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EVALUATION OF DIZAL INC., PRINTED ALUMINUM SIDING SYSTEM IDENTIFIED AS "DIGITALLY PRINTED ALUMINUM SIDING / 6" " FOR WIND LOAD RESISTANCE IN ACCORDANCE WITH ISO 7895

Report to:	DiZal Inc. 1020 Bouvier, Suite 400 Quebec City, Quebec G2K 0K9
Attention:	Mr. Louis-Andre Gaudreau
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Report No.:	16-06-M0274-3 10 Pages, 2 Appendices
Proposal No.:	16-006-457671
Date:	March 15, 2017

1.0 INTRODUCTION

At the request of DiZal Inc., Exova was retained to evaluate the "Digitally Printed Aluminum Siding / 6" " extruded Aluminum cladding system for evaluation purposes. The testing was conducted in accordance to a CCMC Draft Technical Guide (Reference only) and ISO 7892 as outlined in Proposal Number: 16-006-457671 for Wind Load Resistance.

Upon receipt and construction, the specimen was assigned the following Exova Specimen Number:

Client Specimen Description	**Exova Specimen No.**
Digitally Printed Aluminum Siding / 6" (Horizontal Cladding- Wind Load) *(for CCMC Draft Technical Guide, " Wind Load Resistance" Testing)*	16-06-M0274-3

Specimens were constructed by DiZal Inc.'s representative at Exova on November 29, 2016

2.0 PROCEDURE

Test Method	Test Description
CCMC Draft Technical Guide referencing ISO 7895 and ASTM E 330, Procedure B	Wind Load Resistance

2.1 TEST WALL CONSTRUCTION

Wind Load Resistance Test Wall

One test wall were constructed to test the siding for wind load resistance in the horizontal orientation. The 2959 mm (116.5″) wide by x 2959 mm (116.5″) high test wall section was constructed by Exova trained staff at Exova's Mississauga facility on November 29, 2016.

The wind load resistance base wall sections consisted of nominal 50.8 x 152.4 mm (2" x 6") SPF studs and head and sill plates, and standard 12.7 mm (1/2") Plywood sheathing. The spacing between each stud section was nominally 406 mm (16") on-center, except for the last stud at one end of the test wall, where the stud was positioned 241 mm (9-1/2″) on centre from the outside edge of the adjacent perimeter stud. The head and sill plates were fastened to the studs using three 3-1/4″ long x 0.120″ thick galvanized ardox nails per stud end. The plywood sheathing was fastened to the SPF framing using 2-1/4″ long x 0.099″ thick galvanized ardox nails on nominal 203 mm (8″) centres.

Each piece of horizontal cladding measured 170 mm (6.7″) wide with an exposure of 153 mm (6.0″), with nominal thickness of 11.4 mm (0.449″). The pieces of cladding were provided precut by DiZal prior to installation on the respective test wall. Along one edge of the cladding there were slots present measuring nominally 406mm (16") on centre for fastener installation. Along the backside, adjacent to the other long edge, was a lip that engaged the long edge (with fastener slots) of the adjacent, previously installed course of cladding.

2.1 TEST WALL CONSTRUCTION (CONTINUED)

The cladding system installed in the horizontal orientation was secured to the exterior face of the wall section directly to the plywood sheathing using the same stud spacing pattern as the framing members. A full-width aluminum starter strip as fastened along the bottom of the wall on the exterior face using #8 38mm (1-1/2") long Robertson screws fastened every 406 mm (16″) on centre. The starter strip along the bottom edge that engaged the backside of the first course of siding.

Each test wall section was installed into a steel transport frame lined with (51 mm x 152 mm) 2″ x 6″ SPF lumber.

DiZal Inc. provided installation details are located in Appendix A. The cladding on both test walls was installed by DiZal Inc. personnel. A general construction detail of the wall section constructed is located in Appendix B of this test report.

Note: The wall assemblies did not contain furring strips.

Prior to installation of the cladding system on the test walls, a 6 mil polyethylene sheet was loosely fitted to the exterior face of each wall and sealed to the test wall perimeter. This was used to apply a negative wind load to the cladding system by introducing a positive pressure differential onto the backside of the cladding system. A 6 mil polyethylene sheet was also loosely fitted to the exterior face of each wall on top of the cladding system and sealed to the test wall perimeter. This was used to apply a positive wind load to the cladding system by introducing a negative pressure differential onto the surface of the cladding system. Positive and negative wind loads were applied using a blower system. Pressure differentials were monitored using a calibrated digital manometer, and deflections were monitored using calibrated string-type deflection gauges.

2.2 WIND PRESSURE CONDITIONING

Cladding in Horizontal Orientation

At the request of DiZal Inc., the following wind pressure loading schedule was applied to the wall system using the wind load level $Q_{50} \leq 1.00$ as referenced in Table 2 of CCMC Draft Technical Guide:

Sustained Loads:

Deformation Test (Sustained Pressure, P_1, Positive Wind Load)

The wall system was subject to increasing pressure in four stages for a minimum period of 10 seconds at each stage, up to the maximum target pressure of 1000 Pa which was maintained for 1-hour.

Deformation Test (Sustained Pressure, P'_1, Negative Wind Load)

The wall system was subject to increasing pressure in four stages for a minimum period of 10 seconds at each stage, up to the maximum target pressure of -1000 Pa which was maintained for 1-hour.

The deformation measurements were taken continuously during pressurisation.

Cyclic Loads:

Repeated Positive and Negative Pressure Test (Cyclic Pressure, P_2 & P'_2)

The wall system was subject to 2,000 cycles of pressure. The first 1000 cycles were from 0 to +1,460 Pa and was followed by 1000 cycles from 0 to –1460 Pa. The deformation measurements were taken continuously during cycling.

Safety Test (Gust Wind, P_3 & P'_3):

The wall system was then subjected to a 'Gust Wind' pressure of +2180 Pa followed by a repeated 'Gust Wind' pressure of –2,180 Pa. These pressures were held for a minimum of 3 seconds. The maximum deformation readings were taken for each gust pressure.

2.3 STRUCTURAL PERFORMANCE (DEFLECTON MEASUREMENTS)

Cladding in Horizontal Orientation

Upon completing the Wind Pressure Conditioning test the specimen was subjected to wind pressure loading as outlined in CCMC Draft Technical Guide, Wind Loading Table 1. Based on the $Q_{50} \leq 1.00$ kPa value, P_1 value (1000 Pa * 2.18), the specimen was subjected to a wind load pressure of 2,180 Pa *(i.e. gust wind)* in both positive and negative cases and held for 10 seconds. The deflection readings were recorded and the pressure was released.

Note: During wind load resistance testing, all loads (both positive & negative) were applied directly to the cladding material using a 6-mil plastic membrane which transferred the loads to the supporting structure.

