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Report on the Repeat Air Permeability Testing of the
 Passivhaus Refurbishment of:

57 Portfield Street, Hereford

16th July 2010



Address:	57 Portfield St	Target:
Air Change Rate (ACH @ 50 Pa):	0.79	1.0
Airflow @ 50 Pa (m ³ /hr):	392.3	n/a
Air Permeability (m ³ /hr/m ² @ 50 Pa)	0.82	1.0
Air flow exponent, n-value:	0.77	0.5 ≤ n ≤ 1.0
Correlation coefficient, r ² -value:	1.000	r ² ≥ 0.98
Customer:	<i>Toby Balson, Energy Saving Trust</i>	
Test Engineer:	<i>Paul Jennings, ALDAS Limited</i>	

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Air Leakage Detailing & Awareness Services

Company Directors

Jackie Carpenter & Paul Jennings

Co. Registration No:

06578439

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Registered Address:

Air Leakage Detailing and Awareness Services Limited, Trelay Farm, Bude, Cornwall EX23 0NJ



Test Engineer: Paul Jennings

Objectives:

1. To ascertain the air permeability ($\text{m}^3/\text{hr}/\text{m}^2$ @ 50 Pa) and air change rate (ACH @ 50 Pa) of the refurbished house at 57 Portfield Street, Hereford, approximately one year after the completion of remedial works.
2. To complete a full air change rate test in conformance with the draft Enerphit standard from the PassivHaus Institute, including a detailed inspection for residual leakage sites.

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 rear single doorway, part of the original construction. 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 previous acceptance 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 six periods of 30 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 $\text{m}^3 / (\text{h} \cdot \text{Pa})$

$C_L = C_{\text{env}} (\rho_e / \rho_0)^{(1-n)}$ 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.

An initial leakage investigation was undertaken with the dwelling depressurised to approximately 25 Pa, where those attending the test undertook visual inspections and used our hands to check for draughts at interfaces and joints between sections of the building envelope, as well as around penetrations through the envelope.



Some minor leakage was identified beneath doors and at the corners of window frames, also in the basement stairwell and above the front door where the foam sealing has not yet been finished off. No leakage could be found along the party wall, nor around the service penetrations associated with the heat recovery ventilation. A slight concentration of leakage was identified around the cable hole to the ceiling rose in the upstairs bedroom in the newbuild extension. Some leakage was also identified in the rear upstairs bathroom wall, where there had been some residual leakage at the time of the acceptance testing.

Following the leakage inspection, measurements of flow and pressure were recorded for 10 different pressures, using Magnahelic gauges, for the full depressurisation test. The fan was then turned around and a second series of readings recorded for the pressurisation 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
10.30am, 13 th July	15.0	21.0	1.0	99,350	0.0	-1.5	-1.5

Full Acceptance Test:

A full multi-point depressurisation test was carried out, followed by a pressurisation test. The readings collected are detailed below:

Depressurisation

Reading:	1	2	3	4	5	6	7	8	9	10
Building Pressure, Pa:	-59.5	-51	-58.5	-47.5	-41.5	-48.5	-16	-18.5	-20.5	-24.5
Corrected Flow m ³ /hr:	427.8	370.4	416.1	347.7	313.3	356.9	142.1	160.7	177.2	207.7

Pressurisation

Reading:	1	2	3	4	5	6	7	8	9	10
Building Pressure, Pa:	36	44	49.5	53.5	57.5	60	19.5	18	16.5	11.5
Corrected Flow m ³ /hr:	309.2	349.6	382.8	405.1	425.3	446.5	200.6	185.2	173.5	134.9

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
12.30 pm	15.0	21.0	1.0	99,350	0.0	-1.5	-1.5

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)	19.37
Air Flow Coefficient, C_{env}	(m^3/h)	19.61
Air Flow Exponent	-	0.77
Correlation Coefficient	-	1.00
Air Changes / Hour @ 50Pa	(/hr)	0.79
Air Permeability @ 50 Pa	($m^3/h/m^2$)	0.82
Airflow @ 50 Pa	(m^3/hr)	392.3

Conclusion:

With an Air Permeability of 0.82 and an Air Change Rate of 0.79 ACH @ 50 Pa, the refurbished house at 57 Portfield Street, Hereford, has improved since the previous acceptance test in June 2009. Some of this is will be the result of easing and adjusting the four doors to the property, particularly the double doors to the rear kitchen, which was carried out subsequent to that test. However such a significant improvement suggests that there was also some substantial unidentified leakage at the time of the test. This might have been through the area where sealing works were incomplete – the party wall to the adjacent house – or perhaps some temporary sealing, most likely in the basement, had come partially away during the testing. The similarity of the results between the pressurisation and depressurisation tests suggests that there are no significant problems with the membranes in the walls or roof, since this would tend to be substantially worse under one or other of the two different pressure regimes.

Overall the property at 57 Portfield Street is substantially better than is required to be in **COMPLIANCE** with the Building Regulations 'Approved Document L1B – Conservation of fuel and power in existing dwellings (2006)'. It also meets the draft airtightness target (1.0 ACH @ 50 Pa) set by the Passivhaus Institute in the forthcoming Enerphit standard for refurbished Passivhaus dwellings.



