



AIR TEST REPORT

Remedial Window Measures Evaluation,
Room 264, Student Accommodation, University of Newcastle,
10 Leazes Terrace, Newcastle, Tyne and Wear, NE1 7RU

Ref: 03-16-56299 R264 T1
Issue Date: 6th April 2016

Prepared for:
Mark Huelin
The Energy Savers Limited

Prepared by:
Sarah Rogers - (ATTMA Level 2)

Prepared by:
Marc Cowlin - (ATTMA Level 2)

Undertaken on behalf of:
The Energy Savers Limited,
Quattro Seal,
Shenn Valley,
Peel,
Isle of Man,
IM5 2AH



DETAILS OF TESTED BUILDING

Windows Tested:	3 No. 77.5° Bay Windows (1.164m W x2.462m H x0.389m D 1.164m W x2.462m H x0.415m D 1.190m W x2.462m H x0.384m D)	Nett Floor Area, A _F :	19.59 m ²
Enclosure:	Room 264, Student Accommodation, University of Newcastle, 10 Leazes Terrace, Newcastle, Tyne and Wear, NE1 7RU	Envelope Area, A _E :	98.90 m ²
		Geometry Prepared By:	Mathew Atkinson of Stroma
Est. Year Built:	2016	Geometry Verified By:	Mark Huelin of The Energy Savers
Test Date:	23 rd March 2016		
Building Heating:	N/A	Test Method:	B (Building envelope)
Building Ventilation:	N/A	Test Engineer:	Sarah Rogers (ATTMA Level 2)

INTERPRETATION OF RESULTS

Stroma were requested to undertake the testing of remedial measures undertaken to existing glazing unit located with Room 264. The methodology employed was to undertake a depressurisation test of the enclosure in the 4 following states of preparation:

1. Existing window temporary sealed with tape
2. Window as-found
3. Existing window brush seals removed
4. After immediate application of Quattro Seal

The differences between the volumetric airflow rates measured is then attributed in full to works completed.

RESULTS AND SUMMARY

The air leakage was determined by means of both a depressurisation and pressurisation test. The initial normalised air flow at a pressure differential of 50 Pascals (Q_{50}) was established in accordance with the required test methodology of ATTMA TSL2. The result attained from this test was: -

Test 1: Existing window temporary sealed with tape
Volumetric Air Flow, Q_{50} : 616.6 $\text{m}^3 \cdot \text{h}^{-1}$ @ 50 Pa

Test 1: Windows As-found
Volumetric Air Flow, Q_{50} : 1,153 $\text{m}^3 \cdot \text{h}^{-1}$ @ 50 Pa

Test 2: Existing window brush seals removed
Volumetric Air Flow, Q_{50} : 1,215 $\text{m}^3 \cdot \text{h}^{-1}$ @ 50 Pa

Test 3: After immediate application of Quattro Seal
Volumetric Air Flow, Q_{50} : 582.0 $\text{m}^3 \cdot \text{h}^{-1}$ @ 50 Pa

Difference between Test 4 and Test 2 = Reduction in airflow through window
Volumetric Air Flow, Q_{50} : 571.0 $\text{m}^3 \cdot \text{h}^{-1}$ @ 50 Pa

The reduction in air leakage equates to 49.5%, which has all been attributed to the freshly applied Quattro Seal.

Stroma Technology is a UKAS accredited testing laboratory No. 2731, and ATTMA registered company.

TEST DATA

Windows – Temporarily sealed

Test Date: 23 March 2016
 Test Time: 09:46
 Engineer Controlling Test: SLR
 Test No: 1
 Type of Test Undertaken: Depressurisation
 Engineer Locations: Inside the building under test.

