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PERFORMANCE EVALUATION OF THE CARTER ARCHITECTURAL PANELS, INC. "FUSION™ DRILLFREE™ PANEL SYSTEM" IN ACCORDANCE WITH ASTM E283, E331, AND E330 FOR AIR INFILTRATION, WATER PENETRATION AND STRUCTURAL PERFORMANCE

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Report No.:	20-06-B0075-1 8 Pages, 2 Appendices
Proposal No.:	20-006-162693 RV1
Report Date:	July 31, 2020

1.0 INTRODUCTION

Element 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 20-006-162693 RV1.

The wall assembly was assigned the following Element Specimen Number:

Client Specimen Description	**Element Specimen No.**
FUSION™ DRILLFREE™ Panel System *("T" Panel Scheme / 3 panels, not individually pressure isolated)*	20-06-B0075-1

Note: The ACM used in the "FUSION™ DRILLFREE™ Panel System" by Carter Architectural Panels, Inc., is "etalbond® by ELVAL COLOUR." A complete bill-of-materials and details for the specimen identified above is located in Appendix A.

Test Backup Wall Description:

9.7 ft. x 9.7 ft Opaque wall comprising of two vertical sheathing joint (with joints sealed)

Frame Construction: *6" Steel studs (vertical), 18 ga / 16" O/C*
1.5" Steel bridging (horizontal), 18 ga at centre

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 Element)*. 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) Element Specimen No.: 20-06-B0075-1 *(Test Date: July 9, 2020)*		
Test Pressure Differential	**Infiltration**	**Exfiltration**
75 Pa *(1.57 lbs./ft²)*	0.001 L/s m² (0.0002 CFM/ft²)	0.002 L/s m² (0.0003 CFM/ft²)
300 Pa *(6.24 lbs./ft²)*	0.009 L/s m² (0.0017 CFM/ft²)	0.008 L/s m² (0.0015 CFM/ft²)

Table No. 2 - Summarized Air Leakage Results Configuration 2 – ASTM E283-04 (2012) Element Specimen No.: 20-06-B0075-1 *(Test Date: July 9, 2020)*	
Test Pressure Differential	**Infiltration(1)**
75 Pa (1.57 *lbs./ft²*)	0.61 L/s m² (0.12 CFM/ft²)

(1) Ninety-one (91) 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. 3 - Summarized Water Penetration Resistance Results Configuration 2 – ASTM E331-02 (2012) Element Specimen No.: 20-06-B0075-1 *(Test Date: July 10, 2020)*			
Test Pressure Differential	**Test Period**	**Observations**	**Comments**
137 Pa *(2.86 lbs./ft²)*	15 minutes	1.55 % 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)**
300 Pa *(6.27 lbs./ft²)*	15 minutes	2.80 % 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. 4 - Summarized Structural Results, Positive Wind Load Direction Configuration 2 – ASTM E330/E330M-14 – SI & IP Units Element Specimen No.: 20-06-B0075-1 *(Test Date: July 14, 2020)*				
Test Pressure	**Gauge No. and Deflection**			
	1	**2**	**3**	**Net Deflection**
3,591 Pa(1) *(75.0 lbs. /ft²)*	-2.9 mm *(-0.114 inches)*	-10.9 mm *(-0.429 inches)*	-3.5 mm *(-0.138 inches)*	-7.8 mm *(-0.307 inches)*
Residual Deflection	-0.4 mm *(-0.016 inches)*	-0.8 mm *(-0.031 inches)*	-0.8 mm *(-0.031 inches)*	-0.3 mm *(-0.011 inches)*