2.4 TEST DATES

Cladding Horizontal:

Test Criteria	**Testing Date**
Wind Pressure Conditioning	February 18, 2017
Structural Performance	February 18, 2017

2.5 GENERAL TEST SPECIMEN SETUP PHOTOGRAPHS FOR WIND LOAD RESISTANCE

Figure 1 – Testing Chamber Prior to Specimen Installation *(Stock Photo)*

Figure 2 – Wall Section (Cladding Horizontal) Prior to Section Installation on Test Chamber

Figure 3 – General Specimen Installation in Chamber and Interior-Side Gauging

3.0 SUMMARIZED TEST RESULTS

Cladding Horizontal

Table 1 – Summarized Test Results
CCMC Draft Technical Guide
Wind Load Resistance

Test	Requirements	Results	Comment
Wind Load Resistance	The cladding system shall be capable of resisting and transmitting to its points of support the positive and negative forces generated by the design wind loads without any fracture or permanent deterioration of the surfaces resulting from such design loads	The cladding system resisted and transmitted to its points of support the following positive and negative forces wind design value: $Q_{50} \leq$ 1.00 kPa @ 12 m (non-post disaster) P_1 = 1000 Pa, Pass P_2 = 1460 Pa, Pass P_3 = 2180 Pa, Pass *(Test results are presented in Section 4, Tables 3-6)*	Sustained Loads Outlined for: $Q_{50} \leq$ 1.00 kPa @ 12 m *(non-post disaster)*

4.0 DETAILED WIND LOAD RESISTANCE & IMPACT TEST RESULTS- HORIZONTAL CLADDING

Table 2 – Wind Load Resistance Deflection Results in Accordance with CCMC Draft Technical Guide Exova Specimen No.: 16-06-M0274-3 -Horizontal Cladding

Cycle	Pressure (Pa) $Q_{50} \leq 1.00$ kPa @ 12 meters	Gauging Positions & Maximum Deflections (mm)									
		Exterior Side (Cladding Face)					Interior Side (Stud and Sheathing Face)				
		1	2	3	4	5	6	7	8	9	10
Sustained Loads	250	1.6	0.4	4.3	1.8	2.6	-3.8	-2.0	-2.3	-2.9	-3.8
	500	3.8	3.3	2.9	3.6	4.0	-3.7	-2.5	-3.1	-6.1	-3.7
	750	4.6	2.2	6.8	6.0	6.4	-4.8	-2.9	-4.3	-6.0	-4.8
	1000 (P_1)	7.4	9.1	11.3	10.2	9.6	-9.2	-5.6	-7.6	-20.9	-9.2
	Residual	0.7	0.4	0.8	1.1	1.1	-4.2	-1.5	-1.1	-0.7	-4.2
	-250	-0.4	-0.3	-0.3	-0.4	-1.4	1.5	2.5	3.1	3.2	1.8
	-500	-0.7	-1.0	-0.9	-0.7	-1.7	1.8	2.4	5.0	2.2	1.7
	-750	-1.4	-2.2	-2.2	-1.4	-2.9	1.8	2.5	2.9	3.1	1.7
	-1000 (P_1')	-4.3	-6.4	-6.5	-4.3	-5.5	3.7	4.4	10.3	6.5	7.1
	Residual	-0.6	-2.5	-0.1	-0.6	-0.6	0.0	0.2	0.3	0.3	0.4
Cyclic Loads	**0 to 1460 (P_2)**	9.6	13.9	11.4	19.8	8.5	-6.1	-10.9	-23.4	-15.5	-9.2
	Residual	3.9	4.4	5.2	8.3	6.9	-1.3	-4.8	-5.4	-4.2	-3.7
	0 to -1460 (P_2')	-15.8	-19.9	-14.0	-9.2	-7.0	5.9	9.1	18.1	10.6	8.4
	Residual	-1.6	-2.4	-2.4	-2.0	-1.6	1.5	2.4	2.5	2.2	2.2
Gust Loads	**0 to 2180 (P_3)**	7.9	17.3	16.3	17.7	13.8	-7.9	-16.1	-19.2	-16.7	-11.6
	Residual	1.3	2.8	2.7	2.8	3.4	-1.2	-2.7	-2.5	-2.6	-1.9
	0 to -2180 (P_3')	-11.5	-23.4	-17.7	-18.3	-13.3	0.2	8.6	18.0	18.1	17.6
	Residual	-2.0	-3.7	-3.4	-3.3	-3.3	2.2	3.5	3.5	3.4	4.1

Table 3 – Wind Pressure Load Deflection Results in Accordance with CCMC Draft Technical Guide – Deflection Measurements Exova Specimen No.: 16-06-M0274-3 –Horizontal Cladding

Cycle	Pressure (Pa) $Q_{50} \leq 1.00$ kPa @ 12 meters	Gauging Positions & Deflections (mm)									
		Interior Side (Stud and Sheathing Face)					Exterior Side (Cladding Face)				
		1	2	3	4	5	6	7	8	9	10
Wind Loading	0 to 2180	7.9	17.3	16.3	17.7	13.8	-7.9	-16.1	-19.2	-16.7	-11.6
	Residual	1.3	2.8	2.7	2.8	3.4	-1.2	-2.7	-2.5	-2.6	-1.9
	0 to –2180	-11.5	-23.4	-17.7	-18.3	-13.3	0.2	8.6	18.0	18.1	17.6
	Residual	-2.0	-3.7	-3.4	-3.3	-3.3	2.2	3.5	3.5	3.4	4.1

The positions of the gauge locations are located on Page 12, Figure 6.

4.0 DETAILED WIND LOAD RESISTANCE & IMPACT TEST RESULTS (CONTINUED)

Table 4 – Wind Load Resistance Deflection Results in Accordance with CCMC Draft Technical Guide Exova Specimen No.: 16-06-M0274-3 – Horizontal Cladding

Cycle	Pressure (Pa) $Q_{50} \leq$ 1.00 kPa @ 12 meters	Maximum Movement of the Exterior Cladding from the Supporting Members Measurement Locations (mm)				
		Location #1	Location #2	Location #3	Location #4	Location #5
Sustained Loads	250	-2.2	-1.6	-2.0	-1.1	-1.2
	500	-0.1	-0.8	-0.2	-2.5	-0.3
	750	-0.2	-0.7	-2.5	-0.0	-1.6
	1000 (P_1)	-1.8	-3.5	-3.7	-10.7	-0.4
	Residual	-3.5	-1.1	-0.3	-0.4	-3.1
	-250	1.1	2.2	2.8	2.8	0.4
	-500	1.1	1.4	4.1	1.5	0.0
	-750	0.4	0.3	0.7	1.7	1.2
	-1000 (P_1')	0.6	2.0	3.8	2.2	1.6
	Residual	0.6	2.7	0.2	0.9	1.0
Cyclic Loads	**0 to 1460 (P_2)**	-3.5	-3.0	-12.0	-4.3	-0.7
	Residual	-2.6	-0.4	-0.2	-4.1	-3.2
	0 to -1460 (P_2')	9.9	10.8	4.1	1.4	1.4
	Residual	0.1	0.0	0.1	0.2	0.6
Gust Loads	**0 to 2180 (P_3)**	-0.0	-1.2	-2.9	-1.0	-2.2
	Residual	-0.1	-0.1	-0.2	-0.2	-1.5
	0 to -2180 (P_3')	11.3	14.8	0.3	0.2	4.3
	Residual	0.2	0.2	0.1	0.1	0.8

Table 5 – Wind Pressure Load Deflection Results in Accordance with CCMC Draft Technical Guide – Deflection Measurements Exova Specimen No.: 16-06-M0274-3 – Horizontal Cladding

Cycle	Pressure (Pa) $Q_{50} \leq$ 1.00 kPa @ 12 meters	Maximum Movement of the Exterior Cladding from the Supporting Members Measurement Locations (mm)				
		Location #1	Location #2	Location #3	Location #4	Location #5
Wind Loading	0 to 2180	-0.0	-1.2	-2.9	-1.0	-2.2
	Residual	-0.1	-0.1	-0.2	-0.2	-1.5
	0 to –2180	11.3	14.8	0.3	0.2	4.3
	Residual	0.2	0.2	0.1	0.1	0.8

Note:

- Positive (+) deflection values indicate movement of cladding system towards from the cladding support from the neutral position.
- Negative (-) deflection values indicate movement of the cladding system away from the cladding support from the neutral position.

