Air Permeability and Thermographic Analysis Report

Client:
Project-OECOTOP Building Systems

At:
20A Baskin Cottages
Cloghran,
Co. Dublin.

Date: 11th & 12th August 2007

Author
Pat Kyne
Technical Director

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1.1 Confidentiality Statement

1.2 Document Reference Number

HOTP2007 Rev 01.

1.3 Document Name

Air Permeability Test Report.

1.4 Document Owner

PK Energy Controls Ltd.

1.5 Customer Name

Oecotop-Project.

1.6 Update Strategy

Document updated with new REV for each template amendment.

Related Documentation

Document Ref No.	Document Title	Author	Document Location
I.S. EN 13829 : 2000	Thermal Performance of Buildings – Determination of Air Permeability of Buildings – Fan pressurisation Method	National Standards Authority of Ireland.	n/a
I.S. EN 13187 :1999	Thermal Performance of Buildings – Qualative Detection of Thermal Irregularities in Building Envelopes – Infrared Method (ISO 6781:1983)	National Standards Authority of Ireland.	n/a
CIBSE TM-23	Testing Buildings for Air Leakage	The Chartered Institution of Building Services Engineers	n/a
ATTMA TS-1 Issue 2	Technical Standard 1	ATTMA	n/a

Table 1-1 Related Documentation

1.7 Revision History

Rev No.	Revision Details	Revised By	Date Of Rev
01	Initial Revision	Pat Kyne	25-02-2007

Table 1-2 Revision History

2 Test Equipment

2.1 Infrared Camera

Manufacturer	SAT
Model	S280
Serial Number	9028010020
Thermal Resolution	80mK @ 30DegC
Image Resolution	388 x 284 pixels
Spectral Range	8 – 14 µM
Calibration Date	February 2007

Table 2-1 Infrared Camera

2.2 Blower Door Fan

Manufacturer	Retrotec
Model	2200
Max Air Flow	9514 M3/Hr @50Pa

Table 2-2 Blower Door Fan Specification

2.3 Digital Pressure Gauge

Table 2-3 Digital Pressure Gauge

Make	Retrotec
Model	DM-2
Pressure Range	- 1250 Pa to + 1250 Pa
Accuracy	1% of pressure reading or 0.15 Pa
Serial No.	098154
Calibration Date	December 2006
Calibration Due	December 2007
Associated Software	Door Fan 3.0 Version 3.114

3 Test Detail

3.1 Customer Detail

Requested By	Daniel Steiger
Request Date	11th July 2007
Company	Oecotop-Project
Position	Project Manager
Company Address	Po-box 1407, D-78106 St. Georgen/Germany
Telephone No.	+49 - (0)77 24 - 9478800
Building Contractor	Oecotop-Project
Contractor Representative	Daniel Steiger
Contractor Telephone No.	+49 - (0)77 24 - 9478800

Table 3-1 Customer Detail

3.2 Building Detail

Test Zone Address	20A Baskin Cottages, Cloghran, Co. Dublin
Building Type	Detached
Construction Type	Eco Build
Ventilation Type	Breathable structure
Sealing Type	Pro-Clima tapes with additional specialist material
Internal Volume M^3	582 M^3
Floor Area	135 M^2
Envelope Area	484 M^2
Stage of Completion	70 % Complete
IR Analysis Internal Temperature ℃	18℃
IR Analysis External Temperature ℃	18℃
Wind Speed	1.5 M/Sec (<6M/Sec)
Wind Direction	West
Building Front Orientation	South
Nominal Test Pressure	50 Pascals

Table 3-2 Building Detail

3.3 Background to testing.

A request for Air Permeability testing was requested by the Project Manager Daniel Steiger at their specialist eco build house in Cloghran Co. Dublin for their client Marcel Lashkody.

This dwelling includes a warm roof space and the overall construction was approximately 70% complete. The building envelope air barrier was at the final stages of completion and thus provided for an opportune time to test and execute any remedial works that should be required.

Temporary seals were placed in the following areas prior to test:

- External duct
- Soil pipe openings

4 Air Permeability Test Results

Note: The test results below were generated with Retrotec Door Fan 3.0 Zone Leakage Analysis Software licensed to PK Energy Controls Ltd.

4.1 Test Data & Results

Depressurisation Door Fan Test Report

Tester Information

PK Energy Controls Ltd.
Carrowpeter,
Tuam,
Co.Galway,
Ireland.

Web: pkenergycontrols.ie

Building Under Test: Detached Eco Build Dwelling.
Marcel Lashkody,
20A Baskin Cottages,
Cloghran,
Co. Dublin.

Test #: 14
Performed On 12th August 2007
Operator Pat Kyne
Standard ATTMA TS-1

Fan Calibration Detail			
Fan Serial	S00635	expires	2012-03-06
Room Gauge Serial #	098154	expires	2008-03-06
Flow Gauge Serial #	098154	expires	2008-03-06

Table 4-1 Door Fan Calibration Detail

Environmental Conditions		
Measured Unit	**Before**	**After**
Barometric Pressure	100300 Pa	100300 Pa
Relative Humidity	71%	71%
Wind Speed	2Kts	2Kts
Outside Temperature	18.0 ℃	18.0 ℃
Inside Temperature	18.0 ℃	18.0 ℃
Static Pressure (+) Average	0.87 Pa	1.8 Pa
Static Pressure (-) Average	-0.13 Pa	-0.46 Pa
Static Pressure (Average)	0.67 Pa	0.67

Table 4-2 Environmental Conditions

Static pressure points gathered before test									
1.44 Pa	0.95 Pa	0.19 Pa	0.35 Pa	-0.06 Pa	-0.2 Pa	0.18 Pa	0.5 Pa	1.79 Pa	1.59 Pa

Table 4-3 Static Pressures – Pre-test

Static pressure points gathered after test									
-0.71 Pa	-1.07 Pa	-0.1 Pa	-0.38Pa	2.46 Pa	2.96 Pa	0.97 Pa	-0.04 Pa	1.01 Pa	1.62 Pa

