Air Leakage Test Report

In compliance with ATTMA TSL1 and TSL2 and AS/NZS ISO 9972:2015

Efficiency Matrix
Building Envelope & Air Tightness

Building Address:	1 Efficiency Matrix Road Glen Waverley, Melbourne Victoria Australia 3150
Performed for:	Joe Bloggs
Performed by:	John Konstantakopoulos
Test date:	2018-04-28

green building council australia
MEMBER 2018-2019

Summary

Test date: **2018-04-28**	By: **John Konstantakopoulos**
Customer:	**Joe Bloggs**
Building address:	**1 Efficiency Matrix Road** **Glen Waverley, Melbourne** **Victoria** **Australia** **3150**

Building and Test Information	
Test file name:	**Generic Air tightness Report**
Building volume:	**370**
Building Height (from ground to top):	**0**
Floor Area:	**125**
Envelope Area:	**290**

Results	
Air flow at 50 Pa, Q_{50} [m^3/h]	**3462.5**
Air changes, n_{50}	**9.36 ACH@50Pa**
Equivalent leakage area at 50 Pa [cm^2]	**966.5**
Permeability at 50 Pa [$m^3/h/m^2$]	**11.940 +/-2.0%**

Building Information

Building Measurements

Building Volume [m^3]:	370
Building Floor Area [m^2]:	125
Envelope Area (A_T) [m^2]:	290

Measurements of the envelope area were developed using Adobe Acrobat and PDF plans. The extent of the test areas was confirmed with the project team.

Construction Type:

- Brick Vaneer
- Concrete tiled roof

Test Method

Carried out by the following standards:

- ATTMA TS1 Issue 2 – Measuring Air Permeability of Building Envelopes
- AS/NZS ISO 9972:2015 - Thermal performance of buildings— Determination of air permeability of buildings—Fan pressurization method.

- BS EN13829:2001 Thermal Performance of Buildings
- BINDT – Quality Procedures and Explanatory Notes for Air Tightness Testing

The building was tested using the equipment listed in the equipment appendix.

Information on residential air tightness

http://efficiencymatrix.com.au/residential-blower-door-testing/

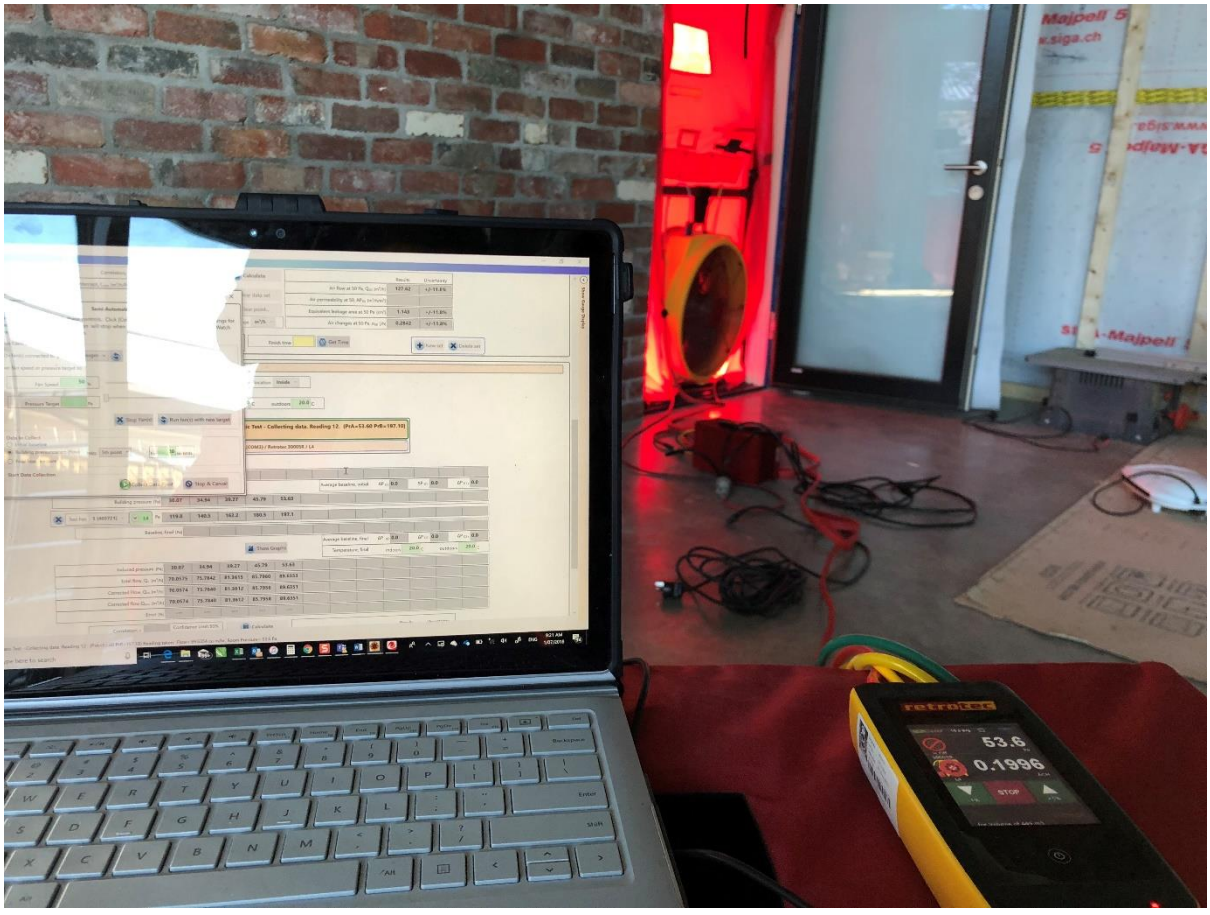
http://efficiencymatrix.com.au/upside-residential-energy-efficiency-retrofit/

