

AIR TIGHTNESS TESTING (incorporating ADL 2010 Revisions)

1 Air tightness: background and regulation

Buildings account for a large proportion of the UK's overall energy consumption and contribute almost half of our carbon emissions. The most significant use of energy in a building is space heating or cooling. To minimise energy losses linked to 'conditioning' the air, the building's fabric must be well insulated and 'airtight'.

Whilst buildings are never completely airtight, by minimising the exfiltration of conditioned air and/or the infiltration of external air, total space heating/cooling costs could be reduced by up to 40% (BRE, BR Guide 448: Air tightness in Commercial and Public Buildings, 2002, p3).

Air permeability is a key factor in achieving the government's wider commitment to carbon emission reductions (e.g. Zero Carbon Homes, Kyoto and the European Directive on Energy Performance of Buildings).

Air tightness testing involves pressurising a building or unit to measure uncontrolled leakage of conditioned air through the fabric.

Energy in buildings and the consequent carbon emissions are covered by Approved Document L (ADL) of the Building Regulations – Conservation of Fuel and Power. ADL requires buildings to achieve a Target Emission Rate (TER) for overall compliance. The TER is calculated using Standard Assessment Procedure (SAP) for dwellings and Simplified Building Energy Model (SBEM) for non-dwellings.



2 What air tightness level must be achieved?

ADL prescribes a minimum level of air permeability of $10\text{m}^3/(\text{h}\cdot\text{m}^2)$ at a pressure difference of 50Pa for all buildings. However, the actual air test result will be dictated by the specific SAP or SBEM calculation for each building unit. '10' represents a relatively leaky building, with a 20 pence piece-size hole for every square metre of the envelope area. Best practice for naturally ventilated dwellings is considered to be '3' and low energy building initiatives such as PassivHaus typically require less than '1'.

The 2010 Edition of ADL requires a 16-40% improvement in the overall TER compared with the 2006 version. This can be achieved by improving a wide range of energy related aspects of the building design and specification, including the design air permeability. It is highly likely that due to the perceived lower cost of improving air tightness over upgrading boilers, increasing insulation, improving

U-values, etc that air permeabilities will be significantly reduced in order to achieve the lower TER.

In addition, air tightness test targets may be further reduced if results from tested dwellings are to be utilised in SAP calculations for untested plots. In these instances, the test result will be increased by $2\text{m}^3/(\text{h.m}^2)$. This means that the test result will need to be '2' less than the design air permeability in SAP or each plot will need to be tested in its own right.

The importance of balancing air tightness with ventilation has been recognised, so Approved Document F has also been revised. Dwellings with a design air permeability of '5' or under will need to increase ventilation provision.

3 Which buildings need to be tested?

Air tightness is a requirement for new dwellings, new buildings other than dwellings and large extensions to buildings other than dwellings under Approved Documents L1A, L2A and L2B of the Building Regulations respectively. As such, it is a necessary factor in achieving Building Control sign-off.

3.1 New Dwellings (ADL1A)

A sample of new dwellings is required to be tested based on dwelling types. ADL1A prescribes a number of criteria for defining dwelling types, variation in any of the following will require a separate sample of those types to be tested:

- Generic form - e.g. detached, end terrace/semi-detached or mid terraced house and ground, intermediate or top floor flat
- Principal construction details - based on the Accredited Construction Details (www.planningportal.gov.uk)
- Size - 10% variation in envelope area
- Storey number
- Design Air Permeability (DAP)
- Adjacency to heated spaces – e.g. internal garages, stairwells, etc
- Number of significant penetrations i.e. variation by 1 or more in the number of windows, doors, flues, soil vent pipes, etc

NB: Blocks of flats are considered to be separate developments.

The tester will be responsible for allocating dwelling types but Building Control will still have the final say over which units will need to be tested. Tests should be conducted early in the project to avoid repetition of mistakes on later plots. 50% of tests should be conducted on the first 25% of any type. **Significantly more types will be identified under the 2010 revision than under 2006 and in essence will lead to more units being tested.**

3 or 50% of each dwelling type will need to be tested (whichever is less).

This represents a significant increase from 2006 where typically 1 or 2 of any type would be tested plus there is no reduction in the test sample for adoption of the Accredited Construction Details.

'Small developments' of one or two dwellings may be exempt from testing if:

- A dwelling of the same type has been built by the same builder within the last 12 months and successfully passed the air tightness test.
- A poor default value of $15\text{m}^3/(\text{h.m}^2)$ can be used in the SAP calculations. **However given the 25% improvement in the overall energy requirements, it will be difficult/expensive to achieve the TER using this value, meaning the vast majority of developments will require testing.**

3.2 New buildings other than dwellings (ADL2A)

Every new building other than a dwelling is required to be tested including schools, hospitals, care homes, student accommodation, retail units, offices, industrial units, etc.

With the following exceptions:

- Buildings under 500m^2 total useful floor area may be able to accept a poor default value of $15\text{m}^3/(\text{h.m}^2)$ in the SBEM calculation, by compensating through higher specification of the other aspects of the TER e.g. heating, glazing, insulation. **The overall improvement in emission ratings in 2010 will make this less feasible and require more projects to be tested than under the 2006 requirements.**
- Factory-built modular buildings (of less than 500m^2 floor area and 2 years' planned use) may use evidence from at least 5 site tests of the same modules and links, as long as the

average result is $1\text{m}^3/(\text{h}\cdot\text{m}^2)$ better than the design air permeability.