Table 4-4 Static Pressures – Post test

Depressurisation Values									
Room Pressure (Pa):	-77.05	-69.37	-66.04	-62.39	-57.08	-51.44	-51.21	-50.62	-43.64
Corrected Room Pr (Pa):	77.72	70.04	66.71	63.06	57.75	52.11	51.88	51.29	44.31
Flow Pressure (Pa):	158.68	127.36	122.22	111.67	95.44	85.72	83.96	86.47	66.63
Corrected Flow Pr (Pa):	158.7	127.4	122.2	111.7	95.4	85.7	84.0	86.5	66.6
Measured Flow (m^3/h):	262.9	231.9	227.2	216.2	198.1	187.5	185.2	188.8	163.5
Best Fit Flow (m^3/h):	256.8	236.3	227.3	217.3	202.5	186.6	185.9	184.2	163.9
Error (%):	2.3	-1.9	0	-0.5	-2.3	0.5	-0.4	2.5	-0.2

Table 4-5 Depressurisation values

Data Analysis	Air Flow Exponent	Intercept	Correlation
Best Fit: Least Squares	**n**	**C m^3/h**	(%)
Depressurise	0.7999	7.8962	99.38

Table 4-6 Data Analysis

Zone Dimensions		
Net Floor Area	135	m^2
Zone Area	484	m^2
Internal Volume	582	m^3

Table 4-7 Zone Dimensions

Result Details	Eng Units	Values
Air Flow Coefficient	(m^3/h)	7.896
Air flow Exponent		0.7999
Confidence Factor	%	99.38
Flow@ 50 Pa	m^3/h	180.5
Air Changes/Hour (ACH) @ 50 Pa	/hr	0.31
Permeability @ 50 Pa	$m^3/h.m^2$	0.37

Table 4-8 Test Results

Door Fan 3.0 Zone Leakage Analysis Software (Version 3.123) By: Retrotec Energy Innovations Ltd (Canada). Copyright 2006, 2007 This software conforms to the ATTMA: TS-1 testing standard

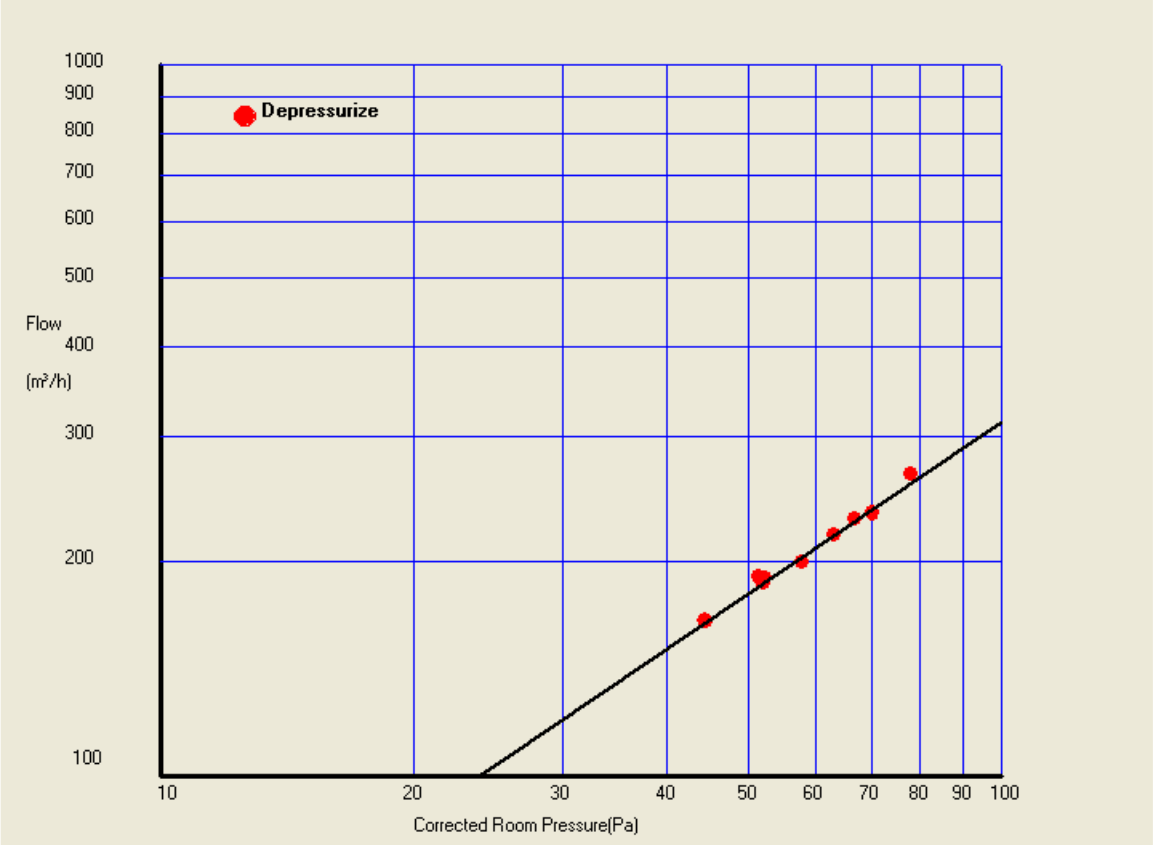


Figure 1 Flow – Pressure Chart

Pressurisation Door Fan Test Report

Tester Information

PK Energy Controls Ltd.
Carrowpeter,
Tuam,
Co.Galway,
Ireland.

Web: pkenergycontrols.ie

Building Under Test: Detached Eco Build Dwelling.
Marcel Lashkody,
20A Baskin Cottages,
Cloghran,
Co. Dublin.

