Dwelling Airtightness Testing Report

BSRIA Airtightness
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Report N°: DAT-DRA01-NA01-SOU01-1-PL1-T1

Date:	14/05/2010	**Airtightness Engineer:**	P Dooley
Accreditation Body:	ATTMA	**Registration Number:**	0005

Client:	Dr Antony Cowling	**Plot N°:**	1
Region:	N/A	**Developers Type:**	N/A
Address:	7 South Drive Sonning Reading Berkshire RG4 6GB	**Development Name:**	South Drive
Telephone:	0118 969 8326	**Development Address:**	7 South Drive Sonning Reading Berkshire RG4 6GB
Facsimile:			

Test Results at 50 Pascals

		Q_{50}: Airflow (m^3/h):	506
Measured Air Permeability ($m^3/(h.m^2)$):	0.98	**Design Air Permeability ($m^3/(h.m^2)$):**	1.00

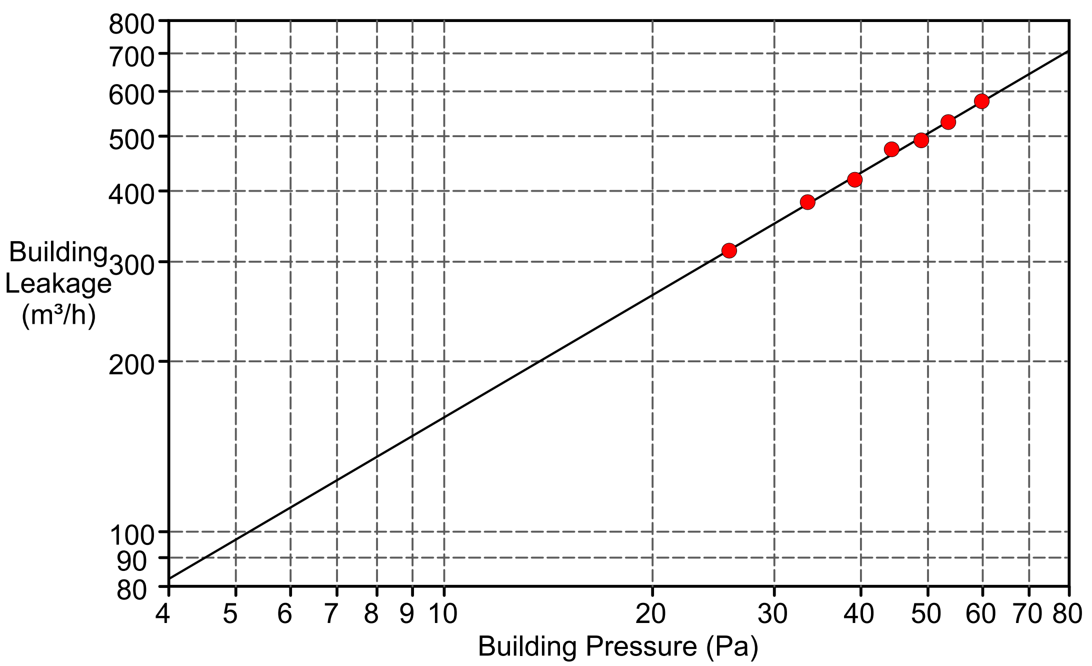
Did the dwelling achieve the required air permeability as specified in the SAP calculations?	**YES**

Building Leakage Curve

Air Flow Coefficient (C_{env}):	30.3	**Air Leakage Coefficient (C_L):**	30.5
Exponent (n):	0.72	**Correlation Coefficient (r^2):**	0.9983

Test Information

		TS1 Leakage Area (m^2):	0.025
Type of Test:	Depressurisation	**Test Method:**	B
Test Standard:	TS1	**Regulation Complied With:**	ADL1A



Dwelling Information

Type	Detached	**Envelope Area Verified**	Yes
Envelope Area	516.00	**Construction**	Traditional
Gross Floor Area	240.00	**Heating**	None
Storeys	3.0	**Type of Air Conditioning**	None
Cold Floor Present	No	**Type of Ventilation**	HRV
Warm Roof Construction	No	**Year of Construction**	2010

Equipment Information

Type	Manufacturer	Model	Identifier	Calibration Identifier	Calibration Expiry
Fan	Energy Conservatory	Model 3 (110V)	BDS12-1	57753	02/09/2010
Micromanometer	Energy Conservatory	DG700	BDS12-2	57754	03/09/2010
Barometer	Testo	511	BDS12-9	57757	04/09/2010
Thermometer	Testo	110	BDS12-3	57756	04/09/2010
Anemometer	Kaindl	Windtronic 2	BDS12-13	57758	04/09/2010

