Air Leakage Test Report

In compliance with ASTM E-779 (2019)

Holistic Test and Balance

Single Story Residence

Building Address:	205 SW Madison Court Lakecity, Columbia FL USA 32024
Performed for:	Ronnie Shuman
Performed by:	LU / JB
Test date:	2024-07-26
Associated Test file:	ASTM2019 2024-07-26 0846
Report Number:	000045982
Unique Property ID Number:	

Summary Single Story Residence

retrotec **FanTestic**	version: **5.15.86**	licensed to: **Holistic Test and Balance**
Test date: **2024-07-26**	By: **LU / JB**	
Customer:	**Ronnie Shuman**	
Building Lot Number:		
Building address:	**205 SW Madison Court** **Lakecity, Columbia** **FL** **USA** **32024**	

Building and Test Information	
Test file name:	**ASTM2019 2024-07-26 0846**
Building volume [cu ft]:	**22,600**
Envelope Area [sq ft]:	**2,260**
Floor Area [sq ft]:	**2,260**
Building Height (from ground to top) [ft]:	**19.5**
Altitude [ft]:	**115**

Results	
CFM at 50 Pa:	**2546.1**
Leakage Area (EqLA) [sq in]:	**253.5**
Leakage Area (EfLA) [sq in]:	**132.2**
Air Changes per hour ACH50:	**6.76**

Compliance

Assumptions and warnings

Building Information Single Story Residence

Building Measurements

Building Volume [cu ft]: 22,600

Envelope Area (A_E) [sq ft]: 2,260
(defined as the area of external walls plus the area of the roof and ground floor.)

Net Floor Area (A_f) [sq ft]: 2,260

Building Height (from ground to top) [ft]: 19.5

Heating/Ventilation System

HVAC Systems Present:

Pictures

Test Method

All intentional openings were set to the operating condition expected during occupancy.

Discussion of Results

Leakage rate

The measured air flow at a test pressure of 50 Pa was 2546.1 CFM which equates to an equivalent leakage area of 253.5 sq in, based on adding up the leakage from all the holes and cracks in the exterior.

This leakage also equates to a one inch gap, 21.13 feet long. The building leaks as if there is one hole this size in the wall.

Air leakage in your ducts to the outdoors was not measured in this test but can greatly increase the above loss rate and can also cause air quality problems. Repairing this type of duct leakage should be the first priority.

Safety concerns

Whenever changes are made to house and duct leakage, a thorough evaluation of the "house as a system" will optimize comfort, energy and air quality while ensuring a higher degree of safety and protecting the integrity of the structure of the building.

