BSRIA

Airtightness Testing

The essential guide to F1 & F2 of the Building (Amendment) Regulations (Northern Ireland) 2006

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Introduction

This BSRIA Guide outlines the requirements of the Building (Amendment) Regulations (Northern Ireland) 2006. The methodology of airtightness testing techniques is presented along with methods of identifying air leakage paths such as smoke testing and thermographic surveys.

The DFPNI Technical Booklet F1 for work in new dwellings will require, with few exceptions, type-testing of all new dwellings to an airtightness standard of no greater than 10 m^3/ (h.m^2) at 50 Pa. For some dwellings where the carbon emission rate is difficult to meet for architectural reasons, the airtightness target under the SAP calculations may need to be reduced to 7, 5 or even 3 m^3/ (h.m^2) at 50Pa to meet the overall carbon emission rate required by the Regulations.

The DFPNI Technical Booklet F2 for work in buildings other than dwellings requires all commercial and industrial buildings with a gross floor area greater than 500 m^2 to be tested for air permeability to a minimum standard of 10 m^3/ (h.m^2) at 50Pa.

This guide explains what the requirements mean to all parties in the construction process, and provides ready -made checklists and specification clauses to use when procuring an airtightness test.

Rising energy costs and environmentally driven regulatory changes are forcing rapid and demanding changes in the way buildings are constructed. Airtightness is a vital component of sustainable design. Buildings that are not airtight will cause their mechanical ventilation and air conditioning systems to struggle to maintain comfort conditions. A leaky naturally-ventilated building will suffer poor control, draughty conditions, and, in all likelihood, excessive energy consumption for heating.

In order to control this energy loss, the Building Regulations will regulate the overall leakage of the building structure by testing, using a pressurising/depressurising fan method. This document specifically covers the methods used to comply with the airtightness component of the Regulations.

Airtightness is not only a legal requirement but also a commercially (and environmentally) correct decision. Follow the rules explained in this guide, and you won't go wrong.

David Anderson
Managing Director

Airtightness Testing

The essential guide to F1 & F2 of the 2006 Building Regulations (NI)

Produced by Jonny Bell on behalf of Anderson Mechanical Services

AIRTIGHTNESS TESTING

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AIRTIGHTNESS TESTING

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BINDT — THE BRITISH INSTITUTE OF NON-DESTRUCTIVE TESTING

ATTMA

BSRIA is a founder member of ATTMA, the Air Tightness Testing and Measurement Association, which promotes good practice and competency in Airtightness testing

BENEFITS OF THE GUIDE

1.0 BENEFITS OF THIS GUIDE

This guide has been created to assist the construction supply chain in meeting the airtightness targets set out in *DFPNI Technical Booklet F1 & F2.* It will be beneficial for:

- Building control officers (BCOs)
- Architects
- Building service designers
- Contractors
- Building service contractors

1.1 Benefits for BCOs

BCOs need to know precisely what the 2006 Building Regulations require in terms of building airtightness testing. This guide explains:

⇒ The regulatory requirements in simple, straightforward terms

⇒ How to ensure that the pressure testing has been done by a competent person.

1.2 Benefits for architects

As airtightness starts at the design stage, architects need to know what makes a building inherently airtight. This guide:

⇒ Identifies where air leakage paths are most likely to occur so they can be designed out or at least sealed properly by the contractors

1.3 Benefits for building services designers

This guides' rules will assist in constructing an airtight building. An airtight building:

⇒ Will require less energy to heat and cool

⇒ Will be more comfortable

⇒ Will remove the need for excessive design margins in the building services

1.4 Benefits for contractors

Contractors are generally the procurers of airtightness testing. The contractor is critical to ensuring the airtightness of the building by good construction. This guide explains:

⇒ How to seal buildings

⇒ How to procure a test

⇒ What happens at the test

1.5 Benefits for building services contractors

Builders and contractors are the gatekeepers of good design, specifically when it comes to making buildings airtight. Building services contractors need to know why it is vital to reduce air leakage from shafts, raised floors and ductwork systems.

