2395 Speakman Dr.
Mississauga, ON
Canada L5K 1B3

P: 1 905 822 4111
F: 1 905 823 1446
info.toronto.industrials@element.com
element.com

EVALUATION OF POLYURETHANE SPRAY FOAM MATERIAL

"BOREAL NATURE ELITE"

IN ACCORDANCE WITH CCMC TECHNICAL GUIDE MF 07 27 09.01 (ISSUE DATE 1996-02-09, TECHNICAL UPDATE 2016-06-20)

Report to:	**Genyk** 1701 3e Avenue Grand-Mere, QC G9T 2W6
Attention:	Mike Richmond
Telephone:	+1 (226) 339-3089
Email:	mikerichmond@genyk.com
Report No.:	20-06-B0040 4 Pages, 5 Appendicies
Proposal No.:	20-006-95292
Date:	November 16, 2020

1.0 INTRODUCTION

At the request of *Genyk*, Element Materials Technology was retained to evaluate the performance of polyurethane spray foam material identified as "Boreal Nature Elite" in accordance with CCMC Technical Guide MF 07 27 09.01 (Issue Date: 1996-02-09, Technical Update: 2016-06-20) Section 8.1 NBC 2015 Compliance Requirements. The material was tested as outlined in Element Proposal No.: 20-006-95292.

The material used for testing was sample selected by an Element technical representative and prepared at the Element Toronto facility by Genyk personnel. A sample selection report can be found in Appendix A.

Upon receipt, the samples were assigned the following Element Sample Number:

Client Sample Description:	**Element Specimen No.:**
Boreal Nature Elite	20-06-B0040

2.0 PROCEDURE

The sample was evaluated for the following tests referenced in CCMC TG 07 27 09.01:

Test Description	Test Method
Technical Guide for Air Barrier Systems (ABS) for Exterior Walls of Buildings	**CCMC TG 07 27 09.01** (Issue Date: 1996-02-09, Technical Update: 2016-06-20)
Drying Potential (WVP of outermost layer)	ASTM E96, Procedure A (Desiccant Method)
Air Leakage Rating	CAN/ULC-S742
Structural Performance	CAN/ULC-S742
Durability of Materials	CCMC TG 07 27 09.01, Appendix E4
Air Barrier Material	CAN/ULC-S741

Optional Performance Requirements:

Test Description	Test Method
Fire Performance	CAN/ULC-S102

3.0 RESULTS

A summary of test results is shown in Table 1 below. Detailed test results and procedures are outlined in the corresponding appendices. SI units are the primary units of measure.

Table 1: Summary of Test Results
CCMC TG 07 27 09.01 – 'Boreal Nature Elite'
Element Sample No.: 20-06-B0040

Physical Property	Requirements	Results	Comments
Drying Potential, (WVP of outermost layer)	Report Value	45.5 ng/Pa•s•m^2 (0.80 US Perms)	See Appendix B for details.
Air Leakage Rating, Steel Stud with DensGlass® Sheathing CMU	≤ 0.05 L/s•m^2	Steel Stud: 0.05 L/s•m^2 *(max)* CMU: 0.02 L/s•m^2 *(max)*	Pass See Appendix C for details.
Structural Performance Steel Stud with DensGlass® Sheathing CMU	Report classification based on air leakage rating (A1…A5) and structural performance (S_/H_)	A1 – air leakage rating classification at a 1 in 50 hourly wind pressure difference of 650 Pa (13.58 psf) at 12 meters (39.4 feet) above ground	
Durability of Materials Thermal Resistance after Heat Aging of Weathered Samples Air Permeance after Heat Aging of Weathered Samples	≥ 90% retention ≤ 110% of original value	91% retention 107% of original value	Pass See Appendix D for details.
Air Barrier Material, Air Permeance after Heating Aging of Weathered Samples	≤ 0.001 L/s•m^2 increase	≤ 0.001 L/s•m^2	Pass See Appendix E for details.
Fire Performance, Surface Burning Characteristics	Report Value	160 FSR 550 SDC	See Appendix F for details.

4.0 CONCLUSION

The material submitted by Genyk, identified as *"Boreal Nature Elite",* was tested in accordance with CCMC TG 0 27 09.01 for NBC 2015 Compliance Requirements, as described in this report.

The material conforms all the requirements outlined in Table 8.1.1 of CCMC TG 0 27 09.01 (Issue Date 1996-02-09, Technical Update 2016-06-20).

5.0 REPORT REVISION SUMMARY

Revision No:	**Date:**	**Description of Revisions:**
N/A	November 16, 2020	Original Document

Reported by:

Fadi G. Basmaji, M.A.Sc., B.Eng., Ext. 11227
Building Science Specialist
Building Science Division

Reviewed by:

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

Direct readings presented by the test methods are the values being reported and form the bases for acceptance or rejection (pass/fail) and to not take into account or incorporate uncertainity. This report is related only to product identified and shall not be reproduced, except in full, without the approval of Element Materials Technology Canada Inc. This report and service are covered under Element Materials Technology Canada Inc.'s Standard Terms and Conditions of Contract, which may be found on our company's website www.element.com, or by calling 1-866-263-9268.

APPENDIX A

Drum Witnessing Report for Material Used.

Report Number: 20-06-B0040-SS (5 Pages)

element

2395 Speakman Dr.
Mississauga, ON
Canada L5K 1B3

P: 1 905 822 4111
F: 1 905 823 1446
info.toronto.industrials@element.com
element.com

Sample Selection Report

Genyk
1701 3e Avenue
Grand-Mere, QC
G9T 2W6

Report No.: 20-06-B0040-SS
Date: 2020-02-20
Proposal No.: 20-006-95292

Attn: **Mike Richmond**

At the request of *Genyk*, an Element representative witnessed the selection of chemical drums at the Genyk facility located in Cambridge, ON on February 20, 2020. Three sets of Resin and ISO were randomly selected from available inventory.

Details of the selection are provided below.

Sample Details

Sample 1 – Detailed Information - ISO Element Sample No.: 20-06-B0040-ISO	
Client Sample Name	ISO A-2732
Number of Drums Witnessed	3
Lot #	0319017301 Manufactured Date: 10/10/2019 Expiry Day: 10/10/2020
Type of Material	ISO –Part A
Dimensions	227 kg each drum
Date of Witness	2020-02-20
Markings	'Element' Signature of Element Representative Date (Picture on page 3)

Sample 2 – Detailed Information - Resin Element Sample No.: 20-06-B0040-Resin	
Client Sample Name	Boreal Nature Elite - Winter
Manufacturing Date	2020-01-20 2020-07-20
Number of Drums Witnessed	3
Lot #	L-20023
Type of Material	Resin
Dimensions	243.5 kg each drum
Markings	'Element' Signature of Element Representative Date (Picture on page 4)

Element Witness

Witnessing Information	
Location of Selection	**Genyk** 101 Sheldon Dr., Unit 3 Cambridge, ON N1R 6T6
Element Technical Representative	Fadi Basmaji Building Systems Specialist Building Science Division
Element Signature	

Photos:


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Element
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APPENDIX B

Drying Potential – ASTM E96 - Detailed Test Procedure and Results.

Element Report No.: 20-06-B0040-WVP

(4 Pages)

element

2395 Speakman Dr.
Mississauga, ON
Canada L5K 1B3

P: 1 905 822 4111
F: 1 905 823 1446
info.toronto.industrials@element.com
element.com

EVALUATION OF 'BOREAL NATURE ELITE' SPRAY FOAM MATERIAL FOR WATER VAPOR PERMEANCE IN ACCORDANCE WITH ASTM E96/E96M-16

Report to:	**Genyk** 1701 3e Avenue Grand-Mere, QC G9T 2W6
Attention:	Mike Richmond
Telephone:	+1 (226) 339-3089
Email:	mikerichmond@genyk.com
Report No.:	20-06-B0040-WVP 4 Pages
Proposal No.:	20-006-95292
Original Date:	September 4, 2020

1.0 INTRODUCTION

At the request of *Genyk*, Element Materials Technology was retained to evaluate a sample of spray foam material for water vapor permeance properties in accordance with ASTM E96/96M-16 test method.

Upon receipt, the sample was assigned the following Element Sample No.:

Client Sample Identification	Element Sample No.
Boreal Nature Elite	20-06-B0040-WVP

2.0 PROCEDURE

The sample was evaluated using the following test method:

Test Description	Test Method
Standard Test Methods for Water Vapor Transmission of Materials	ASTME96/E96M-16, Procedure A (Desiccant)

Procedure:	Method A (Desiccant)
No. of Specimens:	Three (3) and one (1) dummy
Sealant:	Type 1 GE Silicone (100% silicone) 60% microcrystalline wax; 40% refined crystalline paraffin wax
Equipment:	Mitutoyo Micrometer, MII# B05010 Digital Calipers, MII# B10643 Digital Balance (0.01g), MII# B17286 Barometer, MII# B14977 Environmental Controller, MII# B11364
Conditioning:	>88 hours at 23 ± 2°C, 50 ± 5% RH
Test Area:	0.0645 m^2
Container Design:	Stainless Steel Square Tray
Thickness:	57.48 mm *(average of 7 measurements)*
Test Conditions:	23 ± 2°C, 50 ± 5% RH
Test Dates:	2020-08-19 to 2020-08-31

3.0 RESULTS

A summary of the water vapor permeance test results is presented in Table 1 and Figure 1. SI units are the primary unit of measure.

Table 1 – Water Vapor Permeance Test Results
Applicable Standard: ASTM E96/E96M-16
Element Sample No.: 20-06-B00040-WVP

Specimen Number	Mass, g			Water Vapor Permeance	
	Initial	Final	Change	ng/Pa·s·m^2	US Perms
1	3030.350	3034.120	3.770	45.165	0.790
2	3034.060	3037.890	3.830	46.416	0.811
3	3146.720	3150.430	3.710	44.868	0.784
Average	**3070.377**	**3074.147**	**3.770**	**45.5**	**0.80**

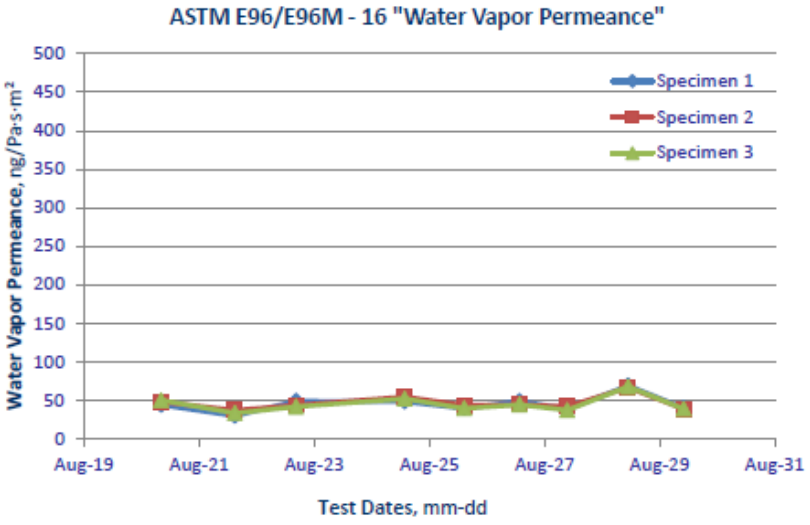


Figure 1: Elapsed time vs Water Vapor Permeance for *Element Sample No.: 20-06-B0040-WVP.*

4.0 CONCLUSION

The material submitted by *Genyk*, identified as "Boreal Nature Elite", was tested as described in this report. The material had a measured water vapor permeance of 45.5 ng/Pa•s•m^2 [0.80 US perms].

5.0 REVISION HISTORY

Date:	Revision:	Comments:
2020-09-04	Original Document	N/A

Reported by:

Fadi G. Basmaji, M.A.Sc., B.Eng., Ext. 11227
Building Products Specialist
Products Testing Group

Reviewed by:

Rubaiyat Khondker, P. Eng., M.A.Sc., Ext. 11662
Supervisor, Building Products
Products Testing Group

APPENDIX C

Air Leakage and Structural Performance – CAN/ULC-S742 -Detailed Test Procedure and Results.

Element Report No.: 20-06-B0040-W1

(113 Pages)

element

2395 Speakman Dr.
Mississauga, ON
Canada L5K 1B3

P: 1 905 822 4111
F: 1 905 823 1446
info.toronto.industrials@element.com
element.com

EVALUATION OF "BOREAL NATURE ELITE" SELF-ADHERED AIR BARRIER MEMBRANE ASSEMBLIES IN ACCORDANCE WITH CAN/ULC-S742-11

Report to:	Genyk 1701 3e Avenue Grand-Mere, QC G9T 2W6
Attention:	Mike Richmond
Telephone: **Email:**	226-339-3089 mikerichmond@genyk.com
Report No.:	20-06-B0040-W1 41 Pages, 10 Appendices
Proposal No.:	20-006-95292
Date:	November 6, 2020

TABLE OF CONTENTS

APPENDICES

1.0 INTRODUCTION

At the request of Genyk, Element Materials Technology Inc. was retained to evaluate various wall assembly configurations using the "Boreal Nature Elite" spray polyurethane foam air vapour barrier applied to exterior gypsum sheathed and concrete masonary block (CMU) walls in accordance with CAN/ULC-S742-11 as outlined in Element proposal number 20-006-95292.

Upon receipt, construction and air barrier system application, the specimens were assigned the following Element Specimen Numbers:

Steel Stud (SS) with Exterior Gypsum Sheathing Wall Specimens:

Client Specimen Description	**Element Specimen No.**
Primary Air Barrier Material: *Boreal Nature Elite Spray Polyurethane Foam*	20-06-B0040-SS-OP-1

Wall Specimen Description
Opaque wall assembly test specimen with exterior gypsum with metal studs.

Steel Studs: 18 ga. channel-shaped nominal 152 mm (6") deep on nominal 406 mm (16") O/C
Exterior Sheathing: nominal 1219 mm x 2438 mm x 12.7 mm thick (4' x 8' x 1/2" thick) thick Georgia Pacific gypsum exterior sheathing as per CAN/ULC-S742-11, Figure D4

Client Specimen Description	**Element Specimen No.**
Primary Air Barrier Material: *Boreal Nature Elite Spray Polyurethane Foam*	20-06-B0040-SS-PT-2

Wall Specimen Description
Wall assembly test specimen with exterior gypsum with metal studs and penetrations (masonry ties and anchors).

Steel Studs: 18 ga. channel-shaped nominal 152 mm (6") deep on nominal 406 mm (16") O/C
Exterior Sheathing: nominal 1219 mm x 2438 mm x 12.7 mm thick (4' x 8' x 1/2" thick) thick Georgia Pacific gypsum exterior sheathing as per CAN/ULC-S742-11, Figure D5

Client Specimen Description	**Element Specimen No.**
Primary Air Barrier Material: *Boreal Nature Elite Spray Polyurethane Foam*	20-06-B0040-SS-CB-3

Wall Specimen Description
Opaque wall assembly test specimen with exterior gypsum with metal studs to foundation interface.

Steel Studs: 18 ga. channel-shaped nominal 152 mm (6") deep on nominal 406 mm (16") O/C
Exterior Sheathing: nominal 1219 mm x 2438 mm x 12.7 mm thick (4' x 8' x 1/2" thick) thick Georgia Pacific gypsum exterior sheathing as per CAN/ULC-S742-11, Figure D6

Masonry Block (CMU) Wall Specimens:

Client Specimen Description — **Element Specimen No.**

Primary Air Barrier Material: *Boreal Nature Elite Spray Polyurethane Foam* — 20-06-B0040-CMU-OP-4

Wall Specimen Description
Opaque wall assembly test specimen for masonry block

Masonry Block: 8" x 16" x 8" / 200 mm x 400 mm x 203 mm (Typical) as per CAN/ULC-S742-11, Figure D1

Client Specimen Description — **Element Specimen No.**

Primary Air Barrier Material: *Boreal Nature Elite Spray Polyurethane Foam* — 20-06-B0040-CMU-PT-5

Wall Specimen Description
Wall assembly test specimen for masonry block with penetrations (masonry ties and anchors).

Masonry Block: 8" x 16" x 8" / 200 mm x 400 mm x 203 mm (Typical) as per CAN/ULC-S742-11, Figure D2

Client Specimen Description — **Element Specimen No.**

Primary Air Barrier Material: *Boreal Nature Elite Spray Polyurethane Foam* — 20-06-B0040-CMU-CB-6

Wall Specimen Description
Wall assembly test specimen for masonry block with foundation interface.

Masonry Block: 8" x 16" x 8" / 200 mm x 400 mm x 203 mm (Typical) as per CAN/ULC-S742-11, Figure D3

Note: Photographs documenting the air barrier installation for each respective wall assembly are located in Appendices G to L. Detail drawings for both wall sections are located in Appendices M & N.

2.0 TEST WALL CONSTRUCTION

2.1 Steel Stud (SS) with Exterior Gypsum Sheathing Wall Specimens:

Opaque Wall Section – Specimens 20-06-B0040-SS-OP-1

The 2959 mm x 2959 mm (116.5" x 116.5") test wall section was constructed using commercially purchased steel studs/tracks, fasteners, and exterior gypsum during the period of March 16th – 27th, 2020 and built as per the construction details located in Figure D4 of CAN/ULC-S742-11.

The 18 ga.channel-shaped galvanized steel studs measured 152 mm (6") deep with 33.7 mm (1-21/64") long returns. The 18 ga galvanized steel top and bottom channels measured nominally 152 mm (6") deep (inside dimension) with 33.3 mm (1-5/16") returns. An 18 ga. horizontal channel-shaped galvanized steel bridging bar spanned the studs, passing through the pre-punched openings in the studs, approximately 1727 mm (68") up from the bottom of the test sample. The bridging bar measured 38.1 mm (1-1/2") wide with 12.7 mm (1/2") returns. The bridging bar was fastened to the studs via an 82.6 mm (3-1/4") long section of 38.1 mm x 38.1 mm (1-1/2" x 1-1/2") galvanized steel angle (bridging clip), one per stud. Two #8 x 12.7 mm (1/2") long modified truss-head self-drilling screws secured each bridging clip to the adjacent stud, and two #8 x 12.7 mm (1/2") long modified truss-head self-drilling screws secured each bridging clip to the bridging bar. The bridging bar spanned the intermediate studs. The gypsum sheathing was orientated with the long edges horizontal and fastened to the steel studs using #6 x 31.8 mm (1-1/4") long scavenger (flat)-head self-drilling drywall screws on nominal 203 mm (8") centers. Further details of the wall configurations are located in Appendix G.

Penetrations Wall Section – Specimens 20-06-B0040-SS-PT-2

The 2959 mm x 2959 mm (116.5" x 116.5") test wall section was constructed on top of the curb using commercially purchased steel studs/tracks, fasteners, and exterior gypsum during the period of March 16th – 27th, 2020 and built as per the construction details located in Figures D5 of CAN/ULC-S742-11.

The steel stud, steel top and bottom channel, and bridging bar detail (including fastening details) were as mentioned above. The bridging bar spanned the five intermediate studs adjacent to the window opening, 1197 mm (47-1/8") up from the bottom of the test sample. Additional steel stud sections and top and bottom steel channel sections were used in the construction of the rough window opening. The gypsum sheathing was orientated with the long edges horizontal and fastened to the steel studs using #6 x 31.8 mm (1-1/4") long scavenger (flat)-head self-drilling drywall screws on nominal 203 mm (8") centers. Further details of the wall configurations are located in Appendix H.

Opaque Foundation Interface Wall Section – Specimens 20-06-B0040-SS-CB-3

The steel test frame opening was complete with a 305 mm (12") high, 203 mm (8") deep concrete curb along the bottom. The 2959 mm x 2654 mm (116.5" x 104.5") test wall section was constructed on top of the curb using commercially purchased el studs/tracks, fasteners, and exterior gypsum during the period of March 16th – 27th, 2020 and built as per the construction details located in Figures D6 of CAN/ULC-S742-11.

The steel stud, steel top and bottom channel, and bridging bar detail (including fastening details) were as mentioned above for the Opaque Wall Section. The gypsum sheathing was orientated with the long edges horizontal and fastened to the steel studs using #6 x 31.8 mm (1-1/4") long scavenger (flat)-head self-drilling drywall screws on nominal 203 mm (8") centers. Further details of the wall configurations are located in Appendix I.

2.2 Masonry Block (CMU) Wall Specimens:

Opaque Wall Section – Specimens 20-06-B0040-CMU-OP-4

The 2959 mm x 2959 mm (116.5" x 116.5") test wall section was constructed using commercially purchased CMU block (8" x 16") on March 28th, 2020 and built as per the construction details located in Figure D1 of CAN/ULC-S742-11. Further details of the wall configurations are located in Appendix J. The wall assembly was permitted to cure for a minimum of 30-days prior to air barrier system application.

Penetrations Wall Section – Specimens 20-06-B0040-CMU-PT-5

The 2959 mm x 2959 mm (116.5" x 116.5") test wall section was constructed using commercially purchased CMU block (8" x 16") on March 28th, 2020 and built as per the construction details located in Figures D2 of CAN/ULC-S742-11. Further details of the wall configurations are located in Appendix K. The wall assembly was permitted to cure for a minimum of 30-days prior to air barrier system application.

Opaque Foundation Interface Wall Section – Specimens 20-06-B0040-CMU-CB-6

The 2959 mm x 2654 mm (116.5" x 104.5") test wall section was constructed using commercially purchased CMU block (8" x 16") on March 28th, 2020 and built as per the construction details located in Figures D3 of CAN/ULC-S742-11. Further details of the wall configurations are located in Appendix L. The wall assembly was permitted to cure for a minimum of 30-days prior to air barrier system application.

2.3 Application of Air Barrier

The "Boreal Nature Elite" spray polyurethane foam air vapour barrier was applied on the exterior side of the test walls at Element's Systems Laboratory by representatives from Genyk on April 3rd, 2020 for the steel stud walls with exterior gypsum and on May 27th, 2020 for the CMU block walls. The air barrier application was witnessed by representatives of Element's Building Systems Laboratory staff.

Steel Stud (SS) with Exterior Gypsum Sheathing Wall Specimens:
The exterior gypsum surface to the test frame perimeter including Element's steel frame and wood liner, window rough openings, and foundation interfaces were primed with Henry Blueskin Adhesive followed by application of Henry Blueskin self-adhesive membrane, 1 mm (40 mil) x 229 mm (9"). The penetrations (brick-ties, electrical boxes, steel square box, and pipes) were sealed with Henry Blueskin 925 BES Sealant. Please refer to Appendice G to I for details.

The mock-up window was installed (shimmed and screwed in place) into the rough opening, the perimeter rough opening was fitted with backer rod, which was then sealed with low expansion insulating foam sealant on the exterior.

Masonry Block (CMU) Wall Specimens:
The exterior CMU block surface to the test frame perimeter including Element's steel frame and wood liner, window rough openings, and foundation interfaces were primed with Henry Blueskin Adhesive followed by application of Henry Blueskin self-adhesive membrane, 1 mm (40 mil) x 229 mm (9"). The penetrations (brick-ties, electrical boxes, steel square box, and pipes) were sealed with Dow Dowsil Contractors Weatherproofing Sealant. Please refer to Appendice J to L for details.

The mock-up window was installed (shimmed and screwed in place) into the rough opening, the perimeter rough opening was fitted with backer rod, which was then sealed with low expansion insulating foam sealant on the exterior.

3.0 PROCEDURE

Test Method	Test Description
Section 6.3.2.1 (A), ASTM E2357-11, Section 9.1	Air Leakage
Section 6.3.3.2 (A)	Wind Pressure Loading
Section 6.3.4	Deflection
Section 6.3.2.1 (A), ASTM E2357-11, Section 9.3	Post Conditioning Air Permeance

Note: SI Units are the primary units of measure.

3.1 Air Leakage Testing

Testing was conducted in both exfiltration (-) and infiltration (+) directions. Upon mounting the wall system on the wall test apparatus, a sheet of 6 mil poly was draped over and sealed against the exterior face of the specimen's test frame utilizing sheathing tape and double-sided gasket material for extraneous air leakage measurement purposes.

Using the procedure outlined in CAN/ULC-S742-11, Referencing ASTM E2357-11, Section 9.1.2, the wall section was subjected to positive and negative pressures of: 25, 50, 75, 100, 150, 250, and 300 Pa (0.52, 1.04, 1.57, 2.09, 3.13, 5.22, and 6.27 psf). Upon completion of the extraneous air leakage, the 6 mil poly was carefully removed and the actual specimen air leakage testing was conducted at the test pressure noted above.

As per ASTM E2357-11, Section 11.4.1 logarithmic graphs for each air leakage test (infiltration / exfiltration) displaying the linear regression ($r^2 > 0.95$) values are located in Appendices A to F.

The air leakage testing as described above was also conducted upon completion of the "Wind Pressure Loading & Deflection" portion as outlined in the standard.

3.2 Wind Pressure Conditioning

The following wind pressure loading schedule was applied to the wall system using the loads prescribed for a sustained 1 in 50 hourly wind pressure difference of 650 Pa (13.58 psf) at a building height 12 meters (39.4 feet) above grade:

Sustained Loads, P_1 & P'_1:

Deformation Test (Sustained Pressure, P_1)
The wall system was subjected to increasing pressure in increasing stages for a minimum period of 10 seconds at each stage, up to a maximum pressure of 650 Pa (13.58 psf) which was maintained for 1-hour.

Deformation Test (Sustained Pressure, P'_1)
The wall system was subjected to increasing pressure in increasing stages for a minimum period of 10 seconds at each stage, up to a maximum pressure of -650 Pa (-13.58 psf) which was maintained for 1-hour.

The deformation measurements were taken continuously during pressurisation.

Note: As per CAN/ULC-S742-11, Section 6.3.3.5, P_1 air pressure differences are to be applied in 100 Pa (2.09 psf) increments. However, as testing was also conducted in conjunction with ASTM E2357-11, the loading increments used were 100 Pa (2.09 psf) stepping followed by the 650 Pa (13.58 psf) pressure hold (which exceeds the standard requirement of 600 Pa (12.53 psf) to match ASTM E2357-11). This is considered a more severe stepping increment and is representative of the procedure outlined in CAN 07272, in which the CAN/ULC-S742 standard is based.

Cyclic Loads, P_2 & P'_2:

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 +950 Pa (19.84 psf) and was followed by 1,000 cycles from 0 to –950 Pa (-19.84 psf). The deformation measurements were taken continuously during cycling.

Gust Loads, P_3 & P'_3:

The wall system was then subjected to a 'Gust Wind' pressure of +1410 Pa (29.45 psf) followed by a repeat 'Gust Wind' pressure of –1410 Pa (-29.45 psf). These pressures were held for a minimum of 3 seconds. The maximum deformation readings were taken after each gust pressure.

3.3 Deflection

Upon completing the wind pressure conditioning sub-section, the wall specimens were subjected to wind pressure loading of ±1440 Pa (±30.08 psf) for 10 seconds (exceeding the P_2 and P'_2 values as per CAN/ULC-S742-11, Section 6.3.4) which matches the ASTM E2357-11, Table 2 $Q_{10} > 0.40$ kPa (8.35 psf) / $D_{0.60}$ @ 1440 Pa (30.08 psf) values.

After completing the deflection loads above, air leakage testing was again conducted at ambient conditions at an exterior temperature of -20°C (-4°F) and the interior temperature of 20°C (68°F) as per CAN/ULC-S742-11, Section 6.3.2.3 in both exfiltration (-) and infiltration (+) cases.

3.4 Test Dates

Specimen Number	Test Criteria	Testing Date
20-06-B0040-SS-OP-1	Air Leakage (Exfiltration) - Prior	May 13, 2020
	Air Leakage (Infiltration) - Prior	May 13, 2020
	Wind Load Conditioning	May 14, 2020
	Wind Load Durability	May 14, 2020
	Air Leakage (Exfiltration) - Ambient	May 14, 2020
	Air Leakage (Infiltration) - Ambient	May 14, 2020
	Air Leakage (Exfiltration) - Cold	May 15, 2020
	Air Leakage (Infiltration) - Cold	May 15, 2020
20-06-B0040-SS-PT-2	Air Leakage (Exfiltration) - Prior	May 27, 2020
	Air Leakage (Infiltration) - Prior	May 27, 2020
	Wind Load Conditioning	May 28, 2020
	Wind Load Durability	May 28, 2020
	Air Leakage (Exfiltration) - Ambient	May 28, 2020
	Air Leakage (Infiltration) - Ambient	May 28, 2020
	Air Leakage (Exfiltration) - Cold	May 29, 2020
	Air Leakage (Infiltration) - Cold	May 29, 2020
20-06-B0040-SS-CB-3	Air Leakage (Exfiltration) - Prior	June 16, 2020
	Air Leakage (Infiltration) - Prior	June 16, 2020
	Wind Load Conditioning	June 16, 2020
	Wind Load Durability	June 16, 2020
	Air Leakage (Exfiltration) - Ambient	June 17, 2020
	Air Leakage (Infiltration) - Ambient	June 17, 2020
	Air Leakage (Exfiltration) - Cold	June 18, 2020
	Air Leakage (Infiltration) - Cold	June 18, 2020
20-06-B0040-CMU-OP-4	Air Leakage (Exfiltration) - Prior	June 29, 2020
	Air Leakage (Infiltration) - Prior	June 29, 2020
	Wind Load Conditioning	June 30, 2020
	Wind Load Durability	June 30, 2020
	Air Leakage (Exfiltration) - Ambient	June 30, 2020
	Air Leakage (Infiltration) - Ambient	June 30, 2020
	Air Leakage (Exfiltration) - Cold	July 2, 2020
	Air Leakage (Infiltration) - Cold	July 2, 2020
20-06-B0040-CMU-PT-5	Air Leakage (Exfiltration) - Prior	July 3, 2020
	Air Leakage (Infiltration) - Prior	July 3, 2020
	Wind Load Conditioning	July 6, 2020
	Wind Load Durability	July 6, 2020
	Air Leakage (Exfiltration) - Ambient	July 6, 2020
	Air Leakage (Infiltration) - Ambient	July 6, 2020
	Air Leakage (Exfiltration) - Cold	July 7, 2020
	Air Leakage (Infiltration) - Cold	July 7, 2020
20-06-B0040-CMU-CB-5	Air Leakage (Exfiltration) - Prior	July 22, 2020
	Air Leakage (Infiltration) - Prior	July 22, 2020
	Wind Load Conditioning	July 23, 2020
	Wind Load Durability	July 23, 2020
	Air Leakage (Exfiltration) - Ambient	July 23, 2020
	Air Leakage (Infiltration) - Ambient	July 23, 2020
	Air Leakage (Exfiltration) - Cold	July 25, 2020
	Air Leakage (Infiltration) - Cold	July 25, 2020

3.5 General Test Specimen Setup Photographs

Figure 1 – Hygrothermal Chamber Prior to Specimen Installation Displaying Location of Air Seal

Figure 2 – General Specimen Installation between Warm Side and Hygrothermal Chamber

4.0 RESULTS FOR STEEL STUDS (SS) WITH EXTERIOR GYPSUM SHEATHING WALL SPECIMENS

Table 1 – Summarized Air Leakage Results at 75 Pa (1.57 psf) in Accordance with CAN/ULC-S742-11, Section 6.3.2.1 (A), referencing ASTM E2357-11 – Section 9.1, Air Leakage Testing

Element Specimen No.:	Airflow Direction	Optional	Ambient	Cold	Air Leakage Rate Classification[2]
		Calculated Air Leakage at 75 Pa (1.57 psf) Prior to Wind Pressure Conditioning L/s·m² (cfm/ft²)	Calculated Air Leakage at 75 Pa (1.57 psf) After Wind Pressure Conditioning L/s·m² (cfm/ft²)	Calculated Air Leakage at 75 Pa (1.57 psf) After Wind Pressure Conditioning L/s·m² (cfm/ft²)	
20-06-B0040-SS-OP-1 *(Opaque Wall)*	- EXF	0.0037 (0.0007)	0.0044 (0.0009)	0.0099 (0.0020)	A1[2]
	+ INF	0.0083 (0.0017)	0.0139[1] (0.0028)	0.0132 (0.0027)	
20-06-B0040-SS-PT-2 *(Penetration Wall)*	- EXF	0.0462 (0.0093)	0.0500 (0.0100)	0.0245 (0.0049)	
	+ INF	0.0474 (0.0095)	0.0503[1] (0.0101)	0.0354 (0.0071)	
20-06-B0040-SS-PT-3 *(Opague Wall with Foundation Interface)*	- EXF	0.0440 (0.0088)	0.0469[1] (0.0094)	0.0183 (0.0037)	
	+ INF	0.0473 (0.0095)	0.0434 (0.0087)	0.0212 (0.0043)	

Notes: '-' denotes exfiltration airflow direction (simulated negative wind loading)
'+' denotes infiltration airflow direction (simulated positive wind loading)

[1] Highest measured air leakage rate at 75 Pa (1.57 psf).

[2] As per CAN/ULC-S742-11, an air barrier in compliance with this standard shall be classified as one of the types listed in clause 4.1.1.1 to clause 4.1.1.5 according to its reference air leakage rate:

4.1.1.1 A1 – The reference air leakage rate shall not exceed 0.05 L/(s·m²) (0.009 cfm/ft²) at a pressure difference of 75 Pa (1.57 psf).
4.1.1.2 A2 – The reference air leakage rate shall not exceed 0.10 L/(s·m2) (0.019 cfm/ft2) at a pressure difference of 75 Pa (1.57 psf).
4.1.1.3 A3 – The reference air leakage rate shall not exceed 0.15 L/(s·m²) (0.029 cfm/ft²) at a pressure difference of 75 Pa (1.57 psf).
4.1.1.4 A4 – The reference air leakage rate shall not exceed 0.20 L/(s·m²) (0.039 cfm/ft²) at a pressure difference of 75 Pa (1.57 psf).
4.1.1.5 A5 – The reference air leakage rate shall not exceed 0.50 L/(s·m²) (0.098 cfm/ft²) at a pressure difference of 75 Pa (1.57 psf).

The reference air leakage rate is the highest air leakage rate of those recorded among all specimens when tested in accordance with CAN/ULC-S742-11, Section 6.

4.1 Detailed Element Specimen No. 20-06-B0040-SS-OP-1 Results

Table 2 – Summarized Air Leakage Results in Accordance with ASTM E2357-11 - Section 9.1, Air Leakage Testing Element Specimen No.: 20-06-B0040-SS-OP-1 (Exfiltration '-')

Differential Pressure Pa (psf)	Optional		Ambient		Cold [-20°C (-4°F)]	
	Calculated Air Leakage Prior to Wind Pressure Conditioning		Calculated Air Leakage After Wind Pressure Conditioning		Calculated Air Leakage After Wind Pressure Conditioning	
	L/s·m²	cfm/ft²	L/s·m²	cfm/ft²	L/s·m²	cfm/ft²
25 (0.52)	0.0027	0.0005	0.0035	0.0007	0.0058	0.0012
50 (1.04)	0.0033	0.0007	0.0040	0.0008	0.0081	0.0016
75 (1.57)	**0.0037**	**0.0007**	**0.0044**	**0.0009**	**0.0099**	**0.0020**
100 (2.09)	0.0040	0.0008	0.0047	0.0009	0.0113	0.0023
150 (3.13)	0.0045	0.0009	0.0051	0.0010	0.0137	0.0028
250 (5.22)	0.0053	0.0011	0.0057	0.0011	0.0175	0.0035
300 (6.24)	0.0056	0.0011	0.0059	0.0012	0.0190	0.0038

Table 3 – Summarized Air Leakage Results in Accordance with ASTM E2357-11 - Section 9.1, Air Leakage Testing Element Specimen No.: 20-06-B0040-SS-OP-1 (Infiltration '+')

Differential Pressure Pa (psf)	Optional		Ambient		Cold [-20°C (-4°F)]	
	Calculated Air Leakage Prior to Wind Pressure Conditioning		Calculated Air Leakage After Wind Pressure Conditioning		Calculated Air Leakage After Wind Pressure Conditioning	
	L/s·m²	cfm/ft²	L/s·m²	cfm/ft²	L/s·m²	cfm/ft²
25 (0.52)	0.0031	0.0006	0.0068	0.0014	0.0060	0.0012
50 (1.04)	0.0057	0.0012	0.0107	0.0021	0.0099	0.0020
75 (1.57)	**0.0083**	**0.0017**	**0.0139**	**0.0028**	**0.0132**	**0.0027**
100 (2.09)	0.0108	0.0022	0.0168	0.0034	0.0163	0.0033
150 (3.13)	0.0155	0.0031	0.0219	0.0044	0.0219	0.0044
250 (5.22)	0.0246	0.0049	0.0306	0.0061	0.0317	0.0064
300 (6.24)	0.0290	0.0058	0.0344	0.0069	0.0362	0.0073

* As per ASTM E2357-11, logarithmic graphs for each air leakage test (infiltration/exfiltration) displaying the linear regression (r^2) value are located in Appendix A.

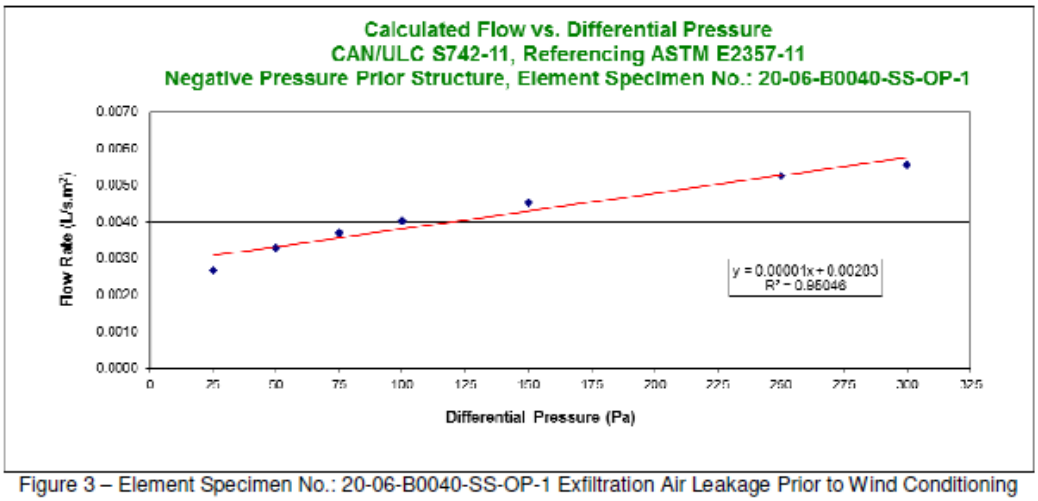


Figure 3 – Element Specimen No.: 20-06-B0040-SS-OP-1 Exfiltration Air Leakage Prior to Wind Conditioning

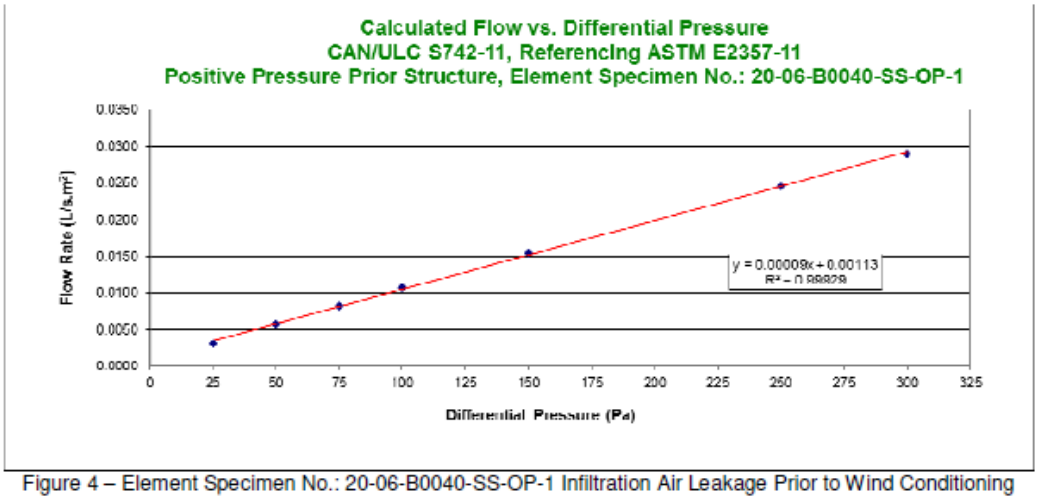


Figure 4 – Element Specimen No.: 20-06-B0040-SS-OP-1 Infiltration Air Leakage Prior to Wind Conditioning

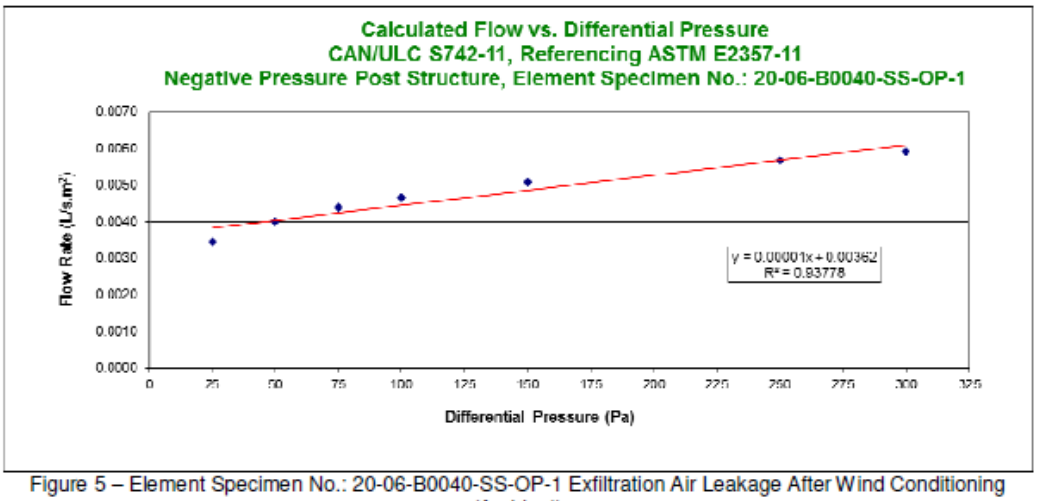


Figure 5 – Element Specimen No.: 20-06-B0040-SS-OP-1 Exfiltration Air Leakage After Wind Conditioning (Ambient)

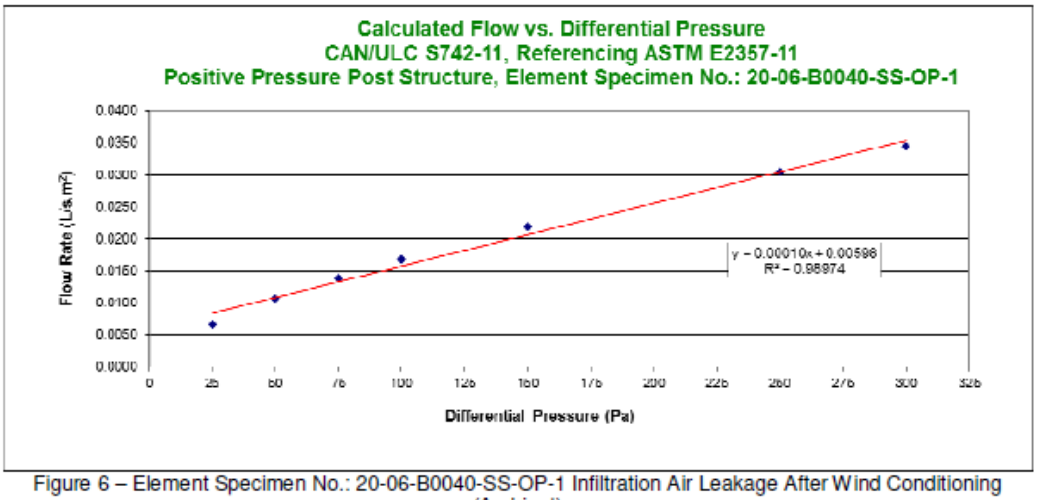


Figure 6 – Element Specimen No.: 20-06-B0040-SS-OP-1 Infiltration Air Leakage After Wind Conditioning (Ambient)

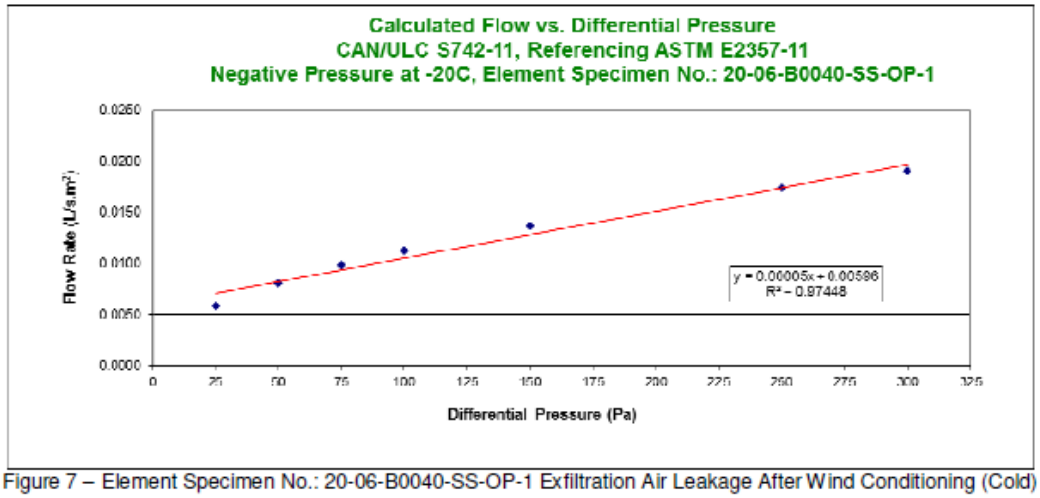


Figure 7 – Element Specimen No.: 20-06-B0040-SS-OP-1 Exfiltration Air Leakage After Wind Conditioning (Cold)

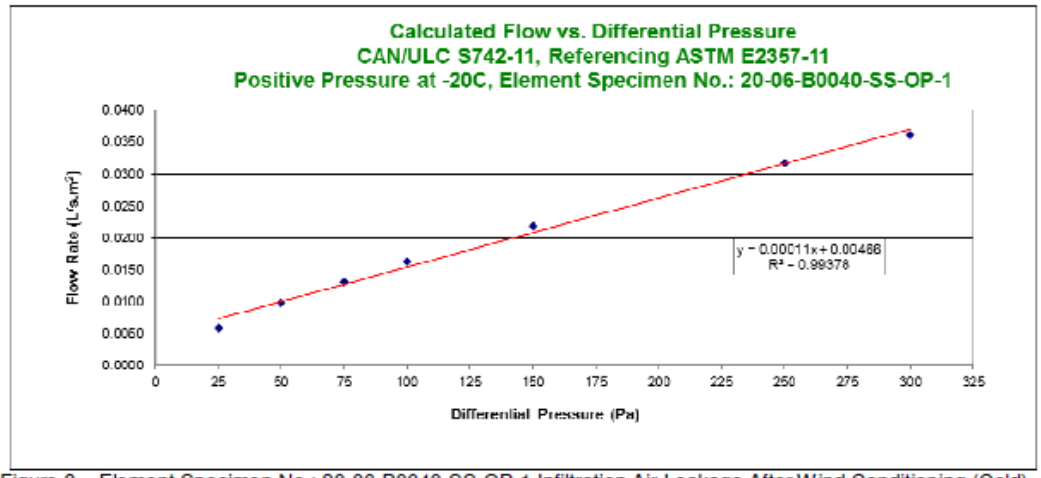


Figure 8 – Element Specimen No.: 20-06-B0040-SS-OP-1 Infiltration Air Leakage After Wind Conditioning (Cold)

Table 4 – Wind Pressure Loading Deflection Results (Metric Units) in Accordance with CAN/ULC-S742-11, Section 6.3.3 Element Specimen No.: 20-06-B0040-SS-OP-1

Cycle	Pressure (Pa) Q_{10} > 0.20 kPa	Gauge Numbers (Locations) & Maximum Deflections (mm)						
		1	2	3	4	5	6	7
Sustained Loads	100	0.19	-0.13	0.09	-0.28	-0.26	-0.33	-0.06
	200	-0.07	0.13	-0.60	-0.54	-0.73	-0.24	-0.15
	300	-0.04	0.84	-0.87	-0.69	-1.10	-0.15	-0.32
	400	-0.02	-0.20	-1.60	-1.12	-1.58	-0.20	-0.39
	500	-0.65	-0.13	-1.60	-1.51	-1.99	-0.41	-0.65
	600	-0.73	-0.13	-1.79	-1.75	-2.40	-0.28	-0.61
	650 (P_1)	-0.87	-0.33	-2.20	-2.14	-1.36	-0.56	-1.13
	-100	-0.06	0.45	0.24	0.41	0.13	-0.02	0.13
	-200	-0.04	0.09	0.60	0.74	0.82	0.07	0.45
	-300	0.04	-0.28	1.17	1.23	1.23	0.07	0.58
	-400	-0.15	0.09	1.54	1.60	1.36	0.04	0.82
	-500	0.07	0.20	1.88	1.93	1.86	0.22	1.06
	-600	0.43	0.15	2.27	2.38	2.68	0.22	1.34
	-650 (P'_1)	0.71	-0.97	2.94	3.16	2.96	0.22	1.67
Cyclic Loads	**0 to 950 (P_2)**	-1.23	-0.09	-2.51	-2.47	-2.33	-0.32	-1.60
	0 to -950 (P'_2)	1.43	0.26	3.26	3.31	2.90	-0.89	2.72
Gust Loads	**0 to 1410 (P_2)**	-1.66	-0.50	-5.34	-5.15	-5.49	-0.24	-1.88
	0 to -1410 (P'_2)	1.77	0.97	6.21	6.75	6.81	0.74	4.33

Table 5 – Deflection Results (Metric Units) in Accordance with CAN/ULC-S742-11, Section 6.3.4 (Pressure exceeds that of ASTM E2357-11) Element Specimen No.: 20-06-B0040-SS-OP-1

Cycle	Pressure (Pa) Q_{10} > 0.40 kPa / $D_{0.60}$	Gauge Numbers (Locations) & Maximum Deflections (mm)						
		1	2	3	4	5	6	7
Wind Loading	0 to +1440	-2.49	-0.45	-5.54	-5.67	-6.08	-0.58	-2.85
	0 to –1440	2.44	0.17	5.95	6.38	5.64	1.17	3.24

Note: The locations for each gauge number are located in Figure 9.

Table 6 – Wind Pressure Loading Deflection Results (Imperial Units) in Accordance with CAN/ULC-S742-11, Section 6.3.3
Element Specimen No.: 20-06-B0040-SS-OP-1

Cycle	Pressure (PSF) Q_{10} > 0.20 kPa	Gauge Numbers (Locations) & Maximum Deflections (inches)						
		1	2	3	4	5	6	7
Sustained Loads	2.09	0.007	-0.005	0.004	-0.011	-0.010	-0.013	-0.002
	4.18	-0.003	0.005	-0.024	-0.021	-0.029	-0.009	-0.006
	6.27	-0.002	0.033	-0.034	-0.027	-0.043	-0.006	-0.013
	8.35	-0.001	-0.008	-0.063	-0.044	-0.062	-0.008	-0.015
	10.44	-0.026	-0.005	-0.063	-0.059	-0.078	-0.016	-0.026
	12.53	-0.029	-0.005	-0.070	-0.069	-0.094	-0.011	-0.024
	13.58 (P_1)	-0.034	-0.013	-0.087	-0.084	-0.054	-0.022	-0.044
	-2.09	-0.002	0.018	0.009	0.016	0.005	-0.001	0.005
	-4.18	-0.002	0.004	0.024	0.029	0.032	0.003	0.018
	-6.27	0.002	-0.011	0.046	0.048	0.048	0.003	0.023
	-8.35	-0.006	0.004	0.061	0.063	0.054	0.002	0.032
	-10.44	0.003	0.008	0.074	0.076	0.073	0.009	0.042
	-12.53	0.017	0.006	0.089	0.094	0.106	0.009	0.053
	-13.58 (P'_1)	0.028	-0.038	0.116	0.124	0.117	0.009	0.066
Cyclic Loads	**0 to 19.84 (P_2)**	-0.048	-0.004	-0.099	-0.097	-0.092	-0.013	-0.063
	0 to -19.84 (P'_2)	0.056	0.010	0.128	0.130	0.114	-0.035	0.107
Gust Loads	**0 to 29.45 (P_2)**	-0.065	-0.020	-0.210	-0.203	-0.216	-0.009	-0.074
	0 to -29.45 (P'_2)	0.070	0.038	0.244	0.266	0.268	0.029	0.170

Table 7 – Deflection Results (Imperial Units) in Accordance with CAN/ULC-S742-11, Section 6.3.4 (Pressure exceeds that of ASTM E2357-11)
Element Specimen No.: 20-06-B0040-SS-OP-1

Cycle	Pressure (PSF) Q_{10} > 0.40 kPa / $D_{0.60}$	Gauge Numbers (Locations) & Maximum Deflections (inches)						
		1	2	3	4	5	6	7
Wind Loading	0 to +30.08	-0.098	-0.018	-0.218	-0.223	-0.239	-0.023	-0.112
	0 to –30.08	0.096	0.007	0.234	0.251	0.222	0.046	0.128

Note: The locations for each gauge number are located in Figure 9.

Wall Section Observations During Structural Wind Loading

During the wind loading schedule as shown in Tables 4 and 5, there were no visible signs of Element Specimen No. 20-06-B0040-SS-OP-1 tearing, cracking or peeling from the wall section.