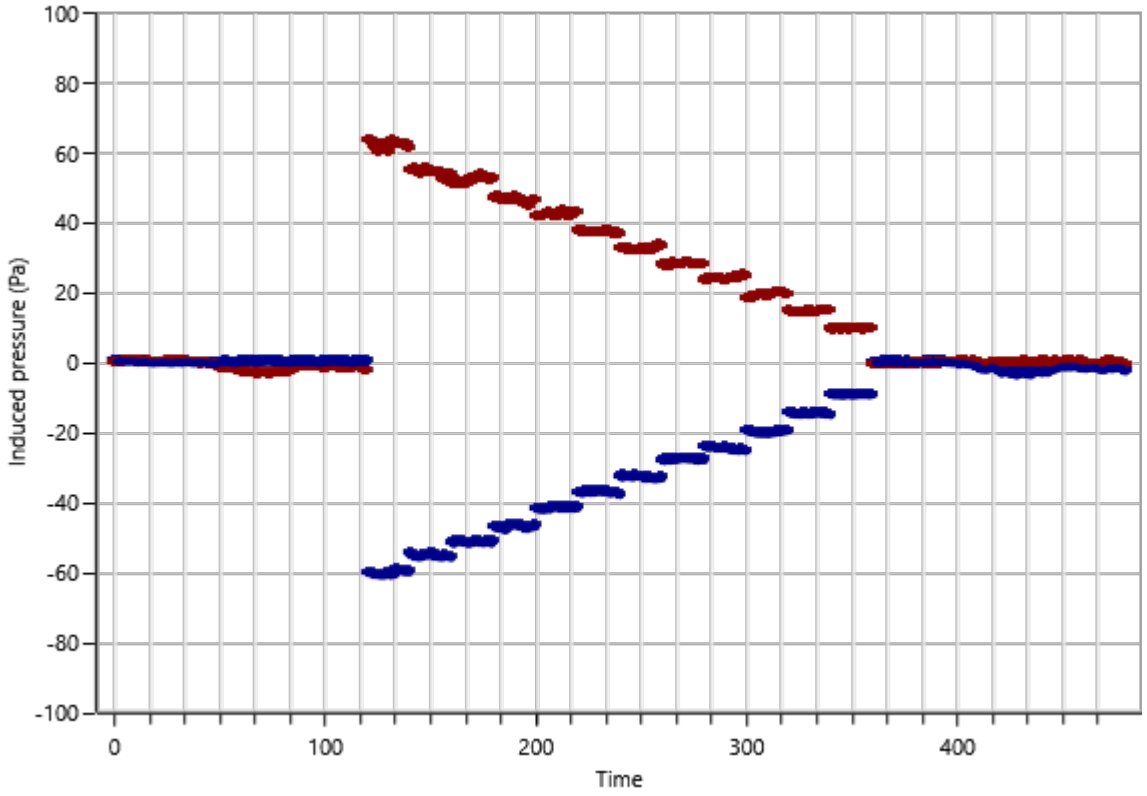
Ventilation

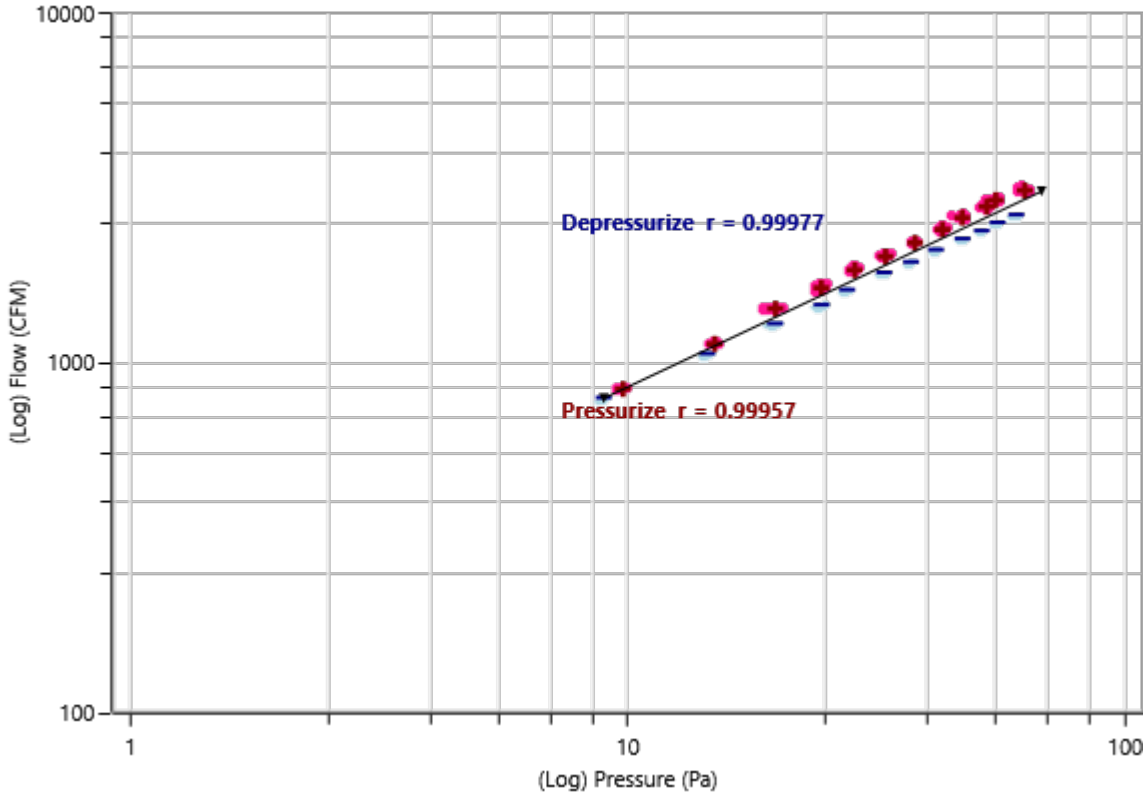
The air in the building will be replaced with outdoor air every 8.88 minutes on average. That is about 6.76 air changes each hour.