Dwelling Preparation Comments

HRV system sealed at source
Water traps filled
Internal doors opened
Windows closed
Kitchen extract sealed (taped)

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Depressurization Test:

Environmental Data

	Internal Temperature(°C)	External Temperature(°C)	Barometric Pressure(mbar)	Wind Speed (m/s)
Pre-Test	19.5	12.9	1006.1	0.0
Post-Test	19.9	12.9	1006.1	0.0
Average	19.7	12.9	1006.1	0.0

Fan-Off Pressure Data

Pre-Test

$\Delta p_{0,1}-$	$\Delta p_{0,1}+$	$\Delta p_{0,1}$
0.0	2.7	2.7

Post-Test

$\Delta p_{0,2}-$	$\Delta p_{0,2}+$	$\Delta p_{0,2}$
0.0	2.9	2.9

Data Points

Dwelling Pressure (Pa)	Fan Pressure (Pa)	Uncorrected Flow (m³/h)	Corrected Flow (m³/h)	% Error	Fan Configuration
2.7	n/a				
-23.0	80.2	319	314	-0.2	Ring C
-30.7	116.1	388	382	0.7	Ring C
-36.4	137.8	425	419	-1.4	Ring C
-41.5	25.5	481	474	2.2	Ring B
-46.1	27.4	499	492	-1.2	Ring B
-50.7	31.7	538	530	-0.2	Ring B
-57.0	37.4	585	576	0.2	Ring B
2.9	n/a				

Deviations from Standard - Comments

None

Deviations from Standard - Test Parameters

None

□ **Equations Used to Calculate Test Data as Specified in ATTMA-TS1, Appendix A, 13/07/07**

A1.1. Corrections for zero flow pressure differences

Zero flow pressure difference corrections are applied to the observed building differential pressures for wind and stack effects. The average zero-flow pressure difference is subtracted from each of the measured pressure differences, Δp_m, to obtain the induced pressure differences, Δp_{env}, using equation:

$$\Delta p_{env} = \Delta p_m - (\Delta p_{0,1} + \Delta p_{0,2})/2$$

where $\Delta p_{0,1}$ is the average of all zero flow pressure differences at the start of the test and $\Delta p_{0,2}$ is the average of all zero flow pressure differences at the end of the test.

A1.2. Calculation of air density

The air density, ρ , in kg/m^3, at a temperature, θ, in ^{o}C and the absolute pressure, p_{bar} , in Pa, is obtained by using the following equation. This is calculated as an average of temperature and absolute pressure readings taken immediately before, during and immediately after the test.

$$\rho = (p_{bar}/287.055 (\theta + 273.15)$$

A1.3. Correction for actual and observed airflow through the measuring device

The actual flow rate through the fan is a function of the measured values at the last fan calibration and measured values during the air test. This is calculated by equation:

$$Q_m = Q_c(\rho_c/\rho_m)$$

where Q_m is the actual volumetric flow rate through the fan during the test, Q_c is the airflow rate from the last calibration of the fan, ρ_m is the density of air passing through the fan (kg/m^3) and ρ_c is the air density recorded during fan calibration.

A1.4. Correction for internal/external air density differences

A correction is made for the internal/external density differences between air passing through the airflow measuring device and air passing through the building envelope. The applied correction depends on whether the building is being pressurised or depressurised.

A1.4.1. Corrections to airflow rate for pressurisation tests:

The measured airflow rate, Q_m , is converted to airflow through the building envelope, $Q_{env(out)}$, for pressurisation using equation:

$$Q_{env(out)} = Q_m(\rho_e/\rho_i)$$

where $Q_{env(out)}$ is the actual air flow volume out through the envelope, ρ_e is the mean external air density (kg/m^3) and ρ_i is the mean internal air density (kg/m^3).

A1.4.2. Corrections to airflow rate for depressurisation tests:

The measured airflow rate, Q_m , is converted to airflow through the building envelope, $Q_{env(in)}$, for depressurisation using equation:

$$Q_{env(in)} = Q_m(\rho_i/\rho_e)$$

Where $Q_{env(in)}$ is the actual air flow volume out through the envelope, ρ_e is the mean external air density (kg/m^3) and ρ_i is the mean internal air density (kg/m^3).

