

Building Enclosure & Energy Performance of Log & Timber Homes

Appendix B: Whole House Air Leakage Test Results



PREPARED FOR: BC Log and Timber Frame Home Market Expansion Project

SUBMITTED BY RDH Building Engineering Ltd.
224 West 8th Avenue
Vancouver, BC V5Y 1N5
Canada

PROJECT NUMBER 5197.10

DATE April 29, 2013

Table of Contents

Infiltrometer Air Leakage Test Results – Test House 1

Infiltrometer Air Leakage Test Results – Test House 2

Infiltrometer Air Leakage Test Results – Test House 3

Infiltrometer Air Leakage Test Results – Test House 4

Infiltrometer Air Leakage Test Results

**In Compliance with CAN/CGSB 149.10-2002
Standards
(Imperial Units)**

Test file name: **Test House #1**
Test technician: **Christopher Black**
Test company: **RDH Building Engineering**

Building address:
Building Volume: **17,508 cu ft**
Envelope Area: **3,873.6 sq ft**

Building envelope:

Fan Model: **Retrotec 3000SR**

Fan SN:

Gauge Model: **DM-2**

Gauge SN: **97860**

Calibrated:

Calibrated:

Depressurize Set

Environmental Conditions

Wind speed: **0 mph** from the
Wind variability:
Barometric Pressure **101.3 kPa** from **Stand. temp. and pressure**
Operator Location: **Inside** the building

Initial Conditions:

Baseline Pressure: **-2.79 Pa,**
Temperature: indoors: **66 °F**, outdoors: **39 °F**

Final Conditions:

Baseline Pressure: **-2.28 Pa,**
Temperature: indoors: **68 °F**, outdoors: **68 °F**

Test Results

Test Date and Time: **2013-01-31**
11:01

Air leakage coefficient, C_p : **67.35 CFM·Paⁿ**

Exponent, n : **0.6396**

Correlation coefficient, r : **0.9998**

Corrected Flow at 50 Pa: **822.5 CFM**
+/-0.3%

Air Changes per hour at 50 Pa: **2.820 /hr**
+/-0.3%

Corrected Flow at 10 Pa: **297.0 CFM**
+/-0.6%

Equivalent Leakage Area: **86.30 sq in at 10
+/-0.6%**

Normalized Leakage Area: **0.022 sq in / sq ft**

Permeability at 50 pa: **0.212 CFM / sq ft**

Specific Leakage rate, SLR at 50 pa: **0.268 cfm / sq ft**

Effective leakage area, EflA at 4 pa: **46.31 sq in**

Test Data

Set-up Conditions:

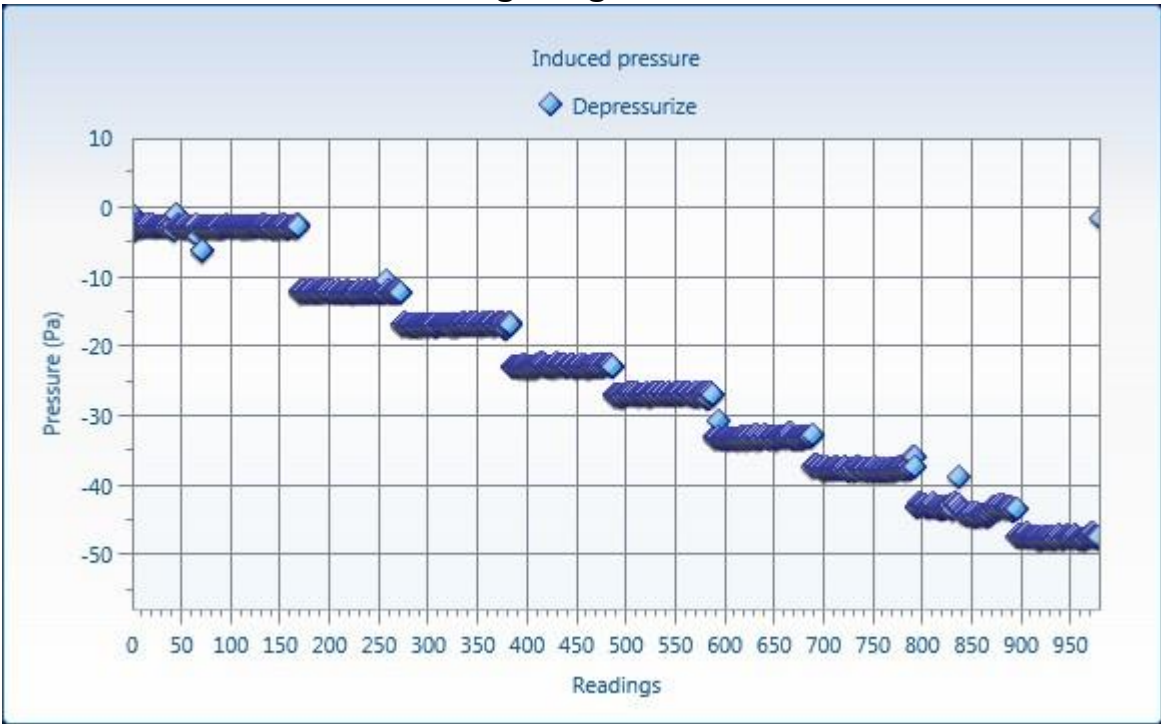
Deviations from the test method:

Induced pressure, ΔP (Pa)	-14.7	-19.4	-25.3	-29.4	-35.6	-40.1	-45.9	-50.0				
Fan Pressure ΔP (Pa) Range: C8	17.7	27.3	40.5	49.9	64.3	74	90.2	99.9				
Corrected Fan Pressure ΔP (Pa)	17.7	27.3	40.5	49.9	64.3	74	90.2	99.9				
Flow Q (CFM)	334.2	415.6	506.6	563.4	641.3	688.9	763.1	804.6				
Corrected Flow Q (CFM)	329.9	410.2	500.0	556.1	633.0	680.1	753.3	794.2				
Error [%]	-0.9%	0.0%	0.4%	0.5%	0.2%	-0.7%	0.3%	-0.1%				
Range Plate Used	C8	C8	C8	C8	C8	C8	C8	C8				

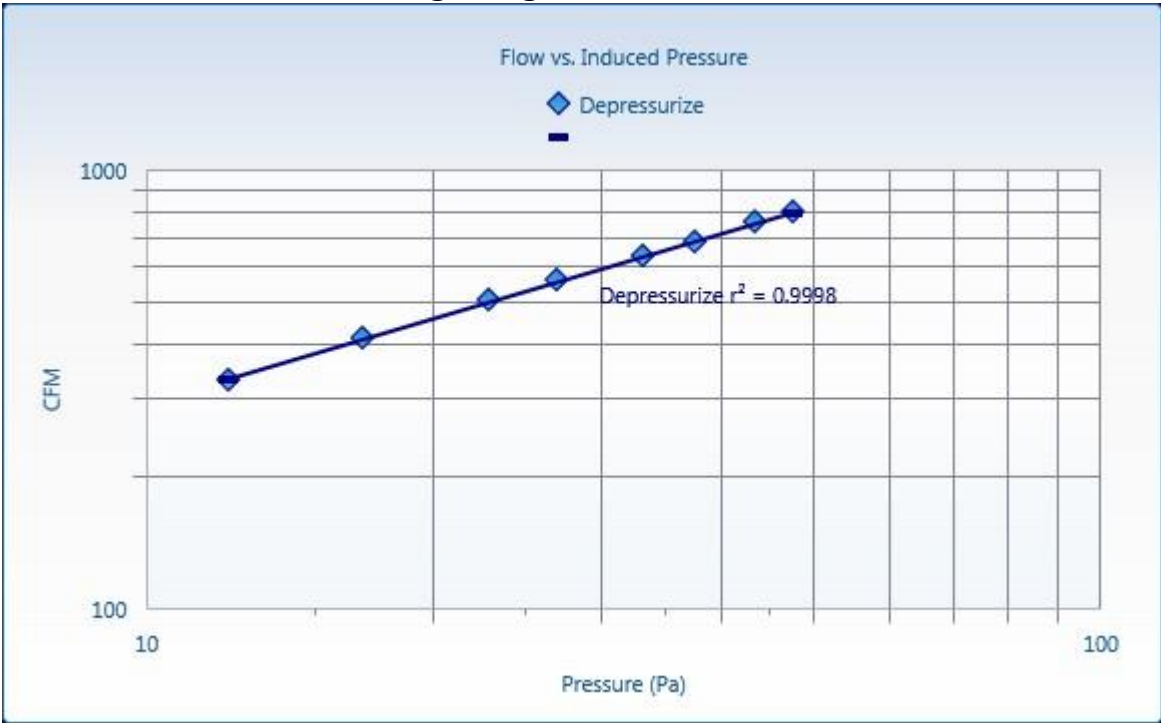
Building pressures taken for **20** seconds.