According to the ASHRAE standard 62.2, the building does not require any additional ventilation even when windows and doors are closed. Bringing in air from a clean outdoor location and removing stale indoor air from kitchens, bathrooms and other locations may still be important in order to improve air quality. If air sealing work is undertaken, the air leakage rate must be re-measured to determine ventilation requirements based on the new leakage rate.

Combined Test Data (Average Values)

	Results	Uncertainty
Air $flow_{STP}$, [CFM at 50 Pa]	2546.1	+/-0.9%
Air change rate at 50 Pa [/h]	6.76	+/-0.9%
Flow per unit floor area at 50 Pa [CFM/sq ft]	1.127	+/-0.9%
Flow per unit envelope area at 50 Pa [CFM/sq ft]	1.127	+/-0.9%
Equivalent leakage area at 10 Pa [sq in]	253.5	+/-1.5%
LBL Effective leakage area at 4 Pa [sq in]	132.2	+/-2.6%
LEED Permeability at 4 Pa [sq in/ 100 sq ft]	5.848	+/-2.6%





Air Leakage Test Data Appendix– Single Story Residence

Depressurize Data Set 1

Test Dataset Date: 2024-07-26
Start time: 11:03:15 UTC-5

Environmental Conditions		
Wind speed:	1	from the WSW
Operator Location:	Inside the building	
Initial Bias Pressure:	0.48 Pa	
Final Bias Pressure:	-0.90 Pa	
Average Bias Pressure:	-0.21 Pa	
Initial Temperature:	indoors: 81 °F	outdoors: 85 °F
Final Temperature:	indoors: 81 °F	outdoors: 85 °F

Test Analysis	Results	Uncertainty
Height x Temperature difference:	78 ft °F	
Air leakage coefficient, C:	195 CFM/Pa^n	+/- 3.38
Exponent, n:	0.636	+/- 1.510
Correlation coefficient, r:	0.99977	
Air flow$_{STP}$:	2355.5 CFM at 50 Pa	+/-0.7
Air change rate, ACH:	6.254 air changes per hour at 50 Pa	+/-0.7
Flow per unit floor area:	1.042 CFM per sq ft at 50 Pa	+/-0.7
Flow per unit envelope area:	1.042 CFM per sq ft at 50 Pa	+/-0.7
Equivalent leakage area at 10 Pa [sq in]	249.1	+/-1.2
Effective leakage area at 4 Pa [sq in]	134.2	+/-2.0
LEED Permeability at 4 Pa [sq in/ 100 sq ft]	5.938	+/-2.0

Measured pressure [Pa]		-60.1	-55.1	-51.2	-46.9	-41.5	-36.9	-32.7	-27.6	-24.5	-19.8	-14.5	-9.1
Induced Pressure [Pa]		-59.8	-54.9	-51.0	-46.7	-41.3	-36.7	-32.5	-27.3	-24.3	-19.6	-14.3	-8.9
#1, Range A	Fan Pressure [Pa]	77.0	69.6	62.4	56.2	48.5	41.3	36.0	28.6	23.5			
	Flow [CFM]	2606	2479	2347	2227	2069	1911	1784	1590	1441			
#1, Range B8	Fan Pressure [Pa]										86.7	59.4	
	Flow [CFM]										1275	1046	