The positions of the gauge locations are located on the following page (Figure 6)

Wall Section Observations During and After Structural Wind Load Resistance Schedule

During and after the wind loading schedule as shown in Tables 3-6, the cladding system (Exova Specimen Number: 16-06-M0274-3) was capable of resisting and transmitting to it's supports the positive and negative forces generated by the design wind loads without any fracture or permanent deterioration of the surfaces.

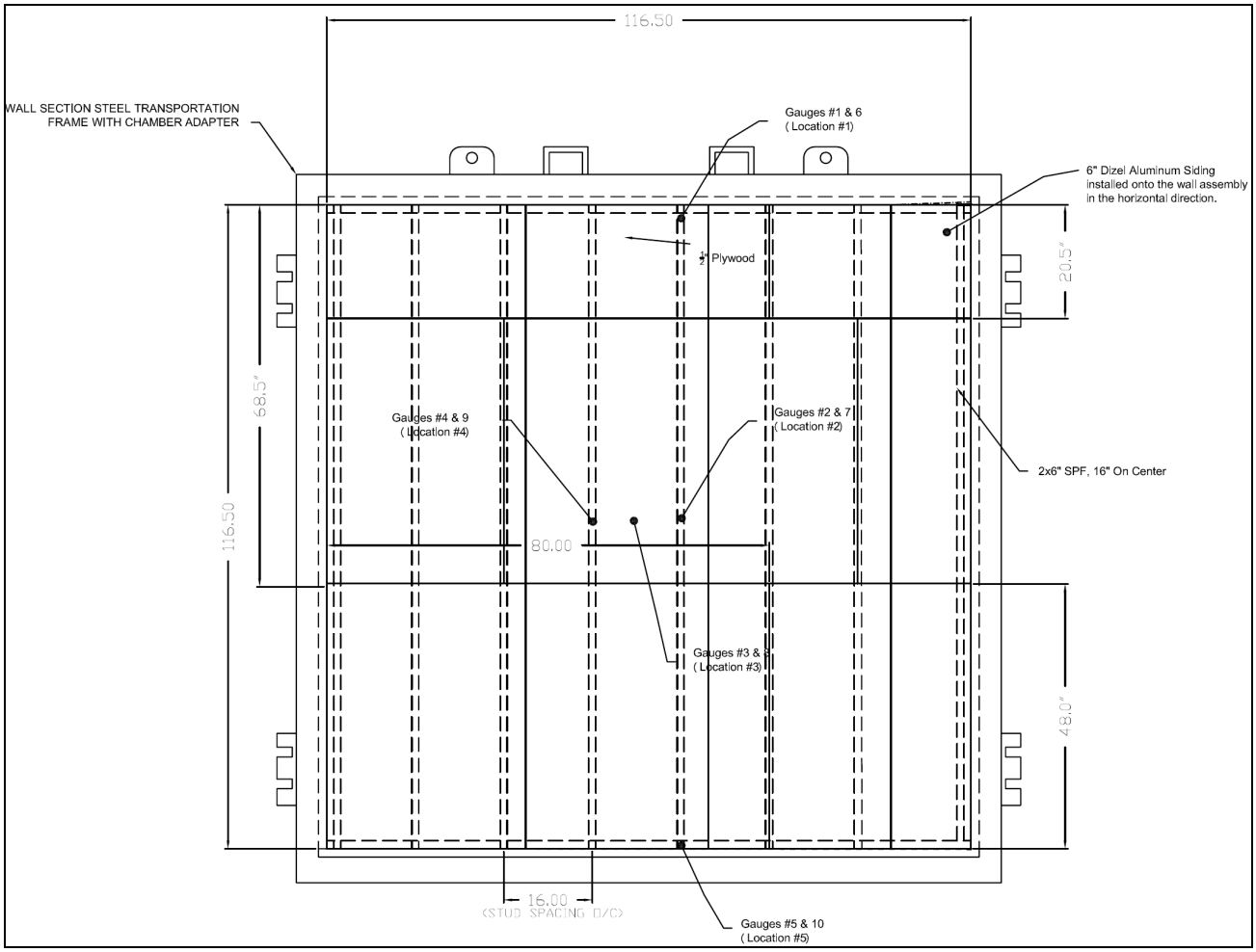


Figure 6 – Exova Specimen 16-06-M0274-3 Gauge Locations

Gauge Location Legend:

Measurement Location	Deflection Difference between Gauges
Location #1	Gauges 1 & 6
Location #2	Gauges 2 & 7
Location #3	Gauges 3 & 8
Location #4	Gauges 4 & 9
Location #5	Gauges 5 & 10

Gauges 1-5 on siding
Gauges 6-10 on studs

5.0 CONCLUSION

Exova Specimens 16-06-M0274-3 identified as "Digitally Printed Aluminum Siding / 6" installed in the horizontal orientation (installation method described herein) were tested for general evaluation purposes for Wind Load Resistance [$Q_{50} \leq$ *1.00 kPa @ 12 m (non-post disaster)]* for cladding installed in the horizontal orientation.

3.0 REPORT REVISION SUMMARY

Revision No:	**Date:**	**Description of Revisions:**
16-06-M0274-3	2017-March 15	Original Document

Reported by:

Sunny Ling, C.E.T, MET Ext. 11412
Supervisor, Building Systems
Products Testing Division

Reviewed & Authorized by:

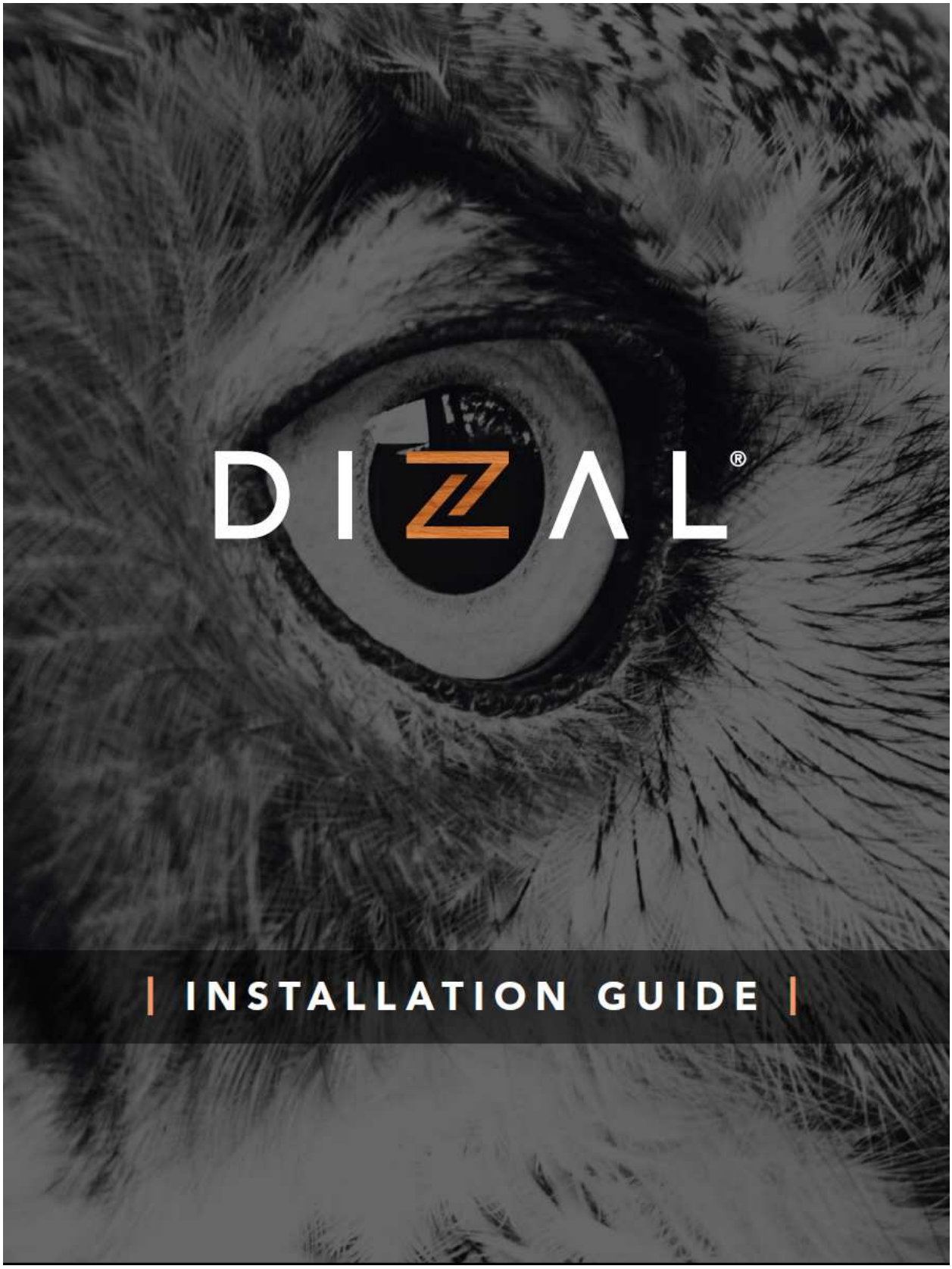
David Wren, P.Eng.,Ext. 11250
Technical Manager, Products Division
Product Testing Division

APPENDIX A

Client Installation Guide and Product Drawings
(As Provided by DiZal Inc.)

(11 Pages)

EXOVA



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INSTALLATION STEPS

1. IMPORTANT NOTES

Use galvanized screws #8 x 1.5" every 16"

Aluminum undergoes expansion and contraction due to temperature variation. Do not screw completely. Keep 1/16" and screw in the center of the slot.

Always use a piece of wood to "snap" the cap on the base of the accessories. A protection must be used on the wood not to damage the texture.

2. TO START

Install the base of the J-Trim, H-Trim and outside corner first.

Screw through the base every 16".

3. STARTER STRIP

Install the starter strip as showed and keep 3/16" on both ends for expansion and contraction.

Make sure the starter strip is level.

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4. PLANKS

The planks must be well insert one on the other before screwing.

Always start left to right.

5. J-TRIM

Keep 3/16" between the trim and the plank to permit expansion and contraction.

Use a piece of wood to "snap" the cap on the base of the J-Trim.

6. H-TRIM

Keep 3/16" between the trim and the plank to permit expansion and contraction.

Use a piece of wood to "snap" the cap on the base of the H-Trim.

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INSTALLATION STEPS

7. OUTSIDE CORNER (OSC)

Keep 3/16" between the outside corner and the plank to permit expansion and contraction.

Use a piece of wood to "snap" the cap to the base of the OSC.

A protection must be used on the wood not to damage the texture.

8. INSIDE CORNER

To make an inside corner, finish the first wall with J-Trim 1 ¾" and start the adjacent wall with J-Trim 1".

Keep 3/16" between the trims and the planks to permit expansion and contraction.

Use a piece of wood to "snap" the cap on the base of the J-Trim.

9. LAST ROW

On the last row use J-Trim 1" or J-Trim 1 ¾" as shown.

Install a small spacer 0.400" to avoid movement on the last row.

Keep 3/16" from the "snap wall" and on both ends of the plank for expansion and contraction.

Use a piece of wood to "snap" the cap on the base of the J-Trim.

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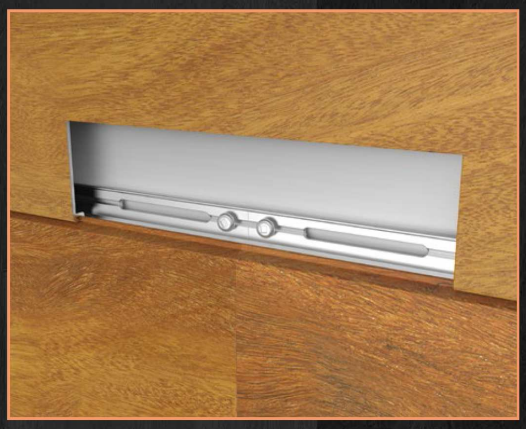
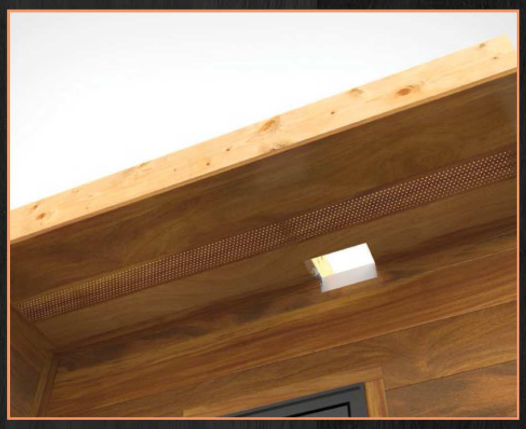
10. WINDOW

For a window or a door, simply use J-Trim 1" or J-Trim 1 3/4" as shown.