Test #: 12
Performed On 12th August 2007
Operator Pat Kyne
Standard ATTMA TS-1

Fan Calibration Detail			
Fan Serial	S00635	expires	2012-03-06
Room Gauge Serial #	098154	expires	2008-03-06
Flow Gauge Serial #	098154	expires	2008-03-06

Table 4-9 Door Fan Calibration Detail

Environmental Conditions		
Measured Unit	**Before**	**After**
Barometric Pressure	100300 Pa	100300 Pa
Relative Humidity	71%	71%
Wind Speed	2Kts	2Kts
Outside Temperature	18.0 ℃	18.0 ℃
Inside Temperature	18.0 ℃	18.0 ℃
Static Pressure (+) Average	0.27 Pa	0.13 Pa
Static Pressure (-) Average	-0.6 Pa	-0.4 Pa
Static Pressure (Average)	-0.34 Pa	-0.29

Table 4-10 Environmental Conditions

Static pressure points gathered before test									
0.59 Pa	-0.44 Pa	-1.06 Pa	0.05 Pa	-0.43 Pa	-0.07 Pa	-1.82 Pa	-0.08 Pa	-0.28 Pa	0.17 Pa

Table 4-11 Static Pressures – Pre-test

Static pressure points gathered after test									
-0.33 Pa	-0.14 Pa	-0.4 Pa	-0.09 Pa	-0.57 Pa	-0.83 Pa	-0.67 Pa	-0.15 Pa	0.24 Pa	0.02 Pa

Table 4-12 Static Pressures – Post test

Pressurisation Values									
Room Pressure (Pa):	73.86	70.01	66.89	61.15	56.51	53.43	50.10	45.70	44.60
Corrected Room Pr (Pa):	74.18	70.33	67.20	61.46	56.83	53.75	50.42	46.02	44.92
Flow Pressure (Pa):	185.23	178.76	163.84	151.30	132.70	130.09	120.22	102.27	104.95
Corrected Flow Pr (Pa):	185.2	178.8	163.8	151.3	132.7	130.1	120.2	102.3	105.0
Measured Flow (m^3/h):	208.6	206.8	193.3	186.7	169.3	171.4	163.3	143.9	150.7
Best Fit Flow (m^3/h):	210.6	202.8	196.4	184.3	174.3	167.5	160.1	150.1	147.5
Error (%):	-1	1.9	-1.6	1.3	-2.9	2.2	1.9	-4.3	2.1

Table 4-13 Pressurisation values

Data Analysis	Air Flow Exponent	Intercept	Correlation
Best Fit: Least Squares	**n**	**C m^3/h**	(%)
Depressurise	0.7105	7.8962	98.23

Table 4-14 Data Analysis

Zone Dimensions		
Net Floor Area	135	m^2
Zone Area	484	m^2
Internal Volume	582	m^3

Table 4-15 Zone Dimensions

Result Details	Eng Units	Values
Air Flow Coefficient	(m^3/h)	7.896
Air flow Exponent		0.7999
Confidence Factor	%	98.23
Flow@ 50 Pa	m^3/h	159.2
Air Changes/Hour (ACH) @ 50 Pa	/hr	0.27
Permeability @ 50 Pa	$m^3/h.m^2$	0.33

Table 4-16 Test Results

Door Fan 3.0 Zone Leakage Analysis Software (Version 3.123)
By: Retrotec Energy Innovations Ltd (Canada).
Copyright 2006, 2007
This software conforms to the ATTMA: TS-1 testing standard

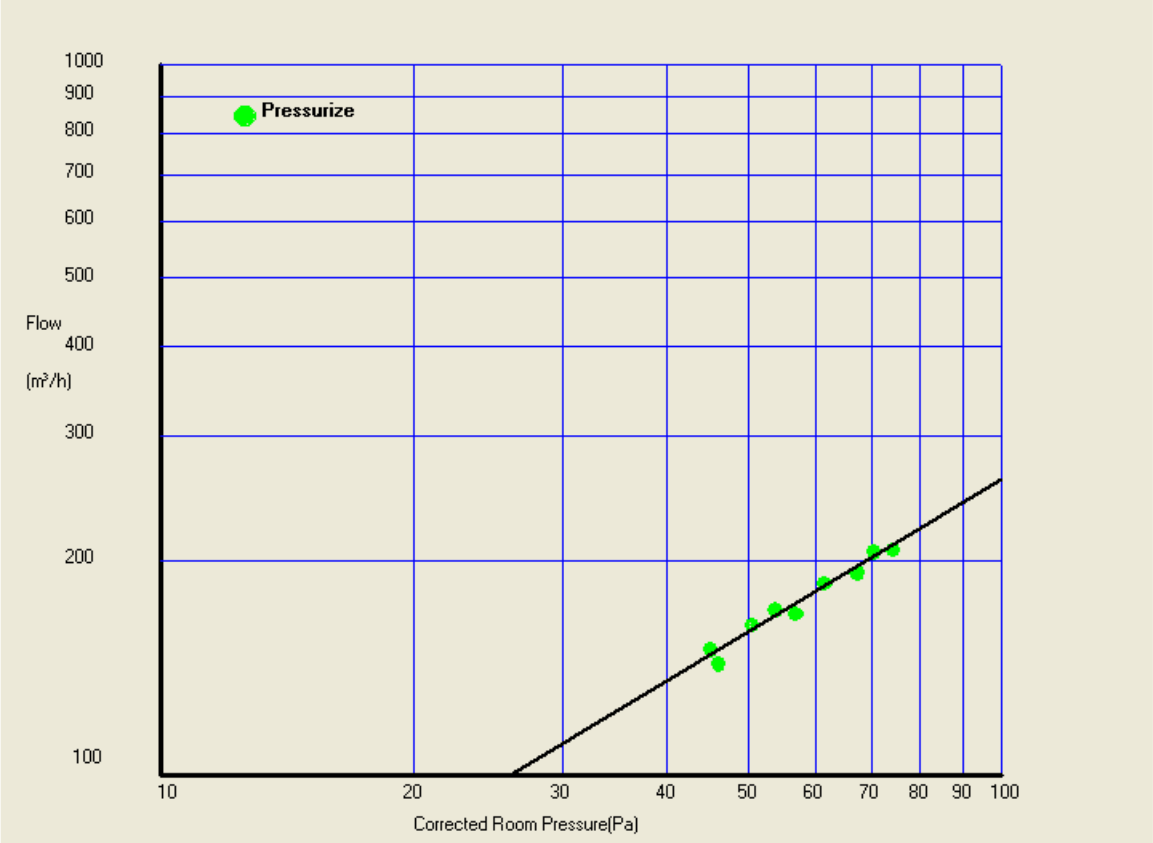


Figure 2 Flow – Pressure Chart

4.2 Depressurisation – Images

Note: In this instance internal temperatures at the time of the survey ranged from 18℃ -19℃.
Outside temperature = 18℃. Due to the small differ entials in temperature the infrared image capture of infiltration was attainable but did not provide for sharp imagery.
Arrows indicate the infiltration points.

