

The Blower Door test: measuring how much energy escapes from a home

A high-capacity fan mounted in the front door makes it possible to quantify, with precision, the air leaks that are invisible to the naked eye. At PAPIK Group it is part of the quality process of nearly every Eskimohaus home.

Few construction tests are as revealing as the Blower Door test. A high-capacity fan is mounted in the front door, the perimeter is sealed and the fan runs at full power while a technician walks through the home with a smoke generator. The goal is not to scare bees or chase ghosts: it is to detect leaks and measure something far more important, how much energy escapes from a home without anyone noticing.

At PAPIK Group the test is part of the quality process of nearly every Eskimohaus home we build, and not as an administrative formality or to obtain a certificate. It is the only reliable way to know, truly, whether a home is as airtight as it should be. Below we explain where it comes from, how it works, what it is for and why the result changes the way an energy bill is understood.

Where the name "Blower Door" comes from

The name is literal English: **blower** (fan) and **door**, because the device is installed in place of the door. The equipment consists of an adjustable frame that fits any opening, a fabric panel that hermetically seals the space and, at the centre, a large variable-capacity fan with highly precise pressure and airflow sensors.

The technique originated in the United States in the 1970s, in the middle of the oil crisis, when energy engineers began to ask where so much energy was escaping from American homes. Since then the protocol has been standardised internationally and today it is the worldwide reference test for measuring the airtightness of buildings. In Europe, the governing standard is ISO 9972, equivalent to EN 13829.

What measuring airtightness is for

When people talk about energy efficiency, the first thing that comes to mind is insulation. Insulation is extremely important, of course, but there is a second mechanism of energy loss that is often forgotten: air infiltration.

A home may have 30 cm of rock wool in the roof and triple glazing on every window, but if the envelope has gaps, however small, warm indoor air escapes constantly and cold outdoor air enters without control, without a filter and with no heat recovery possible. In summer the process reverses. It is a net loss of temperature and comfort, and the Blower Door test makes it possible to quantify and prevent it.

Uncontrolled air infiltration can account for between 20 % and 40 % of the total heating demand of a conventional home. That translates directly into the bill paid every month. We explore that invisible cost, carried throughout the entire service life of the home, in our article on the [energy mortgage](#).

A well-insulated home with air leaks is like a very thick coat with a broken zip: the cold gets in all the same.

How the test works, step by step

The procedure looks simple, but behind it lies a very precise protocol. This is its actual sequence.

1. Preparing the home

Before switching anything on, the home has to be prepared to simulate normal operating conditions. All exterior windows and doors are closed, but all interior doors are opened so that air circulates freely through the entire interior volume. Intentional ventilation openings, such as the MVHR vents, are temporarily sealed with tape or plugs, because the test measures unintended leaks, not controlled ventilation. Trap drains are sealed with water.

2. Installing the Blower Door

The frame is installed in the main entrance door. The fabric hermetically seals the perimeter and, at the centre, sits the calibrated fan, connected to a digital manometer, which measures pressure, and a flow meter, which measures airflow.

3. Pressurisation and depressurisation

The fan starts and begins to extract air from the home (depressurisation) until it reaches a pressure difference of 50 pascals relative to the outside. Fifty pascals is a relatively small pressure, equivalent to a water column of less than a centimetre, but enough to reveal every gap in the envelope.

To put it in concrete terms: 50 Pa is roughly the pressure exerted by a wind of 30 to 35 km/h against the facade. It is not a hurricane, it is what an autumn windy day can produce.

The standard protocol then repeats the measurement under pressurisation, with the fan blowing inward, to obtain data in both directions and calculate the average. During the test, a technician walks through the home with a smoke detector or a thermal camera to locate visually where the leaks escape: the gaps become visible through the smoke filaments that deflect around them, or as cold zones in the thermal image.

4. The result: the n50 value

The manometer records the airflow needed to maintain the pressure of 50 Pa. The greater that airflow, the more leaks the home has. With that value and the interior volume of the building, the n50 is calculated: the number of air changes per hour at 50 pascals.

The formula is direct: $n_{50} = \text{airflow at 50 Pa (m}^3/\text{h)} \div \text{interior volume of the building (m}^3\text{)}$. An n_{50} of 1 means that, holding 50 Pa of pressure for one hour, all the indoor air would be renewed once; an n_{50} of 10 means it would be renewed ten times. The smaller the value, the better: fewer leaks and therefore less energy lost.

When during construction the test is carried out

There is an important nuance that many people are unaware of: the Blower Door test can, and should, be carried out twice.

The first time, during the works, just when the airtightness layer has been completed but before the dry linings and false ceilings are closed. That way, if a leak is detected, it is still easy and cheap to fix. The technician locates the gap, the builder seals it, and the measurement is repeated. Repairing a leak during the works can cost tens of euros; repairing it once the home is finished can mean opening walls and cost hundreds or thousands.

