing to failure)

*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 "FUSION™ DRILLFREE™ 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 m² (0.01 CFM/ft²) @ 75 Pa (1.57 lbs/ft²)
0.05 L/s m² (0.01 CFM/ft²) @ 300 Pa (6.24 lbs/ft²)
- Water Penetration Configuration No. 1: 957 Pa (20 lbs. /ft²)
Configuration No. 2: 300 Pa (6.24 lbs. /ft²)
- Structural-Performance: 3,591 Pa (75.0 lbs. /ft²) – Specified Design Load
8,260 Pa⁽³⁾ (172.5 lbs. /ft²) – Maximum Pressure Achieved
(Equivalent to 260 mph / 418 km/h based on Enswiler formula)

⁽³⁾ Cladding system did not disengage from the wall assembly. The "FUSION™ DRILLFREE™ Panel System" did not fail at 8,260 Pa, whereas, the vertical steel studs behind the wall assembly buckled in the center, thereby, concluding the test procedure.

6.0 REVISION HISTORY

<u>Date:</u>	<u>Revision:</u>	<u>Comments:</u>
2016-06-30	Original Document	N/A

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APPENDIX A

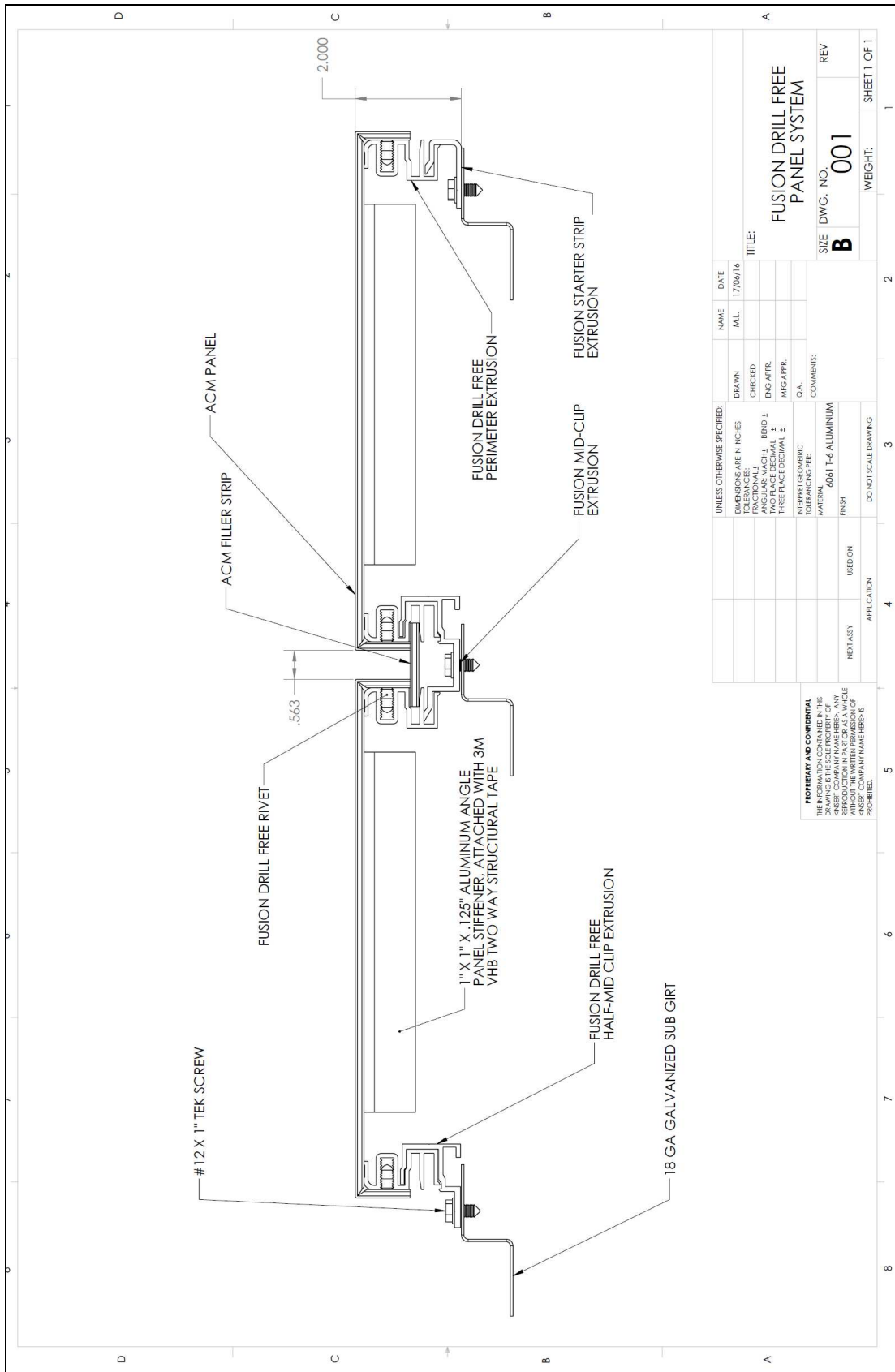
Specimen Bill or Materials and Detailed Drawing as Provided by Carter Architectural Panels Inc.

