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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

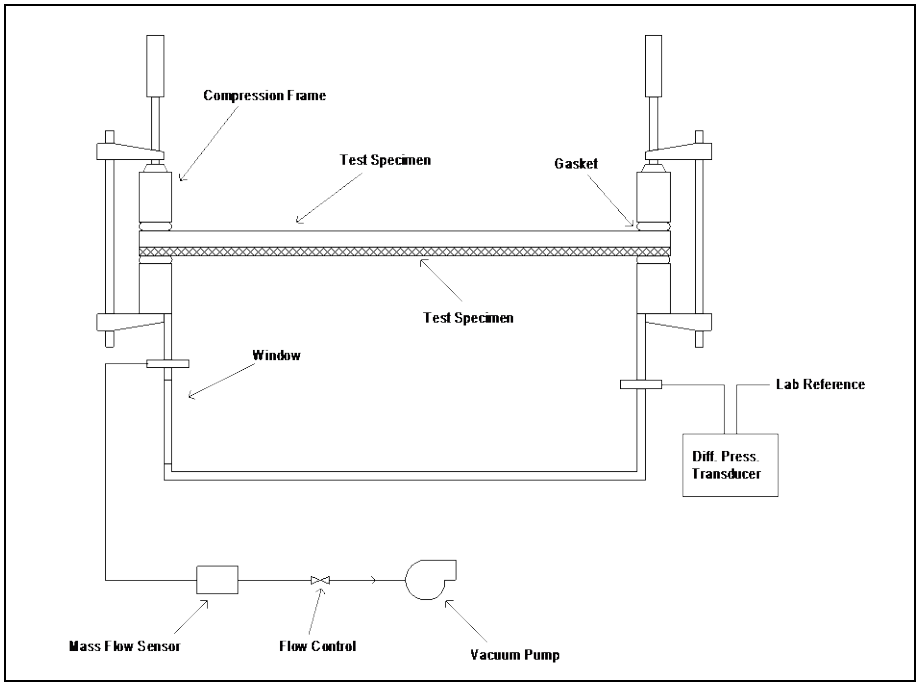

Figure 1 – Test Setup (ASTM E2178-13)

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·m^2)**	**(L/s·m^2)**	**(L/s·m^2)**	**(L/s·m^2)**		
25	0.0010	0.0038	0.0014	0.0042	**Unconditioned (Prior to UV & Heat Exposure):** < 0.02 L/s·m^2 @ 75 Pa **Conditioned (Post UV & Heat Exposure):** Specimen shall not increase by more than 0.001 (L/s·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;

<u>As per CAN/ULC S741-08:</u>

"*Where the air leakage characteristic determined for unconditioned specimens is less than 0.01 L/(s·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·m^2) at 75 Pa pressure difference.*"

3.0 RESULTS (continued)

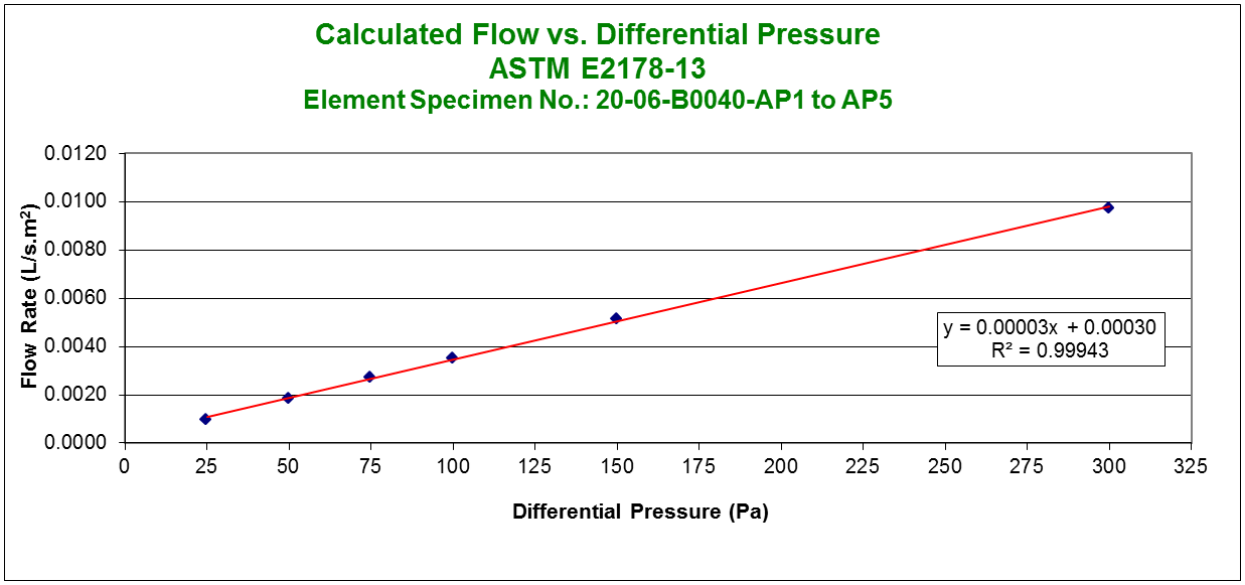

Figure 2 - Average Calculated Flow vs. Differential Pressure for Infiltration, Prior to UV Exposure Prior to UV + Heat Exposure

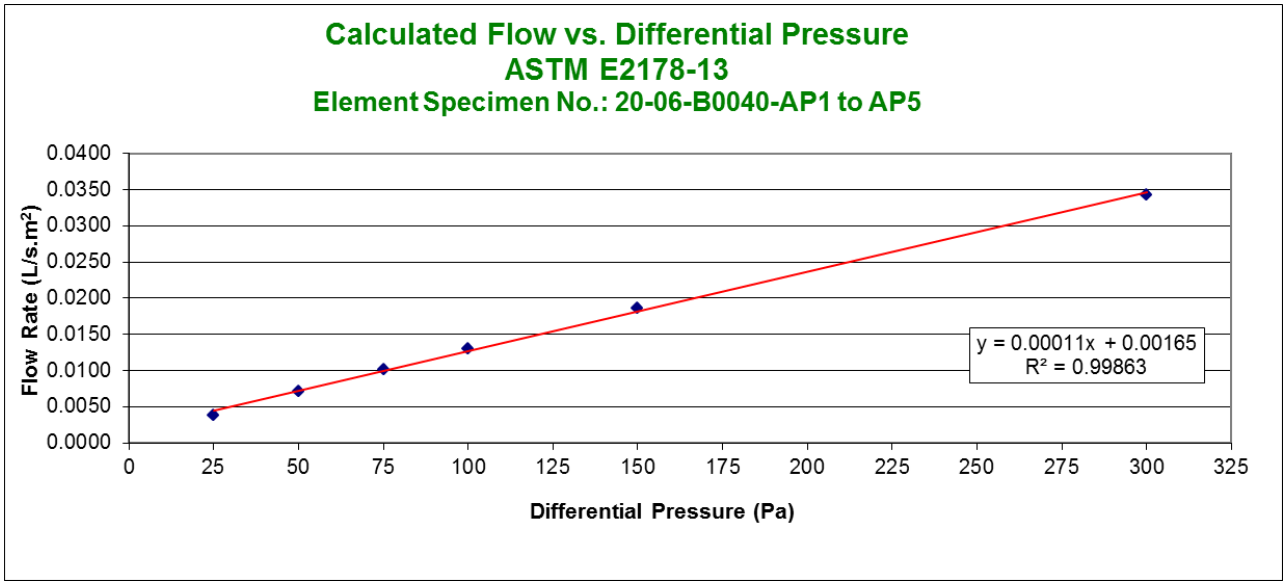

Figure 3 - Average Calculated Flow vs. Differential Pressure for Exfiltration, Prior to UV Exposure Prior to UV + Heat Exposure

3.0 RESULTS (continued)

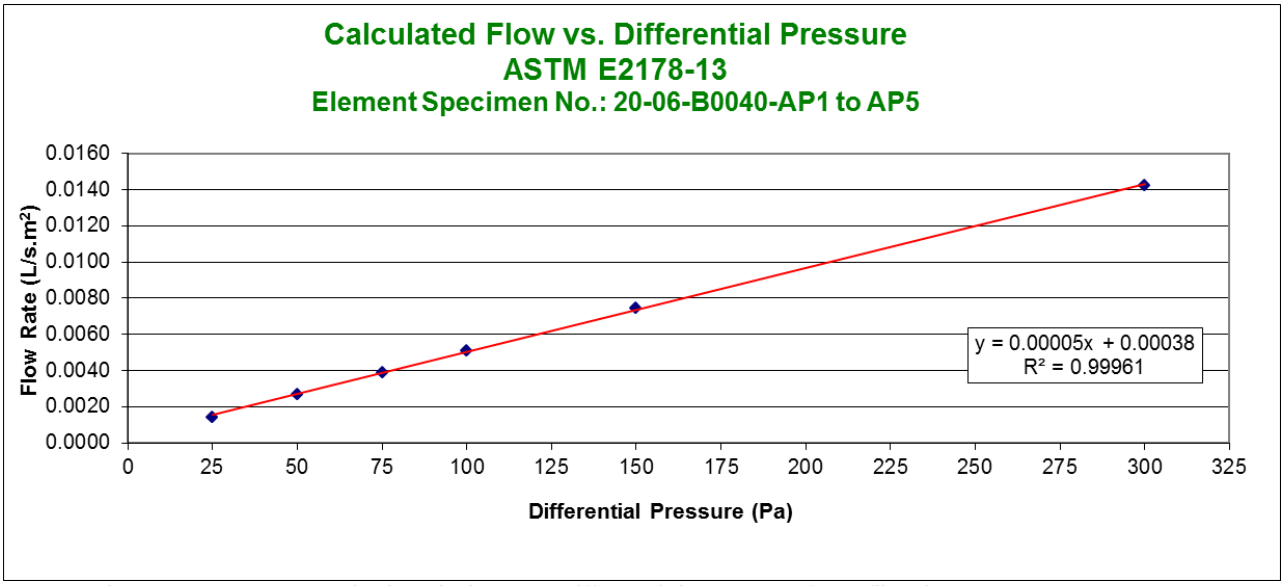

Figure 4 - Average Calculated Flow vs. Differential Pressure for Infiltration, Post UV Exposure Post UV + Heat Exposure

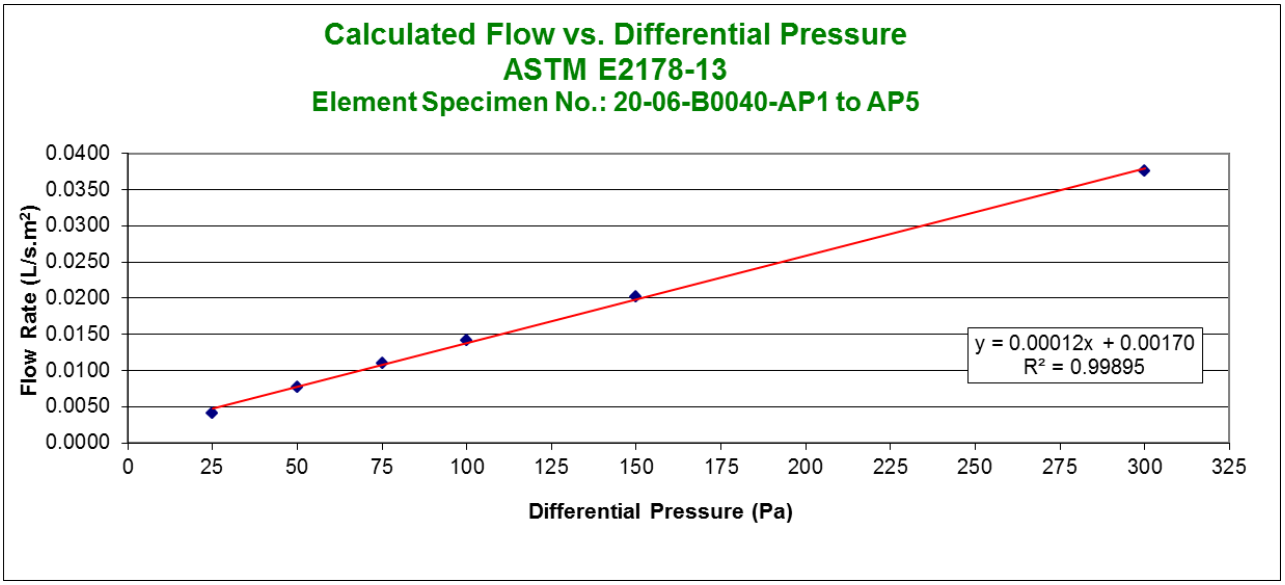

Figure 5 - Average Calculated Flow vs. Differential Pressure for Exfiltration, Post UV Exposure Post UV + Heat Exposure

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)

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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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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	**($L/s \cdot m^2$)**	**($L/s \cdot m^2$)**	**($L/s \cdot m^2$)**	**($L/s \cdot m^2$)**
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	**($L/s \cdot m^2$)**	**($L/s \cdot m^2$)**	**($L/s \cdot m^2$)**	**($L/s \cdot m^2$)**
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·m^2)**	**(L/s·m^2)**	**(L/s·m^2)**	**(L/s·m^2)**
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·m^2)**	**(L/s·m^2)**	**(L/s·m^2)**	**(L/s·m^2)**
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·m^2)**	**(L/s·m^2)**	**(L/s·m^2)**	**(L/s·m^2)**
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)

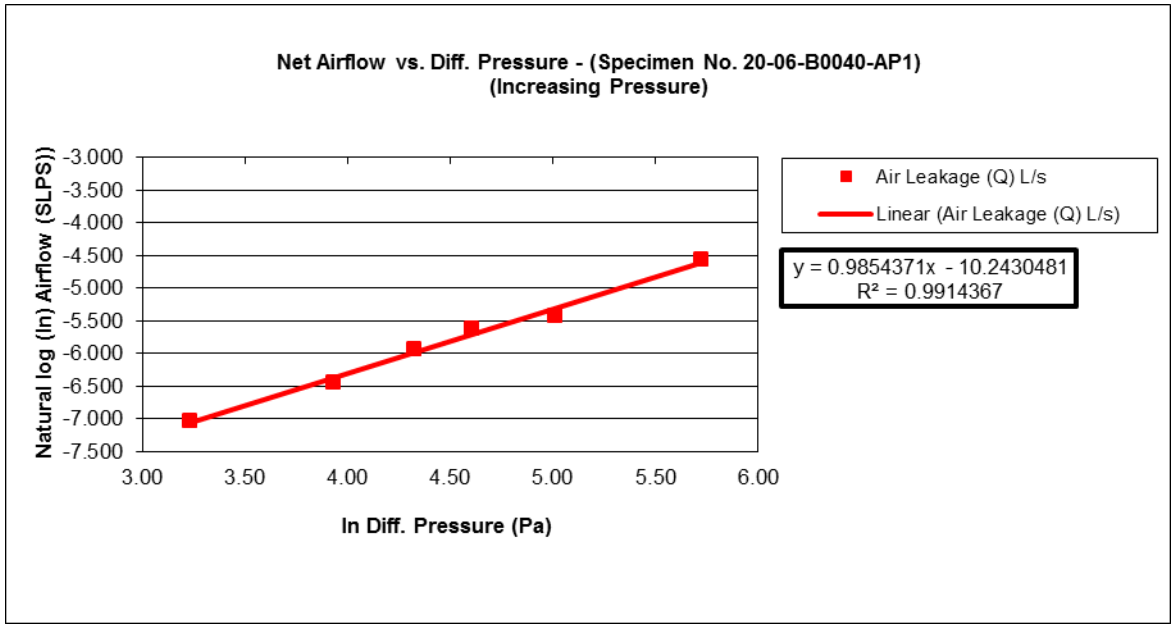

Figure C-1 – Element Specimen No.: 20-06-B0040-AP1 Increasing Air Flow vs. Pressure
Direction of Air Flow: Infiltration

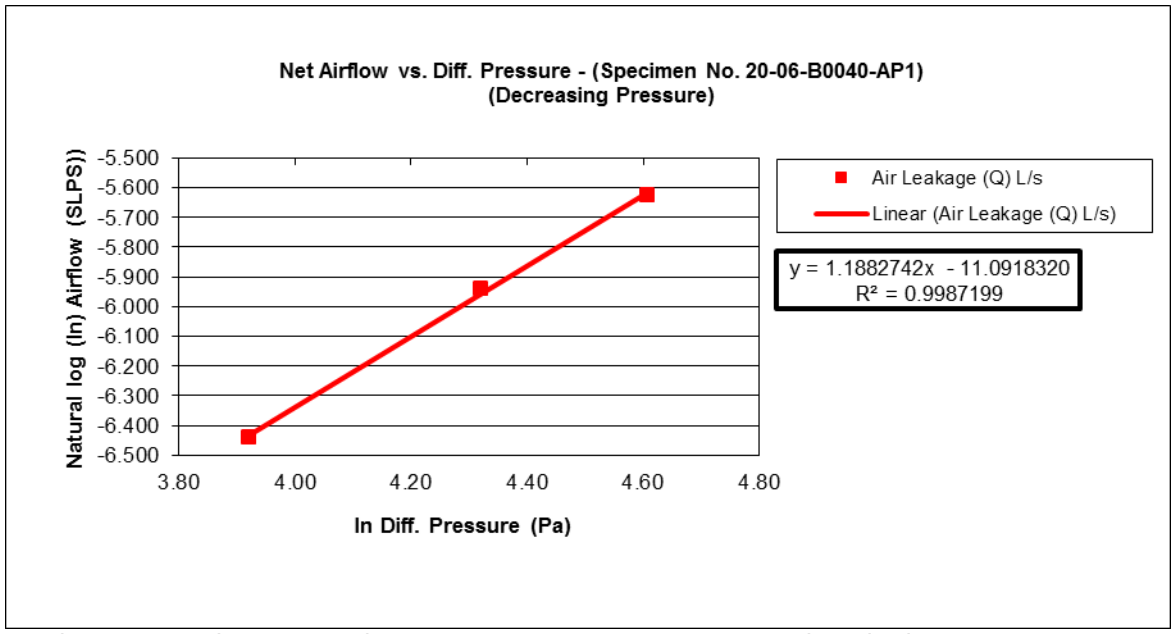

Figure C-2 – Element Specimen No.: 20-06-B0040-AP1 Decreasing Air Flow vs. Pressure
Direction of Air Flow: Infiltration.