4.2.1 Living Area

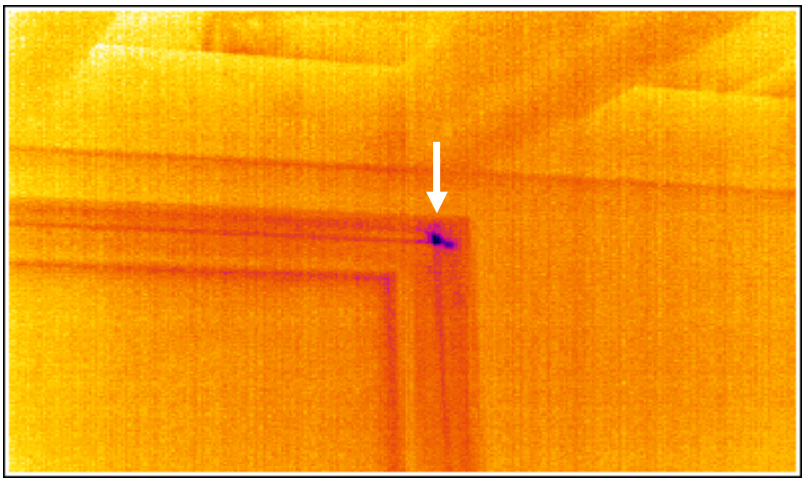


Figure 3 West Window – Infrared (Iron)

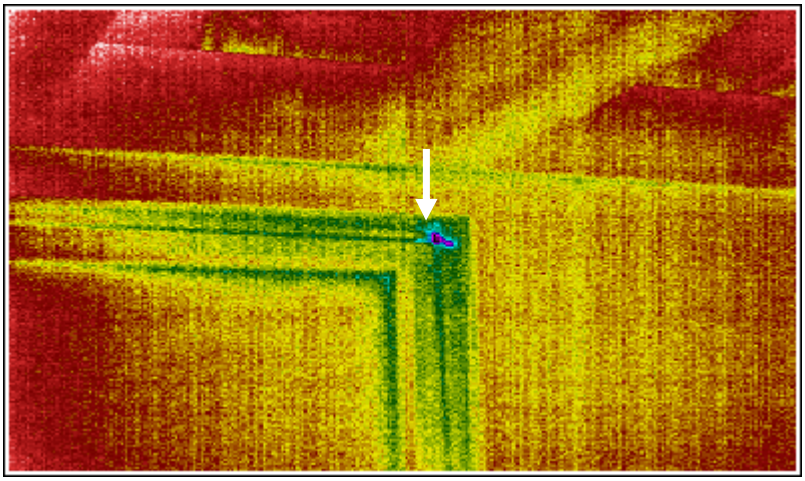


Figure 4 West Window – Infrared (Rainbow)

Figure 5 West Window – Visible

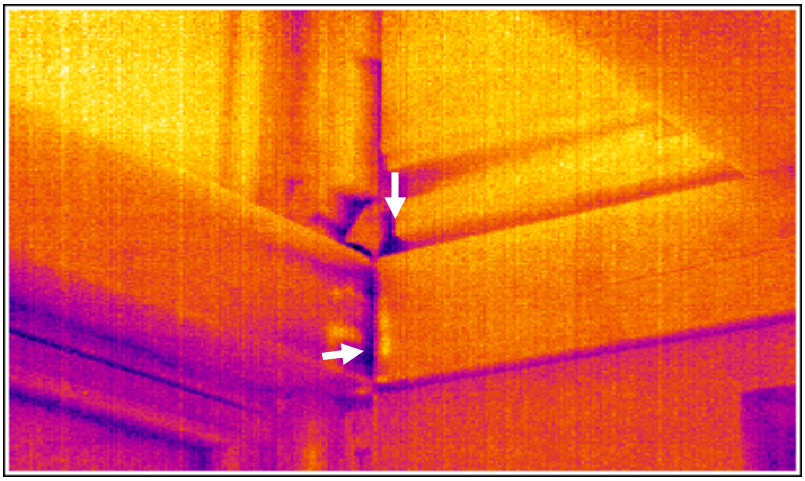


Figure 6 South West Corner Living Area– Infrared (Rainbow)

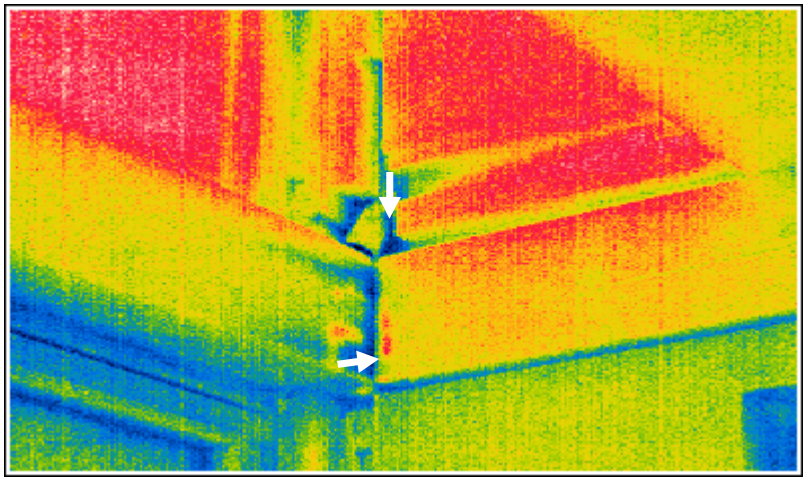


Figure 7 South West Corner Living Area – Infrared (Feather)