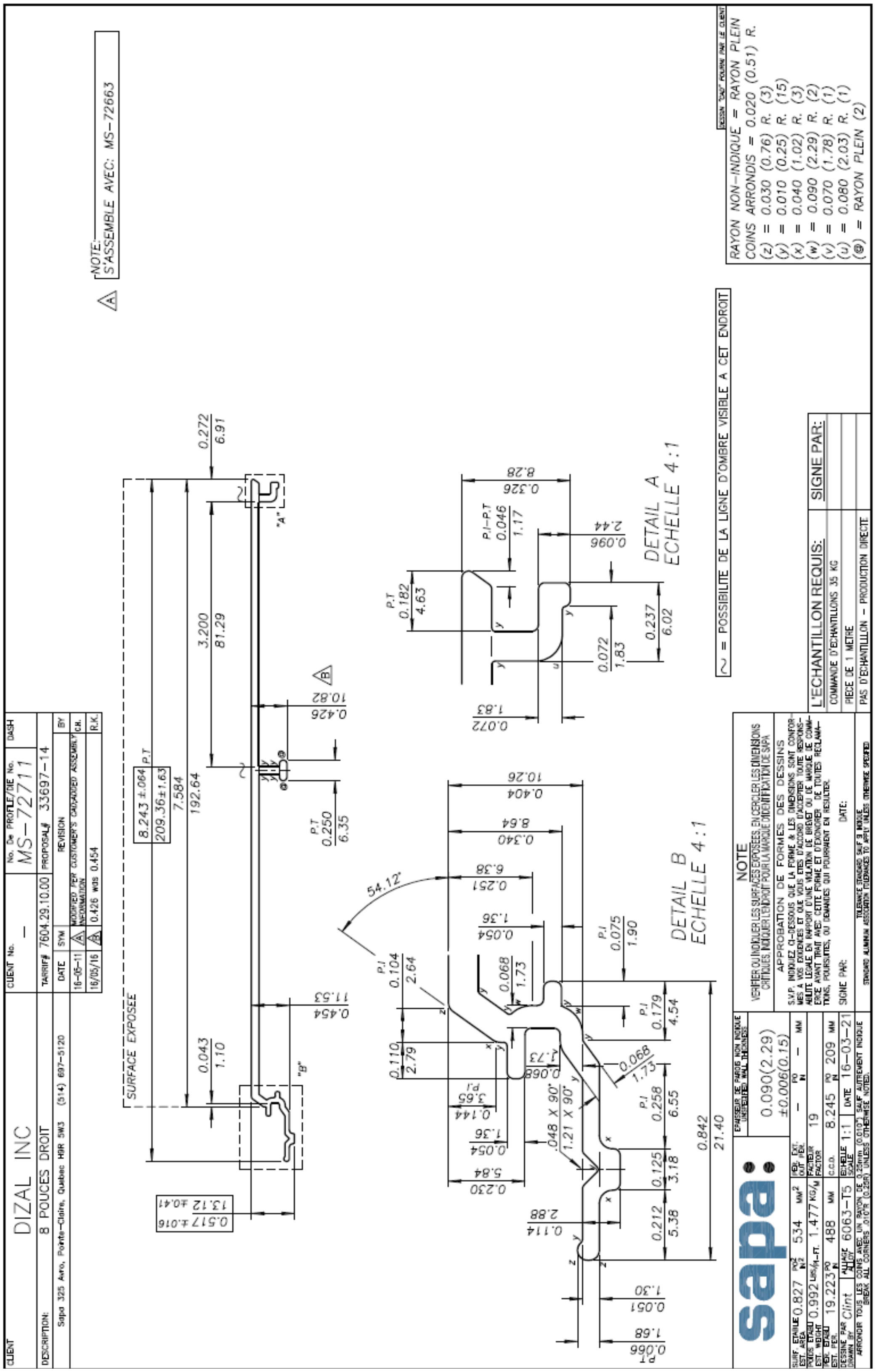
11. ADJACENT PLANKS

It is possible to install two planks without using an H-Trim. In that case, you must lock them at the junction and screw every 16" using the slots.



12. SOFFIT

The plank can be used as a soffit. The junction from the wall to the soffit is done as an inside corner. (Step 8.)