#1, Range B4	Fan Pressure [Pa]												137.4
	Flow [CFM]												782.4
Total Flow [CFM]		2605.96	2479.07	2347.24	2227.47	2069.03	1910.54	1783.77	1590.15	1441.45	1274.77	1045.52	782.349
Corrected Flow [CFM]		2658.0	2528.6	2394.1	2271.9	2110.3	1948.7	1819.4	1621.9	1470.2	1300.2	1066.4	797.97
Error [%]		0.0%	0.5%	-0.3%	0.1%	0.5%	-0.1%	0.9%	0.3%	-1.9%	-0.6%	-0.4%	1.1%

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

Total of 108 readings taken before test over 97 s of the required 120 s.

Total of 108 readings taken after test over 97 s of the required 120 s.

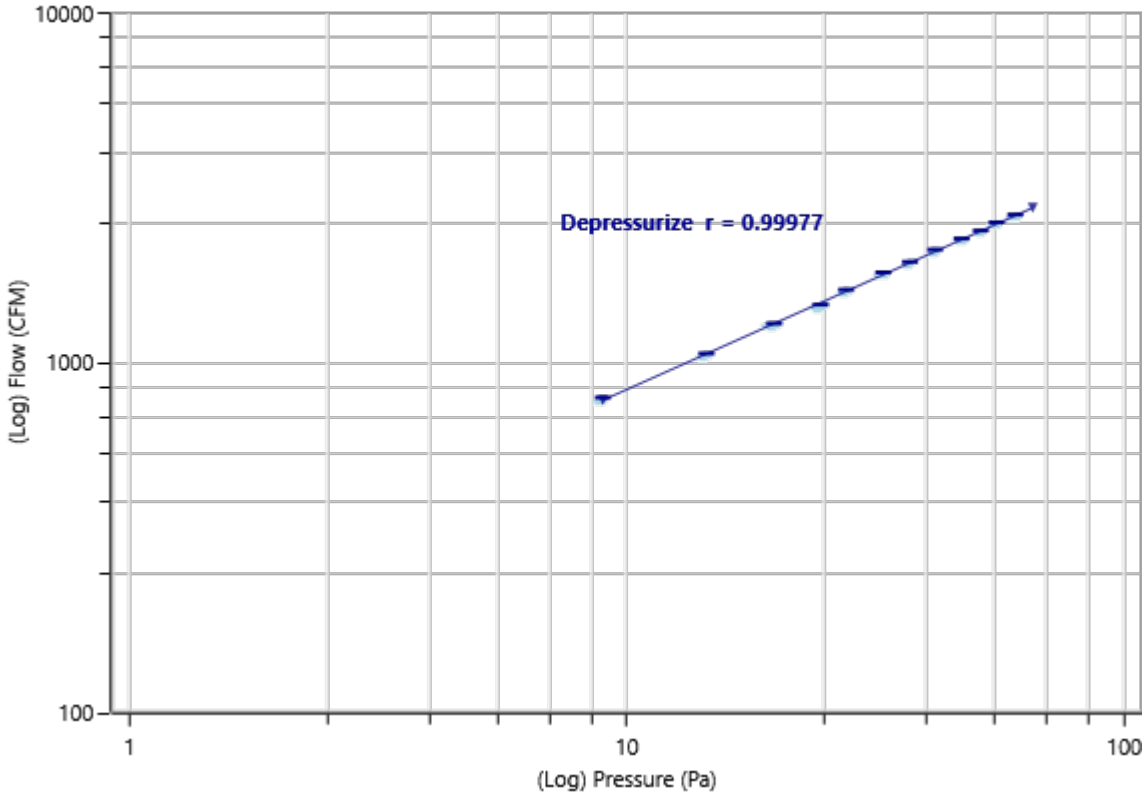
12 baseline pressures shown in UI, each taken for 10 of required 10 seconds.