Pre Test Conditions

Atmospheric Conditions

Internal Temperature #1:	15.5 °C	Location of Reading	Center of Room	External Temperature:	10.2 °C
Internal Temperature #2:	°C			Barometric Pressure:	1,007 mbar
Internal Temperature #3:	°C				
Internal Temperature #4:	°C				
Internal Temperature #5:	°C				

Fan Off Pressures

Manometer Number	#1	#2	#3	#4	#5	#6	
Gauge Serial Number	724606A						
Readings (Pa)	0.5						Corrected Values Average Positive Values, $\Delta p_{0,1+}$ 0.5 Pa Average Negative Values, $\Delta p_{0,1-}$ Pa Total Average Values, $\Delta p_{0,1}$ 0.5 Pa
	0.6						
	0.5						
	0.4						
	0.5						

Post Test Conditions

Atmospheric Conditions

Internal Temperature #1:	16.3 °C	Location of Reading	Center of Room	External Temperature:	8.8 °C
Internal Temperature #2:	°C			Barometric Pressure:	1,007 mbar
Internal Temperature #3:	°C				
Internal Temperature #4:	°C				
Internal Temperature #5:	°C				

Fan Off Pressures

Manometer Number	#1	#2	#3	#4	#5	#6	
Gauge Serial Number	724606A						
Readings (Pa)	0.6						Corrected Values Average Positive Values, $\Delta p_{0,2+}$ 0.5 Pa Average Negative Values, $\Delta p_{0,2-}$ Pa Total Average Values, $\Delta p_{0,2}$ 0.5 Pa
	0.5						
	0.4						
	0.5						
	0.4						

Average Test Conditions

Corrected Average Internal Temperature:	15.7 °C	Internal Air Density, ρ_i	1.21 kg.m ⁻³
Corrected Average External Temperature:	9.2 °C	External Air Density, ρ_e	1.24 kg.m ⁻³
Corrected Average Barometric Pressure:	1,007.9 mbar	Assumed Relative Humidity:	50%

Summary of Building Test Results

Permeability @ 50 Pa, AP_{50} m ³ .h ⁻¹ .m ⁻²	Flow @ 50 Pa, Q_{50} m ³ .h ⁻¹	Effective Leakage Area, A m ²	Flow Exponent, n	Flow Coeff, C_{env} m ³ .h ⁻¹ .Pa ⁻ⁿ	Air Leakage Coeff, C_L m ³ .h ⁻¹ .Pa ⁻ⁿ	Correlation r^2
6.23	616.6	0.031	0.9259	16.44	16.48	0.9962

Calibration Information for Equipment Used

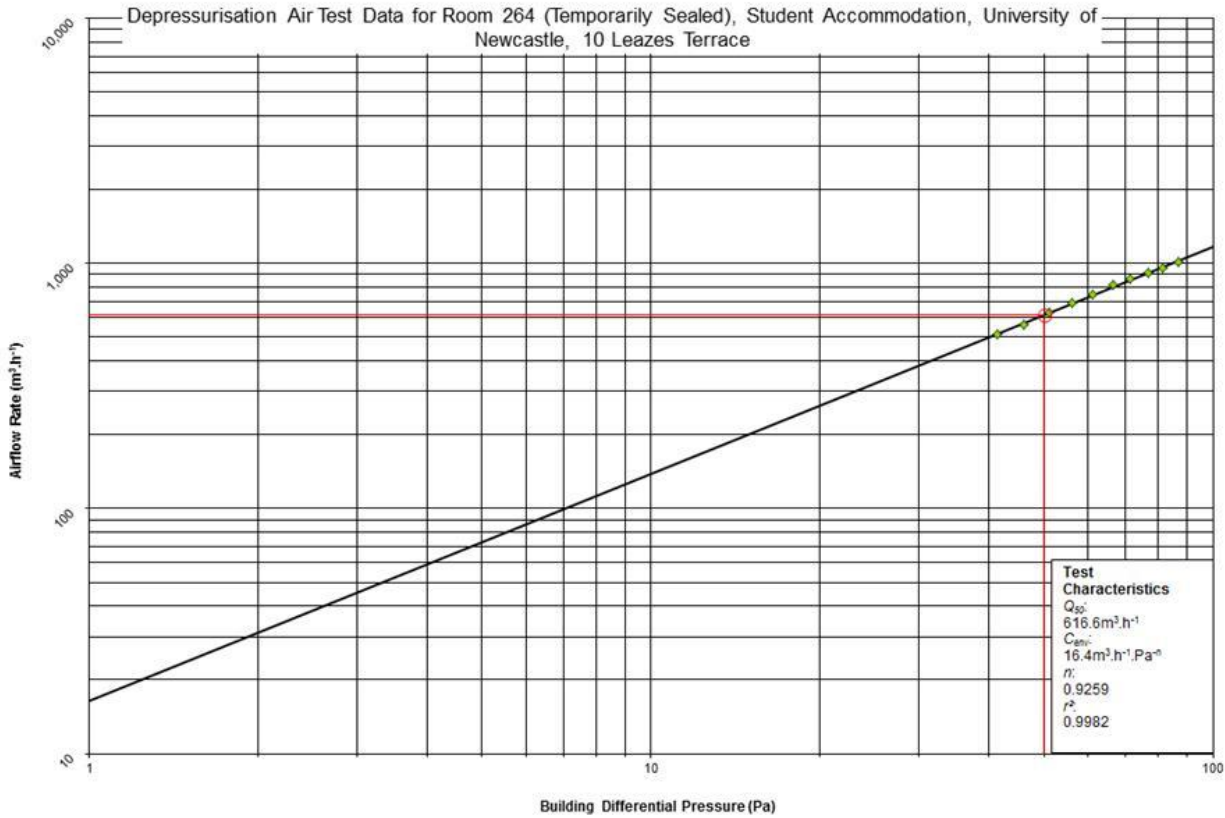
Serial Number	Equipment Type	Calib. Expiry Date
1304-75547-4	Anemometer	21 February 2017
GPB0115	Barometer	21 February 2017
GTH0031	Thermometer	21 February 2017
724606A	Manometer (Build)	21 February 2017
724606B	Manometer (Fan)	21 February 2017
H01591	Fan	21 February 2017

