



**Air Leakage
Detailing &
Awareness
Services**

**Report on the Acceptance Air Permeability Testing of the
Passivhaus Refurbishment of:**

57 Portfield Street, Hereford

4th June 2009



Customer:		Test Engineer:
<i>Phil Rigby, Knauf Insulation UK</i>		<i>Paul Jennings</i>
Test Date:		Paul Jennings
<i>3rd June 2009</i>		

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Final Air Permeability Report for:

57 Portfield Street, Hereford



Test/ Job No: ALD09-03-0105B

Test Date: 3rd June 2009

Test Engineer: Paul Jennings

Objectives:

1. To ascertain the final air permeability ($\text{m}^3/\text{hr}/\text{m}^2$ @ 50 Pa) and air change rate of the refurbished house at 57 Portfield Street, Hereford.
2. To identify any residual leakage sites which may be addressed during snagging and final completion to further improve the airtightness of the building

Measurement Procedures:

Test procedures in accordance with the following standards: ATTMA TS1, Method B.

Based upon: BS EN 13829:2001

Site Layout & Description of Testing:

The site comprised a two storey semi-detached house, with a newbuild rear extension and an unheated basement (which, other than the access stairs, was outside the test volume). The test equipment was mounted in the side doorway of the new extension. The building was inspected; external doors and windows were closed, internal doors opened. The supply and return ducts from the heat recovery ventilation system were temporarily sealed for the duration of testing.

Building Measurements:

The building envelope area and volume measurements used were calculated by the owner & architect, Andy Simmonds, and checked on site during the initial air permeability test by the test engineer, having regard to the ATTMA measuring conventions detailed in TS1.

Volume m^3	Envelope area m^2	Exposed envelope area m^2
498	480	438

TEST METHOD AND PROCEDURE

Method

Prior to testing the average of positive and negative values of the existing pressure differential, with the fan unit not operating, were recorded over three periods of 60 seconds each to ensure that the pressure difference between the external and internal environments did not exceed +/- 5Pa, as required by TS1.

The existing pressure differential, the barometric pressure, the external wind speed and the internal and external temperatures were recorded at the beginning of the test, and the wind speed and internal and external temperatures, as well as any existing pressure differential, were also recorded at the completion of the test.



During the test, measurements of airflow and the corresponding imposed pressure differential were taken and recorded at a series of fan speeds. This was by depressurising 57 Portfield Street, using a calibrated fan. The test was conducted in accordance with ATTMA TS1 adopting Method B of BS EN 13829:2001.

The air leakage rate V_L , for the depressurisation test, was calculated using equation (8) of BS EN 13829:2001.

$$V_L = C_L$$

C_L is the air leakage coefficient, in $m^3 / (h.Pa)$

$$C_L = C_{env} (\rho_e/\rho_0)^{(1-n)}$$
 from BS EN 13829:2001 (Page 12)

Procedure:

Prior to switching on the fan(s), the test engineer was satisfied with the weather conditions and the wind speed, and established that the static pressure readings between the building and the external environment did not exceed +/- 5Pa. Then the dwelling was depressurised to create a difference in excess of 35 Pa to the external environment. This is an acceptable deviation from the TS1 test method, where the target pressure differential is 50 Pa but a reading above 35 Pa is required. An initial leakage investigation was undertaken with the dwelling depressurised to approximately 45 Pa, where those attending the test undertook visual inspections and used chemical smoke puffers to check interfaces and joints between sections of the building envelope, together with penetrations through the envelope. Leakage sites identified were recorded for future attention, and this process also identified (a) that one of the windows on the front of the building remained open (which explained the very poor initial reading) and (b) that the rooftop supply duct to the MVHR system had not been sealed off. These deficiencies were rectified and an initial single point test was undertaken before measurements of flow and pressure were recorded for 10 different pressures, by using magnahelic gauges, for the full acceptance test. The test report was subsequently generated offsite by the testing organization.