Average Baseline, ΔP: -0.21 Pa

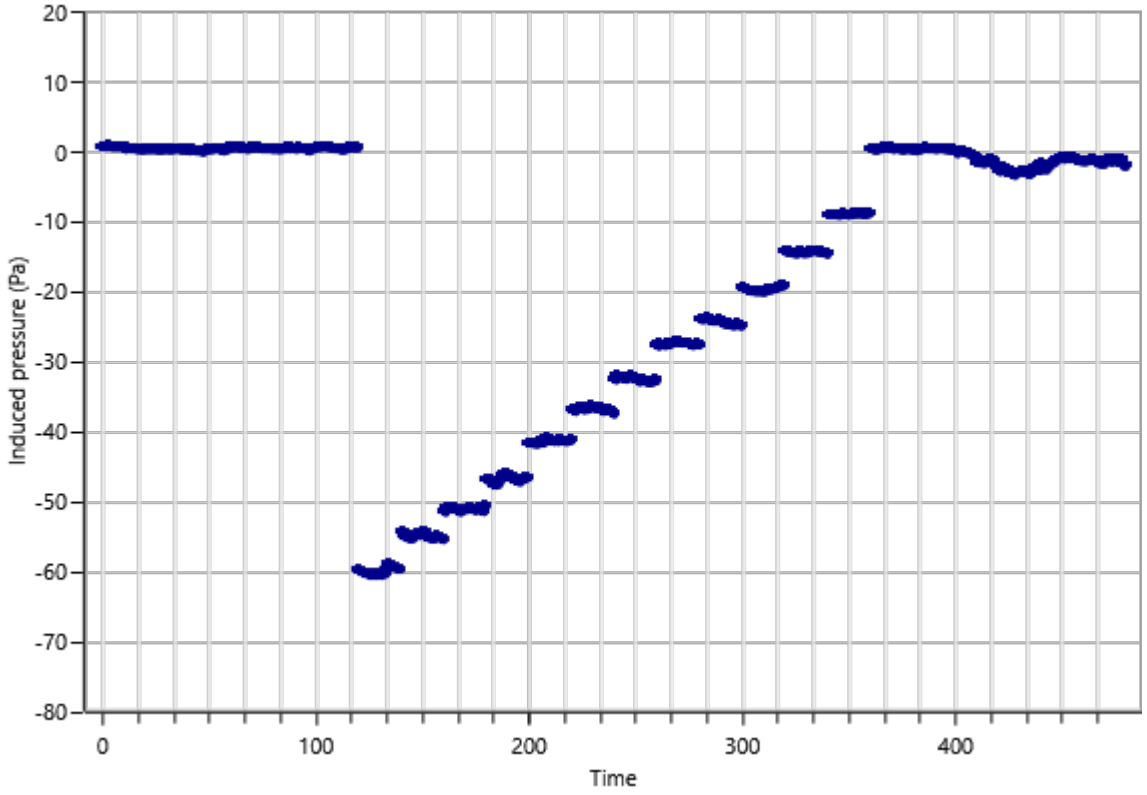
Static Pressure Averages:			
Average Baseline [Pa]	ΔP -0.21		
initial [Pa]	ΔP01 0.48	ΔP01- 0.00	ΔP01+ 0.48
final [Pa]	ΔP02 -0.90	ΔP02- -1.56	ΔP02+ 0.43

Baseline, initial [Pa]	0.79	0.43	0.37	0.38	0.22	0.40	0.57	0.56	0.49	0.44	0.64	0.50
Baseline, final [Pa]	0.49	0.40	0.44	0.39	-0.21	-1.49	-2.77	-2.66	-1.62	-1.00	-1.38	-1.36

Flow vs Induced Pressure (Depressurize Set)