Differential Building Pressures

Gauge #1	Kit / Eng	Room Pressure	$\Delta p_{0,1}$	Δp_m										$\Delta p_{0,2}$
724606A	SLR		0.5	-75.4	-70.2	-65.5	-60.2	-55.3	-50.1	-45.1	-40.5	-30.1	-25.5	0.5
		Corrected (Pa)	0.5	-76.1	-70.8	-66.1	-60.7	-55.8	-50.6	-45.5	-40.9	-30.8	-26.3	0.5
		Avg Corrected, Δp (Pa)	////	-76.6	-71.3	-66.6	-61.2	-56.3	-51.0	-46.0	-41.4	-31.3	-26.8	////

Fan Flow Pressures and Volume Flow Rates

Type	Serial No.	Range	Gauge Ref	Kit / Eng	Flow Pressure Corrected (Pa)	Flow Q_{st} (m ³ /s)	Total Flow, Q_{env} (m ³ /hr)	Error (%)	Initial Static Pressure Fan Blanked Off	Final Static Pressure Fan Blanked Off				
T_5	H01591	Ring C4	724606B	SLR	169.5	150.5	136.5	114.4	96.6	81.1	65.5	55.6	185.5	205.5
					170.2	151.1	136.1	114.9	97.0	81.4	65.8	55.8	186.3	206.3
					0.26	0.25	0.23	0.21	0.20	0.18	0.16	0.15	0.28	0.29
					915	861	816	748	686	627	562	516	958	1,010
					0.3%	0.7%	1.7%	0.8%	-0.1%	0.0%	-1.4%	0.1%	-0.7%	-1.4%



Windows – As found

Test Date: 23 March 2016
 Test Time: 10:32
 Engineer Controlling Test: SLR
 Test No: 1.1
 Type of Test Undertaken: Depressurisation
 Engineer Location: Inside the building under test.

Pre Test Conditions
Atmospheric Conditions

Internal Temperature #1: 19.3 °C
 Internal Temperature #2: °C
 Internal Temperature #3: °C
 Internal Temperature #4: °C
 Internal Temperature #5: °C

Location of Reading
 Center of Room

External Temperature: 8.6 °C
 Barometric Pressure: 1,006 mbar

Fan Off Pressures

Manometer Number	#1	#2	#3	#4	#5	#6
Gauge Serial Number	724606A					
Readings (Pa)	0.5					
	0.6					
	0.4					
	0.5					
	0.6					

Corrected Values
 Average Positive Values, $\Delta p_{0.1+}$: 0.5 Pa
 Average Negative Values, $\Delta p_{0.1-}$: Pa
 Total Average Values, $\Delta p_{0.1}$: 0.5 Pa

Post Test Conditions
Atmospheric Conditions

Internal Temperature #1: 20.1 °C
 Internal Temperature #2: °C
 Internal Temperature #3: °C
 Internal Temperature #4: °C
 Internal Temperature #5: °C