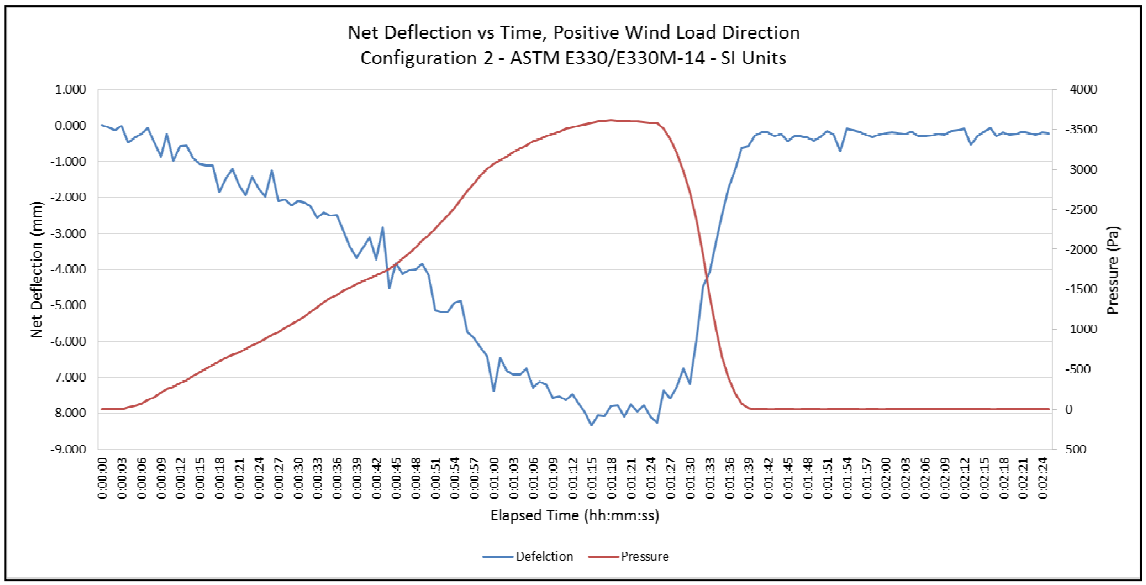


Figure No. 1 – Net Deflection vs Time, Positive Wind Direction, SI Units

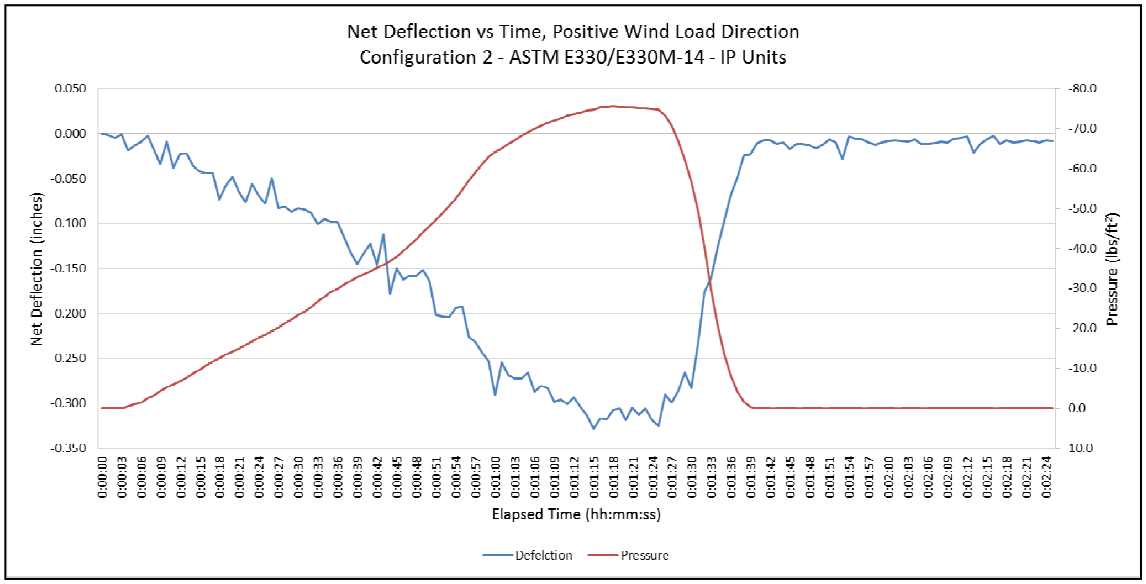


Figure No. 2 – Net Deflection vs Time, Positive Wind Direction, IP Units

Table No. 5 - Summarized Structural Results, Negative Wind Load Direction Configuration 2 – ASTM E330/E330M-14 – SI & IP Units Element Specimen No.: 20-06-B0075-1 *(Test Date: July 14, 2020)*				
Test Pressure	**Gauge No. and Deflection**			
	1	**2**	**3**	**Net Deflection**
3,591 Pa(1) *(75.0 lbs. /ft²)*	2.6 mm *(0.102 inches)*	11.9 mm *(0.469 inches)*	4.2 mm *(0.165 inches)*	8.5 mm *(0.334 inches)*
Residual Deflection	0.6 mm *(0.024 inches)*	1.6 mm *(0.063 inches)*	1.5 mm *(0.059 inches)*	0.5 mm *(0.020 inches)*