Baseline pressures taken for **30** seconds.

Building Gauge Pressure



Building Gauge Pressure vs. Flow



Pressurization

Pressurize Set

Environmental Conditions

Wind speed: **0 mph** from the
Wind variability:
Barometric Pressure **101.3 kPa** from **Stand. temp. and pressure**
Operator Location: **Inside** the building

Initial Conditions:

Baseline Pressure: **-1.59 Pa,**
Temperature: indoors: **66 °F**, outdoors: **39 °F**

Final Conditions:

Baseline Pressure: **-1.58 Pa,**
Temperature: indoors: **68 °F**, outdoors: **68 °F**

Test Results

Test Date and Time: **2013-01-31
12:34**

Air leakage coefficient, C,: **54.61 CFM·Paⁿ**

Exponent, n: **0.7116**

Correlation coefficient, r: **0.9986**

Corrected Flow at 50 Pa: **883.5 CFM
+/-0.6%**

Air Changes per hour at 50 Pa: **3.030 /hr
+/-0.6%**

Corrected Flow at 10 Pa: **281.5 CFM
+/-2.1%**

Equivalent Leakage Area: **82.55 sq in at 10
{2-EQLA-error}**

Normalized Leakage Area: **0.021 sq in / sq ft**

Permeability at 50 pa: **0.228 CFM / sq ft**

Specific Leakage rate, SLR at 50 pa: **0.254 cfm / sq ft**

Effective leakage area, EflA at 4 pa: **41.50 sq ft**

Test Data

Set-up Conditions:

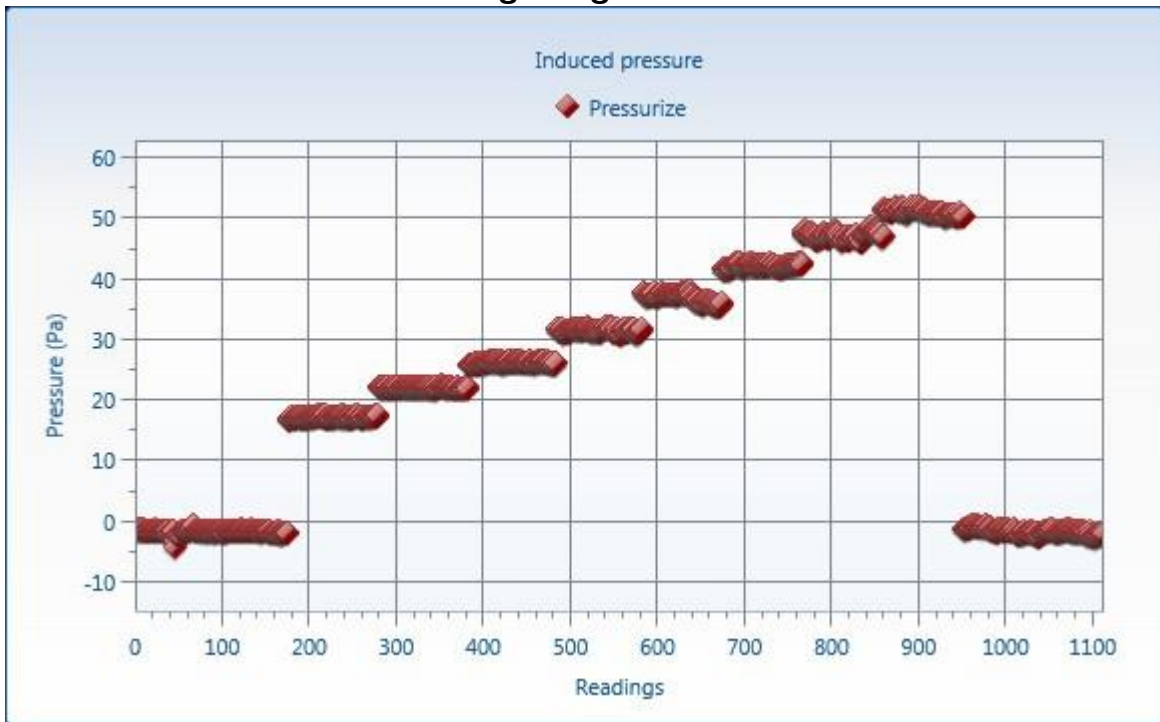
Deviations from the test method:

Induced pressure, ΔP (Pa)	15.7	20.5	24.7	30.0	35.4	40.6	45.6	49.5				
Fan Pressure ΔP (Pa) Range: C8	29	39.3	49.7	65.3	79.9	98.7	110	129.9				
Corrected Fan Pressure ΔP (Pa)	29	39.3	49.7	65.3	79.9	98.7	110	129.9				
Flow Q (CFM)	427.7	498.8	561.9	645.5	716.3	798.8	845.2	921.7				
Corrected Flow Q (CFM)	422.2	492.4	554.7	637.1	707.1	788.5	834.3	909.8				
Error [%]	1.9%	-0.4%	-0.7%	0.0%	-0.8%	0.6%	-1.7%	1.4%				
Range Plate Used	C8	C8	C8	C8	C8	C8	C8	C8				

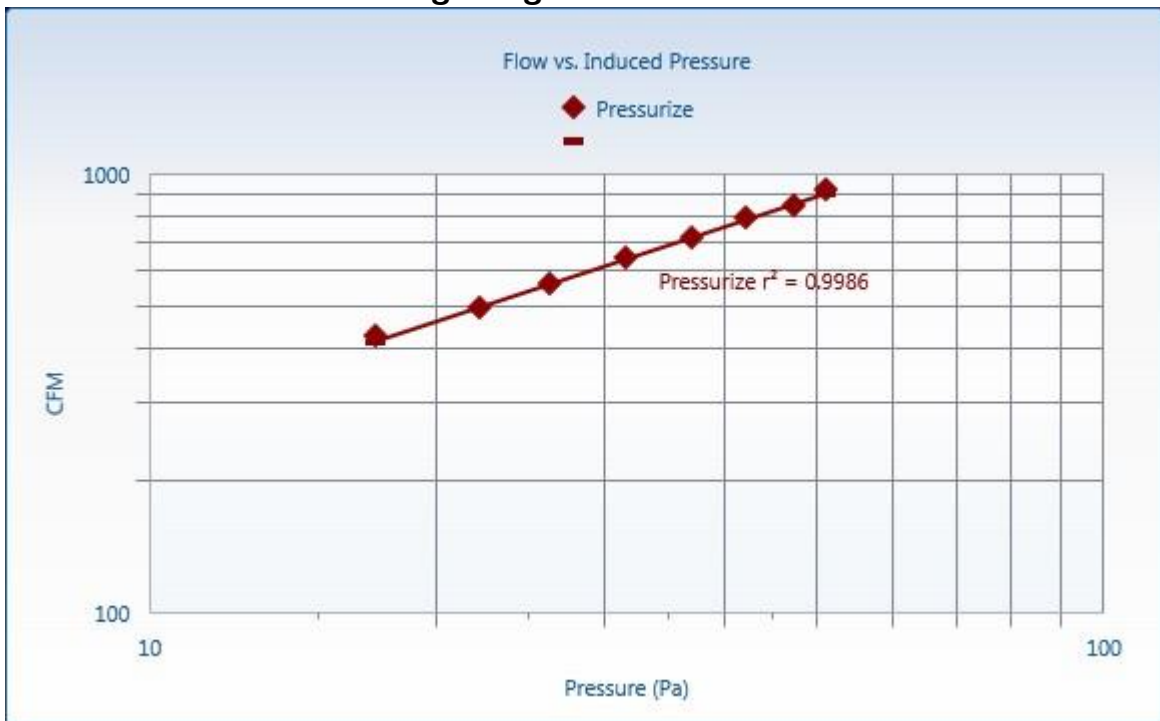
Building pressures taken for **20** seconds.

Baseline pressures taken for **30** seconds.