Figure 8 South West Corner Living Area – Visible

4.2.2 East Windows

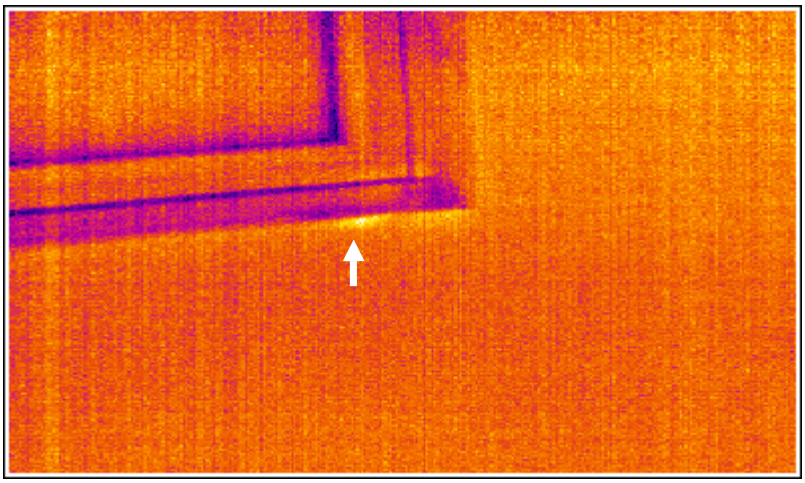


Figure 9 East window left hand side – Infrared (Iron)

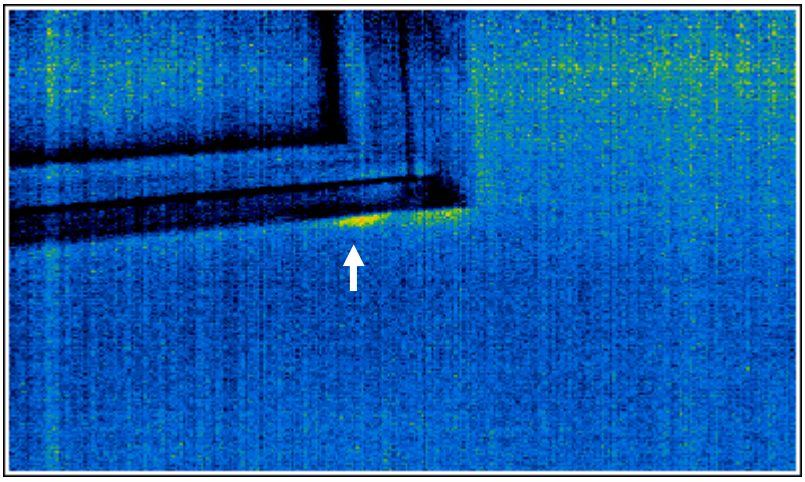


Figure 10 East window left hand side – Infrared (Rainbow)

Figure 11 East window left hand side – Visible

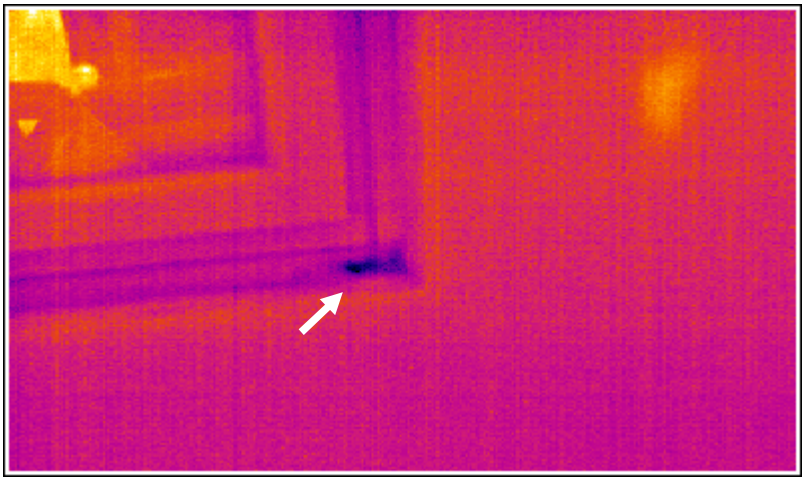


Figure 12 East window right hand side - Infrared (Iron)

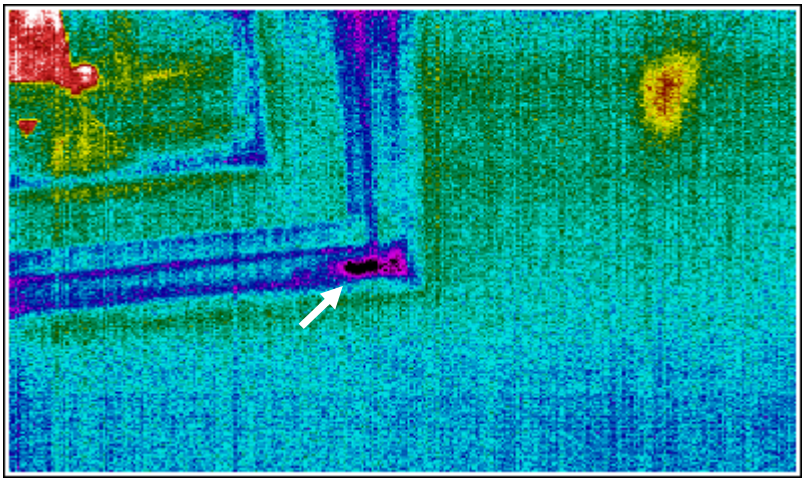


Figure 13 East window right hand side - Infrared (Rainbow)