- Large and/or complex buildings can be impractical to test, in these cases a justification can be submitted to Building Control in advance of construction providing it is endorsed by a suitably approved tester (ATTMA member). It may then be possible for the tester to undertake a detailed programme of design development, component testing and site supervision to provide the necessary confidence.





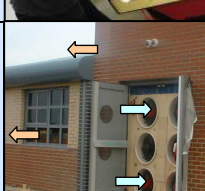
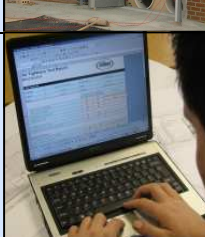
3.3 Existing buildings other than dwellings (ADL2A)

All extensions to existing buildings other than dwellings will require air tightness testing, providing they are:

- greater than 100m^2 , and
- greater than 25% of the total useful floor area

4 The air tightness testing process

Air tightness testing in the UK is conducted against Air Tightness Testing & Measurement Association (ATTMA) Technical Standard L1 for dwellings and L2 for non-dwellings.

<p>a) Measure the environmental conditions – the result is corrected to account for temperature, humidity and barometric pressure.</p> <p>Measure/verify the exact envelope area* as this is a key part of the final air permeability calculation.</p>	
<p>b) Identify an appropriate opening in the building's envelope (normally the front entrance) and install a template to hold the fans.</p> <p>Prepare the building for test, including sealing of ALL ventilation.</p>	
<p>c) Install the appropriate number of fans for the building size and target air permeability. Typically, a single fan will pressurise a dwelling whilst non-dwellings may require multiple fans.</p>	
<p>d) The fans are used to create a 50 Pascal pressure difference between the inside and outside of the building (this can be done by blowing air into the building or drawing air out). Most works can continue whilst the building is being tested.</p>	
<p>e) Air flow measurements are taken at a range of pressure differentials. The quantity of air being supplied to or drawn from the building to maintain pressure levels will be approximately equal to the amount of conditioned air escaping through 'uncontrolled ventilation' (gaps, cracks, holes, etc). Any 'controlled ventilation' (extractor fans, trickle vents, etc) is sealed or closed.</p>	
<p>f) All the measurements are entered into a specially-designed software package which calculates the air leakage rate in cubic metres per hour per square metre of envelope area at an internal-external pressure difference of 50 Pascal.</p>	

*envelope area comprises ground floor area, total area of all walls and the ceiling area.

5 What happens if the test result fails to meet the target air permeability?

In the case of buildings other than dwellings the contractor will need to undertake remedial work and commission further testing to confirm that the required performance is achieved.

In the case of dwellings, the contractor will need to undertake remedial work and then

commission a re-test on the same unit as well as an additional test on another unit. Testing and re-testing will continue until the tests prove that the performance is satisfactory. Failed test results must be submitted to Building Control.

A number of diagnostic tools can be employed to pinpoint leakage paths and guide remedial works e.g. depressurisation, smoke pens, smoke testing and infra-red thermography. Depending on the nature and scale of the remedial work this can sometimes be undertaken on the same day as the test and an improved test result achieved.

6 Who should perform the air tightness testing?

ADL authorises Building Control to accept evidence from the British Institute of Non-destructive Testing (BINDT) registered test providers.

BINDT registration for dwellings testing is based on approved training of **individual** testers or **company** membership of the Air Tightness Testing & Measurement Association (ATTMA).

For buildings other than dwellings, BINDT registration can only be achieved by becoming an ATTMA member which requires UKAS accreditation to check equipment, training, competence and procedures, plus an in-depth technical review.

7 Summary of changes between ADL 2006 & 2010

Aspect	Dwellings (ADL1A)	Non-dwellings (ADL2A & B)
Maximum air permeability	10m ³ /(h.m ²) (<i>no change</i>)	10m ³ /(h.m ²) (<i>no change</i>)
Actual design air permeability	Tighter to achieve 25% improvement in overall emission rating based on SAP. May need to be a further '2' tighter for tested plots to allow re-use of results.	Tighter to achieve 16-40% improvement in overall emission rating based on SBEM
Number of units tested	More - 3 or 50% of any type and based on a larger number of types. In some cases, all plots may need to be tested.	All (<i>no change</i>)
Exceptions	Fewer based on an assumed air permeability of 15m ³ /(h.m ²)	Fewer based on an assumed air permeability of 15m ³ /(h.m ²)

9 Further Information

Website

www.chilterndynamics.co.uk

Technical Information Sheets

- TI-0809: Achieving Air Tightness - In Buildings
- TI-0912: Acoustic Testing - Achieving Compliance

Seminars

Air Tightness Testing Explained (see website for details)



Chiltern Dynamics
Stocking Lane . Hughenden Valley . High Wycombe . HP14 4ND . UK

t +44 (0) 1494 569800
f +44 (0) 1494 564895
e air@chilterndynamics.co.uk
w www.chilterndynamics.co.uk