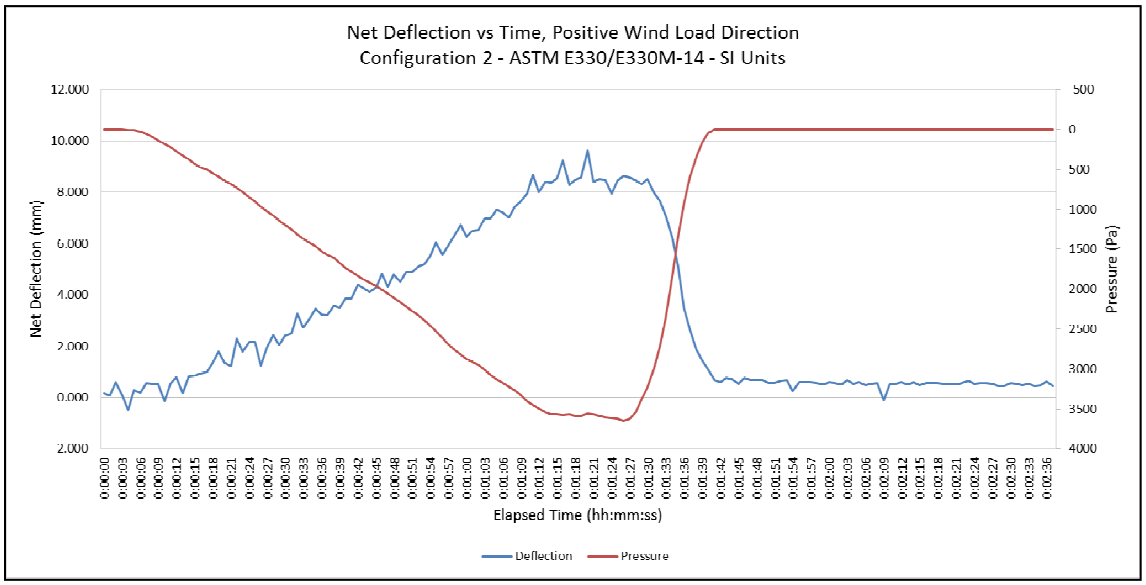


Figure No. 3 – Net Deflection vs Time, Negative Wind Direction, SI Units

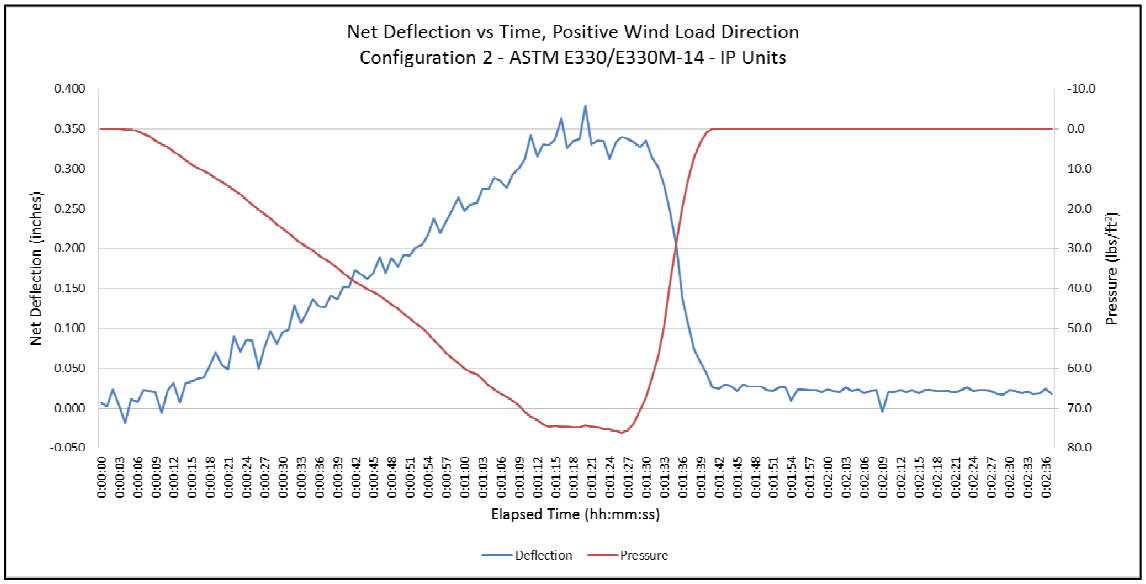


Figure No. 4 – Net Deflection vs Time, Negative Wind Direction, IP Units

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 Test Load: (+3591 Pa) = 7.8 mm < *16.4 mm Requirement*
Negative Loading Net Deflection Test Load (-3591 Pa) = 8.5 mm < *16.4 mm Requirement*

Positive Loading Net Deflection Test Load: (+75.0 lbs. /ft²) = 0.307 inches < *0.646 inch Requirement*
Negative Loading Net Deflection Test Load (-75.0 lbs. /ft²) = 0.334 inches < *0.646 inch Requirement*

(1) 3,591 Pa = 76.5 m/s or 272 km/h *(169 mph)*.
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.