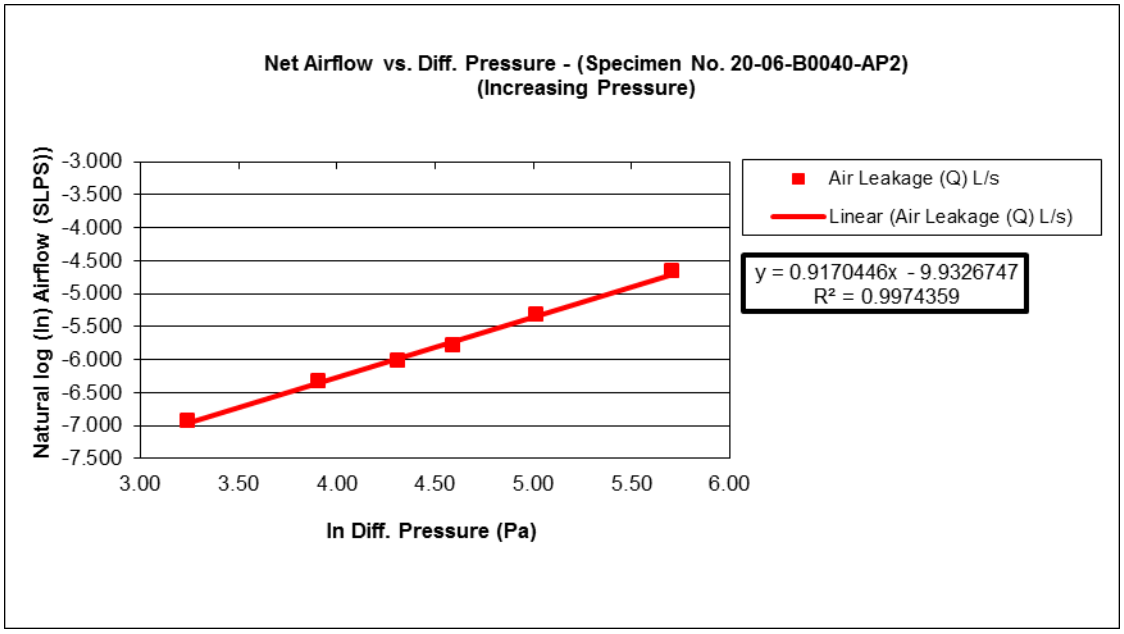

Figure C-3 – Element Specimen No.: 20-06-B0040-AP2 Increasing Air Flow vs. Pressure Direction of Air Flow: Infiltration

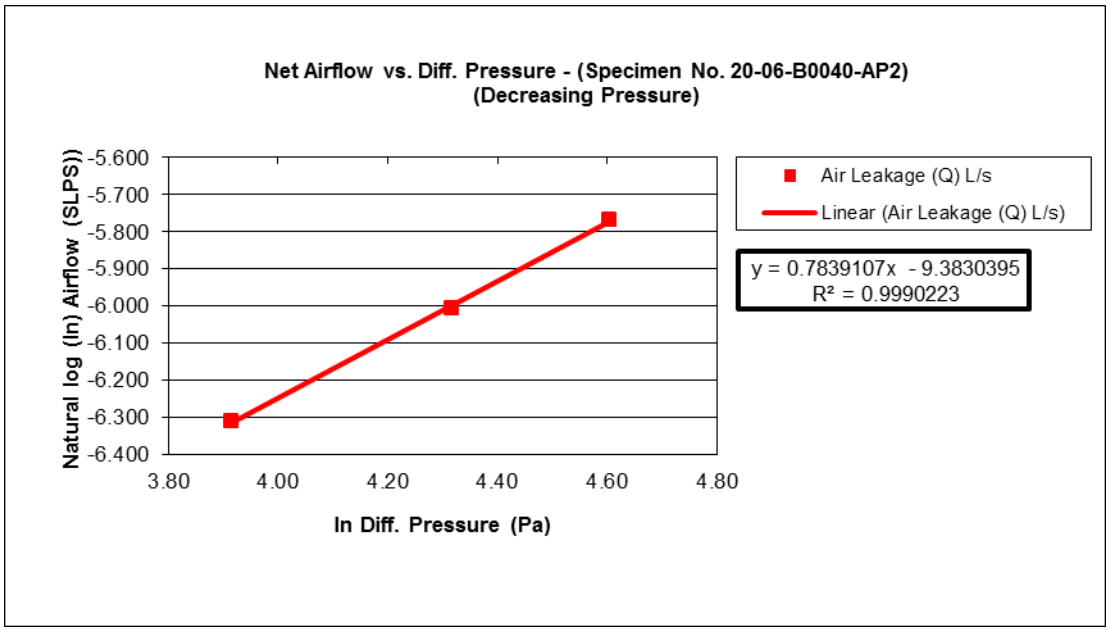

Figure C-4 – Element Specimen No.: 20-06-B0040-AP2 Decreasing Air Flow vs. Pressure Direction of Air Flow: Infiltration.

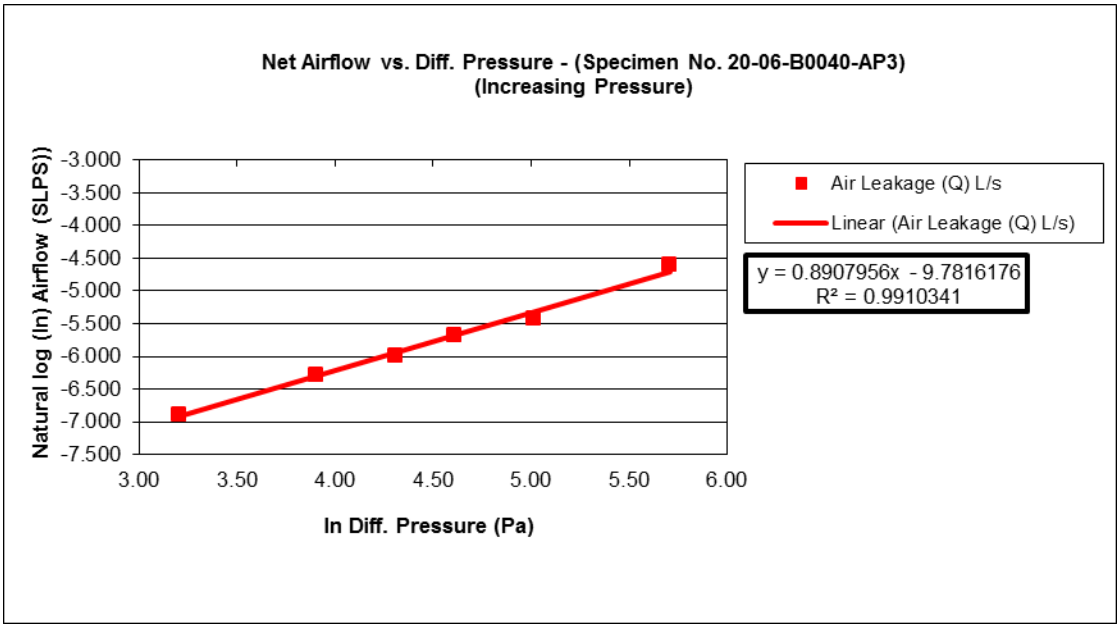

Figure C-5 – Element Specimen No.: 20-06-B0040-AP3 Increasing Air Flow vs. Pressure Direction of Air Flow: Infiltration

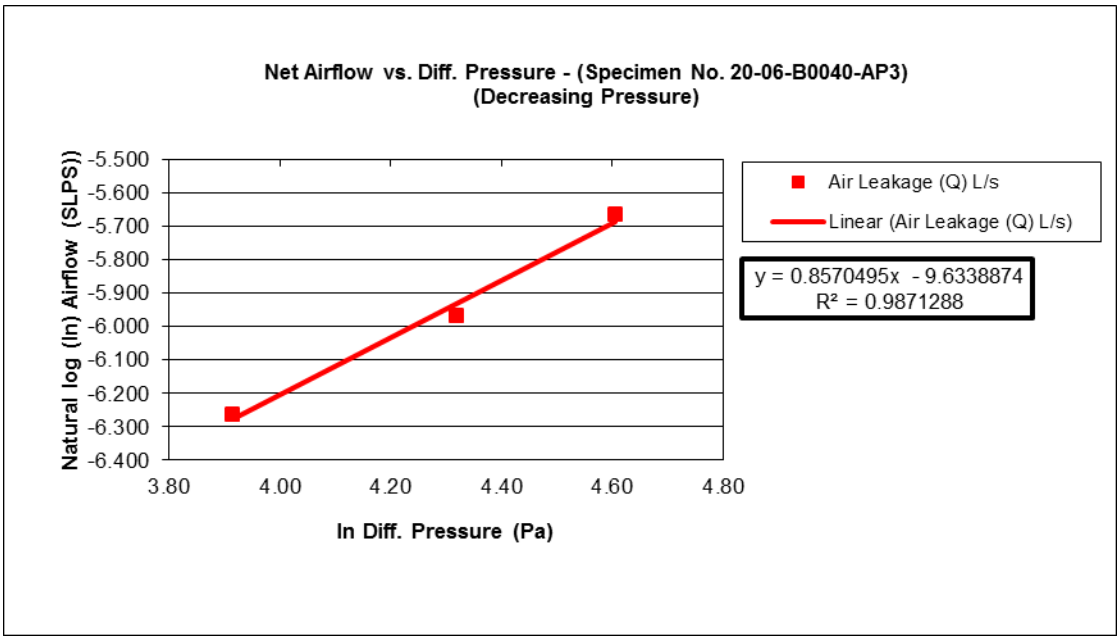

Figure C-6 – Element Specimen No.: 20-06-B0040-AP3 Decreasing Air Flow vs. Pressure Direction of Air Flow: Infiltration.

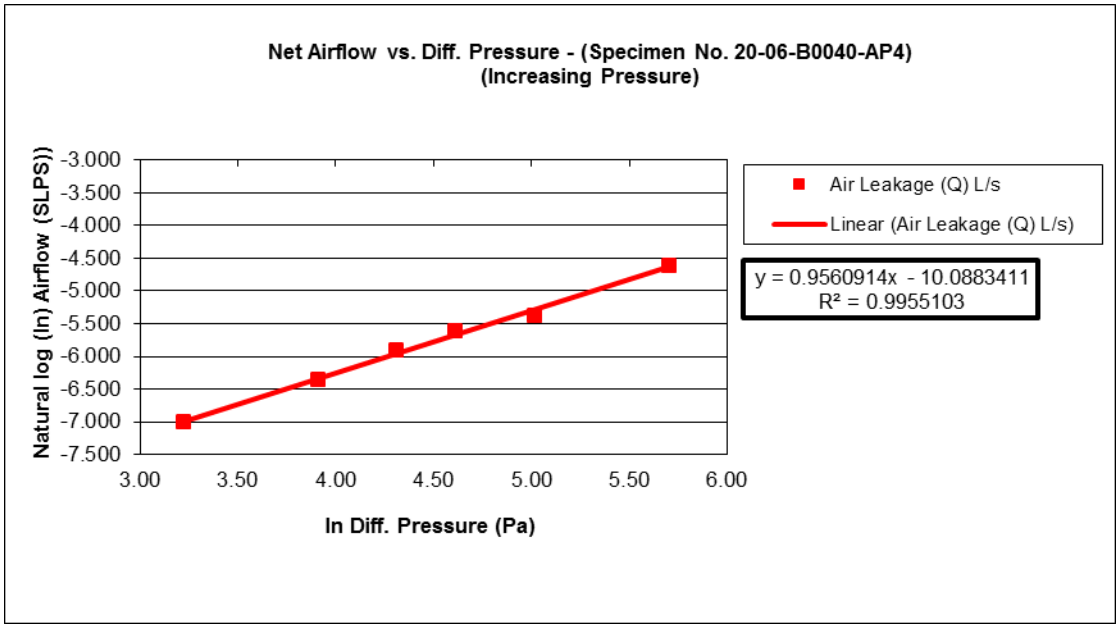

Figure C-7 – Element Specimen No.: 20-06-B0040-AP4 Increasing Air Flow vs. Pressure Direction of Air Flow: Infiltration

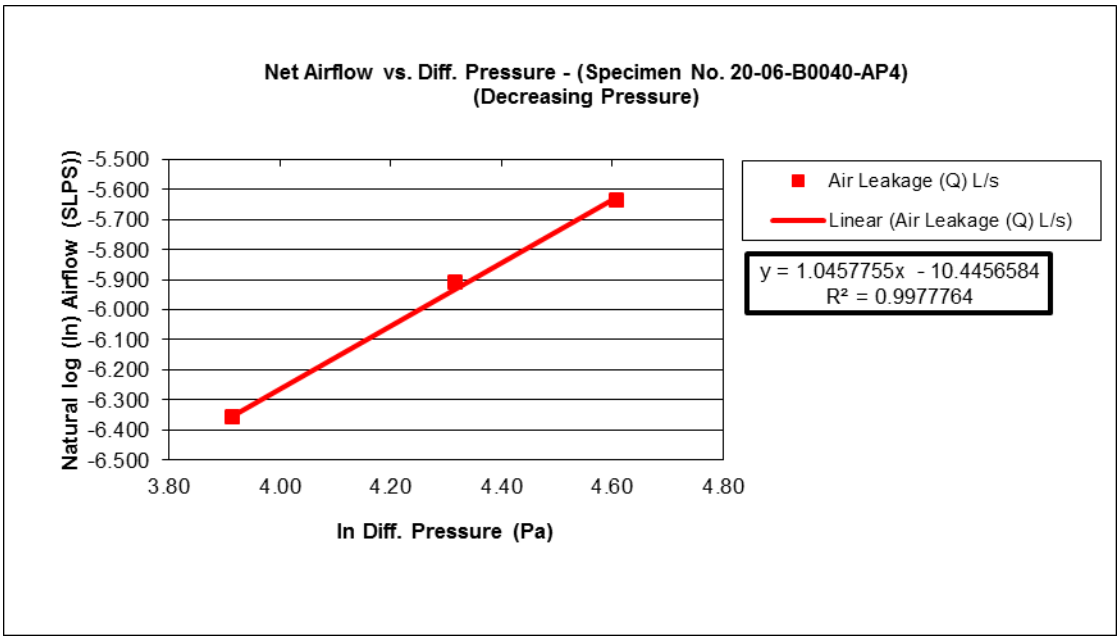

Figure C-8 – Element Specimen No.: 20-06-B0040-AP4 Decreasing Air Flow vs. Pressure Direction of Air Flow: Infiltration.