Location of Reading
 Center of Room

External Temperature: 8.6 °C
 Barometric Pressure: 1,006 mbar

Fan Off Pressures

Manometer Number	#1	#2	#3	#4	#5	#6
Gauge Serial Number	724606A					
Readings (Pa)	0.5					
	0.5					
	0.4					
	0.1					
	0.1					

Corrected Values
 Average Positive Values, $\Delta p_{0.2+}$: 0.3 Pa
 Average Negative Values, $\Delta p_{0.2-}$: Pa
 Total Average Values, $\Delta p_{0.2}$: 0.3 Pa

Average Test Conditions

Corrected Average Internal Temperature: 19.5 °C
 Corrected Average External Temperature: 8.4 °C
 Corrected Average Barometric Pressure: 1,007.3 mbar

Internal Air Density, ρ_i : 1.19 kg.m⁻³
 External Air Density, ρ_e : 1.24 kg.m⁻³
 Assumed Relative Humidity: 50%

Summary of Building Test Results

Permeability @ 50 Pa, AP_{50} m ³ .h ⁻¹ .m ⁻²	Flow @ 50 Pa, Q_{50} m ³ .h ⁻¹	Effective Leakage Area, A m ²	Flow Exponent, n	Flow Coeff, C_{env} m ³ .h ⁻¹ .Pa ⁻ⁿ	Air Leakage Coeff, C_L m ³ .h ⁻¹ .Pa ⁻ⁿ	Correlation r^2
11.66	1.153	0.058	0.5019	159.0	161.9	0.9979

Calibration Information for Equipment Used

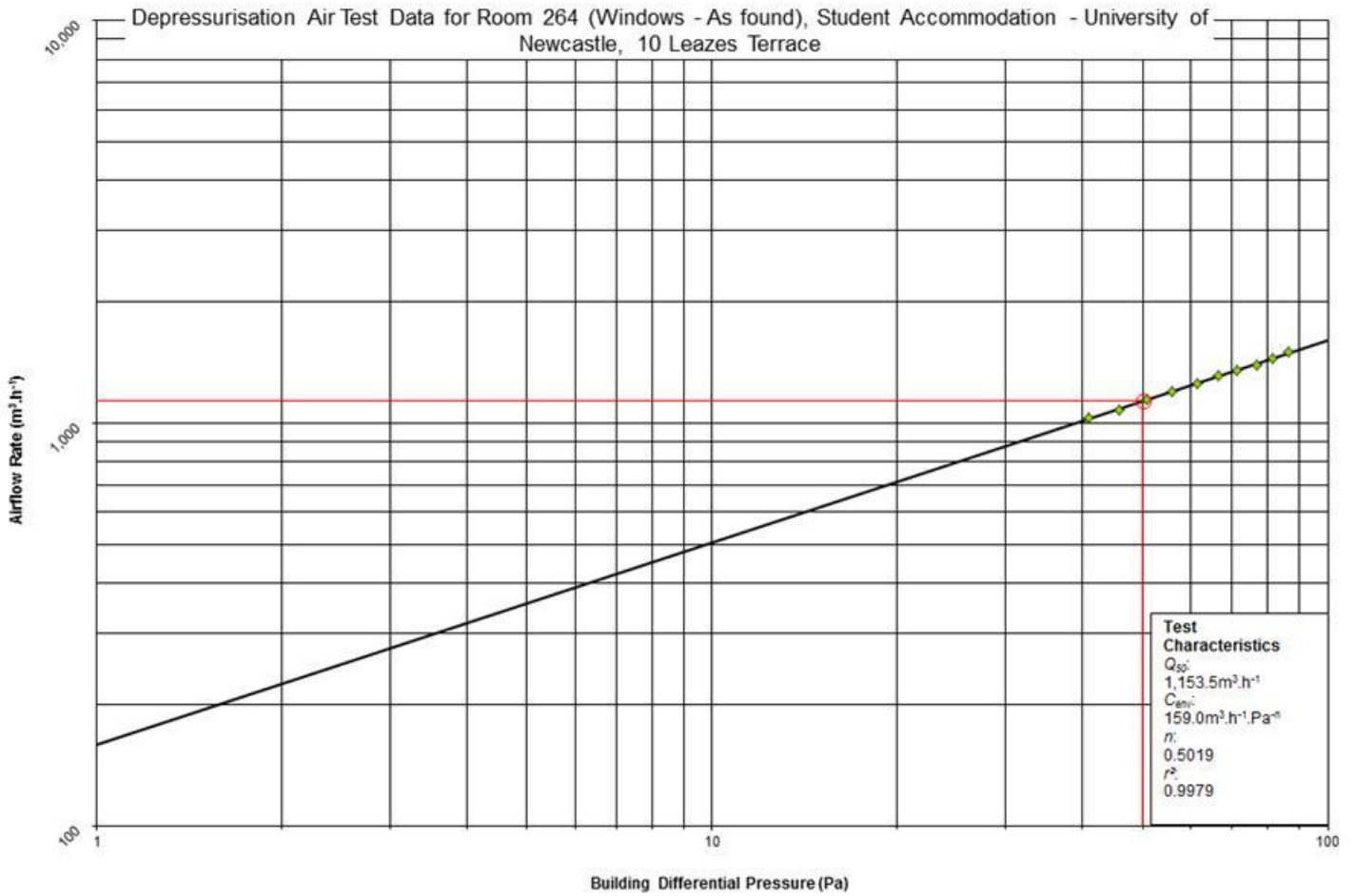
Serial Number	Equipment Type	Calib. Expiry Date
1304-75547-4	Anemometer	21 February 2017
GPB0115	Barometer	21 February 2017
GTH0031	Thermometer	21 February 2017
724606A	Manometer (Build)	21 February 2017
724606B	Manometer (Fan)	21 February 2017
H01591	Fan	21 February 2017