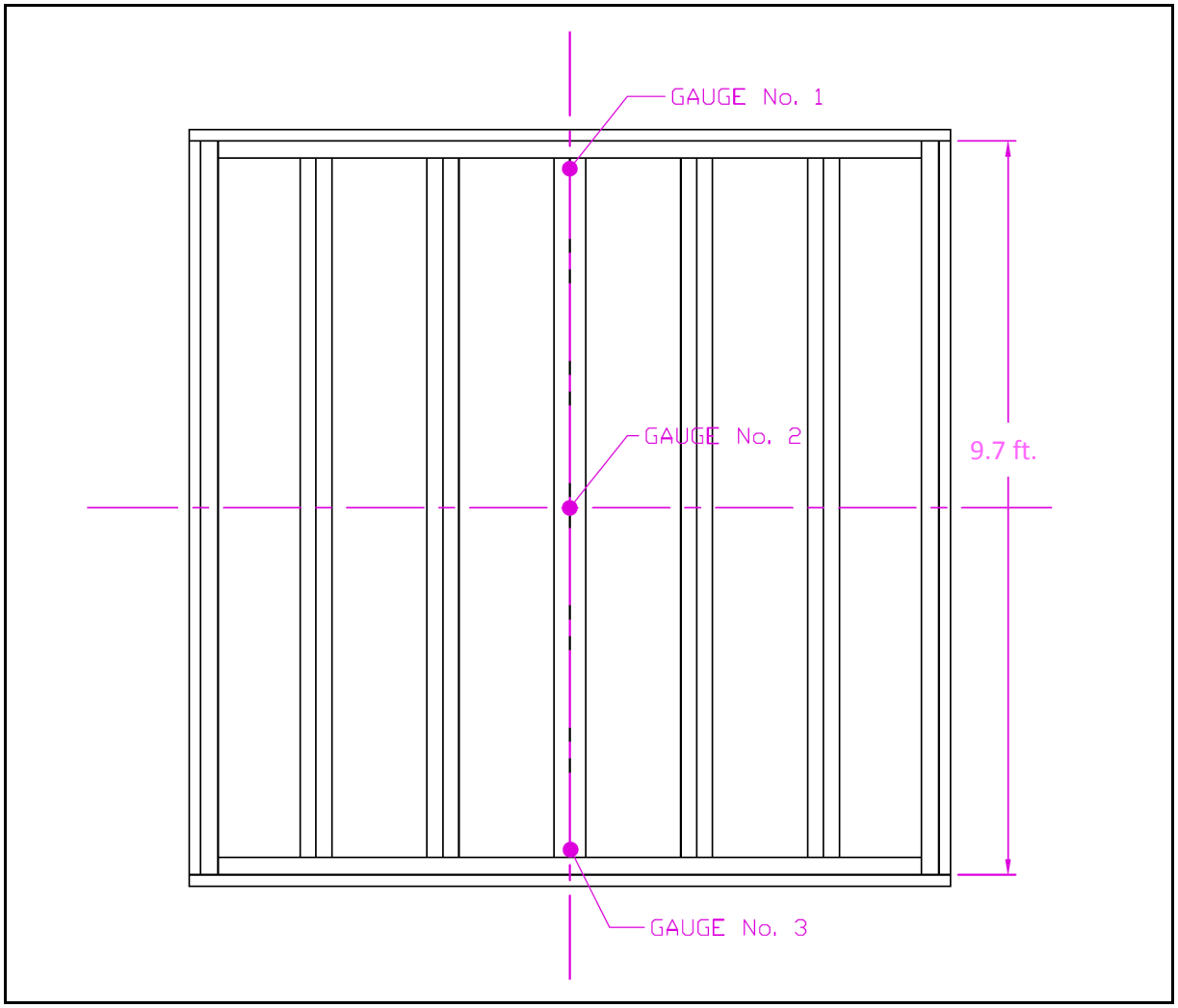


Figure No. 5 – Deflection Gauge Loactions

Table No. 6 - Summarized Structural Results Test to Failure in the Negative Wind Load Direction Configuration 2 – ASTM E330 – SI & IP Units Element Specimen No.: 15-06-M0159 *(Test Date: July 14, 2020)*	
Maximum Pressure Achieved	**Comments**
5,387 Pa[(2)] *(112.5 lbs. /ft²)*	Cladding System did not disengage from wall assembly. However, vertical supporting steel studs buckled in the center

[(2)] 5,387 Pa = 93.7 m/s or 337 km/h *(210 mph)*.
Load Calculation based on the Ensewiler formula, where $P = 0.613 \cdot V^2$, V is m/s & P is N/m²

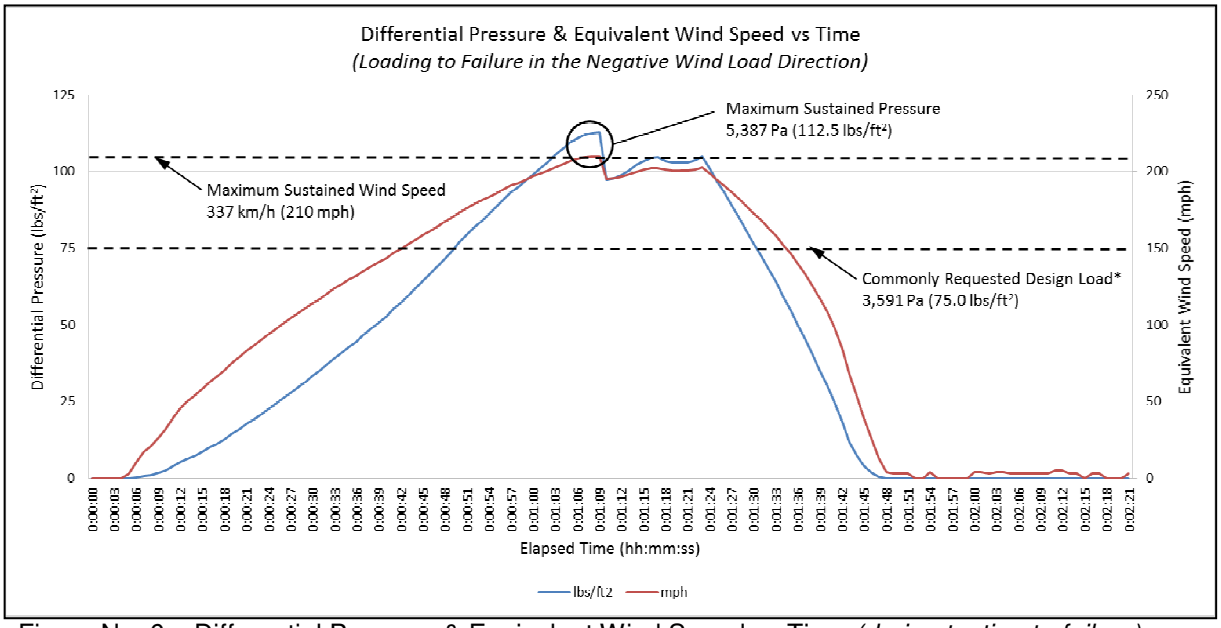


Figure No. 6 – Differential Pressure & Equivalent Wind Speed vs Time *(during testing to failure)*

*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: 0.001 L/s m² *(0.0002 CFM/ft²)* @ 75 Pa *(1.57 lbs/ft²)*
  0.009 L/s m² *(0.0008 CFM/ft²)* @ 300 Pa *(6.24 lbs/ft²)*
- Water Penetration 300 Pa *(6.27 lbs/ft²)*
- Structural Performance: 3,591 Pa *(75.0 lbs. /ft²)* – Specified Test Pressure
  5,387 Pa[(3)] *(112.5 lbs. /ft²)* – Maximum Pressure Achieved (-)
  (Equivalent to 337 km/h *(210 mph) based on Ensewiler formula)*

[(3)] Cladding system did not disengage from the wall assembly. The "FUSION™ DRILLFREE™ Panel System*"* did not fail at 5,387 Pa *(112.5 lbs. /ft²),* whereas, the vertical steel studs behind the wall assembly buckled in the center, thereby, concluding the test procedure.