COMPLIANCE WITH THE 2006 BUILDING REGULATIONS

2.0 DEFINITION OF TERMS

Airtightness of a building is usually described as **air permeability**. This is the air flow rate required to pressurise or de-pressurise a building to a stated pressure differential (normally 50 Pa) divided by the surface area of the building.

The **surface area** used for air permeability is defined as the area of walls, plus the area of the ground floor slab, plus the area of the roof.

Target CO_2 Emission Rate (TER) is the minimum energy performance required by the regulations. It is the mass of CO_2 emitted per year per square metre of the total useful floor area of the building kg/ (m^2.year).

BER is the Building CO_2 Emission Rate.

DER is the Dwelling CO_2 Emission Rate.

3.0 DFPNI TECHNICAL BOOKLET F

Part F of the *Building (Amendment) Regulations (Northern Ireland) 2006* requires new buildings to be tested for airtightness. The *DFPNI Technical Booklet F*, which supports these *Regulations*, is in two parts:

3.1 DFPNI Technical Booklet F1

The DFPNI Technical Booklet F1 (Conservation of fuel and power in dwellings) refers to new dwellings, but excludes nursing homes and student accommodation. It requires samples of all types of dwellings on a development to be airtightness tested. There is no requirement for testing of extensions to dwellings.

Figure 3.1A Paragraph 2.28

The maximum acceptable air permeability is 10 m^3/ ($h.m^2$). Achieving the TER may need the design air permeability to be better than the limit value.
DFPNI Technical Booklet F1

3.11 Quality of construction

While the maximum allowable building air leakage rate is 10 $m^3/(h.m^2)$ at 50 Pa, designers may choose to create an even more airtight construction (7, 5 or even 3 $m^3/(h.m^2)$ at 50 Pa) and to use the calculated energy saving to trade off against other building details.

The DER should be less than the TER. Where U-values for elemental type, allowable areas of windows or doors, and quoted efficiency of heating appliances do not (in total) enable the dwelling to meet the required TER, then the target air permeability may need to be lower than 10 $m^3/(h.m^2)$ at 50 Pa.

COMPLIANCE WITH THE 2006 BUILDING REGULATIONS

3.12 Accredited and non-accredited construction details

Both routes to airtightness compliance will require airtightness testing of samples of each dwelling type. Various generic forms of dwelling are considered as separate discreet types. Examples include:

⇒ Detached	⇒ Ground floor flat
⇒ Semi-detached	⇒ Mid floor flat
⇒ Mid-terrace	⇒ Top floor flat

Figure 3.1B Paragraph 2.46 to 2.53

> The approved circumstances which require testing to be carried out are set out in paragraphs 2.46 to 2.53.
>
> *DFPNI Technical Booklet F1*

3.13 Accredited construction details

The pressure test value to be attained will be defined by the designer in the SAP 2005 evaluation, but in any case will not be greater than 10 $m^3/(h.m^2)$ as this is the upper limit for air permeability set by the *Building Regulations*, except for developments with two or fewer dwellings.

On a particular site, one of each type of dwelling from the first completed batch of units should be tested to confirm the robustness of each design.

Figure 3.1C Paragraph 2.48

> **On each development site, an air pressure test should be carried out on a unit of each dwelling type selected by the district council.** For the purpose of this Technical Booklet, a block of flats should be treated as a separate development irrespective of the number of blocks on the site.
>
> *DFPNI Technical Booklet F1*

However, achieving an air permeability of 10 $m^3/(h.m^2)$ at 50Pa should not be an arduous task. This accredited construction detail route to airtightness testing may be preferred by some building contractors, as it has the potential to involve the fewest number of tests, although it may prove far more expensive than airtightness testing. As the district council will select the dwellings to be tested, the builder must ensure that the quality of construction is consistent.

