Report on the Preliminary Air Leakage Testing of 8 Benson Place in Oxford, in compliance with ATTMA TSL1 (2010)

Result: Satisfactory

Site address: 8 Benson Place, Oxford, OX2 6QH

Test Reference No.:		**JALDAS5037/R2**
Test Dates:		**19th December 2013**
Testing carried out for:	**Client:**	**Tim Nicholson**
Testing carried out by:	**Test Engineer:**	**Paul Jennings**
	Company:	**Aldas**
	Contact Tel:	**01452 532878 / 07866 948200**
	Contact E-mail:	**Doorfanman@hotmail.com**
Target Air Changes, ACH^{-1} @ 50 Pa:		**≤ 1.0 (EnerPHit)**
Achieved Air Changes, ACH^{-1} @ 50 Pa:		**0.89**
Achieved Air Permeability, $m^3/hr/m^2$ @ 50 Pa:		**0.82**
Data consistency, r^2 (requirement, $r^2 \geq 0.98$):		**0.998**
Slope, n (requirement, $0.5 \leq n \leq 1.0$):		**0.70**

ALDAS, 54 Melville Road, Churchdown, Gloucester GL3 2RG
Aldas is a trading name of Jennings Aldas Limited, Co. Reg 8409614
Director: Clare Corley
Air Leakage Specialist: Paul Jennings, BSc, MSc doorfanman@hotmail.com 07866 948200

Introduction & Set-Up:

Preliminary air leakage testing of 8 Benson Place in Oxford was carried out on the 11th and the 19th of December 2013. Testing was carried out using a Retrotec 3000SR high-power fan mounted in the front door of the house.

Testing was carried out in accordance with the requirements of BS EN 13829 and the BINDT Quality Procedure, in conformance with the ATTMA TSL1 standard (2010), Method B. Any queries or complaints about this test should be addressed in the first instance to the test engineer and in the second instance to BINDT.

BINDT contact details:Newton Building, St. George's Avenue, Northampton NN2 6JB
Tel: 01604 893860 www.bindt.org

All external doors and windows, other than that where the test equipment was mounted, were temporarily sealed for the duration of testing, many with OSB and/or polythene sheet since the replacement windows have yet to be fitted. Internal doors were kept open to ensure the building acted as a single volume.

The pictures below illustrate key parts of the equipment and test set-up used:

P2) Test equipment mounted in front entrance doorway

P3) Temporary seal over end of duct through ground floor

P4) Temporary seal over bathroom waste through ground floor

		
P5) Temporary seal over end of flue for wood burner (not yet fitted)		P6) Temporary seal over end of incoming air duct for wood burner (not yet fitted)
		
P7) Temporary seal to end of duct from MVHR system in cupboard off landing		P8) Temporary seal over end of MVHR ductwork through upstairs ceiling
		
P9) Temporary seal to ground floor opening when new window yet to be fitted		P10) Temporary seal to bedroom window where new window yet to be fitted, also tape seal to damaged membrane above window

Measurement Procedures:

Test procedures in accordance with the following standards: ATTMA TSL1, 2010, Method B. After a preliminary single-point depressurisation test and a short leakage check, a full multi-point depressurisation test was carried out. As required by the PassivHaus Institute, a full multi-point pressurisation test was also then undertaken, after turning the fan around.

The Envelope Area and Volume were calculated by the test engineer directly from measurements made on site on the 11th December. **Based upon:** BS EN 13829:2001.

Dwelling	**Envelope area m^2 (ATTMA conventions)**	**Volume m^3 (PHI conventions)**
8 Benson Place, Oxford, OX2 6QH	**343**	**316.5**

Measurements Recorded:

Averages of zero flow pressure differentials were recorded before and after the test, as were internal and external temperatures, windspeed and barometric pressure.