http://efficiencymatrix.com.au/how-can-air-leakage-testing-help-you/

http://efficiencymatrix.com.au/the-pyramid-for-building-renovating-smarter/

http://efficiencymatrix.com.au/how-air-tightness-fixes-air-quality-even-mould/

http://efficiencymatrix.com.au/the-evolution-of-heating-the-home/



Openings and Temporary Sealing

The building was prepared by Efficiency Matrix in accordance with common practices according to ATTMA TS1 Issue 2, AS/NZS ISO 9972:2015, and NEBB Building Enclosure Testing specifications. Preparations are shown below, with additional information located in the Building Preparation Appendix.

Blower door Fan setup

https://www.youtube.com/watch?v=oG511Ewx3iM

Test Notes

The test was conducted by ATTMA TSL2 standards and AS/NZS ISO 9972:2015, including the following procedures:

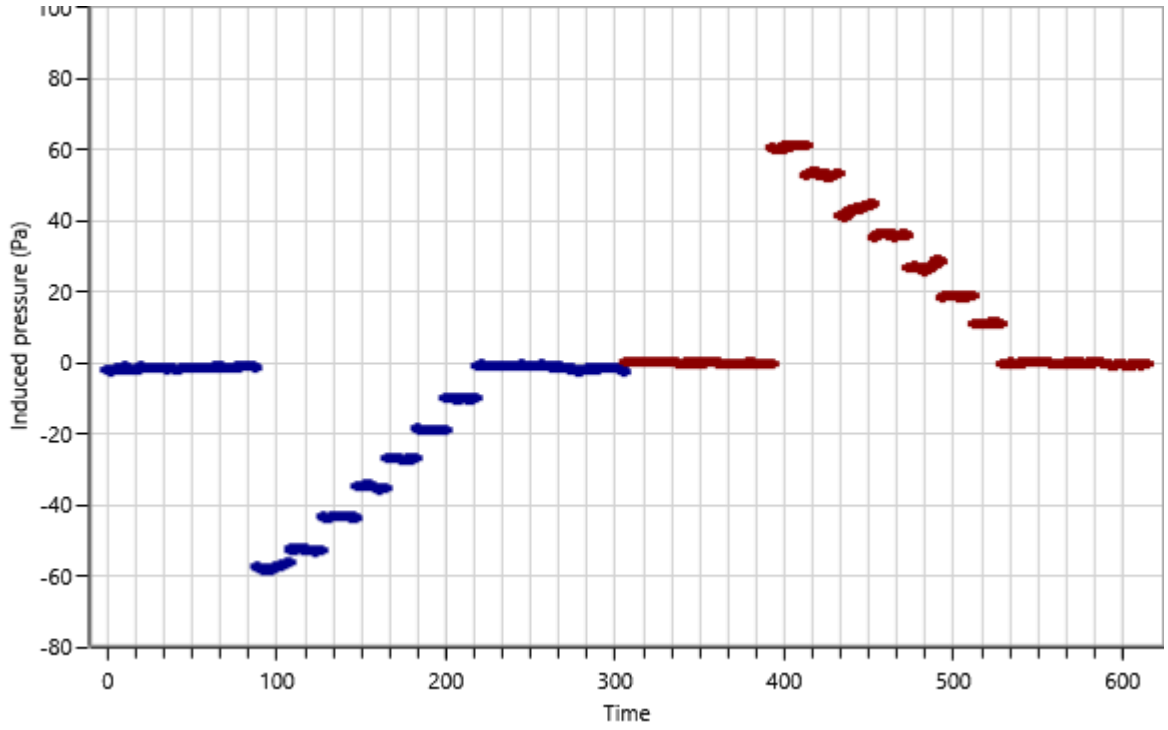
- Fans and pressure measuring devices have been calibrated and are within the accuracy specifications of the standard