3.14 Non-accredited details

Paragraph 2.49 of the *Building Regulations* says that pre-completion pressure testing will be required in accordance with Table 3.1D (see page 8).

COMPLIANCE WITH THE 2006 BUILDING REGULATIONS

Table 3.1D: The number of pressure tests for dwellings that have not adopted accredited construction details (from table 2.4, paragraph 2.49, of DFPNI Technical Booklet F1).

Number of instances of the dwelling type	**Number of tests to be carried out on the dwelling type**
4 or less	One test of each dwelling type
Greater than 4, but equal to or less than 40	Two tests of each dwelling type
More than 40	At least 5% of the dwelling type, unless the first 5 units of the type that are tested achieve the design air permeability, when the sampling frequency can be subsequently reduced to 2%

3.15 Sample size

50% of the required airtightness tests should be carried out during construction of the first 25% of each dwelling type. This is simply to demonstrate to the district council - as early as possible in the building programme - that the buildings are complying with the *Regulations*. It would be prudent (for best practice) to test the first of each dwelling type on each site in order to identify and modify any details that are causing an airtightness problem.

Figure 3.1D Paragraph 2.50

The specific dwellings making up the test sample will be selected by the district council in consultation with the builder.

DFPNI Technical Booklet F1

3.16 Exempted areas

Where a conservatory is thermally separated from the new dwelling it will not be included within the building envelope. Rules for extensions are contained within Section 3 which is for work in existing dwellings for which no airtightness testing is required. The situation for garages is a little less clear, but if they are not conditioned spaces, they would be outside the scope of the *Regulations.*

3.17 Remedial measures

The *Regulations* stipulate for each dwelling that fails the initial test, remedial measures should be carried out as required by paragraph 2.52, and one further dwelling scheduled for testing.

It is a reporting requirement that the independent testing company will know the design target for the dwelling's airtightness. It is the responsibility of the district council to ensure that all the appropriate information relating to the compliance of the DER fulfils the requirements of the *Building Regulations.* However, in practice, it is probable that the testing company will be in a position to advise the client on the need for remedial works and re-testing requirements.

COMPLIANCE WITH THE 2006 BUILDING REGULATIONS

3.2 DFPNI Technical Booklet F2

DFPNI Technical Booklet F2 (Conservation of fuel and power in buildings other than dwellings) refers to all new buildings except dwellings. All new buildings with a usable floor area of 500 m^2 and over must be tested.

For smaller buildings, testing is not mandatory. However, if the building is not tested an assumption of an air permeability of 15 $m^3/(h.m^2)$ must be put into the National Calculation Methodology software (such as Simplified Building Energy Model (SBEM)).

If the TER is not met, then some action will be required to improve the energy efficiency of the proposed building. Reducing the air permeability will be a contributor to achieving the required TER and the building will then need to be airtightness tested.

For large, complex buildings where pressure testing of the whole building is impractical, compliance may be demonstrated by appointing a suitably competent person such as an ATTMA member like BSRIA to undertake a detailed programme of design, development, component testing and site supervision.

There is no requirement for airtightness testing of extensions which are less than 100 m^2 and does not increase the usable area by more than 25%. Large extensions come under F2 requirements and the new part of the building will require testing. Within F2, there is also a requirement for consequential improvements to the existing building. Improving the airtightness of the existing building may be one way of achieving this aim.

Figure 3.2A Paragraph 2.27

The maximum acceptable air permeability is 10 $m^3/(h.m^2)$. There is also a requirement to demonstrate, via the SBEM (or equivalent) for non dwellings, that the BER for the proposed building is less than or equal to the TER.
DFPNI Technical Booklet F2

In many cases, building designers choose to achieve the required energy efficiency by reducing the air permeability. As a rule of thumb, reducing air permeability from 15 $m^3/(h.m^2)$ to 5 $m^3/(h.m^2)$ will reduce the BER by 30% in a naturally ventilated building.