Equipment Calibration:

All test equipment and accessories are calibrated. The table below provides details of the equipment and the calibration validity for each:

Retrotec 3000SR Blower Unit	Serial No: PH001057	Expires 15th April 2014
Retrotec DM2A Digital Gauge	Serial No: 102036	Expires 15th April 2014
Testo 511 Digital Barometer	Serial No: 39107531/301	Expires 6th June 2014
Testo 110 Digital Thermometer	Serial No: 33949361/208	Expires 9th June 2014
Testo 525 Digital Anemometer	Serial No: 01712338	Expires 16th June 2014

Depressurisation Test

During the extensive leakage check, a number of major and minor leakage sites were identified, which are discussed later in this report. The only leakage site which was both accessible and could be practically tackled immediately was around the boiler flue through the wall, which was resealed by the resident. A full multi-point pressurisation test was then carried out.

Test date: **19th December 2013** Time: **11.42 am** to **12.17 pm**

Environmental Conditions:

Barometric Pressure:		**99.9**	KPa	Wind speed:	**0.5 m/s**
Temperature:	Initial:	indoors	**12°C**	outdoors	**12°C**
	Final:	indoors	**11°C**	outdoors	**9°C**

Test Data:

At least **3** static pressures taken for **10** sec each.
A minimum of **10** induced pressures taken for **≥20** sec each.

Existing Pressure Differentials (Static pressure):

Baseline, initial [Pa]	+0.3	0.0	0.0	+0.1	-0.2	-0.2
Baseline, final[Pa]	-0.3	+0.1	-0.2	0.0	+0.2	-0.1

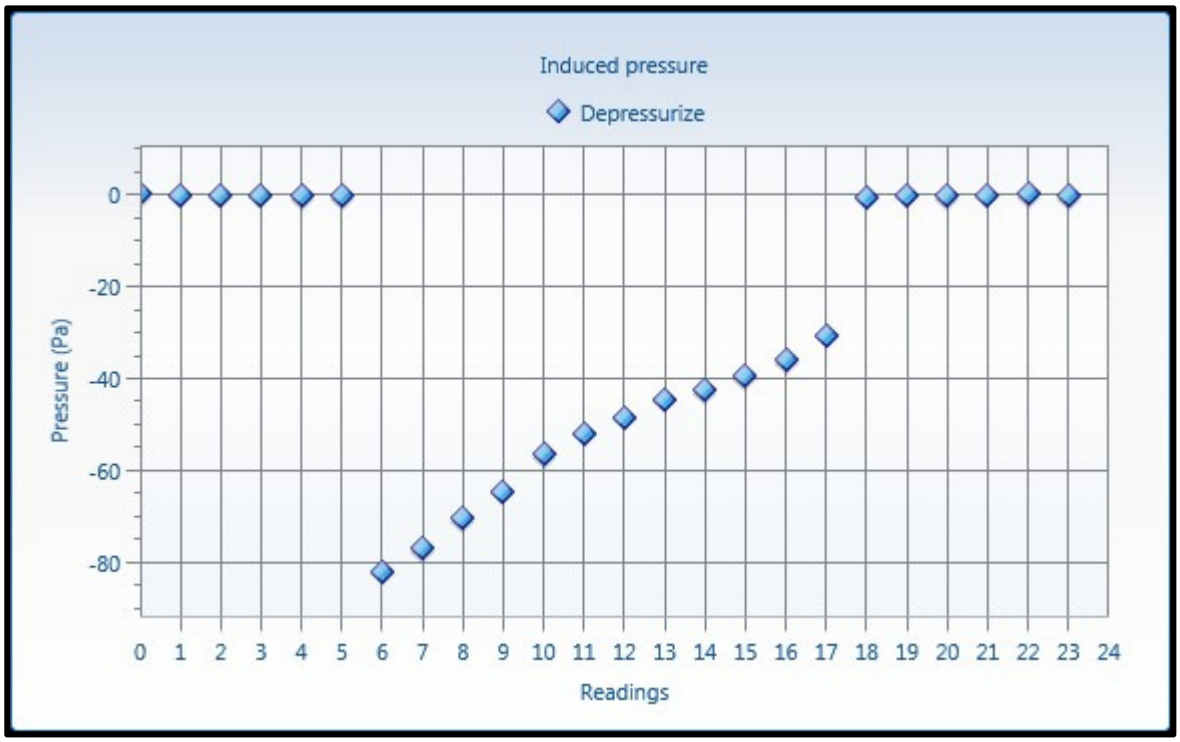
Static Pressure Averages:	initial [Pa]	ΔP_{01}	**0.00**	ΔP_{01-}	**-0.20**	ΔP_{01+}	**+0.10**
	final [Pa]	ΔP_{02}	**-0.05**	ΔP_{02-}	**-0.20**	ΔP_{02+}	**+0.10**