Figure 14 East window right hand side - Visible

4.2.3 South East Top Corner

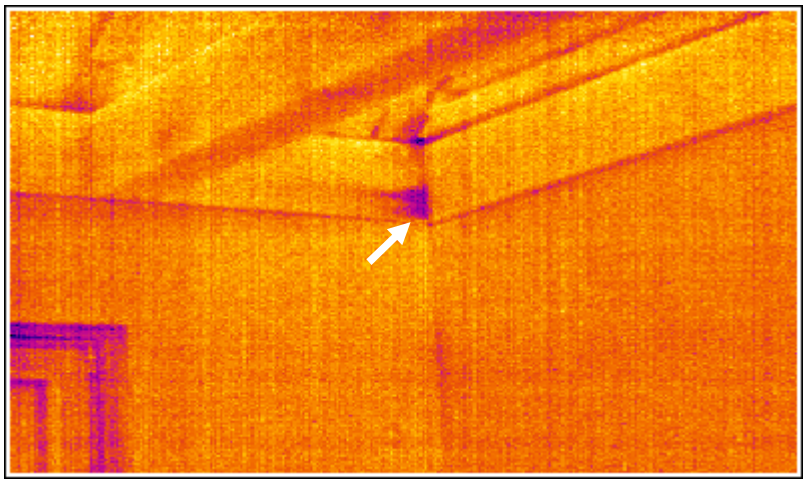


Figure 15 South East Top Corner – Infrared (Iron)

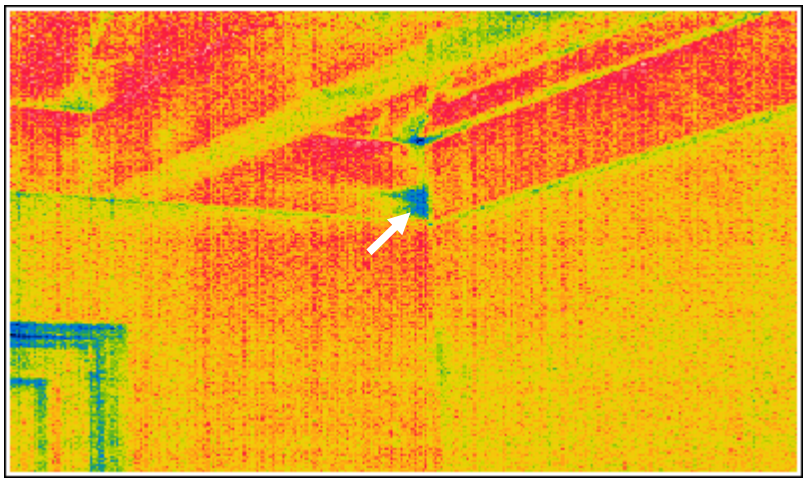


Figure 16 South East Top Corner – Infrared (Feather)

Figure 17 South East Top Corner – Visible

4.2.4 Master Bedroom

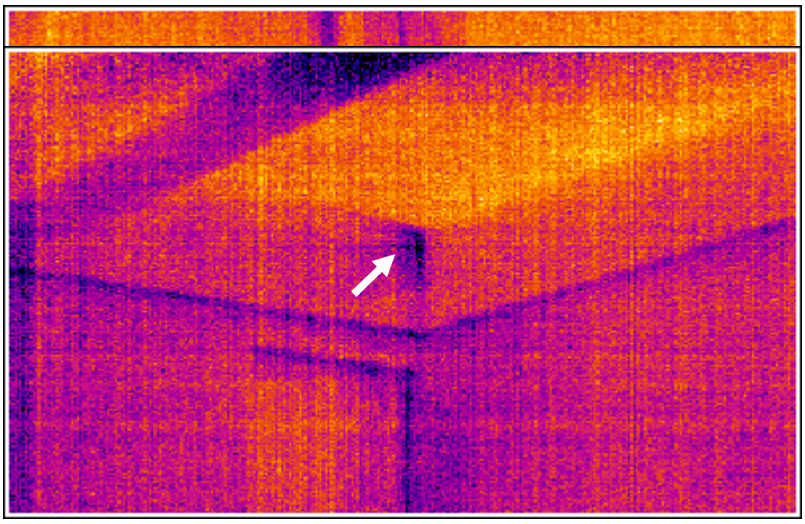


Figure 18 Southwest Top Corner – Infrared (Iron)

Figure 19 Southwest Top Corner – Visible

4.2.5 Bedroom 2

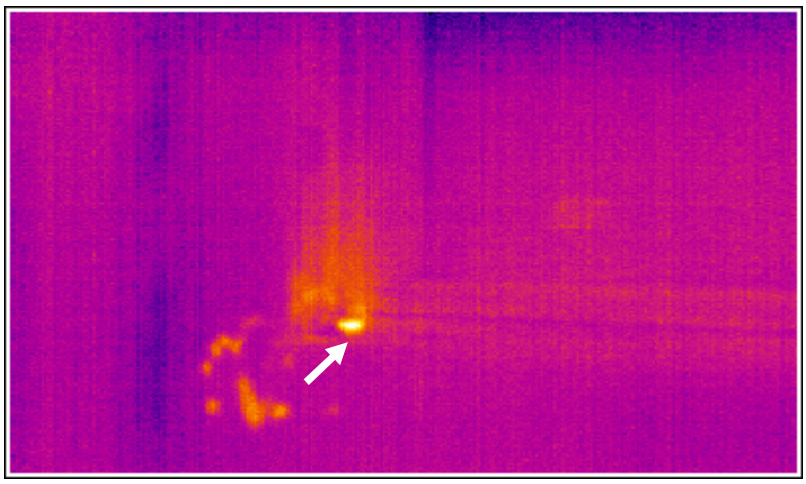


Figure 20 East Windows North Corner – Infrared (Iron)