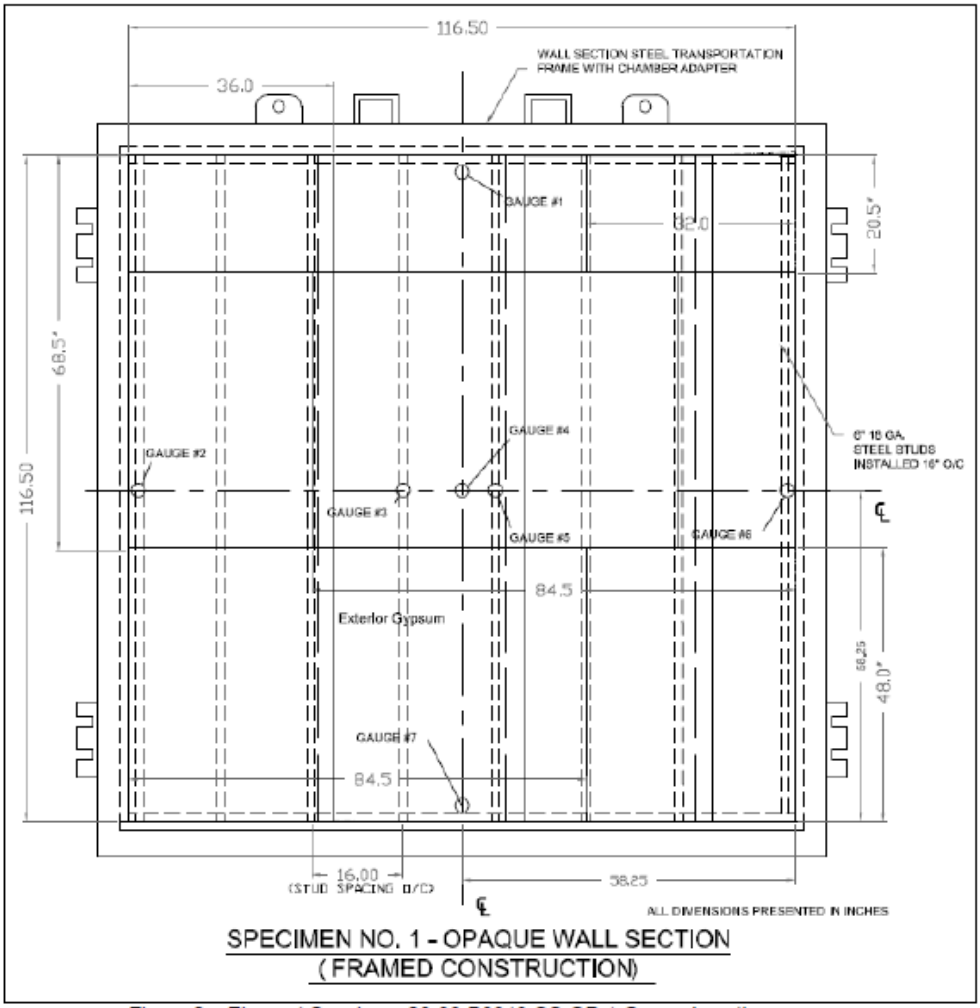


Figure 9 – Element Specimen 20-06-B0040-SS-OP-1 Gauge Locations

4.2 Detailed Element Specimen No. 20-06-B0040-SS-PT-2 Results

Table 8 – Summarized Air Leakage Results in Accordance with ASTM E2357-11 - Section 9.1, Air Leakage Testing Element Specimen No.: 20-06-B0040-SS-PT-2 (Exfiltration '-')

Differential Pressure Pa (psf)	Optional		Ambient		Cold [-20°C (4°F)]	
	Calculated Air Leakage Prior to Wind Pressure Conditioning		Calculated Air Leakage After Wind Pressure Conditioning		Calculated Air Leakage After Wind Pressure Conditioning	
	L/s·m²	cfm/ft²	L/s·m²	cfm/ft²	L/s·m²	cfm/ft²
25 (0.52)	0.0226	0.0045	0.0247	0.0050	0.0088	0.0018
50 (1.04)	0.0355	0.0071	0.0386	0.0077	0.0168	0.0034
75 (1.57)	**0.0462**	**0.0093**	**0.0500**	**0.0100**	**0.0245**	**0.0049**
100 (2.09)	0.0557	0.0112	0.0601	0.0121	0.0320	0.0064
150 (3.13)	0.0726	0.0146	0.0778	0.0156	0.0468	0.0094
250 (5.22)	0.1014	0.0204	0.1079	0.0217	0.0755	0.0152
300 (6.24)	0.1142	0.0229	0.1213	0.0244	0.0896	0.0180

Table 9 – Summarized Air Leakage Results in Accordance with ASTM E2357-11 - Section 9.1, Air Leakage Testing Element Specimen No.: 20-06-B0040-SS-PT-2 (Infiltration '+')

Differential Pressure Pa (psf)	Optional		Ambient		Cold [-20°C (4°F)]	
	Calculated Air Leakage Prior to Wind Pressure Conditioning		Calculated Air Leakage After Wind Pressure Conditioning		Calculated Air Leakage After Wind Pressure Conditioning	
	L/s·m²	cfm/ft²	L/s·m²	cfm/ft²	L/s·m²	cfm/ft²
25 (0.52)	0.0207	0.0042	0.0225	0.0045	0.0108	0.0022
50 (1.04)	0.0349	0.0070	0.0374	0.0075	0.0229	0.0046
75 (1.57)	**0.0474**	**0.0095**	**0.0503**	**0.0101**	**0.0354**	**0.0071**
100 (2.09)	0.0589	0.0118	0.0621	0.0125	0.0484	0.0097
150 (3.13)	0.0799	0.0161	0.0837	0.0168	0.0750	0.0151
250 (5.22)	0.1176	0.0236	0.1217	0.0244	0.1302	0.0262
300 (6.24)	0.1349	0.0271	0.1391	0.0279	0.1586	0.0319

* As per ASTM E2357-11, logarithmic graphs for each air leakage test (infiltration/exfiltration) displaying the linear regression (r^2) value are located in Appendix B.

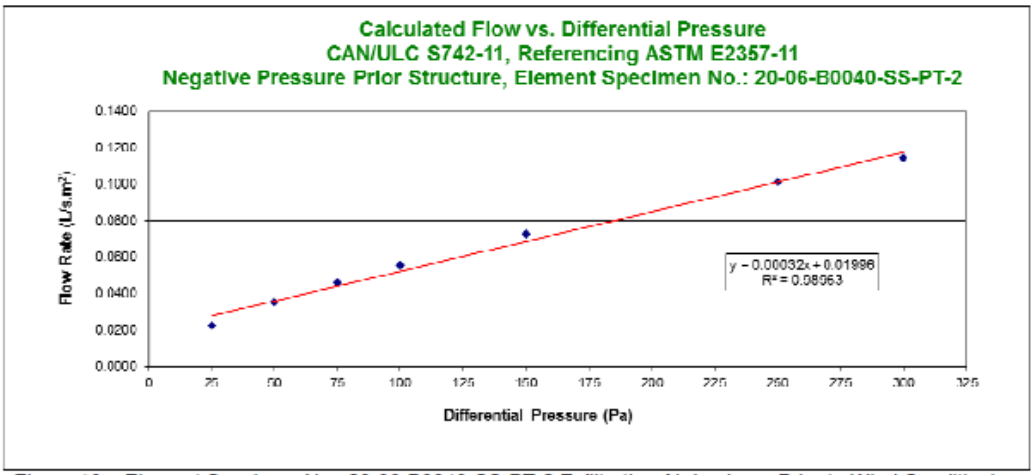


Figure 10 – Element Specimen No.: 20-06-B0040-SS-PT-2 Exfiltration Air Leakage Prior to Wind Conditioning

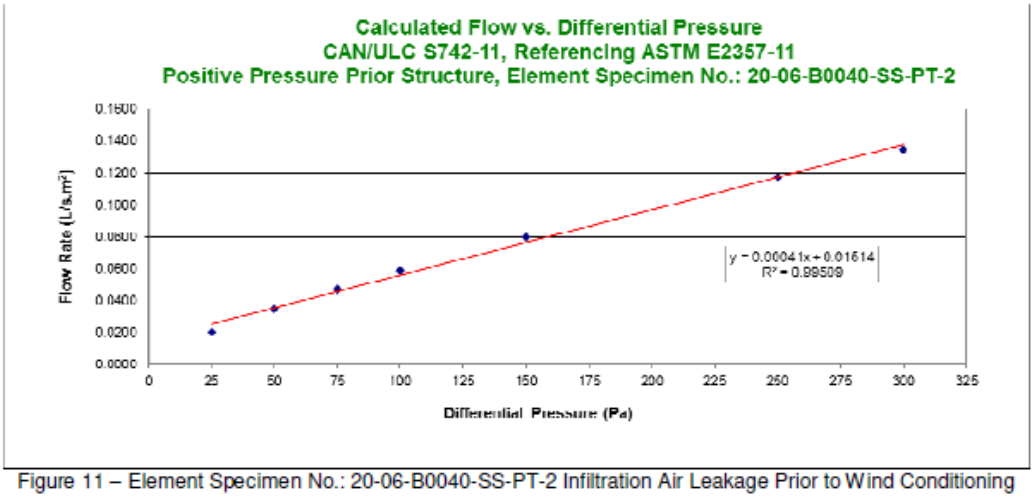


Figure 11 – Element Specimen No.: 20-06-B0040-SS-PT-2 Infiltration Air Leakage Prior to Wind Conditioning

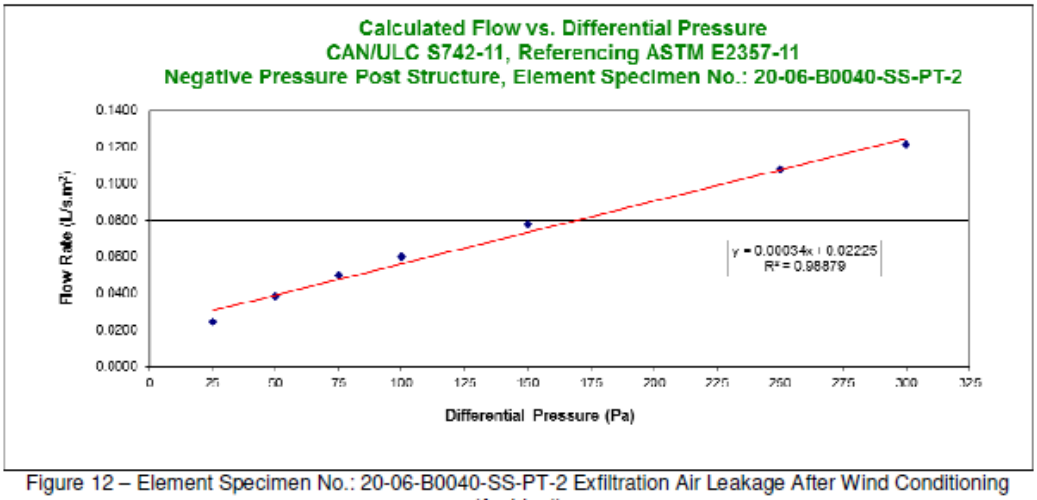


Figure 12 – Element Specimen No.: 20-06-B0040-SS-PT-2 Exfiltration Air Leakage After Wind Conditioning (Ambient)

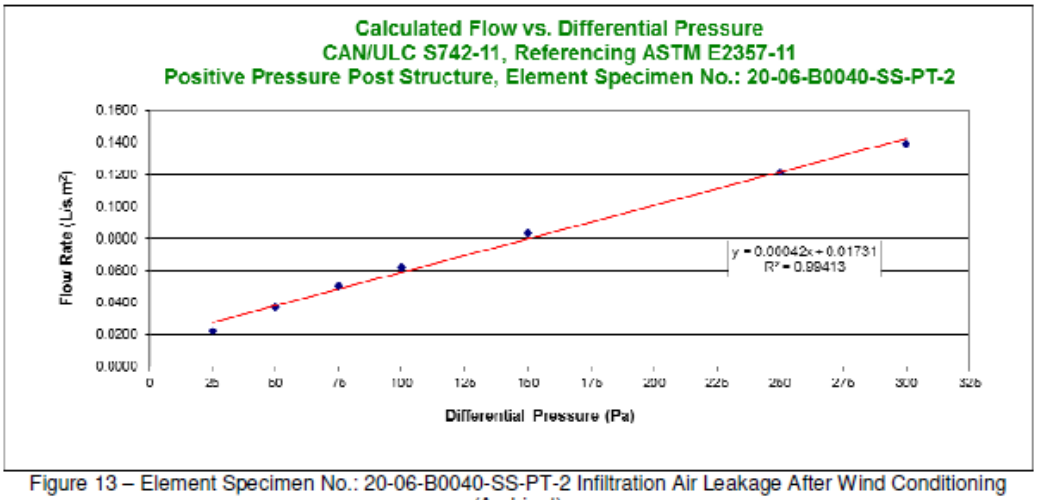


Figure 13 – Element Specimen No.: 20-06-B0040-SS-PT-2 Infiltration Air Leakage After Wind Conditioning (Ambient)

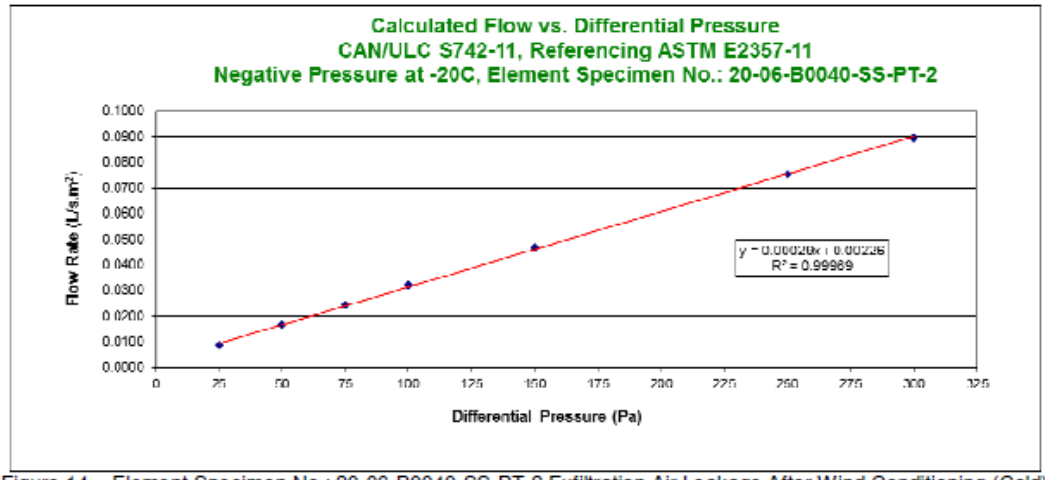


Figure 14 – Element Specimen No.: 20-06-B0040-SS-PT-2 Exfiltration Air Leakage After Wind Conditioning (Cold)

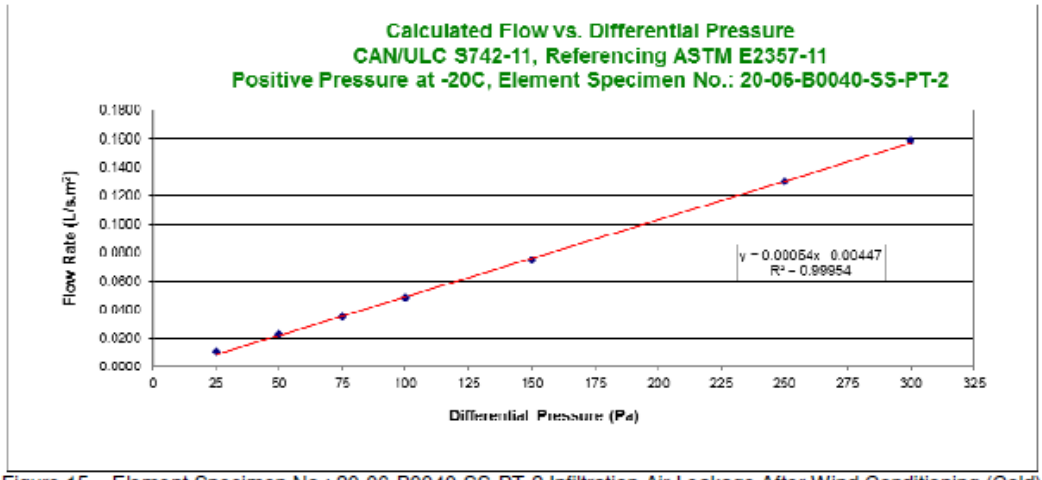


Figure 15 – Element Specimen No.: 20-06-B0040-SS-PT-2 Infiltration Air Leakage After Wind Conditioning (Cold)

Table 10 – Wind Pressure Loading Deflection Results (Metric Units) in Accordance with CAN/ULC-S742-11, Section 6.3.3 Element Specimen No.: 20-06-B0040-SS-PT-2

Cycle	Pressure (Pa) Q_{10} > 0.20 kPa	Gauge Numbers (Locations) & Maximum Deflections (mm)						
		1	2	3	4	5	6	7
Sustained Loads	100	-0.24	-0.04	-0.06	-0.30	-0.45	0.32	-0.78
	200	-0.43	0.07	-0.47	-0.60	-0.65	-0.04	-0.99
	300	-0.50	-0.04	-0.89	-0.84	-1.32	0.07	-0.93
	400	-0.37	0.37	-0.86	-1.00	-1.69	0.04	-0.97
	500	-0.71	-0.28	-1.12	-1.41	-2.42	-0.07	-1.34
	600	-0.84	-0.32	-1.25	-1.64	-3.22	-0.22	-1.36
	650 (P_1)	-0.91	-0.09	-2.21	-1.90	-3.40	-0.32	-1.28
	-100	-0.20	-0.56	0.30	0.45	0.19	0.04	0.07
	-200	-0.13	-0.20	0.41	0.74	0.50	-0.15	0.20
	-300	-0.09	0.26	0.67	0.93	0.78	0.09	0.13
	-400	-0.63	-0.07	0.99	1.25	1.40	0.02	0.32
	-500	0.17	-0.11	1.38	1.49	1.62	-0.15	0.28
	-600	-0.41	0.09	1.66	1.71	1.88	-0.19	0.47
	-650 (P'_1)	0.78	0.09	2.03	2.14	2.55	0.22	0.52
Cyclic Loads	**0 to 950 (P_2)**	-0.89	-0.02	-1.75	-1.77	3.65	-0.09	-0.71
	0 to -950 (P'_2)	0.22	0.02	1.71	1.90	1.53	-0.13	0.78
Gust Loads	**0 to 1410 (P_2)**	-0.82	-0.78	-4.28	-4.41	-5.10	-1.67	-1.12
	0 to -1410 (P'_2)	0.63	0.09	4.28	4.28	4.93	-0.09	0.97

Table 11 – Deflection Results (Metric Units) in Accordance with CAN/ULC-S742-11, Section 6.3.4 (Pressure exceeds that of ASTM E2357-11) Element Specimen No.: 20-06-B0040-SS-PT-2

Cycle	Pressure (Pa) Q_{10} > 0.40 kPa / $D_{0.60}$	Gauge Numbers (Locations) & Maximum Deflections (mm)						
		1	2	3	4	5	6	7
Wind Loading	0 to +1440	-1.30	-0.28	-4.50	-4.48	-5.30	-0.13	-1.21
	0 to –1440	1.06	0.22	4.58	4.80	5.43	0.33	1.21

Note: The locations for each gauge number are located on the following page in Figure 16.

Table 12 – Wind Pressure Loading Deflection Results (Imperial Units) in Accordance with CAN/ULC-S742-11, Section 6.3.3
Element Specimen No.: 20-06-B0040-SS-PT-2

Cycle	Pressure (PSF) Q_{10} > 0.20 kPa	Gauge Numbers (Locations) & Maximum Deflections (inches)						
		1	2	3	4	5	6	7
Sustained Loads	2.09	-0.009	-0.002	-0.002	-0.012	-0.018	0.013	-0.031
	4.18	-0.017	0.003	-0.019	-0.024	-0.026	-0.002	-0.039
	6.27	-0.020	-0.002	-0.035	-0.033	-0.052	0.003	-0.037
	8.35	-0.015	0.015	-0.034	-0.039	-0.067	0.002	-0.038
	10.44	-0.028	-0.011	-0.044	-0.056	-0.095	-0.003	-0.053
	12.53	-0.033	-0.013	-0.049	-0.065	-0.127	-0.009	-0.054
	13.58 (P_1)	-0.036	-0.004	-0.087	-0.075	-0.134	-0.013	-0.050
	-2.09	-0.008	-0.022	0.012	0.018	0.007	0.002	0.003
	-4.18	-0.005	-0.008	0.016	0.029	0.020	-0.006	0.008
	-6.27	-0.004	0.010	0.026	0.037	0.031	0.004	0.005
	-8.35	-0.025	-0.003	0.039	0.049	0.055	0.001	0.013
	-10.44	0.007	-0.004	0.054	0.059	0.064	-0.006	0.011
	-12.53	-0.016	0.004	0.065	0.067	0.074	-0.007	0.019
	-13.58 (P'_1)	0.031	0.004	0.080	0.084	0.100	0.009	0.020
Cyclic Loads	**0 to 19.84 (P_2)**	-0.035	-0.001	-0.069	-0.070	0.144	-0.004	-0.028
	0 to -19.84 (P'_2)	0.009	0.001	0.067	0.075	0.060	-0.005	0.031
Gust Loads	**0 to 29.45 (P_2)**	-0.032	-0.031	-0.169	-0.174	-0.201	-0.066	-0.044
	0 to -29.45 (P'_2)	0.025	0.004	0.169	0.169	0.194	-0.004	0.038

Table 13 – Deflection Results (Imperial Units) in Accordance with CAN/ULC-S742-11, Section 6.3.4 (Pressure exceeds that of ASTM E2357-11)
Element Specimen No.: 20-06-B0040-SS-PT-2

Cycle	Pressure (PSF) Q_{10} > 0.40 kPa / $D_{0.60}$	Gauge Numbers (Locations) & Maximum Deflections (inches)						
		1	2	3	4	5	6	7
Wind Loading	0 to +30.08	-0.051	-0.011	-0.177	-0.176	-0.209	-0.005	-0.048
	0 to –30.08	0.042	0.009	0.180	0.189	0.214	0.013	0.048

Note: The locations for each gauge number are located on the following page in Figure 16.

Wall Section Observations During Structural Wind Loading

During the wind loading schedule as shown in Tables 10 and 11, there were no visible signs of Element Specimen No. 20-06-B0040-SS-PT-2 tearing, peeling or cracking away from the wall section.

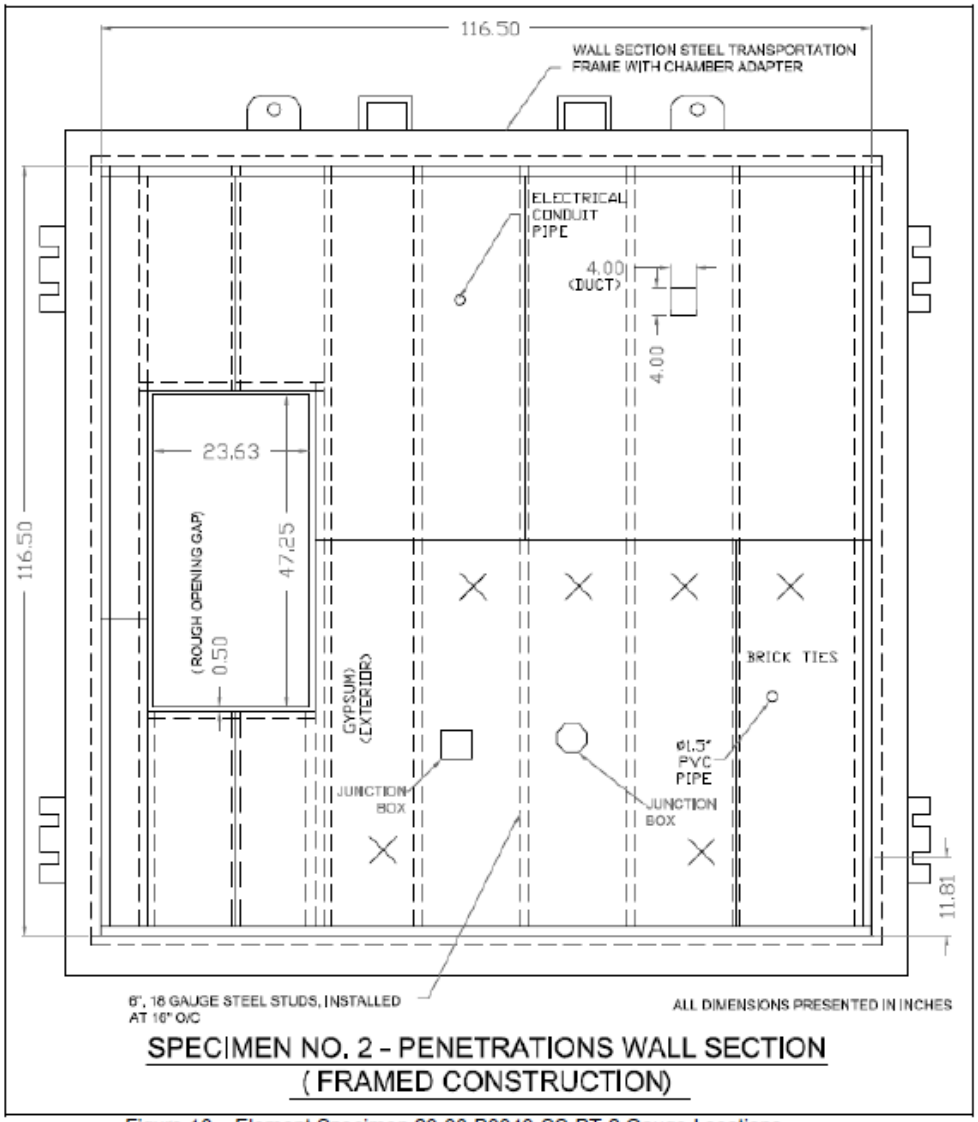


Figure 16 – Element Specimen 20-06-B0040-SS-PT-2 Gauge Locations

4.3 Detailed Element Specimen No. 20-06-B0040-SS-CB-3 Results

Table 14 – Summarized Air Leakage Results in Accordance with ASTM E2357-11 - Section 9.1, Air Leakage Testing Element Specimen No.: 20-06-B0040-SS-CB-3 (Exfiltration '-')

Differential Pressure Pa (psf)	Optional		Ambient		Cold [-20°C (-4°F)]	
	Calculated Air Leakage Prior to Wind Pressure Conditioning		Calculated Air Leakage After Wind Pressure Conditioning		Calculated Air Leakage After Wind Pressure Conditioning	
	L/s·m²	cfm/ft²	L/s·m²	cfm/ft²	L/s·m²	cfm/ft²
25 (0.52)	0.0240	0.0048	0.0292	0.0059	0.0107	0.0021
50 (1.04)	0.0352	0.0071	0.0394	0.0079	0.0150	0.0030
75 (1.57)	**0.0440**	**0.0088**	**0.0469**	**0.0094**	**0.0183**	**0.0037**
100 (2.09)	0.0516	0.0104	0.0531	0.0107	0.0210	0.0042
150 (3.13)	0.0644	0.0129	0.0633	0.0127	0.0256	0.0051
250 (5.22)	0.0854	0.0172	0.0789	0.0158	0.0329	0.0066
300 (6.24)	0.0944	0.0190	0.0853	0.0171	0.0359	0.0072

Table 15 – Summarized Air Leakage Results in Accordance with ASTM E2357-11 - Section 9.1, Air Leakage Testing Element Specimen No.: 20-06-B0040-SS-CB-3 (Infiltration '+')

Differential Pressure Pa (psf)	Optional		Ambient		Cold [-20°C (-4°F)]	
	Calculated Air Leakage Prior to Wind Pressure Conditioning		Calculated Air Leakage After Wind Pressure Conditioning		Calculated Air Leakage After Wind Pressure Conditioning	
	L/s·m²	cfm/ft²	L/s·m²	cfm/ft²	L/s·m²	cfm/ft²
25 (0.52)	0.0233	0.0047	0.0208	0.0042	0.0074	0.0015
50 (1.04)	0.0364	0.0073	0.0331	0.0066	0.0144	0.0029
75 (1.57)	**0.0473**	**0.0095**	**0.0434**	**0.0087**	**0.0212**	**0.0043**
100 (2.09)	0.0569	0.0114	0.0527	0.0106	0.0279	0.0056
150 (3.13)	0.0740	0.0149	0.0692	0.0139	0.0412	0.0083
250 (5.22)	0.1028	0.0207	0.0976	0.0196	0.0673	0.0135
300 (6.24)	0.1157	0.0232	0.1103	0.0222	0.0802	0.0161

* As per ASTM E2357-11, logarithmic graphs for each air leakage test (infiltration/exfiltration) displaying the linear regression (r^2) value are located in Appendix A.

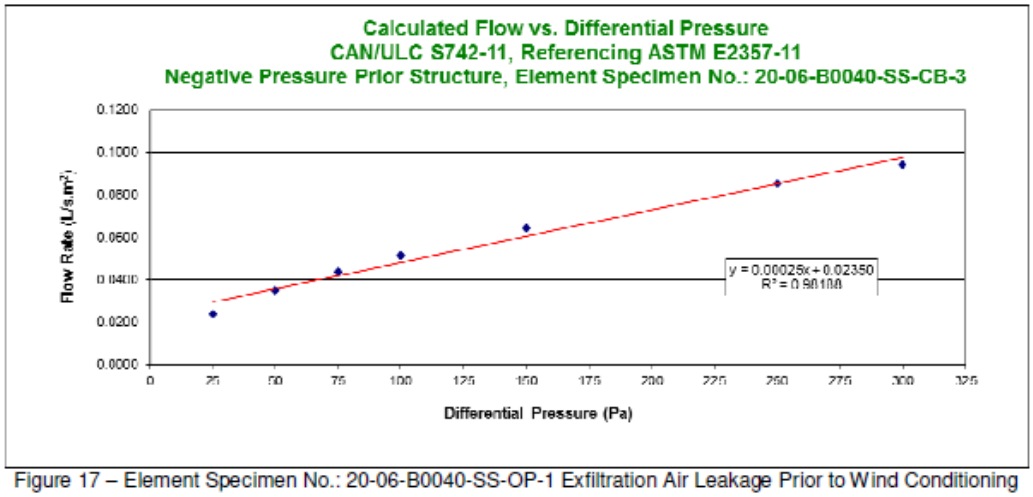


Figure 17 – Element Specimen No.: 20-06-B0040-SS-OP-1 Exfiltration Air Leakage Prior to Wind Conditioning

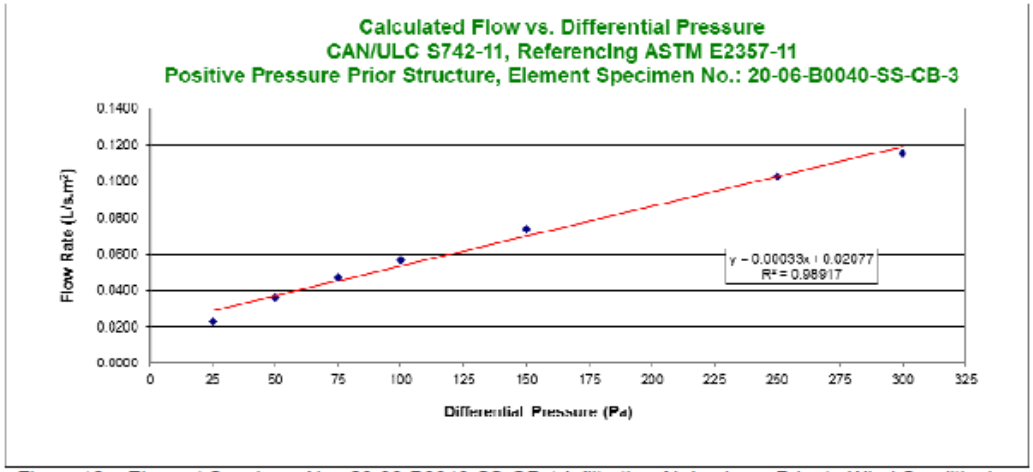


Figure 18 – Element Specimen No.: 20-06-B0040-SS-OP-1 Infiltration Air Leakage Prior to Wind Conditioning

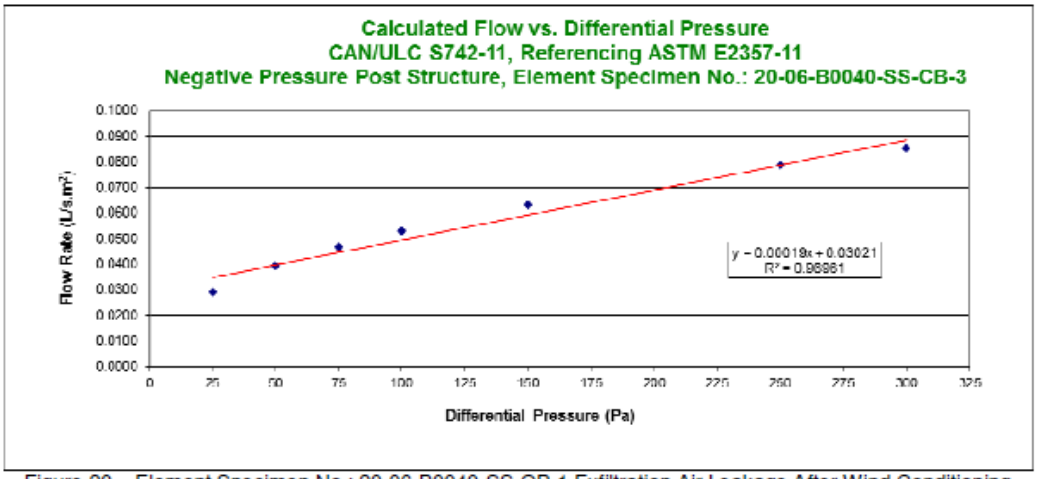


Figure 20 – Element Specimen No.: 20-06-B0040-SS-OP-1 Exfiltration Air Leakage After Wind Conditioning (Ambient)

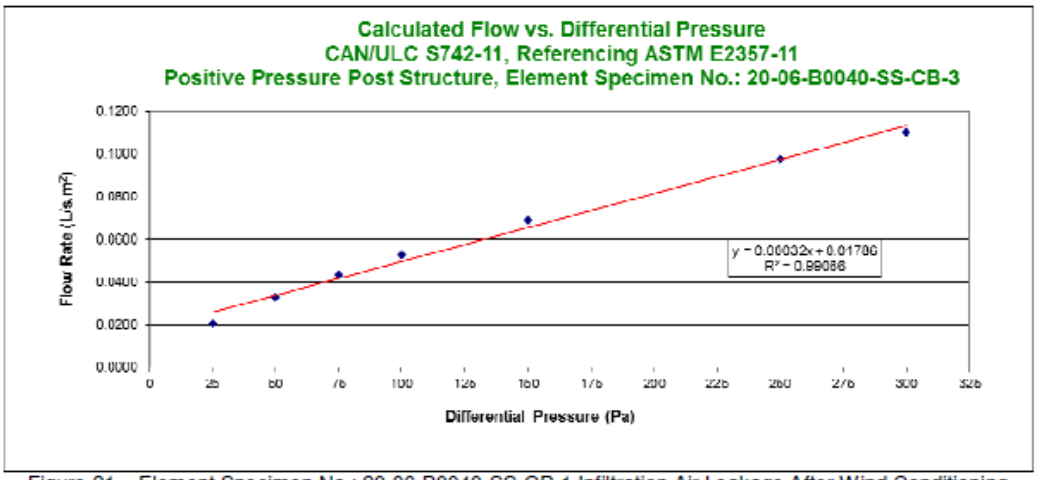


Figure 21 – Element Specimen No.: 20-06-B0040-SS-OP-1 Infiltration Air Leakage After Wind Conditioning (Ambient)

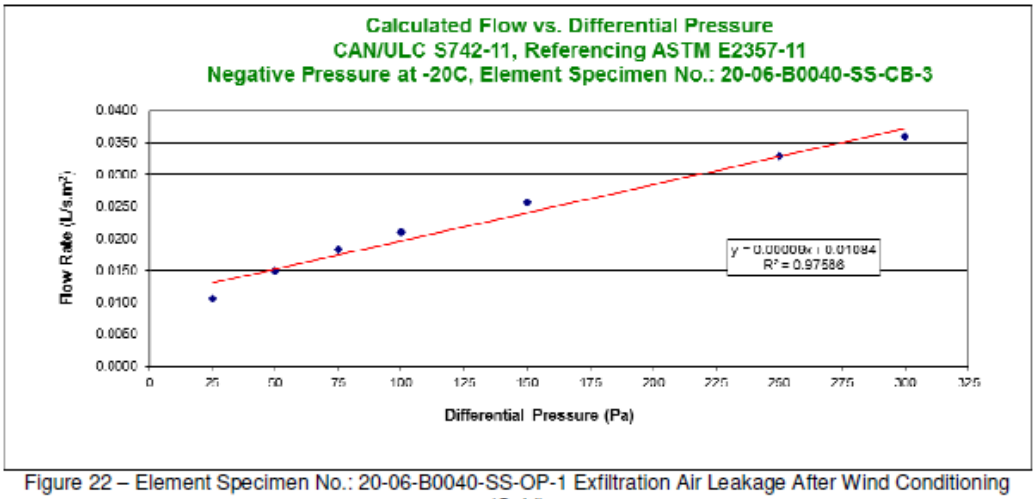


Figure 22 – Element Specimen No.: 20-06-B0040-SS-OP-1 Exfiltration Air Leakage After Wind Conditioning (Cold)

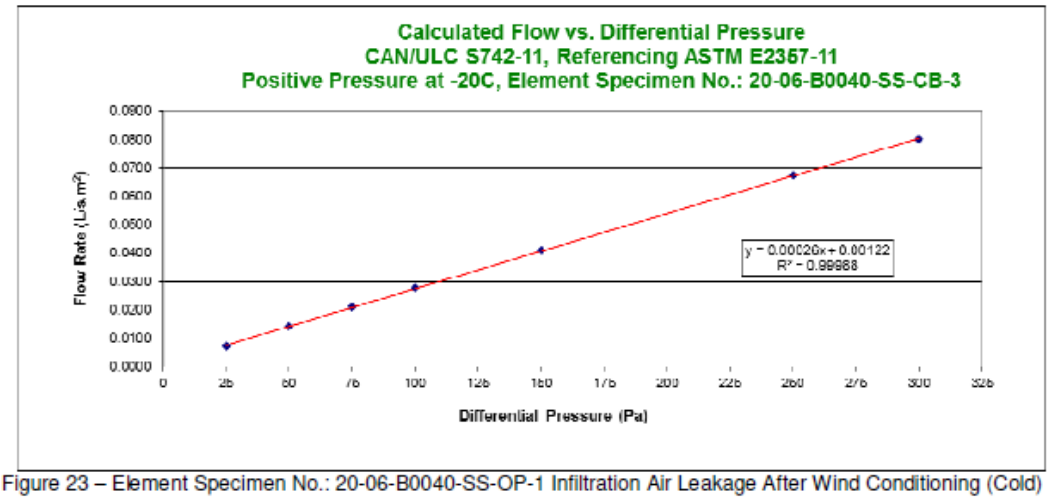


Figure 23 – Element Specimen No.: 20-06-B0040-SS-OP-1 Infiltration Air Leakage After Wind Conditioning (Cold)

Table 16 – Wind Pressure Loading Deflection Results (Metric Units) in Accordance with CAN/ULC-S742-11, Section 6.3.3
Element Specimen No.: 20-06-B0040-SS-CB-3

Cycle	Pressure (Pa) Q_{10} > 0.20 kPa	Gauge Numbers (Locations) & Maximum Deflections (mm)						
		1	2	3	4	5	6	7
Sustained Loads	100	-0.33	0.04	0.69	-0.19	-0.60	-0.15	0.20
	200	-0.33	-0.04	-0.33	-0.58	-0.69	0.07	-0.04
	300	-0.20	-0.09	-0.54	-0.71	-0.78	0.09	0.11
	400	-0.15	0.04	-0.73	-0.82	-1.06	-0.15	-0.04
	500	-0.73	-0.07	-0.93	-1.19	-1.28	0.32	-0.30
	600	-0.15	-0.13	-1.17	-1.56	-1.45	0.43	-0.20
	650 (P_1)	-0.87	-0.19	-1.54	-1.82	-1.82	-0.32	-0.30
	-100	0.06	0.13	0.41	0.47	0.47	-0.06	-0.04
	-200	0.48	0.20	0.52	0.65	0.61	0.02	0.19
	-300	0.52	0.24	1.02	0.84	0.95	0.11	0.00
	-400	0.47	0.20	1.27	1.25	1.45	0.07	0.37
	-500	0.93	0.17	1.49	1.36	1.54	0.02	0.20
	-600	0.71	0.13	1.66	1.67	1.86	0.26	0.45
	-650 (P'_1)	0.99	0.22	2.18	1.99	2.20	0.19	0.54
Cyclic Loads	**0 to 950 (P_2)**	-1.43	-0.32	-2.49	-1.90	-2.34	-0.24	-0.71
	0 to -950 (P'_2)	1.62	0.35	2.06	2.98	2.08	0.28	0.80
Gust Loads	**0 to 1410 (P_2)**	-1.84	-0.65	-4.22	-4.26	-4.13	-0.47	-1.49
	0 to -1410 (P'_2)	0.30	0.48	3.96	4.43	3.85	0.24	1.41

Table 17 – Deflection Results (Metric Units) in Accordance with CAN/ULC-S742-11, Section 6.3.4 (Pressure exceeds that of ASTM E2357-11)
Element Specimen No.: 20-06-B0040-SS-CB-3

Cycle	Pressure (Pa) Q_{10} > 0.40 kPa / $D_{0.60}$	Gauge Numbers (Locations) & Maximum Deflections (mm)						
		1	2	3	4	5	6	7
Wind Loading	0 to +1440	-2.18	-0.99	-3.96	-4.35	-3.83	0.26	-1.27
	0 to –1440	1.19	0.63	4.41	4.41	4.73	0.54	1.54

Note: The locations for each gauge number are located in Figure 9.

Table 18 – Wind Pressure Loading Deflection Results (Imperial Units) in Accordance with CAN/ULC-S742-11, Section 6.3.3
Element Specimen No.: 20-06-B0040-SS-CB-3

Cycle	Pressure (PSF) Q_{10} > 0.20 kPa	Gauge Numbers (Locations) & Maximum Deflections (inches)						
		1	2	3	4	5	6	7
Sustained Loads	2.09	-0.013	0.002	0.027	-0.007	-0.024	-0.006	0.008
	4.18	-0.013	-0.002	-0.013	-0.023	-0.027	0.003	-0.002
	6.27	-0.008	-0.004	-0.021	-0.028	-0.031	0.004	0.004
	8.35	-0.006	0.002	-0.029	-0.032	-0.042	-0.006	-0.002
	10.44	-0.029	-0.003	-0.037	-0.047	-0.050	0.013	-0.012
	12.53	-0.006	-0.005	-0.046	-0.061	-0.057	0.017	-0.008
	13.58 (P_1)	-0.034	-0.007	-0.061	-0.072	-0.072	-0.013	-0.012
	-2.09	0.002	0.005	0.016	0.019	0.019	-0.002	-0.002
	-4.18	0.019	0.008	0.020	0.026	0.024	0.001	0.007
	-6.27	0.020	0.009	0.040	0.033	0.037	0.004	0.000
	-8.35	0.019	0.008	0.050	0.049	0.057	0.003	0.015
	-10.44	0.037	0.007	0.059	0.054	0.061	0.001	0.008
	-12.53	0.028	0.005	0.065	0.066	0.073	0.010	0.018
	-13.58 (P'_1)	0.039	0.009	0.086	0.078	0.087	0.007	0.021
Cyclic Loads	**0 to 19.84 (P_2)**	-0.056	-0.013	-0.098	-0.075	-0.092	-0.009	-0.028
	0 to -19.84 (P'_2)	0.064	0.014	0.081	0.117	0.082	0.011	0.031
Gust Loads	**0 to 29.45 (P_2)**	-0.072	-0.026	-0.166	-0.168	-0.163	-0.019	-0.059
	0 to -29.45 (P'_2)	0.012	0.019	0.156	0.174	0.152	0.009	0.056

Table 19 – Deflection Results (Imperial Units) in Accordance with CAN/ULC-S742-11, Section 6.3.4 (Pressure exceeds that of ASTM E2357-11)
Element Specimen No.: 20-06-B0040-SS-CB-3

Cycle	Pressure (PSF) Q_{10} > 0.40 kPa / $D_{0.60}$	Gauge Numbers (Locations) & Maximum Deflections (inches)						
		1	2	3	4	5	6	7
Wind Loading	0 to +30.08	-0.086	-0.039	-0.156	-0.171	-0.151	0.010	-0.050
	0 to –30.08	0.047	0.025	0.174	0.174	0.186	0.021	0.061

Note: The locations for each gauge number are located in Figure 9.

Wall Section Observations During Structural Wind Loading

During the wind loading schedule as shown in Tables 16 and 17, there were no visible signs of Element Specimen No. 20-06-B0040-SS-CB-3 tearing, cracking or peeling from the wall section.

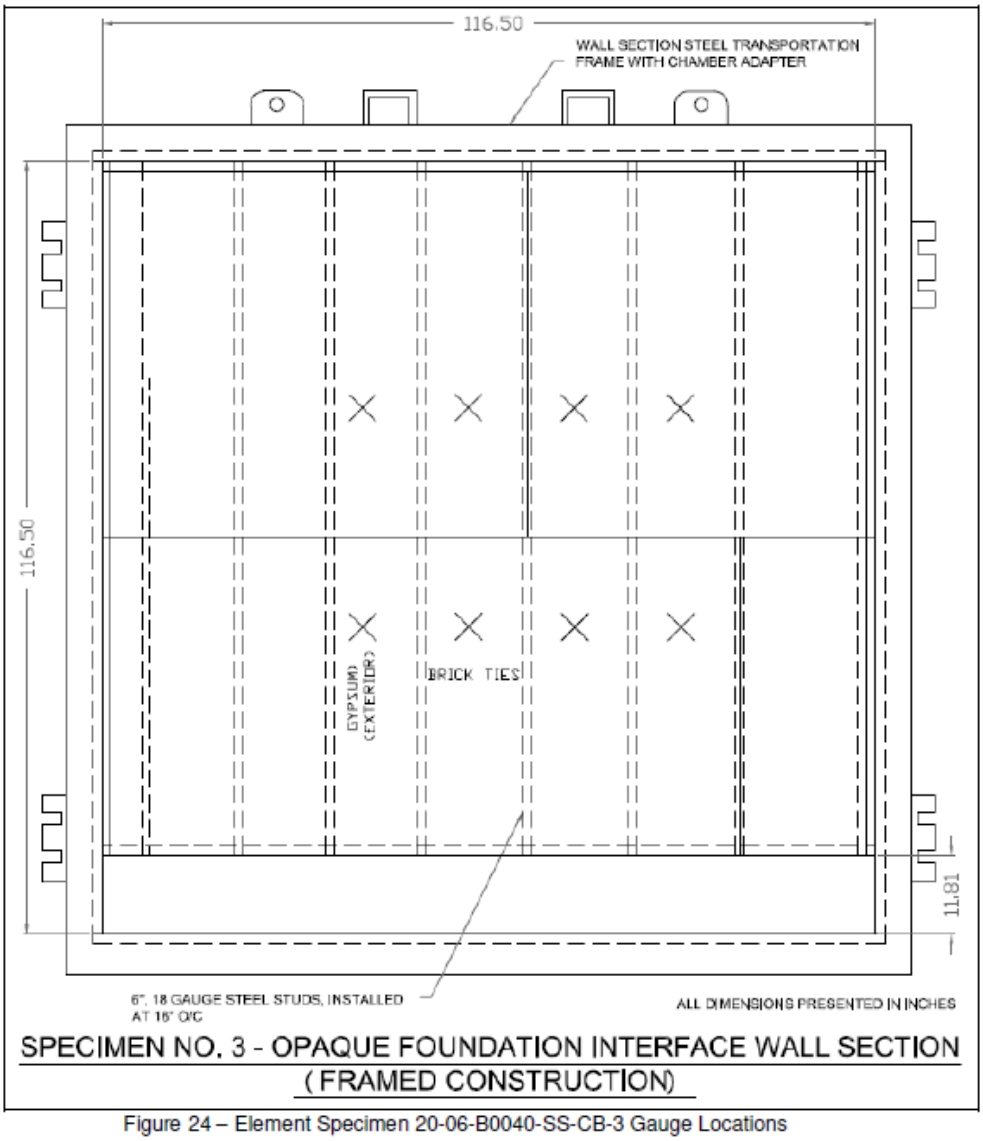


Figure 24 – Element Specimen 20-06-B0040-SS-CB-3 Gauge Locations

4.4 Client requested test – Water penetration resistance

Table 20 – ASTM E331-00 (2016) - Water Penetration Resistance
Element Specimen No.: 20-06-B0040-SS-PT-2

Requested Test Pressure Pa (psf)	Requirements	Results	Comments
137 *(2.86)* (15-Minutes)	As per client request, the opaque wall assembly shall not have water penetration through the wall assembly at the requested test pressure for 15-minutes. No water shall be observed from the interior side such as the sheathing and sheathing joints.	No water penetration was observed at the interior side of the wall assembly at the conclusion of the test	**Meets requested requirement**
300 *(6.27)* (15-Minutes)	As per client request, the opaque wall assembly shall not have water penetration through the wall assembly at the requested test pressure for 15-minutes. No water shall be observed from the interior side such as the sheathing and sheathing joints.	No water penetration was observed at the interior side of the wall assembly at the conclusion of the test	**Meets requested requirement**

Table 21 – ASTM E331-00 (2016) - Water Penetration Resistance
Element Specimen No.: 20-06-B0040-SS-CB-3

Requested Test Pressure Pa (psf)	Requirements	Results	Comments
137 *(2.86)* (15-Minutes)	As per client request, the opaque wall assembly shall not have water penetration through the wall assembly at the requested test pressure for 15-minutes. No water shall be observed from the interior side such as the sheathing, sheathing joints, PVC and metal pipe, electrical junction boxes, square metal duct, brick ties, roof and foundation interface, and around the window rough opening.	No water penetration was observed at the interior side of the wall assembly at the conclusion of the test	**Meets requested requirement**
300 *(6.27)* (15-Minutes)	As per client request, the opaque wall assembly shall not have water penetration through the wall assembly at the requested test pressure for 15-minutes. No water shall be observed from the interior side such as the sheathing, sheathing joints, PVC and metal pipe, electrical junction boxes, square metal duct, brick ties, roof and foundation interface, and around the window rough opening.	No water penetration was observed at the interior side of the wall assembly at the conclusion of the test	**Meets requested requirement**

5.0 RESULTS FOR MASONRY BLOCK WALL (CMU) SPECIMENS

Table 22 – Summarized Air Leakage Results at 75 Pa (1.57 psf) in Accordance with CAN/ULC-S742-11, Section 6.3.2.1 (A), referencing ASTM E2357-11 – Section 9.1, Air Leakage Testing

Element Specimen No.:	Airflow Direction	Optional	Ambient	Cold	Air Leakage Rate Classification[2]
		Calculated Air Leakage at 75 Pa (1.57 psf) Prior to Wind Pressure Conditioning L/s·m² (cfm/ft²)	Calculated Air Leakage at 75 Pa (1.57 psf) After Wind Pressure Conditioning L/s·m² (cfm/ft²)	Calculated Air Leakage at 75 Pa (1.57 psf) After Wind Pressure Conditioning L/s·m² (cfm/ft²)	
20-06-B0040-CMU-OP-4 *(Opaque Wall)*	- EXF	0.0083 (0.0017)	0.0165[1] (0.0033)	0.0053 (0.0011)	A1[2]
	+ INF	0.0009 (0.0002)	0.0030 (0.0006)	0.0053 (0.0011)	
20-06-B0040-CMU-PT-5 *(Penetration Wall)*	- EXF	0.0008 (0.0002)	0.0011 (0.0002)	0.0237[1] (0.0048)	
	+ INF	0.0023 (0.0005)	0.0059 (0.0012)	0.0053 (0.0011)	
20-06-B0040-CMU-CB-6 *(Opaque Wall with Foundation Interface)*	- EXF	0.0037 (0.0007)	0.0044 (0.0009)	0.0088 (0.0018)	
	+ INF	0.0083 (0.0017)	0.0139[1] (0.0028)	0.0107 (0.0021)	

Notes: '-' denotes exfiltration airflow direction (simulated negative wind loading)
'+' denotes infiltration airflow direction (simulated positive wind loading)

[1] Highest measured air leakage rate at 75 Pa (1.57 psf).

[2] As per CAN/ULC-S742-11, an air barrier in compliance with this standard shall be classified as one of the types listed in clause 4.1.1.1 to clause 4.1.1.5 according to its reference air leakage rate:

4.1.1.1 A1 – The reference air leakage rate shall not exceed 0.05 L/(s·m²) (0.009 cfm/ft²) at a pressure difference of 75 Pa (1.57 psf).
4.1.1.2 A2 – The reference air leakage rate shall not exceed 0.10 L/(s·m2) (0.019 cfm/ft2) at a pressure difference of 75 Pa (1.57 psf).
4.1.1.3 A3 – The reference air leakage rate shall not exceed 0.15 L/(s·m²) (0.029 cfm/ft²) at a pressure difference of 75 Pa (1.57 psf).
4.1.1.4 A4 – The reference air leakage rate shall not exceed 0.20 L/(s·m²) (0.039 cfm/ft²) at a pressure difference of 75 Pa (1.57 psf).
4.1.1.5 A5 – The reference air leakage rate shall not exceed 0.50 L/(s·m²) (0.098 cfm/ft²) at a pressure difference of 75 Pa (1.57 psf).

The reference air leakage rate is the highest air leakage rate of those recorded among all specimens when tested in accordance with CAN/ULC-S742-11, Section 6.