Measurements Recorded:

Pre-Test Site Data:

Date and Time	External Temp °C	Internal Temp °C	Wind Speed m/s	Barometric Pressure Pa	Zero Flow Pressure Differential Pa		
					+ve	-ve	average
2.30pm, 3 rd June	22.0	20.0	1.0	1,017,000	0.0	-1.5	-1.5

Initial Single-Point Test:

Reading:	1
Building Pressure, Pa:	56
Corrected Flow m^3/hr :	533.5

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Full Acceptance Test:

A full multi-point depressurisation acceptance test was then carried out. The readings collected are detailed below:

Reading:	1	2	3	4	5	6	7	8	9	10
Building Pressure, Pa:	58	57	56.5	54.5	51.5	49	47	30	26	22.5
Corrected Flow m ³ /hr:	526	524	511	498	479	461	446	329	291	260

Post-Test Site Data:

Time	External Temp °C	Internal Temp °C	Wind Speed m/s	Barometric Pressure Pa	Zero Flow Pressure Differential Pa		
					+ve	-ve	average
3.40 pm	22.0	20.0	1.0	1,017,000	0.0	-2.0	-2.0

Results:

All results are compared to the standards set in Building Regulations 'Approved Document L1A – Conservation of fuel and power in new dwellings (2006)'. Results are calculated using the formula set out in ATTMA TS1 (section 3.2)

RESULT	UNITS	DEPRESSURISE
Air Leakage Coefficient, C _L	(m ³ /h)	31.5
Air Flow Coefficient, C _{env}	(m ³ /h)	31.5
Air Flow Exponent	-	0.70
Correlation Coefficient	-	0.999
Air Changes / Hour @ 50Pa	(/hr)	0.97
Air Permeability @ 50Pa	(m ³ /h/m ²)	1.00

Conclusion:

With an achieved Air Permeability of 1.0 and an Air Change Rate of 0.97 ACH @ 50 Pa, the refurbished house at 57 Portfield Street, Hereford, is substantially better than required to be in **COMPLIANCE** with the Building Regulations 'Approved Document L1B – Conservation of fuel and power in existing dwellings (2006)', and comes close to meeting the airtightness target set by the Passivhaus Institute for **NEWBUILD** Passivhaus dwellings. Since this is much more difficult to achieve in a refurbishment project, especially when the dwelling in question has a large expanse of party wall and an unheated basement, this is clearly an excellent result and reflects the extensive efforts of the architect and the builder contractor to design and implement good airtightness detailing.

The measured effective whole house leakage area of 24100 square millimeters (at the raised test pressure of 50 Pascals, approximately equivalent to a 20 mile an hour wind), corresponds to a leakage area of just over 50 square millimeters (i.e. approximately the cross-section of a small biro) per square metre of envelope area.



**Air Leakage
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Air Permeability Certificate

In accordance with BS EN 13829
& CIBSE Technical Memorandum 23 / ATTMA Technical Standard 1

Building tested: 57 Portfield Street, Hereford
Test Date: 3rd June 2009
Test Engineer: Paul Jennings
Site Contact & Company: Andy Simmonds, Simmonds Mills Architects/ Mike Neate,
Eco-Design & Construction
Certificate No: ALD09-02-0105B

This is to certify that the above named structure has been tested for air tightness in accordance with the BS EN 13829:2001 methodology.

The Key Leakage Characteristics of the building were recorded as follows:

Air Permeability Rate @ 50 Pa: 1.00 m³/(hr.m²)

Effective Leakage Area: 0.0241 m² at 50Pa
Correlation of results, R²: 0.999
Slope, n: 0.70
Air Flow Coefficient, C_{env}: 31.5 m³/(hr.Paⁿ)
Intercept, C_L: 31.5 m³/(hr.Paⁿ)

Test Parameters:

Envelope Area, A_E: 480 m²
Env. Calc Prepared by: Andy Simmonds
Env. Calc Verified by: Paul Jennings of ALDAS Limited

Initial Offset Pressure:	-1.5 Pa	Final Offset Pressure:	-2.0 Pa
Initial Inside Temperature:	20.0 °C	Final Inside Temperature:	20.0 °C
Average Outside Temperature:	22.0 °C	Barometric Pressure:	1,017,000 Pa

This test certificate should be read in conjunction with the report ALD09-02-0105B and associated test method statement.

Signed: _____ Name: Paul Jennings Date Issued: 4th June 2009

Position: Chief Engineer

ALDAS Limited
Trelay Farm, St. Gennys, Bude, Cornwall EX23 0NJ

Tel: 01840 230228 E-mail: Doorfanman@hotmail.com



Comments

The initial air leakage testing was undertaken in March and achieved an air permeability of 1.56 whilst the internal finishes of the new extension to 57 Portfield Street were largely incomplete. Tackling the leakage sites identified during the initial test, together with the anticipated process of finishing the building works achieved a substantial improvement to the achieved air permeability value of 1.0. Some sealing works were undertaken during the process of testing, before the set of acceptance measurements were recorded. Two small holes in the membrane sealing off the unheated basement from the access stairwell were patched, however of much more significant was the sealing carried out along the bottom of the skirting board along the party wall in the front room of the existing house. There is a cavity in the party wall between the two houses, and it was clear that substantial amounts of air were leaking through this element. Once this cavity is filled and the wall surface made good, including more robust sealing along the bottom edge of the skirting board and to holes through the floor boards along the edge adjacent to the skirting board, the residual air leakage via this element should be next to nothing.