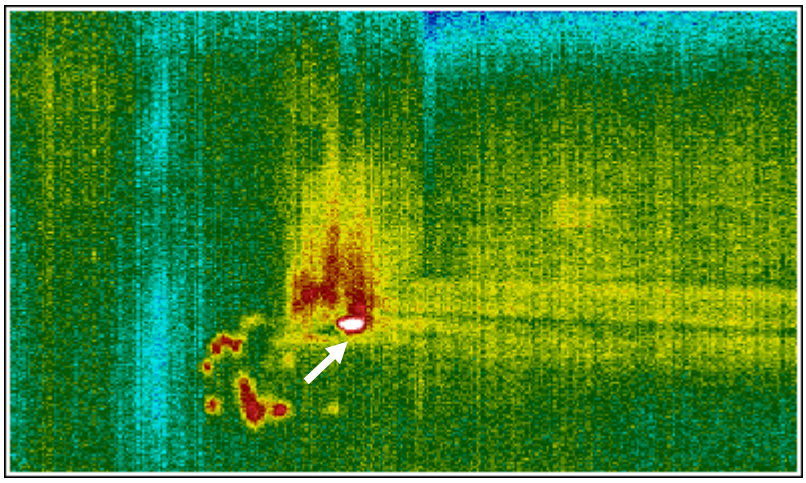


Figure 21 East Windows North Corner – Infrared (Rainbow)

Figure 22 East Windows North Corner – Visible

4.2.6 Utility Window

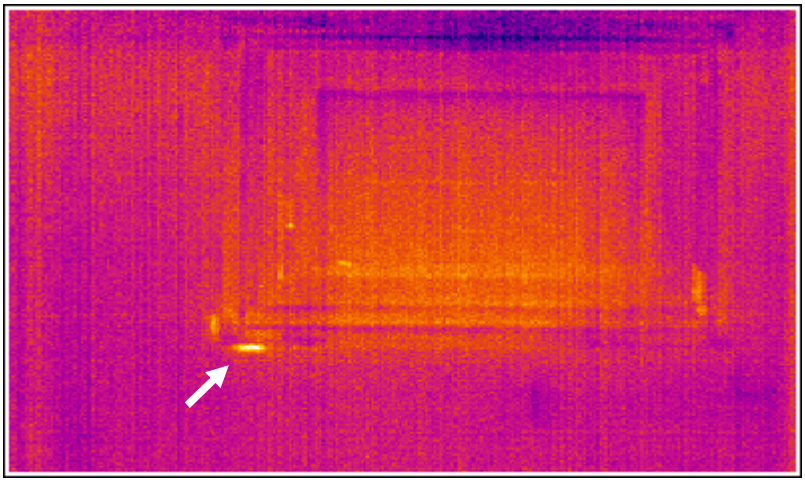


Figure 23 Utility Window – Infrared (Iron)

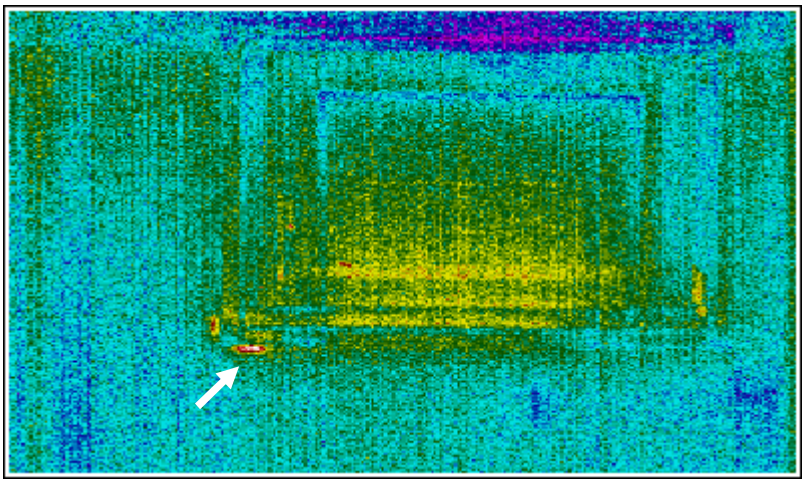


Figure 24 Utility Window – Infrared (Rainbow)

Figure 25 Utility Window – Visible

4.2.7 Roof Space

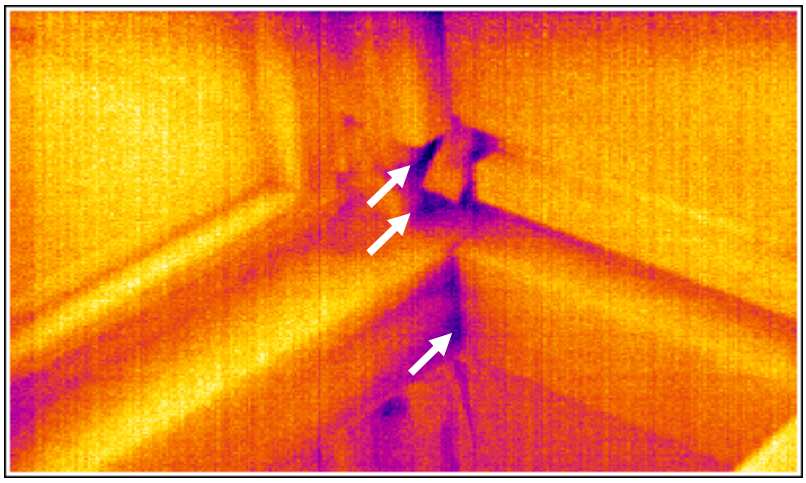


Figure 26 South West Corner Floor Level – Infrared (Iron)