- Weather conditions were observed for their potential impact on measurement quality
- Baseline pressure measurements were taken to establish whether the building was under significant influence of stack effect or weather conditions
- Pressure and flow measurements were taken at some points
- A regression analysis was conducted on the log of flow and pressure measurements
- Leakage coefficients (C) and pressure exponents (n) were determined from this regression

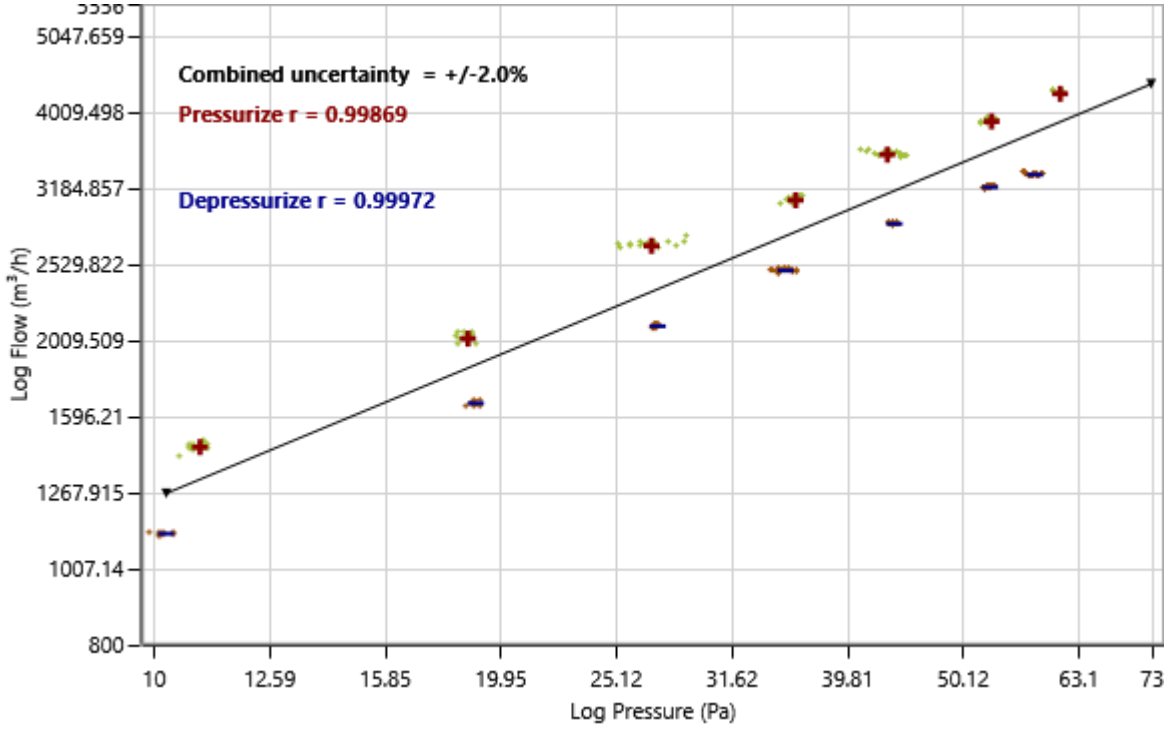
The data show excellent correlation between pressure and flow measurements and provide confidence in the reported leakage rates. The r^2 value, denoting correlation between pressure and flow measurements, was greater than 0.98 as required by ATTMA (was 0.99972), indicating a high quality of data. Further information about the test results and ATTMA guidelines is below.