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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
 Repeat Test Date: 13th July 2010
 Test Engineer: Paul Jennings
 Site Contact & Company: Andy Simmonds, Simmonds Mills Architects/ Toby Balson,
 Energy Saving Trust
 Certificate No: ALD10-06-0251

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:	0.82 m ³ /(hr.m ²)
Air Change Rate @ 50 Pa:	0.79 ACH
Airflow @ 50 Pa:	392.3 m ³ /hr
Correlation of results, R ² :	1.00 (average)
Slope, n:	0.77 (average)
Air Flow Coefficient, C _{env} :	19.61 m ³ /(hr.Pa ⁿ) (average)
Intercept, C _L :	19.37 m ³ /(hr.Pa ⁿ) (average)

Test Parameters:

Envelope Area, A _E :	480 m ²
Volume:	498 m ³
Env. Calc Prepared by:	Andy Simmonds
Env. Calc Verified by:	Paul Jennings of ALDAS Limited

Initial Offset Pressure:	-1.5 Pa	Final Offset Pressure:	-1.5
Initial Inside Temperature:	21 °C	Final Inside Temperature:	21 °C
Average Outside Temperature:	15 °C	Barometric Pressure:	99,350 Pa

This test certificate should be read in conjunction with the report ALD10-06-0251 and associated test method statement.

Paul Jennings

Signed: _____ Name: Paul Jennings Date Issued: 16th July 2010

Air Leakage Detailing & Awareness Services

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Scottish Office:	23 Forth Street, Edinburgh, Scotland EH1 3LE		



Appendix One

Software Printout

Retrotec Door Fan Test Report

Tester Information		
		Air Leakage Detailing & Awareness Services Limited
		Trelay Farm
		St. Gennys, Bude, Cornwall
		UK, EX23 0NJ
		Telephone: +44 (0)8456 808048
		info@aldas.co.uk
Customer		
Group Name		Energy Saving Trust
Contact Person		Toby Balson / Andy Simmonds
Building Under Test		
Details		Refurbishment
Address		57 Portfield Street
City		Hereford HR1 2SE
ATTMA Building Type		Dwelling – mechanically ventilated
Air Permeability Targets		Best Practice : 3 , Normal : 5
Temporary Air Sealing		HRV ducts – inlet & exhaust
Test		
Test #:		1
Performed On		2010/07/13
Operator		In the Room
Direction(s)		Test both directions
Standard		ATTMA: TS-1

Environmental Conditions

		<u>Before</u>			<u>After</u>
Barometric Pressure		99350 Pa			99350 Pa
Wind Speed		1m/s			1m/s
Inside Temperature		21 °C			21 °C
Outside Temperature		15 °C			15 °C
Static Pressure	P01+	0.0 Pa		P02+	0.0 Pa
	P01-	-1.5 Pa		P02-	-1.5 Pa
	P01	-1.5 Pa		P02	-1.5 Pa

Baseline static pressure measured before test.

-1.5	-1.0	-2.0	-1.5	-1.0	-2.0		
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Depressurize

Room Pressure (Pa):	-59.5	-51	-58.5	-47.5	-41.5	-48.5	-16	-18.5	-20.5	-24.5
Corrected Room Pr (Pa):	58	49.5	57	46	40	47	14.5	17	19	23
Corrected Flow Pr (Pa):	427.8	370.4	416.1	347.7	313.3	356.9	142.1	160.7	177.2	207.7
Measured Flow (m ³ /h):	439.5	380.6	427.5	357.2	321.9	366.7	146.0	165.1	182.1	213.4
Best Fit Flow (m ³ /h):	435.1	384.5	429.3	363.1	325.5	369.2	147.4	166.8	182.0	211.3
Error (%):	1.	-1.	-4	-1.6	-1.1	-7	-9	-1.1	0	1.

Pressurize

Room Pressure (Pa):	36	44	49.5	53.5	57.5	60	19.5	18	16.5	11.5
Corrected Room Pr (Pa):	37.5	45.5	51	55	59	61.5	21	19.5	18	13
Corrected Flow Pr (Pa):	309.2	349.6	382.8	405.1	425.3	446.5	200.6	185.2	173.5	134.9
Measured Flow (m ³ /h):	324.3	366.7	401.5	424.9	446.1	468.3	210.4	194.2	182.0	141.5
Best Fit Flow (m ³ /h):	319.3	369.7	403.1	426.9	450.2	464.6	205.8	194.6	183.1	143.1
Error (%):	1.5	-8	-4	-5	-9	.8	2.2	-2	-6	-1.1



Baseline static pressure measured after test.

-1.0	-2.0	-1.5	-2.0	-1.0	-1.5		
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Data Analysis

	Slope (n)	Intercept (C) (m ³ /h)	Correlation (r ²)
Best Fit: Least Squares			
Depressurize	0.7811	18.2479	99.98
Pressurize	0.7578	20.4858	99.97
Average	0.7694	19.36685	99.98

Zone Dimensions

Net Floor Area	50	m ²
Envelope Area	480	m ²
Internal Volume	498	m ³

Results

		Units	Depressurise	Pressurise	Average
Air Flow Coefficient	C _L	(m ³ /h)	18.248	20.486	19.367
Air Flow Coefficient	C _{env}	(m ³ /h)	18.412	20.800	19.606
Air flow Exponent	n		0.7811	0.7578	0.7694
Correlation Coefficient	r ²	(%)	99.98	99.97	99.98
Flow@ 50 Pa		(m ³ /h)	387.52	397.13	392.3
Air Changes/Hour @ 50 Pa	ACH	(/hr)	0.778	0.8	0.7878
Air Permeability@ 50 Pa		(m ³ /h.m ²)	0.81	0.83	0.82
Specific Leakage Rate @ 50 Pa	SLR	(m ³ /h.m ²)	7.75	7.94	7.85

Door Fan 3.0 Enclosure Leakage Analysis Software (Version 3.260)

By: Retrotec Energy Innovations Ltd (Canada).

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This software conforms to the ATTMA: TS-1 testing standard