The National Calculation Methodology will need to be used to determine the energy efficiency of the building. The computer models require information on U-values, thermal bridges, window glazing and frame types, details of the heating, ventilation or air conditioning system, lighting efficiencies and air permeability, along with a description of the building size, its orientation, doors, rooflights, and type of occupancy.

Using the program, designers will need to demonstrate a 23.5% reduction in carbon emissions for naturally ventilated buildings, and a 28% reduction for other buildings, against a notional building of the same size and type as detailed in SBEM.

COMPLIANCE WITH THE 2006 BUILDING REGULATIONS

3.2 DFPNI Technical Booklet F2 (contd)

The air permeability value is a primary input into the SBEM. A value of 10 $m^3/(h.m^2)$ is the starting value, except for buildings below 500 m^2 usable floor area. For buildings less than 500 m^2 an air permeability of 15 $m^3/ (h.m^2)$ can be assumed. This will only be acceptable if the TER is met.

The design air permeability may have to be lower than 10 $m^3/(h.m^2)$, particularly for naturally ventilated buildings, since ironically it will, in general, be more difficult to achieve the required 23.5% energy reduction for these buildings, than the 28% reduction needed for mechanically ventilated buildings.

Permission to construct the building will not be granted if the BER exceeds the TER. Whatever airtightness target the designer chooses, it will need to be met by testing the completed project.

Failing airtightness targets may be costly and lead to delays on practical completion.

Prior to handover as-built parameters including the measured air permeability need to be re-input to the SBEM software to demonstrate that the building does not exceed the TER. The district council can then sign off the building.

HOW DO I SPECIFY AN AIRTIGHTNESS TEST

4.0 PATH TO ACHIEVING AIRTIGHTNESS TARGETS

1. Specify the airtightness target at an early design stage (such as the design air permeability used to derive the TER)
2. Specify the air seal line at a very early stage. The inside surface of the structure is usually the airtight surface. The airtight surface should be brought inside rooms which will be ventilated to outside, such as boiler rooms, plant rooms, electrical switch rooms and lift shafts.
3. Require air sealing detail drawings from the architect or design and build contractor.
4. Consider specifying an airtightness consultant such as BSRIA to review drawings.
5. Specify that airtightness testing shall be undertaken by an independent organisation (such as BSRIA) which is a member of ATTMA, the testing organisation for the British Institute of Non-Destructive Testing. This is referenced in the *DFPNI Technical Booklet F2*, paragraph 2.57.
6. In liaison with the testing organisation, specify all aspects of the airtightness contract process (see pg.19 for sample clauses). Where necessary, specify penalty charges for failures not rectified in a reasonable timescale.
7. Consider specifying an airtightness consultant to inspect the building during the construction process.
8. Clearly communicate the requirements to all design and construction parties.

BINDT, The British Institute for Non-Destructive Testing, the competence body for air pressure testing operates the scheme through ATTMA

ATTMA, is the Air Tightness Testing and Measurement Association. Members of the Association must be accomplished in the field of airtightness measurement and hold a UKAS (United Kingdom Accreditation Service) Certificate for building airtightness measurement.

A condition of ATTMA membership requires more strict tolerances on the results than required in BS EN 13829, thus reassuring the specifier of the reliability of the testing.

BSRIA undertakes all test work strictly in accordance with ATTMA Technical Specification 1, which can be freely downloaded from www.attma.org

AMS provides a full range of airtightness testing services in accordance with ATTMA Technical Specification 1 for all buildings to meet F1 (domestic) and F2 (commercial).

AIRTIGHTNESS TARGETS

4.1 Quality building airtightness targets

Achieving an airtightness target of 10 $m^3/(h.m^2)$ is not an arduous task. For many years specifiers have demanded significantly better standards of airtightness in quality buildings to ensure that the occupants enjoy a satisfactory state of comfort and well-being.