Discussion of Results

Combined Test Data (Average Values)

	Results	Uncertainty
Air flow at 50 Pa, Q_{50} [m^3/h]	3462.5	+/-2.0%
Air changes, n_{50}	**9.36 ACH@50Pa**	**+/-2.0%**
Equivalent leakage area at 50 Pa [cm^2]	966.5	+/-2.0%
Permeability at 50 Pa [$m^3/h/m^2$]	**11.940**	**+/-2.0%**


Induced pressure (Pa)
100
80
60
40
20
0
-20
-40
-60
-80
0
100
200
300
400
500
600
Time


Combined uncertainty = +/-2.0%
Pressurize r = 0.99869
Depressurize r = 0.99972
Log Flow (m³/h)
5047.659
4009.498
3184.857
2529.822
2009.509
1596.21
1267.915
1007.14
800
10
12.59
15.85
19.95
25.12
31.62
39.81
50.12
63.1
73
Log Pressure (Pa)

Air Leakage Test Data Appendix

Depressurize Data Set

Test Dataset Date and Time: 2018-04-28-10:24

Environmental Conditions		
Wind speed:	1m/s	from the West
Operator Location:	Inside the building	
Initial Bias Pressure:	-1.61 Pa	
Final Bias Pressure:	-1.39 Pa	
Initial Temperature:	indoors: 18	outdoors: 15.
Final Temperature:	indoors: 17	outdoors: 15.
Barometric Pressure	101.3 kPa	from Direct measurement

Test Analysis			
Correlation, r:	0.99972	95% confidence limits	
Slope, n:	0.635	0.61801	0.65287
Intercept, C_{env} [$m^3/h/Pa^n$]:	257.50	242.4	273.5

	Results	Uncertainty	
Air flow at 50 Pa, Q_{50} m^3/h	3093.0	+/-1.3%	
Air changes, n_{50}:	8.359	+/-1.3%	
Equivalent leakage area at 50 Pa [cm^2]	847.1	+/-1.3%	
Permeability at 50 Pa, AP_{50} [$m^3/h/m^2$]	10.6655	+/-1.3%	

Measured pressure [Pa]		-59.1	-54.2	-45.0	-36.5	-28.7	-20.4	-11.7
#1, Range B	Fan Pressure [Pa]	125.2	116.1	93.1	70.1	50.0	31.4	14.3
	Flow [m^3/h]	3324	3201	2866	2487	2102	1665	1122

Total Flow, Q_c [m^3/h]		3324.36	3201.16	2866.14	2486.81	2101.81	1665.26	1122.06
Corrected Flow, Q_{env} [m^3/h]		3324.35	3201.15	2866.13	2486.80	2101.81	1665.25	1122.05
Error [%]		-1.7%	0.2%	1.2%	0.8%	0.1%	-0.1%	-0.4%