DIZAL INC
8 POUCES DROIT
Sapa 325 Ave, Pointe-Claire, Quebec H9R 5W3 (514) 697-5120
MS-72711
TARRIF# 7604.29.10.00 PROPOSAL# 33697-14
NOTE: S'ASSEMBLE AVEC: MS-72663
SURFACE EXPOSEE
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DETAIL B ECHELLE 4:1
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0.090(2.29)
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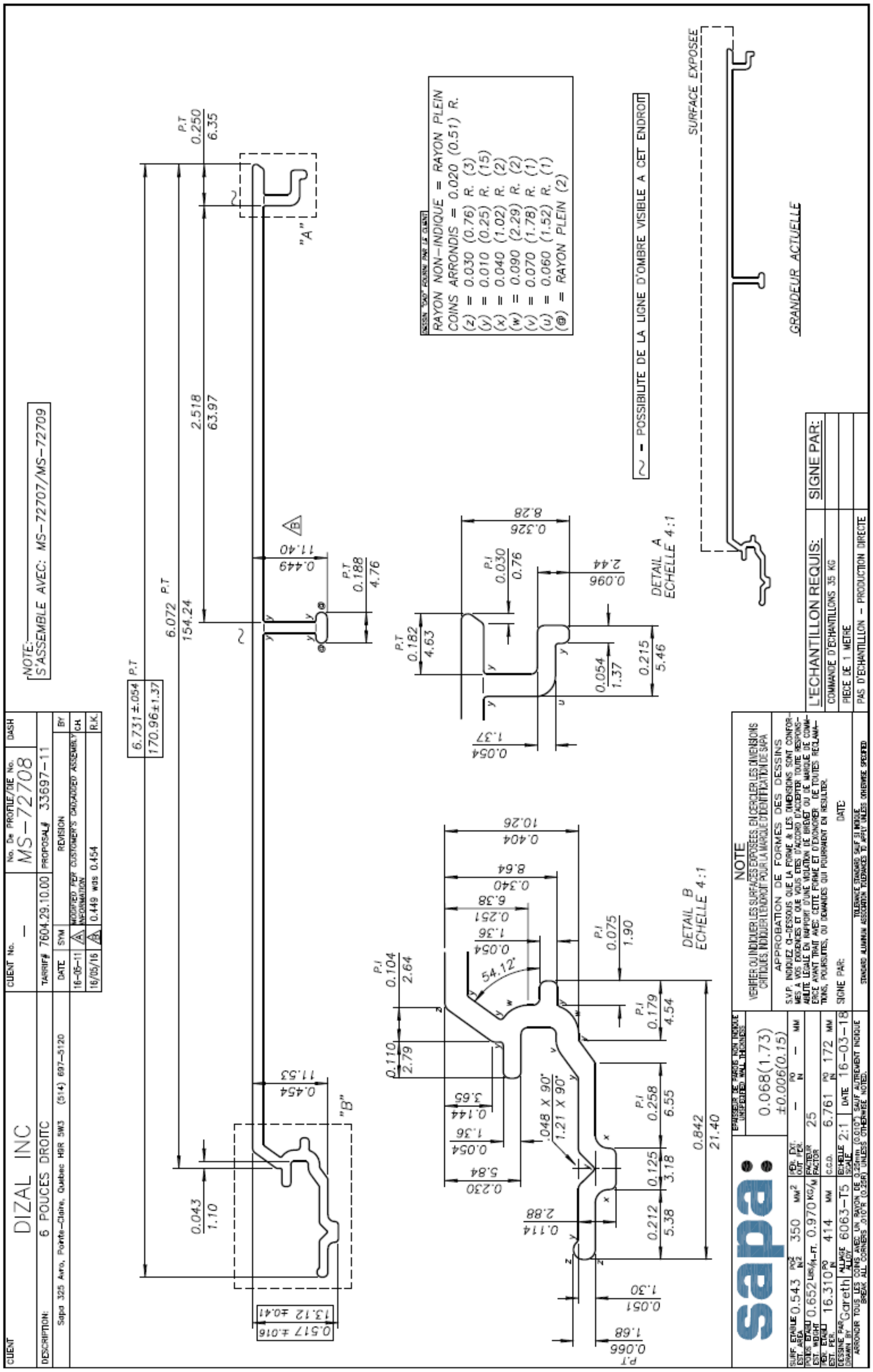
DIZAL INC
6 POUCES DROITC
Sapa 325 Avro, Pointe-Claire, Quebec H9R 5W3 (514) 697-5120
MS-72708