Building Gauge Pressure (Depressurize Set)



Pressurize Data Set 2

Test Dataset Date: 2024-07-26
Start time: 11:19:05 UTC-5

Environmental Conditions		
Wind speed:	1	from the WSW
Operator Location:	Inside the building	
{STM3158}Greatest Baseline Pressure Point:	Pa	
Initial Bias Pressure:	-0.90 Pa	
Final Bias Pressure:	0.12 Pa	
Average Bias Pressure:	-0.39 Pa	
Initial Temperature:	indoors: 81 °F	outdoors: 85 °F
Final Temperature:	indoors: 81 °F	outdoors: 85 °F

Test Analysis	Results	Uncertainty
Height x Temperature difference:	78 ft °F	
Air leakage coefficient, C:	171 CFM/Pa^n	+/- 5.20
Exponent, n:	0.707	+/- 2.057
Correlation coefficient, r:	0.99957	
Air flow$_{STP}$:	2736.6 CFM at 50 Pa	+/-1.1
Air change rate:	7.265 air changes / hour at 50 Pa	+/-1.1
Flow per unit floor area:	1.211 CFM per sq ft at 50 Pa	+/-1.1
Flow per unit envelope area:	1.211 CFM per sq ft at 50 Pa	+/-1.1
Equivalent leakage area at 10 Pa [sq in]	257.9	+/-1.8
Effective leakage area at 4 Pa [sq in]	130.1	+/-3.1
LEED Permeability at 4 Pa [sq in/ 100 sq ft]	5.757	+/-3.1

Measured pressure [Pa]		61.9	54.0	51.8	46.2	42.1	37.1	32.3	27.9	23.9	19.2	14.4	9.3
Induced Pressure [Pa]		62.3	54.4	52.2	46.6	42.5	37.4	32.7	28.3	24.3	19.6	14.8	9.7
#1, Range A	Fan Pressure [Pa]	171.7	150.7	140.4	122.9	107.7	92.1	78.2	66.4	54.3			

	Flow [CFM]	3112	2919	2795	2602	2406	2204	2014	1844	1640			
#1, Range B8	Fan Pressure [Pa]										127.1	83.8	
	Flow [CFM]										1430	1134	
#1, Range B4	Fan Pressure [Pa]												168.4
	Flow [CFM]												843.8
Total Flow [CFM]		3112.18	2919.48	2795.46	2602.19	2406.32	2204.49	2014.41	1844.16	1639.57	1430.49	1134.34	843.838
Corrected Flow [CFM]		3137.2	2943.0	2817.9	2623.1	2425.7	2222.2	2030.6	1859.0	1652.8	1442.0	1143.5	850.63
Error [%]		-2.0%	1.2%	-0.2%	0.6%	-0.7%	-0.5%	0.1%	1.4%	0.6%	2.0%	-1.3%	-0.9%

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

Total of 108 readings taken before test over 97 s of the required 120 s.

Total of 108 readings taken after test over 98 s of the required 120 s.