Building Gauge Pressure



Building Gauge Pressure vs. Flow



Calibration Certificate

Retrotec 3000SR .						
Range	N	K	K1	K2	K3	K4
Open(22)	0.5214	519.618	-0.07	0.8	-0.115	1
A	0.503	264.996	-0.075	1	0	1
B	0.5	174.8824	0	0.3	0	1
C8	0.5	78.5	-0.02	0.5	0.016	1
C6	0.505	61.3	0.054	0.5	0.004	1
C4	0.5077	42	0.009	0.5	0.0009	1
C2	0.52	22	0.11	0.5	-0.001	1
C1	0.541	11.9239	0.13	0.4	-0.0014	1
L4	0.48	4.0995	0.003	1	0.0004	1
L2	0.502	2.0678	0	0.5	0.0001	1
L1	0.4925	1.1614	0.1	0.5	0.0001	1

Infiltrometer Air Leakage Test Results

**In Compliance with CAN/CGSB 149.10-2002
Standards
(Imperial Units)**

Test file name: **Test House #2**
Test technician: **Christopher Black**
Test company: **RDH Building Engineering**

Building address:
Building Volume: **13,401 cu ft**
Envelope Area: **3,266 sq ft**

Building envelope:

Fan Model: **Retrotec 3000SR**

Fan SN:

Gauge Model: **DM-2**

Gauge SN: **97860**

Calibrated:

Calibrated:

Depressurize Set

Environmental Conditions

Wind speed: **0 mph** from the
Wind variability:
Barometric Pressure **101.3 kPa** from **Stand. temp. and pressure**
Operator Location: **Inside** the building

Initial Conditions:

Baseline Pressure: **-2.58 Pa,**
Temperature: indoors: **68 °F**, outdoors: **68 °F**

Final Conditions:

Baseline Pressure: **-2.63 Pa,**
Temperature: indoors: **65 °F**, outdoors: **39 °F**

Test Results

Test Date and Time: **2013-01-31**
14:20

Air leakage coefficient, C_p : **80.70 CFM·Paⁿ**

Exponent, n : **0.6487**

Correlation coefficient, r : **1.000**

Corrected Flow at 50 Pa: **1020 CFM**
+/-0.1%

Air Changes per hour at 50 Pa: **4.570 /hr**
+/-0.1%

Corrected Flow at 10 Pa: **363.0 CFM**
+/-0.3%

Equivalent Leakage Area: **105.5 sq in at 10**
+/-0.3%

Normalized Leakage Area: **0.032 sq in / sq ft**
 Permeability at 50 pa: **0.313 CFM / sq ft**
 Specific Leakage rate, SLR at 50 pa: **0.332 cfm / sq ft**
 Effective leakage area, EflA at 4 pa: **56.15 sq in**

Test Data

Set-up Conditions:

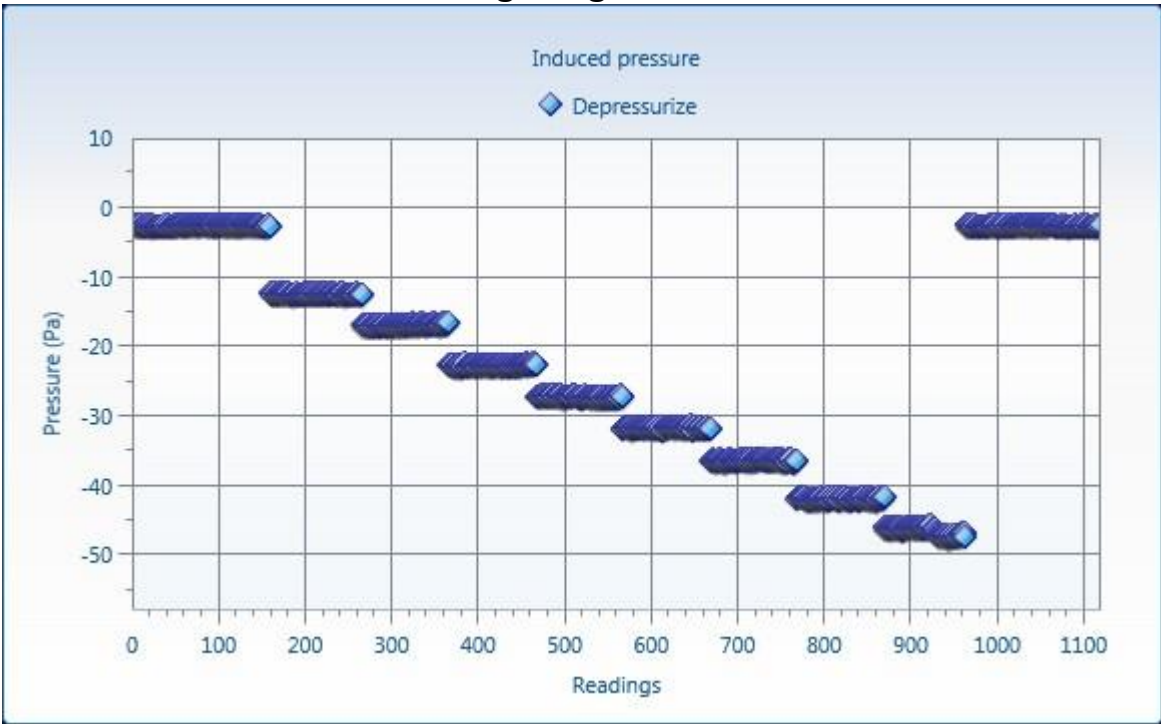
Deviations from the test method:

Induced pressure, ΔP (Pa)	-15.1	-19.5	-25.3	-29.8	-34.3	-39.0	-44.5	-49.1				
Fan Pressure ΔP (Pa) Range: C8	27.5	41.6	60.4	76.2	91.8	108.9	129.5	147.7				
Corrected Fan Pressure ΔP (Pa)	27.5	41.6	60.4	76.2	91.8	108.9	129.5	147.7				
Flow Q _v (CFM)	416.4	513.0	620.1	698.6	768.8	840.5	920.2	986.0				
Corrected Flow Q _v (CFM)	411.2	506.6	612.4	689.9	759.3	830.0	908.7	973.7				
Error [%]	-0.7%	0.3%	0.1%	0.3%	0.0%	0.0%	-0.1%	0.0%				
Range Plate Used	C8	C8	C8	C8	C8	C8	C8	C8				

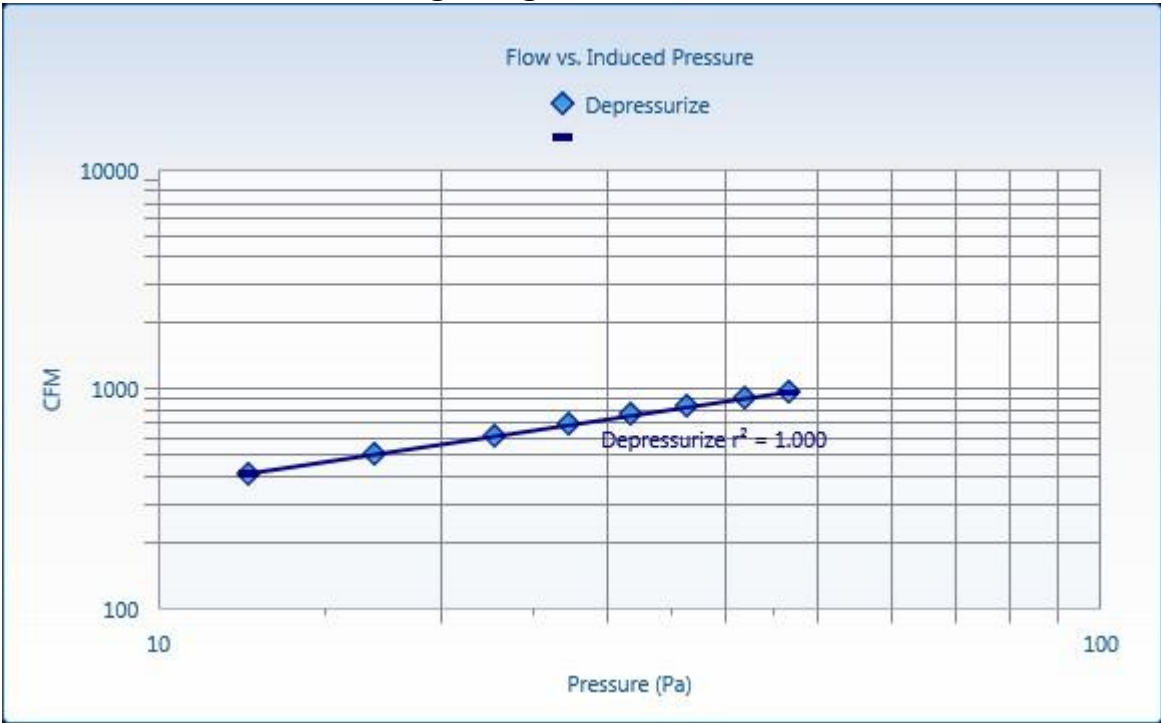
Building pressures taken for **20** seconds.