The second time, at the end of the works, with the home completely finished. This is the official measurement that goes on the certificate and that determines whether the home meets the Passivhaus standard or not. At PAPIK Group we use the Blower Door test precisely to detect possible leaks and repair them, achieving high final quality. It is part of our process in building Eskimohaus homes.

Where the usual leaks hide

A home has many points where different materials and systems meet, and every junction is a potential leak risk that the test can detect. These are the most common critical points:

- **Roller-blind boxes.** One of the most significant leak sources in conventional construction. The box communicates directly with the outside and often has no sealing at all.
- **Window and door sub-frames.** The joint between the sub-frame and the wall is a classic leak point if it is not executed correctly.
- **Service penetrations.** Every electrical, water, gas or telecommunications conduit that crosses the envelope is a potential gap. Without specific sealing, they let air pass freely.
- **Floor-slab to facade junction.** In conventional buildings, the floor slab reaches the facade and creates a discontinuity in the insulation and the airtightness layer.
- **Roof joints.** The junctions between roof and walls, around skylights or ventilation outlets, concentrate many leaks in poorly detailed homes.
- **Sockets and switches on exterior walls.** Recessed electrical boxes often cross the airtightness barrier with no rear sealing.

In an Eskimohaus home each of these points is resolved with a specific construction detail, designed and executed with precision. We explain how we do it in our article on the [key technologies in Passivhaus construction](#).

The Blower Door test and ventilation

One question always arises: if the home is sealed so tightly, won't we run out of air? The answer is no, and this is where mechanical ventilation with heat recovery (MVHR) comes in. A Passivhaus home is airtight, but not hermetic in the sense of closed: it has a controlled ventilation system that renews the air constantly, with filters, without draughts, and recovering up to 96 % of the heat from the outgoing air to warm the fresh air coming in.

The key is precisely this: in an airtight home, air enters where you want it to, not wherever it can. The Blower Door test guarantees that there are no uncontrolled escape routes, and the MVHR guarantees that the incoming air is clean, tempered and filtered. The result is an indoor air quality far superior to that of any conventional home, even with the windows closed.

The technical part

For architects, technicians or anyone who wants to understand the test in depth, these are its more technical details.

The standard and the measurement methods

The test is carried out following ISO 9972:2015, equivalent to EN 13829, which defines three methods:

- **Method A.** The building is measured in real operating conditions, without sealing any ventilation opening. It gives a picture of the building's actual behaviour.
- **Method B.** All intentional openings (MVHR vents, chimneys, etc.) are sealed and only the unintended permeability of the envelope is measured. It is the method required for Passivhaus certification.
- **Method C.** Informal, sometimes used for diagnostics, without following the full strict protocol.

The pressure curve and the infiltration coefficient

A complete test is not done only at 50 Pa. The rigorous protocol measures airflow at multiple pressure points, between 10 and 70 Pa in increments, both under pressurisation and depressurisation. With all these points a regression curve is drawn that follows the power law $Q = C \cdot \Delta P^n$, where Q is the airflow (m^3/h), ΔP the pressure difference (Pa), C the infiltration coefficient of the envelope and n the flow exponent, between 0.5 and 1.0.

The exponent n provides qualitative information about the dominant leak type: a value close to 0.5 indicates that the main leaks are large openings, such as wide gaps or open joints, while a value close to 1.0 indicates diffuse microporosity through the materials. In a well-executed envelope, n is usually between 0.6 and 0.8. The coefficient C , normalised by envelope surface area, is equivalent to the CL parameter (Specific Leakage) that appears in Passivhaus certification reports and in the PHPP software, the official energy calculation tool of the Passivhaus Institute.

From n50 to real infiltration in use conditions

The n50 value is measured at 50 Pa, but a home in normal use does not operate at that pressure. To estimate the real infiltration under typical conditions, a correction factor is applied, the wind protection factor N, which depends on the location, height and wind exposure of the building, following the relation $n_{\text{real}} \approx n50 / N$. The usual values of N are 20 for a building very protected from the wind (dense urban setting), 14 for moderate exposure (typical suburban setting) and 10 for a very exposed building (high ground, open country, front line).

For an Eskimohaus home with $n50 = 0.6$ in a standard location ($N = 20$), the real infiltration would be approximately 0.03 air changes per hour, a value that is practically negligible in energy terms. By comparison, a conventional home with $n50 = 5$ in the same location would have a real infiltration of 0.25 air changes per hour, eight times higher.

A commitment to quality, not a formality

The Blower Door test is not a bureaucratic formality carried out to satisfy a regulation. It is the proof that a home is what it promises to be, that the team that built it did its job well, and that the energy paid for over the next fifty years will not escape.

At PAPIK Group, when the fan stops and the result appears on the manometer screen, it is one of the most satisfying moments of the whole build. Not out of a passion for numbers, but because we know that behind that 0.6 or less there is a family that will live comfortably, warm in winter and cool in summer, without worrying about the bill. The real results can be seen in our [projects gallery](#).

The value on the manometer does not only measure air: it measures whether a home will deliver, for decades, everything it promised the day it was designed.