For air-conditioned buildings, and buildings which aim to be low energy, a maximum air permeability standard of 3 $m^3/(h.m^2)$ has been set by many building owners and operators. The major benefits of a tighter airtightness standard are far better control, fewer staff complaints and improved energy efficiency. Many clients in the retail sector have adopted lower airtightness standards than required by the *Building Regulations*, such as 2 $m^3/(h.m^2)$ for new build projects. Even extensions to existing buildings can routinely achieve an air permeability target of 3 $m^3/(h.m^2)$.

4.2 Sensible and achievable airtightness targets

Setting an achievable airtightness target is an important element depending on the type of building. Clearly, some areas will require tight targets and special attention to achieving them, but designers should not choose airtightness targets which are very costly just to achieve the TER. Changing other parameters in the design may be more cost effective.

The following table provides guidance on current normal and best practice. Normal practice can generally be easily achieved, but specifications substantially lower than best practice should be avoided unless it is a very special case.

Table 4.2A: Normal and best practice in air permeability

Building type	**Air permeability in $m^3/(h.m^2)$ at 50Pa**	
	Normal practice	**Best practice**
Building Regulations	10	
Offices		
Naturally ventilated	7	3
Mixed-mode	5	2.5
Air-conditioned	5	2
Factories and warehouses	6	2
Superstores	5	1
Schools	9	3
Hospitals	9	5
Musuems and archival storage	1.5	1
Cold stores	0.3	0.2
Dwellings		
Naturally ventilated	9	3
Mechanically ventilated	5	3

Sources: *ATTMA Technical Specification Standard 1, Measuring Air Permeability of Building Envelopes.* July 2007

There should, in essence, be no great problem for factories, warehouses, superstores and distribution centres to achieve very good air permeability standards, due to large expanses of cladding and roofing being continuous and installed by the same contractor. Schools, hospitals and prestigious offices suffer from being one-off structures, often with courtyards and lightwells, and often designed with greater architectural licence.

5.0 AIRTIGHTNESS CHECKLIST

Typical examples of air leakage paths	Check	Comments
Seal hollow concrete beams at the ends before delivery to site since internal penetrations of the beams would allow air to pass into the cavity.		
Seal profiles in profiled metal sheeting - for ceiling where concrete is poured on to profiled metal sheeting, the underside will have indents in the profile. These should be sealed with mastic or similar.		
Check blockwork leakage. Plastered blockwork does not leak and so quality of blockwork is immaterial. However, where there are raised floors and suspended ceilings, the quality of blockwork is important if these areas are not plastered. Blockwork may leak by up to $60m^3/(h.m^2)$. BSRIA has tested over 100 blockwork walls in the laboratory and the manufacturers should have data on the air leakage of the blockwork. Painting good quality blockwork reduces the air leakage but painting poor quality blockwork has very little effect.		
Seal joints of profiled metal decking. The underside of profiled metal decking roofs is the air tight membrane. All joints will require to be effectively sealed during the laying of the sheets. Perforated liner sheets and using the vapour barrier should be avoided since they usually underperform.		
Effectively seal all walls to ceiling and roof joints.		
Fill all expansion joints between concrete beams and blockwork to blockwork with an airtight compound.		
Drylining systems should be sealed to the floor, roof and walls and all service penetrations sealed. Care should be exercised where internal walls meet those external walls to avoid a lattice of air leakage paths.		
Seal joints of curtain walling systems to other building systems where problems are most likely to occur.		
Seal riser shafts effectively to avoid air penetrating the cavity and or plant rooms.		
Seal windows and door frames effectively to the inside surface of the structure and seal the cavity preferably before the final finishes are carried out.		
Seal steelwork penetrations through the inside surface of the structure adequately.		
Seal pipework and electrical penetrations through the building envelope including penetrations to the plant room, electrical switch rooms, external lighting systems, and power and communications in to the building.		
Provide adequate seals for lift shaft doors below raised floors to prevent air penetrating the lift shaft.		
Check doors and shutters. Loading bay doors should preferably be of the panel type with adequate seals. Security shutters are not particularly good from an airtightness point of view.		
Fill water traps and condensate traps before testing the structure.		
Take extra care with sealing details for renewables, such as light pipes through to roofing sheets, mounting, pipe and cables penetrations for solar water heating and photovoltaics. Even mounts and cables for wind generators mounted on roofs of buildings should be carefully sealed.		
Do not use unfaced mineral wool or equivalent to fill gaps.		
Do not use tape to seal joints in buildings.		
Avoid the use of expanding foam.		