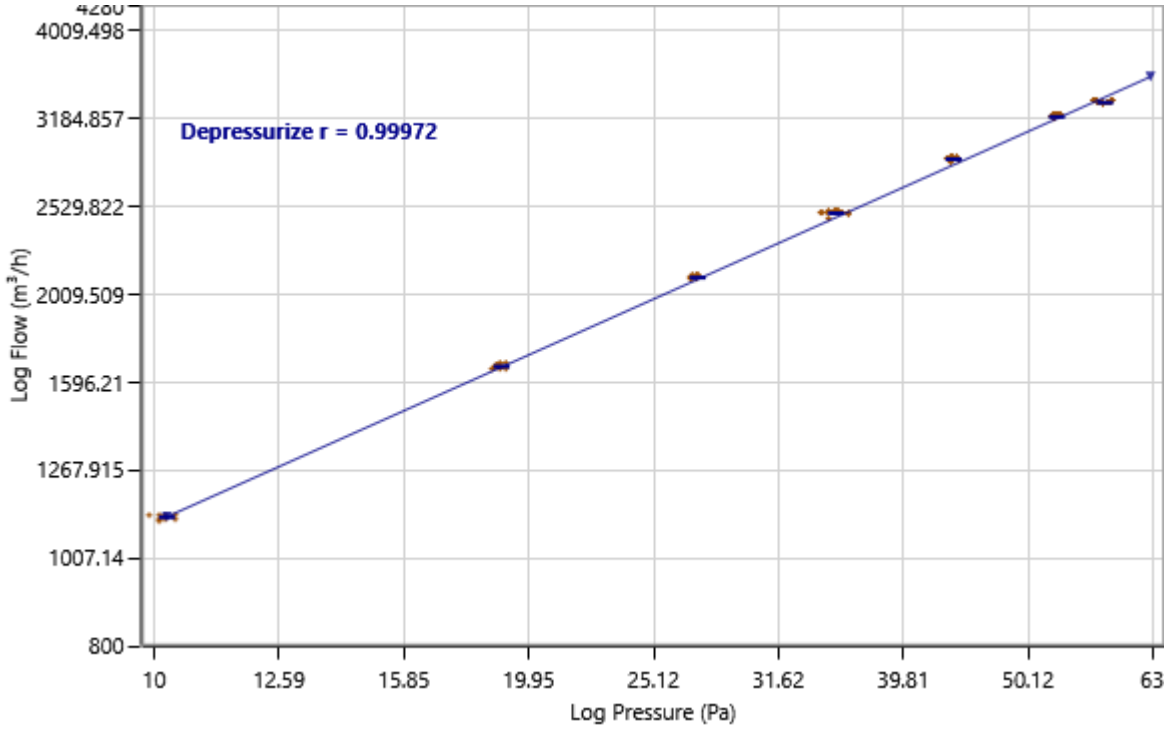
7 induced pressures each taken for 20 of the required 20 seconds.

8 baseline pressures each taken for 10 of the required 10 seconds.