6.0 REVISION HISTORY

Date:	**Revision:**	**Comments:**
July 31, 2020	20-06-B0075-1	Original Document

Reported by:

Allan Lawrence, Ext 11212
Supervisor, Building Science
Building Science Division

Reviewed and Authorized by:

Jordan M. Church, B.Tech., Ext. 11546
Ops. Manager, Building Science & Fire Testing
Technical Manager, Building Systems
Building Science Division

APPENDIX A

Specimen Bill of Materials and Detailed Drawing

(6 Pages)

4MM FUSION™ with etalbond® ACM - Bill of Materials

Framework:

6 pcs 1.0" x 1.0" x 2" x 1.0" x 1.0" Pre-punched Hat channel 18 Gauge G-90 Galvanized profile

4 pcs 2" x 1.0" x 2" Pre-punched U-channel 18 Gauge G-90 Galvanized profile

100 pcs #12 x 1.5" self-drilling screws

Panel Assemblies:

56.750" X 57.125" 4mm FUSION™ Panel assembly (Below list is per panel, 2 panels used in assembly)

2 pcs Patented FUSION™ DRILLFREE™ perimeter extrusion square cut @ 54.125" 6061-T6

2 pcs Patented FUSION™ DRILLFREE™ perimeter extrusion square cut @ 54.625" 6061-T6

4 pcs FUSION™ 4mm AAMA 508 FUSION™ 60 Durometer High Temp Silicon Corner blocks

4 pcs FUSION™ corner bracket 3003 Alloy

4mm etalbond® Fire Rated Aluminum Composite Material.

30 EVO Torxalig zinc coated screws

30 FUSION™ DRILLFREE™ RIVETS

3 pcs Patented EVO™ Integrated stiffener square cut to 54.5" 6061-T6

2 tubes of Dymonic FC adhesive

3 pcs 1" x .5" bug screen to cover weep holes

56.750" X 115" 4mm FUISON Panel assembly (1 pc in assembly)

2 pcs Patented FUSION™ DRILLFREE™ perimeter extrusion square cut @ 54.125" 6061-T6

2 pcs Patented FUSION™ DRILLFREE™ perimeter extrusion square cut @ 112.5" 6061-T6

4 pcs FUSION™ 4mm AAMA 508 60 Durometer High Temp Silicon Corner block

14 pcs FUSION™ corner bracket 3003 Alloy

4mm etalbond® Fire Rated Aluminum Composite Material.

32 EVO™ Torxalig zinc coated screws

25 FUSION™ DRILLFREE™ RIVETS

5 pcs Patented EVO™ Integrated stiffener square cut to 54.54" 6061-T6

1 tube of Dymonic FC adhesive

5 pcs 1" x .5" bug screen to cover weep holes

Wall assembly:

1 pc Patented FUSION™ DRILLFREE™ Starter Strip 6061-T6 profile square cut to 115.5"

12 pc Patented FUSION™ DRILLFREE™ Mid-Clip 6061 -T6 profile square cut to 3" with pre-punched slot (Mounted on 16" maximum centre distance)

24 pc Patented FUSION™ DRILLFREE™ Half-Clip 6061- T6 profile square cut to 3" with pre-punched slot (Mounted on 16" maximum centre distance)

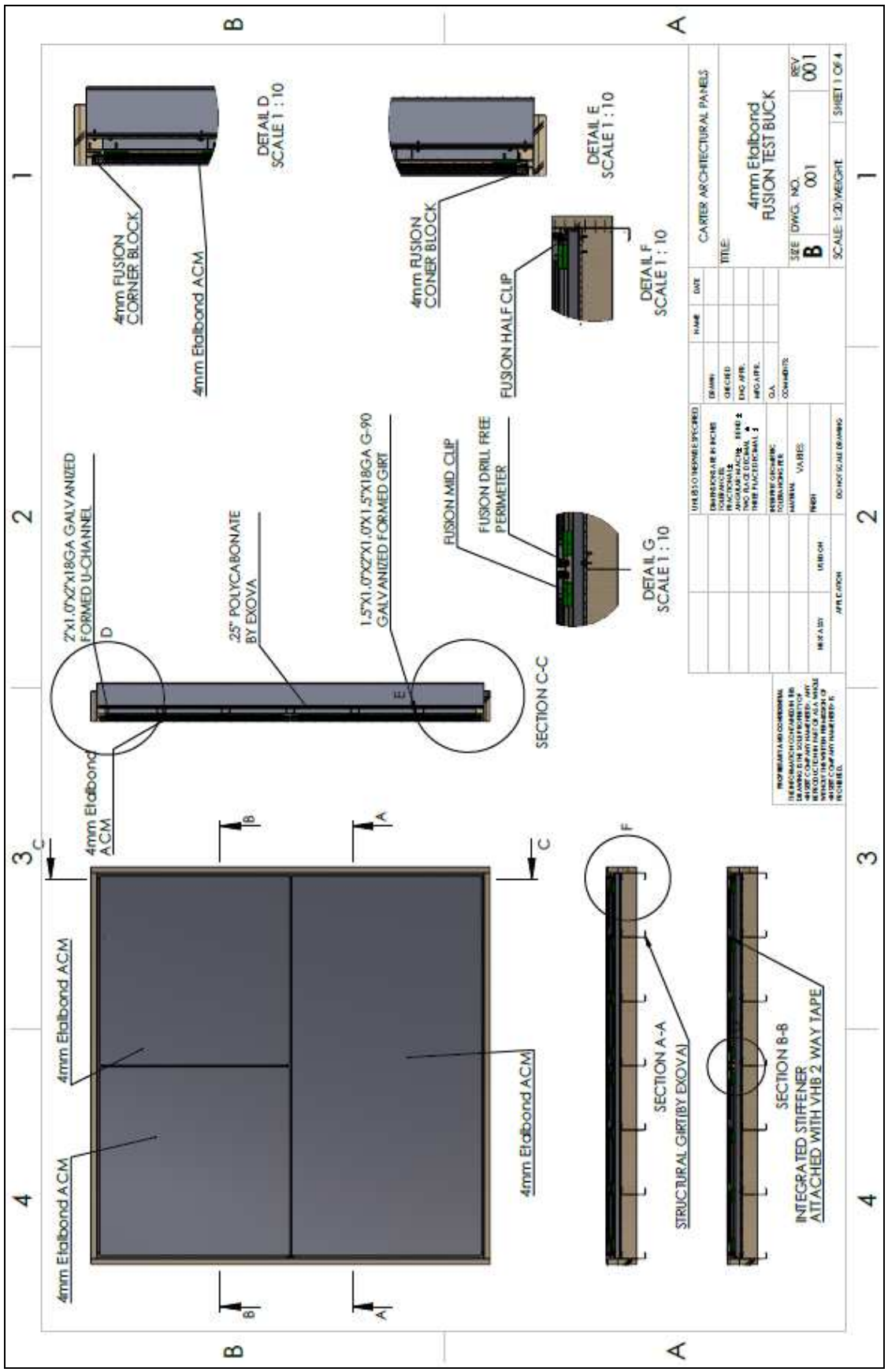
1 pc 4mm etalbond® Fire Rated Aluminum Composite Material, cut 2" x 115.5" long (Horizontal Centre Filler Strip)

