BM TRADA

Technical information

Air tightness testing

01 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 pressuring a building to measure uncontrolled leakage of conditioned air through the fabric. This is not to be confused with ventilation. Air tightness and ventilation should go hand in hand. A very air tight building should have adequate ventilation in accordance with Approved Document F, a leakier building may not have such stringent ventilation requirements.

Energy in buildings and the consequent carbon emissions are covered by Approved Document L (ADL) of the Building Regulations – Conservation of Fuel and Power. Approved Document L 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.

02 What air tightness level must be achieved?

Approved Document L prescribes a maximum level of air permeability of 10.00m³/(h.m²) at a pressure difference of 50 Pa for all buildings. However, the actual air test target (Design Air Permeability - DAP) 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 3.00m³/(h.m²)@50 Pa and low energy building initiatives such as PassivHaus typically require less than 0.60m³/(h.m²)@50 Pa.

The 2013 Edition of Approved Document L saw air test targets drop from the normal 8.00 - 10.00 to requiring around 3.00 - 5.00m³/(h.m²)@50 Pa. With 3.00 being the current threshold for low air test targets in what is practically achievable, the 2013 Edition places more emphasis on energy efficiency, such as improved glazing specifications and increased levels of insulation.

03 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 mandatory 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. Approved Document L1A (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
- 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.

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 2.00m³/(h.m²)@50 Pa. This means that the test results will need to be '2.00' less than the design air permeability in SAP or each plot will need to be tested in its own right.

The tester or testing company 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 2010/2013 revisions than under 2006.

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.

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 500m² total useful floor area may be able to accept a poor default value of 15.00m³/(h.m²) @50 Pa 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 2010/2013 will make this less feasible and require more projects to be tested than under the 2006 requirements.
- Factory-built modular buildings (of less than 500m² 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 1.00m³/(h.m²) 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 100m², and
- greater than 25% of the total useful floor area.

04 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. The process steps:

a) Measure the environmental conditions – the result is corrected to account for temperature, humidity and barometric pressure.

b) Measure and verify the exact envelope area as this is a key part of the final air permeability calculation. The envelope area comprises the ground floor area, total area of all walls (including party walls) and the ceiling area expressed in m^2.

c) Identify an appropriate opening in the building's envelope (normally the front entrance) and install a template to hold the fans.

d) Prepare the building for test, including sealing of ALL ventilation as the test is of the building fabric and not the ventilation system.

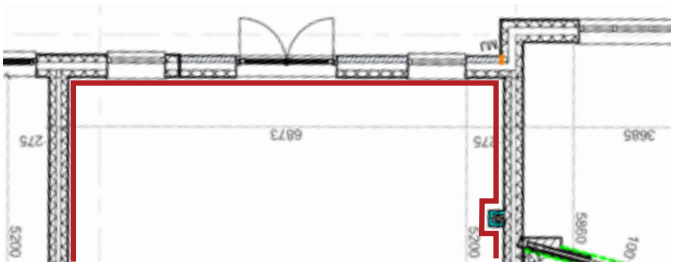
e) Install the appropriate number of fans for the building size and target air permeability. Typically, a single fan will pressurise a dwelling whilst non-dwellings may require multiple fans.

f) 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.

g) 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.

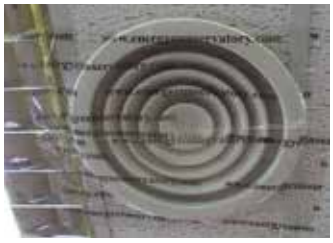
h) All the measurements are entered into a specially-designed software package which calculates the air leakage rate in cubic metres per hour per square metre of envelope area at an internal-external pressure difference of 50 Pascal.

a) Measuring the environmental conditions.



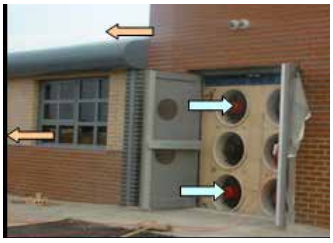
b) The envelope area (EA) is calculated using the drawings (depicted in red) and expressed in m^2. The EA is based on the internal surface area of the external facades.

c) Installation of template to hold the fans.



d) Sealing all ventilation is a requirement for accurate testing.

e) Installation of fans.



g) Air flow measurements are taken at a range of pressure differentials.

h) Software is used to calculate the air leakage rate.

05 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.

06 Who should perform the air tightness testing?

ADL authorises Building Control to accept evidence from the Air Tightness Testing & measurement Association (ATTMA). ATTMA's approved training is based on two levels - Level 1 for dwelling testing and Level 2 for non-dwelling (commercial) testing. Both levels require training and an exam with ATTMA. It is a requirement to be UKAS accredited for L2 testing.

07 Summary of changes between ADL 2006, 2010 & 2013

L1 (Dwellings)

Aspect	2006	2010	2013
Maximum air permeability	10.00$m^3/(h.m^2)$@ Pa	10.00$m^3/(h.m^2)$@ Pa	10.00$m^3/(h.m^2)$@ Pa
Likely design air permeability (DAP)	10.00$m^3/(h.m^2)$@ Pa	5.00$m^3/(h.m^2)$@ Pa *Approx 25% improvement on 2006*	4.00$m^3/(h.m^2)$@ Pa *Approx 6% improvement on 2010*
Number of units to be tested	Approx. 25% of all dwellings per site	Approx. 70% of all dwellings per site	Approx. 70% of all dwellings per site - lower targets could mean 100% testing.

L2 (Non-dwellings)

Aspect	2006	2010	2013
Maximum air permeability	10.00$m^3/(h.m^2)$@ Pa	10.00$m^3/(h.m^2)$@ Pa	10.00$m^3/(h.m^2)$@ Pa
Likely design air permeability (DAP)	10.00$m^3/(h.m^2)$@ Pa	5.00$m^3/(h.m^2)$@ Pa *Approx 25% improvement on 2006*	4.00$m^3/(h.m^2)$@ Pa *Approx 6% improvement on 2010*
Number of units to be tested	All units	All units	All units

Denotes change between the editions

ATTMA

UKAS TESTING 1762