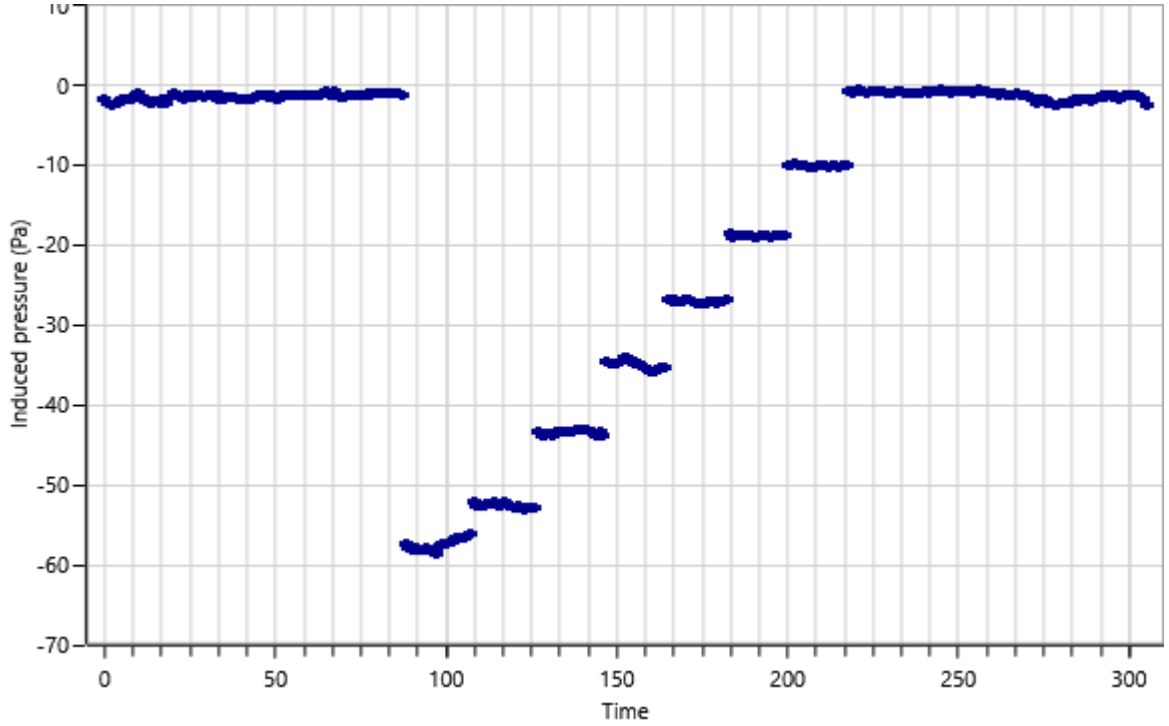
Static Pressure Averages:			
initial [Pa]	ΔP01 -1.61	ΔP01- -1.61	ΔP01+ 0.00
final [Pa]	ΔP02 -1.39	ΔP02- -1.39	ΔP02+ 0.00

Baseline, initial [Pa]	-1.99	-1.97	-1.55	-1.82	-1.57	-1.37	-1.43	-1.21
Baseline, final [Pa]	-0.92	-1.06	-0.92	-0.96	-1.44	-2.31	-1.80	-1.72

Induced Pressure vs. Flow (Depressurize Set)



Building Gauge Pressure (Depressurize Set)



Pressurize Data Set

Test Dataset Date and Time: 2018-04-28-10:34

Test was carried out under (method A, B or C).

Environmental Conditions		
Wind speed:	1m/s	from the West
Operator Location:	Inside the building	
Initial Bias Pressure:	-0.25 Pa	
Final Bias Pressure:	-0.41 Pa	
Initial Temperature:	indoors: 17	outdoors: 15.
Final Temperature:	indoors: 17	outdoors: 15.
Barometric Pressure	101.3 kPa	from Direct measurement

Test Analysis			
Correlation, r:	0.99869	95% confidence limits	
Slope, n:	0.628	0.59073	0.66464
Intercept, C_{env} [m³/h/m²]:	328.88	289.2	374.0

	Results	Uncertainty	
Air flow at 50 Pa, Q_{50} m³/h	3832.2	+/-2.7%	
Air changes, n_{50}:	10.36	+/-2.7%	
Equivalent leakage area at 50 Pa [cm²]	1086	+/-2.7%	
Permeability at 50 Pa, AP_{50} [m³/h/m²]	13.2146	+/-2.7%	

Measured pressure [Pa]		60.2	52.5	42.6	35.4	26.5	18.3	10.6
#1, Range B	Fan Pressure [Pa]	205.6	174.0	142.3	108.0	81.9	46.7	24.2
	Flow [m³/h]	4261	3919	3544	3087	2689	2031	1462

Total Flow, Q_c [m³/h]		4260.88	3919.05	3543.97	3087.50	2689.03	2030.95	1462.15
Corrected Flow, Q_{env} [m³/h]		4260.87	3919.04	3543.96	3087.49	2689.02	2030.95	1462.15
Error [%]		-1.4%	-1.2%	1.8%	-0.6%	3.7%	-1.5%	-0.8%