Differential Building Pressures

Gauge #1:	Kit / Eng	Room Pressure	Δp_{in}										Δp_{o2}	
			Δp_{o1}											
724606A	SLR	0.5	-85.4	-80.1	-75.5	-70.1	-65.5	-60.5	-55.1	-50.1	-45.1	-40.1	0.3	
		Corrected (Pa)	0.5	-86.2	-80.8	-76.2	-70.7	-66.1	-61.0	-55.6	-50.6	-45.5	-40.5	0.3
		Avg Corrected, Δp (Pa)	////	-86.6	-81.2	-76.6	-71.2	-66.5	-61.5	-56.0	-51.0	-45.9	-40.9	////

Fan Flow Pressures and Volume Flow Rates

Type	Serial No.	Range	Gauge Ref	Kit / Eng	Flow Pressure Corrected (Pa)	Flow Q_{st} (m ³ /s)	Total Flow, Q_{env} (m ³ /hr)	Error (%)	Initial Static Pressure Fan Blanked Off	Final Static Pressure Fan Blanked Off
T 5	H01591	Ring C4	724606B	SLR	447.4	0.43	1,502	0.7%	449.2	216.4
					416.5	0.42	1,448	0.2%	418.2	216.4
					385.5	0.40	1,392	-0.8%	387.1	216.4
					364.4	0.39	1,352	0.0%	365.9	216.4
					342.5	0.38	1,310	0.2%	343.9	216.4
					314.4	0.36	1,254	-0.2%	315.7	216.4
					285.2	0.34	1,192	-0.6%	286.4	216.4
					264.4	0.33	1,147	0.3%	265.5	216.4
					234.1	0.31	1,077	-0.7%	235.1	216.4
					215.5	0.30	1,033	0.9%	216.4	216.4



Windows – Existing Brush Seals Removed

Test Date: 23 March 2016
 Test Time: 10:52
 Engineer Controlling Test: SLR
 Test No: 1.2
 Type of Test Undertaken: Depressurisation
 Engineer Location: Inside the building under test.