5.1 Detailed Element Specimen No. 20-06-B0040-CMU-OP-4 Results

Table 23 – Summarized Air Leakage Results in Accordance with ASTM E2357-11 - Section 9.1, Air Leakage Testing Element Specimen No.: 20-06-B0040-CMU-OP-4 (Exfiltration '-')

Differential Pressure Pa (psf)	Optional		Ambient		Cold [-20°C (-4°F)]	
	Calculated Air Leakage Prior to Wind Pressure Conditioning		Calculated Air Leakage After Wind Pressure Conditioning		Calculated Air Leakage After Wind Pressure Conditioning	
	L/s·m²	cfm/ft²	L/s·m²	cfm/ft²	L/s·m²	cfm/ft²
25 (0.52)	0.0037	0.0007	0.0084	0.0017	0.0022	0.0004
50 (1.04)	0.0061	0.0012	0.0128	0.0026	0.0039	0.0008
75 (1.57)	**0.0083**	**0.0017**	**0.0165**	**0.0033**	**0.0053**	**0.0011**
100 (2.09)	0.0103	0.0021	0.0197	0.0040	0.0067	0.0013
150 (3.13)	0.0139	0.0028	0.0253	0.0051	0.0092	0.0019
250 (5.22)	0.0203	0.0041	0.0347	0.0070	0.0139	0.0028
300 (6.24)	0.0232	0.0047	0.0389	0.0078	0.0160	0.0032

Table 24 – Summarized Air Leakage Results in Accordance with ASTM E2357-11 - Section 9.1, Air Leakage Testing Element Specimen No.: 20-06-B0040-CMU-OP-4 (Infiltration '+')

Differential Pressure Pa (psf)	Optional		Ambient		Cold [-20°C (-4°F)]	
	Calculated Air Leakage Prior to Wind Pressure Conditioning		Calculated Air Leakage After Wind Pressure Conditioning		Calculated Air Leakage After Wind Pressure Conditioning	
	L/s·m²	cfm/ft²	L/s·m²	cfm/ft²	L/s·m²	cfm/ft²
25 (0.52)	0.0002	0.0000	0.0007	0.0001	0.0020	0.0004
50 (1.04)	0.0005	0.0001	0.0017	0.0003	0.0037	0.0007
75 (1.57)	**0.0009**	**0.0002**	**0.0030**	**0.0006**	**0.0053**	**0.0011**
100 (2.09)	0.0012	0.0002	0.0043	0.0009	0.0069	0.0014
150 (3.13)	0.0019	0.0004	0.0074	0.0015	0.0101	0.0020
250 (5.22)	0.0033	0.0007	0.0144	0.0029	0.0160	0.0032
300 (6.24)	0.0041	0.0008	0.0183	0.0037	0.0189	0.0038

* As per ASTM E2357-11, logarithmic graphs for each air leakage test (infiltration/exfiltration) displaying the linear regression (r^2) value are located in Appendix C.

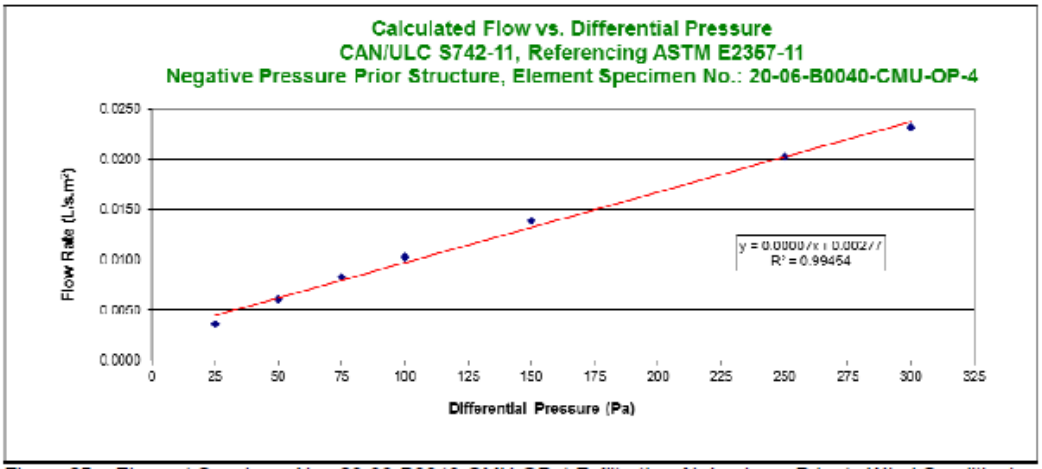


Figure 25 – Element Specimen No.: 20-06-B0040-CMU-OP-4 Exfiltration Air Leakage Prior to Wind Conditioning

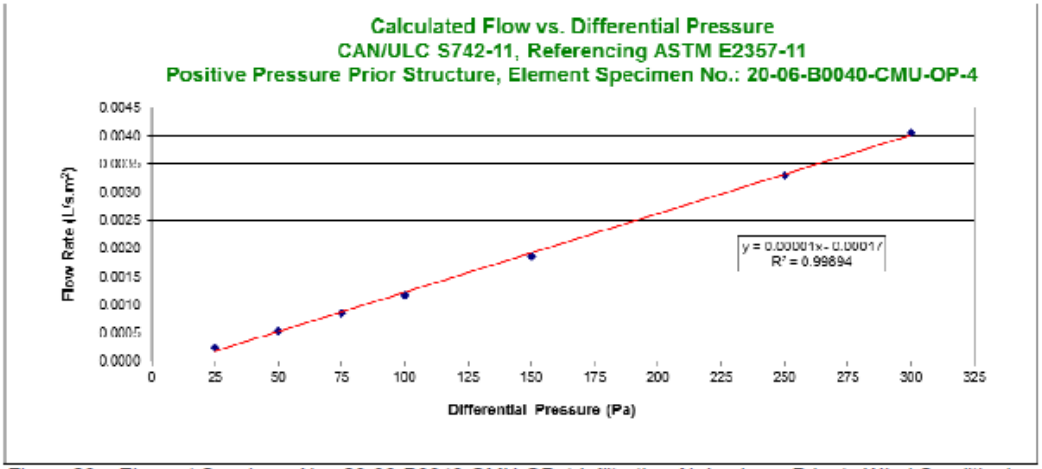


Figure 26 – Element Specimen No.: 20-06-B0040-CMU-OP-4 Infiltration Air Leakage Prior to Wind Conditioning

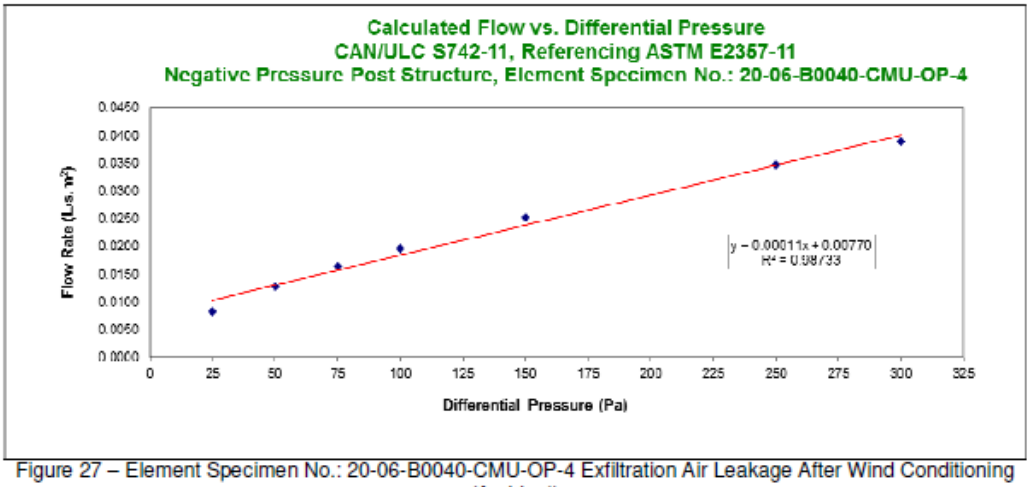


Figure 27 – Element Specimen No.: 20-06-B0040-CMU-OP-4 Exfiltration Air Leakage After Wind Conditioning (Ambient)

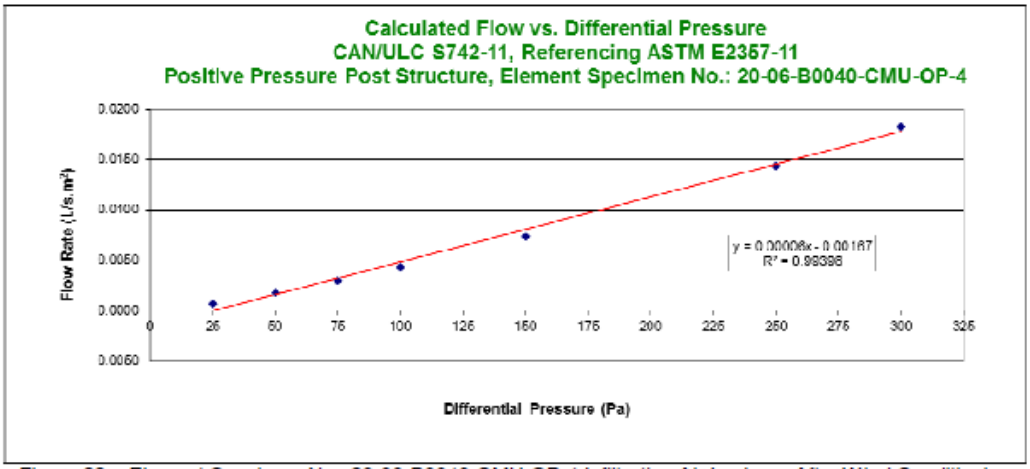


Figure 28 – Element Specimen No.: 20-06-B0040-CMU-OP-4 Infiltration Air Leakage After Wind Conditioning (Ambient)

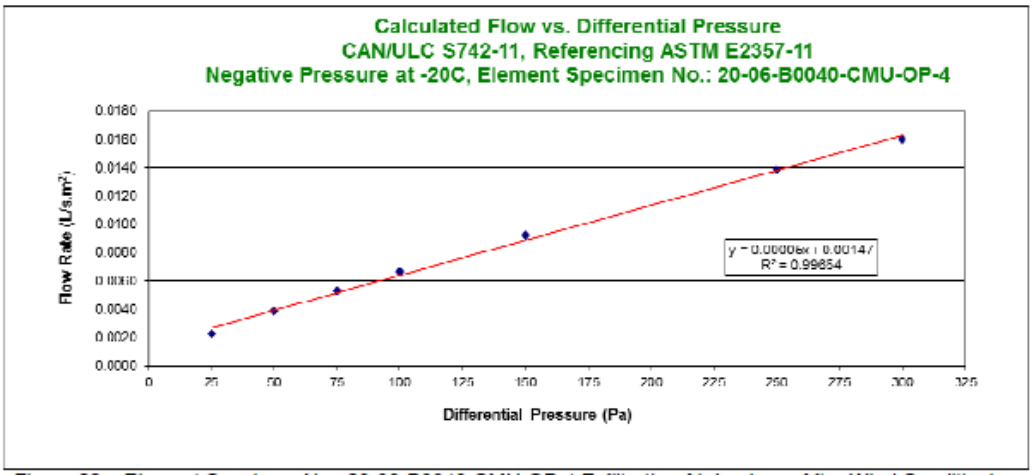


Figure 29 – Element Specimen No.: 20-06-B0040-CMU-OP-4 Exfiltration Air Leakage After Wind Conditioning (Cold)

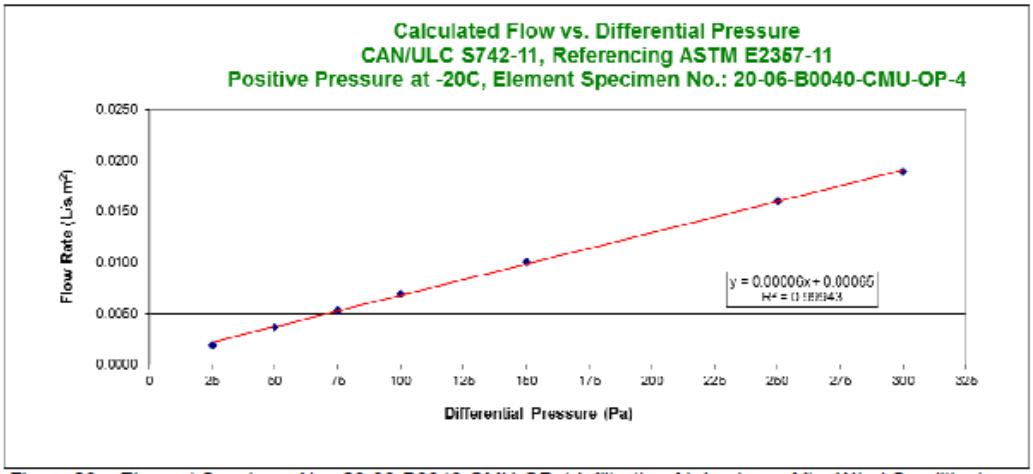


Figure 30 – Element Specimen No.: 20-06-B0040-CMU-OP-4 Infiltration Air Leakage After Wind Conditioning (Cold)

Table 25 – Wind Pressure Loading Deflection Results (Metric Units) in Accordance with CAN/ULC-S742-11, Section 6.3.3
Element Specimen No.: 20-06-B0040-CMU-OP-4

Cycle	Pressure (Pa) Q_{10} > 0.20 kPa	Gauge Numbers (Locations) & Maximum Deflections (mm)						
		1	2	3	4	5	6	7
Sustained Loads	100	0.33	0.04	0.06	0.11	0.04	0.00	0.20
	200	-0.63	-0.04	0.09	0.41	-0.11	0.04	-0.04
	300	0.74	-0.09	-0.37	-0.13	-0.19	-0.04	0.11
	400	0.39	0.04	0.02	-0.35	-0.04	0.02	-0.04
	500	0.28	-0.07	-0.09	-0.09	-0.17	-0.04	-0.30
	600	-0.84	-0.13	-0.37	-0.15	-0.26	-0.07	-0.20
	650 (P_1)	0.61	-0.19	-0.54	-0.13	-0.15	-0.11	-0.30
	-100	0.26	0.13	-0.11	0.07	0.24	0.07	-0.04
	-200	0.04	0.20	-0.02	0.07	0.22	0.33	0.19
	-300	0.17	0.24	-0.20	0.20	0.11	0.13	0.00
	-400	0.15	0.20	-0.09	-0.32	0.11	0.19	0.37
	-500	0.54	0.17	0.17	0.30	0.09	0.28	0.20
	-600	0.67	0.13	0.26	0.33	0.32	0.26	0.45
	-650 (P'_1)	-0.86	0.22	0.30	0.43	0.60	0.28	0.54
Cyclic Loads	**0 to 950 (P_2)**	-0.58	-0.32	-0.13	-0.54	-0.54	-0.37	-0.71
	0 to -950 (P'_2)	0.80	0.35	0.86	0.65	0.56	0.80	0.80
Gust Loads	**0 to 1410 (P_2)**	0.45	-0.65	-0.54	-0.67	-0.69	-0.65	0.52
	0 to -1410 (P'_2)	-0.69	0.48	0.15	0.71	0.78	0.60	-0.52

Table 26 – Deflection Results (Metric Units) in Accordance with CAN/ULC-S742-11, Section 6.3.4 (Pressure exceeds that of ASTM E2357-11)
Element Specimen No.: 20-06-B0040-CMU-OP-4

Cycle	Pressure (Pa) Q_{10} > 0.40 kPa / $D_{0.60}$	Gauge Numbers (Locations) & Maximum Deflections (mm)						
		1	2	3	4	5	6	7
Wind Loading	0 to +1440	-0.28	-0.99	-0.65	-0.82	-0.61	-0.47	0.48
	0 to –1440	0.67	0.63	1.10	1.21	1.06	0.73	0.60

Note: The locations for each gauge number are located in Figure 31.

Table 27 – Wind Pressure Loading Deflection Results (Imperial Units) in Accordance with CAN/ULC-S742-11, Section 6.3.3
Element Specimen No.: 20-06-B0040-CMU-OP-4

Cycle	Pressure (PSF) Q_{10} > 0.20 kPa	Gauge Numbers (Locations) & Maximum Deflections (inches)						
		1	2	3	4	5	6	7
Sustained Loads	2.09	0.013	0.002	0.002	0.004	0.002	0.000	0.008
	4.18	-0.025	-0.002	0.004	0.016	-0.004	0.002	-0.002
	6.27	0.029	-0.004	-0.015	-0.005	-0.007	-0.002	0.004
	8.35	0.015	0.002	0.001	-0.014	-0.002	0.001	-0.002
	10.44	0.011	-0.003	-0.004	-0.004	-0.007	-0.002	-0.012
	12.53	-0.033	-0.005	-0.015	-0.006	-0.010	-0.003	-0.008
	13.58 (P_1)	0.024	-0.007	-0.021	-0.005	-0.006	-0.004	-0.012
	-2.09	0.010	0.005	-0.004	0.003	0.009	0.003	-0.002
	-4.18	0.002	0.008	-0.001	0.003	0.009	0.013	0.007
	-6.27	0.007	0.009	-0.008	0.008	0.004	0.005	0.000
	-8.35	0.006	0.008	-0.004	-0.013	0.004	0.007	0.015
	-10.44	0.021	0.007	0.007	0.012	0.004	0.011	0.008
	-12.53	0.026	0.005	0.010	0.013	0.013	0.010	0.018
	-13.58 (P'_1)	-0.034	0.009	0.012	0.017	0.024	0.011	0.021
Cyclic Loads	**0 to 19.84 (P_2)**	-0.023	-0.013	-0.005	-0.021	-0.021	-0.015	-0.028
	0 to -19.84 (P'_2)	0.031	0.014	0.034	0.026	0.022	0.031	0.031
Gust Loads	**0 to 29.45 (P_2)**	0.018	-0.026	-0.021	-0.026	-0.027	-0.026	0.020
	0 to -29.45 (P'_2)	-0.027	0.019	0.006	0.028	0.031	0.024	-0.020

Table 28 – Deflection Results (Imperial Units) in Accordance with CAN/ULC-S742-11, Section 6.3.4 (Pressure exceeds that of ASTM E2357-11)
Element Specimen No.: 20-06-B0040-CMU-OP-4

Cycle	Pressure (PSF) Q_{10} > 0.40 kPa / $D_{0.60}$	Gauge Numbers (Locations) & Maximum Deflections (inches)						
		1	2	3	4	5	6	7
Wind Loading	0 to +30.08	-0.011	-0.039	-0.026	-0.032	-0.024	-0.019	0.019
	0 to –30.08	0.026	0.025	0.043	0.048	0.042	0.029	0.024

Note: The locations for each gauge number are located in Figure 31.

Wall Section Observations During Structural Wind Loading

During the wind loading schedule as shown in Tables 25 and 26, there were no visible signs of Element Specimen No. 20-06-B0040-CMU-OP-4 tearing, cracking or peeling from the wall section.

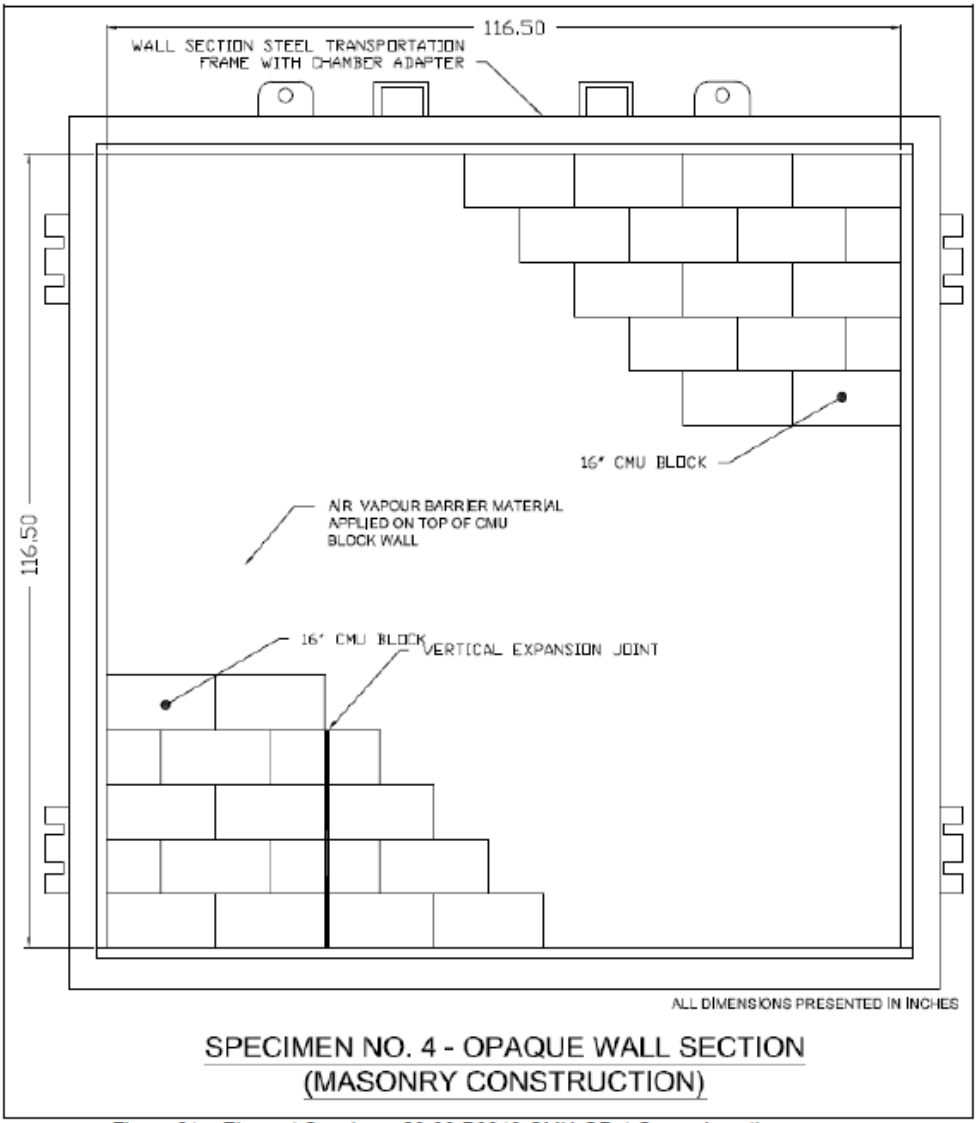


Figure 31 – Element Specimen 20-06-B0040-CMU-OP-4 Gauge Locations

5.2 Detailed Element Specimen No. 20-06-B0040-CMU-PT-5 Results

Table 29 – Summarized Air Leakage Results in Accordance with ASTM E2357-11 - Section 9.1, Air Leakage Testing Element Specimen No.: 20-06-B0040-CMU-PT-5 (Exfiltration '-')

Differential Pressure Pa (psf)	Optional		Ambient		Cold [-20°C (4°F)]	
	Calculated Air Leakage Prior to Wind Pressure Conditioning		Calculated Air Leakage After Wind Pressure Conditioning		Calculated Air Leakage After Wind Pressure Conditioning	
	L/s·m²	cfm/ft²	L/s·m²	cfm/ft²	L/s·m²	cfm/ft²
25 (0.52)	0.0002	0.0000	0.0003	0.0001	0.0172	0.0035
50 (1.04)	0.0005	0.0001	0.0007	0.0001	0.0211	0.0042
75 (1.57)	**0.0008**	**0.0002**	**0.0011**	**0.0002**	**0.0237**	**0.0048**
100 (2.09)	0.0010	0.0002	0.0016	0.0003	0.0257	0.0052
150 (3.13)	0.0017	0.0003	0.0026	0.0005	0.0290	0.0058
250 (5.22)	0.0030	0.0006	0.0048	0.0010	0.0336	0.0067
300 (6.24)	0.0036	0.0007	0.0060	0.0012	0.0354	0.0071

Table 30 – Summarized Air Leakage Results in Accordance with ASTM E2357-11 - Section 9.1, Air Leakage Testing Element Specimen No.: 20-06-B0040-CMU-PT-5 (Infiltration '+')

Differential Pressure Pa (psf)	Optional		Ambient		Cold [-20°C (4°F)]	
	Calculated Air Leakage Prior to Wind Pressure Conditioning		Calculated Air Leakage After Wind Pressure Conditioning		Calculated Air Leakage After Wind Pressure Conditioning	
	L/s·m²	cfm/ft²	L/s·m²	cfm/ft²	L/s·m²	cfm/ft²
25 (0.52)	0.0006	0.0001	0.0030	0.0006	0.0013	0.0003
50 (1.04)	0.0014	0.0003	0.0046	0.0009	0.0032	0.0006
75 (1.57)	**0.0023**	**0.0005**	**0.0059**	**0.0012**	**0.0053**	**0.0011**
100 (2.09)	0.0034	0.0007	0.0071	0.0014	0.0076	0.0015
150 (3.13)	0.0057	0.0011	0.0091	0.0018	0.0126	0.0025
250 (5.22)	0.0109	0.0022	0.0125	0.0025	0.0239	0.0048
300 (6.24)	0.0137	0.0028	0.0140	0.0028	0.0301	0.0060

* As per ASTM E2357-11, logarithmic graphs for each air leakage test (infiltration/exfiltration) displaying the linear regression (r^2) value are located in Appendix D.

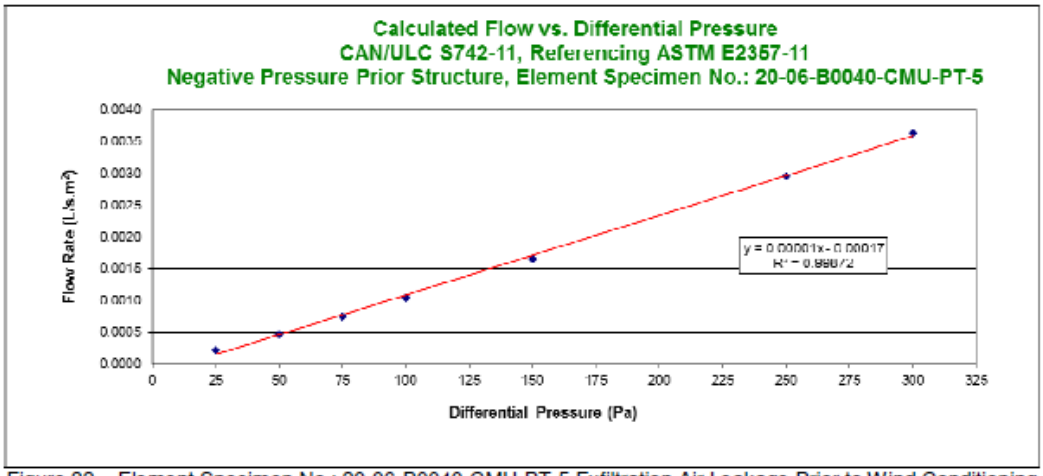


Figure 32 – Element Specimen No.: 20-06-B0040-CMU-PT-5 Exfiltration Air Leakage Prior to Wind Conditioning

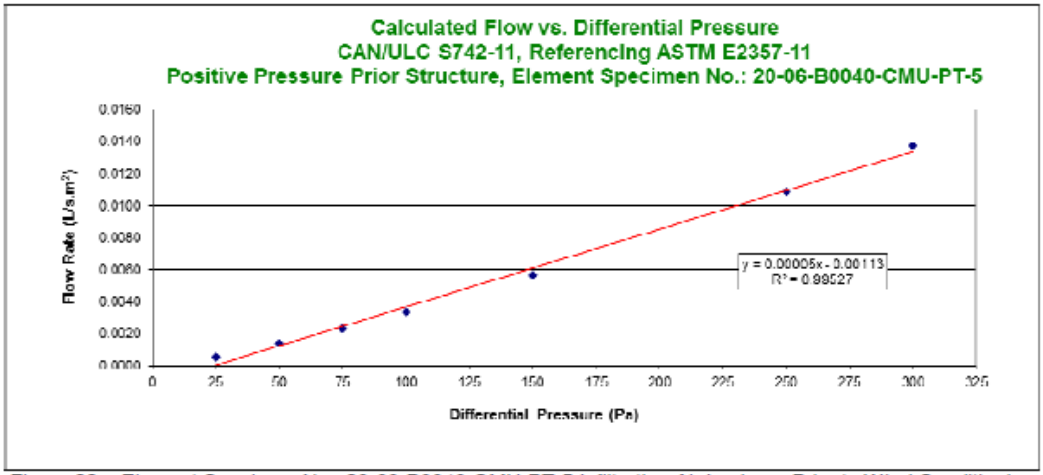


Figure 33 – Element Specimen No.: 20-06-B0040-CMU-PT-5 Infiltration Air Leakage Prior to Wind Conditioning

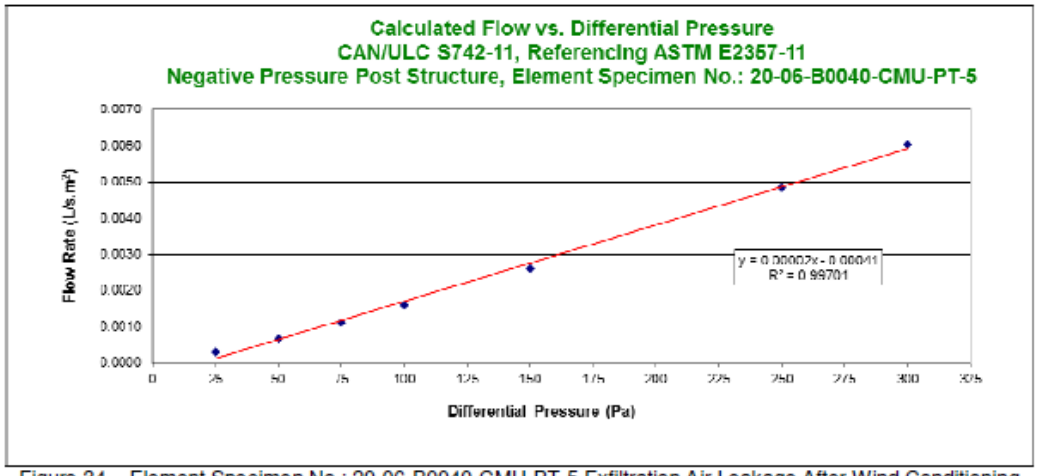


Figure 34 – Element Specimen No.: 20-06-B0040-CMU-PT-5 Exfiltration Air Leakage After Wind Conditioning (Ambient)

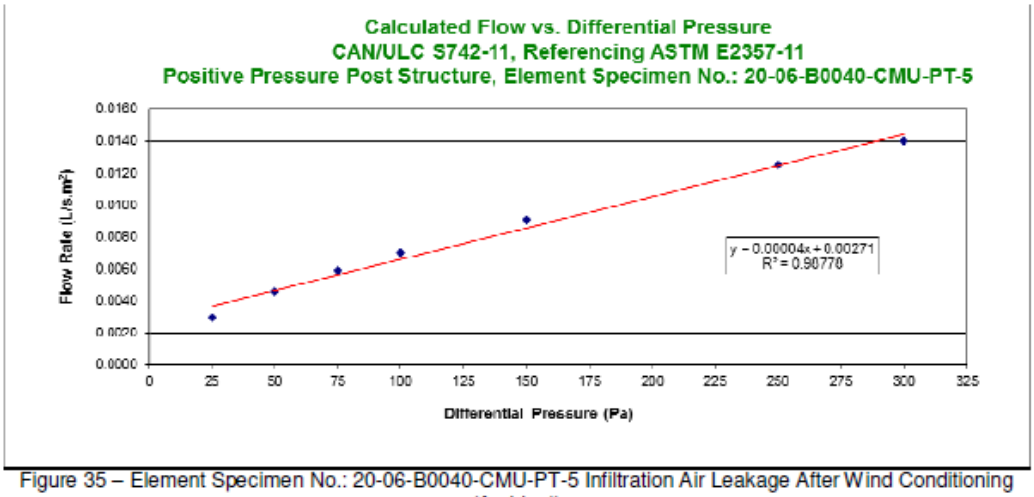


Figure 35 – Element Specimen No.: 20-06-B0040-CMU-PT-5 Infiltration Air Leakage After Wind Conditioning (Ambient)

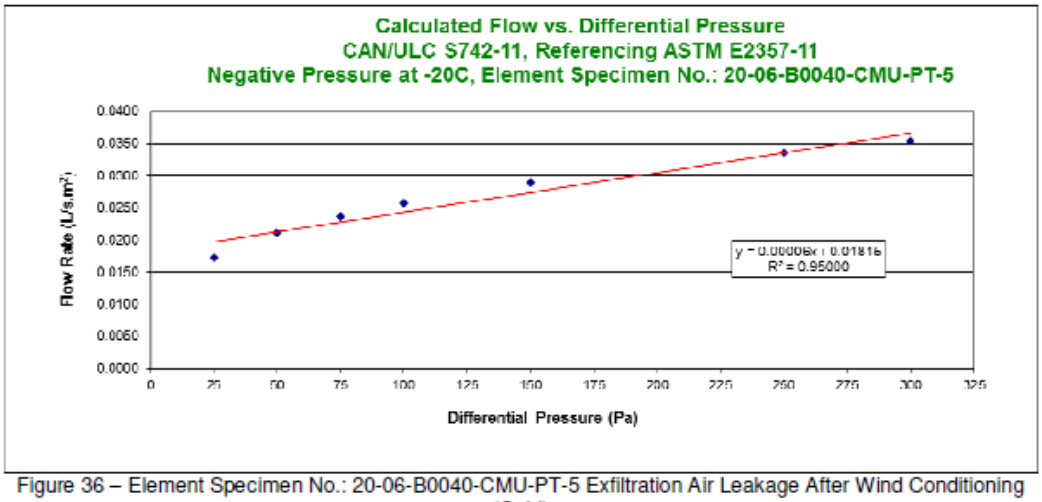


Figure 36 – Element Specimen No.: 20-06-B0040-CMU-PT-5 Exfiltration Air Leakage After Wind Conditioning (Cold)

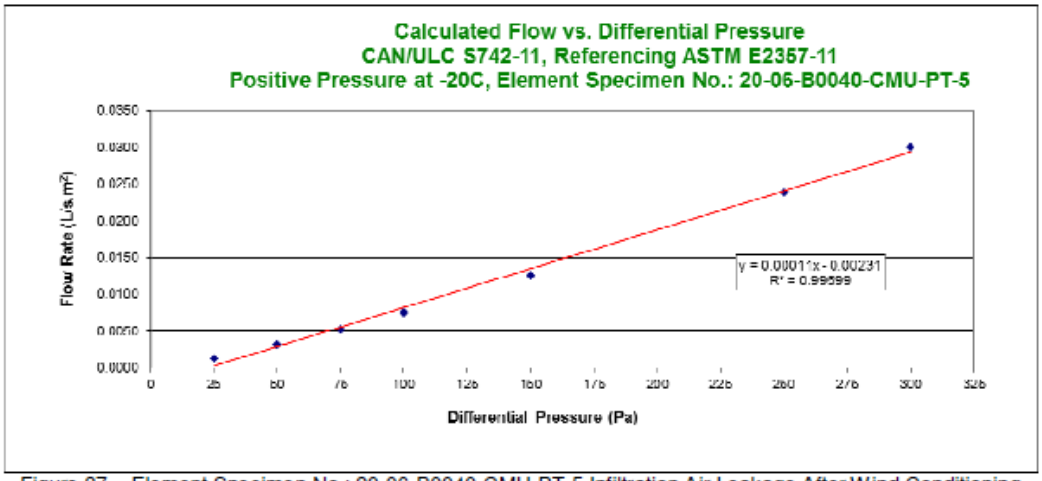


Figure 37 – Element Specimen No.: 20-06-B0040-CMU-PT-5 Infiltration Air Leakage After Wind Conditioning (Cold)

Table 31 – Wind Pressure Loading Deflection Results (Metric Units) in Accordance with CAN/ULC-S742-11, Section 6.3.3
Element Specimen No.: 20-06-B0040-CMU-PT-5

Cycle	Pressure (Pa) Q_{10} > 0.20 kPa	Gauge Numbers (Locations) & Maximum Deflections (mm)						
		1	2	3	4	5	6	7
Sustained Loads	100	0.11	0.04	-0.48	-0.04	-0.22	0.07	0.20
	200	0.47	-0.04	0.15	-0.06	-0.20	-0.06	-0.04
	300	-0.89	-0.09	-0.73	-0.41	-0.32	-0.07	0.11
	400	-0.52	0.04	0.09	-0.15	-0.30	-0.20	-0.04
	500	-0.07	-0.07	-0.37	-0.17	-0.39	-0.26	-0.30
	600	-0.76	-0.13	-0.37	-0.15	-0.26	-0.07	-0.20
	650 (P_1)	0.61	-0.19	-0.22	-0.30	-0.35	-0.39	-0.30
	-100	0.60	0.13	0.26	-0.09	0.26	0.19	-0.04
	-200	0.58	0.20	0.60	-0.65	0.22	0.09	0.19
	-300	0.37	0.24	0.43	0.19	0.22	0.17	0.00
	-400	0.47	0.20	0.63	-0.43	0.47	0.32	0.37
	-500	0.43	0.17	0.54	0.19	0.58	0.15	0.20
	-600	0.54	0.13	-0.93	0.30	0.63	0.52	0.45
	-650 (P'_1)	0.61	0.22	0.95	0.48	0.87	0.43	0.54
Cyclic Loads	**0 to 950 (P_2)**	-1.88	-0.32	-0.37	-0.63	-0.45	-0.86	-0.71
	0 to -950 (P'_2)	1.40	0.35	0.50	0.28	1.06	0.33	0.80
Gust Loads	**0 to 1410 (P_2)**	0.22	-0.65	-0.65	-0.95	-1.08	-0.80	0.52
	0 to -1410 (P'_2)	1.19	0.48	1.66	1.66	1.58	1.40	-0.52

Table 32 – Deflection Results (Metric Units) in Accordance with CAN/ULC-S742-11, Section 6.3.4 (Pressure exceeds that of ASTM E2357-11)
Element Specimen No.: 20-06-B0040-CMU-PT-5

Cycle	Pressure (Pa) Q_{10} > 0.40 kPa / $D_{0.60}$	Gauge Numbers (Locations) & Maximum Deflections (mm)						
		1	2	3	4	5	6	7
Wind Loading	0 to +1440	-0.17	-0.99	-1.12	-1.34	-1.23	-1.02	0.48
	0 to –1440	0.71	0.63	1.71	1.54	2.27	1.58	0.60

Note: The locations for each gauge number are located on the following page in Figure 38.

Table 33 – Wind Pressure Loading Deflection Results (Imperial Units) in Accordance with CAN/ULC-S742-11, Section 6.3.3
Element Specimen No.: 20-06-B0040-CMU-PT-5

Cycle	Pressure (PSF) Q_{10} > 0.20 kPa	Gauge Numbers (Locations) & Maximum Deflections (inches)						
		1	2	3	4	5	6	7
Sustained Loads	2.09	0.004	0.002	-0.019	-0.002	-0.009	0.003	0.008
	4.18	0.019	-0.002	0.006	-0.002	-0.008	-0.002	-0.002
	6.27	-0.035	-0.004	-0.029	-0.016	-0.013	-0.003	0.004
	8.35	-0.020	0.002	0.004	-0.006	-0.012	-0.008	-0.002
	10.44	-0.003	-0.003	-0.015	-0.007	-0.015	-0.010	-0.012
	12.53	-0.030	-0.005	-0.015	-0.006	-0.010	-0.003	-0.008
	13.58 (P_1)	0.024	-0.007	-0.009	-0.012	-0.014	-0.015	-0.012
	-2.09	0.024	0.005	0.010	-0.004	0.010	0.007	-0.002
	-4.18	0.023	0.008	0.024	-0.026	0.009	0.004	0.007
	-6.27	0.015	0.009	0.017	0.007	0.009	0.007	0.000
	-8.35	0.019	0.008	0.025	-0.017	0.019	0.013	0.015
	-10.44	0.017	0.007	0.021	0.007	0.023	0.006	0.008
	-12.53	0.021	0.005	-0.037	0.012	0.025	0.020	0.018
	-13.58 (P'_1)	0.024	0.009	0.037	0.019	0.034	0.017	0.021
Cyclic Loads	**0 to 19.84 (P_2)**	-0.074	-0.013	-0.015	-0.025	-0.018	-0.034	-0.028
	0 to -19.84 (P'_2)	0.055	0.014	0.020	0.011	0.042	0.013	0.031
Gust Loads	**0 to 29.45 (P_2)**	0.009	-0.026	-0.026	-0.037	-0.043	-0.031	0.020
	0 to -29.45 (P'_2)	0.047	0.019	0.065	0.065	0.062	0.055	-0.020

Table 34 – Deflection Results (Imperial Units) in Accordance with CAN/ULC-S742-11, Section 6.3.4 (Pressure exceeds that of ASTM E2357-11)
Element Specimen No.: 20-06-B0040-CMU-PT-5

Cycle	Pressure (PSF) Q_{10} > 0.40 kPa / $D_{0.60}$	Gauge Numbers (Locations) & Maximum Deflections (inches)						
		1	2	3	4	5	6	7
Wind Loading	0 to +30.08	-0.007	-0.039	-0.044	-0.053	-0.048	-0.040	0.019
	0 to –30.08	0.028	0.025	0.067	0.061	0.089	0.062	0.024

Note: The locations for each gauge number are located on the following page in Figure 38.

Wall Section Observations During Structural Wind Loading

During the wind loading schedule as shown in Tables 31 and 32, there were no visible signs of Element Specimen No. 20-06-B0040-CMU-PT-4 tearing, peeling or cracking away from the wall section.

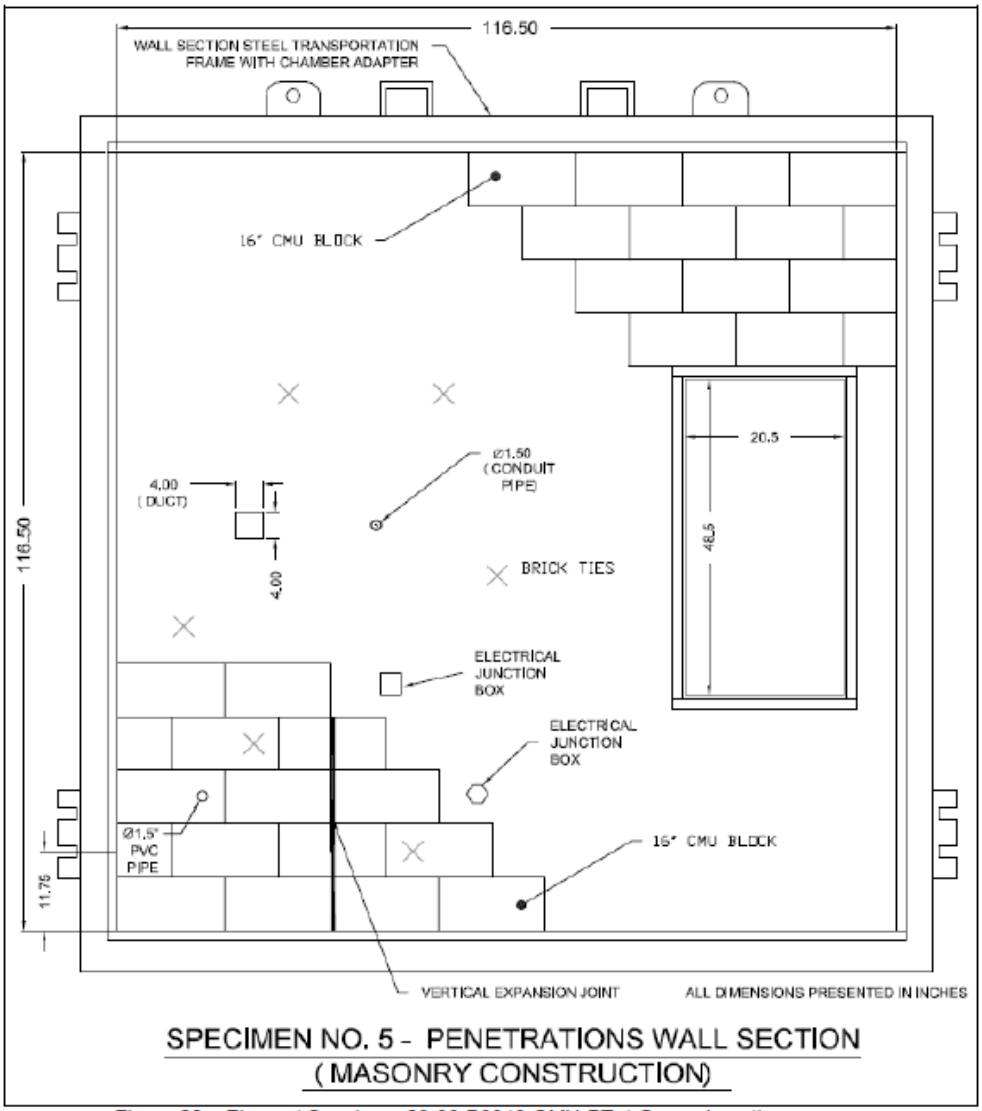


Figure 38 – Element Specimen 20-06-B0040-CMU-PT-4 Gauge Locations

5.3 Detailed Element Specimen No. 20-06-B0040-CMU-CB-6 Results

Table 35 – Summarized Air Leakage Results in Accordance with ASTM E2357-11 - Section 9.1, Air Leakage Testing Element Specimen No.: 20-06-B0040-CMU-CB-6 (Exfiltration '-')

Differential Pressure Pa (psf)	Optional		Ambient		Cold [-20°C (-4°F)]	
	Calculated Air Leakage Prior to Wind Pressure Conditioning		Calculated Air Leakage After Wind Pressure Conditioning		Calculated Air Leakage After Wind Pressure Conditioning	
	L/s·m²	cfm/ft²	L/s·m²	cfm/ft²	L/s·m²	cfm/ft²
25 (0.52)	0.0027	0.0005	0.0035	0.0007	0.0046	0.0009
50 (1.04)	0.0033	0.0007	0.0040	0.0008	0.0070	0.0014
75 (1.57)	**0.0037**	**0.0007**	**0.0044**	**0.0009**	**0.0088**	**0.0018**
100 (2.09)	0.0040	0.0008	0.0047	0.0009	0.0104	0.0021
150 (3.13)	0.0045	0.0009	0.0051	0.0010	0.0132	0.0027
250 (5.22)	0.0053	0.0011	0.0057	0.0011	0.0179	0.0036
300 (6.24)	0.0056	0.0011	0.0059	0.0012	0.0199	0.0040

Table 36 – Summarized Air Leakage Results in Accordance with ASTM E2357-11 - Section 9.1, Air Leakage Testing Element Specimen No.: 20-06-B0040-CMU-CB-6 (Infiltration '+')

Differential Pressure Pa (psf)	Optional		Ambient		Cold [-20°C (-4°F)]	
	Calculated Air Leakage Prior to Wind Pressure Conditioning		Calculated Air Leakage After Wind Pressure Conditioning		Calculated Air Leakage After Wind Pressure Conditioning	
	L/s·m²	cfm/ft²	L/s·m²	cfm/ft²	L/s·m²	cfm/ft²
25 (0.52)	0.0031	0.0006	0.0068	0.0014	0.0040	0.0008
50 (1.04)	0.0057	0.0012	0.0107	0.0021	0.0075	0.0015
75 (1.57)	**0.0083**	**0.0017**	**0.0139**	**0.0028**	**0.0107**	**0.0021**
100 (2.09)	0.0108	0.0022	0.0168	0.0034	0.0138	0.0028
150 (3.13)	0.0155	0.0031	0.0219	0.0044	0.0198	0.0040
250 (5.22)	0.0246	0.0049	0.0306	0.0061	0.0312	0.0063
300 (6.24)	0.0290	0.0058	0.0344	0.0069	0.0368	0.0074

* As per ASTM E2357-11, logarithmic graphs for each air leakage test (infiltration/exfiltration) displaying the linear regression (r^2) value are located in Appendix C.

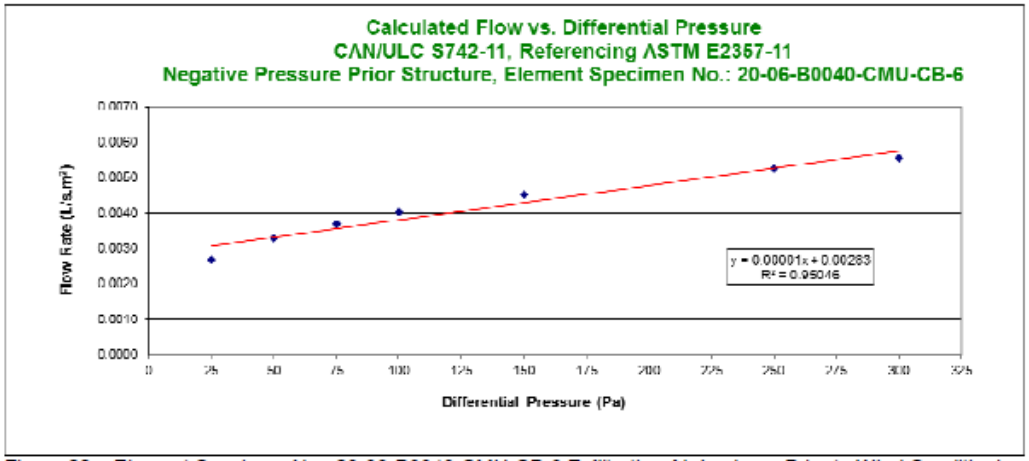


Figure 39 – Element Specimen No.: 20-06-B0040-CMU-CB-6 Exfiltration Air Leakage Prior to Wind Conditioning

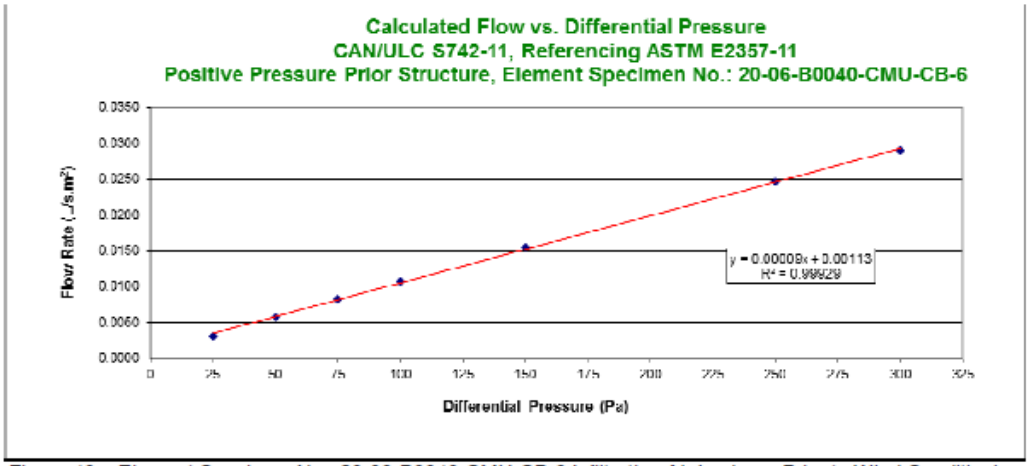


Figure 40 – Element Specimen No.: 20-06-B0040-CMU-CB-6 Infiltration Air Leakage Prior to Wind Conditioning

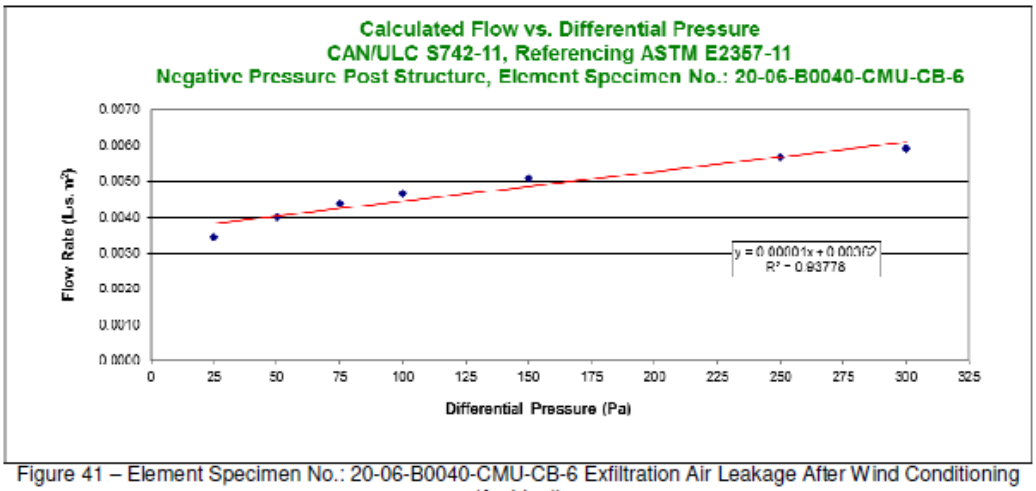


Figure 41 – Element Specimen No.: 20-06-B0040-CMU-CB-6 Exfiltration Air Leakage After Wind Conditioning (Ambient)

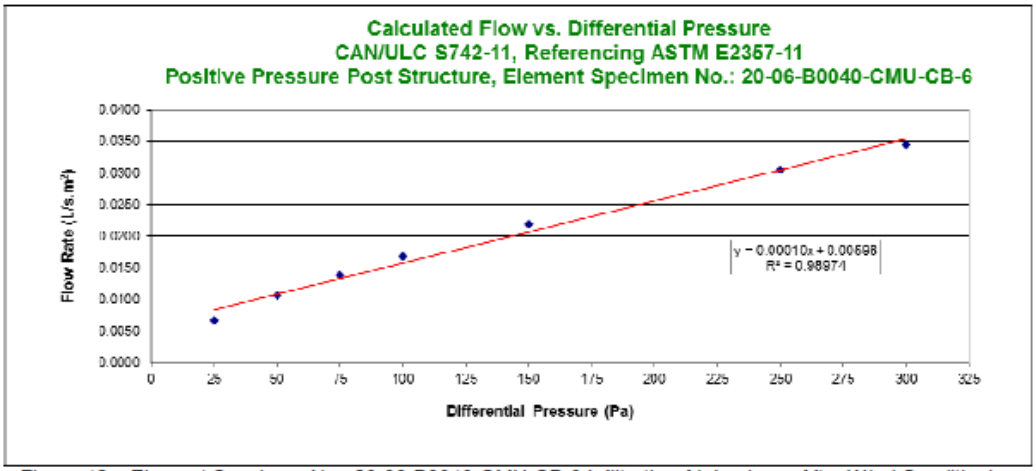


Figure 42 – Element Specimen No.: 20-06-B0040-CMU-CB-6 Infiltration Air Leakage After Wind Conditioning (Ambient)

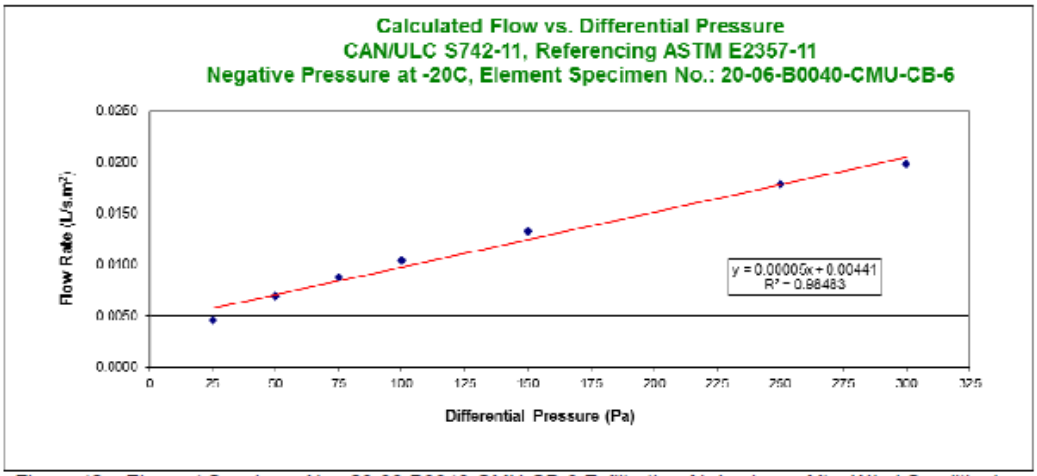


Figure 43 – Element Specimen No.: 20-06-B0040-CMU-CB-6 Exfiltration Air Leakage After Wind Conditioning (Cold)

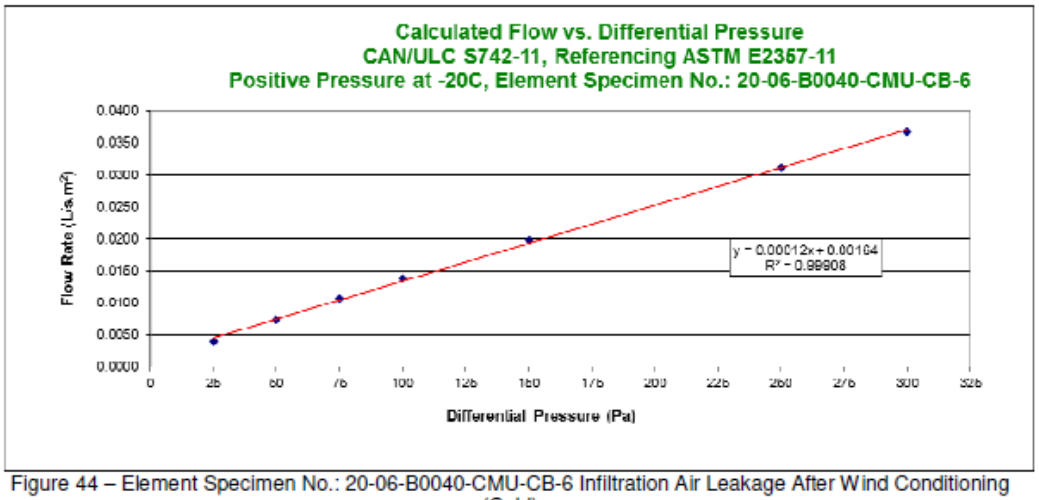


Figure 44 – Element Specimen No.: 20-06-B0040-CMU-CB-6 Infiltration Air Leakage After Wind Conditioning (Cold)

Table 37 – Wind Pressure Loading Deflection Results (Metric Units) in Accordance with CAN/ULC-S742-11, Section 6.3.3
Element Specimen No.: 20-06-B0040-CMU-CB-6

Cycle	Pressure (Pa) Q_{10} > 0.20 kPa	Gauge Numbers (Locations) & Maximum Deflections (mm)						
		1	2	3	4	5	6	7
Sustained Loads	100	-0.64	-0.69	0.04	0.00	0.06	0.02	0.73
	200	-0.35	0.78	0.02	0.19	0.17	-0.09	0.00
	300	-0.48	0.60	0.13	-0.06	0.07	-0.06	0.47
	400	-0.41	0.37	0.06	0.63	-0.02	-0.13	-0.60
	500	-0.61	0.47	0.04	-0.09	-0.37	-0.28	0.86
	600	-0.80	0.35	-0.22	-0.47	-0.19	-0.33	-0.50
	650 (P_1)	0.52	0.30	-0.43	-0.33	-0.43	-0.33	0.99
	-100	0.13	-0.73	0.22	-0.07	0.09	0.07	3.31
	-200	0.37	-0.80	0.35	0.20	-0.04	0.20	-0.71
	-300	-0.54	0.33	0.28	-0.09	-0.07	0.26	0.47
	-400	-0.35	0.67	0.56	0.17	0.20	0.20	0.69
	-500	0.67	-0.54	0.48	0.20	0.24	0.28	0.87
	-600	-0.35	0.06	0.52	0.39	0.41	-0.11	0.56
	-650 (P'_1)	-0.92	0.32	0.80	0.74	0.69	0.60	-0.26
Cyclic Loads	**0 to 950 (P_2)**	0.63	-0.85	-0.93	-0.87	-0.41	-0.45	0.38
	0 to -950 (P'_2)	0.44	0.63	0.82	0.97	0.87	0.61	0.48
Gust Loads	**0 to 1410 (P_2)**	-0.45	-1.04	-1.28	-1.21	-1.15	-0.80	-0.89
	0 to -1410 (P'_2)	0.02	1.12	1.56	1.34	1.30	0.86	1.06

Table 38 – Deflection Results (Metric Units) in Accordance with CAN/ULC-S742-11, Section 6.3.4 (Pressure exceeds that of ASTM E2357-11)
Element Specimen No.: 20-06-B0040-CMU-CB-6

Cycle	Pressure (Pa) Q_{10} > 0.40 kPa / $D_{0.60}$	Gauge Numbers (Locations) & Maximum Deflections (mm)						
		1	2	3	4	5	6	7
Wind Loading	0 to +1440	-0.71	-1.56	-1.25	-0.95	-1.13	-0.74	1.08
	0 to –1440	-0.84	1.17	1.56	1.86	1.43	0.71	-1.13

Note: The locations for each gauge number are located in Figure 45.