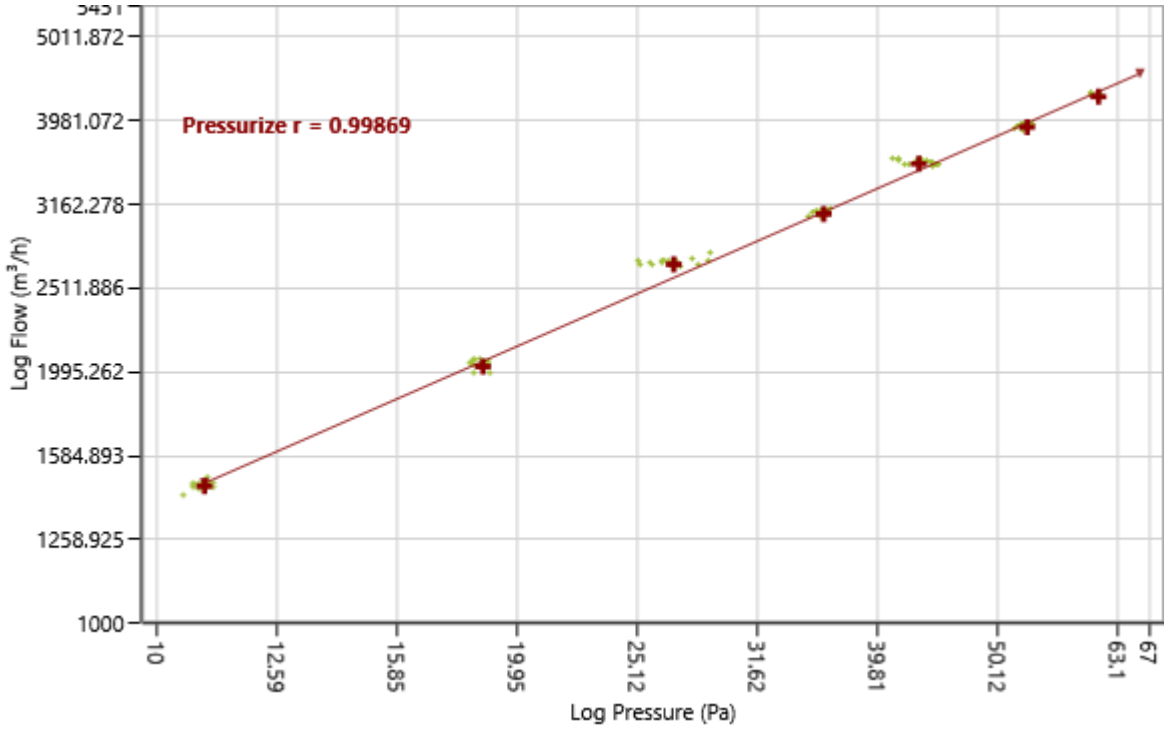
7 induced pressures each taken for 20 of the required 20 seconds.

8 baseline pressures each taken for 10 of required 10 seconds.