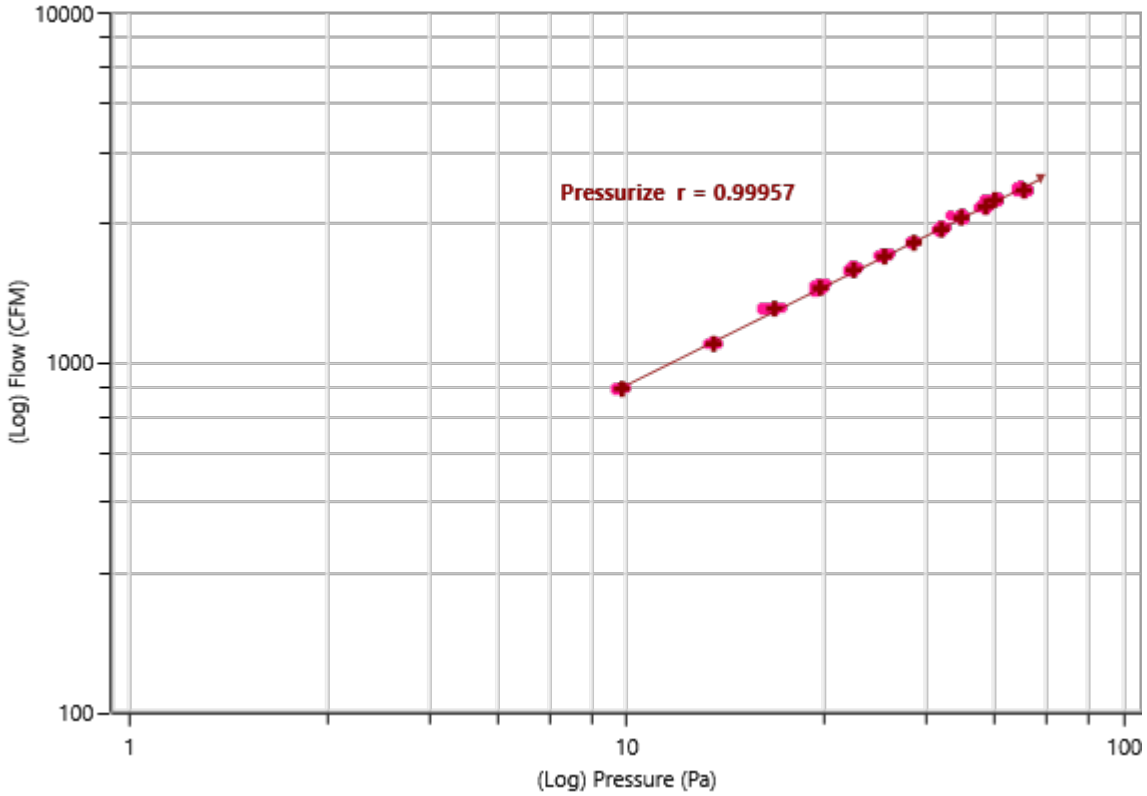
12 baseline pressures shown in UI, each taken for 10 of required 10 seconds.

Average Baseline, ΔP: -0.39 Pa

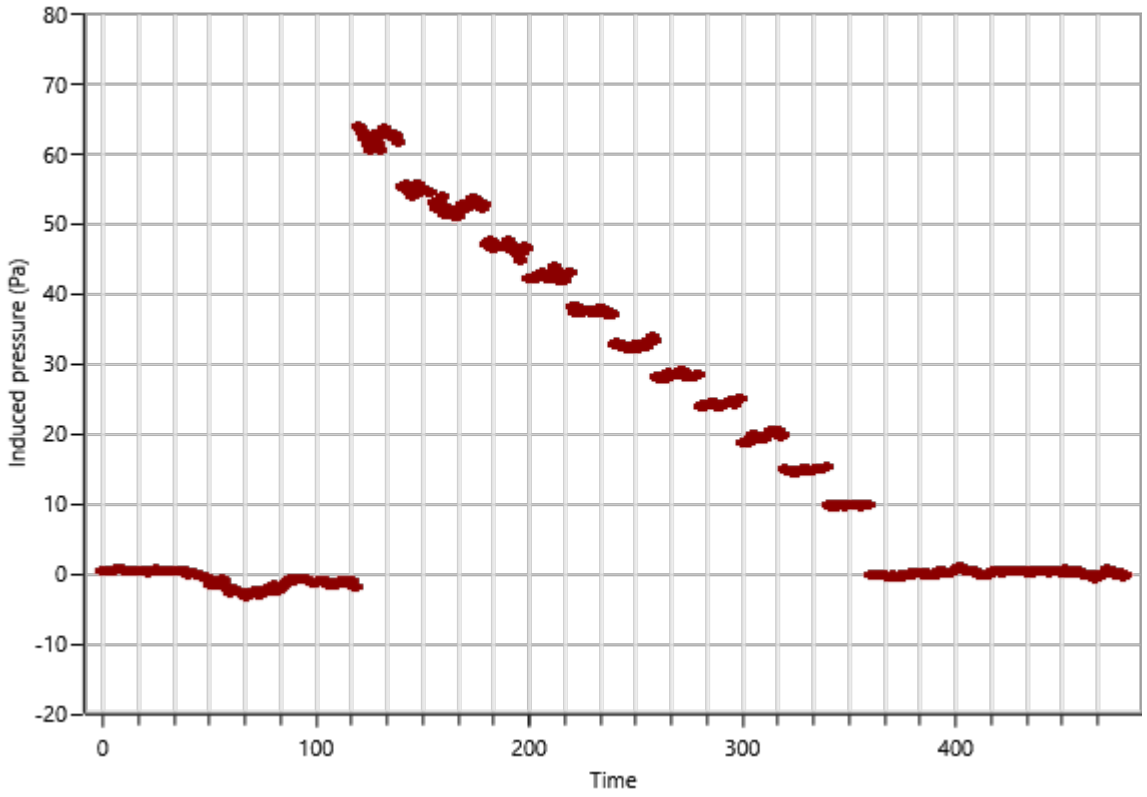
Static Pressure Averages:			
Average [Pa]	ΔP -0.39	Number of readings ({2-StaticReadingsCount})	
initial [Pa]	ΔP01 -0.90	ΔP01- -1.56	ΔP01+ 0.43
final [Pa]	ΔP02 0.12	ΔP02- -0.20	ΔP02+ 0.28