WHAT DOES AN AIRTIGHTNESS TEST INVOLVE

6.0 BUILDING PRESSURE TESTS

A professional airtightness testing service should include a full proposal comprising a method statement and a clear quotation. This will need to cover site requirements, suitable proof of public liability insurance, professional indemnity insurance, a health and safety risk assessment covering substances which may be hazardous to health (such as smoke fluids), proof of staff training with regard to site safety (such as skill cards) and appropriate personal protective equipment.

Special contract terms may be included to cover the possibility of cancellation of testing due to high wind speeds which can invalidate a result.

An airtightness test can be undertaken in about 10-15 minutes after set-up, but may take longer if the process is not automated or well organised. Good documentation will be required.

The tester will need the following information to respond to an enquiry:

⇒ Site location

⇒ Building plans will be needed to determine envelope areas

⇒ Design air permeability (available from the SAP assessment). (To what standard is the building being tested?)

⇒ Will the client require a smoke test or thermographic survey should the building not meet the required specification?

⇒ Are there any specific requirements for the airtightness test? (e.g. will it need to be performed outside working hours?)

The accuracy of the pressure test will be affected by local wind conditions. Ideally the wind speed at the time of the test should be less than 6 m/s. If the wind speed is higher than this, the test may need to be carried out on a calmer day.

An essential check is to measure the pressure difference between the inside and outside of the building, with the test fans sealed and all required pre-test actions taken, such as sealing mechanical ventilation openings. It must be less than +/- 5 Pascals (Pa) to satisfy the test standard. A valid test cannot be determined outside these limits.

6.1 Domestic Pressure Tests

Step 1

Set up the blower fan, close all external doors and windows and tape up other intentional openings, such as bathroom extracts, cooker hoods and fireplaces

Step 2

Carry out the pressure test, measure the results and report it to the client

Step 3

Dismantle the blower door and fans and remove all temporary seals

6.2 Commercial Pressure Tests

Before the test

1. The integrity of the structure should be complete for the tests
2. All mechanical ventilation openings should be sealed with polythene sheet or Cordek and self-adhesive tape. Smoke extract fans should not be sealed.
3. Sufficient access to a door is required for the test equipment. The airtightness contractor will advise contractors of the amount of space needed which varies according to the size of building and air permeability.
4. All internal doors should be wedged open.

During the test

5. All exterior doors and windows need to be kept closed during the actual pressurisation tests.
6. The actual test (after set-up) is usually completed in well under one hour. During this period no personnel should enter or exit the building. It is preferable if the building is unoccupied.
7. There should be no movable objects near the fan unit inside the building, since they would be displaced by the air flow.

Additionally for smoke tests

8. A longer period of time is required for the building to be evacuated for smoke tests.
9. For the whole building smoke test, an electrical supply will be required.

After the test

10. A statement of the air leakage rate is immediately available, and a full report with corrections for air density and air volume will be provided.

7.0 CONSTRUCTION DETAILS FOR SPECIAL ATTENTION - Builders' Shafts

Builders shafts

The air leakage of builders' shafts acting as ventilation ductwork often runs into difficulties with regard to specification and indeed achievement of a specification.