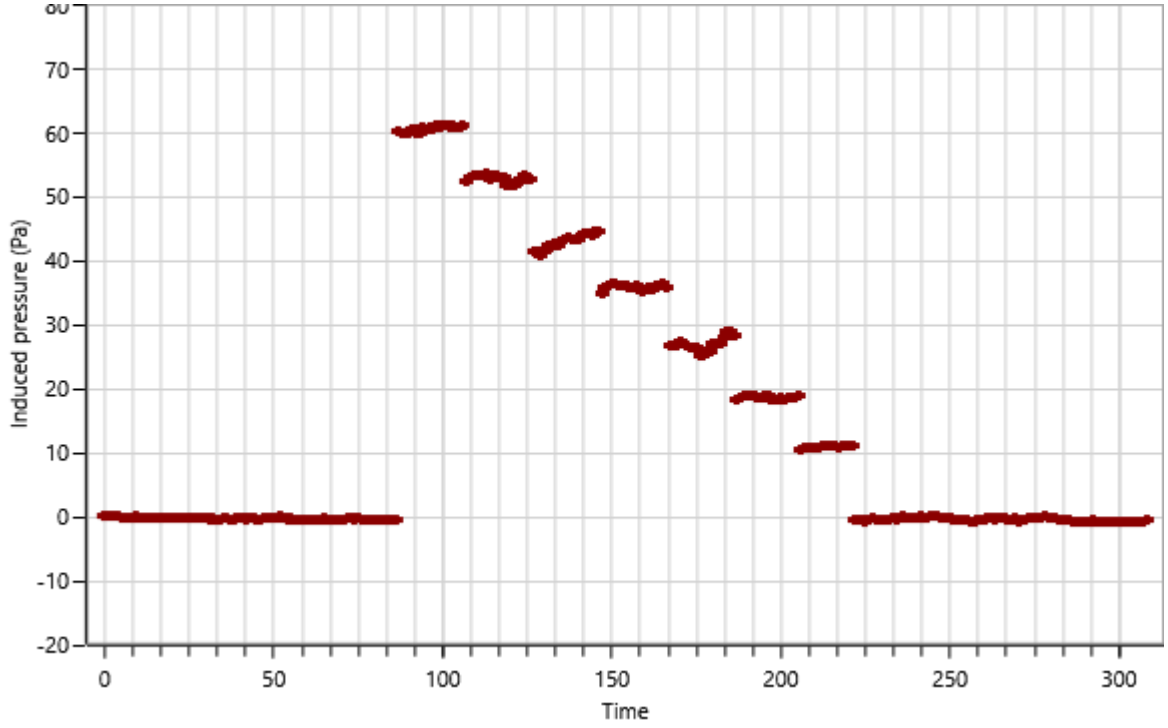
Static Pressure Averages:			
initial [Pa]	ΔP01 -0.25	ΔP01- -0.25	ΔP01+ 0.00
final [Pa]	ΔP02 -0.41	ΔP02- -0.41	ΔP02+ 0.00

Baseline, initial [Pa]	-0.03	-0.12	-0.20	-0.30	-0.21	-0.38	-0.33	-0.46
Baseline, final [Pa]	-0.45	-0.12	-0.17	-0.42	-0.31	-0.32	-0.78	-0.72

Induced Pressure vs. Flow (Pressurize Set)



Building Gauge Pressure (Pressurize Set)



Test Equipment Appendix

The following test equipment was used in the performance of the air leakage tests.

	Fan	Fan serial	Fan location	Gauge	Gauge serial
#1	Retrotec 3000SR	PH0002597	Front Door	DM32	406277

Fan Calibration Certificate Retrotec 3000SR:

Retrotec 3000SR Fan last calibrated: (Flow Equation Parameters - B1) . Published Flow Equation Parameters, Round B1 CFM							
Range	**n**	**K**	**K1**	**K2**	**K3**	**K4**	**MF**
Open(22)	0.5214	519.6183	-0.07	0.8	-0.115	1	8.6
A	0.503	264.9959	-0.075	1	0	1	12
B	0.5	174.8824	0	0.3	0	1	10
C8	0.5	78.5	-0.02	0.5	0.016	1	10
C6	0.505	61.3	0.054	0.5	0.004	1	10
C4	0.5077	42	0.009	0.5	0.0009	1	10
C2	0.52	22	0.11	0.5	-0.001	1	10
C1	0.541	11.9239	0.13	0.4	-0.0014	1	10
L4	0.48	4.0995	0.003	1	0.0004	1	10
L2	0.502	2.0678	0	0.5	0.0001	1	10
L1	0.4925	1.1614	0.1	0.5	0.0001	1	10

Fan Pressure (FP) is the measured fan pressure when using a self-referenced fan or when Room Pressure is negative. If using a fan which is not self-referenced, and Room Pressure is positive, Fan Pressure is calculated by subtracting the measured Room Pressure from the Absolute Value of the Fan Pressure.

If PrA>0 and fan is not self-referencing: FP = |PrB|-PrA
If PrA<0 or fan is self-referencing: FP = PrB

Flow calculations are not valid if Fan Pressure is less than either MF or (K2 x |CR|).

Flow in CFM using the above coefficients is calculated as follows for standard Ranges:

$$flow = (FP - CR \times K1)^n \times (K + K3 \times FP) \times K4$$

FP = fan pressure, CR = corrected room pressure