AIR TIGHTNESS TESTING PROTOCOL FOR PASSIVHAUS AND ENERPHIT PROJECTS

The air tightness testing protocol is NOT the same for Passivhaus Certification as it is for UK Building Regulations compliance.

This document sets out guidance for the specific testing requirements for Passivhaus and EnerPHit certification.

Prior to any testing, familiarity with the standards and the calculation method is very important, as Passivhaus calculation and methodology is different to standard methods employed by air testing companies in the UK.

Different Units

Passivhaus methodology, n_{50}

The Passivhaus standard measures the Air Change Rate (ACH) @50Pa (the n_{50} measurement), or in other words the number of times the volume of air within the building is changed in an hour. So, it is a purely volumetric measure. The Passivhaus methodology considers the volume of air which needs to be heated. Therefore internal walls and floors are excluded. This is a measure of air infiltration, and hence the heating energy cost of the building.

UK methodology, q_{50}

Building Regulations requires air tightness to be measured as Air Permeability, in $m^3/h/m^2$@50Pa (the q_{50} measurement), or in other words the air leakage per square metre of building envelope. The ATTMA (Air Tightness Testing and Measurement Association) TS1 standard defines the building envelope as everything within the air barrier line *'along the line of the component to be relied upon for air sealing'*. This could be anywhere within the building envelope (even the external render). This is a measure of building envelope airtightness.

Passivhaus Air Tightness Criterion

The criterion for Passivhaus certification relating to air tightness requires that

$n_{50} \leq 0.6\ h^{-1}$ @ 50Pa

The target is the same for EnerPHit, however, if the target is not achieved even though remedial measures are taken after an initial test then there is a back stop limit of

$n_{50} \leq 1.0\ h^{-1}$ @ 50Pa

There is also a q_{50} requirement for large buildings, where the air volume is in excess of $4{,}000m^3$

Test Method

Both n_{50} and q_{50} are calculated from a measurement of the airflow ($\dot{V}_{50}$) at 50Pa. The measurement of airflow should be carried out in accordance with EN13829 and ATTMA Technical Standard TSL1 for dwellings and TSL2 for non-dwellings.

For Building Regulation compliance testing: $q_{50} = \frac{\dot{V}_{50}}{A_E}$

Where A_E is the building envelope area as defined by EN13829.

For Passivhaus compliance testing: $n_{50} = \frac{\dot{V}_{50}}{V}$

Where V is the building air volume as defined by DIN 4108-7.

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VOLUME CALCULATION

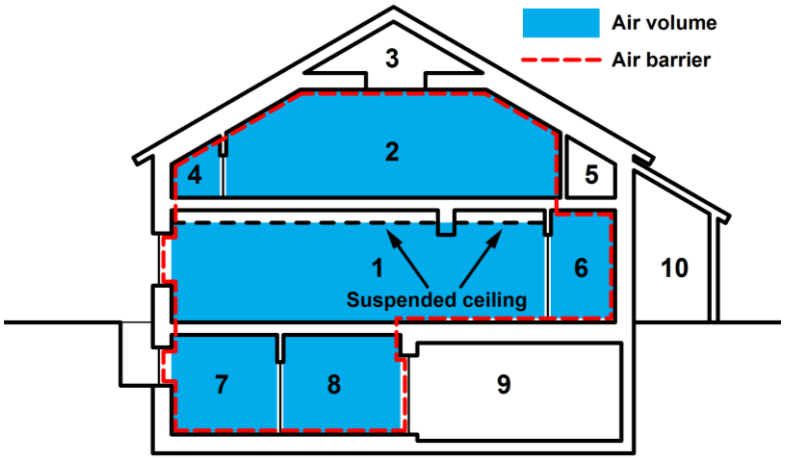
Room by Room

The air volume V used for calculating the n_{50} result for Passivhaus compliance is defined by the German standard DIN 4108-7. The volume is the internal area of each room multiplied by the clear height of the room. This is not the same as the total enclosed volume (gross volume). The volume should be determined separately for each room. A full and comprehensible volume calculation of each room must be provided for each test.