Table 39 – Wind Pressure Loading Deflection Results (Imperial Units) in Accordance with CAN/ULC-S742-11, Section 6.3.3
Element Specimen No.: 20-06-B0040-CMU-CB-6

Cycle	Pressure (PSF) Q_{10} > 0.20 kPa	Gauge Numbers (Locations) & Maximum Deflections (inches)						
		1	2	3	4	5	6	7
Sustained Loads	2.09	-0.025	-0.027	0.002	0.000	0.002	0.001	0.029
	4.18	-0.014	0.031	0.001	0.007	0.007	-0.004	0.000
	6.27	-0.019	0.024	0.005	-0.002	0.003	-0.002	0.019
	8.35	-0.016	0.015	0.002	0.025	-0.001	-0.005	-0.024
	10.44	-0.024	0.019	0.002	-0.004	-0.015	-0.011	0.034
	12.53	-0.031	0.014	-0.009	-0.019	-0.007	-0.013	-0.020
	13.58 (P_1)	0.020	0.012	-0.017	-0.013	-0.017	-0.013	0.039
	-2.09	0.005	-0.029	0.009	-0.003	0.004	0.003	0.130
	-4.18	0.015	-0.031	0.014	0.008	-0.002	0.008	-0.028
	-6.27	-0.021	0.013	0.011	-0.004	-0.003	0.010	0.019
	-8.35	-0.014	0.026	0.022	0.007	0.008	0.008	0.027
	-10.44	0.026	-0.021	0.019	0.008	0.009	0.011	0.034
	-12.53	-0.014	0.002	0.020	0.015	0.016	-0.004	0.022
	-13.58 (P'_1)	-0.036	0.013	0.031	0.029	0.027	0.024	-0.010
Cyclic Loads	**0 to 19.84 (P_2)**	0.025	-0.033	-0.037	-0.034	-0.016	-0.018	0.015
	0 to -19.84 (P'_2)	0.017	0.025	0.032	0.038	0.034	0.024	0.019
Gust Loads	**0 to 29.45 (P_2)**	-0.018	-0.041	-0.050	-0.048	-0.045	-0.031	-0.035
	0 to -29.45 (P'_2)	0.001	0.044	0.061	0.053	0.051	0.034	0.042

Table 40 – Deflection Results (Imperial Units) in Accordance with CAN/ULC-S742-11, Section 6.3.4 (Pressure exceeds that of ASTM E2357-11)
Element Specimen No.: 20-06-B0040-CMU-CB-6

Cycle	Pressure (PSF) Q_{10} > 0.40 kPa / $D_{0.60}$	Gauge Numbers (Locations) & Maximum Deflections (inches)						
		1	2	3	4	5	6	7
Wind Loading	0 to +30.08	-0.028	-0.061	-0.049	-0.037	-0.044	-0.029	0.043
	0 to –30.08	-0.033	0.046	0.061	0.073	0.056	0.028	-0.044

Note: The locations for each gauge number are located in Figure 45.

Wall Section Observations During Structural Wind Loading

During the wind loading schedule as shown in Tables 37 and 38, there were no visible signs of Element Specimen No. 20-06-B0040-CMU-CB-6 tearing, cracking or peeling from the wall section.

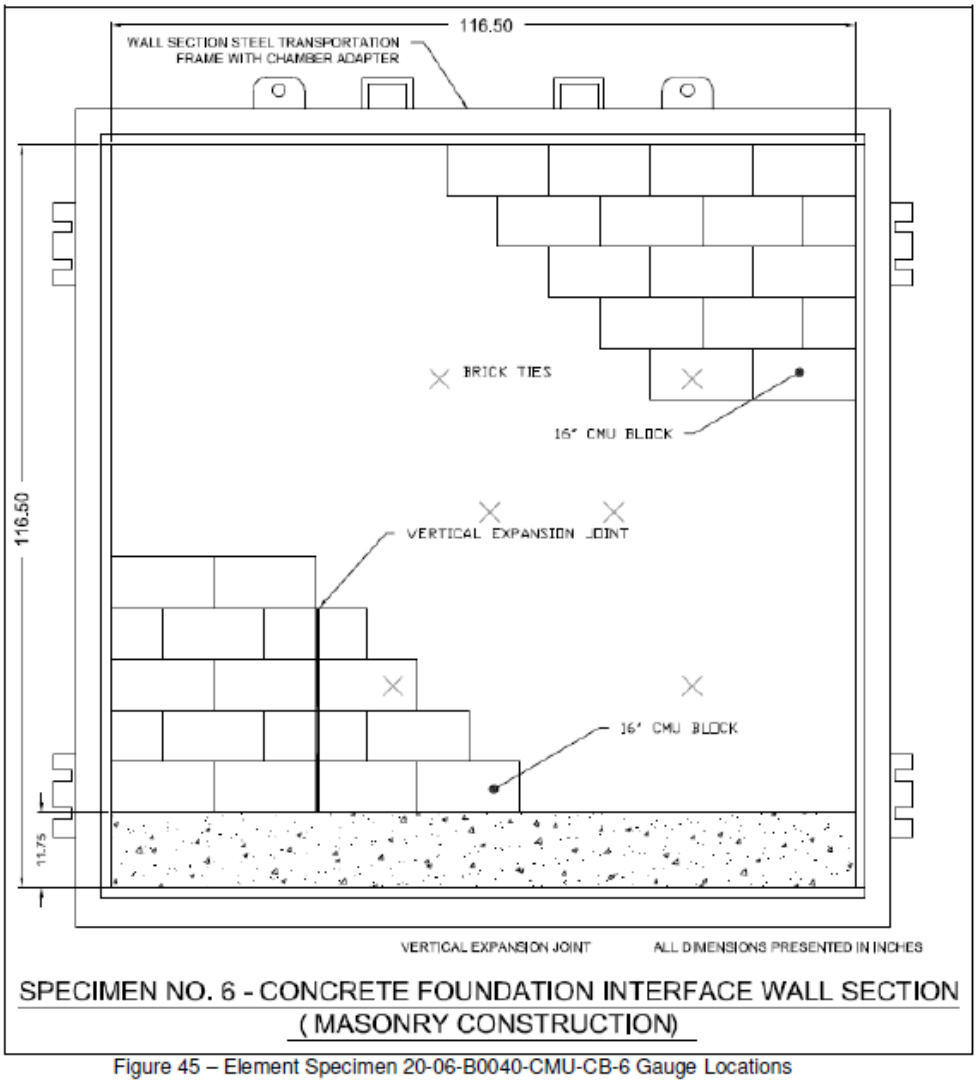


Figure 45 – Element Specimen 20-06-B0040-CMU-CB-6 Gauge Locations

5.4 Client requested test – Water penetration resistance

Table 41 – ASTM E331-00 (2016) - Water Penetration Resistance
Element Specimen No.: 20-06-B0040-CMU-PT-5

Requested Test Pressure Pa (psf)	Requirements	Results	Comments
137 *(2.86)* (15-Minutes)	As per client request, the opaque wall assembly shall not have water penetration through the wall assembly at the requested test pressure for 15-minutes. No water shall be observed from the interior side such as the sheathing and sheathing joints.	No water penetration was observed at the interior side of the wall assembly at the conclusion of the test	**Meets Client's Requirement**
300 *(6.27)* (15-Minutes)	As per client request, the opaque wall assembly shall not have water penetration through the wall assembly at the requested test pressure for 15-minutes. No water shall be observed from the interior side such as the sheathing and sheathing joints.	No water penetration was observed at the interior side of the wall assembly at the conclusion of the test	**Meets Client's Requirement**

Table 42 – ASTM E331-00 (2016) - Water Penetration Resistance
Element Specimen No.: 20-06-B0040-CMU-CB-6

Requested Test Pressure Pa (psf)	Requirements	Results	Comments
137 *(2.86)* (15-Minutes)	As per client request, the opaque wall assembly shall not have water penetration through the wall assembly at the requested test pressure for 15-minutes. No water shall be observed from the interior side such as the sheathing, sheathing joints, PVC and metal pipe, electrical junction boxes, square metal duct, brick ties, roof and foundation interface, and around the window rough opening.	No water penetration was observed at the interior side of the wall assembly at the conclusion of the test	**Meets Client's Requirement**
300 *(6.27)* (15-Minutes)	As per client request, the opaque wall assembly shall not have water penetration through the wall assembly at the requested test pressure for 15-minutes. No water shall be observed from the interior side such as the sheathing, sheathing joints, PVC and metal pipe, electrical junction boxes, square metal duct, brick ties, roof and foundation interface, and around the window rough opening.	No water penetration was observed at the interior side of the wall assembly at the conclusion of the test	**Meets Client's Requirement**

6.0 CONCLUSION

The Genyk, "Boreal Nature Elite" air barrier assemblies encompassed in Element Specimens: 20-06-B0040-SS-OP-1, PT-2, & CB-3, comply with the air leakage requirements of CAN/ULC-S742-11 utilizing various wall section configurations and achieved an "A1" air leakage rate classification at a 1 in 50 hourly wind pressure difference of 650 Pa (13.58 psf) at 12 meters (39.4 feet) above grade.

The summarized test results are located in the tables below:

Table 43 – Summarized Air Leakage Results at 75 Pa (1.57 psf) in Accordance with CAN/ULC-S742-11, Section 6.3.2.1 (A), referencing ASTM E2357-11 – Section 9.1, Air Leakage Testing

Element Specimen No.:	Airflow Direction	Optional	Ambient	Cold	Air Leakage Rate Classification
		Calculated Air Leakage at 75 Pa (1.57 psf) Prior to Wind Pressure Conditioning L/s·m² (cfm/ft²)	Calculated Air Leakage at 75 Pa (1.57 psf) After Wind Pressure Conditioning L/s·m² (cfm/ft²)	Calculated Air Leakage at 75 Pa (1.57 psf) After Wind Pressure Conditioning L/s·m² (cfm/ft²)	
20-06-B0040-SS-OP-1 *(Opaque Wall)*	- EXF	0.0037 (0.0007)	0.0044 (0.0009)	0.0099 (0.0020)	A1
	+ INF	0.0083 (0.0017)	**0.0139 (0.0028)**	0.0132 (0.0027)	
20-06-B0040-SS-PT-2 *(Penetration Wall)*	- EXF	0.0462 (0.0093)	0.0500 (0.0100)	0.0245 (0.0049)	
	+ INF	0.0474 (0.0095)	**0.0503 (0.0101)**	0.0354 (0.0071)	
20-06-B0040-SS-PT-3 *(Opague Wall with Foundation Interface)*	- EXF	0.0440 (0.0088)	**0.0469 (0.0094)**	0.0183 (0.0037)	
	+ INF	0.0473 (0.0095)	0.0434 (0.0087)	0.0212 (0.0043)	

Notes: '-' denotes exfiltration airflow direction (simulated negative wind loading)
'+' denotes infiltration airflow direction (simulated positive wind loading)

The Genyk, "Boreal Nature Elite" air barrier assemblies encompassed in Element Specimens: 20-06-B0040-CMU-OP-4, PT-5, & CB-6, comply with the air leakage requirements of CAN/ULC-S742-11 utilizing various wall section configurations and achieved an "A1" air leakage rate classification at a 1 in 50 hourly wind pressure difference of 650 Pa (13.58 psf) at 12 meters (39.4 feet) above grade.

The summarized test results are located in the tables below:

Table 44 – Summarized Air Leakage Results at 75 Pa (1.57 psf) in Accordance with CAN/ULC-S742-11, Section 6.3.2.1 (A), referencing ASTM E2357-11 – Section 9.1, Air Leakage Testing

Element Specimen No.:	Airflow Direction	Optional	Ambient	Cold	Air Leakage Rate Classification
		Calculated Air Leakage at 75 Pa (1.57 psf) Prior to Wind Pressure Conditioning L/s·m² (cfm/ft²)	Calculated Air Leakage at 75 Pa (1.57 psf) After Wind Pressure Conditioning L/s·m² (cfm/ft²)	Calculated Air Leakage at 75 Pa (1.57 psf) After Wind Pressure Conditioning L/s·m² (cfm/ft²)	
20-06-B0040-CMU-OP-4 *(Opaque Wall)*	- EXF	0.0083 (0.0017)	0.0165[1] (0.0033)	0.0053 (0.0011)	A1
	+ INF	0.0009 (0.0002)	0.0030 (0.0006)	0.0053 (0.0011)	
20-06-B0040-CMU-PT-5 *(Penetration Wall)*	- EXF	0.0008 (0.0002)	0.0011 (0.0002)	0.0237[1] (0.0048)	
	+ INF	0.0023 (0.0005)	0.0059 (0.0012)	0.0053 (0.0011)	
20-06-B0040-CMU-CB-6 *(Opague Wall with Foundation Interface)*	- EXF	0.0037 (0.0007)	0.0044 (0.0009)	0.0088 (0.0018)	
	+ INF	0.0083 (0.0017)	0.0139[1] (0.0028)	0.0107 (0.0021)	

Notes: '-' denotes exfiltration airflow direction (simulated negative wind loading)
'+' denotes infiltration airflow direction (simulated positive wind loading)

7.0 REPORT REVISION SUMMARY

Revision No.:	Date:	Description of Revisions:
Original	November 6, 2020	Original Document

Reviewed by:

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

Reported & Authorized by:

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

APPENDIX A

Logarithmic Air Leakage Graphs
Element Specimen No.: 20-06-B0040-SS-OP-1
(Opaque Wall Section)

(3 Pages)

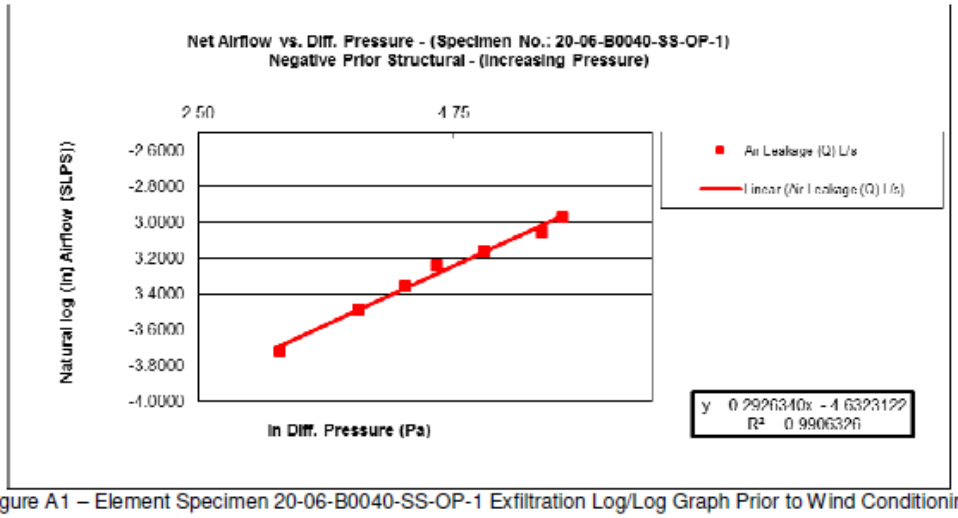


Figure A1 – Element Specimen 20-06-B0040-SS-OP-1 Exfiltration Log/Log Graph Prior to Wind Conditioning

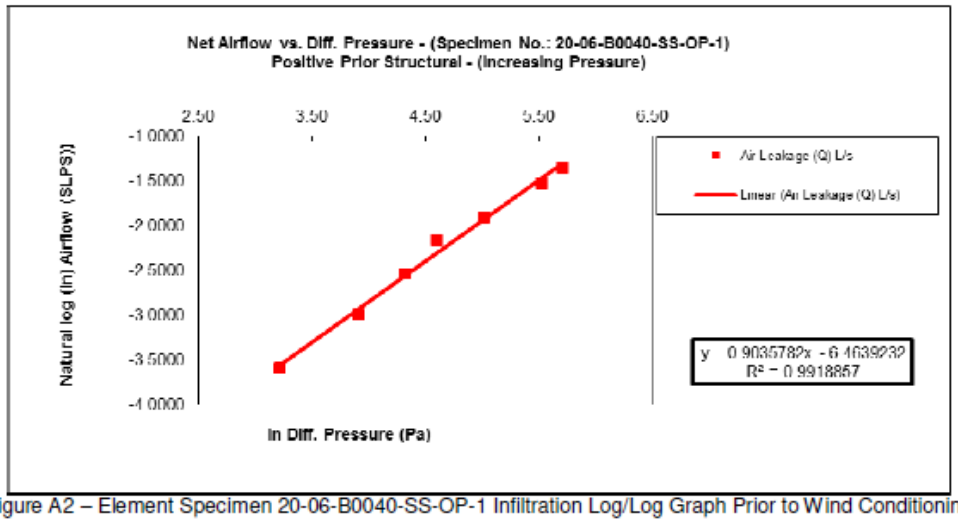


Figure A2 – Element Specimen 20-06-B0040-SS-OP-1 Infiltration Log/Log Graph Prior to Wind Conditioning

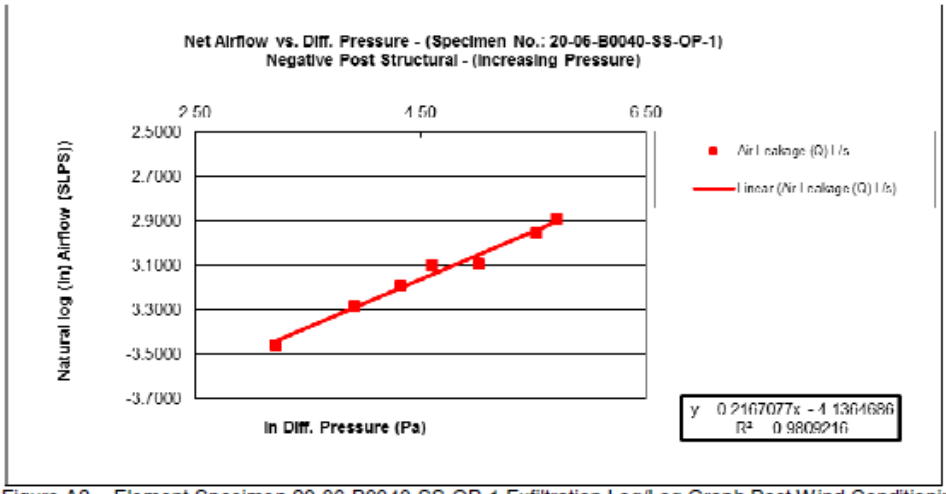


Figure A3 – Element Specimen 20-06-B0040-SS-OP-1 Exfiltration Log/Log Graph Post Wind Conditioning

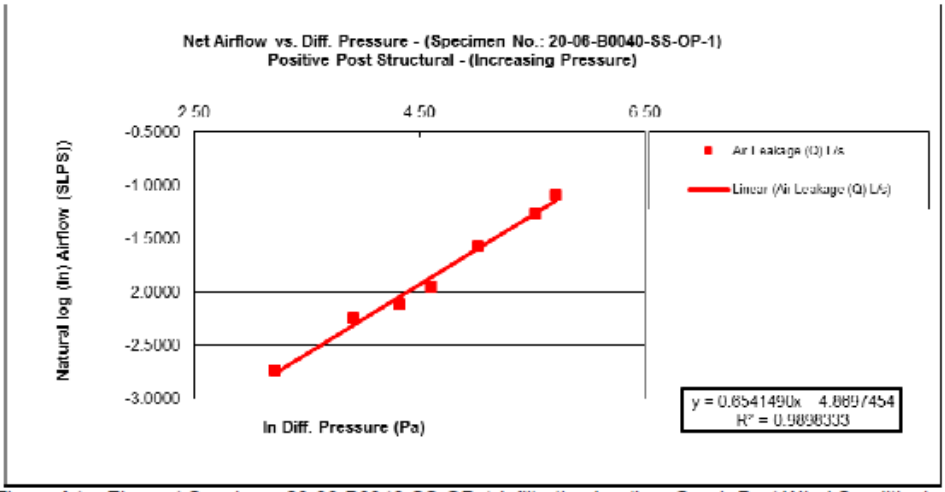


Figure A4 – Element Specimen 20-06-B0040-SS-OP-1 Infiltration Log/Log Graph Post Wind Conditioning

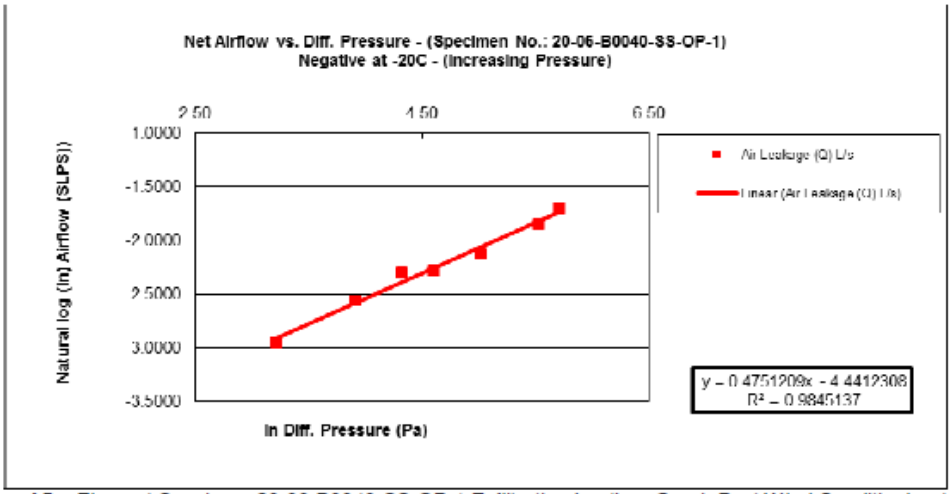


Figure A5 – Element Specimen 20-06-B0040-SS-OP-1 Exfiltration Log/Log Graph Post Wind Conditioning (-20°C)

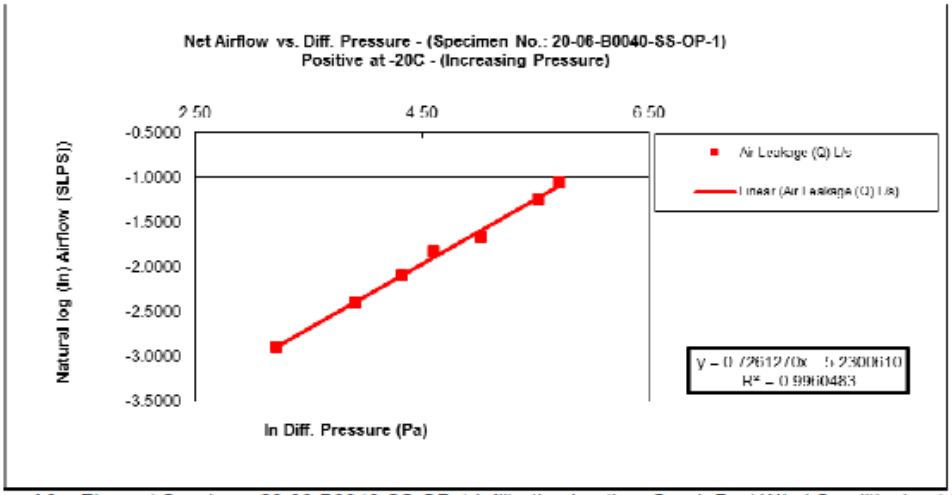


Figure A6 – Element Specimen 20-06-B0040-SS-OP-1 Infiltration Log/Log Graph Post Wind Conditioning (-20°C)

APPENDIX B

Logarithmic Air Leakage Graphs
Element Specimen No.: 20-06-B0040-SS-PT-2
(Penetrations Wall Section)

(3 Pages)

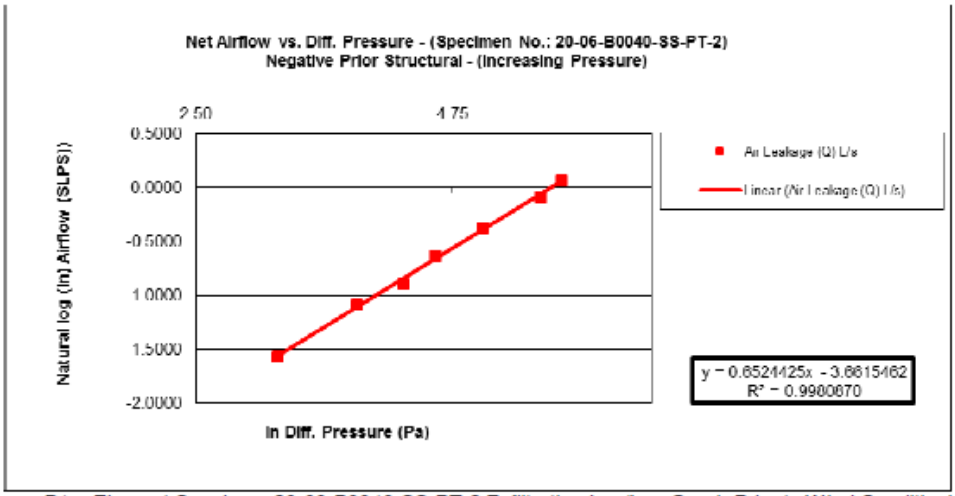


Figure B1 – Element Specimen 20-06-B0040-SS-PT-2 Exfiltration Log/Log Graph Prior to Wind Conditioning

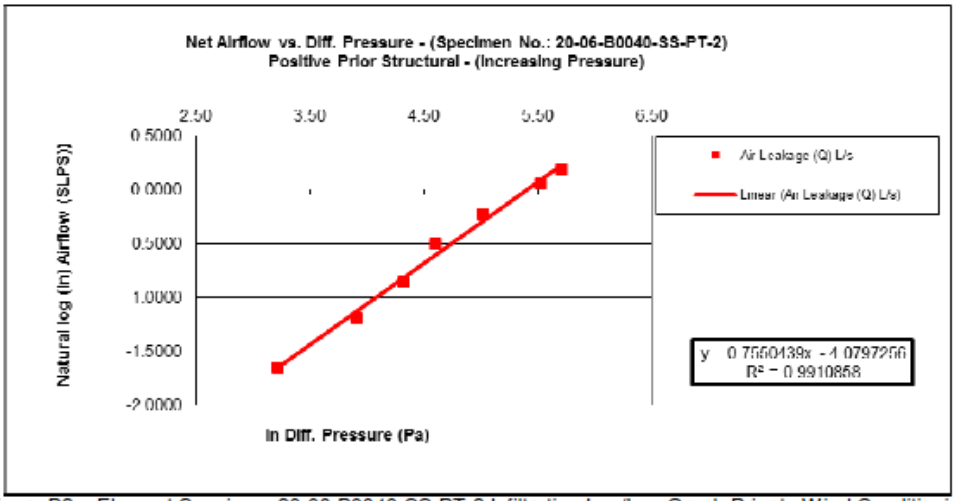


Figure B2 – Element Specimen 20-06-B0040-SS-PT-2 Infiltration Log/Log Graph Prior to Wind Conditioning

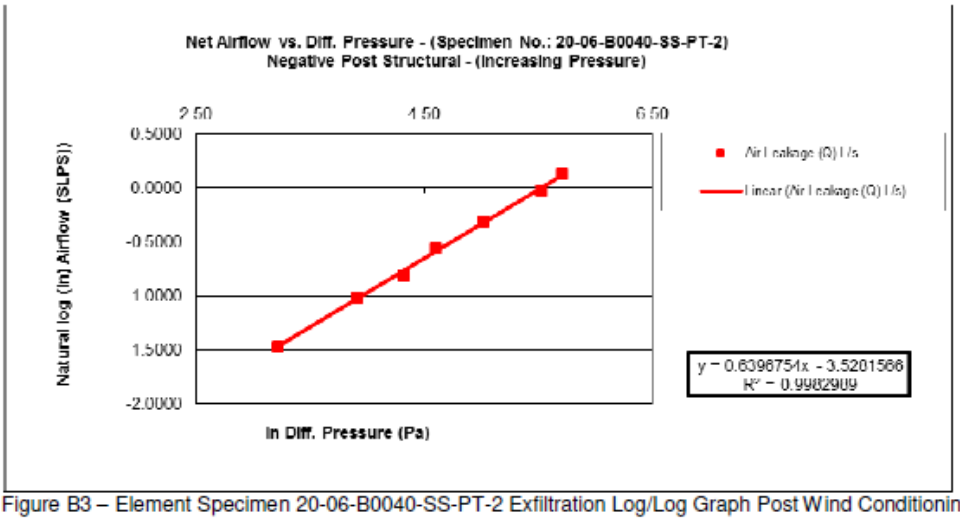


Figure B3 – Element Specimen 20-06-B0040-SS-PT-2 Exfiltration Log/Log Graph Post Wind Conditioning

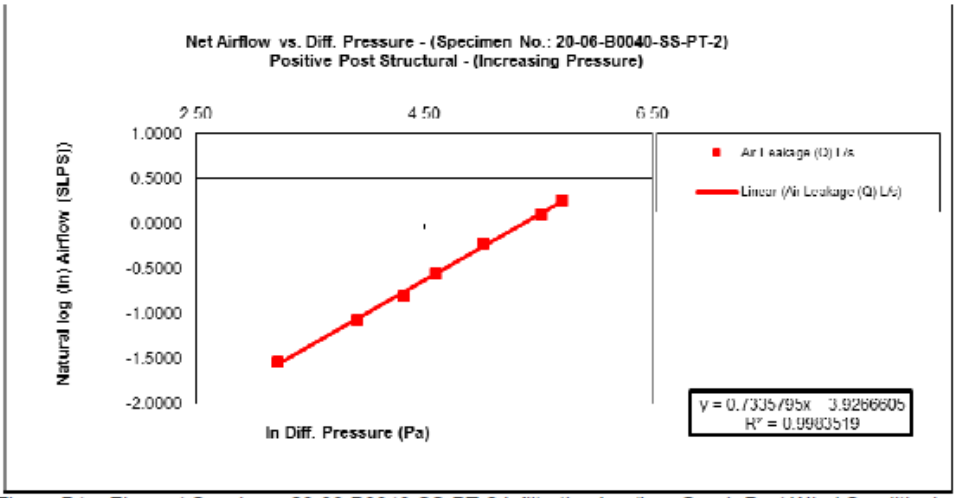


Figure B4 – Element Specimen 20-06-B0040-SS-PT-2 Infiltration Log/Log Graph Post Wind Conditioning

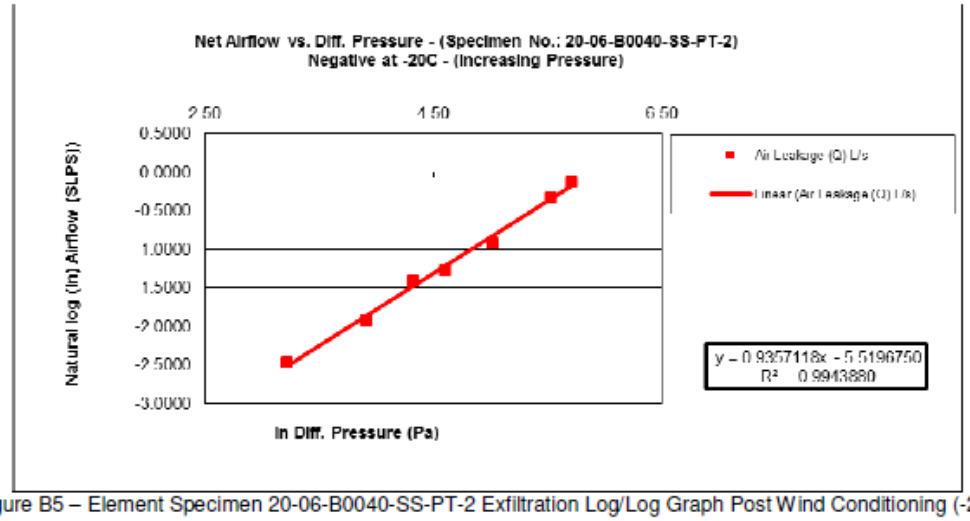


Figure B5 – Element Specimen 20-06-B0040-SS-PT-2 Exfiltration Log/Log Graph Post Wind Conditioning (-20°C)

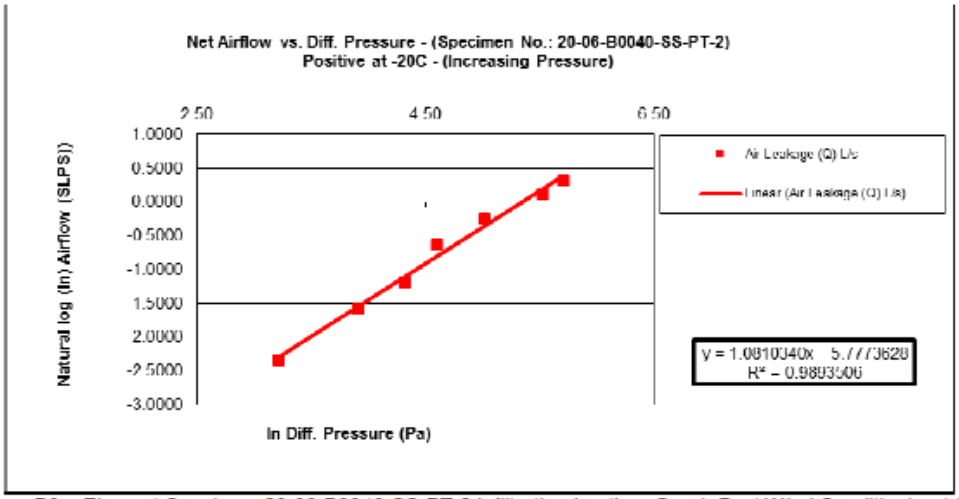


Figure B6 – Element Specimen 20-06-B0040-SS-PT-2 Infiltration Log/Log Graph Post Wind Conditioning (-20°C)

APPENDIX C

Logarithmic Air Leakage Graphs
Element Specimen No.: 20-06-B0040-SS-CB-3
(Opaque Foundation Wall Section)

(3 Pages)

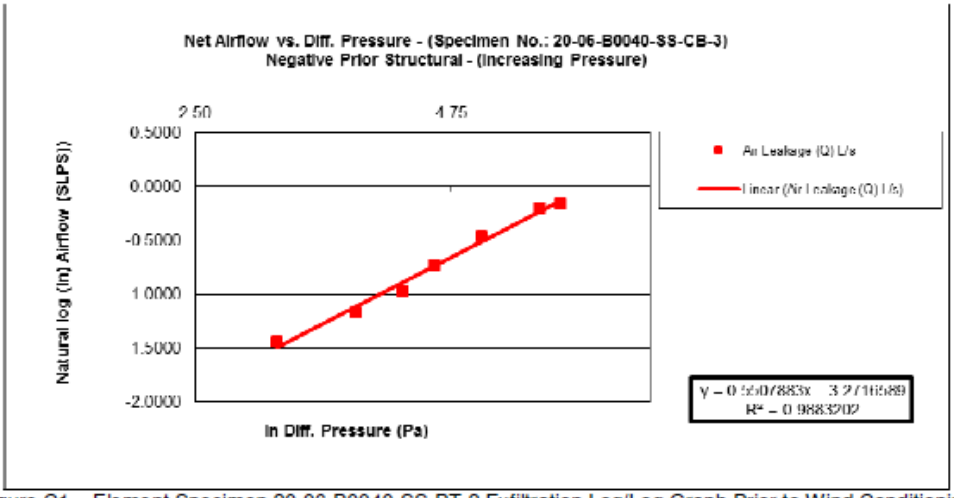


Figure C1 – Element Specimen 20-06-B0040-SS-PT-2 Exfiltration Log/Log Graph Prior to Wind Conditioning

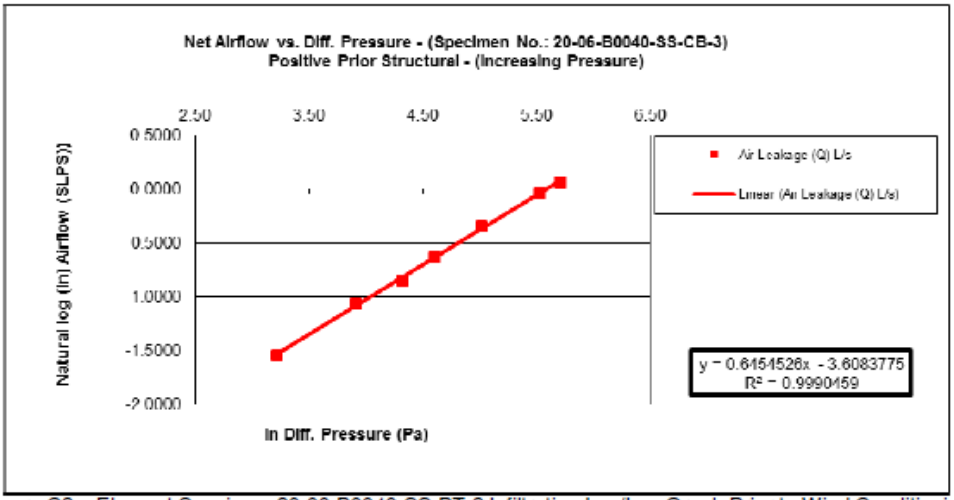


Figure C2 – Element Specimen 20-06-B0040-SS-PT-2 Infiltration Log/Log Graph Prior to Wind Conditioning

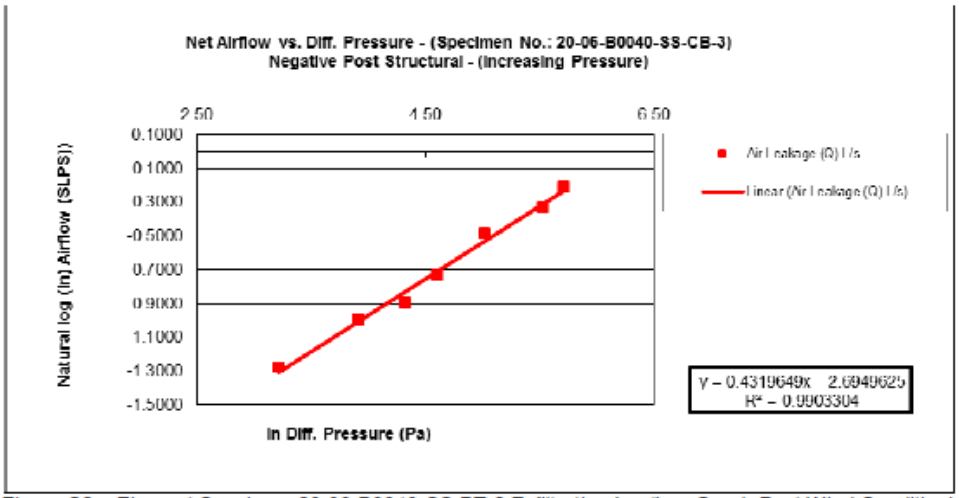


Figure C3 – Element Specimen 20-06-B0040-SS-PT-2 Exfiltration Log/Log Graph Post Wind Conditioning

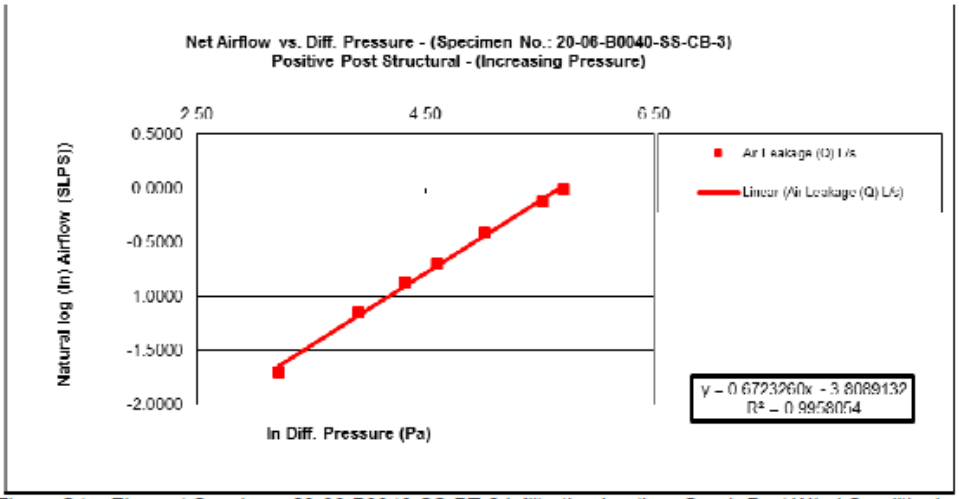


Figure C4 – Element Specimen 20-06-B0040-SS-PT-2 Infiltration Log/Log Graph Post Wind Conditioning

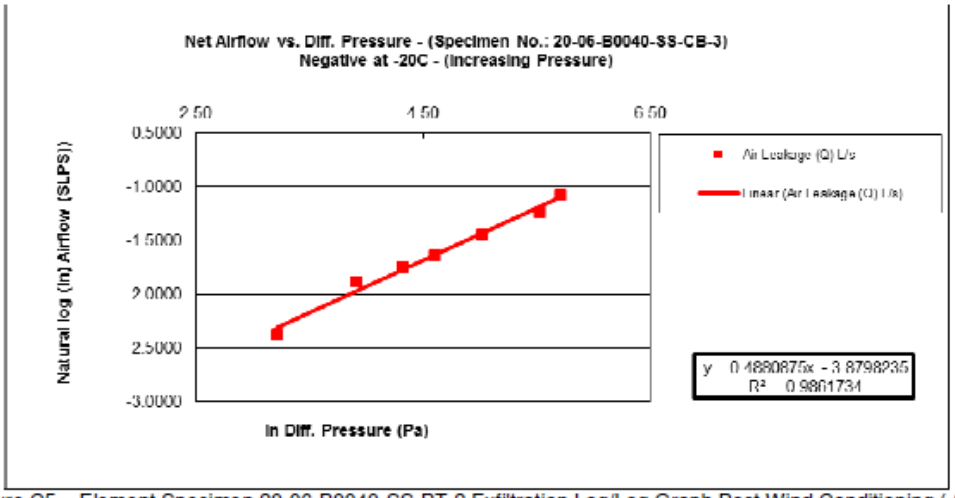


Figure C5 – Element Specimen 20-06-B0040-SS-PT-2 Exfiltration Log/Log Graph Post Wind Conditioning (-20°C)

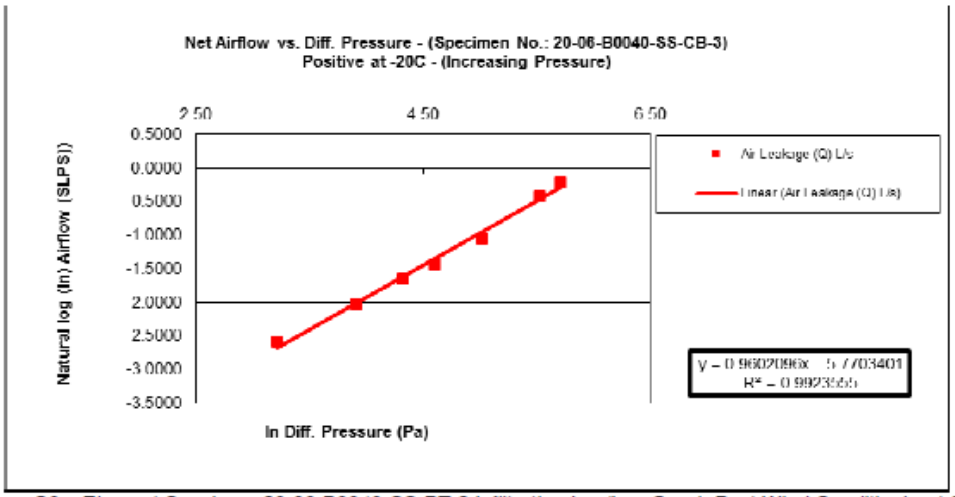


Figure C6 – Element Specimen 20-06-B0040-SS-PT-2 Infiltration Log/Log Graph Post Wind Conditioning (-20°C)

APPENDIX D

Logarithmic Air Leakage Graphs
Element Specimen No.: 20-06-B0040-CMU-OP-4
(Opaque Wall Section)

(3 Pages)

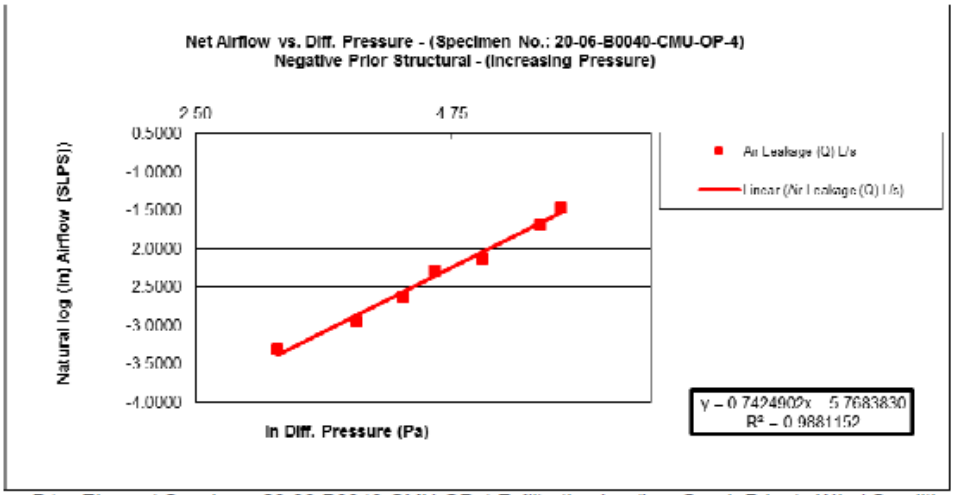


Figure D1 – Element Specimen 20-06-B0040-CMU-OP-4 Exfiltration Log/Log Graph Prior to Wind Conditioning

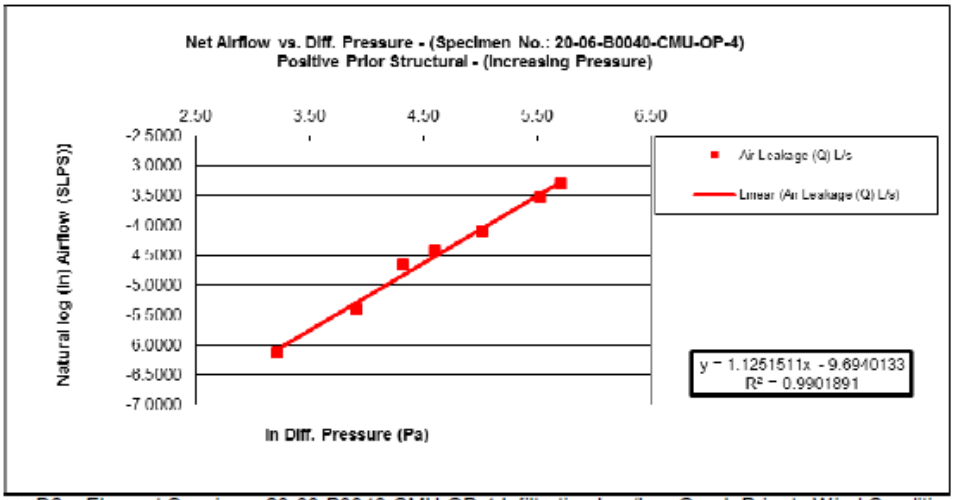


Figure D2 – Element Specimen 20-06-B0040-CMU-OP-4 Infiltration Log/Log Graph Prior to Wind Conditioning