Pre Test Conditions
Atmospheric Conditions

Internal Temperature #1: 19.3 °C
 Internal Temperature #2: °C
 Internal Temperature #3: °C
 Internal Temperature #4: °C
 Internal Temperature #5: °C

Location of Reading
 Center of Room

External Temperature: 8.6 °C
 Barometric Pressure: 1,006 mbar

Fan Off Pressures

Manometer Number	#1	#2	#3	#4	#5	#6
Gauge Serial Number	724606A					
Readings (Pa)	0.5					
	0.4					
	1.0					
	1.1					
	1.1					

Corrected Values
 Average Positive Values, $\Delta p_{0.1+}$: 0.8 Pa
 Average Negative Values, $\Delta p_{0.1-}$: Pa
 Total Average Values, $\Delta p_{0.1}$: 0.8 Pa

Post Test Conditions
Atmospheric Conditions

Internal Temperature #1: 20.4 °C
 Internal Temperature #2: °C
 Internal Temperature #3: °C
 Internal Temperature #4: °C
 Internal Temperature #5: °C

Location of Reading
 Center of Room

External Temperature: 9.2 °C
 Barometric Pressure: 1,006 mbar

Fan Off Pressures

Manometer Number	#1	#2	#3	#4	#5	#6
Gauge Serial Number	724606A					
Readings (Pa)	1.1					
	1.2					
	1.3					
	1.2					
	1.1					

Corrected Values
 Average Positive Values, $\Delta p_{0.2+}$: 1.2 Pa
 Average Negative Values, $\Delta p_{0.2-}$: Pa
 Total Average Values, $\Delta p_{0.2}$: 1.2 Pa

Average Test Conditions

Corrected Average Internal Temperature: 19.6 °C
 Corrected Average External Temperature: 8.7 °C
 Corrected Average Barometric Pressure: 1,007.3 mbar

Internal Air Density, ρ_i : 1.19 kg.m⁻³
 External Air Density, ρ_e : 1.24 kg.m⁻³
 Assumed Relative Humidity: 50%

Summary of Building Test Results

Permeability @ 50 Pa, AP_{50} m ³ .h ⁻¹ .m ⁻²	Flow @ 50 Pa, Q_{50} m ³ .h ⁻¹	Effective Leakage Area, A m ²	Flow Exponent, n	Flow Coeff, C_{env} m ³ .h ⁻¹ .Pa ⁻ⁿ	Air Leakage Coeff, C_L m ³ .h ⁻¹ .Pa ⁻ⁿ	Correlation r^2
12.29	1.215	0.061	0.8081	51.14	51.49	0.9986

Calibration Information for Equipment Used

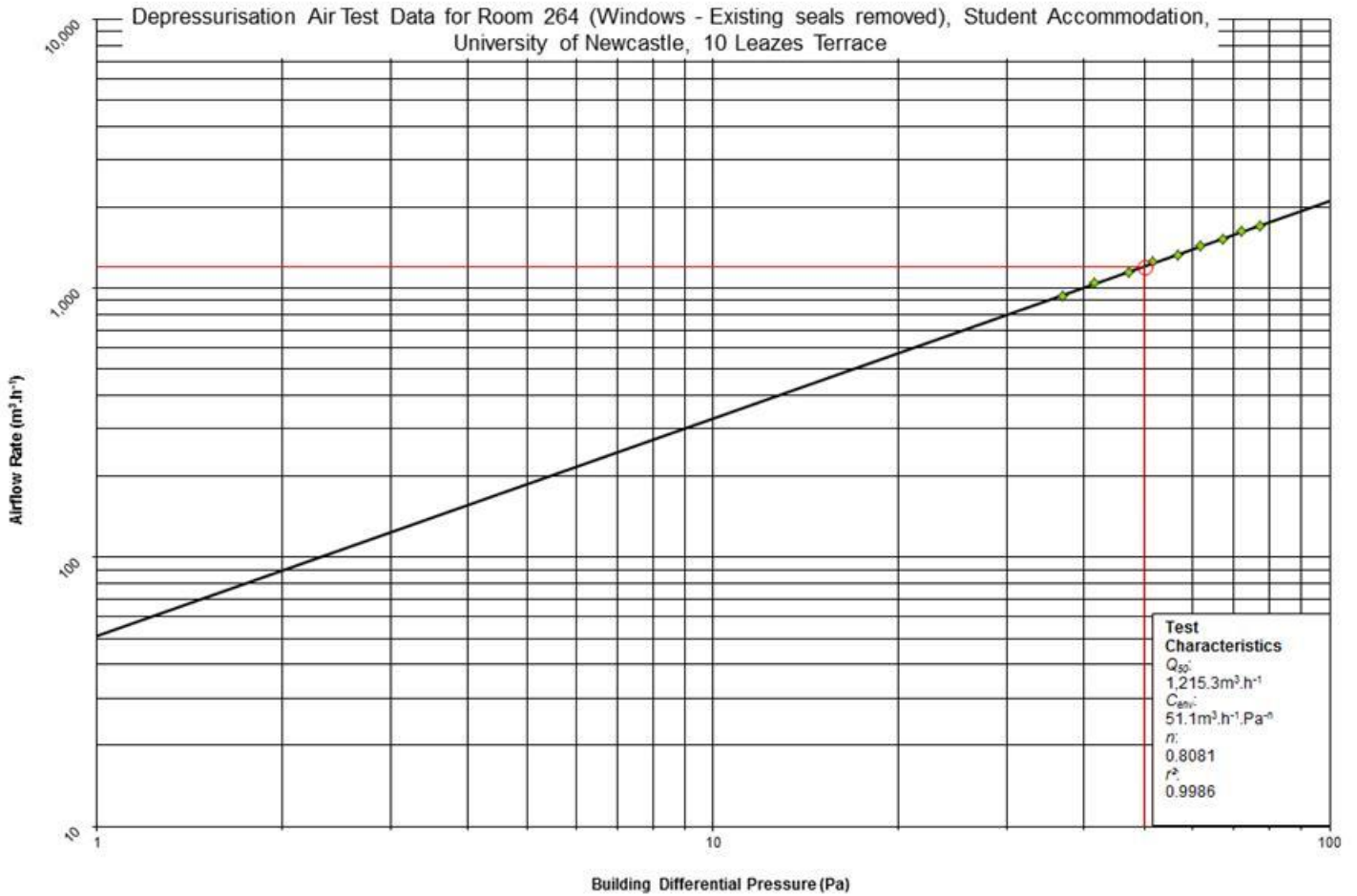
Serial Number	Equipment Type	Calib. Expiry Date
130475547-4	Anemometer	21 February 2017
GPB0115	Barometer	21 February 2017
GTH0031	Thermometer	21 February 2017
724606A	Manometer (Build)	21 February 2017
724606B	Manometer (Fan)	21 February 2017
H01591	Fan	21 February 2017

