AIR TIGHTNESS TESTING

Air tightness is a key consideration when retrofitting a property. Here, Ben Nixon, Associate Partner and PAS 2035 accredited retrofit coordinator, explains what it is, how we test it and its role in the retrofit process.

What is airtightness?

Airtightness is exactly as the name suggests. It relates to the 'leakiness' of the property. It may also be referred to as 'infiltration'; this is defined as unwanted air making its way into a space.

There is a standardised way of testing this. A pressured environment is introduced to the property and the rate of pressure is measured over a period of time to understand a result. The measurable is cubic meters of air lost in an hour for each square metre of the building envelope, at a pressure of 50 Pascals (m3/(h.m^2)@50Pa).

How is it tested?

Airtightness, it is tested by either a blower or pulse test. The blower method is a big fan put over the front door that inducts air into the dwelling space and works out the air loss by maintaining the pressure at 50Pa. A pulse test is carried out by a machine that is placed in a unit with all vents, windows and external doors closed and a pressure of around 4Pa (or sometimes more) is maintained, which is then multiplied to gain an airtightness figure at 50Pa. Though the latter is a recognised measure, it can be subject to varied results where a pressure of 50Pa is never reached, and accordingly the former is an industry standard.

In our experience, we find that when establishing strong archetype design, the use of a blower for core results is a necessity, however, for large scale roll-out of testing, pulse testing is more economical (there is then a bench mark established to compare the pulse testing to). It is important to note that a pulse test relies on a periodic pulse that can fade in a large property, like a townhouse, so coupling (two pulse test machines) would need to be used.

In terms of standards, the minimum requirement for a new-build property is 8 m3/(h.m2)@50Pa (this was previously 10 m3/(h.m2)@50Pa). When assessing SAP ratings for EPCs, RdSAP assumes an airtightness of 15 m3/(h.m2)@50Pa.

What is its role in PAS 2035 and generally?

Airtightness is provided as an improvement under the 'fabric first' banner but has a much more complex relationship with services than other fabric first elements.

The PAS 2035 standard notes: *"When the insulation and air-tightness of the building fabric are improved, adequate ventilation should be maintained."*

This is key. By introducing air-tightness, natural ventilation is being taken away. This is not a bad thing as some may think; the leakier the building, the moreuncontrollable ventilation it has. If the airtightness is improved, it means ventilation and air changes within the building can be controlled, which in turn, means less heat loss through uncontrolled ventilation.

In our experience, we find wet-masonary build (bricks/blocks/mortar/render) is generally better performing than non-traditional system builds (such as Orlit, Cornish, No-Fines, Unity and the like).

We also find that pre-war properties were often designed to be ventilated, which requires a detailed plan to ensure the properties remain adequately ventilated. This, of course, affects airtightness, especially given these types of properties feature a suspended timber floor and a fireplace that needs to be ventilated.

When does it need to be tested?

PAS 2035 states:

> *9.1.12 - Path A – Retrofit Designer shall consider the adequacy of the existing ventilation of the dwellings as revealed by the dwelling assessment report (if fabric insulation/airtightness measures used)*
> *9.2.5 - Path B – testing may not be required. Only assessment of the adequacy of the existing ventilation system and upgrade in accordance with Annex C is.*
> *9.3.3 - Path C - where the retrofit design includes any EEMs for the improvement of the building fabric.*

It is worth noting that the standard states that a selection of sample dwellings can be tested in a block, or the whole envelope in cases such as conversions and maisonettes.

If there are any airtightness measures being installed (these include anything that could affect the airtightness), a pre- and post-installation test is required. There is also provision for a test during works within PAS 2030 (before, during and/or after installation of the EEMs, as specified by the designer). This is to ensure the strategy and design are accurate insofar as the airtightness and ventilation strategy is concerned. It is recommended that air-tightness testing is undertaken as part of the initial assessment work to understand the physical limitations of the current installation. An experienced tester will also be able to provide indications around where leakage points may be, often with the use of a 'smoke pen' which can assist the assessment and strategy.

This can take place alongside thermographic/infra-red images which will give an excellent depiction of key air and heat loss areas while a test is in progress.