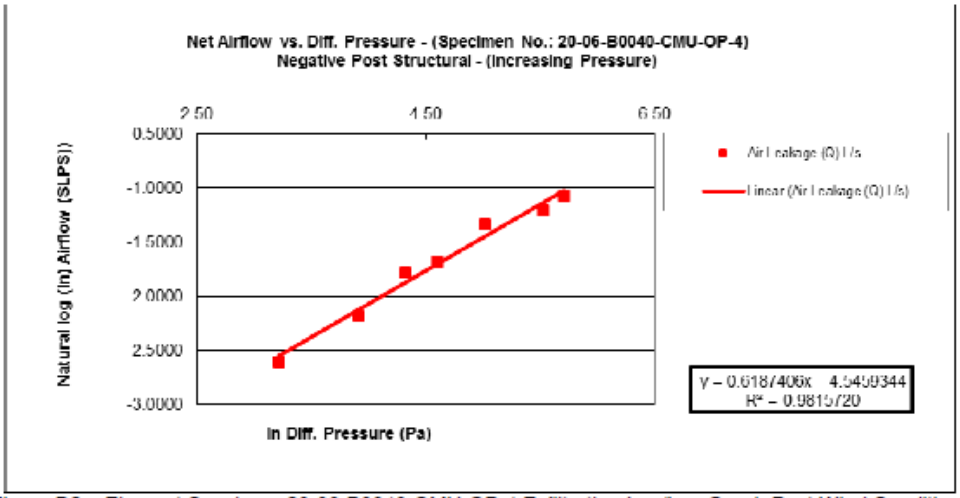


Figure D3 – Element Specimen 20-06-B0040-CMU-OP-4 Exfiltration Log/Log Graph Post Wind Conditioning

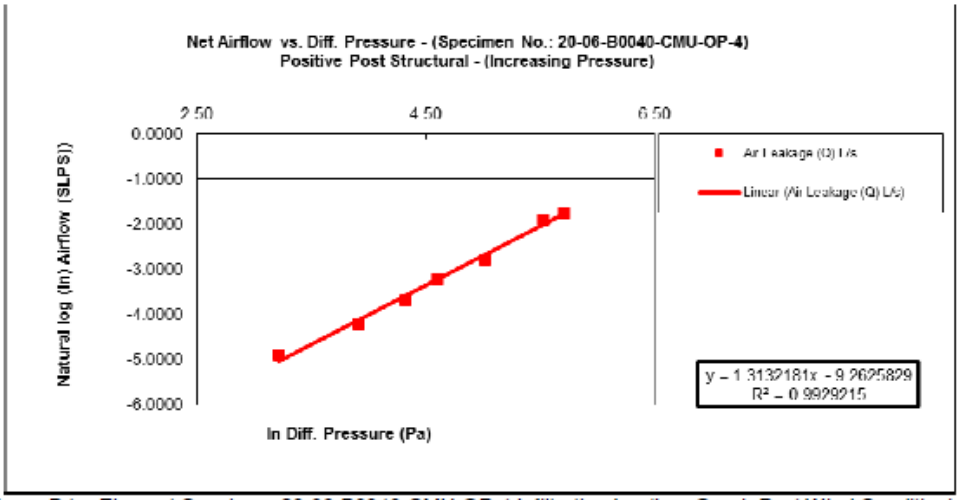


Figure D4 – Element Specimen 20-06-B0040-CMU-OP-4 Infiltration Log/Log Graph Post Wind Conditioning

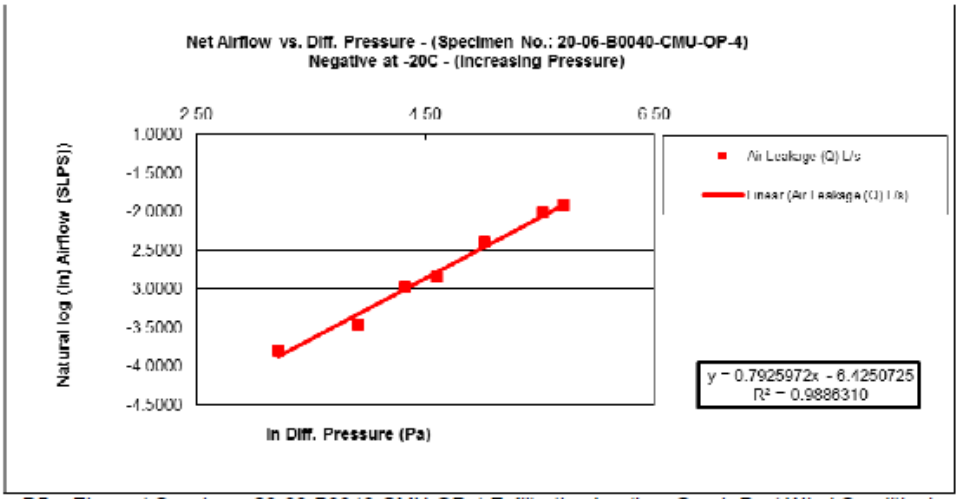


Figure D5 – Element Specimen 20-06-B0040-CMU-OP-4 Exfiltration Log/Log Graph Post Wind Conditioning (-20°C)

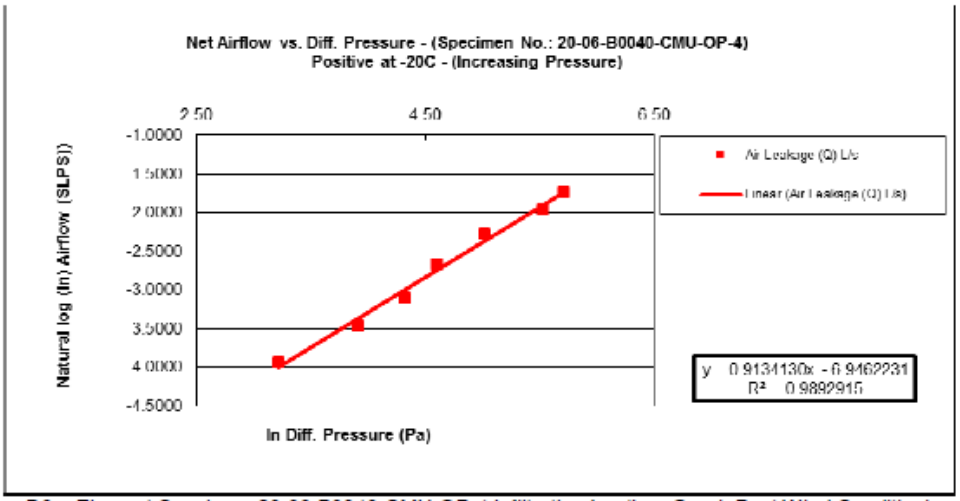


Figure D6 – Element Specimen 20-06-B0040-CMU-OP-4 Infiltration Log/Log Graph Post Wind Conditioning (-20°C)

APPENDIX E

Logarithmic Air Leakage Graphs
Element Specimen No.: 20-06-B0040-CMU-PT-5
(Opaque Wall Section)

(3 Pages)

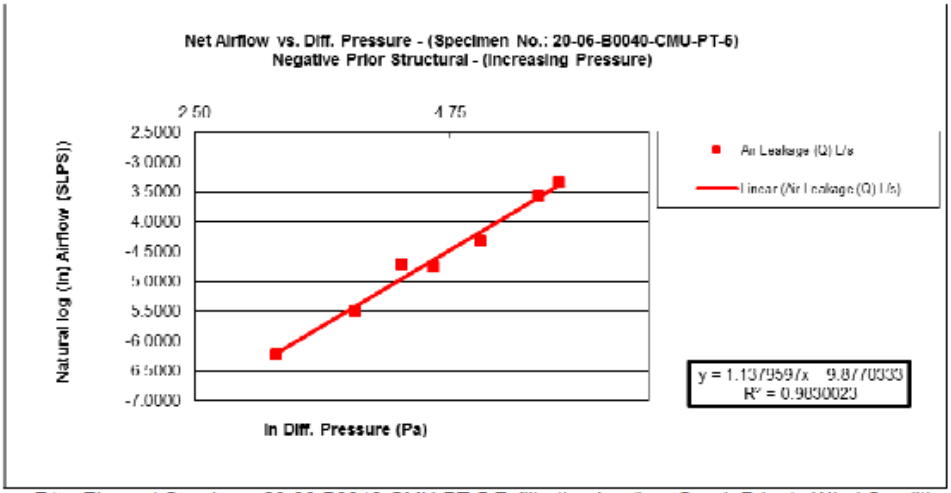


Figure E1 – Element Specimen 20-06-B0040-CMU-PT-5 Exfiltration Log/Log Graph Prior to Wind Conditioning

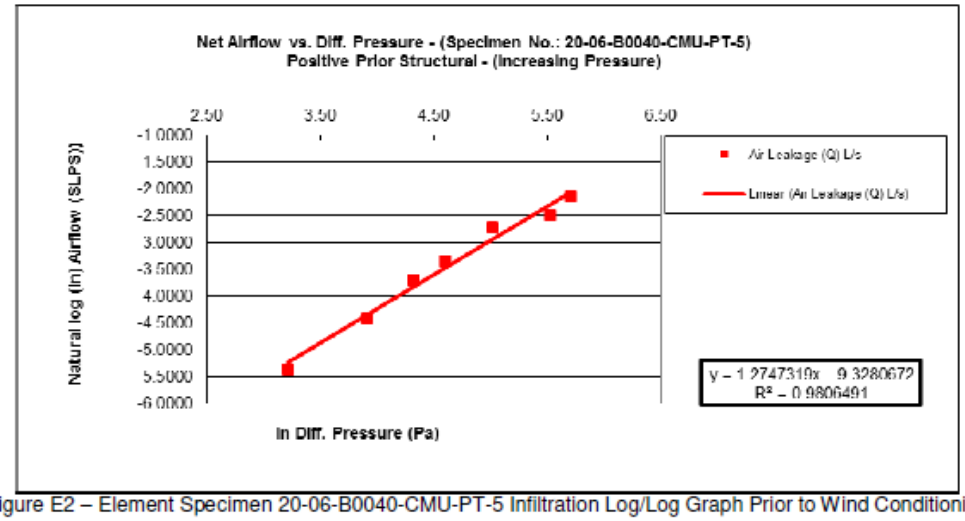


Figure E2 – Element Specimen 20-06-B0040-CMU-PT-5 Infiltration Log/Log Graph Prior to Wind Conditioning

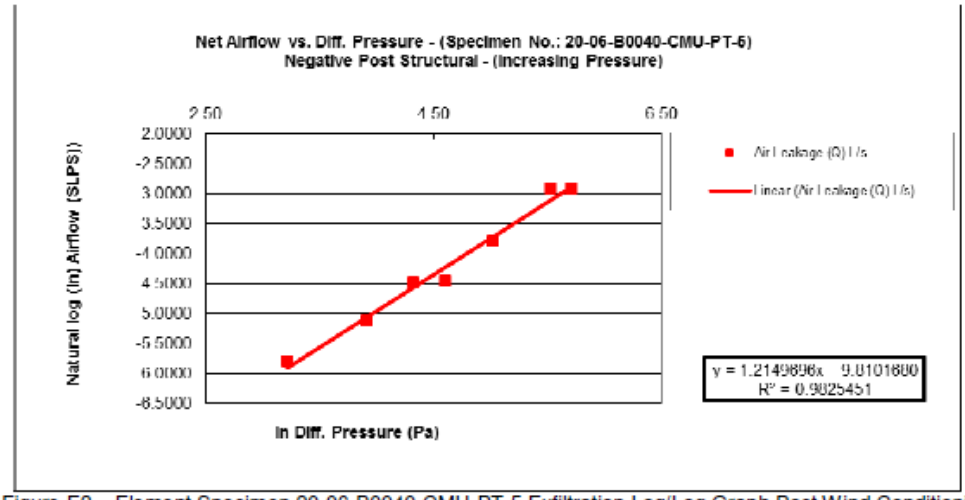


Figure E3 – Element Specimen 20-06-B0040-CMU-PT-5 Exfiltration Log/Log Graph Post Wind Conditioning

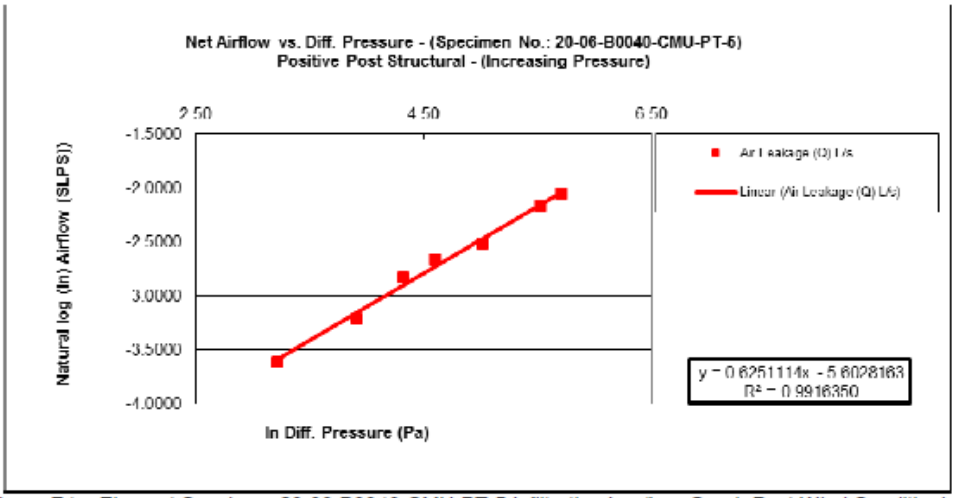


Figure E4 – Element Specimen 20-06-B0040-CMU-PT-5 Infiltration Log/Log Graph Post Wind Conditioning

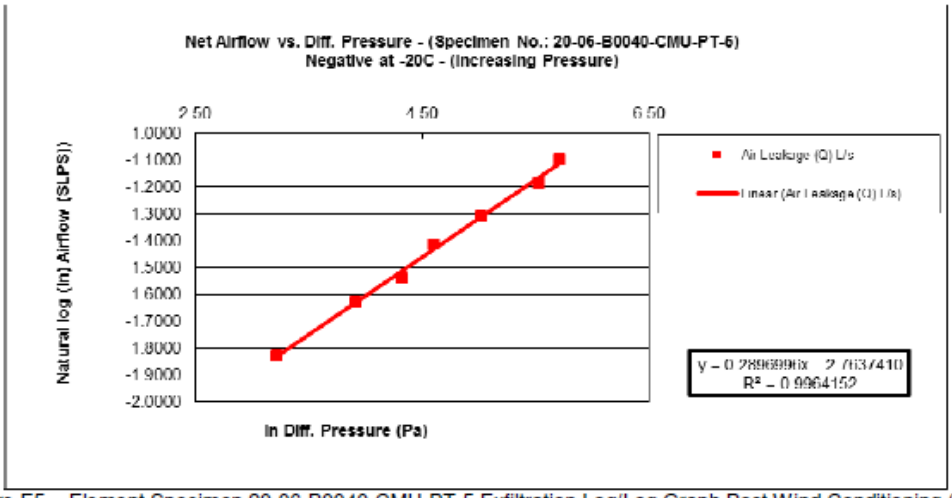


Figure E5 – Element Specimen 20-06-B0040-CMU-PT-5 Exfiltration Log/Log Graph Post Wind Conditioning (-20°C)

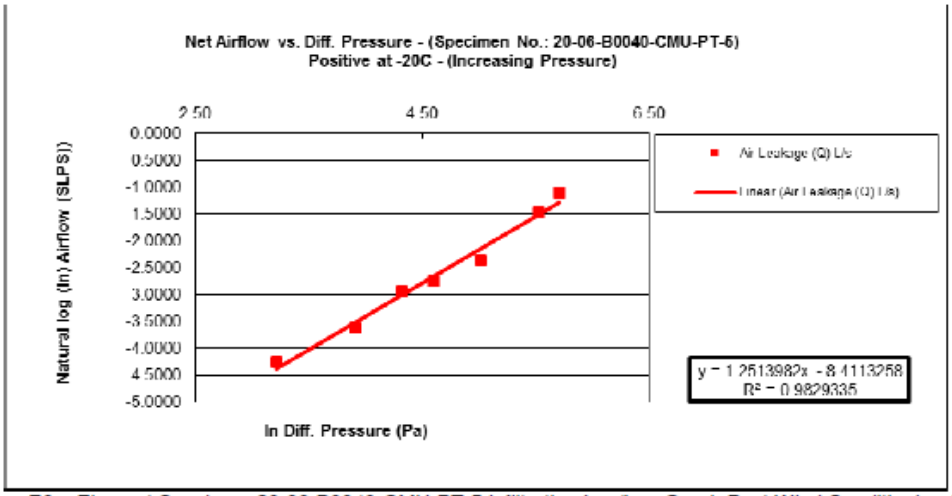


Figure E6 – Element Specimen 20-06-B0040-CMU-PT-5 Infiltration Log/Log Graph Post Wind Conditioning (-20°C)

APPENDIX F

Logarithmic Air Leakage Graphs
Element Specimen No.: 20-06-B0040-CMU-CB-6
(Opaque Wall Section)

(3 Pages)

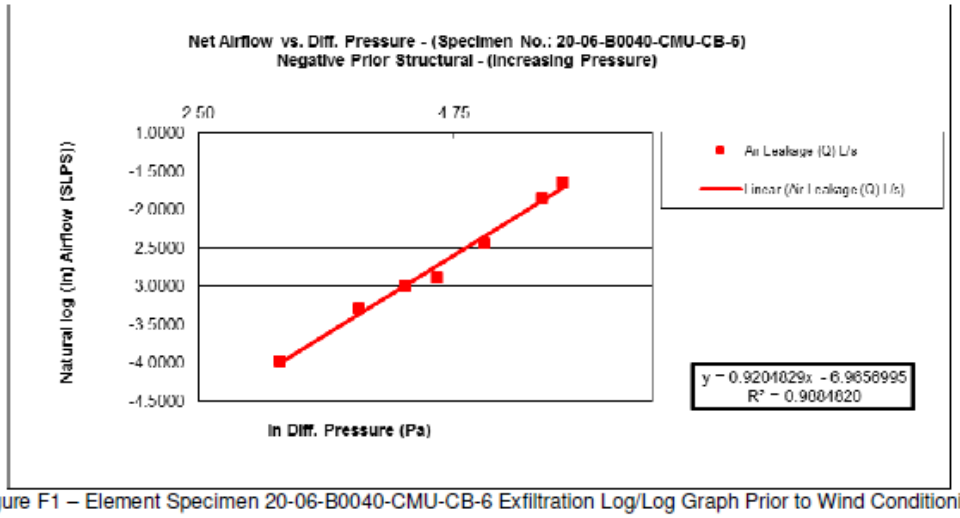


Figure F1 – Element Specimen 20-06-B0040-CMU-CB-6 Exfiltration Log/Log Graph Prior to Wind Conditioning

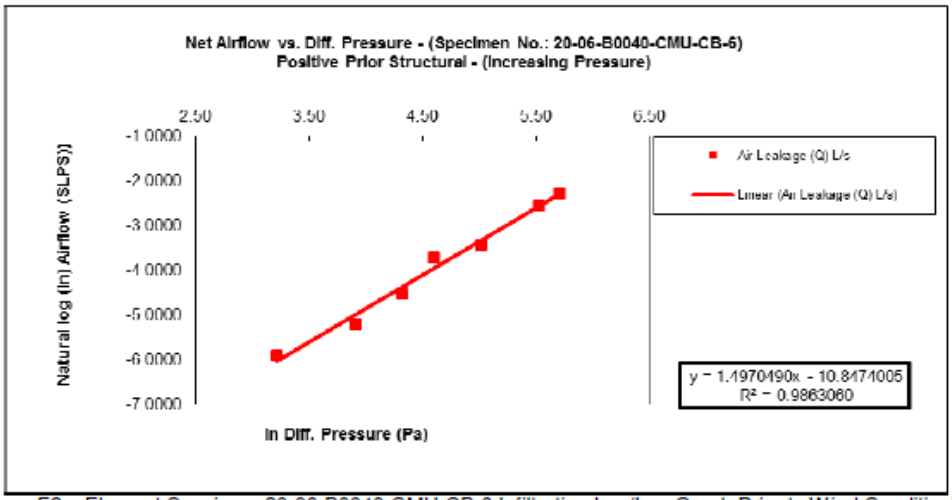


Figure F2 – Element Specimen 20-06-B0040-CMU-CB-6 Infiltration Log/Log Graph Prior to Wind Conditioning

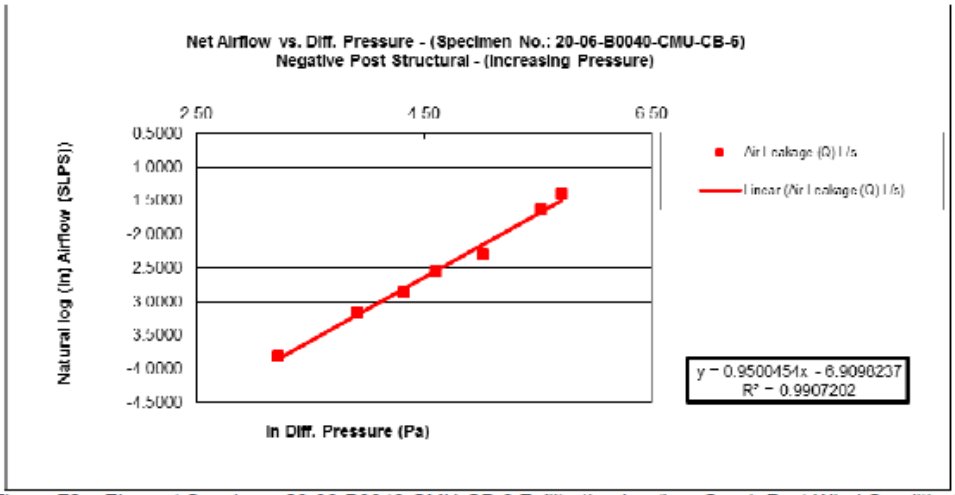


Figure F3 – Element Specimen 20-06-B0040-CMU-CB-6 Exfiltration Log/Log Graph Post Wind Conditioning

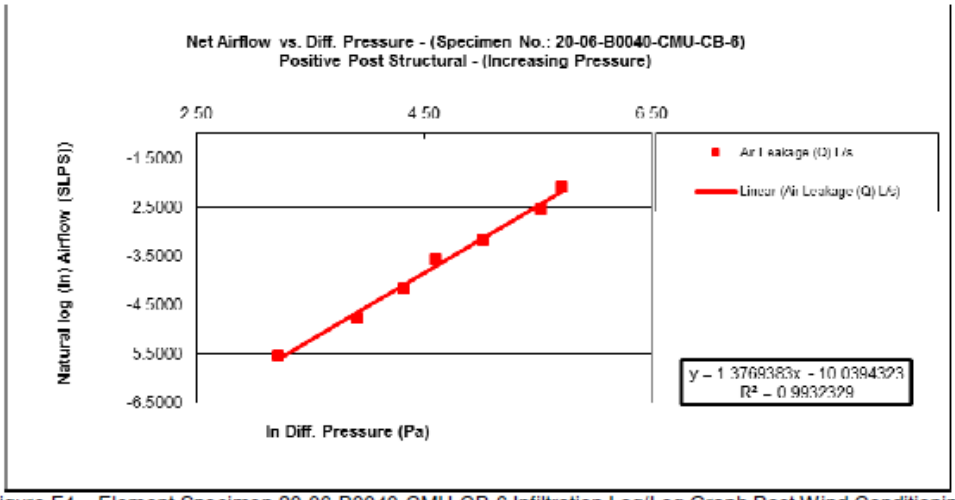


Figure F4 – Element Specimen 20-06-B0040-CMU-CB-6 Infiltration Log/Log Graph Post Wind Conditioning

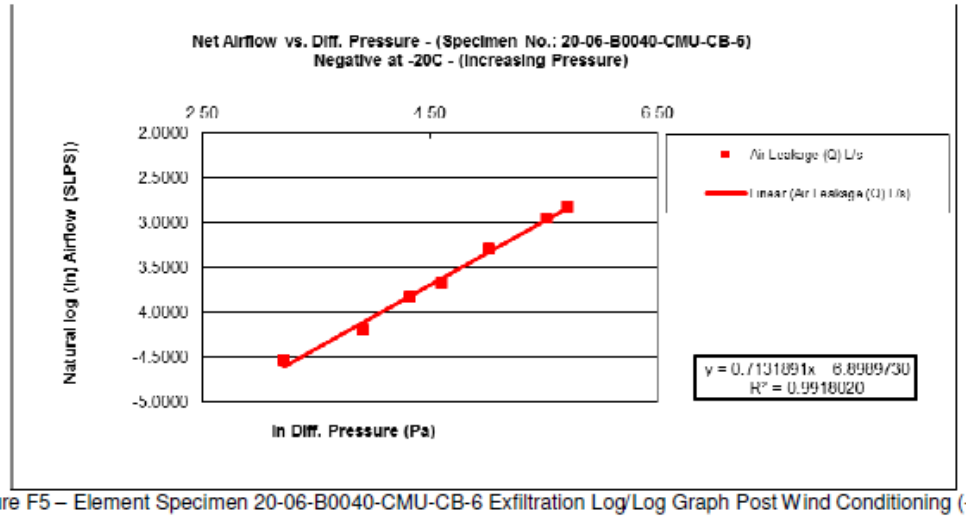


Figure F5 – Element Specimen 20-06-B0040-CMU-CB-6 Exfiltration Log/Log Graph Post Wind Conditioning (-20°C)

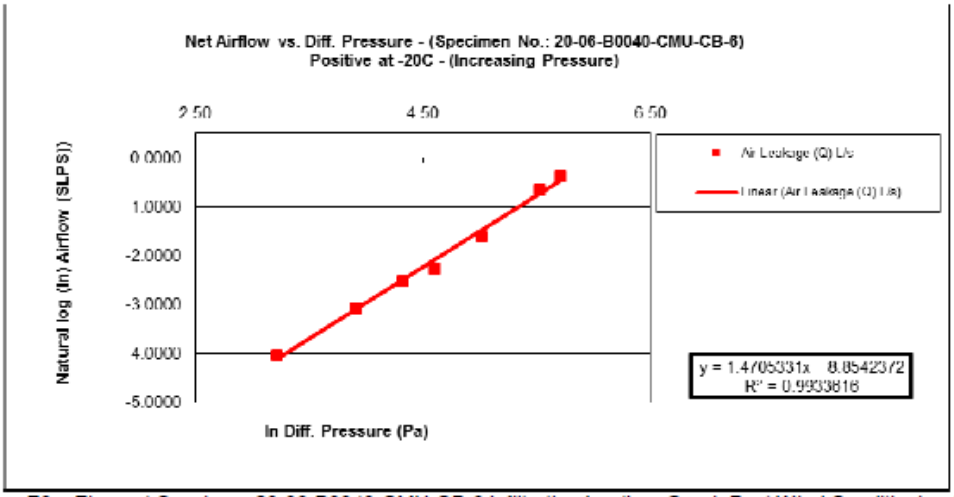


Figure F6 – Element Specimen 20-06-B0040-CMU-CB-6 Infiltration Log/Log Graph Post Wind Conditioning (-20°C)

APPENDIX G

Application Photographs

Element Specimen No.:20-06-B0040-SS-OP-1
(Steel Stud with Exterior Gypsum – Opaque Wall Section)

(2 Pages)

Photo G1 – Opaque steel stud wall section prior to product application

Photo G2 – Air barrier applied onto sheathed wall

APPENDIX H

Application Photographs

Element Specimen No.: 20-06-B0040-SS-PT-2
(Steel Stud with Exterior Gypsum – Penetrations Wall Section)

(4 Pages)

Photo H1 – Penetrations wall section; wall perimeter and window rough open prepared with membrane and penetrations sealed with sealant prior to product application

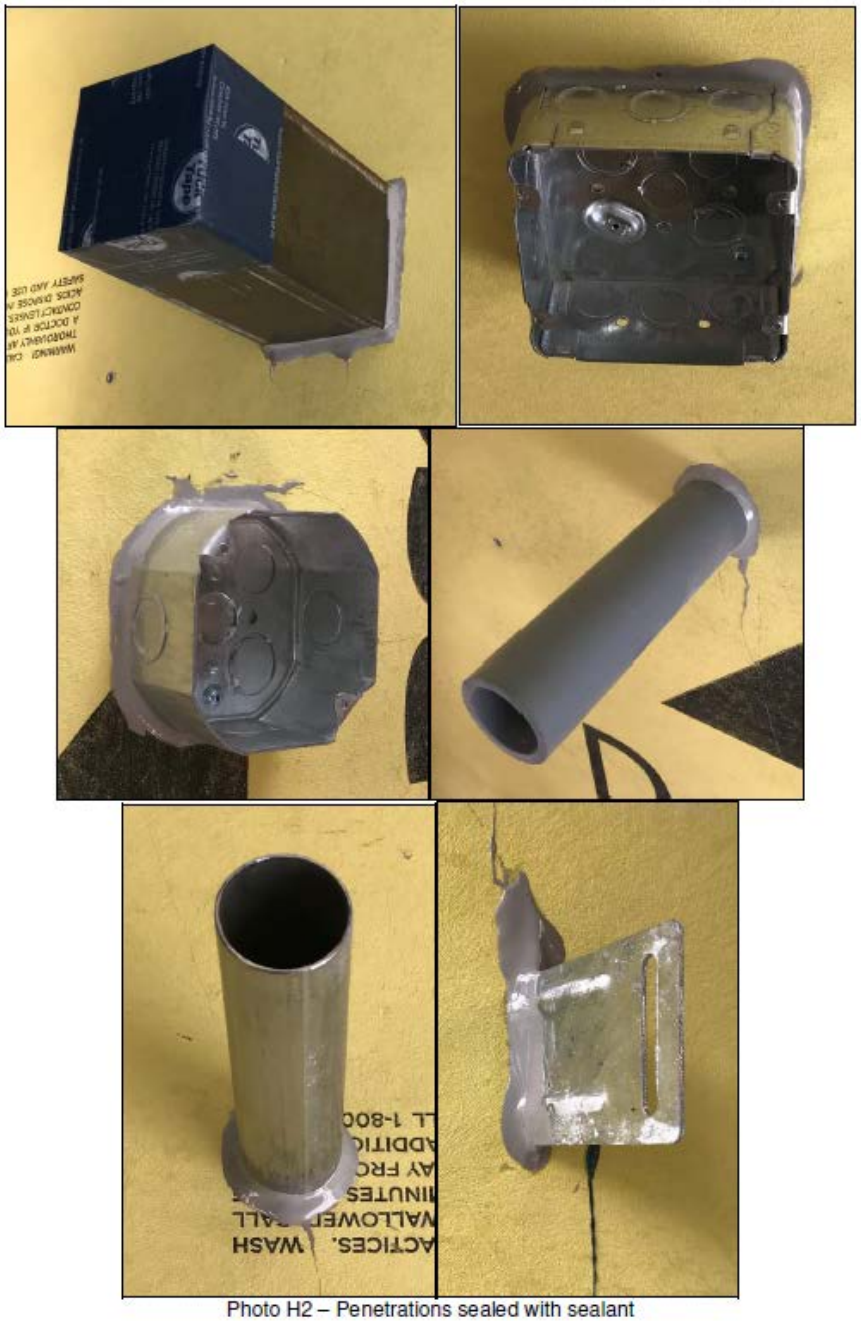


Photo H2 – Penetrations sealed with sealant

Photo H3 – Air barrier sprayed around wall perimeter and window perimeter

Photo H3 – Air barrier applied onto sheathed wall

APPENDIX I

Application Photographs

Element Specimen No.:20-06-B0040-SS-CB-3
(Steel Stud with Exterior Gypsum – Opaque Foundation Interface Wall Section)

(2 Pages)

Photo I1 – Opaque steel stud with foundation interface wall section; wall perimeter prepared with membrane and brick ties sealed with sealant prior to product application

Photo I2 – Air barrier applied onto CMU wall (typical wall and not actual represatation)

APPENDIX J

Application Photographs

Element Specimen No.: 20-06-B0040-CMU-OP-4
(Masonry Block – Opaque Wall Section)

(2 Pages)

Photo J1 – Opaque CMU wall section prior to product application

Photo J2 – Air barrier applied onto CMU wall

APPENDIX K

Application Photographs

Element Specimen No.: 20-06-B0040-CMU-PT-5
(Masonry Block – Penetration Wall Section)

(4 Pages)

Photo K1 – Opaque CMU wall section prior to product application

Photo K2 – Penetrations wall section; wall perimeter and window rough open prepared with membrane and penetrations sealed with sealant prior to product application

Photo K3 – Penetrations sealed with sealant

Photo K4 – Air barrier applied onto CMU wall

APPENDIX L

Application Photographs

Element Specimen No.: 20-06-B0040-CMU-CB-6
(Masonry Block – Opaque Foundation Interface Wall Section)

(2 Pages)

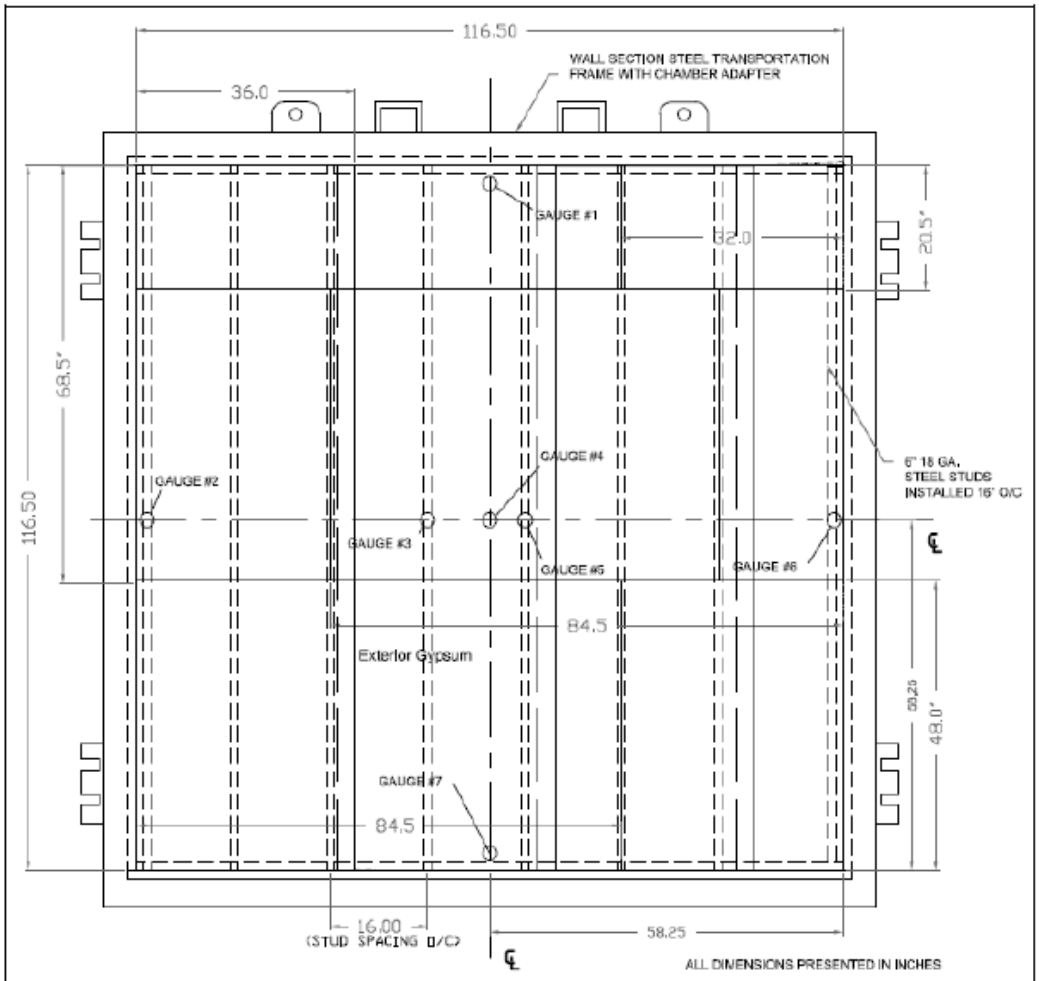
Photo L1 – Penetrations wall section; wall perimeter and foundation interface prepared with membrane and prior to product application

Photo L2 – Air barrier applied onto CMU wall

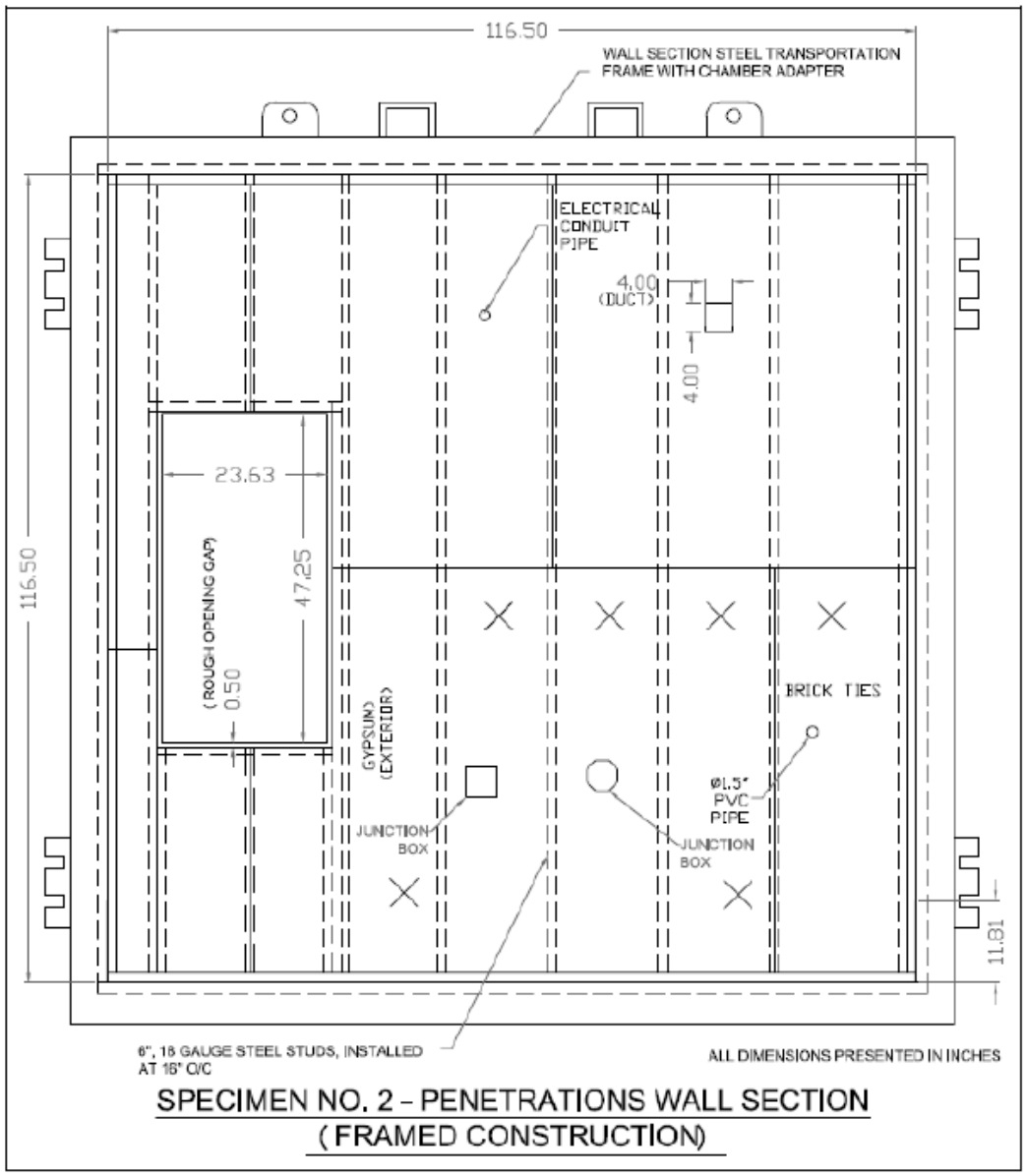
APPENDIX M

General Wall Construction Detail Drawings
(Exterior Gypsum Sheating Wall Specimens)

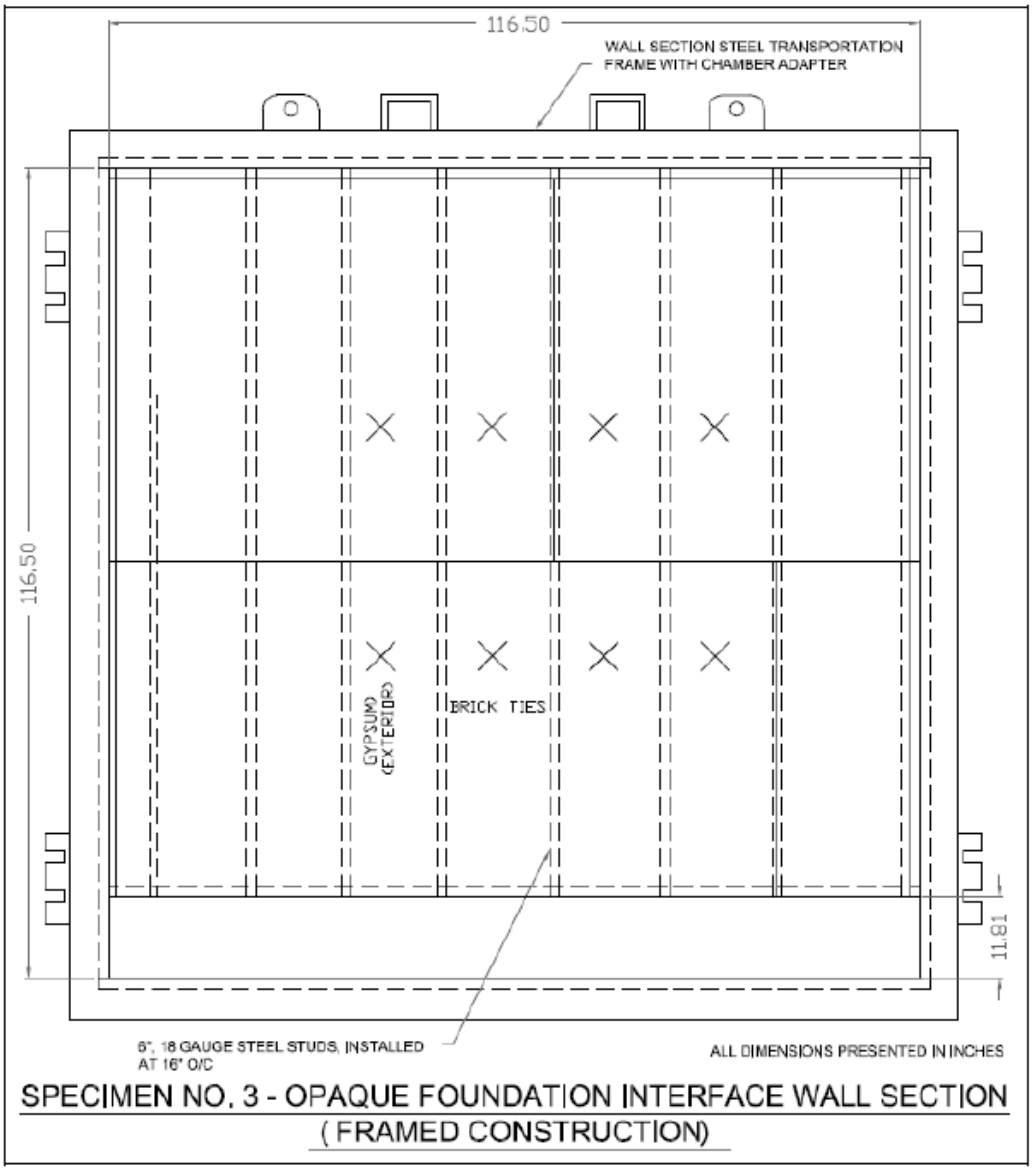
(3 Pages)



SPECIMEN NO. 1 - OPAQUE WALL SECTION
(FRAMED CONSTRUCTION)



SPECIMEN NO. 2 – PENETRATIONS WALL SECTION
(FRAMED CONSTRUCTION)

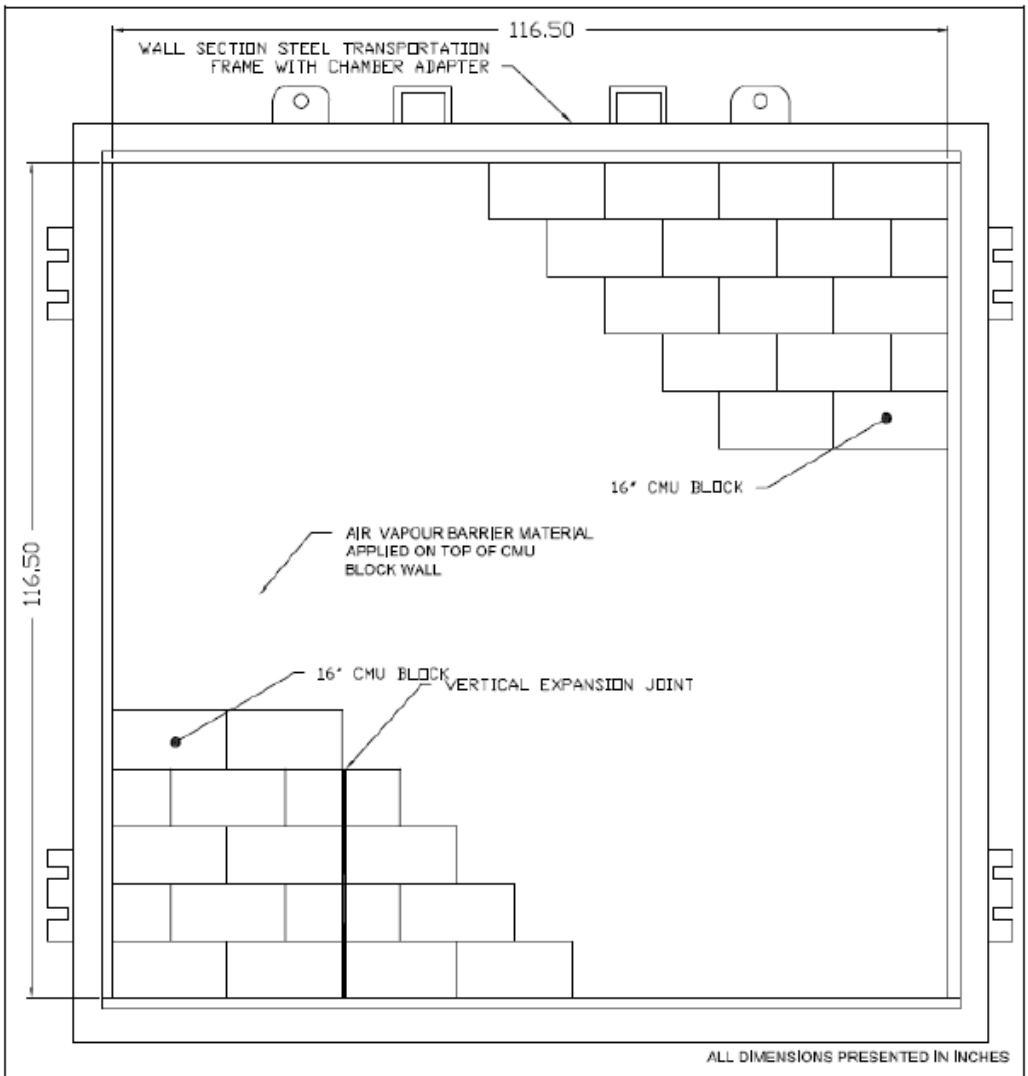


SPECIMEN NO. 3 - OPAQUE FOUNDATION INTERFACE WALL SECTION
(FRAMED CONSTRUCTION)

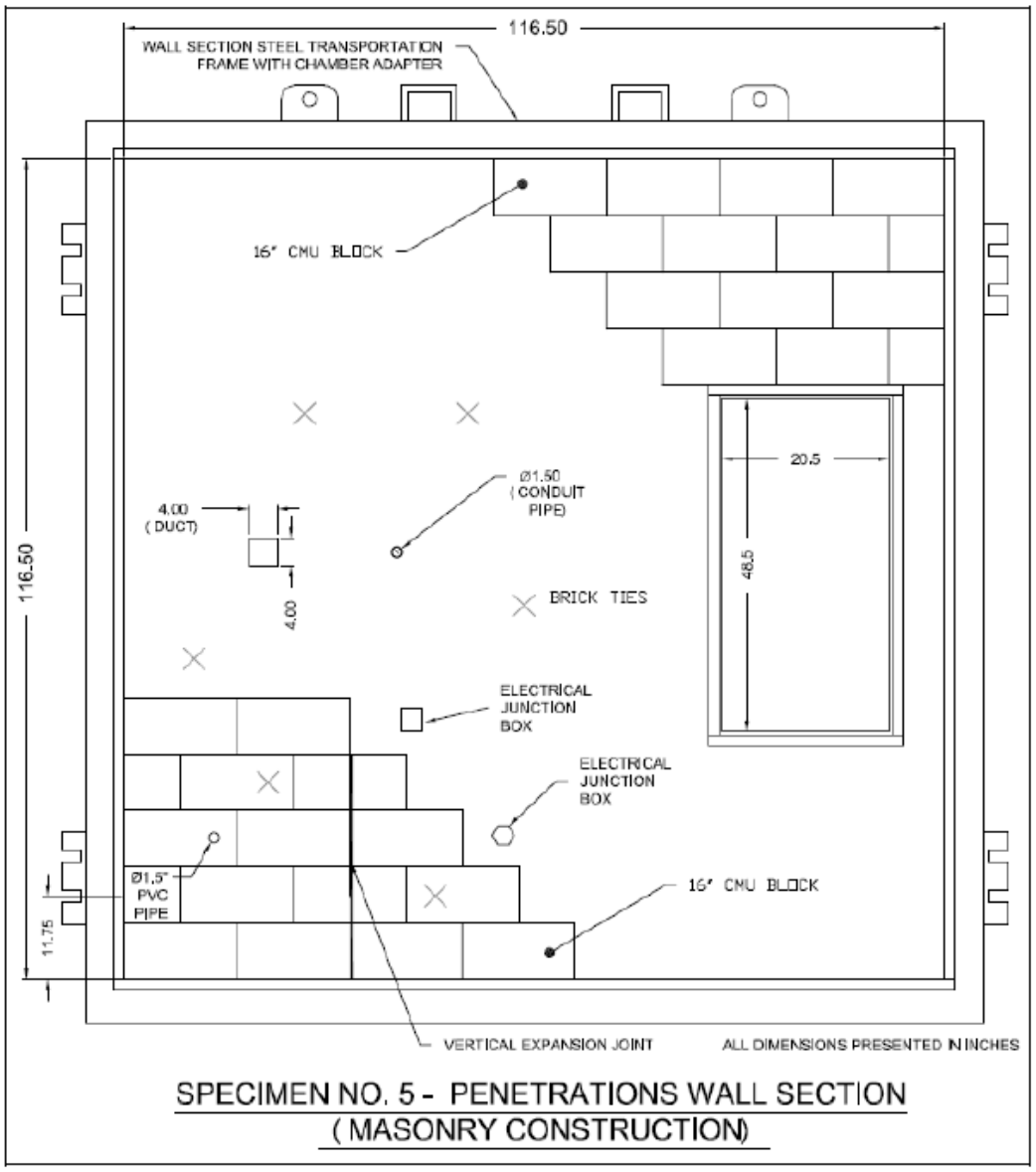
APPENDIX N

General Wall Construction Detail Drawings
(Masonry Block Wall Specimens)

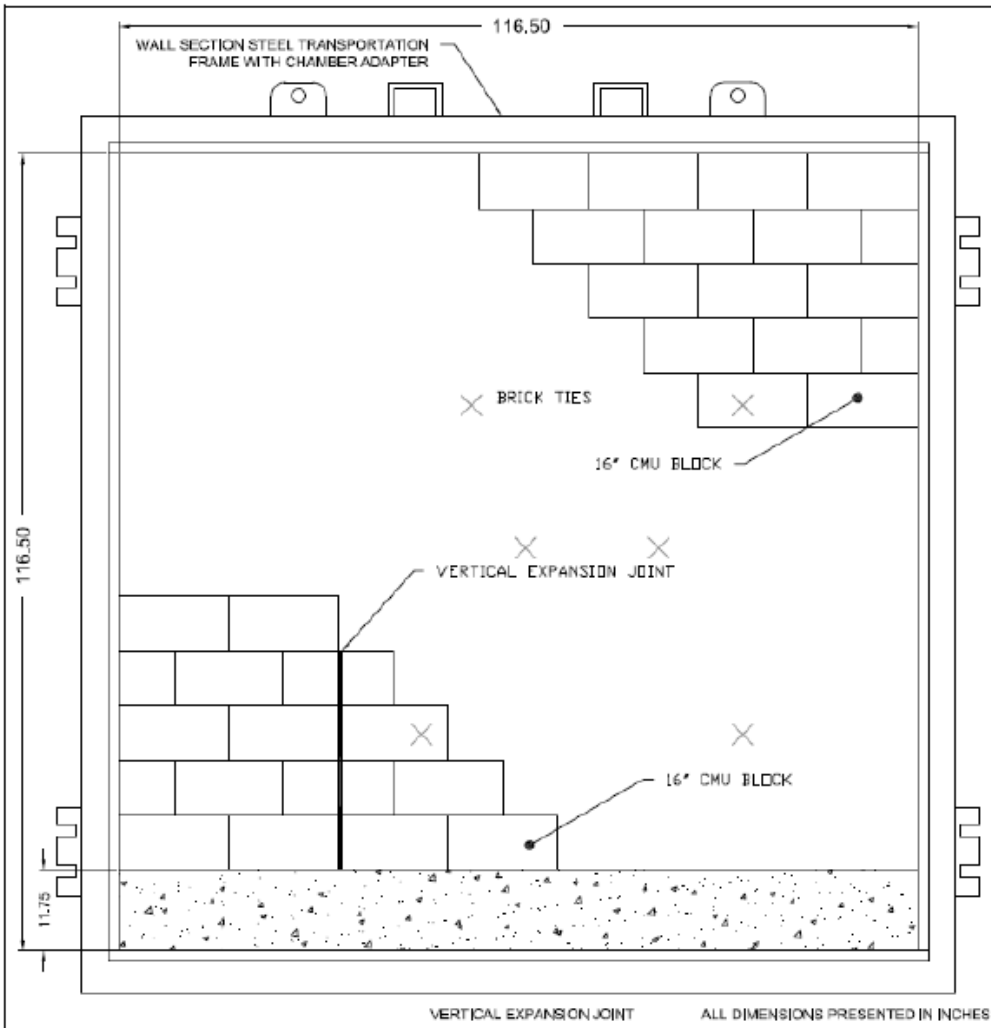
(3 Pages)



SPECIMEN NO. 4 - OPAQUE WALL SECTION
(MASONRY CONSTRUCTION)



SPECIMEN NO. 5 - PENETRATIONS WALL SECTION
(MASONRY CONSTRUCTION)



SPECIMEN NO. 6 - CONCRETE FOUNDATION INTERFACE WALL SECTION
(MASONRY CONSTRUCTION)

APPENDIX D

Durability of Materials – CCMC TG MF 07 27 09.01 – Appendix E4 - Detailed Test Procedure and Results.