Results:

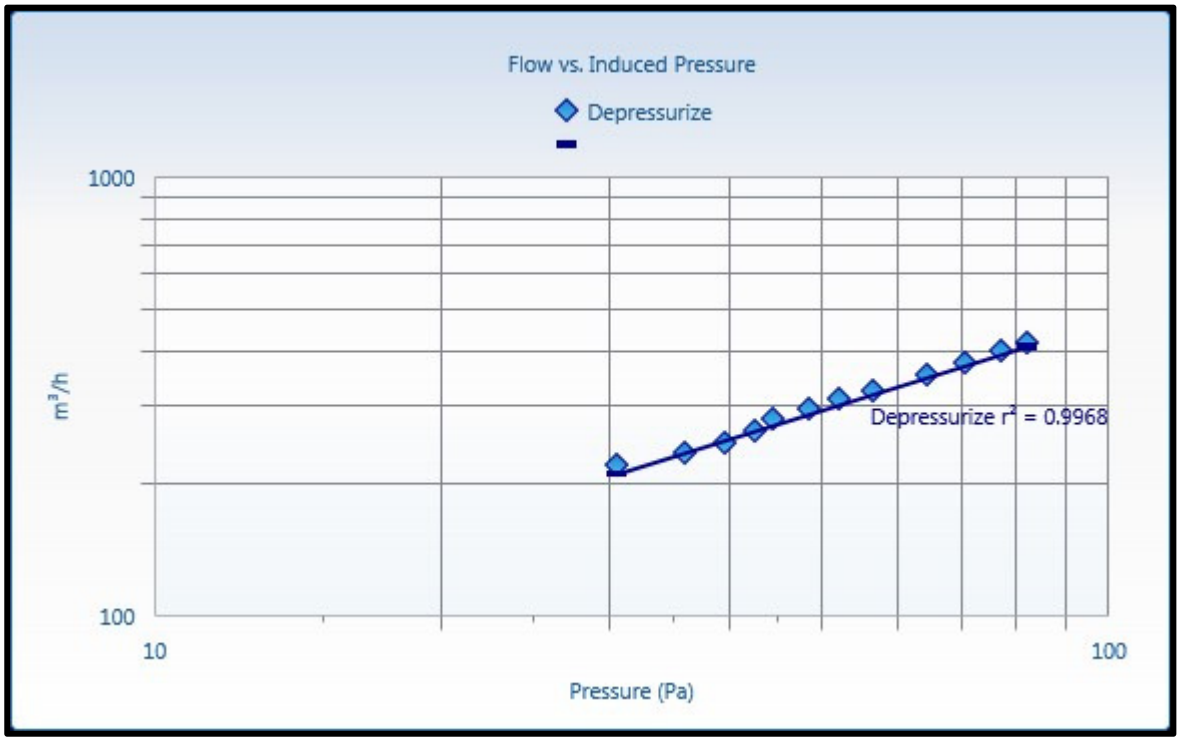
All results are compared to the standards set in Building Regulations 'Approved Document L1A – Conservation of fuel and power in new dwellings (2010)'. Results are calculated using the formula set out in ATTMA TSL1 (Section 3.2). Readings collected are detailed below:

Reading:	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Induced Pressure [Pa]	-82.0	-77.0	-70.5	-64.5	-56.5	-52.0	-48.5	-44.5	-42.5	-39.5	-36.0	-30.5
Total flow, Q_r [m^3/h]	419.4	401.2	378.0	353.2	326.7	312.6	297.7	282.2	265.5	247.8	235.0	220.4
Corrected flow, Q_{env} [m^3/h]	411.0	393.1	370.4	346.1	320.1	306.3	291.7	276.5	260.1	242.8	230.2	216.0
Error [%]	+0.1%	-0.1%	-0.1%	-0.9%	+0.3%	+1.5%	+1.3%	+1.8%	-1.2%	-3.1%	-2.2%	+2.6%