Baseline pressures taken for **30** seconds.

Building Gauge Pressure



Building Gauge Pressure vs. Flow



Pressurize Set

Environmental Conditions

Wind speed: **0 mph** from the
Wind variability:
Barometric Pressure **101.3 kPa** from **Stand. temp. and pressure**
Operator Location: **Inside** the building

Initial Conditions:
Baseline Pressure: **-2.63 Pa,**
Temperature: indoors: **68 °F**, outdoors: **68 °F**

Final Conditions:
Baseline Pressure: **-1.79 Pa,**
Temperature: indoors: **65 °F**, outdoors: **39 °F**

Test Results

Test Date and Time: **2013-01-31**
15:00

Air leakage coefficient, C_p : **76.55 CFM·Paⁿ**

Exponent, n: **0.6811**

Correlation coefficient, r: **0.9999**

Corrected Flow at 50 Pa: **1100 CFM**
+/-0.2%

Air Changes per hour at 50 Pa: **4.920 /hr**
+/-0.2%

Corrected Flow at 10 Pa: **367.5 CFM**
+/-0.5%

Equivalent Leakage Area: **108.0 sq in at 10**
{2-EQLA-error}

Normalized Leakage Area: **0.033 sq in / sq ft**

Permeability at 50 pa: **0.336 CFM / sq ft**

Specific Leakage rate, SLR at 50 pa: **0.336 cfm / sq ft**

Effective leakage area, EflA at 4 pa: **55.70 sq ft**

Test Data

Set-up Conditions:

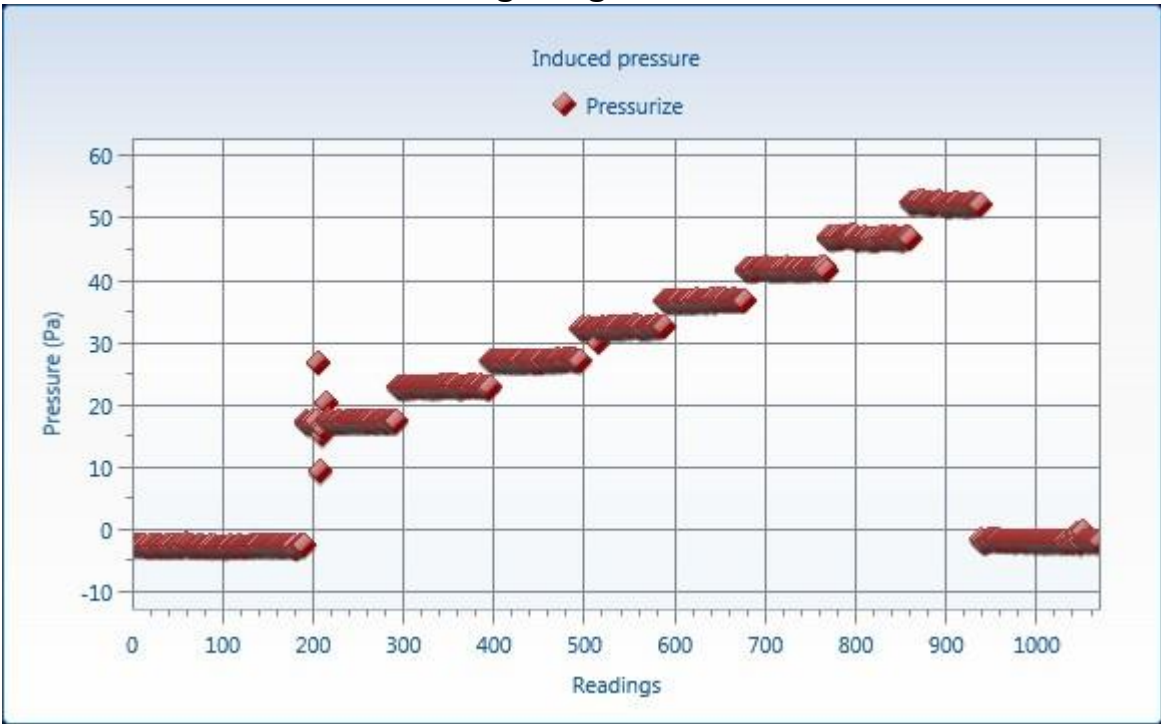
Deviations from the test method:

Induced pressure, ΔP (Pa)	15.2	20.8	24.9	30.3	34.6	39.7	44.7	50.2				
Fan Pressure ΔP (Pa) Range: C8	46.8	66.8	84.5	106.3	124.9	148.1	170	198				
Corrected Fan Pressure ΔP (Pa)	46.8	66.8	84.5	106.3	124.9	148.1	170	198				
Flow Q (CFM)	544.2	652.1	736.1	829.4	902.1	986.7	1061.8	1152.0				
Corrected Flow Q (CFM)	537.4	644.0	726.9	819.1	890.9	974.4	1049	1138				
Error [%]	0.5%	-0.6%	0.3%	0.0%	-0.2%	0.0%	-0.3%	0.3%				
Range Plate Used	C8	C8	C8	C8	C8	C8	C8	C8				

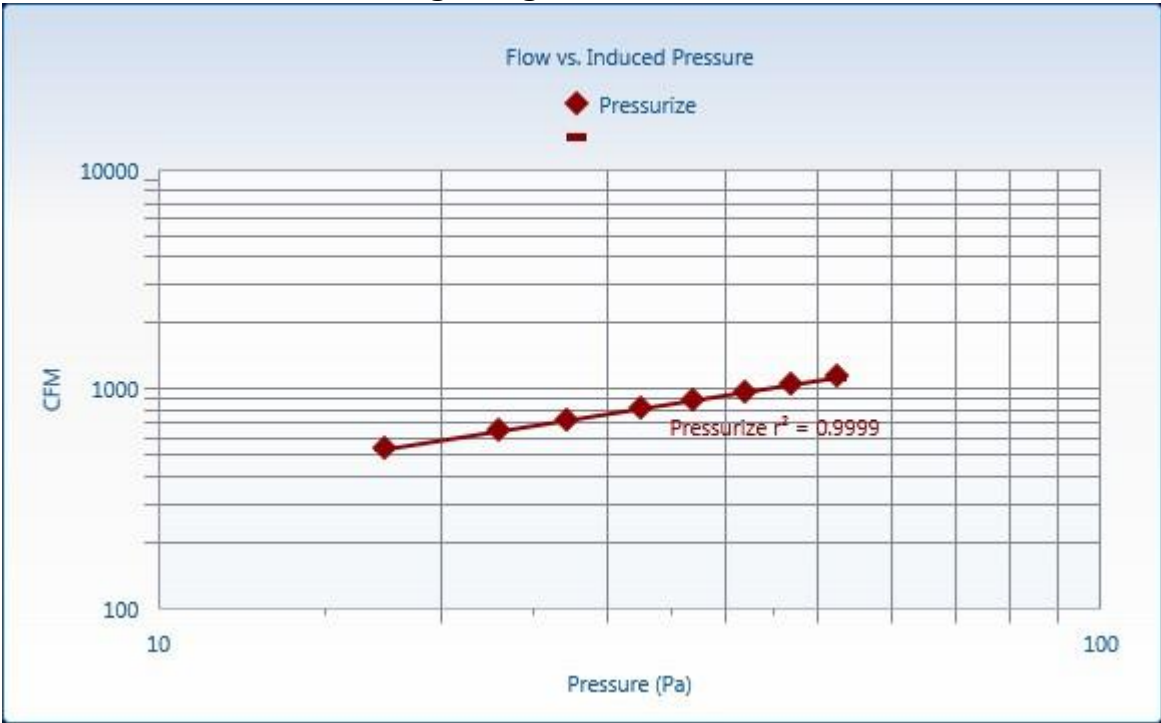
Building pressures taken for **20** seconds.