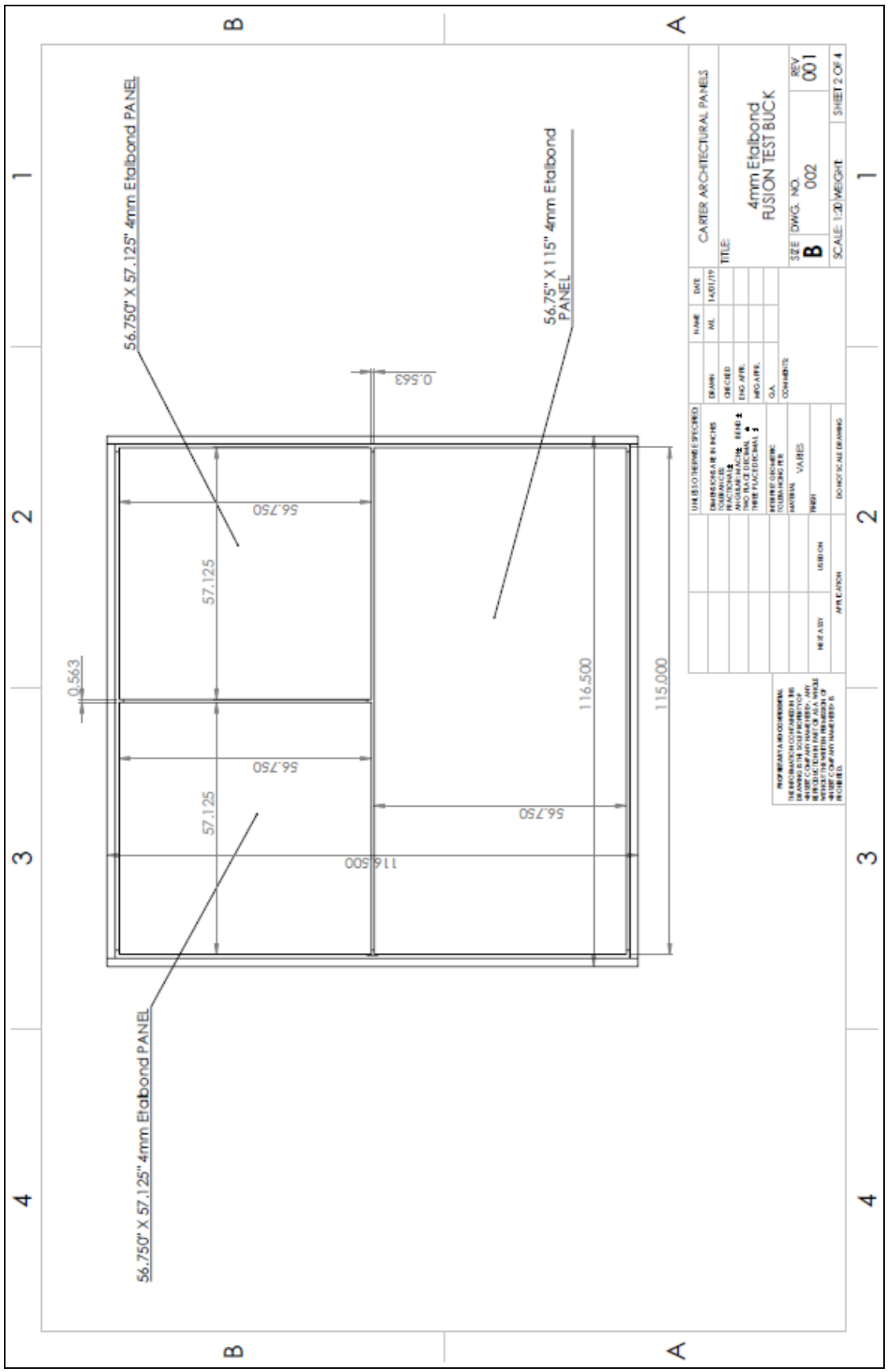
2 pc 4mm etalbond® Fire Rated Aluminum Composite Material cut to 1.25" x 115.5" long (Top and bottom Filler Strip)