G1: Graph of imposed pressure differentials, depressurisation:



G2: Graph of imposed pressure differential against airflow, depressurisation:



Depressurisation Test Results

	Results		
Correlation, r^2	**0.997**	95% confidence limits	
Intercept, C_{env} [$m^3/h.Pa^n$]	**21.0**	**18.0**	**24.3**
Slope, n	**0.68**	**0.64**	**0.71**

	Results	Uncertainty
Air flow at 50 Pa, Q_{50} [m^3/h]	**295.5**	**±1.1%**
Permeability at 50 Pa, AP_{50} [$m^3/h.m^2$]	**0.86**	**±1.2%**
Equivalent leakage area at 50 Pa [m^2]	**0.015**	**±1.1%**
Air changes, n_{50}	**0.93**	**±1.2%**

Pressurisation Test

After the depressurisation test a full multi-point pressurisation test was then carried out, as required by the PassivHaus Institute.

Test date: **19th December 2013** Time: **1.34 pm** to **1.51 pm**

Environmental Conditions:

Barometric Pressure:		**99.9**	KPa	Wind speed:	**0.5 m/s**
Temperature:	Initial:	indoors	**12°C**	outdoors	**9°C**
	Final:	indoors	**11°C**	outdoors	**7°C**

Test Data:

At least **3** static pressures taken for **10** sec each.
A minimum of **10** induced pressures taken for **≥20** sec each.

Existing Pressure Differentials (Static pressure):

Baseline, initial [Pa]	-0.3	+0.1	-0.2	0.0	+0.2	-0.1
Baseline, final[Pa]	+0.6	+0.8	+2.6	+0.4	+0.8	+0.8

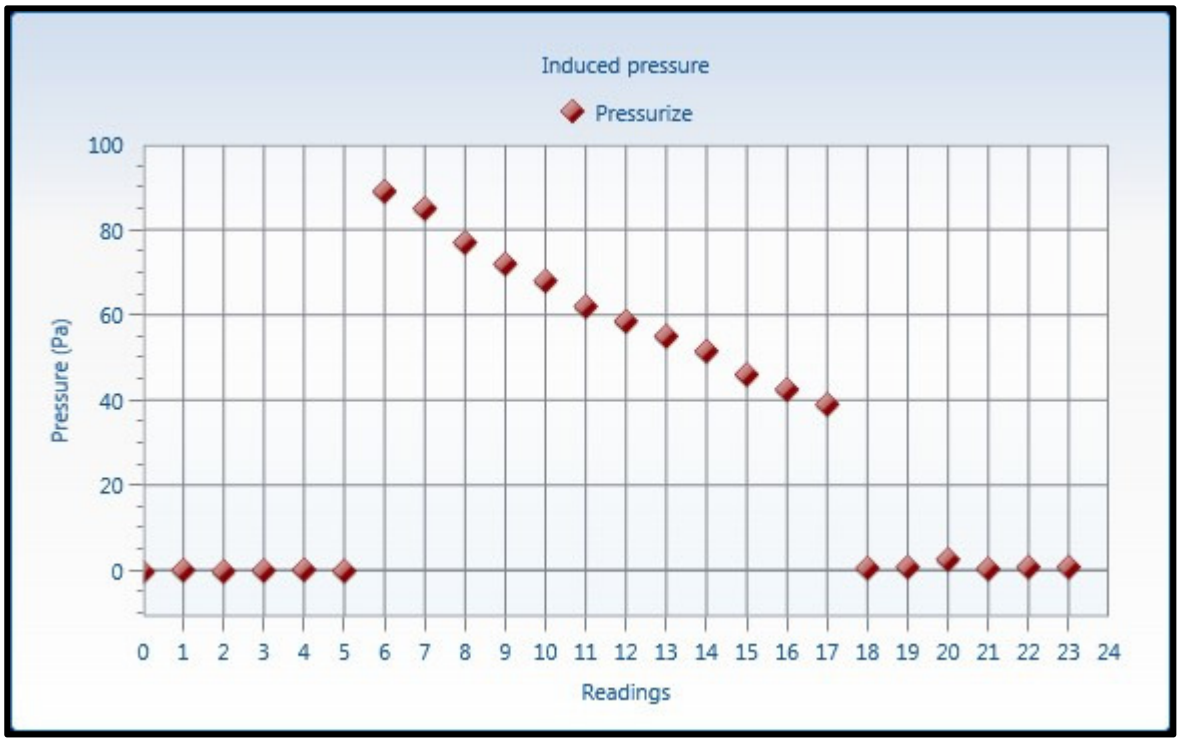
Static Pressure Averages:	initial [Pa]	ΔP_{01}	**-0.05**	ΔP_{01-}	**-0.20**	ΔP_{01+}	**+0.10**
	final [Pa]	ΔP_{02}	**+1.00**	ΔP_{02-}	**-0.00**	ΔP_{02+}	**+1.00**

