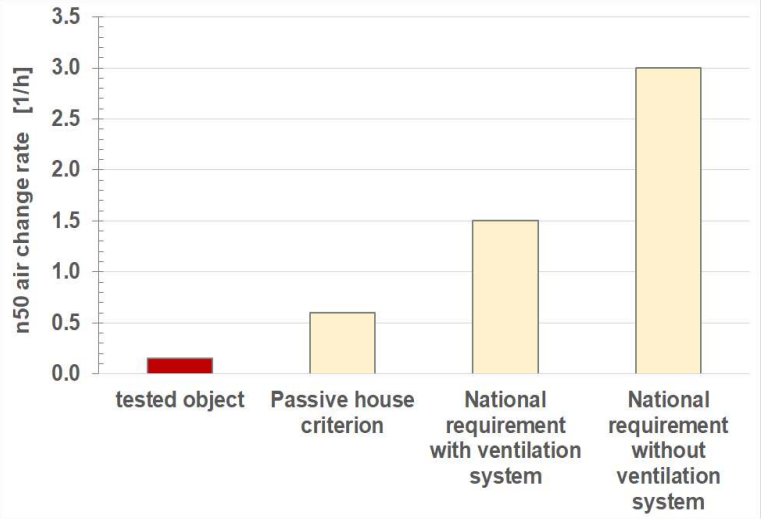
# *Determination of air permeability of buildings*

## *according ISO 9972:2015*

**Tested Object:**

**Villa MaxMusterfrau**
Testweg 1
12345 Testhausen

**Test Date:** 16.05.2023




**Customer:**

**Max Musterfrau**
Testweg 1
12345 Testhausen
Phone: 123456789
Email: max.musterfrau@aktiv.de

Tester:

Darmstadt, 22.05.2023 S. Peper

The test report consists of 8 pages incl. cover sheet.

## Purpose of Measurement

Air permeability measurement is used to check the airtightness of the building.

Requirements according to: **PHI**

## Test Result

The measurement results are based on a differential pressure of 50 Pa between the inside of the building and the outside environment (reference pressure difference).

| **Test Result at 50 Pa** | | | Depressurization | Pressurization | **Average** | **Requirement** [1] |
|---|---|---|---|---|---|---|
| **Air Leakage Rate** | $q_{50}$ | m³/h | 98,41 ± 1 % | 102,58 ± 3 % | 100,49 ± 2 % | - |
| **Air Change Rate** | $n_{50}$ | 1/h | 0,15 | 0,15 | **0,15** | **0,6** |
| **Air Permeability** | $q_{E50}$ | m³/(h·m²) | - | - | **-** | **-** |
| **Specific Leakage Rate per Floor Area** | $q_{F50}$ | m³/(hm²) | - | - | **-** | **-** |

[1] PHI

**The limiting value ist met**

Note:
With the method of air permeability measurement, certain flows in the air barrier can be detected. Other ( hidden ) leaks cannot be excluded.

## Test Standard and Method

Test Standard: **ISO 9972:2015**
Method: Procedure 1 - Testing of the building in the state of use

## Customer

| | |
|---|---|
| Name: | Max Musterfrau |
| Address: | Testweg 1<br>12345 Testhausen<br>Germany |
| Phone: | 123456789 |
| Fax: | |
| Email: | max.musterfrau@aktiv.de |
| Website: | www.passiv.de |

## Business Information

| | |
|---|---|
| Name: | Passive House Institute |
| Address: | Rheinstrasse 44/46<br>D-64283 Darmstadt<br>Germany |
| Phone: | 0049-6151-82699-0 |
| Fax: | 0049-6151-82699-11 |
| Email: | mail@passiv.de |
| Website: | www.passiv.de |