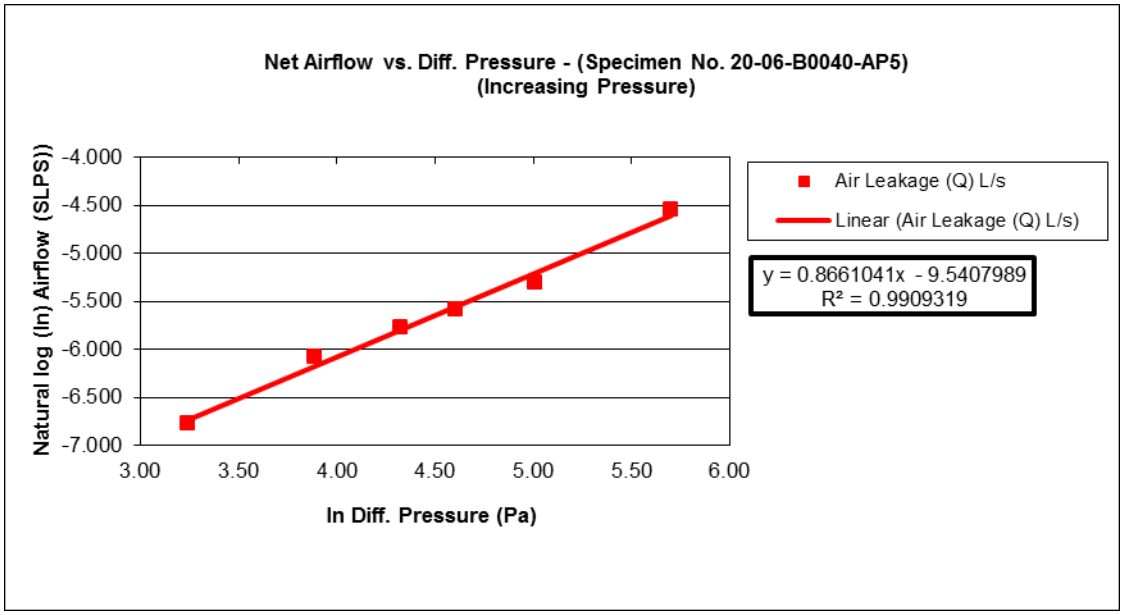

Figure C-9 – Element Specimen No.: 20-06-B0040-AP5 Increasing Air Flow vs. Pressure Direction of Air Flow: Infiltration

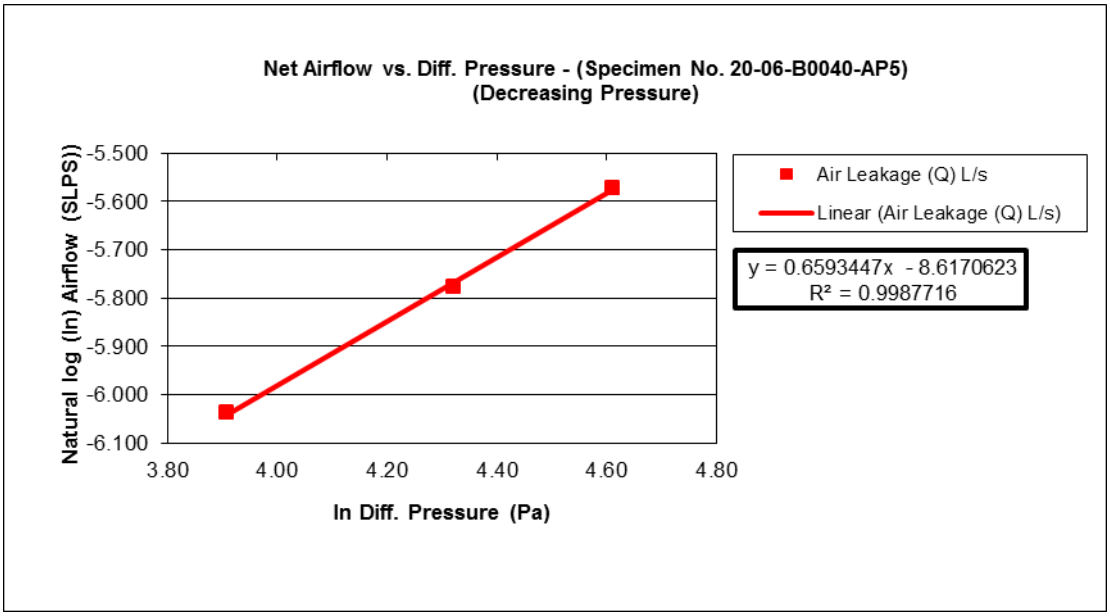

Figure C-10 – Element Specimen No.: 20-06-B0040-AP5 Decreasing Air Flow vs. Pressure Direction of Air Flow: Infiltration.

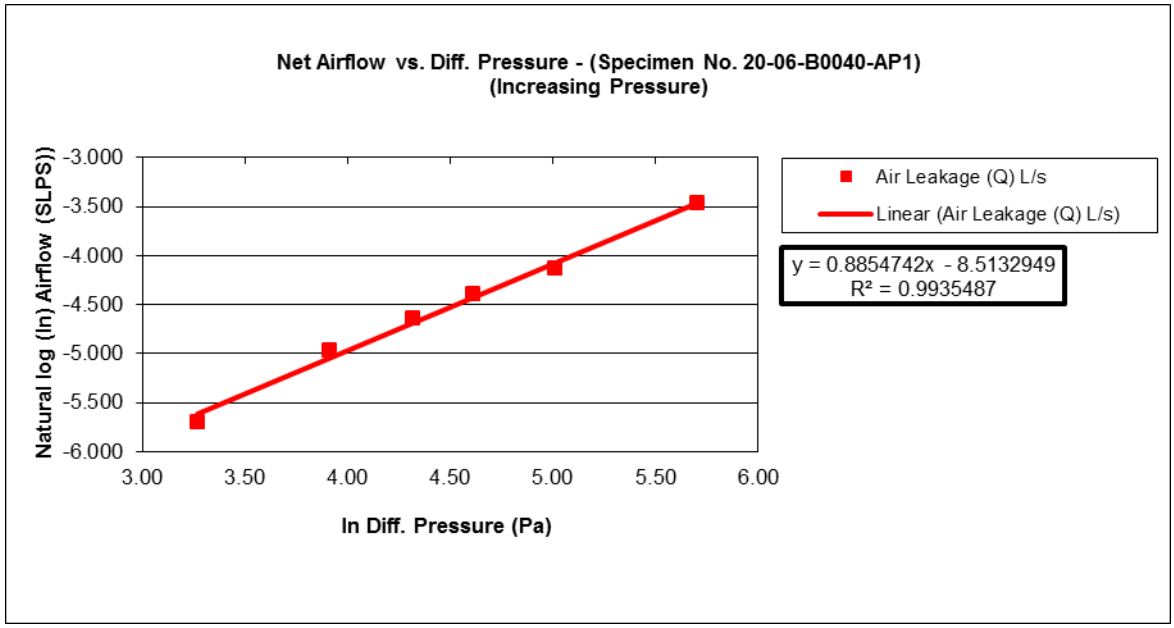

Figure C-11 – Element Specimen No.: 20-06-B0040-AP1 Increasing Air Flow vs. Pressure Direction of Air Flow: Exfiltration.

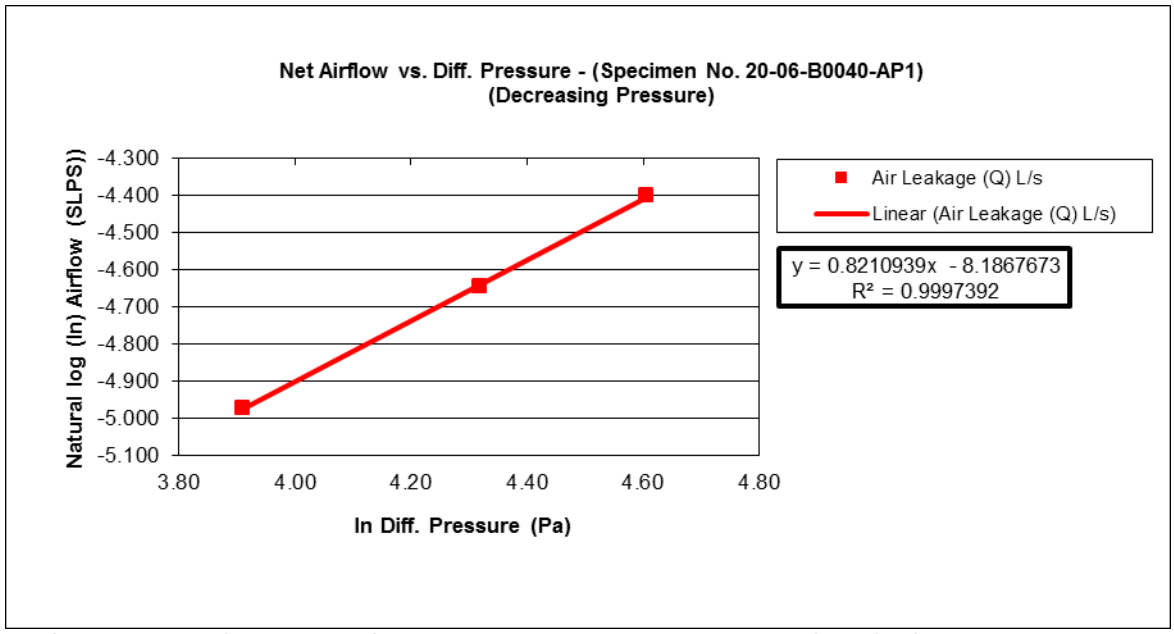

Figure C-12 – Element Specimen No.: 20-06-B0040-AP1 Decreasing Air Flow vs. Pressure Direction of Air Flow: Exfiltration.

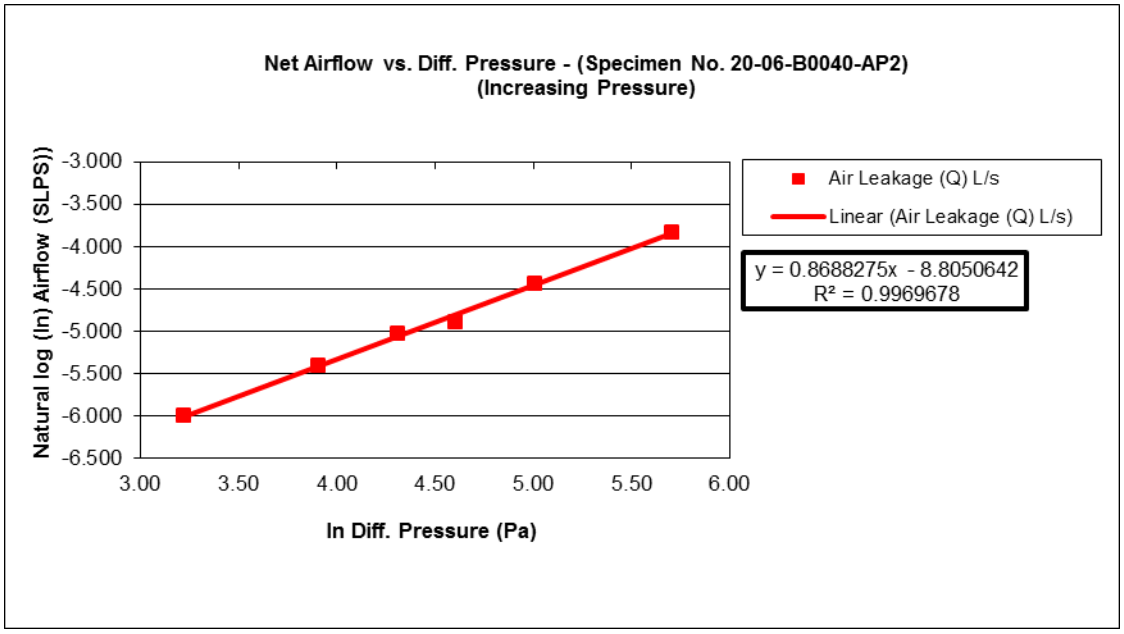

Figure C-13 – Element Specimen No.: 20-06-B0040-AP2 Increasing Air Flow vs. Pressure Direction of Air Flow: Exfiltration.

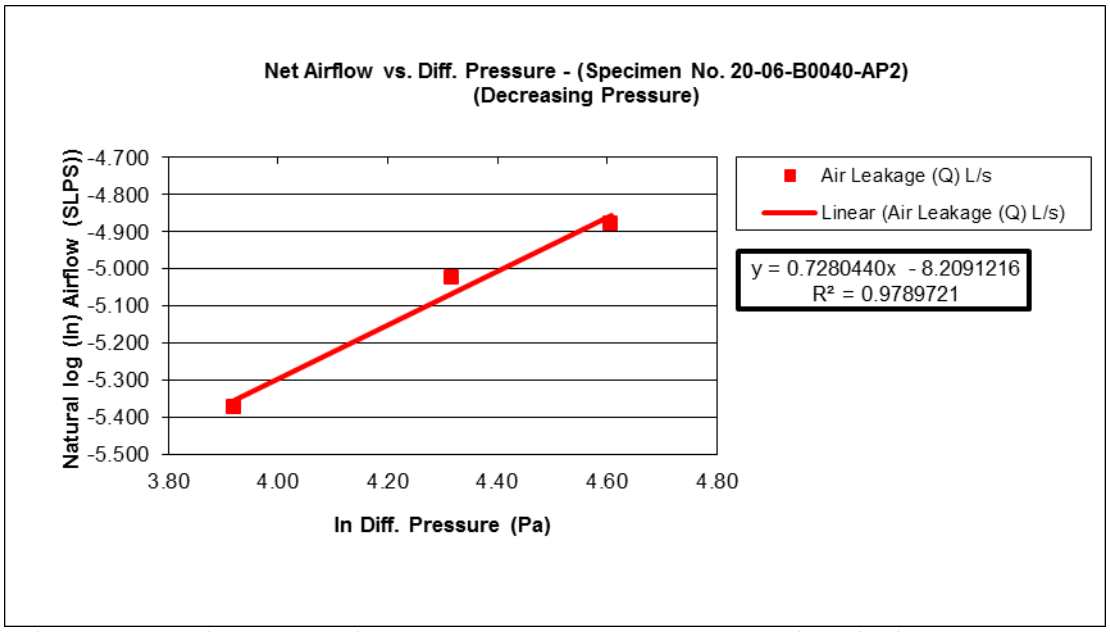

Figure C-14 – Element Specimen No.: 20-06-B0040-AP2 Decreasing Air Flow vs. Pressure Direction of Air Flow: Exfiltration.

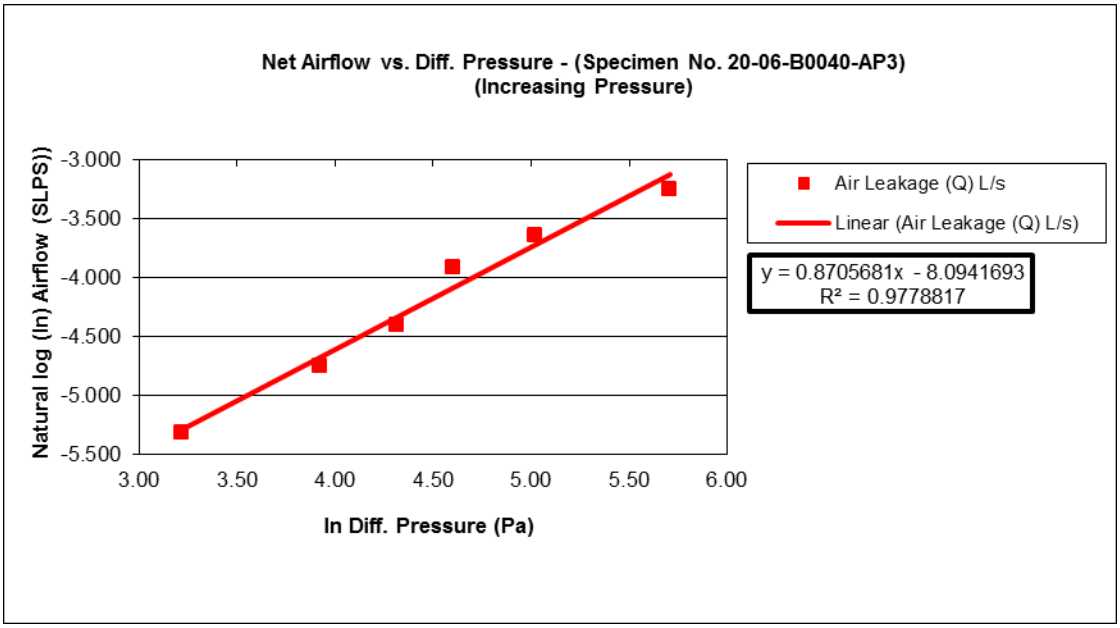

Figure C-15 – Element Specimen No.: 20-06-B0040-AP3 Increasing Air Flow vs. Pressure Direction of Air Flow: Exfiltration.