Common pitfalls

In terms of getting an air test, it is recommended that the company is a member of the ATTMA (Air Tightness Testing and Measurement Association). The ATTMA is a professional association, formed in 2002, to promote technical excellence and commercial effectiveness in air tightness testing and air leakage measurement applications. It is also a Department for Levelling Up (formerly DCLG) appointed operator of a Competent Persons Scheme for air-tightness testing. There are

some companies who claim to be testers and have bought equipment and are neither adequately trained in the use of the equipment nor able to adequately interpret results, which the ATTMA would not clear in their vetting process.

Another pitfall is stating an absolute in terms of airtightness. Where there are so many leakage points in a dwelling, to provide an absolute airtightness figure would be an onerous venture. A range at most, but preferably a minimum (or maximum) should be stipulated. Passivhaus Enerphit provides a stringent target, but it is still a minimum (1 or below).

The reason a 'mid works' air test is recommended is to ensure the target set is achievable and provides an assurance, relatively inexpensively, that the installed measures will complement the ventilation strategy. For example – if the ventilation strategy involves Mechanical Ventilation with Heat Recovery (MVHR) and is over a leakage rate of 5, the MVHR will not provide the efficiencies required to justify its installation. Similarly, if the airtightness is a lot better than expected and falls below 3, a simple de-centralised (individual extraction) system is unlikely to be suitable. A 'mid works' test needs to take place after the installation of a measure, with windows taped and vents blocked to provide accurate information on the specific measure.

Airtightness and its relation to SAP scoring is another pitfall. This can affect a SAP score by anywhere up to 15%, and potentially even be the difference between an EPC rating. It is estimated that up to 10kWh/m^2 (kWh/m2 - kilowatt hours is how domestic energy is measured, it is bunched as 'per meter squared' to ensure a benchmark can be relevant across property sizes) per year can be attributable to poor airtightness and uncontrolled heat loss in dwellings. At 30p per 10kWh/m^2, that's potentially up to £300 in a 100m^2 dwelling!

Outweighing all of these is the consideration for thermal comfort. We have all had those days where no matter what we do, we can't seem to heat the house – one of the key drivers for this is heat loss. Having an A-rated dwelling means little if there is a continuous loss of heat through drafty areas; the mitigation of this loss provides peace of mind for residents' comfort, but also their ascertained energy spend.

What improves airtightness?

Firstly, as inferred above, a ventilation strategy accounting for the upgrade to any air-tightness is absolutely critical. There is a correlation between airtightness and ventilation, which is why a ventilation assessment and strategy is a core part of the assessment and design process in PAS 2035. Changing the airtightness changes the balance of ventilation and heat in the property, which causes a condensation risk. To mitigate this, we always recommend thermal bridging models are commissioned, and that the ventilation strategy considers any services installed.

Airtightness is, at the same time, both the easiest and most difficult thing to improve as there are some 'quick win' measures that can be utilised, all the way up to particularly technical, complex measures. The measures for fabric-first installation nearly all affect airtightness as they are centered around keeping heat in a dwelling. From simple to complex, here are some examples:

- Draft proofing
- Filling penetrations (pipes, wires, redundant holes, uncontrolled passive vents)
- Controlled ventilation (trickle vents, closing MEVs)
- New Windows and doors
- Floor/wall/loft insulation measures
- Specialist airtightness paint

Summary

There is no 'compliant' position on airtightness as far as PAS2035 is concerned. However, like many of the measures listed as improvements, there is an effect on the greater goal where consideration alongside other energy efficiency measures provides a route to 'least regrets' retrofit and a clear plan to achieve net zero by 2050.

If different standards as part of a compliance package are present (for example, Enerphit), there will be a compliance associated with this. The only compliant position really affecting airtightness is the codependence with ventilation:

- If the post-retrofit Q50 is better than 5 $m^3/hr/m^2$ then continuous running ventilation (such as MVHR or MEV) is recommended.
- If post-retrofit Q50 is worse (i.e. leakier) than 5 $m^3/hr/m^2$, trickle vents with intermittent or passive ventilation are permitted.

The 'compliant' position is the sum of the retrofit, rather than the individual items themselves; the aims for funding are largely around EPC ratings and energy use (C and <90kW/h m^2 where achievable). Airtightness helps to achieve this.

How we can help

At Baily Garner we have a team of retrofit experts including PAS2035 Retrofit Coordinators who can assist with planning for delivery your retrofit project. To find out how we can help contact:

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