2 pc 4mm etalbond® Fire Rated Aluminum Composite Material cut to 1.25" x 115.5" long (Side Filler Strips)

2 pc 4mm etalbond® Fire Rated Aluminum Composite Material cut to 1.25" x 54" long (Vertical Centre Filler Strip)

etalbond® ACM is manufactured by ELVAL COLOUR


4mm FUSION CORNER BLOCK
4mm Etalbond ACM
DETAIL D SCALE 1 : 10
4mm FUSION CORNER BLOCK
FUSION HALF CLIP
DETAIL E SCALE 1 : 10
DETAIL F SCALE 1 : 10
2"X1.0"X2"X18GA GALVANIZED FORMED U-CHANNEL
.25" POLYCABONATE BY EXOVA
1.5"X1.0"X2"X1.0"X1.5"X18GA G-90 GALVANIZED FORMED GIRT
FUSION MID CLIP
FUSION DRILL FREE PERIMETER
DETAIL G SCALE 1 : 10
SECTION C-C
4mm Etalbond ACM
4mm Etalbond ACM
4mm Etalbond ACM
4mm Etalbond ACM
SECTION A-A
STRUCTURAL GIRT(BY EXOVA)
SECTION B-B
INTEGRATED STIFFENER ATTACHED WITH VHB 2 WAY TAPE
CARTER ARCHITECTURAL PANELS
4mm Etalbond FUSION TEST BUCK
DWG. NO. 001
REV 001
SCALE: 1:20 WEIGHT
SHEET 1 OF 4