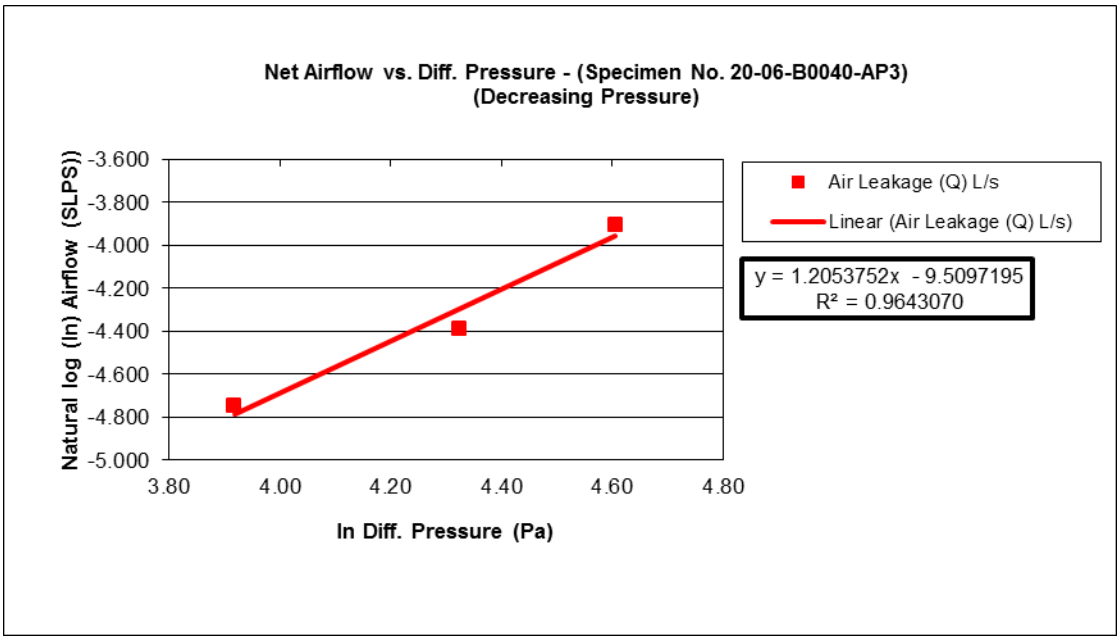

Figure C-16 – Element Specimen No.: 20-06-B0040-AP3 Decreasing Air Flow vs. Pressure Direction of Air Flow: Exfiltration.

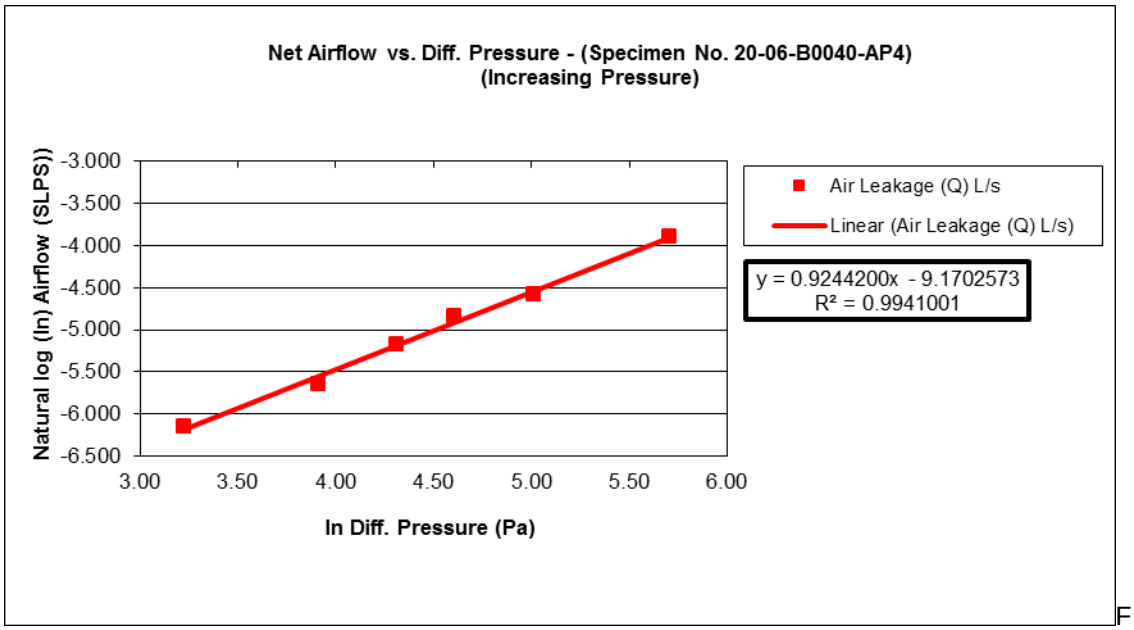

Figure C-17 – Element Specimen No.: 20-06-B0040-AP4 Increasing Air Flow vs. Pressure Direction of Air Flow: Exfiltration.

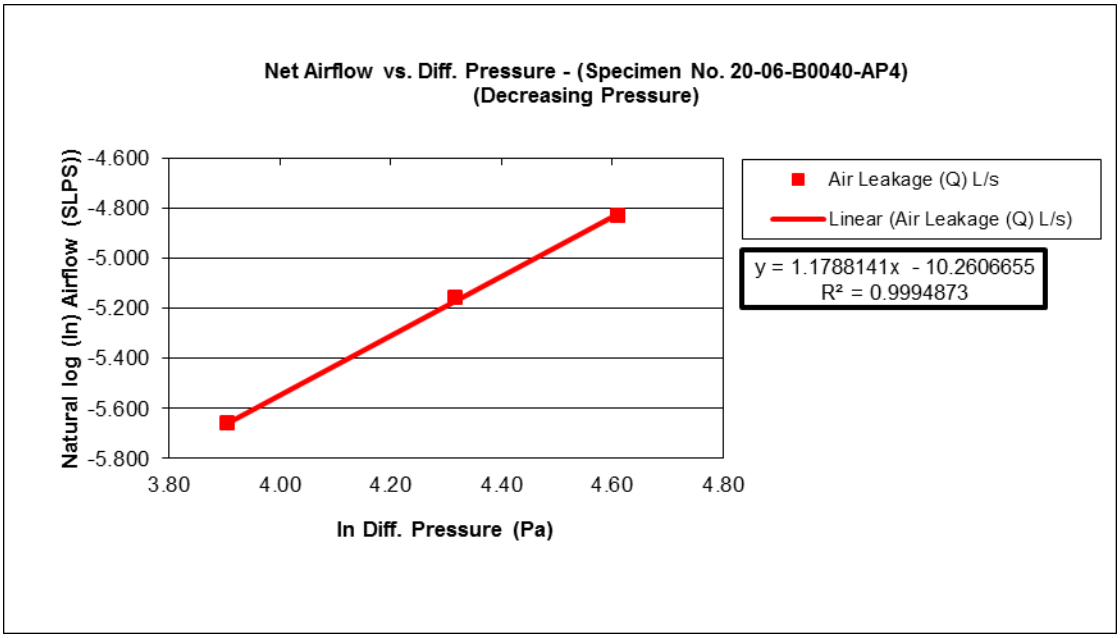

Figure C-18 – Element Specimen No.: 20-06-B0040-AP4 Decreasing Air Flow vs. Pressure Direction of Air Flow: Exfiltration.

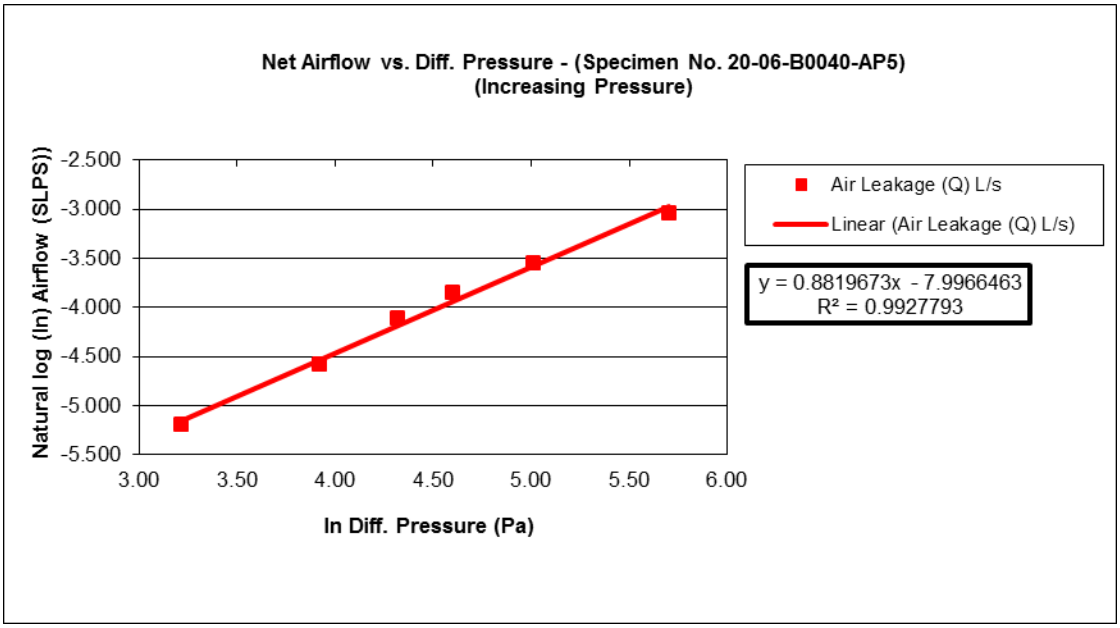

Figure C-19 – Element Specimen No.: 20-06-B0040-AP5 Increasing Air Flow vs. Pressure Direction of Air Flow: Exfiltration.

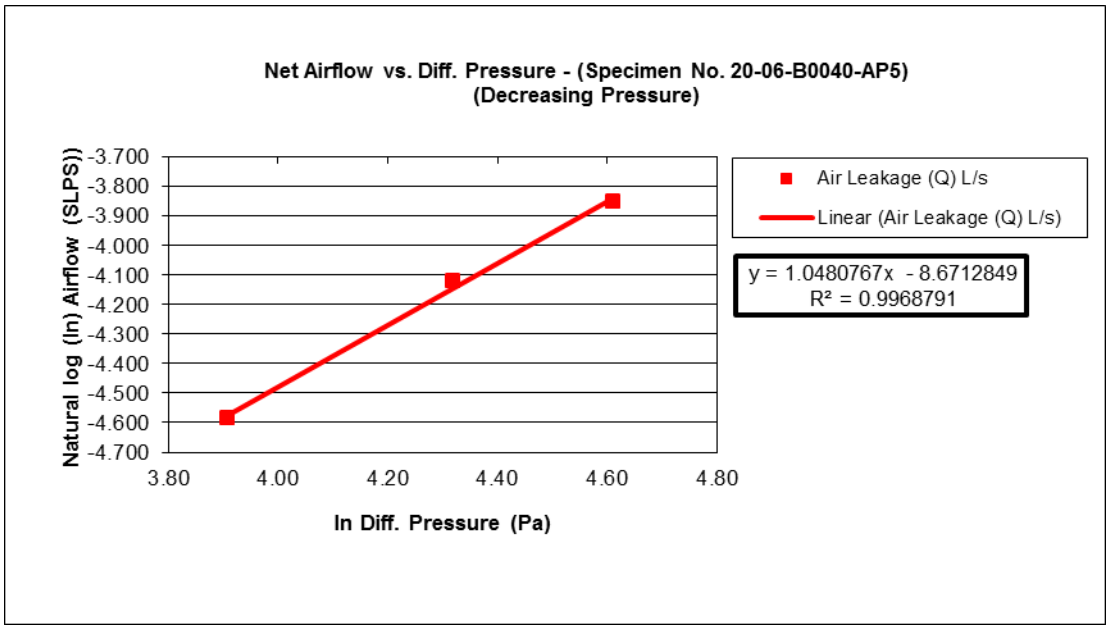

Figure C-20 – Element Specimen No.: 20-06-B0040-AP5 Decreasing Air Flow vs. Pressure Direction of Air Flow: Exfiltration.

APPENDIX D

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

(10 Pages)

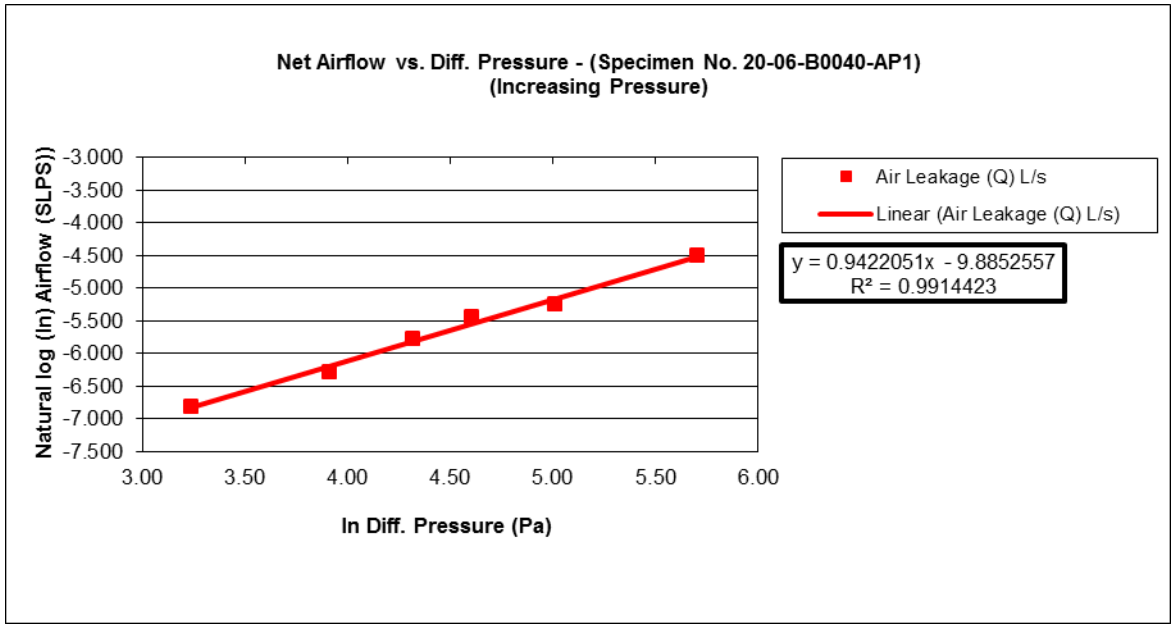

Figure D-1 – Element Specimen No.: 20-06-B0040-AP1 Increasing Air Flow vs. Pressure
Direction of Air Flow: Infiltration