## Information Inspected Object

| | |
|---|---|
| Label: | Villa MaxMusterfrau |
| Address: | Testweg 1<br>12345 Testhausen<br>Germany |
| Year of Construction: | 2023 |
| Interior volume: | 670 m³ (calculated according to EN 13829 or PHI) |
| Net floor area: | - m² (calculated according to ISO 9972) |
| Building envelope: | - m² (calculated according to ISO 9972) |
| Uncertainty of the reference values: | 3 % |
| Building/room height (optional): | - m |
| Type of heating: | heat pump |
| Type of air conditioning: | none |
| Type of Ventilation: | Ventilation with heat recovery (passive HRV) |

# Measurement Series and Climate Data

## Depressurizaton Test :

### Temperature and Wind Conditions

| internal temperature (°C) | outside temperature (°C) | Barometric pressure (Pa) | wind force (Beaufort) |
|---|---|---|---|
| 13,0 | 15,0 | 101325 | 3 |

### Baseline Pressure

**before measurement**

| $\Delta p_{01-}$ (Pa) | $\Delta p_{01+}$ (Pa) | $\Delta p_{01}$ (Pa) |
|---|---|---|
| -0,14 | 0,10 | -0,09 |

**after measurementt**

| $\Delta p_{02-}$ (Pa) | $\Delta p_{02+}$ (Pa) | $\Delta p_{02}$ (Pa) |
|---|---|---|
| -0,97 | 0,39 | -0,06 |

### Depressurizaton

| Measured Building-Pressure $\Delta p_m$ (Pa) | Induced Building-Pressure $\Delta p$ (Pa) | Fan-pressure - (Pa) | Mearsured airflow $q_r$ (m³/h) | Corrected airflow $q_{env}$ (m³/h) | Airflow at standard conditions (m³/h) | % Error (Regression) | Ring - |
|---|---|---|---|---|---|---|---|
| -66,72 | -66,64 | 36,06 | 122,49 | 121,97 | 122,53 | 0,86 | C |
| -59,36 | -59,28 | 29,95 | 111,31 | 110,83 | 111,34 | -0,13 | C |
| -59,23 | -59,15 | 29,39 | 110,19 | 109,77 | 110,28 | -0,94 | C |
| -49,63 | -49,55 | 23,36 | 97,93 | 97,51 | 97,96 | 0,21 | C |
| -46,19 | -46,11 | 20,75 | 92,12 | 91,74 | 92,16 | -0,63 | C |
| -41,24 | -41,16 | 18,09 | 85,85 | 85,46 | 85,85 | 0,61 | C |

| Leakage curve parameters | | | confidence interval (95%) | |
|---|---|---|---|---|
| | | | Min | Max |
| flow coefficient | $C_{env}$ (m³/ h / Pa$^n$) | 5,57 | 4,50 | 6,88 |
| leakage coefficient | $C_L$ (m³/ h / Pa$^n$) | 5,59 | 4,52 | 6,91 |
| flow exponent | n (-) | 0,73 | 0,68 | 0,79 |
| coeff. of determination | $r^2$ (-) | 1,00 | | |
| correlation coefficient | r (-) | 1,00 | | |

## Pressurizaton Test:

### Temperature and Wind Conditions

| internal temperature (°C) | outside temperature (°C) | Barometric pressure (Pa) | wind force (Beaufort) |
|---|---|---|---|
| 13,0 | 15,0 | 101325 | 3 |

### Baseline Pressure

**before measurement**

| $\Delta p_{01-}$ (Pa) | $\Delta p_{01+}$ (Pa) | $\Delta p_{01}$ (Pa) |
|---|---|---|
| -0,02 | 0,12 | 0,10 |