Baseline pressures taken for **30** seconds.

Building Gauge Pressure



Building Gauge Pressure vs. Flow



Calibration Certificate

Retrotec 3000SR .						
Range	N	K	K1	K2	K3	K4
Open(22)	0.5214	519.618	-0.07	0.8	-0.115	1
A	0.503	264.996	-0.075	1	0	1
B	0.5	174.8824	0	0.3	0	1
C8	0.5	78.5	-0.02	0.5	0.016	1
C6	0.505	61.3	0.054	0.5	0.004	1
C4	0.5077	42	0.009	0.5	0.0009	1
C2	0.52	22	0.11	0.5	-0.001	1
C1	0.541	11.9239	0.13	0.4	-0.0014	1
L4	0.48	4.0995	0.003	1	0.0004	1
L2	0.502	2.0678	0	0.5	0.0001	1
L1	0.4925	1.1614	0.1	0.5	0.0001	1

Infiltrometer Air Leakage Test Results

**In Compliance with CAN/CGSB 149.10-2002
Standards
(Imperial Units)**

Test file name: **Test House #3**
Test technician: **Christopher Black**
Test company: **RDH Building Engineering**

Building address:
Building Volume: **33,412 cu ft**
Envelope Area: **6,728 sq ft**

Building envelope:

Fan Model: **Retrotec 3000**

Fan SN:

Gauge Model: **DM-2**

Gauge SN: **200949**

Calibrated:

Calibrated:

Depressurize Set

Environmental Conditions

Wind speed: **0 mph** from the
Wind variability: **dead calm**
Barometric Pressure **101.3 kPa** from **Stand. temp. and pressure**
Operator Location: **Inside** the building

Initial Conditions:

Baseline Pressure: **-1.40 Pa,**
Temperature: indoors: **72 °F**, outdoors: **60 °F**

Final Conditions:

Baseline Pressure: **-1.34 Pa,**
Temperature: indoors: **68 °F**, outdoors: **68 °F**

Test Results

Test Date and Time: **2013-02-03**
09:29

Air leakage coefficient, C_p : **192.5 CFM·Paⁿ**

Exponent, n: **0.3622**

Correlation coefficient, r: **0.9097**

Corrected Flow at 50 Pa: **794.0 CFM**
+/-4.3%

Air Changes per hour at 50 Pa: **1.425 /hr**
+/-4.3%

Corrected Flow at 10 Pa: **445.0 CFM**
+/-8.6%

Equivalent Leakage Area: **130.0 sq in at 10**
+/-8.6%

Normalized Leakage Area: **0.019 sq in / sq ft**

Permeability at 50 pa: **0.118 CFM / sq ft**
 Specific Leakage rate, SLR at 50 pa: **0.157 cfm / sq ft**
 Effective leakage area, EflA at 4 pa: **90.11 sq in**

Test Data

Set-up Conditions:

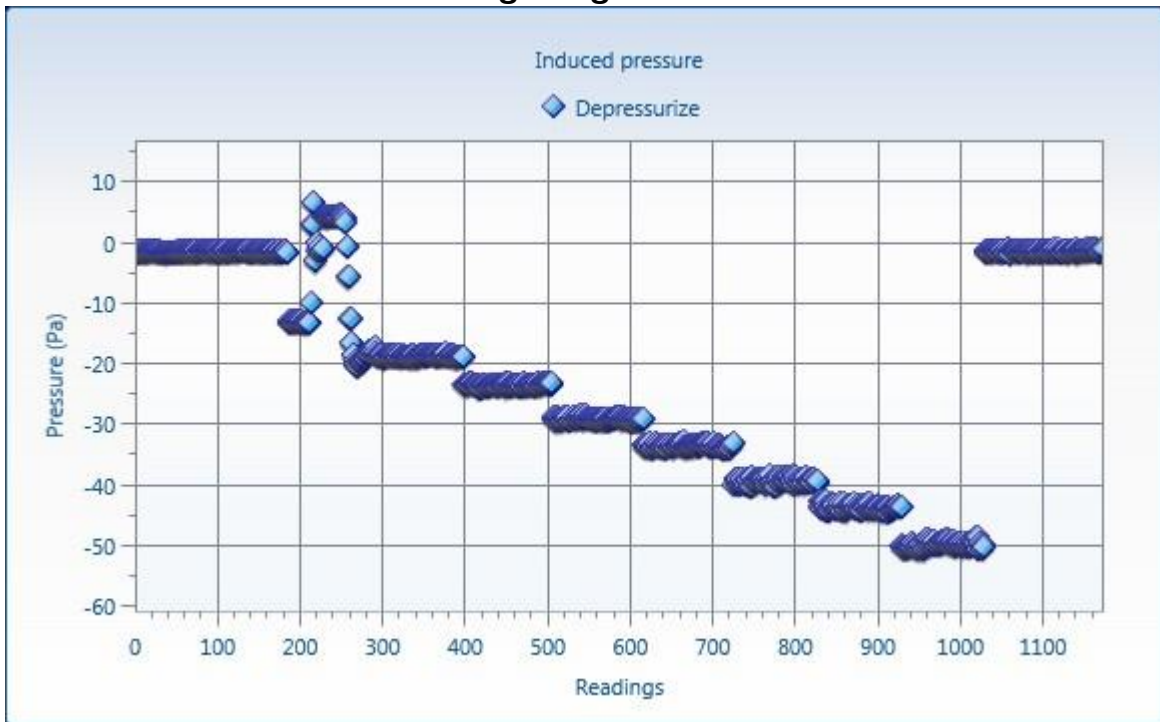
Deviations from the test method:

Induced pressure, ΔP_s (Pa)	-9.2	-20.0	-24.8	-30.4	-34.9	-40.6	-45.0	-51.2				
Fan Pressure ΔP (Pa) Range: C6	62.3	58.6	75.3	96.9	114.5	137.9	155.8	178.5				
Corrected Fan Pressure ΔP (Pa)	62.3	58.6	75.3	96.9	114.5	137.9	155.8	178.5				
Flow Q _v (CFM)	484.6	476.1	541.4	616.0	671.1	738.3	786.4	843.5				
Corrected Flow Q (CFM)	481.8	473.4	538.3	612.5	667.3	734.1	782.0	838.7				
Error [%]	18.8%	-14.8%	-10.8%	-6.1%	-2.8%	0.9%	3.5%	5.8%				
Range Plate Used	C6	C6	C6	C6	C6	C6	C6	C6				

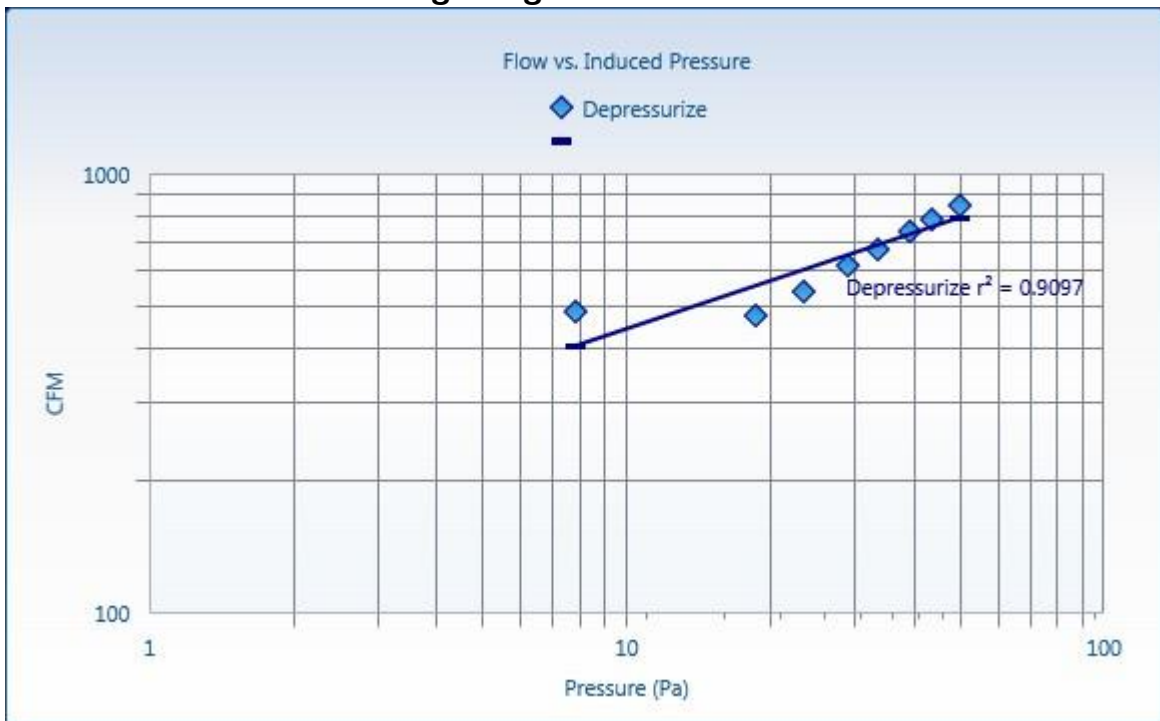
Building pressures taken for **20** seconds.