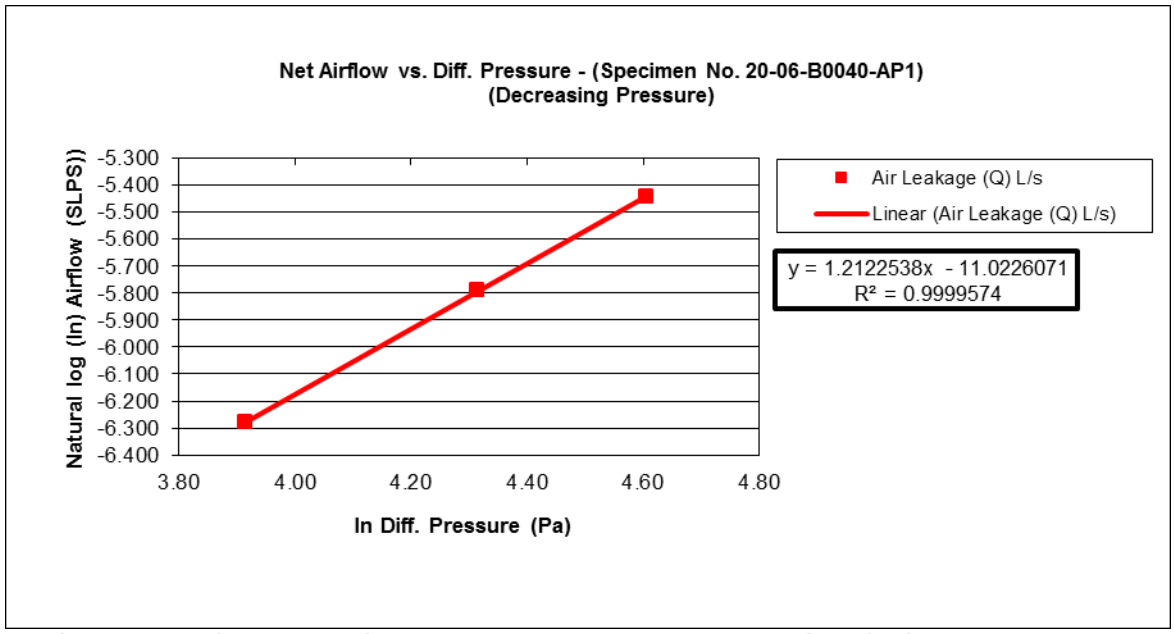

Figure D-2 – Element Specimen No.: 20-06-B0040-AP1 Decreasing Air Flow vs. Pressure
Direction of Air Flow: Infiltration

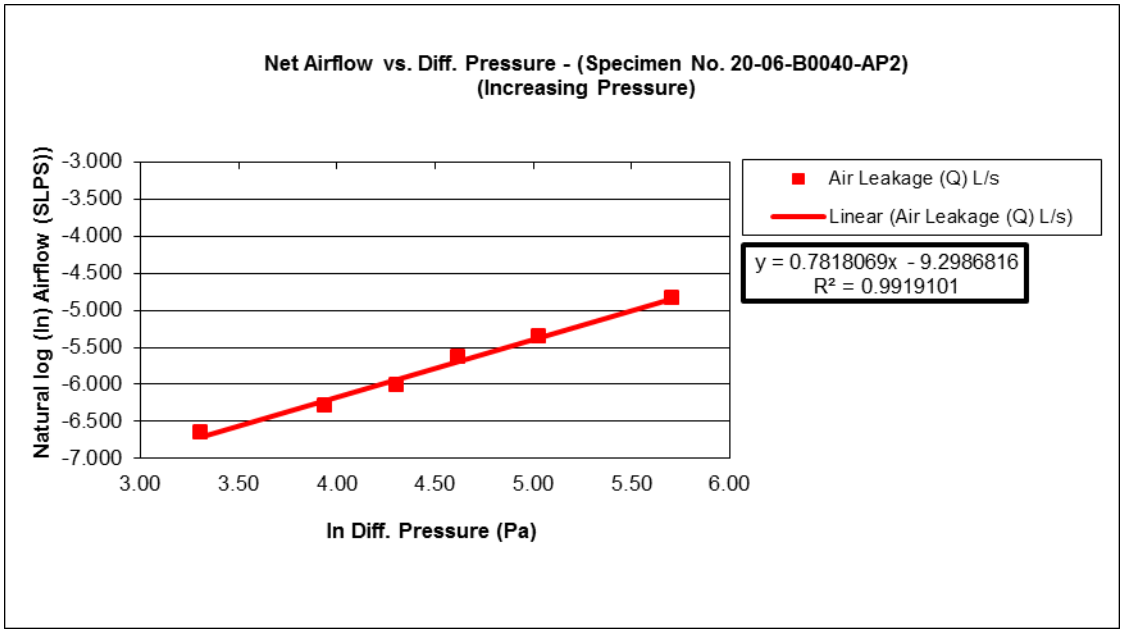

Figure D-3 – Element Specimen No.: 20-06-B0040-AP2 Increasing Air Flow vs. Pressure Direction of Air Flow: Infiltration.

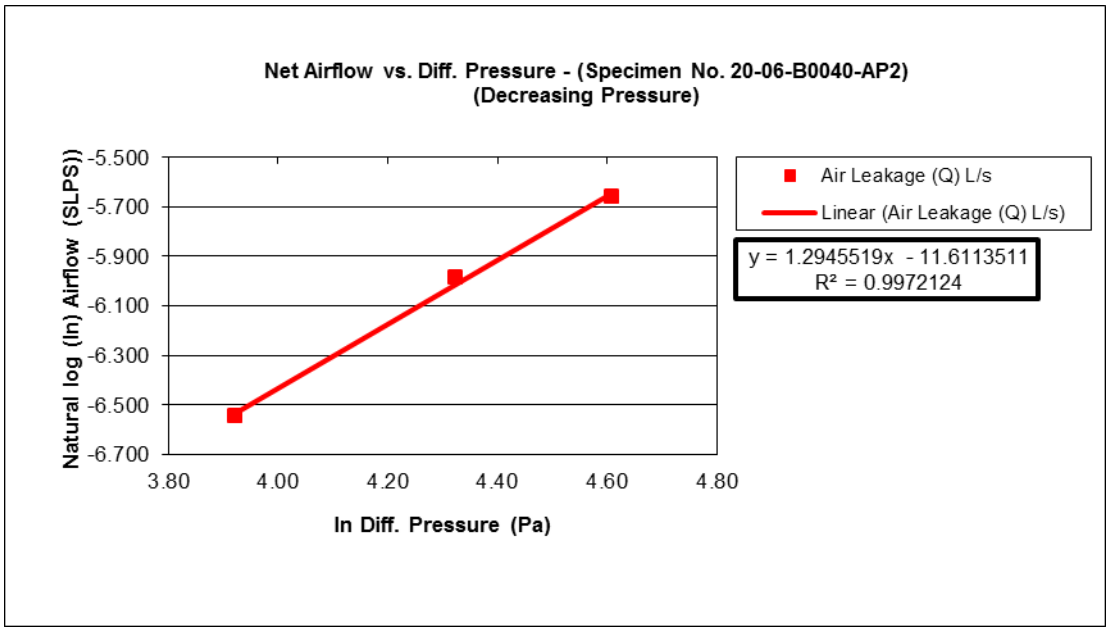

Figure D-4 – Element Specimen No.: 20-06-B0040-AP2 Decreasing Air Flow vs. Pressure Direction of Air Flow: Infiltration.

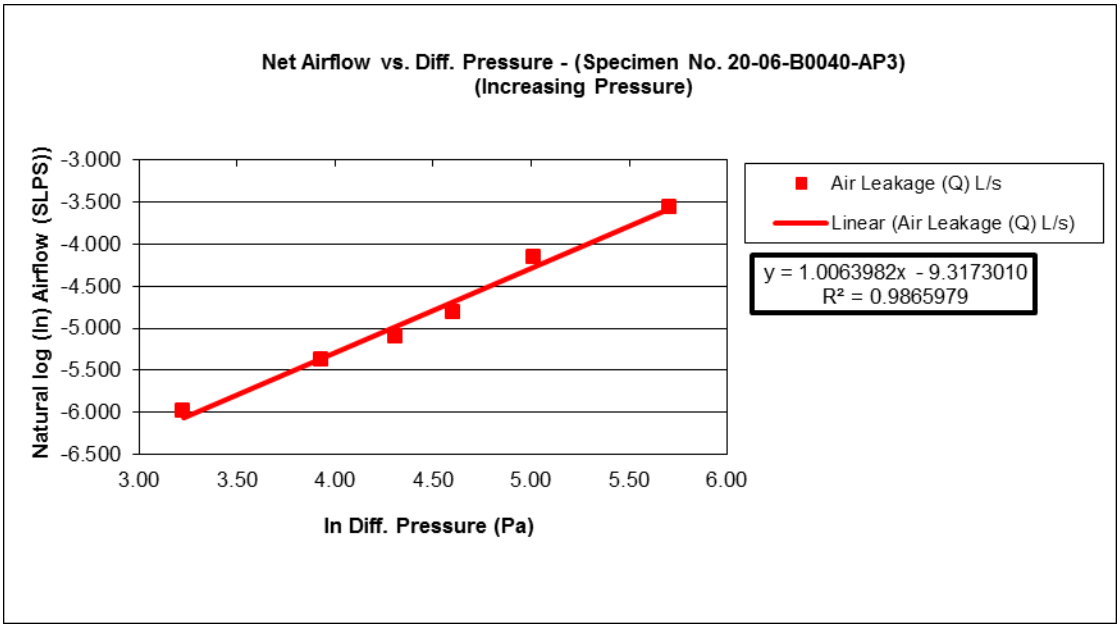

Figure D-5 – Element Specimen No.: 20-06-B0040-AP3 Increasing Air Flow vs. Pressure Direction of Air Flow: Infiltration.

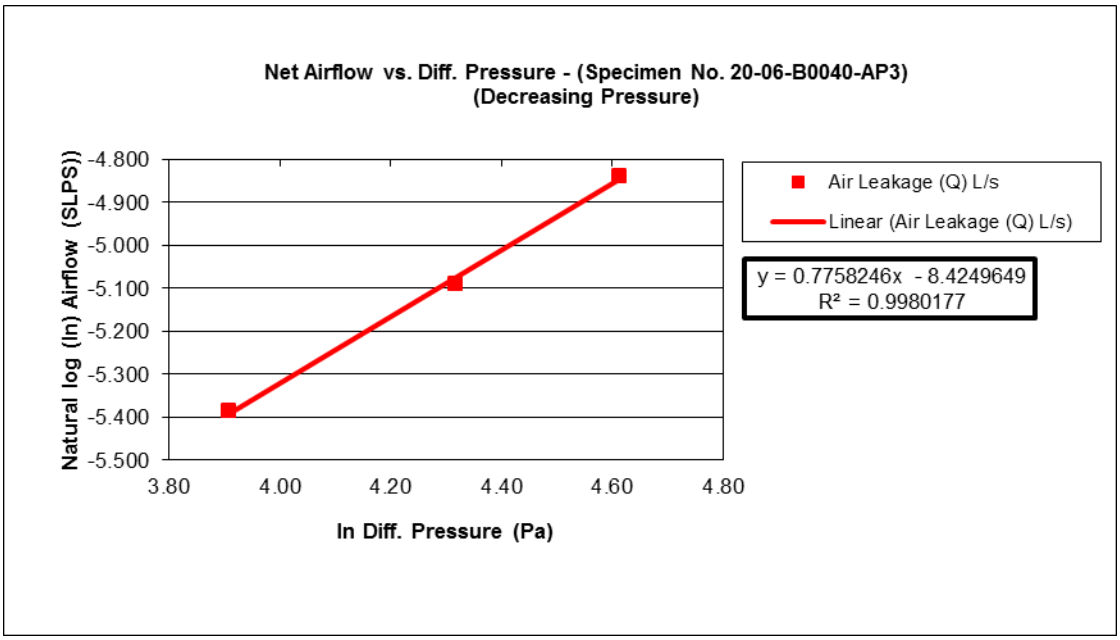

Figure D-6 – Element Specimen No.: 20-06-B0040-AP3 Decreasing Air Flow vs. Pressure Direction of Air Flow: Infiltration.

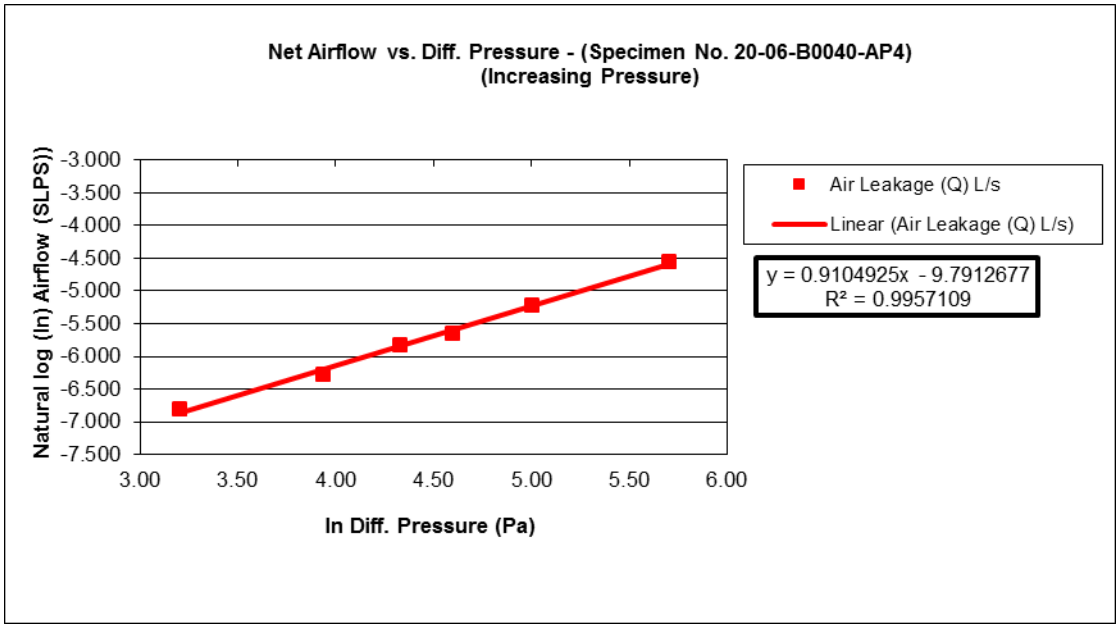

Figure D-7 – Element Specimen No.: 20-06-B0040-AP4 Increasing Air Flow vs. Pressure Direction of Air Flow: Infiltration.

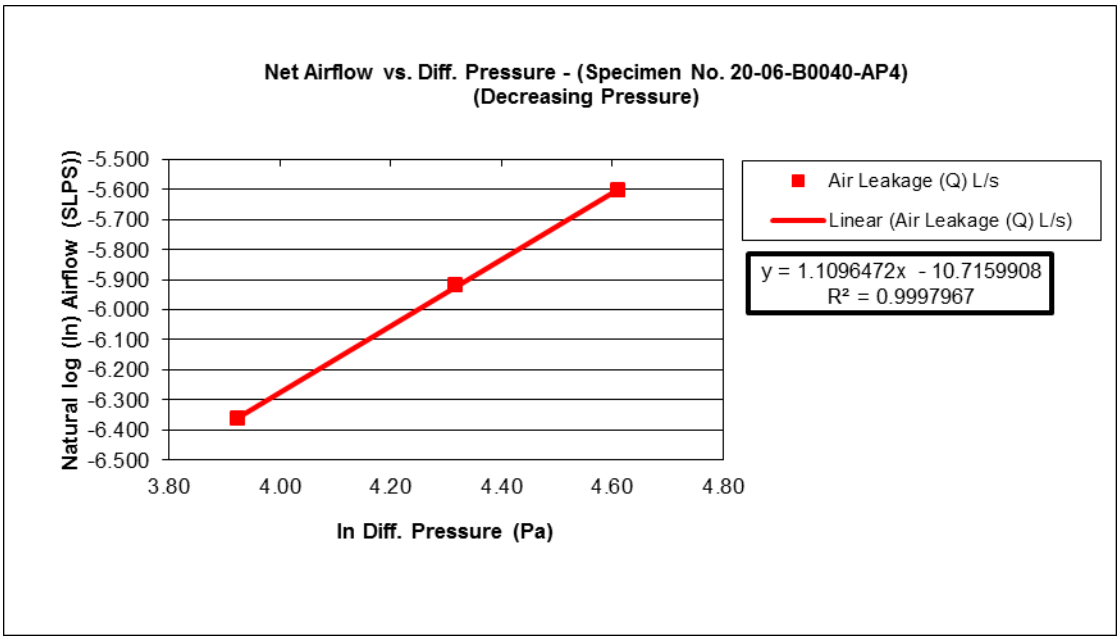

Figure D-8 – Element Specimen No.: 20-06-B0040-AP4 Decreasing Air Flow vs. Pressure Direction of Air Flow: Infiltration.