Element Report No.: 20-06-B0040-D

(32 Pages)

element

2395 Speakman Dr.
Mississauga, ON
Canada L5K 1B3

P: 1 905 822 4111
F: 1 905 823 1446
info.toronto.industrials@element.com
element.com

EVALUATION OF THE DURABILTIY OF MATERIALS OF

"BOREAL NATURE ELITE"

POLYURETHANE SPRAY FOAM MATERIAL IN ACCORDANCE WITH CCMC TECHNICAL GUIDE MF 07 27 09.01 (ISSUE DATE 1996-02-09, TECHNICAL UPDATE 2016-06-20) APPENDIX E4

Report to:	**Genyk** 1701 3e Avenue Grand-Mere, QC G9T 2W6
Attention:	Mike Richmond
Telephone:	+1 (226) 339-3089
Email:	mikerichmond@genyk.com
Report No.:	20-06-B0040-D 3 Pages, 4 Appendicies
Proposal No.:	20-006-95292
Original Date:	November 9, 2020

1.0 INTRODUCTION

At the request of *Genyk*, Element Materials Technology was retained to evaluate the durability performance of polyurethane spray foam material identified as "Boreal Nature Elite" in accordance with CCMC Technical Guide MF 07 27 09.01 (Issue Date: 1996-02-09, Technical Update: 2016-06-20) Appendix E4. The material was tested for the durability criteria for a foam plastic insulation, as outlined in Element Proposal No.: 20-006-95292.

The material used for testing was sample selected by an Element technical representative and prepared at the Element Toronto facility by Genyk personnel. A sample selection report can be found in Appendix A.

Upon receipt, the samples were assigned the following Element Sample Numbers:

Client Sample Description:	**Element Specimen No.:**
Boreal Nature Elite	20-06-B0040-D

2.0 PROCEDURE

The sample was evaluated for the following tests referenced in CCMC TG 07 27 09.01:

Test Description	Test Method
Technical Guide for Air Barrier Systems (ABS) for Exterior Walls of Buildings	**CCMC TG 07 27 09.01** (Issue Date: 1996-02-09, Technical Update: 2016-06-20)
Standard Test Method for Air Permeance of Building Materials	ASTM E2178-13
Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flor Meter Apparatus	ASTM C518-17

The material used for testing was conditioned for 90 days using conditions as per CAN/CGSB-51.26-M86, Sections 7.2, 7.3.1, and 7.3.2. The material was sprayed on 16 mm HDPE boards and conditioned at 23 ± 2°C and 50 ± 5% RH for 90 days as a whole board. The material was cut into the test specimens (12"x12") immediately before testing. The thermal transmission property and air permeance testing was conducted in triplicate. The thermal transmission property specimens had the top skin removed and cut to a nominal thickness of 1". This allowed for sufficient contact to the heat flow meter apparatus. The air permeance specimens had both skins intact and tested as-sprayed thickness (2" – *nominal)*.

Weathering is performed according to CAN/CGSB-37GP-56M (Par. 7.2.11) modified by using 360 cycles of 2 hours (1 hour irradiation followed by 1 hour of rain cycle). The air permeance testing was modified using ASTM E2178, with reference to NRC/Building Research Note No. 227. Following the weathering cycles, the specimens were heat aged in an air circulation oven operated at 70 ± 2°C for 336 hours for a non-accessible air barrier system (ABS).

3.0 RESULTS

A summary of test results for air permeance and thermal transmission properties is shown in Table 1. Detailed test results and procedures are outlined in the corresponding appendices. SI units are the primary units of measure.

Table 1: Summary of Physical Properties
CCMC TG 07 27 09.01 – 'Boreal Nature Elite'
Element Sample No.: 20-06-B0040-D

Physical Property	Requirements	Results	Comments
Thermal Resistance of Conditioned Boards, m^2•K/W (BTU·in/h·ft^2·°F) *Average thickness, 25.02 mm (0.99")*	Report Value	1.10 (6.26)	See Appendix B for details.
Thermal Resistance after Heat Aging of Weathered Samples, m^2•K/W *Average thickness, 26.64 mm (1.05")*	≥ 90% Retention	1.00 (5.65)	91% Retention Meets requirements. See Appendix B for details.
Air Permeance of Conditioned Boards at 75 Pa, L/(s•m^2)	Report Value	0.0027	See Appendix C for details.
Air Permeance after Heat Aging of Weathered Samples at 75 Pa, L/(s•m^2)	≤ 110% of original value	0.0029	107% of Original Value. Meets requirements See Appendix C for details.

Note: Weathering exposure procedure and test details can be found in Appendix D.

4.0 CONCLUSION

The material submitted by Genyk, identified as *"Boreal Nature Elite"*, was tested in accordance with CCMC TG 0 27 09.01 for 'Durability of Materials – Appendix E4', as described in this report. The material conforms to the requirements outlined in Table E4 of CCMC TG 0 27 09.01.

5.0 REPORT REVISION SUMMARY

Revision No:	Date:	Description of Revisions:
N/A	November 9, 2020	Original Document

Reported and Authorized by:

Fadi G. Basmaji, M.A.Sc., B.Eng., Ext. 11227
Building Science Specialist
Building Science Division

Reviewed by:

Franz C. Bauer, B. Eng., Ext. 11403
Technical Manager
Products Testing Group

APPENDIX A

Drum Witnessing Report for Material Used.

Report Number: 20-06-B0040-SS (5 Pages)

2395 Speakman Dr.
Mississauga, ON
Canada L5K 1B3

P: 1 905 822 4111
F: 1 905 823 1446
info.torontoindustrials@element.com
element.com

Sample Selection Report

Genyk
1701 3e Avenue
Grand-Mere, QC
G9T 2W6

Report No.: 20-06-B0040-SS
Date: 2020-02-20
Proposal No.: 20-006-95292

Attn: **Mike Richmond**

At the request of *Genyk*, an Element representative witnessed the selection of chemical drums at the Genyk facility located in Cambridge, ON on February 20, 2020. Three sets of Resin and ISO were randomly selected from available inventory.

Details of the selection are provided below.

Sample Details

Sample 1 – Detailed Information - ISO Element Sample No.: 20-06-B0040-ISO	
Client Sample Name	ISO A-2732
Number of Drums Witnessed	3
Lot #	0319017301 Manufactured Date: 10/10/2019 Expiry Day: 10/10/2020
Type of Material	ISO –Part A
Dimensions	227 kg each drum
Date of Witness	2020-02-20
Markings	'Element' Signature of Element Representative Date (Picture on page 3)

Sample 2 – Detailed Information - Resin Element Sample No.: 20-06-B0040-Resin	
Client Sample Name	Boreal Nature Elite - Winter
Manufacturing Date	2020-01-20 2020-07-20
Number of Drums Witnessed	3
Lot #	L-20023
Type of Material	Resin
Dimensions	243.5 kg each drum
Markings	'Element' Signature of Element Representative Date (Picture on page 4)

Element Witness

Witnessing Information	
Location of Selection	**Genyk** 101 Sheldon Dr., Unit 3 Cambridge, ON N1R 6T6
Element Technical Representative	Fadi Basmaji Building Systems Specialist Building Science Division
Element Signature	

Photos:


HFO
TAMPER EVIDENT TAPE
F.Basm
Element
2020-02-20
213


BOREAL
nature
Hiver / Winter
B
HFO
GENYK

APPENDIX B

Thermal Transmission Properties Detailed Procedure and Test Results.

(2 Pages)

B THERMAL TRANSMISSION PROPERTIES

PROCEDURE

Specimen Dimensions:	305 mm x 305 mm x 25 mm *(nominal)*	
No. of Specimens:	Three (3)	
Equipment:	LaserComp FOX314 Heat Flow Meter, LaserComp FOX314 Heat Flow Meter,	MII# A14505 MII# B13096
Measurement:	Mitutoyo Digital Calipers, Digital Balance, Circulating Oven, Thermocouple, Agilent Data Logger, Environmental Controller,	MII# B10644 MII# B17286 MII# A14218 MII# B13216 MII# B11586 MII# B14944
Pre-Conditioning:	90 days at 23 ± 2°C; 50 ± 5% RH	
Conditioning Dates:	2020-05-12 to 2020-08-13	
Heat Aging:	70 ± 2°C, ambient RH for 336 hours	
Heat Aging Dates:	2020-09-15 to 2020-09-29	
Test Conditions:	Mean Temperature 24.00°C ΔT = 22°C	
Test Date:	2020-08-13 for Initial Condition Samples (90 day conditioning) 2020-10-13 for Heat Aged of Weathered Samples	

RESULTS

A summary of average thermal transmission test results are presented in Tables B1 and B2, for the initial and heat aged of weathered samples, respectively. SI units are the primary unit of measure.

Table B1 – Thermal Transmission Properties *(average of 3 specimens)*
Applicable Standard: ASTM C518
Element Sample No.: 20-06-B0040-D-Initial

Description	Results			
	Value	SI Units	Value	Imperial Units
Measured Length	299.70	mm	11.80	in
Measured Width	298.57	mm	11.75	in
Test Thickness	25.02	mm	0.99	in
Measured Mass	77.34	g	0.17	lb
Density	34.55	kg/m³	2.16	lb/ft³
Upper Surface Temperature	13.02	°C	55.44	°F
Lower Surface Temperature	35.02	°C	95.04	°F
Temperature Differential	22.00	°C	39.60	°F
Mean Temperature	24.02	°C	75.24	°F
Rate of Heat Flux	19.96	W/m²	6.33	BTU/h·ft²
Thermal Conductance	0.91	W/m²·K	0.16	BTU/h·ft²·°F
Thermal Resistance	1.10	K·m²/W	6.26	°F·ft²·h/BTU
Thermal Conductivity	0.02270	W/m·K	0.157	BTU·in/h·ft²·°F
Thermal Resistivity	44.06	K·m/W	6.35	°F·ft²·h/BTU·in

Table B2 – Thermal Transmission Properties *(average of 3 specimens)*
Applicable Standard: ASTM C518
Element Sample No.: 20-06-B0040-D-Heat Aged and Weathered

Description	Results			
	Value	SI Units	Value	Imperial Units
Measured Length	299.70	mm	11.80	in
Measured Width	298.57	mm	11.75	in
Test Thickness	26.64[1]	mm	1.05	in
Measured Mass	77.34	g	0.17	lb
Density	32.45	kg/m³	2.03	lb/ft³
Upper Surface Temperature	13.02	°C	55.44	°F
Lower Surface Temperature	35.02	°C	95.04	°F
Temperature Differential	22.00	°C	39.60	°F
Mean Temperature	24.02	°C	75.24	°F
Rate of Heat Flux	22.11	W/m²	7.01	BTU/h·ft²
Thermal Conductance	1.01	W/m²·K	0.18	BTU/h·ft²·°F
Thermal Resistance	1.00	K·m²/W	5.65	°F·ft²·h/BTU
Thermal Conductivity	0.02678	W/m·K	0.186	BTU·in/h·ft²·°F
Thermal Resistivity	37.35	K·m/W	5.39	°F·ft²·h/BTU·in

[1] Thickness of the specimens swelled due to removal of both skins for contact in HFM. Specimens were exposed to a rain cycle during Xenon weathering.

APPENDIX C

Air Permeance Properties Detailed Procedure and Test Results.

(3 Pages)

C AIR PERMEANCE

PROCEDURE

Test Frame:	305 mm x 305 mm (*nominal)* - stainless steel tray	
Test Area:	0.0645 m^2	
No. of Specimens:	Three (3)	
Sealant:	Type 1 Mono Silicone (100% Silicone) 60% microcrystalline wax; 40% refined crystalline paraffin wax	
Equipment:	Mass Flow Meter, Manometer, Digital Calipers, Multimeter, Conditioning Room,	MII# A09200 MII# B12064 MII# B10963 MII# B05011 MII# B14944
Thickness:	49.19 mm (1.94") – *average of 3 specimens*	
Pre-Conditioning:	90 days at 23 ± 2°C; 50 ± 5% RH	
Conditioning Dates:	2020-05-12 to 2020-08-13	
Heat Aging:	70 ± 2°C, ambient RH for 336 hours	
Heat Aging Dates:	2020-09-15 to 2020-09-29	

The initial air leakage rate was measured by exhausting the air within the test chamber at a rate required to maintain the following incremental test pressure differentials of 25, 50, 75, 100, 150, and 300 Pa (0.52, 1.04, 1.57, 2.09, 3.13, and 6.27 psf), followed by decremental pressure differentials of 100, 75 and 50 Pa (2.09, 1.57, and 1.04 psf). Simultaneously, the test specimen was monitored for any physical changes

RESULTS

A summary of as-received (90 day conditioning) and conditioned air permeance test results can be found in Table B1. The corresponding calculated flow vs differential pressure graphs can be found in Figure B1 and B2, respectively. SI units are the primary unit of measure.

Table B1 – Air Permeance Averages in Accordance with CCMC TG 07 27 09.01 – Appendix E4
Average of Element Sample Numbers: 20-06-B0040-D-AP1 to AP3

Differential Pressure	Unconditioned (Prior to UV & Heat Exposure)	Conditioned (Post UV & Heat Exposure)	Requirement	Comments
	Calculated Air Flow (Infiltration)	Calculated Air Flow (Infiltration)		
Pa	(L/s·m^2)	(L/s·m^2)		
25	0.0013	0.0015	**Conditioned (Post UV & Heat Exposure):** Specimen shall not increase by more than 110% of original value	**107% increase.** Post UV & Heat Exposure Meet Requirements.
50	0.0020	0.0023		
75	0.0026	0.0029		
100	0.0031	0.0035		
150	0.0041	0.0045		
300	0.0065	0.0070		
100	0.0034	0.0036		
75	0.0027	0.0029		
50	0.0019	0.0022		

Average Sample Thickness: 49.19 mm (1.94")

*Meets the post UV and heat aging exposure air permeance requirements outlined in Table E4 of CCMC TG 07 27 09.01 for ABS Durability Criteria for Foam Plastic Insulation.

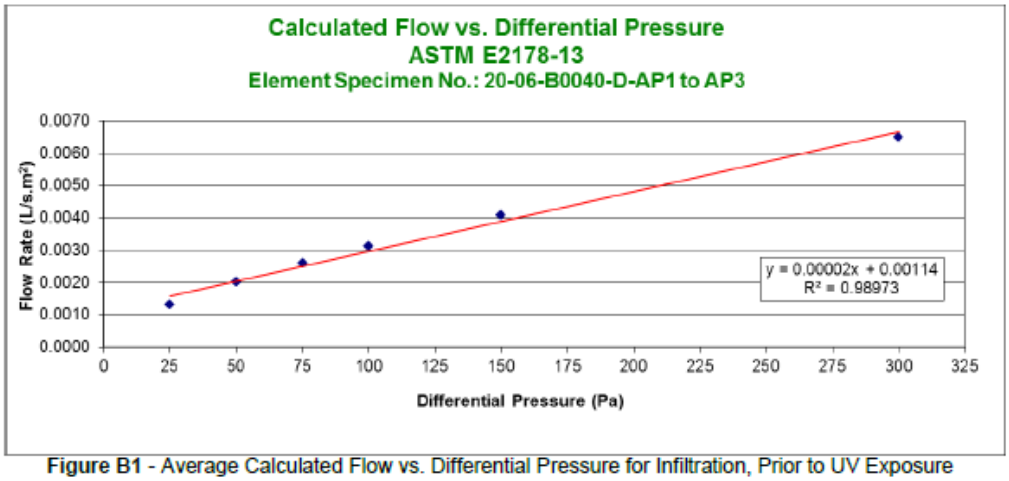


Figure B1 - Average Calculated Flow vs. Differential Pressure for Infiltration, Prior to UV Exposure Prior to UV + Heat Exposure

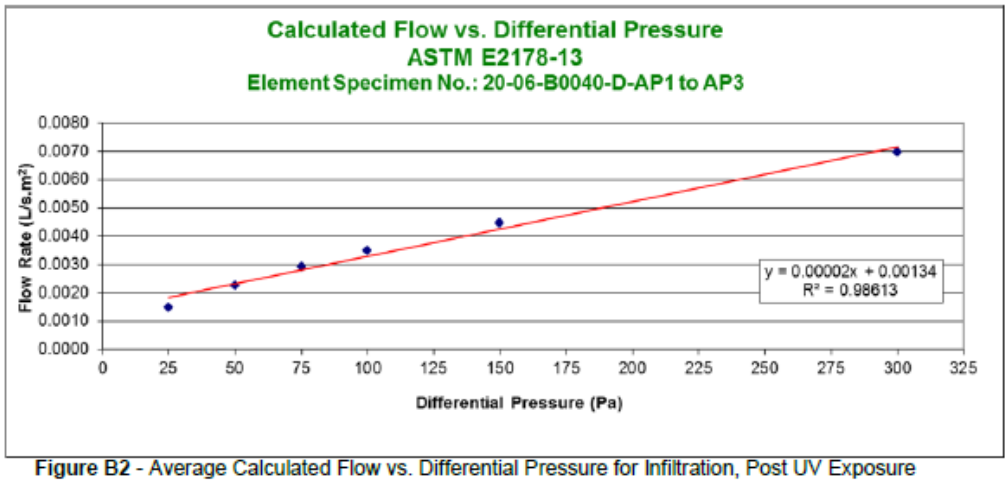


Figure B2 - Average Calculated Flow vs. Differential Pressure for Infiltration, Post UV Exposure Post UV + Heat Exposure

APPENDIX D

Accelerated Weathering Detailed Procedure and Test Results.

Element Report No.: 20-06-B0040-W1

(15 Pages)

2395 Speakman Dr.
Mississauga, ON
Canada L5K 1B3

P: 1 905 822 4111
F: 1 905 823 1446
info.toronto.industrials@element.com
element.com

ACCELERATED WEATHERING EXPOSURE EVALUATION OF "BOREAL NATURE ELITE" SPRAY POLYURETHANE FOAM INSULATION FOR GENYK

Report to:	Genyk 1701 3e Avenue Grand-Mere, Quebec G9T 2W6
Attention:	Mike Richmond
Telephone:	226-339-3089
Email:	mikerichmond@genyk.com
Report No.	20-06-B0040-W1 6 Pages, 3 Appendices
Proposal No.	20-006-95292
Date:	September 18, 2020

1.0 INTRODUCTION

At the request of Genyk, Element Toronto was retained to perform accelerated weathering performance evaluation on various spray polyurethane foam insulation specimens identified as "Boreal Nature Elite" in accordance with CCMC 07 27 09.01 Table E2 Notes referencing CGSB 37 GP 56M Section 7.2.11. Element is an ISO 17025 accredited laboratory through IAS in which the aforementioned test method is included.

Upon receipt, the provided specimens were assigned the following Element Identification Numbers:

Client Identification	Element ID No.	Comments
Boreal Nature Elite Spray Polyurethane Foam Insulation	20-06-E0040-D1	12" x 12" x 1 " SPF Insulation - Skin Off
	20-06-E0040-D2	12" x 12" x 1 " SPF Insulation - Skin Off
	20-06-E0040-D3	12" x 12" x 1 " SPF Insulation - Skin Off
	20-06-E0040-D4	12" x 12" x 1 " SPF Insulation - Skin Off
	20-06-E0040-D5	12" x 12" x 1.5 " SPF Insulation - Skin On
	20-06-E0040-D6	12" x 12" x 1.5 " SPF Insulation - Skin On
	20-06-E0040-D7	12" x 12" x 1.5 " SPF Insulation - Skin On

2.0 TEST SPECIFICATIONS

Test Method:	ASTM G155-13 Cycle 1
Test Chamber:	Atlas Ci5000
Lamp Types:	12000 W Xenon Arc
Irradiance Measurement Point:	340 nm
Inner Optical Filter:	Borosilicate
Outer Optical Filter:	Borosilicate
Thermometer Type:	Uninsulated Black Panel Sensor
Total Exposure Duration:	720 Hours (360 Cycles)
Start Date:	2020-08-14
Completion Date:	2020-09-14
Sequence No. 1	
Black Panel Temperature:	63 ± 3°C
Irradiance:	0.35 ± 0.02 W/m² at 340 nm
Chamber Temperature:	Uncontrolled
Chamber Humidity:	50 ± 10 %RH
Sequence Duration:	60 minutes
Specimen Spray:	Off
Rack Spray:	Off
Sequence No. 2	
Black Panel Temperature:	Uncontrolled
Irradiance:	0.35 ± 0.02 W/m² at 340 nm
Chamber Temperature:	Uncontrolled
Chamber Humidity:	Uncontrolled
Sequence Duration:	60 minutes
Specimen Spray:	On
Rack Spray:	Off

3.0 PROCEDURE

Following an initial irradiance of the xenon-arc lamp, the test specimens of were individually positioned in the test chamber parallel to the Xenon-Arc lamp as displayed in below Figure No. 1 and subsequently exposed to the cyclic environmental conditions described in Section No. 2.0 for a period of 720 hours. Upon completion, the specimens were removed from conditioning and visually inspected for evidence of discolouration, warping, flaking, cracking, and/or other deleterious effects of the exposed surfaces.

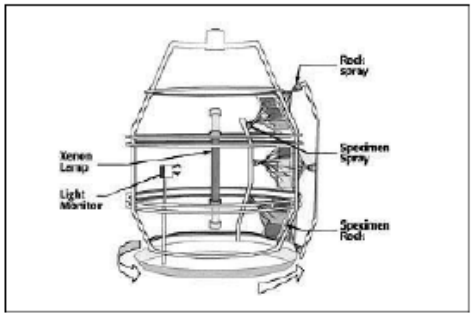


Figure No. 1 – Xenon Arc Apparatus

4.0 EQUIPMENT

Table No. 1 – Utilized Test Equipment
Element Report No.: 20-06-E0040-W1

Device	Element MII	Cal. Date	Cal. Due Date
Atlas Ci5000 Xenon-Arc Weatherometer	A15317	2019-09-18	2020-09-18
Calibration Xenon Reference Lamp	B08687	2018-07-25	2018-09-25

5.0 RESULTS

At the conclusion of the test program, each specimens was removed from visually examined for evidence of degradation as summarized in Table No. 2 below.

Table No. 2 – Post Exposure Observations
Boreal Nature Elite Spray Polyurethane Foam Insulation - Skin Off
Element Report No.: 20-06-E0040-W1

Element ID No.	Discolouration	Warping	Flaking	Cracking
20-06-B0040-D-1	S	L	M	N
20-06-B0040-D-2	S	L	M	N
20-06-B0040-D-3	S	L	M	N
20-06-B0040-D-4	S	L	M	N

Note: N = None, F = Faint, L = Light, M = Moderate, S = Severe, N/A = Not Applicable

Table No. 2 *(continued)* – Post Exposure Observations
Boreal Nature Elite Spray Polyurethane Foam Insulation - Skin On
Element Report No.: 20-06-E0040-W1

Element ID No.	Discolouration	Warping	Flaking	Cracking
20-06-B0040-D-5	S	N	L	N
20-06-B0040-D-6	S	N	L	N
20-06-B0040-D-6	S	N	L	N

Note: N = None, F = Faint, L = Light, M = Moderate, S = Severe, N/A = Not Applicable

6.0 CONCLUSION

At the conclusion of the test program, the specimens were returned to Element Building Systems for further evaluation.

7.0 REVISION HISTORY

Revision No	Date	Description of Revisions:
Original	2020-09-18	Original Document

Reported by:

Alexander Jackson, MET
Project Manager – Energy Systems
Accelerated Weathering & Environmental Durability

Reviewed by:

Steven Huynh, P.Eng.
Technical Manager – Energy Systems
Product Technologies Group

Appendix A
Specimen Photographs
(7 Pages)

Figure A1 – Element Specimen 20-06-B0040-D-1– Pre Exposure

Figure A2 – Element Specimen 20-06-B0040-D-1– 720 Hours Exposure

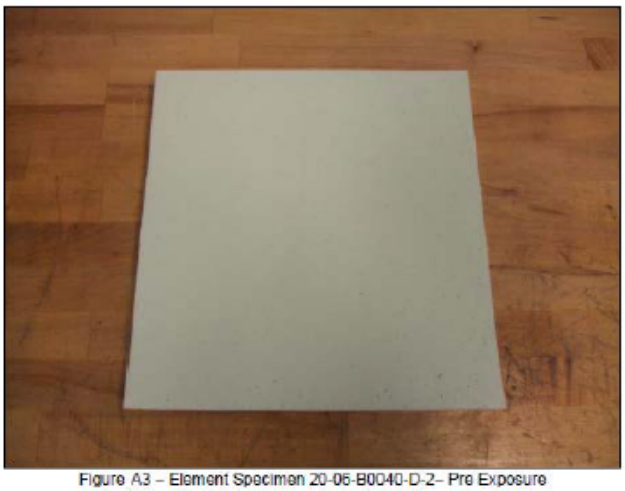


Figure A3 – Element Specimen 20-06-B0040-D-2– Pre Exposure

Figure A4 – Element Specimen 20-06-B0040-D-2– 720 Hours Exposure

Figure A5 – Element Specimen 20-06-B0040-D-3– Pre Exposure

Figure A6 – Element Specimen 20-06-B0040-D-3– 720 Hours Exposure

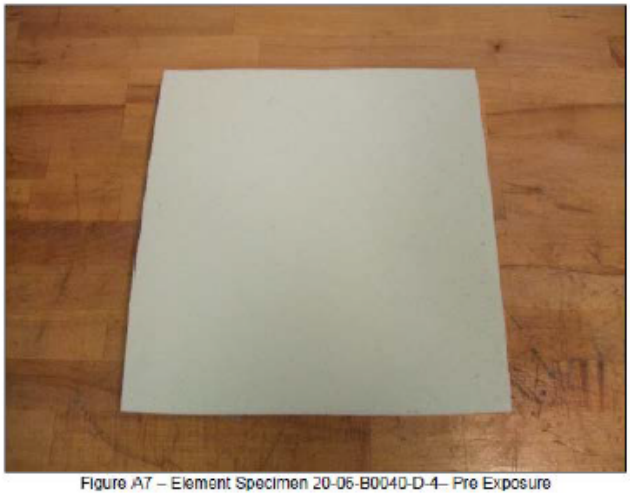


Figure A7 – Element Specimen 20-06-B0040-D-4– Pre Exposure

Figure A8 – Element Specimen 20-06-B0040-D-4– 720 Hours Exposure

Figure A9 – Element Specimen 20-06-B0040-D-5– Pre Exposure

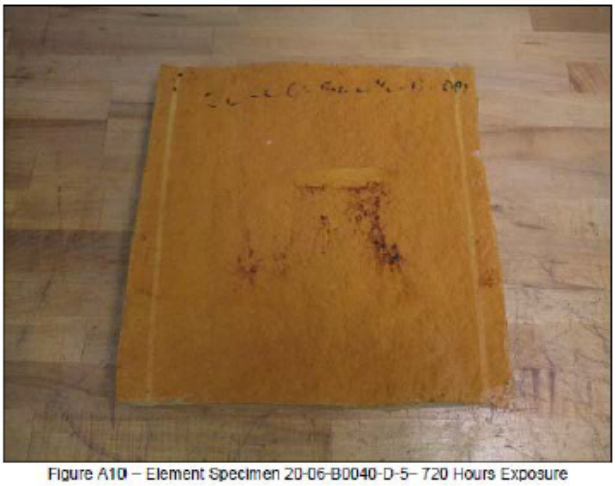


Figure A10 – Element Specimen 20-06-B0040-D-5– 720 Hours Exposure

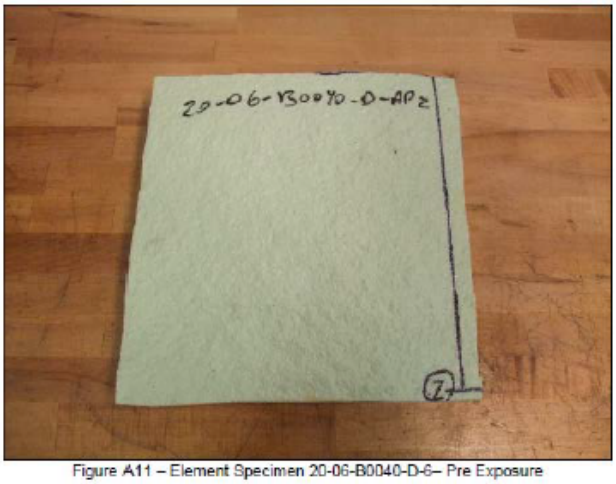


Figure A11 – Element Specimen 20-06-B0040-D-6– Pre Exposure

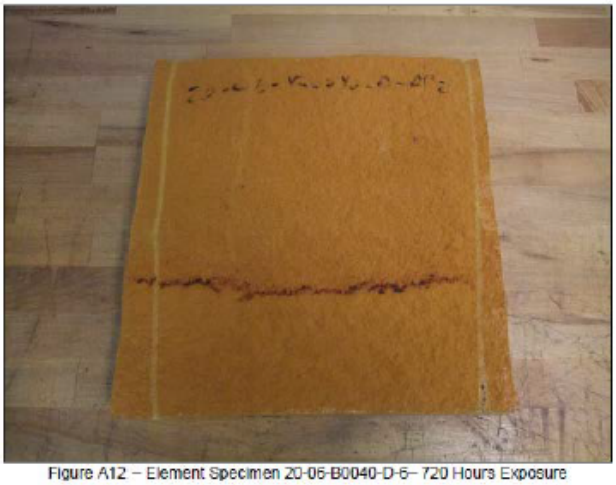


Figure A12 – Element Specimen 20-06-B0040-D-6– 720 Hours Exposure

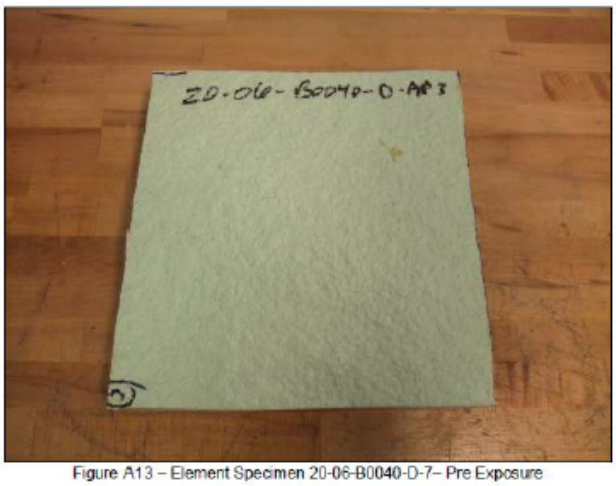


Figure A13 – Element Specimen 20-06-B0040-D-7– Pre Exposure

Figure A14 – Element Specimen 20-06-B0040-D-7– 720 Hours Exposure

Appendix B
Xenon-Arc Daily Chamber Conditions
(2 Pages)

Table No. B1 – Daily Chamber Measurements
CCMC TG 07 27 09.01 Table E2 Notes
Element Report No.: 20-06-E0040-W1

Date	Chamber Hours	Irradiance (W/m²)	Black Panel (°C)	Dry Bulb (°C)	Humidity (%RH)
2020-08-14	80004.0	Start Exposure, Irradiance Calibration			
2020-08-14	80005.3	0.34	42.1	47	68.2
2020-08-15	Weekend				
2020-08-16					
2020-08-17	80072.2	0.34	61.5	44.1	51.3
2020-08-17	80080.3	0.34	62.3	44.2	53.4
2020-08-18	80091.1	0.35	43.9	46.9	64.3
2020-08-18	80097.3	0.35	42.4	46.8	61.9
2020-08-19	80116.1	0.35	50.1	47.0	50.9
2020-08-19	80123.9	0.34	50.3	46.9	66.4
2020-08-20	80139.4	0.34	44.0	47.0	62.1
2020-08-20	80146.6	0.34	52.5	45.1	70.3
2020-08-21	80163.7	0.34	49.6	46.8	63.1
2020-08-21	80169.9	0.35	48.3	47.0	62.3
2020-08-22	Weekend				
2020-08-23					
2020-08-24	80236.4	0.34	63.1	46.8	50.8
2020-08-24	80242.5	0.34	62.8	46.9	50.8
2020-08-25	80259.4	0.34	50.7	47.0	56.4
2020-08-25	80266.5	0.34	62.9	46.7	54.3
2020-08-26	80284.5	0.34	62.3	46.8	49.1
2020-08-26	80290.3	0.34	64.6	50.2	57.6
2020-08-27	80308.1	0.34	62.5	46.6	54.2
2020-08-27	80314.8	0.34	63.4	47.2	49.5
2020-08-28	80331.5	0.34	47.2	48.0	58.2
2020-08-28	80337.8	0.34	50.2	47.0	58.8
2020-08-29	Weekend				
2020-08-30					
2020-08-31	80404.0	Replace Inner Filter			
2020-08-31	80408.8	0.25	62.8	47.1	49.1
2020-09-01	80426.2	0.34	50.3	46.9	65.0
2020-09-01	80432.9	0.34	63.3	47.1	49.0

Table No. B1 ***(continued)*** **– Daily Chamber Measurements**
CCMC TG 07 27 09.01 Table E2 Notes
Element Report No.: 20-06-E0040-W1

Date	Chamber Hours	Irradiance (W/m²)	Black Panel (°C)	Dry Bulb (°C)	Wet Bulb Depression (°C)
2020-09-02	80450.2	0.35	51.1	47.1	64.3
2020-09-02	80456.8	0.35	63.9	48.1	62.1
2020-09-03	80474.2	0.34	44.6	47.1	69.1
2020-09-03	80481.8	0.34	51.3	46.9	61.2
2020-09-04	80499.1	0.34	53.2	47.2	55.2
2020-09-04	80504.2	0.34	50.5	47.1	65.8
2020-09-05	Weekend				
2020-09-06					
2020-09-07					
2020-09-08	80593.8	0.35	44.7	46.8	65.9
2020-09-08	80600.2	0.35	44.8	47.0	63.4
2020-09-09	80619.1	0.34	62.4	43.1	69.1
2020-09-09	80625.1	0.34	61.1	42.7	71.5
2020-09-10	80643.6	0.34	47.8	46.8	63.5
2020-09-10	80648.3	0.35	44.9	46.9	67.0
2020-09-11	80666.1	0.35	43.8	47.1	66.1
2020-09-11	80673.2	0.35	62.8	47.2	51.0
2020-09-12	Weekend				
2020-09-13					
2020-09-14	80724.4	720 Hours Exposure Complete			

APPENDIX E

Air Barrier – CAN/ULC-S741 - Detailed Test Procedure and Results.

Element Report No.: 20-06-B0040-M

(62 Pages)

element

2395 Speakman Dr.
Mississauga, ON
Canada L5K 1B3

P: 1 905 822 4111
F: 1 905 823 1446
info.toronto.industrials@element.com
element.com

EVALUATION OF "BOREAL NATURE ELITE" POLYURETHANE SPRAY FOAM AIR BARRIER IN ACCORDANCE WITH CAN/ULC S741-08

Report to:	**Genyk** 1701 3e Avenue Grand-Mere, QC G9T 2W6
Attention:	Mike Richmond
Telephone:	+1 (226) 339-3089
Email:	mikerichmond@genyk.com
Report No.:	20-06-B0040-M 5 Pages, 6 Appendicies
Proposal No.:	20-006-95292
Date:	November 2, 2020

1.0 INTRODUCTION

At the request of *Genyk,* Element Materials Technology Inc. was retained to evaluate an air barrier using "Boreal Nature Elite" in accordance with CAN/ULC S741-08, Section 4.1.1 (Standard for Air Barrier Materials – Specification) as outlined in Element proposal number 20-006-95292.

The material used for testing was sample selected by an Element technical representative before being shipped to Element Toronto for testing. The sampling report can be found in Appendix A.

Upon receipt, the specimens were assigned the following Element Specimen Numbers:

Client Sample Description:	**Element Specimen No.:**
Boreal Nature Elite	20-06-B0040-AP1 to AP5

2.0 PROCEDURE

The sample was evaluated for the following test:

Test Description	Test Method
Standard for Air Barrier Materials – Specification	CAN/ULC-S741-08

Note: SI units are the primary units of measure.

Air Permeance Specimen Preparation:

Material, five (5) 1.1 m x 1.1 m (43.34" x 43.34") test samples were sprayed on 16 mm HDPE boards and conditioned for a minimum of 7 days at 23 ± 2ºC and 50 ± 5% The specimens tested had both skins intact.

Each specimen was installed within the air sealed test chamber as prescribed by ASTM E2178-13 standard *(Figure 1)*.

The initial air leakage rate was measured by exhausting the air within the test chamber at a rate required to maintain the following incremental test pressure differentials of 25, 50, 75, 100, 150, and 300 Pa (0.52, 1.04, 1.57, 2.09, 3.13, and 6.27 psf), followed by decremental pressure differentials of 100, 75 and 50 Pa (2.09, 1.57, and 1.04 psf). Simultaneously, the test specimens were monitored for any physical changes.

Upon completion of the initial air leakage measurements, the specimens were tested for Ultra-Violet / Condensation exposure in accordance with ASTM G154-16 standard Cycle 1, and followed by Heat Exposure as an "non-accessible air barrier" for 772 hours at 50°C ± 2°C (4°F) in accordance with Annex A, A3.1-A.

At the conclusion of the exposure cycles, the final air leakage rate was measured at the following incremental pressure differentials of 25, 50, 75, 100, 150, and 300 Pa (0.52, 1.04, 1.57, 2.09, 3.13, and 6.27 psf), followed by decremental pressure differentials of 100, 75 and 50 Pa (2.09, 1.57, and 1.04 psf) as required by the test procedure. Simultaneously, the test specimen was monitored for any physical changes.

2.0 PROCEDURE

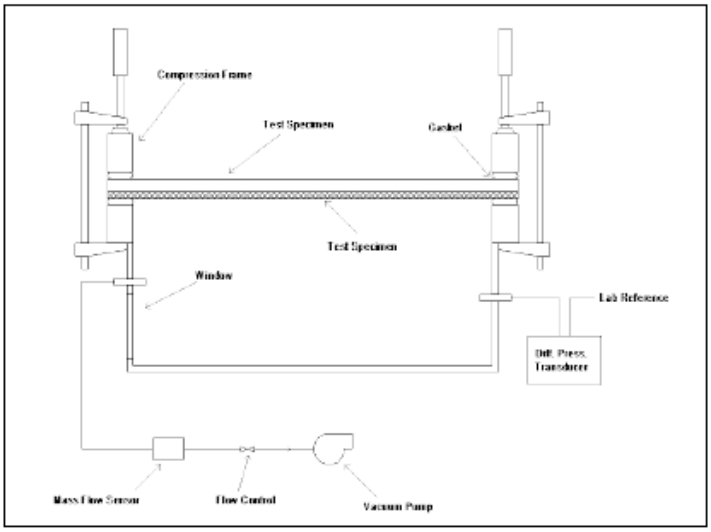


Figure 1 – Test Setup (ASTM E2178-13)

Equipment Used for Air Flow Measurements:

Manometer:	MII B12064
Mass Flow Meter:	MII A09200
Multimeter:	MII B11550
Condition Room:	MII B09680
Calipers:	MII B10963
ASTM E2178-13 Chamber:	07973 *(for reference)*

Testing for individual specimens was conducted on the following dates:

Test Dates – Prior UV and Heat Exposure Specimen:

Element Specimen No.:	Infiltration Date:	Exfiltration Date :
20-06-B0040-AP1	April 16, 2020	April 21, 2020
20-06-B0040-AP2	April 17, 2020	April 22, 2020
20-06-B0040-AP3	April 17, 2020	April 23, 2020
20-06-B0040-AP4	April 20, 2020	April 23, 2020
20-06-B0040-AP5	April 21, 2020	April 23, 2020

Test Dates – Post UV and Heat Exposure Specimen:

Element Specimen No.:	Infiltration Date:	Exfiltration Date :
20-06-B0040-AP1	July 20, 2020	July 23, 2020
20-06-B0040-AP2	July 20, 2020	July 24, 2020
20-06-B0040-AP3	July 21, 2020	July 21, 2020
20-06-B0040-AP4	July 21, 2020	July 22, 2020
20-06-B0040-AP5	July 20, 2020	July 24, 2020

Physical Characterization:
See Appendix F for water vapour transmission details.

3.0 RESULTS

Table 1 – Air Permeance Averages in Accordance with CAN/ULC-S741-08, Section 4.1.1
Average of Element Sample Numbers: 20-06-B0040-AP1 to AP5

Differential Pressure	Unconditioned (Prior to UV & Heat Exposure)		Conditioned (Post UV & Heat Exposure)		Requirement	Comment*
	Calculated Air Flow (Infiltration)	Calculated Air Flow (Exfiltration)	Calculated Air Flow (Infiltration)	Calculated Air Flow (Exfiltration)		
Pa	($L/s \cdot m^2$)	($L/s \cdot m^2$)	($L/s \cdot m^2$)	($L/s \cdot m^2$)		
25	0.0010	0.0038	0.0014	0.0042	**Unconditioned (Prior to UV & Heat Exposure):** < 0.02 $L/s \cdot m^2$ @ 75 Pa **Conditioned (Post UV & Heat Exposure):** Specimen shall not increase by more than 0.001 ($L/s \cdot m^2$) @ 75Pa	Prior to UV & Heat Exposure Meets Requirement. Post UV & Heat Exposure Meet Requirements
50	0.0019	0.0071	0.0027	0.0077		
75	0.0027	0.0101	0.0039	0.0109		
100	0.0035	0.0130	0.0051	0.0141		
150	0.0051	0.0186	0.0074	0.0203		
300	0.0097	0.0343	0.0142	0.0376		
100	0.0036	0.0140	0.0049	0.0146		
75	0.0028	0.0104	0.0037	0.0114		
50	0.0019	0.0069	0.0024	0.0080		

Average Sample Thickness: 47.89 mm (1.885")

Note: The individual specimen results are located in Appendix A. The measured infiltration and exfiltration airflow versus pressure differential graphs can be location in Appendix B.

* Meets the post UV and heat aging exposure air permeance requirements when applying the number of significant digits prescribed by CAN/ULC S741-08;

As per CAN/ULC S741-08:

"Where the air leakage characteristic determined for unconditioned specimens is less than 0.01 $L/(s \cdot m^2)$ at 75 Pa pressure difference, the air leakage characteristic of the conditioned specimens shall not increase by more than 0.001 $L/(s \cdot m^2)$ at 75 Pa pressure difference."

3.0 RESULTS (continued)

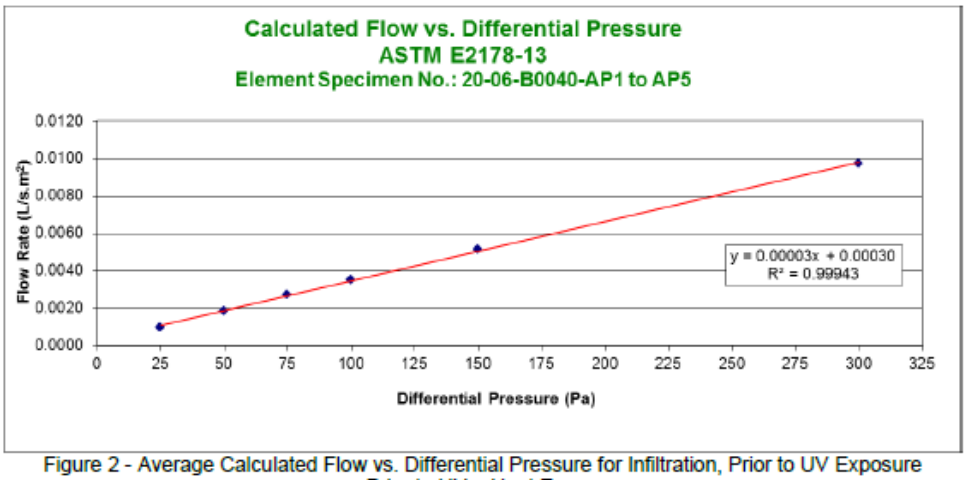


Figure 2 - Average Calculated Flow vs. Differential Pressure for Infiltration, Prior to UV Exposure Prior to UV + Heat Exposure

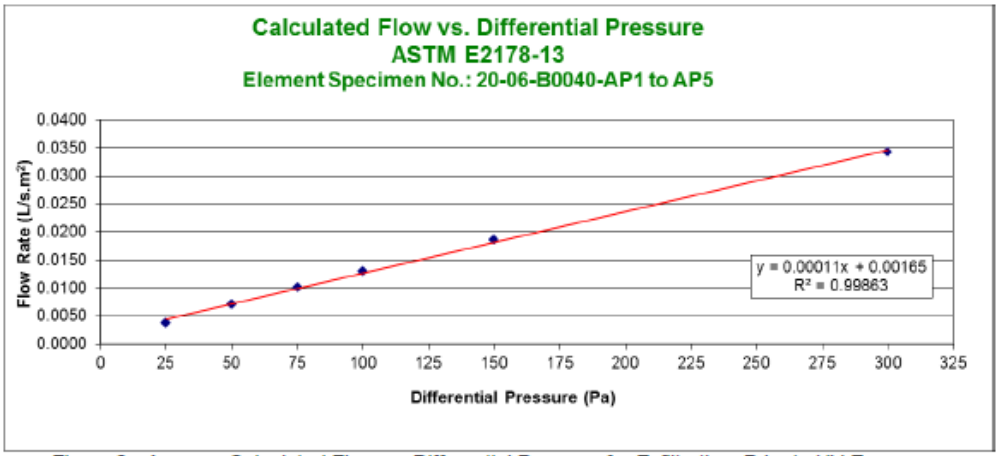


Figure 3 - Average Calculated Flow vs. Differential Pressure for Exfiltration, Prior to UV Exposure Prior to UV + Heat Exposure

3.0 RESULTS (continued)

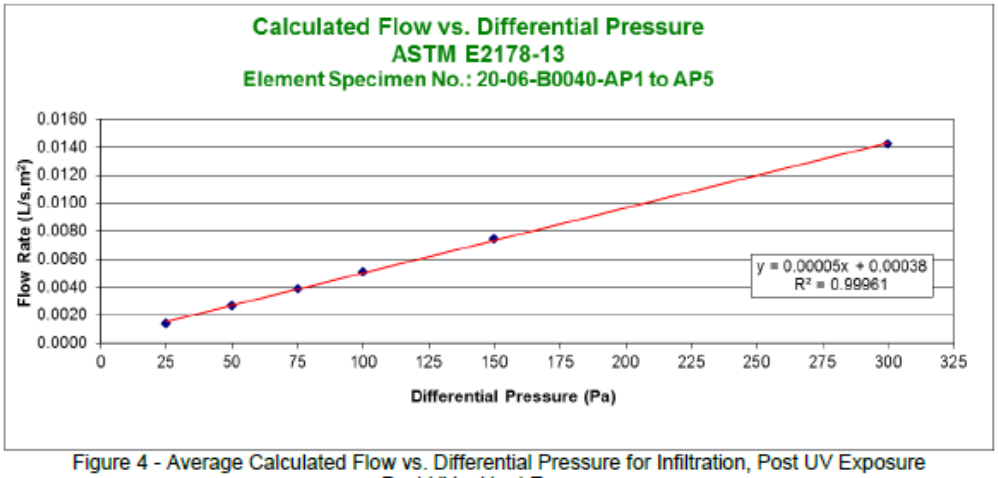


Figure 4 - Average Calculated Flow vs. Differential Pressure for Infiltration, Post UV Exposure Post UV + Heat Exposure

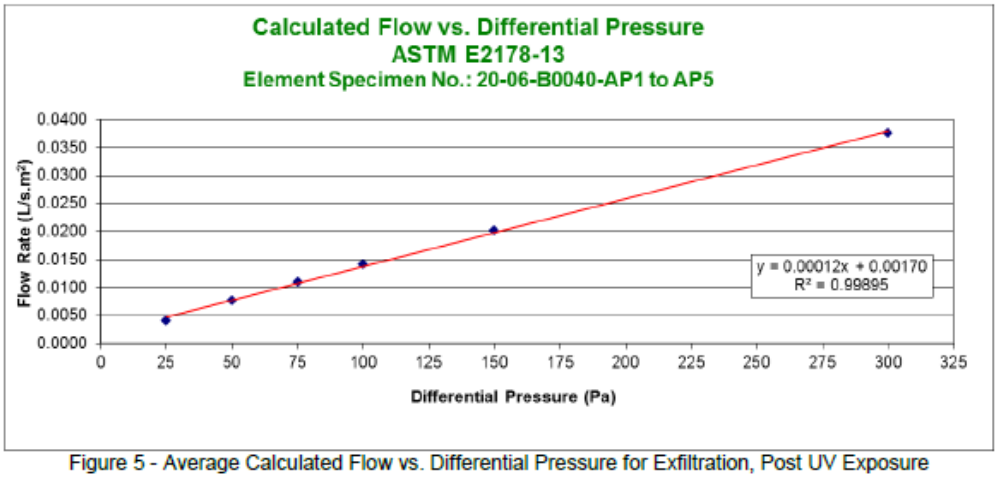


Figure 5 - Average Calculated Flow vs. Differential Pressure for Exfiltration, Post UV Exposure Post UV + Heat Exposure

3.0 RESULTS (continued)

UV Exposure

Please see Appendix E for Ultra Violet and Condensation Exposure Report.

Heat Exposure (conducted after UV Exposure)

Table 2 – Heat Exposure Test Data
CAN/ULC-S741-08, Section 4.1.1
Non Accessible Air Barrier – 772 Hours of Heat Exposure

Test Description	Temperature
Heat Exposure	50 ± 2°C

Physical Characterization Results:

Table 3 – Water Vapour Permeance
ASTM E96/E96M-14, Desiccant Method – Vapour Flow –Exfiltration
Element Sample No.: 20-06-B0040-M-WVP1 to WVP3

Specimen No.	Mass, g			Water Vapour Permeance	
	Initial	Final	Mass Gain	ng/Pa·s·m^2	US Perms
1	1189.67	1190.91	1.24	54.642	0.955
2	1176.96	1178.27	1.31	56.087	0.981
3	1189.21	1190.37	1.16	49.987	0.874
Average	**1185.28**	**1186.52**	**1.24**	**53.57**	**0.94**

Average Sample Thickness: 57.37 mm (2.26")

Table 4 – Water Vapour Permeance
ASTM E96/E96M-14, Desiccant Method – Vapour Flow – Infiltration
Element Sample No.: 20-06-B0040-M-WVP3 to WVP6

Specimen No.	Mass, g			Water Vapour Permeance	
	Initial	Final	Mass Gain	ng/Pa·s·m^2	US Perms
1	1201.45	1202.61	1.16	51.075	0.893
2	1197.16	1198.47	1.31	57.363	1.003
3	1213.40	1214.81	1.41	60.405	1.056
Average	**1204.0**	**1205.30**	**1.29**	**56.28**	**0.98**

Average Sample Thickness: 58.27 mm (2.29")

Note: Water Vapour Permeance Desiccant Method "ASTM E96/E96M-16 Procedure A" full test report is located in Appendix F of this report.

4.0 CONCLUSION

The material submitted by Genyk, identified as *"Boreal Nature Elite"* was tested and meets all requirements of CAN/ULC-S741-08 when tested as a non-accessible[1] air barrier material, as described in this report. The material tested conforms to the conditioned (post UV & heat exposure) air permeance requirements, with aged specimens not increasing by more than 0.001 (L/s·m2) at a pressure differential of 75 Pa.

5.0 REPORT REVISION SUMMARY

Revision No.:	Date:	Description of Revisions:
Original Document	November 2, 2020	N/A

Reported by:

Fadi G. Basmaji, M.A.Sc., B.Eng., Ext. 11227
Building Products Specialist
Building Science Division

Reviewed and Authorized by:

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

[1] Non-accessible air barrier materials undergo 772 h of heat exposure per CAN/ULC S741-Annex A3.1 procedure as compared to 336 h for an accessible air barrier material.

APPENDIX A

Drum Witnessing Report for Material Used.

Report Number: 20-06-B0040-SS (5 Pages)

2395 Speakman Dr.
Mississauga, ON
Canada L5K 1B3

P: 1 905 822 4111
F: 1 905 823 1446
info.torontoindustrials@element.com
element.com

Sample Selection Report

Genyk
1701 3e Avenue
Grand-Mere, QC
G9T 2W6

Report No.: 20-06-B0040-SS
Date: 2020-02-20
Proposal No.: 20-006-95292

Attn: **Mike Richmond**

At the request of *Genyk*, an Element representative witnessed the selection of chemical drums at the Genyk facility located in Cambridge, ON on February 20, 2020. Three sets of Resin and ISO were randomly selected from available inventory.

Details of the selection are provided below.