Results:

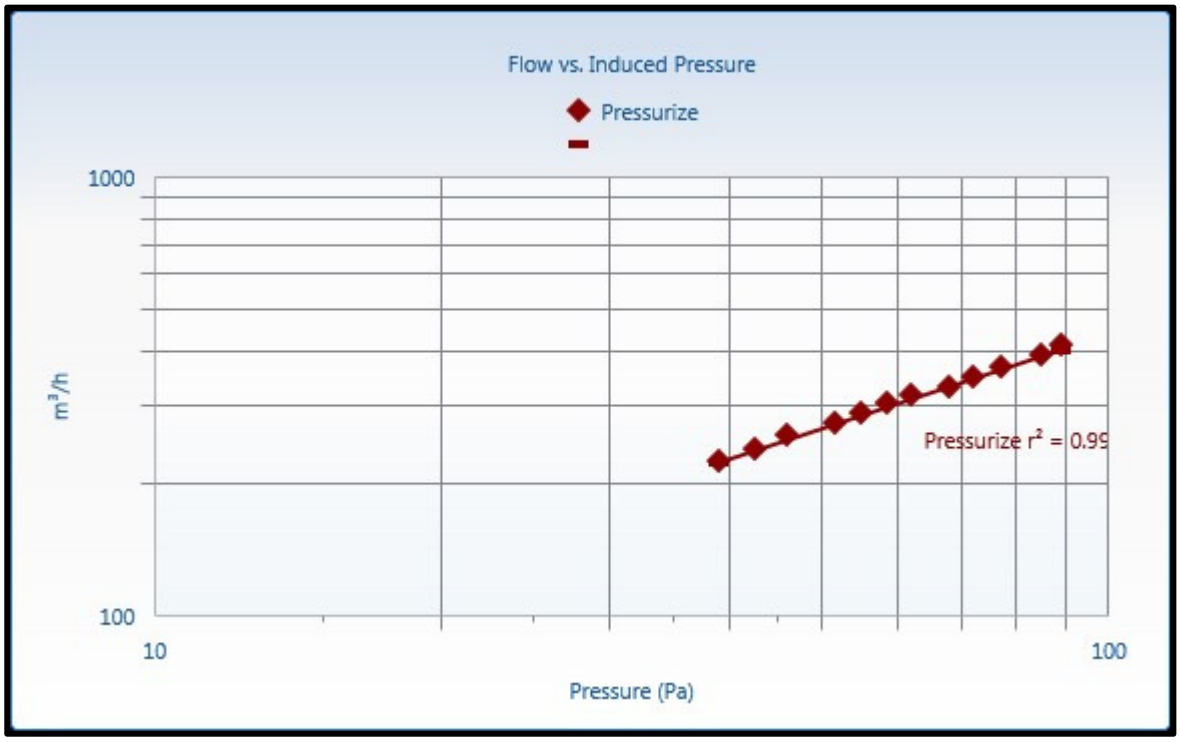
All results are compared to the standards set in Building Regulations 'Approved Document L1A – Conservation of fuel and power in new dwellings (2010)'. Results are calculated using the formula set out in ATTMA TSL1 (Section 3.2). Readings collected are detailed below:

Reading:	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Induced Pressure [Pa]	89.5	85.5	77.5	72.5	68.5	62.5	59.0	55.5	52.0	46.5	43.0	39.5
Total flow, Q_r [m^3/h]	415.0	392.5	368.9	352.2	334.6	321.1	306.6	291.5	275.5	258.9	240.9	226.3
Corrected flow, Q_{env} [m^3/h]	407.5	385.4	362.3	345.9	328.5	315.3	301.1	286.2	270.5	2564.2	236.6	222.3
Error [%]	+1.1%	-1.2%	-0.3%	-0.1%	-1.2%	+1.3%	+0.8%	+0.2%	-0.8%	+1.1%	-0.4%	-0.5%

G3: Graph of imposed pressure differentials, pressurisation:



G4: Graph of imposed pressure differential against airflow, pressurisation:



Pressurisation Test Results

	Results		
Correlation, r^2	**0.999**	95% confidence limits	
Intercept, C_{env} [$m^3/h.Pa^n$]	**16.3**	**14.8**	**16.3**
Slope, n	**0.71**	**0.69**	**0.71**

	Results	Uncertainty
Air flow at 50 Pa, Q_{50} [m^3/h]	**267.0**	**±0.7%**
Permeability at 50 Pa, AP_{50} [$m^3/h.m^2$]	**0.78**	**±0.9%**
Equivalent leakage area at 50 Pa [m^2]	**0.013**	**±0.7%**
Air changes, n_{50}	**0.85**	**±0.9%**

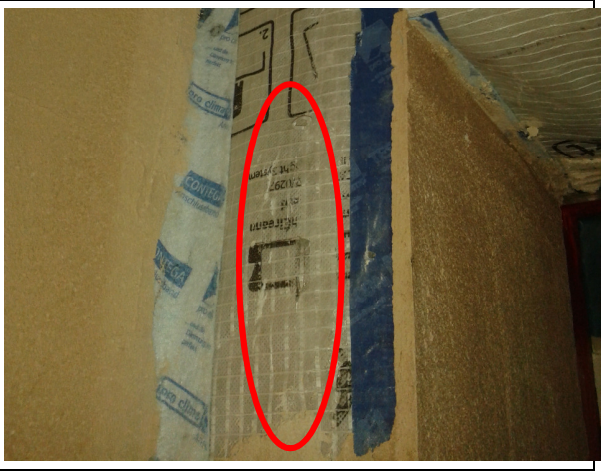
Leakage Inspection

Extensive inspections for leakage were carried out during both visits, with considerable permanent and temporary remedial sealing works being undertaken prior to the full multi-point testing. Various leakage sites were identified, which are illustrated in the pictures below and on the following pages:

P11) Leakage behind conduit, removed and wall parged before final test

P12) Red tape sealing crack across top of existing window

		
P13) Leakage in various gaps in brickwork at locations around existing fireplace		P14) Fireplace completely parged before final test
		
P15) Expanding foam used to seal void behind intermediate floor joist near existing chimney		P16) Tape seal around end of floor joist into wall
		
P17) Leakage found at edge of floor behind existing chimney		P18) Foam around floor edge trimmed back and then parged over to seal before final test

		
P19) Significant hole found in extrenal wall beneath upper internal partition wall		P20) Same section of wall parged to eliminate leakage
		
P21) Temporary mastic sealing to remove leaks around existing windows that will be replaced before the acceptance test		P22) Damaged membrane around window opening temporarily sealed before final test (see P10)

Comments & Conclusions:

The air leakage results achieved in the preliminary air leakage testing of the refurbished dwelling at 8 Benson Place in Oxford were an average Air Change Rate of 0.89 ACH^{-1} @ 50 Pa and an average Air Permeability of 0.82 $m^3/hr/m^2$ @ 50 Pa. These are excellent results, and already meet the EnerPHit target of $\leq$ 1.0 ACH^{-1} @ 50 Pa. Although there is obviously a risk of additional leakage as the new windows have yet to be installed and most of the services are incomplete, yet we would also expect the current residual leakage to be reduced as the plastering of the walls is finished and the plasterboard ceilings are installed. Hence we confidently expect the final Acceptance Test to achieve an Air Change Rate of $\leq$ 1.0 ACH^{-1} @ 50 Pa and therefore meet the EnerPHit target.