Baseline pressures taken for **30** seconds.

Building Gauge Pressure



Building Gauge Pressure vs. Flow



Pressurize Set

Environmental Conditions

Wind speed: **0 mph** from the
Wind variability: **dead calm**
Barometric Pressure **101.3** kPa from **Stand. temp. and pressure**
Operator Location: **Inside** the building

Initial Conditions:
Baseline Pressure: **-1.07 Pa,**
Temperature: indoors: **72 °F**, outdoors: **60 °F**

Final Conditions:
Baseline Pressure: **-0.56 Pa,**
Temperature: indoors: **68 °F**, outdoors: **68 °F**

Test Results

Test Date and Time: **2013-02-03**
10:16

Air leakage coefficient, C_p : **42.00 CFM·Paⁿ**

Exponent, n: **0.7959**

Correlation coefficient, r: **0.9998**

Corrected Flow at 50 Pa: **945.0 CFM**
+/-0.3%

Air Changes per hour at 50 Pa: **1.695 /hr**
+/-0.3%

Corrected Flow at 10 Pa: **262.5 CFM**
+/-0.9%

Equivalent Leakage Area: **77.00 sq in at 10**
{2-EQLA-error}

Normalized Leakage Area: **0.012 sq in / sq ft**

Permeability at 50 pa: **0.141 CFM / sq ft**

Specific Leakage rate, SLR at 50 pa: **0.092 cfm / sq ft**

Effective leakage area, EflA at 4 pa: **35.85 sq ft**

Test Data

Set-up Conditions:

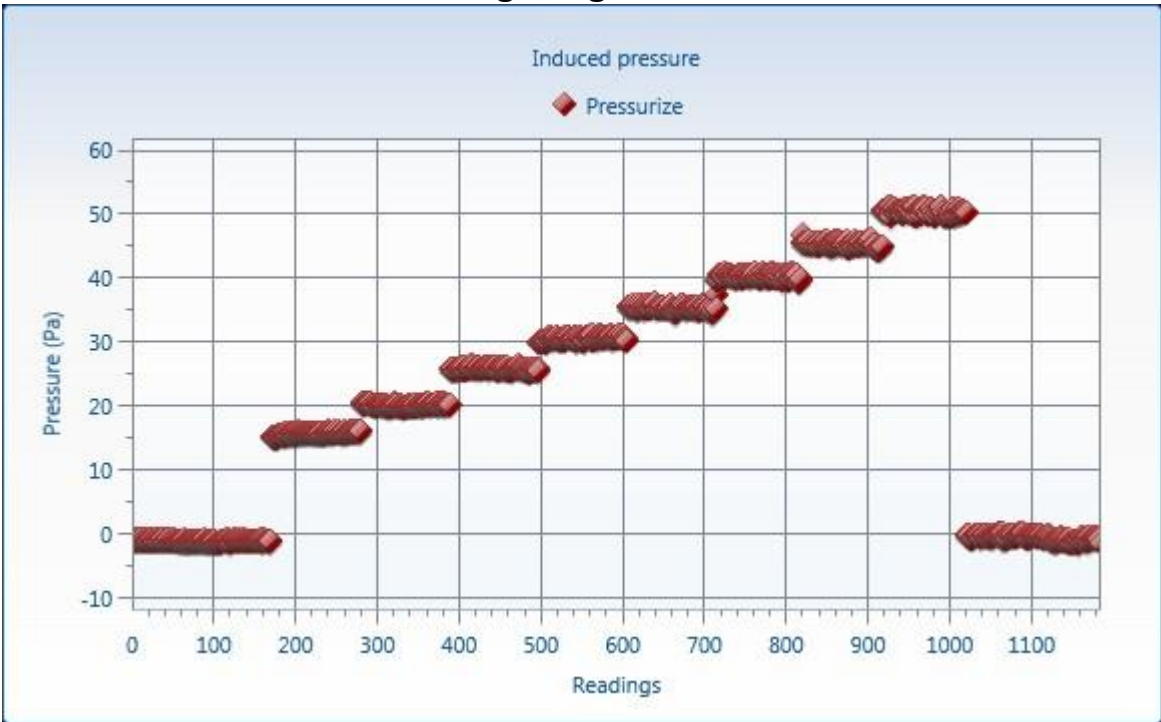
Deviations from the test method:

Induced pressure, ΔP (Pa)	14.9	19.4	25.1	29.8	34.6	39.5	44.5	49.7				
Fan Pressure ΔP (Pa) Range: C6	51.8	74.4	105.1	136.7	167.5	201.5	238.3	274.4				
Corrected Fan Pressure ΔP (Pa)	36.9	55.1	80.1	106.9	132.9	162	193.8	224.7				
Flow Q (CFM)	375.6	461.2	558.8	648.3	725.2	803.3	881.6	952.2				
Corrected Flow Q (CFM)	373.4	458.6	555.7	644.6	721.1	798.7	876.6	946.8				
Error [%]	-0.8%	-0.1%	-0.7%	0.8%	0.4%	0.3%	0.2%	-0.6%				
Range Plate Used	C6	C6	C6	C6	C6	C6	C6	C6				

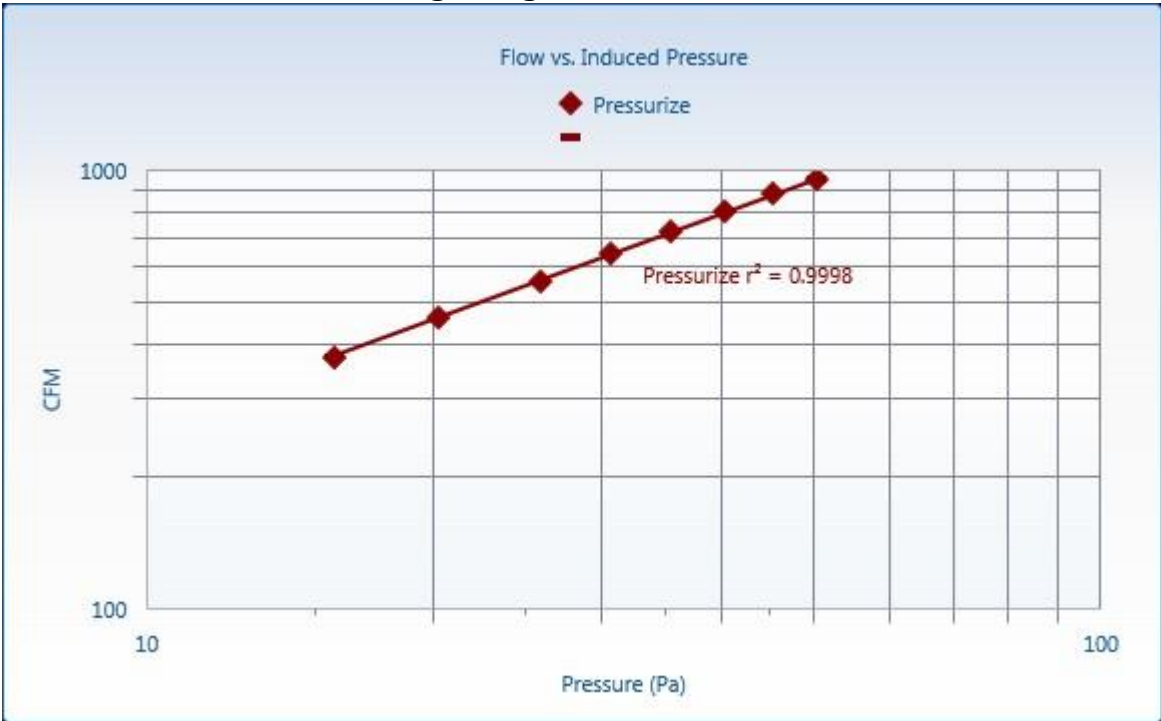
Building pressures taken for **20** seconds.