Sample Details

Sample 1 – Detailed Information - ISO Element Sample No.: 20-06-B0040-ISO	
Client Sample Name	ISO A-2732
Number of Drums Witnessed	3
Lot #	0319017301 Manufactured Date: 10/10/2019 Expiry Day: 10/10/2020
Type of Material	ISO –Part A
Dimensions	227 kg each drum
Date of Witness	2020-02-20
Markings	'Element' Signature of Element Representative Date (Picture on page 3)

Sample 2 – Detailed Information - Resin Element Sample No.: 20-06-B0040-Resin	
Client Sample Name	Boreal Nature Elite - Winter
Manufacturing Date	2020-01-20 2020-07-20
Number of Drums Witnessed	3
Lot #	L-20023
Type of Material	Resin
Dimensions	243.5 kg each drum
Markings	'Element' Signature of Element Representative Date (Picture on page 4)

Element Witness

Witnessing Information	
Location of Selection	**Genyk** 101 Sheldon Dr., Unit 3 Cambridge, ON N1R 6T6
Element Technical Representative	Fadi Basmaji Building Systems Specialist Building Science Division
Element Signature	

Photos:


HFO
9
FB
TAMPER EVIDENT TAPE
F.Basm
Element
2020-02-20
213


BOREAL
nature
Hiver /
Winter
B
HFO
GENYK

APPENDIX B

Individual Test Specimen Details

(3 Pages)

Table B1 – Air Permeance Results in Accordance with CAN/ULC-S741-08, Section 4.1.1
Element Sample No.: 20-06-B0040-AP1

Differential Pressure	Unconditioned (Prior to UV + Heat Exposure)		Conditioned (Post UV + Heat Exposure)	
	Calculated Air Flow (Infiltration)	Calculated Air Flow (Exfiltration)	Calculated Air Flow (Infiltration)	Calculated Air Flow (Exfiltration)
Pa	(L/s·m²)	(L/s·m²)	(L/s·m²)	(L/s·m²)
25	0.0009	0.0035	0.0011	0.0032
50	0.0017	0.0065	0.0021	0.0058
75	0.0026	0.0094	0.0030	0.0082
100	0.0034	0.0121	0.0040	0.0106
150	0.0051	0.0173	0.0058	0.0150
300	0.0100	0.0320	0.0112	0.0273
100	0.0037	0.0125	0.0044	0.0116
75	0.0026	0.0098	0.0031	0.0084
50	0.0016	0.0071	0.0019	0.0053

Average Sample Thickness: 39.69 mm (1.563")

Table B2 – Air Permeance Results in Accordance with CAN/ULC-S741-08, Section 4.1.1
Element Sample No.: 20-06-B0040-AP2

Differential Pressure	Unconditioned (Prior to UV + Heat Exposure)		Conditioned (Post UV + Heat Exposure)	
	Calculated Air Flow (Infiltration)	Calculated Air Flow (Exfiltration)	Calculated Air Flow (Infiltration)	Calculated Air Flow (Exfiltration)
Pa	(L/s·m²)	(L/s·m²)	(L/s·m²)	(L/s·m²)
25	0.0009	0.0025	0.0012	0.0028
50	0.0018	0.0046	0.0020	0.0051
75	0.0026	0.0065	0.0027	0.0073
100	0.0034	0.0084	0.0034	0.0095
150	0.0049	0.0119	0.0047	0.0136
300	0.0093	0.0217	0.0081	0.0252
100	0.0032	0.0079	0.0036	0.0097
75	0.0025	0.0064	0.0025	0.0078
50	0.0018	0.0048	0.0015	0.0058

Average Sample Thickness: 49.71mm (1.957")

Table B3 – Air Permeance Results in Accordance with CAN/ULC-S741-08, Section 4.1.1
Element Sample No.: 20-06-B0040-AP3

Differential Pressure	Unconditioned (Prior to UV + Heat Exposure)		Conditioned (Post UV + Heat Exposure)	
	Calculated Air Flow (Infiltration)	Calculated Air Flow (Exfiltration)	Calculated Air Flow (Infiltration)	Calculated Air Flow (Exfiltration)
Pa	(L/s·m²)	(L/s·m²)	(L/s·m²)	(L/s·m²)
25	0.0010	0.0051	0.0023	0.0045
50	0.0019	0.0094	0.0047	0.0092
75	**0.0027**	**0.0134**	**0.0071**	**0.0139**
100	0.0035	0.0172	0.0094	0.0186
150	0.0050	0.0244	0.0142	0.0283
300	0.0093	0.0447	0.0285	0.0575
100	0.0035	0.0195	0.0080	0.0202
75	**0.0027**	**0.0138**	**0.0064**	**0.0147**
50	0.0019	0.0084	0.0047	0.0094

Average Sample Thickness: 48.98 mm (1.929")

Table B4 – Air Permeance Results in Accordance with CAN/ULC-S741-08, Section 4.1.1
Element Sample No.: 20-06-B0040-AP4

Differential Pressure	Unconditioned (Prior to UV + Heat Exposure)		Conditioned (Post UV + Heat Exposure)	
	Calculated Air Flow (Infiltration)	Calculated Air Flow (Exfiltration)	Calculated Air Flow (Infiltration)	Calculated Air Flow (Exfiltration)
Pa	(L/s·m²)	(L/s·m²)	(L/s·m²)	(L/s·m²)
25	0.0009	0.0021	0.0011	0.0042
50	0.0018	0.0040	0.0020	0.0075
75	**0.0026**	**0.0057**	**0.0029**	**0.0106**
100	0.0035	0.0075	0.0038	0.0135
150	0.0051	0.0109	0.0055	0.0191
300	0.0099	0.0207	0.0103	0.0344
100	0.0037	0.0081	0.0038	0.0131
75	**0.0027**	**0.0058**	**0.0027**	**0.0110**
50	0.0018	0.0036	0.0017	0.0086

Average Sample Thickness: 46.55 mm (1.833")

Table B5 – Air Permeance Results in Accordance with CAN/ULC-S741-08, Section 4.1.1
Element Sample No.: 20-06-B0040-AP5

Differential Pressure	Unconditioned (Prior to UV + Heat Exposure)		Conditioned (Post UV + Heat Exposure)	
	Calculated Air Flow (Infiltration)	Calculated Air Flow (Exfiltration)	Calculated Air Flow (Infiltration)	Calculated Air Flow (Exfiltration)
Pa	(L/s·m²)	(L/s·m²)	(L/s·m²)	(L/s·m²)
25	0.0012	0.0059	0.0014	0.0062
50	0.0022	0.0108	0.0026	0.0107
75	0.0031	0.0155	0.0038	0.0147
100	0.0040	0.0199	0.0049	0.0184
150	0.0056	0.0285	0.0070	0.0253
300	0.0102	0.0526	0.0131	0.0436
100	0.0038	0.0218	0.0049	0.0182
75	0.0032	0.0161	0.0036	0.0149
50	0.0024	0.0106	0.0024	0.0111

Average Sample Thickness: 54.51 mm (2.146")

APPENDIX C

Air Flow Versus Pressure Differential (log/log) Graphs
Prior to UV and Heat Exposure (Unconditioned Air Permeance)

(10 Pages)

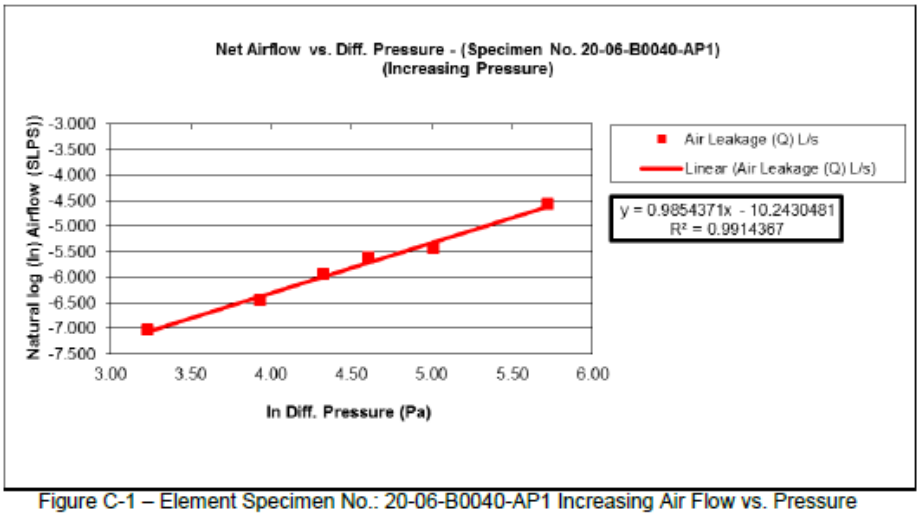


Figure C-1 – Element Specimen No.: 20-06-B0040-AP1 Increasing Air Flow vs. Pressure
Direction of Air Flow: Infiltration

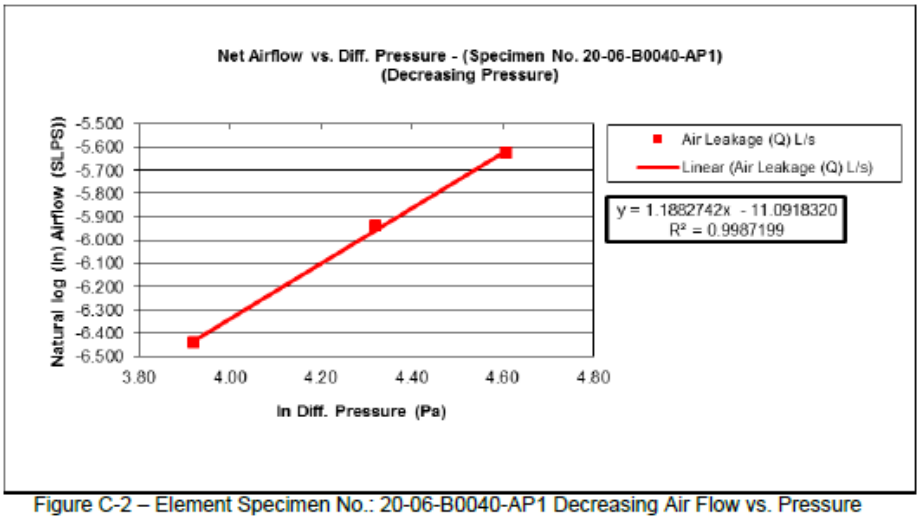


Figure C-2 – Element Specimen No.: 20-06-B0040-AP1 Decreasing Air Flow vs. Pressure
Direction of Air Flow: Infiltration.

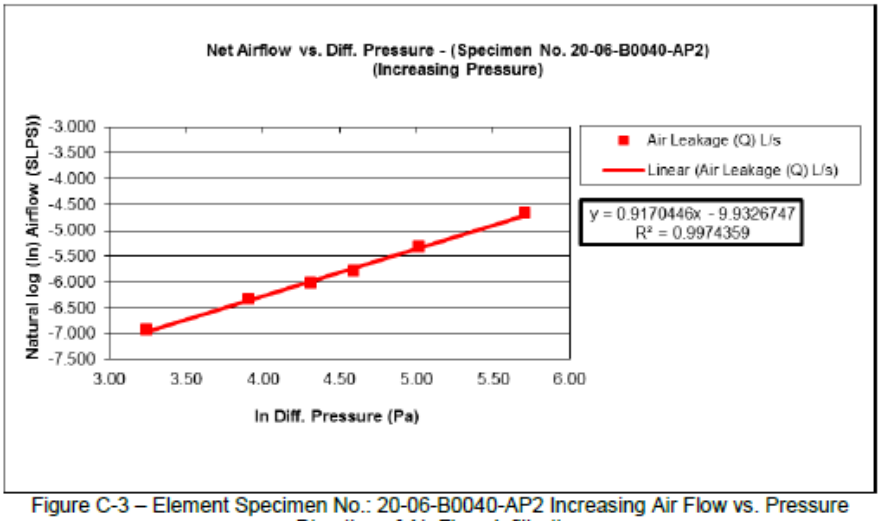


Figure C-3 – Element Specimen No.: 20-06-B0040-AP2 Increasing Air Flow vs. Pressure
Direction of Air Flow: Infiltration

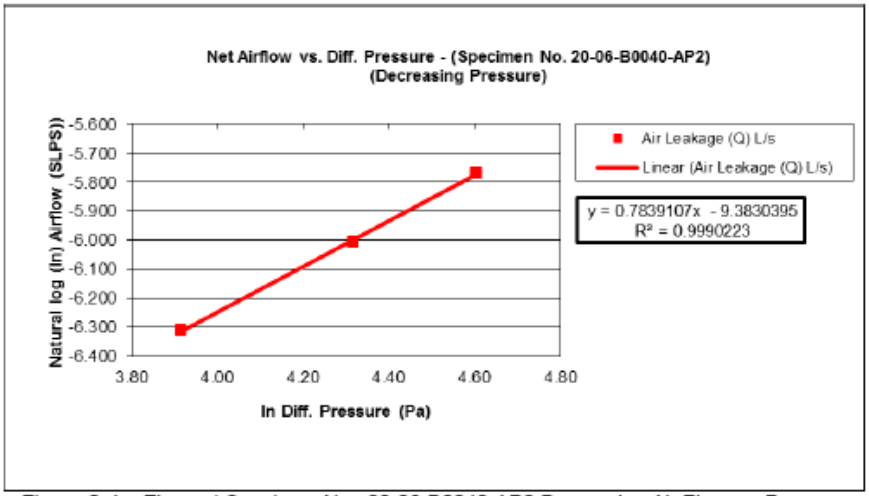


Figure C-4 – Element Specimen No.: 20-06-B0040-AP2 Decreasing Air Flow vs. Pressure
Direction of Air Flow: Infiltration.

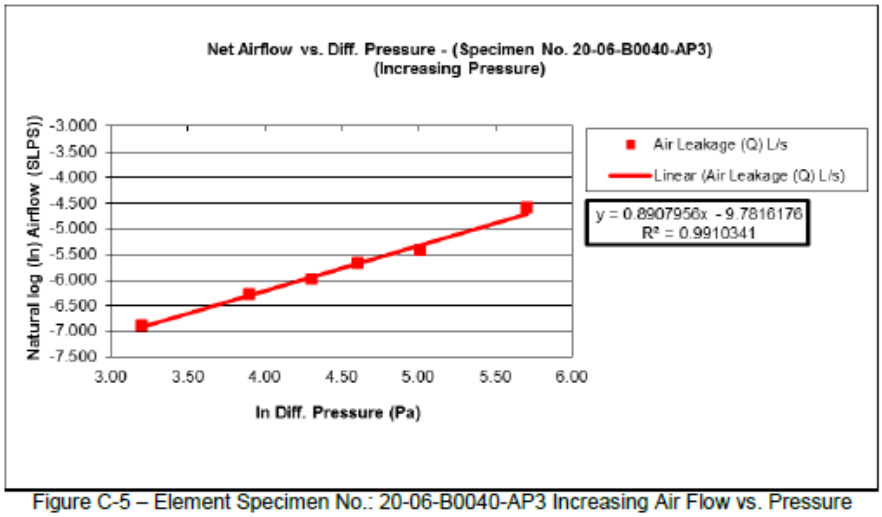


Figure C-5 – Element Specimen No.: 20-06-B0040-AP3 Increasing Air Flow vs. Pressure Direction of Air Flow: Infiltration

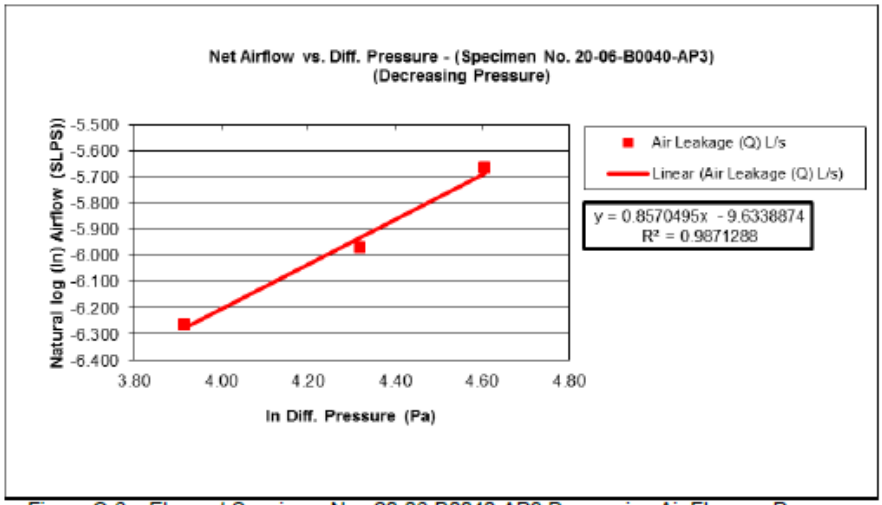


Figure C-6 – Element Specimen No.: 20-06-B0040-AP3 Decreasing Air Flow vs. Pressure Direction of Air Flow: Infiltration.

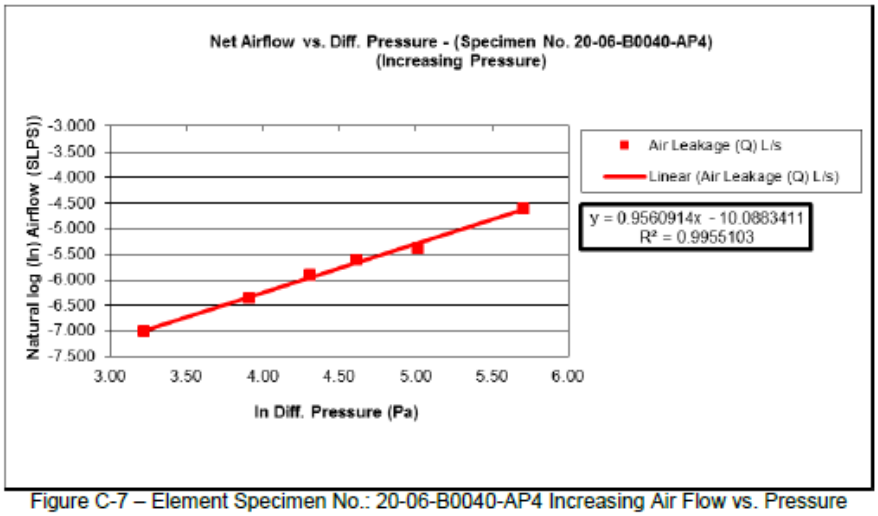


Figure C-7 – Element Specimen No.: 20-06-B0040-AP4 Increasing Air Flow vs. Pressure Direction of Air Flow: Infiltration

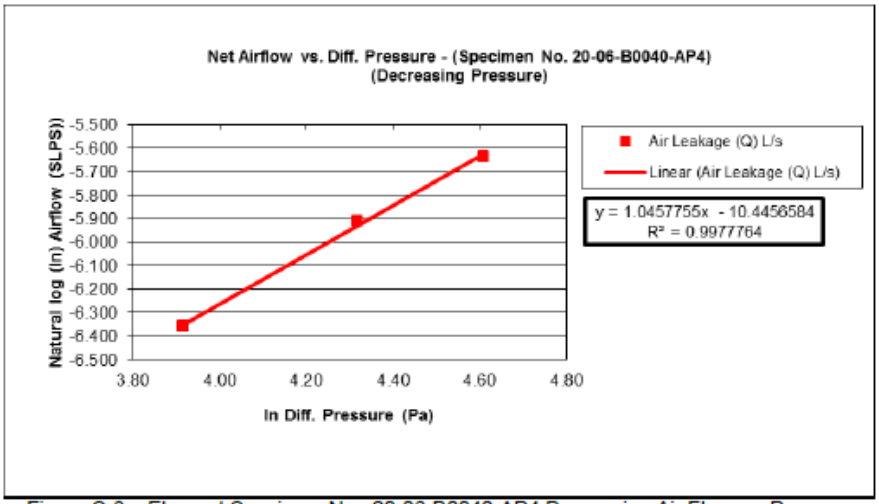


Figure C-8 – Element Specimen No.: 20-06-B0040-AP4 Decreasing Air Flow vs. Pressure Direction of Air Flow: Infiltration.

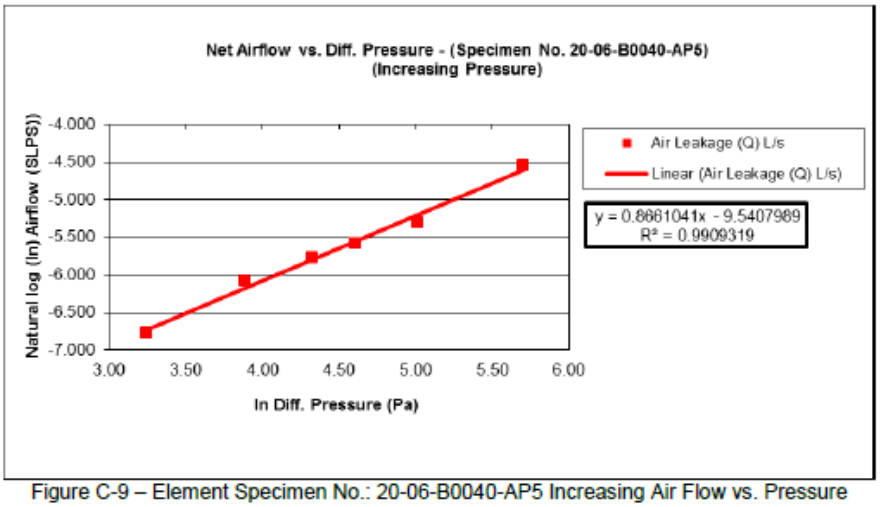


Figure C-9 – Element Specimen No.: 20-06-B0040-AP5 Increasing Air Flow vs. Pressure
Direction of Air Flow: Infiltration

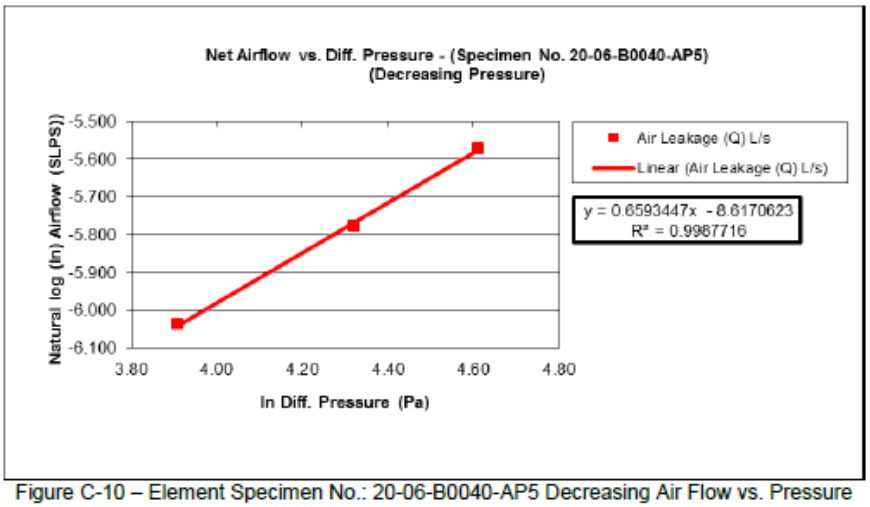


Figure C-10 – Element Specimen No.: 20-06-B0040-AP5 Decreasing Air Flow vs. Pressure
Direction of Air Flow: Infiltration.

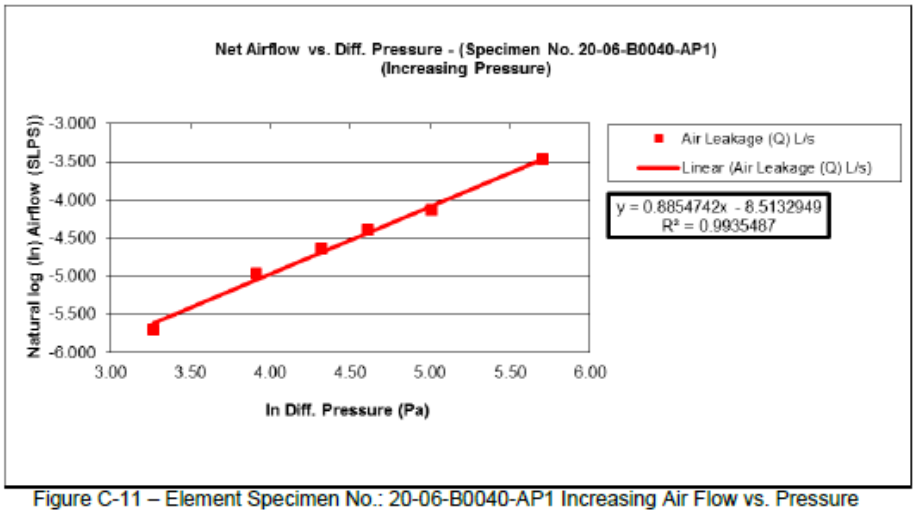


Figure C-11 – Element Specimen No.: 20-06-B0040-AP1 Increasing Air Flow vs. Pressure
Direction of Air Flow: Exfiltration.

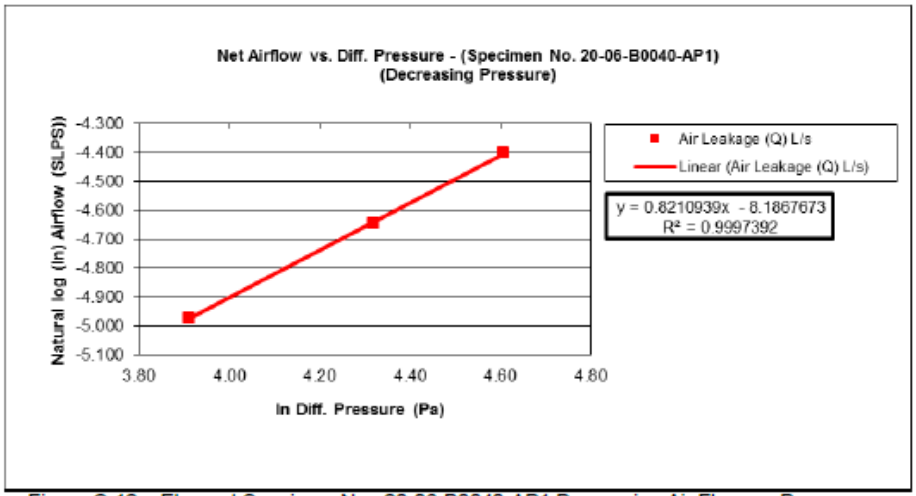


Figure C-12 – Element Specimen No.: 20-06-B0040-AP1 Decreasing Air Flow vs. Pressure
Direction of Air Flow: Exfiltration.

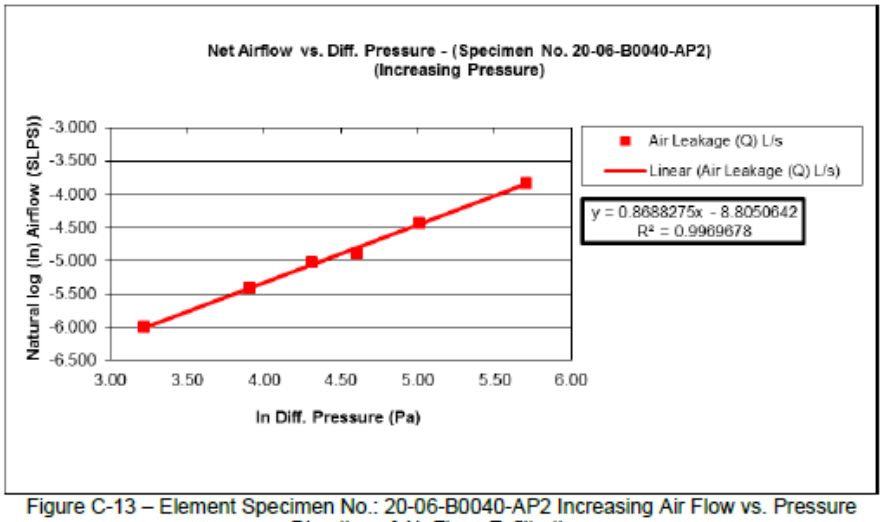


Figure C-13 – Element Specimen No.: 20-06-B0040-AP2 Increasing Air Flow vs. Pressure
Direction of Air Flow: Exfiltration.

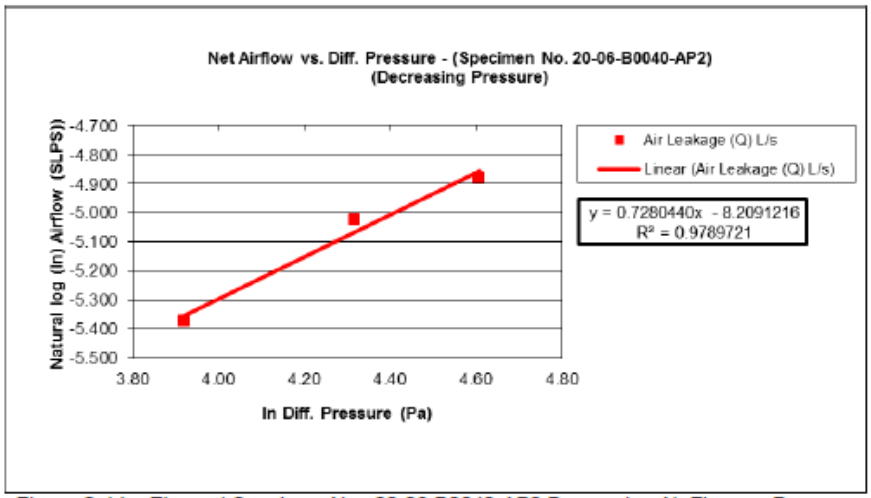


Figure C-14 – Element Specimen No.: 20-06-B0040-AP2 Decreasing Air Flow vs. Pressure
Direction of Air Flow: Exfiltration.

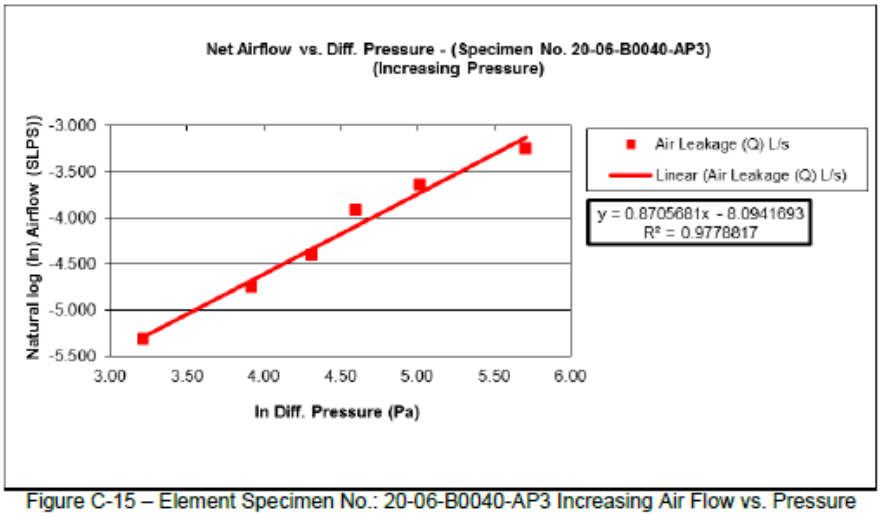


Figure C-15 – Element Specimen No.: 20-06-B0040-AP3 Increasing Air Flow vs. Pressure Direction of Air Flow: Exfiltration.

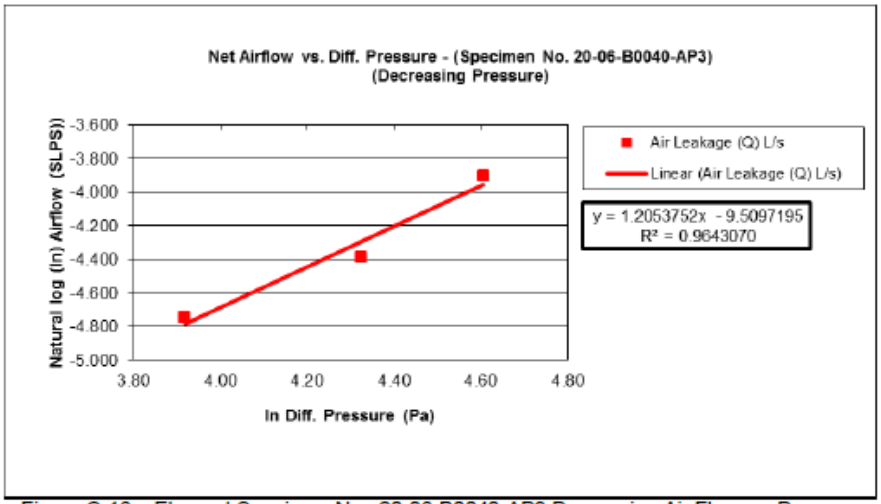
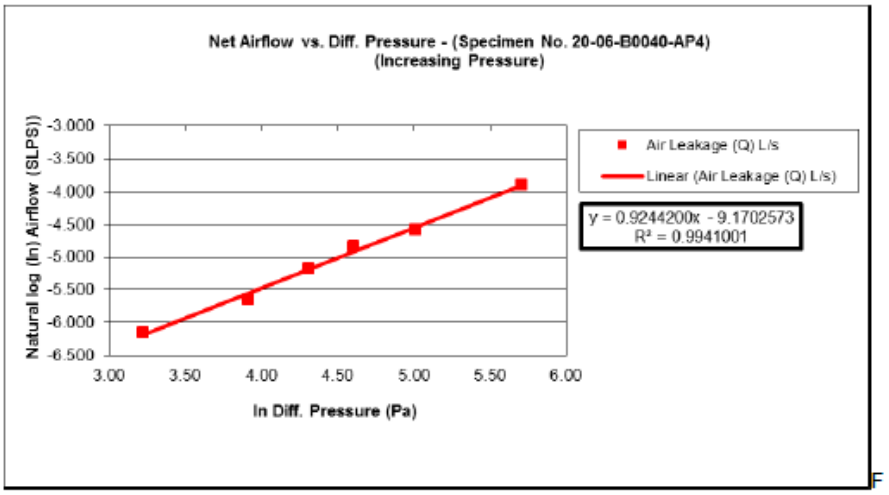


Figure C-16 – Element Specimen No.: 20-06-B0040-AP3 Decreasing Air Flow vs. Pressure Direction of Air Flow: Exfiltration.



igure C-17 – Element Specimen No.: 20-06-B0040-AP4 Increasing Air Flow vs. Pressure Direction of Air Flow: Exfiltration.

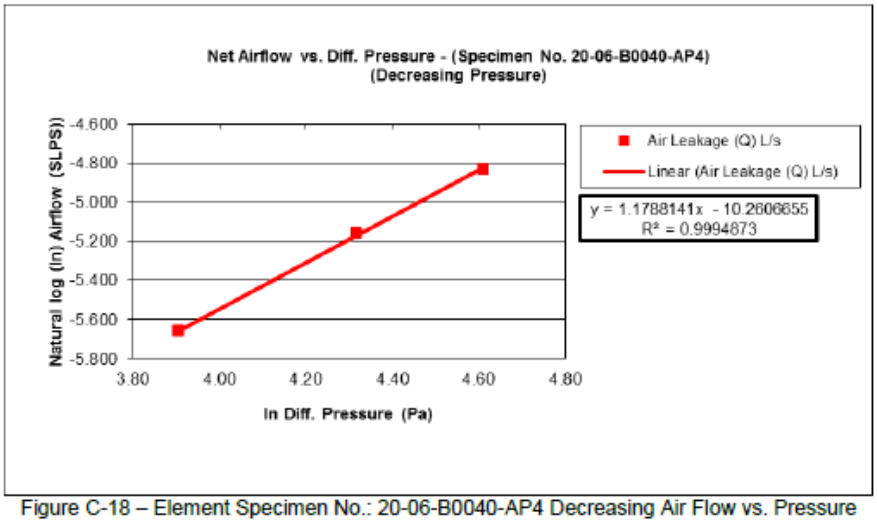


Figure C-18 – Element Specimen No.: 20-06-B0040-AP4 Decreasing Air Flow vs. Pressure Direction of Air Flow: Exfiltration.

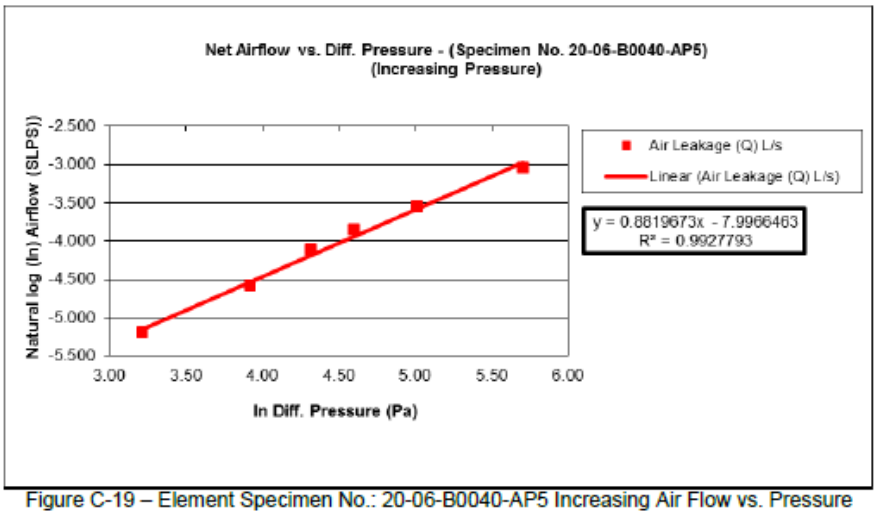


Figure C-19 – Element Specimen No.: 20-06-B0040-AP5 Increasing Air Flow vs. Pressure Direction of Air Flow: Exfiltration.

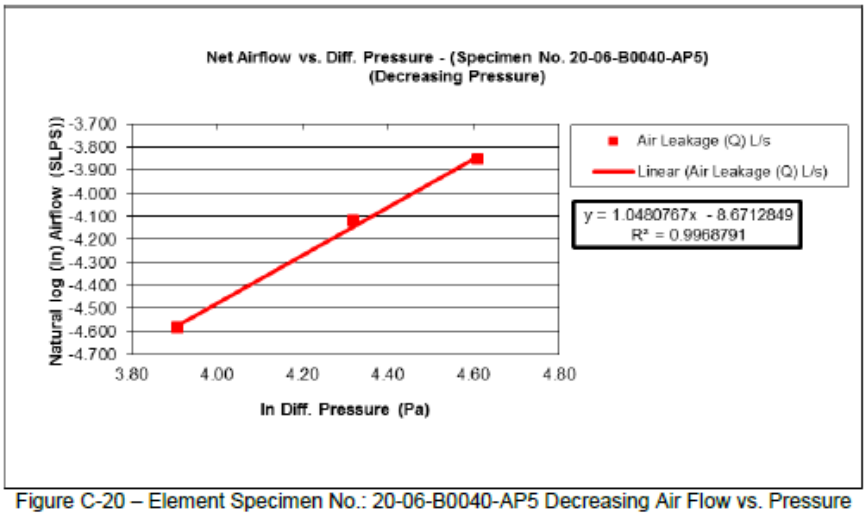


Figure C-20 – Element Specimen No.: 20-06-B0040-AP5 Decreasing Air Flow vs. Pressure Direction of Air Flow: Exfiltration.

APPENDIX D

Air Flow Versus Pressure Differential (log/log) Graphs
Post UV and Heat Exposure (Conditioned Air Permeance)

(10 Pages)

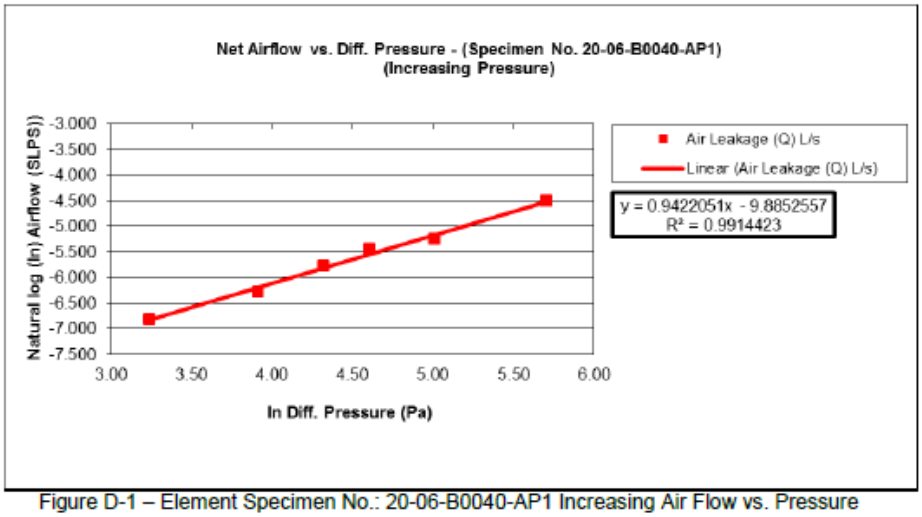


Figure D-1 – Element Specimen No.: 20-06-B0040-AP1 Increasing Air Flow vs. Pressure
Direction of Air Flow: Infiltration

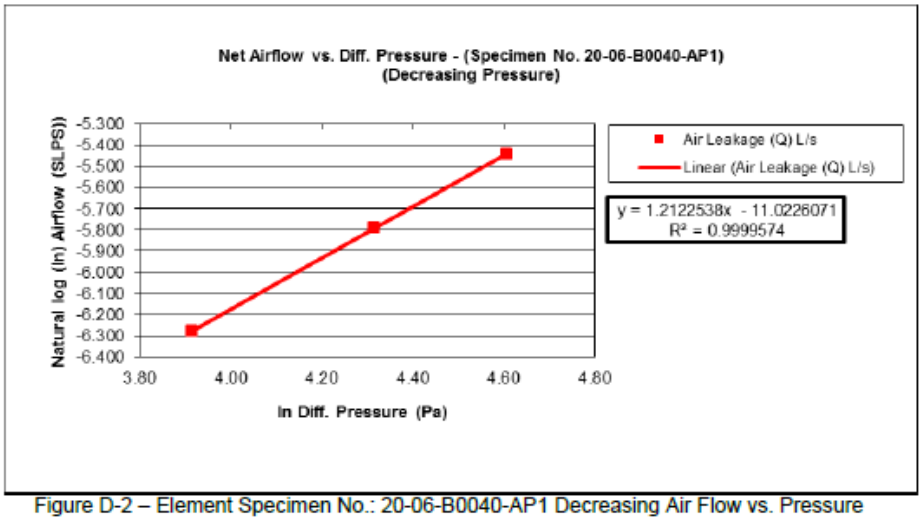


Figure D-2 – Element Specimen No.: 20-06-B0040-AP1 Decreasing Air Flow vs. Pressure
Direction of Air Flow: Infiltration

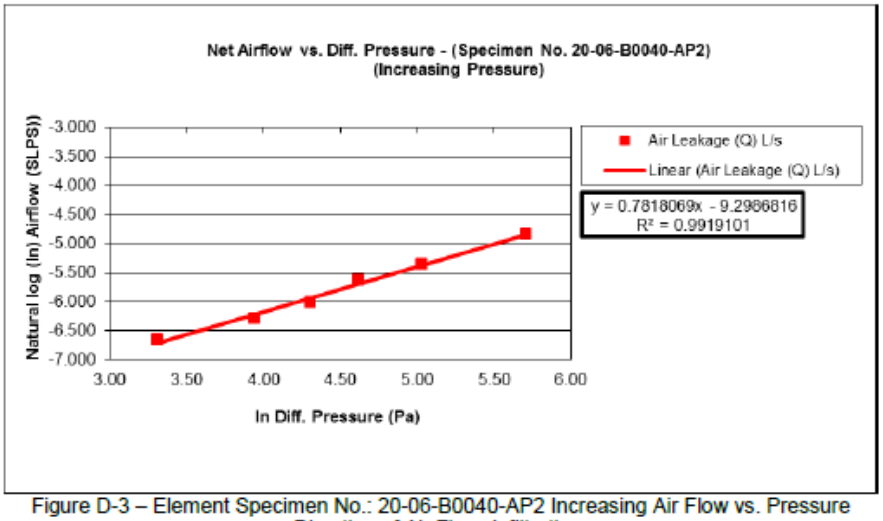


Figure D-3 – Element Specimen No.: 20-06-B0040-AP2 Increasing Air Flow vs. Pressure
Direction of Air Flow: Infiltration.

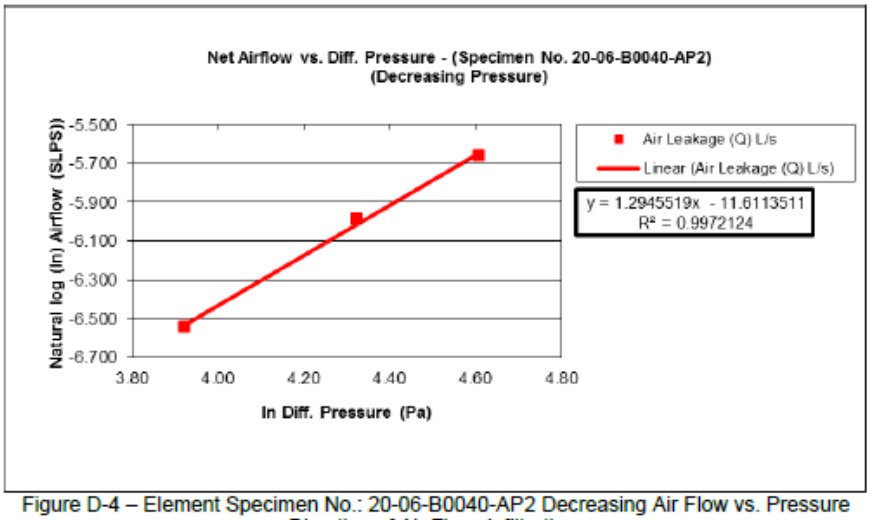


Figure D-4 – Element Specimen No.: 20-06-B0040-AP2 Decreasing Air Flow vs. Pressure
Direction of Air Flow: Infiltration.

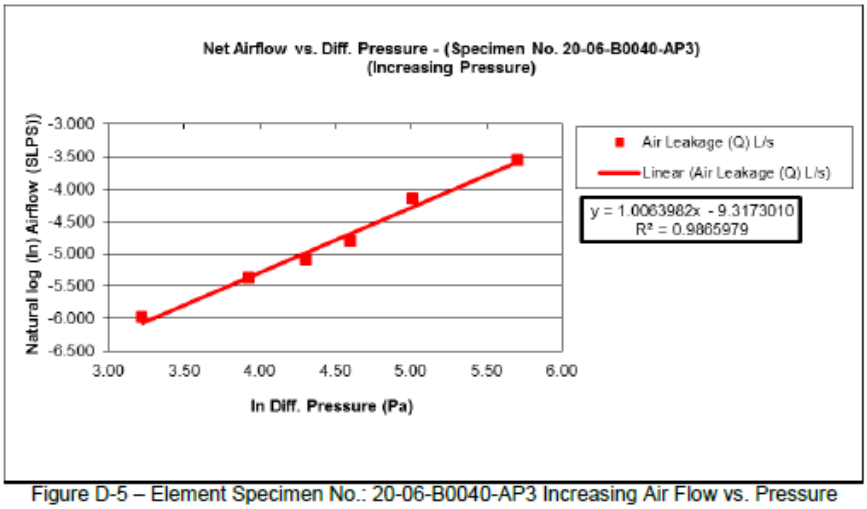


Figure D-5 – Element Specimen No.: 20-06-B0040-AP3 Increasing Air Flow vs. Pressure Direction of Air Flow: Infiltration.

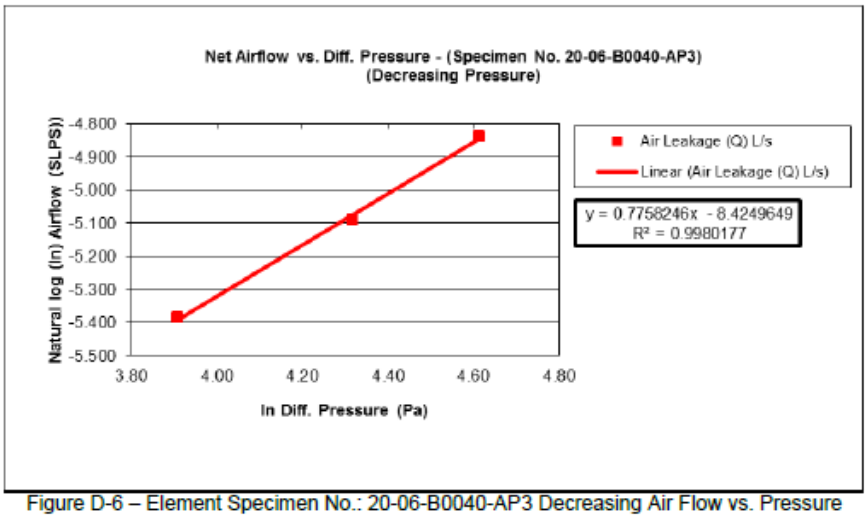


Figure D-6 – Element Specimen No.: 20-06-B0040-AP3 Decreasing Air Flow vs. Pressure Direction of Air Flow: Infiltration.

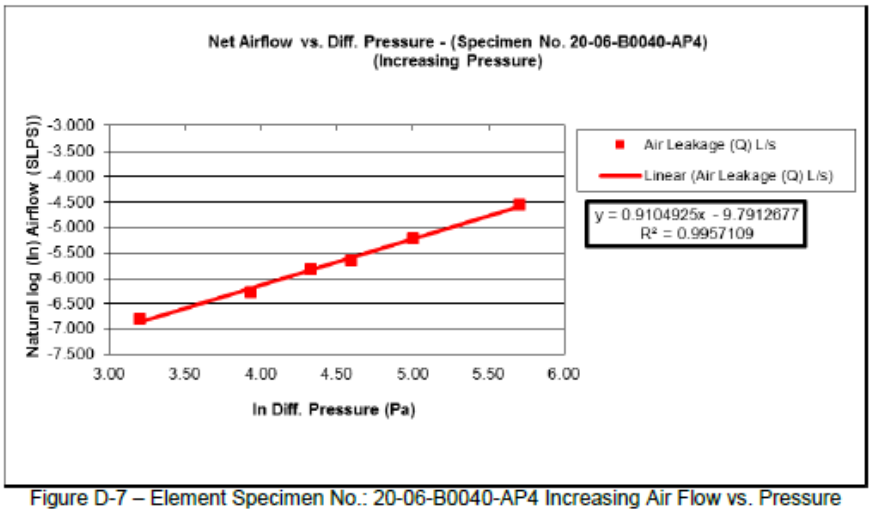


Figure D-7 – Element Specimen No.: 20-06-B0040-AP4 Increasing Air Flow vs. Pressure
Direction of Air Flow: Infiltration.

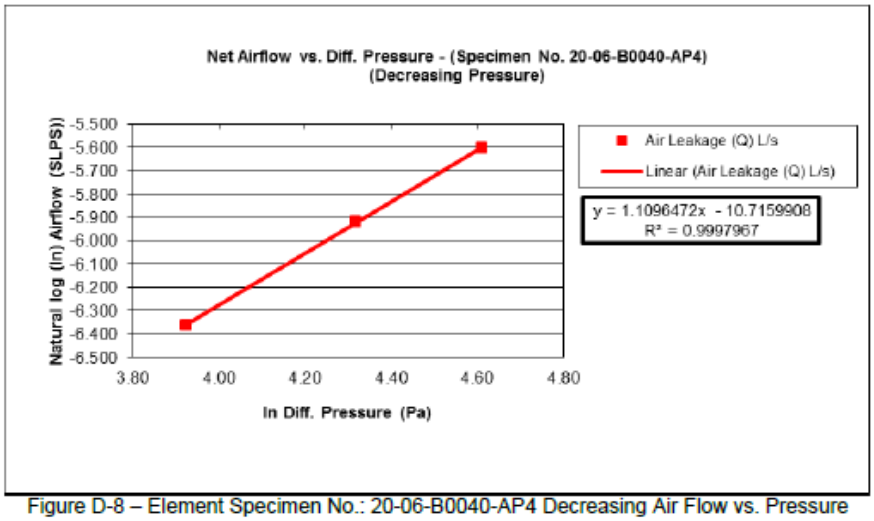


Figure D-8 – Element Specimen No.: 20-06-B0040-AP4 Decreasing Air Flow vs. Pressure
Direction of Air Flow: Infiltration.