56.750" X 57.125" 4mm Etalbond PANEL
56.75" X 115" 4mm Etalbond PANEL
56.750" X 57.125" 4mm Etalbond PANEL
0.563
56.750
57.125
116.500
115.000
CARTER ARCHITECTURAL PANELS
4mm Etalbond
FUSION TEST BUCK
SIZE B
DWG. NO. 002
REV 001
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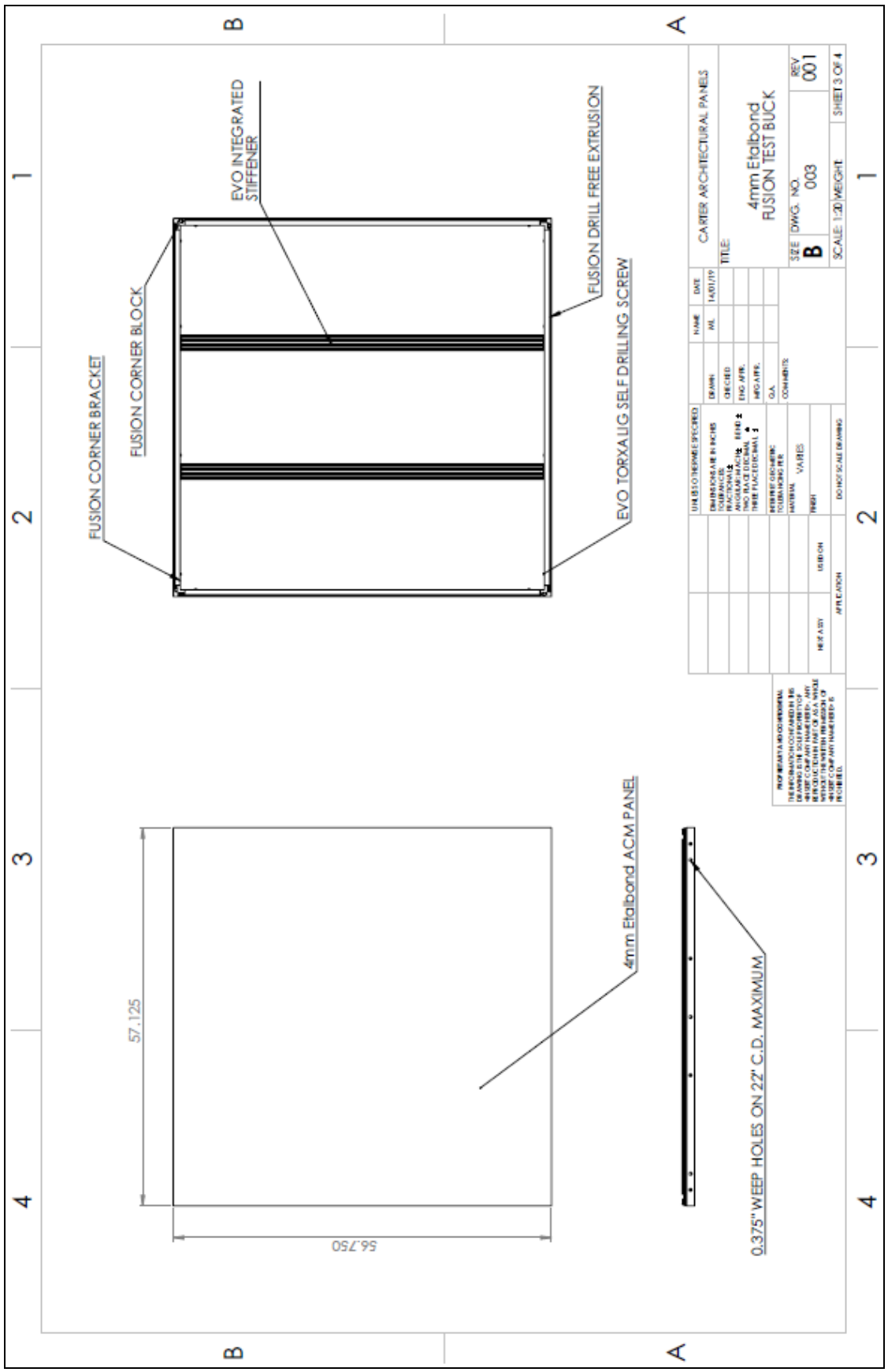
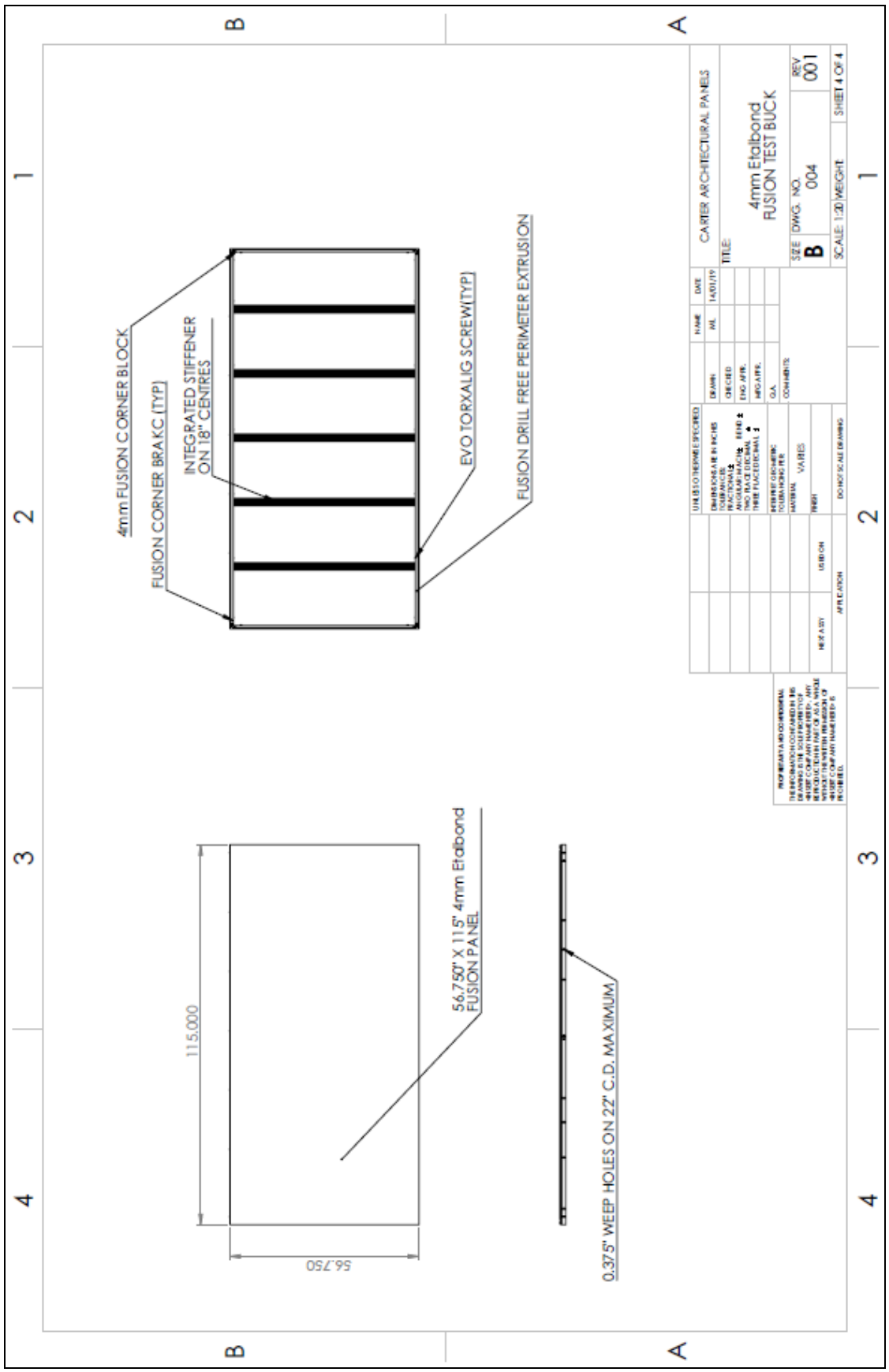
SHEET 2 OF 4


EVO INTEGRATED STIFFENER
FUSION CORNER BLOCK
FUSION CORNER BRACKET
FUSION DRILL FREE EXTRUSION
EVO TORXALUG SELF DRILLING SCREW
4mm Etalbond ACM PANEL
57.125
56.750
0.375" WEEP HOLES ON 22" C.C. MAXIMUM
CARTER ARCHITECTURAL PANELS
4mm Etalbond
FUSION TEST BUCK
SIZE B
DWG. NO. 003
REV 001
SCALE: 1:20 WEIGHT
SHEET 3 OF 4


4mm FUSION CORNER BLOCK
FUSION CORNER BRAKC (TYP)
INTEGRATED STIFFENER ON 18" CENTRES
EVO TORXALIG SCREW(TYP)
FUSION DRILL FREE PERIMETER EXTRUSION
56.750" X 115" 4mm Etalbond FUSION PANEL
115.000
56.750
0.375" WEEP HOLES ON 22" C.D. MAXIMUM
CARTER ARCHITECTURAL PANELS
4mm Etalbond FUSION TEST BUCK
DWG. NO. 004
REV 001
SCALE: 1:20 WEIGHT
SHEET 4 OF 4

APPENDIX B

Photographs of Rain Screen System

(2 Pages)

Figure B1 – Test Specimen (Exterior View)

Figure B2 – Test Specimen (Interior View)