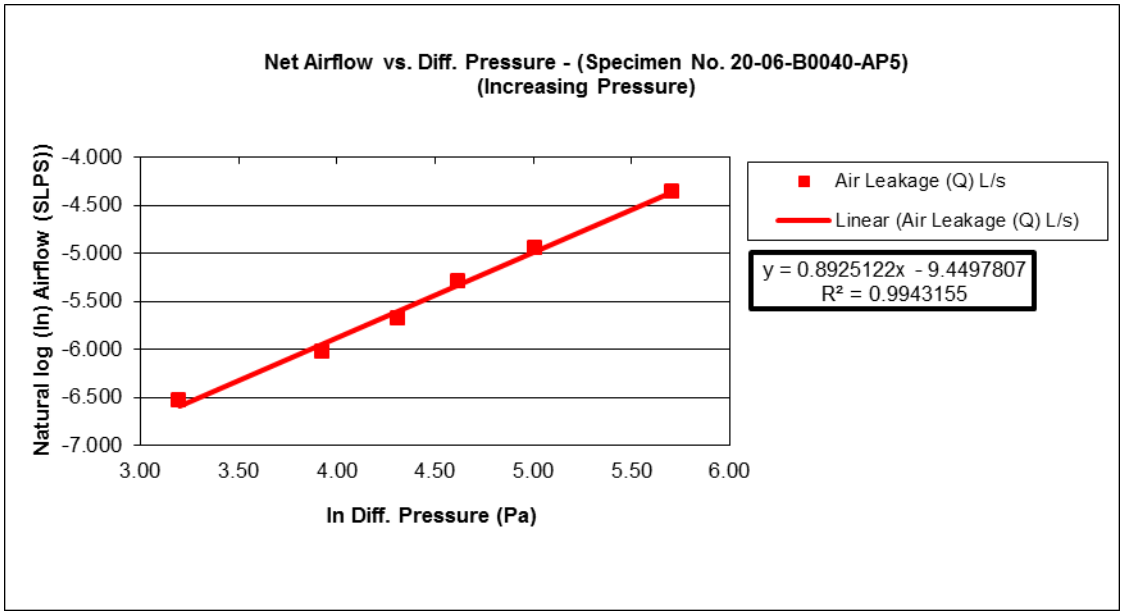

Figure D-9 – Element Specimen No.: 20-06-B0040-AP5 Increasing Air Flow vs. Pressure Direction of Air Flow: Infiltration

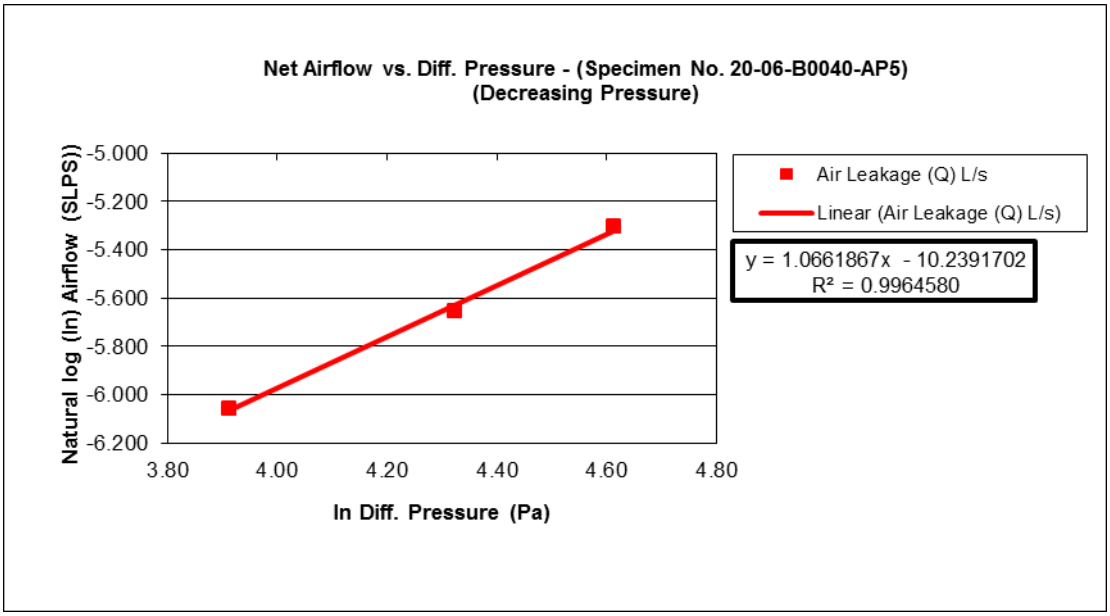

Figure D-10 – Element Specimen No.: 20-06-B0040-AP5 Decreasing Air Flow vs. Pressure Direction of Air Flow: Infiltration

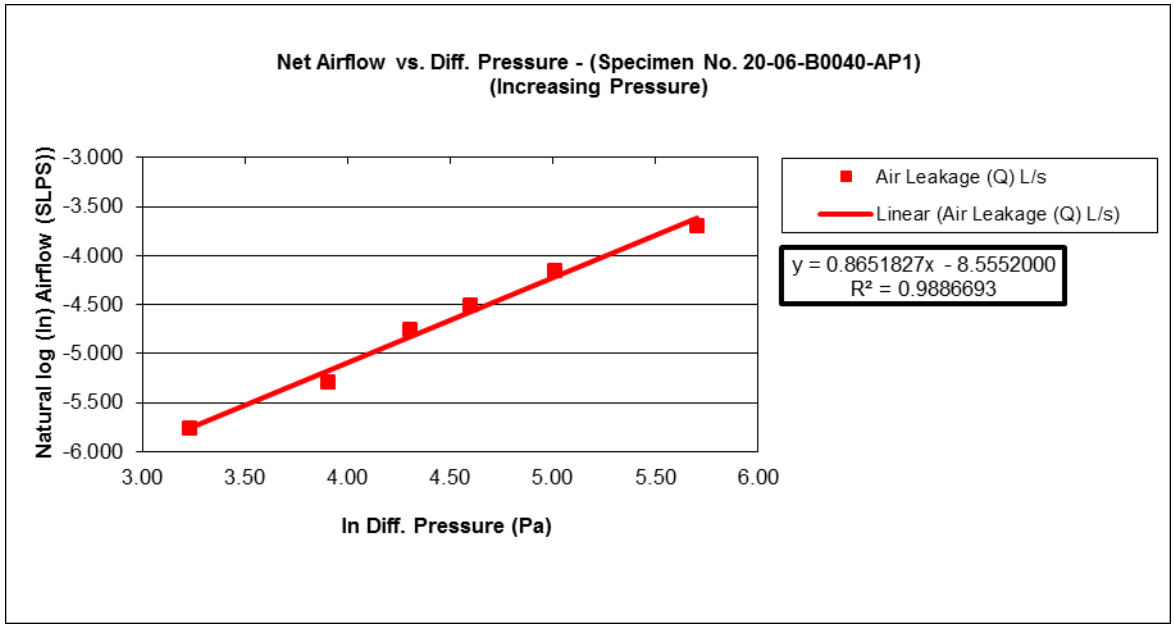

Figure D-11 – Element Specimen No.: 20-06-B0040-AP1 Increasing Air Flow vs. Pressure Direction of Air Flow: Exfiltration.

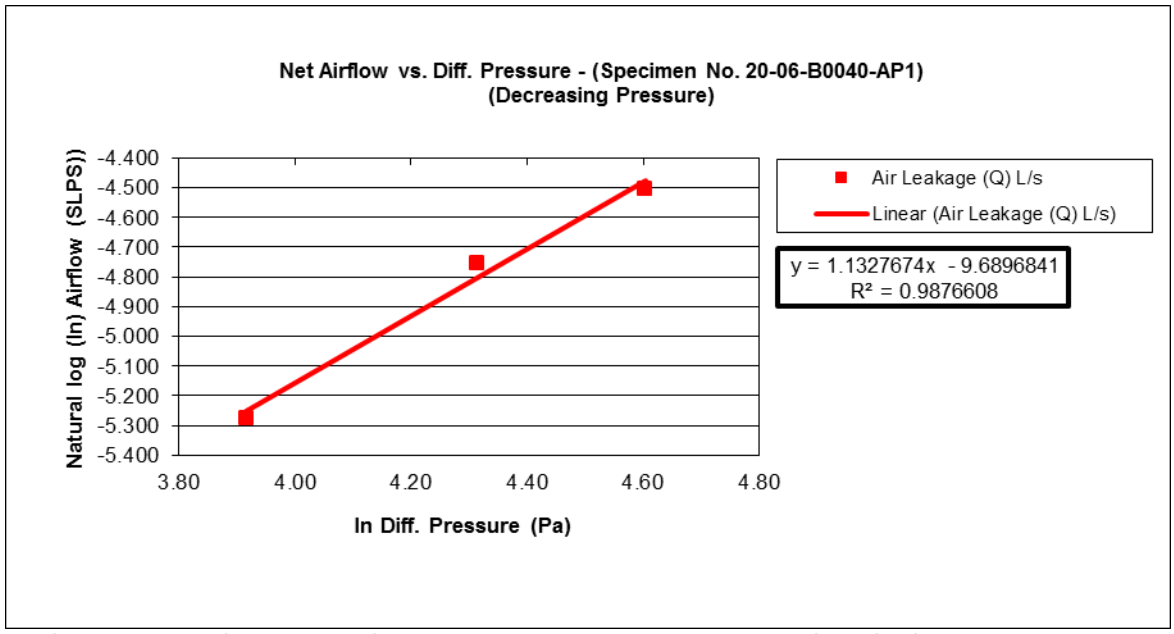

Figure D-12 – Element Specimen No.: 20-06-B0040-AP1 Decreasing Air Flow vs. Pressure Direction of Air Flow: Exfiltration.

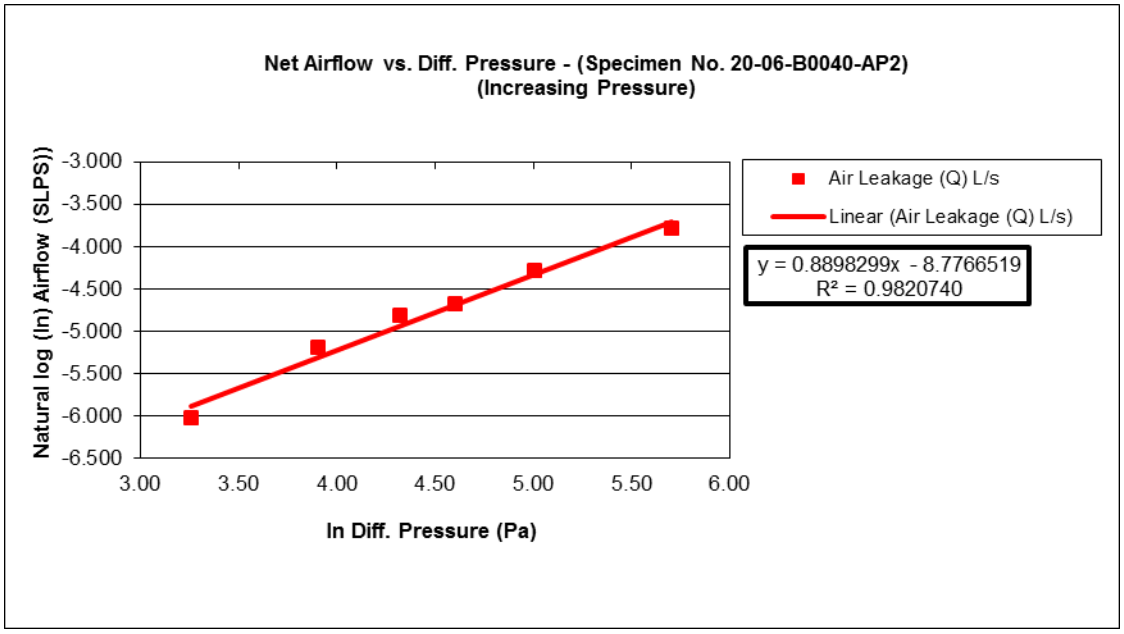

Figure D-13 – Element Specimen No.: 20-06-B0040-AP2 Increasing Air Flow vs. Pressure Direction of Air Flow: Exfiltration.

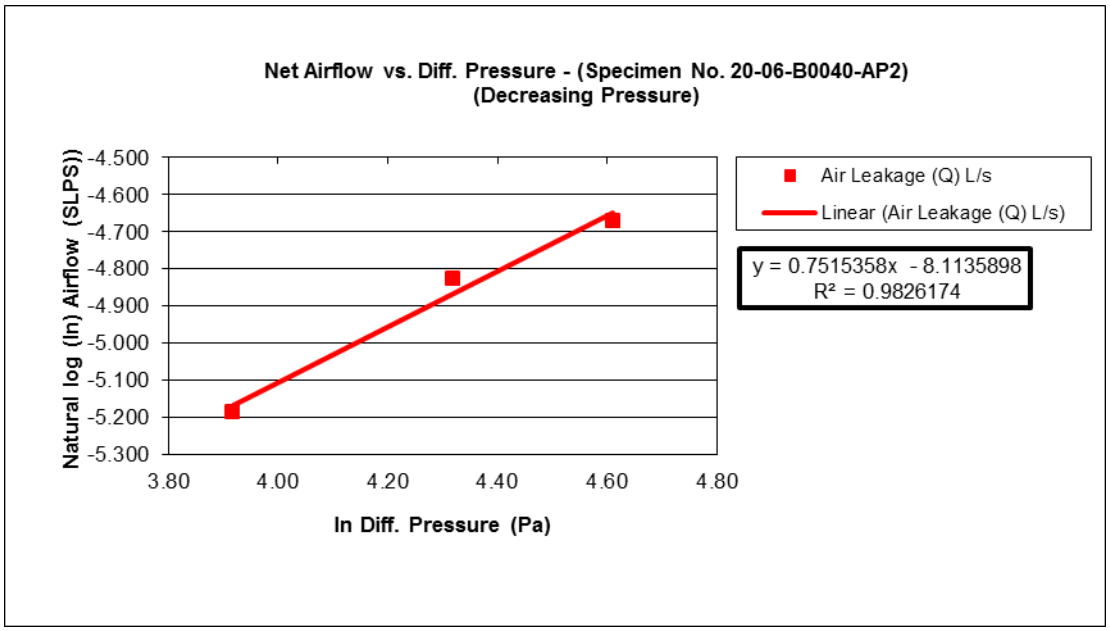

Figure D-14 – Element Specimen No.: 20-06-B0040-AP2 Decreasing Air Flow vs. Pressure Direction of Air Flow: Exfiltration.

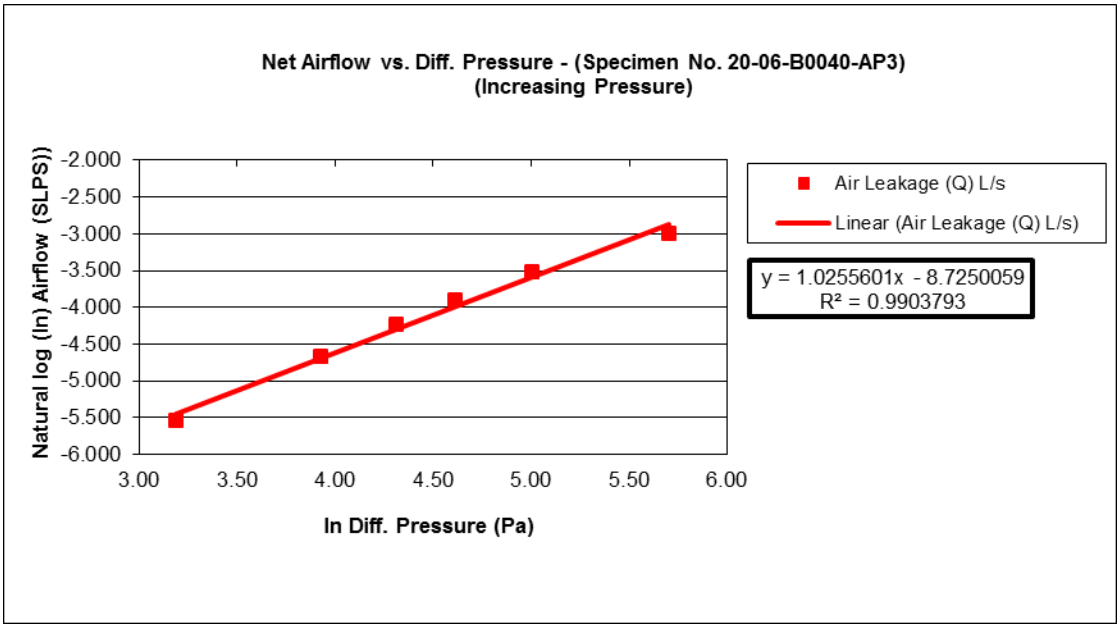

Figure D-15 – Element Specimen No.: 20-06-B0040-AP3 Increasing Air Flow vs. Pressure Direction of Air Flow: Exfiltration.