Another unfinished area where some residual leakage was identified was above and beside the front entrance door, where finishing plasterwork was incomplete. Despite the parge coat on the outside of the brickwork, there was clearly air entering the dwelling (when depressurised during the test) through the brickwork and also through some expanded foam sealing between the lintel and the top of the door frame.

A further residual leak identified was along the bottom of the Internorm doors (one single door and one double door) on the rear elevation of the extension to the building. These doors have yet to be adjusted, so it is anticipated that this leakage will be significantly reduced during the final stages of completing the works to 57 Portfield Street. Hence it was decided to temporarily seal the bottom edges of these two doors and undertake a further single point depressurisation test to investigate the order of magnitude of this leakage source.

The results of this final air permeability test, with approximately a three metre length of door threshold and bottom edge temporarily sealed with Gaffa tape, was an air permeability of 0.97 (down from 1.0) and an effective leakage area, at 50 Pa test pressure, of 0.0233 square metres. By subtraction, this gives an effective hole size for this leakage site of 0.0008 square metres, or 800 square millimeters, an average gap of slightly less than $\frac{1}{4}$ of a millimeter along the length of the two door thresholds. Because of the relatively crude comparisons that give rise to this value, it must be treated with caution, but it does suggest that final adjustment of these doors will almost certainly give a final air permeability value for 57 Portfield Street of less than 1.0. Of course, as the building works settle in, dry out etc., particularly over the first year of occupancy, the air permeability is likely to increase somewhat, and we would therefore suggest carrying out a repeat test in approximately one years time.



Leakage Inspection

Alongside the acceptance testing, a detailed inspection of the dwelling was undertaken whilst in was depressurised to identify actual and potential residual leakage sites. Pictures of the locations identified, with appropriate comments, are provided below and on the following pages:

<p>Putty patches to holes through membrane at base of access stairs to basement.</p>		<p>Leakage in basement in places between timber framing and brick front wall, also around service penetration.</p>
<p>Expanded foam last minute sealing around waste pipe from kitchen – to be cut back and mastic over-sealed for a neat & airtight finish.</p>		<p>Some leakage across head of rear double door – to be adjusted.</p>



<p>Air leakage through lock, even with key in place!</p>		<p>Leakage along bottom of skirting on party wall, connecting to unfilled cavity between dwellings – to be further reduced.</p>
<p>Leakage through gaps behind plasterboard beside entrance door.</p>		<p>Leakage between foam and lintel where plastering above door not yet done.</p>



<p>Minor leakage at wall/ ceiling corner in upper bathroom, at complex junction of internal and external air barriers.</p>		<p>Minor leakage through service void entering dwelling around cable.</p>
<p>Minor leakage at joint in window frame.</p>		<p>Leakage in corner of high level window.</p>
<p>Temporary seal across bottom of single door during final test.</p>		<p>Temporary seal across bottom of double door during final test.</p>

Final Air Permeability Report for:

57 Portfield Street, Hereford



Test/ Job No: ALD09-03-0105B

Test Date: 3rd June 2009

Software Printout:

Air Leakage Report

Energy 2001 airtightness test program version 1.0(build 1.0.7)

Complies with UK standard TM23: 2000

By Retrotec, Inc, 2200 Queen Street, Bellingham, WA USA 98226 360-738-9835 www.retrotec.com

Software Licensed to: **Retrotec (Europe) Limited**

Building address **57 Portfield Street, Hereford HR1 2SE, UK**
Name, Phone **Andy Simmonds,**

Test number **2**

Calibration Certificate # **388** Certificate created **2002/09/30**

Test date/time	2009/06/03 13:48	Building Volume	498.0 m³
Standard used	TM23: 2000	Exposed envelope area	438.0 m²
Tester	Paul Jennings	Envelope area	480.0 m²
Certified to Level:	3 - Multiple blower tests	Fireplace	No fireplace
Signature	External doors & windows	Closed
Barometric pressure	1,017,000.0 Pa.	Exhaust Fans	Sealed
Windspeed Average	1.0 m/sec	Window air-conditioners	No window A/C
Combustion appliances	Off		
Internal doors & hatches	Open		
Ventilation openings	Closed		
Dryer	None		