The ductwork standard DW144 from the HVCA recommends a maximum air leakage for low pressure Class A ductwork of 0.54 $l/(s.m^2)$ (1.94 $m^3/(h.m^2)$) at a pressure differential of 100 Pa. For medium pressure Class B ductwork, the value is 0.18 $l/(s.m^2)$ (0.65 $m^3/(h.m^2)$ at a pressure differential of 100 Pa.

It would be unreasonable to expect a builder's shaft to conform to low pressure ductwork standards. However, it should achieve an air permeability better than a good building.

7.1 Floor Voids

Where floor voids are used for ventilation plenums as in displacement ventilation systems, BSRIA recommends an airtightness criterion of 1.0 litre per second per square metre of floor area at a test pressure of 50 Pa, excluding the air leakage to the occupied zone.

It is important that the conditioned air in the floor void supplies air to the occupied zone. The system can be severely compromised if air leaks into cavities and risers, or other zones of a building.

DIAGNOSTIC TOOLS FOR AIRTIGHTNESS

8.0 DIAGNOSTIC TOOLS FOR AIRTIGHTNESS

How do I assess the results of a pressure test?

Air leakage in buildings can be diagnosed in three ways. Local leakage can usually be identified using a smoke pencil, which is a simple handheld device used to find leaks around window frames, window sills and other visible or accessible joints. To identify hidden or inaccessible gaps in the building envelope a smoke test can be performed using a portable smoke generator or, in the case of a whole-building smoke test, multiple static generators. A thermographic survey can also be conducted using an infrared thermographic camera.

8.1 Whole Building Smoke Tests

For larger buildings, the most useful approach is to distribute smoke generators around the whole building and leave them switched on for a period of up to an hour. The building should then be pressurised to between 20 and 30 Pa and the smoke egress from the building observed and preferably recorded on video. Such tests take less than three hours, even for quite large buildings, and give building contractors a good idea of the location of problem areas.

A slightly different technique involves pointing a smoke generator or ducted outlet towards a section of cladding or roofing, again while the building is being pressurised. This is a somewhat less usual method than using smoke pencils, but allows easy identification of the air leakage paths.

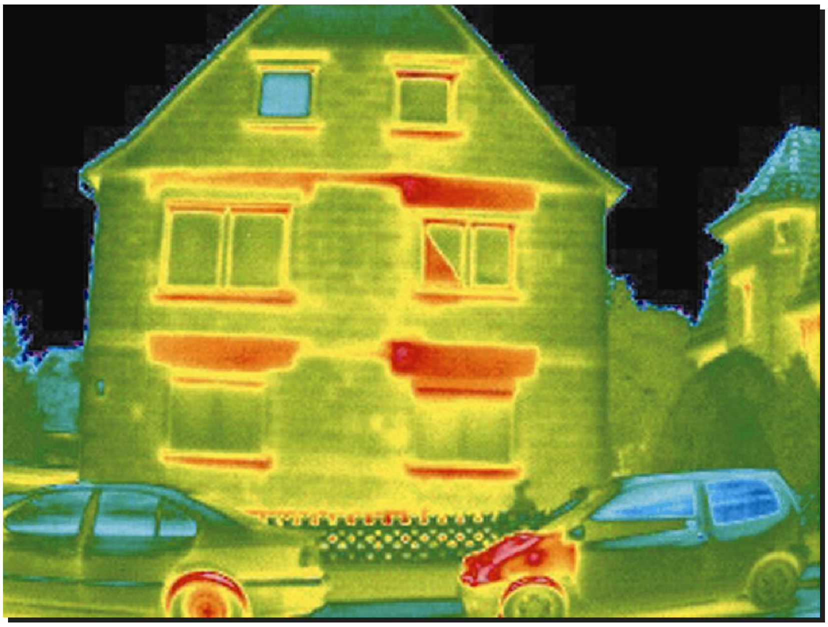
8.2 Thermal Imaging

A good thermal image requires the building to be depressurised and optimally the internal to external temperature difference should be more than 10ºK.