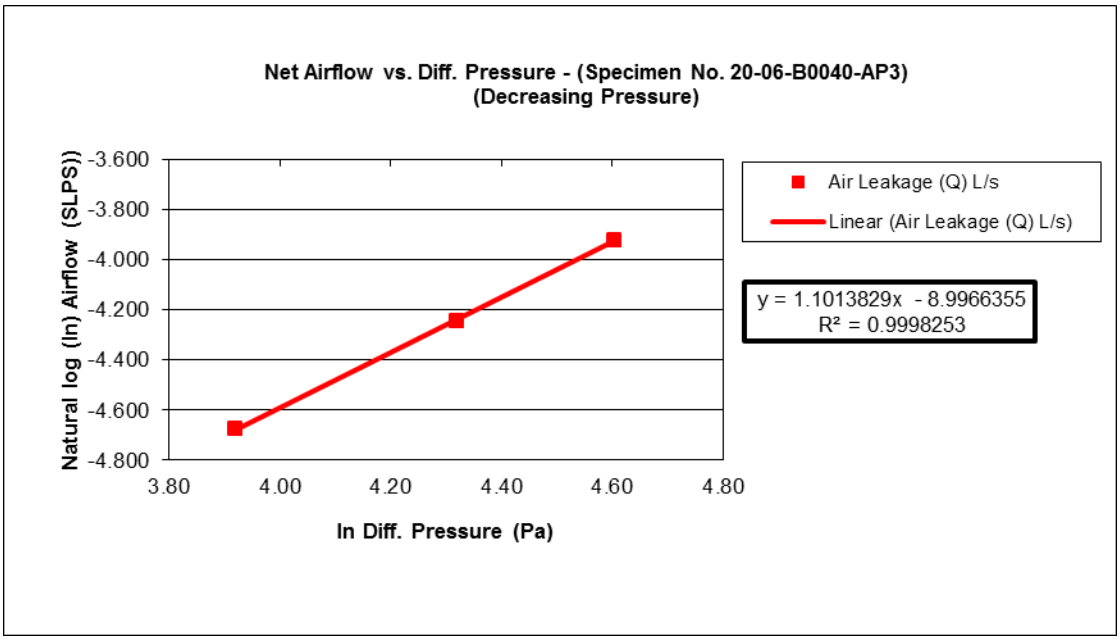

Figure D-16 – Element Specimen No.: 20-06-B0040-AP3 Decreasing Air Flow vs. Pressure Direction of Air Flow: Exfiltration.

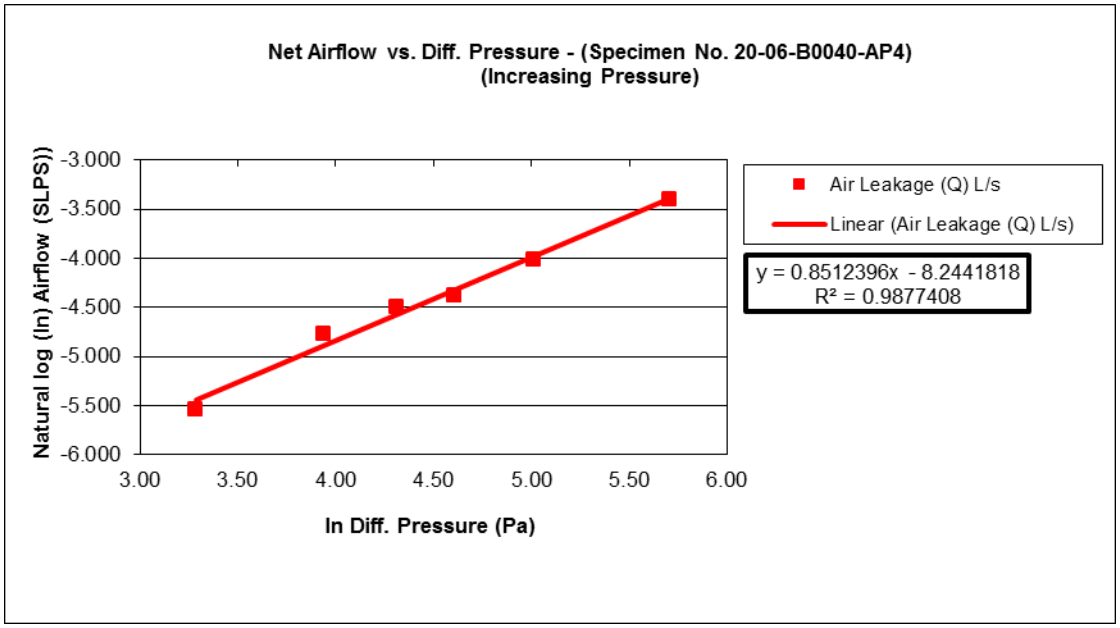

Figure D-17 – Element Specimen No.: 20-06-B0040-AP4 Increasing Air Flow vs. Pressure Direction of Air Flow: Exfiltration.

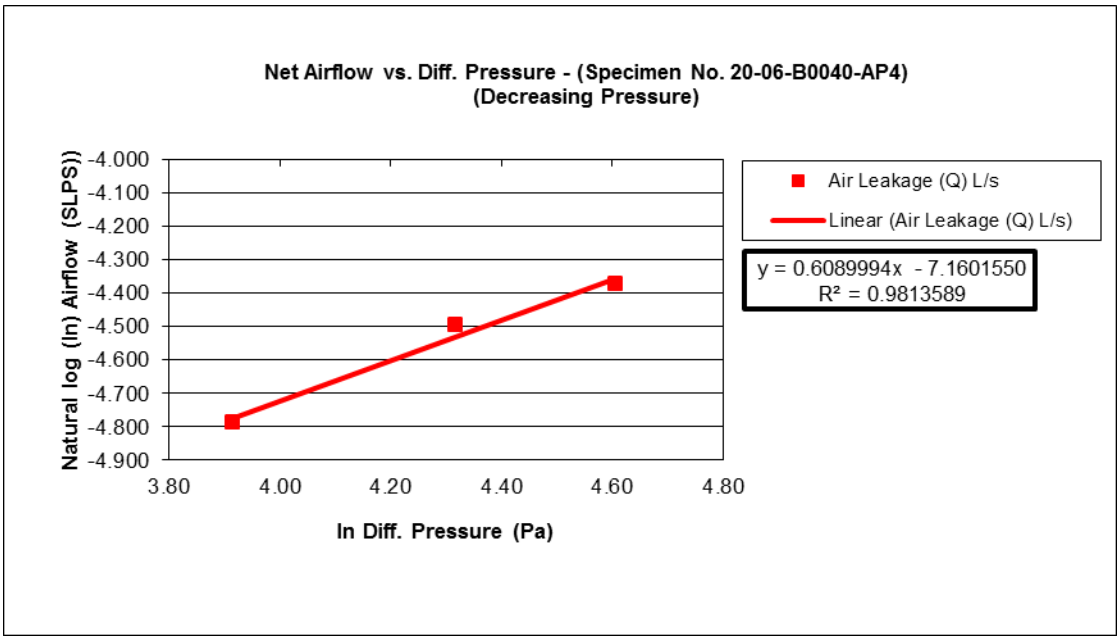

Figure D-18 – Element Specimen No.: 20-06-B0040-AP4 Decreasing Air Flow vs. Pressure Direction of Air Flow: Exfiltration.

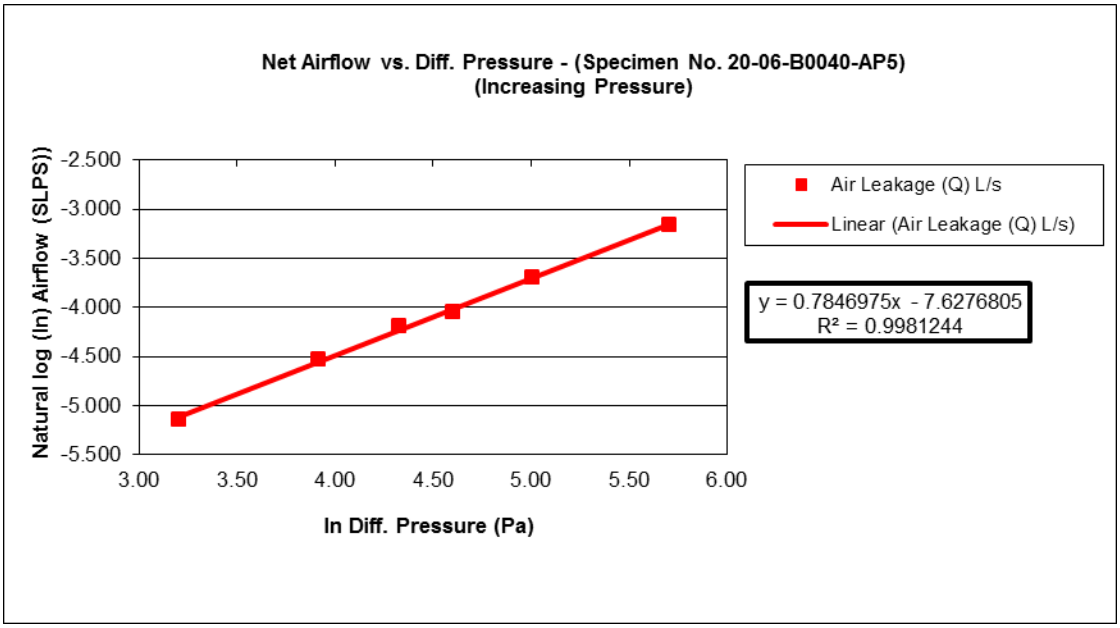

Figure D-19 – Element Specimen No.: 20-06-B0040-AP5 Increasing Air Flow vs. Pressure Direction of Air Flow: Exfiltration.

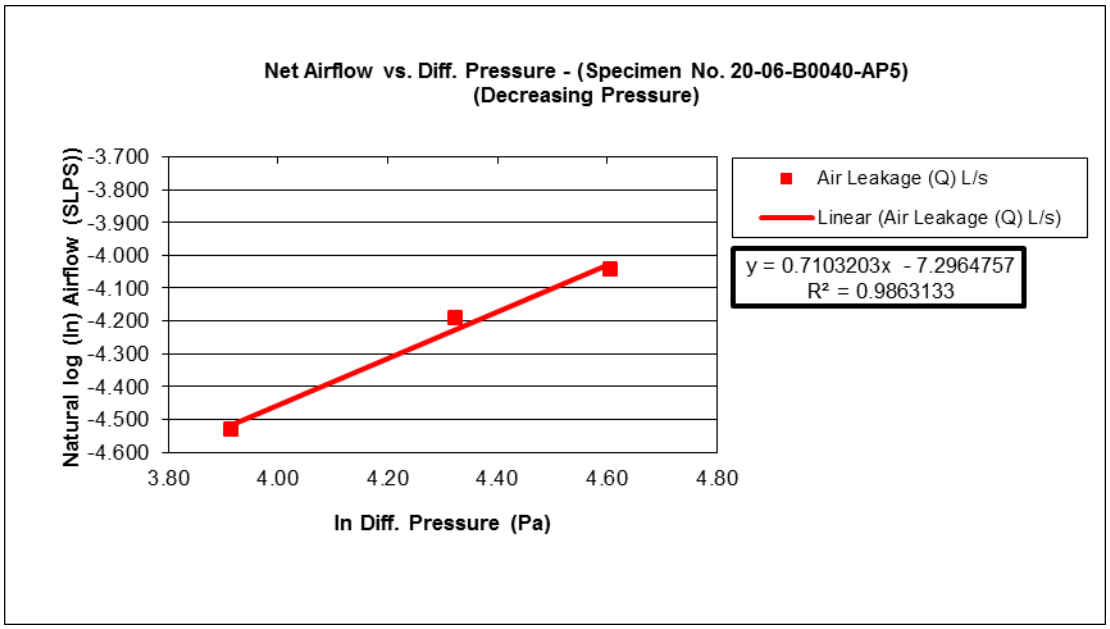

Figure D-20 – Element Specimen No.: 20-06-B0040-AP5 Decreasing Air Flow vs. Pressure Direction of Air Flow: Exfiltration.

APPENDIX E

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

(16 Pages)

element

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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

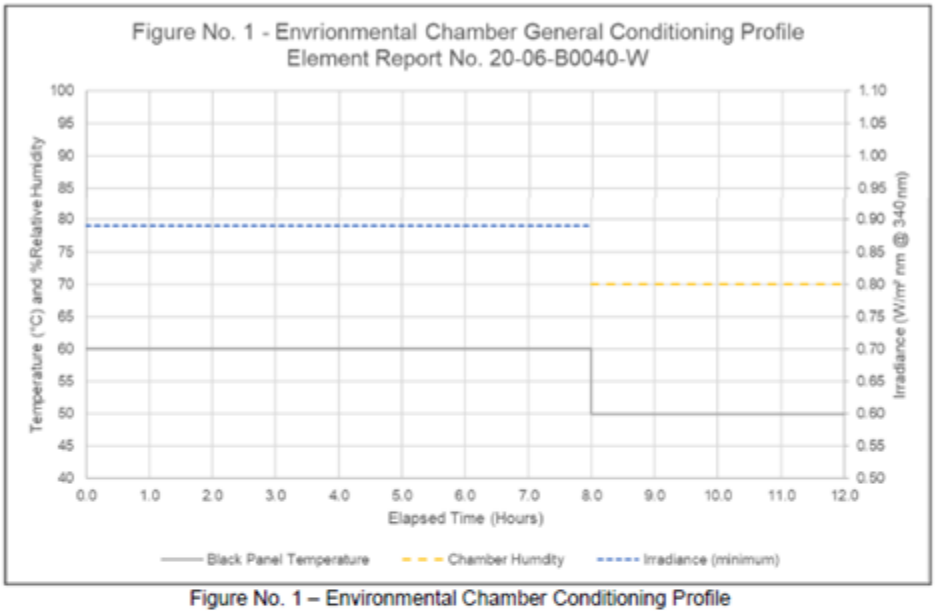


Figure No. 1 – Environmental Chamber Conditioning Profile

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.