Baseline, initial [Pa]	0.49	0.40	0.44	0.39	-0.21	-1.49	-2.77	-2.66	-1.62	-1.00	-1.38	-1.36
Baseline, final [Pa]	-0.28	-0.27	-0.08	0.16	0.54	0.06	0.30	0.33	0.37	0.34	-0.18	0.12

Flow vs Induced Pressure (Pressurize Set)



Building Gauge Pressure (Pressurize Set)



Test Equipment

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

	Fan	Fan serial	Fan location	Gauge	Gauge serial	Gauge Calibration
#1	Retrotec 5000	5FN100809	FrontDoor	DM32	407586	2023-03-27

Fan Calibration Certificate Retrotec 5000:

Retrotec 5000 5FN100809 Fan last calibrated: 2023-04-03. Flow Equation Parameters - Retrotec: 202303280944-5FN100809. CFM							
Range	**n**	**K**	**K1**	**K2**	**K3**	**K4**	**MF**
Open	0.49890064	557.458454	0	0.3	0	1	10
A	0.4987391	298.711326	0	0.40000001	0	1	20
B8	0.52555618	122.191485	0	0.7	0	1	35

Polynomial Range	**g**	**f**	**a**	**b**	**c**	**d**	**K2**	**MF**
B4	50	0.45468675	0.000027914442	-0.020530773	7.08566877	105.35160754	0.8	35
B2	50	0.500291112	0.000013771244 2	-0.010567453	3.67079756	-22.47597667	1	50
B1	50	0.117715556	0.000004762645 3	-0.003977805	1.58679484	0.51215807	1	60
B74	25	0.15	0.000000796	-0.0009501	0.59	18	0.8	35
B47	25	0.09	0.000000269043 2	-0.000359055	0.2435	12.05	1	50
B29	25	-0.02	0.000000111	-0.000149	0.092	4.4	0.6	50

Fan Pressure (FP) is the measured fan pressure when using a self-referenced fan or when Room Pressure (RP) 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 |RP|).

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

$$flow = (FP - (|RP| \times K1))^N \times (K + (K3 \times FP))$$

Flow in CFM using the above polynomial coefficients is calculated as follows:

$$flow = (a \times FP^3) + (b \times FP^2) + (c \times FP) + d + ((g - |RP|) \times f)$$