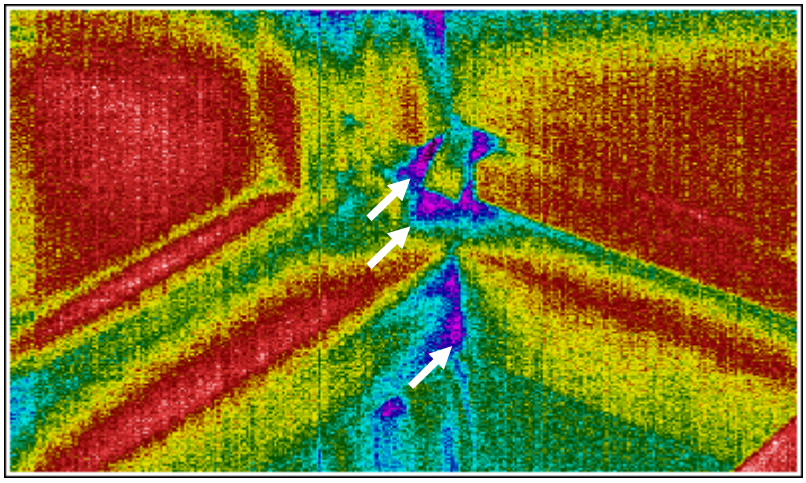
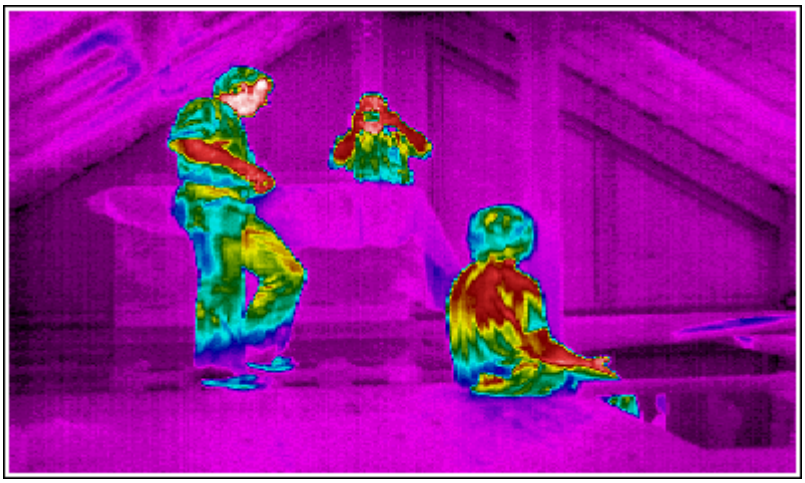


Figure 27 South West Corner Floor Level – Infrared (Rainbow)

Figure 28 South West Corner Floor Level – Visible

4.2.8 Men at Work!



5 Test Summary.

5.1 Air Permeability Test Result Analogy.

The test results are generated by a software programme that is compliant with the ATTMA TS-1 standard.

Air Permeability Standards

Good and Best Practice Standards

Recommended air tightness standards for a variety of different building types have been established over many years. U.K Air tightness standards up until the introduction of the 2002 Building Regulations were based on an air leakage index in which the envelope area was defined as the area of walls and roof.
The air tightness of buildings as defined in the U.K. Building Regulations is based on air permeability where the envelope area is defined as the area of walls, roof and ground floor slab.

The following table provides current normal and best practice air tightness criteria for naturally ventilated dwellings:

Depressurised

Building Type	**U.K. Dwellings Naturally Ventilated**		
Air permeability m3/(h.m2) at 50 Pascals	**Best Practice**	**Normal**	
	3.0	**9.0**	
Actual Result m3/(h.m2) *(Depressurised)*	**0.37**		
Air Changes/Hr @50 Pascals	**Tight**	**Moderate**	**Leaky**
	< 5.0	**5.0 - 8.0**	**> 8.0**
Actual Result ACH_{50} *(Depressurised)*	**0.31**		

Table 5-1 Air Permeability / Air Changes – Depressurised Results

Pressurised

Building Type	U.K. Dwellings Naturally Ventilated		
Air permeability m3/(h.m2) at 50 Pascals	Best Practice	Normal	
	3.0	9.0	
Actual Result m3/(h.m2) *(Pressurised)*	0.33		
Air Changes/Hr @50 Pascals	Tight	Moderate	Leaky
	< 5.0	5.0 - 8.0	> 8.0
Actual Result ACH_{50} *(Pressurised)*	0.27		

Table 5-2 Air Permeability / Air Changes – Pressurised Results

5.2 Results Summary

The air infiltration test result of 0.27 ACH^{50} when pressurised and 0.31 ACH^{50} when depressurised depicts excellent air tightness not before witnessed by PK Energy Controls Ltd.
Although infiltration points were found, the level of infiltration was found to be minimal. The reason for a slightly better result achieved under pressurisation than that the result achieved under depressurisation is most likely the result of sealing glue applied to the breather membrane that may not have been given sufficient setting time as sealing works were ongoing prior to testing commencement.

To put the result into perspective the ACH^{50} readings obtained from masonry builds in Ireland = 8 ACH^{50} to 12 ACH^{50}.

5.3 Most significant infiltration points

1) Roof space – works ongoing

2) Window frames – works ongoing

5.4 Advisory Communications

Building Representatives	Martin Wetzel / Daniel Steiger
Building Representative advised on test results. Yes/No	Yes
Date	12th August 2007

Table 5-3 Advisory communications

5.5 Additional Information

Please note the following is from the Irish Building Regulations Technical Guidance Document 2005 Part L for Conservation of fuel and Energy.

Section 1.2.5 AIR INFILTRATION
1.2.5.1
Infiltration of cold outside air should be limited by reducing unintentional air paths as far as is practicable. Measures to include this are:

- *(a) sealing the void between dry-lining and masonry walls at the edges of openings such as windows and doors, and at the junctions with walls, floors and ceilings (e.g. by continuous bands of bonding plaster or battens),*
- *(b) sealing vapour control membranes in timber frame constructions,*
- *(c) fitting draught stripping in the frames of openable elements of windows, doors and rooflights,*
- *(d) sealing around loft hatches,*
- *(e) ensuring boxing for concealed services is sealed at floor and ceiling levels and sealing piped services where they penetrate or project into hollow constructions or voids.*

6 Remedial Action Report

6.1 Remedial Works

Any remedial works to be done by Project-Oecotop.

7 Follow up Testing

No follow testing scheduled 12th August.