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NOTE: S'ASSEMBLE AVEC: MS-72707/MS-72709
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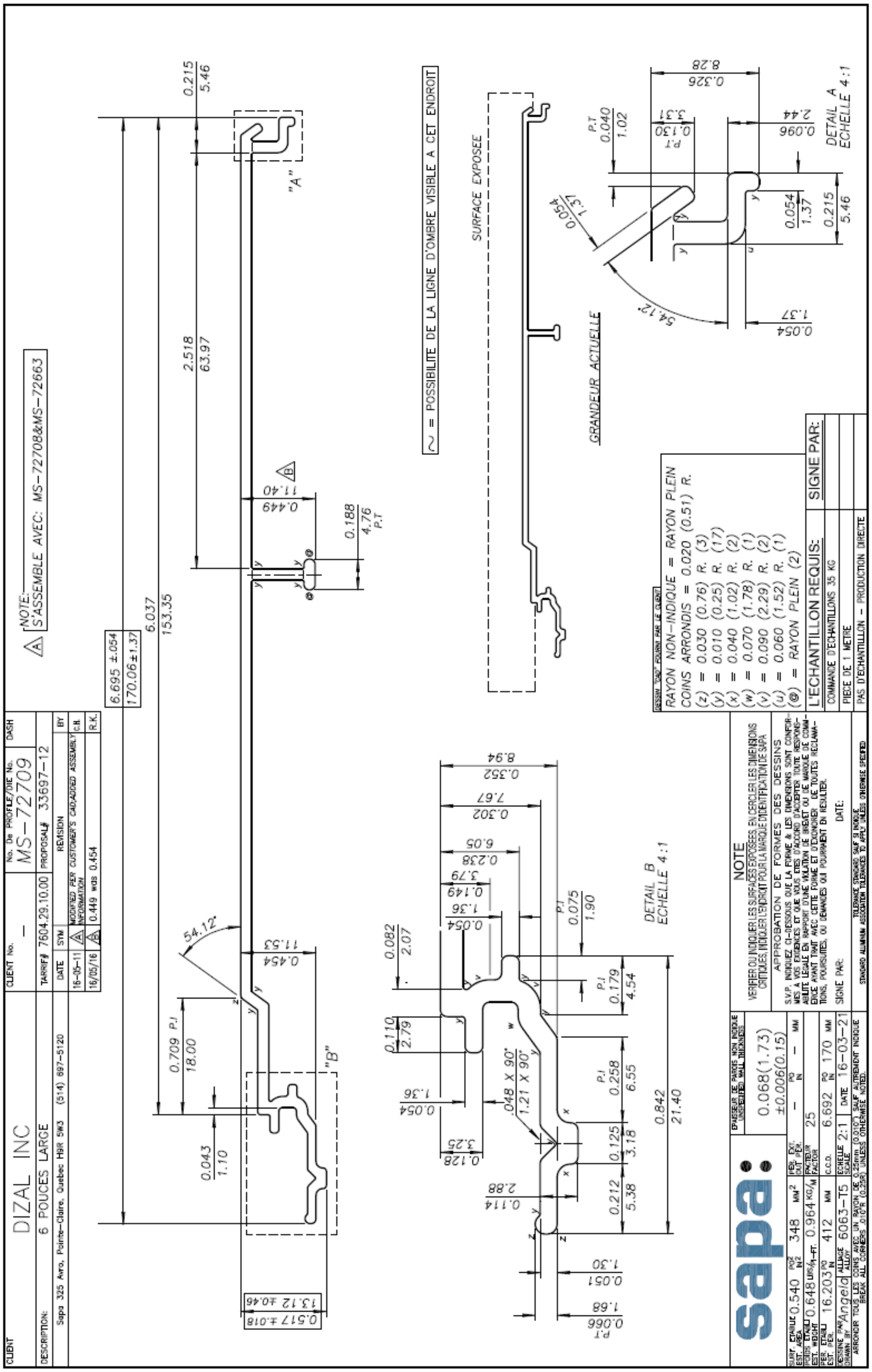
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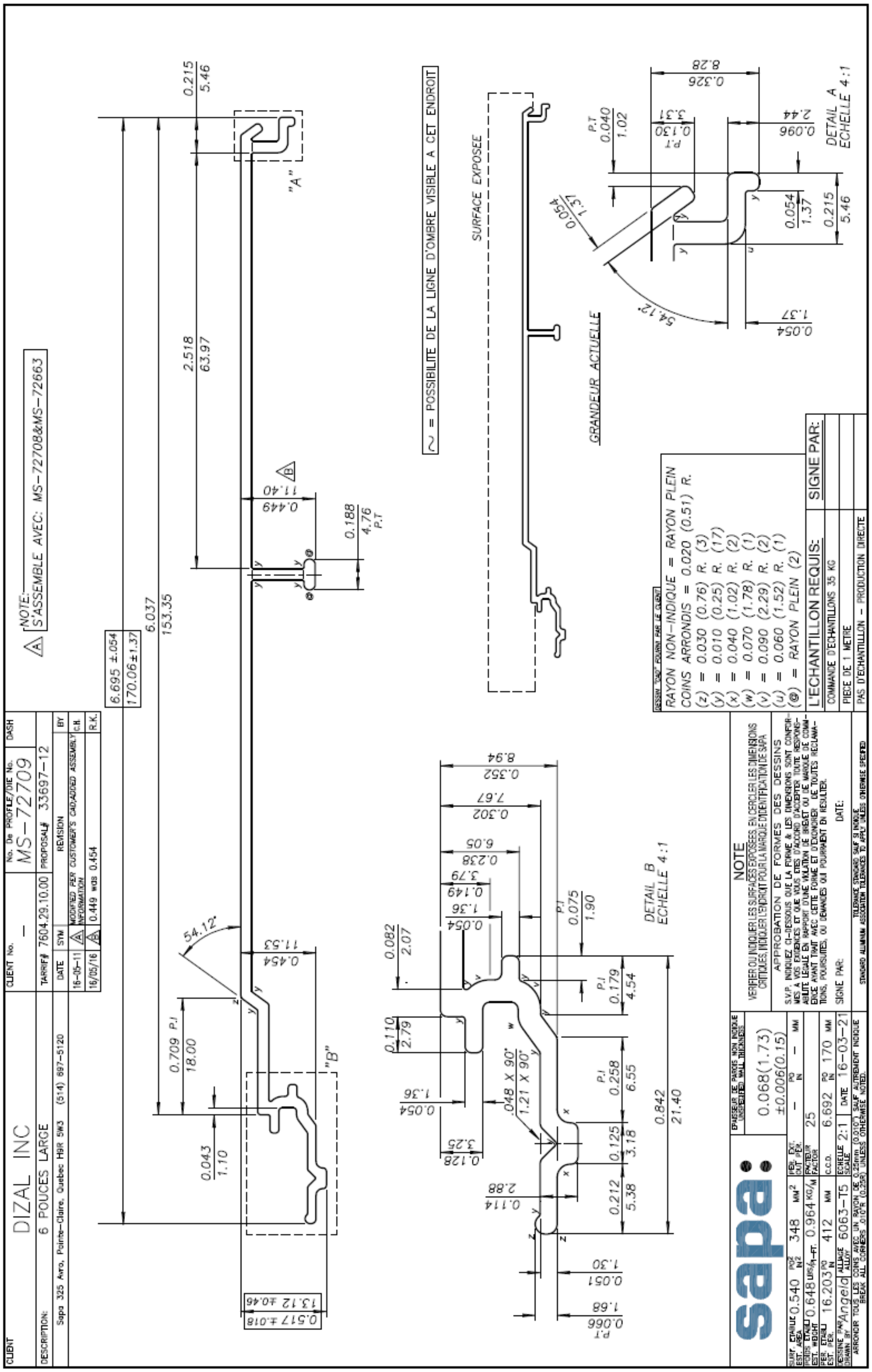
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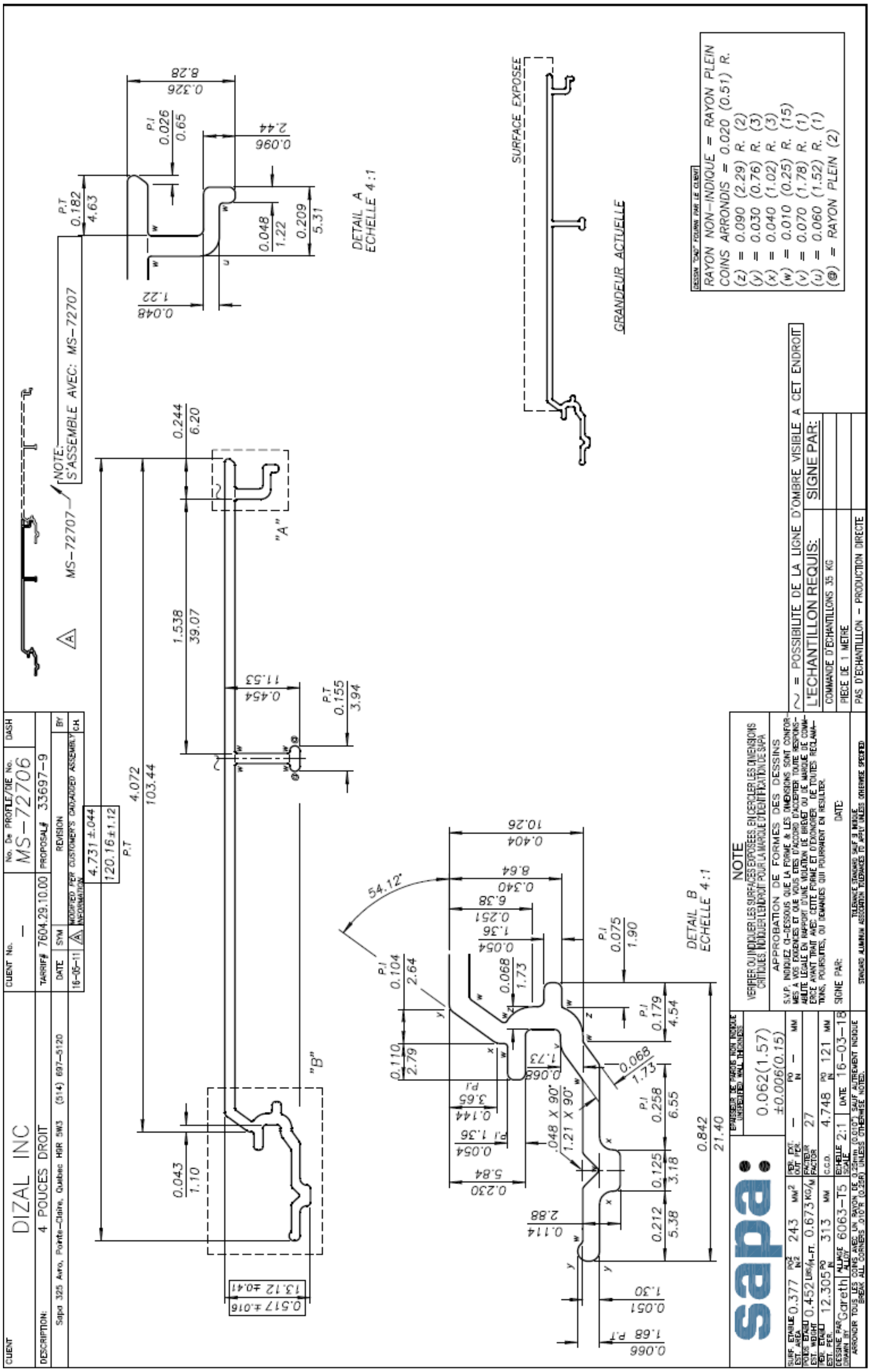
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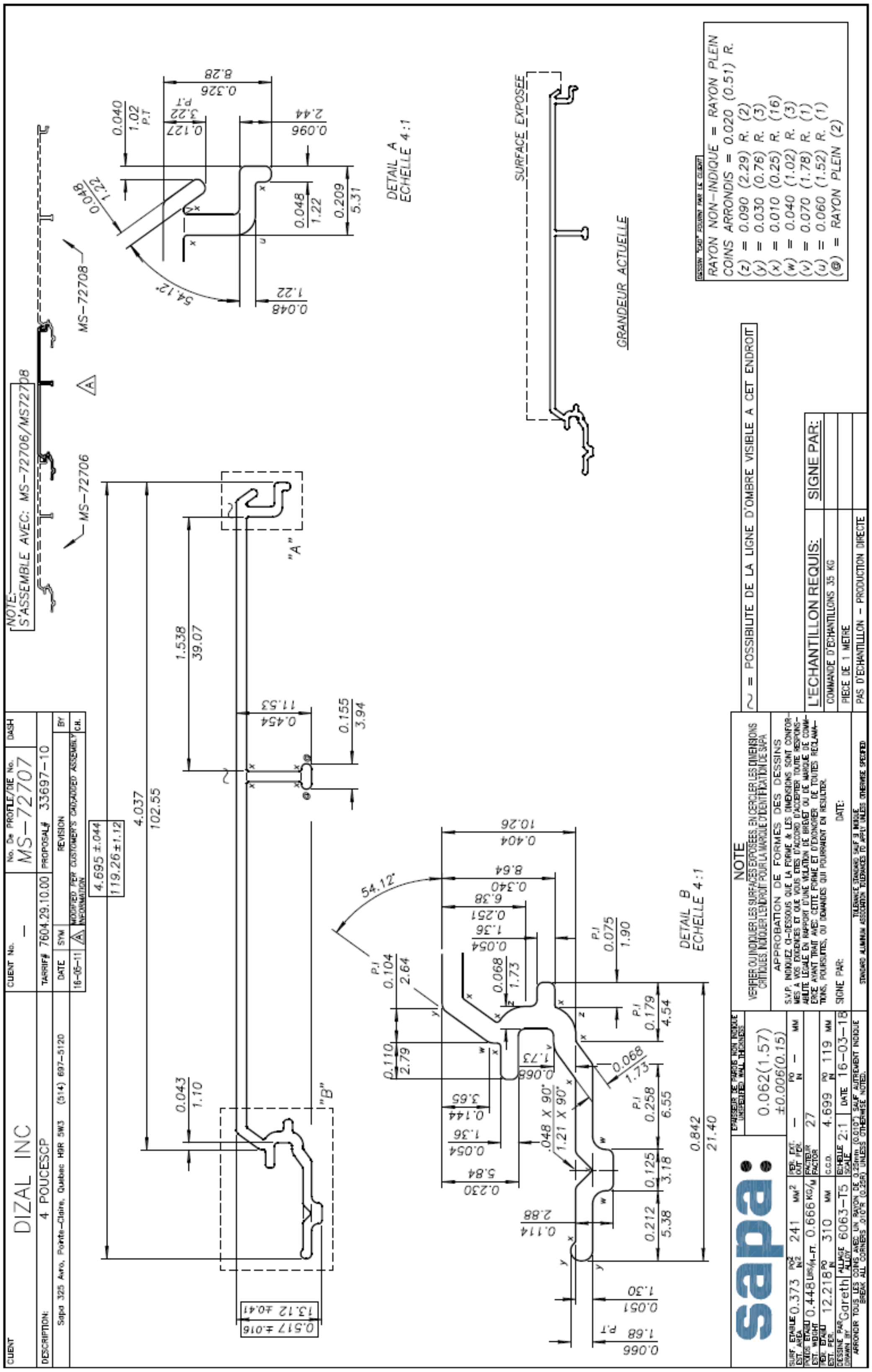
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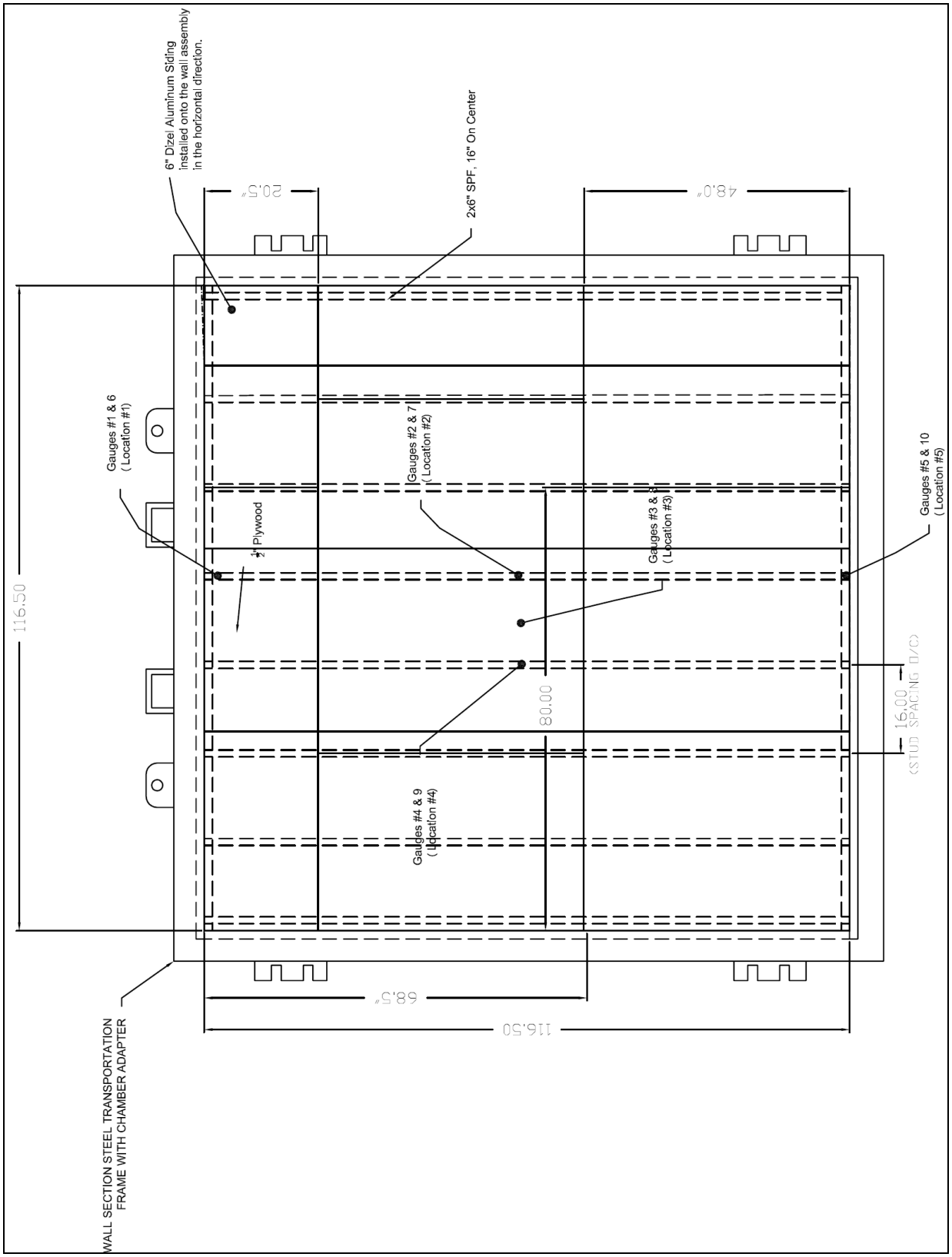
APPENDIX B

Framing and Sheathing Detail

Exova Specimen No.: 16-06-M0274-3

(1 Page)


6" Dizel Aluminum Siding installed onto the wall assembly in the horizontal direction.
2x6" SPF, 16" On Center
20.5"
48.0"
Gauges #1 & 6 (Location #1)
Gauges #2 & 7 (Location #2)
Gauges #3 & 8 (Location #3)
Gauges #5 & 10 (Location #5)
1" Plywood
116.50
80.00
16.00 (STUD SPACING O/C)
Gauges #4 & 9 (Location #4)
68.5"
116.50
WALL SECTION STEEL TRANSPORTATION FRAME WITH CHAMBER ADAPTER