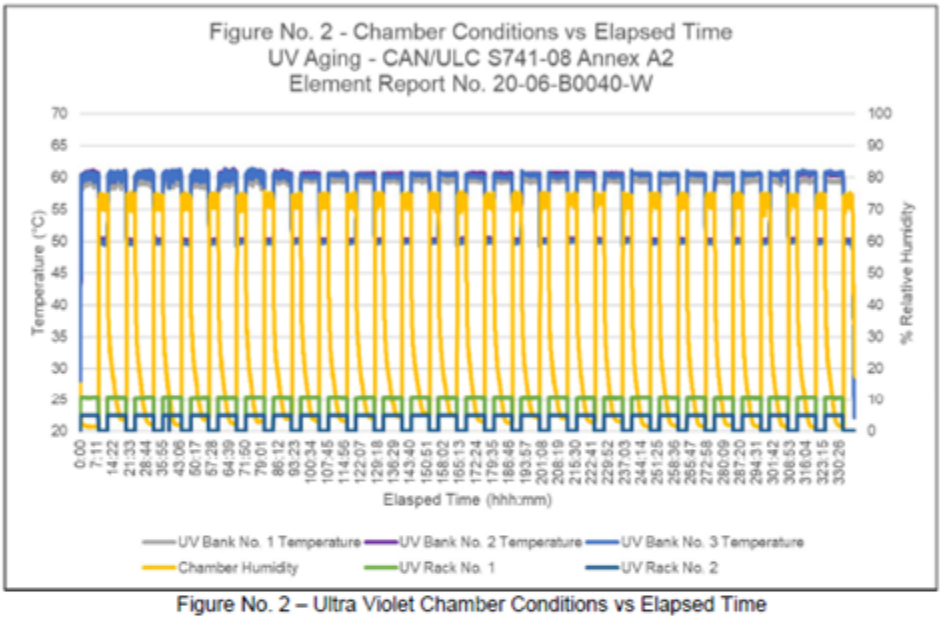


Figure No. 2 – Ultra Violet Chamber Conditions vs Elapsed Time

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)

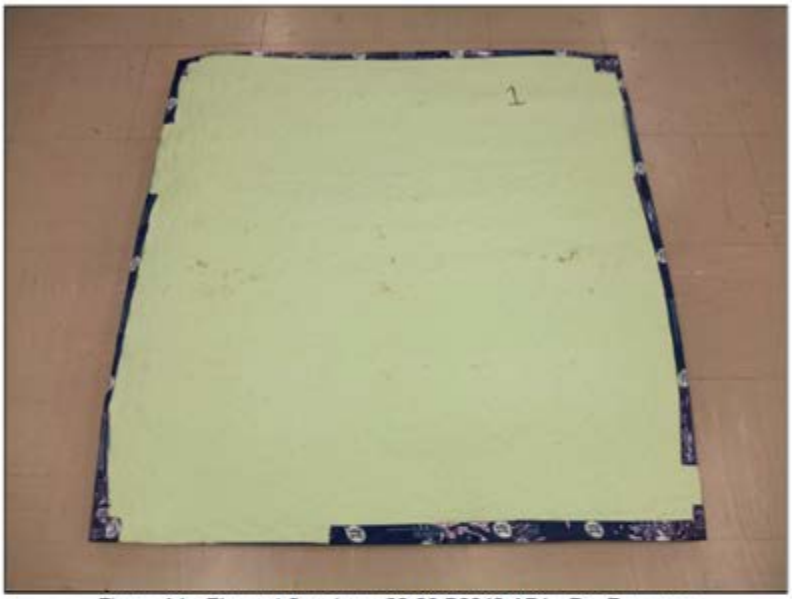


Figure A1 - Element Specimen 20-06-B0040-AP1 - Pre Exposure

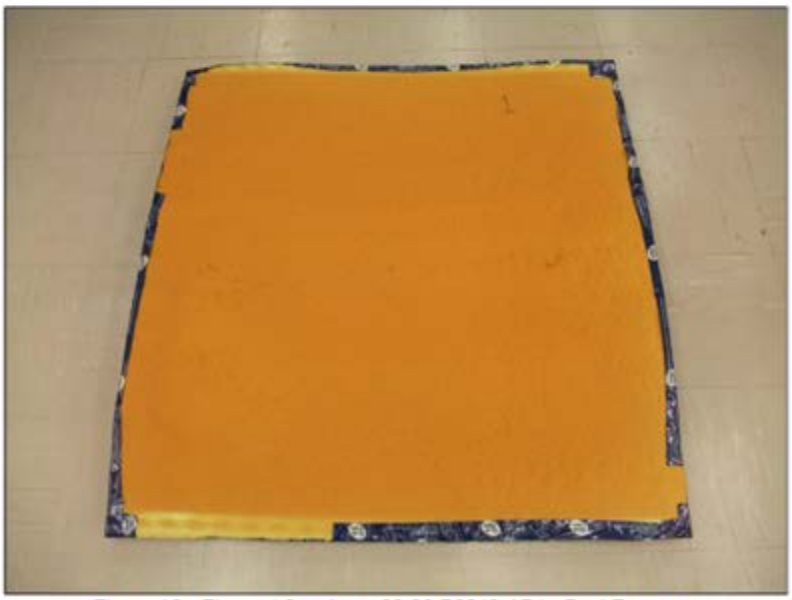


Figure A2 - Element Specimen 20-06-B0040-AP1 - Post Exposure

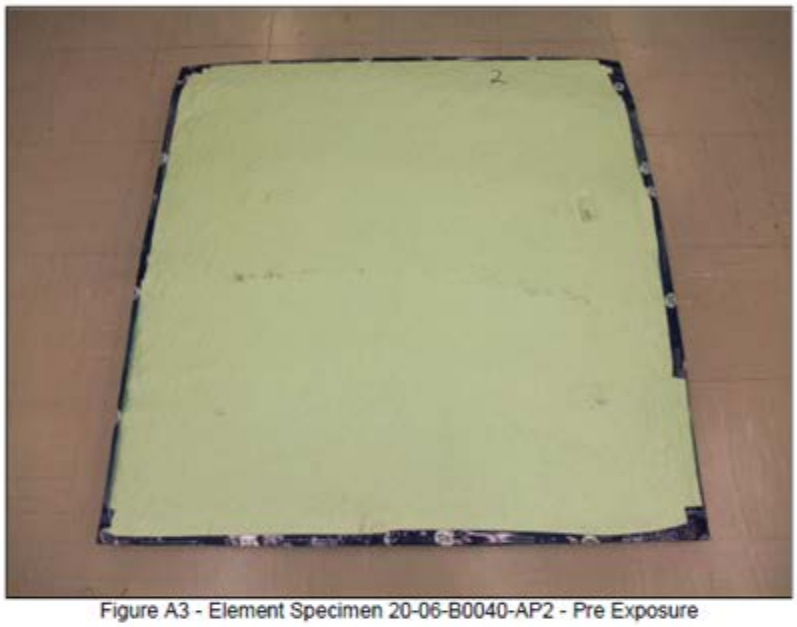


Figure A3 - Element Specimen 20-06-B0040-AP2 - Pre Exposure

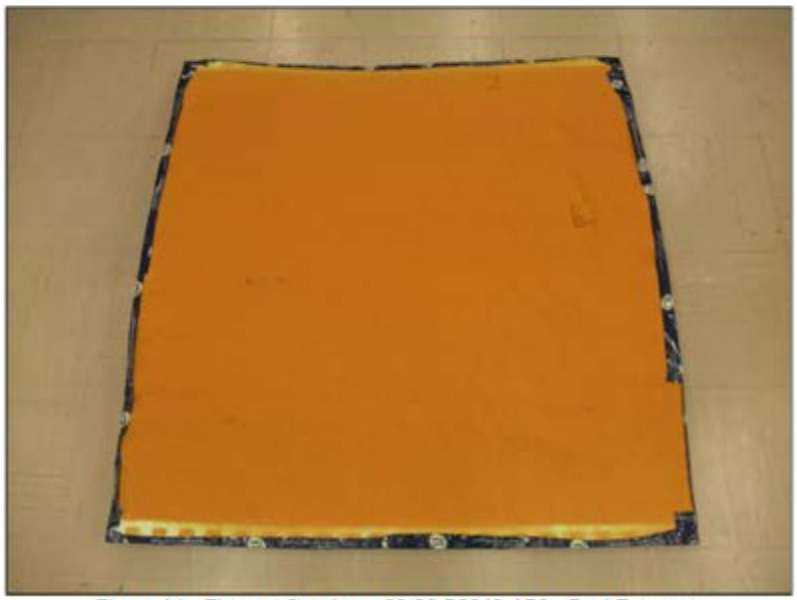


Figure A4 - Element Specimen 20-06-B0040-AP2 - Post Exposure

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

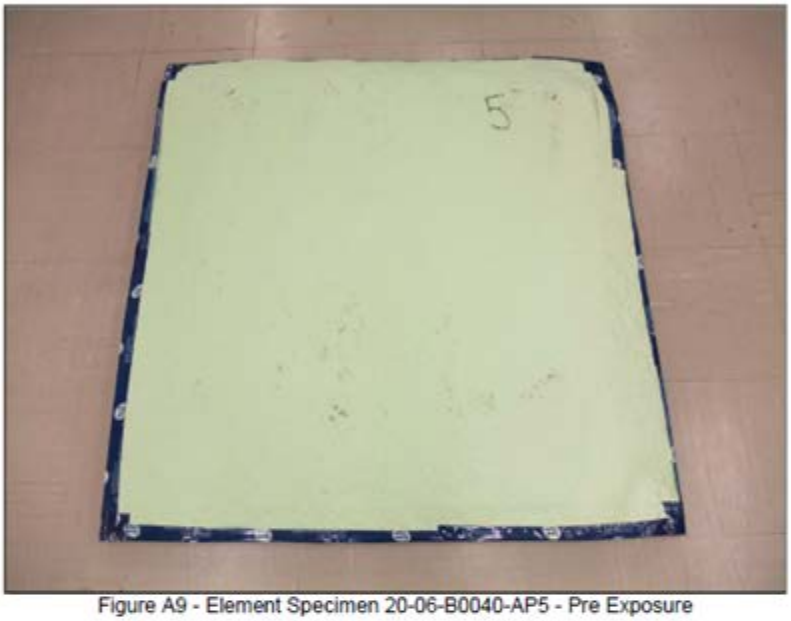


Figure A9 - Element Specimen 20-06-B0040-AP5 - Pre Exposure

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

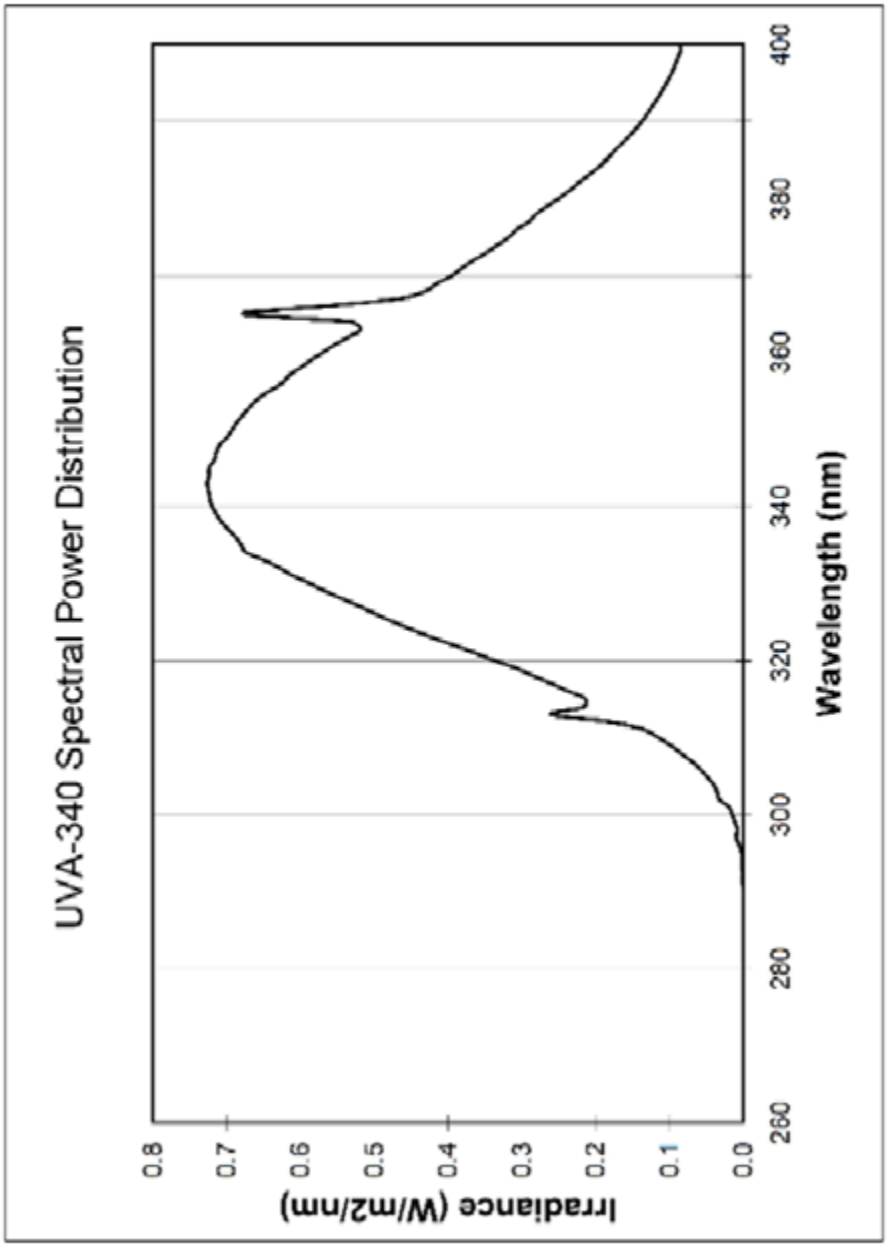
Table A4–Spectral Irradiance Measurements ASTM G151-10 Annex A Element Specimen No. 20-06-B0040-AP4					
Spectral Irradiance (W/m² @ 340 nm)					
	A	B	C	D	*Avg.*
1	1.07	1.08	1.09	1.03	***1.07***
2	1.34	1.34	1.33	1.28	***1.32***
3	1.34	1.32	1.33	1.30	***1.32***
4	1.18	1.17	1.17	1.11	***1.16***
Avg.	***1.23***	***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)
260
280
300
320
340
360
380
400

APPENDIX F

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

(4 Pages)

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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, MII# B10643 Digital Balance (0.01g), MII# B17286 Barometer, MII# B14977 Environmental Controller, 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**

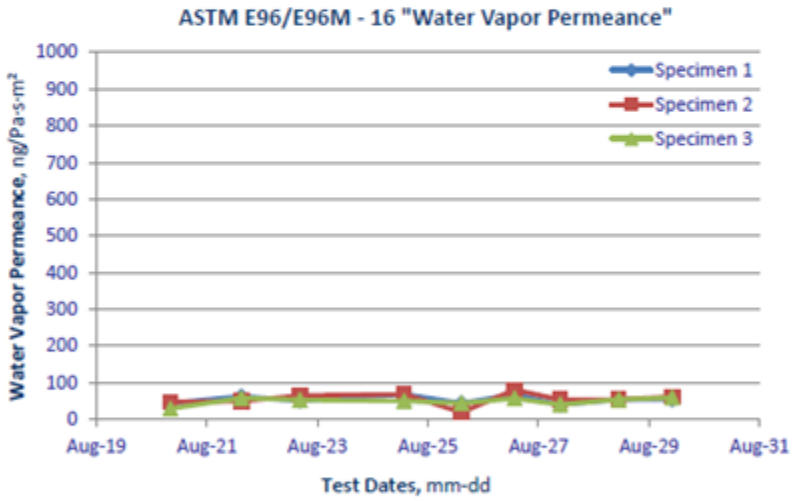

Figure 1: Elapsed time vs Water Vapor Permeance for *Element Sample No.: 20-06-B00040-M-WVP-Exfil.*

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**

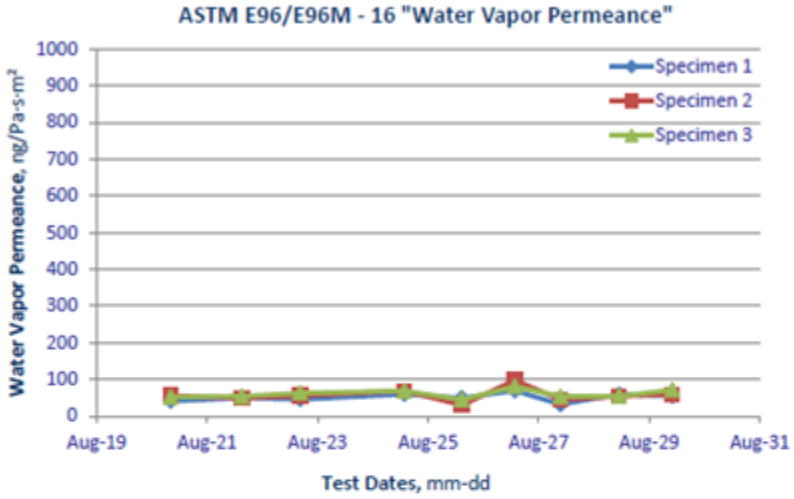

Figure 2: Elapsed time vs Water Vapor Permeance for *Element Sample No.: 20-06-B00040-M-WVP-Infil.*

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•m^2 [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•m^2 [0.98 US perms] when tested in the 'Infiltration' direction.

5.0 REVISION HISTORY

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

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