Baseline pressures taken for **30** seconds.

Building Gauge Pressure



Building Gauge Pressure vs. Flow



Calibration Certificate

Retrotec 3000 .						
Range	N	K	K1	K2	K3	K4
Open(22)	0.5214	519.618	-0.07	0.8	-0.115	1
A	0.503	264.996	-0.075	1	0	1
B	0.5	174.8824	0	0.3	0	1
C8	0.5	78.5	-0.02	0.5	0.016	1
C6	0.505	61.3	0.054	0.5	0.004	1
C4	0.5077	42	0.009	0.5	0.0009	1
C2	0.52	22	0.11	0.5	-0.001	1
C1	0.541	11.9239	0.13	0.4	-0.0014	1
L4	0.48	4.0995	0.003	1	0.0004	1
L2	0.502	2.0678	0	0.5	0.0001	1
L1	0.4925	1.1614	0.1	0.5	0.0001	1

Infiltrometer Air Leakage Test Results

**In Compliance with CAN/CGSB 149.10-2002
Standards
(Imperial Units)**

Permeability at 50 pa: **0.703 CFM / sq ft**
 Specific Leakage rate, SLR at 50 pa: **0.367 cfm / sq ft**
 Effective leakage area, EflA at 4 pa: **163.5 sq in**

Test Data

Set-up Conditions:

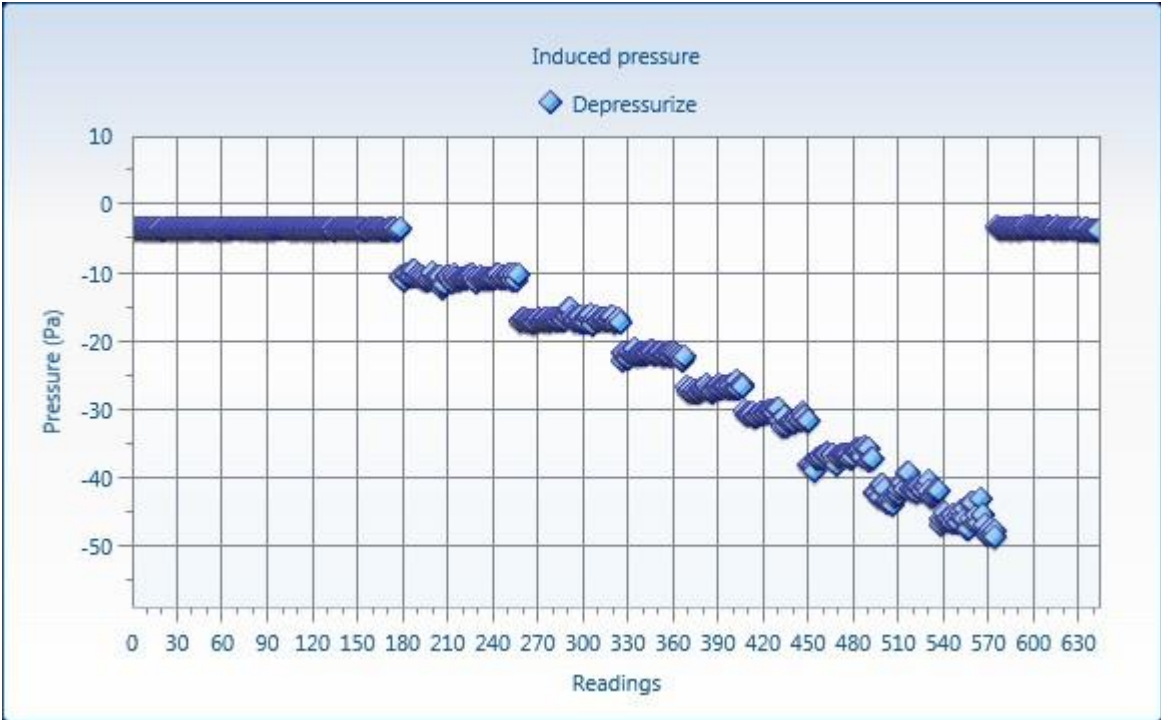
Deviations from the test method:

Induced pressure, ΔP_s (Pa)	-14.3	-20.4	-25.5	-30.5	-34.6	-40.4	-45.5	-49.8				
Fan Pressure ΔP (Pa) Range: A	15.7	30	43.1	57.2	68.9	84.2	101	116.6				
Corrected Fan Pressure ΔP (Pa)	15.7	30	43.1	57.2	68.9	84.2	101	116.6				
Flow Q_s (CFM)	1095.0	1504.3	1797.4	2068.1	2269.1	2508.6	2745.9	2949.2				
Corrected Flow Q (CFM)	1095	1504	1797	2068	2269	2509	2746	2949				
Error [%]	-1.5%	0.1%	0.3%	0.8%	0.7%	-0.9%	-0.4%	0.3%				
Range Plate Used	A	A	A	A	A	A	A	A				

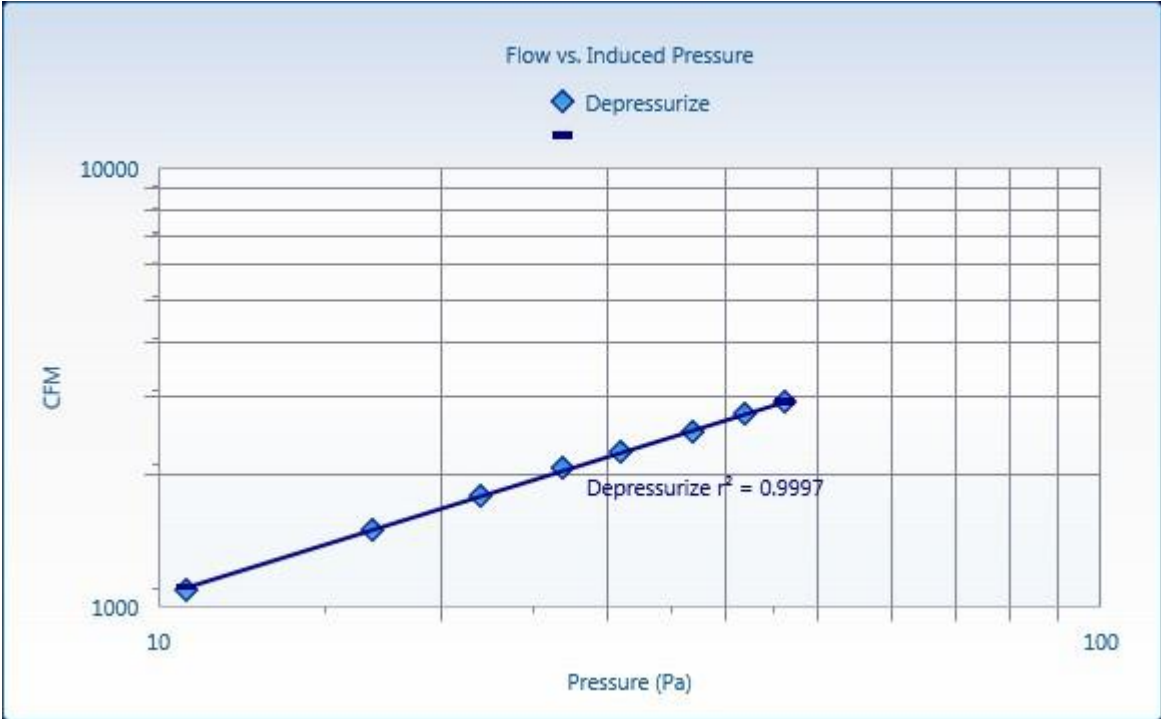
Building pressures taken for **20** seconds.

Baseline pressures taken for **30** seconds.

Building Gauge Pressure



Building Gauge Pressure vs. Flow



Garage door frame sealed, fan off.