RESULT	UNITS	First Test, Depressurize	Final Test, Depressurize
Flow @ 50 Pa	m ³ /hr	495.63	482.17
Airchanges, ACH @ 50 Pa	m ³ /hr/m ³	1.00	0.97
Air Leakage Index @ 50 Pa	m ³ /hr/m ²	1.13	1.10
Permeability @ 50 Pa	m ³ /hr/m ²	1.03	1.00
Effective Leakage Area @ 4 Pa, EflA	m ²	0.0104	0.0089
Equivalent Leakage Area @ 50 Pa	m ²	0.0248	0.0241

Notes

Witnesses

Final Air Permeability Report for:
57 Portfield Street, Hereford



Test/ Job No: **ALD09-03-0105B**
 Test Date: **3rd June 2009**

DOOR FAN TEST -- First Test Leakage Data

Energy 2001 airtightness test program version 1.0(build 1.0.7)
 Complies with UK standard TM23: 2000
 By Retrotec, Inc, 2200 Queen Street, Bellingham, WA USA 98226 360-738-9835 www.retrotec.com
 Software Licensed to: **Retrotec (Europe) Limited**

Building address **57 Portfield Street, Hereford HR1 2SE, UK**
 Name, Phone **Andy Simmonds,**

Test number **2**

Calibration Certificate # **388** Certificate created **2002/09/30**

Operator In the room **First test of building leakage**
 Smoke moves into the room Temperature during test (F)
 Static pressure -2 Pa 68 inside 72 outside

Depressurization		Take 10 readings at 60, 55, 50, 45, 40, 35, 30, 25, 20 & 15.
Blower range	Building pressure	-56
	Auto corrected BP	-56
Ring C2	Flow pressure	212
	Auto corrected FP	208
Corrected flow (m ³ /hr)		-534

	Q m ³ /hr	@ pa	EfLA m ²	Slope, n	Intercept, C m ³ /hr/Pa ⁿ	Correlation %	Standard Error, %	EqLA @ 50Pa m ²
Depressurization	495.63	50	0.0104	0.65	38.978	NA	NA	0.0248

Technician: **Paul Jennings** Certified to Level: **3 - Multiple blower tests**
Yes Level 1 –Understanding the technicalities of airtightness in buildings
Yes Level 2 – Single blower door-fan testing of buildings
Yes Level 3 – Multiple blower door-fan testing of buildings

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57 Portfield Street, Hereford



Test/ Job No: **ALD09-03-0105B**
 Test Date: **3rd June 2009**

DOOR FAN TEST -- Final Test Leakage Data

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 Complies with UK standard TM23: 2000
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 Software Licensed to: **Retrotec (Europe) Limited**

Building address **57 Portfield Street, Hereford HR1 2SE, UK**
 Name, Phone **Andy Simmonds,**

Test number **2**

Calibration Certificate # **388** Certificate created **2002/09/30**

Final test of building leakage

Operator In the room Smoke moves into the room Temperature during test (F)
 Static pressure -1.75 Pa 68 inside 72 outside

Depressurization		Take 10 readings at 60, 55, 50, 45, 40, 35, 30, 25, 20 & 15.											
Blower range	Building pressure	-58	-56.5	-54.5	-51.5	-49	-47	-22.5	-26	-30	-57		
	Auto corrected BP	-58	-56.5	-54.5	-51.5	-49	-47	-22.5	-26	-30	-57		
Ring C2	Flow pressure	208	197	188	175	163	153	54	67	85	206		
	Auto corrected FP	204	193	184	171.2	159.4	149.6	52.5	65.4	83.1	202		
	Corrected flow (m ³ /hr)	-526	-511	-498	-479	-461	-446	-260	-291	-329	-524		
	Error %	0.6	-0.6	-0.6	-0.3	-0.5	-0.9	-0.6	-0.2	1.6	1.3		

	Q m ³ /hr	@ pa	EfLA m ²	Slope, n	Intercept, C m ³ /hr/Pa ⁿ	Correlation %	Standard Error, %	EqLA @ 50Pa m ²
Depressurization	482.17	50	0.0089	0.70	31.500	99.9	1.73	0.0241

Technician: **Paul Jennings** Certified to Level: **3 - Multiple blower tests**
Yes Level 1 – Understanding the technicalities of airtightness in buildings
Yes Level 2 – Single blower door-fan testing of buildings
Yes Level 3 – Multiple blower door-fan testing of buildings



DOOR FAN TEST -- Graph

Energy 2001 airtightness test program version 1.0(build 1.0.7)
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