The volumes taken up by internal walls, partitions, suspended ceilings, intermediate floors and window reveals should not be included, however the volume taken up by beams, staircases, layers of plaster, plasterboard and bulkheads can be included.

Irrespective of the timing of the test, the dimensions used should always be those of the finished building. It is essential to use the correct volume, even if testing takes place before interior spaces are fully finished or internal walls and floors are constructed.

The diagram below, taken from Passipedia, explains in more detail what is included in the volume calculation. The red dashed line represents the air barrier, not the building air volume.



Room	Inside the airtight envelope?	Volume calculation
1	Yes	Clear height up to (planned) suspended ceiling; the beam is not deducted from the volume
2	**Yes**	Complete volume (roof inclinations are taken into account)
3	No	Volume is not taken into account (outside of the envelope)
4	Yes	Complete volume (roof inclinations are taken into account)
5	No	Volume is not taken into account (outside of the envelope)
6	Yes	Clear height up to the ceiling
7	Yes	Basement: complete volume
8	Yes	Basement: complete volume
9	No	Basement: volume is not taken into account (outside of the envelope)
10	No	Porch/conservatory: volume is not taken into account (outside of the envelope)

TEST METHOD

Test methodology should generally follow EN13829 – Method A for “testing of a building in use”.

Method A does not generally allow temporary sealing of intentional openings. The exception is the intake/exhaust ducts to a heat recovery ventilation system. This system is balanced when in operation during the heating season and therefore not a source of air leakage when the building is in use. The intake/exhaust ducts can justifiably be sealed at the outside to avoid measurement of air leakage through ductwork or the ventilation unit. A referenced photographic record of every sealing measure is necessary for a compliant test.

Air Leakage Audits

Air leakage audits are recommended during construction. This involves use of a leakchecker fan, similar to that used for compliance testing but usually not calibrated to give accurate test results. The purpose is not necessarily to obtain a test result but instead to place the building or even just a room under a negative pressure so that a comprehensive search for leaks can be made whilst the air barrier is still exposed and subsequently remedial measures taken to reduce air leakage.

Co-pressure Test

In certain cases (often in large or complex buildings) it is necessary to divide the building into a number of air test zones. If the air tight layer is designed to wrap around air test zones, rather than compartmentalize them, then it may be necessary to carry out co-pressure testing in order to eliminate air leakage between zones. During co-pressure testing, adjacent zones of a building are pressurized to the same extent as the zone to be tested. This is only acceptable when adjacent zones are inside the thermal envelope.

Negative AND Excess Pressure Measurement

Unlike EN13829 the Passivhaus air tightness testing protocol requires both negative pressure and excess (positive) pressure to be measured at 10 pressure intervals. The air tightness parameter of the building is then determined as an average value calculated from the results of the negative and excess pressure tests.

Intermediate Test

The intermediate test is recommended to take place directly after completion of the air tight layer. The air tight layer is considered complete once all windows and doors are installed and all service penetrations are completed. If temporary sealing is necessary during the test this should be fully documented. The purpose of the test is to enable remedial measures to be implemented to enhance air tightness, whilst the air barrier is still exposed and accessible.

Compliance Test

The compliance test should ideally take place when the building is complete, just before handover. At this stage it will not be possible to access the air tight layer in a non-destructive manner and remedial measures to reduce air leakage will not be practical. For particularly robust build systems and processes it is possible to accept an earlier test for compliance, however it is important that any construction work carried out after testing is carefully supervised so that it does not cause damage to the air tight layer.

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REFERENCES

BS EN 13829:2001, Thermal performance of buildings. Determination of air permeability of buildings. Fan pressurization method

ATTMA, *Technical Standard L1, Measuring Air Permeability of Building Envelopes (Dwellings), October 2010 Issue*

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Passive House certification criteria, http://www.passivehouse-international.org/index.php?page_id=150

Passipedia http://passipedia.org/start

NEED MORE INFORMATION?

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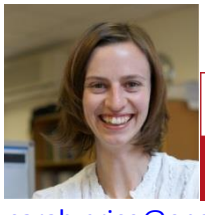

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