The technique not only identifies air leakage paths but also poorly insulated areas, discontinuous insulation and thermal bridges. To carry out the thermography test, the infrared camera should be set up for the correct background temperatures, distance and emmissivities. The camera should be in focus and reflections should be avoided. The inside and outside of the building should be scanned for temperature anomalies that exist prior to the building being depressurised. All such locations should be noted and recorded.

Once the building has been depressurised for a little while, the building should be scanned and new thermal anomalies noted and recorded. The surveyor should check for local sources of heat, check whether they were there before depressurisation, and eliminate the possibility of other causes.

The location of each anomaly should then be checked against the construction details. A report should be issued showing thermograms, location of anomalies and detailing conformance to the environmental conditions as set out above.



AIRTIGHTNESS SPECIFICATION CLAUSES

These clauses should provide sufficient information to enable a client to procure an airtightness test for their building, without specialist knowledge of the subject.

Clauses

Suggested clauses are given below. They are not particular to any standard form of contract format, but specific versions can be produced if required.

Clause 1 Airtightness pressure test

Carry out a building airtightness pressure test at the following property, as required by *Building (Amendment) Regulations (Northern Ireland) 2006, DFPNI Technical Booklet F2.*

Building/project: ....

Address: ....

....

....

Postcode: ....

Building type: ....

Clause 2 Test standard

The building airtightness pressure test required in Clause 1 shall be carried out in accordance with the requirements detailed in the ATTMA *Technical Standard 1, Measuring Air Permeability of Building Envelopes*.

Clause 3 Approved contractor

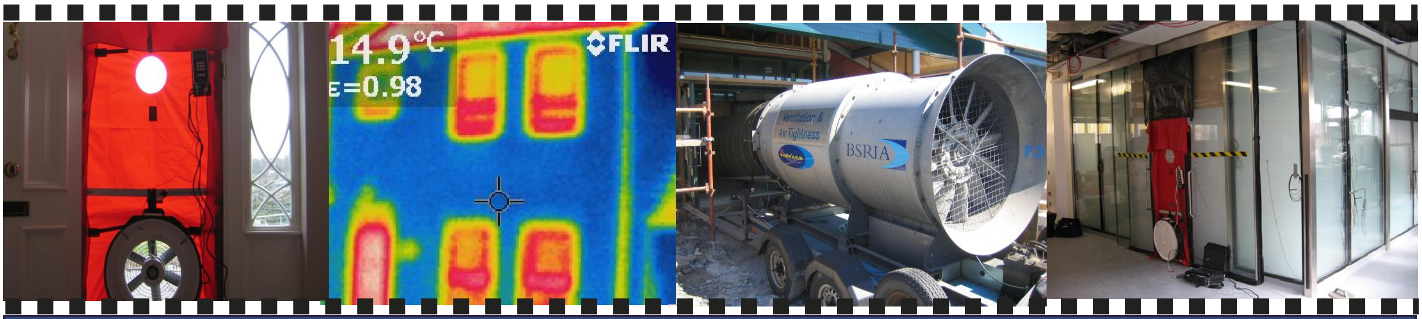
The building airtightness test shall be carried out by Anderson Mechanical Services (Tel: 028 3889 1320) or any member company of ATTMA. The company shall also be UKAS Certified and BINDT registered as required by *Building (Amendments) Regulations (Northern Ireland) 2006, DFPNI Technical Booklet F2.*

Clause 4 Air permeability standard

The building has been designed to achieve an air permeability of $10m^3/(h.m^2)$ or .... (insert as required in TER calculations, page 12) at an applied pressure difference of 50 Pa.

Clause 5 Instrumentation

The instrumentation used to carry out the building airtightness test shall be UKAS certified and have a valid calibration certificate.



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