Depressurize Set

Environmental Conditions

Wind speed: **0 mph** from the
Wind variability:
Barometric Pressure **101.3 kPa** from **Stand. temp. and pressure**
Operator Location: **Inside** the building

Initial Conditions:

Baseline Pressure: **-3.71 Pa,**
Temperature: indoors: **68 °F**, outdoors: **68 °F**

Final Conditions:

Baseline Pressure: **-3.74 Pa,**
Temperature: indoors: **68 °F**, outdoors: **68 °F**

Test Results

Test Date and Time: **2013-02-15**
09:35

Air leakage coefficient, C_p : **245.0 CFM·Paⁿ**

Exponent, n: **0.6441**

Correlation coefficient, r: **0.9978**

Corrected Flow at 50 Pa: **3045 CFM**
+/-1.0%

Air Changes per hour at 50 Pa: **6.425 /hr**
+/-1.0%

Corrected Flow at 10 Pa: **1070 CFM**
+/-2.2%

Equivalent Leakage Area: **316.0 sq in at 10**
{2-EQLA-error}

Normalized Leakage Area: **0.072 sq in / sq ft**

Permeability at 50 pa: **0.690 CFM / sq ft**

Specific Leakage rate, SLR at 50 pa: **0.373 cfm / sq ft**

Effective leakage area, EflA at 4 pa: **169.5 sq ft**

Test Data

Set-up Conditions:

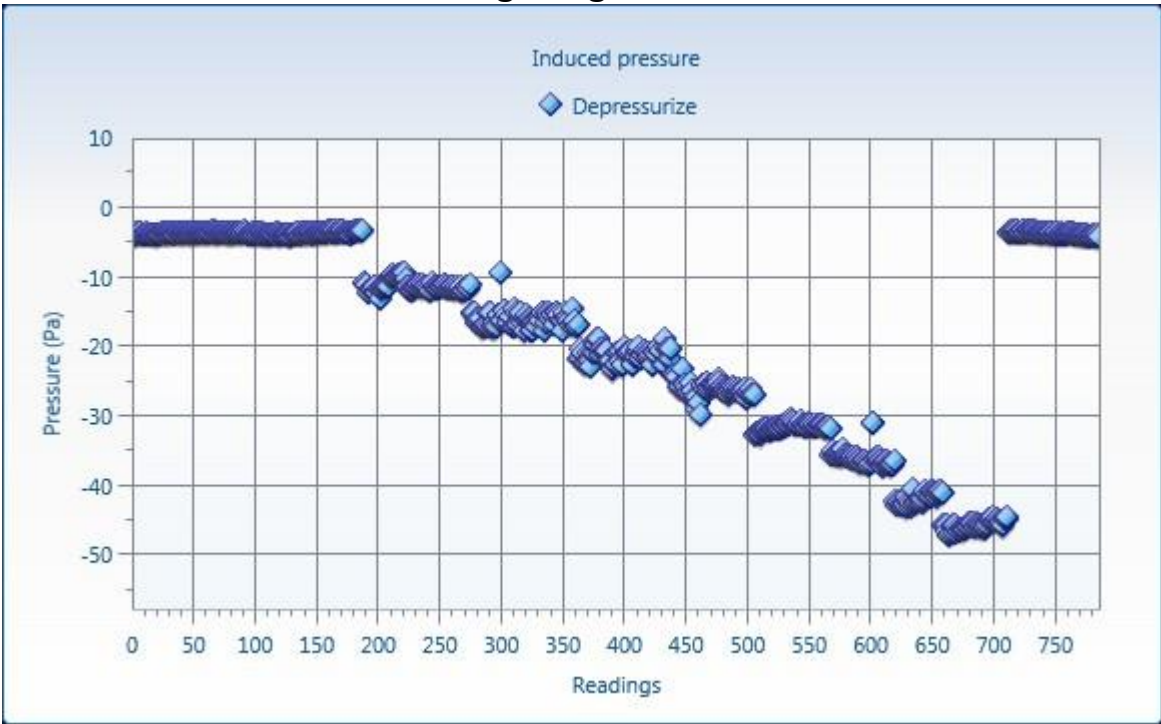
Deviations from the test method:

Induced pressure, ΔP_i (Pa)	-15.0	-19.8	-25.0	-29.9	-35.3	-39.8	-45.6	-49.5				
Fan Pressure ΔP (Pa) Range: A	19.6	28.6	37.3	53.5	67.8	83	99.3	110.8				
Corrected Fan Pressure ΔP (Pa)	19.6	28.6	37.3	53.5	67.8	83	99.3	110.8				
Flow Q_i (CFM)	1215.9	1469.6	1677.7	2001.2	2252.0	2490.4	2723.9	2876.3				
Corrected Flow Q (CFM)	1216	1470	1678	2001	2252	2490	2724	2876				
Error [%]	4.2%	0.3%	-4.4%	-0.1%	-0.5%	1.0%	0.3%	0.1%				
Range Plate Used	A	A	A	A	A	A	A	A				

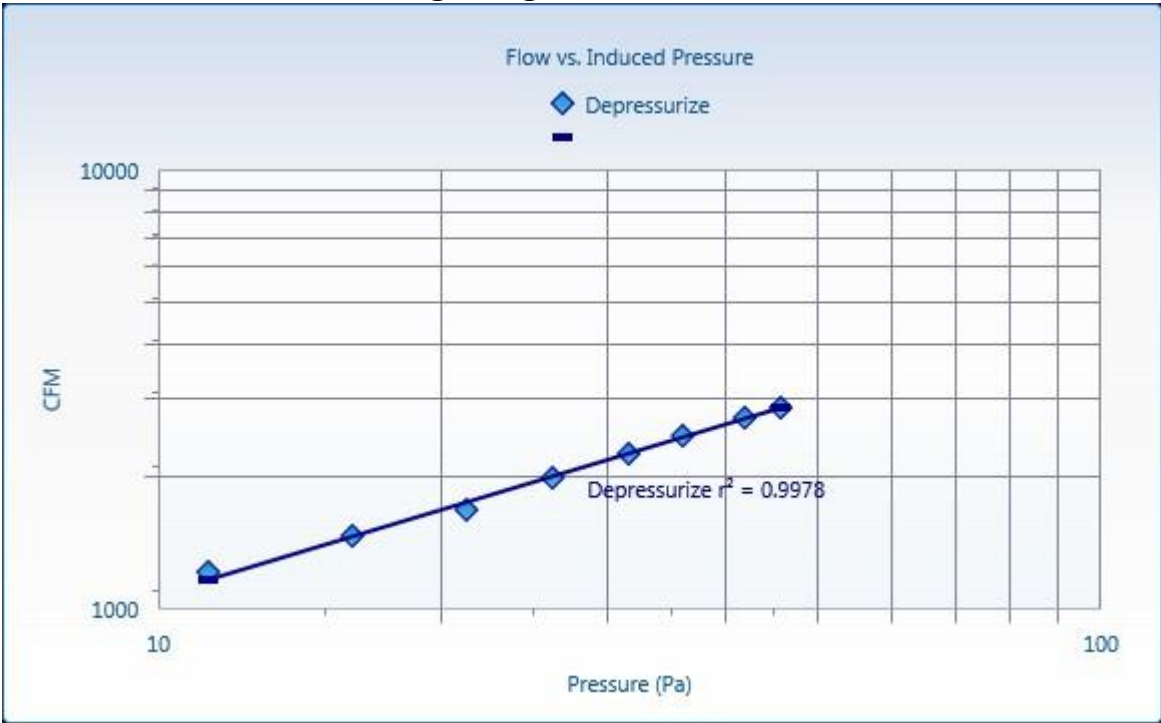
Building pressures taken for **20** seconds.

Baseline pressures taken for **30** seconds.

Building Gauge Pressure



Building Gauge Pressure vs. Flow



Calibration Certificate

Range	N	K	K1	K2	K3	K4
Open(22)	0.5214	519.618	-0.07	0.8	-0.115	1
A	0.503	264.996	-0.075	1	0	1
B	0.5	174.8824	0	0.3	0	1
C8	0.5	78.5	-0.02	0.5	0.016	1
C6	0.505	61.3	0.054	0.5	0.004	1
C4	0.5077	42	0.009	0.5	0.0009	1
C2	0.52	22	0.11	0.5	-0.001	1
C1	0.541	11.9239	0.13	0.4	-0.0014	1
L4	0.48	4.0995	0.003	1	0.0004	1
L2	0.502	2.0678	0	0.5	0.0001	1
L1	0.4925	1.1614	0.1	0.5	0.0001	1