Differential Building Pressures

Gauge #1:	Kit / Eng		$\Delta p_{0,1}$	Δp_m										$\Delta p_{0,2}$
724606A	SLR	Room Pressure	0.8	-75.4	-70.2	-65.5	-60.2	-55.2	-50.1	-45.9	-40.2	-35.5	1.2	
		Corrected (Pa)	0.8	-76.1	-70.8	-66.1	-60.7	-55.7	-50.6	-46.3	-40.6	-35.8	1.2	
		Avg Corrected, Δp (Pa):	////	-77.1	-71.8	-67.1	-61.8	-56.7	-51.6	-47.3	-41.6	-36.8	////	

Fan Flow Pressures and Volume Flow Rates

Type	Serial No.	Range	Gauge Ref	Kit / Eng	Flow Pressure	Corrected (Pa)	Flow Q_{st} (m ³ /s)	Total Flow, Q_{env} (m ³ /hr)	Error (%)	Initial Static Pressure Fan Blanked Off	Final Static Pressure Fan Blanked Off		
T.S	H01591	Ring Cb	724606B	SLR	164.4	146.5	131.0	118.6	99.6	89.5	75.5	62.5	50.0
					165.1	149.1	131.5	117.1	100.0	89.9	75.8	62.6	50.2
					0.49	0.47	0.44	0.41	0.38	0.36	0.33	0.30	0.27
					1,709	1,623	1,523	1,436	1,325	1,256	1,152	1,047	935
					-0.2%	0.3%	-0.5%	0.3%	-0.8%	1.4%	-0.2%	0.7%	-0.9%



Windows – Quattro Seal Applied

Test Date: 23 March 2016
 Test Time: 10:57
 Engineer Controlling Test: SLR
 Test No: 1.3
 Type of Test Undertaken: Depressurisation
 Engineer Locations: Inside the building under test

Pre Test Conditions
Atmospheric Conditions

Internal Temperature #1: 20.6 °C
 Internal Temperature #2: °C
 Internal Temperature #3: °C
 Internal Temperature #4: °C
 Internal Temperature #5: °C