A1.5. Determination of constants C and n using a least squares technique

The results from a steady state building test give a dataset comprised of building differential pressures (ΔP_{env}) and corresponding fan flow rates (Q). A linear least squares curve fitting approximation is used to produce a best-fit line between these points. The most straightforward of these is the least squares approximation. For this, the straight line

$$y = mx + b$$

is fitted through the given points (x_1, y_1),….,(x_n , y_n) so that the sum of the squares of the distances of those points from the straight line is minimum, where the distance is measured in the vertical direction. The airflow rates and corresponding pressure differences are plotted on a log-log graph for pressurisation and depressurisation as required.

The calculation of the factors m and b for a given pressurisation test are as follows:

$$dSumXY = \Sigma(\ln \Delta P_{env} * \ln Qc)$$

$$dSumXX = \Sigma(\ln \Delta P_{env} * \ln \Delta Penv)$$

$$dSumX = \Sigma(\ln \Delta P_{env})$$

$$dSumY = \Sigma(\ln Q_C)$$

$$m = (dSumX * dSumY - Numpnts * dSumXY) / (dSumX * dSumX - dSumXX * Numpnts)$$

$$b = (dSumX * dSumXY - dSumXX * dSumY) / (dSumX * dSumX - dSumXX * Numpnts)$$

From this the air flow coefficient, C_{env} , and air flow exponent, n, are obtained:

$$C_{env} = exp^b$$

$$n = m$$

A1.6. Correction of airflow rates through the envelope to STP

The relationship is established between volumetric flow rate through the fan and the induced building envelope pressure difference:

$$Q_{env} = C_{env}(\Delta p_{env})$$

where Q_{env} is the air flow rate through the building envelope (m^3/h) and Δp_{env} is the induced pressure difference, in Pascals.

The air leakage coefficient, C_L , is obtained by correcting the air flow coefficient, C_{env} , to standard conditions (i.e. 20 oC and 101325 Pa) for pressurisation using equation:

$$C_L = C_{env}(\rho_i/\rho_s)^{1-n}$$

where ρ_i is the indoor air density (kg m^{-3}) and ρ_s is the air density at standard conditions (kg/m^3).

The air leakage coefficient, C_L , is obtained by correcting the air flow coefficient, C_{env} , to standard conditions (i.e. 20 ^oC and 101325 Pa) for depressurisation using equation:

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

where ρ_e is the outdoor air density (kg/m^3) and ρs is the air density at standard conditions (kg/m^3)

The air leakage rate, Q , for a given building differential pressure, Δp_{env} , can be calculated using equation:

$$Q = C_L(\Delta p_{env})^n$$

where CL is the air leakage coefficient, in $m^3/(h\cdot Pa^n)$, Δp_{env} is the induced pressure difference (Pa)
and n is the air flow exponent.

A1.7. Air permeability

The air permeability, $Q_{50}/(S+F)$, is the air leakage rate at a pressure difference of 50 Pa, divided by the building envelope area S + F (m^2). Units are m^3h^{-1} per m^2 of envelope area.
The air permeability is calculated from:

$$Q_{50} = C * (\Delta P)^n$$

$$\text{Air Permeability} = 3600 * Q_{50} / (S + F)$$

where S is the exposed surface area of the walls and roof, and F is the area of the solid ground floor.

A1.8. Correlation coefficient (r^2)

The correlation coefficient (r^2) is a measure of the strength of association between the observed values of building differential pressure (Δρenv) and corresponding fan flow rates.

$$\text{Correlation coefficient} = S_{xy} / \sqrt{(\sigma^2)} \text{ where;}$$

$$\sigma^2 = (\text{Numpnts} * \text{dSumXX} - \text{dSumX} * \text{dSumX}) * (\text{Numpnts} * \text{dSumYY} - \text{dSumY} * \text{dSumY})$$

$$S_{xy} = \text{Numpnts} * \text{dSumXY} - \text{dSumX} * \text{dSumY}.$$

C. Equivalent Leakage Area

It is often useful for the test engineer to translate the results of an air leakage test in to a more readily understandable form such as equivalent leakage area, m. Area of 'holes' left in the structure can be a useful guide, but it is only an aerodynamic equivalent area based on a sharp edged orifice and should therefore be regarded as approximate. The flow rate of air can be expressed by:

$$Q = A.C_d\{2\Delta p/\rho\}^{0.5}\ m^3.s^{-1}$$

Where the discharge coefficient, C_d for a sharp edged orifice can be taken as 0.61 and if ρ is taken as 1.2 $kg.m^{-3}$ this can be simplified to:

$$Q_{\Delta p} = 0.788.\ A\ (\Delta p)^{0.5}\ m^3.s^{-1}$$

or at a test pressure of 50 pascals, Equivalent Leakage Area is:

$$A = Q_{50}/5.57\ m^2$$