**after measurementt**

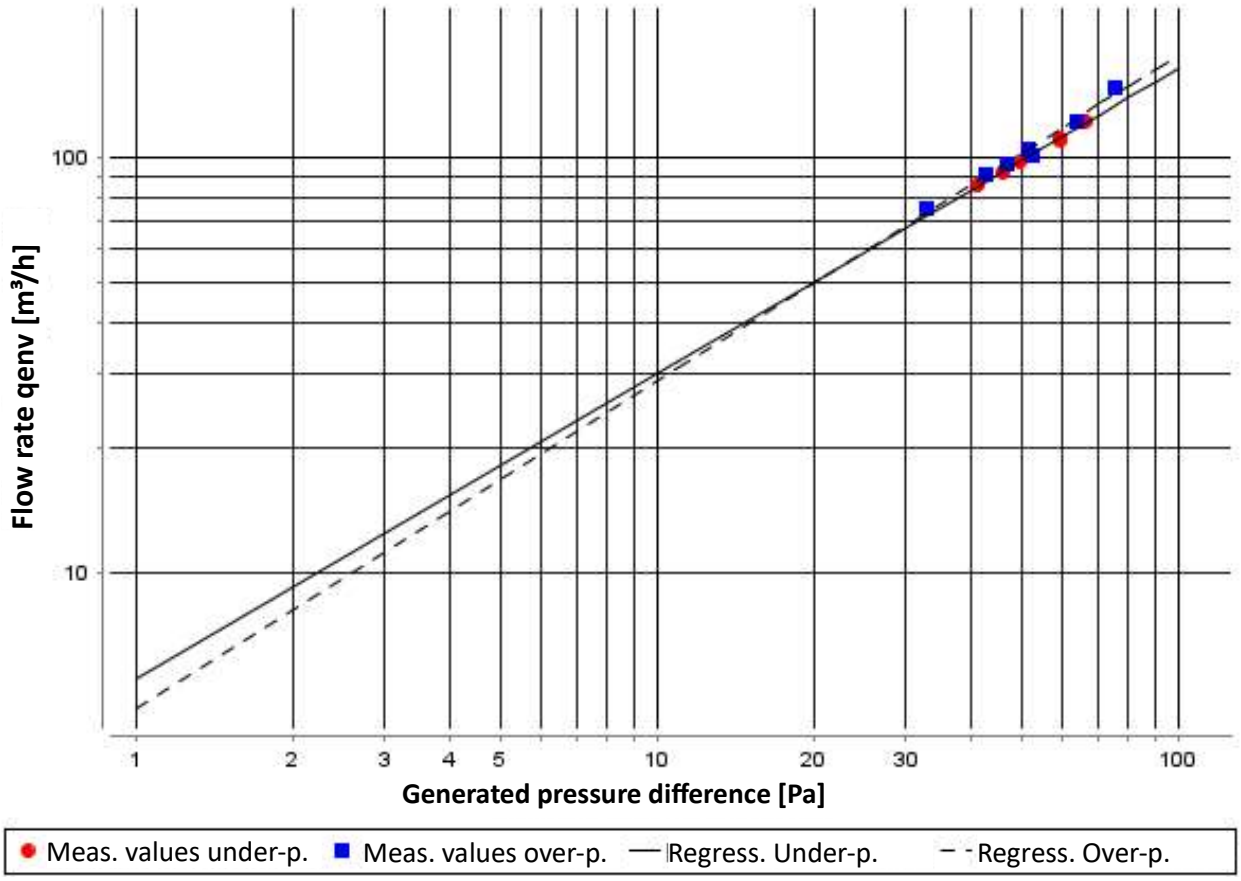
| $\Delta p_{02-}$ (Pa) | $\Delta p_{02+}$ (Pa) | $\Delta p_{02}$ (Pa) |
|---|---|---|
| -0,44 | 0,25 | -0,09 |

### Pressurizaton

| Measured Building-Pressure $\Delta p_m$ (Pa) | Induced Building-Pressure $\Delta p$ (Pa) | Fan-pressure - (Pa) | Mearsured airflow $q_r$ (m³/h) | Corrected airflow $q_{env}$ (m³/h) | Airflow at standard conditions (m³/h) | % Error (Regression) | Ring - |
|---|---|---|---|---|---|---|---|
| 76,00 | 75,99 | 53,10 | 149,56 | 147,37 | 148,13 | 3,79 | C |
| 63,63 | 63,63 | 36,64 | 123,58 | 121,71 | 122,35 | -1,32 | C |
| 52,33 | 52,33 | 25,47 | 102,42 | 100,90 | 101,42 | -4,82 | C |
| 51,62 | 51,61 | 27,09 | 105,75 | 104,16 | 104,70 | -0,45 | C |
| 46,77 | 46,77 | 23,23 | 97,70 | 96,23 | 96,73 | -0,63 | C |
| 42,83 | 42,83 | 20,94 | 92,57 | 91,20 | 91,68 | 0,93 | C |
| 32,77 | 32,77 | 14,30 | 76,01 | 74,92 | 75,31 | 2,27 | C |