Location of Reading
 Center of Room

External Temperature: 9.1 °C
 Barometric Pressure: 1,008 mbar

Fan Off Pressures

Manometer Number	#1	#2	#3	#4	#5	#6
Gauge Serial Number	724606A					
Readings (Pa)	0.5					
	0.4					
	0.4					
	0.6					
	0.5					

Corrected Values
 Average Positive Values, $\Delta p_{0,1+}$: 0.5 Pa
 Average Negative Values, $\Delta p_{0,1-}$: Pa
 Total Average Values, $\Delta p_{0,1}$: 0.5 Pa

Post Test Conditions
Atmospheric Conditions

Internal Temperature #1: 21.3 °C
 Internal Temperature #2: °C
 Internal Temperature #3: °C
 Internal Temperature #4: °C
 Internal Temperature #5: °C

Location of Reading
 Center of Room

External Temperature: 9.2 °C
 Barometric Pressure: 1,008 mbar

Fan Off Pressures

Manometer Number	#1	#2	#3	#4	#5	#6
Gauge Serial Number	724606A					
Readings (Pa)	0.6					
	0.5					
	0.4					
	0.5					
	0.4					

Corrected Values
 Average Positive Values, $\Delta p_{0,2+}$: 0.5 Pa
 Average Negative Values, $\Delta p_{0,2-}$: Pa
 Total Average Values, $\Delta p_{0,2}$: 0.5 Pa

Average Test Conditions

Corrected Average Internal Temperature: 20.7 °C
 Corrected Average External Temperature: 8.9 °C
 Corrected Average Barometric Pressure: 1,007.1 mbar

Internal Air Density, ρ_i : 1.19 kg.m⁻³
 External Air Density, ρ_e : 1.24 kg.m⁻³
 Assumed Relative Humidity: 50%

Summary of Building Test Results

Permeability @ 50 Pa, AP_{50} m ² .h ⁻¹ .m ⁻²	Flow @ 50 Pa, Q_{50} m ³ .h ⁻¹	Effective Leakage Area, A m ²	Flow Exponent, n	Flow Coeff, C_{env} m ³ .h ⁻¹ .Pa ⁻ⁿ	Air Leakage Coeff, C_L m ³ .h ⁻¹ .Pa ⁻ⁿ	Correlation r^2
5.88	582.0	0.029	0.6400	47.01	47.60	0.9992

Calibration Information for Equipment Used

Serial Number	Equipment Type	Calib. Expiry Date
1304-75547-4	Anemometer	21 February 2017
GPB0115	Barometer	21 February 2017
GTH031	Thermometer	21 February 2017
724606A	Manometer (Build)	21 February 2017
724606B	Manometer (Fan)	21 February 2017
H01591	Fan	21 February 2017

Differential Building Pressures

Gauge #1:	Kit / Eng	Room Pressure	Δp_{01}	Δp_m										Δp_{02}
724606A	SLR		0.5	-75.2	-70.3	-65.9	-60.8	-55.2	-50.2	-45.2	-40.3	-35.6	-30.0	0.5
		Corrected (Pa)	0.5	-75.9	-70.9	-66.5	-61.3	-55.7	-50.7	-45.6	-40.7	-35.9	-30.3	0.5
		Avg Corrected, Δp (Pa):	////	-76.4	-71.4	-67.0	-61.8	-56.2	-51.1	-46.1	-41.1	-36.4	-30.8	////

Fan Flow Pressures and Volume Flow Rates

Type	Serial No.	Range	Gauge Ref	Kit / Eng	Flow Pressure Corrected (Pa)	Flow Q_{50} (m ³ /s)	Total Flow, Q_{env} (m ³ /hr)	Error (%)	Initial Static Pressure Fan Blanked Off	Final Static Pressure Fan Blanked Off				
T.S	H01591	Ring C2	724606B	SLR	375.5	352.5	316.6	285.5	256.6	224.4	201.1	174.4	145.5	118.5
					377.0	353.9	317.9	286.7	257.6	225.3	201.9	175.1	146.1	119.0
					0.22	0.21	0.20	0.19	0.18	0.17	0.16	0.15	0.13	0.12
					752	728	690	655	621	580	549	511	467	421
					-0.3%	0.8%	-0.5%	-0.5%	0.2%	-0.5%	0.6%	0.7%	-0.6%	-0.1%