(2 Pages)

Bill of Materials

- 4 panels each 48" x 48"
- Each panel constructed with 4mm Larson ACM
- Rivets placed on maximum center distance of 16" between rivets.
- 3 weep holes per panel at .375" diameter with foam bug screen backing.
- All aluminum extrusion components are 6061 T-6 Aluminum, custom profiles
- Each panel perimeter is attached by Fusion Drill Free 3/16" rivets to Custom Fusion Drill Free perimeter extrusion (continuous around panel)
- 3" Long Mid-Clip Extrusion (Custom extruded Profile) located on 16" centers attached to panel perimeter extrusion and screwed to 18 GA galvanized sub-girts (G-90) with a 1" TEK screw.
- 2" Wide filler strip (4mm Larson ACM) used to cover the panel to panel joints
- Starter strip used on base of wall assembly.
- 3" Long Half Mid clips (custom extruded profile) used at top on termination condition to attach the panel to the galvanized sub girt.

Note: The ACM used in the "FUSION™ DRILLFREE™ Panel System" by Carter Architectural Panels Inc., 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.



UNLESS OTHERWISE SPECIFIED:		NAME	DATE
DIMENSIONS ARE IN INCHES	DRAWN	M.L.	17/06/16
FRACTIONAL TOLERANCES:	CHECKED		
FRACTIONAL 1/16" .0015" .0030" .0045" .0075" .0150" .0300" .0600" .1200"	ENG APPR.		
TWO PLACE DECIMAL .01 .03 .06 .12 .25 .50 .75 .150 .300 .450 .600 .900 1.200	MFG APPR.		
THREE PLACE DECIMAL .001 .003 .006 .012 .025 .050 .075 .112 .150 .225 .300 .450 .600 .900 1.200	Q.A.		
INTERFEROMETRIC TOLERANCING PER:	COMMENTS:		
MATERIAL	6061 T-6 ALUMINUM		
FINISH			
NEXT ASY	USED ON		
APPLICATION	DO NOT SCALE DRAWING		

TITLE:		FUSION DRILL FREE PANEL SYSTEM	
SIZE	DWG. NO.	REV	
B	001		
WEIGHT:		SHEET 1 OF 1	

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APPENDIX B

Photographs

(1 Page)

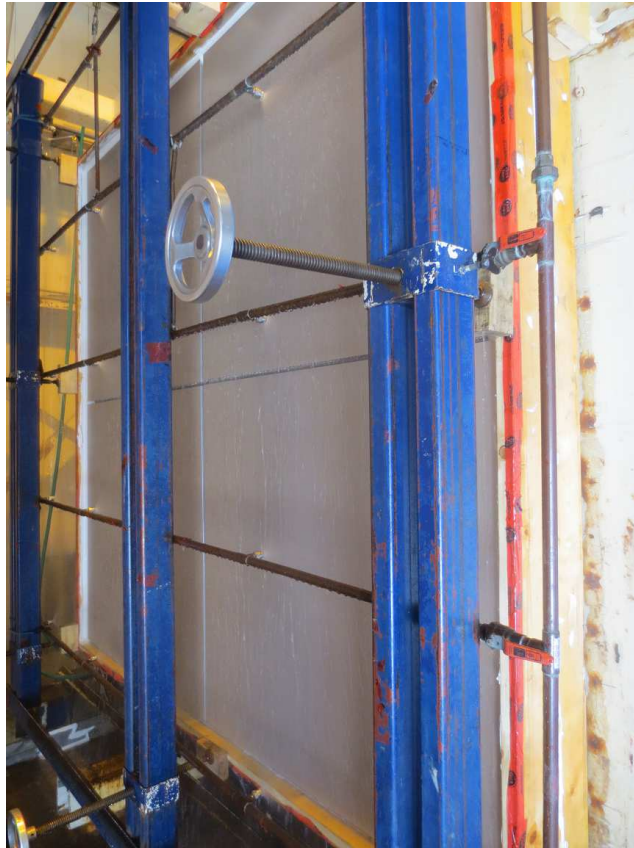


Figure B1 – Test Specimen (Exterior View)



Figure B2 – Test Specimen (Interior View)