| Leakage curve parameters | | | confidence interval (95%) | |
|---|---|---|---|---|
| | | | Min | Max |
| flow coefficient | $C_{env}$ (m³/ h / Pa$^n$) | 4,72 | 2,98 | 7,48 |
| leakage coefficient | $C_L$ (m³/ h / Pa$^n$) | 4,75 | 3,00 | 7,51 |
| flow exponent | n (-) | 0,79 | 0,67 | 0,90 |
| coeff. of determination | $r^2$ (-) | 0,98 | | |
| correlation coefficient | r (-) | 0,99 | | |

## Leakage Curve




## Measurement Equipment

| device type | model description | serial number | calibration date |
|---|---|---|---|
| Fan | Minneapolis BlowerDoor Modell 4 | CE1234 | 01.01.2023 |
| Differential pressure gauge | DG700 | 654321 | 01.01.2023 |

## Position of Air-moving Equipment

Front door

## Measured extent

Entire building incl. basement (within the thermal envelope)

## Condition of Building at the Time of Measurement

Building ready for occupancy

## Building Preparation

Sealing of the ventilation system in the unit (outside and exhaust air)

# Leakages

small leakage at the sealing of the front door (bottom)
Missing point cable penetration satellite rivet-dish (attic).
No other significant leaks were found

## Comments

The measurement is based on ISO 9972
Deviations:
- the lowest pressure level was set too high (should set be 10 Pa).
- the difference between the pressure levels are not uniform.

## Annex

**Volume calculation (room by room according to EN 13829)**

Villa MaxMustermann

| room | Net area chargeable | Clearance height | Area deduction | Height | Volume |
|---|---|---|---|---|---|
| **Basement** | | | | | |
| Basement corridor | 7.27 | 2.66 | 2.73 | 0.29 | **18.6** |
| Technics | 7.52 | 2.50 | | | **18.8** |
| Hobby room | 29.75 | 2.15 | | | **64.0** |
| Storeroom | 20.06 | 2.50 | | | **50.1** |
| **1 First floor** | | | | | |
| corridor | 7.84 | 2.87 | | | **22.5** |
| WC | 2.52 | 2.87 | 0.38 | 2.87 | **6.1** |
| Hallway | 7.53 | 3.15 | 3.85 | 0.29 | **22.6** |
| Study | 16.55 | 2.87 | 0.42 | 2.87 | **46.2** |
| kitchen-living room | 30.31 | 3.22 | | | **97.5** |
| **2nd floor** | | | | | |
| corridor | 10.65 | 2.80 | 5.85 | 0.29 | **28.2** |
| bedroom 2 | 14.87 | 2.52 | 0.54 | 2.52 | **36.0** |
| bedroom 3 | 14.87 | 2.52 | | | **37.4** |
| bedroom 5 | 20.03 | 2.52 | | | **50.4** |
| bathroom | 4.41 | 2.52 | 0.35 | 2.52 | **10.2** |
| **Attic** | | | | | |
| corridor | 7.53 | 3.45 | | | **26.0** |
| bedroom | 31.39 | 1.98 | | | **62.0** |
| Dormer | 10.19 | 2.13 | | | **21.7** |
| Bathroom | 7.53 | 3.45 | 0.46 | 2.50 | **24.8** |
| Storeroom | 20.40 | 1.38 | 0.48 | 2.50 | **26.9** |
| | | | **Total volume** | | **669.9** |