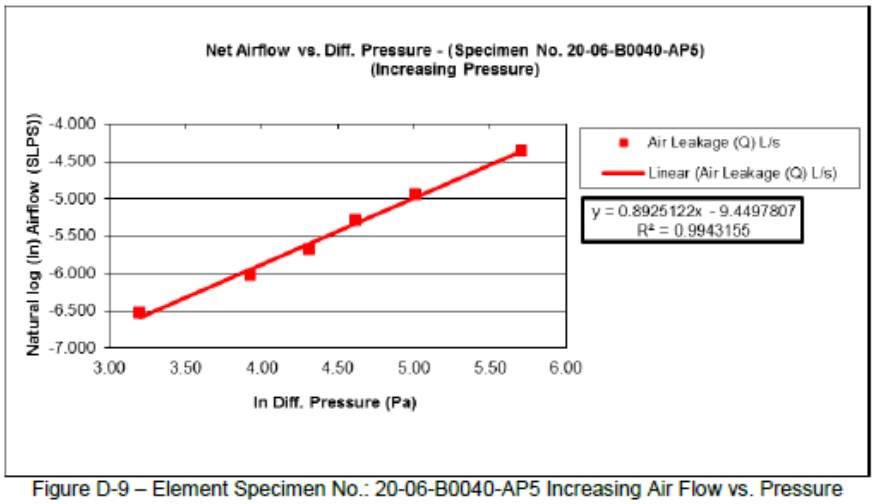


Figure D-9 – Element Specimen No.: 20-06-B0040-AP5 Increasing Air Flow vs. Pressure
Direction of Air Flow: Infiltration

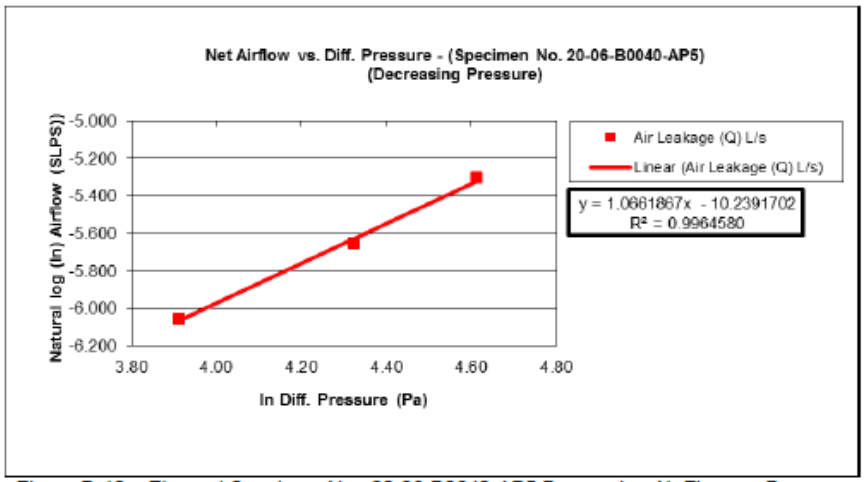


Figure D-10 – Element Specimen No.: 20-06-B0040-AP5 Decreasing Air Flow vs. Pressure
Direction of Air Flow: Infiltration

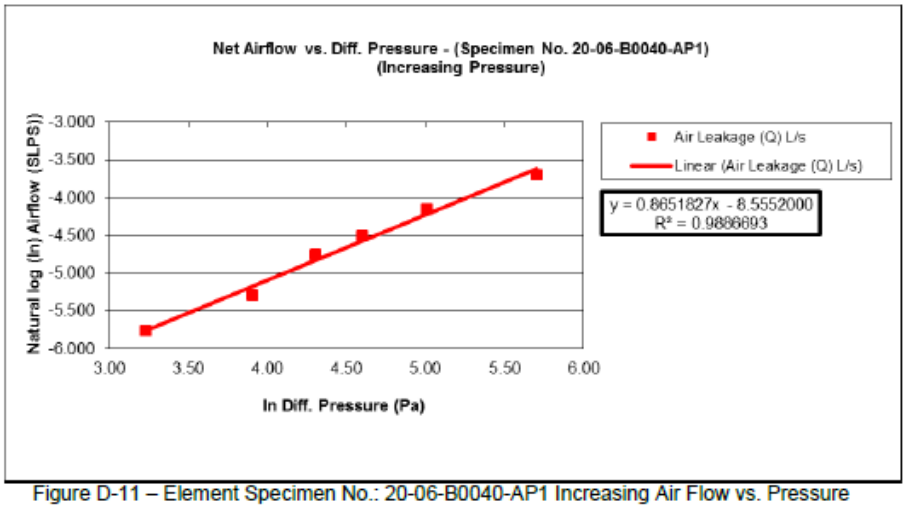


Figure D-11 – Element Specimen No.: 20-06-B0040-AP1 Increasing Air Flow vs. Pressure
Direction of Air Flow: Exfiltration.

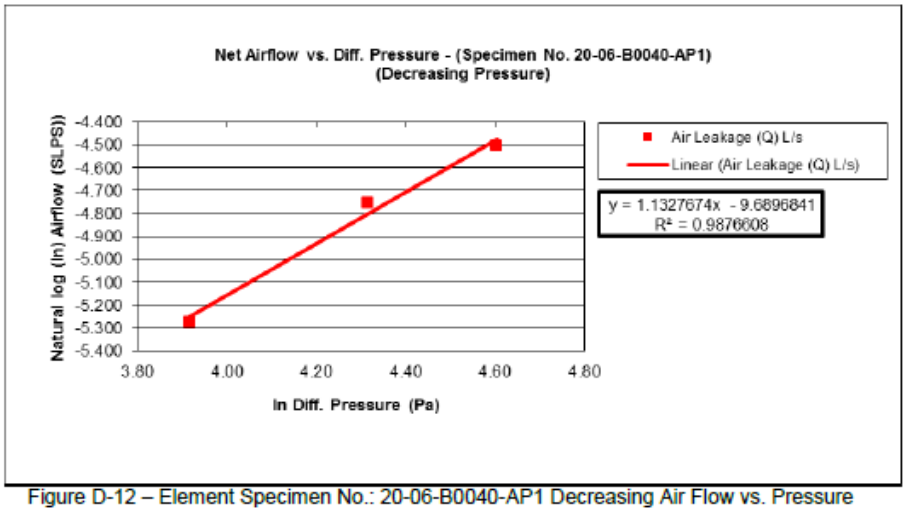


Figure D-12 – Element Specimen No.: 20-06-B0040-AP1 Decreasing Air Flow vs. Pressure
Direction of Air Flow: Exfiltration.

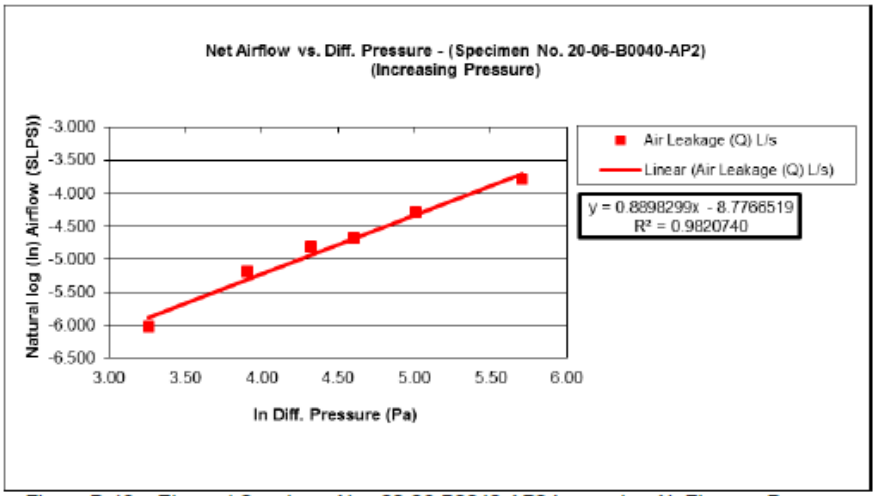


Figure D-13 – Element Specimen No.: 20-06-B0040-AP2 Increasing Air Flow vs. Pressure Direction of Air Flow: Exfiltration.

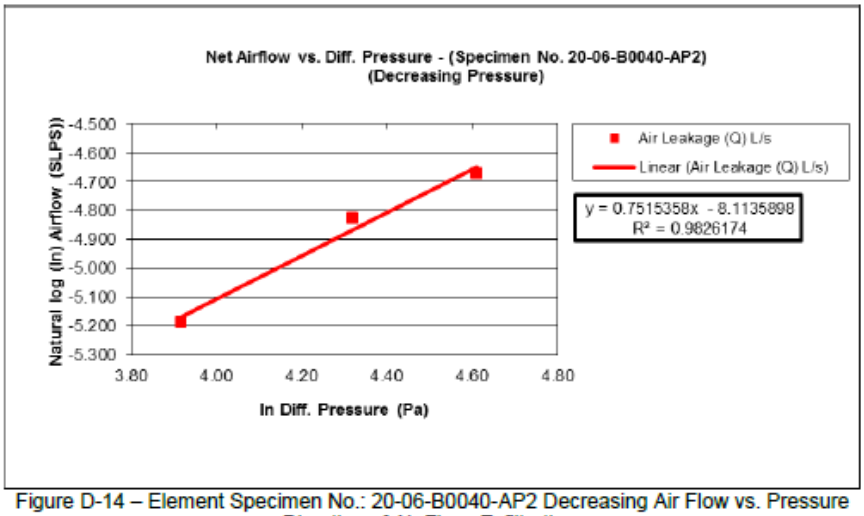


Figure D-14 – Element Specimen No.: 20-06-B0040-AP2 Decreasing Air Flow vs. Pressure Direction of Air Flow: Exfiltration.

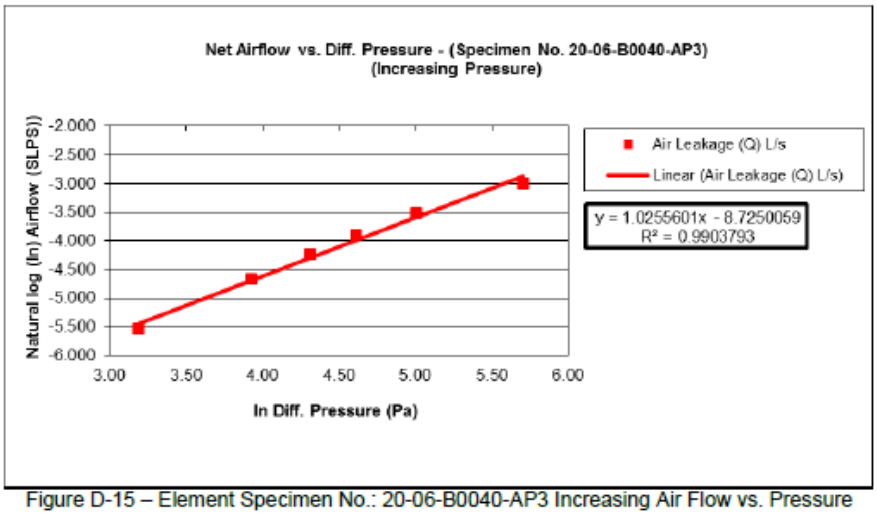


Figure D-15 – Element Specimen No.: 20-06-B0040-AP3 Increasing Air Flow vs. Pressure Direction of Air Flow: Exfiltration.

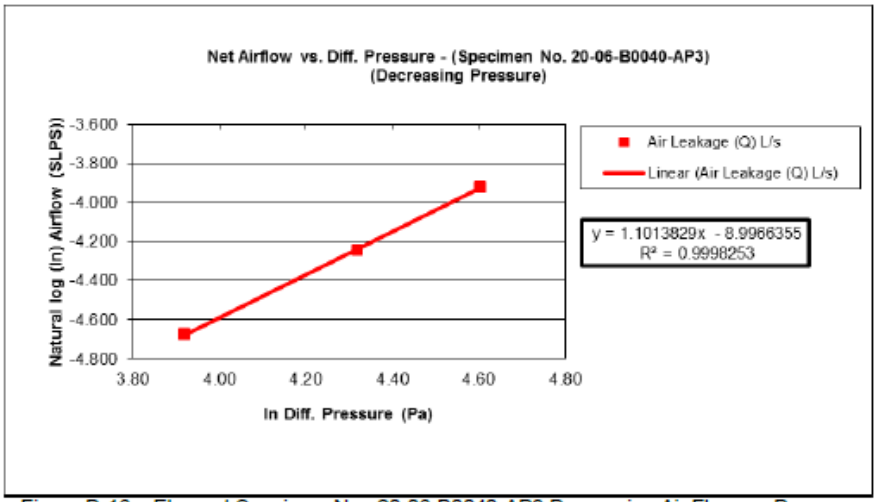


Figure D-16 – Element Specimen No.: 20-06-B0040-AP3 Decreasing Air Flow vs. Pressure Direction of Air Flow: Exfiltration.

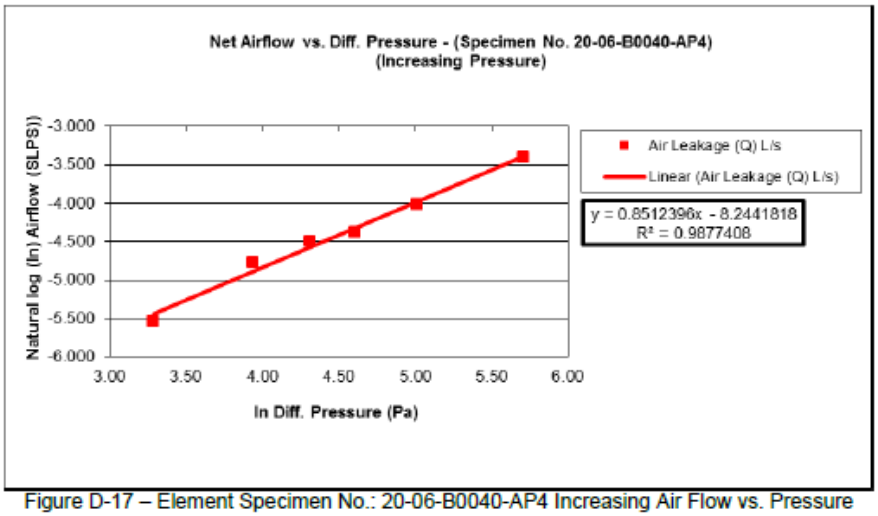


Figure D-17 – Element Specimen No.: 20-06-B0040-AP4 Increasing Air Flow vs. Pressure Direction of Air Flow: Exfiltration.

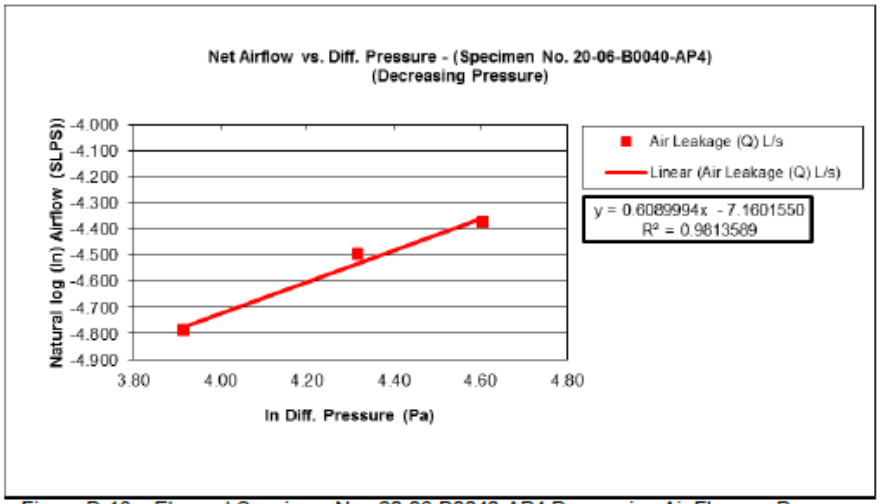


Figure D-18 – Element Specimen No.: 20-06-B0040-AP4 Decreasing Air Flow vs. Pressure Direction of Air Flow: Exfiltration.

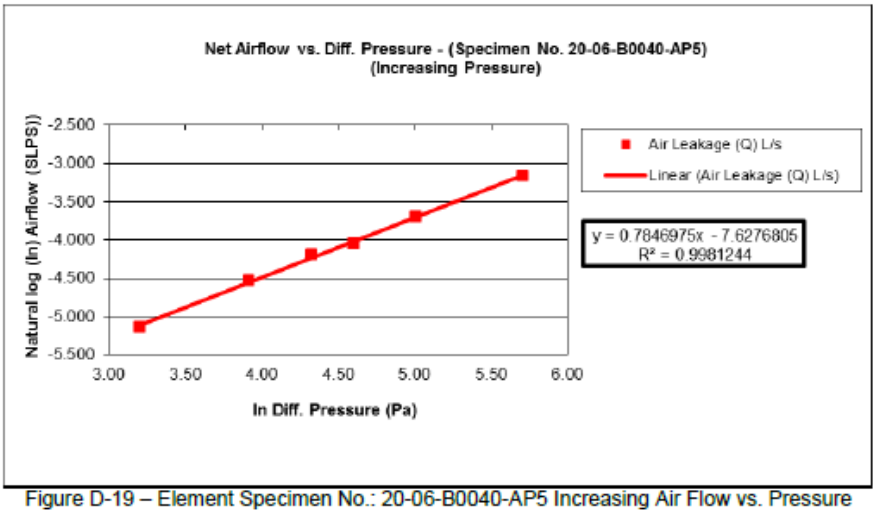


Figure D-19 – Element Specimen No.: 20-06-B0040-AP5 Increasing Air Flow vs. Pressure Direction of Air Flow: Exfiltration.

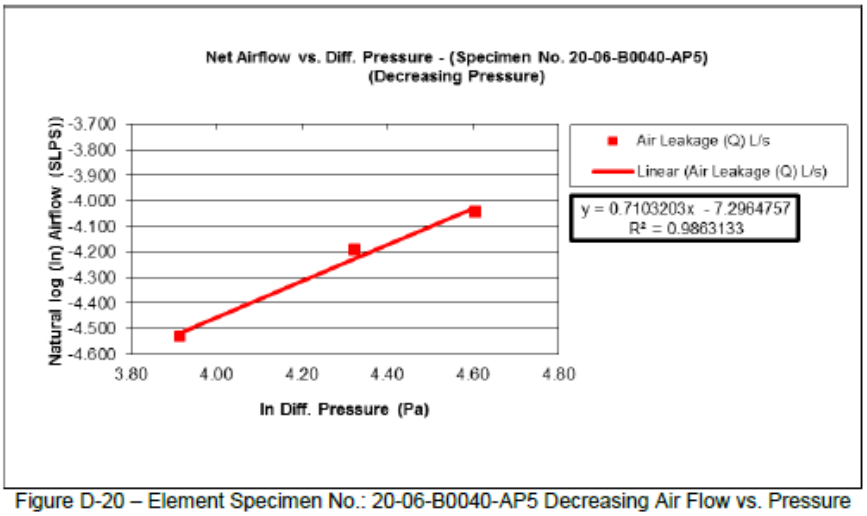


Figure D-20 – Element Specimen No.: 20-06-B0040-AP5 Decreasing Air Flow vs. Pressure Direction of Air Flow: Exfiltration.

APPENDIX E

UV Exposure Test
Element Test Report No.: 20-06-B0040-W

(16 Pages)

2395 Speakman Dr.
Mississauga, ON
Canada L5K 1B3

P: 1 905 822 4111
F: 1 905 823 1446
info.toronto.industrials@element.com
element.com

ULTRA VILOLET EXPOSURE EVALUATION OF
"BOREAL NATURE ELITE" SPRAY POLYURETHANE FOAM INSULATION
FOR GENYK

Report to:	Genyk 1701 3e Avenue Grand-Mere, Quebec G9T 2W6
Attention:	Mike Richmond
Telephone:	226-339-3089
Email:	mikerichmond@genyk.com
Report No.	20-06-B0040-W 6 Pages, 3 Appendices
Proposal No.	20-006-95292
Date:	May 15, 2020

1.0 INTRODUCTION

At the request of Genyk, Element Toronto was retained to conduct an ultra violet exposure evaluation of five (5) 1.1 m x 1.1 m spray polyurethane foam specimens identified as "Boreal Nature Elite" in accordance with CAN/ULC S741-08 Annex A2 and Standard Bulletin 2011-11 Interpretation: Clause 4.7F. Element is an ISO 17025 accredited laboratory through IAS in which the aforementioned test method is included.

Upon receipt, the exposure specimens were assigned the following Element Specimen Numbers:

Client Identification:	Element Sample Identification
Boreal Nature Elite	20-06-B0040-AP1 to AP5

2.0 PROCEDURE

Prior to exposure, the spectral irradiance within the UV test fixtures was verified utilizing a calibrated 340 nm radiometer. A total of sixteen irradiance measurements were recorded along the periphery and centre of each proposed exposure area referencing ASTM G151 Annex A1 in which the results are displayed in Appendix B of this report. The test specimens were secured, vertically, within the UV test fixture and individually equipped with a black panel Type "T" Thermometers positioned parallel to the specimen surfaces. In addition, the test chamber was equipped with a temperature/humidity sensor positioned in the geometric centre of the exposure area. The black panel thermocouples and temperature/humidity senor were subsequently connected to a data acquisition system to monitor and record instantaneous simulated surface temperature, chamber temperature, and chamber humidity at one-minute intervals respectively throughout the duration of the exposure.

3.0 SPECIFICATION

Test Method:	CAN/ULC S741-08 Annex A2 Standard Bulletin 2011-11 Interpretation: Clause 4.7F
Reference Test Method:	ASTM G154-16
Bulb Type:	UVA 340
Thermometer:	Black Body Type "T" Thermocouple (x3)
Irradiance:	See Appendix B
Cycle Duration:	12 hours
Total Exposure Duration:	336 hours (28 Cycles)
Start Date:	April 24, 2020
End Date:	May 8, 2020
Irradiance Sequence	
Black Panel Temperature:	60 ± 3°C
Cycle Duration:	8 Hours
Irradiance:	Yes
Condensation:	No
Condensation Sequence	
Black Panel Temperature:	50 ± 3°C
Cycle Duration:	4 Hours
Irradiance:	No
Condensation:	Yes

Figure No. 1 - Envrionmental Chamber General Conditioning Profile
Element Report No. 20-06-B0040-W

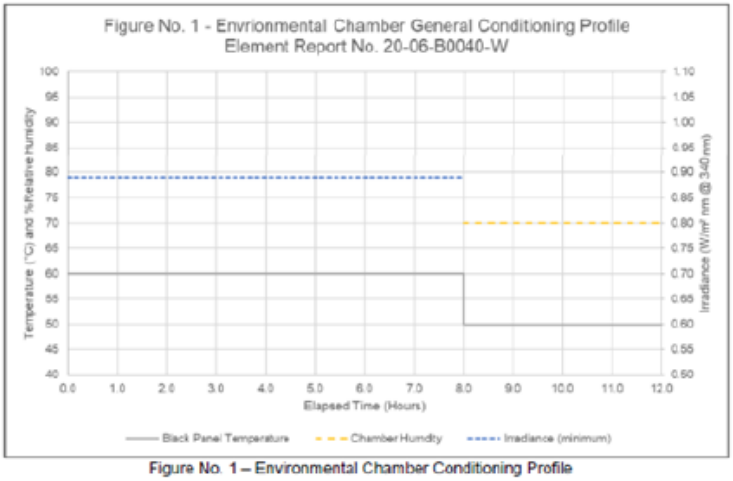


Figure No. 1 – Environmental Chamber Conditioning Profile

4.0 EQUIPMENT

Table No. 1 – Utilized Test Equipment
Element Report No: 20-06-B0040-W

Device	Element MII No.	Cal. Date	Cal. Due Date
PV Conditioning Chamber 8	B13113	N/A	N/A
Humidity/Temperature Probe	B11365	2020-03-17	2020-09-17
Data Acquisition System	B11588	2019-05-14	2020-11-14
20 Channel Multiplexer	B11579	2019-05-31	2020-11-30
Type "T" Thermocouple wire	B13980	2013-07-02	2023-07-02
340 nm Radiometer	B14456	2019-05-31	2020-05-31
Element UV Fixture 1	N/A	N/A	N/A
Element UV Fixture 2	N/A	N/A	N/A

5.0 RESULTS

The test specimens were sequentially subjected to the environmental profiles displayed in Figure No. 2.

Figure No. 2 - Chamber Conditions vs Elapsed Time
UV Aging - CAN/ULC S741-08 Annex A2
Element Report No. 20-06-B0040-W

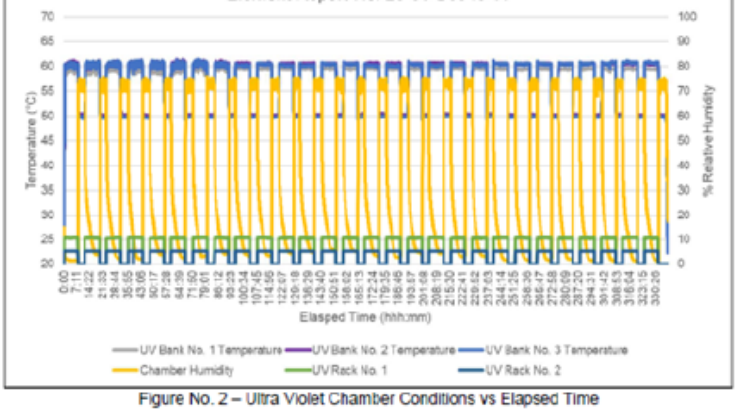


Figure No. 2 – Ultra Violet Chamber Conditions vs Elapsed Time

Table No. 2 – Post Ultra Violet Exposure Observations
Element Report No: 20-06-B0040-W

Element ID	Discolouration	Warping	Cracking	Flaking
20-06-B0040-AP1	S	M	N	N
20-06-B0040-AP2	S	M	N	N
20-06-B0040-AP3	S	M	N	N
20-06-B0040-AP4	S	M	N	N
20-06-B0040-AP5	S	M	N	N

Note: N = None, F = Faint, L = Light, M = Moderate, S = Severe

6.0 CONCLUSION

At the conclusion of the Ultra Violet exposure, the specimens were removed from conditioning and visually inspected. All specimens displayed varying degrees of moderate to severe discolouration and warpage of the exposed surfaces as summarized in Table No. 2 of this report. The specimens were, subsequently, returned to Element Building Systems for further evaluation.

7.0 REVISION HISTORY

Revision No	Date	Description of Revisions:
Original	2020-05-15	Original Document

Reported by:

Alexander Jackson, MET
Project Manager - Energy Systems
Weathering & Environmental Durability

Reviewed by:

Steven Huynh, P.Eng.
Technical Manager – Energy Systems
Product Technologies Group

Appendix A
Specimen Photographs
(5 Pages)

Figure A1 - Element Specimen 20-06-B0040-AP1 - Pre Exposure

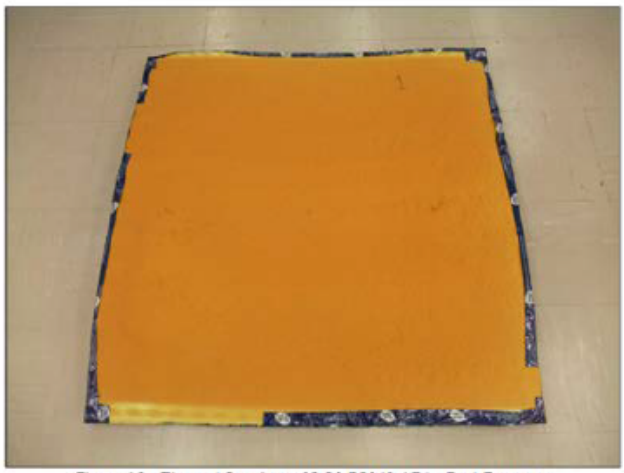


Figure A2 - Element Specimen 20-06-B0040-AP1 - Post Exposure

Figure A3 - Element Specimen 20-06-B0040-AP2 - Pre Exposure

Figure A4 - Element Specimen 20-06-B0040-AP2 - Post Exposure

Figure A5 - Element Specimen 20-06-B0040-AP3 - Pre Exposure

Figure A6 - Element Specimen 20-06-B0040-AP3 - Post Exposure

Figure A7 - Element Specimen 20-06-B0040-AP4 - Pre Exposure

Figure A8 - Element Specimen 20-06-B0040-AP4 - Post Exposure

Figure A9 - Element Specimen 20-06-B0040-AP5 - Pre Exposure

Figure A10 - Element Specimen 20-06-B0040- Post Exposure

Appendix B
Spectral Irradiance Measurements
(2 Pages)

Table A1–Spectral Irradiance Measurements ASTM G151-10 Annex A Element Specimen No. 20-06-B0040-AP1					
Spectral Irradiance (W/m² @ 340 nm)					
	A	B	C	D	*Avg.*
1	1.07	1.14	1.15	1.16	*1.13*
2	1.31	1.40	1.42	1.41	*1.39*
3	1.32	1.39	1.41	1.40	*1.38*
4	1.11	1.23	1.23	1.19	*1.19*
Avg.	*1.20*	*1.29*	*1.30*	*1.29*	

Average Irradiance = 1.27 W.m² @ 340 nm

Table A2–Spectral Irradiance Measurements ASTM G151-10 Annex A Element Specimen No. 20-06-B0040-AP2					
Spectral Irradiance (W/m² @ 340 nm)					
	A	B	C	D	*Avg.*
1	1,11	1.08	1.06	1.06	*1.07*
2	1.39	1.37	1.36	1.33	*1.36*
3	1.89	1.37	1.36	1.32	*1.49*
4	1.24	1.22	1.20	1.17	*1.21*
Avg.	*1.51*	*1.26*	*1.25*	*1.22*	

Average Irradiance = 1.29 W.m² @ 340 nm

Table A3–Spectral Irradiance Measurements ASTM G151-10 Annex A Element Specimen No. 20-06-B0040-AP3					
Spectral Irradiance (W/m² @ 340 nm)					
	A	B	C	D	*Avg.*
1	0.99	1.05	1.05	1.10	*1.05*
2	1.20	1.29	1.30	1.34	*1.28*
3	1.22	1.28	1.29	1.33	*1.28*
4	1.05	1.09	1.07	1.09	*1.08*
Avg.	*1.12*	*1.18*	*1.18*	*1.22*	

Average Irradiance = 1.17 W.m² @ 340 nm

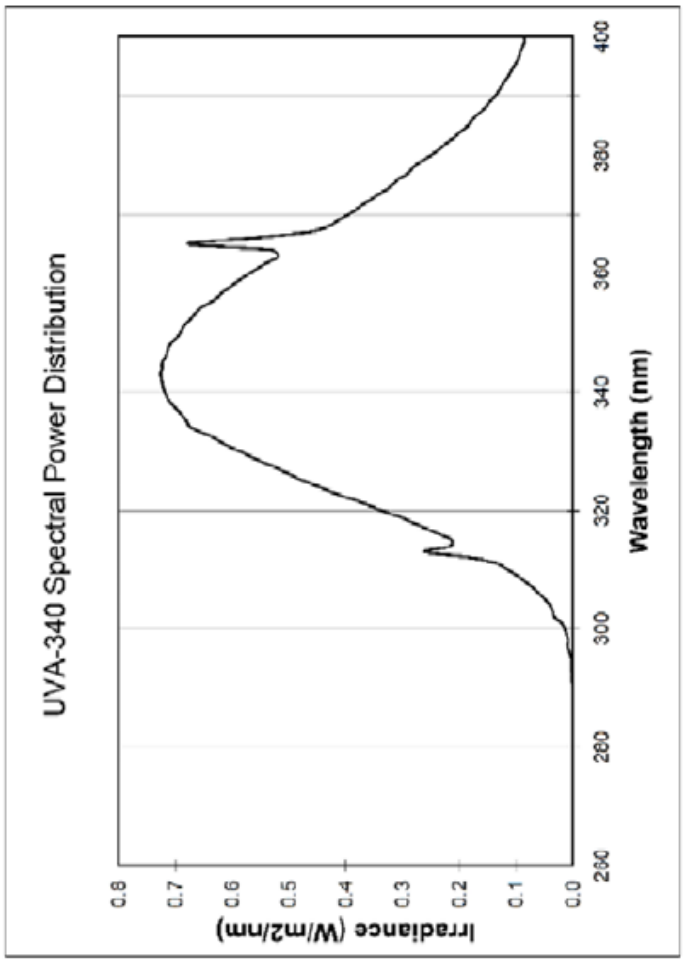
Table A4–Spectral Irradiance Measurements ASTM G151-10 Annex A Element Specimen No. 20-06-B0040-AP4					
Spectral Irradiance (W/m² @ 340 nm)					
	A	B	C	D	*Avg.*
1	1.07	1.08	1.09	1.03	***1.07***
2	1.34	1.34	1.33	1.28	***1.32***
3	1.34	1.32	1.33	1.30	***1.32***
4	1.18	1.17	1.17	1.11	***1.16***
Avg.	***1.23***	***1.23***	***1.23***	***1.18***	

Average Irradiance = 1.22 W.m² @ 340 nm

Table A5–Spectral Irradiance Measurements ASTM G151-10 Annex A Element Specimen No. 20-06-B0040-AP5					
Spectral Irradiance (W/m² @ 340 nm)					
	A	B	C	D	*Avg.*
1	1.07	1.18	1.18	1.24	***1.17***
2	1.24	1.35	1.36	1.38	***1.33***
3	1.24	1.34	1.36	1.36	***1.33***
4	1.05	1.15	1.14	1.06	***1.10***
Avg.	***1.15***	***1.26***	***1.26***	***1.26***	

Average Irradiance = 1.23 W.m² @ 340 nm

Appendix C
UVA-340 Spectral Power Distribution as Provided by the Manufacturer
(1 Page)


UVA-340 Spectral Power Distribution
Irradiance (W/m2/nm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Wavelength (nm)
280
300
320
340
360
380
400

APPENDIX F

Water Vapour Permeance Test Results
Test Report No.: 20-06-B0040-M-WVP

(4 Pages)

2395 Speakman Dr.
Mississauga, ON
Canada L5K 1B3

P: 1 905 822 4111
F: 1 905 823 1446
info.toronto.industrials@element.com
element.com

EVALUATION OF 'BOREAL NATURE ELITE' SPRAY FOAM MATERIAL FOR WATER VAPOR PERMEANCE IN ACCORDANCE WITH ASTM E96/E96M-16

Report to:	**Genyk** 1701 3e Avenue Grand-Mere, QC G9T 2W6
Attention:	Mike Richmond
Telephone:	+1 (226) 339-3089
Email:	mikerichmond@genyk.com
Report No.:	20-06-B0040-M-WVP 4 Pages
Proposal No.:	20-006-95292
Original Date:	September 4, 2020

1.0 INTRODUCTION

At the request of *Genyk*, Element Materials Technology was retained to evaluate a sample of spray foam material for water vapor permeance properties in accordance with CAN/ULC S741-08, as outlined in Element Proposal No.: 20-006-95292.

The material used for testing was sample selected by an Element technical representative and was applied at the Element Toronto facility. This small-scale testing was conducted as part of a larger testing protocol conducted by Element Materials Technology – Building Systems department.

Upon receipt, the sample was assigned the following Element Sample No.:

Client Sample Identification	Element Sample No.
Boreal Nature Elite	20-06-B0040-M-WVP

2.0 PROCEDURE

The sample was evaluated using the following test method:

Test Description	Test Method
"Standard For Air Barrier Materials" referencing "Standard Test Methods for Water Vapor Transmission of Materials"	CAN/ULC-S741-8, ref.ASTME96/E96M-16, Procedure A (Desiccant)

Procedure:	Method A (Desiccant)	
No. of Specimens:	Three (3) for 'Exfiltration' direction Three (3) for 'Infiltration' direction	
Sealant:	Type 1 GE Silicone (100% silicone) 60% microcrystalline wax; 40% refined crystalline paraffin wax	
Equipment:	Digital Calipers, Digital Balance (0.01g), Barometer, Environmental Controller,	MII# B10643 MII# B17286 MII# B14977 MII# B14944
Conditioning:	>88 hours at 23 ± 2°C, 50 ± 5% RH	
Test Area:	0.0177 m^2	
Container Design:	150 mm. Stainless Steel Round Tray	
Thickness:	57.37 mm *(average of 7 measurements)* - Exfiltration 58.27 mm *(average of 7 measurements)* - Infiltration	
Test Conditions:	23 ± 2°C, 50 ± 5% RH	
Test Dates:	2020-08-19 to 2020-08-31	

3.0 RESULTS

A summary of the water vapor permeance test results is presented in Table 1 and Figure 1 for 'Exfiltration' direction and Table 2 and Figure 2 for 'Infiltration' direction. SI units are the primary unit of measure.

Table 1 – Water Vapor Permeance Test Results
Applicable Standard: ASTM E96/E96M-16
Element Sample No.: 20-06-B0040-M-WVP-Exfil

Specimen Number	Mass, g			Water Vapor Permeance	
	Initial	Final	Change	ng/Pa·s·m²	US Perms
1	1189.670	1190.910	1.240	54.642	0.955
2	1176.960	1178.270	1.310	56.087	0.981
3	1189.210	1190.370	1.160	49.987	0.874
Average	**1185.280**	**1186.517**	**1.237**	**53.6**	**0.94**

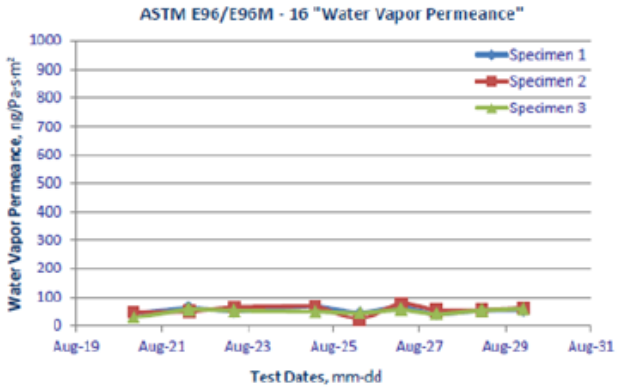


Figure 1: Elapsed time vs Water Vapor Permeance for *Element Sample No.: 20-06-B00040-M-WVP-Exfil.*

Table 2 – Water Vapor Permeance – Infiltration
Applicable Standard: ASTM E96/E96M-16
Element Sample No.: 20-06-B0040-M-WVP-Infil

Specimen Number	Mass, g			Water Vapor Permeance	
	Initial	Final	Change	ng/Pa·s·m²	US Perms
1	1201.450	1202.610	1.160	51.075	0.893
2	1197.160	1198.470	1.310	57.363	1.003
3	1213.400	1214.810	1.410	60.405	1.056
Average	**1204.003**	**1205.297**	**1.293**	**56.28**	**0.98**

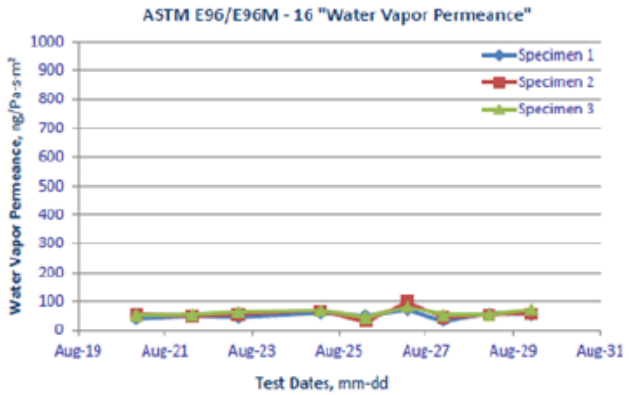


Figure 2: Elapsed time vs Water Vapor Permeance for *Element Sample No.: 20-06-B00040-M-WVP-infil.*

4.0 CONCLUSION

The material submitted by *Genyk*, identified as "Boreal Nature Elite", was tested as described in this report. The material had a measured water vapor permeance of 53.6 ng/Pa•s•m² [0.94 US perms] when tested in the 'Exfiltration' direction. While the material had a measured water vapor permeance of 56.28 ng/Pa•s•m² [0.98 US perms] when tested in the 'Infiltration' direction.

5.0 REVISION HISTORY

Date:	Revision:	Comments:
2020-09-04	Original Document	N/A

Reported by:

Fadi G. Basmaji, M.A.Sc., B.Eng., Ext. 11227
Building Products Specialist
Products Testing Group

Reviewed by:

Rubaiyat Khondker, P. Eng., M.A.Sc., Ext. 11662
Supervisor, Building Products
Products Testing Group

APPENDIX F

Surface Burning Characteristic – CAN/ULC-S102 - Detailed Test Procedure and Results.

Element Report No.: 20-002-197

(6 Pages)

element

2395 Speakman Dr.
Mississauga, ON
Canada L5K 1B3

P: 1 905 822 4111
F: 1 905 823 1446
info.toronto.fire@element.com
element.com

CAN/ULC-S102 Surface Burning Characteristics of "Boreal Nature Elite"

A Report To:	**Genyk** 1701, 3e Avenue Grand-Mère, QC Canada G9T 2W6
Phone:	+1 819-729-0395
Attention: E-mail:	Mike Richmond mikerichmond@genyk.com
Submitted by:	Element Fire Testing
Report No.	20-002-197 6 Pages
Date:	April 27, 2020

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Test Report No.: 20-002-197
CAN/ULC-S102 Testing of "Boreal Nature Elite"
For: Genyk

ACCREDITATION To ISO/IEC 17025 for a defined Scope of Testing by the International Accreditation Service

SPECIFICATIONS OF ORDER

Determine Flame Spread Rating and Smoke Developed Classification based upon triplicate testing conducted in accordance with CAN/ULC-S102-2018 (as referenced in CAN/ULC-S705.1-15 Rev1), as per Element Building Science Project No. 20-06-B0040, Element Work Order No. 543502 and Proposal No. 20-006-95292.

SAMPLE IDENTIFICATION (Element sample identification number 20-06-B0040)

Spray Foam Insulation material, applied to a gypsum board substrate, identified as:
"Boreal Nature Elite"

TEST PROCEDURE

The method, designated as CAN/ULC-S102-2018, "*Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies*", is designed to determine the relative surface burning characteristics of materials under specific test conditions. Results of less than three identical specimens are expressed in terms of Flame Spread Value (FSV) and Smoke Developed Value (SDV). Results of three or more replicate tests on identical samples produce average values expressed as Flame Spread Rating (FSR) and Smoke Developed Classification (SDC).

Although the procedure is applicable to materials, products and assemblies used in building construction for development of comparative surface spread of flame data, the test results may not reflect the relative surface burning characteristics of tested materials under all building fire conditions.

SAMPLE PREPARATION

The spray foam material was applied to a gypsum board substrate. Each test specimen consisted of a total of three prepared sections of material, each approximately 50 mm in thickness by 559 mm in width by 2438 mm in length. The sections were butted together to create the total specimen length. Prior to testing, the specimens were conditioned to constant mass at a temperature of 23 ± 3°C and a relative humidity of 50 ± 5%. During testing, each specimen was self-supporting.

Testing was performed on: Test #1: 2020-04-23 Test #2: 2020-04-23 Test #3: 2020-04-23

SUMMARY OF TEST PROCEDURE

The tunnel is preheated to 85°C, as measured by the backwall-embedded thermocouple located 7090 mm downstream of the burner ports, and allowed to cool to 40°C, as measured by the backwall-embedded thermocouple located 4000 mm from the burners. At this time the tunnel lid is raised and the test sample is placed along the ledges of the tunnel so as to form a continuous ceiling 7315 mm long, 305 mm above the floor. The lid is then lowered into place.

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SUMMARY OF TEST PROCEDURE (continued)

Upon ignition of the gas burners, the flame spread distance is observed and recorded every second. Flame spread distance versus time is plotted. Calculations ignore all flame front recessions and the Flame Spread Values (FSV) are determined by calculating the total area under the curve for each test sample. If the total area under the curve (AT) is less than or equal to 29.7 m·min, FSV = 1.85·AT; if greater, FSV = 1640/(59.4-AT).

The Smoke Developed Value is determined by comparing the area under the obscuration curve for the test sample to that of inorganic reinforced cement board and red oak, established as 0 and 100, respectively. The Smoke Developed Value (SDV) is determined by dividing the total area under the obscuration curve by that of red oak and multiplying by 100.

TEST RESULTS **SAMPLE: "Boreal Nature Elite"**

Test	Approx. Time to Ignition (s)	Maximum Flame Front Distance (m)	Time to Maximum Flame Front (s)	Maximum Air Temperature (°C)	Flame Spread Value (FSV)	Smoke Developed Value (SDV)	"Corrected" Flame Spread Value (FSV-92.5 d/t))
1	4	2.75	127	321	**46**	**408**	**120**
2	4	4.74	90	254	**104**	**587**	**292**
3	4	5.94	482	393	69	655	68
				Average:	73	550	160
				Rounded Average Flame Spread Rating (**FSR**):	**75**	-	**160**
				Rounded Average Smoke Developed Classification (**SDC**):	-	**550**	-

Observations of Burning Characteristics

The specimens ignited approximately 4 seconds after exposure to the test flame. Falling char was observed at approximately 100 seconds into the test.

Results Interpretation

CAN/ULC-S102 contains no performance criteria of its own. The National Building Code of Canada (NBCC) or other jurisdictional documentation should be referenced to determine the FSR and/or SDC performance criteria that is applicable to the material, for the intended application. CAN/ULC-S102, section 9.2.5 states that materials with low thermal inertia (like foamed plastics) could exhibit anomalous behavior such that an early flame front advance occurs, and then slows down or fails to advance further. CAN/ULC-S102 then requires the use of a "Corrected" FSV equation. Other conditions may also require additional testing, using CAN/ULC-S127 *Standard Corner Wall Method of Test for Flammability Characteristics of Non-Melting Foam Plastic Building Materials*, in order to verify the FSR. The highest FSR would apply. In this case, FSR = 160 unless CAN/ULC-S127 produces a higher value.

Francis Williams,
Technician.

Ian Smith,
Technical Manager.

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Test 1 of 3 **Sample: "Boreal Nature Elite"**

Chart 1. FLAME SPREAD (Specimen #1)

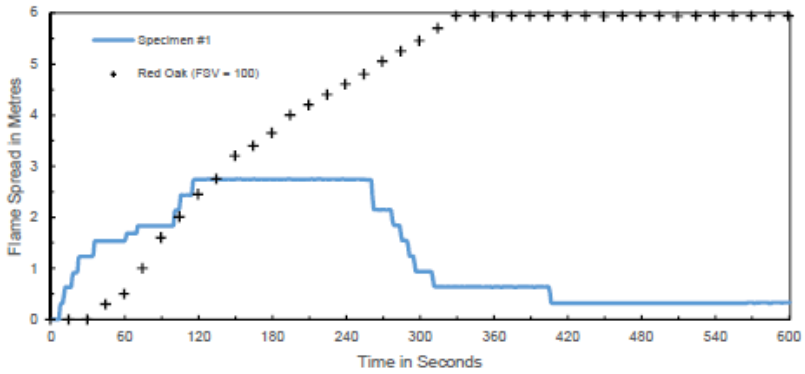


Chart 2. SMOKE DEVELOPED (Specimen #1)

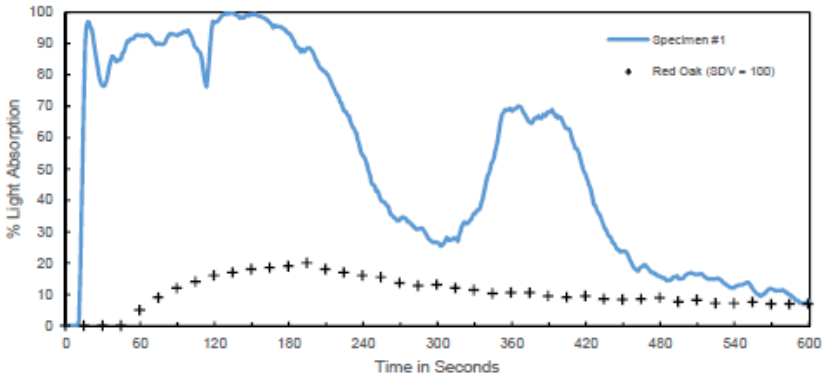
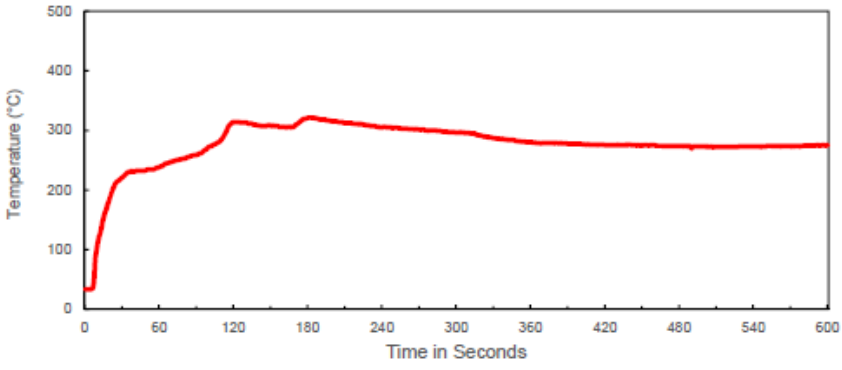


Chart 3. TEMPERATURE (Specimen #1)



Flame Spread Value (FSV)	Smoke Developed Value (SDV)	Maximum Air Temperature (°C)
46	**408**	321

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Test 2 of 3 **Sample: "Boreal Nature Elite"**

Chart 4. FLAME SPREAD (Specimen #2)

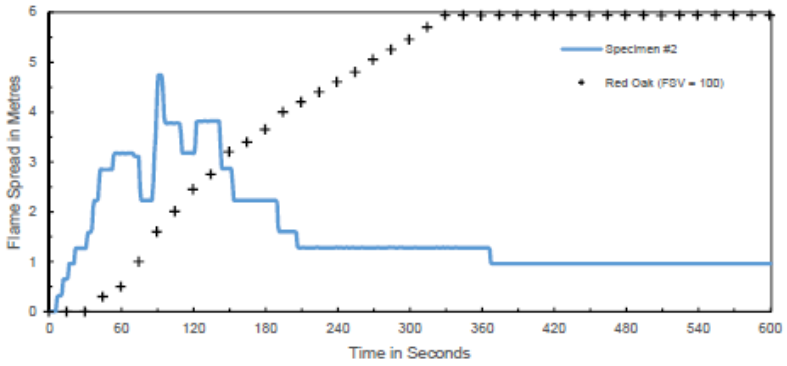


Chart 5. SMOKE DEVELOPED (Specimen #2)

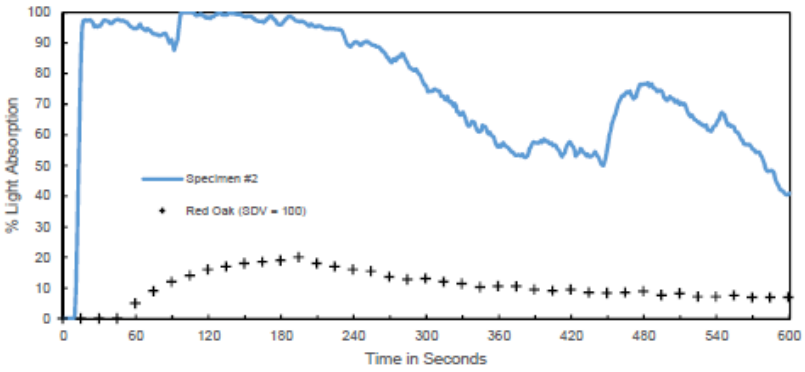
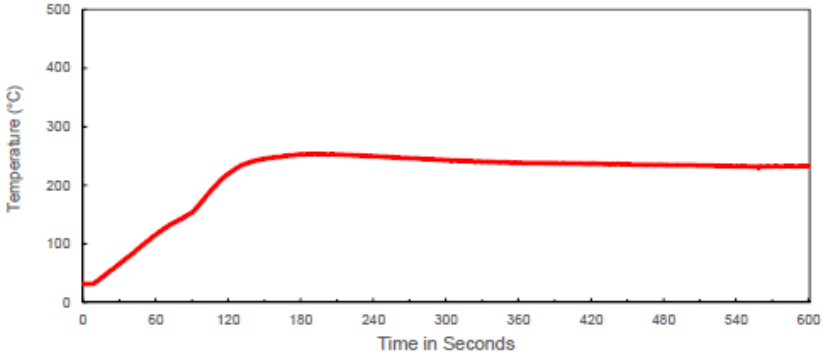


Chart 6. TEMPERATURE (Specimen #2)



Flame Spread Value (FSV)	Smoke Developed Value (SDV)	Maximum Air Temperature (°C)
104	**587**	254

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Test 3 of 3 **Sample: "Boreal Nature Elite"**

Chart 7. FLAME SPREAD (Specimen #3)

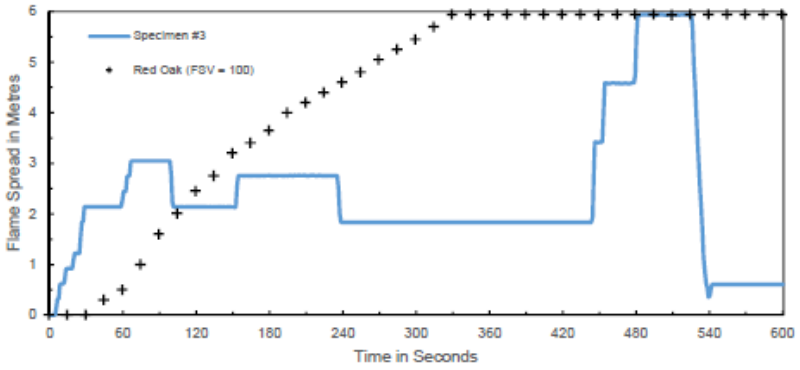


Chart 8. SMOKE DEVELOPED (Specimen #3)

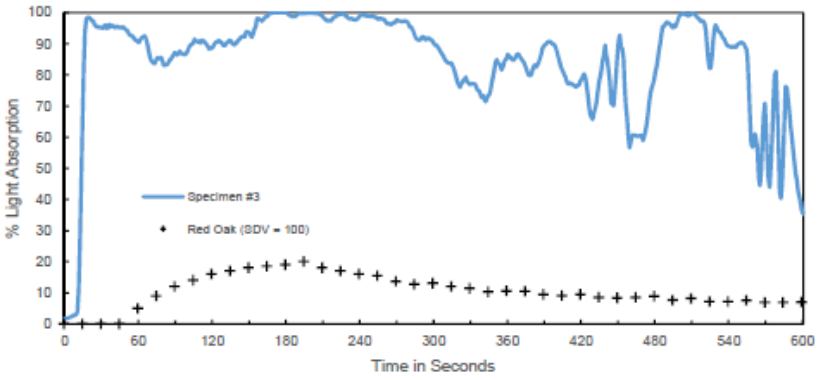
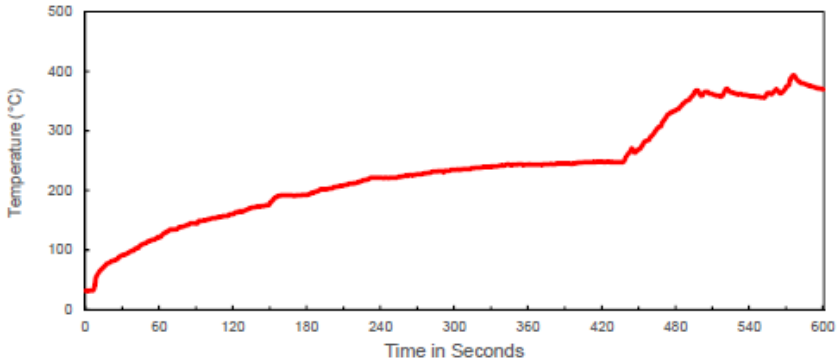


Chart 9. TEMPERATURE (Specimen #3)



Flame Spread Value (FSV)	Smoke Developed Value (SDV)	Maximum Air Temperature (°C)
69	655	393